Navy Earth System Prediction Capability (ESPC)

AT A GLANCE

U.S.NAVAL

RESEARCH LABORATORY

What is it?

Fully coupled atmosphere, ocean, sea ice, and wave models to create a daily 16-day high-resolution deterministic forecast and a weekly 45-day probabilistic lower-resolution ensemble prediction capability for the globe from the top of the atmosphere to the bottom of the ocean.

How does it work?

The system assimilates real-time observations of the atmosphere, ocean and cryosphere to constrain the Earth system at the initialization time. The models then act as dynamical interpolators accurately forecasting forward in time.

What will it accomplish?

It extends the limits of environmental prediction beyond the existing standalone operational atmosphere and ocean/sea ice systems. It also provides ensemble ocean and sea ice forecasts for the first time.

R&D Sponsor(s)

Office of Naval Research

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Near-surface air temperature (°C) (left) from NAVGEM, sea surface temperature (°C) (middle) from HYCOM, and sea ice thickness (m) (right) from CICE on 21 January 2020.

The U.S. Naval Research Laboratory is spearheading the development of the Navy Earth System Prediction Capability (ESPC). The Navy ESPC couples four models: NAVGEM, HYCOM, CICE, and WAVEWATCH III[®]. The horizontal resolution of the ocean and sea ice components is exceptionally high for a global coupled forecast system.

NAVy Global Environmental Model (NAVGEM). NAVGEM is the atmospheric prediction system used by Fleet Numerical Meteorology and Oceanography Center (FNMOC) for global weather prediction out to 16 days. In addition, NAVGEM provides the lateral boundary conditions for high-resolution limited area models and other applications such as length of day calculations.

HYbrid Coordinate Ocean Model (HYCOM). HYCOM is the ocean model component that depicts the location of mesoscale features such as oceanic eddies and fronts, i.e. the "ocean weather", and provides accurate 3D ocean temperature, salinity, and current structure to the Fleet. These environmental fields provide real-time predictions of derived acoustic parameters important to undersea sound propagation.

Community Ice CodE (CICE). CICE is the sea ice component that depicts the cryosphere in the polar latitudes of both hemispheres. It forecasts sea ice concentration, thickness, and drift that is important to naval operations in the marginal ice zone. Fractures, leads and polynya forecasts are also valuable to the naval submarine community.

WAVEWATCH III (WW3): WW3 is the surface wave component and is a phase-averaged spectral model to depict wave actin spectral density. It is primarily used to predict significant wave height.

Each model component (except WW3) assimilates real-time observations for initialization.

Developing state of the art technology to support the Future Fleet

- Version 1 of Navy ESPC 45-day ensemble forecasts, run weekly, went operational at FNMOC in August 2020, with atmosphere, ocean and sea ice products available.
- Navy ESPC Version 2 includes coupling to WAVEWATCH III[®] (wave model) and extends NAVGEM's top to 100 km. A deterministic version run daily went operational in August 2024, and the ensemble version should become operational in 2025.
- Navy ESPC is used for basic research at NRL and by organizations including the U.S. National Ice Center to support polar exercises and resupply missions and the Joint Typhoon Warning Center for tropical cyclone genesis prediction.