



Environment
Canada

Environnement
Canada

Canada

Cccmarad et la prochaine implantation du GEM15

**Séminaire RPN
RPN, Dorval, Québec
Paul Vaillancourt
DRM
5 septembre 2008**

Plan du séminaire

- 1) Décrire et justifier le nouveau schéma de transfert radiatif **cccmarad** (*pour le projet GEM-Méso-Strato aussi*)
- 2) Décrire la prochaine proposition d'implantation du GEM15 (CPOP du 9 septembre)

Collaborateurs

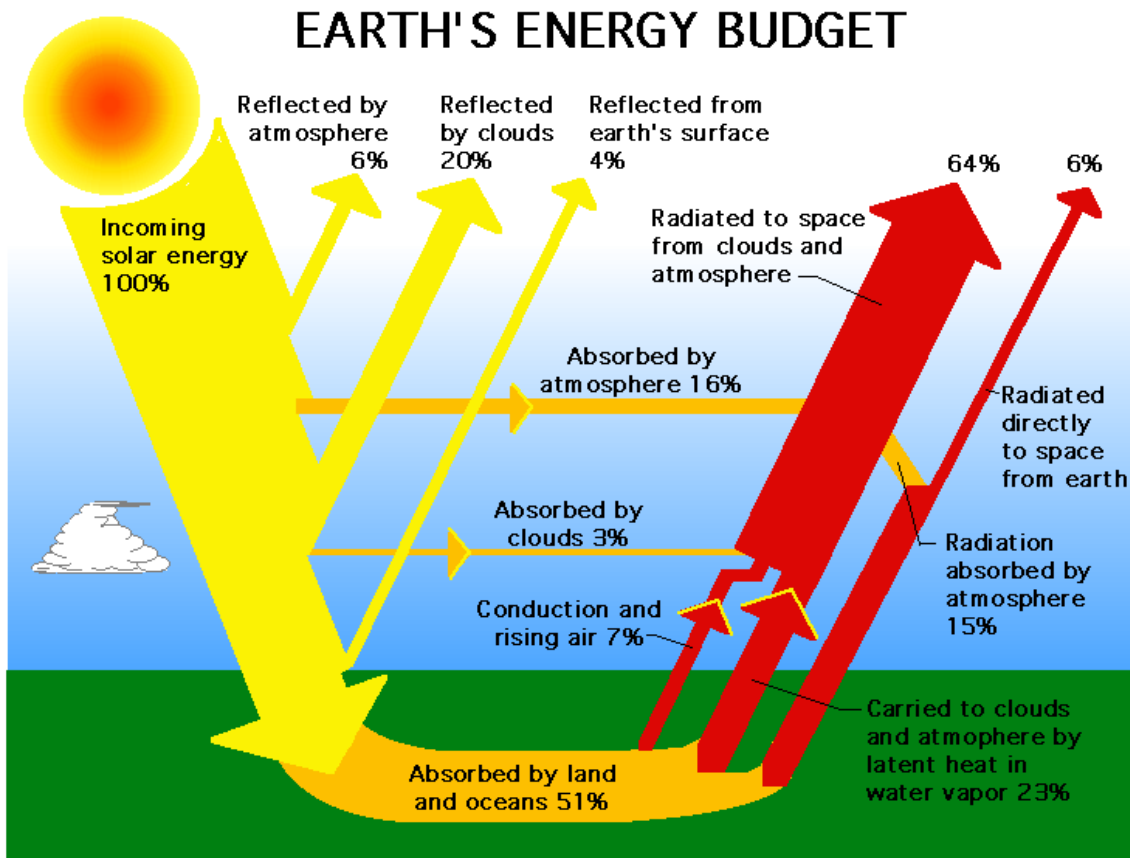
GEM15:

A. Patoine, A. Zadra, groupe infrastructure modèle

Cccmarad:

- *RPN*: B. Dugas, K. Winger, M. Roch, A. Zadra, M. Charron, I. Paunova, J. DeGrandPré, groupe infrastructure modèle
- *CMC*: D. Talbot, A. Patoine, A.M. Leduc
- *CCCma*: J. Li, M. Lazarre, K. VonSalzen
- *Cloud Physics*: F. Boudala
- *UQAM*: M. Markovich, D. Ricard-Paquin

A) Radiative transfer parameterization



SW:

- Absorption by O_2, O_3, H_2O
- Rayleigh scattering
- Scattering and absorption by clouds and aerosols
- Reflection by surface

LW:

- Absorption and emission by $H_2O, CO_2, O_3, CH_4, N_2O, CFC's$
- Scattering and absorption by clouds and aerosols
- Emission by surface

Result: temperature tendency, radiative fluxes at surface and top of atmosphere

gem_settings.nml

```
&physics_cfgs
  phy_pck_version = 'RPN-CMC_4.6',

  RADIA          = 'cccmarad'      , KNTRAD          = 4,
  ozone_file_S    = 'ozoclim_Fortuin_Kelder1998',

  RADFLTR         = .false.        ,
  TS_FLXIR        = .true.         , } S/O avec cccmarad
```

RADIA

- 1) 'nil'
- 2) 'oldrad'
- 3) 'newrad'
- 4) 'cccmarad'

ozone_file_S

- 1) 'ozoclim_Fortuin_Kelder1998'
(GEM15 proposé et GEM-Méso-Strato)
- 2) 'ozoclim_phy45'



Site web interne de Paul Vaillancourt:

Chercheur scientifique - RPN, Environnement Canada
Professeur Associé - Dépt. des Sciences de la Terre et de l'Atmosphère, UQÀM
Membre affilié - Centre pour l'étude et la simulation du climat à l'échelle régionale, UQÀM

Documentation se trouve sur ma page iweb à la section **Projet Rayonnement**

- [Liste des publications](#)
- [Conférences, séminaires, autres présentations et rapports internes](#)
- [Documentation sur le modèle régional](#)
- [Projet Rayonnement](#)
- [Projet Cirrus; biais froid à la tropopause](#)
- [Projet Vérification\(précipitation, nuages, flux radiatifs...\)](#)
- [Liste de definition des variables](#)
- [Projet Nuages-Ménage \(physique 4.4\)](#)



Projet:

Un nouveau schema de transfert radiatif pour les modeles NWP: CCCMARAD

Documentation

- [Brief description of new radiative transfer scheme of Li and Barker \(CCCMARAD\) \(PDF\)](#)
- [Organigram of CCCMARAD with description \(PDF\)](#)
- [Reference paper in JAS by Li and Barker \(2005\)](#)
- [References for CCCmarad \(optical properties, overlap assumptions...\)](#)
- [Séminaire de Paul Vaillancourt du 17 juin 2005](#)
- [Séminaire de Jiangnan Li du 18 novembre 2005](#)
- [Séminaire de Bernard Dugas du 23 mars 2005 \(mode climat\)](#)



État du projet

- [Rencontre modélisation globale - état du projet rayonnement - 9 juin 2004](#)
- [Rencontre modélisation globale - état du projet rayonnement - 6 octobre 2004](#)
- [Rencontre modélisation globale - état du projet rayonnement - 14 février 2005](#)
- [Rencontre modélisation globale - état du projet rayonnement - 7 septembre 2005](#)
- [Rencontre modélisation globale - état du projet rayonnement - 15 février 2006](#)

Résultats

- [Résultats d'expériences de sensibilité - Mai 2007](#)
- [Étude de comparaison, CCCmarad vs Newrad - March 2005](#)
- [Notes sur l'effet d'utiliser l'ozone de Fortuin et Kelder](#)

Flow chart of new radiative transfer option CCCMARAD:

Paul Vaillancourt, -May 2004

Revised August 2008

PHYEXE1

CCCMARAD [prepare inputs for raddriv, prepare outputs]

CLDOPPRO [determines optical properties of clouds]

AEROOPPRO [initializes and partially determines aerosol optical properties]

RPN

RADDRIV

CALL CLDIFM

[this subroutine determines the info for cloud and level info for gaseous calculation]

CALL PREINTP [this subroutine determines the pressure interpretation points]

CALL RAYLEI [rayleigh scattering for bands2-bands4, near infrared region]

CALL RAYLEV [rayleigh scattering for each sub-band in bands1, visible region]

CALL SATTENU

[calculation of solar attenuation above the model top level. For band1 only O3 and O2 are considered]

CALL ATTENUE

[this subroutine calculates the downward flux attenuation above the model top level]

CALL STRANDN

[calculation of the downward flux from top level to 1 mb, no scattering effect is considered]

CALL GASOPTS

[calculation of the optical depths due to nongray gaseous absorption for the solar, in each layer for a given band ib and cumulative probability gw]

CALL TLINE1 [calculation of optical depth for one gas (line contribution only)]

CALL TLINE2 [the same as tline1, but with two mixed gases, one must be h2o]

CALL SWTRAN

[delta-eddy approximation and adding process for clear and all sky, the adding method by Coakley et al (1983). this code can deal with solar radiative transfer through atmosphere with proper treatment of cloud overlap (random + maximum or random + slantwise) and cloud sub-grid variability. the theory for adding, cloud overlap Li and Dobbie (2003). cloud sub-grid variability]

CALL STRANUP

[calculation of the upward solar flux above 1 mb, no scattering effect is considered]

CALL SATTENU

[calculation of solar attenuation above the model top level. for band1 only o3 and o2 are considered]

CALL ATTENUE

[this subroutine calculates the downward flux attenuation above the model top level]

CALL STRANDNGH

[calculation of the downward solar flux under the condition that the extinction coefficient of gas is very large, the scattering effects can be neglected. the cloud optical depth is much smaller than the gaseous optical depth, the cloud effect is very small and be treated simply]

CALL TLINE1 [calculation of optical depth for one gas (line contribution only)]

CALL TLINE2 [the same as tline1, but with two mixed gases, one must be h2o]

CALL PREINTR

[this subroutine determines the interpretation points for the ratio of h2o and co2]

CALL PLANCK [calculation of planck function in valid range 120 - 360 k]

CALL GASOPTL

[calculation of the optical depths due to nongray gaseous absorption for the infrared, in each layer for a given band ib and cumulative probability gw]

CALL TLINE2 [the same as tline1, but with two mixed gases, one must be h2o]

CALL TLINE1 [calculation of optical depth for one gas (line contribution only)]

CALL TCONTL [infrared water vapor continuum]

CALL TLINE3

[the same as tline1, but with three mixed gases. one with varying mixing ratio the other two with constant mixing ratio]

CALL TLINEHC

[this subroutine determines the optical depth for h2o and co2 in the region of 540-800 cm^{-1}]

CALL TCONTHL

[water vapor continuum for 540-800 cm^{-1} . different from tcontl, variation of mass mixing ratio for h2o and co2 is consider.]

CALL LWTRAN

[calculation of longwave radiative transfer using absorption approximation. the finite cloud effect is properly considered with random and full overlap assumption. cloud subgrid variability is included (based on Li, 2002 JAS p3302; Li and Barker JAS p3321).]

CALL GASOPTLGH

[the same as gasoptl but for intervals close to 1 in the accumulated probability space]

CALL TLINE1 [calculation of optical depth for one gas (line contribution only)]

CALL TCONTL [infrared water vapor continuum]

CALL TLINE3

[the same as tline1, but with three mixed gases. one with varying mixing ratio the other two with constant mixing ratio]

CALL TLINE2 [the same as tline1, but with two mixed gases, one must be h2o]

CALL LATTENU

[calculation of the attenuation for the downward flux above the model top level]

CALL ATTENUE

[this subroutine calculates the downward flux attenuation above the model top level]

CALL LWTRAGH

[in the g space with interval close 1 (very large optical depth) or in the case with cloud absorption is very small or the weight of flux and cooling rate are very small. the cloud radiative process can be highly simplified. the absorption approximation method is used and cloud random and maximum overlap is considered, but cloud scattering and inhomogeneity are ignored. the exponential source planck function is used which is more accurate in the region above 200 mb in comparison with linear source function]

DATAERO: contains common statements and data statements for aerosol optical properties

TRACEDATA: contains common statements and data statements for trace gas concentrations

CKDLW: contains common statements and data statements for LW CKD radiative transfer

CKDSW contains common statements and data statements for SW NIR CKD radiative transfer

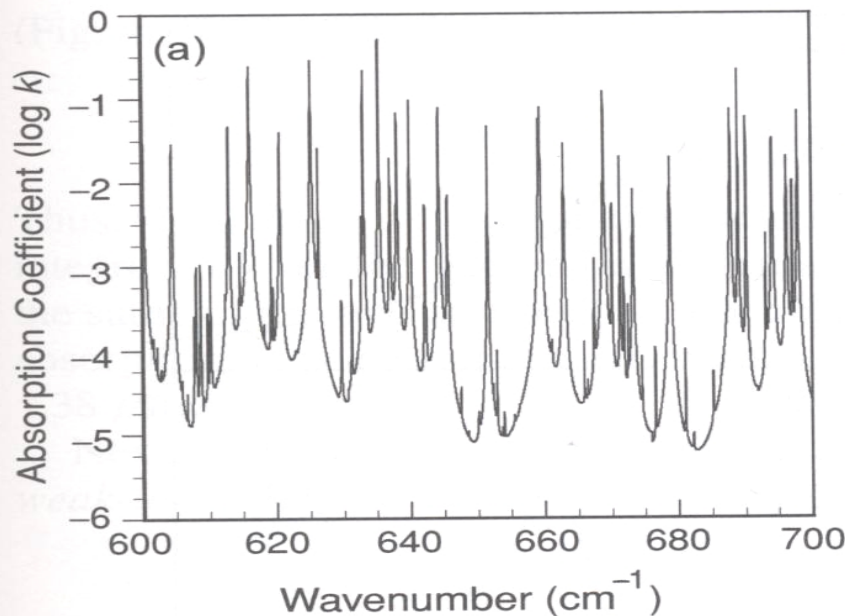
Cccmarad

- Developped by Jiangnan Li of CCCma for the GCM4
- Li and Barker (2005): A Radiation Algorithm with Correlated k-distribution, JAS
- CKD method now used in many climate and NWP models(operational at ECMWF)
- CMC: Operational in one model of the seasonal forecasting system

Cccmarad - why?

- ♦ Valid up to 100km
- ♦ LW calculations scale linearly with number of levels
- ♦ 3D interactive treatment of water vapor continuum, CO₂, O₃, N₂O, CH₄, CFC11, CFC12, CFC113, and CFC114
- ♦ Use the CKD method for absorption/emission of LW and SW-NIR
- ♦ Proper treatment of SW and LW spectrum overlap
- ♦ Cloud and aerosol infrared scattering
- ♦ New and more detailed outputs:
 - Diffuse and direct SW flux (flux on slopes, photosynthesis, solar forecasting)
 - Fluxes over 9 bands in LW, 3 bands in NIR, 9 bands in UV-Vis₁₀
 - Clear sky fluxes

Correlated K Distribution method for infrared radiative transfer



Absorption coefficient K in spectral space, H_2O rotational band $P=660\text{hPa}$, $T=260\text{K}$

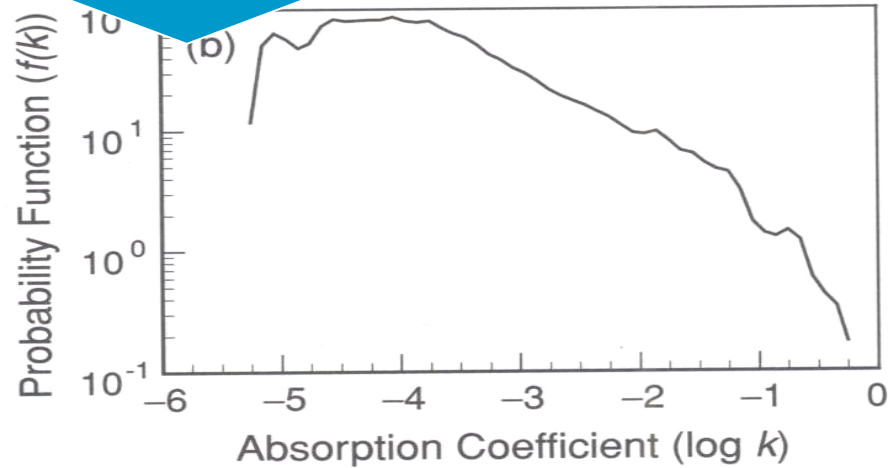
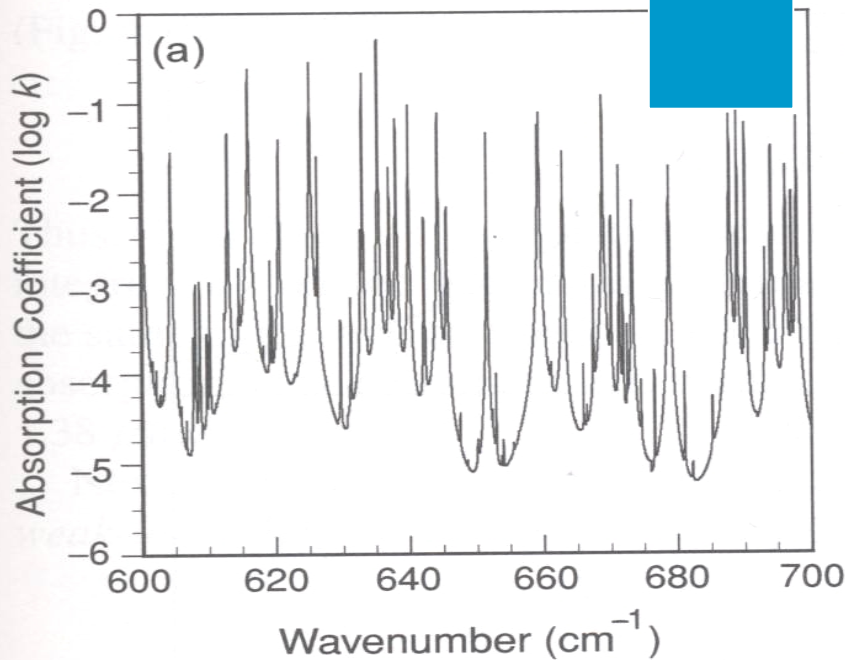
$$\text{Tr}(w) = \frac{1}{\Delta\nu} \int_{\Delta\nu} e^{-w k(\nu)} d\nu, \quad (1)$$

How to integrate such an irregular function?

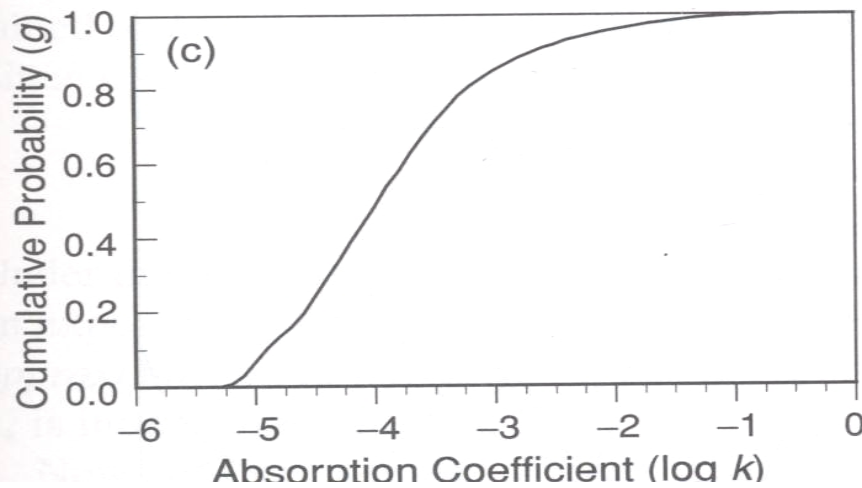
- 1) Line by Line (LBL) codes (over 10^6 line parameters available)
- 2) Band models
- 3) CKD method:
 - Subdivide in spectral bands
 - Identify main absorbers for each band

Adapted from "An Introduction to Atmospheric Radiation, K.N. Liou, 2nd edition, fig. 4.5

CKD: from spectral to g-space for each gas in each band



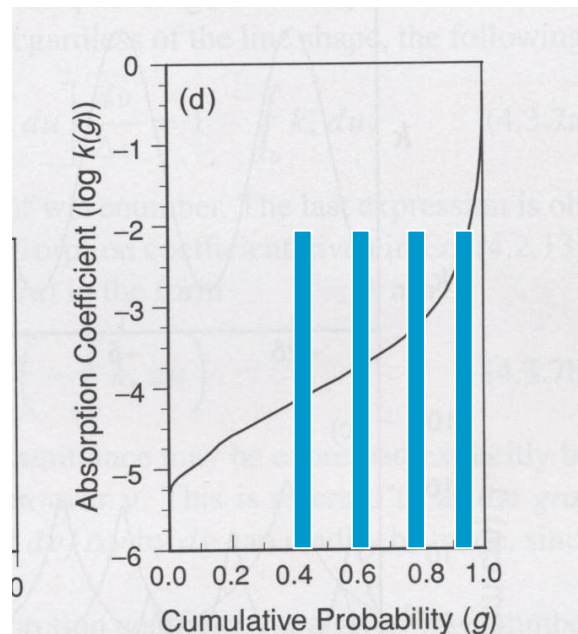
To cumulative probability space (CPS or g-space)



Adapted from "An Introduction to Atmospheric Radiation, K.N. Liou, 2nd edition, fig. 4.5

CKD: from spectral to g-space

Smoothly varying function: easier to integrate in g-space!



Segment into intervals

Adapted from "An Introduction to Atmospheric Radiation, K.N. Liou, 2nd edition, fig. 4.5

Minor intervals: ($g \sim 1$), large K 's : neglect scattering, reflection from surface...
Major intervals: ($g < 1$) full RT calculations

Cccmarad

	Band (cm ⁻¹)	Absorber	No. of intervals in CPS				Solar weight (W m ⁻²)
			Major	Minor	Minor (above 1 mb)	Continuum	
Solar	14 500–50 000	O ₃ , O ₂ , H ₂ O	6	3			628.5946
	8400–14 500	H ₂ O, O ₃ , O ₂	4	3	1		438.2265
	4200–8400	H ₂ O, CO ₂	6	3	1		246.9080
	2500–4200	H ₂ O, CO ₂	4	6	3		40.5737
		Total	20	15	5		
	2200–2500	H ₂ O, CO ₂ , N ₂ O	1	1	3	0	3.6754
	1900–2200	H ₂ O, N ₂ O	1	1		(2)	2.7949
	1400–1900	H ₂ O,	2	2	1	(3)	3.2008
	1100–1400	H ₂ O, N ₂ O, CH ₄ , CFC12, CFC113, CFC114	3	4		(3)	1.1388
	Infrared	980–1100	H ₂ O, O ₃ , CO ₂ , CFC11, CFC12, CFC113, CFC114	2	3	1	(4)
800–980		H ₂ O, CO ₂ , CFC11, CFC12, CFC113, CFC114	2	0		(1)	0.3537
540–800		H ₂ O, CO ₂ , N ₂ O, O ₃	3	6	1	(3)	0.2956
340–540		H ₂ O	6	2	1	(4)	0.099 62
0–340		H ₂ O	4	3	3	(4)	0.023 22
		Total	24	22	10		

CKD



9 bands in LW and 3 in SW are treated by CKD method

Cccmarad

UV-Visible part of SW spectrum is treated spectrally,
it is subdivided into 9 bands

Subband	Spectral range (cm ⁻¹)	Absorber	Absorption coefficient (cm ² g ⁻¹) O ₃	Solar weight (W m ⁻²)
1	50 000–42 000	UVC	O ₃ , ray, O ₂	1.571 22
2	42 000–37 400	UVC	O ₃ , ray	2.788 22
3	37 400–35 700	UVC	O ₃ , ray	2.784 86
4	35 700–34 000	UVB	O ₃ , ray	5.542 84
5	34 000–32 185	UVB, UVA	O ₃ , ray	9.711 53
6	32 185–30 300	UVA, <i>J</i> value: 32 185	O ₃ , ray	16.033 34
7	30 300–25 000	UVA	O ₃ , ray	73.073 72
8	25 000–20 000	PAR	O ₃ , ray	187.186 23
9	20 000–14 500	PAR	O ₃ , ray H ₂ O, O ₂	330.385 62

Cccmarad – RPN/CMC changes

- Contributed several code modifications to CCCma (robustness, portability, efficiency)
- Albedo over ocean (angle and wind dependent)
- Ozone monthly 2D climatology (Fortuin and Kelder 1998 + Haloe)
- *Updated GHG's to 2006 levels*
- *Partition of water content into liquid and ice*
- *No filter on clouds (e.g. tuneop factors)*
- *Effective radius for ice and liquid clouds*

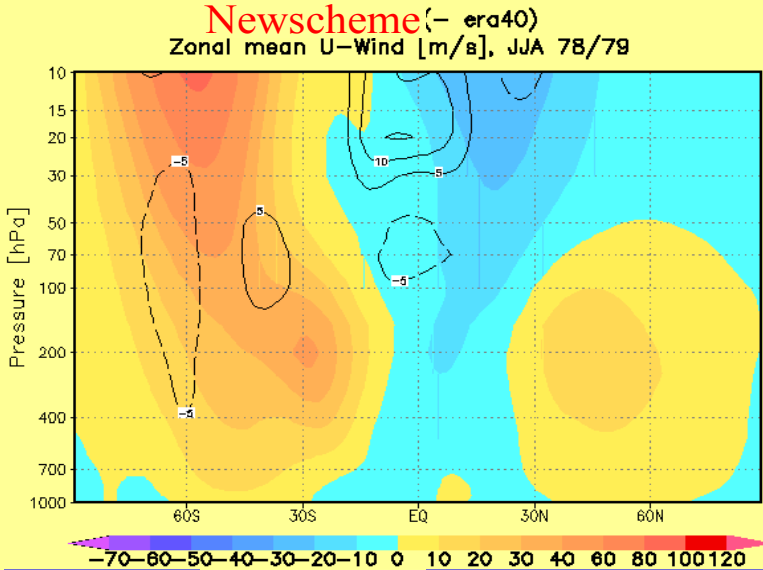
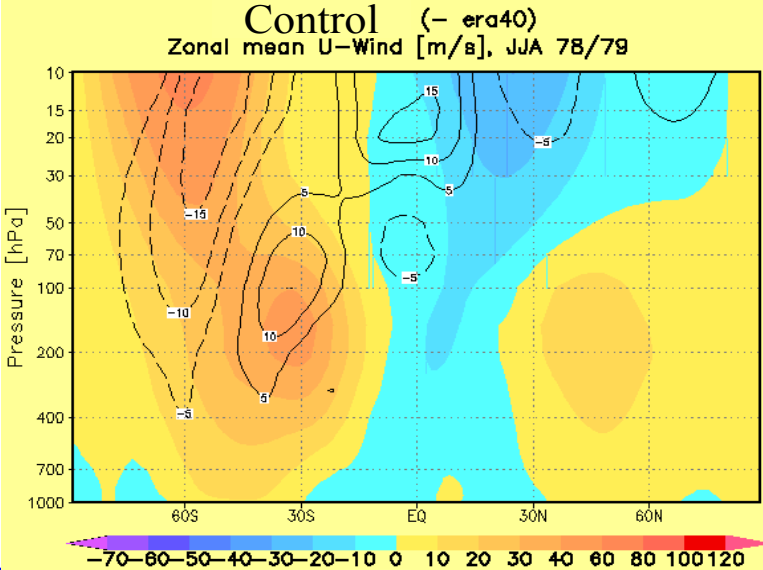
Only in most recent results

Cccmarad – results

- Climate-AMIP runs by B. Dugas, K. Winger
- GEMclim-LAM¹: Evaluation of fluxes against surface stations
- GEMclim-LAM: Evaluation of fluxes, surface radiation budget, clouds by UQAM students
- NWP runs with GEM-Méso, GEM15-strato

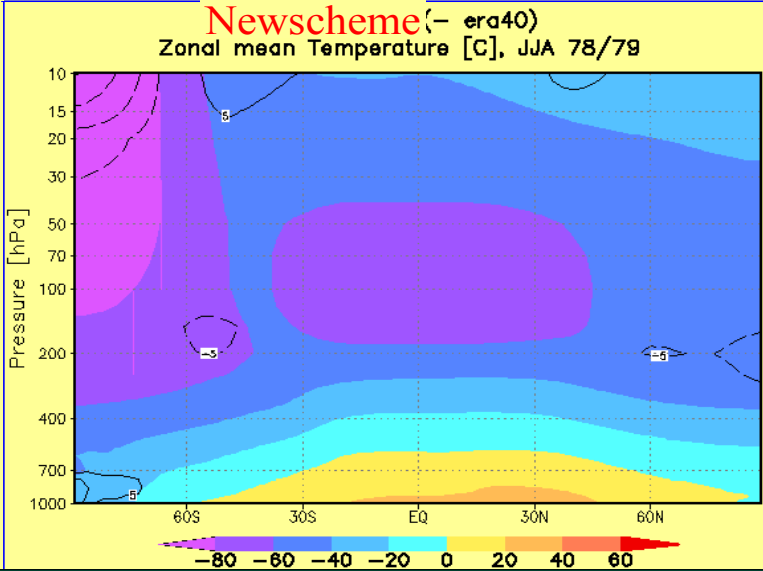
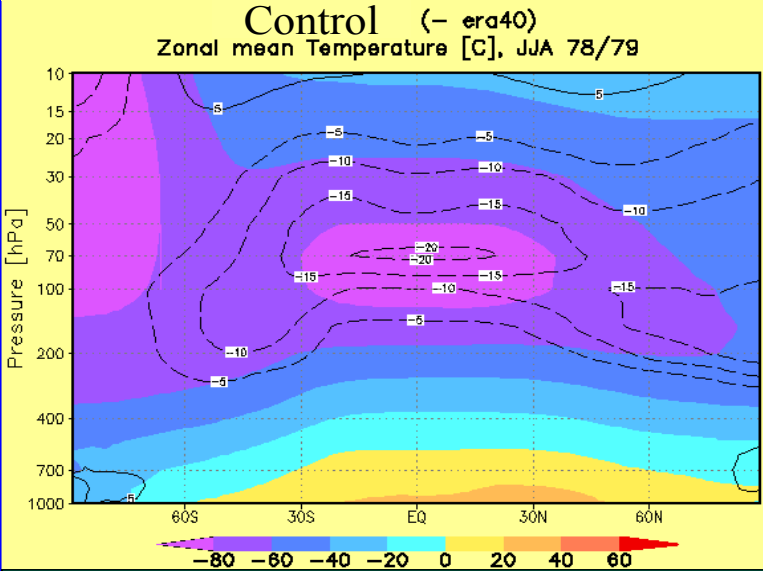
¹ Physics of GEM-Méso + cccmarad

Results in climate runs -GEMclim-global



Impact
significatif à
grande échelle

Zonal mean wind

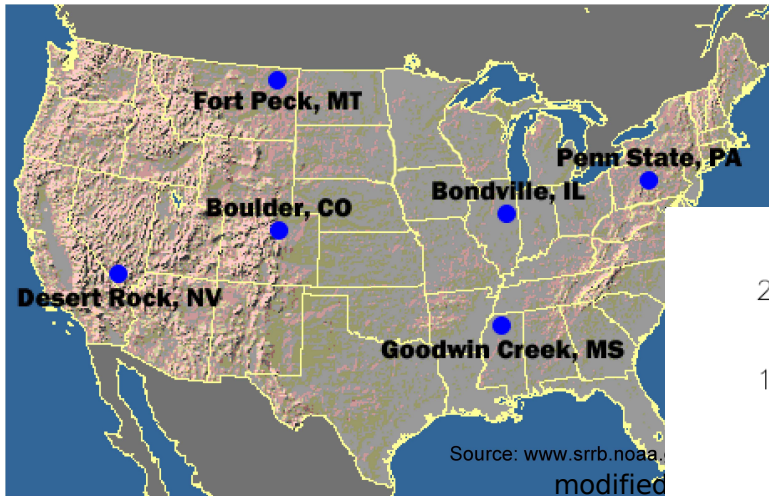


Temperature

Model fields (color) and contours of the difference (model - ERA40) for the average of two summer seasons.

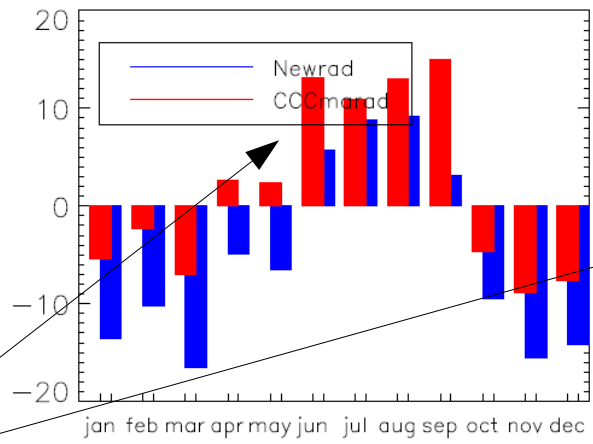
Voir séminaire
de B. Dugas
de mars 2005

Comparaison des flux LW et SW de newrad et cccmarad avec les observations du réseau CAVE

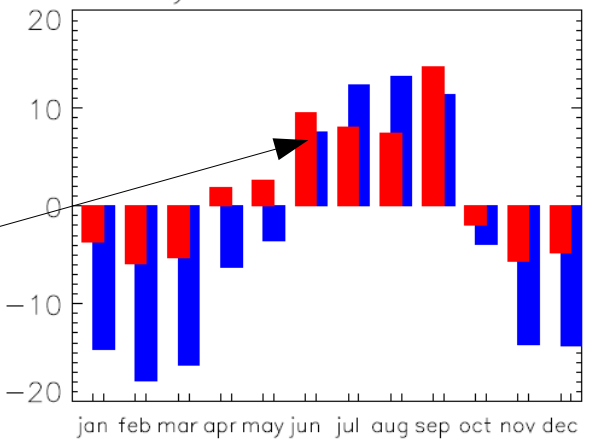


LW_down – cycle annuel du biais

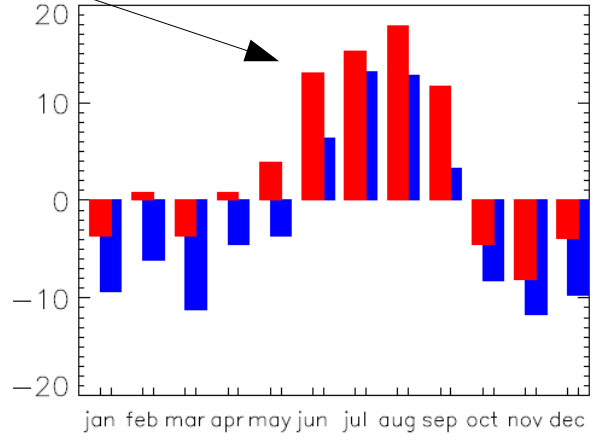
Toutes conditions



Jour-ciel clair



Jour-ciel couvert



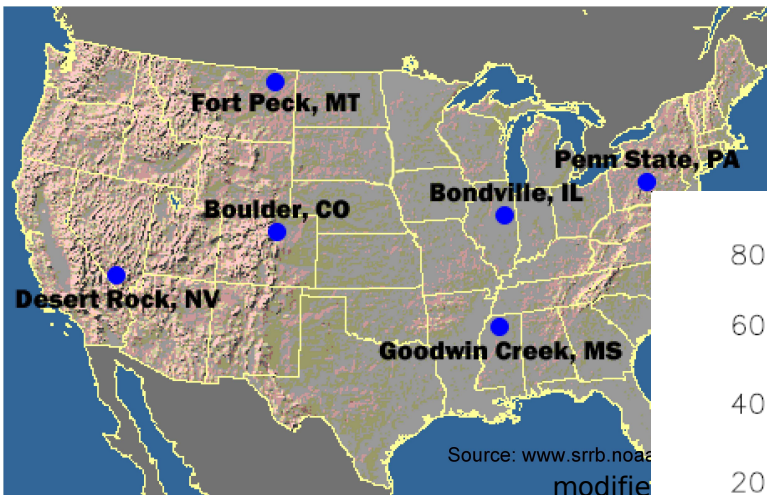
GEMclim-LAM sur l'Amérique du Nord de 2000-2004

Attention: en mode climat, un biais chaud d'environ 5K se développe en été au centre de l'Amérique du Nord.

Note: Fraction nuageuse n'est observée que de jour

Hiver: **réduction significative des biais**

Comparaison des flux LW et SW de newrad et cccmarad avec les observations du réseau CAVE

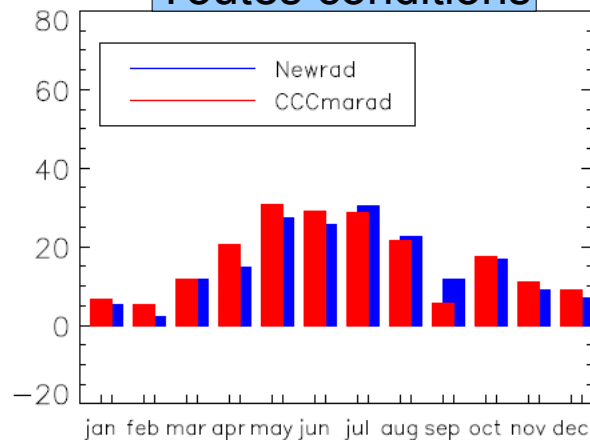


GEMclim-LAM sur l'Amérique du Nord de 2000-2004:

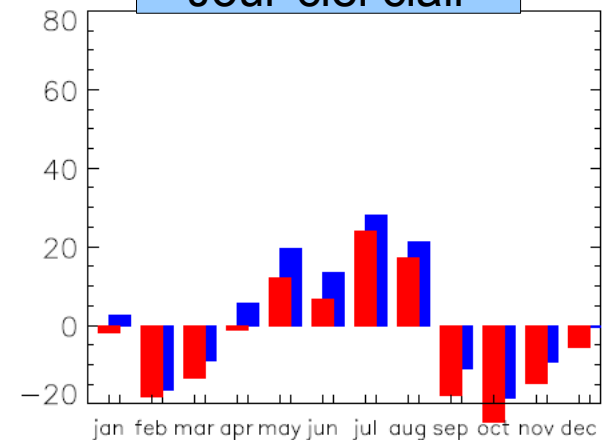
- Biais positif, plus fort en ciel couvert.
- Nuages avec Newrad sont beaucoup plus absorbant
- À refaire avec dernières modifications (diminution de SW_down)

SW_down – cycle annuel du biais

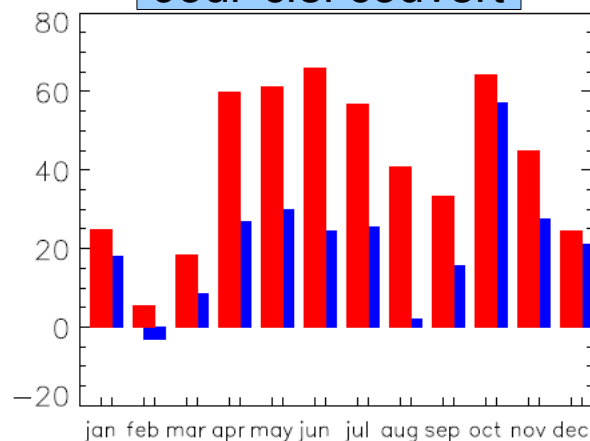
Toutes conditions



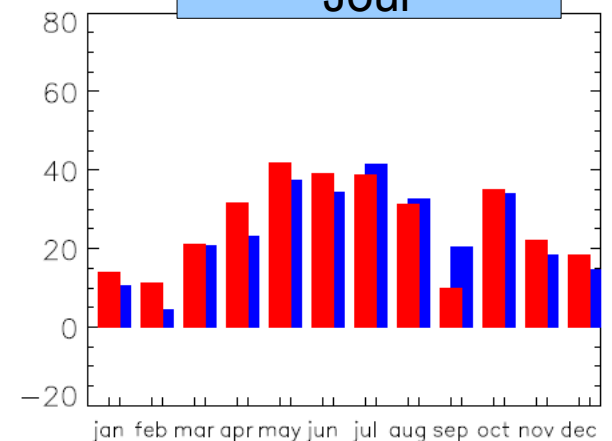
Jour-ciel clair



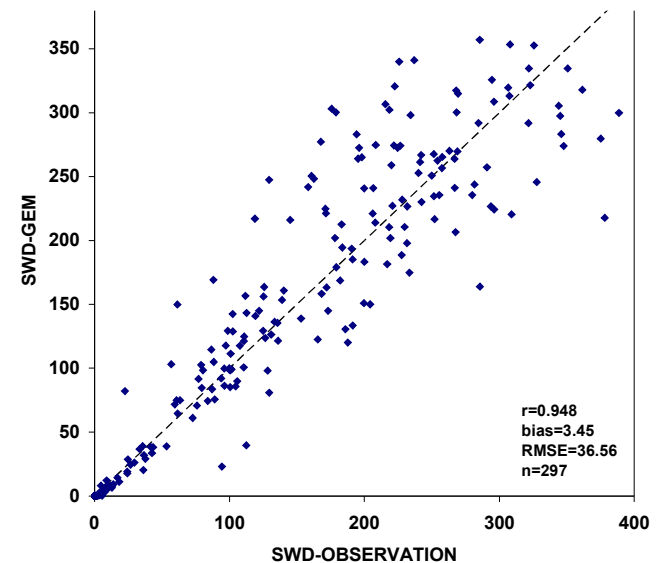
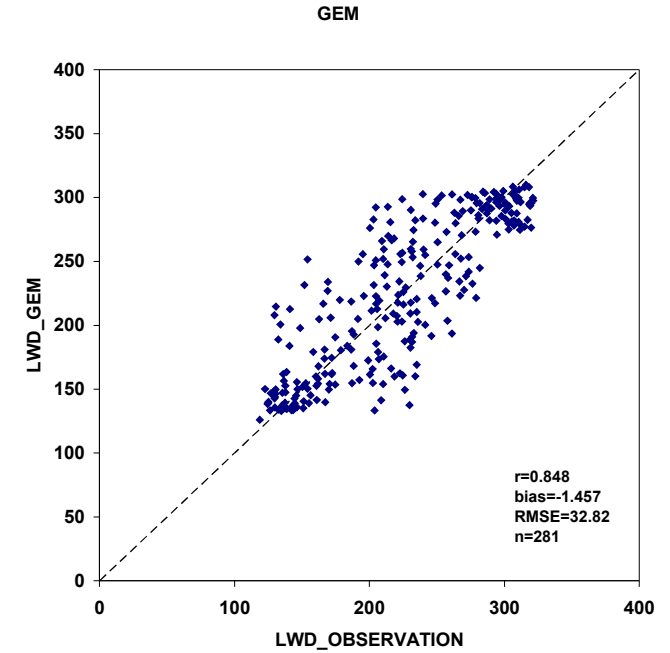
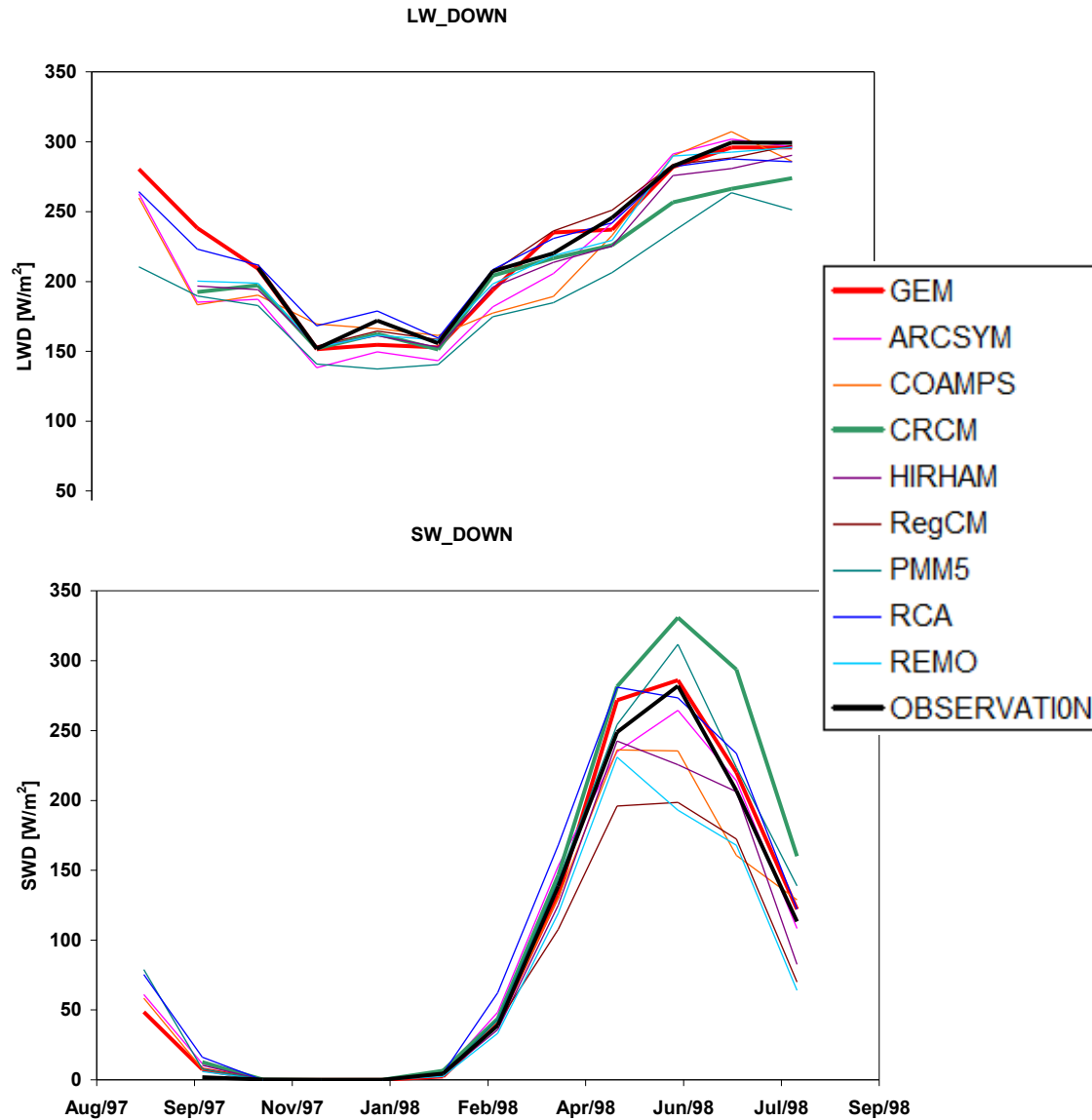
Jour-ciel couvert



Jour

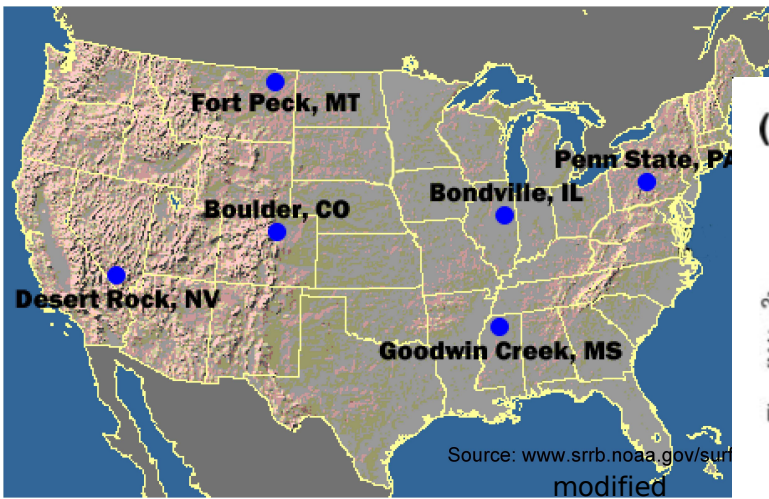


Évaluation des processus radiatifs et des nuages par le modèle GEMclim-LAM pour l'année SHEBA en Arctique (Dragan Simjanovski - UQAM)



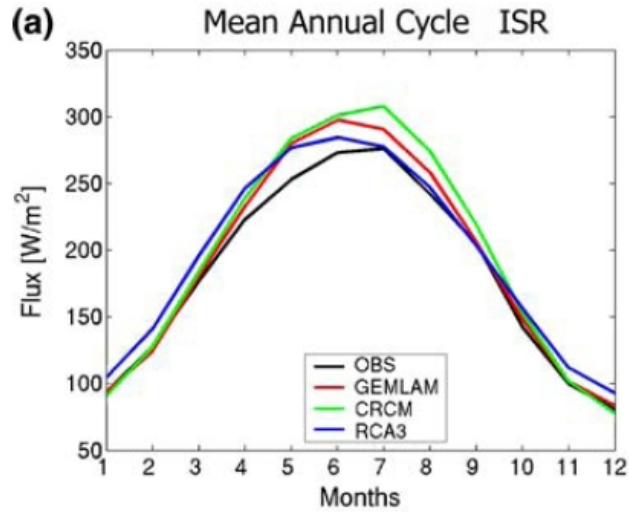
An Evaluation of the Surface Radiation Budget Over North America for a Suite of Regional Climate Models

Marko Marković (UQAM)



Comparaison de trois modèles, dont **GEMclim-LAM**, aux 6 stations SURFRAD de 2000-2004

SW_down



LW_down

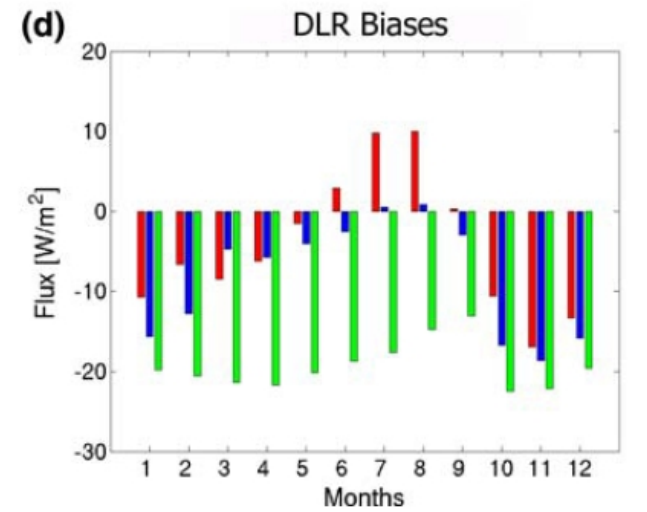
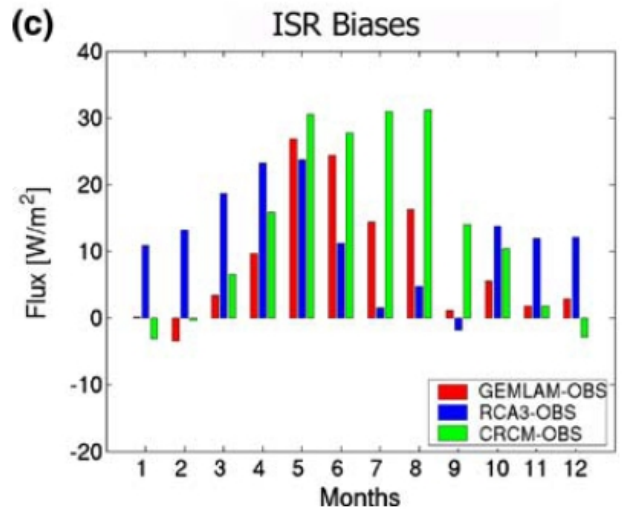
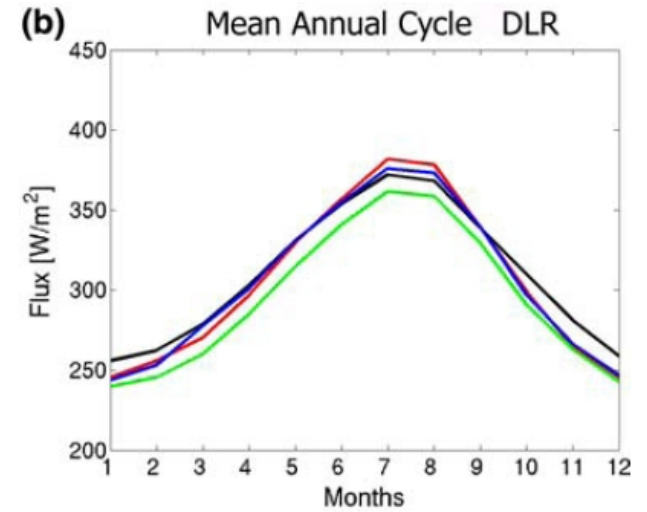
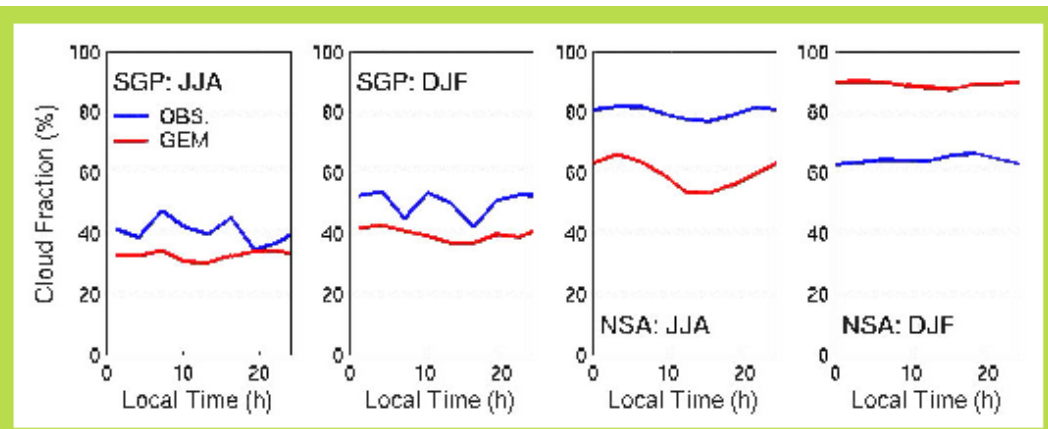
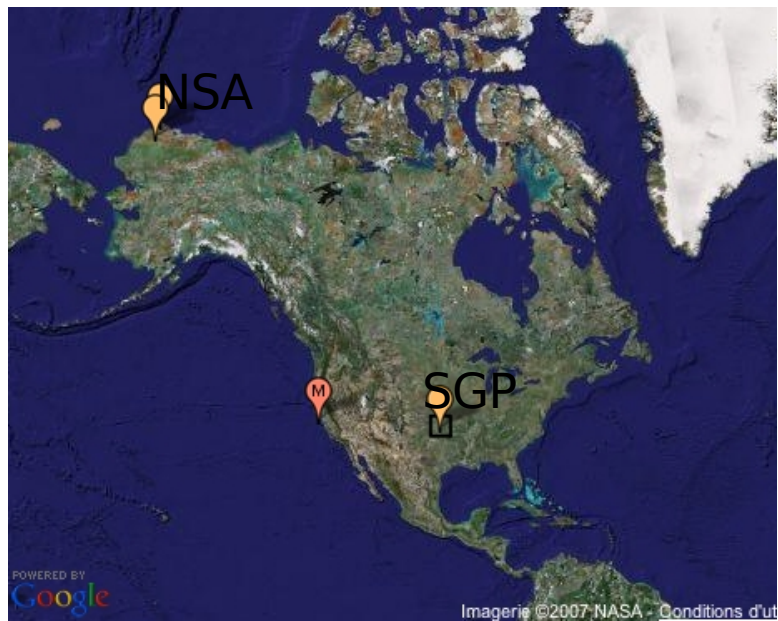


Figure tirée de *Markovic et al., 2008, J. of Clim Dyn.*

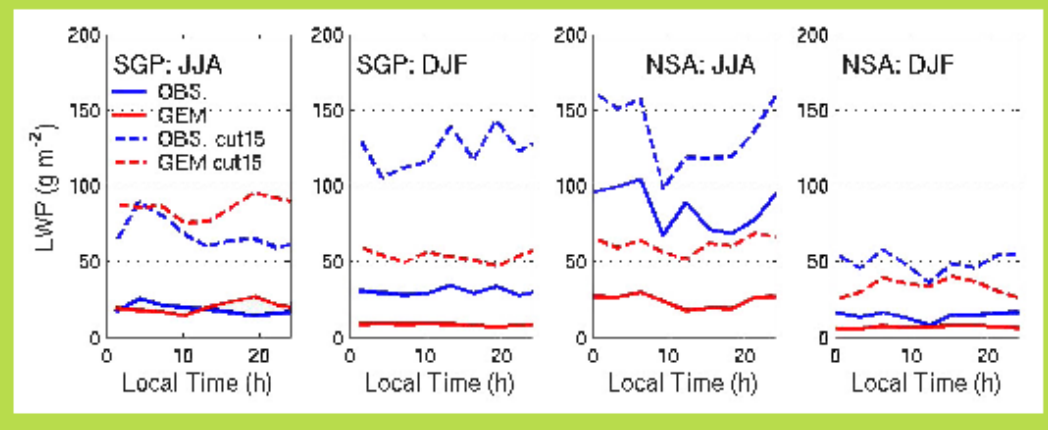
Using ARM surface cloud and radiation observations to evaluate simulated cloud-radiation processes in climate and NWP models (soumis à MWR)

Danahé Paquin-Ricard (UQAM)

Danahé tente de comprendre les biais SW et LW en évaluant la fraction nuageuse, le condensé liquide intégré, la précipitation.



Fraction nuageuse généralement trop faible

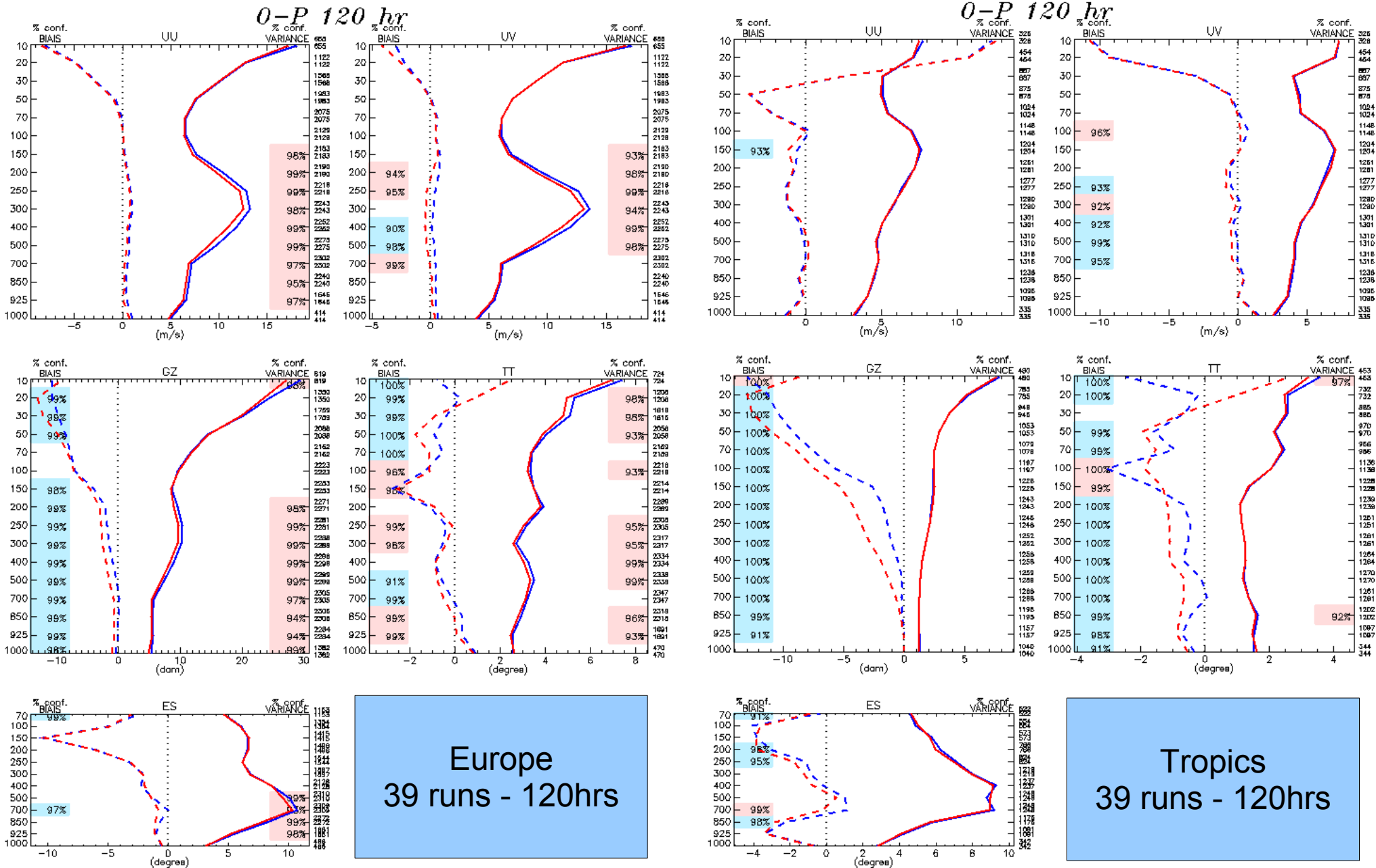


LWP généralement trop faible

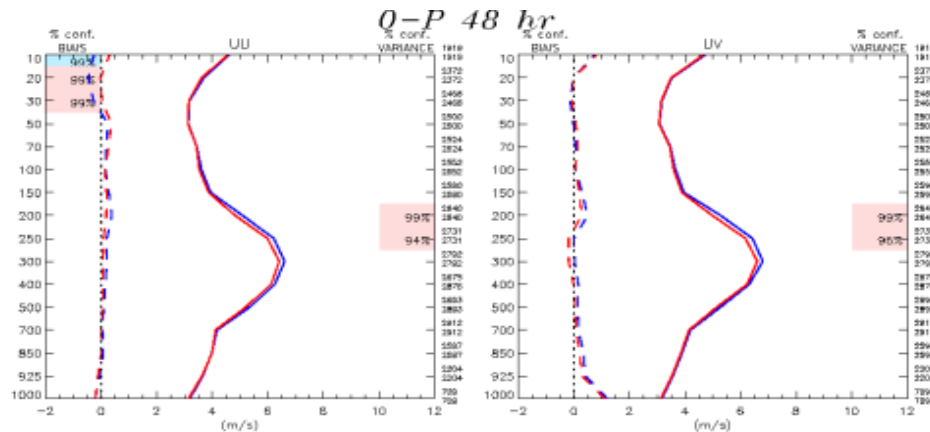
Comparaison de GEMclim-LAM, à deux stations ARM (Alaska, Oklahoma) de 1999-2005

Hypothèse: Sundqvist produit de la précipitation pour de trop faible contenu en eau nuageuse → nuages optiquement trop mince

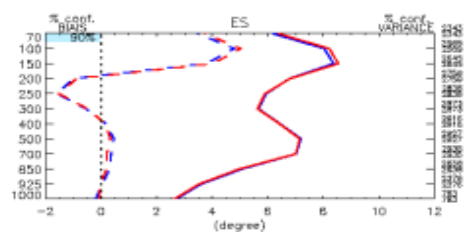
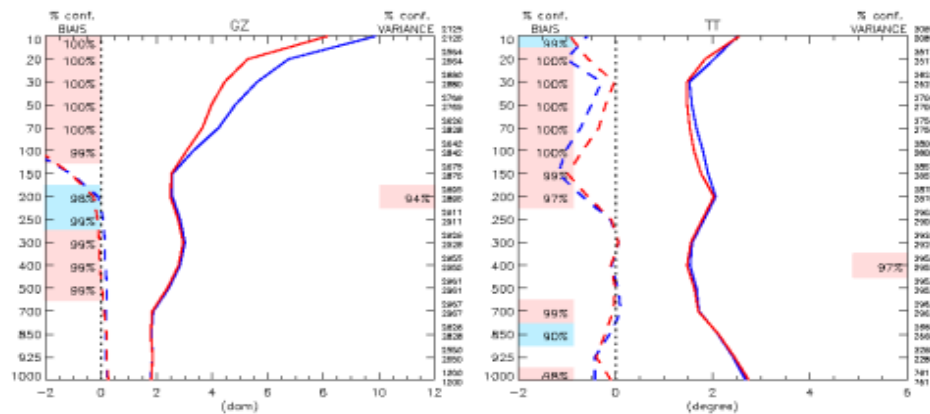
Cccmarad – initial NWP results with GEM-Méso



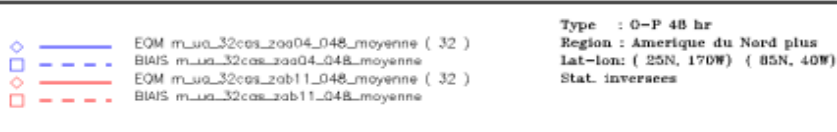
Comparaison des schémas radiatifs dans GEM15-strato (0.1 hPa)



Pas de comportement étrange dans la basse stratosphère lorsque le toit est élevé



Hiver
Am. Nord +
32 cas - 48hrs



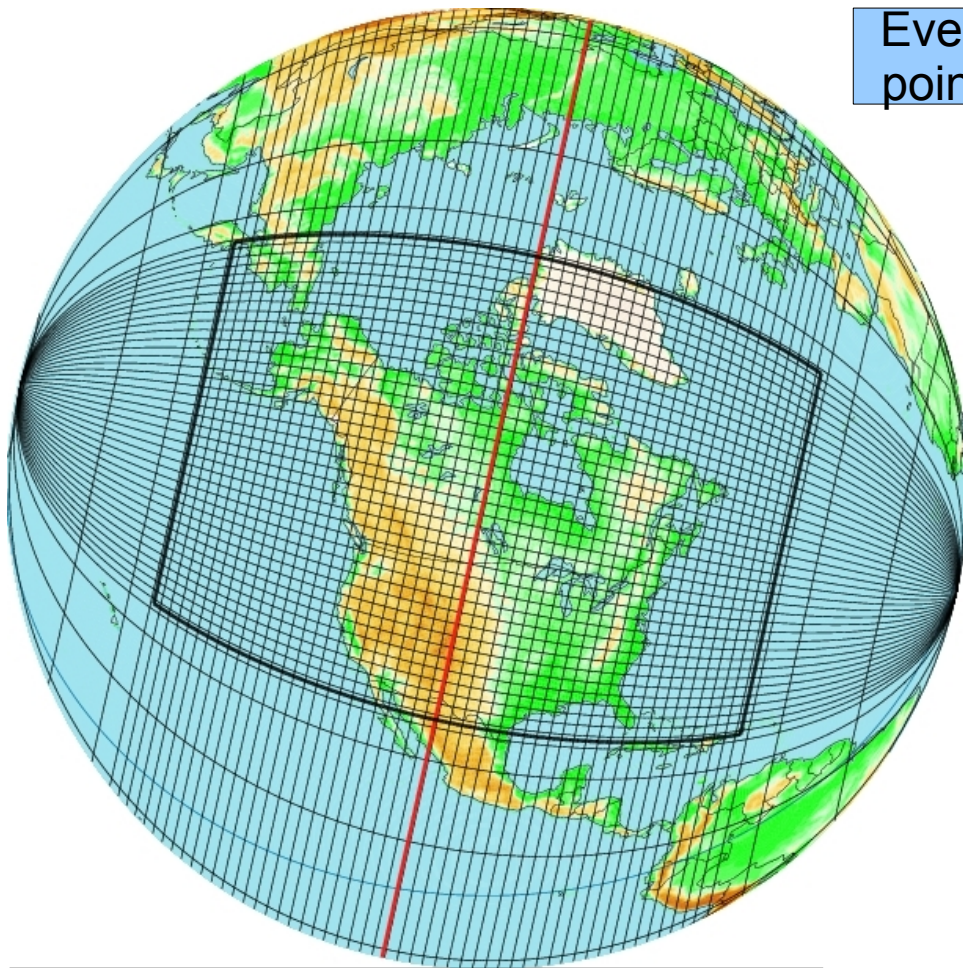
A) Radiative transfer – futur work

- Code band flux outputs
- CCCma code upgrade (CH₄ sw absorption)
- Improve parameterisation of ice effective radius (test Boudala et al. 2008)
- Improve aerosol climatology (I. Paunova)
- Improve link to microphysics (test new cloud schemes, McICA approach – F. Chosson, D. Paquin-Ricard, J. Milbrandt)
- Improve land and ocean surface albedo and emissivity

B) Modification du GEM15 - description

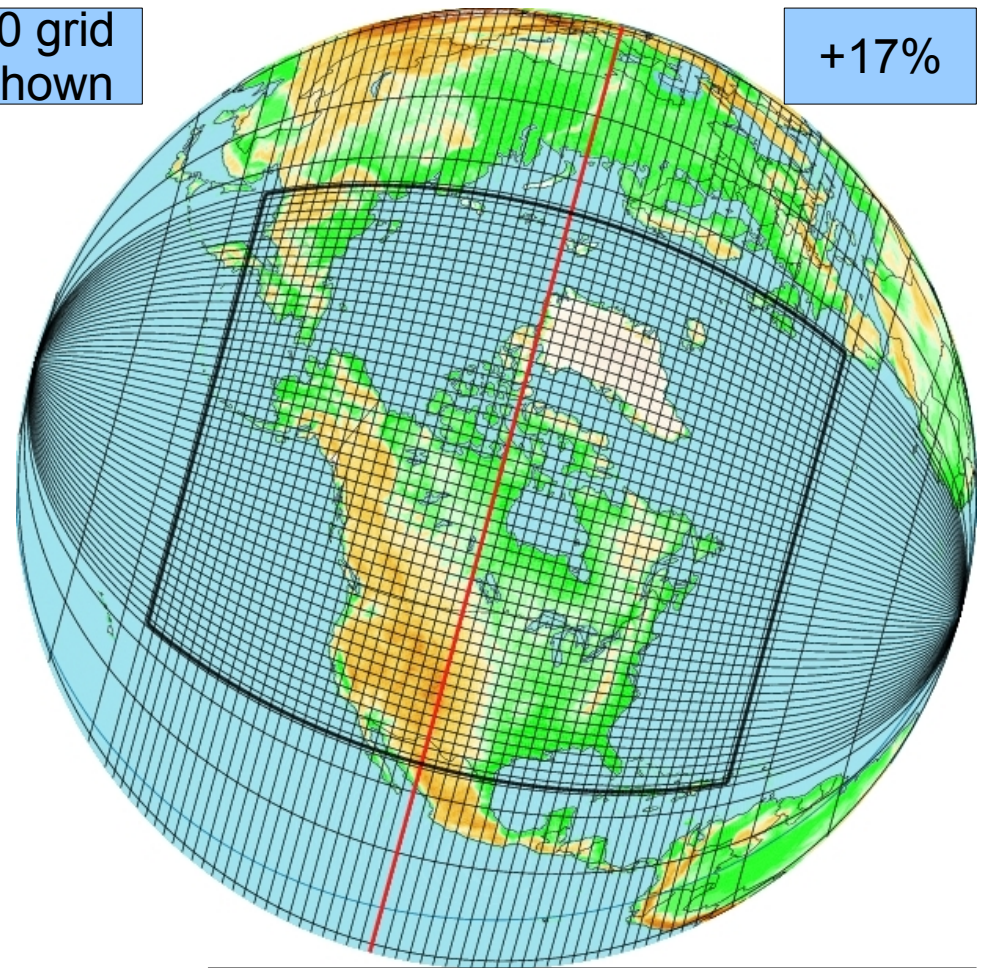
- Nouveau schéma de transfert radiatif: **Cccmarad**
 - Justification: Diminuer le biais froid de surface
- Grille étendue
 - Justification: Engagement du CMC pour IPY
- Nouveaux champs géophysiques
 - Justification: Grille étendue, cohérence avec GEM-Méso, bugfixs
- Bugfixs
- Librairies: dyn-3.3.1 phy-4.6
 - Justification: Gem15 opérationnel sur la même librairie que Gem-Méso-Strato, ISST

B) Modification du GEM15 – Grille étendue



Every 10 grid points shown

Grd_ni = 575 , Grd_nj = 641
Grd_nila= 432 , Grd_njla = 565



+17%

Grd_ni = 671 , Grd_nj = 641
Grd_nila= 532 , Grd_njla = 565

B) GEM15: Nouveaux champs géophysiques

Report: Generation of geophysical fields for the extended (polar) version of the regional model

by A. Zadra, July 2008

Available at :

http://iweb.cmc.ec.gc.ca/~armnaza/TAWEPI_documents.html

Methodology

Criteria for choice of **databases**:

- consistency with mesoglobal
- elimination of a few problems (e.g. non-realistic values)

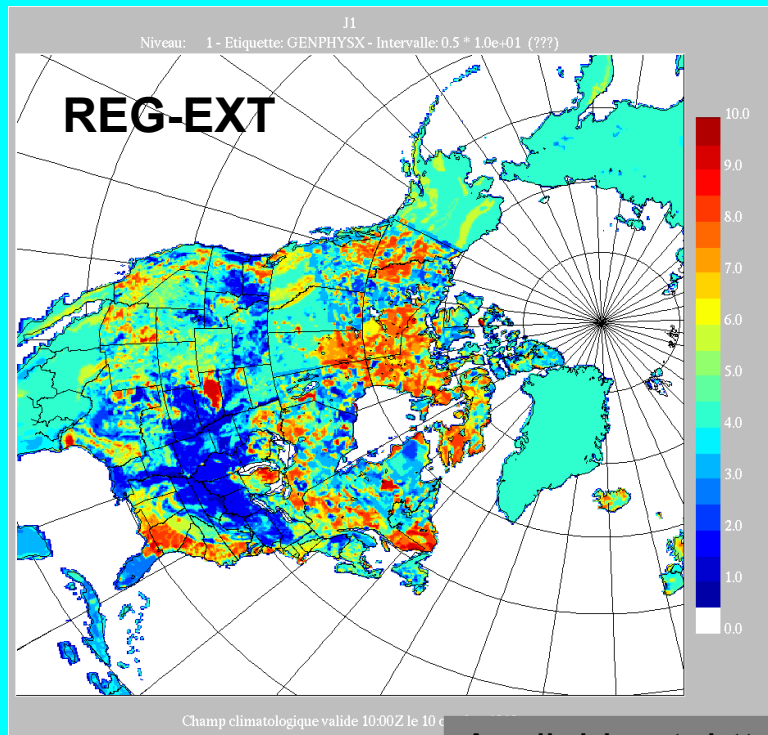
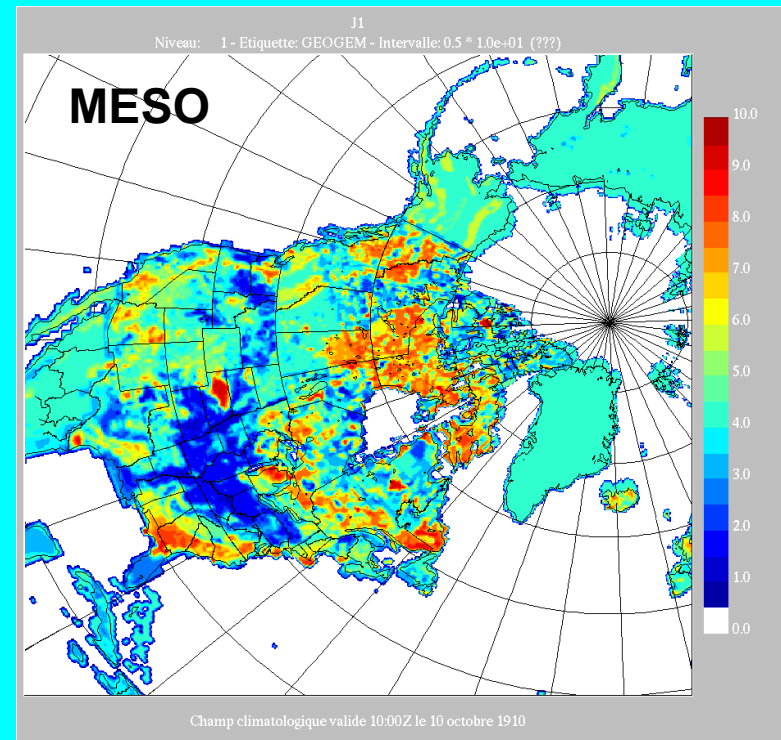
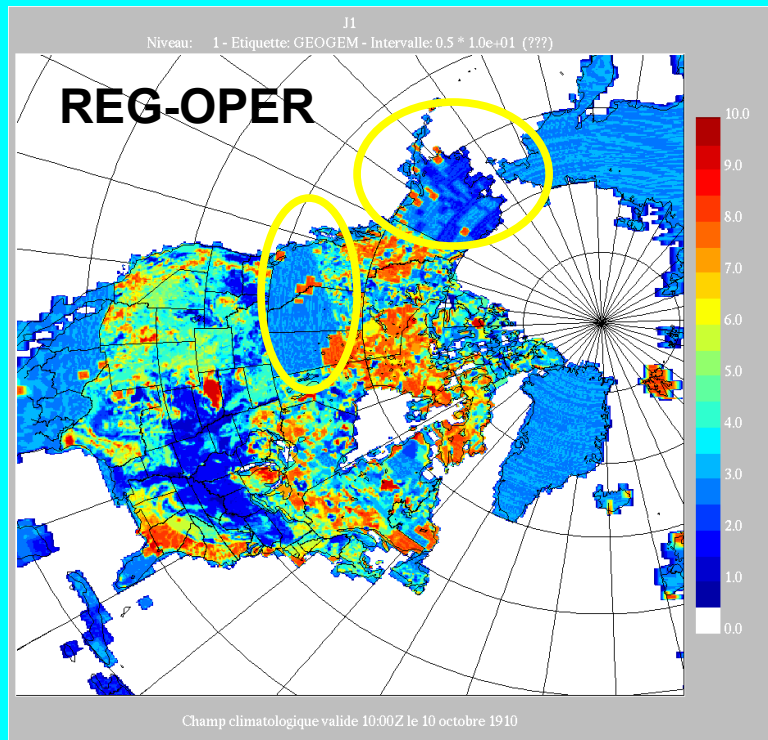
Using **GenPhysX**¹ to generate simple-average fields:

- allows usage of “cleaned” databases (e.g. for sand/clay fraction)
- expected neutral impact (based on previous tests with mesoglobal & regional)

Using **auto_genesis** to generate subgrid-scale fields:

- decision to postpone use of new formulas of GenPhysX since they have not yet been validated (this may require re-balancing some physics parametrizations)

¹ J.P. Gauthier, A. Leroux, S. Bélair, L. Chardon, A. Zadra



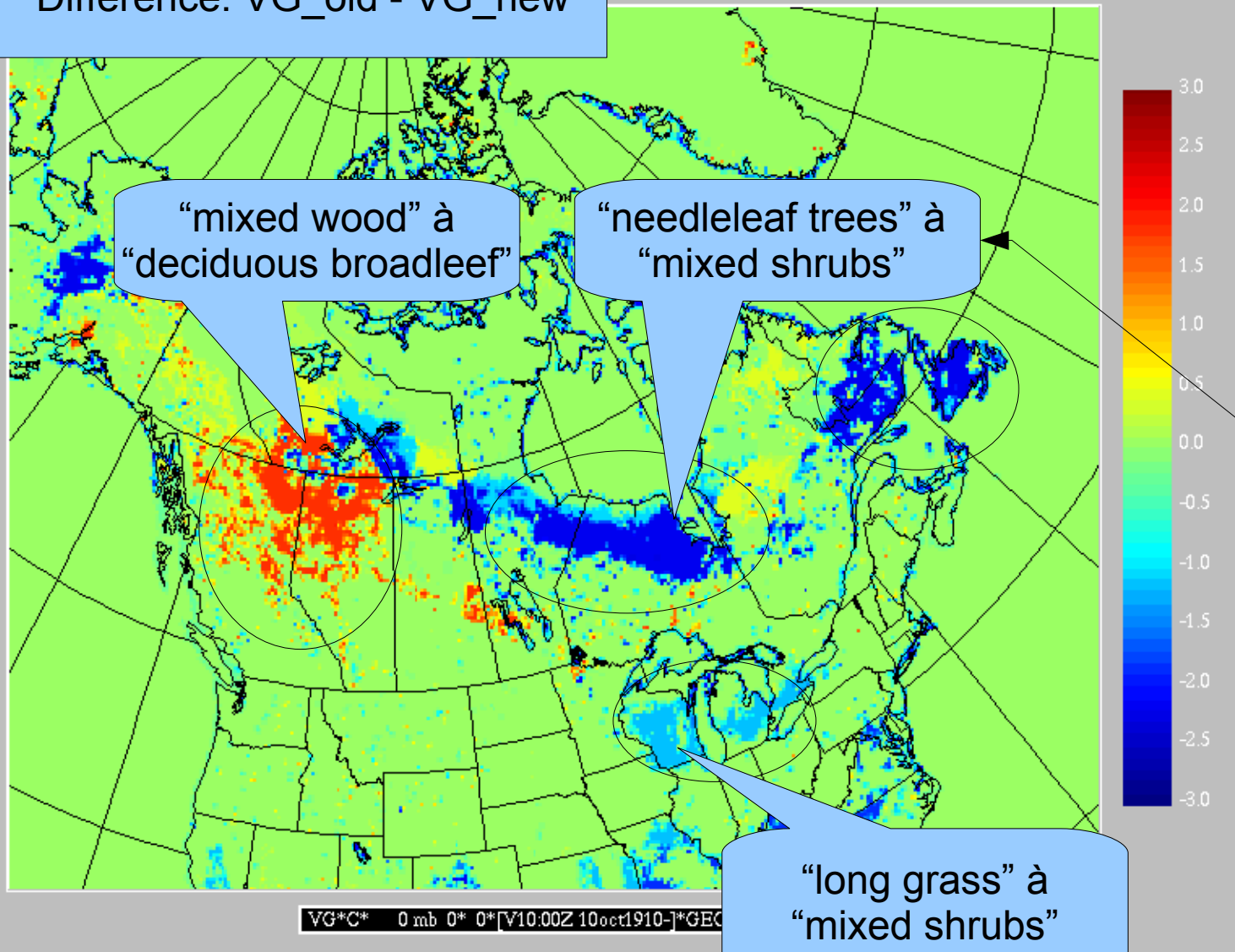
Field:
J1(1) = sand fraction, level 1

Issue:
Local differences/inconsistencies
between operational regional and
mesoglobal

B) GEM15: Nouveaux champs géophysiques

VG - type de végétation dominant

Difference: VG_old - VG_new

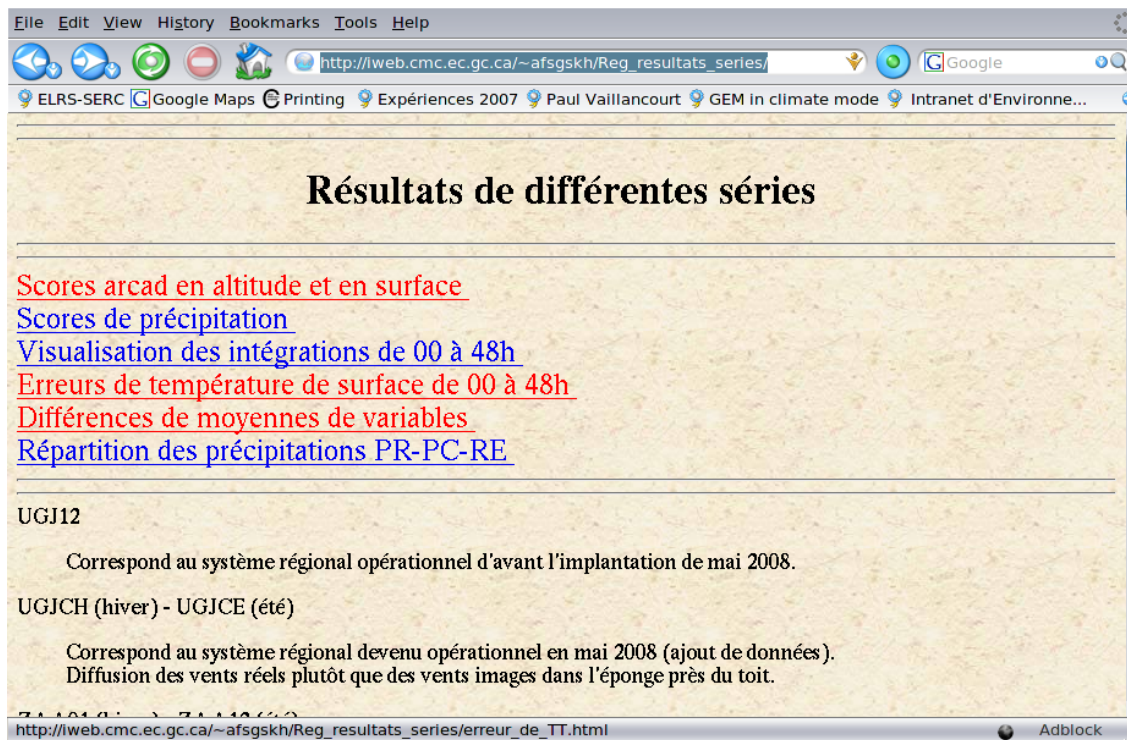


B) Modification du GEM15 – Bugfixs (inclus dans phy4.6)

- agrege1 (FL) (correction a l'agrégation)
- flxsurf3 (LS) (facteur beta et précision accrue pour certains calculs)
- moistke4 (AML) (z0 manquant pour le calcul de ZN)
- ebudget1 (SB) (correctif pour éviter réchauffement indue en présence de pluie dans la neige)
- surf_precip2, bourge3d (AML) (lorsque la pluie regèle dans une couche foide, le schéma de surface voit des ice pellets plutôt que de la pluie)

C) Modification du GEM15: résultats

- 40 cas d'hiver: 1er janv 2007 – 28 fév 2007
- 40 cas d'été: 25 juin 2006 – 22 août 2006
- Surface: TT_2m; carte des différences des moyennes
- Surface: TT_2m; scores arcad
- Surface: Précipitation: carte des différences des moyennes
- UA: scores arcad



File Edit View History Bookmarks Tools Help

http://web.cmc.ec.gc.ca/~afsgskh/Reg_resultats_series/

ELRS-SERC Google Maps Printing Expériences 2007 Paul Vaillancourt GEM in climate mode Intranet d'Environne...

Résultats de différentes séries

[Scores arcad en altitude et en surface](#)

[Scores de précipitation](#)

[Visualisation des intégrations de 00 à 48h](#)

[Erreurs de température de surface de 00 à 48h](#)

[Différences de moyennes de variables](#)

[Répartition des précipitations PR-PC-RE](#)

UGJ12

Correspond au système régional opérationnel d'avant l'implantation de mai 2008.

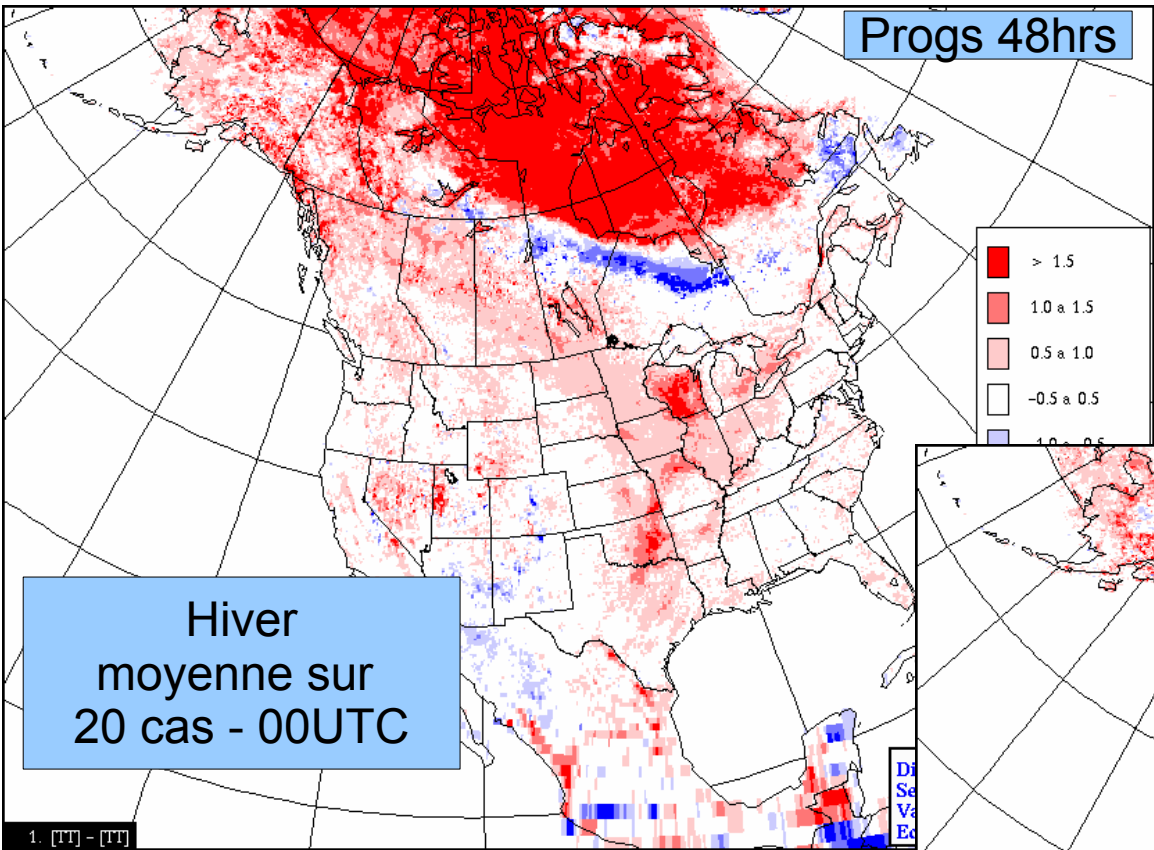
UGJCH (hiver) - UGJCE (été)

Correspond au système régional devenu opérationnel en mai 2008 (ajout de données).
Diffusion des vents réels plutôt que des vents images dans l'éponge près du toit.

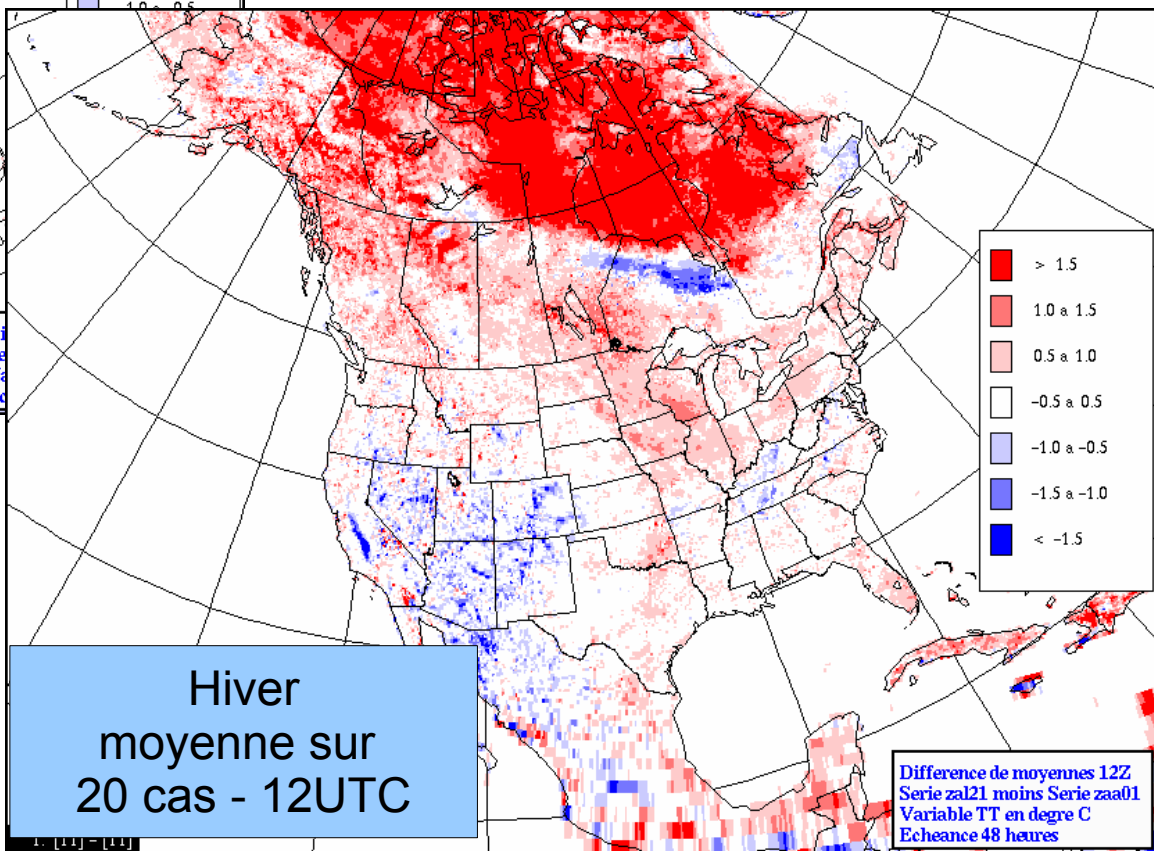
http://web.cmc.ec.gc.ca/~afsgskh/Reg_resultats_series/erreur_de_TT.html

Page iweb de Alain Patoine
http://iweb.cmc.ec.gc.ca/~afsgskh/Reg_resultats_series/

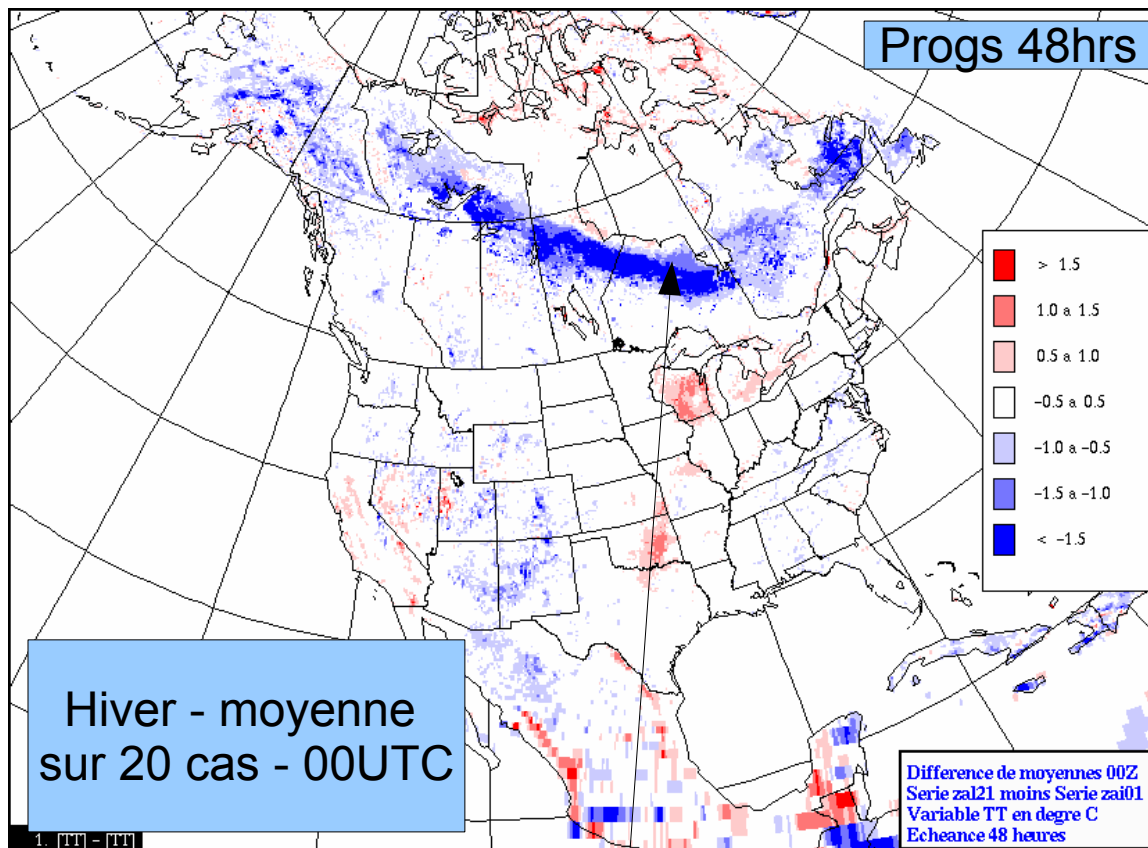
C) Modification du GEM15 - sfc



Différence des moyennes de
TT_2m

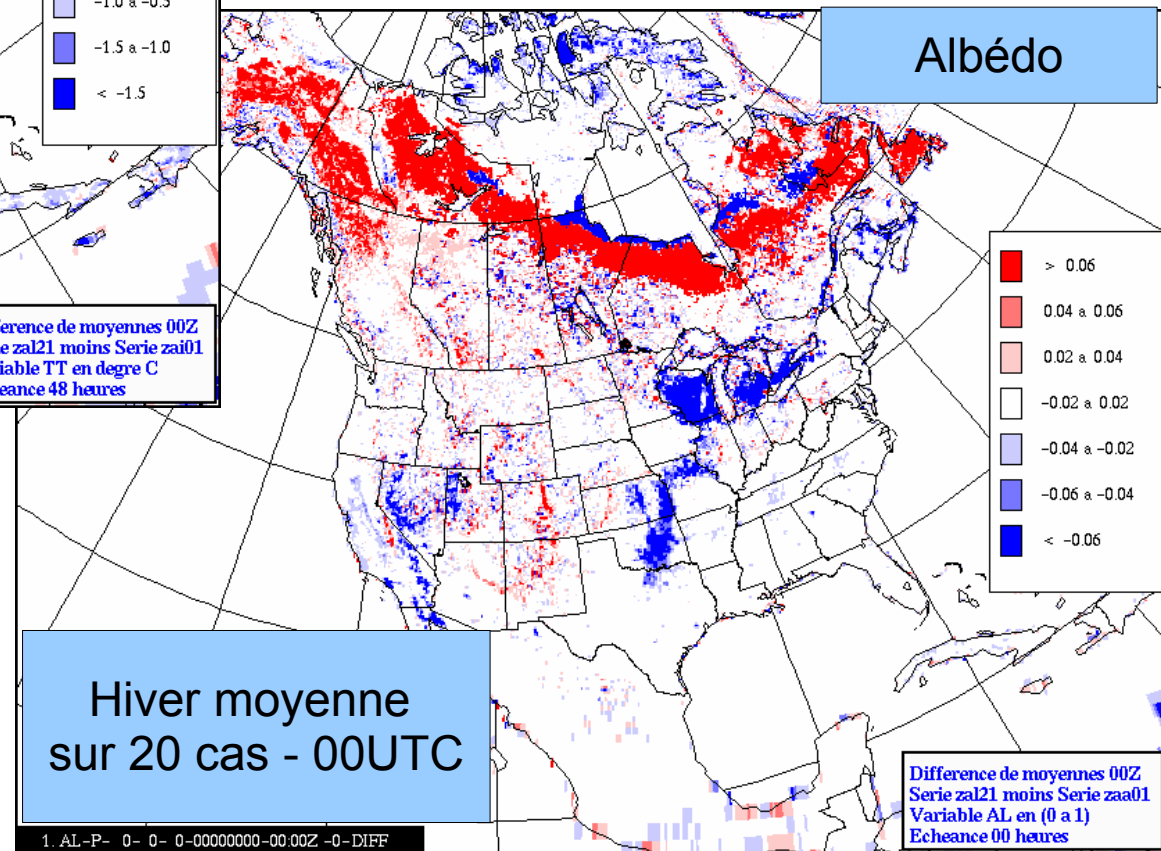


C) Modification du GEM15 – sfc grille + géophys + bugfixs



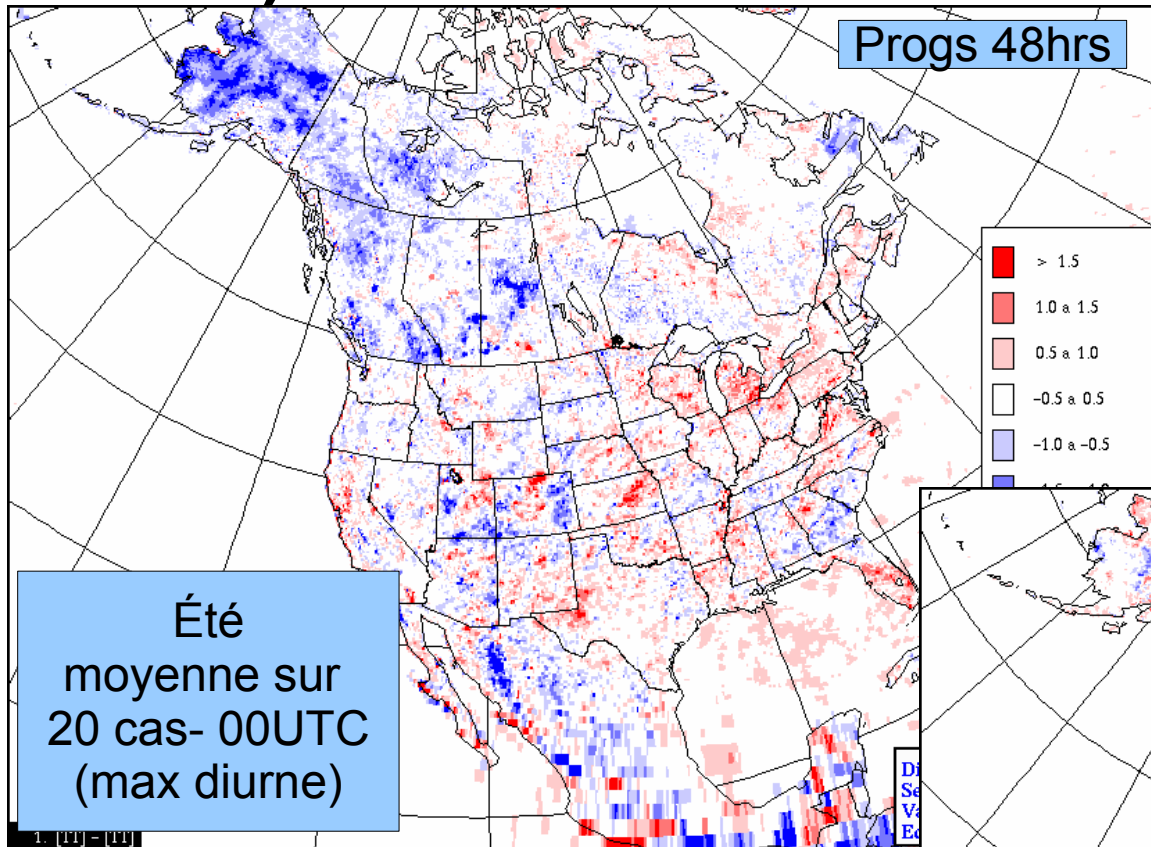
Différence des moyennes de TT_2m provient des changements de champs géophysiques comme VF,ME, J1,J2...

VF change → AL change → TT_2m

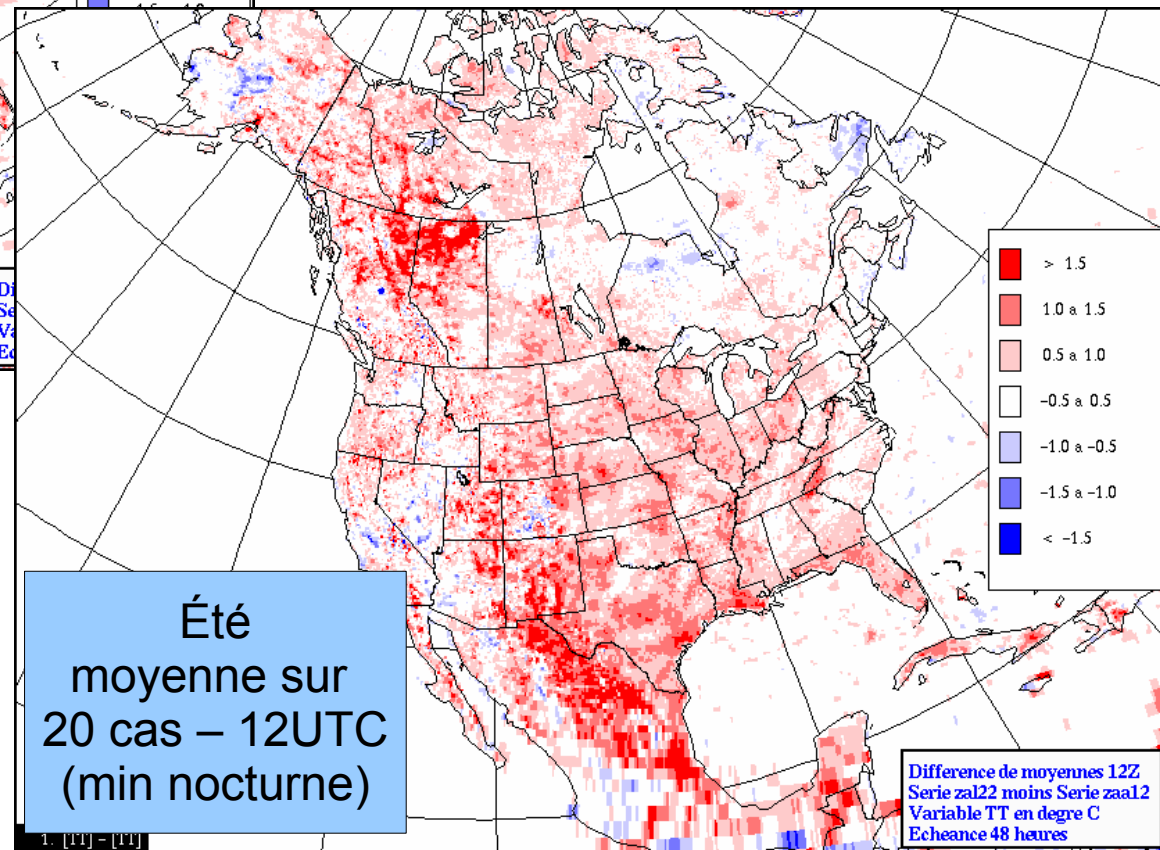


1. AL-P- 0- 0- 0-00000000-00.00Z -0-DIFF

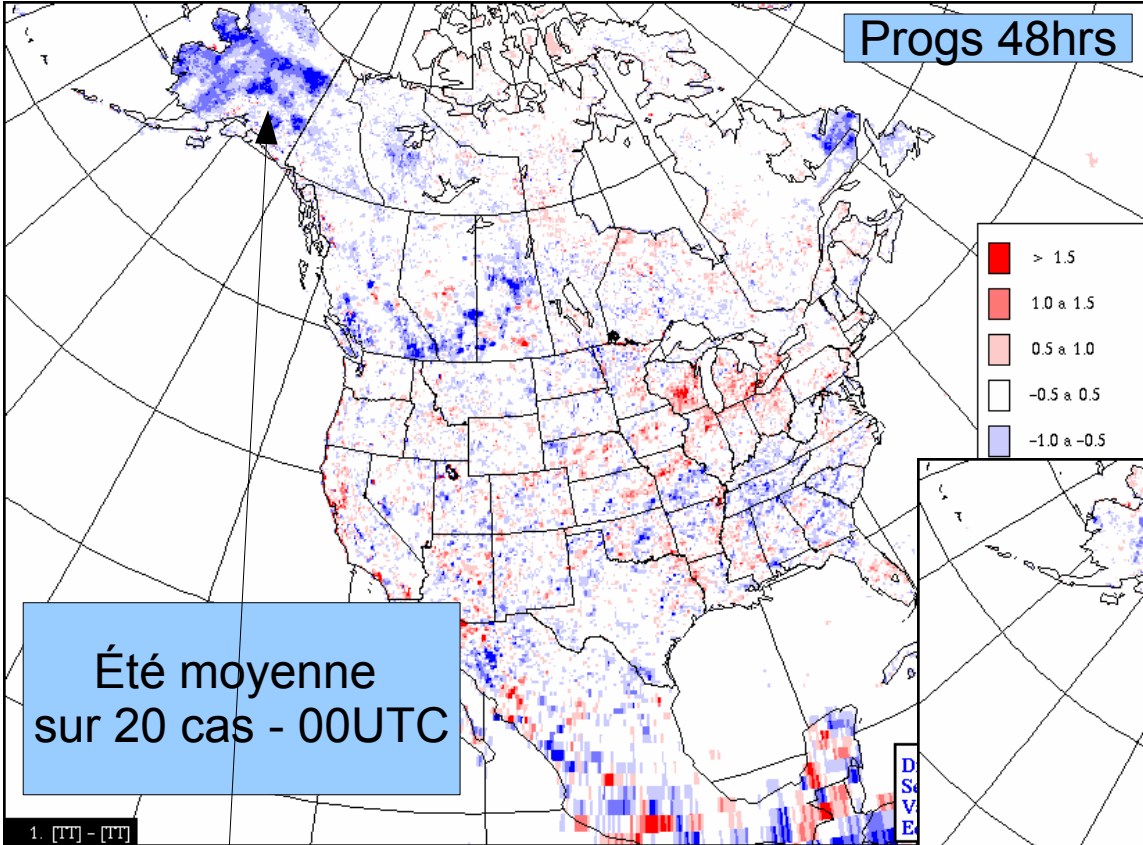
C) Modification du GEM15 - sfc



Différence des moyennes de
TT_2m

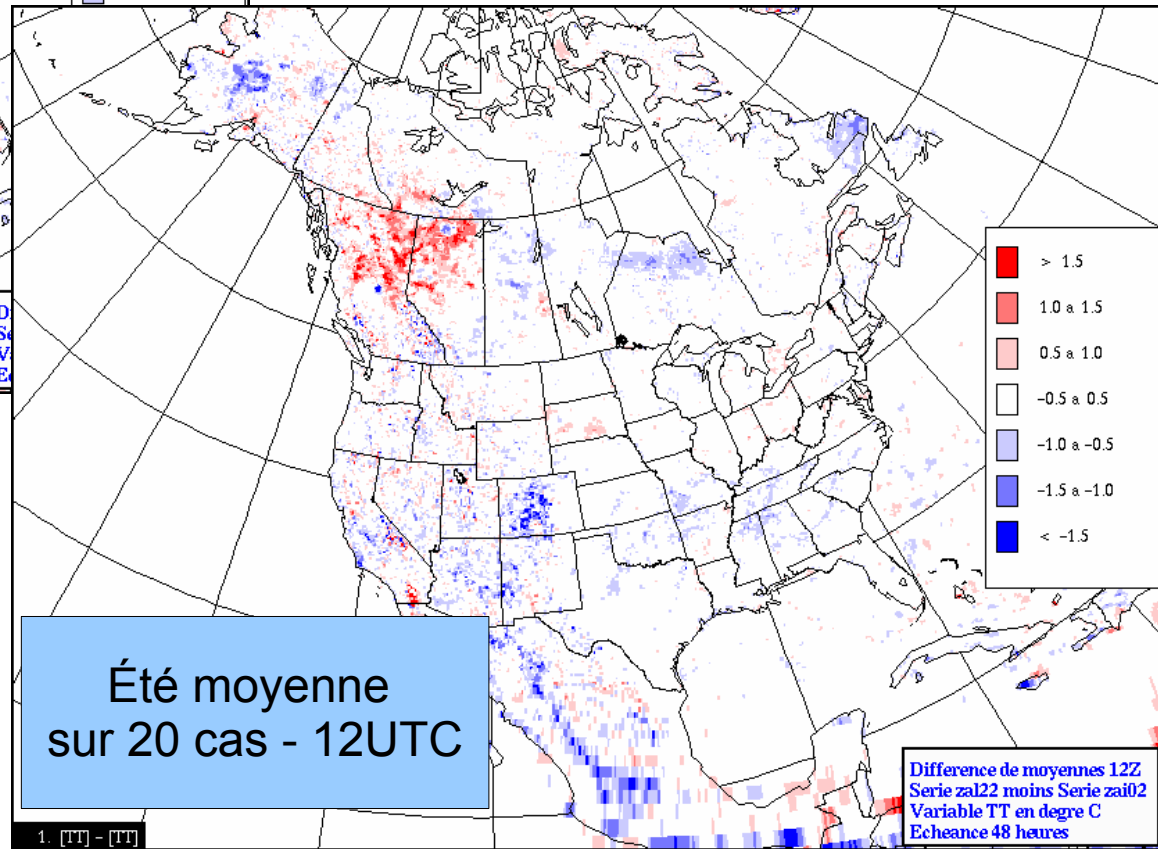


C) Modification du GEM15 – sfc grille + géophy + bugfixs



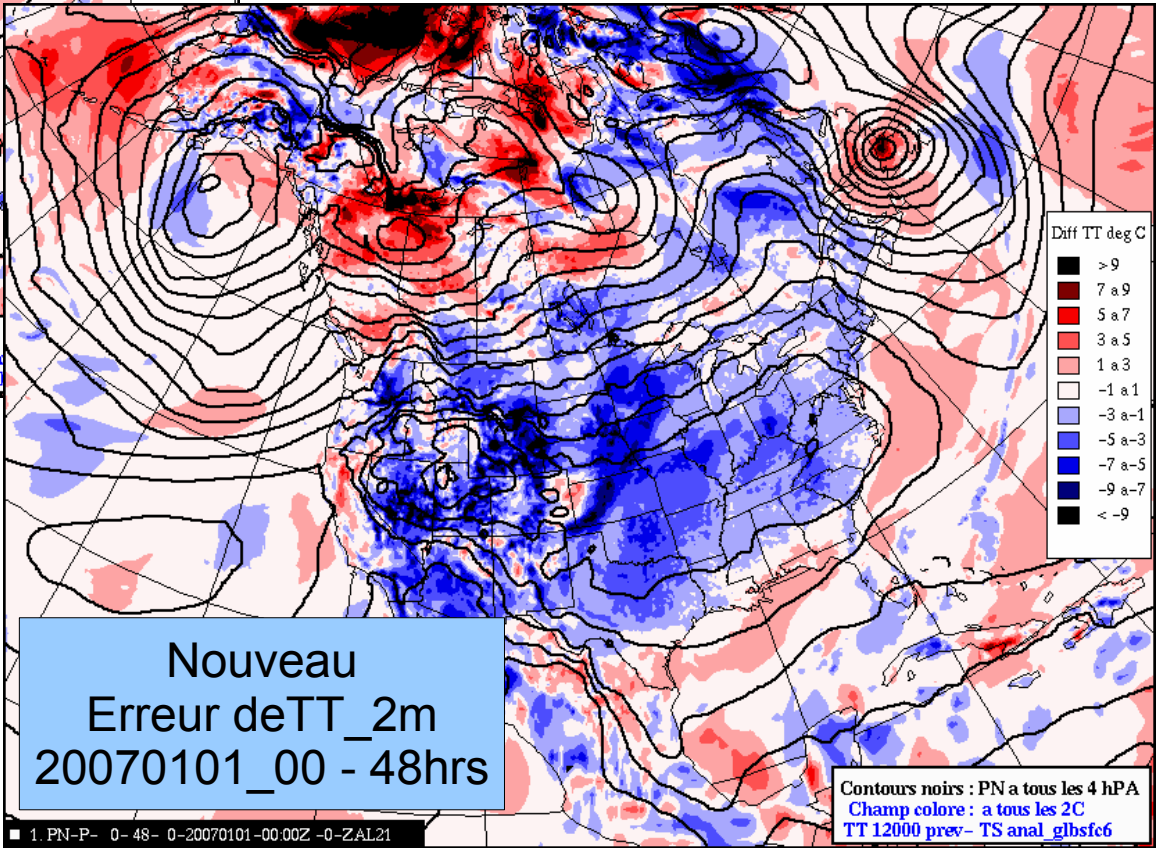
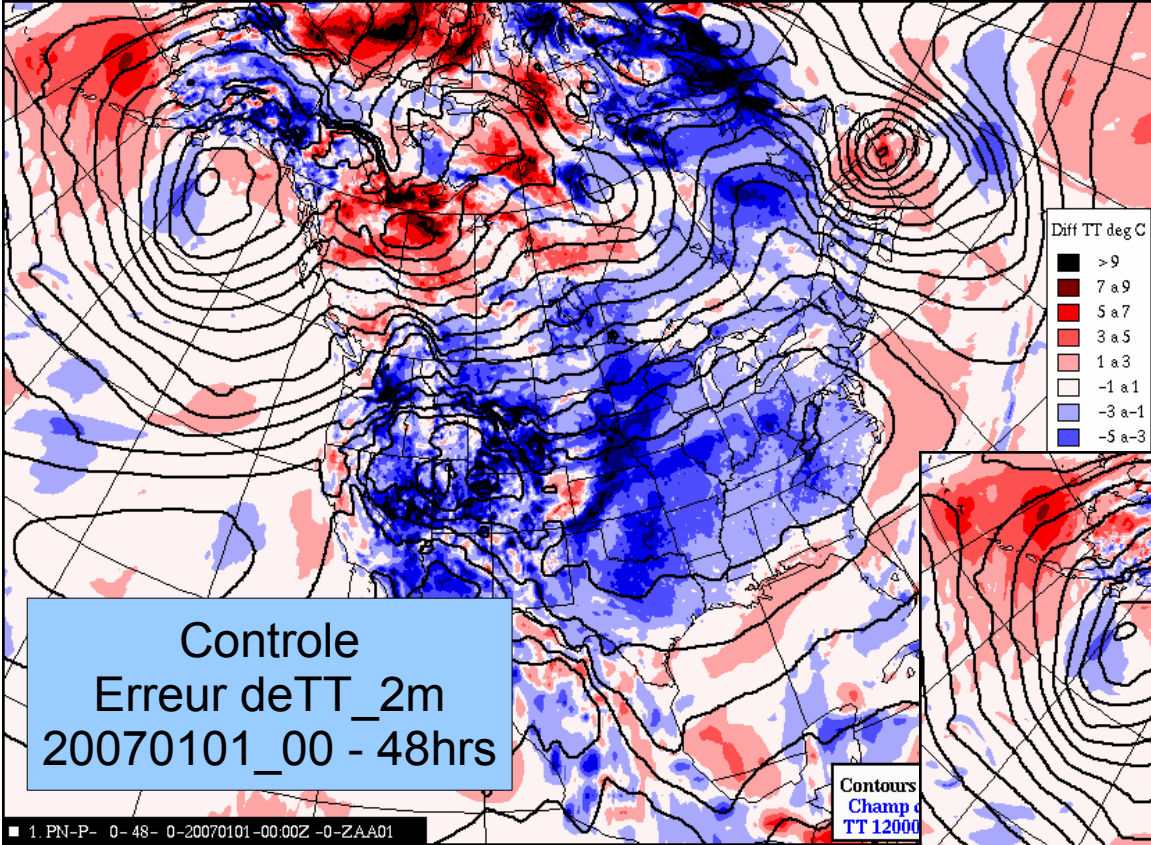
Différence des moyennes de TT_{2m} provient des changements de champs géophysiques comme VF, ME, J1, J2...

J1, J2 change → I1 change → TT_{2m}



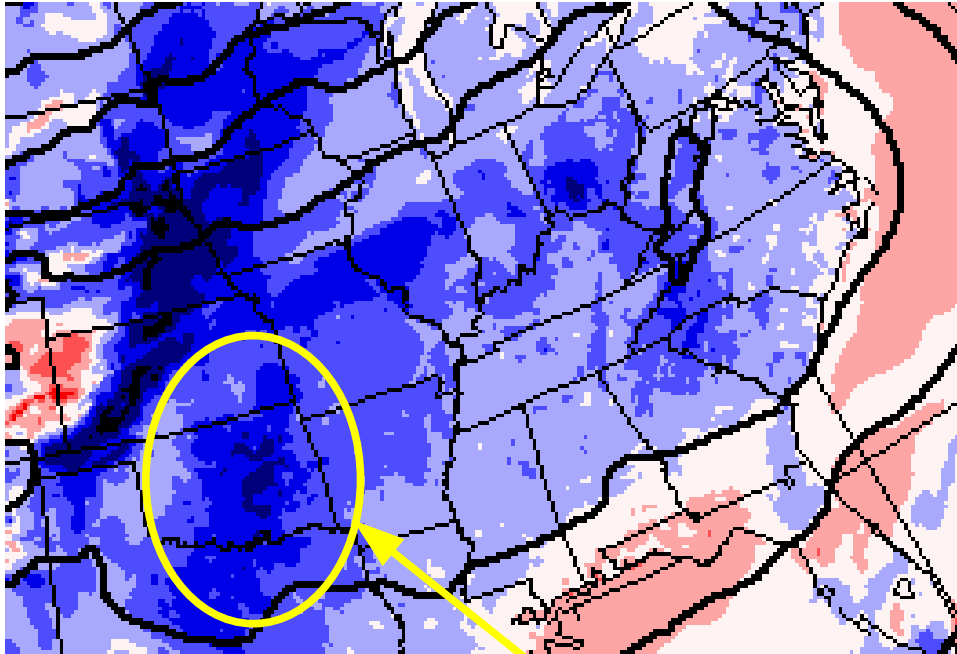
C) Modification du GEM15 - sfc

Cartes d'erreur de TT_2m
(modèle -TS_anal_glbsfc6)
aux 6hrs disponibles sur le
site web de A. Patoine pour
les 80cas été et hiver.

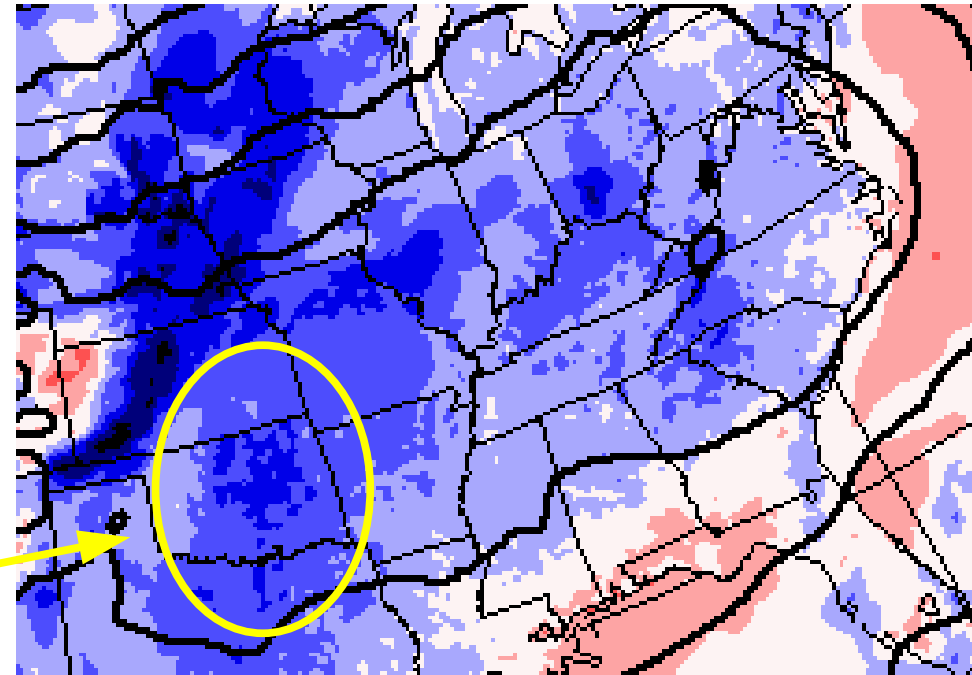


C) Modification du GEM15 - sfc

Progs 48hrs



Controle
Erreur deTT_2m
20070101_00 - 48hrs



Nouveau
Erreur deTT_2m
20070101_00 - 48hrs

Disparition des erreurs dans
l'intervalle -7à-9K, réduction dans
l'intervalle -5à-7K

C) Modification du GEM15 - sfc

Différence du flux LW ↓
moyen sur 48 hrs

- Augmenté en ciel clair (voir sud ouest)
- Augmenté sous les nuages de glace (voir nord)

Hiver
moyenne sur
20 cas- 00UTC

1_AD-P- 0- 48- 0-19101008-10.00Z -1-DIFF

Diff
Seri
Var
Ech

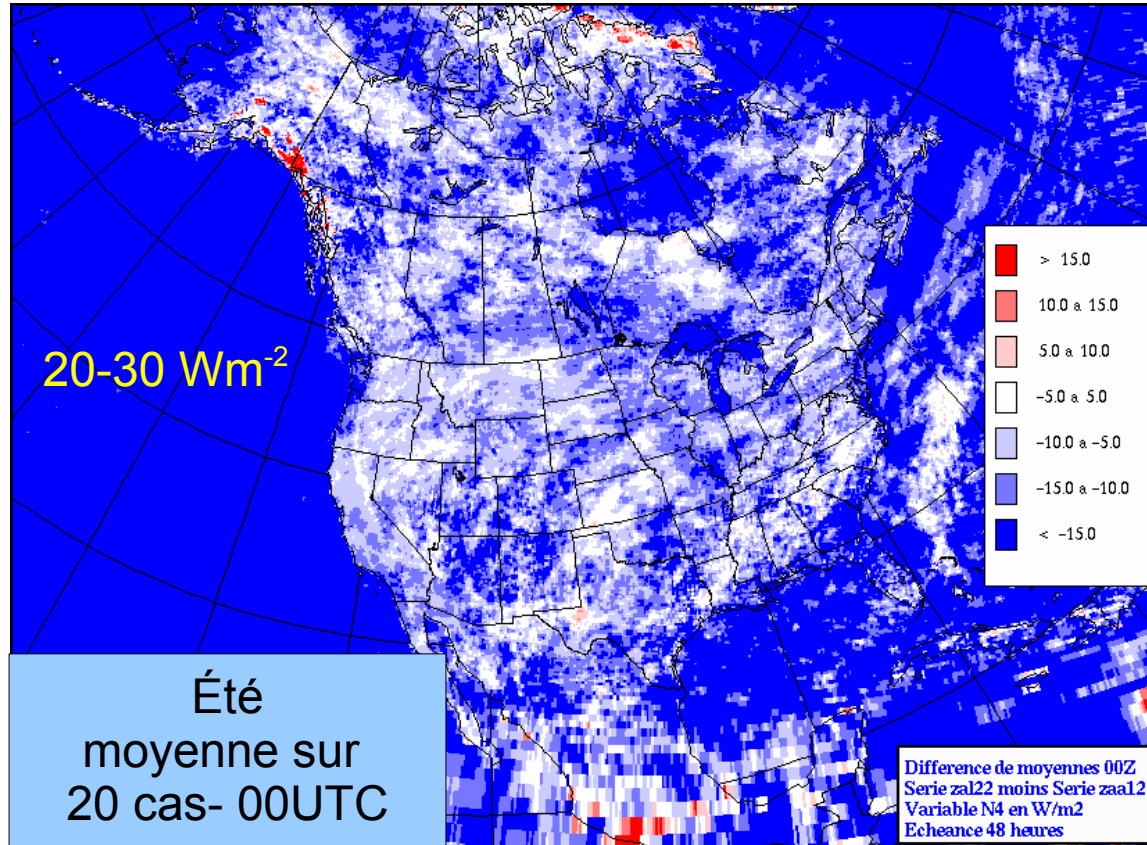
Impact sur TT_2m de
cccmrad vient surtout
de l'augmentation du flux d'ondes
longues

Été
moyenne sur
20 cas- 00UTC

1_AD-P- 0- 48- 0-19101008-10.00Z -1-DIFF

Difference de moyennes 00Z
Serie za122 moins Serie zaal2
Variable AD en W/m2
Echeance 48 heures

C) Modification du GEM15 - sfc



Différence du flux SW ↓
moyen sur 48 hrs

- Diminution de la moyenne globale de 10 Wm^{-2}
- Diminue en ciel clair (gaz sont plus absorbants avec cccmarad)
- Diminue en ciel nuageux (nuages sont moins absorbants mais plus réfléchissant)
- Contraste terre-mer, glaciers?

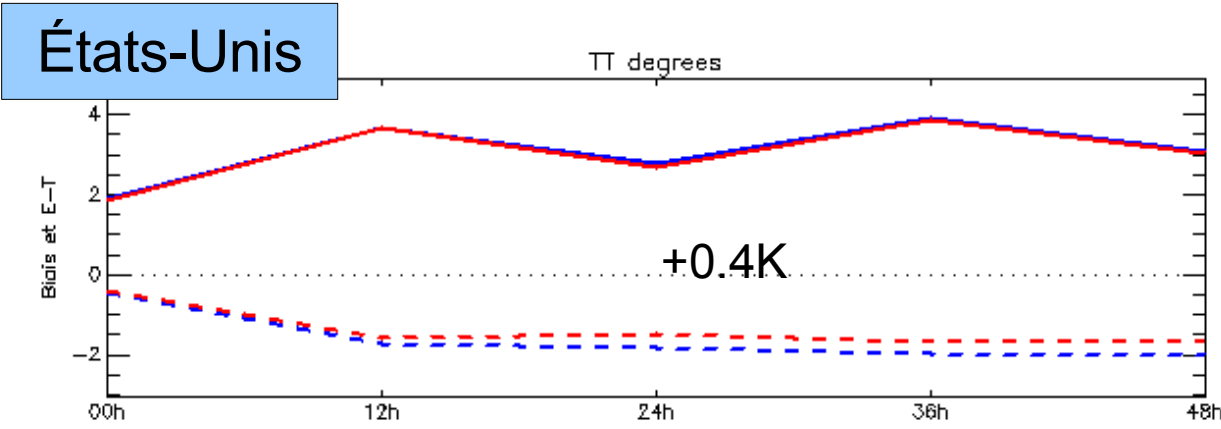
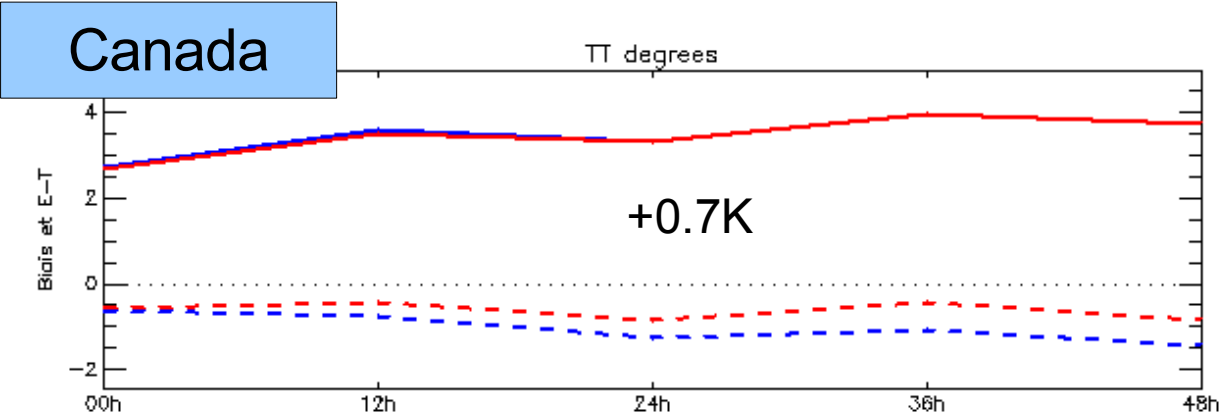
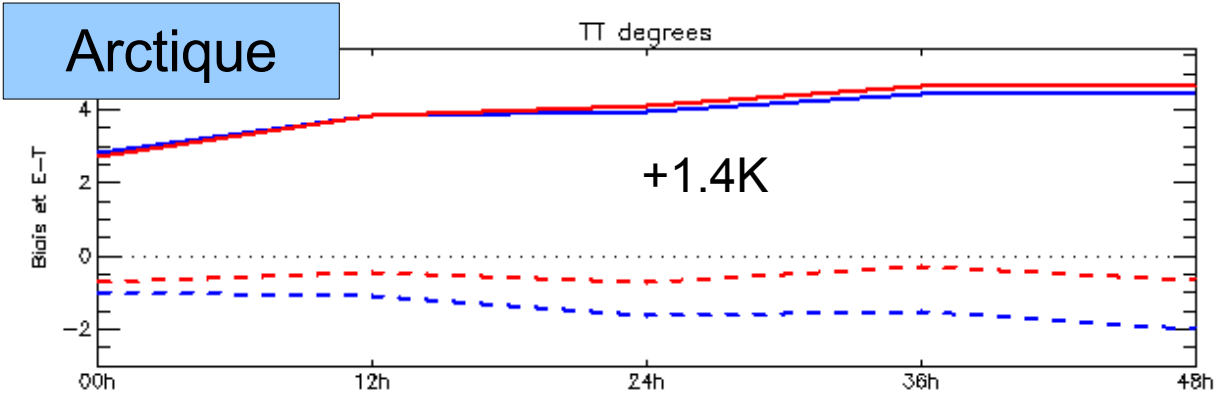
Compense pour l'augmentation de
LW_down le jour.

C) Modification du GEM15 - sfc

Scores arcad
Hiver
Moyenne sur les 20 runs
00UTC

Modèle - Obs

A peu près le même
impact de jour ou de
nuit, dans l'est comme
dans l'ouest

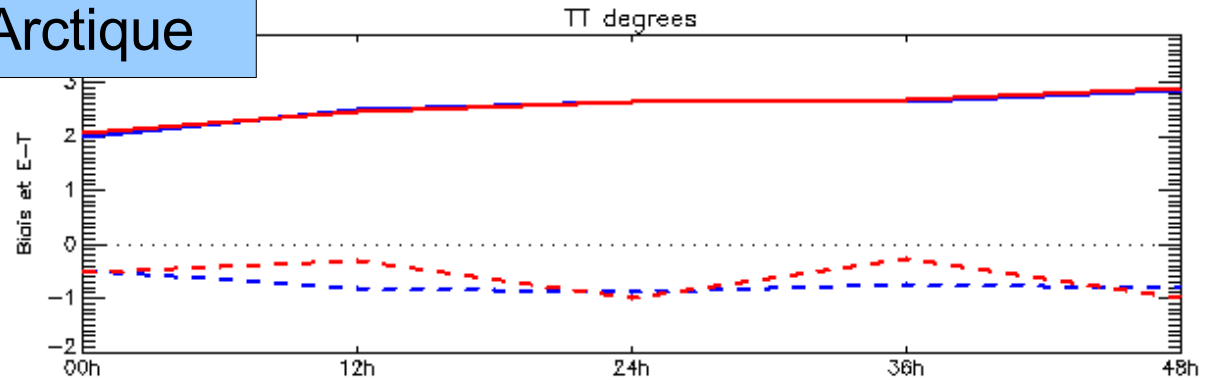


C) Modification du GEM15 - sfc

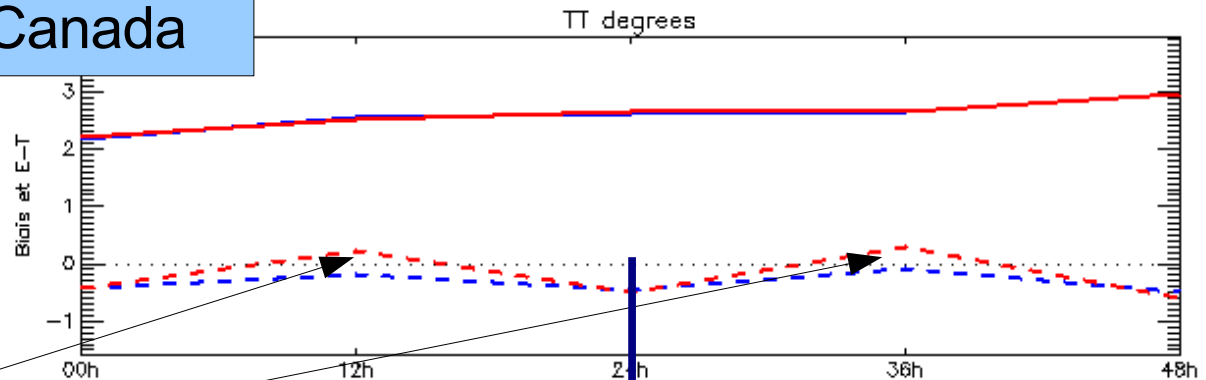
Scores arcad
Été
Moyenne sur les 20 runs
00UTC

Modèle - Obs

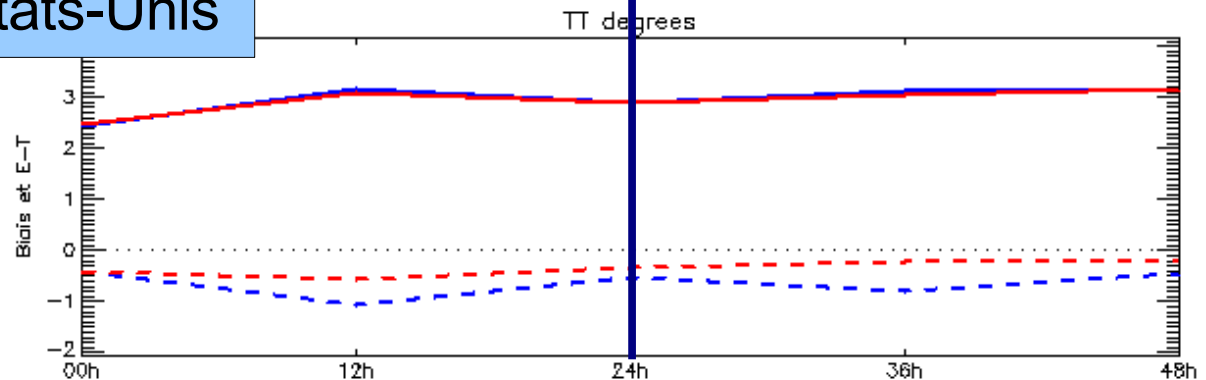
Arctique



Canada



États-Unis



Impact maximal (+0.6K)
vers 12 UTC, près du
min nocturne,
peu d'impact sur le
max diurne

00UTC

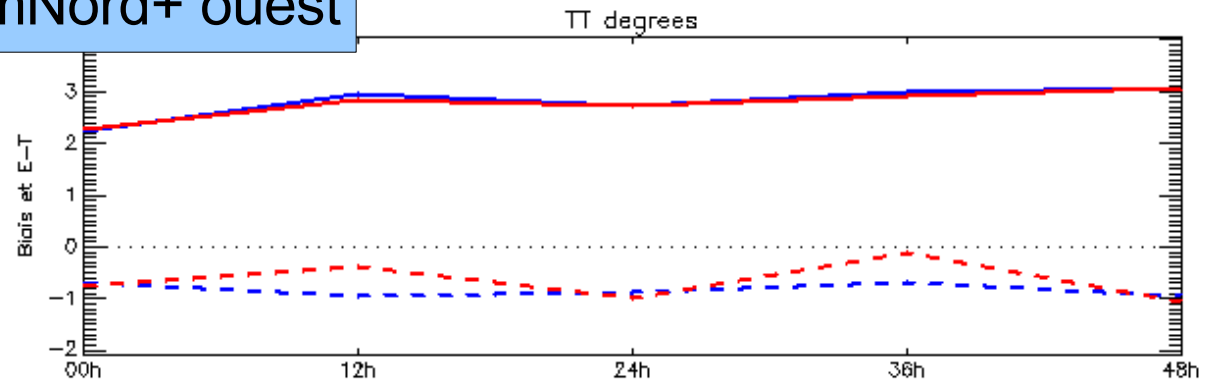
C) Modification du GEM15 - sfc

Scores arcad
Été
Moyenne sur les 20 runs
00UTC

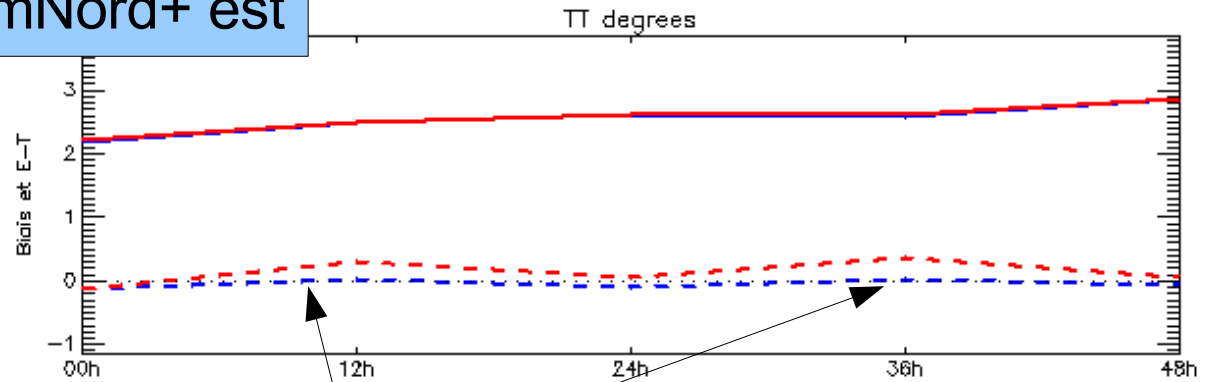
Modèle - Obs

Impact maximal (+0.6K)
vers 12 UTC, près du
min nocturne,
peu d'impact sur le
max diurne

AmNord+ ouest



AmNord+ est



Biais chaud de 0.3K
au min nocturne
dans l'est

C) GEM-Méso-Strato - sfc

Scores arcad
aux 24hrs
Moyenne sur
> 60 runs

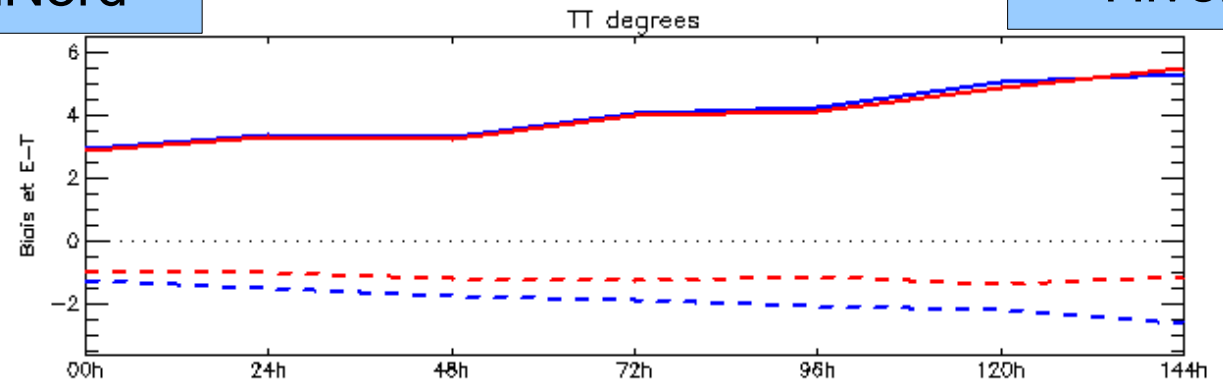
Modèle - Obs

Avec cycle
d'assimilation et
cycle de surface:

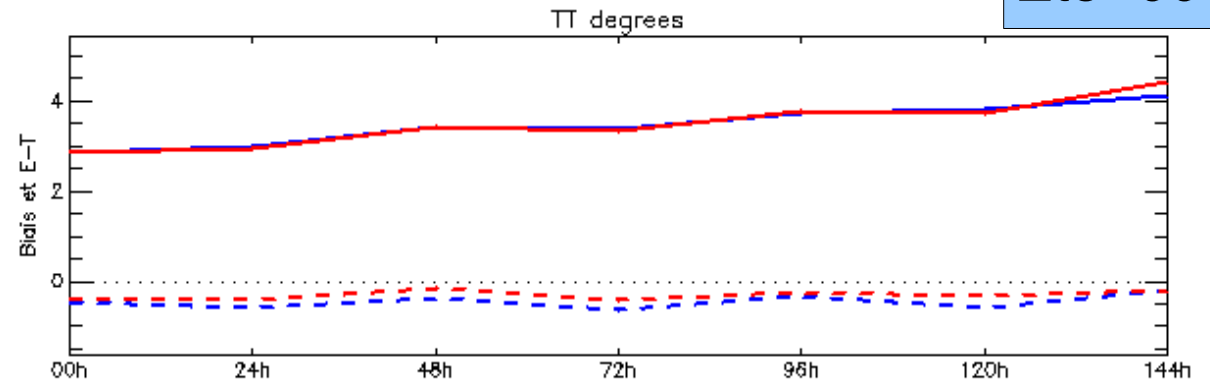
→ **Pas de problème
à plus long terme**

AmNord+

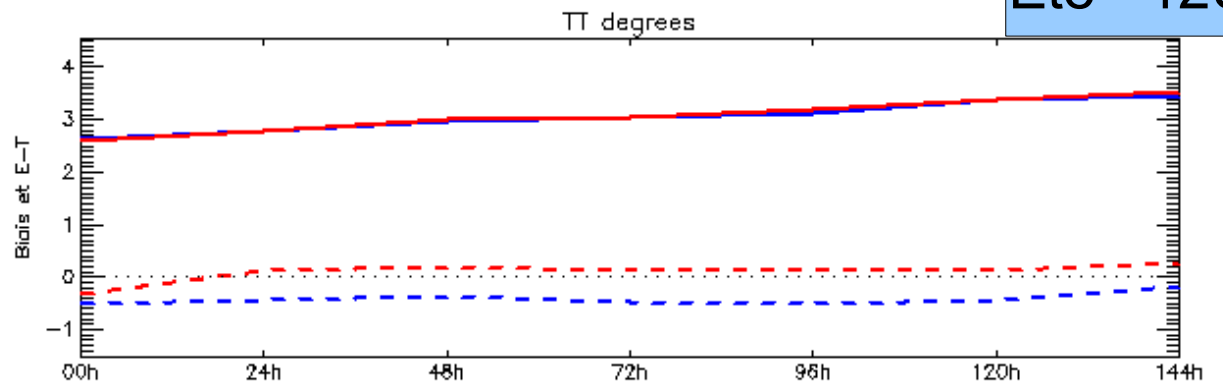
Hiver



Été- 00UTC

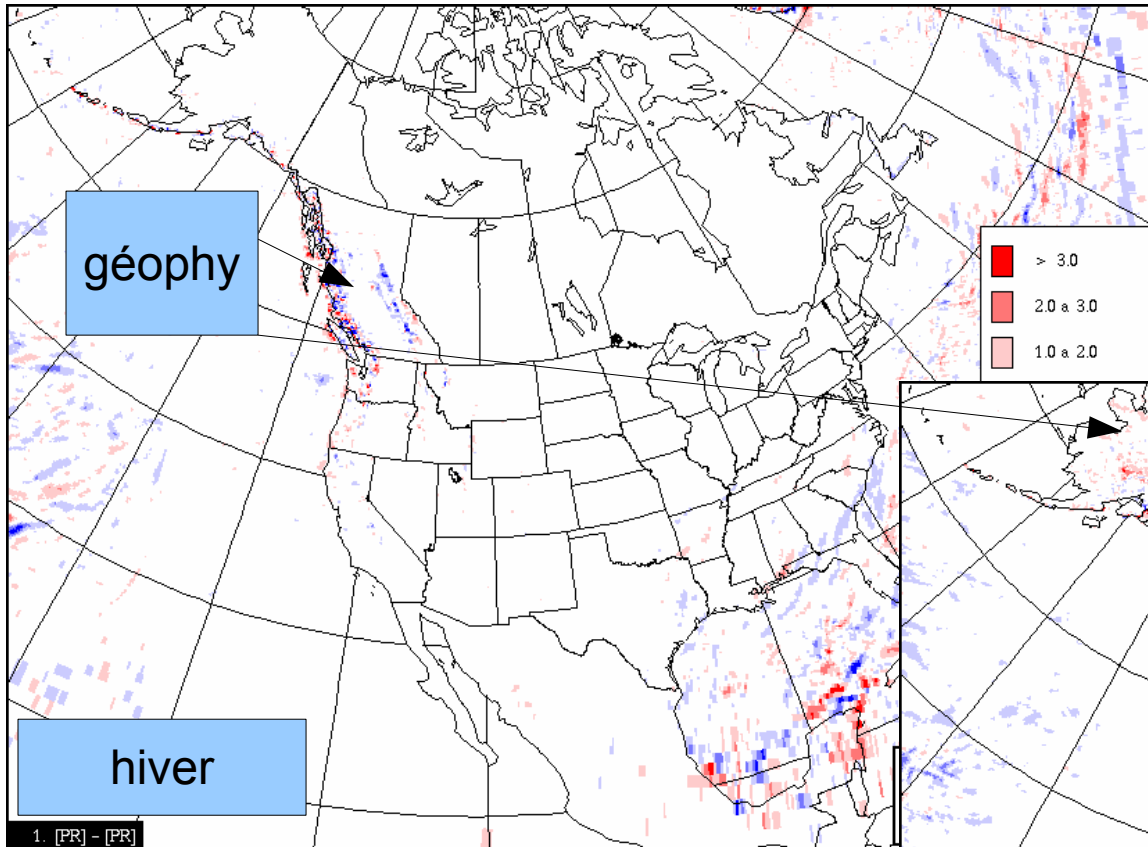


Été - 12UTC

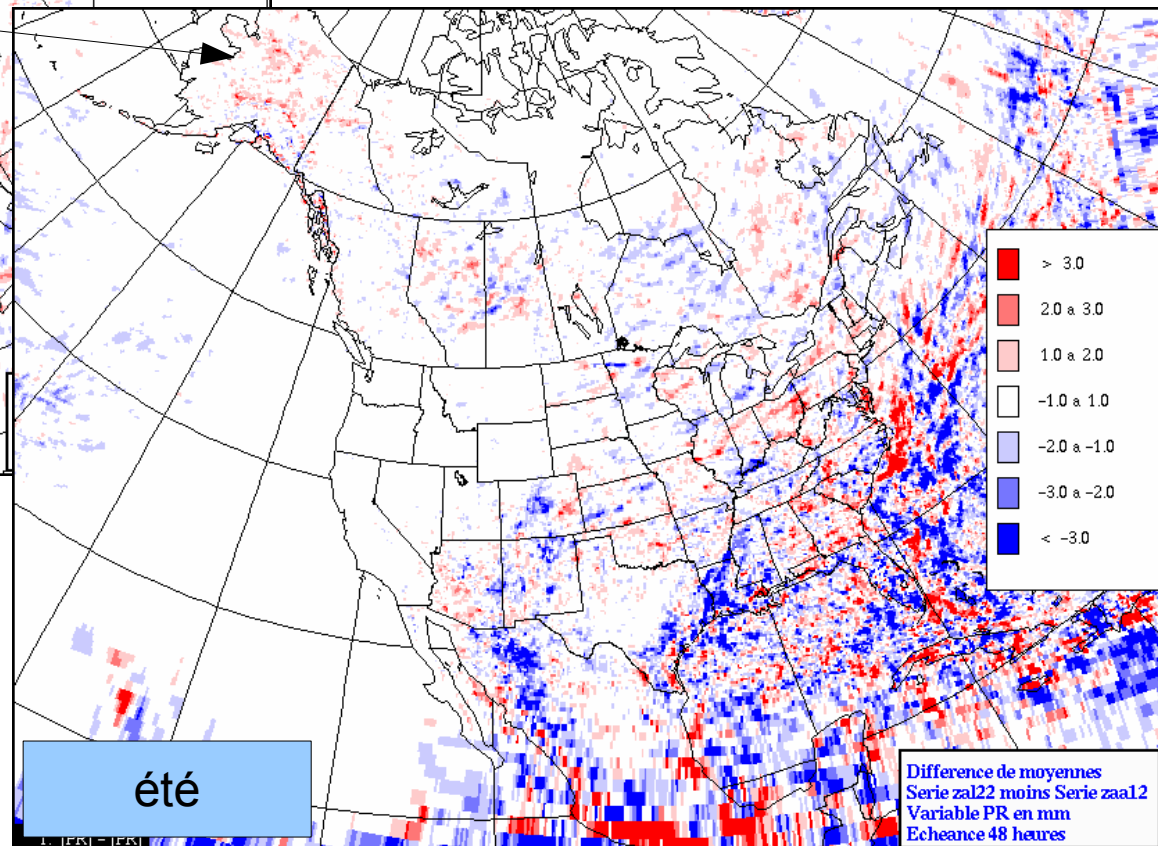


C) Modification du GEM15

Précipitation:

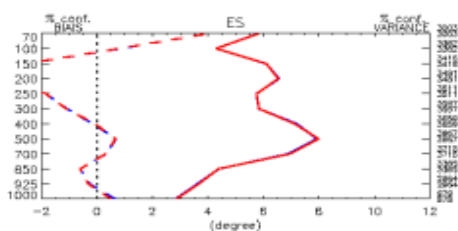
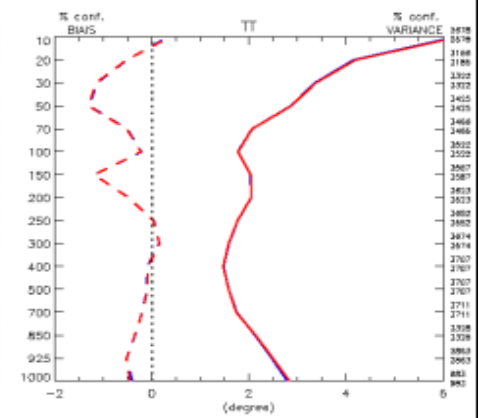
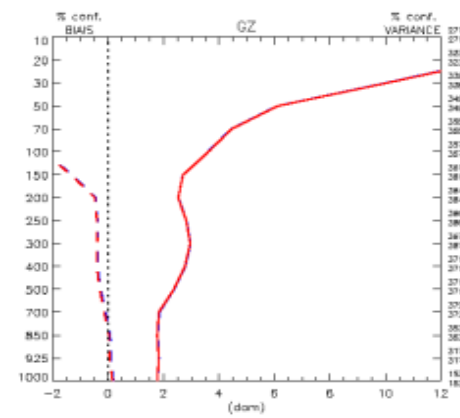
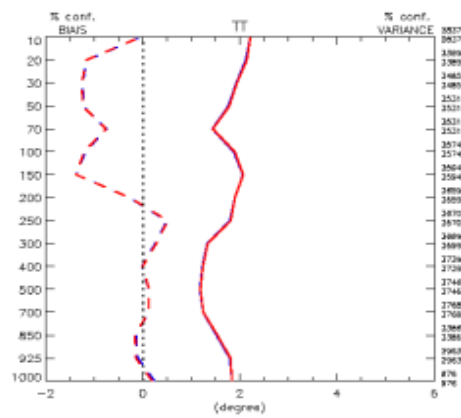
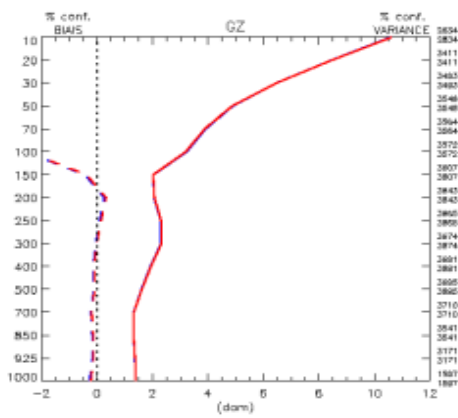
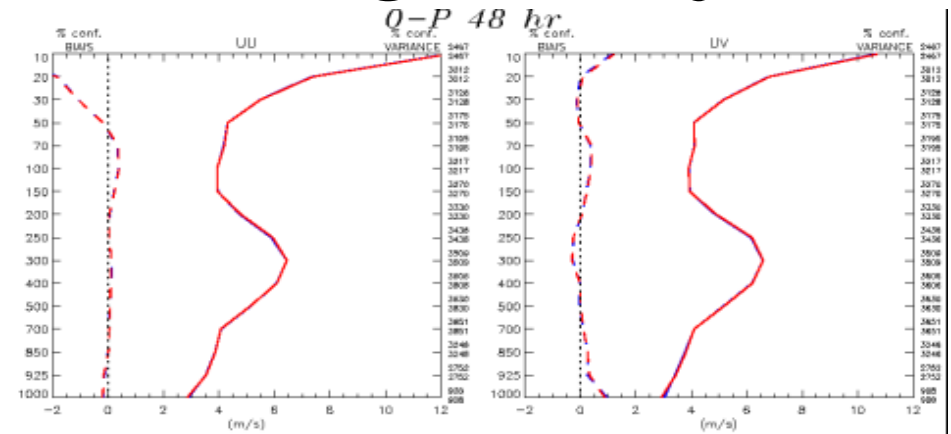
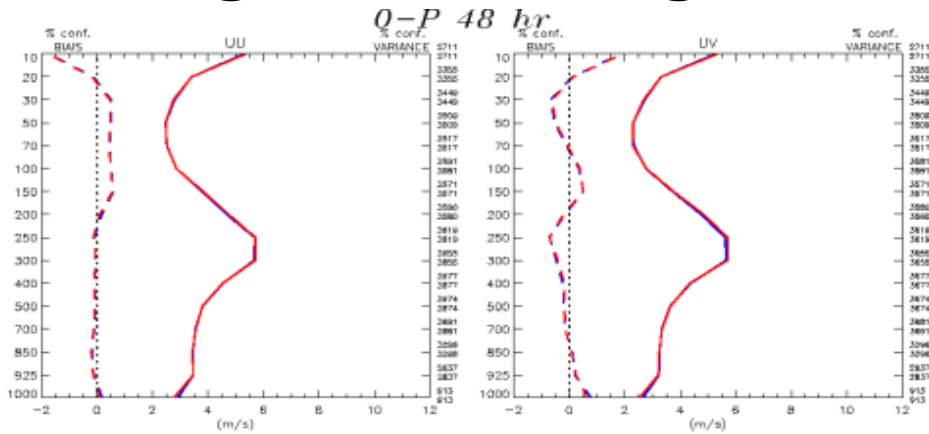


Différence de la moyenne de PR après 48hrs

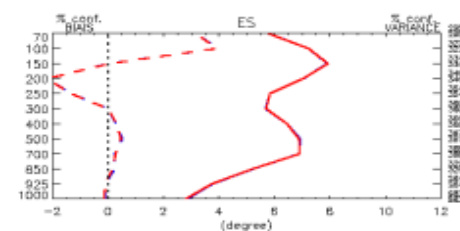


Les scores de précipitation (synop et shef) ne montrent pas de changement significatifs

C) Modification du GEM15 – UA grille+bugfixs+champs géophysy



Été



Hiver

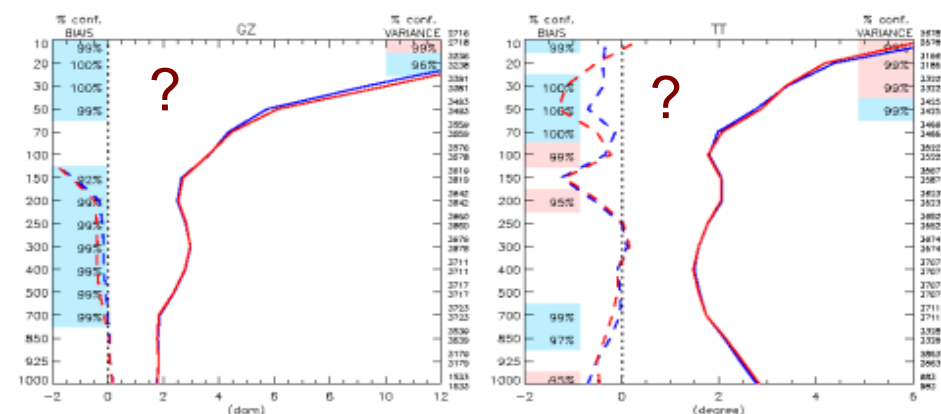
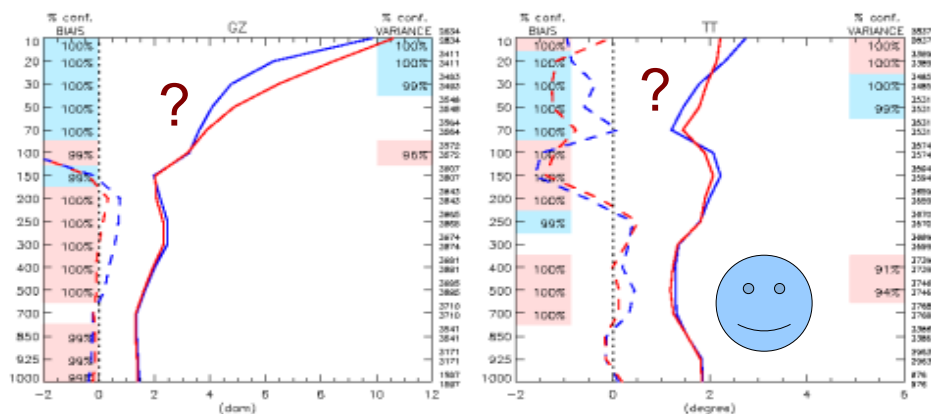
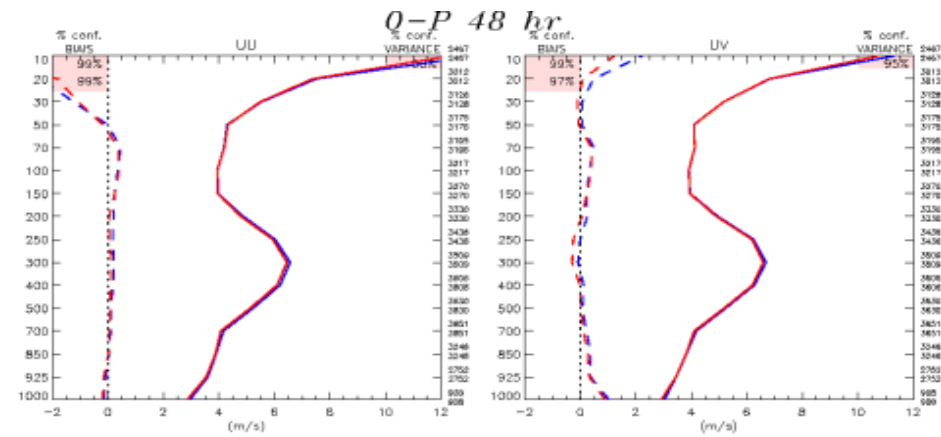
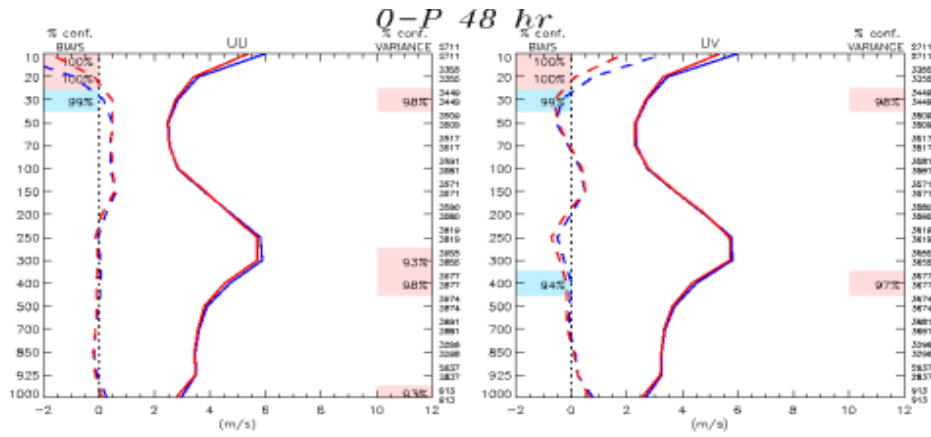
Type : Q-P 48 hr
 Region : Amerique du Nord plus
 Lat-lon : (25N, 170W) (85N, 40W)
 Stat. invercees

— EOM_m_uo_40ces_zai02_048_moyenne { 40 }
- - - BIAIS_m_uo_40ces_zai02_048_moyenne
— EOM_m_uo_40ces_zai22_048_moyenne { 40 }
- - - BIAIS_m_uo_40ces_zai22_048_moyenne

Type : Q-P 48 hr
 Region : Amerique du Nord plus
 Lat-lon : (25N, 170W) (85N, 40W)
 Stat. invercees

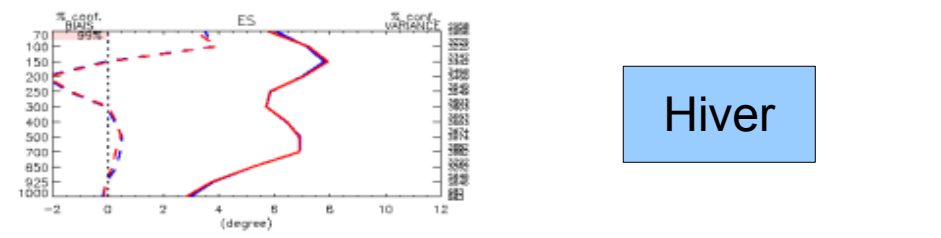
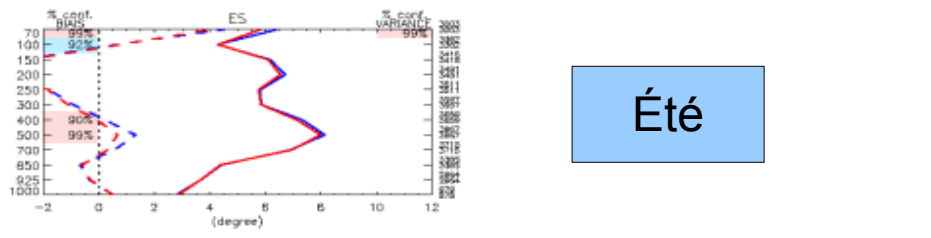
— EOM_m_uo_40ces_zai01_048_moyenne { 40 }
- - - BIAIS_m_uo_40ces_zai01_048_moyenne
— EOM_m_uo_40ces_zai21_048_moyenne { 40 }
- - - BIAIS_m_uo_40ces_zai21_048_moyenne

C) Modification du GEM15 – UA



Été

Hiver



Type : Q-P 48 hr
 Region : Amérique du Nord plus
 Lat-Ion : (25N, 170W) (85N, 40W)
 Stat. inversées

- ◇ — EOM m_ua_40cas_zaa12_048_moyenne (40)
- — BIAIS m_ua_40cas_zaa12_048_moyenne
- ◇ — EOM m_ua_40cas_zal22_048_moyenne (40)
- — BIAIS m_ua_40cas_zal22_048_moyenne

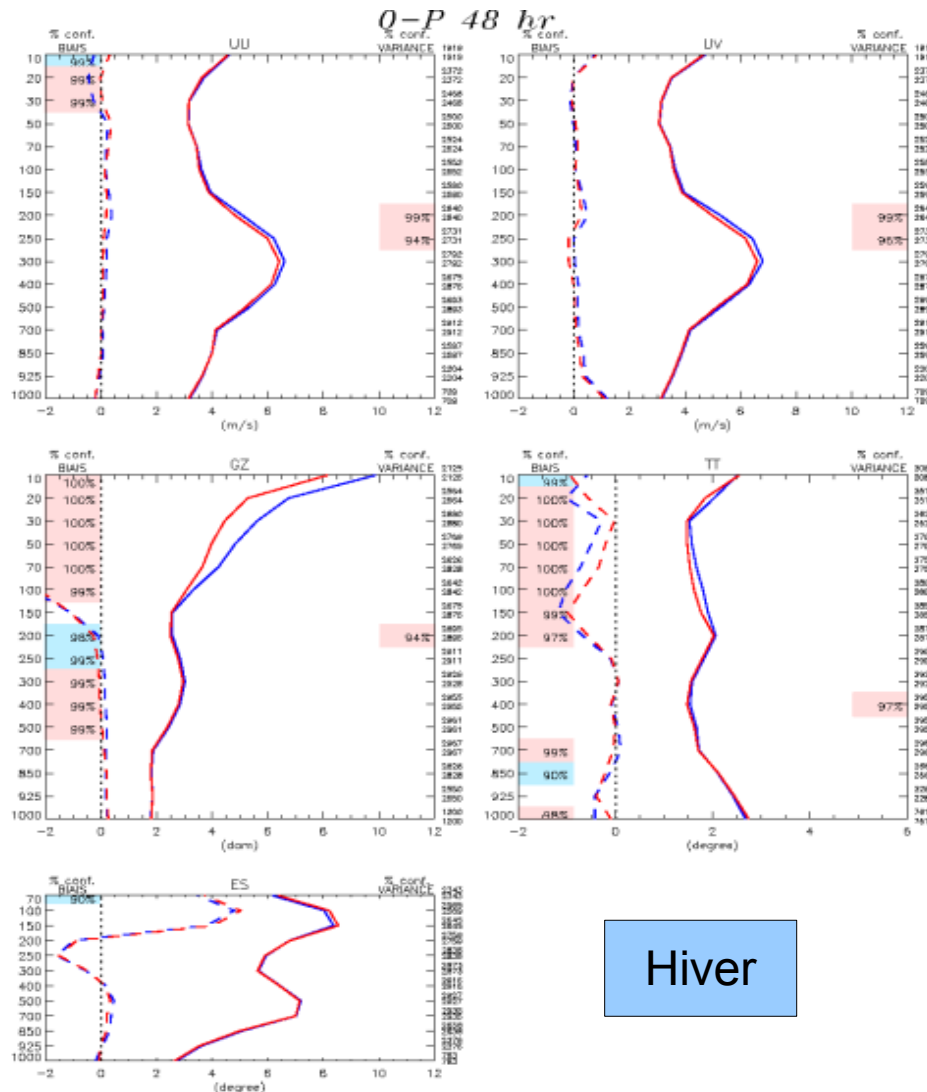
Type : Q-P 48 hr
 Region : Amérique du Nord plus
 Lat-Ion : (25N, 170W) (85N, 40W)
 Stat. inversées

- ◇ — EOM m_ua_40cas_zaa01_048_moyenne (40)
- — BIAIS m_ua_40cas_zaa01_048_moyenne
- ◇ — EOM m_ua_40cas_zal21_048_moyenne (40)
- — BIAIS m_ua_40cas_zal21_048_moyenne

B) Modification du GEM15 :

- Que se passe t'il en haut de 80 hPa ??
 - Compare cccmarad à “radfac” - fit des taux de réchauffement entre 80 hPa et le toit
 - Changement de climatologie d'ozone
 - “Moon layer”

Comparaison des schémas radiatifs dans GEM15-strato (0.1 hPa)



Impact du nouveau rayonnement devient de neutre à positif presque partout !

Hiver



C) Modification du GEM15: résumé

- UA: l'impact vient surtout de cccmarad. Positif en été. Mitigé en hiver. On attend des gains plus intéressants avec le toit a 0.1hPa.
- Surface: l'impact vient de cccmarad et des nouveaux géophy
 - Hiver: réchauffement moyen entre 0.4 et 1.4K, diminution significative du biais froid moyen.
 - Été: réchauffement surtout la nuit (max de 0.6K), diminue le biais froid moyen dans la plupart des régions. Cause un biais chaud du min nocturne dans l'est du continent.
- Cout: +38% (96 CPU)
- À venir:
 - “Eye-balling”, pointage des précipitations (Alain P., A&P)
 - Tests avec GPS-RO
 - Entraînement UMOS
 - Effet du cycle de surface?
 - Besoin de la patch(gradient max)?

Futur du GEM15km

- 1) Décembre 2008: Cccmarad, géophy, grille étendue, bugfixs
- 2) Printemps 2009: GEM15-Strato
- 3) 2009-2011: LAM4d, Diffusion verticale, Rayonnement, Surface (Caldas), Résolution (GEM10?)