GEFSv13 updates

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Outline

- Brief review of GEFSv13 development
- Results from the recent experiments
- Challenges and future plan

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Model Configurations (GEFSv12 vs GEFSv13)

Components		V12 (Sep 23. 2020)	V13 (targeting FY26)
Atmos	Dynamics	FV3 (Finite-Vol Cubed-Sphere) GFSv15	FV3 (Finite-Vol Cubed-Sphere) GFSv17
	Physics	saSAS, GFDL-MP, K-EDMF, oroGWD	saSAS, Thompson-MP, sa-TKE-EDMF, uGWD
	Initial perturbation	EnKF f06 (previous cycle)	EnKF f00 (early cycle)
	Model uncertainty	5-scale SPPT and SKEB	5-scale SPPT, SKEB, SPP, CA
	Boundary (ocean surface)	NSST + 2-tiered SST	NSST
	Resolutions	C384L64 (25km)	C384L127 (25km)
Land	Model	NOAH-LSM	NOAH-MP
	Initial perturbation	N/A	Soil moisture
Ocean	Model	N/A	MOM6 (0.25°L75)
	Initial perturbation		SOCA-Ens
	Model uncertainty		5-scale oSPPT and ePBL
Ice	Model		CICE6 (0.25°)
	Initial perturbation		SOCA-Ens
Wave	Model	WW3 (1-way) (0.5°)	WW3 (2-way) (0.25° lat/lon grid)
Aerosol	Model	GOCART (1-way)	GCAFS

Aerosol component will be separated, and a new Global Chemistry and Aerosol Forecast System (GCAFS) is being developed.

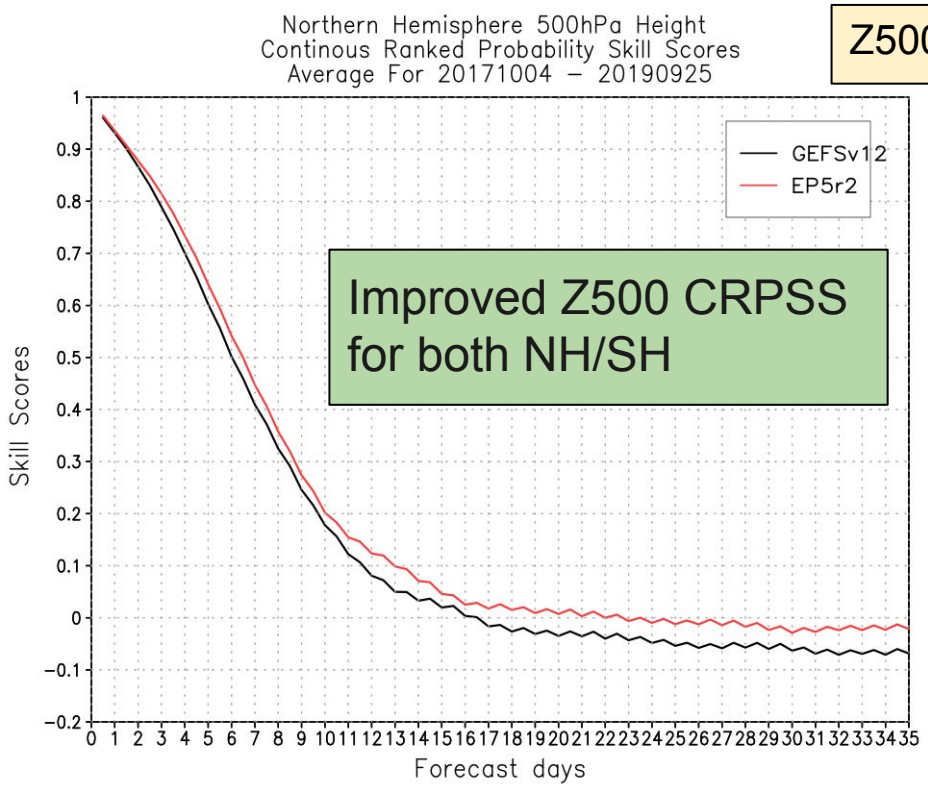
Ensemble prototypes for GEFSv13

Ensemble Prototype (UFS prototype)	Timestamp of the model tag
EP1 (P5)	09/16/2020
EP2 (P7)	08/23/2021
EP3 (P8)	05/31/2022
EP4* (HR1)	01/30/2023
EP5* (HR3)	01/11/2024
EP6 (HR4)	08/23/2024

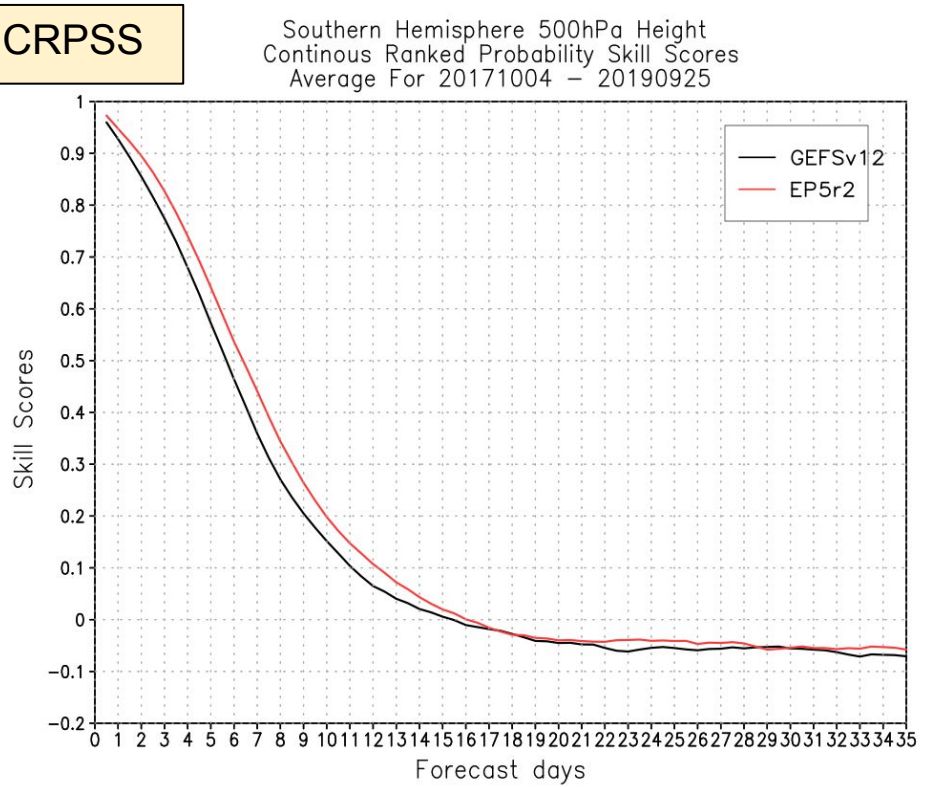
Following development of UFS coupled model, we have built 6 ensemble prototypes.

EP5r2 results

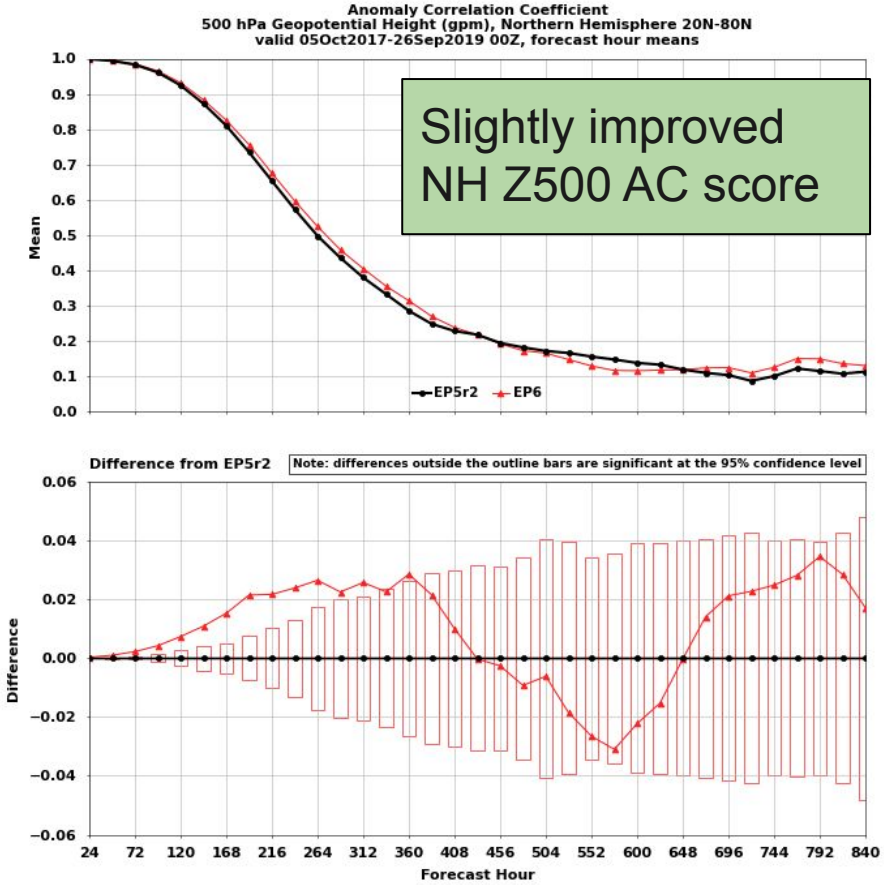
Z500 CRPSS



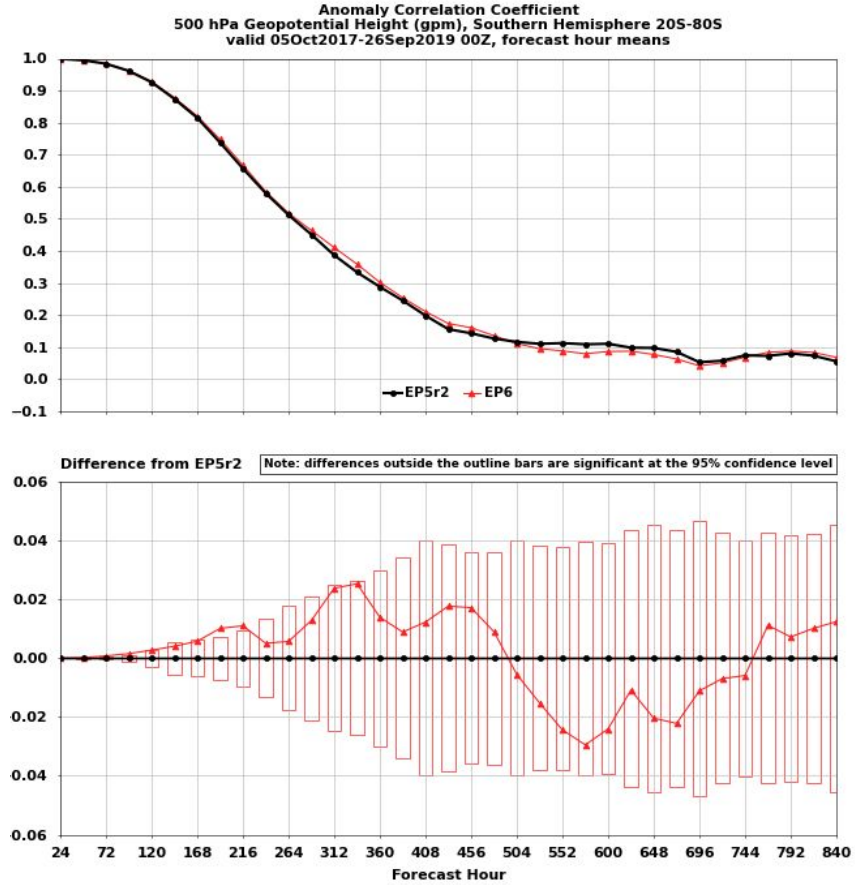
Improved Z500 CRPSS for both NH/SH



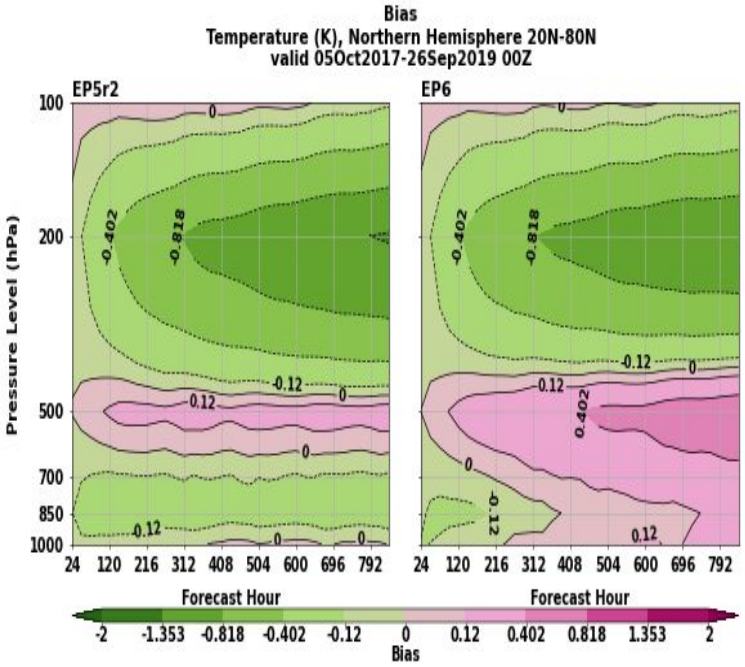
EP6 (current reforecast) results

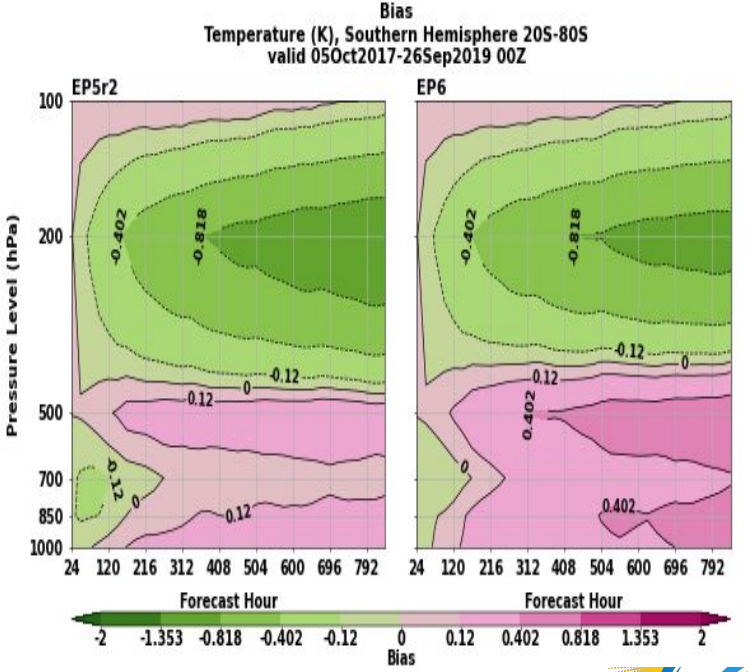


Slightly improved NH Z500 AC score



EP6 (current reforecast) results





- Reduction of upper level cold bias
- Increase of lower level warm bias

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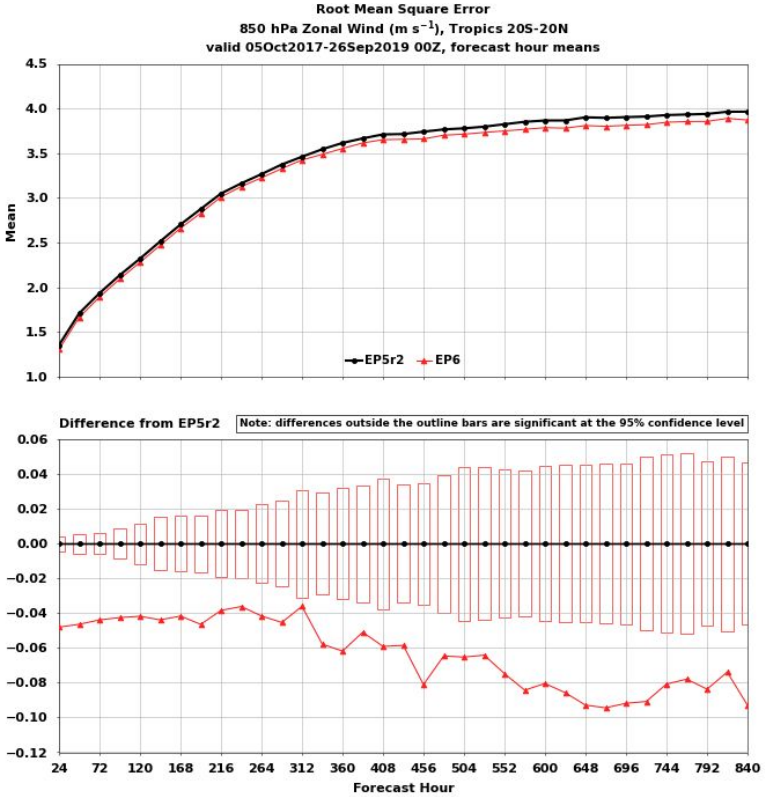
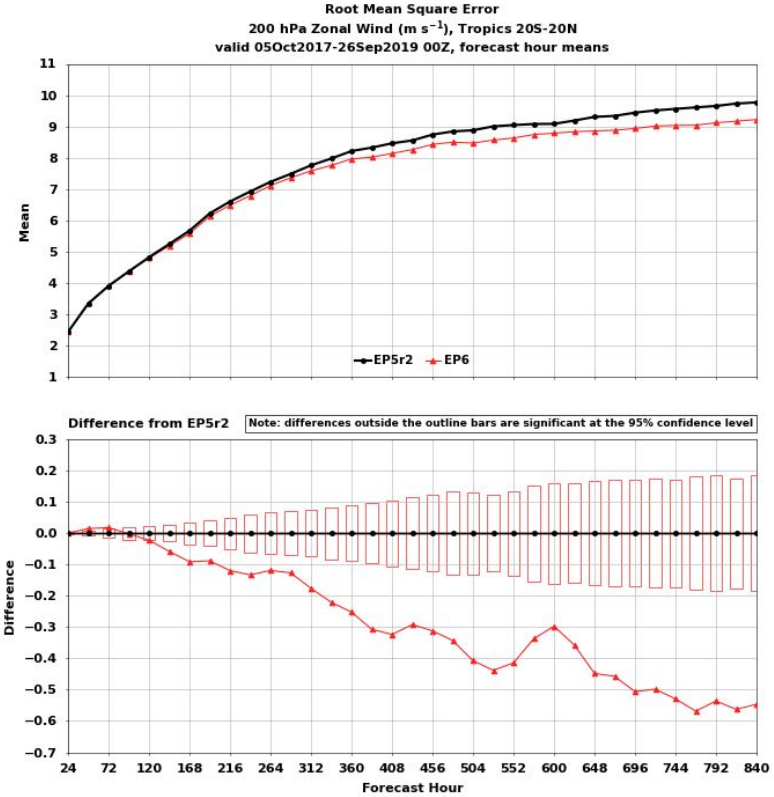
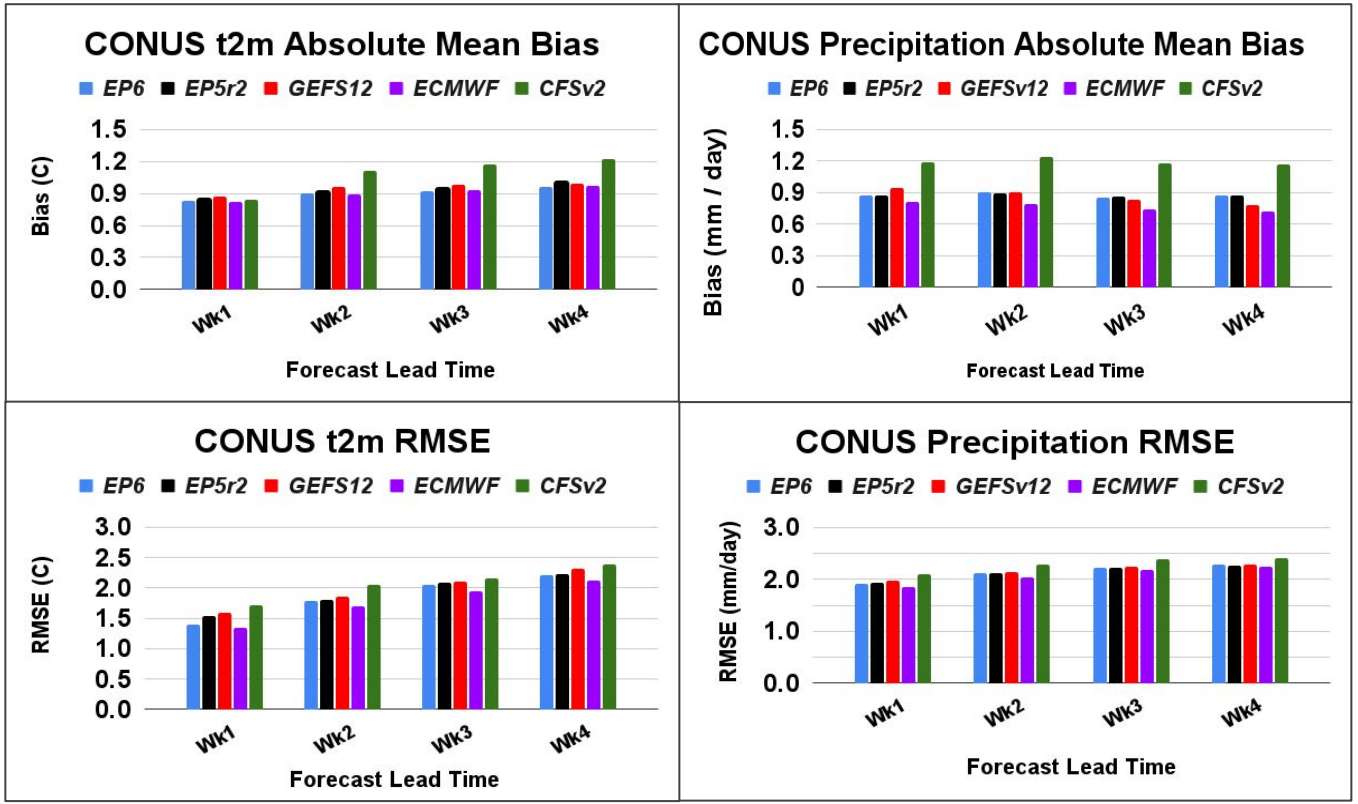
EP6 (current reforecast) results





- Significantly reduced RMSE for tropical lower level winds

EP6 (current reforecast) results



(Figure from Robert Long etc, CPC)

- EP6, EP5r2 precipitation bias consistent with reference reforecast models
- EP6 t2m has less error than EP5r2, GEFSv12, and CFSv2 at all forecast leads

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Challenges of current reforecast

- Issues found from the reforecast:
  - Some crashes due to inconsistent surface initial conditions (related to grid mismatch)
  - Stokes drift not turned on in wave input file
  - Slightly degraded MJO skills
  - Some bugs in model code
- Future operational GEFSv13 and GFSv17 will be using an updated version of the model

Change of GEFSv13 implementation plan:

GEFSv13 will be implemented after GFSv17

Updated plan for reforecast

- Use the latest model with all the bug fixes:
- Switch to using surface IC directly from spinup and snow DA (avoid inconsistency)

Benefits

- Fix the model crash due to inconsistent surface IC
- Reforecast will be using the same model as future operational model and GFSv17 (this is crucial for model calibration)

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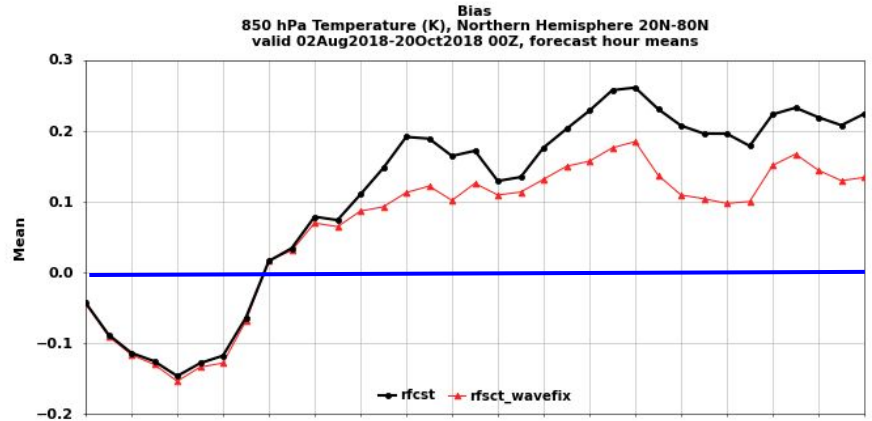
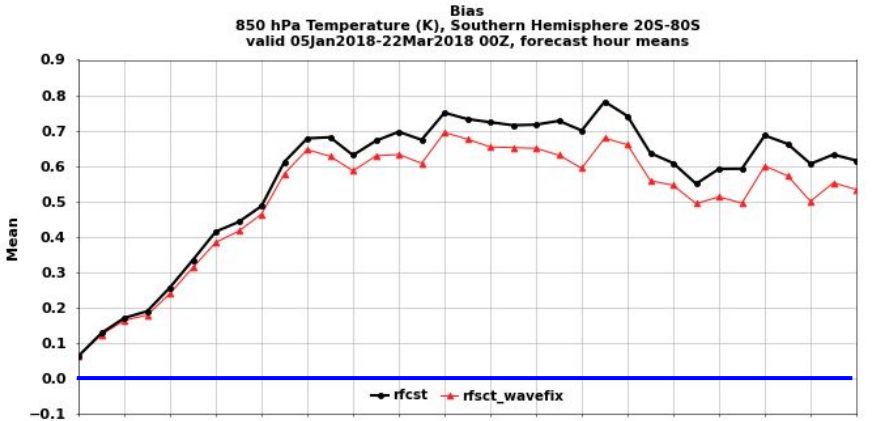
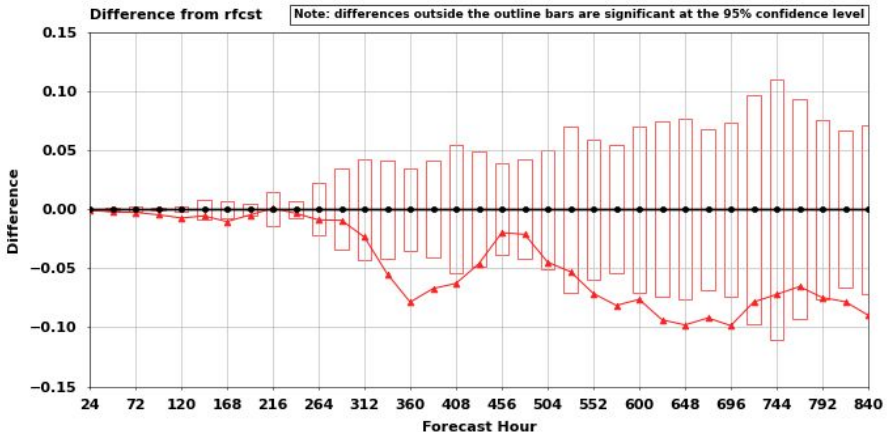
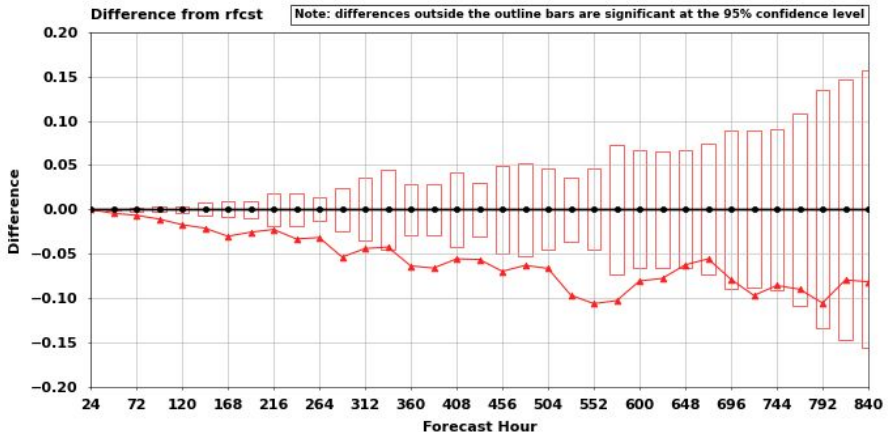
Wave bug fix results (bias reduced)

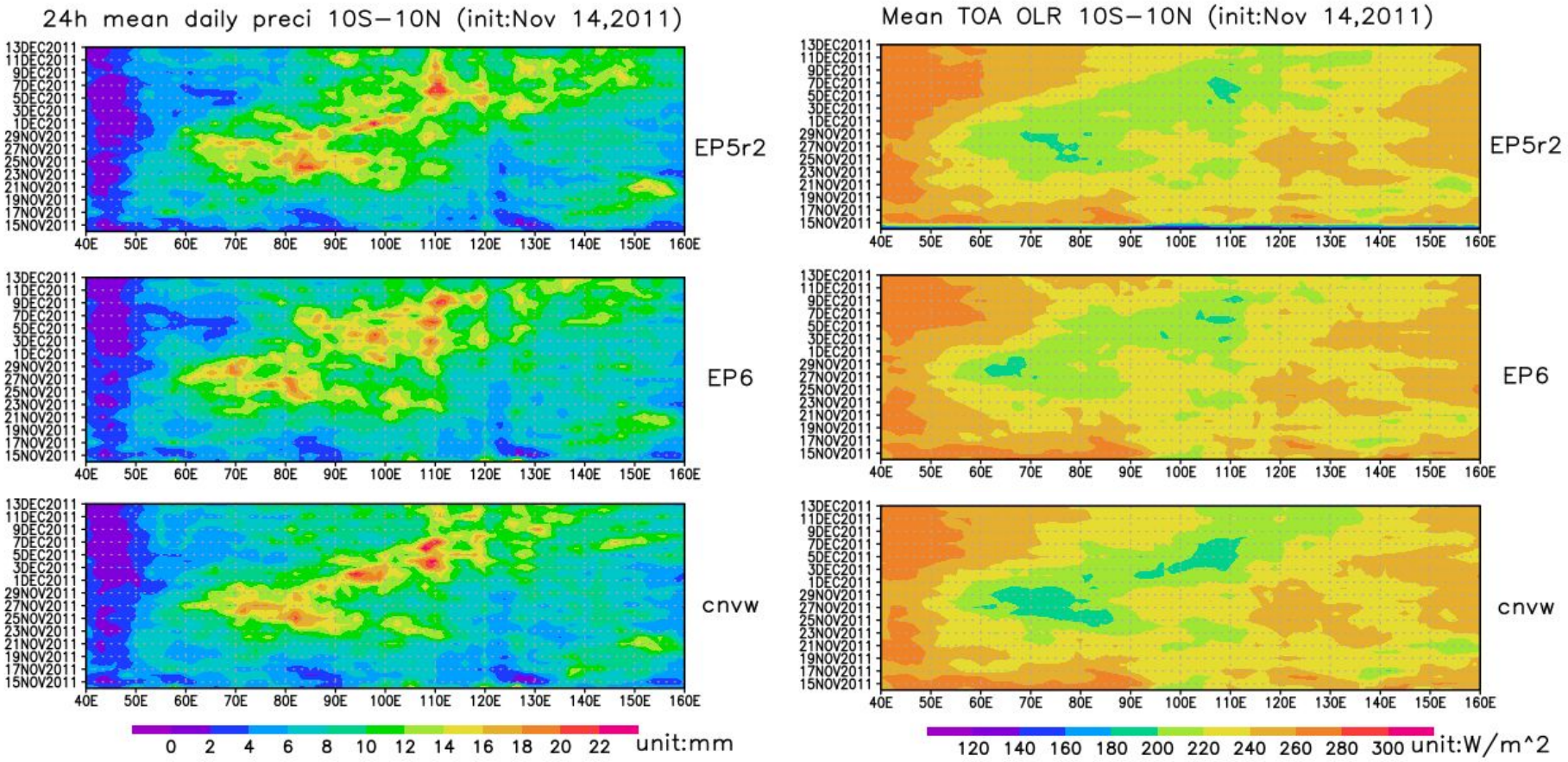








Improved Precip and OLR in the latest model



Summary

- Aerosol component will be excluded in the GEFSv13
- The current reforecast (EP6) is comparable with previous ensemble prototype. Some highlights include slightly improved Z500 AC score and reduced RMSE for low-level winds
- Some issues were found in the current reforecast. As the GEFSv13 implementation plan has changed, we updated the plan for GEFSv13 reforecast by switching to a newer version model which will be the same model for future operational GEFSv13 and GFSv17

Thank you for your attention!