Stream 2 Science Issues

Jeff Whitaker and Fuqing Zhang

What we've learned from 2009 Demo

- EnKF with high-res models can improve forecasts, especially ensembles, both global and regional models
- But, there are problems:
  - Initial vortex undergoes adjustment (tends to decay).
  - Can't use inner core obs very well (at least in global models).
  - Forecasts of storms in highly-sheared Atlantic this year were not very good.
  - Some models generate lots of spurious storms, esp. in E. Pacific.
  - Rapid intensification was hit or miss.
- For regional models, cloud-permitting ensemble analysis and/or forecasting assimilating inner-core obs show promise, but high-res alone clearly is not enough.

What needs work

- Models (i.e parameterizations)
  - Better diagnostics, tying together modeling, data assimilation and obs. diagnostic efforts to evaluate models.
  - What limits skill? (examine the reasons for the success and failure of the past experiments)
- Representation of model error in ensembles (especially important in tropics).
  - Stochastic physics?
  - Multi-model ensembles?
- How to deal with “representativeness” issues for obs within hurricane (and non-gaussian observation errors).
- Regional and global EnKF systems should be tightly integrated.
- Calibrating probabilities estimated from ensemble (ensemble reanalyses/reforecasts?).
- Methods for sub-sampling analysis ensemble.

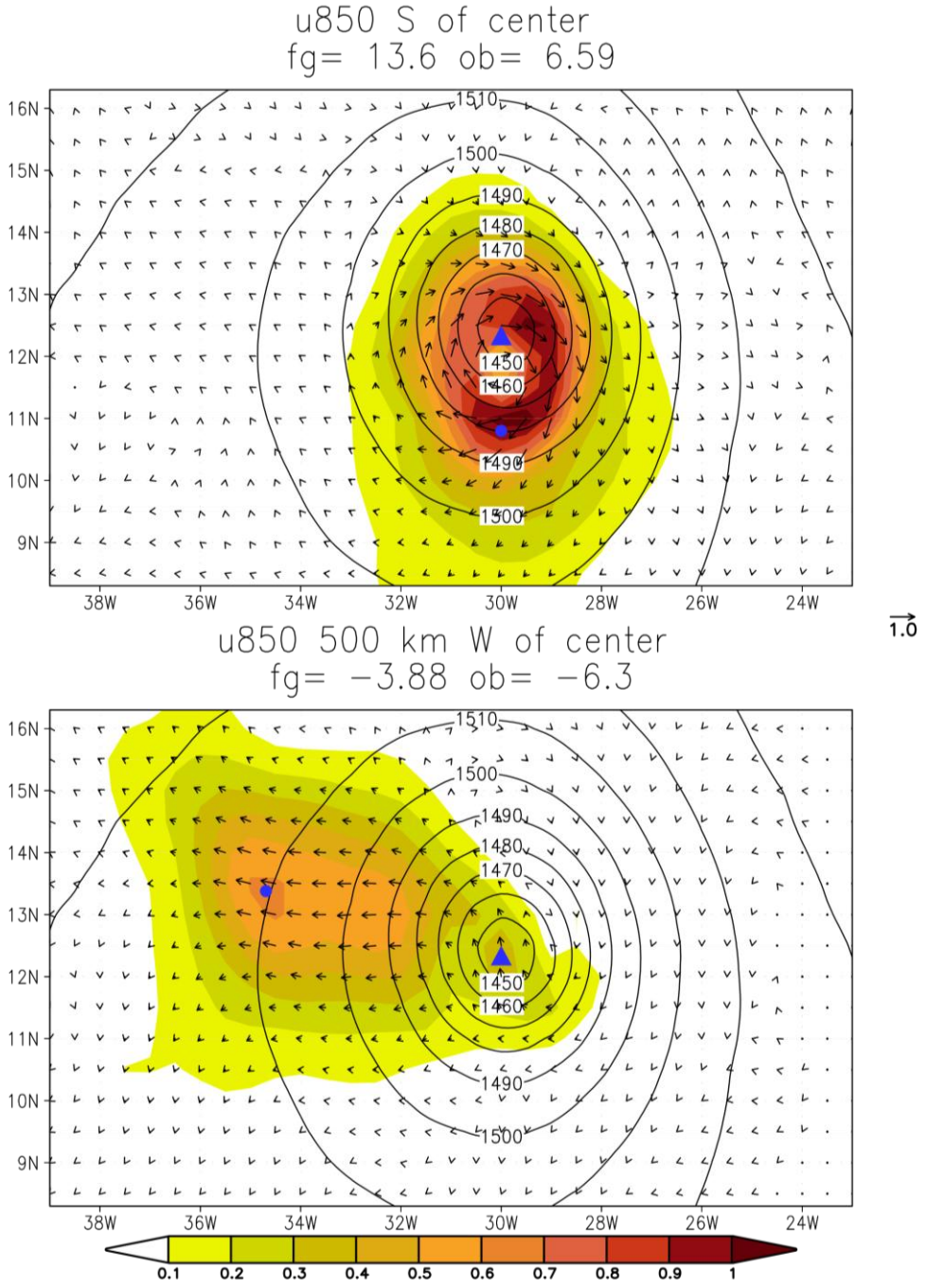
What's next?

- A proposal for future HFIP demo:
  - Continue global EnKF analysis and forecast as in 2009. Multiple models (FIM, GFS, GFDL)? Increase resolution to 15km?
  - Perform multi-model (ARW, HWRF, COAMPS-TC) cloud-resolving regional-scale ensemble forecast at identical resolution and domains using global EnKF analysis as ICs, forecasts as BCs.
  - Continue experiments of regional-scale EnKF analysis and forecast with high-resolution inner-core observations.
  - Perform OSEs, develop diagnostics to assess models, ob impacts.

Hurricane Fred 00Z 9 Sep

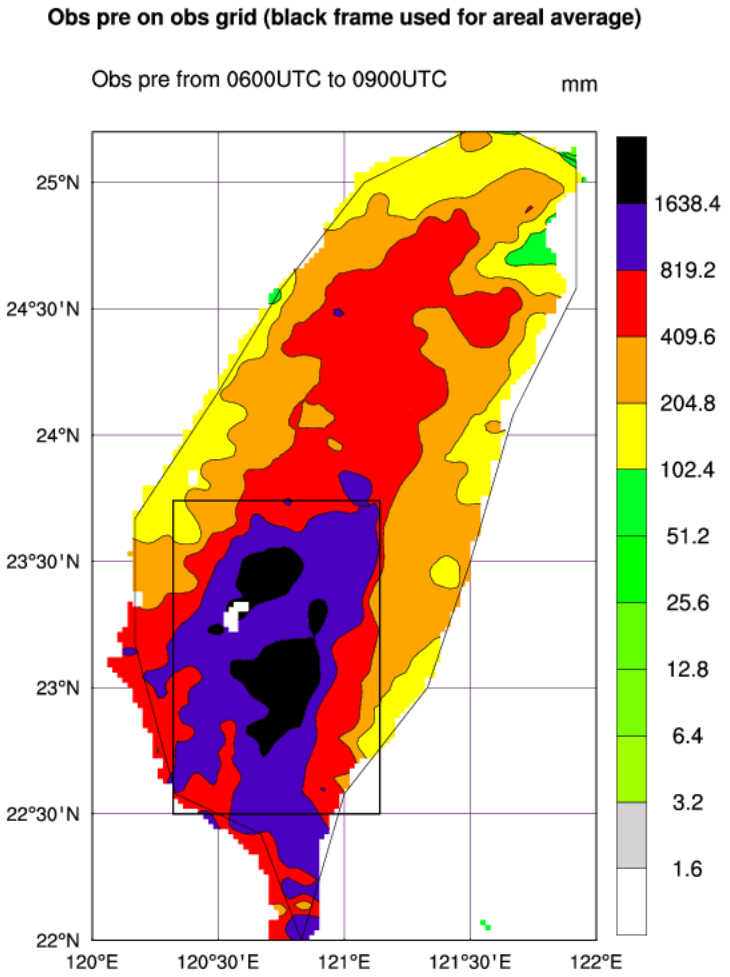
Single ob increments for 850 hPa u ob 1 m/s different than background.

- *Increments highly flow dependent.*
- *Analysis "knows" there is a hurricane.*



***Solid contours**: 850 hPa background geopotential height.*
***Colors**: wind speed increment*
***Arrows**: vector wind increment*
***Blue triangle**: hurrican center.*
***Blue circle**: location of ob.*

5-day event total rainfall forecast - downscaled with WRF/ARW at 4.5km on inner nest



Prob Precip > 1 meter