2015 SAMOS Data Quality Report

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Base funding for the SAMOS data center at COAPS is provided by the Climate Observation Division, Climate Program Office, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, through a grant (N11OAR4320199) administered by the Northern Gulf Cooperative Institute at the Mississippi State University. Support for participation by university-operated vessels within SAMOS is provided by the National Science Foundation (NSF), Oceanographic Instrumentation and Technical Services Program under grant OCE-1447797. In 2013, the Schmidt Ocean Institute (SOI) provided contract funding to recruit the *RV Falkor* to the SAMOS initiative. Any opinions, findings, and conclusions/recommendations expressed in this report are those of the authors and do not necessarily reflect the views of NOAA, NSF, or SOI.

The authors wish to thank the technicians working onboard participating research vessels. You are the backbone to the data system, which makes the SAMOS Initiative possible and successful. We also thank the operators, captains, and crews of these vessels.

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1. Introduction

This report describes the quantity and quality of observations collected in 2015 by research vessels participating in the Shipboard Automated Meteorological and Oceanographic System (SAMOS) initiative. The SAMOS initiative focuses on improving the quality of, and access to, surface marine meteorological and oceanographic data collected *in-situ* by automated instrumentation on research vessels (RVs). A SAMOS is typically a computerized data logging system that continuously records navigational (ship position, course, speed, and heading), meteorological (winds, air temperature, pressure, moisture, rainfall, and radiation), and near-surface oceanographic (sea temperature, conductivity, and salinity) parameters while the RV is underway. Measurements are recorded at high-temporal sampling rates (typically 1 minute or less). A SAMOS comprises scientific instrumentation deployed by the RV operator and typically differs from instruments provided by national meteorological services for routine marine weather reports. The instruments are not provided by the SAMOS initiative.

Data management at the SAMOS data assembly center (DAC) provides a ship-to-shore-to-user data pathway (Figure 1). SAMOS version 1.0 relies on daily packages of one-minute interval SAMOS data being sent to the DAC at the Florida State University via e-mail attachment. Broadband satellite communication facilitates this transfer as near as possible to 0000 UTC daily. For SAMOS 1.0, a preliminary version of the SAMOS data is made available via web services within five minutes of receipt. All preliminary data undergo common formatting, metadata enhancement, and automated quality control (QC). A data quality analyst examines each preliminary file to identify any major problems (e.g., sensor failures). When necessary, the analyst will notify the responsible shipboard technician via email while the vessel is at sea. On a 10-day delay, all preliminary data received for each ship and calendar day are merged to create daily intermediate files. The merge considers and removes temporal duplicates. For all NOAA vessels and the *Falkor* visual QC is conducted on the intermediate files by a qualified marine meteorologist, resulting in research-quality SAMOS products that are nominally distributed with a 10-day delay from the original data collection date. All data and metadata are version controlled and tracked using a structured query language (SQL) database. All data are distributed free of charge and proprietary holds through the web (http://samos.coaps.fsu.edu/html/) under “Data Access” and long-term archiving occurs at the US National Centers for Environmental Information (NCEI). SAMOS data at NCEI are accessible in monthly packages sorted by ship and have been assigned a collection-level reference and digital object identifier (Smith et al. 2009) to facilitate referencing the SAMOS data in publications.

In 2015, out of 34 active recruits, a total of 29 research vessels routinely provided SAMOS observations to the DAC (Table 1). One additional recruited vessel – the *Healy* – submitted one day of data in 2015. A further vessel – the *Melville* – was separated from the SAMOS initiative as of 1 January 2015 but continues to submit data from the dock in San Diego. Her data quality is not analysed herein. SAMOS data providers included the National Oceanographic and Atmospheric Administration (NOAA, 16 vessels), the Woods Hole Oceanographic Institution (WHOI, 1 vessel), National Science Foundation Office of Polar Programs (OPP, 2 vessels), University of Hawaii (UH, 1 vessel), University of Washington (UW, 1 vessel), Scripps Institution of Oceanography (SIO, 3 vessels), Bermuda Institute of Ocean Sciences (BIOS, 1 vessel), Schmidt Ocean Institute (SOI, 1 vessel), the Australian Integrated Marine Observing System (IMOS, 1 vessel), the University of Alaska (UA, 1 vessel), and the Louisiana Universities Marine Consortium (LUMCON, 1 vessel). One additional IMOS vessel – the *Aurora Australis* – one additional United States Coast Guard (USCG) vessel – the *Polar Sea* – the University of Rhode Island (URI) vessel – the *Endeavor* – and one additional vessel formerly with WHOI and transferred to Oregon State University in March 2012 – *Oceanus* – were active in the SAMOS system but for reasons beyond the control of the SAMOS DAC (e.g., caretaker status, changes to shipboard acquisition or delivery systems, satellite communication problems, etc.) were unable to contribute data in 2015.

IMOS is an initiative to observe the oceans around Australia (see 2008 reference). One component of the system, the "IMOS underway ship flux project" (hereafter referred to as IMOS), is modelled on SAMOS and obtains routine meteorological and surface-ocean observations from one New Zealand (*Tangaroa*) and one Australian (*Aurora Australis*) RV. Software problems at IMOS have resulted in the interruption of the data flow from the *Aurora Australis*. In 2015 code was developed at the SAMOS DAC to harvest *Tangaroa* SAMOS data directly from the IMOS THREDDS catalogue. We hope to begin trialling SAMOS data from the new IMOS vessel *Investigator* in 2016. In addition to running a parallel system to SAMOS in Australia, IMOS is the only international data contributor to SAMOS.

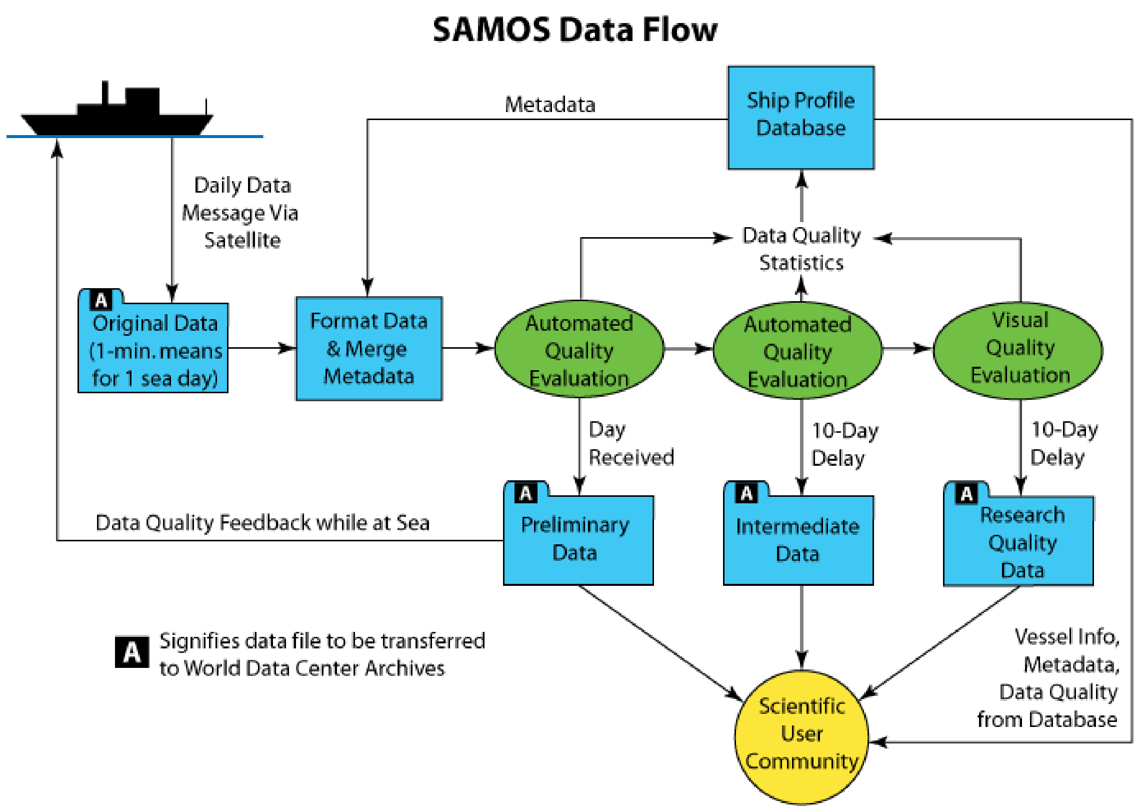

Figure 1: Diagram of operational data flow for the SAMOS initiative in 2015.

Beginning in 2013, funding did not allow for visual quality control procedures for any non-NOAA vessels except the *Falkor*, which is separately supported via a contract with SOI. As such, visual QC for all remaining vessels was discontinued, until such time as funding is extended to cover them. It should be noted that in the case of the *Aurora Australis* and *Tangaroa*, the IMOS project conducted their own visual QC until a personnel change there in June 2013. Since, only automated QC for these vessels occurs at the SAMOS DAC. The quality results presented herein are from the research quality products for all NOAA vessels and the *Falkor*, and automated-only quality control-level (intermediate) products for all remaining vessels. During 2015, the overall quality of data received varied widely between different vessels and the individual sensors on the vessels. Major problems included poor sensor placement that enhanced flow distortion (nearly all vessels experience some degree of flow distortion), sensors or equipment that remained problematic for extended periods (namely, the atmospheric pressure sensor on board the *Pisces* and one of the atmospheric pressure sensors on board the *Falkor*, the wind sensors on board the *Bigelow*, *Oregon II*, and *Ron Brown*, one of the temperature and relative humidity sensors on board the *Falkor,* and the (suspected) sea temperature sensor on board the *New Horizon*), oversights at both the DAC and at the vessel end that meant some data were temporarily reported in the wrong units (*Pisces*, *Atlantis*, and *Sikuliaq*), and data transmission oversights or issues that created a significant volume of backlogged data (*Healy, Atlantic Explorer, Fairweather, Falkor, Kilo Moana,* and *Revelle*).

This report begins with an overview of the vessels contributing SAMOS observations to the DAC in 2015 (section 2). The overview treats the individual vessels as part of a surface ocean observing system, considering the parameters measured by each vessel and the completeness of data and metadata received by the DAC. Section 3 discusses the quality of the SAMOS observations. Statistics are provided for each vessel and major problems are discussed. An overview status of vessel and instrumental metadata for each vessel is provided in section 4. Recommendations for improving metadata records are discussed. The report is concluded with the plans for the SAMOS project in 2016. Annexes include a listing of vessel data identified as suspect but not flagged by quality control procedures (Annex A), web interface instructions for accessing SAMOS observations (Annex B, part 1) and metadata submission by vessel operators (Annex B, part2), and complete snapshots of all active vessels' current metadata status, as of the writing of this report (Annex C).

2. System review

In 2015, a total of 34 research vessels were under active recruitment to the SAMOS initiative; 29 of those vessels routinely provided SAMOS observations to the DAC, with the *Healy* additionally providing a single day of data (Table 1). The *Polar Sea* was out of service in 2015, so naturally there was no data from her. The *Healy*, however, did sail but data were not transmitted using the SAMOS 1.0 protocol in 2015. Several attempts have been made to restart the data flow with the operator and these efforts continue in 2016. The *Aurora Australis* also sailed in 2015 but the data processing/delivery systems in place for the IMOS vessels had some failures that have not yet been resolved (partially the result of IMOS funding challenges). In March 2012 stewardship of the *Oceanus* was transferred from WHOI to OSU and she underwent a major refit. *Oceanus* planned to return to SAMOS using the 2.0 data protocol, but this transition will not occur, hence the lack of any data since 2012. In 2016 we will open a dialog to restore the *Oceanus* using SAMOS 1.0. Real-time data were not received in 2015 from the *Endeavor* because problems with satellite communications limit the *Endeavor's* ability to transmit SAMOS 2.0 formatted data files. New options are being explored to transition the *Endeavor* to SAMOS 1.0 in 2016.

In total, 5,462 ship days were received by the DAC for the January 1 to December 31 2015 period, resulting in 7,270,163 records. Each record represents a single (one minute) collection of measurements. Records often will not contain the same quantity of information from vessel to vessel, as each vessel hosts its own suite of instrumentation. Even within the same vessel system, the quantity of information can vary from record to record because of occasional missing or otherwise unusable data. From the 7,270,163 records received in 2015, a total of 140,190,313 distinct measurements were logged. Of those, 6,993,608 were assigned A-Y quality control flags – about 5 percent – by the SAMOS DAC (see section 3a for descriptions of the QC flags). This percentage is just slightly higher than that in 2014 (about 3.5%). Measurements deemed "good data," through both automated and visual QC inspection, are assigned Z flags. In total, thirteen of the SAMOS vessels (the *Tangaroa, Healy, Atlantis, Laurence M. Gould, Nathaniel B. Palmer, T.G. Thompson, Kilo Moana, Atlantic Explorer, Pelican, Sikuliaq, Roger Revelle, New Horizon,* and the *Robert Gordon Sproul*) only underwent automated QC. None of these vessels' data were assigned any additional flags, nor were any automatically assigned flags removed via visual QC.

SHIP NAME	CALL SIGN	# of Days	# of Vars	# of Records	# of A-Y Flags	# of All Flags
TOTAL	-	5,462	567	7,270,163	6,993,608	140,190,313
ROGER REVELLE	KAOU	321	24	441,352	240,093	10,435,320
ATLANTIS	KAQP	305	29	422,072	80,435	12,240,088
THOMAS G. THOMPSON	KTDQ	256	21	337,648	197,560	6,513,261
HEALY	NEPP	1	19	304	1,216	5,776
NATHANIEL B. PALMER	WBP3210	340	23	486,645	938,110	11,078,830
LAURENCE M. GOULD	WCX7445	363	23	522,553	121,247	11,375,129
KILO MOANA	WDA7827	166	21	222,136	2,361	4,664,856
ATLANTIC EXPLORER	WDC9417	167	28	182,339	121,543	4,462,282
PELICAN	WDD6114	96	16	101,632	102,859	1,619,497
SIKULIAQ	WDG7520	172	21	246,224	192,514	4,226,274
NEW HORIZON	WKWB	116	27	155,096	149,224	4,167,484
ROBERT GORDON SPROUL	WSQ2674	317	18	411,485	94,477	7,363,089
HENRY B. BIGELOW	WTDF	165	16	206,346	230,862	3,299,082
OKEANOS EXPLORER	WTDH	123	16	152,997	85,670	2,447,832
PISCES	WTDL	130	16	166,279	522,159	2,626,872
OREGON II	WTDO	184	16	188,861	637,282	3,800,639
THOMAS JEFFERSON	WTEA	151	16	149,949	156,709	3,021,776
FAIRWEATHER	WTEB	142	13	186,314	172,462	2,413,444
RONALD H. BROWN	WTEC	202	17	271,082	304,956	4,607,575
BELL M. SHIMADA	WTED	202	22	261,622	192,302	5,255,204
OSCAR ELTON SETTE	WTEE	120	16	157,587	52,146	2,496,282
RAINIER	WTEF	137	13	183,987	154,540	2,391,831
REUBEN LASKER	WTEG	106	15	140,333	178,109	2,012,429
FERDINAND HASSLER	WTEK	28	13	34,704	24,963	405,708
GORDON GUNTER	WTEO	164	16	209,382	241,796	3,330,930
OSCAR DYSON	WTEP	179	16	239,576	64,537	3,833,216
NANCY FOSTER	WTER	137	14	173,759	86,379	2,432,626
HI'IALAKAI	WTEY	233	19	317,968	644,055	5,673,480
FALKOR	ZCYL5	204	26	272,279	674,127	6,267,089
TANGAROA	ZMFR	235	17	338,215	328,915	5,722,412

Table 1: CY2015 summary table showing (column three) number of vessel days received by the DAC, (column four) number of variables reported per vessel, (column five) number of records received by DAC per vessel, (column six) total incidences of A-Y flags per vessel, (column seven) total incidences of A-Z flags per vessel.

a. Temporal coverage

As demonstrated in Figure 2, the files received by the DAC from each vessel are not often equally matched to the scheduled days reported by each institution. (*Note that full CY2015 scheduling information was not obtainable for the *Tangaroa* prior to this report distribution.) Scheduled days sometimes include days spent at port (denoted with a "P" in Figure 2, when possible), which are assumedly of less interest to the scientific community than those spent at sea. We are therefore not intensely concerned when we do not receive data during port stays, although if a vessel chooses to transmit port data we are pleased to apply automated and visual QC and archive it. Occasionally vessel technicians may be under orders not to transmit data due to vessel location in a maritime exclusive economic zone (EEZ, denoted with a "*" in Figure 2, when known). However, when a vessel is reportedly "at sea" (denoted with an "*S*" in Figure 2, when possible) and we have not received expected underway data, we endeavor to reclaim any available data, usually via email communication with vessel technicians and/or lead contact personnel. For this reason we perform visual QC on a 10 day delay. SAMOS data analysts strive to follow each vessel's time at sea by focusing on continuity between daily files and utilizing online resources (when available), but as ship scheduling is subject to change and in some cases is unavailable in real time, we may be unaware a vessel is at sea until well after the 10 day delay period. An automated reporting service went live in early 2013 that, among other things, provides interested parties with a summary of ship days received by the DAC for each vessel. This product is available in both PDF and comma-separated values formats and can be emailed out automatically at the end of every month, the intent being that files that were “missed” can be identified and manually sent to the DAC. (Reports are accessed at https://samos.coaps.fsu.edu/html/subscription/index.php with a login ID and password; see Section 4 for additional details.) It should be noted, however, that current funding for the SAMOS initiative would not permit the visual quality control of a large number of “late” files, so it is important that vessel operators and SAMOS data analysts do their best to ensure files are received within the 10 day delayed-mode window. There is also a tool available to the DAC that can alert analysts, via email reporting and a JSON web service, when a vessel has not submitted data for a chosen amount of days, providing one additional step towards ensuring no “missed/late” data.

In Figure 2, we directly compare the data we've received (green and blue) to final 2015 ship schedules provided by each vessel's institution. (*Note again that the full schedule was not obtained for the *Tangaroa.*) A “blue” day denotes that the data file was received past the 10-day delayed-mode window (or otherwise entered the SAMOS processing system well past the window) and thus missed timely processing and visual quality control, although processing (and visual QC where applicable) was eventually applied. (It must be noted, though, that “late” data always incurs the risk of not being visually quality controlled, based on any time or funding constraints.) Days identified on the vessel institution’s schedule for which no data was received by the DAC are shown in grey. Within the grey boxes, an italicized "*S*" indicates a day reportedly "at sea." As an added metric, Table 2 attempts to measure each vessel’s actual submission performance by matching scheduled at-sea (or assumed at-sea) days to the availability of SAMOS data files for those days. All data received for 2015, with the exception of the *Tangaroa*, has been archived at the NCEI. Through agreement with IMOS, we receive data for the *Tangaroa* and the *Aurora Australis* and for these vessels perform automated QC only. IMOS data is archived within the IMOS DAC-eMarine Information Infrastructure (eMII).

JANUARY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
KAOU																															
KAQP																								P							S
KTDQ													S																		
NEPP																															
VNAA	P	P	P	S	S	S	S	S	S	S	S	S	P	P	P	P	P	S	S	S	S	S	S	S	S	P	P	S	S	S	S
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WCX7445																															
WDA7827		S	S	S	S	S	S	S	S	S	S																				
WDC9417	S	S	S	S																									S	P	P
WDD6114																		S	S	S	S	S	S	S	S	S	S	S	S	S	S
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FEBRUARY	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28			
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Figure 2: 2015 calendar showing (**green** and **blue**) ship days received by DAC and (**grey**) additional days reported afloat by vessels; "*S*" denotes vessel reportedly at sea, "P" denotes vessel reportedly at port, "*" denotes vessel known to be in a maritime EEZ with no expectation of data. Vessels are listed by call sign (see Table 1).

APRIL	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
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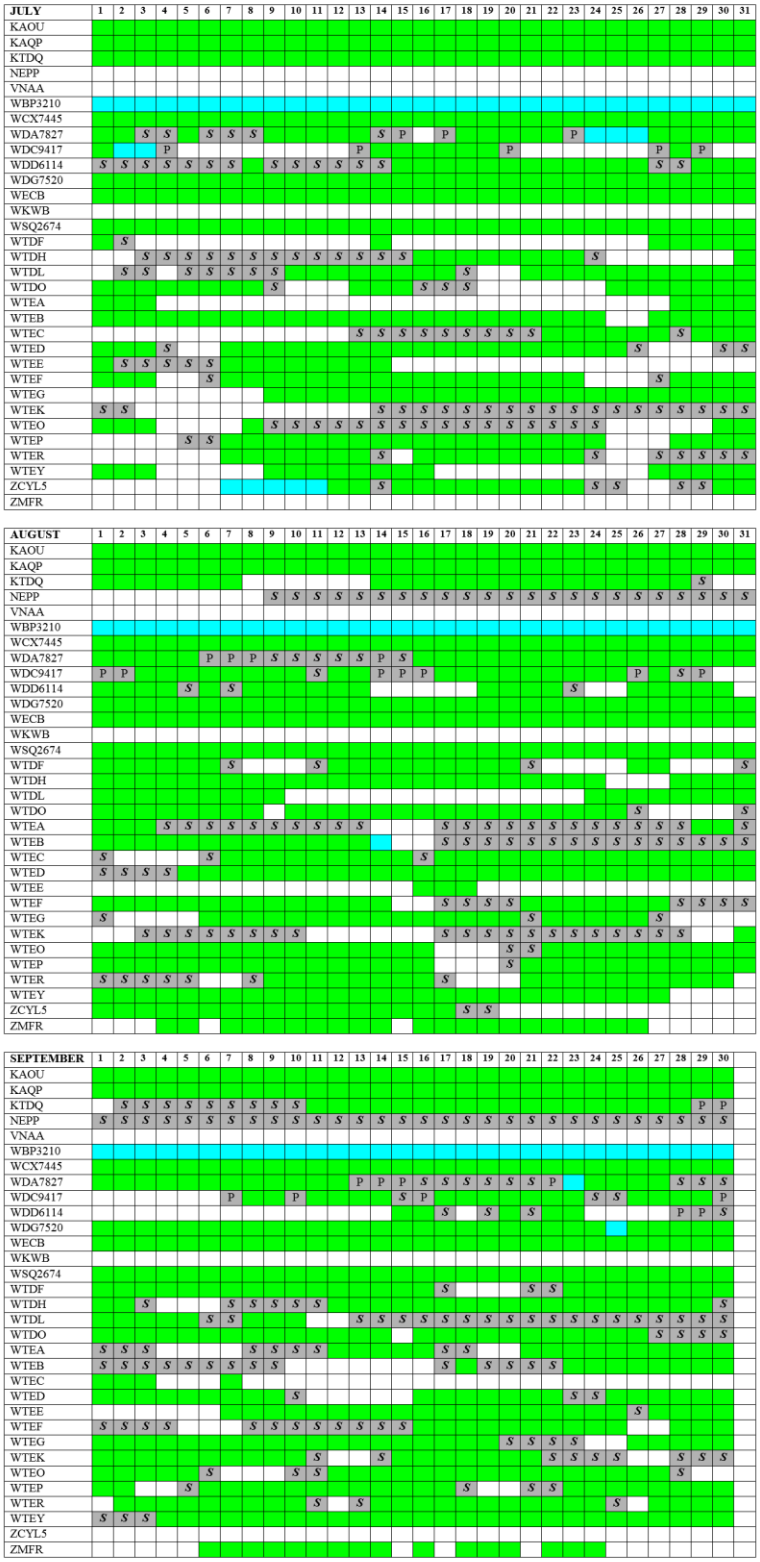
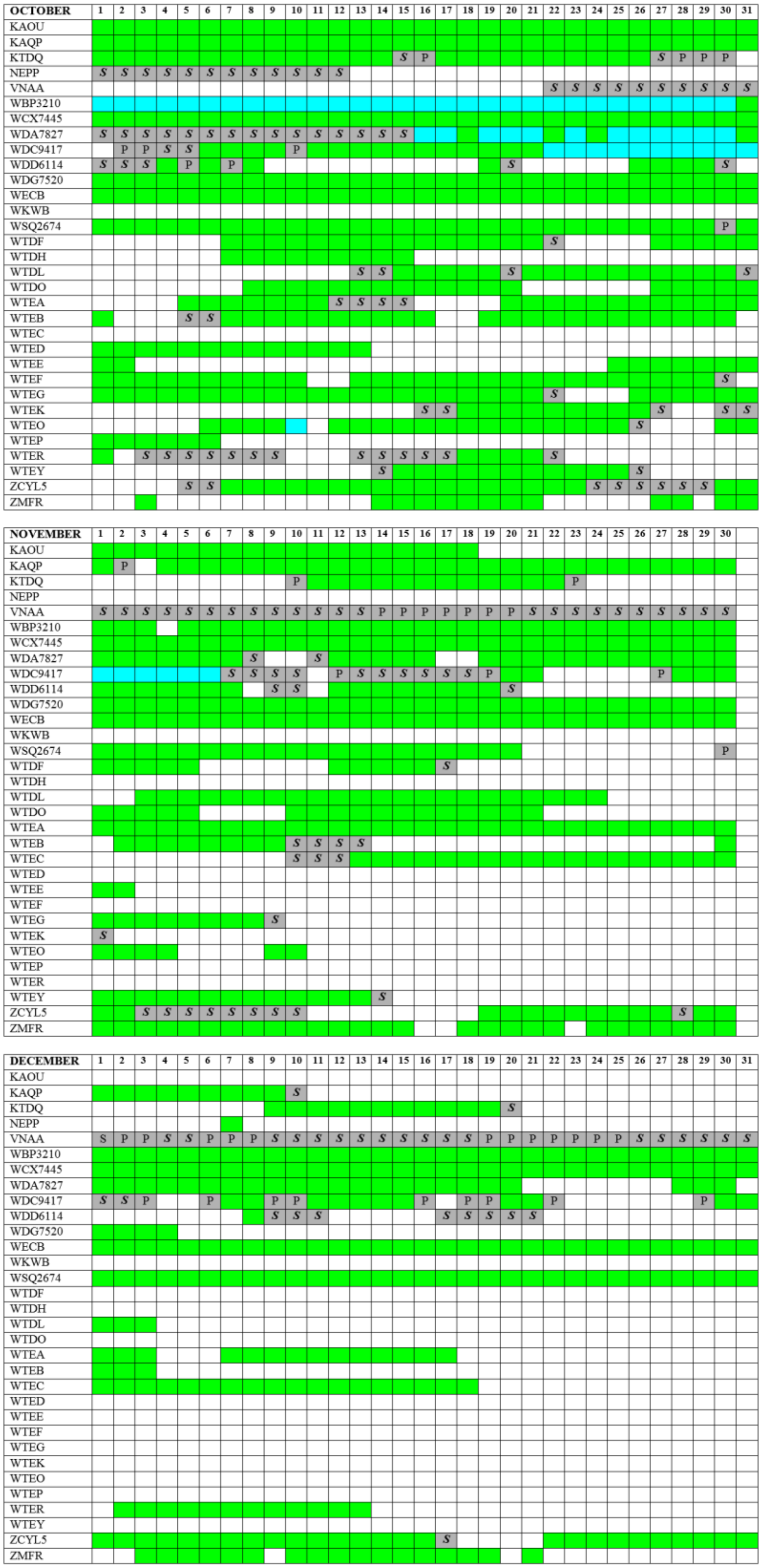
WTEF			S	S	S						S	S	S	S	S	S	S	S													
WTEG																															
WTEK	S	S	S	S	S			S	S	S	S	S	S	S	S	S	S	S	S			S	S	S	S	S	S	S	S	S	
WTEO				S	S							S	S				S	S													
WTEP																														S	
WTER			S				S	S				S		S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S		
WTEY																															
ZCYL5											S	S																			
ZMFR																															

(Figure 2: cont'd)



(Figure 2: cont'd)



(Figure 2: cont'd)

NOAA								
Ship Name	Bell M. Shimada	Fairweather	Ferdinand Hassler	Gordon Gunter	Henry Bigelow	Hi'ialakai	Nancy Foster	Okeanos Explorer
Call Sign/ Ship Code	WTED/SH	WTEB/FA	WTEK/FH	WTEO/GU	WTDF/HB	WTEY/HI	WTER/NF	WTDH/EX
# SDAL scheduled days	198	169	139	178	175	228	191	165
# matching SAMOS days	183	123	25	147	155	214	133	98
→% received	92%	73%	18%	83%	89%	94%	70%	59%

NOAA (cont'd)								
Ship Name	Oregon II	Oscar Dyson	Oscar E. Sette	Pisces	Rainier	Reuben Lasker	Ronald Brown	Thomas Jefferson
Call Sign/ Ship Code	WTDO/OT	WTEP/OD	WTEE/OS	WTDL/PI	WTEF/RA	WTEG/RL	WTEC/RB	WTEA/TJ
# SDAL scheduled days	193	184	113	151	164	109	222	159
# matching SAMOS days	179	172	99	112	130	100	193	123
→% received	93%	93%	88%	74%	79%	92%	87%	77%

TOTAL SDAL scheduled days:	2738
TOTAL matching SAMOS days:	2186
OVERALL RATIO:	80%

OPP		
Ship Name	Laurence M. Gould	Nathaniel B. Palmer
Call Sign	WCX7445	WBP3210
# scheduled days	148	212
# matching SAMOS days	148	212
→% received	100%	100%

TOTAL scheduled days:	778
TOTAL matching SAMOS days:	778
OVERALL RATIO:	100%

SIO			
Ship Name	New Horizon	Robert G. Sproul	Roger Revelle
Call Sign	WKWB	WSQ2674	KAOU
# scheduled at-sea days	49	88	281
# matching SAMOS days	49	88	281
→% received	100%	100%	100%

TOTAL scheduled at-sea days:	418
TOTAL matching SAMOS days:	418
OVERALL RATIO:	100%

Table 2: 2015 data submission performance metrics, listed by institution and ship. Note that where official schedules specified "at sea" days, only those days were counted. In all other cases "at sea" was assumed and scheduled days were counted as-is. Note also that while SAMOS days follow GMT, ship schedules may not. This leaves room for some small margin of error. Lastly, note that any transit through maritime EEZs may preclude data transmission. Public ship schedule resources are listed in the References, where possible.

	BIOS	IMOS	LUMCON	SOI	UAF	UHI	USCGC	UW
Ship Name	Atlantic Explorer	Tangaroa	Pelican	Falkor	Sikuliaq	Kilo Moana	Healy	Thomas G. Thompson
Call Sign	WDC9417	ZMFR	WDD6114	ZCYL5	WDG7520	WDA7827	NEPP	KTDQ
TOTAL scheduled at-sea days	179	43	168	216	170	229	65	226
TOTAL matching SAMOS days	148	35	32	168	103	162	0	209
OVERALL RATIO:	83%	81%	19%	78%	61%	71%	0%	92%

	WHOI
Ship Name	R/V Atlantis
Call Sign	KAQP
TOTAL scheduled at-sea days	271
TOTAL matching SAMOS days	259
OVERALL RATIO:	96%

(Table 2: cont'd)

b. Spatial coverage

Geographically, SAMOS data coverage continues to be fairly comprehensive in 2015. Cruise coverage for the January 1, 2015 to December 31, 2015 period (Figure 3) again includes Antarctic exposure (*Palmer*, *Gould*, and *Tangaroa*), exposure in Alaskan waters (*Sikuliaq*, *Ron Brown*, *Oscar Dyson*, *Rainier*, and *Fairweather*), the far Northern Atlantic (*Atlantis)* and samples along the northern Caribbean island coastlines, from Cuba to Puerto Rico (*Nancy Foster* and *Pisces*). The *Roger Revelle* again sampled the Indian Ocean and the *Tangaroa* and *Falkor* covered the waters south of Australia and New Zealand. The *Atlantic Explorer* provided a broad sample of the Atlantic, while the *Ron Brown*, *Oscar Elton Sette*, *Falkor*, *Okeanos Explorer*, *Hi'ialakai*, and *Kilo Moana* together do the same for the Pacific, both the *Hi'ialakai* and *Oscar Elton Sette* particularly sampling around Guam and the Northern Mariana Islands. Natively, the western coastal United States is covered by, among others, the *Bell M. Shimada*, *Robert Gordon Sproul*, *T.G. Thompson*, and *Reuben Lasker*; additionally, the waters east of South America are observed by the *Atlantis*. The eastern coastal waters of the United States are heavily covered by the *Henry Bigelow*, *Gordon Gunter*, and *Thomas Jefferson*, among others. The northern Gulf of Mexico is virtually covered by the *Oregon II* and *Gordon Gunter*. Hawai'ian waters are well sampled by the *Oscar Elton Sette*, *Kilo Moana*, and *Hi'ialakai*. Naturally, the oceans around Bermuda are again well covered by the *Atlantic Explorer*.

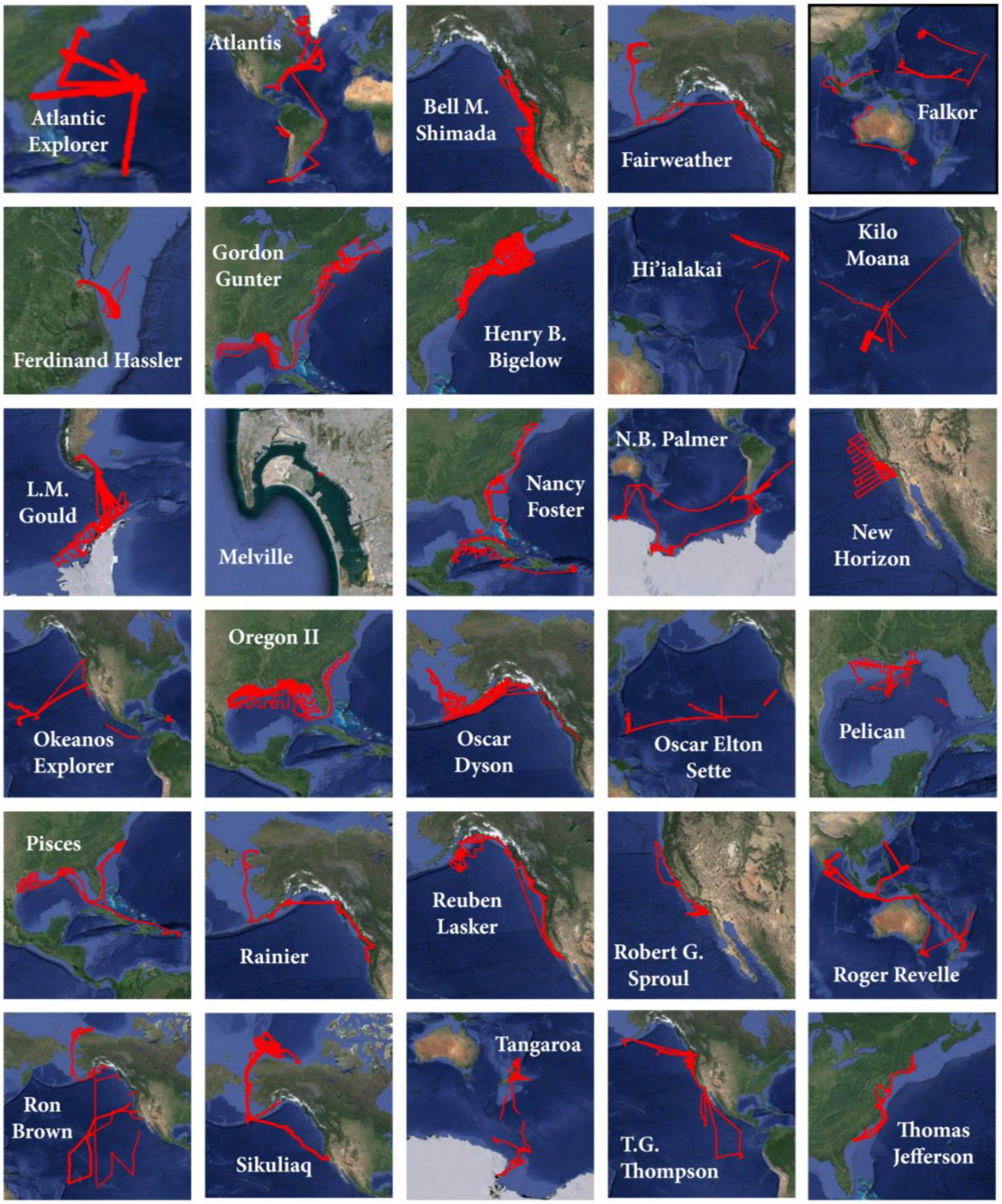


Figure 3: Cruise maps plotted for each vessel in 2015.

c. Available parameter coverage

The core meteorological parameters – earth relative wind speed and direction, atmospheric pressure, and air temperature and relative humidity – and the oceanographic parameter sea temperature are reported by all ships. Many SAMOS vessels also report precipitation accumulation, rain rate, longwave, shortwave, net, and photosynthetically active radiations, along with seawater conductivity and salinity. Additionally, the *Healy*, *Roger Revelle*, and *Thomas Jefferson* are all capable of providing dew point temperature, although only the *Thomas Jefferson* did so in 2015, just as in 2013 and 2014. The *Jefferson* is also the only vessel set up to provide wet bulb temperature, and did so in 2015. A quick glance at Table 4 (located in Section 4) shows which parameters are reported by each vessel: those boxes in columns 6 through 26 with an entry not in italics indicate a parameter was enabled for reporting and processing in 2015. (Further detail on Table 4 is discussed in Section 4.) Some vessels furnish redundant sensors, which can be extremely helpful for visually assessing data quality. Again referring to Table 4, those boxes in columns 6 through 26 with multiple entries indicate the number of redundant sensors available for reporting and processing in 2015; boxes with a single entry indicate the existence of a single sensor.

3. Data quality

a. SAMOS quality control

Definitions of A-Z SAMOS quality control flags are listed in Table 3. It should be noted that no secondary automated QC was active in 2015 (SASSI), so quality control flags U-Y were not in use. If a coded variable does not contain an integer pointer to the flag attribute it is assigned a "special value" (set equal to -8888). A special value may also be set for any overflow value that does not fit the memory space allocated by the internal SAMOS format (e.g., character data value received when numeric value was expected). A "missing value" (set equal to -9999) is assigned for any missing data across all variables except time, latitude, and longitude, which must always be present. In general, visual QC will only involve the application of quality control flags H, I, J, K, M, N and S. Quality control flags J, K, and S are the most commonly applied by visual inspection, with K being the catchall for the various issues common to most vessels, such as (among others) steps in data due to platform speed changes or obstructed platform relative wind directions, data from sensors affected by stack exhaust contamination, or data that appears out of range for the vessel's region of operation. M flags are primarily assigned when there has been communication with vessel personnel in which they have dictated or confirmed there was an actual sensor malfunction. Port (N) flags are reserved for the latitude and longitude parameters and are rarely used, in an effort to minimize over-flagging. The primary application of the port flag occurs when a vessel is known to be in dry dock. The port flag may also be applied, often in conjunction with flags on other parameters, to indicate that the vessel is confirmed (visually or via operator) in port and any questionable data are likely attributable to dockside structural interference, although this practice is traditionally only used in extreme cases. SAMOS data analysts may also apply Z flags to data, in effect removing flags that were applied by automated QC. For example, B flagging is dependent on latitude and occasionally a realistic value is assigned a B flag simply because it occurred very close to a latitude boundary. This happens with sea temperature from time to time in the extreme northern Gulf of Mexico – TS values of 32˚C or 33ºC are not unusual there in the summer, but portions of the coastline are north of 30 degrees latitude and thus fall into a region where such high temperature are coded as "out of bounds." In this case the B flags would be removed by the data analyst and replaced with good data (Z) flags.

Flag	Description
A	Original data had unknown units. The units shown were determined using a climatology or some other method.
B	Original data were out of a physically realistic range bounds outlined.
C	Time data are not sequential or date/time not valid.
D	Data failed the T>=Tw>=Td test. In the free atmosphere, the value of the temperature is always greater than or equal to the wet-bulb temperature, which in turn is always greater than or equal to the dew point temperature.
E	Data failed the resultant wind re-computation check. When the data set includes the platform's heading, course, and speed along with platform relative wind speed and direction, a program re-computes the earth relative wind speed and direction. A failed test occurs when the wind direction difference is >20 or the wind speed difference is >2.5 m/s.
F	Platform velocity unrealistic. Determined by analyzing latitude and longitude positions as well as reported platform speed data.
G	Data are greater than 4 standard deviations from the ICOADS climatological means (da Silva et al. 1994). The test is only applied to pressure, temperature, sea temperature, relative humidity, and wind speed data.
H	Discontinuity found in the data.
I	Interesting feature found in the data. More specific information on the feature is contained in the data reports. Examples include: hurricanes passing stations, sharp seawater temperature gradients, strong convective events, etc.
J	Data are of poor quality by visual inspection, DO NOT USE.
K	Data suspect/use with caution – this flag applies when the data look to have obvious errors, but no specific reason for the error can be determined.
L	Oceanographic platform passes over land or fixed platform moves dramatically.
M	Known instrument malfunction.
N	Signifies that the data were collected while the vessel was in port. Typically these data, though realistic, are significantly different from open ocean conditions.
O	Original units differ from those listed in the *original_units* variable attribute. See quality control report for details.
P	Position of platform or its movement is uncertain. Data should be used with caution.
Q	Questionable – data arrived at DAC already flagged as questionable/uncertain.
R	Replaced with an interpolated value. Done prior to arrival at the DAC. Flag is used to note condition. Method of interpolation is often poorly documented.
S	Spike in the data. Usually one or two sequential data values (sometimes up to 4 values) that are drastically out of the current data trend. Spikes for many reasons including power surges, typos, data logging problems, lightning strikes, etc.
T	Time duplicate.
U	Data failed statistical threshold test in comparison to temporal neighbors. This flag is output by automated Spike and Stair-step Indicator (SASSI) procedure developed by the DAC.
V	Data spike as determined by SASSI.
X	Step/discontinuity in data as determined by SASSI.
Y	Suspect values between X-flagged data (from SASSI).
Z	Data passed evaluation.

Table 3: Definitions of SAMOS quality control flags

b. 2015 quality across-system

This section presents the overall quality from the system of ships providing observations to the SAMOS data center in 2015. The results are presented for each variable type for which we receive data and are broken down by month. The number of individual 1 minute observations varies by parameter and month due to changes in the number of vessels at sea and transmitting data.

Readers of previous years' reports may notice the volume of flags seen specifically in the bar graphs in this section (3b) seems somewhat increased from previous years; During the course of writing this report it was discovered our statistical tool which produces these bar graphs looked at intermediate level file information only (i.e. automated QC only). We have adjusted our code and the graphs now represent the highest level file information for all vessels (i.e. visual QC for those vessels that receive it, and automated QC for those that don't). Since the bulk of QC flags is typically applied during visual QC, it follows that an increase in flag volumes is perceived in these bar graphs this year. In the future we hope to amend previous years' reports to incorporate the new statistical tool code, as well. We also note that while the *Melville's* data quality was not monitored in 2015 and is not discussed in this report (she was officially "separated" from SAMOS in 2015), she nevertheless transmitted data to us throughout the year and thus underwent automatic SAMOS processing/automated QC. Any automated QC flags her data may have incurred are not exempted from the overall quality figures in this section.

The quality of SAMOS atmospheric pressure data is good, overall (Figure 4). The most common problems with the pressure sensors are flow obstruction and barometer response to changes in platform speed. Figures 41 and 49 do a good job of demonstrating these issues. Unwanted pressure response to vessel motion can be avoided by ensuring good exposure of the pressure port to the atmosphere (not in a lab, bridge, or under an overhanging deck) and by using a Gill-type pressure port. Note that *Falkor's* P data was almost entirely J-flagged (poor quality) for the entirety of 2015, and *Oregon II's* and *Henry Bigelow's* P both incurred a good deal of K-flagging (suspicious quality) throughout the year (documented; see individual vessel description in section 3c for details). It isn't immediately apparent what caused the increase in flagging of P2 seen in July or the increase in flagging of P3 seen in February, though we note *Atlantis* is the only vessel that currently carries P3. Additionally, a quantity of special value flags was applied to *Atlantis's* P2 during the period 23-30 June (along with several other of *Atlantis's* variables), contributing the major portion of the special value flag volume seen in that month. Details surrounding this event of data not fitting the specified floating point variable format are not known.

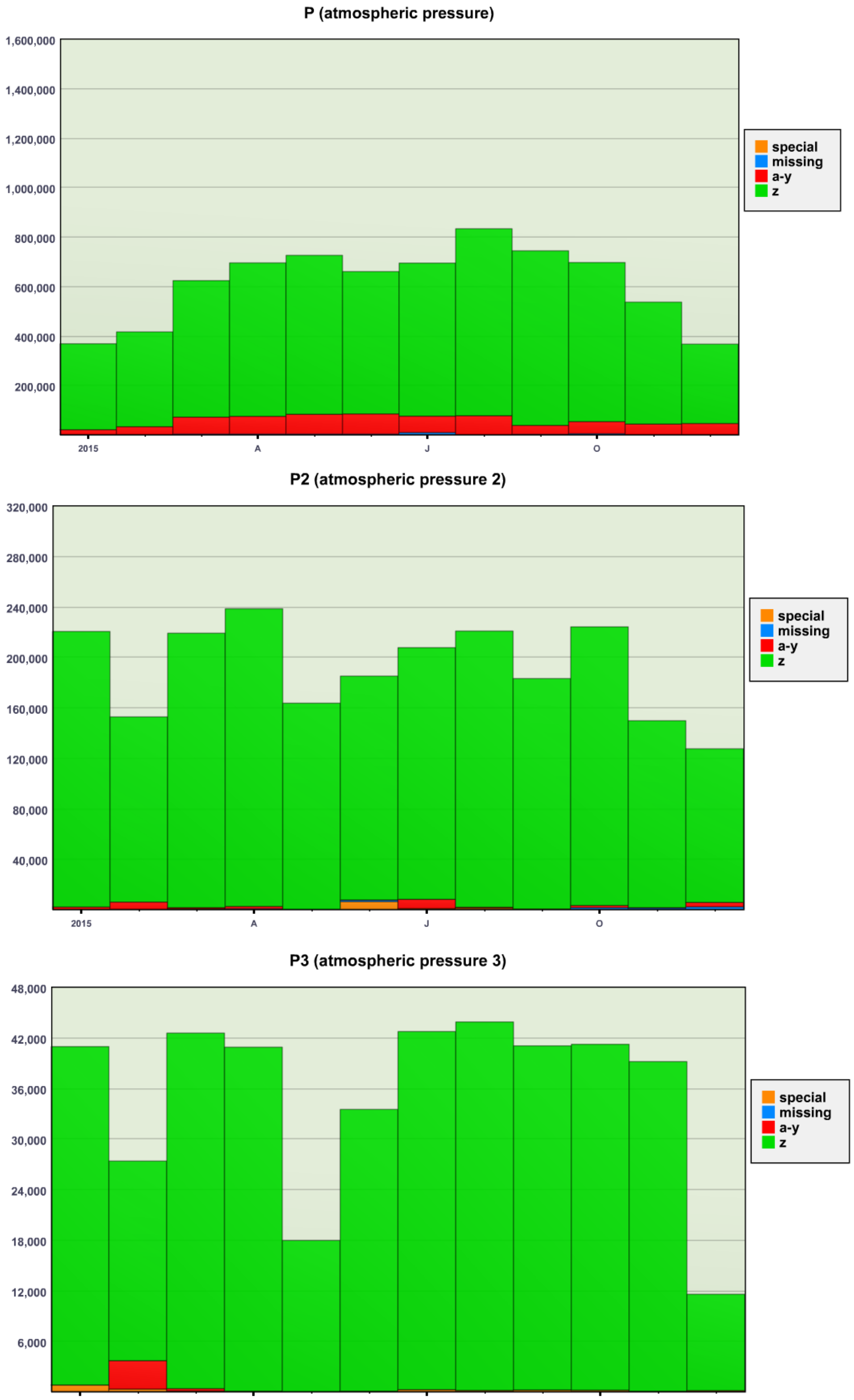


Figure 4: Total number of (top) atmospheric pressure – P – (middle) atmospheric pressure 2 – P2 – and (bottom) atmospheric pressure 3 – P3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Air temperature was also of decent quality (Figure 5). The *Hi'ialakai*, *Okeanos Explorer*, and *Pelican* are the likely culprits of the increase in flagging of T in February-June, as each of those vessels was experiencing issues with T within that period (documented; see individual vessel description in section 3c for details). Similar to P2, it isn't immediately apparent what caused the increases in flagging of T2 seen in March and October. We note, too, that T2 was another of *Atlantis's* variables that received a quantity of special value flags during 23-30 June (details unknown). But for the most part, flagging occurred across multiple vessels in any given month for typical reasons. With the air temperature sensors, again flow obstruction was a primary problem. In this case, when the platform relative wind direction is such that regular flow to the sensor is blocked, unnatural heating of the sensor location can occur. Deck heating can also occur simply when winds are light and the sensor is mounted on or near a large structure that easily retains heat (usually metal). Figure 37 does a good job of demonstrating sensor heating. Contamination from stack exhaust was also a common problem. Figure 54 does a good job of demonstrating stack exhaust contamination. Each of these incidences will result in the application of either caution/suspect (K) or poor quality (J) flags. In the case of stack exhaust, the authors wish to stress that adequate digital imagery, when used in combination with platform relative wind data, can facilitate the identification of exhaust contamination and subsequent recommendations to operators to change the exposure of their thermometer.

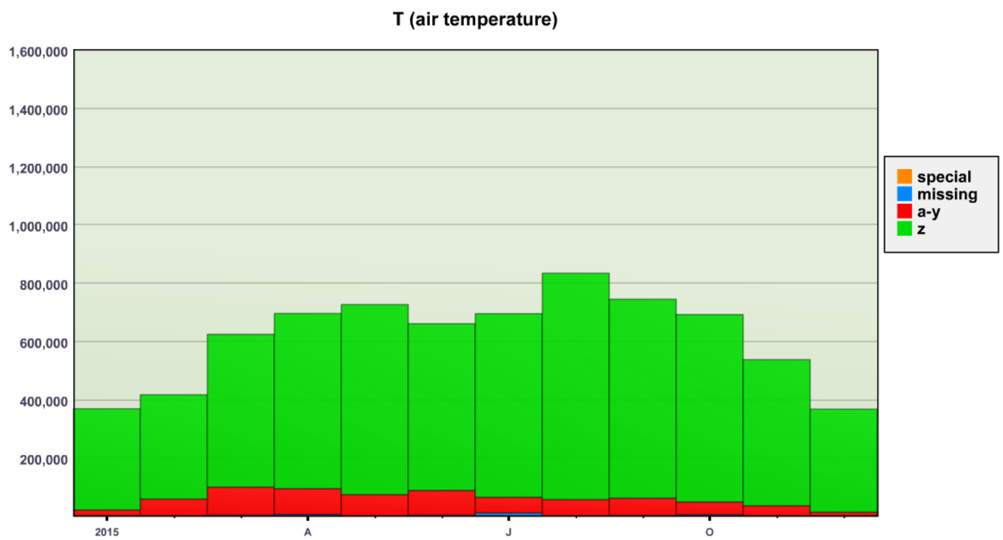
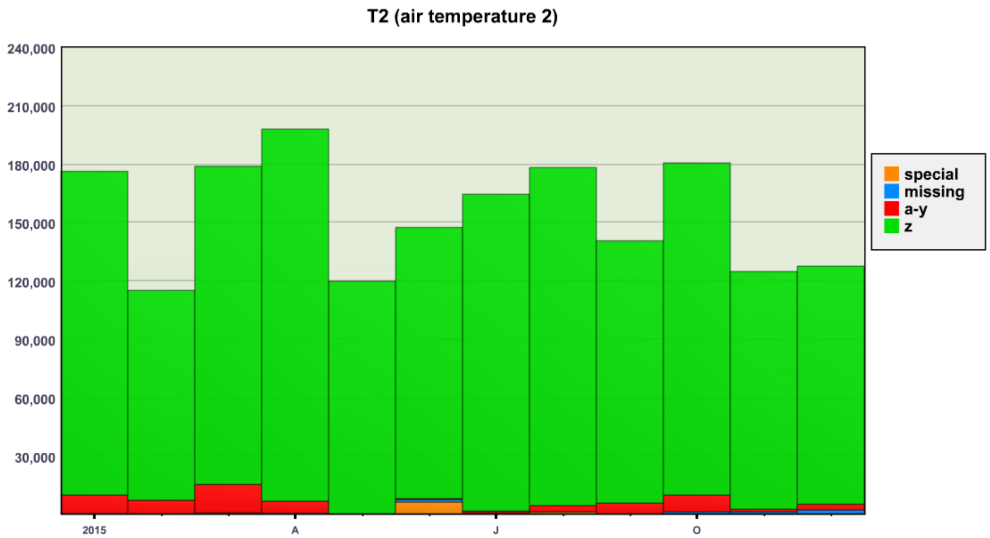
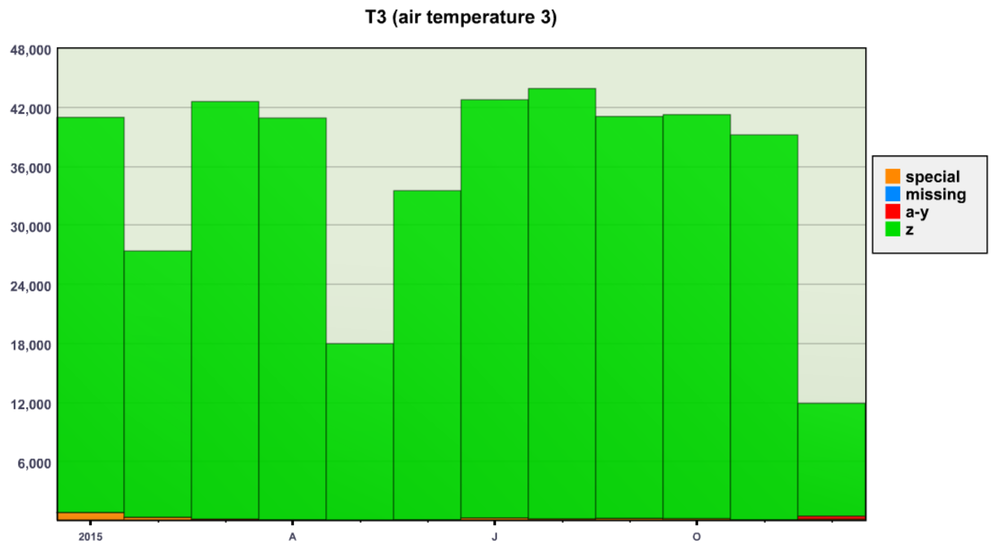


Figure 5: Total number of (this page) air temperature – T – (next page, top) air temperature 2 – T2 – and (next page, bottom) air temperature 3 – T3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.





(Figure 5: cont'd)

Wet bulb temperature (Figure 6) was reported by only one vessel in 2015; namely, the *Thomas Jefferson*, which is also the only vessel currently set up to report wet bulb. The flags applied in this case were mainly due to steps in the data as a result of platform relative wind direction sensitivity, as described in the individual vessel description in section 3c. No significant issues appear to exist with the parameter.

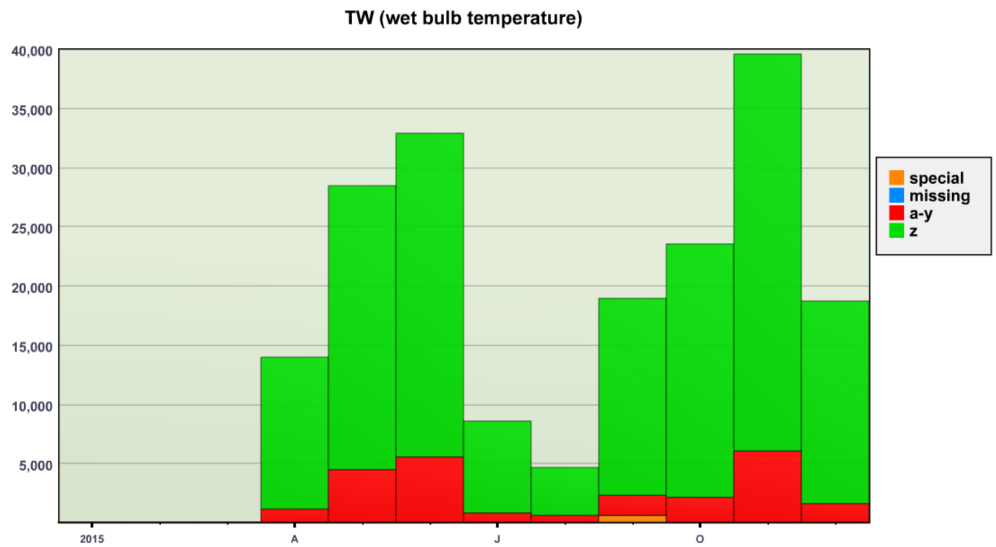


Figure 6: Total number of wet bulb temperature – TW – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Dew point temperature (Figure 7) also was only reported by one vessel in 2015; again, the *Thomas Jefferson*, although two other vessels are currently set up to report dew point if they wish. So the flags seen here, again, were mainly due to steps in the data as a result of platform relative wind direction sensitivity, as described in the individual vessel description in section 3c. No significant issues appear to exist with the parameter.

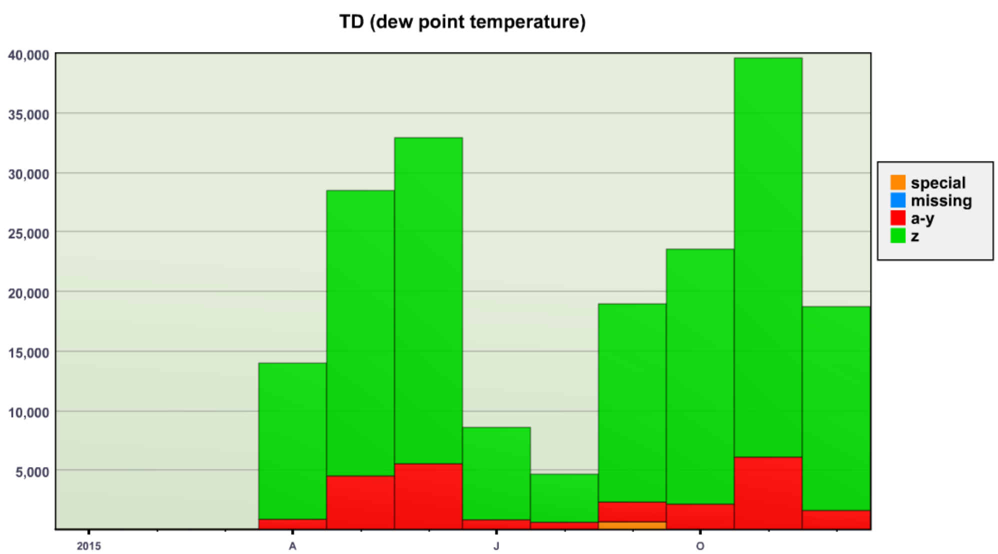


Figure 7: Total number of dew point temperature – TD – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

With relative humidity, the most common issue is readings slightly greater than 100%. If these measurements were sound they would imply supersaturated conditions, but in fact that scenario is quite rare near the surface of the ocean. When it comes to relative humidity, the mechanics of most types of sensors is such that it is easier to obtain high accuracy over a narrow range than over a broader range, say from 10% to 100% (Wiederhold, 2010). It is often desirable to tune these sensors for the greatest accuracy within ranges much less than 100%. The offshoot of such tuning, of course, is that when conditions are at or near saturation (e.g. rainy or foggy conditions) the sensor performs with less accuracy and readings over 100% commonly occur. While these readings are not really in grave error, they are nonetheless physically implausible and should not be used. Thus, they are B flagged by the automated QC flagger. These B flags likely account for a large portion of the A-Y flagged portions depicted in Figure 8. Additionally, several vessels (e.g. *Pelican*, *Hi'ialakai*, *Okeanos Explorer*, among others) encountered some challenges with their RH data a various points throughout the year; the confluence of these events likely explain any increases in flagging seen in RH (documented; see individual vessel description in section 3c for details). The bulk of the flags seen in RH2 in January and February are likely due to the *Falkor*, whose RH2 was not functioning properly during that period (also documented; see individual vessel description in section 3c for details). We note that RH2 was also another of *Atlantis's* variables that received a quantity of special value flags during 23-30 June (details unknown).

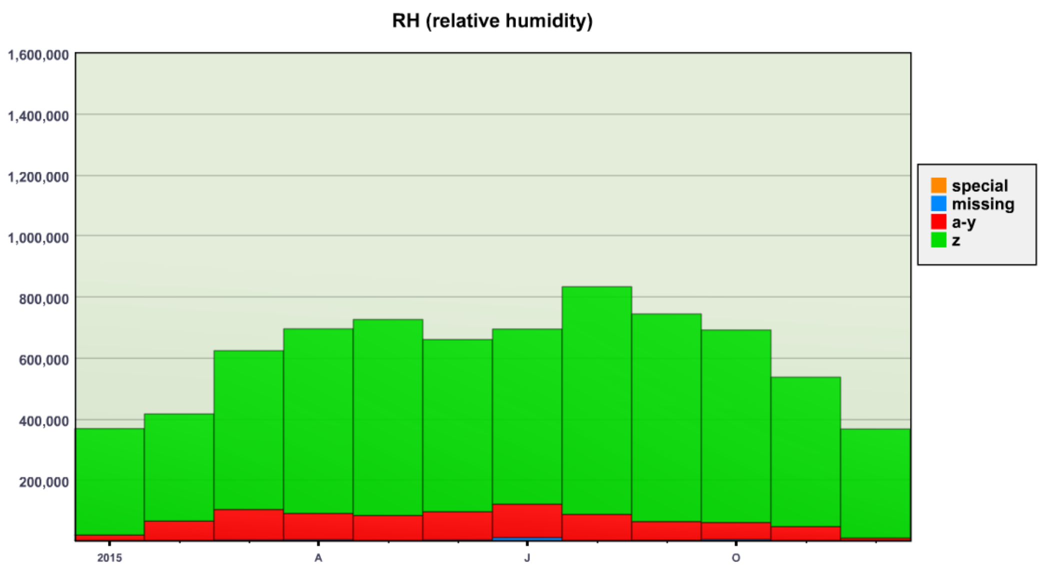
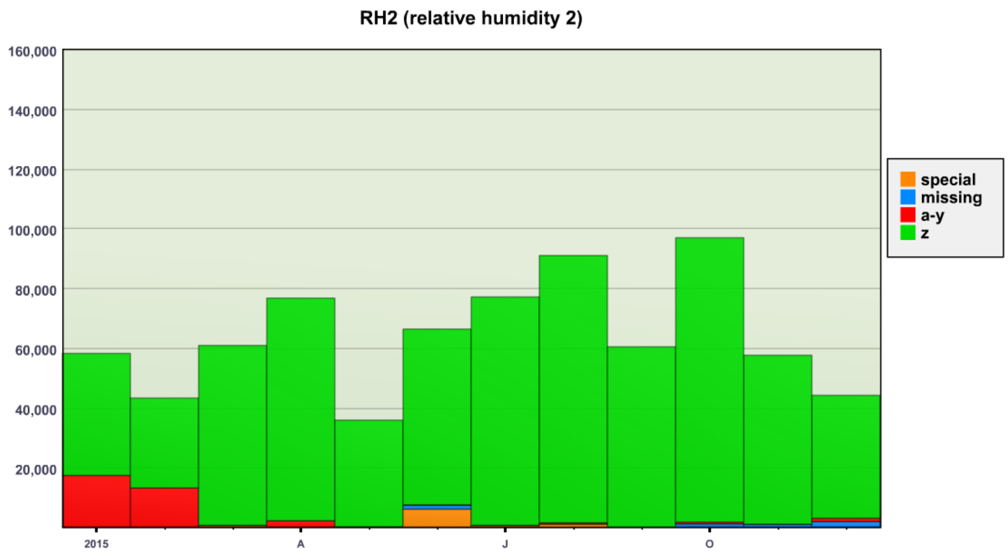
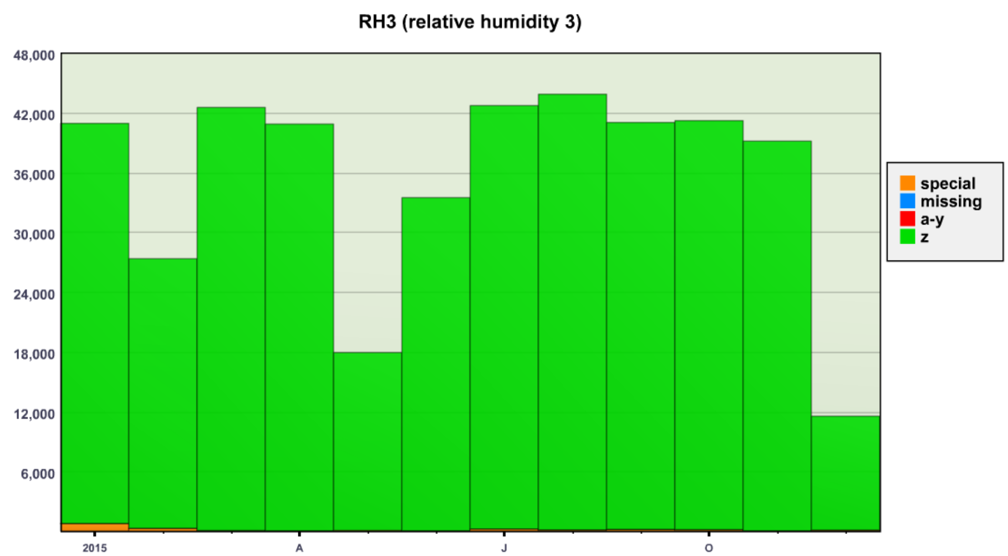


Figure 8: Total number of (this page) relative humidity – RH – (next page, top) relative humidity 2 – RH2 – and (next page, bottom) relative humidity 3 – RH3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.





(Figure 8: cont'd)

Wind sensors, both direction and speed, are arguably the instruments most affected by flow obstruction and changes in platform speed. Because research vessels traditionally carry bulky scientific equipment and typically have multi-level superstructures, it is a challenge to find locations on a research vessel where the sensors will capture the free-atmospheric circulation. Unlike other met sensors such as air temperature and relative humidity that are designed to function more or less independent of the micro scale nuances in airflow surrounding them, nuances in flow are the very thing that wind sensors are intended to measure. This is why obstructed flow is so readily incorporated into wind measurements. These flow-obstructed and platform speed-affected wind data were a common problem across SAMOS vessels in 2015.

There is an obvious increase in flagging of DIR/DIR2 and SPD/SPD2 in the period July – October, as shown in Figures 9 (earth relative wind direction) and 10 (earth relative wind speed). This surely must be due to both the *Atlantic Explorer* and the *Nathaniel Palmer* experiencing issues with the calculation of their true wind data during that exact period (documented; see individual vessel description in section 3c for details). It isn't immediately apparent what caused the slight increases in flagging of DIR3/SPD3 in January; however, we note that the *Atlantis* is the only vessel currently carrying that parameter. We note that DIR2 and SPD2 were two more of *Atlantis's* variables that received a quantity of special value flags during 23-30 June (details unknown). Otherwise, the overall quality of the 2015 SAMOS wind data was relatively good. In SAMOS visual quality control, compromised wind data is addressed with caution/suspect (K), visual spike (S), and sometimes poor quality (J) flags. Where comprehensive metadata and digital imagery exist, flow obstructed platform relative wind bands can often be diagnosed based on the structural configuration of the vessel and recommendations can be made to the vessel operator to improve sensor locations. Another diagnostic tool available to SAMOS data analysts is a polar plotting routine, which can look at a single variable and identify the ratio of flagged observations to total observations in one degree (platform relative wind direction) bins. In this way, platform relative wind bands that interfere with sensor readings may be identified. Currently the polar plot program is configured to accept air temperature, humidity, and true wind speed and direction data with corresponding platform relative wind data. The polar plotting program is not currently in regular use by SAMOS data analysts because it is a time consuming process and the routines need more tuning, but its attributes could be improved and its benefits further explored in the future. Figures 41 and 45 in the next section do a good job of showing the steps that can occur in DIR and/or SPD when flow obstruction or distortion occurs; spikes are pretty self-explanatory.

The other major problem with earth relative wind data is errors caused by changes in platform speed. Occasionally, a wind direction sensor is also suspected of being "off" by a number of degrees. Satellite wind products and in-situ data (buoys, pier-based stations, etc.) can sometimes clue data analysts in to such a bias, particularly if the bias is very large. But in general, if a technician suspects a wind direction bias it is critical they communicate that suspicion to SAMOS personnel, as otherwise the data analysts often will have no reliable means of discovering the problem themselves. Suspected wind direction biases are typically flagged with K flags, or J flags if the case is extreme and/or verifiable.

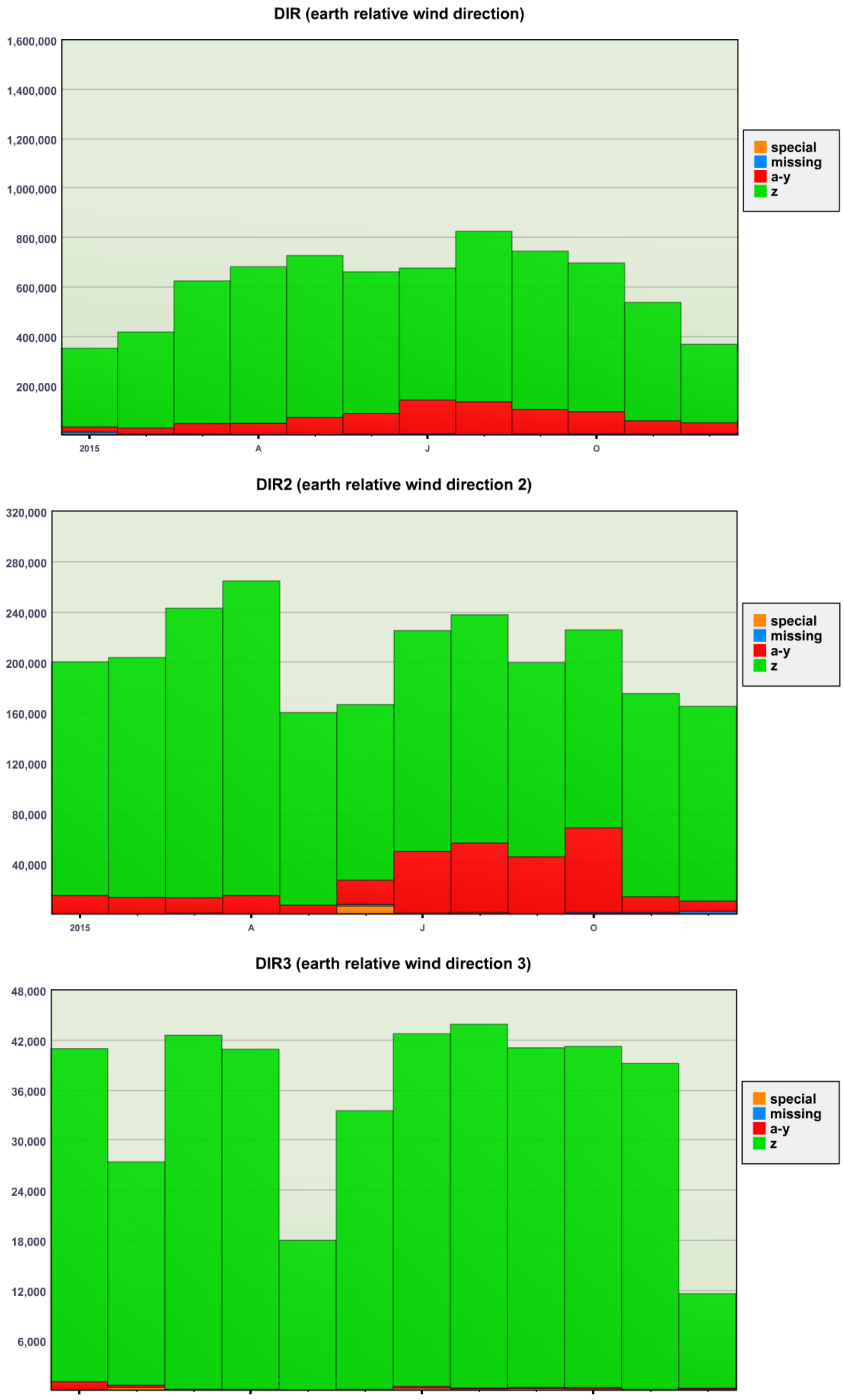


Figure 9: Total number of (top) earth relative wind direction – DIR – (middle) earth relative wind direction 2 – DIR2 – and (bottom) earth relative wind direction 3 – DIR3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

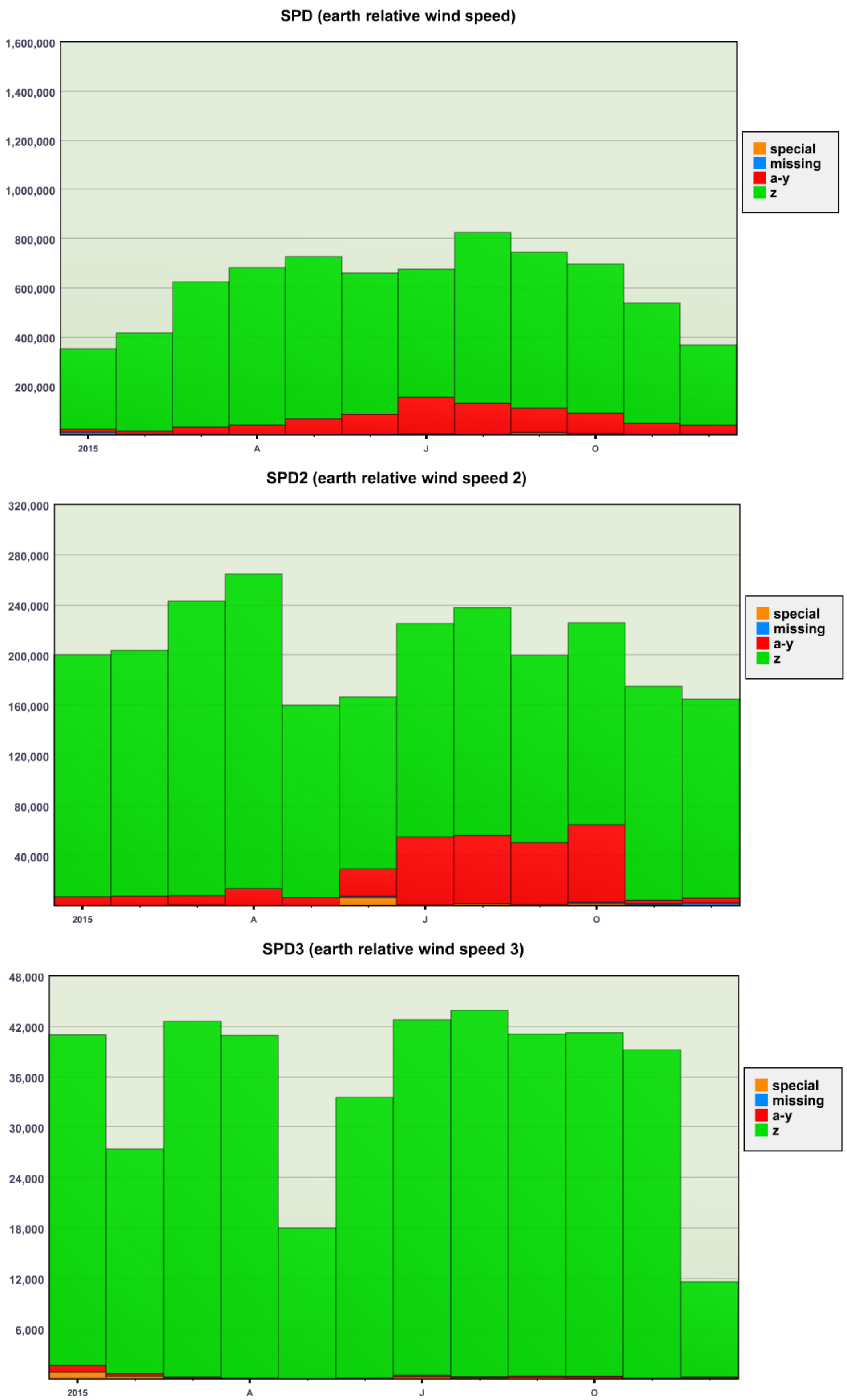


Figure 10: Total number of (top) earth relative wind speed – SPD – (middle) earth relative wind speed 2 – SPD2 – and (bottom) earth relative wind speed 3 – SPD3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Most of the flags applied to the radiation parameters were assigned by the autoflagger, primarily to short wave radiation (Figure 11). Short wave radiation tends to have the largest percentage of data flagged for parameters submitted to SAMOS. Out of bounds (B) flags dominate in this case. Like the relative humidity sensors, this is again a situation where a high degree of accuracy is impossible over a large range of values. As such, shortwave sensors are typically tuned to permit greater accuracy at large radiation values. Consequently, shortwave radiation values near zero (i.e., measured at night) often read slightly below zero. Once again, while these values are not a significant error, they are nonetheless invalid and unsuitable for use as is and should be set to zero by any user of these data. Long wave atmospheric radiation, on the other hand, has perhaps the smallest percentage of data flagged for parameters submitted to SAMOS (Figure 12). The increase in flagging of RAD_LW in January was likely due to a sensor failure on the *New Horizon* that month, and the increases in flagging of RAD_LW in October – November and in RAD_PAR in October were probably due to some extreme behavior in *Revelle's* sensors during the October – November period. The increase in flagging of RAD_PAR in July may have been owed to the *T.G. Thompson*, whose sensor was a bit unsteady that month. (Note all of these issues are documented; see individual vessel description in section 3c for details.) It isn't immediately evident what caused the increased flagging of RAD_PAR in May, nor some of the heavier flagging in RAD_SW2, although in that case we note the *Tangaroa* is the only vessel currently carrying that parameter. The majority of the special value flag volume seen in RAD_NET2 in September was allotted to the *Nathaniel Palmer* (details unknown). Otherwise, overall quality for the short wave and long wave parameters looks good, as does the overall quality for photosynthetically active atmospheric radiation and net atmospheric radiation (Figures 13, and 14, respectively).

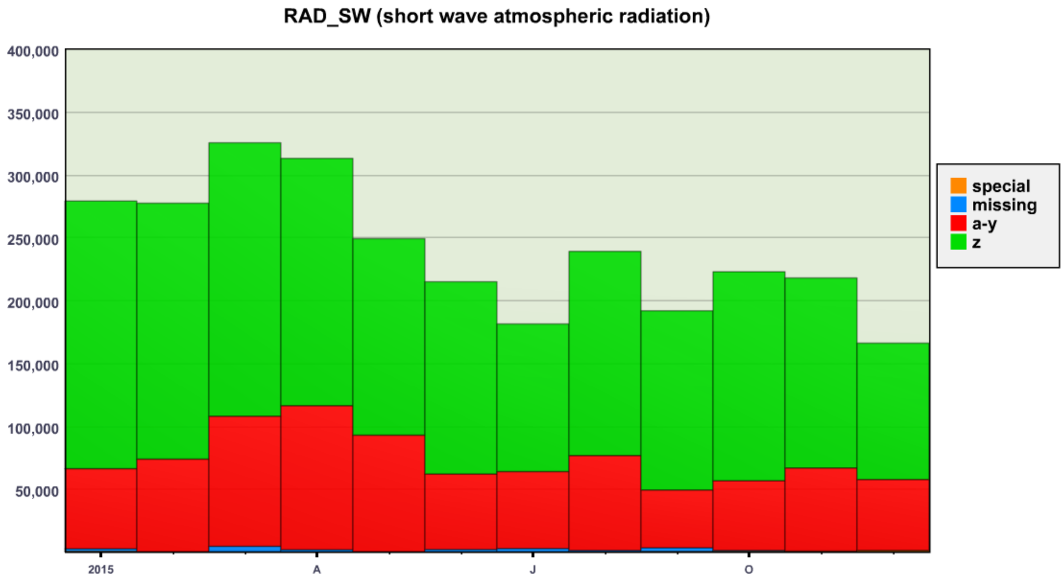
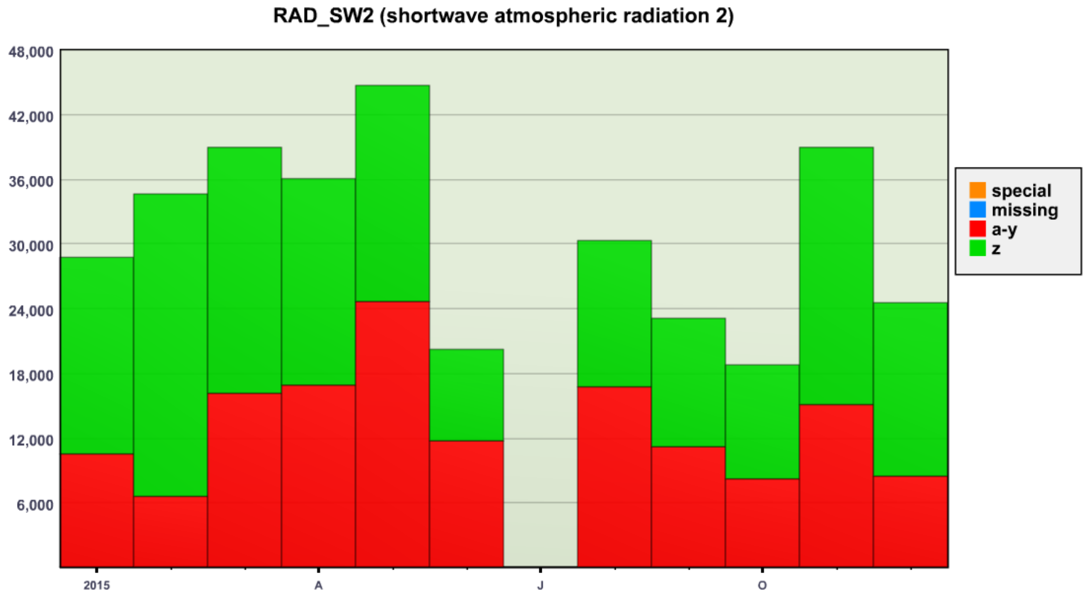


Figure 11: Total number of (this page) shortwave atmospheric radiation – RAD_SW – and (next page) shortwave atmospheric radiation 2 – RAD_SW2 –observations provided by all ships for each month in 2014. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



(Figure 11: cont'd)

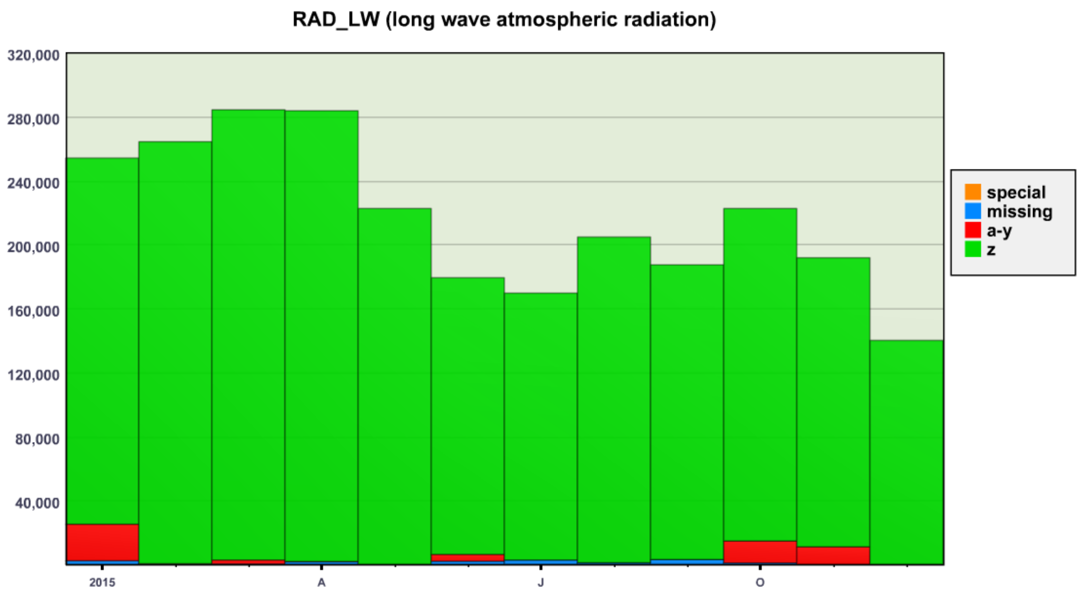
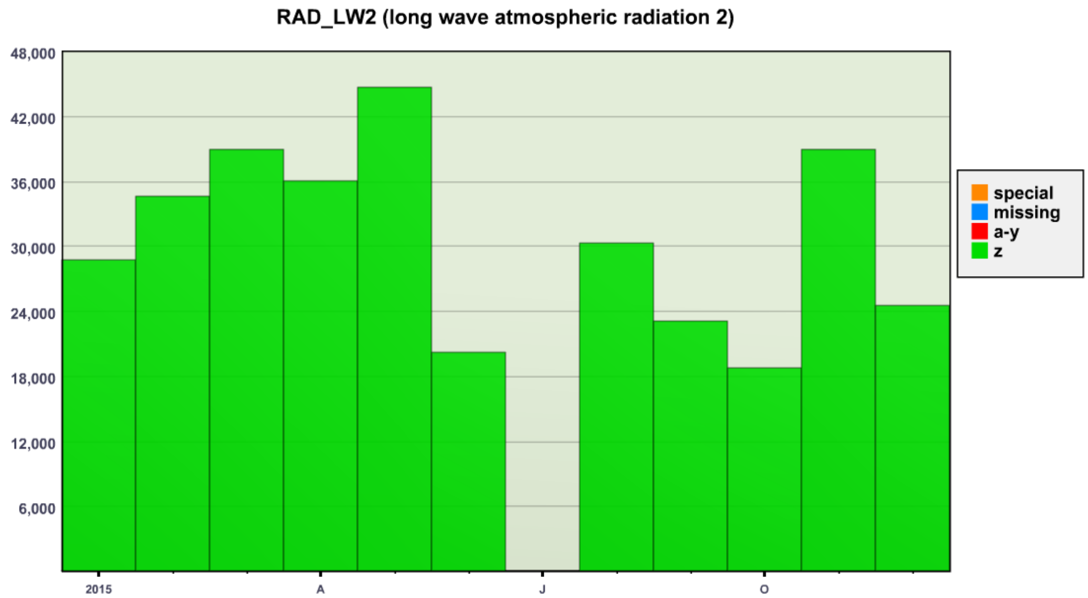


Figure 12: Total number of (this page) long wave atmospheric radiation – RAD_LW – and (next page) long wave atmospheric radiation 2 – RAD_LW2 –observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



(Figure 12: cont'd)

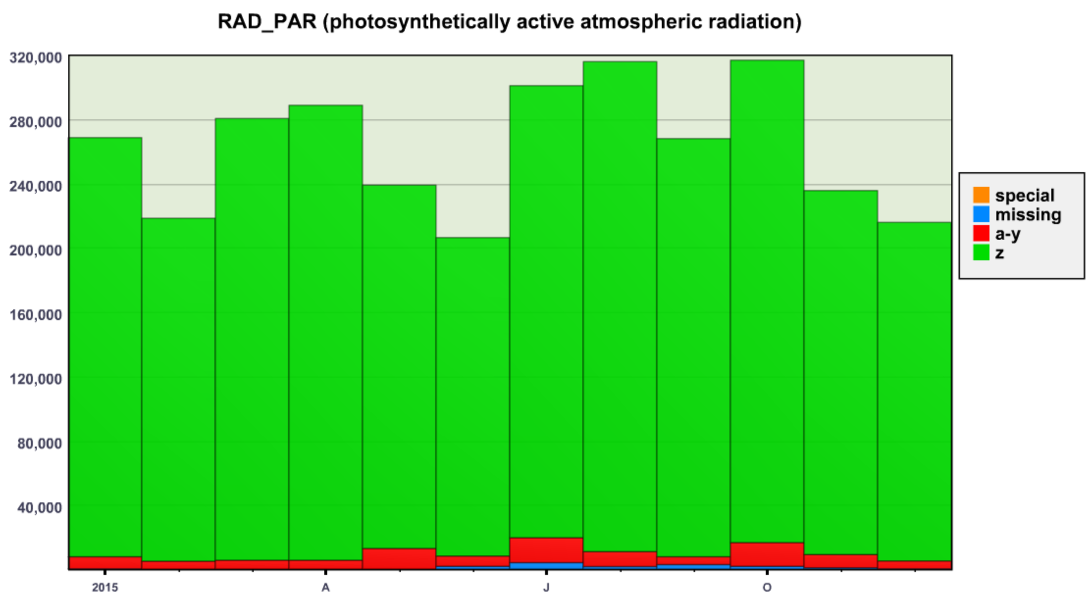
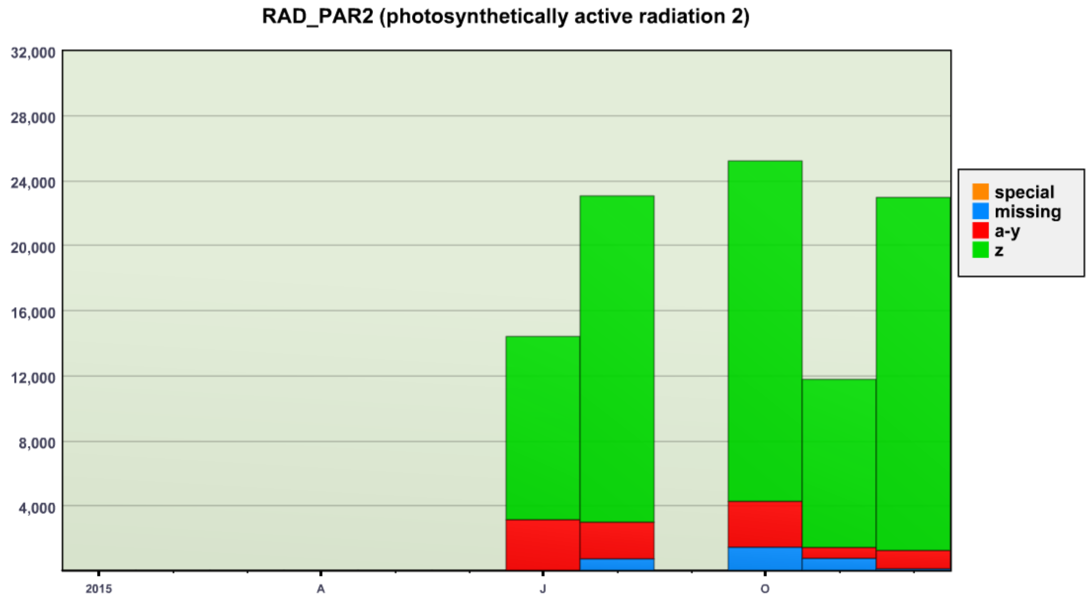


Figure 13: Total number of (this page) photosynthetically active atmospheric radiation – RAD_PAR – and (next page) photosynthetically active atmospheric radiation 2 – RAD_PAR2 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



(Figure 13: cont'd)

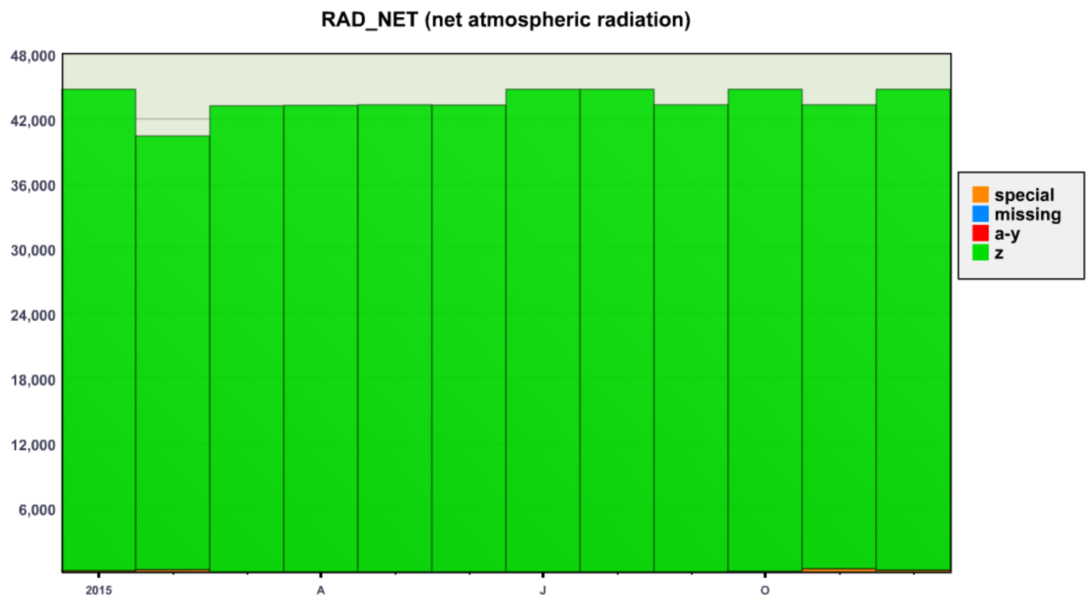
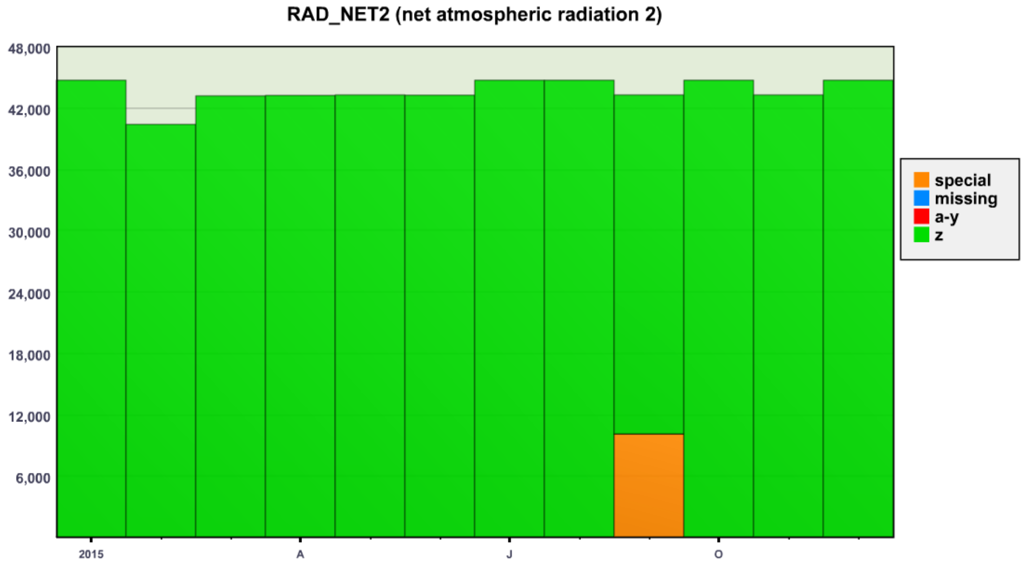


Figure 14: Total number of (this page) net atmospheric radiation – RAD_NET – and (next page) net atmospheric radiation 2 – RAD_NET2 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



(Figure 14: cont'd)

There were no major problems of note with either the rain rate (Figure 15) or precipitation accumulation (Figure 16) parameters, although we note that RRATE2 and PRECIP2 were two more of *Atlantis's* variables that received a quantity of special value flags during 23-30 June (details unknown). It should also be noted that some accumulation sensors occasionally exhibit slow leaks and/or evaporation. These data are not typically flagged; nevertheless, frequent emptying of precipitation accumulation sensors is always advisable.

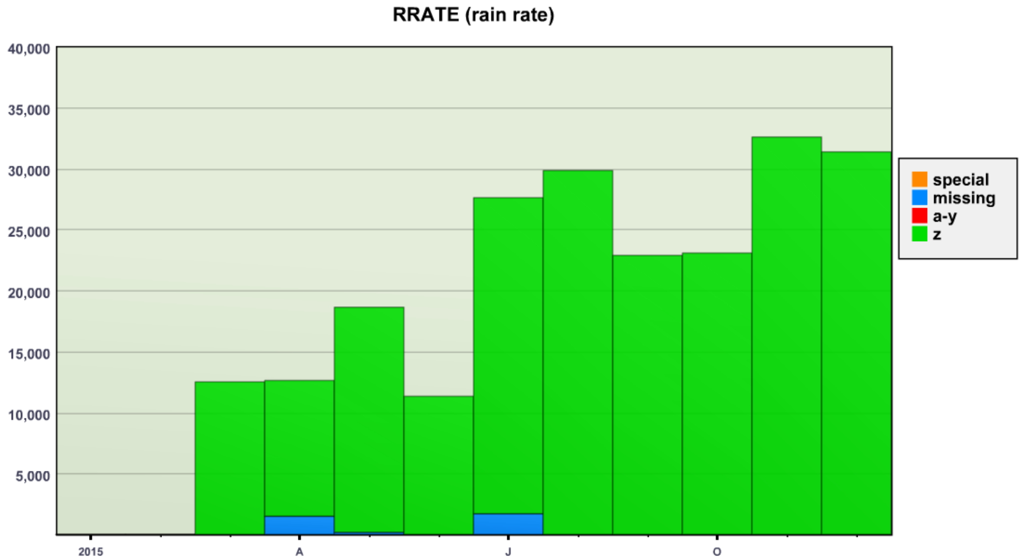
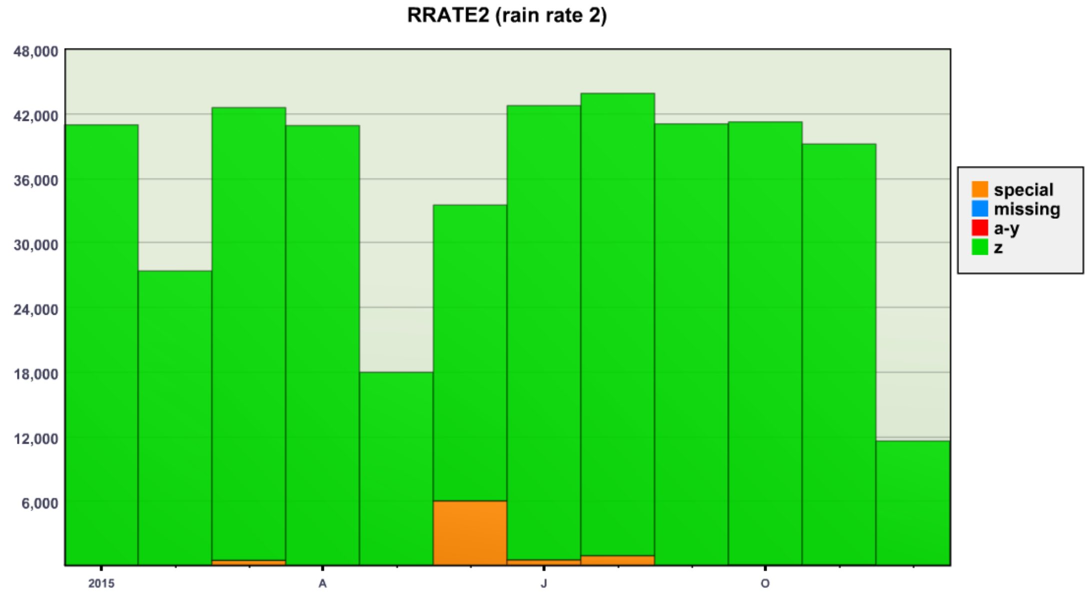
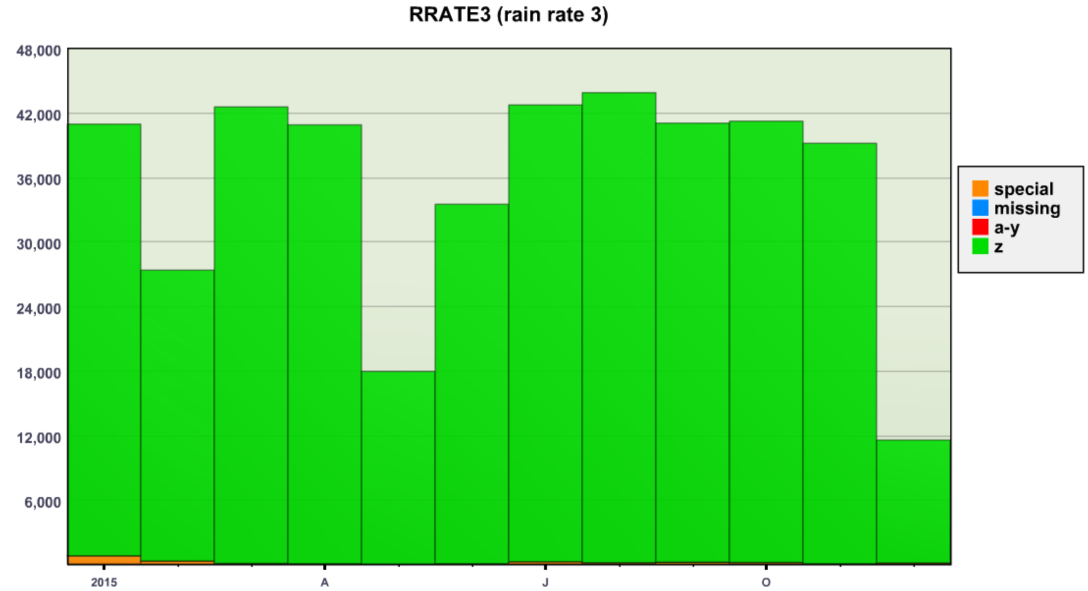


Figure 15: Total number of (this page) rain rate – RRATE – (next page, top) rain rate 2 – RRATE2 – and (next page, bottom) rain rate 3 – RRATE3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.





(Figure 15: cont'd)

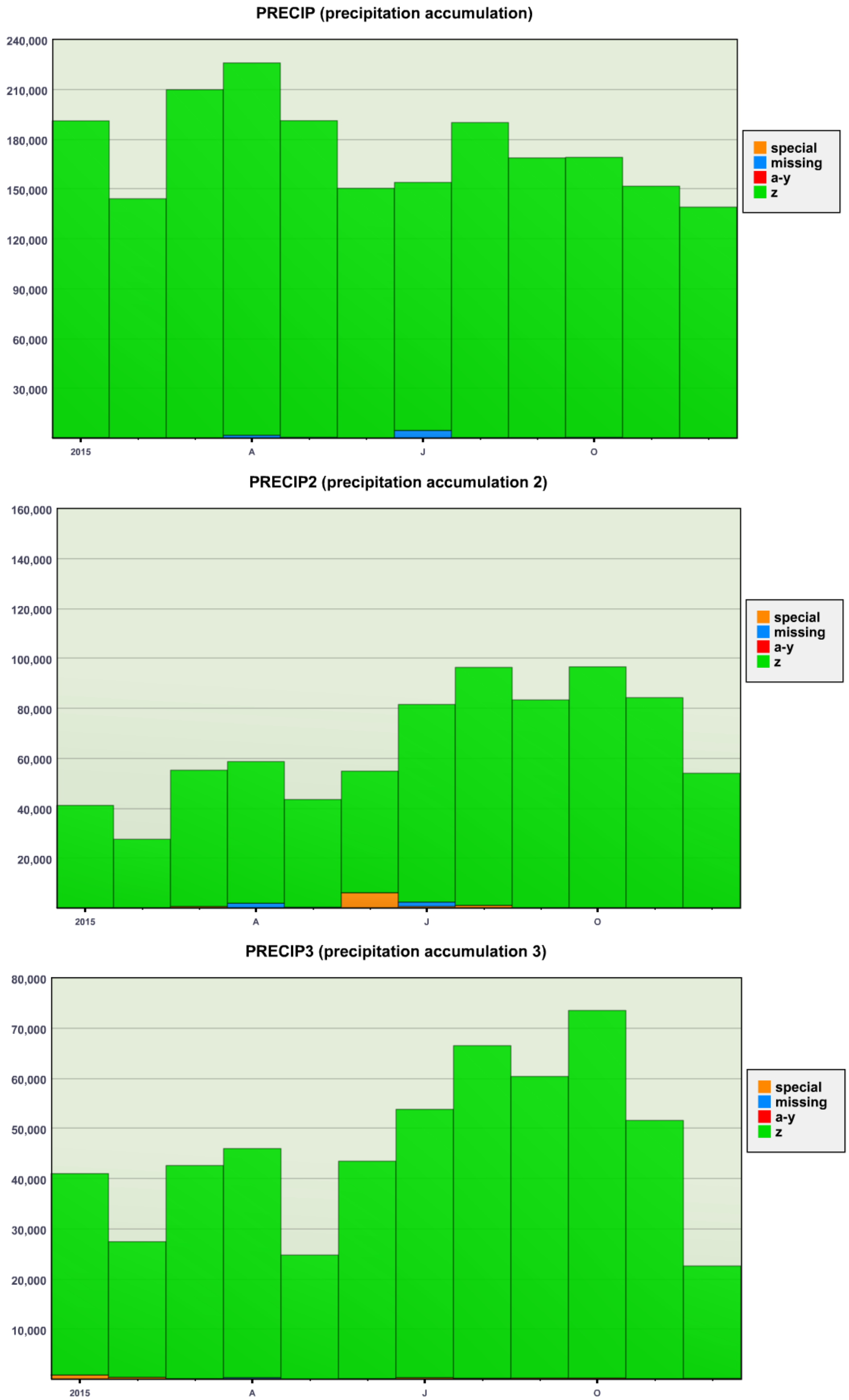


Figure 16: Total number of (top) precipitation accumulation – PRECIP – (middle) precipitation accumulation 2 – PRECIP2 – and (bottom) precipitation accumulation 3 – PRECIP3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

The main problem identified with the sea temperature parameter (Figure 17) occurs when the sensor is denied a continuous supply of seawater. In these situations, either the resultant sea temperature values are deemed inappropriate for the region of operation (using gridded SST fields as a guide), in which case they are flagged with suspect/caution (K) flags or occasionally poor quality (J) flags if the readings are extraordinarily high or low, or else the sensor reports a constant value for an extended period of time, in which case they are unanimously J-flagged. The events are also frequently extreme enough for the autoflagger to catch them and assign greater than four standard deviations from climatology (G) or out of bounds (B) flags. The authors note that this stagnant seawater scenario often occurs while a vessel is in port, which is rather anticipated as the normal ship operation practice by SAMOS data analysts. Other than this expected performance, the TS data were generally good in 2015. A good deal of the flagging seen in TS is likely explained via the *Pisces*, as the parameter was actually outputting a voltage value until mid September (documented; see individual vessel description in section 3c for details). Likewise a good deal of the flagging of TS2 is likely explained via the *Sikuliaq*, as their infrared thermometer commonly pointed at the dock when they were tied up, effectively measuring the dock temperature, which was subsequently frequently flagged as greater than four standard deviations from climatology (G). The volume of special value flags seen in July and August in TS are mainly owed to the *Reuben Lasker*, who experienced a few hiccups during their initial spin-up after being recruited to SAMOS mid-2015 (documented; see individual vessel description in section 3c for details).

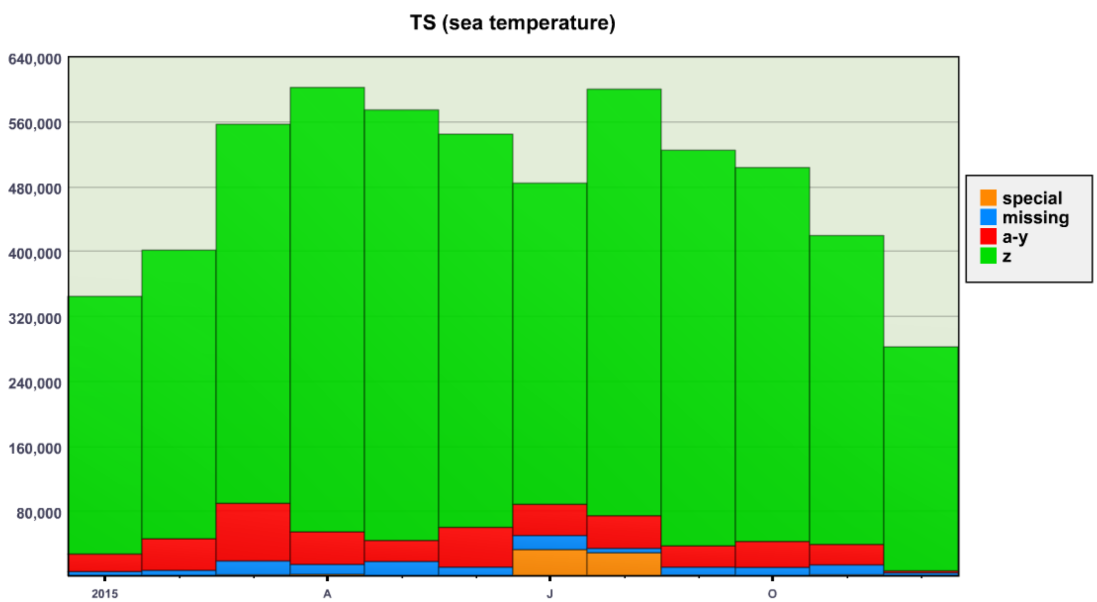
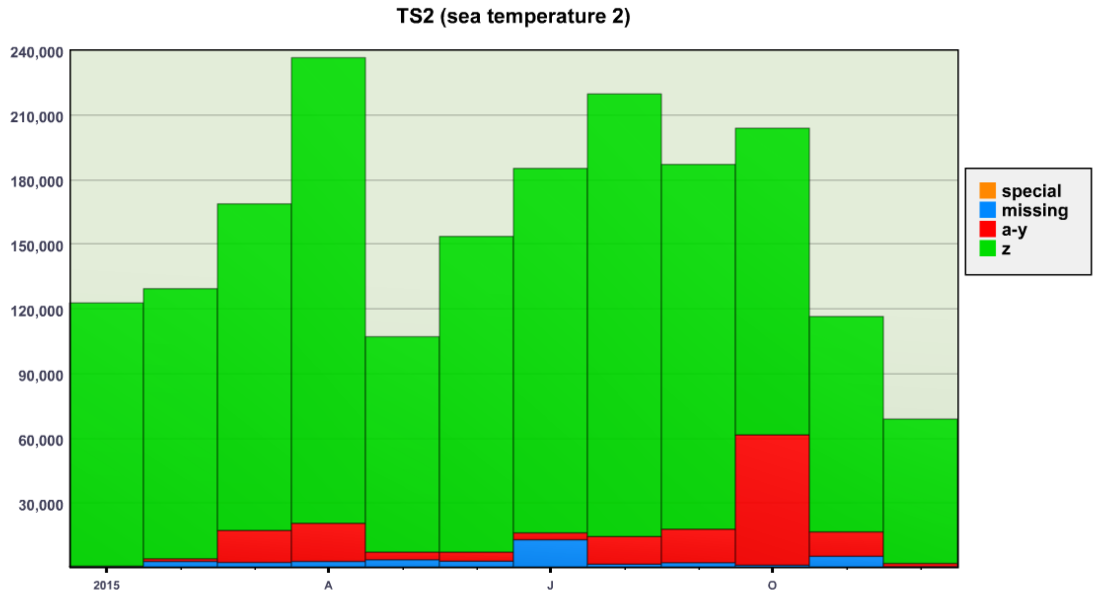
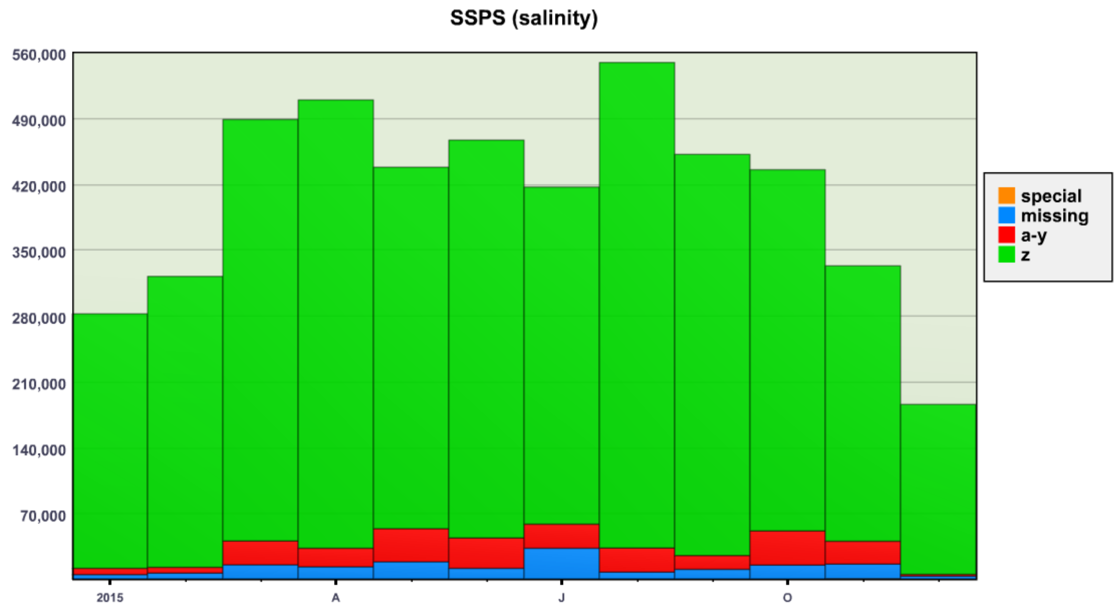


Figure 17: Total number of (this page) sea temperature – TS – and (next page) sea temperature 2 – TS2 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



(Figure 17: cont'd)

Salinity and conductivity (Figures 18 and 19, respectively) experienced the same major issue as sea temperature; namely, when a vessel was in port or ice or rough seas the flow water system that feeds the probes was usually shut off, resulting in either inappropriate or static values. Another fairly common issue with salinity and conductivity, though, is that on some vessels the intake port is a little shallower than is desirable, such that in heavy seas the intake cyclically rises above the waterline and air gets into the sample. When this occurs, the data can be fraught with spikes. Data such as this is typically flagged with either spike (S), suspicious quality (K), or occasionally even poor quality (J) flags. In spite of these issues, though, salinity and conductivity data in 2015 was still rather good. The increase in flagging noted in CNDC2 during the period July – October was almost certainly owing to the *Revelle*, but this case, too, was likely an issue of the flow water pump being turned off as opposed to a problem with the sensor (documented; see individual vessel description in section 3c for details). The authors do note that all the salinity values are relative and no effort was made to benchmark the values to water calibration samples. Calibration of salinity data is presently beyond the scope of SAMOS.



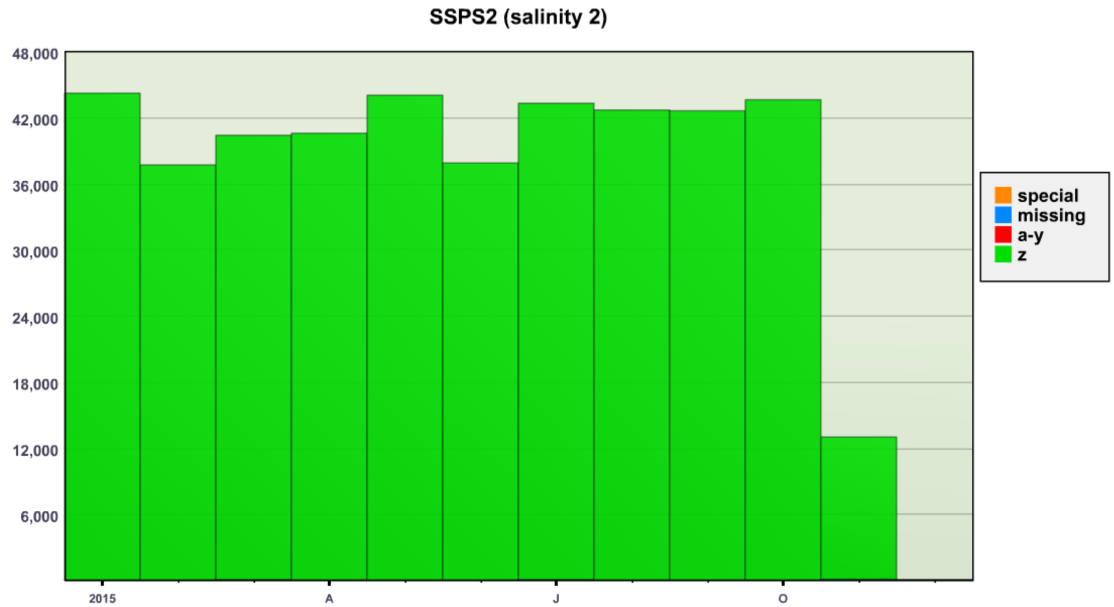


Figure 18: Total number of (top) salinity – SSPS – and (bottom) salinity 2 – SSPS2 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

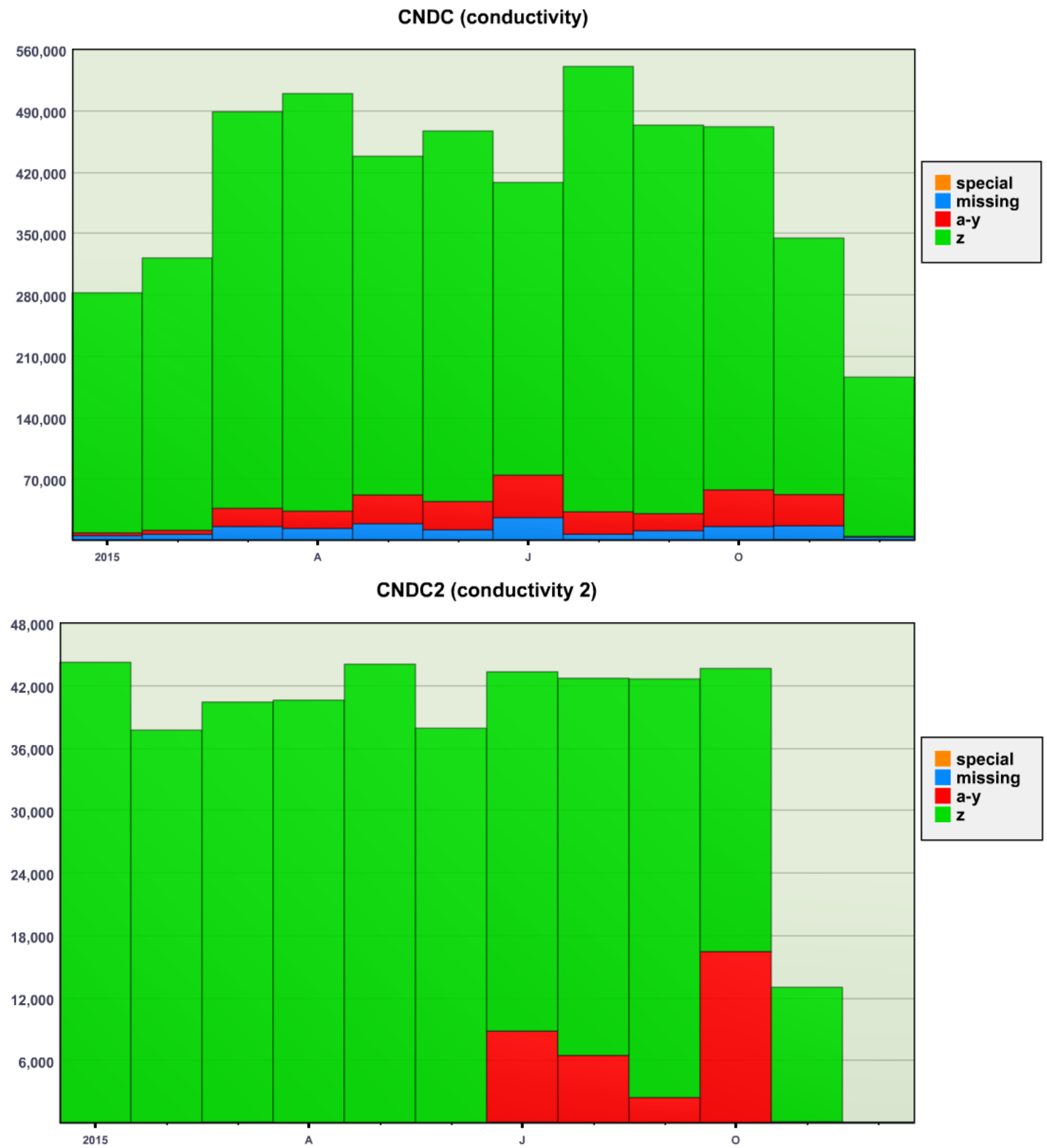
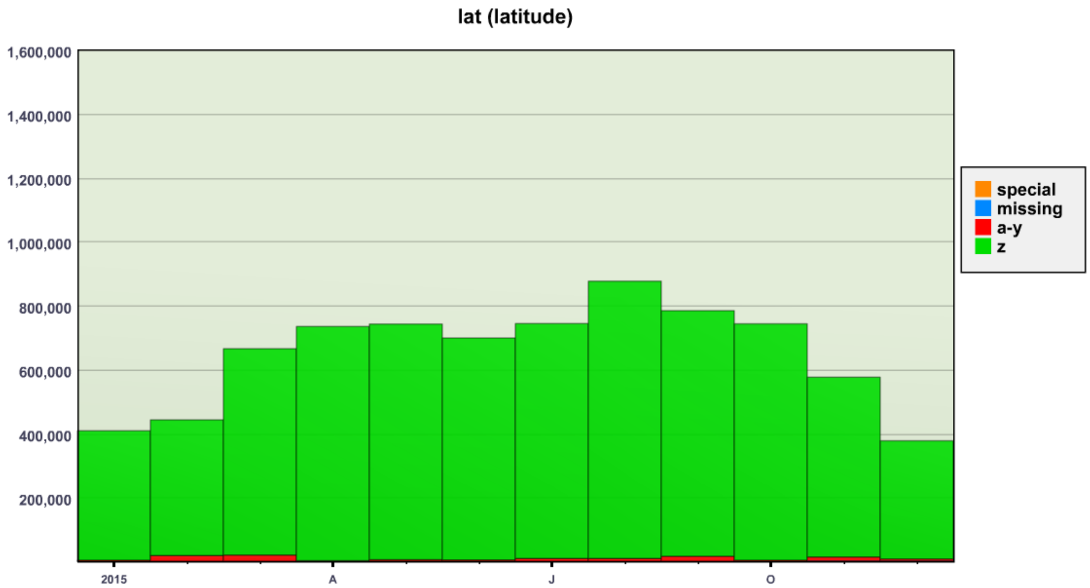


Figure 19: Total number of (top) conductivity – CNDC – and (bottom) conductivity 2 – CNDC2 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Latitude and longitude (Figure 20) primarily only receive flags via the autoflagger, although occasionally the data analyst will apply port (N) flags as prescribed in the preceding section 3a, and in the rare cases of system-wide failure they can each be assigned malfunction (M) flags by the data analyst. Other than these few cases, LAT and LON each primarily receive land error flags, which are often removed by the data analyst when it is determined that the vessel was simply very close to land, but still over water (although for non-visual QC ships this step is not taken). The geographic land/water mask in use for determining land positions in 2015 was a two-minute grid. It should be noted that *Atlantis* and *Pelican* in particular transmit a good deal of port data and since they do not receive visual QC, some amount of erroneous L (position over land) autoflagging would be expected for 2015. It should also be noted that a new one-minute land-sea mask is currently undergoing testing at the SAMOS DAC. It is expected that the overall application of L flags will decrease once the new land-sea mask is operational.



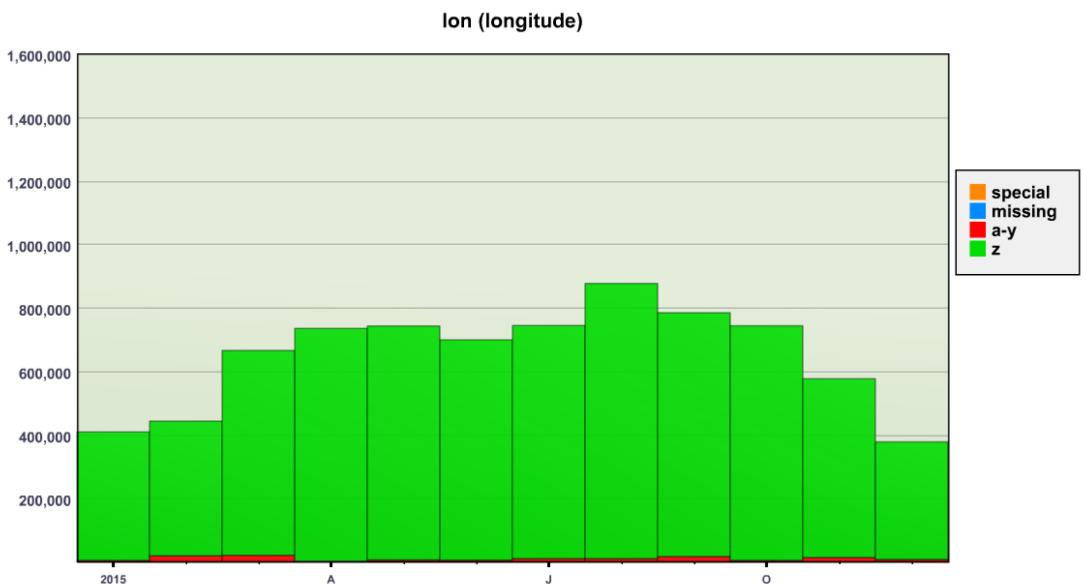


Figure 20: Total number of (top) latitude – LAT – and (bottom) longitude – LON – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

The remainder of the navigational parameters exhibited no problems of note. They are nevertheless included for completeness: platform heading (Figure 21), platform course (Figure 22), platform speed over ground (Figure 23), and platform speed over water (Figure 24). We note that the *Nathanial Palmer* is the culprit behind the special value flags seen in PL_SPD during the period July-October (details unknown).

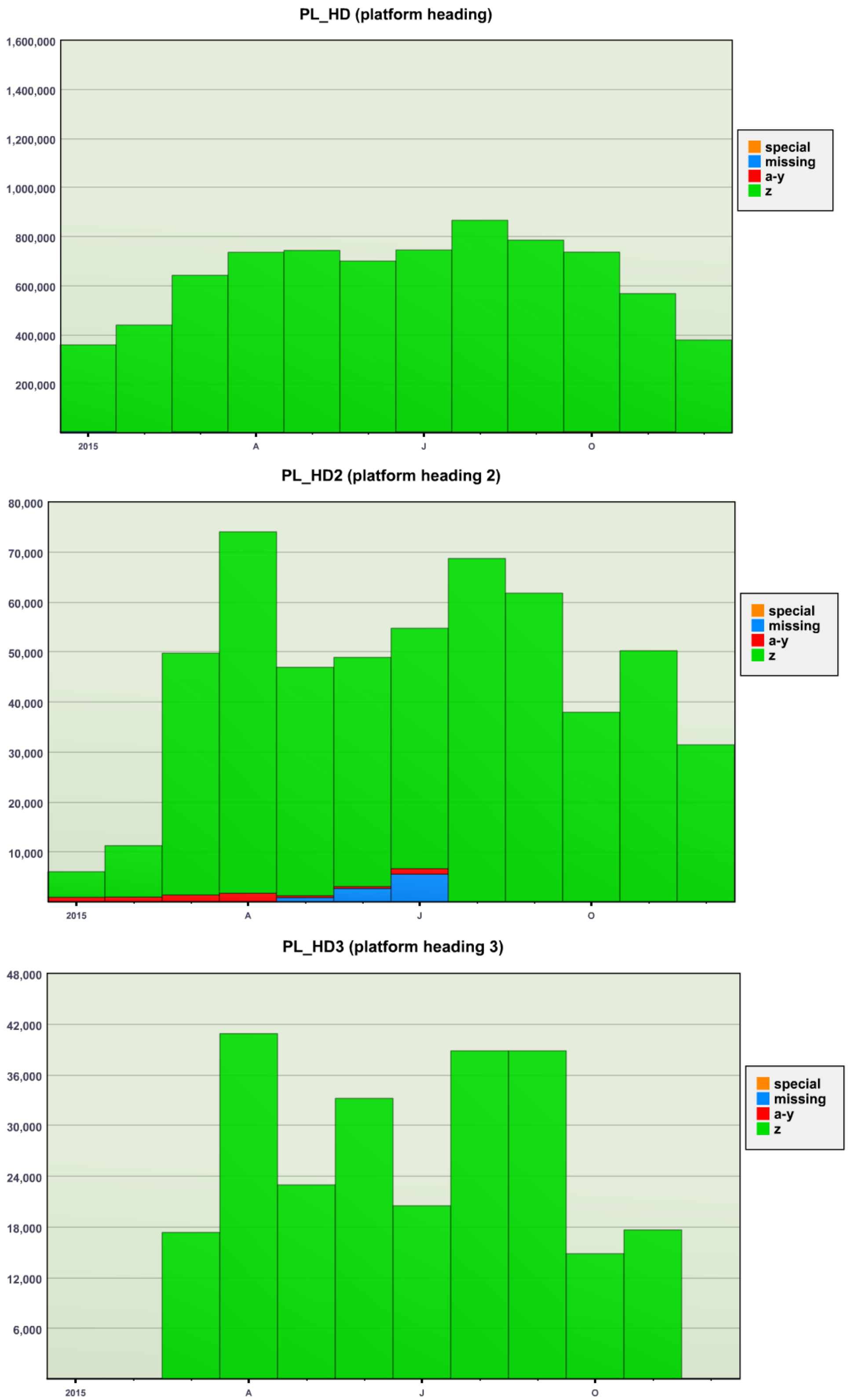


Figure 21: Total number of (top) platform heading – PL_HD – (middle) platform heading 2 – PL_HD2 – and (bottom) platform heading 3 – PL_HD3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

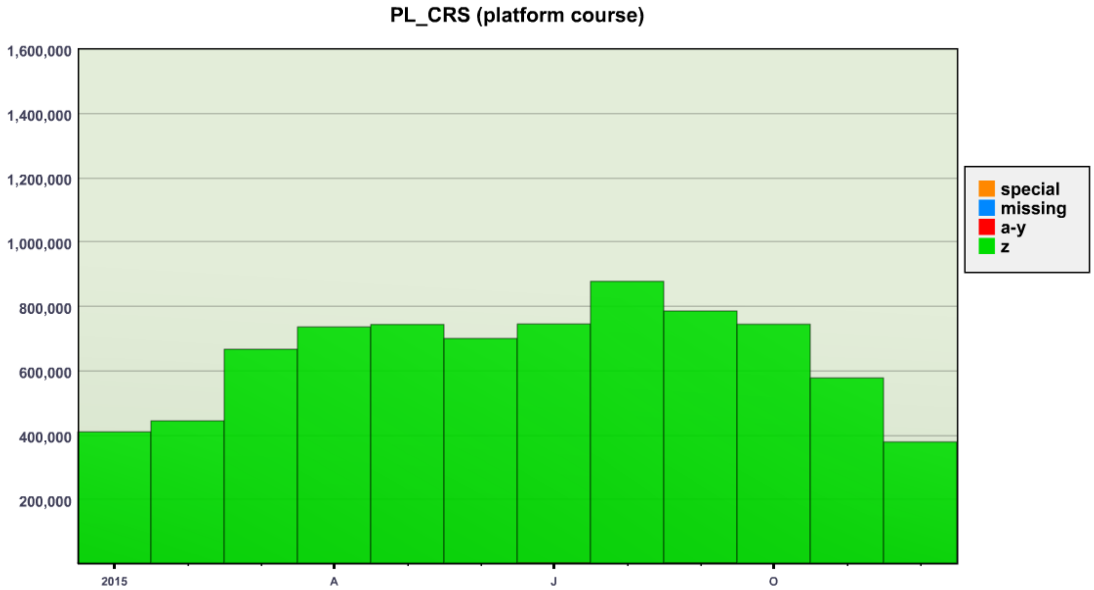


Figure 22: Total number of platform course – PL_CRS –observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

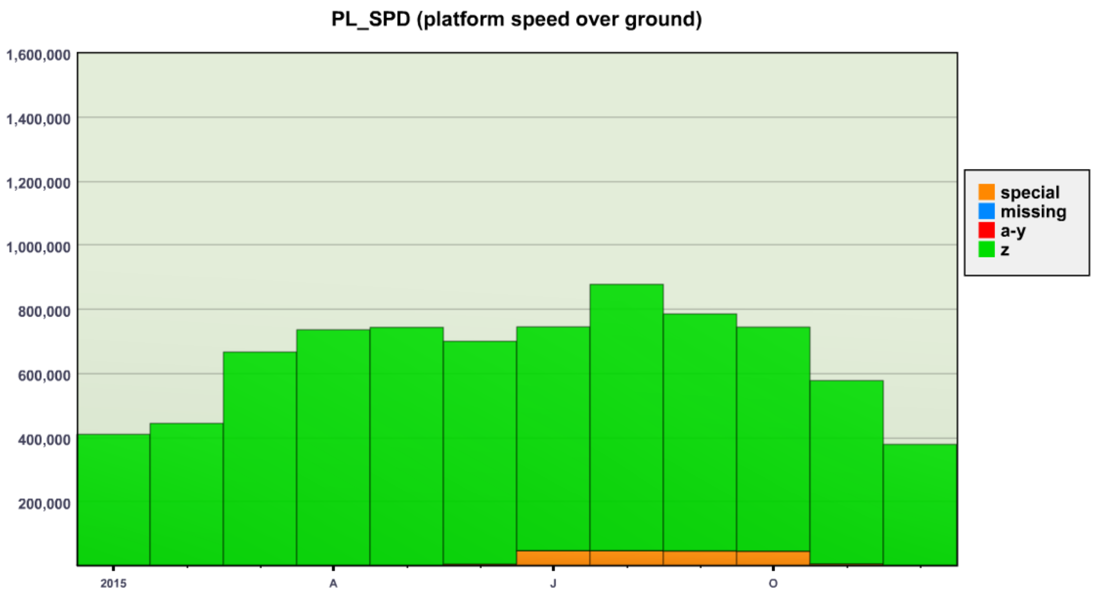
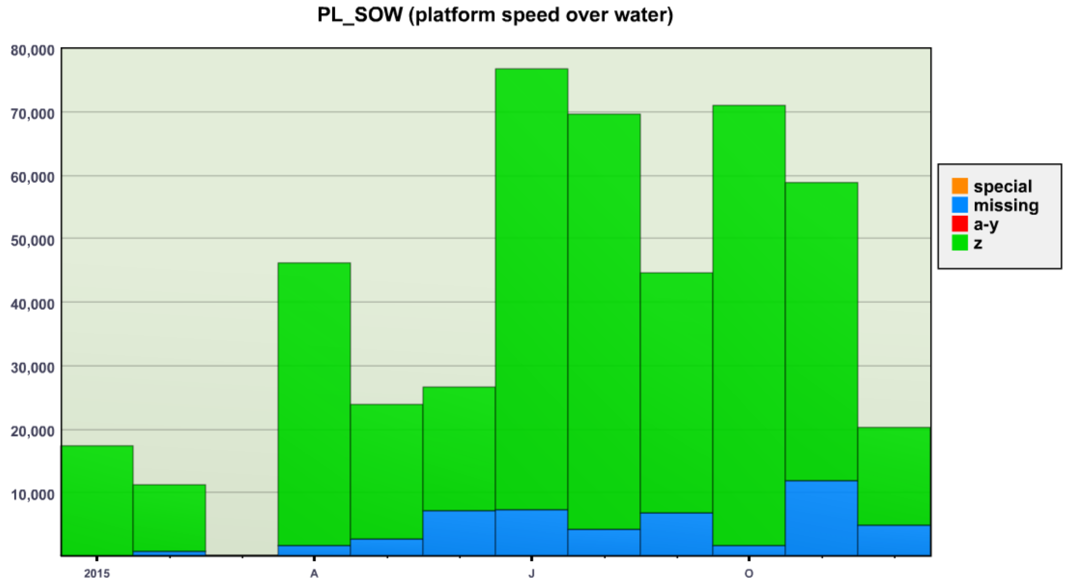


Figure 23: Total number of platform speed over ground – PL_SPD –observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



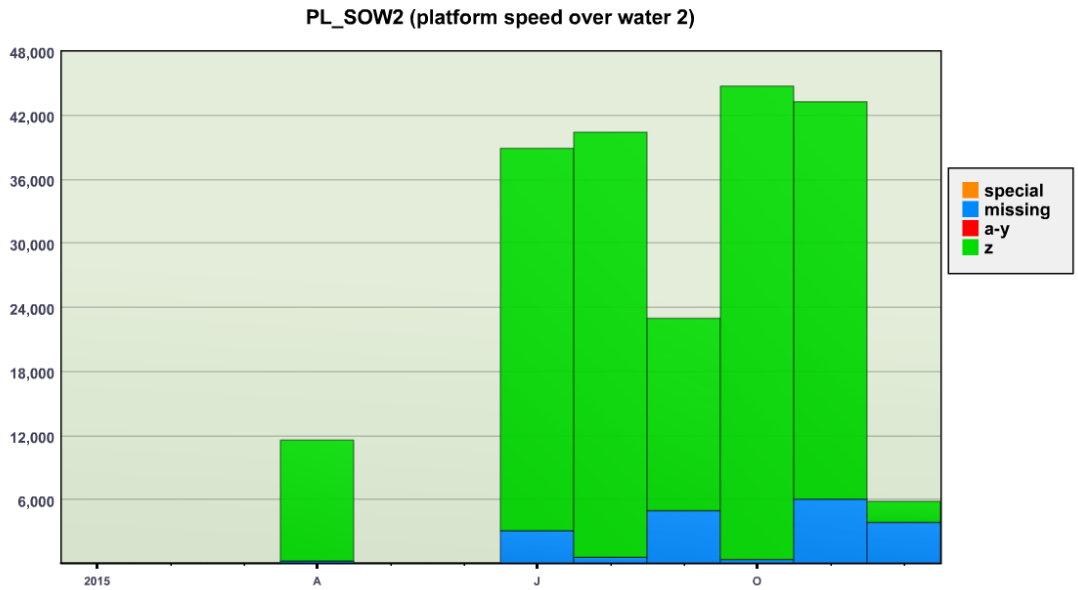
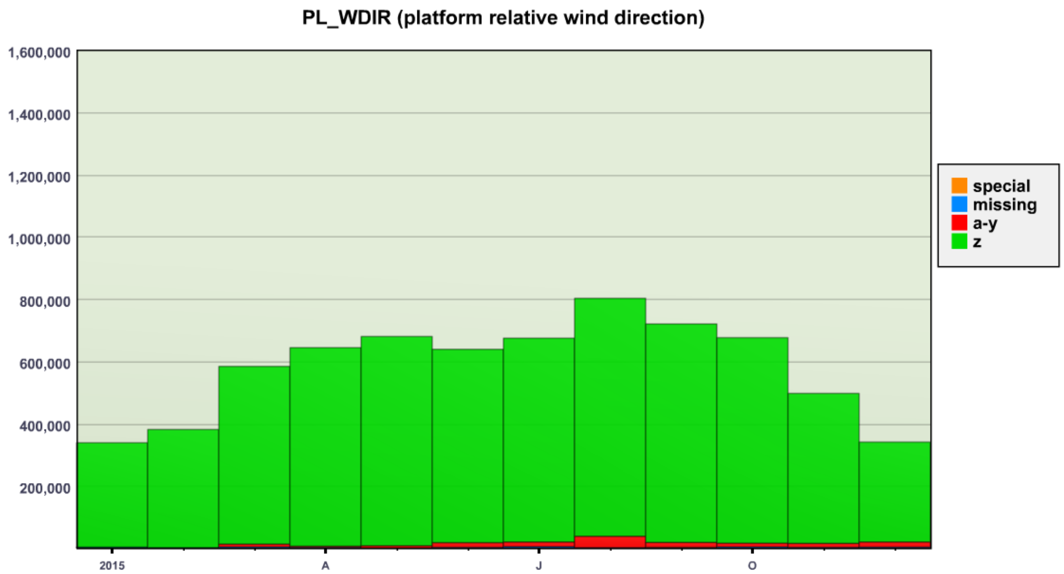


Figure 24: Total number of (top) platform speed over water – PL_SOW – and (bottom) platform speed over water 2 – PL_SOW2 observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Regarding the platform relative wind parameters, both direction (Figure 25) and speed (Figure 26), any issues were confined to just a few specific vessels. The *Oregon II's* PL_WDIR received some K and J flagging throughout their sailing season (March-November) owing to an unexplained issue with that sensor (documented; see individual vessel description in section 3c for details). Additionally, owing to a verified 90-degree PL_WDIR wind rotation, *Ron Brown's* PL_WDIR received some J and K flagging in December (also documented; see individual vessel description in section 3c for details). Lastly, there were several days in October in which the *Falkor's* second wind sensor agreed poorly with both the primary wind sensor and environmental verification data, likely due to storms and/or rough seas (as discussed in individual vessel description in section 3c), which resulted in some flagging of PL_WDIR2 and, to a lesser degree, PL_WSPD2. We point out, too, that PL_WDIR2 and PL_WSPD2 were the final two of *Atlantis's* variables that received a quantity of special value flags during 23-30 June (details unknown).



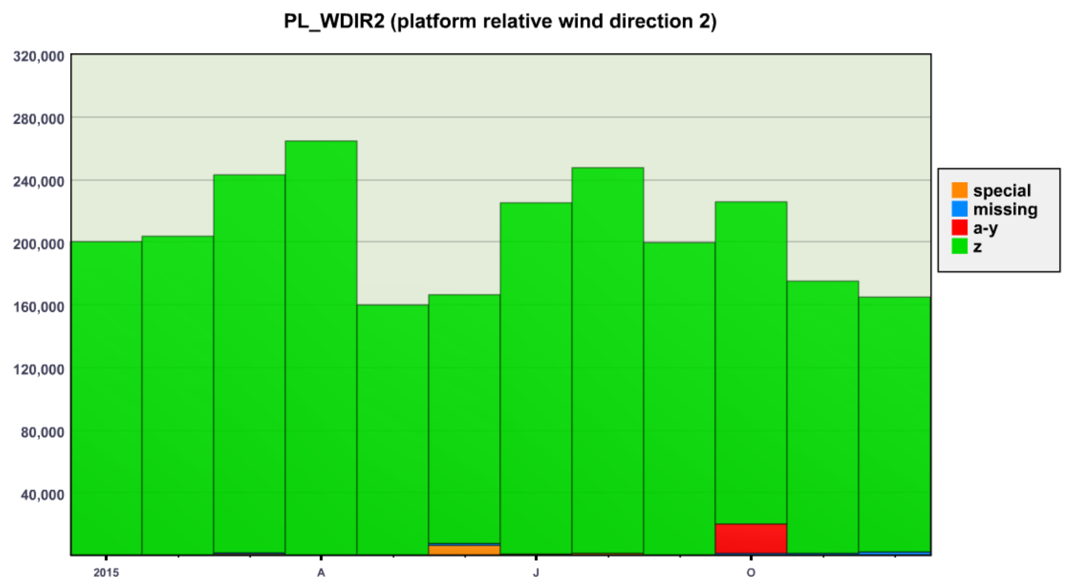
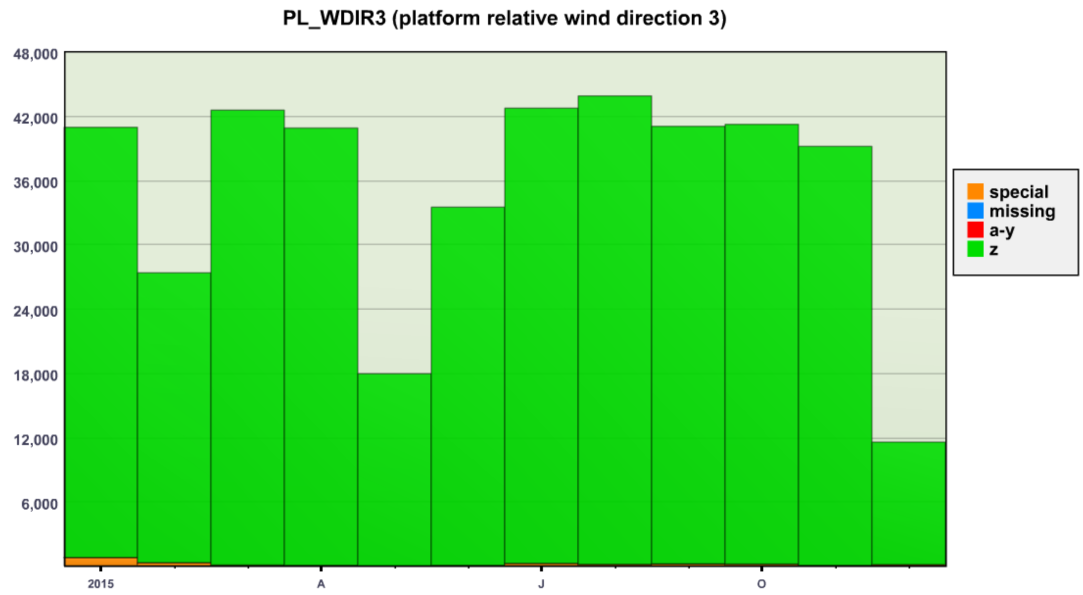


Figure 25: Total number of (this page, top) platform relative wind direction – PL_WDIR –(this page, bottom) platform relative wind direction 2 – PL_WDIR2 – and (next page) platform relative wind direction 3 – PL_WDIR3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



(Figure 25: cont'd)

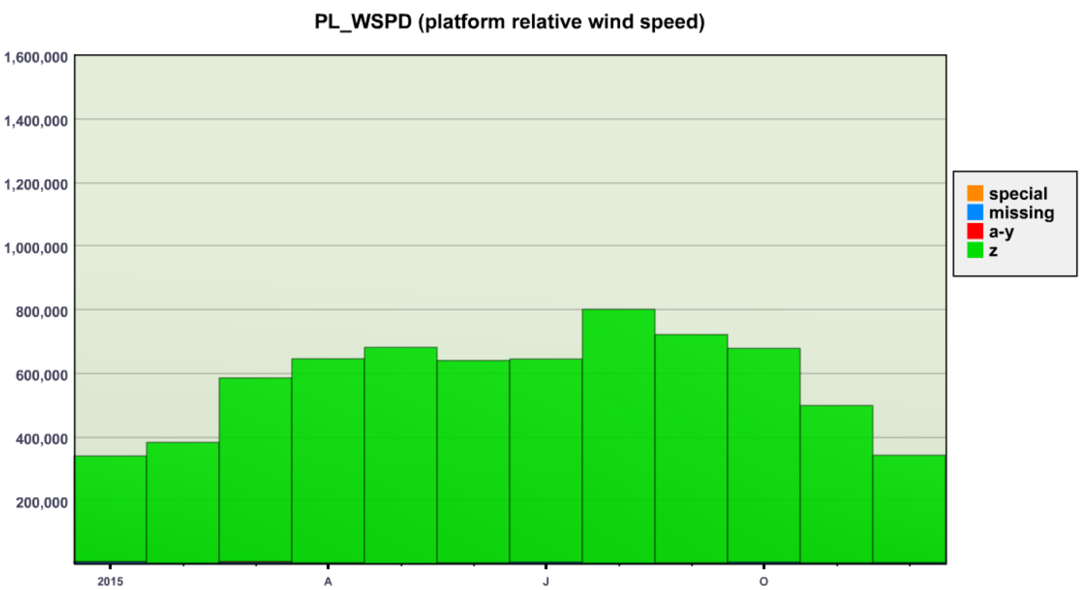
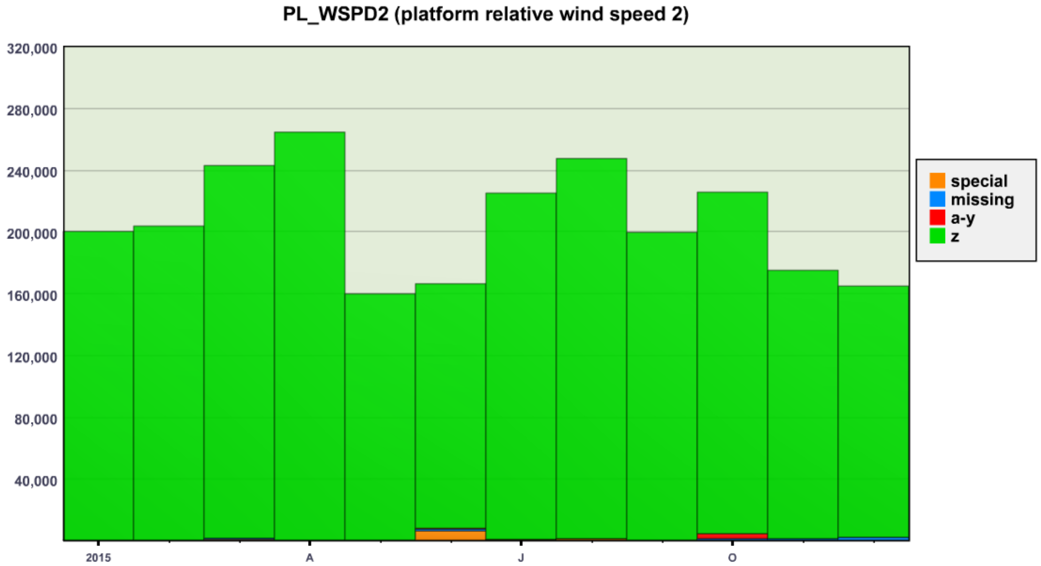
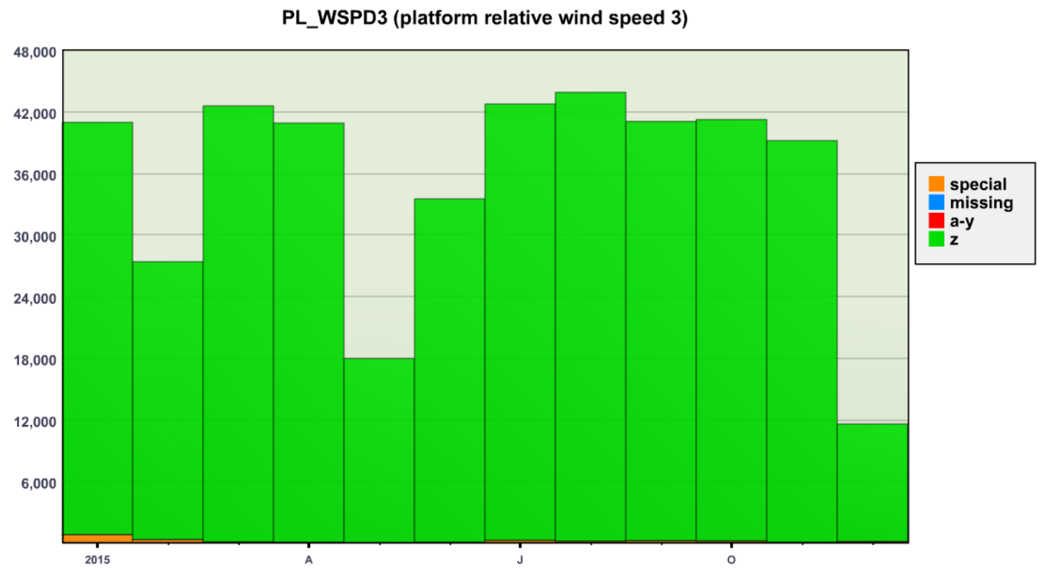


Figure 26: Total number of (this page) platform relative wind speed – PL_WSPD – (next page, top) platform relative wind speed 2 – PL_WSPD2 – and (next page, bottom) platform relative wind speed 3 – PL_WSPD3 – observations provided by all ships for each month in 2015. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.





(Figure 26: cont'd)

c. 2015 quality by ship

Atlantic Explorer

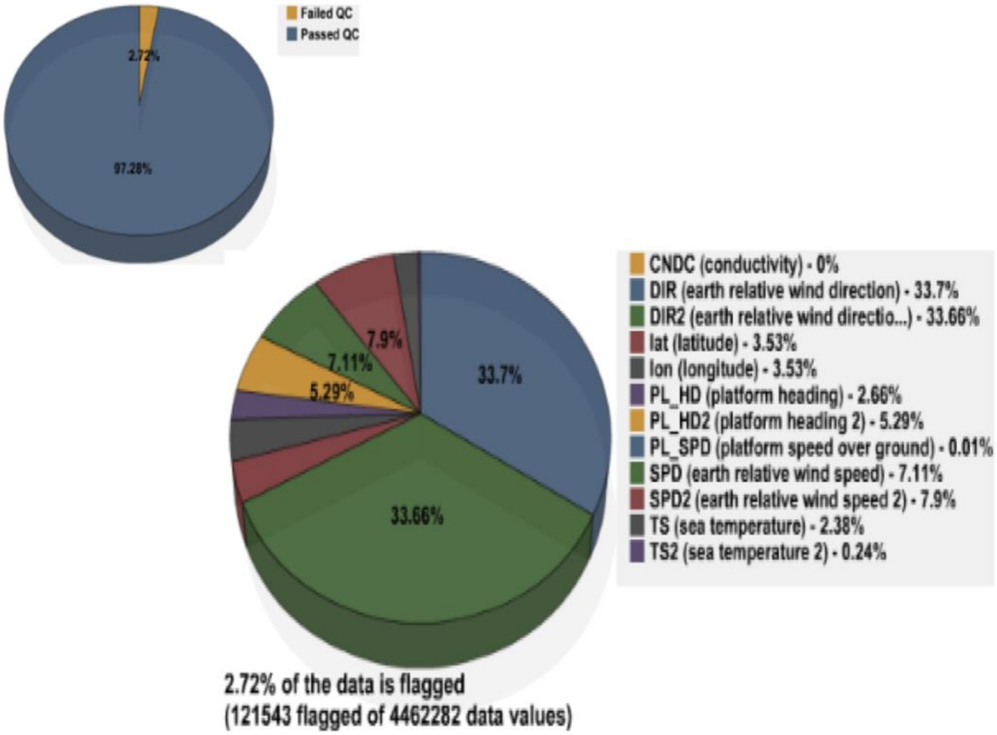


Figure 27: For the *Atlantic Explorer* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Atlantic Explorer* provided SAMOS data for 167 ship days, resulting in 4,462,282 distinct data values. After automated QC, 2.72% of the data were flagged using A-Y flags (Figure 27). This is a notably low percentage of flagged values, but it is important to note that the *Atlantic Explorer* does not receive visual QC (due to a lack of funding), which is when the bulk of flags are usually applied.

Echoing previous years, *Explorer's* earth relative wind parameters, both direction (DIR and DIR2) and speed (SPD and SPD2), received a good deal of "failing the true wind test" (E) flags (Figure 30). Indeed, over half of all flags were applied to DIR and DIR2. We continue to assert the possibility this is due to a combination of less than ideal sensor location (i.e. flow distortion) and possible true wind averaging problems; however, these unfortunately are not issues we are currently funded to sort out.

In addition to these two possible explanations, though, in 2015 there were also some problems with both of the *Explorer's* gyroscopes (platform heading – PL_HD – and platform heading 2 – PL_HD2, not shown) that probably contributed to the total E flags applied to the true winds. On or around 11 May, the *Explorer's* second gyro (an Ashtec, PL_HD2) apparently started going bad, with values often dipping into the negative numbers (Figure 28). The issue appears to have worsened during the next few months' several short cruises, with the addition of large data dropouts most days and even a few days when no PL_HD2 data was reported. Then, from 3 to 10 August the *Explorer* did not report any gyro data at all. This of course meant no derived winds were reported for the duration either. When contacted about the situation via email, the vessel technician explained they were having trouble getting their gyro data into the Scientific Computer System (SCS). On 11 August heading data resumed via the *Explorer's* other gyro (a Sperry, PL_HD), whereas the Ashtec remained offline or at least unreported for the remainder of the year. However, now the Sperry immediately began exhibiting numerous unrealistic spikes (Figure 29), and this behavior persisted until 6 November. Vessel technicians were contacted for information/confirmation of the Sperry gyro issue on 21 October, but no response was received. It's possible these spikes were similar to the PL_HD2 case in previous years whereby missing values would get into the averaging, resulting in many out of bounds (B) flags. It is important to note that while any of the gyro values that were truly out of bounds would have been flagged as such, any other portions of the gyro data that were likely questionable would not have been caught by the autoflagger. Nevertheless, any "bad" gyro data (flagged or unflagged) in connection with a derived wind may easily have prompted E flags on DIR/DIR2 and SPD/SPD2, although we further note it's unknown which one or the other (or both) of the gyros is actually involved in the true wind calculation.

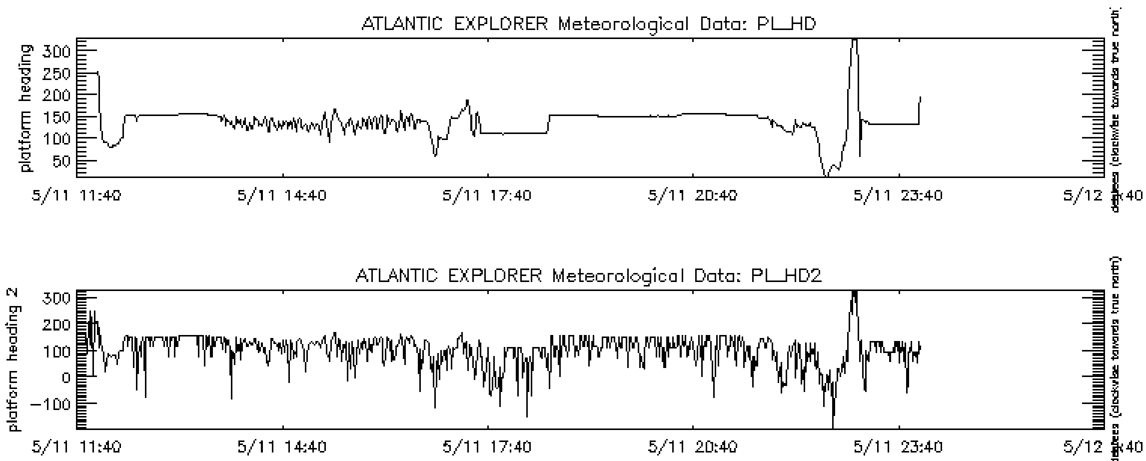


Figure 28: *Atlantic Explorer* SAMOS (top) platform heading – PL_HD – and (bottom) platform heading 2 – PL_HD2 – data for 11 May 2015. Note unrealistic negative vessel heading values in PL_HD2 data.

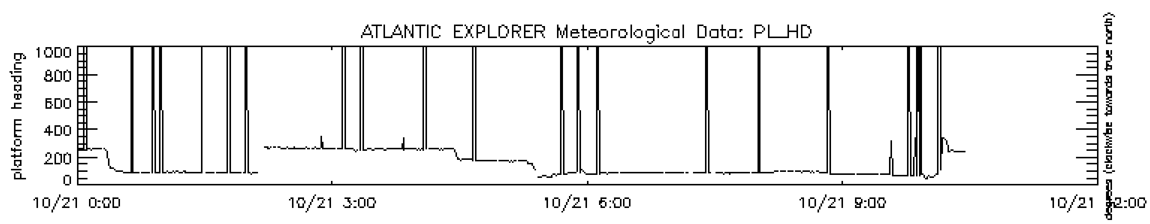


Figure 29: *Atlantic Explorer* SAMOS platform heading – PL_HD – data for 11 May 2015. Note unrealistic positive spikes.

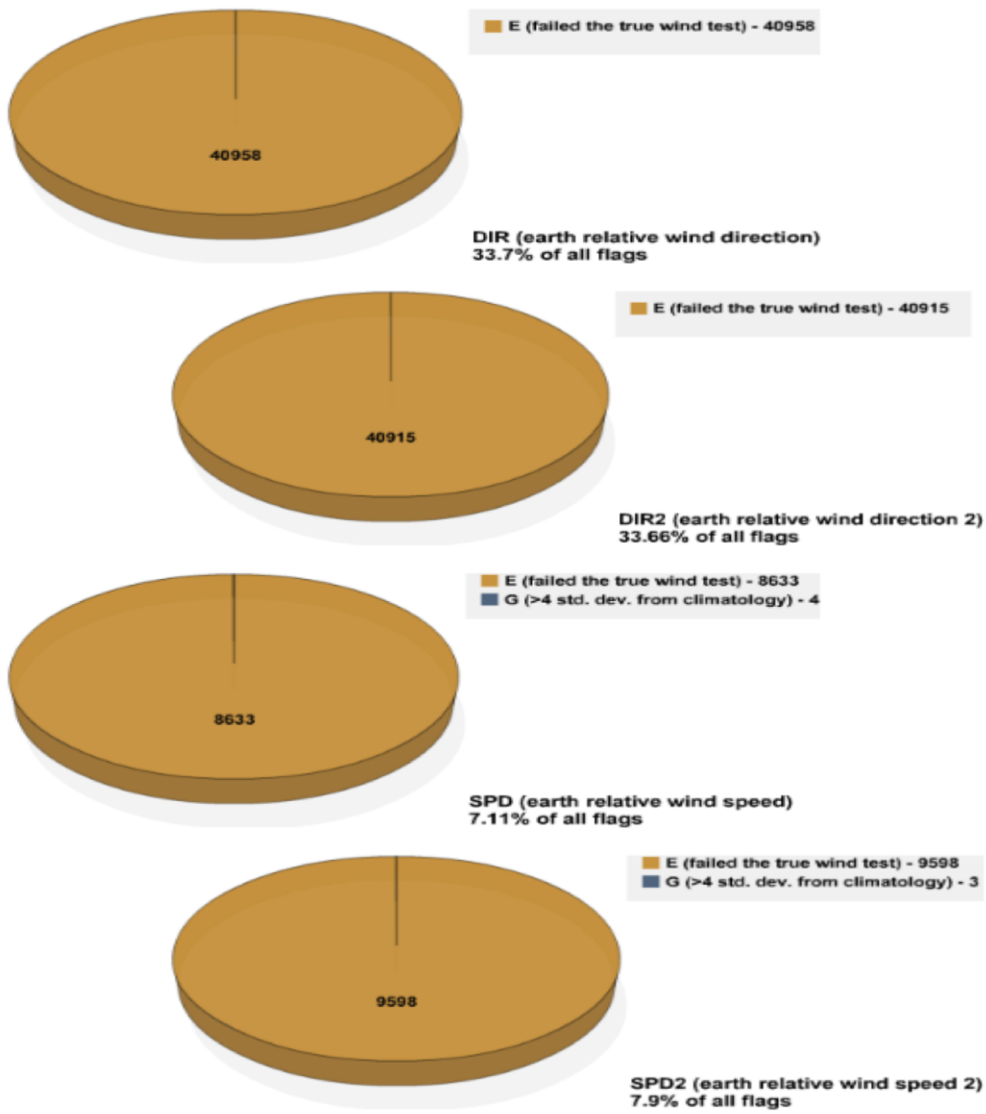


Figure 30: Distribution of SAMOS quality control flags for (first) earth relative wind direction – DIR – (second) earth relative wind direction 2 – DIR2 – (third) earth relative wind speed – SPD – and (last) earth relative wind speed 2 – SPD2 – for the *Atlantic Explorer* in 2015.

Tangaroa

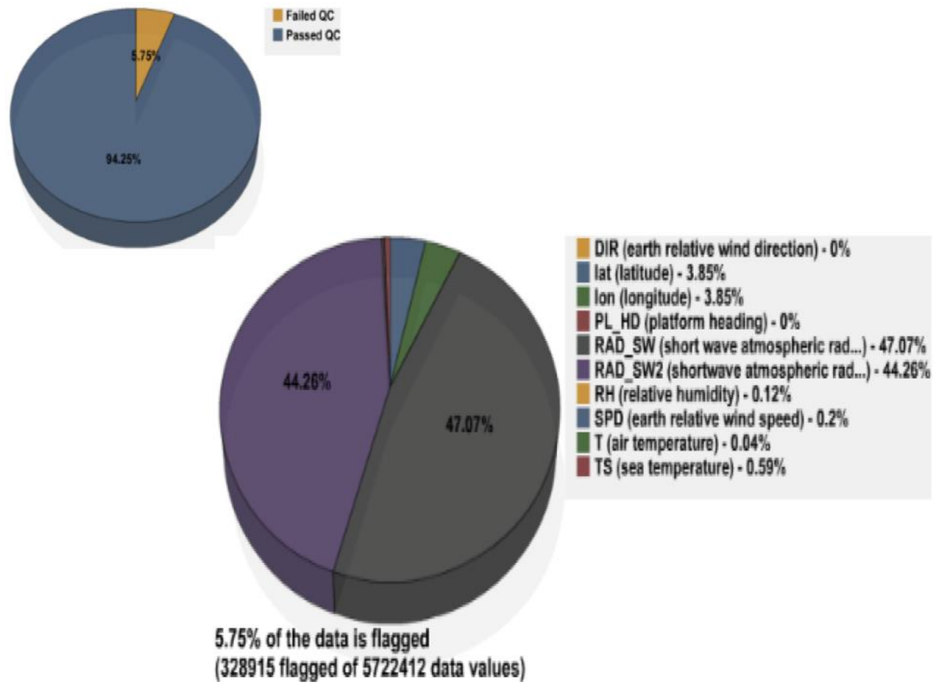


Figure 31: For the *Tangaroa* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Tangaroa* provided SAMOS data for 235 ship days, resulting in 5,722,412 distinct data values. After automated QC, 5.75% of the data were flagged using A-Y flags (Figure 31). NOTE: the *Tangaroa* does not receive visual quality control by the SAMOS DAC, so all of the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Tangaroa*).

During the first half of 2015 code was developed at the SAMOS DAC to enable direct harvesting of SAMOS daily files for the *Tangaroa* from the IMOS THREDDS service, as prior changeups of both personnel and processing had left IMOS with an inability to transmit SAMOS data using the previously established email protocol. Once the DAC code went live, all previously missed files were acquired and processed, and we commenced the automatic pulling of daily files going forward.

Tangaroa's two short wave atmospheric radiation parameters (RAD_SW and RAD_SW2) made up over 90% of the total flags (Figure 31). All of these flags were out of bounds (B) flags (Figure 32). Upon inspection it appears most or all of the B flags applied to RAD_SW and RAD_SW2 were linked to short wave radiation values slightly less than zero. Although technically impossible, short wave radiation sensors commonly read slightly below zero at night, owing to sensor tuning (see 3b for discussion). We note that the IMOS group at the Australian Bureau of Meteorology did conduct visual quality control and made research quality data files for the *Tangaroa* until a personnel change in June 2013. Since that change, no visual quality control was or is applied for the *Tangaroa*, either at SAMOS or at IMOS.

We thank the folks at the Australian Bureau of Meteorology (BOM) for their help in reconnecting the SAMOS initiative with IMOS vessel data, and we note that we further anticipate adding the new IMOS vessel *Investigator* to the SAMOS roster in 2016.

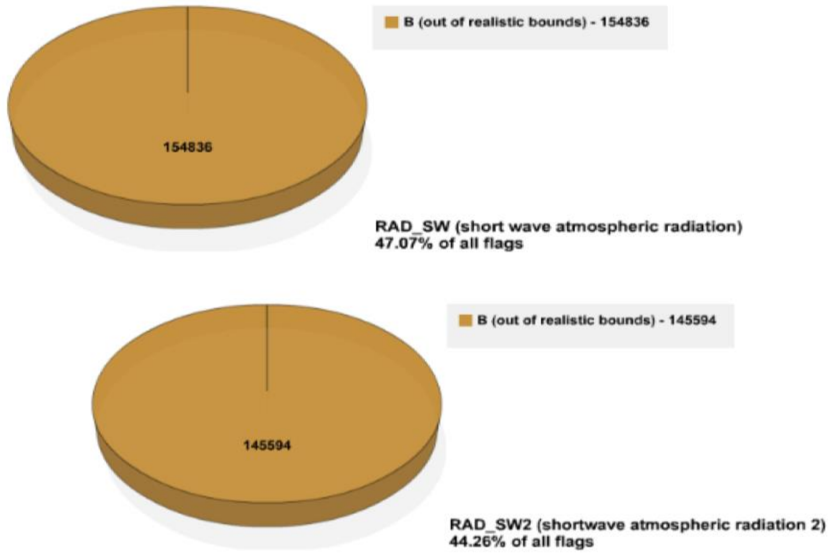


Figure 32: Distribution of SAMOS quality control flags for (top) short wave atmospheric radiation – RAD_SW – and (bottom) short wave atmospheric radiation 2 – RAD_SW2 – for the *Tangaroa* in 2015.

Pelican

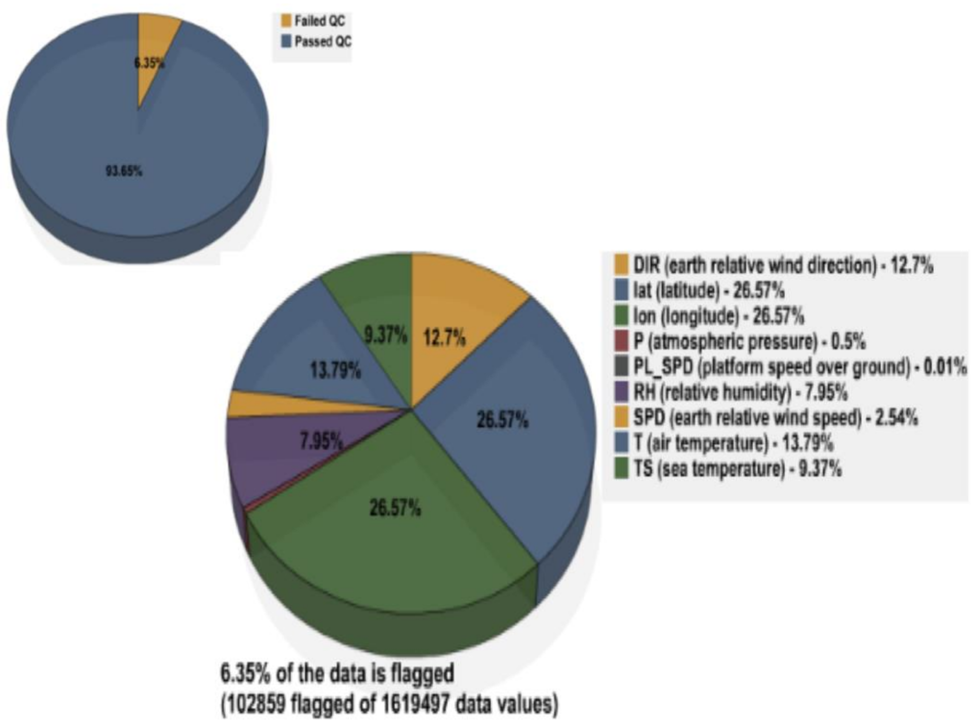


Figure 33: For the *Pelican* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The Pelican was made operational in the SAMOS database in late February 2015; 13 February marks the first daily SAMOS file. The *Pelican* provided SAMOS data for 96 ship days, resulting in 1,619,497 distinct data values. After automated QC, 6.35% of the data were flagged using A-Y flags (Figure 33). NOTE: the *Pelican* does not receive visual quality control by the SAMOS DAC, so all of the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Pelican*).

Over half of all flags were applied to the latitude and longitude (LAT, LON) parameters (Figure 33). The majority of these were platform over land (L) flags (Figure 35). Upon inspection, these L flags were applied mainly while the vessel sat afloat at her home port, nestled in the Louisiana bayou at LUMCON. This L flagging of position data in narrow channels is a common occurrence, owing to the two minute land-water mask used in SAMOS data processing. We note that in these cases the L flags would normally be removed by during visual quality inspection; however, the *Pelican* is not currently funded for visual QC.

Earth relative wind direction (DIR) received about 12% of the total flags (Figure 33). These were exclusively failing the true wind recalculation test (E) flags (Figure 35). Upon inspection, it seems that the platform relative wind direction and/or DIR can at times become noisy, with no clear indication why (Figure 34). Current position metadata for the *Pelican's* wind sensor puts it somewhere amidships, potentially somewhere over the bridge. It's possible there is an issue with the sensor location whereby vessel relative wind from a certain direction or directions is disrupted by objects or structures in its path, but without digital imagery of the sensor location it is difficult to guess. It may also be an issue with the true wind calculation itself – perhaps an averaging problem – as the noise in DIR isn't always present in conjunction with obvious noise in other related parameters. Unfortunately, these are not issues we are currently funded to sort out. At best, we can urge a thorough investigation of the *Pelican's* true wind calculation, and also request personnel augment *Pelican's* SAMOS metadata with detailed digital imagery of the vessel and the sensor locations, at which point we might suggest more ideal sensor placement.

Air temperature (T) and relative humidity (RH) also received a fair portion of flags, over 20% combined (Figure 33). A good deal of these flags were out of realistic bounds (B) flags, with some greater than four standard deviations from climatology (G) flags as well (Figure 35). Upon inspection, during the initial two weeks of *Pelican* data T often read unreasonably low for the region of operation, and RH experienced several days of reading a constant ~103%. Vessel technicians were notified about the constant RH readings, and response came back immediately thanking us for pointing it out. A T/RH sensor swap was planned and data does appear to have shortly returned to more reasonable values. Later in the year T again read unreasonably low, with much B and G flagging of the T parameter beginning around 15 September. Vessel technicians were contacted via email on 18 September and again on 25 September regarding the T/RH readings, and on 25 September the T/RH sensor was again swapped for a newly calibrated model, after which time the data again appears to have improved.

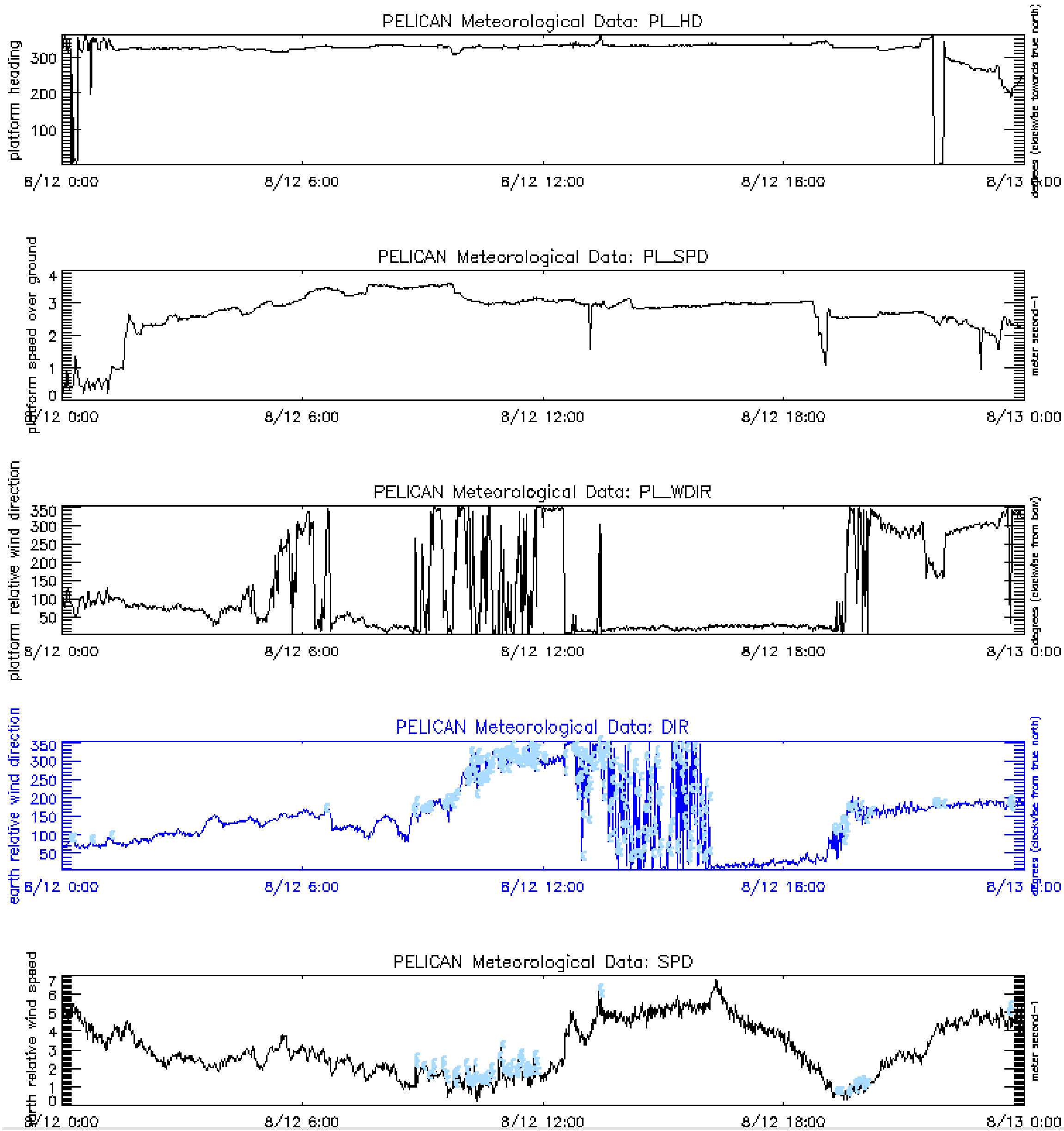


Figure 34: *Pelican* SAMOS (first) platform heading – PL_HD – (second) platform speed – PL_SPD – (third) platform wind direction – PL_WDIR – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 12 August 2015. Note light blue failing the true wind test "E" flags on DIR, some in conjunction with noise in PL_WDIR and some placed on noise in DIR with no clear origin of noise seen elsewhere.

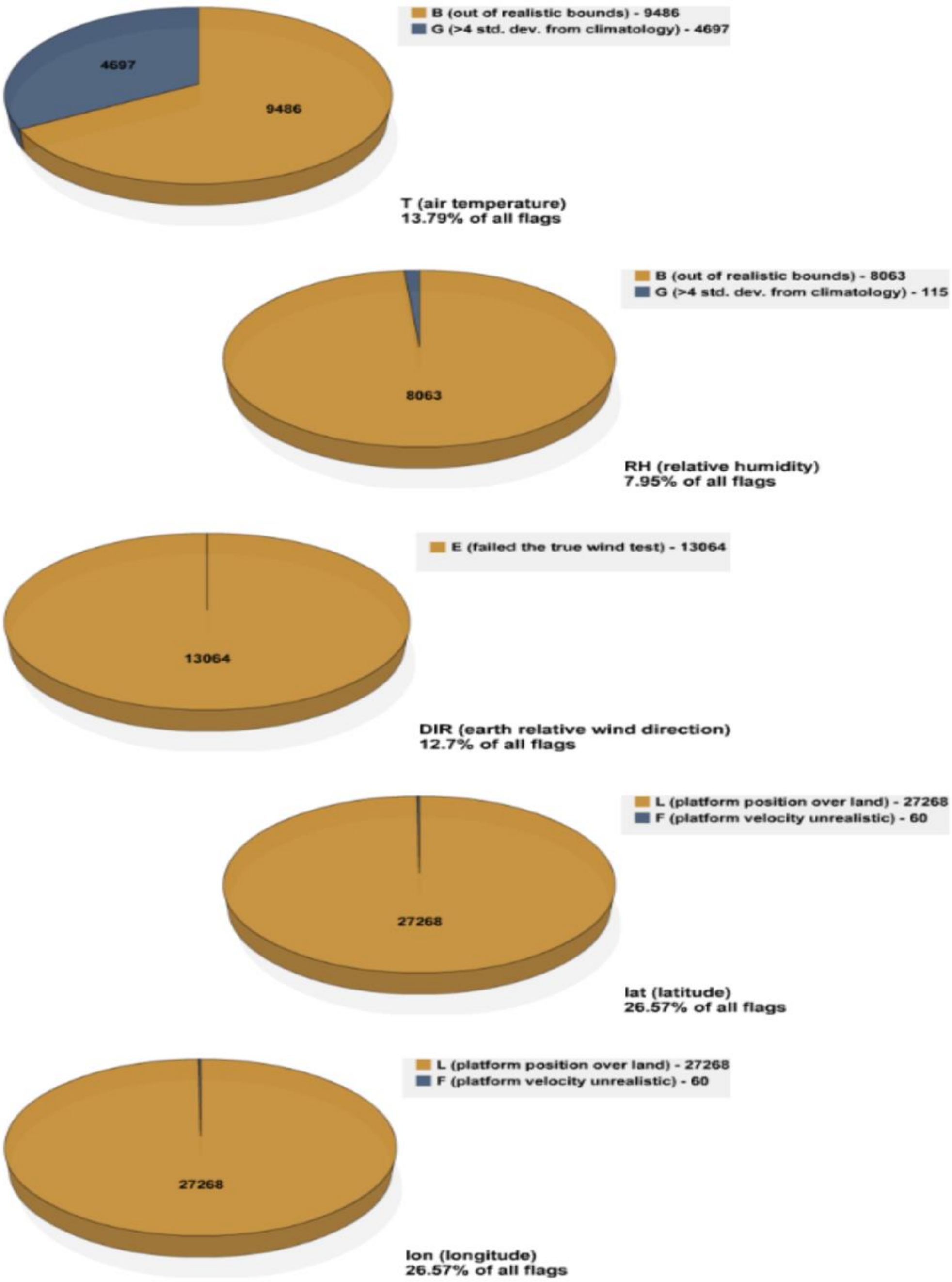


Figure 35: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) relative humidity – RH – (third) earth relative wind direction – DIR – (fourth) latitude – LAT – and (last) longitude – LON – for the *Pelican* in 2015.

Bell M. Shimada

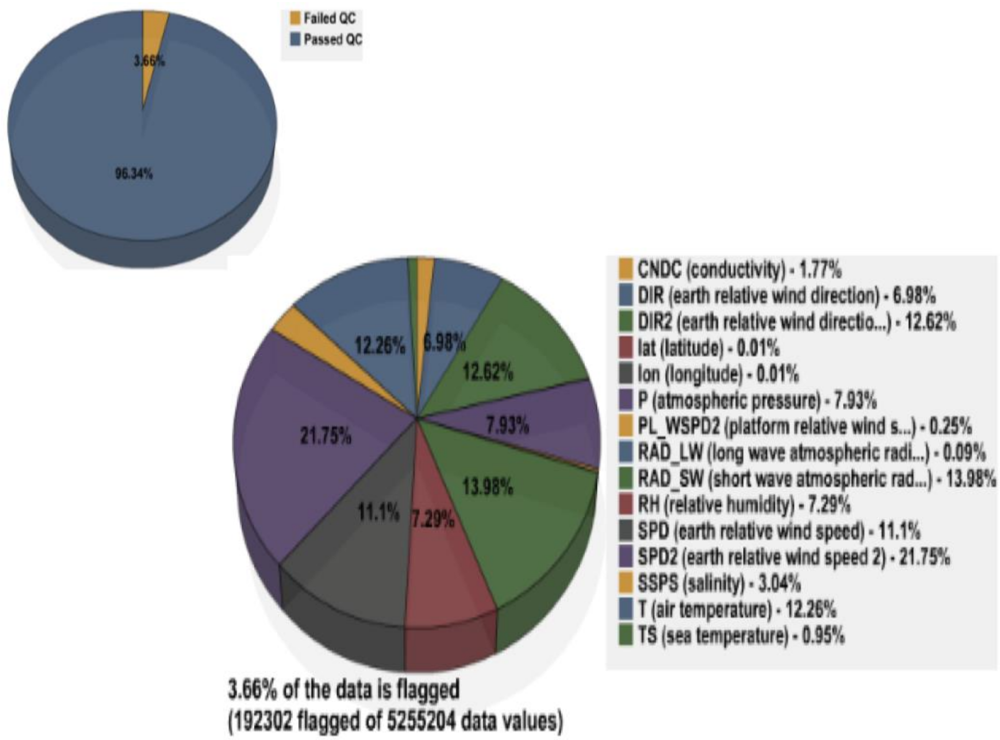


Figure 36: For the *Bell M. Shimada* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Bell M. Shimada* provided SAMOS data for 202 ship days, resulting in 5,255,204 distinct data values. After both automated and visual QC, 3.66% of the data were flagged using A-Y flags (Figure 36), an improvement of nearly 2% over 2014 performance (5.57%) that brings *Shimada* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

It can be a challenge to site sensors ideally on a ship. As with most vessels, *Shimada's* various meteorological sensors do occasionally exhibit data distortion that is dependent on the vessel relative wind direction and, in the case of air temperature, likely ship heating. Where the data appears affected, it is generally flagged with caution/suspect (K) flags. This type of flagging constitutes the majority of the percentages seen in *Shimada's* atmospheric variables (see Figure 36) – namely, the earth relative wind direction and speed (DIR, DIR2, SPD, SPD2) and the pressure, air temperature, and relative humidity (P, T, RH). We note, though, that with such a low overall flag percentage these sensor location issues are not terribly consequential.

The starboard ultrasonic wind measurements (DIR2 and SPD2) often deviate from the forward windbird measurements (DIR and SPD), primarily depending upon the platform relative wind direction. DIR2 and SPD2, located amidships on a tower with other structures nearby, experience more instances of distortion than the jackstaff winds DIR and SPD, although we do stress *Shimada's* ultrasonic measurements appear more robust in general than those from the traditional prop vane. Directionally speaking, DIR and

SPD sometimes suffer when the wind is from the stern, while DIR2 and SPD2 experience flow obstruction when the apparent wind is roughly 20 degrees to either side of the port beam. Differences between the two sensors often results in mainly K flagging in either sensor, with the higher percentages of flags going to DIR2 and SPD2 (Figure 39). In most cases, though, the redundant sensors do act as a sanity check each for the other. In fact, a ship schematic for *Shimada* in our metadata shows a third wind sensor, a port ultrasonic, and it would be desirable to add this data to our roster.

As indicated in the ship schematic, the air temperature sensor (T) likely suffers from proximity to a satellite dome, which would tend to heat up on a sunny day. Apparently located on the starboard underside of the V-sat dome, unnatural heating is particularly evident in T during the daytime whenever apparent winds are from roughly 270° (example Figure 37). Affected T data is generally flagged with K flags (Figure 39).

Aside from these sensor location issues, around mid-February *Shimada's* short wave radiation parameter (RAD_SW) also began displaying erratic behavior. Data would suddenly drop off into the -1000's W/m^2, a completely unrealistic range of values, and just as suddenly return to normal (example Figure 38). *Shimada* personnel were notified of the issue via email on 16 February and response came back immediately that technicians were both aware of and attempting to diagnose the problem. They suspected a cabling issue, and we were advised to disregard RAD_SW until further notice; however the issue continued to worsen and as of 3 March 2015 RAD_SW data was discontinued for the remainder of the year. Prior to its discontinuation the erroneous RAD_SW data was flagged with primarily out of bounds (B) flags (Figure 39). We note that three data values seem to have been flagged with land error (L) flags. This was certainly accidental on the part of the data analyst, as L flags are reserved for position data, and we do apologize for the mistake.

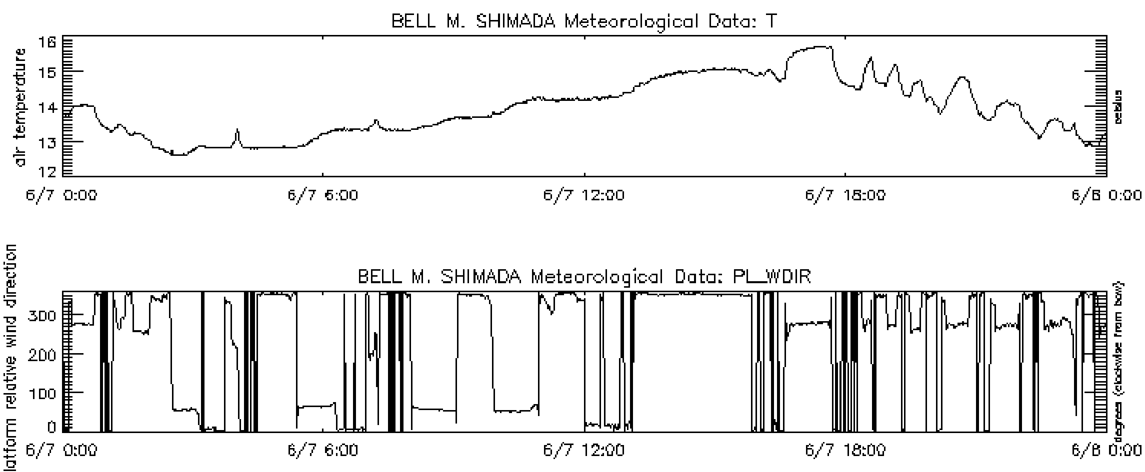


Figure 37: *Shimada* SAMOS (top) air temperature – T – and (bottom) platform relative wind direction – PL_WDIR – data for 7 June 2015. Note steps in T when PL_WDIR is from ~270° during the day.

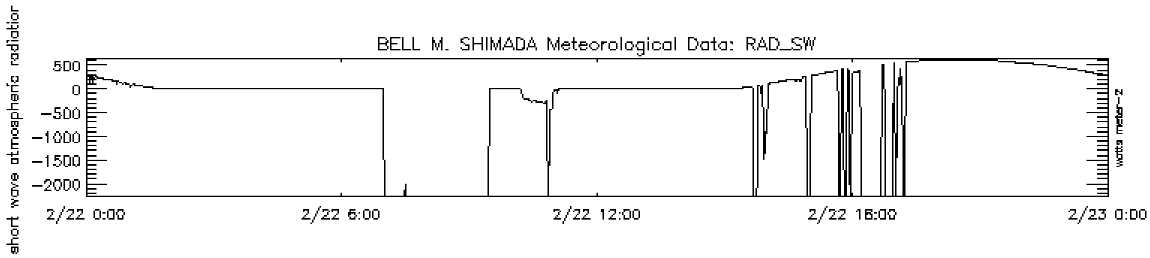


Figure 38: *Shimada* SAMOS short wave atmospheric radiation – RAD_SW – data for 22 February, 2015.

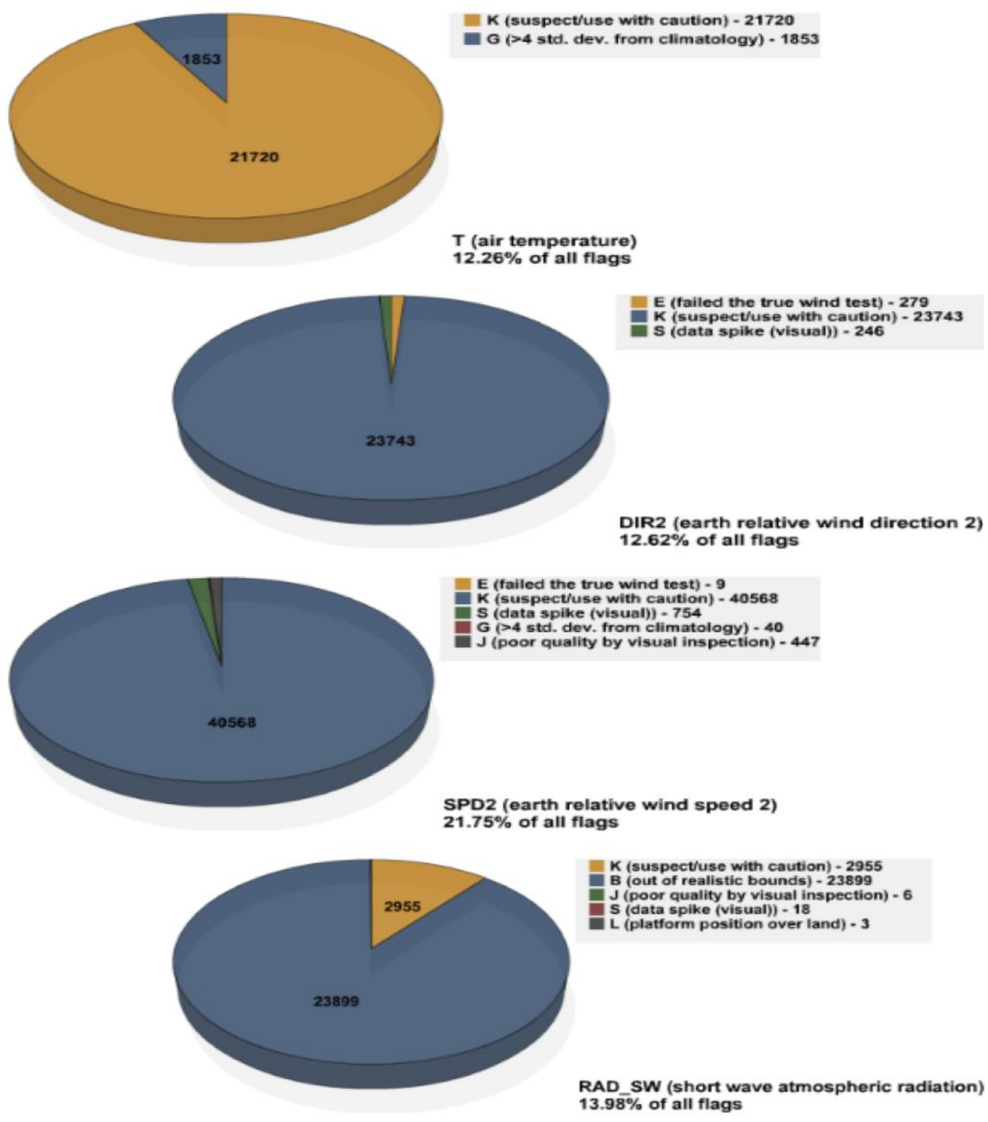


Figure 39: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) earth relative wind direction 2 – DIR2 – (third) earth relative wind speed 2 – SPD2 – and (last) short wave atmospheric radiation – RAD_SW – for the *Bell M. Shimada* in 2015.

Fairweather

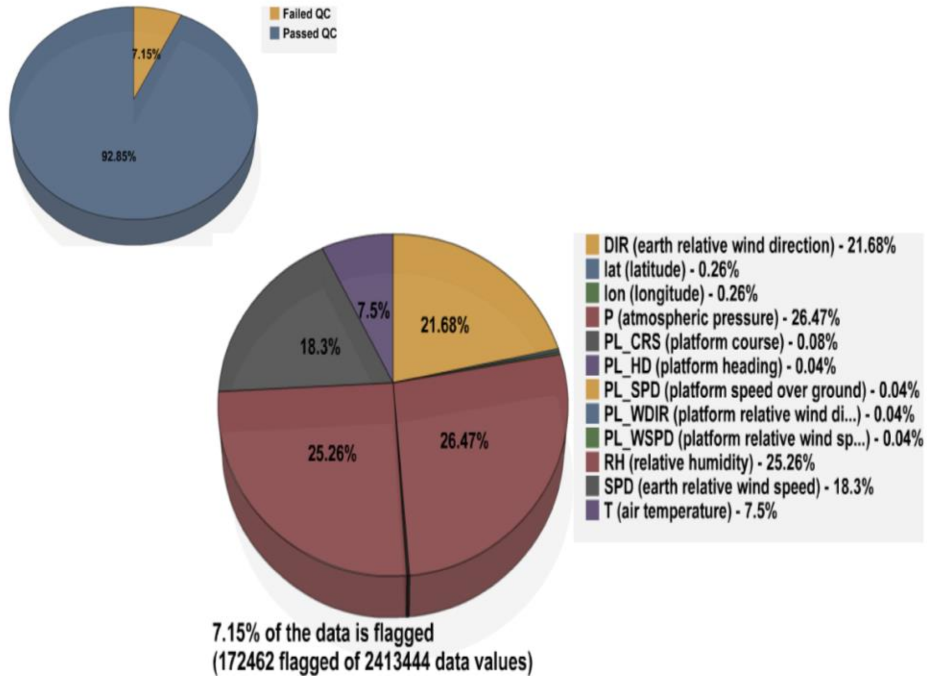


Figure 40: For the *Fairweather* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Fairweather* provided SAMOS data for 142 ship days, resulting in 2,413,444 distinct data values. After both automated and visual QC, 7.15% of the data were flagged using A-Y flags (Figure 40), an increase of about 2% over 2014 performance (4.94%) that brings *Fairweather* outside the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

The biggest issue with the *Fairweather* data likely continues to be problematic sensor location, although neither adequate metadata (refer to Table 4 or Annex C), nor digital imagery or a detailed flow analysis exists for this vessel preventing confirmation. All five of the meteorological parameters offered by *Fairweather* – earth relative wind direction (DIR), earth relative wind speed (SPD), air temperature (T), relative humidity (RH), and atmospheric pressure (P) – show a considerable amount of flow obstruction and/or interference from stack exhaust or ship heating, which is plainly reflected in the flagged percentages seen in Figure 40. Effects are most evident in the wind and pressure data, where steps are frequently seen as the platform relative wind direction/speed changes (Figure 41). These steps are generally assigned caution/suspect (K) flags. There are also some additional true wind test failed (E) flags on the wind parameters, mainly DIR (Figure 43).

T and RH similarly show signs of corrupted air flow, though not as acutely as winds and P, and the affected T/RH data are also generally K flagged (Figure 43). RH exhibited a secondary issue as well whereby seemingly during times of near atmosphere saturation the reading would occasionally drift to or even jump to ~110% or more and remain there for an extended period until drifting or jumping back down to ~90% and resuming normal behavior (Figure 42). In this case, the >100% readings seem less likely to be related to sensor tuning (see 3b), and more likely an issue of sensor degradation or needed calibration. Any RH data over 100% are automatically flagged with out of bounds (B) flags (Figure 43).

It should be mentioned again that, just as in 2014, the *Fairweather* contributed several backlogged batches of data (separate from the duplicates alluded to above), submitting data for 26 and 28-29 April, 12 May, 23-30 June, and 14 August well after the 10-day delayed mode window for visual quality control. While these files were eventually given visual QC (as time permitted) it's important to note that there is no guarantee of undergoing visual QC analysis in the case of "late" files and every effort should therefore be made to ensure timely arrival of daily SAMOS data files.

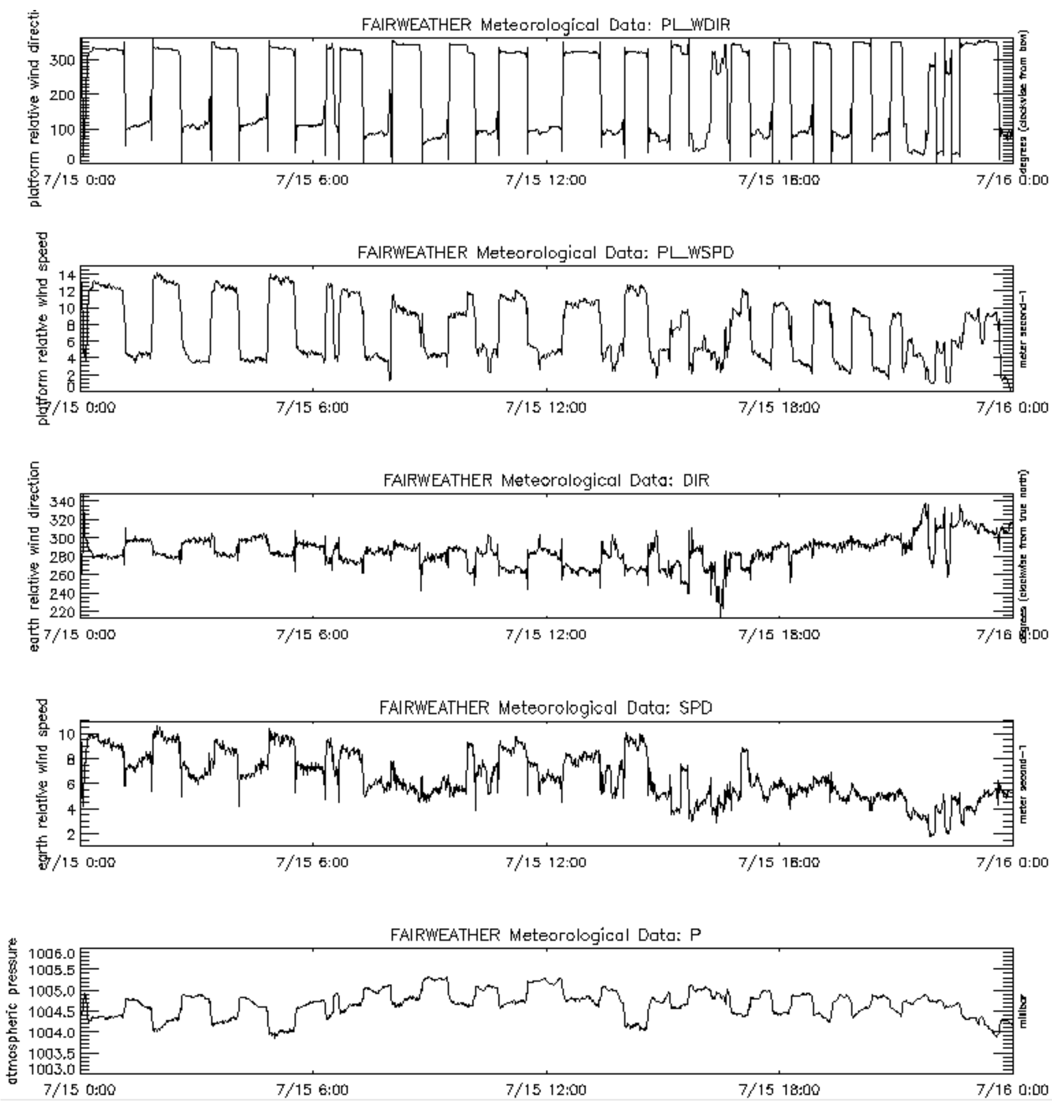


Figure 41: *Fairweather* SAMOS (first) platform relative wind direction – PL_WDIR – (second) platform relative wind speed – PL_WSPD – (third) earth relative wind direction –DIR – (fourth) earth relative wind speed – SPD – and (last) atmospheric pressure – P – data for 15 July 2015. Note the many steps in DIR, SPD, and P in conjunction with changing PL_WDIR/PL_WSPD. There likely exist multiple platform relative wind directions that interfere with the various met sensors.

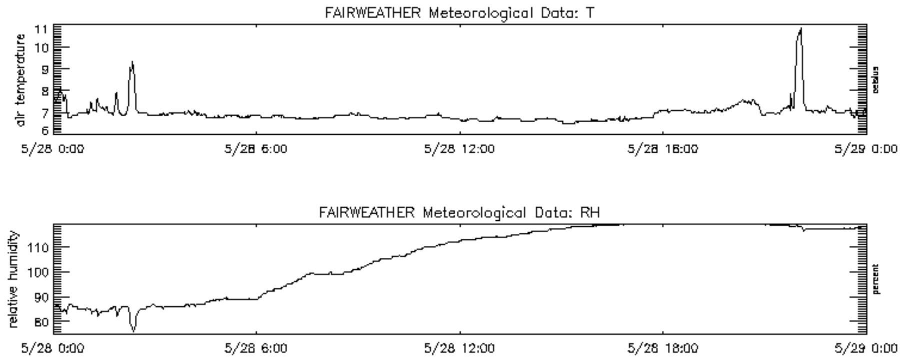


Figure 42: *Fairweather* SAMOS (top) air temperature – T – and (bottom) relative humidity – RH – data for 28 May 2015. Note the gradual rise to ~120% relative humidity. Evidence of flow distortion likely in combination with ship heating or exhaust is also clearly seen in T.

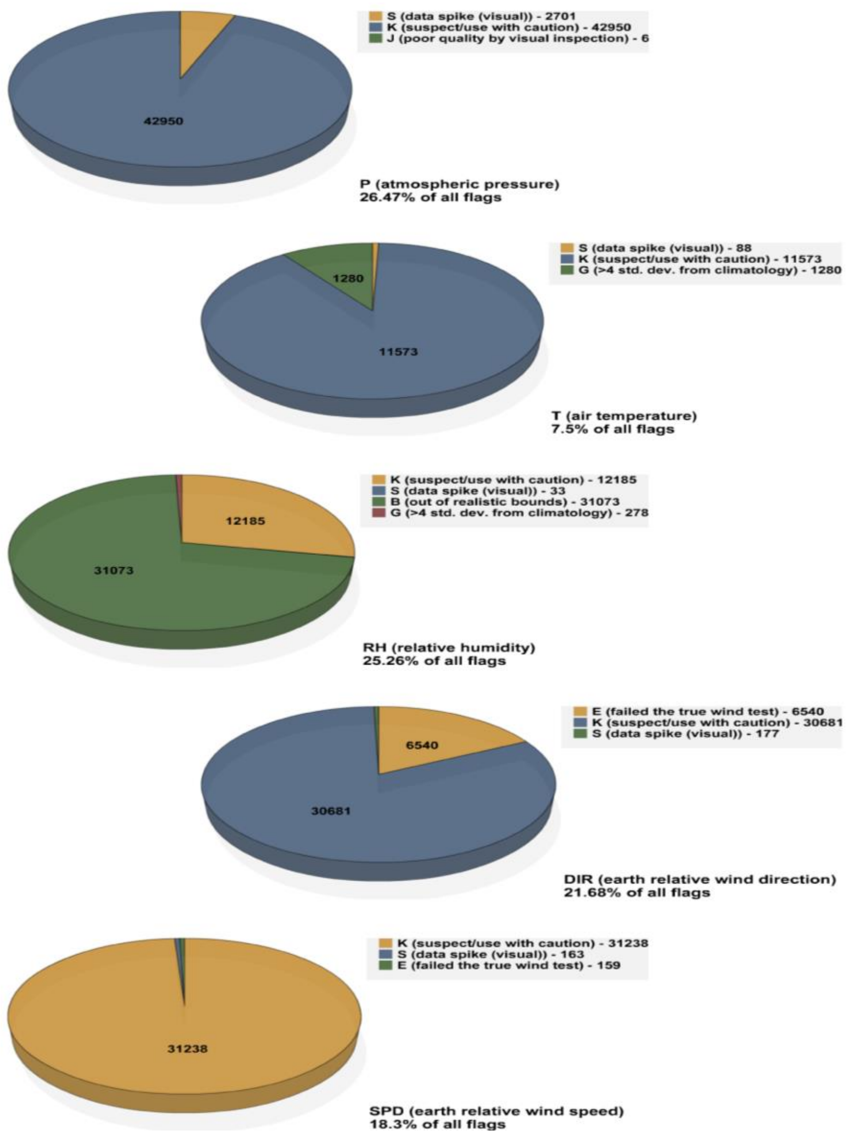


Figure 43: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – for the *Fairweather* in 2015.

Ferdinand Hassler

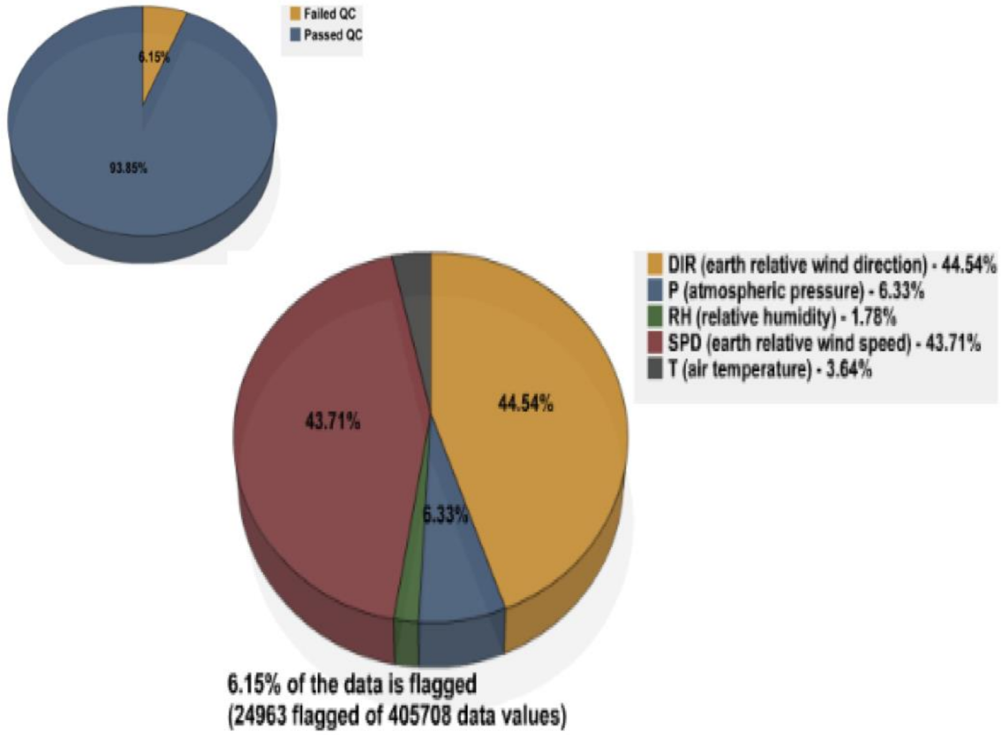


Figure 44: For the *Ferdinand Hassler* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Hassler* provided SAMOS data for 28 ship days, resulting in 405,708 distinct data values. After both automated and visual QC, 6.15% of the data were flagged using A-Y flags (Figure 44). This is a 5% increase over *Hassler's* 2014 performance (1.17%). However, we note that as of their 2015 SAMOS submissions the *Hassler* now includes earth relative winds, which are common culprits for data flagging.

Indeed, over 88% of the total flags went to the earth relative wind direction (DIR) and earth relative wind speed (SPD), primarily caution/suspect (K) flags (Figure 46). These flags were mainly applied to steps that appear frequently in *Hassler's* earth relative wind parameters (example Figure 45). Problems with the true wind calculation seem unlikely to be the culprit in the case – though that possibility still exists – as the platform speed often remains relatively constant while the winds are stepping. Rather, this is probably primarily an issue of flow distortion, whereby flow to the sensors is regularly blocked or accelerated when the platform relative wind is from a specific direction or directions. Unfortunately, adequate metadata and digital imagery are needed to confirm this suspicion, and the *Hassler* currently lacks both (see Table 4 and Annex C).

Evidence of flow distortion is also occasionally seen in the atmospheric pressure (P) parameter (not shown), and to an even milder extent the air temperature (T), and relative humidity (RH) parameters (not shown), but it is surmised that these three sensors may benefit from better exposure than the wind sensors. Again, metadata and digital imagery would probably confirm.

There was also a hiccup from 18-22 October wherein scientific data was not included in the SAMOS files, only position and navigation data. Ship personnel were notified by email on 21 October and, while no direct response was received from *Hassler*, the full roster of scientific data resumed two days later.

We note that we still do not receive thermosalinograph data from the *Hassler*, although we became aware of the existence of TSG data from the *Hassler* in late 2014 when it appeared in some augmented, backlogged files. (We were unable to process the backlogged 2014 TSG data because the original data files had already undergone visual QC, and also because we have no metadata for the TSG.) No TSG data were present in *Hassler's* 2015 SAMOS files, but if the TSG data are in fact available we would like to add them to her SAMOS submissions if at all possible. Again, we also would still need metadata for the TSG, as the data cannot be processed without it.

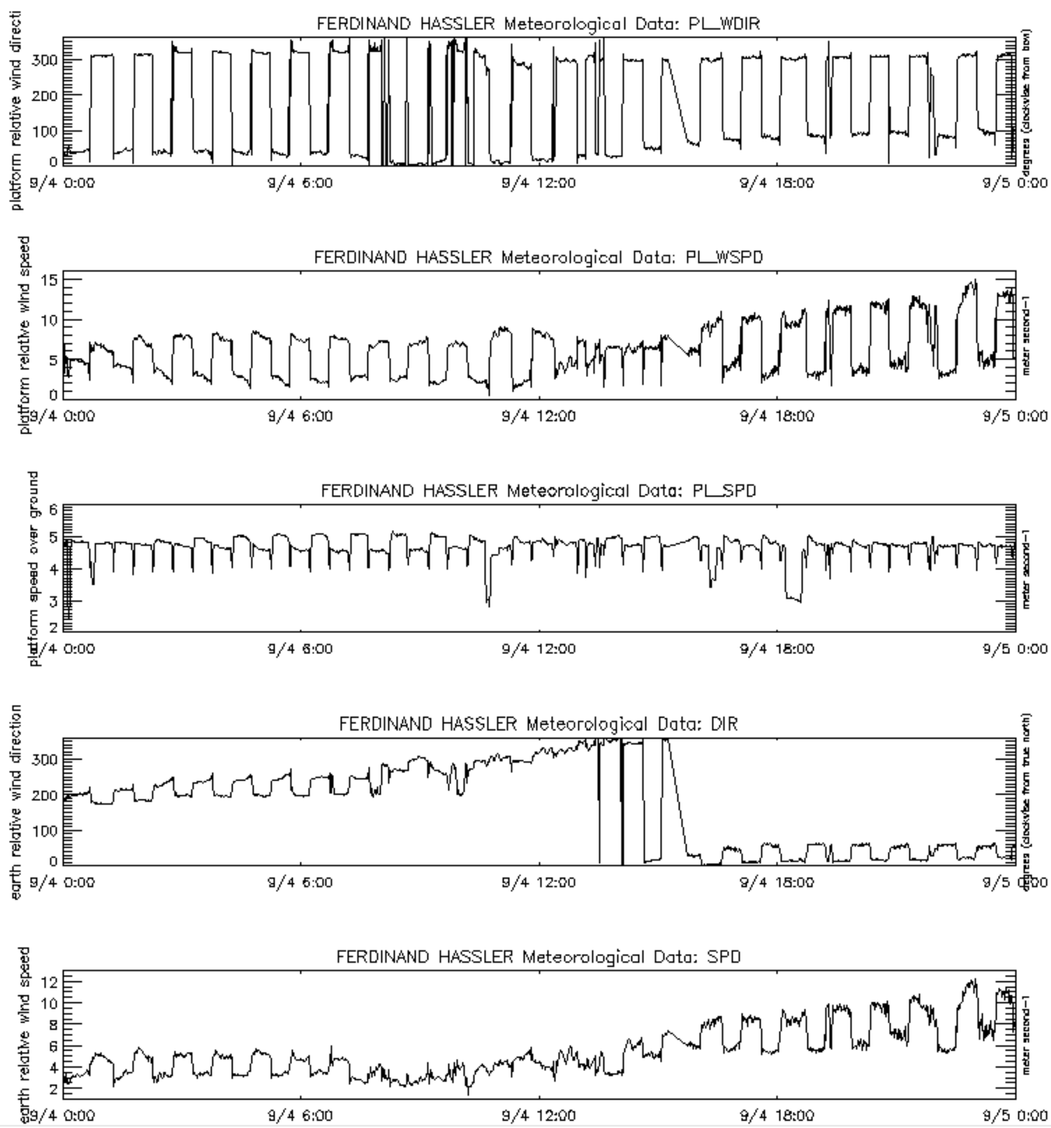


Figure 45: *Hassler* SAMOS (top) platform relative wind direction – PL_WDIR – (second) platform relative wind speed – PL_WSPD – (third) platform speed – PL_SPD – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 4 September 2015. Note the many steps in DIR, and SPD in conjunction with changing PL_WDIR/PL_WSPD. There may exist multiple platform relative wind directions that interfere with the wind sensors.

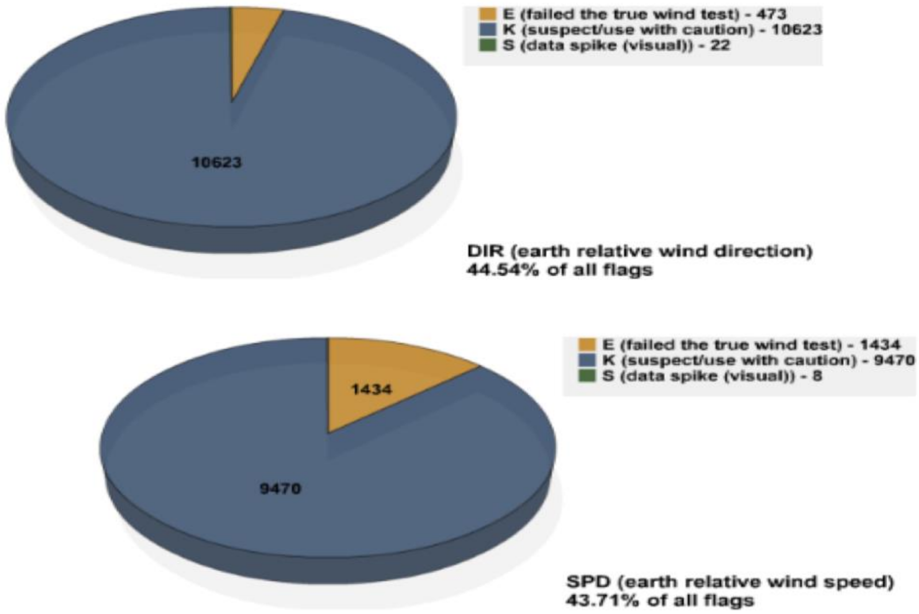


Figure 46: Distribution of SAMOS quality control flags for (top) earth relative wind direction – DIR – and (bottom) earth relative wind speed – SPD – for the *Ferdinand Hassler* in 2015.

Gordon Gunter

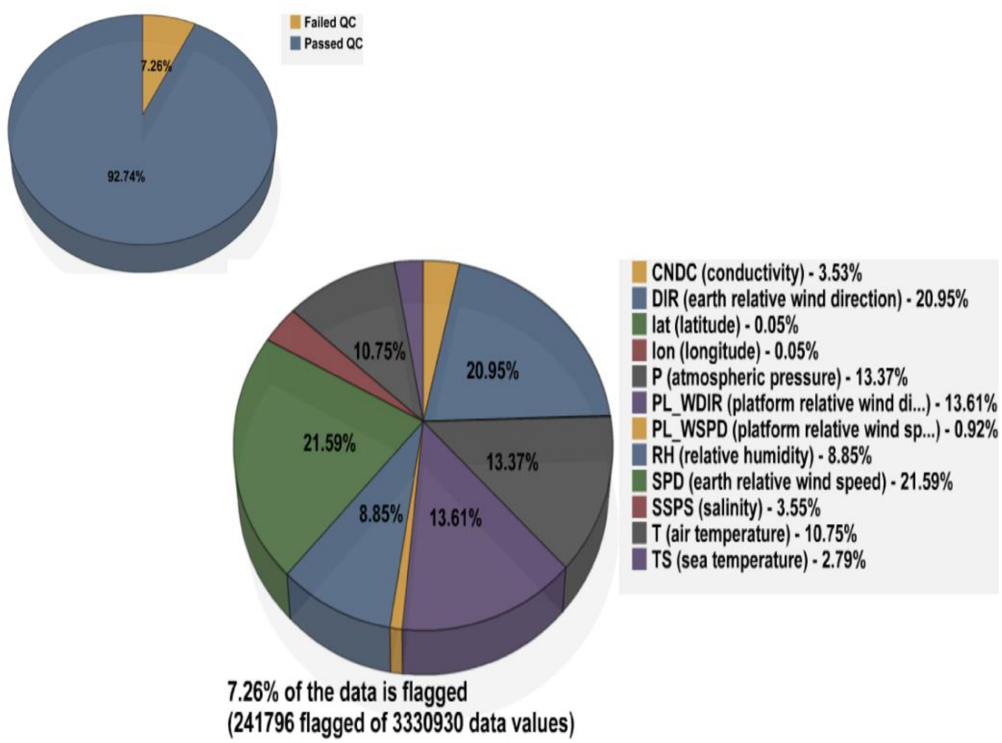


Figure 47: For the *Gordon Gunter* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Gordon Gunter* provided SAMOS data for 164 ship days, resulting in 3,330,930 distinct data values. After both automated and visual QC, 7.26% of the data were flagged using A-Y flags (Figure 47). This is about a 3% improvement over the 2014 total flag percentage (10.55%) and brings *Gunter* back a little closer to the < 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

The biggest issue with *Gunter's* data involved an elusive hardware issue somewhere between her translator and her windbird, which heavily influenced the percentage of flags applied to the earth relative wind direction (DIR) and speed (SPD) and the platform relative wind direction (PL_WDIR). Indeed, these three parameters combined made up over 55% of the total flags (Figure 47). Sometime around mid-June *Gunter's* winds began looking suspicious, with PL_WDIR often not showing expected variations during vessel heading changes (Figure 48). Then on 7 July *Gunter* personnel notified the SAMOS DAC via email that their windbird had been sending incorrect relative direction, which was in turn skewing all of the derived wind data. They were attempting to hunt down the culprit, but the result was that from about 9 June to 16 August PL_WDIR, DIR, and SPD were all assigned initially a lot of caution/suspect (K) flags, and later a lot of poor quality (J) flags (Figure 50).

There was also an incident at the beginning of *Gunter's* sailing season wherein a frayed connection was discovered between their data collection system and their RM Young translator. The connection was rebuilt in short order, but we were advised by ship personnel that meteorological data for 3-5 March should be considered unusable. For that period, all of DIR, SPD, PL_WDIR, platform relative wind speed (PL_WSPD), atmospheric pressure (P), air temperature (T), and relative humidity (RH) were tagged with malfunction (M) flags (Figure 50, not all shown).

Additionally, winds, air temperature, relative humidity, and atmospheric pressure all showed signs of moderate flow distortion (common on most vessels), which often resulted in some K flagging. P in particular exhibited a lot of "step" behavior whenever the vessel was moving and relative winds were from approximately 300° (Figure 49). This occurred despite the presence of a Gill pressure port on the P sensor, suggesting the sensor would still benefit from relocation away from its current position on the outside port wall of the wheelhouse. The induced steps resulted in a lot of K flagging of P (Figure 50), comprising the majority of the ~14% of total flags that were applied to that parameter (Figure 47).

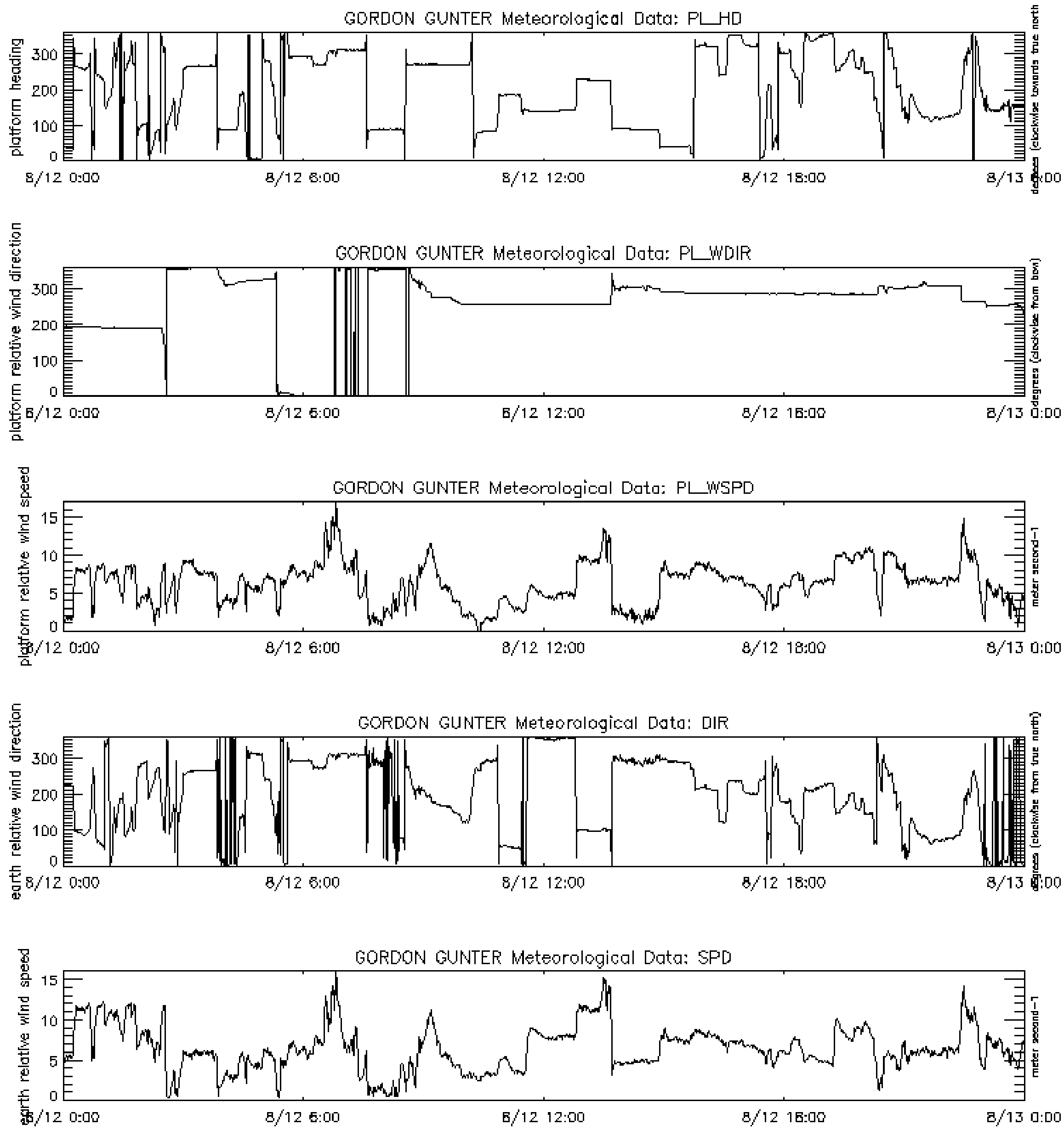


Figure 48: *Gordon Gunter* SAMOS (first) platform heading – PL_HD – (second) platform relative wind direction – PL_WDIR – (third) platform relative wind speed – PL_WSPD – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 12 August 2015. Note suspicious lack of variation in PL_WDIR when measured against PL_HD, and resultant suspicious behavior in DIR and SPD whereby they often mimic PL_HD and PL_WSPD, respectively.

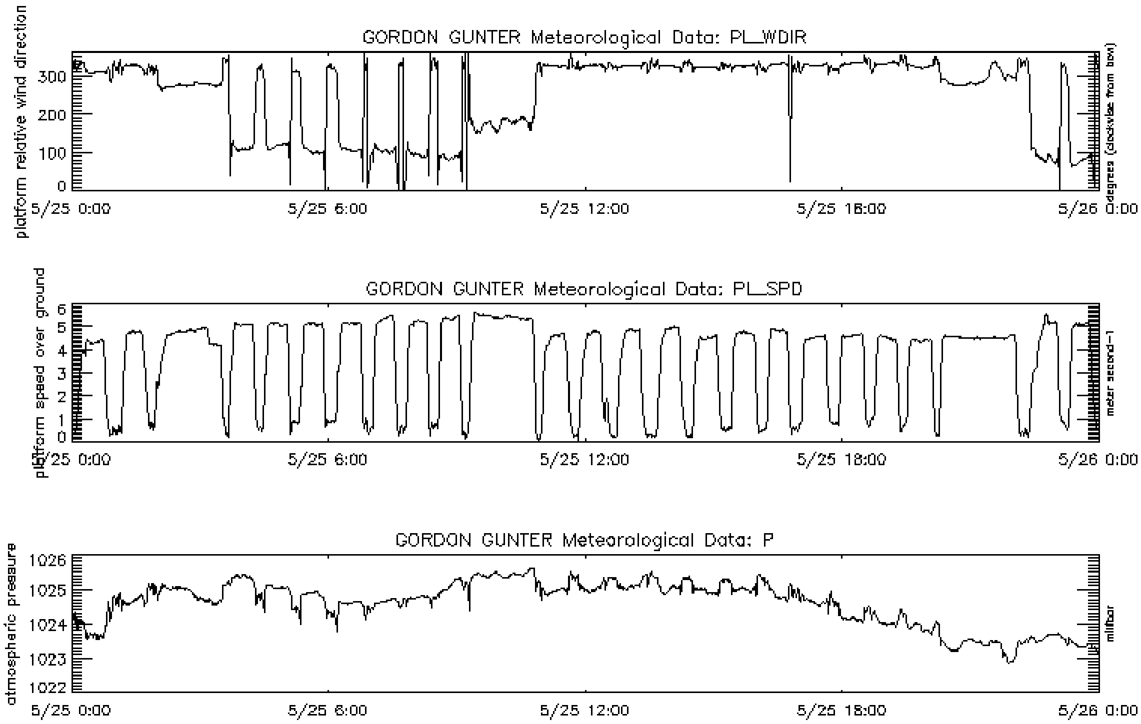


Figure 49: *Gordon Gunter* SAMOS (top) platform relative wind direction – PL_WDIR – (middle) platform speed – PL_SPD – and (bottom) atmospheric pressure – P – data for 25 May 2015. Note negative steps in P particularly whenever PL_WDIR is roughly 300° and vessel is moving.

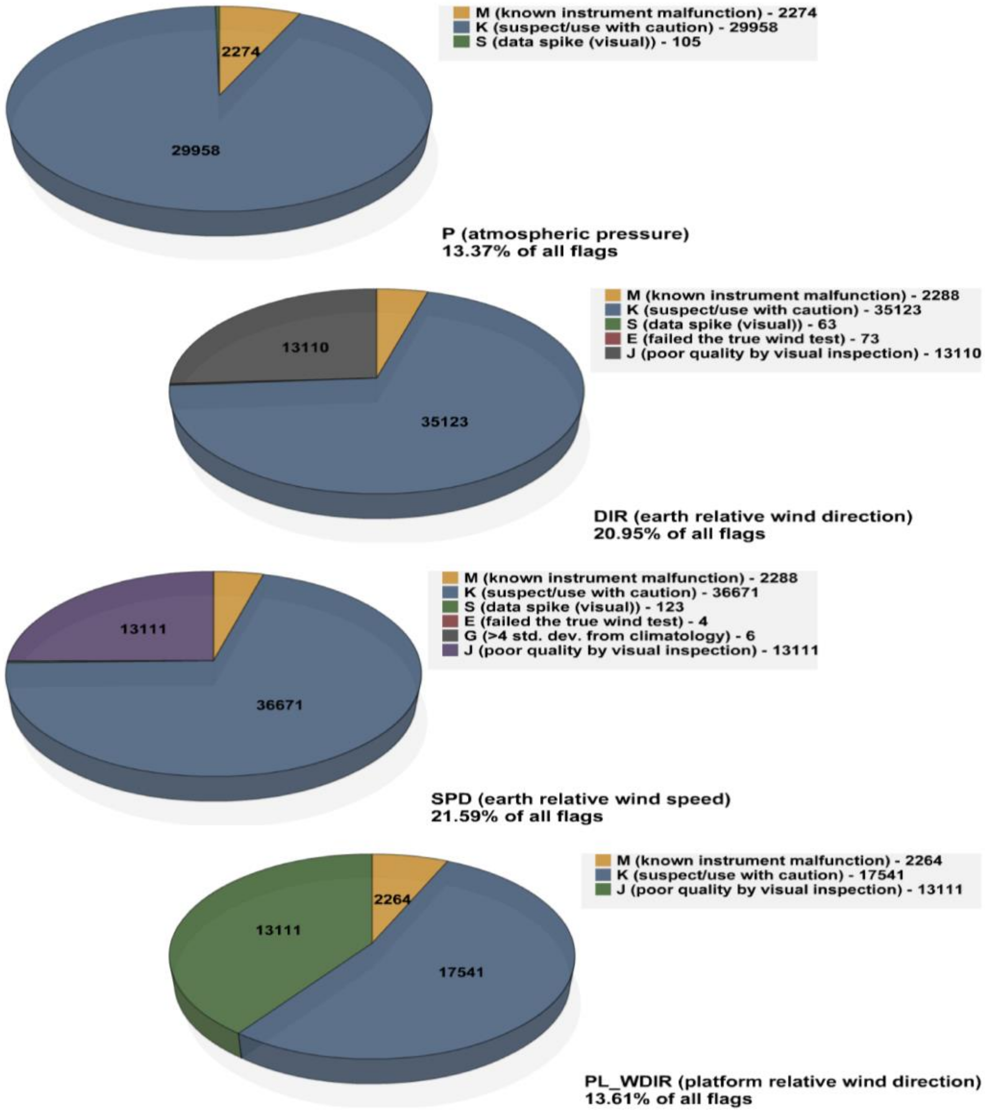


Figure 50: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) earth relative wind direction – DIR – (third) earth relative wind speed – SPD – and (last) platform relative wind direction – PL_WDIR – for the *Gordon Gunter* in 2015.

Henry B. Bigelow

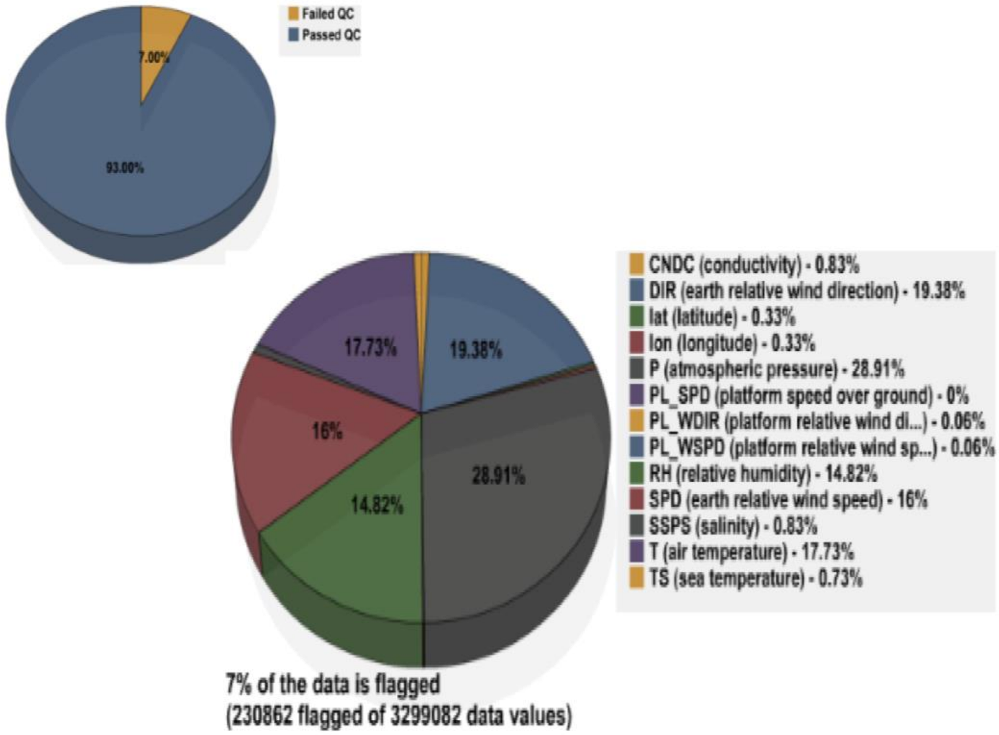


Figure 51: For the *Henry B. Bigelow* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Henry Bigelow* provided SAMOS data for 165 ship days, resulting in 3,299,082 distinct data values. After both automated and visual QC, 7% of the data were flagged using A-Y flags (Figure 51). This is a couple of percentage points decline over 2014 (4.86% total flagged) and brings the *Bigelow* back outside the < 5% total flagged bracket regarded by SAMOS to represent “very good” data.

The atmospheric pressure parameter (P) presents the largest issue with *Bigelow's* SAMOS data, comprising 28.91% of the total flags (Figure 51). The difficulty with *Bigelow's* P readings is rather a known quantity, and early in her sailing season a lengthy discussion took place via email between the SAMOS DAC, several *Bigelow* personnel, and representatives of VOS regarding questionable (suspected of being too high or low) P data and possible explanation. While some of the confusion may have related back to inaccurate model comparison data and differing vessel barometers, what has remained clear for *Bigelow* P is that there is likely a sensor exposure issue, whereby flow is interrupted at certain platform relative directions. Additionally the sensor may not be properly ported to the outside with a Gill-type pressure port. There may even be degradation of the sensor itself. It isn't entirely clear, however, which of the vessel's barometers is used for SAMOS, although metadata does list it as the RM Young 207. (Discussion participants were unsure, though, and we note the P metadata is over 6 years old.) In any case the metadata is lacking instrument location specifics and no digital imagery exists in the database to help identify sensor location/possible sources of data contamination.

Qualitatively, the P data can sometimes behave highly suspiciously without obvious cause, like vessel speed or orientation changes. Figure 52 offers a good example of this unexplained behavior: The sudden pressure rise around 11Z, about an hour after frontal passage, was in stark disagreement with analyzed pressure fields, and there was no correlation with vessel relative wind direction or vessel speed. In fact, *Bigelow* was nearly stationary at this time. The pressure also often ranged too high during the daytime and/or too low during the nighttime. Further investigation of this sensor is crucial, and metadata should be fortified with detailed digital imagery and sensor location information, as P receives a good deal of caution/suspect (K) flags (Figure 55).

Bigelow continues to have some complications with the earth relative wind speed (SPD) and direction (DIR) parameters as well, comprising another ~35% combined of all flags (Figure 51). The issue has been ongoing since at least 2013: namely, throughout the year, and always at or around the same time of day, both DIR and SPD will often suddenly exhibit questionable behavior that roughly follows (or responds to) the shape of the platform speed parameter and/or the platform heading, as demonstrated in Figure 53. After a few hours the behavior of SPD and DIR just as abruptly returns to normal. This analyst continues to retain no record of an explanation for this anomalous behavior. As a result of the aberrations in 2015 there was a fair amount of suspect/caution (K) flagging of both parameters (Figure 55). Possible explanations might be some sort of periodic interference with the true wind calculation, or perhaps some sort of electrical interference with the wind sensor itself. The issue did not however appear to have any sort of relationship with platform relative wind direction. Additionally, both DIR and SPD incur a fair amount of "failed the true wind test" (E) flags from the autoflagger.

Temperature (T) and relative humidity (RH) show signs of flow contamination and picked up a further ~32% of total flags combined (Figure 51). Steps in T and RH are commonly seen when the relative wind is from somewhere along the port side, generally from astern (example Figure 54). These steps are always assigned K flags (Figure 55). As there is no diurnal signal apparent in the steps and the vessel seems usually to be underway at the time, this is quite likely a situation of stack exhaust contamination. Again, though, metadata do not specify instrument location and we are therefore not prepared to adequately diagnose.

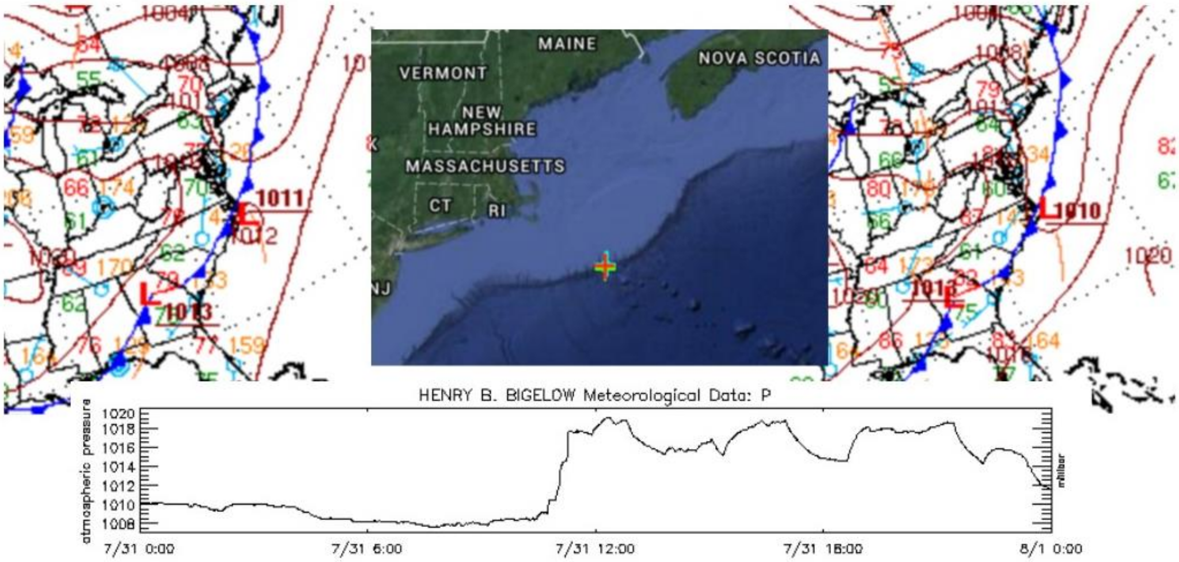


Figure 52: Composite showing (top left) NWS archived North American 31 July 2015 12Z surface analysis, (top middle) vessel *Bigelow* position 31 July 2015, (top right) NWS archived North American 31 July 2015 15Z surface analysis, and (bottom) *Henry Bigelow* SAMOS atmospheric pressure (P) data for 31 July 2015. Note ship position near frontal boundary and highly suspicious P increase to nearly 1020 mb around this time. Also note uncharacteristic shape of P trace after the increase (strange, almost boxy 4 mb rising and falling).

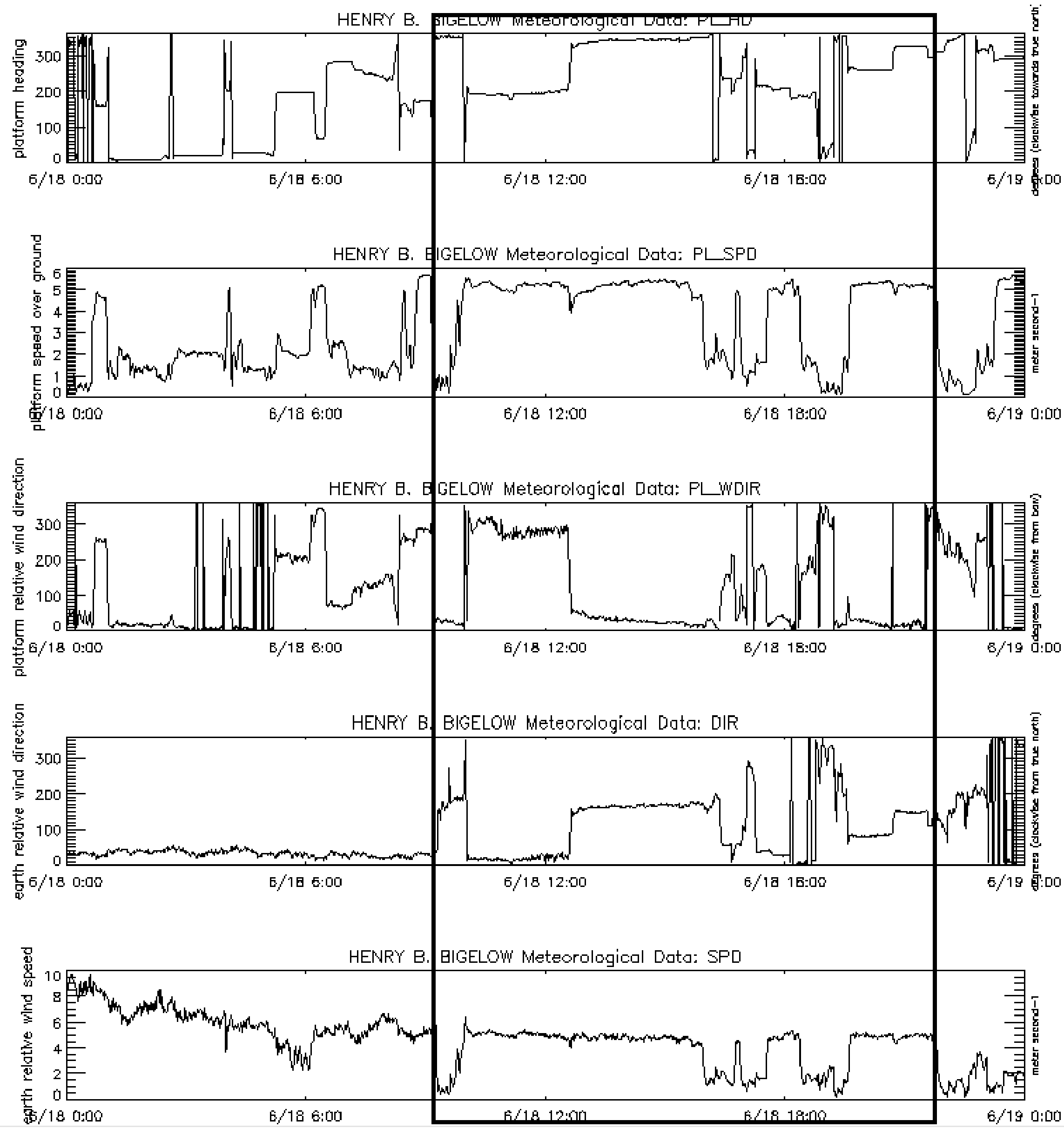


Figure 53: *Henry Bigelow* SAMOS (first) platform heading – PL_HD – (second) platform speed over ground – PL_SPD – (third) platform relative wind direction – PL_WDIR – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 18 June 2015. Note the sudden changes to both DIR and SPD inside the boxed area; the character of each changes and appears to become somehow linked to PL_SPD and/or PL_HD, largely irrespective of PL_WDIR.

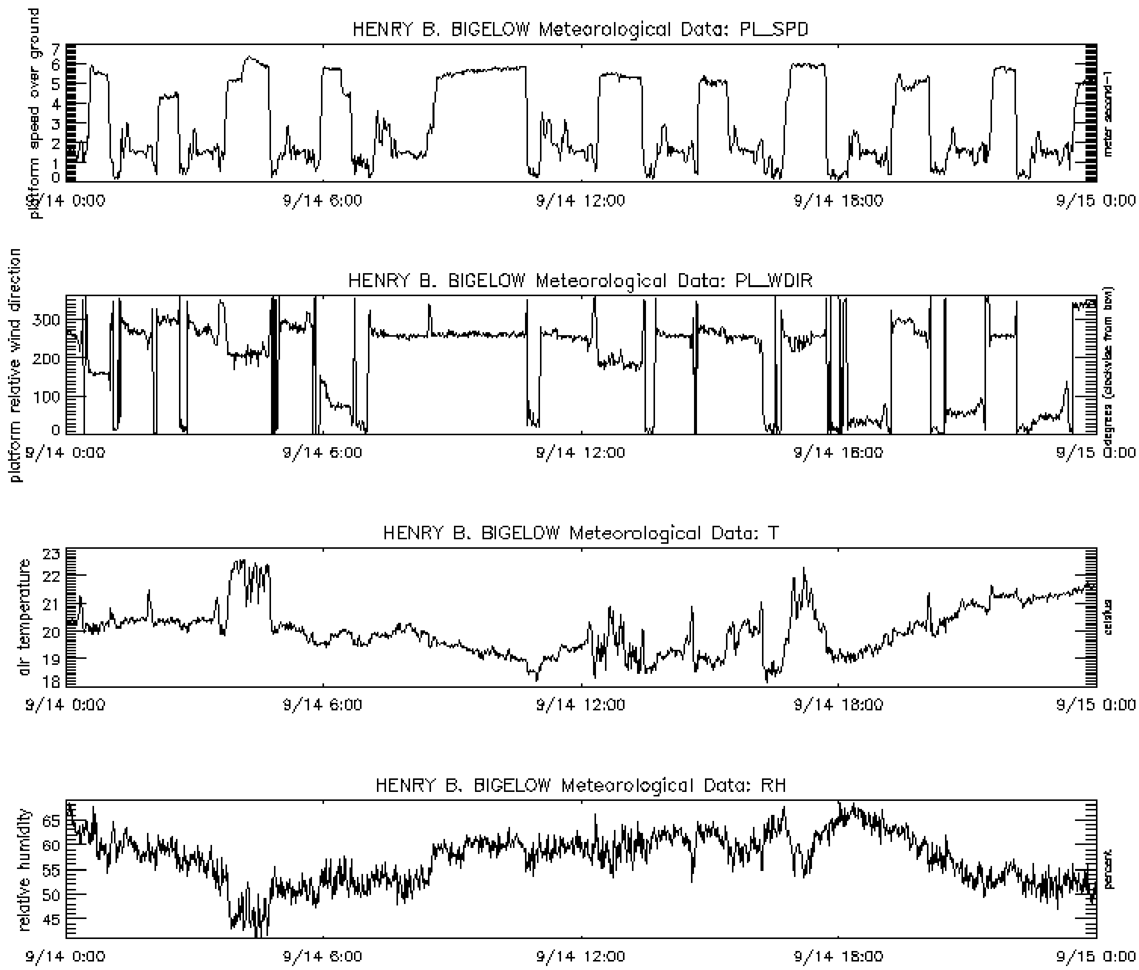


Figure 54: *Henry Bigelow* SAMOS (first) platform speed over ground – PL_SPD – (second) platform relative wind direction – PL_WDIR – (third) air temperature – T – and (last) relative humidity – RH – data for 14 September 2015. Note steps in T and to a lesser degree RH in response to changing PL_WDIR.

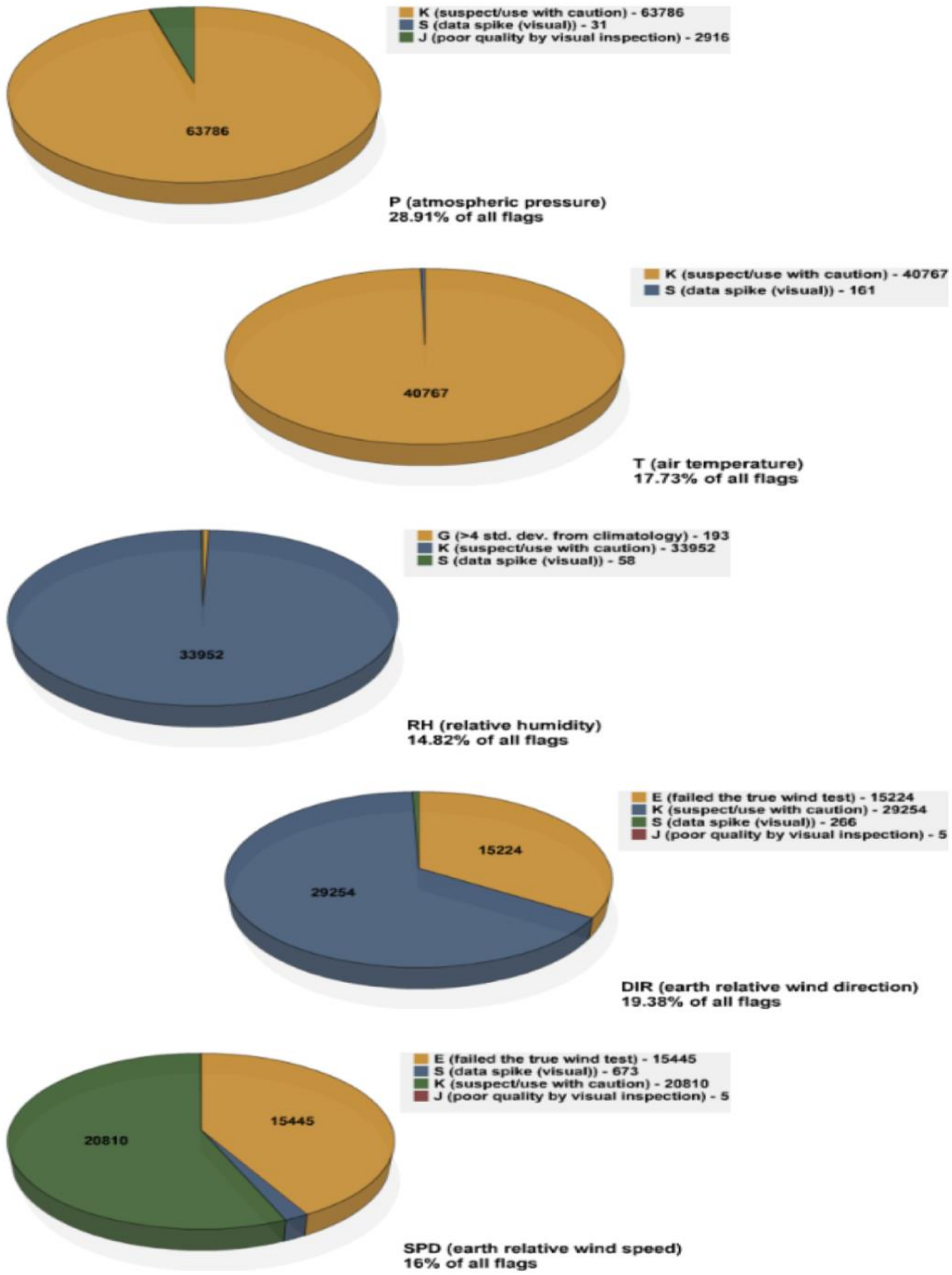


Figure 55: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – for the *Henry B. Bigelow* in 2015.

Hi'ialakai

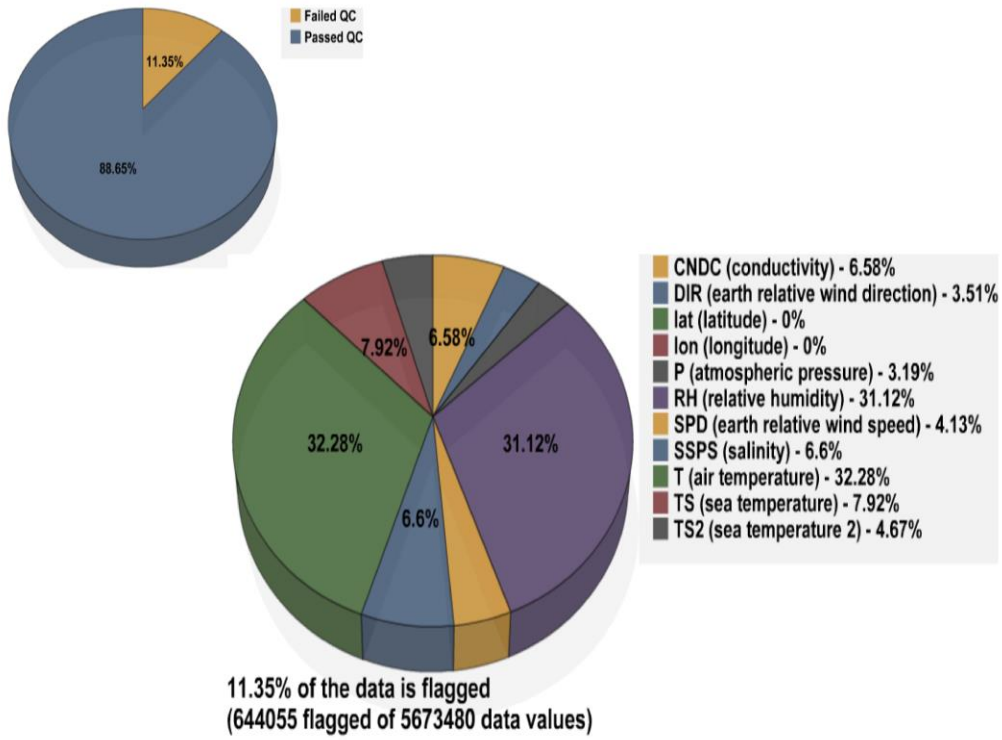


Figure 56: For the *Hi'ialakai* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Hi'ialakai* provided SAMOS data for 233 ship days, resulting in 5,673,480 distinct data values. After both automated and visual QC, 11.35% of the data were flagged using A-Y flags (Figure 56). This is a sizable increase over 2014 (4.54% total flagged) and unfortunately puts the *Hi’ialakai* well outside the < 5% total flagged bracket regarded by SAMOS to represent “very good” data.

Both the temperature (T) and relative humidity (RH) parameters received a hefty portion of flagging, about 60% of the total flags combined (Figure 56). The sensors were previously known to suffer from radiative heating contamination, so around early April a radiation cap was installed, as communicated to us via email by *Hi'ialakai* personnel. Unfortunately the problem of T often reading much too high and concomitant questionable RH readings persisted over the next several months, despite several sensor swaps and ongoing onboard troubleshooting. It is well worth noting that during this time, and indeed even carrying over from 2014, communication was continual between the *Hi'ialakai* and the SAMOS DAC, even through a changeup of the lead technician mid-season 2015. In any case, though, from the beginning of *Hi'ialakai's* sailing season until 3 July, when a final new sensor install seems to have solved the problem, both T and RH were extensively flagged with first mainly caution/suspect (K) and poor quality (J) flags, and eventually malfunction (M) flags (Figure 57).

The sea parameters conductivity (CNDC), salinity (SSPS), sea temperature (TS) and sea temperature 2 (TS2) together took on another ~26% of the total flags (Figure 56).

These were partly due to what appeared at first to be a switched off intake pump but turned out to be an inadvertently partially closed valve on the TSG manifold. The accidental closure was discovered on 11 April, after once again much back and forth emailing between *Hi'ialakai* and the DAC. In fact, coming out of this investigation, several improvements to the seawater system were actually implemented or planned for future implementation. Other than the partially closed valve activity, there were also a number of periods when the intake pump was actually turned off while the vessel was tied up or stationary, which is a common occurrence. All of these incidences resulted in periods of the two sea temperatures (TS and TS2) reading near ambient room temperature rather than actual sea temperature, and the conductivity (CNDC) and salinity (SSPS) reading much lower than sea conditions. All of these data were flagged with mainly K and J flags at various times throughout the year (Figure 57, TS and TS2).

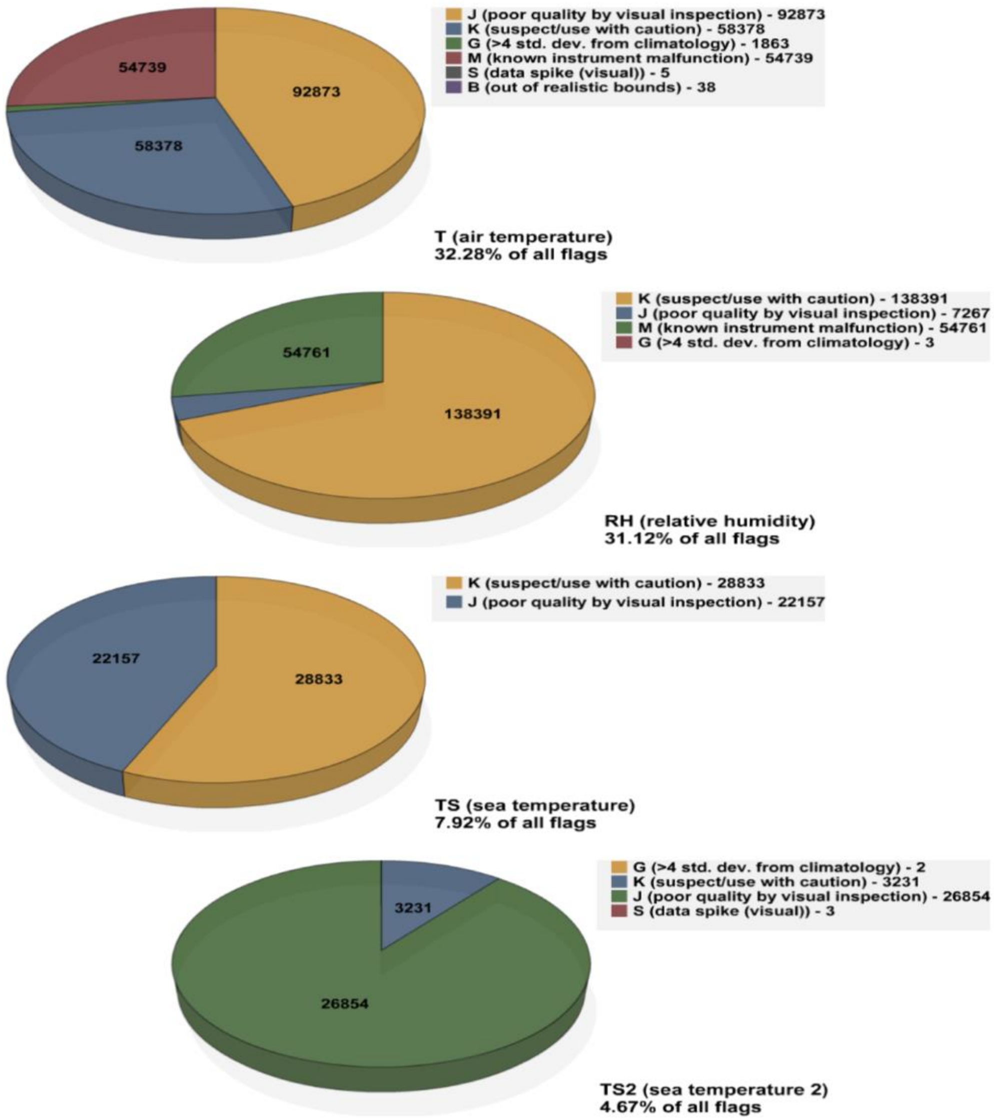


Figure 57: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) relative humidity – RH – (third) sea temperature – TS – and (last) sea temperature 2 – TS2 – for the *Hi'ialakai* in 2015.

Nancy Foster

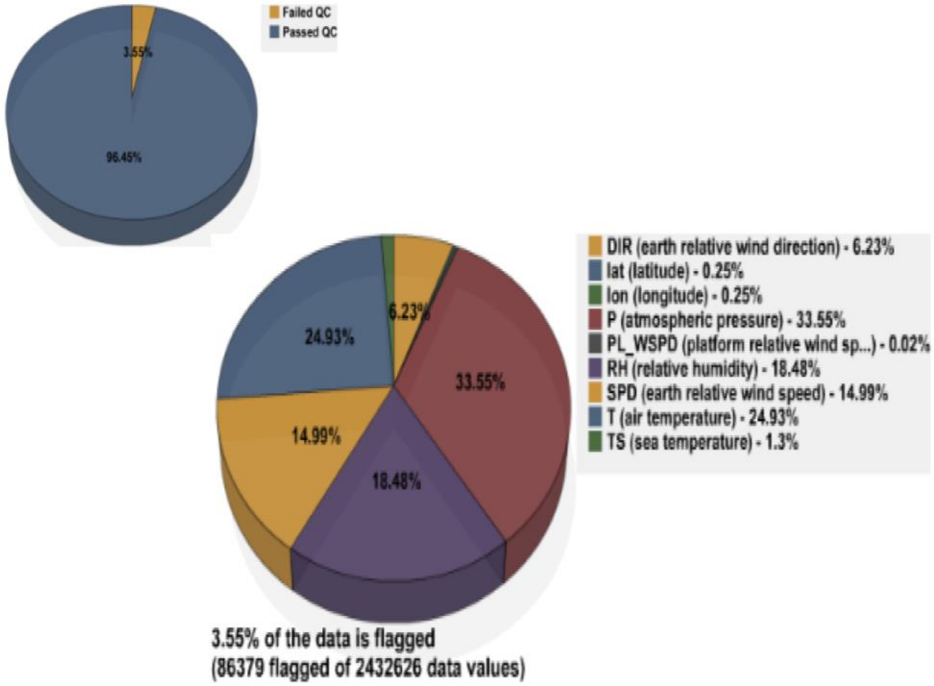


Figure 58: For the *Nancy Foster* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Nancy Foster* provided SAMOS data for 137 ship days, resulting in 2,432,626 distinct data values. After both automated and visual QC, 3.55% of the data were flagged using A-Y flags (Figure 58). This is a sizeable improvement over 2014 (10.68% total flagged), and brings the *Foster* well back under the < 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

The three atmospheric parameters air temperature (T), pressure (P), and relative humidity (RH) together comprised over 75% of the total flags, with a further ~15% going to the earth relative wind speed (SPD) (Figure 58). All four of these parameters exhibited a large number of spikes (see example Figure 59) throughout the sailing season, to which mainly spike (S) and some small amount of caution/suspect (K) and/or poor quality (J) flags were assigned (Figure 61). The spikes appear unrelated to vessel motion or orientation with respect to wind flow. This spike behavior had been previously communicated to *Foster* personnel in 2013 with no response, but after the distribution of last year's annual SAMOS Data Quality Report a request was made by the Chief ET to direct all communications to a specific set of ship email addresses in order to ensure someone would always receive them. Response went out immediately (to all available email addresses) from the DAC apologizing for the oversight and raising the issue of the spikes on P, T, RH, and SPD once more, as they were still ongoing. The question was asked whether the spikes were even showing up in the raw data onboard. Unfortunately once again no word came back and the spikes persisted throughout the *Foster's* sailing season. It is still unclear what is causing these spikes or, as propounded, whether they are even visible to the onboard technicians. Subsequent attempts to raise the issue continue to produce no definitive answer. We do stress here, though, that with 3.55% total flagged data the *Foster's* SAMOS data is still considered very good, even in spite of these multitudinous spikes.

In addition to the spike issue, P, T, and RH also exhibit sensor exposure issues (common on most vessels), which resulted in some further K flagging of all three parameters (Figure 61). Flow to the sensors generally seems contaminated when vessel relative winds are from the stern (see example Figure 60), but *Foster* metadata is lacking instrument location specifics and detailed digital imagery of the vessel, both of which could aid in diagnosing the problem.

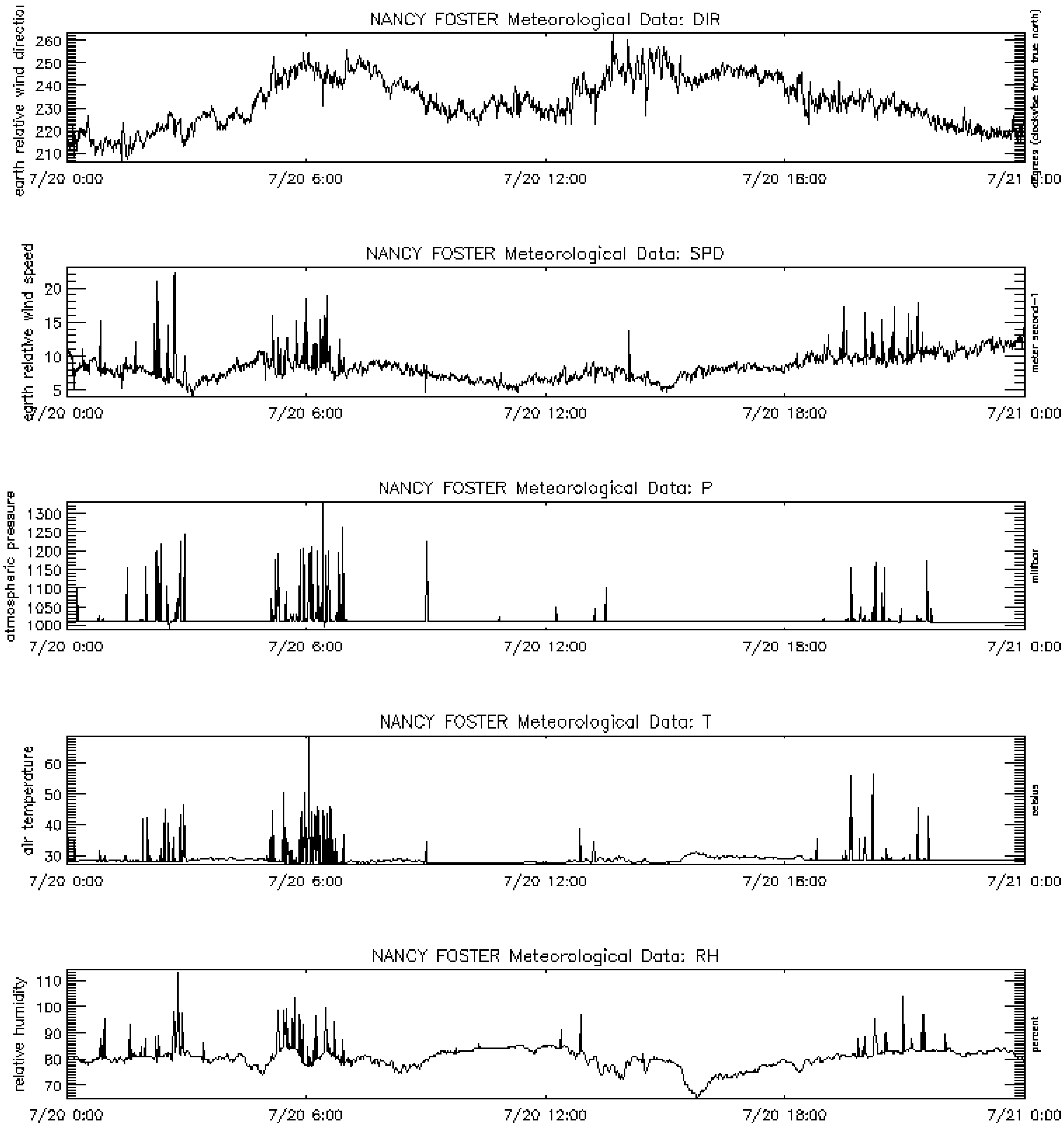


Figure 59: *Nancy Foster* SAMOS (first) earth relative wind direction – DIR – (second) earth relative wind speed – SPD – (third) atmospheric pressure – P – (fourth) air temperature – T – and (last) relative humidity – T – data for 20 July 2015. Note anomalous spikes in SPD, P, T, and RH. Also note lack of spikes in DIR.

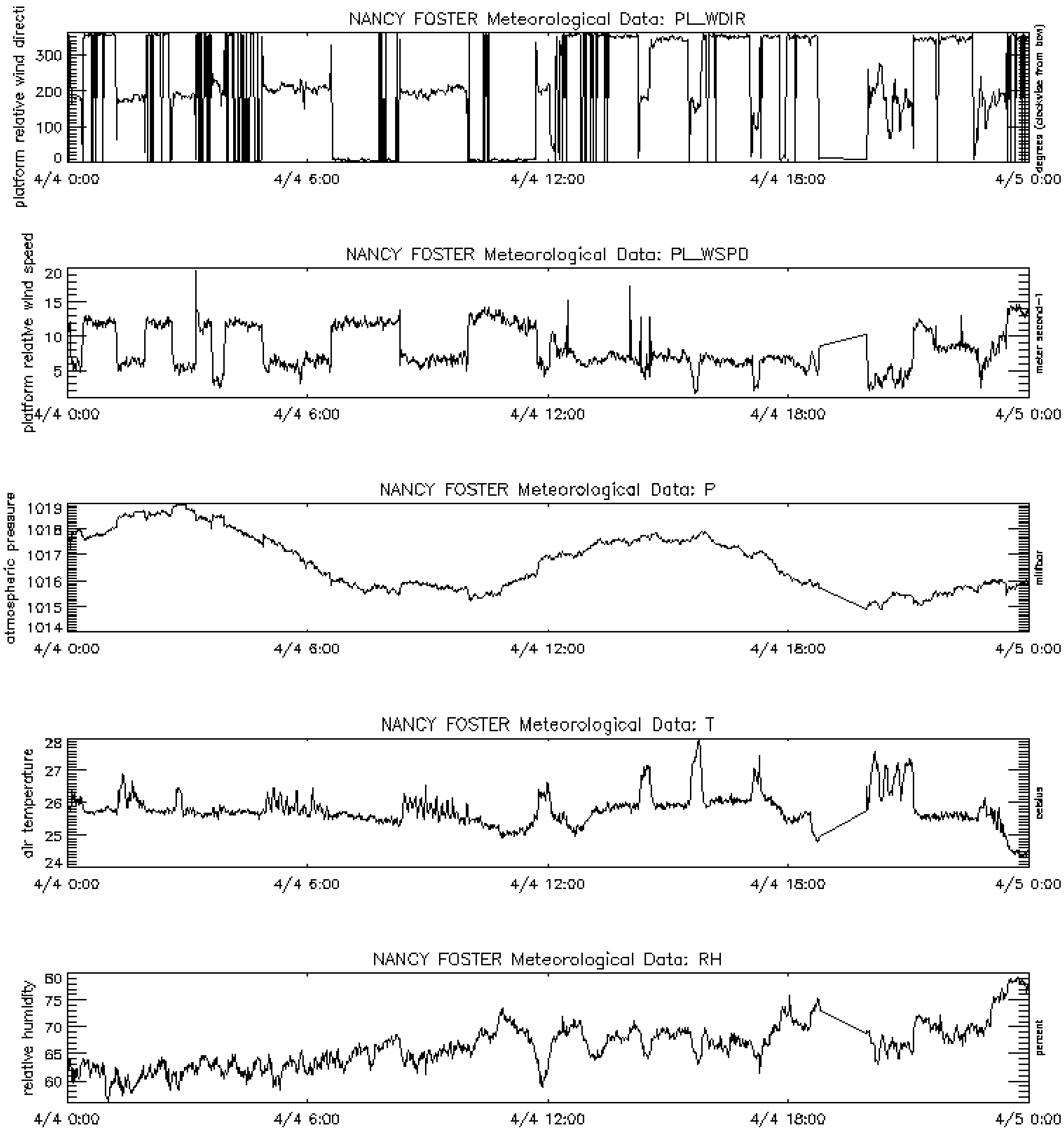


Figure 60: *Nancy Foster* SAMOS (first) platform relative wind direction – PL_WDIR – (second) platform relative wind speed – PL_SPD – (third) atmospheric pressure – P – (fourth) air temperature – T – and (last) relative humidity – T – data for 4 April 2015. Note steps in P, T, and to a lesser degree RH whenever PL_WDIR is from astern/PL_WSPD drops. The lack of a diurnal signal in the steps in T may further point towards stack exhaust contamination.

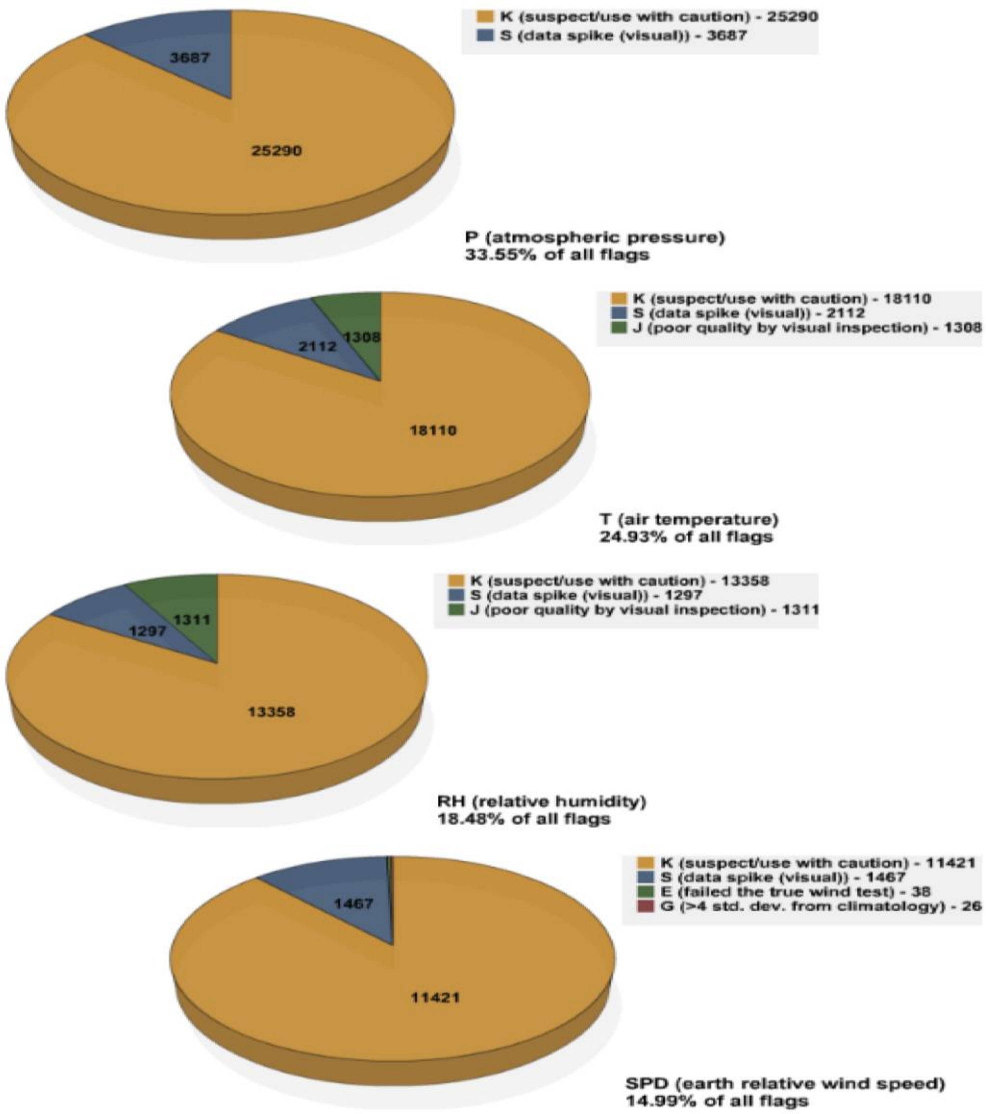


Figure 61: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) and (last) earth relative wind speed – SPD – for the *Nancy Foster* in 2015.

Okeanos Explorer

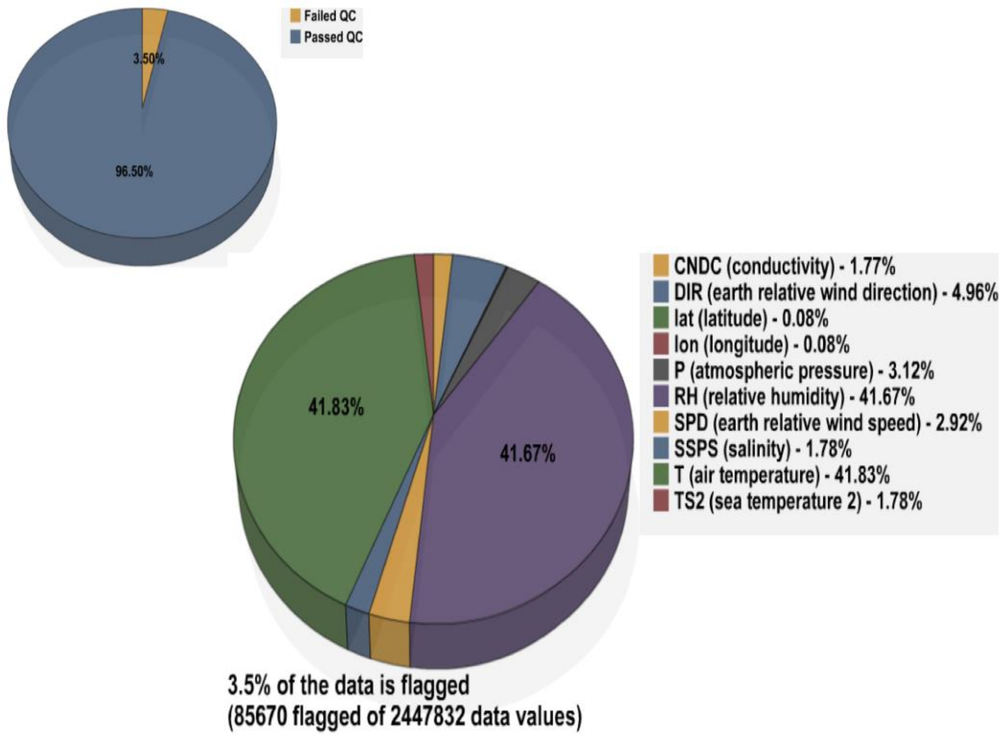


Figure 62: For the *Okeanos Explorer* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Okeanos Explorer* provided SAMOS data for 123 ship days, resulting in 2,447,832 distinct data values. After both automated and visual QC, 3.5% of the data were flagged using A-Y flags (Figure 62). This is about a 3% improvement over 2014 (6.73% total flagged) and places the *Explorer* back inside the < 5% flagged bracket regarded by SAMOS to represent "very good" data.

The only significant issue with *Explorer's* SAMOS data in 2015 involved the air temperature (T) and relative humidity (RH) parameters. Together, T and RH accumulated over 83% of the total flags (Figure 62). Most of these were poor quality (J) flags (Figure 63), which were blanket-applied over the period 19 March through 17 April. During this period there was no T/RH sensor installed, as was discovered by technicians initially troubleshooting the bad T/RH data. SAMOS personnel contacted the vessel on 24 March, just after their sail season commenced, regarding reported negative RH readings. Word came back immediately that vessel technicians already troubleshooting the issue had discovered there was no sensor installed and the system was simply spitting out default values. A purchase order for a new sensor was already underway, and as of 25 April the new sensor was installed and data resumed normal readings.

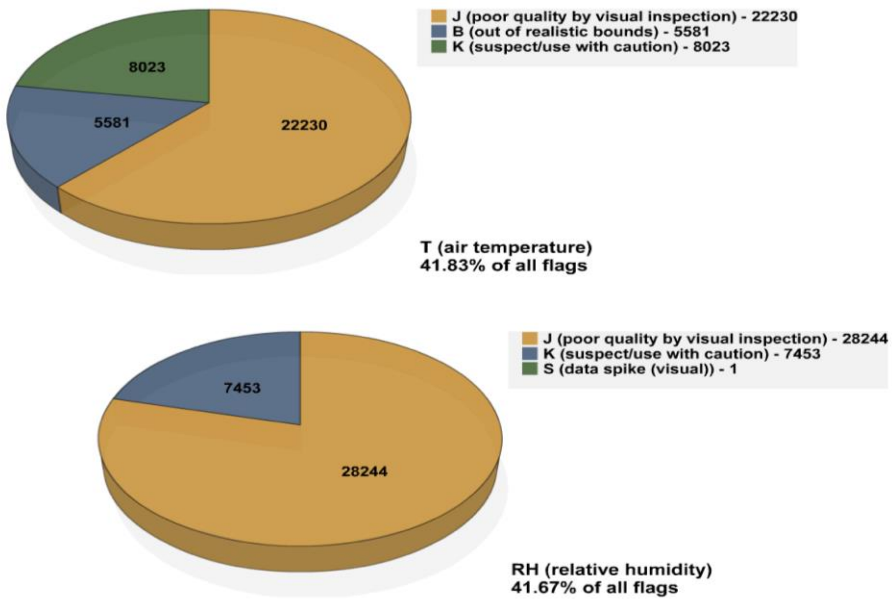


Figure 63: Distribution of SAMOS quality control flags for (top) air temperature – T – and (bottom) relative humidity – RH –for the *Okeanos Explorer* in 2015.

Oregon II

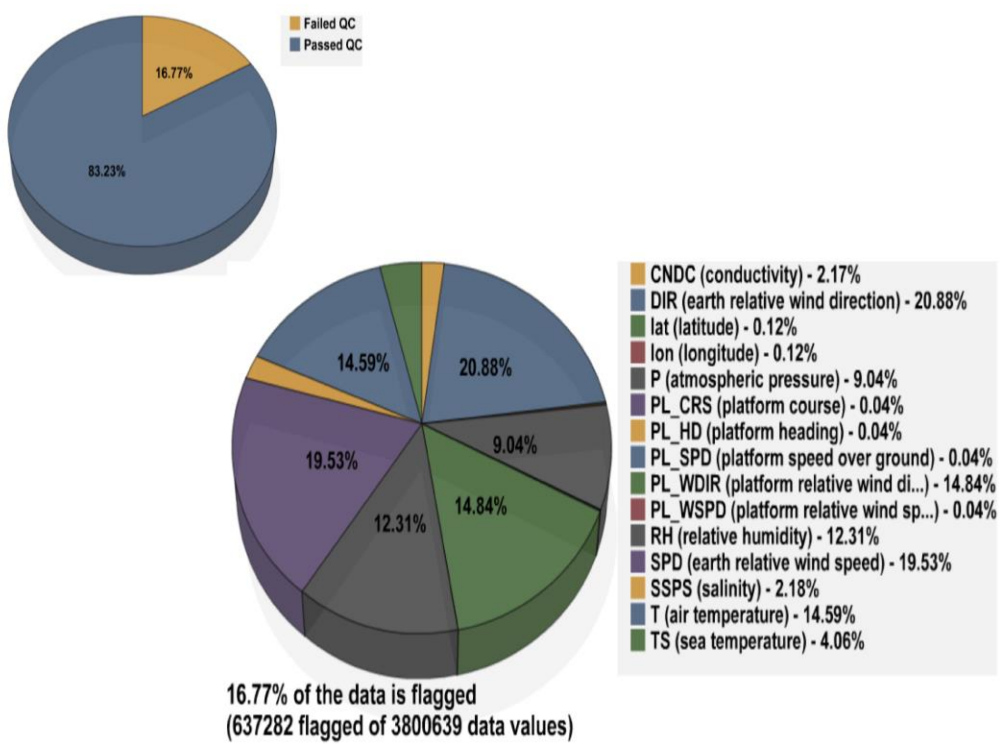


Figure 64: For the *Oregon II* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Oregon II* provided SAMOS data for 184 ship days, resulting in 3,800,639 distinct data values. After both automated and visual QC, 16.77% of the data were flagged using A-Y flags (Figure 64). This is over 10% higher than 2014 (5.97% total flagged).

The most severe issue with *Oregon's* data concerned the platform relative wind direction (PL_WDIR), which in turn impacted the earth relative wind direction (DIR) and speed (SPD). Each of these three parameters garnered a substantial portion of the total flags: 20.88% for DIR, 19.53% for SPD, and 14.84% for PL_WDIR (Figure 64). The problem seemed to be that from the start of *Oregon's* sailing season in mid March PL_WDIR routinely kept flatlining around ~225° for some obscure reason, causing DIR to step abruptly out of line and SPD to read very similar in shape to the platform speed (example Figure 65). Compounding the issue, the PL_WDIR readings of ~225° often appeared inconsistent with the reality of satellite wind fields and occasional buoy data to begin with. Further, PL_WDIR values greater than ~225° were rarely seen, prompting the SAMOS visual QC analyst to question via email (8 April) whether there was some new structure nearby the sensors badly blocking air flow, or perhaps some loose hardware anchoring the wind instrument that kept swinging it into the 225° orientation. Discussion ensued between the SAMOS DAC, vessel technicians, and the NOAA fleet SCS Project Manager, and ultimately a decision was reached to reprogram the RM Young translator. Unfortunately, this did not prove to be the answer and the winds problem persisted through 2015, resulting in a large volume of poor quality (J) and caution/suspect (K) flags on all three affected parameters (Figure 67).

In addition to the PL_WDIR issue, atmospheric pressure (P) data also presented a challenge, and P received another 9.04% of the total flags (Figure 64), mostly K and some J flags (Figure 67). In this case P frequently appeared unreliable in comparison to nearby buoys and archived National Weather Service (NWS) surface analyses, often reading either too high or two low. Figure 66 is a clear example, particularly during the period 1200-1800UTC wherein the *Oregon's* pressure rose to in excess of 1020 mb while both a nearby buoy and surface analyses seemed to agree on a pretty constant 1016 mb during the period. At the same time the wind issue was being communicated to *Oregon*, the P issue was also raised and it was put forth by the visual QC analyst that the abnormal readings may have had much to do with the location of the sensor. It is known that the *Oregon II* is a low vessel and stack exhaust has been an issue in the past, but as the P data seemed worse than usual it was worth pointing it out again to see if something more nefarious might be going on. Again, the proposed solution for any of the ongoing data issues was a translator reprogram, but this does not seem to have solved the P problem either. Some flagging of the P parameter continued throughout 2015.

Air temperature (T), and relative humidity (RH) parameters also took on a combined ~27% of the total flags (Figure 64). These were overwhelmingly suspect/caution (K) flags (not shown) and continued to appear to be largely due to flow distortion or obstruction, just as in past years. Specifically, the T, RH, and additionally the P sensors seem to be in a wind shadow whenever apparent winds are from the port side and/or astern, particularly during daytime. T and RH were also occasionally affected by the apparent ~225° PL_WDIR occurrences (whether valid or not), though this may have only been coincidence. From the variable metadata we can at least tell that both the atmospheric pressure and relative humidity sensors are located about 20m back from the bow at heights less than 10m from the waterline. Digital imagery and ship measurements (length, breadth, freeboard, and draft) still do not exist in the SAMOS database for the *Oregon II* so nothing can be confirmed, but considering the relatively low heights of these two sensors and probable location amidships, it is suspected that they are installed somewhere on a level with the wheelhouse on the starboard side and thus in a severe wind shadow when the winds come in from the port. The air temperature sensor, reported to be at a height of about 16 meters, is a little less easy to conjecture about, but it would seem at least that it is located close to some ship structure prone to heating up from insolation when cut off from the platform relative winds (again, from the port). The suspected radiative heating appears strongest in the summer months, further supporting the conjecture. We stress again, too, that the *Oregon II* is understood to have an atypical structure – she is an old and low vessel – and it is suspected that her data problems may also be related to stack exhaust.

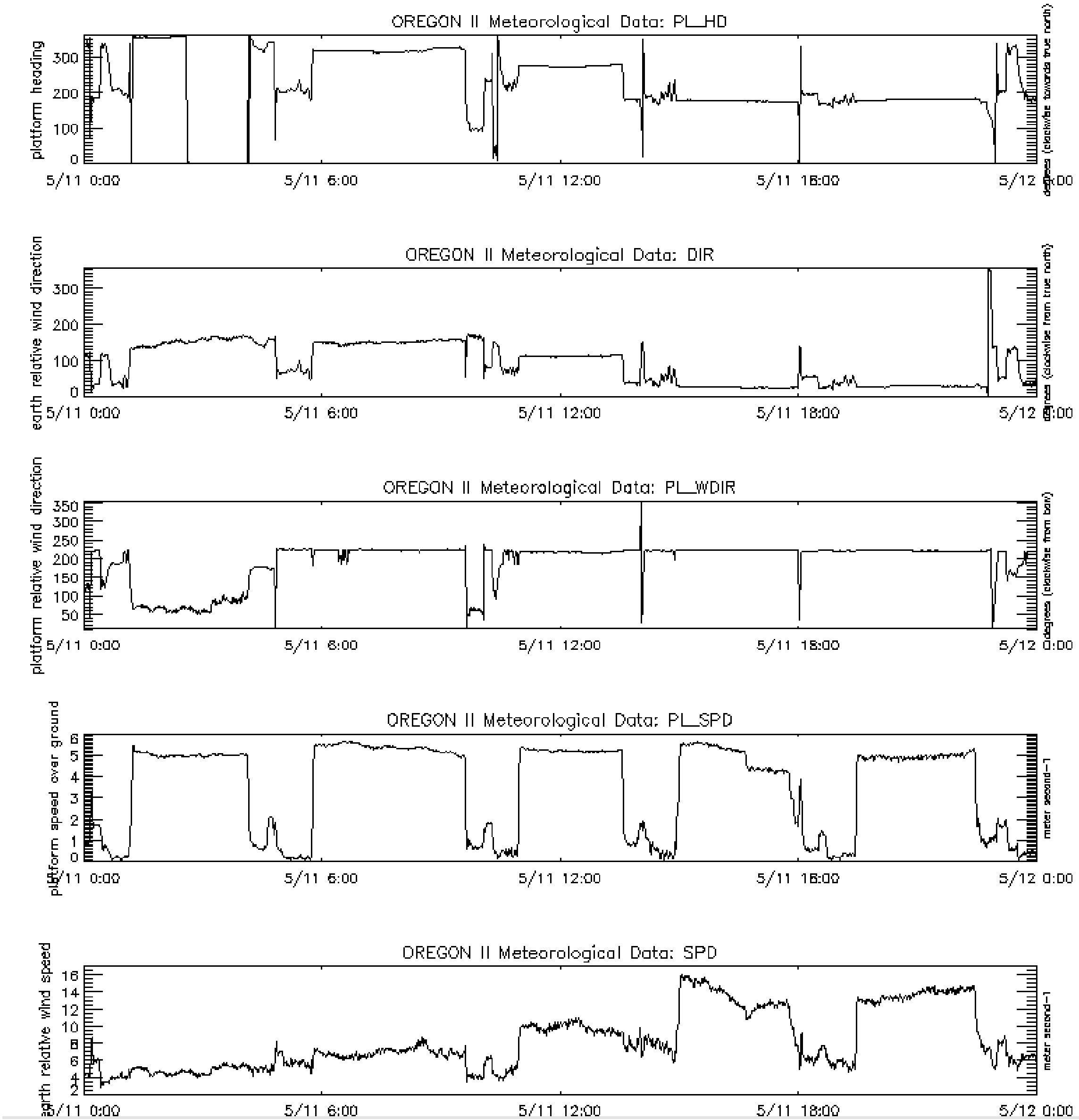
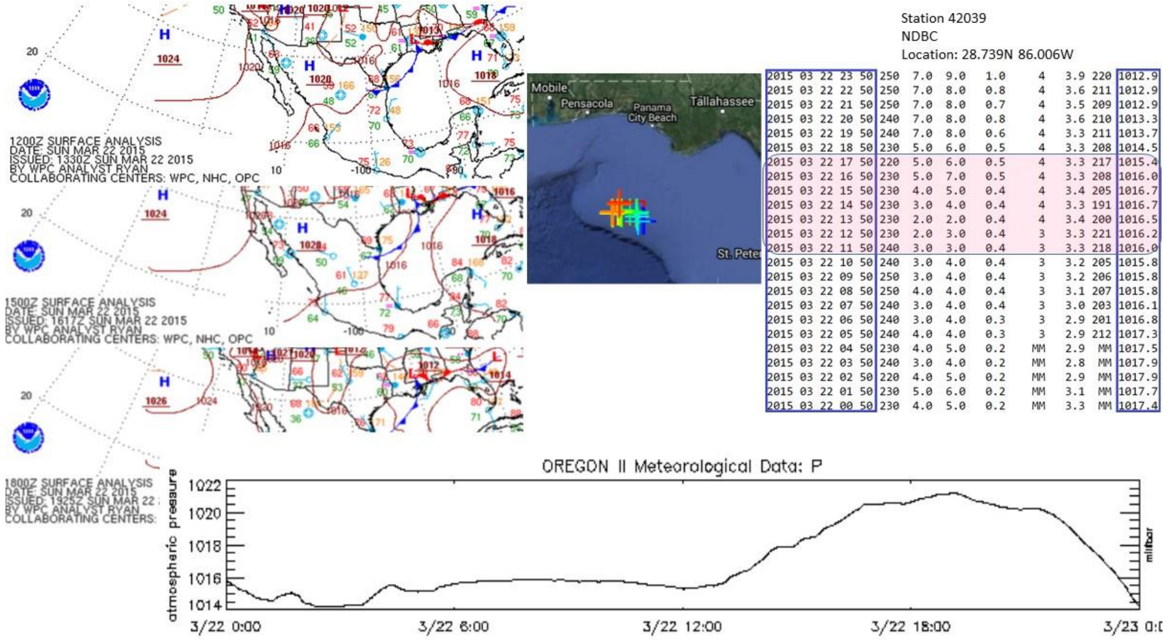


Figure 65: *Oregon II* SAMOS (first) platform heading – PL_HD – (second) earth relative wind direction – DIR – (third) platform relative wind direction – PL_WDIR – (fourth) platform speed – PL_SPD – and (last) earth relative wind speed – SPD – data for 11 May 2015.



2015	03	22	23	50	250	7.0	9.0	1.0	4	3.9	220	1012.9
2015	03	22	22	50	250	7.0	8.0	0.8	4	3.6	211	1012.9
2015	03	22	21	50	250	7.0	8.0	0.7	4	3.5	209	1012.9
2015	03	22	20	50	240	7.0	8.0	0.8	4	3.6	210	1013.3
2015	03	22	19	50	240	7.0	8.0	0.6	4	3.3	211	1013.7
2015	03	22	18	50	230	5.0	6.0	0.5	4	3.3	208	1014.5
2015	03	22	17	50	220	5.0	6.0	0.5	4	3.3	217	1015.4
2015	03	22	16	50	230	5.0	7.0	0.5	4	3.3	208	1016.0
2015	03	22	15	50	230	4.0	5.0	0.4	4	3.4	205	1016.7
2015	03	22	14	50	230	3.0	4.0	0.4	4	3.3	191	1016.7
2015	03	22	13	50	230	2.0	2.0	0.4	4	3.4	200	1016.5
2015	03	22	12	50	230	2.0	3.0	0.4	3	3.3	221	1016.2
2015	03	22	11	50	240	3.0	3.0	0.4	3	3.3	218	1016.0
2015	03	22	10	50	240	3.0	4.0	0.4	3	3.2	205	1015.8
2015	03	22	09	50	250	3.0	4.0	0.4	3	3.2	206	1015.8
2015	03	22	08	50	250	4.0	4.0	0.4	3	3.1	207	1015.8
2015	03	22	07	50	240	3.0	4.0	0.4	3	3.0	203	1016.1
2015	03	22	06	50	240	3.0	4.0	0.3	3	2.9	201	1016.8
2015	03	22	05	50	240	4.0	4.0	0.3	3	2.9	212	1017.3
2015	03	22	04	50	230	4.0	5.0	0.2	MM	2.9	MM	1017.5
2015	03	22	03	50	240	3.0	4.0	0.2	MM	2.8	MM	1017.9
2015	03	22	02	50	220	4.0	5.0	0.2	MM	2.9	MM	1017.9
2015	03	22	01	50	230	5.0	6.0	0.2	MM	3.1	MM	1017.7
2015	03	22	00	50	230	4.0	5.0	0.2	MM	3.3	MM	1017.4

Figure 66: Composite showing (top left, three panels) NWS archived North American 22 March 2015 12Z, 15Z, and 18Z surface analyses, (top middle) vessel *Oregon II* cruise track 22 March 2015 (0Z – blue – to 23Z – red), (top right) NDBC Station 42039 archived date/time and pressure data (in blue boxes, relevant data highlighted in pink), and (bottom) *Oregon II* SAMOS atmospheric pressure (P) data for 22 March 2015. Note disagreements between SAMOS P and surface analysis/buoy data, particularly during highlighted period.

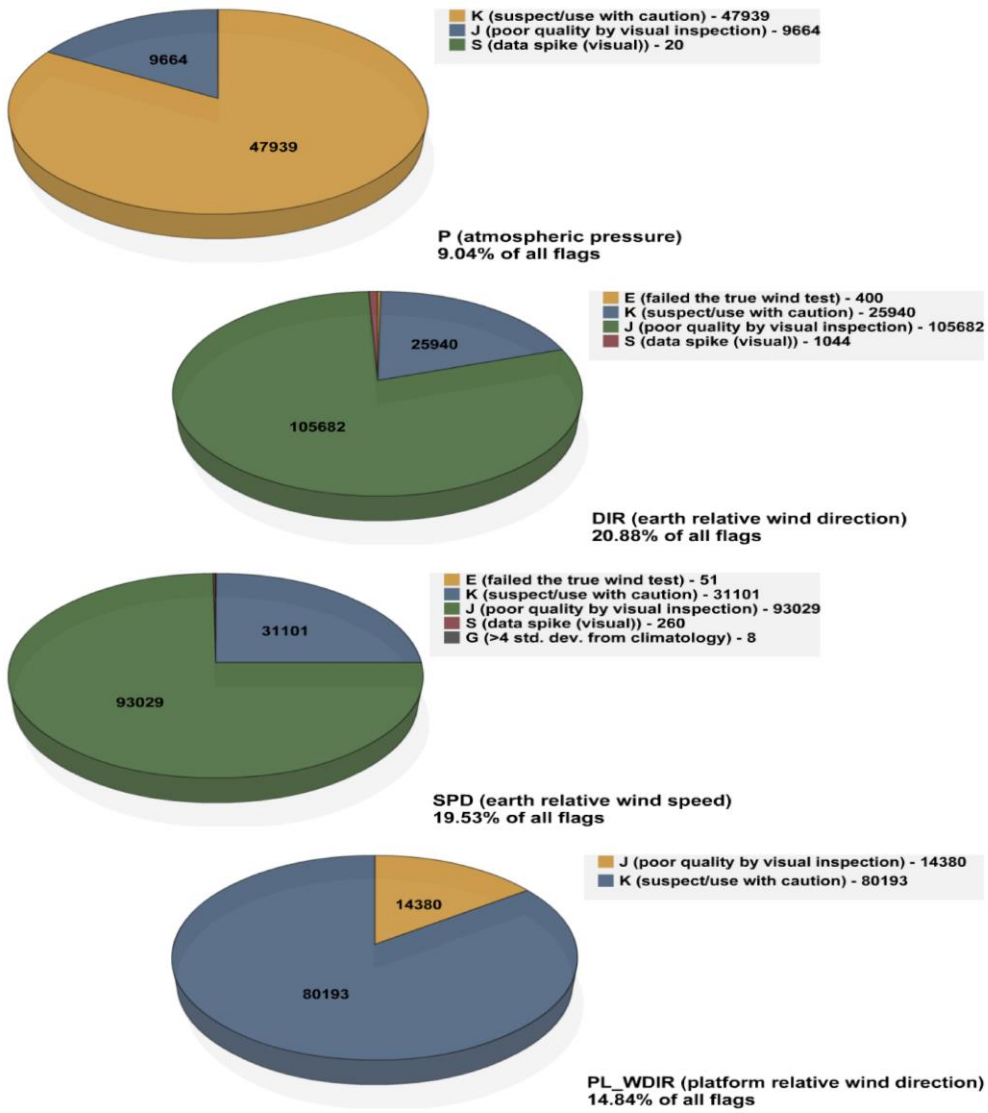


Figure 67: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) earth relative wind direction – DIR – (third) earth relative wind speed – SPD – and (last) platform relative wind direction – PL_WDIR –for the *Oregon II* in 2015.

Oscar Dyson

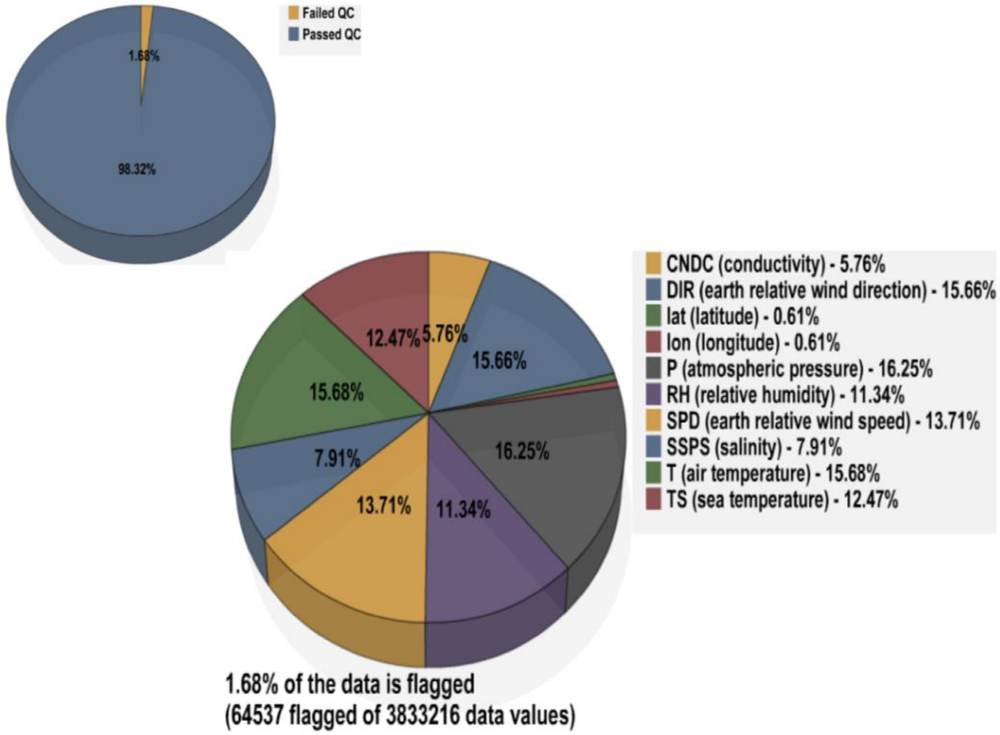


Figure 68: For the *Oscar Dyson* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Oscar Dyson* provided SAMOS data for 179 ship days, resulting in 3,833,216 distinct data values. After both automated and visual QC, 1.68% of the data were flagged using A-Y flags (Figure 68). This is about a 2% improvement over 2014 and a virtual return to 2013 overall performance (3.97% and 1.83% total flagged, respectively) and *Dyson* remains robustly within the < 5% flagged bracket regarded by SAMOS to represent "very good" data.

The *Dyson* does suffer mildly from a bit of flow distortion and ship heating affecting her various atmospheric sensors, as do virtually all vessels, but really with so low a total flag percentage it seems the best message to deliver here is "job well done." But for the sake of pursuing perfection, we shall here repeat our recommendations from last year:

Digital imagery currently on file for the *Dyson* appears to show a potentially problematic location for the temperature (T) and relative humidity (RH) sensors in particular, low down on an instrument mast amidships and not far from the exhaust stack. As her metadata have never been updated, it's assumed that is still the location of her T/RH sensors, but again her total flagged percentage points toward minimal issue. It's possible that radiative heating is in this case less of a concern than we'd normally expect given the location of the sensors, simply by virtue of the *Dyson's* usual region of operations (generally sub-polar). Additionally, earth relative winds (direction – DIR – and speed – SPD) experience a bit of flow distortion particularly when the winds are from the stern. Digital imagery points to an explanation here, too, as the anemometer is shown to be on the jackstaff, with the main structure of the ship behind it (a common and fairly ideal placement, all things considered). Finally, digital imagery and variable metadata unfortunately do not specify where on the ship the atmospheric pressure (P) sensor is located. Looking at *Dyson's* P data, it isn't always clear whether the instrument is sensitive to a particular apparent wind direction, changes in ship speed, or both; all that is really certain is that the P data are relatively sensitive. It is likely either due to poor exposure or the need for a pressure port to attenuate any wind effects – perhaps both.

But once again our main message must be, "bravo, *Dyson*!"

Oscar Elton Sette

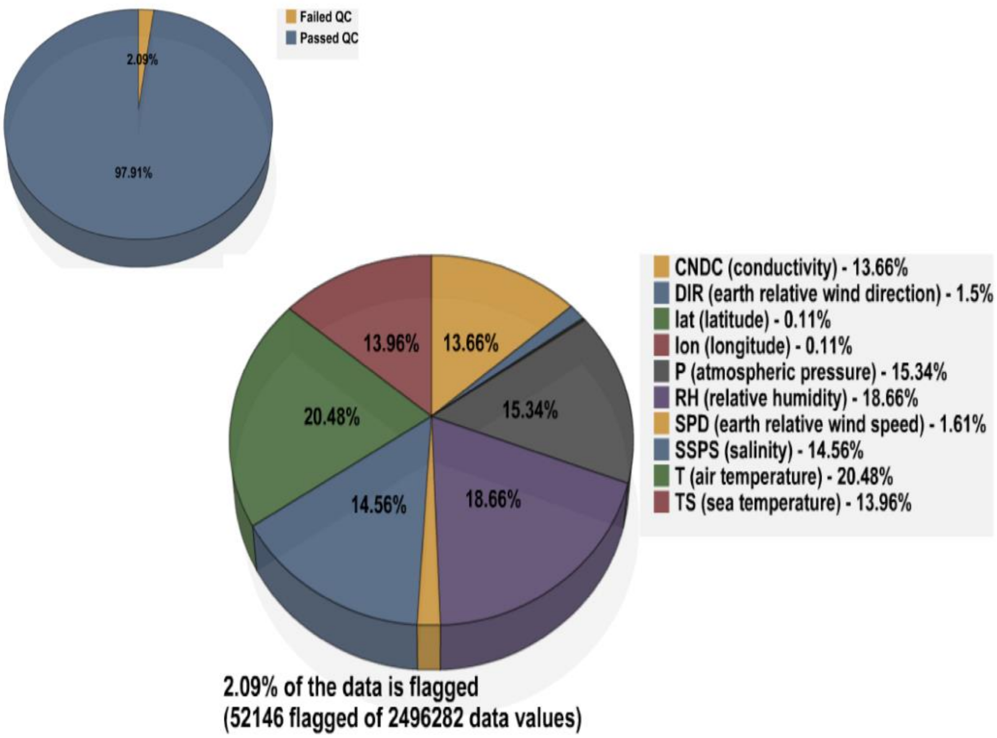


Figure 69: For the *Oscar Elton Sette* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Oscar Elton Sette* provided SAMOS data for 120 ship days, resulting in 2,496,282 distinct data values. After both automated and visual QC, 2.09% of the data were flagged using A-Y flags (Figure 69). This is virtually unchanged from 2014 (1.86% total flagged) and is once again impressively well inside of the < 5% total flagged bracket regarded by SAMOS to represent "very good" data.

With such an admirable flag percentage, and similar to the breakdown for the *Dyson* above, the main message that we have for the *Sette* must be "well done!" There are nevertheless a few items to note here.

Firstly, there were several known cases of the thermosalinograph system being impacted, meaning sea temperature (TS), salinity (SSPS), and conductivity (CNDC) took on a combined ~42% of the total (diminutive) flags. The first case involved the TSG pump going air bound and the technician subsequently performing a fresh water flush of the system; the latter cases all involved the TSG system being secured, either due to harbor proximity or else rough sea (both common practices). While most of these incidences resulted in poor quality (J) flagging (Figure 70) of the three sea parameters (during the last reported incident TS/SSPS/CNDC were actually temporarily removed from SCS), we nevertheless stress that each incidence was not only of very short duration but also well communicated to the SAMOS DAC by *Sette* personnel, a valued practice within the SAMOS cooperative. What actually is more noteworthy, and somewhat of concern, is that during the course of these notifications it came to light the *Sette* techs occasionally switch the TSG system between their deep and shallow intakes at random. This custom is unlikely to produce broad differences in their TSG readings, but it does imply some ambiguity to the data, especially considering the TSG metadata is not and in fact never has been updated. (Though, indeed, there is no depth measurement given for the TSG in the metadata in the first place.) The best case scenario for this practice may involve setting up two sets of metadata for the sea parameters, each with a different designator and the depth of the intake spelled out, and adopting a religion of switching between the designators any time the intakes are switched. We accept that this may not be a practical solution on board a busy ship, though.

Additionally, the air temperature (T), relative humidity (RH), and atmospheric pressure (P) parameters do occasionally exhibit minor effects of flow distortion, as do virtually all vessels, but we again point out how low the overall flag percentage is to begin with. The fairly even spread of flag percentages across T, RH, and P further points to there not being any outstanding problems among the three (Figure 69). We will only note that more complete instrument location metadata for each of the three sensors, plus digital imagery showing their locations and surroundings, would enable quality analysts at the DAC to diagnose whether and from what direction any flow contamination issues might be expected.

Lastly, we here repeat a caution from last year: Now and again the *Sette's* navigational data (latitude – LAT – and longitude – LON) exhibit anomalous spikes. It isn't clear what causes the spikes, and of course they incur unrealistic movement (F) or poor quality (J) flags (not shown). But even though they presented again throughout 2015 they contributed only a diminutive percentage to the already small total number of flags (Figure 69). They are thus of relatively minor concern to the SAMOS team, aside from noting that any faulty navigation data may affect true wind calculation.

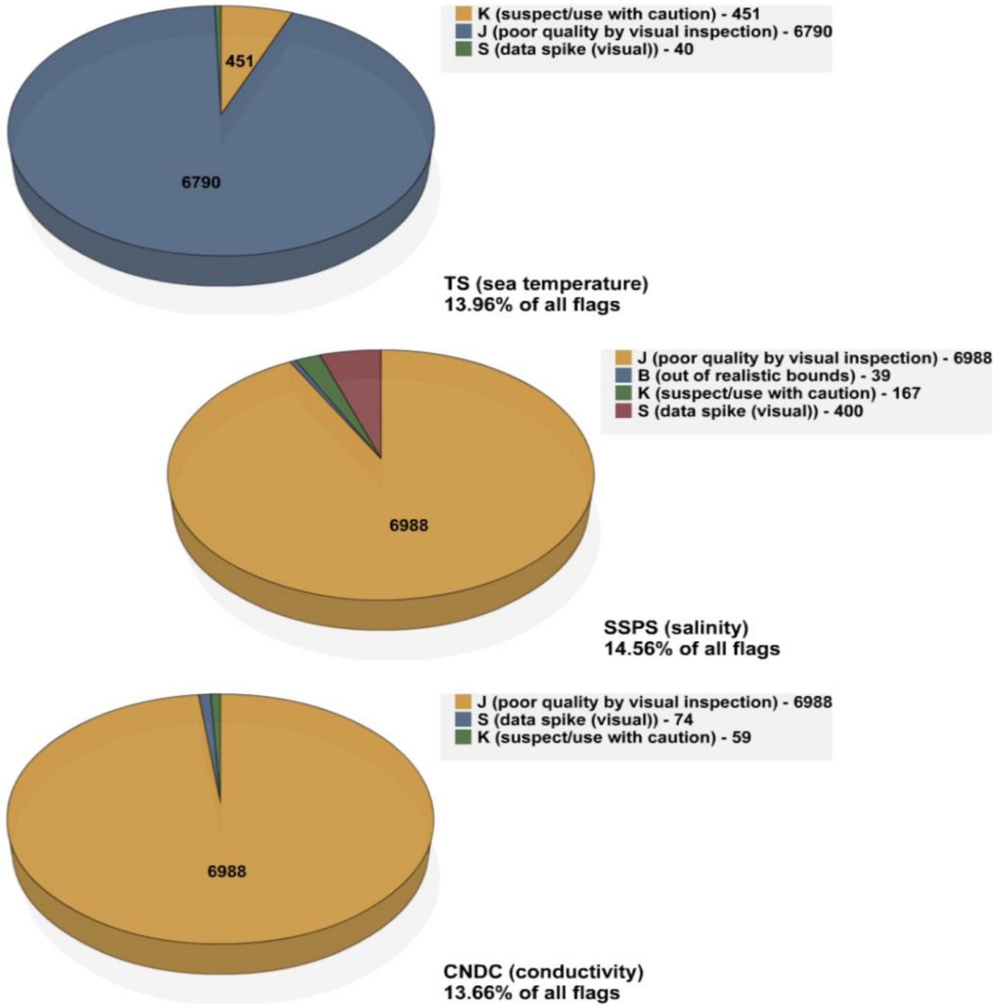


Figure 70: Distribution of SAMOS quality control flags for (top) sea temperature – TS – (middle) salinity – SSPS – and (bottom) conductivity – CNDC – for the *Oscar Elton Sette* in 2015.

Pisces

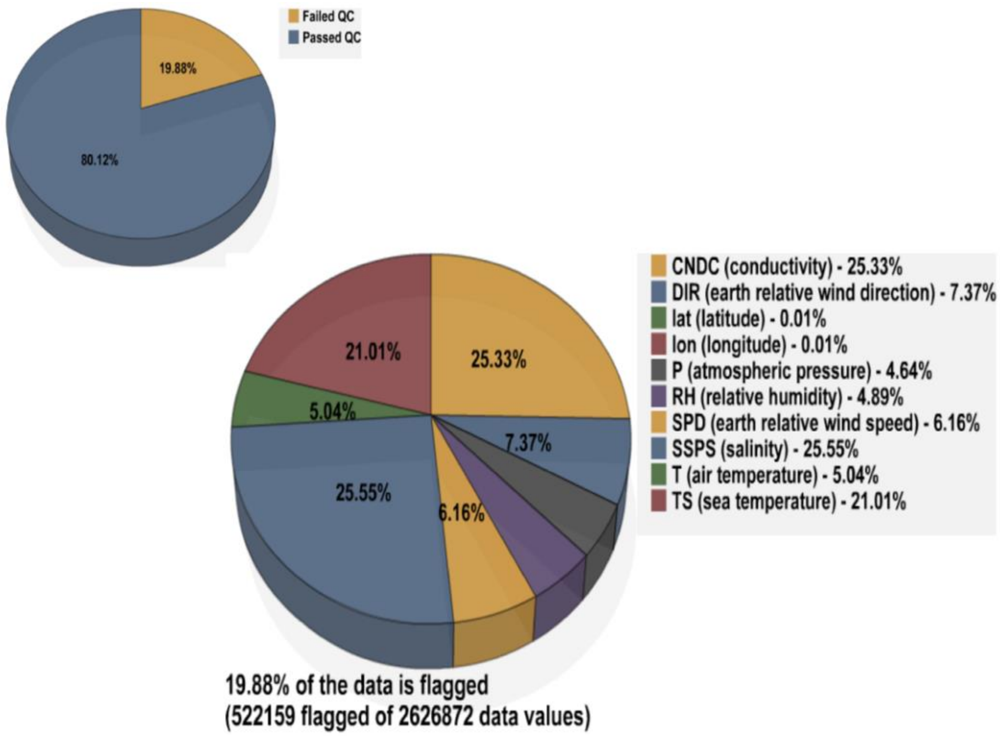


Figure 71: For the *Pisces* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Pisces* provided SAMOS data for 130 ship days, resulting in 2,626,872 distinct data values. After both automated and visual QC, 19.88% of the data were flagged using A-Y flags (Figure 71). This is over 8% higher than 2014 (11.11% total flagged).

Sea temperature (TS), salinity (SSPS), and conductivity (CNDC) were the most problematic sensors for the *Pisces* in 2015, obtaining 21.01%, 25.55%, and 25.33% of the total flags, respectively (Figure 71). Initially, there was a carry-over issue from 2014 that involved a bogus saw tooth pattern in TS with values well out of range, suspect erratic behavior in SSPS, and CNDC values that were suspected out of range (example Figure 72). Previous email attempts had not achieved a solution, so SAMOS personnel contacted the *Pisces* regarding the sea parameter data again in mid-May. Response came back that they had just turned the intake pump back on and values were expected to come back into range; however, the bogus TS/SSPS/CNDC data continued. (We acknowledge that this may have been a case of miscommunication.) Then on 8 September, after a SAMOS Vessel Update teleconference with OMAO HQ during which the *Pisces* TSG data issues were presented, meeting participant Phil White reached out to the *Pisces* on his own account and communicated the scope of the TSG issue. As a result, good communication between *Pisces* and the SAMOS DAC was reestablished and TS readings returned to normal. It was explained that (1) one of the TSG elements had been mislabeled as "internal temperature" but was actually outputting a "scan count," causing the saw tooth pattern of very large TS values, (2) there had been several potential data issues on board, including that the TSG 21 was routed through Seasave before reaching SCS (creating less reliability, and a more places for things to go wrong), TSG computers were occasionally shut down without permission, which meant the serial outputs to SCS afterwards had to be rebuilt from scratch, and cruise engineers often required the scientific seawater to be secured anytime the vessel was within 12 nautical miles of shore, and (3) the *Pisces* ET's had of late pulled back from dealing with data issues, as there was a new Chief ET on board, which may have explained any previous hazy communications. The TS base sensor was subsequently switched to the SBE 38 to avoid any potential Seasave routing issues. Additionally, a new lead contact (i.e. the Chief ET) was identified for the *Pisces* and it was determined to which email addresses all future communications should be addressed, a worthy outcome of this episode, all things considered. It isn't entirely clear what was affecting the SSPS behavior seen in Figure 72, but (2) above seems a likely place to look for explanation.

Through subsequent email communications it was also discovered on 15 September that CNDC was being reported in milliSiemens/cm. Here again this author must apologize, as when this information was cross referenced with the reported units metadata on file for CNDC I mistakenly thought we were in agreement. As it turns out, the reported units we have on file are actually Siemens/m and in fact always have been, implying the reported units actually *had* been changed without notice at some point. This oversight notwithstanding, though, the reported units appear to have reverted once again back, without notice, to Siemens/m as of 9 November, which aligns once more with the reported units we have on file. This still leaves all of the CNDC data between 9 May (the onset of the 2015 season) and 8 November flagged as either suspect (K) or poor/unusable (J), when in fact it some portion of it may be usable if a conversion of ×10 is applied. Additionally, SSPS continued to be flagged as suspect (K) between 8 September and 8 November, while the CNDC was still (erroneously) presumed under suspicion. We will carefully watch the CNDC value range once *Pisces* begins sailing in 2016 to see if any units adjustment is needed in the metadata.

All of the preceding TSG issues led to a large volume of primarily J and K flags on TS, SSPS, and CNDC (Figure 74).

The rest of the issues with *Pisces* 2015 data remain essentially unchanged from previous years. We recount those issues here:

Pisces wind data is among the least reliable of vessels reporting to SAMOS. Earth relative wind speed (SPD) and direction (DIR) received a combined ~13% of the total flags (Figure 71). Most of the flags applied to earth relative wind data were caution/suspect (K) flags (not shown). This continually appears to be an airflow distortion/obstruction issue, originating at multiple platform relative wind directions. Several digital images of *Pisces* sensors do exist at SAMOS; however, it is not entirely clear in the images from which wind sensor SAMOS receives its data (the *Pisces* has several wind sensors). Without knowing this for a certainty, definitively diagnosing the issue with the wind data will be impossible.

Air temperature (T), relative humidity (RH), and atmospheric pressure (P) exhibit similar flow distortion behavior to DIR and SPD (flag breakdown not shown) and picked up a further ~14% combined of the total flags in 2014 (Figure 71). It appears in the digital imagery as though the T, RH, and P sensors, at least, are in a potentially problematic location very close to the exhaust stack structure. This could certainly be a culprit of flow distortion where those three sensors are concerned; stack exhaust could also potentially interfere with those sensors' readings. Additionally, the pressure data continue to exhibit mysterious downward "steps" from time to time that appear unrelated to either platform relative wind direction or platform speed (example Figure 73). If the mysterious P steps issue still persists in 2016, attempts will again be made to contact *Pisces* personnel and get to the bottom of it.

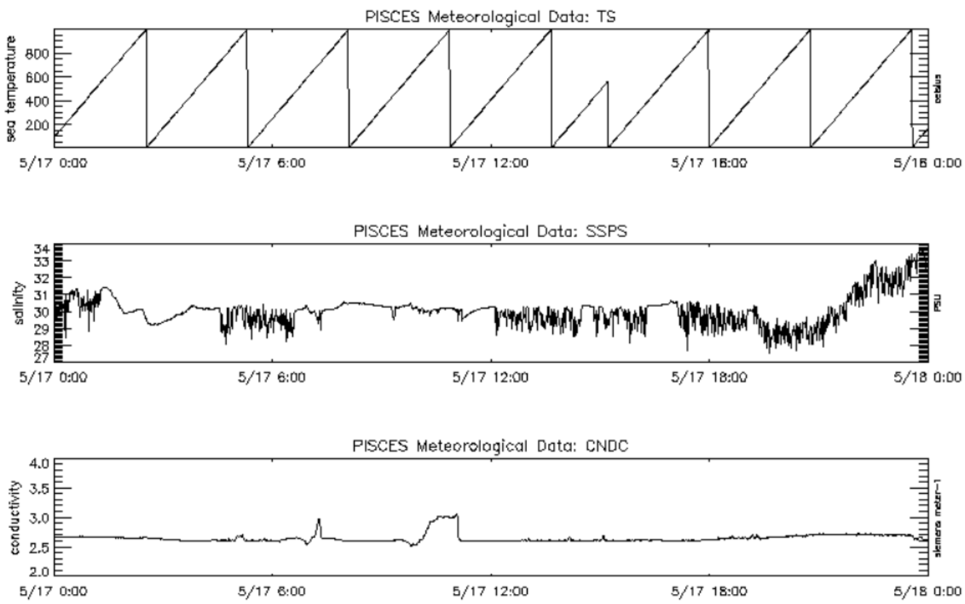


Figure 72: *Pisces* SAMOS (top) sea temperature – TS – (middle) salinity – SSPS – and (bottom) conductivity – CNDC – data for 17 May 2015. The data represented by TS was actually a "scan count." Note also the erratic, unexplained behavior in SSPS and the suspicious range of CNDC values.

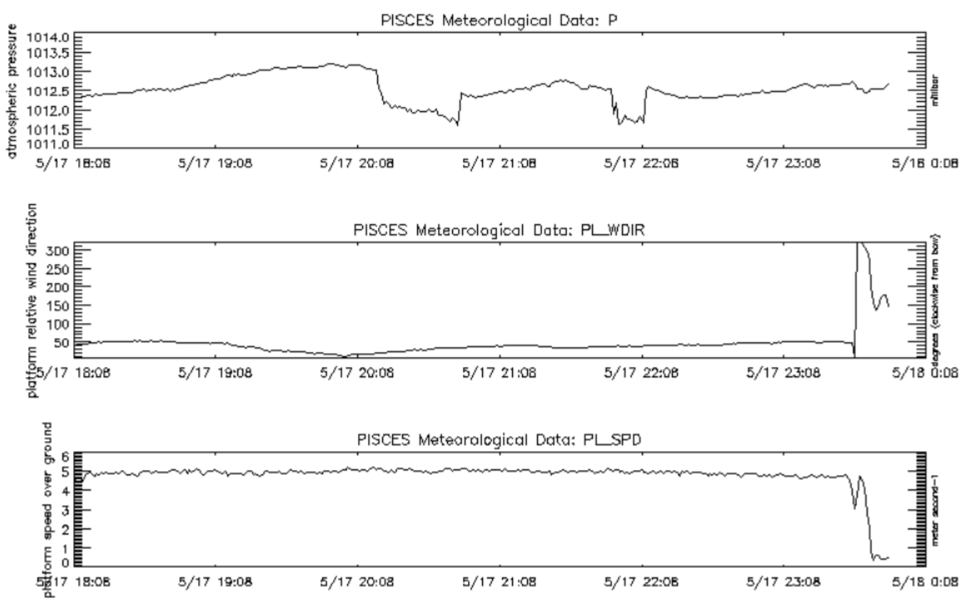


Figure 73: *Pisces* SAMOS (top) atmospheric pressure – P – (middle) platform relative wind direction – PL_WDIR – and (bottom) platform speed – PL_SPD – data for 17 May 2015. Note the unexplained steps in P, which seems to bear no correlation with either PL_WDIR or PL_SPD.

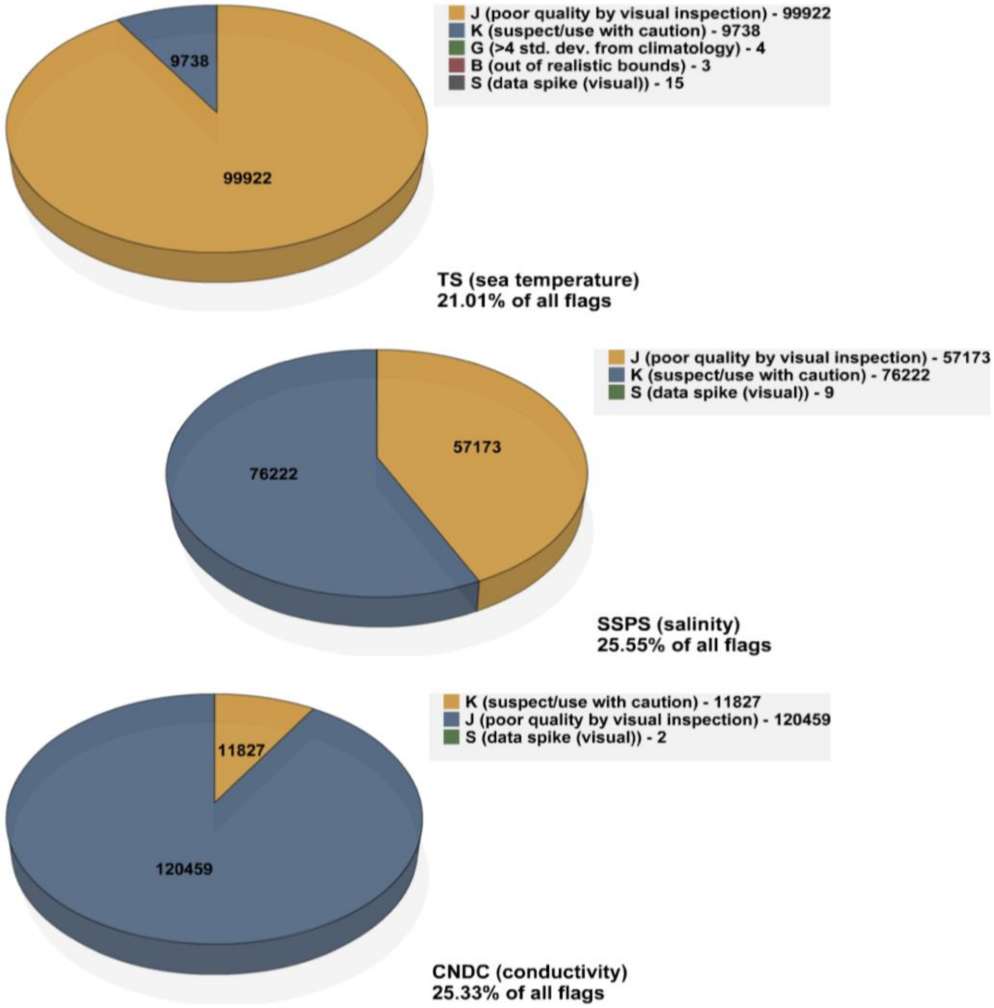


Figure 74: Distribution of SAMOS quality control flags for (top) sea temperature – TS – (middle) salinity – SSPS – and (bottom) conductivity – CNDC – for the *Pisces* in 2015.

Rainier

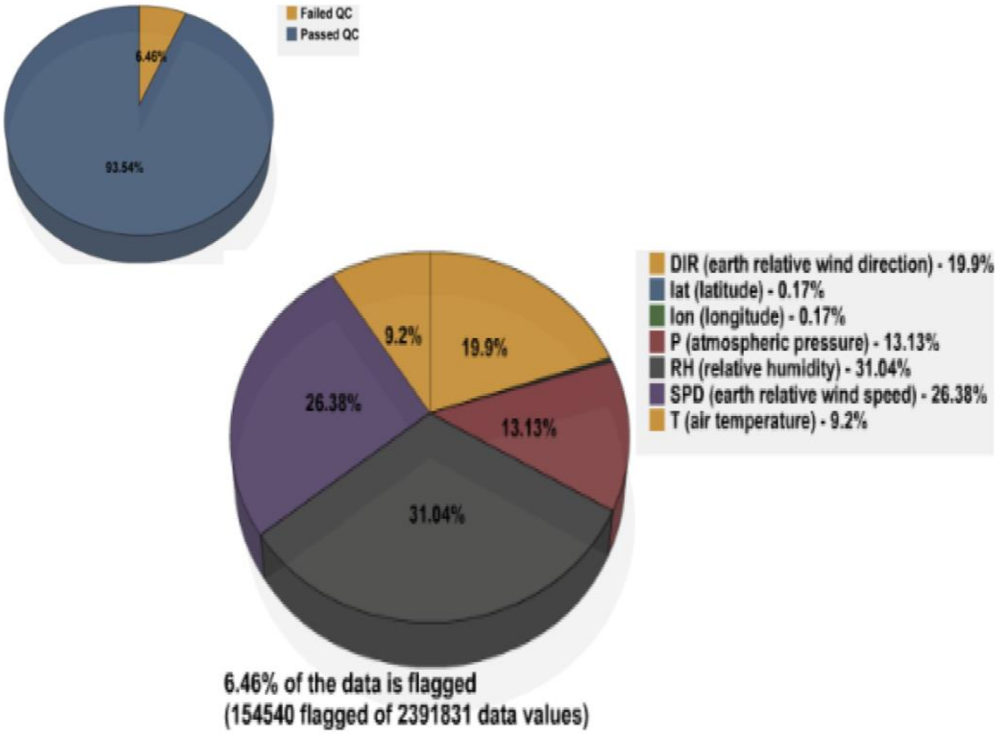


Figure 75: For the *Rainier* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Rainier* provided SAMOS data for 137 ship days, resulting in 2,391,831 distinct data values. After both automated and visual QC, 6.46% of the data were flagged using A-Y flags (Figure 75). This is about a one and a half percent improvement over 2014 (8.02% total flagged) and inches the *Rainier* closer to the < 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

The first item of note, not reflected in the flag analysis, is that no sea parameter data (i.e. sea temperature – TS, salinity – SSPS, conductivity – CNDC) were reported in 2015. The designators for those variables remain in the data files, but there are no values reported at any time. This was also the case for the period 4 July 2013 – 16 May 2014. If there has been a specific reason for this lack of thermosalinograph data, it is not known or is at least not recalled as of the writing of this report. We note, too, that the situation has not changed as of the start of *Rainier's* 2016 season: designators appear in the files but no data are recorded. We are aware the *Rainier* is a hydrographic survey ship, with a mission that does not focus on underway meteorological or oceanographic data; however, these data are valued by secondary science users and should receive more attention. It is possible the TSG data were deemed of lower quality and were removed from the SCS SAMOS data package. (In fact, the omission of the *Rainier's* TSG data in 2015 likely led to the apparent improvement in her total flag percentage, as TS, SSPS, and CNDC claimed the largest portion of last year's total flags.) Or the TSG may not even have been in use at all in 2015. In any case, if at any time there is robust TSG data available to report we do wish to receive it.

The main issue with *Rainier's* reported data is a rather pronounced flow distortion problem. Unfortunately *Rainier's* sensor metadata is still insufficient for us to be able to pinpoint the problem (see Annex C); we do not have any clue about where the sensors are located, and there is no adequate digital imagery available to show what structures might be interfering with the flow over the ship. But we do know that all of the meteorological parameters (atmospheric pressure – P, air temperature – T, relative humidity – RH, earth relative wind direction – DIR, earth relative wind speed – SPD) come from an Airmar weather station. These all-in-one weather stations typically do not produce the best underway data to begin with. (Again, we note *Rainier* is designated a hydrographic survey vessel, not a science vessel.) Steps are readily seen in all of the met parameters (example Figure 76), prompting a sizable volume of mainly caution/suspect (K) flags on all of the parameters (Figure 77). In addition, RH occasionally virtually stagnates at 100% for long periods (several days or more), even while various verification data (e.g. buoys, other nearby vessels) do not support the readings. This again is probably related to the lower quality of the Airmar – the RH sensor is probably getting wet/saturated with condensation. While relocating the Airmar might alleviate some of the flow distortion problems mentioned above, we acknowledge there would likely still be some data issues; namely, P would probably still suffer from the lack of a Gill-type pressure port, RH might still condense easily, and all of the data would probably still not be superlative, simply because the Airmar isn't capable of producing as robust data as we would like. All of this said, 6.46% total flagged still is not that bad of a showing, being only about 1.5% away from "good data."

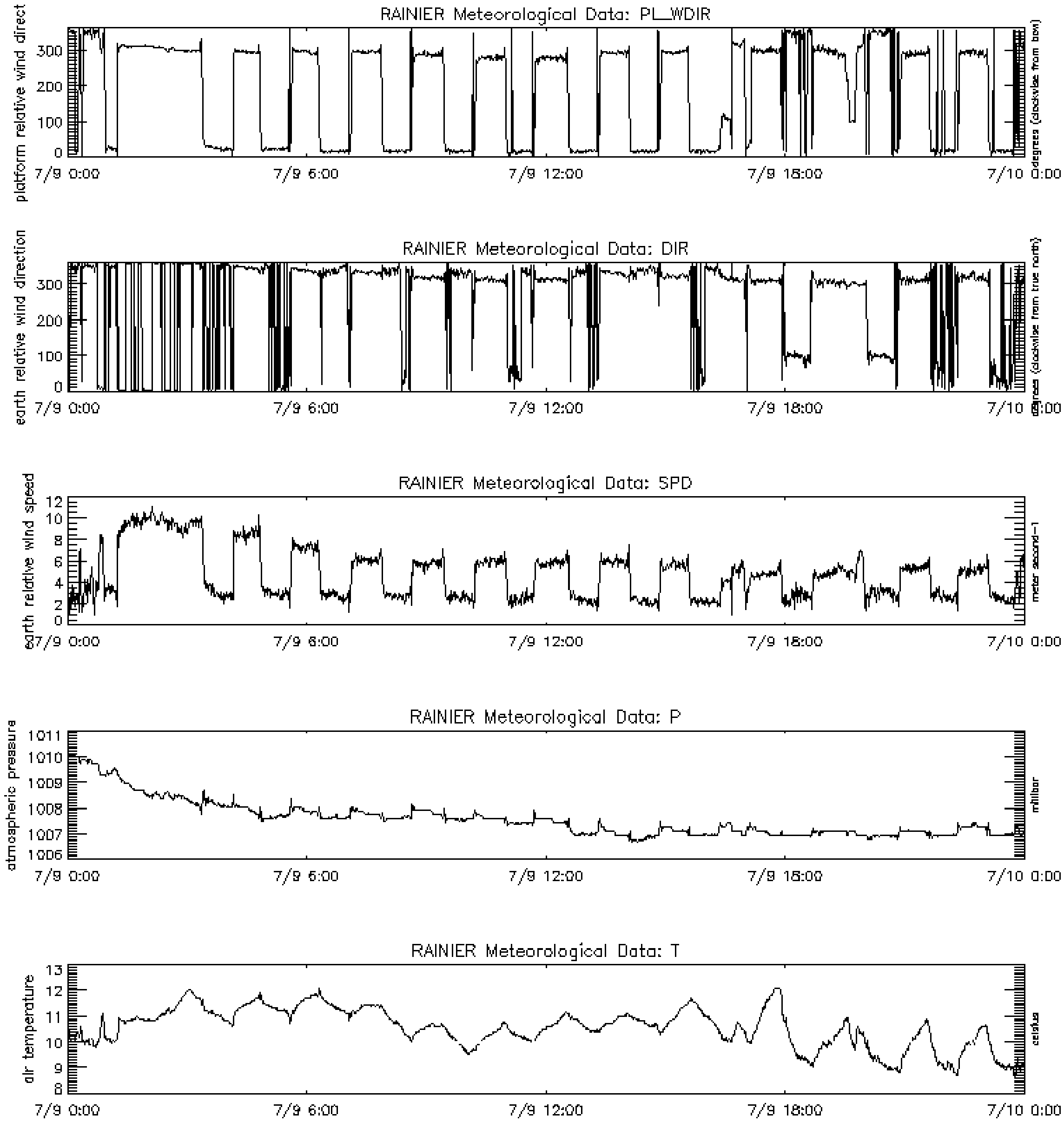


Figure 76: *Rainier* SAMOS (first) platform relative wind direction – PL_WDIR – (second) earth relative wind direction – DIR – (third) earth relative wind speed – SPD – (fourth) atmospheric pressure – P – and (last) air temperature – T – data for 9 July 2015. Note the step behavior in all DIR, SPD, P, and T. RH not shown here, as it read constant 100% on this particular day, but RH may also exhibit these steps.

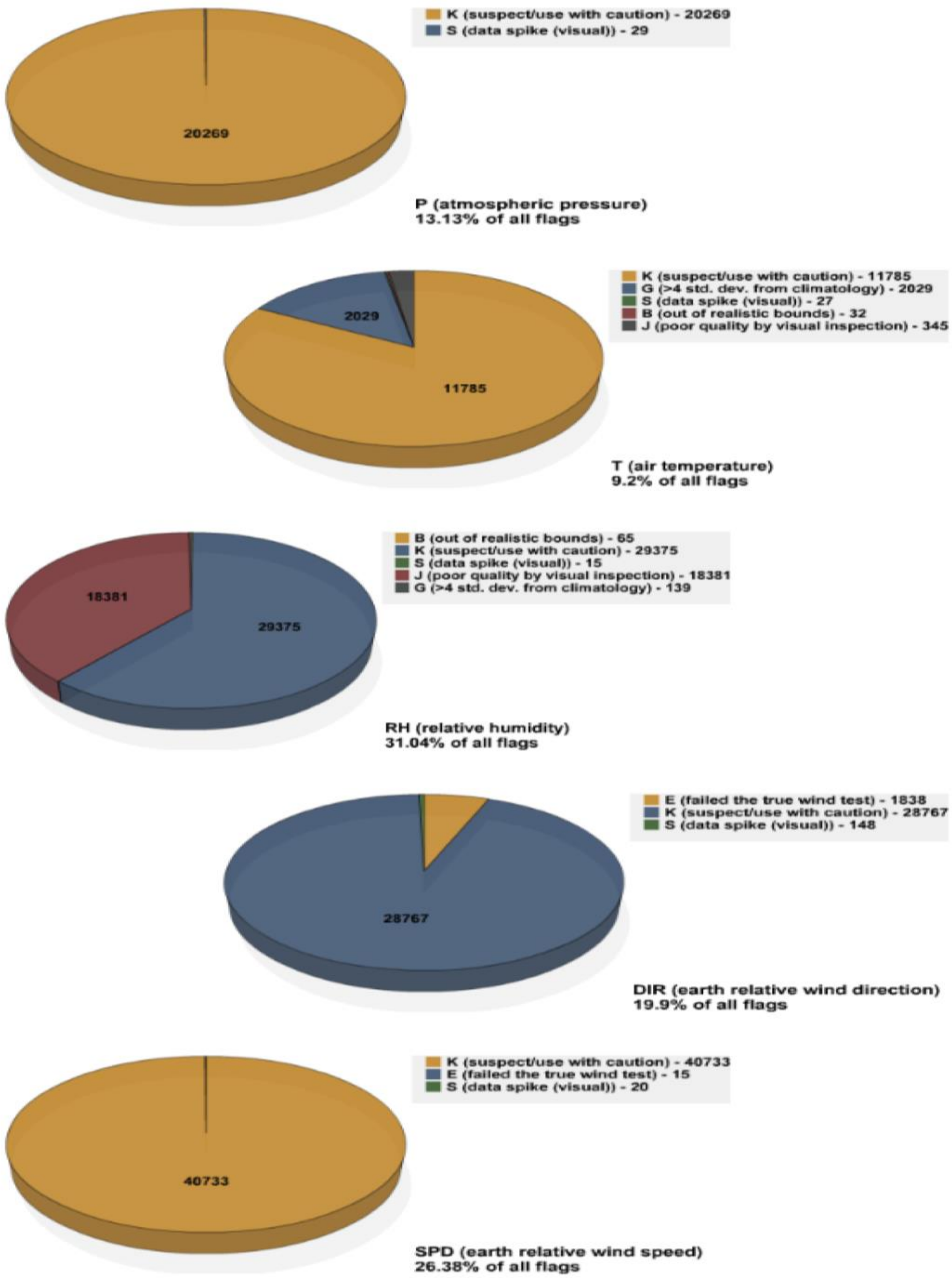


Figure 77: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD for the *Rainier* in 2015.

Reuben Lasker

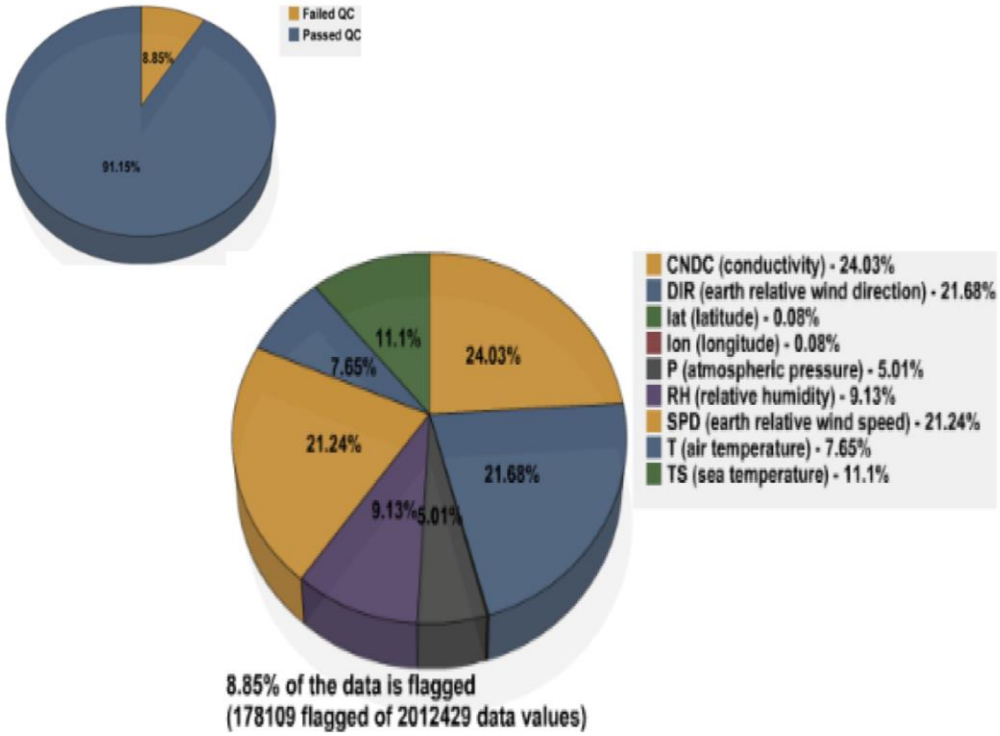


Figure 78: For the *Reuben Lasker* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Reuben Lasker* was first actively recruited to the SAMOS initiative on 8 July 2015, and afterwards provided SAMOS data for 106 ship days, resulting in 2,012,429 distinct data values. After both automated and visual QC, 8.85% of the data were flagged using A-Y flags (Figure 78).

Conductivity (CNDC) took the biggest portion of the total flags, holding ~24% (Figure 78). Upon inspection, these were mainly caution/suspect (K) flags applied when it appeared the thermosalinograph intake pump was turned off (echoed in sea temperature – TS – as well) and some poor quality (J) flags blanket-applied during the period 9-25 July, when CNDC read exactly 0 Siemens/m (see flags, Figure 81). As the sea temperature reported missing values for the duration of the July event, and as all TSG data afterwards ceased being transmitted until 9 September, we suspect there was simply a startup hiccup with the TSG data, being as the *Lasker* was a new SAMOS vessel at the time. Also, in the course of composing this report, it has come to light that the *Lasker's* salinity (SSPS) data were not processed on our end in 2015, though the data appears in her SAMOS files under seemingly the correct designator. We have not been able to determine why the data did not process, and we do regret the oversight, but we note that as of 2016 *Lasker* SSPS is processing normally. If any subsequent investigation does reveal the cause of the 2015 impediment and we are able to correct it we may do so and reprocess, although we note it would unfortunately be too late to apply visual QC to the 2015 SSPS as we currently have no way to add new data to files that have already reached the research quality level; the SSPS data would have to exist in additional intermediate level files only.

The main issue with *Lasker's* data really seems to be varying degrees of flow contamination acting on the meteorological sensors (atmospheric pressure – P, air temperature – T, relative humidity – RH, earth relative wind direction – DIR, earth relative wind speed – D). This is common on most vessels. When the wind is from certain vessel-relative directions, it may be blocked or altered by structures in its path at particular locations, and this frequently causes "steps" to appear in the data of any affected sensor. Additionally, effects of ship heating or stack exhaust may become an issue from certain vessel-relative wind directions.

Steps are particularly evident in T and RH when the vessel relative winds are from astern and perhaps slightly to port (example Figure 79). This case appears similar to classical cases of stack exhaust contamination, and these steps generally receive caution/suspect (K) flags (Figure 81). DIR and SPD also exhibit steps, which are also K-flagged (Figure 81), though the affected vessel-relative winds are perhaps a bit more difficult to pin down. We note that we have no location measurements nor digital imagery of the vessel or any of the sensors in our metadata, so it is not currently possible to accurately diagnose any flow contamination issues. We hope that in 2016 *Lasker's* metadata can be augmented so we might make sensor placement recommendations and improve her data enough to nudge her under the < 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

Additionally, for the first month of her SAMOS data *Lasker's* DIR and SPD appeared suspicious, often mirroring the shape of platform heading or platform speed data and appearing in poor agreement with verification mediums (e.g. buoy data, satellite wind data) (Figure 80). This engendered an additional portion of K and sometimes J flagging of DIR and SPD (Figure 81), leaving DIR and SPD with a larger portion of the total flags than either P, T, or RH (Figure 78). Again, the time frame for this event suggests this may simply have been a spin-up glitch – perhaps the true wind calculation was initially incorrect – and afterwards the data behaved normally.

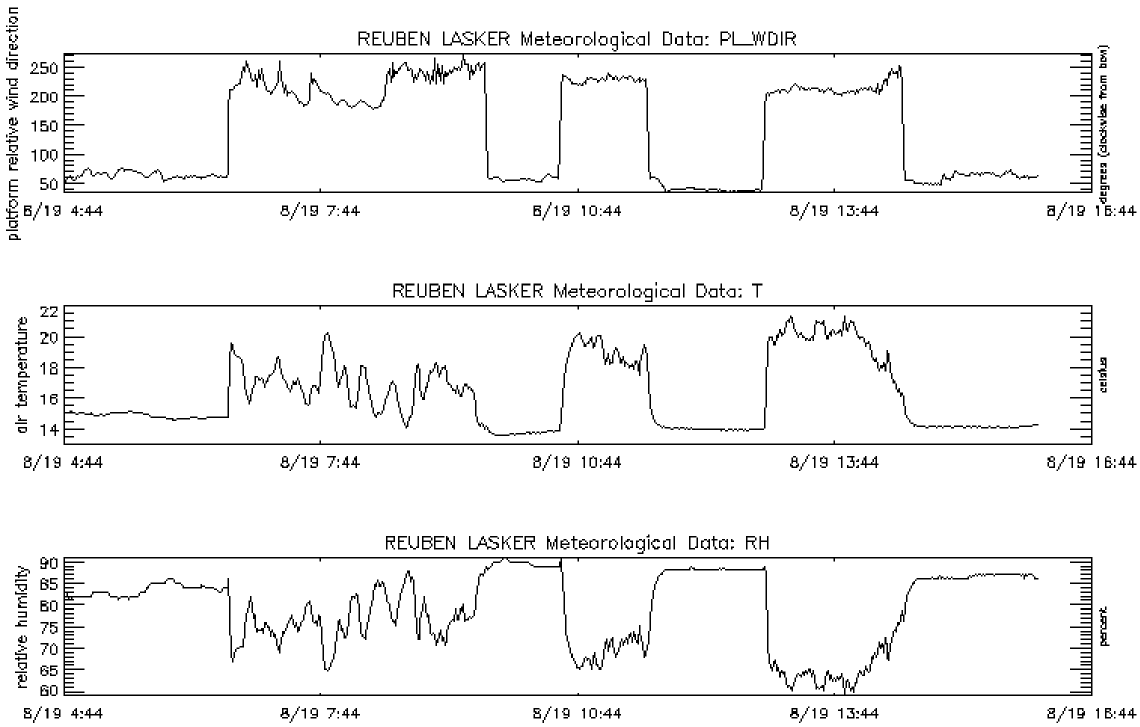


Figure 79: *Reuben Lasker* SAMOS (top) platform relative wind direction – PL_WDIR – (middle) air temperature – T – and (bottom) relative humidity – RH – data for 19 August 2015. Note steps in T/RH when PL_WDIR is from astern.

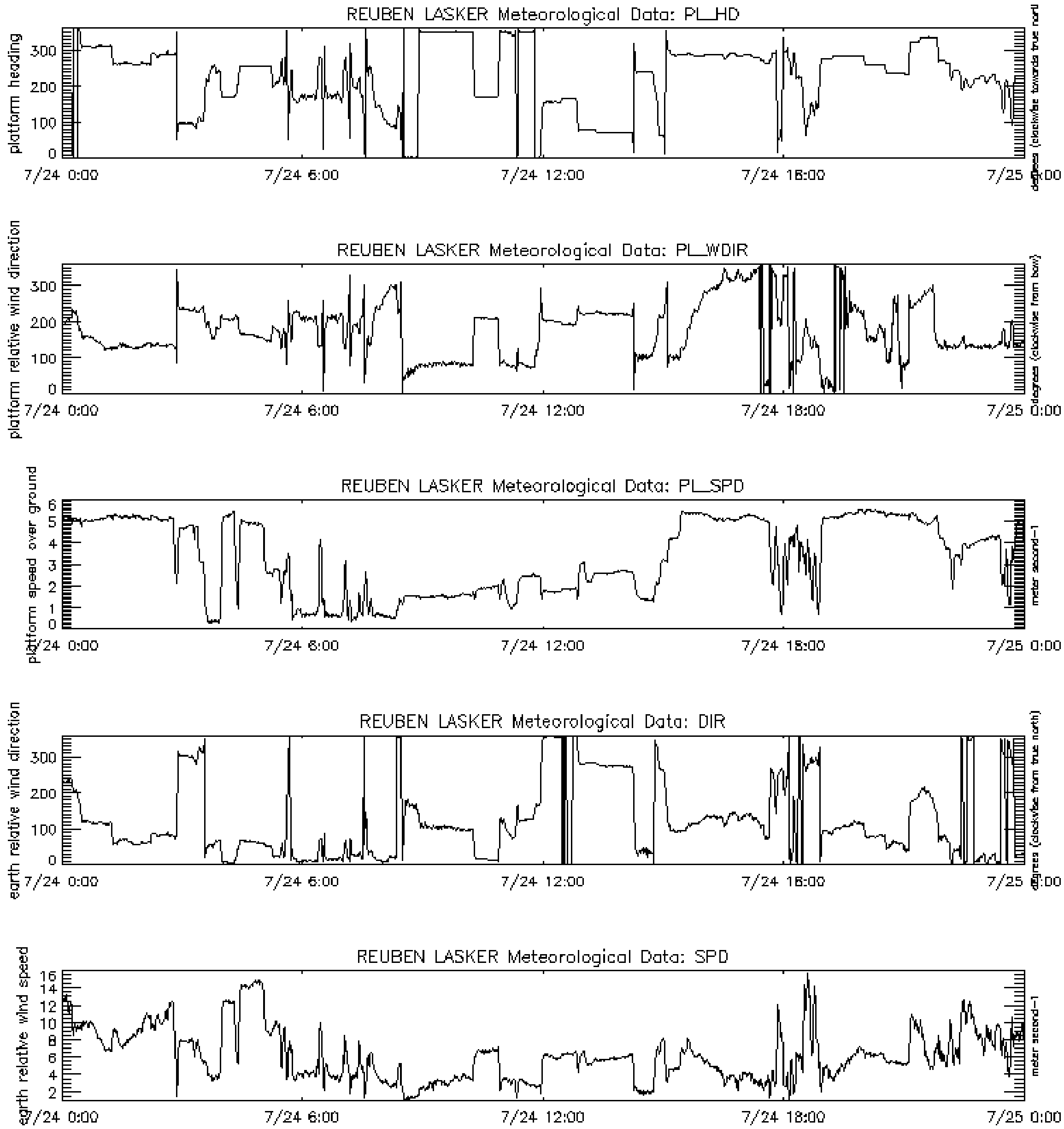


Figure 80: *Reuben Lasker* SAMOS (first) platform heading – PL_HD – (second) platform relative wind direction – PL_WDIR – (third) platform speed – PL_SPD – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 24 July 2015. Note DIR/SPD appearing to echo PL_HD/PL_SPD, respectively, in many cases.

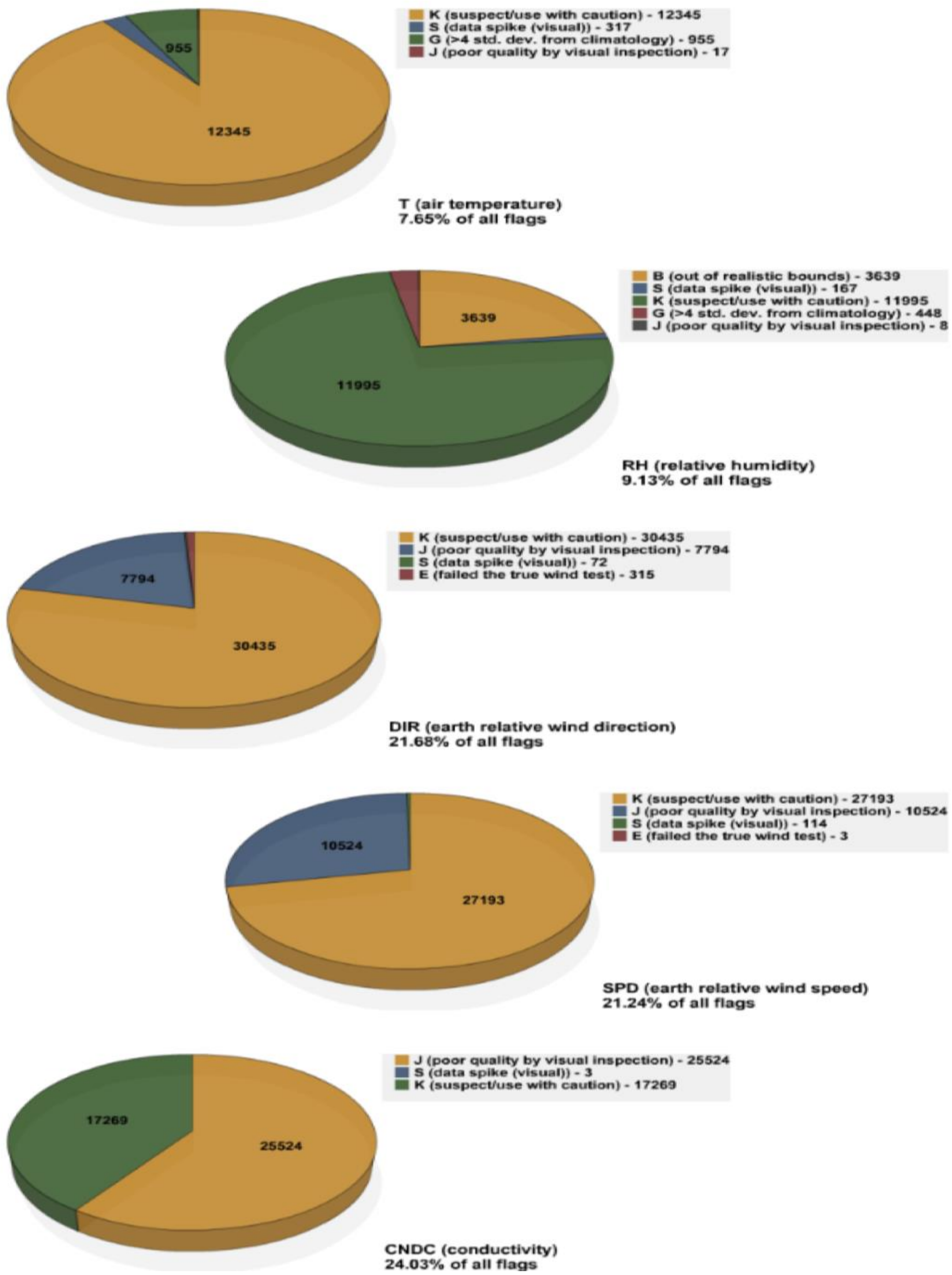


Figure 81: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) relative humidity – RH – (third) earth relative wind direction – DIR – (fourth) earth relative wind speed – SPD – and (last) conductivity – CNDC – for the *Reuben Lasker* in 2015.

Ronald H. Brown

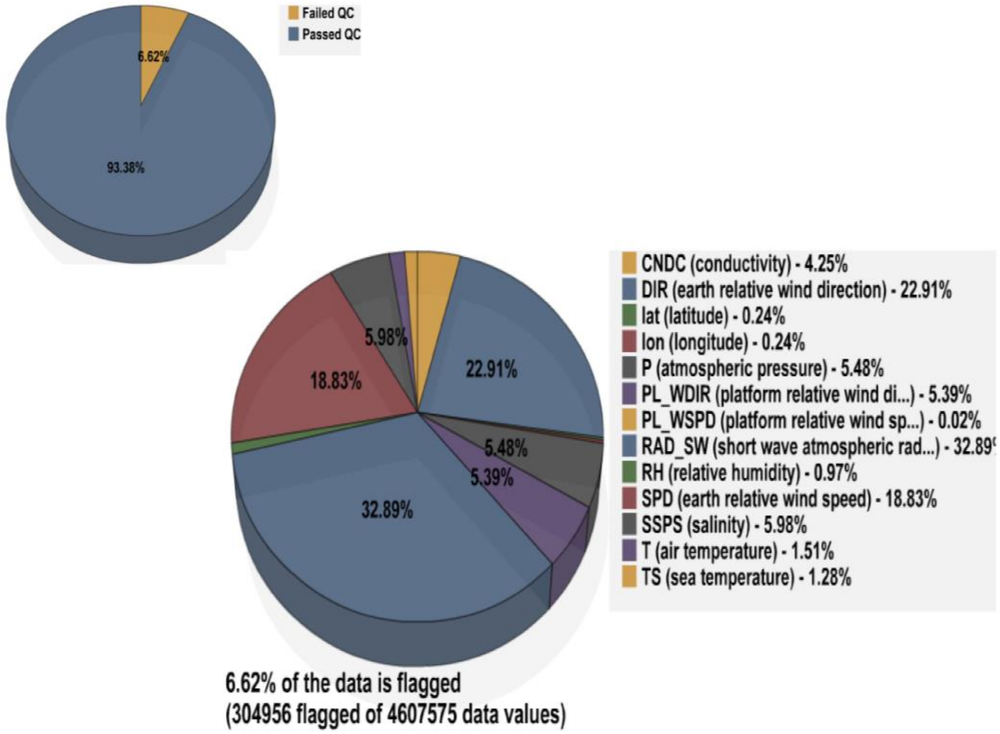


Figure 82: For the *Ronald H. Brown* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Ronald H. Brown* provided SAMOS data for 202 ship days, resulting in 4,607,575 distinct data values. After both automated and visual QC, 6.62% of the data were flagged using A-Y flags (Figure 82). This is essentially unchanged from 2014 (6.95% total flagged).

At first glance the biggest issue with the *Ron Brown* data would appear to be the short wave atmospheric radiation (RAD_SW) parameter, holding a third of the total flags for 2015 (Figure 82). However, the flags applied to RAD_SW were overwhelmingly out of bounds (B) flags (Figure 85), applied to readings just slightly below zero as commonly occurs with these sensors at night (see 3b for details).

Rather, the main issue involves the earth relative wind parameters, both direction (DIR) and speed (SPD). DIR took on nearly 23% of the total flags, and SPD over 18% (Figure 82). A good deal of these were caution/suspect (K) and failing the true wind calculation (E) flags (Figure 85). The anemometer being reported to SAMOS appeared to suffer from either vessel-relative air flow contamination or perhaps faulty true wind calculation, as SPD and to a lesser degree DIR often exhibited steps concomitant with noisy platform relative wind direction (PL_WDIR) data and/or steps in the vessel speed. There was also some automatic E flagging of DIR in relation to the noisy platform relative wind direction (example Figure 83).

A separate wind issue began late in the year (roughly around late November) and persisted into 2016, whereby DIR was found mainly disagreeing starkly with archived satellite wind fields, with no clear indication why (example Figure 84). SPD also often appeared suspect as compared to the satellite winds. At first this prompted a lot of K flagging of both DIR and SPD, and later PL_WDIR as well. Then on 8 December PL_WDIR flatlined at 0° and stayed flatlined through 15 December, the last day of data in 2015. As a result, DIR essentially mimicked the shape of the platform heading (though with an apparent shift) and both DIR and PL_WDIR were assigned J flags, while SPD continued to receive K flags (Figure 85, PL_WDIR not shown), as comparisons to satellite-based wind speeds remained somewhat inconclusive. We reiterate that the issue more or less persisted into 2016 (PL_WDIR was eventually restored, though with a now 90° apparent shift) and note that the *Brown* was contacted multiple times regarding the winds, without much initial response or success. We also note, though, that as of the writing of this report the wind issues are finally under heavy scrutiny by a visiting scientist from NOAA's Earth Systems Research Laboratory.

Finally, there were a few short known cases of unreliable sea temp, salinity, and conductivity data, owing to both choppy sea conditions and then later some issues with the sensors, all of which resulted in some minor flagging of each of the sea parameters (not shown). This isn't really uncommon, but what is noteworthy is the fact that in each case vessel technicians immediately and clearly communicated the situation to SAMOS personnel via email. This kind of heads-up notification is always very much appreciated.

We also received notification from the vessel that they were unable to transmit any data 27-28 February, owing to their location in the Mexican EEZ and their CO declaring they could not transmit any data until they left the region. Again, this occurs with other vessels occasionally as well, and we are grateful to have the explanation for the lack of data on record.

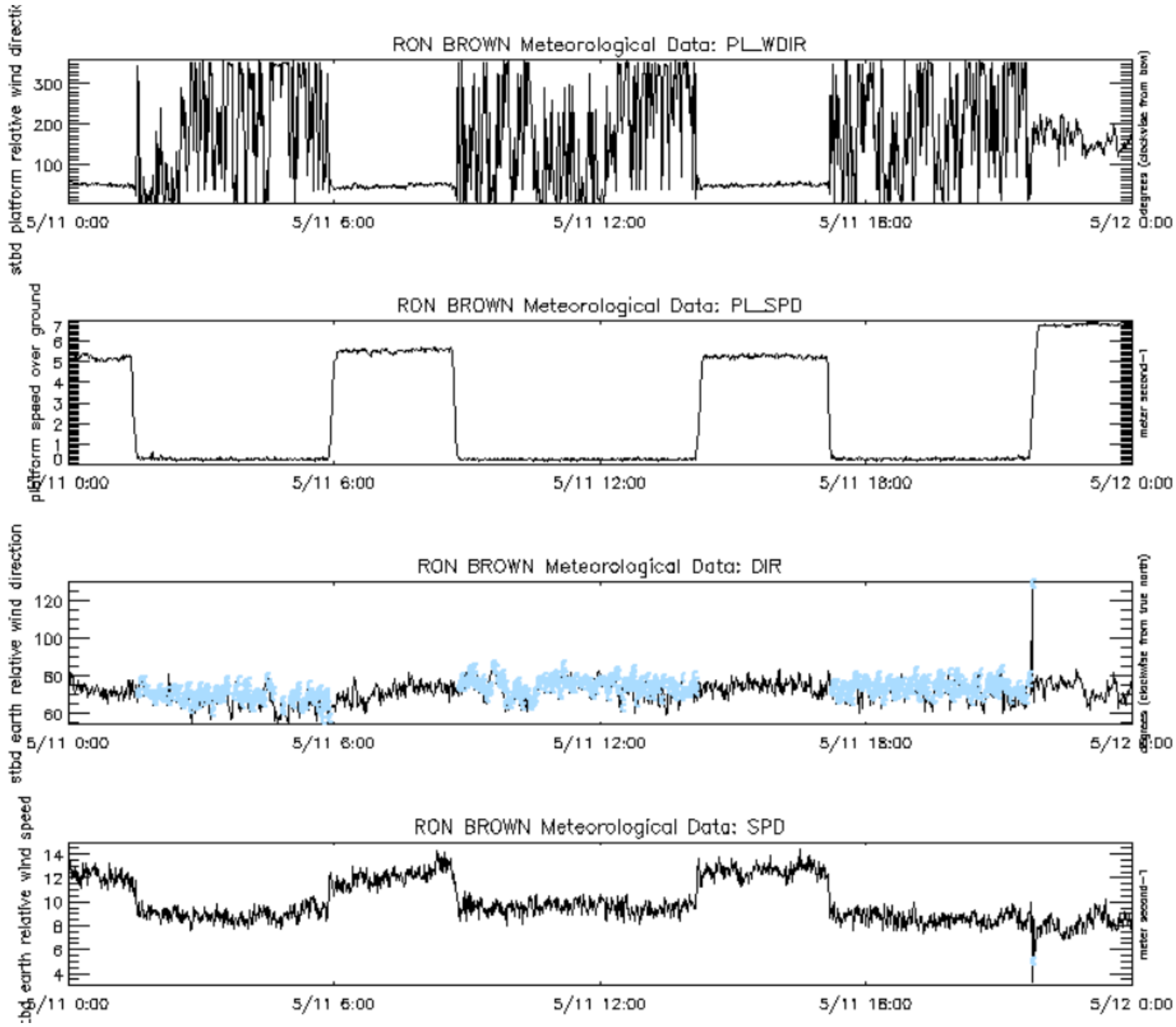


Figure 83: *Ron Brown* SAMOS (first) platform relative wind direction – PL_WDIR – (second) platform speed – PL_SPD – (third) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 11 May 2015. Note the obvious steps in SPD and the automated QC "failed the true wind test" E flags applied to DIR in conjunction with noisy PL_WDIR.

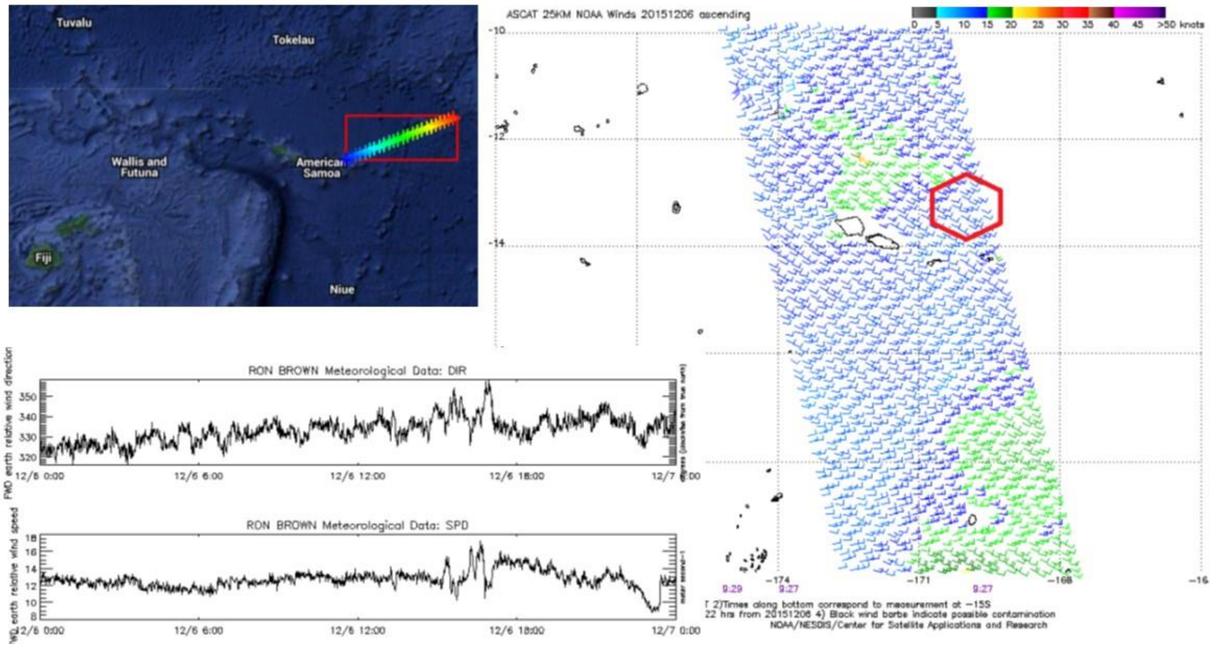


Figure 84: Composite showing (top left) vessel *Ron Brown* cruise track 6 December 2015 (from blue to red, location marked with + every 60 minutes), (bottom left) *Ron Brown* SAMOS earth relative wind direction (DIR) and speed (SPD) data for 6 December 2015, and (right) archived ASCAT 25 km NOAA wind swath at 9:27 UTC, 6 December 2015, approximate location of *Ron Brown* inside red hexagon. Note approximate 180° disagreement between SAMOS DIR and ASCAT, as well as suspect SAMOS SPD values.

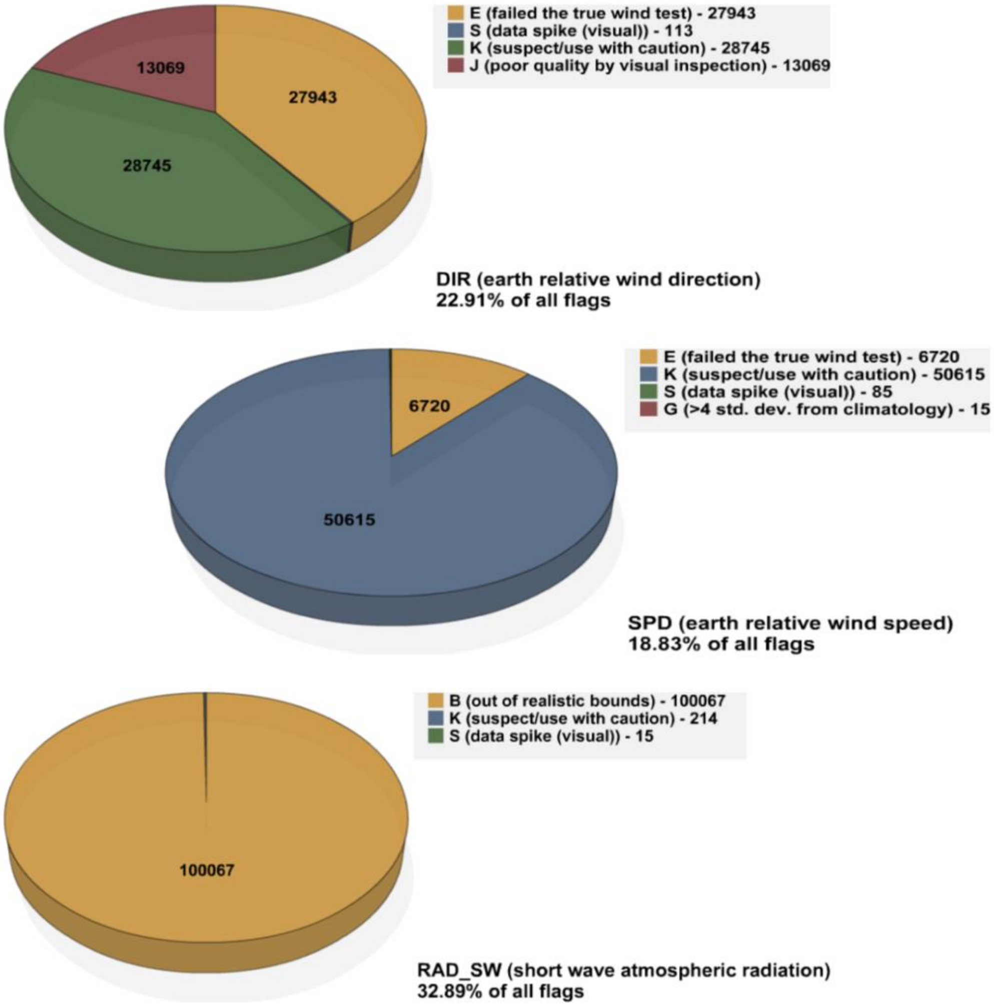


Figure 85: Distribution of SAMOS quality control flags for (top) earth relative wind direction – DIR – (middle) earth relative wind speed – SPD – and (bottom) short wave atmospheric radiation – RAD_SW – for the *Ronald H. Brown* in 2015.

Thomas Jefferson

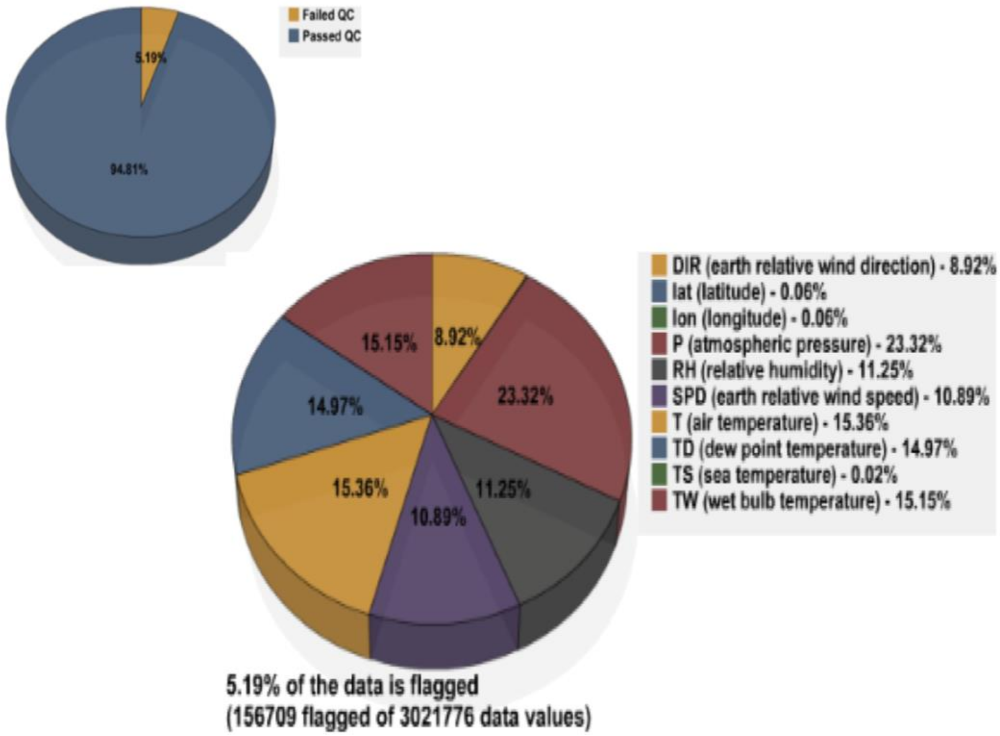


Figure 86: For the *Thomas Jefferson* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Thomas Jefferson* provided SAMOS data for 151 ship days, resulting in 3,021,776 distinct data values. After both automated and visual QC, 5.19% of the data were flagged using A-Y flags (Figure 86). This is a little less than a percentage point increase over 2014 (4.29% total flagged) and pops the *Jefferson* only just beyond the < 5% flagged cutoff regarded by SAMOS to represent "very good" data.

Echoing previous years, the main issue evident in the *Jefferson's* data appears once again to be the sensitivity of nearly all of the meteorological parameters to platform relative wind direction, and still none more so than atmospheric pressure (P), with almost a quarter of the total flags being assigned to that variable in 2015 (Figure 86). Throughout the sailing season there were a lot of steps in P, air temperature (T), and subsequently both wet bulb and dew point temperatures (TW and TD, respectively), relative humidity (RH), and the earth relative winds, both direction (DIR) and speed (SPD) (examples Figure 87), resulting in the need for a good amount of suspect/caution (K) flagging of each affected parameter (Figure 88, TW and TD not shown). It was again anticipated that these types of suspicious behavior would be the case with the *Jefferson*, as it's understood to be a hydrographic survey vessel that is not equipped with research-quality meteorological sensors. However, if digital imagery of the vessel and of the various sensor locations were provided we might be able to at least suggest more suitable locations for many of the sensors, thereby potentially cutting off some of the flagging due to air flow obstruction/distortion. At any rate, though, as data quality continues to hover so close to < 5% total flagged, there isn't an enormous amount of concern here.

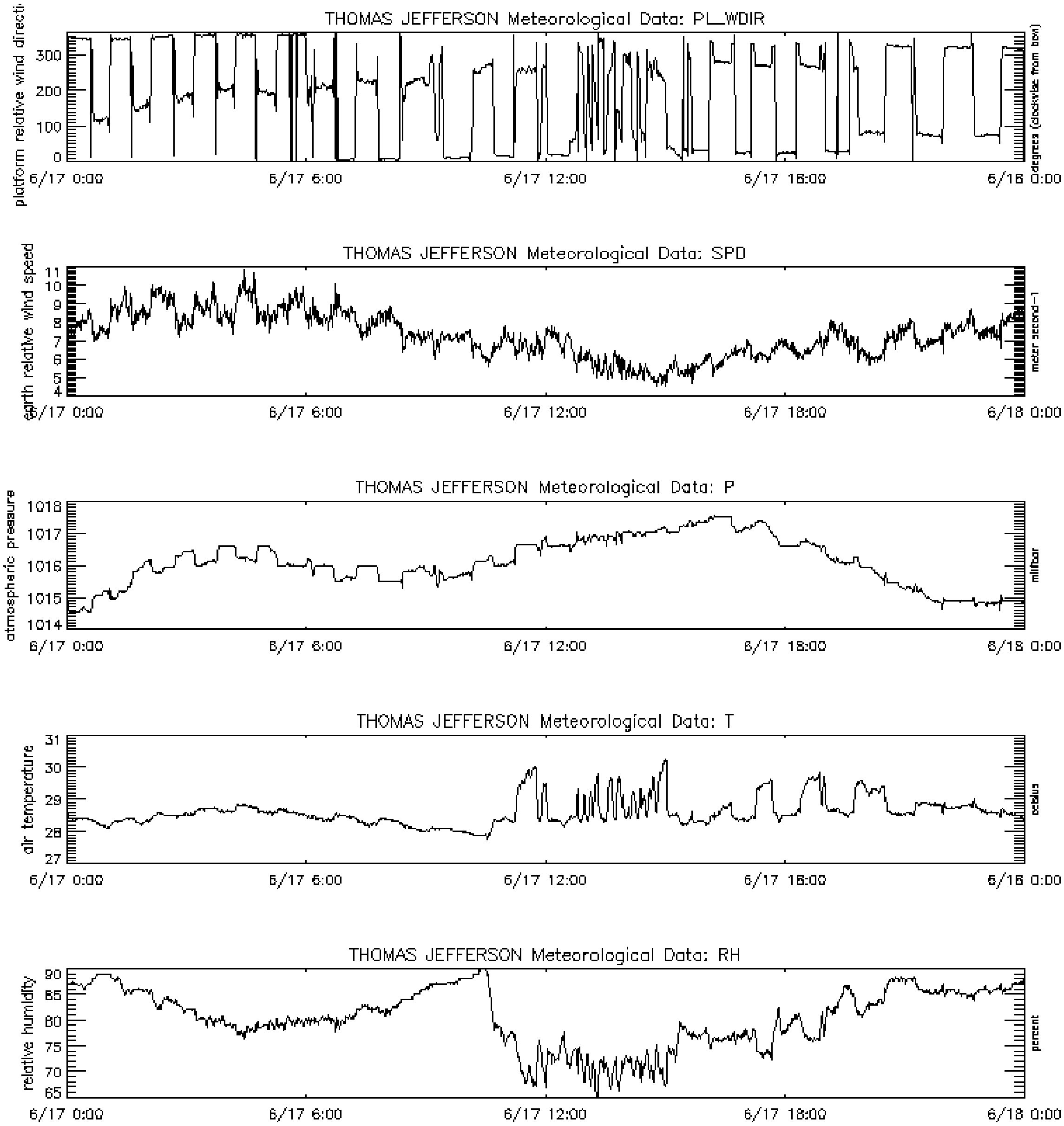


Figure 87: *Thomas Jefferson* SAMOS (first) platform relative wind direction –PL_WDIR – (second) earth relative wind speed – SPD – (third) atmospheric pressure – P – (fourth) air temperature – T – and (last) relative humidity – RH – data for 17 June 2015. Note frequent steps in the met parameters P when PL_WDIR changes.

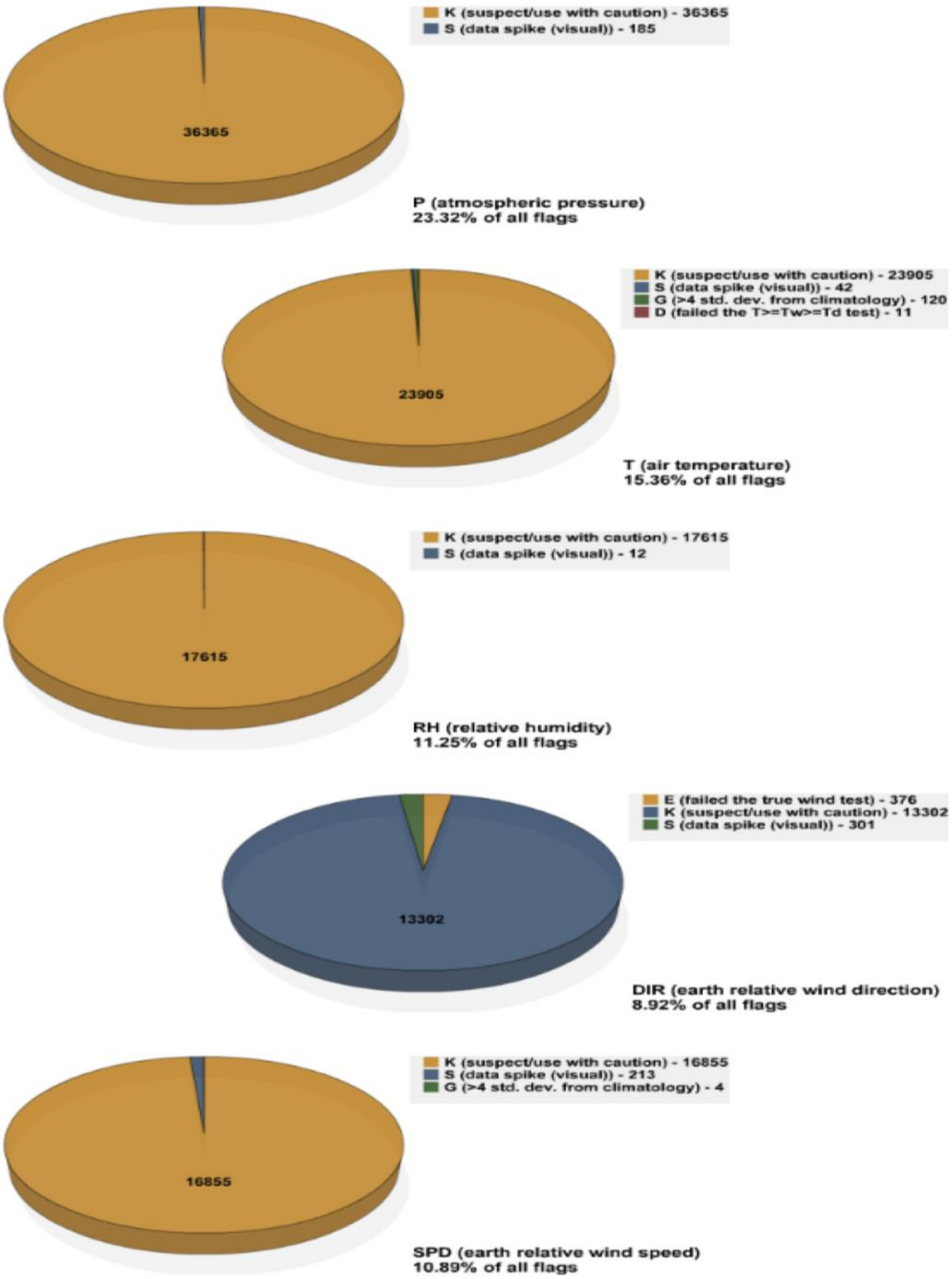
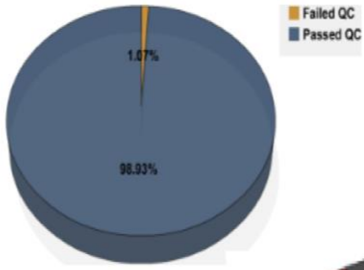


Figure 88: Distribution of SAMOS quality control flags for (top) atmospheric pressure – P – and (bottom) earth relative wind direction – DIR – for the *Thomas Jefferson* in 2015.

Laurence M. Gould



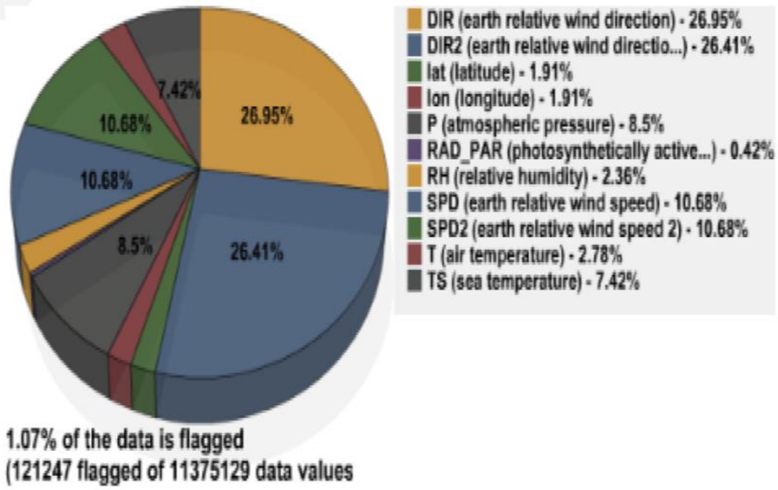


Figure 89: For the *Laurence M. Gould* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Laurence M. Gould* provided SAMOS data for 363 ship days, resulting in 11,375,129 distinct data values. After automated QC, 1.07% of the data were flagged using A-Y flags (Figure 89), which is about one percent lower than 2014 (2.29% total flagged). However, as the *Gould* does not receive visual QC this percentage is likely misleading, since visual QC is when the bulk of flags are usually applied and the *Gould* historically maintains multiple data issues, owing in large part to the massive superstructure resident on the vessel.

Realistically, with such a low total flag percentage there isn't much use in attempting to diagnose potential data issues based on the distribution of flags. There is only one item of note on record for *Gould* in 2015, an issue that was brought to light by the quick visual inspection that occurs when data files are first received. On 26 May the lead data analyst noted a "significant, unexpected, and unrealistic shift" in the previous day's atmospheric pressure (P) data, wherein P jumped from 965 mb to over 980 mb in two minutes (see Figure 90). The analyst immediately contacted *Gould* via email, requesting that if a numerical correction had been applied, the details of such correction be made clear. Word came back the same day from the vessel thanking the analyst for spotting this issue, as they do not always spot such occurrences, and also stating that they suspected frozen condensation was the culprit. On 27 May vessel technicians were able to service the barometer and they contacted the SAMOS DAC to alert us we should see a step of about 10 mb in the P data as it returned to normal, which we did see. It is interesting to note here, however, that it was a further 10 mb step *up*, implying previous P readings may have been erroneously low, for an indeterminate span of time. We are not currently funded to sort that out, unfortunately. We note that had *Gould* been a vessel that receives visual quality control, the affected P data (both during the noted event and perhaps prior) would have been flagged as suspicious (K flags) or poor quality (J flags).

In any case, this notification/resolution event underscores the importance of two-way communication between the SAMOS data analysts and the SAMOS vessel operators, especially in the case of ships that do not receive visual quality control (like the *Gould*). In many of these non-visQC cases there is nothing we can do to highlight suspicious or poor quality data, aside from making a formal note in these annual reports. But at least we can try to minimize the damage by pinpointing any issues early on and getting them resolved as quickly as possible with the help of the ships' technicians.

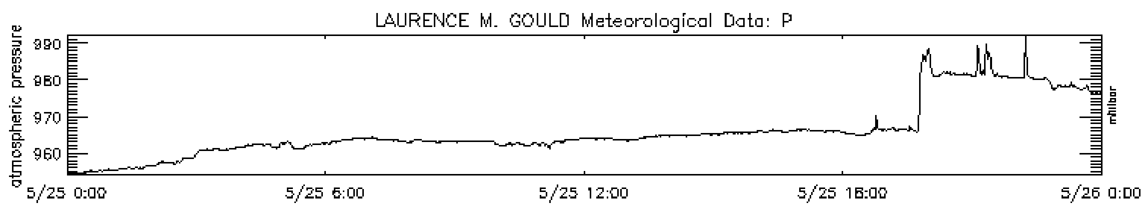


Figure 90: *Laurence M. Gould* SAMOS atmospheric pressure – P – data for 25 May 2015. Note unrealistic step after 18Z.

Nathaniel B. Palmer

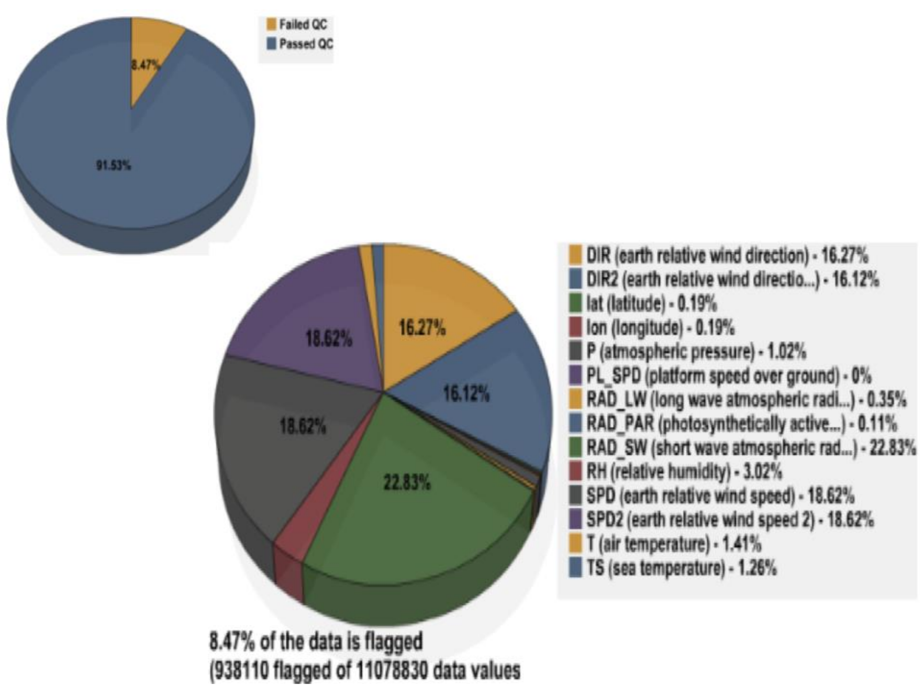


Figure 91: For the *Nathaniel B. Palmer* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Nathaniel Palmer* provided SAMOS data for 340 ship days, resulting in 11,078,830 distinct data values. After automated QC, 8.47% of the data were flagged using A-Y flags (Figure 91). This is about a five and a half percent increase over 2014 (3% total flagged). Like the *Gould*, the *Palmer* does not receive visual QC so again the percentage itself is likely to be misleading, though the increase does have implications. Visual quality control is generally when the bulk of quality control flags are applied, and the *Palmer* and *Gould* alike have a history of multiple data issues, owing in large part to the massive superstructures resident on each vessel.

There were several issues of note with *Palmer* SAMOS data in 2015, and most of these were caught by the lead analyst and are documented in email communications between the vessel and the SAMOS DAC, even if they may not all be apparent in the variable flag percentages.

Clearly one of these issues, as is evidenced in the flag percentages (Figure 91), involved the earth relative wind parameters (direction – DIR and DIR2 – and speed – SPD and SPD2). Each of these parameters received a good deal of failing the true wind test (E) flags from the autoflagger (Figure 94). There were actually two separate incidents feeding these flags: First, in early January the navigational data flatlined for several days. The lead data analyst notified vessel technicians about the issue on 7 January and then again on the 8th. It appears the issue, whatever it was, was resolved by the following day. But in the meantime all of the earth relative wind parameters endured a lot of E flagging during the period 6-8 January, as they were being calculated with corrupt nav data. Second, upon inspection it appears all platform speed data were assigned "special values" (set equal to -8888, see 3a) for the period 29 June through 25 October, which for similar reasons to the previous incident foisted another large volume of E flags on DIR, DIR2, SPD, and SPD2. Unfortunately, this data all fell within a very large batch of backlogged data (11 June through 30 October, all received on 11 November), so naturally it could not be caught in time to correct whatever the issue may have been. This event underscores the importance of ensuring timely delivery of the daily SAMOS files, enabling us to identify problems as the files come in and getting to a resolution as quickly as possible.

Another notable issue was a thermometer that appeared to have failed on 25 April, causing unrealistically low/high air temperature (T)/relative humidity (RH) values (Figure 92). This occurrence, too, was immediately communicated to the vessel via email and technicians were able to replace the sensor on 27 April, after which time T/RH data appear to have returned to normal. A good deal of out of bounds (B) flags and a small amount of greater than four standard deviations from climatology (G) flags were applied to these parameters while the problem persisted (not shown), but we note that any unflagged data portions would likely have also been flagged by visual QC and any G flags would likely have been swapped out for either caution/suspect (K) or poor quality (J) flags. Or perhaps both parameters would have just been blanket-flagged with malfunction (M) flags.

One final issue that is nowhere reflected in the flag percentages involves the short wave (RAD_SW) and long wave (RAD_LW) radiation designators being swapped without notice, such that our RAD_SW data was actually long wave, and vice versa (Figure 93). This apparent switch was noted by the lead data analyst during quick visual inspection on 10 June, and an email was sent to the vessel pointing out the likely swap. Word came back from the vessel that they'd swapped sensor configurations back in mid April, as they'd noticed an inconsistency on their end, and they wondered if that explained the June behavior. But upon inspection, evidently it did not, as RAD data in April appears correctly assigned. In any case, the apparent swap noted in June only appears to have lasted until the 11th. After a short break in daily SAMOS data transmission, the two affected RAD parameters appear to have returned to normal when data resumed on 29 June. Again, this entire incident unfortunately went unflagged, as the "erroneous" data were nevertheless within reasonable bounds.

We do note that while short wave atmospheric radiation is the parameter with the highest flag percentage, comprising 22.83% of the total flags (Figure 91), these continue to be exclusively out of bounds (B) flags (not shown) and a cursory inspection of the data reveals the issue is still likely just sensor tuning, whereby the sensor reads slightly negative values at night (details in Section 3b). This is a common occurrence, and one that really can’t be remedied without risking the precision of the large positive values expected during daytime.

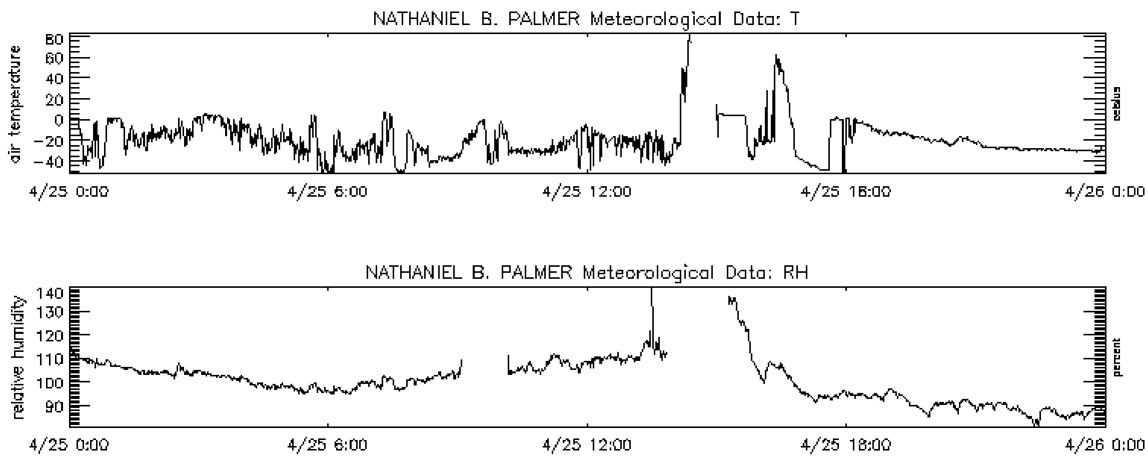


Figure 92: *Nathaniel B. Palmer* SAMOS (top) air temperature – T – and (bottom) relative humidity – RH – data for 25 April 2015. Note some unrealistically low T values and some RH values much in excess of 100%.

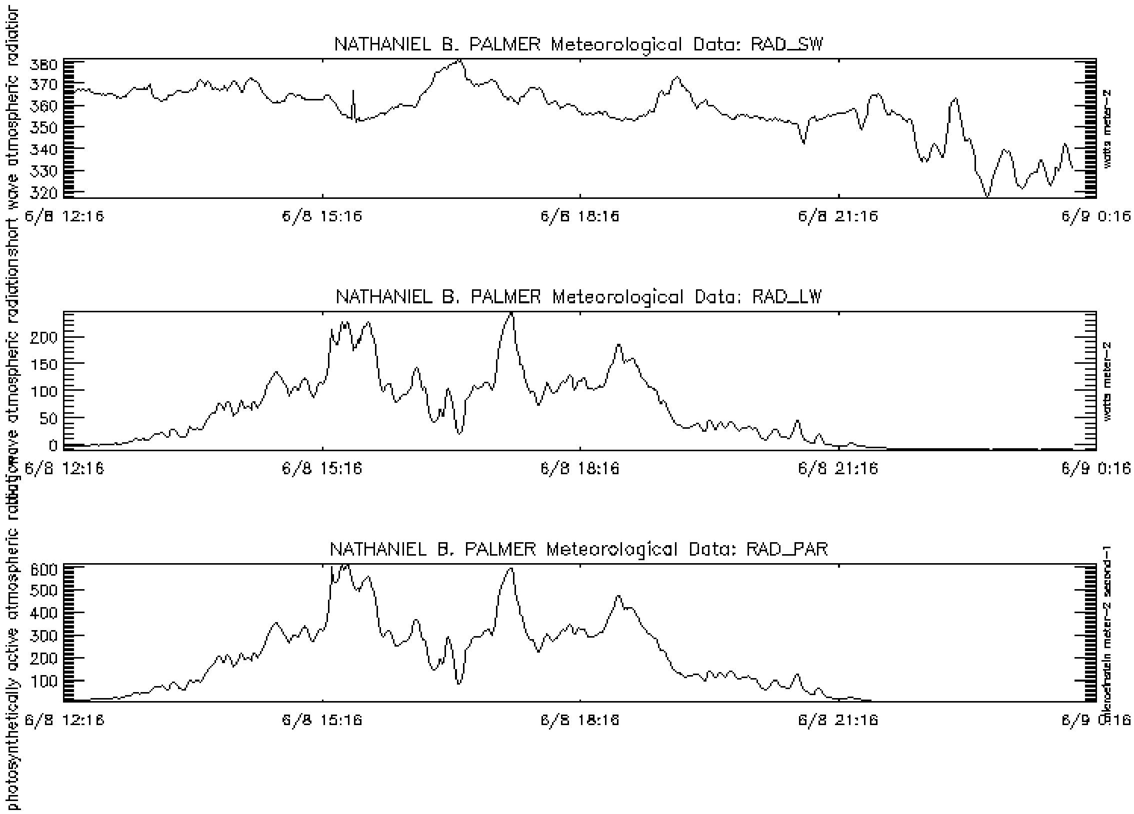


Figure 93: *Nathaniel B. Palmer* SAMOS (top) short wave atmospheric radiation – RAD_SW – (middle) long wave atmospheric radiation – RAD_LW – and (bottom) photosynthetically active atmospheric radiation – RAD_PAR – data for 8 June 2015. Note the obvious swap of RAD_SW and RAD_LW.

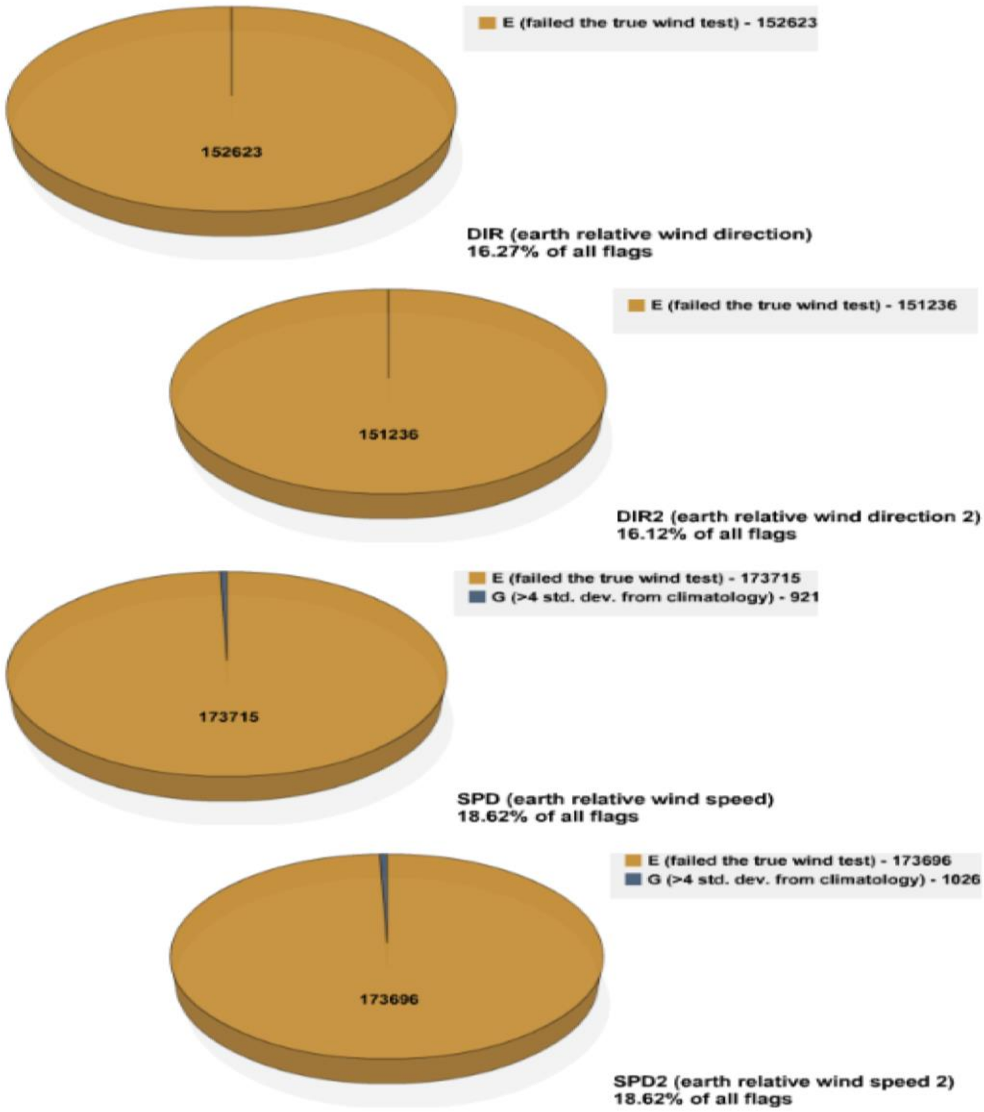


Figure 94: Distribution of SAMOS quality control flags for (first) earth relative wind direction – DIR – (second) earth relative wind direction 2 – DIR2 – (third) earth relative wind speed – SPD – and (last) earth relative wind speed 2 – SPD2 – for the *Nathaniel B. Palmer* in 2015.

New Horizon

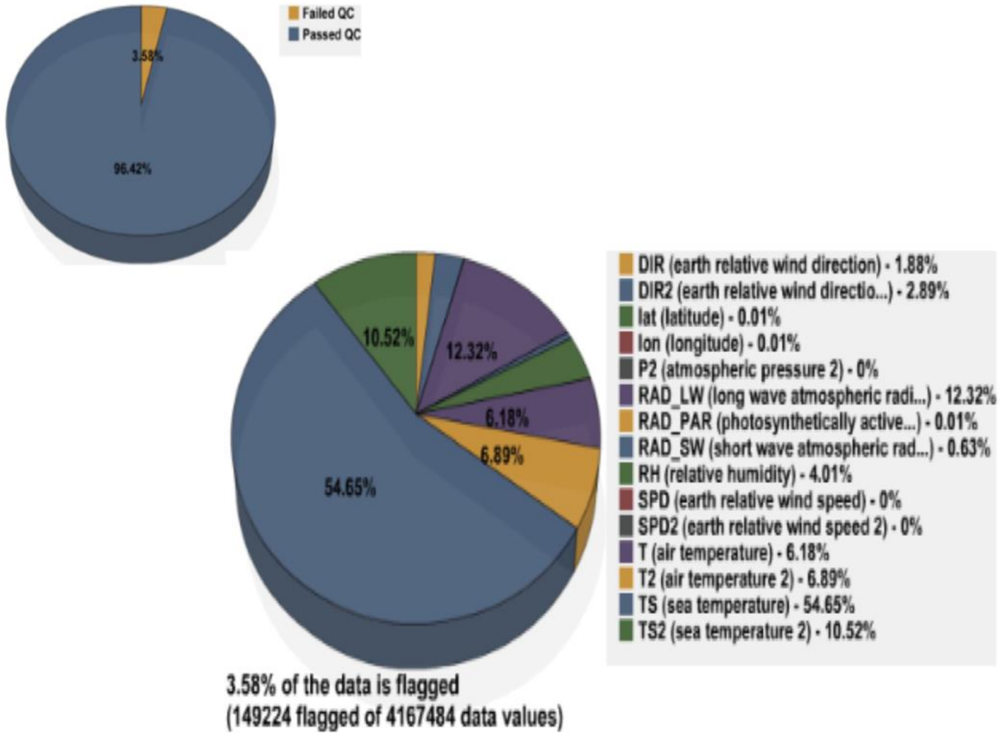


Figure 95: For the *New Horizon* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

New Horizon was officially out of service as of 1 May 2015; as such, she officially separated from the SAMOS initiative as of that date. Prior to her separation, *New Horizon* provided SAMOS data for 116 ship days, resulting in 4,167,484 distinct data values. After automated QC, 3.58% of the data were flagged using A-Y flags (Figure 95), about 2% higher than 2014 (1.6% flagged). NOTE: the *New Horizon* did not receive visual quality control by the SAMOS DAC, so all of the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *New Horizon*).

The highest percentage of flags by far (54.65%) was applied to sea temperature (TS). Most of those flags were “greater than 4 standard deviations from climatology” (G) flags (Figure 97). These values may or may not have been realistic; we are not currently funded to investigate cases like this for the *New Horizon*. But as this TS flag analysis is identical to that in both 2013 and 2014, the likelihood exists that the sensor does in fact exhibit a bias for some reason. It could be noted here that if *New Horizon* did receive visual quality control and had the flagged values been discovered to be unrealistic they likely would have been changed to suspect/caution (K) or poor quality (J) flags during visual QC to avoid confusion on the part of the end-user.

Another issue with the *New Horizon* data also reflected in the flag totals was discovered during the quick visual inspection that occurs when vessel data first comes into the DAC. On 17 January the lead data analyst noted an apparent failure of the long wave atmospheric radiation (RAD_LW) parameter, causing unrealistic negative values

(Figure 96). The vessel was immediately notified and although there is no response on record, the issue appeared resolved as of 29 January. During the event (17-28 January) RAD_LW received a good deal of out of bounds (B) flags from the autoflagger (Figure 97).

Again, we note that *New Horizon* is now officially separated from SAMOS. We would like to take this opportunity to thank her technicians and SAMOS data stewards for their participation; it has been a pleasure working together.

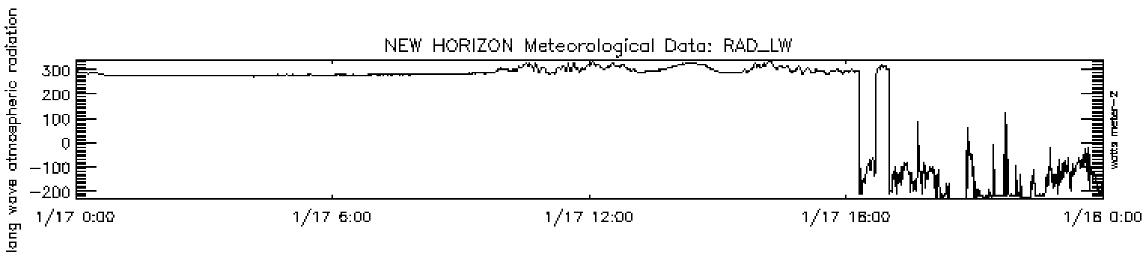


Figure 96: *New Horizon* SAMOS long wave atmospheric radiation data for 17 January 2015. Note the unrealistic negative values.

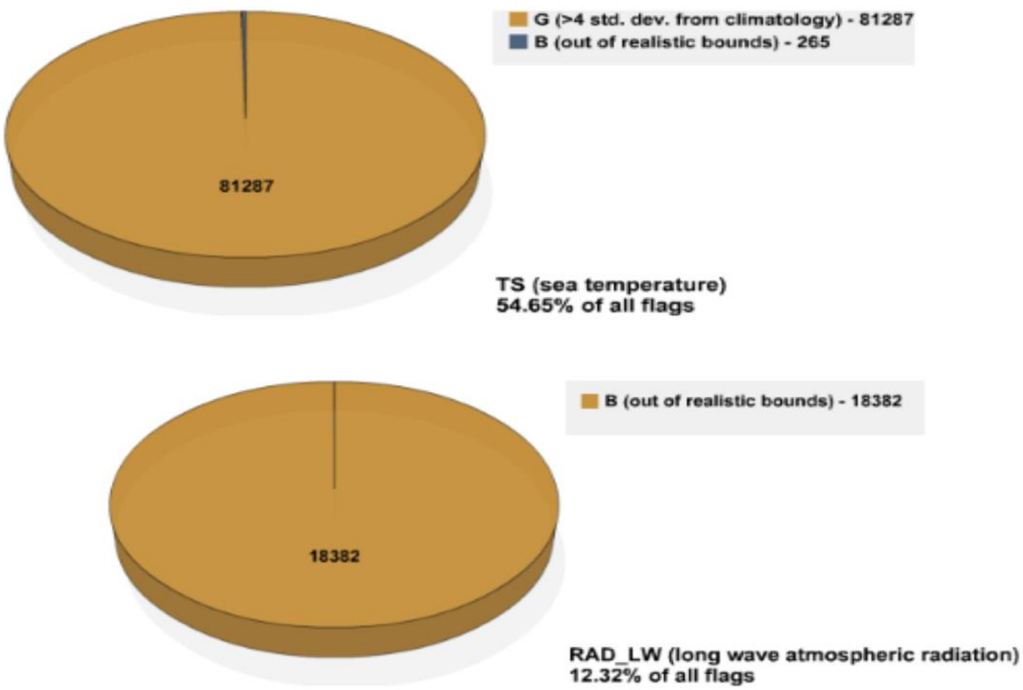


Figure 97: Distribution of SAMOS quality control flags for (top) sea temperature – TS – and (bottom) long wave atmospheric radiation – RAD_LW – for the *New Horizon* in 2015.

Robert Gordon Sproul

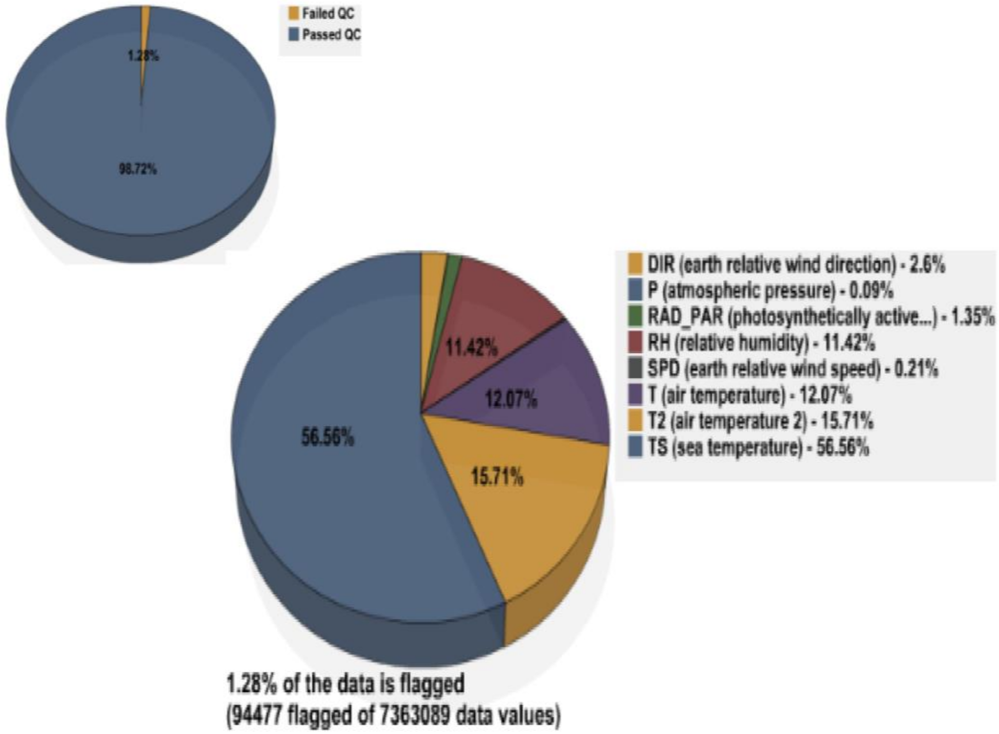


Figure 98: For the *Robert Gordon Sproul* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Robert Gordon Sproul* provided SAMOS data for 317 ship days, resulting in 7,363,089 distinct data values. After automated QC, 1.28% of the data were flagged using A-Y flags (Figure 98). This is a more than 2% improvement over 2014 (3.94% total flagged) and is a notably low percentage; however, the *Robert Gordon Sproul* does not receive visual quality control by the SAMOS DAC, which is when the bulk of quality flags are usually applied, so the low percentage may be misleading. All of the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Robert Gordon Sproul*).

There are no data issues of note on record for the *Sproul* in 2015. And again, realistically, with such a low total flag percentage there isn't much use in attempting to diagnose potential data issues based on the distribution of flags. Yet a quick glance at sea temperature (TS), which gathered the largest portion of the (diminutive) flags (Figure 98), suggests the possibility of a slight bias in TS, similar to that suspected in *New Horizon's* TS, as all of the flags applied to *Sproul's* TS were greater than four standard deviations from climatology (G) flags (Figure 99). Other possibilities include actual cooler or warmer than normal TS in some of the areas *Sproul* cruised, or TS mimicking temperature inside the hull as a result of an intake pump being shut off while the vessel is in port (a common occurrence among vessels). Considering the G flag episodes appear in distinct clusters throughout the year rather than being uniformly distributed these latter possibilities actually seem more likely. In any case, these are not issues we are currently funded to sort out.

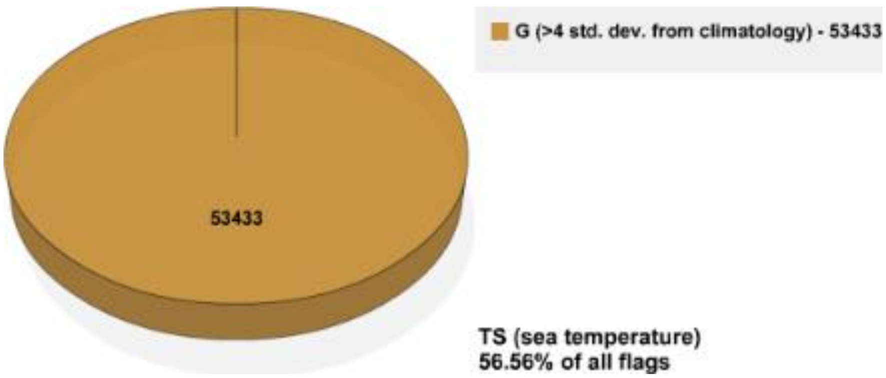
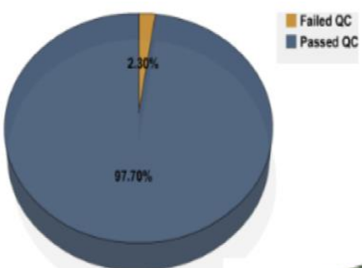


Figure 99: Distribution of SAMOS quality control flags for sea temperature – TS – for the *Robert Gordon Sproul* in 2015.

Roger Revelle



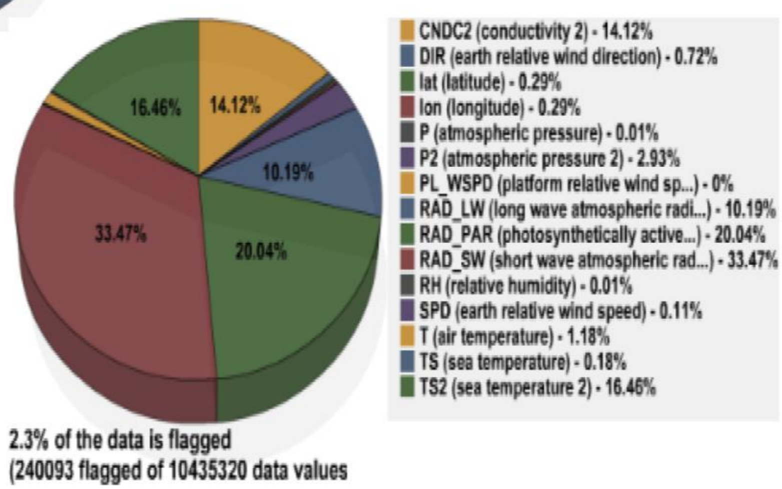


Figure 100: For the *Roger Revelle* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Roger Revelle* provided SAMOS data for 321 ship days, resulting in 10,435,320 distinct data values. After automated QC, 2.3% of the data were flagged using A-Y flags (Figure 100). This is only a very slight increase over 2014 (1.41% total flagged) and is a notably low percentage; however, just as with the *Robert Gordon Sproul*, the *Revelle* does not receive visual quality control by the SAMOS DAC, which is when the bulk of quality flags are usually applied, so the low percentage may be misleading. All of the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Roger Revelle*).

Some of the highest percentages of flags were applied to the short wave atmospheric radiation (RAD_SW, 33.47%), sea temperature 2 (TS2, 16.46%), and conductivity 2 (CNDC2, 14.12%) parameters (Figure 100). However, upon inspection these all appear to be the typical result of routine operations and not indicative of a problem. In the case of RAD_SW, the flags applied are exclusively out of bounds (B) flags (Figure 102) mainly assigned to values slightly below zero at night, as commonly occurs with short wave sensors owing to sensor tuning (see details 3b). Likewise the flags applied to CNDC2 are exclusively B flags and those applied to TS2 are almost exclusively greater than four standard deviations (G) flags (Figure 102), the majority of which appear to have been applied to the data while an intake pump was off. This securing of the seawater system is a pretty standard practice for vessels in port or occasionally in an excessive chop.

On the other hand, the two remaining parameters with notable flag percentages, namely long wave atmospheric radiation (RAD_LW, 10.19%) and photosynthetically active radiation (RAD_PAR, 20.04%) (Figure 100) actually did experience a problem. On or around 10 October it appears both RAD_LW and RAD_PAR frequently began reading too high, with RAD_LW values in the 500-1300 W/m^2 range and RAD_PAR values ranging between -35 and 1300 microEinstein m/s^2. (We note the negative RAD_PAR values were actually probably due to sensor tuning, similar to RAD_SW above.) The lead data analyst noticed the extreme behavior of the two parameters and notified *Revelle* via email on 15 October. We immediately received word back from the technician informing us that *Revelle* would be heading to the shipyard after 18 November and most of the meteorological sensors would be replaced while she was out of service. Prior to going out of service, both RAD_LW and RAD_PAR amassed a lot of B flags (Figure 102) during the period 10 October – 9 November (the last day of SAMOS data).

There was a second item of note, of very short duration, in which the air temperature (T) sensor appeared to have malfunctioned. On 16 January the lead data analyst contacted *Revelle* to alert technicians that over the course of 14-15 January T had risen to in excess of 50 C (Figure 101). The analyst also questioned whether relative humidity RH might be a little low. *Revelle* again responded immediately, thanking the analyst for the heads up and stating that they were investigating the issue. It is not known what caused the malfunction, but by the end of 16 January everything appeared to have returned to normal. During the event T took on some quantity of G and B flags (not shown), but we note that had *Revelle* been a vessel that receives visual QC we would likely have applied malfunction (M) flags to the entire T episode.

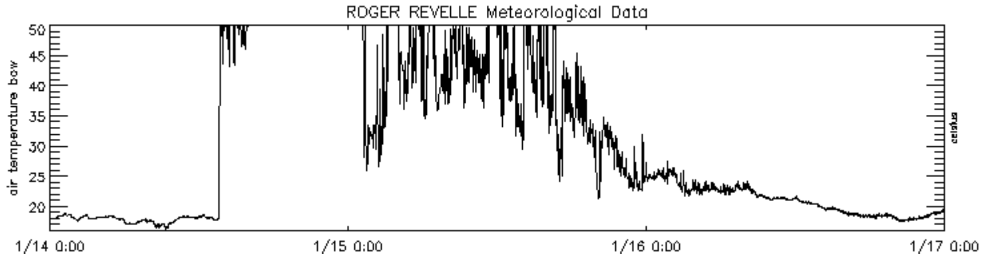


Figure 101: *Roger Revelle* SAMOS air temperature (T) data for 14-16 January 2015.

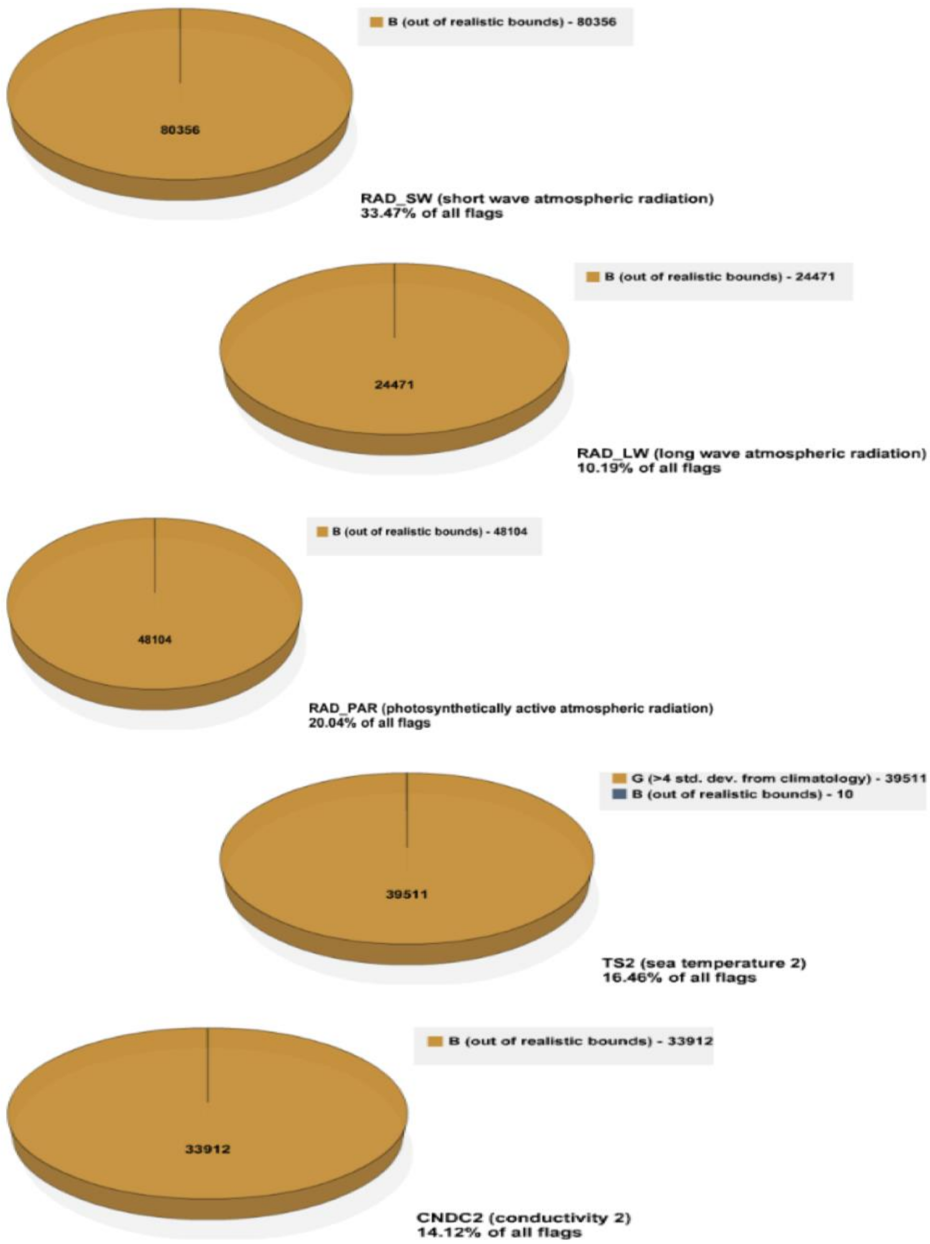


Figure 102: Distribution of SAMOS quality control flags for (first) short wave atmospheric radiation – RAD_SW – (second) long wave atmospheric radiation – RAD_LW – (third) photosynthetically active radiation – RAD_PAR – (fourth) sea temperature 2 – TS2 – and (last) conductivity 2 – CNDC2 – for the *Roger Revelle* in 2015.

Falkor

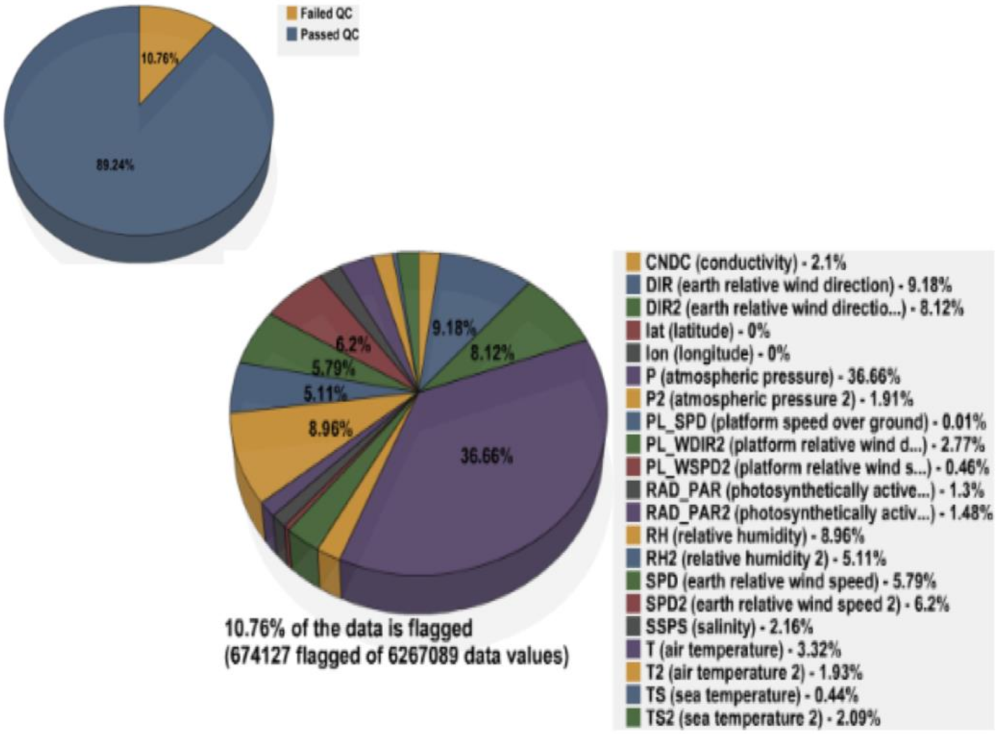


Figure 103: For the *Falkor* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Falkor* provided SAMOS data for 204 ship days, resulting in 6,267,089 distinct data values. After both automated and visual QC, 10.76% of the data were flagged using A-Y flags (Figure 103). This is about one percent higher than 2014 (9.87% total flagged).

The atmospheric pressure (P) parameter continued to present challenges in 2015, as it did in late 2014 and, as of the writing of this report, continues to do in 2016. Part of the problem certainly must be that P resides under the hood of the ship's Vaisala weather package, considered a “navigation grade” instrument (as opposed to science) which has further never been calibrated. In fact, during one of our many email conversations with the *Falkor* technicians regarding the Vaisala data it was expressed to us that some of the bad effects we were seeing were expected of the sensor at this point. There was talk of replacing the Vaisala sometime in late summer, however it doesn't appear those plans have yet come to fruition. At any rate, in 2015 there were a couple of larger issues beyond just sensor capabilities at play regarding P, and these issues were the main source of the flags applied to the parameter.

The first noted issue was carried over from late 2014; namely, the P data only ranged between about 9.5 and 10 mb. SAMOS personnel were in touch with *Falkor* about P right from the beginning of this particular episode, but as of the start of the 2015 season it was still unclear what was causing the low readings. We continued emailing the *Falkor* periodically, regarding P and other data issues as well, until finally on 3 June one of the techs had a bit of a breakthrough: It turns out that the Vaisala was originally connected to their old helodeck met system, but after they resurrected the Vaisala in late 2014 (after the Gill metpak, their primary sensor, was removed for maintenance) they plugged it directly into their own system. There was a units conversion from Pascals to hectoPascals somewhere in place for when the Vaisala had been connected to the old system, but that was no longer needed with the new system and unfortunately it was still being applied without their realizing it. Once identified, the conversion problem was addressed, and as of 4 June that particular facet of the bad P data was fixed for good.

Unfortunately, even once the units were corrected P was still too low, reading roughly in the range of 840 to 960 mb or so. While these values aren't exactly out of bounds for atmospheric pressure, they were fully unrealistic for *Falkor's* cruises, as any available verification data (included the *Falkor's* own Gill metpak pressure, i.e. P2) confirmed. This information was immediately relayed to the *Falkor*, and by 10 June the P data had more or less shifted up into a reasonable range of values (not counting the plentiful spikes, which will be discussed further on). However, it isn't really clear what enabled the shift. One of the technicians thought it might have been because she had neglected to restart SCS until a few days after the units conversion fix, but this doesn't seem the correct explanation, as the 840-960 mb data were clearly after the units conversion had been removed. Sadly, by 7 July, when a new cruise began, the P data had dropped back into the general 840-960 mb range. This trend continued for several more months, during which time we reminded *Falkor* once or twice about the low range via email (as well as discussed other data issues). Then in mid October there was seemingly another breakthrough: One of the techs discovered a second message, basically a supervisor message containing heating element and voltage information, that was being generated by the Vaisala every second. This additional output had been present since November 2014 (read: right around the time the Vaisala was "resurrected") and was getting into the data averages. She anticipated that she could remove the additional line easily and had written a script to post-process the files. Unfortunately it seems that either this task was not completed or else it did not solve the problem, because P's range did not budge by the end of 2015 and is in fact mostly still too low in 2016. (We touched base with the crew again in early January 2016.)

Regarding this supervisor message, the technician who found it believed it was also getting into the averages for air temperature (T) and relative humidity (RH), which along with P had been exhibiting a lot of spikes since the Vaisala was brought back online in late 2014. Note that P in fact exhibited a great deal more spikes than did T and RH, but in particular whenever a spike appeared in T/RH it also appeared in P (see example Figure 104). It's possible there were two separate issues causing the spikes, one affecting P only and the other – perhaps the supervisor message – affecting all three parameters. Throughout the year SAMOS personnel reminded the *Falkor* folks about these spikes, but the message that generally came back was that the Vaisala was not expected to perform well and was slated for eventual replacement, which is an understandable position to take, at least regarding the spikes. We note that the P/T/RH spike issue has not been resolved to date, either.

As a result of the various Vaisala issues, T and RH received a pretty sizable volume of spike (S) flags over the course of the year (not shown), and P was flagged essentially the entire year with primarily poor quality (J) flags with a significant amount of S flags as well (Figure 106).

Moving on to the Gill metpak data – namely, air temperature 2 (T2), relative humidity 2 (RH2), atmospheric pressure 2 (P2), earth relative wind direction 2 (DIR2), and earth relative wind speed 2 (SPD2) – the main issue there seems to be that in stormy conditions the instrument easily gets washed with seawater. This causes a lot of noisy variability particularly in P2, T2, and RH2 (example Figure 105), and to some degree in the winds as well. All of the noisy data is caution/suspect (K) flagged during visual QC (not shown). We note that when conditions are especially bad *Falkor* occasionally suspends the Gill metpak SAMOS data for a time. In addition to these weather-related issues, at the start of 2015 RH2 was already experiencing an issue of its own. The RH2 readings seemed stuck at >95% while RH (from the Vaisala) was ranging 40-60%. This issue was rolled over from late 2014; however, as it first showed up in some end-of-year backlogged data, we were unable to address it until a bit later. The technicians were notified about RH2 via email on 20 January and the response came back that it would be looked into immediately. The Gill metpak was suspended from the SAMOS daily files after 11 February, perhaps to address the RH2 issue, and when the Gill data resumed on 17 March the issue was fixed. Before it went offline, the >95% RH2 data was J flagged (not shown). We have no definitive cause on record, but we note the most likely explanation for the stagnant RH2 readings was salt contamination or saturation of the sensor because of exposure to sea water.

During the period 15-21 October it was noted by the lead data analyst that the platform course (PL_CRS) was reading 180° opposite to the platform heading (PL_HD), which was causing a lot of failed the true wind test (E) flags (not shown) on the earth relative wind parameters, both direction (DIR and DIR2) and speed (SPD and SPD2). When this information was relayed to the *Falkor* one of the technicians did some digging and realized that the polar quantity PL_CRS was being averaged arithmetically, so that whenever the vessel was fluctuating around a north heading the averaged PL_CRS was roughly half of what it should have been. She wasn't immediately sure how to correct this, but it does appear it was probably repaired, although admittedly this author has not been particularly keeping an eye out for a north heading. Nevertheless if the issue does pop up again we will surely spot it.

Falkor had added two photosynthetically active radiation sensors (PAR and PAR2) to their repertoire in 2014 and after several months of email discussion about getting the data into acceptable units for SAMOS we were finally able to begin processing the PAR and PAR2 in mid 2015. The one item of note with these sensors is that each experiences an appreciable amount of shadowing, in a fairly complementary fashion in fact, as the two sensors are located port and starboard. As far as shadowing is concerned, it's good that the two sensors complement each other, so there is almost always "good" data between the two of them. These episodes of shadowing incur some K flags (not shown).

There are two final items that should be mentioned, though they are not actually data issues. The first is that we were notified there wasn't intended to be any SAMOS data transmitted during the period 24 April to 23 May, as the vessel was in various countries' EEZ's. This occasionally happens with vessels, and it's good to have the explanation on record. The second item to note is that the *Falkor* did submit one small backlogged batch of data in 2015 (7-11 July). While this isn't an especially bothersome amount of late data, it's still a good time to remind everyone that this practice should be avoided as much as possible. Just to reiterate a message from last year: As the *Falkor* SAMOS contract is always written for a set number of sea days, visual QC will always be performed on her data files, regardless of how late they come in. But it is important to note that the process of identifying any issues with the data, notifying the techs, and getting to a resolution progresses far more advantageously when files are received on time. Continuity of visual quality control application, too, can be of issue with backlogged data. It often takes time to reestablish familiarity with the data, particularly if there had been any ongoing data issues at the time the data stopped being received.

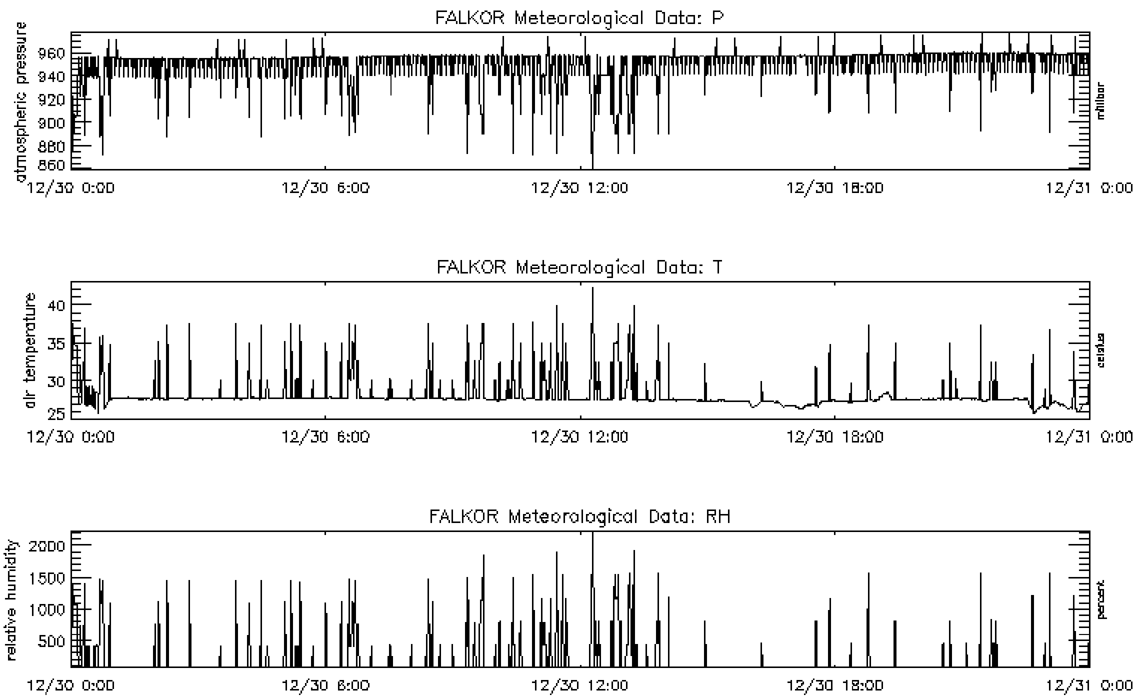


Figure 104: *Falkor* SAMOS (top) atmospheric pressure – P – (middle) air temperature – T – and (bottom) relative humidity – RH – data for 30 December 2015. Note excessive amount of spikes in all three parameters. Note also that while P exhibits a larger number of spikes than T or RH, there is always a spike in P when there is one in T/RH, suggesting two separate mechanisms affecting P.

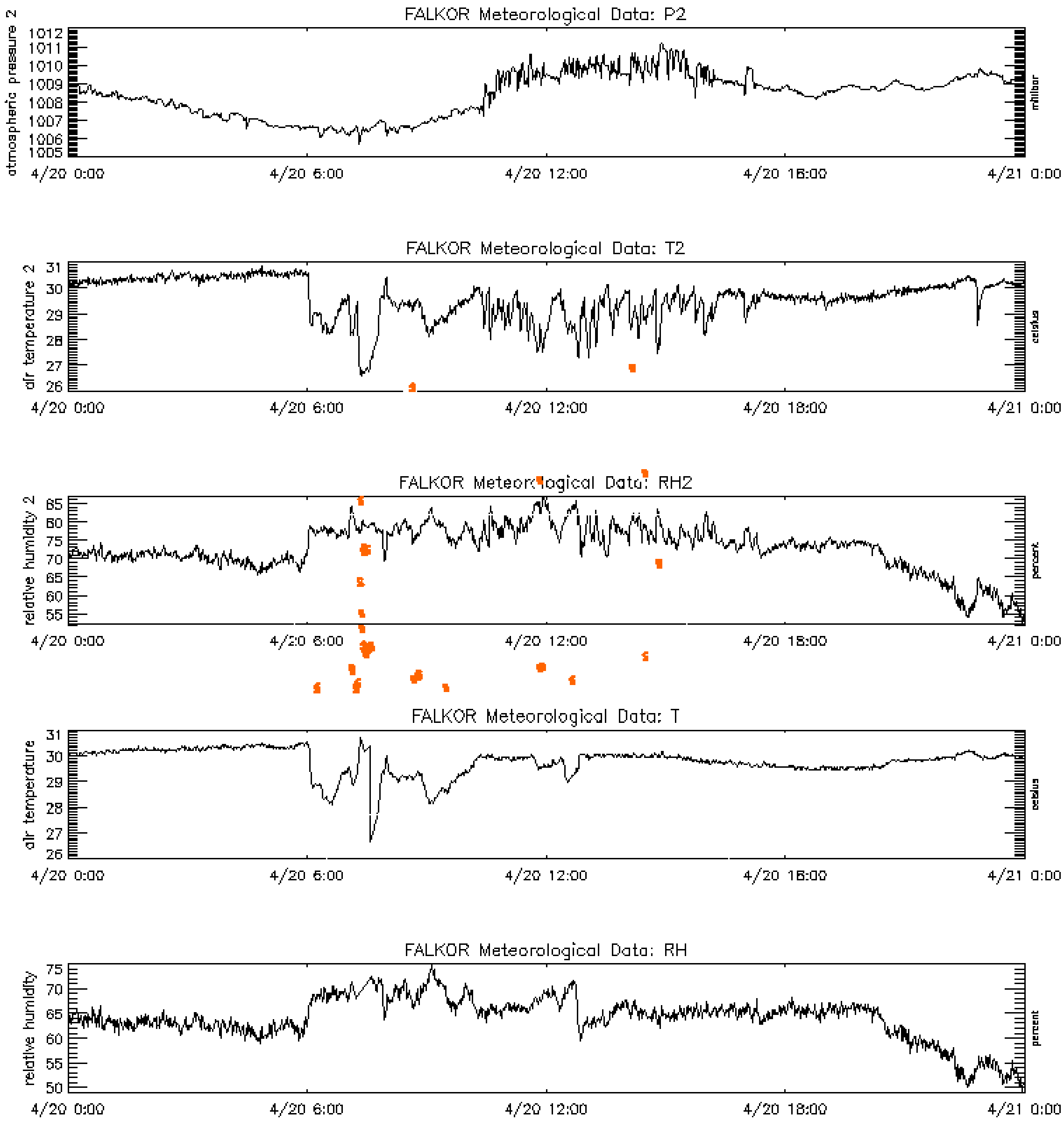


Figure 105: *Falkor* SAMOS (first) atmospheric pressure 2 – P2 – (second) air temperature 2 – T2 – (third) relative humidity 2 – RH2 – (fourth) air temperature – T – and (last) relative humidity – RH – data for 20 April 2015. Note noisy variability in P2/T2/RH2, not seen in T/RH. (Note spikes, i.e. the orange S's, were removed from T/RH for clarity.)

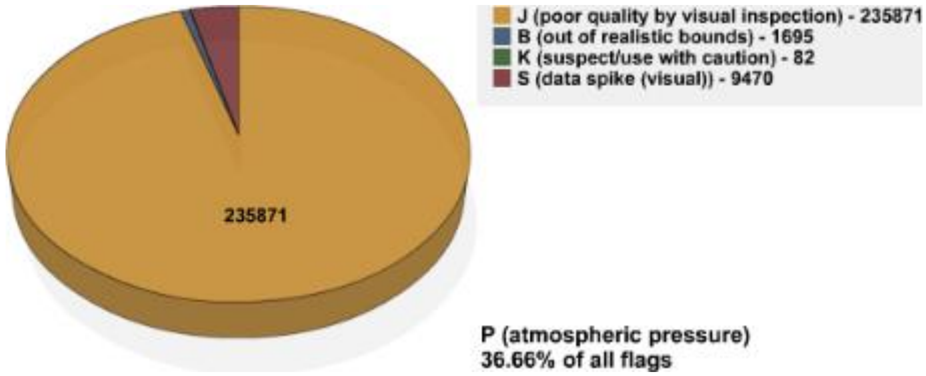


Figure 106: Distribution of SAMOS quality control flags for atmospheric pressure – P – for the *Falkor* in 2015.

Sikuliaq

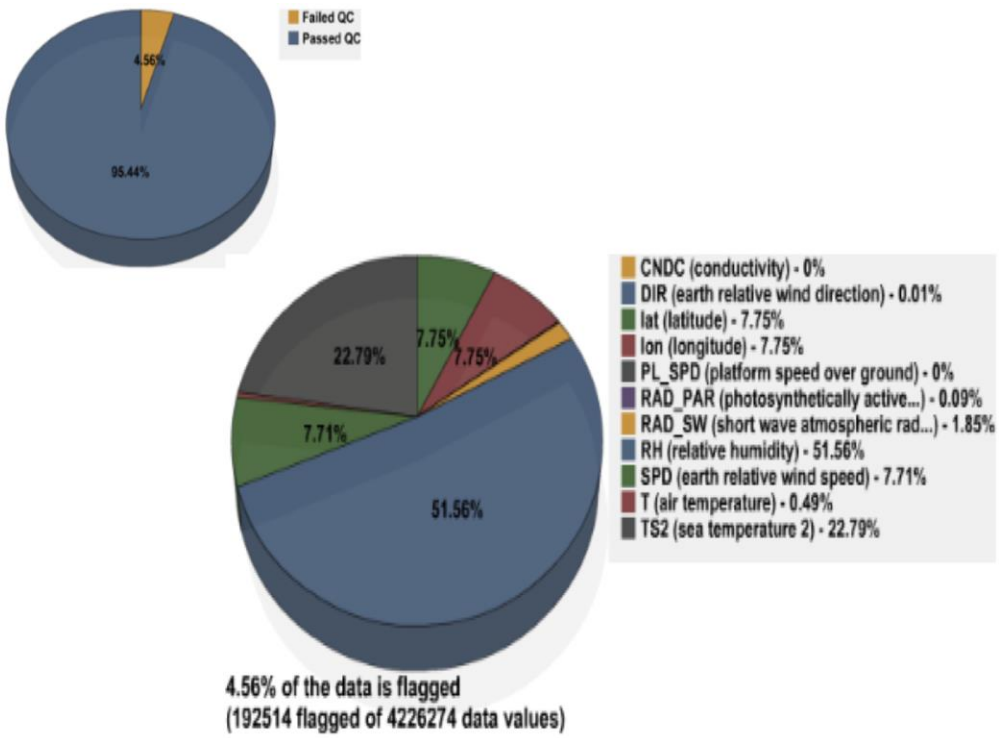


Figure 107: For the *Sikuliaq* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Sikuliaq* was first actively recruited to the SAMOS initiative on 1 February 2015, and afterwards provided SAMOS data for 172 ship days, resulting in 4,226,274 distinct data values. After automated QC, 4.56% of the data were flagged using A-Y flags (Figure 107). NOTE: the *Sikuliaq* did not receive visual quality control by the SAMOS DAC, so all of the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Sikuliaq*).

Over half of all flags were assigned to the relative humidity (RH) parameter (Figure 107). These were almost exclusively out of bounds (B) flags (Figure 110). In early November, the lead data analyst noted that the RH reading was jumping around quite a bit, frequently hitting a little over 100% (example Figure 108). *Sikuliaq* was notified about the suspicious data via email on 9 November. The vessel technician quickly replied, stating that he'd found the RH unit's purge heater was turning on and off every few seconds. He noted they were in heavy seas so he suspected perhaps seawater was getting in the sensor. Whatever the cause, any of the RH data that was over 100% was automatically B flagged. Upon inspection, it appears there were several periods of similar behavior in RH over the course of the year, each of which would have resulted in more B flagging.

Nearly another quarter of all flags were applied to the sea temperature 2 (TS2) parameter (Figure 107), which is the *Sikuliaq's* infrared (IR) skin temperature (skint) sensor. We note this is the first IR skint we've seen at SAMOS. While there doesn't seem to be an issue with the sensor itself, the problem seems to be that when the vessel is in port with the dock on her starboard side the IR thermometer is often pointing directly at concrete, rather than the water. When this happens TS2 is essentially recording the temperature of the dock rather than sea temperature (example Figure 109). In addition, when the vessel is operating in the sea ice pack, this type of sensor will measure the temperature of the ice surface (not the ocean) which will generally be colder than the water. These occurrences resulted in a fair amount of TS2 data that were out of bounds or at least unusual for an actual sea temperature, meaning the parameter was automatically assigned a fair portion of B flags and greater than four standard deviations from climatology (G) flags (Figure 110). We know of no automation that can account for the temperature variations in the ice pack, but we recommend users note the vessel's location and ignore TS2 data when the vessel is in port.

Earth relative wind speed (SPD) took on another 7.71% of the total flags (Figure 107). These were almost exclusively failing the true wind test (E) flags (Figure 110). This case was actually due to an oversight on our end, in which we had the incorrect units for the SPD sensor in our database. The oversight was caught on 28 July and the units were immediately corrected, after which point E flagging of SPD decreased dramatically. We note to the science community that any SAMOS *Sikuliaq* SPD data prior to 28 July is actually in knots as opposed to the declared m/s.

A second oversight on our end similarly caused the *Sikuliaq* SAMOS conductivity (CNDC) data prior to 21 September to be incorrectly scaled. After the lead analyst noted CNDC values were in the in the 0 to < 1.0 range, it was discovered that we had incorrectly listed the CNDC data as milliSiemens/cm in our database, meaning we were applying a conversion factor of 0.1 to present the data as being in Siemens/m (our standard units for CNDC) when in fact the data were being logged in Siemens/m. No flags were applied to the data, as values were still within bounds, but we caution the science community that any CNDC data prior to 21 September, when we corrected the units in our database, should actually be read as Siemens/m x 0.1.

One further note not related to data quality: In mid April *Sikuliaq* headed in to dry dock and after a reportedly rough yard period it took a little while to get all of her sensors back online. As such, some of her scientific data between about 24 June and 4 July are missing. We note that, in fact, the long wave and short wave atmospheric sensors never came back online in 2015. Her initial 2015 daily files are also similarly spotty data-wise – understandable, as she was initially spinning up after recruitment to the SAMOS initiative.

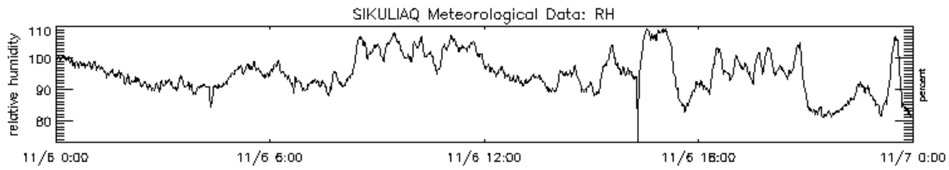


Figure 108: *Sikuliaq* SAMOS relative humidity – RH – data for 6 November 2015. Note variability and values >100%.

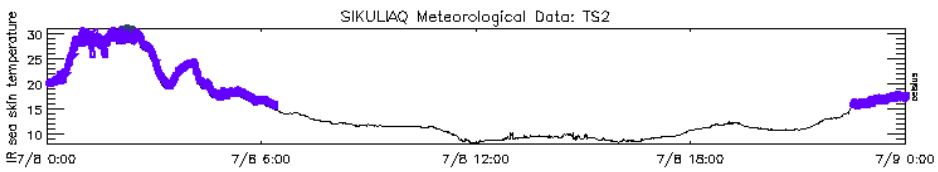


Figure 109: *Sikuliaq* SAMOS sea temperature 2 – TS2 – data for 8 July 2015. Note greater than four standard deviations from climatology (G) flags on higher temperature values as TS2 recorded air temperature due to dock proximity.

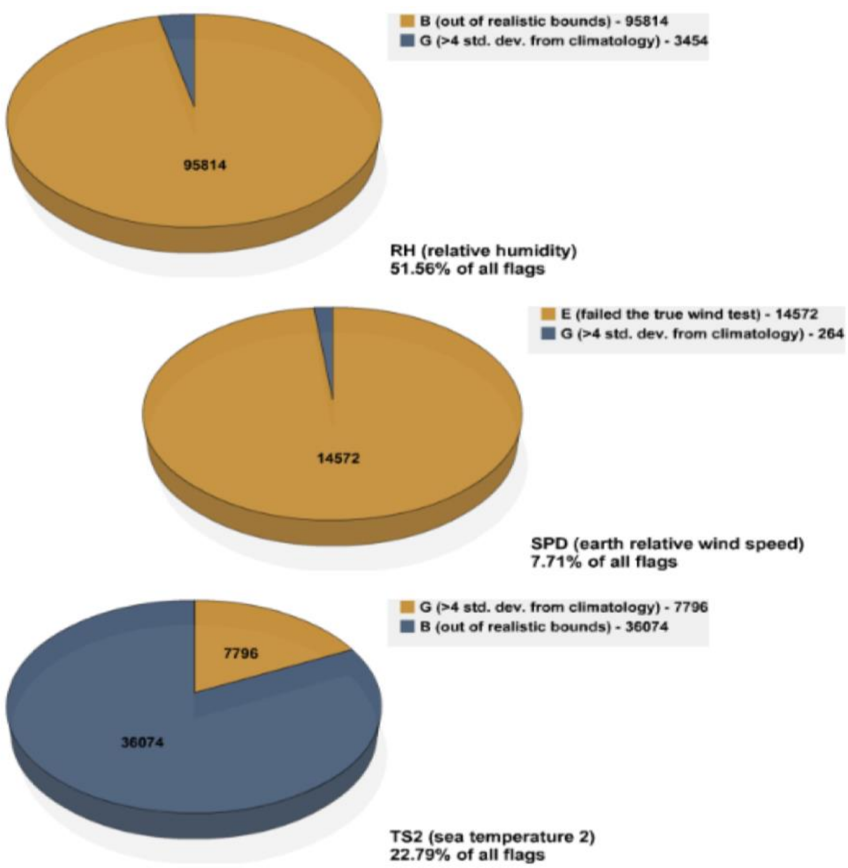


Figure 110: Distribution of SAMOS quality control flags for (top) relative humidity – RH – (middle) earth relative wind speed – SPD – and (bottom) sea temperature 2 – TS2 – for the *Sikuliaq* in 2015.

Kilo Moana

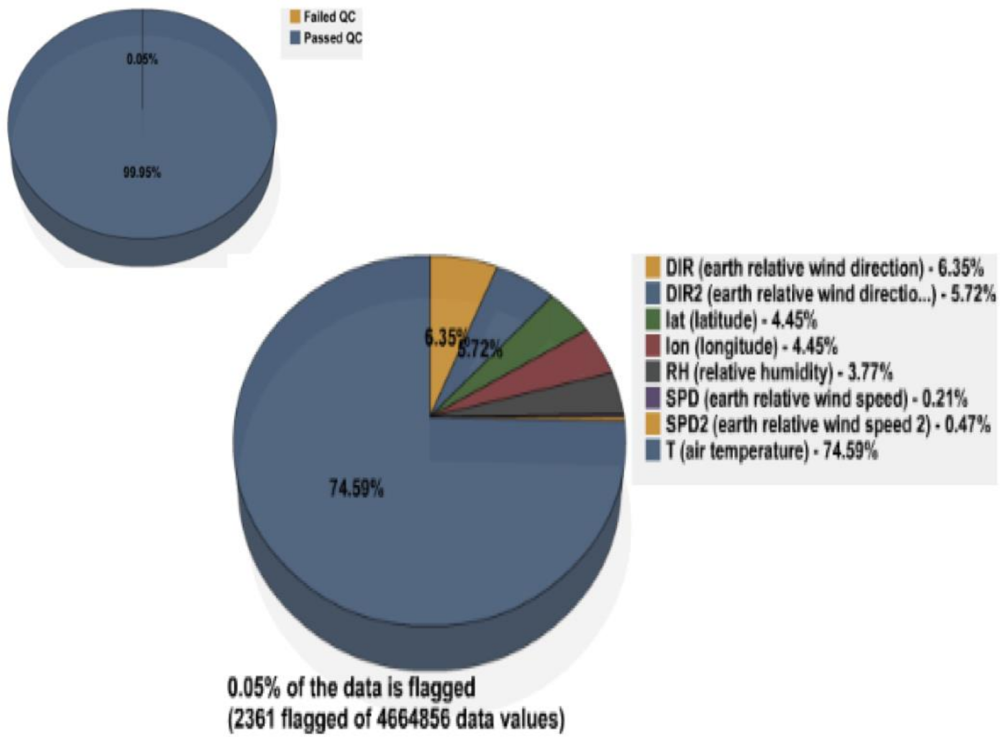


Figure 111: For the *Kilo Moana* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Kilo Moana* provided SAMOS data for 166 ship days, resulting in 4,664,856 distinct data values. After automated QC, 0.05% of the data were flagged using A-Y flags (Figure 111). This is both an extremely low flag percentage and essentially unchanged from previous years. However, due to funding constraints, the *Kilo Moana* does not receive visual QC, which is when the bulk of quality control flags are usually applied. Hopefully resources can be secured in the future for visual QC, as it's entirely within the realm of possibility that *Kilo Moana* would actually represent one of the best research quality data sets at SAMOS, if it were to reach that level.

With such an extraordinarily low flagged percentage it doesn't make much sense to attempt any individual parameter quality analysis based on the flags applied. Additionally, there are no issues of note on record for the *Kilo Moana*. The only item worth mentioning is there were again several backlogged batches of data in 2015, likely owing to a persistent data logging problem. The *Kilo* uses a Campbell Data Logger and has previously expressed an inherent instability there. Data for the periods and dates 24-26 July, 23 September, and 16-17, 19-21, and 25-30 October all arrived more than 10 days late. This is not really a problem for processing purposes, and the *Kilo* does not receive visual quality control so there's no issue there. Nevertheless we stress the importance of timely data transmission, as it enables the data analysts to promptly identify any data issues and make attempts to get those issues resolved as quickly as possible. We further note, we were informed via email from the *Kilo* that data for 3-4 July were lost due to problems with the data logger.

Healy

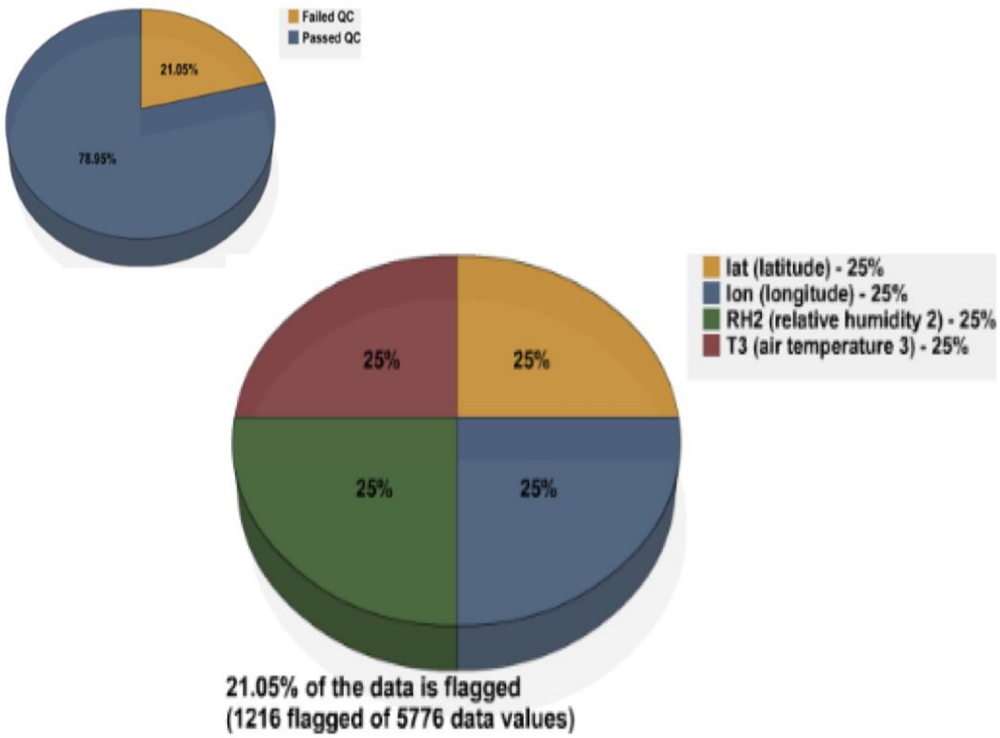


Figure 112: For the *Healy* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Healy* provided SAMOS data for 1 (incomplete) ship day, resulting in 5,776 distinct data values. After automated QC, 21.05% of the data were flagged using A-Y flags (Figure 112). NOTE: the *Healy* did not receive visual quality control by the SAMOS DAC, so all of the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Healy* in 2015).

Obviously nothing of value can be said here regarding *Healy's* data quality, with less than one full day of data to consider. We have nevertheless included her here for posterity. We note that it has been a challenge trying to get the *Healy* SAMOS data transmission started again. (Regular transmission ceased after 30 October 2013.) We are hopeful that in 2016 any formatting/transmission issues can be ironed out, and we additionally are hopeful that we can eventually acquire, in SAMOS format, the huge backlog of data that is said to exist, either from the ship itself or from the R2R repository.

Thomas G Thompson

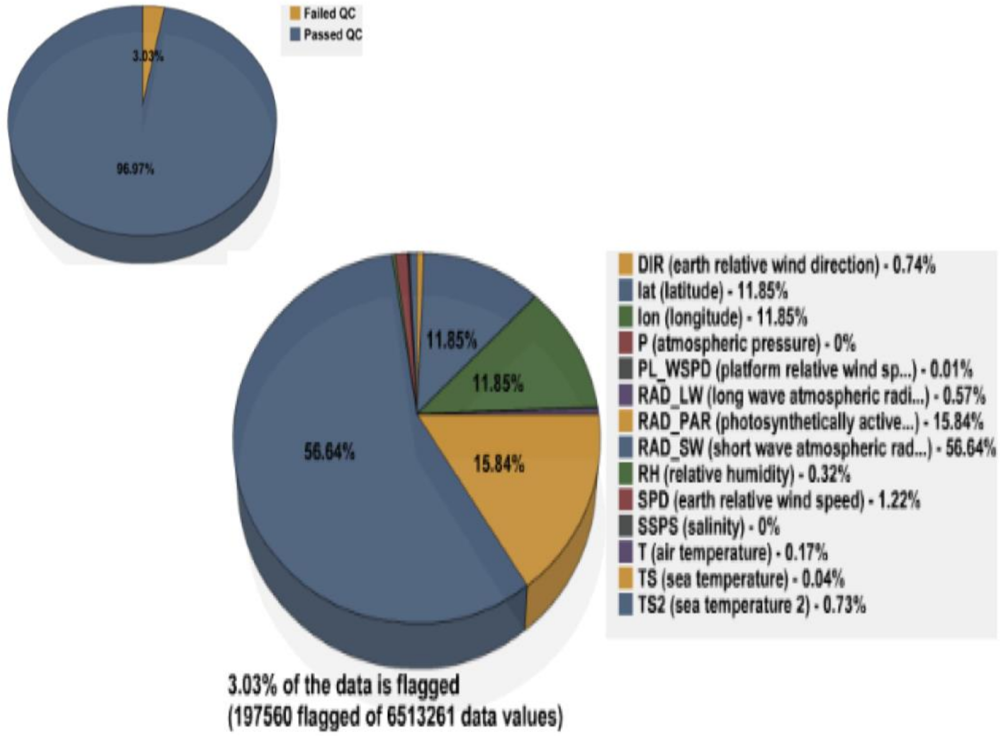


Figure 113: For the *Thomas G Thompson* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *T.G. Thompson* provided SAMOS data for 256 ship days, resulting in 6,513,261 distinct data values. After automated QC, 3.03% of the data were flagged using A-Y flags (Figure 113). This is about a 1% increase over 2014 (1.9% total flagged). NOTE: the *T.G. Thompson* does not receive visual quality control by the SAMOS DAC where the majority of flags are applied, so all of the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Thomas G Thompson*).

The overwhelming majority of the flags applied to the *Thompson* data were again applied to short wave atmospheric radiation (RAD_SW), as they have been in previous years (Figure 113). These were entirely out of bounds (B) flags (Figure 114). Upon inspection, most of these were applied to the slightly negative values that commonly read out at night owing to sensor tuning (see 3b for details).

Photosynthetically active radiation (RAD_PAR) received a further 15.84% of the total flags (Figure 113). In this case there was a documented issue with the sensor. It looks like at some time around late April/early May RAD_PAR began occasionally outputting out of bounds values, which were assigned B flags by the automated processing (Figure 114). This behavior continued for a few months and then around mid-July the RAD_PAR sensor issue suddenly appeared resolved. No definitive cause of the questionable behavior was ever found, but there was a rather enjoyable email from one of the techs in which he explains how the sensor came back to life after some unconventional efforts – he mentions soothingly probing the data cable to the sensor, and some muttered threats that the unit would be replaced with a pen and ink paper recorder if it didn't behave. Very entertaining, and clearly indicative of the type of easy rapport we have with *Thompson* folks.

Latitude (LAT) and longitude (LON) each received a further ~16% of the total flags (Figure 113). These were primarily land error (L) flags (Figure 114), and upon inspection it appears these were probably applied when the vessel was in port in Seattle. This isn't indicative of a problem; position data are often inadvertently flagged with L in intercoastal channels and narrow waterways, owing to the two degree grid land mask in place in SAMOS data processing (see 3b for details).   Note that during visual QC these flags would normally be removed by the visual data quality analyst.

It is well worth mentioning again that the support group onboard the *Thompson* excels at keeping SAMOS personnel informed of their status – both regarding data issues and when data should or should not be expected. In fact, they are on record again in 2015 as being one of the only active users of our subscription reporting service. Efforts like this are highly appreciated within the SAMOS group, it helps both us and the vessel operators to keep on top of data flow. We recommend other operators take advantage of the subscription and web services to monitor their data submission and quality. These services can be found at http://samos.coaps.fsu.edu/html/webservices.php

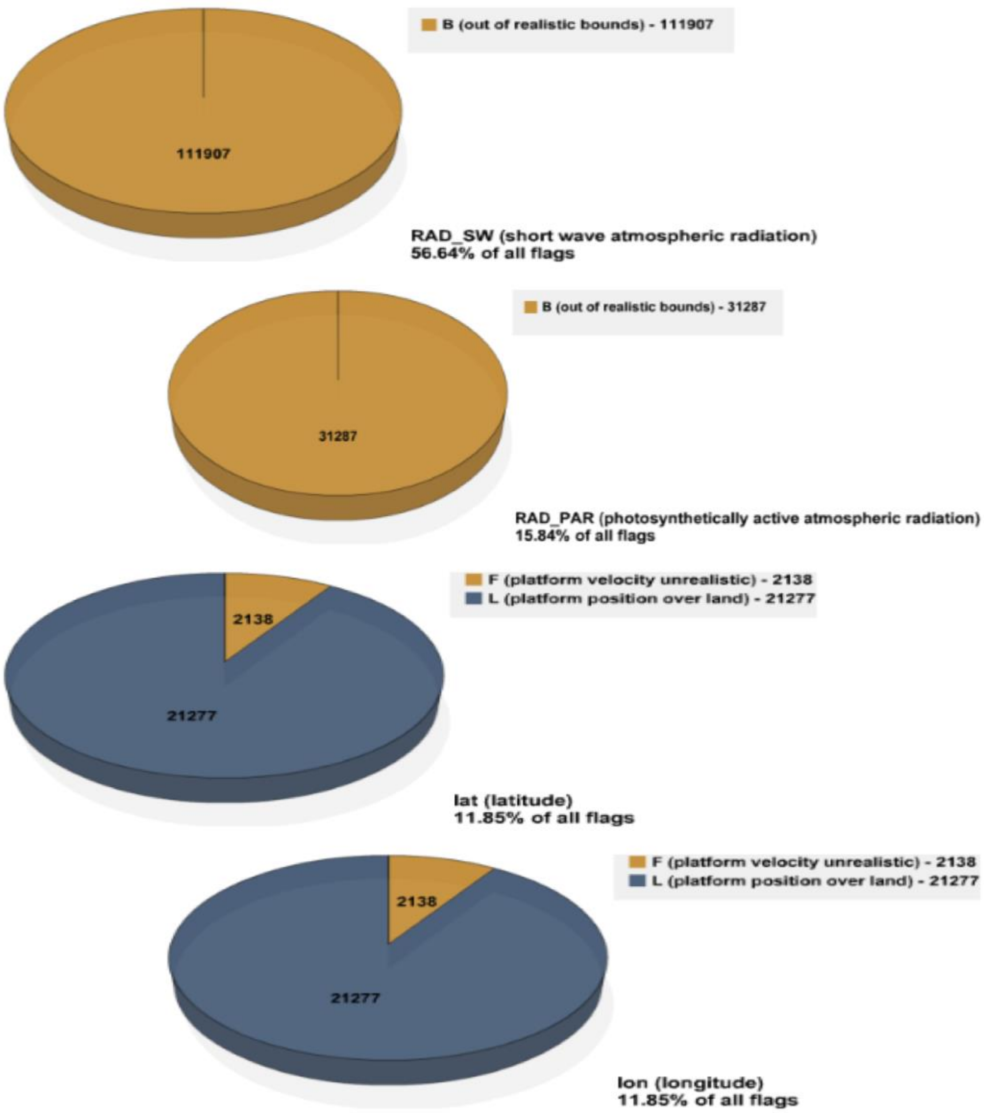


Figure 114: Distribution of SAMOS quality control flags for (first) short wave active atmospheric radiation – RAD_SW – (second) photosynthetically active radiation – RAD_PAR – (third) latitude – lat – and (last) longitude – lon – for the *Thomas G. Thompson* in 2014.

R/V Atlantis

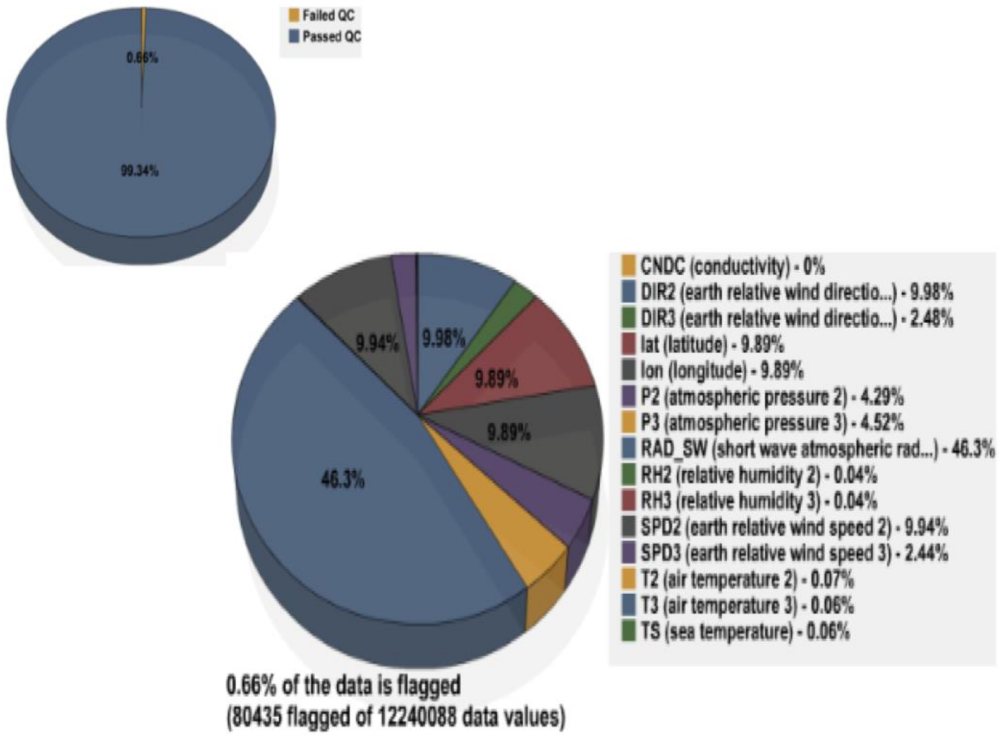


Figure 115: For the *R/V Atlantis* from 1/1/15 through 12/31/15, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *R/V Atlantis* provided SAMOS data for 305 ship days, resulting in 12,240,088 distinct data values. After automated QC, 0.66% of the data were flagged using A-Y flags (Figure 115). This is about a one percent improvement over 2014 (1.79% total flagged), and it is a remarkably low percentage; however, we note that the *R/V Atlantis* does not receive visual quality control by the SAMOS DAC, which is when the bulk of quality flags are usually applied, so the low flagged percentage may be misleading. All of the (diminutive) flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *R/V Atlantis* in 2015).

With such a low total flagged percentage it makes little sense to attempt a full data quality analysis based on the applied flags. However, there are a few issues on record for the Atlantis is 2015:

On or around 7 April the lead data analyst who performs the quick visual inspection that typically occurs when SAMOS files are first received noticed that the short wave radiation (RAD_SW) parameter was reporting nighttime values well below 0. A few -Wm^{-2} at night is not unexpected, owing to sensor tuning, even though the negative values are technically physically impossible (see 3b for details) but in this case minimum values were much closer to -100 Wm^{-2}. A quick spot check revealed other sporadic cases of this behavior in RAD_SW, usually only a day or two at a time. There is no response on record from *Atlantis* regarding what the issue might have been, but we note this same behavior also cropped up back in 2014 and in that case it was determined that neither

RAD_SW nor the long wave radiation sensor was functioning properly. These episodes of large negative RAD_SW values were naturally caught by the autoflagger and assigned out of bounds (B) flags (Figure 116), and together with the usual B flags applied to any values slightly below 0 (again, par for the course with most RAD_SW sensors) it made up the 46.3% of the total flags held by RAD_SW (Figure 115).

The other data item of note is not reflected in the flag percentages, but is of importance to the science community. On 20 March it was discovered that the conductivity (CNDC) units we had for *Atlantis* in our database were incorrect. Upon noticing CNDC values in the range of 0 to < 1 Siemens/m (seemingly) and then reaching out to the *Atlantis* via email, it was learned that they made an unannounced change to their reported units during the 2012-2013 winter inport, and unfortunately it was not caught on our end until 2015. What this means to the data user is that the CNDC data for 2013 through 19 March 2014, which are reported by us as Siemens/m, are actually in units of Siemens/m × 0.1.

One final note unrelated to any data issues: We would like to point out that the folks on the *Atlantis* are exceptionally conscientious about keeping us informed when we should and should not be expecting SAMOS data from them. They also sometimes alert us when the seawater system is secured, which is useful information to have on record as the *Atlantis* does not receive visual quality control and much of the oceanographic data is likely to go unflagged in these situations. (Note that we keep a written log of such notifications in Annex A of this report.) We are extremely appreciative of these efforts, thank you, *Atlantis*!

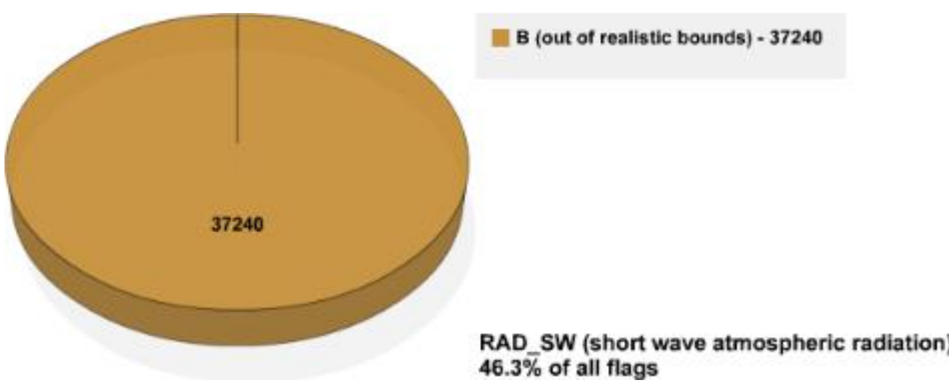


Figure 116: Distribution of SAMOS quality control flags for short wave atmospheric radiation – RAD_SW – for the *R/V Atlantis* in 2015.

4. Metadata summary

Adequate metadata is the backbone of good visual QC. As such, vessel operators are strongly advised to keep vessel and parameter metadata complete and up to date. Annex B, Part Two walks SAMOS operators through editing metadata online, step by step, while Part One offers instructions for monitoring metadata and data performance. For vessel metadata, the following are the minimum required items in consideration for completeness: Vessel information requires vessel name, call sign, IMO number, vessel type, operating country, home port, date of recruitment to the SAMOS initiative, and data reporting interval. Vessel layout requires length, breadth, freeboard, and draught measurements. Vessel contact information requires the name and address of the home institution, a named contact person and either a corresponding email address or phone number, and at least one onboard technician email address. A technician name, while helpful, is not vital. Vessel metadata should also include vessel imagery (highly desirable, see Figure 117 for examples) and a web address for a vessel's home page, if available.

Parameter metadata requirements for completeness vary among the different parameters, but in all cases "completeness" is founded on filling in all available fields in the SAMOS metadata form for that parameter, as demonstrated in Figure 118. (Any questions regarding the various fields should be directed to samos@coaps.fsu.edu. Helpful information may also be found at http://samos.coaps.fsu.edu/html/docs/samos_metadata_tutorial_p2.pdf, which is the metadata instruction document located on the SAMOS web site.) In this example (Figure 118 b.), as is frequently the case, the only missing field is the date of the last instrument calibration. Calibration dates may be overlooked as important metadata, but there are several situations where knowing the last calibration date is helpful. For example, if a bias or trending is suspected in the data, knowing that a sensor was last calibrated several years prior may strongly support that suspicion. Alternatively, if multiple sensors give different readings, the sensor with a more recent last calibration date may be favored over one whose last calibration occurred years ago. The authors wish to point out that the field "Data Reporting Interval" erroneously appears in several of the parameters. This field is actually only applicable to the time parameter and the Vessel information metadata. The erroneous field needs to be removed and was not considered for completeness of any parameter in Table 4. Through our online self-service Subscription and Report services (found at https://samos.coaps.fsu.edu/html/subscription/index.php), metadata summary tables for each ship can be viewed/downloaded at any time. To request login credentials for the subscription and report service, please send an email to samos@coaps.fsu.edu. The most recent version of these for all active ships is included in Annex C.

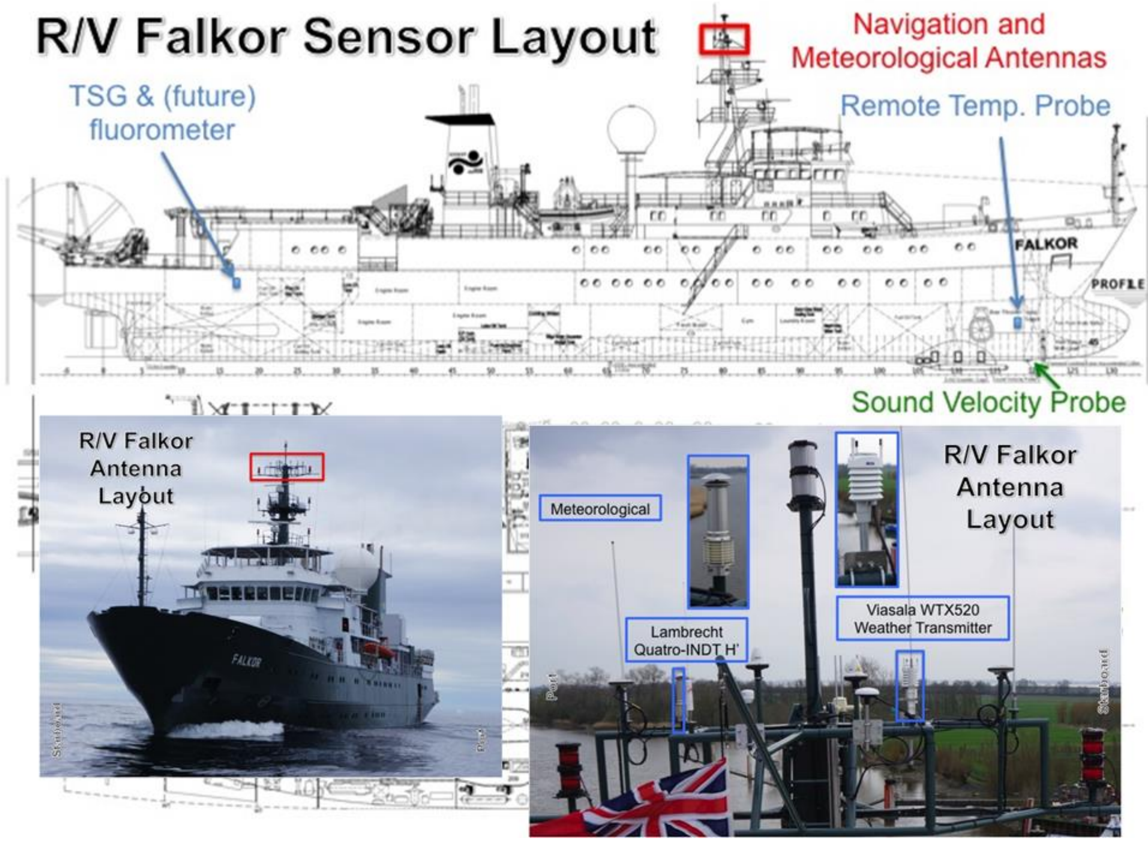


Figure 117: Examples of detailed vessel instrument imagery from the *R/V Falkor*.

a.

sea temperature			
Designator		Date Valid	
SST		06/01/2005 to Today	
Descriptive Name	Original Units	Instrument Make & Model	Last Calibration
sea temperature	celsius	Falmouth Science Inc. OTM-S-212 (OTM1378)	August 2004
TS Sensor Category	Observation Type	Distance from Bow	Distance from Center Line
12	measured	0	0
Height	Average Method	Averaging Time Center	Average Length
-5.4	average	time at end of period	1
Sampling Rate	Data Precision		
4	0.01		

b.

sea temperature			
Designator		Date Valid	
SST		05/09/2005 to Today	
Descriptive Name	Original Units	Instrument Make & Model	Last Calibration
sea temperature	celsius	Sea-bird SBE48 Hull Sensor	
TS Sensor Category	Observation Type	Distance from Bow	Distance from Center Line
hull contact sensor	measured	0	0
Height	Average Method	Averaging Time Center	Average Length
-5	average	time at end of period	1
Sampling Rate	Data Precision		
4	0.01		

Figure 118: Example showing parameter metadata completeness (a.) vs. incompleteness (b.). Note missing information in the "Last Calibration" field in (b.)

Following the above guidelines for completeness, Table 4 summarizes the current state of all SAMOS vessel and parameter metadata:

	Vessel Info	Contact Info	Vessel Layout	Digital Imagery	LAT	LON	HD	CRS	PL SPD	PL WSPD	PL WDIR	SPD	DIR	T	Td	Tw	P	RH	PRECIP	R RATE	LW	SW	NET RAD	PAR	TS	CON	SAL
KAOU	C	C	C	No	I	I	I	I	I	I	I	I	I	I	I		I,I	I	I		I	I		I	I,I,I	I,I	I,I
KAQP	C	C	C	Yes	I	I	I	I	I	C,I,I	C,I,I	C,I,I	C,I,I	C,I,I			C,I,I	C,I,I	*C*,I,I	I,I,I	I	I			C	I	C
KTDQ	C	C	C	No	I	I	I	I	I,C	C	C	C	C	C			C	C			C	I		I	I,I	C	C
NEPP	C	C	C	Yes	I	I	I,*I*	I	I,*I*,*I*	C,C	C,C	C,C	C,C	C,C,C	*C*,*C*		C,C	*C*,C	C		C,*C*	C		C	C,I	C	C
NRUO	C	I	I	No	I	I	I	I,I	I,I	I,I	I,I	I,I	I,I	I			I	I							I,I		I
VNAA	C	C	C	No	I	I	I,I	I	I	I,I	I,I	I,I	I,I	I,I			I	I,I	I,I	I	I,I	I,I		I,I	I		
WBP3210	C	I	C	Yes	I	I	I	I	I	I,I	I,I	I,I	I,I	I			I	I			I	I		I	I	I	I
WCX7445	C	C	C	Yes	I	I	I	I	I	I,I	I,I	I,I	I,I	C			C	I					I,I	I	I,I	C	I
WDA7827	C	C	C	No	I	I	I,I	I	I,*I*	I,I	I,I	I,I	I,I	I			I	I	I,I	I	I				I		I
WDC9417	C	C	C	Yes	I	I	I,I	I	I	I,I	I,I	I,I	I,I	I,I			I,I	I,I	*I*,I,I						I,I	I	I
WDD6114	C	C	I	No	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WDG7520	I	I	I	No	I	I	I	I	I,I,I	C	I	I	I	C			C	C			I	I		I	*C*,C	C	I
WSQ2674	C	I	I	No	I	I	I	I	I	I	I	I	I	I,I			I,I	I	I					I	I		
WTDF	C	C	C	No	I	I	I	I	I,I,I	I	I	I	I	I			I	I			I	I			I	I	I
WTDH	C	I	C	Yes	I	I	I	I	I	I	I	I	I	I			C	I							I,I	I	I
WTDL	C	I	C	Yes	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTDO	C	I	C	No	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTEA	C	C	C	No	I	I	I	I	I	I	I	I	I	I	I	I	I	I							I		
WTEB	I	I	C	No	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTEC	C	I	C	No	I	I	I	I	I	C	I	C	C	C			C	C				I			I	C	I
WTED	C	C	C	Yes	I	I	I	I	I	I,I	I,I	I,I	I,I	I,*I*			I	I,*I*			I	I			I	I	I
WTEE	C	C	C	No	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTEF	I	I	C	No	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTEG	I	I	I	No	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTEK	I	I	C	No	I	I	I	I	I	I	I	I	I	I			I	I									
WTEO	C	I	C	Yes	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTEP	C	I	C	Yes	I	I	I	I	I	I	I	I	I	I			I	I							I	I	I
WTER	C	I	I	Yes	I	I	I	I	I	I	I	I	I	I			I	I							I,I	I	I
WTEY	C	I	C	Yes	I	I	I,I,I	I	I	I	I	I	I	I			I,*I*	I							I,I	I	I
ZCYL5	C	C	C	Yes	C	C	C	C	C,C,C	C,C	C,C	C,C,*C*	C,C,*C*	C,C			I,I	C,C						I,I	C,C	C	C
ZMFR	I	I	C	No	I	I	I	I	I			C	C	C			I	C	I		I,I	I,I			I		

Table 4: Vessel and parameter metadata overview. "C" indicates complete metadata; "I" indicates incomplete metadata; *light type italics* indicate discontinued variables. Under "Digital Imagery," "Yes" indicates the existence of vessel/instrument imagery in the SAMOS database, "No" indicates non-existence. Empty boxes indicate non-existence of a parameter; multiple entries in any box indicate multiple sensors for that parameter and vessel.

5. Plans for 2016

As the SAMOS initiative continues its second decade following the workshop where the concept was born (http://coaps.fsu.edu/RVSMDC/marine_workshop/Workshop.html), the SAMOS chairman would like to personally thank all of the technicians, operators, captains, and crew of the SAMOS research vessels for their dedication to the project. The data center team would also like to thank personnel within our funding agencies, NOAA OMAO, NOAA NCEI, NOAA ESRL, Australian IMOS project, and the Schmidt Ocean Institute for their continued support of the SAMOS initiative.

The SAMOS DAC also recognizes an ongoing partnership with the Rolling deck To Repository (R2R; http://www.rvdata.us/overview) project. Funded by the National Science Foundation, R2R is developing a protocol for transferring all underway data (navigation, meteorology, oceanographic, seismic, bathymetry, etc.) collected on U. S. University-National Oceanographic Laboratory System (UNOLS) research vessels to a central onshore repository. During 2015, the university-operated vessels contributing to the SAMOS DAC were those operated by LUMCON, WHOI, SIO, UA, UH, UW, and BIOS. The focus of the R2R is collecting and archiving the full-sampling-level (e.g., sampling rates up to 1 Hz) underway data at the end of each planned cruise, which are the source data for the 1-min averages submitted to SAMOS in daily emails. In 2016 we plan to recruit four additional university-operated vessels into SAMOS including the newly launched *Neil Armstrong* from WHOI and the *Sally Ride* from SIO.

In 2016 the DAC will be completing a major server migration and software upgrades that will ensure the SAMOS data processing will be stable for the next 3-5 years. During this process we will implement several new quality tests (including using a one-minute grid land-ocean mask to verify a vessel's position as over water). Beyond summer 2016, new development of the SAMOS QC system will be limited until additional resources can be secured. Although improved automation is helpful, the chairman does wish to note that failure to conduct full visual quality control does degrade the quality of the data being provided to our users. Automated QC will never be able to replace a set of experienced "eyes on the data".

Also planned for 2016 is the inclusion of an hourly subset of all available SAMOS data (2005-2014) in the upcoming release 3.0 of the International Comprehensive Ocean-Atmosphere DataSet (ICOADS; Woodruff et al. 2011) – Anticipated April/May 2016. ICOADS offers surface marine data dating back to the 17th Century, with simple gridded monthly summary products for 2° latitude x 2° longitude boxes back to 1800 (and 1°x1° boxes since 1960)—these data and products are freely distributed worldwide. Inclusion of your data in ICOADS will expand the reach of the SAMOS observations to the wider marine climate and research communities. The procedure has been completed (Smith and Elya 2015) and we plan to begin providing monthly updates to ICOADS once release 3.0 is available.

6. References

The Australian Integrated Marine Observing System, 2008: *J. Ocean Technology* **3**(3), 80-81.

Pieter R. Wiederhold, cited 2010: True Accuracy of Humidity Measurement. [Available online at http://archives.sensorsmag.com/articles/0997/humidity/index.htm.]

Smith, S. R., and J. Elya: 2015. Procedure for placing hourly super-observations from the Shipboard Automated Meteorological and Oceanographic System (SAMOS) Initiative into ICOADS**.** COAPS, Tallahassee, FL, USA, 34 pp. Available from Center for Ocean-Atmospheric Prediction Studies, Florida State University, Tallahassee, Florida, 32306-2840, USA and online at http://icoads.noaa.gov/e-doc/other/transpec/samos/SAMOS_RVtoIMMAprocedure_v2p1.pdf.

Smith, S. R., J. J. Rolph, K. Briggs, M. A. Bourassa, 2009: Quality-Controlled Underway Oceanographic and Meteorological Data from the Center for Ocean-Atmospheric Predictions Center (COAPS) - Shipboard Automated Meteorological and Oceanographic System (SAMOS). National Oceanographic Data Center, NOAA. Dataset. doi:10.7289/V5QJ7F8R

Woodruff, S.D., S.J. Worley, S.J. Lubker, Z. Ji, J.E. Freeman, D.I. Berry, P. Brohan, E.C. Kent, R.W. Reynolds, S.R. Smith, and C. Wilkinson, 2011: ICOADS Release 2.5: Extensions and enhancements to the surface marine meteorological archive. *Int. J. Climatol.* (CLIMAR-III Special Issue), **31**, 951-967 (doi:10.1002/joc.2103).

Ship schedule references, publicly available only:

UNOLS vessels are found online at http://strs.unols.org/public/search/diu_all_schedules.aspx?ship_id=0&year=2010 (*Atlantic Explorer*, *Atlantis*, *Kilo Moana*, *Knorr*, *Laurence M. Gould*, *Nathaniel B. Palmer*, *New Horizon*, *Pelican*, *Robert Gordon Sproul*, *Roger Revelle*, *Sikuliaq*, and *Thomas G. Thompson*)

R2R vessels are found online at http://www.rvdata.us/catalog (All of the above, and *Falkor*, *Healy*)

Aurora Australis and *Tangaroa* are found online at https://its-app3.aad.gov.au/public/schedules/index.cfm

Annex A: Data Subsets with Verified Issues, Unflagged (listed by vessel)

All of the following data subsets should be considered either suspect or unreliable, as noted. The vessels listed here do not receive visual quality control. As such, this compilation relies only on notifications sent to the DAC by vessel operators or email exchanges initiated by the DAC; in many cases the exact cause and/or the exact date range under impact are unknown.

Atlantic Explorer: no notes.

Atlantis:

- 1 January – 19 March: CNDC units misidentified as Siemens/m; units are actually Siemens/m × 0.1 (note this inaccuracy actually dates back to 1 January 2013)
- 2 May from 15:00 to 18:00 GMT: TS, SSPS, CNDC unreliable (flow through system secured during port stop)
- 7 June – termination unknown: TS, SSPS, CNDC unreliable (flow through seawater system down)

Kilo Moana: no notes.

Laurence M. Gould:

- onset unknown – 27 May: P suspect (low values, suspected frozen condensation involved; barometer serviced on 27 May)

Nathaniel B. Palmer:

- 8 – 11 June: RAD_SW, RAD_LW unreliable (sensor designators apparently swapped. note data may be usable as long as this swap is recognized.)

New Horizon: no notes.

Pelican:

- 8 – 14 August: TS, SSPS, CNDC unreliable (TSG through-flow pump turned off. Note TS is G flagged (greater than four standard deviations from climatology), the data should nevertheless be considered unreliable.)

Robert Gordon Sproul: no notes.

Roger Revelle: no notes.

Sikuliaq:

- 7 April – 27 July: SPD units misidentified as m/s; units are actually kts.
- 7 April – 20 September: CNDC units misidentified as Siemens/m; units are actually Siemens/m × 0.1

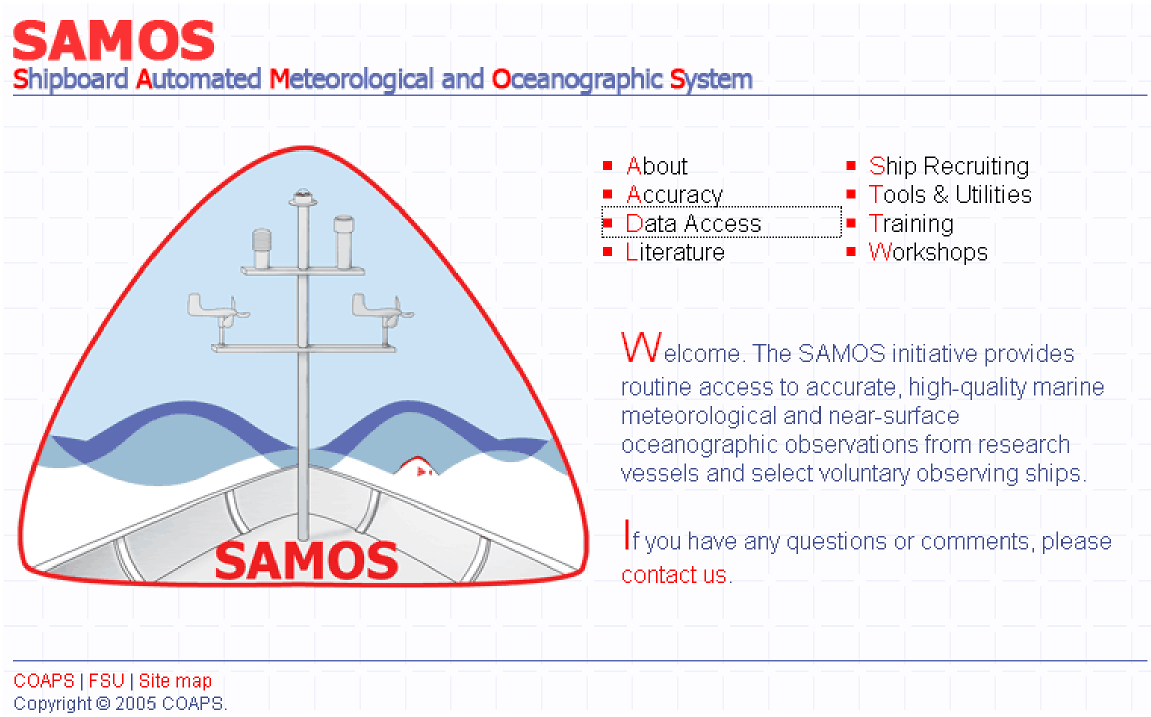
Tangaroa: no notes.

Thomas G. Thompson: no notes.

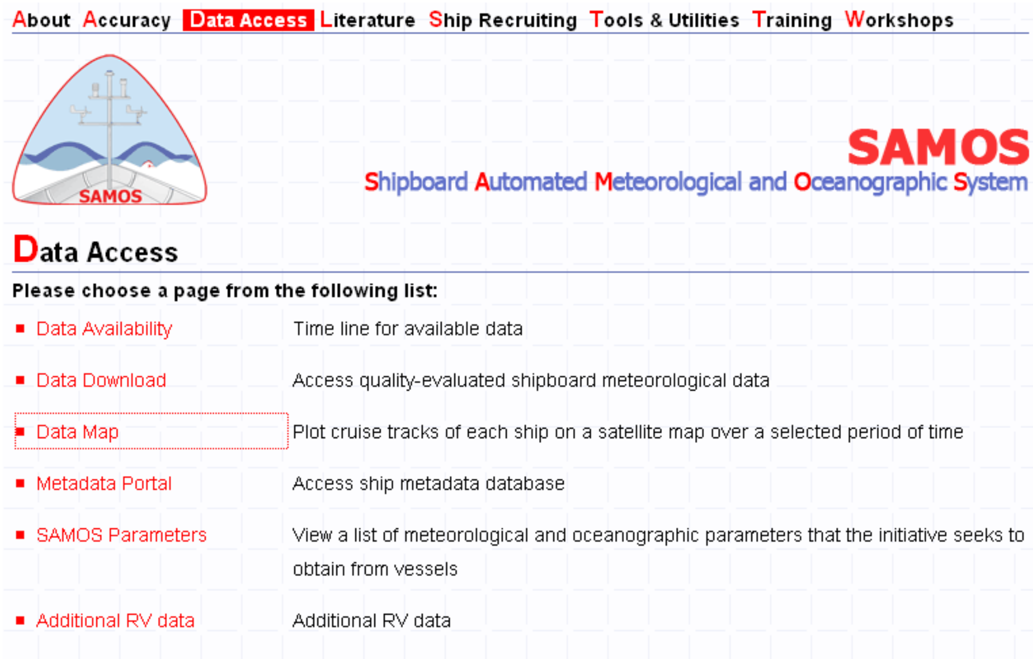
Annex B: SAMOS Online Metadata System Walk-through Tutorial

PART 1: the end user

The SAMOS public website can be entered via the main page at http://samos.coaps.fsu.edu/html/



By choosing the Data Access link (boxed area), the user can access preliminary, intermediate, and research-quality data along with graphical representations of data availability and quality. As an example, consider the user who wants to find 2009 in situ wind and temperature data for the north-polar region. The first step would be to identify which ships frequented this area in 2009. To do so, choose Data Map on the Data Access page:


About Accuracy Data Access Literature Ship Recruiting Tools & Utilities Training Workshops

SAMOS

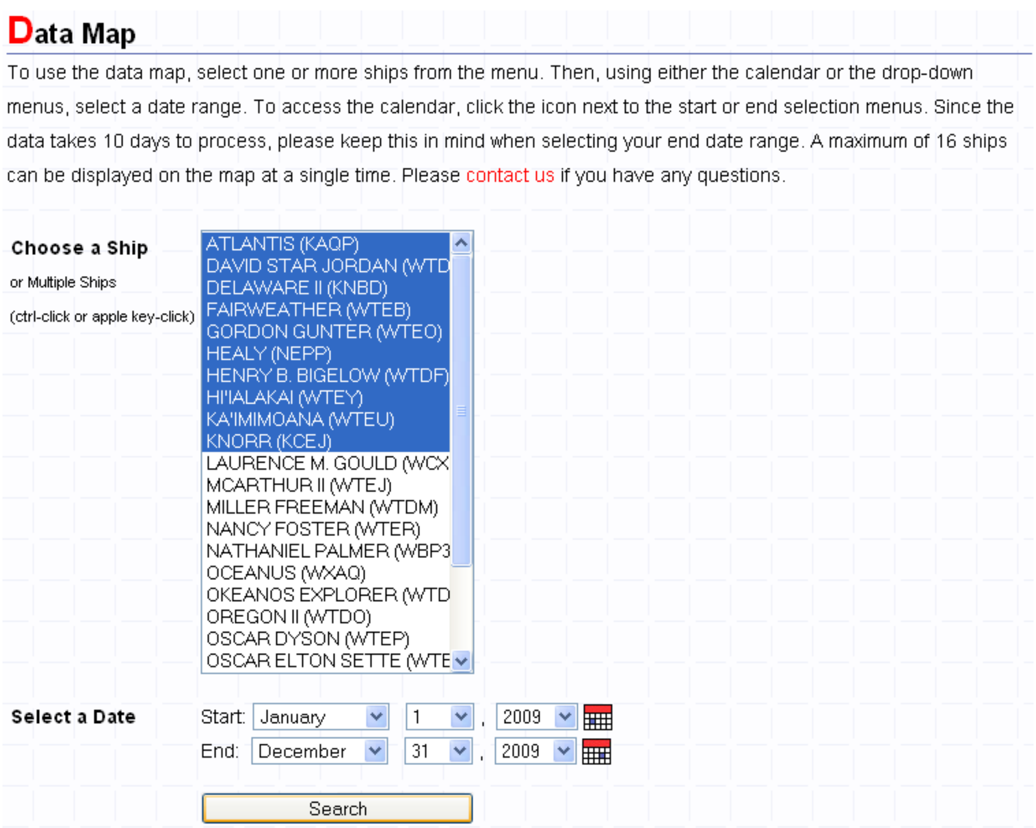
Shipboard Automated Meteorological and Oceanographic System

Data Access

Please choose a page from the following list:

Data Availability	Time line for available data
Data Download	Access quality-evaluated shipboard meteorological data
Data Map	Plot cruise tracks of each ship on a satellite map over a selected period of time
Metadata Portal	Access ship metadata database
SAMOS Parameters	View a list of meteorological and oceanographic parameters that the initiative seeks to obtain from vessels
Additional RV data	Additional RV data

The user highlights a set of ships from the available list (10 ships may be chosen at a time):


Data Map

To use the data map, select one or more ships from the menu. Then, using either the calendar or the drop-down menus, select a date range. To access the calendar, click the icon next to the start or end selection menus. Since the data takes 10 days to process, please keep this in mind when selecting your end date range. A maximum of 16 ships can be displayed on the map at a single time. Please contact us if you have any questions.

Choose a Ship
or Multiple Ships
(ctrl-click or apple key-click)

ATLANTIS (KAQP)
DAVID STAR JORDAN (WTD
DELAWARE II (KNBD)
FAIRWEATHER (WTEB)
GORDON GUNTER (WTEO)
HEALY (NEPP)
HENRY B. BIGELOW (WTDF)
HI'IALAKAI (WTEY)
KA'IMIMOANA (WTEU)
KNORR (KCEJ)
LAURENCE M. GOULD (WCX
MCARTHUR II (WTEJ)
MILLER FREEMAN (WTDM)
NANCY FOSTER (WTER)
NATHANIEL PALMER (WBP3
OCEANUS (WXAQ)
OKEANOS EXPLORER (WTD
OREGON II (WTDO)
OSCAR DYSON (WTEP)
OSCAR ELTON SETTE (WTE

Select a Date

Start: January 1 , 2009
End: December 31 , 2009

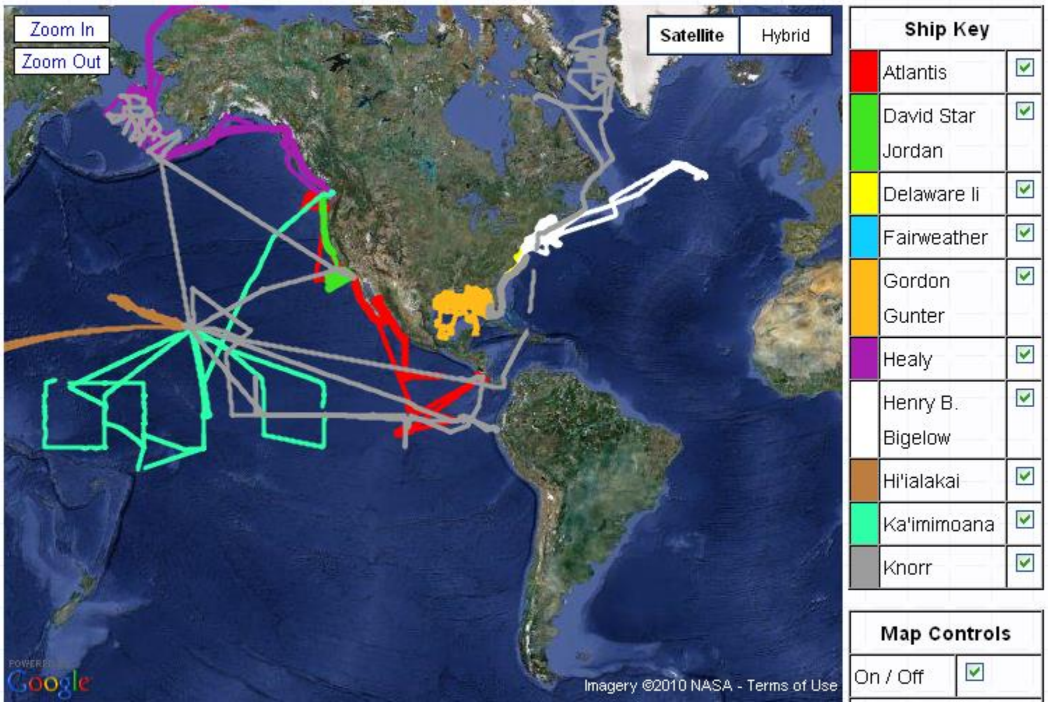
Search

By entering a date range of January 1, 2009 to December 31, 2009 and clicking "search," a map is displayed showing all of the selected ship's tracks for the year 2009:

Data Map

The purpose of this page is for the user to select ships and date ranges. Then, using Google maps, a track of the ship(s) will be displayed for the selected dates. To view the tracks of other ships or dates, click here. To learn more about the map and ship tracks, please read the documentation.

January 1, 2009 - December 31, 2009



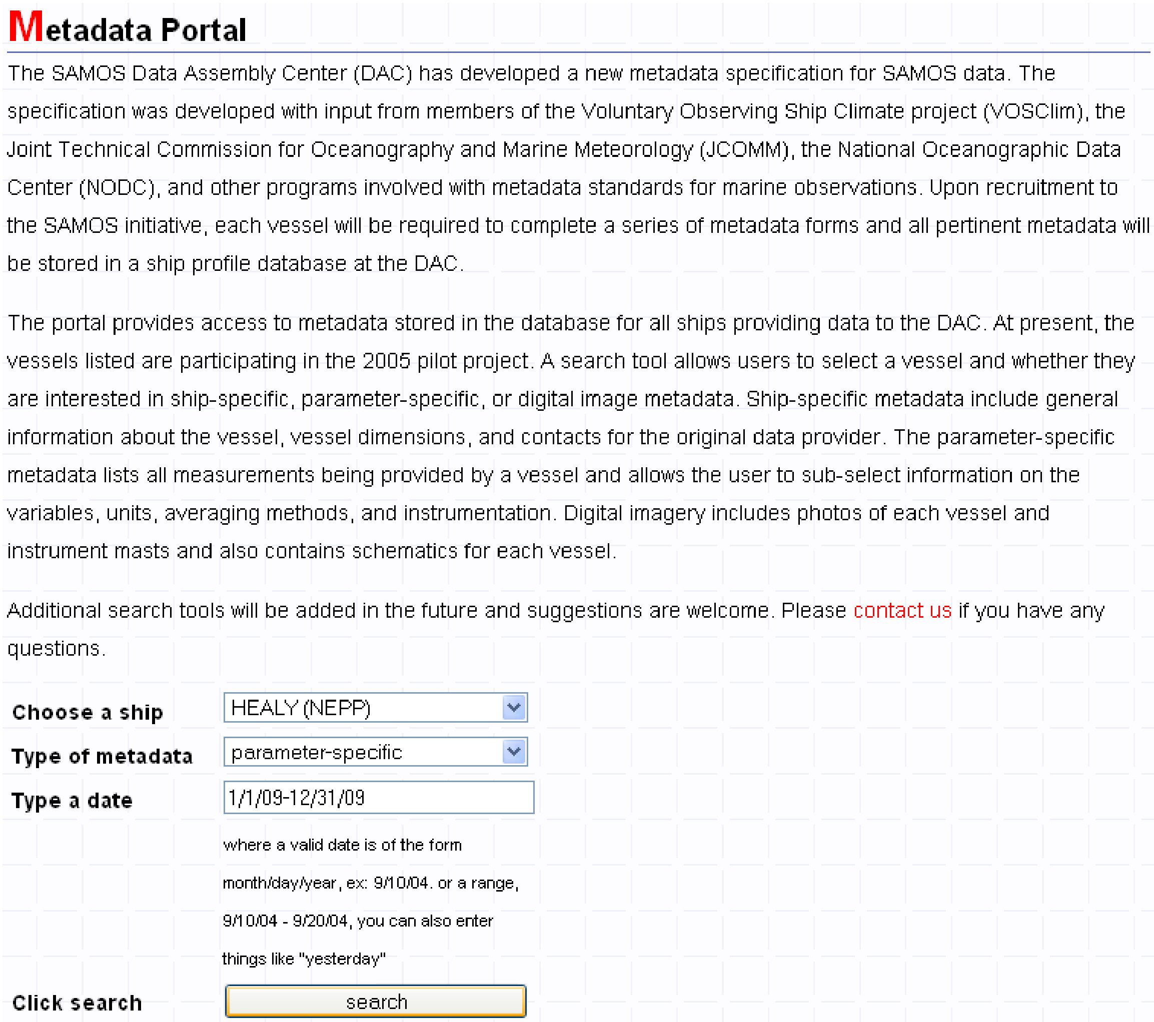
Now the user can see that both the *Healy* and the *Knorr* cruised in the north-polar region in 2009. The next step might be to see what parameters are available on each ship. Returning to the Data Access page, the user this time selects the Metadata Portal:

Data Access

Please choose a page from the following list:

■ Data Availability	Time line for available data
■ Data Download	Access quality-evaluated shipboard meteorological data
■ Data Map	Plot cruise tracks of each ship on a satellite map over a selected period of time
■ Metadata Portal	Access ship metadata database
■ SAMOS Parameters	View a list of meteorological and oceanographic parameters that the initiative seeks to obtain from vessels
■ Additional RV data	Additional RV data

and first inputs the proper information for the *Healy*:



Metadata Portal

The SAMOS Data Assembly Center (DAC) has developed a new metadata specification for SAMOS data. The specification was developed with input from members of the Voluntary Observing Ship Climate project (VOSClim), the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM), the National Oceanographic Data Center (NODC), and other programs involved with metadata standards for marine observations. Upon recruitment to the SAMOS initiative, each vessel will be required to complete a series of metadata forms and all pertinent metadata will be stored in a ship profile database at the DAC.

The portal provides access to metadata stored in the database for all ships providing data to the DAC. At present, the vessels listed are participating in the 2005 pilot project. A search tool allows users to select a vessel and whether they are interested in ship-specific, parameter-specific, or digital image metadata. Ship-specific metadata include general information about the vessel, vessel dimensions, and contacts for the original data provider. The parameter-specific metadata lists all measurements being provided by a vessel and allows the user to sub-select information on the variables, units, averaging methods, and instrumentation. Digital imagery includes photos of each vessel and instrument masts and also contains schematics for each vessel.

Additional search tools will be added in the future and suggestions are welcome. Please contact us if you have any questions.

Choose a ship	HEALY (NEPP)
Type of metadata	parameter-specific
Type a date	1/1/09-12/31/09
	where a valid date is of the form month/day/year, ex: 9/10/04. or a range, 9/10/04 - 9/20/04, you can also enter things like "yesterday"
Click search	search

The result, once "search" is clicked, is an exhaustive list of all parameters available from the *Healy* in 2009:

Metadata Portal

HEALY

Expand each of the ship's variables for a detailed view

[Show All] [Hide All]

Order: [Alphabetically] [netCDF order]

Download PDF

- + **time**
- + **latitude**
- + **longitude**
- + **platform heading**
- + **platform heading 2**
- + **platform course**
- + **earth relative wind direction**
- + **earth relative wind direction 2**
- + **platform relative wind direction**
- + **platform relative wind direction 2**
- + **platform speed over ground**
- + **platform speed over water**
- + **platform speed over water 2**
- + **earth relative wind speed**
- + **earth relative wind speed 2**

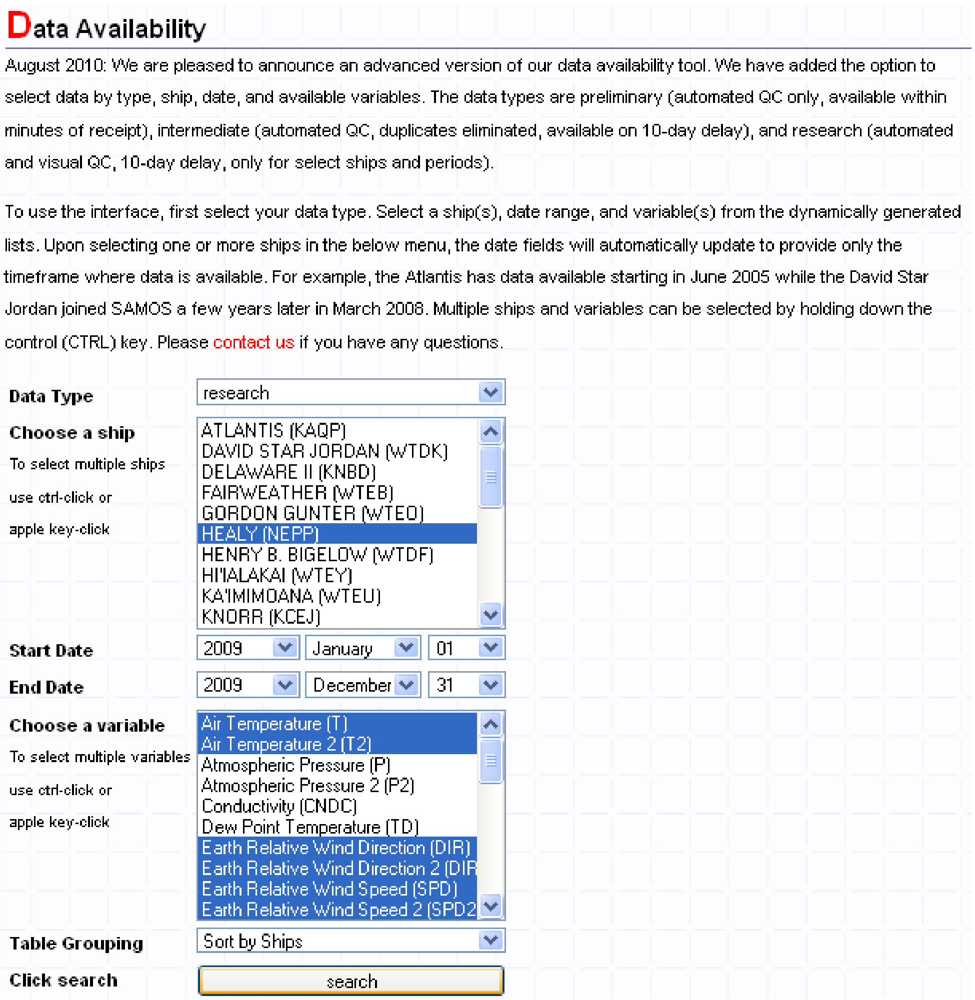
A thorough investigation of the list (note: image is truncated) tells the user the *Healy* did in fact provide both wind and temperature data in 2009. (Throughout the online SAMOS system, clicking on a "+" will yield further information; in this case the result would be metadata for the individual parameters.) Now the user will want to know the quality of the wind and temperature data. To find that, he returns once again to the Data Access page and this time chooses Data Availability:

Data Access

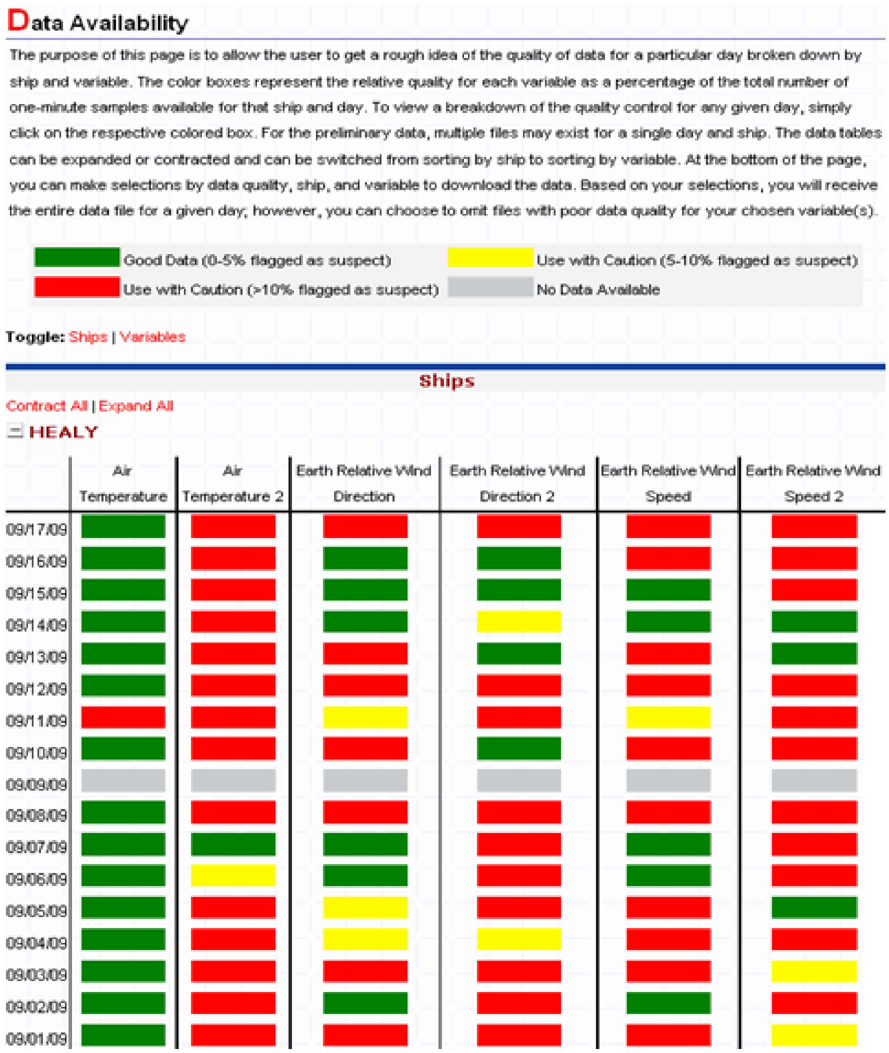
Please choose a page from the following list:

Data Availability	Time line for available data
Data Download	Access quality-evaluated shipboard meteorological data
Data Map	Plot cruise tracks of each ship on a satellite map over a selected period of time
Metadata Portal	Access ship metadata database
SAMOS Parameters	View a list of meteorological and oceanographic parameters that the initiative seeks to obtain from vessels
Additional RV data	Additional RV data

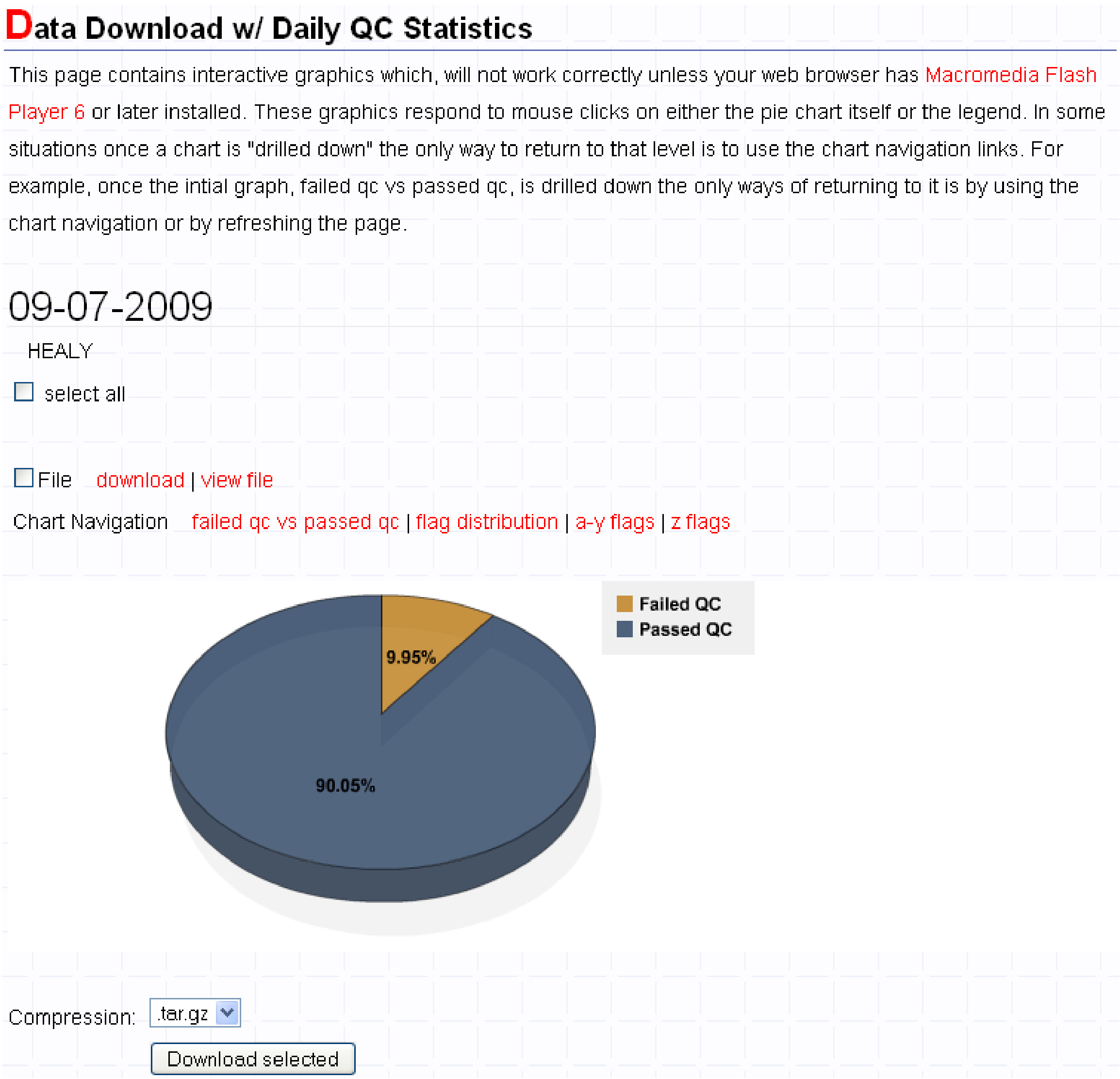
After selecting the *Healy* along with the desired parameter(s), date range, and data version (preliminary, intermediate, or research), noting that the default date range and available parameters will change once a vessel and data version are selected, and then clicking "search":



the user arrives at a timeline showing on which days in 2009 the Healy provided data for the chosen parameter(s), as well as the quality of that data for each calendar day (note: image has been customized):



Color-coding alerts the user to the perceived quality of the data. As explained in the key at the top of the page, green indicates "Good Data" (with 0-5% flagged as suspect), yellow indicates "Use with Caution" (with 5-10% flagged as suspect), and red indicates a more emphatic "Use with Caution" (with >10% flagged as suspect). A grey box indicates that no data exists for that day and variable. In this case, the user can automatically see that on 09/07/09 all of the *Healy's* temperature data and the winds from the first wind sensor are considered "Good Data." More detailed flag information, as well as information pertaining to all other available parameters, can be found by simply clicking on any colored box. As an example, by clicking over the red bar for DIR2 on the date 09/07/09 a user can find out more specific information about data quality to determine whether the wind data might also be useful. When the red bar is clicked, the user is first directed to a pie chart showing overall quality:



Data Download w/ Daily QC Statistics

This page contains interactive graphics which, will not work correctly unless your web browser has Macromedia Flash Player 6 or later installed. These graphics respond to mouse clicks on either the pie chart itself or the legend. In some situations once a chart is "drilled down" the only way to return to that level is to use the chart navigation links. For example, once the intial graph, failed qc vs passed qc, is drilled down the only ways of returning to it is by using the chart navigation or by refreshing the page.

09-07-2009

HEALY

select all

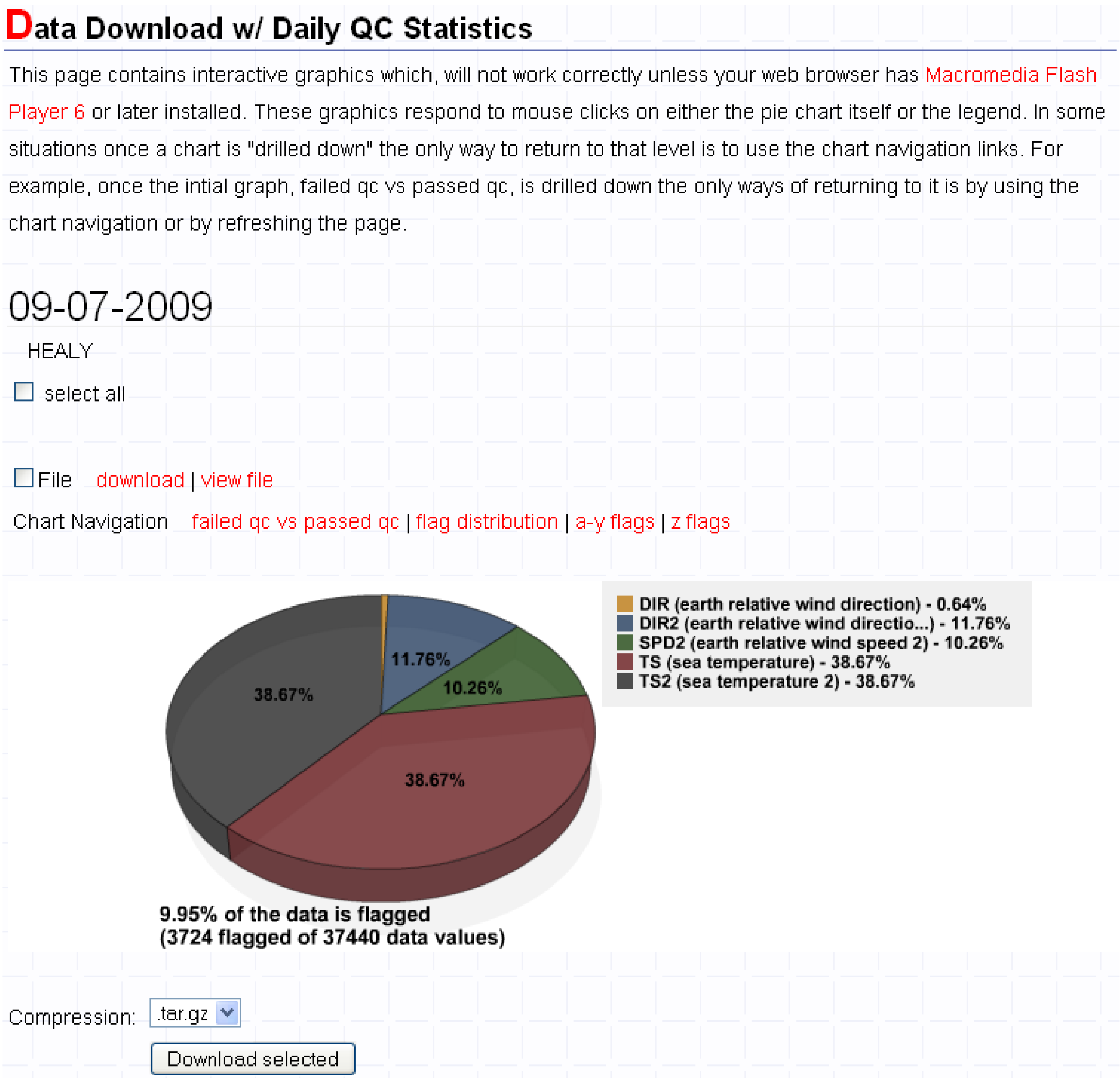
File download | view file

Chart Navigation failed qc vs passed qc | flag distribution | a-y flags | z flags

Compression: .tar.gz

Download selected

Clicking over the yellow pie slice showing the percentage of data that failed quality control yields a more in-depth look:



The user can now check to see precisely what types of flags were applied to the second wind sensor data, as only a portion of the data were flagged and they may still be usable. By clicking on either the blue pie slice for "DIR2" or the "DIR2" line in the grey box, he determines that "caution" flags were applied to a portion of the data:

Data Download w/ Daily QC Statistics

This page contains interactive graphics which, will not work correctly unless your web browser has Macromedia Flash Player 6 or later installed. These graphics respond to mouse clicks on either the pie chart itself or the legend. In some situations once a chart is "drilled down" the only way to return to that level is to use the chart navigation links. For example, once the intial graph, failed qc vs passed qc, is drilled down the only ways of returning to it is by using the chart navigation or by refreshing the page.

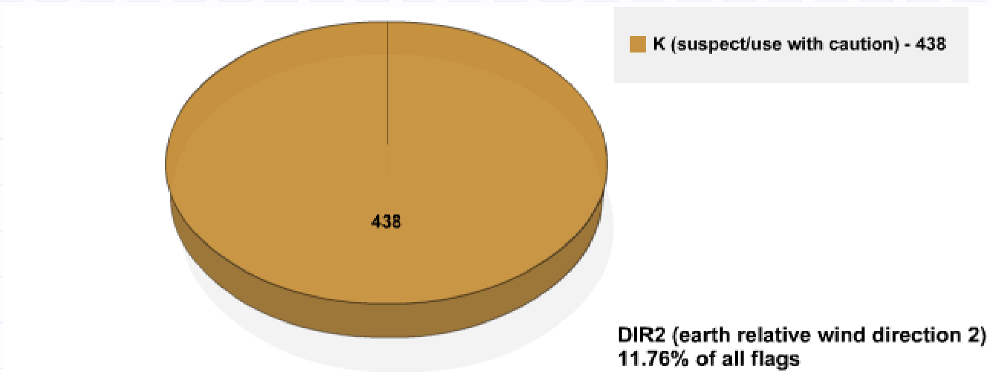
09-07-2009

HEALY

☐ select all

☑ File   download | view file

Chart Navigation   failed qc vs passed qc | flag distribution | a-y flags | z flags



Compression: .zip

Download selected

In this example, the user might repeat these steps to evaluate the quality of "SPD2" for 09/07/09. In the end, perhaps he decides the second wind sensor data will also be useful to him and now he would like to download the data. There are a couple of ways to accomplish this: By toggling a check mark in the "File" box (as shown above) and choosing the preferred file compression format (".zip" in this case) on this or any of the pie chart pages, the 09/07/09 file containing all available parameters for that date is downloaded once "Download selected" is clicked. (Note that the entire file must be downloaded; individual parameters are not available for singular download at this time.) Alternatively, the user can return to the Data Access page and choose Data Download, where he will have an opportunity to download multiple files at one time:

Data Access

Please choose a page from the following list:

Data Availability	Time line for available data
Data Download	Access quality-evaluated shipboard meteorological data
Data Map	Plot cruise tracks of each ship on a satellite map over a selected period of time
Metadata Portal	Access ship metadata database
SAMOS Parameters	View a list of meteorological and oceanographic parameters that the initiative seeks to obtain from vessels
Additional RV data	Additional RV data

Let us assume that, after careful consideration of the quality of wind and temperature data from the *Healy* for the period from 09/07/09 to 09/11/09, the user decides he would like to download all available data from that period. By filling in the proper information on the Data Download page:

Choose a ship

or multiple ships (ctrl-click or apple key-click), or no ships

ATLANTIS (KAQP)
DAVID STAR JORDAN (WTD
DELAWARE II (KNBD)
FAIRWEATHER (WTEB)
GORDON GUNTER (WTEO)
HEALY (NEPP)
HENRY B. BIGELOW (WTDF)
HI'IALAKAI (WTEY)
KA'IMIMOANA (WTEU)
KNORR (KCEJ)
LAURENCE M. GOULD (WCX
MCARTHUR II (WTEJ)
MILLER FREEMAN (WTDM)
NANCY FOSTER (WTER)
NATHANIEL PALMER (WBP3
OCEANUS (WXAQ)
OKEANOS EXPLORER (WTD
OREGON II (WTDO)
OSCAR DYSON (WTEP)
OSCAR ELTON SETTE (WTE

Type a date

9/7/09-9/11/09

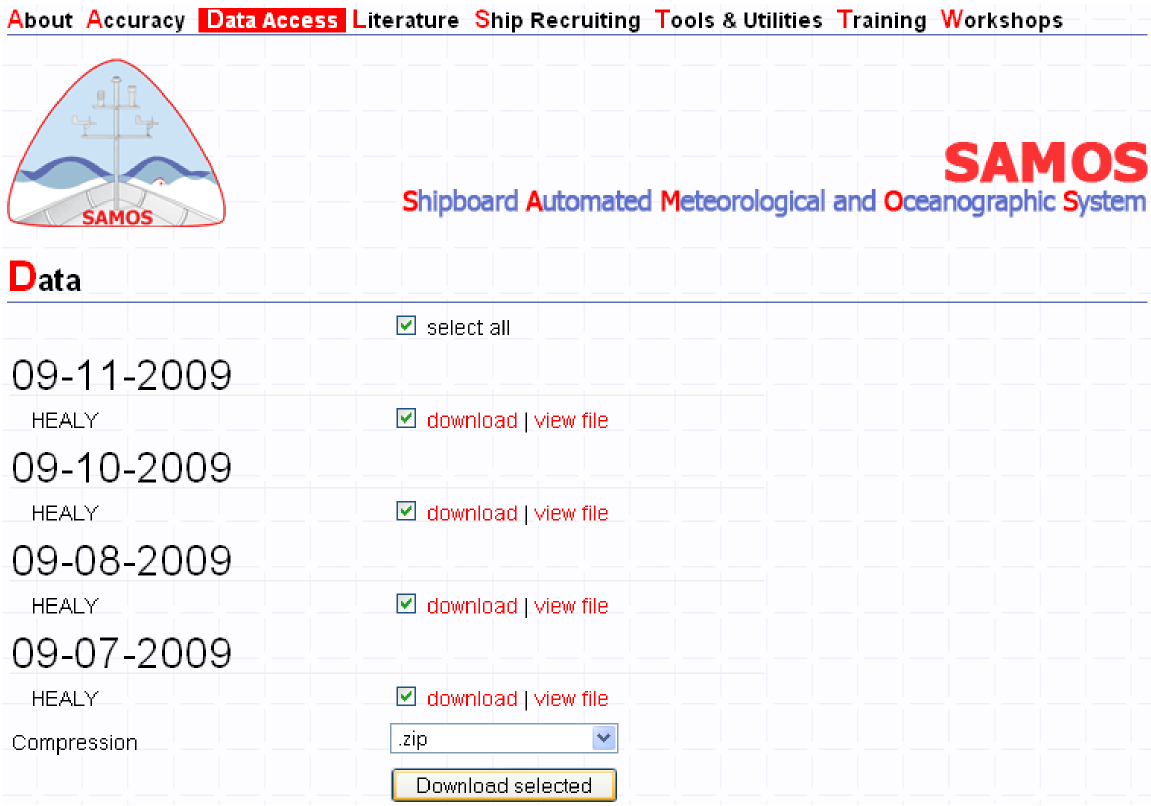
where a valid date is of the form month/day/year, ex: 9/10/04. or a range, 9/10/04 - 9/20/04, you can also enter things like "yesterday". if nothing is entered, everything is returned (this will take some time)

Sorted by date collected

Data research

Click search search

the user can choose "select all," along with a file compression format, and click "Download selected" to begin the download:



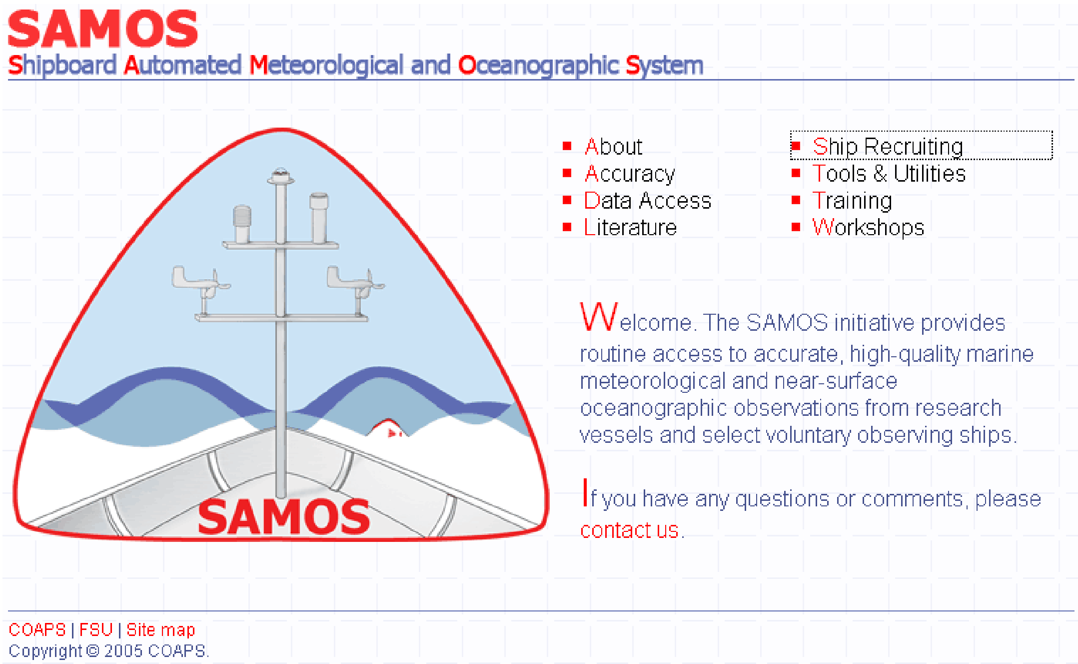
PART 2: the SAMOS operator

(NOTE: a step-by-step example created by a shipboard technician, suitable for saving and generalizing to any SAMOS instrument metadata change, follows this summary)

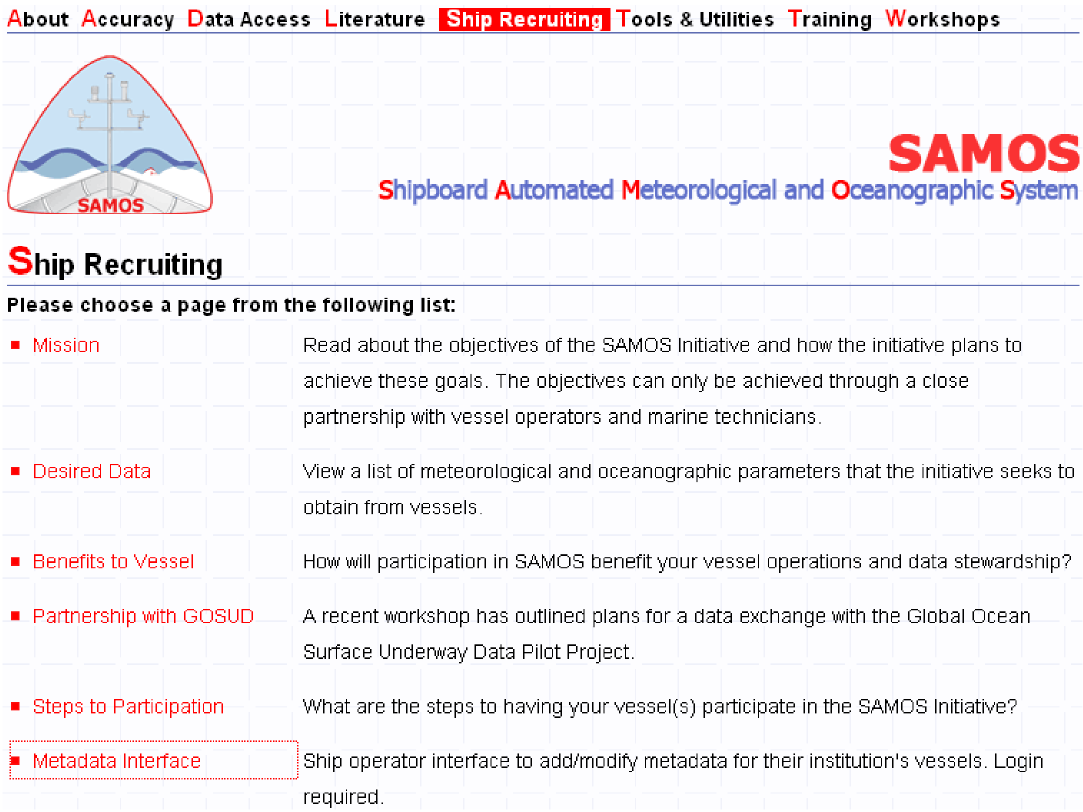
A SAMOS operator might choose to follow the steps outlined in part one as a simple way to keep tabs on the performance of his instruments. When problems are observed, vessel and instrument metadata are important tools for diagnosing a problem and finding a solution. For this reason we strongly emphasize the need for complete, accurate, up-to-date information about the instruments in use. Digital imagery of the ship itself and of the locations of instruments on the ship is also highly desirable, as it is often beneficial in diagnosing flow obstruction issues. As a SAMOS operator, it is important to note that metadata (vessel and/or instrument) should be updated whenever new instruments are added or changes are made to existing instruments (for example moving an instrument or performing a calibration). Inputting and modifying both vessel and instrument metadata are easy tasks that the SAMOS operator can perform via the internet at any time, provided the ship exists in the database and has been assigned "original time units" by a

SAMOS associate at COAPS. In order to use the online system, the SAMOS operator will need to be assigned a unique login and password for his ship, which is obtained by contacting samos@coaps.fsu.edu. With a login and password in hand, the following steps outline the methods for inputting and updating metadata.

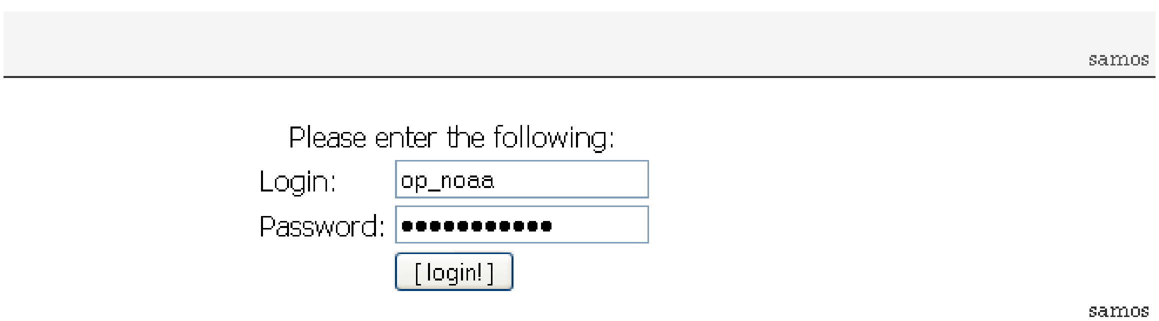
The database can be accessed by visiting the main page and choosing Ship Recruiting:



(or by navigating directly to the Ship Recruiting page, located at http://samos.coaps.fsu.edu/html/nav.php?s=4), and then choosing Metadata Interface:



The user will then be directed to log in, using their group's username and password (please contact samos@coaps.fsu.edu to obtain a username or for misplaced passwords):



Once logged in, the SAMOS operator chooses to modify either Vessel or Instrument Metadata..

a. Select Vessel Metadata

user ship related

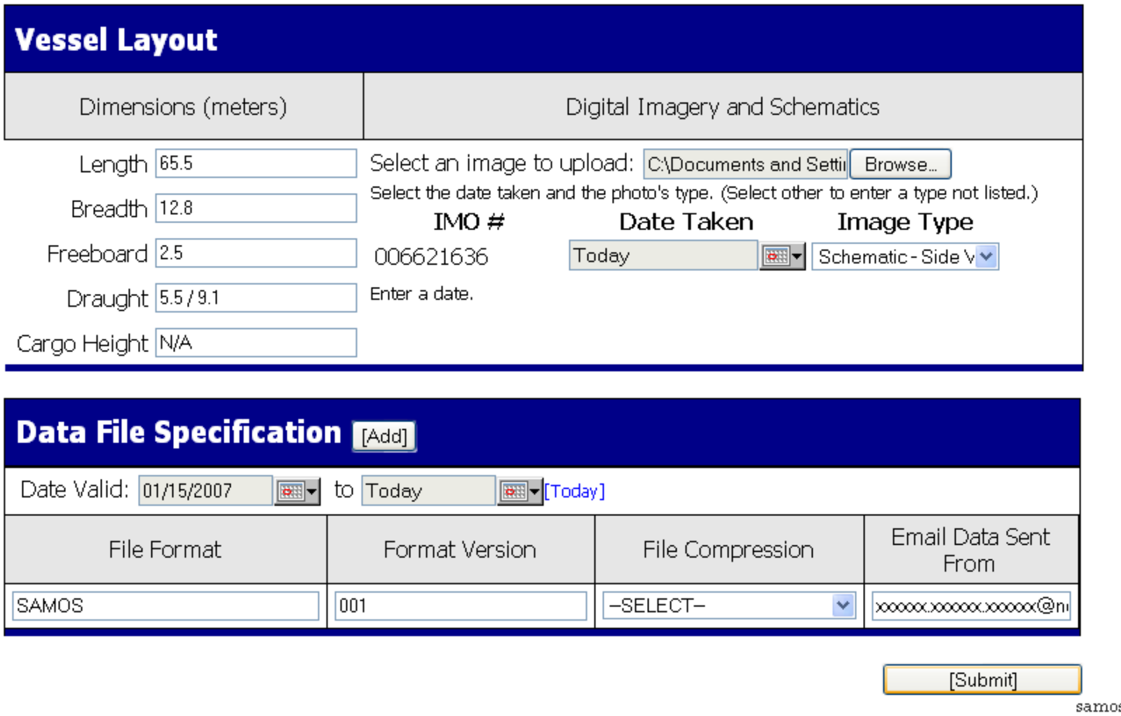
Edit Metadata

Ships for user op_noaa:

Ship Name	Call Sign	Vessel Metadata	Instrument Metadata
DAVID STAR JORDAN	WTDK	[modify]	[modify]
FAIRWEATHER	WTEB	[modify]	[modify]
GORDON GUNTER	WTEO	[modify]	[modify]
HENRY B. BIGELOW	WTDF	[modify]	[modify]
HI'IALAKAI	WTEY	[modify]	[modify]
KA'IMIMOANA	WTEU	[modify]	[modify]
MILLER FREEMAN	WTDM	[modify]	[modify]
NANCY FOSTER	WTER	[modify]	[modify]
OSCAR DYSON	WTEP	[modify]	[modify]
RAINIER	WTEF	[modify]	[modify]
RON BROWN	WTEC	[modify]	[modify]

samos

This metadata form provides Vessel Information (such as call sign and home port location), Contact Information for the home institution and shipboard technicians (as well as any other important persons), Vessel Layout, which details ship dimensions and allows for the uploading of digital imagery, and Data File Specification, which refers to the file format and file compression associated with SAMOS data transmission. On this page, all an operator would need to do is fill in the appropriate information and click "submit." For example, let us assume operator op_noaa desires to add a digital image to his vessel's metadata. Assuming the desired image is located on his native computer, he would merely need to click "Browse" to find the image he wants, fill in a Date Taken (if known) and choose an Image Type from the dropdown list, and then click "Submit" at the bottom of the page:



When editing Vessel Metadata, it is important to remember that submitting any new information will overwrite any existing information. The user should therefore take special care not to accidentally overwrite a valid field, for example the vessel Draught field. However, adding an image, as previously demonstrated, will not overwrite any existing images. This is true even if a duplicate Image Type is selected. The only way to remove an image is to contact SAMOS database personnel at COAPS. In any case, other than the addition of photos, Vessel Metadata does not often change. Additionally, except in the incidental case of Data File Specification (shown in image), changes are not date-tracked. Regarding the Date Valid field in the Data File Specification section, this date window maps to the File Format, Version, and Compression properties; it is not intended to capture the date Vessel Metadata changes were made by the SAMOS operator.

b. Select Instrument Metadata

(NOTE: a step-by-step example created by a shipboard technician, suitable for saving and generalizing to any SAMOS instrument metadata change, follows this summary)

user ship related

Edit Metadata

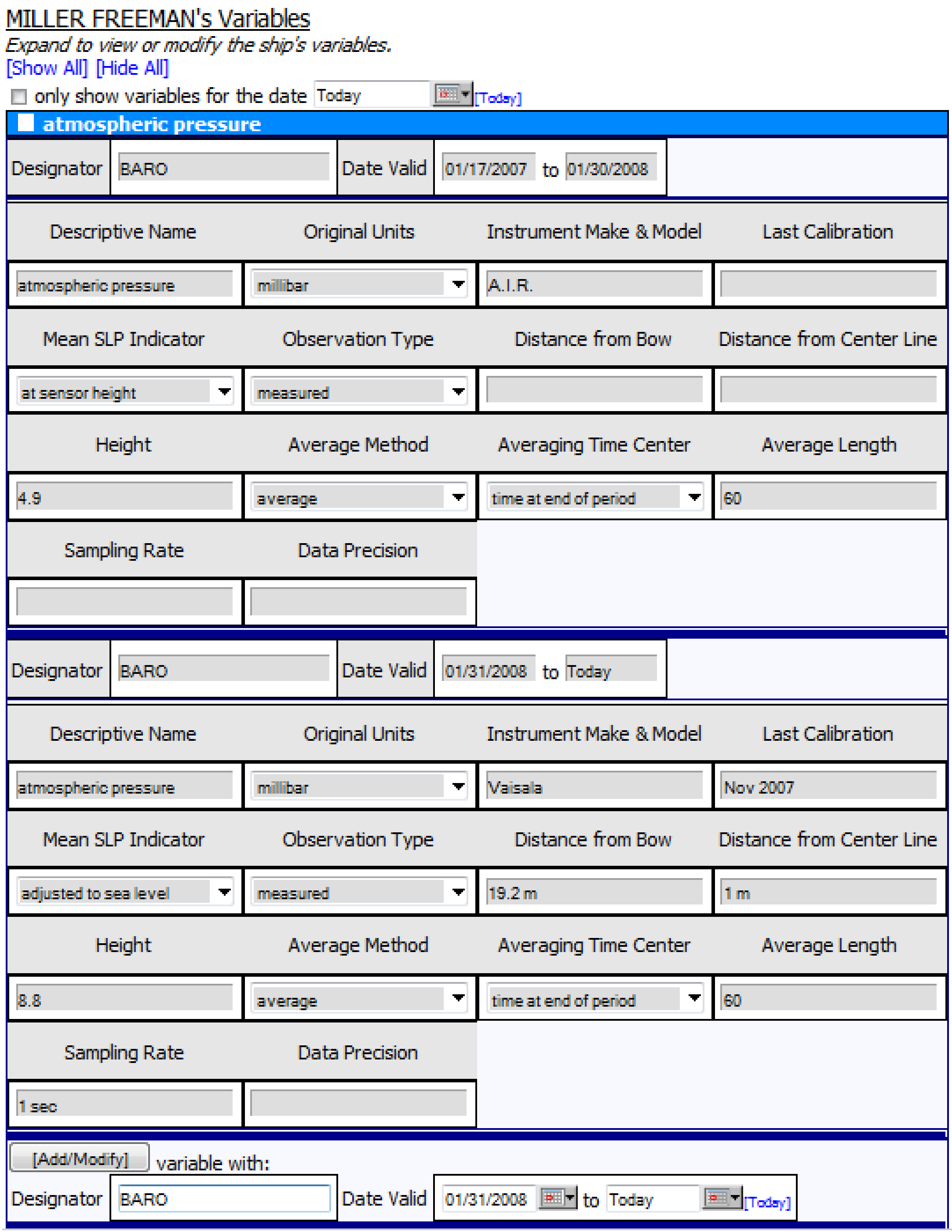
Ships for user op_noaa:

Ship Name	Call Sign	Vessel Metadata	Instrument Metadata
DAVID STAR JORDAN	WTDK	[modify]	[modify]
FAIRWEATHER	WTEB	[modify]	[modify]
GORDON GUNTER	WTEO	[modify]	[modify]
HENRY B. BIGELOW	WTDF	[modify]	[modify]
HI'IALAKAI	WTEY	[modify]	[modify]
KA'IMIMOANA	WTEU	[modify]	[modify]
MILLER FREEMAN	WTDM	[modify]	[modify]
NANCY FOSTER	WTER	[modify]	[modify]
OSCAR DYSON	WTEP	[modify]	[modify]
RAINIER	WTEF	[modify]	[modify]
RON BROWN	WTEC	[modify]	[modify]

samos

Adding and editing instrument (or parameter) metadata follow a slightly different procedure. The first step for the SAMOS operator is to identify which parameter he wishes to add or modify. Let us first consider the case of modifying a parameter already in use. Let us assume that a pressure sensor has been moved and user op_noaa wants to update the metadata for that parameter to reflect the new location. He would toggle a check in the box for *atmospheric pressure*, resulting in an expansion bar at the bottom of the screen:

Clicking over the "+" for atmospheric pressure opens the list of metadata fields associated with that parameter. The first step is to identify to the system which version (i.e. range of dates for which the listed metadata values are valid for the instrument) of the parameter metadata is being modified. (In most cases that will be the current version; however, it should be noted that occasionally there are multiple versions listed, as in this case, and a previous version needs to be edited retrospectively. For clarity, though, we will only be modifying the most recent in this example.) This identification is accomplished by filling in the sequestered set of Designator and Date Valid fields (located at the bottom below the metadata name, e.g., atmospheric pressure in the example below.) to exactly match those of the desired version metadata and then clicking "Add/Modify." Note that because we are modifying the most recent version, we choose our dates to match 01/31/2008 to today, instead of 01/17/2007 to 01/30/2008:



MILLER FREEMAN's Variables

Expand to view or modify the ship's variables.

[Show All] [Hide All]

☐ only show variables for the date Today [Today]

atmospheric pressure

Designator	BARO	Date Valid	01/17/2007 to 01/30/2008

Descriptive Name	Original Units	Instrument Make & Model	Last Calibration
atmospheric pressure	millibar	A.I.R.	
Mean SLP Indicator	**Observation Type**	**Distance from Bow**	**Distance from Center Line**
at sensor height	measured		
Height	**Average Method**	**Averaging Time Center**	**Average Length**
4.9	average	time at end of period	60
Sampling Rate	**Data Precision**		

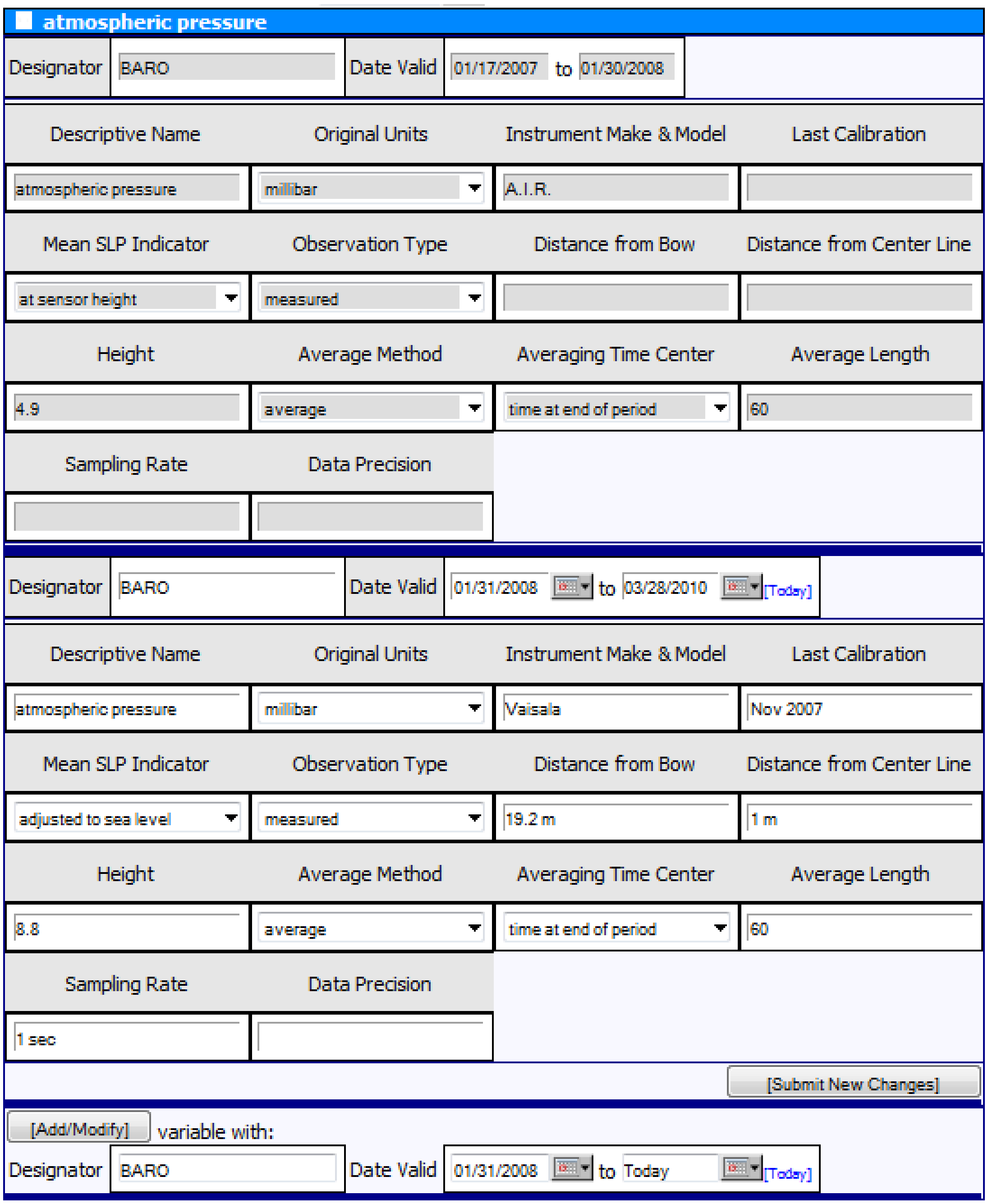
Designator	BARO	Date Valid	01/31/2008 to Today

Descriptive Name	Original Units	Instrument Make & Model	Last Calibration
atmospheric pressure	millibar	Vaisala	Nov 2007
Mean SLP Indicator	**Observation Type**	**Distance from Bow**	**Distance from Center Line**
adjusted to sea level	measured	19.2 m	1 m
Height	**Average Method**	**Averaging Time Center**	**Average Length**
8.8	average	time at end of period	60
Sampling Rate	**Data Precision**		
1 sec			

[Add/Modify] variable with:

Designator	BARO	Date Valid	01/31/2008 to Today [Today]

If the identification procedure is successful, there will be a "Submit New Changes" button visible in the desired version metadata area. User op_noaa must first close out the current metadata version (so the previous data is still associated with the correct information) and then initiate a new version. To close out the current version, the user would change the Date Valid field in the metadata area to reflect the last date the metadata displayed for an instrument was associated with at the old location and then click "Submit New Changes." (Note the first version, i.e. with Dates Valid 01/17/2007 to 01/30/2008, is left untouched):

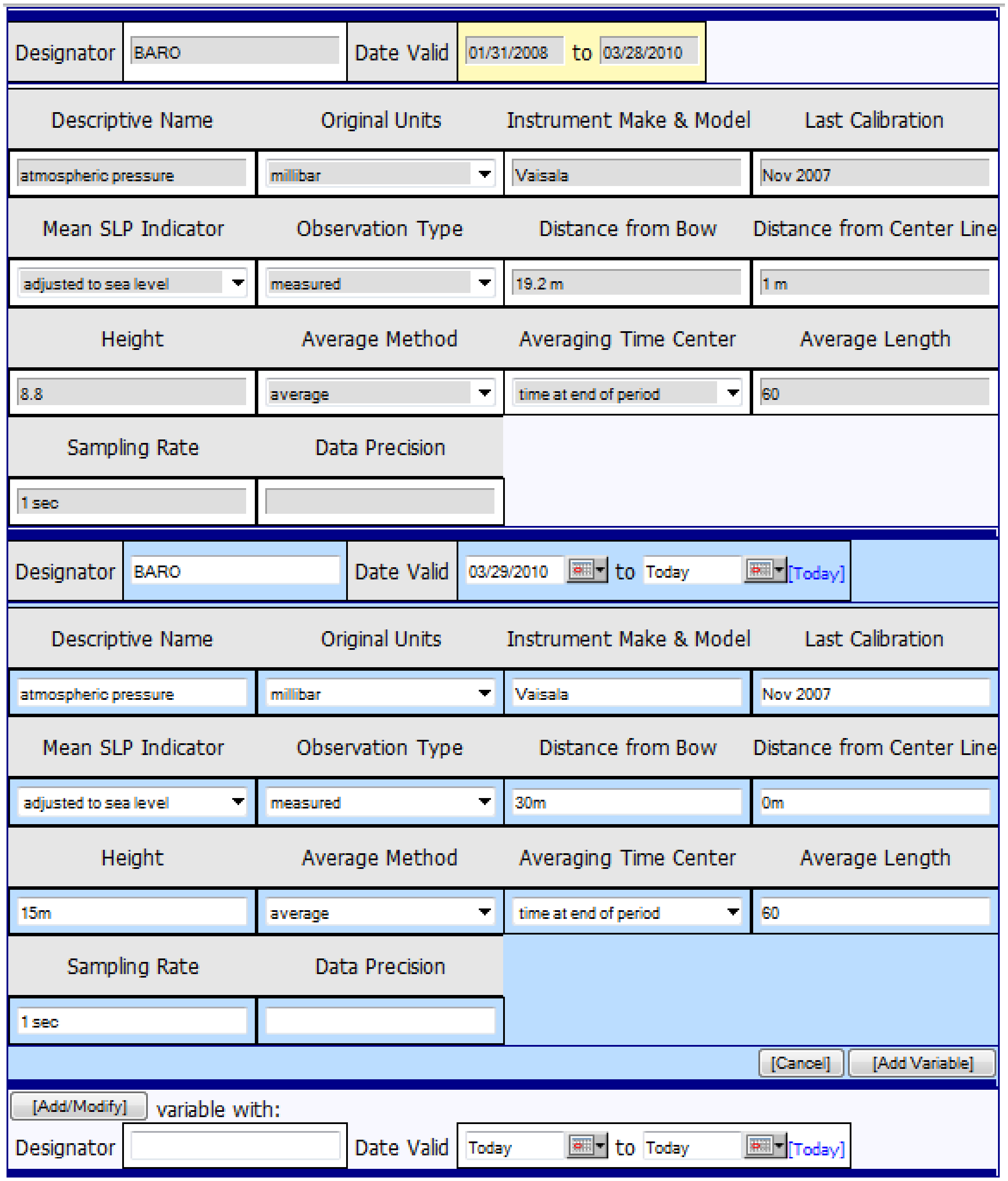


The user then initiates a new version by filling in the sequestered set of Designator and Date Valid fields to reflect the new period for the new or altered metadata, beginning at the date the instrument was relocated, and once again clicking "Add/Modify":

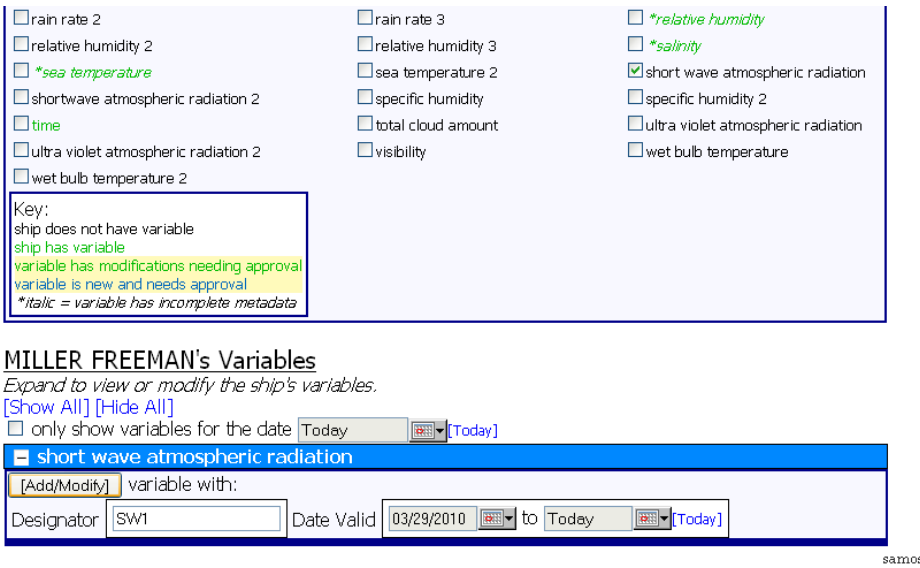

atmospheric pressure
Designator BARO Date Valid 01/17/2007 to 01/30/2008
Descriptive Name: atmospheric pressure
Original Units: millibar
Instrument Make & Model: A.I.R.
Last Calibration:
Mean SLP Indicator: at sensor height
Observation Type: measured
Distance from Bow:
Distance from Center Line:
Height: 4.9
Average Method: average
Averaging Time Center: time at end of period
Average Length: 60
Sampling Rate:
Data Precision:
Designator BARO Date Valid 01/31/2008 to 03/28/2010
Descriptive Name: atmospheric pressure
Original Units: millibar
Instrument Make & Model: Vaisala
Last Calibration: Nov 2007
Mean SLP Indicator: adjusted to sea level
Observation Type: measured
Distance from Bow: 19.2 m
Distance from Center Line: 1 m
Height: 8.8
Average Method: average
Averaging Time Center: time at end of period
Average Length: 60
Sampling Rate: 1 sec
Data Precision:
[Add/Modify] variable with:
Designator BARO Date Valid 03/29/2010 to Today [Today]

*It is crucial to note that Valid Dates cannot overlap for a single Designator, so if an instrument is moved in the middle of the day (and the Designator is not to be changed), the SAMOS user must decide which day is to be considered the "last" day at the old location, i.e. the day of the change or the day before the change. If the day of the change is considered the last day, then the new version must be made effective as of the day after the change. Likewise, if the day before the change is considered the last day, then the new version becomes effective as of the day of change. Let us assume the technician moved the instrument on 03/28/2010 and user op_noaa chose to consider that the last valid date for the old information, as demonstrated in the preceding figure.

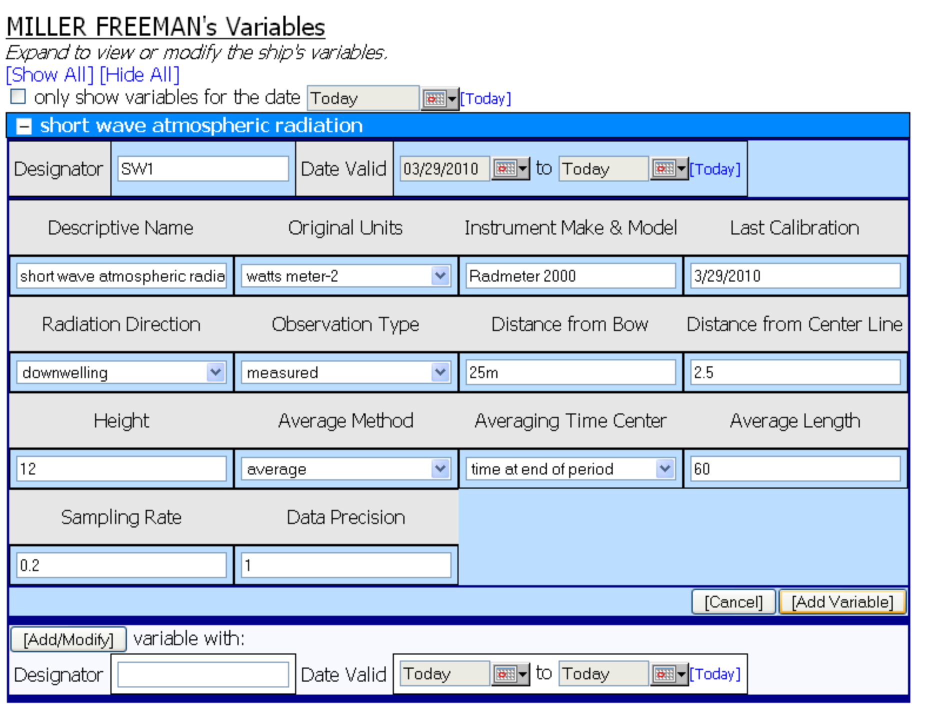
Once "Add/Modify" is clicked, a new set of fields opens up for the BARO parameter. All op_noaa need do at this point is recreate the parameter metadata entry, of course taking care to fill in the new location information, and click "Add Variable":



Adding an entirely new parameter follows only the latter part of these instructions: by simply choosing a parameter (for example short wave atmospheric radiation), clicking the "+" on the expansion bar, and entering either a new or not currently in use Designator and any Date Valid window:



the user is immediately given the new set of fields, to be filled in as desired:



Once an addition or modification to metadata has been submitted, a SAMOS associate at COAPS is automatically notified that approval is needed. Once approved, the new information will be visible to the public, via the Metadata Portal, accessed from the Data Access page as outlined in part one:

Data Access

Please choose a page from the following list:

■ Data Availability	Time line for available data
■ Data Download	Access quality-evaluated shipboard meteorological data
■ Data Map	Plot cruise tracks of each ship on a satellite map over a selected period of time
■ Metadata Portal	Access ship metadata database
■ SAMOS Parameters	View a list of meteorological and oceanographic parameters that the initiative seeks to obtain from vessels
■ Additional RV data	Additional RV data

For example, let's say we'd like to see the photo added by op_noaa for the *Miller Freeman*. We would simply choose the correct vessel from the dropdown list, choose "ship-specific" for the Type of metadata, and type in a date. (We choose "today" because we want the most up-to-date information.) Once we click "search,"

Metadata Portal

The SAMOS Data Assembly Center (DAC) has developed a new metadata specification for SAMOS data. The specification was developed with input from members of the Voluntary Observing Ship Climate project (VOSClim), the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM), the National Oceanographic Data Center (NODC), and other programs involved with metadata standards for marine observations. Upon recruitment to the SAMOS initiative, each vessel will be required to complete a series of metadata forms and all pertinent metadata will be stored in a ship profile database at the DAC.

The portal provides access to metadata stored in the database for all ships providing data to the DAC. At present, the vessels listed are participating in the 2005 pilot project. A search tool allows users to select a vessel and whether they are interested in ship-specific, parameter-specific, or digital image metadata. Ship-specific metadata include general information about the vessel, vessel dimensions, and contacts for the original data provider. The parameter-specific metadata lists all measurements being provided by a vessel and allows the user to sub-select information on the variables, units, averaging methods, and instrumentation. Digital imagery includes photos of each vessel and instrument masts and also contains schematics for each vessel.

Additional search tools will be added in the future and suggestions are welcome. Please contact us if you have any questions.

Choose a ship	MILLER FREEMAN (WTDM)
Type of metadata	ship-specific
Type a date	today
	where a valid date is of the form month/day/year, ex: 9/10/04. or a range, 9/10/04 - 9/20/04, you can also enter things like "yesterday"
Click search	search

we are directed to a listing of all valid ship-specific information. At the bottom of the page we find the Vessel Layout items, including the newly added photo at the bottom of the Digital Imagery and Schematics scroll list:

Vessel Layout

Dimensions (meters)	Digital Imagery and Schematics
Length: 65.5 Breadth: 12.8 Freeboard: 2.5 Draught: 5.5 / 9.1 Cargo Height: N/A	 Schematic - Side View 

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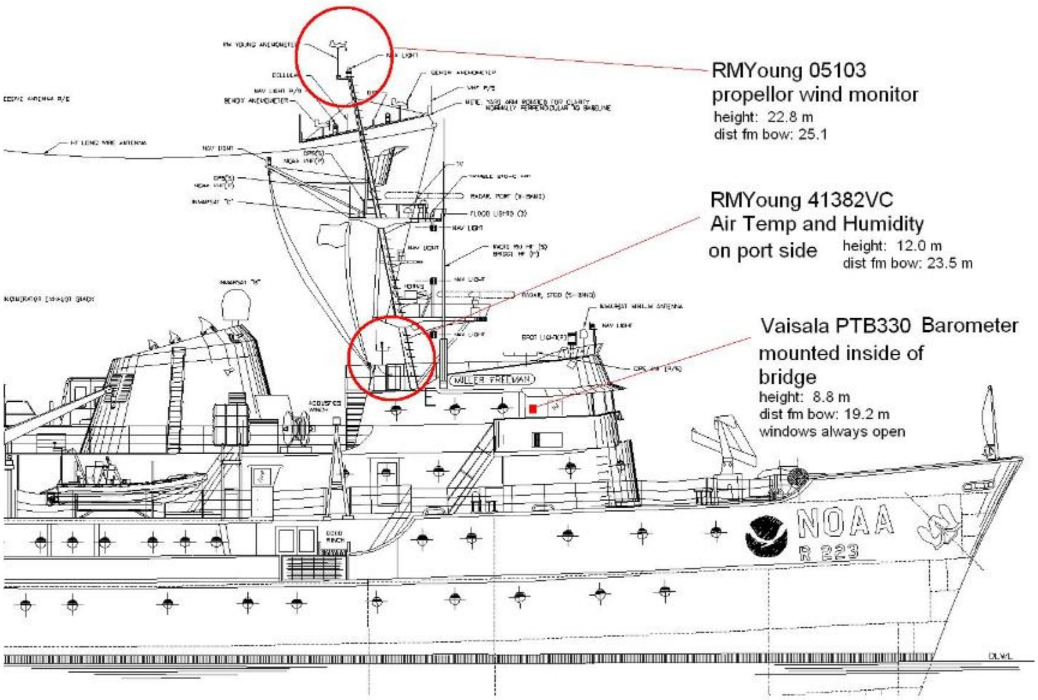
Clicking on the image itself would give us an enlarged view. In this case, the photo provides details about the locations of three MET sensors:



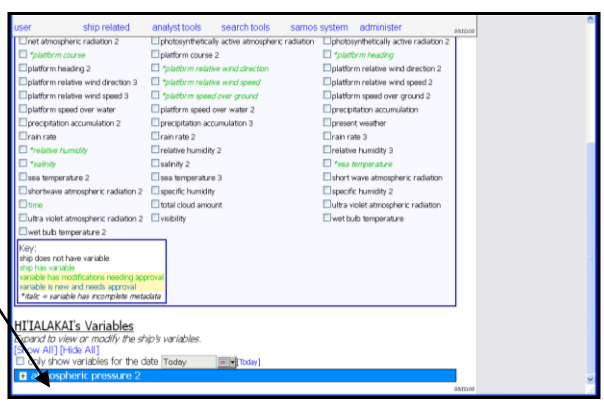
As a SAMOS user becomes familiar with following the metadata modification steps outlined in this section, chores such as adding duplicate sensors, logging sensor relocations, and keeping calibrations up-to-date become straightforward tasks. Naturally, complete and accurate metadata make for better scientific data. (and thus, happier end users!)

UPDATING SAMOS METADATA: STEP BY STEP EXAMPLE

(credit: Lauren Fuqua, chief technician for *Hi'ialakai*)

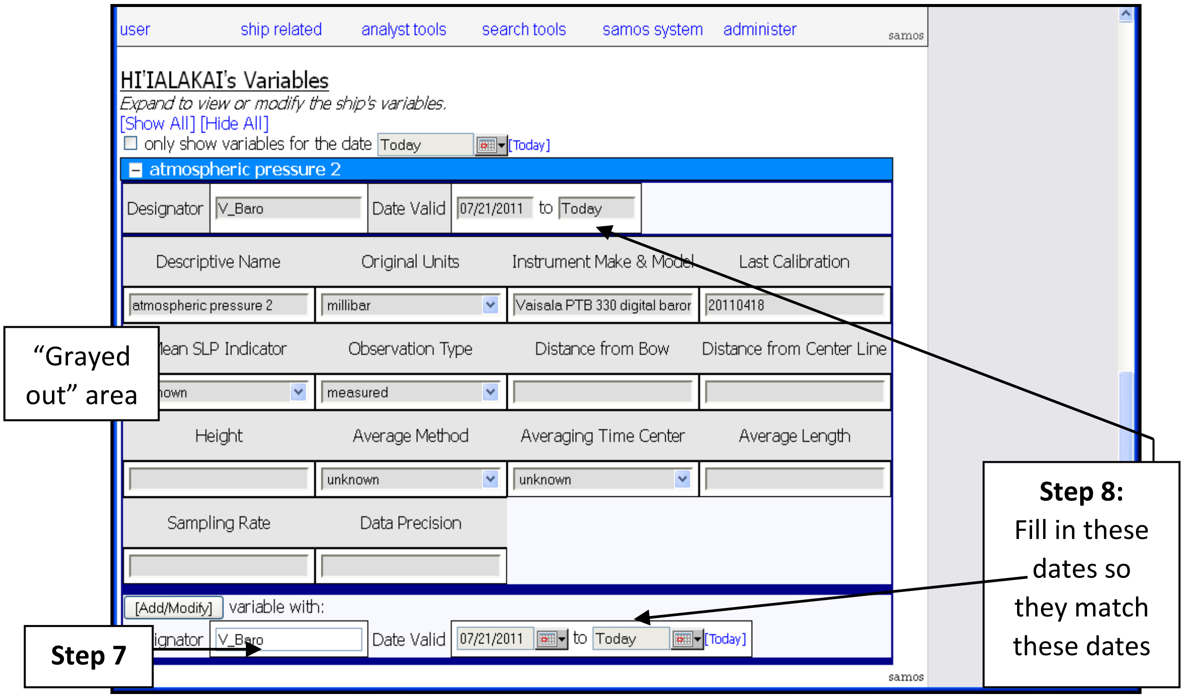
1. Go to: http://samos.coaps.fsu.edu/html/
    a. Click "Ship Recruiting"
    b. Click "Metadata Interface"
2. Enter login ID and password (case sensitive)
3. You can choose to modify Vessel or Instrument Metadata; you will likely choose Instrument. Vessel Metadata does not often change, other than the addition of photos.
4. Once "Instrument Metadata" is clicked, a box of sensors will appear. You will usually only be dealing with the Green ones (will look different if entering a new sensor).
    a. Select the sensor you want to Modify by clicking the box to the left of it

5. You will now see that sensor below, highlighted in Blue; click the plus sign to the left to expand the info about that sensor



6. You will now see the current data for that sensor, grayed out at the top (see image below). You are unable to make changes at this point in the grayed out sensor info area.

a. If this is a brand new sensor you will only see Designator and Date Valid.
b. If changes have already been made to this sensor you will see several sets of data boxes; scroll to the bottom one.



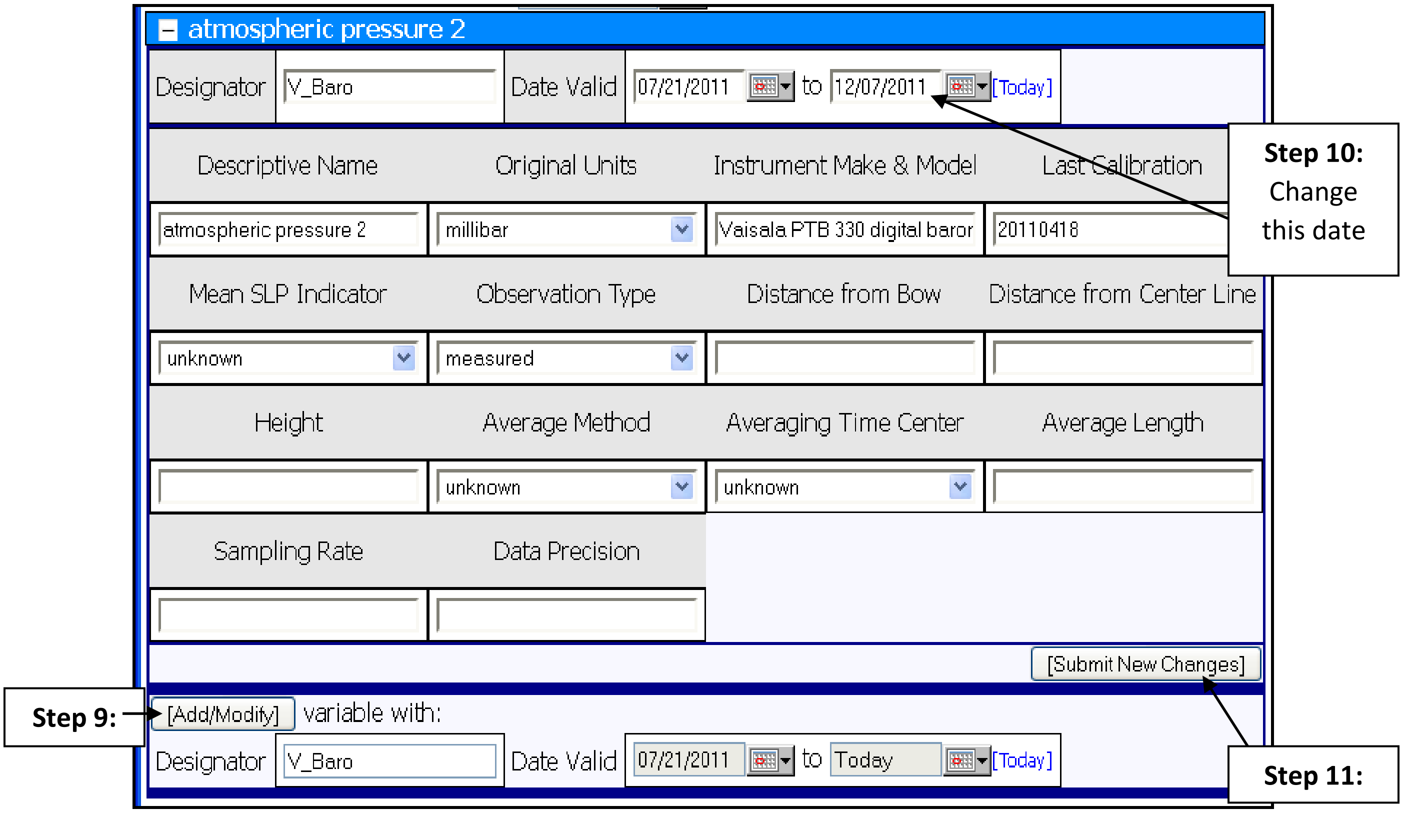
7. You first need to let the system know for which sensor you want to change information. In the box that appears at the very bottom (see image above), enter the name of the designator just at it appears in the box next to 'Designator' in the grayed out area.
   a. For the example above you would enter 'V_Baro' for atmospheric pressure 2

   * Note that before an updated version of sensor information can be entered, you must first "close out" the existing version. This is accomplished via steps 8 through 11. (The updated information will be entered in steps 12 through 15.)
8. In the bottom "Date Valid" boxes, make the dates match what you see above for the "Date Valid" dates in the grayed out area
   a. For the example above you would enter 02/01/2011 in the left box and you would click the blue [Today] button to make the right box read Today
   b. The right box will probably say 'TODAY' by default, and that is likely what you want.
      i. **NOTE:** The word 'Today' in any "Date Valid" entry is a floating date that implies the sensor is currently valid, no matter what day it is. The actual calendar dates mean the sensor starts & stops on the actual dates shown.

c. Months are changed using the arrows

d. Year is changed by clicking on the year (it will now be highlighted) and then typing in the year you want.

9. Click the [Add/Modify] button (see image below); this should change the text boxes in the data area from gray to white (as in the image below), so that you can now put your cursor in there. If you are unable to make changes in the data area, then the date valid dates and/or designator you entered are incorrect.



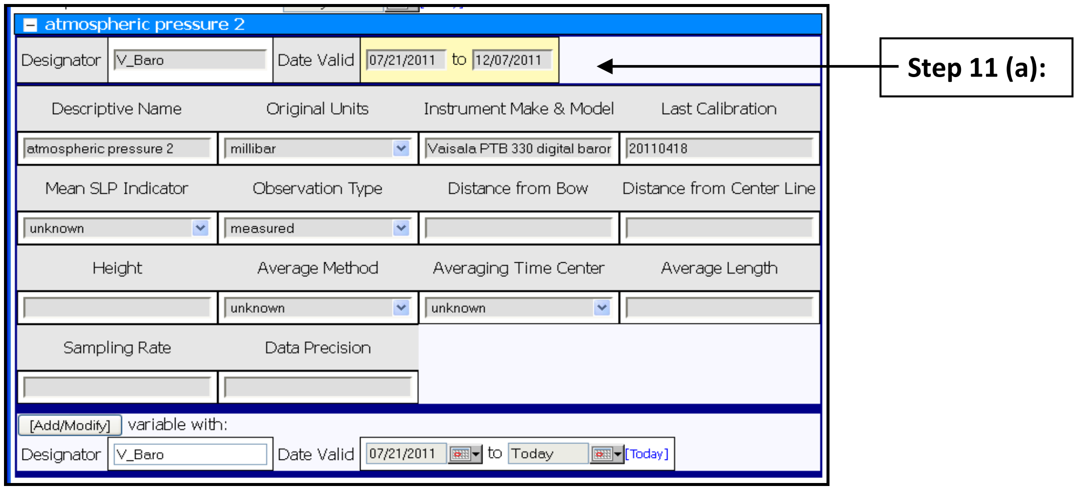
10. You now want to change the "Date Valid" info in this data box. The "Date Valid" start date (on the left) in this now edit-able area will likely stay the same unless you want to correct a previously entered erroneous start date. More than likely you will only be changing the end date, on the right.

a. This step simply closes out the current data; letting the system know the start and end dates for which the data on the screen about that sensor are valid. You will probably not change any data here; only the end date.

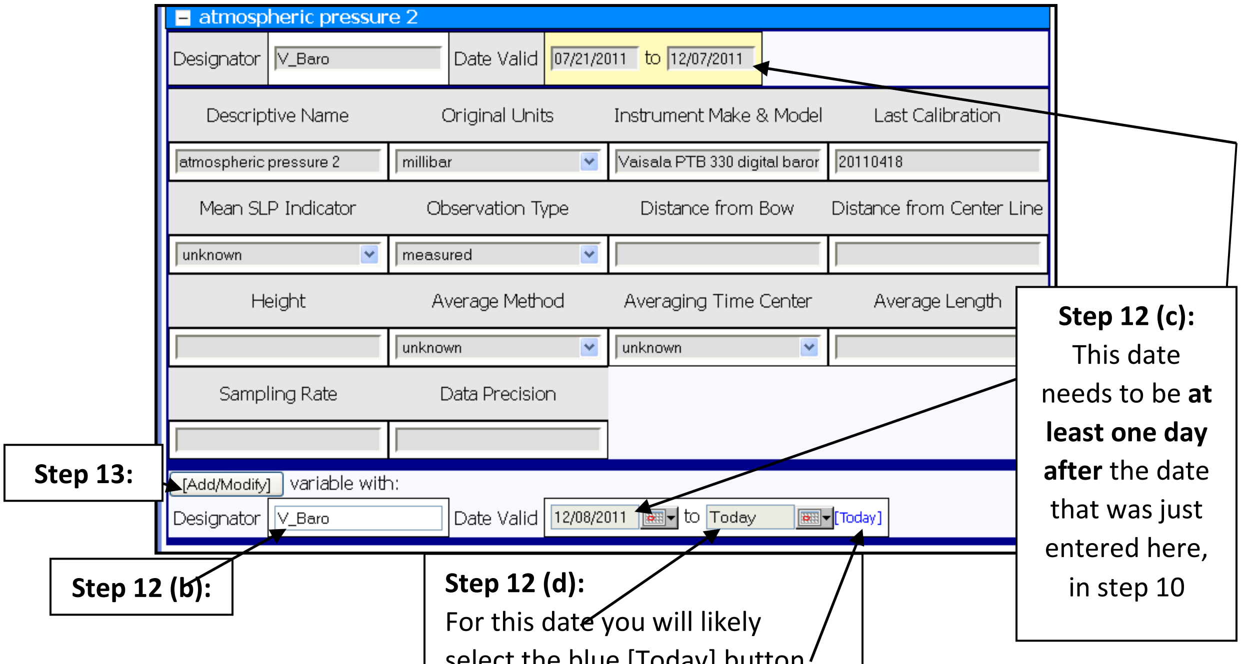
b. You will most likely be entering a calendar date in the right hand "Date Valid" box to close out the existing data for the sensor.

11. Click "Submit New Changes" on the bottom right of the data box (see image above)

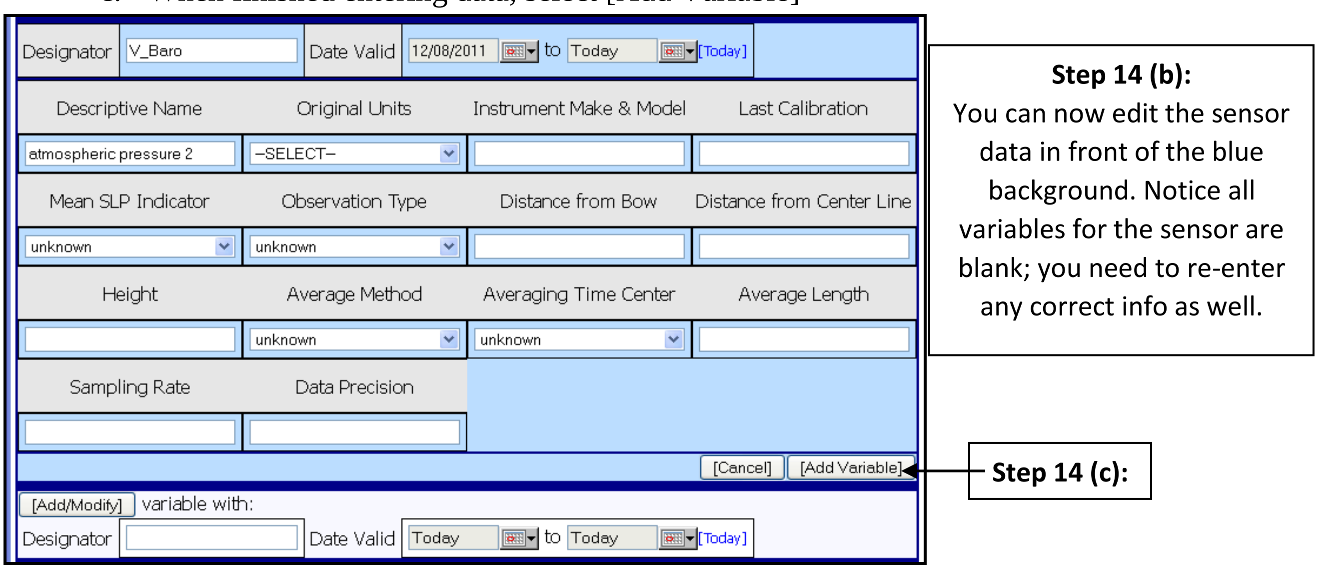
a. The text boxes in the data entry area should be grayed out again. The background of the dates that you just edited will be yellow (see image below).



12. Now you need to choose new "Date Valid" info in the bottom window (see image below). *Note again that steps 12 through 15 should NOT be performed until the previous set of instrument metadata has been "closed out" for that instrument, via steps 8 through 11.
    a. This step lets the system know the new valid dates for the new information about this sensor (you will enter the new information in Step 14).
    b. Make sure the same designator name is in the 'Designator' box
    c. The left box in the Date Valid area will indicate the start date for which the new sensor info is valid. **That start date needs to be at least one day after the end date that was just entered above in Step 10; the valid dates cannot overlap.**
    d. The right "Date Valid" date will most likely be Today (again, do this by clicking the blue [Today] button to the right of the box; not by putting in today's date on the calendar).
    e. Note: If you are seeing X's over the calendar date you want to select on the left hand "Date Valid" box, change the right hand box to Today first, and you will now be able to change the left box to the date you want.

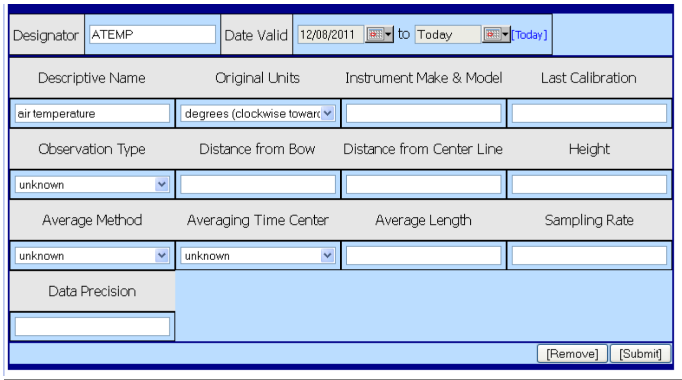


13. Click the [Add/Modify] button again (see image above)
14. You will now see a new, editable data box at the bottom of the screen that has blue around the sensor info instead of gray.
    a. Leave the Date Valid area the same
    b. You can now change the sensor data to reflect updates and add new information. Note that you need to re-enter any existing, correct info about the sensor.
    c. When finished entering data, select [Add Variable]



15. You do not need to click [Submit] on the new window that appears (see image below) unless you make any additional changes or corrections immediately after finishing step 11, for example if you realize you've entered incorrect info or you've accidentally left something out. Otherwise, your new data are now

waiting for approval from the SAMOS staff. To prevent anything being changed mistakenly from this point on, you should now close out that sensor window by going to the top window that has all of the sensors listed and un-checking the sensor you just edited. You can now either exit the website or select a new sensor



Step 15:

If all info entered is correct, **DO NOT** select the [Submit] button. Simply close out of SAMOS

Annex C: Current Metadata Status Snapshots (all active vessels)

Atlantic Explorer
Atlantis
Aurora Australis
Bell M. Shimada
Fairweather
Falkor
Ferdinand Hassler
Gordon Gunter
Healy
Henry B. Bigelow
Hi'ialakai
Kilo Moana
Laurence M. Gould
Nancy Foster
Nathaniel B. Palmer
Okeanos Explorer
Oregon II
Oscar Dyson
Oscar Elton Sette
Pelican
Pisces
Polar Sea
Rainier
Reuben Lasker
Robert Gordon Sproul
Roger Revelle
Ronald H. Brown
Sikuliaq
Tangaroa
Thomas G. Thompson
Thomas Jefferson

WDC9417 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡
Air Temperature 2	RT2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Atmospheric Pressure	BP	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡
Atmospheric Pressure 2	BP2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Conductivity	TC	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TIS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	–
Earth Relative Wind Direction 2	TIP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Earth Relative Wind Speed	TKS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	–
Earth Relative Wind Speed 2	TKP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Latitude	LA	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Longitude	LO	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Platform Course	CR	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Platform Heading	GY	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🔴	🟢
Platform Heading 2	SH	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Platform Relative Wind Direction	WDS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Relative Wind Direction 2	WDP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Relative Wind Speed	WSS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Relative Wind Speed 2	WSP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Speed Over Ground	SP	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Precipitation Accumulation	PR	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🟡	🟡
Precipitation Accumulation 2	PT1	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Precipitation Accumulation 3	PT2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🟢

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Relative Humidity	RH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Relative Humidity 2	RH2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Salinity	SA	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Sea Temperature	TT1	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Sea Temperature 2	WT	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🟡	🔴	🟡	🟡	🟡	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

KAQP 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	green	green	green	green	green	green	green	green	green	green	green	green	green
Air Temperature 2	WPAT	red	red	green	red	red	green	green	red	red	red	red	red	red
Air Temperature 3	WSAT	red	red	green	red	red	green	red	red	red	red	red	red	red
Atmospheric Pressure	BP	green	green	green	green	green	green	green	green	green	green	green	green	green
Atmospheric Pressure 2	WPBP	red	red	green	red	red	green	green	red	red	red	red	red	red
Atmospheric Pressure 3	WSBP	red	red	green	red	red	green	red	red	red	red	red	red	red
Conductivity	SSC	green	green	green	red	red	red	red	red	red	red	red	red	red
Earth Relative Wind Direction	TIP	green	green	green	green	green	green	green	green	green	green	green	green	–
Earth Relative Wind Direction 2	WPTD	green	green	green	red	red	green	green	green	green	green	red	red	red
Earth Relative Wind Direction 3	WSTD	green	green	green	red	red	green	green	green	green	green	red	red	red
Earth Relative Wind Speed	TWP	green	green	green	green	green	green	green	green	green	green	green	green	–
Earth Relative Wind Speed 2	WPTS	green	green	green	red	red	green	green	green	green	green	red	red	red
Earth Relative Wind Speed 3	WSTS	green	green	green	red	red	green	green	green	green	green	red	red	–
Latitude	LA	green	green	green	–	–	–	green	red	red	red	red	green	red
Long Wave Atmospheric Radiation	LWR	red	red	green	red	red	red	green	red	red	red	red	red	red
Longitude	LO	green	green	green	–	–	–	green	red	red	red	red	green	red
Platform Course	COG	green	green	green	–	–	–	green	red	red	red	red	green	red
Platform Heading	GY	green	green	green	–	–	–	green	red	red	red	red	green	red
Platform Relative Wind Direction	Imet_wndd	green	green	green	green	green	green	green	green	green	green	green	green	green
Platform Relative Wind Direction 2	WPRD	green	green	green	red	red	green	red	red	red	red	red	red	red
Platform Relative Wind Direction 3	WSRD	green	green	green	red	red	green	red	red	red	red	red	red	red
Platform Relative Wind Speed	Imet_wnds	green	green	green	green	green	green	green	green	green	green	green	green	green

green : <=6 months old | yellow : >6 months old | red : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Platform Relative Wind Speed 2	WPRS	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed 3	WSRS	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🟢	🔴
Precipitation Accumulation	PRC	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Precipitation Accumulation 2	WPRC	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Precipitation Accumulation 3	WSRC	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Rain Rate	PRC	🔴	🔴	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Rain Rate 2	WPRI	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Rain Rate 3	WSRI	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	HRH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Relative Humidity 2	WPRH	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity 3	WSRH	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Salinity	SAL	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature	SST	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Short Wave Atmospheric Radiation	SWR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

VNAA 2012-06 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATP	●	●	●	●	●	●	●	●	●	●	●	●	■
Air Temperature 2	ATS	●	●	●	●	●	●	●	●	●	●	●	●	■
Atmospheric Pressure	BP	●	●	●	●	●	●	●	●	●	●	●	●	■
Earth Relative Wind Direction	TIP	■	■	●	●	●	●	●	●	●	●	●	●	–
Earth Relative Wind Direction 2	TIS	■	■	●	●	●	●	●	●	●	●	●	●	■
Earth Relative Wind Speed	TKP	■	■	●	●	●	●	●	●	●	●	●	●	–
Earth Relative Wind Speed 2	TKS	■	■	●	●	●	●	●	●	●	●	●	●	■
Latitude	LA	●	●	●	–	–	–	●	●	●	●	●	●	■
Long Wave Atmospheric Radiation	LWP	●	●	●	●	●	●	●	●	●	●	●	●	■
Long Wave Atmospheric Radiation 2	LWS	●	●	●	●	●	●	●	●	●	●	●	●	■
Longitude	LO	●	●	●	–	–	–	●	●	●	●	●	●	■
Photosynthetically Active Atmospheric Radiation	PAR1P	●	●	●	●	●	●	●	●	●	●	●	●	■
Photosynthetically Active Radiation 2	PAR1S	●	●	●	●	●	●	●	●	●	●	●	●	■
Platform Course	COG	●	●	●	–	–	–	●	●	●	●	●	●	■
Platform Heading	HD	●	●	●	–	–	–	●	●	●	●	●	●	■
Platform Heading 2	GY	■	■	●	–	–	–	●	●	●	●	●	●	■
Platform Relative Wind Direction	WDP	●	●	●	●	●	●	●	●	●	●	●	●	■
Platform Relative Wind Direction 2	WDS	●	●	●	●	●	●	●	●	●	●	●	●	■
Platform Relative Wind Speed	WSP	●	●	●	●	●	●	●	●	●	●	●	●	■
Platform Relative Wind Speed 2	WSS	●	●	●	●	●	●	●	●	●	●	●	●	■
Platform Speed Over Ground	SOG	●	●	●	–	–	–	●	●	●	●	●	●	■
Precipitation Accumulation	PR2	●	●	●	●	●	●	●	●	■	●	■	■	■

● : <=6 months old | ▲ : >6 months old | ■ : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Precipitation Accumulation 2	PR	●	●	●	●	●	●	●	●	●	●	●	●	■
Rain Rate	PT	●	●	●	●	●	●	●	●	●	●	●	●	■
Relative Humidity	RHP	●	●	●	●	●	●	●	●	●	●	●	●	■
Relative Humidity 2	RHS	●	●	●	●	●	●	●	●	●	●	●	●	■
Sea Temperature	ST	●	●	●	■	■	●	●	●	●	●	●	●	■
Short Wave Atmospheric Radiation	SWP	●	●	●	●	●	●	●	●	●	●	●	●	■
Shortwave Atmospheric Radiation 2	SWS	●	●	●	●	●	●	●	●	●	●	●	●	■

● : <6 months old | ▲ : >6 months old | ■ : no metadata reported

WTED 2015-10 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Air Temperature 2	ATEMP2	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🔴	🟡	🟡
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Conductivity	TSGC	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	–
Earth Relative Wind Direction 2	UTWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	–
Earth Relative Wind Speed 2	UTWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🟢	🟢	🟢	🔴
Long Wave Atmospheric Radiation	RADLW	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🟢	🟢	🟢	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🔴	🔴	🔴	🟢	🟢	🔴	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🔴	🔴	🔴	🟢	🟢	🟢	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Relative Wind Direction 2	URWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Relative Wind Speed 2	URWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🔴	🔴	🔴	🟢	🟢	🟢	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢	🟢	🟢
Relative Humidity 2	RELH2	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🟡	🔴	🟡
Salinity	TSGS	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢
Sea Temperature	TSGWT	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Short Wave Atmospheric Radiation	RADSW	green	green	green	green	green	green	green	green	red	green	green	green	green

green : <6 months old | yellow : >6 months old | red : no metadata reported

WTEB 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Atmospheric Pressure	BARO	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Conductivity	TSGCOND	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	RELHUM	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Salinity	TSGSAL	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴
Sea Temperature	TSGTEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

ZCYL5 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Air Temperature 2	ATEMP2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure 2	BARO2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity	TSGC	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Earth Relative Wind Direction 2	TWDIR2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Direction 3	TWDIR	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Earth Relative Wind Speed	TWSPD2	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	–
Earth Relative Wind Speed 2	TWSPD2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Speed 3	TWSPD	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Photosynthetically Active Atmospheric Radiation	PPAR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Photosynthetically Active Radiation 2	SPAR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Direction 2	RWDIR2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Speed 2	RWSPD2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Platform Speed Over Water	LWS	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Speed Over Water 2	TWS	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Relative Humidity 2	RELH2	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Salinity	TSGS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature	TSGEXT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature 2	TSGINT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEK 2015-10 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Atmospheric Pressure	BARO	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TRUE WIND DIR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TRUE WIND SPEED	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	RELH	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEO 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🔴	🟡	🔴	🔴	🟡
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Conductivity	TSGC	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Salinity	TSGS	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Sea Temperature	SST	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

NEPP 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Air Temperature 2	AT1	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Air Temperature 3	RTT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BARO	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Atmospheric Pressure 2	BST	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity	TC	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Dew Point Temperature	DP	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Dew Point Temperature 2	DPT	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Earth Relative Wind Direction	TI	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	–
Earth Relative Wind Direction 2	TIS	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Earth Relative Wind Speed	TS	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	–
Earth Relative Wind Speed 2	TWM	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Latitude	LA	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Long Wave Atmospheric Radiation	LWH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Long Wave Atmospheric Radiation 2	LD	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Longitude	LON	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Photosynthetically Active Atmospheric Radiation	PAH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Course	COG	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Platform Heading	GY	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Platform Heading 2	POSHDT	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Platform Relative Wind Direction	WDPR	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Platform Relative Wind Direction 2	WDSR	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Platform Relative Wind Speed	WS	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Platform Relative Wind Speed 2	WSSR	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Platform Speed Over Ground	SOG	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Platform Speed Over Water	SL	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Platform Speed Over Water 2	SPPS	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Precipitation Accumulation	PR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Relative Humidity	RH	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Relative Humidity 2	RHT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Salinity	SAW	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature	ST	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡
Sea Temperature 2	STI	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Short Wave Atmospheric Radiation	SW	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡	🟡

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTDF 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴
Atmospheric Pressure	BARO	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Conductivity	TSGC	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Long Wave Atmospheric Radiation	LWAVE	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🟢	🟢	🟢	🟢	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Speed Over Water	FAWTRSPD	🟢	🟢	🟢	–	–	–	🔴	🔴	🟢	🟢	🟢	🔴	🔴
Platform Speed Over Water 2	PSWTRSPD	🟢	🟢	🟢	–	–	–	🔴	🔴	🟢	🟢	🟢	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🔴
Salinity	TSGS	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Sea Temperature	TSGWTEX	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Short Wave Atmospheric Radiation	SWAVE	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEY 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Atmospheric Pressure	BARO	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Atmospheric Pressure 2	V_Baro	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🟡
Conductivity	TSGC	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟢	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	–
Latitude	POSMV-LAT	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LON	🔴	🔴	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🔴	🔴
Platform Course	COG	🔴	🔴	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🔴	🔴
Platform Heading	POSMV-HDG	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading 2	GYRO	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading 3	GYRO2	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Salinity	TSGS	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Sea Temperature	TSGWT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Sea Temperature 2	TSGWTINT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WDA7827 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BP	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TWDP	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Direction 2	TWDS	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Earth Relative Wind Speed	TWSP	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Speed 2	TWSS	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Latitude	LA	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Long Wave Atmospheric Radiation	PIR	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Longitude	LO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Course	CG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Heading	HG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Heading 2	GY	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Direction	RWDP	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Relative Wind Direction 2	RWDS	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Relative Wind Speed	RWSP	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Relative Wind Speed 2	RWSS	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Speed Over Ground	SG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Speed Over Water	SL	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🔴	🔴
Precipitation Accumulation	PAO	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Precipitation Accumulation 2	PAY	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Rain Rate	PRO	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Relative Humidity	RH	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🔴

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Salinity	S45S	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Sea Temperature	SST	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WCX7445 2015-03 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🟢
Conductivity	TC	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Earth Relative Wind Direction	TWDP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	–
Earth Relative Wind Direction 2	TWDS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Earth Relative Wind Speed	TWSP	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢	🔴	–
Earth Relative Wind Speed 2	TWSS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Latitude	LA	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Longitude	LO	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Net Atmospheric Radiation	SW	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢	🔴	🟢
Net Atmospheric Radiation 2	LW	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢	🔴	🟢
Photosynthetically Active Atmospheric Radiation	PA	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢	🔴	🟢
Platform Course	CR	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Platform Heading	GY	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Platform Relative Wind Direction	WDP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Platform Relative Wind Direction 2	WDS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Platform Relative Wind Speed	WSP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🟢
Platform Relative Wind Speed 2	WSS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🟢	🔴
Relative Humidity	RH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🔴	🟢
Salinity	SA	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🟢	🔴	🟢
Sea Temperature	SST	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🟢	🔴	🟢	🟢	🟢	🟢

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Sea Temperature 2	SST2	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTER 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Atmospheric Pressure	BARO	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Conductivity	TSGC	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🔴	🟢	🟢	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Salinity	TSGS	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Sea Temperature	WTEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Sea Temperature 2	TSGWT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WBP3210 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	16	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🟢
Atmospheric Pressure	BP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Conductivity	TC	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	15	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Direction 2	TWDS	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Speed	14	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed 2	TWSS	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Latitude	LA	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Long Wave Atmospheric Radiation	22	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	04	🔴	🔴	🟡	–	–	–	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Photosynthetically Active Atmospheric Radiation	PA	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Course	08	🟡	🟡	🟡	–	–	–	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GY	🟢	🟢	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	WDP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction 2	WDS	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	WSP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed 2	WSS	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	05	🟡	🟡	🟡	–	–	–	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	17	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Salinity	12	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Sea Temperature	SST	🔴	🔴	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Short Wave Atmospheric Radiation	21	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTDH 2015-10 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity	TSGC	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🔴	🟢	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Salinity	TSGS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Sea Temperature	EXTWT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🔴	🟢	🟢
Sea Temperature 2	TSGWT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTDO 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Conductivity	TSGC	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Salinity	TSGS	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴
Sea Temperature	SST	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEP 2015-10 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Atmospheric Pressure	BARO	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Conductivity	TSGC	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Speed	TWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Direction	RWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Speed	RWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Relative Humidity	RELH	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Salinity	TSGS	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴
Sea Temperature	TSGWT	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEE 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Atmospheric Pressure	BARO	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Conductivity	TSGC	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🟢	🔴	🟢	🔴	🔴	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Platform Heading	HDG	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🔴
Salinity	TSGS	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Sea Temperature	TSGT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WDD6114 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Conductivity	TSGC	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Salinity	TSGS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢
Sea Temperature	TSGWT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTDL 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Atmospheric Pressure	BARO	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Conductivity	TSGC	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	RELH	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Salinity	TSGS	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Sea Temperature	TSGWT	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTDL 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Atmospheric Pressure	BARO	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Conductivity	TSGC	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	RELH	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Salinity	TSGS	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Sea Temperature	TSGWT	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEF 2015-10 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Atmospheric Pressure	BARO	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Conductivity	TSGC	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	–
Latitude	LAT	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LON	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Course	COG	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYRO	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Relative Humidity	RELHUM	🟡	🟡	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Salinity	TSGS	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Sea Temperature	TSGTEMP	🔴	🔴	🟡	🔴	🔴	🔴	🟡	🔴	🔴	🔴	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEG 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red
Atmospheric Pressure	BARO	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● green
Conductivity	TSGC	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red
Earth Relative Wind Direction	TWDIR	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	–
Earth Relative Wind Speed	TWSPD	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	–
Latitude	LAT	● green	● green	● green	–	–	–	● green	● green	● red	● green	● red	● green	● red
Longitude	LON	● green	● green	● green	–	–	–	● green	● green	● red	● green	● red	● green	● red
Platform Course	COG	● green	● green	● green	–	–	–	● green	● green	● red	● green	● red	● green	● red
Platform Heading	GYRO	● red	● red	● green	–	–	–	● green	● green	● red	● green	● red	● green	● red
Platform Relative Wind Direction	RWDIR	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red
Platform Relative Wind Speed	RWSPD	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red
Platform Speed Over Ground	SOG	● green	● green	● green	–	–	–	● green	● green	● red	● green	● red	● green	● red
Relative Humidity	RELH	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red
Salinity	TSGS	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red
Sea Temperature	SST	● green	● green	● green	● red	● red	● red	● green	● green	● red	● green	● red	● green	● red

● green : <6 months old | ● yellow : >6 months old | ● red : no metadata reported

WSQ2674 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🟢
Air Temperature 2	RTT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🟢
Atmospheric Pressure	BPT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🟢
Atmospheric Pressure 2	BST	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Earth Relative Wind Direction	TIT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	–
Earth Relative Wind Speed	TWT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	–
Latitude	LAR	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Longitude	LOR	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Photosynthetically Active Atmospheric Radiation	PAT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🟢
Platform Course	CRR	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GYR	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	WDT	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Speed	WST	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Speed Over Ground	SPR	🔴	🔴	🟢	–	–	–	🔴	🔴	🔴	🔴	🔴	🔴	🔴
Precipitation Accumulation	PRT	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🟢
Relative Humidity	RHT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🔴	🟢	🔴	🔴	🟢
Sea Temperature	STE	🟢	🟢	🟢	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🔴	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

KAOU 2015-11 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BPB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure 2	BSB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity	TCU	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity 2	TCY	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Dew Point Temperature	DPB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TIB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Earth Relative Wind Speed	TWB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Latitude	LA	🟡	🟡	🟡	–	–	–	🟡	🟡	🟡	🟡	🟡	🟡	🔴
Long Wave Atmospheric Radiation	LWB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢
Longitude	LOE	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Photosynthetically Active Atmospheric Radiation	PAB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Course	CRE	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Platform Heading	GTE	🔴	🔴	🟡	–	–	–	🟡	🔴	🔴	🔴	🔴	🔴	🔴
Platform Relative Wind Direction	WDB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Speed	WSB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Speed Over Ground	SPE	🔴	🔴	🟢	–	–	–	🟢	🔴	🔴	🔴	🔴	🔴	🔴
Precipitation Accumulation	PRB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Relative Humidity	RHB	🟢	🟢	🟢	🔴	🔴	🟢	🔴	🔴	🔴	🔴	🔴	🟢	🟢
Salinity	SAU	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Salinity 2	SAY	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature	TTU	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢

🟢 : <=6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Sea Temperature 2	TTY	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature 3	STU	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Short Wave Atmospheric Radiation	SWB	🟢	🟢	🟢	🔴	🔴	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEC 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity	TSGC	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Speed Over Ground	SOG	🔴	🔴	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Salinity	TSGS	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🔴	🔴	🔴
Sea Temperature	TSGWT	🟢	🟢	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Short Wave Atmospheric Radiation	SWR	🔴	🔴	🟢	🔴	🔴	🔴	🟢	🟢	🟢	🟢	🔴	🔴	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WDG7520 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	green	green	green	green	green	green	green	green	green	green	green	green	green
Atmospheric Pressure	APRES	green	green	green	green	green	green	green	green	green	green	green	green	green
Conductivity	COND	green	green	green	green	green	green	green	green	green	green	green	green	green
Earth Relative Wind Direction	WDIRT	green	green	green	green	green	green	green	green	green	green	green	red	–
Earth Relative Wind Speed	WSPDT	green	green	green	green	green	green	green	green	green	green	green	red	–
Latitude	LAT	green	green	green	–	–	–	green	green	green	green	green	red	red
Long Wave Atmospheric Radiation	LW	green	green	green	green	green	green	green	green	green	green	green	red	green
Longitude	LON	green	green	green	–	–	–	green	green	green	green	green	red	red
Photosynthetically Active Atmospheric Radiation	PAR	green	green	green	green	green	green	green	green	green	green	green	red	green
Platform Course	COG	green	green	green	–	–	–	green	green	green	green	green	green	red
Platform Heading	HDT	green	green	green	–	–	–	green	green	green	green	green	red	red
Platform Relative Wind Direction	WDIRR	green	green	green	green	green	green	green	green	green	green	green	red	green
Platform Relative Wind Speed	WSPDR	green	green	green	green	green	green	green	green	green	green	green	green	green
Platform Speed Over Ground	SOG	green	green	green	–	–	–	green	green	green	green	green	red	red
Platform Speed Over Water	STWL	green	green	green	–	–	–	green	green	green	green	red	red	red
Platform Speed Over Water 2	STWT	green	green	green	–	–	–	green	green	green	green	red	red	red
Relative Humidity	RH	green	green	green	green	green	green	green	green	green	green	green	green	green
Salinity	SAL	green	green	green	green	green	green	green	green	green	green	green	red	green
Sea Temperature	SST	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow	yellow
Sea Temperature 2	SKINT	green	green	green	green	green	green	green	green	green	green	green	green	green
Short Wave Atmospheric Radiation	SW	green	green	green	green	green	green	green	green	green	green	green	red	green

green : <6 months old | yellow : >6 months old | red : no metadata reported

ZMFR 2012-06 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	●	●	●	●	●	●	●	●	●	●	●	●	●
Atmospheric Pressure	BP	●	●	●	●	●	●	●	●	■	■	●	●	●
Earth Relative Wind Direction	TI	●	●	●	●	●	●	●	●	●	●	●	●	–
Earth Relative Wind Speed	TK	●	●	●	●	●	●	●	●	●	●	●	●	–
Latitude	LA	■	■	●	–	–	–	●	●	■	■	●	●	■
Long Wave Atmospheric Radiation	LWS	●	●	●	●	●	●	●	●	●	●	●	●	■
Long Wave Atmospheric Radiation 2	LWP	●	●	●	●	●	●	●	●	●	●	●	●	■
Longitude	LO	■	■	●	–	–	–	●	●	■	■	●	●	■
Platform Course	COG	■	■	●	–	–	–	●	●	■	■	●	●	■
Platform Heading	GY	●	●	●	–	–	–	●	●	■	■	●	●	■
Platform Speed Over Ground	SOG	■	■	●	–	–	–	●	●	■	■	●	●	■
Precipitation Accumulation	PR	●	●	●	●	●	●	●	●	■	■	●	●	■
Relative Humidity	RH	●	●	●	●	●	●	●	●	●	●	●	●	●
Sea Temperature	ST	●	●	●	■	■	●	●	●	■	■	●	●	■
Short Wave Atmospheric Radiation	SWS	●	●	●	●	●	●	●	●	●	●	●	●	■
Shortwave Atmospheric Radiation 2	SWP	●	●	●	●	●	●	●	●	●	●	●	●	■

● : <6 months old | ▲ : >6 months old | ■ : no metadata reported

KTDQ 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	AT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Atmospheric Pressure	BP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Conductivity	TC	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Earth Relative Wind Direction	TWD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Earth Relative Wind Speed	TWS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	–
Latitude	LA	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Long Wave Atmospheric Radiation	LW	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Longitude	LO	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🔴	🔴
Photosynthetically Active Atmospheric Radiation	PR	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🟢	🟢	🟢	🟢	🔴
Platform Course	CG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Heading	GY	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Relative Wind Direction	RWD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Relative Wind Speed	RWS	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Platform Speed Over Ground	SG	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🔴
Platform Speed Over Water	SL	🟢	🟢	🟢	–	–	–	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Relative Humidity	RH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Salinity	SA	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature	WT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Sea Temperature 2	TT	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢
Short Wave Atmospheric Radiation	SW	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported

WTEA 2015-12 Metadata Status

Parameter	Designator	Make	Model	Units	From bow	P/S from center line	Height / Depth	Measured / Calculated	Spot vs. Average Value	Value Time Center	Length (sec)	Sampling rate (Hz)	Data precision (decimal)	Date in/last calibration
Air Temperature	ATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢
Atmospheric Pressure	BARO	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢
Dew Point Temperature	DEWP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢
Earth Relative Wind Direction	TWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	–
Earth Relative Wind Speed	TWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	–
Latitude	LAT	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🟢	🔴	🔴
Longitude	LON	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Platform Course	COG	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Platform Heading	GYRO	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Platform Relative Wind Direction	RWDIR	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢
Platform Relative Wind Speed	RWSPD	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢
Platform Speed Over Ground	SOG	🟢	🟢	🟢	–	–	–	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Relative Humidity	RELH	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢
Sea Temperature	SEATEMP	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🔴
Wet Bulb Temperature	WETB	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🟢	🔴	🟢	🔴	🟢	🟢

🟢 : <6 months old | 🟡 : >6 months old | 🔴 : no metadata reported