

# **Droughts in Canada: An Overview**



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# Outline

- Background
- Past drought occurrence
- Large-scale atmospheric causes
- Current monitoring & prediction
- Future droughts
- Research requirements

# Droughts in Canada



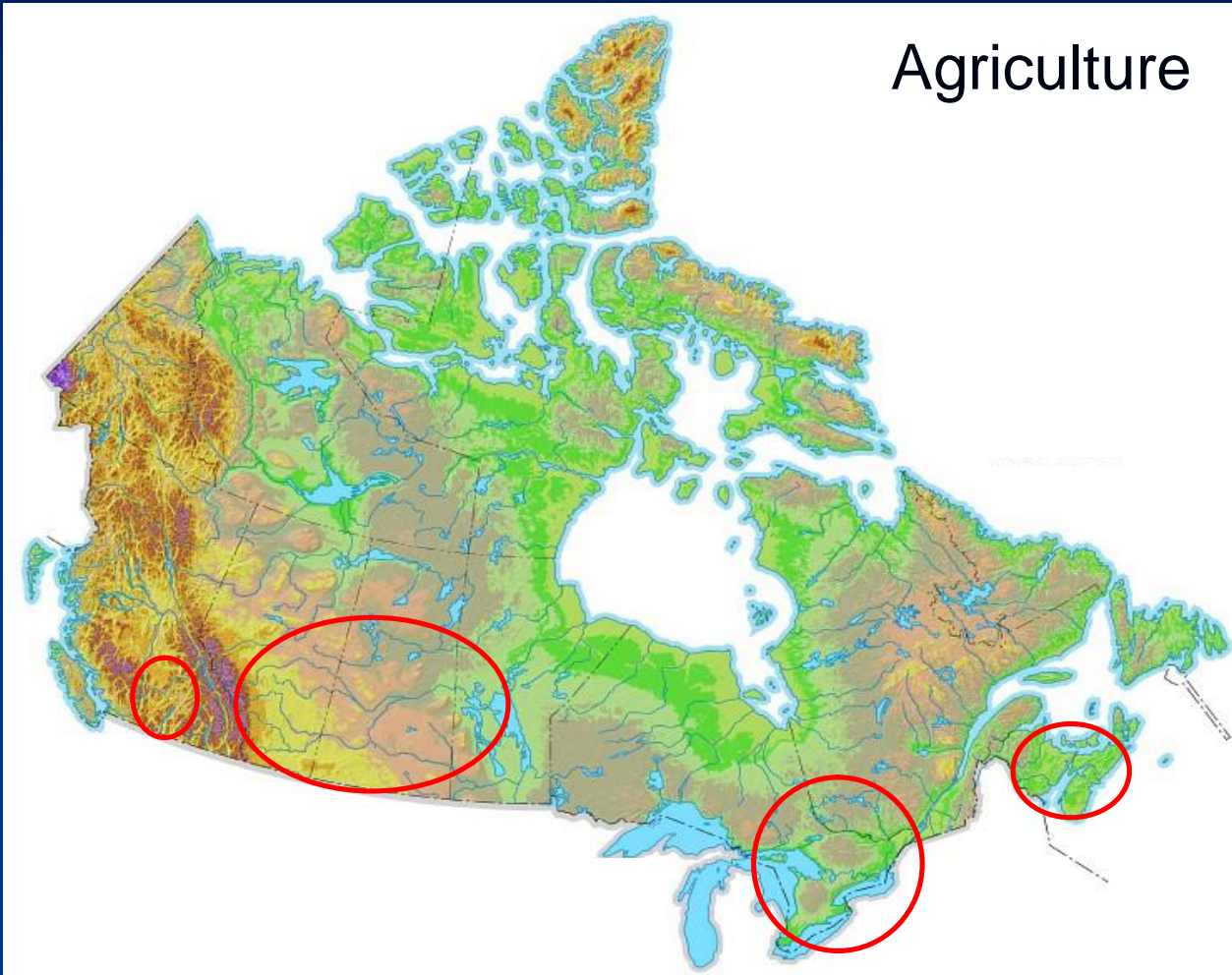
 A collage of newspaper headlines and images related to drought in Canada. The headlines include:
 

- Drought, from coast to coast** (with a photo of two people standing in a field)
- St. Lawrence Seaway volumes dip 2001** (with a map of the St. Lawrence Seaway area)
- Drought losses mount in Sask., Alta.** (with a photo of a field)
- Drought fallout widespread** (with a photo of a field)
- Drought puts pastures in peril** (with a photo of horses in a field)
- Hot, dry summer hits areas across Canada** (with a photo of a field)
- Drought-stressed farmers need help** (with a photo of a field)
- Farm earnings shrivel** (with a table showing net farm income)
- Drought costs economy millions** (with a photo of a field)

 The table for "Net farm income" shows a 12.2 per cent decline in Saskatchewan. The table includes columns for "2000" and "2001" and rows for "Gross", "Net income", "Operating", "Total", and "Per acre".

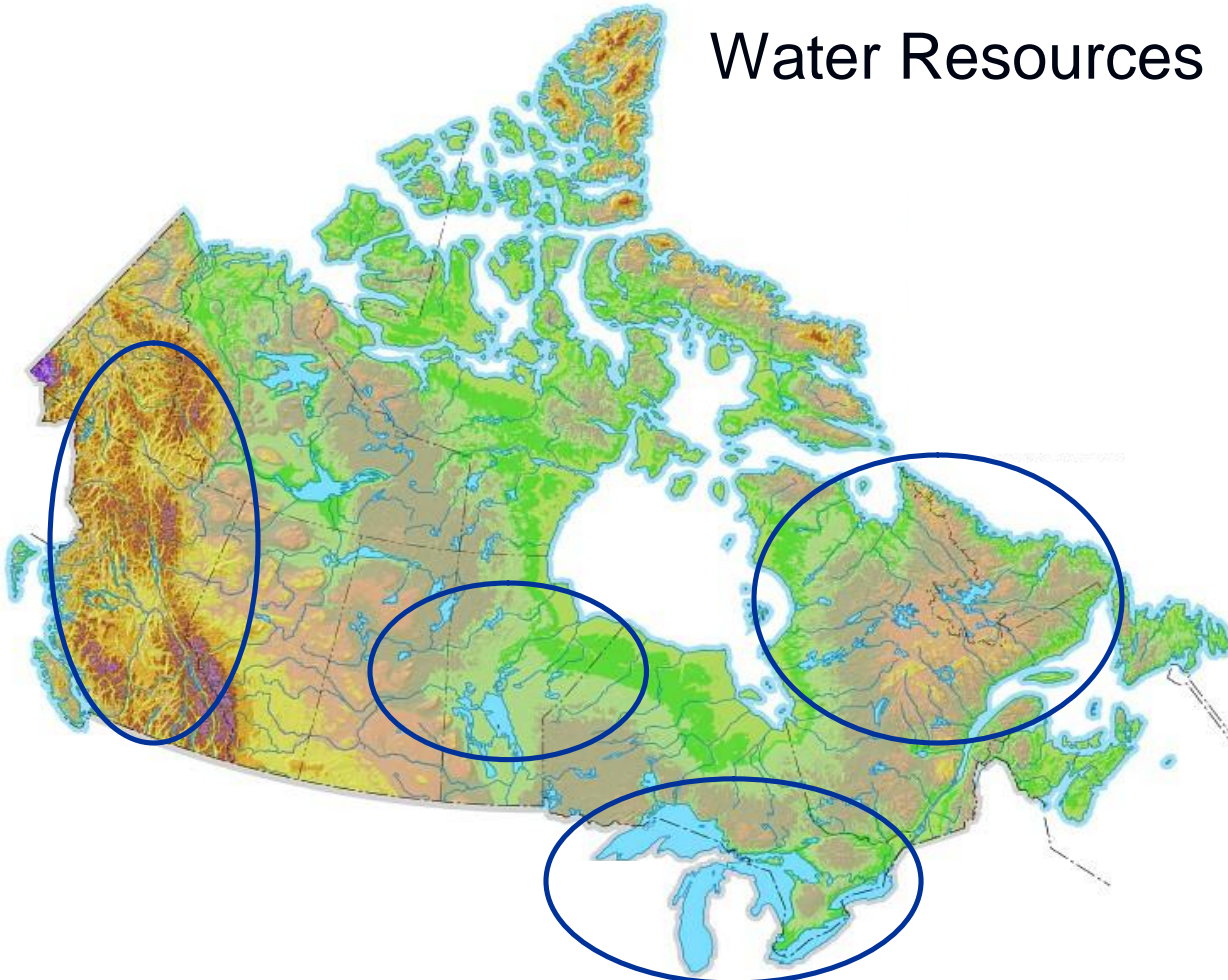
# Drought Impacts

## Agriculture

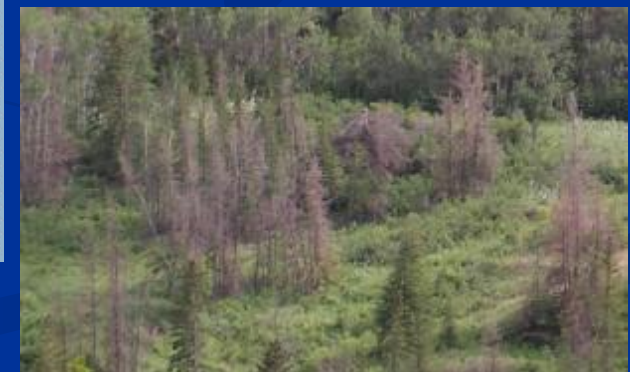
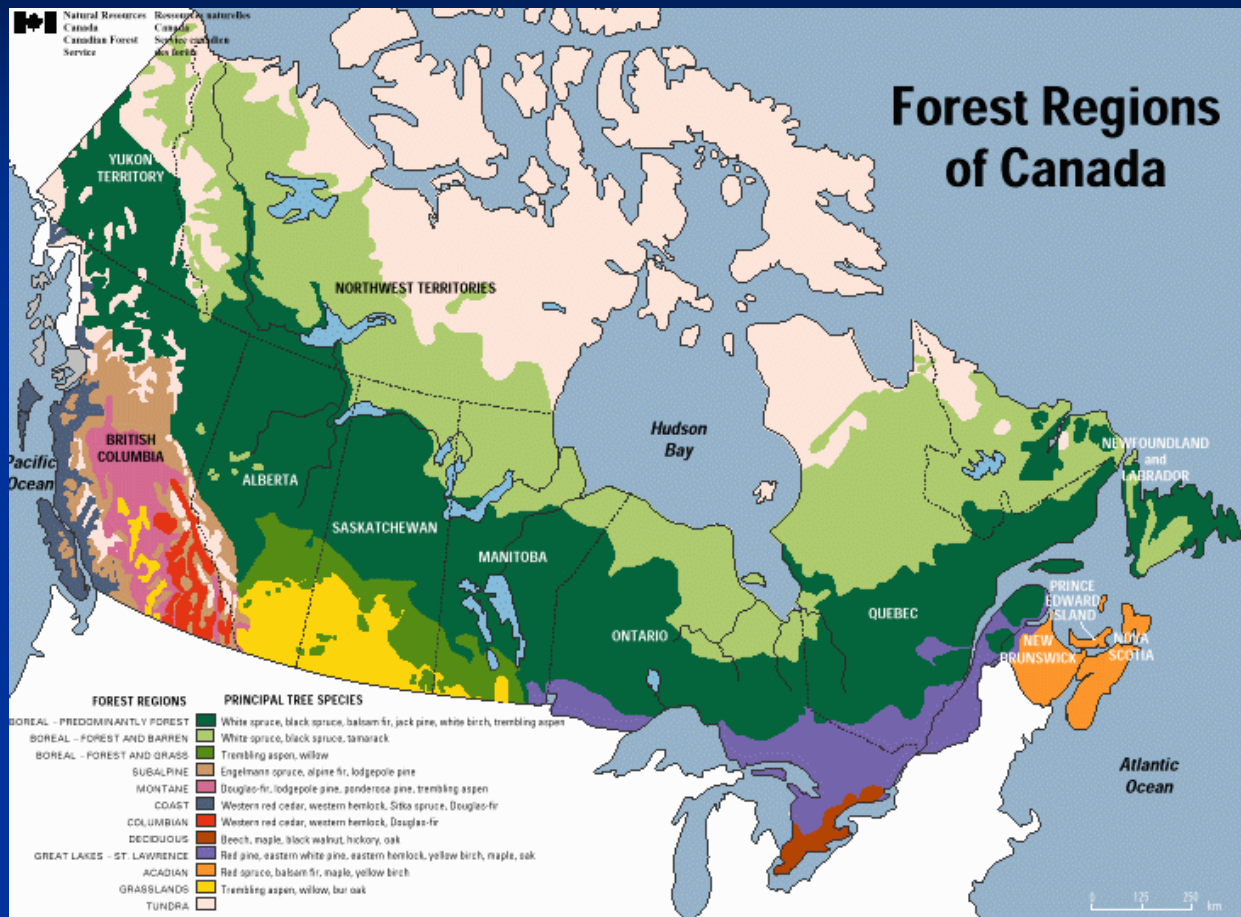


# Drought Impacts

Water Resources

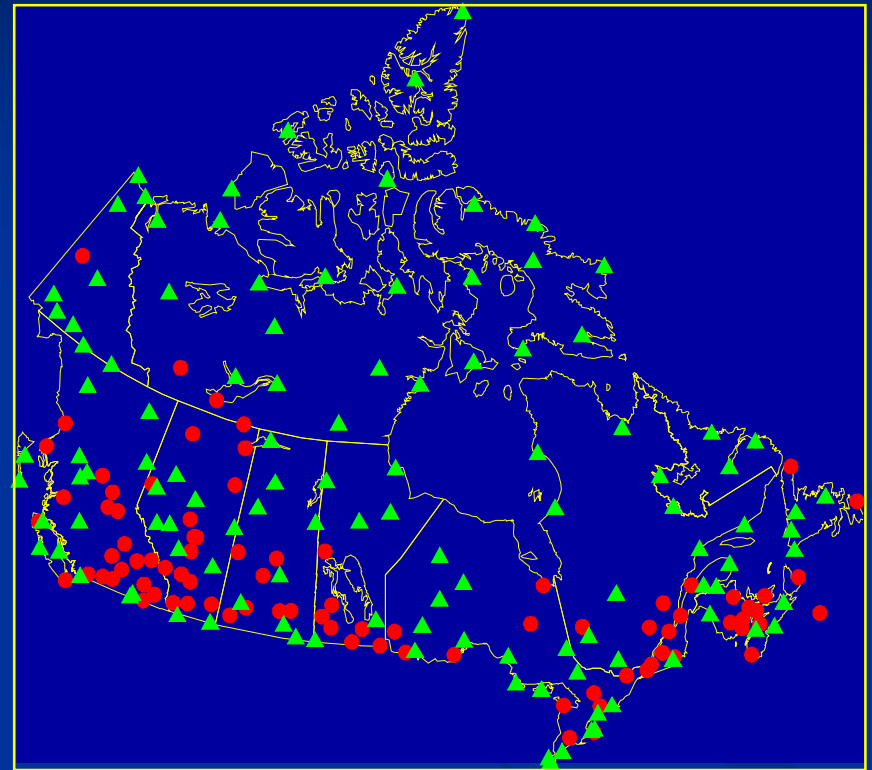


# Drought Impacts

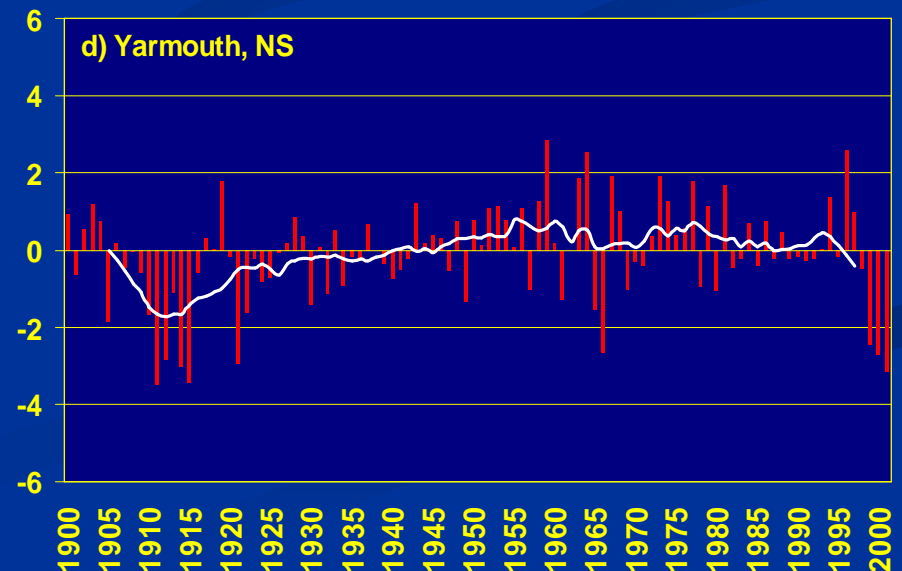
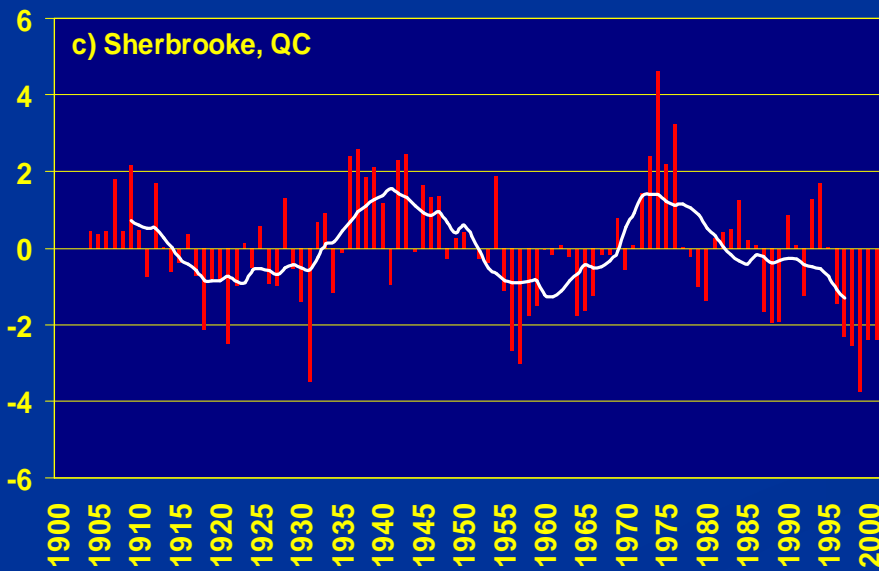
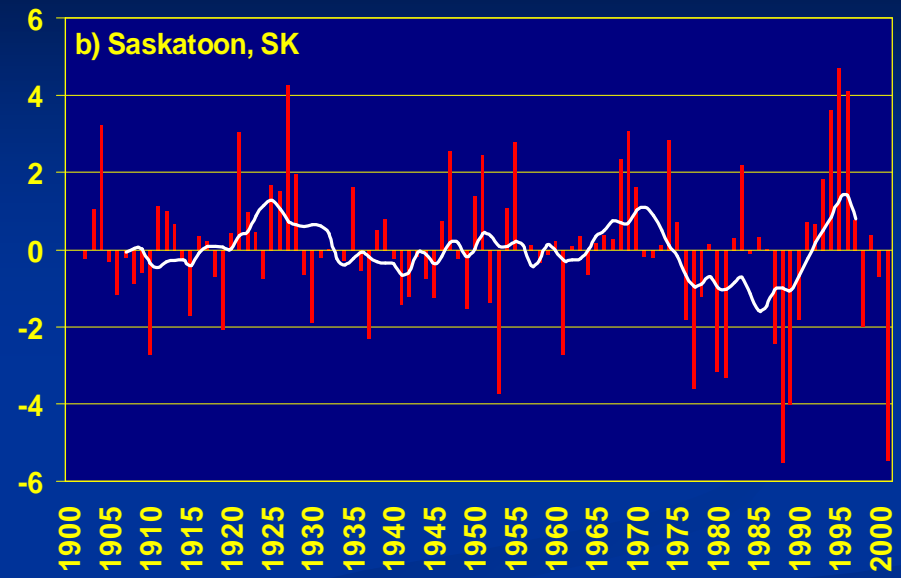
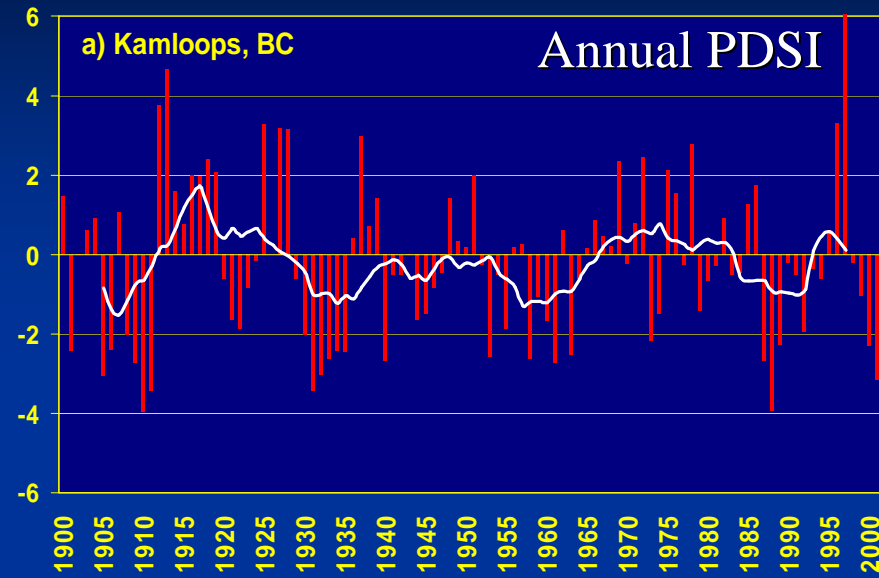


# Drought Research in Canada

- Fragmented – spatially and temporally
- Based on severe drought occurrence (e.g., 1999-2005)
- Majority for Canadian Prairies
- Historical comparisons difficult due to short and variable climate station records
- Canadian droughts unique – both cold and warm season phenomenon

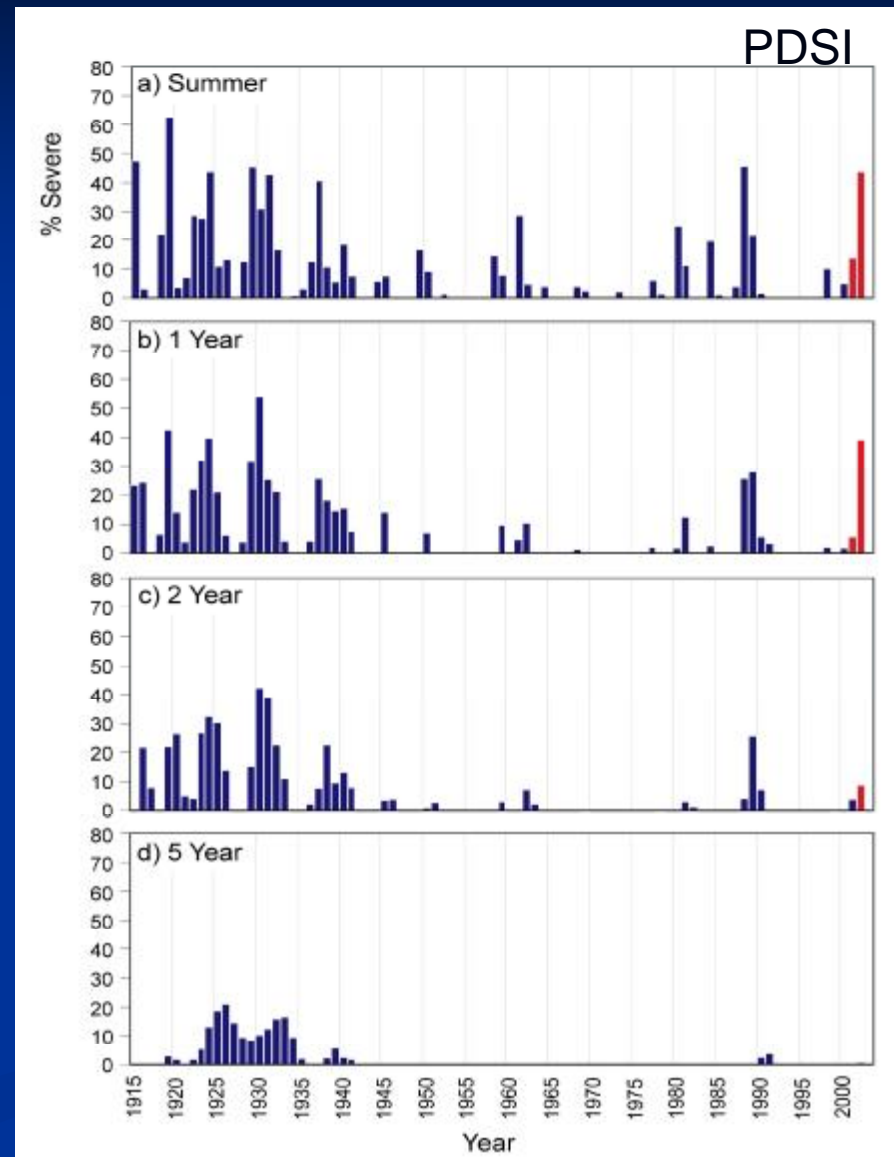
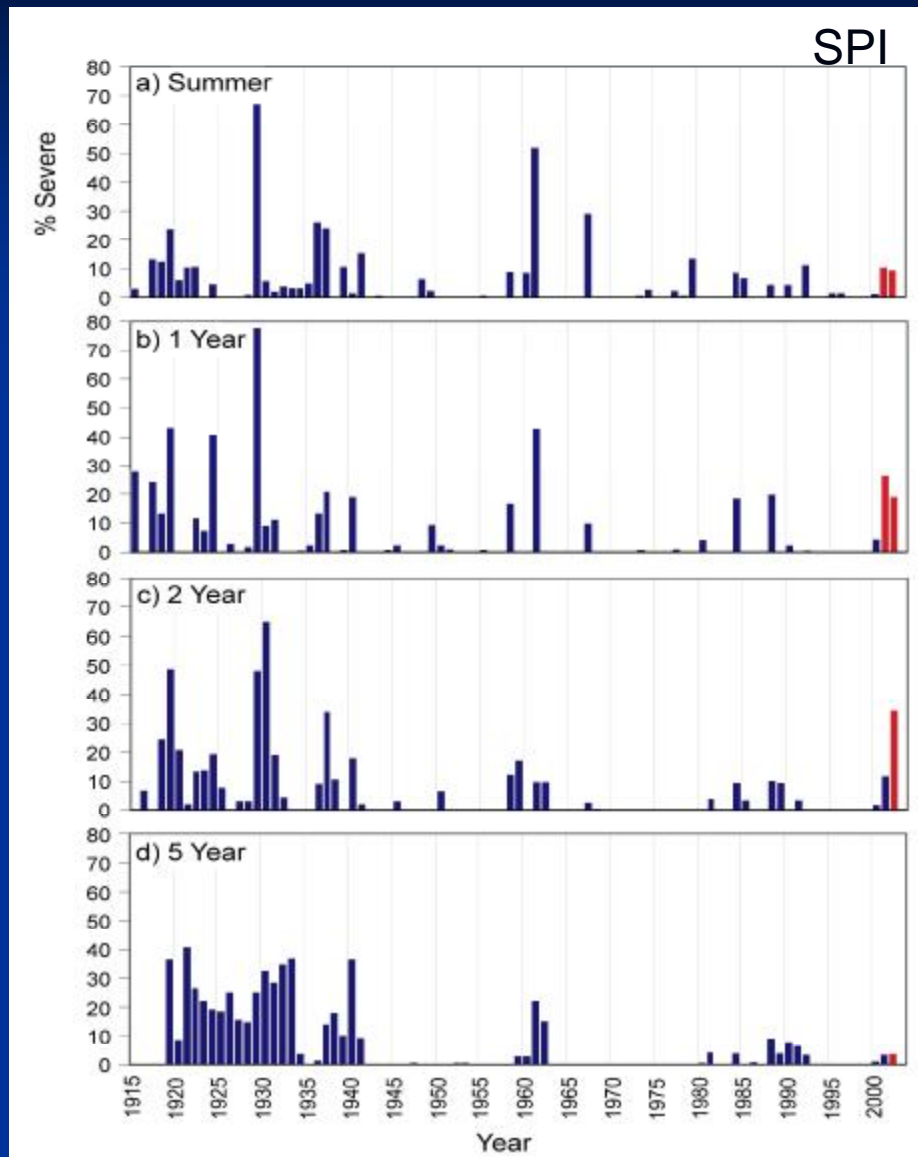


# Drought Occurrence





# Drought Occurrence – Southern Prairies (1915-2002)

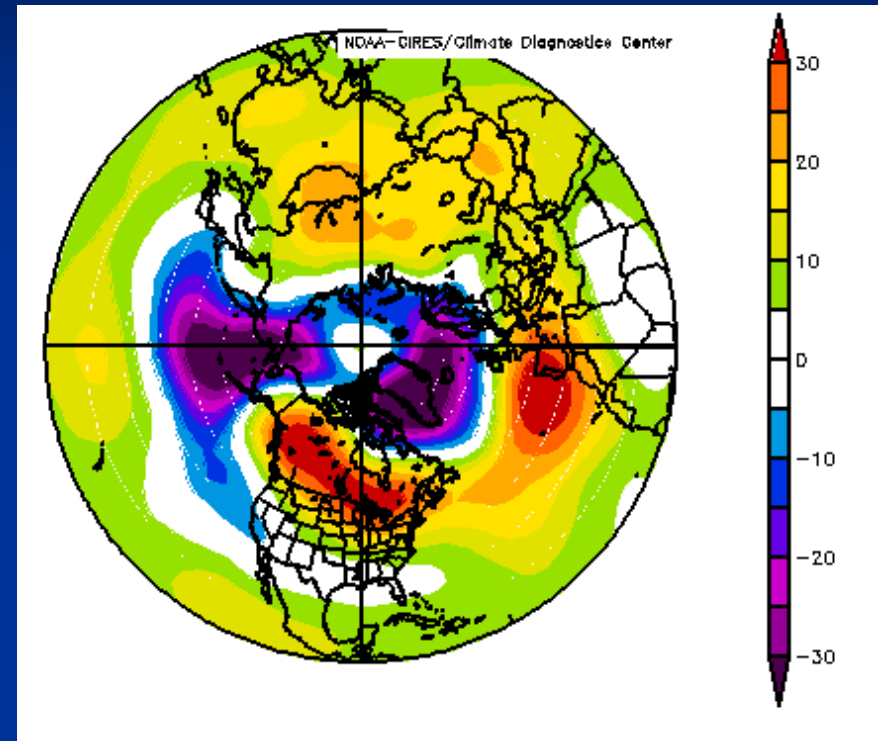


# Warm, Dry Winters Over Canada

**500mb Flow**



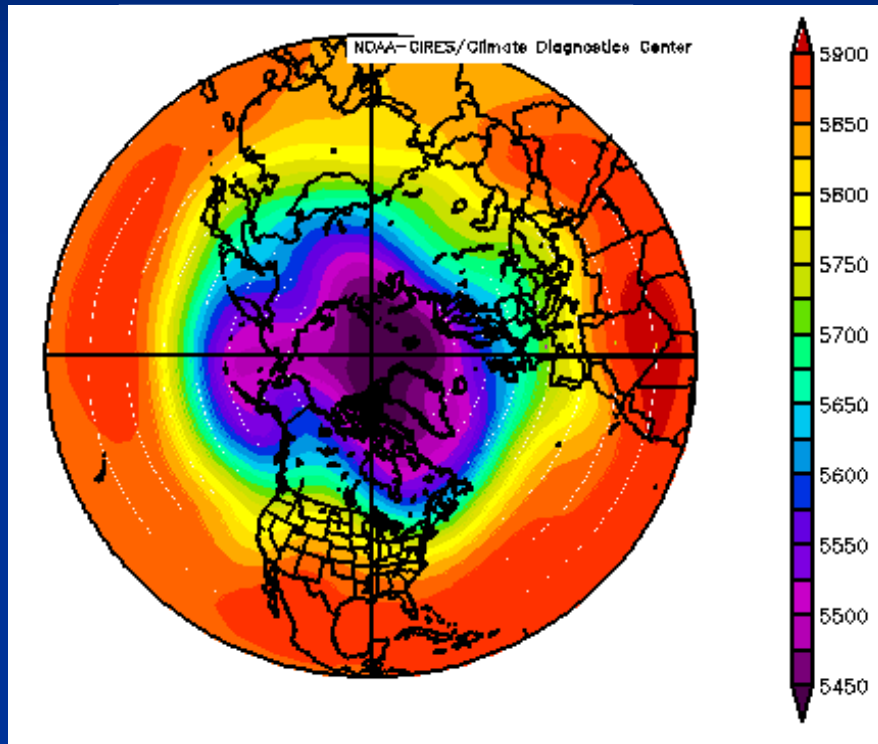
**500mb Anomalies**



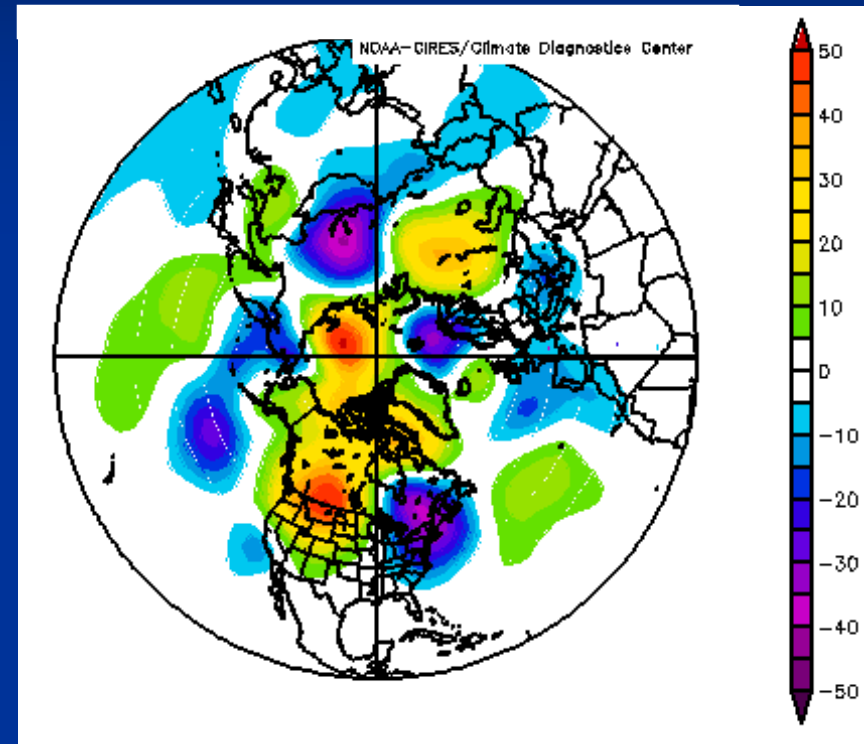
**§ El Niño, +PNA, +PDO, Deep Aleutian Low**

# Hot, Dry Summers Over Western Canada

## 500mb Flow

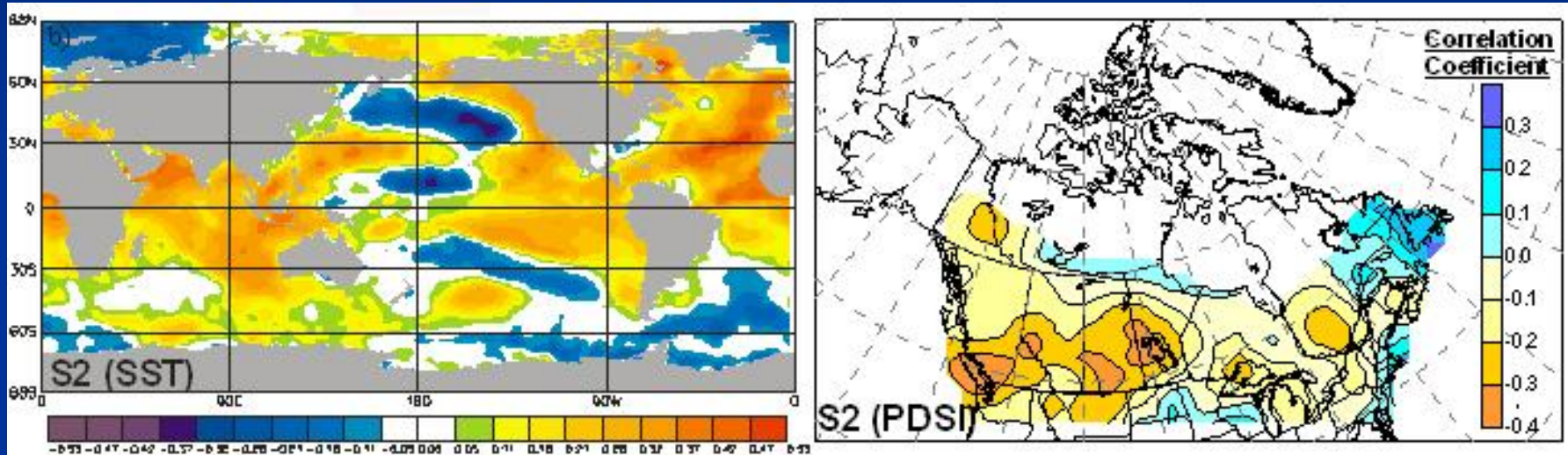


## 500mb Anomalies



§ +PNA, Meridional Flow, +PDO?

# Coupled SVD pattern between Global Winter SSTs and Summer PDSI (1940-2002)



Winter Interannual and interdecadal ENSO-like pattern is associated with dry summer conditions in western and central Canada. Squared Covariance Fraction = 28%, Correlation between time expansion = 0.5

(Shabbar and Skinner, 2004)

# Drought Monitoring

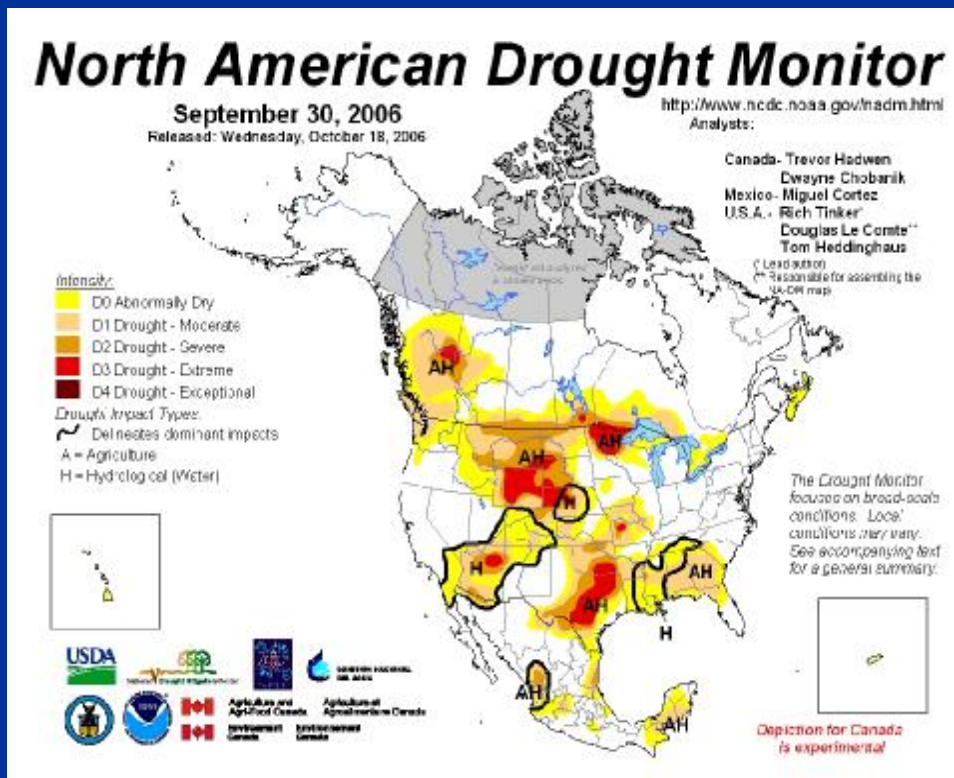


- **Real-time information on drought conditions over agricultural regions of Canada**

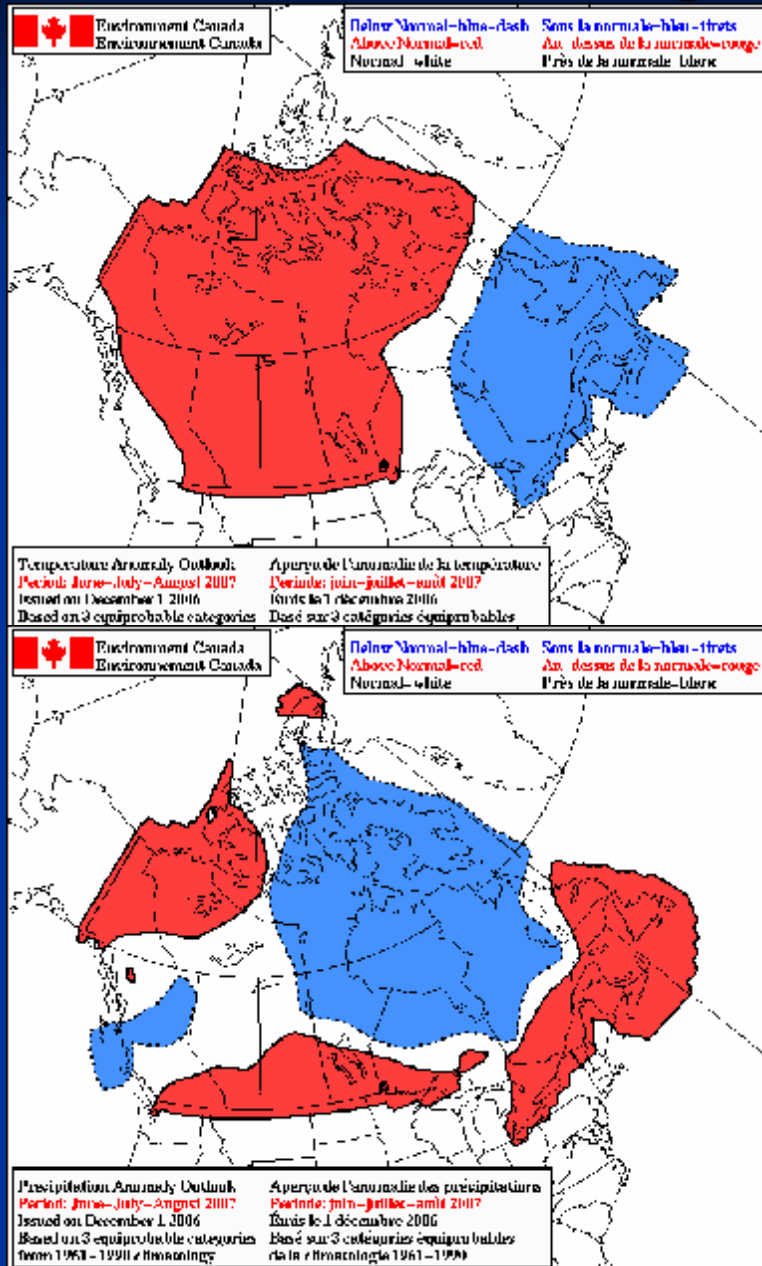
- **National map illustrating current and historical temperature, precipitation, and drought index maps (SPI, PDSI) at various time steps**

- **Reports of lake and reservoir levels, stream flows, snowpack accumulations, water-supply volume forecasts, dugout water levels, pasture conditions (for the Prairies)**

- **The North American Drought Monitor**

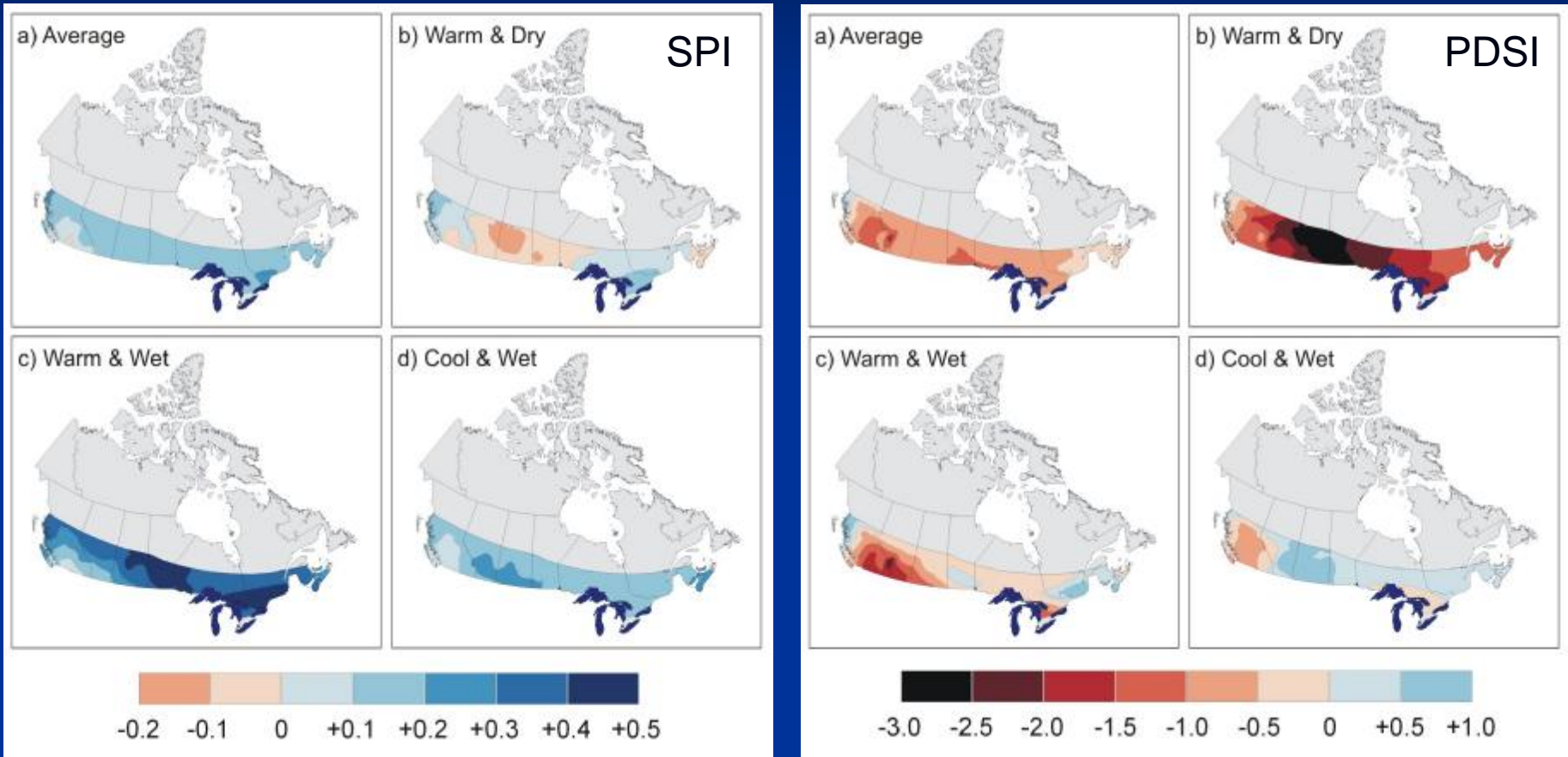


# Drought Prediction



- Drought prediction involves anticipating climatic anomalies that produce unusually hot, dry conditions for extended periods
- EC currently produces monthly and seasonal forecasts for T & P for lead times of 3, 6, 9, and 12 months
- 0 to 3 month forecasts are made using NWP models
- Longer lead times use a statistical (CCA) model using SST anomalies over the previous 12 months
- Skill higher for cold season and for temperature

# Future Droughts



# Research Needs

1. A better understanding of the physical causes of drought initiation, persistence, and termination at a variety of spatial and temporal scales
  - Large-scale atmospheric and oceanic oscillations
  - Soil moisture anomalies
  - Storm tracks
  - Moisture sources
  - Physical causes of multi-year droughts
  - Drought migration



# Research Needs

## 2. Quantification and assessment of past drought occurrences

- Past trends and variability
- Drought indices
- Paleo-drought studies

## 3. Better knowledge regarding future drought occurrence

- More reliable GCM/RCM output
- Improved downscaling methods
- Future changes to large-scale circulation patterns

# Research Needs

4. Ability to more accurately predict drought onset, intensity, and termination
  - Improvements in modelling and monitoring of current drought conditions
  - More reliable short term (seasonal) climate forecast
  
5. More effective short and long-term adaptation strategies to defend against future droughts



**DROUGHT RESEARCH INITIATIVE**  
**RÉSEAU DE RECHERCHE SUR LA SÉCHERESSE**