High-Resolution Marine Meteorology Workshop

Center for Ocean-Atmospheric Prediction Studies

The Florida State University, Tallahassee, FL USA

3-5 March 2003

Summary

On 3-5 March 2003, the Center for Ocean-Atmospheric Prediction Studies (COAPS), directed by Dr. James J. O'Brien, hosted the first "Workshop on High-resolution Marine Meteorology" in Tallahassee, Florida. The workshop was sponsored by the NOAA Office of Global Programs to identify those scientific objectives that require high-resolution, high-accuracy marine meteorological observations and to discuss a sustained U.S. effort to obtain and disseminate these data in a manner consistent with the identified scientific goals. The workshop focused on in-situ marine meteorological observations from ships and buoys. Central discussions included data accuracy, calibration and inter-calibration, improved access to quality-assured, high-resolution (sampling interval 1 to 60 minutes) observations for the scientific community, and a sustained observing system to meet short- and long-term science objectives.

Co-chairs Dr. R. Michael Reynolds (Brookhaven National Laboratory) and Mr. Shawn R. Smith (COAPS) organized a workshop panel with representatives from the scientific and operational marine observation communities. Participants included personnel from four NOAA laboratories, the Naval Research Laboratory, the U. S. Coast Guard, and the U. S. CLIVAR Office. The university community was represented by the Woods Hole Oceanographic Institution, the Scripps Institution of Oceanography, the University of Miami, Oregon State University, and the Florida State University. International attendees included representatives from CSIRO (Australia) and the Southampton Oceanography Centre.

The workshop was organized around four main topics: (1) science objectives; (2) status of U.S. high-resolution observing programs; (3) accuracy, calibration, and inter-calibration; and (4) a sustained data collection, distribution, and archival system. Invited speakers began each session with talks to stimulate topic-oriented discussions. Round-table discussions provided a free exchange of ideas for improving both the quantity and quality of marine observations. Several discussions focused on the need to improve instrument calibration and to provide for routine inter-calibration between instrument systems and platforms (e.g., ships versus buoys). Currently, only a few ships and buoys are capable of determining air-sea interaction variables to a sufficient degree of accuracy for climate studies. Participants noted that while research vessels are able to provide the highest quality data, often in under-sampled regions of the ocean, this resource is not being effectively utilized and data essential to climate studies are being lost. Discussions included the need to improve instrument siting on ships and to standardize measurement of meteorological and ship motion parameters and metadata formats. In addition, attendees addressed improving data quality and access for the user community. The discussions resulted in thirteen recommendations that the attendees agreed to disseminate widely through the scientific and operational marine communities and at the program level.

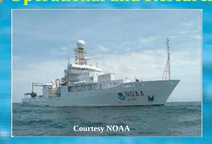
Definitions

High-resolution meteorological data have the following characteristics:

- Sampling rates 1-60 minutes
- Collected by continuously recording automated weather station (AWS)

Platforms of primary interest

- U.S. sponsored research vessels (R/Vs)
- Volunteer Observing Ships (VOS) equipped with AWS
- Operational and Research moorings with AWS



Courtesy NOAA


Courtesy WHOI

Benefits

Increase access to high-quality, high-resolution marine meteorological data to

- Anchor regional and global surface flux fields
- Validate satellite sensors
- Evaluate numerical ocean and atmosphere models

High-quality estimates of fine spatial and temporal resolution variability

- Critical knowledge for data assimilation
- Crucial to determine accuracy of satellite data

Vessel Operators and technicians will have access to timely feedback

- Instrument malfunctions
- Inadequate placement of instrumentation

Issues Raised

Need to consider individual platforms (R/Vs, VOS, moorings) as part of a global data system

- Build partnerships to develop instrumentation, data and communication systems, calibration methods, etc.

Improve data quality

- A key concern to achieve flux accuracy desired by international climate programs
- Better calibration methods
- Uniform metadata
- Regular evaluation of both instrument systems and data collected

Improve data access for research and operations

- Include data streams not readily available
- Collect all necessary parameters and metadata to estimate quality air-sea fluxes

Progress

Recommendations are being disseminated to interested scientific, operational, and program communities

Resources are being identified for flux reference sites, the portable standard instrument suite, and the research vessel data assembly center

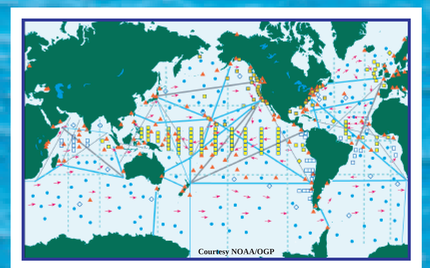
Existing data collection and metadata standards are being evaluated to develop a high-resolution standard

Recommendations

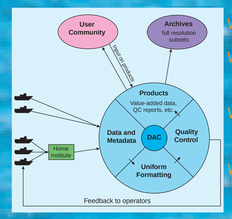
1. Develop a sustained system of calibrated, quality-assured marine meteorological observations built around the surface flux reference sites, drifting buoys, research vessels (R/Vs), and volunteer observing ships (VOS) to support science objectives of national and international climate programs.

2. Improve global coverage, especially from important but data sparse regions (e.g., Southern Ocean), by working with and making use of national and international observing efforts, research programs, and infrastructure development initiatives.

- Rethink role of R/V and AWS equipped VOS as part of a global observing system
- Place flux reference sites in locations that are both scientifically interesting but also near routine hydrographic lines


Courtesy NOAA/OGP

3. Establish a data assembly center (DAC) for U. S. R/V (e.g., UNOLS, NOAA, Navy, Coast Guard) meteorological observations to unify data collection, quality assurance (QA), and distribution. The DAC will also provide for permanent data archiving and long-term availability of data at national archive centers.



- R/V data currently lacking unified data system
- Real-time and delayed-mode data from multiple sources would receive common formatting and QA
- Providers would be notified when problems are detected
- DAC would provide service to user community and be responsive to user needs

4. Establish standards for sensor calibration and data collection on ships and moorings, including accuracy and resolution, sampling rates and averaging periods, data acquisition and display software, data transmission, recommended instrument siting, and provision of metadata.

5. Produce a reference manual of best procedures and practices for the observation and documentation of meteorological parameters, including radiative and turbulent fluxes, in the marine environment. The manual will be maintained online and will be a resource for marine weather system standards.

- Standards essential to achieve science goals set by climate initiatives
- Plan to work with existing programs to set standards (e.g., VOSClim, GOOS)
- Flexible reference manual essential to disseminate standards, recommendations, and procedures to marine technicians, system designers, and scientists

6. Establish sources/contacts where expertise can be obtained by operators and made available for QA development.

- Technical expertise desired to ensure that sensors are properly installed, sited, and calibrated
- Sources needed for various parameters to aide the design of QA techniques
- Resources will be provide and updated using the online manual

7. Develop a portable, state-of-the-art, standard instrument suite and implement on-board inter-comparison between the portable standard and ship-board instruments to improve R/V and VOS automated meteorological observations.

- A big step towards onboard inter-calibration of vessel's instrumentation
- System envisioned to include:
  - Flux instrument suite optimally mounted to evaluate ship's operational system
  - Set of individual standards to be sited next to ship's instruments for direct sensor-to-sensor comparisons
- Envisioned to be deployed on vessel for a period of days to weeks
- System technician will work with R/V technician to evaluate inter-comparison in the field and recommend improvements to R/V AWS

8. Endorse development of robust sensors for use in severe environments to improve data accuracy and allow accurate data to be collected from data sparse regions.

9. Implement a program in computational fluid dynamics (CFD) modeling of the wind flow regime over ships to determine optimal wind sensor siting, wind correction factors, and effective measurement heights.

- Distortion of air flowing over a ship impacts most atmospheric measurements
- CFD modeling allows corrections factors to be determined for each vessel
- CFD models should be run as part of the design process for new research vessel to ensure optimal instrument siting

10. Encourage (i.e,. fund) R/Vs to schedule meteorological inter-comparisons with surface flux reference sites and, where appropriate, with one another.

- TOGA/COARE and EPIC have shown the advantages of inter-comparing observations from ships and buoy
- Take advantage of repeat hydrographic lines when placing surface flux reference sites
- Vessels should be encouraged to spend at least one diurnal cycle at reference site
- With early cruise scheduling, it may be possible to have several vessels near reference site for multi-platform inter-calibration


Courtesy WHOI

11. Recommend that certain ship data not currently logged be made available to the research crew (e.g., pitch/roll, heading, currents, speed of ship in water). These data should be routinely recorded to improve flux calculations and QA.

12. Encourage funding agencies to require that new shipboard meteorological instrumentation purchased within research grants be installed and operated, and the measurements distributed and archived according to the principles embodied in points 3, 4, 5, and 7 above.

13. Strongly encourage funding agencies to support human capital development through education and training.

- Marine technicians are heavily tasked to maintain oceanographic and atmospheric instrumentation
- Current shipboard priorities often limit time spent monitoring atmospheric instruments
- Technicians concerned with the need for improved training related to siting, calibration, and desired accuracy for marine weather systems
- Marine technicians are on the front lines of data collection, agencies need to invest resources to educate technicians