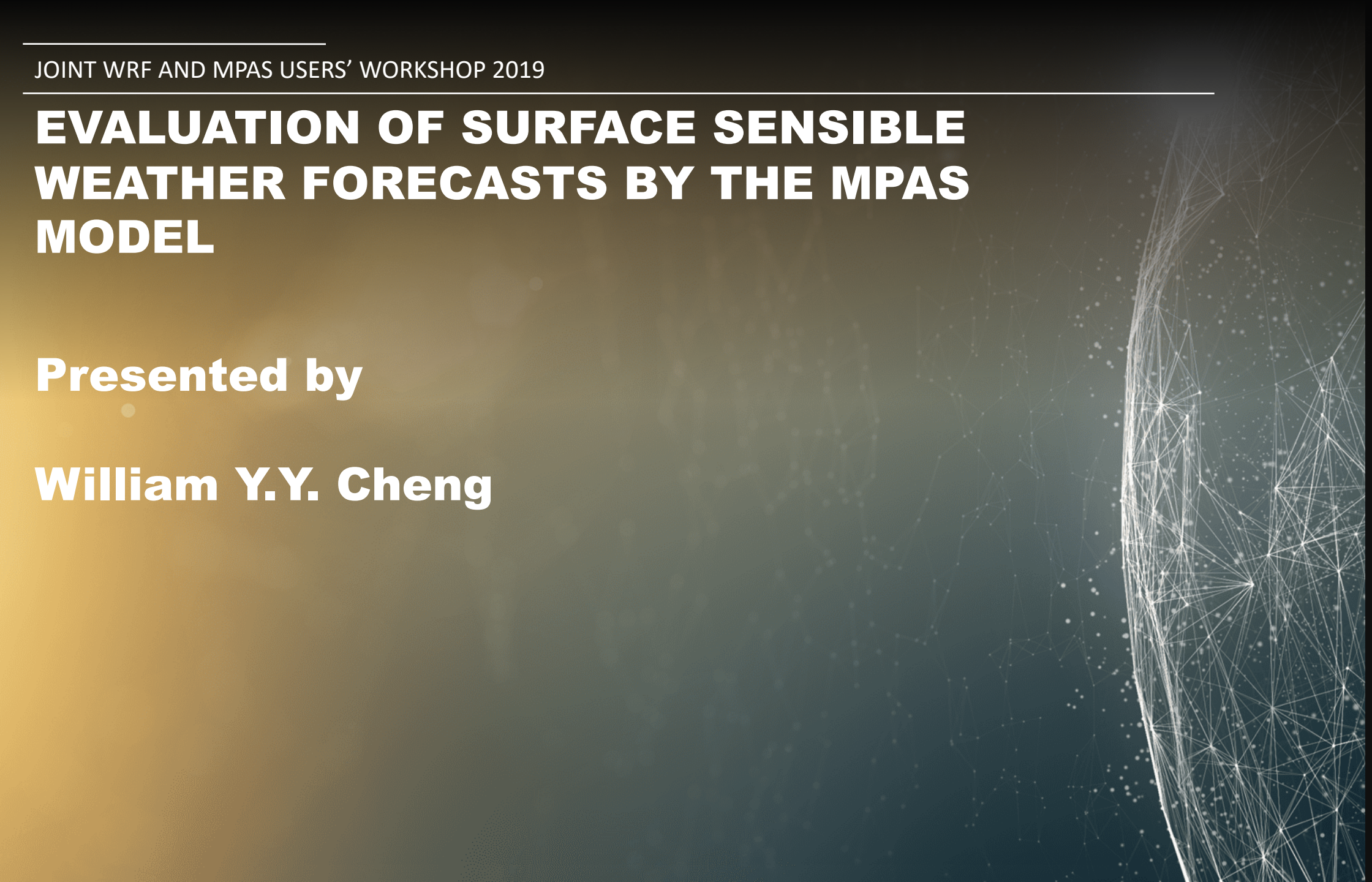
EVALUATION OF SURFACE SENSIBLE WEATHER FORECASTS BY THE MPAS MODEL

Presented by

William Y.Y. Cheng



CO-AUTHORS

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MOTIVATION

- Most of the MPAS studies at the past WRF/MPAS Workshops focused on tropical cyclones and precipitation.
- Fewer studies at the WRF/MPAS Workshop have covered surface sensible weather variables and compared with other models or geographic regions as a baseline.
- Surface sensible weather variables are of interest to weather forecasters and general public.
- Goal of this study is to verify surface weather forecast from MPAS and compare with 0.25^{o} GFS forecast as a baseline – identify strengths and weakness which may help to improve MPAS – also show results from modified MPAS V6.1.

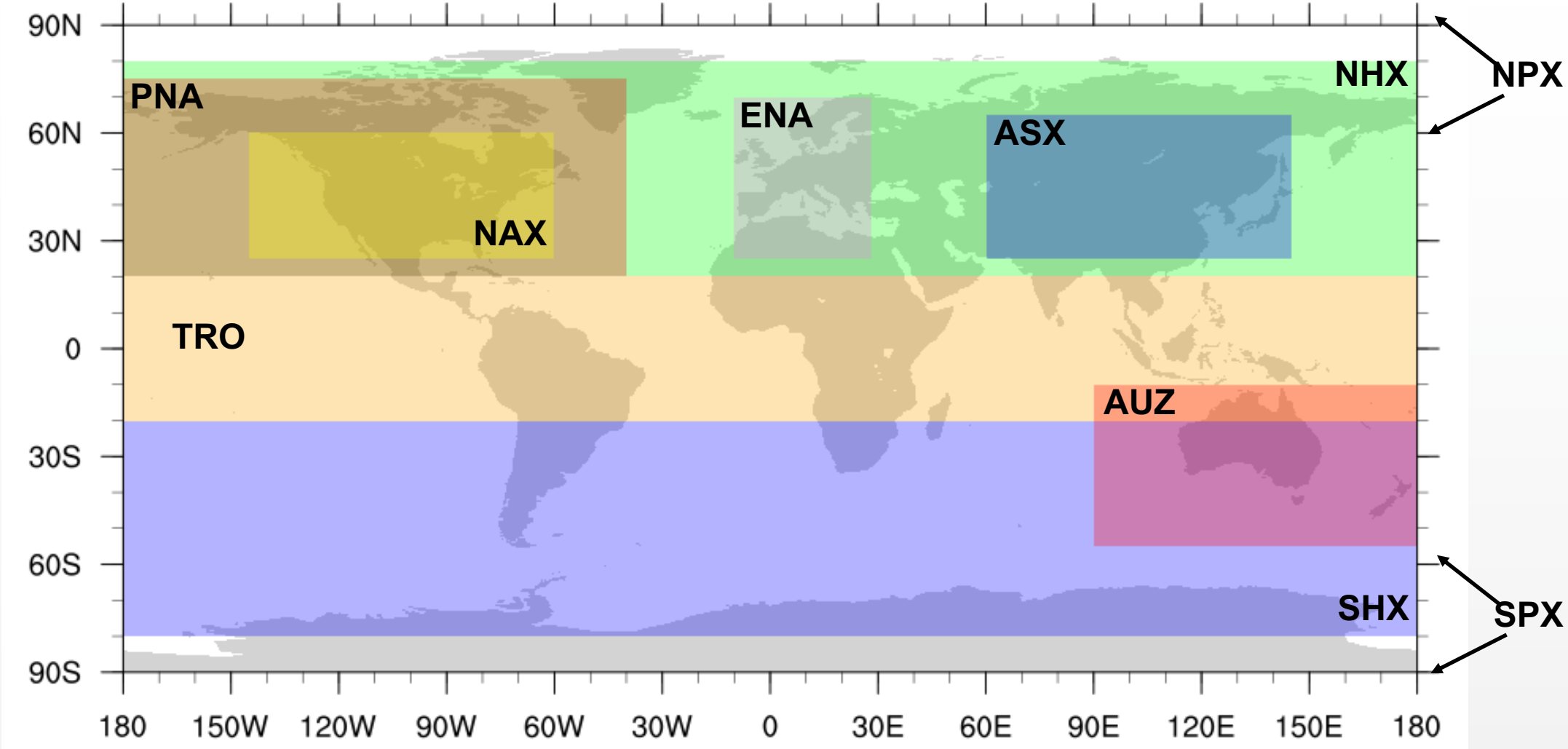
METHODOLOGY

- Almost one year worth of 7-day forecast (output every 6-h) with MPAS V6.1 using the uniform ~30 km grid with 2 cold starts per day using 0.25^{o} GFS initialization.
- Observations for verification NCEP PREPBUFR land-based stations with QC flag <= 3:
  - 2-m T, 2-m qv, 10-m ws, 10-m wd.
- Due to time limit, results only for 2-m T – 00Z init: summer 2018 (06/15-09/15) and winter 2018-2019 (12/01-02/28).
- Model temperature mapped to observed location by bilinear interpolation and adjusted by 6.5 K/km for difference in observed and model terrain.

DOMAINS OF VERIFICATION

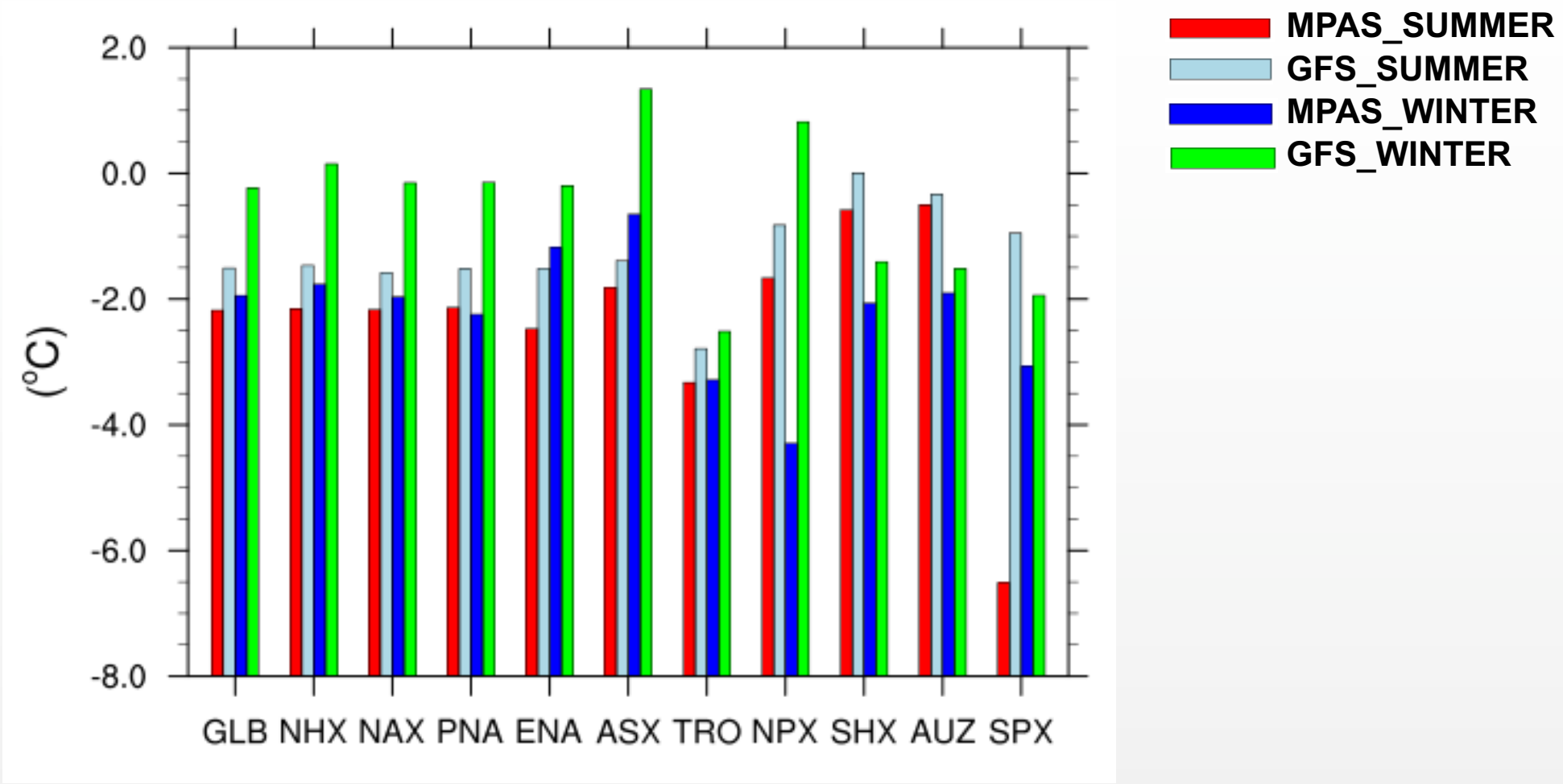
Region	lat1	lat2	lon1	lon2	stns
GLB (global)	-90	90	-180	180	10892
NHX (N. Hem)	20	80	-180	180	8842
SHX (S. Hem)	-80	-20	-180	180	724
TRO (Tropics)	-20	20	-180	180	1313
PNA (Pac. North America)	20	75	-180	-40	3520
NAX (North America)	25	60	-145	-50	3133
ENA (Europe/North Africa)	25	70	-10	28	2444
ASX (Asia)	25	65	60	145	1461
AUZ (Australia/New Zealand)	-55	-10	90	180	325
NPX (Northern Polar Region)	60	90	-180	180	1046
SPX (Southern Polar Region)	-90	-60	-180	180	46

DOMAINS OF VERIFICATION



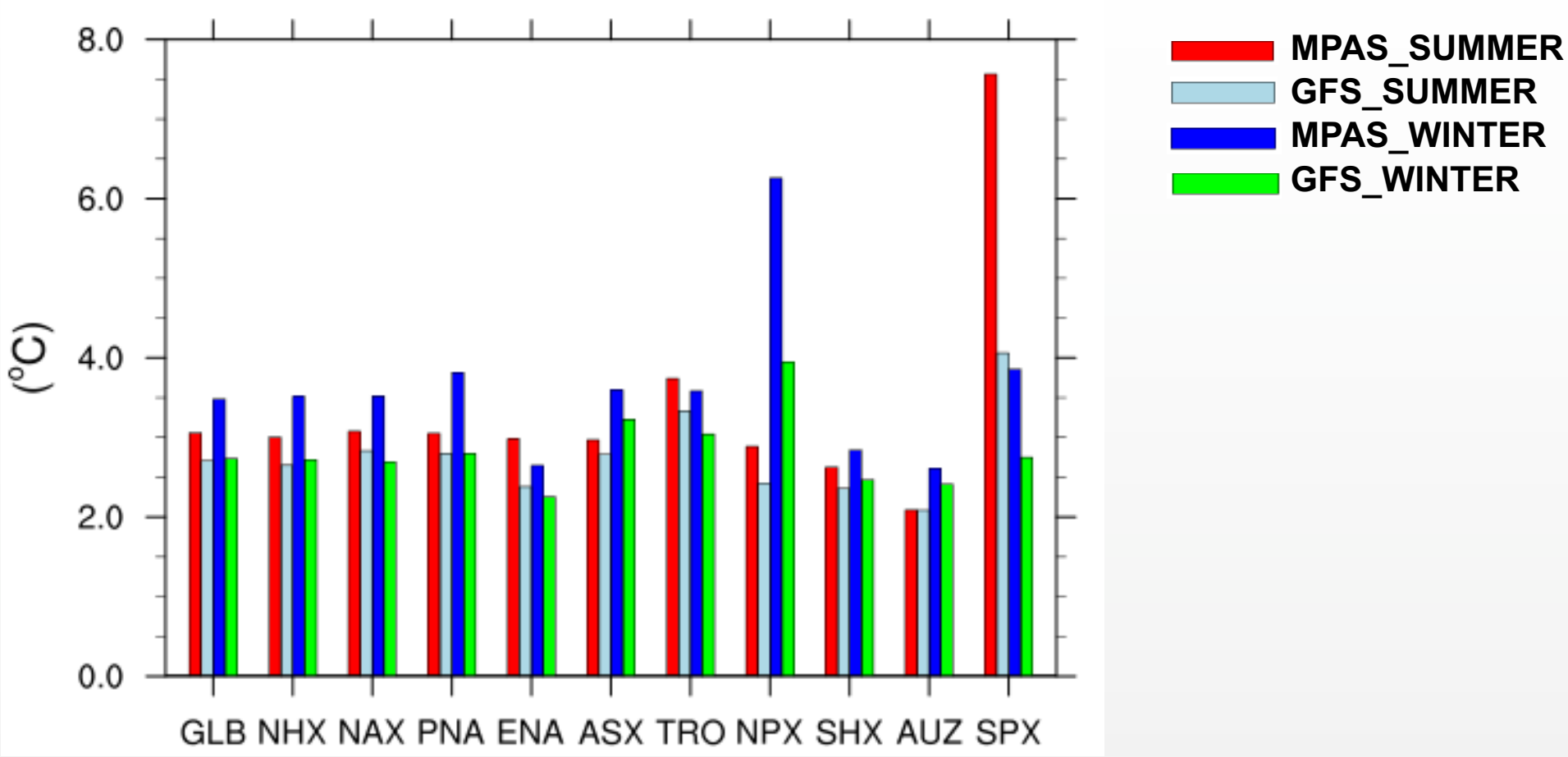
CUMULATIVE ERROR STATISTICS

Cumulative 7-Day Temperature BE



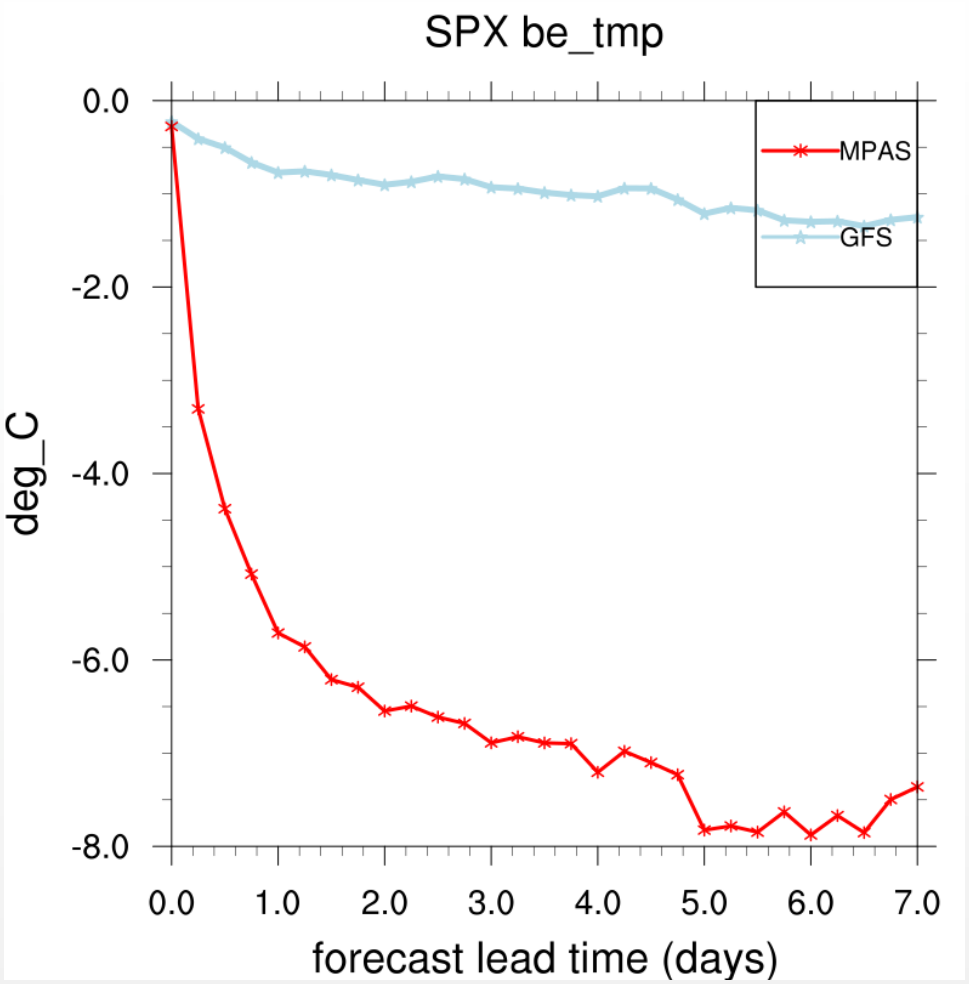
CUMULATIVE ERROR STATISTICS

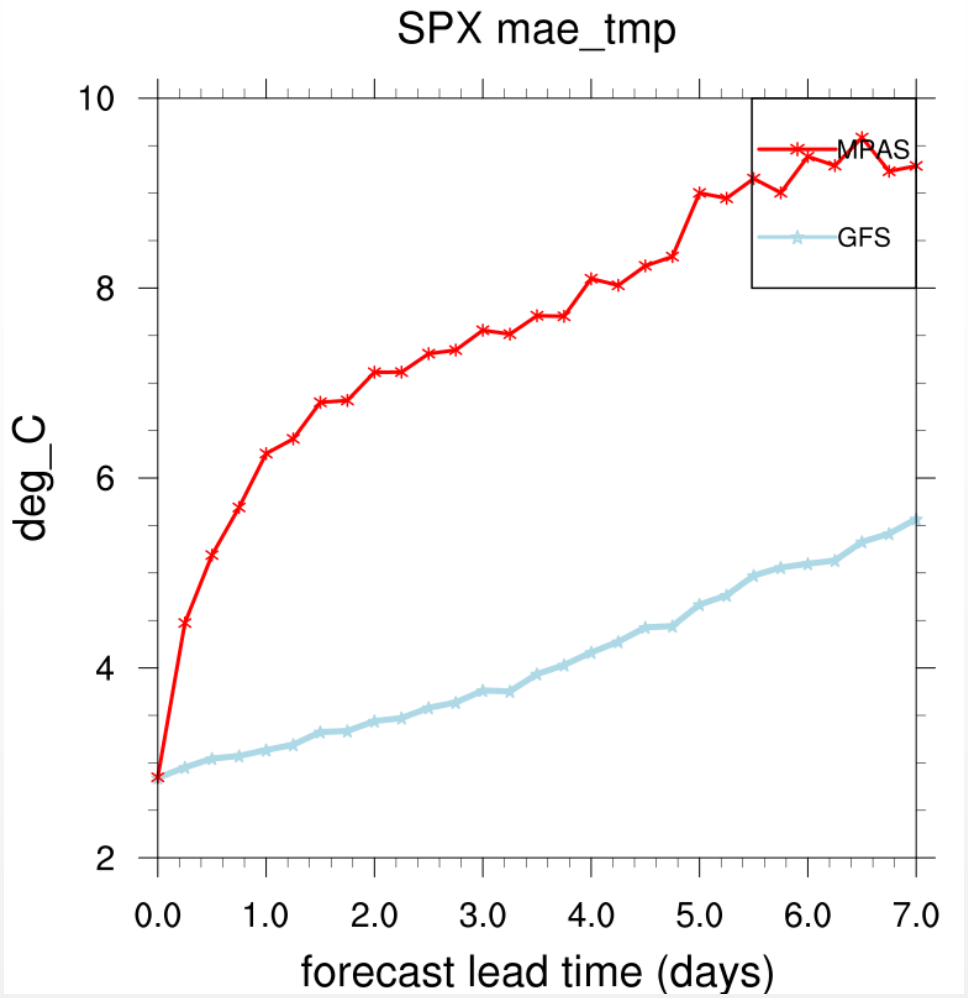
Cumulative 7-Day Temperature MAE



CUMULATIVE ERROR STATISTICS

2018-06-15 – 2018-09-15





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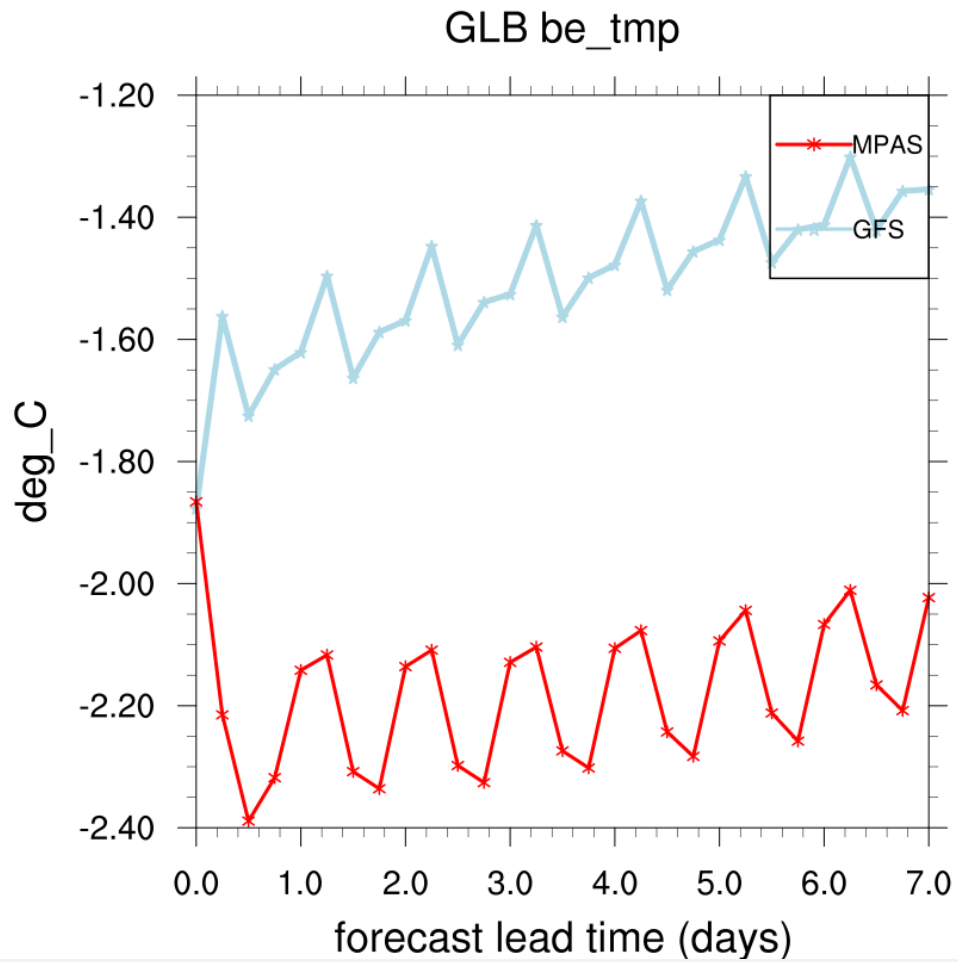
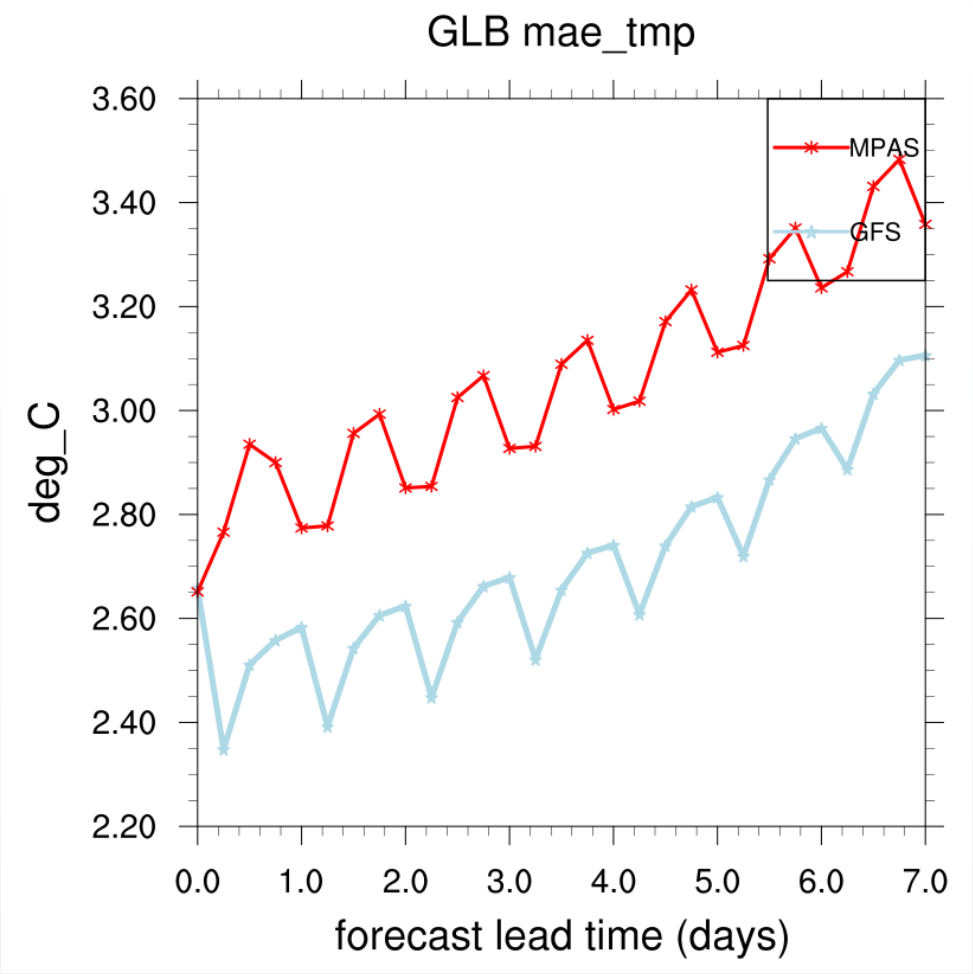
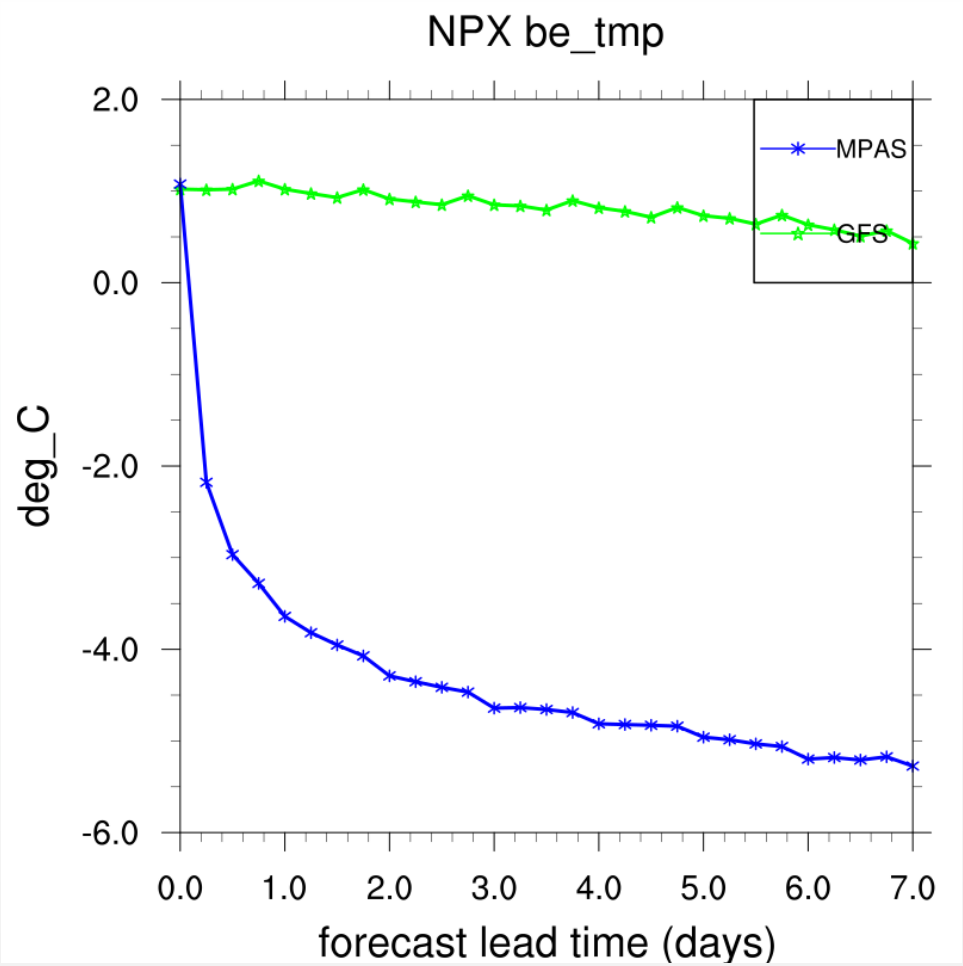
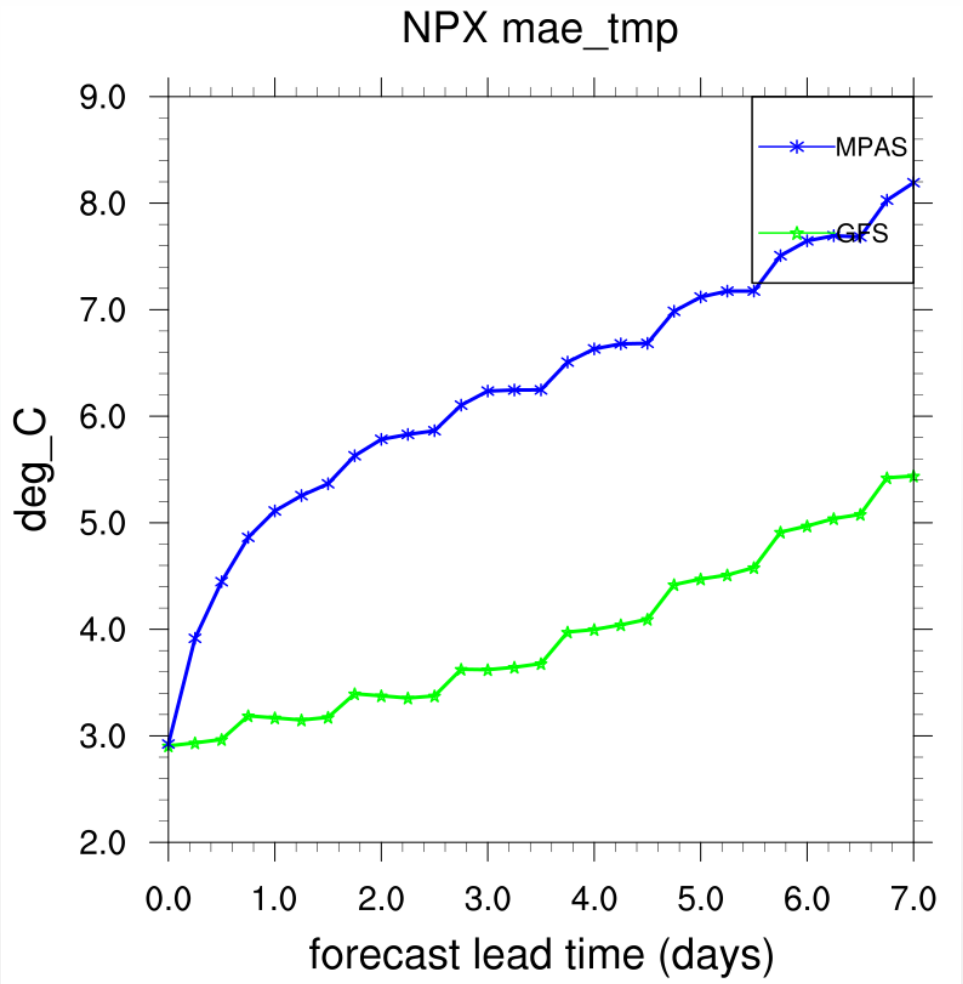




CUMULATIVE ERROR STATISTICS

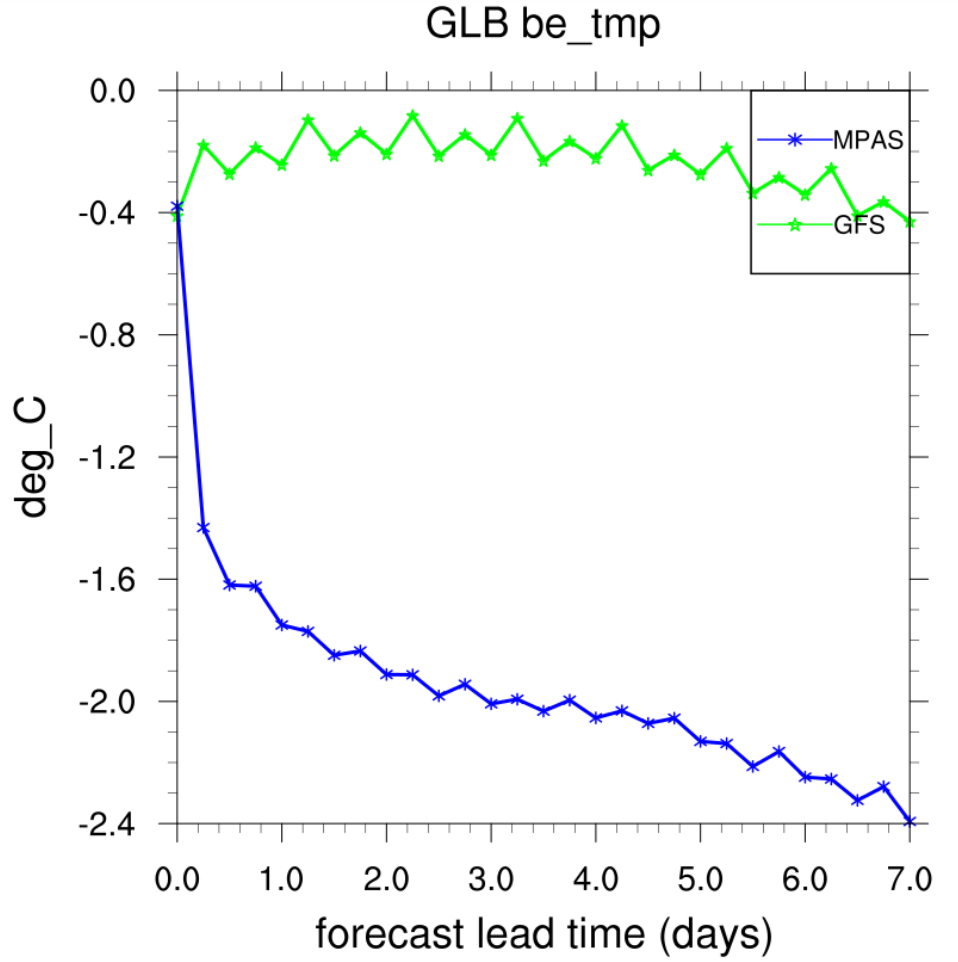
2018-12-01 – 2019-02-28

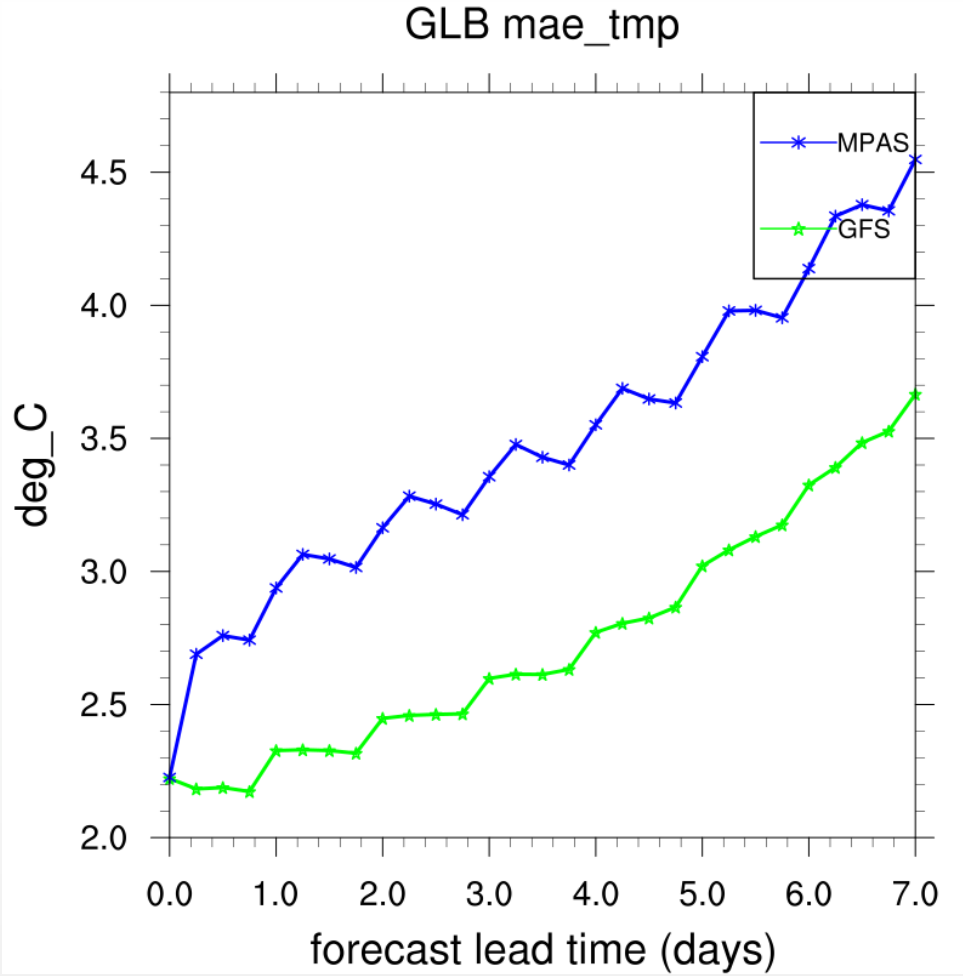




CUMULATIVE ERROR STATISTICS

2018-12-01 – 2019-02-28



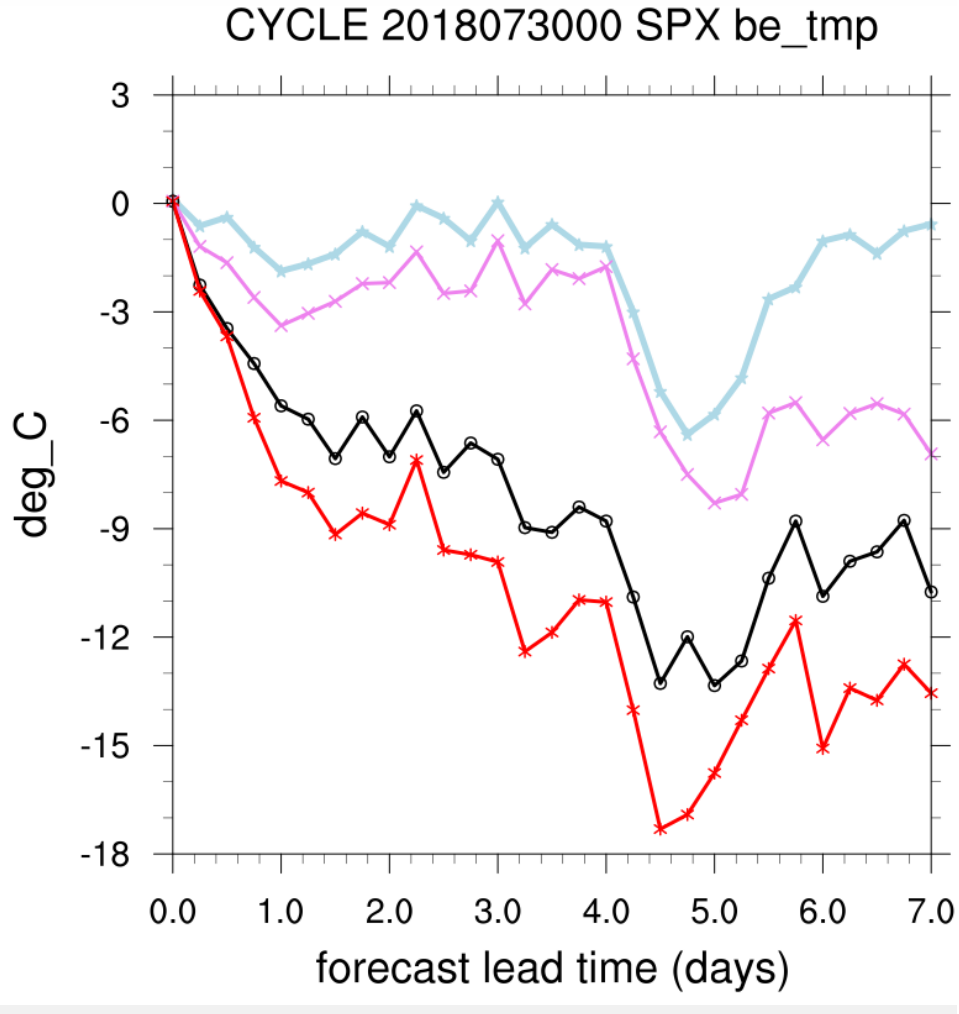


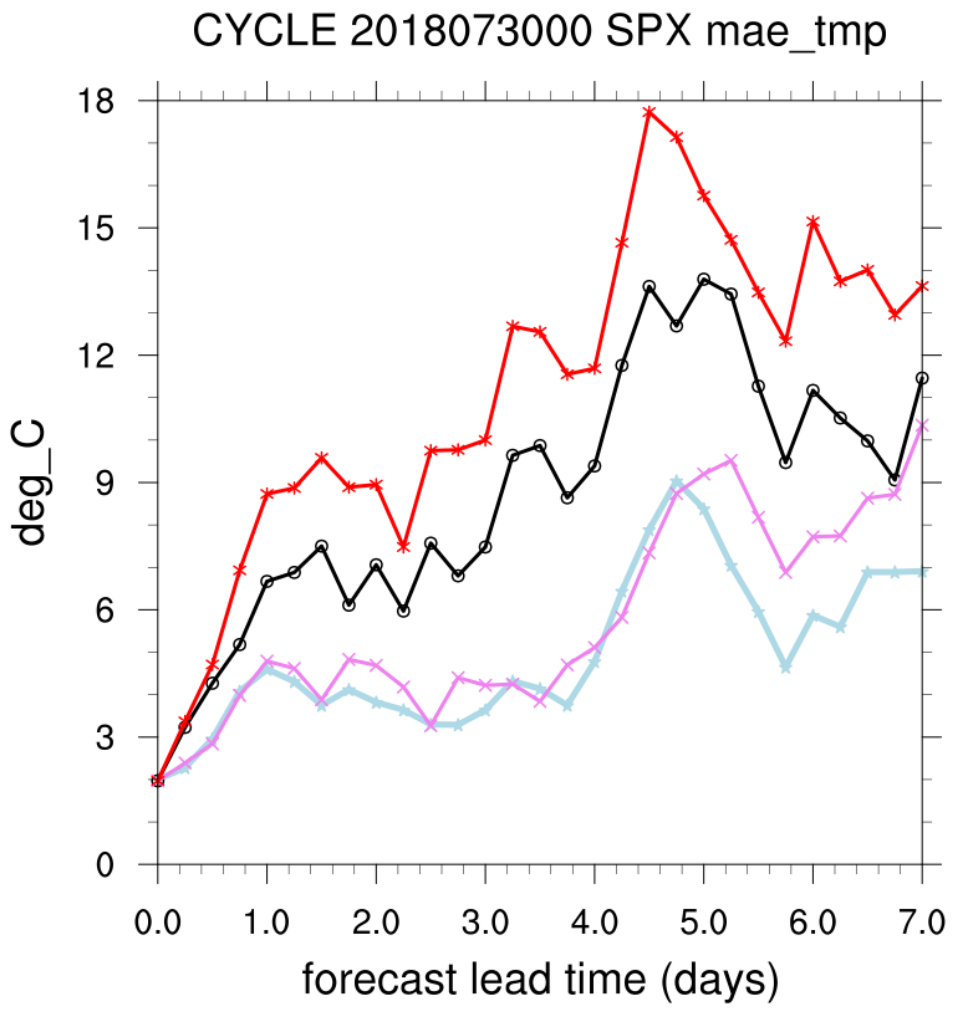
MODIFICATIONS OF MPAS CODE

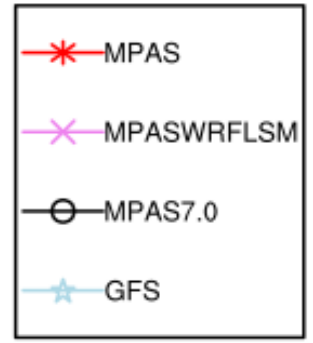
- Comparison of WRF V4.0.3 Physics with MPAS V6.1 Physics revealed major differences in the Noah LSM (mainly in land ice treatment).
- Ported Noah LSM from WRF V4.0.3 to MPAS V6.1
  - Low hanging fruit to improve MPAS
  - Other modules needed to be modified and works without urban option.
- Ran two cases (summer and winter cases) to test and compare with original MPAS V6.1 and MPAS V7.0.

RESULTS FROM MODIFIED MPAS CODE

SUMMER CASE







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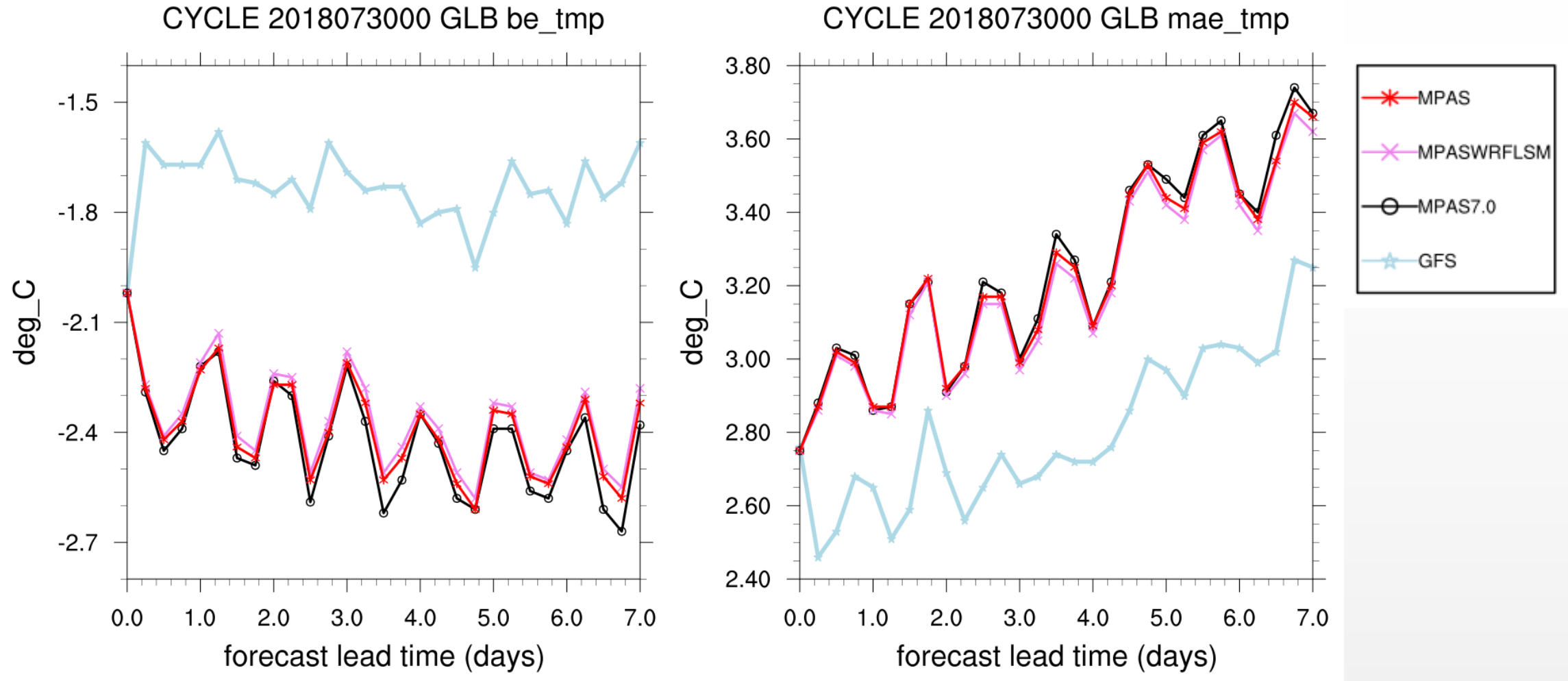
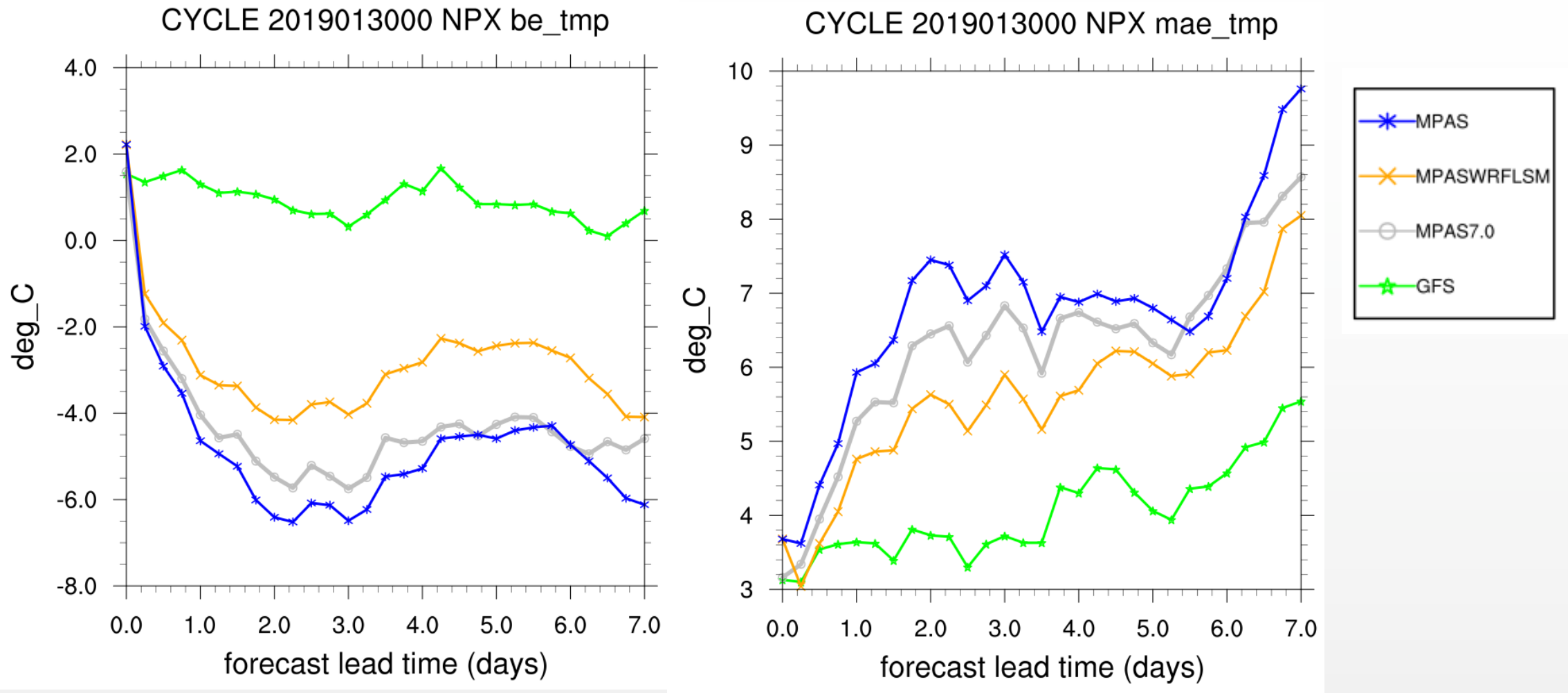
SUMMER CASE



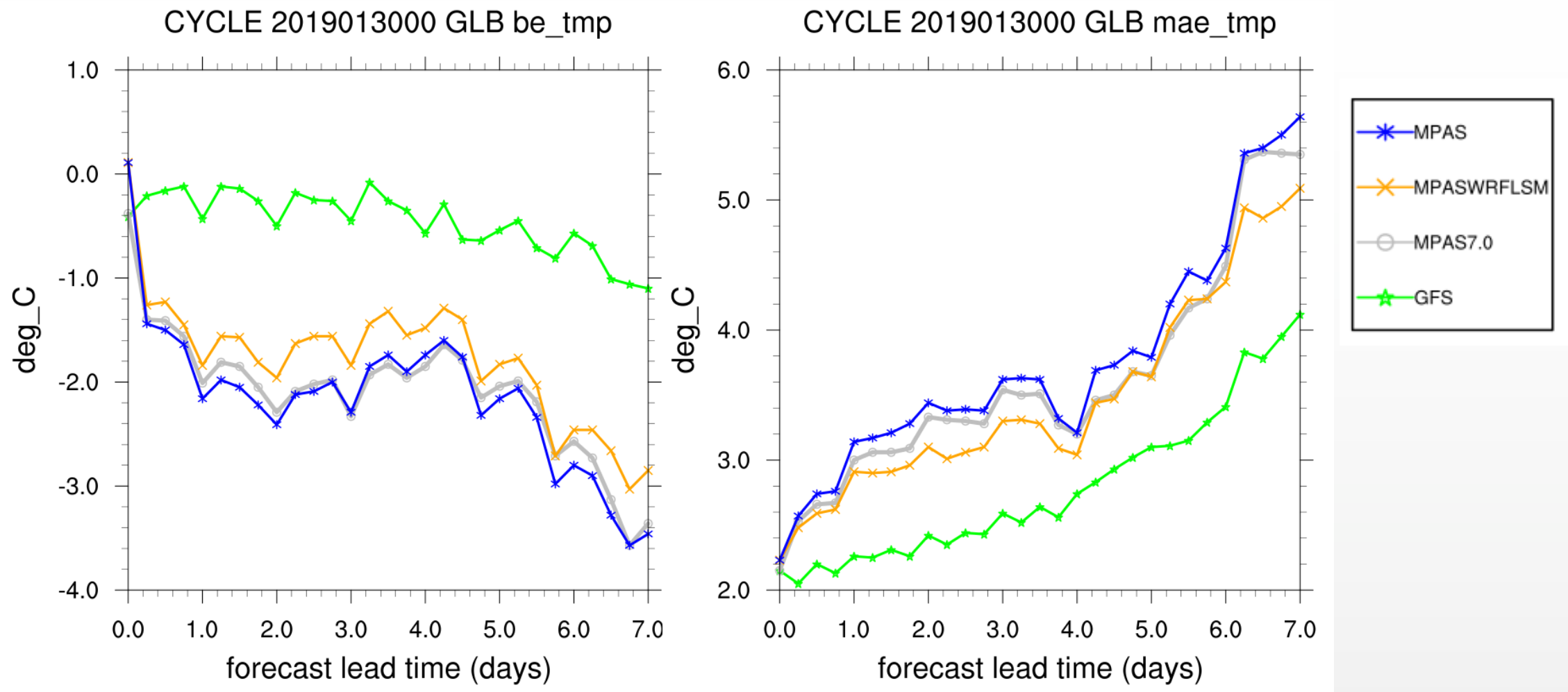
RESULTS FROM MODIFIED MPAS CODE

WINTER CASE



RESULTS FROM MODIFIED MPAS CODE

WINTER CASE



SUMMARY REMARKS

- Temperature bias in MPAS tended to be more negative than GFS.
- Globally, MPAS temperature MAE was 0.3 (0.8) deg C higher than that of GFS for the summer (winter). Results probably due to more stations in NH.
- Temperature BE and MAE much worse than GFS in the winter pole even though errors in both models started at about the same value.
- Modified MPAS with WRF V4.0.3 Noah LSM reduced temperature errors (particular in polar regions) by as much as 10 deg C MAE for certain forecast lead times in a case study – and modest improvements in MAE globally (winter).

SUMMARY REMARKS

- MPAS V7.0 improved upon MPAS V6.1 but not as much as modfied MPAS V6.1 for the two case studies.
- Still need to address the temperature error issue in other parts of the world and further improvements in the polar regions.
  - Further look at code differences between modified MPAS V6.1 and MPAS V7.0.

THANK YOU!

SAN FRANCISCO | BOULDER | GLASGOW | LUXEMBOURG | SINGAPORE