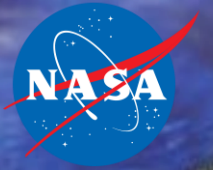


National Aeronautics and
Space Administration



Modeling, Analysis and Prediction Program

David B. Considine,
ECCO Science Team Meeting
January 25, 2023



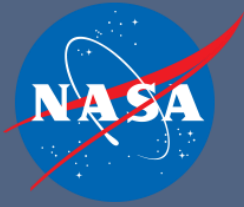
MAP Program Characteristics

- Develop an understanding of the Earth as a complete, dynamic, interacting system.
- Use that understanding in development of comprehensive, representative, interactive, physically-based Earth system models.
 - Spanning the entire Earth system.
- Earth system characterization, diagnosis, prediction, observing system design.
- Observation-driven modeling
 - Direction of research driven by available observations .
 - Goal - use modeling in together with observations to extract value from the obs.
- Modeling with a purpose – provision of social benefits, understanding observations.
 - Curiosity is not enough!
- Time scales from seconds to multi-decadal.
- Analyses/reanalyses/state estimates effectively combine models and observations to both characterize and diagnose the Earth system – this is where ECCO fits.



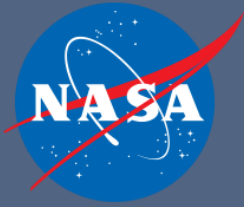
Why does MAP support ECCO?

- ECCO is consistent with the Earth system characterization and diagnosis goals of MAP.
- State estimation approach is interesting and different from meteorological data assimilation methodology.
 - Consequence of sparse ocean sampling?
 - Advantage – no anomalous sources/sinks
 - Global spatial and temporal minimization
 - Disadvantages – computational resources, mismatch with other assimilation efforts reducing possibility of integration/collaboration with other MAP-funded efforts
- ECCO is a productive effort and an enabling effort.
- ECCO uniquely and broadly addresses Earth system science spanning the Climate Variability and Change Focus Area.
- Understanding the interaction between the ocean and the cryosphere – e.g. sea ice, ocean/ice sheet interactions.



ECCO-relevant MAP Research Goals

1. Understanding, representation and prediction of global sea level rise
 - ECCO appropriate for characterization and diagnosis, also prediction initialization.
 - MAP is interested in integrated and interactive representation of SLR – not ad hoc methods.
2. Representation of the cryosphere and ocean/cryosphere interactions
 - Focus on ice sheet/ice shelf/sea ice with ocean as boundary condition.
3. Ocean modeling and data assimilation including the cryosphere
 - Focus on ocean circulation/state with ice sheet/ice shelf/sea ice boundary conditions
 - Ocean/atmosphere interactions – exchanges of heat, momentum, trace gases.
 - Includes ocean biosphere/biogeochemistry



Archetypal MAP Modeling Effort

Goddard Modeling and Assimilation Office “GEOS” Model:

- Modular/configurable comprehensive global Earth system model combining land, atmosphere, cryosphere, ocean components, with data assimilation system

Utilization:

- Weather analysis and prediction: GEOS-FP system
- Sub-seasonal to seasonal prediction: GEOS-S2S model
- Reanalysis: MERRA, MERRA-2, Reanalysis of the 21st Century, PolarMERRA, MERRA-3 (FY25)
- GEOS-CCM Atmospheric Chemistry/Climate Modeling
- GEOS-CTM Atmospheric Chemistry and Transport Model
- Observing System Experiments/ Observing System Simulation Experiments