

AMOC State, Variability, and Change

Zoltan and Claudia

- Continue monitoring where we already have established arrays/latitudes.
- Adjust monitoring methods for sustainability.
- Post intermediate data products from each array (e.g. boundary currents, water mass transport, mass balance adjustment), heat and salt transports.
- Recommendation to make code public, not so much that others can use it directly, but so that others can find useful methods in it. Because there is no funding for a help desk. Written documentation is also important.
- Recommend that observational programs include funding for submitting to national/international data centers.
- Transition from research funding to more operational funding (e.g. NOAA, NASA) should be a medium-range goal to make it more likely to continue long-term.
 - What can motivate NOAA to take on funding AMOC: societal benefits; ecosystem impacts (add BGC sensors to arrays), prediction of ice coverage in northern ocean.
 - What can motivate NASA: synergies to explore like using mooring records as ground truth for remote sensing records. Using altimetry and GRACE for estimating ocean transports (including at mooring arrays).
 - Leverage new NSF projects to advance our understanding, even if NSF transitions away from funding core observational arrays
- Value of transport estimates for validation of data assimilation models

AMOC Mechanisms and Predictability

Mike and Aixue

TT3: Mechanisms and Predictability

Two big themes going forward:

1. Freshwater budget and impacts

- a) Exchange between the Arctic, Nordic Seas, and Subpolar North Atlantic
- b) Ocean/sea ice interactions in the Arctic (eastern Arctic AW influence, Beaufort Gyre storage/release)
- c) Freshwater flux on shelves and exchange with interior convection regions (and model bias)
- d) How can we obtain observations necessary to evaluate and constrain ocean models?
- e) What are the impacts of freshwater on the stability of AMOC?
- f) Need for instrument development to measure salinity in high latitude environments

2. Interannual (to decadal) AMOC variability

- a) mechanisms: wind effects, free and forced waves
- b) impacts on weather, hurricanes, biogeochemistry, sea level
- c) predictability
- d) focus on subtropical latitudes (?) leverage 26.5 observations

Issues common to both themes:

1. Need to combine observations, models, and theory
2. High resolution global models, need more computing resources
3. Better way to describe 4 dimensional “AMOC”
4. Continue development of common framework for evaluation and intercomparison between models

Climate Sensitivity to AMOC: Climate/Ecosystem Impacts

Chris

Big questions/science needs

- **What are the [biggest] impacts to society of AMOC-induced/associated changes in climate?**
- **How do we isolate (and quantify) AMOC impacts in the presence of strong and evolving forcing? Vice versa: how can we use impacts/climate in order to partition the AMOC and non-AMOC forced components?**
- **How can we better identify emergent/unprecedented/societally relevant AMOC variability/change?**

Ways forward

- **Highlight and itemize the impacts**
 - SST, subsurface temperature, Heat and freshwater, salinity, sea/land ice, heat waves (ocean land), sea level (coastal/open ocean), carbon cycle, biogeochemical cycles, ecosystem/fisheries, TC/ETCs genesis and storm track, climate sensitivity, drought/hydrological cycle/monsoon, MLD modulation, European climate anomalies; Gulf stream path, oxygen and carbon transport...
- **Categorize along different dimensions**
 - **Attributability to AMOC (or at least one “component”)**
 - **Stationarity**
 - **Measureability?**
 - **Modellable, given processes and biases**
 - **Societal impact**
 - **With consideration of timescale**
- **Frame the discussion of AMOC research gaps from an impacts perspective?**
 - **Discuss with particular timescale in mind (when would predictability be desired/possible?)**
 - **Identify the elements of AMOC for which mechanisms underlying linkages between ocean transport and impact are understood, and confer predictability?**
 - **How are they related to AMOC over timescale of predictability, and what would we need to measure, model?**
- **There are many more concrete/impact-specific observational and modelling needs (shelf-open ocean linkages)**
 - **Regional and/or high-resolution modelling approaches; downscaling with ecosystem/BGC components**
- **Think about how to combine (“multi-indicator” approached) to give a more coherent picture**

Paleo AMOC

Hali and Al

Is AMOC in an unprecedented state today?

- A high near-term priority is a coordinated synthesis and development effort to estimate AMOC state and variability in a focused geographical region entering the instrumental era.
 - Western boundary identified as a key strategic starting point - including FL straits/Bahamas north to Nova Scotia
 - Combining instrumental observations, paleo data, models and data synthesis and quantification of real transport uncertainties.
- Putting Rapid/OSNAP in longer term context [decadal and centennial] needed for **attribution!!!** [the path to the future lies in the past] -
 - Gathering/synthesizing evidence from a wide geographic range of AMOC components
- Need pursue mechanisms for coordinating international and national efforts (NSF/NERC, etc).
 - HELP!
- Continue partnering with people with diverse expertise (play outside the paleo sandbox)