Seasonal Prediction and Land-Atmosphere Coupling

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Collaborators: Jacques Derome, George Boer, Daniel Caya, John Hanesiak, Rick Raddatz (and others?)

Questions

- How well was the current drought predicted on the seasonal time scale?
- What is the effect of soil moisture/snow cover anomalies on predictability, and how does this compare with the sea surface temperature anomalies?
- What is the effect of soil moisture on atmospheric convection?

Methodology

- Historical Forecast Project (HFP)
  - CLIVAR (Derome, Boer): Multi-model (global) ensemble seasonal forecast (operational), ~200 km resolution
  - GCM3/CLASS, 1969-2000 completed, extend to 2004
  - Evaluation of current drought forecast
  - Sensitivity to soil moisture/snow cover anomalies
- Canadian Regional Climate Model (CRCM4/CLASS)
  - Ouranos (Caya): 1958-present, 45 km resolution
  - Additional 5-year sensitivity runs to determine effects of soil moisture anomalies
- Column model for GCM3 (CCCma)
  - DRI collaborators: Hanesiak, Raddatz
  - Sensitivity of atmospheric convection to soil moisture

Soil moisture can be as important as SST in providing predictability

Difference field in GCM-simulated precipitation (summer 1993-1988)

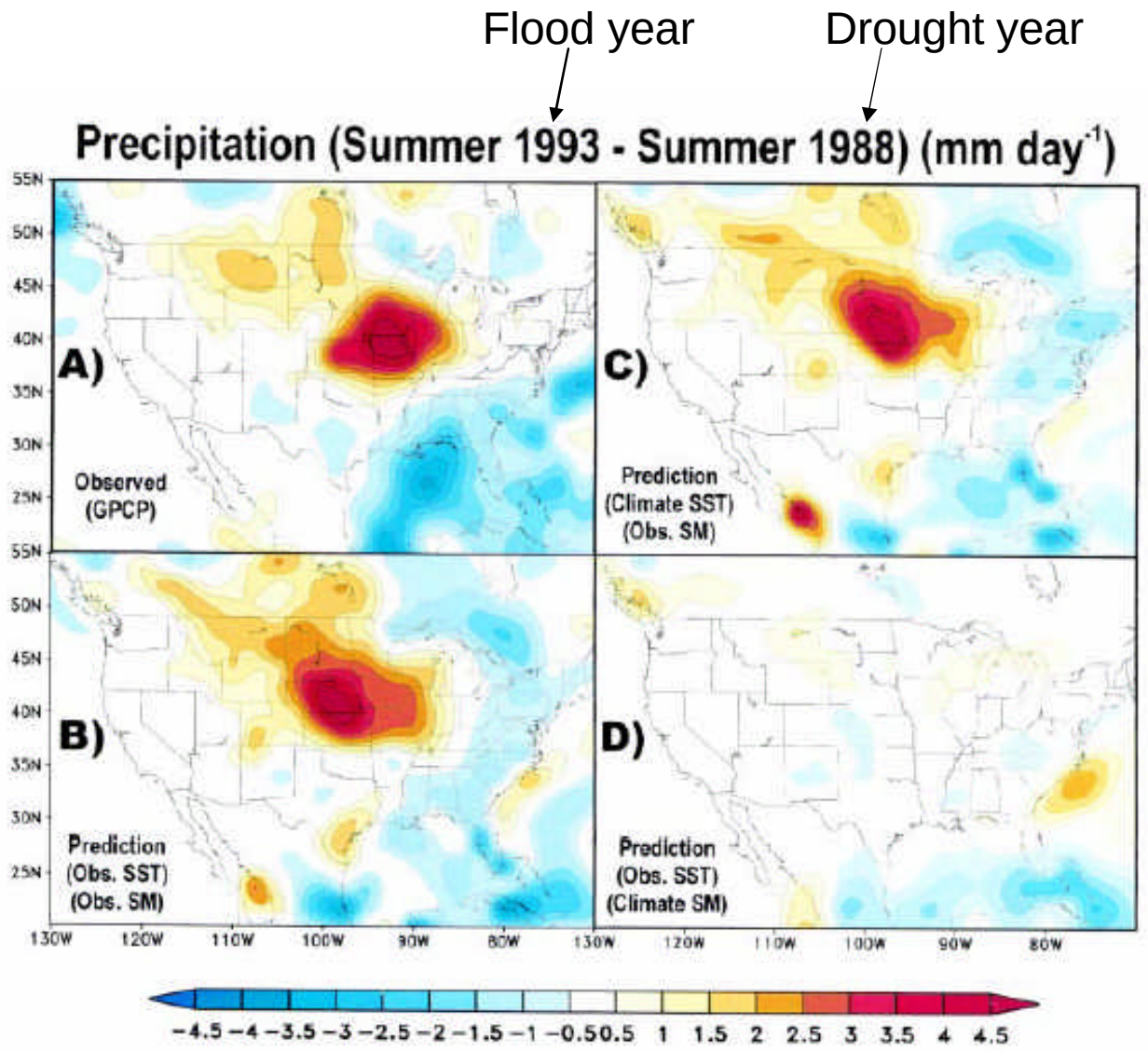
A) Observations

GCM simulations:

B) Control

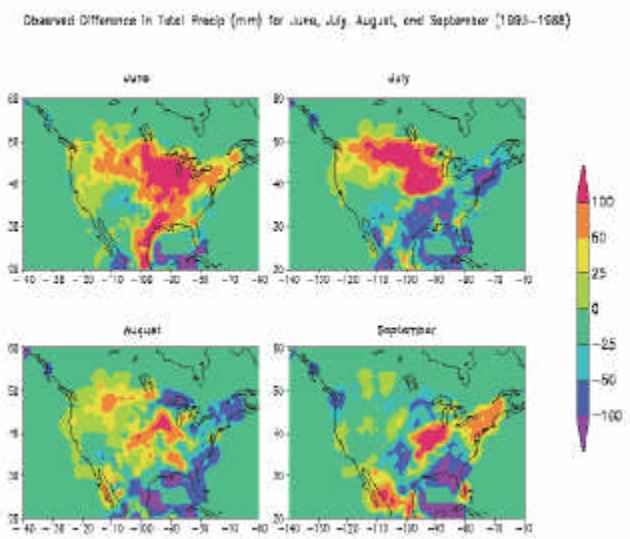
C) Climatological SST

D) Climatological soil moisture



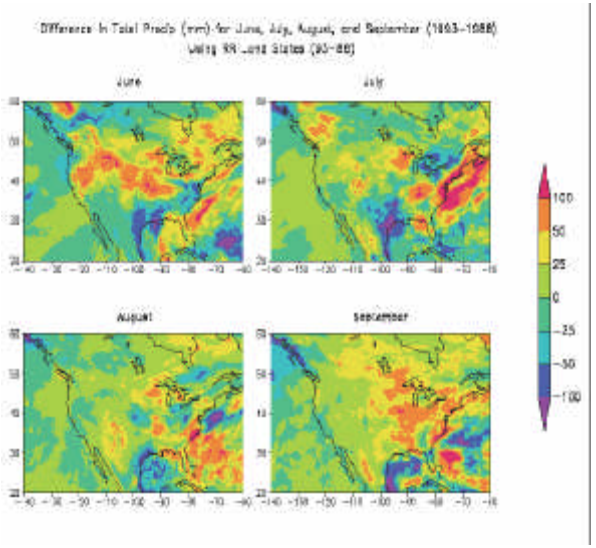
Entekhabi et al. (1999); Suarez et al. (1999)

JJAS 1993-1988 difference in precipitation from observations



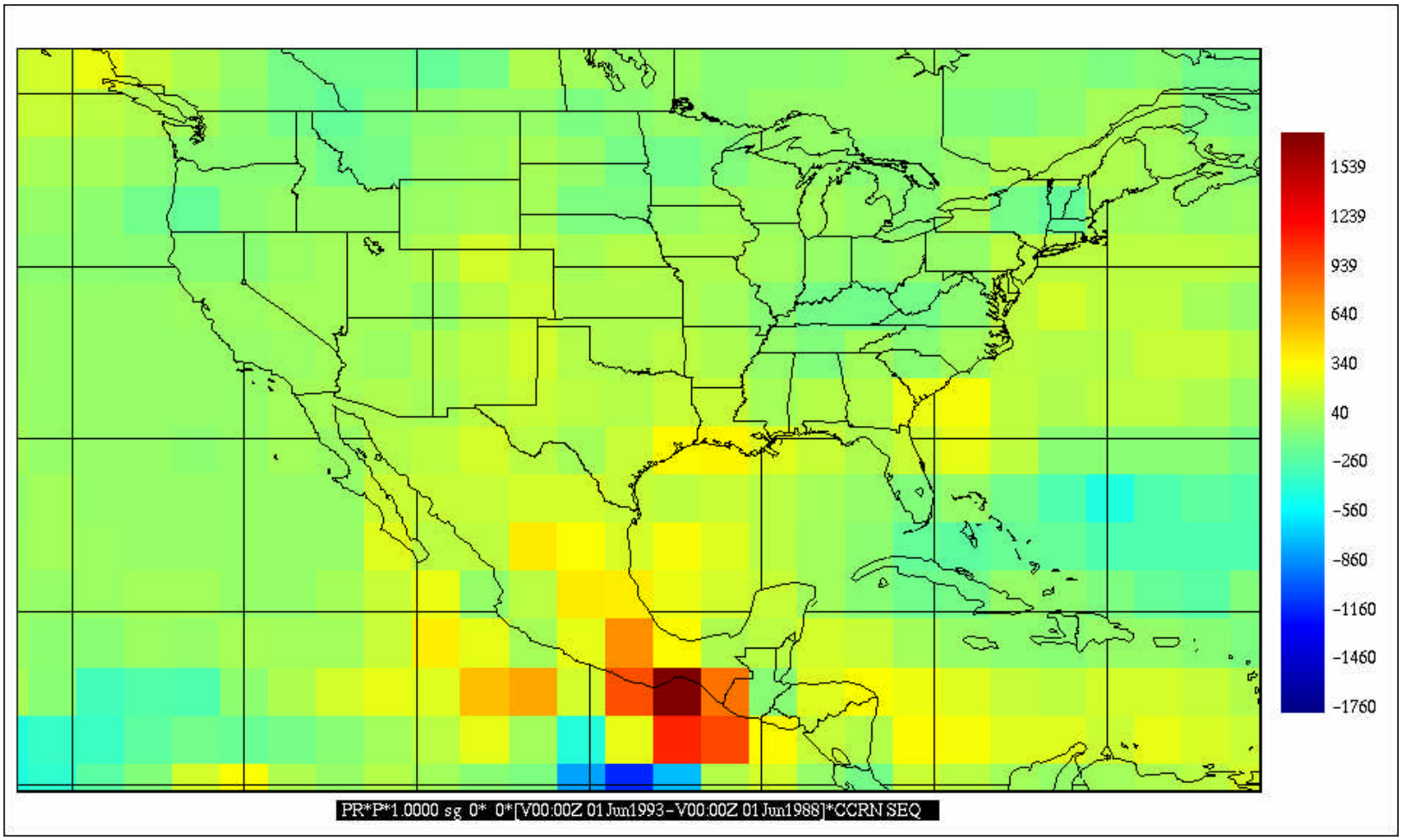
Yang and Mitchell (2005)

JJAS 1993-1988 difference in precipitation from 30-km NCEP Eta regional model ensemble



Yang and Mitchell (2005)

JJA 1993-1988 difference in precipitation from GCM3/CLASS of Historical Seasonal Forecast Project (HFP)



(From Jacques Derome)

Supplementary slides

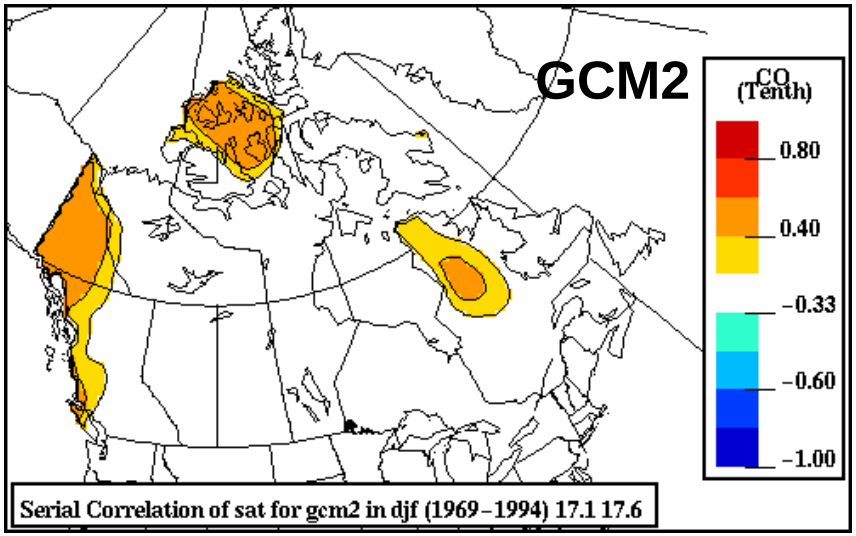
Historical Seasonal Forecast Project (HFP)

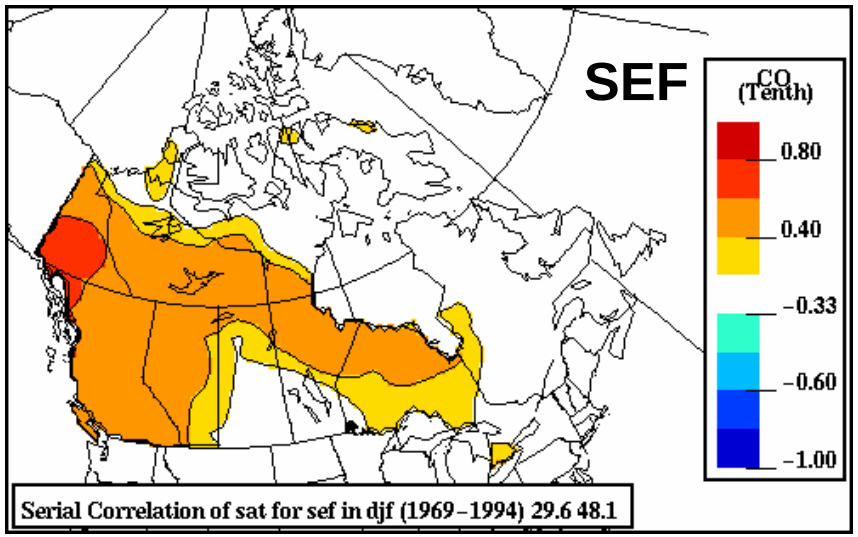
- Lead: Jacques Derome (McGill; PI of CLIVAR)
- McGill, CCCma, RPN, CMC
- Sources of variability
  - Internal: model generated
  - External: only due to SST
- Ensemble approach
  - Multiple runs with perturbed initial conditions
  - Two global models
  - Probabilistic methodology

HFP (continued)

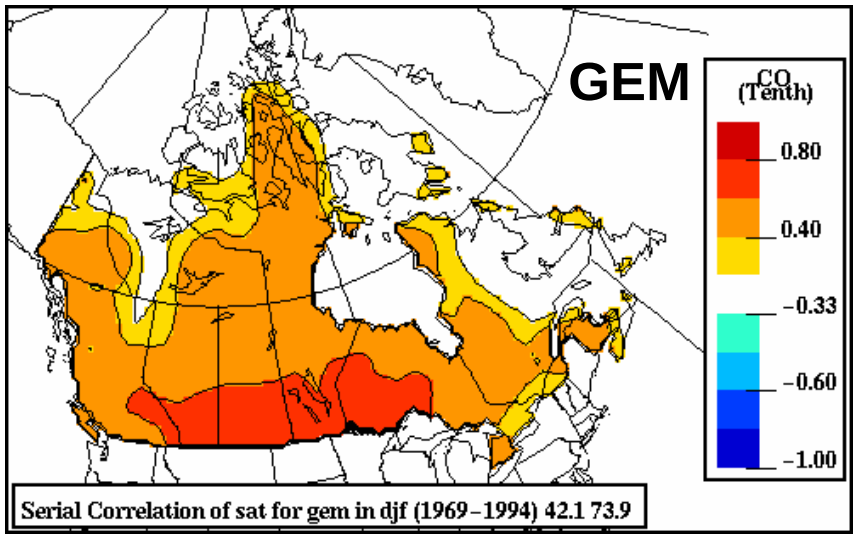
- HFP1
  - Climate model: GCM2 (Force-restore land surface scheme)
  - Weather prediction model: SEF (Force-restore)
  - 26 winters, 1969-95
- HFP2
  - GCM3 (coupled with CLASS)
  - GEM (Force-restore)
  - 30 winters, 1969-99
- CMC uses HFP modelling methodology to produce operational seasonal forecasts
  - Deterministic for public
  - Probabilistic for forecasters (3 categories)

Temporal correlation for surface temperature: Observed *vs* Ensemble Mean for 26 winters (1969-95)





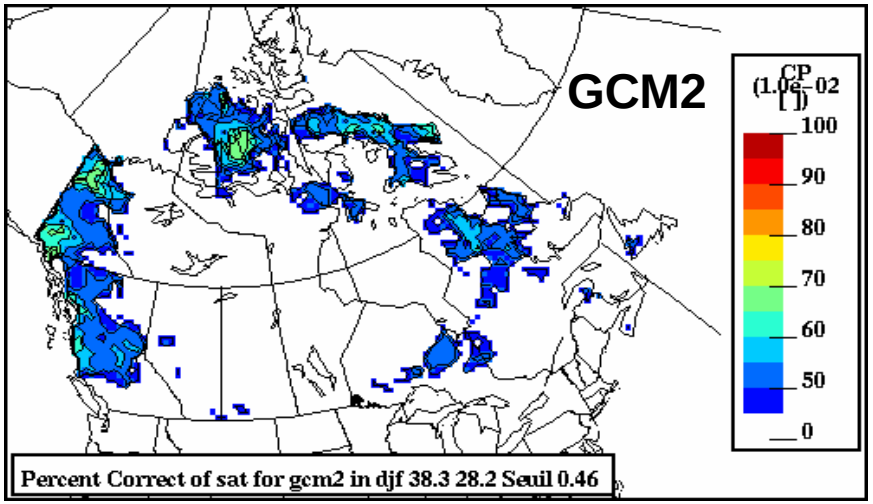
HFP1

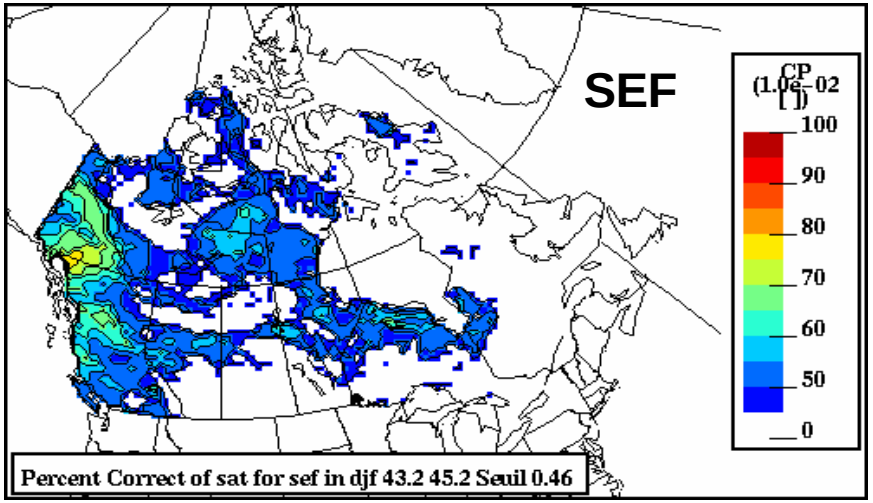


HFP2

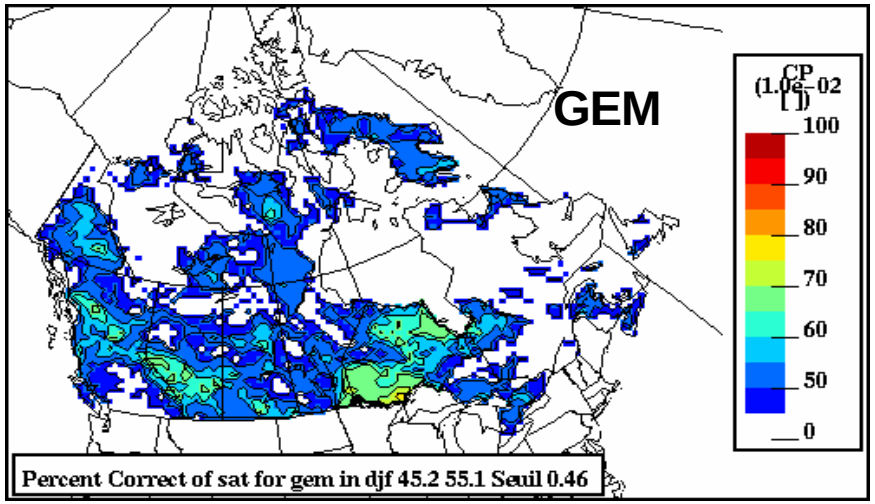
(From J. Derome)

% of correct deterministic forecasts (3 categories) 1969-1995





HFP1



HFP2

(From J. Derome)

Proposed Approach

- Use HFP2 framework
- Modify methodology to include soil moisture initialization
  - Run 1
    - Dec-Jan-Feb forecast for a particular year with previous Nov SST persisted
  - Run 2
    - As Run 1 but with Nov soil moisture initialized from previous seasonal forecast
- Compare Runs 1 and 2
- Multi-year, multi-model ensemble
  - GCM3 coupled with CLASS

Proposed Approach (continued)

- Assess skill/uncertainty of prediction
  - Temperature, precipitation, …
  - Probabilistic methodology
- Personnel
  - B. Winter, McGill Ph.D. student supervised jointly by Lin and Derome
- Computer resources
  - CMC will provide

Interaction with Other Projects

- CLIVAR 2
  - Will focus on seasonal prediction with coupled atmosphere-ocean models
- Drought Network
  - R. Stewart, PI
  - Includes several MAGS members (Stewart, Lin, Szeto, Gyakum, Leighton, …)
  - Proposal to be submitted to CFCAS