HFIP 2012 Global GSI/EnKF hybrid configuration

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Global GSI/EnKF hybrid now operational

- Became operational for GFS May 22.
- Very similar to configuration run in previous HFIP realtime demo.
- T574 control forecast, 80 member T254 EnKF ensemble.
- TC relocation runs on 6-h forecast (control and ensemble) before DA.

How is the 2012 HFIP system different than operational system?

- Higher resolution (T878 control/T382 ensemble).
  - T1152/T574 tested with Semi-Lagrangian GFS, but systematic errors led to degraded tropical forecasts.
- No TC relocation.
- 20 member ensemble (to 5 days) initialized from EnKF (operational GEFS still uses Ensemble Transform scheme with degraded vertical resolution).
- ECMWF "stochastically perturbed physics tendencies" (SPPT) scheme implemented in GFS, active in 5-day forecast (not DA cycle).

ECMWF SPPT method

- Perturbed Physics tendencies

$$X_p = (1 + r\mu)X_c$$

Original tendencies from gbphys

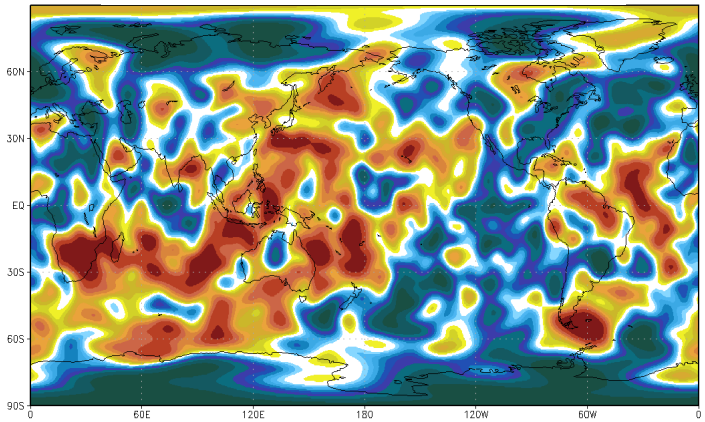
r- vertical weight: 1 from surface to 100 hPa, damps to zero at 50 hPa

μ- horizontal weights: ranges from -1.0 to 1.0, a red noise process with a

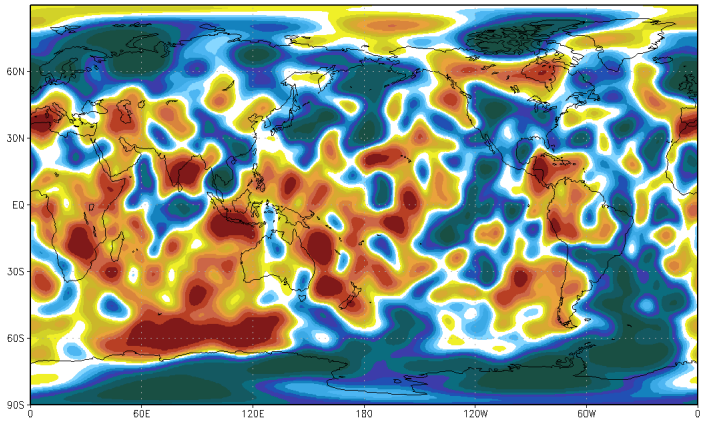
- Temporal timescale of 6 hours
- e-folding spatial scale of 500 km

Example of horizontal Patterns: μ

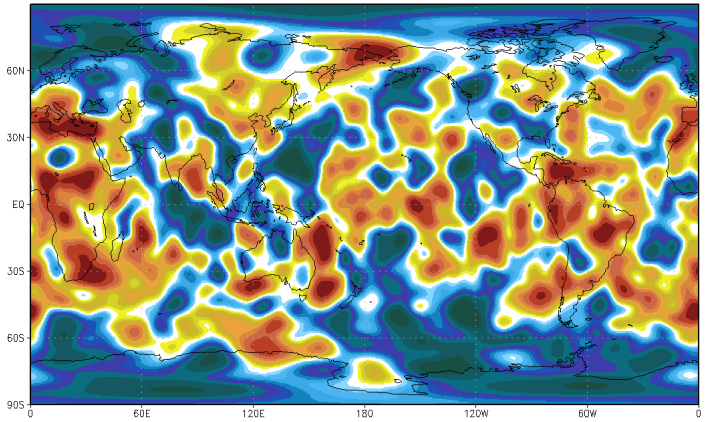
tau=0hr



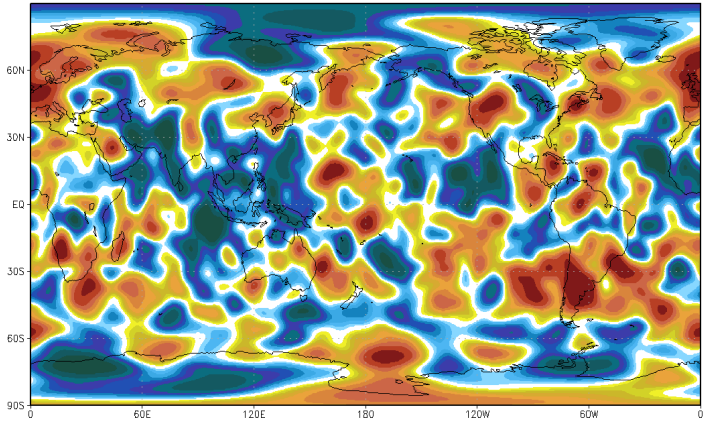
tau=6hr



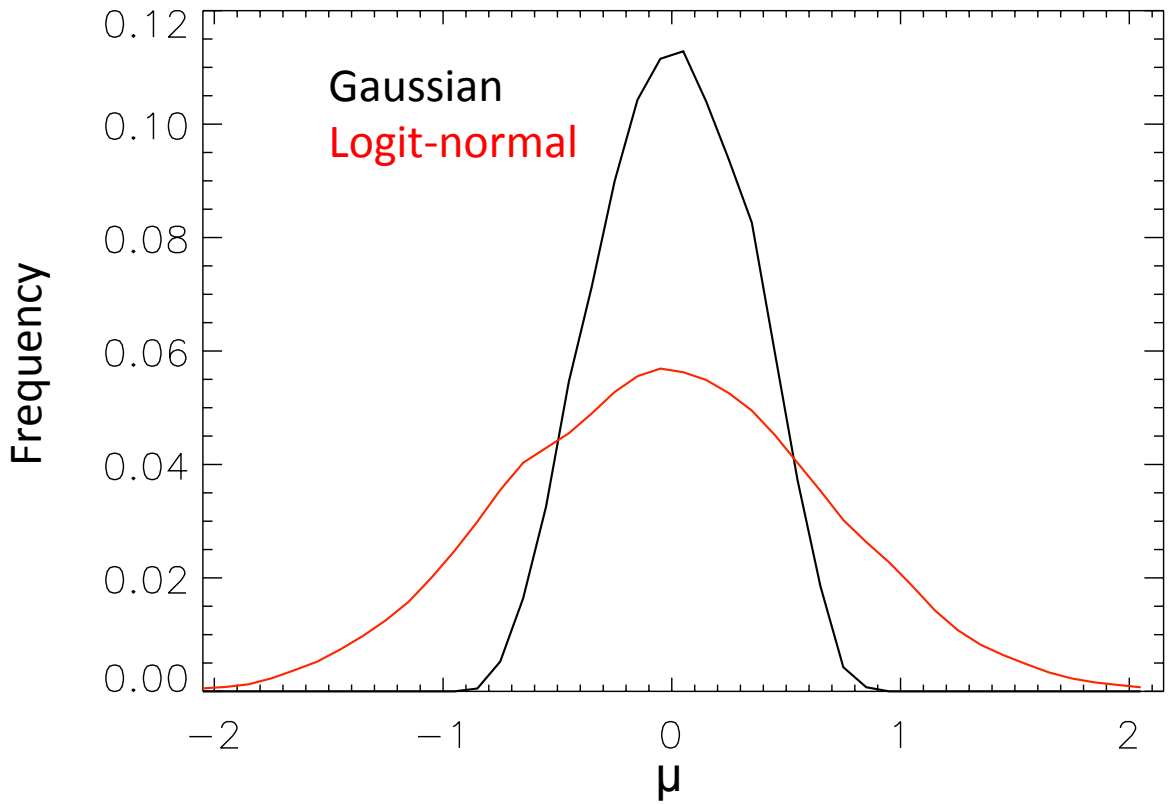
tau=12hr



tau=18hr



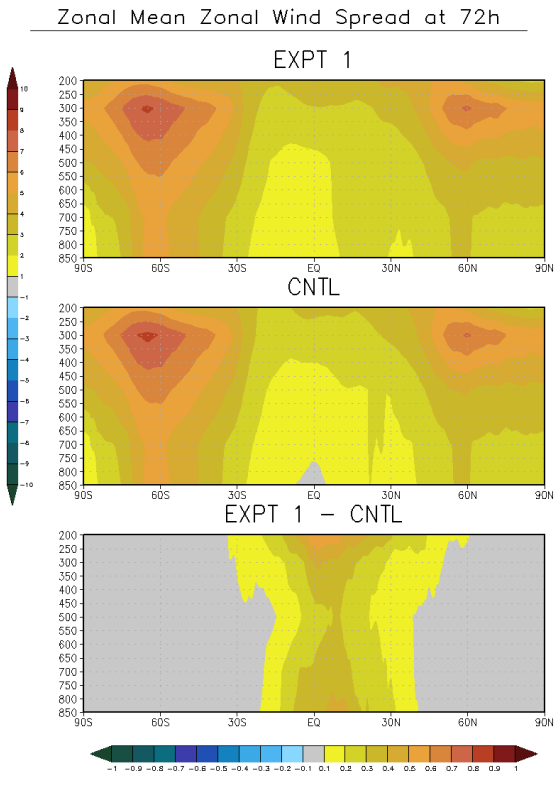
Histogram of perturbations



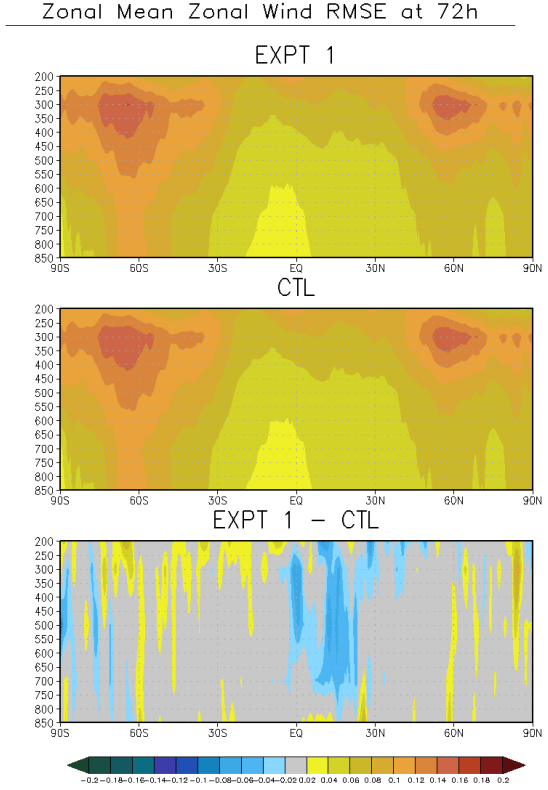
Original implementation at ECMWF used a Gaussian distribution.
GFS crashed when the sign of the total physics tendency is negative (e.q. $\mu < -1$)
Thus use of a logit-normal distribution prevents μ from getting less than -1

72hr forecast of zonal wind
(1 Aug-17 Sept 2011, 20 member ensembles)

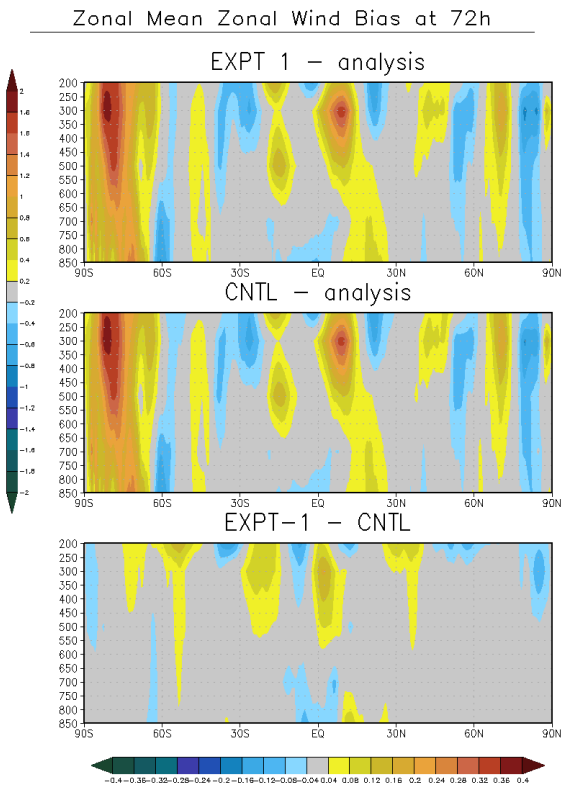
Spread



RMS

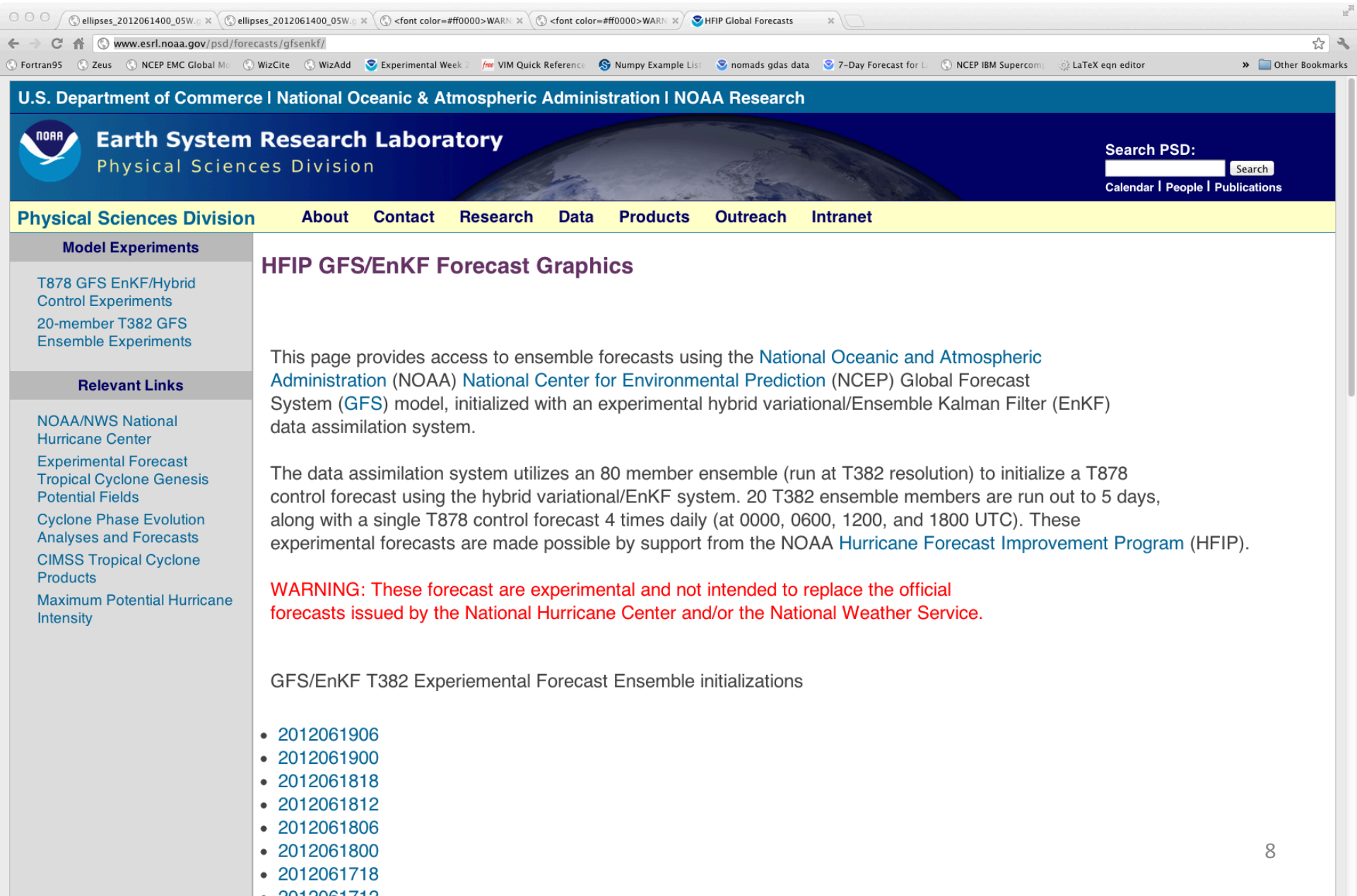


Bias

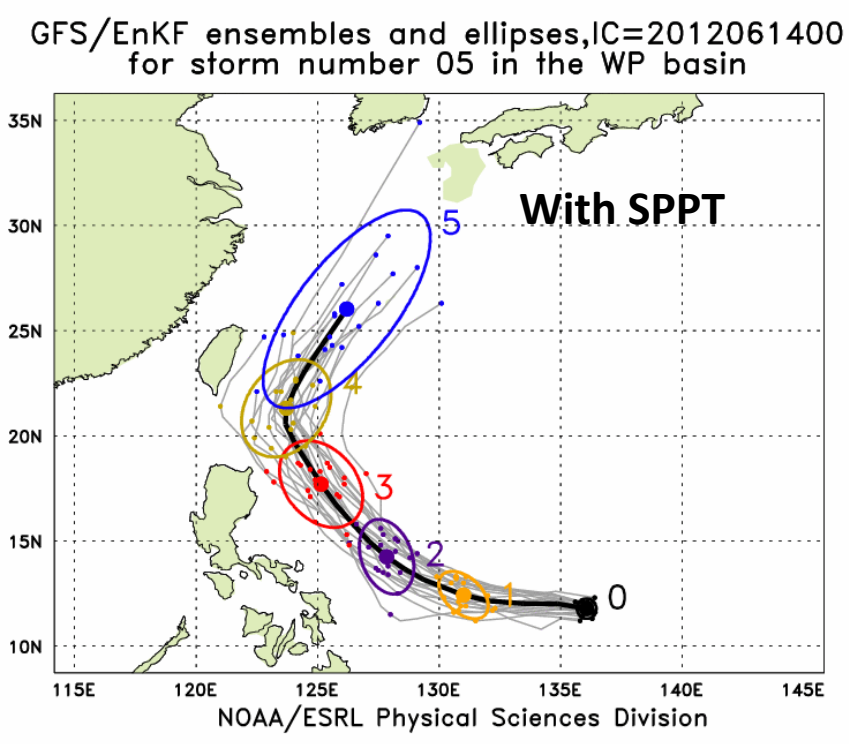


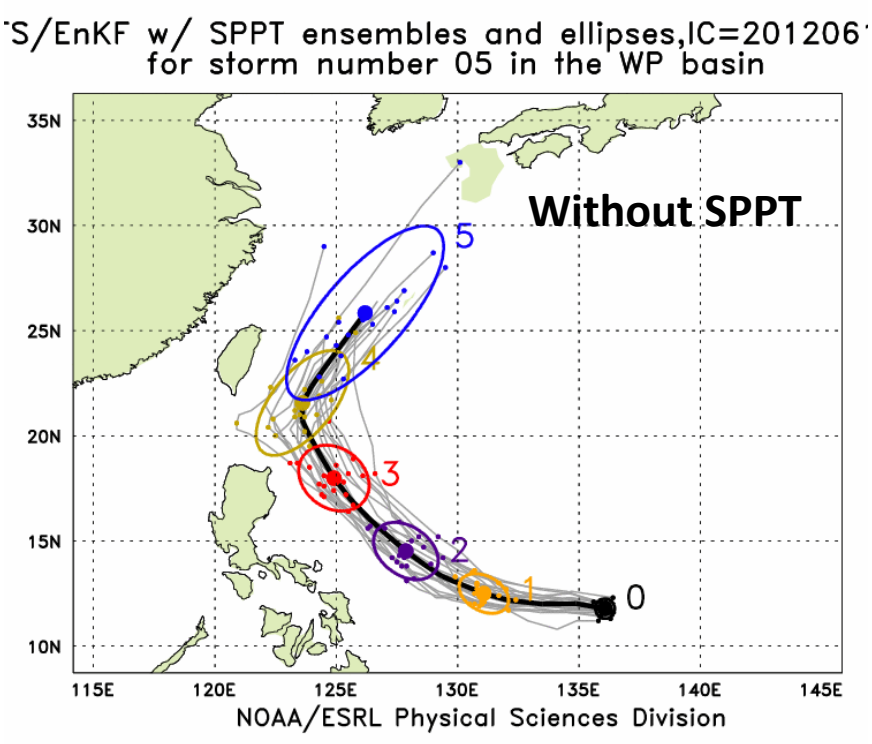
Zonal wind spread increase is greatest in the tropics.
Causes a small reduction in the RMS error in the tropics.

Realtime products online since 1 June

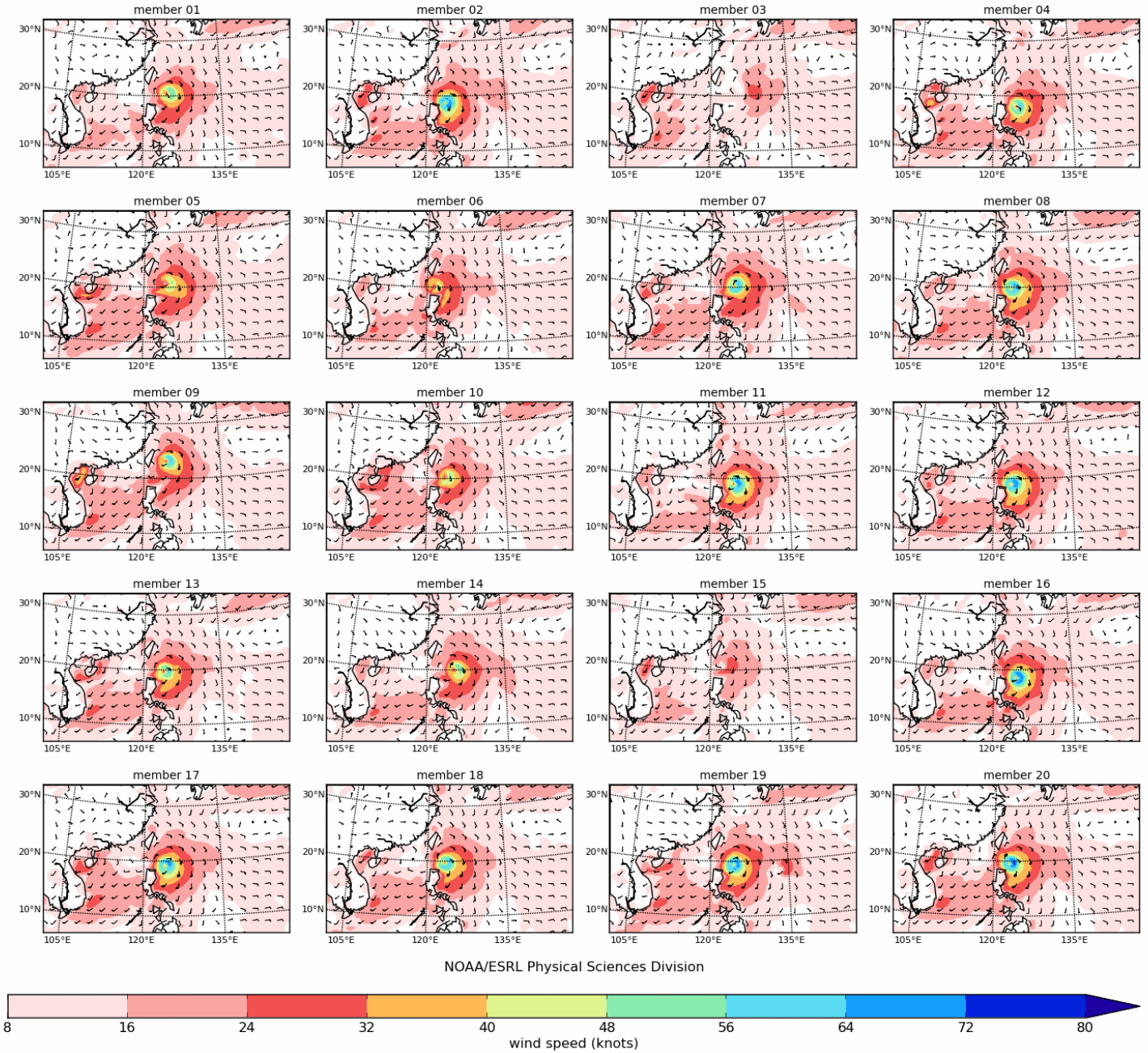


Example: Forecast for 05W (Guchol)

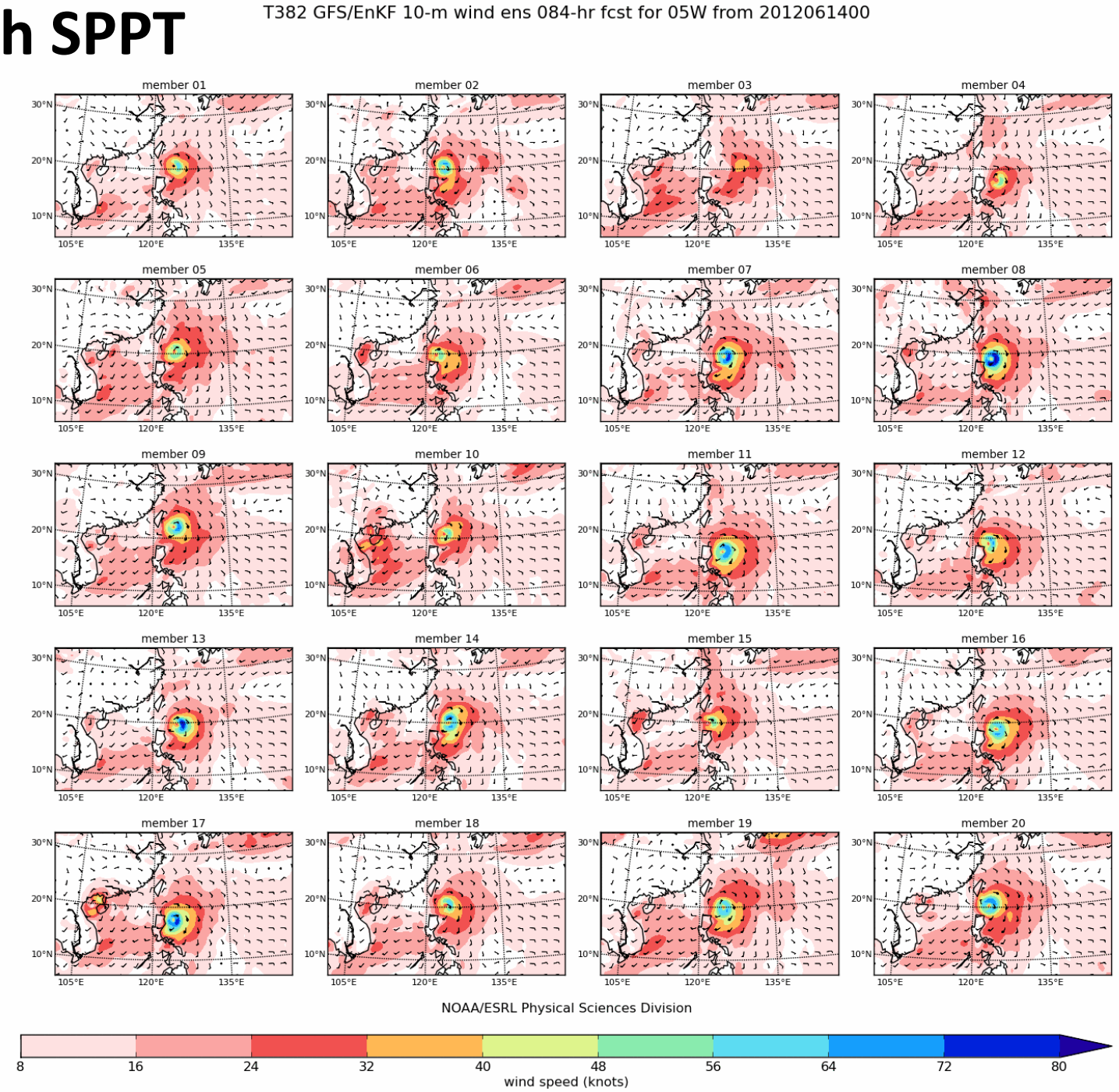




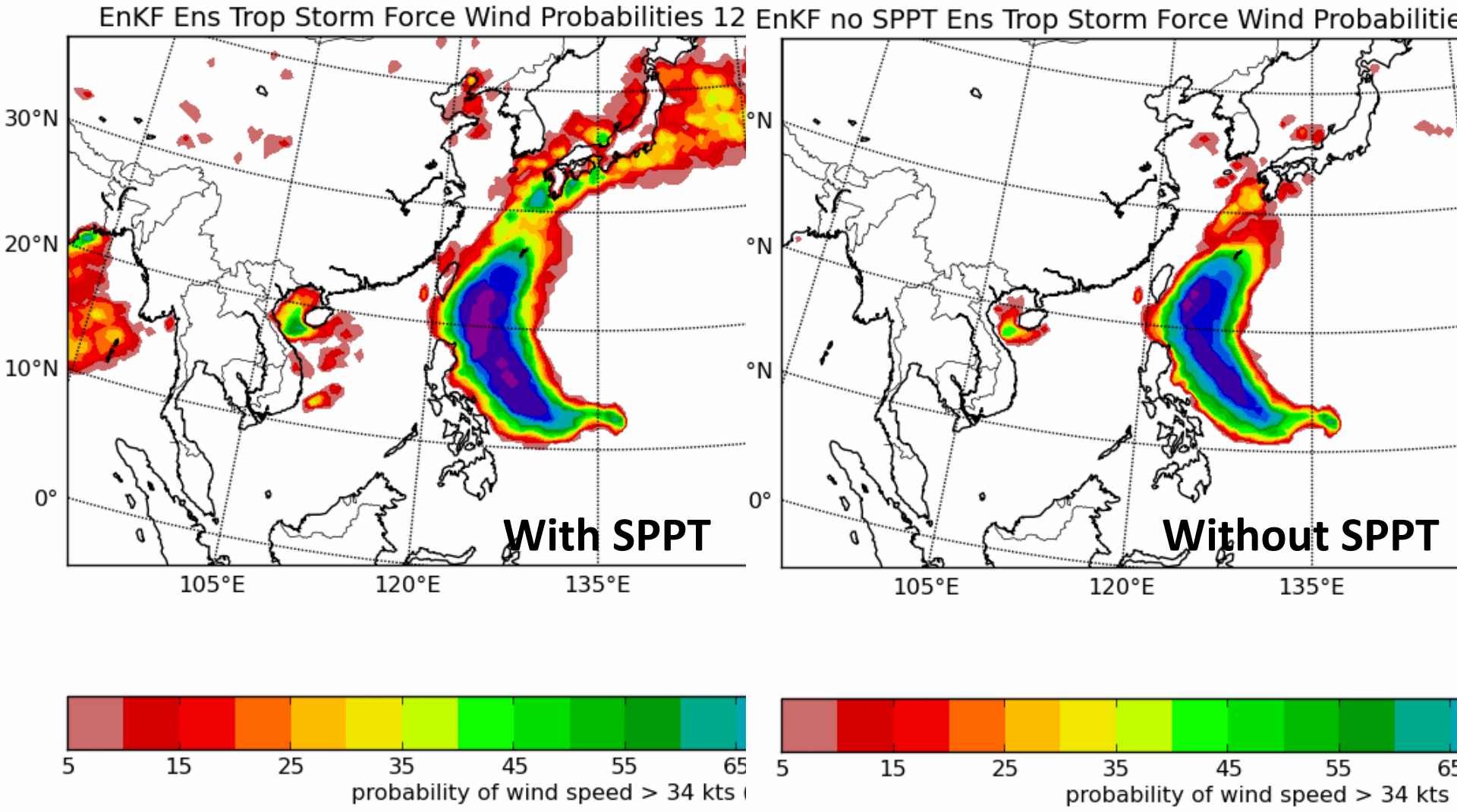
Without SPPT



With SPPT

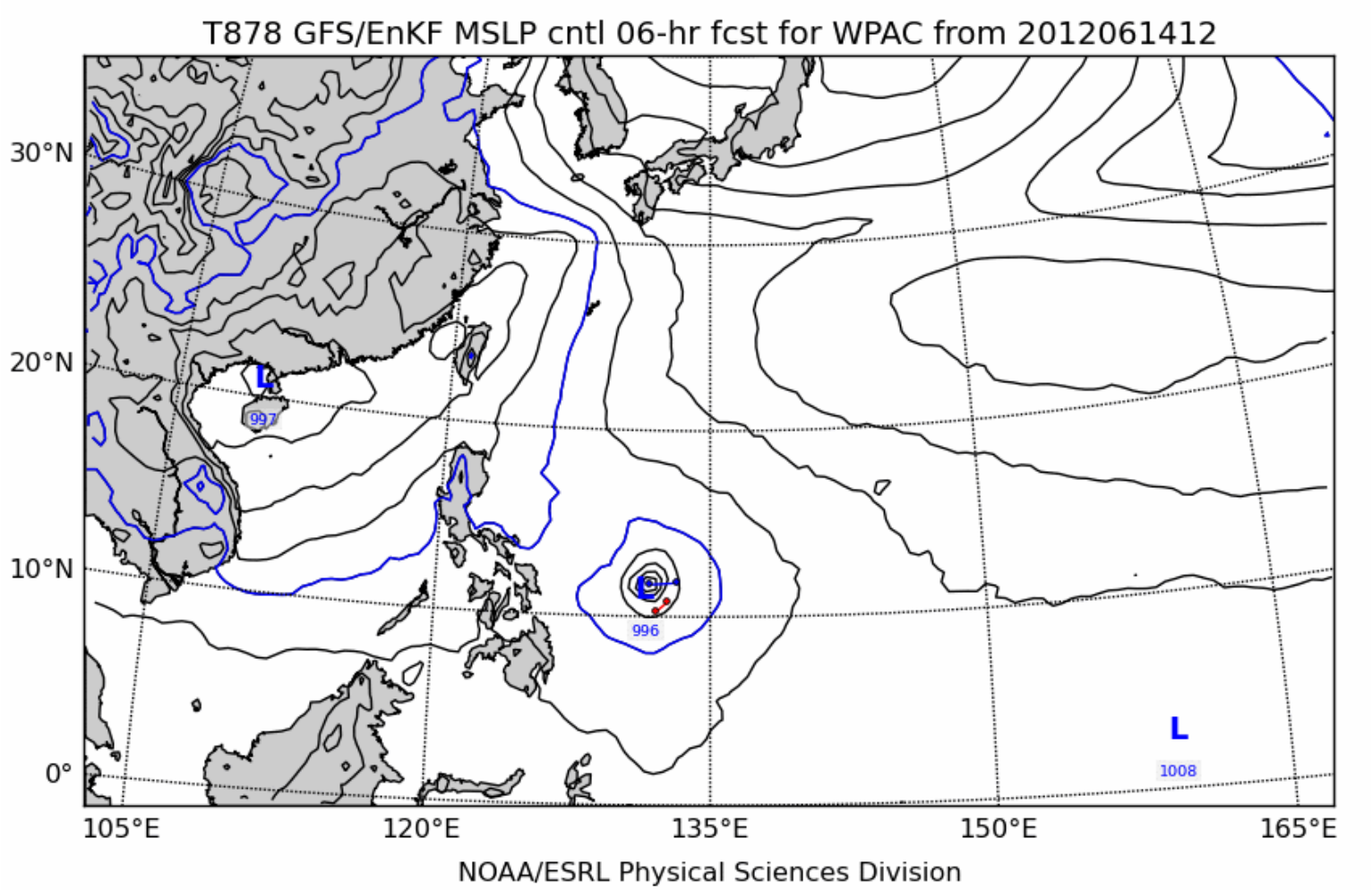

T382 GFS/EnKF 10-m wind ens 084-hr fcst for 05W from 2012061400
member 01
member 02
member 03
member 04
member 05
member 06
member 07
member 08
member 09
member 10
member 11
member 12
member 13
member 14
member 15
member 16
member 17
member 18
member 19
member 20
30°N
20°N
10°N
105°E
120°E
135°E
NOAA/ESRL Physical Sciences Division
8
16
24
32
40
48
56
64
72
80
wind speed (knots)

TS wind prob swaths



A recurring problem …

- storm spins up in the wrong place
- all the ensemble spread goes with the model storm
- obs cannot correct the forecast



Plans

- LGEM/SPICE post-processing (with CSU).
- Evaluate impact of enhanced resolution and stochastic physics (input to EMC for planning next GFS/GEFS upgrade).
- Test stochastic physics in DA after the hurricane season.
- Feed boundary conditions to HWRF hybrid DA.