

**Physical Oceanography Division
Summary of Retreat
May 12, 2015**

The Physical Oceanography Division – Gustavo Goni, Presenter

The Physical Oceanography Division (PHOD, www.aoml.noaa.gov/phod) is a part of the Atlantic Oceanographic and Meteorological Laboratory (AOML) together with the Ocean Chemistry and Hurricane Research Divisions. The Physical Oceanography Division work addresses NOAA's mission, by carrying out interdisciplinary scientific investigations of the physics of ocean to:

- Understand and predict changes in climate, weather, oceans, and coasts
- Share that knowledge and information with others
- Conserve and manage coastal and marine ecosystems and resources.

The tools used to carry out these studies range from sensors on deep ocean moorings, to satellite-based instruments, to measurements made on research and commercial shipping vessels and autonomous vehicles, and include data analysis and numerical modeling as well as theoretical approaches.

The objective of the retreat was to meet in an off campus location to present and discuss current and future work in the division, some of them in collaboration with other agencies and university partners. The main areas of research in the division were presented and discussed during the retreat:

- Oceans and Climate
- Oceans and Ecosystems
- Ocean Dynamics
- Oceans and Extreme Weather events

Work and discussions highlighted the importance of current and future sustained and targeted observations and data analysis, in a multiplatform and interdisciplinary environment, and in conjunction with numerical modeling and theoretical analysis. The different means of scientific communication of knowledge were highlighted, including publication in peer reviewed journals, web pages, outreach, OAR communications, Keynotes, etc. In addition, the importance of transitioning products from research to applications and operations was highlighted, products that have been transitioned were presented, and potential transitions were discussed.

A list of Action Items derived from this meeting are listed at the end of this report. These Action Items reflect some of the priorities that divisional personnel agreed to focus on the near future to continue addressing NOAA's mission.

Oceans and Climate – Molly Baringer, Presenter

This session covered studies of large-scale ocean circulation processes that impact climate. Topics presented and discussed included climate data and climate science, e.g. the global ocean observing system as well as long-lead time, large spatial scale studies of circulation, sea-level and climate related trends.

Studies of large-scale circulation having direct impact on climate or health

- Impact of the Atlantic warm pool on North American climate
- Influence of the North Atlantic Ocean on Pacific climate
- Hiatus studies
- Surface wind response to global warming
- Effects of climate change on the incidence of Vibrio infections

Regional circulation studies

- Arctic sea level
- Mediterranean-Black Sea
- variability of the South Atlantic subtropical gyre over the past two decades
- Variability of AMOC water mass pathways in South Atlantic
- Variability of the Brazil Current
- Fate of the DWBC in the South Atlantic
- Characterizing the variability of DWBC and MOC at 34.5S with SAM data and XBT data
- Continuous records of the mixed layer heat budget in the tropical Atlantic

Observing System Projects

- PIRATA Northeast Extension (Lumpkin)
- Global Drifter Program (Lumpkin)
- SAM (Meinen)
- WBTS (Meinen)
- Iridium transmission program and iridium modem housing design (Pena)

Ocean Dynamics – Rick Lumpkin, Presenter

The talks and discussions in this session were about studies of ocean processes, at scales from turbulent mixing to the global overturning circulation. Although there is overlap with Climate, this session was about studies that focus more on ocean processes than on the coupled ocean/atmosphere climate system.

Regional to local studies of current variations

- Ocean conditions during Deepwater Horizon spill
- Operational real-time surface currents
- Interannual variability of Tropical Instability Waves

- Tropical Atlantic Current Observation Study
- XBT/altimetry monitoring of boundary currents including Brazil Current
- Estimates of surface and depth-averaged currents using gliders
- Variability and dynamics of the Hawaiian Lee Countercurrent

Studies of basin-scale current structure and variability

- Variability of Tropical Atlantic currents
- Cross-equatorial structure of tropical Atlantic overturning
- Variability of the ACC
- The AMOC and AMO in CMIP5 simulations
- The South Atlantic subtropical gyre
- South Atlantic Transport changes
- Deep South Atlantic Circulation
- Seasonal variations of the Indian Ocean MOC
- Monsoon-driven changes in Indian Ocean surface currents
- Distribution of mixing scales in the Indian Ocean
- Sea Surface Salinity studies (SPURS)
- Arctic Ocean mass and sea level
- Mediterranean and Black sea elevation relation
- ENSO variability during onset, peak and decay

Studies of global-scale current structure and variability

- Structure and variability of global surface currents
- R2A: Global Hourly Drifter data set, a Task III proposal
- Near inertial energy pathways
- Global analysis of looping trajectories: evidence of sampling bias?

Other ocean dynamics:

- T/S relationships for salinity
- SST and sea surface color products via CoastWatch/OceanWatch

Ocean and ecosystems – Sang-Ki Lee, Presenter

Presentation and discussions were about active and on-going oceans and ecosystems research projects (or activities) in PhOD (15 projects or activities). It is divided into three subgroups (observations and data analyses, modeling and other activities). This talk also covers three major areas of oceans and ecosystems research activities, namely coral reefs, fisheries, and biogeochemistry (e.g., CO₂ and Ocean Acidification).

Biophysical observations and data analyses

- CRER: Coral Reef Ecosystem Research
- MBON: National Marine Sanctuaries as Sentinel Sites for a Marine Biodiversity Observations Network
- Connectivity of the Pulley Ridge – South Florida Coral Reef Ecosystem: Processes to Decision-Support Tools
- US Caribbean Biophysical Connectivity: a partnership between AOML/PHOD and SEFSC
- Temporal and spatial variability of environmental conditions of highly commercial species in the Gulf of Mexico
- Evidence of climate-driven ecosystem reorganization in the Gulf of Mexico
- Emerging *Vibrio* risk at high latitudes in response to ocean warming

Ocean-biogeochemical modeling

- High-resolution ocean-biogeochemistry modeling for the East and Gulf coasts of the U.S. in support of the coastal monitoring and research objectives of the NOAA OA Program
- Predicting the impact of anthropogenic climate change on physical and biogeochemical processes in the northern Gulf of Mexico
- Modeling reef futures using a resolution modular ocean model
- Atlantic bluefin tuna and other highly migratory fish in the Gulf of Mexico under IPCC climate change scenarios

Other oceans and ecosystems activities

- Mandatory Ship Reporting system - an multi-institutional effort to protect northern right whales
- Operations readiness as a response of ocean environmental disasters
- Estimating global Carbon fluxes and Ocean Acidification for Caribbean Sea using satellite-derived parameters
- Plans for ecosystem research using underwater gliders

Oceans and Extreme Weather Events - Gregory Foltz, Presenter

This talk and discussions related to ongoing research within PhOD and were connected to interactions between the ocean and extreme weather events over a broad range of time scales. Over several-day time scales, the ocean exerts a leading-order influence on the intensity of tropical cyclones. Over seasonal and longer time scales, the ocean influences climatological variability of severe weather events such as tropical cyclones and tornadoes, and also influences persistent climate anomalies in temperature and rainfall that have serious economic consequences.

Projects with primarily short-term forecast applications

- Gliders in the Caribbean Sea and Tropical North Atlantic Ocean

- Optimizing Ocean Observations for Hurricane Forecast Improvement and Broader Applications (Sandy Supplemental)
- Ocean Model Evaluation and Improvement in the NOAA HWRF Tropical Cyclone Prediction Model
- Tropical Cyclone Rapid Intensification in the North Atlantic
- Generating a Global Hourly Drifter Product

Projects with primarily climate applications

- Intra-American Study of Climate Processes
- Ocean and Heat Waves
- Climate and Tropical Cyclone Activity in the North Atlantic and Western North Pacific
- Toward Developing a Seasonal Outlook for the Occurrence of Major Tornado Outbreaks
- Variability and Predictability of the Atlantic Warm Pool and its Impacts on Extreme Events in North America
- The Pacific Decadal Oscillation Modulation of the Relationship Between ENSO and Typhoon Activity in the Western North Pacific

Projects with both forecast and climate applications

- Satellite Ocean Monitoring
- Tropical Cyclone Heat Potential
- Role of Ocean Stratification in Tropical Cyclone Intensification
- Impact of Tropical Cyclones on Surface Chlorophyll in the Subtropical North Atlantic
- Tropical Atlantic Current Observation Study Sampling Ocean Currents and Current Shear in the top 100m and Connecting to Wind/Weather Events
- SST and Monsoons

Action Items and Recommendations

PHOD staff recommended to continue carrying out the current research topics, and to continue adding emphasis to multiplatform and to multidisciplinary studies. The main recommendations were:

Oceans and Climate

- 1) In addition to the work currently being done to investigate the link between the SAMOC and heat waves, explore the possibility to include other extreme events, such as forest fires, droughts, etc.
- 2) Carry out research on the link between the tropical Atlantic and the AMOC at 35S and 26N
- 3) Carry out a comparison of the time series of AMOC obtained using different observations, in particular with observations carried out by AOML

- 4) Explore the potential use of underwater gliders in the Florida Current.
- 5) Can AOML contribute and/or enhance its current contribution to the ocean observing system in support of climate hiatus research?
- 6) Resume studies of Agulhas rings link to AMOC

Oceans and Ecosystems

- 1) Monitoring the NBC rings and Amazon River waters in real-time
- 2) Collaborate with SEFSC scientists with main ocean indicators to investigate link between environment and fisheries
- 3) Support future SEFSC-AOML workshops with emphasis on enhancing partnerships

Ocean Dynamics

- 1) Explore opportunities for divisional and/or extramural funding to carry out research on mixing and on submesoscale processes
- 2) Explore opportunities for divisional and/or extramural funding to carry out analysis of pairs of surface drifters
- 3) PHOD staff members to make recommendations on how to enhance the divisional investment in new/additional technology, observations, etc.
- 4) Conduct comparisons of current transports/locations currently being computed in PHOD using different methodologies

Oceans and Weather

- 1) Explore research opportunities to investigate the link between tropical cyclone activity and interannual variability of chlorophyll.
- 2) Continue collaboration with HRD on field operations during the upcoming hurricane season.
- 3) Explore opportunities to submit a SWOT proposal to the NASA PO call.