2017 SAMOS Data Quality Report

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1. Introduction

This report describes the quantity and quality of observations collected in 2017 by research vessels participating in the Shipboard Automated Meteorological and Oceanographic System (SAMOS) initiative. The SAMOS initiative focuses on improving the quality of, and access to, surface marine meteorological and oceanographic data collected in-situ by automated instrumentation on research vessels (RVs). A SAMOS is typically a computerized data logging system that continuously records navigational (ship position, course, speed, and heading), meteorological (winds, air temperature, pressure, moisture, rainfall, and radiation), and near-surface oceanographic (sea temperature, conductivity, and salinity) parameters while the RV is underway. 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 enhancement, and automated quality control (QC). A data quality analyst examines each preliminary file to identify any major problems (e.g., sensor failures). When necessary, the analyst will notify the responsible shipboard technician via email while the vessel is at sea. On a 10-day delay, all preliminary data received for each ship and calendar day are merged to create daily intermediate files. The merge considers and removes temporal duplicates. For all NOAA vessels and the Falkor visual QC is conducted on the intermediate files by a qualified marine meteorologist, resulting in research-quality SAMOS products that are nominally distributed with a 10-day delay from the original data collection date. All data and metadata are version controlled and tracked using a structured query language (SQL) database. All data are distributed free of charge and proprietary holds through the web (http://samos.coaps.fsu.edu/html/) under “Data Access” and long-term archiving occurs at the US National Centers for Environmental Information (NCEI). SAMOS data at NCEI are accessible in monthly packages sorted by ship and have been assigned a collection-level reference and digital object identifier (Smith et al. 2009) to facilitate referencing the SAMOS data in publications.

In 2017, out of 36 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, 16 vessels), the Woods Hole Oceanographic Institution (WHOI, 2 vessels), National Science Foundation Office of Polar Programs (OPP, 2 vessels), University of Hawaii (UH, 1 vessel), Scripps Institution of Oceanography (SIO, 3 vessels, including the new vessel Sally Ride),
Bermuda Institute of Ocean Sciences (BIOS, 1 vessel), Schmidt Ocean Institute (SOI, 1 vessel), the Australian Integrated Marine Observing System (IMOS, 2 vessels), and the University of Alaska (UA, 1 vessel). One additional IMOS vessel – the *Aurora Australis* – two United States Coast Guard (USCG) vessels – the *Healy* and the *Polar Sea* – the Louisiana Universities Marine Consortium (LUMCON) vessel – the *Pelican* – the University of Washington (UW) vessel – the *Thomas G. Thompson* – the University of Rhode Island (URI) vessel – the *Endeavor* – and one additional vessel formerly with WHOI and transferred to Oregon State University in March 2012 – *Oceanus* – were active in the SAMOS system but for reasons beyond the control of the SAMOS DAC (e.g., caretaker status, mid-life refit, changes to shipboard acquisition or delivery systems, satellite communication problems, etc.) were unable to contribute data in 2017.

IMOS is an initiative to observe the oceans around Australia (see 2008 reference). One component of the system, the “IMOS underway ship flux project” (hereafter referred to as IMOS), is modelled on SAMOS and obtains routine meteorological and surface-ocean observations from one vessel (*Tangaroa*) operated by New Zealand and two vessels (*Investigator* and *Aurora Australis*) operated by Australia. Software problems at IMOS have resulted in the interruption of the data flow from the *Aurora Australis*. In 2015 code was developed at the SAMOS DAC which allows for harvesting both *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 2017.](image-url)
Beginning in 2013, funding did not allow for visual quality control procedures for any non-NOAA vessels except the *Falkor*, which is separately supported via a contract with SOI. As such, visual QC for all remaining vessels was discontinued, until such time as funding is extended to cover them. It should be noted that in the case of the *Aurora Australis* and *Tangaroa*, the IMOS project conducted their own visual QC until a personnel change there in June 2013. Only automated QC for the *Investigator, Aurora Australis*, and *Tangaroa* occurs at the SAMOS DAC. The quality results presented herein are from the research quality products for all NOAA vessels and the *Falkor*, and automated-only quality control-level (intermediate) products for all remaining vessels. During 2017, the overall quality of data received varied widely between different vessels and the individual sensors on the vessels. Major problems included poor sensor placement that enhanced flow distortion (nearly all vessels experience some degree of flow distortion), sensors suspected of inferior quality (*Rainier*), sensor failures (many vessels), in particular sensor or equipment affected by moisture issues (*Gordon Gunter, Henry Bigelow, Thomas Jefferson, Robert Gordon Sproul*), sensors or equipment that remained problematic or missing for extended periods (namely, the relative wind sensors on board the *Ron Brown*, the radiation sensors onboard the *Henry Bigelow*, the temperature and relative humidity onboard the *Okeanos Explorer*, and the atmospheric pressure onboard the *Ferdinand Hassler*), reporting incorrect data values (*Falkor* and *Fairweather*), problems adding new sensors to SCS (*Thomas Jefferson*), and data transmission oversights or issues.

This report begins with an overview of the vessels contributing SAMOS observations to the DAC in 2017 (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. An overview status of vessel and instrumental metadata for each vessel is provided in section 4. Recommendations for improving metadata records are discussed. The report is concluded with the plans for the SAMOS project in 2018. Annexes include a listing of vessel notifications and vessel data identified as suspect but not flagged by quality control procedures (Annex A) and web interface instructions for accessing SAMOS observations (Annex B, part 1) and metadata submission by vessel operators (Annex B, part2).
2. System review

In 2017, a total of 36 research vessels were under active recruitment to the SAMOS initiative; 29 of those vessels routinely provided SAMOS observations to the DAC (Table 1). The *Thomas G. Thompson* underwent her mid-life refit in 2017 and thus did not sail. The *Polar Sea* was out of service in 2017, so naturally there was no data from her, either. The *Healy* did sail her Arctic West Summer (AWS) deployments in 2017 but her daily SAMOS file transmission, reestablished only briefly in 2016, was nonexistent in 2017. Likewise, the *Pelican* sailed in 2017 but did not transmit any data, despite several attempts by the DAC to reestablish her data flow. The *Aurora Australis* also sailed in 2017 but the data processing/delivery systems in place for the IMOS vessels had some failures that have not yet been resolved (partially the result of IMOS funding challenges). In March 2012 stewardship of the *Oceanus* was transferred from WHOI to OSU and she underwent a major refit. *Oceanus* planned to return to SAMOS using the 2.0 data protocol, but this transition will not occur, hence the lack of any data since 2012. Real-time data were not received in 2017 from the *Endeavor* because they have not been able to transition back to SAMOS 1.0 format (FSU is no longer developing SAMOS 2.0).

In total, 5,565 ship days were received by the DAC for the January 1 to December 31 2017 period, resulting in 7,439,870 records. Each record represents a single (one minute) collection of measurements. Records often will not contain the same quantity of information from vessel to vessel, as each vessel hosts its own suite of instrumentation. Even within the same vessel system, the quantity of information can vary from record to record because of occasional missing or otherwise unusable data. From the 7,439,870 records received in 2017, a total of 149,398,889 distinct measurements were logged. Of those, 7,312,988 were assigned A-Y quality control flags – about 5 percent – by the SAMOS DAC (see section 3a for descriptions of the QC flags). This is around a percentage point higher than that in 2016 (about 4%) and on par with that in 2015 (about 5%). Measurements deemed "good data," through both automated and visual QC inspection, are assigned Z flags. In total, twelve of the SAMOS vessels (the *Tangaroa, Investigator, Atlantis, Neil Armstrong, Laurence M. Gould, Nathaniel B. Palmer, Kilo Moana, Atlantic Explorer, Sikuliaq, Roger Revelle, Sally Ride*, and the *Robert Gordon Sprout*) only underwent automated QC. None of these vessels’ data were assigned any additional flags, nor were any automatically assigned flags removed via visual QC.
Table 1: CY2017 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.

<table>
<thead>
<tr>
<th>SHIP NAME</th>
<th>CALL SIGN</th>
<th># of Days</th>
<th># of Vars</th>
<th># of Records</th>
<th># of A-Y Flags</th>
<th># of All Flags</th>
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</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>-</td>
<td>5,565</td>
<td>565</td>
<td>7,439,870</td>
<td>7,312,988</td>
<td>149,394,889</td>
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<td>ROGER REVELLE</td>
<td>KAOI</td>
<td>337</td>
<td>24</td>
<td>442,516</td>
<td>763,270</td>
<td>10,620,384</td>
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<td>ATLANTIS</td>
<td>KAQP</td>
<td>300</td>
<td>29</td>
<td>421,895</td>
<td>213,418</td>
<td>12,234,955</td>
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<td>31</td>
<td>265,805</td>
<td>331,975</td>
<td>8,111,503</td>
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<td>NEIL ARMSTRONG</td>
<td>WARE</td>
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<td>31</td>
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<td>11,246,820</td>
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<td>NATHANIEL B. PALMER</td>
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<td>23</td>
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<td>9,222,732</td>
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<td>LAURENCE M. GOULD</td>
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<td>345</td>
<td>25</td>
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<td>483,337</td>
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<td>KILO MOANA</td>
<td>WDA782T</td>
<td>204</td>
<td>21</td>
<td>277,977</td>
<td>17,327</td>
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<td>SIKULLAQ</td>
<td>WDG7520</td>
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<td>516,468</td>
<td>352,518</td>
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<tr>
<td>SALLY RIDE</td>
<td>WSAP</td>
<td>133</td>
<td>22</td>
<td>166,120</td>
<td>112,724</td>
<td>3,636,636</td>
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<td>ROBERT GORDON SPROUL</td>
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<td>18</td>
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<td>7,272,166</td>
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<td>HENRY B. BIELOW</td>
<td>WTDG</td>
<td>79</td>
<td>16</td>
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<td>105,334</td>
<td>1,559,633</td>
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<td>OKEANOS EXPLORER</td>
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<td>16</td>
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<td>PISCES</td>
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<td>391,484</td>
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<td>OREGON II</td>
<td>WTDQ</td>
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<td>16</td>
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<td>266,579</td>
<td>3,614,768</td>
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<td>THOMAS JEFFERSON</td>
<td>WTEA</td>
<td>102</td>
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<td>136,937</td>
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<td>2,190,992</td>
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<td>FAIRWEATHER</td>
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<td>RONALD H. BROWN</td>
<td>WTEC</td>
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<td>2,564,776</td>
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<td>BELL M. SHIMADA</td>
<td>WTED</td>
<td>187</td>
<td>20</td>
<td>239,591</td>
<td>152,385</td>
<td>4,439,006</td>
</tr>
<tr>
<td>OSCAR ELTON SETTE</td>
<td>WTEE</td>
<td>167</td>
<td>16</td>
<td>231,006</td>
<td>110,285</td>
<td>3,518,722</td>
</tr>
<tr>
<td>RAINIER</td>
<td>WTEF</td>
<td>156</td>
<td>13</td>
<td>203,328</td>
<td>103,441</td>
<td>2,641,264</td>
</tr>
<tr>
<td>REUBEN LASKER</td>
<td>WTEG</td>
<td>236</td>
<td>16</td>
<td>312,056</td>
<td>216,538</td>
<td>4,980,555</td>
</tr>
<tr>
<td>FERDINAND HASSLER</td>
<td>WTEK</td>
<td>49</td>
<td>13</td>
<td>63,823</td>
<td>109,907</td>
<td>829,699</td>
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<td>GORDON GUNTER</td>
<td>WTEO</td>
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<td>16</td>
<td>195,645</td>
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<td>3,113,789</td>
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<tr>
<td>OSCAR DYSON</td>
<td>WTEP</td>
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<td>16</td>
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<td>3,655,092</td>
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<td>NANCY FOSTER</td>
<td>WTER</td>
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<td>HITALAKAI</td>
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<td>189,282</td>
<td>3,360,759</td>
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<td>FALKOR</td>
<td>ZCYL5</td>
<td>159</td>
<td>33</td>
<td>211,609</td>
<td>299,073</td>
<td>6,162,485</td>
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<tr>
<td>TANGAROA</td>
<td>ZMF4</td>
<td>190</td>
<td>17</td>
<td>273,401</td>
<td>491,580</td>
<td>4,629,119</td>
</tr>
</tbody>
</table>

**a. Temporal coverage**

As demonstrated in Figure 2, the files received by the DAC from each vessel are not often equally matched to the scheduled days reported by each institution. (*Note that CY2017 scheduling information was not obtainable for the Tangaroa prior to this report distribution. A full CY2017 itinerary for the Healy also was not obtainable prior to this report distribution.*) 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, 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 (http://samos.coaps.fsu.edu/html/webservices.php) to allow interested parties to track the
data was last received by the DAC for each vessel (Preliminary File) and the results of the automated quality control on these files (Preliminary Quality). 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 and blue) to final 2017 ship schedules provided by each vessel's institution. (*Note again that the schedule was not obtained for the Tangaroa, nor was a comprehensive schedule obtainable for the Healy.*) A “blue” day denotes that the data file was received past the 10-day delayed-mode window (or otherwise entered the SAMOS processing system well past the window) and thus missed timely processing and visual quality control, although processing (and visual QC where applicable) was eventually applied. (It must be noted, though, that “late” data always incurs the risk of not being visually quality controlled, based on any time or funding constraints.) Days identified on the vessel institution’s schedule for which no data was received by the DAC are shown in grey. Within the grey boxes, an italicized "S" indicates a day reportedly "at sea." As an added metric, Table 2 attempts to measure each vessel’s actual submission performance by matching scheduled at-sea (or assumed at-sea) days to the availability of SAMOS data files for those days. All data received for 2017, with the exceptions of Tangaroa and Investigator, has been archived at the NCEI. Through agreement with IMOS, we receive data for the Tangaroa, the Investigator, and the Aurora Australis and for these vessels perform automated QC only. IMOS data is archived within the IMOS DAC-eMarine Information Infrastructure (eMII).
Figure 2: 2017 calendar showing (green and blue) ship days received by DAC and (grey) additional days reported afloat by vessels; "S" denotes vessel reportedly at sea, "*" denotes vessel known to be in a maritime EEZ with no expectation of data. Vessels are listed by call sign (see Table 1).
| MAY  | 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 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| KAOQ |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| NEPP |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| VLMI |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| VNAA |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WARL |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WBP3210 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WCN7443 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WDA7927 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WDC9417 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WDD6114 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WDG7520 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WSAP |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WSAF |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WSQ5674 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTDL |   | S |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTDI |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTDH |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTDJ |   | S |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTDK |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEA |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEB |   | S |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEC |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTED |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEF |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEG |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEH |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEJ |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEK |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEP |   | S |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTER |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| WTEY |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ZCYL5 |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| ZMFR |   |   |   |   |   |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

(Figure 2: cont'd)
(Figure 2: cont'd)
| SEPTEMBER | 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 |
|-----------|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| KAO57     | $ | $ | $ | 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 |
| KAO58     | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| NEPI      | 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 |
| VLMU      | $ | 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 |
| VNAA      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WAPL      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WPB210    | 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 |
| WX774     | 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 |
| 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 | S | S | S | S | S |
| WDC9417   | 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 |
| WDD6517   | 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 |
| WDG1750   | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WSAI      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WSG7674   | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WDF       | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WIDH      | $ | 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 |
| WIDL      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WIDO      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WTEA      | 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 |
| WTEB      | 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 |
| WTEC      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WTEG      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WTEK      | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S | S |
| WTEO      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WTEP      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WTER      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| WTEY      | 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 |
| ZCYI5     | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |
| ZMEF      | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ | $ |

(Figure 2: cont'd)
|        | 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  |
|--------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| KA00J  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| KA0P   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| NEPP   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| VLMJ   |     |     | S   | S   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| VNAA   | 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   |
| WRL    |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WBP3210|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WCSS445|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WDA7827|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WDC917 |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WDD6114|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WDG7520|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WSAR   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WSQS654|     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTDI   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTDH   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTDL   | S   | S   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WDDD   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEA   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEB   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEC   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTED   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEF   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEG   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEH   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEI   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEJ   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEK   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTLH   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| WTEO   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| ZCY15  |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |
| ZMER   |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |     |

(Figure 2: cont'd)
Table 2: 2017 data submission performance metrics, listed by institution and ship. Note that where official schedules specified “at sea” days, only those days were counted. In all other cases “at sea” was assumed and scheduled days were counted as-is. Note also that while SAMOS days follow GMT, ship schedules may not. This leaves room for some small margin of error. Lastly, note that any transit through an exclusive economic zone, marine protected area, etc. may preclude data transmission. Except for Investigator, Aurora Australis, Falkor, and Healy (listed in the References), only private ship schedule resources were available in 2017. Note in the case of Healy scheduled at-sea days could only be estimated from the available source.
<table>
<thead>
<tr>
<th>WHOI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ship Name</strong></td>
</tr>
<tr>
<td><strong>Call Sign</strong></td>
</tr>
<tr>
<td># scheduled at-sea days</td>
</tr>
<tr>
<td># matching SAMOS days</td>
</tr>
<tr>
<td>% received</td>
</tr>
<tr>
<td><strong>TOTAL scheduled at-sea days:</strong></td>
</tr>
<tr>
<td><strong>TOTAL matching SAMOS days:</strong></td>
</tr>
<tr>
<td><strong>OVERALL RATIO:</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BIOS</th>
<th>IMOS</th>
<th>LUMCON</th>
<th>SOI</th>
<th>UAF</th>
<th>UHI</th>
<th>USCGC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ship Name</strong></td>
<td>Atlantic Explorer</td>
<td>Investigator</td>
<td>Pelican</td>
<td>Falkor</td>
<td>Sikuilaq</td>
<td>Kilo Moana</td>
</tr>
<tr>
<td><strong>Call Sign</strong></td>
<td>WDC0417</td>
<td>VLMJ</td>
<td>WDD6114</td>
<td>ZCYL5</td>
<td>WDG7520</td>
<td>WDA7827</td>
</tr>
<tr>
<td><strong>TOTAL scheduled at-sea days</strong></td>
<td>124</td>
<td>218</td>
<td>200</td>
<td>173</td>
<td>245</td>
<td>231</td>
</tr>
<tr>
<td><strong>TOTAL matching SAMOS days</strong></td>
<td>24</td>
<td>199</td>
<td>0</td>
<td>155</td>
<td>239</td>
<td>214</td>
</tr>
<tr>
<td><strong>OVERALL RATIO:</strong></td>
<td>19%</td>
<td>91%</td>
<td>0%</td>
<td>90%</td>
<td>98%</td>
<td>93%</td>
</tr>
</tbody>
</table>

*(Table 2: cont’d)*
b. Spatial coverage

Geographically, SAMOS data coverage continues to be fairly comprehensive in 2017. Cruise coverage for the January 1, 2017 to December 31, 2017 period (Figure 3) again includes Antarctic/Southern Ocean exposure and the Strait of Magellan (Palmer and Gould), exposure in Alaskan waters (Fairweather, Dyson, Rainier, and Sikuliaq), the far Northern Atlantic (Atlantis and Neil Armstrong), and samples along the northern Caribbean island coastlines, from Cuba to Puerto Rico (Nancy Foster and Thomas Jefferson). The Roger Revelle sampled the Taiwanese coastline and the Philippine Sea, the Falkor spent some time in the South Pacific north of Samoa and Tokelau, and the Investigator and Tangaroa covered the waters around Australia and New Zealand, respectively. The Atlantic Explorer provided a wide sample of the Atlantic (including Bermuda), while the Atlantis, Falkor, Ron Brown, Kilo Moana, Okeanos Explorer, and Roger Revelle together make a very broad sample of the Pacific. Natively, the western coastal United States is heavily covered by, among others, the Bell M. Shimada, Rainier, and Reuben Lasker, with additional coverage of the Meso and South American coastlines by the Atlantis and Ron Brown; the Atlantis even provided another transit through the Panama Canal, as she did in 2016. Specific focus along the Southern California coastline and the Channel Islands was also provided by the Sally Ride and Gordon Sproul. The eastern coastal waters of the United States are thoroughly canvassed from the southern tip of Florida all the way up to Nova Scotia by the Gordon Gunter, Henry Bigelow, Ferdinand Hassler, Pisces, and Thomas Jefferson, among others. The northern Gulf of Mexico is virtually covered by the Oregon II and Gordon Gunter. Hawaiian waters are well sampled by the Oscar Elton Sette, Kilo Moana, and Hi’ialakai.
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, longwave,
shortwave, net, and photosynthetically active radiations, along with seawater conductivity and salinity. Additionally, the Healy, Roger Revelle, Sally Ride and Thomas Jefferson are all capable of providing dew point temperature, although only the Thomas Jefferson did so in 2017. The Jefferson is also the only vessel set up to provide wet bulb temperature and did so in 2017. A quick glance at Table 4 (located in Section 4) shows which parameters are reported by each vessel: those boxes in columns 6 through 26 with an entry 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 26 in Table 4 with multiple entries indicate the number of redundant sensors available for reporting and processing in 2017/2018; boxes with a single entry indicate the existence of a single sensor.
3. Data quality
   a. SAMOS quality control

Definitions of A-Z SAMOS quality control flags are listed in Table 3. It should be noted that no secondary automated QC was active in 2017 (SASSI), so quality control flags U-Y were not in use. If a coded variable does not contain an integer pointer to the flag attribute it is assigned a "special value" (set equal to -8888). A special value may also be set for any overflow value that does not fit the memory space allocated by the internal SAMOS format (e.g., character data value received when numeric value was expected). A "missing value" (set equal to -9999) is assigned for any missing data across all variables except time, latitude, and longitude, which must always be present. In general, visual QC will only involve the application of quality control flags H, I, J, K, M, N and S. Quality control flags J, K, and S are the most commonly applied by visual inspection, with K being the catchall for the various issues common to most vessels, such as (among others) steps in data due to platform speed changes or obstructed platform relative wind directions, data from sensors affected by stack exhaust contamination, or data that appears out of range for the vessel's region of operation. M flags are primarily assigned when there has been communication with vessel personnel in which they have dictated or confirmed there was an actual sensor malfunction. Port (N) flags are reserved for the latitude and longitude parameters and are rarely used, in an effort to minimize over-flagging. The primary application of the port flag occurs when a vessel is known to be in dry dock. The port flag may also be applied, often in conjunction with flags on other parameters, to indicate that the vessel is confirmed (visually or via operator) in port and any questionable data are likely attributable to dockside structural interference, although this practice is traditionally only used in extreme cases. (We note that, owing to a timeworn visual flagging platform, the H flag is not routinely used, in order 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 33°C 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.
<table>
<thead>
<tr>
<th>Flag</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Original data had unknown units. The units shown were determined using a climatology or some other method.</td>
</tr>
<tr>
<td>B</td>
<td>Original data were out of a physically realistic range bounds outlined.</td>
</tr>
<tr>
<td>C</td>
<td>Time data are not sequential or date/time not valid.</td>
</tr>
<tr>
<td>D</td>
<td>Data failed the T&gt;=Tw&gt;=Td test. In the free atmosphere, the value of the temperature is always greater than or equal to the wet-bulb temperature, which in turn is always greater than or equal to the dew point temperature.</td>
</tr>
<tr>
<td>E</td>
<td>Data failed the resultant wind re-computation check. When the data set includes the platform's heading, course, and speed along with platform relative wind speed and direction, a program re-computes the earth relative wind speed and direction. A failed test occurs when the wind direction difference is &gt;20 or the wind speed difference is &gt;2.5 m/s.</td>
</tr>
<tr>
<td>F</td>
<td>Platform velocity unrealistic. Determined by analyzing latitude and longitude positions as well as reported platform speed data.</td>
</tr>
<tr>
<td>G</td>
<td>Data are greater than 4 standard deviations from the ICOADS climatological means (da Silva et al. 1994). The test is only applied to pressure, temperature, sea temperature, relative humidity, and wind speed data.</td>
</tr>
<tr>
<td>H</td>
<td>Discontinuity found in the data.</td>
</tr>
<tr>
<td>I</td>
<td>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.</td>
</tr>
<tr>
<td>J</td>
<td>Data are of poor quality by visual inspection, DO NOT USE.</td>
</tr>
<tr>
<td>K</td>
<td>Data suspect/use with caution – this flag applies when the data look to have obvious errors, but no specific reason for the error can be determined.</td>
</tr>
<tr>
<td>L</td>
<td>Oceanographic platform passes over land or fixed platform moves dramatically.</td>
</tr>
<tr>
<td>M</td>
<td>Known instrument malfunction.</td>
</tr>
<tr>
<td>N</td>
<td>Signifies that the data were collected while the vessel was in port. Typically these data, though realistic, are significantly different from open ocean conditions.</td>
</tr>
<tr>
<td>O</td>
<td>Original units differ from those listed in the original_units variable attribute. See quality control report for details.</td>
</tr>
<tr>
<td>P</td>
<td>Position of platform or its movement is uncertain. Data should be used with caution.</td>
</tr>
<tr>
<td>Q</td>
<td>Questionable – data arrived at DAC already flagged as questionable/uncertain.</td>
</tr>
<tr>
<td>R</td>
<td>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.</td>
</tr>
<tr>
<td>S</td>
<td>Spike in the data. Usually one or two sequential data values (sometimes up to 4 values) that are drastically out of the current data trend. Spikes for many reasons including power surges, typos, data logging problems, lightning strikes, etc.</td>
</tr>
<tr>
<td>T</td>
<td>Time duplicate.</td>
</tr>
<tr>
<td>U</td>
<td>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.</td>
</tr>
<tr>
<td>V</td>
<td>Data spike as determined by SASSI.</td>
</tr>
<tr>
<td>X</td>
<td>Step/discontinuity in data as determined by SASSI.</td>
</tr>
<tr>
<td>Y</td>
<td>Suspect values between X-flagged data (from SASSI).</td>
</tr>
<tr>
<td>Z</td>
<td>Data passed evaluation.</td>
</tr>
</tbody>
</table>

Table 3: Definitions of SAMOS quality control flags

b. 2017 quality across-system

This section presents the overall quality from the system of ships providing observations to the SAMOS data center in 2017. 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.

The quality of SAMOS atmospheric pressure data is generally good (Figure 4). 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.

The uptick in flagging seen in P in February, March, and April is likely attributed to the Ferdinand Hassler, Henry Bigelow, and Okeanos Explorer, each of which experienced persistent issues with the parameter (documented; see individual vessel descriptions in section 3c for details). It isn’t clear what caused the increases seen in P2 in May and December. The combination of several vessels experiencing some of the most common sensor problems may go a long way towards explaining increases in flagging, in general. The special values seen in P and P2 (as well as a good number of other parameters) in February and December are attributed to the Neil Armstrong. The details surrounding the special values, however, are unknown.

Figure 4: Total number of (this page) atmospheric pressure – P – (next page, top) atmospheric pressure 2 – P2 – and (next page, bottom) atmospheric pressure 3 – P3 – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Air temperature was also of decent quality (Figure 5). 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. Deck heating can also occur simply when winds are light and the sensor is mounted on or near a large structure that easily retains heat (usually metal). Contamination from stack exhaust was also a common problem. Figure 47 does a good job of demonstrating stack exhaust contamination. Each of these incidences will result in the application of either caution/suspect (K) or poor quality (J) flags. In the case of stack exhaust, the authors wish to stress that adequate digital
imagery, when used in combination with platform relative wind data, can facilitate the identification of exhaust contamination and subsequent recommendations to operators to change the exposure of their thermometer.

There are no particular standouts in either T or T3, although we note that T was flagged for almost the entire year on *Okeanos Explorer* (documented; see individual vessel description in section 3c for details), apart from November, when there was no data. It isn’t clear what caused the increase seen in T2 in September. The combination of several vessels experiencing some of the most common sensor problems may go a long way towards explaining increases in flagging, in general. The special values seen in T and T2 (as well as a good number of other parameters) in February and December are attributed to the *Neil Armstrong*. The details surrounding the special values, however, are unknown.

Figure 5: Total number of (this page) air temperature – T – (next page, top) air temperature 2 – T2 – and (next page, bottom) air temperature 3 – T3 – observations provided by all ships for each month in 2017. 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.
Wet bulb temperature (Figure 6) was reported by only one vessel in 2017; namely, the *Thomas Jefferson*, which is also the only vessel currently set up to report wet bulb. The flagging seen in August through October is attributed to a moisture issue with *Jefferson’s* relative humidity sensor, from which the wet bulb temperature is derived (documented;
Figure 6: Total number of wet bulb temperature – TW – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Dew point temperature (Figure 7) was also only reported by one vessel in 2017; again, the Thomas Jefferson, although two other vessels are currently set up to report dew point if they wish. Again, the flagging seen in August through October is attributed to a moisture issue with Jefferson’s relative humidity sensor, from which the dew point temperature is derived (documented; see individual vessel description in section 3c for details).
Figure 7: Total number of dew point temperature – TD – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

With relative humidity, the most common issue is readings slightly greater than 100%. If these measurements were sound they would imply supersaturated conditions, but in fact that scenario is quite rare near the surface of the ocean. When it comes to relative humidity, the mechanics of most types of sensors is such that it is easier to obtain high accuracy over a narrow range than over a broader range, say from 10% to 100% (Wiederhold, 2010). It is often desirable to tune these sensors for the greatest accuracy within ranges much less than 100%. The offshoot of such tuning, of course, is that when conditions are at or near saturation (e.g. rainy or foggy conditions) the sensor performs with less accuracy and readings over 100% commonly occur. While these readings are not really in grave error, they are nonetheless physically implausible and should not be used. Thus, they are B flagged by the automated QC flagger. These B flags likely account for a large portion of the A-Y flagged portions depicted in Figure 8.

We note that RH was flagged for almost the entire year on Okeanos Explorer (documented; see individual vessel description in section 3c for details), apart from November, when there was no data. Several other vessels (Investigator, Gordon Gunter, Oscar Elton Sette, Thomas Jefferson, Roger Revelle, Gordon Sproul) also experienced problems with RH at various times throughout the year (documented; see individual vessel descriptions in section 3c for details). The special values seen in RH and RH2 (as well as a good number of other parameters) in February and December are attributed to the Neil Armstrong. The details surrounding the special values, however, are unknown.
Figure 8: 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 2017. 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.
Wind sensors, both direction and speed, are arguably the instruments most affected by flow obstruction and changes in platform speed. Because research vessels traditionally carry bulky scientific equipment and typically have multi-level superstructures, it is a challenge to find locations on a research vessel where the sensors will capture the free-atmospheric circulation. Unlike other met sensors such as air temperature and relative humidity that are designed to function more or less independent of the micro scale nuances in airflow surrounding them, nuances in flow are the very thing that wind sensors are intended to measure. This is why obstructed flow is so readily incorporated into wind measurements. These flow-obstructed and platform speed-affected wind data were a common problem across SAMOS vessels in 2017. 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.

We note the Falkor experienced a wind sensor orientation issue in January that resulted in a period of universal flagging of DIR2 and SPD2. We also note the special values seen in DIR, DIR2, SPD, and SPD2 (as well as a good number of other parameters) in
February and December are attributed to the Neil Armstrong. The details surrounding the special values, however, are unknown.

Figure 9: 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 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Figure 10: Total number of (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 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Most of the flags applied to the radiation parameters were assigned by the auto flagger, primarily to short wave radiation (Figure 11). Short wave radiation tends to have the largest percentage of data flagged for parameters submitted to SAMOS. Out of bounds (B) flags dominate in this case. Like the relative humidity sensors, this is again a situation where a high degree of accuracy is impossible over a large range of values. As such, shortwave sensors are typically tuned to permit greater accuracy at large radiation values. Consequently, shortwave radiation values near zero (i.e., measured at night) often read slightly below zero. Once again, while these values are not a significant error, they are nonetheless invalid and unsuitable for use as is and should be set to zero by any
user of these data. Long wave atmospheric radiation, on the other hand, usually has the smallest percentage of data flagged among the radiation parameters submitted to SAMOS (Figure 12).

The increase in flagging of RAD_SW in May is attributed to a sensor failure on the Nathaniel Palmer (documented; see individual vessel description in section 3c for details). It isn’t immediately clear what caused the increase in RAD_SW seen in September, nor the increases seen in RAD_LW in May and December. In both June and August, the Falkor’s RAD_PAR and RAD_PAR2 were both universally flagged, owing to an issue with the data reporting units (documented; see individual vessel description in section 3c for details). The missing values observed in RAD_PAR2 in August were likely from the Investigator (cause unknown). The special values observed in RAD_SW, RAD_LW, and RAD_PAR may be attributed to the Neil Armstrong, who reported special values in many other parameters in December.

Figure 11: Total number of (this page) shortwave atmospheric radiation – RAD_SW – and (next page) shortwave atmospheric radiation 2 – RAD_SW2 – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Figure 12: 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 2017. 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: 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 2017. 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: Total number of (this page) net atmospheric radiation – RAD_NET – and (next page) net atmospheric radiation 2 – RAD_NET2 – observations provided by all ships for each month in 2017. 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.
There were no major problems of note with either the rain rate (Figure 15) or precipitation accumulation (Figure 16) parameters, although we note that RRATE, RRATE2, PRECIP, and PRECIP2 were four more of the Neil Armstrong’s variables that received a quantity of special value flags in February and December (details unknown). It should also be noted that some accumulation sensors occasionally exhibit slow leaks and/or evaporation. These data are not typically flagged; nevertheless, frequent emptying of precipitation accumulation sensors is always advisable.
Figure 15: Total number of (this page, top) rain rate – RRATE – (this page, bottom) rain rate 2 – RRATE2 – and (next page) rain rate 3 – RRATE3 – observations provided by all ships for each month in 2017. 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: Total number of (this page) precipitation accumulation – PRECIP – (next page, top) precipitation accumulation 2 – PRECIP2 – and (next page, bottom) precipitation accumulation 3 – PRECIP3 – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
The main problem identified with the sea temperature parameter (Figure 17) occurs when the sensor is denied a continuous supply of seawater. In these situations, either the resultant sea temperature values are deemed inappropriate for the region of operation (using gridded SST fields as a guide), in which case they are flagged with suspect/caution (K) flags or occasionally poor quality (J) flags if the readings are extraordinarily high or low, or else the sensor reports a constant value for an extended period, 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 rather anticipated as the normal ship operation practice by SAMOS data analysts. Other than this expected performance, the TS data were generally good in 2017. The increases in flagging in TS2 seen May and September are probably attributed to the *Hi’ialakai* and *Atlantic Explorer*, respectively, each of who experienced an issue with that sensor in their respective months (documented; see individual vessel descriptions in section 3c for details). A good deal of the flagging of TS2 is likely explained via the *Sikuliaq*, as their infrared thermometer is commonly pointed at the dock when they are tied up, effectively measuring the dock temperature, which was subsequently frequently flagged as greater than four standard deviations from climatology (G).

![Figure 17: Total number of (top) sea temperature – TS – and (bottom) sea temperature 2 – TS2 – observations provided by all ships for each month in 2017. 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.](image-url)
Salinity and conductivity (Figures 18 and 19, respectively) experienced the same major issue as sea temperature; namely, when a vessel was in port or ice or rough seas the flow water system that feeds the probes was usually shut off, resulting in either inappropriate or static values. Another fairly common issue with salinity and conductivity, though, is that on some vessels the intake port is a little shallower than is desirable, such that in heavy seas the intake cyclically rises above the waterline and air gets into the sample. When this occurs, the data can be fraught with spikes. Data such as this is typically flagged with either spike (S), suspicious quality (K), or occasionally even poor quality (J) flags. Despite these issues, though, salinity and conductivity data in 2017 were still rather good. The increases in flagging noted in both SSPS and CNDC in May are attributed to both the Hi’ialakai and the Oregon II (documented; see individual vessel description in section 3c for details). It isn’t immediately clear what caused the very large proportion of flags seen in SSPS2 and CNDC2 in December; likely it was stagnant water data transmitted while in port.

Figure 18: Total number of (this page) salinity – SSPS – and (next page) salinity 2 – SSPS2 – observations provided by all ships for each month in 2017. 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) conductivity – CNDC – and (next page) conductivity 2 – CNDC2 – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Latitude and longitude (Figure 20) primarily only receive flags via the 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 land error flags, which are often removed by the data analyst when it is determined that the vessel was simply very close to land, but still over water (although for non-visual QC ships this step is not taken). It should be noted that Atlantis, 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 2017. It should also be noted that a new one-minute land mask, used for the land check routine, was implemented on 1 June 2017, replacing the previous two-minute land mask. We note the switch to a one-minute land mask has resulted in a slight increase in L-flagging overall, presumably as coastlines and small oceanic landmasses have become better defined (i.e. what once was “water” may now be “land”). This slight increase is suggested in Figure 20, seen from June onward, although the uptick in flagging seen in May was likely due to Sikuliaq and Tangaroa, both of which transmitted from the dock for most of the month.
The remainder of the navigational parameters exhibited no real problems of note. They are nevertheless included for completeness: platform heading (Figure 21), platform course (Figure 22), platform speed over ground (Figure 23), and platform speed over water (Figure 24).
Figure 21: 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 2017. 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 platform course – PL_CRS – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Figure 23: Total number of platform speed over ground – PL_SPD – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.

Figure 24: Total number of (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 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
Regarding the platform relative wind parameters, both direction (Figure 25) and speed (Figure 26), we note that the slight increases in flagging seen in January in both PL_WDIR2 and PL_WSPD2 are attributed to the *Falkor* and her wind sensor orientation issue (documented; see individual vessel description in section 3c for details). We point out, too, that PL_WDIR2 and PL_WSPD2 were the final two of *Neil Armstrong*’s variables that received a quantity of special value flags in February and December (details unknown).

Figure 25: Total number of (this page) platform relative wind direction – PL_WDIR – (next page, top) platform relative wind direction 2 – PL_WDIR2 – and (next page, bottom) platform relative wind direction 3 – PL_WDIR3 – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
(Figure 25: cont’d)
Figure 26: Total number of (this page, top) platform relative wind speed – PL_WSPD – (this page, bottom) platform relative wind speed 2 – PL_WSPD2 – and (next page) platform relative wind speed 3 – PL_WSPD3 – observations provided by all ships for each month in 2017. The colors represent the number of good (green) values versus the values that failed one of the SAMOS QC tests (red). Values noted as missing or special values by the SAMOS processing are also marked in blue and orange, respectively.
(Figure 26: cont’d)
c. 2017 quality by ship

*Atlantic Explorer*

![Pie chart showing quality control results for the Atlantic Explorer.](image)

Figure 27: For the *Atlantic Explorer* from 1/1/17 through 12/31/17, (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 28 ship days, resulting in 554,514 distinct data values. After automated QC, 3.22% of the data were flagged using A-Y flags (Figure 27). This is a few percentage points higher than in 2016 (0.9%) but is still under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must be noted the *Explorer* 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 *Atlantic Explorer*).

It is worth mentioning that the *Explorer*'s SAMOS data transmission rate was about 19% in 2017 (see Table 2), down quite a bit from 2016’s 60% transmission rate. The vessel was contacted via email regarding her transmission in early March 2017 and again in early June, both times being advised that the most recent file we had received from her was dated November 2016. It was suspected there was a problem with her data transmission system. In late July daily transmission was finally restarted, but by October it unfortunately ceased again. It would be desirable to recover any SAMOS data not received by us.

Regarding the data received, nearly all QC flags were applied to *Explorer*’s three sea parameters. Sea temperature (TS), sea temperature 2 (TS2), and salinity (SSPS) together were assigned over 95% of all flags (Figure 27), the great majority of which were out of
bounds (B) flags (Figure 29). A quick inspection of the data suggests an issue developed with TS2 on or around 31 August. Reported values were unrealistically high, exceeding 55 C. It appears perhaps a bit of troubleshooting took place 1-2 September, resulting in the bad TS and SSPS data that was flagged (Figure 28). However, TS2 continued to read over 55 C thereafter and for the remainder of 2017 SAMOS transmission. It should be noted that the conductivity data was also compromised during 1-2 September, reading exactly zero, but because it was still within reasonable bounds it was not flagged by automated processing. It might also be noted that the greater than four standard deviations (G) flags applied to TS2 during the apparent troubleshoot would have certainly been changed to poor quality (J) flags had the Explorer received visual quality control.

Figure 28: Atlantic Explorer SAMOS (first) sea temperature – TS – (second) sea temperature 2 – TS2 – (third) salinity – SSPS – and (last) conductivity – CNDC – for 1 September 2017. Note out of bounds (B) flags (in grey) on TS, TS2, and SSPS and greater than four standard deviations from climatology (G) flags (in purple) on TS2. Note also unflagged CNDC values of exactly zero.
Figure 29: Distribution of SAMOS quality control flags for (top) sea temperature – TS – (middle) sea temperature 2 – TS2 – and (bottom) salinity – SSPS – for the *Atlantic Explorer* in 2017.
Figure 30: For the Investigator from 1/1/17 through 12/31/17, (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 215 ship days, resulting in 8,111,503 distinct data values. After automated QC, 4.09% of the data were flagged using A-Y flags (Figure 30). This is virtually unchanged from 2016’s total flagged percentage (4.06%). 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).

About 60% of the total flags were applied to the redundant short wave atmospheric radiation parameters (RAD_SW and RAD_SW2) (Figure 30). Upon inspection the flags, which are unanimously out of bounds (B) flags (Figure 32), 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 16.46% of the flags were applied to relative humidity (RH) (Figure 30), and these were a split between B and greater than four standard deviations from climatology (G) flags (Figure 32). Upon inspection, early in the year RH appears to have consistently read several percent higher than the redundant relative humidity sensor RH2. When the atmosphere was saturated this typically meant RH read several percent over 100, which resulted in B flags. As demonstrated in Figure 31, the shape of RH agreed well with RH2, despite any physically invalid values. Hence, this may have been a case of problematic RH instrument tuning, or perhaps poor calibration. It appears that later in the
year RH reported 0% for an extended period, this being the cause of the G flags, so perhaps the sensor was removed for maintenance. In the final months of 2017 any issues look to have been resolved, with good agreement finally between RH and RH2.

Figure 31: *Investigator* SAMOS (top) relative humidity – RH – and (bottom) relative humidity 2 – RH2 – for 2 February 2017. Note the similarity in shape of RH and RH2, despite the positive skew reflected in RH values. Note out of bounds (B) flags (in grey) on RH values >100%.
Figure 32: Distribution of SAMOS quality control flags for (top) relative humidity – RH – (middle) short wave atmospheric radiation – RAD_SW – and (bottom) short wave atmospheric radiation 2 – RAD_SW2 – for the *Investigator* in 2017.
Figure 3: For the Tangaroa from 1/1/17 through 12/31/17, (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 190 ship days, resulting in 4,629,119 distinct data values. After automated QC, 10.62% of the data were flagged using A-Y flags (Figure 3). This is several percentage points higher than in 2016 (6.19%). 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).

As in previous years, Tangaroa’s two short wave atmospheric radiation parameters (RAD_SW and RAD_SW2) acquired a sizable portion of the total flags, around 25% each (Figure 3). These were exclusively out of bounds (B) flags (Figure 34). Once again, it appears most, or all the B flags applied to RAD_SW and RAD_SW2 were the result of the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

Latitude (LAT) and longitude (LON) together collected a further ~45% of the total flags (Figure 33). A quick inspection reveals these mainly land check (L) flags (Figure 34) were generally applied when the vessel was in port. 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 an inland port. This is true of both the older 2-minute land mask and the newer 1-minute one introduced in mid-2017.
Figure 34: Distribution of SAMOS quality control flags for (first) short wave atmospheric radiation – RAD_SW – (second) short wave atmospheric radiation 2 – RAD_SW2 – (third) latitude – LAT – and (last) longitude – LON – for the *Tangaroa* in 2017.
Figure 3: For the Bell M. Shimada from 1/1/17 through 12/31/17, (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 187 ship days, resulting in 4,439,006 distinct data values. After both automated and visual QC, 3.43% of the data were flagged using A-Y flags (Figure 3). This is virtually unchanged from 2016 (3.58% total flagged) and Shimada remains under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

Shimada experienced no specific data issues in 2017, as evidenced by the low total flagged percentage and the fairly even spread across most parameters of those flags applied (Figure 3). Shimada's various meteorological sensors do occasionally exhibit data distortion that is dependent on the vessel relative wind direction and, in the case of air temperature, likely ship heating. Where the data appears affected, it is generally flagged with caution/suspect (K) flags. This type of flagging (not shown) constitutes the majority of the percentages seen in Shimada's atmospheric variables — namely, the earth relative wind direction and speed (DIR, DIR2, SPD, SPD2) and the pressure, air temperature, and relative humidity (P, T, RH). It can be a challenge to site sensors ideally on a ship. But we note that with such a low overall flag percentage as the Shimada typically receives these sensor location issues are not terribly consequential for her.
The *Fairweather* provided SAMOS data for 126 ship days, resulting in 2,474,147 distinct data values. After both automated and visual QC, 13.09% of the data were flagged using A-Y flags (Figure 36). This is a significantly higher total flagged percentage than in 2016 (5.5%).

It is worth mentioning that the *Fairweather*’s SAMOS data transmission rate was about 51% in 2017 (see Table 2). The vessel was contacted via email regarding her transmission several times throughout the year by both SAMOS and OMAO personnel. Nevertheless, transmission remained spotty throughout most of the year. It would be desirable to recover any SAMOS data not received by us (see Figure 2), although it might not be possible to apply visual QC, especially for any data more than a year old.

*Fairweather* data continues to suffer from problematic sensor location, although neither adequate metadata nor digital imagery nor a detailed flow analysis exists for this vessel, preventing diagnosis (see Table 4). All five of the meteorological parameters offered by *Fairweather* – earth relative wind direction (DIR), earth relative wind speed (SPD), air temperature (T), relative humidity (RH), and atmospheric pressure (P) – show a considerable amount of flow obstruction and/or interference from stack exhaust or ship heating, which is reflected in the flagged percentages seen in Figure 36. Effects are generally seen as "steps" in the affected data in concert with platform speed and/or platform relative wind direction/speed changes, and frequently when the vessel is moored.
in chop and the ship’s orientation vacillates (Figure 37). These steps are generally assigned caution/suspect (K) flags (not shown).

In addition to the usual relative wind-related steps, from 13-19 December, at the end of *Fairweather’s* sail season and while she was in port, T reported a constant -50 C and RH reported a constant 0%. It is suspected the sensors may have been removed, as this was the end of the season. T accumulated some out of bounds (B) flags and RH some poor quality (J) flags as a result (Figure 38).

In terms of the highest flag percentages, sea temperature (TS), salinity (SSPS), and conductivity (CNDC) put together acquired ~75% of the total flags (Figure 36). However, these were primarily K flags (Figure 38), assigned while the vessel was in port with the sea water flow-through system disengaged.

One final matter existed with CNDC that is not reflected in the flag totals. During late May, while the *Fairweather’s* 2017 transmission was gearing up, the values in the CNDC field of her SAMOS files appeared to be calendar dates rather than scientific measurements. These erroneous data were assigned special (-8888.) flags by SAMOS auto processing. The vessel was notified of the mistake via email on 15 June and a discussion with the ship’s technician ensued. Consequently, when the vessel set sail a few days later the issue was resolved.

![Figure 37: Fairweather SAMOS (first) platform heading – PL_HD – (second) earth relative wind direction – DIR – (third) earth relative wind speed – SPD – and (last) atmospheric pressure – P – for 13 August 2017. Note the many steps in DIR, SPD, and P in conjunction with changing PL_HD. These data were recorded while the vessel was moored in the middle of Port Clarence, AK.](image-url)
Figure 38: Distribution of SAMOS quality control flags for (first) air temperature – T – (second) relative humidity – RH – (third) sea temperature – TS – (fourth) salinity – SSPS – and (last) conductivity – CNDC – for the *Fairweather* in 2017.
Ferdinand Hassler

Figure 39: For the Ferdinand Hassler from 1/1/17 through 12/31/17, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The Hassler provided SAMOS data for 49 ship days, resulting in 829,699 distinct data values. After both automated and visual QC, 13.25% of the data were flagged using A-Y flags (Figure 39). This is several percentage points higher than in 2016 (8.83%).

It is worth mentioning that Hassler’s SAMOS data transmission rate was around 53% in 2017 (see Table 2), and while this is better than the 35% transmission rate in 2016 there is still room for improvement. It would be desirable to recover any data not received by us (see Figure 2), although it might not be possible to apply visual QC, especially for any data more than a year old.

In February, at the start of Hassler’s 2017 SAMOS transmission, it was suspected that the atmospheric pressure (P) was a few mb low (a carryover from 2016). The vessel was advised as much in an email dated 20 February. In response, the ship’s technician conveyed awareness and stated that the sensor was scheduled for replacement during Hassler’s upcoming Spring shipyard period. Unfortunately, after 2 April we received only about a week’s worth more of 2017 data, in October. At that time P was still suspected of being low, as judged by gridded surface analyses and any nearby buoys/stations. Consequently, P acquired a sizable ~55% of all flags (Figure 39) over the course of the year, principally suspect/caution (K) flags (Figure 41).

Most of the remaining flags belong to the earth relative wind direction (DIR) and earth relative wind speed (SPD) parameters (Figure 39). These were mainly K flags (Figure
applied to the exaggerated steps commonly seen in Hassler’s earth relative wind parameters (Figure 40). It remains unclear what causes the steps in the true wind data; it’s suspected there may be issues with both the way the data are recorded and the way the true winds are calculated. Flow distortion, whereby flow to the sensors is regularly blocked or accelerated when the platform relative wind is from a specific direction or directions, also has not been ruled out. (We note adequate metadata and digital imagery—necessary aids in flow analysis—are unavailable for the wind parameters.) It is hoped we might visit Hassler soon and work out the issues with her true winds. As a further note here, to a lesser extent air temperature (T) and relative humidity (RH) (not shown, but also lacking adequate metadata) also appear subject to flow distortion or possibly ship heating.

Figure 40: Hassler SAMOS (first) platform heading – PL_HD – (second) platform relative wind direction – PL_WDIR – (third) platform speed – PL_SPD – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – for 14 October 2017. Note the many steps in DIR and SPD in conjunction with changing PL_WDIR despite only small changes in PL_SPD. There may exist multiple platform relative wind directions that interfere with the sensors.
Figure 41: Distribution of SAMOS quality control flags for (top) atmospheric pressure – P – (middle) earth relative wind direction – DIR – and (bottom) earth relative wind speed – SPD – for the Ferdinand Hassler in 2017.
The *Gordon Gunter* provided SAMOS data for 151 ship days, resulting in 3,113,789 distinct data values. After both automated and visual QC, 4.39% of the data were flagged using A-Y flags (Figure 42). This is only a small change from the total flagged percentage in 2016 (3.44%) and *Gunter* remain under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

Beginning around 22 May *Gunter*'s air temperature (T) and relative humidity (RH) appeared to be on the fritz, with odd depressions and noise regularly appearing in the data (Figure 43). SAMOS personnel emailed the vessel on 24 May, suspecting either an issue with the sensors or else some electrical interference. On 8 June a ship’s technician responded, explaining he’d found water in the body of the temperature sensor, which had repeatedly shorted out the T/RH signals. To address the problem, the sensor was drained and resealed. However, the shorts in T/RH persisted and were finally found by the technician to be affecting the rest of the parameters derived from the same RM Young translator. This, along with an overload of errors from the speed logger, forced a restart of SCS on 15 June, with the RM Young translator not being restored until 17 June. T and RH still appeared unstable through about 23 June but were improved thereafter. While the bogus T/RH data were in appearance T accumulated both out of bounds (B) and poor quality (J) flags, and RH collected J flags (Figure 44), contributing to the combined ~44% of all flags acquired by those two variables (Figure 42).
Salinity (SSPS) and conductivity (CNDC) also acquired a quantity of J flags (Figure 44); however, these were merely applied when the parameters reported constant 0 values because the vessel was in port (or otherwise stationary) and the apparatus was not turned on.

As a general note, T, RH, earth relative wind direction and speed (DIR and SPD, respectively), and atmospheric pressure (P) on the Gunter all show signs of moderate flow distortion (common on most vessels), which oftentimes results in caution/suspect (K) flags for each of those parameters (not shown). It can be a challenge to site sensors ideally on a ship. Yet with an overall flag percentage under 5%, and this despite a prolonged issue with T/RH, any sensor location issues on the Gunter should not be considered terribly consequential.

Figure 43: Gordon Gunter SAMOS (top) air temperature – T – and (bottom) relative humidity – RH – data for 23 May 2017. Note dubious depressions and noise.
The Henry Bigelow provided SAMOS data for 79 ship days, resulting in 1,559,633 distinct data values. After both automated and visual QC, 6.75% of the data were flagged using A-Y flags (Figure 45). This is only a small change from the total flagged percentage in 2016 (7.71%).

It is worth mentioning that Bigelow’s SAMOS data transmission rate was around 69% in 2017 (see Table 2). While this is not terrible there is certainly room for improvement. It would be desirable to recover any data not received by us (see Figure 2), although it might not be possible to apply visual QC, especially for any data more than a year old.

Sometime in late March Bigelow’s atmospheric pressure (P) began exhibiting odd behavior, with mysterious increases of at least several millibars over short periods of time and time series plots that deviated quite a bit from a traditional diurnal structure (Figure 46). This odd behavior resulted in P acquiring some caution/suspect (K) flags as well as some out of bounds (B) and poor quality (J) flags (Figure 48). On 11 April the vessel was contacted by SAMOS personnel via email. It was suggested there might be water in a loop of the pressure tubing, as had happened onboard Bigelow in 2016. A response was received the same day stating the issue would be investigated and noting that there had been some recent moisture issues with some of the other equipment on the flying bridge (where P is evidently located). On 16 April there was a jump of over 100 mb that may have signified a checking/clearing of the pressure tubing, and certainly by about 18 April
P looked much better. But while the odd behavior endured, P accumulated caution/suspect (K), poor quality (J), and out of bounds (B) flags (Figure 48).

Virtually all of Bigelow’s flags in 2017 were applied to the meteorological parameters – P, earth relative wind direction and speed (DIR and SPD, respectively), air temperature (T), and relative humidity (RH) (Figure 45). All meteorological parameters reported by the Henry Bigelow suffer the myriad effects of less-than-ideal sensor placement (e.g. flow interruption, exhaust contamination). The result is steps and spikes in the data, which acquire spike (S) and K flags (Figure 48). This is not uncommon among sea-faring vessels, although the effects are perhaps a little more pronounced on the Bigelow than on the average SAMOS ship. Exhaust contamination is particularly evident in T and RH when the wind is from the stern (Figure 47).

RH additionally sometimes read a few percent over 100 in 2017, which resulted in B flags (Figure 48). This may have been the commonplace result of sensor tuning and saturated atmospheric conditions (see 3b.), although the possibility exists there could have been a moisture issue such as was discovered in other equipment on the flying bridge.

We note that no short wave or long wave radiation data were received from the Bigelow in 2017. SAMOS personnel emailed the vessel on 14 February to inquire about their absence, and a ship’s technician responded that the instruments had been shipped to the manufacturer to address data quality issues noted in 2016. He stated the instruments would be reinstalled once they were received back from service, but a further email request for an ETA went unanswered and the radiation data did not resume at any time in 2017.

![Henry Bigelow SAMOS atmospheric pressure – P – for 1 April 2017. Note especially 10+ mb increase over ~15 min span before 3:00, as well as unconventional overall shape of trace.](image)
Figure 47: Henry Bigelow SAMOS (first) platform relative wind direction – PL_WDIR – (second) earth relative wind direction – DIR – (third) earth relative wind speed – SPD – (fourth) air temperature – T – and (last) relative humidity – RH – for 22 April 2017. Note pronounced steps in T and RH (inside maroon boxes) when the relative wind is ~180°, as well as the suggestion of corresponding steps/spikes in DIR and SPD.
The Hi’ialakai provided SAMOS data for 146 ship days, resulting in 3,360,759 distinct data values. After both automated and visual QC, 5.63% of the data were flagged using A-Y flags (Figure 49). This is about the same as in 2016 (4.91%), although it is just over the 5% total flagged cutoff regarded by SAMOS to represent “very good” data.

On 21 February Hi’ialakai personnel contacted SAMOS to explain that the SBE21 thermostalinograph was out for calibration and thus would not be reporting any data for a while. This involved the conductivity (CNDC) and salinity (SSPS) as well as sea temperature 2 (TS2), which was the internal TSG temperature, and sea temperature (TS), which was the time-averaged data from an external SBE38, routed through the SBE21. TS2, CNDC, and SSPS reappeared in the SAMOS data on 28 March, but TS did not. Some emailing between Hi’ialakai and SAMOS continued in early April, and it was revealed there was an unknown problem preventing the SBE38 from being plugged into the SBE21. Troubleshooting efforts ensued over the next several months:

In late May there was a brief shakeup while a technician attempted to reinstate TS, which made for some sporadic bad TS and a few days of bad/questionable TS2, CNDC, and SSPS (flags not shown). As of 1 June, TS was being reliably output to the SAMOS files, however it was obvious bad data, reading a constant 0°C (again, flags not shown). Then on 8 June TS data ceased again. At the same time CNDC jumped to over 8 S/m, fully out of realistic bounds and thus assigned out of bounds (B) flags (Figure 51), which continued to accumulate for two weeks. SAMOS personnel checked back in with the
vessel on 23 June, during a lull in data transmission, and were told to expect improved data the following day when the vessel got underway again. No data were received, however, and on 3 July another email went out asking for an update on data transmission and the status of the sea parameters. Sporadic emailing back and forth continued for most of July, during which it was revealed there had been an SCS upgrade which had complicated the situation. Eventually the ship’s technician contacted OMAO personnel for assistance, and on 24 July SAMOS transmission resumed, now with all four sea parameters present and sound. At that time SAMOS personnel were advised TS was coming from an SBE45. It is not known for certain whether this means the internal SBE45 microthermosalinograph sea temperature, or the external SBE38 sea temperature, now routed through the SBE45 rather than the SBE21. In any case, after 29 August TS became the only sea parameter reported for the remainder of 2017 transmission, for reasons unknown. It is worth acknowledging that the technician onboard Hi’ialakai was known to be working alone throughout 2017. We appreciate that troubleshooting the sea parameter issues might have taken longer than usual. We thank this technician for his efforts.

As a general note, T, relative humidity (RH), earth relative wind direction and speed (DIR and SPD, respectively), and atmospheric pressure (P) on the Hi’ialakai all show signs of moderate flow distortion and, in the case of T and RH, contamination from daytime ship heating and/or stack exhaust (all common on most vessels), which oftentimes results in caution/suspect (K) flags for each of those parameters (not shown). These K flags explain the majority of the percentages seen in Figure 49 for those variables. However, T, holding the largest percentage, also suffered from what appeared to be low-grade electrical interference on and off throughout the year (Figure 50), meaning a higher proportion of K flags for that variable (Figure 51).

![Figure 50: Hi’ialakai SAMOS air temperature – T – for 17 May 2017. Note periodic signal present in the data (presumed electrical interference).](image-url)
Figure 51: Distribution of SAMOS quality control flags for (top) air temperature – $T$ – and (bottom) conductivity – CNDC – for the Hi’ialakai in 2017.
The Nancy Foster provided SAMOS data for 85 ship days, resulting in 1,455,010 distinct data values. After both automated and visual QC, 3.97% of the data were flagged using A-Y flags (Figure 52). This is about the same as the total flagged percentage in 2016 (3.41%) and maintains the Foster's standing under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

It is worth mentioning that Foster's SAMOS data transmission rate was around 56% in 2017 (see Table 2), though we also note there was a known issue with the SAMOS mailer which ultimately required either a server upgrade or an SCS update to resolve. In a mid-August email communication between SAMOS and OMAO personnel, it was determined that SAMOS transmission would not be expected while a decision between the two routes was contemplated. Regular transmission resumed after 13 September. It would be desirable to recover any data not received by us, if possible (see Figure 2), although it might not be possible to apply visual QC, especially for any data more than a year old.

Air temperature (T), pressure (P), relative humidity (RH), and to a lesser extent platform- and earth-relative wind speeds (PL_WSPD and SPD, respectively) and (only occasionally) earth relative wind direction (DIR) are prone to exhibiting spikes (Figure 53) at various times in the sailing season, to which mainly spike (S) flags are assigned (Figure 54). It is not certain whether these spikes are tied to a particular platform relative wind direction, although this analyst suspects not. This has been the ongoing
scenario for several years, and despite numerous attempts over the years to identify the spikes’ origin, the cause remains unknown. We note that possibilities raised in 2016 on our end include the potential absence of a pressure port to dampen effects from the winds, and/or installation location perhaps playing a role in the contamination of the data (e.g. stack exhaust, etc.).

As a general note, in addition to the spike issue, P, T, RH, and, to a lesser extent, both SPD and DIR exhibit clear sensor exposure issues (common on most vessels), which generally results in the application of caution/suspect (K) flags (Figure 54). Flow to the meteorological sensors generally seems contaminated when vessel relative winds are from the stern, but Foster metadata is still lacking instrument location specifics and detailed digital imagery of the vessel, both of which could aid in diagnosing the problem. In any case, with an overall flag percentage under 5%, any sensor location issues on the Foster should not be considered terribly consequential.

Figure 53: Nancy Foster SAMOS (first) platform relative wind direction – PL, WDIR – (second) earth relative wind speed – SPD – (third) atmospheric pressure – P – (fourth) air temperature – T – and (last) relative humidity – RH – for 16 March 2017. Note anomalous spikes in SPD, P, T, and RH.
Figure 54: 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 2017.
**Okeanos Explorer**

Figure 5: For the *Okeanos Explorer* from 1/1/17 through 12/31/17, (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 210 ship days, resulting in 4,371,763 distinct data values. After both automated and visual QC, 12.54% of the data were flagged using A-Y flags (Figure 5). This is a few percentage points lower than 2016’s total flagged percentage (15.62%).

At the start of the Explorer’s 2017 SAMOS transmission it was noted that air temperature (T) and relative humidity (RH) appeared compromised (Figure 56), with RH values mainly well over 100% and T values that generally ranged between dubious extremes (for example, 0 C to 45 C during a single day spent in the tropics). SAMOS personnel were in touch with the vessel immediately via email, and what follows describes continuing conversation and issue troubleshooting that spanned all of 2017:

In early February, a ship’s technician acknowledged the T/RH issue and stated they had noticed “everything” was off. He advised that they had already ruled out any components belowdecks and concluded the issue must be in the mast wiring. It was suspected things may not have been wired back up correctly after some mast work completed the previous November, and the technician planned to get up the mast soon to check. In the meantime, both T and RH continued to accumulate mainly poor quality (J) flags (Figure 58). On 20 February the situation visibly worsened, with an abrupt 4 mb drop in the atmospheric pressure (P) and a corresponding shift in T into the 400-500 C range (Figure 57). At this point both T and RH began acquiring out of bounds (B) flags across the board, and P, now suspected of being too low, began acquiring caution/suspect
(K) flags. It was suspected the technician had been modifying things on the mast; however, when prompted via email, he stated he had not yet had the chance to address anything. It is therefore unknown what precipitated the developments on 20 February. During 10-11 March P, T, and RH experienced another brief shakeup after which T abruptly dropped to the 40-50 °C range and RH began reporting persistently below 0%, while P values no longer appeared low (not shown). Ongoing troubleshooting is assumed of this event, although not confirmed. T and RH continued reporting out of range throughout the Spring and Summer, with the vessel and SAMOS occasionally checking in with each other but no real progress made. On 31 August OMAO personnel, who had by then been drawn into the ongoing conversation, noted that quality reports from the Voluntary Observing Ships Scheme (VOS) indicated the T/RH data Explorer provided to VOS was spot-on with climatological models, and yet the SAMOS T/RH values were somehow wrong. He inquired whether the vessel had changed out any instruments and forgotten to update SAMOS. (There is no response to this question on record.) The bad T/RH data continued, and then in mid-October the vessel experienced technical issues with their Zeno Met translator box, which prevented any meteorological data from making its way into the SAMOS files for a few days. A visiting Chief Survey Technician happened to be onboard at the time and fortunately the translator issue was pretty quickly resolved, but, as the visiting Chief ST noted, T and RH were afterwards still erroneous. He also noted ambiguous sensor wiring diagrams and bad weather were making repair efforts difficult. After some further discussion, it was decided that T and RH should be blocked from SAMOS processing for the time being. The sensors had been determined to be dysfunctional and were to be sent out for maintenance once another instrument could be swapped in. T and RH flags were switched to malfunction (M) flags (Figure 58) in the days leading up to the parameters’ removal from SAMOS processing (note visual QC, which applies M flags, occurs on a 10-day delay). On 5 December a newly calibrated Vaisala T/RH instrument was installed, and the data were reinstated to SAMOS processing. Unfortunately, T and RH were still under some suspicion by both the ship’s technician and SAMOS personnel, with T reading generally a few degrees C too high and RH reading conspicuously too low (for example, 60% during a rain event). As such, for the remainder of 2017 T and RH accumulated mainly K flags (Figure 58). It is worth acknowledging that the technician onboard Okeanos Explorer was known to be working alone for much of the year. We appreciate that troubleshooting the T/RH issue might have taken longer than usual. We thank everyone involved for their efforts.

Throughout the year, earth relative wind direction and speed (DIR and SPD, respectively) also occasionally suffered lateral effects of the ongoing T/RH issue and/or resolution efforts, which led to some sporadic accumulation of K and J flags for those two parameters (Figure 58). And as a general note, DIR, SPD, and P also all show signs of moderate flow distortion (common on most vessels), which also generally resulted in K flags (Figure 58).
Figure 56: Okeanos Explorer SAMOS (top) air temperature – $T$ – and (bottom) relative humidity – $RH$ – for 9 February 2017. Note RH values well in excess of 100% and unlikely range of $T$ values for the location in the tropical South Pacific.

Figure 57: Okeanos Explorer SAMOS (top) atmospheric pressure – $P$ – (middle) air temperature – $T$ – and (bottom) relative humidity – $RH$ – for 20 February 2017. Note $T$ and $RH$ values well out of any realistic range and a discontinuous drop in $P$ around 3:00.
Figure 58: 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 *Okeanos Explorer* in 2017.
The *Oregon II* provided SAMOS data for 171 ship days, resulting in 3,614,768 distinct data values. After both automated and visual QC, 7.37% of the data were flagged using A-Y flags (Figure 59). This is several percentage points lower than in 2016 (11.49%).

Beginning around early May SAMOS personnel began suspecting *Oregon’s* conductivity (CNDC) and salinity (SSPS) data were a little low, although it was difficult to be sure as the vessel was spending most of its time near the New Orleans and bayou region of the Louisiana coastline where there is a lot of riverine input. By the first week of June the vessel cruised the open Gulf a bit and because CNDC and SSPS still looked low the vessel was contacted via email on 9 June. After an initial reply claiming no known issue, a ship’s technician responded again on 12 June that he’d discovered the wrong sensor calibration file was being used for the two sensors. He switched the sensor file to the correct one and the data immediately improved. Prior to the resolution, both CNDC and SSPS accumulated caution/suspect (K) flags (Figure 62), likely contributing the bulk of the ~14% of total flags received by each parameter (Figure 59).

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 II* all suffer the myriad effects of less-than-ideal sensor placement (e.g. flow distortion, stack exhaust contamination), which oftentimes results in K flags for each of
those parameters (Figure 62, not all shown). What looks like exhaust contamination seems particularly evident in T and RH when the relative wind is from broadly port to astern (Figure 60). 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 than on the average SAMOS ship. We note Oregon II metadata is still lacking instrument location specifics and digital imagery/schematics of the vessel, both of which could aid in diagnosing flow issues. In any case, the resulting flags make up the majority of the percentages seen in Figure 59 for each parameter. Additionally, both air temperature (T) and atmospheric pressure (P) occasionally exhibited what appeared to be some sort of low-grade electrical interference (Figures 60 and 61, respectively), contributing a further small portion of K flags to each of those parameters (Figure 62). In the case of T, at least, it might be that something nearby the sensor is resonating when the vessel is in a near-headwind and that signal is contaminating the T sensor feed.

Figure 60: Oregon II SAMOS (top) platform relative wind direction – PL_WDIR – (middle) air temperature – T – and (bottom) relative humidity – RH – for 21 March 2017. Note low-grade oscillations in T when PL_WDIR is about 340° (inside maroon box). Also note steps in T and RH when PL_WDIR is between ~180-270°.
Figure 61: Oregon II SAMOS (top) platform relative wind direction – PL_WDIR – and (bottom) atmospheric pressure – P – for 29 March 2017. Note spurious oscillations in P.
The *Oscar Dyson* provided SAMOS data for 188 ship days, resulting in 3,655,092 distinct data values. After both automated and visual QC, 1.06% of the data were flagged using A-Y flags (Figure 63). This is about the same as 2016’s total flagged percentage (1.51%) and *Dyson* remains well under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

No specific issues were noted for the *Dyson* in 2017. The vessel suffers mildly from a bit of flow distortion and ship heating/stack exhaust contamination affecting her various atmospheric sensors. Virtually all vessels do, but the effects are perhaps minimized on the *Dyson*, as compared to the average SAMOS vessel. Nevertheless, throughout 2017 a relatively small amount of mainly caution/suspect (K) flags were accumulated by air temperature (T), relative humidity (RH), atmospheric pressure (P), and earth relative wind speed and direction (SPD and DIR, respectively) as a result (Figure 64).
Figure 64: 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 Oscar Dyson in 2017.
Oscar Elton Sette

Figure 65: For the Oscar Elton Sette from 1/1/17 through 12/31/17, (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 191 ship days, resulting in 3,961,618 distinct data values. After both automated and visual QC, 3.13% of the data were flagged using A-Y flags (Figure 65). This is a few percentage points higher than in 2016 (1.67%) and maintains the Sette’s standing under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

From mid-July through late August, both relative humidity (RH) and to a lesser extent air temperature (T) seemed to be suffering the effects of an undiagnosed issue wherein RH very frequently read slightly over 100% (not uncommon in saturated conditions, although the long duration foments suspicion) and both T and RH experienced a fair number of anomalous spikes (Figure 66). This resulted in RH accumulating a fair amount of out of bounds (B) flags and both T and RH acquiring some spike (S) flags (Figure 68). We regret investigation of this apparent issue slipped through the cracks at the time, thus an explanation was not pursued by SAMOS personnel.

Much earlier in the year, on 1 April, a ship’s technician contacted SAMOS personnel via email to provide details about the Sette’s sea water intake setup: She stated they were using their shallow (-3.5 m) intake for the thermosalinograph (TSG), as the deeper intake had been discovered to have a leak and the run from the shallow intake to the instrument was shorter anyway (meaning water spent less time adjusting to the interior temperature of the ship). The consequence of using the shallower intake, she explained, was that due to varying sea state the suction at the intake was occasionally lost, meaning the sea
temperature (TS), conductivity (CNDC), and salinity (SSPS) experienced noise/freefalls and spikes (Figure 67). When these data were affected, they were assigned a variety of caution/suspect (K), poor quality (J), B, and S flags (Figure 68). In very rough weather the TSG might even be secured, producing some inconsistency in the TSG data collection over the year. In a response by SAMOS personnel to the propounded intake information, it was suggested that the Sette could provide TSG data from the deep intake (-4.5 m) in addition to the shallow intake TSG, once any leaks were repaired, as well as a remote sea temperature data from the deep intake, once installed. To date these additions have not taken place.

As a general note, T, RH, earth relative wind direction and speed (DIR and SPD, respectively), and atmospheric pressure (P) on the Sette all show signs of moderate flow distortion (common on most vessels), which oftentimes results in caution/suspect (K) flags for each of those parameters (Figure 68, not all shown). It can be a challenge to site sensors ideally on a ship. Yet with an overall flag percentage under 5%, and this despite issues with T/RH and with TS/SSPS/CNDC, any sensor location issues on the Sette should not be considered terribly consequential.

Figure 66: Oscar Elton Sette SAMOS (top) air temperature – T – (middle) relative humidity – RH – and (bottom) platform relative wind direction – PL_WDIR – for 28 July 2017. Note RH trend slightly above 100%. Also note numerous spikes in T and RH with no obvious connection to PL_WDIR.
Figure 67: Oscar Elton Sette SAMOS (top) sea temperature – TS – (middle) salinity – SSPS – and (bottom) conductivity – CNDC – for 25 May 2017. Note noise, spikes, and freefalling values in all three parameters that occurred whenever the intake suction was compromised.
For the *Pisces* from 1/1/17 through 12/31/17, (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 171 ship days, resulting in 4,007,376 distinct data values. After both automated and visual QC, 9.77% of the data were flagged using A-Y flags (Figure 69). This is a few percentage points lower than in 2016 (12.1%).

Early in the year the *Pisces*’ Senior Survey Technician contacted SAMOS personnel via email to provide some new information: She wanted us to know that the technicians onboard *Pisces* are given very little control over the operating state of both the sea water pump and the thermosalinograph (TSG), meaning we at SAMOS often receive sea temperature (TS), salinity (SSPS), and conductivity (CNDC) data that are not reflective of actual sea conditions, and occasionally we are not furnished with any TSG data despite the vessel being underway. She added that there is very poor sea water piping on the *Pisces*, and that ambitions to address the problem have strained to gain traction. These revelations likely explain the bulk of the ~35% combined total flagged percentages assigned to TS, SSPS, and CNDC in 2017 (Figure 69). The Senior Survey Tech also wanted us to know she had been pushing for a while to augment the wind data reported to SAMOS with data from the two additional wind sensors resident on the vessel. She noted we were receiving data from the port wind bird, which was widely known to be the least reliable of *Pisces*’ sensors. However, she had recently been able to finally plug their jackstaff wind bird into SCS. (She stated the technicians were also trying to figure out how to get the starboard windbird into SCS, but it seems likely that effort was pushed to the wayside because of Sea Trials and the Senior Survey Tech leaving the vessel for the
relief pool soon after.) Within days of her email, and with some help from SAMOS personnel and SAMOS-based SCS teaching materials, the Senior Survey Tech was able to add the jackstaff sensor to the *Pisces*’ SAMOS setup and we began receiving a second set of platform relative winds. (True wind derived sensors, we learned, had not been created from the jackstaff wind bird.)

From mid- to late October, the primary platform relative wind speed parameter (PL_WSPD) intermittently appeared to have reduced functionality, occasionally just “dropping out” for no apparent reason (Figure 70). By the time SAMOS personnel notified the vessel via email on 1 November the technicians had already discovered and fixed a loose wire which was causing the problem. Prior to receiving the ship’s response, PL_WSPD accumulated caution/suspect (K) and poor quality (J) flags; earth relative wind direction and speed (DIR and SPD, respectively), being derived from PL_WSPD, also acquired K and J flags (Figure 72). After learning the cause of the suspicious PL_WSPD data, flagging for all three parameters was switched to malfunction (M) flags (Figure 72) from 23 October until 27 October, the date of the fix (note that visual quality control, which assigns M flags, takes place on a 10-day delay).

As a general note, air temperature (T), relative humidity (RH), atmospheric pressure (P), and especially DIR and SPD on the *Pisces* all show signs of moderate flow distortion and ship heating/stack exhaust contamination (common on most vessels), which oftentimes results in caution/suspect (K) flags for each of those parameters (Figure 72, not all shown). This scenario goes a long way towards explaining the various total flagged percentages seen for each of those variables in Figure 69. P further suffers from a long-standing issue of indeterminate source wherein occasional mysterious negative steps are observed in the data (Figure 71). Such steps are assigned additional K flags (Figure 72).

![Figure 70: Pisces SAMOS (top) platform relative wind direction – PL_WDIR – (middle) platform speed – PL_SPD – and (bottom) platform relative wind speed – PL_WSPD – for 16 October 2017. Note spurious “dropouts” in PL_WSPD.](image)
Figure 71: Pisces SAMOS (first) platform relative wind direction – PL_WDIR – (second) platform speed – PL_SPD – (third) earth relative wind speed – SPD – (fourth) air temperature – T – and (last) atmospheric pressure – P – for 25 June 2017. Note negative steps in P with no apparent correlation to any other parameter.
Figure 72: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) earth relative wind direction – DIR – (third) earth relative wind speed – SPD – and (last) platform relative wind speed – PL_WSPD – for the *Pisces* in 2017.
The *Rainier* provided SAMOS data for 156 ship days, resulting in 2,643,264 distinct data values. After both automated and visual QC, 3.91% of the data were flagged using A-Y flags (Figure 73). This is significantly lower than 2016’s total flagged percentage (18.97%) and brings her under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

There are no specific issues noted for *Rainier* in 2017. As a general note, it is known that *Rainier* exhibits a somewhat pronounced flow distortion problem. This is compounded by the fact her meteorological parameters – namely, air temperature (T), relative humidity (RH), atmospheric pressure (P), and earth relative wind direction and speed (DIR and SPD, respectively) – all come from an all-in-one Airmar weather station, known to be of lesser scientific quality than other types of vessel-bound weather equipment installations. The flow distortion frequently requires the application of caution/suspect (K) flags for all five parameters (Figure 74). Additionally, RH occasionally gets stuck at slightly over 100% after a bout of atmospheric saturation, leading to an accumulation of out of bounds (B) flags (Figure 74). We note that *Rainier*’s sensor metadata is still insufficient for us to be able to pinpoint any flow problems. The digital imagery available to us is also inadequate for diagnosis. Notwithstanding the low overall flagged percentage acquired by *Rainier* in 2017, we further reiterate that the Airmar isn’t capable of producing as robust data as is required to
meet many scientific objectives. If the vessel prefers to operate with an all-in-one sensor, we can suggest several better alternatives.

Additionally, no sea water data were reported by the Rainier in 2017. It is not known definitively why not, although we recognize that the sea data provided in 2016 were the main cause of her significantly higher total flagged percentage that year. It was suggested in last year’s report that it might make sense to discontinue the sea data if it could not be improved.

Figure 74: Distribution of SAMOS quality control flags for (first) atmospheric pressure – P – (second) air temperature – T – (third) relative humidity – RH – (fourth) earth relative wind direction – DIR – and (last) earth relative wind speed – SPD – for the Rainier in 2017.
Reuben Lasker

Figure 75: For the Reuben Lasker from 1/1/17 through 12/31/17, (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 236 ship days, resulting in 4,980,535 distinct data values. After both automated and visual QC, 4.35% of the data were flagged using A-Y flags (Figure 75). This is a few percentage points lower than in 2016 (7.24%) and brings Lasker under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

In a continuation from 2016, at the start of 2017 Lasker's conductivity (CNDC) and salinity (SSPS) still looked low. Then, after a sudden period of 1400+ PSU SSPS and missing CNDC lasting from roughly 9-12 January, the data appeared much more realistic. It was suspected there had been some clog activity in the sea water pipes, as has been known to happen with this vessel, and 9-12 January may have signified the issue was under repair. As this was at the beginning of Lasker's 2017 transmission, though, vessel operation spin up is also a possibility. Either way, some supposed clog-related ill effects briefly reappeared in SSPS and CNDC around 17 January (Figure 76) but were cleared up within a few days. The total flagged percentages for CNDC and SSPS (~8.5% and ~10%, respectively) seen in Figure 75 are likely mainly due to the caution/suspect (K), poor quality (J), and out of bounds (B) flags acquired by the two parameters during this early transmission period (Figure 77).

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
Laske all show signs of moderate flow distortion (common on most vessels), which oftentimes results in caution/suspect (K) flags for each of those parameters (not shown). It can be a challenge to site sensors ideally on a ship. Yet with an overall flag percentage under 5%, any sensor location issues on the Lasker should not be considered terribly consequential.

Figure 76: Reuben Lasker SAMOS (top) sea temperature – TS – (middle) salinity – SSPS – and (bottom) conductivity – CNDC – data for 17 January 2017. Note aberrant “saw-toothed” activity, not present in TS, seen in SSPS and CNDC after 6:00. A clog in the sea water intake system is suspected.
The *Ronald H. Brown* provided SAMOS data for 146 ship days, resulting in 2,564,776 distinct data values. After both automated and visual QC, 4.38% of the data were flagged using A-Y flags (Figure 79). This is a few percentage points lower than in 2016 (7.22%) and brings *Brown* under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.

Most of the issues on record for the *Brown* in 2017 are not reflected in the flag percentages seen in Figure 78:

- Platform relative winds, both direction and speed, have not been reported by the *Brown* since sometime in 2015. SAMOS personnel periodically request that steps be taken to reinstate the parameters, as they are of great importance for quality control, but to date there has not been any resolution. On 19 October an OMAO affiliate who was made aware of the situation also reached out to the vessel and seemed hopeful progress might be made, but unfortunately no change followed. We continue to stress the importance of the platform relative wind data in 2018.

- Conductivity and salinity data also disappeared from the *Brown’s* SAMOS transmission late in 2016 and did not resume at any point in 2017. Repeated requests for any information regarding their absence went unanswered.
Short wave radiation (RAD_SW) staged another disappearance from the Brown’s SAMOS transmission after 26 January. The vessel was contacted via email regarding the missing RAD_SW data on 22 February. On 23 February transmission of RAD_SW resumed, and a day later an email response was received stating that the problem had been fixed. It is not known what the issue was.

In terms of the highest flag percentages, RAD_SW acquired ~66% of the total flags (Figure 78). However, the flags applied to RAD_SW were exclusively out of bounds (B) flags (Figure 79), applied to readings just slightly below zero as commonly occurs with these sensors at night (see 3b for details).

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 Brown all show signs of moderate flow distortion (common on most vessels), which results in some portion of caution/suspect (K) flags for each of those parameters (not shown). It can be a challenge to site sensors ideally on a ship. Yet with an overall flag percentage under 5%, and especially considering the fraction of all flags that were applied to those parameters in 2017 (~24% of the total flags, altogether, Figure 78), any sensor location issues on the Brown should not be considered terribly consequential.

![Pie Chart: Distribution of SAMOS quality control flags for short wave atmospheric radiation – RAD_SW – for the Ronald Brown in 2017.](image)

Figure 79: Distribution of SAMOS quality control flags for short wave atmospheric radiation – RAD_SW – for the Ronald Brown in 2017.
The *Thomas Jefferson* provided SAMOS data for 102 ship days, resulting in 2,190,992 distinct data values. After both automated and visual QC, 9.76% of the data were flagged using A-Y flags (Figure 80). This is several percentage points higher than in 2016 (5.09%).

On 25 July a technician onboard the *Jefferson* contacted SAMOS personnel via email to announce a recent installed a Sea Bird SBE 45 micro thermosalinograph (micro TSG) and express a desire to transmit the data to SAMOS. To begin the process, metadata for the micro TSG sensors were collected and added to the SAMOS processing database. The data values, however, did not show up in the SAMOS files when they were expected a short time later. A lengthy email conversation followed, with both an OMAO/NOAA affiliate well versed in the SCS data acquisition system and the SAMOS group’s own resident SCS-knowledgeable person getting involved to try to diagnose the issue and move it towards a solution. After more than a week’s worth of emailing, no solution could be found (there was not necessarily even a common understanding of the nature of the problem), and it seems all efforts to get the SBE 45 data transmitting to SAMOS were unfortunately abandoned.

Relative humidity (RH) and, by extension the two derived parameters wet bulb and dew point temperature (TW and TD, respectively), sometime in mid-August began displaying some intermittent erratic behavior wherein RH would alternate between highly
variable noise (echoed in both TW and TD) and a near-constant 0% (resulting in unrealistically low TW and TD) (Figure 81). The issue appeared sporadically throughout the late Summer period, always seeming to correct itself in the end. But by early Fall the issue had become quite pronounced. SAMOS personnel touched base with the vessel via email on 11 October. On 19 October, in a return communication from the vessel, it was revealed the air temp/RH sensor had failed and was replaced sometime after 13 October while the vessel was in port. Afterwards all the data coming from the sensor appeared normal. While the issue persisted, though, all three parameters acquired a quantity of poor quality (J) and, in the case of TD, J and out of bounds (B) flags (Figure 82), which contributed heavily to the combined ~75% of all total flags accumulated by those parameters (Figure 80).

As a general note, air temperature (T), relative humidity (RH), TD, TW, earth relative wind direction and speed (DIR and SPD, respectively), and especially atmospheric pressure (P) on the Jefferson all suffer the myriad effects of less-than-ideal sensor placement (e.g. flow interruption, exhaust contamination) and susceptibility to changes in the ship’s motion. The result is frequent steps and spikes in the data, which acquire spike (S) and caution/suspect (K) flags (not shown). This is not uncommon among sea-faring vessels, although the effects are perhaps a little more pronounced on the Jefferson than on the average SAMOS ship. It’s understood that the Jefferson is a hydrographic survey vessel not equipped with research quality meteorological sensors. However, if digital imagery of the vessel and of the various sensor locations were provided we might be able to suggest more suitable locations for many of the sensors, thereby potentially alleviating some of the flagging.

Figure 81: Thomas Jefferson SAMOS (top) wet bulb temperature – TW – (middle) dew point temperature – TD – and (bottom) relative humidity – RH – for 23 August 2017. Note noise in all three parameters, followed by unrealistically low values in all three parameters.
Figure 82: Distribution of SAMOS quality control flags for (top) wet bulb temperature – TW – (middle) dew point temperature – TD – and (bottom) relative humidity – RH – for the Thomas Jefferson in 2017.
Laurence M. Gould

Figure 8: For the Laurence M. Gould from 1/1/17 through 12/31/17, (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 345 ship days, resulting in 10,728,369 distinct data values. After automated QC, 4.51% of the data were flagged using A-Y flags (Figure 8). This is a few percentage points higher than in 2016 (1.27%) but is still under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must be noted the Gould receives only automated QC, and visual QC is when the bulk of flags are typically applied.

On 30 May a contact for the Gould emailed SAMOS personnel to inquire about the vessel's recent SAMOS transmission. It was determined that several data files had been missed in March and April. Once identified, the missing data were emailed to SAMOS in bulk.

There were no other specific issues noted in 2017 for the Gould. Looking at the flag percentages in Figure 8, nearly all the flags applied were assigned to latitude (LAT), longitude (LON), and short wave atmospheric radiation (RAD_SW). These were land error (L) flags in the case of LAT and LON (Figure 84), which look to have been acquired mainly when the vessel was either in port or else moored just off the Antarctic coastline. 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 an inland port (or, indeed, the Antarctic coastline). This is true of both the older 2-minute land mask and the newer 1-minute one introduced in mid-2017. Notably, however, some of the L flags were applied when the vessel was supposed to be at the shipyard and transmission was not to be
expected (roughly 5-20 June, as communicated to us in the 30 May email). In the case of RAD_SW, all the flags applied were out of bounds (B) flags (Figure 84) and look to have been mainly the result of the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

As a general note, it is known that the Gould 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 83.

Figure 84: Distribution of SAMOS quality control flags for (top) short wave atmospheric radiation – RAD_SW – (middle) latitude – LAT – and (bottom) longitude – LON – for the Laurence M. Gould in 2017.
The Nathaniel Palmer provided SAMOS data for 287 ship days, resulting in 9,222,732 distinct data values. After automated QC, 4.56% of the data were flagged using A-Y flags (Figure 85). This is a few percentage points higher than in 2016 (2.73%) but is still under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must be noted the Palmer receives only automated QC, and visual QC is when the bulk of flags are typically applied.

In late May a SAMOS data analyst noted some suspicious behavior in the Palmer’s photosynthetically active atmospheric radiation (RAD_PAR) and short wave atmospheric radiation (RAD_SW). RAD_PAR values were all mainly between -3.5 and -1.5 μE m\(^{-2}\) s\(^{-1}\) and there were very few RAD_SW values over 0 W m\(^{-2}\). The data analyst contacted the vessel about the suspicious activity via email on 30 May and questioned whether there was a known issue or whether the data might actually be the result of prolonged darkness, given the vessel was operating around -70° latitude. A ship’s technician responded, confirming that there was a problem with the RAD_PAR sensor, which would likely not get fixed before their next port call. He advised that the RAD_SW data, on the other hand, were probably sound because they were in fact experiencing near 24-hour darkness. While the RAD_PAR data were bad they accumulated out of bounds (B) flags (Figure 86). Any slightly negative RAD_SW values, such as occur commonly with these sensors at night (or, in this case, near 24-hour darkness - a consequence of instrument tuning, see 3b.) also accumulated B flags (Figure 86) and we note the same is true of any slightly
negative RAD_PAR values that may occur in darkness. Between all these automated B-flagging processes, RAD_PAR and RAD_SW together made up nearly 70% of all flags in 2017 (Figure 85).

As a general note, it is known that the Palmer 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 particularly evident in the flag percentages seen in Figure 85.

![Figure 86: Distribution of SAMOS quality control flags for (top) short wave atmospheric radiation – RAD_SW – and (bottom) photosynthetically active atmospheric radiation – RAD_PAR – for the Nathaniel B. Palmer in 2017.](image-url)
The *Robert Gordon Sproul* provided SAMOS data for 347 ship days, resulting in 7,772,166 distinct data values. After automated QC, 4.02% of the data were flagged using A-Y flags (Figure 87). This is a few percentage points higher than in 2016 (1.03%) but is still under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must 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*).

In mid-September a SAMOS data analyst noted a significant discrepancy between *Sproul’s* two air temperature sensors (T and T2), with one varying between ~10-17 C while the other varied between ~17-21 C. He emailed the vessel on 20 September to advise them of the situation and requested return notification of the source of the problem, once identified. The next day a ship’s technician replied that he’d replaced the humidity sensor with a new, freshly calibrated unit that was of a different make and model. He explained that he suspected the older sensor may have been periodically hit with sea spray and the filter cap on the sensor kept it from drying out, which would cause the temperature readings to fluctuate and humidity readings to go either very high or else drop to nearly zero. It should be noted that in this scenario likely neither T nor T2 acquired many, if any, flags as they were probably still within realistic bounds. (RH may have accumulated some out of bounds (B) flags if any of the values went above 100%...
and would likely have accumulated greater than four standard deviations from climatology (G) flags if any of the values were near 0%.

There were no other specific issues noted for the Sproul in 2017. Looking at the flag percentages in Figure 87, RH and photosynthetically active atmospheric radiation (RAD_PAR) together made up ~75% of the total flags for the year. The flags applied to RH were mainly B and G flags (Figure 88). It’s likely at least some of these were a result of the sea spray scenario described above. Spot checking the rest of data reveals many of the B flags were applied to values slightly over 100%. This may have been the commonplace result of sensor tuning and saturated atmospheric conditions (see 3b.), although the possibility exists the sea spray scenario was a more widespread issue than is detailed herein. Regarding RAD_PAR, the accumulated flags were strictly B flags (Figure 88). A quick inspection of the data suggests these were mainly the result of the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

![Figure 88: Distribution of SAMOS quality control flags for (top) relative humidity – RH – and (bottom) photosynthetically active atmospheric radiation – RAD_PAR – for the Robert Gordon Sproul in 2017.](image-url)
Figure 89: For the *Roger Revelle* from 1/1/17 through 12/31/17, (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 337 ship days, resulting in 10,620,384 distinct data values. After automated QC, 7.19% of the data were flagged using A-Y flags (Figure 89). This is a few percentage points higher than in 2016 (4.04%). It should be noted 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*).

In January a SAMOS data analyst noted an ongoing issue with the relative humidity (RH) whereby the values appeared unrealistically low for the vessel’s marine environment. An initial email notification did not produce results, so on 30 January the data analyst contacted the vessel again to convey the RH situation and requested any information regarding the issue and its resolution. The following day a response came back, and a ship's technician stated the sensor had been identified as a “dud” in terms of the RH only. He advised that a spare was being located and we would be notified once it was installed. On 14 February that notification came, and RH data appeared more reasonable thereafter. Prior to the switch being made RH accumulated greater than four standard deviations from climatology (G) flags (Figure 90), likely explaining a sizable portion of the ~11% of the total flags assigned to that variable (Figure 89).

Looking at the other flag percentages in Figure 89, sea temperature 2 (TS2) acquired ~12% of the total flags and photosynthetically active atmospheric radiation (RAD_PAR) acquired ~11%. A quick inspection of these data reveals firstly that there was a period
from about 15-30 May during which virtually all Revelle’s parameters reported a constant value of -99 (probably a missing value indicator). This resulted in an accumulation of B flags almost across the board (not shown), and probably goes a long way towards explaining most of the flag percentages seen in Figure 89. But further inspection specific to TS2 indicates the portion of G flags acquired by the variable (Figure 90) were mainly applied while an intake pump was off, a standard practice for vessels in port or in excessively rough seas. Regarding RAD_PAR, further inspection of that variable indicated only B flags (Figure 90) such as result from the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)

Figure 90: Distribution of SAMOS quality control flags for (top) relative humidity – RH – (middle) photosynthetically active atmospheric radiation – RAD_PAR – and (bottom) sea temperature 2 – TS2 – for the Roger Revelle in 2017.
**Sally Ride**

Figure 91: For the Sally Ride from 1/1/17 through 12/31/17, (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 was made operational in the SAMOS database in early August 2017; 9 August marks the first daily SAMOS file. The Sally Ride provided SAMOS data for 133 ship days, resulting in 3,636,636 distinct data values. After automated QC, 3.1% of the data were flagged using A-Y flags (Figure 91), which is under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must be noted 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).

There were no specific issues noted for the Sally Ride in 2017. Looking at the flag percentages in Figure 91, the majority of the total flags (~60%) were assigned to short wave atmospheric radiation (RAD_SW). The acquired flags were exclusively out of bounds (B) flags (Figure 92). A quick inspection of the data reveals these flags were mainly the result of the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)
Figure 92: Distribution of SAMOS quality control flags for short wave atmospheric radiation – RAD_SW – for the Sally Ride in 2017.

**Falkor**

Figure 93: For the Falkor from 1/1/17 through 12/31/17, (left) the percentage of all observations that passed vs. failed SAMOS quality control tests and (right) the percentage of the overall failed observations broken down by parameter.

The **Falkor** provided SAMOS data for 159 ship days, resulting in 6,162,485 distinct data values. After both automated and visual QC, 4.85% of the data were flagged using A-Y flags (Figure 93). This is a few percentage points lower than in 2016 (8.41%) and brings the **Falkor** under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data.
With the cruise starting 26 January, a 90° directional difference was noted between the *Falkor*’s port anemometer and her other two anemometers. On 30 January SAMOS personnel contacted the vessel via email to inquire whether a new instrument had been installed, possibly with faulty orientation. After investigating, a ship’s technician confirmed the sensor had been reinstalled with the wrong orientation. As a result, all of platform relative wind direction 2 (PL_WDIR2), earth relative wind direction 2 (DIR2), platform relative wind speed 2 (PL_WSPD2), and earth relative wind speed 2 (SPD2) accumulated malfunction (M) flags for the period 26-31 January (Figure 94, not all shown).

On 14 February it was discovered that the two photosynthetically active atmospheric radiation parameters (RAD_PAR and RAD_PAR2), previously missing after an issue with the sensors arose in late November 2016, had been added back into *Falkor*’s SAMOS transmission on 29 December 2016 with different designators and no notification. We were unaware the data had been transmitting, as processing of incoming SAMOS data is fully automated, and the automation relies on the exact designators listed in a vessel’s metadata. Once the oversight was discovered, the vessel was prompted for the necessary information for updating the database. It was decided by SAMOS personnel that, since the data prior to 14 February had already undergone visual qc, no RAD_PAR or RAD_PAR2 data prior to that date would receive visual qc or even, for the time being, undergo initial processing. (It is at present not possible to merge new data with a research-level, i.e. visually qc’d, files. Processing the latent RAD_PAR and RAD_PAR2 data has been tabled until this issue can be resolved.)

Beginning 4 June both RAD_PAR and RAD_PAR2 were reporting values that were low by about a factor of 1000 μE m⁻² s⁻¹. On 10 June SAMOS personnel contacted the vessel via email to inquire whether the units had changed, as there had been recent metadata updates for the sensors. A lead technician responded that she was aware their system was subject to a conversion program, but that the technician who wrote the program was currently on leave and further she had been experiencing issues with running the program of late. She followed up with a second email stating that it appeared the system was taking in the raw voltage values from the two sensors and saving them as μE m⁻² s⁻¹. She reiterated that she would have to wait to check how the coefficients and calibrations were applied to derived (aka DERIV) values. Unfortunately, no solution was forthcoming, and the sensors were taken offline after 27 August with the expectation the issue would be addressed sometime in September. RAD_PAR and RAD_PAR2 transmission did not resume at any time in 2017. For the 11 days of RAD_PAR and RAD_PAR2 data that were received between 4 June and 27 August both parameters were assigned mainly poor quality (J) flags (Figure 94).

~21% of the total flags in 2017 were given to the three SBE 45 thermosalinograph parameters, meaning sea temperature 2 (TS2), conductivity (CNDC), and salinity (SSPS). These were mainly J flags (Figure 94) that were assigned when the intake pump was turned off, usually because the vessel was in port (a common occurrence).

As a general note, it is known that data from the foremast Gill metpak sensors – namely, air temperature (T), relative humidity (RH), atmospheric pressure (P), and earth relative wind speed and direction (SPD and DIR, respectively) – often suffer in rough seas and/or bad weather because the instrument is basically underwater, easily getting
washed with seawater. This leads to frequent caution/suspect (K) flagging of all affected parameters (not shown) and explains the majority of the flag percentages seen in Figure 93 for those parameters. We note that when conditions are especially bad *Falkor* technicians occasionally suspend the foremast Gill metpak SAMOS data for a time. To a lesser extent data from the two main mast Gill metpak sensors (i.e. the “2” and “3” versions of the foremast parameters listed above) also suffer in bad weather, likewise accumulating K flags when necessary (not shown).

Figure 94: Distribution of SAMOS quality control flags for (first) earth relative wind direction 2 – DIR2 – (second) earth relative wind speed 2 – SPD2 – (third) photosynthetically active atmospheric radiation – RAD_PAR – (fourth) photosynthetically active atmospheric radiation 2 – RAD_PAR2 – and (last) sea temperature 2 – TS2 – for the *Falkor* in 2017.
The *Sikuliaq* provided SAMOS data for 359 ship days, resulting in 9,369,739 distinct data values. After automated QC, 3.76% of the data were flagged using A-Y flags (Figure 101). This is only a small change from the total flagged percentage in 2016 (2.21%) and is still under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must 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 no specific issues noted for the *Sikuliaq* in 2017. Looking at the flag percentages in Figure 95, the highest single percentage (~40%) was held by relative humidity (RH). These were mainly out of bounds (B) flags (Figure 96). From past years, it is known RH on the *Sikuliaq* frequently reads a little over 100% (~110%). A quick inspection of the data reveals the same scenario in 2017. A *Sikuliaq* technician has previously noted that in heavy seas seawater may be getting in the sensor. Whatever the cause in 2017, any of the RH data that was over 100% was automatically B-flagged. About 50% of the total flags were held by latitude (LAT) and longitude (LON) combined (Figure 95). These were exclusively land error (L) flags (Figure 96), assigned when the vessel was in port (generally either in Seattle or else her home port in Seward, AK). This is not an uncommon occurrence, as the land mask in use for the land check routine is often incapable of resolving the very fine detail of an inland port. This is true of both the older 2-minute land mask and the newer 1-minute one introduced in mid-2017.
Figure 96: Distribution of SAMOS quality control flags for (top) relative humidity – RH – (middle) latitude – LAT – and (bottom) longitude – LON – for the Sikuliaq in 2017.
Figure 97: For the *Kilo Moana* from 1/1/17 through 12/31/17, (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 204 ship days, resulting in 5,836,136 distinct data values. After automated QC, 0.3% of the data were flagged using A-Y flags (Figure 103). This is virtually unchanged from 2016’s total flagged percentage (0.04%) and is well under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must be noted 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*).

With such an extraordinarily low flagged percentage it isn’t practical to attempt any individual parameter quality analysis based on the flags applied. Additionally, there were no specific issues noted for the *Kilo Moana* in 2017.
**R/V Atlantis**

Figure 98: For the *R/V Atlantis* from 1/1/17 through 12/31/17, (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 300 ship days, resulting in 12,234,955 distinct data values. After automated QC, 1.74% of the data were flagged using A-Y flags (Figure 109). This is virtually unchanged from 2016’s total flagged percentage (1.54%) and is well under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must be noted the *Kilo Moana* receives only automated QC, and visual QC is when the bulk of flags are typically applied.

There were no specific issues noted for the *R/V Atlantis* in 2017. Looking at the flag percentages in Figure 98, the only parameter that stands out is short wave atmospheric radiation (RAD_SW), holding ~90% of all flags in 2017. A quick inspection reveals exclusively out of bound (B) flags (Figure 99) which were mainly the result of the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.)
Figure 99: Distribution of SAMOS quality control flags for short wave atmospheric radiation – RAD_SW – for the R/V Atlantis in 2017.

**R/V Neil Armstrong**

Figure 100: For the R/V Neil Armstrong from 1/1/17 through 12/31/17, (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 291 ship days, resulting in 11,740,820 distinct data values. After automated QC, 3.58% of the data were flagged using A-Y flags (Figure 100). This is virtually unchanged from 2016’s total flagged percentage (3.76%) and is well under the 5% total flagged cutoff regarded by SAMOS to represent "very good" data, although it must 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).

There were no specific issues noted for the R/V Neil Armstrong in 2017. Looking at the flag percentages in Figure 100, the only two parameters that stand out are short wave atmospheric radiation (RAD_SW) and photosynthetically active radiation (RAD_PAR), together holding ~85% of the total flags. A quick inspection reveals exclusively out of bounds (B) flags (Figure 101) which were mainly the result of the slightly negative values that can occur with these sensors at night (a consequence of instrument tuning, see 3b.).

Figure 101: Distribution of SAMOS quality control flags for (top) short wave atmospheric radiation – RAD_SW – and (bottom) photosynthetically active atmospheric radiation – RAD_PAR – for the R/V Neil Armstrong in 2017.
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, and data reporting interval. Vessel layout requires length, breadth, freeboard, and draught measurements. Vessel contact information requires the name and address of the home institution, a named contact person and either a corresponding email address or phone number, and at least one onboard technician email address. A technician name, while helpful, is not vital. Vessel metadata should also include vessel imagery (highly desirable, see Figure 102 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 103. (Any questions regarding the various fields should be directed to samos@coaps.fsu.edu. Helpful information may also be found at http://samos.coaps.fsu.edu/html/docs/samos_metadata_tutorial_p2.pdf, which is the metadata instruction document located on the SAMOS web site.) In this example (Figure 103b.), 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.)
Figure 102: Examples of detailed vessel instrument imagery from the R/V Falkor.

Figure 103: 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:
Table 4: Vessel and parameter metadata overview. "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.
5. Plans for 2018

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

The SAMOS DAC also recognizes an ongoing partnership with the Rolling deck To Repository (R2R; http://www.rvdata.us/overview) project. Funded by the National Science Foundation, R2R is developing a protocol for transferring all underway data (navigation, meteorology, oceanographic, seismic, bathymetry, etc.) collected on U. S. University-National Oceanographic Laboratory System (UNOLS) research vessels to a central onshore repository. During 2017, the university-operated vessels contributing to the SAMOS DAC were those operated by WHOI, SIO, UA, UH, and BIOS. The focus of the R2R is collecting and archiving the full-sampling-level (e.g., sampling rates up to 1 Hz) underway data at the end of each planned cruise, which are the source data for the 1-min averages submitted to SAMOS in daily emails. In 2018 we plan to recruit additional university-operated vessels into SAMOS and restart data flow from the Thompson and Pelican.

Also planned for 2018 is the creation of an hourly subset of all available SAMOS data for the period 2015-2017 for inclusion in the International Comprehensive Ocean-Atmosphere DataSet (ICOADS; Freeman et al. 2016). ICOADS offers surface marine data dating back to the 17th Century, with simple gridded monthly summary products for 2° latitude x 2° longitude boxes back to 1800 (and 1°x1° boxes since 1960)—these data and products are freely distributed worldwide. Inclusion of your data in ICOADS will expand the reach of the SAMOS observations to the wider marine climate and research communities. The procedure (Smith and Elya 2015) was developed to submit SAMOS data for 2005-2014 to ICOADS in 2016. We will also be publishing a manuscript in the Geoscience Data Journal documenting the SAMOS data product from its inception in 2005 through 2017, which will include the first peer-reviewed documentation of the SAMOS quality control and data processing procedures.
6. References


**Ship schedule references, publicly available only:**

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

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

*Investigator* is found online at http://mnf.csiro.au/Voyages/Investigator-schedules.aspx

*Healy* information is found online at http://www.pacificarea.uscg.mil/Our-Organization/Cutters/cgcHealy/
Annex A: Notifications and Data Subsets with Verified Issues, Unflagged (listed by vessel)

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

*Atlantic Explorer:* no notes.

*Atlantis:* no notes.

*Investigator:* no notes.

*Kilo Moana:* no notes.

*Laurence M. Gould:*

- 24 March: AT/RH probe filter cleaned with deionized water ~1400 GMT
- 13 April: primary and secondary AT/RH sensors cleaned ~1700 GMT
- 19 October: membrane on RH sensor washed ~1225 GMT
- 5-20 June: data transmitted while vessel was supposedly at the shipyard, any data present should be considered suspect

*Nathaniel B. Palmer:* no notes.

*Neil Armstrong:* no notes.

*Robert Gordon Sproul:*

- ~20/21 September: T/T2/RH suspected compromised by sea spray, data should be considered suspect

*Roger Revelle:* no notes.

*Sally Ride:* no notes.

*Sikuliaq:* no notes.

*Tangaroa:* no notes.
Annex B: SAMOS Online Metadata System Walk-through Tutorial

PART 1: the end user

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

By choosing the Data Access link (boxed area), the user can access preliminary, intermediate, and research-quality data along with graphical representations of data availability and quality. As an example, consider the user who wants to find 2009 in situ wind and temperature data for the north-polar region. The first step would be to identify which ships frequented this area in 2009. To do so, choose Data Map on the Data Access page:
The user highlights a set of ships from the available list (10 ships may be chosen at a time):

<table>
<thead>
<tr>
<th>Data Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Availability</td>
</tr>
<tr>
<td>Data Download</td>
</tr>
<tr>
<td><strong>Data Map</strong></td>
</tr>
<tr>
<td>Metadata Portal</td>
</tr>
<tr>
<td>SAMOS Parameters</td>
</tr>
<tr>
<td>Additional RV data</td>
</tr>
</tbody>
</table>

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

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

**Choose a Ship**

- ATLANTIS (KGO)
- DAVID STAR JORDAN (WTD)
- DELAWARE II (CNOS)
- FAIRWEATHER (WTE)
- GORDON GUNTER (WTE)
- HEALY (NEF)
- HENRY B. BIGELOW (WTD)
- HIRAIKAI (WTE)
- NAHIMIMOANA (WTE)
- KNOCR (KCE)
- LAURENCE M. GOULD (WCT)
- McARTHUR II (WTE)
- MILLER FREEMAN (WTD)
- NANCY DODGE (WTE)
- NATHANIEL PALMER (WBP)
- OCEANUS (MIGA)
- OCEANGS EXPLORER (WTD)
- OREGON II (WTD)
- OSCAR D. V. DIVISION (WTE)
- OSCAR ELTON SETTE (WTE)

**Select a Date**

- Start: January 1, 2009
- End: December 31, 2003

[Search button]
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:

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:
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 select 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.

<table>
<thead>
<tr>
<th>Choose a ship</th>
<th>HEALY (NERP)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of metadata</strong></td>
<td>parameter-specific</td>
</tr>
<tr>
<td><strong>Type a date</strong></td>
<td>1/1/09-12/31/09</td>
</tr>
</tbody>
</table>

where a valid date is of the form
mm/dd/yyyy, or a range, 9/1/04 - 5/20/04, 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":

Data Availability

August 2010: We are pleased to announce an advanced version of our data availability tool. We have added the option to select data by type, ship, date, and available variables. The data types are preliminary (automated QC only, available within minutes of receipt), intermediate (automated QC, duplicates eliminated, available on 10-day delay), and research (automated and visual QC, 10-day delay, only for select ships and periods).

To use the interface, first select your data type. Select a ship(s), date range, and variable(s) from the dynamically generated lists. Upon selecting one or more ships in the below menu, the date fields will automatically update to provide only the timeframe where data is available. For example, the Atlantis has data available starting in June 2005 while the David Starr Jordan joined SAMOS a few years later in March 2008. Multiple ships and variables can be selected by holding down the control (CTRL) key. Please contact us if you have any questions.

<table>
<thead>
<tr>
<th>Data Type</th>
<th>research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose a ship</td>
<td>AT(ANTIS) (KAP)</td>
</tr>
<tr>
<td></td>
<td>DAVID STAR JORDAN (WTDF)</td>
</tr>
<tr>
<td></td>
<td>DELAWARE II (KNI)</td>
</tr>
<tr>
<td></td>
<td>FALKLAND (WTEB)</td>
</tr>
<tr>
<td></td>
<td>GORDON GUNTER (WTED)</td>
</tr>
<tr>
<td></td>
<td>HEALY (WTDF)</td>
</tr>
<tr>
<td></td>
<td>HENRY B. BIGELOW (WTDF)</td>
</tr>
<tr>
<td></td>
<td>HIMALAYA (WTEY)</td>
</tr>
<tr>
<td></td>
<td>KAI NING (WTEU)</td>
</tr>
<tr>
<td></td>
<td>KNOFF (KCE)</td>
</tr>
<tr>
<td>Start Date</td>
<td>2003</td>
</tr>
<tr>
<td>End Date</td>
<td>2009</td>
</tr>
<tr>
<td>Choose a variable</td>
<td>Air Temperature [T]</td>
</tr>
<tr>
<td></td>
<td>Air Temperature [P]</td>
</tr>
<tr>
<td></td>
<td>Air Pressure [P]</td>
</tr>
<tr>
<td></td>
<td>Conductivity [CNDC]</td>
</tr>
<tr>
<td></td>
<td>Dew Point Temperature [TD]</td>
</tr>
<tr>
<td></td>
<td>East Relative Wind Direction [DIR]</td>
</tr>
<tr>
<td></td>
<td>East Relative Wind Speed [EFS]</td>
</tr>
<tr>
<td></td>
<td>East Relative Wind Speed [EFD]</td>
</tr>
<tr>
<td>Table Grouping</td>
<td>Sort by Ships</td>
</tr>
<tr>
<td>Click search</td>
<td>search</td>
</tr>
</tbody>
</table>

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:
Clicking over the yellow pie slice showing the percentage of data that failed quality control yields a more in-depth look:
The user can now check to see precisely what types of flags were applied to the second wind sensor data, as only a portion of the data were flagged and they may still be usable. By clicking on either the blue pie slice for "DIR2" or the "DIR2" line in the grey box, he determines that "caution" flags were applied to a portion of the data:
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:
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 (KAGP)
DAVID STAR JORDAN (WTD)
DELWARE II (KNEO)
FAIRWEATHER (WTE)
GORDON GUNDER (WTEO)
HEALY (NEPP)
HENRY B. BIGELOW (WTDF)
H'ALAKA (WTE)
KA'MIMOANA (WTEU)
KNOFF (KCEJ)
LAURENCE M. GOULD (WCX)
MCARTHUR II (WTEJ)
MILLER FREEMAN (WTD)
NANCY FOSTER (WTER)
NATHANIEL PALMER (WBP3)
OCEANUS (WXAC)
OCEANOS EXPLORER (WTD)
OREGON II (WTD)
OSCAR DYSON (WTEF)
OSCAR ELTON SETTLE (WTE)

Type a date
9/7/09-9/11/09

where a valid date is of the form month/day/year, 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
data collected

Data
research

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

PART 2: the SAMOS operator

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

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

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

(or by navigating directly to the Ship Recruiting page, located at http://samos.coaps.fsu.edu/html/nav.php?s=4), and then choosing Metadata Interface:
The user will then be directed to log in, using their group's username and password (please contact samos@coaps.fsu.edu to obtain a username or for misplaced passwords):

- **Login**: op_noaa
- **Password**: ********

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

<table>
<thead>
<tr>
<th>Ship Name</th>
<th>Call Sign</th>
<th>Vessel Metadata</th>
<th>Instrument Metadata</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVID STAR JORDAN</td>
<td>WTEC</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>FAIRWEATHER</td>
<td>WTEB</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>GORDON GUNTER</td>
<td>WTEO</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>HENRY E. BIGELOW</td>
<td>WTEF</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>HITALAKAI</td>
<td>WTEY</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>KAIMIMOANA</td>
<td>WTEU</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>MILLER FREEMAN</td>
<td>WTEO</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>NANCY FOSTER</td>
<td>WTER</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>OSCAR DYSON</td>
<td>WTEP</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>RAINIER</td>
<td>WTEP</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>RDN BROWN</td>
<td>WTEC</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
</tbody>
</table>

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)

Edit Metadata

Ships for user op_noaa:

<table>
<thead>
<tr>
<th>Ship Name</th>
<th>Call Sign</th>
<th>Vessel Metadata</th>
<th>Instrument Metadata</th>
</tr>
</thead>
<tbody>
<tr>
<td>DAVID STAR JORDAN</td>
<td>WTDK</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>FAIRWEATHER</td>
<td>WTEB</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>GORDON GUNTER</td>
<td>WTED</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>HENRY B. BIGELOW</td>
<td>WTDF</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>HIALAKAI</td>
<td>WTEY</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>KAUIMOAANA</td>
<td>WTEU</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>MILLER FREEMAN</td>
<td>WTDM</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>NANCY FOSTER</td>
<td>WTER</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>OSCAR DYSON</td>
<td>WTEP</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>RAINIER</td>
<td>WTEF</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
<tr>
<td>RON BROWN</td>
<td>WTEC</td>
<td>[modify]</td>
<td>[modify]</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Designator</th>
<th>Date Valid</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>atmospheric pressure</td>
<td>01/31/2008 - Today</td>
<td></td>
</tr>
</tbody>
</table>
If the identification procedure is successful, there will be a "Submit New Changes" button visible in the desired version metadata area. User op_noaa must first close out the current metadata version (so the previous data is still associated with the correct information) and then initiate a new version. To close out the current version, the user would change the Date Valid field in the metadata area to reflect the last date the
metadata displayed for an instrument was associated with at the old location and then click "Submit New Changes." (Note the first version, i.e. with Dates Valid 01/17/2007 to 01/30/2008, is left untouched):

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

![Image of metadata form with new version details]
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":

![Image of the data entry form with BARO parameter details]

- **Designator**: BARO
- **Date Valid**: 03/28/2010 to Today
- **Descriptive Name**: atmospheric pressure
- **Original Units**: millibar
- **Instrument Make & Model**: Vaisala
- **Last Calibration**: Nov 2007
- **Mean SLP Indicator**: adjusted to sea level
- **Observation Type**: measured
- **Distance from Bow**: 19.2 m
- **Distance from Center Line**: 1 m
- **Height**: 8.8 m
- **Average Method**: average
- **Averaging Time Center**: time at end of period
- **Average Length**: 60
- **Sampling Rate**: 1 sec
- **Data Precision**:

![Image of the data entry form with BARO parameter details with new location information]
Adding an entirely new parameter follows only the latter part of these instructions: by simply choosing a parameter (for example short wave atmospheric radiation), clicking the “+” on the expansion bar, and entering either a new or not currently in use Designator and any Date Valid window:

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

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

**Data Access**

Please choose a page from the following list:

- **Data Availability**
  - Timeline for available data

- **Data Download**
  - Access quality-evaluated shipboard meteorological data

- **Data Map**
  - Plot cruise tracks of each ship on a satellite map over a selected period of time

- **Metadata Portal**
  - Access ship metadata database

- **SAMOS Parameters**
  - View a list of meteorological and oceanographic parameters that the initiative seeks to obtain from vessels

- **Additional RV data**
  - Additional RV data

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

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

The portal provides access to metadata stored in the database for all ships providing data to the DAC. At present, the vessels listed are participating in the 2005 pilot project. A search tool allows users to select a vessel and whether they are interested in ship-specific, parameter-specific, or digital image metadata. Ship-specific metadata includes 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

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

<table>
<thead>
<tr>
<th>Dimensions (meters)</th>
<th>Digital Imagery and Schematics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length: 65.5</td>
<td>Schematic - Side View</td>
</tr>
<tr>
<td>Breadth: 12.5</td>
<td></td>
</tr>
<tr>
<td>Freeboard: 2.5</td>
<td></td>
</tr>
<tr>
<td>Draught: 5.5 / 9.1</td>
<td></td>
</tr>
<tr>
<td>Cargo Height: N/A</td>
<td></td>
</tr>
</tbody>
</table>
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!)
1. Go to: [http://samos.coaps.fsu.edu/html/](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 as 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.

![Sensor Data Table](image)