COAMPS User Support

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Award Number: N0001414WX20606

LONG-TERM GOALS

The long-term goal of this project is to continue to provide support (e.g., consultation, code updates, training, data transfer, etc.) for those users who obtain the Coupled Ocean/Atmosphere Mesoscale Prediction System (COAMPS®\textsuperscript{1}) through the release of the code as determined by release guidelines. The active distribution of COAMPS to the general scientific community cannot be accomplished without strong support from NRL-Monterey. To fully realize the development potential of the COAMPS system, the Navy must leverage research being performed in the community at large. Through increased usage of COAMPS by the broader community, NRL has been able to leverage discoveries, leading to advances in COAMPS capabilities, including model physics, numerical methods, and coupled modeling.

OBJECTIVES

One of the primary objectives of this project is to develop and improve our comprehensive technical support capability for the COAMPS users, particularly those who have projects supported by ONR. Components in the support structure include, but are not limited to: providing guidance on model code structure and result interpretation, improving/updating to the COAMPS web site, updating versions of the code as necessary, updating the COAMPS documentation, providing user feedback to COAMPS developers, providing users with tools to obtain NOGAPS/NAVGEM data for COAMPS initial and boundary conditions, observations data (both atmospheric and ocean) for historical cases, and maintaining/updating all of the supporting databases.

APPROACH

We have been providing support and consultation services to users through email communications. We have also held tele-cons with those users who need to have more in-depth knowledge about the COAMPS system. At the same time we have gained new insights and improved COAMPS capability through our collaboration with external users. One example is the new appreciation of the significant impact of terrain interpolation methods on TC track forecasts when we performed detailed comparison of the COAMPS-TC results by NRL and by Dr. Ming Xue’s group at the University of Oklahoma (OU). The pre-season testing for the 2014 TC season pointed to improved track forecasts when using the appropriate terrain interpolation method. New development and updates to the COAMPS code

\textsuperscript{1} COAMPS is a registered trademark of the Naval Research Laboratory.
have been achieved by working closely with external collaborators (see examples in the results section).

WORK COMPLETED

The following work was completed in FY14 (milestones are italicized):

1. Periodically update the COAMPS system (new capabilities, improvements)

A more recent version of COAMPS-TC has been released to users with Educational Partner Agreements (OU, University of Rhode Island (URI), and the Pennsylvania State University). We spent considerable time providing in-depth consultation to users, especially those with ONR funded projects. Bug fixes have been provided to the URI group to facilitate their idealized TC simulations.

2. Provide detailed guidance about model performance and result interpretation

We have established close collaboration with external users by sharing our knowledge and expertise. A prototype interface between COAMPS and a hurricane boundary layer roll module was provided to the URI group. We provided detailed advice to the Penn State group when they designed their EnKF radar data assimilation system for COAMPS-TC. Our timely help enable our collaborators to quickly move forward with their ONR sponsored research.

3. Facilitate transferring of new code/systems/insights obtained by external collaborators to NRL.

A more consistent formulation converting GFS moisture fields for COAMPS to use at cold temperatures have obtained through our collaboration with the OU group. Also, a more appropriate terrain interpolation method has been established based on our collaboration with the OU group. We have obtained an updated version of the Community Radiative Transfer Model (CRTM) from the Colorado State University (CSU). The land-emissivity code and database enable us to use the CRTM for cloud verification over land. We now have an initial version of COAMPS-TC that includes the hurricane boundary layer roll module developed at URI. A new method to accurate determine the TC center location has been developed through our collaboration with Dr. Qin Xu of NOAA and the system has been provided NRL for further testing.

4. Continue to develop and improve COAMPS functional interoperability with the WRF physics parameterization suite. Continue to work as a liaison between the COAMPS developers, the scientific community at large, and the DTC.

Leveraging efforts under the HFIP and COAMPS 6.4 projects, we continue to improve COAMPS functional interoperability with physics in other models (e.g., WRF, HWRF). The YSU PBL scheme and the Thompson microphysics have been updated to be consistent with WRFV3.5. The HWRF initialization package has been modified for COAMPS use although further testing is still underway. These new capabilities enable us to better understand the physical processes and provide additional reference points for COAMPS performance evaluation.
RESULTS

We worked closely with the OU group to set up COAMPS-TC at their computer platform. One of interesting tests they performed is to construct a single nest with very high resolution (4-km) over the Northwest Pacific basin. The track forecasts are significantly improved for the two typhoons of 2013 (Fig.1). We performed similar testing and our further analysis indicate that the high-resolution single nest helps to resolve TC inner-core dynamics, the synoptic environment, the interaction between adjacent storms, and interactions between TC and its environment. Also from the collaboration with the OU group, we gained further appreciation of the impact of the terrain on TC track forecasts. A series of terrain interpolation techniques were examined during our pre-season testing and the best option has been adopted for the COAMPS-TC real-time forecasts.

Fig. 1. (a) COAMPS simulated track of Typhoon Fitow (2013) using a single nest of 4-km grid spacing (blue dashes) compared with the COAMPS forecast track using 3 nested domains with 36km, 12km, and 4km grid spacing, respectively (green dashes) and the best track (red dashes); (b) as in (a), except for Typhoon Usagi (2013). (Courtesy of M. Xue and J. Dong, OU)

Fig. 2. (a) COAMPS simulated Typhoon Fitow (2003) surface wind speed (m s$^{-1}$, shaded) and wind vectors (at 48h) superimposed with selected points whose winds and temperature profiles are used to drive the hurricane boundary layer module; (b) the boundary layer rolls simulated the two dimensional boundary layer module. (Courtesy I. Ginis and K. Gao, URI)
We provided detailed guidance and prototype code during the URI’s effort to incorporate the hurricane boundary layer roll module into COAMPS-TC. We performed a series of sensitivity tests to examine impacts from model physics, domain sizes, lateral boundary conditions, and time steps on idealized TC simulations. In return, the implementation of the boundary layer roll module in COAMPS-TC has been progressing steadily. Fig.2 demonstrates the new capability of COAMPS-TC to use the module to capture boundary layer rolls under hurricane winds.

A successful COAMPS-TC simulation of Typhoon Nuri (2008) has been performed to provide model data for detailed dynamic/thermodynamic analysis by Dr. Montgomery’s group at the Naval Postgraduate School. We also provided COAMPS data to Dr. Qin Xu (NOAA) and collaborated with him on a published study on accurately finding a storm center based on dynamic constraints (Xu et al. 2014) rather than the empirical methods currently employed by operational centers. The source code has been fed back to NRL for further testing. Thus, we are engaging in advanced research in the research community and harvesting new capabilities at the same time.

IMPACT/APPLICATIONS

Several long term benefits from this project can be identified: 1) improved opportunities for the next generation of atmospheric researchers to contribute to COAMPS development, 2) increased awareness and visibility of COAMPS in the broader scientific community, and 3) accrued credit to NRL and the Navy from academic research performed using COAMPS.

RELATED PROJECTS

This project is closely coordinated with the HFIP and COAMPS 6.4 projects.

PUBLICATIONS