EMC FY15 Upgrade Review

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GEFS Upgrade

Presented by:

Yuejian Zhu

Update: 03/19/2014

Next GEFS configuration

- Model
  - Current: GFS Euler model
  - Plan: GFS Semi-Lagrangian model
- Horizontal resolution
  - Current: T254 (55km for 0-192 hours), T190 (73km for 192-384 hours)
  - Plan: T574 (T382 physics - 34km for 0-168 hours), T382(T254 physics – 55km for 168-384 hours)
- Vertical resolution
  - Current: L42 hybrid levels
  - Plan: L64 hybrid levels to match with GFS and DA
- Computation cost:
  - Current: 84 nodes (+ post process) for 55 minutes
  - Plan: 300 nodes (first 30 minutes), 250 nodes (2nd 30 minutes)
- Output:
  - Current: every 6-hr for 1*1 degree pgrb files
  - Plan: every 3-hr for 0.5*0.5 degree pgrb files
- Challenges:
  - T574L64 configuration will cost 250-300 nodes for one hour
  - Option: T574L42 configuration will use less resources, but the forecast quality will be degraded.

Next GEFS science

- Initial perturbations
  - Base: EnKF 6hr forecast
  - TS relocation – Yochrio's modification version (simplify the process)
    - Is testing the effect of perturbed TS intensity
  - Ensemble transform (ET) from 80 vectors
    - ET will apply to 80 EnKF f06 vectors
    - Centering for 20 selected perturbations for integration
    - Theoretically, this design will lost the advantage of lag ensemble
      - No continuation of perturbed vectors from cycle to cycle
  - 3 dimensional rescaling (3DR)
    - Building analysis error variance (total energy norm)
    - Monthly average from past years EnKF analysis (less inflated one)
    - Rescaling 6hr forecast perturbations by applying 3DR
- 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
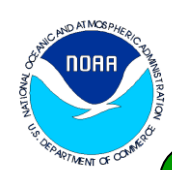
GEFS Upgrade (Q4FY14/Q1FY15)
Project Status as of 03/19/2014

G ## Project Information and Highlights

Lead: Yuejian Zhu, EMC, Chris Magee, NCO

Scope:
- Latest GFS model (SLG version with improved physics).
- Configurations: T574L64 and T382L64 out to 384 hours
    - 0-168hr - T574 (T382 for physics – 33-35km
    - 168-384hr – T382 (T254 for physics) – 51-54km
    - L64 – the same vertical resolution as EnKF, GFS
- Initial perturbations
    - Hybrid - EnkF 6h forecast with ETR
    - Improved TS relocation
- Stochastic physics
    - Tuning parameters for STTP to upgrade GFS model
- Forecast data output
    - All GRIB II format
    - 0.5degree data for pgb files
    - 3 hourly output frequency

Expected Benefits:
- Reduce the surface temperature bias
- Improve TS trick forecast
- Increase probabilistic forecast skill

G ## Scheduling

Milestone (NCEP)	Date	Status
EMC testing complete/ EMC CCB approval	07/31/2014	
Initial Code Delivery to NCO	08/31/2014	
Technical Information Notice Issued	09/30/2014	
Initial Test Complete		
CCB approve parallel data feed		
IT testing begins		
IT testing ends		
Parallel testing begun in NCO (Code Frozen)	10/20/2014	
Real-Time Evaluation Ends	11/20/2014	
Management Briefing		
Implementation		

G ## Issues/Risks
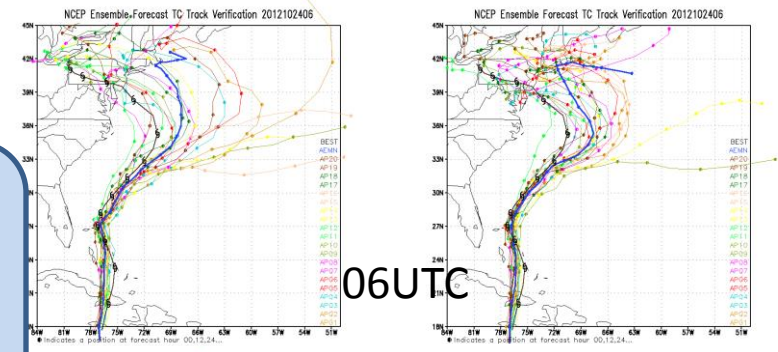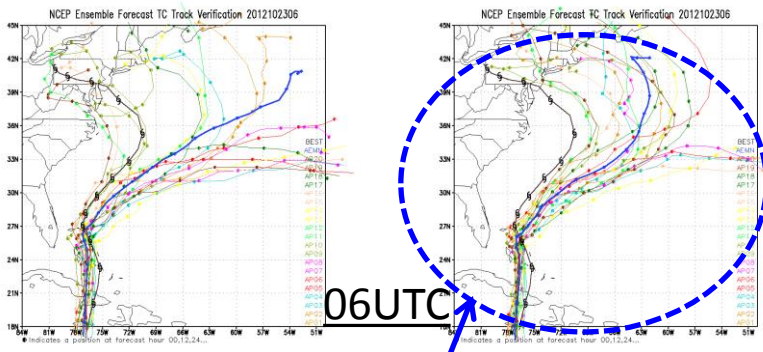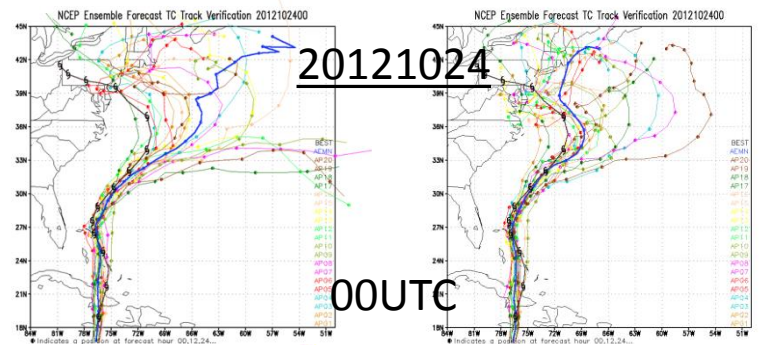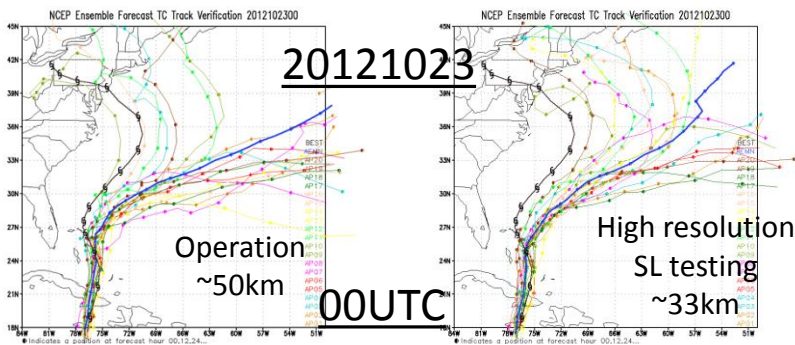
Issues: N/A

Risks:

Mitigation:

G ## Finances
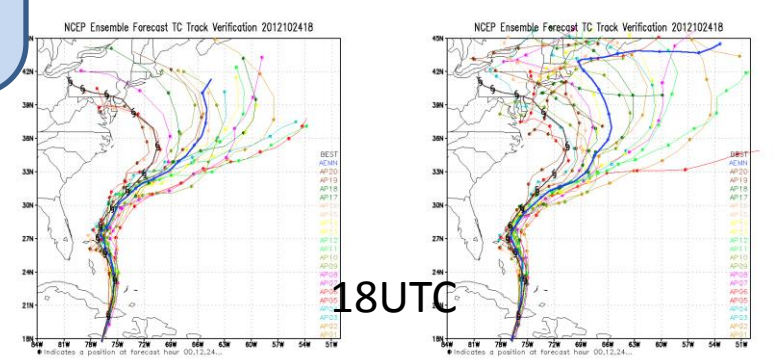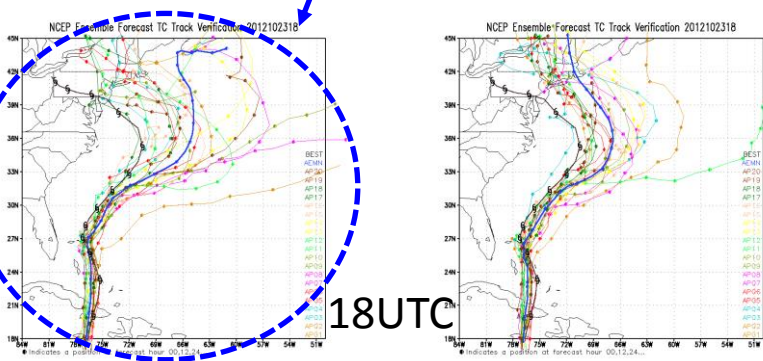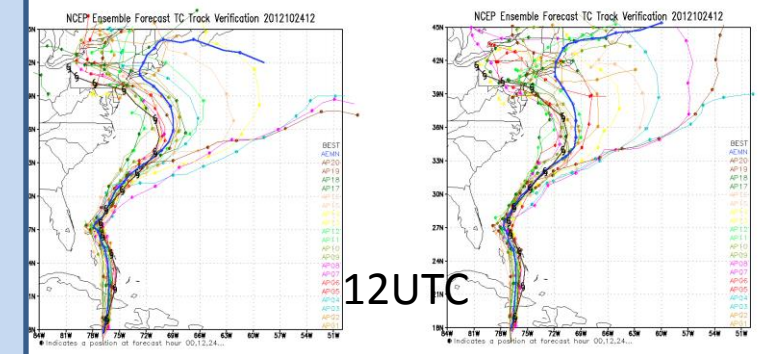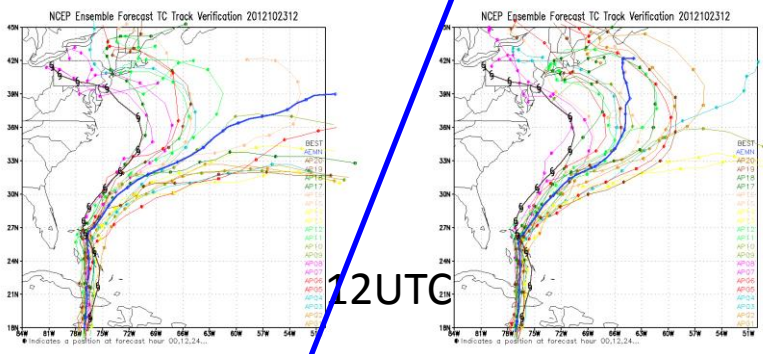
Associated Costs:

Funding Sources: EMC Base: NCO Base:

R	Management Attention Required	**Y**	Potential Management Attention Needed	**G**	On Target

Sandy case set up and experiments

- Earlier version of GFS semi-Lagrangian model (Early 2013)

- T574L42/T574L64 resolutions

- No updated initial condition, still use operational hybrid initial condition.

- No STTP to assimilate model uncertainty

- No ETR cycling for new model, high resolution

- No tuning for initial perturbations

20121023

Operation ~50km

High resolution SL testing ~33km

00UTC

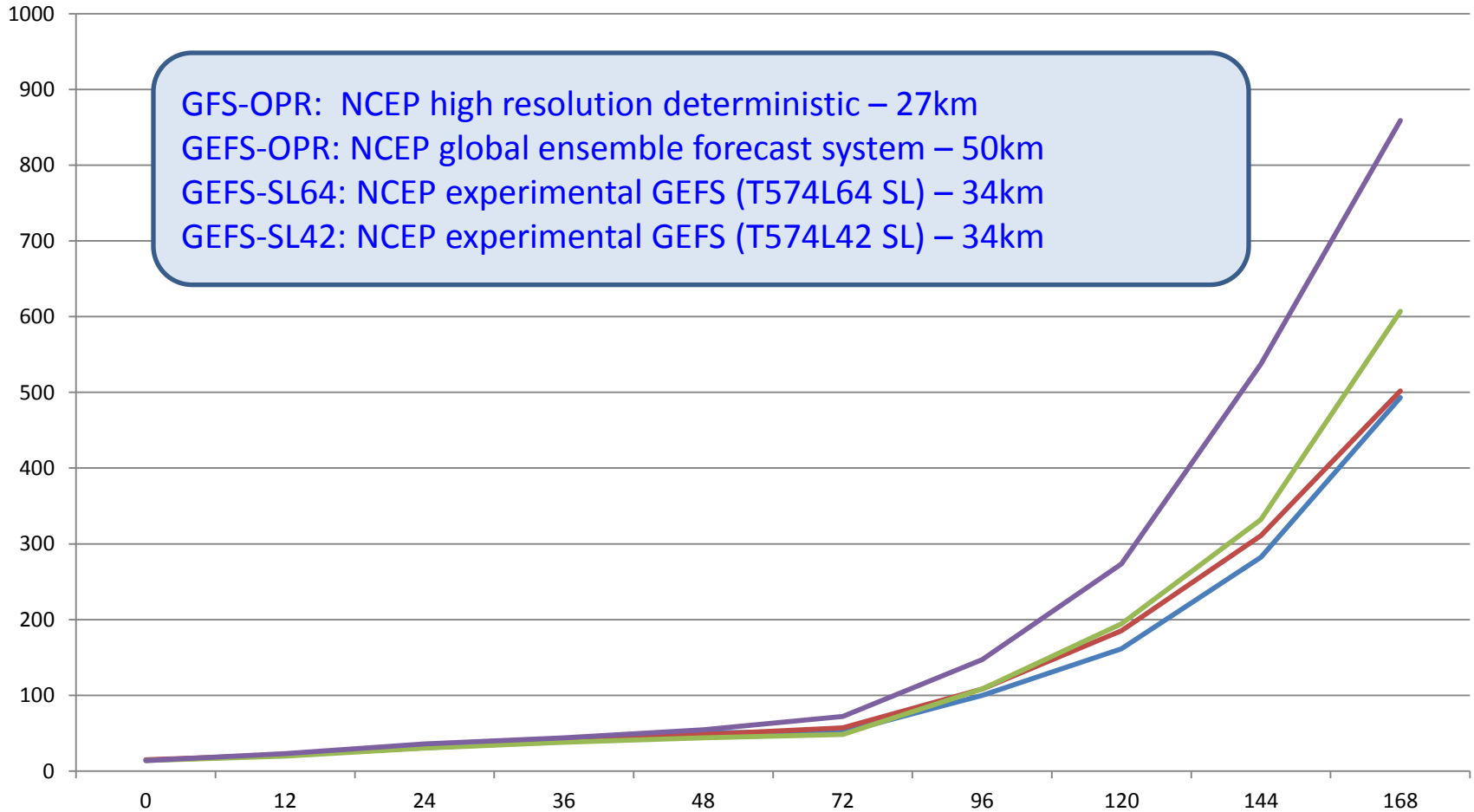06UTC

12UTC

18UTC

20121024

00UTC

06UTC

12UTC

18UTC

New high resolution ensemble has about 12 hour's advantage in predicting Sandy's turned to North

Sandy case study for new GEFS

Legend: GEFS-SL42, GEFS-SL64, GEFS-OPR, GFS-OPR

GFS-OPR: NCEP high resolution deterministic – 27km
GEFS-OPR: NCEP global ensemble forecast system – 50km
GEFS-SL64: NCEP experimental GEFS (T574L64 SL) – 34km
GEFS-SL42: NCEP experimental GEFS (T574L42 SL) – 34km

| CASES | 33 | 33 | 33 | 31 | 29 | 25 | 21 | 17 | 13 | 9 |

Anomaly Correl: HGT P500 G2/NHX 00Z, fh72

3-day

EK   0.976   46
GEFSC   0.973   46
PRHW14 0.977   46
GFS   0.976   46

Anomaly Correl: HGT P500 G2/NHX 00Z, fh120

5-day

EK   0.903   46
GEFSC   0.895   46
PRHW14 0.907   46
GFS   0.905   46

Anomaly Correl: HGT P500 G2/NHX 00Z, fh192

8-day

EK   0.671   46
GEFSC   0.666   46
PRHW14 0.675   46
GFS   0.672   46

Verification Date

Comparison of new GFS model (latest version) against the operational For deterministic Forecast
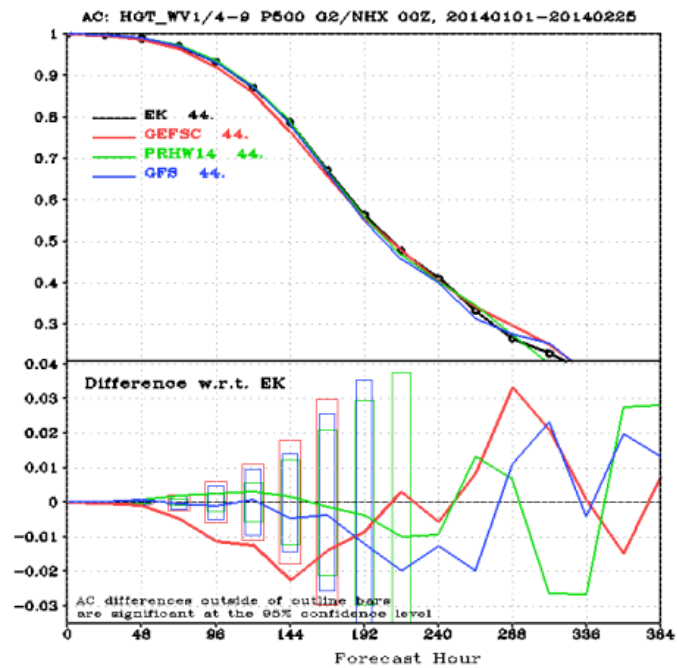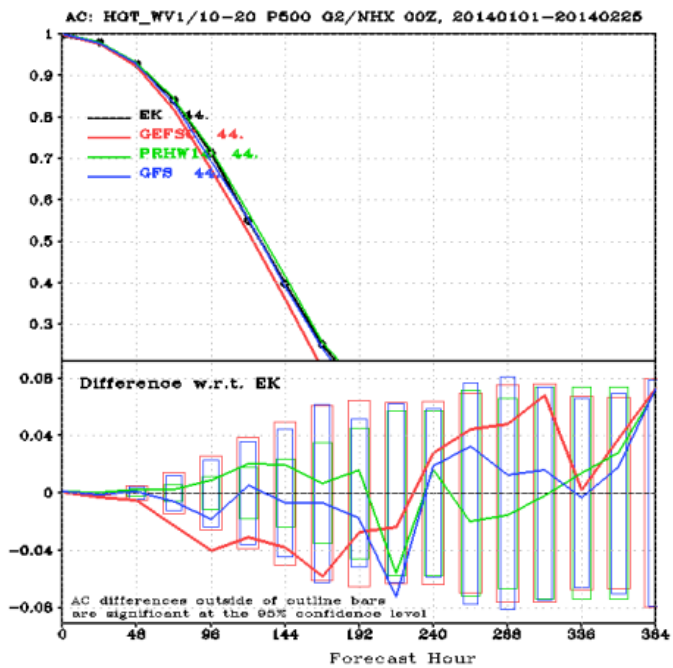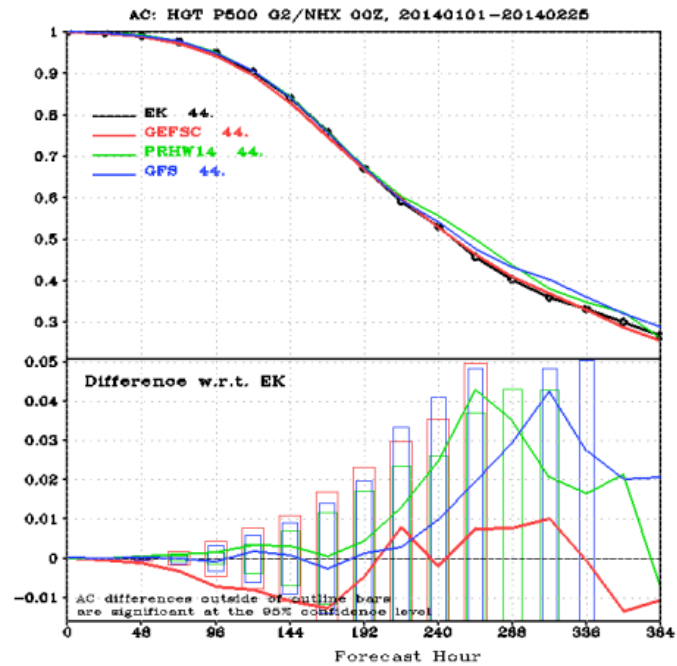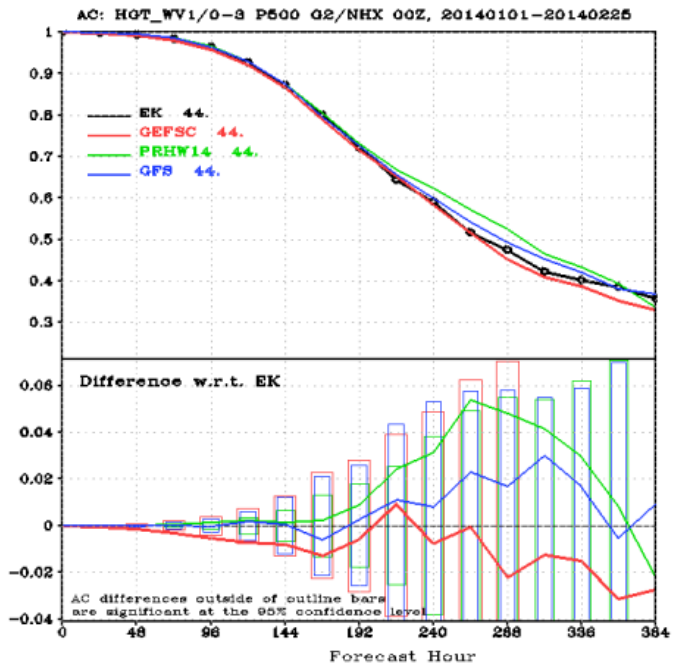
Period: 1/1 -2/24/2014
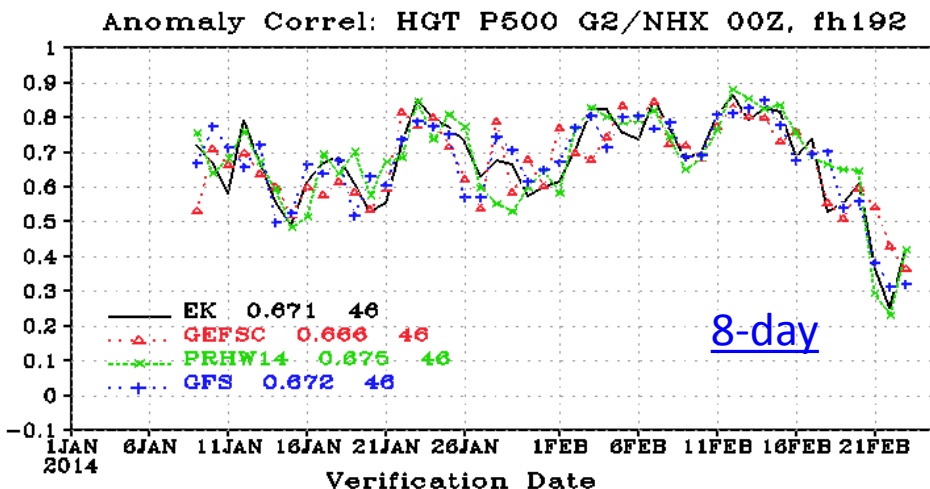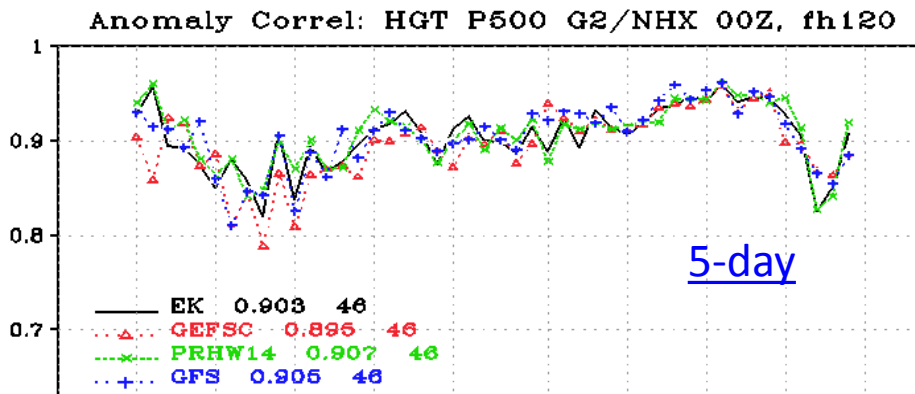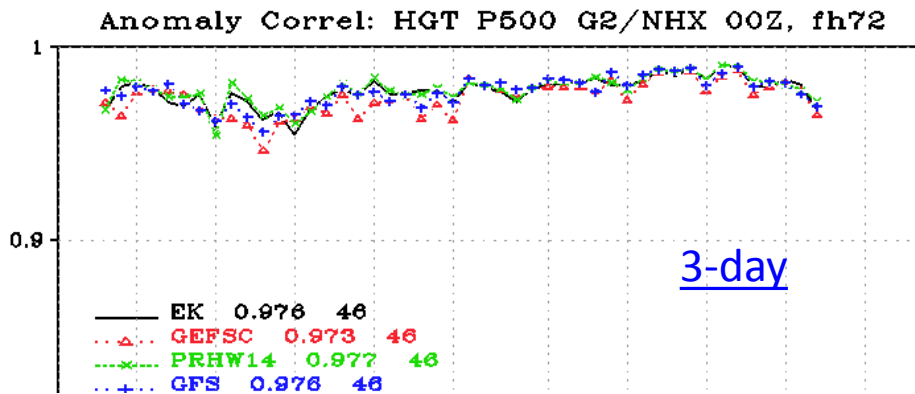
EK – GEFS control (para) - T574L64 EU
GEFSC – GEFS control – T254/190L42 SLG
PRHW15 – GFS (para) – T1534L64   SLG
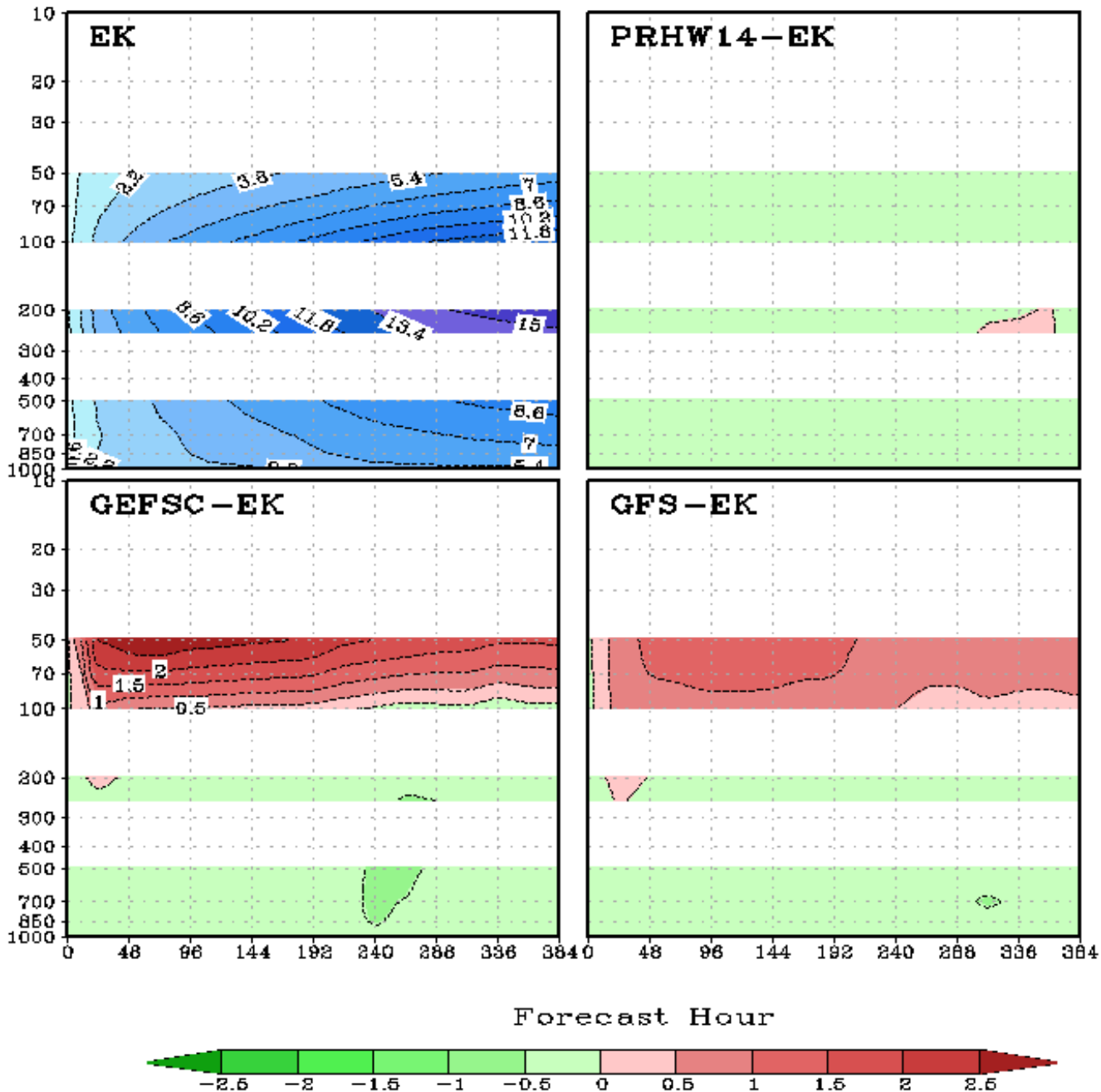GFS – GFS (opr) – T574/382L64   EU

Conclusion:
3-, 5-, 8-day NH 500hPa AC scores of GEFS control parallel are about 0.5% better than current operation, close to operational GFS, but not as good as GFS parallel.

AC: HGT_WV1/0-3 P500 G2/NHX 00Z, 20140101-20140225

AC: HGT P500 G2/NHX 00Z, 20140101-20140225

AC: HGT_WV1/10-20 P500 G2/NHX 00Z, 20140101-20140225

AC: HGT_WV1/4-9 P500 G2/NHX 00Z, 20140101-20140225

WIND: RMSE
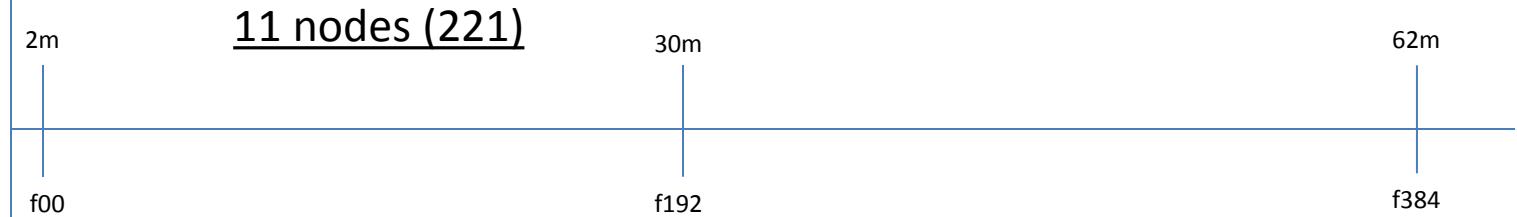20140101–20140225 Mean, G2/TRO 00Z

Tropical wind

1. Not as good as high resolution GFS parallel

2. Better than GFS-opr and GEFS-opr for stratosphere.

3. Worse than GFS-opr and GEFS-opr for lower troposphere.

4. This may affect the skills for MJO prediction, and future coupling for extended forecast
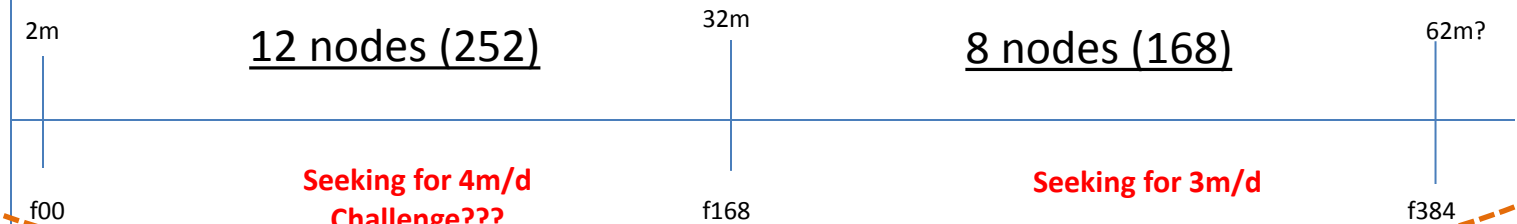
Background!!!

Current WCOSS operation (T254L42 0-192hr, T190-L42 180-384hr)

2m
4 nodes (84)
33m
7m for change resolution
2 nodes (42)
62m

f00
f192
f384
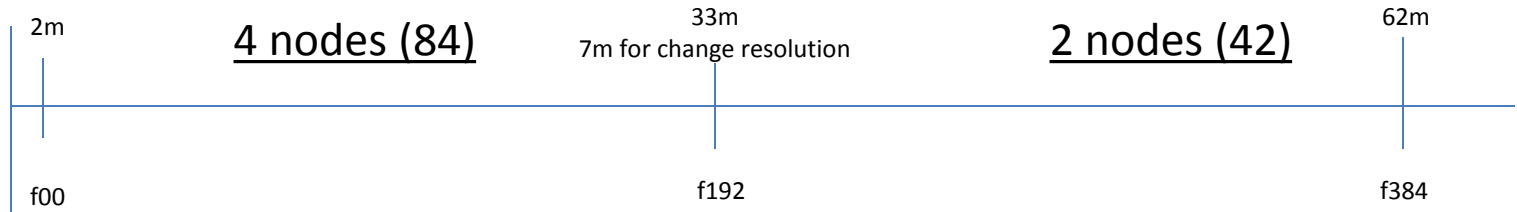
Option one: T574L42 SL (T382 physics) 0-384hrs for 210 nodes (with minimum phys.)

2m
11 nodes (221)
30m
62m

f00
f192
f384

Option two: T574L64 SL (T382 physics) 0-168hrs, T382L64 SL (T254 physics) 156-384hrs

2m
12 nodes (252)
32m
8 nodes (168)
62m?

Seeking for 4m/d
Challenge???
f168
Seeking for 3m/d
f384
f00

Please consider the timing of first 96 hours output for SREF boundary condition