Satellite Derived Snow Cover Datasets for Western Canada

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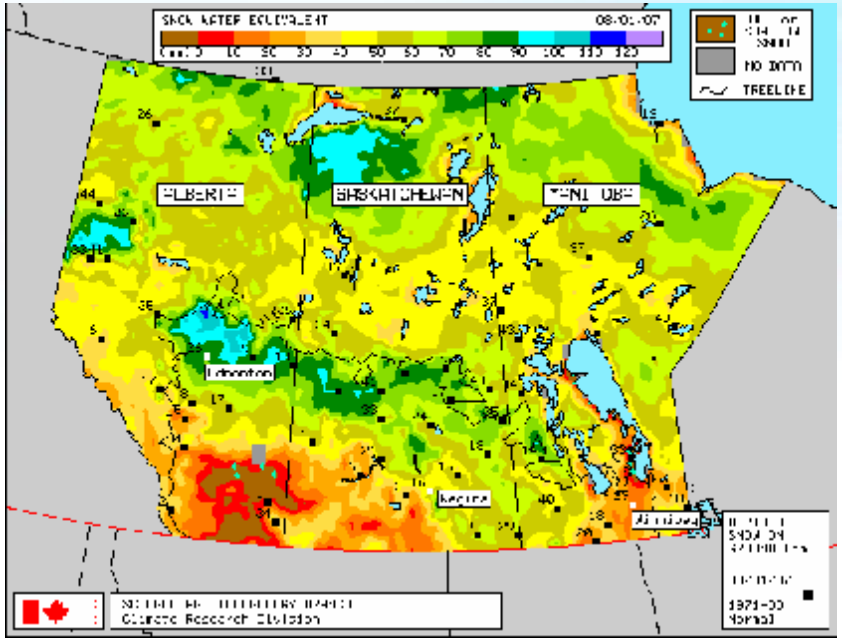
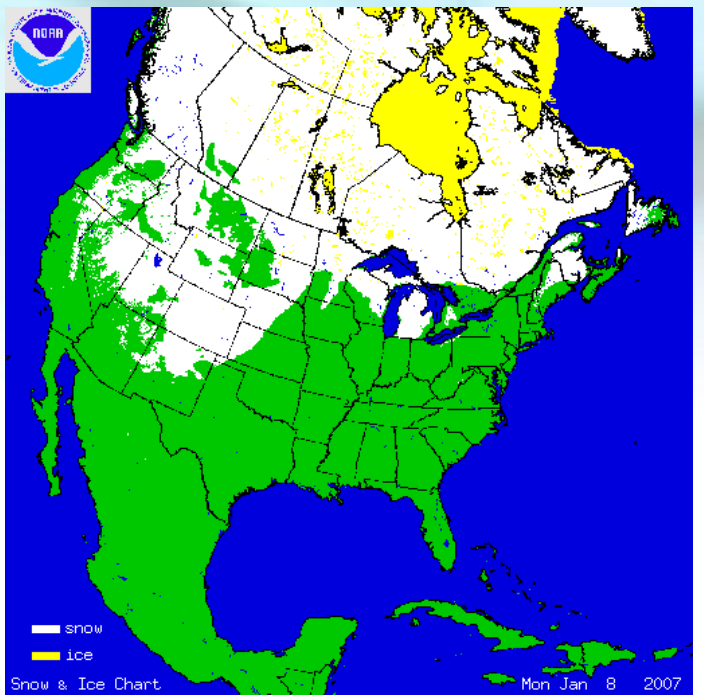
Contributions to DRI Objectives

Produce satellite-derived snow cover information to contribute to *quantifying the physical features of recent drought* and *improve understanding of the winter season contribution to drought processes and feedbacks*.

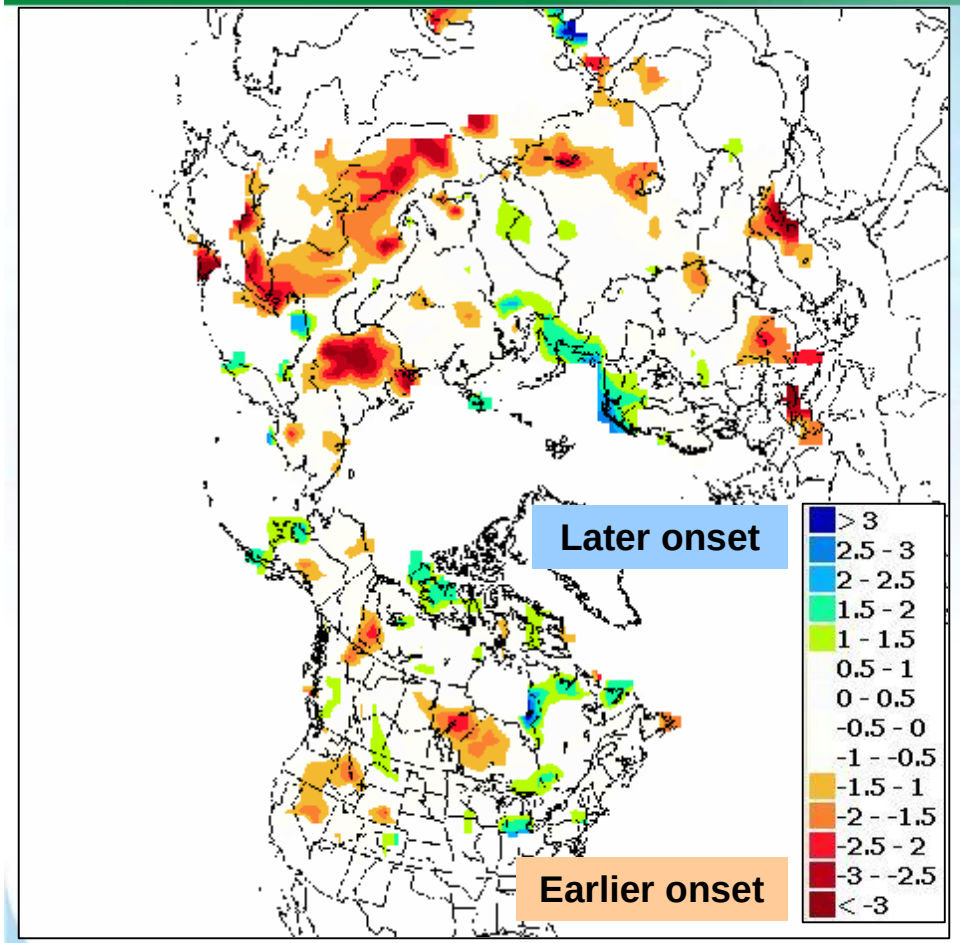


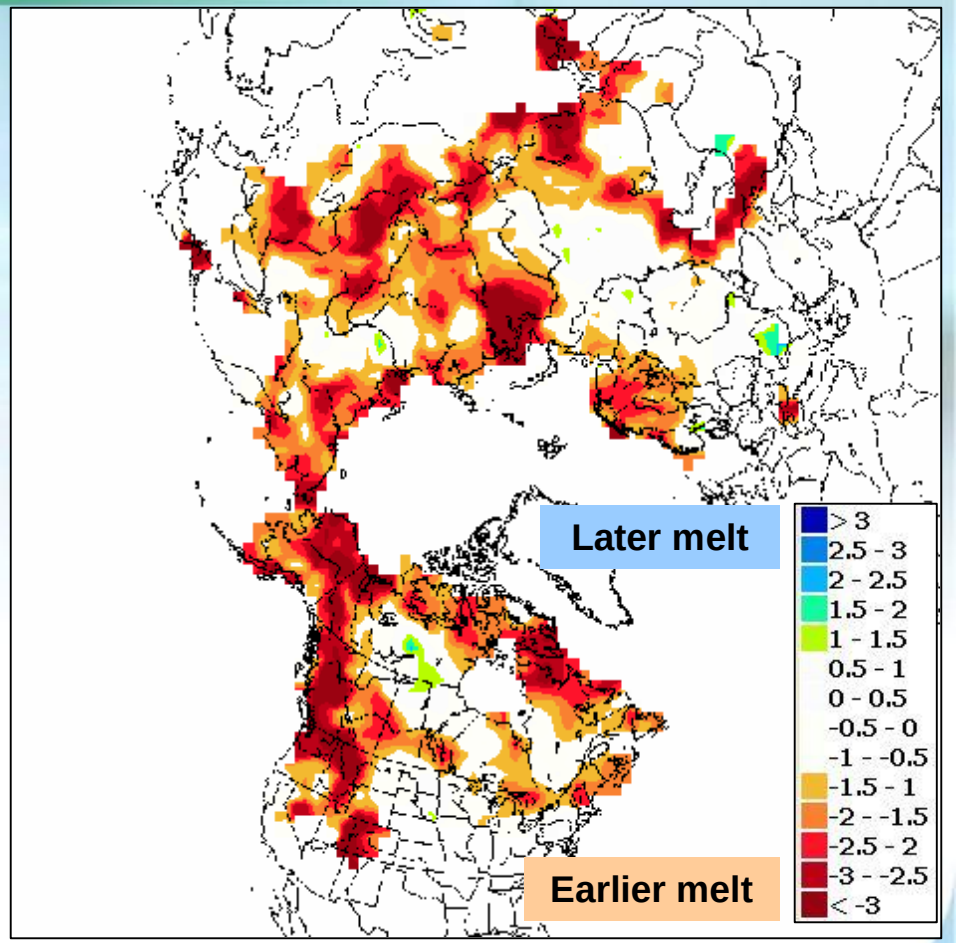
Satellite Passive Microwave Snow Water Equivalent Data 1978-present



NOAA Snow Extent Data 1971-present

Seasonal snow cover variables from the NOAA time series





T-test values, trends in start/end date of snow cover from NOAA weekly dataset, 1971/72 to 2003/04

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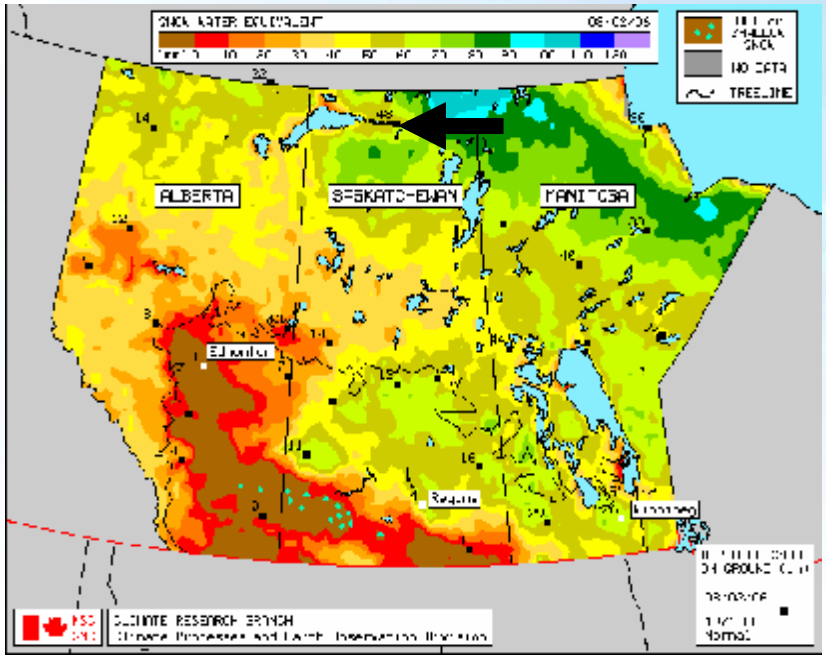
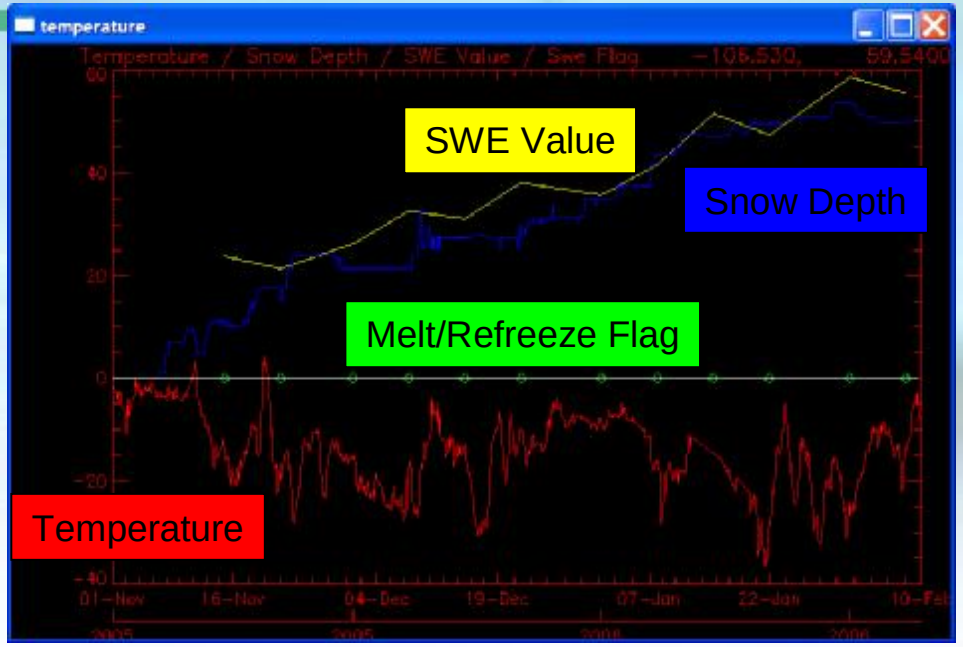
Passive Microwave SWE Time Series

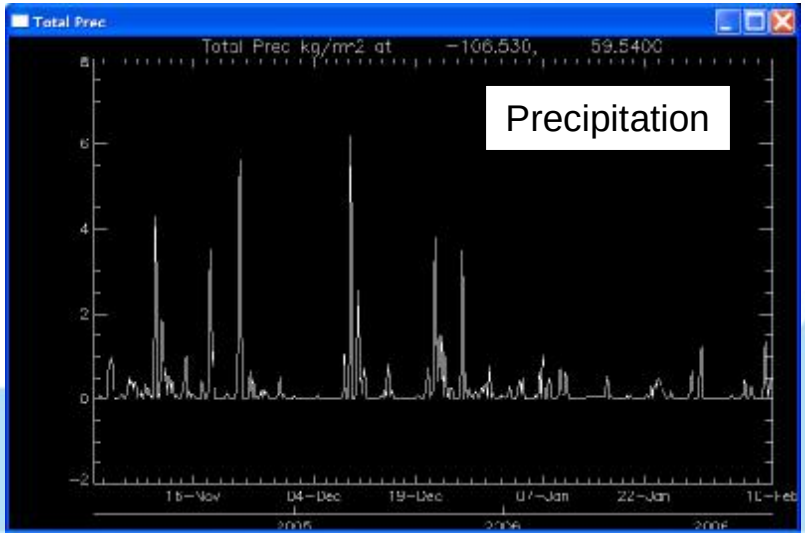
- Satellite record extends from 1978 to present (SMMR; SSM/I; AMSR-E)
- Brightness temperatures adjusted to create homogeneous time series
- Land-cover sensitive algorithm suite developed during BOREAS
- Annual field campaigns for assessment of algorithm performance conducted since 2002
- Five-day and monthly averaged datasets available

Users	
Operational	**Research**
Water resource management agencies: • Flood forecasting • Agriculture • Wildlife • Fire Risk	***Regional climate modelling:*** • Model initialization • Model and algorithm evaluation • Specific simulation experiments
Weather forecast offices: • Changes in SWE distribution/magnitude • Blowing snow events	***Time series analysis:*** • Integrating conventional and satellite measurements • Trend analysis
Hydropower Corporations: • Water storage/reservoir management	***Algorithm development:*** • Application of AMSR-E to high latitudes • Assimilation into NWP

Enhanced Delivery of SWE Information to Users







- **GEM output linked to SWE retrievals within a user controlled interface developed at Noetix.**

- **Initial development in 2005/06, further evaluation with users during 2006/07 season.**

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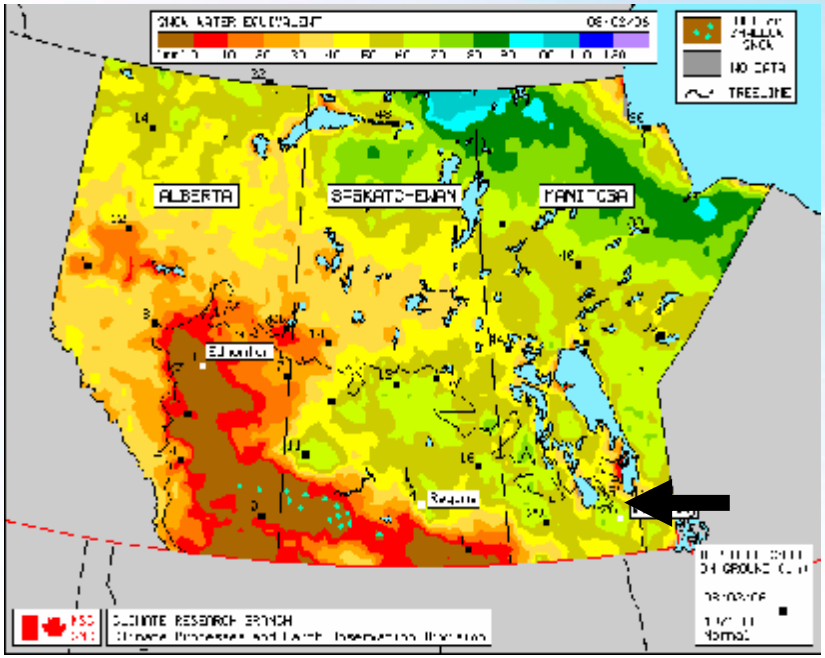
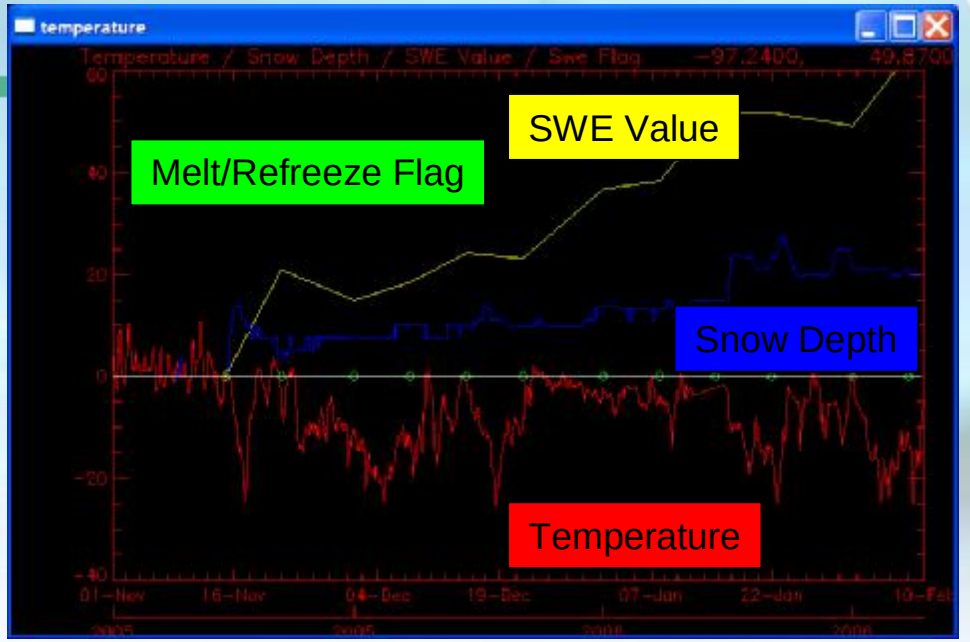
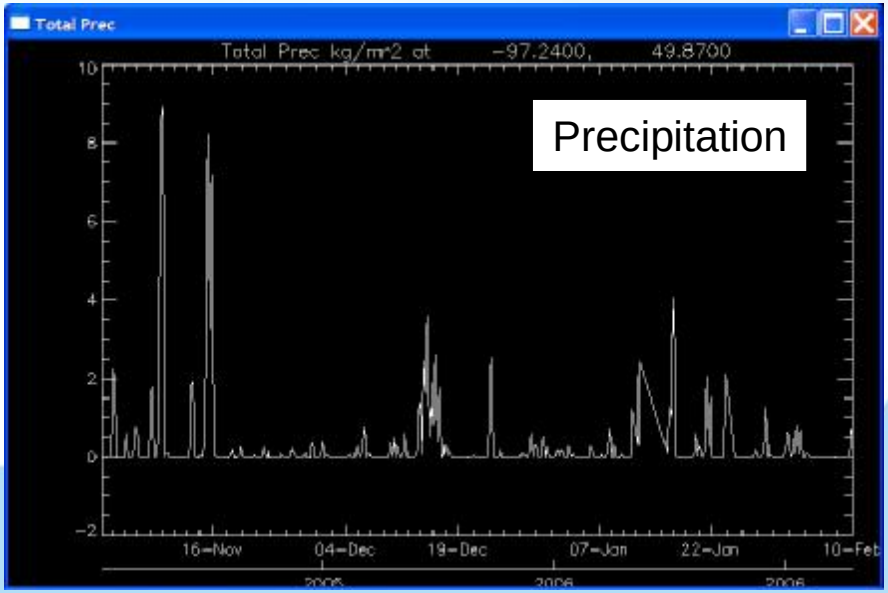
Enhanced Delivery of SWE Information to Users







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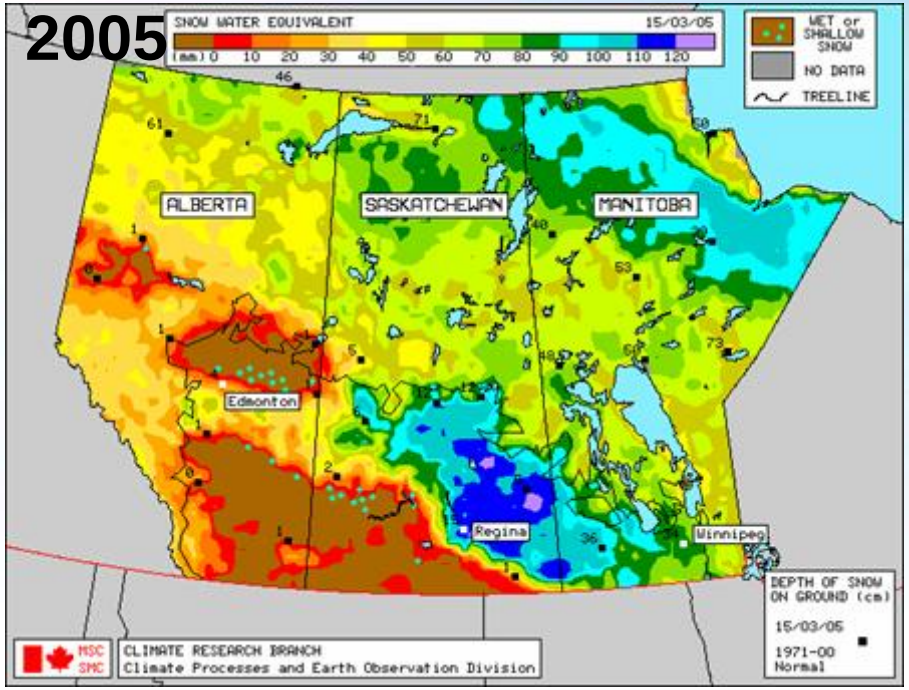
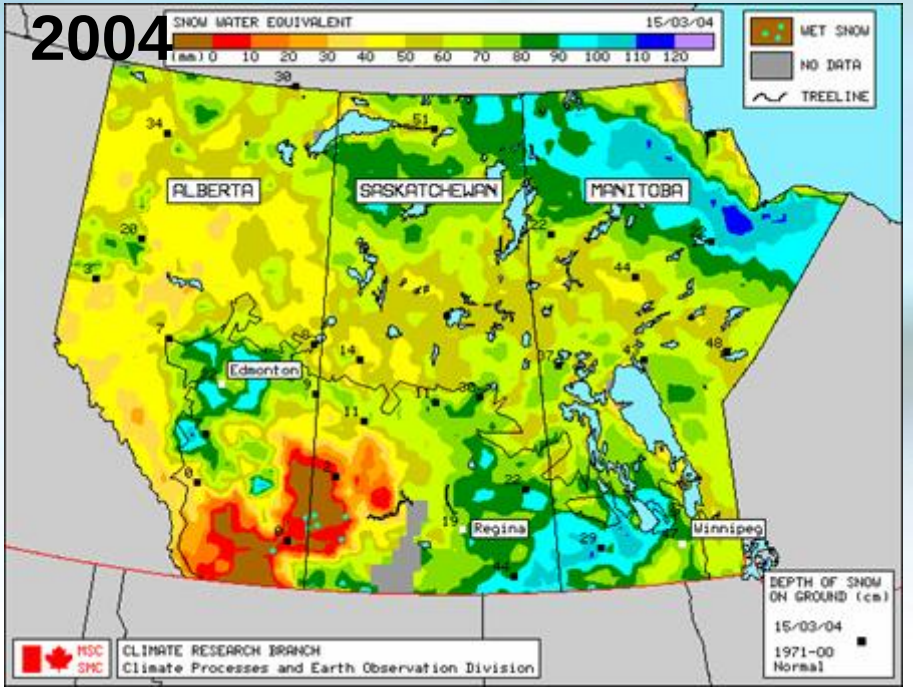
SWE Variability





- SWE patterns across the prairies are highly variable from year to year, while the northern boreal SWE band consistently appears through the passive microwave record.

- Regional snow survey campaigns have validated the SWE band retrievals.

Variability in SWE and Cyclonic Activity

ECMWF Re-Analysis :

- § 6-hourly intervals
- § ONDJFM extended winter season
- § 1978/79 through 2003/04

- **Feature tracking approach (Hodges, 1994, 1995, 1999). Cyclones are identified as minima in MSLP.**
- **Their positions at consecutive time-steps are joined to form their tracks.**

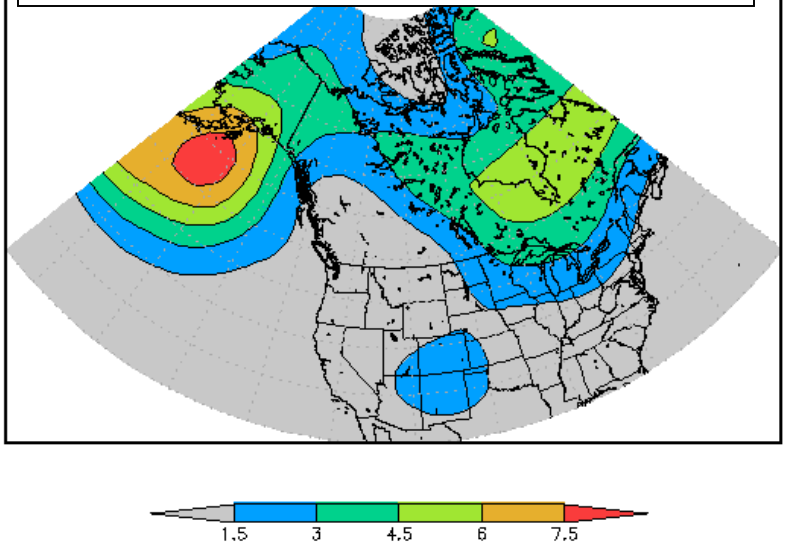
Subject to :

a. smoothness criterion

b. an upper bound on displacement distance

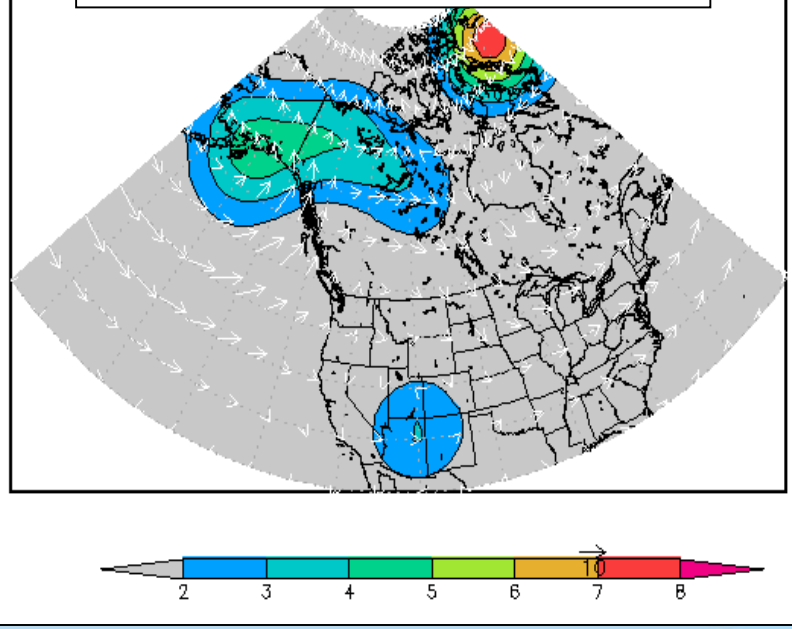
850 hPa Geopotential Height Negative Anomalies - October

Z850 Oct. 1980 Track Density



Positive PNA
winter : 1980-81

Z850 Oct. 1980 Genesis

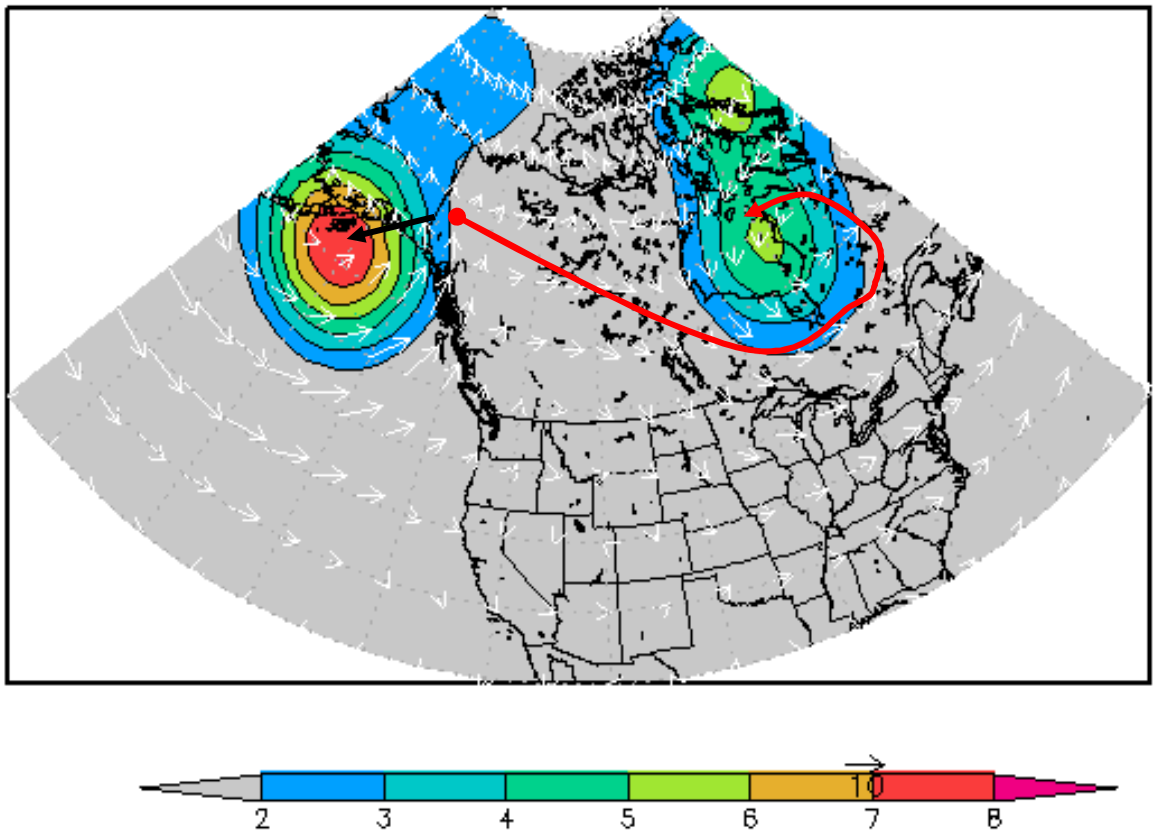


Track densities: centers over Gulf of Alaska and Southern Hudson Bay,

Genesis distribution: center over Alaska intruding inland into Yukon

850 hPa Geopotential Height Negative Anomalies - October

Z850 Oct. 1980 Lysis

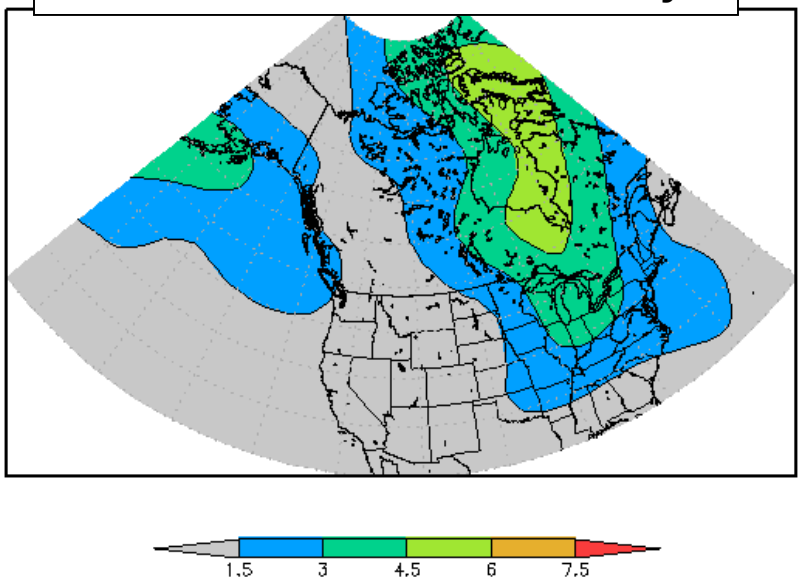


Cyclones generated over Alaska track over the SWE band southeastwards, into NW Ontario where they get entrained into the Hudson Low cyclonic flow, and die over Northern Hudson Bay (Lifetime of approximately of 7-10 days).

Consistent with CRCM simulations that showed establishment of the SWE band in Oct./Nov.

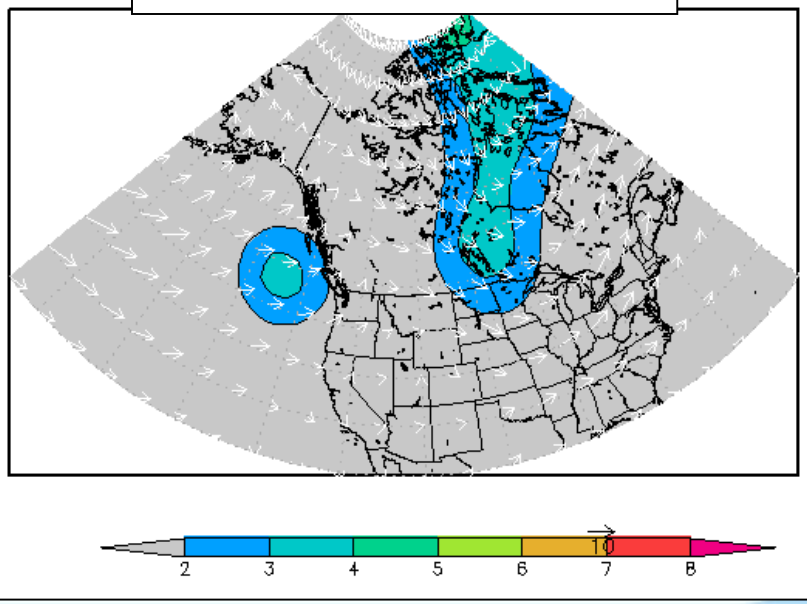
850 hPa Geopotential Height Negative Anomalies - February

Z850 Feb. 1981 Track Density

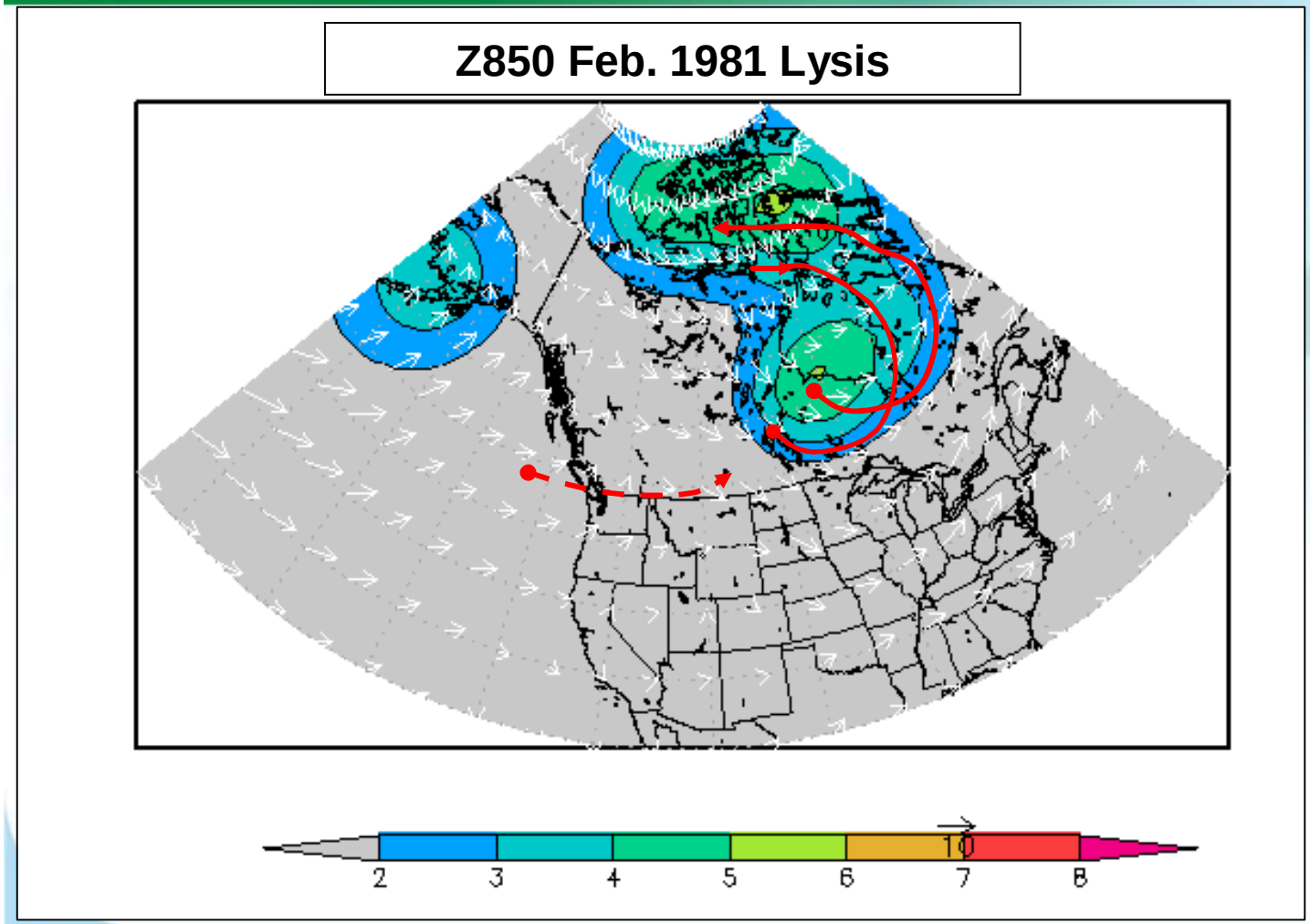


Cyclonic activity now over eastern Canada; connection to the Pacific/Alaska considerably weaker than in October and January.

Z850 Feb. 1981 Genesis



850 hPa Geopotential Height Negative Anomalies - February



Cyclone generation over Manitoba, entrainment into Hudson Bay rotation.

Some zonal cyclonic activity from the Pacific, reaching southern prairies.

Scenario is more in agreement with the concept of a seasonally propagating large scale wave

DRI Collaborations and Future Plans

- Snow-on, snow-off, snow cover duration time series from the NOAA snow extent product are available.

- Passive microwave SWE time series provided to individual investigators, but will be made available via DRI data archive.

- Algorithm development currently focused on boreal forest and tundra regions, but continual assessment is ongoing across the prairies.

- Continue synthesis of atmospheric diagnostics of cyclonic development in the context of SWE variability.

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Thank you!

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Summary

Seasonal diagnostics of cyclonic tracks for a positive PNA year revealed a progressive shift of cyclonic activity from the Alaskan sector across northwestern Canada to James Bay / Hudson Bay and the Great Lakes.

Evident in:
- **Geopotential Height**
- **Relative Vorticity**
- **Relative Humidity**
- **Warm Surface Temperature Anomalies**

This scenario is more in agreement with the concept of a propagating (on seasonal timescales), large scale wave rather than of a standing wave.

Consistent with CRCM simulations that showed establishment of the SWE band in Oct./Nov.