Background and ideas from an OMDP perspective

Coupled Initialisation Scoping Meeting -
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Initialization of Ocean Models—Standards

- CMIP standard approach
- OMIP standard approach
- Decadal predictions standard approach
- Newton-Krylov approach
- Detrending—for OHC and Sea Level

CMIP Approach

- Eyring et al. 2016 (https://doi.org/10.5194/gmd-9-1937-2016)
- piControl (preindustrial control)
  - Spin up of indeterminate length to 1850 conditions
  - >500 years of piControl at 1850 conditions
  - Branches for historical & SSP runs off of piControl
- piControl usually has significant drift in OHC and Sea Level

OMIP Approach

- OMIP (Griffies et al. 2016 https://doi.org/10.5194/gmd-9-3231-2016, Tsujino et al. 2020 https://doi.org/10.5194/gmd-13-3643-2020, Chassignet et al. 2020 https://doi.org/10.5194/gmd-13-4595-2020)
  - T, S initialized to observations in upper 1500m
  - Initial velocities are at rest
  - Sea Ice from observations or spun up model
  - Repeated forcing cycles (OMIP-1 1948-2009, OMIP-2 1958-2018)
    - 6 cycles for low-res (1 degree), 1 cycle for high-res (0.1 degree)
  - Alternatively, May 1 1990 to April 30 1991 are good for repeat (Stewart et al. 2020)
- OMIP-BGC (Orr et al. 2016 https://doi.org/10.5194/gmd-10-2169-2017):
  - Passive tracers added by surface forcing in 4th-6th OMIP cycle
  - Optional—2000 year spin-up.

Decadal Predictions Approach

- A variety of approaches (Meehl et al. 2014)
- Typically full-field initialization, anomaly initialization, or hindcast initialization—rarely data assimilation in ocean
- Anomaly initialization adds the anomalous component of the observed state to the model climatology to minimize the drift during the prediction.

Newton-Krylov Approach to accelerate to steady state

- Primeau and Khatiwala develop the transport-matrix based approach study passive tracer transport.
- Lindsay (2017) demonstrates how ocean tracers can be spun up quickly from a repeating physical state using this matrix and converging to a statistically steady state
- Zanna et al. (2019) and Bronselaer & Zanna (2020) show that anomaly temperature can reasonably treated as a passive tracer, using the same transport matrix approach

Detrending

- In CMIP, OMIP, PMIP runs, there are often residuals in the deep ocean that lead to slow trends. These contaminate the trends in deep OHC and thermometric sea level, among other variables (e.g., AMOC, AABW, etc.).
- The purpose of the piControl run is to provide a control simulation without climate change but with similar trends due to initialization biases.
- Typically, detrending aka drift correction is done in analysis phase, point wise in 3D.
- E.g., https://doi.org/10.1029/2019EF001413

Information Theory

- Aakash Sane (Baylor's student) has developed information theory metrics for ocean models in coastal and climate applications.
- These can be used to evaluate predictability quickly
- These can be used to quantify the impacts of different forcing agents
- Variables are measured against their own distributions, so mismatched-units comparisons are easy
- No parametric assumptions are made about the pdfs of variables
- http://dx.doi.org/10.1002/essoar.10505545.1 http://dx.doi.org/10.1002/essoar.10504826.1