



UNIVERSITY OF WASHINGTON

SCHOOL OF MARINE AFFAIRS

VADM Conrad C. Lautenbacher  
National Oceanic and Atmospheric Administration  
Room 6811  
14<sup>th</sup> St & Constitution Avenue, NW  
Washington, DC 20230

April 4, 2007

Dear VADM Lautenbacher,

This letter is in response to NOAA's request to the Science Advisory Board (SAB) to review NOAA's High Performance Computing (HPC) needs in light of the presentation by K. Cooley, CIO, and F. Toepfer, EMP Manager, on Dec. 5, 2006.

The specific request to the SAB is to provide advice on how to address the large and growing gap between available HPC resources and NOAA's mission requirements.

**RESPONSES OF THE SAB:**

- 1.) Current NOAA process for development and integration of new models into the operational system

It appears that at the time of transition from research to operational implementation, NOAA does not optimize model implementation toward the highest possible sustained performance. It is recommended NOAA establish a core team of expertise, i.e., "HPC engineers" capable of conducting a performance analysis and then modifying the program implementation to obtain the maximum possible performance from existing HPC resources. Since HPC engineers, particularly those capable of performance tuning, are not widely available, sufficient time needs to be planned for identifying these resources.

- 2.) Potential availability of new HPC technologies capable of providing NOAA with significant increases in HPC capabilities

Between now and 2010-2012, new HPC architectures are likely to become available commercially which will be over 100 times more powerful than the HPC computers currently established by NOAA. They will likely use orders of magnitude more processing units and hybrid technology architectures. Such computers will be much

more complex than the current HPC computers in use at NOAA and so will require carefully optimized programming to obtain the high levels of performance necessary for NOAA to be competitive with its peers, domestic and international.

It is recommended the NOAA CIO establish a core team of HPC expertise to assertively monitor new developments in HPC architectures and technologies, and keep NOAA abreast of the trends and directions in HPC technologies and products so it can be prepared to acquire and utilize them as they become available.

In addition, it is recommended the “HPC engineering” experts conduct research in the market and on NOAA operational models and those now in development to understand how best to adapt them to utilize features of new architectures, such as hundreds of thousands of processors, hybrid technology architectures, and software capabilities.

3.) Coordinated research with U.S. federal partners (Department of Defense, Department of Energy, NASA)

It is recommended the NOAA CIO establish formal working relationships other U.S. Federal agencies who are also engaged in HPC. The goal of these relationships is to understand the strategic approach to HPC by those agencies, including how they monitor HPC architecture developments, what “HPC engineering” expertise they have available, and how they engineer new capabilities into model implementations. In addition, the NOAA CIO and his engineers should participate in public forums where HPC developments are discussed.

4.) Coordinated operations with U.S. Department of Defense and international peer partners

As some U.S. Department of Defense and international agencies peer to NOAA have commonalities in their missions and model HPC implementations, it is recommended NOAA investigate those research and operational activities which would further NOAA’s scientific goals and capabilities. Examples include global deterministic model scaling and distributed processing, multi-agency high-resolution ensemble forecasts, and global scale, distributed seasonal and climate forecasts.

5.) Meeting demand for modeling on the micro- and mesoscale

NOAA needs to re-think its fundamental approach to modeling as it prepares to meet the growing demand for operational products and services on the micro- and meso-scales. From data presented in the referenced briefing, the current track that NOAA HPC is following leads to 1 km resolution modeling in 28 years. This is symptomatic that a different approach is needed. The SAB recommends that NOAA consider developing a two-track approach to its future modeling needs. The first track would continue, more or less, the traditional NCEP product suite run as done today on its continuous six-hour update cycle. Most of the items run in this suite are large scale/synoptic products that are essential for many NOAA operations, not just the NWS. The Board believes that attempts to shoe-horn mesoscale models into this

highly structured cycle is a non-starter due to data assimilation issues, and desirability for many mesoscale models to be run on demand, i.e., asynchronously. The second track, to be developed for operational micro-/mesoscale models, would not be nearly as structured and much more flexible in scheduling. It would most likely use computing resources not at NCEP but under NCEP control, e.g., variable amounts of rented cycles from an commercial vendor or a sister federal agency. It is important to note that many of the micro-/mesoscale models require the output from the traditional suite as background conditions, so these tracks have to work in tandem.

#### 6.) Telecommunications needs

While not a main thrust of the briefing, the Board was concerned to hear that NOAA lacks telecommunications capacity to make use of many modern computing technologies, such as distributed or GRID computing. The Board suggests the CIO develop a long term telecommunications vision leading to an initiative to develop a NOAA telecommunications infrastructure needed to meet customer needs in the 21<sup>st</sup> century.

#### 7.) Obtaining new resources

The Board noted that NOAA continues to make arguments regarding its HPC needs based on comparisons with other HPC centers around the world, e.g., ECMWF, the French, the Japanese, etc. The Board believes that all evidence indicates such an appeal to national pride is not a successful strategy for obtaining additional computing resources. The Board recommends that in the future, NOAA make its case based on customer demand. Examples presented at the recent board meeting include both the mesoscale model for improved forecasting of hurricane intensity and the microscale model for dealing with fire meteorology.

Sincerely,



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cc:  
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