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COAMPS User Support

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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®[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 harvest emerging science and technology in the research community. 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. Another objective of this effort is to incorporate new developments in the research community into COAMPS through our close collaboration with scientists, especially those with ONR projects. 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-conferences 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 close collaboration with external users. One example is the new module for hurricane boundary layer rolls that has been developed at University of Rhode Island (URI). We worked closely with the URI group and shared with them our significant insights about COAMPS

[1] COAMPS is the registered trademark of the Naval Research Laboratory.

boundary layer schemes. Other new development and updates to the COAMPS code have also been achieved by working closely with external collaborators (see examples in the results section).

WORK COMPLETED

The following work was completed in FY15 (milestones are italicized):

1. Released more recent versions of COAMPS-TC to tier-1 users; Updated the COAMPS support website with improved security and new features

More recent versions of COAMPS-TC have been released to users with Educational Partner Agreement (e.g., University of Hawaii). The COAMPS support website has been improved with enhanced security and successfully passed NRL security inspection. We have been updating, maintain, and monitoring COAMPS web servers and dynamic web pages for reliable support for both NRL and external users. For example, the COAMPS and NAVDAS subversion source code repositories have been archived safely and reliably. Our regular backup has enabled a timely recovery of the source codes during platform transition or system upgrade.

2. Provide detailed guidance about model performance and result interpretation

We have established close collaboration with external users by sharing our knowledge and expertise. We have been actively engaged in discussions with the URI group when evaluating COAMPS performance with the hurricane boundary layer roll module. We continued to provide detailed advice to the Penn State group for their EnKF radar data assimilation experiments for COAMPS-TC. We stayed in frequent contact with COAMPS users through emails (432 emails in 2015). 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.

We continue to make substantial progress in leveraging new developments in the research community. We supported the implementation and testing in COAMPS-TC of multi-moment microphysical schemes by the OU group and have obtained that version of the model. We updated the CRTM by working with scientists from CIRA/NOAA and now have the capability to generate synthetic satellite imagery for polar orbiting satellites. This will serve as a new verification tool for our Arctic forecasts. We continue to work with the URI group to study the impact of hurricane boundary layer rolls on hurricane intensity change.

4. Continue to work as a liaison between the COAMPS developers, the scientific community at large, and the DTC.

We shared our experience assessing impact of the ECMWF Tiedtke cumulus scheme in COAMPS with NRL colleagues when it was being tested in NEPTUNE. We have obtained the software package from NCEP for TC initialization in HWRF. These new capabilities enable us to better understand the physical processes and provide additional reference points for COAMPS performance evaluation.

RESULTS

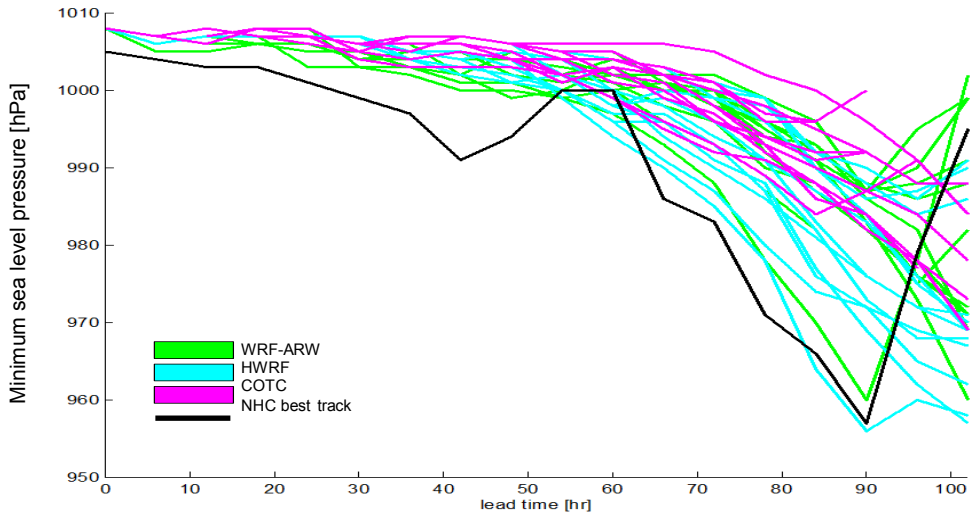

Fig. 1. Minimum sea level pressure analysis and forecast for each model core initialized every 6 hours from the SU-EnKF cycling data assimilation system from 18 UTC 13 September to 12 UT 16 September. (Courtesy of Zhang and Melhauser, PSU

We continued to provide key guidance in PSU's effort incorporating COAMPS-TC in their multi-model EnKF system for TC application (along with other TC models: HWRF, and WRF-ARW). In that pseudo-operational implementation all models use identical initial and boundary conditions to facilitate detailed model comparison. The insights we shared with PSU enabled them to significantly expedite this effort. Ongoing collaboration focuses on diagnosis of the different behavior among models – an additional reference point for COAMPS-TC**.** Fig. 1 shows the predictability study underway for Hurricane Karl (2010).

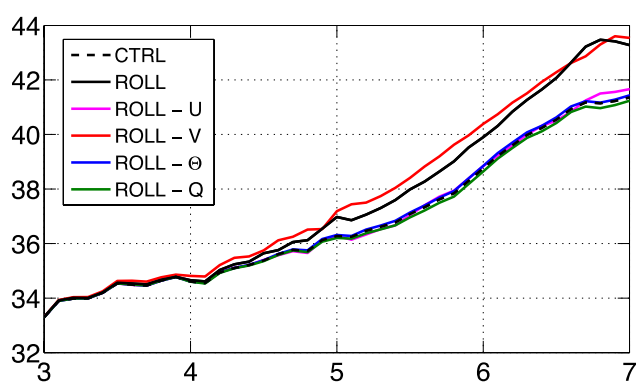

Fig. 2. (a) Time series of the maximum azimuthally-averaged tangential wind at z = 5 km from COAMPS-TC simulations with different contributions from the embedded TC boundary layer roll model: ROLL- full roll-induced impact included; ROLL-U: only the roll-induced radial momentum flux included; ROLL-V: only the roll-induced tangential momentum flux included; ROLL-Θ: only the roll-induced potential temperature flux included; ROLL-Q: Only the roll-induced water vapor mixing ratio flux included. (Gao, et al. 2015)

Our close collaboration with the URI group has been fruitful. We have obtained a version that has the hurricane boundary layer roll module implemented. At the same time, new insights have been obtained from examination of the impact of those rolls on TC intensification. Fig.2 demonstrated differences seen in the COAMPS-TC simulated TC intensity associated with roll-induced impacts in an idealized axisymmetric tropical cyclone.

IMPACT/APPLICATIONS

Several long term benefits from this project can be identified: 1) improving opportunities for the next generation of atmospheric researchers to contribute to COAMPS development, 2) leveraging new capabilities from the broader research community to be incorporated into the COAMPS system, and 3) increasing awareness and visibility of COAMPS in the broader scientific community.

RELATED PROJECTS

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

PUBLICATIONS

- Xu, Q., L. Wei, Y. Jin**,** Q. Zhao, and J. Cao, 2015: A Dynamically Constrained Method for Determining the Vortex Centers of Tropical Cyclones Predicted by High-Resolution Models. *J. Atmos. Sci.*, **72**, 88–103.
- Gao, K. I. Ginis, J.D. Doyle, and Y. Jin: Effects of boundary layer roll vortices on the development of the axisymmetric tropical cyclone. To be submitted to *MWR*.