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Canada

Impact of the Madden-Julian Oscillation on wintertime temperature and precipitation in Canada

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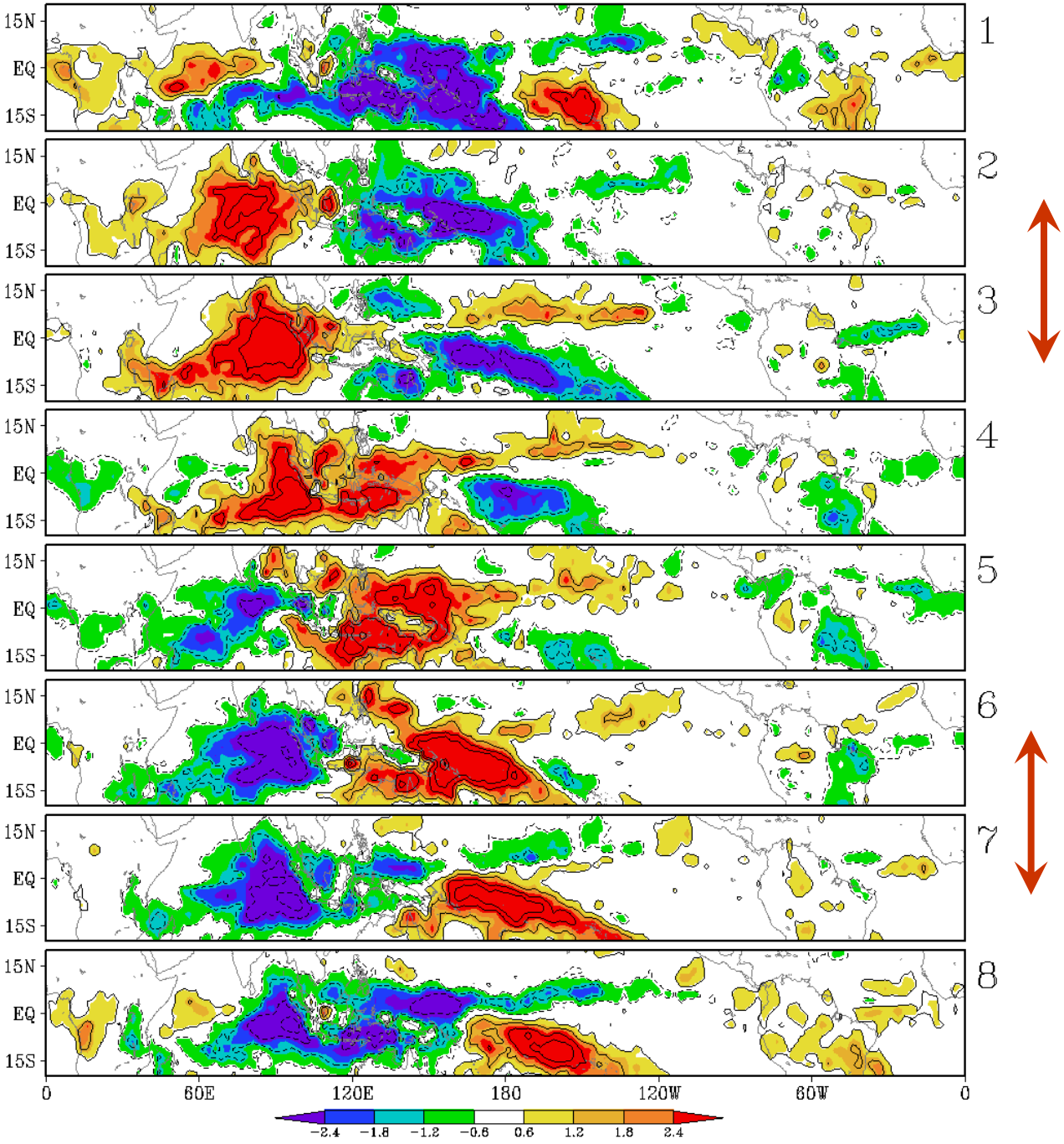
Composites of tropical

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

Xie and Arkin pentad data, 1979-2003



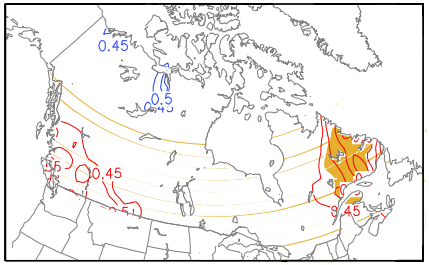
MJO influence on Canadian surface air temperature (SAT)

- Homogenized Canadian historical daily surface air temperature (SAT) --- 210 relatively evenly distributed stations across Canada (Vincent et al. 2002, JCLIM)
- 26 winters (DJF) 1978/80 to 2004/25
- All data grouped into pentads

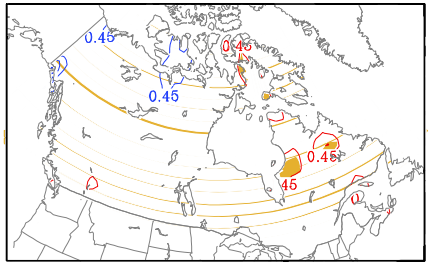
Lagged probability composite for each MJO phase (lag in pentads)

- Three categories: above normal, near normal and below normal
- Each category has 33% average probability

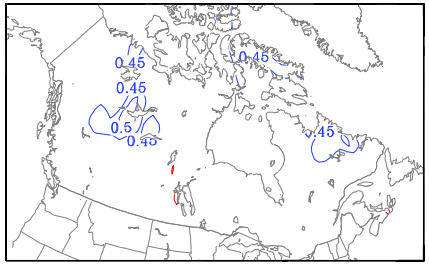
a) PHASE 1 lag=0



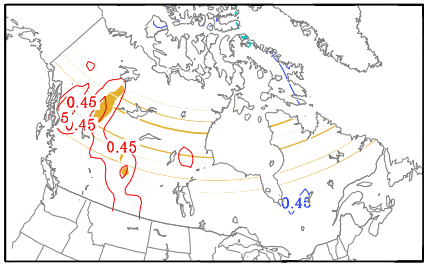
b) PHASE 1 lag=1



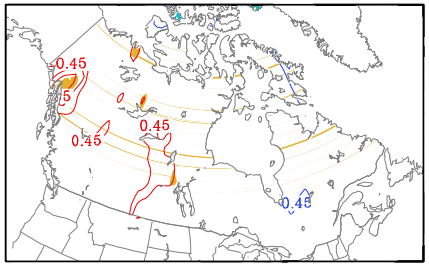
c) PHASE 1 lag=2



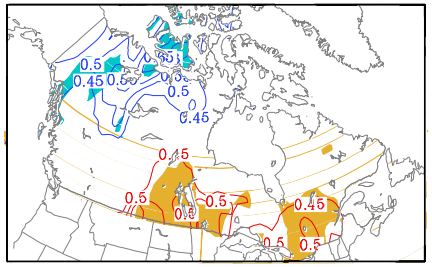
d) PHASE 2 lag=0



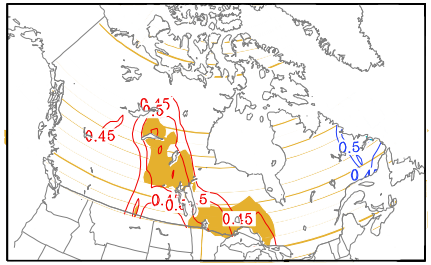
e) PHASE 2 lag=1



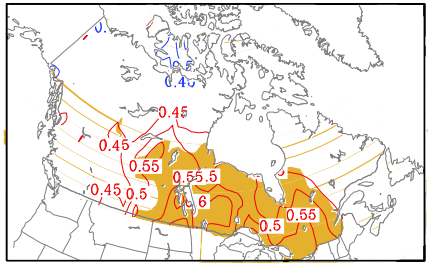
f) PHASE 2 lag=2



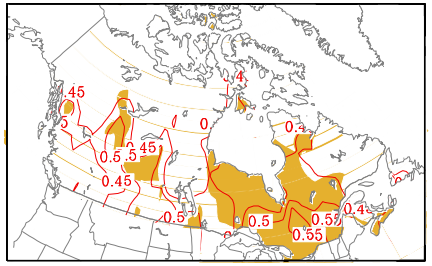
g) PHASE 3 lag=0



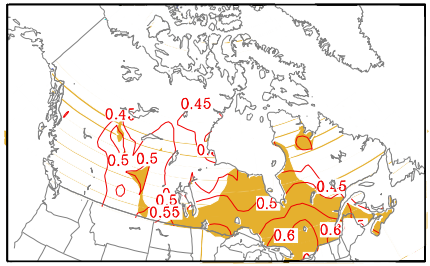
h) PHASE 3 lag=1



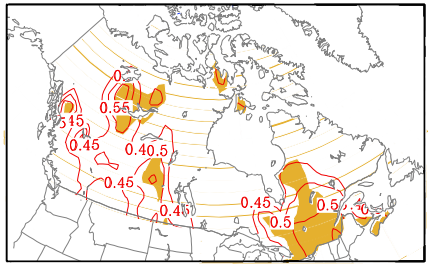
i) PHASE 3 lag=2



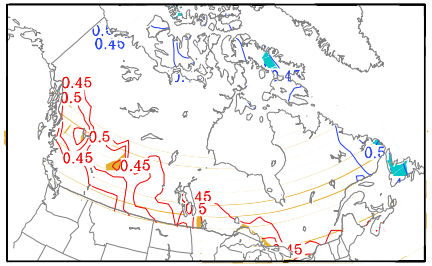
j) PHASE 4 lag=0



k) PHASE 4 lag=1

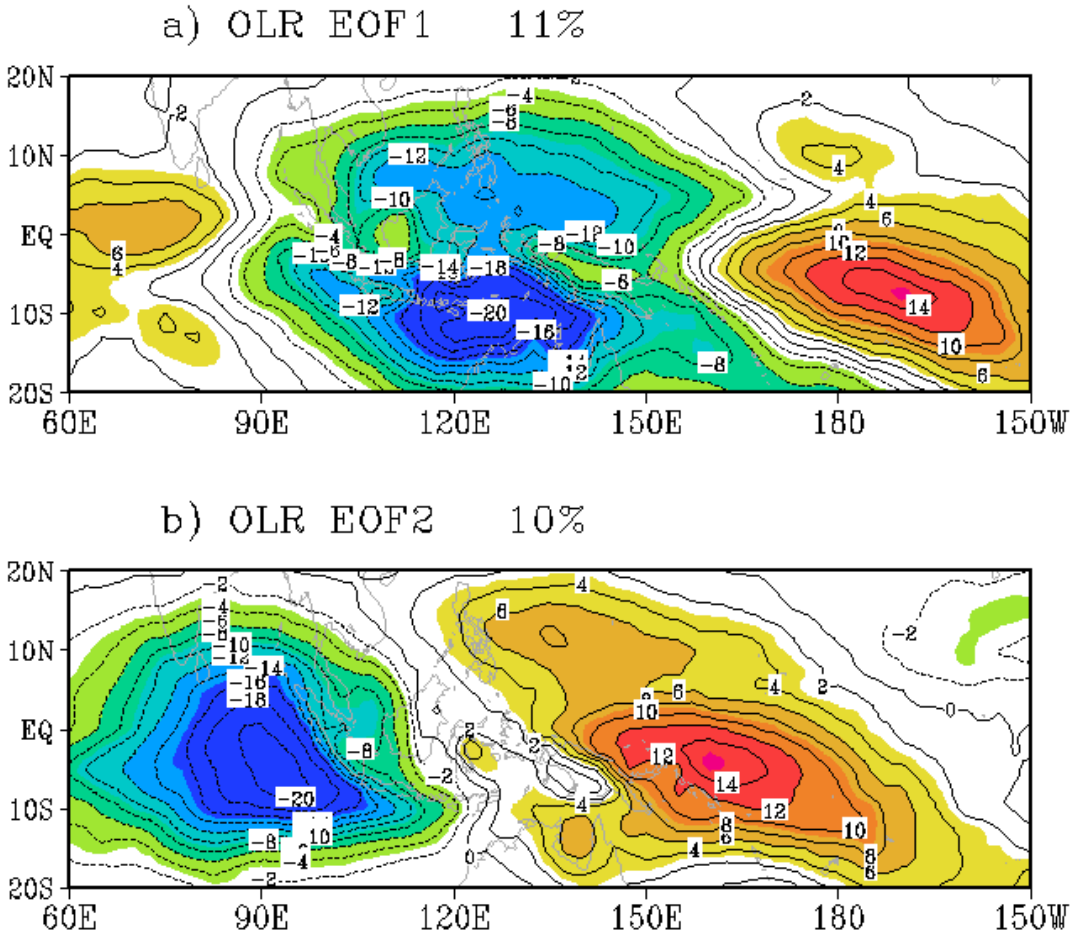


l) PHASE 4 lag=2

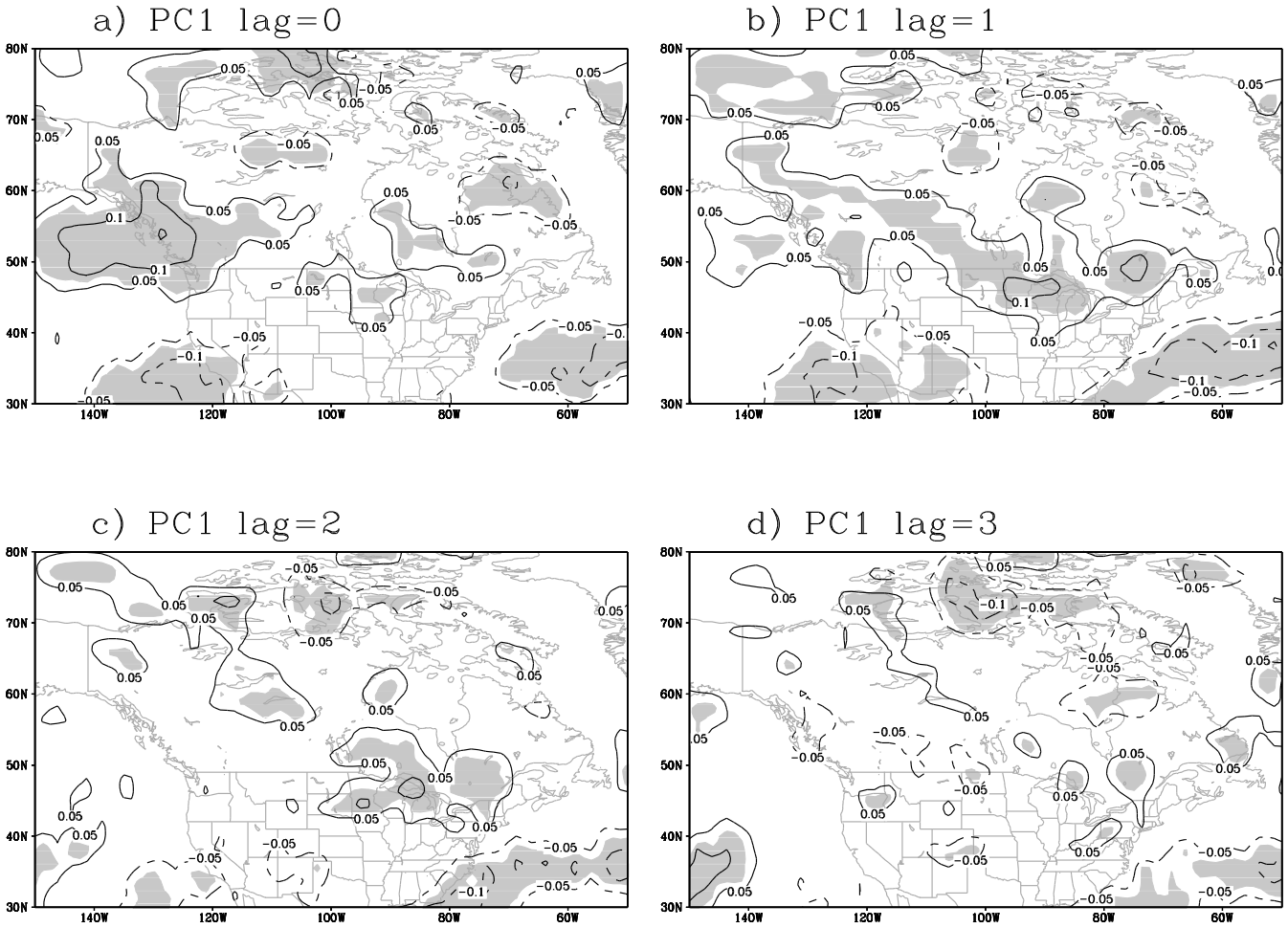


MJO influence on Canadian precipitation

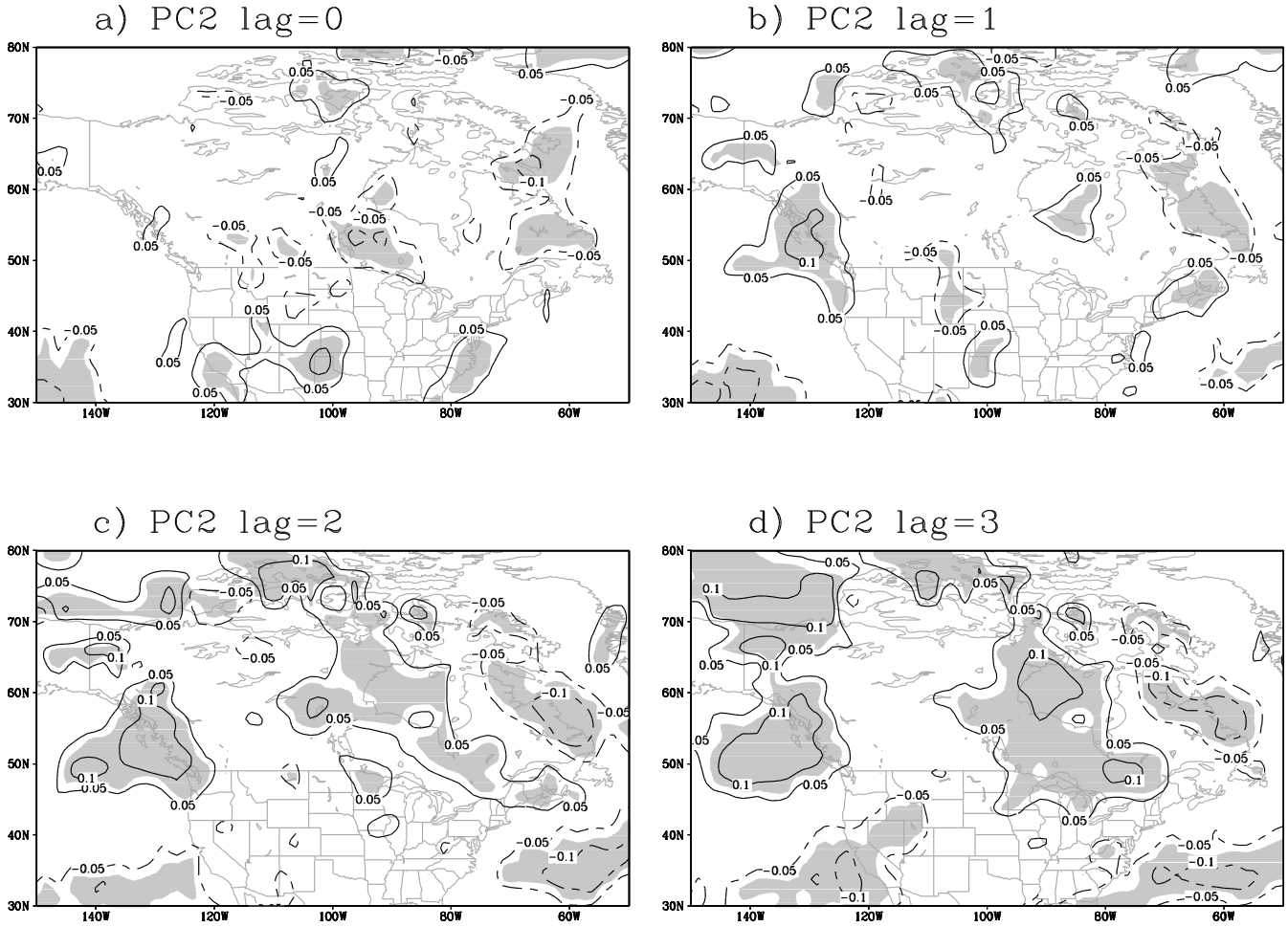
- Adjusted daily precipitation at Canadian stations --- thanks to Eva Mekis of Climate Research Division
- CMAP pentad grid precipitation (Xie and Arkin 1997)
- OLR and NCEP reanalysis
- 30 extended winters (NDJFM) 1979/80 to 2008/09
- All data grouped into pentads



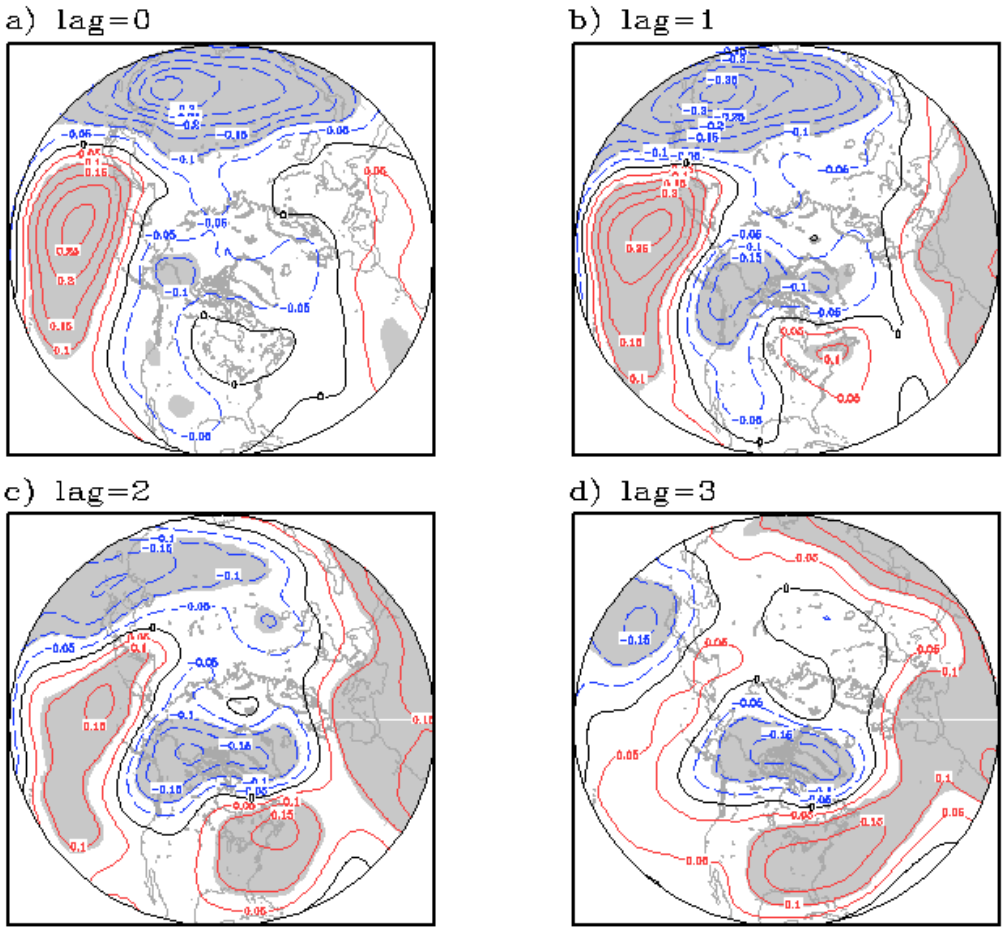
Correlation when PC2 leads PC1 by 2 pentads: 0.66



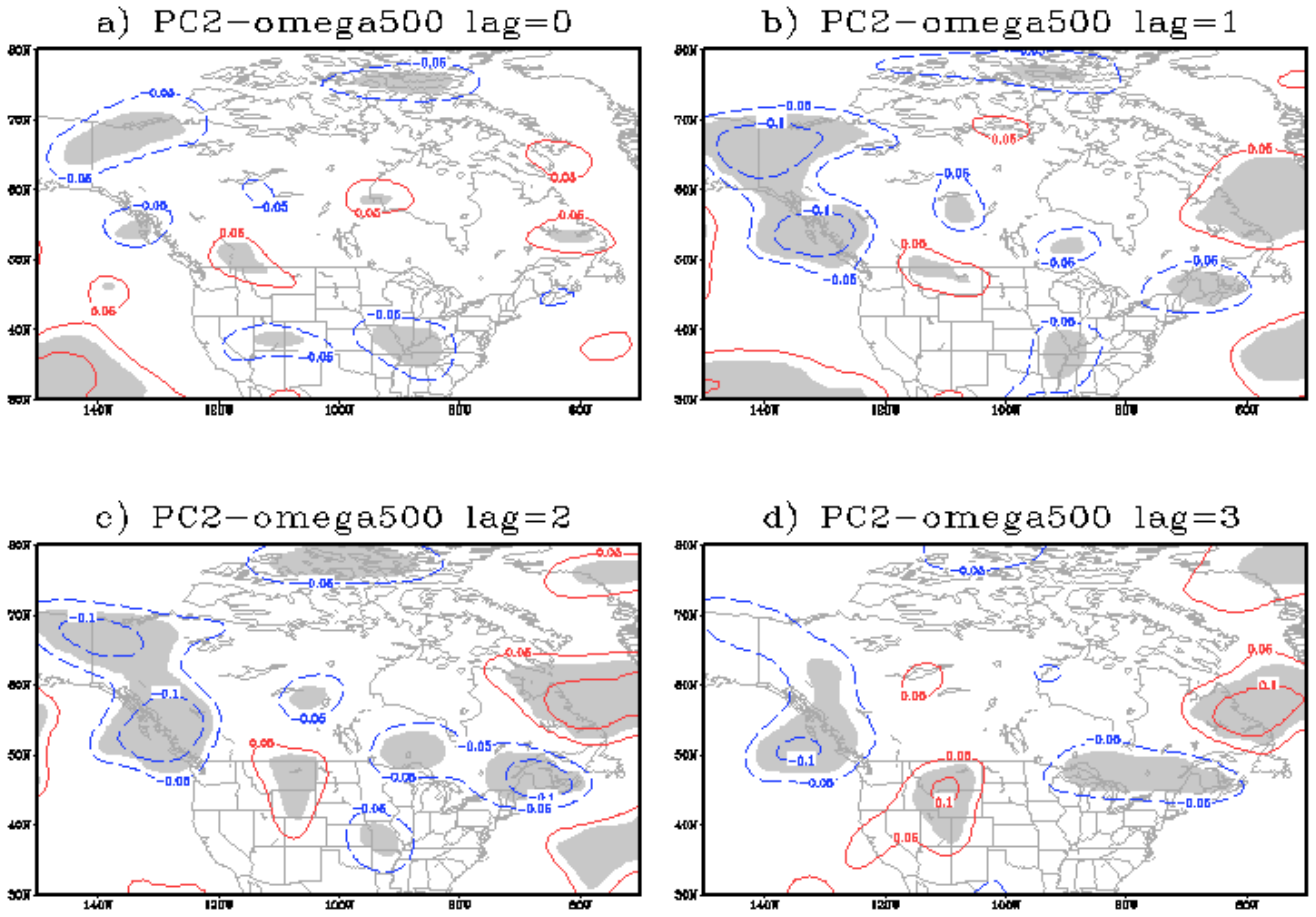
CMAP data: Normalized Precip Rate regression to PC1



CMAP data: Normalized Precip Rate regression to PC2

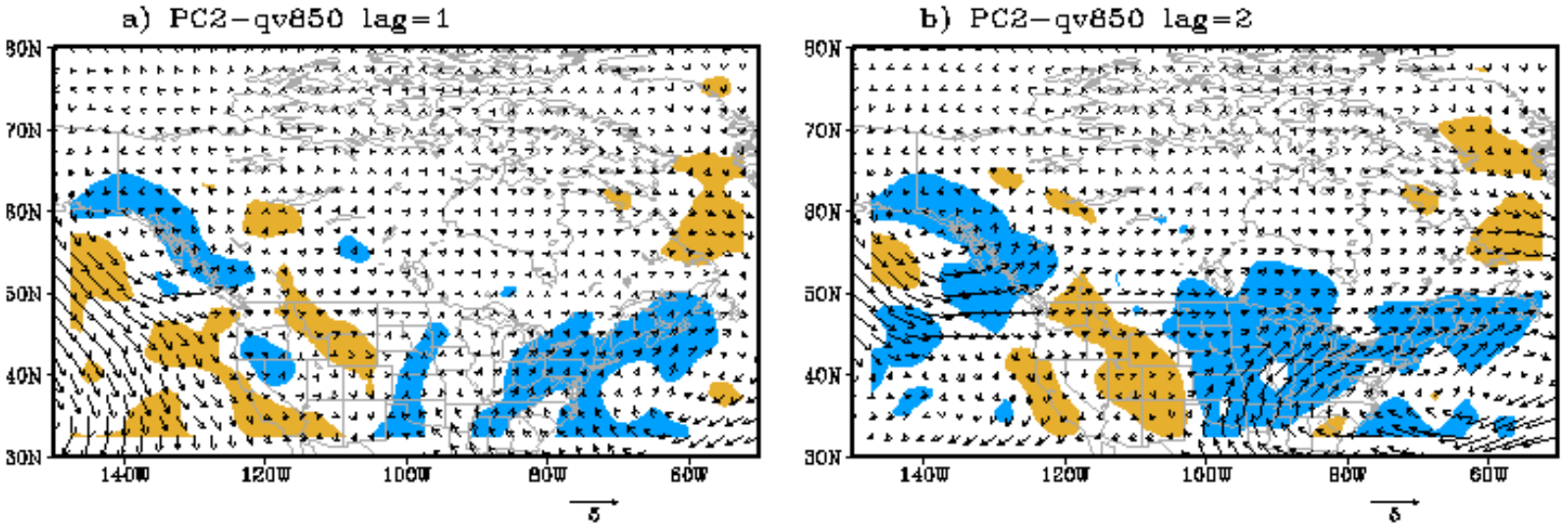


Normalized Z500 regression to PC2



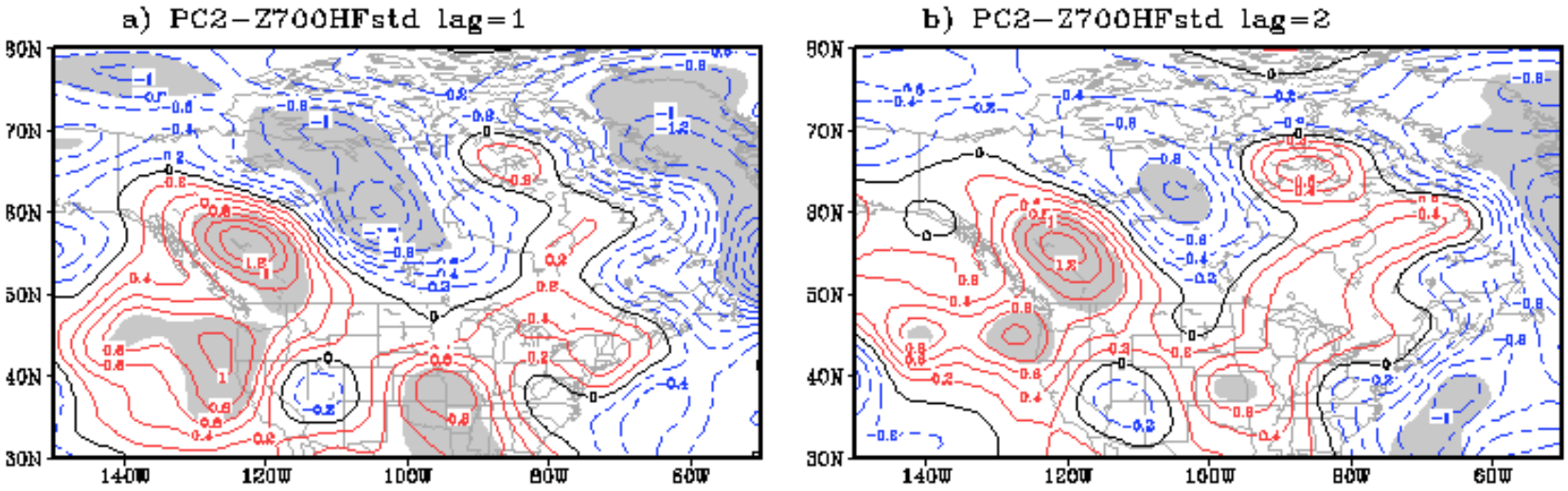
Vertical motion

Normalized omega500 regression to PC2



Moisture flux and convergence at 850 hPa

Normalized qv850 regression to PC2



Changes in storm track activity

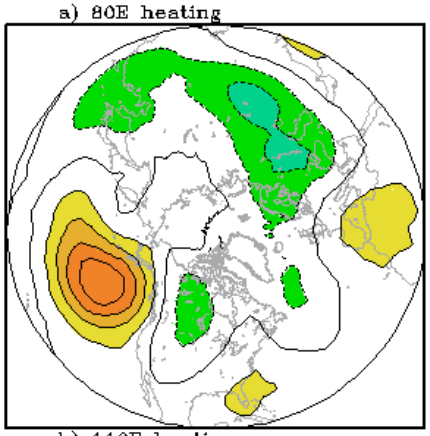
Normalized 700mb Z HFstd regression to PC2

Why the response to a dipole heating is the strongest ?

- Primitive equation GCM (T31, L10)
- Linear integration, winter basic state
- with a single center heating source
- Heating at different longitudes along the equator from 60E to 150W at a 10 degree interval, 16 experiments
- Z500 response at day 10

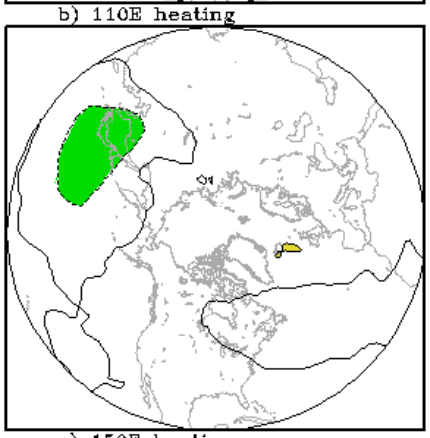
Day 10 Z500 linear response

80E

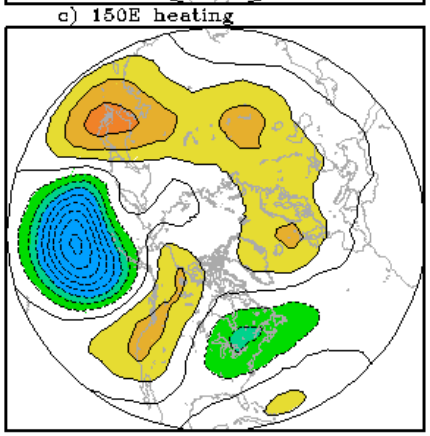


Similar pattern for heating 60-100E

110E



150E



Similar pattern for heating 120-150W

MJO influence

- Significant influence on Canadian wintertime temperature and precipitation
- The influence in the strongest when the MJO forcing has a dipole structure
- The MJO signal take 5-15 days to influence Canada
- Rossby wave train mechanism
- MJO signal could be a useful predictor for extended-range forecasts

Thank you!