Seasonal Extratropical Storm Activity Potential Predictability and its Origins during the Cold Seasons

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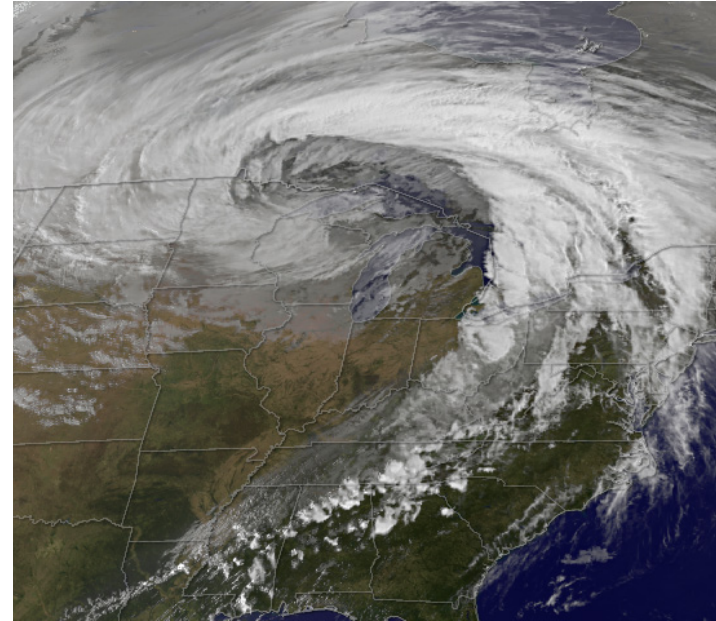Francis W. Zwiers, David E. Atkinson

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ETCs and Seasonal Prediction

- Extratropical cyclones:
  - Often produce hazardous weather conditions
  - Can have detrimental socio-economic impacts
- Society would benefit from skillful prediction of seasonal variations

NASA Earth Observatory

Potential Predictability

- Potentially predictable variability present at seasonal timescale?
- Analysis of Variance (ANOVA)
  - Quantitative and geographical observational evidence
- ECMWF ERA-Interim daily data (1979-2015)
- 3 storm activity proxies:
  - MSLP, absolute pressure tendency, 10-m wind speeds
- OND, NDJ, DJF, JFM seasons
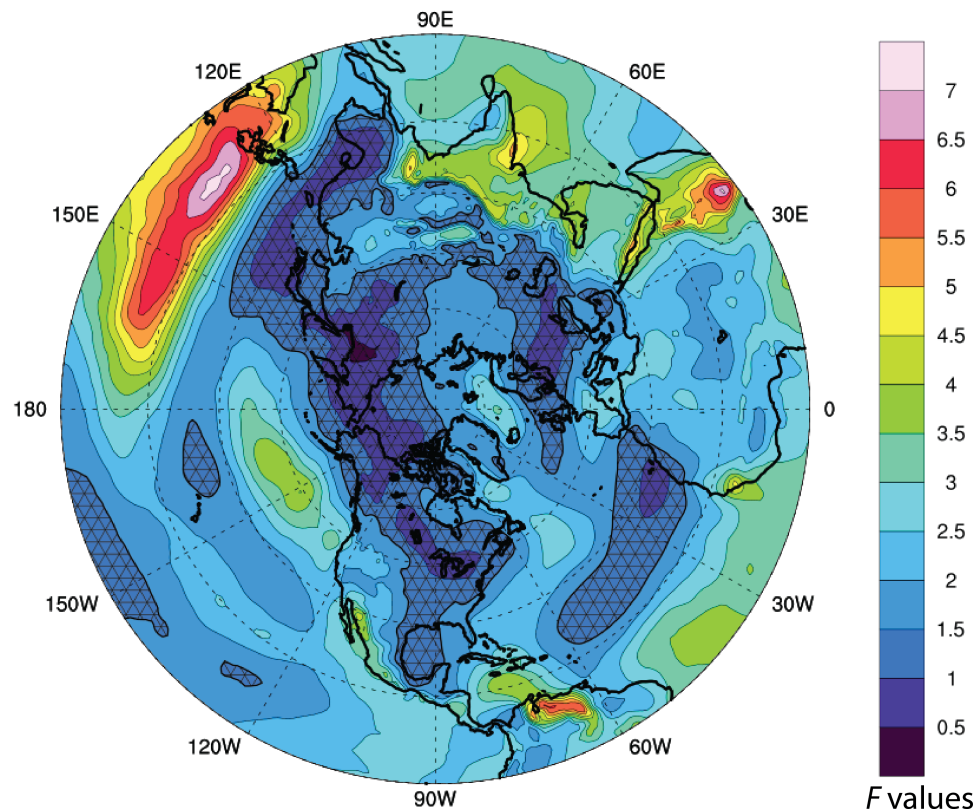
Potential Predictability

- Analysis of Variance (ANOVA)
    - Observed interannual variance exceeds estimated natural variability?
    - Null hypothesis of no potential predictability

$$F = \frac{\hat{\sigma}_m{}^2}{\hat{\sigma}_N{}^2}$$

$\hat{\sigma}_m{}^2$: Observed interannual variance calculated from seasonal means

$\hat{\sigma}_N{}^2$: Estimated natural variability calculated from intra-segmental variance (using daily data) and accounts for autocorrelation
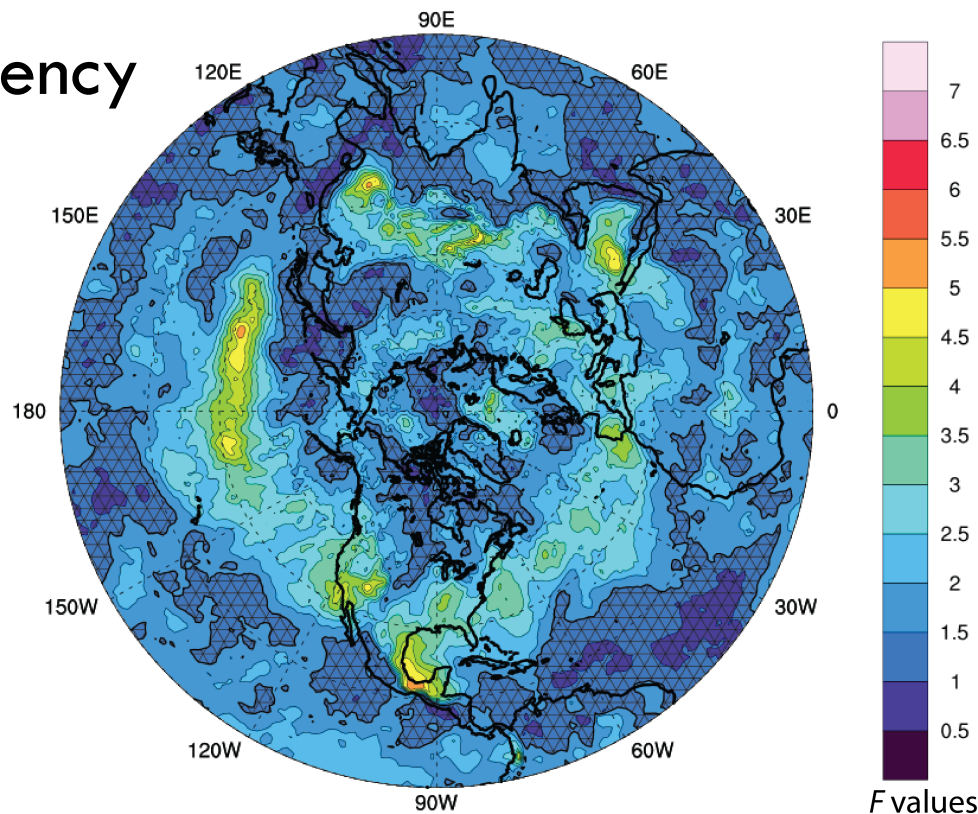
Potential Predictability

- MSLP

- JFM season

- Statistical significance

  - $\alpha = 0.05$

  - F_c value $= 1.5$

F values

Potential Predictability

- Absolute pressure tendency
- OND season
- Statistical significance
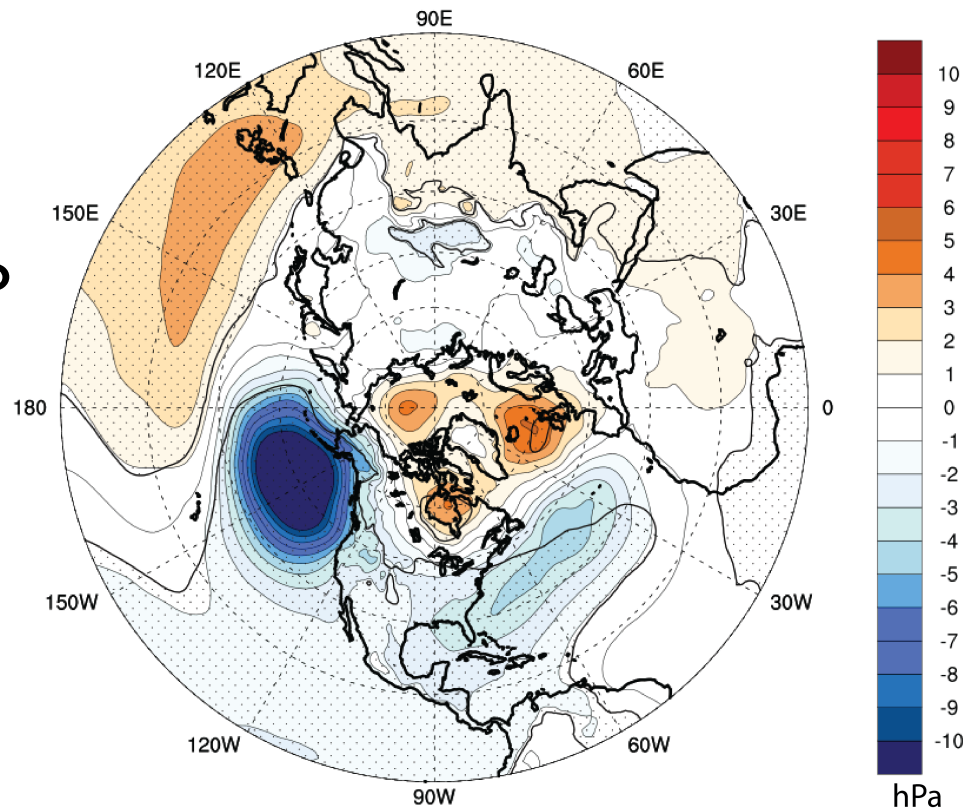 - $\alpha = 0.05$
  - F_c value $= 1.5$

F values

Origins of Potential Predictability

- Identified sources will provide the basis upon which seasonal predictions can be developed (predictors)
- Composite analysis
- 3 large-scale climate signals
  - SO, PDO, NAO
- ERA-Interim daily data (1979-2015)
- 3 storm activity proxies
- OND, NDJ, DJF, JFM seasons

Composite Analysis

☐ MSLP & SO

☐ JFM season

☐ El Niño − La Niña MSLP anomalies

☐ Shading = statistically different; $\alpha = 0.05$

Key Findings

- Potentially predictable signals found in North American coastal regions for all 3 proxies in the cold seasons
  - Highest during earlier seasons for absolute pressure tendency and 10-m winds; later seasons for MSLP
- SO, PDO, and NAO are all found to provide a source of detected potential predictability
  - SO and PDO a source for both coasts; NAO for east coast

Key Findings

- Strong indication that seasonal variations of storm activity are potentially predictable along North American coasts
  - Seasonal forecasting may be possible
- Key sources of detected potential predictability have been identified (use as predictors)
- Insight into which proxy-teleconnection combinations may provide the most promising seasonal forecast development.
  - Plus seasons and conditions (e.g., El Niño) under which a more successful forecast may be producible

Next Steps

- Investigate seasonal predictability in ECCC's Canadian Seasonal to Interannual Prediction System (CanSIPS)

- Develop methods to produce seasonal forecasts

Thank you

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