Recommendations from the High-Resolution Marine Meteorology Workshop

3-5 March 2003

Center for Ocean-Atmospheric Prediction Studies
Florida State University
Tallahassee, FL USA

Foreword

- A new initiative is underway to ensure routine delivery of calibrated, quality assured, surface meteorological data collected using automated weather system (AWS) on research vessels (R/V), Volunteer Observing Ships (VOS), and additional moored buoys.
- The initiative resulted from the recommendations of the High-Resolution Marine Meteorology Workshop.
- The primary focus of Workshop was the role marine AWS data can play in a sustained ocean observing system.
  - Marine AWS are proven resource for validation studies (e.g., global model fields, satellite observations).
  - AWS capable of providing observations with sampling rates and accuracy desired for estimating air-sea fluxes.

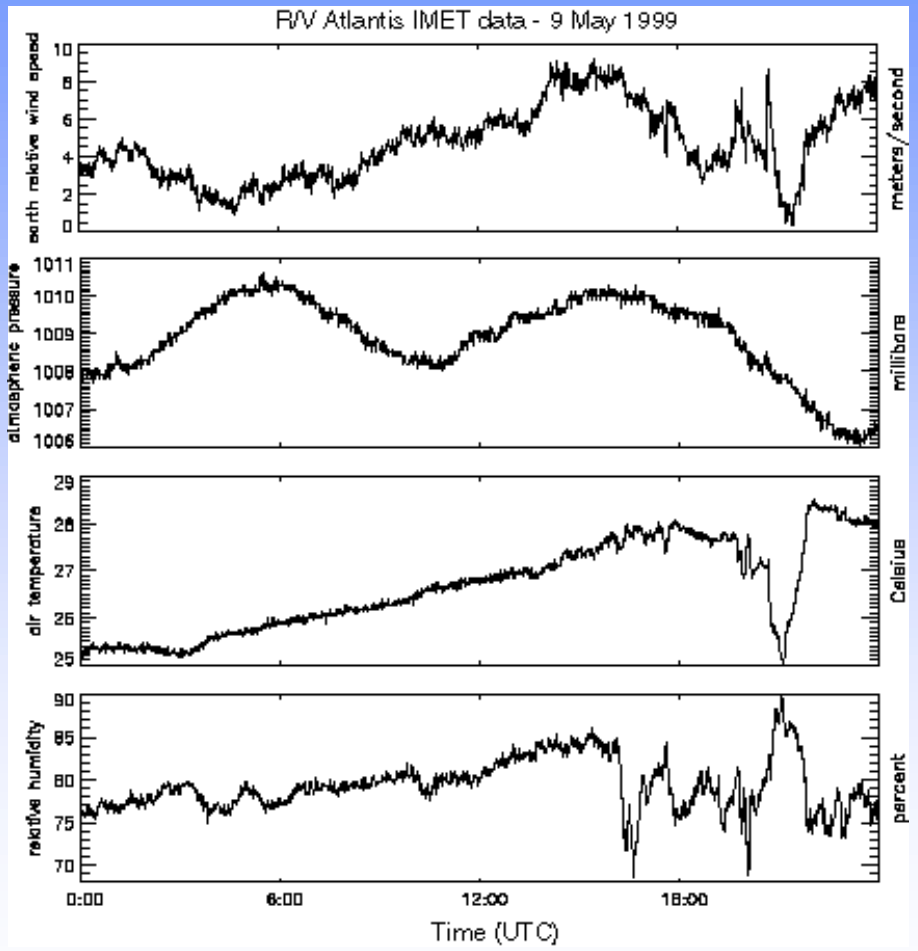
Outline

- What is a marine AWS?
- Workshop objectives and issues
- Workshop recommendations
  - System
  - Data stewardship
  - Data accuracy
  - Education
- New initiatives
- Final thoughts

Definitions

- High-resolution marine AWS
  - Sampling rates 1-60 minutes
  - Continuous recording


Courtesy WHOI



Definitions

- Platforms of primary interest
  - U. S. sponsored research vessels
  - Volunteer Observing Ships equipped with AWS
  - Operational and Research moorings with AWS

Courtesy NOAA

Courtesy WHOI


Courtesy WHOI

Workshop Objectives

- Identify science objectives addressable with high-accuracy marine AWS data
- Provide current status of U. S. sponsored marine AWS data collection
- Identify technical issues related to instrument accuracy, calibration, and inter-calibration
- Outline a plan to ensure routine delivery (real-time and delayed) of calibrated, high quality surface meteorological data consistent with science objectives
- Determine areas where sustained AWS measurements can evolve to meet science objectives in future
- Identify areas where collaborative and joint activities would increase quantity and quality of data

Issues

- Each vessel or buoy array generally operates independently
  - Data collection, calibration, distribution methods differ
  - Data quality assurance (QA) may or may not exist
  - Long term archival lacking in some cases
- 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, calibrations methods, etc.
- Although R/Vs provide far-reaching platform, they are generally under-utilized for meteorological observations

Issues

- 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 to estimate quality air-sea fluxes
  - Decrease time from data collection to making the observations available to the user community

Recommendations: System

- 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.
- Improve global data 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.

Recommendations: Stewardship

- 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.

- 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 sites, and provision of metadata.

- 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.

Recommendations: Accuracy

- Develop a portable, state-of-the-art, standard instrument suite and implement on-board inter-comparison between the portable standard and shipboard instruments to improve R/V and VOS automated meteorological observations.
- 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.
- Implement a program in computational fluid dynamics (CFD) modeling of the wind flow regime over ships to determine optimal wind sensor sites, wind correction factors, and effective measurement heights.
- Encourage (i.e. fund) R/Vs to schedule meteorological inter-comparisons with surface flux reference sites and, where appropriate, with one another.

Courtesy WHOI

Recommendations: Education

- 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.

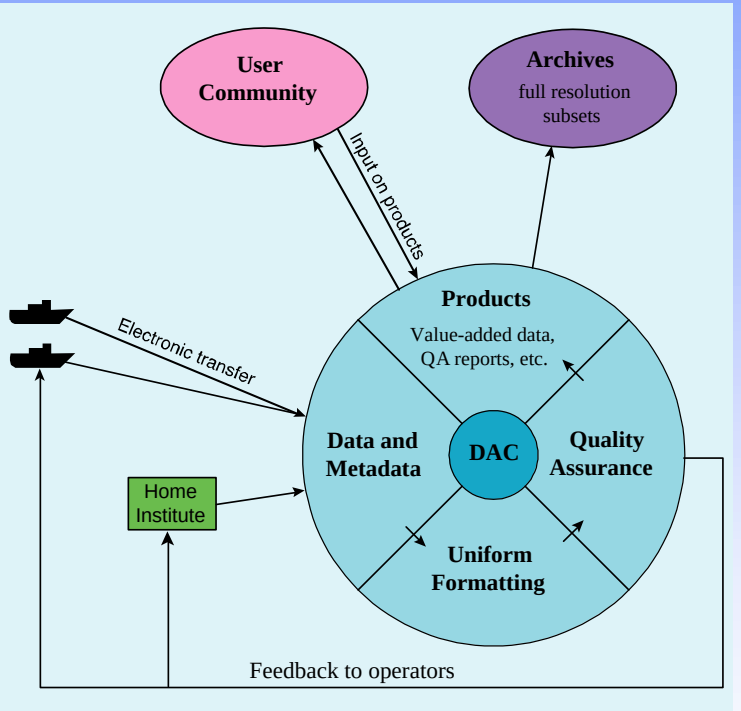
- Establish sources/contacts where expertise can be obtained by operators and made available for QA development.

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

- 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 these recommendations.

Implementation

- Proposal submitted by FSU to fund a surface meteorology DAC for U.S. R/V
- DAC will:
  - plan for near-real-time (daily) data transfer from R/Vs to the DAC
  - complete immediate QA prior to distribution
  - notify (via email) R/V and home institution when problems identified
  - ensure AWS data are placed in permanent archives
  - act as liaison with the user community to provide desired products.



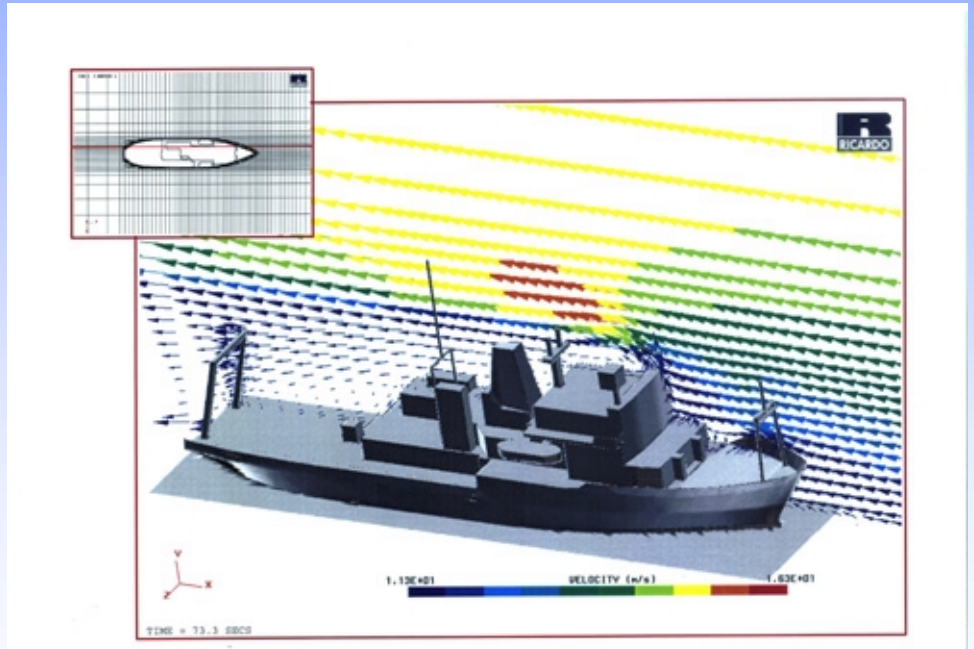
- Plan to include international R/V data in future

Implementation

- Additional proposals submitted by Chris Fairall (NOAA ETL) and Bob Weller (WHOI) to fund development of a portable calibration standard AWS, an on-line reference manual, technician training, and possible CFD modeling.

- The portable standard is envisioned to include a state-of-the-art flux measurement system and a set of individual sensors that will be used for side-by-side comparison to the R/V's AWS.

- The on-line reference and future training workshops will improve access to accuracy requirements, calibration techniques, etc. for R/V technicians.



Courtesy Southampton Oceanography Centre

Implementation

- Open discussion with international community and funding agencies to:
  - Provide additional resources to R/Vs, VOS, and buoy programs so they can meet accuracy standards and data distribution requirements desired by user community
  - Develop parameter and metadata standards for marine AWS measurements (leverage off of current initiatives)
  - Work towards free and open distribution of all routinely collected (not experiment specific) marine AWS observations

Final Thoughts

- Current initiative focuses on U.S. AWS
- International collaboration is desired
  - Standards development (JCOMM, GOOS)
  - Future inclusion of international R/V AWS data into DAC
  - Educational outreach
  - Where should we focus our attention on the international level?
- Plan is for sustained collection, distribution of high-quality marine AWS data
  - Will support international experiments (e.g., CLIVAR, GODAE), but will not limit focus to experiment oriented data
- Second workshop on role of Marine AWS in a Sustained Ocean Observing System (MAWSOOS) is anticipated for Spring 2004

Participants

Co-chairs: Shawn R. Smith (FSU/COAPS), R. Michael Reynolds (BNL)

Sponsor: Michael Johnson (NOAA OGP)

Host: James J. O'Brien (FSU/COAPS)

- CSIRO, Australia
  - Dr. Frank Bradley
- FSU/COAPS
  - Dr. Mark A. Bourassa
  - Ms. Ruth Pryor
- FSU/Meteorology
  - Dr. Carol Anne Clayson
- NOAA/AOML
  - Mr. Steven K. Cook
  - Dr. Rik H.Wanninkhof
- NOAA/ETL
  - Dr. Christopher W. Fairall
- NOAA/CDC
  - Mr. Scott Woodruff
- NOAA/PMEL
  - Mr. Paul Freitag
- NRL
  - Dr. Jeff Reid
- OSU/COAS
  - Ms. Linda Fayler
- SOC, UK
  - Dr. Elizabeth C. Kent
- UCSD/SIO
  - Mr. Carl Mattson
  - Mr. Woody Sutherland
- U. Miami/RSMAS
  - Dr. Edward J. Kearns
  - Dr. Peter Minnett
- U. S. CLIVAR Office
  - Dr. David M. Legler
- U. S. Coast Guard
  - Dr. Phil McGillivary
- WHOI
  - Mr. Frank K. Bahr
  - Mr. David S. Hosom
  - Dr. Robert A. Weller

Benefits

- Increase access to high-quality, high-resolution marine meteorological data to
  - Anchor surface flux fields
  - Validate new satellite sensors
  - Evaluate numerical ocean and atmosphere models
- High-quality estimates of fine spatial and temporal resolution variability
  - Critical knowledge for data assimilation
- Vessels operators and technicians will have access to timely feedback
  - Instrument malfunctions
  - Inadequate placement of instrumentation