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Canada

Subseasonal Forecast Skill over the Northern Polar Region in Three Operational S2S Systems

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Recherche en Prévision Numérique,

Environment and Climate Change Canada

Workshop on Predictability, dynamics and applications research using the TIGGE and S2S ensembles, April 2-5, 2019

ECMWF

Outlines

- Motivations
- Subseasonal forecast models
- T2m skill
- Influence of the Madden-Julian Oscillation (MJO)
- Summary

Motivations

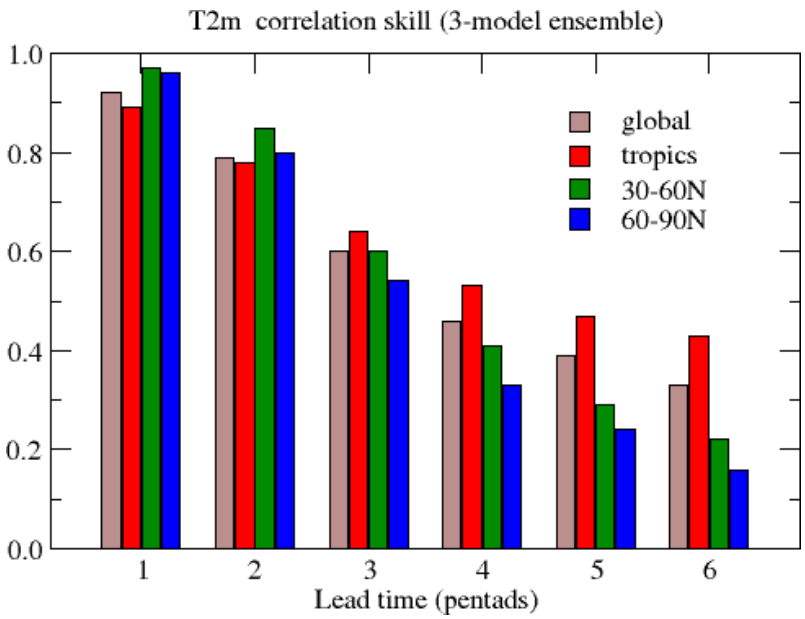
- Surface air temperature influences sea ice
- What is the forecast skill of T2m in polar region on the subseasonal time scale?
- Comparison with other regions
- Coupled model vs atmospheric-only model
- Sources of predictability and skill. e.g., MJO impact

Data and methods

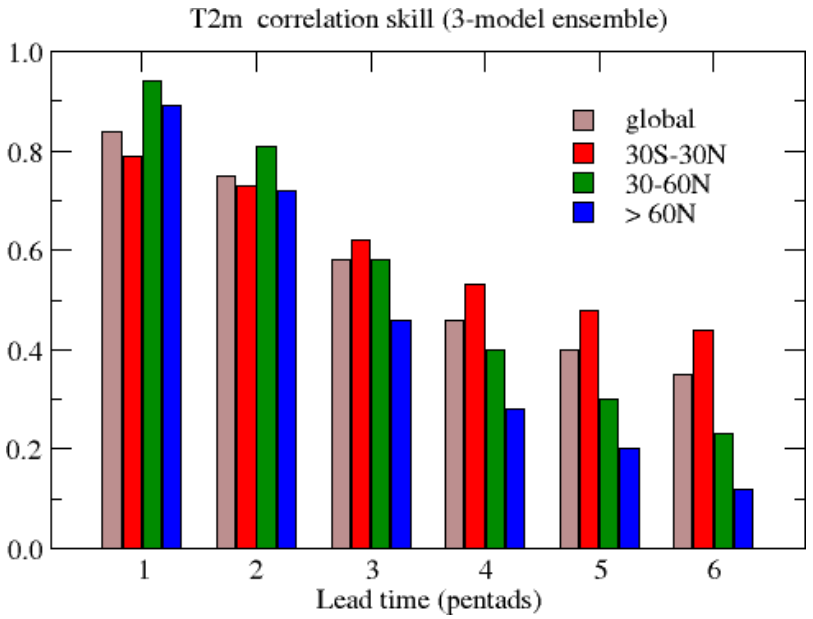
- Hindcast data of S2S archive
- Models used: ECCC, ECMWF and NCEP
- 12 common years 1999-2010, four members each model, once a week
- Pentad averaged data
- Verification with ERAinterim and NCEP/NCAR reanalysis
- Extended winter: NDJFM

T2m skill (3-model ensemble)

against ERA-interim

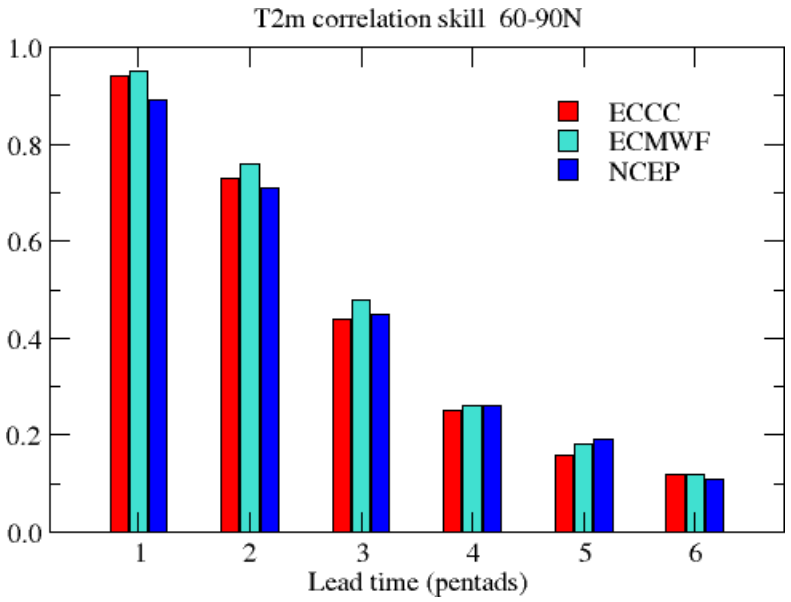


against NCEP/NCAR

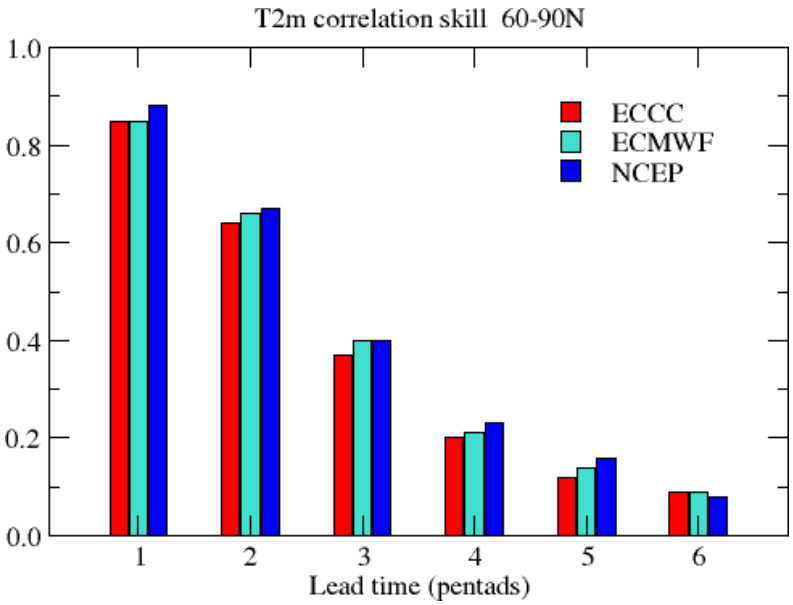


T2m skill (north polar region)

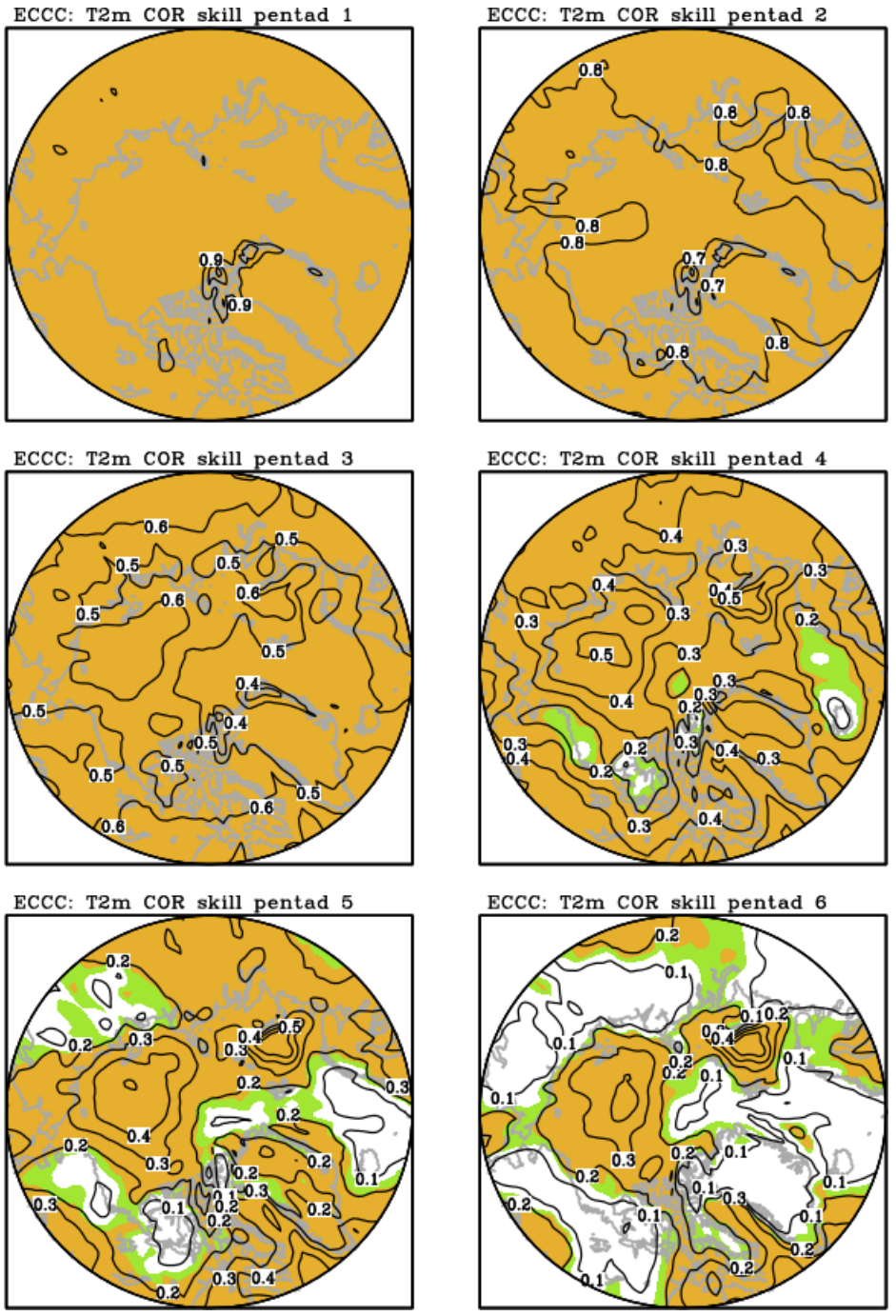
against ERA-interim



against NCEP/NCAR



T2m skill
ECCC

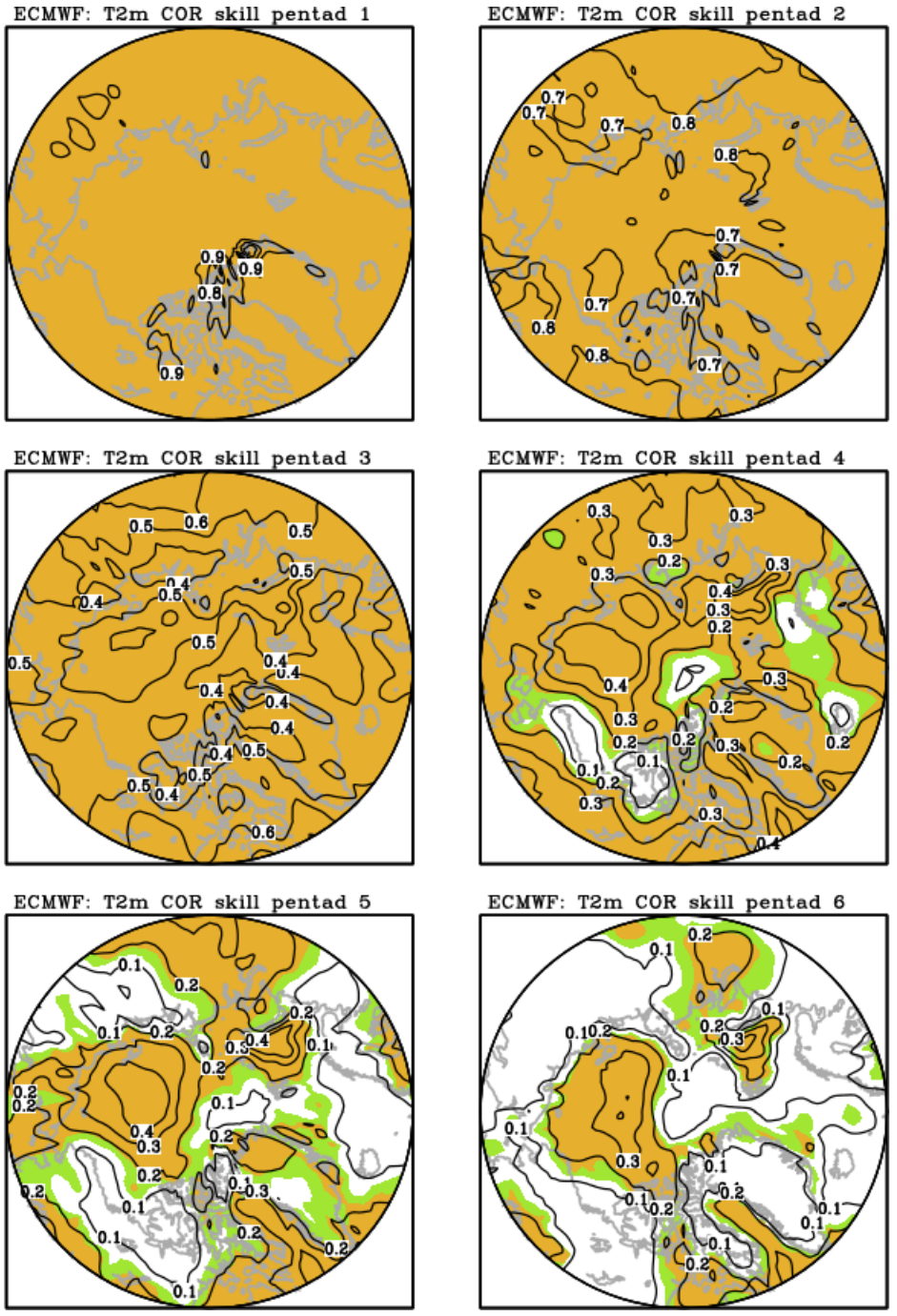


Statistical significance

Light green:
0.05

Orange:
0.01

T2m skill ECMWF



Statistical significance

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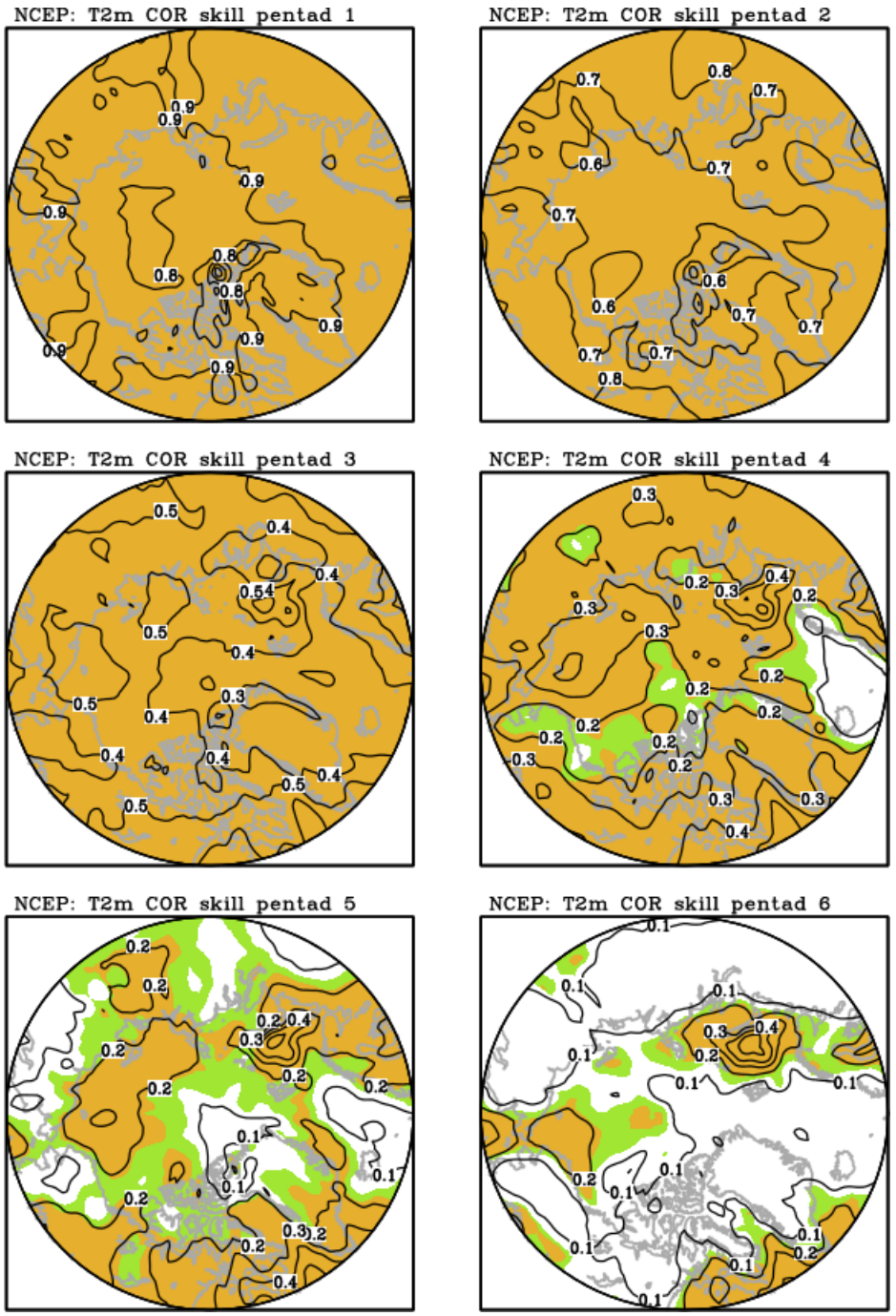
T2m skill
NCEP



Statistical significance

Light green:
0.05

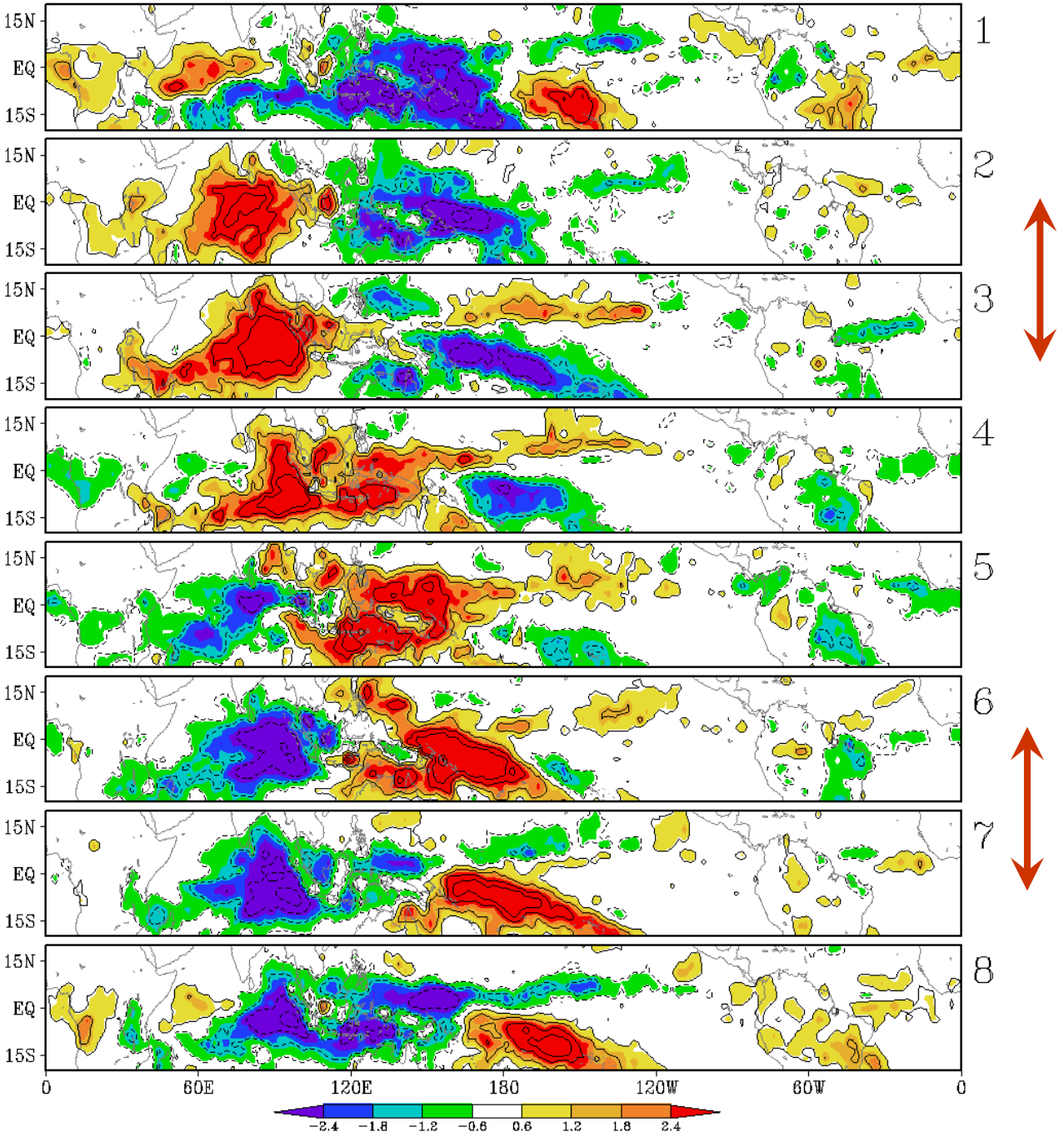
Orange:
0.01

The MJO

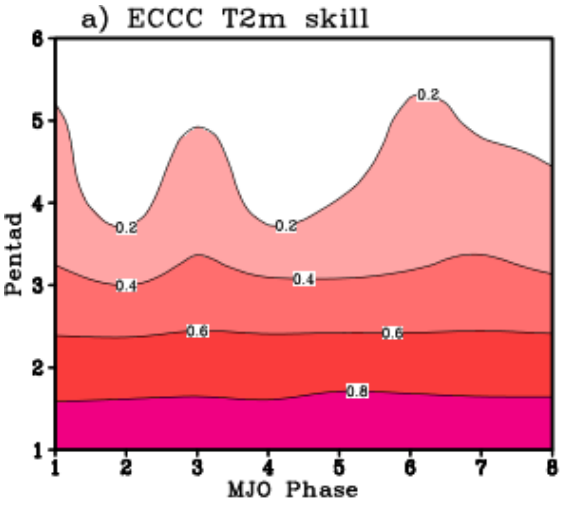
Composites of tropical

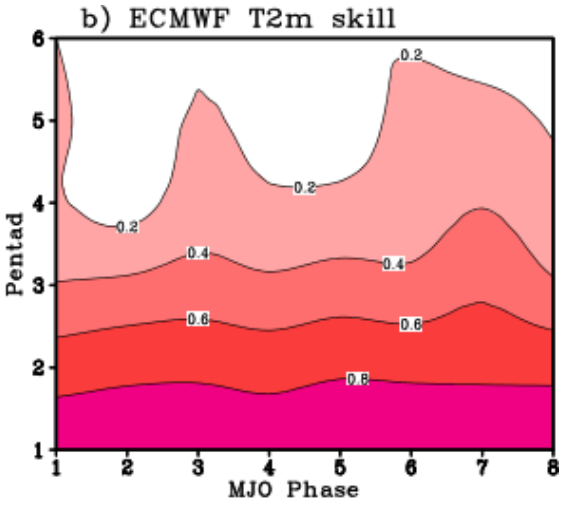
Precipitation rate for 8 MJO phases, according to Wheeler and Hendon index.

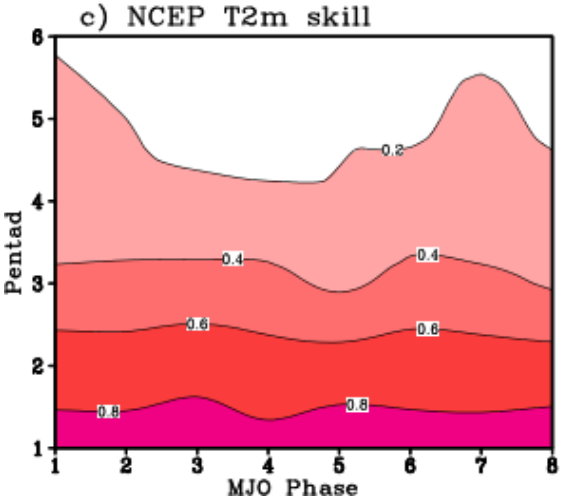
Xie and Arkin pentad data, 1979-2003



Polar (60-90N) T2m skill dependence on MJO phase







MJO impact on NAO and polar temperature

e.g., Lin et al. (2009), Cassou (2008), Lin and Brunet (2010), Yoo et al. (2011)

10-20 days following MJO phase 3:

→ positive NAO, Arctic cooling

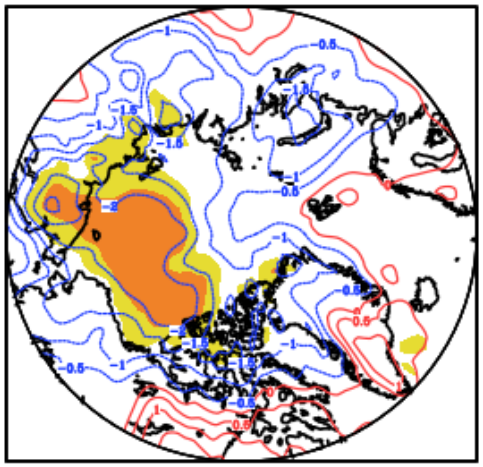
10-20 days following MJO phase 6:

→ negative NAO, Arctic warming

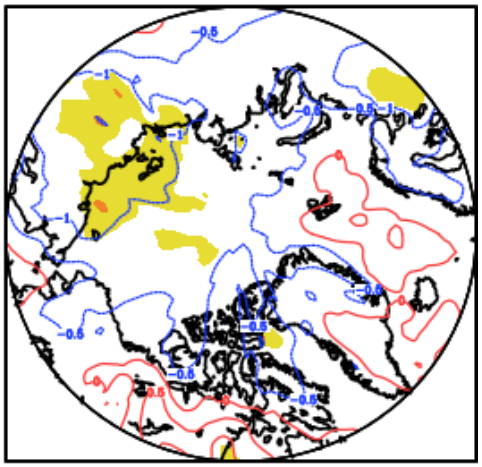
T2m anomaly lagged composites following phase 3

Polar cooling

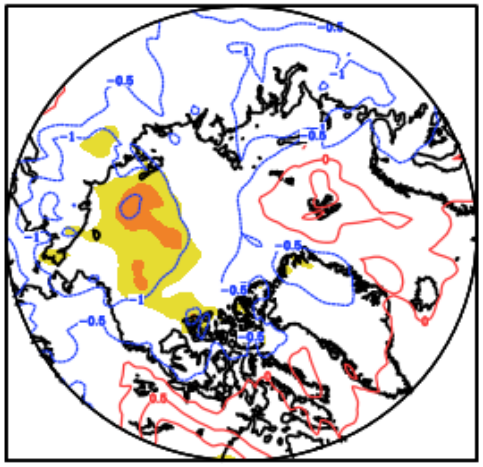
a) OBS ph3 lag=3



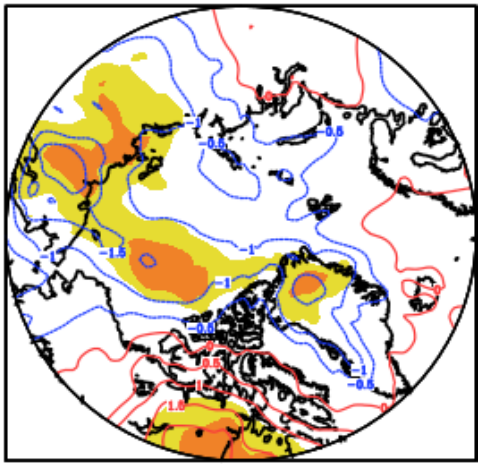
b) ECCC ph3 lag=3



c) ECMWF ph3 lag=3



d) NCEP ph3 lag=3



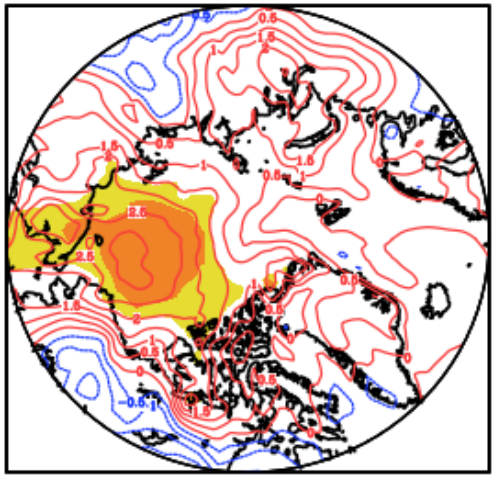
Yellow:
0.05

Orange:
0.01

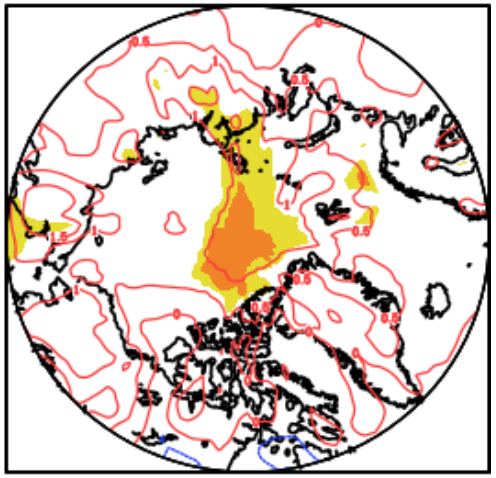
T2m anomaly lagged composites following phase 6

Polar warming

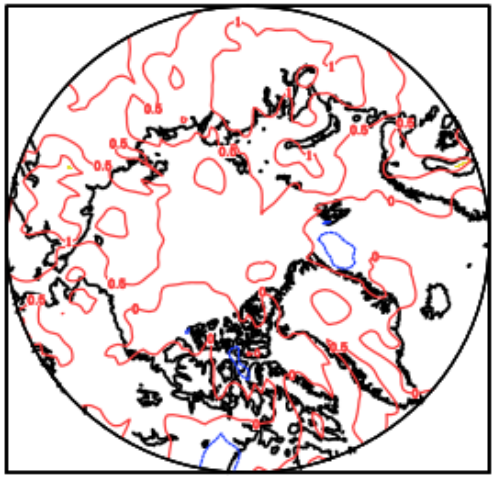
a) OBS ph6 lag=4



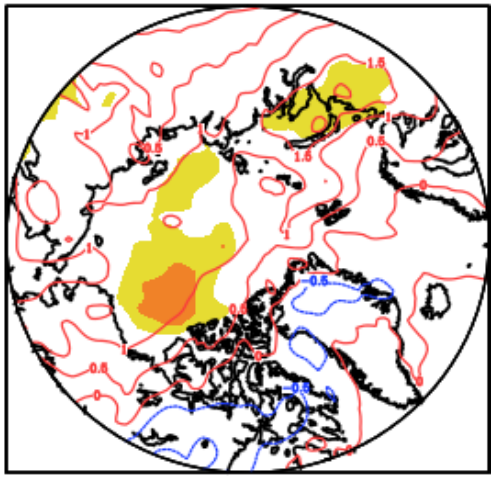
b) ECCC ph6 lag=4



c) ECMWF ph6 lag=4



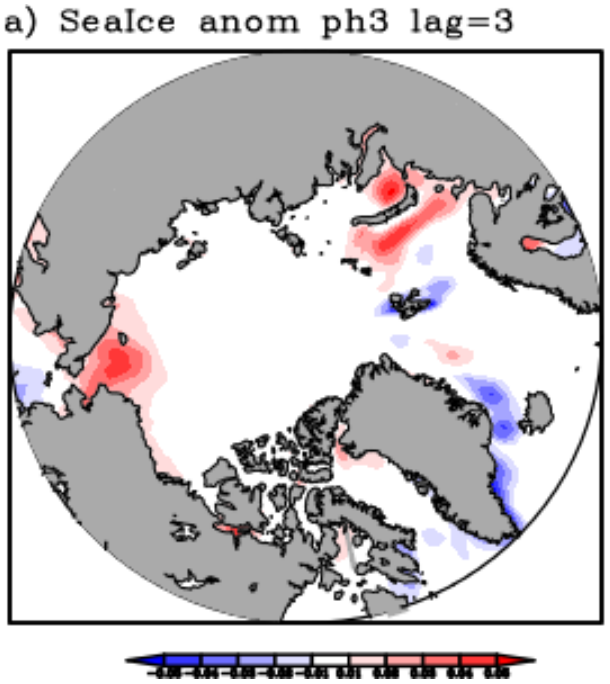
d) NCEP ph6 lag=4

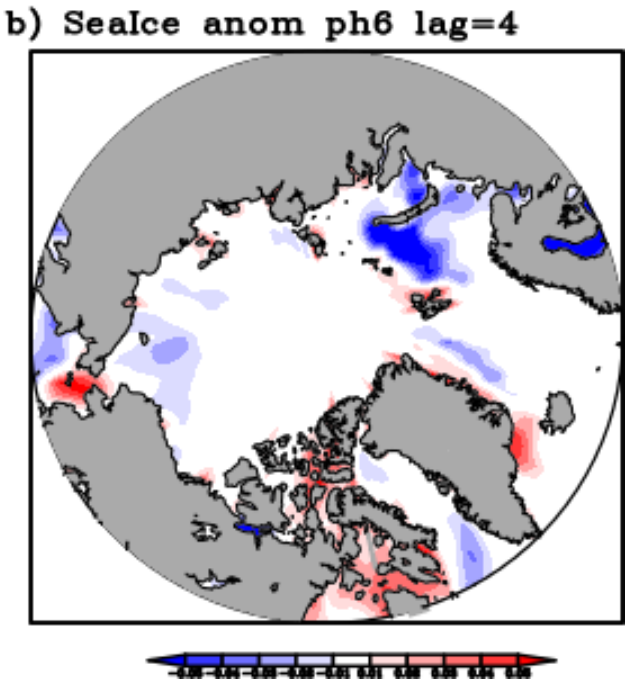


Yellow:
0.05

Orange:
0.01

Observed Sea Ice anomaly lagged composites



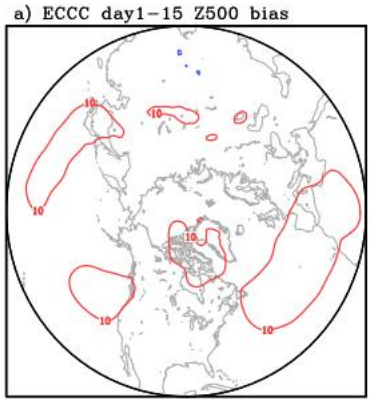


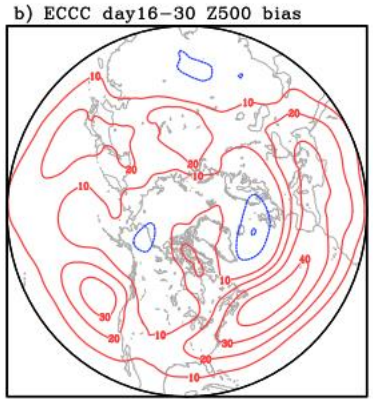
ERA interim

Z500 bias

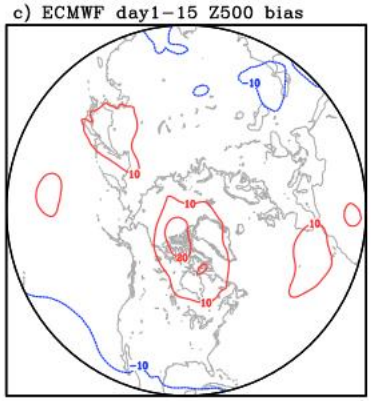
Days 1-15 | Days 16-30

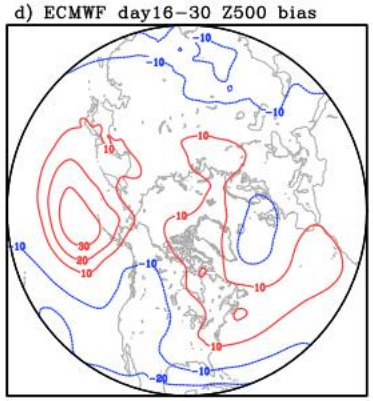
ECCC



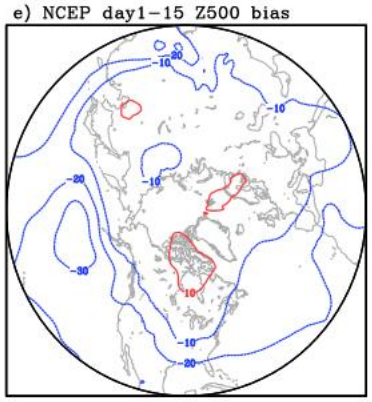


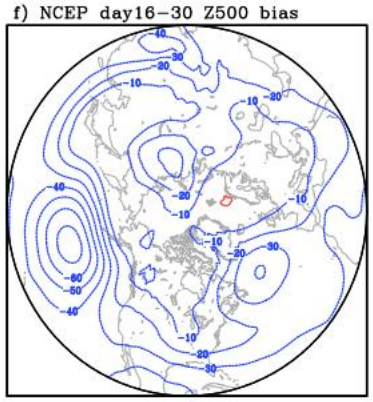
ECMWF





NCEP





Similar bias amplitude
In the North Pacific in days 16-30.

Resulting in MJO-teleconnection errors

Summary

- T2m skill is evaluated for three operational S2S models
- The T2m skill in the polar region is the lowest comparing to the tropical and middle latitude regions
- Three models have comparable forecast skill in surface air temperature over the north polar region.
- There is evidence that the tropical MJO contributes to the T2m skill in the north polar region.
- To improve the polar forecast on the subseasonal time scale, it is important to have well represented tropical MJO and teleconnections in the model.

Thank you!