EM/EO Testbed/Diagnostics Demonstration

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LONG-TERM GOALS

Develop the capability for the Tactical Atmospheric Modeling System/Real-Time (TAMS/RT), an end-to-end on-scene analysis/forecast system for real-time organic data fusion, to provide atmospheric and tactical impact variables (e.g., refractivity) to forward-deployed forces.

OBJECTIVES

Develop the capability to perform hourly rapid environmental assessment (REA) nowcasts and forecasts (36 to 48 hr) of atmospheric and tactical impact variables using data available on-scene. Develop automated data quality control methods and user-friendly interfaces to allow a non-expert to control the system. Incorporate algorithms into the system to compute atmospheric tactical impact variables, and develop interfaces for decision aid connectivity.

APPROACH

Use the atmospheric component of the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS), including the multivariate optimum interpolation (MVOI) and complex quality control (QC) software, as the framework for TAMS/RT. Develop algorithms to automatically use the MVOI to analyze all available data on an hourly basis using the organic COAMPS forecasts as the background fields. Modify existing data processing algorithms to incorporate satellite-derived cloud-drift and water vapor-tracked wind vectors into TAMS/RT for use in the MVOI analysis. (Pedro Tsai (NRL), Larry Phegley (NRL), Dr. Jerry Schmidt (NRL), Mike Frost (A&T), Linda Frost (CSC), and Mugur Georgescu (CSC) performers.)

Link the TAMS/RT COAMPS output to METOC decision aids. Use the capability to conduct case studies and support experiments and exercises with forecasts of the propagation environment. (John Cook (NRL), Prof. Chuck Wash (NPS), Mary Jordan (NPS), John Kent (SAIC), Ron Englebretson (SAIC), and Glenn Handlers (SAIC) performers.)

Develop a “warm start” capability for COAMPS to begin the local data assimilation cycle from COAMPS forecast fields produced by TAMS/RT locally or transmitted from another site. Enhance the user feedback from the system by developing algorithms to estimate the COAMPS run time and provide a running status of COAMPS in a separate window. (Pedro Tsai (NRL), Rob Wade (SAIC), and Lari Nell Migues (NSI) performers.)

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WORK COMPLETED

COAMPS was used as the framework in developing the TAMS/RT system. TAMS/RT consists of three networked computer systems: a COAMPS computational server, a Tactical Environmental Data System (TEDS) server, and a workstation that runs the user interface and includes a dedicated web server. TAMS/RT has been running on a routine basis daily at NRL Monterey and has been installed operationally at the Navy Pacific METOC Facility (NPMOF), San Diego, with additional support from SPAWAR PMW 185 (PE 0603207N X0513-05). The purpose of the system at NPMOF is to provide end-state user feedback with respect to the usefulness, ease of use, quality, and robustness of the system. Examples of areas where detailed COAMPS forecasts have been provided include Bosnia, several areas along the California coast, Antarctic, Pacific Northwest, Hawaii (operational support for the RIMPAC 98 fleet exercise), and several tropical storms. The COAMPS products have been made available on the web server in real time.

The Graphical User Interface (GUI) developed to run the system has been enhanced based on the comments from NPMOF San Diego. In coordination with NPMOF and a NRL visualization project (N0001498WX400008 NRL BE-35-2-21), a set of graphical products have been developed that include diagnostic comparisons of forecasts with observations and satellite imagery. Automated techniques have also been developed to link COAMPS output with the Radio Physical Optics (RPO) electromagnetic propagation model, however, they have yet to be fully implemented into the operational system. Work on the interface to the Advanced Refractive Effects Prediction System (AREPS) is ongoing.

In coordination with the Naval Postgraduate School (NPS), the unique aircraft data set collected by the British Meteorological Research Flight (MRF) during SHAREM 110 was compared to COAMPS forecasts and ship soundings. The data were used to study the evolution of three mesoscale events. The Microwave Propagation Measurement Experiment conducted by the Naval Surface Warfare Center (NSWC), Dahlgren Division, at Wallops Is. was supported with real-time high-resolution COAMPS forecasts during March 1998. Refractivity, temperature, and humidity profiles along the experimental propagation path were extracted from the COAMPS forecast fields. Both the graphical products and data files in RPO input format were provided to the experimenters 24 hr in advance via a custom web page (http://www.nrlmry.navy.mil/wallops-bin/wall_home). Several mesoscale effects on the propagation environment were identified.

RESULTS

TAMS/RT provides an unprecedented capability to run and maintain a sophisticated atmospheric data analysis and forecast system on-scene. The experience running a prolonged real-time demonstration at NPMOF, San Diego has led to several improvements by simplifying the GUI, providing better feedback on the status of COAMPS runs, and allowing more flexibility by initializing the model with either global or mesoscale fields. The ability to run the MVOI with local satellite-derived wind data provides a true organic REA nowcasting capability allowing forward-deployed forces to automatically maintain a database of the current environmental conditions updated hourly. In coordination with the 6.4 SPAWAR PMW 185 project PE 0603207N X1752-01, the TEDS database has well defined application programmer interfaces (APIs) that have been used to provide data for the Vapor Liquid Solid Tracking

(VLSTrack) NBC hazard model, Electro-Optical TDA (Windows EOTDA), AREPS, and Stoplight Hazard Display aid.

Results from COAMPS simulations and analysis of MRF data showed the temporal and spatial evolution of the boundary layer during prefrontal, postfrontal, and deep mixed layer periods in the Arabian Gulf. The impressive COAMPS predictions resolved the important vertical and horizontal structures affecting electromagnetic propagation. The Microwave Propagation Measurement Experiment, Wallops Is. demonstrated the feasibility of automatically providing input files of the forecast propagation environment for the RPO model. The majority of the experimental period was dominated by moderate to strong low level flow from an over ocean trajectory, resulting in near normal propagation conditions. COAMPS correctly forecast the transition late in the period to a southwesterly flow pattern that resulted in several instances of subrefractive propagation conditions due to overrunning in the vicinity of warm fronts.

IMPACT/APPLICATIONS

The success of COAMPS in the on-scene environment is significant and has been recognized by CAPT David G. Markham as "… a monumental achievement that will undoubtedly have a far reaching impact on our future METOC CONOPS." The ability of COAMPS to resolve mesoscale features influenced by complex terrain, and the interface of the simulation data to decision aids, will be of great value to the Navy by improving the safety of operations and enhancing the ability of forward-deployed forces to exploit the environment for tactical advantage.

TRANSITIONS

TAMS/RT was selected by the ONR 1997 Technologies for Rapid Response (Blue Book) for implementation at the Naval Central Meteorology and Oceanography Facility, Bahrain. Progress on the implementation is described in the ONR Annual Report for award number N0001498WX40077. TAMS/RT also transitions to an existing 6.4 program (PE 0603207N X0513-05): the On-Scene Tactical Atmospheric Forecast Capability (STAFC), a component of the Navy Integrated Tactical Environmental Subsystem (NITES I).

RELATED PROJECTS

Related 6.2 projects within PE 0602435N are award numbers N0001498WX30165 (COAMPS improvements for on-scene modeling), N0001498WX30166 (development of radar data assimilation techniques), and N0001498WX400008 which encompasses the following NRL base projects: BE-35-2-18 (mesoscale model development), BE-35-2-19 (data assimilation technique development), BE-35-2-20 (aerosol modeling), BE-35-2-21 (visualization), BE-35-2-26 (satellite remote sensing methods), and BE-35-2-44 (moisture parameterization). The related 6.4 projects under PE 0603207N are X0513-05 (STAFC) and X1752-01 (TEDS).

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