NOAA HURRICANE FORECAST IMPROVEMENT PROJECT

Bi-Weekly Teleconference Summary

The first HFIP–Biweekly teleconference in June 2017 was held 2:00 PM – 3:00 PM ET Wednesday June 14th online from the NWS Headquarters OSTI, Silver Spring, MD. Following roll call (see back for list of participants), Shane Forsythe-Newell (HFIP/PO) welcomed everyone onboard then along with Gopalakrishnan Sundararaman (HRD/HWRF) shared opening remarks noting the purpose of the meeting is to develop contingency plans for the upcoming RT Demo this 2017 hurricane season and to collect input from Team Leads on their HFIP-funded projects. Major highlights of the meeting were the following potential issues for the 2017 hurricane season:

- **Jet Allocations (Project Que):** Last year HYCOM was unable to run in real time (RT) so unallocated computational resources and windfalls were used. Recommended mitigation of risk for 2017 was decided to have Timothy P. Brown (RDHPCS) and Eric Schnepp (RDHPCS) address this possible issue at the next HFIP-Biweekly teleconference (Wed., 6/28/2017) during the first 15 minutes following the meeting's roll-call.
- **Bandwidth:** NEMSIO files sizes were noted to be larger (about twice the size of other files) and Zhan Zhang believes the bandwidth was increased. This was recommended to be verified by Tim Brown/Forrest Hobbs/Eric Schnepp (RDHPCS) at our next HFIP-Biweekly Telecon.
- **Basin-scale HWRF "h217" Code:** Although the h217 code is available on the branch, it may not be available in time for the 2017 RT Demonstration due to version problems. It was emphasized that the HFIP Program Office needs to be aware that h217 is not backwards compatible and one month's time is not long enough to make h217 work including tests. This issue to be brought to the attention of the HFIP Program Office.
- **DTC Coordination:** There is a perceived need to coordinate data beyond the Automated Tropical Cyclone Forecasting System (ATCF) for website display as DTC plans to make results of all RT DEMO available on the website. Paula McCaslin (GSD) has reached out for new products to FSU, NRL, & the Univ. of Albany, NY.

First item of business was eliciting input from applicants supporting the RT DEMO Model runs for this hurricane season:

1. **ADCIRC Storm Surge (rtsurge):** PI: Ed Myers, Technical Leads: Yuji Funakoshi and Sergey Vinogradov. This real-time experiment is to produce output to test experimental storm surge forecast guidance for future use by NCEP.

2. **Utah HFIP DA (rthfip-utah):** PI: Zhaoxia Pu. Technical Lead: Shixuan Zhang. This real-time experiment involves vortex hybrid data assimilation and could result in R2O transition that provides critical hurricane forecasts which could be used to issue real-time warnings and evacuation orders.

3. **HWRFv3 (rthurrun):** PI: Avichal Mehra. Technical Leads: Bin Liu and **Zhan "Zack" Zhang**. This real-time experiment investigates the impact of 3-way (air-sea-wave) coupling on improving hurricane track and intensity forecasts. This is a 2-phased parallel experiment that will compare two 3-way coupling forecasts (HWRF-POM-WW3 and HWRF-HYCOM-WW3). While Bin Liu was not present in today's meeting he did note in correspondence with Shane the 3-way coupled HWRF-POM-WW3 experiment currently on x-jet should be ready for testing with reserved computational resources now. It was noted that 2-km resolution (res.) vs. 3-km res. requires more

computational resources. If 2-km res. is used then current computational resources may not be able to handle even one storm. If 3-km res. is used by HWRFv3 then two storms should be able to be handled simultaneously.

NOTE: It was suggested that more computational resources should be given to HWRFv3 so that 2-km res. RT experiments can be performed. It was added that a possible reduction in computation resource usage may be accomplished by tying the perturbations to the EnKF on HWRF. The original coupler is currently linked only to one storm but in the basin-scale coupling has multiple storms linked capability. The work-around plan for this limitation was described as to only couple the outer domain to take into account the ocean impact to storms as the modular storm coupler is not available yet. The modular coupler should be ready for testing in July. Inner domain coupling is sequential and would slow down performance too much so outer-domain coupling will be conducted for this hurricane season.

Xuejin stated HWRFv3 is running 18-6-2 res. using the old GFS as they do not have the new (FY17) GFS. Currently there is no new GFS on Jet. It is hoped that the new GFS/NEMSIO problem will be solved before hurricane season begins. It was added that the new GFS/NEMSIO is a problem that should be backwards compatible and be solved by the EMC and/or DTC. It was noted that the HFIP Project Office should be aware of this contingency/issue and there should be a Plan-B ready to implement, if needed. The RT systems are dependent upon data flow and access to data otherwise the purpose of conducting the RT Demo comes into question. In terms of Plan-B only NEMSIO is dependent upon GSI/ If GSI is turned off then everything else is good using 2 files. Only GSI depends upon the NEMSIO input. However, it was noted that if GSI is turned off the impacts are unknown to storm forecasts. Frank Marks interjected this problem has existed since the RT idea was setup. Xuejin added that the GSI access to the NEMSIO format of GFS data should already be available now. Even if the new GSI is implemented by July 19th, this is not a realistic option for any developer as systems have to be tested and modified, as needed. NEMSIO data file sizes are double that of the spectral files which could be an issue for the RT Demo this year. Gopal brought up the past problem of bandwidth. Zack responded that he thought the bandwidth had been increased (Tim Brown was not in attendance due to a prior conflict to verify any increase in bandwidth).

4. **HWRF Ensemble (rthwrfv3 or rthwrf-ens):** PI: **Vijay Tallapragada**. Technical Leads: **Zhan "Zack" Zhang** and **Weiguo Wang**. This real-time 20-member HWRF Ensemble Prediction System (**HWRF-EPS**) experiment will test various HWRF physics sensitivities and provide track/intensity probability distribution function (PDF). This experiment will track uncertainty-based initial position, intensity perturbations, and stochastic C_d perturbations.

5. **HWRF-B (fthr-aoml or rtbasin-hwrf):** PI: Xuejin Zhang. Technical Leads: Ghassan Alaka and Russel St. Fleur. This real-time basin-scale HWRF experiment is configured with ocean coupling and interaction of multiple TCs which may serve to provide an alternative to the operational HWRF system. Xuejin noted that he plans to merge the entire h217 HWRF to the DTC trunk by the end of this month so everyone else can use it. However, it was noted that he does not have the h217 version yet and that they are currently using the h216 version. The new h217 version should be available July 1st. *Xuejin noted that they do not have much time to develop their own system so they must use the same version as EMC. Xuejin stated they would likely use h216 and whatever GSI requires.* It was further noted that h217 is not backwards compatible and one month's time is not long enough to make h217 work including tests. It was emphasized that the HFIP Program Office needs to be aware of this issue.

6. **Basin-scale HWRF-DA and Ensemble (rthwrf-ben**): PI's: **Xuejin Zhang** and **Jason Sippel**. Technical Leads: Jonathan Poterjoy and Xuejin Zhang. This real-time experiment will employ outer-domain DA. This is a hybrid GSI ensemble using 80 members for an initial analysis. This system will require a lot of GSI data to transfer to Jet. So there are two plans 18-km and 9-km options to use in dealing with any potential bandwidth issues.

7. **Multimodel Super Ensemble (rthfip-mmse):** PI and Technical Lead: **Tiuvalm Krishnamurti**. This real-time experiment makes use of the multi-model super-ensemble approach with a neural network algorithm for improved intensity forecasts,

8. **HFIP-WISC (rthfip-wisc):** PI and Technical Lead: **William Lewis**. This real-time experiment produces TC forecasts and energetics diagnostics made available to the TC community in real-time. A primary focus is dealing with diagnostics associated with TC outflow. Lewis is interested in running diagnostics on HWRF this year, if possible.

9. **HWRF Analog Ensemble (rthwrf-anen):** PI: **Christopher Rozoff**. Technical Lead: **William E. Lewis**. This real-time experiment tests in real-time a computationally inexpensive product for future operational use. It may refine workflow to be efficient in its communication with the RT HWRF model and be portable to other operational high-performance computing system if approved for operations. Currently processing h217 data runs and should be done within the next 3-weeks.

10. **3-km Nested FV3-GFS (rthfv3gfs):** PI: Shian-Jiann Lin. Technical leads: **Matt Morin** and **Lucas Harris.** This real-time experiment running on x-jet for the Atlantic Ocean will be primarily shared with HRD and GFDL scientists and will be used for inclusion in HRD map discussions and comparisons with basin-scale HWRF in real-time. Running this experiment in real-time is anticipated to aid ins determining if the microphysics package is yielding realistic features, which HRD as experience with. 6-hr interpolation will not be setup in time (requires double the cores) but 12-hr interpolation will be ready for the 2017 RT Demo experiments. We will be using the Vortex tracker that will provide extended ATCF data. Current GFS version and spectral files are downloaded.

11. **HMON 3-km Ensemble (rthmon-ens):** PI: **Avichal Mehra**. Technical Leads: **Weiguo Wang** and **Lin Zhu**. This real-time 10-member coupled with HYCOM HMON Ensemble Prediction System (**HMON-EPS**) experiment is planned to replace GFDL Ensemble products this upcoming July. HMON-EPS will test various HWRF physics sensitivities and provide track/intensity probability distribution function (PDF). This experiment will track uncertainty-based initial position, and intensity perturbations. System is currently being tested on WCOS vs Jet as there are some coding issues on Jet and this will be moved later to Jet.

12. **HWRF-HYCOM (rthwrf-hyc):** PI: **Avichal Mehra**. Technical Leads: **Hyun-Sook Kim** and **Dan Iredell**. This real-time experiment is planned to use h217 and new versions of HYCOM and WW3 for the 2017 hurricane season. In the past forecasts from this system were influenced by El Nino/ENSO in the Eastern North Pacific basin, and HYCOM coupled to HWRF proved the impact of more realistic representation of ocean initial conditions and improved simulations. An example of improved simulations follows: Wind stress is modified by wave stress from WW3 before being passed to the ocean model. The ocean model passes not only seas surface temperature (SST) but also the sea surface currents to the atmospheric model. The SST can be modified by model interactions with waves by including *Coriolis-Stoke* forcing and *Langumir* turbulence. The main upgrade for the ocean component is higher vertical resolution in the upper layer (similar to 2017 upgrade global RTOFS HYCOM), and non-linear interactions with waves. The purpose of the test is to evaluate forecast

performance of 3-way coupling HWRF-HYCOM-WW3, and to investigate the impact of the non-linear interactions with waves.

Action Items:

- □ Schedule Timothy P. Brown to talk about the RT effort (Jet allocations and bandwidth) at the HFIP Teleconference (Shane working with RDHPCS)
- □ Inform the Program manager (STI Modeling Division/HFIP) that the h217 code for Basin-scale HWRF is not backwards compatible and one month's time may not be adequate to make h217 work including tests in time for the 2017 RT DEMO. Try to resolve backwards compatibility of the new GFS/NEMSIO and if needed, help to determine a fall back "Plan-B" option in case the GFS/NEMSIO problem cannot be resolved in time for the RT DEMO. (The RT systems are dependent upon data flow and access to data otherwise the purpose of conducting the RT Demo comes into question). (Shane work with the PM, STI Modeling Division, EMC and DTC to help try to resolve)
- □ Coordinate RT DEMO data with the DTC (Sheema working with Paula McCaslin, GSD)

Next Meeting time – Wednesday, 28 June 2017:

- Shane to send out a reminder. RT Jet Allocations discussion (2:00-2:15 PM ET) following roll-call. The scheduled speaker is Hua Chen who will be presenting immediately following the RT Jet Allocations discussion. Hua Chen will present on the topic of "*Azimuthal distribution of deep convection, environmental factors & TC RI. A perspective from HWRF ensemble forecasts of Hurricane Edouard (2014)*" (2:15-2:45 PM ET) followed by a 10-15 minute questions and answers (Q&A) session.

Participants:

Andrew Penny, Chanh Kieu, Daniel Melendez, Edward Mifflin, Francise Fendell, Frank Marks, Gopal Sundararaman, Hyun-Sook Kim, James Franklin, Jason Sippel, Jon Moskaitis, Kate Musgrove, Morris Bender, Nysheema Lett, Ryan Torn, Shane Forsythe-Newell, Tirthankar Ghosh, Tim Marchok, William Lewis, Xu Lu, Xuejin Zhang and Zhan Zhang