US AMOC Task Team 1: AMOC Observing System and Evaluation

- Near Term Priorities in the 2011 US AMOC Annual Report

- 1. Assessing the meridional coherence of AMOC changes should be a continued focus of prognostic models, state estimation models and enhancement of the AMOC observing system. The design of monitoring systems for the time varying strength of the AMOC in the subpolar North Atlantic and subtropical South Atlantic should be completed this year and implemented during 2012. The importance of deep temperature and salinity measurements (i.e., deep Argo) in monitoring AMOC variability should also be assessed.

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- 2. Assimilation modeling efforts should focus on reaching a consensus on the variability of the AMOC over the past few decades and on placing realistic uncertainty bounds on these estimates. It is important that we understand the uncertainties of existing estimates and the accuracies required to detect climatically important ACMC-related changes.

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Guiding questions for MW #3:

1. What comprises the current AMOC observing system?
2. What are the main limitations of the current AMOC observing system in meeting the goal of measuring the overturning in the Atlantic basin?
3. What are the main limitations of the current AMOC observing system in meeting the goal of gaining a mechanistic understanding of AMOC variability?
4. What component or components should be added to address the limitations in questions 2 and 3?
5. Which elements of the Atlantic circulation does the observing system constrain and how well do these in turn constrain climate-specific metrics?
6. To what extent do satellite data complement the existing and planned in situ observing system(s)?

US AMOC Task Team 1: AMOC Observing System and Evaluation State estimation/data assimilation

Rui Ponte provided an overview of:

- satellite assets for monitoring elements of the Atlantic circulation,
- highlighted capabilities of state estimation systems for improving mechanistic understanding

1. satellites' strength is to provide a basin-wide perspective
2. enable interpretation of the sections in the context of relevant climate indices
3. time-space interpolation consistent with basic dynamics and conservation principles
4. Importance of dynamically consistent estimates with no hidden sources of heat, freshwater, momentum, appropriate for closed property budgets
5. add many other capabilities to studies of the AMOC (e.g., connections to global phenomenology, sensitivity to different parameters, observational strategies and design, predictability and prediction, etc.)
6. Future plans should consider potential of new satellite systems
7. Assessment of currently unavailable data (deep ocean T and S, bottom pressure) for improved observing system
8. DA inherently a modeler's driven effort – requires entrainment of observationalists

US AMOC Task Team 1: AMOC Observing System and Evaluation OceanScope

Tom Rossby: OceanScope

Prospect of instrumenting commercial ships with new-generation ADCP instruments, possibly augmented with other instruments such as XBT's

Would provide a monitoring system which can measure currents.

Commercial shipping industry interested in collaborating

Important question is on how to interpret the data

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CLIVAR/GSOP & Oceanview proposed AMOC metrics (K. Haines)

1. Total maximum AMOC calculated on the model grid, as the number of Sv at 26.5N
2. Total Florida Strait transport
3. Total Ekman transport across the section
4. Total throughflow at this section calculated as the mean volume transport through the section top-bottom
5. Florida section, MidOcean section and Total section
6. MidOcean temperature transports
7. Total temperature transport based on velocity and temperature
8. Ekman heat transport
9. Throughflow temperature transport
10. 10,11,12,13 as above 6-9 but for salt transports in units of Sv×psu

"Do not propose to examine other latitudes than 26N initially although future target latitudes might include 47N, 41N, 10S and 32S."

Similar efforts underway as part of the CLIVAR/WGOMD group with prescribed CORE2 forcing protocol

US AMOC Task Team 1: AMOC Observing System and Evaluation Discussion

- emphasis on deep ocean obs, i.e. deep Argo
- There haven't been design studies on the impact that deep Argo would have
- focus on ocean heat content in addition to volume transports
- how do you make sentence #1 in priority 1 actually happen?
- The prospect of commercial-ship deployment of ADCP velocity measurements by OceanScope (Tom Rossby)
- What about freshwater?
- Observing systems should be able to provide estimates in density coordinates
- State estimation / DA assimilation considered as formal hypothesis testing tool, refuting the model as consistent interpolator points to where/how to improve it
- CLIVAR/GSOP effort underway on comparison of reanalysis
- Similar for WGOMD CORE2-forced comparisons

US AMOC Task Team 1: AMOC Observing System and Evaluation

Four US AMOC program objectives:

- AMOC observing system implementation and evaluation
- An assessment of AMOC state, variability and change
- An assessment of AMOC variability mechanisms and predictability
- An assessment of the AMOC's role in global climate and ecosystems

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- 4. Ocean heat content (OHT) and meridional heat transport (MHT) carried by the AMOC provide the main connection to the climate system. Therefore it is important to explore AMOC and MHT/OHT relationships in various models (forward, assimilation, non-eddy resolving, eddy resolving) in comparison with observational data being generated by this program, to understand the reasons for differences or biases in the relationship between model AMOC intensity and MHT/OHT in available models.
- Freshwater… harder to do.