The Canadian RCM : Presentation of The Model and Example Applications

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and the Ouranos Climate Simulation Team

Outline

- A few words about Ouranos
- Presentation of the CRCM
- Some end-users examples
- Last minute slides

Boulder, 14-15 February 2008

Narccap users' meeting

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The Ouranos Consortium : Unique in Canada

550 Sherbrooke West
Montréal
www.ouranos.ca
(near UQÀM, McGill, INRS, HQ …)
18th and 19th floors, 1800 m²

- **Coordination of interdisciplinary research**
- **90 scientists, students and professionals working together at the same location**
- **Access to an extensive network of experts, users and <u>true</u> stakeholders**

OURANOS

Québec · Hydro Québec · Environnement Canada · Environment Canada

VRQ Valorisation-Recherche Québec

UQÀM Université du Québec à Montréal · McGill

Université Laval · Université du Québec Institut national de la recherche scientifique

MISSION

From the Ouranos' Strategic Plan 2004-2009

The mission of Ouranos is to acquire and develop knowledge on climate change and its impacts, as well as on socio-economic and environmental vulnerabilities, so as to inform decision makers on evolution of the climate and to provide advice on the identification, evaluation, promotion, and implementation of local and regional adaptation strategies.

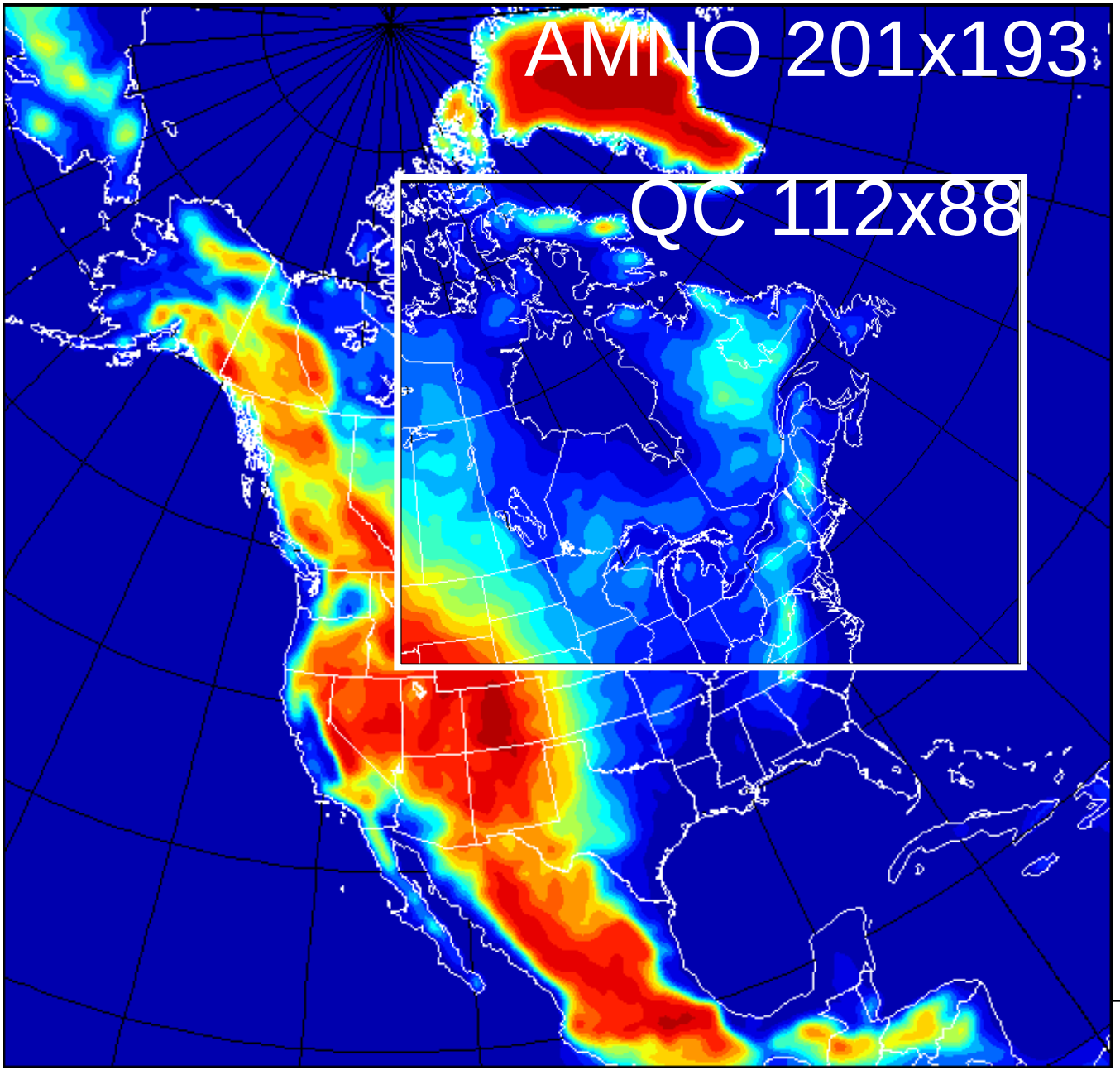
Impacts Linked to Climate Change in Quebec

- Permafrost
- Coastal erosion
- Energy and Forestry
- Urban Infrastructures
- Water resources
- Other economic sectors
- Health, Public Safety and Extreme events
- Ecosystems and Biodiversity

Ouranos Climate Simulation Team and Equipment

- Team of 8 climate simulation specialists
- Two Cray-SX vector computers
- Two SGI front ends (Sun – coming soon)
- One data server (tape + robot)
- One main tool to produce climate data : the Canadian Regional Model (CRCM)

CRCM4



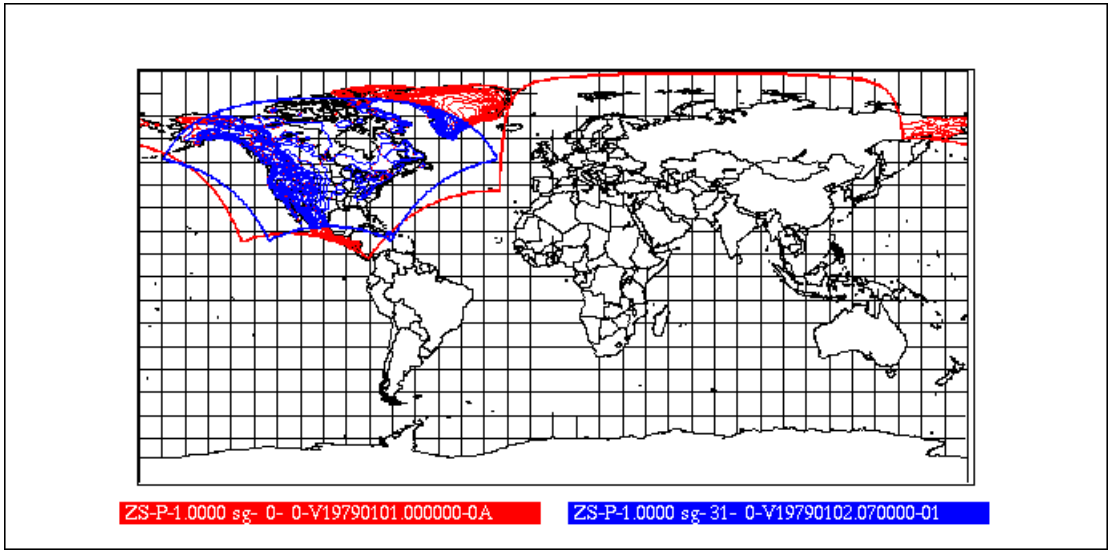
Usual set-up:

- 45km resolution
- 29 levels
- 15min timesteps

Special features:

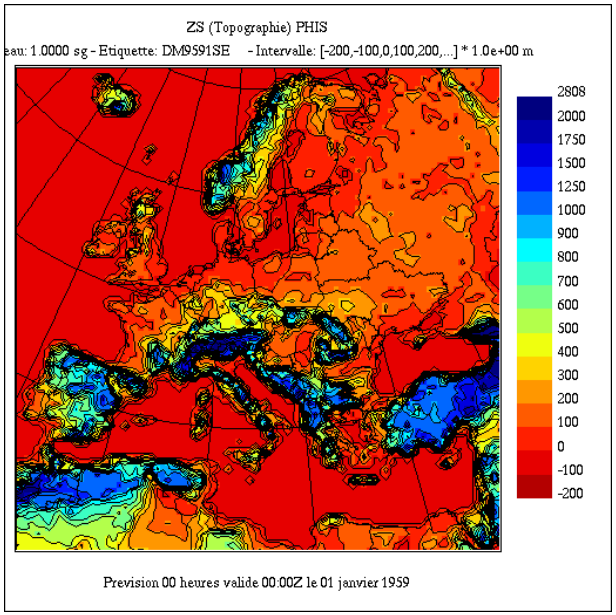
- precipitation available at every timestep
- Large scale nudging
- CLASS land surface scheme with explicit layer for snow cover

Other grids…

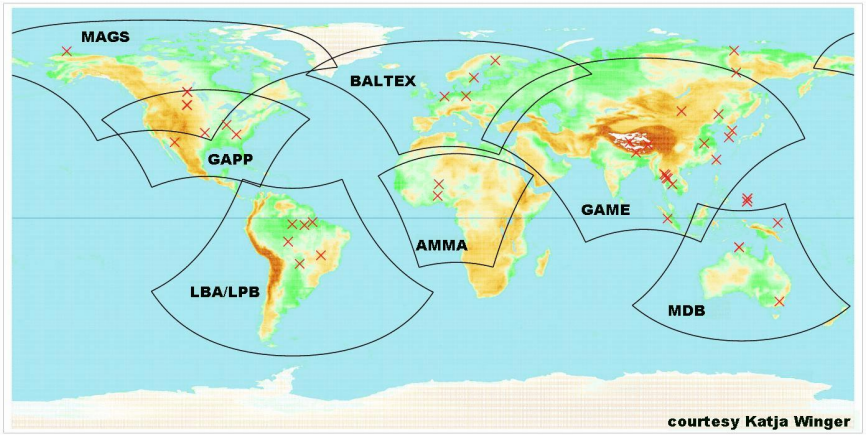


Narccap vs
AMNO

ENSEMBLE

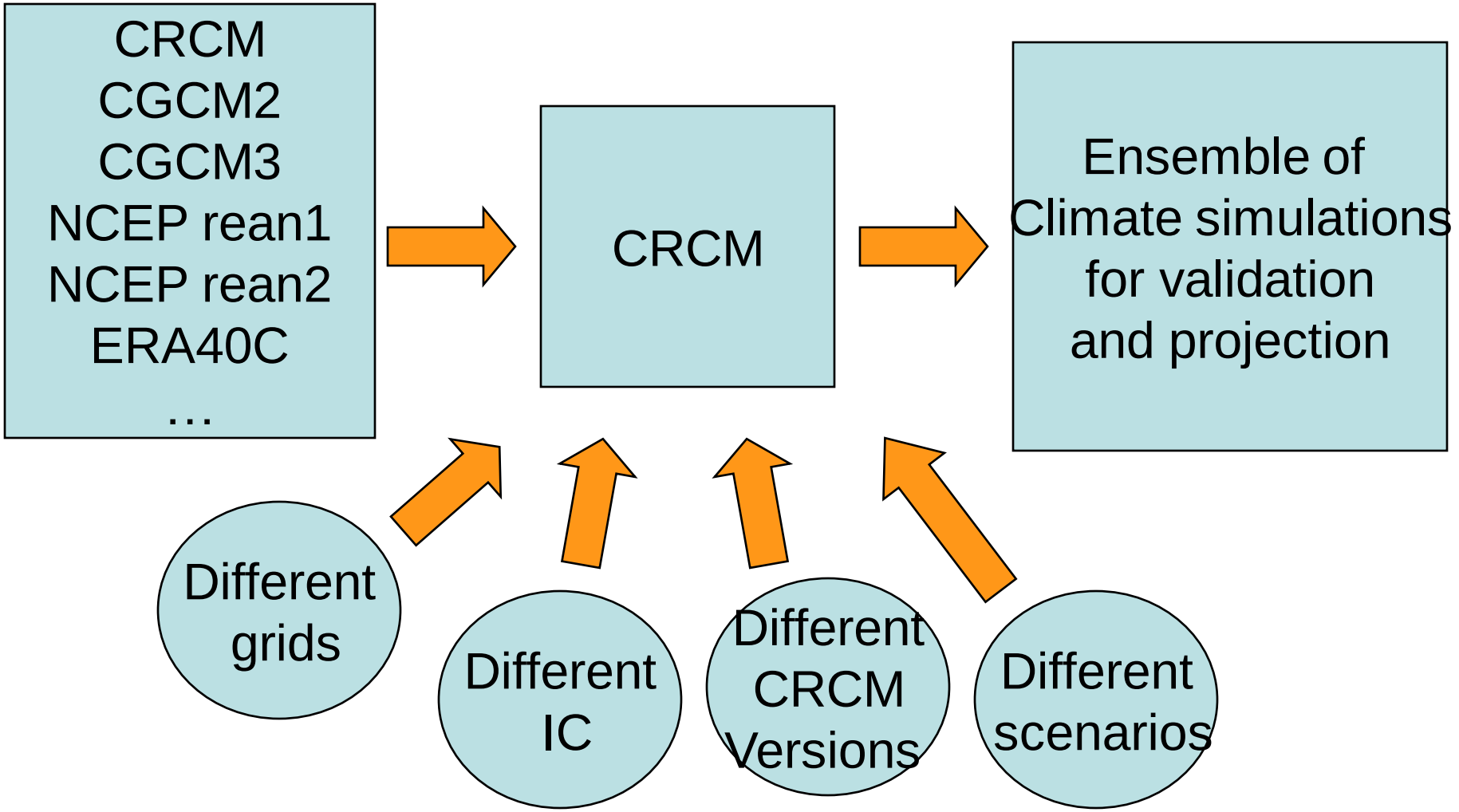


109x109 @50km
209x209 @25km



ICTS DX=50km

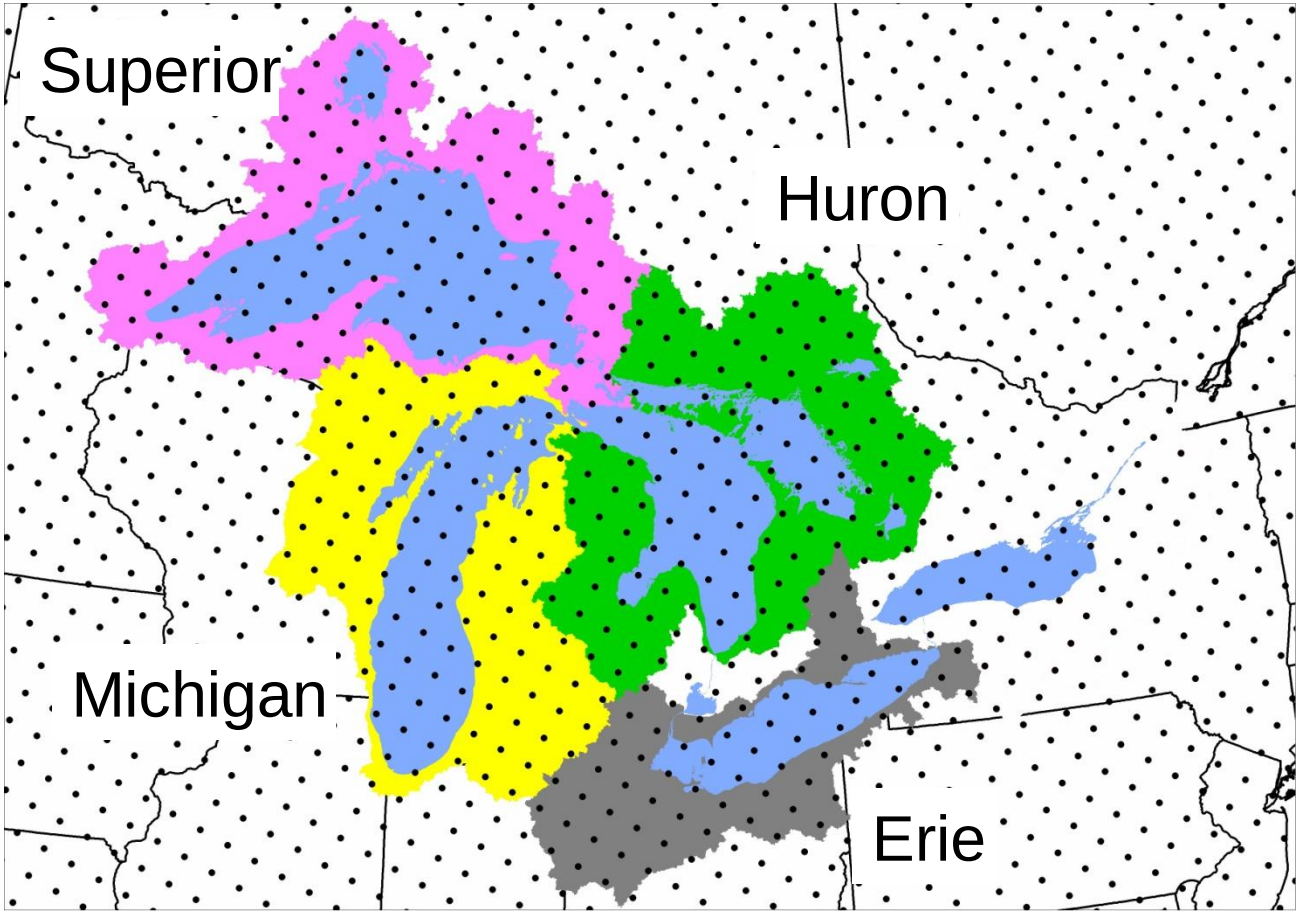
CRCM operational set-up at Ouranos



A few examples of CRCM data use

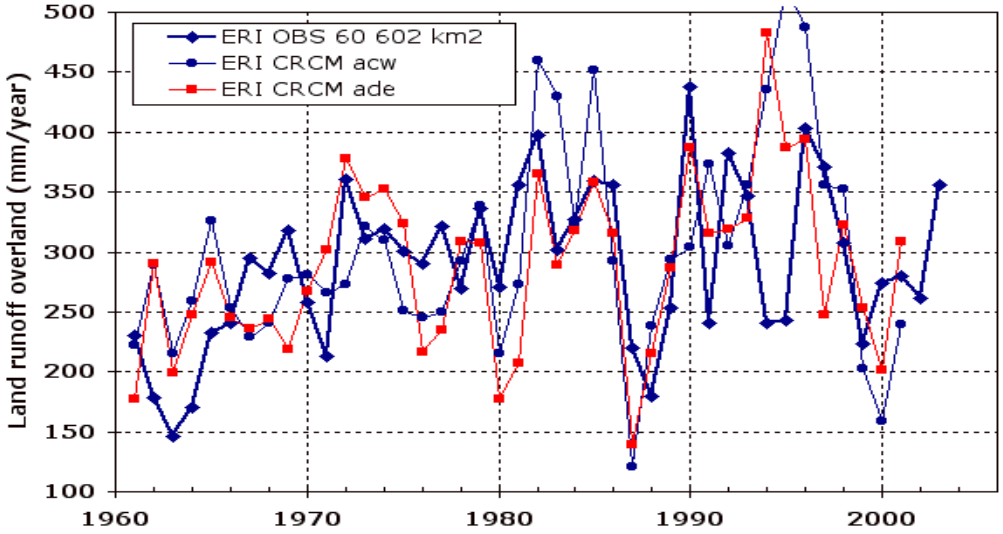
- Water budget and snow analysis
- Precipitation extremes

The Great Lakes



Courtesy of Guay and Frigon

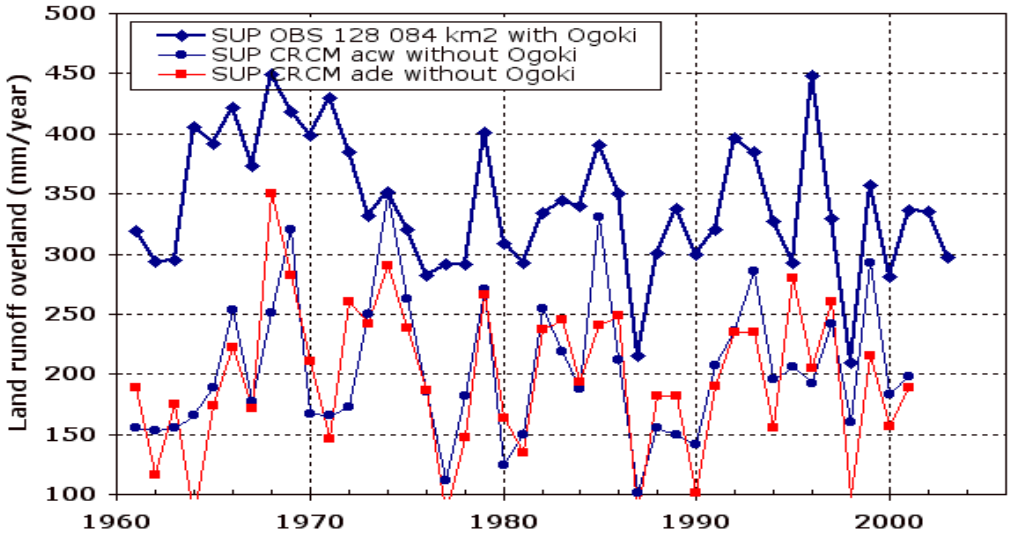
Annual land runoff [mm/y]



1961-1999

CRCM_acw	306	106%
CRCM_ade	290	100%
GLERL OBS	**289**	

- acw: ERA40d driven
- ade: NCEP driven



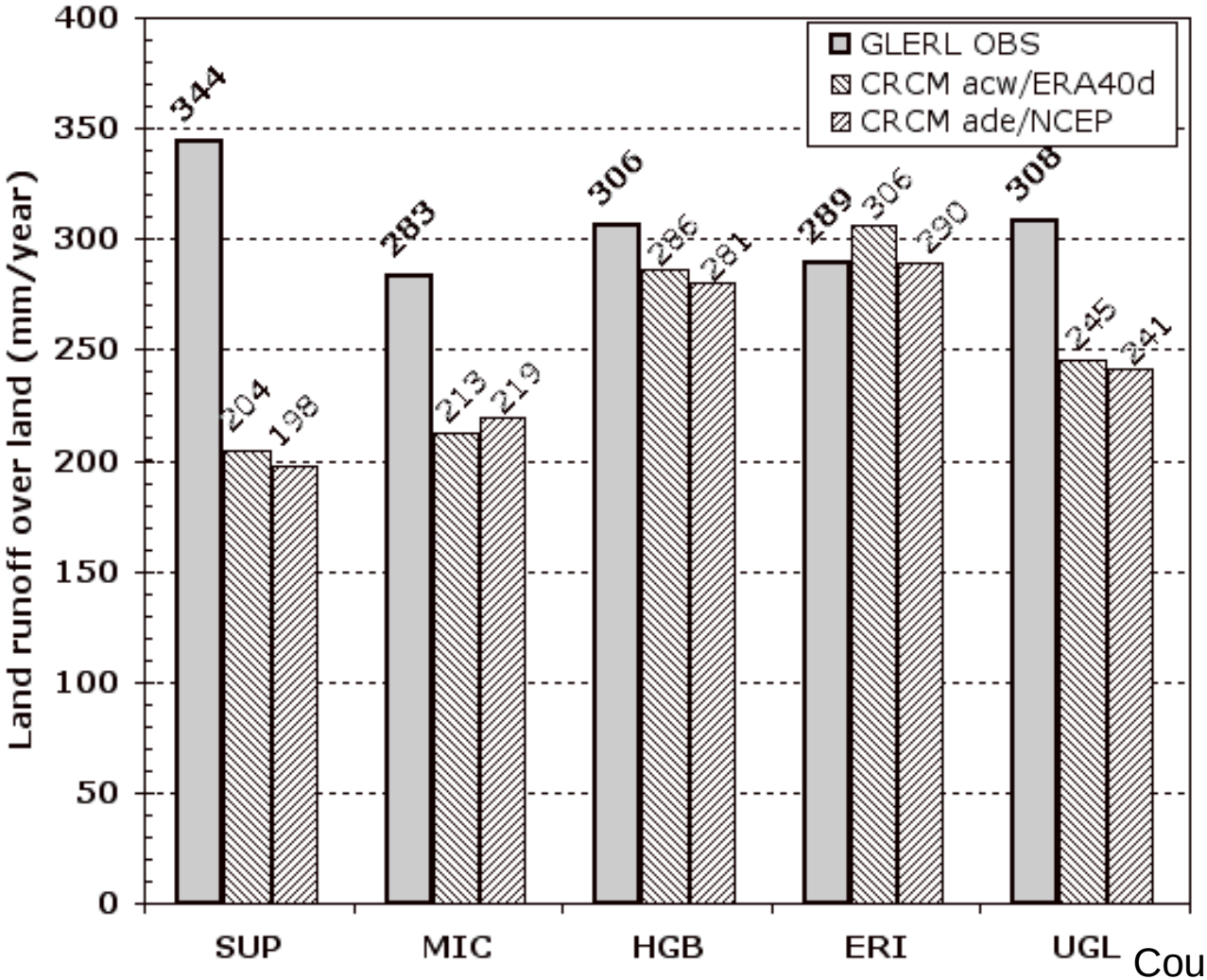
1961-1999

CRCM_acw	204	59%
CRCM_ade	198	57%
GLERL OBS	**344**	

Courtesy of Caya, Frigon and Musi

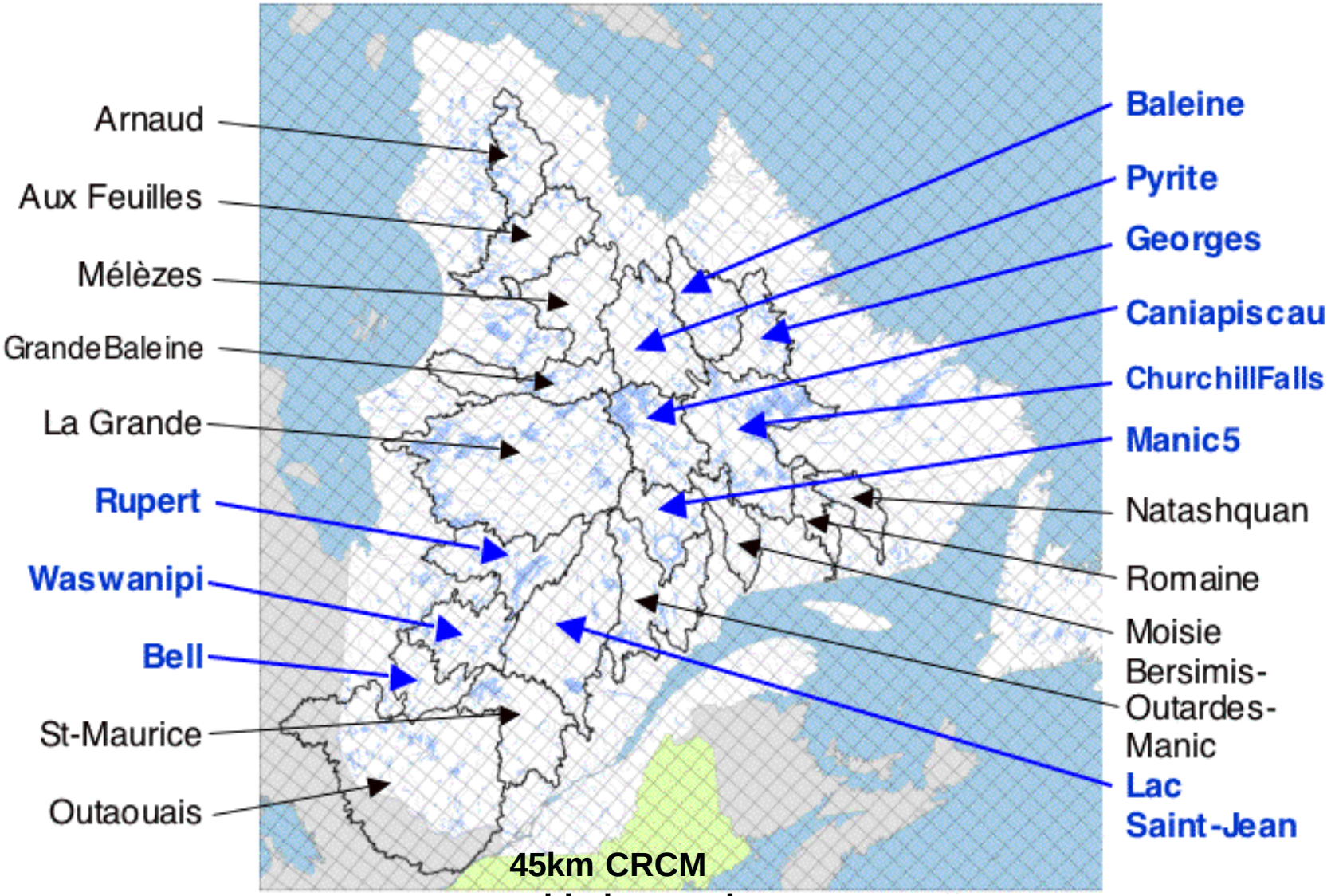
CRCM validation summary

1961-1999 land basin runoff validation



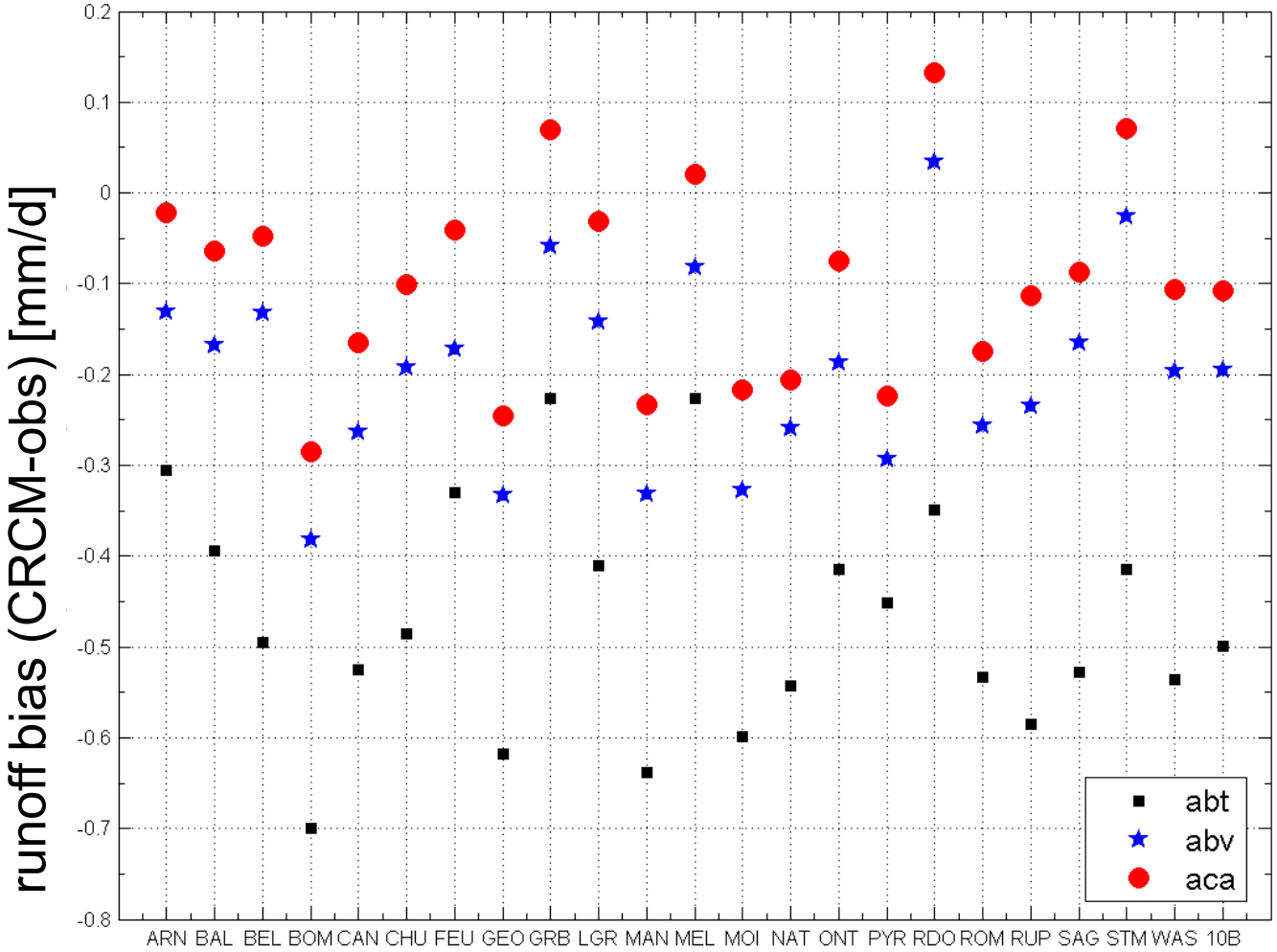
Courtesy of Caya, Frigon and Musi

Hydrology over bassin



Courtesy of Slivitzky and Frigo

Annual runoff bias 1961-1999



Runoff ~ 1,5 mm/d

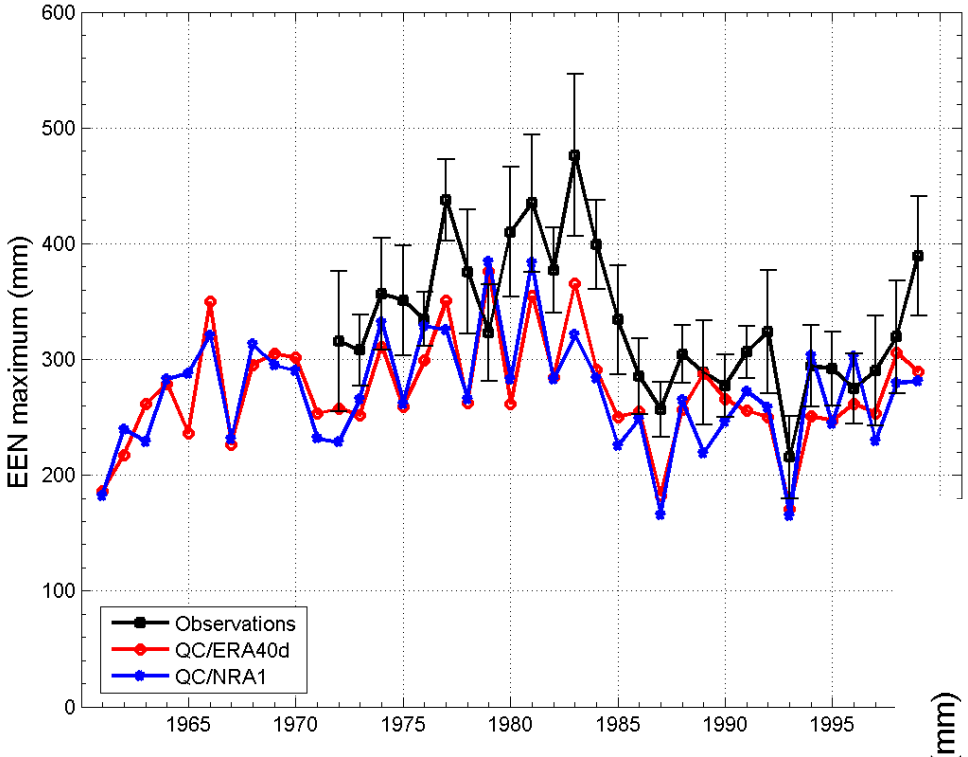
	LBC	grid
abt	NMCR	AMNO
abv	NMCR	QC
aca	era40c	QC

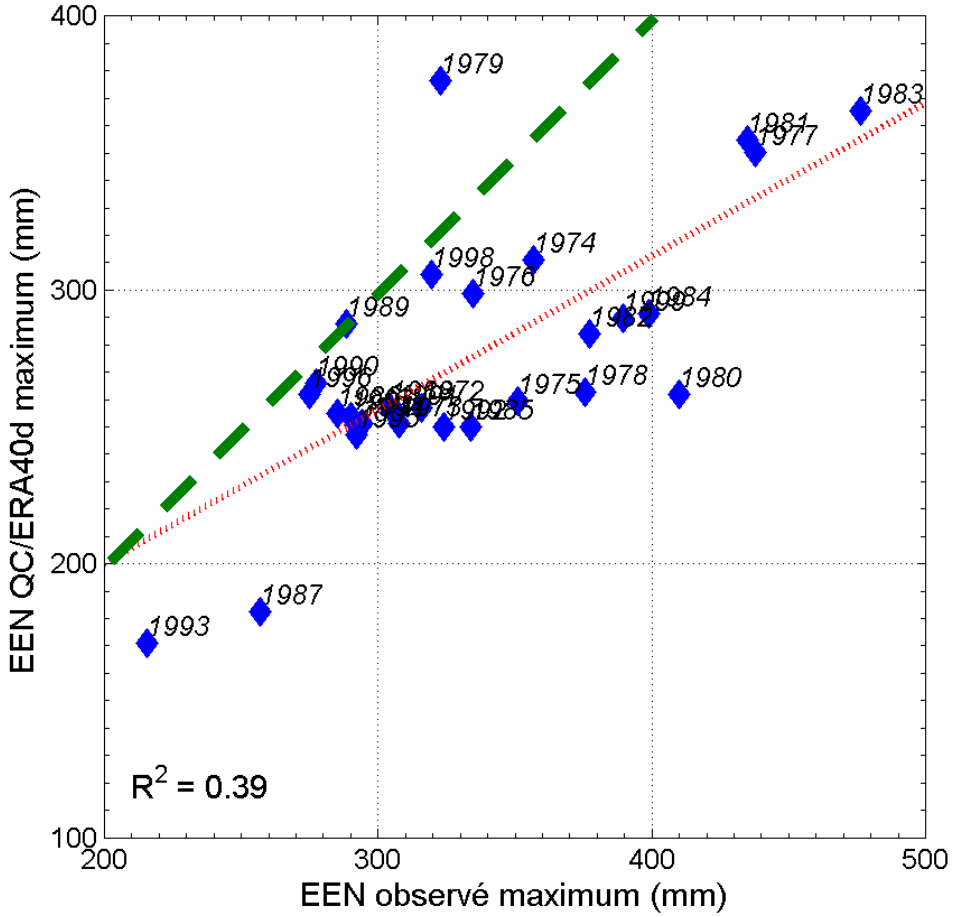
Courtesy of Slivitzky and Frigon

Churchill Falls Reservoir

1961-1999

Maximum snow water equivalent (mm)





Courtesy of Slivitsky and Frigon

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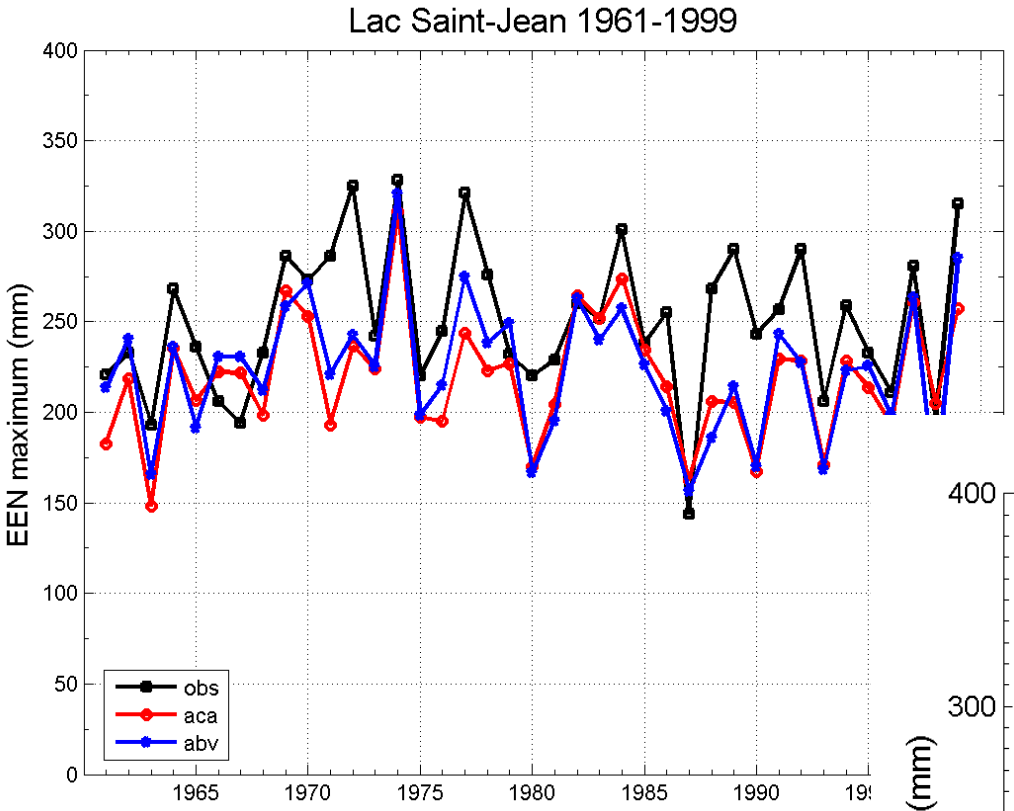
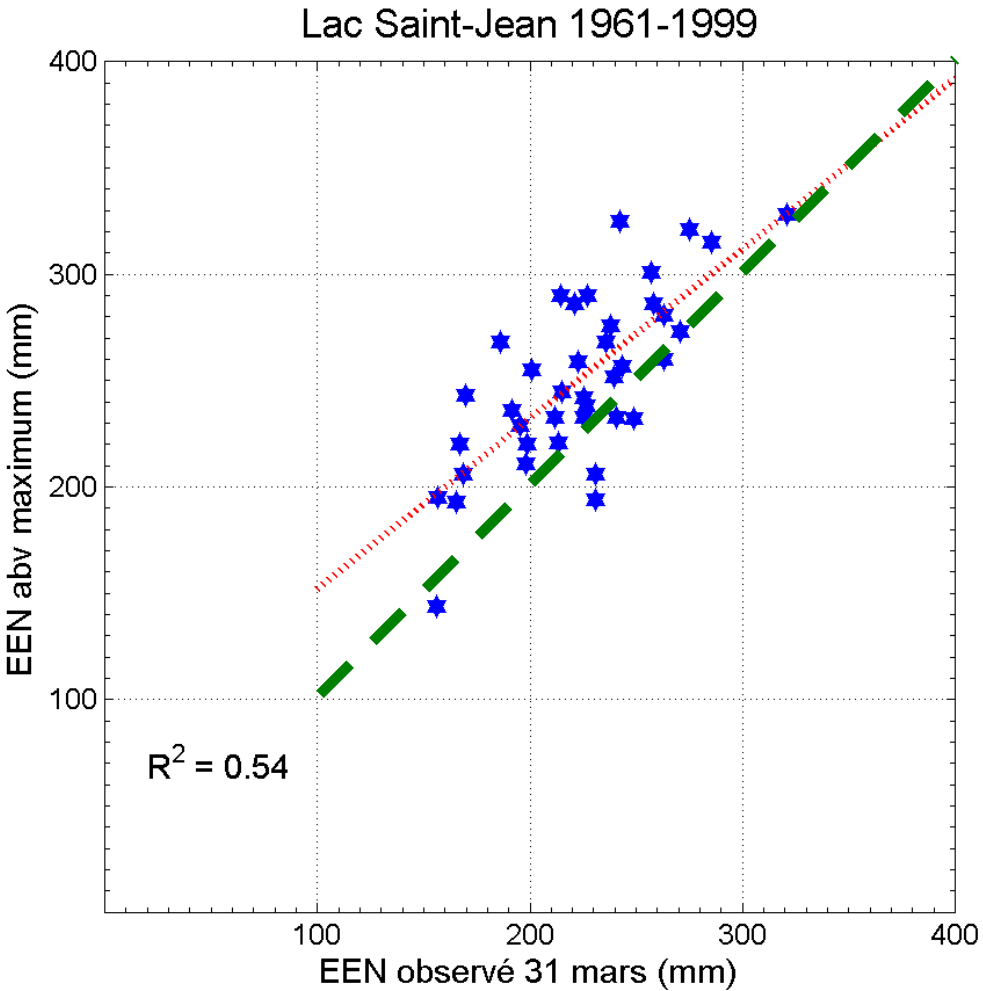
Lac Saint-Jean

1961-1999

Maximum snow water equivalent (mm)





Driven by :

Era40

NCEP rean 2

Courtesy of Slivitsky and Frigon

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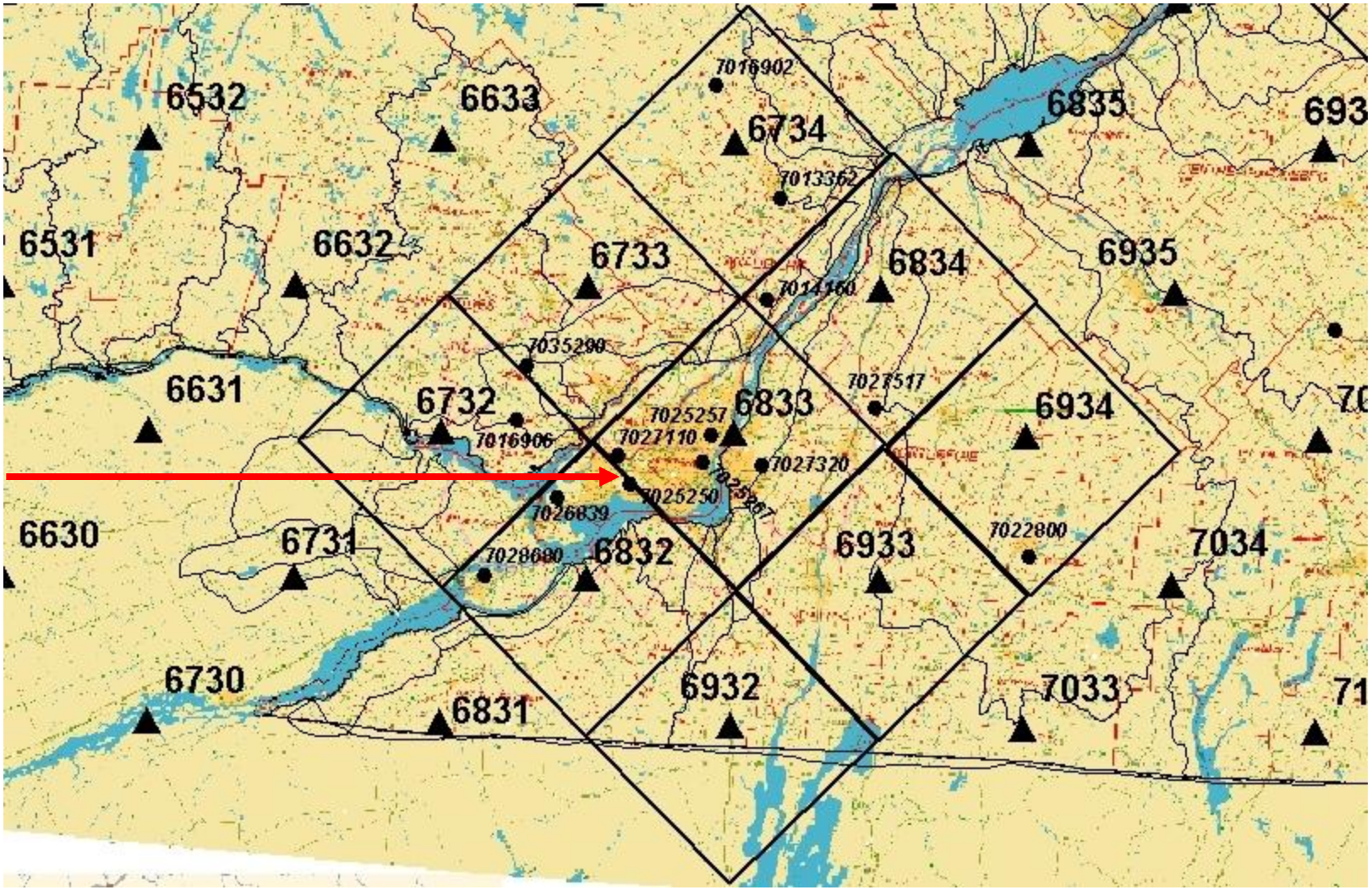
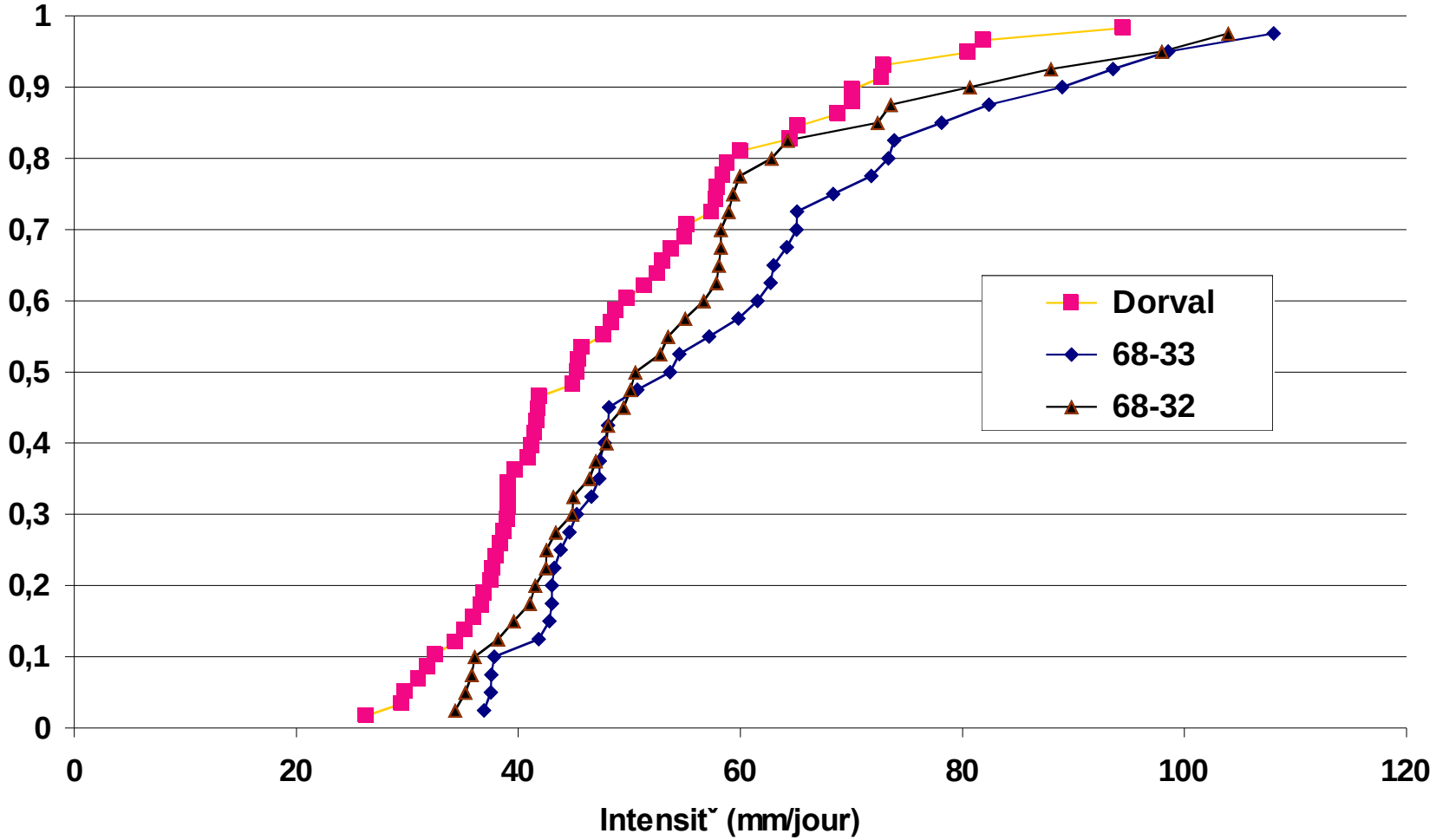
Precipitation Extremes



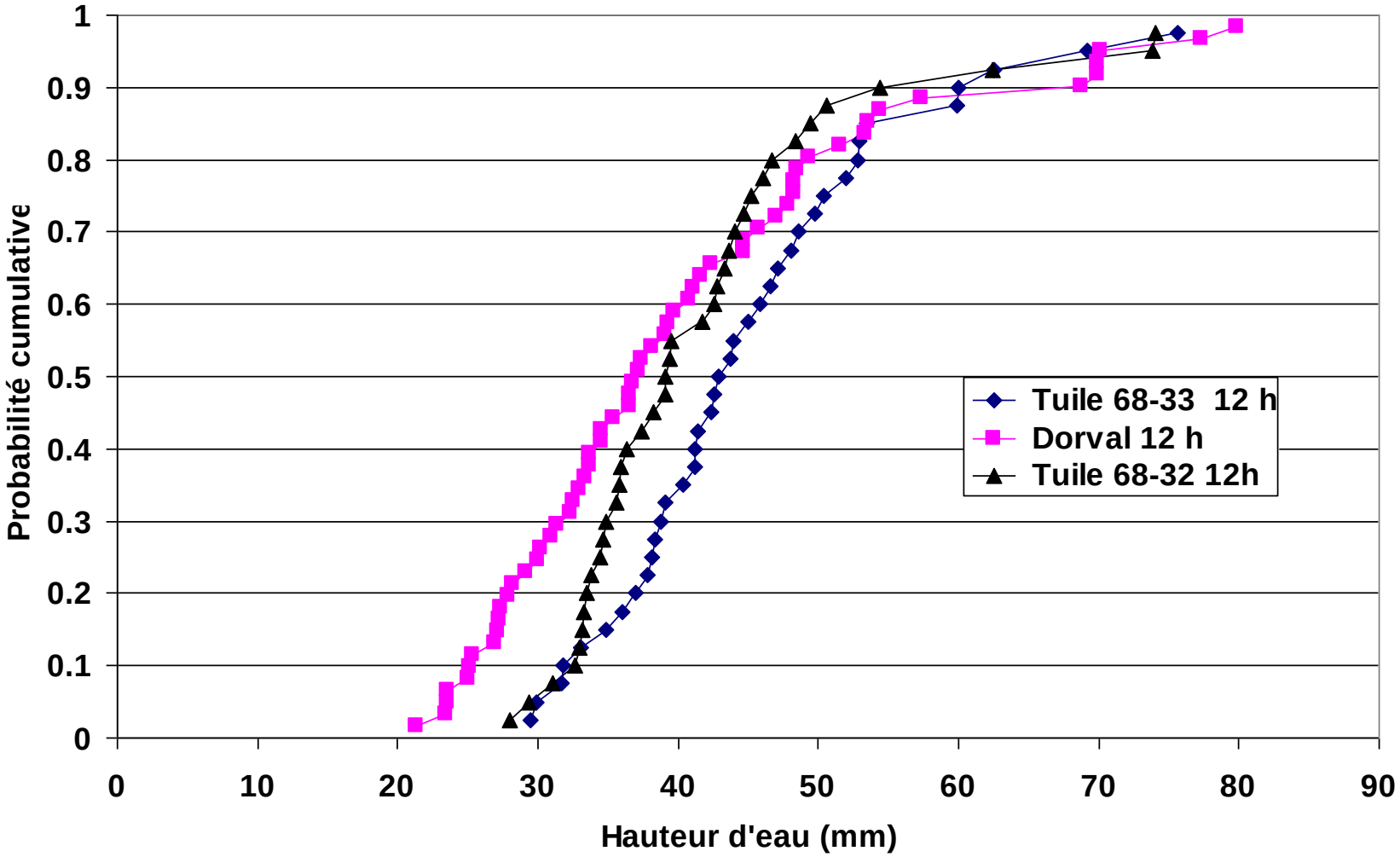
Courtesy of Mailhot, Duchesne and Sima

Cumulative distribution for 24 h extreme – RCM vs Mtl airport



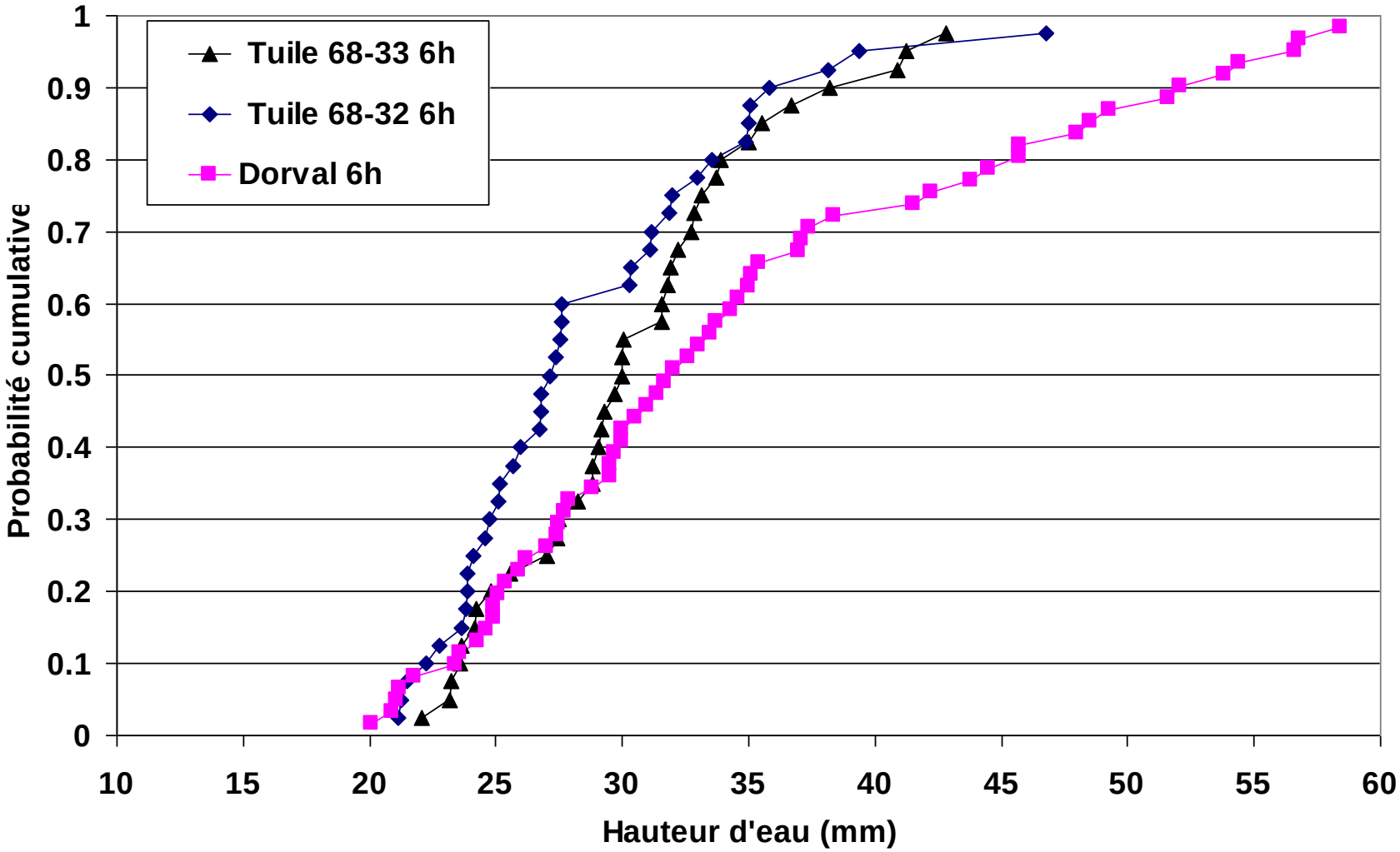
Courtesy of Mailhot, Duchesne and Sima

Cumulative distribution for 12 h extreme – RCM vs Mtl airport



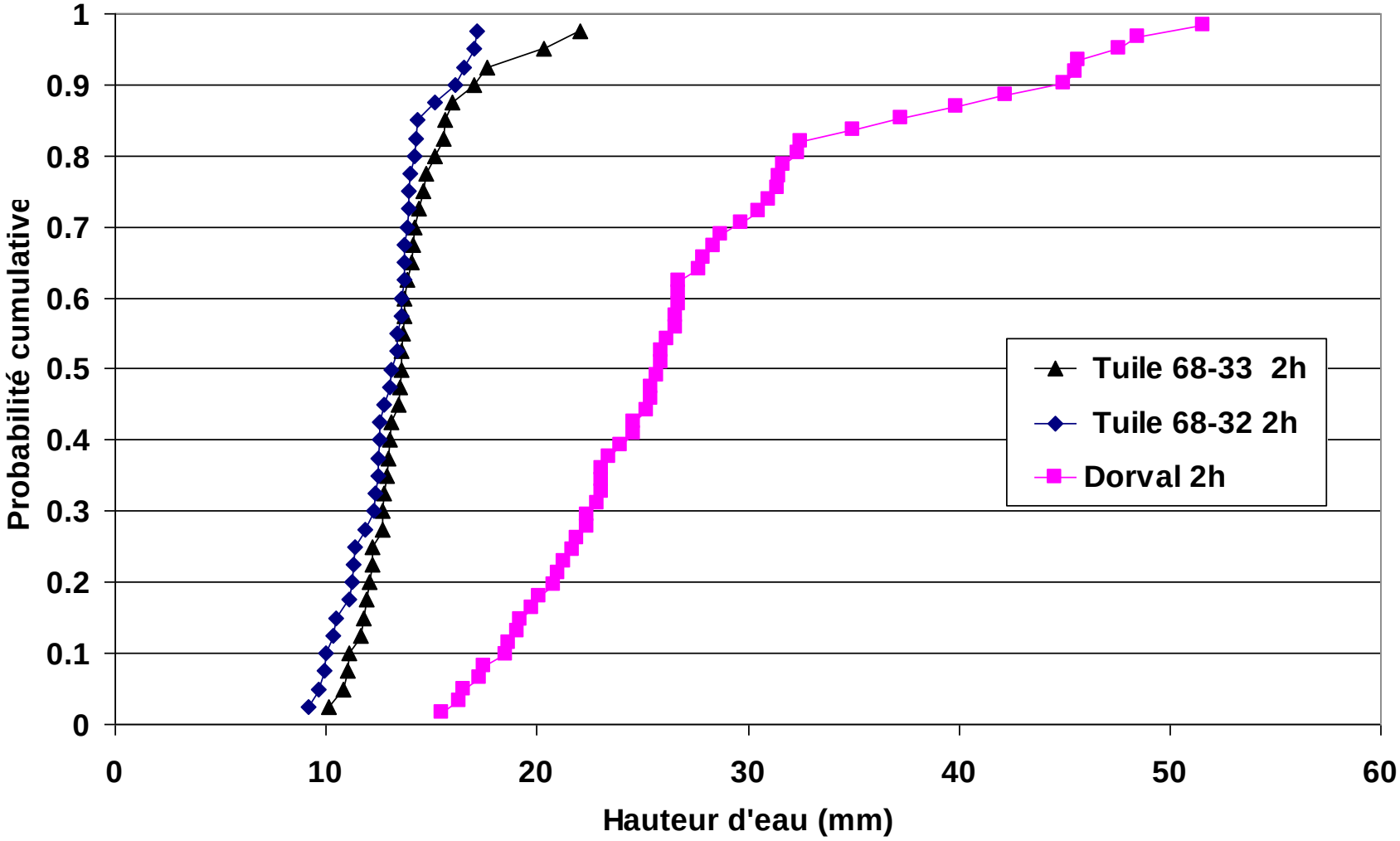
Courtesy of Mailhot, Duchesne and Sima

Cumulative distribution for 6h extreme – RCM vs Mtl airport



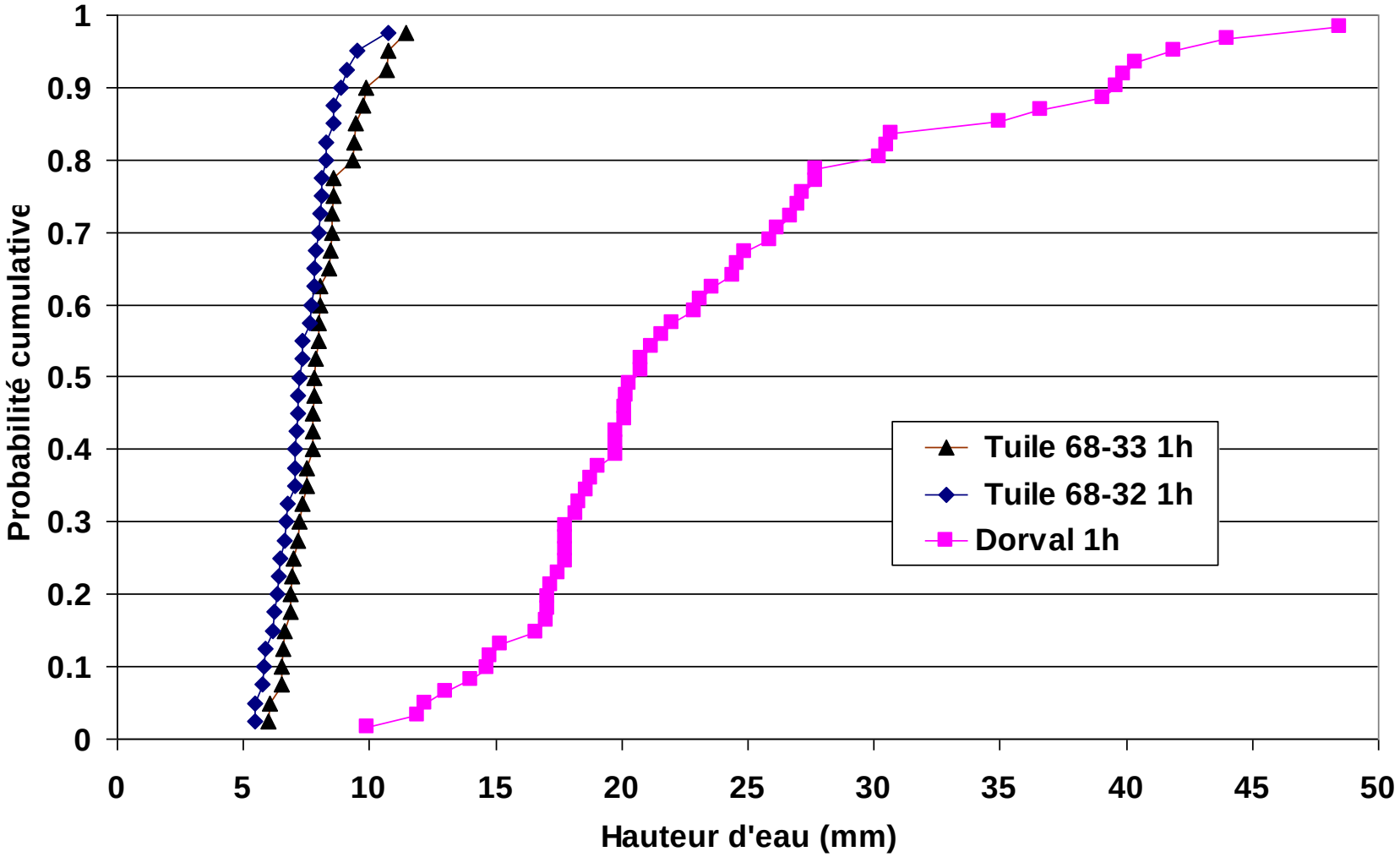
Courtesy of Mailhot, Duchesne and Sima

Cumulative distribution for 2 h extreme – RCM vs Mtl airport



Courtesy of Mailhot, Duchesne and Sima

Cumulative distribution for 1 h extreme – RCM vs Mtl airport



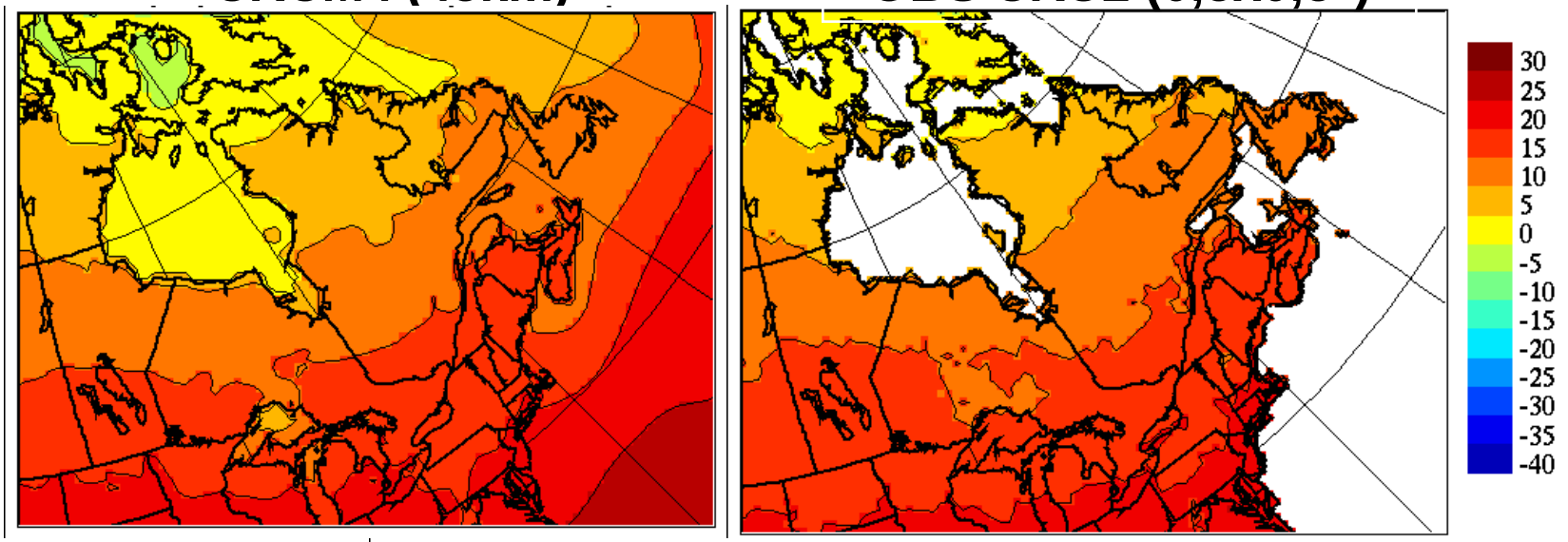
Courtesy of Mailhot, Duchesne and Sima

Last minute slides …

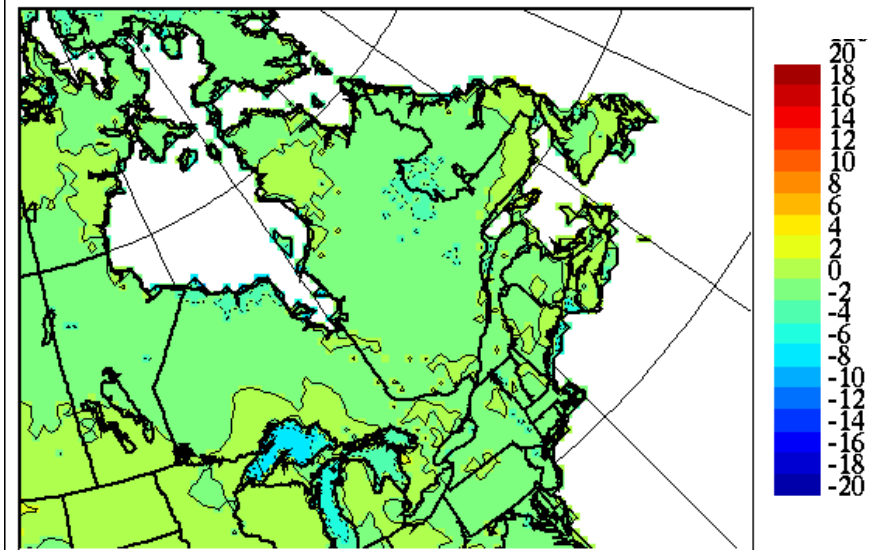
Validation climat 1961 - 1990

CRCM4 (45km)

OBS CRU2 (0,5x0,5º)



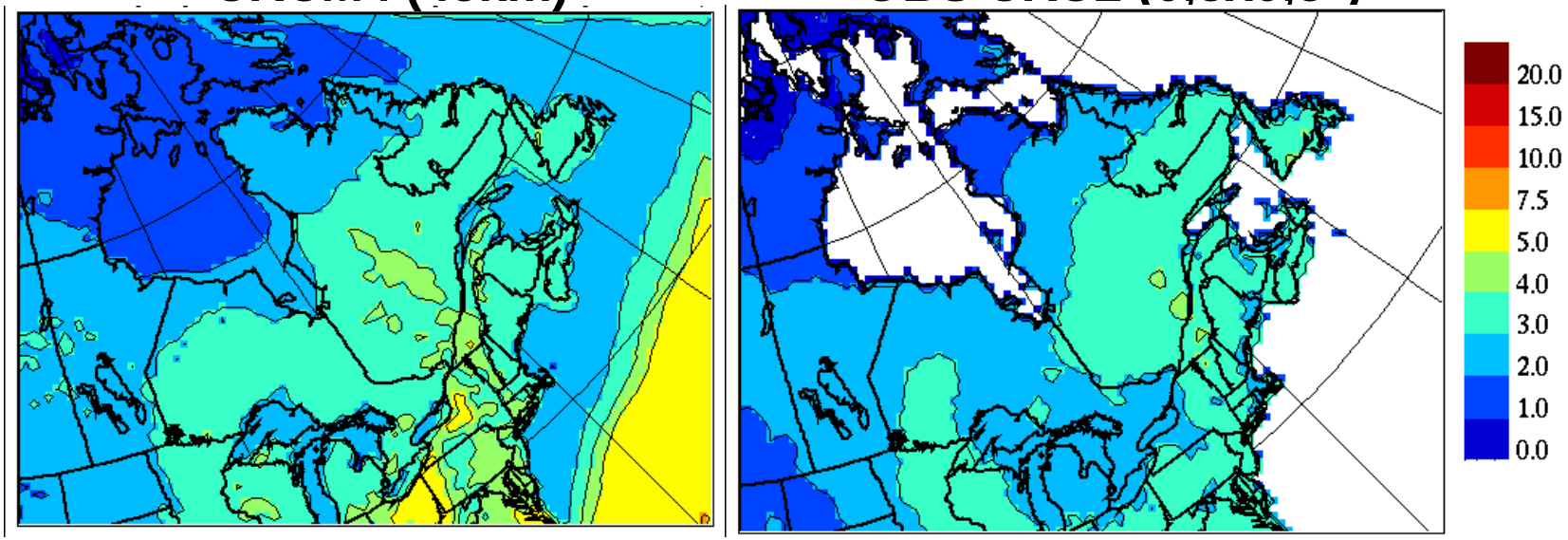
Été (JJA)
température
1961-1990 (°C)



Différence MRCC4 moins OBS CRU2

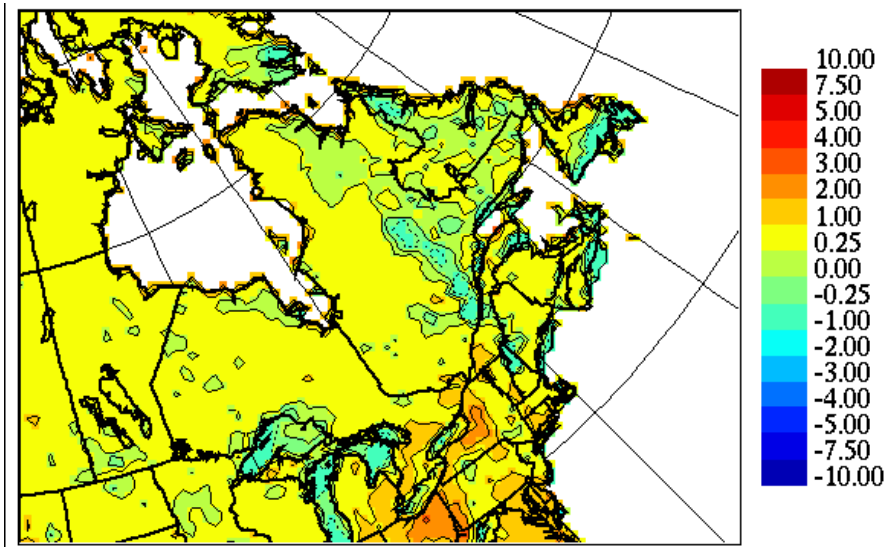
Validation climat 1961 - 1990

CRCM4 (45km) **OBS CRU2 (0,5x0,5º)**



Précipitation d'été spatialement plus bruitée que les observations

Été (JJA) précipitation 1961-1990 (mm/d)



Différence MRCC4 moins OBS CRU2

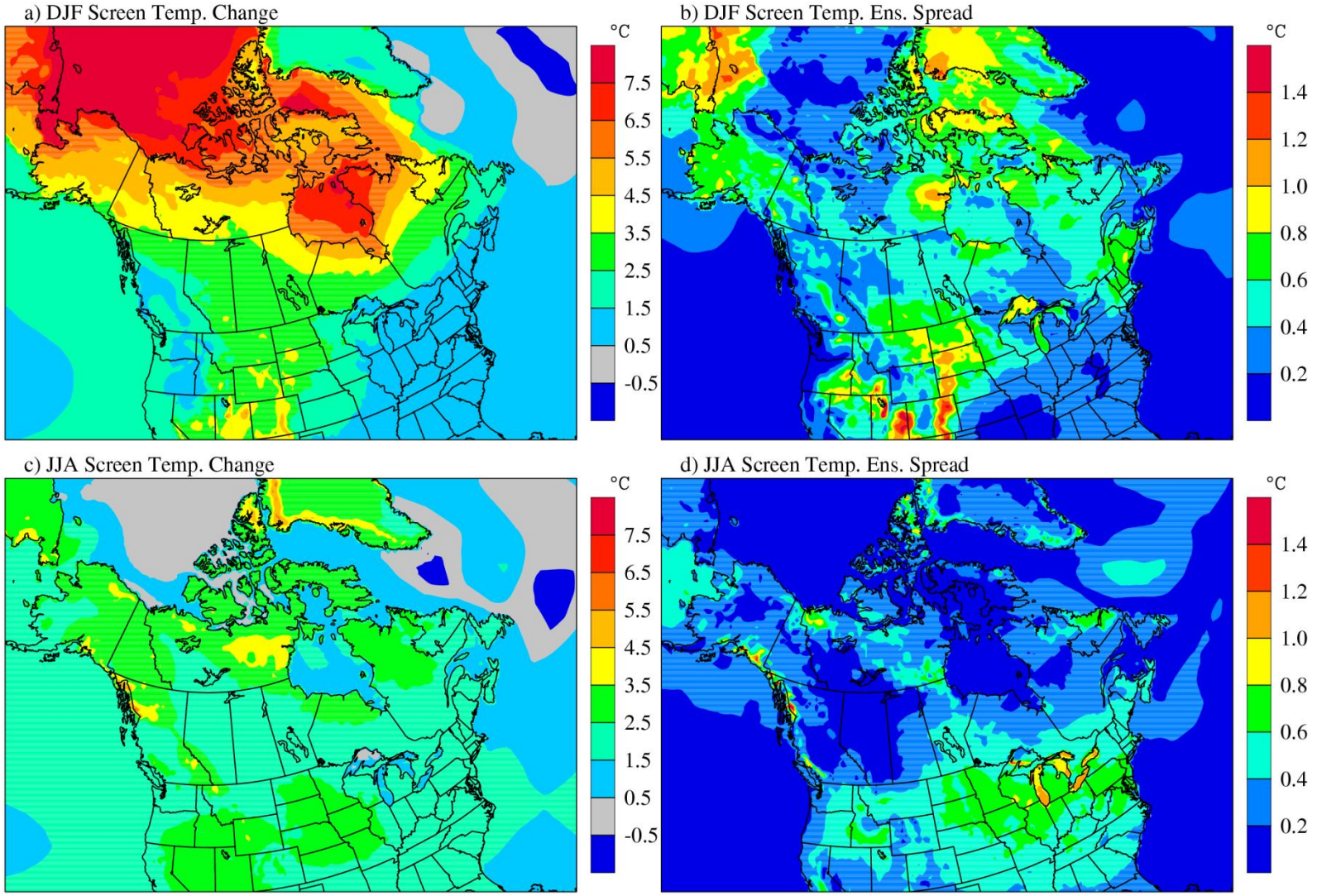
A Poor's Man Ensemble for North-America
1971 - 1990 vs 2041 - 2060

Name	Definition	CRCM version	Domain	Driving data	Projected scenario
PC92a-1	PCfr1 Š PCpr1	3.6	PC	CGCMa-92a	IS92a
AN92a-1	ANfr1a Š ANpr1	3.6	AN	CGCMb-92a	IS92a
ANa2-1	ANfr1b Š ANpr1	3.6	AN	CGCM-a2	A2
ANa2-2	ANfr2 Š ANpr2	3.7	AN	CGCM-a2	A2

From Plummer, Caya, Frigon, Côté, Giguère, Paquin, Biner, Harvey, de Elía J. Climate 2006

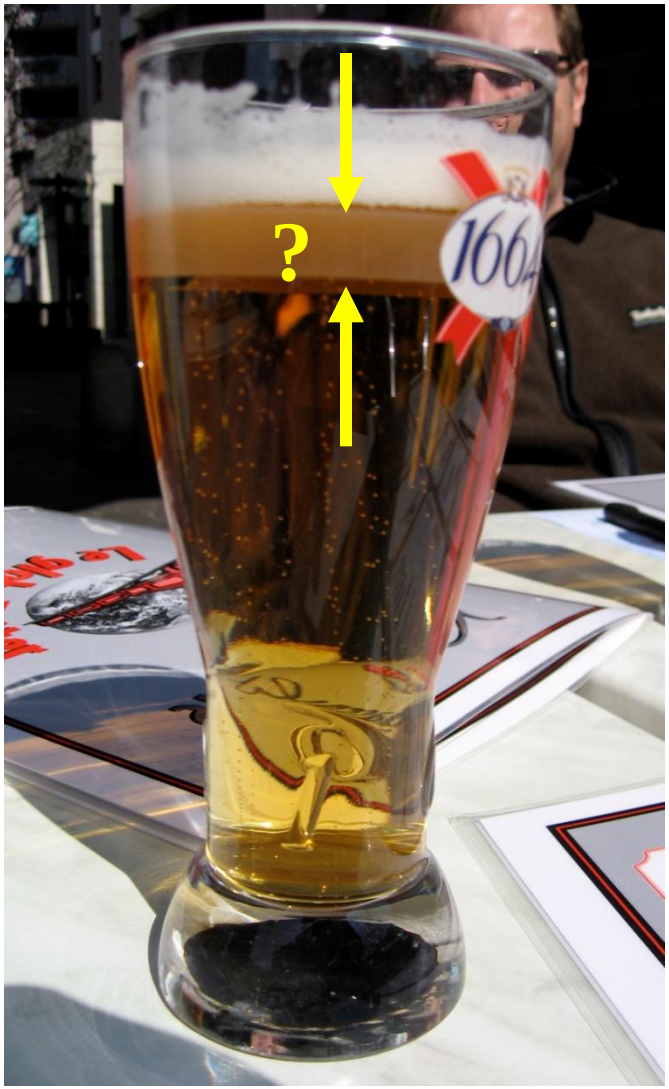
Plummer et al. J. Climate 2006

Climate Change over North America as simulated by the CRCM



Changement climatique moyen de la température entre les périodes 1971-1990 et 2041-2060, et l'écart-type des quatre projections climatiques.

Uncertainty is everywhere

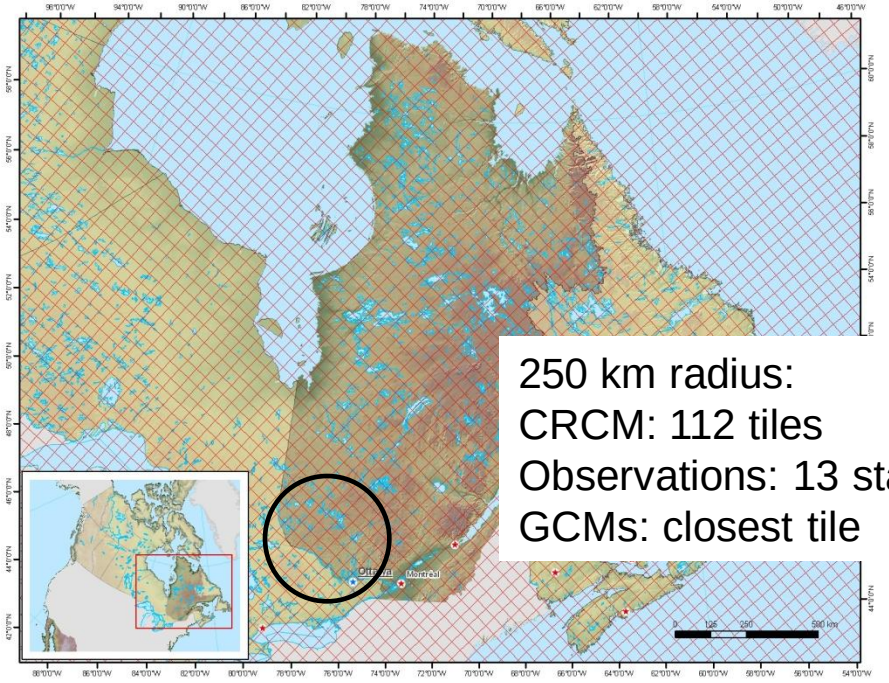


Sponsored by
Daniel Caya

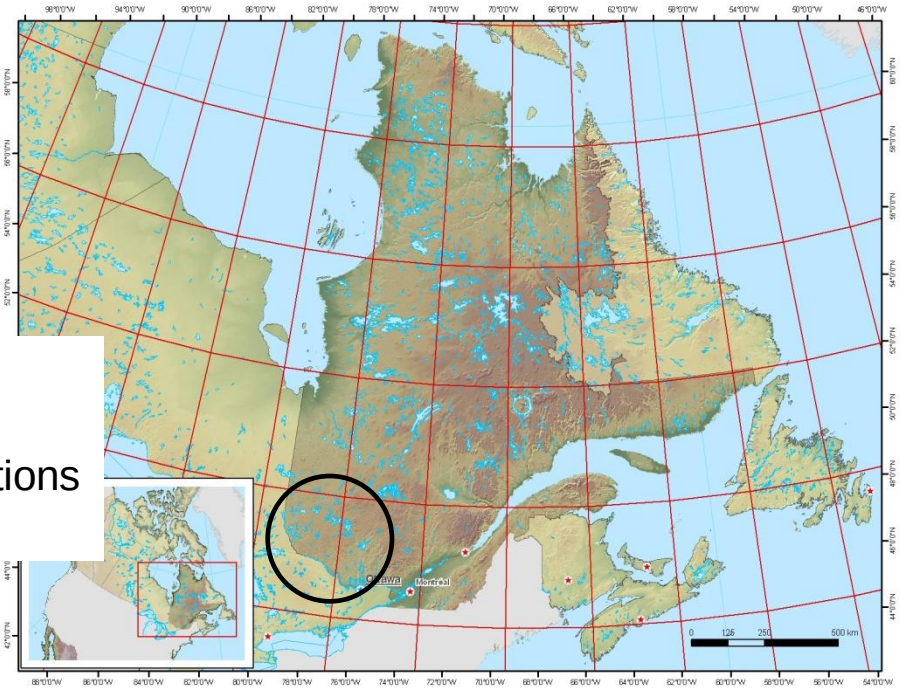
Drought index

- Operational drought index (function of Tmax and precipitation) computed with different time series

CRCM4 grid



CGCM3 grid

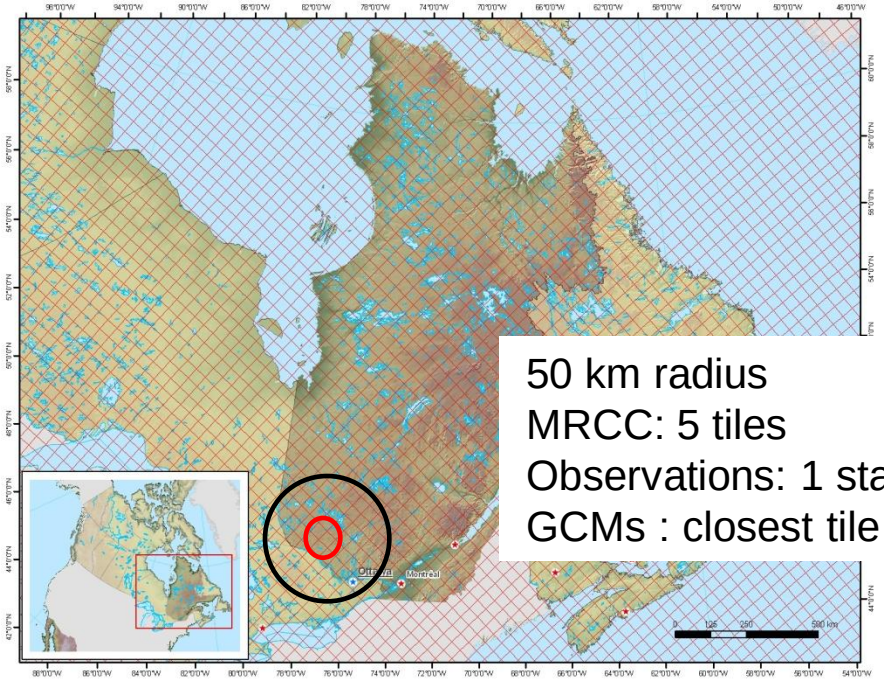


Courtesy of Logan, Chaumont and Caya

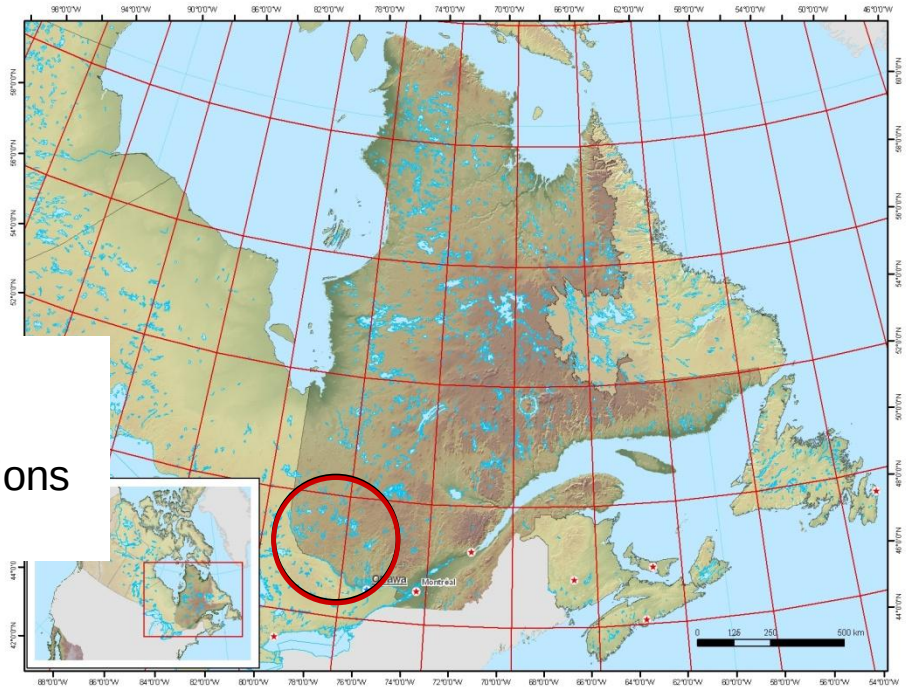
Drought index

- Operational drought index (function of Tmax and precipitation) computed with different time series

CRCM4 grid



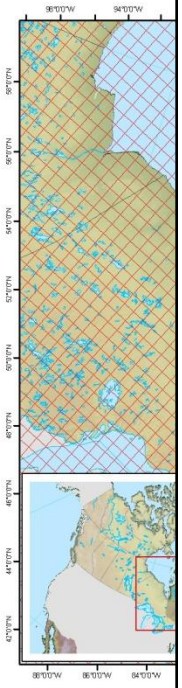
CGCM3 grid

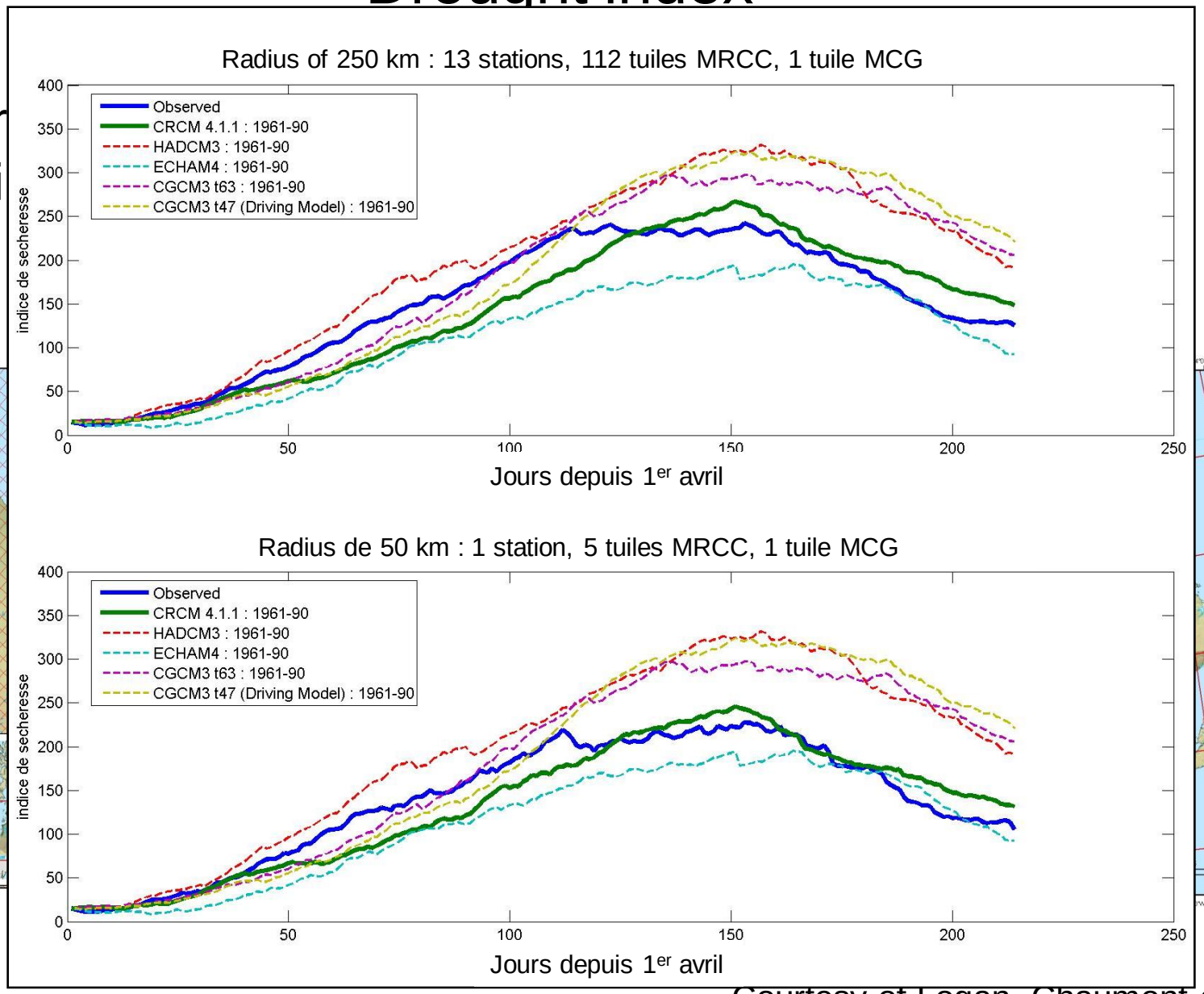


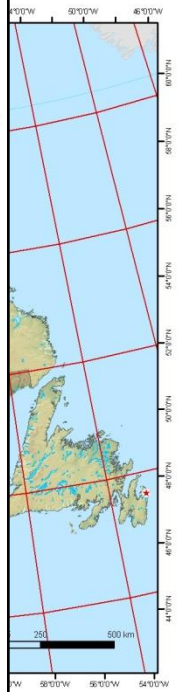
Courtesy of Logan, Chaumont and Caya

Drought index

•Oper
preci



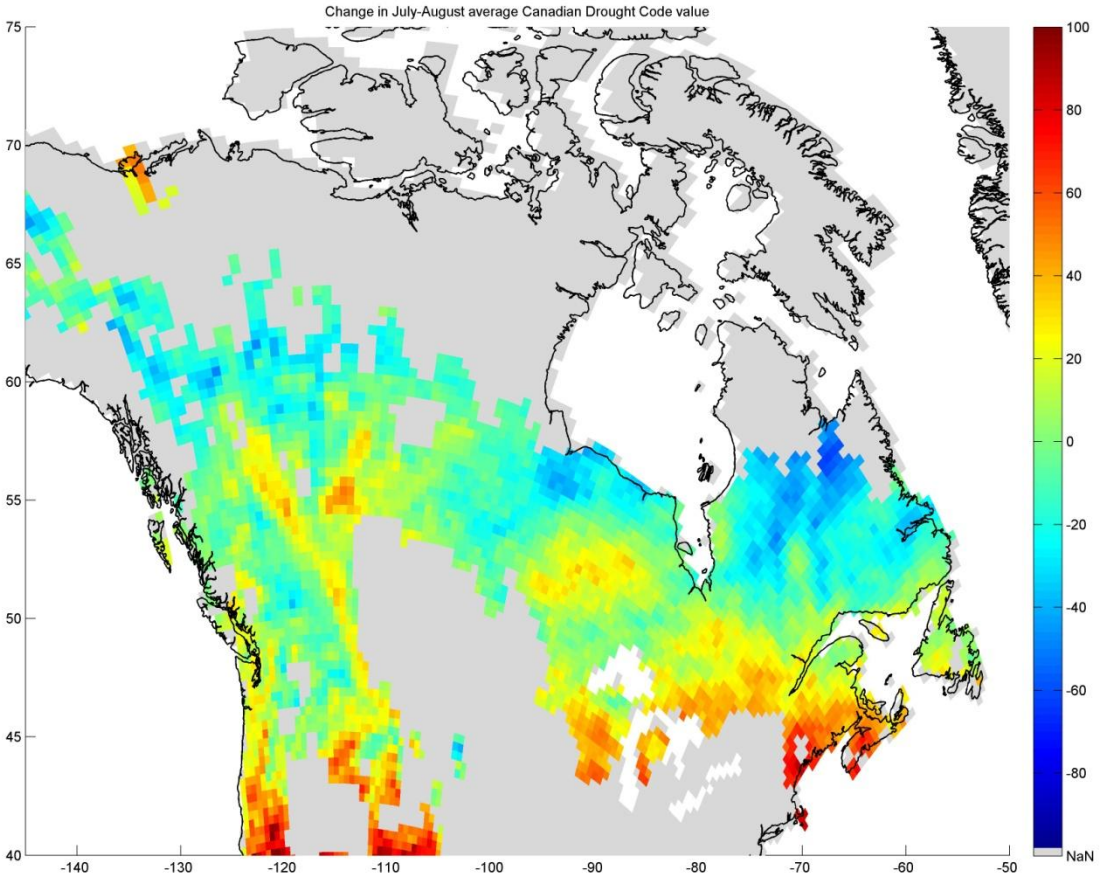




Courtesy of Logan, Chaumont and Caya

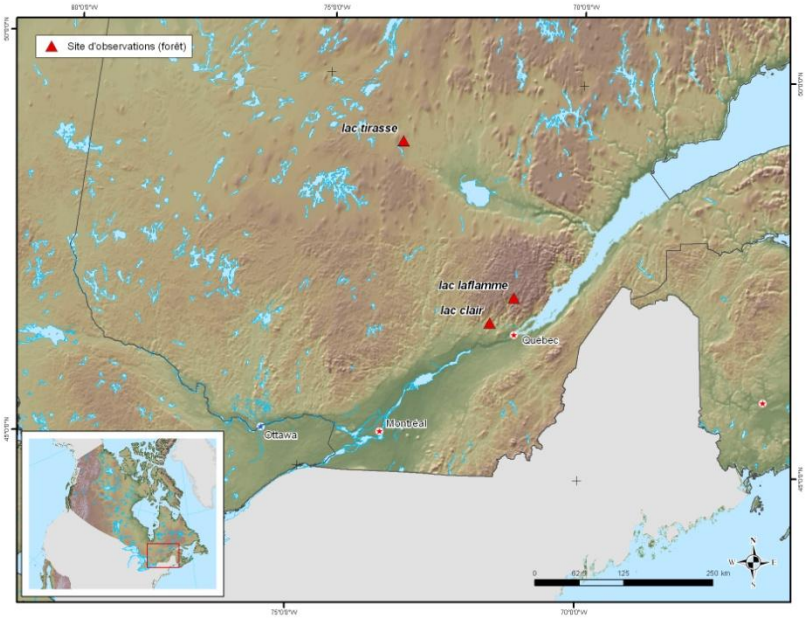
Drought index change for the Boreal forest
MRCC4 - MCCG3 A2
2040-2069 à 1961-1990

Drought index units

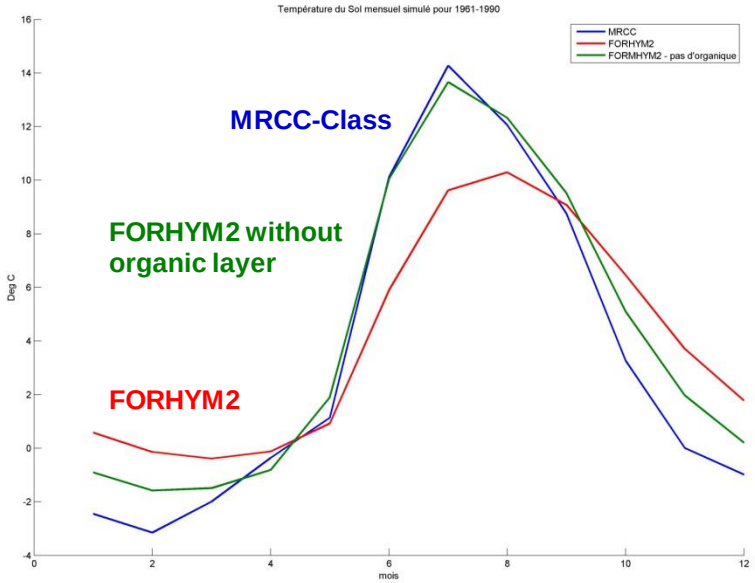


Soil temperature

Observation sites of MRNF



Annual cycle of simulated soil temperature (1961-1990)



Summary

- The climate simulation team at Ouranos has produced a noticable amout of regional climate simlation (validation and projection)
- Narccap to increase our pool of regional climate data (other RCMs, driving GCM, …)
- Users at Ouranos are using more and more direct RCM outputs in their I&A studies

Thank you!