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Trends in Evaporation Estimates for the Canadian Prairies

Canada

Outline

- Why Conduct the study?
- Methodology for Phase 1 – Is there a Trend?
- Results from Phase1
- Methodology for Phase 2 – What caused the Trends?
- Results from Phase 2

Trends in Evaporation Estimates for the Canadian Prairies

Meyer formula:

$$EG = CK(Vw - Va)(1 + 6.2139 \times 10^{-2}W)(1 + 3.28084 \times 10^{-5}A$$

where: EG = monthly gross evaporation in mm

C = coefficient dependent on how saturated vapour pressure is calculated (10.1 to 11)

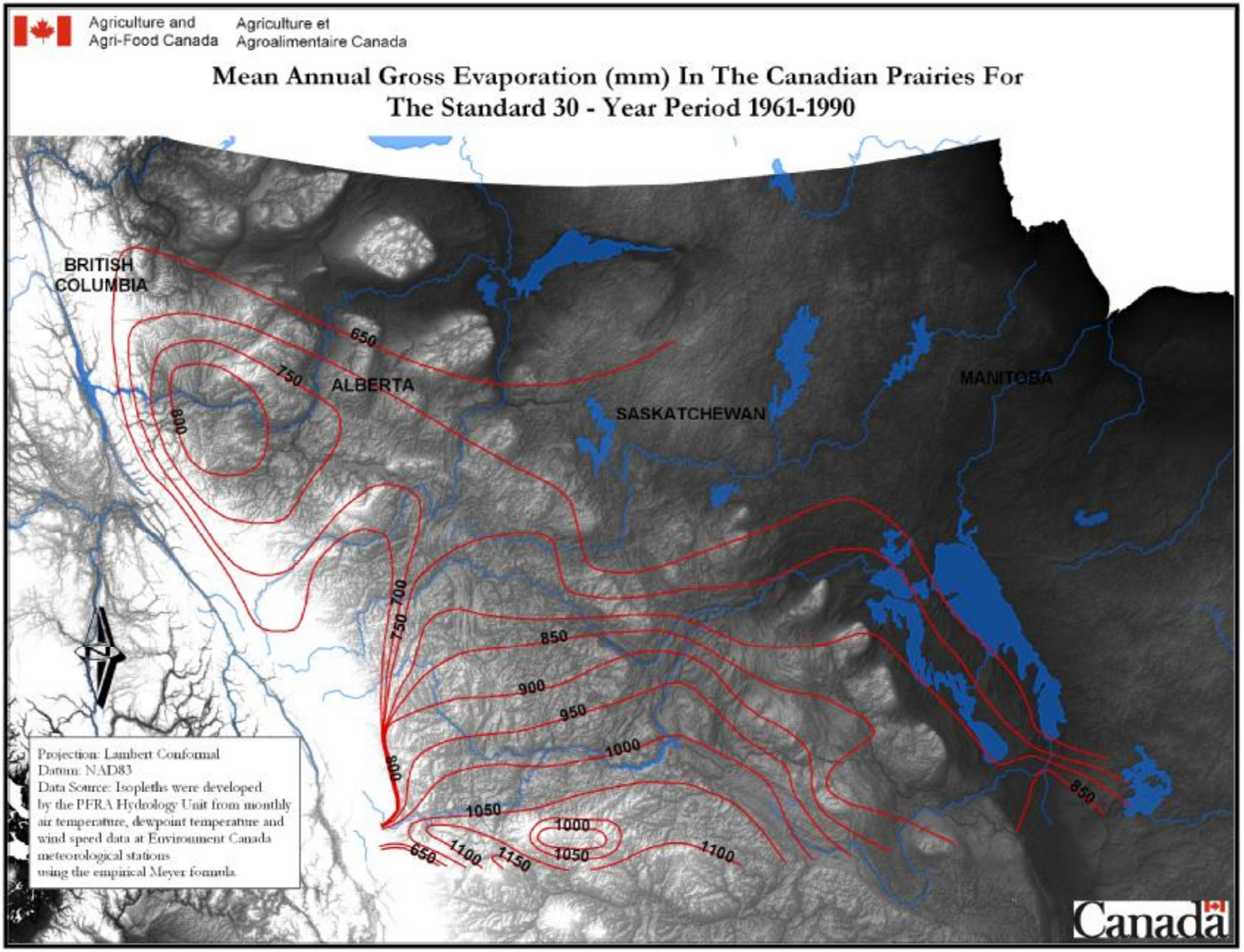
K = metric conversion of 0.750062

V_w = saturated vapour pressure (millibars) at surface of water body

V_a = actual vapour pressure (millibars) at 7.62 metres above ground

W = wind speed (km/hr) at 7.62 metres above ground

A = elevation in metres above sea level


Agriculture and Agri-Food Canada
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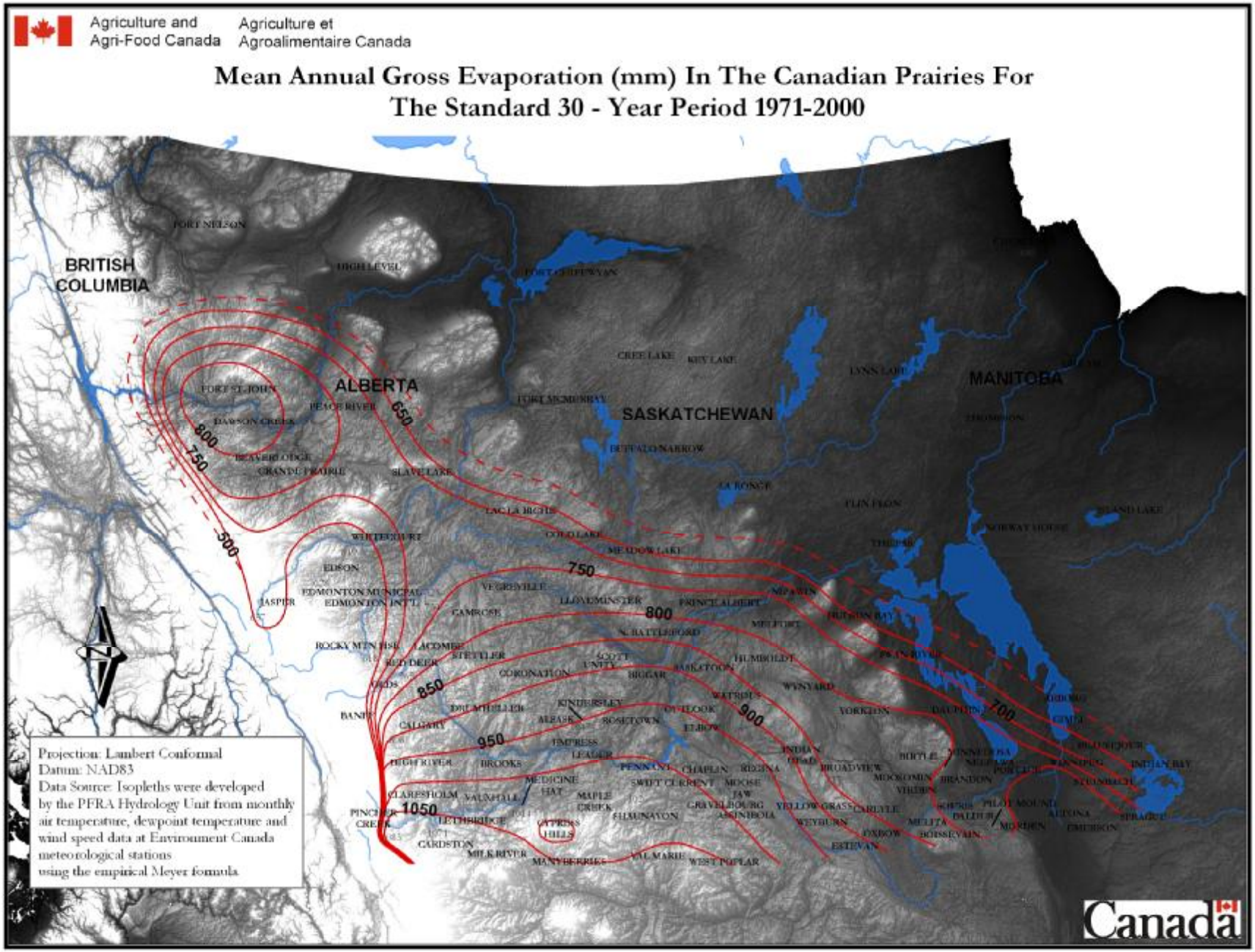
Mean Annual Gross Evaporation (mm) In The Canadian Prairies For The Standard 30 - Year Period 1961-1990
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
650
750
800
700
850
900
950
1000
1050
1100
1150
Projection: Lambert Conformal
Datum: NAD83
Data Source: Isopleths were developed by the PFRA Hydrology Unit from monthly air temperature, dewpoint temperature and wind speed data at Environment Canada meteorological stations using the empirical Meyer formula.
Canada


Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada
Mean Annual Gross Evaporation (mm) In The Canadian Prairies For The Standard 30 - Year Period 1971-2000
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
500
650
750
800
850
900
950
1050
Projection: Lambert Conformal
Datum: NAD83
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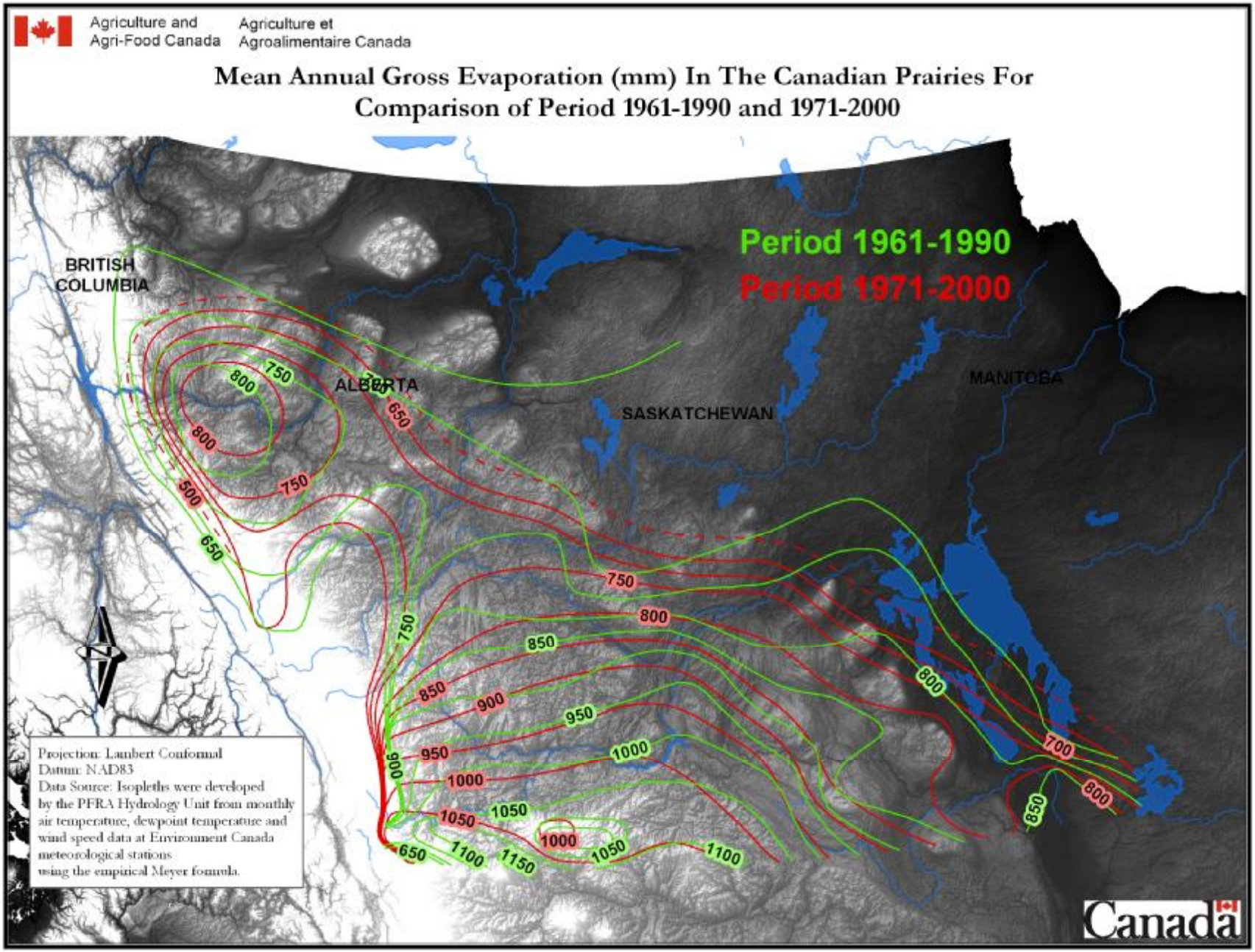
Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada
Mean Annual Gross Evaporation (mm) In The Canadian Prairies For Comparison of Period 1961-1990 and 1971-2000
Period 1961-1990
Period 1971-2000
BRITISH COLUMBIA
ALBERTA
SASKATCHEWAN
MANITOBA
Projection: Lambert Conformal
Datum: NAD83
Data Source: Isopleths were developed by the PFRA Hydrology Unit from monthly air temperature, dewpoint temperature and wind speed data at Environment Canada meteorological stations using the empirical Meyer formula.
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Analysis of Trends in Evaporation – Phase 1

Prepared by:

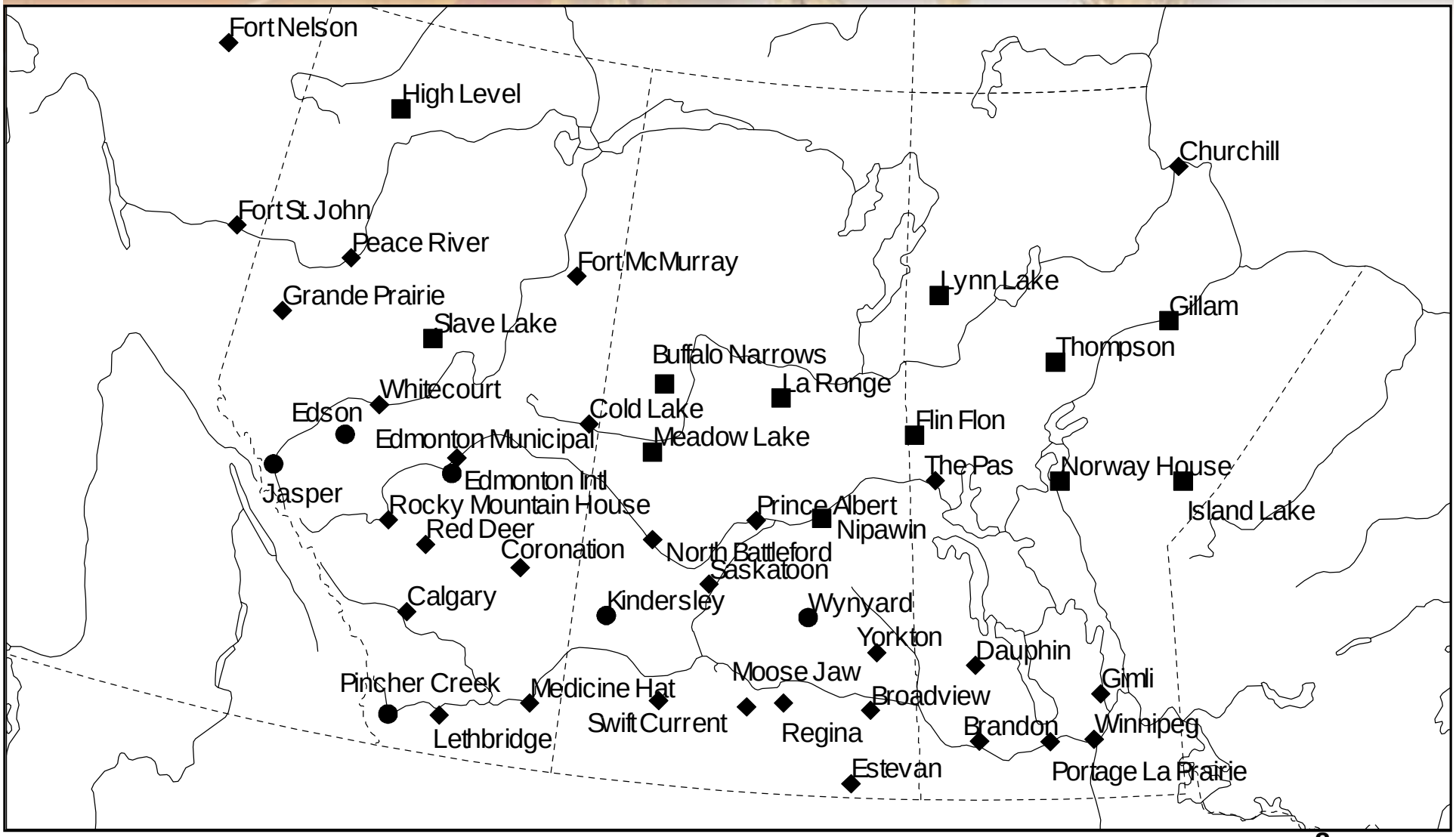
Nicole M. Hesch and Donald H. Burn, Ph.D. P.Eng.

Department of Civil Engineering, University of Waterloo

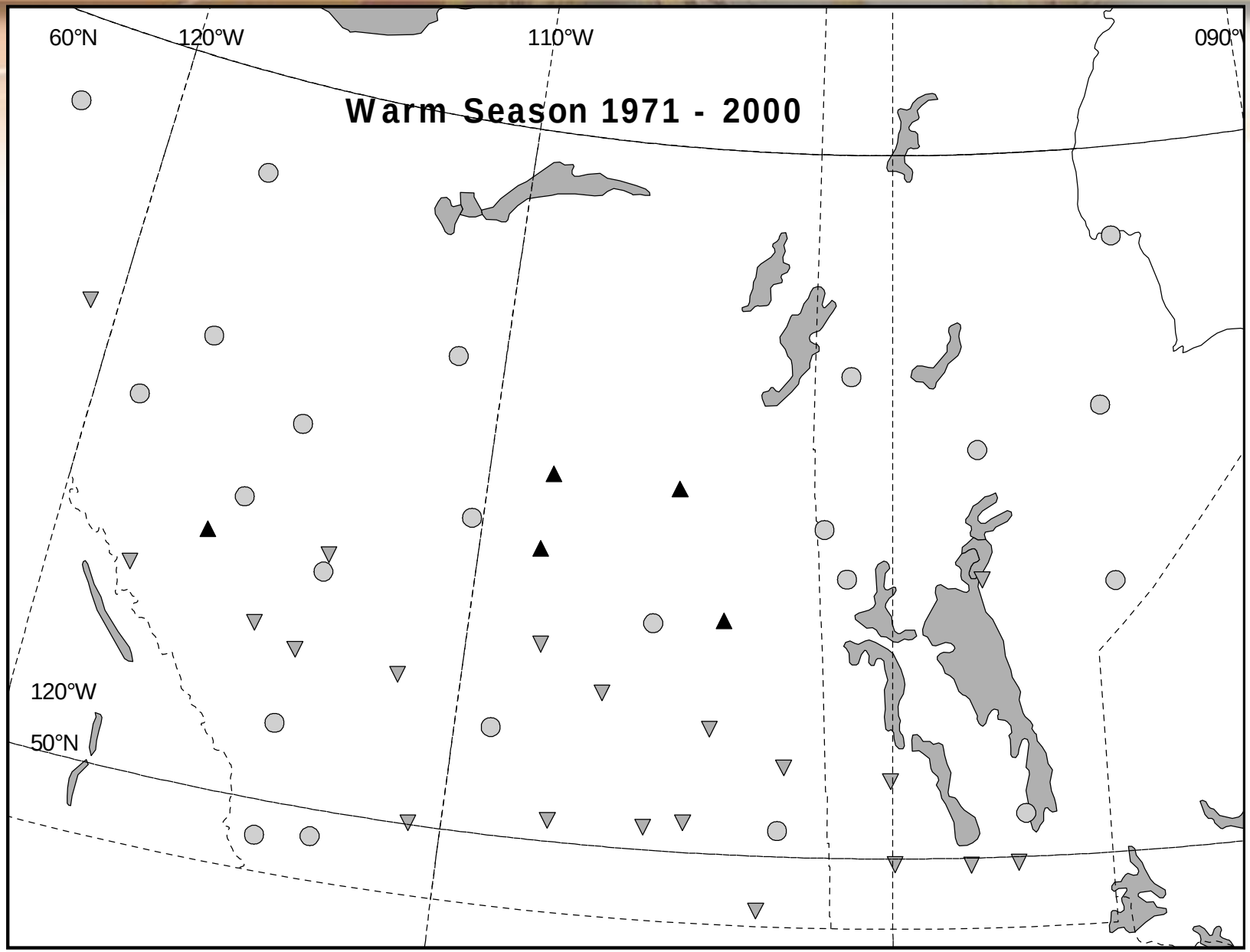
Submitted to Agriculture and Agri-Food Canada – PFRA – May 2005

- Three time periods – 1951-2000, 1961-2000 and 1971-2000
- Significant trends identified using Mann-Kendall statistical test for trend and bootstrapping resampling.
- Comparisons made between gross evaporation and pan evaporation trends

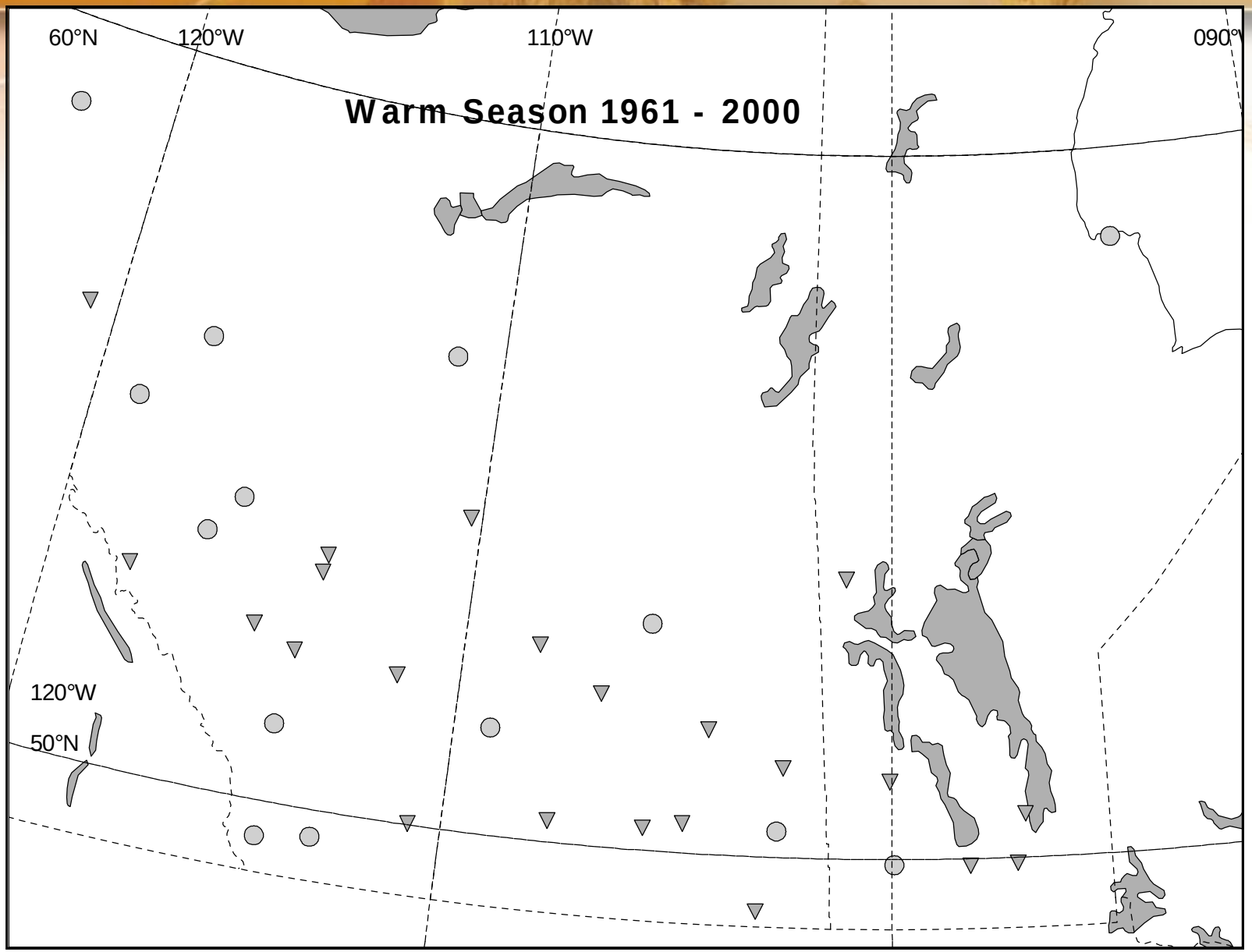
Location Map



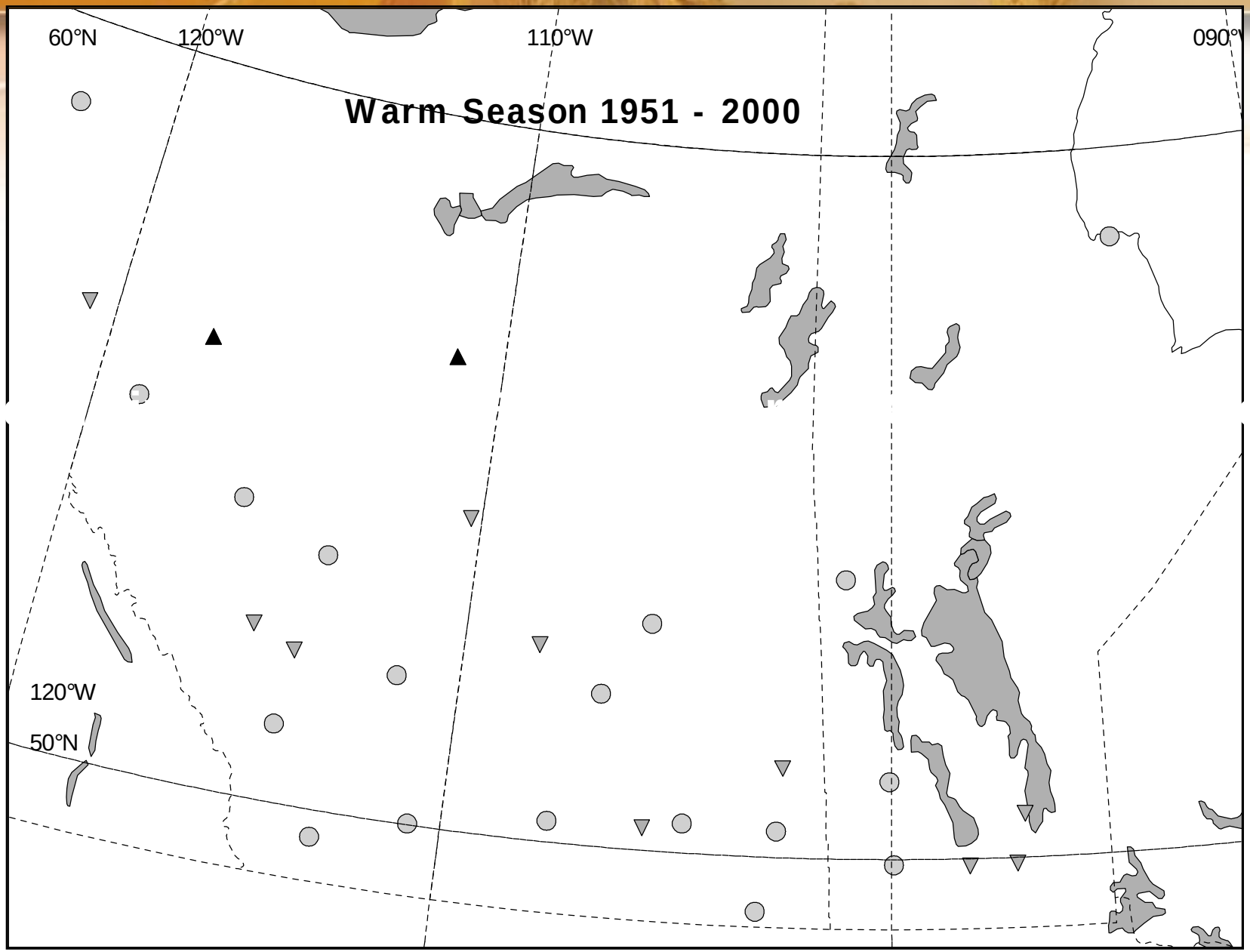
Trends in Evaporation Estimates for the Canadian Prairies



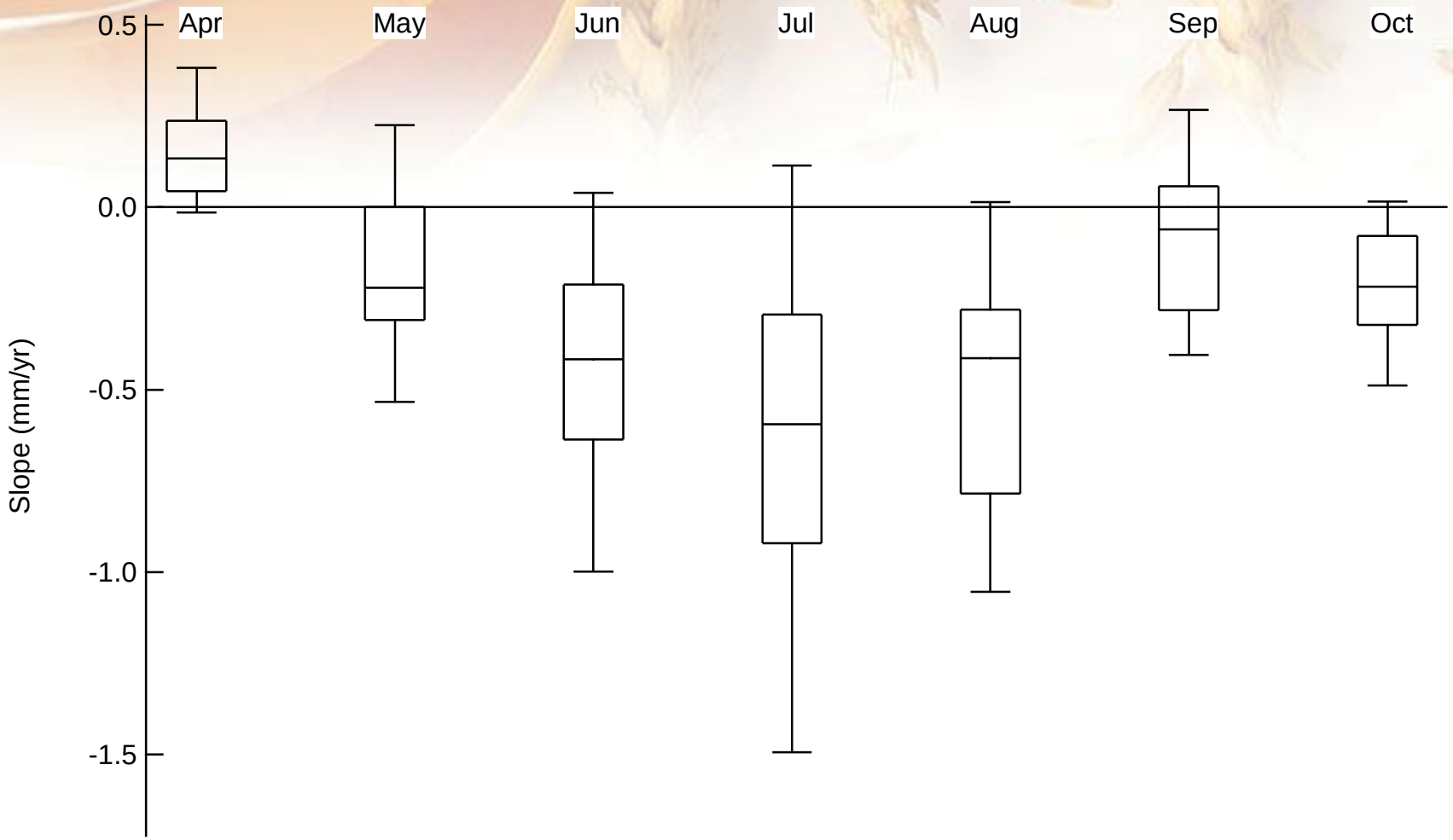
Trends in Evaporation Estimates for the Canadian Prairies



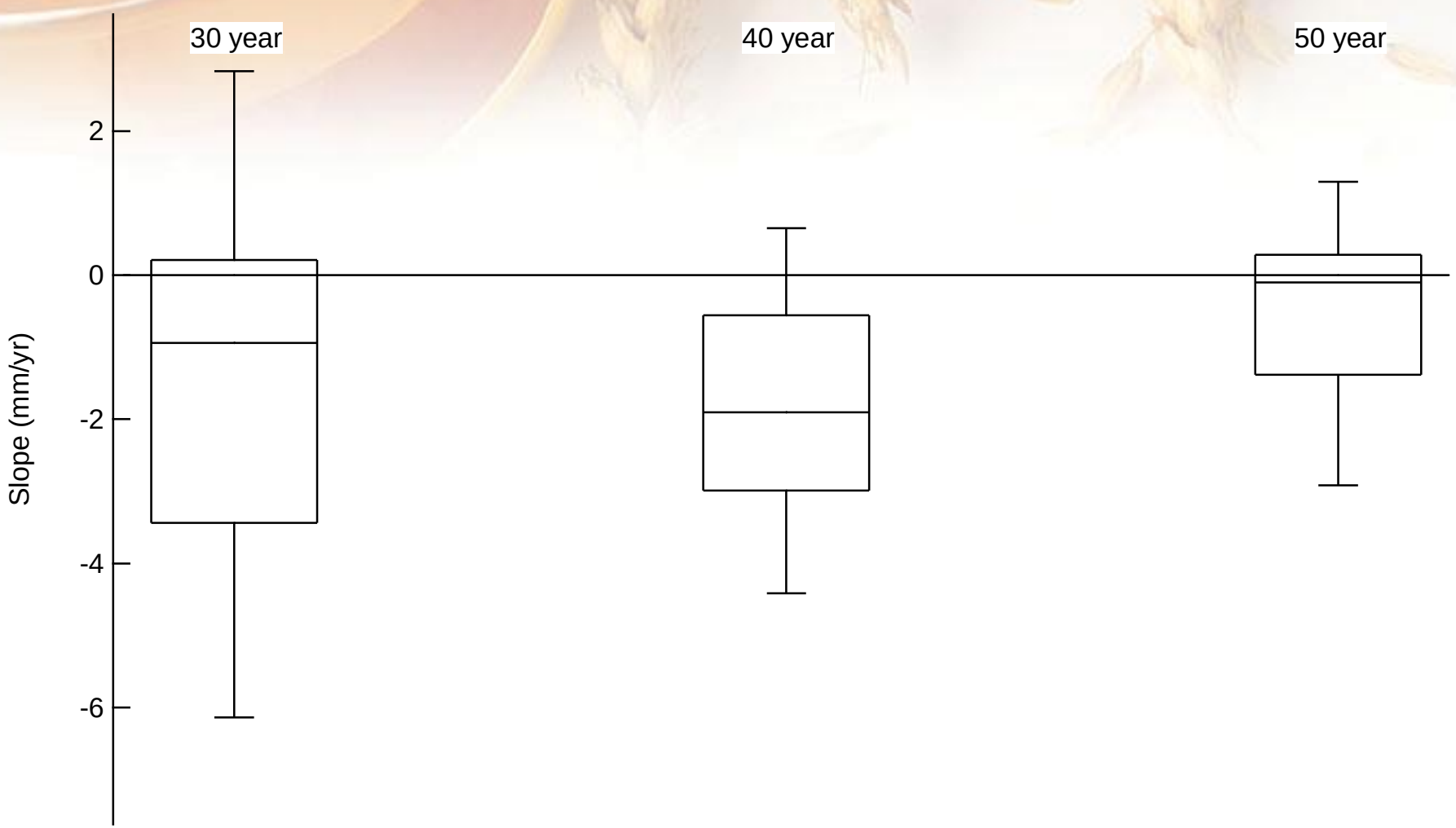
Trends in Evaporation Estimates for the Canadian Prairies



Box and Whisker plots of monthly trend slope values for the 40-year period 1961-2000



Box and Whisker plots of warm season trend slope values for the periods



Analysis of Trends in Evaporation – Phase 2

Prepared by:

Nicole M. Hesch and Donald H. Burn, Ph.D. P.Eng.

Department of Civil Engineering, University of Waterloo

Submitted to Agriculture and Agri-Food Canada – PFRA – January 2006

- Three time periods – 1951-2000, 1961-2000 and 1971-2000
- Explores gross and pan evaporation trends by examining the origins.
- Examined control mechanisms: air temperature, wind speed, dew point temperature, water vapour pressure (V_w) air vapour pressure (V_a) and V_w-V_a (vapour pressure deficit)

Analysis of Trends in Evaporation – Phase 2

Results:

- Wind speed showed field significant trends for all 3 time periods
- Causal mechanisms for gross evaporation were wind speed or $V_w - V_a$
- Wind speed generally more influence for decreasing trends
- $V_w - V_a$ generally more influence for increasing trends
- Causal mechanism for pan evaporation was $V_w - V_a$
- Wind speed exerted influence on gross evaporation and not pan evaporation.

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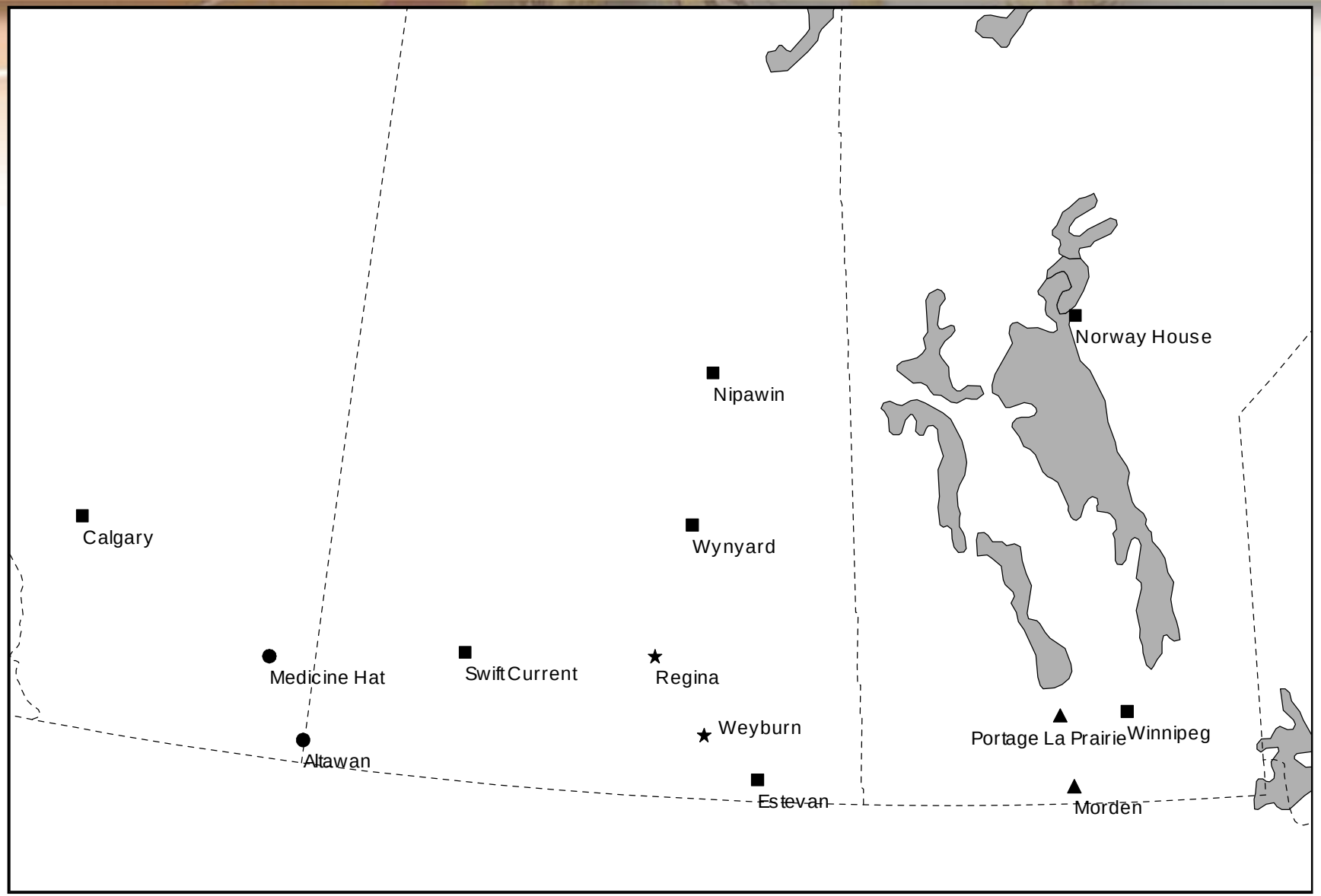
Trends in Evaporation Estimates for the Canadian Prairies



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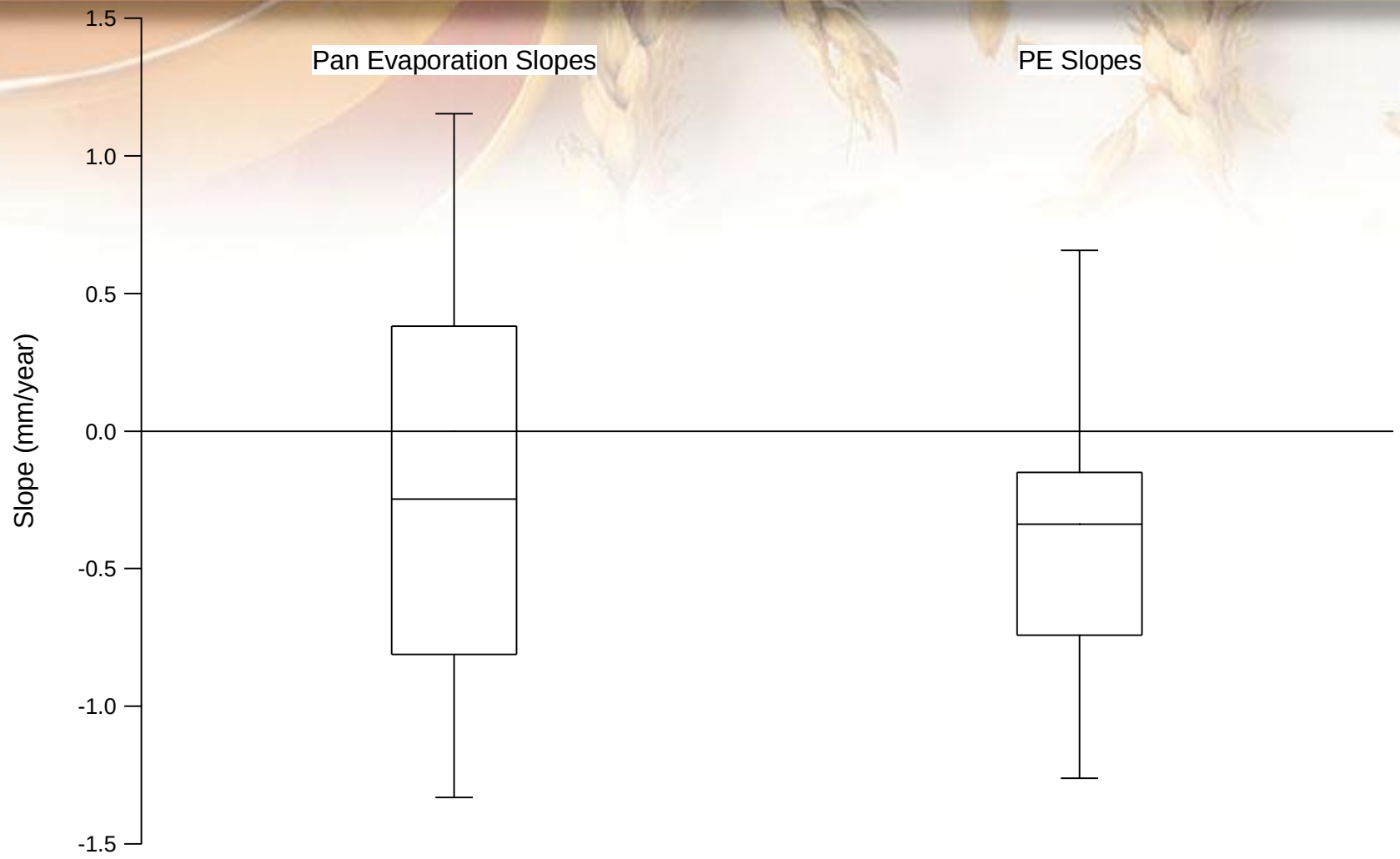
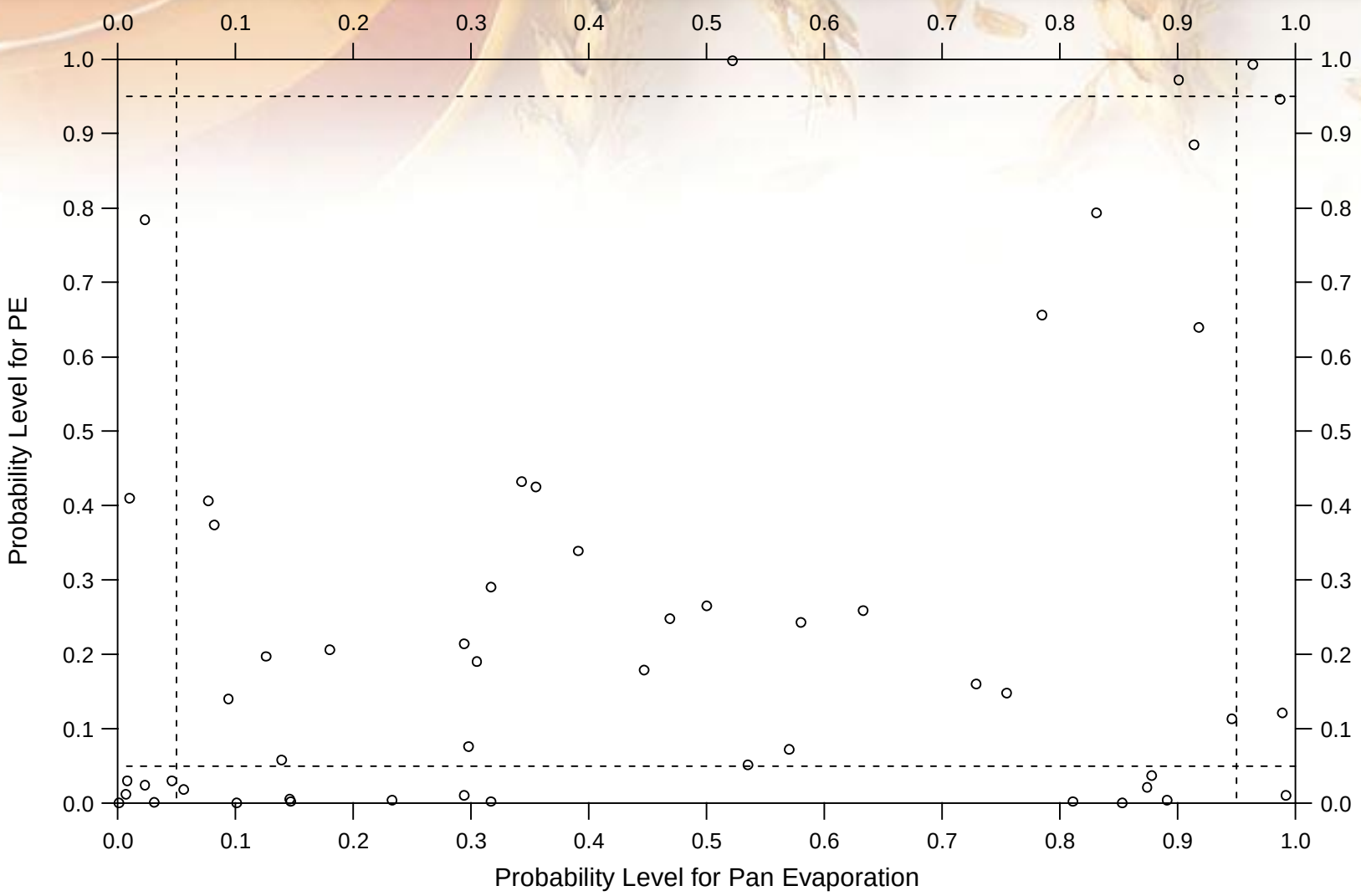
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