# 2022 SAMOS Data Quality Report

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## 1. Introduction

This report describes the quantity and quality of observations collected in 2022 by research vessels participating in the Shipboard Automated Meteorological and Oceanographic System (SAMOS) initiative (Smith et al. 2018). 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. Original measurements from installed instrumentation 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 DAC focuses on 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. Data reduction from original measurements down to 1-minute averages is completed onboard each ship using their respective data acquisition software. Broadband satellite communication facilitates transferal of SAMOS data to the DAC 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 conjoining, 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*, when she was participating), 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 (https://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 2022, out of 30 active recruits, a total of 29 research vessels routinely provided SAMOS observations to the DAC (Table 1). SAMOS data providers included the National Oceanographic and Atmospheric Administration (NOAA, 15 vessels), the Woods Hole Oceanographic Institution (WHOI, 2 vessels), the National Science Foundation Office of Polar Programs (OPP, 2 vessels), the United States Coast Guard (USCG, 1 vessel), the Bermuda Institute of Ocean Sciences (BIOS, 1 vessel), the University of Hawaii (UH, 1 vessel), the University of Washington (UW, 1 vessel), the University of Alaska (UA, 1 vessel), Scripps Institution of Oceanography (SIO, 3 vessels), and the Australian Integrated Marine Observing System (IMOS, 2 vessels). The Louisiana Universities Marine Consortium (LUMCON) vessel *Pelican* was active in the SAMOS system, but for reasons beyond the control of the SAMOS DAC (problems with their shipboard acquisition and data delivery systems) was unable to contribute data in 2022. The Schmidt Ocean Institute (SOI) vessel *Falkor* ended her service in late 2021, so we decommissioned this vessel in SAMOS as of 1 January 2022. *Falkor* is being replaced by the new SOI vessel *Falkor (too)*, which will sail and transmit data to SAMOS in 2023.

IMOS is an initiative to observe the oceans around Australia (Hill et al. 2010). 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 vessel (*Tangaroa)* operated by New Zealand and one vessel (*Investigator*) operated by Australia. In 2015 code was developed at the SAMOS DAC (updated in 2018) which allows for harvesting *Tangaroa* and *Investigator* SAMOS data directly from the IMOS THREDDS catalogue. In addition to running a parallel system to SAMOS in Australia, IMOS is the only international data contributor to SAMOS.

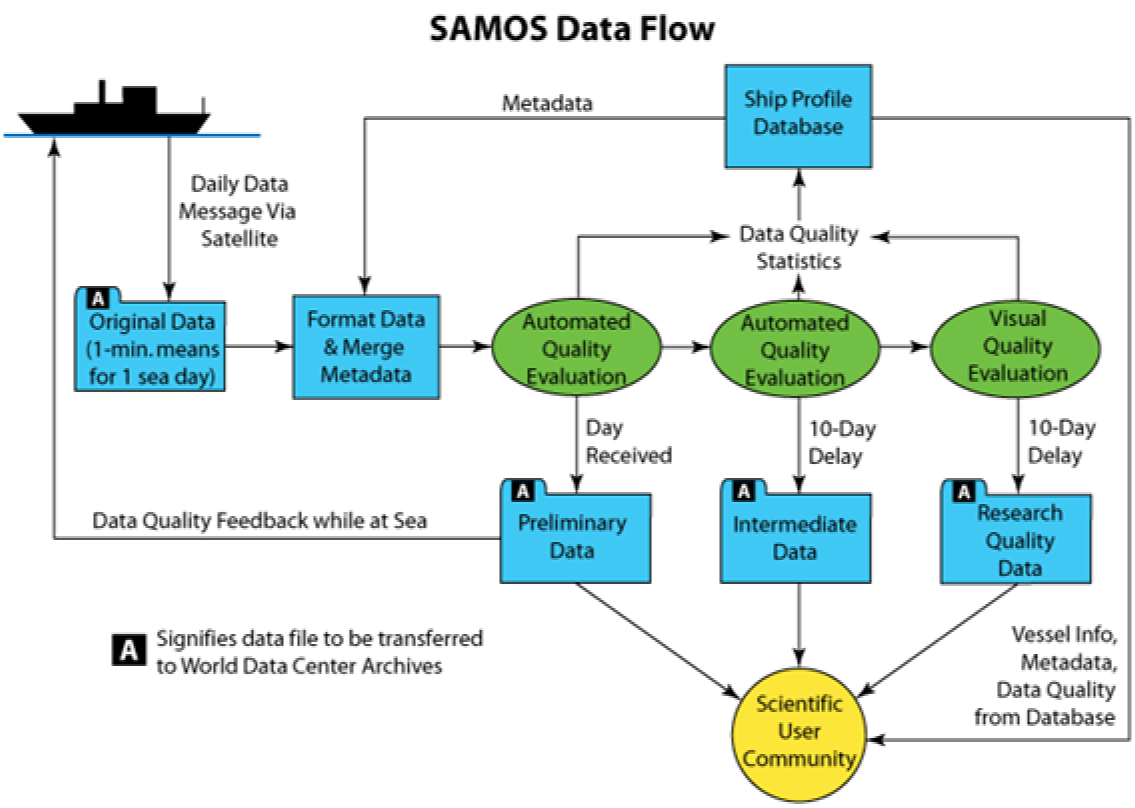


Figure 1: Diagram of operational data flow for the SAMOS initiative in 2022.

Beginning in 2013, funding did not allow for visual quality control procedures for any non-NOAA vessels except the *Falkor* (2013-2021) and her successor the *Falkor (too)* (beginning 2023), the latter of which have been 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 *Tangaroa*, the IMOS project conducted their own visual QC until a personnel change there in June 2013. Only automated QC for the *Investigator* and *Tangaroa* occurs at the SAMOS DAC. The quality results presented herein are from the research quality products for all NOAA vessels and automated-only quality control-level, daily-merged (intermediate) products for all remaining vessels. During 2022, the overall quality of data received varied widely between different vessels and the individual sensors on the vessels. Major problems included non-ideal sensor placement that enhanced flow distortion (nearly all vessels experience some degree of flow distortion), proximity of short wave radiation sensors to a brightly lit nighttime area that impeded normal sensor operation (*Lasker's* short wave radiometer installation on the ship and *Atlantis's* exposure to bright lighting in port), anemometers installed with the incorrect orientation (*Okeanos Explorer*, *Sally Ride*), sea water plumbing issues or failures (*Oscar Elton Sette*, *Rainier*, and *Sikuliaq*, among others), sensor failures/sensors or equipment that remained problematic or missing for extended periods (*Sally Ride*, *Roger Revelle*, *Healy*, *Atlantic Explorer*, *Pisces*, *Bell M. Shimada*, and others), acquisition systems that saw/reported signals for sensors that were not installed (*Thomas Jefferson*, *Robert Gordon Sproul*, *Sally Ride*), sensors that may have been in need of recalibration (*Palmer*, possibly others), various sensor configuration errors such as erroneously entered calibration information (*Atlantic Explorer*) or suspected units improprieties (*Hassler* and *Thomas Jefferson*), sea birds roosting on sensors (*Roger Revelle* and *Thomas G. Thompson*), and data transmission oversights or issues (many vessels).

This report begins with an overview of the vessels contributing SAMOS observations to the DAC in 2022 (section 2). The overview treats the individual vessels as part of a global 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. The 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 2023. Annexes include a listing of vessel notifications and vessel data identified as suspect but not flagged or only partially flagged by quality control procedures (Annex A), as well as web interface instructions for accessing SAMOS observations (Annex B, part 1) and metadata submission by vessel operators (Annex B, part2).

## 2. System review

In 2022, a total of 30 research vessels were under active recruitment to the SAMOS initiative; 29 of those vessels routinely provided SAMOS observations to the DAC (Table 1). The *Pelican* sailed in 2022, but in her case proper configuration of the SAMOS file template and mail server (for the purposes of transmitting SAMOS data) could not be established in 2022 despite efforts to work with the LUMCON team, meaning no SAMOS data from her this year.

In total, 6194 ship days were received by the DAC for the January 1 to December 31, 2022 period, resulting in 8,448,359 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 8,448,359 records received in 2022, a total of 213,249,350 distinct measurements were logged. Of those, 11,421,689 were assigned A-Y quality control flags – about 5.4 percent – by the SAMOS DAC (see section 3a for descriptions of the QC flags). This is about the same as in 2021. Measurements deemed "good data," through both automated and visual QC inspection, are assigned Z flags. In total, fourteen of the SAMOS vessels (the *Tangaroa, Investigator, Atlantis, Neil Armstrong, Laurence M. Gould, Nathaniel B. Palmer, Healy*, *Atlantic Explorer*, *Kilo Moana, Thomas G. Thompson, Sikuliaq*, *Roger Revelle, Sally Ride*, 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 | % Flagged |
|---|---|---|---|---|---|---|---|
| TOTAL | - | 6,194 | 757 | 8,448,359 | 11,421,689 | 213,249,350 | 5.36 |
| ROGER REVELLE | KAOU | 317 | 28 | 446,864 | 339,236 | 12,319,225 | 2.75 |
| ATLANTIS | KAQP | 317 | 30 | 439,475 | 223,528 | 13,184,250 | 1.70 |
| T.G. THOMPSON | KTDQ | 200 | 19 | 256,986 | 100,282 | 4,875,628 | 2.06 |
| HEALY | NEPP | 159 | 38 | 219,493 | 119,118 | 6,987,312 | 1.70 |
| INVESTIGATOR | VLMJ | 257 | 34 | 347,150 | 558,664 | 11,330,724 | 4.93 |
| NEIL ARMSTRONG | WARL | 360 | 32 | 505,087 | 538,901 | 15,705,883 | 3.43 |
| NATHANIEL B. PALMER | WBP3210 | 179 | 23 | 256,168 | 369,054 | 5,728,046 | 6.44 |
| LAURENCE M. GOULD | WCX7445 | 316 | 23 | 451,309 | 688,087 | 9,427,873 | 7.30 |
| KILO MOANA | WDA7827 | 141 | 33 | 189,664 | 15,379 | 5,548,045 | 0.28 |
| ATLANTIC EXPLORER | WDC9417 | 166 | 32 | 205,186 | 223,964 | 6,466,583 | 3.46 |
| SIKULIAQ | WDG7520 | 340 | 37 | 489,488 | 685,374 | 16,781,375 | 4.08 |
| SALLY RIDE | WSAF | 361 | 28 | 510,238 | 453,145 | 13,880,472 | 3.26 |
| ROBERT GORDON SPROUL | WSQ2674 | 304 | 22 | 414,687 | 353,468 | 8,888,749 | 3.98 |
| HENRY B. BIGELOW | WTDF | 155 | 27 | 200,978 | 363,958 | 5,384,179 | 6.76 |
| OKEANOS EXPLORER | WTDH | 196 | 22 | 265,179 | 118,985 | 5,465,188 | 2.18 |
| PISCES | WTDL | 152 | 18 | 200,081 | 276,259 | 3,124,017 | 8.84 |
| OREGON II | WTDO | 75 | 16 | 98,426 | 148,283 | 1,574,726 | 9.42 |
| THOMAS JEFFERSON | WTEA | 208 | 26 | 234,231 | 672,336 | 5,007,589 | 13.43 |
| FAIRWEATHER | WTEB | 151 | 21 | 213,310 | 634,817 | 3,378,168 | 18.79 |
| RON BROWN | WTEC | 137 | 28 | 188,976 | 414,525 | 5,222,493 | 7.94 |
| BELL M. SHIMADA | WTED | 213 | 41 | 294,823 | 375,574 | 11,194,982 | 3.35 |
| OSCAR ELTON SETTE | WTEE | 188 | 26 | 247,967 | 733,108 | 5,632,831 | 13.01 |
| RAINIER | WTEF | 228 | 16 | 324,302 | 347,166 | 5,188,832 | 6.69 |
| REUBEN LASKER | WTEG | 80 | 22 | 97,054 | 112,588 | 2,122,340 | 5.30 |
| FERDINAND HASSLER | WTEK | 313 | 14 | 427,315 | 1,407,109 | 5,430,028 | 25.91 |
| GORDON GUNTER | WTEO | 29 | 16 | 34,926 | 58,227 | 555,607 | 10.48 |
| OSCAR DYSON | WTEP | 151 | 32 | 192,975 | 314,109 | 6,147,893 | 5.11 |
| NANCY FOSTER | WTER | 252 | 36 | 357,832 | 252,029 | 10,961,494 | 2.30 |
| TANGAROA | ZMFR | 249 | 17 | 338,189 | 524,416 | 5,734,818 | 9.14 |

Table 1: CY2022 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 one-minute 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, (column eight) percentage flagged A-Y.

### 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. Scheduled days may sometimes include days spent at port, 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 (e.g., within an exclusive economic zone, marine protected area, underwater cultural heritage site, etc., 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. The DAC provides JSON web services (https://samos.coaps.fsu.edu/html/webservices.php) to allow interested parties to track the date data was last received by the DAC for each vessel (Preliminary File), the results of the automated quality control on these files (Preliminary Quality), and to search for available SAMOS data by cruise identifier for those vessels cataloged by the Rolling Deck to Repository (R2R) project. This allows operators and the DAC to track the completeness of SAMOS data for each vessel and to identify when data are not received within the 10-day limit for visual quality control. When data are received after the 10-day limit, current funding for the SAMOS initiative does 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.

In Figure 2, we directly compare the data we've received (green) to final 2022 ship schedules provided by each vessel's institution. 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 2022, with the exceptions of *Tangaroa* and *Investigator,* has been archived at the NCEI. Through agreement with IMOS, we receive data for the *Tangaroa* and the *Investigator* 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KTDQ | | | | | | | | | | | | | | | S | S | S | S | S | S | | | | | | | | | | | |
| NEPP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VLMJ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WARL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WBP3210 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDA7827 | | | | | | | | | | | | | | S | | | | | | | | | | | | | | | | | |
| WDC9417 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDD6114 | | 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 | S | S | S | S |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSQ2674 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTED | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEP | | | | | | | | S | | | | | | | | | | | | | | | | | | | | | | | |
| WTER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| 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 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KAOU | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KAQP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KTDQ | | | | | | | | | | | | | | | | | | | | | | | | | | * | * | * | | | |
| NEPP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VLMJ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WARL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WBP3210 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDA7827 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDC9417 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDD6114 | S | | | | | | S | S | S | | | | | | | | | | | | | | | | | | | | | | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSQ2674 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEA | | | | | | | | | | | | | | | | | S | | | | | | | | | | | | | | |
| WTEB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTED | | | | | | | | | S | | | | | | | | | | | | | | | | | | | | | | |
| WTEE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEF | | | | | | | | | | | | | | | S | S | | | | | | | | | | | | | | | |
| WTEG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTER | S | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Figure 2: 2022 calendar of ship days received by DAC (**green**) and (**grey**) additional days reported afloat by vessels; "**S**" denotes vessel reportedly at sea, "P" denotes vessel in port, "*****" denotes a known "restricted data" situation (e.g., a maritime EEZ, underwater cultural heritage 'UCH' protocol, etc.) with no expectation of data. Vessels are listed by call sign (see Table 1).

| MARCH | 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KTDQ | * | * | | | | | | | | | | | | | | | | | | S | | | S | S | | S | S | | * | * | |
| NEPP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VLMJ | | | | | | | | | | | | | | | | | | | | | | | | | | S | S | S | S | S | S |
| WARL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WBP3210 | | | | | | | | | | | | | | S | S | S | S | S | S | S | S | | | | | | | | | | |
| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDA7827 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | S | |
| WDC9417 | | | | | | | | | | | | | | | | | | | | | S | S | S | S | S | | | | | | |
| WDD6114 | | S | S | | | | | | | | | | | | | | S | S | S | | | | | | | | | | | | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | S | | | | | | | | | | | | | | | | | | | | | |
| WSQ2674 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| WTEC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTED | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEE | | S | S | S | | | | S | S | S | S | S | S | S | S | S | S | S | | | | | | | | | | | | S | S |
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| WTEK | | | | | | S | S | | | | | | | | | | | | | | | | | | | | | | | | |
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| WTEP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| 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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| KTDQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| WARL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WBP3210 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDA7827 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDC9417 | | | | | | | | | | | | | | | | | | | | | | | | | | | S | | | | |
| WDD6114 | | | | | | | | | | | | | | S | S | S | S | | | | | | | | S | S | S | S | S | S | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSQ2674 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDL | | | | | | | | | | | | | | | S | S | S | | | | | S | S | S | S | S | S | S | S | S | |
| WTDO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEA | | | | | | | | | | | | | | | | | | | | | | | | | | | | S | | | |
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| WTEP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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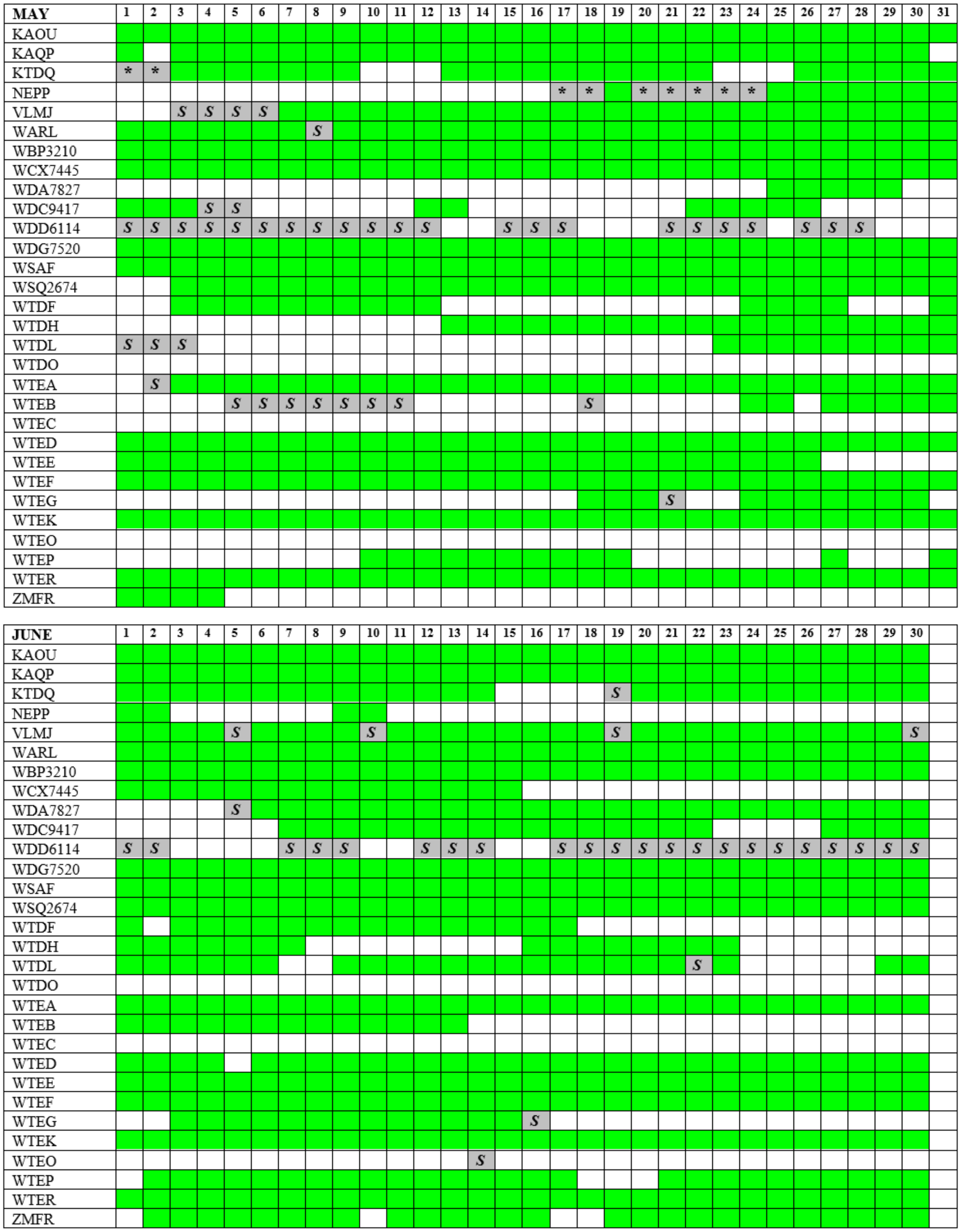
| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

(Figure 2: cont'd)




(Figure 2: cont'd)

| JULY | 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 |
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| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDA7827 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDC9417 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | S | S | | | | | | | |
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| WTEC | | | | | | | | | | | S | S | S | | | | | S | | | | | | | | | | | | | |
| WTED | | | | | | | | | | | S | S | | | | | | | | | | | | | | | | | | | |
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| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| AUGUST | 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 |
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| WBP3210 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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(Figure 2: cont'd)

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| WDD6114 | | | | | | | | | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | | | | | | | S | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| OCTOBER | 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 |
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| WDC9417 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDD6114 | S | S | S | S | S | | | | | | | S | | | | | | | | S | S | S | S | | S | S | S | | | | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| WTEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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(Figure 2: cont'd)

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| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDA7827 | | | | S | S | S | S | S | S | S | S | S | S | S | S | | | | S | S | S | S | S | S | S | S | S | S | S | S | |
| WDC9417 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDD6114 | | S | S | | | | | S | S | S | S | S | S | S | S | S | S | S | | | | | | | | | | | | S | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSQ2674 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTED | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| DECEMBER | 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KTDQ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NEPP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VLMJ | | | | | | | | | | | S | S | | | | | | | | | | | | | | | | | | | |
| WARL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WBP3210 | S | S | S | S | S | S | S | S | S | | | | | | | | | | | | | | | | | S | S | S | S | S | S |
| WCX7445 | | | | | | | | | | | | | | | | | | | | | | | S | S | S | S | | | | | |
| WDA7827 | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | | | | | | | | | | | | | | | |
| WDC9417 | | | | | | | | | | | | | | | | | | S | | | | | S | S | S | S | S | S | S | S | S |
| WDD6114 | S | S | S | S | S | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WDG7520 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSAF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WSQ2674 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDH | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDL | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTDO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEA | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEB | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEC | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTED | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEF | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEG | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEK | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTEP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WTER | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ZMFR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

(Figure 2: cont'd)

| **NOAA** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ship Name | Bell M. Shimada | Fairweather | Ferdinand Hassler | Gordon Gunter | Henry Bigelow | Nancy Foster | Okeanos Explorer | Oregon II |
| Call Sign/ Ship Code | WTED/SH | WTEB/FA | WTEK/FH | WTEO/GU | WTDF/HB | WTER/NF | WTDH/EX | WTDO/OT |
| # scheduled at-sea days | 156 | 94 | 140 | 28 | 151 | 128 | 178 | 80 |
| # matching SAMOS days | 151 | 79 | 138 | 24 | 151 | 127 | 176 | 74 |
| →% received | 97% | 84% | 99% | 86% | 100% | 99% | 99% | 93% |

| **NOAA (cont'd)** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Ship Name | Oscar Dyson | Oscar E. Sette | Pisces | Rainier | Reuben Lasker | Ronald Brown | Thomas Jefferson |
| Call Sign/ Ship Code | WTEP/OD | WTEE/OS | WTDL/PI | WTEF/RA | WTEG/RL | WTEC/RB | WTEA/TJ |
| # scheduled at-sea days | 148 | 160 | 132 | 143 | 76 | 141 | 160 |
| # matching SAMOS days | 142 | 144 | 109 | 140 | 69 | 136 | 156 |
| →% received | 96% | 90% | 83% | 98% | 91% | 96% | 98% |

| | |
|---|---|
| TOTAL scheduled at-sea days: | 1915 |
| TOTAL matching SAMOS days: | 1816 |
| OVERALL RATIO: | 95% |

Table 2: 2022 data submission performance metrics listed by institution and ship. Note where official schedules specify "at sea" days only those days are counted. In all other cases "at sea" is assumed and scheduled days are counted as-is. Note also while SAMOS days follow GMT, ship schedules may not. This leaves room for some small margin of error. Lastly, note any transit through an exclusive economic zone, marine protected area, etc. may preclude data transmission. All public schedule resources are listed in the References.

| IMOS | | |
|---|---|---|
| Ship Name | Investigator | Tangaroa |
| Call Sign | VLMJ | ZMFR |
| # scheduled at-sea days | 204 | 236 |
| # matching SAMOS days | 163 | 236 |
| →% received | 80% | 100% |
| TOTAL scheduled at-sea days: | 440 | |
| TOTAL matching SAMOS days: | 399 | |
| OVERALL RATIO: | 91% | |

| OPP | | |
|---|---|---|
| Ship Name | Laurence M. Gould | Nathaniel B. Palmer |
| Call Sign | WCX7445 | WBP3210 |
| # scheduled at-sea days | 105 | 151 |
| # matching SAMOS days | 100 | 107 |
| →% received | 95% | 71% |
| TOTAL scheduled days: | 256 | |
| TOTAL matching SAMOS days: | 207 | |
| OVERALL RATIO: | 81% | |

| SIO | | | |
|---|---|---|---|
| Ship Name | Robert G. Sproul | Roger Revelle | Sally Ride |
| Call Sign | WSQ2674 | KAOU | WSAF |
| # scheduled at-sea days | 103 | 197 | 143 |
| # matching SAMOS days | 102 | 197 | 140 |
| →% received | 99% | 100% | 98% |
| TOTAL scheduled at-sea days: | 443 | | |
| TOTAL matching SAMOS days: | 439 | | |
| OVERALL RATIO: | 99% | | |

| WHOI | | |
|---|---|---|
| Ship Name | R/V Atlantis | R/V Neil Armstrong |
| Call Sign | KAQP | WARL |
| # scheduled at-sea days | 216 | 236 |
| # matching SAMOS days | 215 | 235 |
| →% received | 100% | 100% |
| TOTAL scheduled at-sea days: | 452 | |
| TOTAL matching SAMOS days: | 450 | |
| OVERALL RATIO: | 100% | |

| | BIOS | LUMCON | UAF | UHI | USCG | UW |
|---|---|---|---|---|---|---|
| Ship Name | Atlantic Explorer | Pelican | Sikuliaq | Kilo Moana | Healy | Thomas G. Thompson |
| Call Sign | WDC9417 | WDD6114 | WDG7520 | WDA7827 | NEPP | KTDQ |
| TOTAL scheduled at-sea days | 176 | 191 | 252 | 234 | 121 | 224 |
| TOTAL matching SAMOS days | 158 | 0 | 252 | 156 | 110 | 195 |
| OVERALL RATIO: | 90% | 0% | 100% | 67% | 91% | 87% |

(Table 2: cont'd)

### b. Spatial coverage

Geographically, SAMOS data coverage continues to be noteworthy in 2022, with both the typical exposures and a few trips outside traditional mapping/shipping lanes. Cruise coverage for the January 1, 2022 to December 31, 2022 period is shown in Figure 3. As usual, there were numerous cruises in the Southern Ocean, from Punta Arenas, Chile to and along the Antarctic shelf, furnished by the two OPP vessels *Nathaniel B. Palmer* and *Laurence M. Gould*. Extensive exposure in the North Atlantic was afforded by the *Atlantic Explorer*, *Okeanos Explorer*, and *Ron Brown* (among others). The two WHOI vessels furthered the northern range up into the Labrador Sea (*Atlantis* and *Neil Armstrong*) and around southern Iceland and Greenland into Baffin Bay (*Neil Armstrong*). Several broad swaths of the North Pacific were provided by the *Kilo Moana*, *Thomas G. Thompson*, *Bell M. Shimada*, *Rainier*, and *Roger Revelle*, with the *Revelle* also venturing into both the Philippine Sea and the South Pacific. Meanwhile, the Gulf of Alaska and the Bering Sea saw heavy coverage between the *Healy*, *Oscar Dyson*, *Bell M. Shimada*, and *Sikuliaq*, with the *Healy* and *Sikuliaq* contributing additional sampling in the Arctic Ocean. The *Okeanos Explorer* and *Atlantis* both made transits through the Panama Canal, while the *Thomas Jefferson* made an unusual trip down the St. Lawrence River to spend much of the field season in Lakes Ontario and Erie. The waters around Australia were explored by the *Revelle* and *Investigator*, and the waters east of New Zealand received heavy coverage from the *Tangaroa*. The *Atlantic Explorer* naturally spent a lot of time cruising around Bermuda, and the *Nancy Foster* spent some time cruising the north shores of the Greater Antilles. Natively, the entire East coast was sampled by the *Ferdinand Hassler*, *Henry Bigelow*, *Atlantis*, *Nancy Foster*, *Ron Brown*, *Pisces*, *Oregon II* and others. Comparable coverage of British Columbia and the West coast was effected by, among others, the *Bell M. Shimada*, *Fairweather, Oscar Dyson, Reuben Lasker*, *Sikuliaq*, and the three Scripps ships *Revelle*, *Sally Ride*, and *Robert Gordon Sproul*. The Hawai'ian archipelago was comprehensively explored by the *Oscar Elton Sette*, *Thomas G. Thompson*, and *Kilo Moana*. There was also the typical coverage in the Gulf of Mexico, as contributed by the *Gordon Gunter*, *Pisces*, *Oregon II*, and others.


Figure 3: Cruise maps plotted for each vessel in 2022.

### c. Available parameter coverage

The core meteorological parameters – earth relative wind speed and direction, atmospheric pressure, and air temperature and relative humidity – are reported by all ships. Most ships also report the oceanographic parameter sea temperature. Many SAMOS vessels additionally report precipitation accumulation; rain rate; and longwave, shortwave, net, and photosynthetically active radiations; along with seawater conductivity and salinity. Additionally, the *Bell M. Shimada*, *Fairweather*, *Nancy Foster*, *Okeanos Explorer*, *Rainier*, and *Thomas Jefferson* provided dew point temperature and wet bulb temperature in 2022. A quick glance at Table 4 (located in Section 4) shows which parameters are reported by each vessel: those boxes in columns 6 through 13 on the first page and columns 2 through 16 on the second page with an entry indicate a parameter was enabled for reporting and processing at the writing of this publication. (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, and those boxes in columns 6 through 13 on the first page and columns 2 through 16 on the second page in Table 4 with multiple entries indicate the number of redundant sensors available for reporting and processing in 2022/2023; 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 and detailed descriptions of the quality tests are provided in Smith et al. (2018). It should be noted that no secondary automated QC was active in 2022 (SASSI), so quality control flags U-Y were not in use. A “special value” (set equal to -8888) may exist in any variable when a value received 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, in an effort to minimize over-flagging, are rarely used. 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. (We note that, owing to a timeworn visual flagging platform, the H flag is not routinely used, to achieve expeditious flagging.) 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. |
| 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 dewpoint temperature. |
| E | Data failed the resultant wind re-computation check. When the data set includes the platform's heading, course over the ground, and speed over the ground 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 difference between the reported and re-computed true wind direction is >20 degrees (or >2.5 m/s for true wind speed). |
| F | Platform velocity unrealistic. Determined by comparing distance travelled between sequential (3-minute interval) latitude and longitude positions. Flags applied to latitude and longitude (not the platform speed). |
| G | Data are greater then 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 (step) found in the data. Flags assigned to the maximum and minimum points in the discontinuity. |
| 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 | Visual inspection shows the value to be erroneous/poor quality. The value should NOT be used. |
| K | Data suspect/use with caution - Applied when the data looks to have obvious errors, but no specific reason for the error can be determined. Some data may be useful, but uncertainty would be high and use is not recommended. |
| L | Oceanographic platform position over land when comparing reported latitude and longitude to ETOPO 1-arc-minute topography dataset. |
| 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 are uncertain. Data should be used with caution. |
| Q | Questionable - observation reported as questionable/uncertain in consultation with vessel operator or data arrived at DAC already flagged as questionable/uncertain (use with caution). |
| 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 5 values) that are drastically out of the current data trend. Spikes occur 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. (SASSI presently not in use). |
| V | Data spike as determined by SASSI. (SASSI presently not in use). |
| X | Step/discontinuity in data as determined by SASSI. (SASSI presently not in use). |
| Y | Suspect values between X-flagged data (from SASSI). (SASSI presently not in use). |
| Z | Data passed evaluation |

Table 3: Definitions of SAMOS quality control flags

### b. 2022 quality across-system

This section presents the overall quality from the system of ships providing observations to the SAMOS data center in 2022. 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.

Latitude and longitude (Figure 4) primarily only receive flags via the auto flagger, 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 either land error flags (L) or platform velocity unrealistic (F) flags. L flags are often removed by the data analyst when it is determined that the vessel was simply very close to land, but still over water and the flag is simply a result of using a 1 arc-minute land mask that cannot resolve the smaller near coastal waters (see Smith et al. 2018, land flag removal is not possible for non-visual QC ships). Otherwise, L and F flags are commonly assigned to spikes in LAT and LON data. It should be noted that *Atlantis*, *Neil Armstrong*, *Revelle*, *Sproul*, *Sikuliaq*, *Palmer*, and *Gould* in particular are known to transmit a good deal of port data and since they do not receive visual QC, some amount of erroneous L (position over land) auto flagging would be expected for 2022. It might also be noted some visual QC ships that have been upgraded to the newest version of NOAA's Scientific Computing System (SCSv5) see an increase in L and F flags, particularly in port, which are not always able to be removed (mainly *Oscar Elton Sette* and *Thomas Jefferson*).

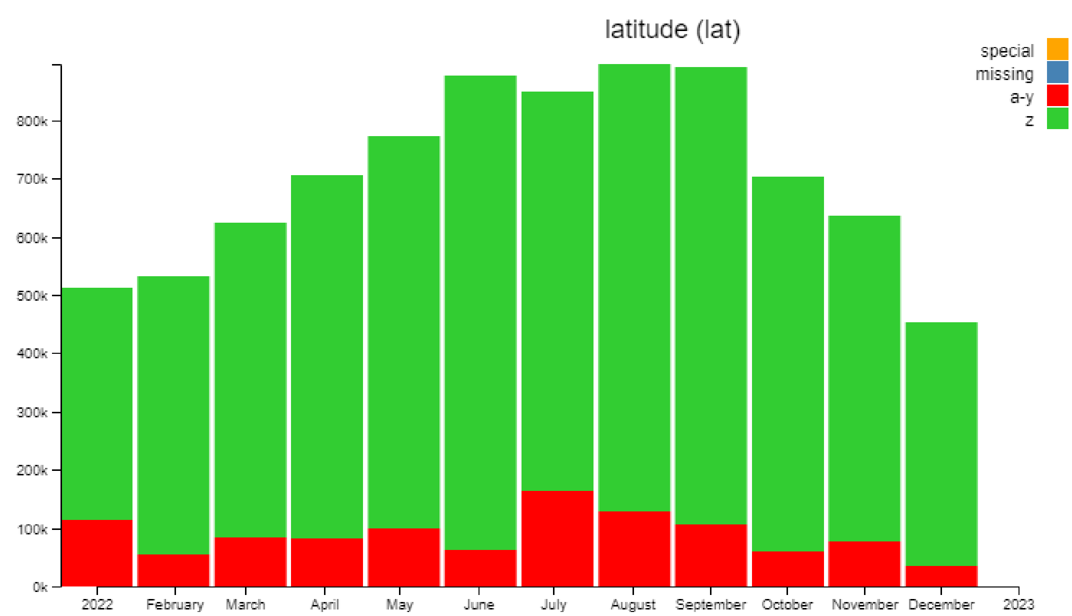



Figure 4: Total number of (this page) latitude – LAT – and (next page) longitude – LON – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

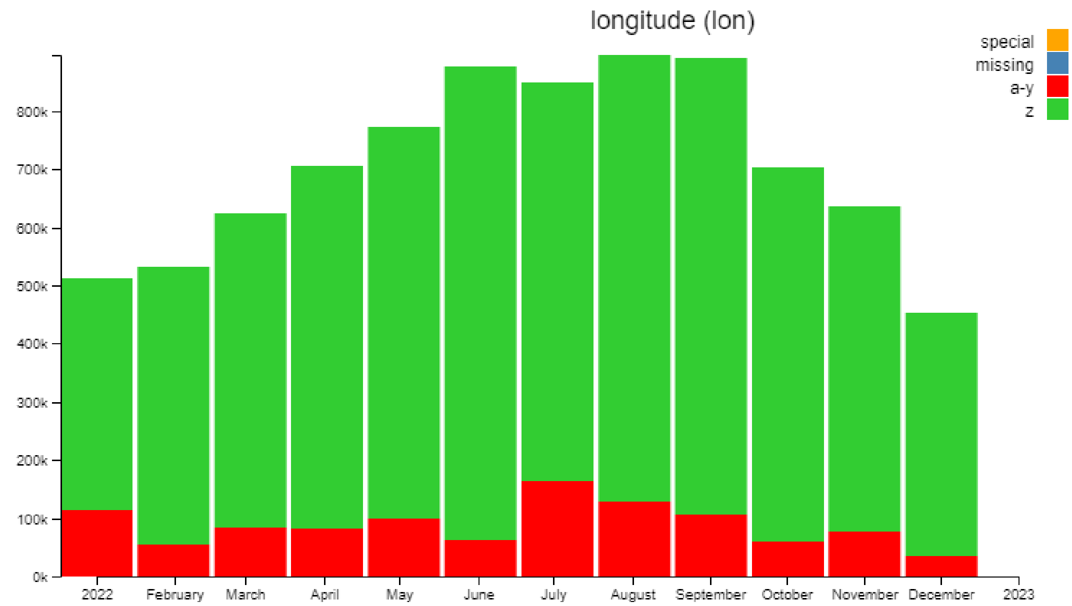
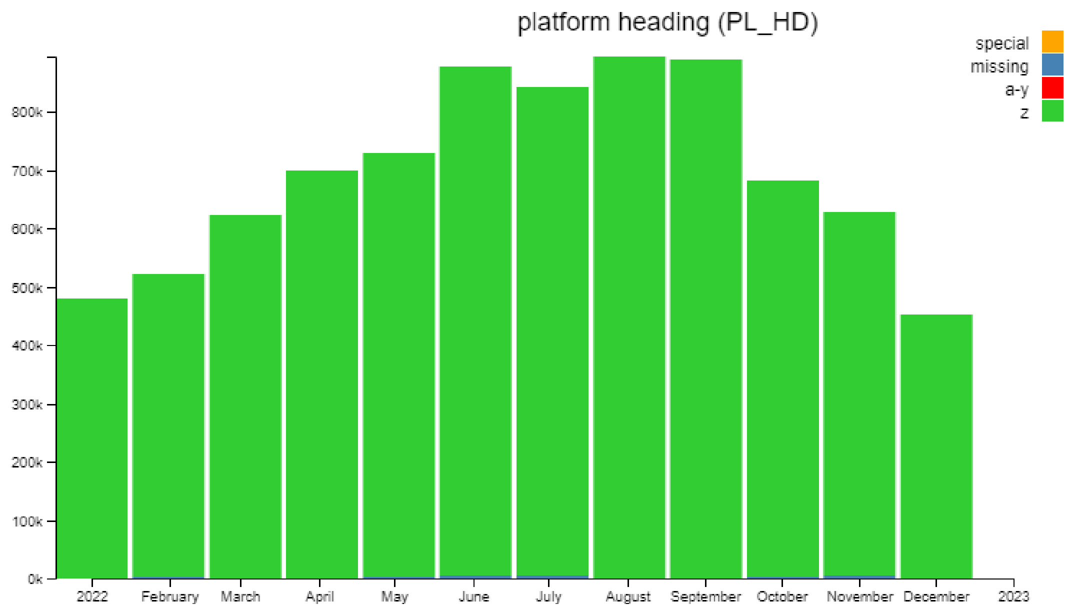



Figure 4: cont'd.

The remainder of the navigational parameters exhibited no real problems of note. They are nevertheless included for completeness: platform heading (Figure 5), platform course (Figure 6), platform speed over ground (Figure 7), and platform speed over water (Figure 8). We note, regarding PL_SOW and PL_SOW2 it is common for these sensors only to transmit data when underway. As such, frequent missing values are the norm for those two.



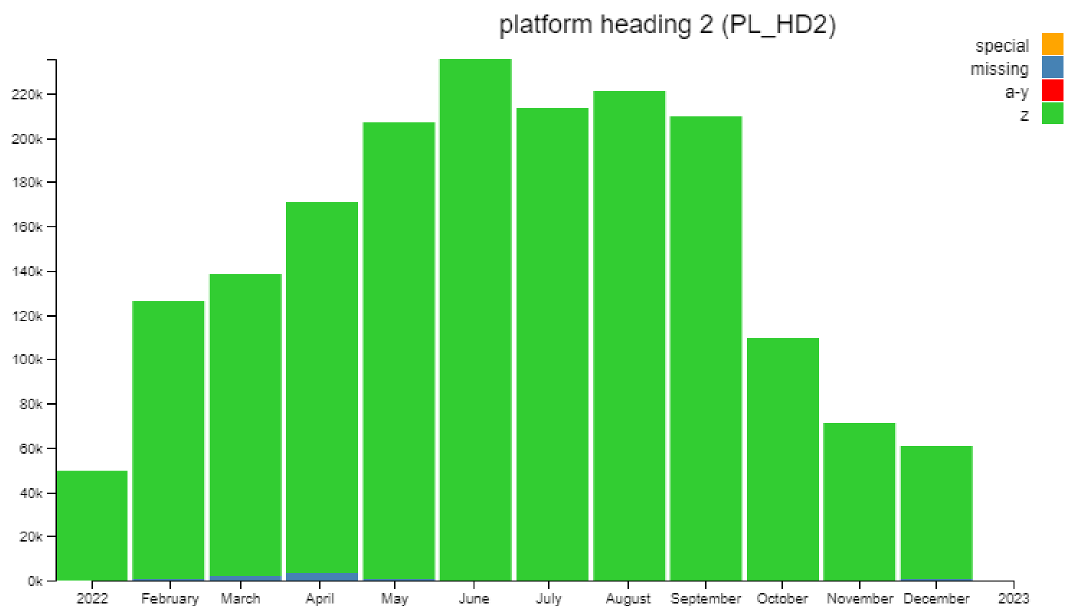




Figure 5: Total number of (this page, top) platform heading – PL_HD – (this page, bottom) platform heading 2 – PL_HD2 – and (next page) platform heading 3 – PL_HD3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that 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.

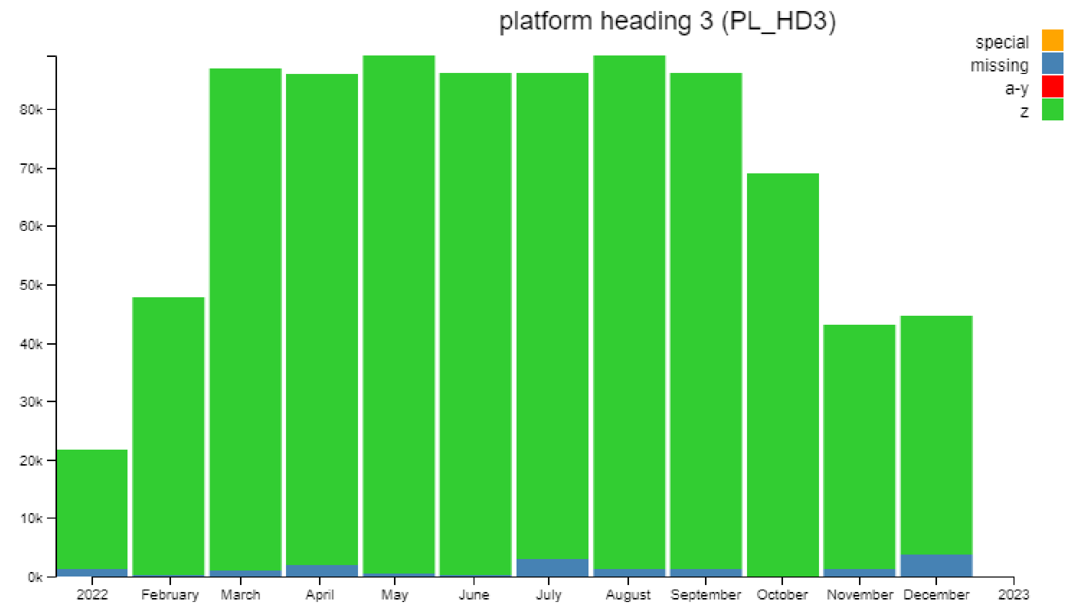



Figure 5: cont'd.

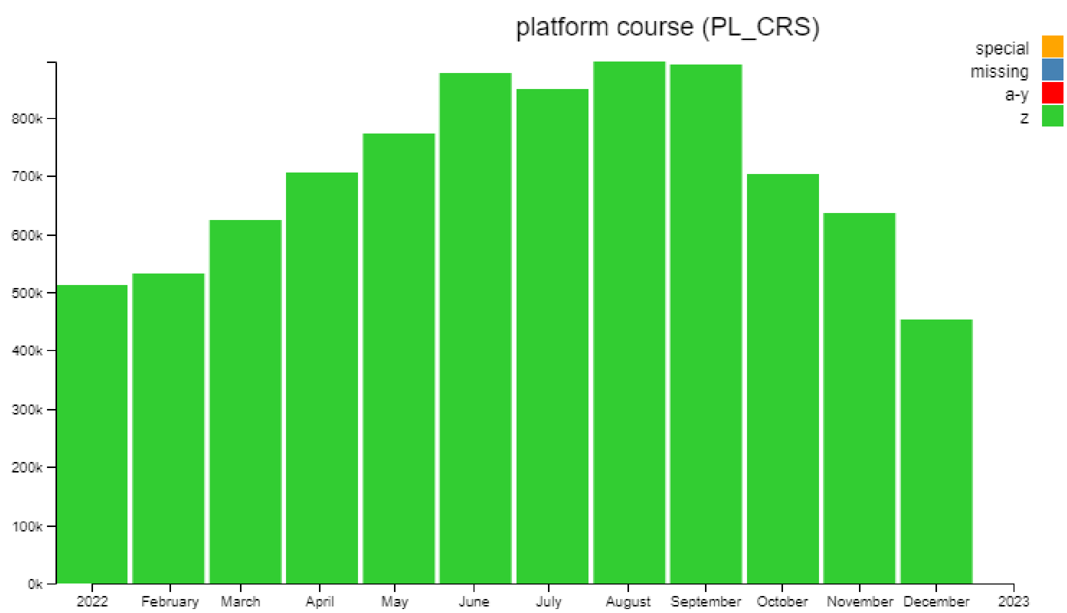
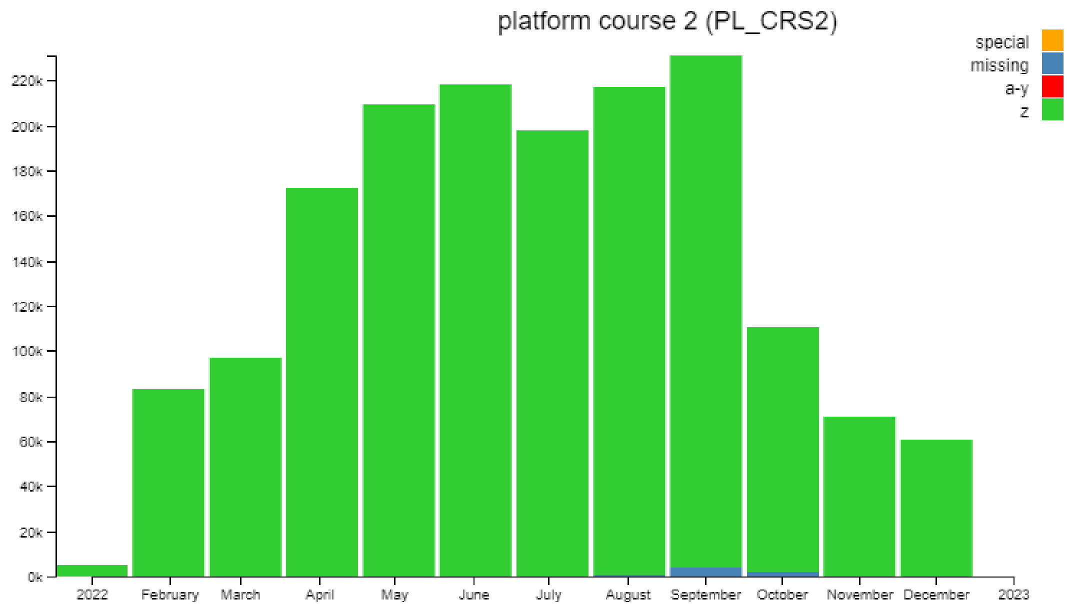



Figure 6: Total number of (this page) platform course – PL_CRS – (next page, top) platform course 2 – PL_CRS2 – and (next page, bottom) platform course 3 – PL_CRS3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that 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.



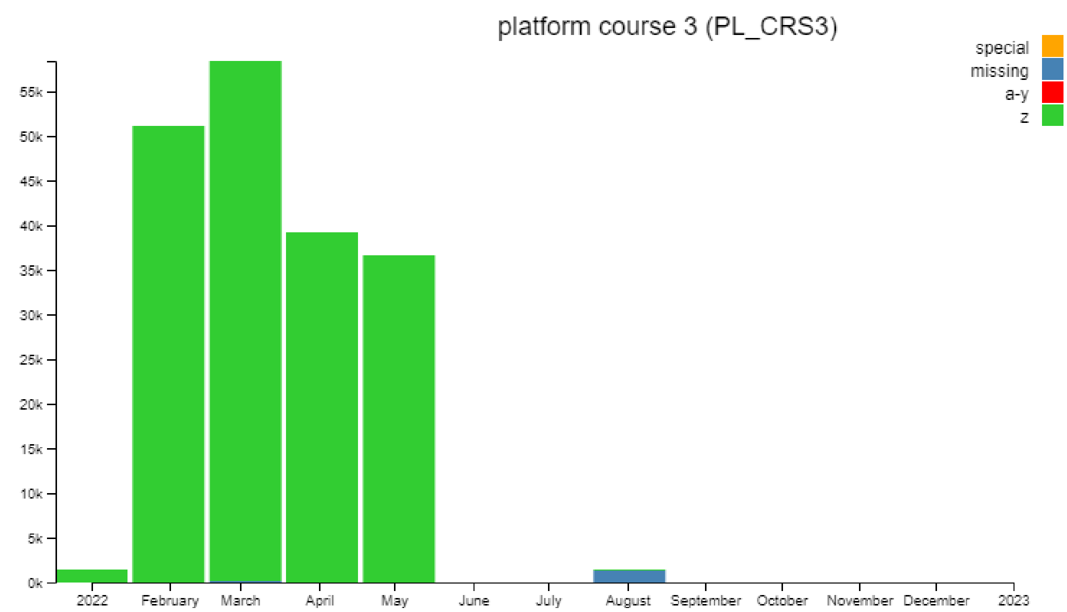
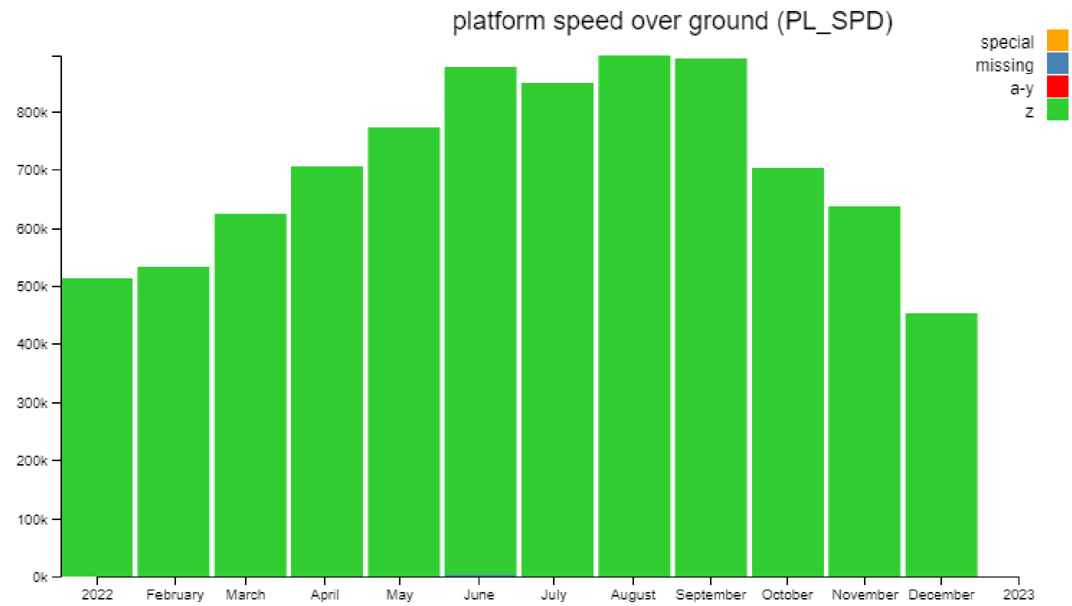




Figure 6: cont'd.



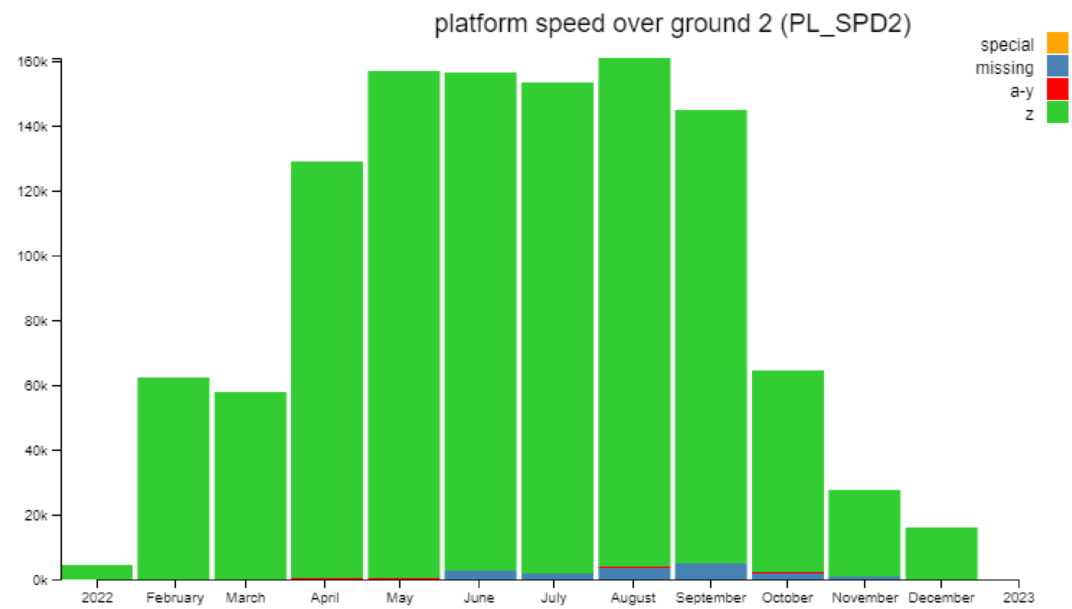




Figure 7: Total number of (this page, top) platform speed over ground – PL_SPD – (this page, bottom) platform speed over ground 2 – PL_SPD2 – and (next page) platform speed over ground 3 – PL_SPD3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) 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.

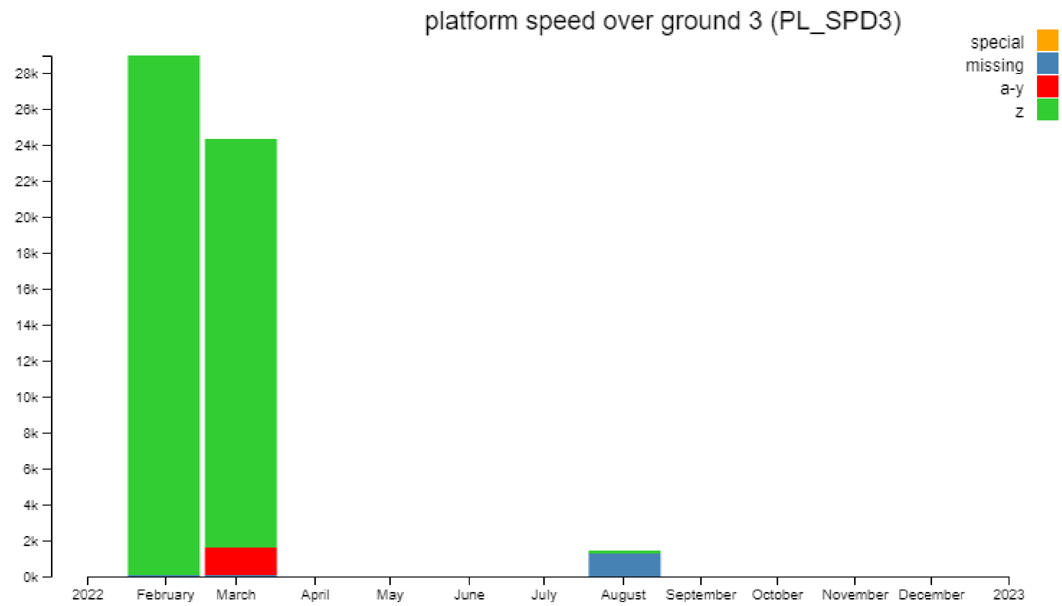



Figure 7: cont'd.

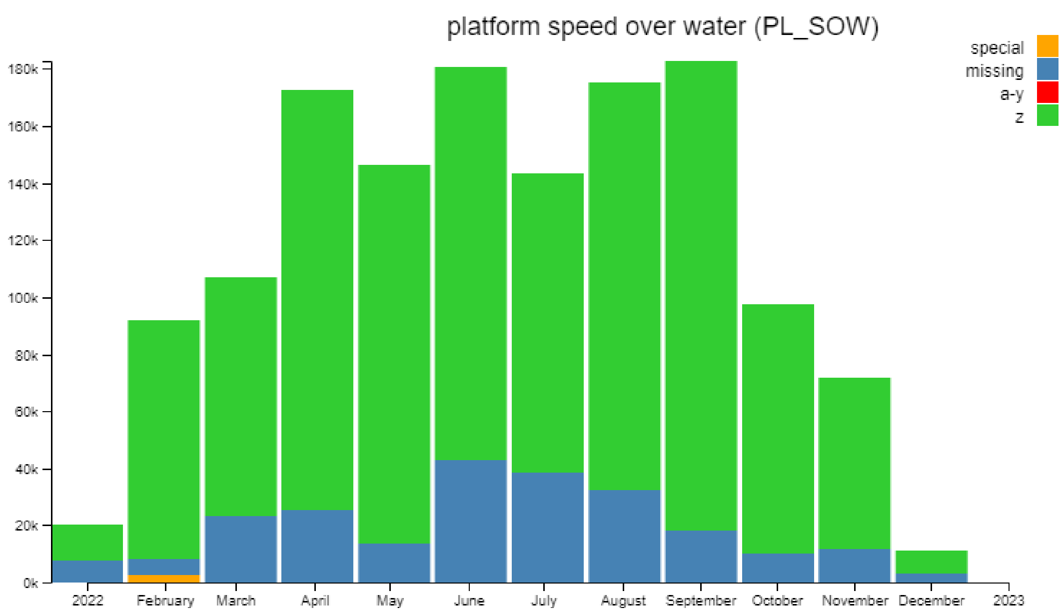



Figure 8: Total number of (this page) platform speed over water – PL_SOW – and (next page) platform speed over water 2 – PL_SOW2 observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

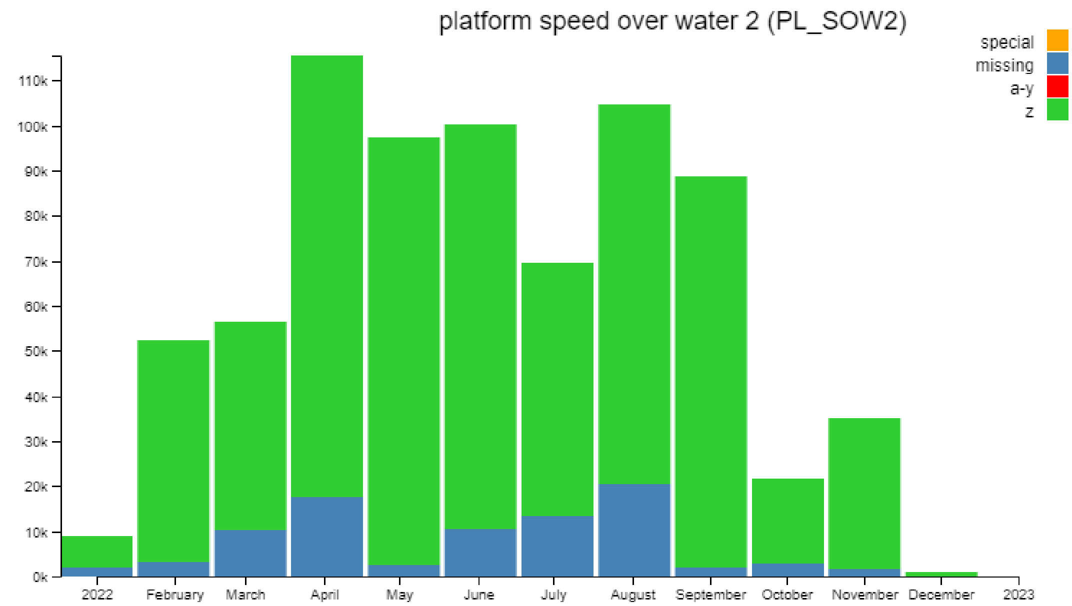
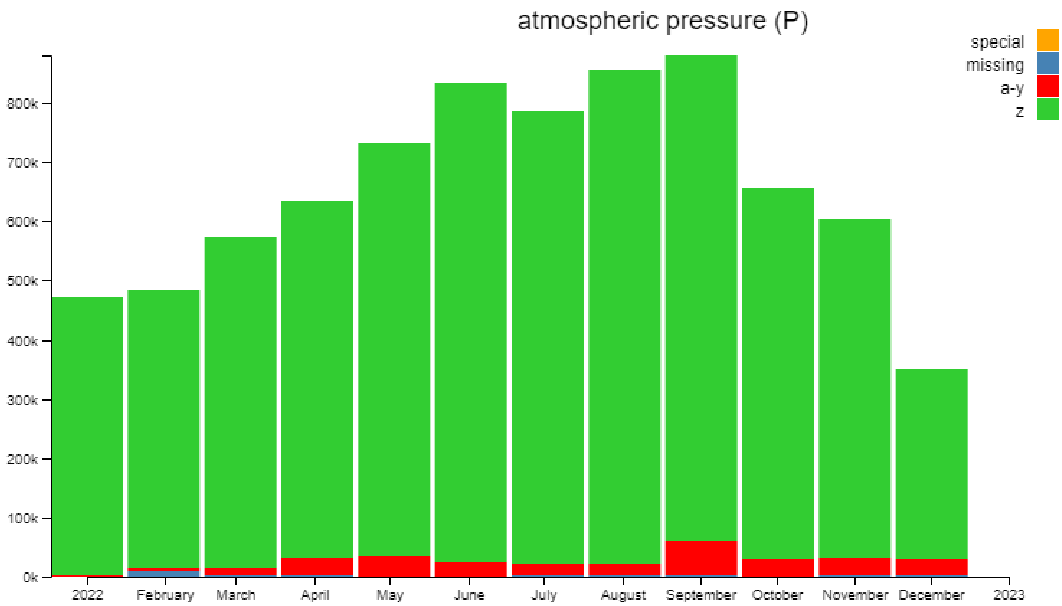



Figure 8: cont'd.

The quality of SAMOS atmospheric pressure data is generally good (Figure 9). The most common problems with the pressure sensors are flow obstruction and barometer response to changes in platform speed. 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. We note it is also fairly common to see water collection in cracked pressure port tubing, which affects the pressure data and can contribute to pressure flags during visual QC.

The uptick in flagging seen in P in September was influenced by an unknown issue on *Gordon Gunter* that caused unrealistic values, while the September uptick in P2 flagging was influenced by a sensor failure on the Atlantic Explorer. Similarly, the uptick in flagging seen in P2 in December was influenced by a sensor failure on *Sally Ride*. (All documented; see individual vessel descriptions in 3c. for details.)



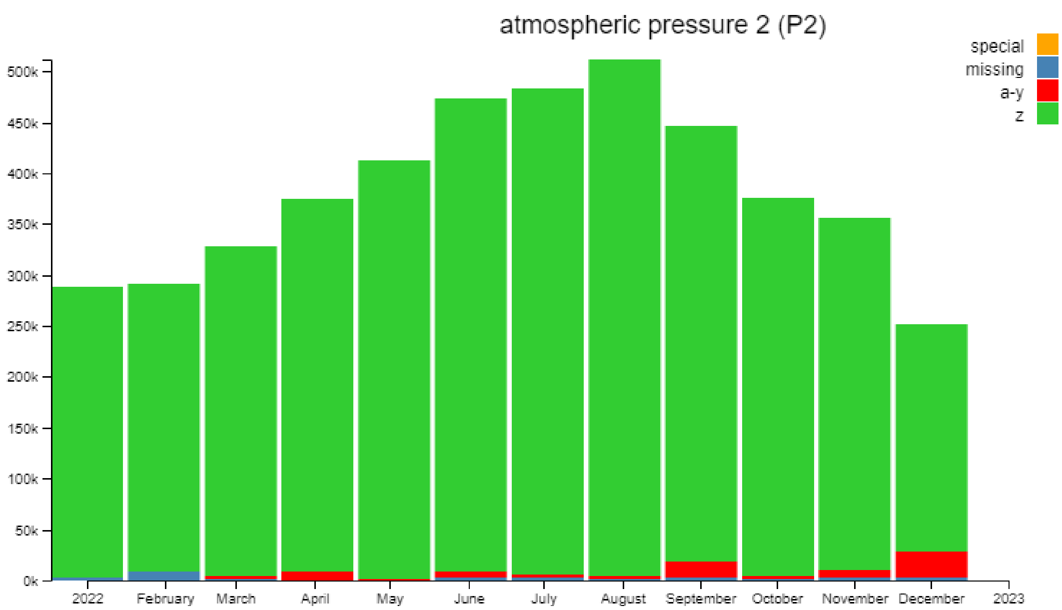
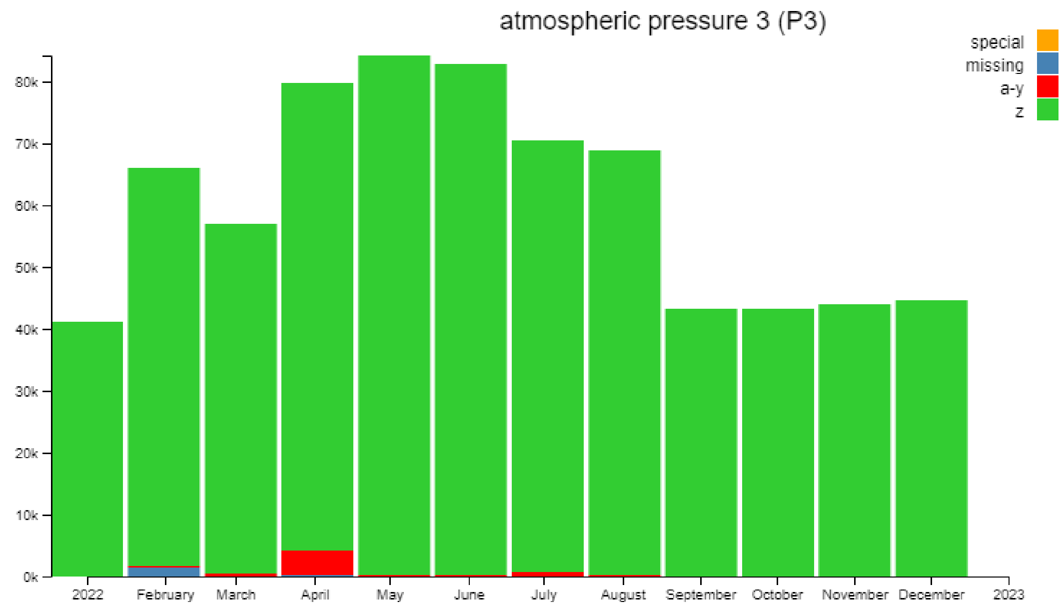



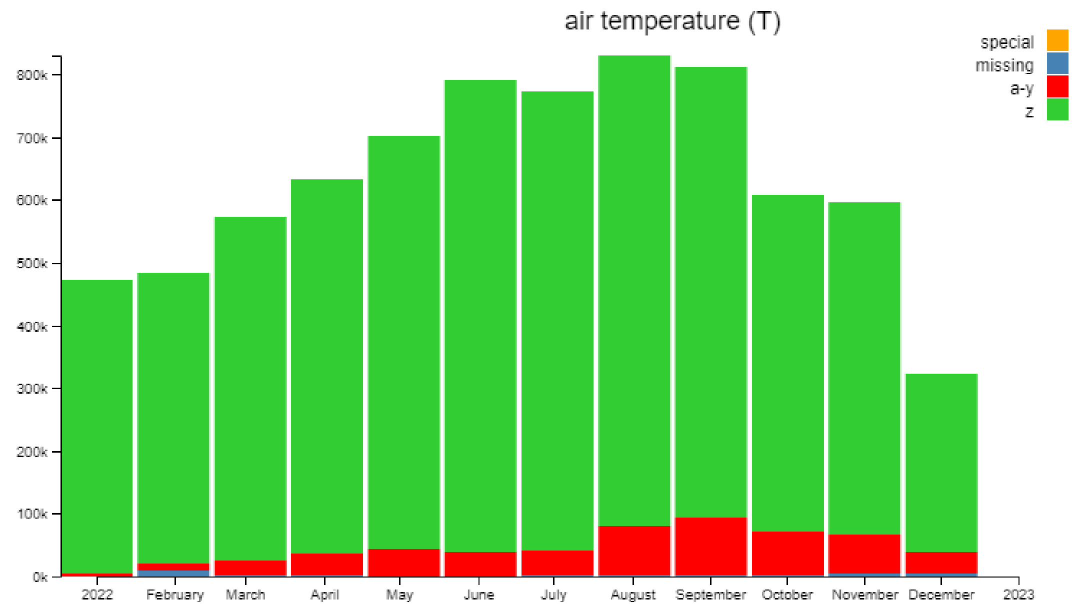

Figure 9: Total number of (this page, top) atmospheric pressure – P – (this page, bottom) atmospheric pressure 2 – P2 – and (next page) atmospheric pressure 3 – P3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that 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 9: cont'd)

Air temperature was also of decent quality (Figure 10). With the air temperature sensors, again flow obstruction is 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. Thermal contamination 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). Contamination from stack exhaust was also a common problem. 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.

The increased flagging seen in T in August through December was largely due to an unknown, prolonged data issue that existed on *Ferdinand Hassler*. The November (and possibly December) upticks in flagging in T2 and T3 were influenced by *Sally Ride* reporting an out-of-bounds signal for sensors that were not installed. (All documented; see individual vessel descriptions in 3c. for details.) Generally speaking, the origins of any upticks in flagging in air temperature are often not clearly identified as belonging to any specific vessel(s) but tend to be due to several vessels simultaneously experiencing common sensor issues.



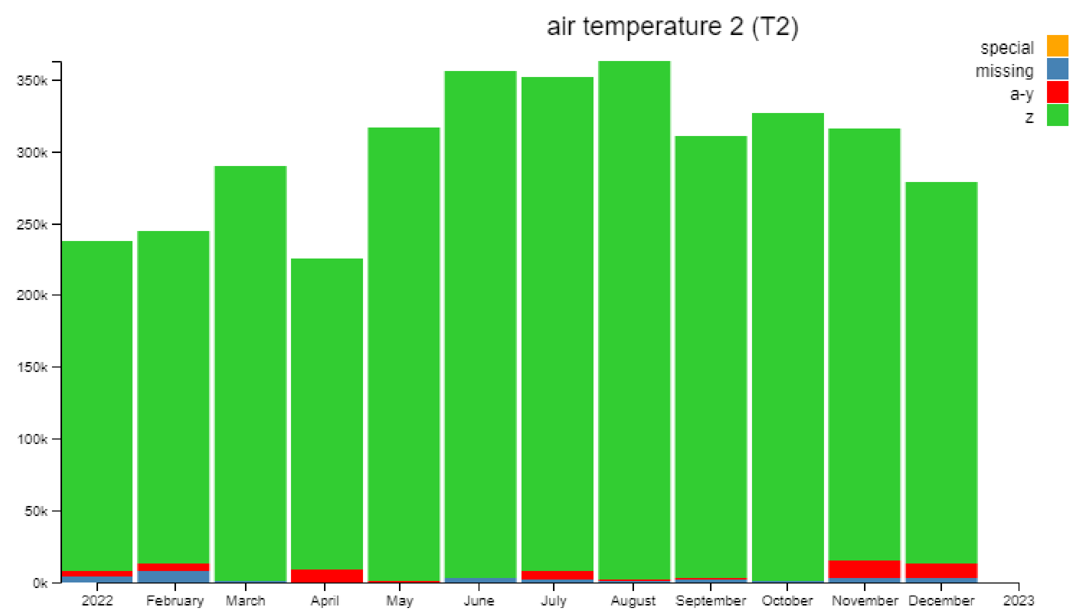
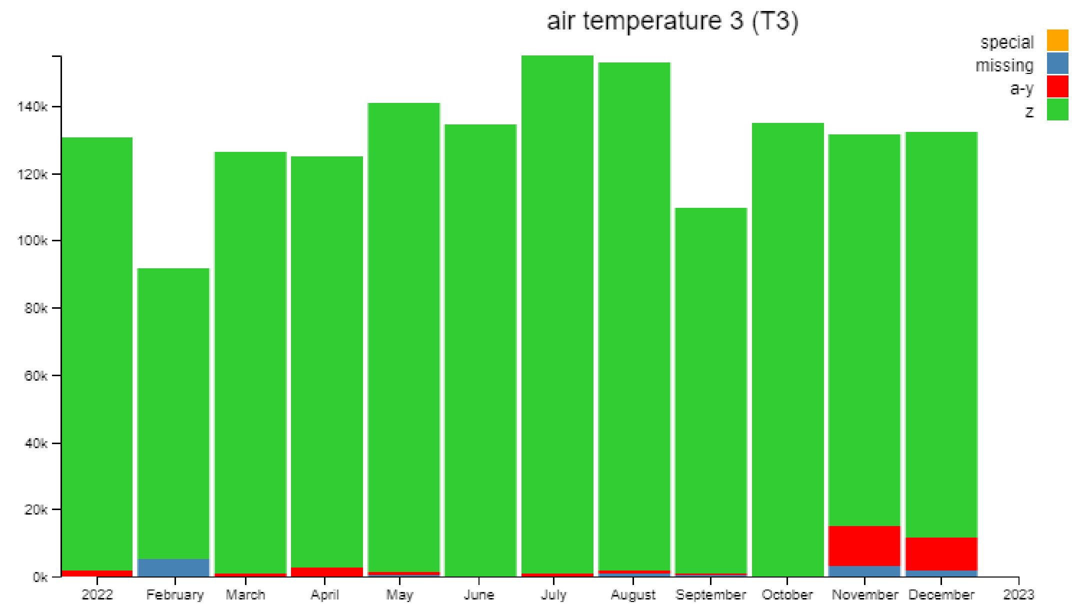
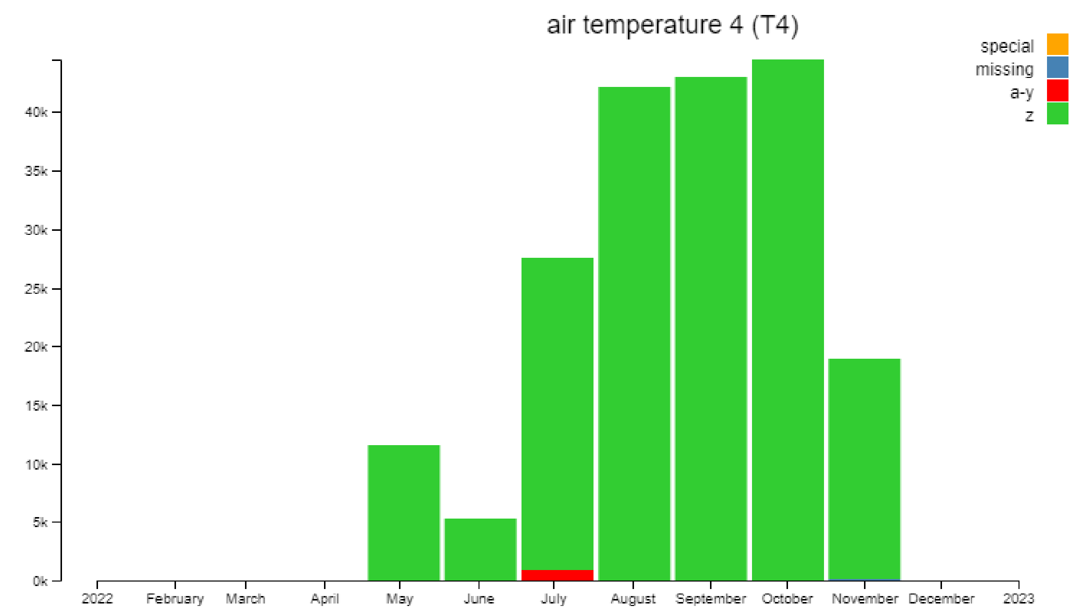




Figure 10: Total number of (this page, top) air temperature – T – (this page, bottom) air temperature 2 – T2 – (next page, top) air temperature 3 – T3 – and (next page, bottom) air temperature 4 – T4 observations provided by all ships for each month in 2022. The colors represent the number of good (green) 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: cont'd)

Wet bulb temperature (Figure 11) was reported by six vessels in 2022: namely, Thomas *Jefferson*, *Bell M. Shimada*, *Rainier*, *Fairweather*, *Nancy Foster*, and *Okeanos Explorer*. We note TW from all four vessels is a calculated value, rather than being directly measured. In the case of both *Rainier* and *Jefferson*, because their relative humidity parameters often top out at just over 100% in saturation (common, see relative humidity topic below) the calculated TW (and TD, below) parameters are often unrealistic, meaning they receive "failed the T>=Tw>=Td test" (D) flags (documented;

see individual vessel description in section 3c for details). Other than these, most flags seen here were the result of flow obstruction and/or ship heating.

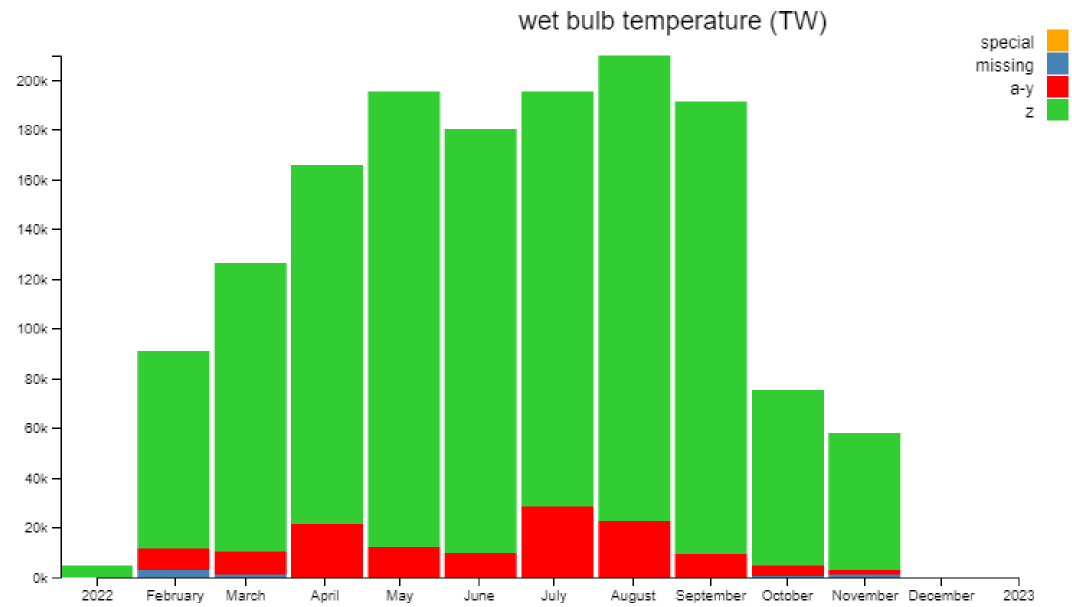



Figure 11: Total number of wet bulb temperature – TW – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Dew point temperature (Figure 12) was also reported by just these six vessels in 2022 (again, *Thomas Jefferson*, *Bell M. Shimada*, *Rainier*, *Fairweather*, *Nancy Foster*, and *Okeanos Explorer*). We reiterate, TD from all four vessels is a calculated value, rather than being directly measured. And again, in the case of both *Rainier* and *Jefferson*, because their relative humidity parameters often top out at just over 100% in saturation (common, see relative humidity topic below) the calculated TD (and TW, above) parameters are often unrealistic, meaning they receive "failed the T>=Tw>=Td test" (D) flags (documented; see individual vessel description in section 3c for details). Other than these, most flags seen here were the result of flow obstruction and/or ship heating.

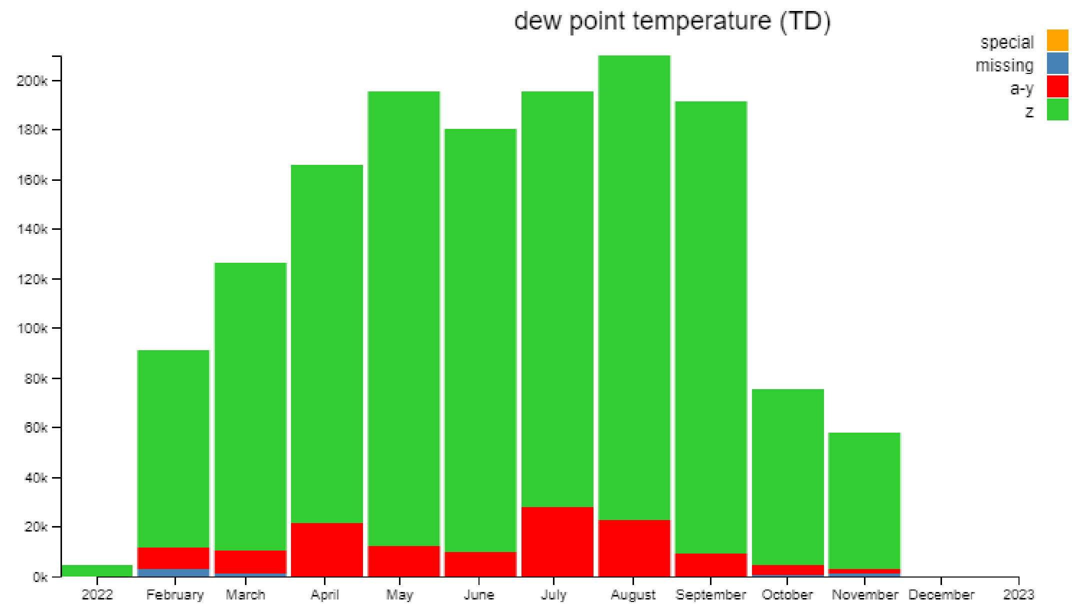
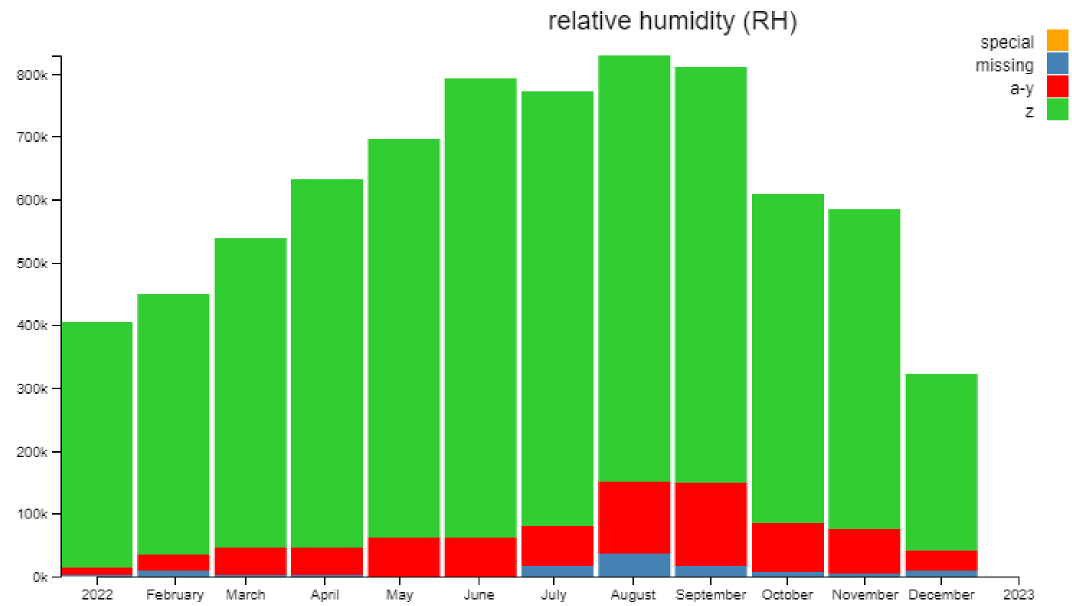



Figure 12: Total number of dew point temperature – TD – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are 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 are 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, or, as desired by the user, simply set to a value of 100%. 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 13.

Like T, the increased flagging seen in RH in August through December was largely due to an unknown, prolonged data issue that existed on *Ferdinand Hassler*. Possibly the missing values in RH2 could be from the *Sally Ride*, whose sensor has a suspected voltage issue wherein it frequently puts out NaN when in saturation. (All documented; see individual vessel description in 3c for details.)



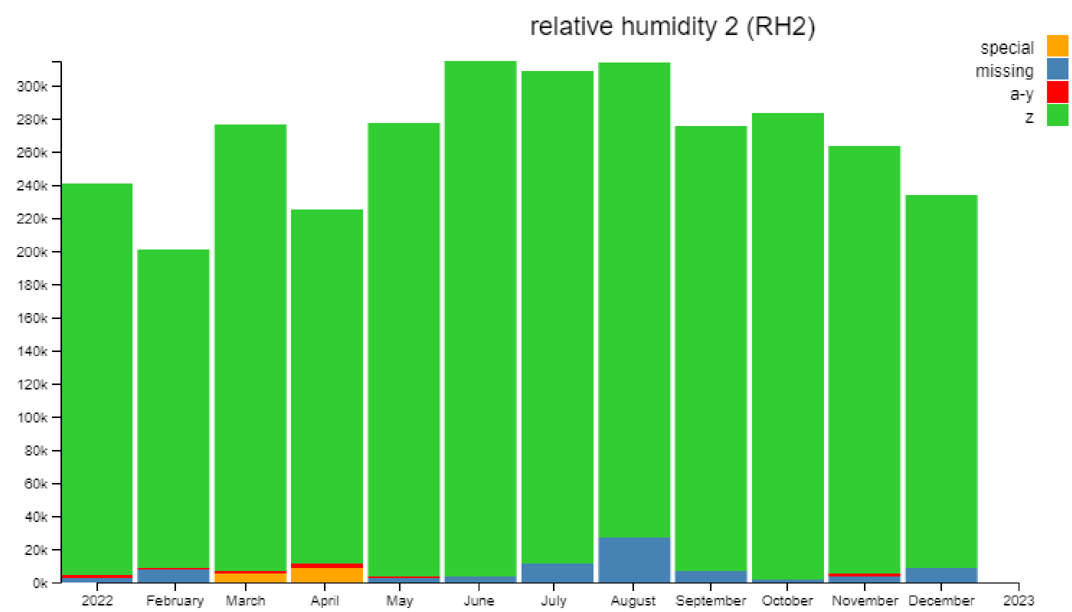
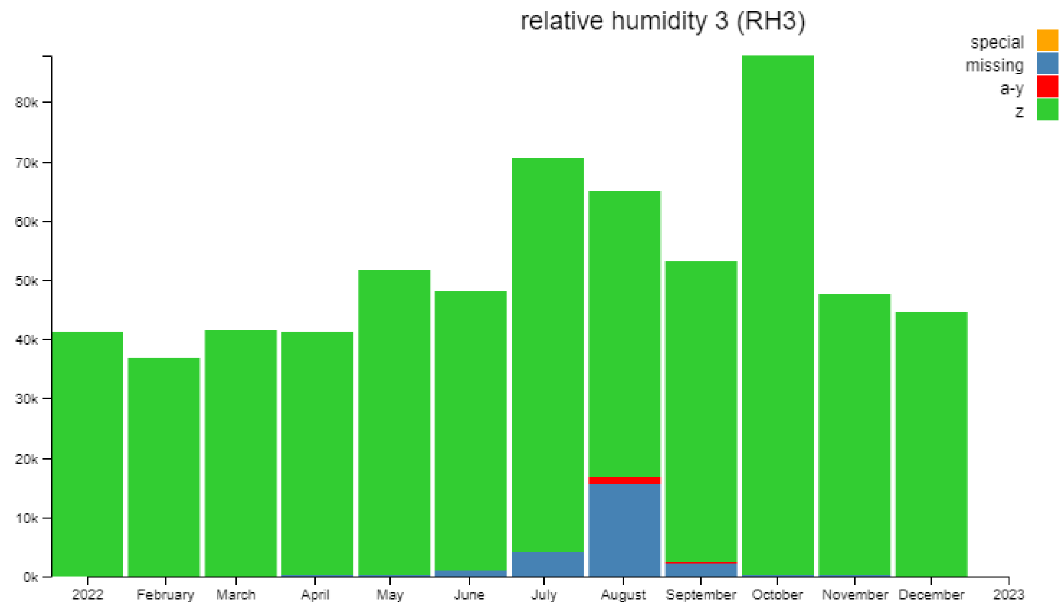




Figure 13: Total number of (this page, top) relative humidity – RH – (this page, bottom) relative humidity 2 – RH2 – and (next page) relative humidity 3 – RH3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed 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.

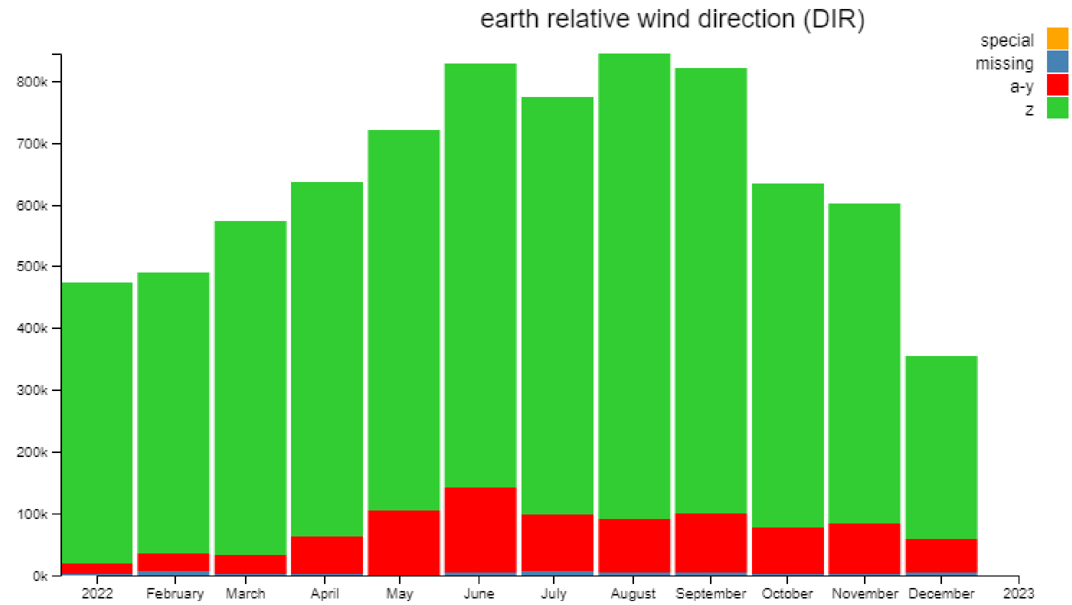



(Figure 13: cont'd)

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-circulating atmosphere. 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 2022. 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.

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 several 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.

In addition, there were either suspected or confirmed platform relative wind speed units issues on two NOAA vessels – *Ferdinand Hassler* (suspected) and *Thomas Jefferson* (confirmed) – that caused erroneous (and thus flagged) DIR and SPD data spanning much of 2022. (All documented; see individual vessel descriptions in 3c for details.)



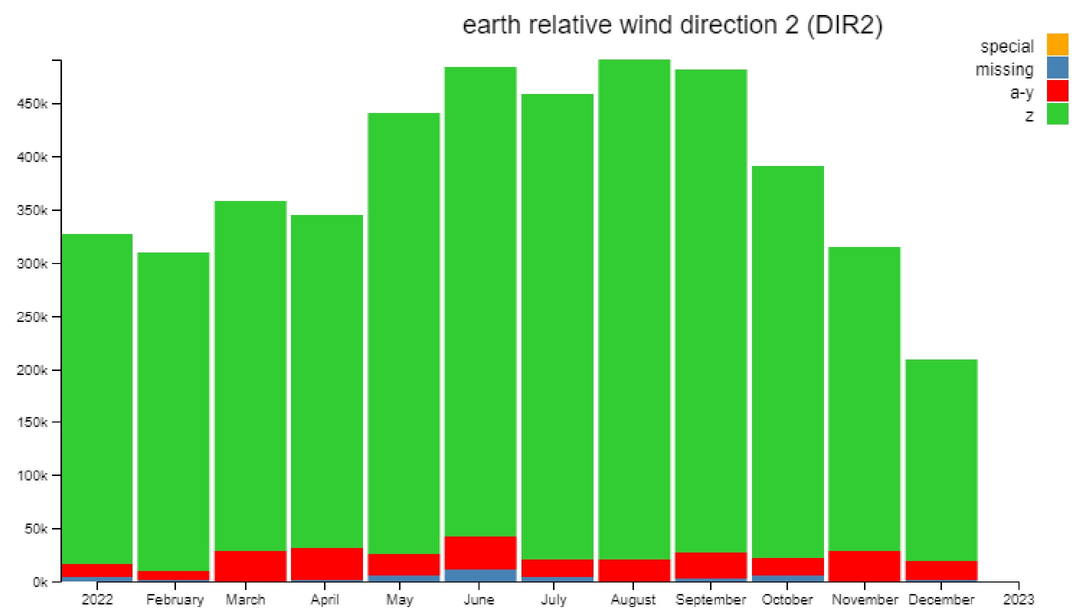
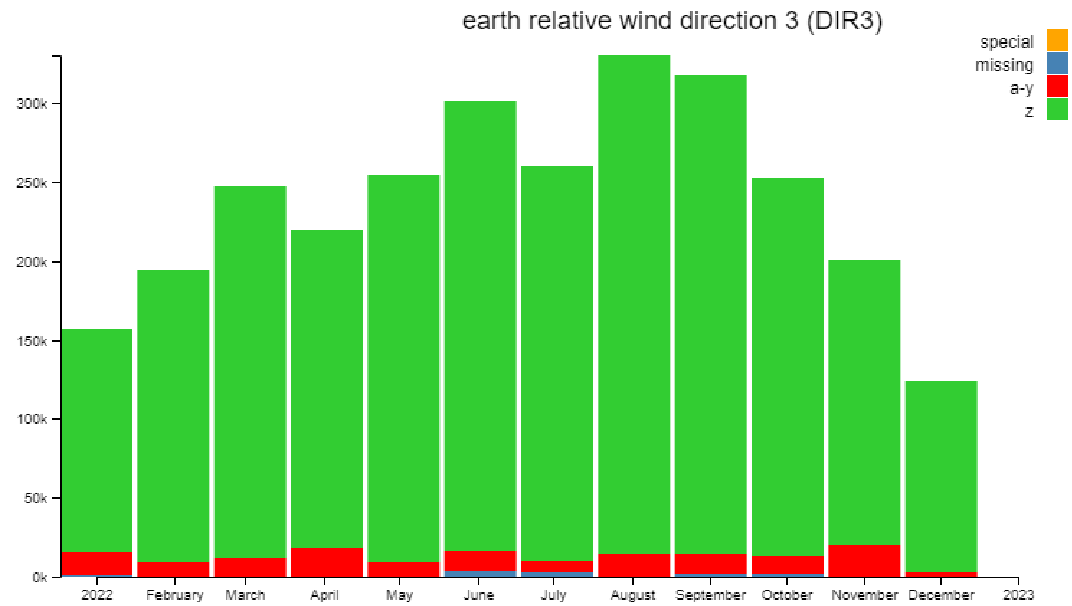




Figure 14: Total number of (this page, top) earth relative wind direction – DIR – (this page, bottom) earth relative wind direction 2 – DIR2 – and (next page) earth relative wind direction 3 – DIR3 – observations provided by all ships for each month in 2021. The colors represent the number of good (green) 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)

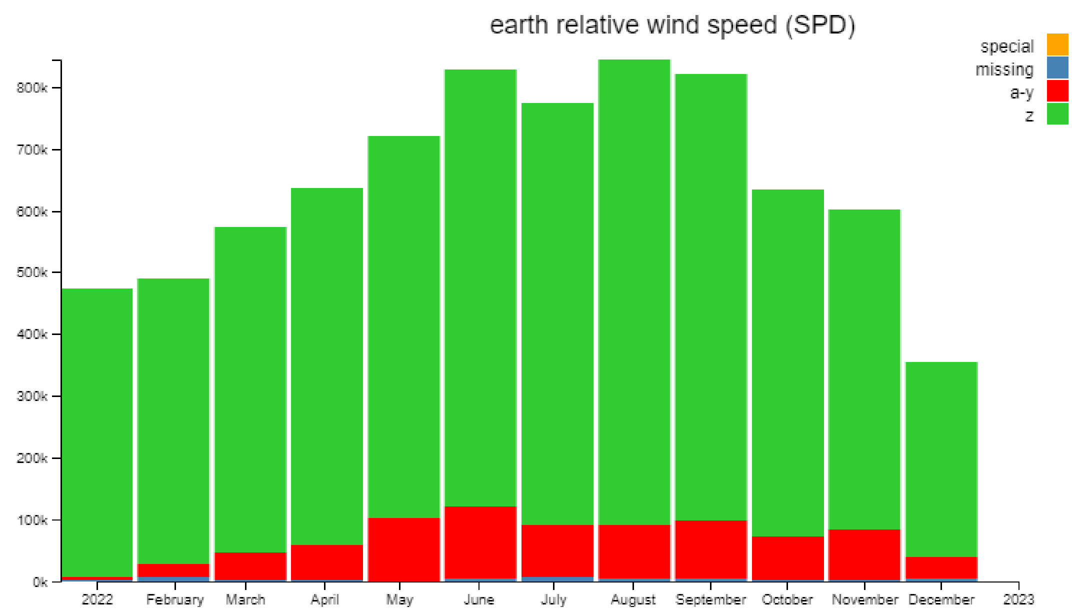
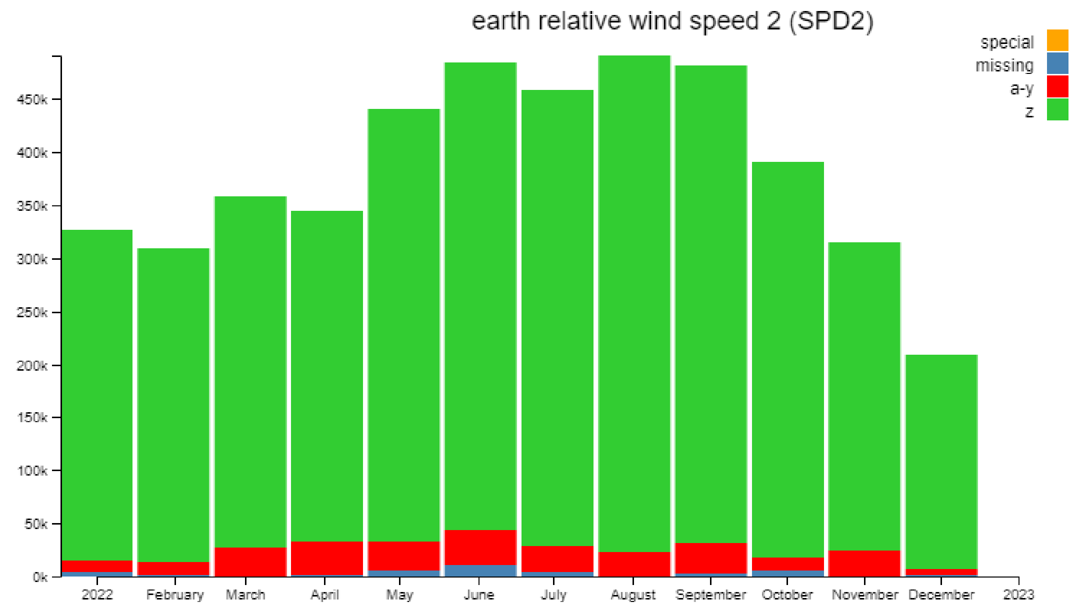
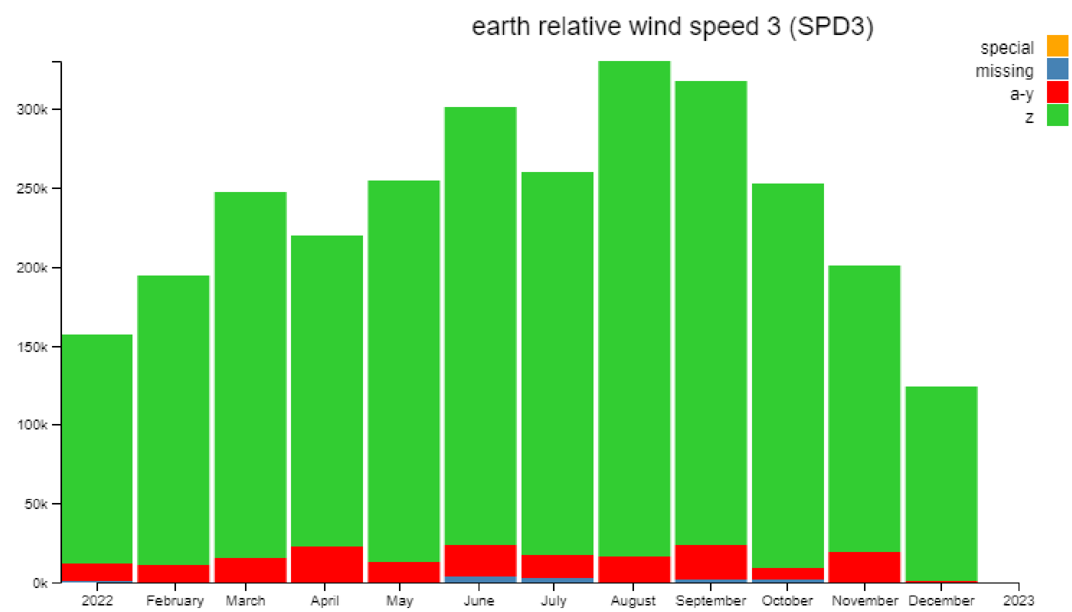


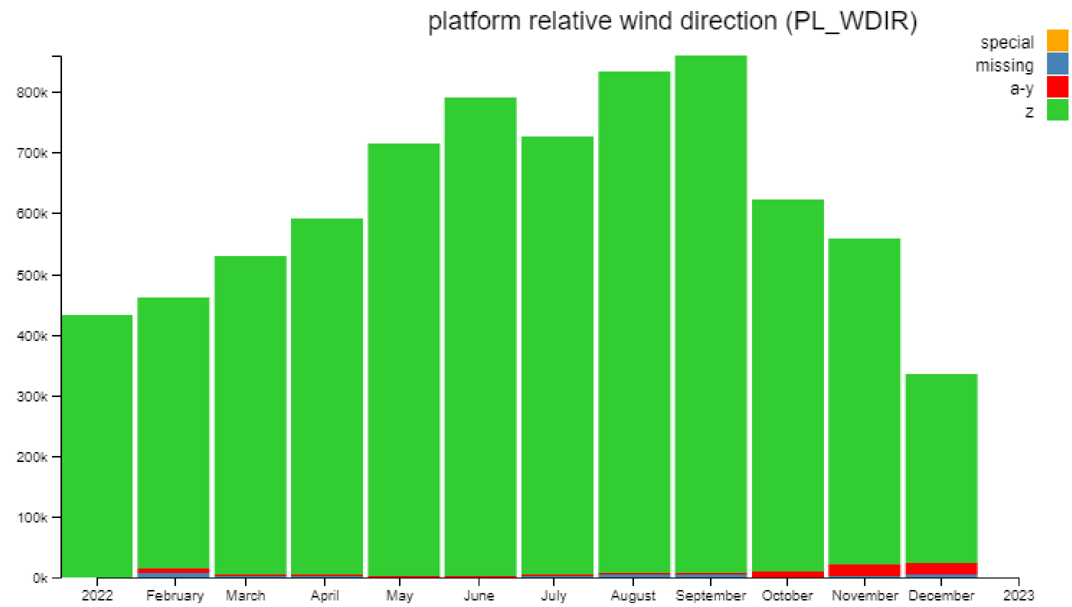

Figure 15: Total number of (this page) earth relative wind speed – SPD – (next page, top) earth relative wind speed 2 – SPD2 – and (next page, bottom) earth relative wind speed 3 – SPD3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values 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)

The platform relative wind parameters, both direction (Figure 16) and speed (Figure 17), mostly exhibited no major problems of note, with a few exceptions: namely, a likely translator issue affecting PL_WDIR2 that existed in May and June on the *Pisces* and the aforementioned suspected or confirmed PL_WSPD units issues on two NOAA vessels – *Ferdinand Hassler* (suspected) and *Thomas Jefferson* (confirmed). The increases in flagging seen in March in PL_WDIR2 and PL_WSPD look to be owed to the *Oscar Dyson*, whose relative and true winds are known to suffer from both POS-MV "thrashing events" and suspected cabling issues. The increases in flagging seen in PL_WDIR late in the year likely originated with the *Ferdinand Hassler*, during which time PL_WDIR values often did not vary much. The reason isn't entirely clear, but *Hassler* had a known history of wind issues throughout 2022. (All documented; see individual vessel descriptions in 3c for details.)



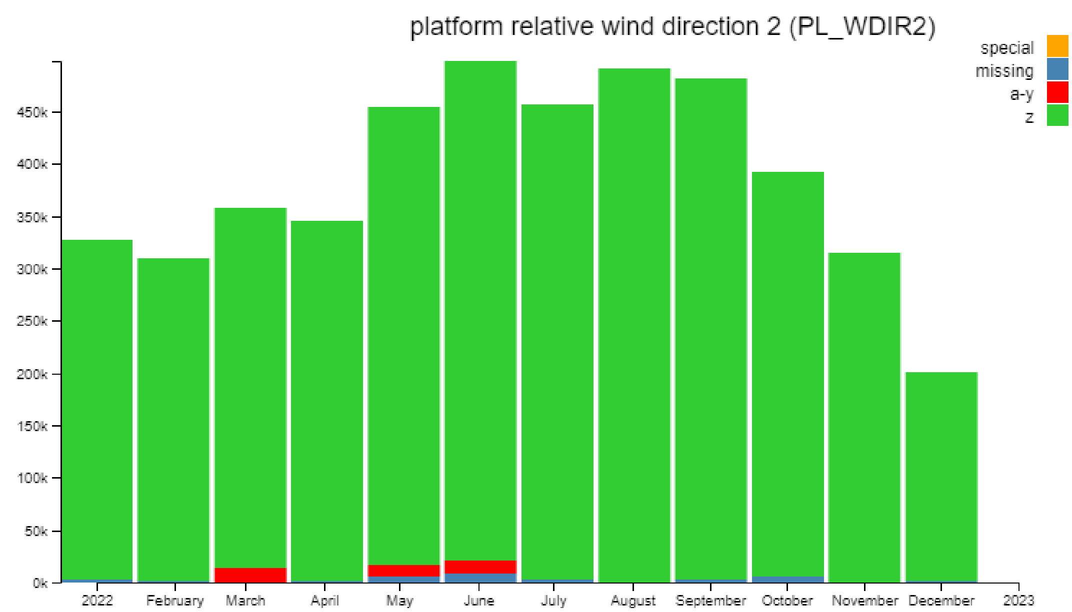
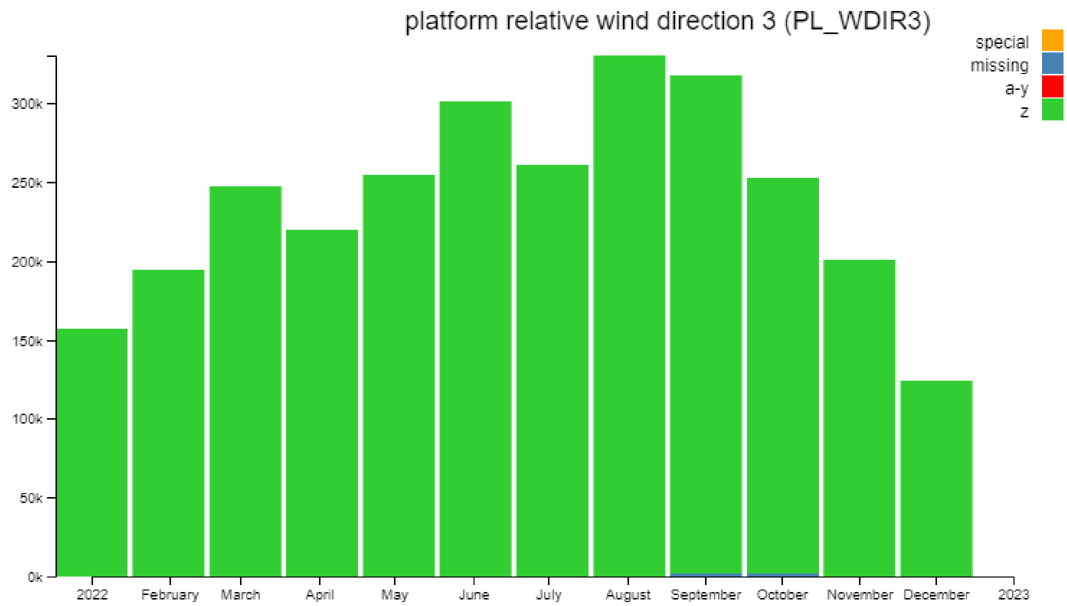




Figure 16: Total number of (this page, top) platform relative wind direction – PL_WDIR – (this page, bottom) platform relative wind direction 2 – PL_WDIR2 – and (next page) platform relative wind direction 3 – PL_WDIR3 – observations provided by all ships for each month in 2022. The colors represent 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 16: cont'd)

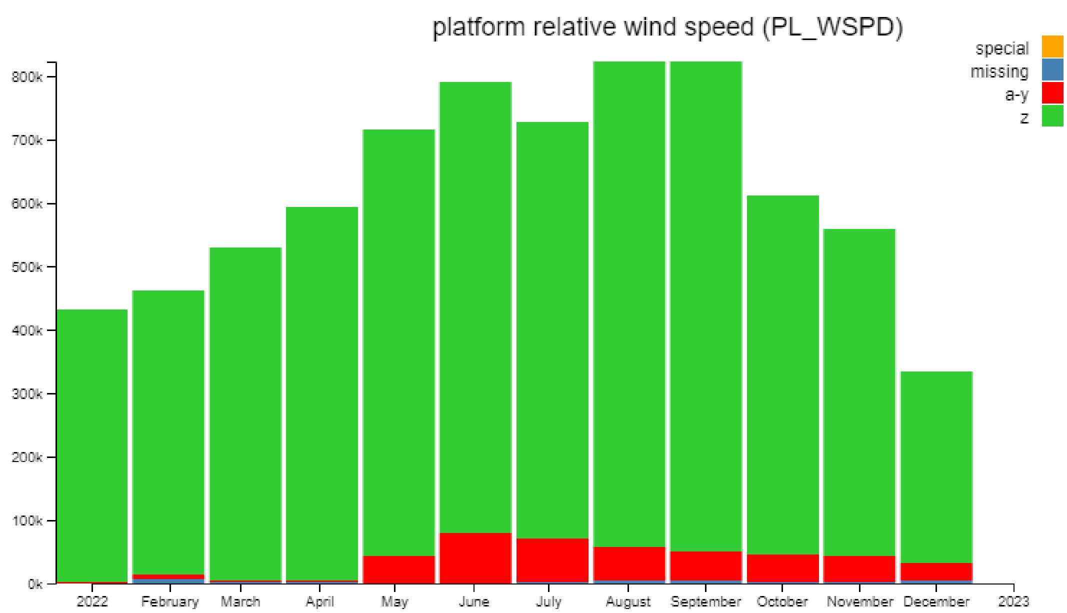
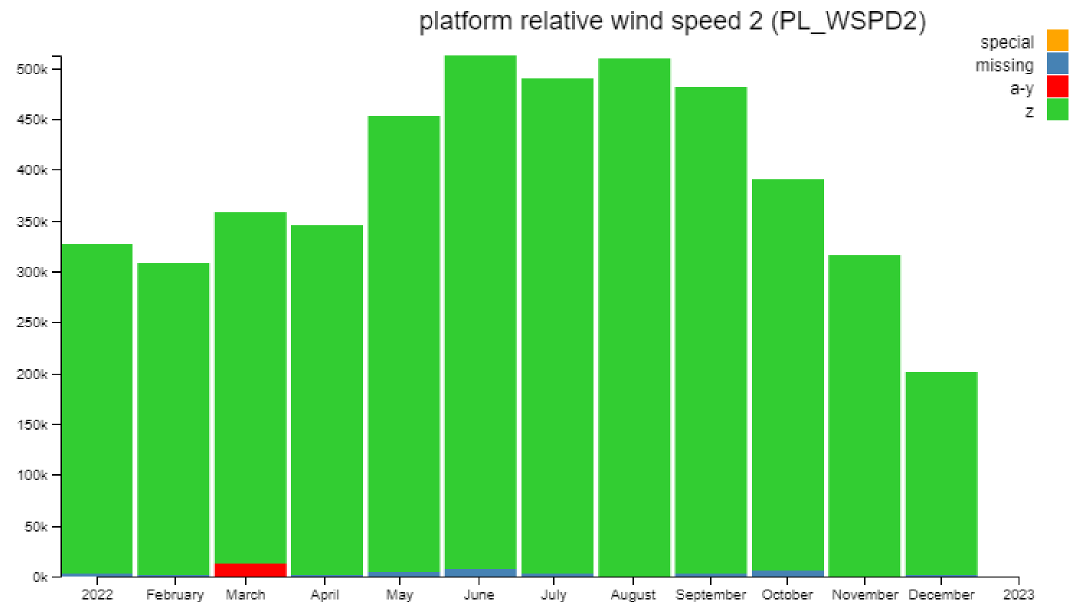
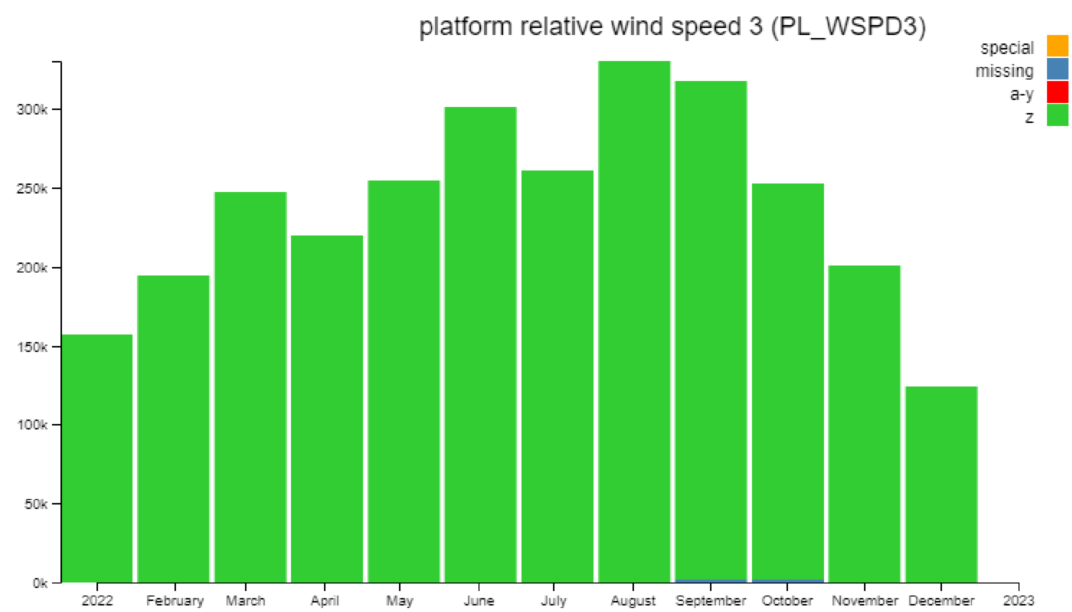



Figure 17: Total number of (this page) platform relative wind speed – PL_WSPD – (next page, top) platform relative wind speed 2 – PL_WSPD2 – and (next page, bottom) platform relative wind speed 3 – PL_WSPD3 – observations provided by all ships for each month in 2022. The colors represent the number of 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)

Most of the flags applied to the radiation parameters were assigned by the auto flagger, primarily to short wave radiation (Figure 18) and photosynthetically active radiation (Figure 20). 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, short wave (and, similarly, photosynthetically active aka PAR) radiation sensors are typically tuned to permit greater accuracy at large radiation values. Consequently, short wave and photosynthetically active 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 (Figure 19), on the other hand, usually has the smallest percentage of data flagged among the radiation parameters submitted to SAMOS.

We note the upticks in flagging seen in RAD_LW from June onward were primarily due to an unknown issue causing highly suspicious/erroneous data from the *Bell M. Shimada* (documented; see individual vessel description in 3c for details). Meanwhile, the uptick in flagging seen in RAD_LW2 in March looks to have come from the Investigator, for reasons unknown.

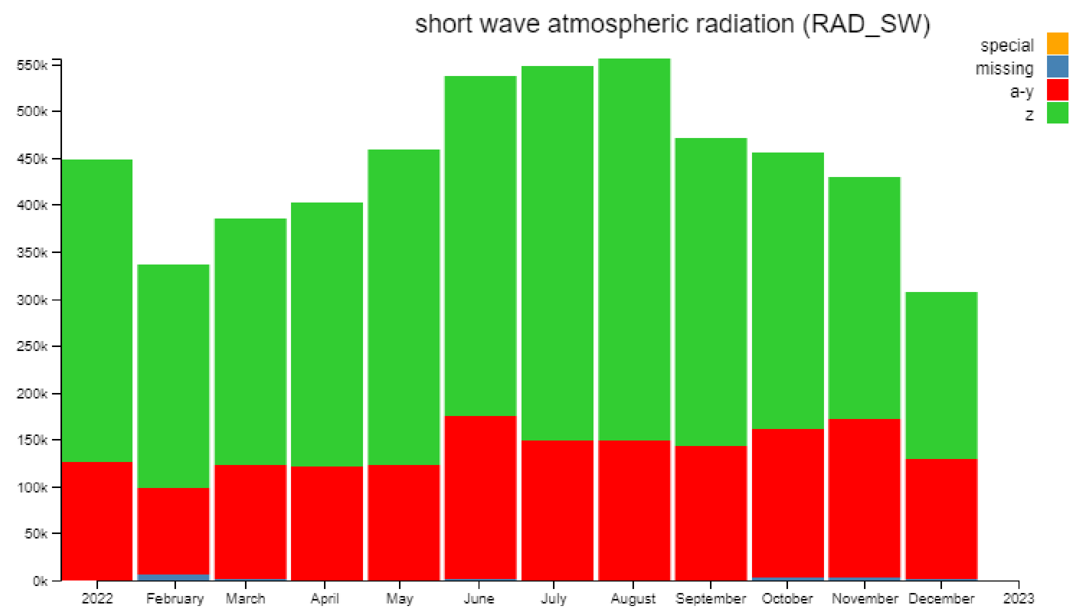
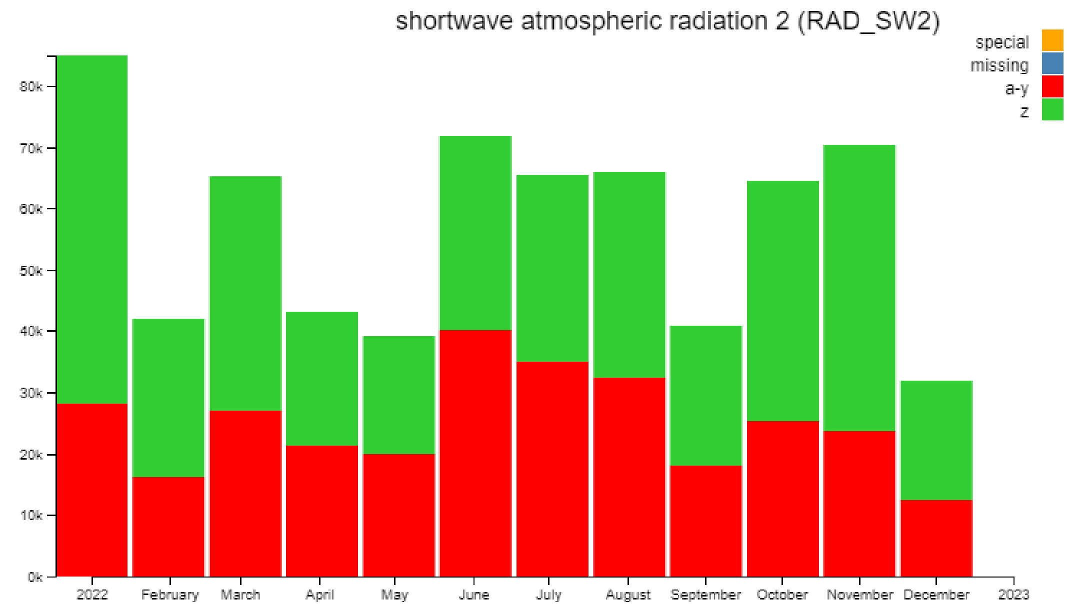



Figure 18: Total number of (this page) shortwave atmospheric radiation – RAD_SW – and (next page) shortwave atmospheric radiation 2 – RAD_SW2 –observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.




(Figure 18: cont'd)

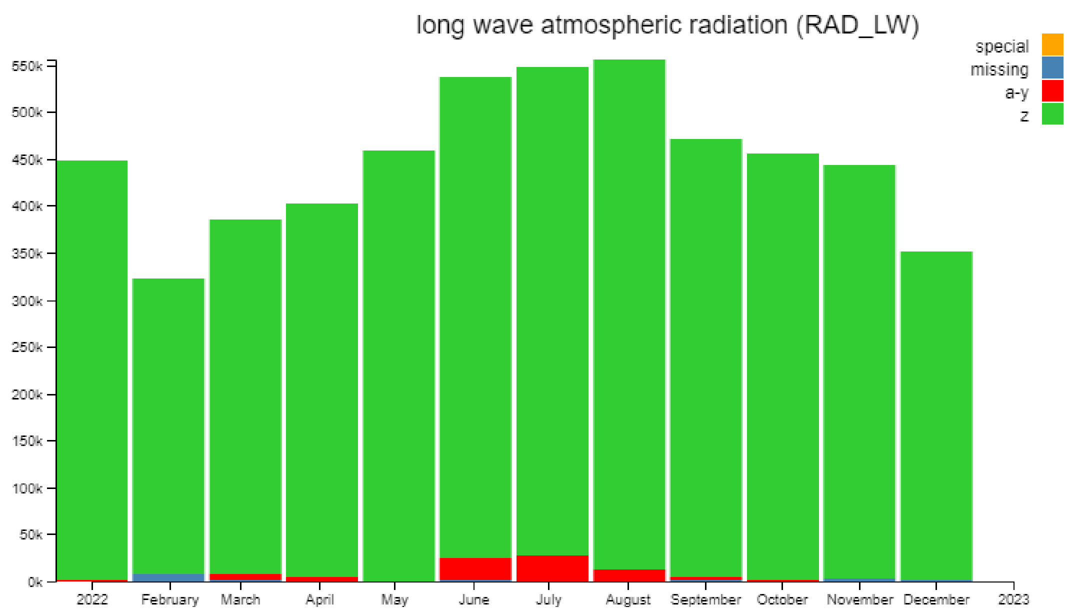
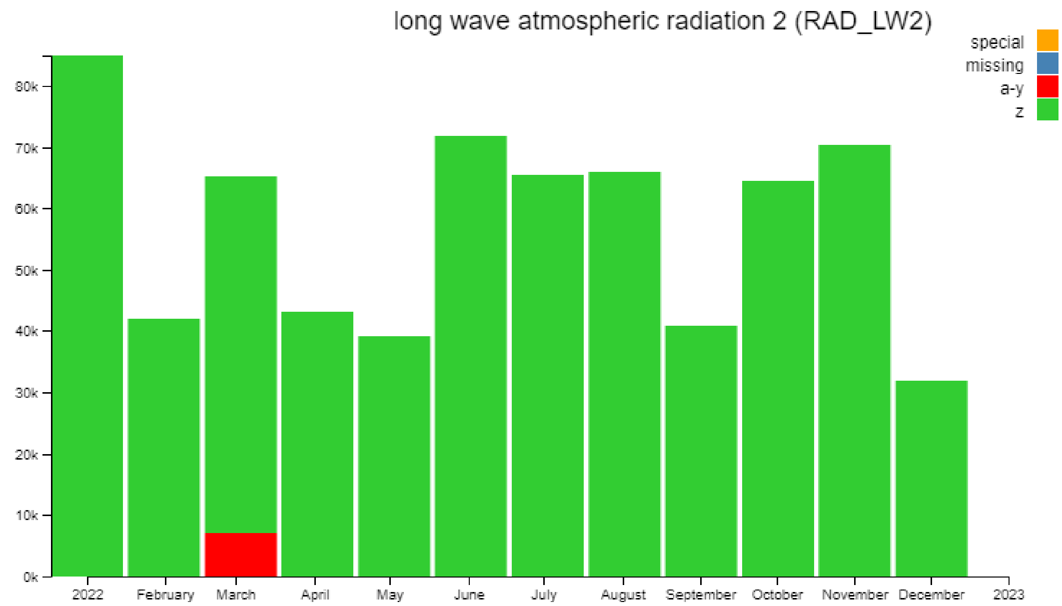



Figure 19: Total number of (this page) long wave atmospheric radiation – RAD_LW – and (next page) long wave atmospheric radiation 2 – RAD_LW2 –observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.




(Figure 19: cont'd)

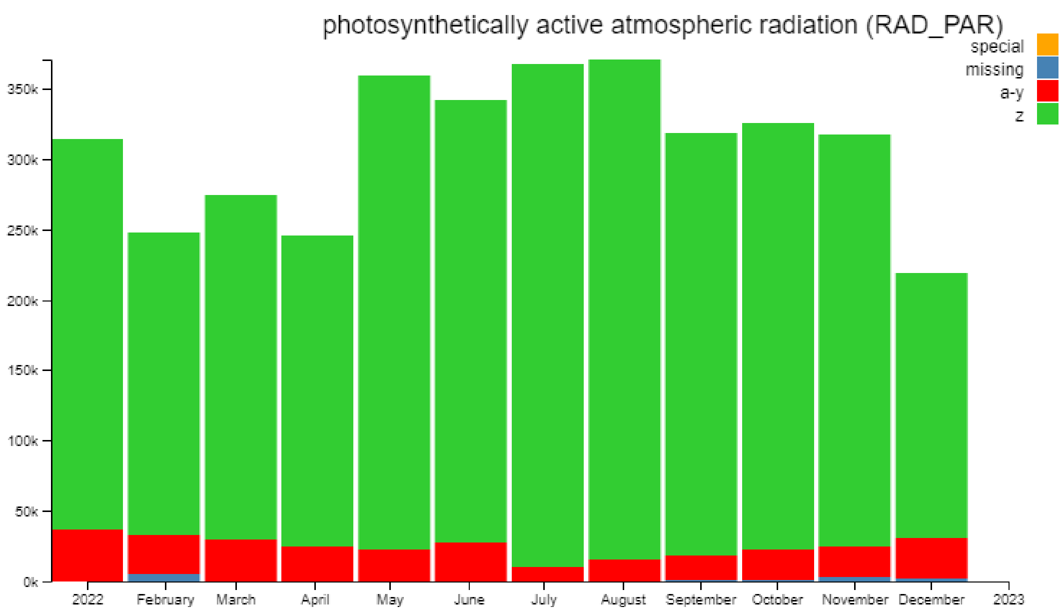
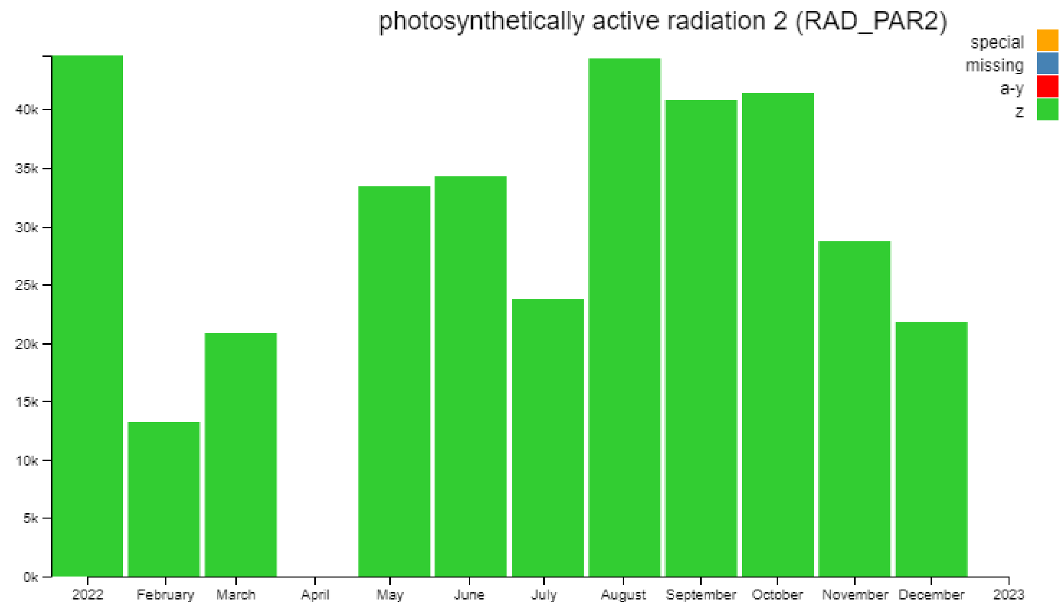



Figure 20: Total number of (this page) photosynthetically active atmospheric radiation – RAD_PAR – and (next page) photosynthetically active atmospheric radiation 2 – RAD_PAR2 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the 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 20: cont'd)

There were no major problems noted for either the rain rate (Figure 21) or precipitation accumulation (Figure 22) parameters. It should be mentioned 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.

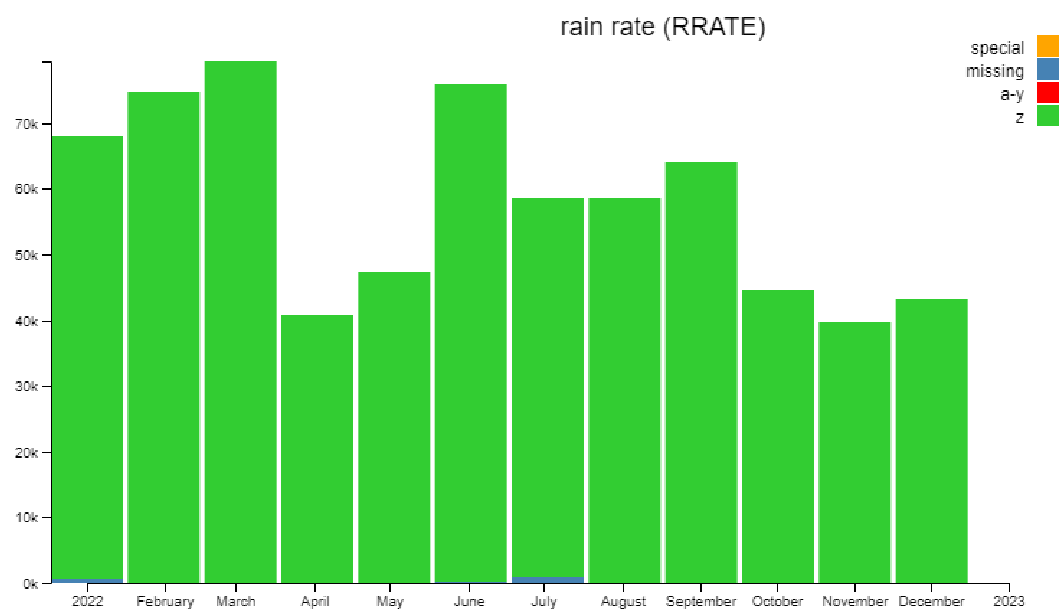
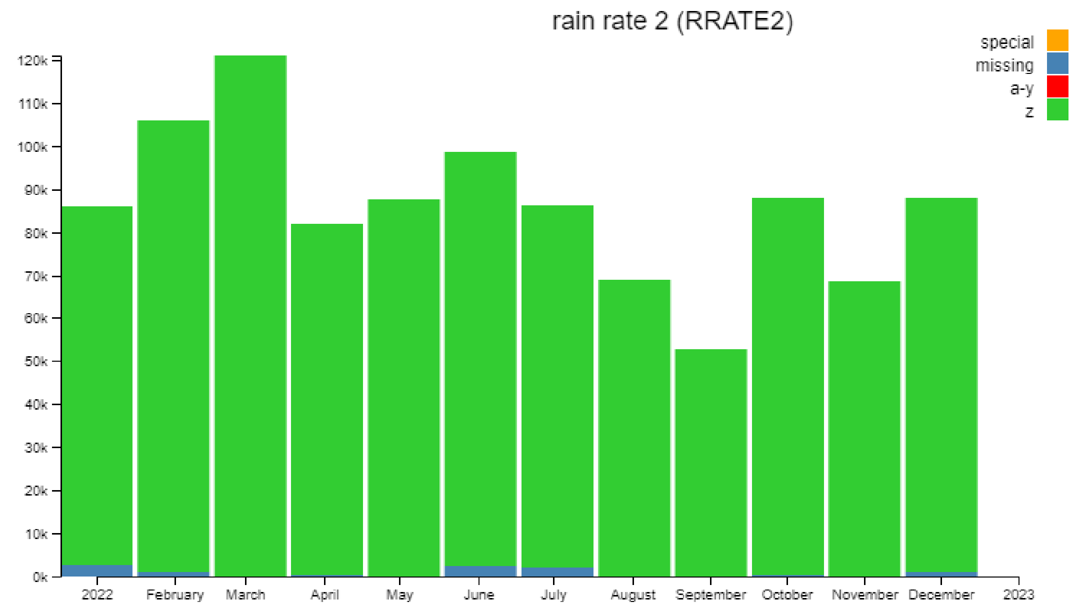
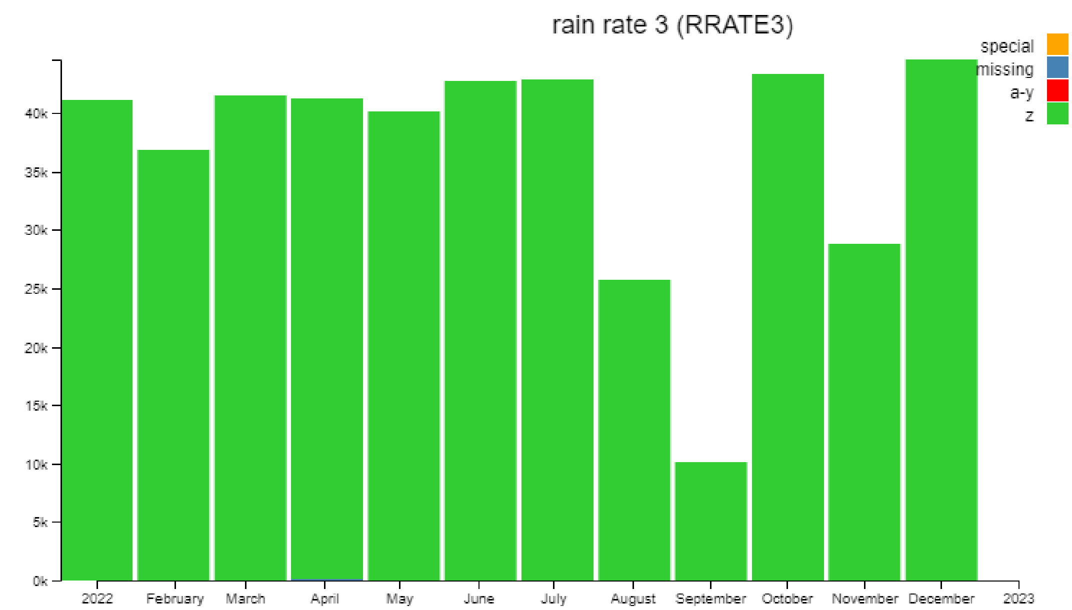
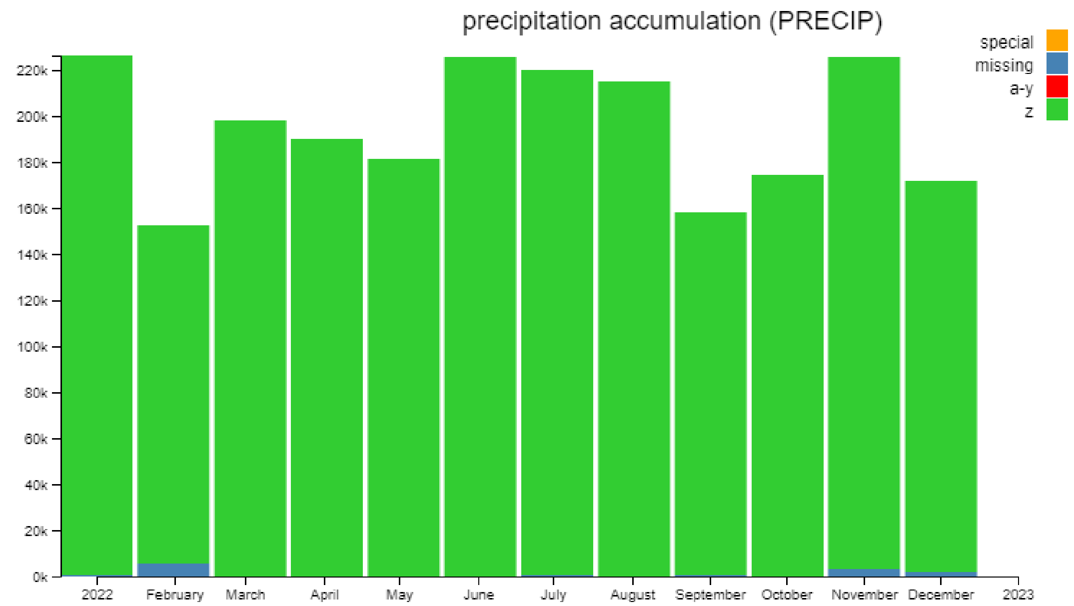



Figure 21: Total number of (this page) rain rate – RRATE – (next page, top) rain rate 2 – RRATE2 – and (next page, bottom) rain rate 3 – RRATE3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.




(Figure 21: cont'd)



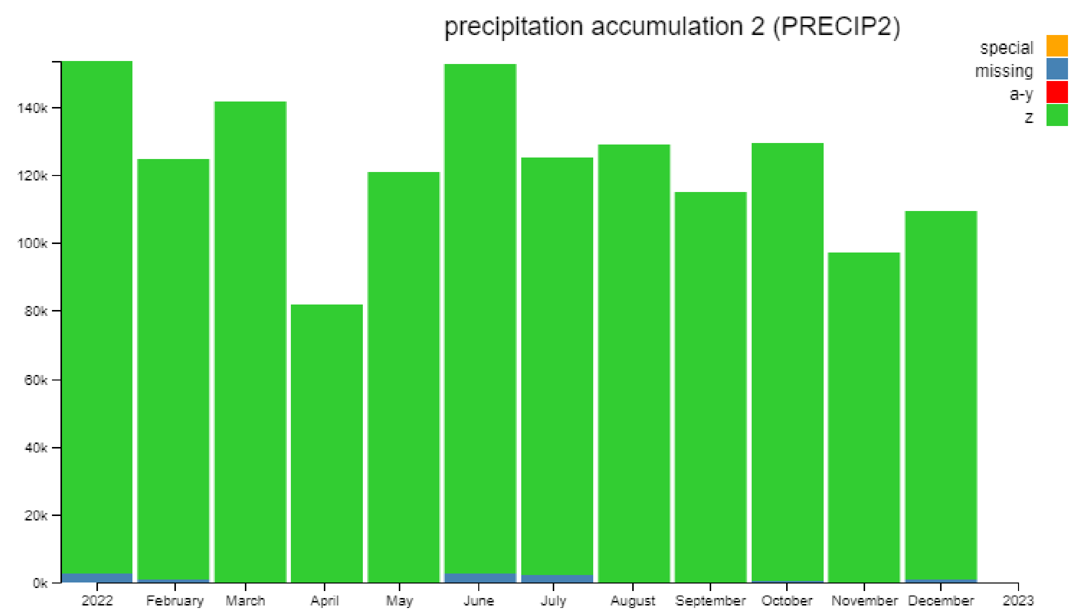
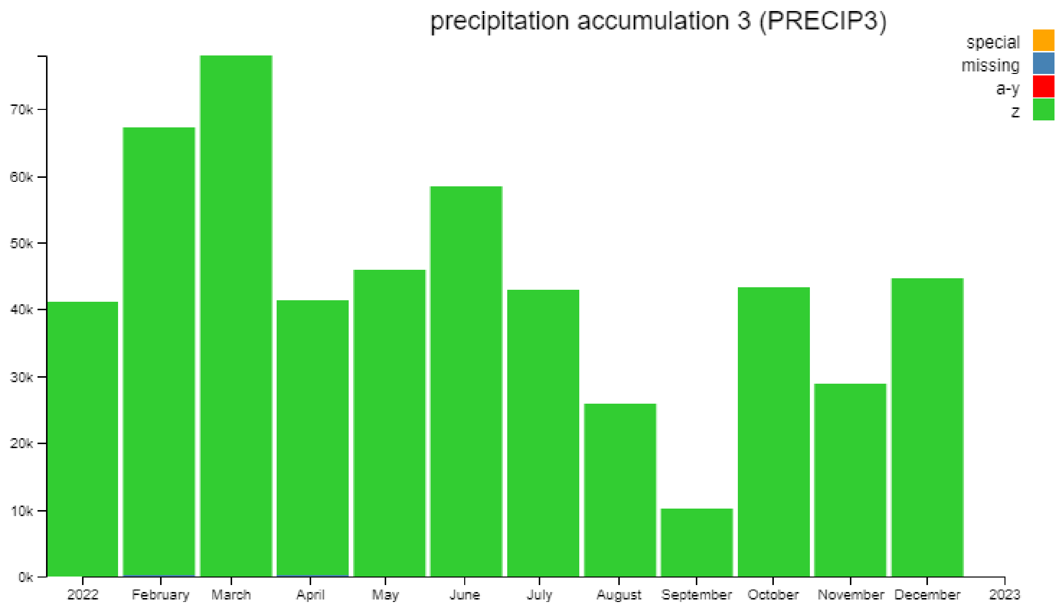



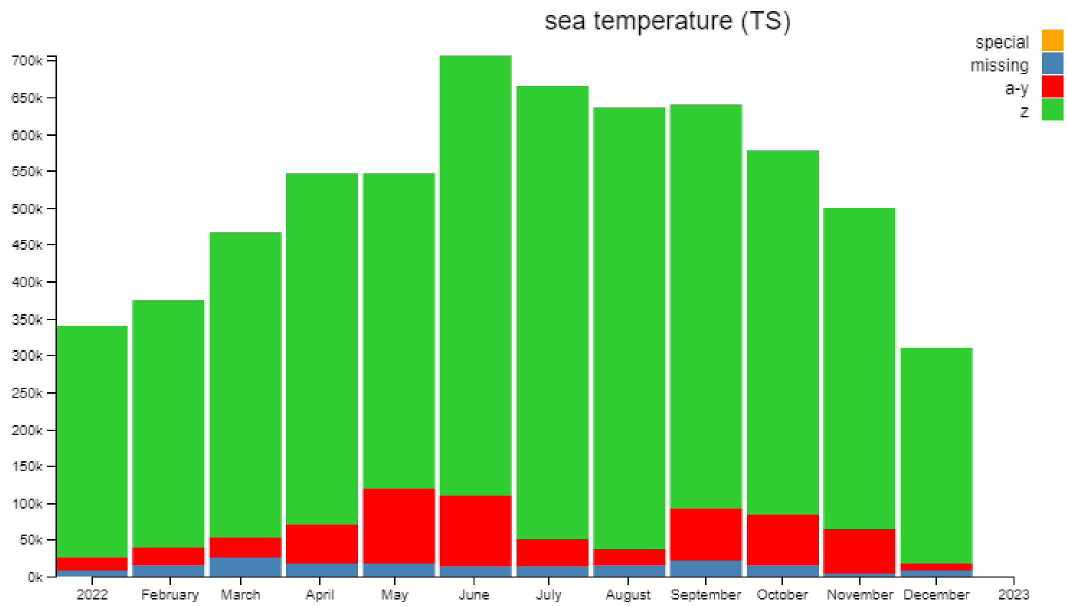

Figure 22: Total number of (this page, top) precipitation accumulation – PRECIP – (this page, bottom) precipitation accumulation 2 – PRECIP2 – and (next page) precipitation accumulation 3 – PRECIP3 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) 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: cont'd)

The main problem identified with the sea temperature parameter (Figure 23) occurs when the sensor is denied a continuous supply of seawater. In these situations (in the case of ships that receive visual QC), 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, in which case they are unanimously J-flagged. The events are also frequently extreme enough for the auto flagger 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 anticipated as the normal ship operation practice by SAMOS data analysts.

Other than this expected performance, the TS data were generally good in 2022. A few notable flagged exceptions in 2022 were erroneous TS from *Pisces* in May and June, for reasons unknown, and suspected intake blockages resulting from the vessel being in the ice pack that affected *Sikuliaq's* TS, TS3, and TS4 (also CNDC, CNDC2, SSPS, and SSPS2) in September. (All documented; see individual vessel descriptions in 3c for details.) The origins of any other a-y flagging seen in the sea temperature and in fact all the sea water parameters are not clearly identified as belonging to any specific vessel(s). Rather, they were likely due to several vessels simultaneously experiencing the common sensor issues we have mentioned above. We also note it's common for sea water data transmission to cease when a vessel is nearing or in port (even while other types of data continue to be transmitted), meaning missing values in these sea water parameters are not unexpected.



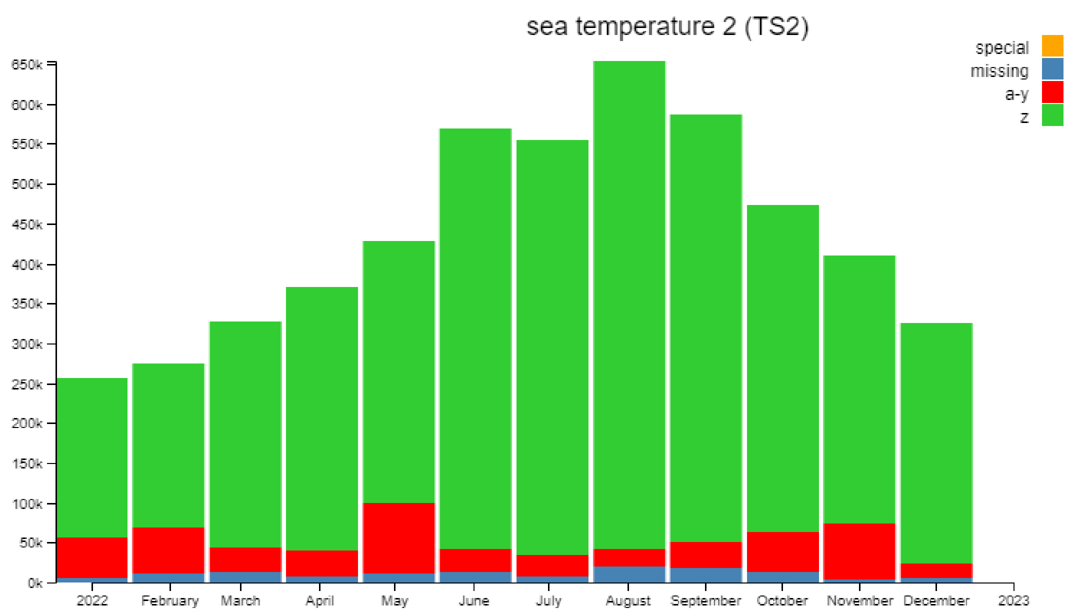
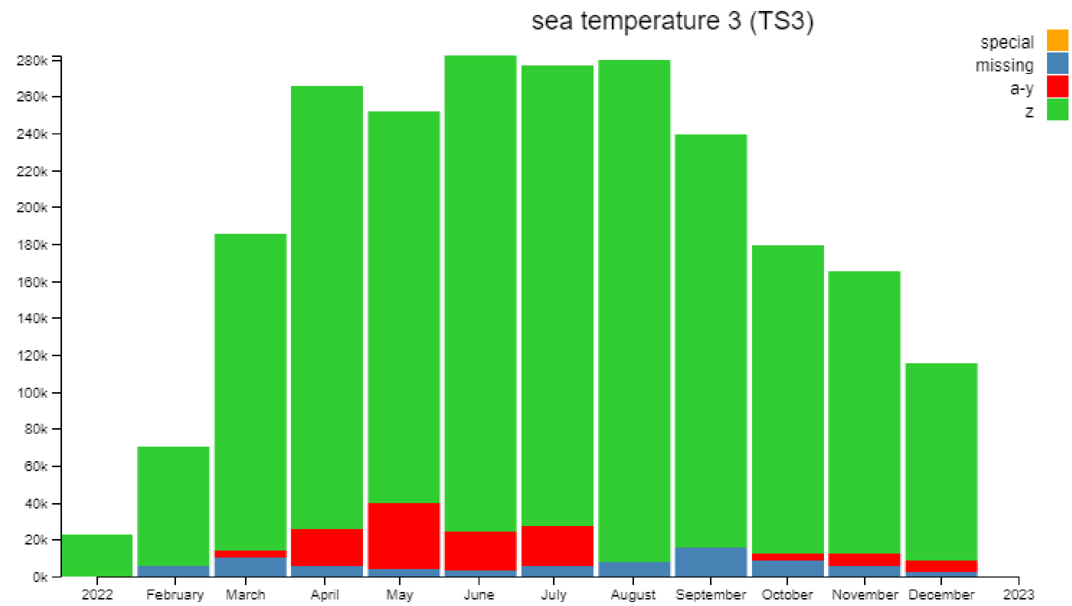
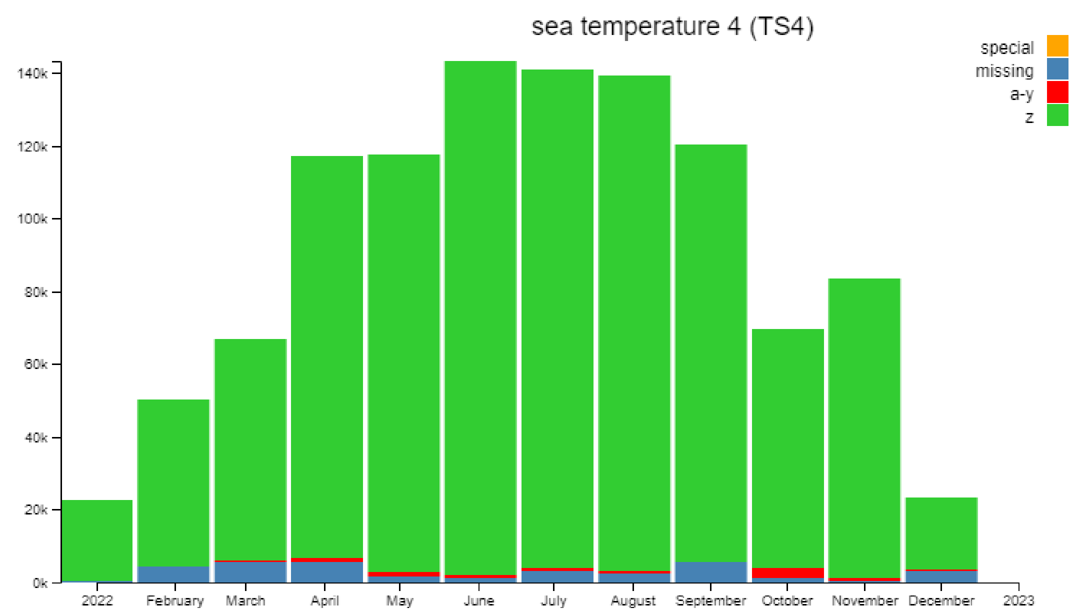
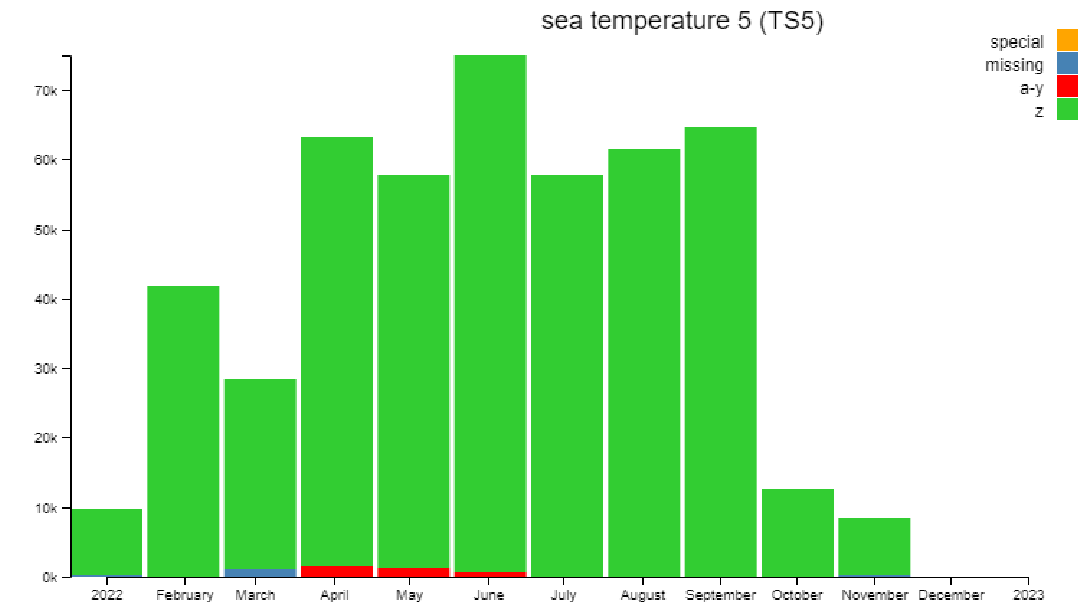




Figure 21: Total number of (this page, top) sea temperature – TS – (this page, bottom) sea temperature 2 – TS2 – (next page, top) sea temperature 3 – TS3 – (next page, bottom) sea temperature 4 – TS4 – and (third page) sea temperature 5 – TS5 – observations provided by all ships for each month in 2022. 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.



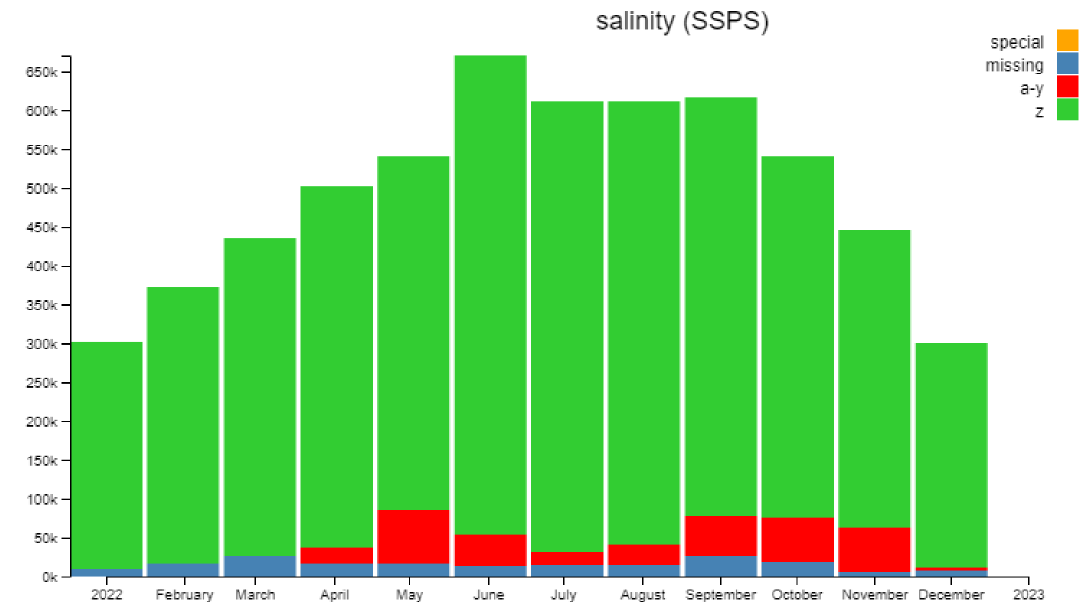

(Figure 23: cont'd.)




(Figure 23: cont'd.)

Salinity and conductivity (Figure 24 and Figure 25, 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.  Like sea temperature, air intrusion is another fairly common issue with salinity and conductivity. 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 during visual quality control, for those vessels that receive it.  Despite these issues, though, the quality of salinity and conductivity data in 2022 was still well within reason.

One of the known cases of (flagged) issues with sea temperature data listed above applies here as well: namely, those with *Sikuliaq's* SSPS, SSPS2, CNDC, and CNDC2 in September (documented; see individual vessel description in 3c for details). But once again the origins of any other a-y flagging seen in all the sea water parameters (including conductivity and salinity) are not clearly identified as belonging to any specific vessel(s). Rather, they were likely due to several vessels simultaneously experiencing the common sensor issues we have mentioned above. We also reiterate it's common for sea water data transmission to cease when a vessel is nearing or in port (even while other types of data continue to be transmitted), meaning missing values in these sea water parameters are not unexpected.



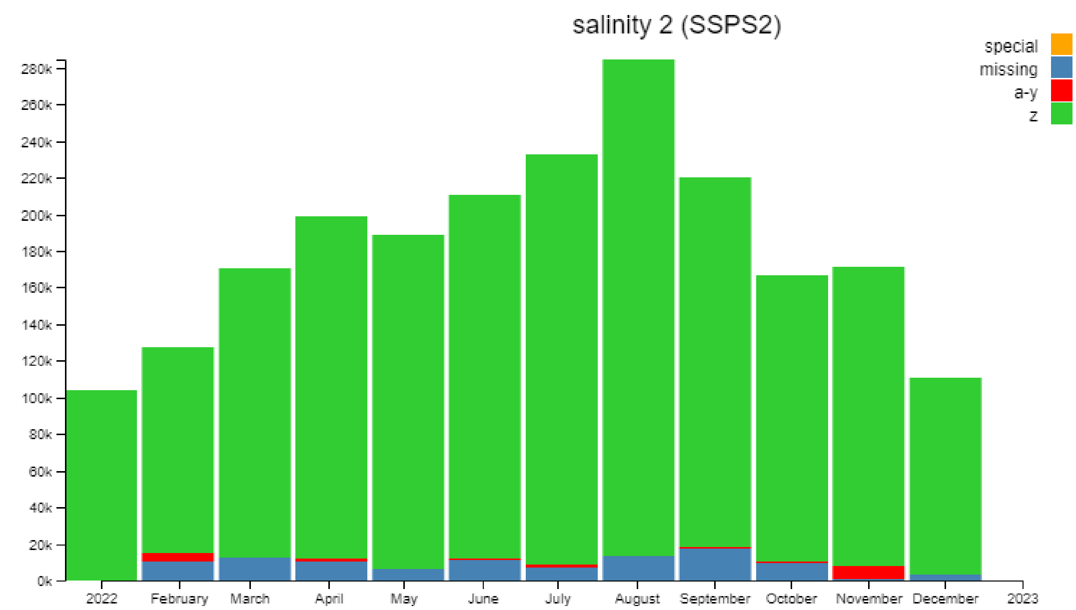
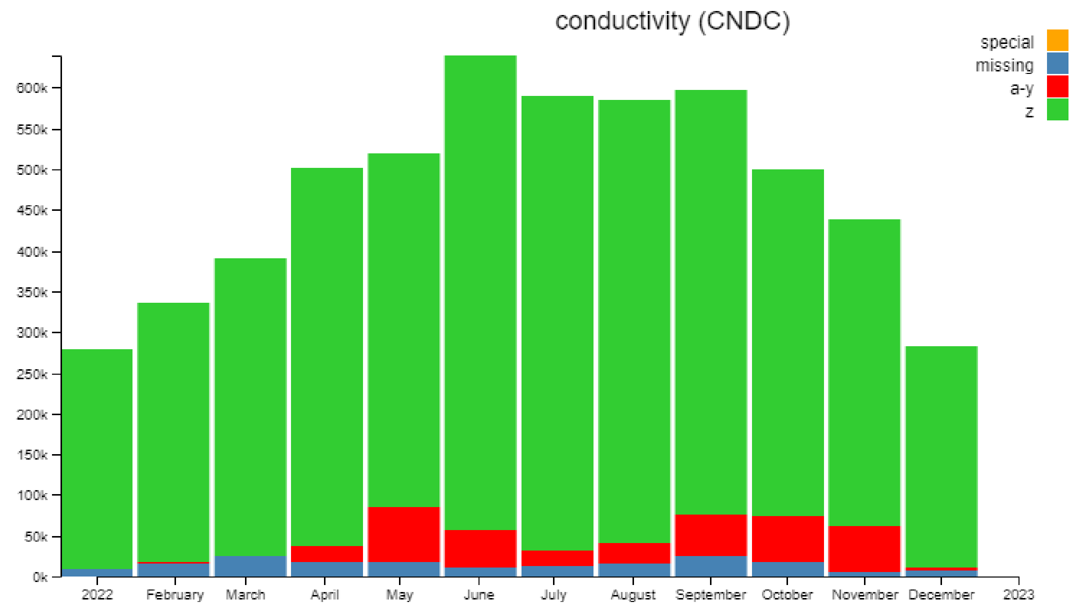




Figure 22: Total number of (top) salinity – SSPS – and (bottom) salinity 2 – SSPS2 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.



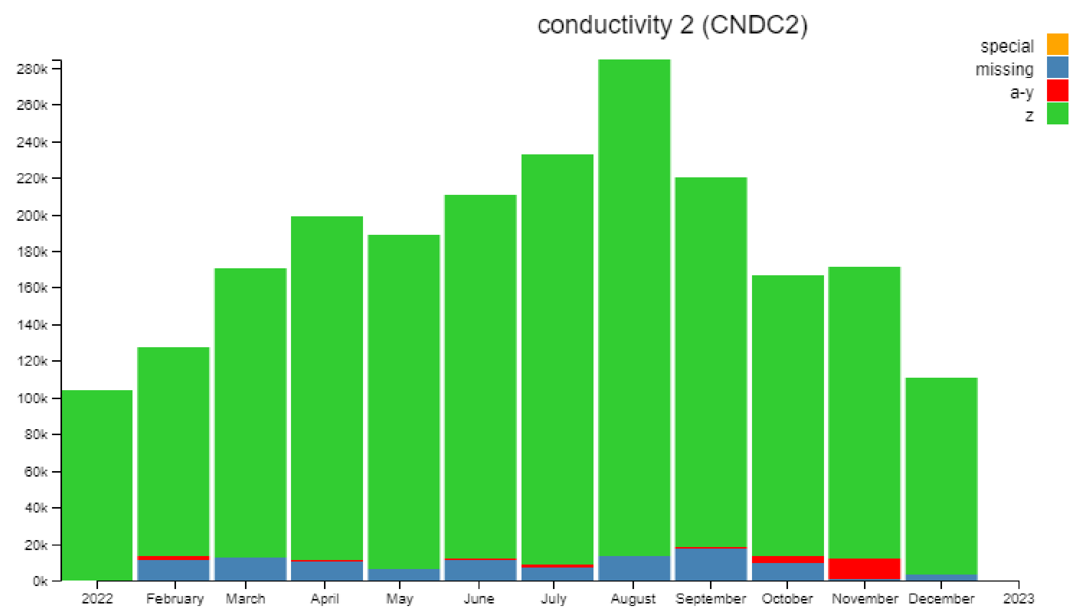




Figure 23: Total number of (top) conductivity – CNDC – and (bottom) conductivity 2 – CNDC2 – observations provided by all ships for each month in 2022. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

### c. 2022 quality by ship

***Atlantic Explorer***

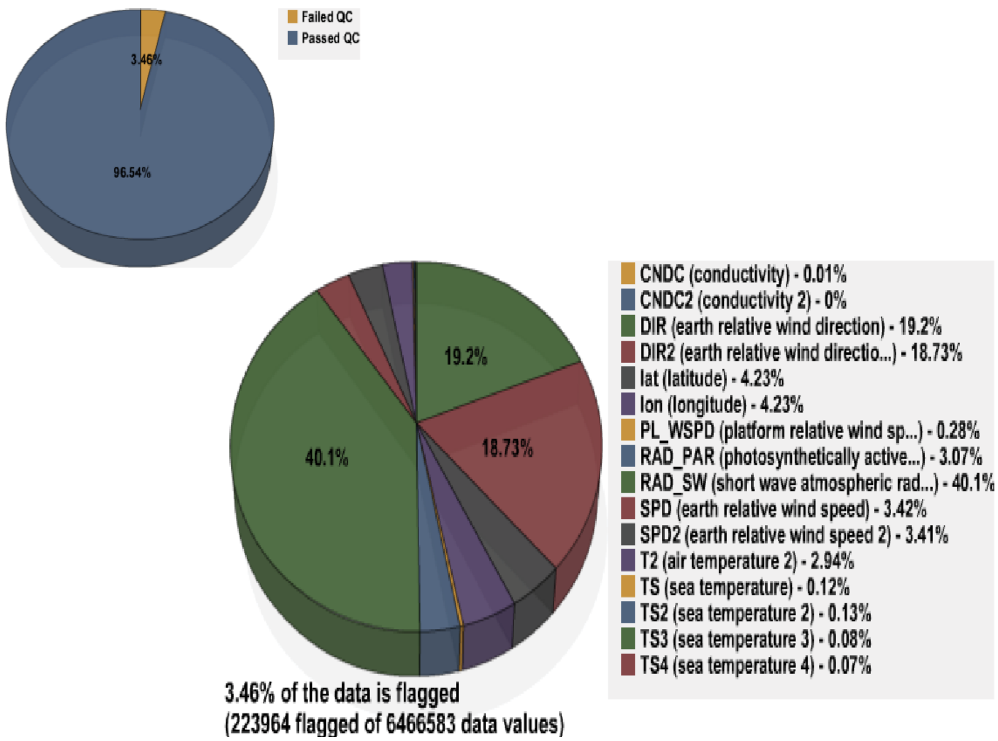



Figure 24: For the Atlantic Explorer from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Atlantic Explorer* provided SAMOS data for 166 ship days, resulting in 6,466,583 distinct data values. After automated QC, 3.46% of the data were flagged using A-Y flags (Figure 26). This is virtually unchanged from 2021 (3.52%) and is under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. NOTE: The *Atlantic Explorer* does not receive visual quality control by the SAMOS DAC, so all the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Atlantic Explorer*).

In March and April 2022, some “greater than four standard deviations from climatology” (G) flags (Figure 27) were applied to air temperature 2 (T2) as a result of incorrectly applied calibration information when a new element was installed for this hydroclip sensor. The problem was resolved around 19 April 2022. This problem likely also affected the values of relative humidity 2 (RH2), though no automated QC flags were applied; however, the T2 and RH2 data should be used with caution from March 2022 – mid April 2022.

There were no other major issues of note in 2022. Looking to the flag percentages in Figure 26, about 40% of the total flags were applied to the short-wave atmospheric radiation parameter (RAD_SW). Upon inspection the flags, which are unanimously “out of bounds” (B) flags (Figure 27), appear to have been applied mainly to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.) Approximately 38% of the total flags were applied to the earth relative wind direction (DIR and DIR2) parameters, combined. These were entirely "failed the true wind recalculation" (E) flags (Figure 27), which may be indicative of the *Atlantic Explorer* mixing averaged values and spot values across the parameters used in true wind calculation (not confirmed to date). Finally, there were a number of periods when the sea temperature (TS, TS2, TS3, TS4), conductivity (CNDC, CNDC2), and salinity (SSPS, SSPS2) data exhibited a smooth time series not representative of real ocean observations. This tends to occur when the pumps to the sea water system are shutdown, particularly when entering or leaving port. This sometimes results in B or G flags being applied to these variables (when the sea water in the pipes is not representative of the surrounding environment), but the autoQC does not flag all occurrences. When noted, the dates of these shutdowns are listed in Annex A.

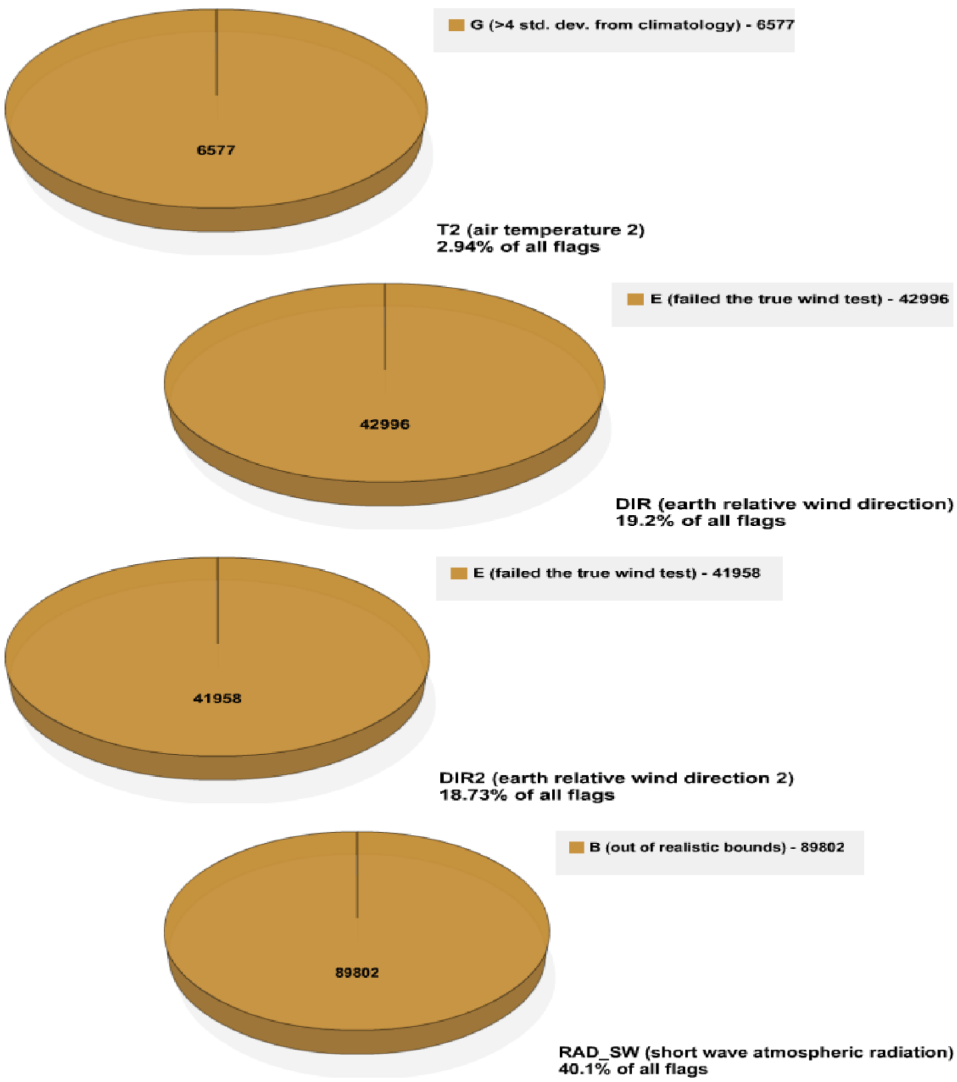



Figure 25: Distribution of SAMOS quality control flags for (first) *air temperature 2 – T2 – (second)* earth relative wind direction – DIR – (*third*) earth relative wind direction 2 – DIR2 – and (last) short wave atmospheric radiation – RAD_SW – for the *Atlantic Explorer* in 2022.

## *Investigator*

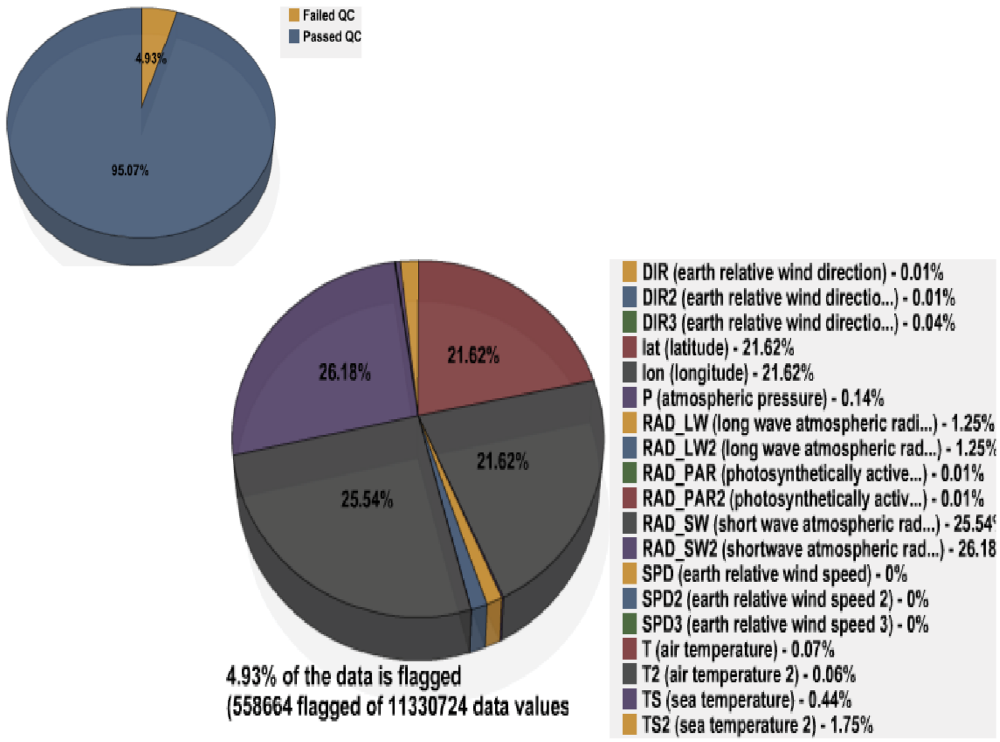



Figure 26: For the *Investigator* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Investigator* provided SAMOS data for 257 ship days, resulting in 11,330,724 distinct data values. After automated QC, 4.93% of the data were flagged using A-Y flags (Figure 28). This is about one and half percentage points higher than in 2021 (3.54%) and is still under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. NOTE: The *Investigator* does not receive visual quality control by the SAMOS DAC, so all the flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Investigator*).

Though rarely flagged by the autoQC, it is worth noting that the sea temperature (TS2) from the ISAR can differ from the intake sea temperature (TS) by 3˚C or more. The ISAR is designed to measure the skin sea temperature using a radiometer but can be prone to internal electronic noise that increases the sensor bias. The IMOS team conducts post cruise processing of the ISAR data and releases a research quality product that may be of interest to some users (Beggs et al. 2017, [https://researchdata.edu.au/rv-investigator-isarsst-2014-onwards/794633)](https://researchdata.edu.au/rv-investigator-isarsst-2014-onwards/794633). When the TS2 values vary from the TS by more than 1˚C, they should be used with caution. As a general advisory, it's been noted all of *Investigator's* earth relative winds, meaning both directions and speeds (i.e., DIR, DIR2, DIR3, SPD, SPD2, SPD3), sometimes show steps in the data in association with changes in the ship speed or vessel orientation. Upon inspection and in consultation with the operator, flow distortion caused by the ship's superstructure obstructing the wind is prevalent for some (particularly for winds from abeam) or all (for winds from astern) wind sensors. Notable examples include 20220819, 20220821-23, and 20220825-20220828. In all cases, users should take care to choose the true winds from the best exposed anemometer based on the ship-relative wind direction.

Looking at the flag percentages in Figure 28, about 52% of the total flags were applied to the shortwave atmospheric radiation parameters (RAD_SW and RAD_SW2). Upon inspection the flags, which are unanimously “out of bounds” (B) flags (Figure 29), appear to have been applied mainly to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.) A further ~43% of the total flags were applied to latitude (LAT) and longitude (LON). Upon inspection these were entirely “platform position over land” (L) flags (Figure 29) that appear generally to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port.

For anyone interested in working with reprocessed, post-cruise data from the *Investigator*, you can access both flux and meteorological observations from the IMOS THREDDS server via http://thredds.aodn.org.au/thredds/catalog/IMOS/SOOP/SOOP-ASF/VLMJ_Investigator/catalog.html. For additional information see Beggs et al. (2017).

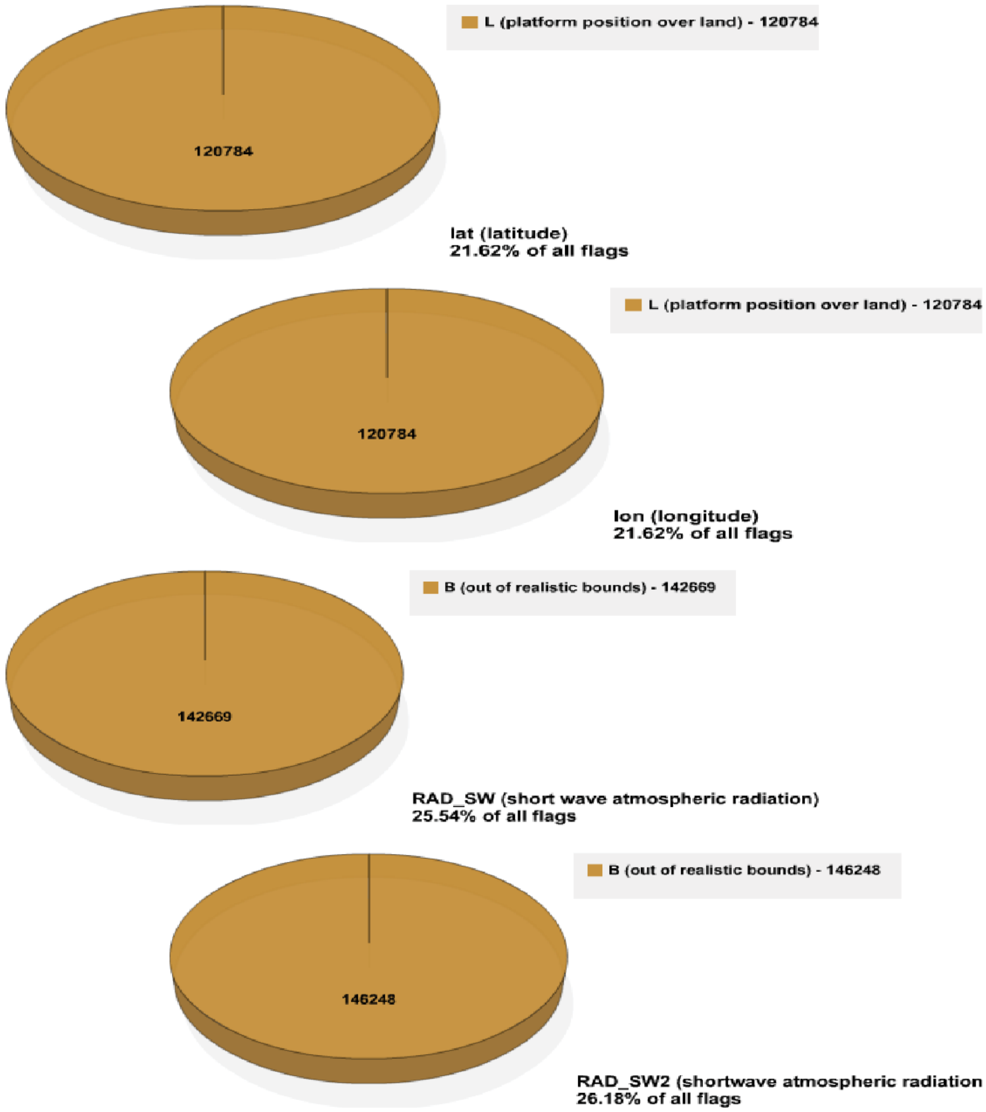



Figure 27: Distribution of SAMOS quality control flags for (first) latitude – LAT – (second) longitude – LON – (third) shortwave atmospheric radiation – RAD_SW – and (last) shortwave atmospheric radiation 2 – RAD_SW2 – for the *Investigator* in 2022.

***Tangaroa***

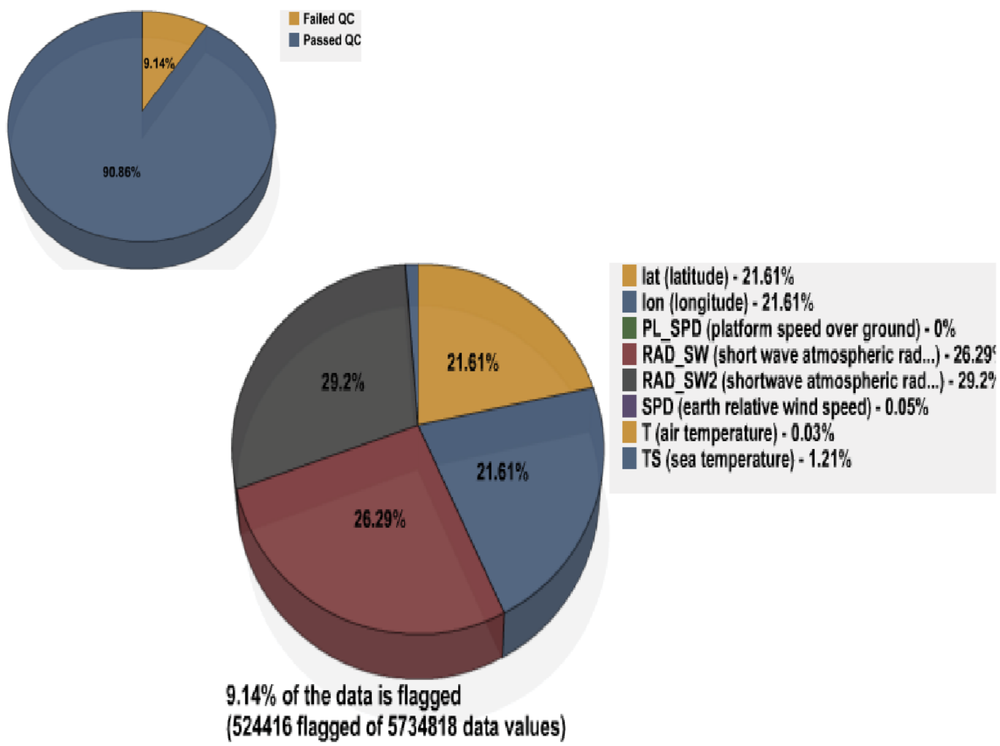



Figure 28: For the *Tangaroa* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Tangaroa* provided SAMOS data for 249 ship days, resulting in 5,734,818 distinct data values. After automated QC, 9.14% of the data were flagged using A-Y flags (Figure 30). This is about two percentage points higher than in 2021 (7.35%). NOTE: the *Tangaroa* does not receive visual quality control by the SAMOS DAC, so all flags are the result of automated QC (no research-level files exist at the SAMOS DAC for the *Tangaroa*).

There were no specific data issues of record for *Tangaroa* in 2022, apart from multiple days when no SAMOS file was received from the vessel because of satellite communications issues. Sometimes these missing days were received and processed on a delay, but others may not be included in the SAMOS data product for 2022. If a user is looking for a specific day of data not included in the SAMOS product, please refer to the IMOS THREDDS server (see below).

Looking to the flag percentages in Figure 30, about 55% of the total flags were applied to the shortwave atmospheric radiation parameters (RAD_SW and RAD_SW2). Upon inspection the flags, which are unanimously “out of bounds” (B) flags (Figure 31), appear to have been applied mainly to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.) A further ~43% of the total flags were applied to latitude (LAT) and longitude (LON). Upon inspection these were entirely “platform position over land” (L) flags (Figure 31) that appear generally to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port. *Tangaroa* is also known to frequently transmit data from port.

For anyone interested in working with reprocessed, post-cruise data from the *Tangaroa*, you can access both flux and meteorological observations from the IMOS THREDDS server via http://thredds.aodn.org.au/thredds/catalog/IMOS/SOOP/SOOP-ASF/ZMFR_Tangaroa/catalog.html. For additional information see Beggs et al. (2017).

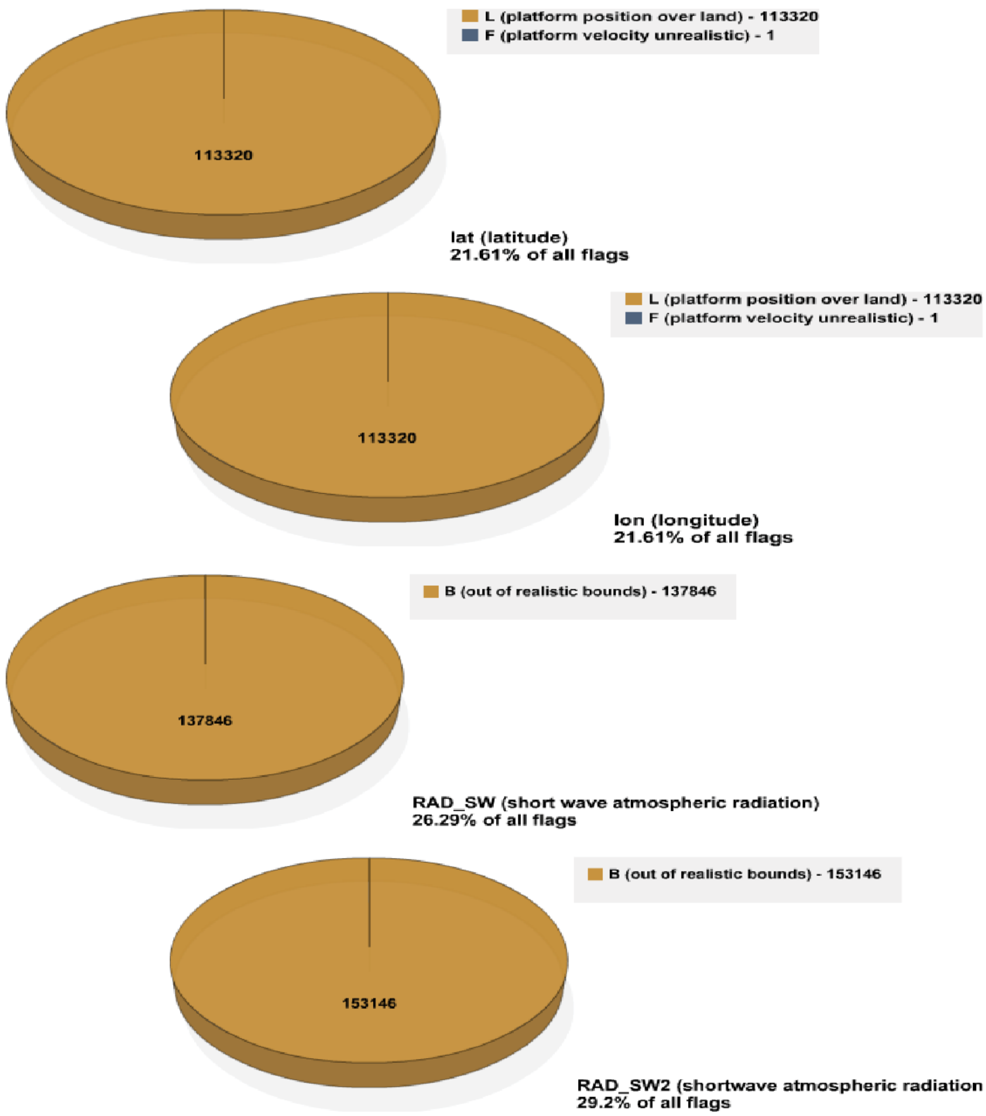



Figure 29: Distribution of SAMOS quality control flags for (first) latitude – LAT – (second) longitude – LON – (third) short wave radiation – RAD_SW – and (last) short wave radiation 2 – RAD_SW2 – for the *Tangaroa* in 2022.

### *Bell M. Shimada*

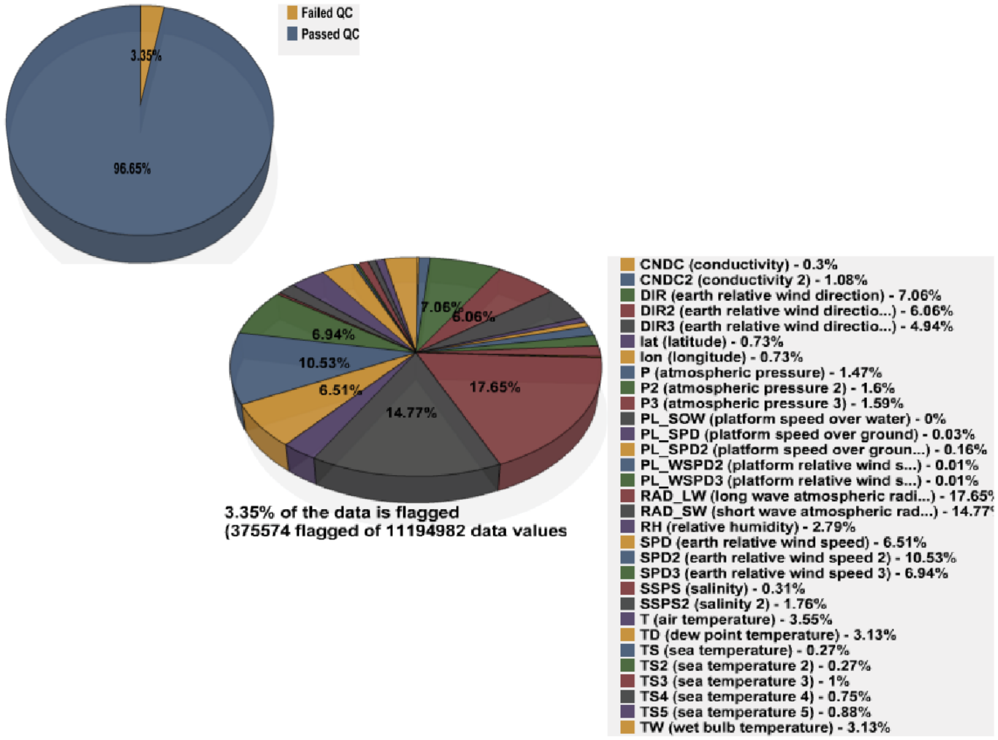



Figure 30: For the *Bell M. Shimada* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Bell M. Shimada* provided SAMOS data for 213 ship days, resulting in 11,194,982 distinct data values. After both automated and visual QC, 3.35% of the data were flagged using A-Y flags (Figure 32). This is about a percentage point lower than in 2021 (4.24% total flagged) and keeps *Shimada* inside the < 5% total flagged bracket regarded by SAMOS to represent "very good" data.

*Bell M. Shimada's* long wave and short wave radiation sensors (RAD_SW and RAD_LW) were not back from calibration at the beginning of the 2022 field season. Once the sensors were finally received and installed on the ship in mid-June, it was noted the long wave data were still – as they were in 2021 – routinely suspiciously high (around 600-800 W/m$^2$) and sometimes completely out of range (> 800 W/m$^2$). The daily time series of RAD_LW also still routinely presented as unusual: often mirroring the shape of Shimada's RAD_SW time series, sometimes showing large, discrete steps, and just generally dissimilar from typical long wave data recorded on other vessels (see Figure 33 for example). The result of the anomalous RAD_LW behaviors was the application of a large volume of "out of bounds" (B) and "caution/suspect" (K) flags (Figure 34). The source of the suspicious RAD_LW characteristics remained indeterminate in 2022. However, in early November a technician onboard the *Shimada* reported the RAD_SW and RAD_LW sensors had been sent out again to be fixed since they had originally come back "broken." (To date, RAD_LW data issues have not resolved.)

There were no other major issues noted for the *Shimada* in 2022. In general *Shimada's* various meteorological sensors are known (like most vessels) to 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 appear affected, they are generally assigned K flags. As is suggested by Figure 32, this is a bit more prevalent in the true winds, both directions (DIR, DIR2, DIR3) and speeds (SPD, SPD2, SPD3). Altogether, around 40% of the total flags were applied to DIR, DIR2, DIR3 and SPD, SPD2, SPD3, these being mostly K and "failed the wind recomputation check" (E) flags (Figure 34, not all shown). Short wave atmospheric radiation garnered a further ~15% of the total flags in 2022 (Figure 34), although in this case they were primarily B flags (Figure 34) such as are applied to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

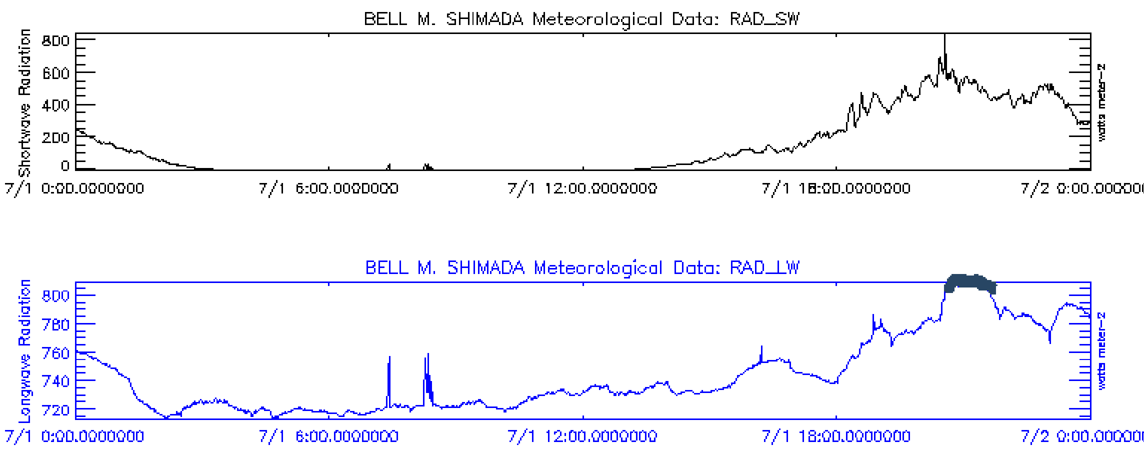



Figure 31: *Bell M. Shimada* SAMOS (top) short wave atmospheric radiation – RAD_SW – and (bottom) long wave atmospheric radiation – RAD_LW – data for 1 July 2022. Note uncommonly high RAD_LW values (typical range 300-500 W/m*2*) including some that are physically out of range ("out of bounds" B flags on values >800 W/m$^2$ shown in grey). Note also general mirroring of RAD_SW pattern.

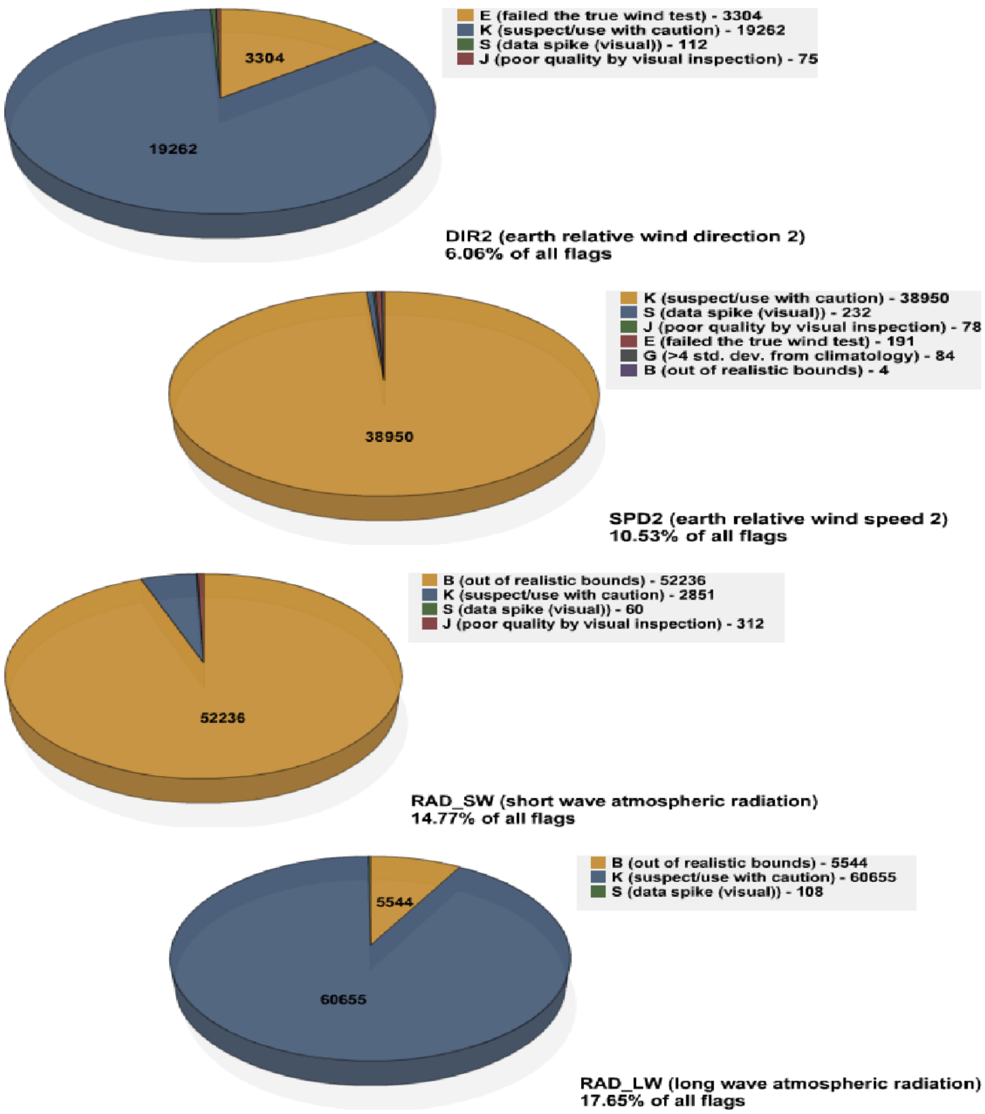



Figure 32: Distribution of SAMOS quality control flags for (first) earth relative wind direction 2 – DIR2 – (second) earth relative wind speed 2 – SPD2 – (third) shortwave atmospheric radiation – RAD_SW – and (last) longwave atmospheric radiation – RAD_LW – for the *Bell M. Shimada* in 2022.

### *Fairweather*

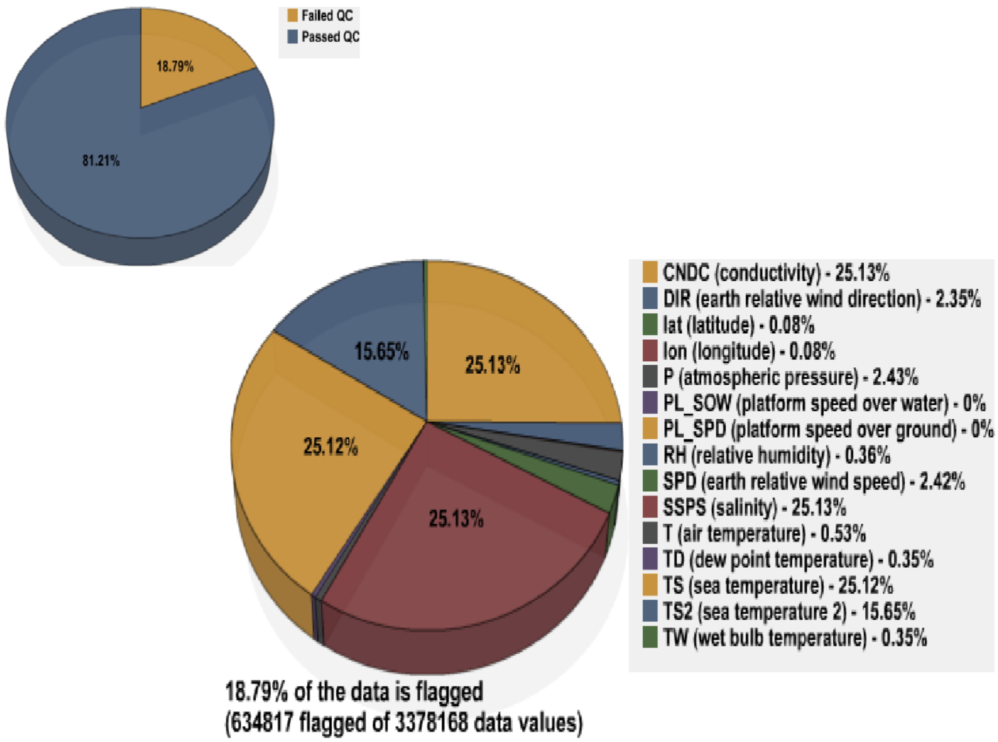



Figure 33: For the *Fairweather* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Fairweather* provided SAMOS data for 151 ship days, resulting in 3,378,168 distinct data values. After both automated and visual QC, 18.79% of the data were flagged using A-Y flags (Figure 35). This is significantly higher than in 2021 (8.59% total flagged).

In mid-May *Fairweather's* SCS data acquisition software was upgraded to version 5. Immediately following the upgrade, the air temperature (T), relative humidity (RH), dew point temperature (TD), and wet bulb temperature (TW) variables were all absent from *Fairweather's* SAMOS files and remained so for an extended period. In late August, a ship technician reported the problem originated with the translator for the temperature and moisture data. Likely compounding the translator issue, new RocketPort hardware was also installed sometime in August. T/TD/TW/RH data transmission ultimately was not reestablished until late October. (It should be noted SCS v5 was a major release and we've typically seen an adjustment period on newly upgraded vessels.)

There are no other issues of note for *Fairweather* in 2022. Looking to the flag percentages in Figure 35, most of the flags were applied to the sea temperatures (TS and TS2) and conductivity/salinity (CNDC/SSPS). These were almost exclusively "caution/suspect" (K) flags (Figure 36) applied primarily when underway sea water collection was restricted, usually because the vessel was either in port or was in rough or inland/murky conditions. We note there is currently no way for a technician to temporarily "disable" sensors configured for reporting to SAMOS in SCSv5 (other than completely turning off the sensor or its raw data logging).

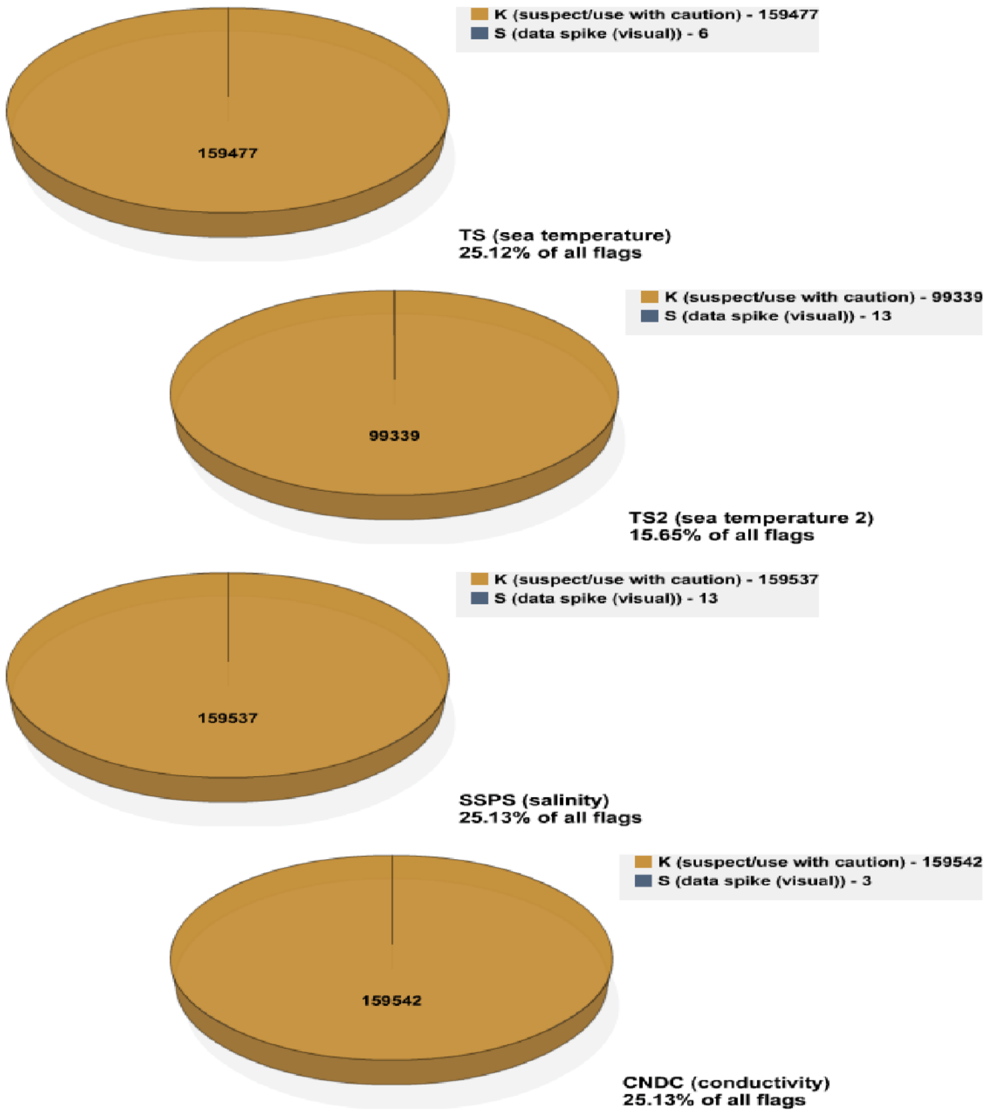



Figure 34: Distribution of SAMOS quality control flags for (first) sea temperature – TS – (second) sea temperature 2 – TS2 – (third) salinity – SSPS – and (last) conductivity – CNDC – for the *Fairweather* in 2022.

*Ferdinand Hassler*

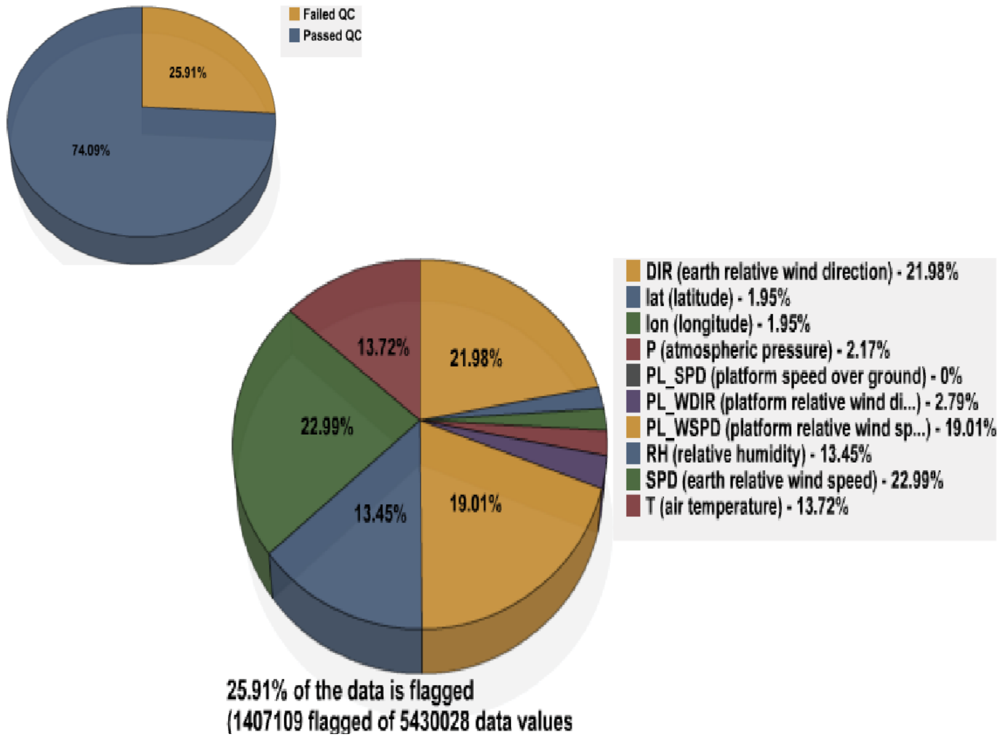



Figure 35: For the *Ferdinand Hassler* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Ferdinand Hassler* provided SAMOS data for 313 ship days, resulting in 5,430,028 distinct data values. After both automated and visual QC, 25.91% of the data were flagged using A-Y flags (Figure 37). This is significantly higher than in 2021 (7.54%).

In 2022 the true wind direction and speed (DIR and SPD) from *Hassler* continued to exhibit an issue that was first noted in 2021. Namely, DIR and SPD often exhibited steps that distinctly echoed changes in the vessel heading. During the summer in 2022 it became clear these DIR and SPD steps were really only present when *Hassler* was moving, i.e., platform speed (PL_SPD) > 0 (see Figure 38). Coincidentally, around this time another SAMOS ship's (*Thomas Jefferson*) true wind data from one of their anemometers appeared to be suffering from the same issue. In their case, we were able to confirm the affected anemometer was, for mysterious reasons, outputting relative wind speed in the wrong units (values were 2x higher than expected). Once this fact was established it became obvious the true wind error lay in the derivation's reliance on mismatched ship speed units and relative wind speed units. (DIR/SPD steps when vessel speed is > 0 are a hallmark of true winds that were calculated based on speed inputs of differing units. Basically, the errant calculation ends up weighting the relative wind speed aka PL_WSPD and PL_SPD inputs unevenly.) Although it's never been confirmed, a very similar scenario is suspected on the *Hassler*, particularly because the relative wind speed (PL_WSPD) values in 2022 always appeared to be much too high (Figure 38) in comparison with any available verification data. DIR and SPD were at first treated with mostly "caution/suspect" (K) flags (Figure 39) when steps were evident. Later in 2022, when suspicion focused in on the PL_WSPD units as the culprit, DIR and SPD flagging was switched mainly to "poor quality" (J) flags. PL_WSPD also received a good deal of mainly J and K flags (Figure 39) over the course of the year. Finally, beginning in late fall PL_WDIR was often too invariant to be realistic, hovering in a small (5-10 degree) range for much of the day. The cause is not known, but where these invariant data appeared they were also typically J-flagged (not shown).

In mid July, when there may have been some troubleshooting of the winds going on, *Hassler* ceased reporting air temperature (T) and relative humidity (RH). When the data streams resumed about a month later values for both T and RH were continuously well out of realistic bounds. No cause for the erroneous values was ever able to be determined, and the issue persisted for the rest of 2022. This resulted in a good amount of "out of bounds" (B) flags being applied to T and RH (Figure 39).

We note there is no permanent Survey Technician position filled on the *Hassler*, nor is there typically anyone onboard familiar with SCS.

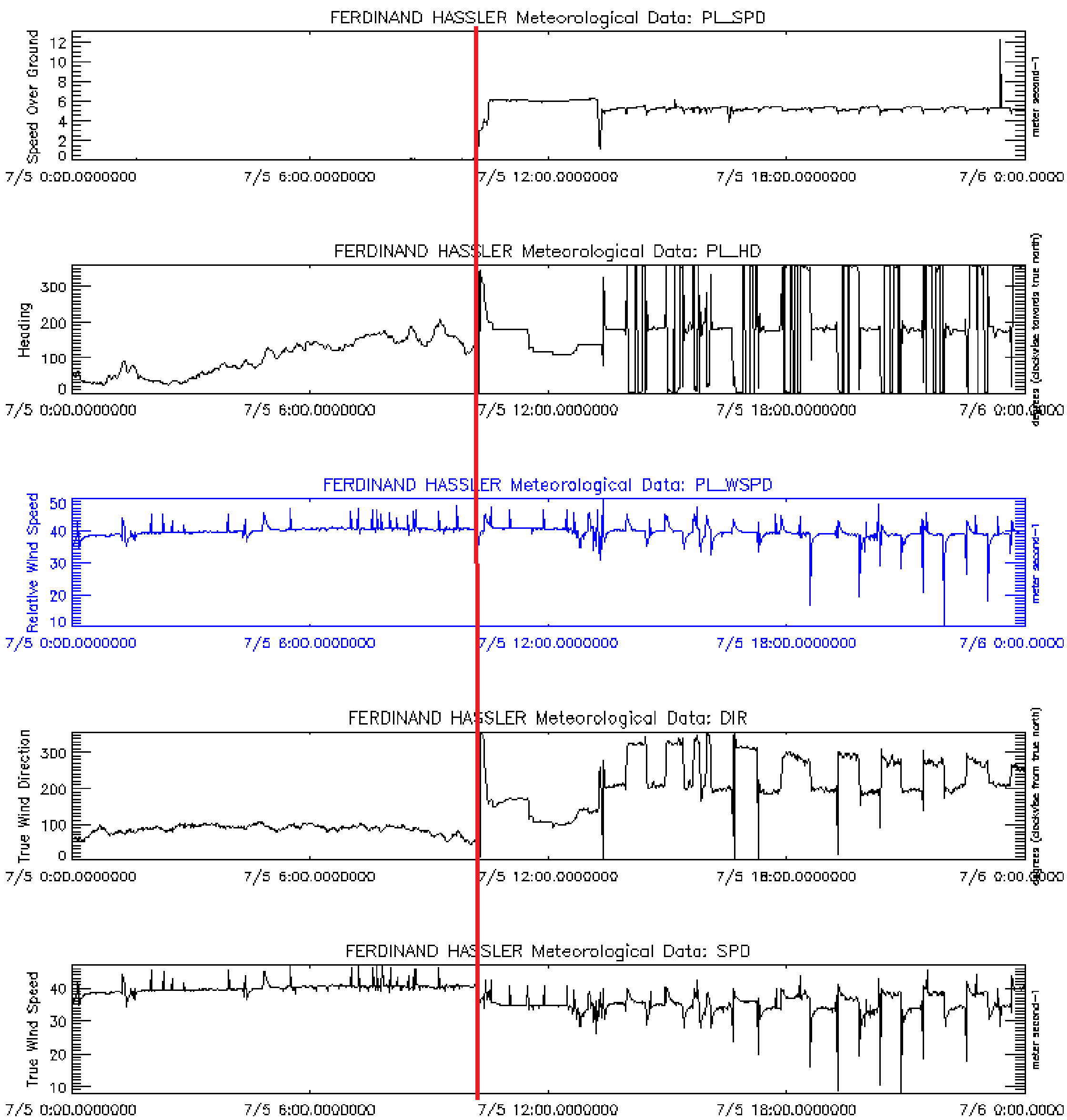



Figure 36: *Ferdinand Hassler* SAMOS (first) platform speed over ground – PL_SPD – (second) platform heading – PL_HD – (third) platform relative wind speed – PL_WSPD – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – data for 5 July 2022. Note discrete steps that echo changes in vessel heading seen in both DIR and SPD when PL_SPD is > 0 (i.e., to the right of red line). Note also dubious PL_WSPD values (in blue) equivalent to Category 1 wind speed on the Saffir-Simpson Scale (vessel located near Cape Lookout, NC – maximum gentle to moderate breeze reported).

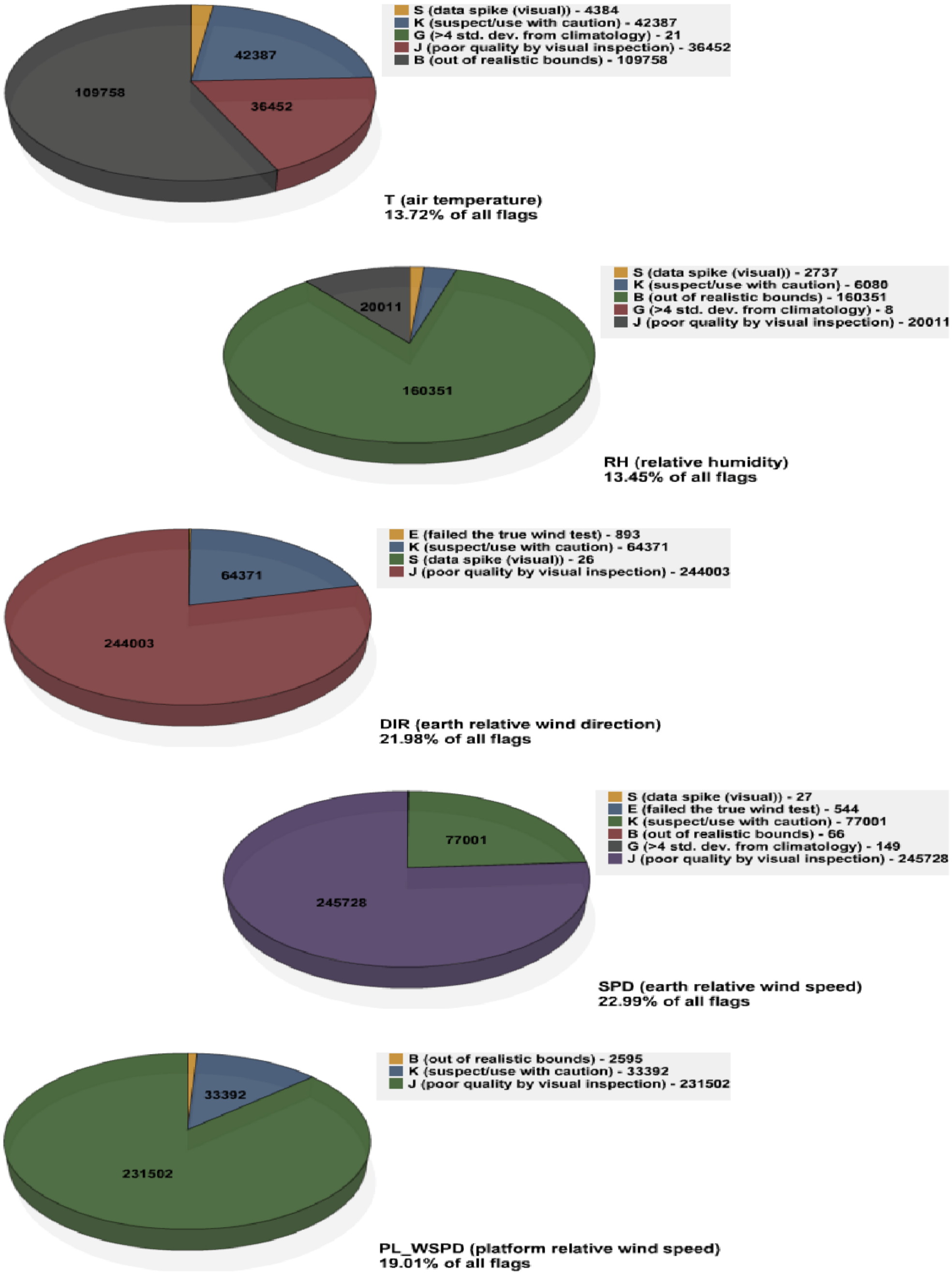



Figure 37: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) relative humidity – RH – (third) earth relative wind direction -- DIR – (fourth) earth relative wind speed – SPD – and (last) platform relative wind speed – PL_WSPD – for the *Ferdinand Hassler* in 2022.

### *Gordon Gunter*

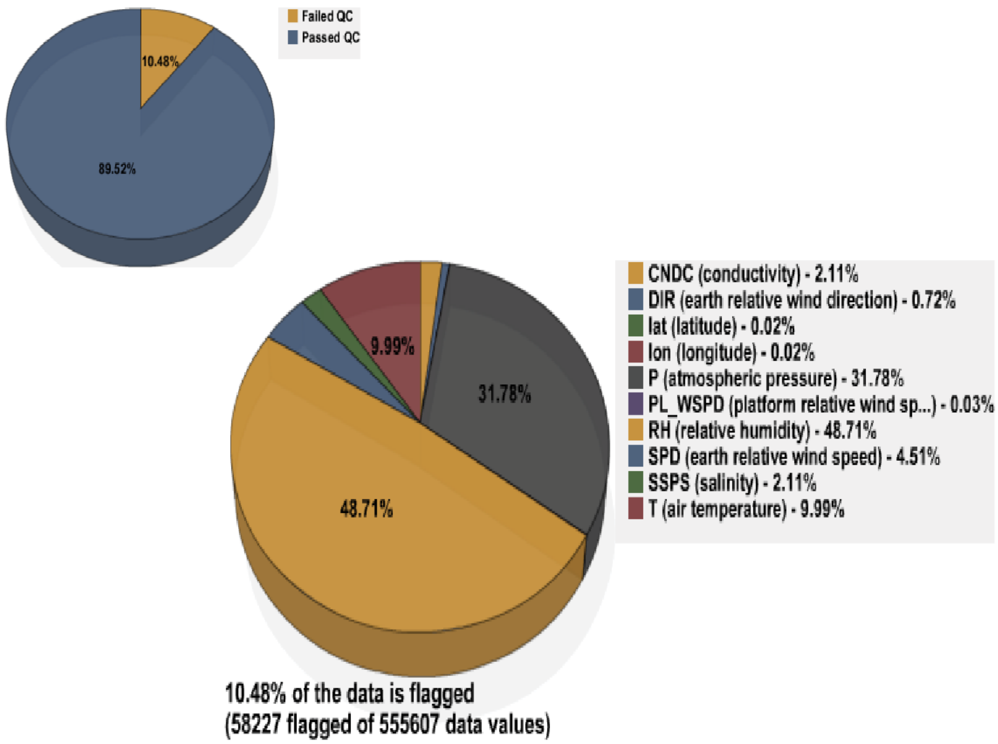



Figure 38: For the *Gordon Gunter* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Gordon Gunter* provided SAMOS data for 29 ship days, resulting in 555,607 distinct data values. After both automated and visual QC, 10.48% of the data were flagged using A-Y flags (Figure 40). This is significantly higher than in 2021 (3.44%).

*Gordon Gunter* only engaged in operations for about a month in 2022, at the end of the summer. For about the first half of this period, between 20 August and 8 September, pressure (P) data were persistently in error with values being reported in the 800's millibar range. These unrealistic values resulted in application of a sizable volume of "out of bounds" (B) and "poor quality" (J) flags to P (Figure 41). It's not known precisely what caused the low P readings, but it was reported early on that *Gunter's* meteorological system had been rewired during the prior repair period and several systems were being troubleshooted. After 8 September P data were improved.

In addition, throughout the operating period the relative humidity data (RH) frequently displayed large, unrealistic swings (changes of 20-30% humidity over a few minutes) whenever the relative wind direction was from roughly starboard. Coincident response in the air temperature data (T) was generally muted or not observable, leading to suspicion the RH disturbances were due to more than just localized heating. Swings in RH and any concurrent smaller bumps in T were all treated with "caution/suspect" (K) flags (Figure 41). As with P, the precise cause of the RH issue is not known, and we note the issue with

RH continues in 2023. Our theory is there may be something amiss in the sensor's setup or configuration, or possibly the incorrect sensor message value is being reported.

There were no other issues of note for *Gunter* in 2022.

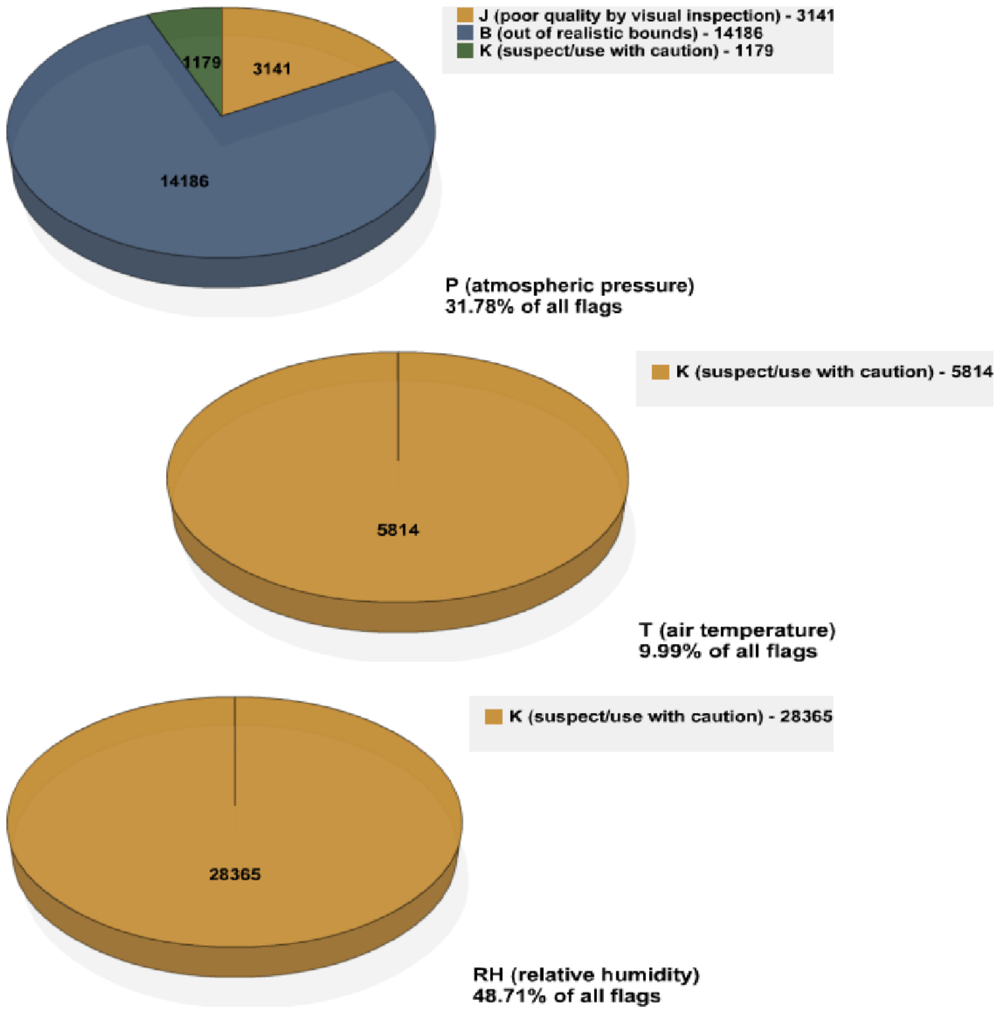



Figure 39: Distribution of SAMOS quality control flags for (top) atmospheric pressure – P – (middle) air temperature – T – and (bottom) relative humidity – RH – for the *Gordon Gunter* in 2022.

***Henry B. Bigelow***

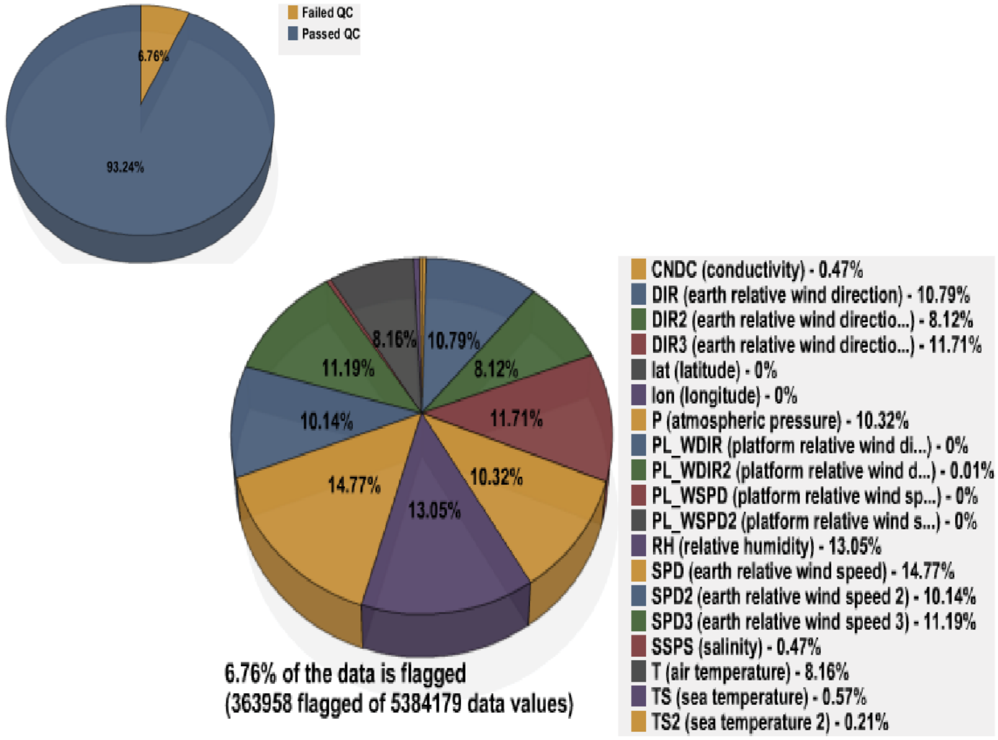



Figure 40: For the *Henry B. Bigelow* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Henry Bigelow* provided SAMOS data for 155 ship days, resulting in 5,384,179 distinct data values. After both automated and visual QC, 6.76% of the data were flagged using A-Y flags (Figure 42). This is exactly one percentage point higher than in 2021 (5.76%).

In mid March *Bigelow's* relative humidity sensor (RH) began intermittently reporting periods of obviously bad data. For no clear reason, every so often RH deviated suddenly from the trend and entered a period of values that were just over 100% or just under 0% (or sometimes both). These periods, which received "out of bounds" (B) flags (Figure 44), often spanned several hours before terminating just as abruptly as they began, with a return to trend afterwards. In April, an attempted repair of the ground wire leading to the RH probe was made. However, the issue continued to pop up randomly. In early June, the temperature and humidity sensor was swapped out with a spare and afterwards the issue with RH was not observed again.

Beginning in early October periods of rapid (10-20 min), sustained ~1 mb oscillations were frequently observed in *Bigelow's* pressure (P) data (see Figure 43). Upon investigating a technician noted the neoprene tubing for the sensor was dried out and weathered. The technician first tried patching and later replacing the neoprene tubing. However, the problem did not resolve by the end of the field season. As a result of the oscillations, P data in October through early December frequently received "caution/suspect" (K) flags (Figure 44).

There were no other major issues noted for the *Bigelow* in 2022. In general *Bigelow's* various meteorological sensors are known (like most vessels) to 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 appear affected, they are generally assigned K flags (Figure 44, not all shown). As is suggested by Figure 42, this is a bit more prevalent in the true winds, both directions (DIR, DIR2, DIR3) and speeds (SPD, SPD2, SPD3). Altogether, around two thirds of the total flags were applied to DIR, DIR2, DIR3 and SPD, SPD2, SPD3.

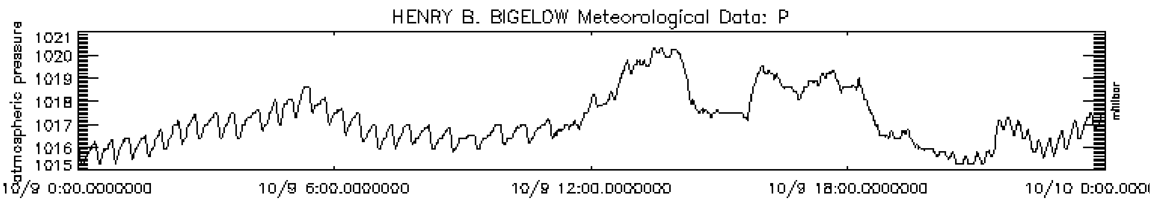



Figure 41: *Henry B. Bigelow* SAMOS atmospheric pressure – P – data for 9 October 2022. Note high frequency ~1 mb oscillations.

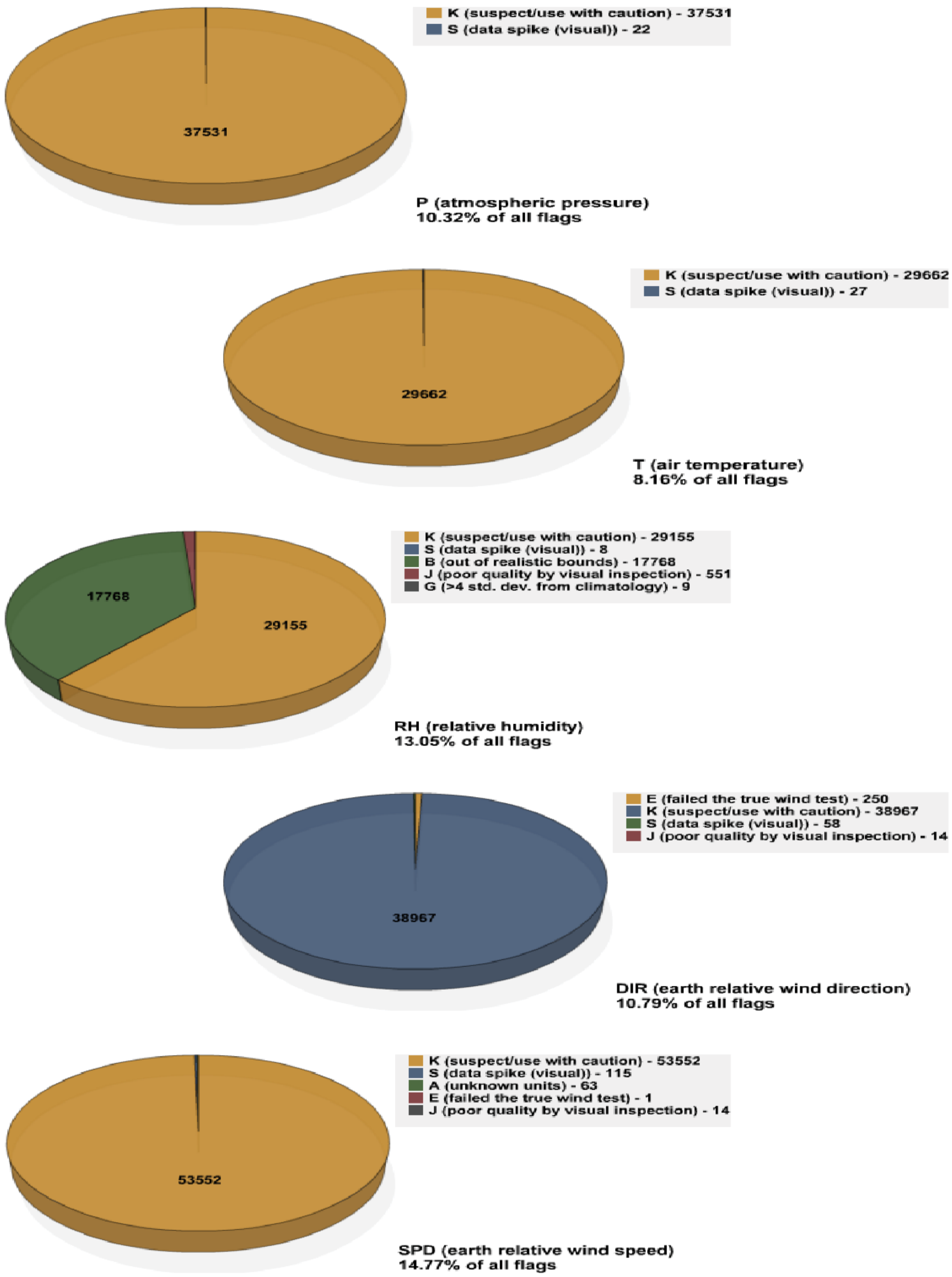



Figure 42: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) earth relative wind direction – DIR – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed –SPD – for the *Henry B. Bigelow* in 2022.

## *Nancy Foster*

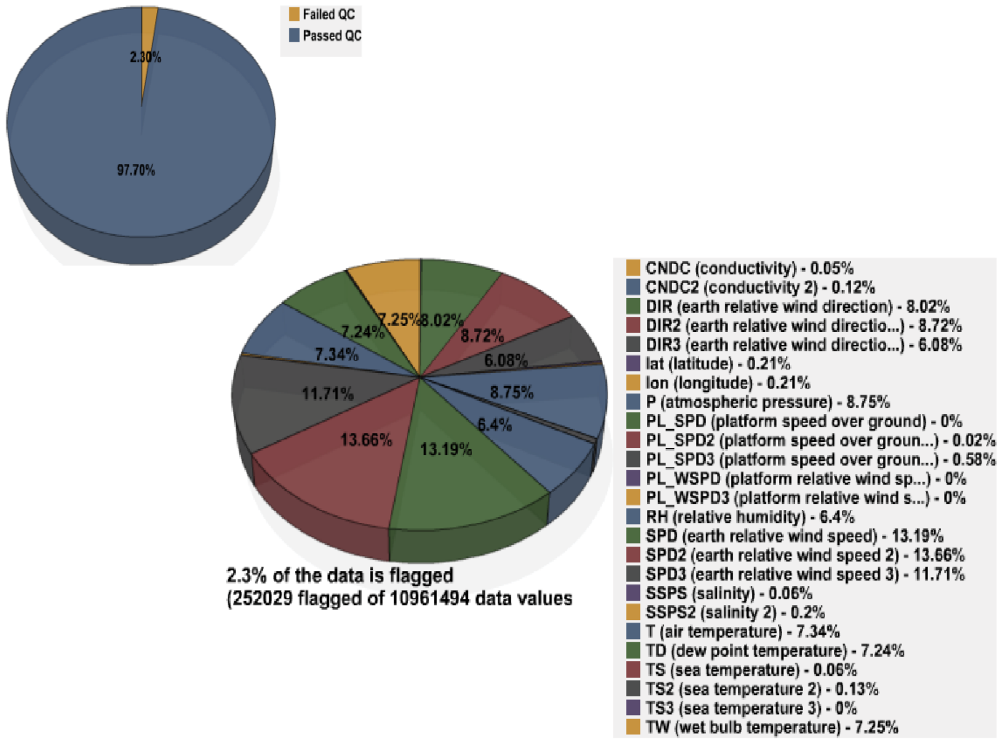



Figure 43: For the *Nancy Foster* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Nancy Foster* provided SAMOS data for 252 ship days, resulting in 10,961,494 distinct data values. After both automated and visual QC, 2.3% of the data were flagged using A-Y flags (Figure 45). This is a few percentage points lower than in 2021 (4.96%) and maintains *Foster's* standing inside the < 5% total flagged bracket regarded by SAMOS to represent "very good" data.

There were no specific issues of note for the *Nancy Foster* in 2022. In general, *Foster's* various meteorological sensors – earth relative wind directions (DIR, DIR2, DIR3), earth relative wind speed (SPD, SPD2, SPD3), air temperature (T), dew point temperature (TD), wet bulb temperature (TW), relative humidity (RH), and atmospheric pressure (P) – do occasionally exhibit data distortion that is dependent on the vessel relative wind direction (common to most vessels). The fairly even spread of flagging across these parameters (Figure 45) suggests none of the instruments supplying the data is in a particularly compromised location. Where any of these data appear affected, they are typically flagged with "caution/suspect" (K) flags (Figure 46, not all shown).

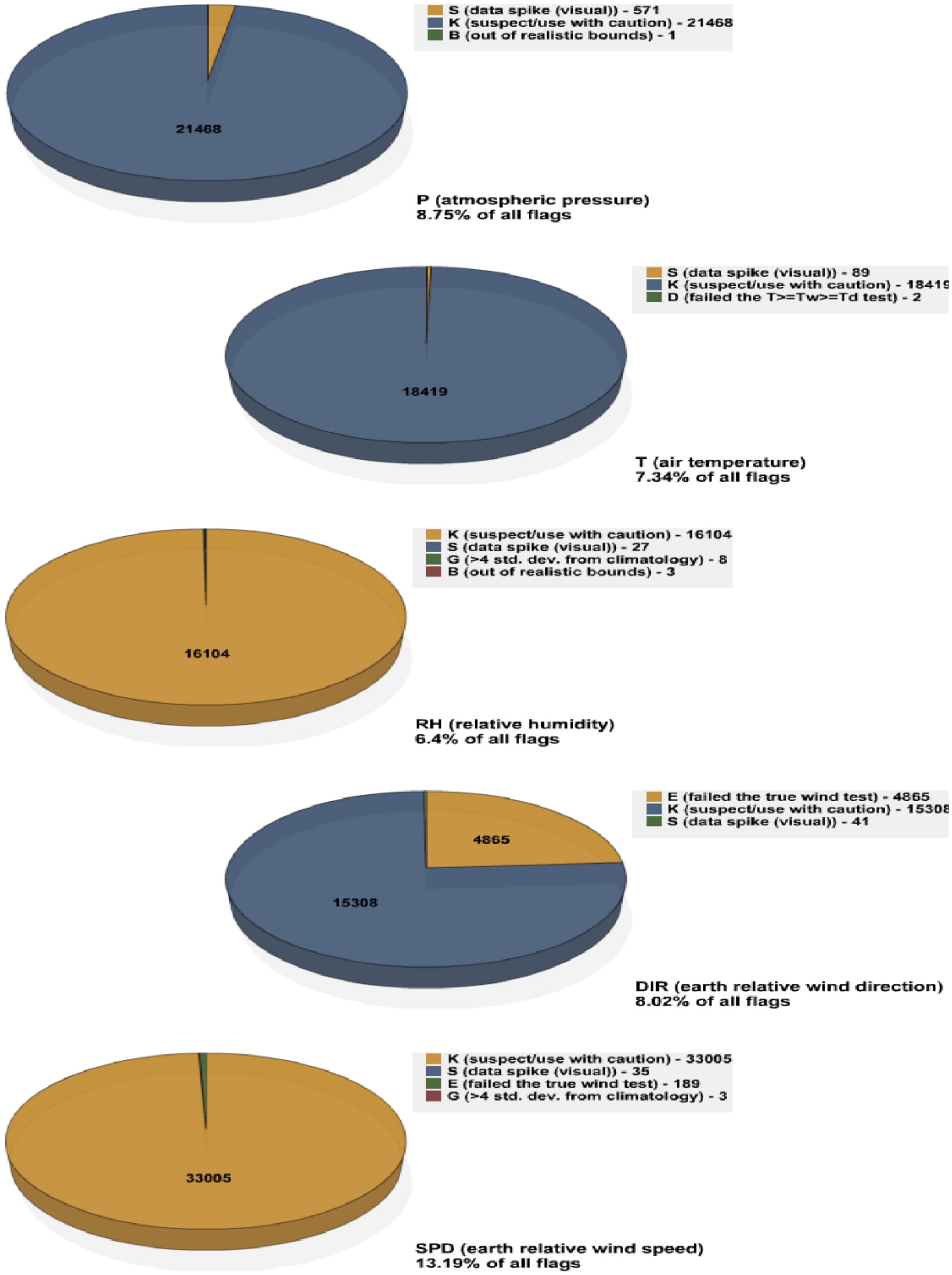



Figure 44: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – for the *Nancy Foster* in 2022.

*Okeanos Explorer*

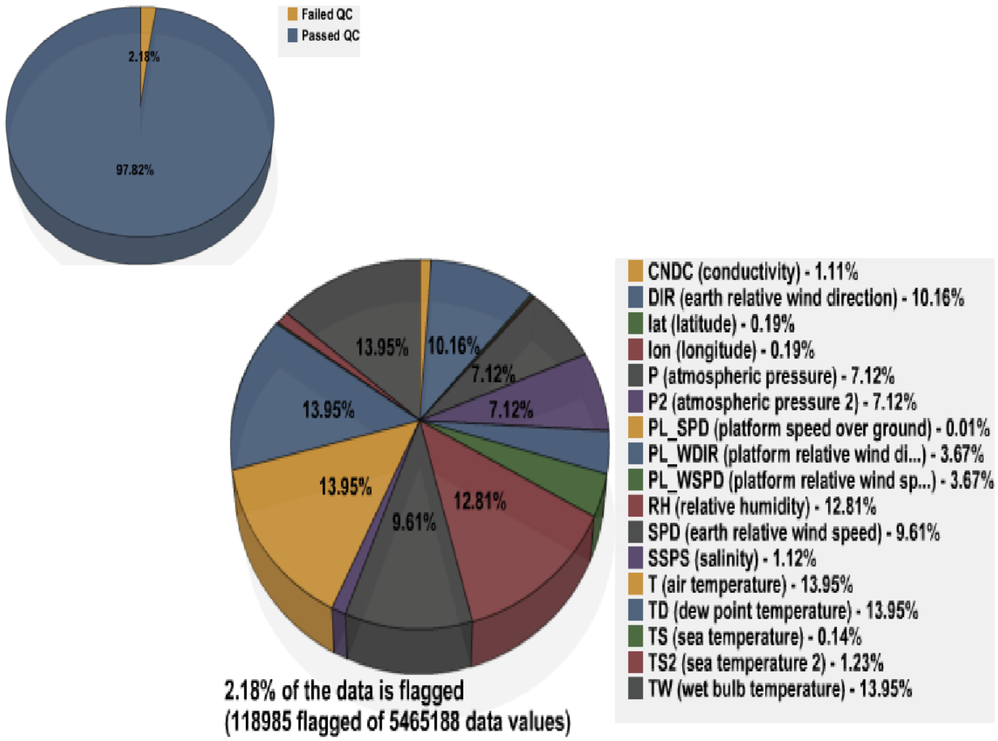



Figure 45: For the *Okeanos Explorer* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Okeanos Explorer* provided SAMOS data for 196 ship days, resulting in 5,465,188 distinct data values. After both automated and visual QC, 2.18% of the data were flagged using A-Y flags (Figure 47). This is a few percentage points lower than 2021 (5.65%) and moves *Explorer* well inside the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

At the onset of *Okeanos Explorer's* field season it was discovered the RM Young 05106 anemometer had been reinstalled backwards (i.e., with the zero line pointing toward the stern). Consequently, the vessel relative wind direction (PL_WDIR) was 180 degrees off and the true wind direction and speed (DIR and SPD) were being incorrectly calculated. As soon as it was feasible to do so the anemometer was reoriented properly. In the meantime, there were a few days in February when the true and relative winds were uniformly flagged with "malfunction" (M) flags (Figure 48, not all shown).

There were no other issues of note for the *Okeanos Explorer* in 2022. In general, *Okeanos Explorer's* meteorological sensors – DIR and SPD, air pressure (P and P2), air temperature (T), wet bulb temperature (TW), dew point temperature (TD), and relative humidity (RH) – do occasionally exhibit data distortion that is dependent on the vessel relative wind direction (common to most vessels) and, in the case of T/TW/TD/RH, likely localized heating from the pilothouse roof.  Where the data appear affected they are typically flagged with "caution/suspect" (K) flags (Figure 48, not all shown).

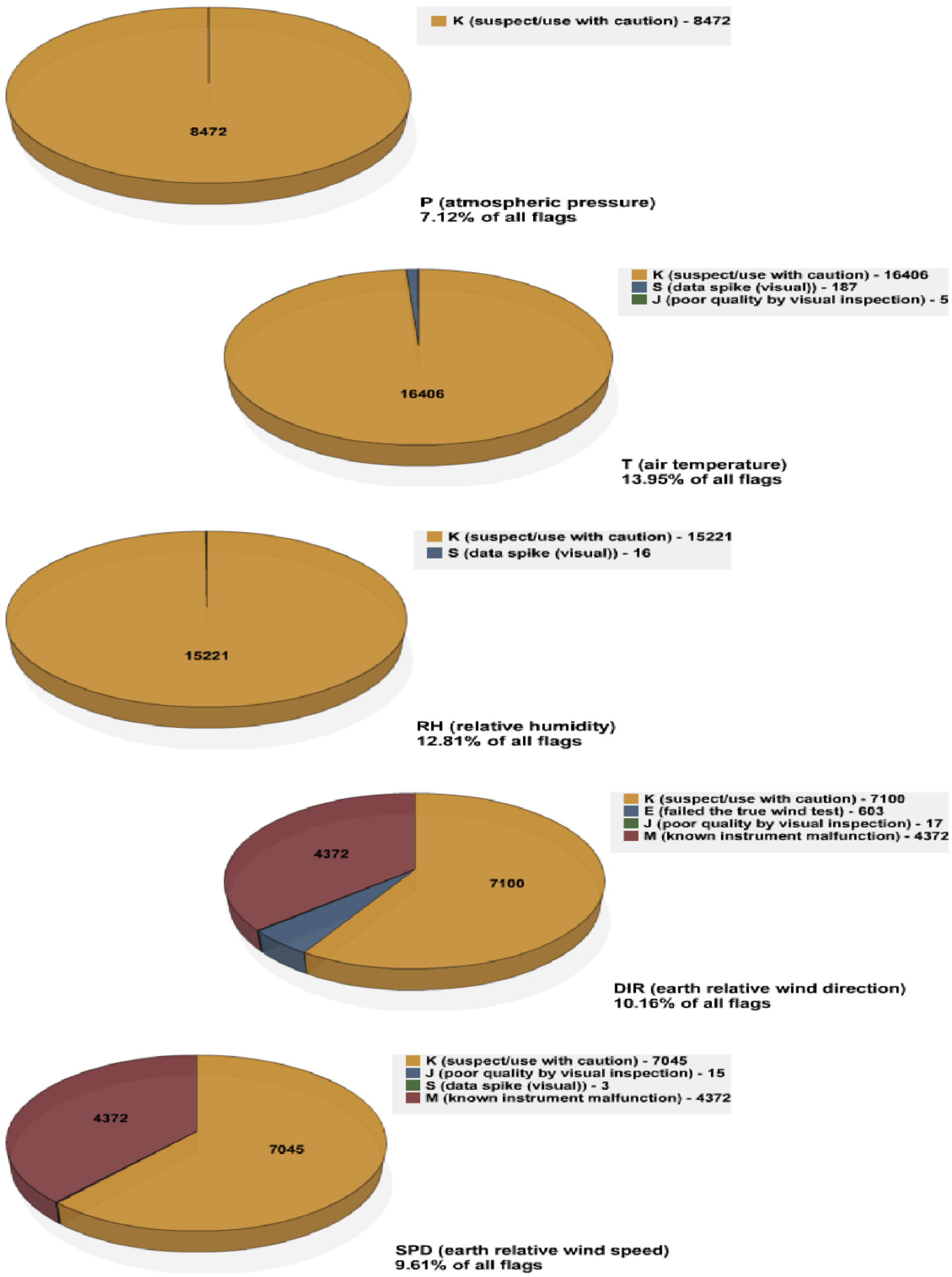



Figure 46: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) earth relative wind direction – DIR – and (last) wind speed – SPD – for the *Okeanos Explorer* in 2022.

### *Oregon II*

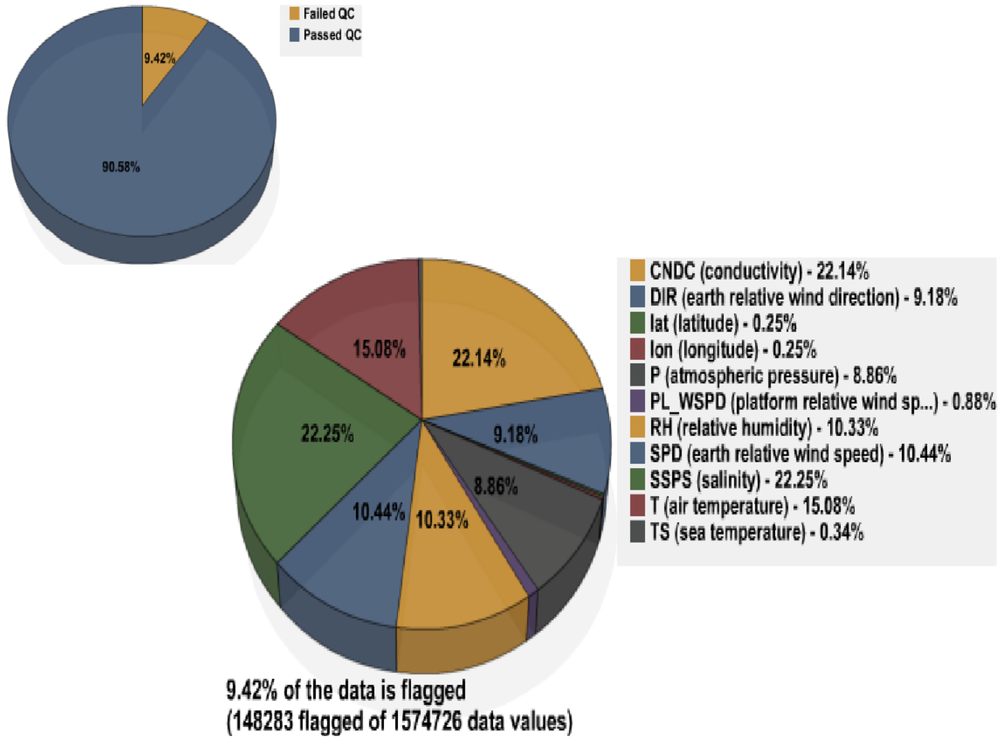



Figure 47: For the *Oregon II* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Oregon II* provided SAMOS data for 75 ship days, resulting in 1,574,726 distinct data values. After both automated and visual QC, 9.42% of the data were flagged using A-Y flags (Figure 49). This is a few percentage points higher than in 2021 (6.35%).

There were no specific issues noted for the *Oregon II* in 2022. As a general note, air temperature (T), relative humidity (RH), earth relative wind direction and speed (DIR and SPD, respectively), and atmospheric pressure (P) on the *Oregon* all suffer the myriad effects of less-than-ideal sensor placement (e.g., flow distortion, stack exhaust contamination, ship heating), which oftentimes results in “caution/suspect” (K) flags for each of those parameters (Figure 50, not all shown). Assumed localized ship heating is particularly evident in T and RH on sunny days when the relative wind is from broadly port to astern. All these effects are common among sea-faring vessels, where instrument siting can be tricky, although the effects are perhaps a little more pronounced on the *Oregon II* than on the average SAMOS ship.

Looking back to the flag percentages in Figure 49, about 44% of the total flags were assigned to the sea parameters salinity (SSPS) and conductivity (CNDC). These were overwhelmingly K flags (Figure 50, only SSPS shown), applied mainly when it appeared the flow-through sea water system that feeds the thermosalinograph was disengaged, such as routinely occurs when a vessel is near/at port or in rough seas.

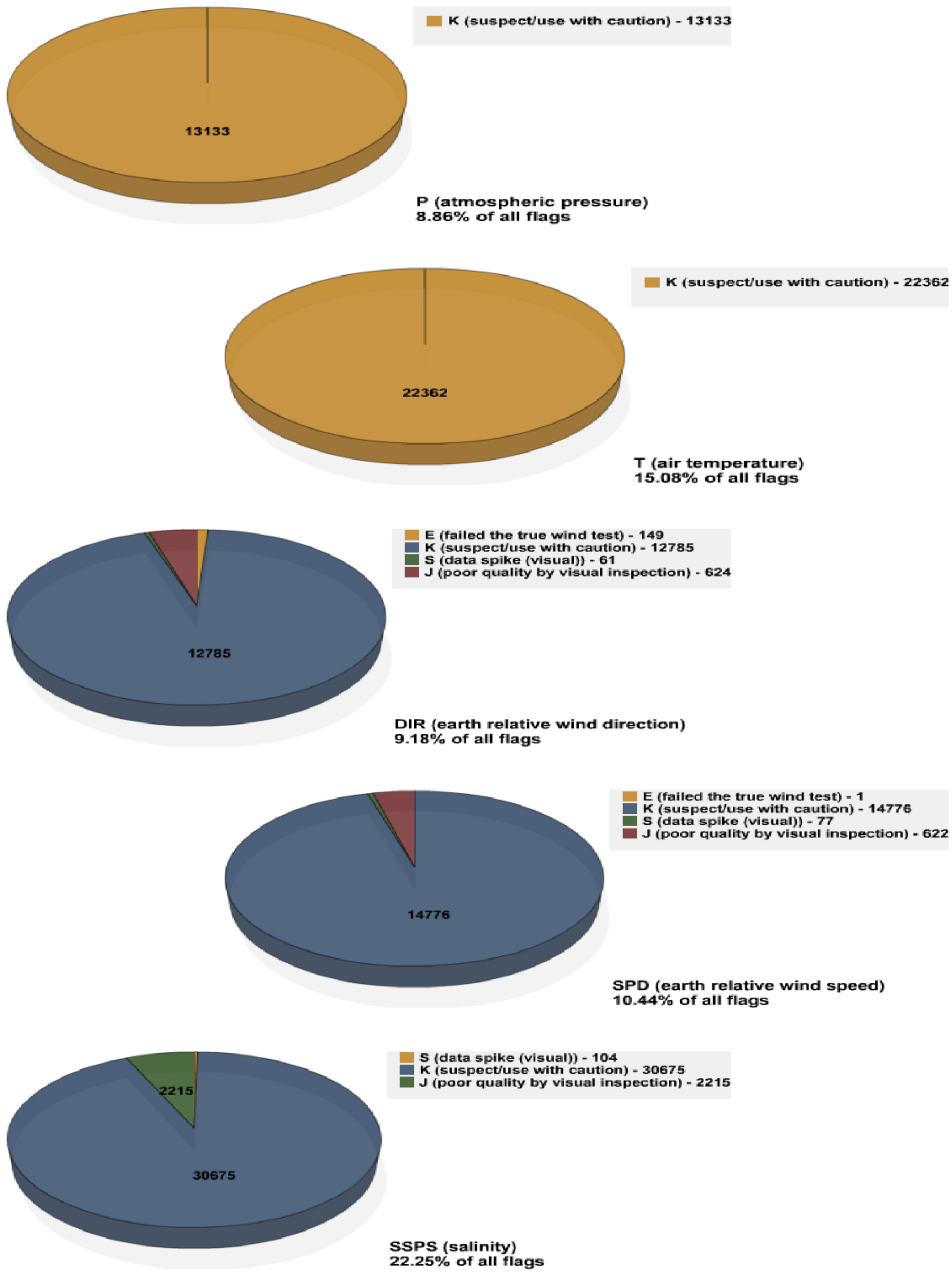



Figure 48: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) earth relative wind speed – DIR – (fourth) earth relative wind speed – SPD – and (last) salinity – SSPS – for the *Oregon II* in 2022.

## *Oscar Dyson*

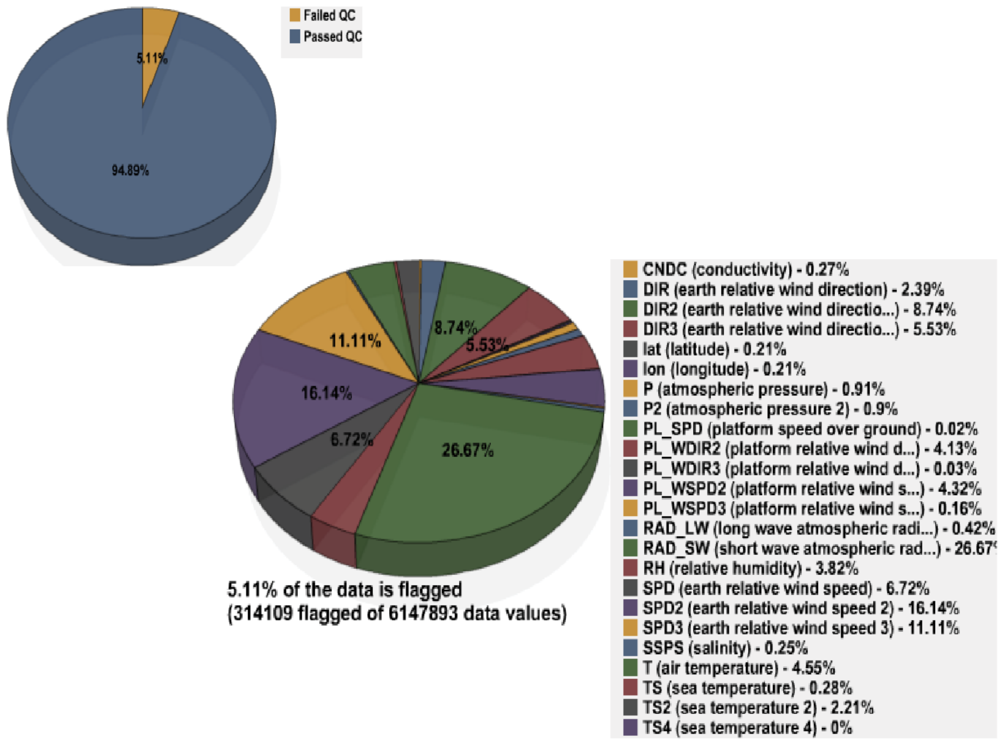



Figure 49: For the *Oscar Dyson* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Oscar Dyson* provided SAMOS data for 151 ship days, resulting in 6,147,893 distinct data values. After both automated and visual QC, 5.11% of the data were flagged using A-Y flags (Figure 51). This is a few percentage points higher than in 2021 (2.1%) and places *Dyson* just over the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

At the onset of *Oscar Dyson's* field season, the short wave atmospheric radiation data (RAD_SW) from the vessel's Eppley PSP were found to be stuck at an unrealistically high value (2438.36 W/m$^2$). These data received "out of bounds" (B) flags during automated QC processing (Figure 52). RAD_SW values remained constant (and B-flagged) over the next several weeks, while the service technician and manufacturer were being consulted for assistance. In early March, a bad cable was identified on the radiometer and replaced, and afterwards RAD_SW data appeared normal again.

In mid March we were informed *Dyson's* air temperature (T) and relative humidity (RH) sensor had failed. These data received "malfunction" (M) flags for the period 15-17 March (Figure 52, only T shown). The T/RH communications and power cable was replaced during *Dyson's* next port stay and once transmission resumed T/RH data returned to normal.

In general, the *Dyson's* two RM Young 85004 ultrasonic anemometers (DIR2, DIR3, SPD2, SPD3, PL_WDIR2, PL_WDIR3, PL_WSPD2, PL_WSPD3) routinely experience discrete periods of unrealistic spikes or steps in the data, which typically results in application of “spike” (S), “poor quality” (J), and/or B flags (Figure 52, not all shown). Sometimes “malfunction” (M) flags are used if the episode is pronounced and/or verbally confirmed by the survey technicians. It is suspected the cabling – which is hard to come by – is a distinct issue with these sensors. True wind data from all three of *Dyson’s* anemometers (DIR, DIR2, DIR3, SPD, SPD2, SPD3) are also occasionally subject to spikes or steps that result from short lived so-called “thrashing events” in the Applanix POSMV, which provides the vessel speed and course over ground for *Dyson’s* true wind calculation. These wind spikes/steps are also typically treated with S, J, or B flags (Figure 52, not all shown). Any evidence of “thrashing events” in the POSMV data (PL_SPD, PL_CRS) typically receives B flags during automated QC procedures.

There were no other major issues noted for the *Oscar Dyson* in 2022. As a general note, *Dyson’s* various meteorological sensors do occasionally exhibit data distortion that is dependent on the vessel relative wind direction and/or stack exhaust contamination and/or, in the case of air temperature (T) and relative humidity (RH), likely ship heating (all common to most vessels). Where any of the meteorological data appear affected by flow distortion, exhaust, or ship heating they are typically flagged with “caution/suspect” (K) flags (Figure 52, not all shown).

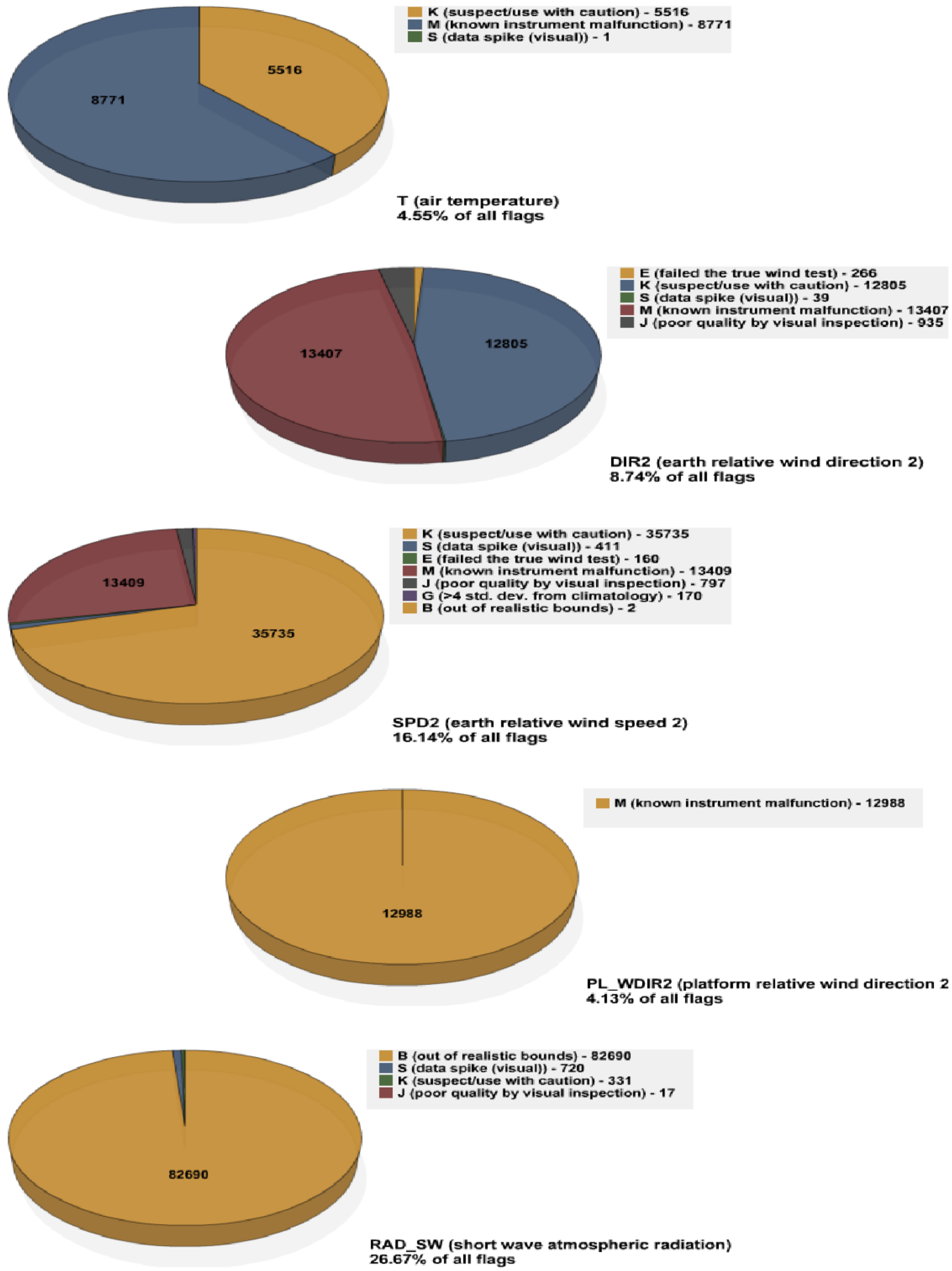



Figure 50: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) earth relative wind direction 2 – DIR2 – (third) earth relative wind speed 2 – SPD2 – (fourth) platform relative wind direction 2 – PL_WDIR2 – and (last) short wave atmospheric radiation – RAD_SW – for the *Oscar Dyson* in 2022.

### *Oscar Elton Sette*

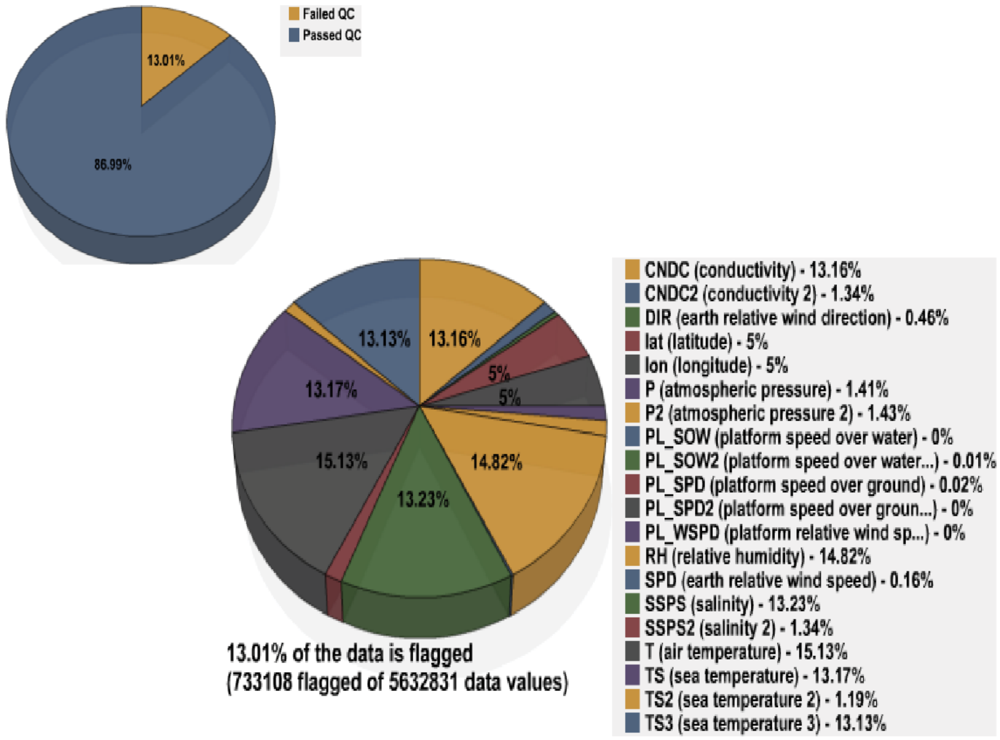



Figure 51: For the *Oscar Elton Sette* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Oscar Elton Sette* provided SAMOS data for 188 ship days, resulting in 5,632,831 distinct data values. After both automated and visual QC, 13.01% of the data were flagged using A-Y flags (Figure 53). This is virtually unchanged from 2021 (13.1%).

Since the *Sette's* data acquisition software upgrade to SCS v5 in 2021 all of her SAMOS data (see list in Figure 53) are subject to spikes, which for the most part are flagged with “spike” (S) flags and, in the case of latitude (LAT) and longitude (LON), “vessel over land” (L) and “platform velocity unrealistic” (F) flags (Figure 55, not all shown).  These spikes vary in intensity from occasional to extremely numerous, depending on the data variable. It is not known what causes the majority of the spikes; nothing has ever been able to be pinned down. But it is suspected they originate somewhere in the data averaging software. We note all the SCS v5 NOAA ships feature spikes in many or all their SAMOS parameters. Some ships, like the *Sette*, just seem to fare worse than others in terms of the overall numbers of spikes.

A special case may have existed with the air temperature (T) and relative humidity (RH). *Sette's* T and RH data in 2022 were always on the ‘extremely numerous’ end of the spike frequency spectrum. But over the course of the year, it began to appear the T and RH spikes might not be completely random, as they seemed to occur primarily in the daytime (see Figure 54). Again, no definitive explanation was ever found. Additionally, the volume of daytime spikes was often so high and the actual trend so obscured that it made sense to employ application of “caution/suspect” (K) and “poor quality” (J) flags, in addition to (or in lieu of) S flags (Figure 55, only T shown). We note as of June 2023, after an extensive shipyard period, *Sette’s* T and RH data appear much improved.

There were no other major issues noted for the *Sette* in 2022. Looking to the flag percentages in Figure 53, a little over half the total flags were applied to the sea water parameters associated with *Sette’s* SBE 45 thermosalinograph (TS, TS3, SSPS, CNDC). It’s understood the seawater pump for this instrument habitually loses suction, especially in rougher seas. Probably for this reason the pump frequently appears to be secured while underway, as evidenced by a “smoothed” appearance in TS and TS3 as well as SSPS and CNDC values near zero. (These characteristics are also seen when *Sette* is in port.) Where these “smoothed” TS and TS3 data appear they are typically K-flagged, and where CNDC and SSPS data are near zero they are J-flagged (Figure 55, not all shown). We note there is currently no way for a technician to temporarily “disable” sensors configured for reporting to SAMOS in SCSv5 (other than completely turning off the sensor or its raw data logging). When it appears the seawater pump for TS/TS3/SSPS/CNDC is running but has briefly lost suction while underway, as evidenced by a smooth “shark fin” curve, these data are all K flagged (Figure 55, not all shown).

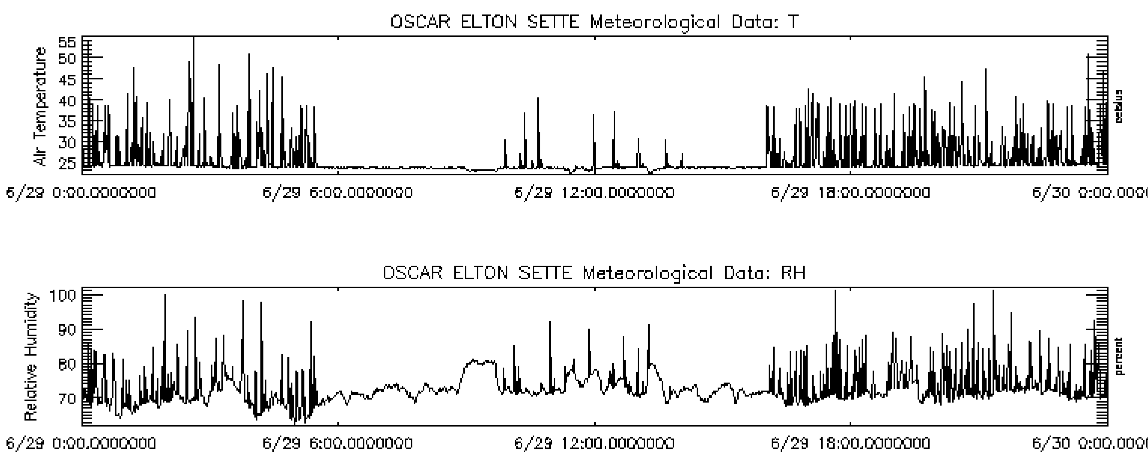



Figure 52: *Oscar Elton Sette* SAMOS (top) air temperature – T – and (bottom) relative humidity – RH – data for 29 June 2022. Note concentration of spikes in both variables during daylight hours (roughly before 0500 UTC and after 1600 UTC).

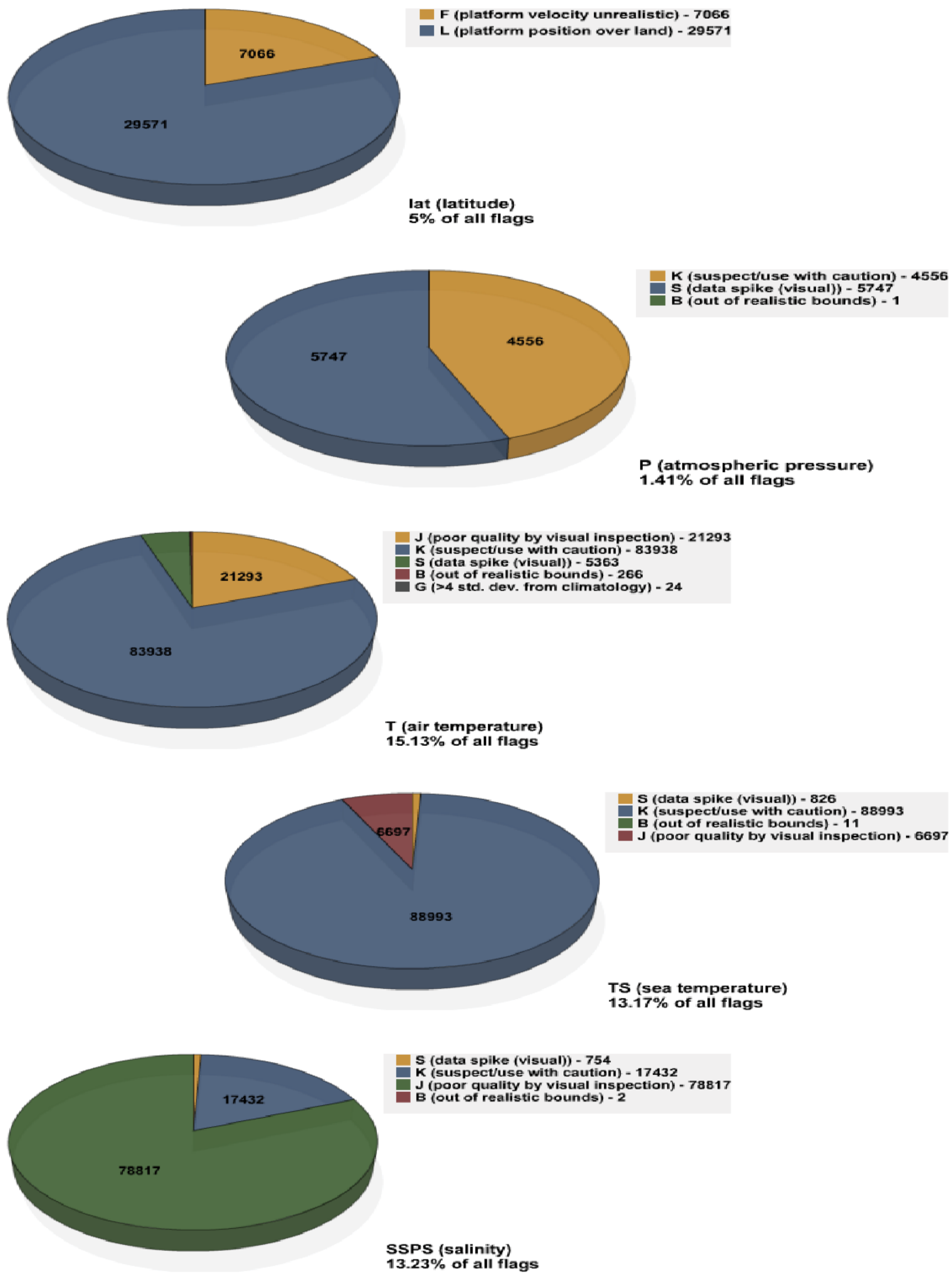



Figure 53: Distribution of SAMOS quality control flags for (first) latitude – LAT – (second) atmospheric pressure – P – (third) air temperature – T – (fourth) sea temperature – TS – and (last) salinity – SSPS – for the *Oscar Elton Sette* in 2022.

*Pisces*

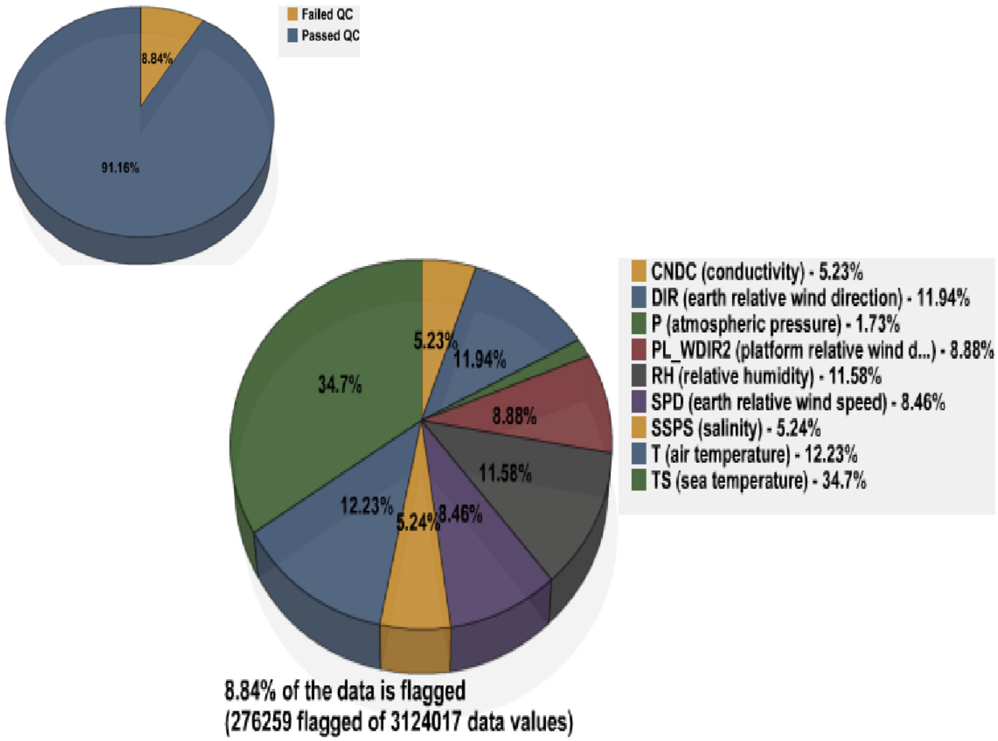



Figure 54: For the *Pisces* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Pisces* provided SAMOS data for 152 ship days, resulting in 3,124,017 distinct data values. After both automated and visual QC, 8.84% of the data were flagged using A-Y flags (Figure 56). This is significantly lower than in 2021 (16.93%).

In 2021 there had been an indeterminate issue with *Pisces* SBE 38 sea temperature (TS) whereby daily time series of TS resembled noise, with values ranging roughly 0-100° C. This pattern was again evident in May 2022, at the onset of *Pisces's* field season. The issue was remedied a month later (fix unknown), but from 23 May through 21 June TS received of "out of bounds" (B), "poor quality" (J), and "instrument malfunction" (M) flags (Figure 57). We note thermosalinograph conductivity (CNDC) and salinity (SSPS) associated with this SBE 38 were unaffected.

There was also an issue with one of *Pisces's* relative wind directions (PL_WDIR2) in 2021 that continued in 2022. Here, PL_WDIR2 constantly waffled between ~359° and 1°, resulting in constant J-flagging (Figure 57). The decision was made to suspend SAMOS processing for PL_WDIR2 as of 13 June, pending troubleshooting by the vessel technicians. On or around 24 June it was discovered the RM Young translator was not passing the relative direction from the affected anemometer down to the lab (or SCS), for unknown reasons. It was later determined the translator likely needed reprogramming, which would be a difficult task. The PL_WDIR2 issue ultimately was unable to be rectified in 2022, hence there are no SAMOS PL_WDIR2 data after 13 June. We note there are no true winds associated with PL_WDIR2.

There were no other major issues noted for the *Pisces* in 2022. In general, *Pisces's* various other meteorological sensors – earth relative wind direction (DIR), earth relative wind speed (SPD), air temperature (T), relative humidity (RH), and to a lesser extent atmospheric pressure (P) – do exhibit some data distortion that is dependent on the vessel relative wind direction and, in the case of T/RH, ship heating (all common to most vessels). Where any of these data appear affected, they are typically flagged with "caution/suspect" (K) flags (Figure 57, not all shown). *Pisces* also occasionally transmits TS, SSPS, and CNDC data while the flow-through sea water system appears to be secured, such as routinely occurs when a vessel is near/at port or in rough seas. Where this trend is apparent TS, SSPS, and CNDC are typically K-flagged (Figure 57, not all shown).

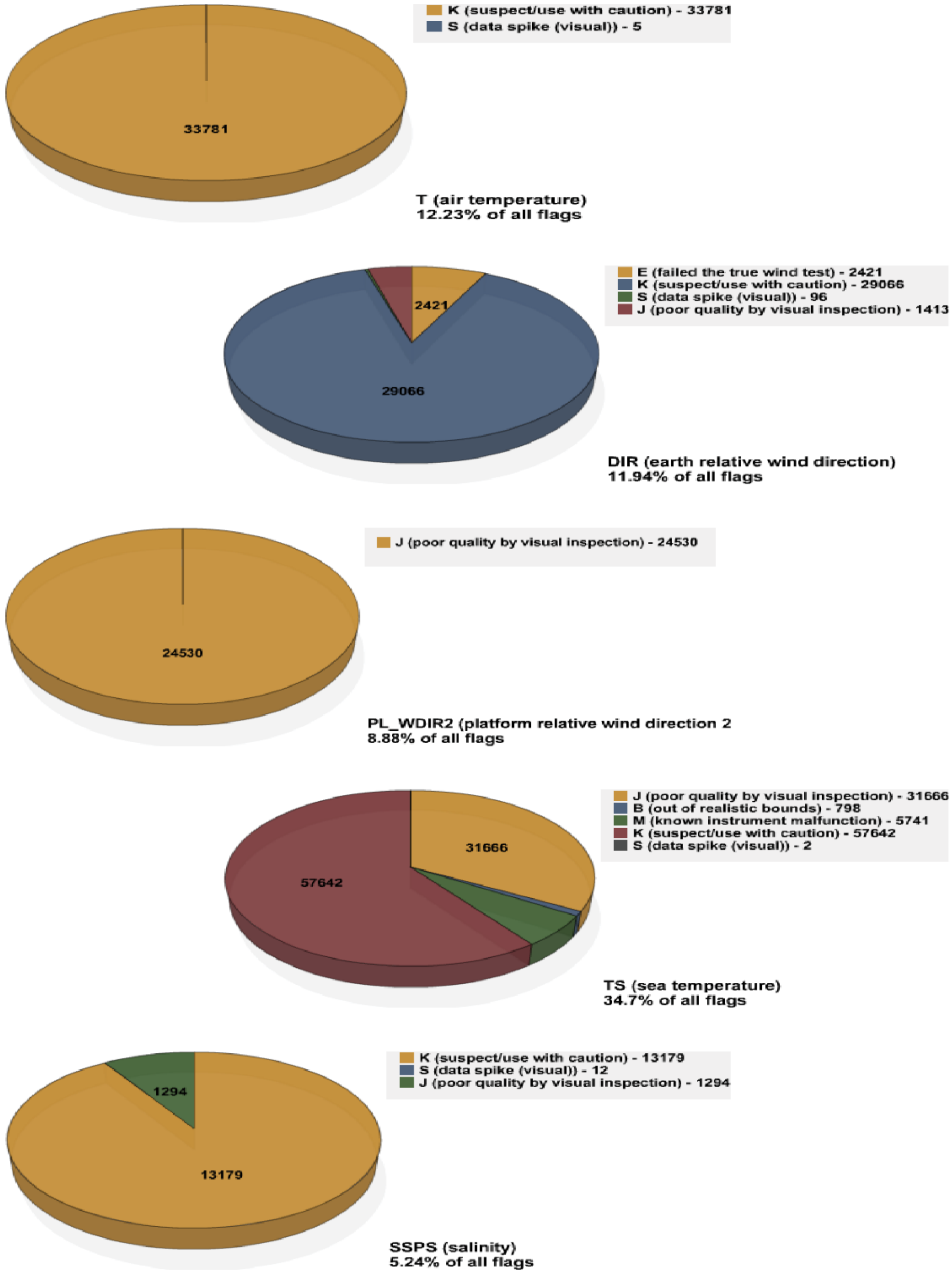



Figure 55: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) earth relative wind direction – DIR – (third) platform relative wind direction 2 – PL_WDIR2 – (fourth) sea temperature – TS – and (last) salinity – SSPS – for the *Pisces* in 2022.

### *Rainier*

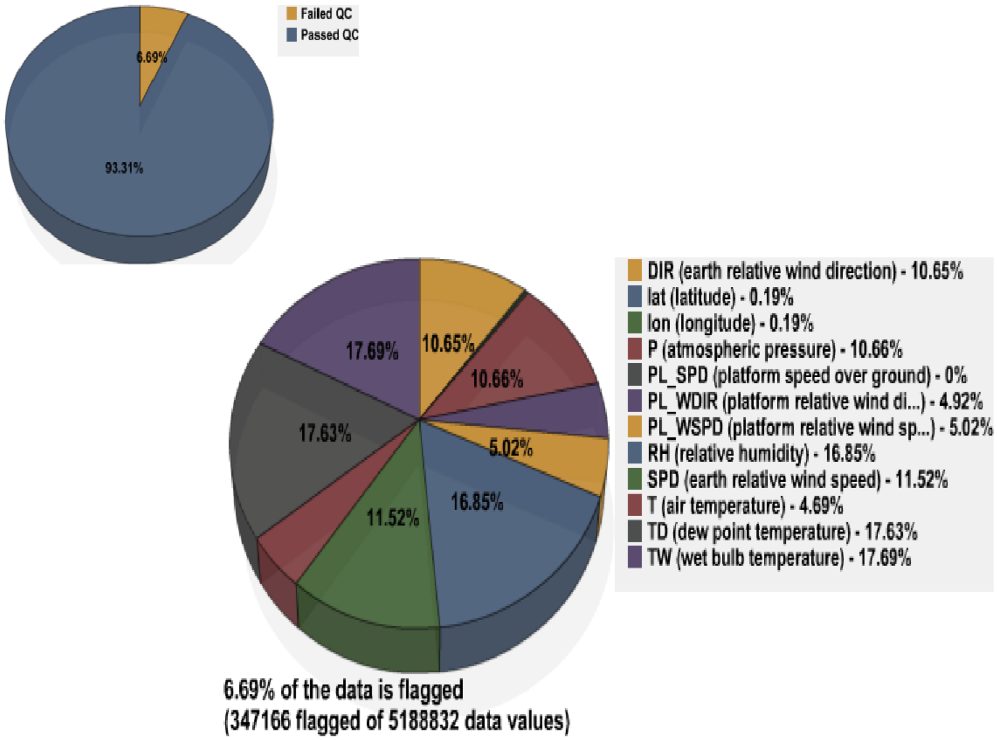



Figure 56: For the *Rainier* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Rainier* provided SAMOS data for 228 ship days, resulting in 5,188,832 distinct data values. After both automated and visual QC, 6.69% of the data were flagged using A-Y flags (Figure 58). This is about a percentage point higher than in 2021 (5.37%).

In a carryover from 2021 (and continuing in 2023), at random times/days *Rainier's* relative winds (PL_WDIR and PL_WSPD) will undergo a period of constant (aka flatlined) values, usually lasting no more than a few hours. These flatline periods do not have any apparent dependency on a particular relative wind direction or vessel speed, nor is the output value the same from one flatline occurrence to the next. A definitive cause has never been found. Whenever PL_WDIR and PL_WSPD flatline they are assigned "poor quality" (J) flags (Figure 59, only PL_WSPD shown). The true winds (DIR and SPD), being calculated from PL_WDIR and PL_WSPD, clearly mirror changes in the platform heading and platform speed during these flatline occurrences. Thus, DIR and SPD are also J-flagged when the relative winds flatline (Figure 59, only SPD shown). Once PL_WDIR and PL_WSPD begin varying again DIR and SPD also resume typical wind patterns.

The installation location of *Rainier's* pressure (P), air temperature (T), and humidity (RH) sensors is known to have exposure issues, being low down on the instrument mast and quite close to the side of the mast structure. As a result, these three parameters are frequently flagged with "caution/suspect" (K) flags (Figure 59, not all shown).

Looking to Figure 58, the largest flag percentages (over 16% each) were allocated to RH and the wet bulb and dew point temperatures (TW and TD). During saturation conditions *Rainier's* RH sensor tends to read just slightly over 100%, which results in automatic application of "out of bounds" (B) flags to those values (Figure 59). This is not an uncommon occurrence, as these sensors are often tuned for better accuracy at lower relative humidities (see 3b.) However, when *Rainier's* RH exceeds 100% her wet bulb (TW) and dew point (TD) temperatures exceed the reported air temperature and consequently acquire "failed the T>=Tw>=Td test" (D) flags (Figure 59, only TD shown). It's assumed *Rainier's* TW and TD are calculated values, thus the unrealistic numbers resulting from unrealistic RH.

One final note, sea water data (sea temperature, salinity, conductivity) continue not to be received from *Rainier*. This is due to their seawater system typically "locking up" as soon as they use their bow thrusters, an ongoing problem that has been on their mission engineers' list to correct.

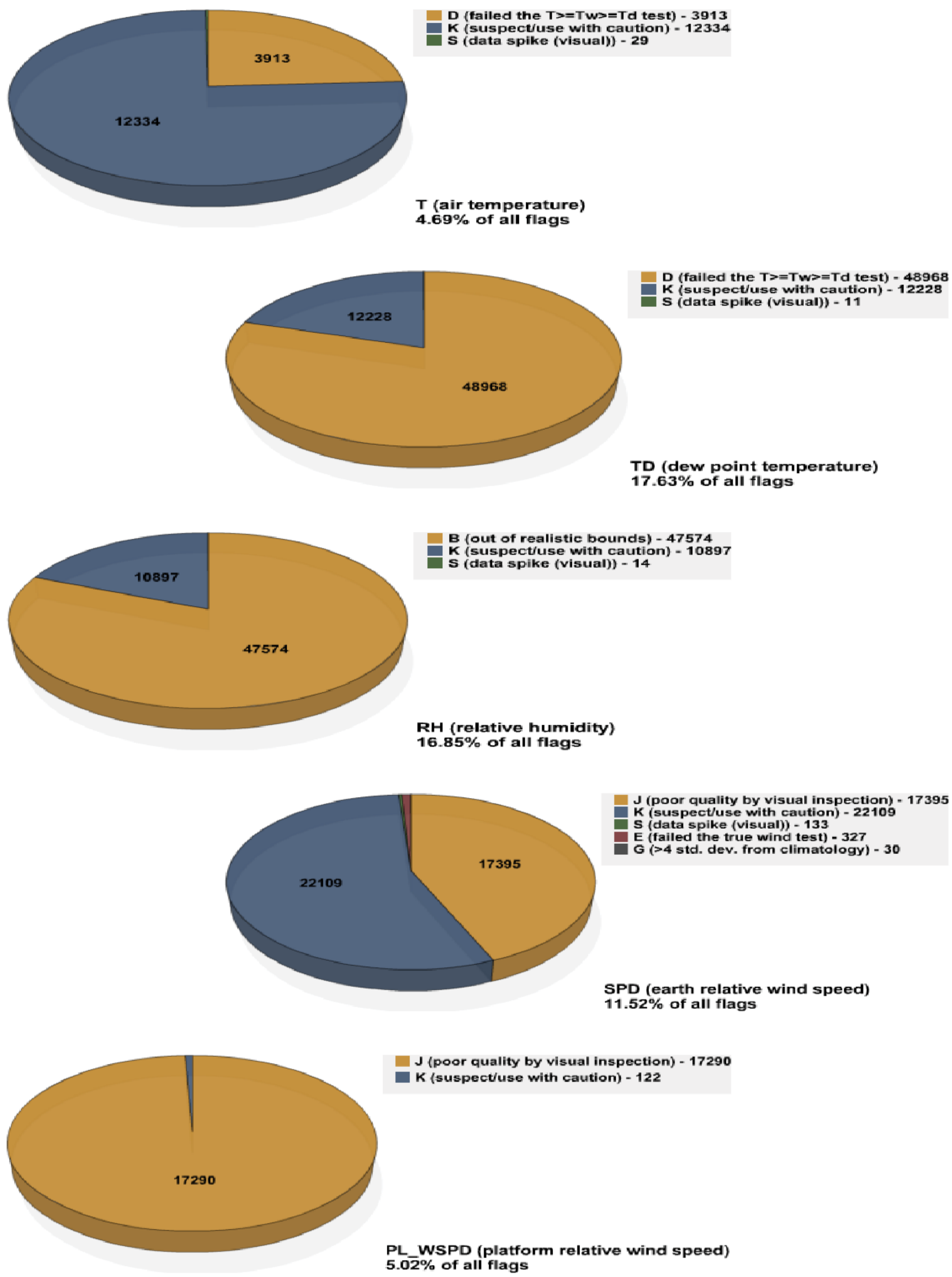



Figure 57: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) dew point temperature – TD – (third) relative humidity – RH – (fourth) earth relative wind speed – SPD – and (last) platform relative wind speed – PL_WSPD – for the *Rainier* in 2022.

***Reuben Lasker***

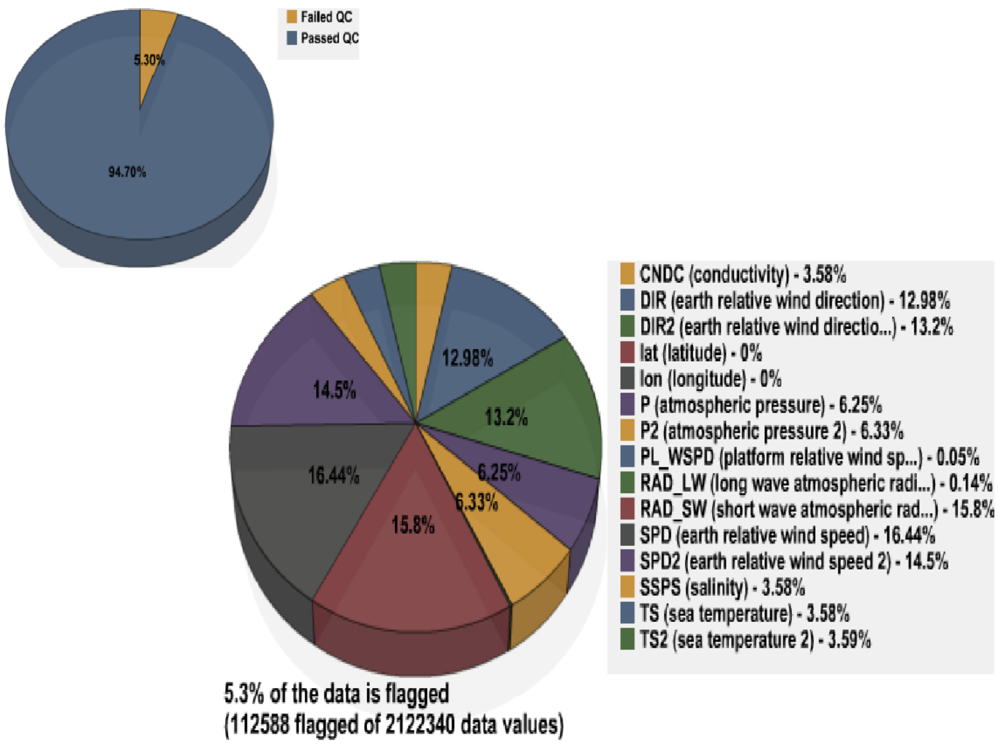



Figure 58: For the *Reuben Lasker* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Reuben Lasker* provided SAMOS data for 80 ship days, resulting in 2,122,340 distinct data values. After both automated and visual QC, 5.3% of the data were flagged using A-Y flags (Figure 60). This is about a half percentage point lower than in 2021 (6%).

In 2021 *Lasker's* temperature and relative humidity (T and RH) instrument was determined to be completely defunct and in need of rewiring or replacing. The issue was unable to be resolved in 2022; hence there were no T/RH data from *Lasker*.

*Lasker's* radiation sensors (RAD_LW and RAD_SW) are known to be located right next to the deck area from where they trawl. This area is routinely lit up very brightly during nighttime trawls. Positive (> 10-20 W/m$^2$) steps are frequently observed in RAD_SW at night, seemingly in response to the bright trawl lights. As such, nighttime RAD_SW are often flagged as either "caution/suspect" (K) or "poor quality" (J) at night (Figure 61). These flags are in addition to the typical "out of bounds" (B) flagging (Figure 61) of slightly negative nighttime values that occur with RAD_SW sensors, owing to sensor tuning (see 3b. for details).

There were no other issues of note for *Lasker* in 2022. In general, *Reuben Lasker's* earth relative wind parameters (SPD, SPD2, DIR, and DIR2) exhibit a fair amount of data distortion that is dependent on the vessel relative wind direction. Where data appear affected, they are generally flagged with "caution/suspect" (K) flags (Figure 61).

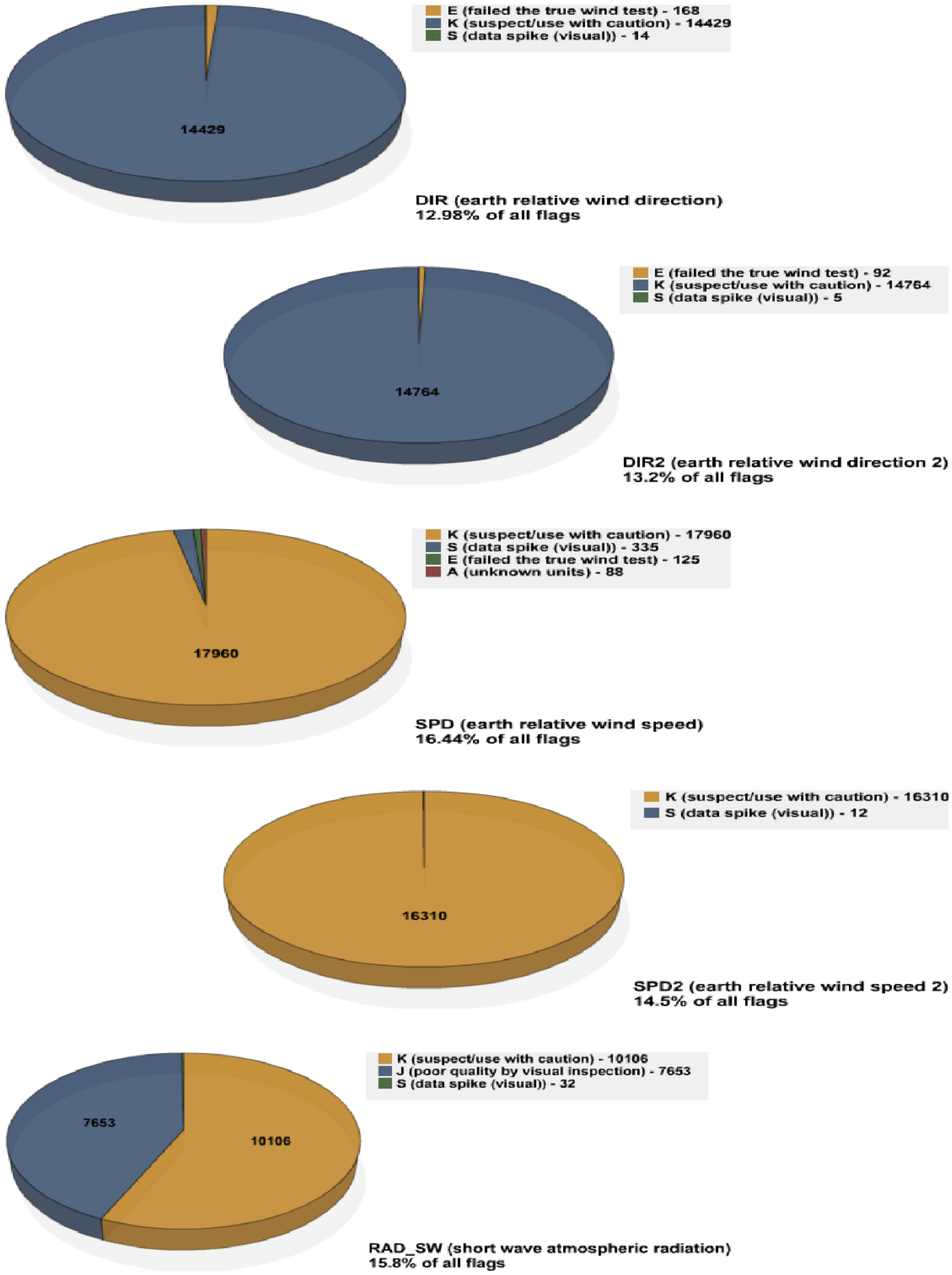



Figure 59: Distribution of SAMOS quality control flags for (first) earth relative wind direction – DIR – (second) earth relative wind direction 2 – DIR2 – (third) earth relative wind speed – SPD – (fourth) earth relative wind speed 2 – SPD2 – and (last) short wave atmospheric radiation – RAD_SW – for the *Reuben Lasker* in 2022.

### *Ronald H. Brown*

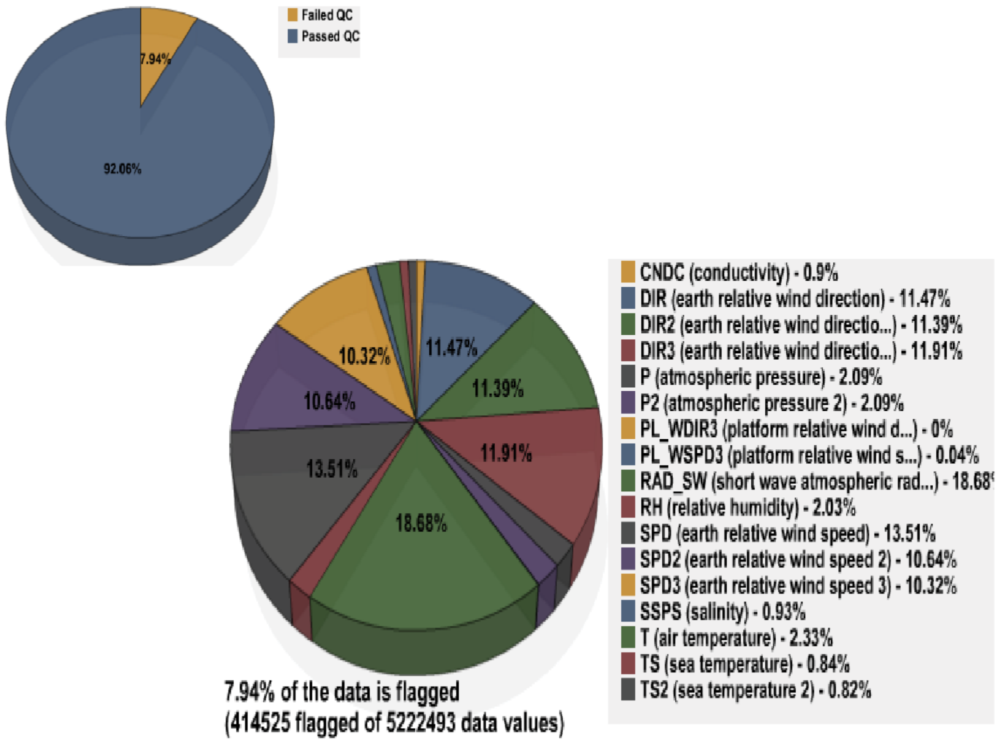



Figure 60: For the *Ronald H. Brown* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Ronald H. Brown* provided SAMOS data for 137 ship days, resulting in 5,222,493 distinct data values. After both automated and visual QC, 7.94% of the data were flagged using A-Y flags (Figure 62). This is essentially the same as in 2021 (8.03%).

An interesting rarity occurred over 15-16 January when *Ron Brown* recorded multiple pressure (P) anomalies associated with passages of the pressure wave generated by the Tonga volcanic eruption (see Figure 63). The largest (and first) wave passage recorded by the *Brown* registered greater than 2.5 hPa peak to trough. One or more subsequent smaller wave passages are also indicated. Since the wave circled the globe in both directions (and based on analyzing other SAMOS vessels' pressure traces from different locations on the globe), it seems quite possible the wave actually passed the *Brown* from two different directions.

There were no other items of record for *Ron Brown* in 2022. As a general note, all three of *Brown's* anemometers are known to exhibit a good deal of data distortion that is dependent on the vessel relative wind direction, with the result being various applications of mostly "caution/suspect" (K) flags (Figure 64, not all shown) to all the earth relative winds (DIR, DIR2, DIR3, SPD, SPD2, SPD3). Additionally, often when the vessel is heading roughly due north the platform course (PL_CRS) becomes noisy, for undetermined reasons (perhaps sea state). This ultimately causes automated application of a lot of “failed the wind re-computation check” (E) flags to all six earth relative wind parameters (Figure 64, again not all shown). Looking back to Figure 62, the largest percentage (~19%) of the total flags was assigned to short wave atmospheric radiation (RAD_SW). These were almost entirely “out of bounds” (B) flags (Figure 64) such as are commonly assigned to slightly negative nighttime RAD_SW values (a consequence of instrument tuning; see 3b. for details).

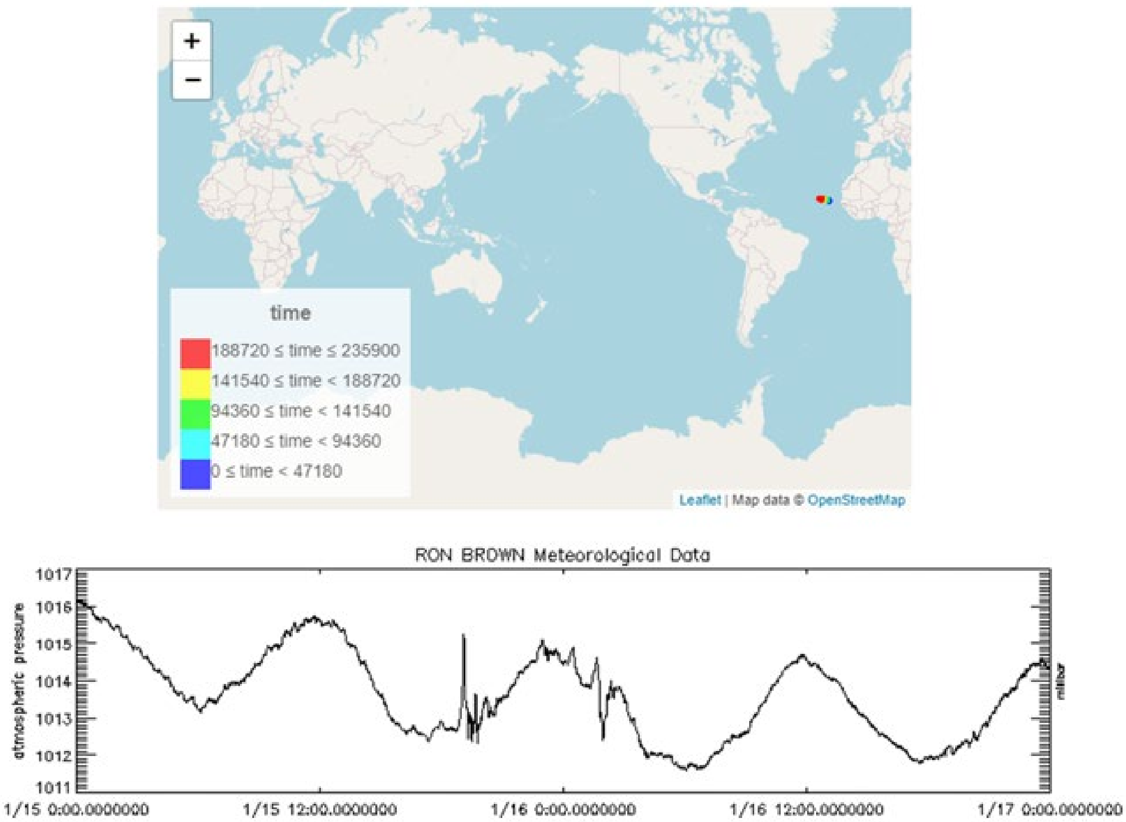



Figure 61: (top) *Ron Brown* cruise track on 15 January 2022 and (bottom) *Ron Brown* SAMOS pressure – P – data for 15-16 January 2022. Note indication of multiple pressure wave passages resulting from Hunga Tonga–Hunga Ha‘apai volcano eruption climax on 15 January.

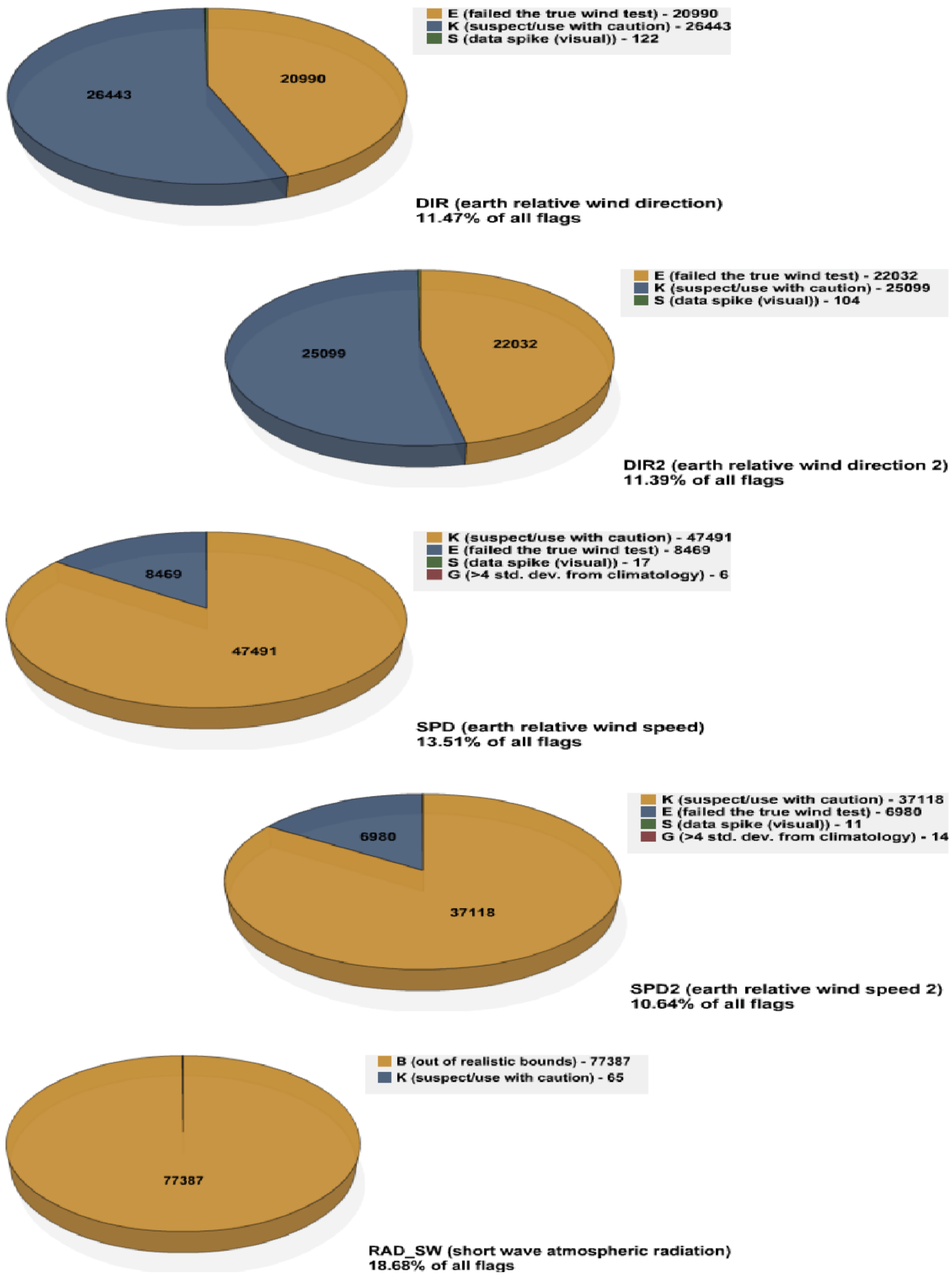



Figure 62: Distribution of SAMOS quality control flags for (first) earth relative wind direction – DIR – (second) earth relative wind direction 2 – DIR2 – (third) earth relative wind speed – SPD – (fourth) earth relative wind speed 2 – SPD2 – and (last) short wave atmospheric radiation – RAD_SW – for the *Ronald H. Brown* in 2022.

### *Thomas Jefferson*

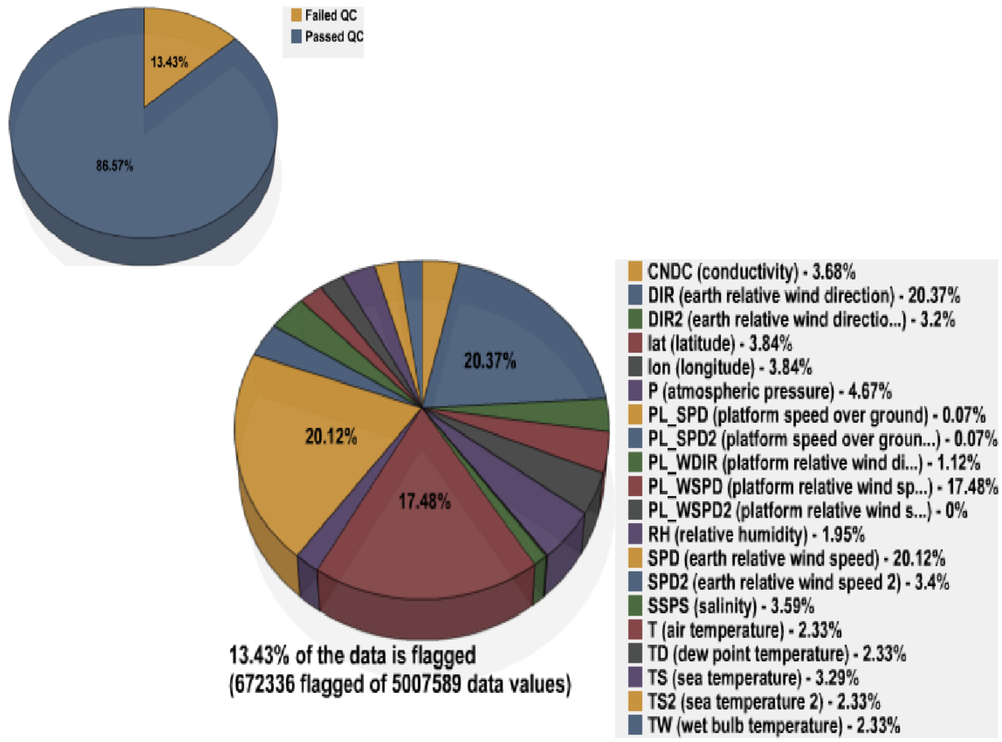



Figure 63: For the *Thomas Jefferson* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Thomas Jefferson* provided SAMOS data for 208 ship days, resulting in 5,007,589 distinct data values. After both automated and visual QC, 13.43% of the data were flagged using A-Y flags (Figure 65). This is significantly higher than in 2021 (7.7%).

At the onset of *Thomas Jefferson's* field season the air, dew point, and wet bulb temperatures (T, TD, and TW) were all reporting values that were out of realistic bounds as well as pretty invariant. Relative humidity (RH) was also reporting constant values of 0. When contacted, vessel technicians confirmed these sensors were not yet hooked up, owing to problems encountered while in the shipyard. A few days later the issue was addressed, and T/TD/TW/RH began flowing normally again. But in the interim T, TD, TW, and RH all received "malfunction" (M) flags (Figure 67, not all shown).

Once things calmed down it was noted relative wind speed values from *Jefferson's* port anemometer (PL_WSPD) were consistently ½ the magnitude of the relative wind speed values from their starboard anemometer (PL_WSPD2). Additionally, steps in the port true winds (DIR and SPD) were occurring whenever the vessel was moving, i.e., platform speed aka PL_SPD > 0. This presentation of steps in DIR and SPD when the vessel is moving is a classic hallmark of true winds that are calculated based on relative wind speed and ship speed inputs with different units (see Figure 66). It was suspected PL_WSPD was outputting in units of m/s rather than the declared units of knots (PL_SPD, meanwhile, was definitely outputting in knots). But when vessel technicians physically looked at the sensor and translator and configurations, they could find no evidence supporting the m/s suspicion. Later, over the summer, one of the technicians took a deeper look at the port anemometer data stream and determined conclusively the sensor was, in fact, erroneously reporting PL_WSPD values ½ as large as the configuration dictated they should be. He could not find any reason this was happening and surmised only a complete reprogramming of the sensor and/or translator would solve the problem. This was not a task anyone on board was willing to undertake, as it was expected it would be very difficult and it could potentially adversely impact other data streams to do so. The decision was thus made on our side to discontinue SAMOS processing of PL_WSPD, DIR, and SPD as of 23 August. Until that date, PL_WSPD, DIR, and SPD variously received "caution/suspect" (K), "poor quality" (J), and (later) M flags (Figure 67).

There were no other major issues noted for *Thomas Jefferson* in 2022. As a general note, *Thomas Jefferson's* various meteorological sensors do occasionally exhibit data distortion that is dependent on the vessel relative wind direction and potentially, in the case of atmospheric pressure (P), the vessel speed. Where the data appears affected, it is generally K-flagged (Figure 67, not all shown). Additionally, during saturation conditions *Jefferson's* RH tends to read just slightly over 100%, which results in automatic application of "out of bounds" (B) flags to those values (Figure 65). This is not an uncommon occurrence, as these sensors are often tuned for better accuracy at lower relative humidities (see 3b.) Interestingly, however, when *Jefferson's* RH exceeds 100% her wet bulb (TW) and dew point (TD) temperatures exceed her reported air temperature (T) and consequently acquire "failed the T>=Tw>=Td test" (D) flags (Figure 67, not all shown). It's assumed *Jefferson's* TW and TD are calculated values, thus the unrealistic numbers resulting from unrealistic RH.

We also note that *Jefferson* spent much of her 2022 field season along the coastline in Lakes Ontario and Erie. When vessels transmit from coastal positions it is not uncommon for the latitude and longitude to receive automated "land error" (L) flags (not shown), as the land mask in use for the SAMOS land check routine is often incapable of resolving the very fine detail of a coastline or an inland port. Such was often the case for the *Jefferson* while she was in the Great Lakes. Unfortunately, owing to a likely quirk of SCS averaging, *Thomas Jefferson's* LAT and LON data also tend to have a lot of data spikes, which generally result in "platform velocity unrealistic" (F) flags (not shown). Generally speaking, these L and F flags can be winnowed quite a bit during visual quality control. However, due to the frequency of the spikes and because the visual editing software for use in changing SAMOS data flags is rather ancient and clunky, time often did not permit for a laborious combing through of the LAT/LON data to remove any unnecessary flags.

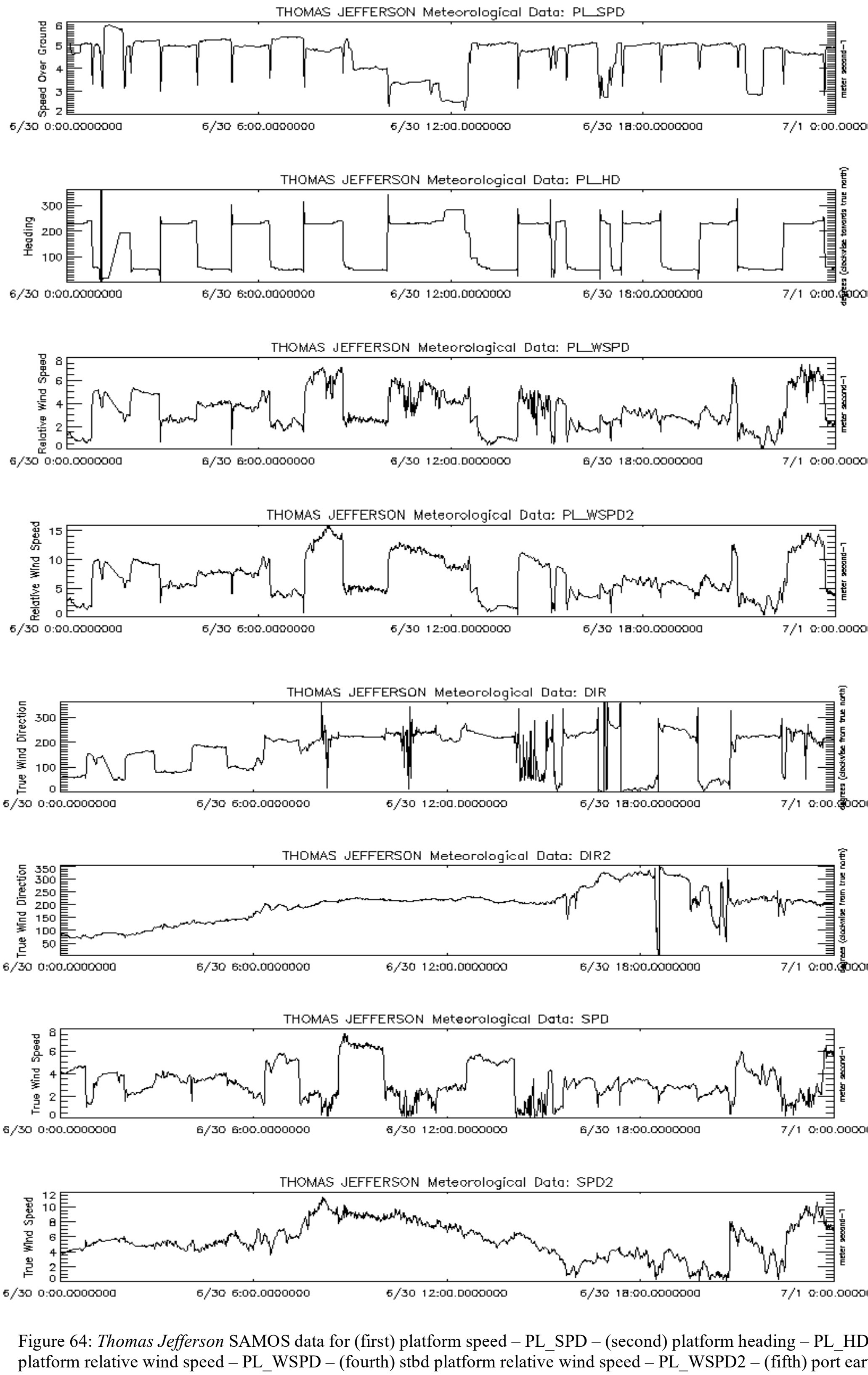



Figure 64: *Thomas Jefferson* SAMOS data for (first) platform speed – PL_SPD – (second) platform heading – PL_HD – (third) port platform relative wind speed – PL_WSPD – (fourth) stbd platform relative wind speed – PL_WSPD2 – (fifth) port earth relative wind direction – DIR – (sixth) stbd earth relative wind direction – DIR2 – (seventh) port earth relative wind speed – SPD – and (last) stbd earth relative wind speed – SPD2 – for 30 June 2022. Note steps in DIR and SPD (not seen in DIR2 and SPD2) when PL_HD changes (note also PL_SPD > 0). Also take note PL_WSPD2 is roughly 2x PL_WSPD.

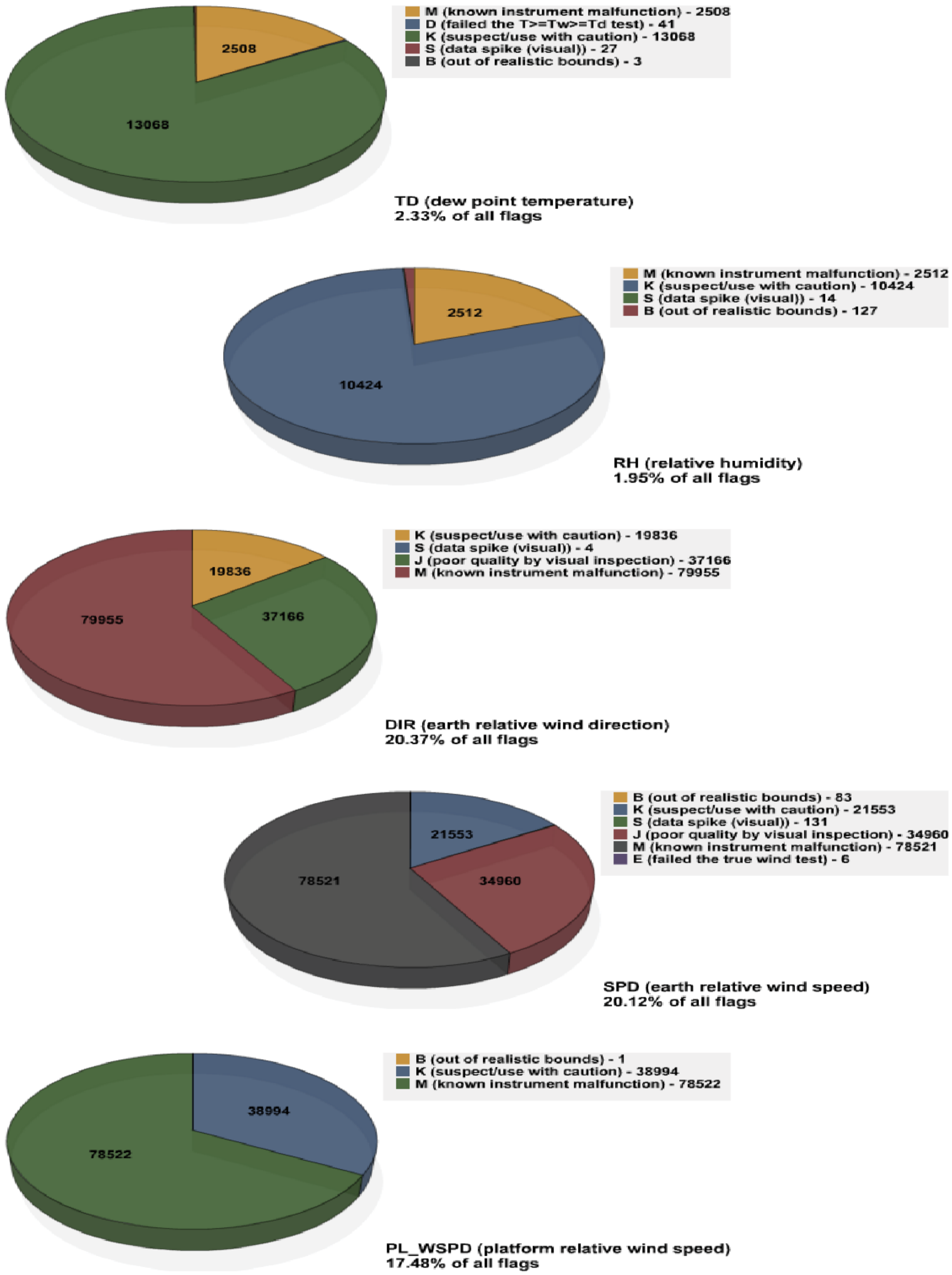



Figure 65: Distribution of SAMOS quality control flags for (first) dew point temperature – TD – (second) relative humidity – RH – (third) earth relative wind direction – DIR – (fourth) earth relative wind speed – SPD – and (last) platform relative wind speed – PL_WSPD – for the *Thomas Jefferson* in 2022.

### *Laurence M. Gould*

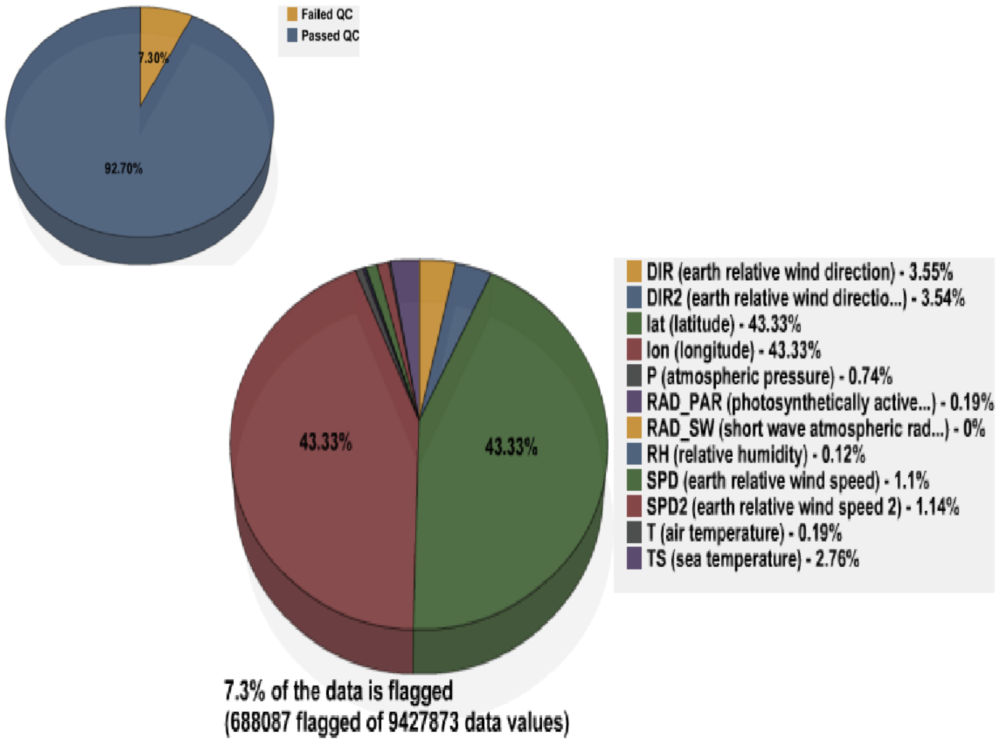
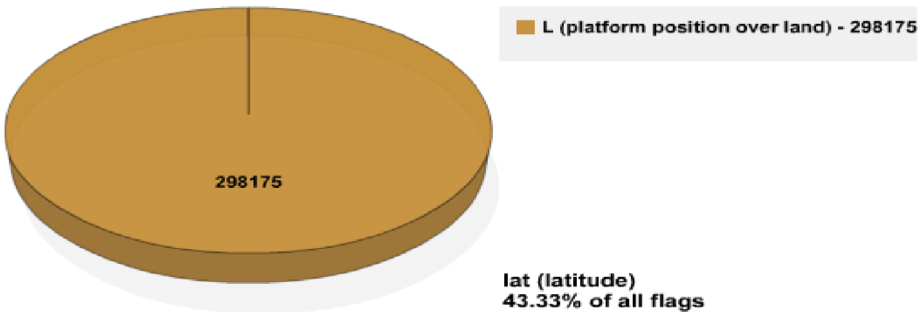



Figure 66: For the *Laurence M. Gould* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Laurence M. Gould* provided SAMOS data for 316 ship days, resulting in 9,427,873 distinct data values. After automated QC, 7.3% of the data were flagged using A-Y flags (Figure 68). This is a few percentage points lower than in 2021 (10.42%). It should be noted the *Gould* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only. Also, much of the 2021 SAMOS data from the *Gould* were sent while the vessel was dockside in Chile, resulting in the large number of land (L) flags.

On several occurrences (28 February to 3 March 2022, 16-17 April 2022, 1-7 June 2022, 3-31 December 2022), the relative wind directions (PL_WDIR, PL_WDIR2) were stuck at a constant value. Constant (flatlined) relative wind values likely resulted in incorrect true wind re-computation and E-Flags from the automated QC. However, we cannot confirm that true winds are correct (though they look comparable to satellite overpasses), so users should be cautious when using the winds on these days. The problem was typically resolved when the technician was notified and restarted their acquisition script.

There were no other issues noted in 2022 for the *Gould*. Looking to the flag percentages in Figure 68, nearly all the flags applied were assigned to latitude (LAT) and longitude (LON). These were exclusively "platform position over land" (L) flags in the case of LAT and LON (Figure 69) that appear generally to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port. As a general note, it is known that Gould's sensors are frequently affected by airflow being deflected around the super structure, as well as stack exhaust contamination, although, being a vessel that does not receive visual QC, none of this is evident in the flag percentages seen in Figure 68.



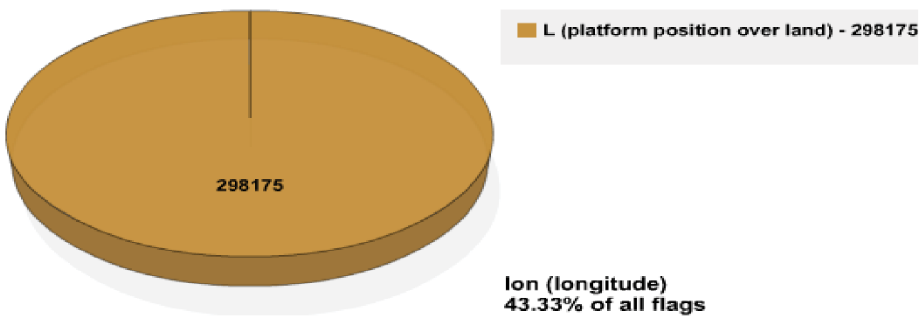




Figure 67: Distribution of SAMOS quality control flags for (top) latitude – LAT – and (bottom) longitude – LON – for the *Laurence M. Gould* in 2022.

***Nathaniel B. Palmer***

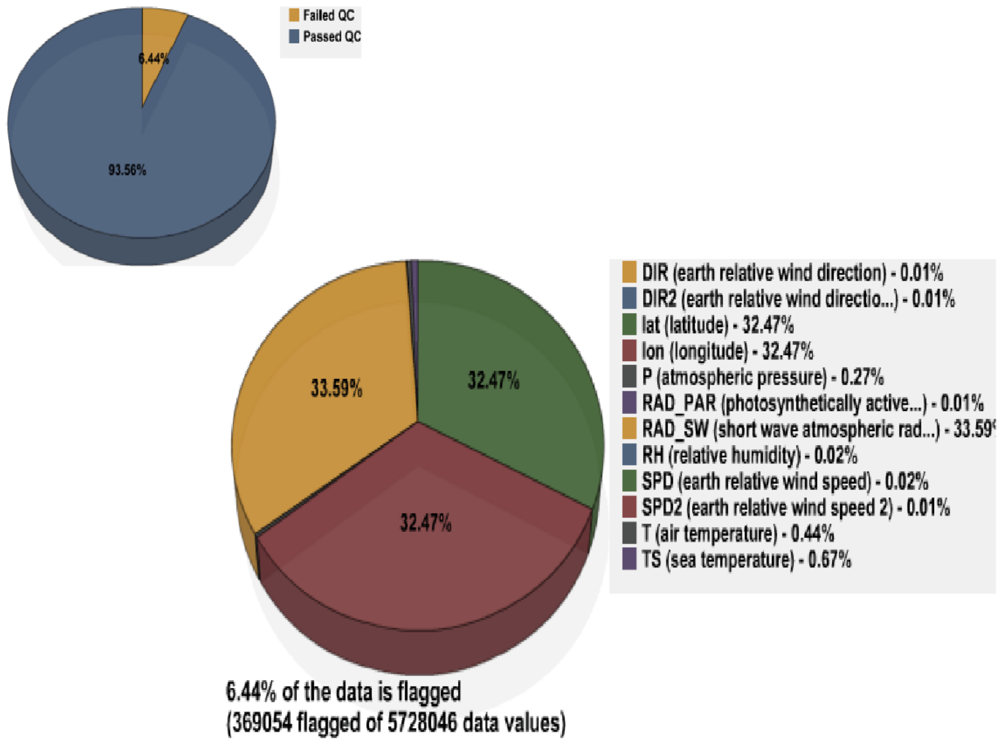



Figure 68: For the *Nathaniel B. Palmer* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Nathaniel Palmer* provided SAMOS data for 179 ship days, resulting in 5,728,046 distinct data values. After automated QC, 6.44% of the data were flagged using A-Y flags (Figure 70). This is several percentage points lower than in 2021 (10.72%). It should be noted that the *Palmer* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only. Also, some of the 2022 SAMOS data from the *Palmer* were sent while the vessel was dockside in Chile, resulting in the large number of land (L) flags.

There were a few interesting events noted in the pressure (P) data from the *Palmer*. On 6 June 2022 between 1100 and 1730 UTC a deep low-pressure center (948 mb minimum measured) passed the *Palmer*. Several of these pressures fell below the 950 mb minimum pressure boundary used by the SAMOS automated QC, although satellite imagery confirmed the existence of this low-pressure center and the flagged pressure values are likely valid. On 10 June 2022 between 0000 and 1200 UTC steps of ~2 mb occurred in the P data which were associated with ship turns. This was a transient problem that resolved and was not seen in later days. Conditions were very windy (20+m/s) with near freezing temperatures and 100% humidity, possibly indicating an icing problem affecting the pressure port. Data in this period should be used with caution.

There were no other issues noted in 2022 for the *Palmer*. Looking to the flag percentages in Figure 70, 65% of the total flags were applied to latitude (LAT) and longitude (LON), and 34% to short wave atmospheric radiation (RAD_SW). These were almost exclusively "platform position over land" (L) flags in the case of LAT and LON (Figure 71) that appear generally to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port. In the case of RAD_SW, all the flags were "out of bounds" (B) flags (Figure 71) and appear to have been applied mainly to negative nighttime values. Once again, slightly negative values commonly occur with these sensors at night; however, the negative drift observed in the nighttime values in late spring suggest the sensor may have been falling out of calibration.

As a general note, it is known that *Palmer's* sensors are frequently affected by airflow being deflected around the super structure, as well as stack exhaust contamination, although, being a vessel that does not receive visual QC, none of this is evident in the flag percentages seen in Figure 70.

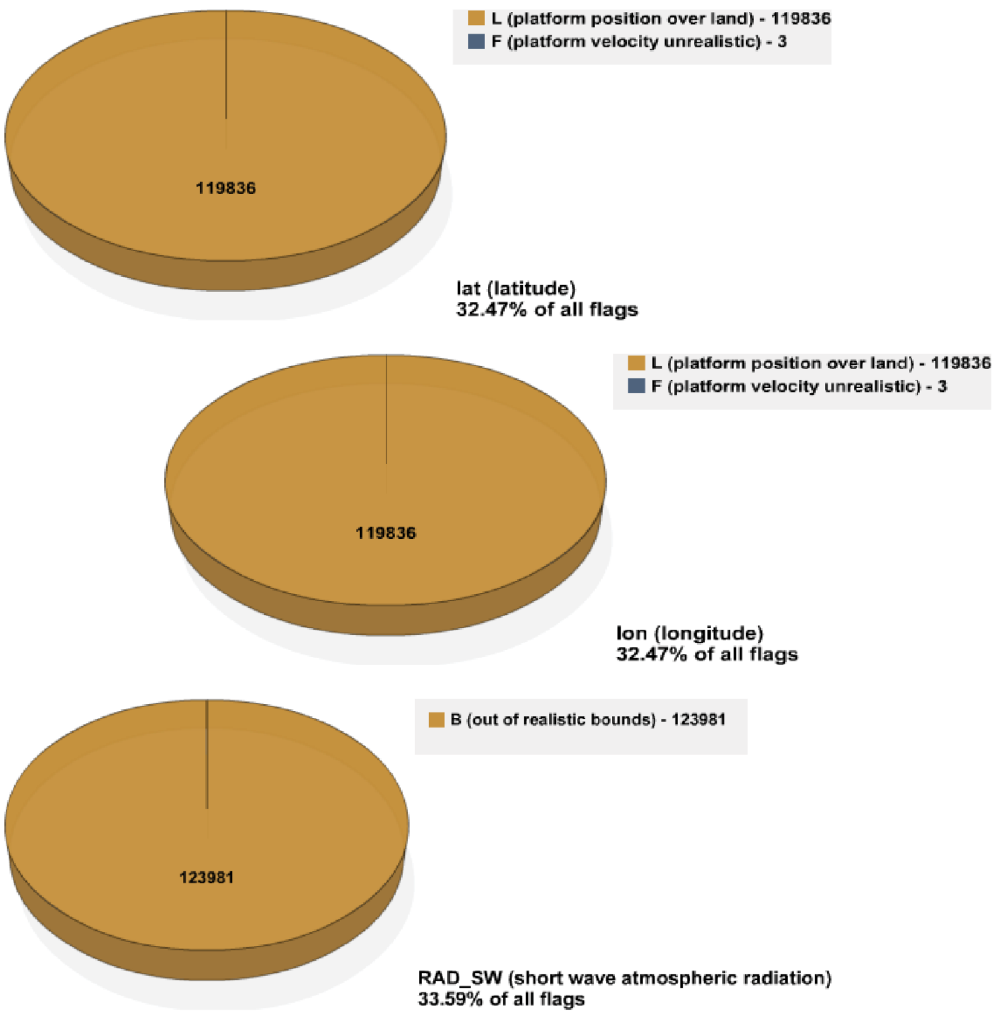



Figure 69: Distribution of SAMOS quality control flags for (top) latitude – LAT – (middle) longitude – LON – and (bottom) short wave atmospheric radiation – RAD_SW – for the *Nathaniel B. Palmer* in 2022.

### *Robert Gordon Sproul*

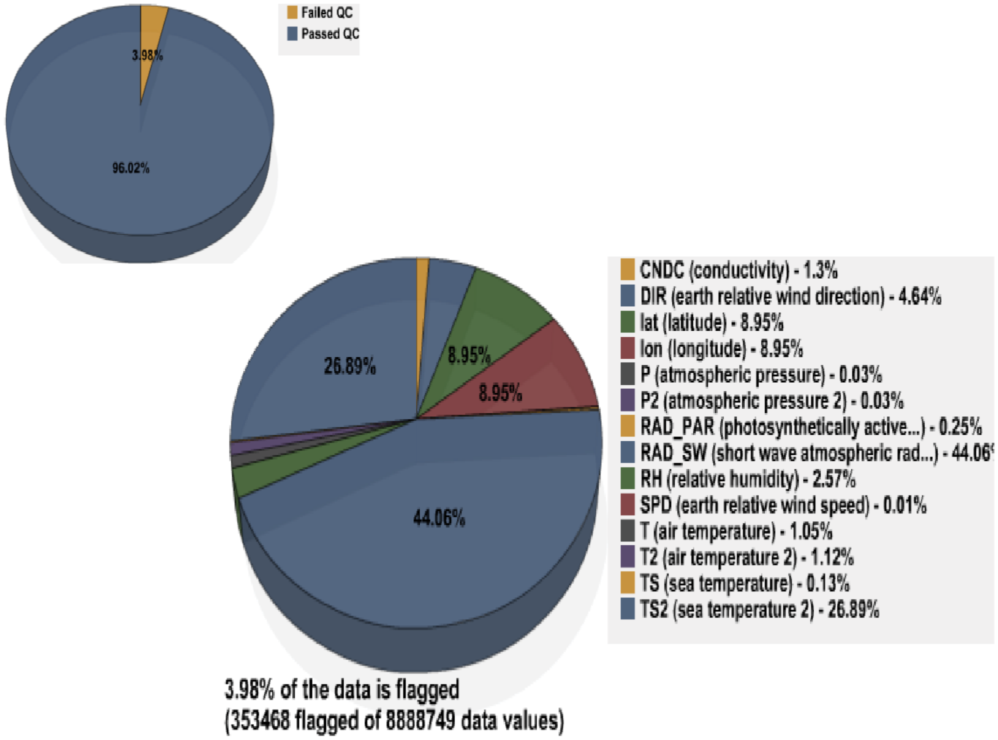


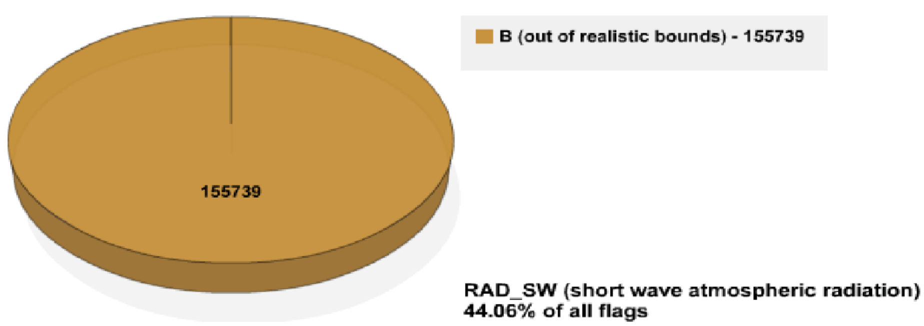

Figure 70: For the *Robert Gordon Sproul* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Robert Gordon Sproul* provided SAMOS data for 304 ship days, resulting in 8,888,749 distinct data values. After automated QC, 3.98% of the data were flagged using A-Y flags (Figure 72). This is virtually unchanged from 2021 (3.96%) and keeps *Sproul* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted the *Sproul* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Robert Gordon Sproul*).

It is worth noting that on 19 December 2022 the barometer on the *Sproul* was removed to be installed on the *Sally Ride*. For part of this day, all pressure (P and P2) data received “out of bounds” (B) flags because the acquisition system was still seeing a signal from the non-existent barometer. The SAMOS team disabled processing for P and P2 on 20 December and pressure data were not available from the *Sproul* for the remainder of 2022.

There were also several occasions when the *Sproul* had to change navigation systems and when this occurred the data being provided to SAMOS would not be processed because our software was looking for a different designator for latitude (LAT) and longitude (LON), both required parameters for SAMOS to process an individual one-minute data record. This occurred on 2-3 September and 10-13 September 2022 when the *Sproul* was in port. SIO switched to their secondary navigation system and no data were processed for these days. Periodically, such a switch in navigation can result in the loss of a few minutes of SAMOS data within a day. This is unavoidable because the SAMOS processing is only designed to work with one (primary) navigation system for each vessel. In these cases, the original data records from the missed minutes will be included in the original data file received from the vessel and archived at NCEI within the vessel's monthly archive packages.

There were no other issues of note for the *Sproul* in 2021. Looking to the flag percentages in Figure 77, nearly 27% of the total flags were applied to the thermosalinograph sea temperature (TS2). These were mostly "greater than four standard deviations from climatology" (G) flags plus a small portion of B flags and were mainly due to instances of the sea water system being off over the course of the year, generally when the vessel was in port (common) but also occasionally during a cruise in which the resident science party did not want the thermosalinograph running (common for this vessel). Short wave radiation (RAD_SW) also received 44% of the total flags (Figure 72). Upon inspection the flags, which are unanimously B flags (Figure 73), appear to have been applied mainly to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.) Finally, there were a number of periods when the sea temperature (TS2), conductivity (CNDC), and salinity (SSPS) data exhibited a smooth time series not representative of real ocean observations. This tends to occur when the pumps to the sea water system are shutdown, particularly when the vessel is still sending SAMOS data while in port. This sometimes results in B or G flags being applied to these variables (when the sea water in the pipes is not representative of the surrounding environment), but the autoQC does not flag all occurrences. When noted, the dates of these shutdowns are listed in Annex A.



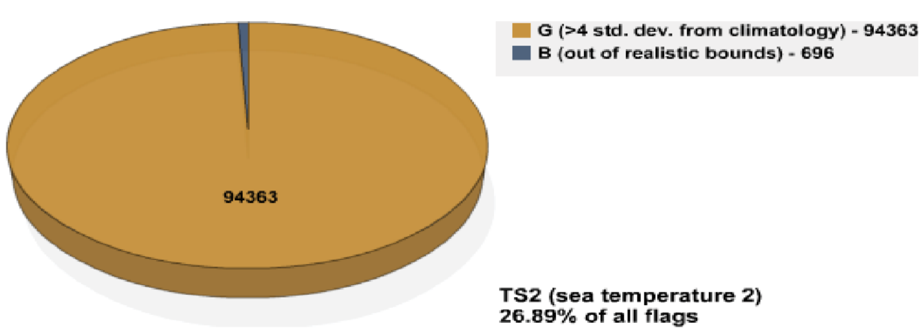




Figure 71: Distribution of SAMOS quality control flags for (top) short wave atmospheric radiation – RAD_SW –and (bottom) sea temperature 2 – TS2 – for the *Robert Gordon Sproul* in 2022.

*Roger Revelle*

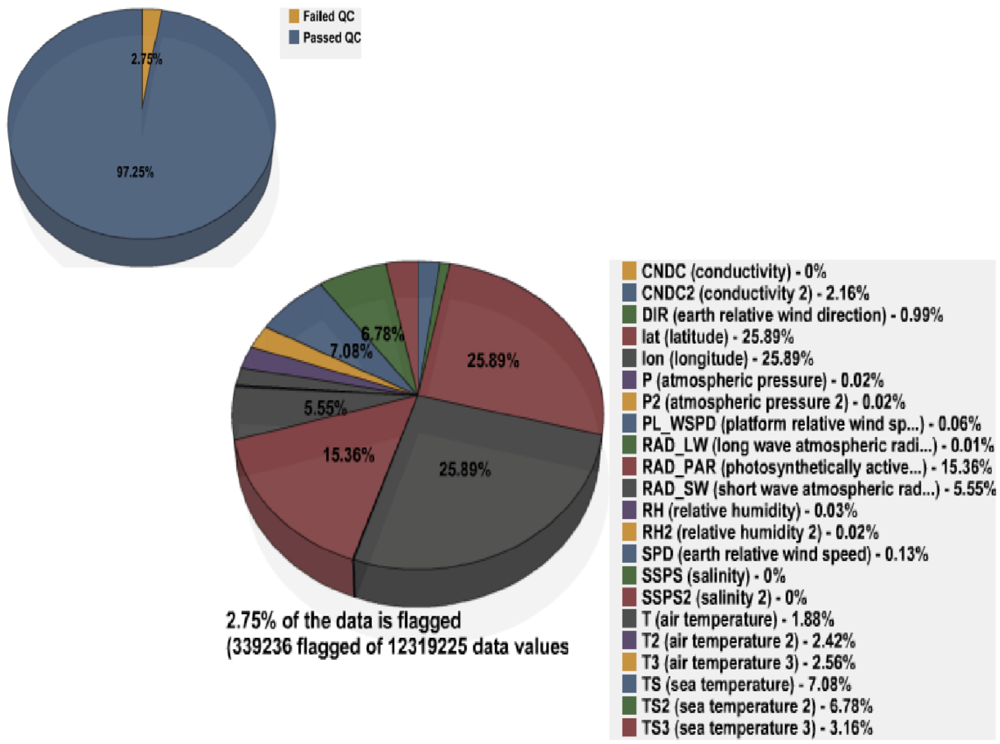



Figure 72: For the *Roger Revelle* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Roger Revelle* provided SAMOS data for 317 ship days, resulting in 12,319,225 distinct data values. After automated QC, 2.75% of the data were flagged using A-Y flags (Figure 74). This is about a percentage point higher than in 2021 (1.88%) and keeps *Revelle* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted that the *Revelle* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Roger Revelle*).

From 23 March – 10 April 2022 several very large (40-200 m/s) platform-relative wind speeds (PL_WSPD) were recorded and flagged. Communication with the operator confirmed these values were the result of sea birds roosting on the meteorological mast, disrupting or causing extreme wind signals from their sonic anemometer. Such an occurrence has also been confirmed on other vessels running sonic anemometers.

Starting on 28 October 2022 the short wave radiation (RAD_SW) exhibited a large number of out-of-range data and the photosynthetically active radiation (RAD_PAR) values flatlined at a constant value. The operators confirmed that an A-D box failed resulting in unusable data from these radiometers. The problem persisted through 22 November 2022, when these variables were disabled in the daily SAMOS processing. RAD_SW and RAD_PAR for this period should not be used, noting that the automated QC will not have flagged all these erroneous values.

There were no other issues of note for the *Revelle* in 2022. Looking to the flag percentages in Figure 74, approximately 52% of the total flags applied were assigned to latitude (LAT) and longitude (LON). These were exclusively “platform position over land” (L) flags in the case of LAT and LON (Figure 75) that appear generally to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port (and the *Revelle* typically sends data while dockside). In addition to the failure of these sensors noted above, RAD_SW and RAD_PAR also received “out of bounds” (B) flags at times when slightly negative values occurred with these sensors at night (a consequence of instrument tuning, see 3b.) Finally, there were a number of periods when the sea temperature (TS, TS2, TS3), conductivity (CNDC, CNDC2), and salinity (SSPS, SSPS2) data exhibited a smooth time series not representative of real ocean observations. This tends to occur when the pumps to the sea water system are shutdown, particularly when the vessel is in port or operating in an EEZ (or other restricted waters). This sometimes results in B or “greater than four standard deviations from climatology” (G) flags being applied to these variables (when the sea water in the pipes is not representative of the surrounding environment), but the autoQC does not flag all occurrences. When noted, the dates of these shutdowns are listed in Annex A.

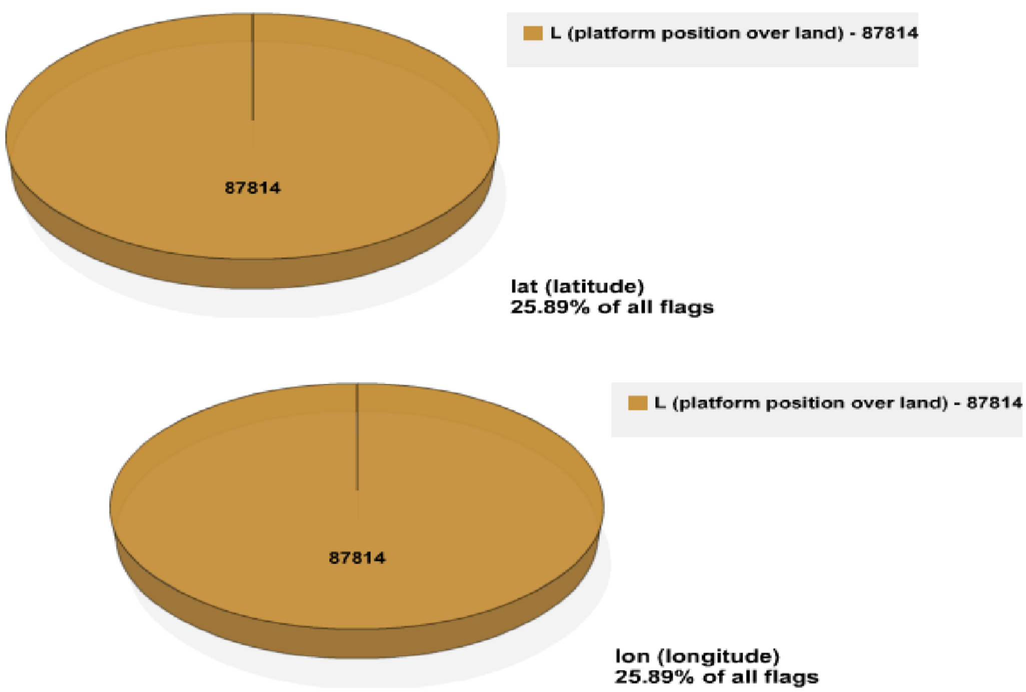



Figure 73: Distribution of SAMOS quality control flags for (top) latitude – LAT – and (bottom) longitude – LON – for the *Roger Revelle* in 2022.

### *Sally Ride*

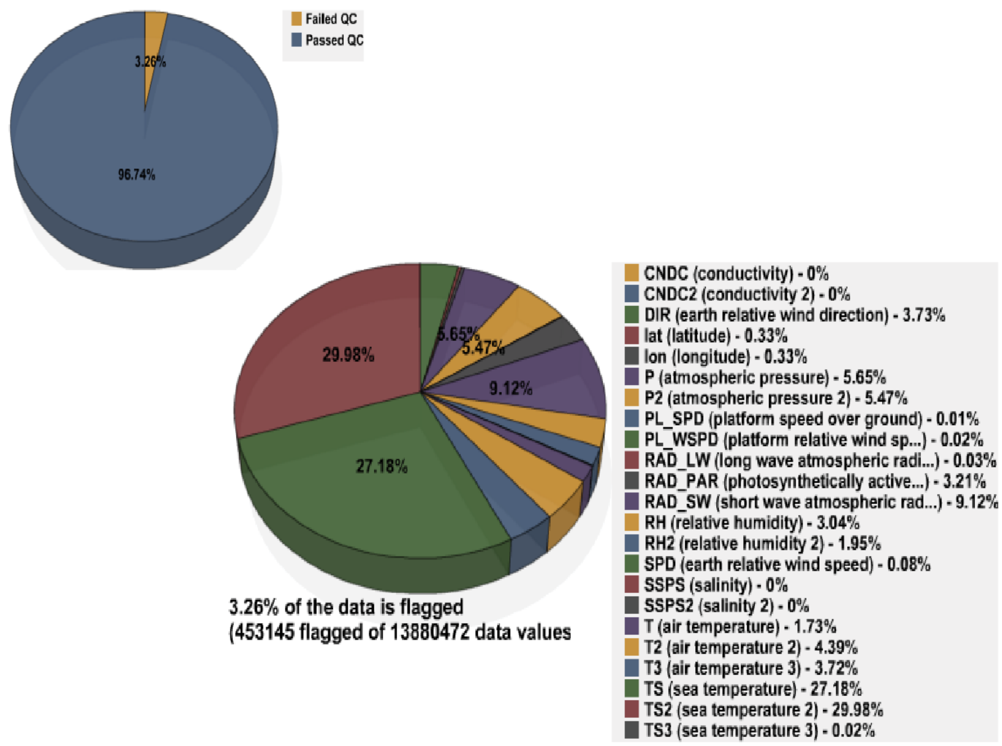



Figure 74: For the *Sally Ride* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Sally Ride* provided SAMOS data for 361 ship days, resulting in 13,880,472 distinct data values. After automated QC, 3.26% of the data were flagged using A-Y flags (Figure 76). This is about a percentage point higher than in 2021 (2.01%) and keeps *Sally Ride* inside the “under 5% total flagged” bracket regarded by SAMOS to represent "very good" data. It should be noted that the *Sally Ride* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Sally Ride*).

Early in 2022 there were several problems with the radiometers on the *Sally Ride*. From around 2-14 February the long wave radiation (RAD_LW) were mostly missing and the short wave radiation (RAD_SW) and photosynthetically active radiation (RAD_PAR) values had a lot of “out of bounds” (B) flags assigned (outside just the typical nighttime below zero readings). During this period, the operator confirmed that no radiometers were installed, but the acquisition system was still capturing a signal from these sensors channels. Any radiation data from this period should not be used. Other maintenance activities affected multiple meteorological sensors while the vessel was in port in February and again from 23 September-5 October 2022. These are noted in Annex A.

From 27-30 June 2022 there were several spikes (up to 40 m/s) in the platform speed (PL_SPD) that was causing spikes in the earth-relative winds (DIR, SPD). This was the result of a failure of the *Sally Ride's* Trimble navigation system. On 1 July 2022, the operator switched the SAMOS navigation feed and the data used for true wind calculations over to the Seapath navigation system.

From 23 November – 1 December both hygrometers were removed for calibration, however, the acquisition system was still receiving values for air temperature (T2 and T3), both flatlined at -39˚C. Obviously these values received B flags and the data should not be used. The sensors were reinstalled on 1 December.

A major problem occurred with the wind sensor that affected the relative and true winds for the period 23 September – 22 November 2022. In September, the anemometer was installed 90 degrees off. The 180-degree (stern) mark on the anemometer was pointing towards 270 degrees (port side). Thus, all platform-relative wind direction (PL_WDIR) values were reported rotated 90 degrees clockwise from the actual direction. This problem was identified through comparison to satellite wind observations, but sadly was not discovered for several months simply because there were very few good satellite overpasses of the *Sally Ride* during this time. The anemometer position was corrected on 22 November in San Diego and subsequent comparison to satellite data looked good. For this period, the PL_WDIR, DIR, and SPD data should not be used as the PLWDIR going into the true wind calculation was offset by 90 degrees. Platform relative wind speed (PL_WSPD) is likely ok as the wind magnitude is not a function of anemometer orientation. A user may be able to correct this offset and recalculate the true winds if desired from the raw wind observations.

Starting on 1 December 2022 at 2145 UTC all the atmospheric pressure data (P, P2) received B flags as the values were nearly static around 900 mb (way too low). The operator confirmed that the barometer had failed, and another barometer (borrowed from the Sproul) was installed on 19 December 2022 at 2345 UTC. None of the pressure values between 1-19 December should be used.

In a note of interest, one quirk with the relative humidity (RH2) from *Sally Ride* continued in 2022. It was observed that when *Ride* was operating in saturated conditions (e.g., fog) her RH2 would often report NaNs for a while, after first hitting 100%, until such time as conditions dried out. When this information was conveyed to the ship, shoreside personnel proposed a technical source, to be investigated at some future time when he was on the ship. His suspicion was that the NaN values resulted from a 0-1V A-D module receiving a > 1V signal in saturated conditions, exceeding its limit. He guessed there was probably a bit of voltage drop on the ground line from the mast box to the RH2 sensor, shifting the sensor output voltage a bit high compared to the mast box ground. This problem has not been resolved to date, so when saturation is reached, RH2 will output NaN, which SAMOS converts to a missing value (-9999). There is no good way to recover the actual RH values in these cases.

There were no other issues of note for *Sally Ride* in 2022. Looking to the flag percentages in Figure 81, over 57 percent of the total flags were applied to the two sea temperature parameters (TS and TS2). In this case there was a mix of G and B flags (Figure 77), mainly due to instances of the sea water system being off but the sensors still providing a data value over the course of the year, either when the vessel was in port (common) or during transit through an exclusive economic zone (also common).Shutdowns of the sea water system will also affect the conductivity (CNDC, CNDC2), and salinity (SSPS, SSPS2) data, exhibited a smooth time series not representative of real ocean observations, but these variables tend not receive flags from the automated QC in these situations. When noted, the dates of these shutdowns are listed in Annex A.

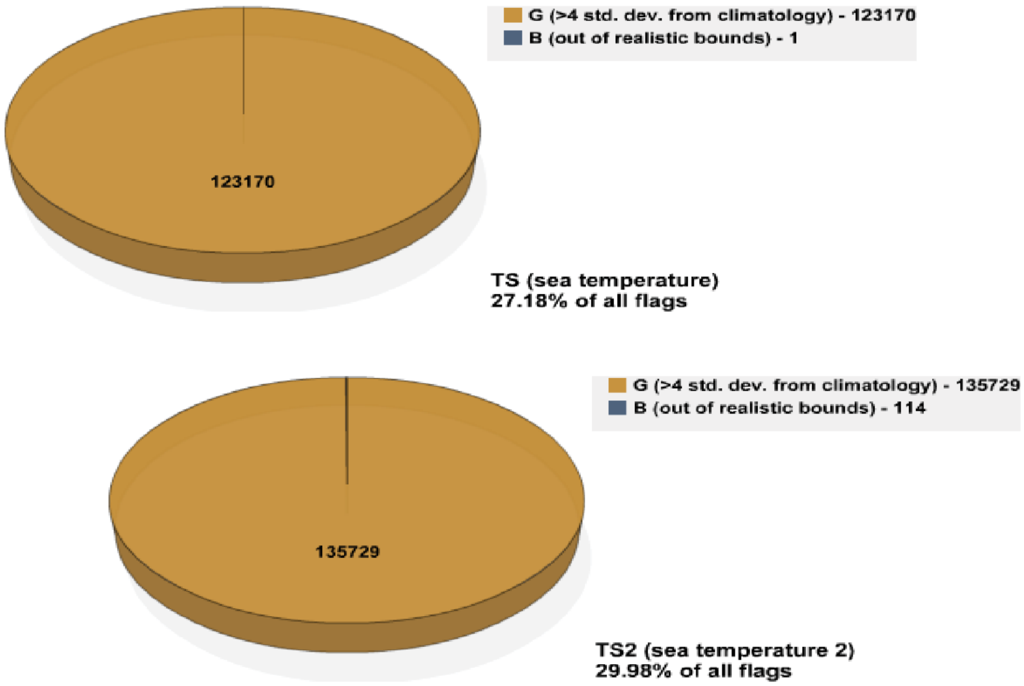



Figure 75: Distribution of SAMOS quality control flags for (top) sea temperature – TS – and (bottom) sea temperature 2 – TS2 – for the *Sally Ride* in 2022.

### *Sikuliaq*

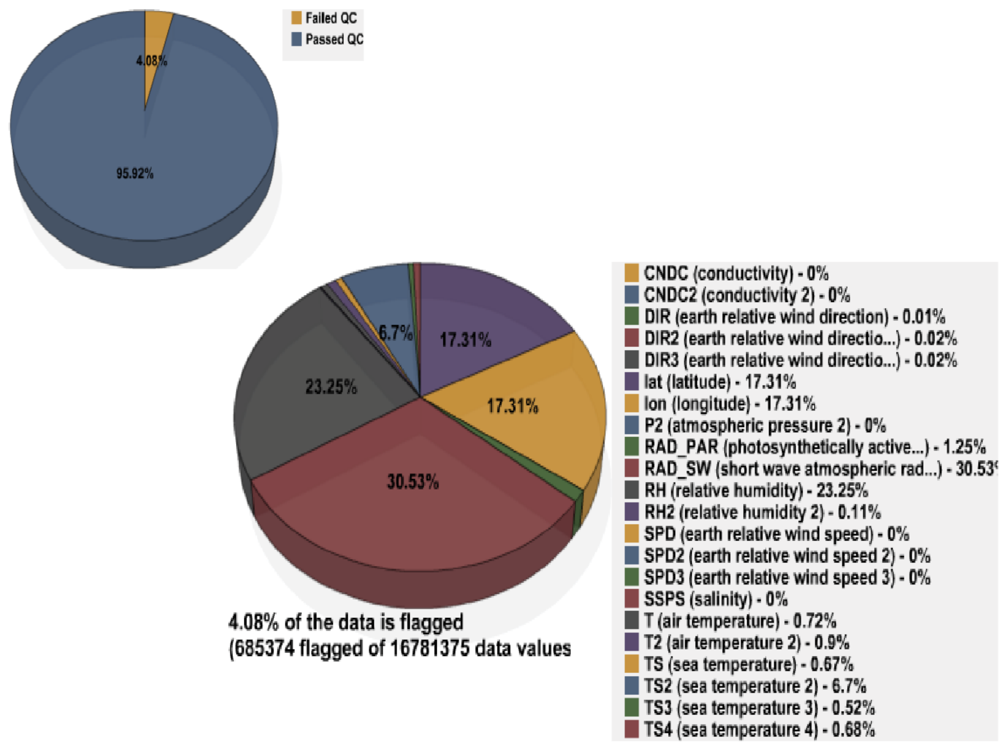



Figure 76: For the *Sikuliaq* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Sikuliaq* provided SAMOS data for 340 ship days, resulting in 16,781,375 distinct data values. After automated QC, 4.08% of the data were flagged using A-Y flags (Figure 78). This is about one and a half percentage points lower than in 2021 (5.62%) and brings *Sikuliaq* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted the *Sikuliaq* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Sikuliaq*).

There were several occurrences where the two air temperatures (T, T2) received “out of bounds” (B) flags because the values exceeded the regional upper bounds quality control of 15˚C north of 60˚ latitude. In these cases, the B flags do not indicate a problem with the observations, but instead that the 15˚C threshold may be too low for the southern coast of Alaska around Seward. There is no easy fix for this in the data QC, so users should verify the ship position for air temperatures with B flags as they may want to keep some of these records.

From 21 September – 1 October 2023, there were many gaps in and flags assigned to the sea temperature (TS, TS3, TS4) and conductivity/salinity (CNDC, CNDC2, SSPS, SSPS2) data. Based on radiometric sea surface temperature (TS2), aka “skin” temperature, falling well below -2.0C and the high latitude of the vessel, we assumed the vessel was in the ice pack. This can result in periodic blockages/shutdowns of sea water intakes. Techs confirmed they were operating in the ice and were intaking science seawater through the centerboard. Please note, when the vessel is stationary, a noticeable warming occurs in the seawater temperature data. This is because the centerboard is recessed 0.64 meters from the hull. There is not continuous flow to that recessed void. These data should be used with caution.

It was noted again in 2022, as it had been in prior years, that *Sikuliaq's* relative humidity (RH) from their Vaisala PTU307 unit generally performed more poorly than the relative humidity (RH2) from their Paroscientific MET4A instrument. RH values in 2022 often read higher than RH2 and in humid conditions tended to exceed 100%, which resulted in application of B flags to RH by automated quality control procedures that accounted for over 23% of the total flags in 2022 (Figure 78). The decision was made at the end of 2022 to decommission the *Sikuliaq*'s PTU307s entirely, retaining only the MET4As, which use a fan-aspirated humidity sensor and perform demonstrably much better in the cold and humid conditions *Sikuliaq* frequently encounters. We recommend that RH2 be given precedence over RH wherever possible, for all of 2022.

There were no other data issues of note for *Sikuliaq* in 2022. Looking to the flag percentages in Figure 78, about 34% of the total flags were applied to latitude (LAT) and longitude (LON). These were exclusively “platform position over land” (L) flags (Figure 79) that appear generally to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port. A further ~30% of the total flags were applied to shortwave atmospheric radiation (RAD_SW), in this case exclusively B flags (Figure 79) such as are applied to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.) Finally, approximately 1% of the total flags were applied to TS2. These were mostly B flags with a few “greater than four deviations from climatology” (G) flags, as well (Figure 79). In this case the flagged data mainly resulted from the infrared thermometer pointing at the dock or at pack ice, meaning it was not actually measuring the sea temperature. We note this does not indicate a problem with the sensor.

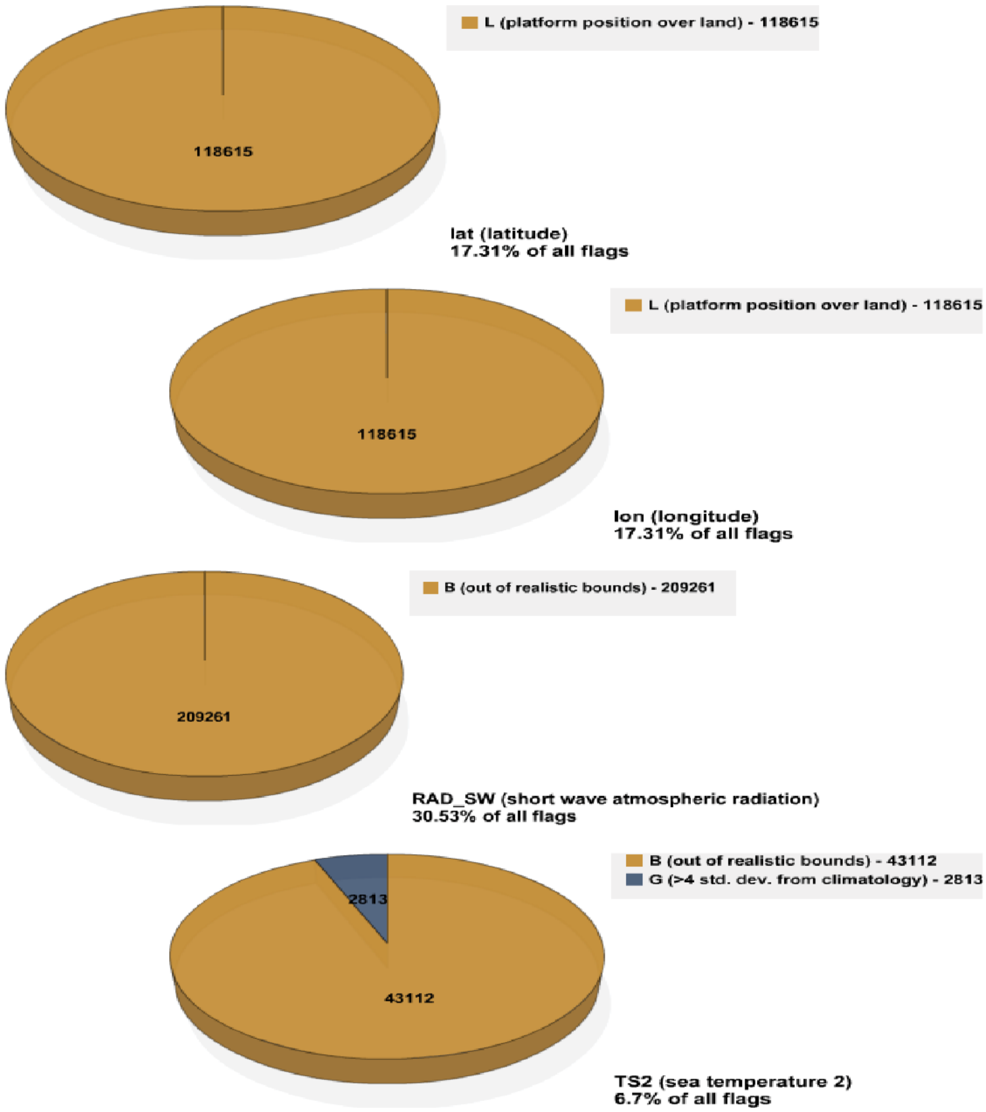



Figure 77: Distribution of SAMOS quality control flags for (first) latitude – LAT – (second) longitude – LON – (third) short wave atmospheric radiation – RAD_SW – and (last) sea temperature 2 – TS2 – for the *Sikuliaq* in 2022.

***Kilo Moana***

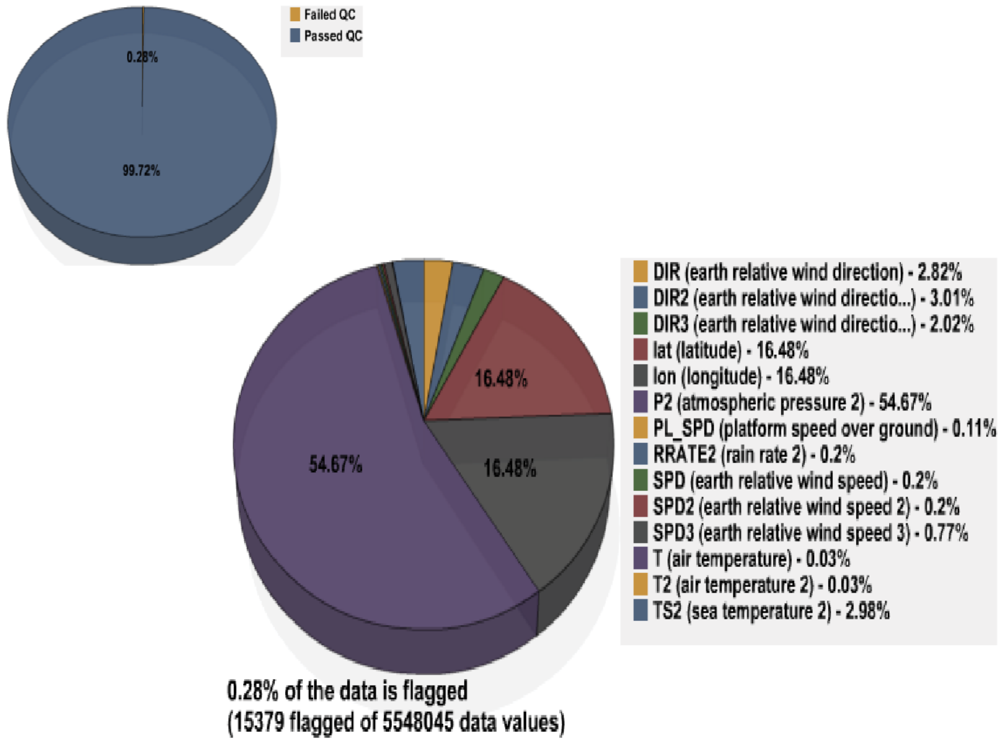


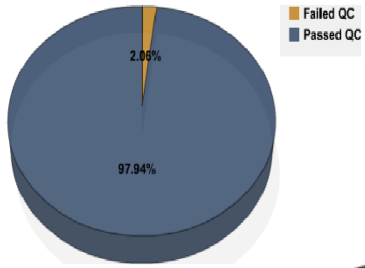

Figure 78: For the *Kilo Moana* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Kilo Moana* provided SAMOS data for 141 ship days, resulting in 5,548,045 distinct data values. After automated QC, just 0.28% of the data were flagged using A-Y flags (Figure 80). This is virtually unchanged from 2021 (0.12%) and obviously maintains *Kilo Moana's* standing well under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted that the *Kilo Moana* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *Kilo Moana*). Still, a total flagged percentage of 0.12% is exceedingly low.

The bulk of the flagged observations are the result of a failure of the barometer feeding P2 that started on 21 September 2022. Prior to the resolution of the barometer failure, the *Kilo Moana* experienced a failure of their email server (on 27 September) which resulted in no other SAMOS data being provided to FSU for the remainder of 2022.

There were no other issues of note for *Kilo Moana* in 2022. Additionally, considering the very low total flagged percentage it is not worth drilling down into the individual parameter flag percentages.

*Thomas G. Thompson*



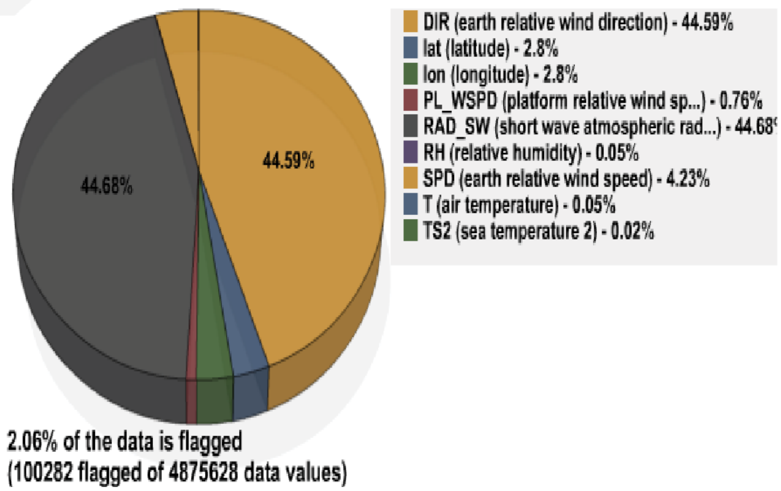




Figure 79: For the *Thomas G. Thompson* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Thomas G. Thompson* provided SAMOS data for 200 ship days, resulting in 4,875,628 distinct data values. After automated QC, 2.06% of the data were flagged using A-Y flags (Figure 81). This is about one and a half percentage points lower than in 2021 (3.42%) and maintains *Thompson's* standing inside the "under 5% total flagged" bracket regarded by SAMOS to represent "very good" data. It should be noted the *T. G. Thompson* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *T. G. Thompson*).

The bulk of the flags in 2022 occurred on the true wind direction (DIR), totaling 44% of the overall flags, and shortwave radiation (RAD_SW), also totaling 44% of the overall flags. The flags on DIR were entirely "failed the wind recomputation check" (E) flags by the automated quality control (Figure 83). The cause of these flags is still unknown but is suspected to be the result of a mix of instantaneous and averaged navigation and platform relative wind data being used in the true wind calculation. These wind values are likely fine but should be used with caution. Sometimes E flags also indicate a level of flow distortion affecting the wind measurements, but no clear pattern of ship-relative wind direction resulting in E flags was apparent. The flags on the shortwave radiation were unanimously "out of bounds" (B) flags (Figure 83), which appear to have been applied mainly to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

On 19-20 April 2022, numerous very large spikes (up to 50+ m/s) were observable in *Thomas G. Thompson's* platform relative and earth relative wind speeds (PL_WSPD and SPD, respectively). This was a return of birds roosting on the meteorological mast (much like shown in the photo from 2021, Figure 82) and these spikes periodically returned throughout the year when the *Thompson* was working in tropical latitudes. When "bird events" occur in the *Thompson's* wind speed data, they are usually assigned either B, G, or E flags by automated quality control procedures (Figure 83).

No other notable problems were identified in the data for the *Thompson* in 2022.

Figure 80: Photo from shipboard technician showing birds roosting on the sonic anemometer and meteorological mast on the *Thomas G. Thompson*. Photo courtesy Adam Stenseth, University of Washington.

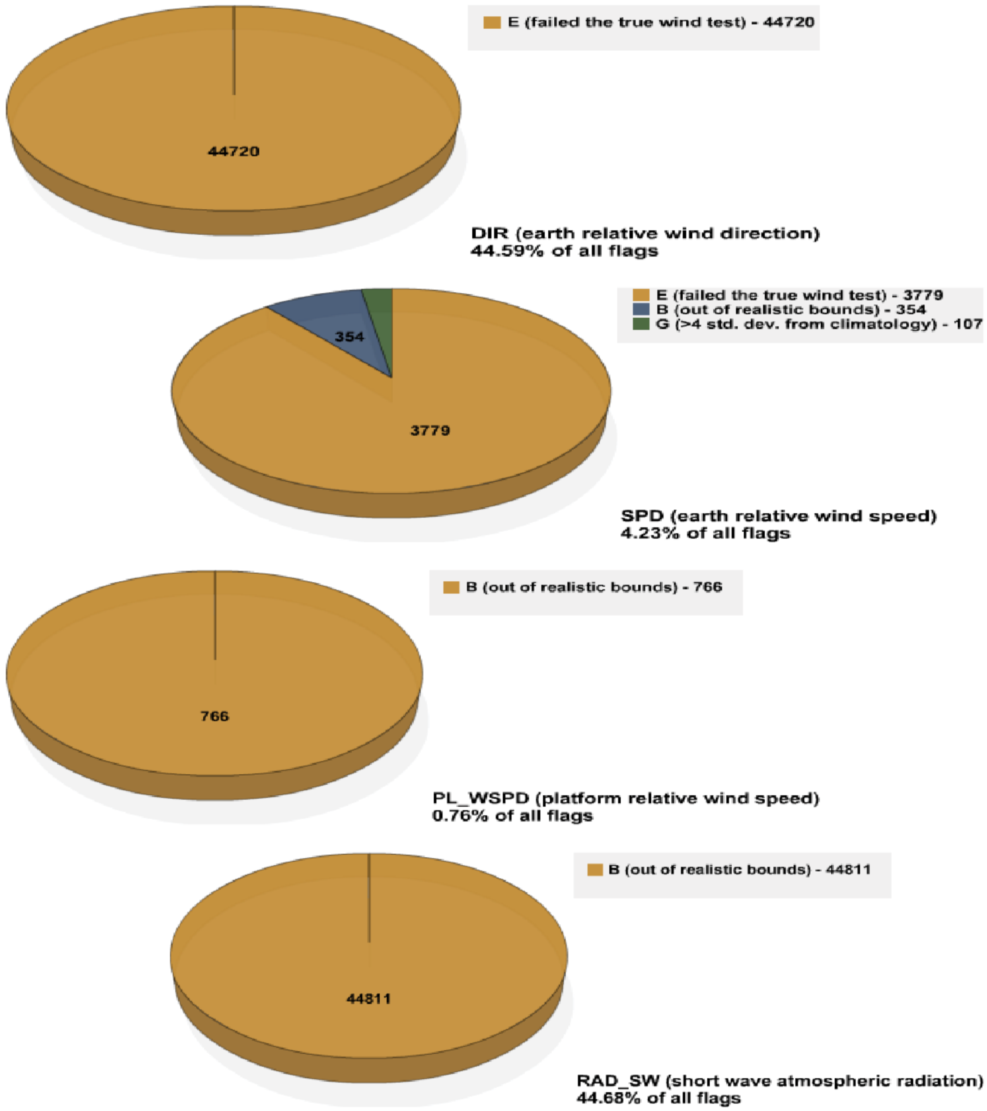



Figure 81: Distribution of SAMOS quality control flags for (first) – DIR – (second) earth relative wind speed – SPD – (third) platform relative wind speed – PL_WSPD – and (last) short wave atmospheric radiation – RAD_SW – for the *Thomas G. Thompson* in 2022.

***Healy***

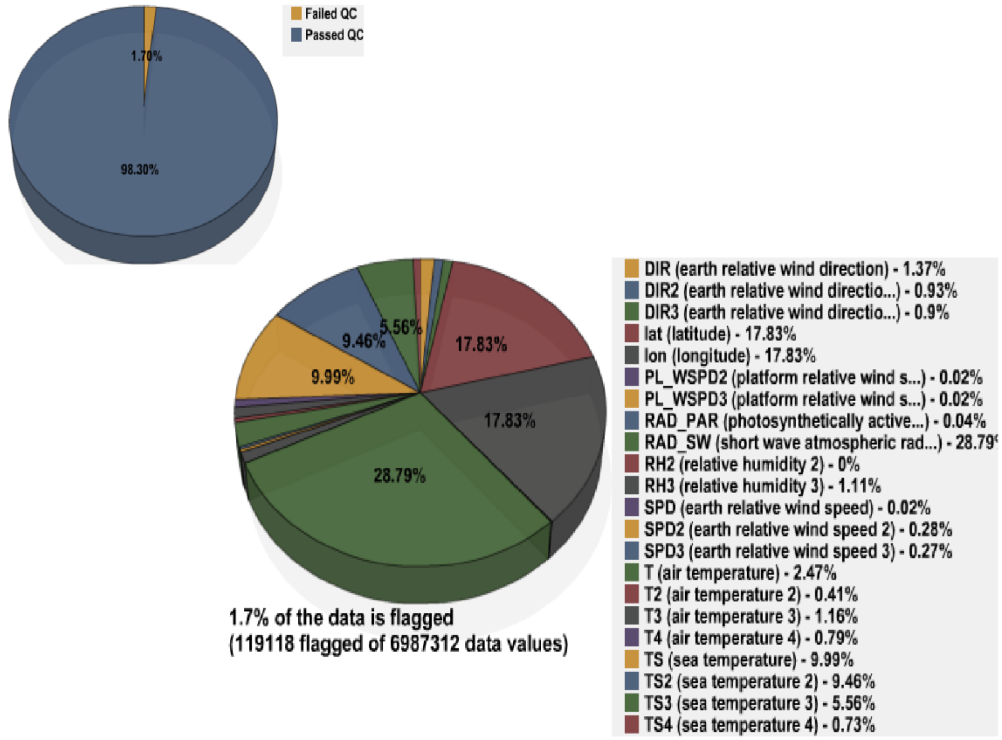



Figure 82: For the *Healy* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *Healy* provided SAMOS data for 159 ship days, resulting in 6,987,312 distinct data values. After automated QC, 1.7% of the data were flagged using A-Y flags (Figure 84). This is about the same as in 2021 (2.06%) and keeps *Healy* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted *Healy* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only.

Around 12 August 2022, the analyst noted that the sea temperature values from the hull contact sensor (TS4) were much higher than any of the other sea water temperatures. After contacting the vessel, the technician determined that the sensor had pulled away from hull. They tried to reattach with thermal gel, but afterwards the problem with the readings persisted. It seemed that either the sensor was off calibration, or the installation was not optimal. Technicians were unable to resolve the installation problems, so the TS4 data feed to SAMOS was discontinued on 20220813. The problem only became apparent when the *Healy* started its first cruise in cold Arctic waters, but the technicians suspect the sensor was not recording reliable data throughout the 2022 field season. The 2022 data from TS4 should thus not be used, even while they may be mostly unflagged.

Referring to Figure 84, about 25% of the total flags were applied to the other three sea temperatures (TS, TS2, and TS3). These are a mixture of “out of bounds” (B) and “greater than four standard deviations from climatology” (G) flags (Figure 85, not all shown) and mostly the result of the flow water system being shut down as the vessel entered port or in heavy sea ice conditions. One clear example occurred between 14-16 October 2022 with some notable biases between the three sea temperatures and some large spikes in the data.

As a general note, steps from suspected flow distortion have been observed in *Healy's* atmospheric pressure (P and P2) and true wind speed (SPD, SPD2, SPD3) data when the relative wind is from abeam (either 90 or 270 degrees). In this case, given the blockhouse bridge/superstructure on *Healy*, there is probably no real solution without moving these sensors higher up on the main mast.

Looking again to the flag percentages in Figure 84, about 29% of the total flags were applied to shortwave atmospheric radiation (RAD_SW), in this case exclusively B flags (Figure 85) such as are applied to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.) A further ~35% of the total flags were applied to latitude (LAT) and longitude (LON). These were virtually all "platform position over land" (L) flags (Figure 85) that were likely mainly to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port.

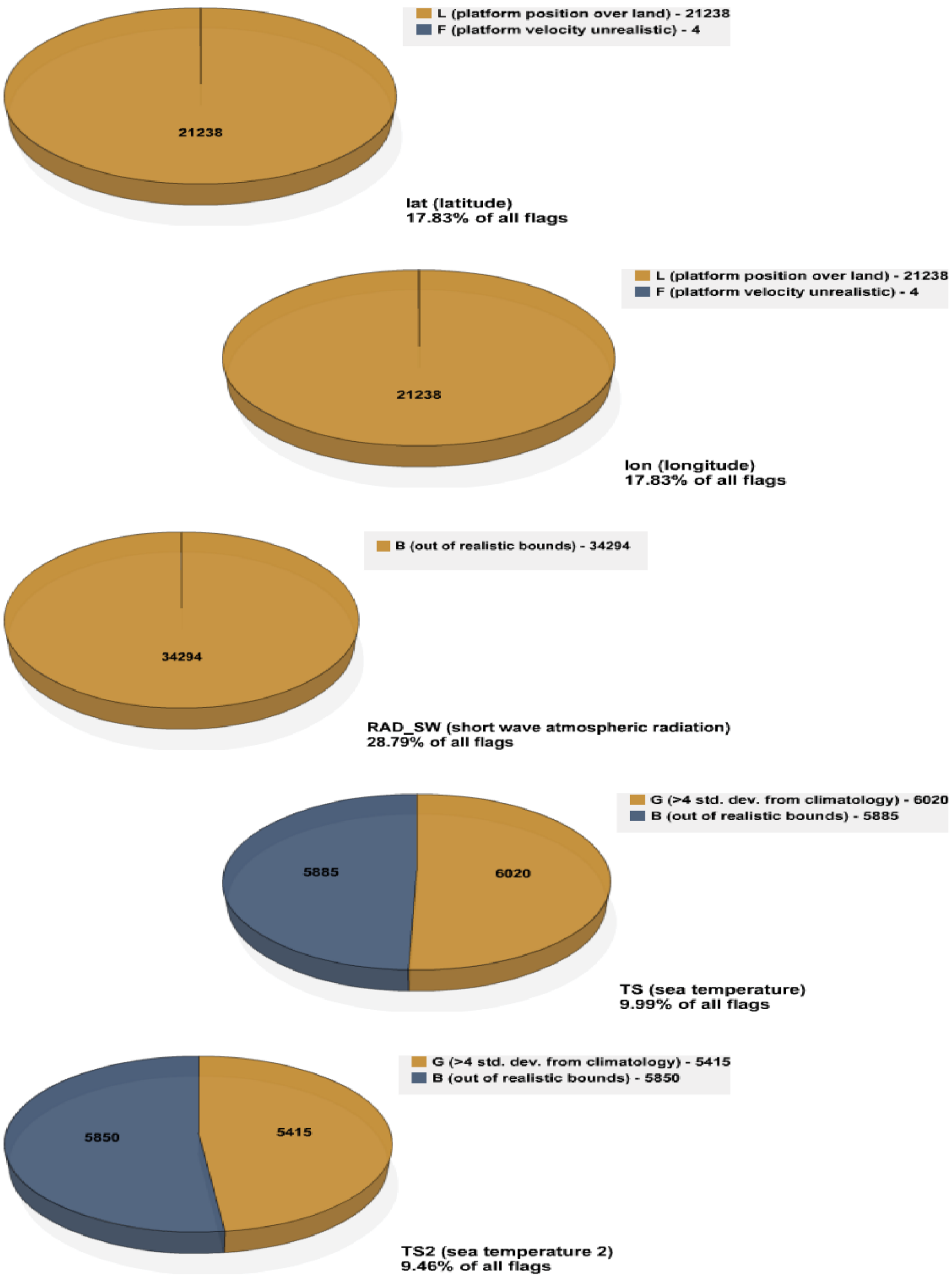



Figure 83: Distribution of SAMOS quality control flags for (first) latitude – LAT – (second) longitude – LON – (third) shortwave atmospheric radiation – RAD_SW – (fourth) sea temperature – TS – and (last) sea temperature 2 – TS2 – for the *Healy* in 2022.

### *R/V Atlantis*

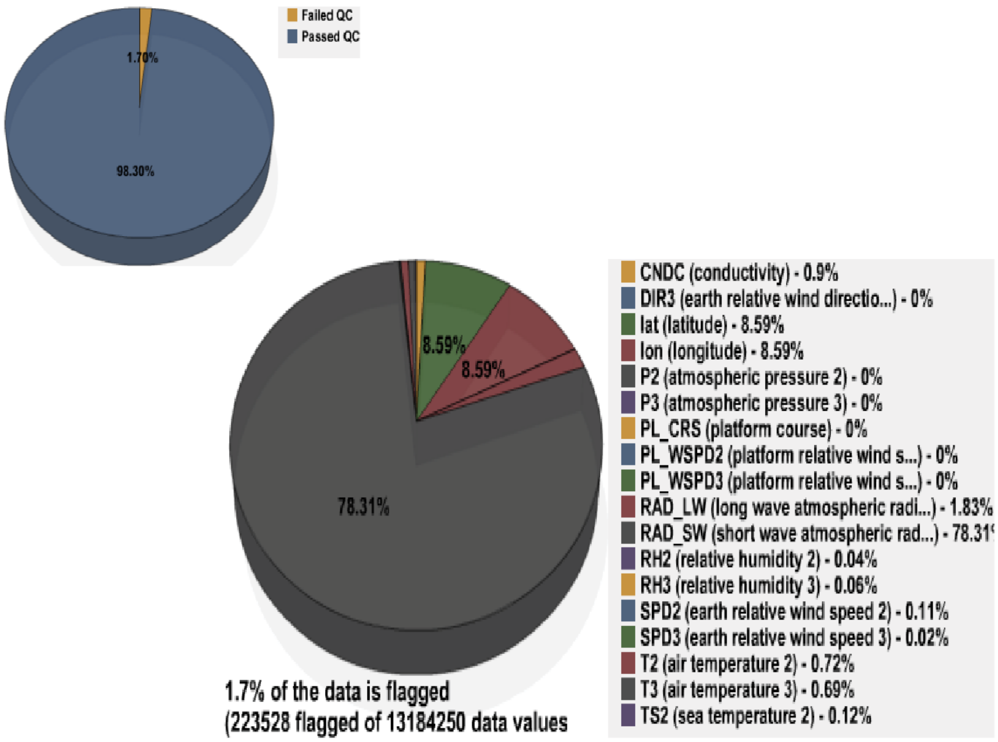



Figure 84: For the *R/V Atlantis* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *R/V Atlantis* provided SAMOS data for 317 ship days, resulting in 13,184,250 distinct data values. After automated QC, 1.7% of the data were flagged using A-Y flags (Figure 86). This is about one and a half percentage points lower than in 2021 (3.15%) and maintains *Atlantis's* standing well under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted that the *R/V Atlantis* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only.

During the period 21-24 April 2022 the *Atlantis's* long wave radiometer (RAD_LW) reported unreasonable values and some very large steps in the data which were assigned "out of bounds" (B) flags (Figure 87). We suspect this was the return of a cable problem with this radiometer but did not receive any confirmation from the vessel at the time. Both the longwave and shortwave sensors were replaced with newly calibrated sensors (and all cables checked) in early July. The problem with RAD_LW did not occur after this date. Another unique occurrence with the short wave radiation (RAD_SW) happened between 7-10 November 2022. At this time, the *Atlantis* was in port in Charleston, SC and it seems that there were a number of very bright lights in the port which resulted in nighttime RAD_SW values not falling below 400 W/m$^2$ (unflagged). The nighttime data during this period should be treated as suspect.

One other minor issue on the *Atlantis* is that the port WXT periodically stops transmitting data. This affects the wind (DIR2, SPD2, PL_WDIR2, PL_WSPD2), pressure (P2), air temperature (T2), relative humidity (RH2), precipitation accumulation (PRECIP2), and rain rate (RRATE2) values from that instrument. These failures are random and are quickly resolved when the technicians power cycle the WXT. The cause is unknown, and it seems to affect mainly the port WXT, although occasionally the same situation is evident in the starboard WXT and associated data values.

There were no other data issues of note for *Atlantis* in 2022. Looking to the flag percentages in Figure 86, over 78% of the total flags were applied to short wave atmospheric radiation (RAD_SW). These were exclusively "out of bounds" (B) flags (Figure 87) and appear to have been applied mainly to the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

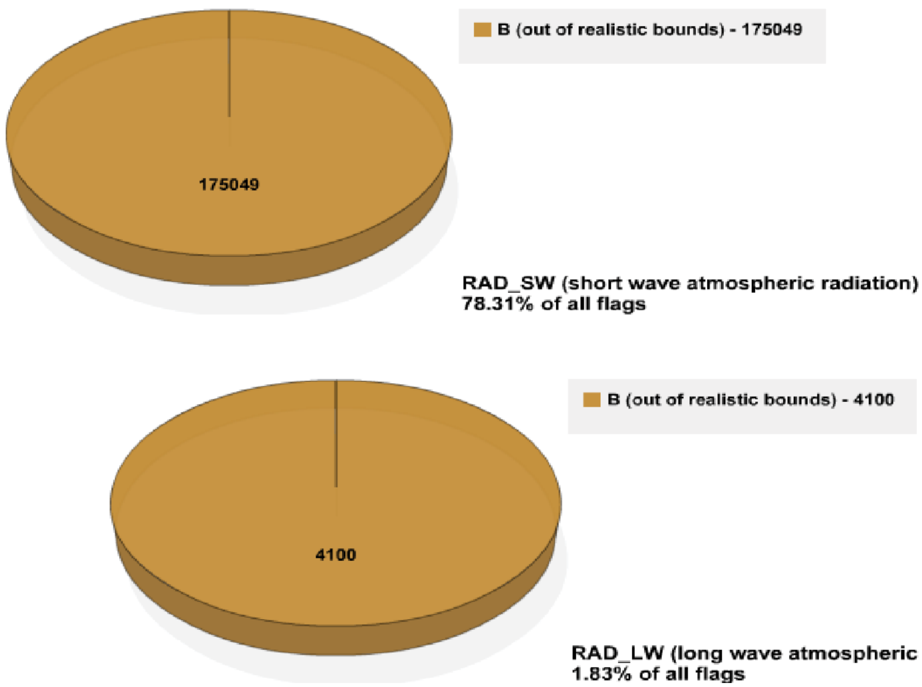



Figure 85: Distribution of SAMOS quality control flags for (top) short wave atmospheric radiation – RAD_SW – and (bottom) long wave atmospheric radiation – RAD_LW – for the *R/V Atlantis* in 2022.

### *R/V Neil Armstrong*

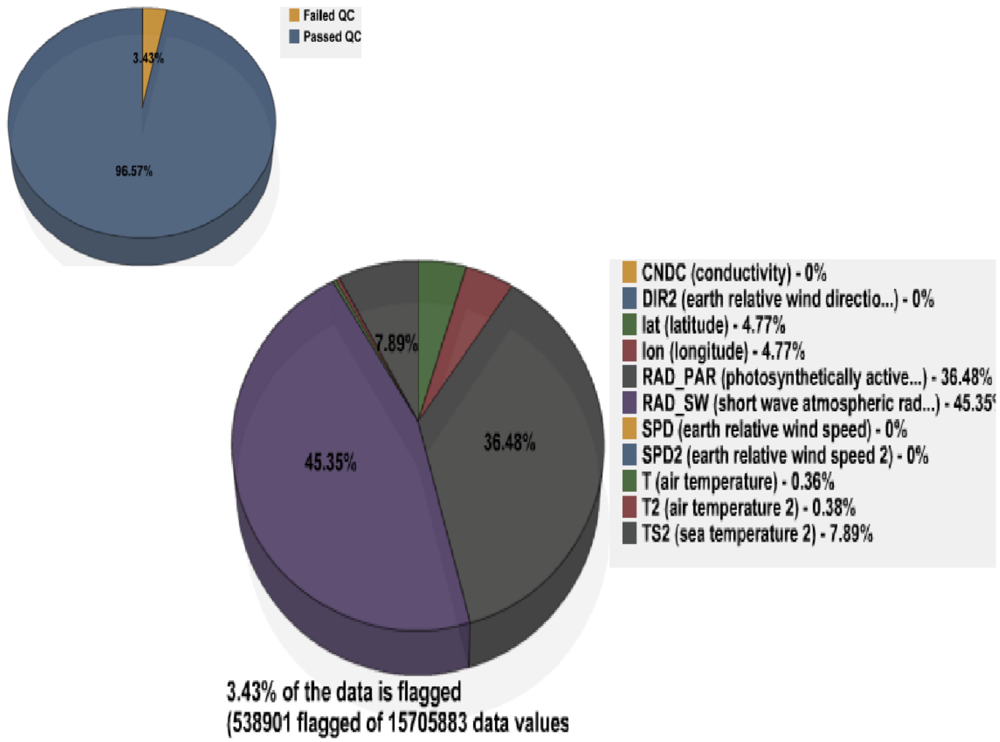



Figure 86: For the *R/V Neil Armstrong* from 1/1/22 through 12/31/22, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The *R/V Neil Armstrong* provided SAMOS data for 360 ship days, resulting in 15,705,883 distinct data values. After automated QC, 3.43% of the data were flagged using A-Y flags (Figure 88). This is about a percentage point higher than in 2021 (2.46%) and keeps *Armstrong* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data. It should be noted the *R/V Neil Armstrong* receives only automated QC, and visual QC is when the bulk of flags are typically applied. All the flags are the result of automated QC only (no research-level files exist at the SAMOS DAC for the *R/V Neil Armstrong*).

Like the *Atlantis*, the WXTs on the *Neil Armstrong* spontaneously stop logging and the only solution is to power cycle all the met mast sensors. This spontaneous ceasing of data logging in *Armstrong's* WXT units results in gaps in the associated pressure (P, P2), air temperature (T, T2), relative humidity (RH, RH2), relative and true winds (PL_WDIR, PL_WDIR2, PL_WSPD, PL_WSPD2, DIR, DIR, SPD, SPD2), precipitation (PRECIP, PRECIP2), and rain rates (RRATE, RRATE2) from the affected WXT that can last hours to a day or more. One clear example occurred from ~0300-0800 UTC on 13 July 2022. The technicians are aware of the problem and, along with the SAMOS data analyst, endeavor to identify and promptly resolve these power events.

The *Neil Armstrong* tends to continue reporting data values from their thermosalinograph even when the flow water system pumps are off. This typically happens when the vessel is either in port or in an EEZ without clearance to collect ocean data. The result is a smooth data trace for the sea temperature (TS2), conductivity (CNDC), and salinity (SSPS) from their SBE45 and sometimes “out of bounds” (B) or “greater than four standard deviations from climatology” (G) flags on TS2 (Figure 89) as the water sitting in the pipes is no longer representative of the actual ocean conditions where the vessel is operating. These data should not be used and whenever possible the occurrences are noted in Annex A. Another issue that occurred with the TSG on 20220627 was many random spikes, steps, and noise (all unflagged) in the SBE45 data that is believed to be the result of air bubbles or other issues while operating in the rough Labrador Sea. Rough seas can also result in “shark fin” shaped steps in the SBE45 data (with or without B/G flags being applied) when the air is drawn into the system and/or the operator temporarily shuts down the flow water pumps. An example occurred between 1-3 October 2022.

There are no other data issues of note for *Neil Armstrong* for 2022. Looking to the flag percentages in Figure 88, almost all the total flags applied were assigned to short wave atmospheric radiation (RAD_SW) and photosynthetically active radiation (RAD_PAR). In both cases these were exclusively B flags (Figure 89) that appear to have been applied mainly to the slightly negative values that can occur with these types of sensors at night (a consequence of instrument tuning, see 3b.) A further ~10% of the total flags were applied to latitude (LAT) and longitude (LON). These were virtually all “platform position over land” (L) flags (Figure 89) that were likely mainly to have been applied when the vessel was either in port or very close to land. This is not uncommon, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of a coastline or an inland port.

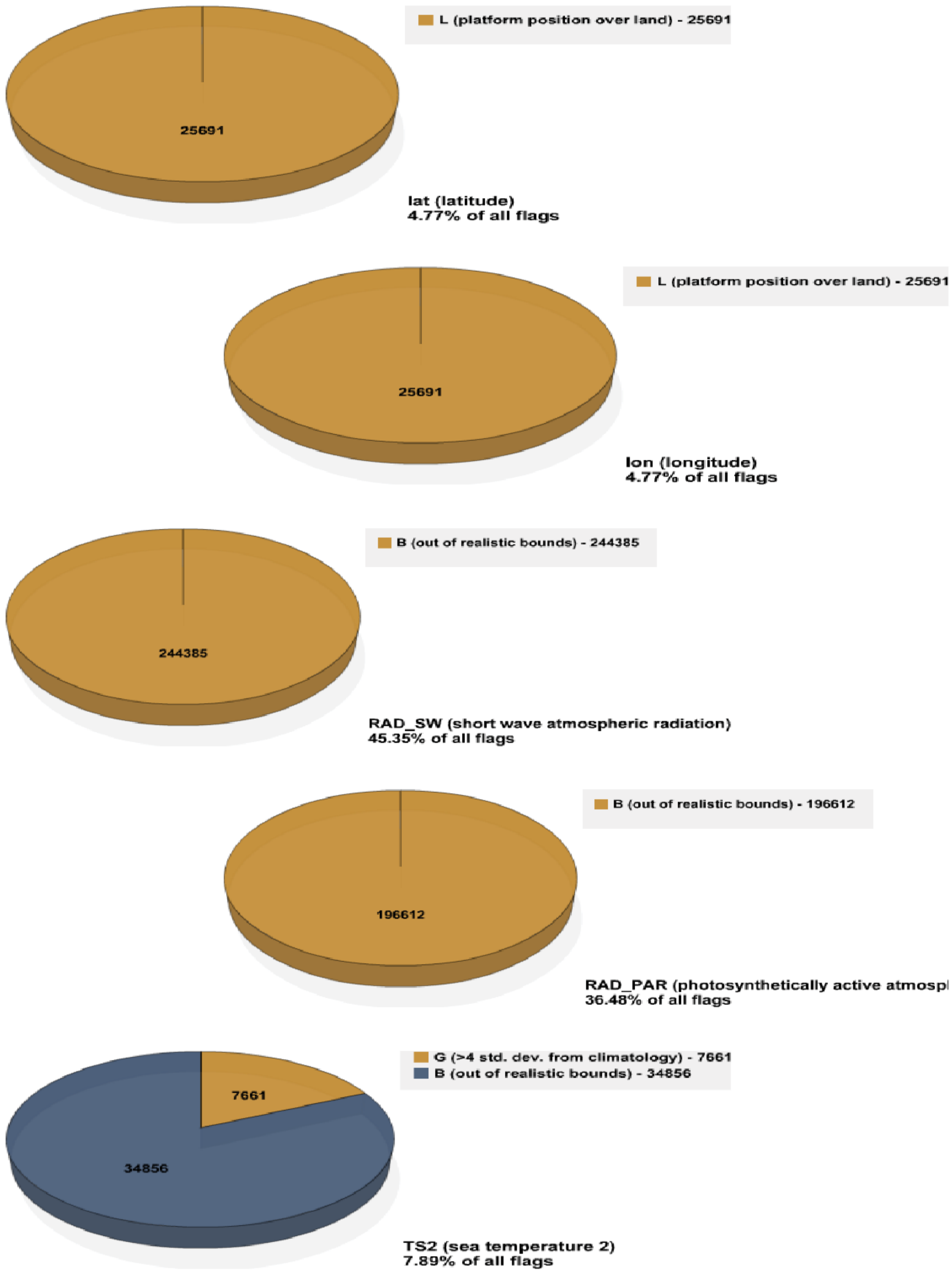



Figure 87: Distribution of SAMOS quality control flags for (first) latitude – LAT – (second) longitude – LON – (third) short wave atmospheric radiation – RAD_SW – (fourth) photosynthetically active radiation – RAD_PAR – and (last) sea temperature 2 – TS2 – for the *R/V Neil Armstrong* in 2022.

### 4. Metadata summary

Adequate metadata is the backbone of good visual QC. It also improves the utility of any data set. 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, data reporting interval, and instrument system name (i.e. data acquisition/assembly software) and, if applicable, version. 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 90 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 91. (Any questions regarding the various fields should be directed to samos@coaps.fsu.edu. Helpful information may also be found at https://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 91 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. (Note that for those sensors not routinely calibrated, such as GPS instruments, an installation date is alternately desired.)

We note here that as of summer 2020 we are now collecting additional flow water metadata elements, namely, intake location and pipe run length. Knowing these details can help establish a basis for any unnatural increase or decrease seen in sea water variable values away from what they would have been directly at the sea water intake. Typically, the further water has travelled inside the ship, the greater the warming/cooling effects of the ship/pipes on the water.

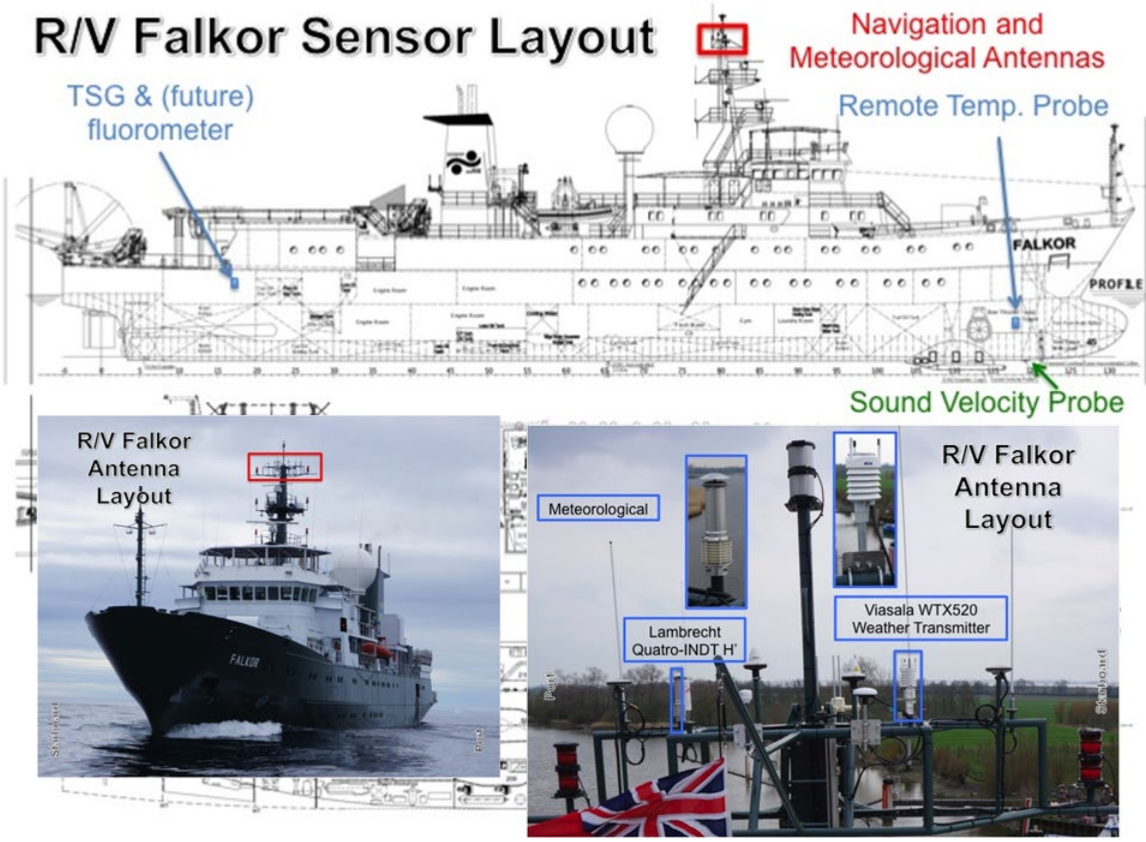



Figure 88: Examples of detailed vessel instrument imagery from the *R/V Falkor*.

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 89: 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 | LATITUDE | LONGITUDE | PLATFORM HEADING | PLATFORM COURSE | PLATFORM SPEED | SEA TEMPERATURE | CONDUCTIVITY | SALINITY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KAOU | C | C | C | Yes | C | C | C | C | C | I,I,I | I,I | I,I |
| KAQP | C | C | C | Yes | C | C | C | C | C | I,I | I | I |
| KTDQ | C | C | C | Yes | C | C | I | C | C | C,C | C | C |
| NEPP | C | I | C | Yes | I | I | C | I | I | I,I,I,I | I,I | I,I |
| VLMJ | I | C | I | No | I | I | I | I | I | I,I | | I |
| WARL | C | C | I | Yes | I | I | I | I | I,I | I,I | I | I |
| WBP3210 | I | C | C | Yes | I | I | I | I | I | I | I | I |
| WCX7445 | C | C | C | Yes | I | I | I | I | I | I | I | I |
| WDA7827 | C | C | C | Yes | I | I | I,I | I | I | I,I | I | I |
| WDC9417 | C | C | C | Yes | C | C | C | C | I | C,C,C,C | C,C | C,C |
| WDD6114 | C | C | I | Yes | I | I | I | I | I | I | I | I |
| WDG7520 | C | C | C | Yes | C | C | C,I,I | C | C | C,I,C,C,I | C,C | C,C |
| WSAF | C | C | I | Yes | C | C | C | I | C | I,I,I | I,I | I,I |
| WSQ2674 | C | C | I | Yes | C | C | C | C | C | I,C | I | I |
| WTDF | C | C | C | Yes | I | I | I | I | I,I,I | I,I | I | I |
| WTDH | C | C | C | Yes | I | I | I | I | I,I,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,I,I | I,I | I,I |
| WTDO | C | I | C | Yes | I | 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 |
| WTEB | C | I | C | No | I | I | I | I,I | I,I | I,I | I | I |
| WTEC | C | C | C | Yes | I | I | I | I | I | C,C | C | C |
| WTED | C | C | C | Yes | 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 | I,I |
| WTEF | C | I | C | No | I | I | I,I | I,I,I | I,I | I | I | I |
| WTEG | C | C | C | Yes | I | I | I,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 | I |
| WTEO | C | I | C | Yes | I | I | I | I | I | I | I | I |
| WTEP | C | C | C | Yes | C | C | C | C | C,C | 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 | I,I |
| ZMFR | I | I | C | No | I | I | I | I | I | I | | |

Table 4: Vessel and parameter metadata overview. Only metadata valid as of the writing of this report is shown. "C" indicates complete metadata; "I" indicates incomplete metadata. 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.

| | RELATIVE WIND SPEED | RELATIVE WIND DIRECTION | TRUE WIND SPEED | TRUE WIND DIRECTION | AIR TEMP | DEW POINT TEMP | WET BULB TEMP | PRESSURE | RELATIVE HUMIDITY | PRECIP | RAIN RATE | LONG WAVE RADIATION | SHORT WAVE RADIATION | NET RADIATION | PHOTOSYNTHETICALLY ACTIVE RADIATION (PAR) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| KAOU | C | C | C | C | C,C,C | | | C,C | C,C | C | | C | C | | C |
| KAQP | C,C | I,I | C,C | C,C | C,I | | | C,I | C,I | C,I | C,I | I | I | | |
| KTDQ | C | C | C | C | C | | | C | C | | | C | C | | C |
| NEPP | C,C,C | I,C,C | C,C,C | C,C,C | C,I,C,C | | | C,C | C,I,C | | | C | C | | C |
| VLMJ | 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 |
| WARL | C,C | C,C | C,C | C,C | C,C | | | C,C | C,C | C,C | C,C | C | C | | C |
| WBP3210 | I,I | I,I | I,I | I,I | I | | | I | I | | | I | I | | I |
| WCX7445 | I,I | I,I | I,I | I,I | I | | | I | I | | | I | I | | I |
| WDA7827 | 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,C | C,C | C,C | C,C | | | C,C | C,I | C | | C | C | | I |
| WDD6114 | I | I | I | I | I | | | I | I | | | | | | |
| WDG7520 | C,I,I | C,I,I | C,C,C | C,C,C | C | | | C | C | | | C | C | | C |
| WSAF | C | C | C | C | C,C,C | | | C,C | C,C | C | | C | C | | C |
| WSQ2674 | C | C | C | C | C,C | | | C,C | C | C | | C | C | | C |
| WTDF | I,I,C | I,I,I | I,I,C | I,I,C | C | | | C | C | | | I | C | | |
| WTDH | C | I | C | C | C | C | C | C,C | C | | | | | | |
| WTDL | I,I | I | I | I | I | I | I | I | I | | | I | I | | |
| WTDO | I,I | I,I | I,I | I,I | I | I | I | I | I | | | | | | |
| WTEA | I | I | I | I | I | I | I | I | I | | | | | | |
| WTEB | I | I | I | I | I | I | I | I | I | | | | | | |
| WTEC | C,C,I | I,I,I | C,C,I | C,C,I | C | | | C,C | C | | | | C | | |
| WTED | I,I,I | I,I,I | I,I,I | I,I,I | I | I | I | I,I,I | I | | | I | I | | |
| WTEE | I | I | I | I | I | | | I,I | I | | | | | | |
| WTEF | I | I | I | I | I | I | I | I | I | | | | | | |
| WTEG | I,I | I,I | I,I | I,I | I,I | | | I | I | | | | | | |
| WTEK | I | I | I | I | I | | | I | I | | | | | | |
| WTEO | I | I | I | I | I | | | I | I | | | | | | |
| WTEP | C,C,C | C,C,C | C,C,C | C,C,C | C | | | C,C | C | | | C | C | | |
| WTER | I,I,I | I,I,I | I,I,I | I,I,I | I | I | I | I | I | | | | | | |
| ZMFR | | | C | C | C | | | C | C | I | | I,I | I,I | | |

(Table 4: cont'd)

## 5. Plans for 2023

As the SAMOS initiative continues its second decade, the SAMOS chairman would like to personally thank all the technicians, operators, captains, and crew of the SAMOS research vessels for their dedication to the project. In 2023, we continue to see the dedication of the vessel operators to provide high-quality underway observations and are pleased to continue to expand our two-way communications between the vessel operators/technicians and DAC personnel. The DAC team would also like to thank personnel within our funding agencies (see page 3), 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; https://www.rvdata.us/) project. Funded by the National Science Foundation, R2R has developed procedures 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. So far in 2023, the university-operated vessels contributing to the SAMOS DAC were those operated by 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. Over the next year, we will continue to collaborate with R2R and the team at Oregon State University leading the build of the Regional Class Research Vessels (RCRVs) to test SAMOS data and metadata flow from the RCRVs and to develop general best practices for underway science flow-through systems. We also plan to work with R2R to update our procedural documentation and revise our metadata forms and instructions.

In 2023, we will continue to retool the SAMOS data ingestion and processing system to take full advantage of the 5$^{th}$ version of NOAA's Scientific Computer System (SCS) software. The big advancement is that we will be receiving daily device metadata XMLs in addition to the daily SAMOS data exchange files. This will allow the SAMOS team to automatically update our device metadata profile when changes are discovered and ensure the metadata are properly linked to the observations in the SAMOS netCDF files. As with any new software, there are ongoing "growing pains," and we are working with the NOAA technicians and developers to debug SCS5 and to modify our automated metadata ingestion procedures. We note that a similar daily device metadata XML is being used by OSU as part of the RCRV data acquisition system, and we plan to further test SAMOS metadata ingestion processes for the R/V *Taani*, the first RCRV which was recently floated.

We also plan to meet virtually many operators providing SAMOS observations in 2023 to review and update their respective instrumental metadata and to discuss any questions the operators may have regarding meteorological sensor selection, placement, etc. Frequent dialog with the operators results in fewer data problems and the up-to-date metadata benefits both the SAMOS team for our quality evaluation and the downstream data users.

## 6. References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**Ship schedule references, publicly available only:**

IMOS data availability is found online at http://opendap.bom.gov.au:8080/thredds/catalog/imos_samos_archive/catalog.html (*Investigator* and *Tangaroa)*

R2R vessels are found online at http://www.rvdata.us/catalog (*Falkor*)

UNOLS vessels are found online at https://strs.unols.org/public/search/diu_all_schedules.aspx?ship_id=0&year=2020 (most other non-NOAA vessels)

## Annex A: Notifications and Data Subsets with Verified Issues, Unflagged or Only Partially Flagged (listed by vessel)

The vessels listed here do not receive visual quality control. As such, this compilation relies almost entirely on notifications sent to the DAC by vessel operators or email exchanges initiated by the DAC; in many cases the exact cause of any issues and/or the exact date range under impact are unknown.

*Atlantic Explorer:*

- Probably ~20220328 – 20220413: sensor failure; T2 should not be used
- Before ~1100 UTC on 20220413: sea water pumps and/or thermosalinographs assumed secured while in/leaving port; TS, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 20220616 – 20220618: sea water pumps assumed secured while in port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 1021 - ~2245 UTC 20220627: sea water pumps assumed secured while in port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- ~1000 - ~1130 UTC 20220713: sea water pumps assumed secured while in port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- Before ~2000 UTC on 20220721: sea water pumps assumed secured while in/leaving port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- ~2030 UTC 20220729 – 20220730: sea water pumps assumed secured while approaching/in port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- ~0000 - ~1630 UTC 20220803: sea water pumps assumed secured while in/leaving port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- After ~0915 UTC on 20220905: sea water pumps assumed secured while approaching/in port; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2
- ~0400 UTC 20221014 – 1544 UTC 20221016: sea water pumps assumed secured while underway; TS, TS2, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used

*Atlantis*:

- 20220206: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- Before 1200 UTC on 20220208: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- 1100 UTC 20220209 – end time not logged 20220215: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- 20220421 – 20220424: unknown issue causing large steps in long wave radiation data at various times; any unflagged RAD_LW should be used with caution

- ~0830 UTC 20220501 – ~1130 UTC 20220504: sea water pump assumed secured while approaching/in port; TS2, SSPS, CNDC should not be used
- 20220507: a few brief periods of constant-valued wind data (cause not confirmed); any constant-valued DIR2, DIR3, SPD2, SPD3, PL_WDIR2, PL_WDIR3, PL_WSPD2, and PL_WSPD3 should not be used.
- ~1245-1255 UTC 20220513: port anemometer wind speed high (25-30 m/s) bias in comparison to starboard anemometer; SPD2, PL_WSPD2 likely should not be used
- ~1000 UTC 20220615 - 20220630 (possibly later): sea water pump and/or thermosalinograph assumed secured while approaching/in port; TS2, SSPS, CNDC should not be used
- ~2000 - ~2015 UTC 20220625: discrete ~100 W/m2 step in long wave radiation, possibly result of Met mast being lowered in port; RAD_SW and RAD_LW should be considered suspect
- ~1230 - 1630 UTC 20220626: instrument tower lowered for maintenance; P2, P3, T2, T3, RH2, RH3, PL_WDIR2, PL_WDIR3, PL_WSPD2, PL_WSPD3, DIR2, DIR3, SPD2, SPD3, PRECIP2, PRECIP3, RRATE2, RRATE3, RAD_SW, RAD_LW should not be used (RAD_LW additionally should not be used until after ~2000 UTC on 20220626 due to incorrect calibration info in sensor firmware)
- ~1100 UTC 20220717 – ~1000 UTC 20220719: sea water pump assumed secured while approaching/in port; TS2, CNDC, SSPS should not be used
- ~1200 UTC 20220723 – ~1645 UTC 20220726: sea water pump assumed secured while approaching/in port; TS2, CNDC, SSPS should not be used
- ~0600 UTC 20220730 – ~1730 UTC 20220803: sea water pump and/or thermosalinograph assumed secured while on station; TS2, CNDC, SSPS should not be used
- ~0430 - ~0830 UTC 20220806: sea water pump assumed secured; TS2, SSPS, CNDC should not be used
- ~1300 UTC 20221009 – ~1510 UTC 20221013: sea water pump assumed secured while in port; TS2, CNDC, SSPS should not be used
- ~-0900 UTC 20221014 – ~1500 UTC 20221015: sea water pump assumed secured while on station; TS2, SSPS, CNDC should not be used
- 20221020 – 20221025: breaker for sea water pumps reported to be repeatedly tripping; TS2, SSPS, CNDC should be used with extreme caution
- ~1230 UTC 20221101 – 2359 UTC 20221110: sea water pump assumed secured while in port; TS2, CNDC, SSPS should not be used
- 20221107 – 20221110: radiometer data reported to be likely affected by bright lights in port; RAD_SW and RAD_LW should be used with caution, any positive nighttime RAD_SW should not be used
- ~1200 UTC 20221125 – ~1300 UTC 20221204: sea water pump assumed secured in Panama Canal; TS2, SSPS, CNDC should not be used

*Healy:*

- ~2000 UTC 20220711 – ~1600 UTC 20220712: sea water pumps assumed secured while leaving port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used
- All day 20220717 – ~0700 UTC 20220719: sea water pumps assumed secured while in port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used
- All of 2022: EE260 temperature/relative humidity gauge has a built-in heater, consequently T and RH occasionally differ from T2/T3 and RH2/RH3; where T/RH do not agree with T2/T3/RH2/RH3 preference should be given to T2/T3/RH2/RH3
- ~1630 UTC 20220723 – ~0030 UTC 20220728: sea water pumps assumed secured while in port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used
- Start date not logged but likely entire 2022 field season: sea temperature from SBE 48 hull contact sensor too high, sensor found to have pulled away from hull on or around 20220814; TS4 should not be used (note TS4 discontinued from SAMOS processing after 20220813)
- 20220825 (probably earlier) – ~2050 UTC 20220828: low biases noted in bridge top E+E Elektronik EE60 air temperature and humidity as compared to other two temp/humidity sensors, bridge top EE60 noted to have been mostly iced up for weeks; T3 and RH3 likely should not be used and preference should be given to T/T2/RH/RH2
- 20221014 (and earlier) – 20221016: occasional spikes/steps observed in all sea water variables as well as slight negative bias observed in SBE 3S intake sea temperature, vessel likely in ice; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should be used with caution
- ~1600 UTC 20221103 – ~0045 UTC 20221108: sea water pumps assumed secured while approaching/in port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used

*Investigator*:

- 20220309 – 20220313: short wave and long wave radiation acquisition device required restart (data = 0); RAD_SW, RAD_LW should not be used
- 20220318 – rest of 2022: ISAR radiometer sometimes low bias in comparison to intake sea temperature; use TS2 with caution whenever it differs from TS by > 1° C
- 20220601 – 20220909: port rain gauge blocked; PRECIP2 should not be used
- 0000 - ~0210 UTC 20220714 : thermosalinograph assumed secured while leaving port; SSPS should not be used
- Before ~2200 UTC on 20220726: SBE 38 sea temperature data too low; unflagged and G-flagged data should be considered highly suspect

*Kilo Moana*:

- 20220205 (possibly earlier) – rest of 2022: Vaisala weather station exposure issue with stern relative wind angle; P2, T2, DIR3, SPD3 should be used with caution when PL_WDIR is ~180-200° (observed steps should not be used)

- 20220606 – rest of 2022: Vaisala weather station suspected of not reporting rain correctly; PRECIP3, RRATE2 should be considered suspect
- Before ~1845 UTC on 20220729: sea water pump and/or thermosalinograph assumed secured while in/leaving port; TS, TS2, SSPS, CNDC should not be used
- Before ~1900 UTC on 20220804: sea water pump and/or thermosalinograph assumed secured while in/leaving port; TS, TS2, SSPS, CNDC should not be used
- ~0430 - ~0600 UTC 20220810 (likely others): clear case of stack exhaust contamination when relative wind angle shifts to/from the stern, steps observed in air temperature and relative humidity; T, T2, RH, RH2 should be used with caution when relative wind is from the stern

*Laurence M. Gould*:

- ~1730 UTC 20220127: spikes in T/RH and PAR due to sensor cleanings; PAR, T, RH should not be used
- 20220228 – 20220303: PL_WDIR and PL_WDIR2 constant-valued; PL_WDIR and PL_WDIR2 should not be used, DIR, DIR2, SPD, SPD2 should be used with caution
- ~1245 UTC 20220410 – 20220422: sea water pump assumed secured while in EEZ; TS, CNDC, SSPS should not be used
- ~1600-2130 UTC 20220416 and ~0000-1800 UTC 20220417: PL_WDIR and PL_WDIR2 constant-valued; PL_WDIR and PL_WDIR2 should not be used, DIR, DIR2, SPD, SPD2 should be used with caution
- After 0122 UTC on 20220515: sea water pump assumed secured while in EEZ; TS, SSPS, CNDC should not be used
- ~1630 UTC 20220601 – 1220 UTC 20220607: PL_WDIR and PL_WDIR2 constant-valued (acquisition script restart required); PL_WDIR and PL_WDIR2 should not be used, DIR, DIR2, SPD, SPD2 should be used with caution
- 20220601 – 20220615: sea water pump assumed off while in EEZ/transit to shipyard; TS, SSPS, CNDC
- ~1445 - ~2330 UTC 20220714: PL_WDIR and PL_WDIR2 constant-valued (0°); PL_WDIR and PL_WDIR2 should not be used, DIR, DIR2, SPD, SPD2 should be used with caution
- ~1645 UTC 20220713 – ~1430 UTC 20220718: sea water pump assumed secured while in EEZ; TS, SSPS, CNDC should not be used
- ~2030 UTC 20221203 – 2359 UTC 20221231: PL_WDIR and PL_WDIR2 constant-valued; PL_WDIR and PL_WDIR2 should not be used, DIR, DIR2, SPD, SPD2 should be used with caution

*Nathaniel B. Palmer*:

- Roughly 0700 - 1400 UTC, 1700 - 1900 UTC, and 2230 - 2330 UTC on 20220507 and 0000 - 1200 UTC on 20220508: suspected network crash caused all variables to flatline; all constant-valued data should not be used
- ~0000 - 1200 UTC on 20220610: ~2 mb steps in pressure observed when ship turns (possible pressure port icing); P should be used with caution
- ~1420 UTC 20220621 – ~1630 UTC 20220622: sea water pump assumed secured while dockside; TS, SSPS, CNDC should not be used

- ~1100 UTC 20220624 – 20220721: thermosalinograph assumed secured while approaching/mostly in port; TS, SSPS, CNDC should not be used

*Neil Armstrong*:

- All day 20220206 – 1700 UTC 20220208: sea water pump and/or thermosalinograph assumed secured while in port; SSPS, CNDC should not be used
- 1630 UTC 20220214 – 1530 UTC 20220215: sea water pump and/or thermosalinograph assumed secured while in port; SSPS, CNDC should not be used
- 1030 UTC 20220417 – 1030 UTC 20220420: sea water pump and/or thermosalinograph assumed secured while approaching/in port; SSPS, CNDC should not be used
- Start date not logged – 1800 UTC 20220506: sea water pump and/or thermosalinograph assumed secured while in port; SSPS, CNDC should not be used
- 1730 UTC 20220507 – 1945 UTC 20220511: sea water pump and/or thermosalinograph assumed secured while approaching/in port; SSPS, CNDC should not be used
- ~1230 UTC 20220614 – 2015 UTC 20220620: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- ~1400 20220621 – 0915 20220624: sea water pump assumed secured while in EEZ; TS2, SSPS, CNDC should not be used
- ~0500 - ~1400 UTC 20220627: random spikes/steps/noise observed in thermosalinograph data; TS2, SSPS, CNDC should be used with caution
- ~1000 UTC 20220714 – ~1015 UTC 20220722: sea water pump assumed secured while in EEZ/port; TS2, SSPS, CNDC should not be used
- ~0015 UTC 20220812 – ~1230 UTC 20220820: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- ~1300 UTC 20220921 – ~1320 UTC 20220930: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- 20221001 – 20221003: spikes, steps, and "shark tooth" signals observed in SBE 45 variables, pump flow confirmed sporadic due to rough weather; TS2, CNDC, SSPS should be used with extreme caution
- ~1500 UTC 20221016 – ~2030 UTC 20221017: spikes, steps, and "shark tooth" signals observed in SBE 45 variables, pump flow known to be sporadic in rough weather; TS2, CNDC, SSPS should be used with extreme caution
- 20221018 – 20221020: spikes, steps, and "shark tooth" signals observed in SBE 45 variables, pump flow known to be sporadic in rough weather; TS2, CNDC, SSPS should be used with extreme caution
- ~0700 - ~0715 UTC 20221019: brief, noisy step observed in port Vaisala wind data; DIR, SPD, PL_WDIR, PL_WSPD should not be used
- ~0830 UTC 20221022 – ~1420 UTC 20221024: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used

- ~1200 UTC 20221031 – ~1810 UTC 20221109: sea water pump assumed secured while approaching/in port; TS2, CNDC, SSPS should not be used
- ~1130 UTC 20221122 – rest of 2022: sea water pump assumed secured while approaching/in port; TS2, CNDC, SSPS should not be used

*Robert Gordon Sproul*:

- 0619 UTC 20220206 – 20220215 (possibly later): sea water pump assumed secured while mostly in port; TS2, SSPS, CNDC should not be used
- 20220506 (probably earlier) – 20220515 (possibly later): sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- ~1940 UTC 20220623 – ~1500 UTC 20220630: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- After ~2200 UTC 20220630 – end date not logged: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- All day 20220701 – ~1630 UTC 20220722: sea water pump assumed secured while in and out of port; TS2, SSPS, CNDC should not be used
- ~1500 UTC 20220725 – ~1930 UTC 20220728: sea water pump assumed secured while approaching/in port; TS2, SSPS, CNDC should not be used
- ~0100 - ~2130 UTC 20220804: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- Before ~1320 UTC on 20220805: sea water pump may have been (re)started underway; TS2, SSPS, CNDC should be used with caution
- ~1400 - ~2000 UTC 20220806: sea water pump assumed secured; TS2, SSPS, CNDC should not be used
- 20220902 (probably earlier) – ~2000 UTC 20220906: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- All day 20220920 – ~1720 UTC 20220930: sea water pump assumed secured while transiting/in port; TS2, SSPS, CNDC should not be used
- ~1500 UTC 20221021 – ~1650 UTC 20221116: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used
- 20221117 – rest of 2022: sea water pump assumed secured while in port; TS2, SSPS, CNDC should not be used

*Roger Revelle*:

- 20220121 – 20220129 sea water pump secured while in EEZ; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 2150 UTC 20220413 – all day 20220430: sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 20220516 – 20220614: primary relative humidity sensor reads several % points higher than secondary relative humidity sensor and primary tends to reach saturation (100%) when secondary is in the mid 90% range; RH should be used with caution
- 20220610 – 20220613: sea water pump assumed secured while approaching/in port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used

- ~0400 UTC 20220716 – ~1700 UTC 20220722: sea water pump assumed secured while approaching/in port; TS, TS2, TS3, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~2030 UTC 20220725 – ~1930 UTC 20220727: sea water pump assumed secured while approaching/in port; TS, TS2, TS3, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~1430 UTC 20220729 – ~2315 UTC 20220801: sea water pump assumed secured while approaching/in port; TS, TS2, TS3, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~1730 UTC 20220803 – ~2030 UTC 20220804: sea water pump assumed secured while approaching/in port; TS, TS2, TS3, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~1600 UTC 20220806 – ~1900 UTC 20220807: sea water pump assumed secured while approaching/in/leaving port; TS, TS2, TS3, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~1500 – 2359 UTC 20220813: all variables flatlined; data should not be used
- 0000 UTC 20220902 (probably earlier) – ~1430 UTC 20220904: sea water pump assumed secured while in port; TS, TS2, TS3, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~1430 20220904 – end date not logged: pump for aft hydrolab SBE 45 thermosalinograph assumed secured (reason unverified); TS2, CNDC2, SSPS2 should not be used
- Start time not logged 20220906 – end date not logged: bow thruster pump assumed secured (reason unverified); TS, TS3, SSPS, CNDC should not be used
- 20220901 – 20220902: random spikes and missing data observed in all MET/TSG variables due to internal network outage; any MET/TSG data should be used with caution
- 20221028 – rest of 2022: short wave and photosynthetically active radiation values incorrect (confirmed); RAD_SW (most/all already B-flagged) and RAD_PAR should not be used.
- 20221028 – 20221103: exhaust piping for bow thruster room waterwall discovered to have been removed during shipyard; TS, TS3, CNDC, SSPS should not be used
- All day 20221128 – ~0400 UTC 20221202: sea water pump assumed secured while in port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used

*Sally Ride*:

- Start time not logged 20220103 – 1700 UTC 20220105: sea water pump secured due to rough seas; TS2, SSPS2, CNDC2 should not be used.
- ~0845 UTC 20220119 – 1800 UTC 20220120: sea water pump assumed secured in EEZ; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used.
- 20220206 (possibly earlier) – 20220215 (possibly later): sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 20220202 (possibly earlier) – ~2200 UTC 20220214: radiometers not installed (data still reported); RAD_SW, RAD_LW, RAD_PAR should not be used

- 20220201 (possibly earlier) – ~20220223: mast work reported ongoing during this period, with bow mast confirmed lowered on 20220214; P, P2, T, T2, T3, RH, RH2, DIR, SPD, PL_WDIR, PL_WSPD, PRECIP, RAD_LW, RAD_SW, RAD_PAR should be used with caution, except 20220214 all above should not be used
- 20220327 – end date not logged (but at least until 20220623): sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 20220413 (probably earlier) – end date not logged: sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- 20220627 – 20220630; Trimble BD982 data invalid; PL_SPD, SPD, DIR should not be used
- ~2330 UTC 20220710 – ~2030 UTC 20220715: sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2
- ~1900 UTC 20220813 – ~1540 UTC 20220816: sea water pump assumed secured while approaching/in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- ~2000 UTC 20220822 – ~1650 UTC 20220827: sea water pump assumed secured while approaching/in port; TS, TS2, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~2000 - ~2200 UTC 20220907: sea water pump confirmed secured; TS2, SSPS2, CNDC2 should not be used
- 0000 UTC 20220912 – ~2330 UTC 20220915: sea water pump assumed secured while in port; TS, TS2, CNDC, CNDC2, SSPS, SSPS2 should not be used
- 0000 UTC 20220923 – ~1700 UTC 20221010: sea water pump assumed secured while in port; TS, TS2, CNDC, CNDC2, SSPS, SSPS2 should not be used
- 20220923 – 20221122: anemometer installed with 180-degree (stern) mark pointing towards 270 degrees (port side), all reported platform relative wind directions rotated 90 degrees clockwise from actual direction; PL_WDIR, DIR, and SPD should not be used, however user may be able to correct offset and recalculate true winds if desired
- ~1740 UTC 20220923 – end time not logged 20221005: instrument mast lowered for maintenance/repair; PL_WDIR, PL_WSPD, DIR, SPD, P, P2, T, T2, T3, RH, RH2, PRECIP, RAD_SW, RAD_LW, RAD_PAR should not be used
- ~1330 - ~2100 UTC 20221015: sea water pump assumed secured while in port; TS, TS2, TS3, SSPS, SSPS2, CNDC, CNDC2 should not be used
- ~2230 UTC 20221018 – ~2130 UTC 20221019: sea water pump assumed secured while approaching/in port; TS, TS2, CNDC, CNDC2, SSPS, SSPS2 should not be used
- ~1645 - ~1730 UTC 20221020: pronounced shark fin curve observed in main lab thermosalinograph data, sea water pump assumed lost suction; TS2, SSPS2, CNDC2 should not be used

- Start time not logged - ~2030 UTC on 20221021: sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used
- Start time not logged 20221023 – ~1545 UTC 20221105: sea water pump assumed secured while in port; TS, TS2, SSPS, SSPS2, CNDC, CNDC2 should not be used

*Sikuliaq*:

- ~1340 - 2359 UTC 20220701: thermosalinograph assumed secured while approaching/in port; TS, TS3, TS4, SSPS, SSPS2, CNDC, CNDC2 should not be used
- ~0700 - ~0730 UTC on 20220713 and ~0400 - ~1000 UTC on 20220714 and ~0600-~1230 UTC on 20220716: random spikes/noise observed in port RM Young anemometer, possible bird interference with anemometer; DIR2, PL_WDIR2, SPD2, PL_WSPD2 should be used with caution
- 20220728 – 20220731: IR skin temperature sensor may have been pointing at the dock; any unflagged TS2 should be used with extreme caution
- ~1510 UTC 20220822 – ~1840 UTC 20220826: thermosalinograph assumed secured while approaching/in port; TS, TS3, TS4, CNDC, CNDC2, SSPS, SSPS2 should not be used
- 20221014 (probably earlier): poor agreement between radiometric sea temperature and other sea temperatures, vessel may have been in ice; use TS2 with extreme caution

*Tangaroa*:

- ~0430 - ~0900 UTC on 20220803 and ~1230 - ~1545 UTC on 20220808: suspect sea water pump may have been secured underway; use TS with caution

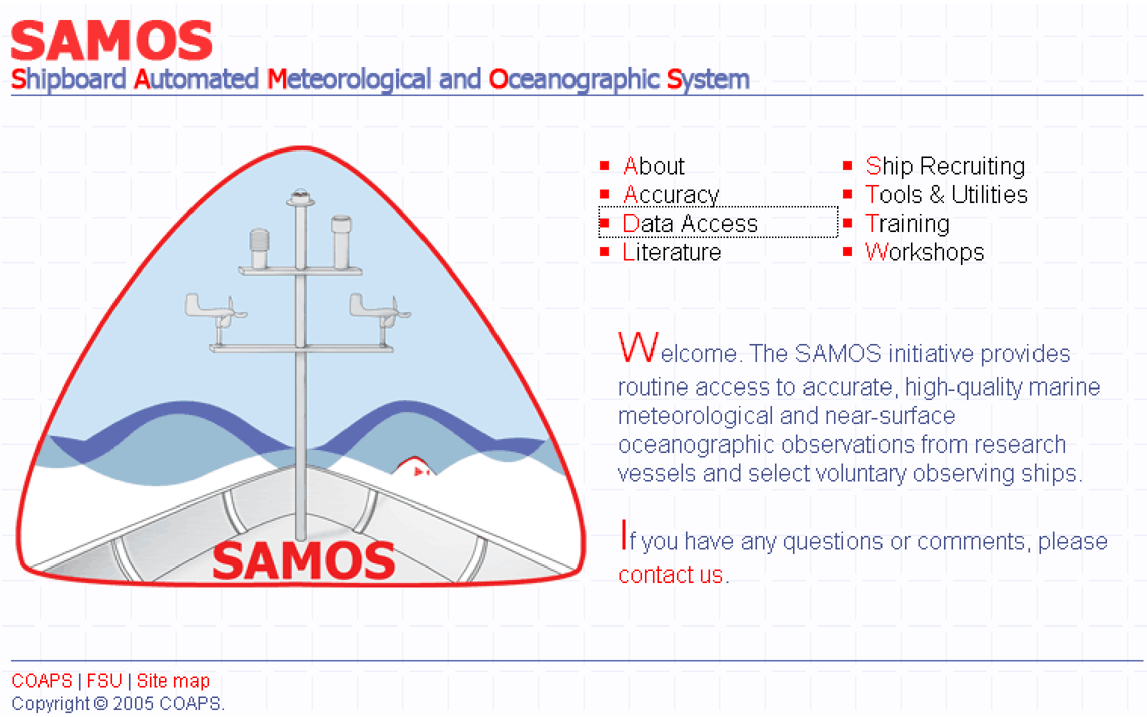
*T.G. Thompson*:

- ~1200 and ~2130 on 20220419 and ~2030 on 20220420: some large (40-50+ m/s) spikes observed in wind speeds, may have had birds roosting on mast (known issue); SPD and PL_WSPD should be used with extreme caution

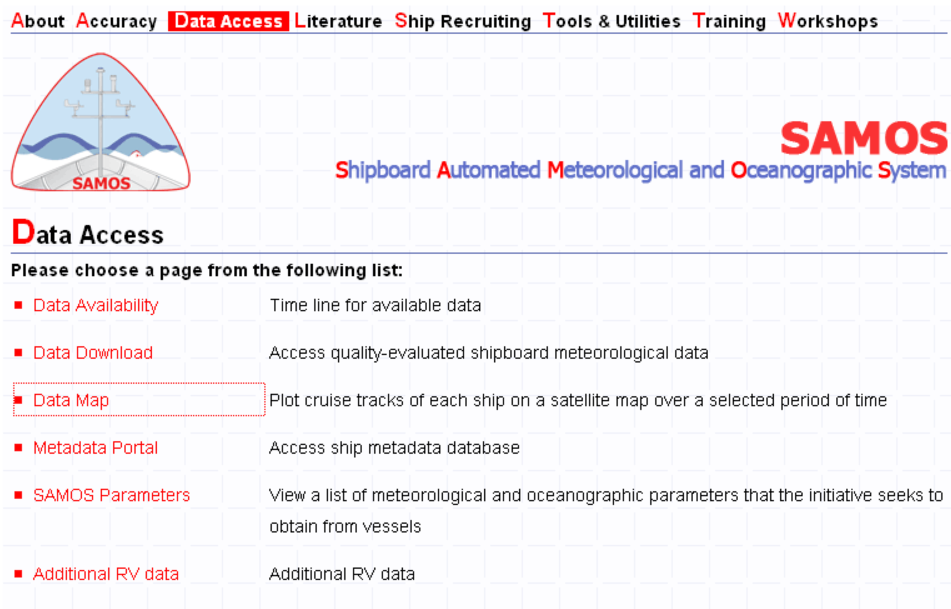
Annex B: SAMOS Online Metadata System Walk-through Tutorial

PART 1: the end user

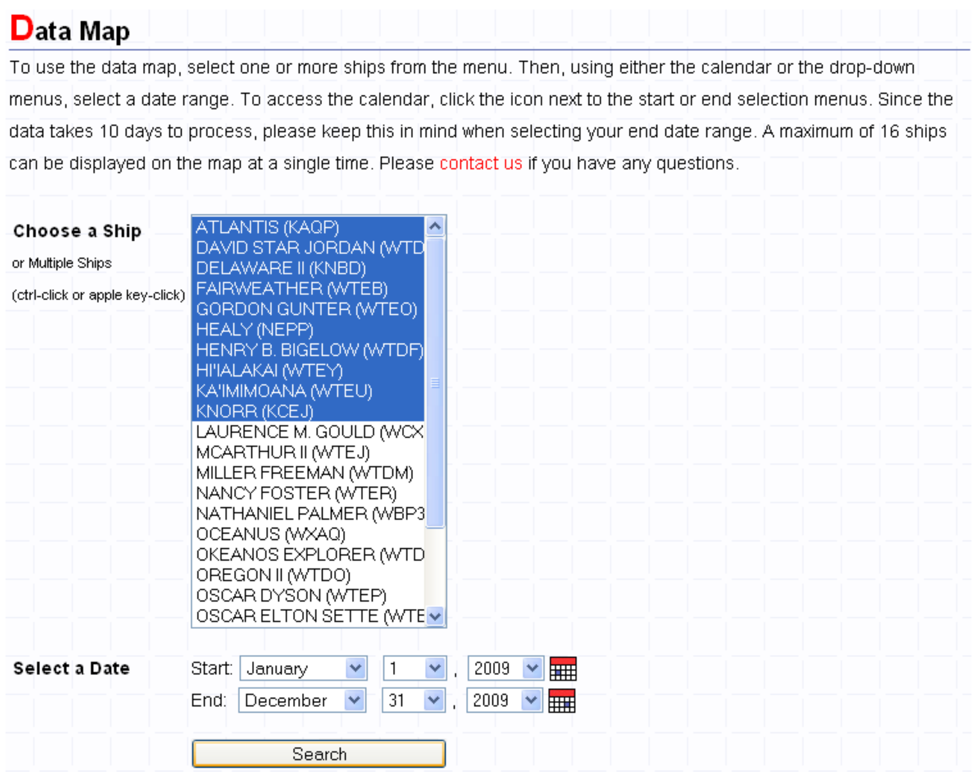
The SAMOS public website can be entered via the main page at
[http://samos.coaps.fsu.edu/html/](http://samos.coaps.fsu.edu/html/)




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:




The user highlights a set of ships from the available list (16 ships may be chosen at a time):



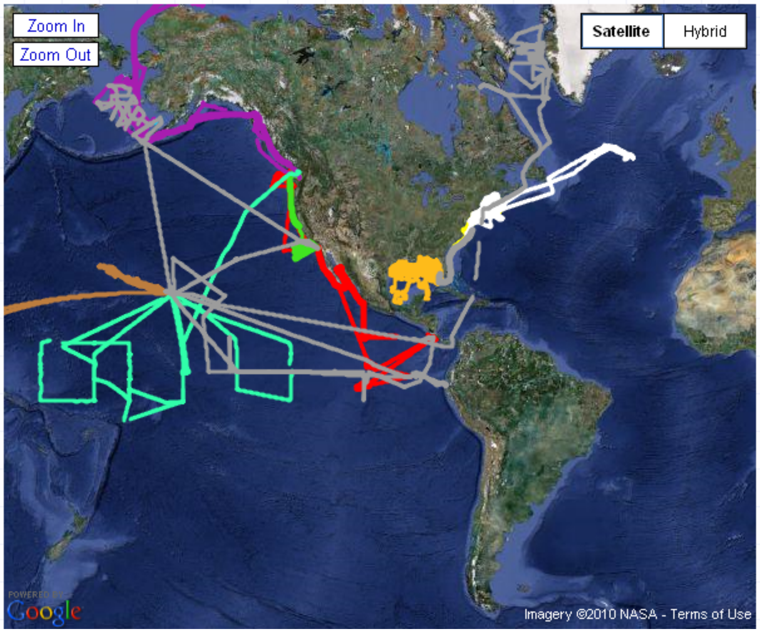

** NOTE: THE MAP TOOL IS IN THE PROCESS OF BEING UPDATED AND IS CURRENTLY NOT FUNCTIONING AS EXPECTED. THE PRESENT TOOL WILL CREATE MAPS FOR A SINGLE SHIP AND SHORT PERIOD OF TIME, BUT IT IS VERY SLOW TO GENERATE THE PLOT. WE ARE WORKING TO COMPLETE THIS UPDATE AS SOON AS POSSIBLE.

By entering a date range of January 1, 2009 to December 31, 2009 and clicking "search," a map is displayed showing all 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**




| Ship Key | |
|---|---|
| Atlantis | ☑ |
| David Star Jordan | ☑ |
| Delaware Ii | ☑ |
| Fairweather | ☑ |
| Gordon Gunter | ☑ |
| Healy | ☑ |
| Henry B. Bigelow | ☑ |
| Hi'ialakai | ☑ |
| Ka'imimoana | ☑ |
| Knorr | ☑ |

| Map Controls | |
|---|---|
| On / Off | ☑ |

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

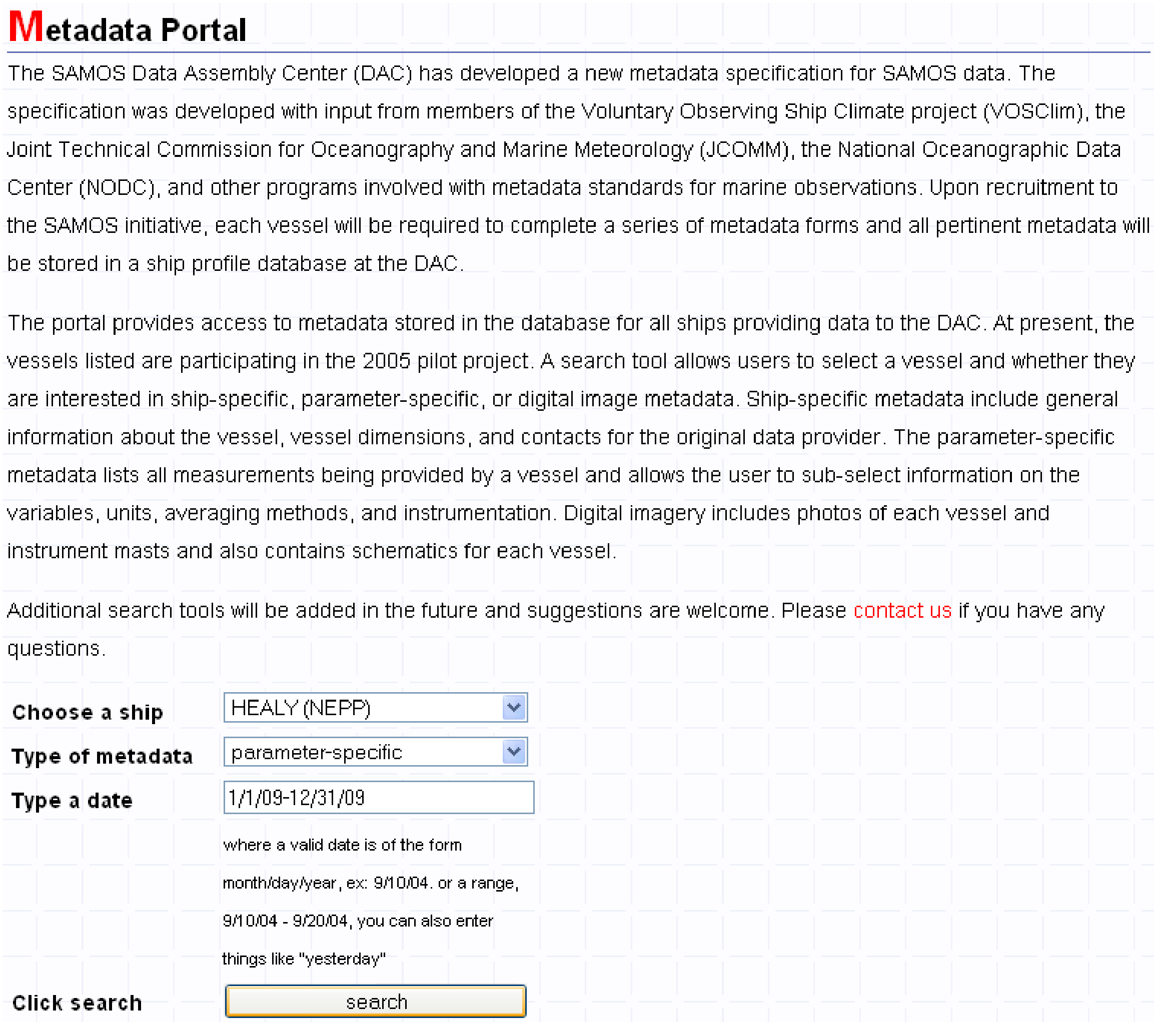
**Please choose a page from the following list:**

| | |
|---|---|
| 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 |

---

** NOTE: THE MAP TOOL IS IN THE PROCESS OF BEING UPDATED AND IS CURRENTLY NOT FUNCTIONING AS EXPECTED. THE PRESENT TOOL WILL CREATE MAPS FOR A SINGLE SHIP AND SHORT PERIOD OF TIME, BUT IT IS VERY SLOW TO GENERATE THE PLOT. WE ARE WORKING TO COMPLETE THIS UPDATE AS SOON AS POSSIBLE.

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



## Metadata Portal

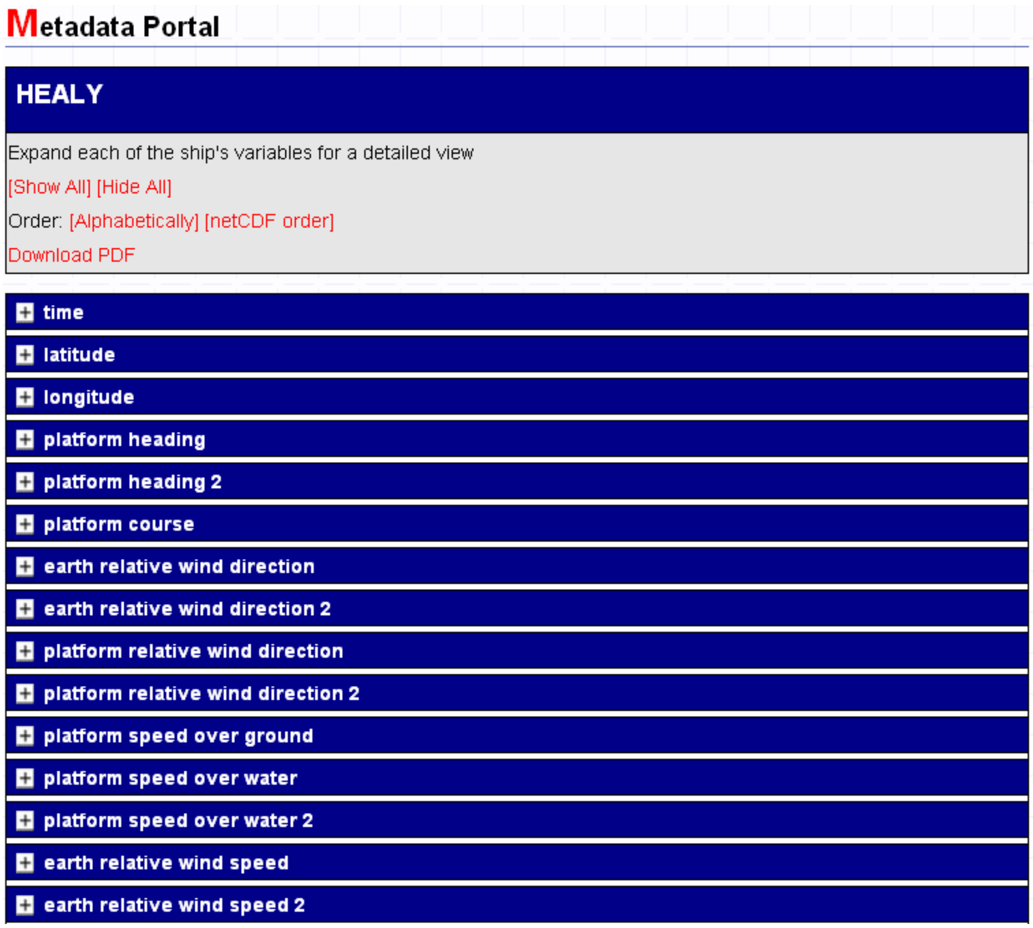
The SAMOS Data Assembly Center (DAC) has developed a new metadata specification for SAMOS data. The specification was developed with input from members of the Voluntary Observing Ship Climate project (VOSClim), the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM), the National 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.

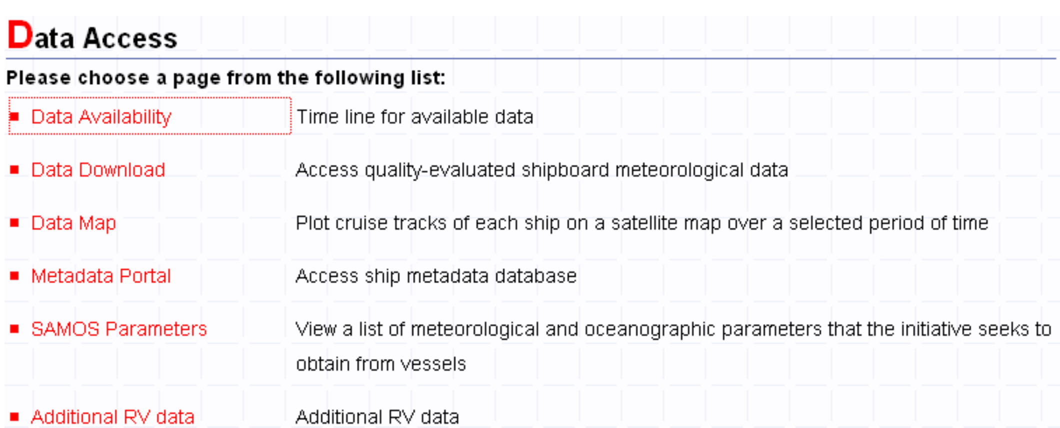
Additional search tools will be added in the future and suggestions are welcome. Please contact us if you have any questions.

| | |
|---|---|
| **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 |

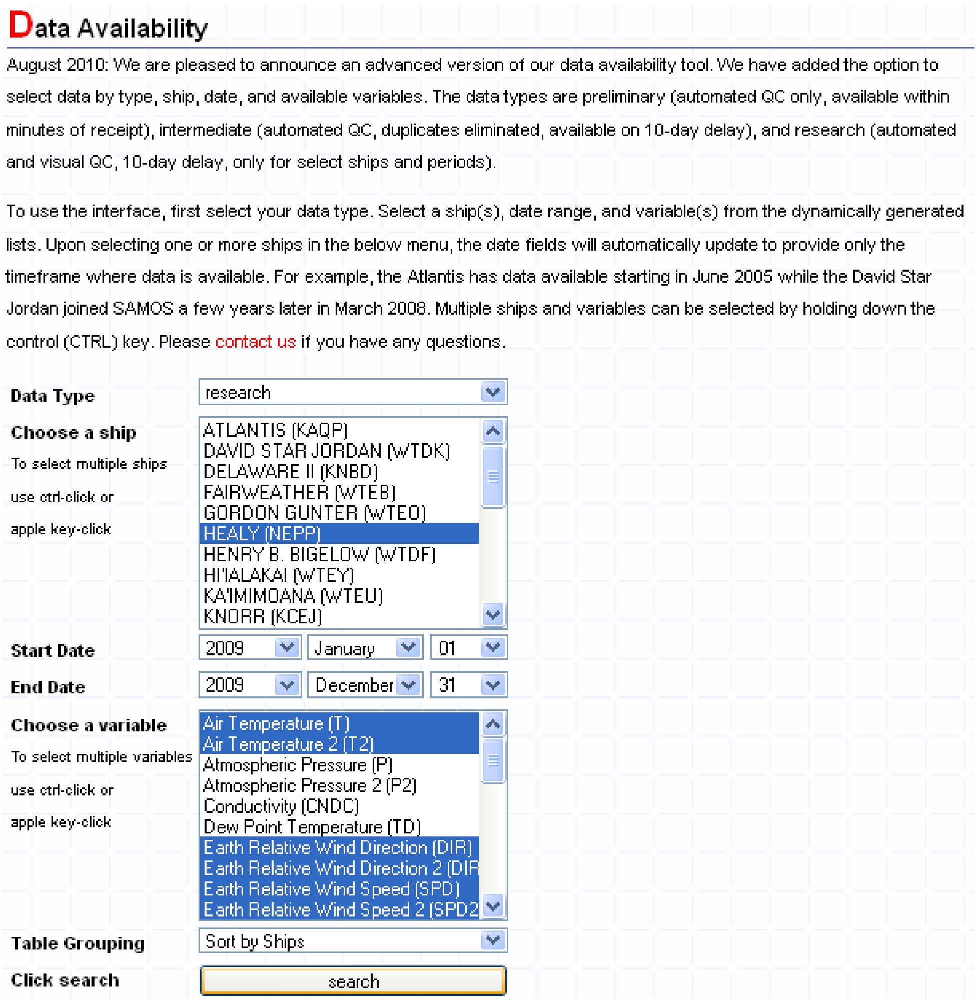
The result, once "search" is clicked, is an exhaustive list of all parameters available from the *Healy* in 2009:



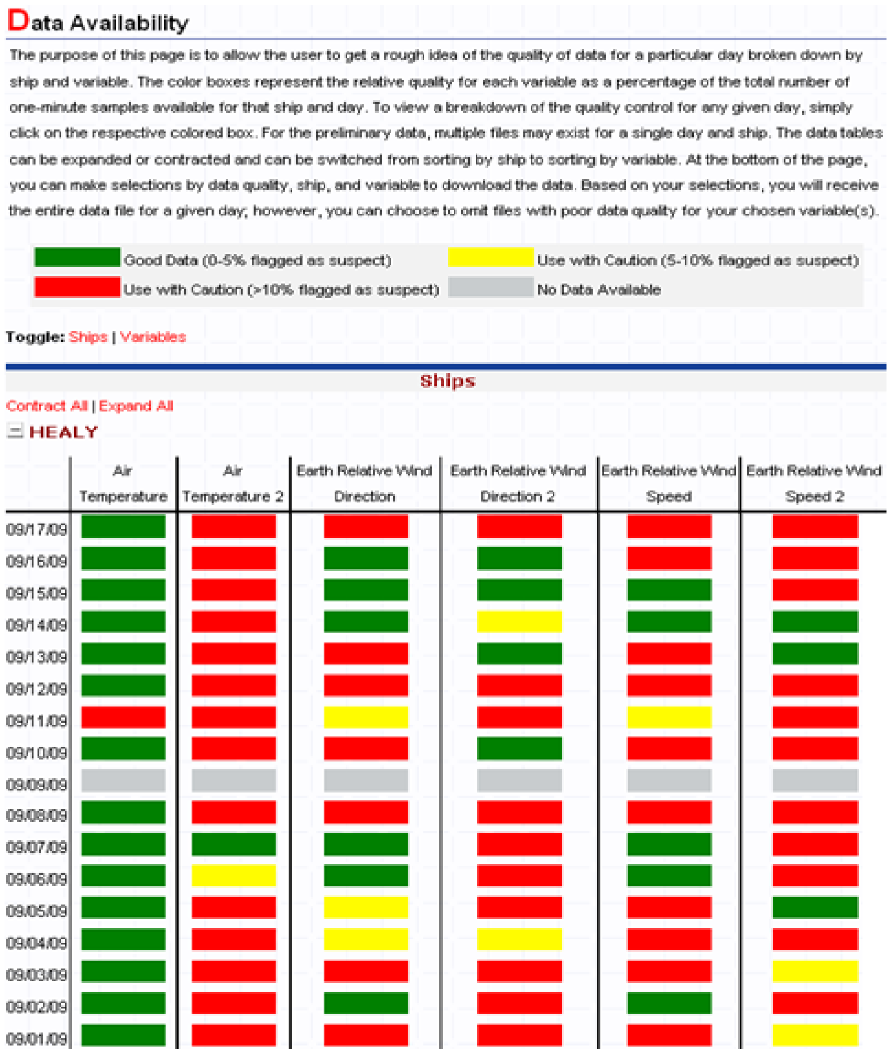

A thorough investigation of the list (note: image is truncated) tells the user the *Healy* did in fact provide both wind and temperature data in 2009. (Throughout the online SAMOS system, clicking on a "+" will yield further information; in this case the result would be metadata for the individual parameters.) 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:



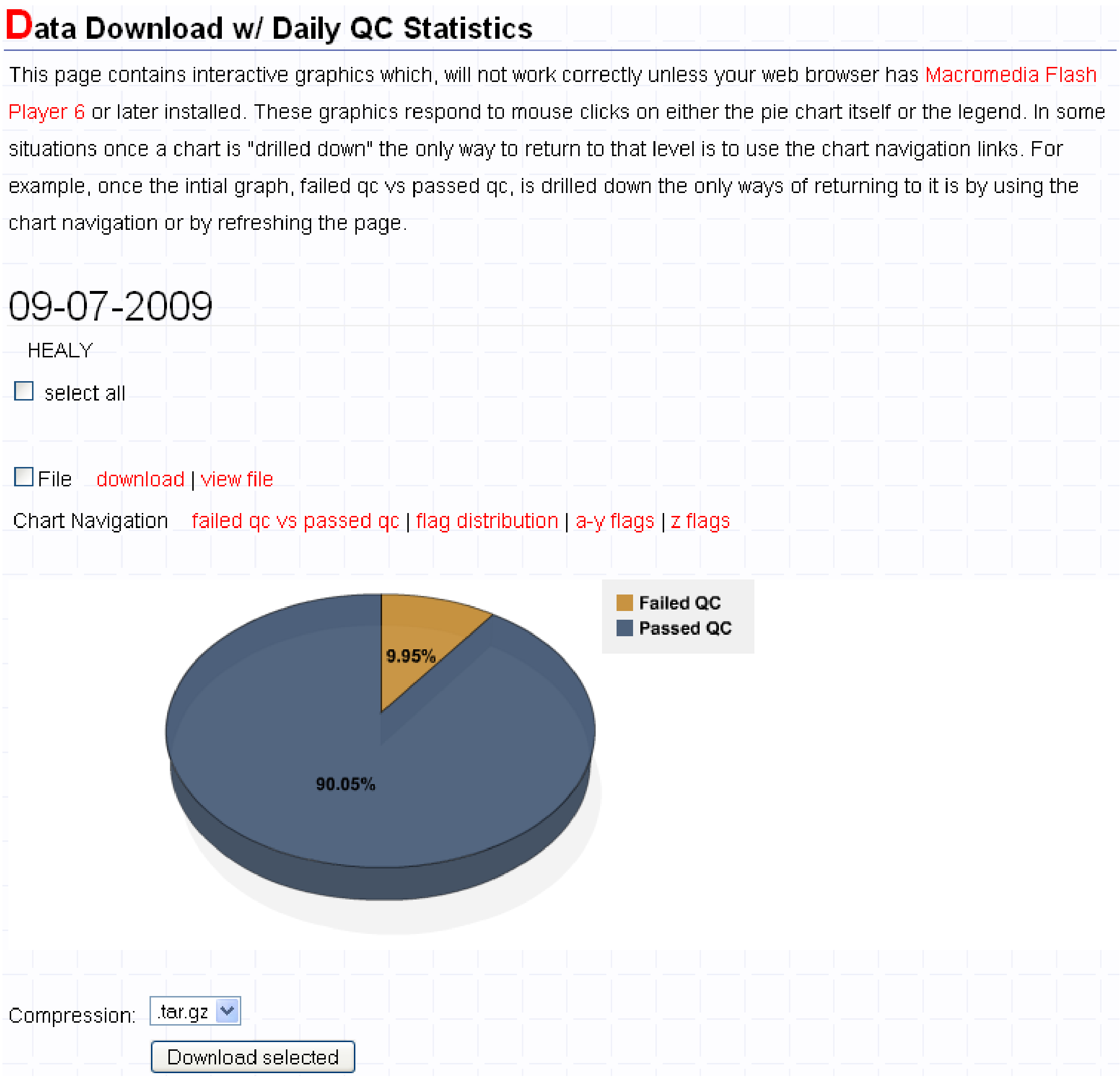
After selecting the *Healy* along with the desired parameter(s), date range, and data version (preliminary, intermediate, or research), noting that the default date range and available parameters will change once a vessel and data version are selected, and then clicking "search":




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 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:

---

** NOTE: THE PIE PLOT TOOL CURRENTLY ONLY WORKS WITH LEGACY FLASH-ENABLED BROWSERS. WE ARE AWARE OF THE PROBLEM, AND WE ARE WORKING ON A FIX.

# 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.

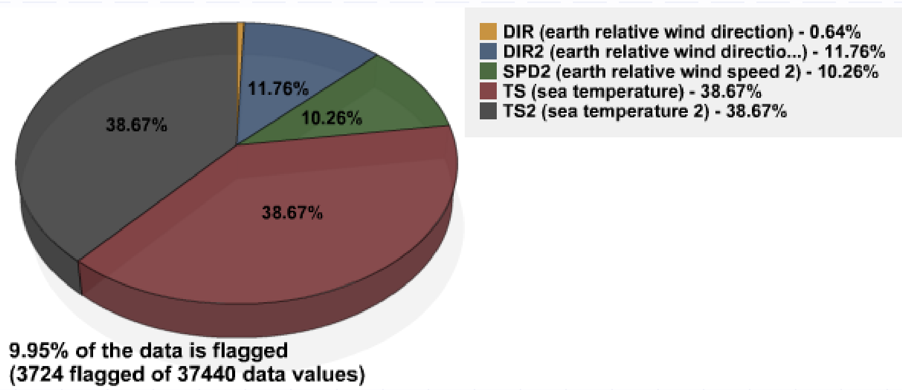
09-07-2009

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

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:

---

** NOTE: THE PIE PLOT TOOL CURRENTLY ONLY WORKS WITH LEGACY FLASH-ENABLED BROWSERS. WE ARE AWARE OF THE PROBLEM, AND WE ARE WORKING ON A FIX.

## **D**ata 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.

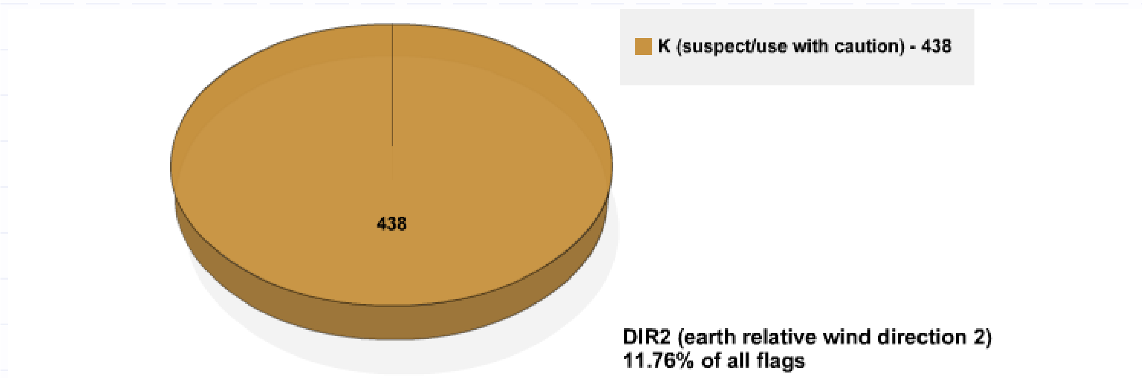
09-07-2009

HEALY

☐ select all

☑ File download | view file

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



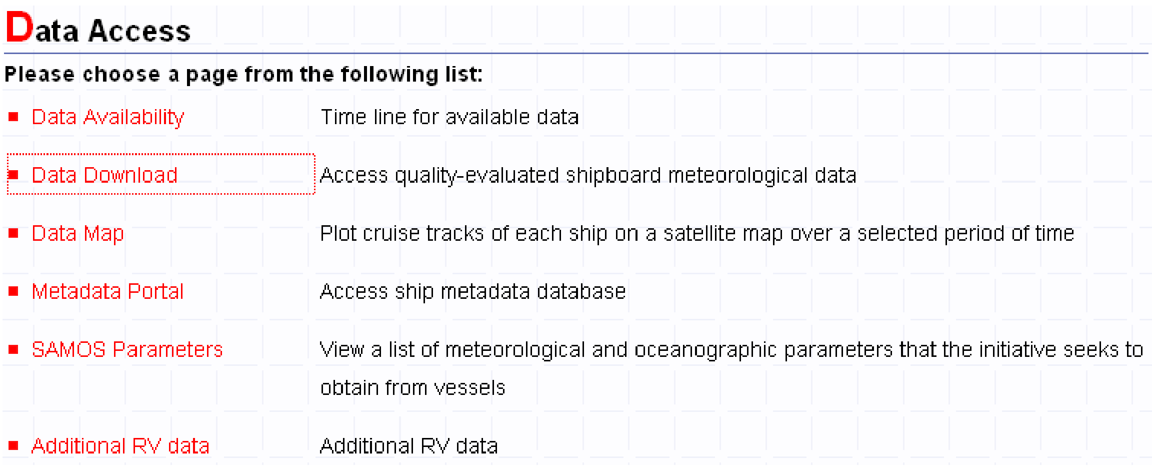

Compression: .zip

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:

---

** NOTE: THE PIE PLOT TOOL CURRENTLY ONLY WORKS WITH LEGACY FLASH-ENABLED BROWSERS. WE ARE AWARE OF THE PROBLEM, AND WE ARE WORKING ON A FIX.

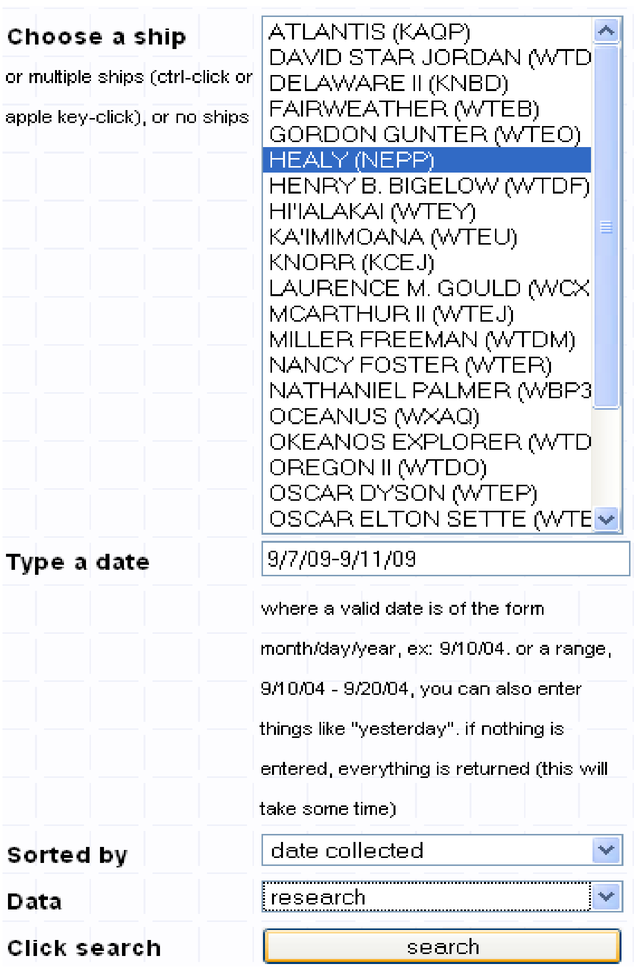


**Data Access**

**Please choose a page from the following list:**

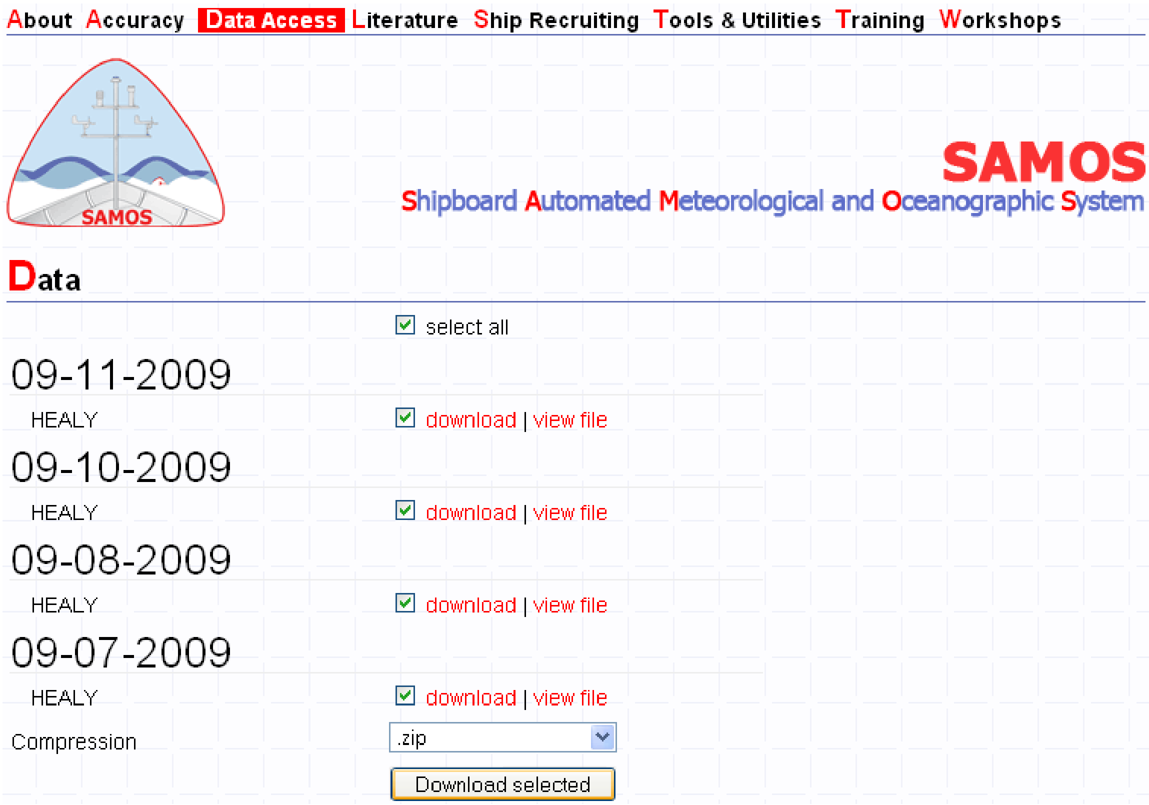
| | |
|---|---|
| Data Availability | Time line for available data |
| Data Download | Access quality-evaluated shipboard meteorological data |
| Data Map | Plot cruise tracks of each ship on a satellite map over a selected period of time |
| Metadata Portal | Access ship metadata database |
| SAMOS 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)<br>DAVID STAR JORDAN (WTD<br>DELAWARE II (KNBD)<br>FAIRWEATHER (WTEB)<br>GORDON GUNTER (WTEO)<br>HEALY (NEPP)<br>HENRY B. BIGELOW (WTDF)<br>HI'IALAKAI (WTEY)<br>KA'IMIMOANA (WTEU)<br>KNORR (KCEJ)<br>LAURENCE M. GOULD (WCX<br>MCARTHUR II (WTEJ)<br>MILLER FREEMAN (WTDM)<br>NANCY FOSTER (WTER)<br>NATHANIEL PALMER (WBP3<br>OCEANUS (WXAQ)<br>OKEANOS EXPLORER (WTD<br>OREGON II (WTDO)<br>OSCAR DYSON (WTEP)<br>OSCAR ELTON SETTE (WTE |
| **Type a date** | 9/7/09-9/11/09<br>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:



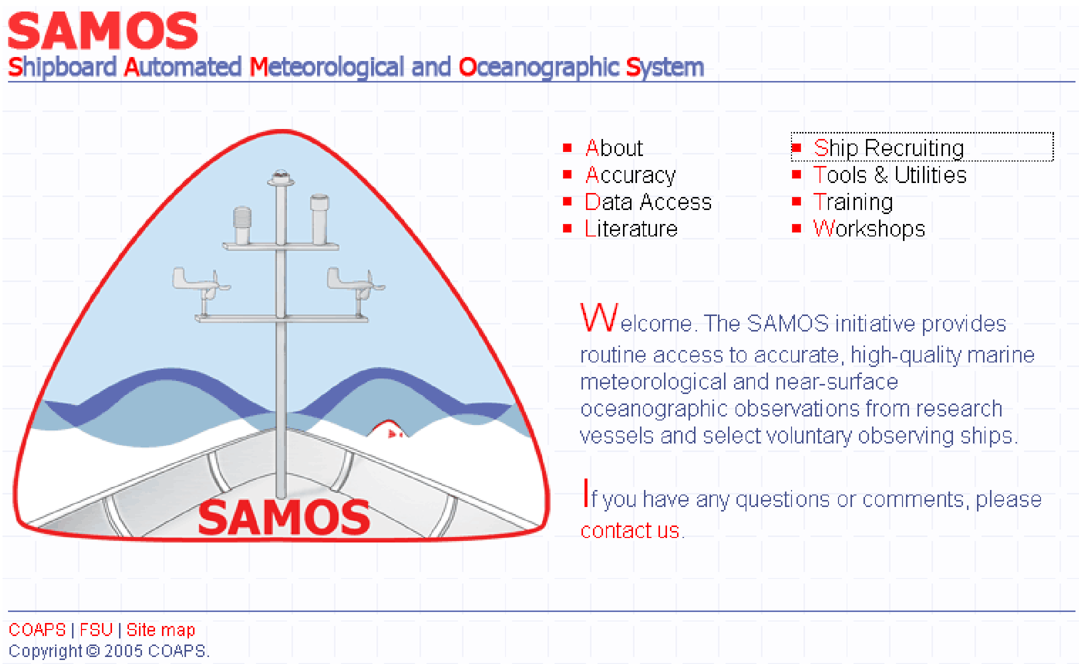

PART 2: the SAMOS operator

**(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)**

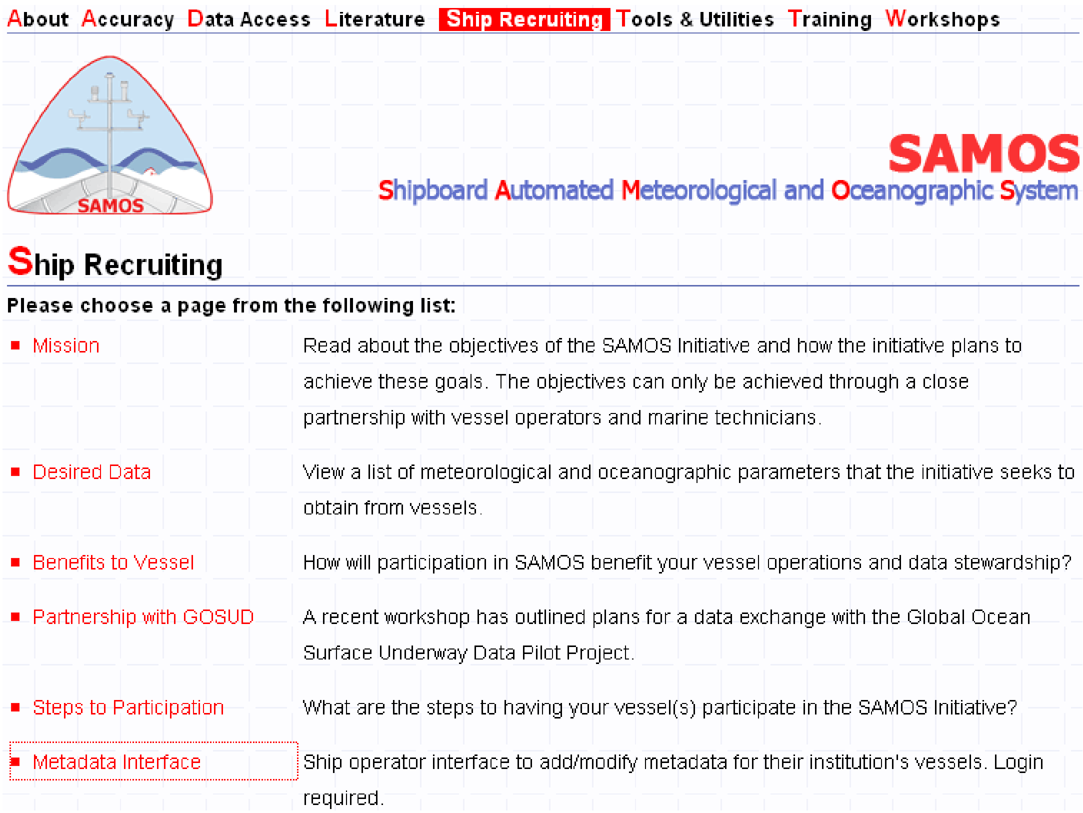
A SAMOS operator might choose to follow the steps outlined in part one as a simple way to track the performance of his instruments. When problems are observed, vessel and instrument metadata are important tools for diagnosing a problem and finding a solution. For this reason, we strongly emphasize the 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.

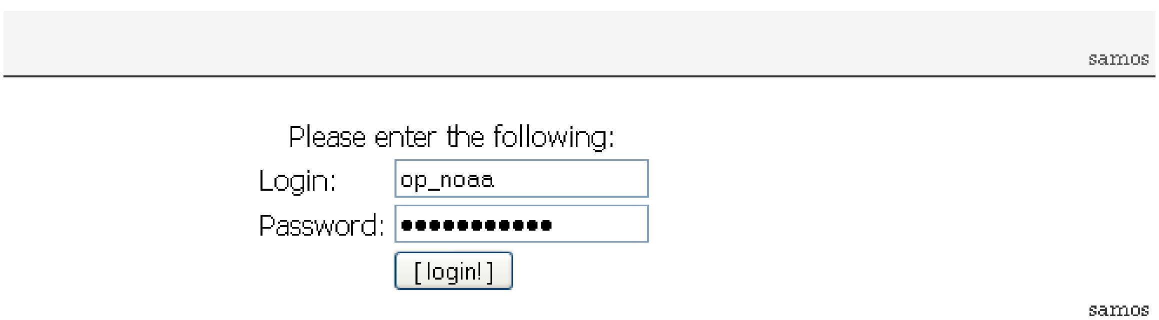
The database can be accessed by visiting the main page and choosing Ship Recruiting:




(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] |

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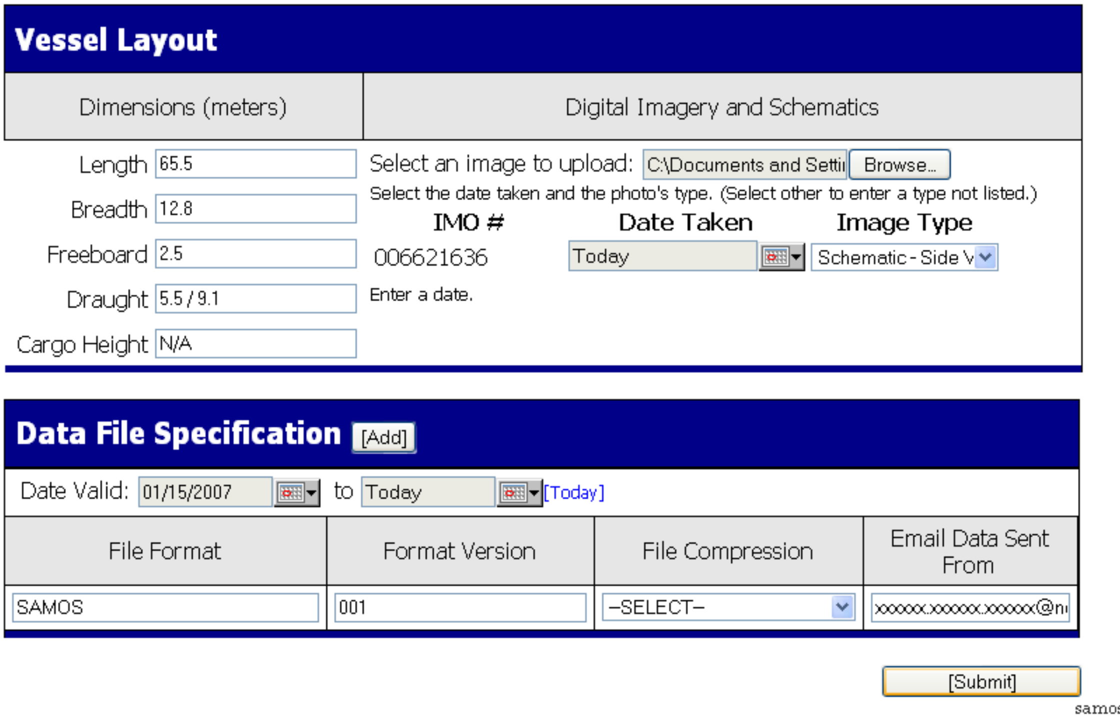
This metadata form provides Vessel Information (such as call sign and home port location), Contact Information for the home institution and shipboard technicians (as well as any other important persons), Vessel Layout, which details ship dimensions and allows for the uploading of digital imagery, and 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] |

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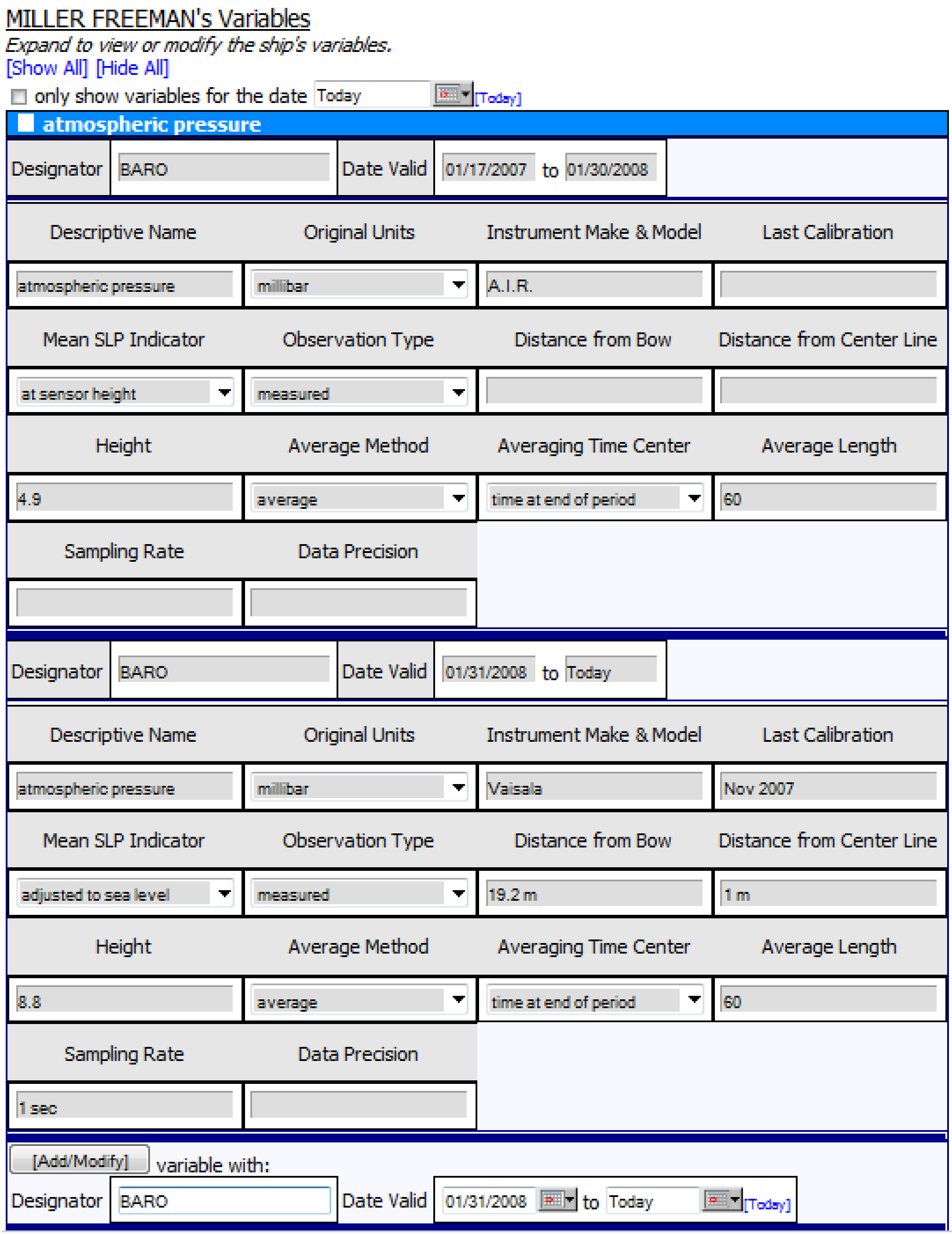
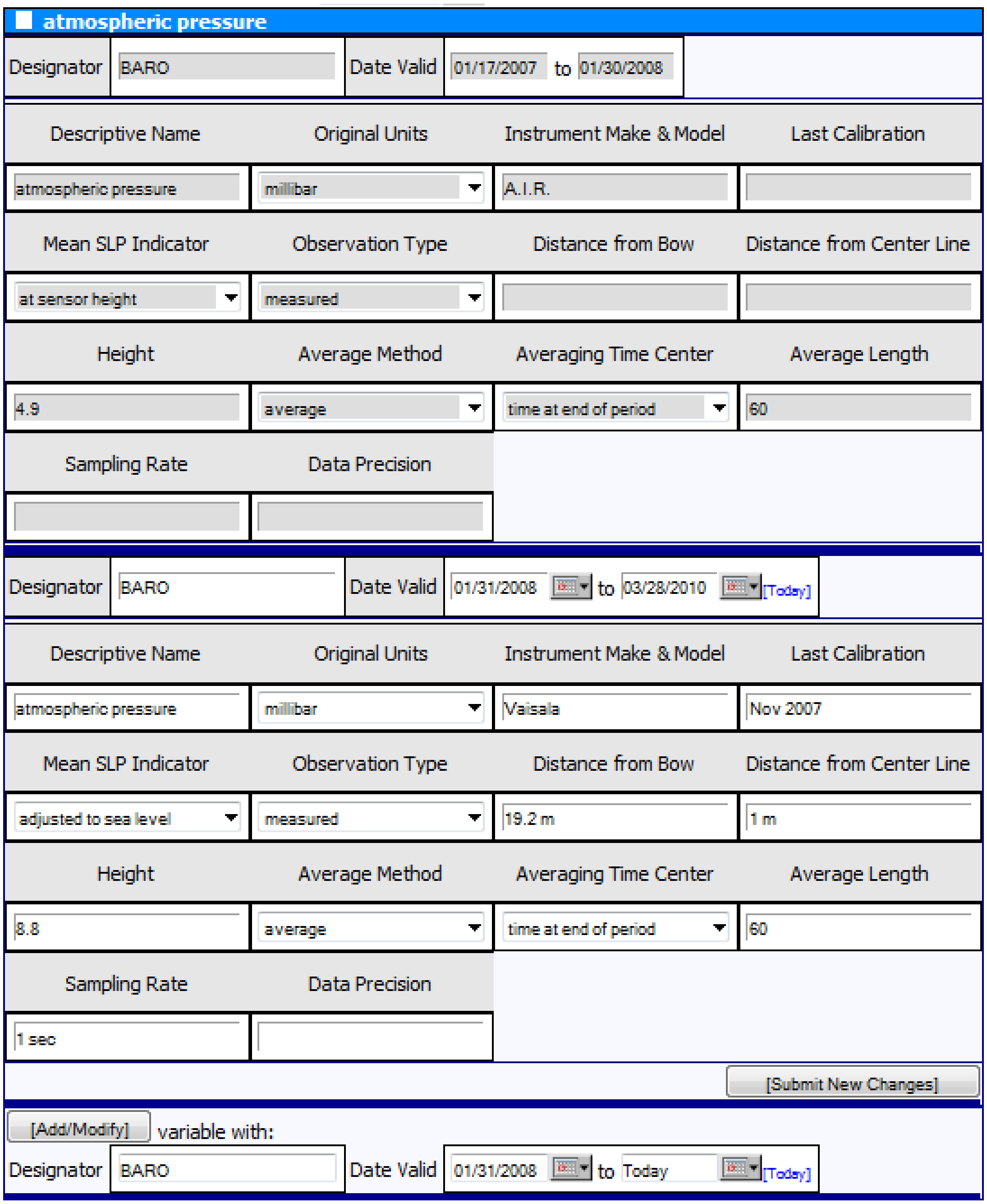
Adding and editing instrument (or parameter) metadata follow a slightly different procedure. The first step for the SAMOS operator is to identify which parameter he wishes to add or modify. Let us first consider the case of modifying a parameter already in use. Let us assume that a pressure sensor has 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:




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):



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 03/28/2010 [Today]

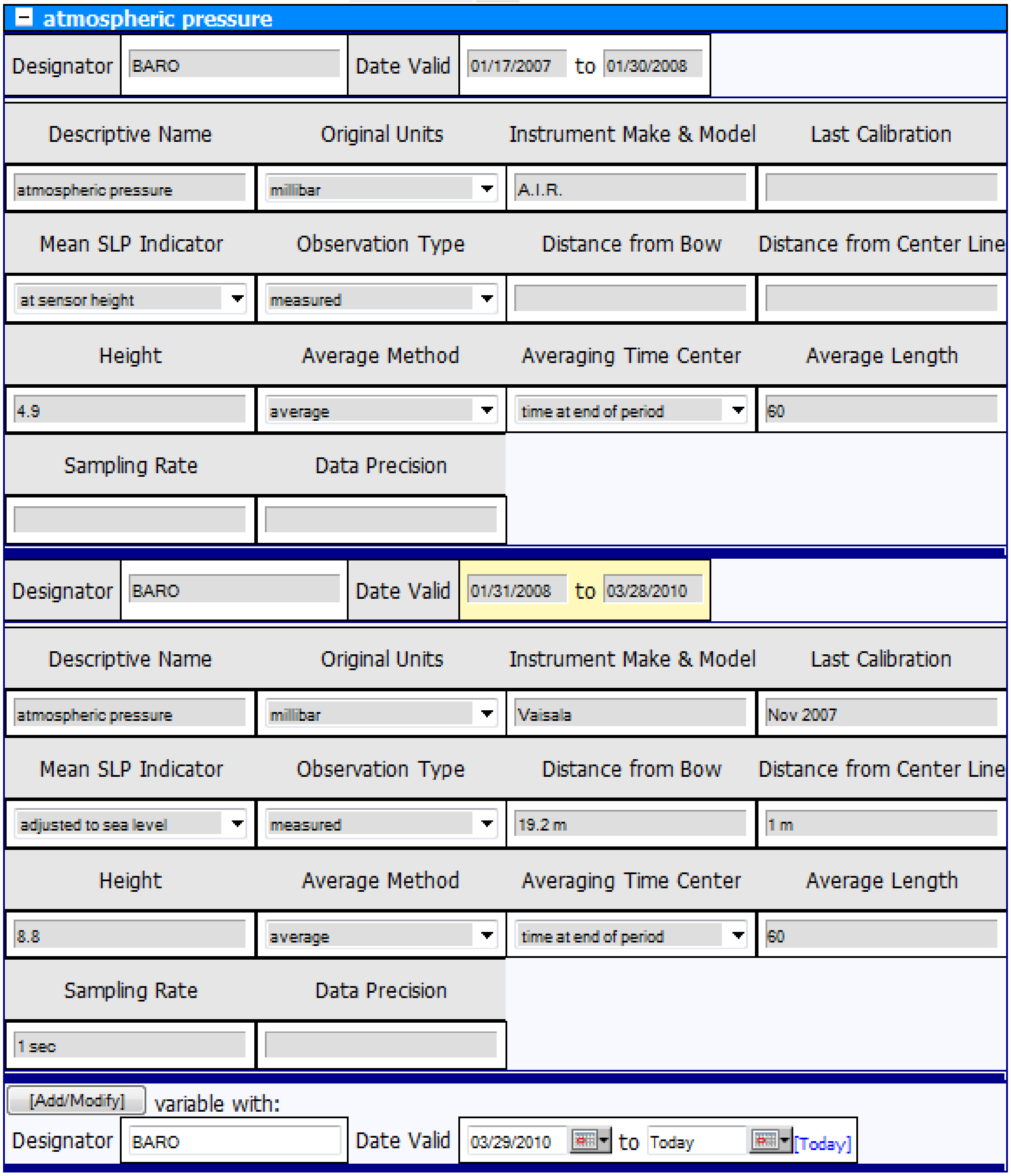
| Descriptive Name | Original Units | Instrument Make & Model | Last Calibration |
|---|---|---|---|
| atmospheric pressure | millibar | Vaisala | Nov 2007 |
| **Mean SLP Indicator** | **Observation Type** | **Distance from Bow** | **Distance from Center Line** |
| adjusted to sea level | measured | 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 | | | |

[Submit New Changes]

[Add/Modify] variable with:

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

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 | 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 03/28/2010 |

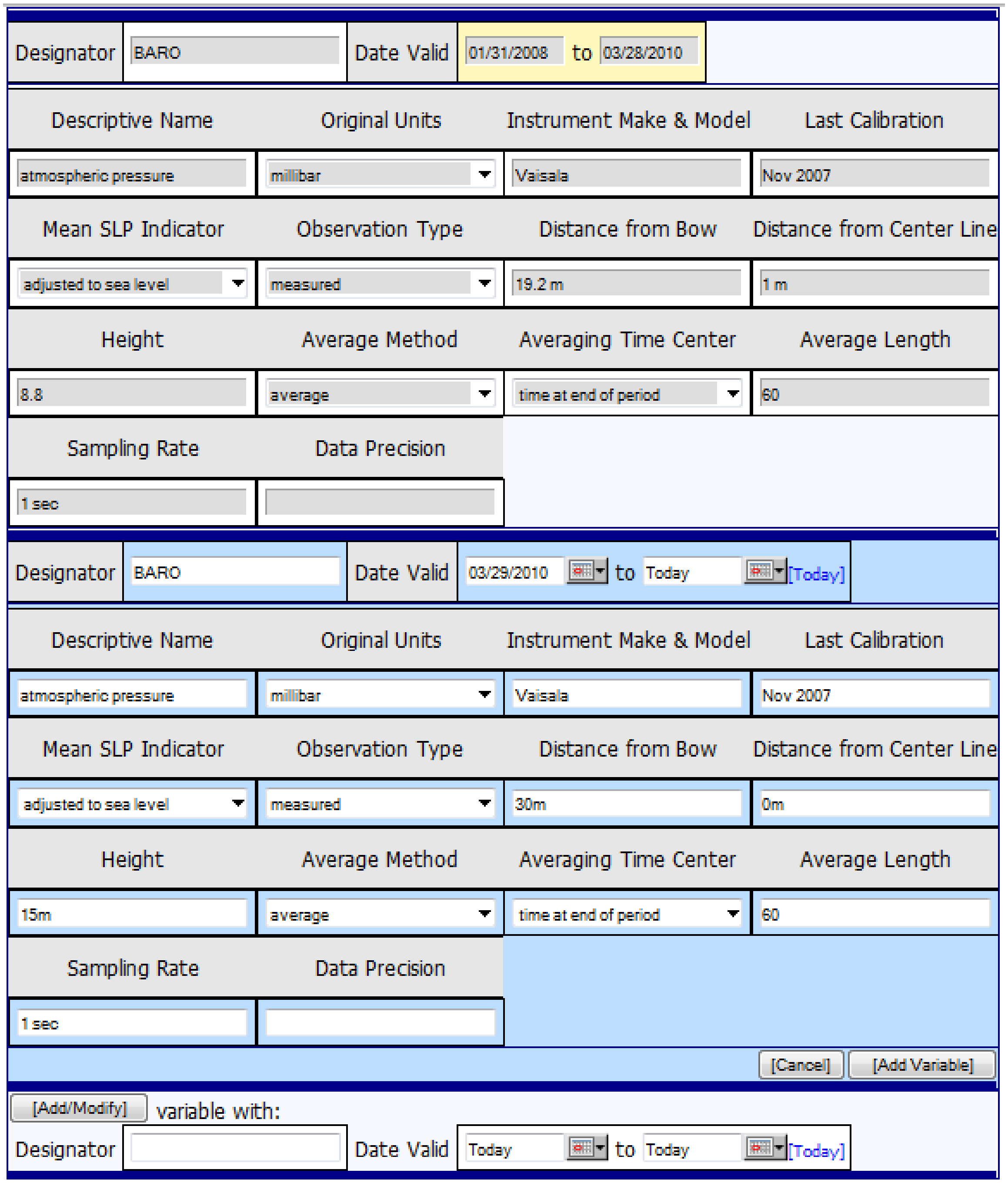
| Descriptive Name | Original Units | Instrument Make & Model | Last Calibration |
|---|---|---|---|
| atmospheric pressure | millibar | Vaisala | Nov 2007 |
| **Mean SLP Indicator** | **Observation Type** | **Distance from Bow** | **Distance from Center Line** |
| adjusted to sea level | measured | 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:

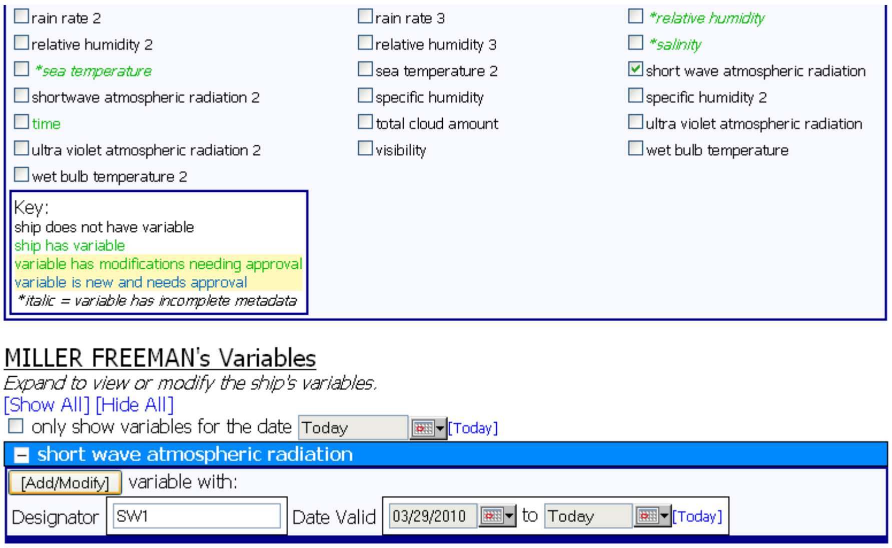
| | | | |
|---|---|---|---|
| Designator | BARO | Date Valid | 03/29/2010 to Today [Today] |

*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:

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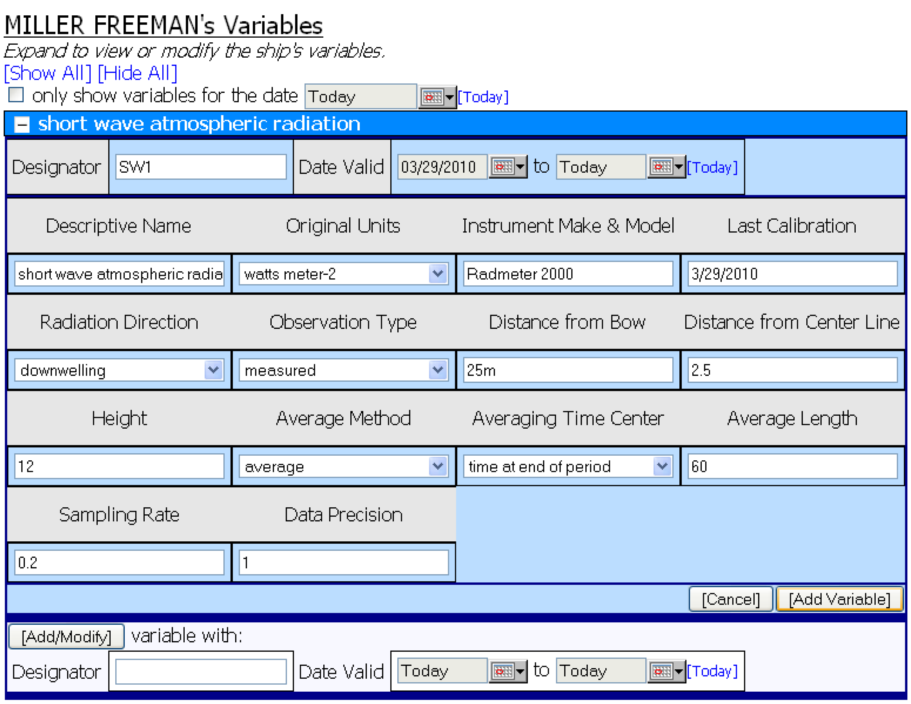
the user is immediately given the new set of fields, to be filled in as desired:

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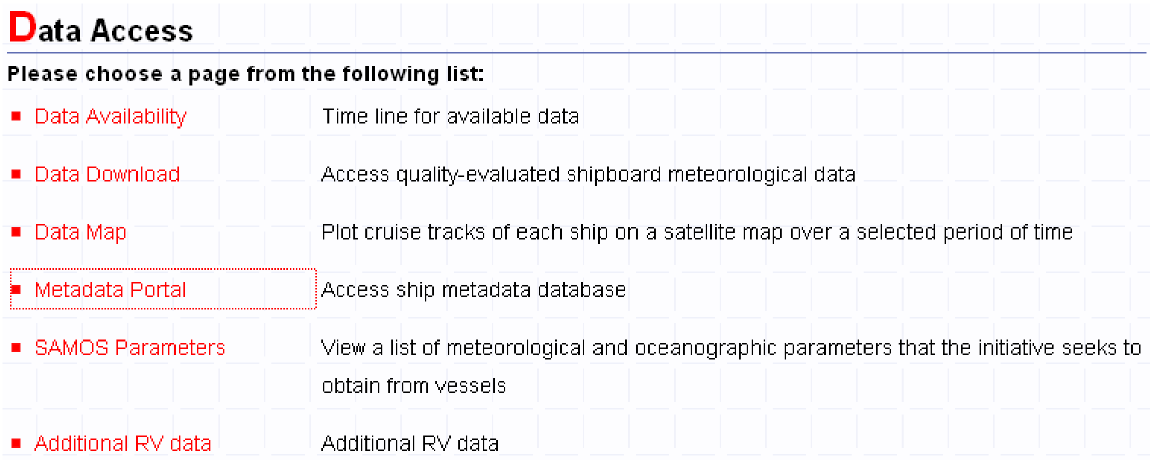
Once an addition or modification to metadata has been submitted, a SAMOS associate at COAPS is automatically notified that approval is needed. Once approved, the new information will be visible to the public, via the Metadata Portal, accessed from the Data Access page as outlined in part one:




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.

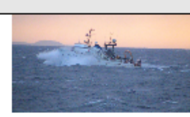
The portal provides access to metadata stored in the database for all ships providing data to the DAC. At present, the vessels listed are participating in the 2005 pilot project. A search tool allows users to select a vessel and whether they are interested in ship-specific, parameter-specific, or digital 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<br>Breadth: 12.8<br>Freeboard: 2.5<br>Draught: 5.5 / 9.1<br>Cargo Height: N/A | <br>Schematic - Side View  |

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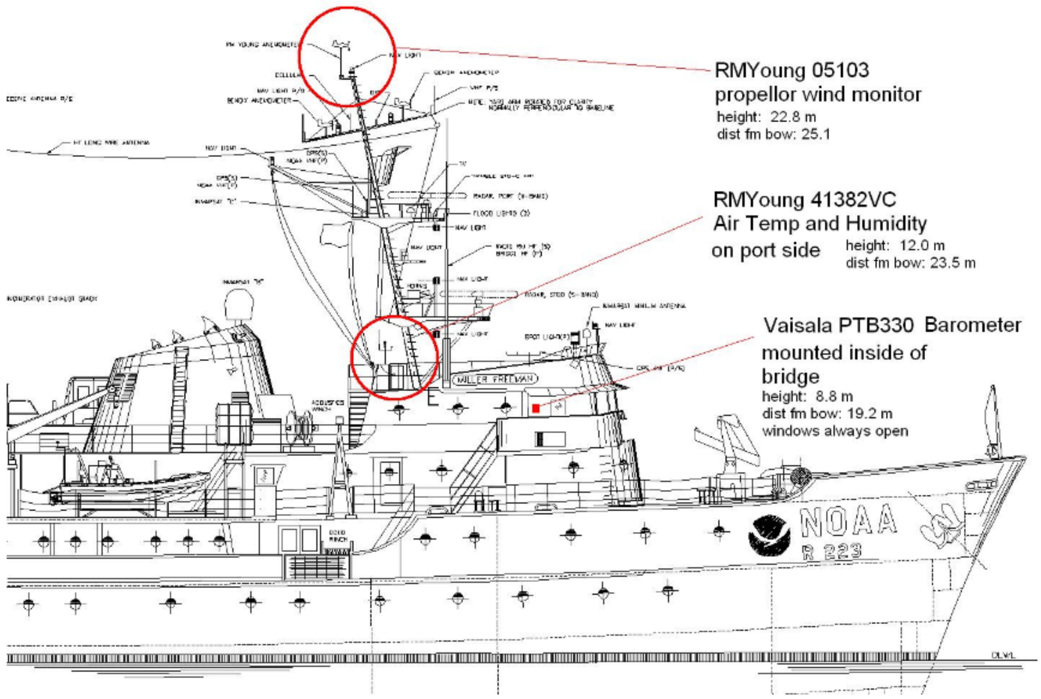
Clicking on the image itself would give us an enlarged view. In this case, the photo provides details about the locations of three MET sensors:



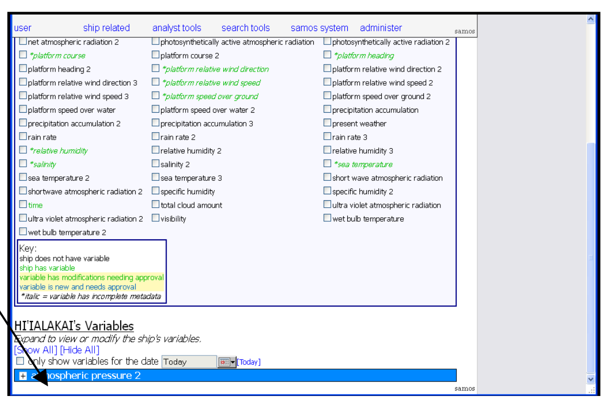

As a SAMOS user becomes familiar with following the metadata modification steps outlined in this section, chores such as adding duplicate sensors, logging sensor relocations, and keeping calibrations up to date become straightforward tasks. Naturally, complete and accurate metadata make for better scientific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

# UPDATING SAMOS METADATA: STEP BY STEP EXAMPLE

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

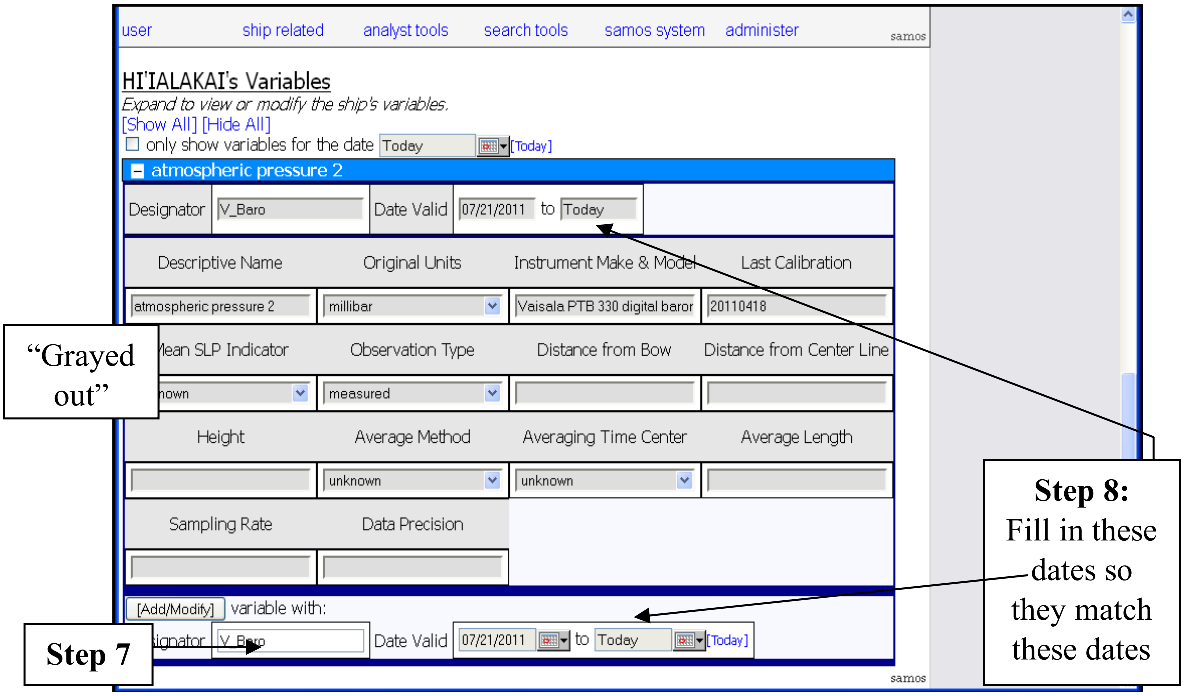
1. Go to: http://samos.coaps.fsu.edu/html/
    a. Click "Ship Recruiting"
    b. Click "Metadata Interface"
2. Enter login ID and password (case sensitive)
3. You can choose to modify Vessel or Instrument Metadata; you will likely choose Instrument. Vessel Metadata does not often change, other than the 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.



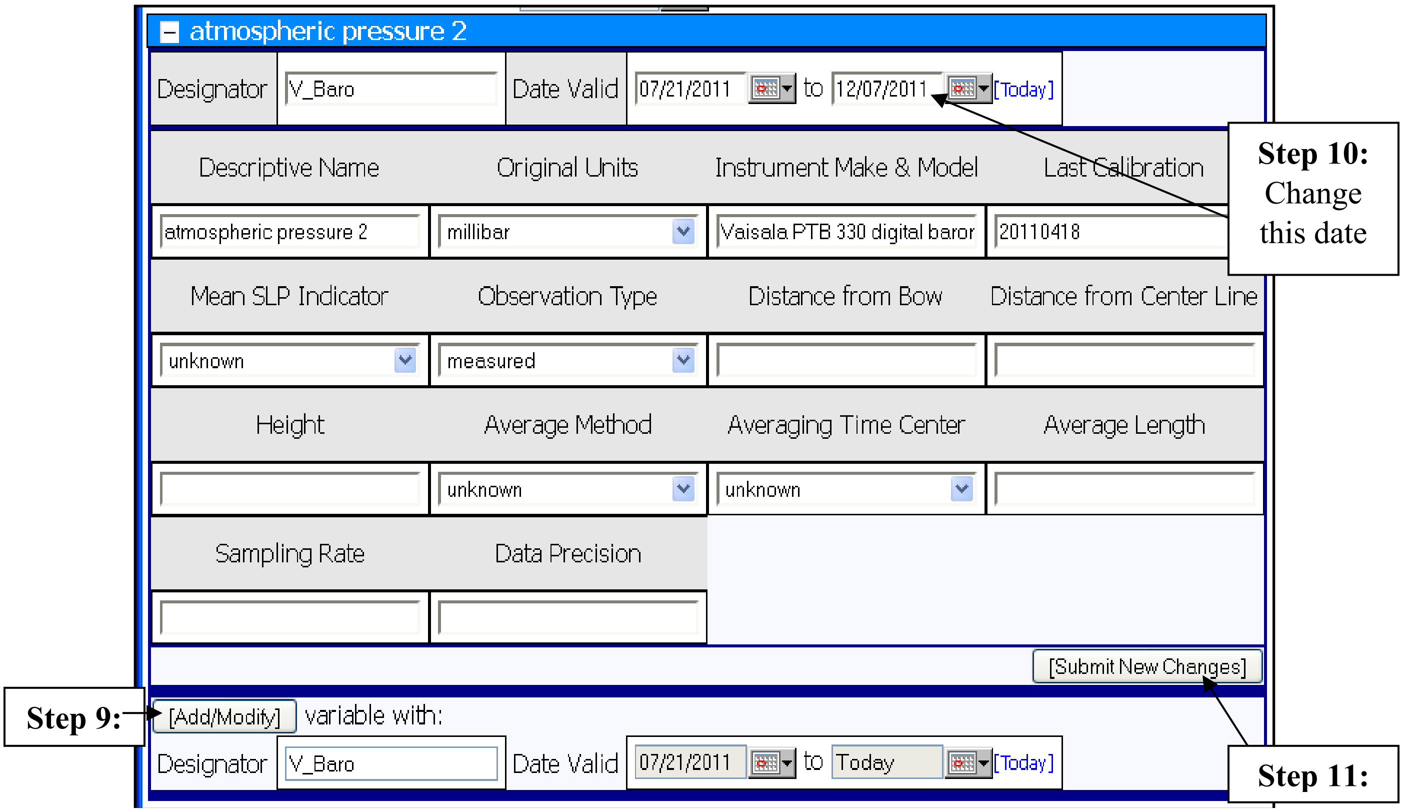

7. You first need to let the system know for which sensor you want to change information. In the box that appears at the very bottom (see image above), enter the name of the designator just at it appears in the box next to 'Designator' in the grayed out area.
    a. For the example above you would enter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



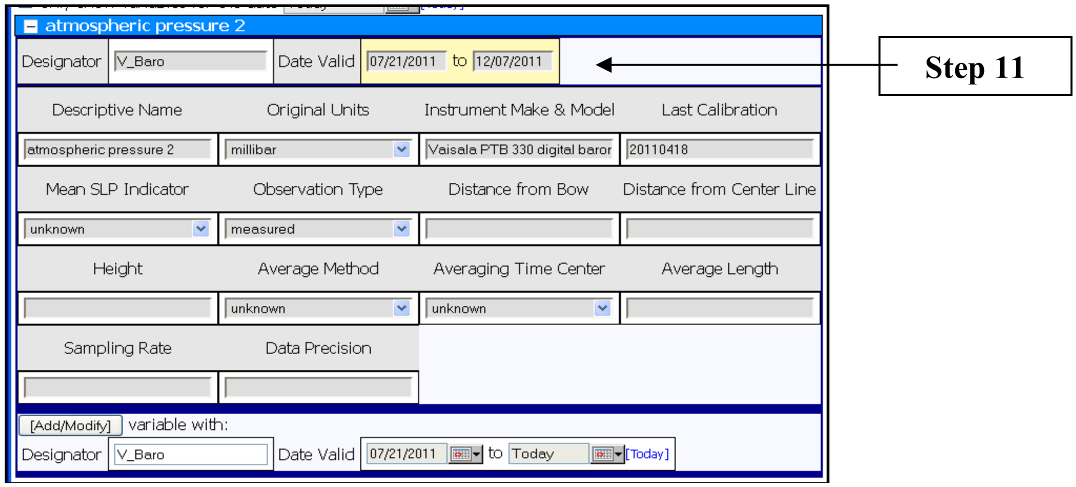

10. You now want to change the "Date Valid" info in this data box. The "Date Valid" start date (on the left) in this now edit-able area will likely stay the same unless you want to correct a previously entered erroneous start date. More than likely you will only be changing the end date, on the right.

    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.

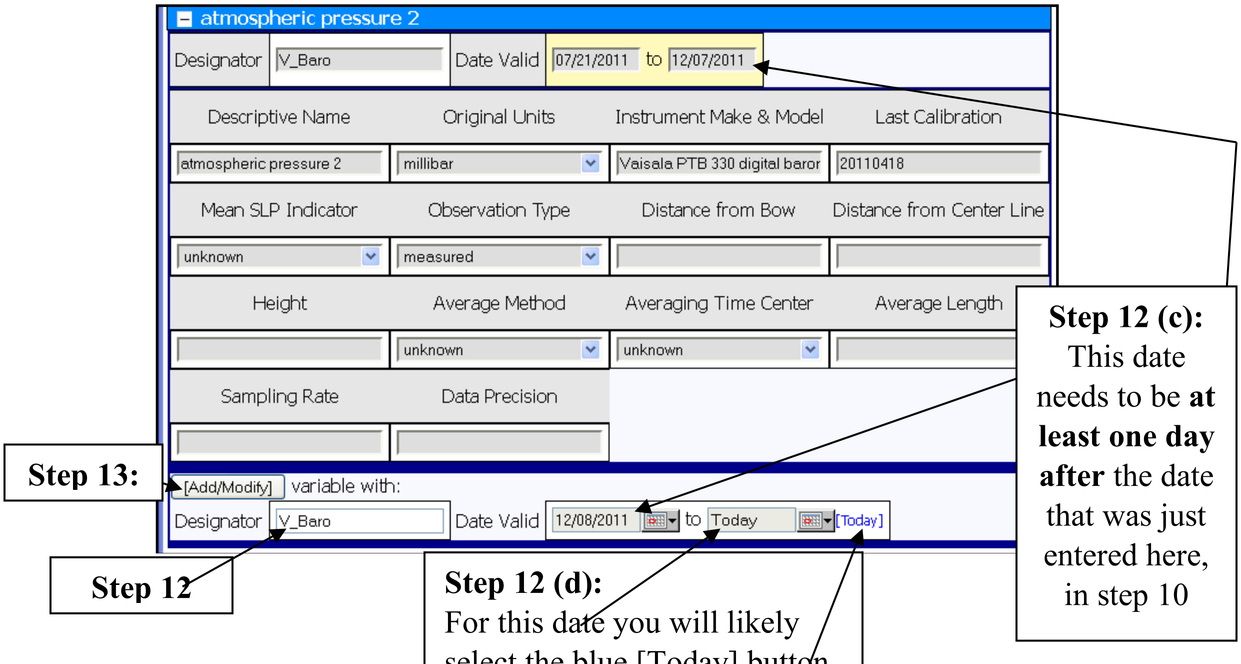
    b. You will most likely be entering a calendar date in the right hand "Date Valid" box to close out the existing data for the sensor.

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

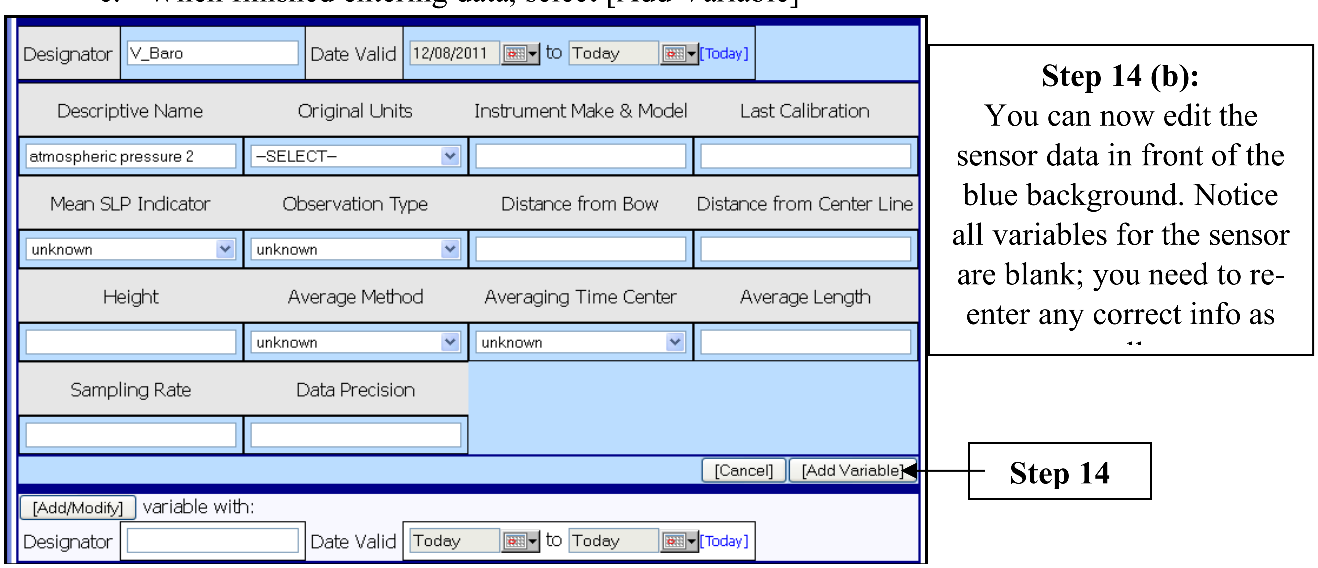
    a. The text boxes in the data entry area should be grayed out again. The background of the dates that you just edited will be yellow (see image below).




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.

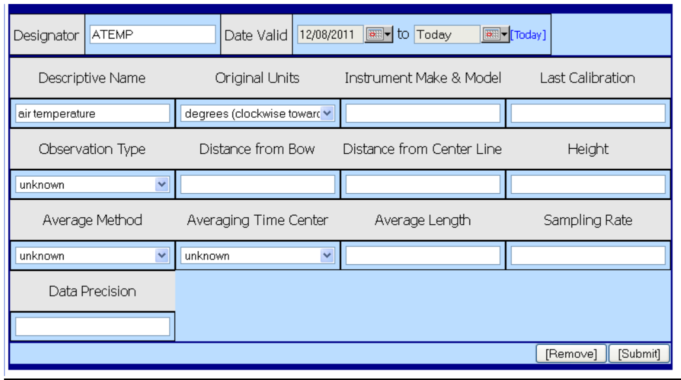



13. Click the [Add/Modify] button again (see image above)
14. You will now see a new, editable data box at the bottom of the screen that has blue around the sensor info instead of gray.
    a. Leave the Date Valid area the same
    b. You can now change the sensor data to reflect updates and add new 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