NEW CAPABILITIES IN THE DATA ASSIMILATION RESEARCH TESTBED FOR THE OCEAN SCIENCE COMMUNITY

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The Data Assimilation Research Testbed (DART; Anderson et al., 2009) is an open-source, freely available community facility for ensemble data assimilation. DART is developed and maintained by the Data Assimilation Research Section at the National Center for Atmospheric Research.

DART has minimal dependencies and can be built on any unix-like machine, from laptops to supercomputers. It has been used in hundreds of earth-system studies to:

- Generate initial conditions for forecasts.
- Create a retrospective estimate of the state of a system, a practice known as producing a reanalysis.
- Assess the relative value of specific observations on forecast skill, a practice known as conducting an observing system experiment, or OSE.
- Estimate the value of hypothetical observations in order to inform the design of an observing system, a practice known as conducting an observing system simulation experiment, or OSSE.
- Determine a model's systematic bias in estimating the state of a system, a practice known as diagnosing model error.

The DART software environment makes it easy to explore a variety of data assimilation methods and observations with different numerical models. It provides powerful, flexible DA tools that are easy to use and customize to support efficient and reliable DA applications. While DART is primarily oriented for DA research, it has also been used in operational settings.

DART includes:

- A tutorial introducing the concepts of ensemble DA.
- Extensive documentation of its source code.
- Interfaces to a variety of models and observation sets that can be used to introduce new users or graduate students to ensemble DA.

DART is also designed to facilitate the combination of assimilation algorithms, models, and real or synthetic observations to allow increased understanding of all three.

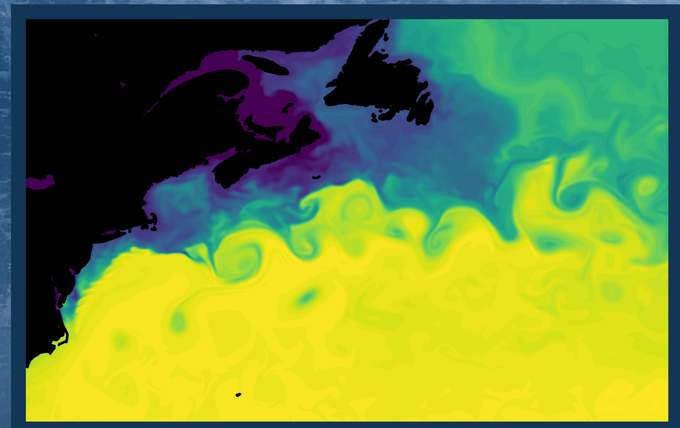
SUPPORTED OCEAN, SEA ICE, AND BGC MODELS

CICE6	FESOM	MITgcm	MPAS
N-BLING	POP2	ROMS	

WHAT'S NEW IN DART FOR OCEAN SCIENCES

The CAM6+DART Reanalysis

This eighty-member reanalysis (Raeder et al., 2021) integrated CAM6 throughout the years 2010-2019. An additional year of reanalysis is underway for 2020. The reanalysis coupler history fields can be used as forcing for other components of the Community Earth System Model (CESM) such as POP2 and CICE6.



Surface salinity from an eddy-resolving POP2 integration.

High-resolution POP2 Capability

DART supports POP2 in the ~0.1° eddy-resolving "t13" Poseidon tripole grid resolution. This configuration within CESM can be forced using the CAM6+DART reanalysis using the "f09_t13" grid.

Please note: running high-resolution POP2 is extremely computationally intensive. Benchmarking tests suggest that integrating a single model year using an eighty member ensemble requires roughly 5-10 million core hours, depending on machine performance.

WHAT'S NEW IN DART, CONTINUED

Inverse-gamma Adaptive Inflation

The adaptive inflation algorithm of Gharamti (2018) has been incorporated into DART. This approach to inflation can be used in ocean domains in which observations are not spatially and/or temporally uniform, such as in the vicinity of moored arrays.

Biogeochemistry

Support has been added for biogeochemistry applications using MITgcm and N-BLING. Support for satellite-observed chlorophyll from AQUA/MODIS and VIIRS has also been added. The addition of this capability was supported by the Red Sea Initiative at King Abdullah University of Science and Technology. This initiative aims to provide an "end-to-end analysis and prediction system for weather, climate, and marine applications in the Red Sea" (Hoteit et al., 2021).

REFERENCES

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