Parameterization of Diabatic Processes in FIM: Implementation, Evaluation and Improvement

J. - W. Bao, G. A. Grell, J. M. Brown, M. Fiorino, S. Benjamin, and J. Lee

NOAA – Earth System Research Laboratory

Motivation

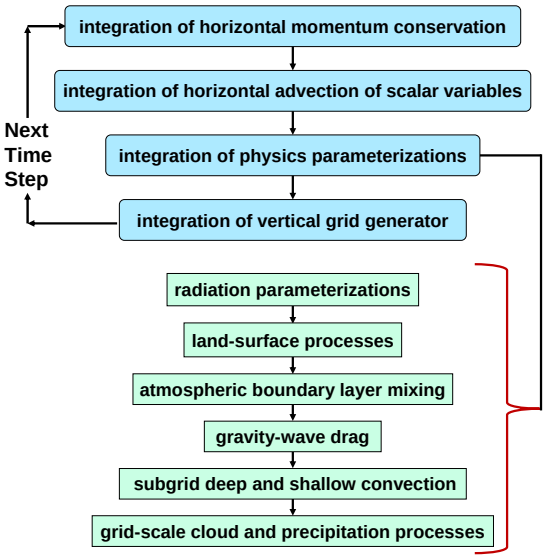
There is a need for a state-of-the-art numerical weather prediction (NWP) model that is skillful in both weather and climate forecasts, as well as capable of simulating physical mechanisms of weather-climate connections. Such a model is necessary in order to effectively and sufficiently accomplish NOAA's mission under the auspices of NOAA's short- and long-term plans: "To understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs".

Path of Implementation

Past: simple diabatic physics
Current: the GFS physics
Future: modified WRF physics for FIM's isentropic coordinate and stochastic physics

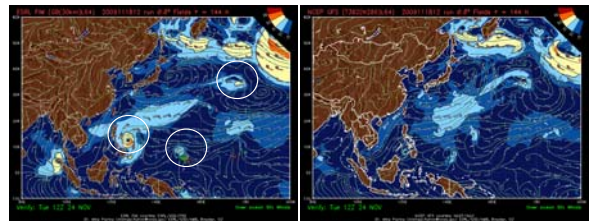
Development Focus

Testing various methods of coupling the time integration of the resolvable dynamic core with the parameterized physics processes to decide on a smooth coupling in FIM.

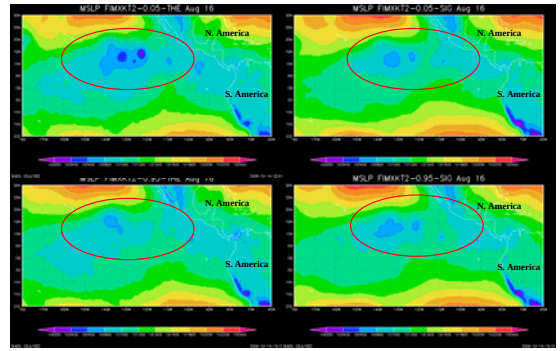


Investigative Evaluation

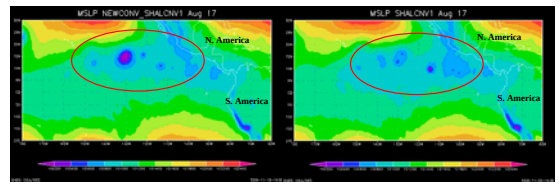
Examples of the Sensitivity of the FIM Forecasted Tropical Activities to Precipitation Physics Parameterizations



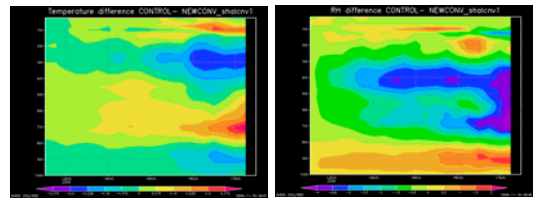
Surface Winds: FIM forecast (left) shows stronger vortical activity in the tropics than the GFS forecast (right)



FIM forecast of the mean sea-level pressure showing the sensitivity to random selection of cloud top



FIM forecast of the mean sea-level pressure showing the sensitivity to variation of the parameterized deep convection

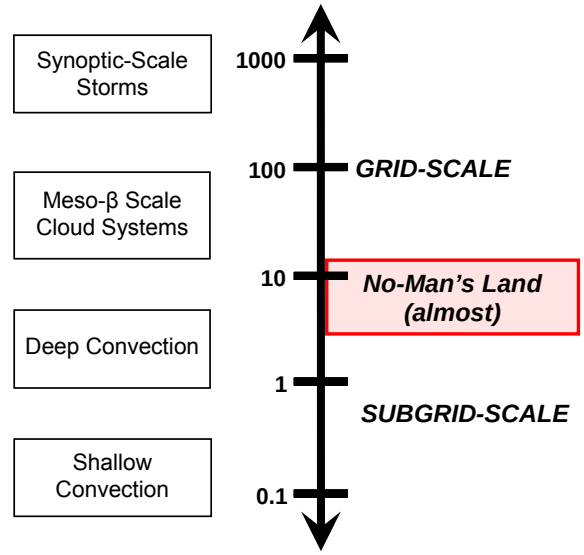


FIM forecast of the time-height cross sections of temperature (left) and relative humidity (right) differences made by the variation of the parameterized deep convection averaged over the area of the above maps.

Research Challenges

- Are physics parameterizations tuned within an Eulerian representation of model dynamics general enough to be used in the semi-Largangian representation?
- What is the fundamental strategy to develop stochastic physics schemes to properly account for sub-gird flow motion and diabatic processes?
- Is it possible to develop a suite of physics parameterizations that are suitable for all the scales (from ~1km to ~100 km) that can be resolved by FIM/NIM?

Grid Spacing in Log(km)



Ongoing Activities

Intense research activities are being conducted at ESRL to take on challenging issues in accurately representing diabatic processes in FIM. Such activities will greatly contribute to the ESRL-wide effort to develop a seamless earth system modeling system. This type of modeling system is required to meet the research and operational requirement for reducing the uncertainties associated with weather and water forecasts and for understanding and predicting climate variability and change.