The SAMOS Initiative –
A Decade of Successful Data Stewardship

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SAMOS Overview

- Since 2005, have collected, evaluated, distributed and archived underway meteorology and surface ocean data from research vessels
  - Position, course, speed, heading
  - Air temperature, humidity, winds, pressure, radiation
  - Sea temp., salinity, conductivity
- Active contributors in 2016:
  - NOAA (16), USCG (1), IMOS (2), NSF Antarctic (2), WHOI (2), BIOS (1), SIO (2), UW (1), U. Hawaii (1), SOI (1), U. Alaska (1), LUMCON (1)
  - *Neil Armstrong* and *Investigator* new in 2016

Number of ships contributing and records processed by SAMOS

<table>
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<tr>
<th>Year</th>
<th>Ships</th>
<th>1-min Records</th>
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Shipboard Automated Meteorological and Oceanographic System
SAMOS Data Processing

- One-minute samples are bundled in daily email messages.
- Automated processing merges data with extensive vessel metadata (based on VOSCLim).
- Data are routinely evaluated.
  - Automated QC (preliminary)
  - Visual QC
    - Research data product
    - For NOAA vessels and Falkor
- Shore-side data monitoring and feedback to technicians at sea
- Distribution is via web, ftp, and OPeNDAP servers.
- Archival occurs at U.S. NCEI.
  - Monthly transfers to archive

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Lessons Learned (1)

- Shore-side data monitoring works!
  - Disciplinary data centers provide expertise that shipboard technicians may not possess.
- Shipboard technicians benefit from at-sea feedback
- Corrects problems before a whole cruise of useless data is collected

Station 46026 (↑)
passage @ ~300 UTC: station reports 311°
Lessons Learned (2)

- Automated quality control misses problems in data
  - Landmasks do not contain all canals and smaller waterways
  - Airflow distortion, stack exhaust, electronic noise hard to diagnose
- Duplicate sensors can help, but third data source often needed to verify which sensor is correct
- Visual QC frequently 5-10% more data
Lessons Learned (3)

- Never enough metadata!
  - Critical for data reuse
  - Supports visual QC
  - Recommend controlled vocabularies (no free text)
- Never enough focus on metadata collection and preservation
  - Easier to capture as data collected
- Example: Sea temperature
  - Need absolute knowledge of sensor location
  - Distance from water intake affects measurement
  - See Carstens et al. poster

Healy sea temperature difference by latitude

2008-2010: Blue, Green
2011-2012: Red, Orange
Lessons Learned (4)

- SAMOS has advocated for fluid dynamics modeling of ship structures in design phase
  - Implemented for *Sikuliaq* and new U.S. regional class R/Vs
  - Allows instrument mast changes early in process
- SAMOS reviewed results and made recommendations for sensor exposure on new R/Vs

Image courtesy The Glosten Associates

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**RCRV - Airflow, 12 kts, Elevation**
April 10, 2014
Operator Best Practices

- Site meteorological sensors as far forward and as high as possible to avoid influence of ship on measurements.
- Avoid sources of RF on vessel, which result in noisy data – particularly from radiation sensors.
- Avoid sources of heat.
- Record sensor locations w.r.t. known vessel coordinate system.
  - Document system with data
- Ensure proper calculation of true winds to remove ship motion.

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SAMOS
Shipboard Automated Meteorological and Oceanographic System
Homogeneity

**Challenges**

- Instrument deployment by vessel operators (Not by NMS)
  - Diverse set of devices
- Uneven metadata collection
- Varying data acquisition procedures
- Varying data quality

**How Addressed**

- SAMOS provides accuracy targets and sensor recommendations
- Metadata forms, minimum requirements
- Moving towards standard vocabularies (SeaDataNet, CF)
- Providing best practices for data averaging, sampling rates, true wind calculation, etc.
- Structured automated and visual quality control
SAMOS in ICOADS

- An hourly subset of SAMOS 1-min data is included in Release 3.0 of ICOADS.
  - Averaging over 10-min. at top of hour mimics synoptic reports from merchant vessels
  - Takes advantage of SAMOS QC
  - ~750 K hourly reports: 2005-2014
  - Data formatted to ICOADS submission specifications (IMMA1)

SAMOS Data Density: 2005-2014

Hourly observations per bin
Along Track Fluxes

- Version 2 of the SAMOS air-sea flux product released early in 2016
  - One-minute interval latent and sensible heat flux, wind stress, and height adjusted (10m) wind speed, specific humidity, and potential temperature
  - 3 algorithms – Smith88, COARE3.5, Bourassa2012
  - Period: 2005-2014
- Data available from NCAR
  - doi: 10.5065/D6930R70
- Described in Smith et al., Geosci. Data J. (2016), doi: 10.1002/gdj3.34

Ship Observation Distribution

Number of observations

0 1000 2000 3000 4000

10E 60E 110E 160E 150W 100W 50W 0W

-80 -60 -40 -20 0 20 40 60 80

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Future

• Seeking opportunities to expand contributions to SAMOS
  • Open source codes and procedures
  • Support distributed data center activities (hard to fund U.S. processing of international vessels)

• Moving forward with development of QC procedures for other flow water parameters
  • Partnering with U.S. Rolling Deck to Repository program
  • Reviewing IOOS, GOSUD procedures

• Additional product development (as resources allow)
  • Routine contributions to ICOADS
  • Improved along track air-sea flux products
Questions?

SAMOS is base funded by NOAA's Climate Observation Division (grant # NA11OAR4320199) and the U. S. National Science Foundation’s Oceanographic Instrumentation and Technical Services Program (grant # OCE-1447797). Since 2013, the Schmidt Ocean Institute (SOI) has funded participation by the RV Falkor in the SAMOS initiative.