

## AT A GLANCE

### What is it?

A flexible next-generation numerical weather prediction model able to fully utilize the most powerful high performance computing available, enabling high resolution global and regional prediction systems extending from the earth's surface to the ionosphere.

### How does it work?

NEPTUNE uses a technology called Spectral Elements, an equation set known as the Deep Atmosphere Equations, sophisticated representation of physical processes, and includes the ability to capture the motions associated with clouds. This allows NEPTUNE to be configured as a global model, a regional model, or even variable resolution within a single model grid.

### What will it accomplish?

High-resolution global and regional NWP systems. Grid refinement. Simplified operations. Use of Navy-specific observations. Leverage community advancements Flexible and robust enough to facilitate wartime forecasts. Can run anywhere. Information assured, protected code.

### R&D Sponsor(s)

ONR N2N6E DARPA

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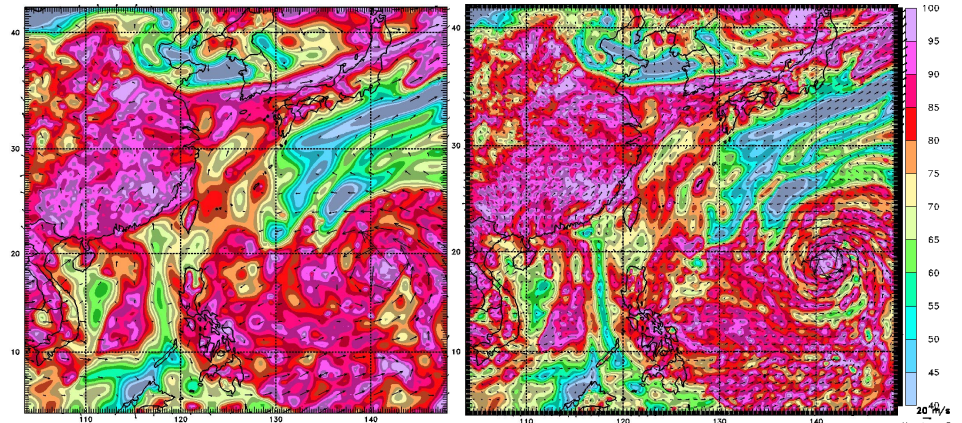


Figure 1. Existing 19km resolution (left) and NEPTUNE-enabled 8km (right) forecasts of relative humidity at 850-hPa.

The U.S. Navy's operational Meteorology and Oceanography experts have gained access to next-generation compute platforms, which provide the infrastructure necessary to run state-of-the-science numerical weather prediction (NWP) models at resolutions similar to other operational centers. NRL has responded by developing a next-generation NWP system that is able to take advantage of that computing and the latest NWP science. NEPTUNE is designed to run on any number of cores and any type of cores (CPU or GPU), enabling operational global forecasts of resolution less than 10km. Reference figure 1.

But wait, there's more. The same code base can be configured to run at meter-scale resolution for focused scientific studies as well as be extended all the way into the ionosphere to provide the warfighter with new high-altitude strategic capabilities.

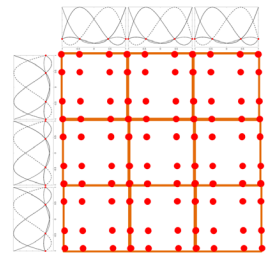


Figure 2. Spectral element grid (3x3) and schematic polynomials representing each element

## A Focus on Wartime METOC

In addition to enabling high-resolution global predictions, NEPTUNE's flexibility allows U.S. Navy scientists to focus on Navy-centric forecasts problems such as boundary layer winds, electromagnetic and optical propagation conditions and clouds. This will allow the U.S. Navy's Fleet Numerical Meteorology and Oceanography Center to configure the model dynamically to best support the needs of the warfighter given available computing and communications.

NEPTUNE is formulated to take advantage of the latest HPC architectures to best meet the evolving needs of the U.S. Navy to understand, define and apply the physical environment towards freedom of action.