Climate Prediction with CESM/DART: From seasons to decades

Spring 2013

I. Description

Energy, agriculture, and many other economic sectors stand to gain huge benefits from predictions of weather and climate patterns for periods ranging from an upcoming season to 10 years ahead. NCAR has decades of experience in developing state-of-the-art climate models as well as data assimilation techniques—methods for bringing critical data into those models. With this experience, NCAR is well positioned to enter the evolving realm of seasonal-to-decadal prediction.

II. Stage of Research

• NCAR’s Community Climate System Model was recently expanded to become the Community Earth System Model. Developed with extensive university involvement, the software in the CESM simulates past and current climates and projects future trends. The software, which ranks among the world’s top climate models, includes submodels that depict the atmosphere, land and vegetation, sea ice, and oceans.

• The quality of model predictions can be boosted by incorporating current observations. NCAR’s Data Assimilation Research Testbed is a well-established, widely used tool for bringing data into weather and climate models. DART is designed in a modular fashion for use with virtually any model or submodel.

• NCAR has used DART for a major simulation that drew on current ocean conditions to project climate 10 to 30 years into the future. This was part of a coordinated study called CMIP5, which involved more than 20 modeling groups from around the world. The NCAR CMIP5 simulations provide a window into many potential climate impacts (see below).

III. Advantages

• Because data assimilation is vital to improving weather and climate prediction, DART greatly enhances the value of CESM for policy makers and planners.
• CESM and DART are carefully vetted, open-source products used by researchers throughout the world.

• Current ocean conditions are vital for better long-range forecasting. CESM/DART can produce analyses of current ocean conditions that can be used to start predictions of the Earth system for a range of lead times, including seasonal, year-to-year, and decadal.

IV. Applications

• Estimating human exposure to climate extremes

• Using predicted ocean conditions to estimate potential changes in ocean ecosystems, such as fish migration and coral bleaching

• Leveraging 10-to-30-year climate predictions to assess regional changes in U.S. weather hazards, such as winter storms and summer heat waves

• Projecting the future of the Arctic Ocean’s summertime sea ice, which will affect shipping, energy production, indigenous populations, and ecosystems

V. Funding and IP Status

Current: National Science Foundation (EaSM2 support for assessing decadal climate variability, its mechanisms, and its impacts)

Seeking additional support to
• improve predictions of the ocean and atmosphere
• expand into emerging areas of prediction, such as sea ice and ecosystems
• translate our predictions into policy-relevant applications, such as regional assessment of weather hazards

These activities will leverage our ongoing work and increase the return on investment in modeling, assimilation, and prediction capabilities at NCAR.

VI. Research Partners

NOAA Geophysical Fluid Dynamics Laboratory
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Woods Hole Oceanographic Institution

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