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NEW CAPABILITIES AND PLANS AT THE
FLEET NUMERICAL METEOROLOGY AND OCEANOGRAPHY CENTER

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ABSTRACT

The U.S. Navy's Fleet Numerical Meteorology and Oceanography Center is taking delivery of some new and exciting numerical models, while adding new information processing system hardware to form the basis for its eventual Cray Y-MP C90 replacement. The status of these new and upgraded models and the current and planned hardware suite used to execute them will be discussed. Fleet Numerical has also upgraded its communication connectivity with other centers to ATM capability, and has undergone a dramatic increase in customer base and operational product volume by using interactive client-server systems and World Wide Web technology. Presently, Fleet Numerical serves over 2500 customers with over 288,000 operational products daily, or a total of over 105,000,000 products a year.

1.   INTRODUCTION

The U. S. Navy's Fleet Numerical Meteorology and Oceanography Center ("Fleet Numerical") in Monterey, CA combines innovative technology with the best available science in order to provide the best weather and oceanographic products, data and services to the operating and support forces of the DoD, anywhere, anytime. Fleet Numerical's analysis and forecast capabilities include numerous global, regional and mesoscale METeorological and OCeanographic (METOC) models which represent a three-dimensional description of the environment from the top of the atmosphere to the bottom of the ocean. Fleet Numerical's primary focus is on coupled sea-air-land modeling to provide seamless predictions of the sea-air-land environment in which naval forces operate. Recent upgrades in hardware, software, and models are providing Fleet Numerical with the tools to meet emerging DoD operational requirements "whenever, wherever and at whatever resolution required" across the globe.

2.   FLEET NUMERICAL'S COMPUTER SUITE

To meet its global requirements for support, Fleet Numerical runs an integrated suite of meteorological and oceanographic numerical models twice daily on its Cray Y-MP C90 Class VII supercomputer. The C90 was recently upgraded from eight to 16 central processing units (CPUs), and hosts 256 million words of memory. It is augmented by two Cray J90 SEs. The Crays are supported by numerous Sun workstations which provide pre-processing of incoming data destined for the models, and which generate derived products from the model output. The suite of computers is completed by a series of workstations and PCS which serve as the

communications interfaces for incoming data, and for outgoing products to the over 2500 customers that Fleet Numerical serves.

3.   FLEET NUMERICAL MODELS

The models run at Fleet Numerical have been described in detail by Plante and Thormeyer (1996), and Moersdorf and Clancy (1997). A number of improvements to several of these models are now imminent, and are described below.

3.1   *Navy Operational Global Prediction System (NOGAPS)*

NOGAPS 4.0, due for operational implementation by June 1998, will have the following improvements:

- Increased vertical resolution from 18 to 24 levels
  - Improved moisture analysis
  - Improved temperature forecasts in the stratosphere
  - Improved surface fluxes (eliminating moisture bias in the tropics)
  - Improved upper boundary conditions.

3.2   *Navy Operational Regional Prediction System (NORAPS)*

The present regional model, NORAPS, has horizontal resolutions ranging from 15 to 45 km, uses 36 vertical levels, and provides forecasts to 48 hours. Several geographic areas are usually running concurrently in the twice-daily operational model run, with locations being adjusted as world conditions and operational requirements dictate. The recent Cray Y-MP C90 upgrade at Fleet Numerical allows more NORAPS areas to be run concurrently, with model output parameters made available in a more timely manner. Present NORAPS incremental updates will improve its analysis and initialization, and will make better use of high resolution / high volume remotely sensed observations.

3.3   *Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS)*

COAMPS is a higher resolution mesoscale model which will initially supplement and eventually replace the regional NORAPS model currently in use. It can be triply nested down to resolutions of less than 10km. It has 30 vertical levels, but because of increased resolution which requires a smaller footprint (maximum size 1000km by 1000km), it is expected to provide forecasts to only 24 hours. COAMPS improvements over NORAPS include the use of non-hydrostatic dynamics, a better moisture analysis, explicit moist physics, and utilization of high resolution terrain data. COAMPS is expected to yield a better forecast of cloud formation, precipitation, fog and wind. COAMPS was tested in March and July 1997 in the Aegean Sea, and is now operational over Bosnia and the adjacent Adriatic sea.

3.4   *Optimum Thermal Interpolation System (OTIS)*

The OTIS model provides thermal structure analysis for the world's oceans. Work is commencing to couple the

OTIS model with COAMPS, which will result in a truly coupled air-ocean model for the first time.

3.5 *Princeton Ocean Model (POM)*

A long-term project has been undertaken to bring this laboratory model (Blumberg and Mellor, 1987) to operational status. To accomplish this, Fleet Numerical is working primarily with the National Centers for Environmental Prediction (NCEP) in a cooperative effort to provide operationally useful forecasts of ocean currents and other dynamic ocean parameters. Fleet Numerical, per agreement with NCEP, is focusing its initial efforts on the west coast of the United States, where a regional ocean model is expected to be operational by March 1998.

4.0   INCREASED DATA SOURCES

Today, Fleet Numerical receives over 6.9 million observations each day, or approximately 80 every second. Over 95 percent of these data are remotely sensed, with huge volumes of scalar winds provided by the Special Sensor Microwave Imagery (SSM/I) sensors aboard several Defense Meteorological Satellite Program (DMSP) satellites, multi-channel sea surface temperatures (MC SSTs) from NOAA polar orbiters, and increasingly, altimeter data for wave height and scatterometer data for the surface wind vectors over the ocean from the European Remote Sensing (ERS) satellite. The scatterometer data is already demonstrating its value for marine forecasting by providing a more complete wind picture over the open oceans than the scalar SSM/I wind speed data could provide alone. The altimeter data from the ERS satellite is currently being used to evaluate the WAM wave forecast model (WAMDI Group, 1988) with the goal of improving wave height forecasting. Comparative data to date has shown a close correlation to actual values output by the WAM model.

5.0   CUSTOMER AND PRODUCT VOLUME

Today Fleet Numerical directly serves over 2500 primarily DoD customers with numerical atmospheric and oceanographic model output and derived products. Hundreds of additional customers are served indirectly through a worldwide network of Navy regional centers, and through the Air Force Weather Agency (AFWA). Further, many civil sector organizations access Fleet Numerical products via NOAA under a Navy-NOAA memorandum of agreement. Each day, over 288,000 individual products are provided to these customers, or approximately 200 each minute (over three per second). Nearly half of these products are provided via the Navy Oceanographic Data Distribution System (NODDS) dial-in system (Garthner, et. al., 1997) and the World Wide Web oriented Joint METOC Viewer (Ravid, et. al., 1997). NODDS product volume has now leveled off at about one million products per month, but the JMV volume is presently growing astronomically and now exceeds three million products per month using World Wide Web and dedicated DoD communication link access.

6.0   SUMMARY

Fleet Numerical, bolstered by an increase in remotely sensed data, improved model physics, and increased computer power, is well positioned to continue to provide leading edge numerical model output to DoD operating forces worldwide and other users well into the 21st century. Recent paradigm changes in world affairs from those of the cold war have also allowed the civil sector, through NOAA, to have access to and leverage Fleet Numerical products. More information, along with sample products, may be found on the Fleet Numerical home page at *http://www.fnmoc.navy.mil.*

7.0   References

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