Predicting the dominant patterns of subseasonal variability of wintertime surface air temperature in extratropical Northern Hemisphere

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Objectives

- Identify the dominant patterns of wintertime subseasonal SAT variability in the whole Northern Hemisphere land domain

- Associated large-scale atmospheric circulation

- How are the dominant modes predicted by current subseasonal systems?

- Which patterns are better predicted than others?

- MJO influence

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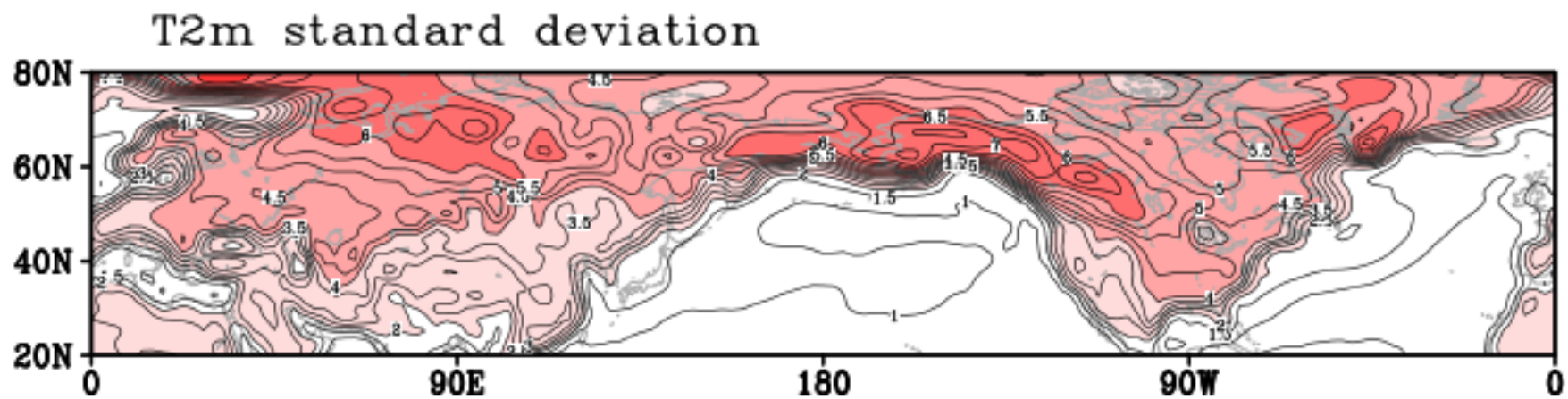Environnement et Changement climatique Canada

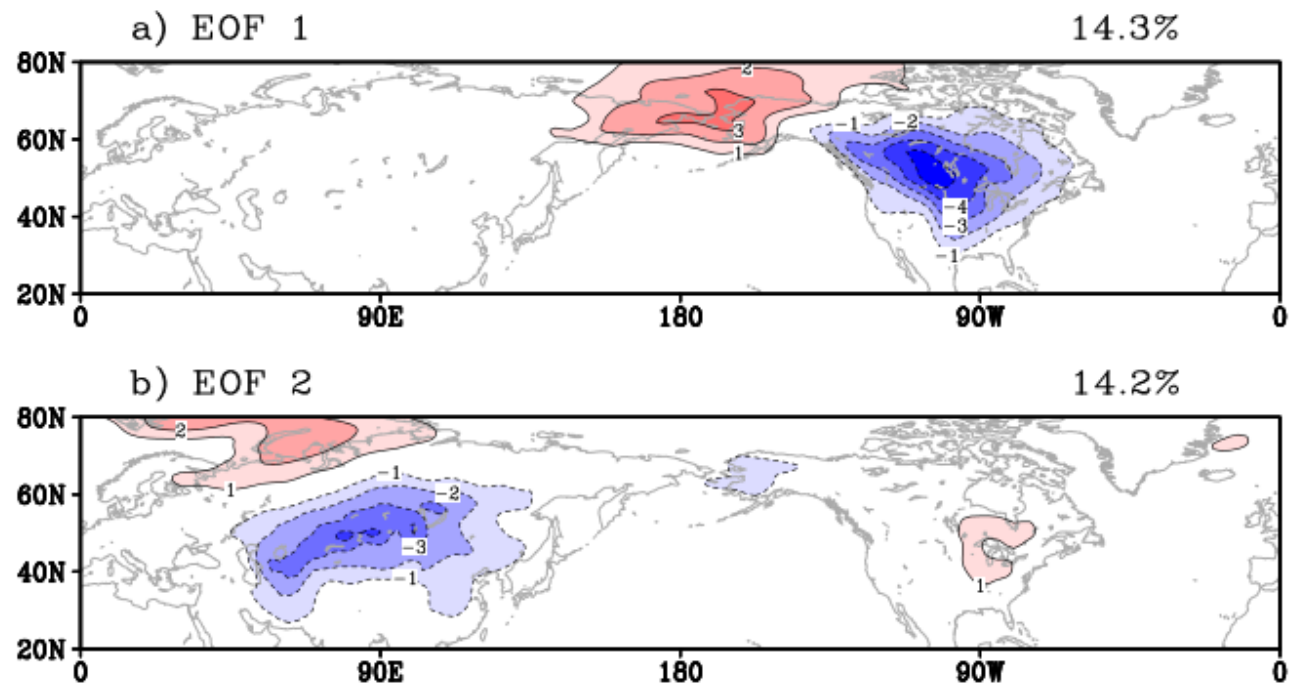Canada

Data and method

- Daily averaged NCEP/NCAR reanalysis

- Pentad (5-day) average

- Extended winter: November to March (30 pentads)

- 1979-2016 (38 extended winters)

- Remove seasonal cycle, and seasonal mean to get anomaly for subseasonal variability

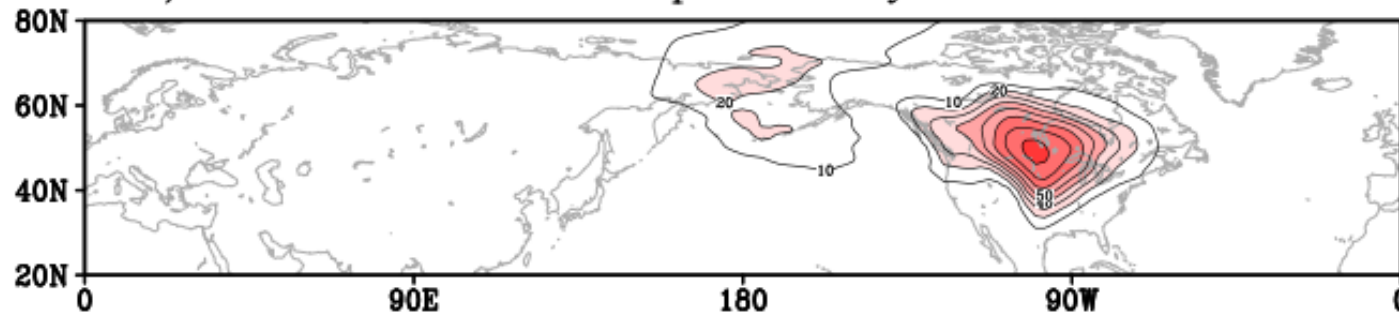- EOF analysis performed on pentad T2m anomaly over land grid points from 20°-70°N

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SAT subseasonal variability

T2m standard deviation

Two leading EOFs of SAT subseasonal variability

a) EOF 1   14.3%

b) EOF 2   14.2%

Variance explained

c) Percent variance explained by EOF 1

d) Percent variance explained by EOF 2

PC1 and PC2

e) auto-correlation
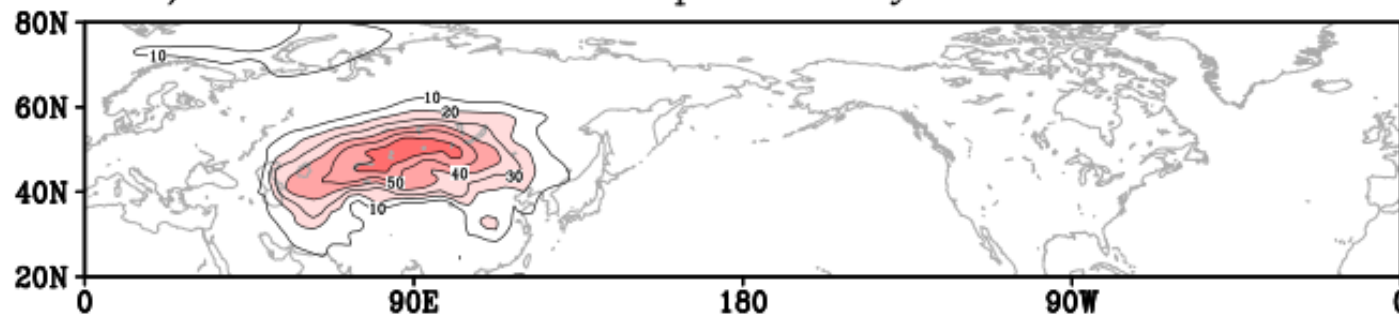
f) cross-correlation PC1 & PC2
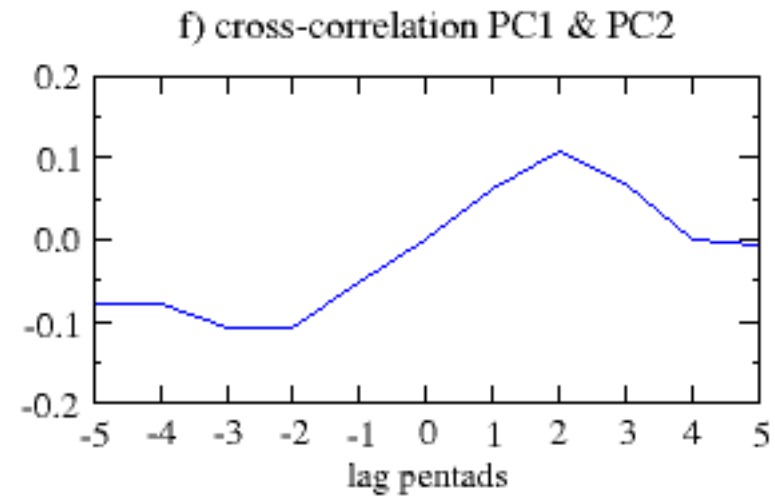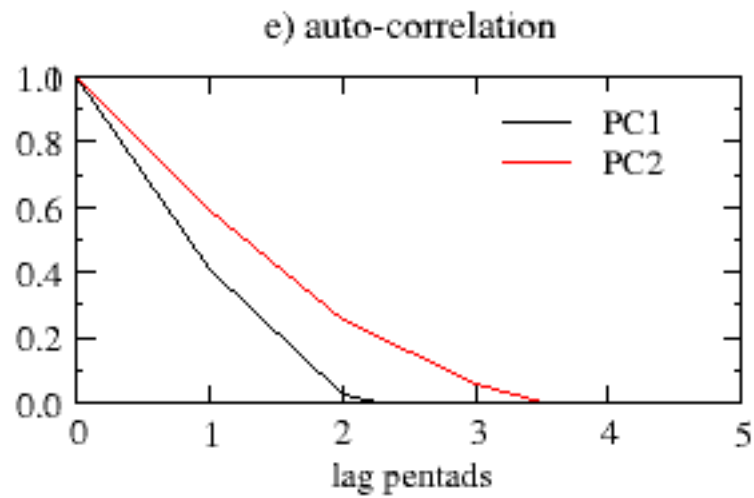
EOF2 is more persistent

EOF2 lags EOF1 by ~2 pentads
+EOF1, +EOF2,-EOF1,-EOF2

→inter-continental connection

Large-scale atmospheric circulation

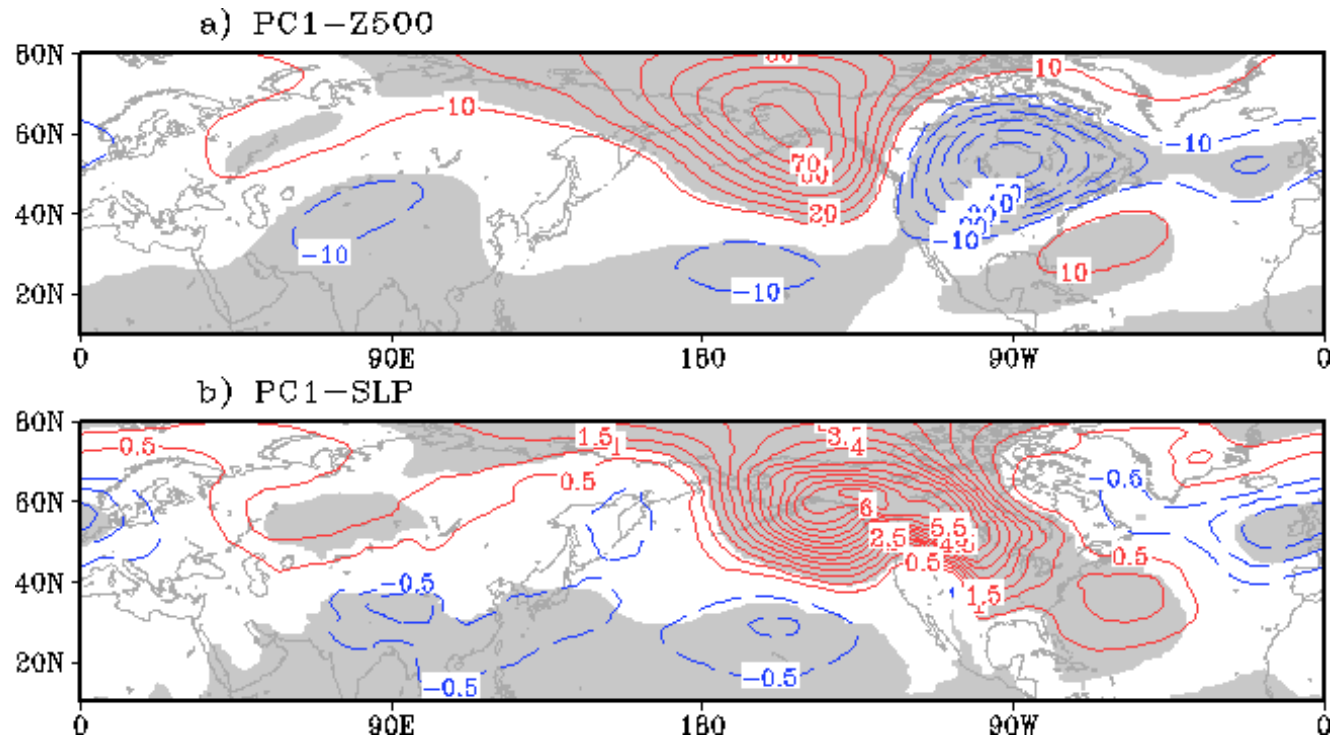- EOF1 and EOF2 represent large-scale swing of air mass between high-latitude regions and the central continents

  Bering Strait and Alaska ←→ North America
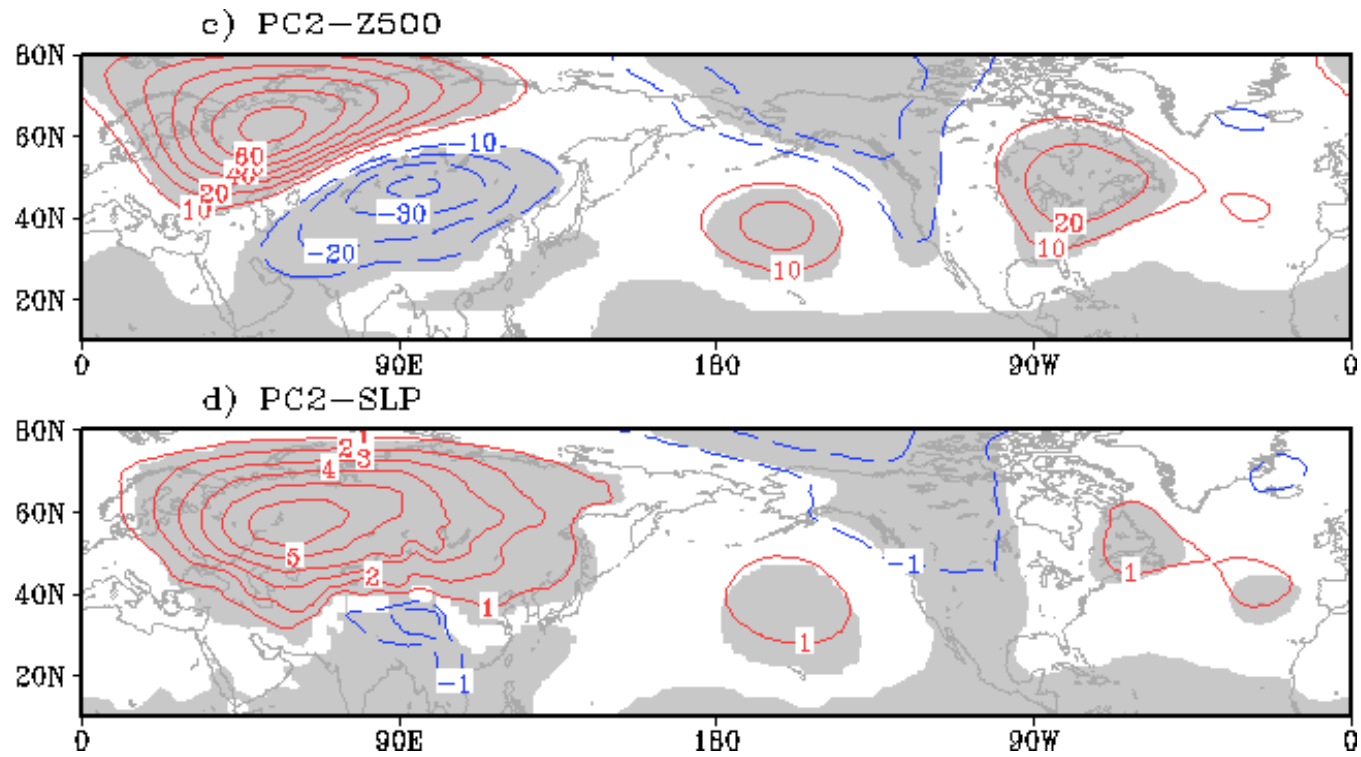
  Arctic coast of northwest Europe ←→ Siberia

EOF1 associated Z500 and SLP anomalies
Simultaneous regression

a) PC1-Z500

b) PC1-SLP

EOF2 associated Z500 and SLP anomalies
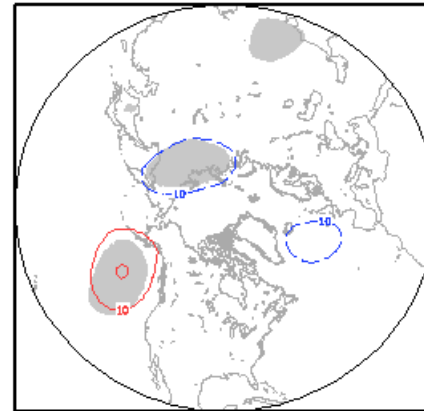Simultaneous regression

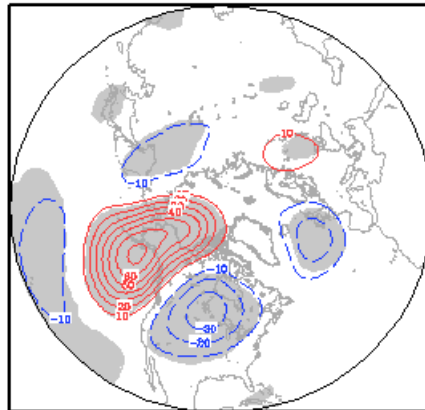# Z500 anomaly leads EOF1
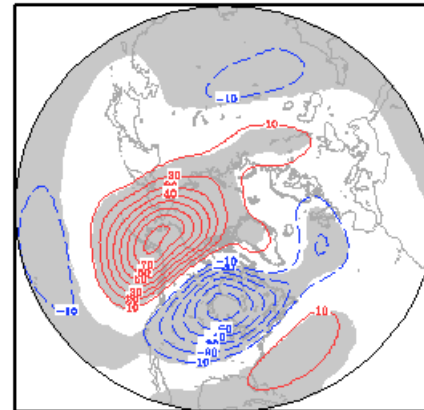## Lagged regression

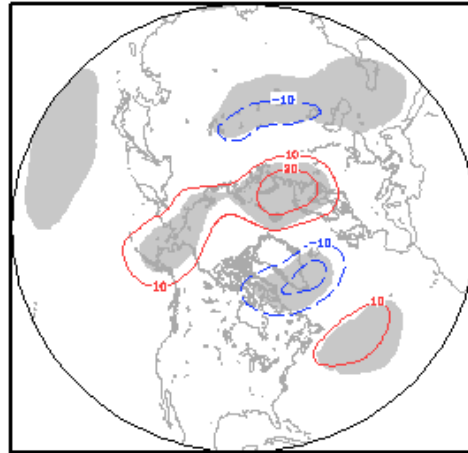a) PC1–z500 lag=–3 b) PC1–z500 lag=–2

c) PC1–z500 lag=–1 d) PC1–z500 lag=0

No clear signal with a lead time longer than two pentads

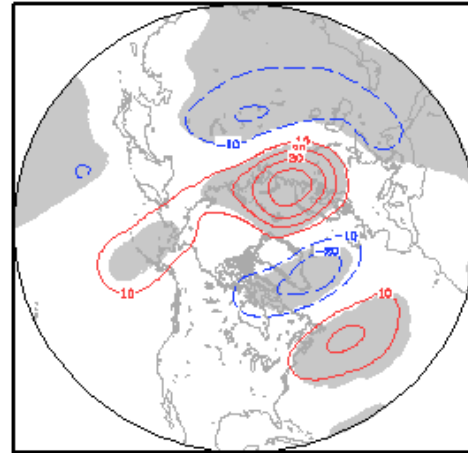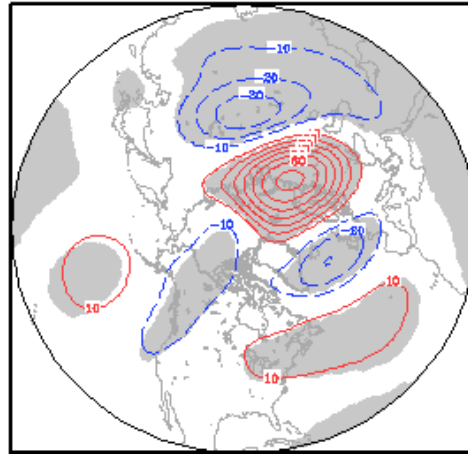# Z500 anomaly leads EOF2
Lagged regression
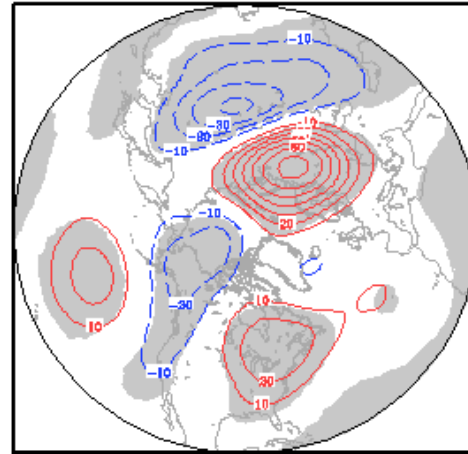
Stronger tropical-extratropicla connections than EOF1

Subseasonal predictions

- 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

- Projecting the forecast T2m pentad anomaly onto the observed EOF1 and EOF2 to get the forecast PC1 and PC2
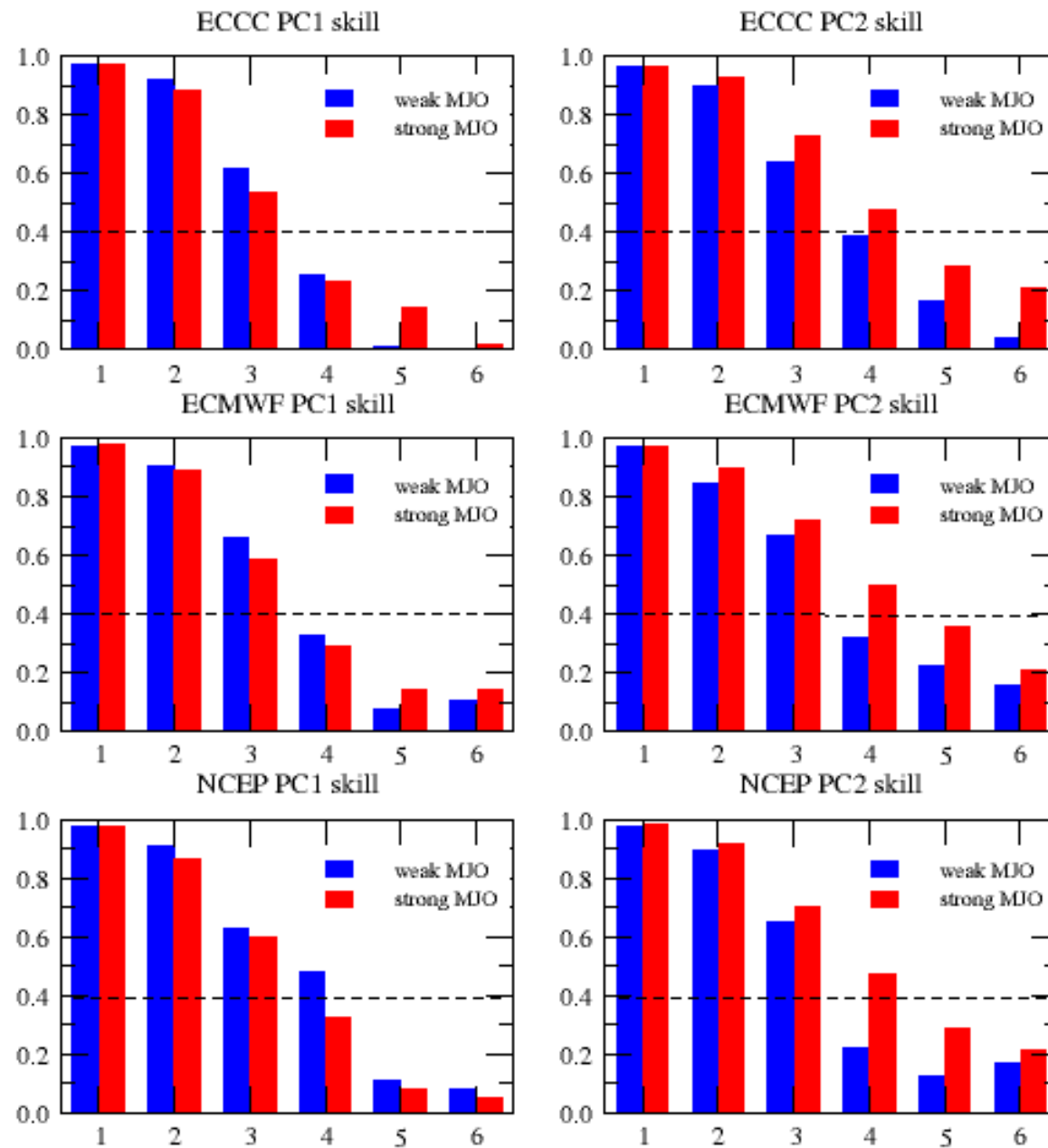
T2m correlation skill of EOF1 and EOF2
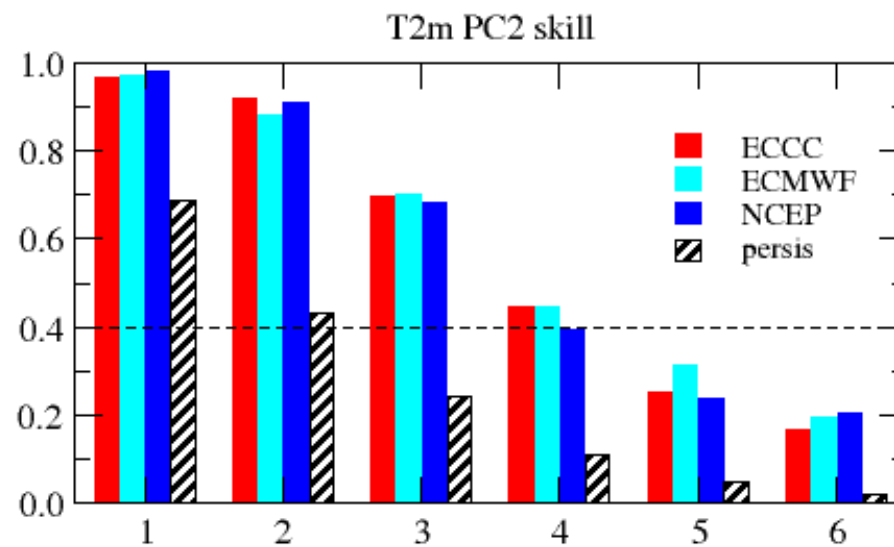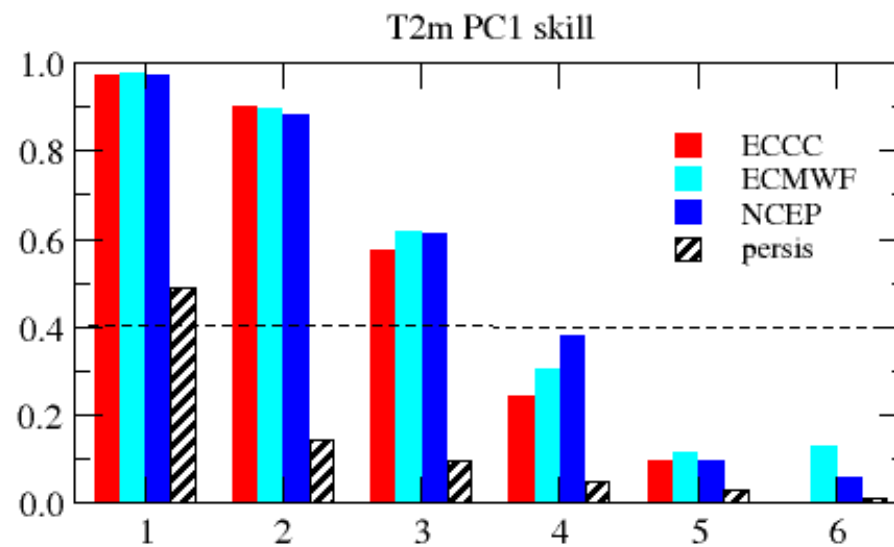
MJO impact
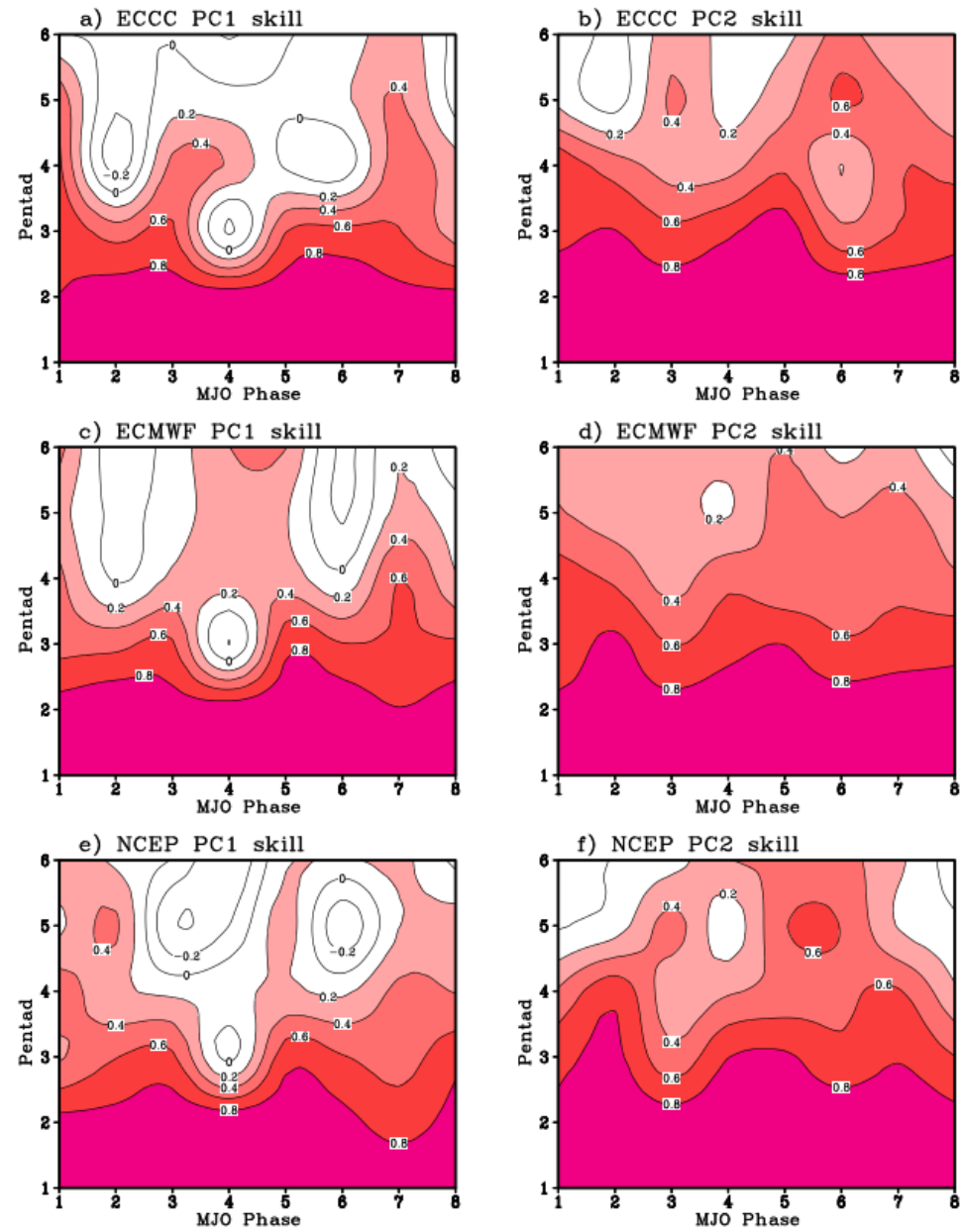
- Compare forecast skill for two groups of forecasts: 1) initial condition with strong MJO (amp>1); 2) initial condition with weak MJO (amp<1)

- 166 strong MJO cases vs 98 weak MJO cases

- Skill dependence on initial MJO phase is also evaluated

T2m skill of EOF1 and EOF2

T2m skill of EOF1 and EOF2

Summary

- Two leading T2m modes well separated geographically: the North American mode and Eurasian mode

- Air mass swing between high latitudes and central continents

- Inter-continental connection of subseasonal temperature variability

- The Eurasian mode (EOF2) has better forecast skill than the North American model (EOF1)

- Different MJO impacts on EOF1 and EOF2 forecast skill

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