Validation of IAU initialized reforecasts with updated snow depth and IAU replay (2000-2018)

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Scott Gregory, Jeff Whitaker and PSD staffs,
and Ensemble staffs,
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Motivation and Background

– The simulation with the old snow depth (see Guan's presentation in Feb. 28) shows that:

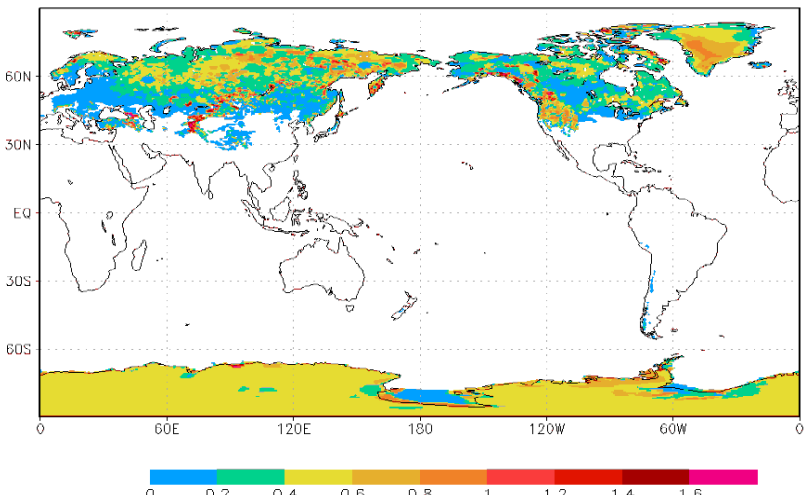
  - The T2M for the reforecast run for Jan. 1-7 2016 is much warmer than the retrospective run in the NH land, particular in the **center of Asia-Europe and North America** from analysis to forecast.
  - The large difference is moving slowly to northeast.

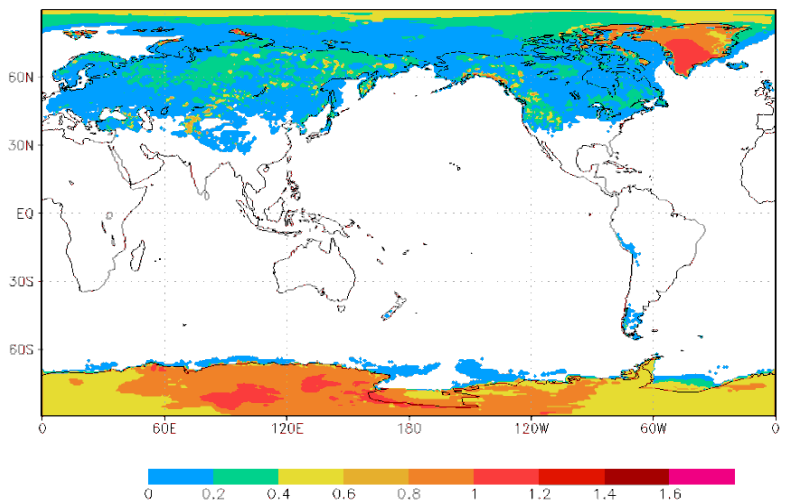
– This large warm bias is mainly attributed to much less snow in reanalysis.

(The snow depth climatology is used for 00Z, 06Z and 12Z with the envelop method.)

Old snow depth (1)

18Z

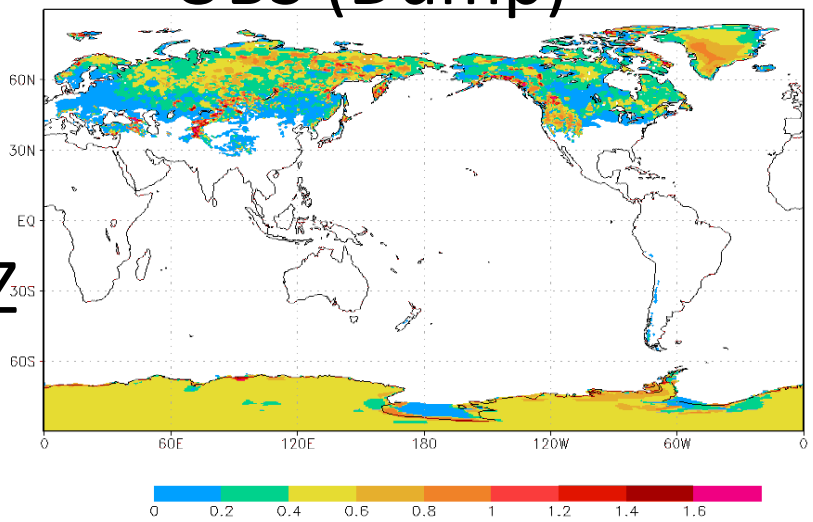


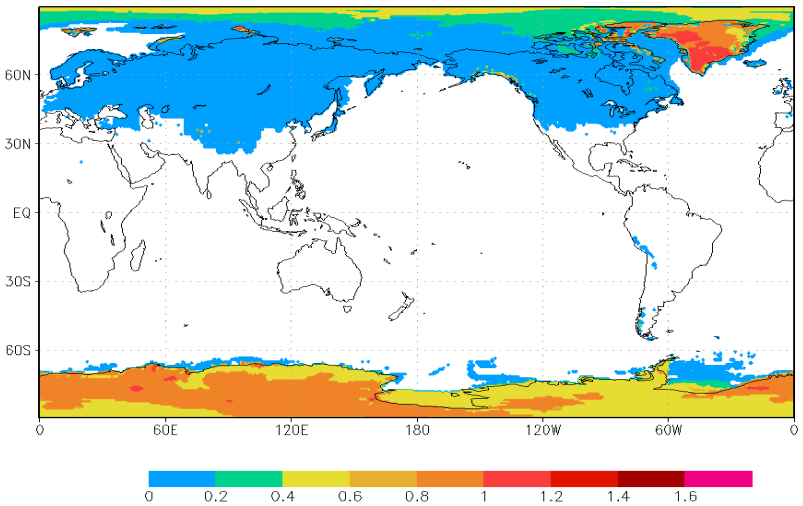


OBS (Dump)

Re-analysis

00Z



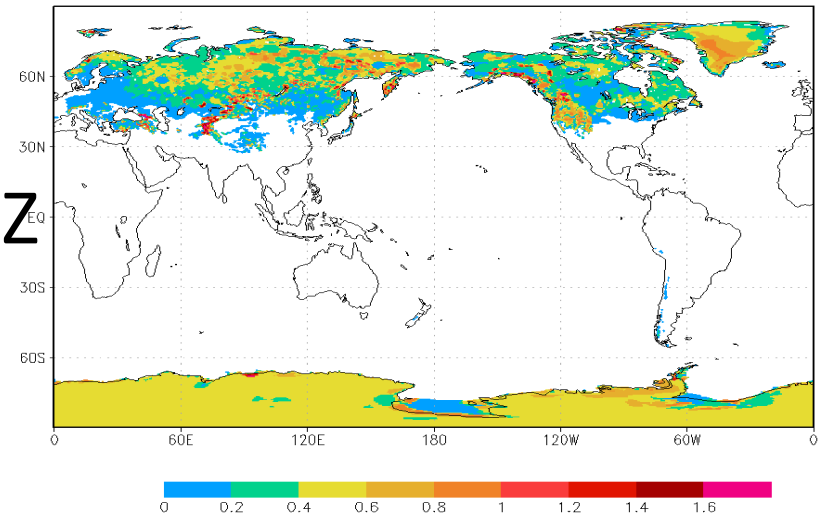


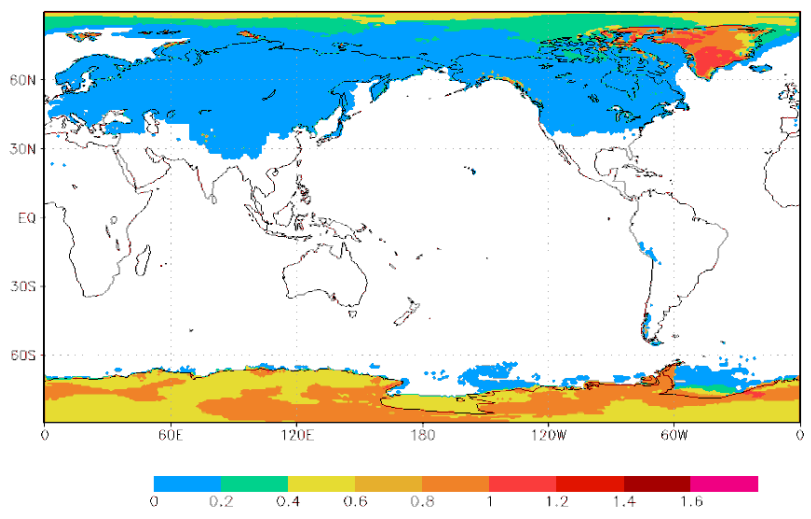
GrADS: COLA/IGES 2019-03-08-14:1 GrADS: COLA/IGES 2019-03-08-14:08

Over NH, Snow depth in Re-analysis for 18Z (00Z) is smaller (much smaller) than OBS.

Old snow depth (2)

06Z

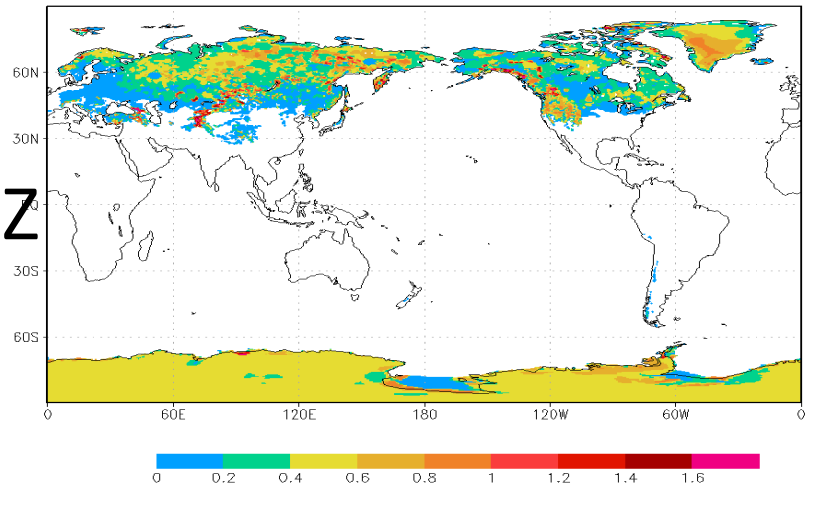


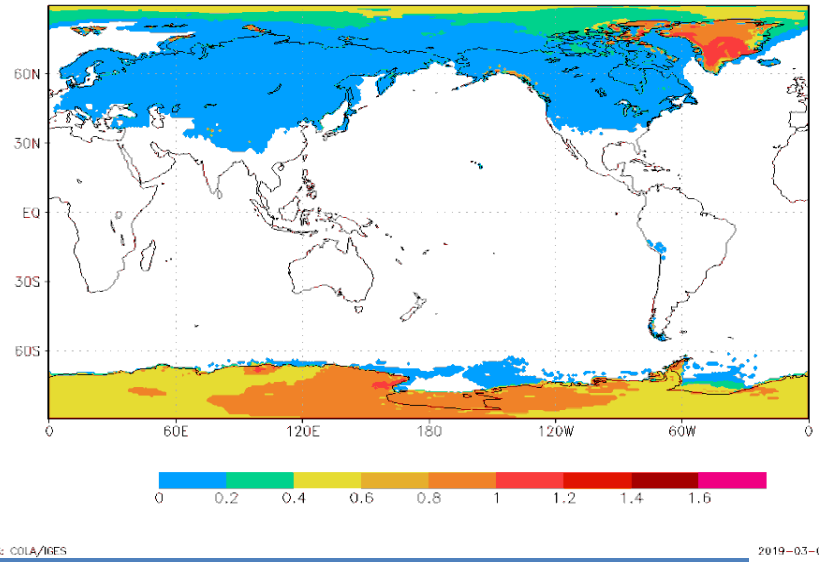


OBS (Dump)

Re-analysis

12Z



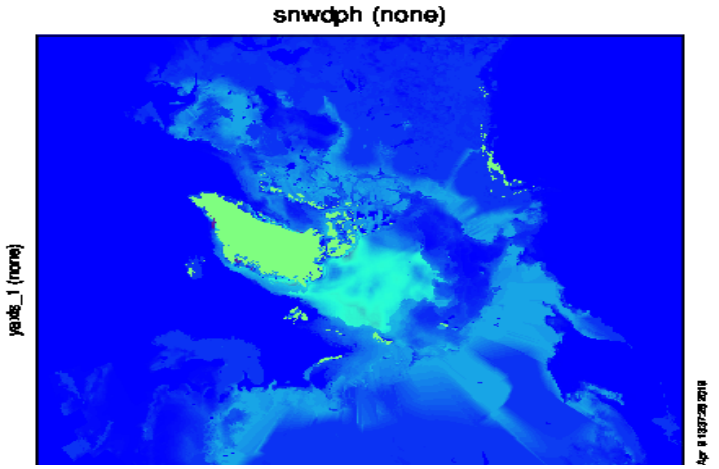


Over NH, snow depth in Re-analysis for 06Z and 12Z is much smaller than OBS.

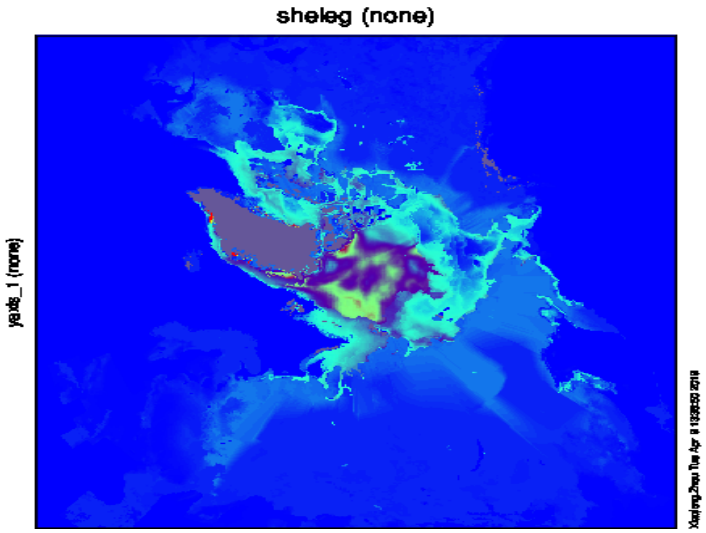
Updated snow depth and snow equivalent water

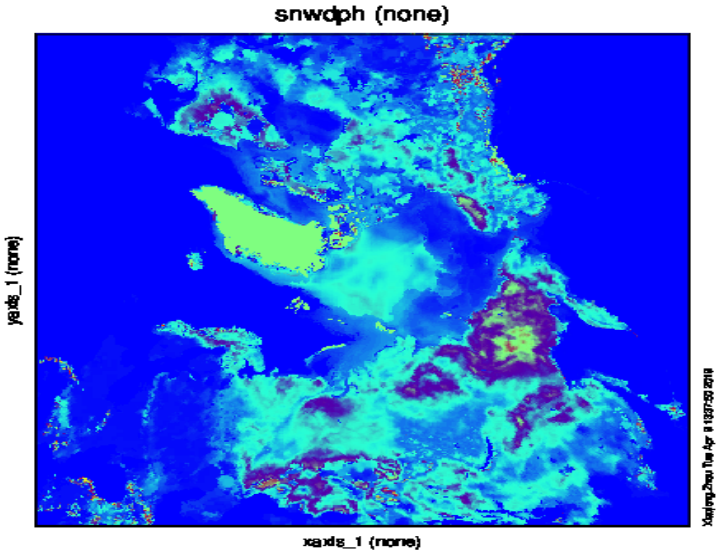
SNWDPH

WEASD

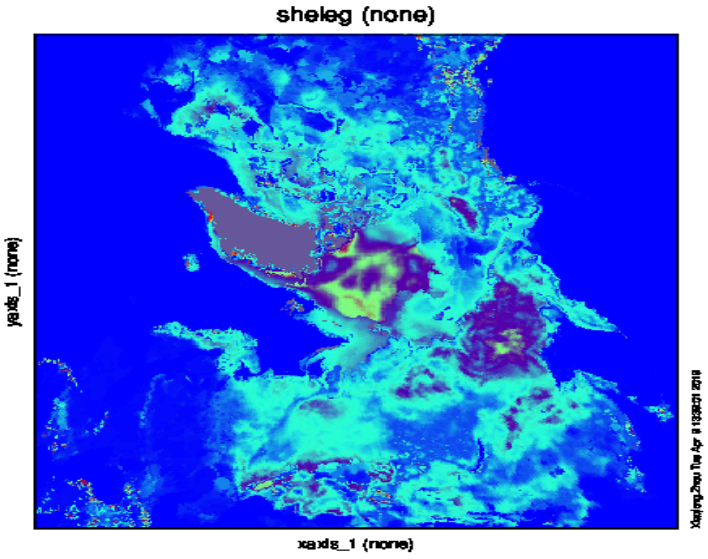


OLD





NEW



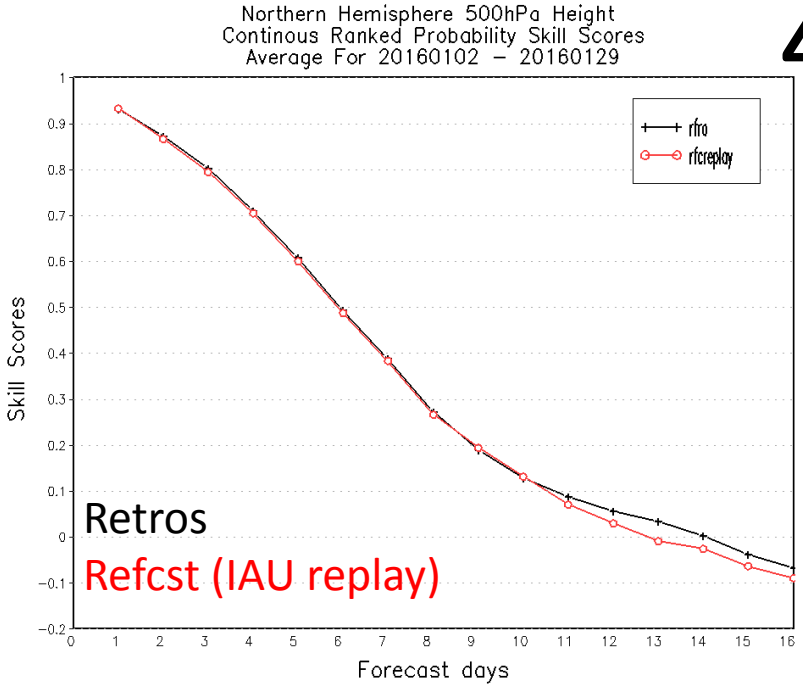
Over NA and Europe, both SNWDPH and WEASD in new Re-analysis are much increased.

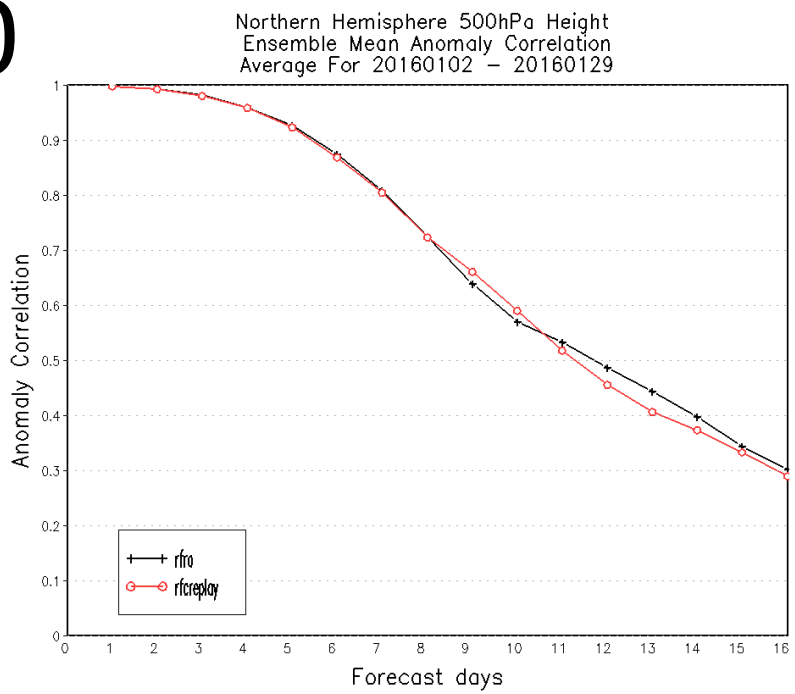
Evaluation

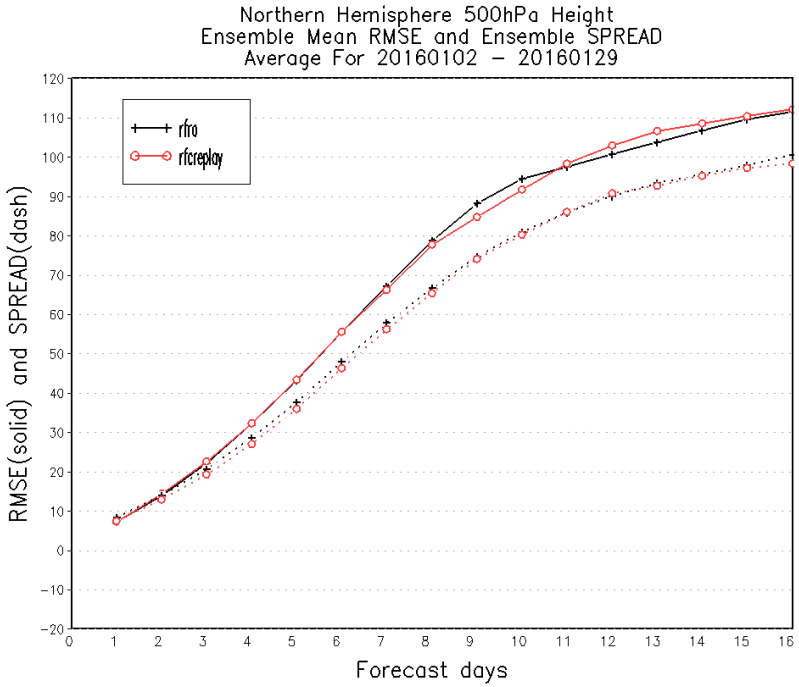
Experiment Setting

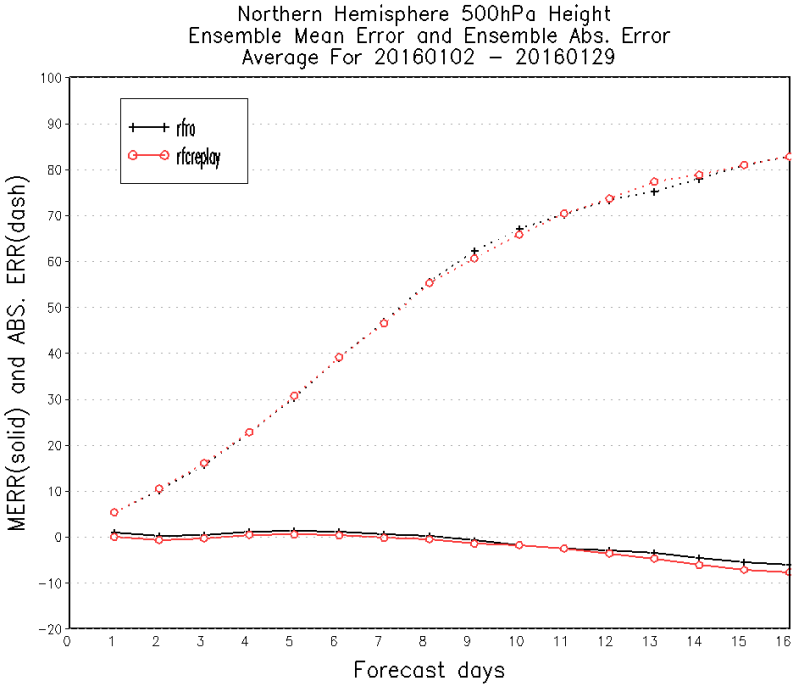
- Period:
  - 28 cases for winter – 1/1 – 1/29/2016
    - 5 members per run out to 16 days
    - Missing one IAU restarted initial condition
- Model configuration
  - Frozen system (Dec. 21 2018)
    - Highlights – Hord=5; radiation bug fixed; SST adjustment; GFDL MP modification
  - Initial conditions
    - End of IAU (+3), and perturbations (EnKF analysis) with re-centerization.
    - Retrospective initials are using hybrid DA cycling (June 2018 version) and F06 of ENKF
- References:
  - Forecasts (using IAU replay with right snow depth)
  - compare to retrospective experiments – only difference is a initial conditions
  - Verification reference – **Own analysis (Reanl – YYYYMMDD06…fhr00)**
- Stats
  - https://www.emc.ncep.noaa.gov/gmb/wd20hg/html/rfc_rtro_20160102_2lines_ranl1.html

Z500

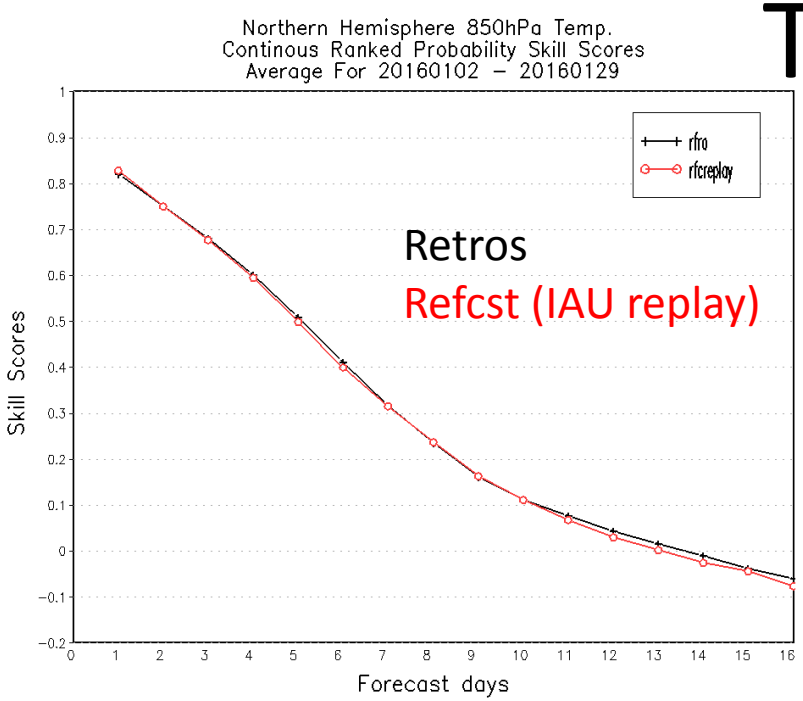

Northern Hemisphere 500hPa Height
Continous Ranked Probability Skill Scores
Average For 20160102 – 20160129
rfro
rfcreplay
Skill Scores
Forecast days
Retros
Refcst (IAU replay)

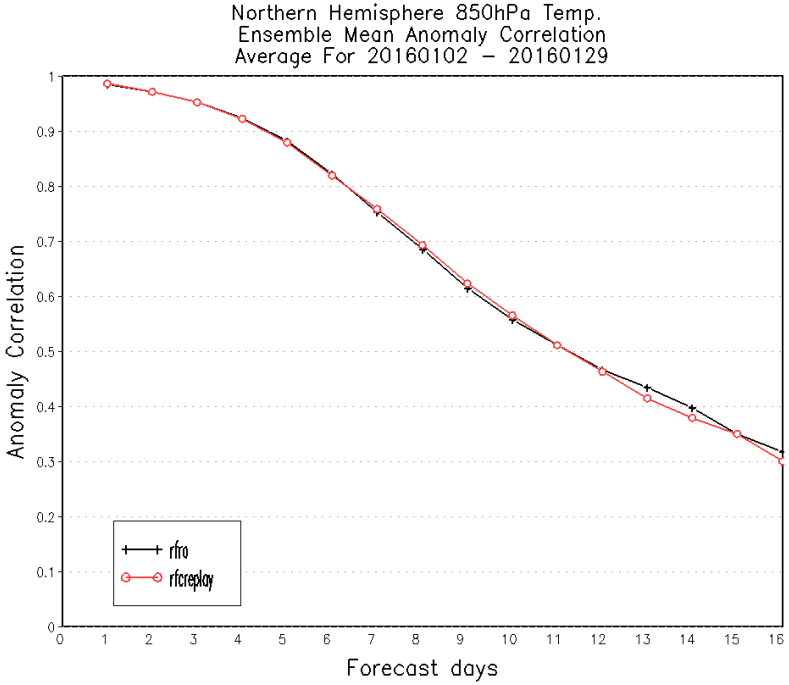

Northern Hemisphere 500hPa Height
Ensemble Mean Anomaly Correlation
Average For 20160102 – 20160129
rfro
rfcreplay
Anomaly Correlation
Forecast days

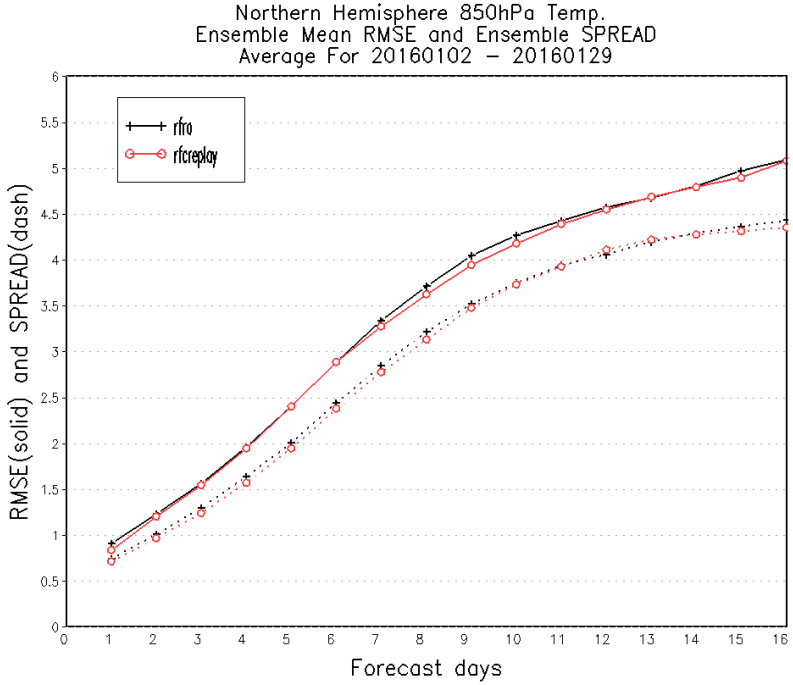

Northern Hemisphere 500hPa Height
Ensemble Mean RMSE and Ensemble SPREAD
Average For 20160102 – 20160129
rfro
rfcreplay
RMSE(solid) and SPREAD(dash)
Forecast days

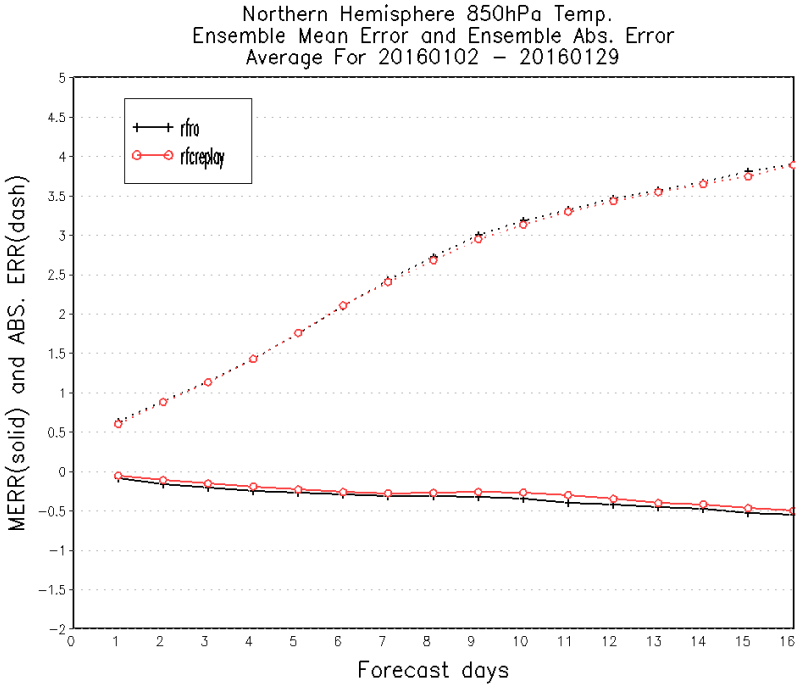

Northern Hemisphere 500hPa Height
Ensemble Mean Error and Ensemble Abs. Error
Average For 20160102 – 20160129
rfro
rfcreplay
MERR(solid) and ABS. ERR(dash)
Forecast days

T850

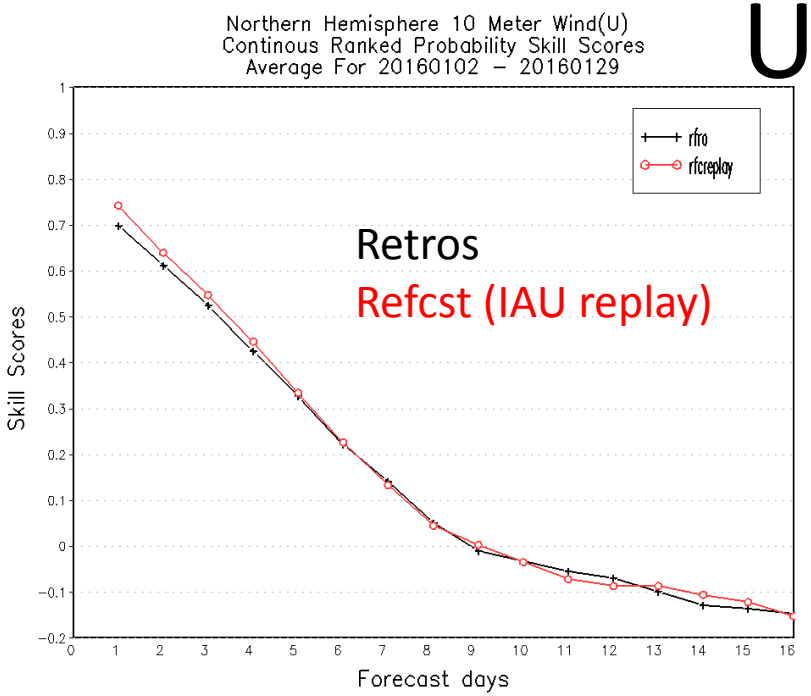

Northern Hemisphere 850hPa Temp.
Continous Ranked Probability Skill Scores
Average For 20160102 – 20160129
rfro
rfcreplay
Retros
Refcst (IAU replay)
Skill Scores
Forecast days

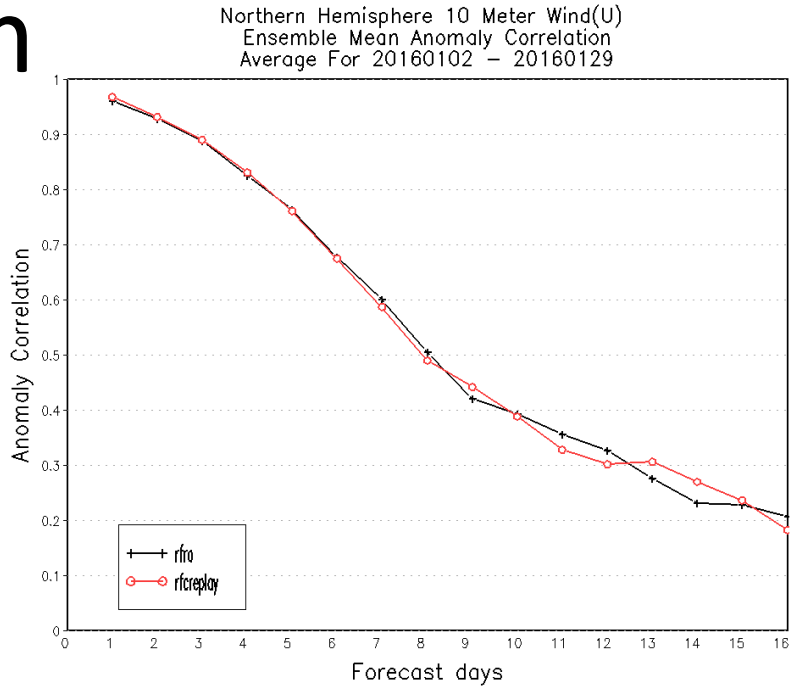

Northern Hemisphere 850hPa Temp.
Ensemble Mean Anomaly Correlation
Average For 20160102 – 20160129
rfro
rfcreplay
Anomaly Correlation
Forecast days

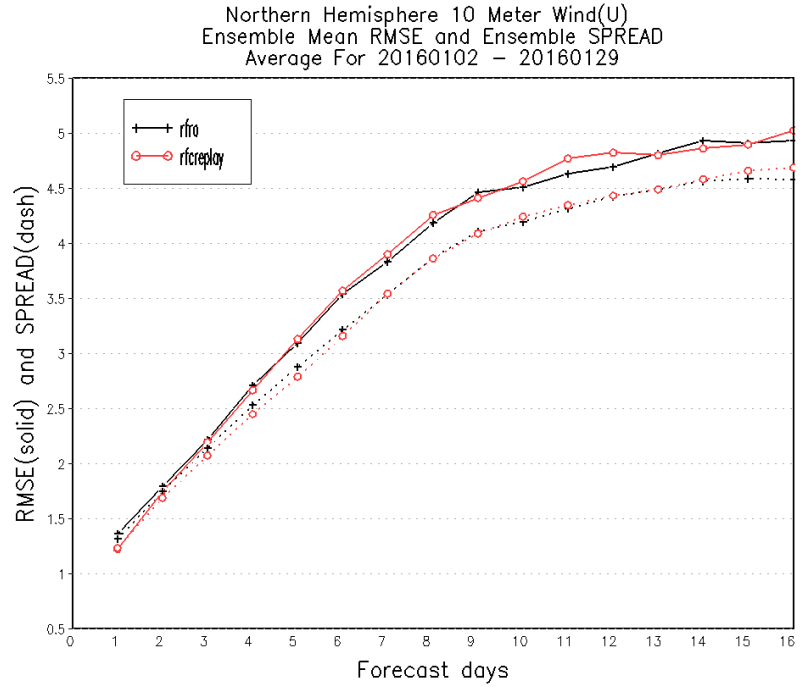

Northern Hemisphere 850hPa Temp.
Ensemble Mean RMSE and Ensemble SPREAD
Average For 20160102 – 20160129
rfro
rfcreplay
RMSE(solid) and SPREAD(dash)
Forecast days


Northern Hemisphere 850hPa Temp.
Ensemble Mean Error and Ensemble Abs. Error
Average For 20160102 – 20160129
rfro
rfcreplay
MERR(solid) and ABS. ERR(dash)
Forecast days

U10m


Northern Hemisphere 10 Meter Wind(U)
Continous Ranked Probability Skill Scores
Average For 20160102 – 20160129
rfro
rfcreplay
Retros
Refcst (IAU replay)
Skill Scores
Forecast days


Northern Hemisphere 10 Meter Wind(U)
Ensemble Mean Anomaly Correlation
Average For 20160102 – 20160129
rfro
rfcreplay
Anomaly Correlation
Forecast days


Northern Hemisphere 10 Meter Wind(U)
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Average For 20160102 – 20160129
rfro
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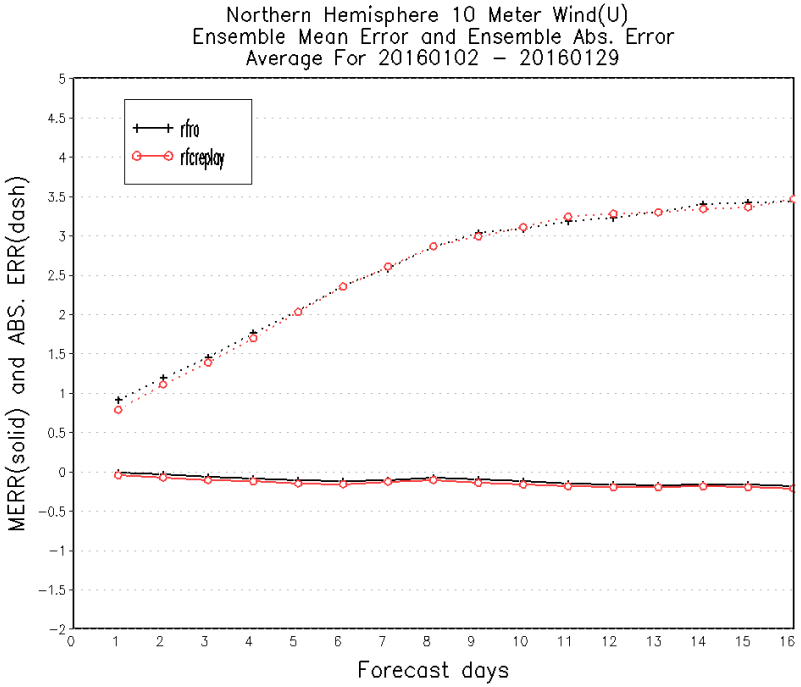
Forecast days


Northern Hemisphere 10 Meter Wind(U)
Ensemble Mean Error and Ensemble Abs. Error
Average For 20160102 – 20160129
rfro
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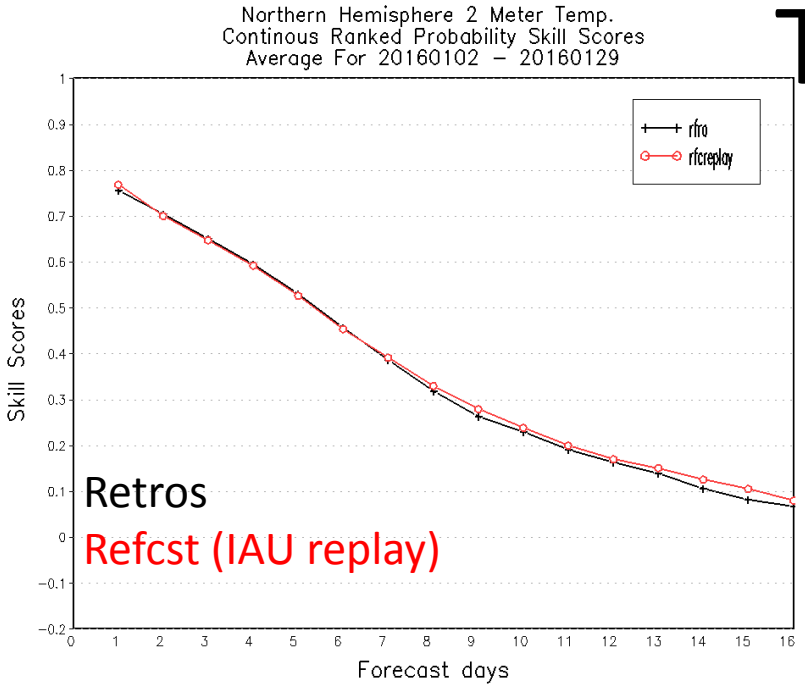
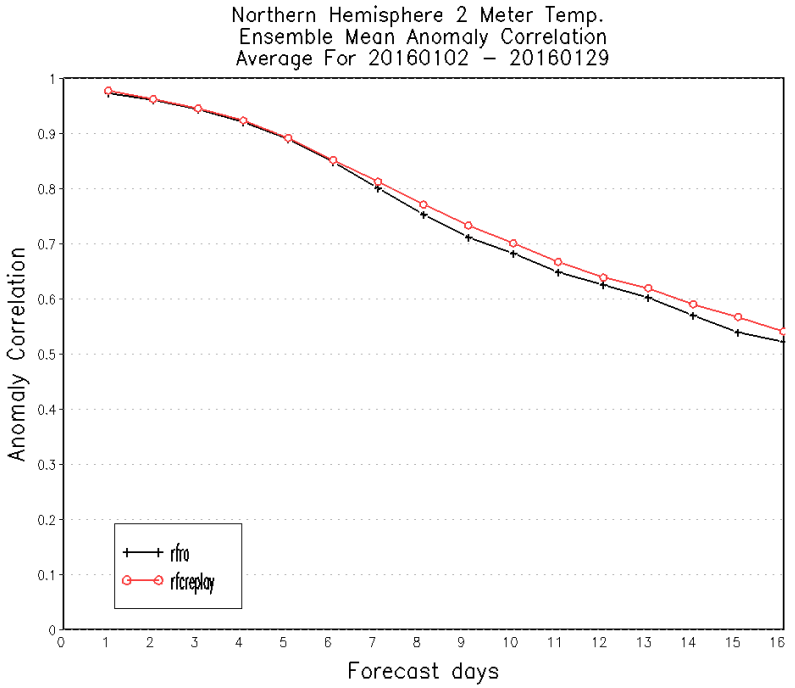
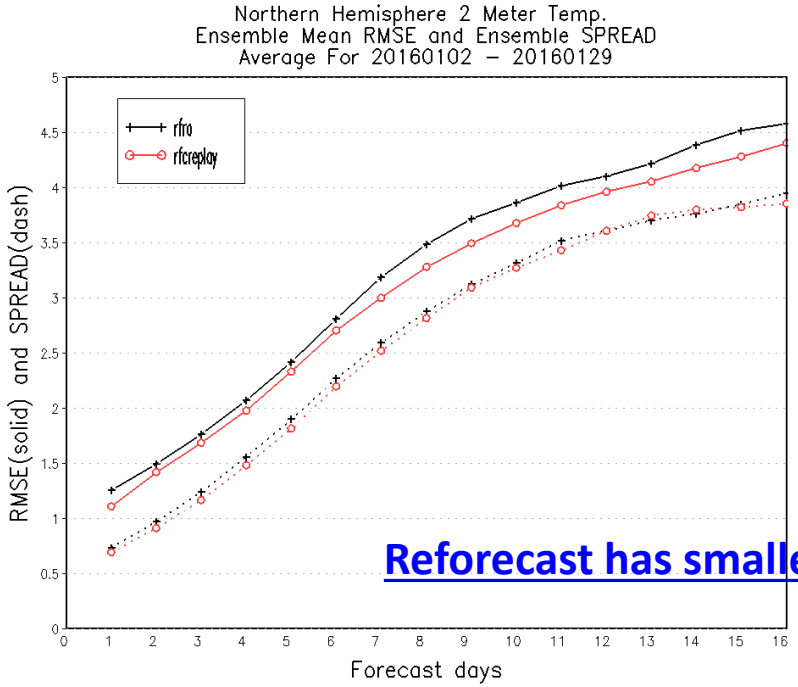
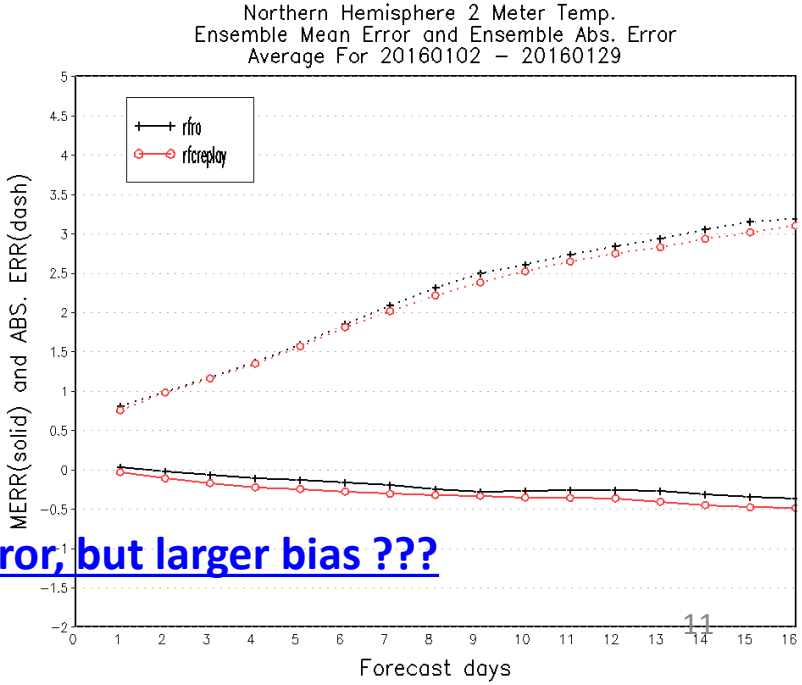
MERR(solid) and ABS. ERR(dash)
Forecast days

T2m



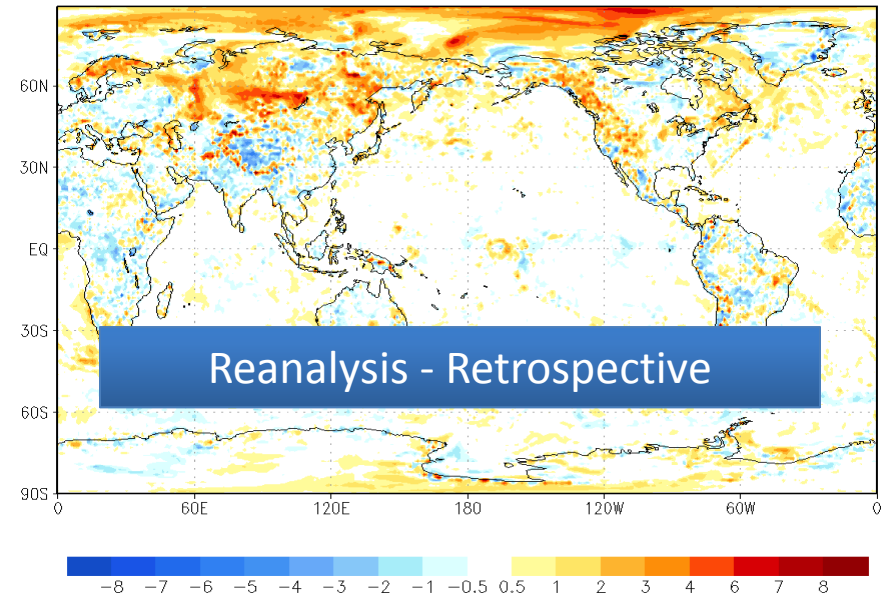




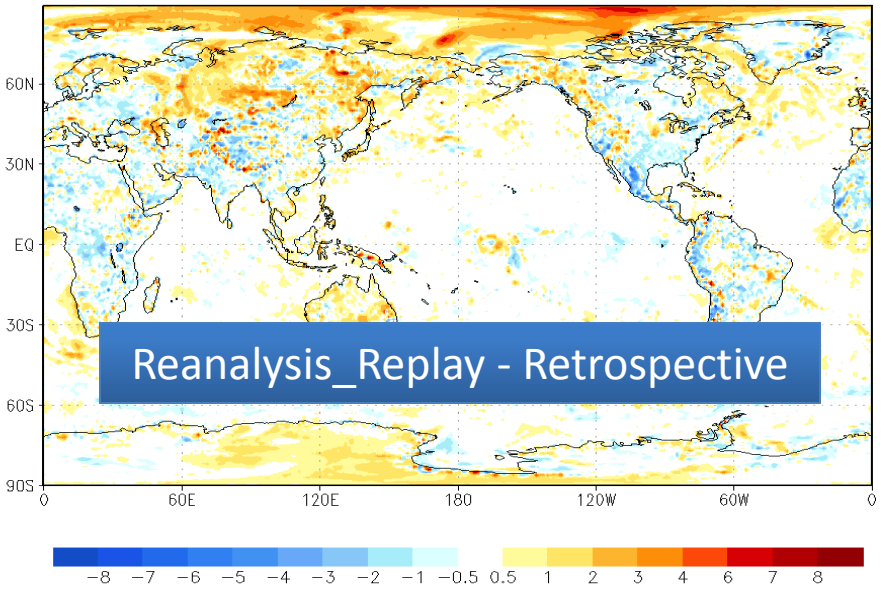


Reforecast has smaller RMS error, but larger bias ???

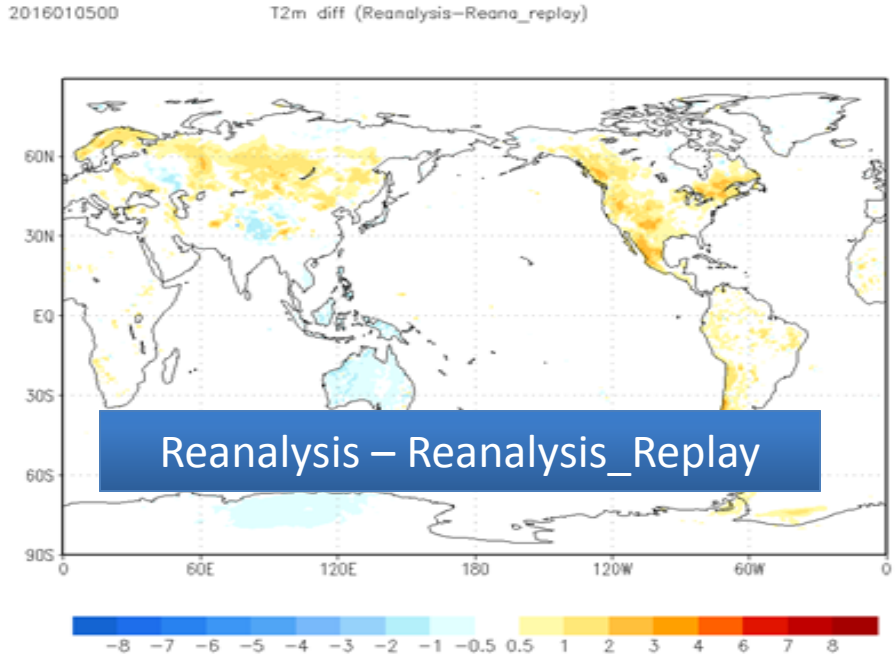
Diff of T2m analysis (one case)



Reanalysis - Retrospective



Reanalysis_Replay - Retrospective

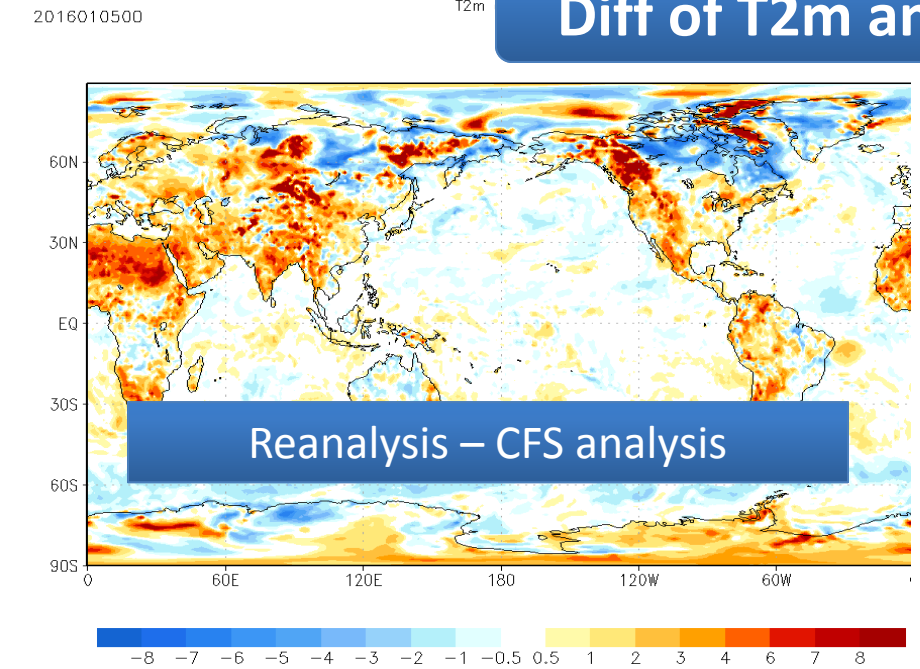


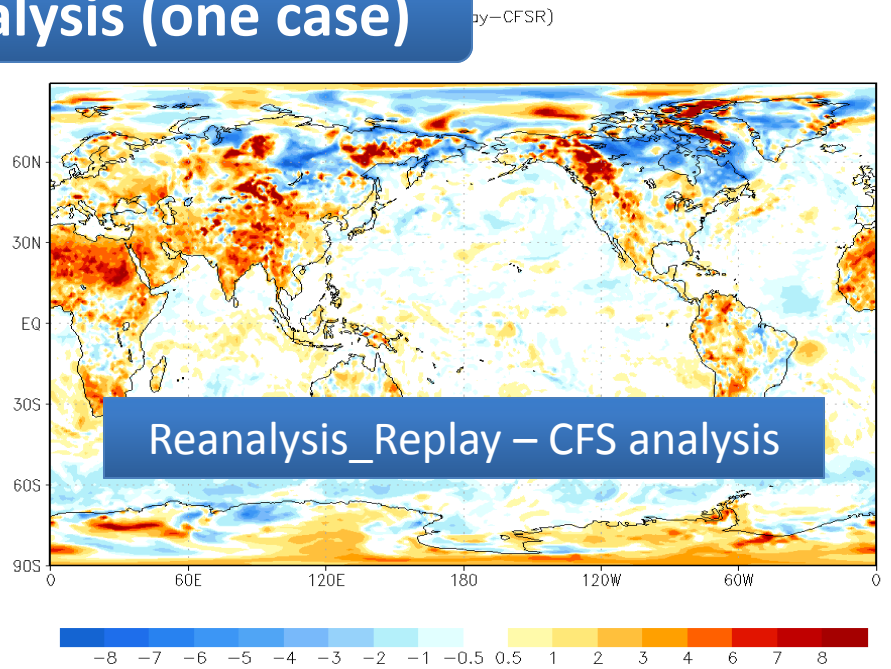
Reanalysis – Reanalysis_Replay

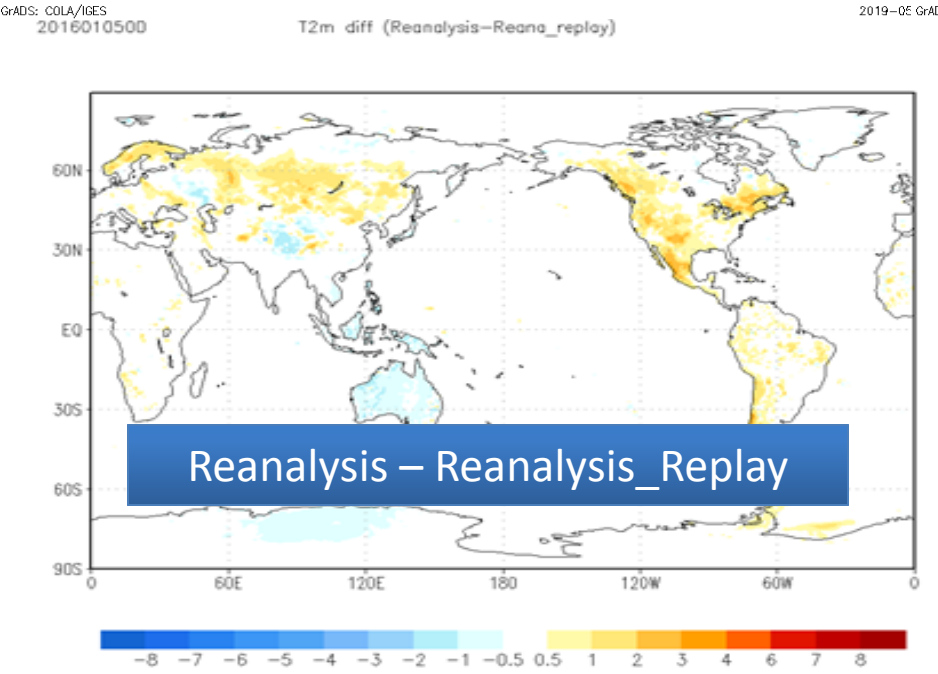
One case: 2016010500

Top left: Reanalysis – Retrospective
Top right: Reanalysis_Replay – Retrospective
Bottom left: Reanalysis – Reanalysis_Replay

Diff of T2m analysis (one case)







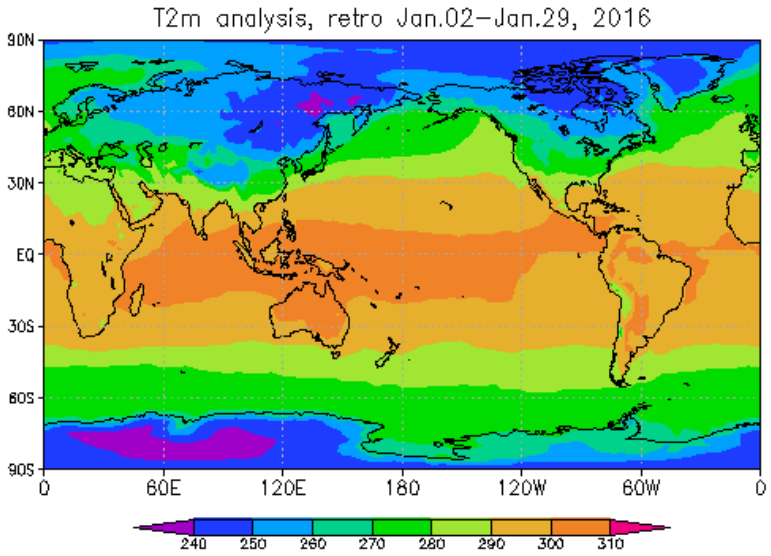
One case: 2016010500

Top left: Reanalysis – CFS analysis
Top right: Reanalysis_Replay – CFS analysis
Bottom left: Reanalysis – Reanalysis_Replay

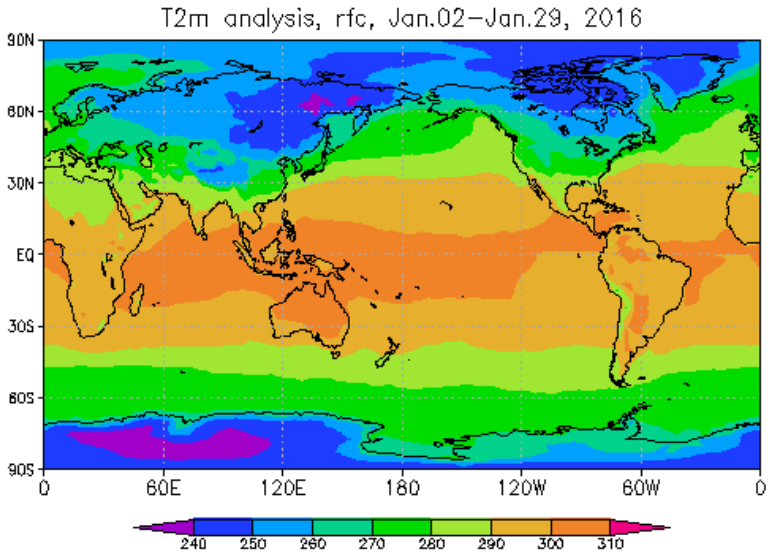
This reference could indicate the difference for 1st 11 years (1989-1999) to later 19 years

T2m (F00/analysis)

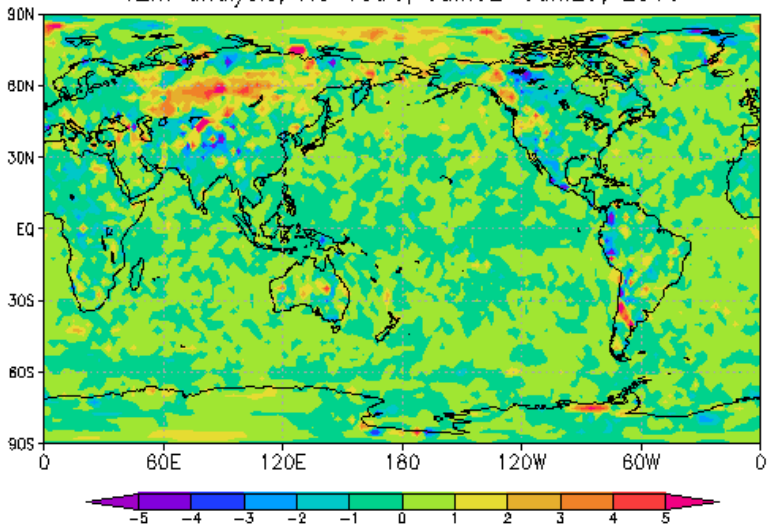
Retros

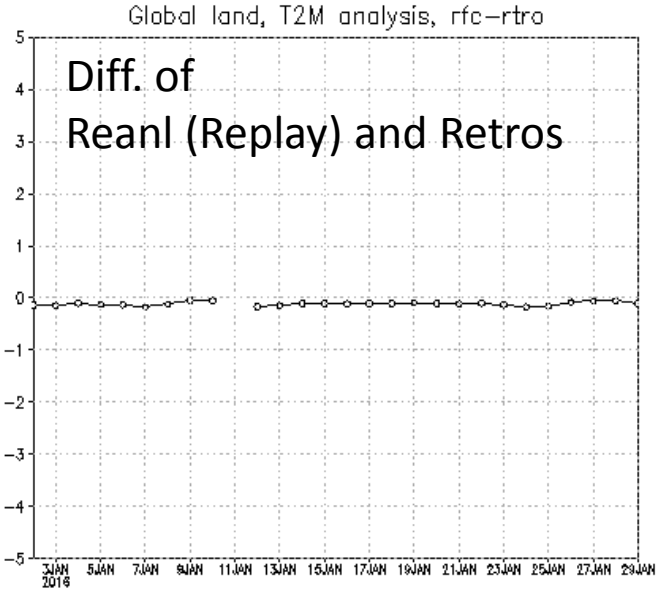


Reanl (Replay)



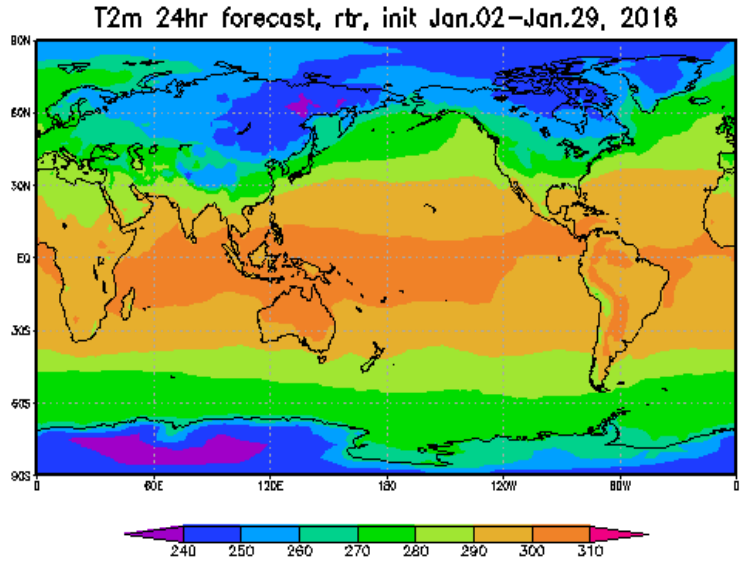
Reanl (Replay) - Retros



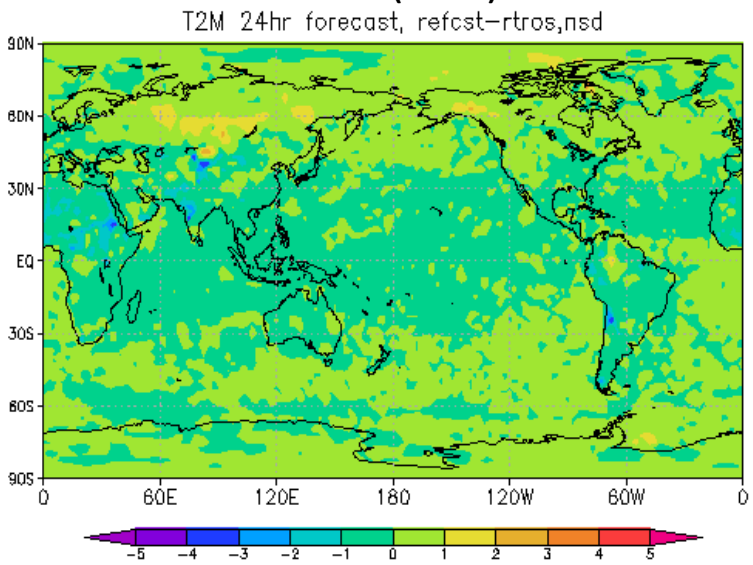


T2m (24hr)

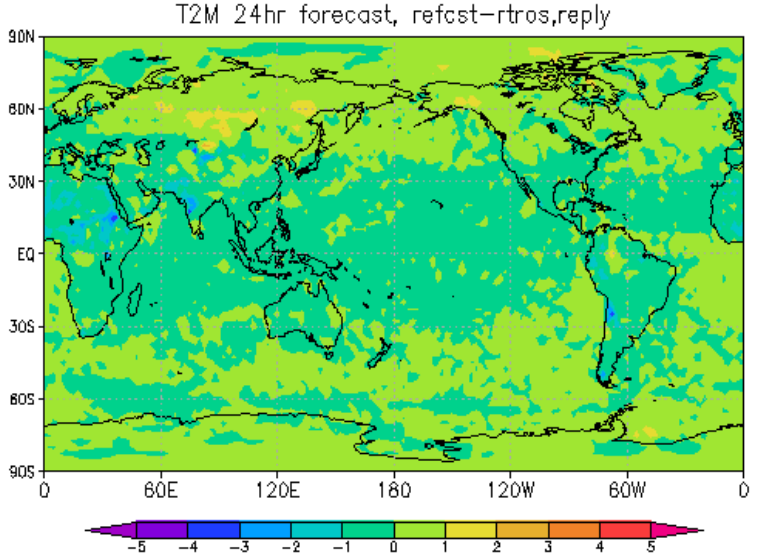
Retros

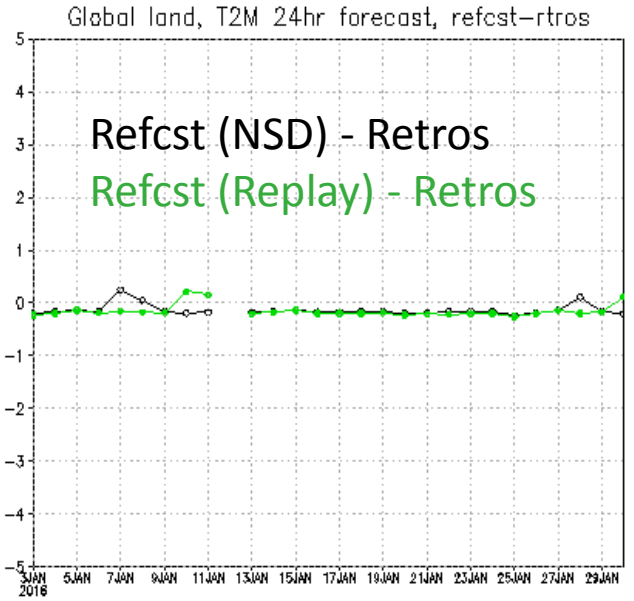


Refcst(NSD) - Retros



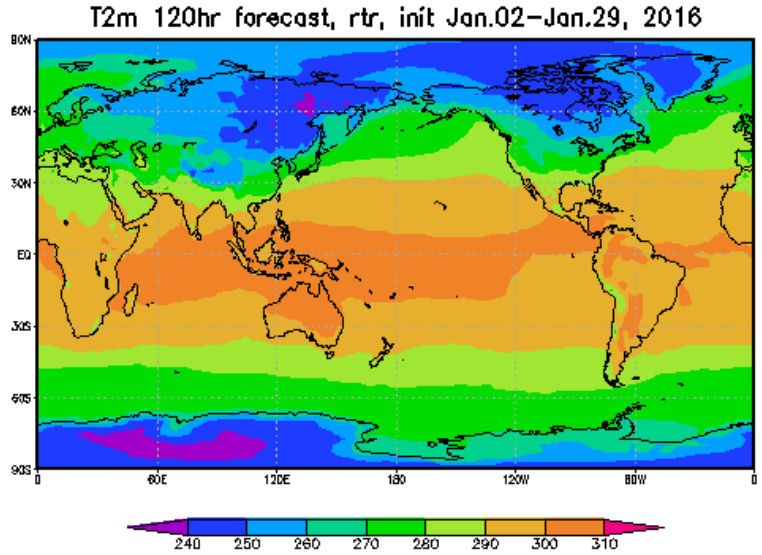
Refcst (Replay) – Retros



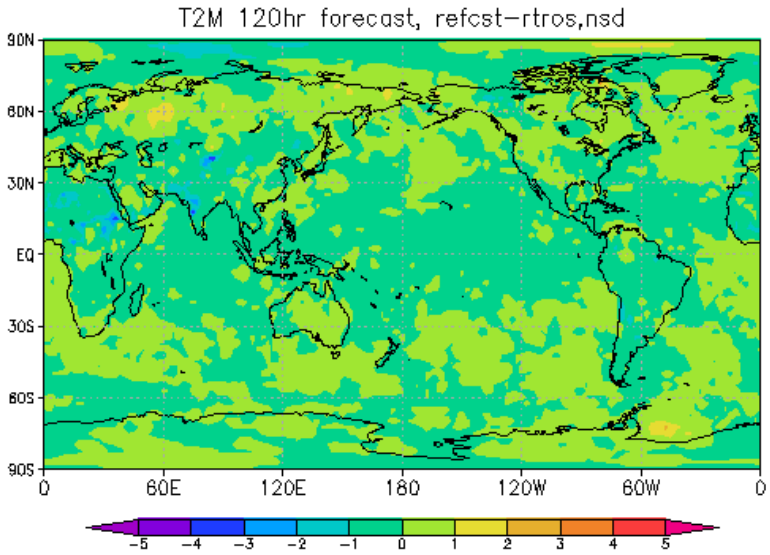


T2m (120hr)

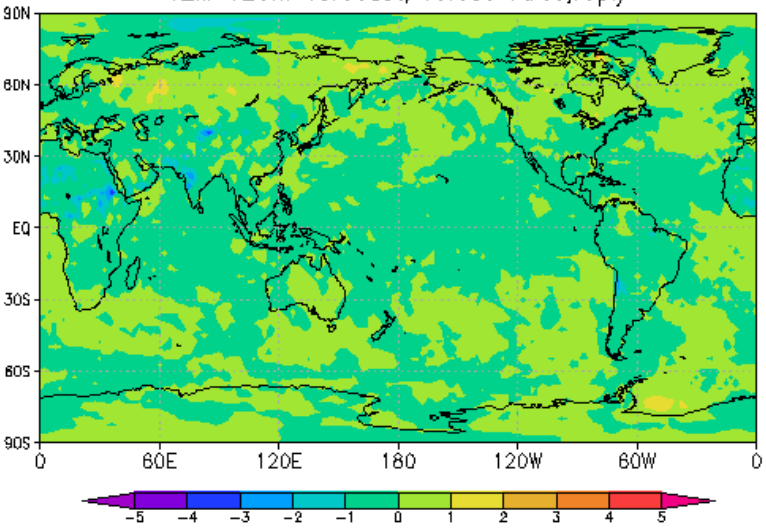
Retros

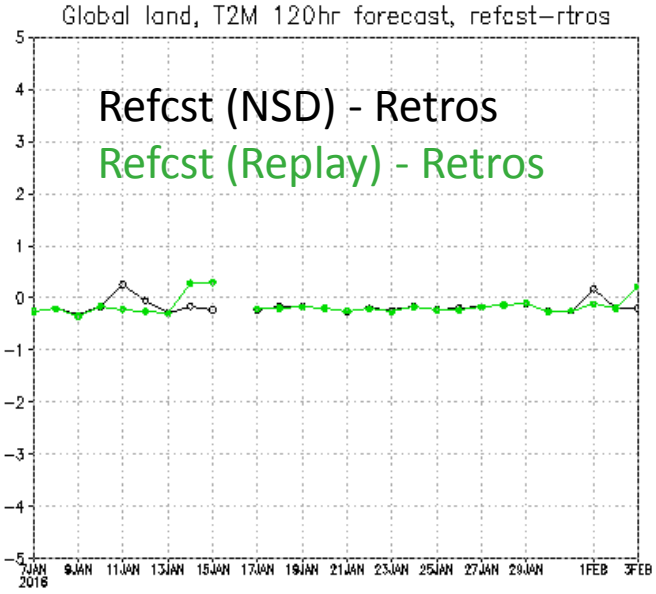


Refcst (NSD) - Retros



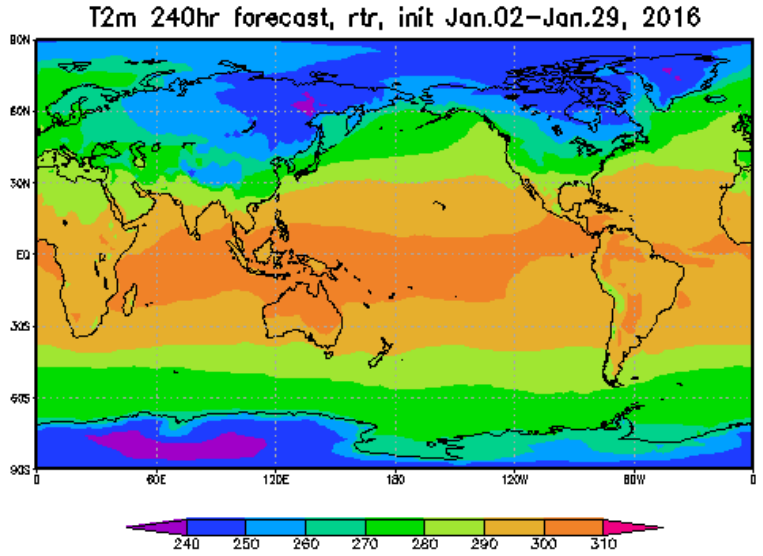
Refcst (Replay) - Retros



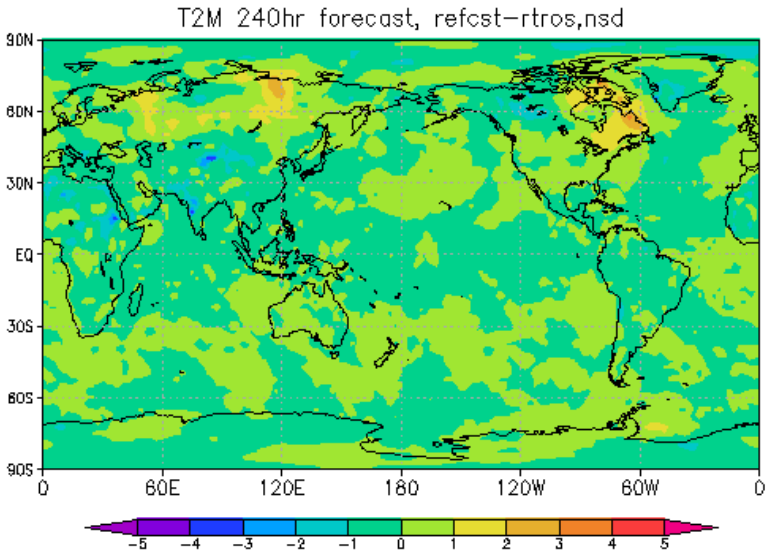


T2m (240hr)

Retros



Refcst (NSD) - Retros



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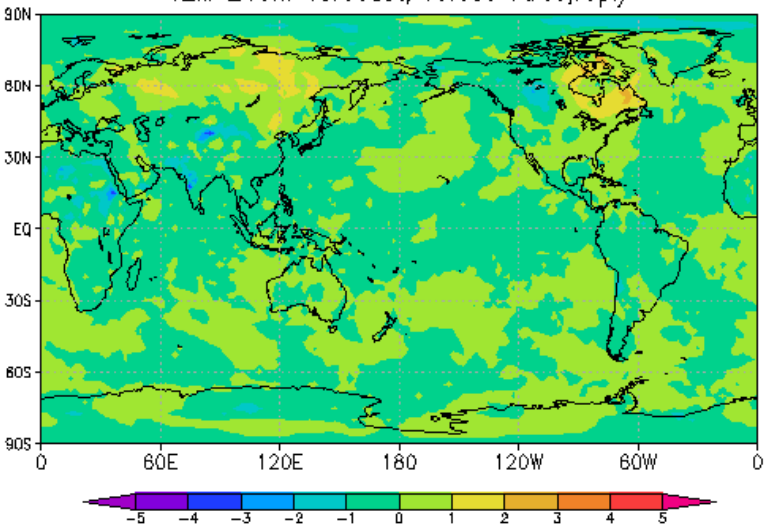
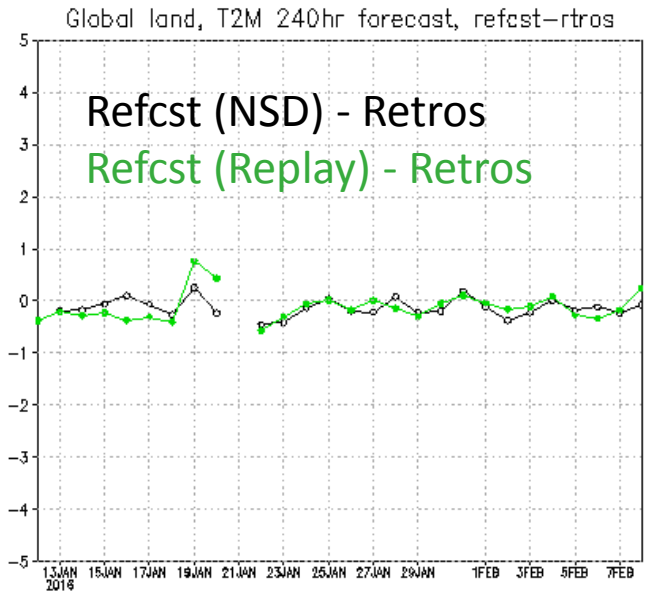
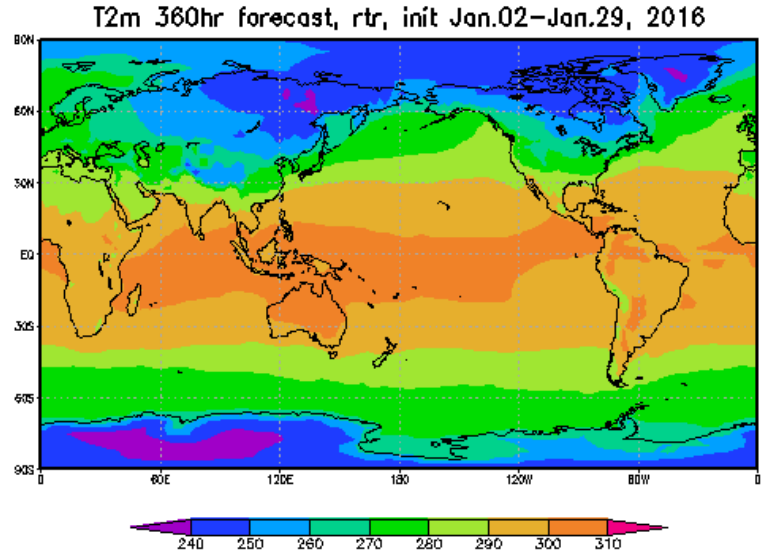


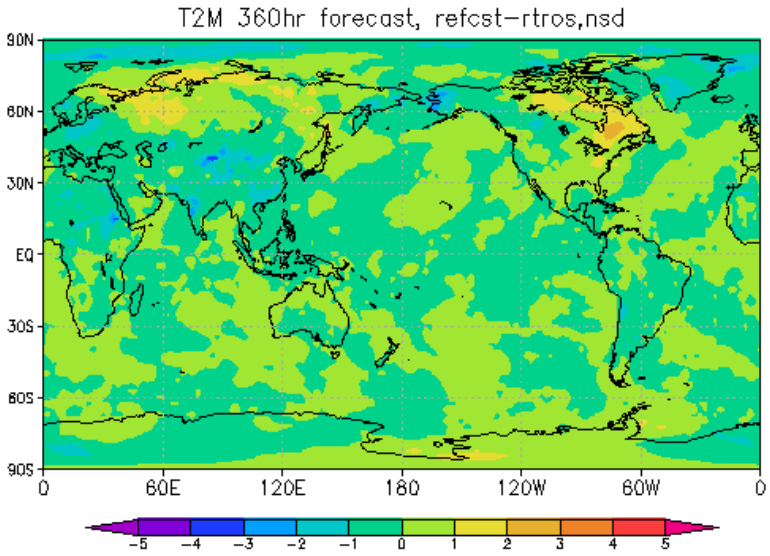


T2m (360hr)

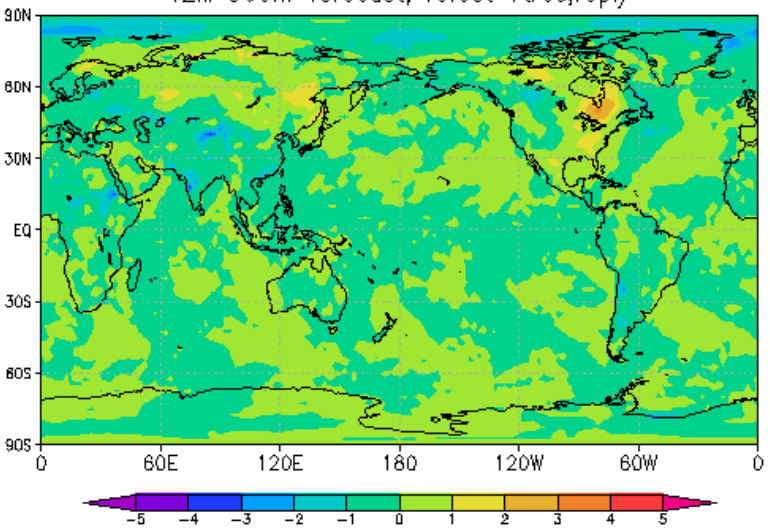
Retros

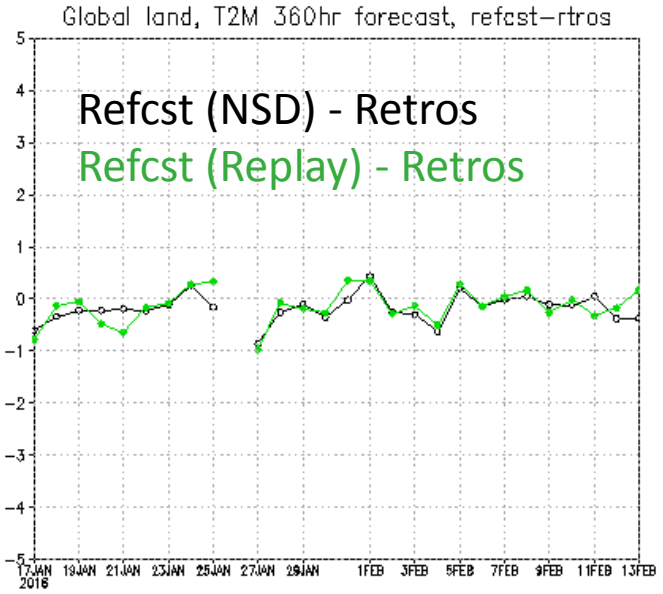


Refcst (NSD) - Retros



Refcst (Replay) - Retros





Summary

- For IAU replay – statistical scores
  - The differences for Z500, T850, U10m between retrospective runs and reforecast runs are small.
  - The difference for T2m – reforecast shows less RMS error, but more cold bias
- For IAU replay – spatial differences
  - The difference of T2m analyses (or F00) are still large for NH high latitude land, which may still impact from snow depth.
  - The difference between reforecast and retrospective forecast is still visible for longer lead time, but much smaller.
- Recommendation
  - Could we re-start to run reforecast if there is no against and no other option?
  - We'd like to hear CPC's comments
- **Major concerns:**
  - **Analysis (or f00) for T2m:**
    - **The difference is still larger comparing to retrospective – see slide #12**
    - **If there is no consistent T2m as reference (f00), it is challenge to estimate model bias even we have consistent model forecast.**
    - **Should we use ERA40 as best reference, particular for T2m?**