Collaborative Research Projects in Support of FNMOC and CNMOC Operational Mission

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LONG-TERM GOALS

The Naval Postgraduate School (NPS) Meteorology Department provides graduate-level instruction in the science of Meteorology and its application in support of military operations. To maintain expertise and provide support to student theses, the faculty performs research in the Navy relevant areas of synoptic and dynamic meteorology, remote sensing, numerical modeling, boundary layer meteorology and environmental effects.

OBJECTIVES

This report describes the three collaborative theses in the Department of Meteorology supported by this project last year. They include: LCDR Alex Cantu study of METOC impacts on aviation safety, LT Keith Barto's production of a new version of FNMOC Joint METOC Viewer (JMV) software with high resolution terrain displays (now JMV version 3.4), and finally LCDR Greg Schmeiser evaluation of NOGAPS and COAMPS forecasts for the surprise January 25, 2000 East Coast cyclone event.

APPROACH

There is a long history of collaboration between Fleet Numerical Meteorology and Oceanography Center (FNMOC) and the NPS Meteorology Department. In fact, over 30 years ago, NPS was responsible for the establishment and flourishing of this Navy operational command on its campus. In 1959, the Naval Weather Service moved its numerical prediction unit from Suitland, Maryland, where it was a part of a joint National (civilian), Navy and Air Force Weather Services organization, to Monterey as a new operational command: Fleet Numerical Weather Central (now called FNMOC). The move to Monterey was prompted by the special requirements of the Navy because of its ocean operations which were not adequately met in the joint civilian-military center. The Navy chose to move its large assembly of science faculty who are intimately familiar with naval operational problems in meteorology and oceanography. For similar reasons the Navy Environmental Prediction Research Facility (NEPRF), now Marine Meteorology Division of NRL, or NRL-Monterey, moved to Monterey in 1971 from Norfolk, Virginia, a further augmentation of meteorological and oceanographic scientists in Monterey, making it the center of naval environmental science.

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14. ABSTRACT
The Naval Postgraduate School (NPS) Meteorology Department provides graduate-level instruction in the science of Meteorology and its application in support of military operations. To maintain expertise and provide support to student theses, the faculty performs research in the Navy relevant areas of synoptic and dynamic meteorology, remote sensing, numerical modeling, boundary layer meteorology and environmental effects

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WORK COMPLETED

Three collaborative research projects have been conducted with support received in FY01.

LT Barto was motivated by deficiencies in current METOC weather visualization tools that did not allow war fighters, forecasters, and researchers to analyze and co-display environmental data over realistic topographic and bathymetric backgrounds. In this thesis LT Barto developed the Joint METOC Global Image Interface and provided decision makers and geoscientists with an intuitive tool for interactively viewing, overlaying, and outputting the full suite of FNMOC distributed environmental data over realistic and accurate terrain, coastlines, hydrography, and locally obtained imagery. Full integration into the Joint METOC Viewer ensures minimal training time for operational use and geodata distribution is accomplished on the program distribution CD or over the web. The evolution of traditional METOC visualization, and the characteristics of the geodatabases were also discussed. LT Barto illustrated these new capabilities using real world examples drawn from diverse application areas.

LCDR Cantu analyzed 235 Class A and Marine (NAVAL) aviation mishaps involving aircrew error between FY90 and FY98 for the possibility of being weather related. In addition to determining the overall role of weather, he compared weather related mishaps to aircraft category, mishap characteristic, the Naval Safety Center human factors (HFACS) taxonomy, and flight phase. In addition, weather related mishap trends were analyzed. Results showed 19% of mishaps involving aircrew error are weather related with helicopter category and controlled flight into terrain (CFIT) mishap characteristic having the largest percent of weather related mishaps for their respective groupings. Visibility related weather elements accounted for over half of all weather related mishaps, and nearly two-thirds of all weather related mishaps were judged to be preventable with a perfect weather forecast believed by aircrew. These and other findings were presented to develop intervention strategies for reducing the number of weather related flight mishaps (FMs) per year.

LCDR Schmeiser analyzed the performance of the Navy models, NOGAPS and COAMPS (West Atlantic) for the 25 January cyclogenesis event, a rapidly developing cyclone that tracked up the East Coast, and produced 12 to 18 inches of snow for major cities from North Carolina to Washington, D.C. This snowstorm deserves special consideration because of the poor numerical and human forecast errors. Deficiencies of the forecasts were identified and a diagnosis of critical model fields that led to these deficiencies is completed. Preliminary investigation of analyses and NOGAPS forecast runs with the new variational data assimilation system, NAVDAS, concluded the research.

RESULTS

The results reveal that NOGAPS poorly forecast storm tracks while COAMPS showed more success. Both NOGAPS and COAMPS produced deficient short- range upper-level height forecasts and had difficulty analyzing two prominent jet streaks. NOGAPS was not able to adequately analyze or forecast cold air damming and coastal frontogenesis, while COAMPS was more successful at resolving these mesoscale features. COAMPS produced better precipitation forecasts than NOGAPS, but still showed deficiencies. Preliminary investigation of NOGAPS forecasts using NAVDAS showed promise and positive impacts.

IMPACT/APPLICATION

This "umbrella" effort funds collaborative research projects by NPS Meteorology Department faculty and students and by FNMOC personnel. The specific projects supported under this proposal were developed by mutual agreement between an NPS thesis student, an NPS-Meteorology faculty member (Thesis Advisor) and an FNMOC employee with whom the NPS personnel will collaborate. Projects are approved by the Chairman of the NPS Meteorology Department and by the FNMOC Technical Director. This report will describe the NPS theses completed or in progress during FY2001 under this project. All of the theses completed under this effort during FY98 through FY01 are listed in the references.

TRANSITION

The consequences of these moves are the substantial involvement of NPS faculty in research projects at NRL-Monterey and enhancement of operational capabilities at FNMOC. Furthermore, personnel from the latter two organizations are able to take advanced courses, and pursue advanced degrees at NPS, and officer-students at NPS can engage in thesis research on "real-life" applications relating environmental parameters to Naval operations. Many theses of NPS graduates have dealt with FNMOC and NRL applications. In addition, numerous research projects have been completed by the faculty that addressed special Navy operational needs based on data available from the two organizations and interaction with their personnel. The purpose of this effort is to enhance further these collaborations.

PUBLICATIONS

Barto, K. P. (2000) Improvements to FNMOC METOC Analysis and Forecast Visualization Tools. M. S. Thesis, Naval Postgraduate School, Sept 2000. (Advisor Wash)

Bommarito, B., (1998) A principle component Approach for FNMOC Probability of Precipitation Forecast. M. S. Thesis, Naval Postgraduate School, September 1998.

Cantu, A. (2001), The Role of Weather in Class A Naval Aviation Mishaps FY 90-98. M. S. Thesis, Naval Postgraduate School, March 2001. (Advisor Wash)

Carsten, Dave M., 2000: Sea-ice Motion from Buoy and Microwave Satellite Analysis. MS Thesis, Naval Postgraduate School, Monterey, CA.

Connon, B. D. (1999) Surface combatant integration of METOC data acquisition and product distribution systems within the IT-21 communications architecture. M. S. Thesis, Naval Postgraduate School, June 1999.