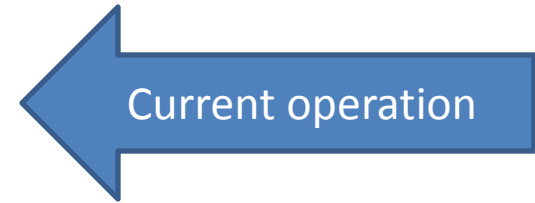# Recently evaluation of GEFS initial perturbations
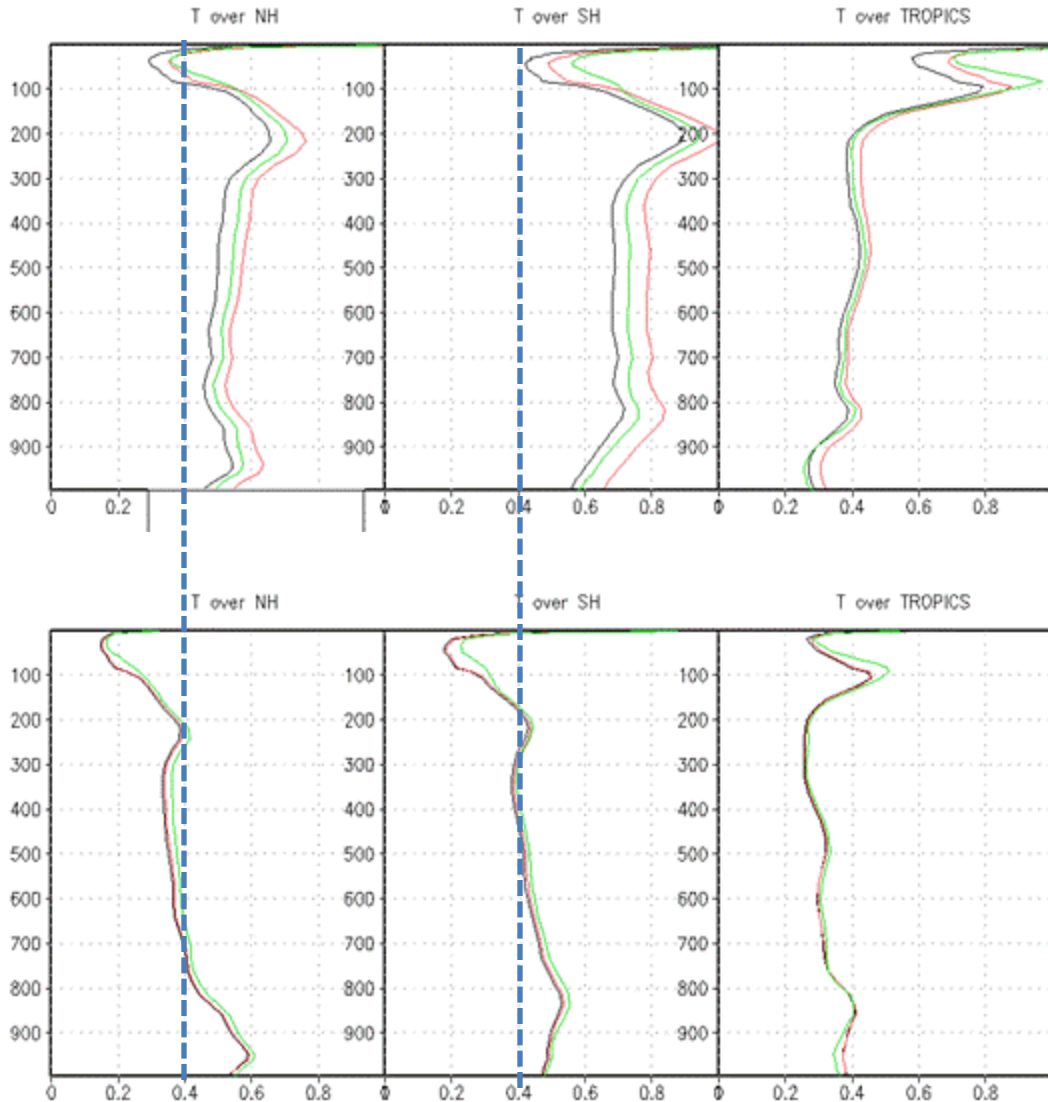
Vertical distribution of perturbation amplitude

One case for 2013070318
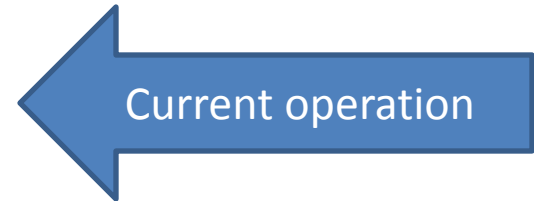

Current operation

Black – EnKF first analysis
Red – EnKF final analysis
Green – EnKF 6-hr forecast

Parallel

Vertical distribution of perturbation amplitude

One case for 2013070318

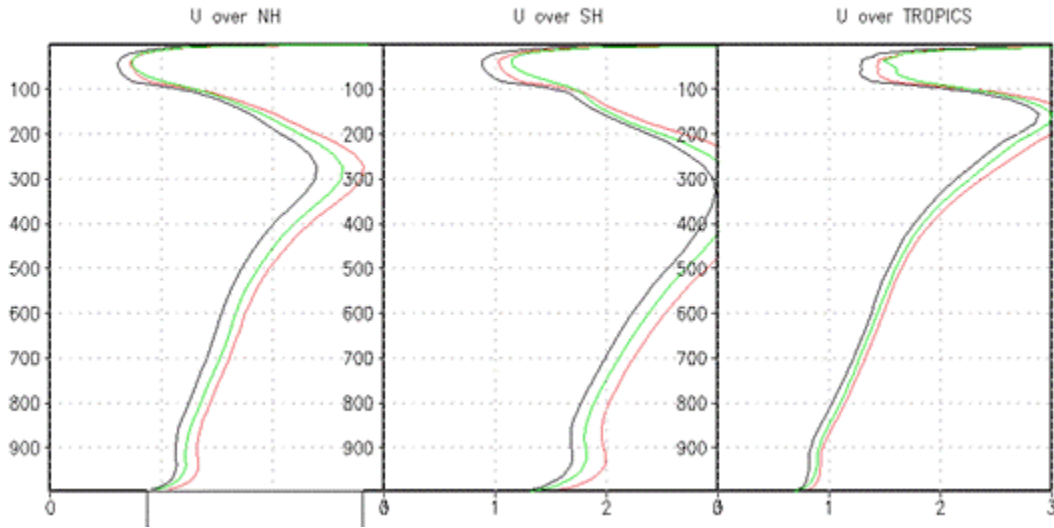Current operation

Black – EnKF first analysis
Red – EnKF final analysis
Green – EnKF 6-hr forecast

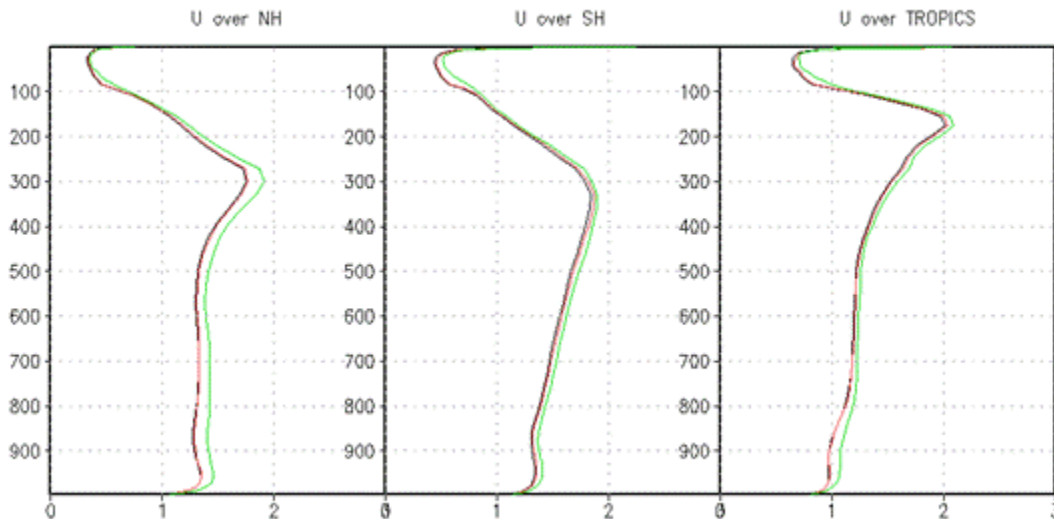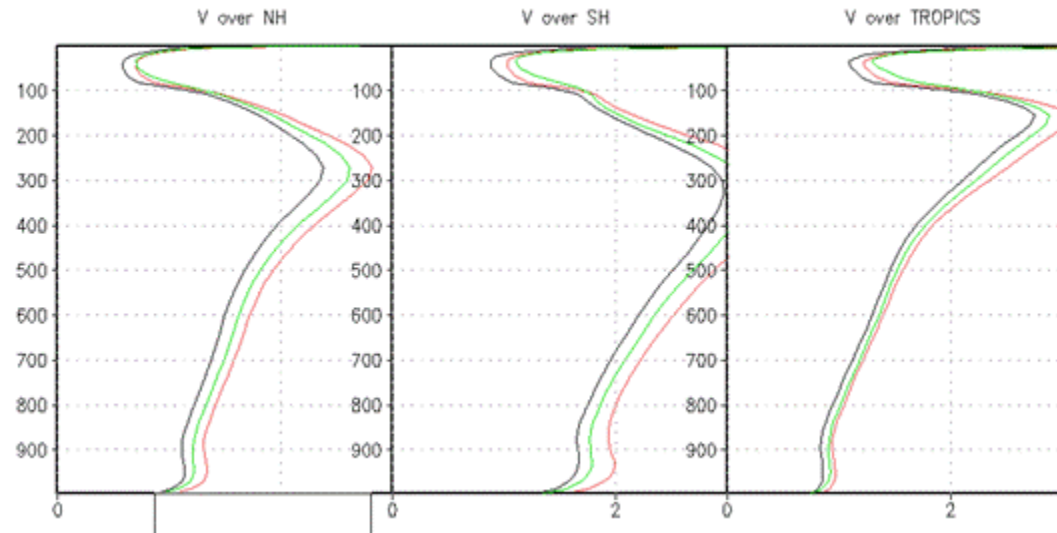Parallel

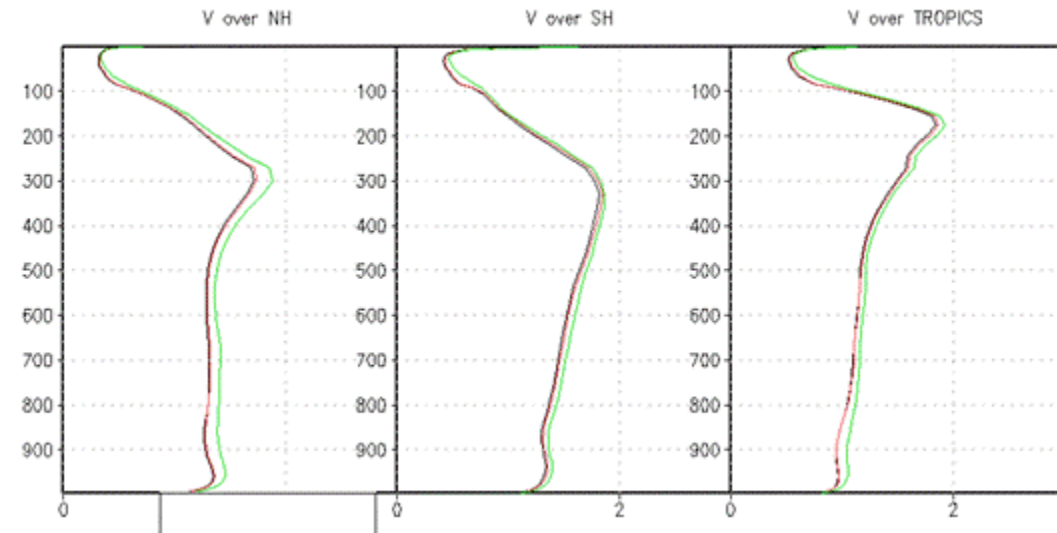# Vertical distribution of perturbation amplitude

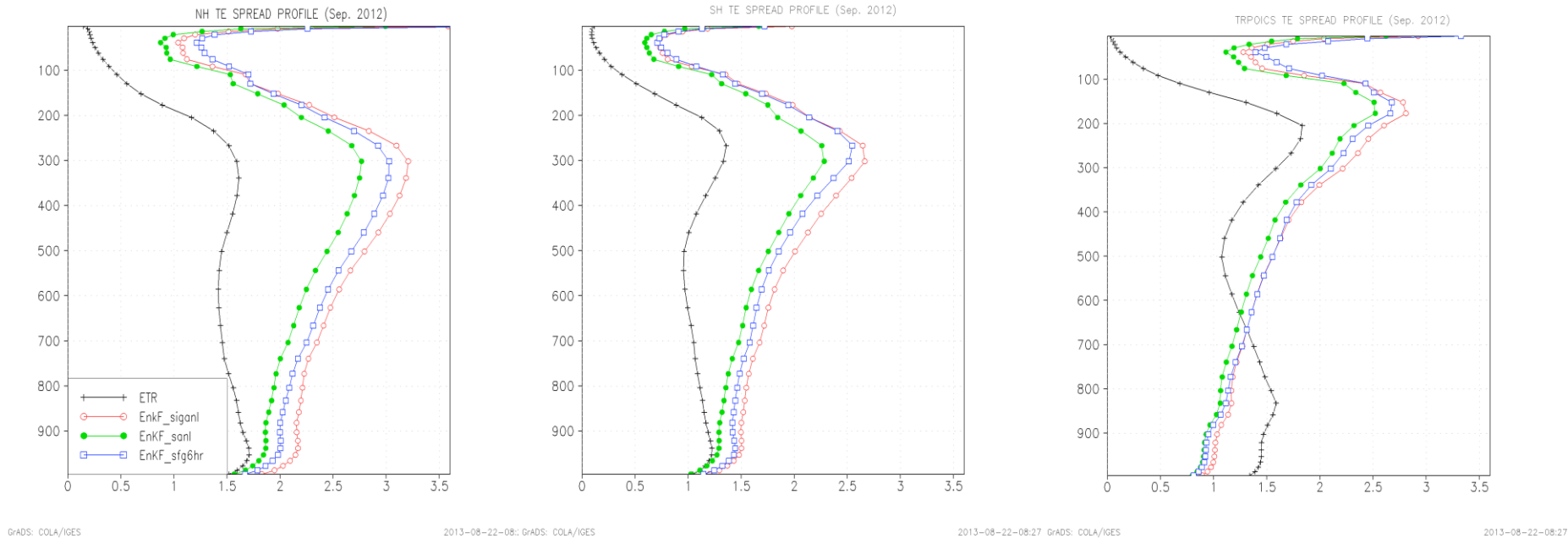One case for 2013070318

Current operation

Black – EnKF first analysis
Red – EnKF final analysis
Green – EnKF 6-hr forecast

Parallel

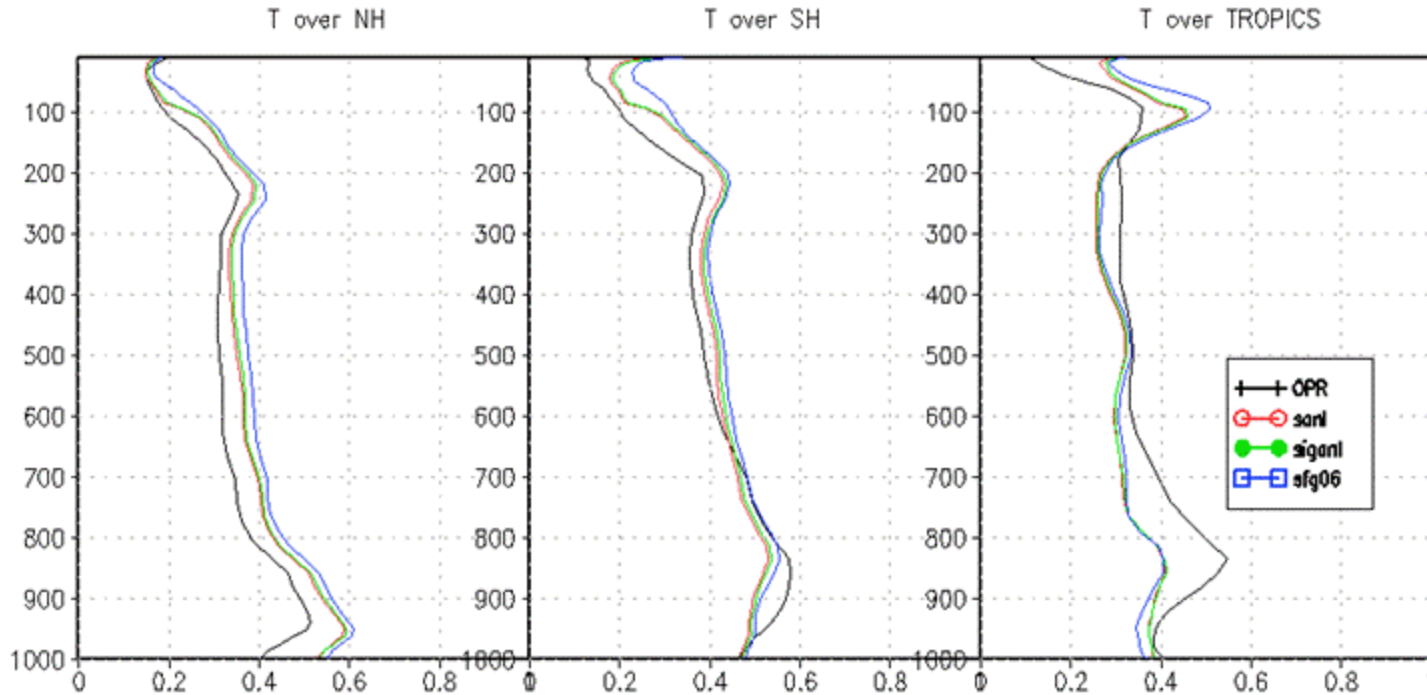# Vertical structure of perturbation amplitude
Early study (2011-2012)

Black-ETR; Green-EnKF analysis without additive inflation; Red-EnKF analysis; Blue-EnKF f06

Vertical profiles of initial perturbation spread in terms of total dry energy in the ETR and EnKF experiments over a) NH, b) SH and c) Tropics.   Three EnKF profiles represent the spread of EnKF perturbations after multiple inflations (green curves), additive inflation (red) and 6-hr forecast (blue). The profiles are averaged from 1 July – 17 Oct. 2011.

Vertical distribution of perturbation amplitude

One case for 2013070318

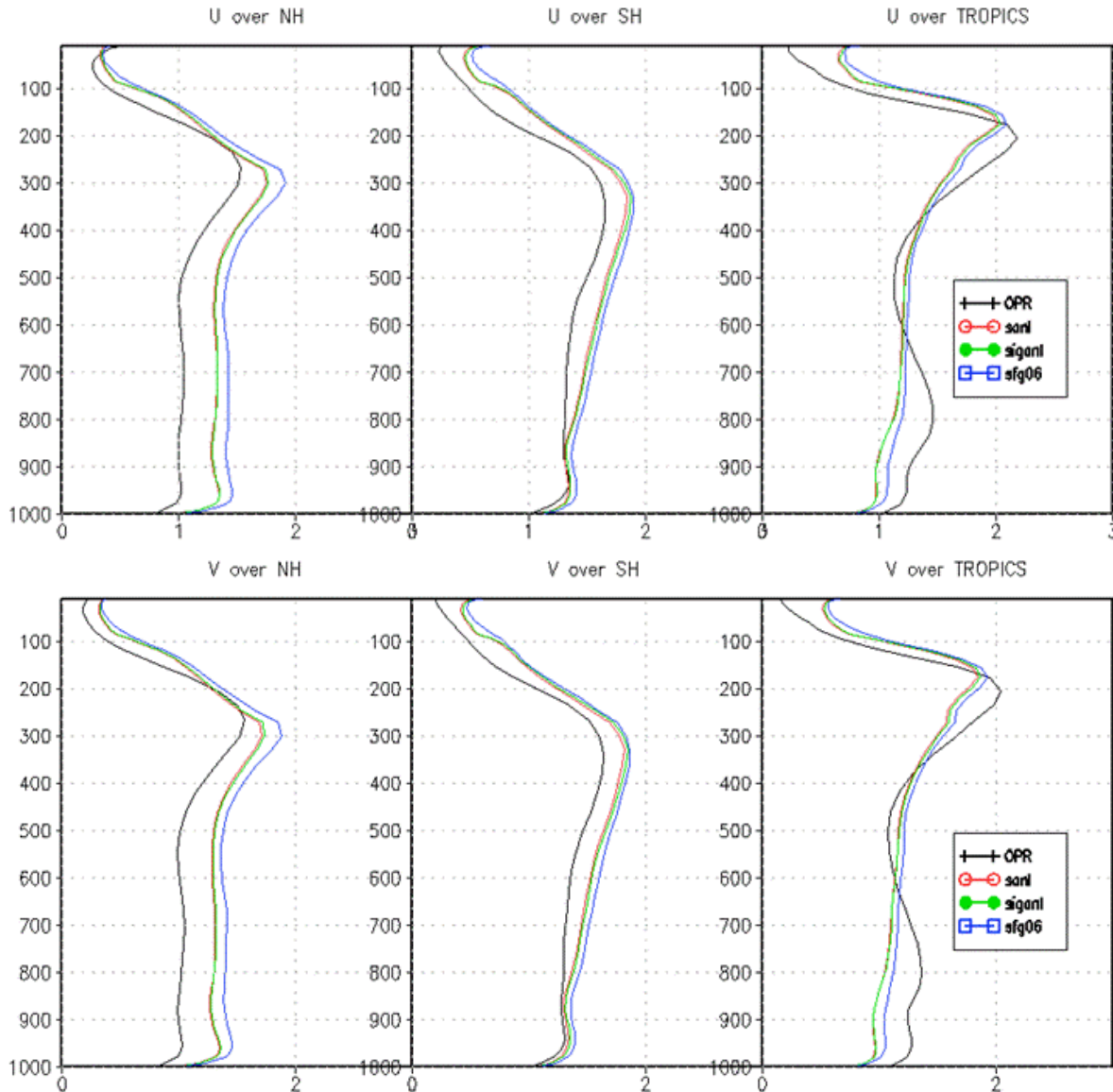Black – current operational BV-ETR perturbations
Red – parallel EnKF first analysis
Green – parallel EnKF final analysis
Blue – parallel EnKF 6-hr forecast

Vertical distribution of perturbation amplitude
One case for 2013070318

Black – Operational BV-ETR perturbations

Red – parallel EnKF first analysis

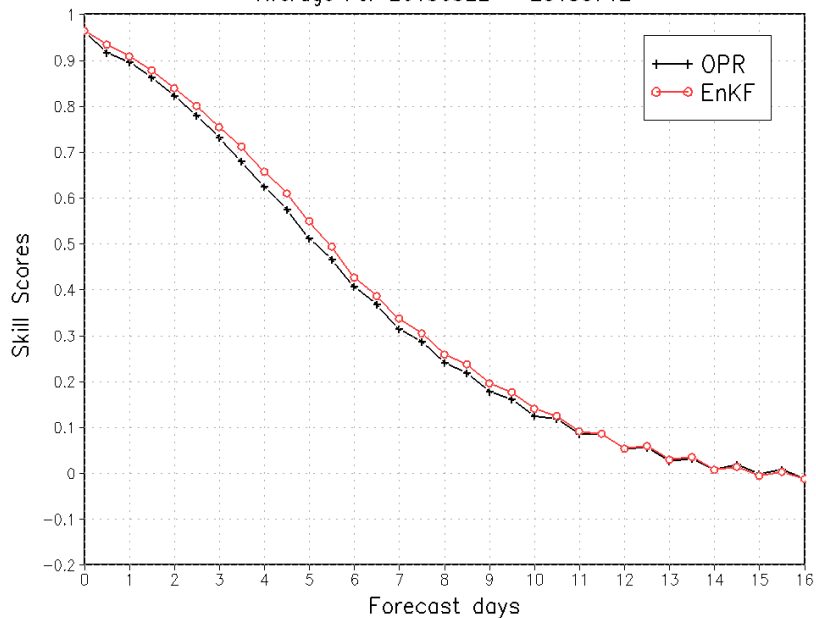Green – parallel EnKF final analysis

Blue – parallel EnKF 6-hr forecast

Quick summary based on this analysis

- The uncertainties of both parallel EnKF anl and f06 are much smaller than current operational, especially for upper atmospheric levels.

- The vertical structures of perturbations are changed, especially for temperature. Therefore, TE norm in the vertical is much close to current BV-ETR.

  – Tom's question - It isn't clear why the TE (total energy?) norm in the vertical being close to the current BV-ETR is desirable. Can you explain this? This is good question indeed.

- EnKF 6-hour forecast is growing from EnKF analysis, not see any (or much) decaying which means EnKF are bringing good stochastic perturbations.
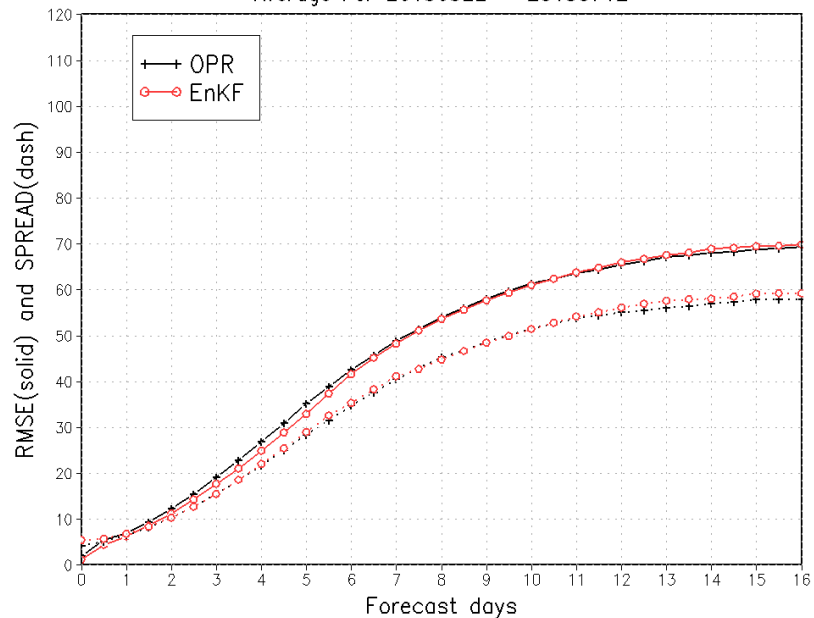
New experiments from parallel EnKF

- Based on EnKF f06 with
  - TS relocation and centralization only
- Period of May 22 – July 12 2013
- Verification analysis – Against own analysis
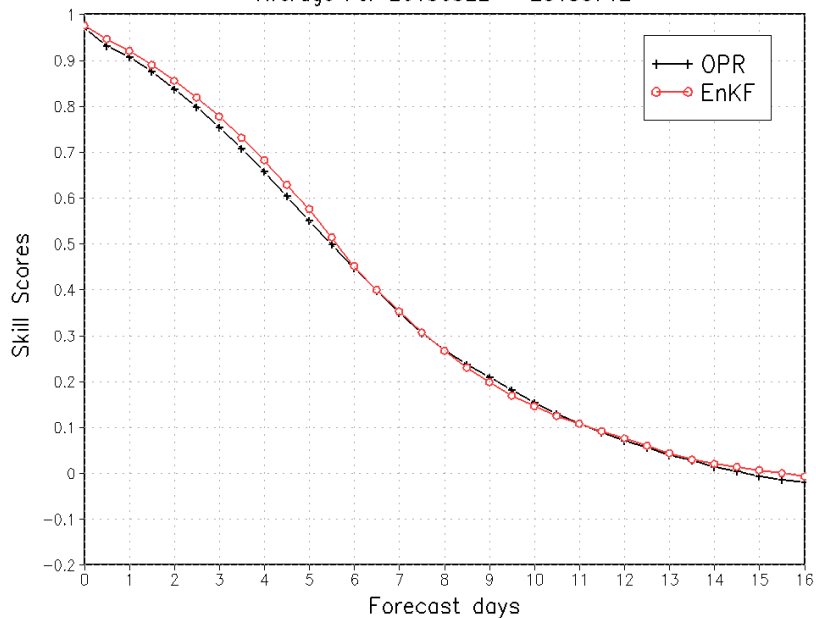- Full stats located at: http://www.emc.ncep.noaa.gov/gc_wmb/xzhou/EnKF_prhs13_2.HTML

Northern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
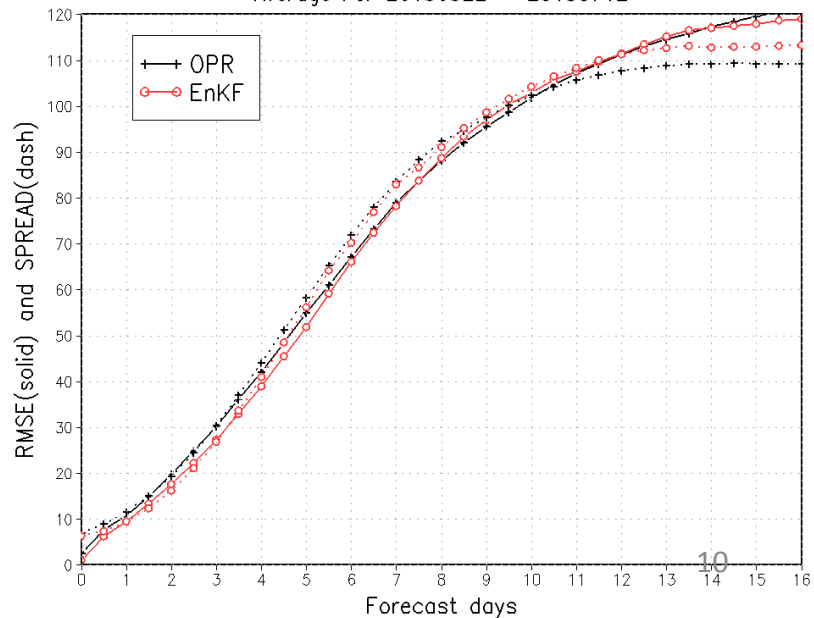Average For 20130522 — 20130712

Northern Hemisphere 500hPa Height
Ensemble Mean RMSE and Ensemble SPREAD
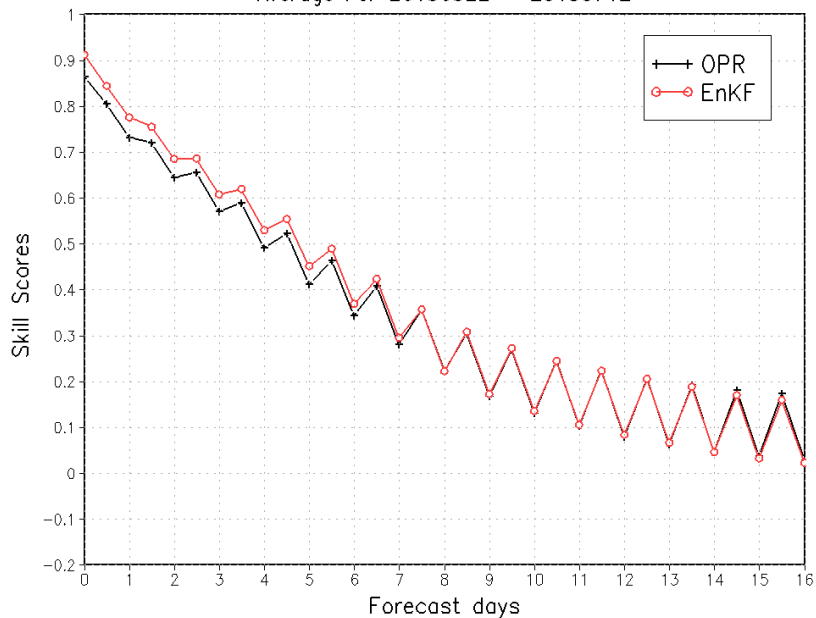Average For 20130522 — 20130712

Southern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
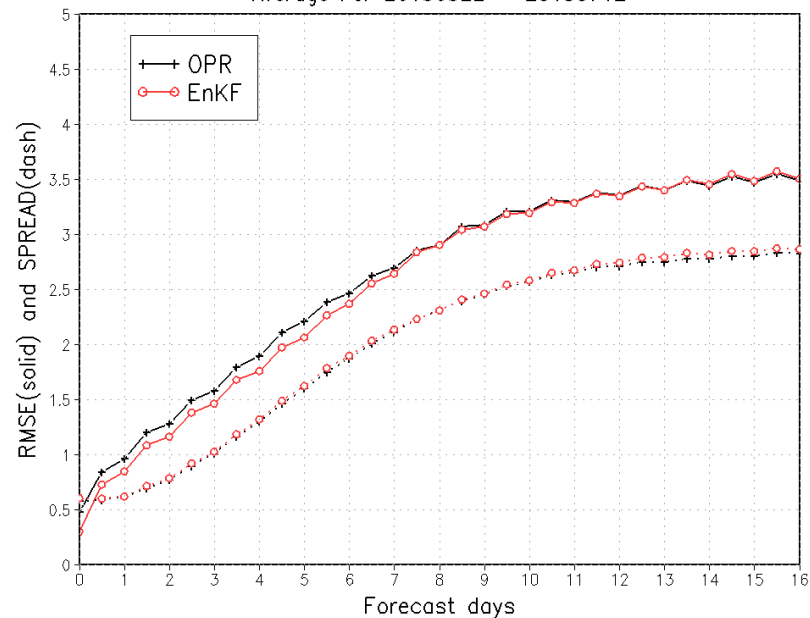Average For 20130522 — 20130712

Southern Hemisphere 500hPa Height
Ensemble Mean RMSE and Ensemble SPREAD
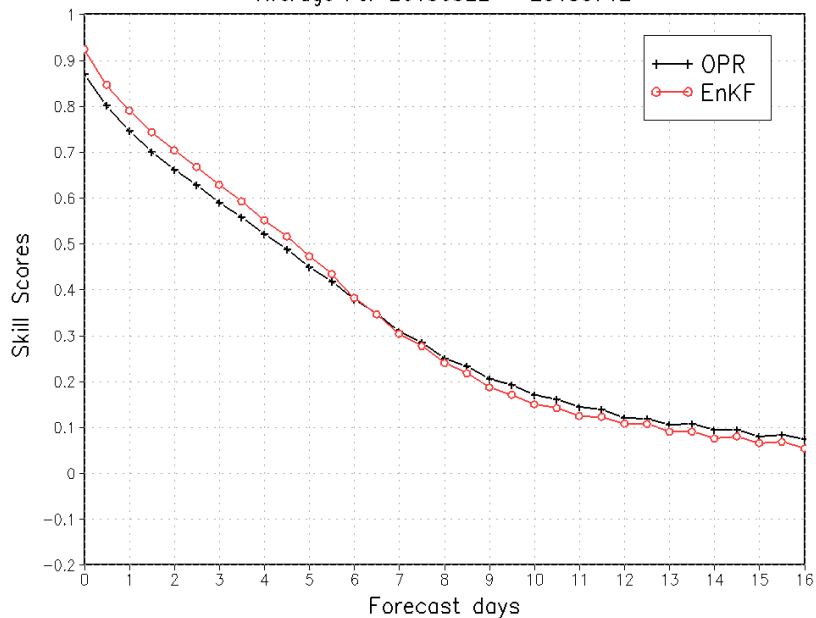Average For 20130522 — 20130712

Northern Hemisphere 850hPa Temp.
Continous Ranked Probability Skill Scores
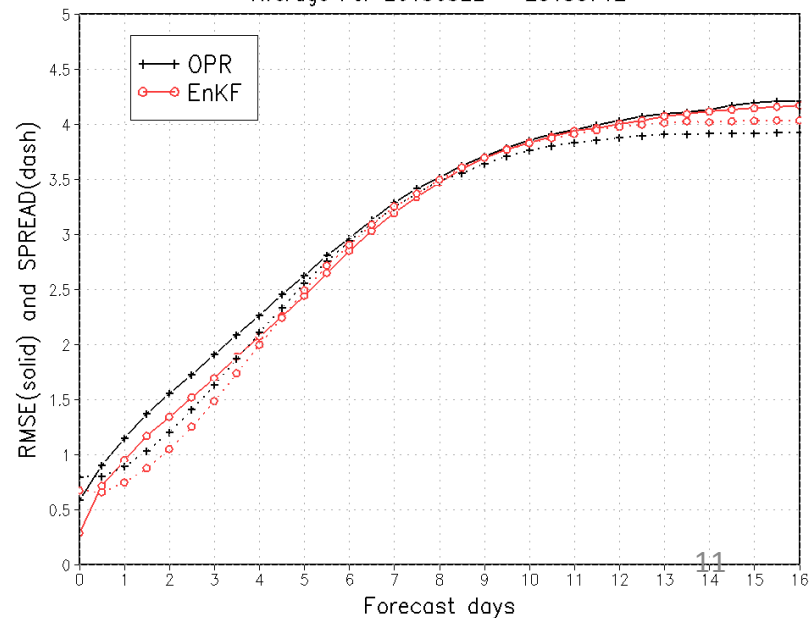Average For 20130522 – 20130712

Northern Hemisphere 850hPa Temp.
Ensemble Mean RMSE and Ensemble SPREAD
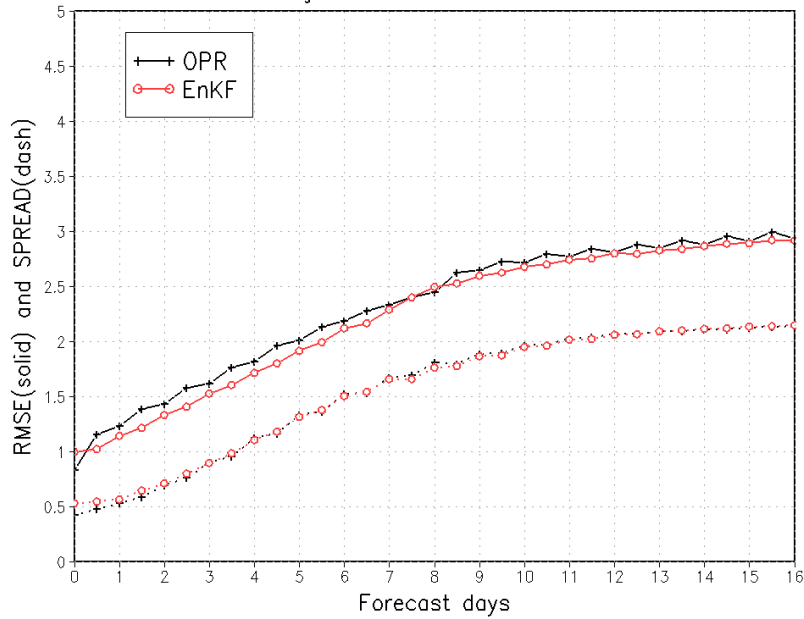Average For 20130522 – 20130712

Southern Hemisphere 850hPa Temp.
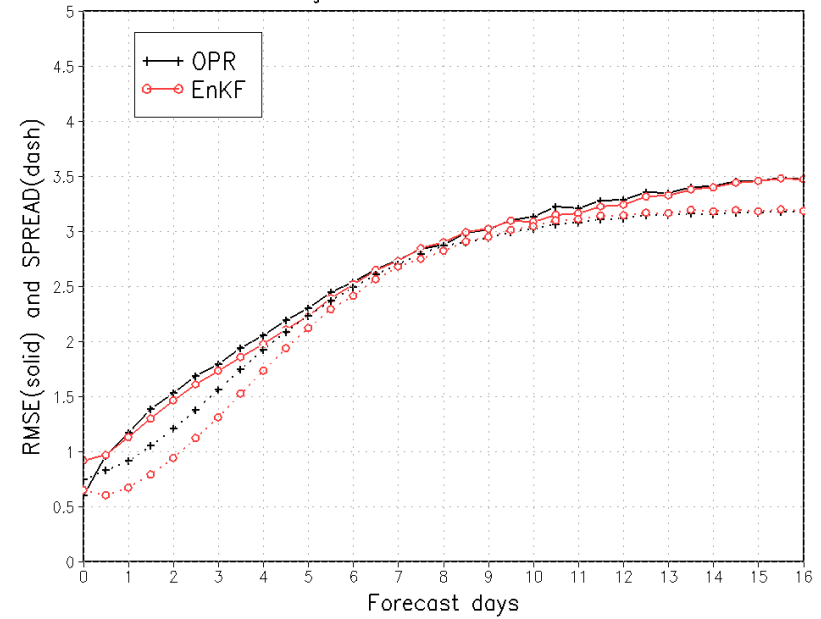Continous Ranked Probability Skill Scores
Average For 20130522 – 20130712

Southern Hemisphere 850hPa Temp.
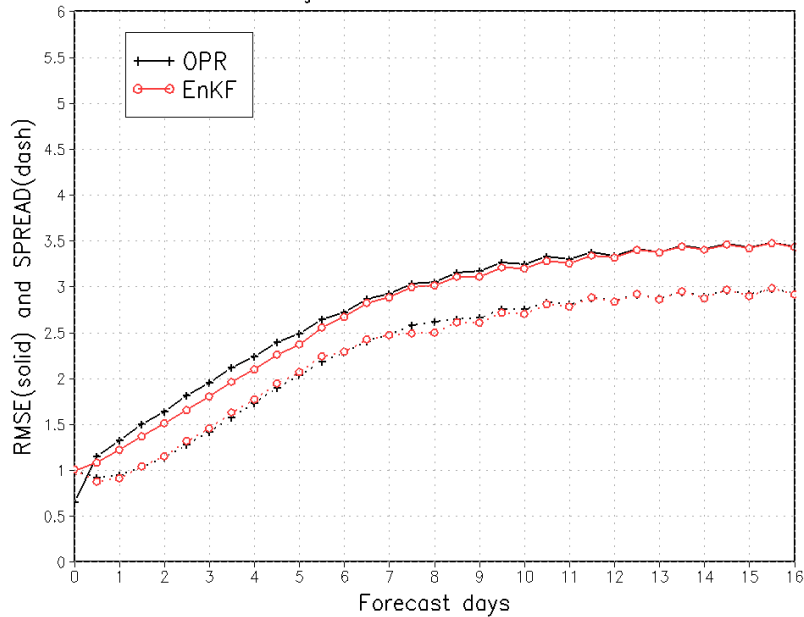Ensemble Mean RMSE and Ensemble SPREAD
Average For 20130522 – 20130712

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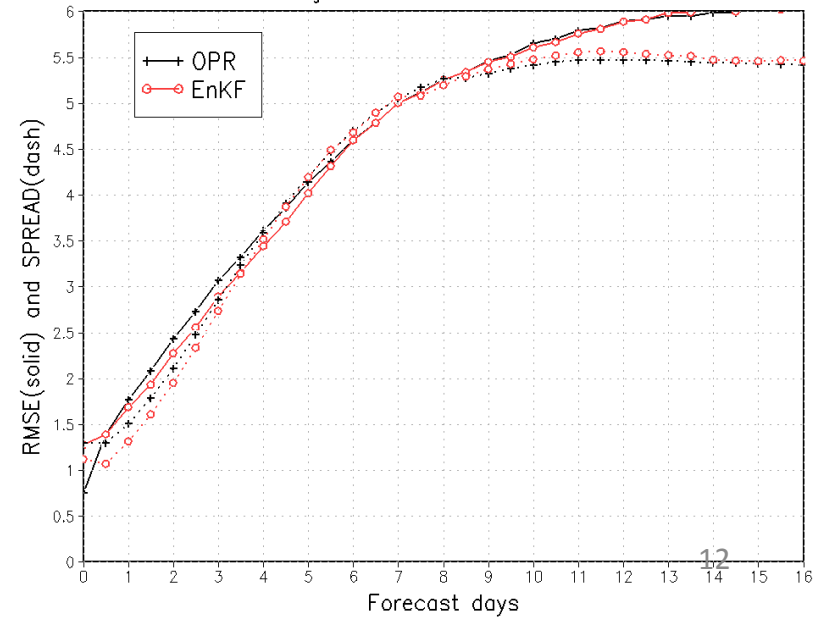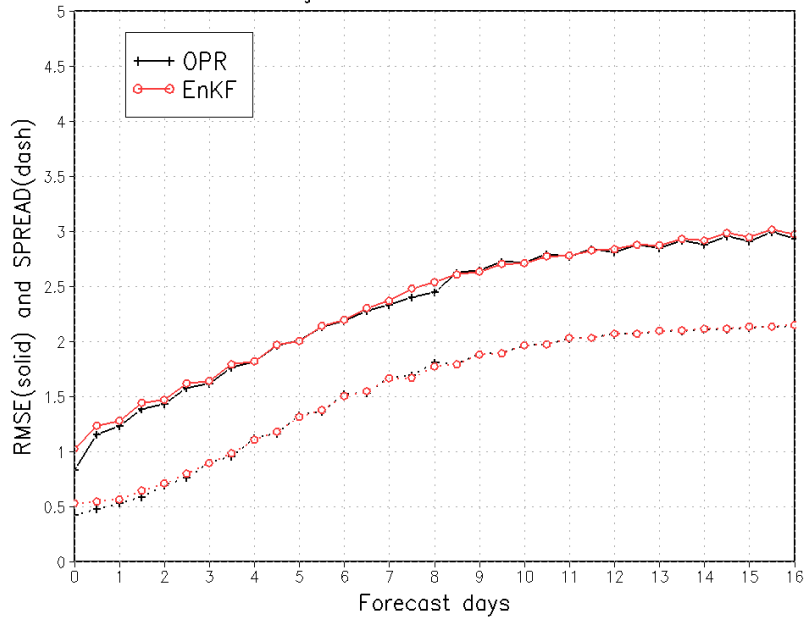Against opr analysis

Against own analysis

Tropical 850hPa U.
Continous Ranked Probability Skill Scores
Average For 20130522 – 20130712

Tropical 850hPa U.
Ensemble Mean RMSE and Ensemble SPREAD
Average For 20130522 – 20130712

Against opr analysis

Tropical 250hPa U.
Continous Ranked Probability Skill Scores
Average For 20130522 – 20130712

Tropical 250hPa U.
Ensemble Mean RMSE and Ensemble SPREAD
Average For 20130522 – 20130712

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Tropical 850hPa U.
Continous Ranked Probability Skill Scores
Average For 20130522 — 20130712

Tropical 850hPa U.
Ensemble Mean RMSE and Ensemble SPREAD
Average For 20130522 — 20130712
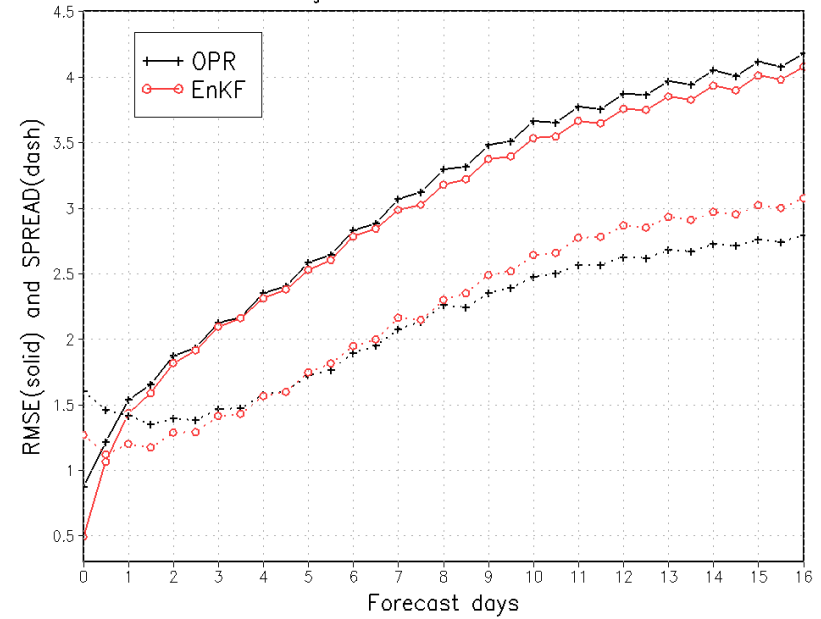
Against own analysis

Tropical 250hPa v.
Continous Ranked Probability Skill Scores
Average For 20130522 — 20130712
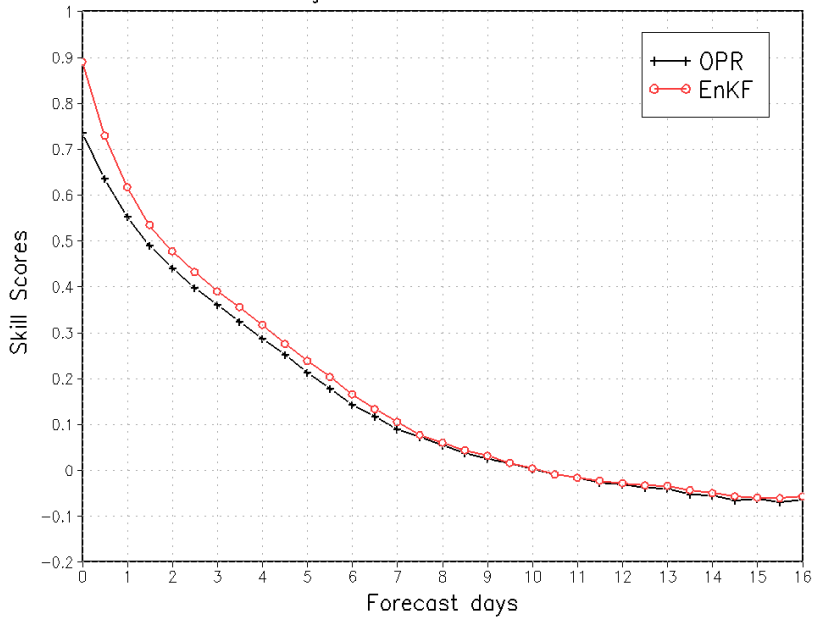
Tropical 250hPa v.
Ensemble Mean RMSE and Ensemble SPREAD
Average For 20130522 — 20130712
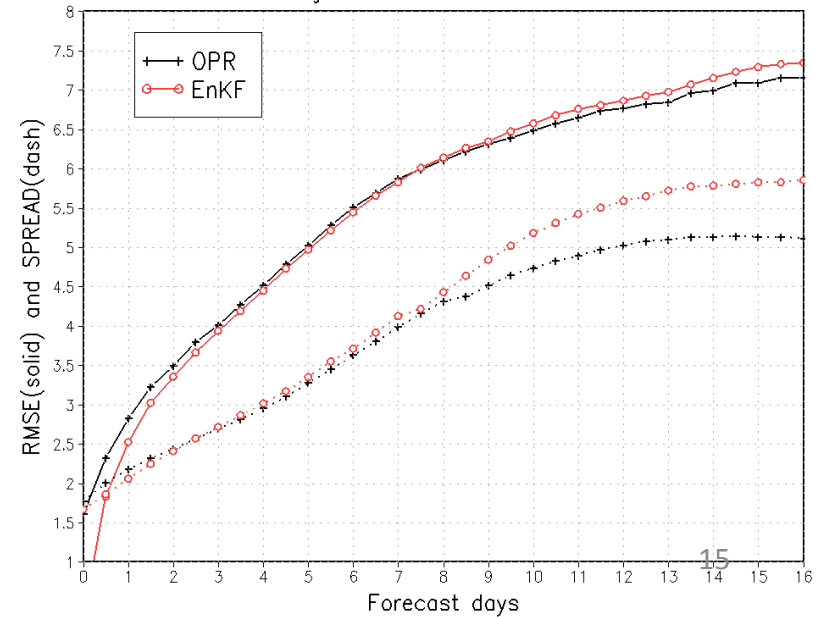
All basins, (05/22-07/12/2013)
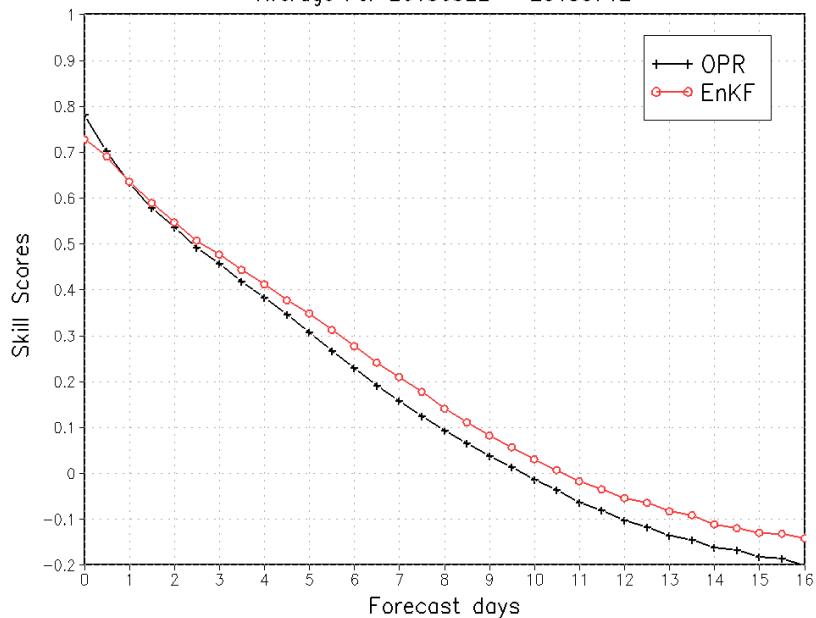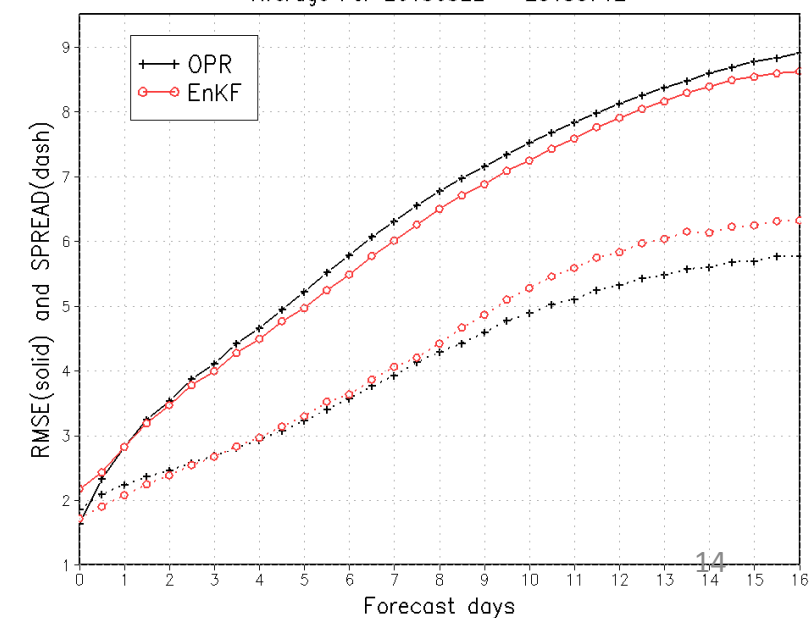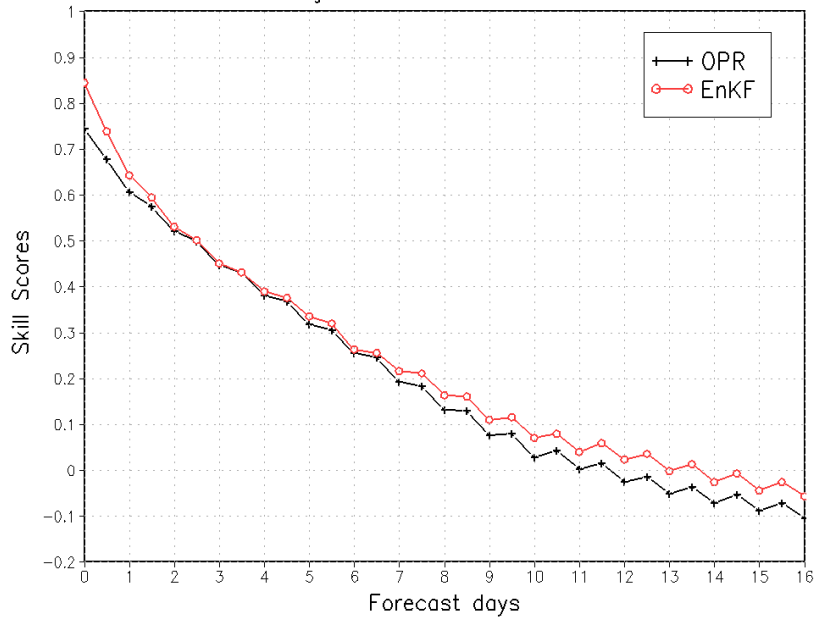

GFS – T574L64 (operation)
GEFS – T254L42 (operation)
EnKF – T574L64 SL (new analysis)

Track error(NM)

Forecast hours

| #CASES | 48 | 47 | 39 | 38 | 28 | 19 | 11 | 6 |
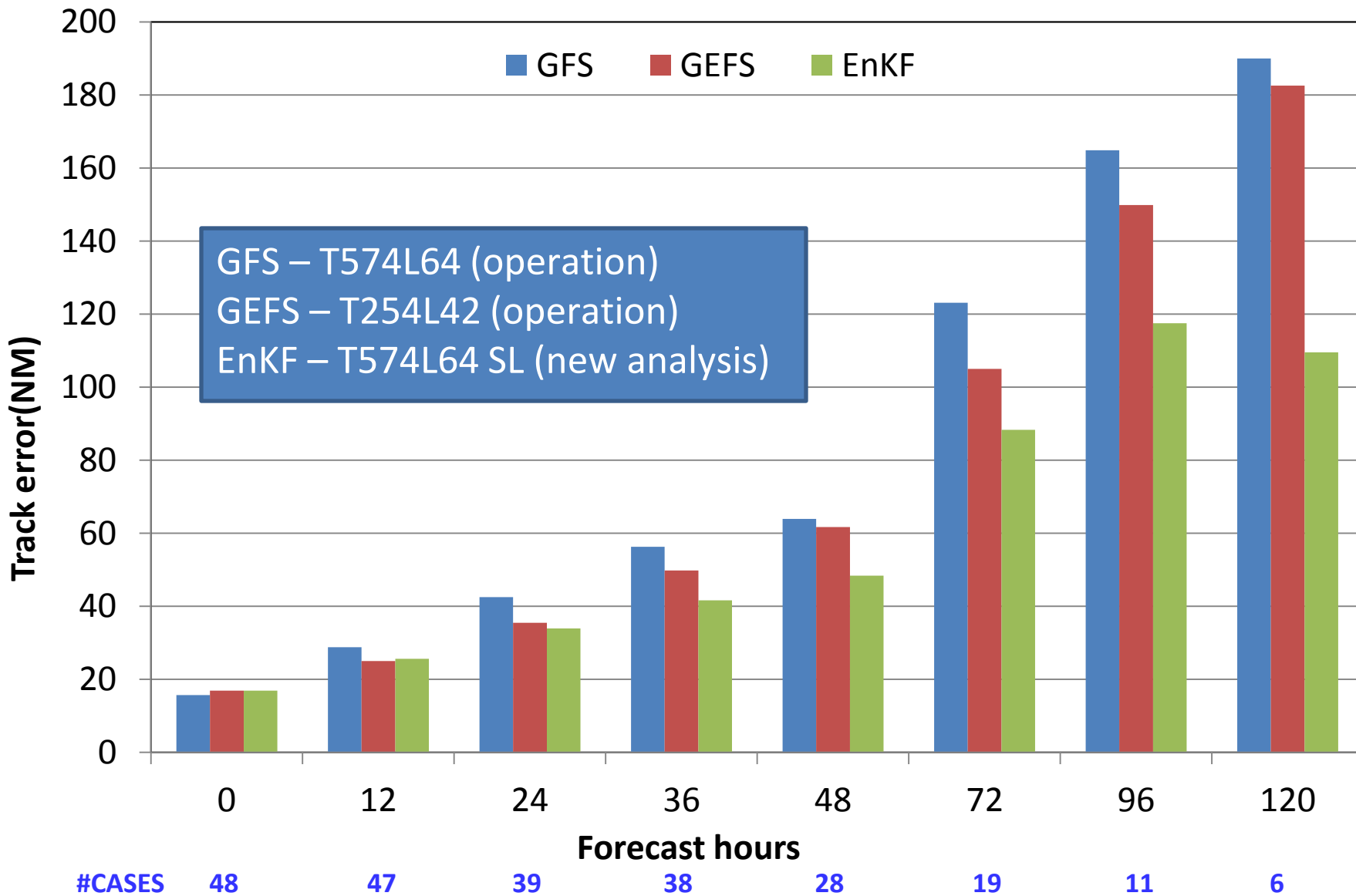
Courtesy of Jiayi Peng

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Precipitation (05/22-07/12/2013)

Ensemble Precipitation Verification for CONUS
Continuous Ranked Probability Scores
Average For 20130522 – 20130712

Other scores: http://www.emc.ncep.noaa.gov/gmb/yluo/tmp_dir/EnKF_prhs13_PQPFvrfy.html
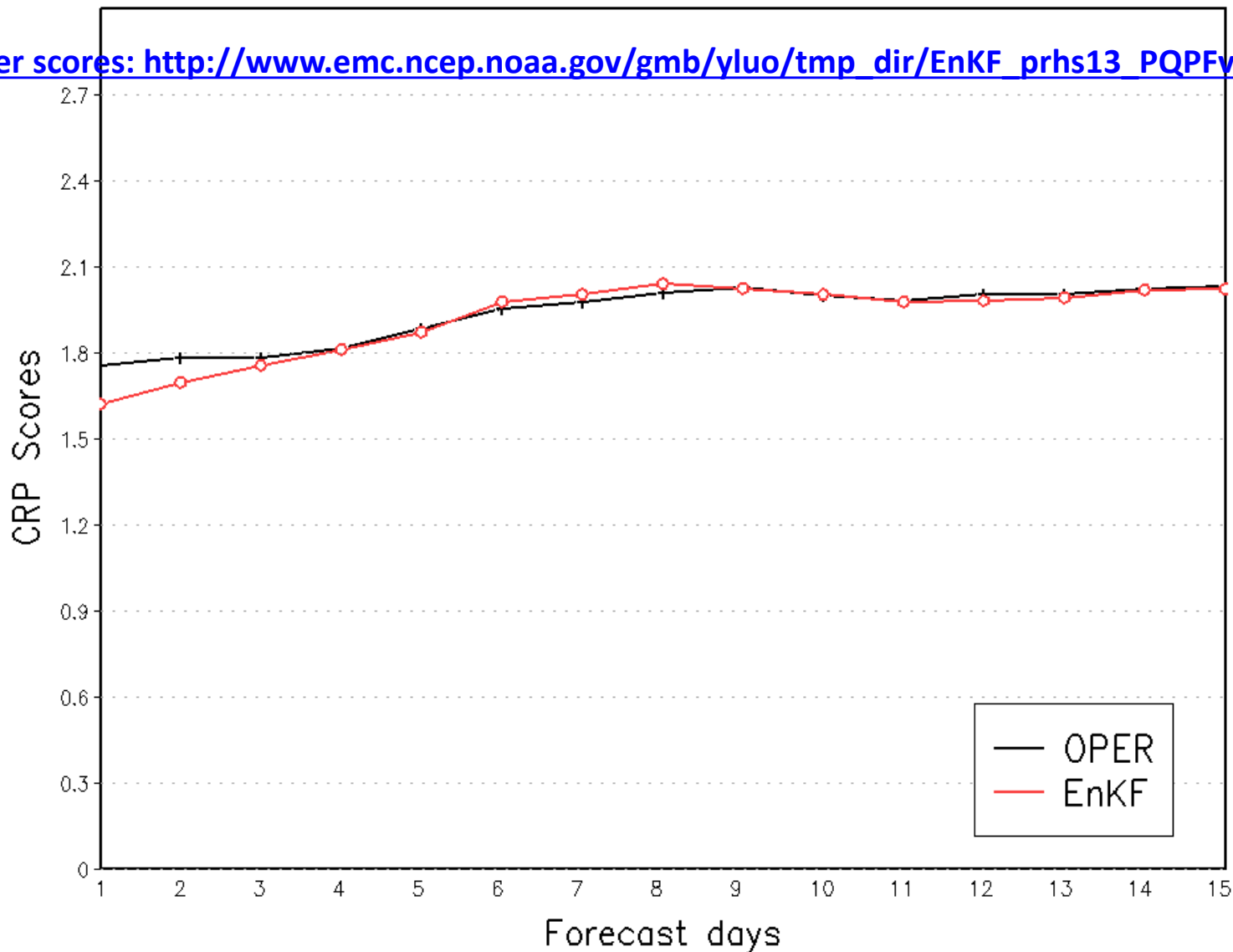
Ensemble Precipitation Verification for CONUS
Brier Score and Brier Skill Score for threshold > 5.00mm/24hours
For 20130522 – 20130712
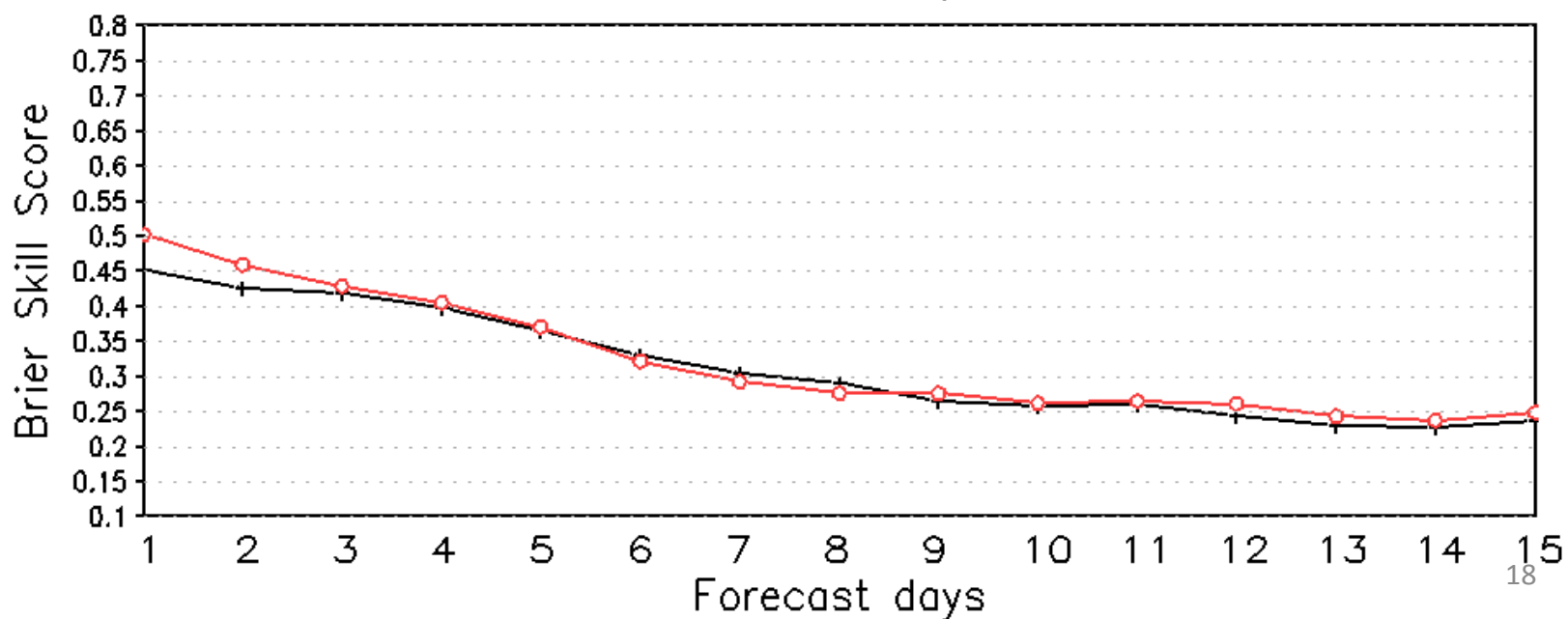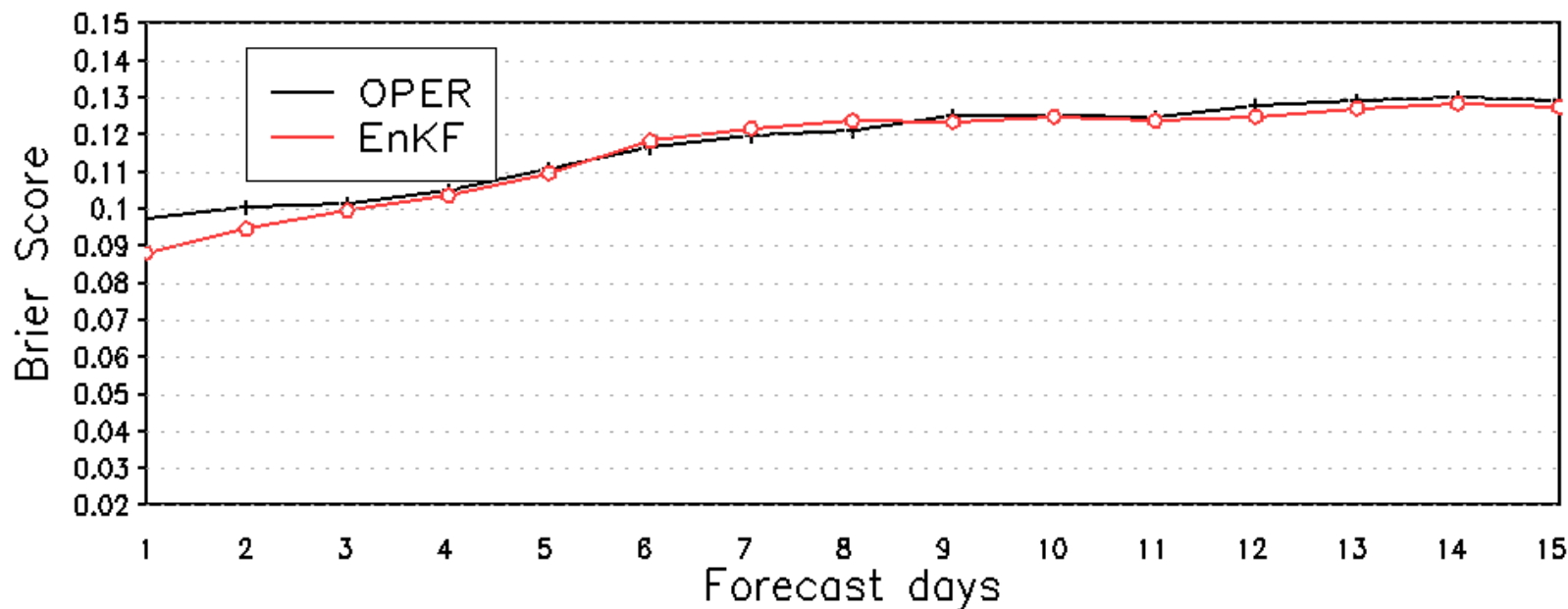
Reliability Diagram
fhr 12-36 For 20130522 - 20130712

Observed frequency (%)

Forecast probability (% >5.00mm)

OPER : RELI=0.016   BSS=0.449
EnKF : RELI=0.008   BSS=0.501
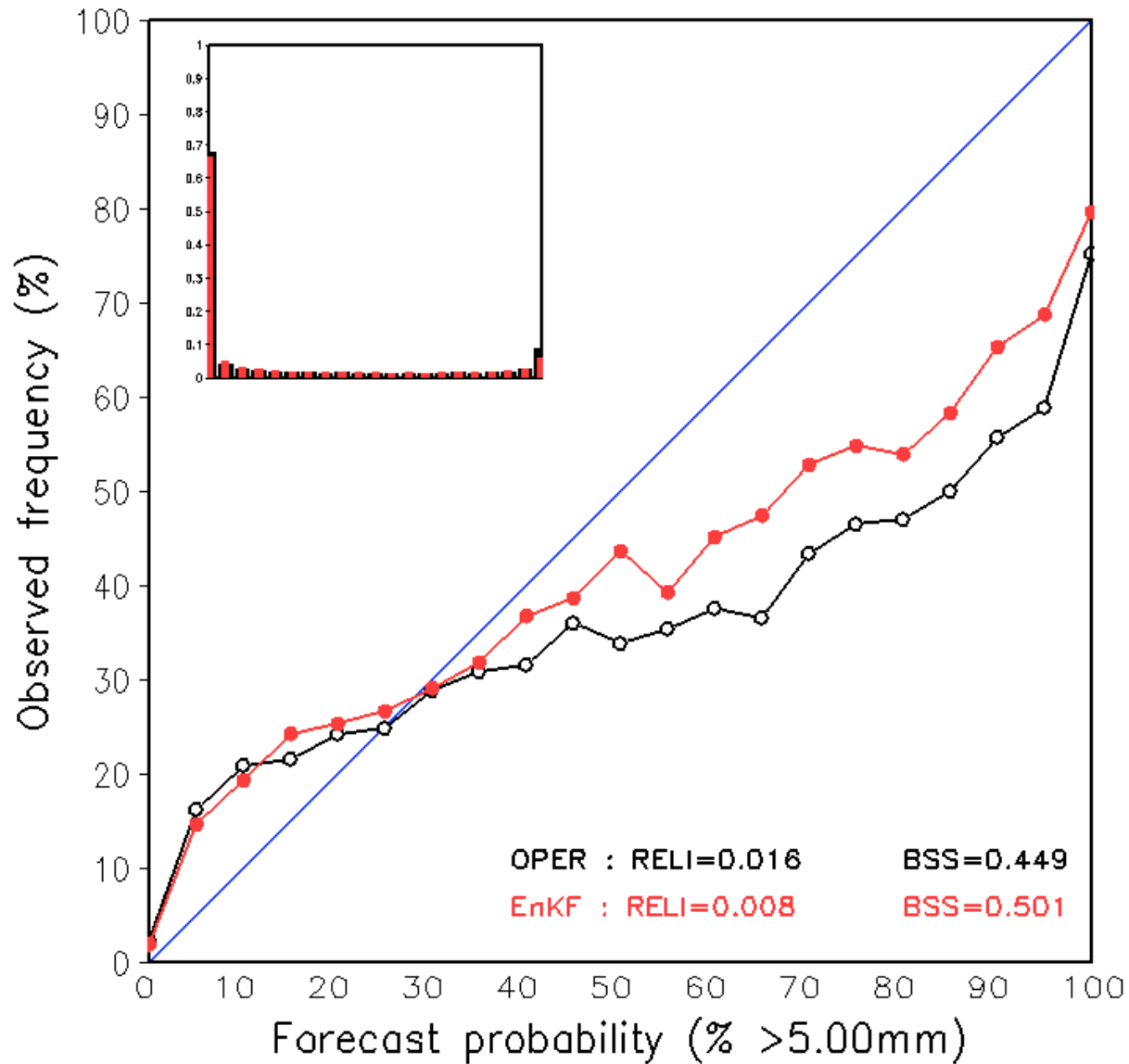
Reliability Diagram
fhr 108–132 For 20130522 – 20130712

OPER : RELI=0.005   BSS=0.364
EnKF : RELI=0.004   BSS=0.370

Observed frequency (%)

Forecast probability (% >5.00mm)
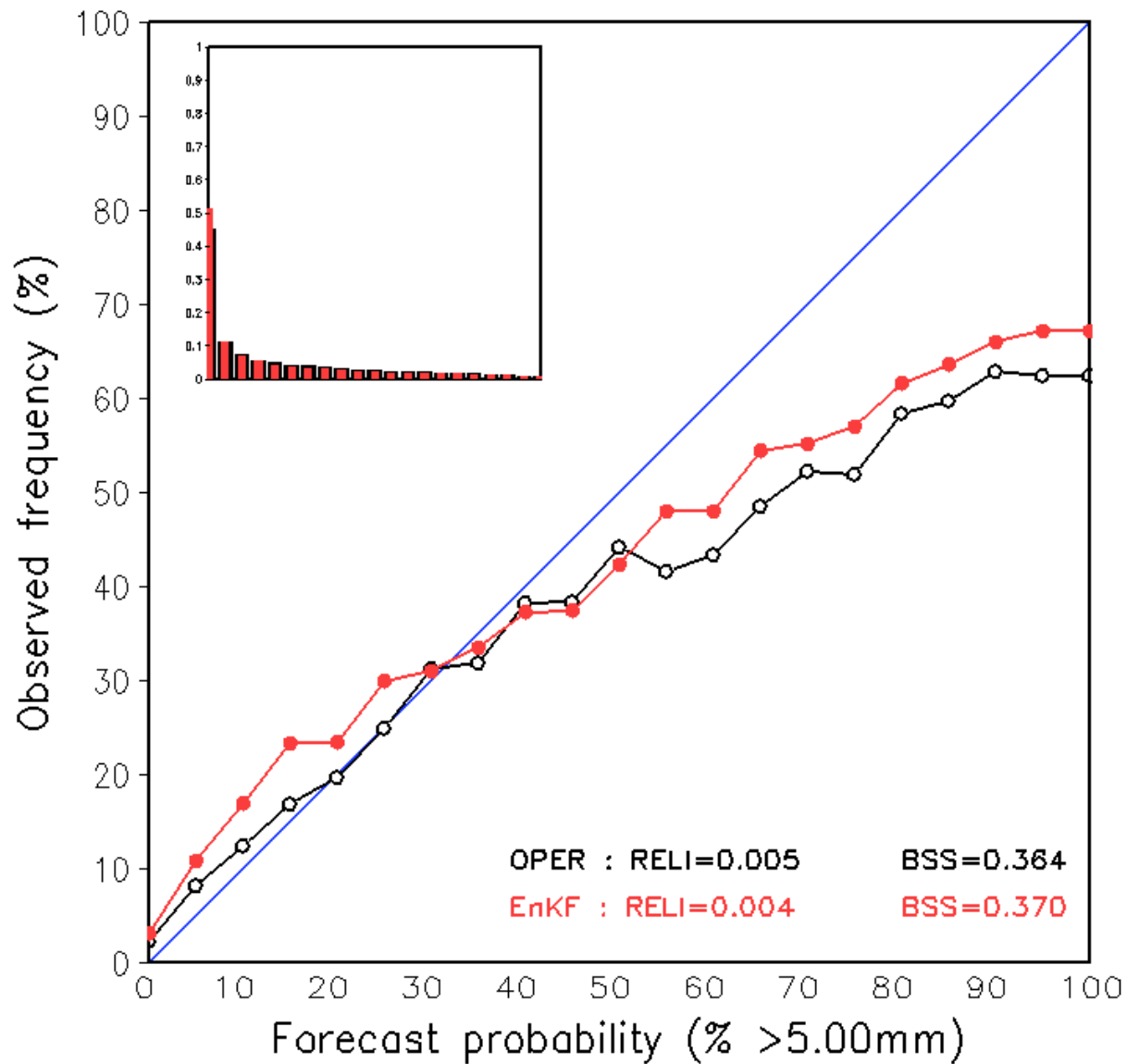
Next GEFS Plan

- Initial perturbations
  - Base: EnKF 6hr forecast
    - TS relocation
    - Ensemble transform - un-necessary if we can not find out significant improvement.
    - Centralization
    - Rescaling – un-necessary if we confirm EnKF parallels have the similar characteristics for different seasons
- Stochastic perturbations
  - Tune STTP for model change and initial perturbation changes
  - Turn off stochastic perturbations for surface pressure in STTP
- Expectations
  - Improve hurricane track forecast
  - Improve probabilistic forecast guidance
  - Improve predictability of HIW and extreme weather event

Test Plan for Next GEFS

- To confirm we have an agreement (with ESRL) for the initial perturbations
 - We need to distribute the new initial perturbations to HIWPP project for initiating FIM ensembles and Nave (NAVGEM) ensembles
- Minor modification for operational STTP toward higher resolution, new model and new initial perturbations
  - Turned off surface pressure (ln Ps) perturbations from STTP scheme
  - Start testing other stochastic schemes
  - Not sure we could insert all (or one) of them to next GEFS
- At least to run retrospective experiments for three full seasons
  - Hurricane seasons (2012, 2013)
  - Winter (2013-2014)
- To evaluate the performances of
  - Upper atmospheric fields
  - Surface elements which include precipitation for CONUS
  - Hurricane tracks (also intensity, even there is less skill comparing to others)

Challenges (list some of them)

- Configurations
  - Computation resources
  - Resolution and ensemble membership
- Initial uncertainties (or perturbations), if it will be good for both
  - EnKF analysis cycling (short-term forecast)
  - Medium-range ensemble forecast
- Lower levels and/or surface perturbations
  - Ensemble forecast is suffering large under-dispersion of surface elements (temperature, winds, precipitation and etc..) in both of the initial and forecast
- Uncertainties for tropical region

Background !!!

Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
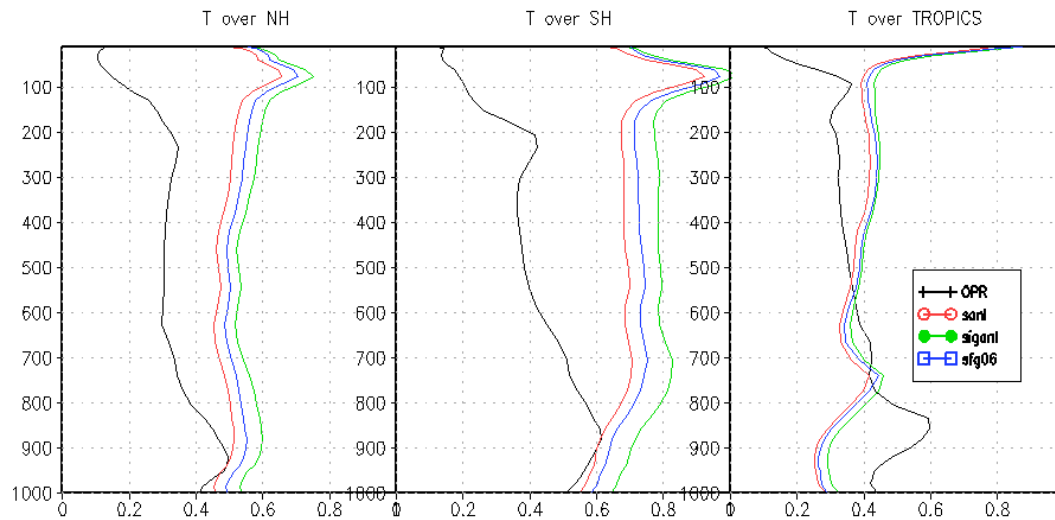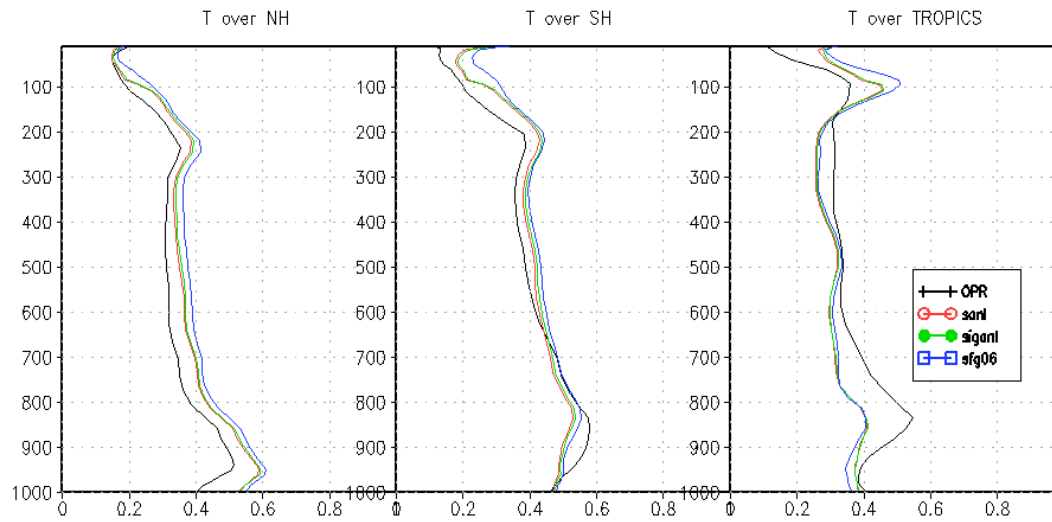Average For 20130522 − 20130712
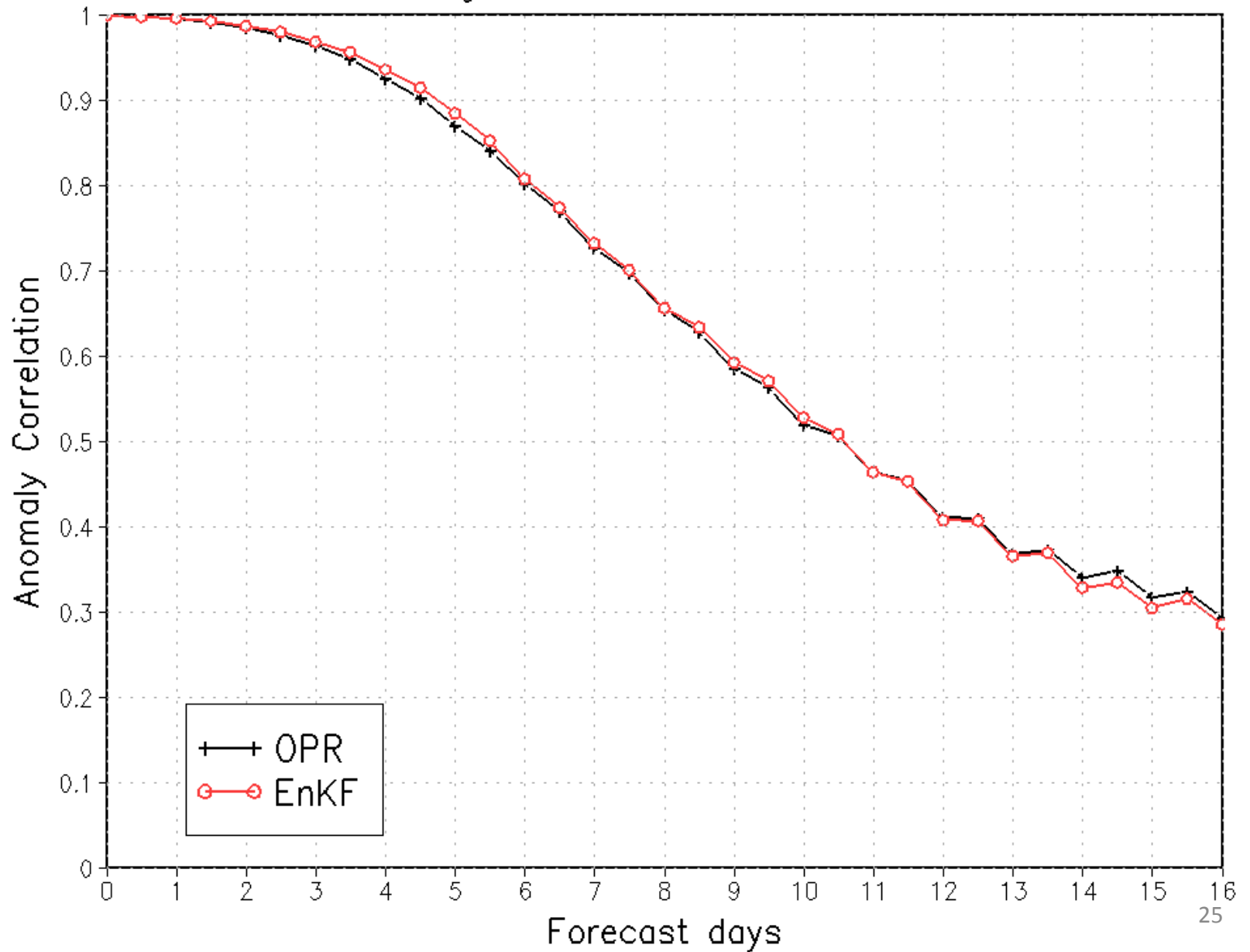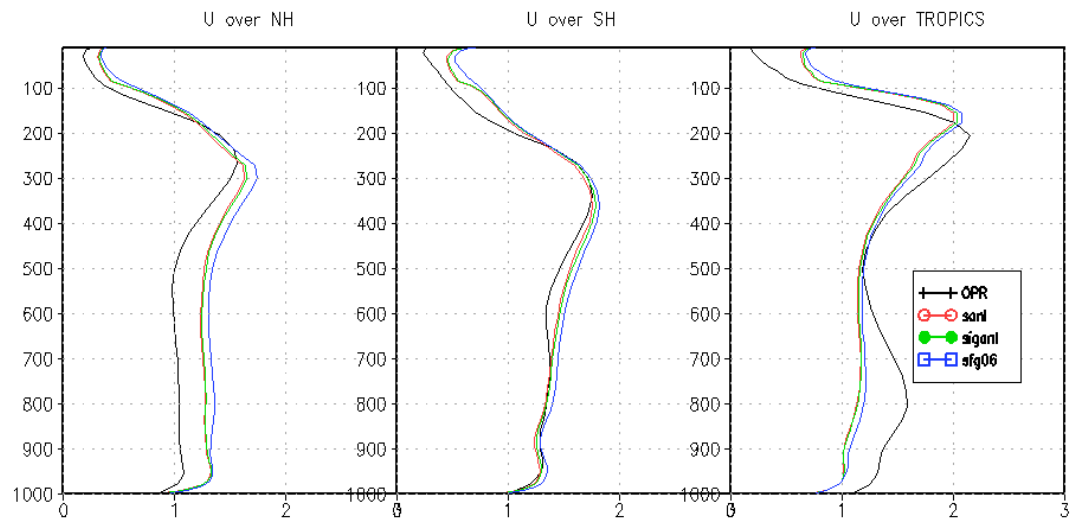
Analysis differences of surface temperature (T2m)

Period: 05/01/2013 – 8/15/13
RMS errors for 107 days (against obs)

Regions	GFS	Par
West	3.227	3.383
East	2.637	2.465
Southwest	3.884	4.203
Northwest	3.368	3.581

T over NH   T over SH   T over TROPICS

OPR
sanl
siganl
sfg06

Parallel
2013081900
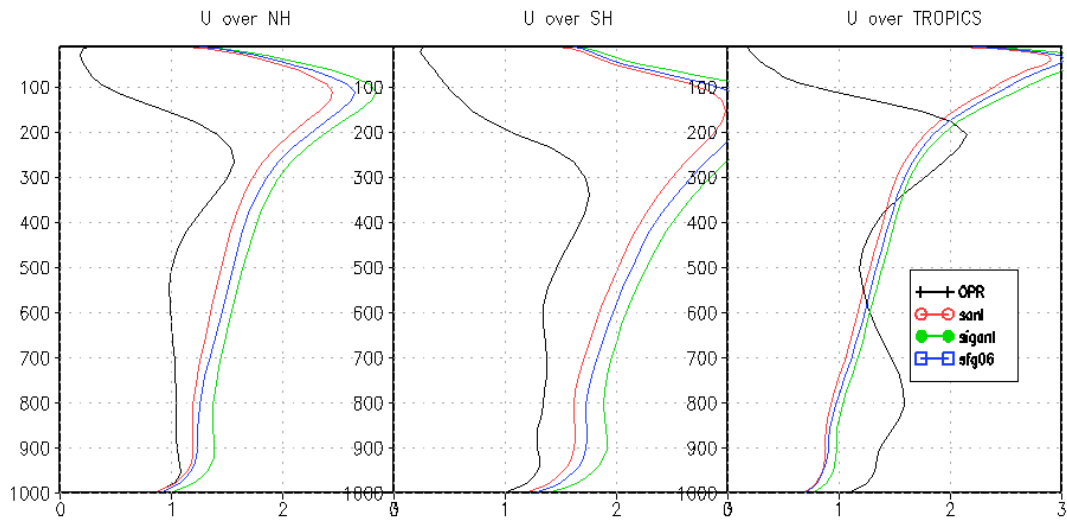
T over NH   T over SH   T over TROPICS

OPR
sanl
siganl
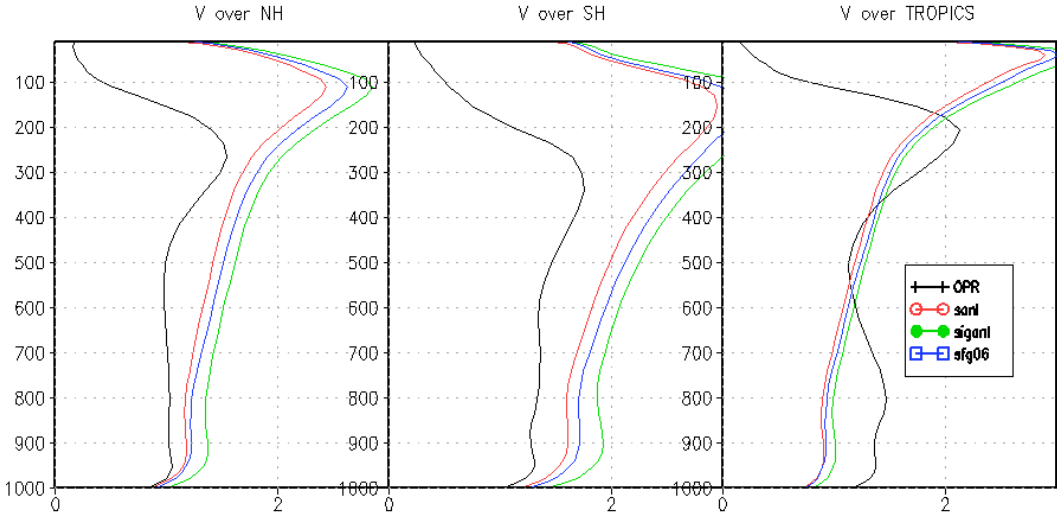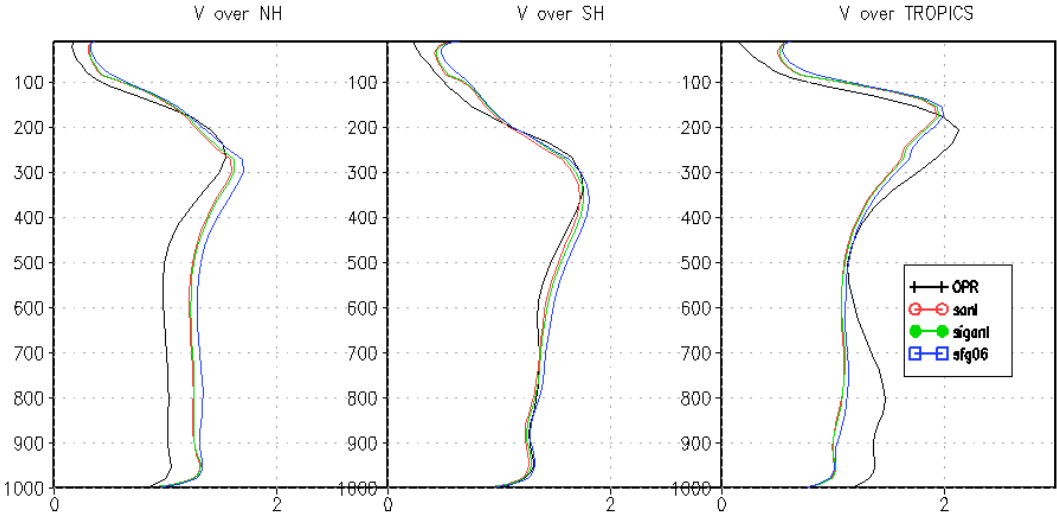sfg06

Operation
2013081900

Parallel
2013081900

Operation
2013081900

Parallel
2013081900

Operation
2013081900