



Factors affecting weather forecast skill in the Arctic

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STAR Final Workshop
Winnipeg, June 14th 2010**

Factors affecting weather forecast skill in the Arctic

- **Observational information on the “state” of the weather**
- **Variability of the weather**
- **Understanding of the weather**
- **And ability to “see ahead” – forecast**
- **Knowledge of the individual forecaster**
- **Location of the forecaster**

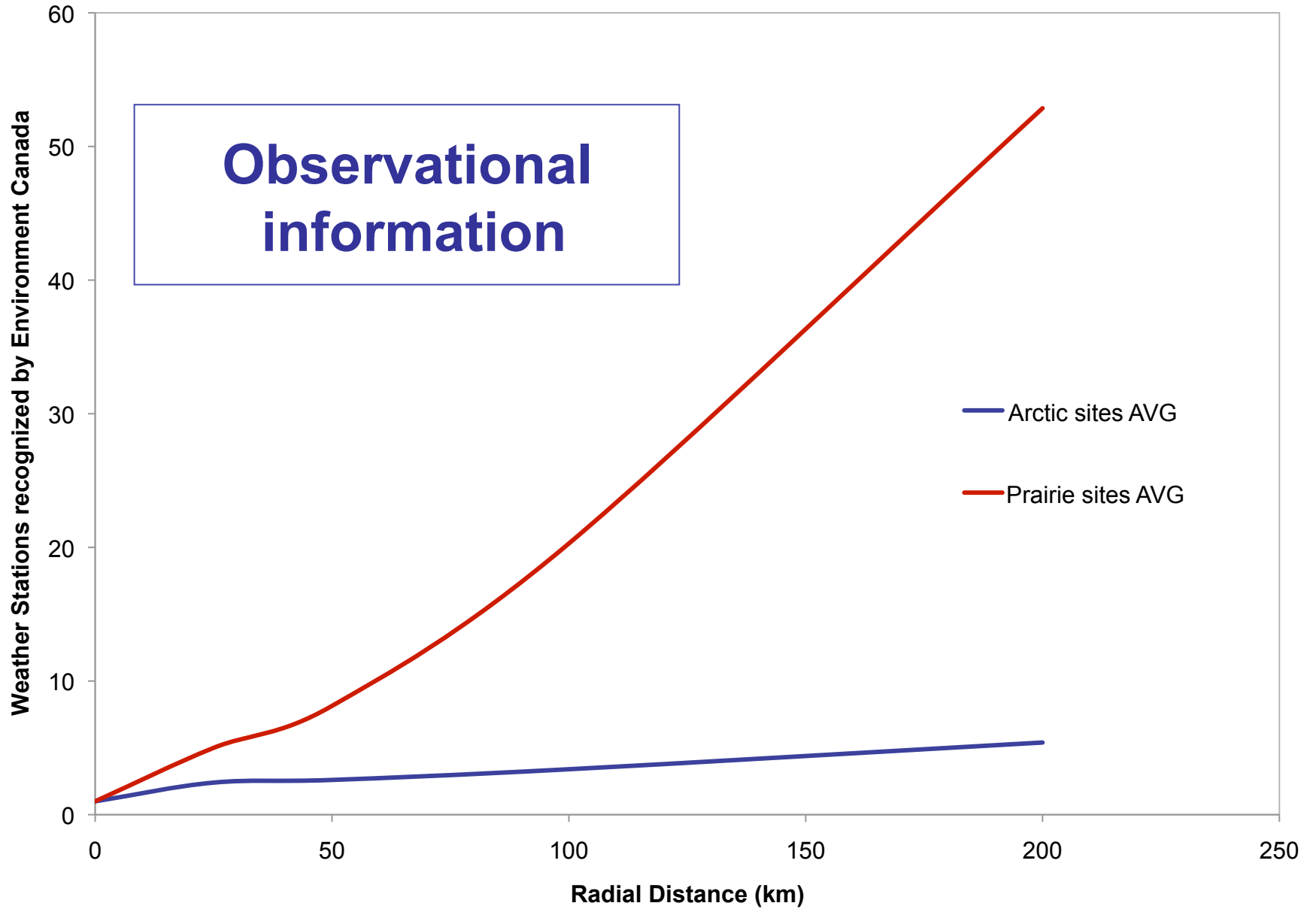
Observational information



Site	Lat	Long	Radar	Radiosonde
Edmonton	53.32	113.58	Yes	Yes
Calgary	51.11	114.02	Yes	
Fort McMurray	56.65	111.22	Yes	
Regina	50.43	104.67	Yes	
Winnipeg	49.92	97.23	Yes	
Saskatoon	52.17	106.72	Yes	
The Pas	53.97	101.1		Yes

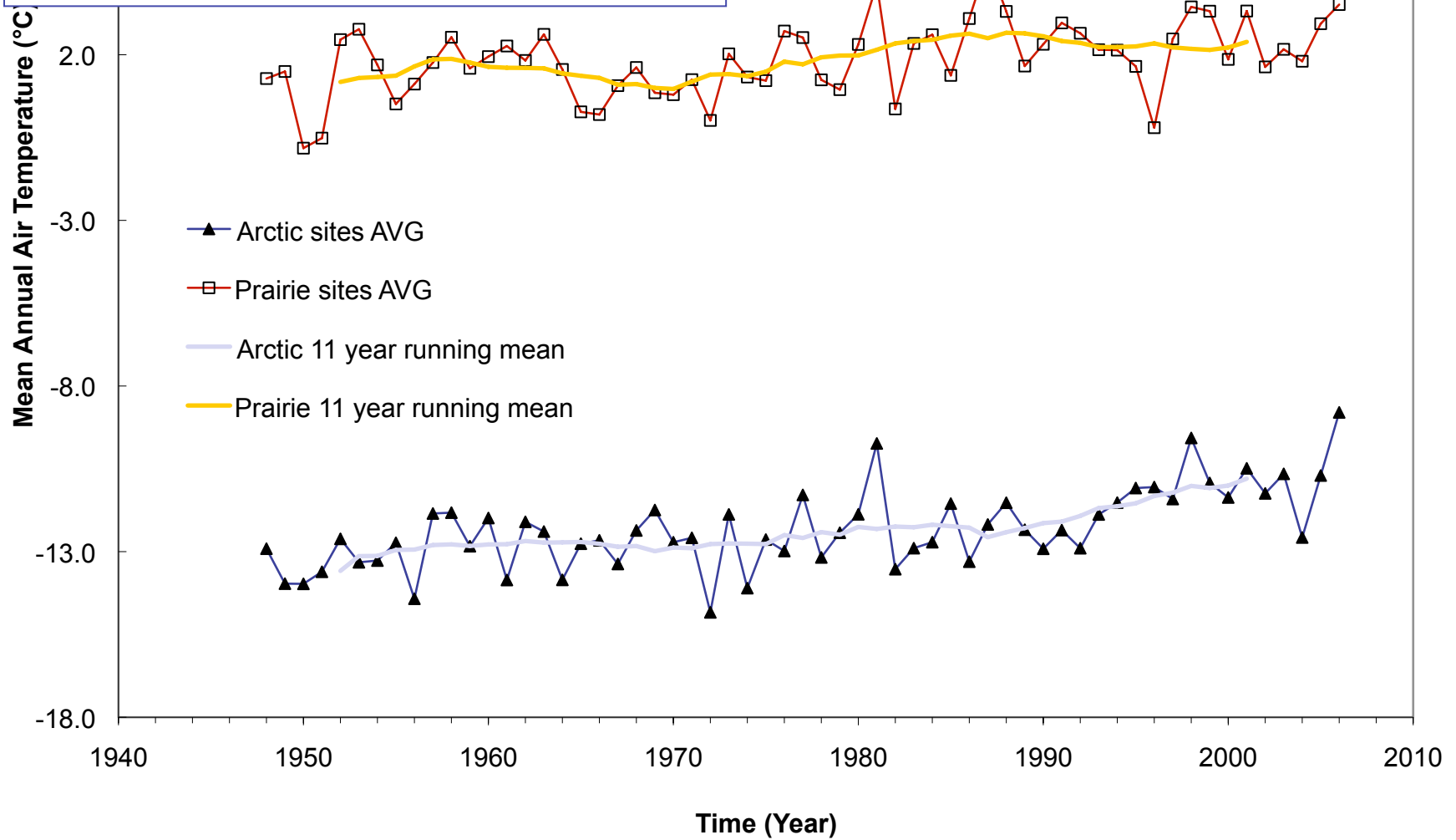
Site	Lat	Long	Radar	Radiosonde
Iqaluit	63.75	68.55		Yes
Inuvik	68.3	133.48		Yes
Cambridge Bay	69.12	105.14		Yes
Resolute	74.72	94.99		Yes
Rankin Inlet	62.82	92.12		

Spatial Proximity of Weather Stations Recognized by Environment Canada (Prairies vs. Arctic)

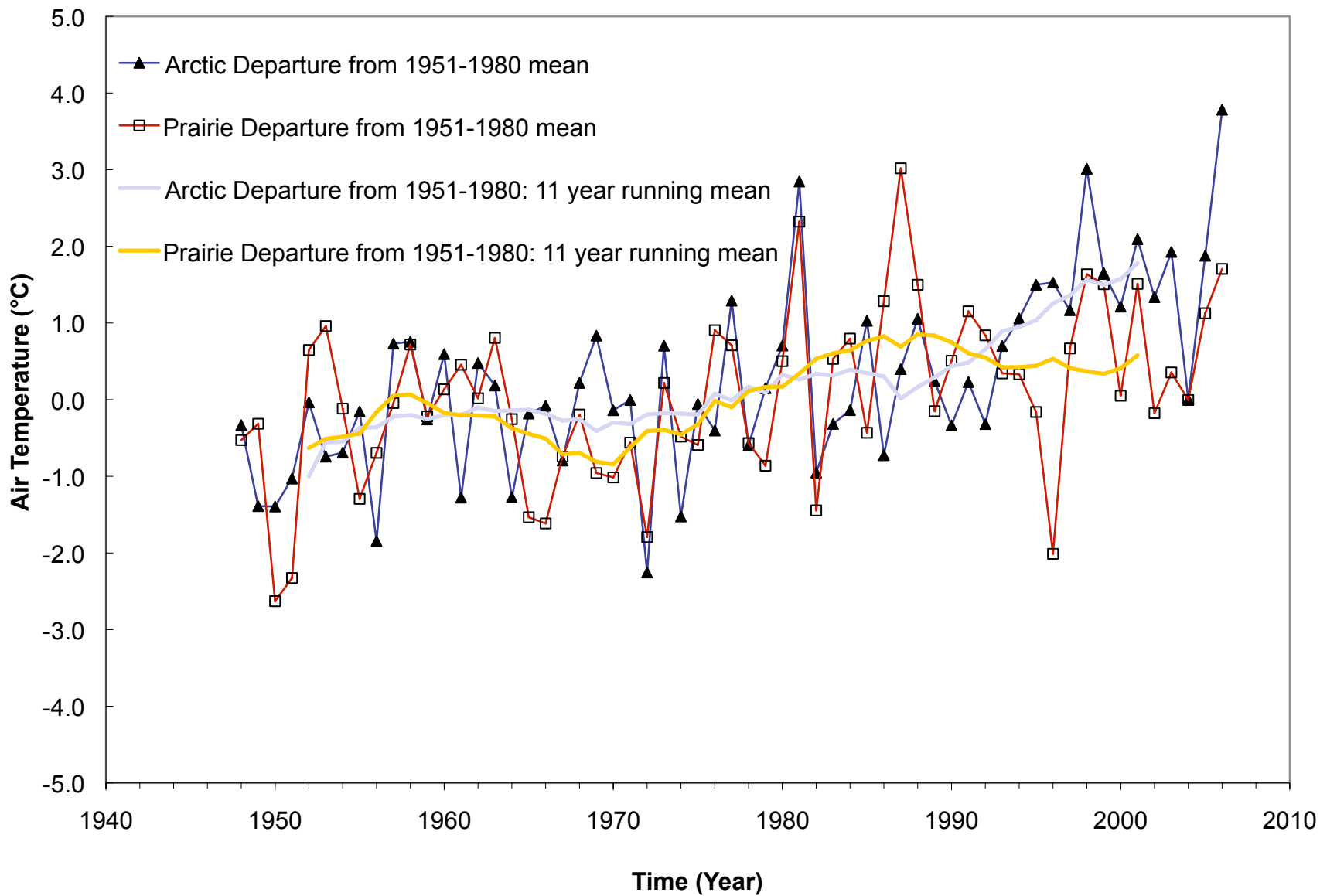


Change in Mean Annual Temperature (Prairies vs. Arctic)

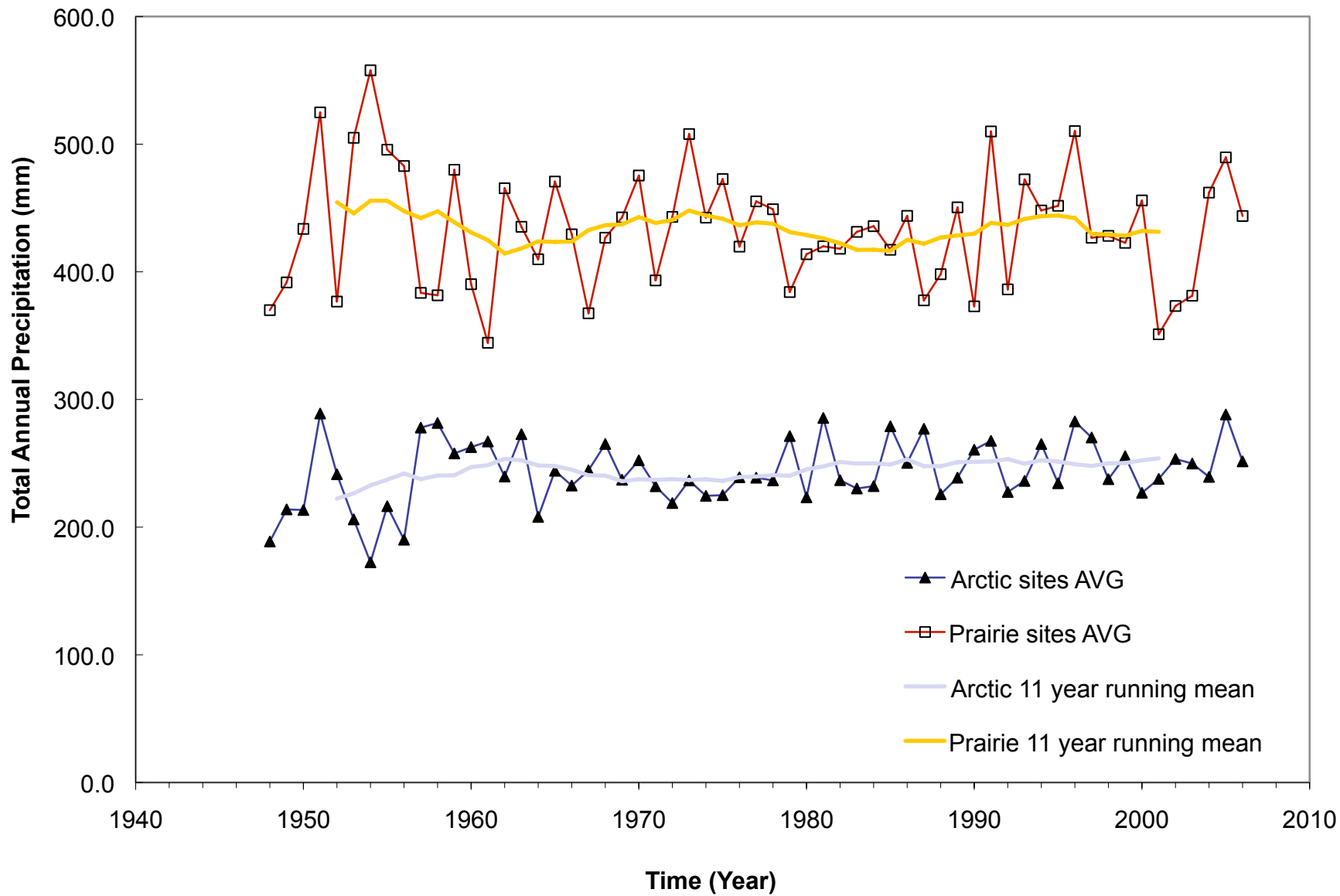
Variability of the weather



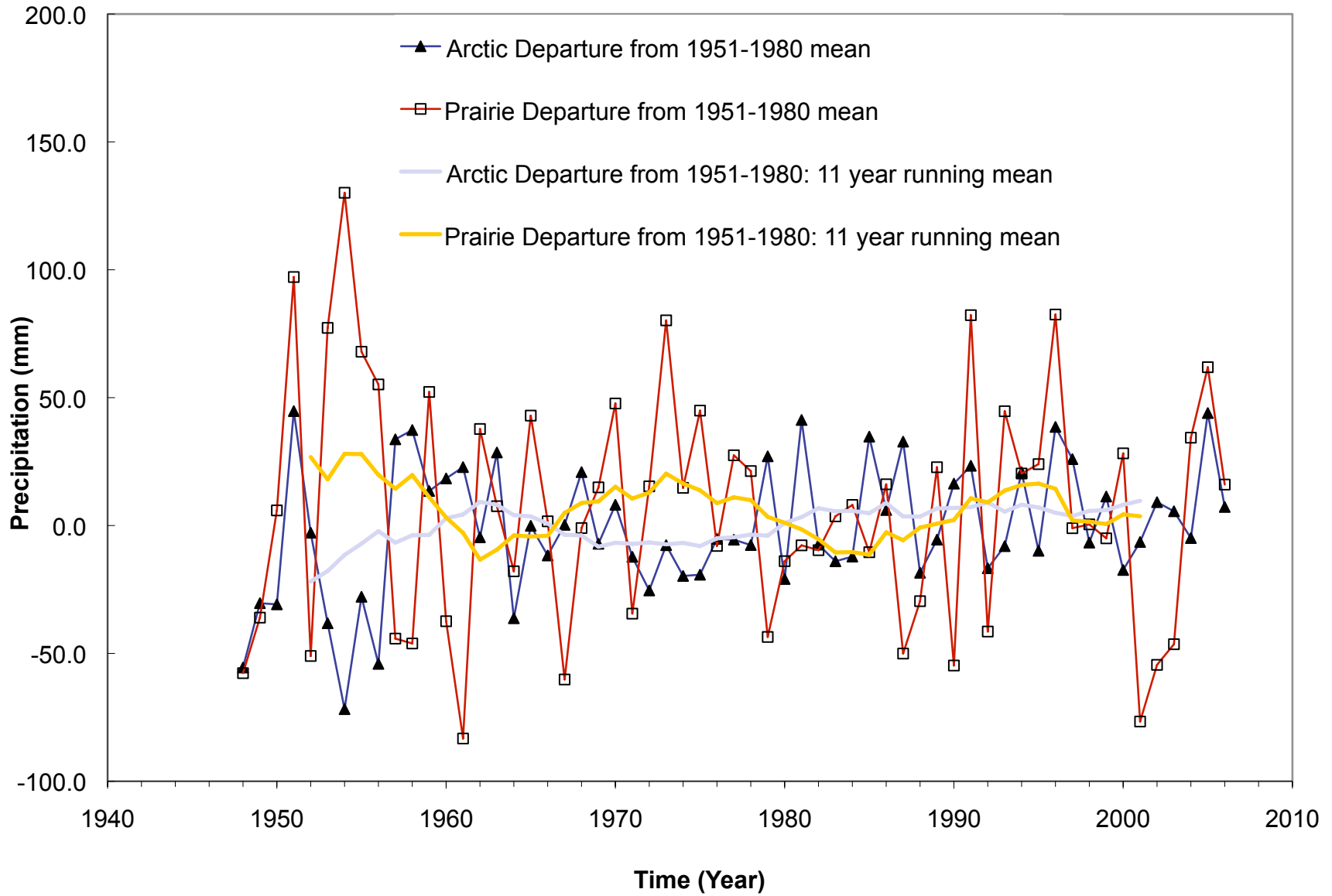
Departure from 1951-1980 Mean Annual Air Temperature (Prairies vs. Arctic)



Change in Total Annual Precipitation (Prairies vs. Arctic)



Departure from 1951-1980 Mean Total Annual Precipitation (Prairies vs. Arctic)



Is the weather becoming variable?

Time Period	Temperature	Dew Point Temperature	RH	Surface Pressure
01/01/1958-08/31/1961	13.97 °C	13.54 °C	10.88 %	1.05 mb
01/01/1978-08/31/1981	13.62 °C	13.89 °C	12.13 %	1.08 mb
01/01/1998-8/31/2001	14.01 °C	14.70 °C	13.23 %	1.06 mb

RMS values for hourly data from Iqaluit for select time periods



Forecasts for period November 1998 to June 2004
 Alternate Limits/ Visual Flight Rules (VFR) = for air flight planning

POD- Probability of Detection:

What fraction of the observed "yes" events were correctly forecast?
 (Perfect score = 1)

$$\text{POD} = \text{hits} / (\text{hits} + \text{misses})$$

FAR- False Alarm Ratio:

CSI- Critical Success Index:

How well did the forecast "yes" events correspond to
 the observed "yes" events? (Perfect score = 1)

$$\text{CSI} = \text{hits} / (\text{hits} + \text{misses} + \text{false alarms})$$

HSS – Heidke Skill Score: What was the accuracy of the forecast
 relative to that of random chance? (Perfect score = 1)

$$\text{HSS} = (\text{C}-\text{E})/(\text{T}-\text{E})$$

C = correct number of forecasts = hits + correct negatives

T = total number of forecasts = hits + misses + false alarms + correct negatives

E = expected number of correct forecasts by chance =

$((\text{hits} + \text{false alarms})(\text{hits} + \text{misses}) + (\text{false alarms} +$

$\text{correct negatives})(\text{misses} + \text{correct negatives})) / \text{T}$



Ar

Edmonton



Forecasts
Nov/98 – Jun/04
ALT_above
ALT_below
VFR_above



Arctic

Forecasts
Nov/98 – Jun/04
ALT_above
ALT_below
VFR_above



Prairies



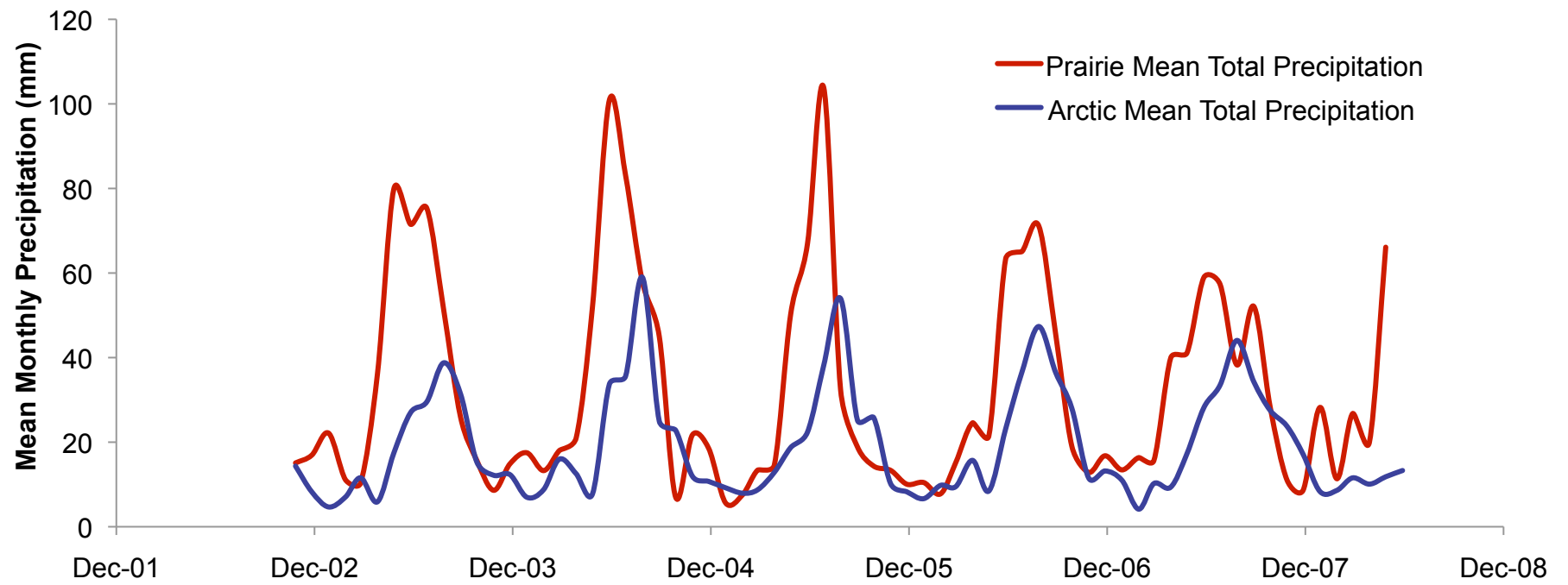
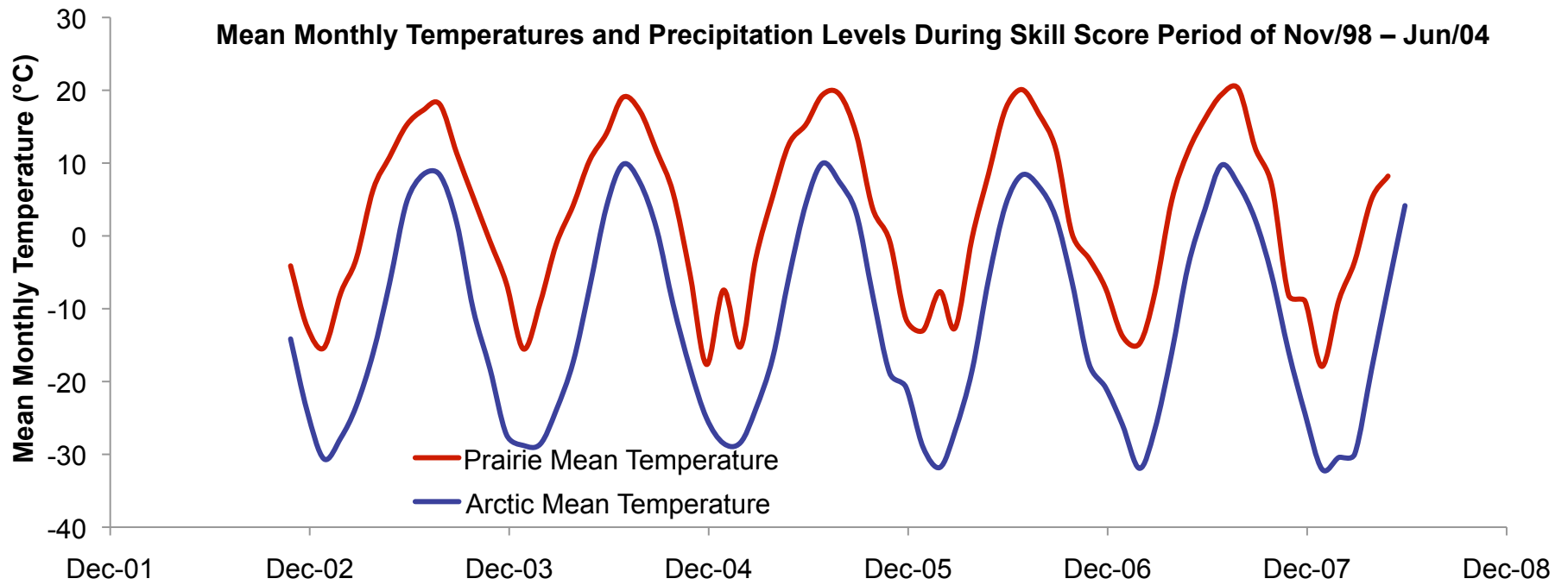
Forecasts

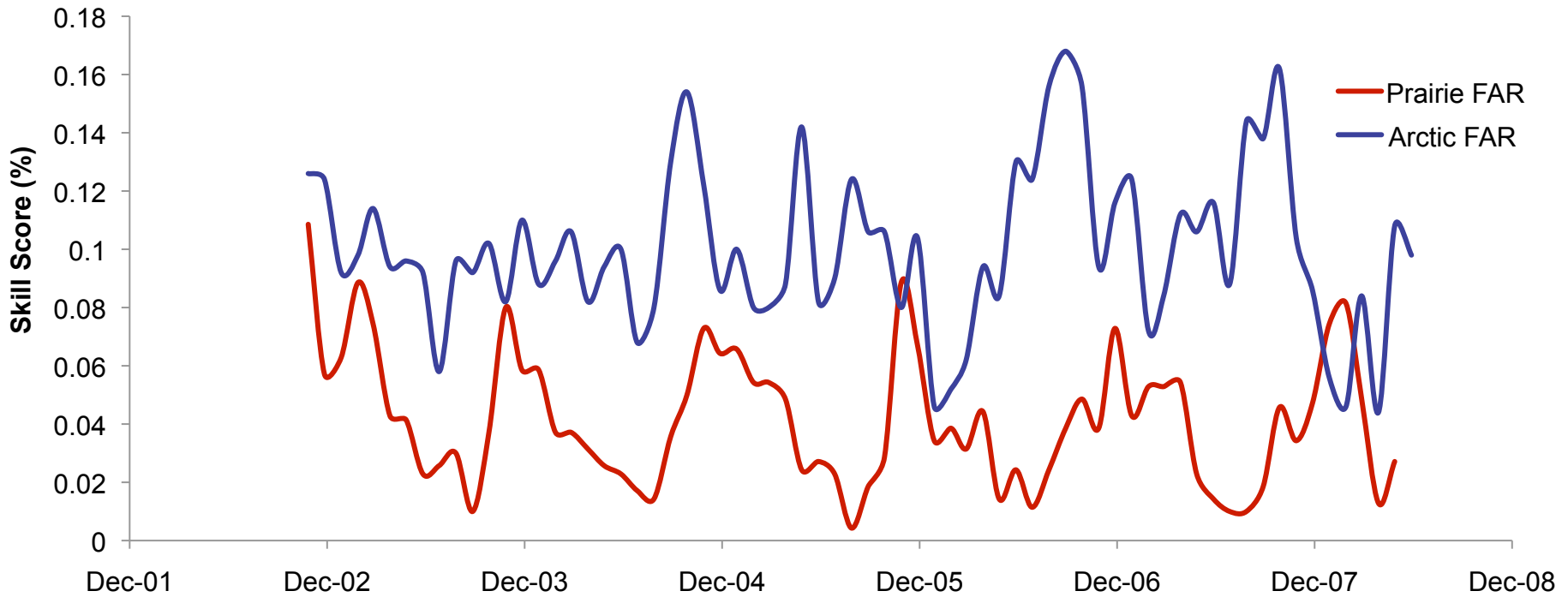
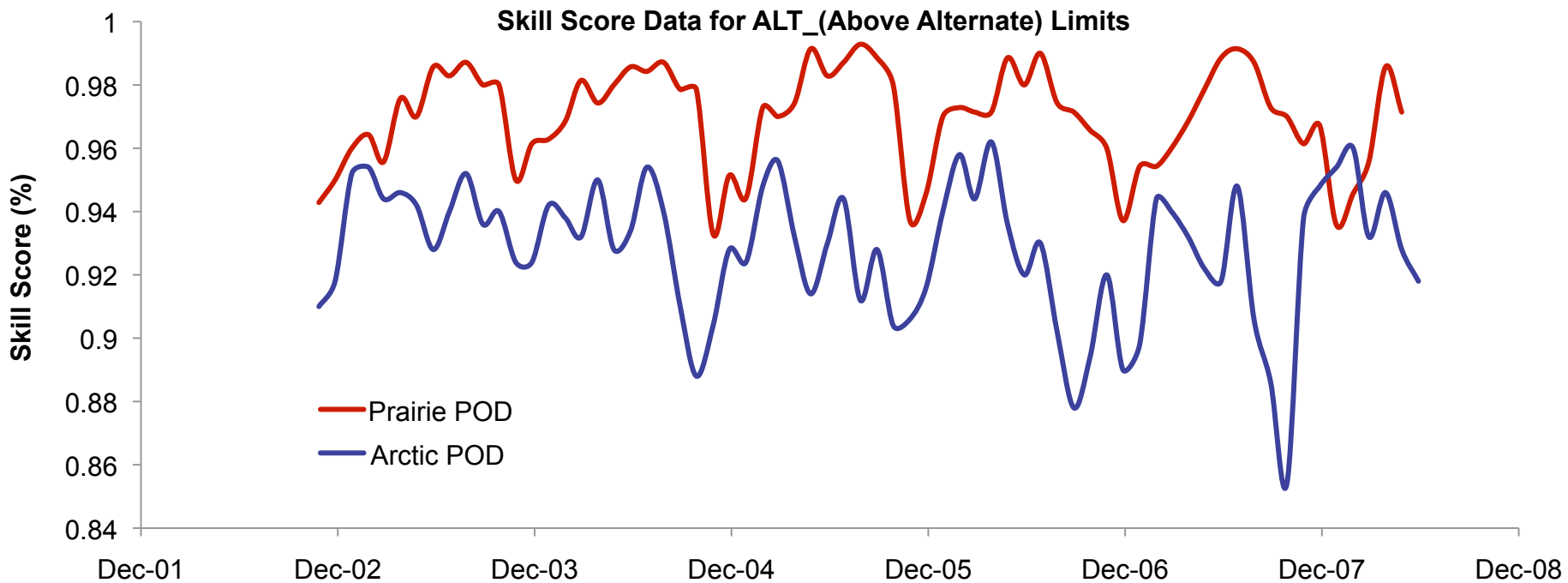
		Yes	No	Total
Observed	Yes	Hits	Misses	Observed Yes
	No	False Alarms	Correct Negatives	Observed No
Total		Forecast Yes	Forecast No	Total

Environment
Canada Data
1948 - 2006

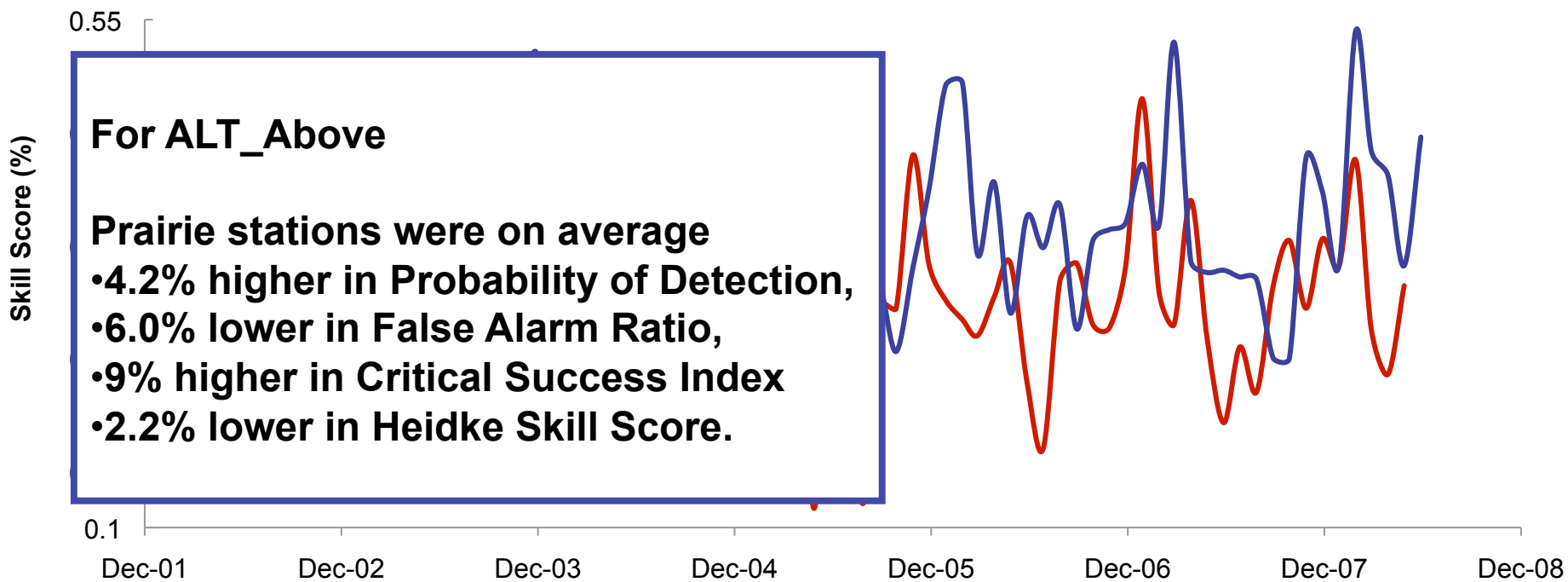
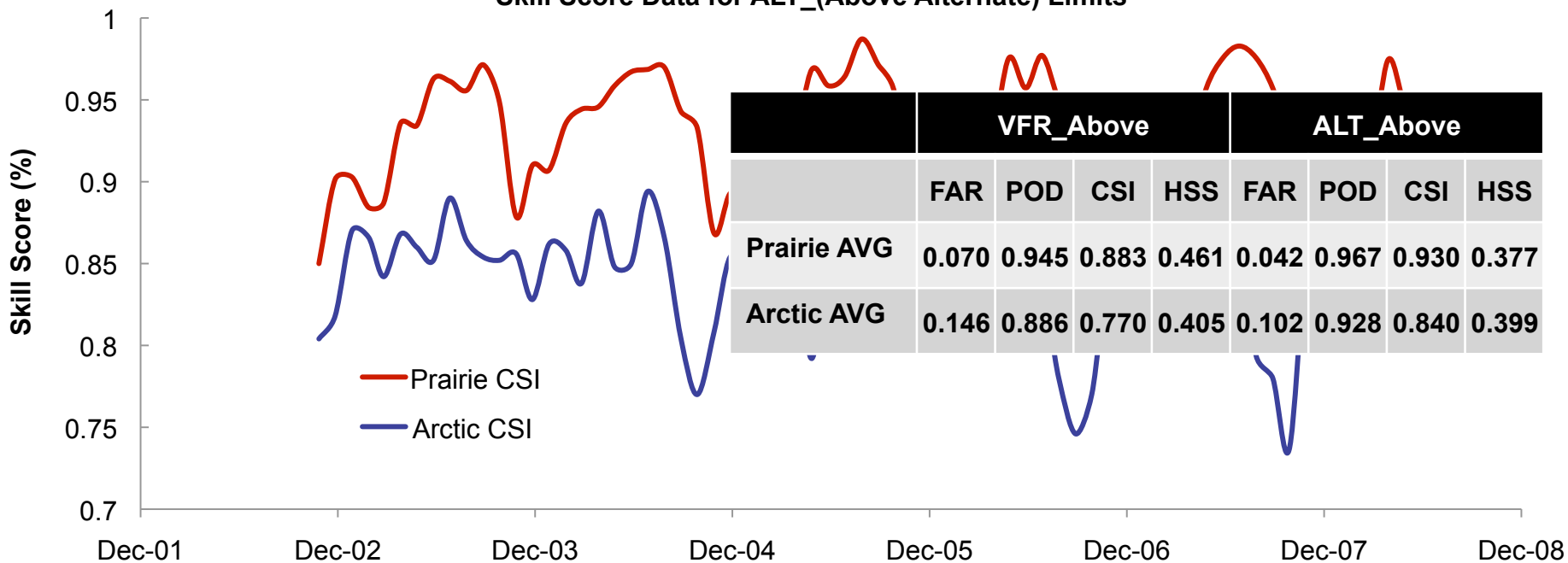
POD – Probability of Detection
FAR – False Alarm Ratio
CSI – Critical Success Index
(Threat Score)
HSS – Heidke Skill Score

Analysis and
Comparison

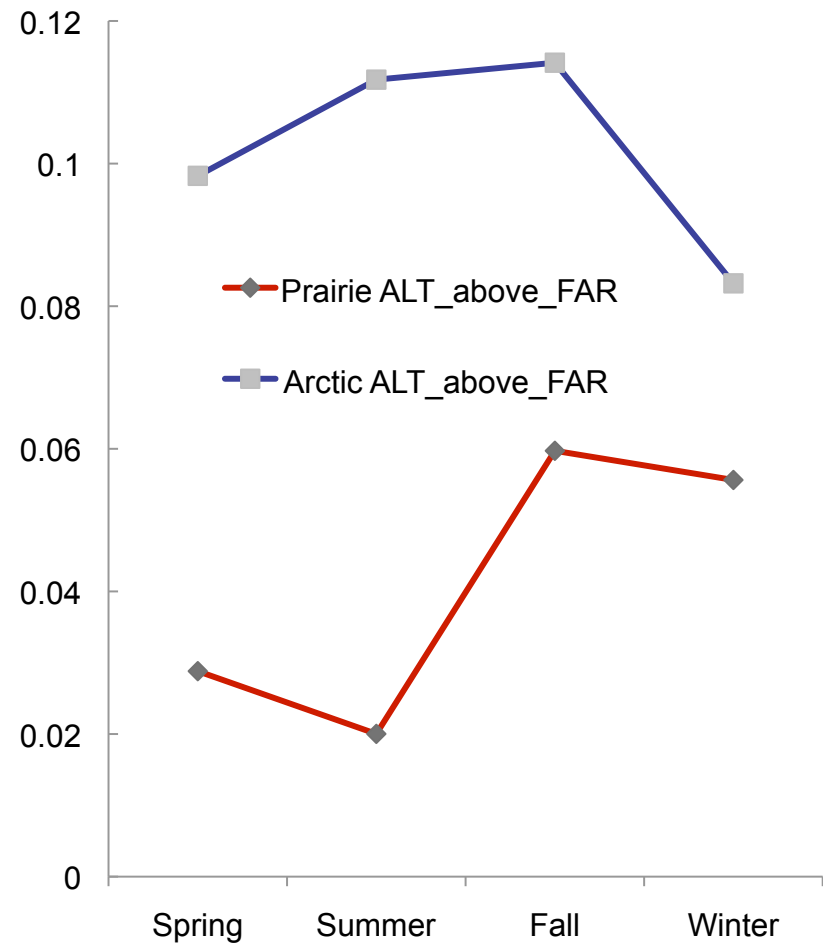
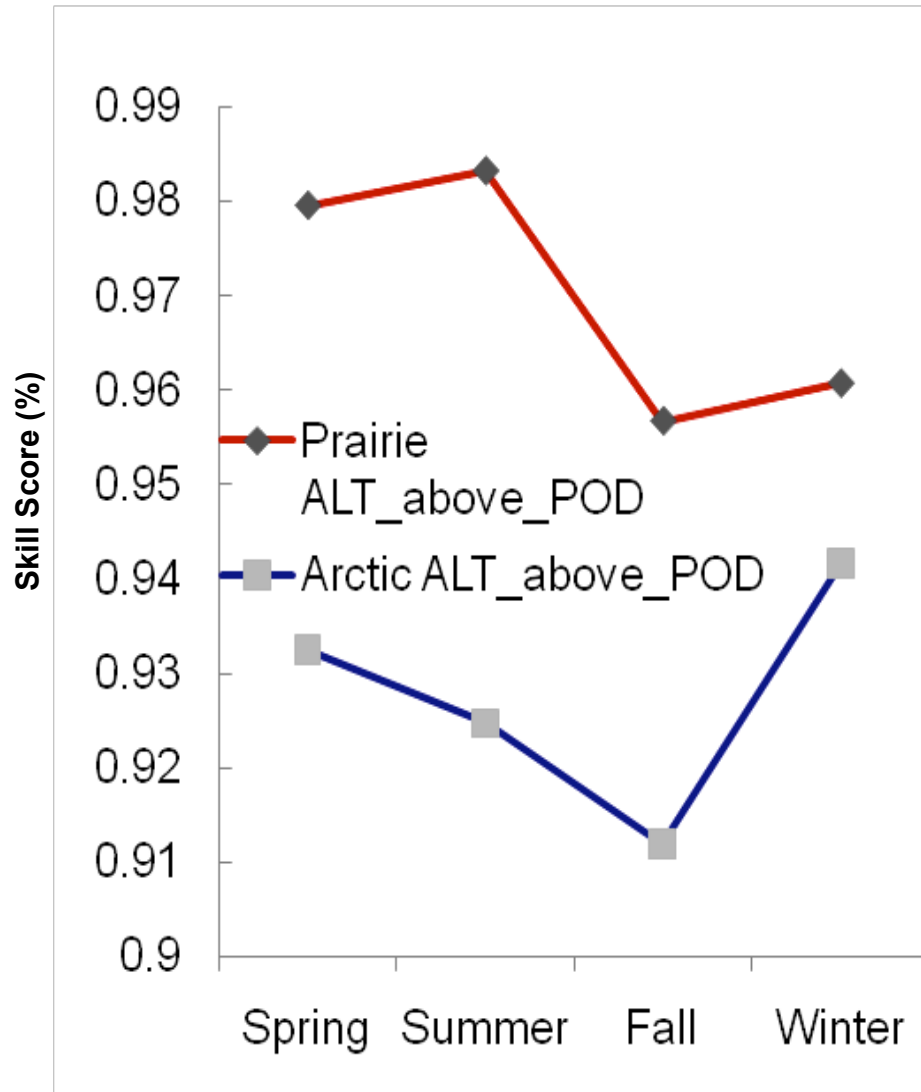




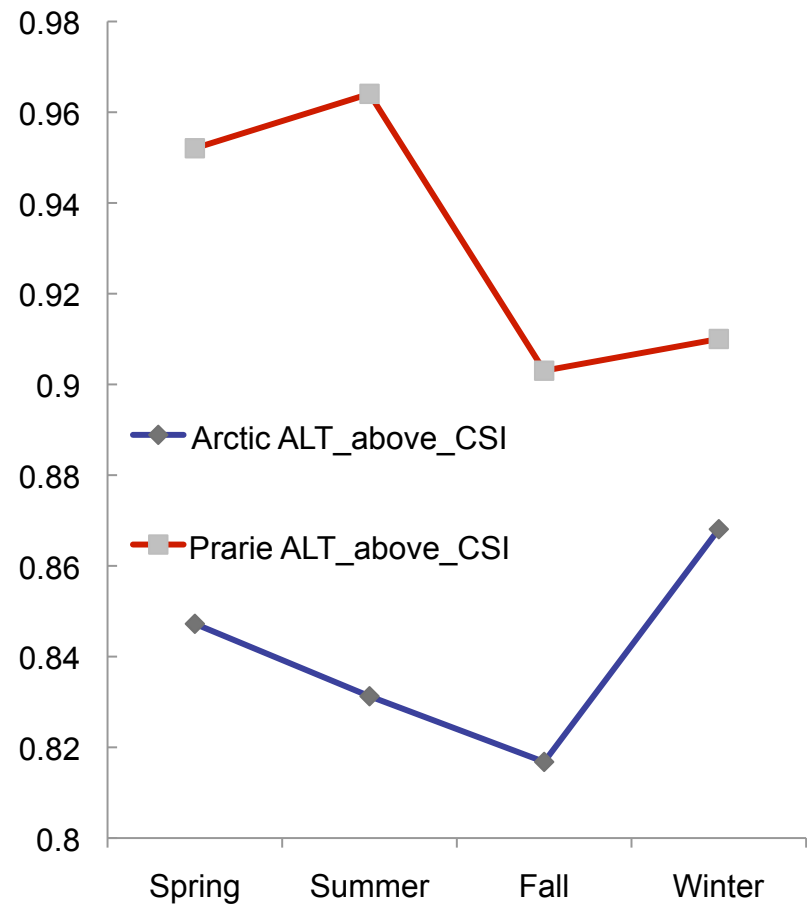
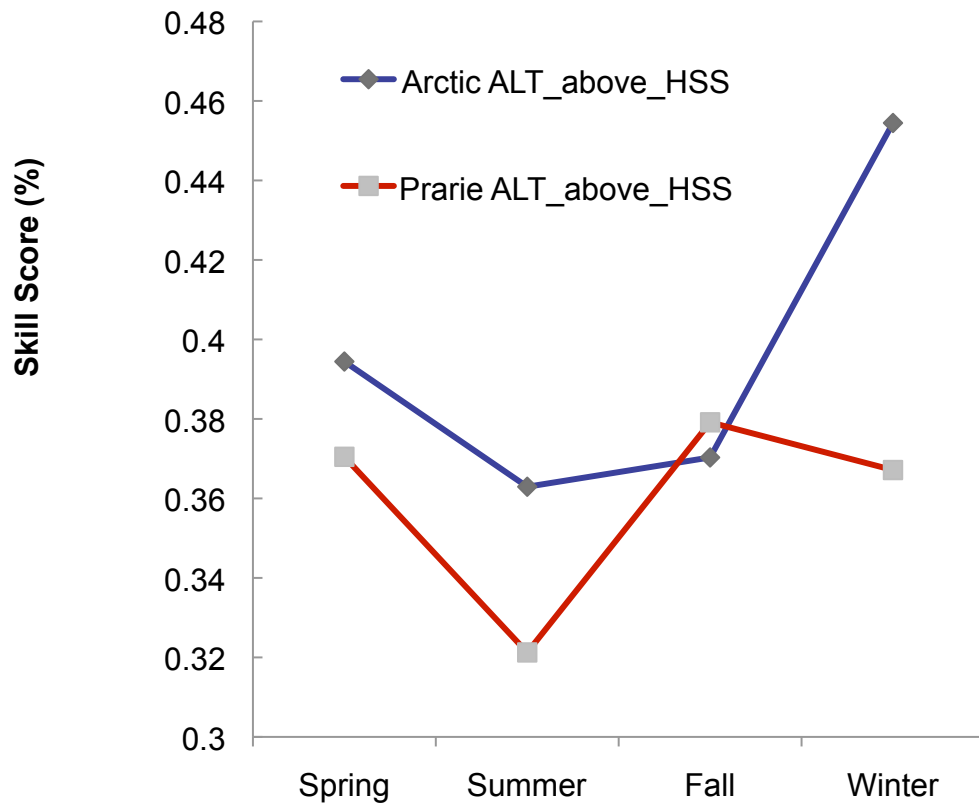
Skill Score Data for ALT_(Above Alternate) Limits

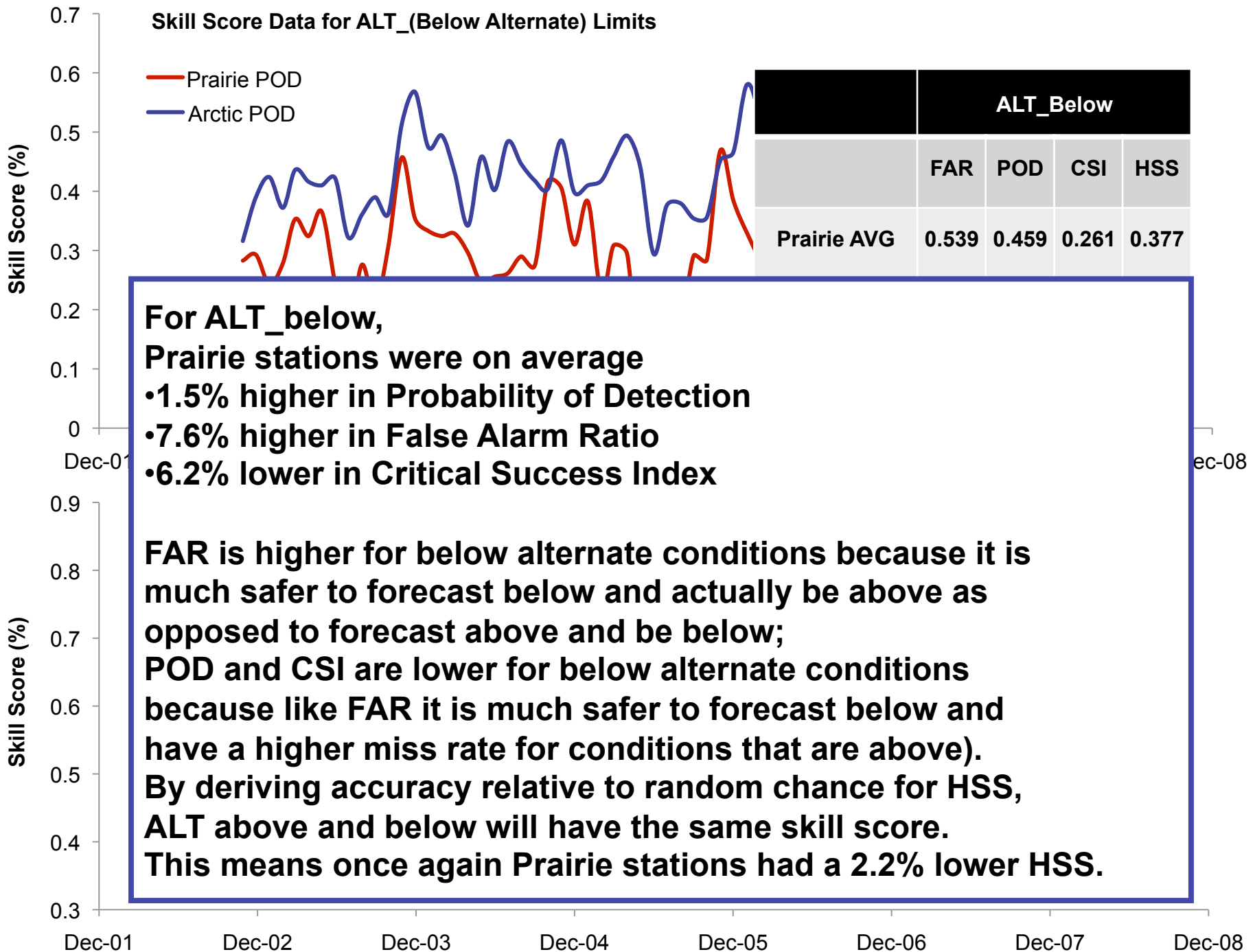


Seasonal Skill Scores Between 1998 – 2004 (Prairies vs. Arctic)

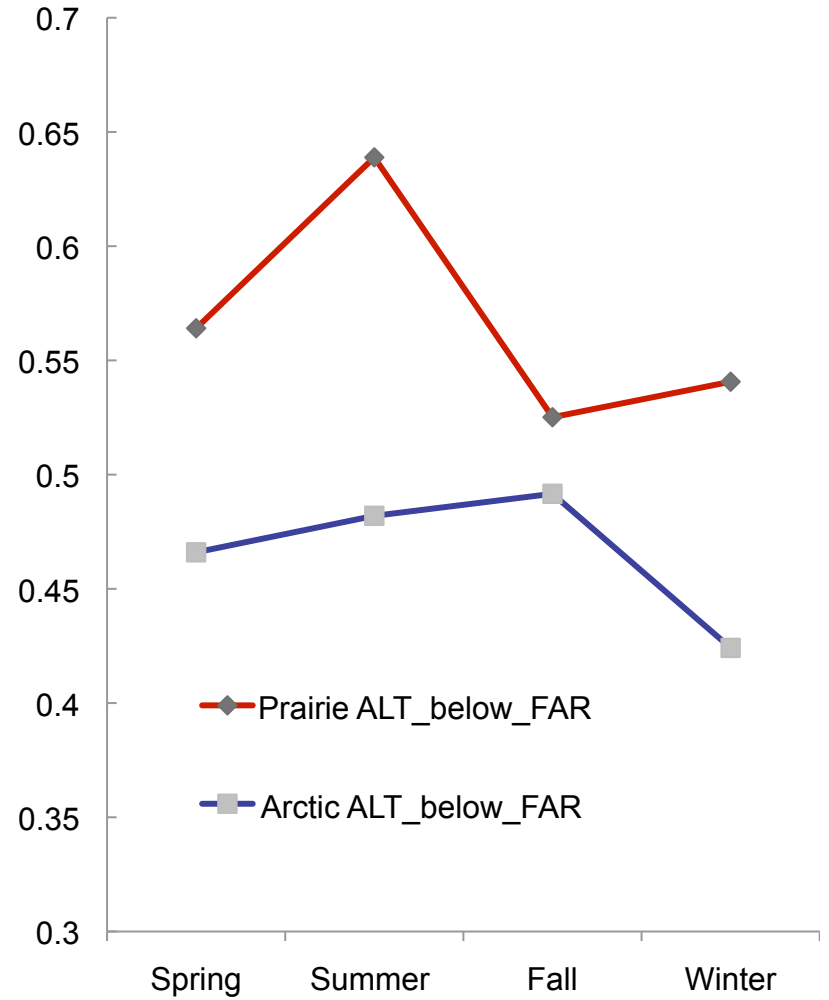
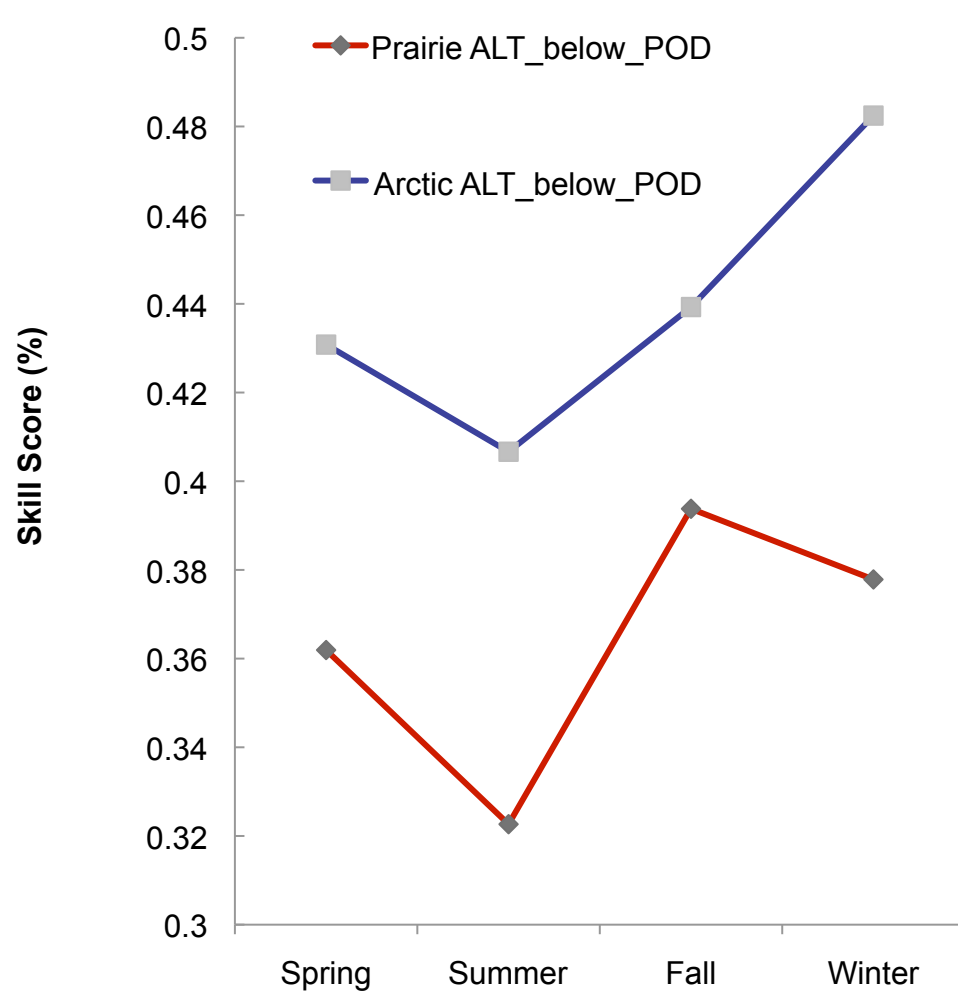


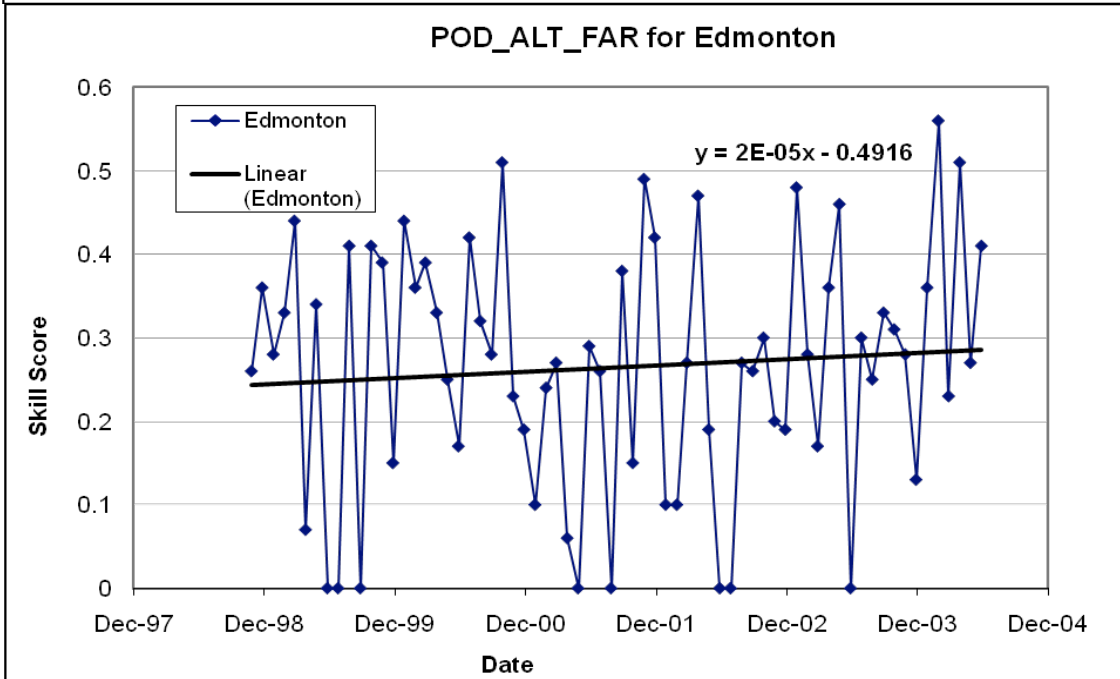
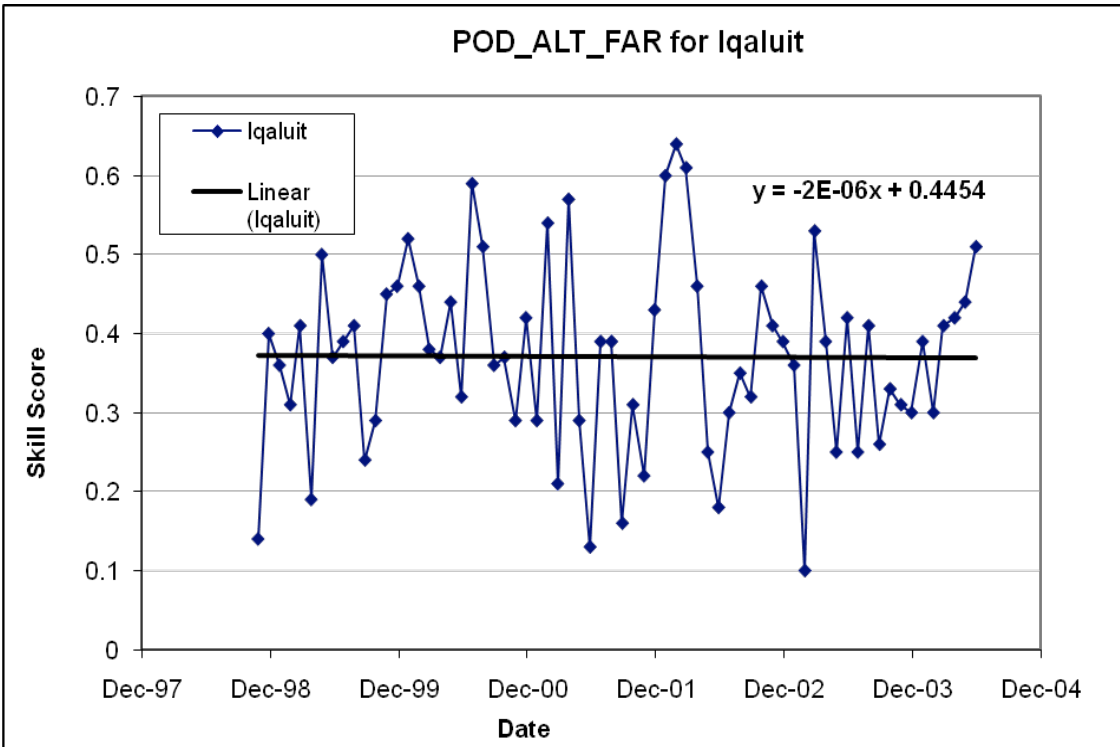
Seasonal Skill Scores Between 1998 – 2004 (Prairies vs. Arctic)





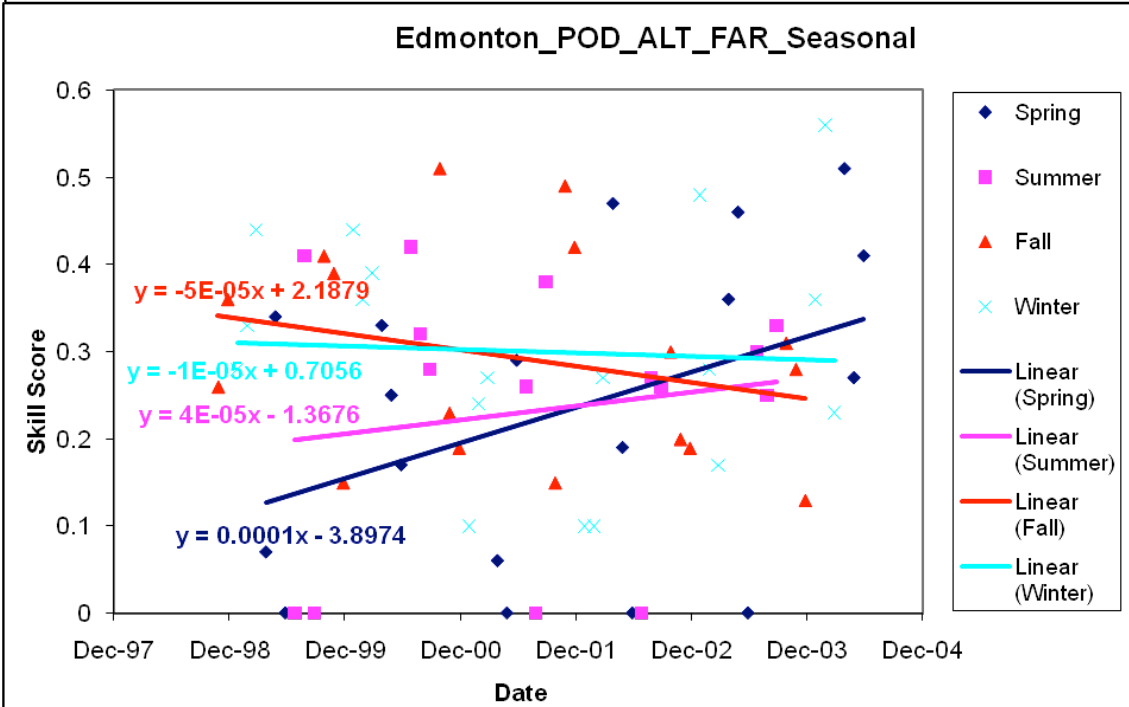
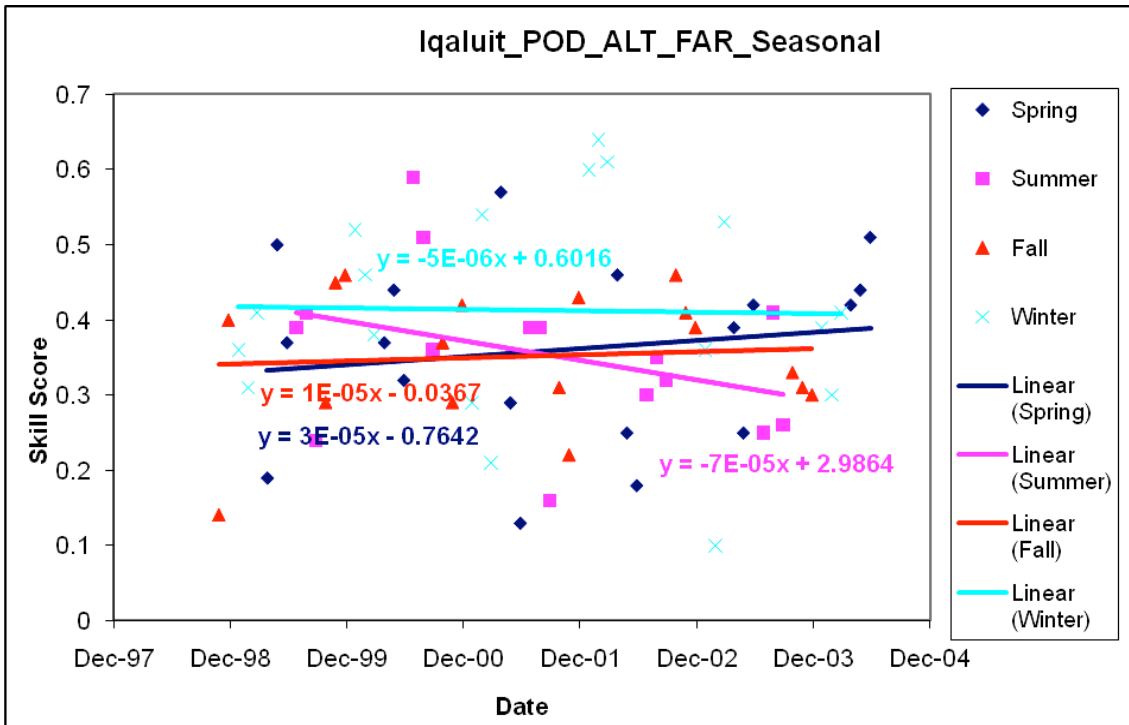
Seasonal Skill Scores Between 1998 – 2004 (Prairies vs. Arctic)





Forecasts for below alternative flight limits - Probability of Detection

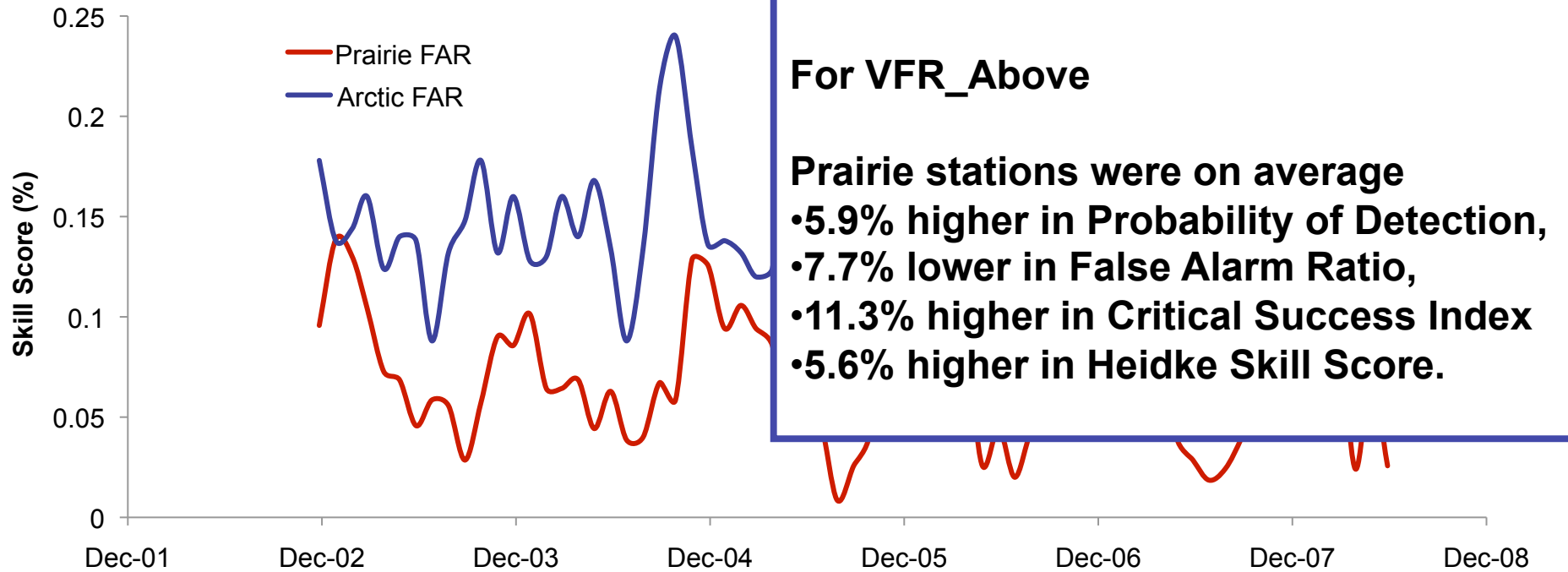
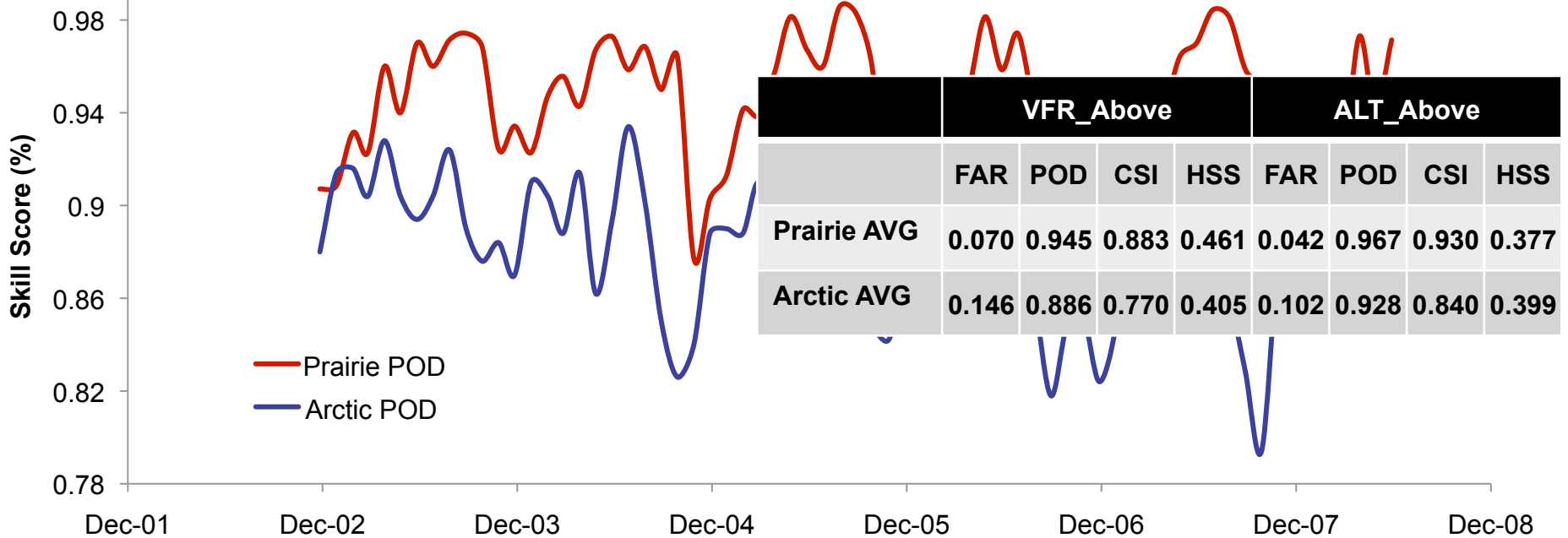
From 1998-2004, there appears to be an improvement for Edmonton forecasts (positive linear slope = $2E-05$) and a slight decline in Iqaluit forecasts (negative linear slope = $-2E-06$).



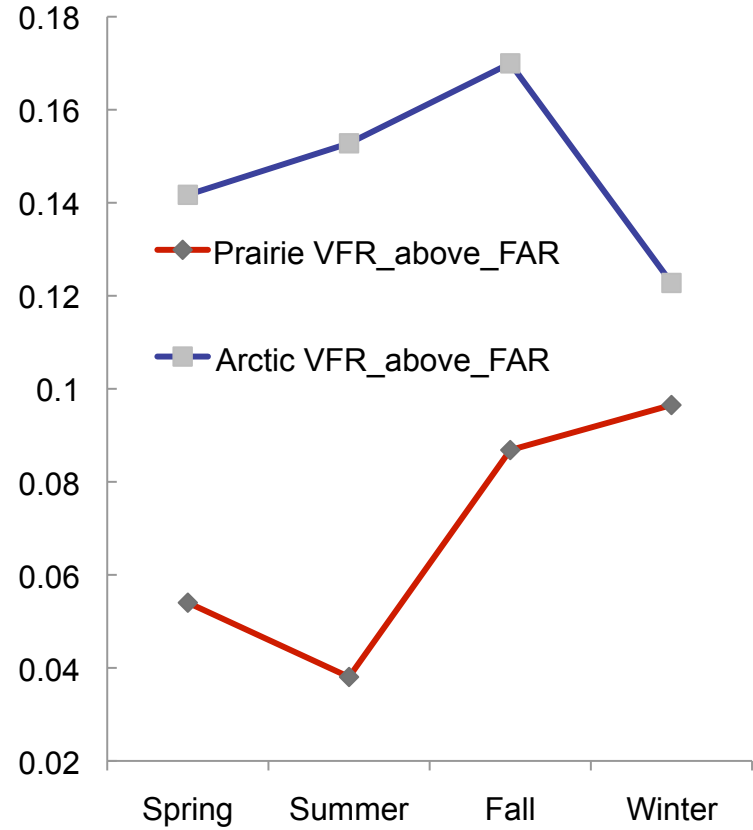
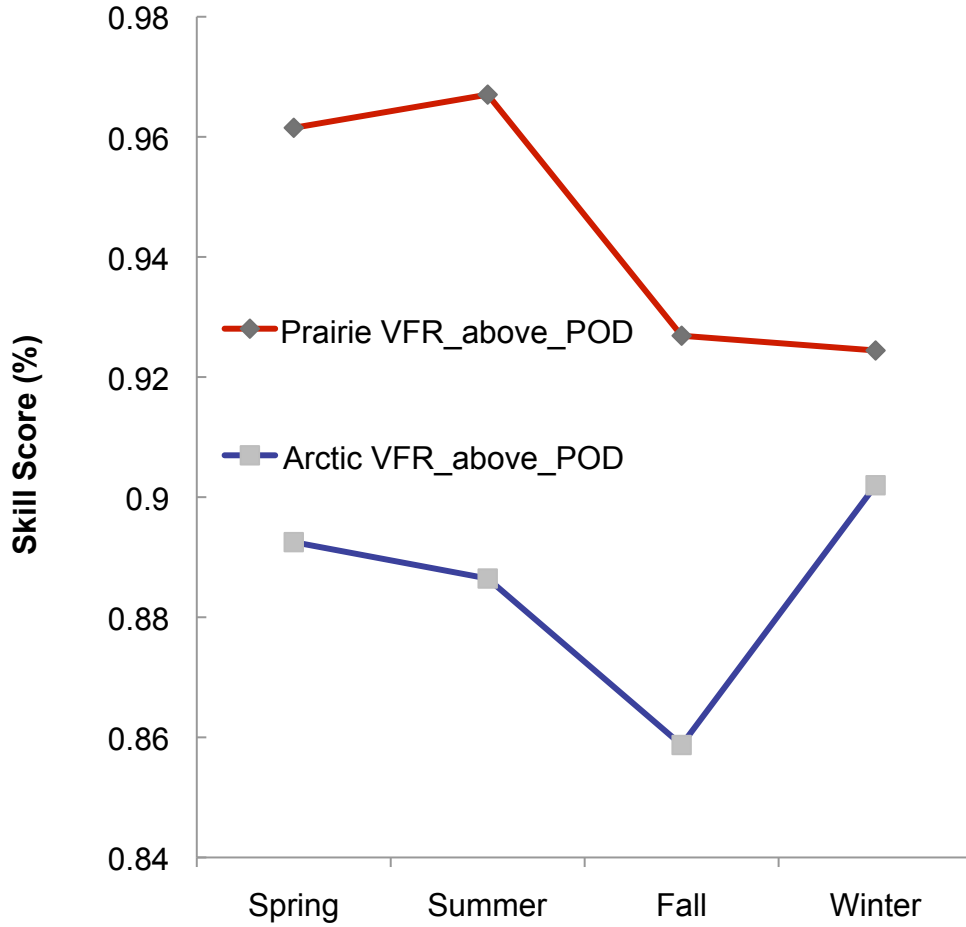
Forecasts for below alternative flight limits - Probability of Detection

On a seasonal basis, Edmonton forecasts are improving in the spring and summer where as Iqaluit forecasts are improving in the spring and fall. Edmonton is experiencing a decline in forecasting in the winter and fall where as Iqaluit is experiencing a decline in the summer and winter.

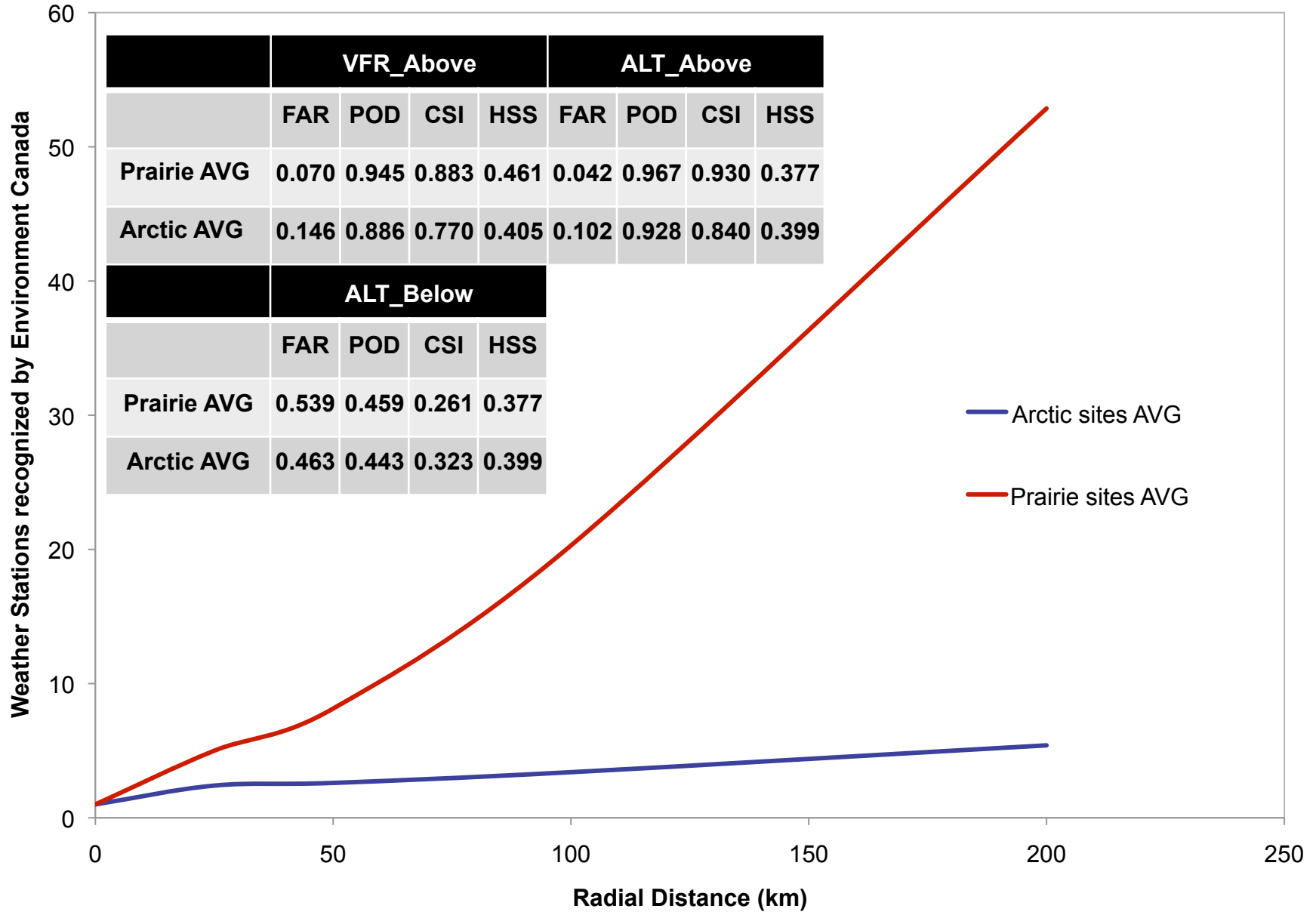
Skill Score Data for VFR_(Above) Limits

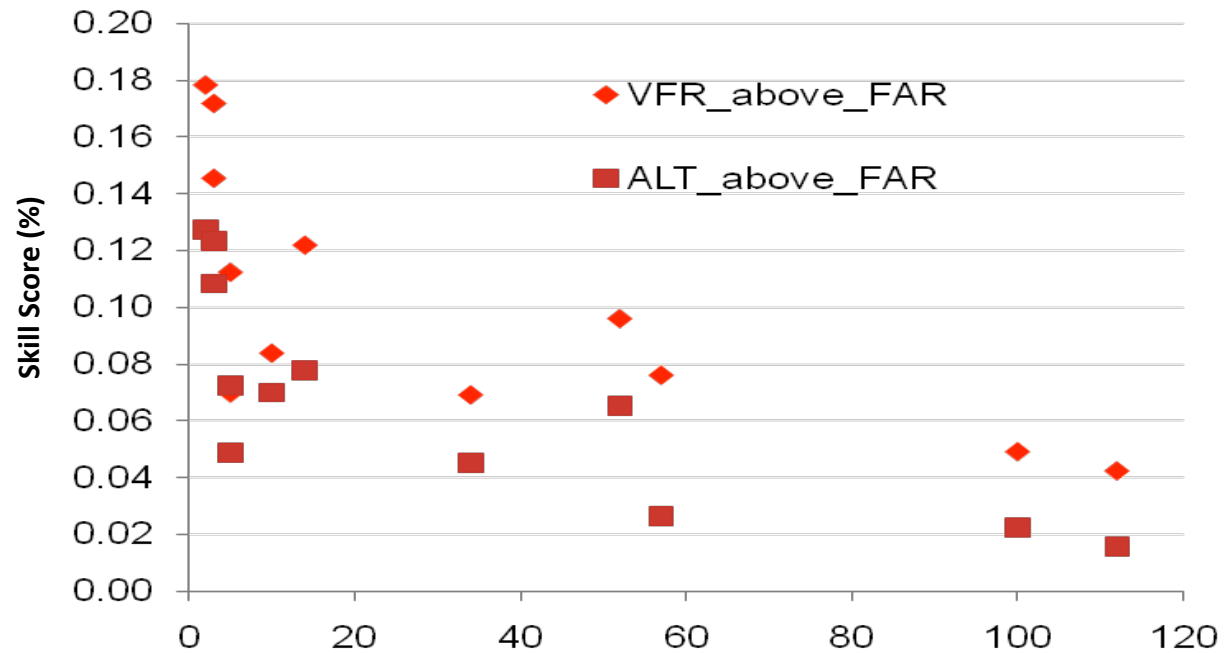
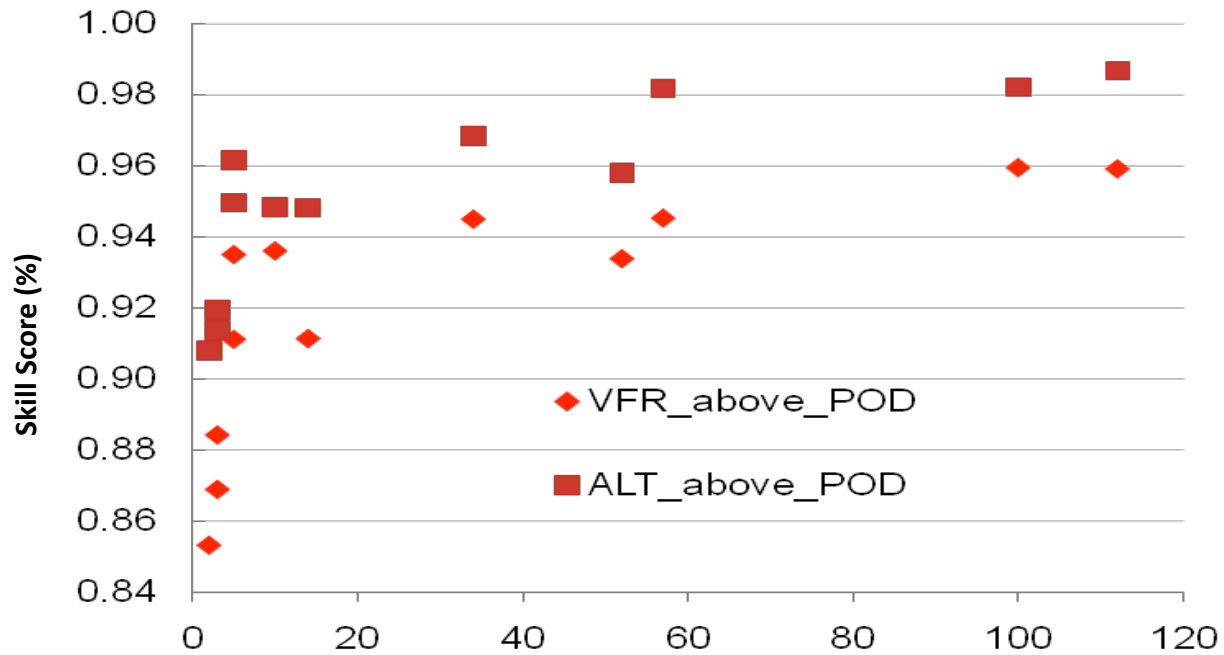


Seasonal Skill Scores Between 1998 – 2004 (Prairies vs. Arctic)



Spatial Proximity of Weather Stations Recognized by Environment Canada (Prairies vs. Arctic)





Number of Recognized Environment Canada Surface Weather Stations Within 200 km

**Skill
depending
on number
of
stations**

Comparison

	VFR_Above				ALT_Above				ALT_Below			
	FAR	POD	CSI	HSS	FAR	POD	CSI	HSS	FAR	POD	CSI	HSS
Prairie AVG	0.070	0.945	0.883	0.461	0.042	0.967	0.930	0.377	0.539	0.459	0.261	0.377
Arctic AVG	0.146	0.886	0.770	0.405	0.102	0.928	0.840	0.399	0.463	0.443	0.323	0.399

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- **Knowledge of the individual forecaster**
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Weather Forecasting Skill in the Arctic



Thank you for listening.

BLACK MOUNTAIN

- TOUR DATES

06/24/10

Calgary, AB - [Republikw/](#) Lord Beginner

06/25/10

Edmonton, AB - [Starlite Roomw/](#) Lord Beginner

06/26/10

Saskatoon, SK - [Amigo'sw/](#) Lord Beginner

06/27/10

Regina, SK - [The Exchangew/](#) Lord Beginner, Orbital Express

06/28/10

Winnipeg, MB - [The Garrick Centrew/](#) Lord Beginner, Sleepy Sun

07/03/10

London, ON - Call the Office w/ One Hundred Dollars

Europe

- 07/23/10

Toronto, ONT - [Horseshoe Tavernw/](#) Quest for Fire