Development of Atmosphere-Ocean-Land Fully Coupled Basin-scale HWRF System

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Collaborators:

HRD, EMC, URI, DTC, and NHC

Objectives

- Develop a basin-scale HWRF system capable of forecasting multiple TCs concurrently (if there exist) to mimic the real evolution of weather systems
- Advance model capabilities to address one of three HFIP goals: 7-day forecast (genesis) without compromising the current operational HWRF forecast ability
- Provide a full forecast system that is applicable to operational transition with minimum implementation cost

Development Approaches

- Adopt full capabilities of current operational HWRF
  - Ocean coupling
  - Land coupling
  - Hybrid one-way DA
  - Vortex initialization
  - Hurricane-oriented physics schemes
  - Advanced nest moving algorithm
  - Workflow management
  - Code management
  - Product suite
- Advance capabilities in basin-scale HWRF
  - Concurrent forecasts of multiple TCs
  - Concurrent initialization of multiple TCs
  - Concurrent initialization of multiple ocean basins (with or without TC)
  - Concurrent coupling of multiple ocean basins and multiple TCs
  - Full basin-scale domain product suite

	2015 Operational HWRF	2013 Basin-scale HWRF	2015 Basin-scale HWRF
Domain	18 KM: 77.58˚ × 77.58˚ 6 KM: 12.66˚ × 12.18˚ 2 KM: 7.90˚ × 7.06˚	27 KM: 178.20˚ ×77.58˚ 9 KM: 10.56˚ × 10.2˚ 3 KM: 6.12˚ × 5.42˚	27 KM: 178.20˚ × 77.58˚ 9 KM: 12.66˚ × 12.18˚§ 3 KM: 7.90˚ × 7.06˚
Model top	2 hPa	2 hPa	2 hPa
Vertical levels	61	61	61
Vortex initialization	Vortex Initialization at 2 km	Vortex Initialization at 3 km	Vortex Initialization at 3 km
Data assimilation	Hybrid DA + HWRF ensemble DA for TDR	No GSI DA	Hybrid DA¶
Cycling	Storm component cycling within 30˚×30˚ analysis domain	Storm component cycling within 30˚×30˚ analysis domain	Storm component cycling within 30˚×30˚ analysis domain
Ocean coupling	18-6 KM: Yes 2 KM: Downscaled	No coupling	27-9 KM: Yes 3 KM: Downscaled
Physics Scheme			
Microphysics	Modified Ferrier-Aligo (High Resolution)	Modified Ferrier (High Resolution)	Modified Ferrier-Aligo (High Resolution)
Radiation	RRTMG(SW,LW)	GFDL	RRTMG (SW,LW)
Surface	GFDL	GFDL	GFDL
PBL	2015 GFS	2013 GFS	2015 GFS
Convection	SAS, No CP (2 KM), Shallow Convection	SAS, No CP (3 KM), Shallow Convection	SAS, No CP (3 KM), Shallow Convection
Land surface	NOAH LSM	GFDL Slab	NOAH LSM

§ : The domain size may be changed in order to obtain better scalability

¶: May explore the independent basin-domain DA if satellite project get funded, not priority before HFIP demo season

Model Configuration

Test and Evaluation Approaches

- Real-time system and experimental products
- Retrospective and real-time forecasts
- Forecast verifications (late and early model forecasts)
- Scientific assessments and findings
- Improvement plan for next season and potential operational transition