Environnement Canada Environment Canada

Canada

# Le système d'analyse Regional- 4D-Var

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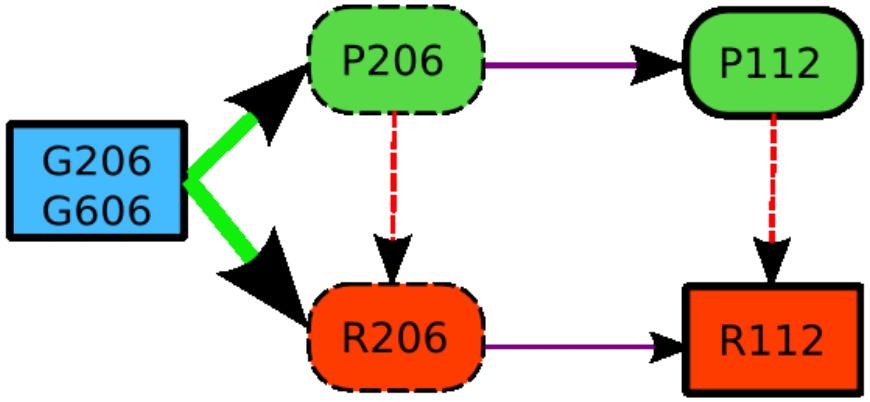
**Seminaire Interne Special**
**Salle des Vents, Dorval, Qc, Can**
**Jeudi 28 Avril 2011, 11h-12h.**

*1 Meteorological Research Division*
*2 Canadian Meteorological Center (Development)*




**G :** Global Model (33 km)

**P :** Pilot Model (55 km)

**R :** Regional Model (15 km)

Piloting

Trial field

Global analysis used

Trial field

3D-VAR FGAT Analysis

4D-VAR Analysis

# Configuration Strato-2B (elaav) (REG-3D)

- Ajouts des nouvelles observations
  - Humidité des avions
  - 4 canaux AIRS assimilés de façon globale (precedemment rejetes pres des poles)
  - IASI du satellite METOP-2 **(62 channels, sensitive to temperature below 150hPa)**
  - SSMI/S (seulement les canaux semblables à SSM/I) **(7 SSMI-like channels)**
  - GeoRad **(3 new geostationary satellites, 1 water vapour channel)**
  - Thinning spatial de 150 km
- Analyse de température de la mer à 0.2 degrés
- Champs de surface du global (33 km) relaxés avec Liebman pour interpolation vers la grille du pilote (55 km)
- Thinning temporel 3D pour le LAM et son pilote

# Configuration (el040) REG-4D

- Mêmes types d'observations que Strato-2B
- Thinning temporel 4D pour le LAM (+80%)
  - Le pilote garde du thinning temporel 3D puisque c'est toujours un 3D-Var
- Filtre digital pour le champ d'essai LAM ainsi que la prévision (GEM-333 + Updates,  Physique 472)
- Le TL-AD LAM est piloté par le champ d'essai pilote
- 25 itérations

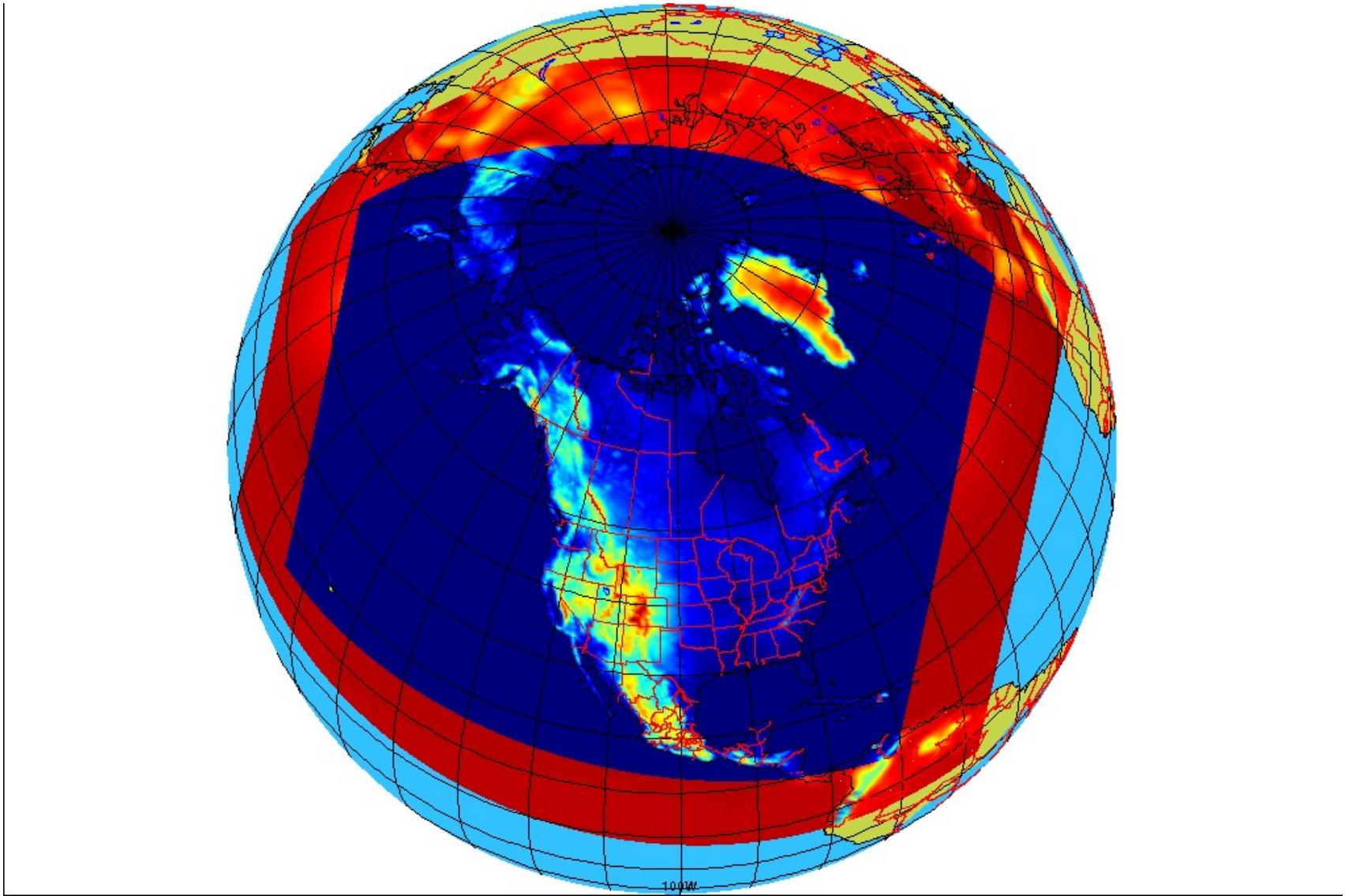
# Description des expériences

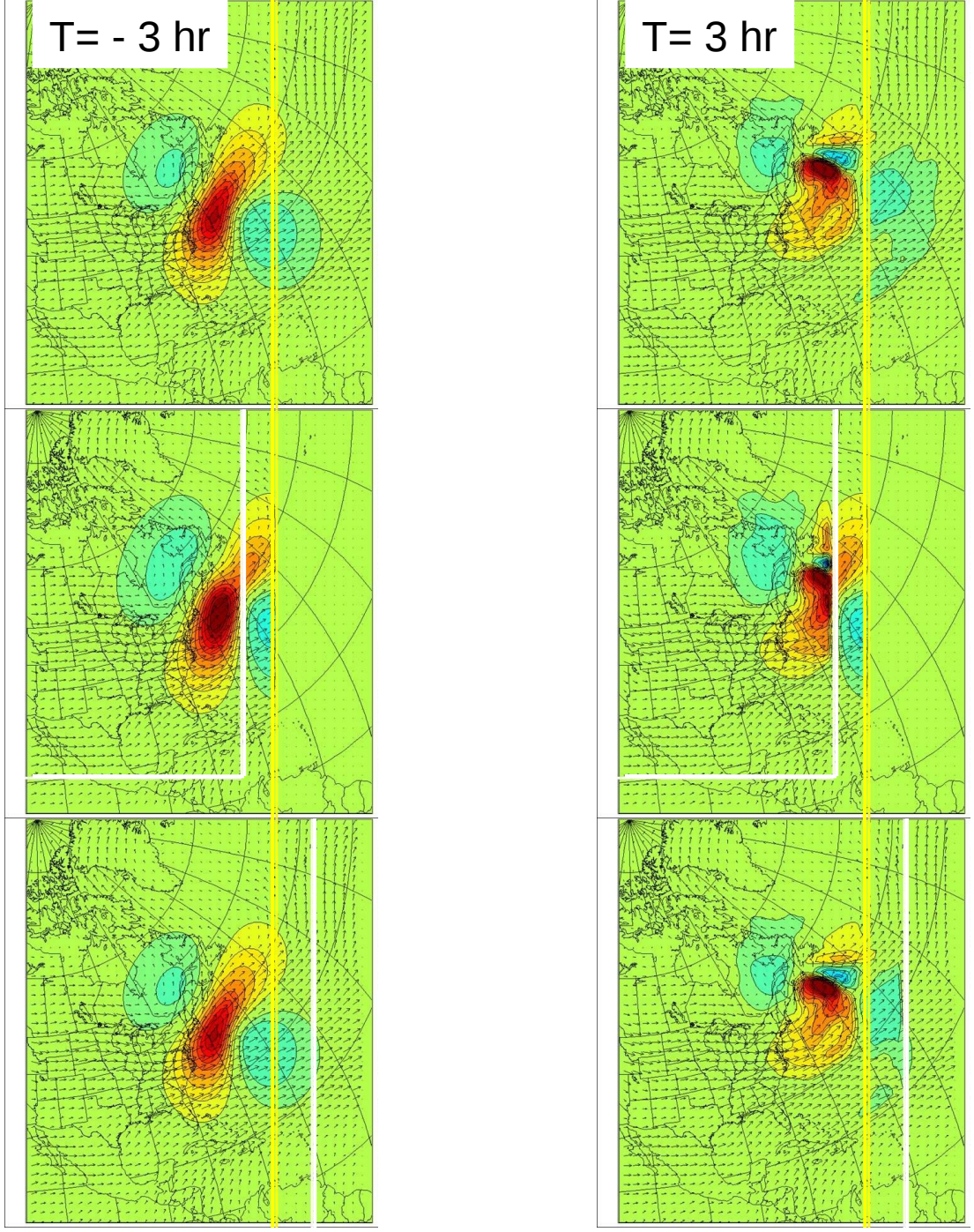
- 118 cas d'hiver
  - du 2009010100 au 2009022812, toutes les 12 heures
- 118 cas d'été
  - du 2008070100 au 2008082812, toutes les 12 heures

## Operational Regional System (REG-LAM3D) Oct. 20th 2010
## Fillion et al. 2010, 25, *Wea. Forecasting*, 1645-1669.

**NL-High 15-km grid (649x672)**

**NL-Low/TL/AD 100-km grid (138x138)**





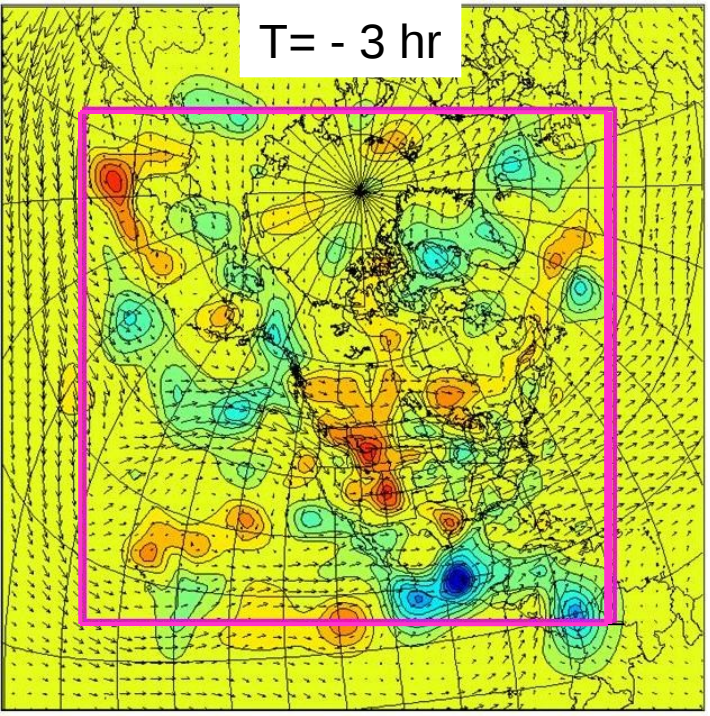

**REG-4D-GLB**
**100 km,  400x200**

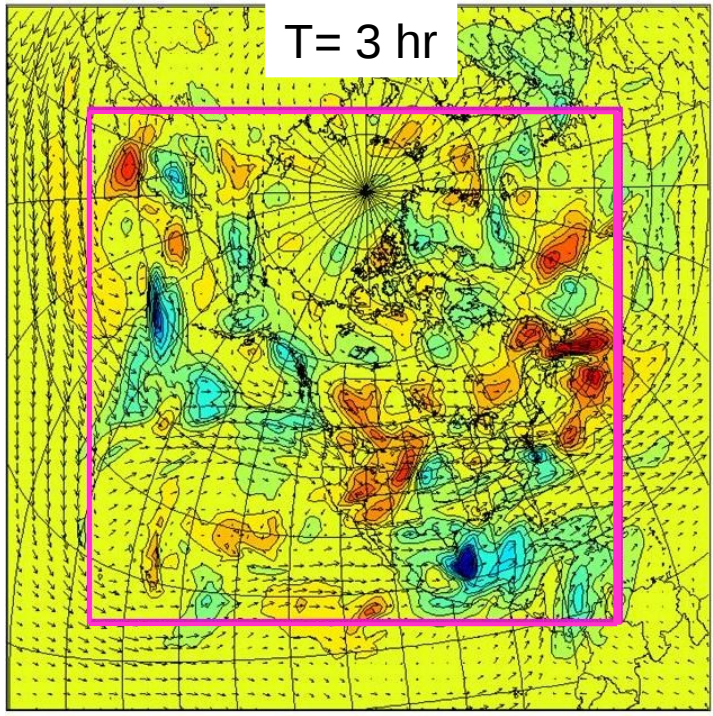
**REG-4D-LAM**
**100 km, 104x104**

**REG-4D-LAM**
**100 km, 138x138**

Cœur TL

Frontière NL




**REG-4D-GLB**
**100 km, 400x200**

Cœur TL

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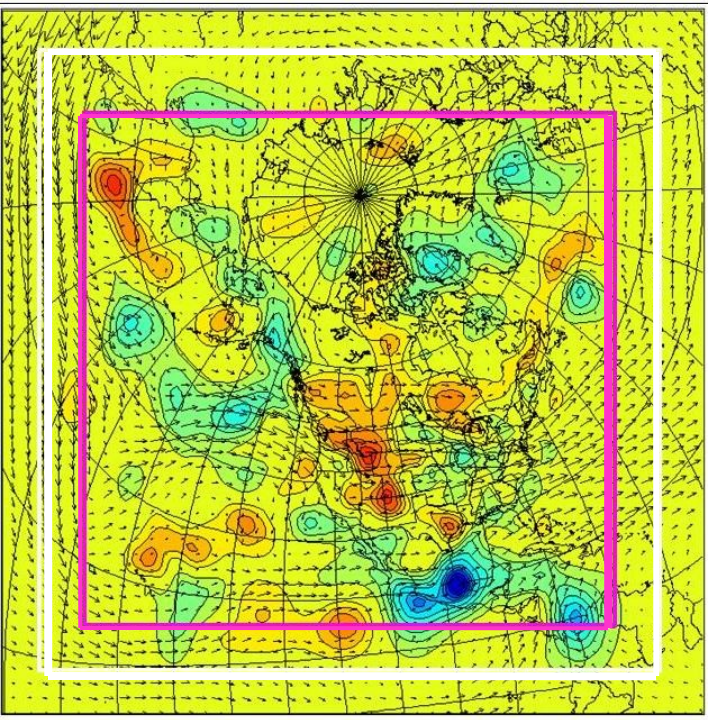
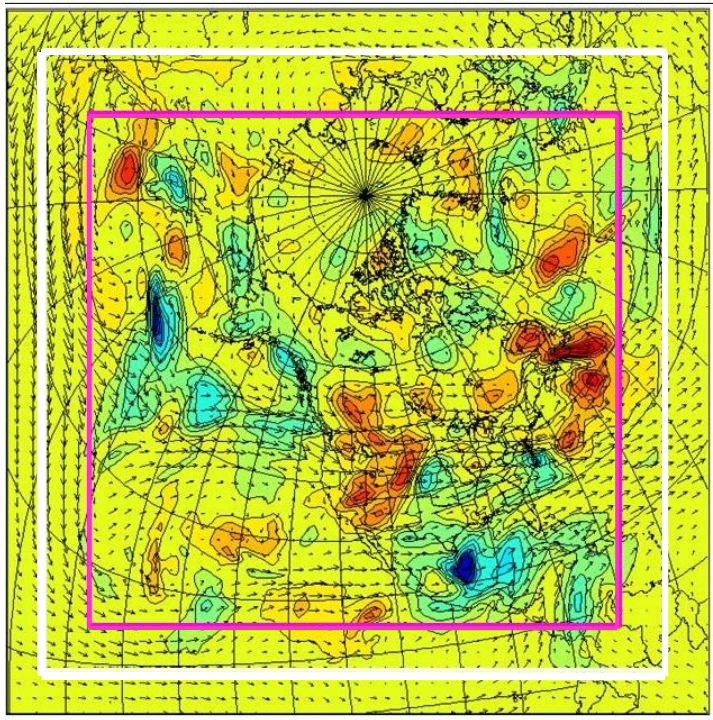
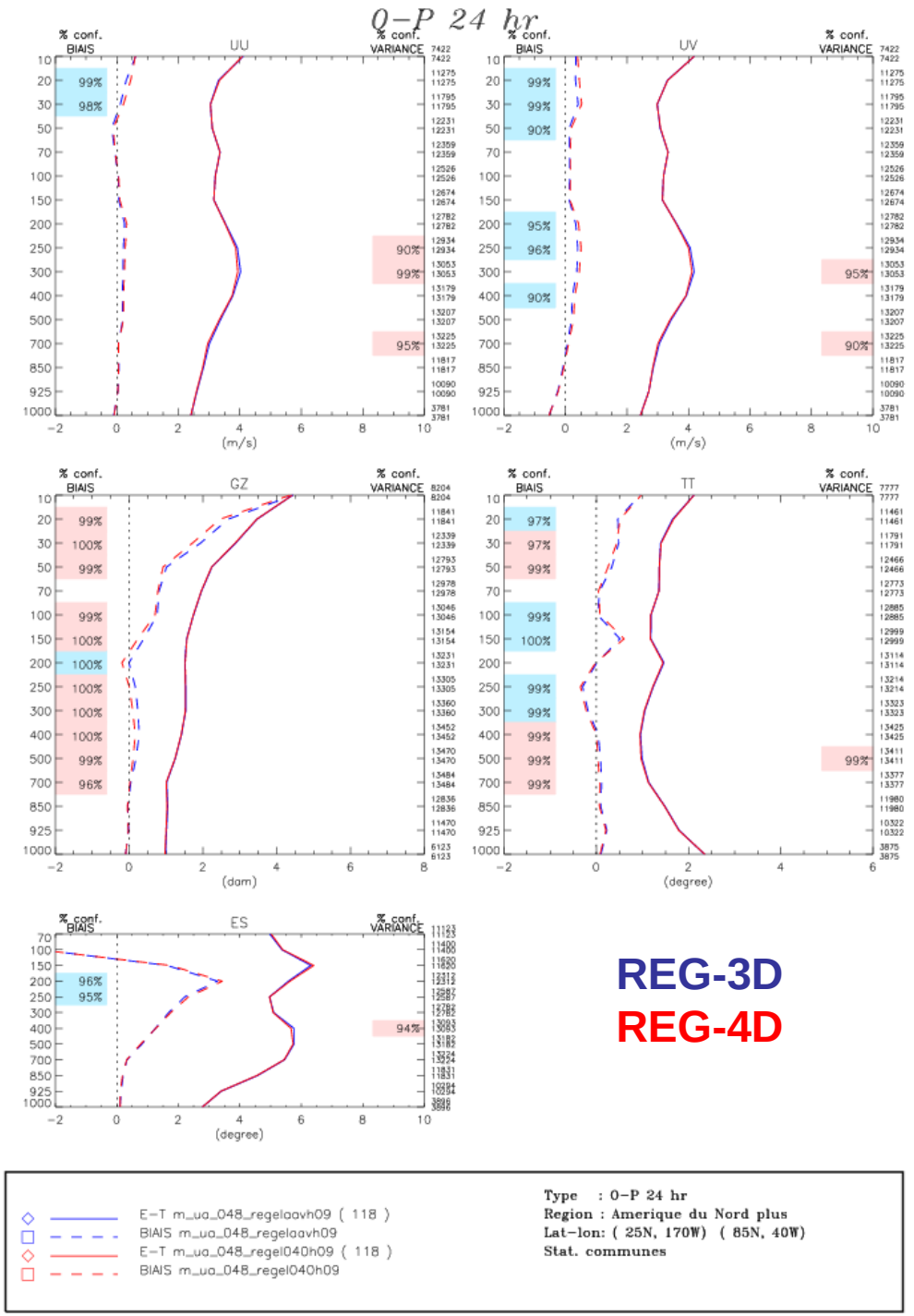


**REG-4D-LAM**
**100 km, 138x138**



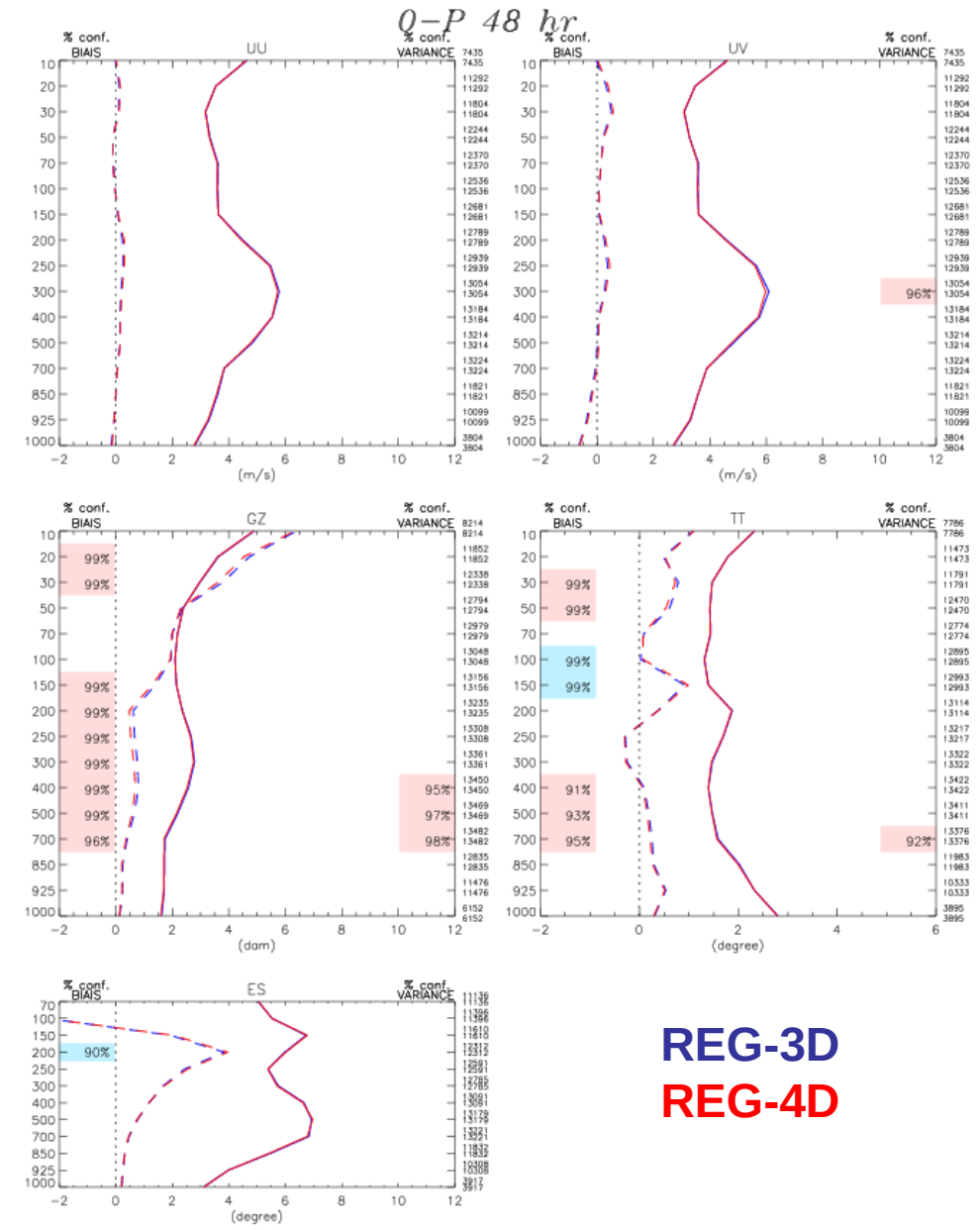
**Winter 2009 (118 cases)**
**24-h**

**NA+**



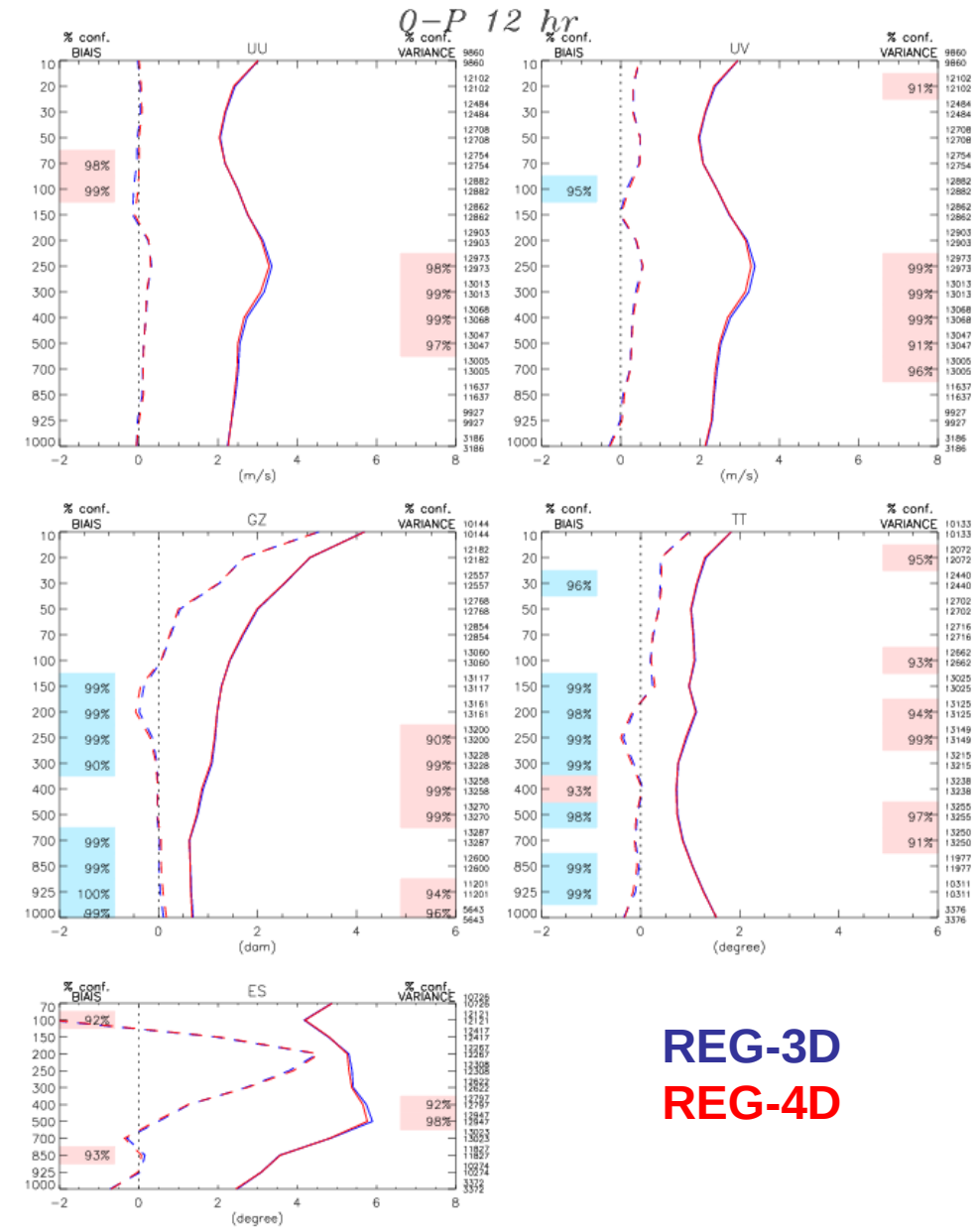
**Winter 2009 (118 cases)**
**48-h**

**NA+**



**Summer 2008 (118 cases)**
**12-h**

**NA+**



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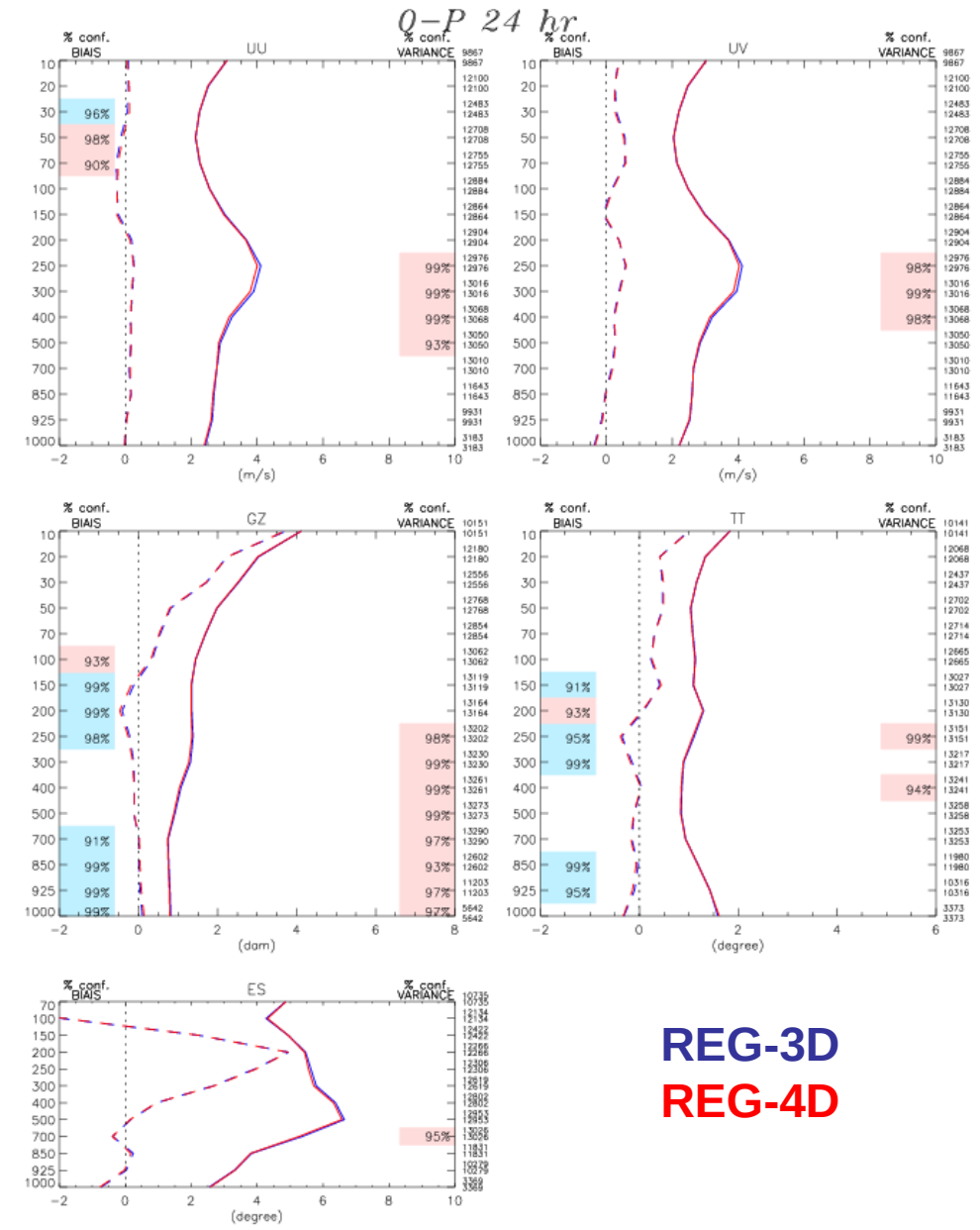
**24-h**

**NA+**



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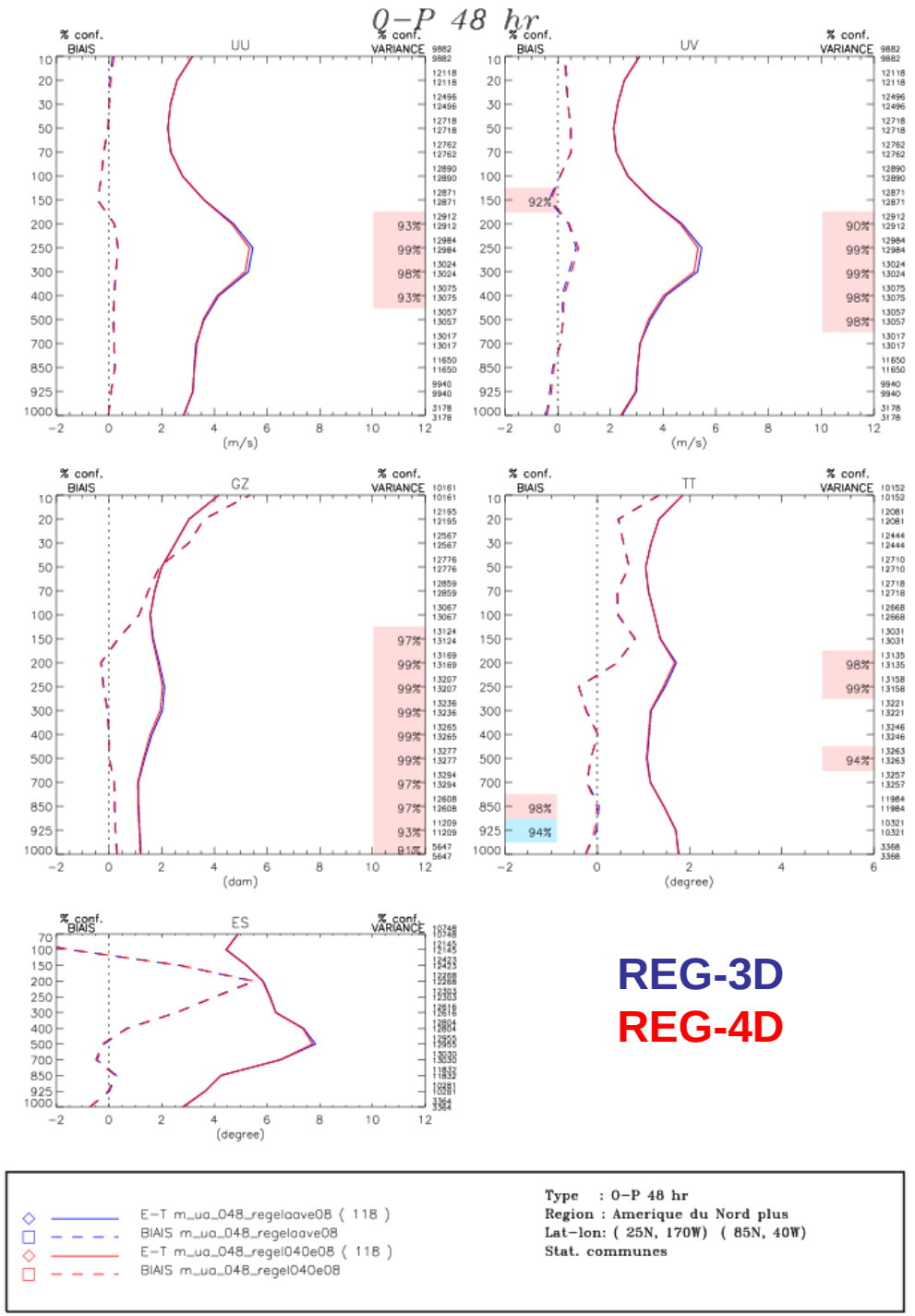
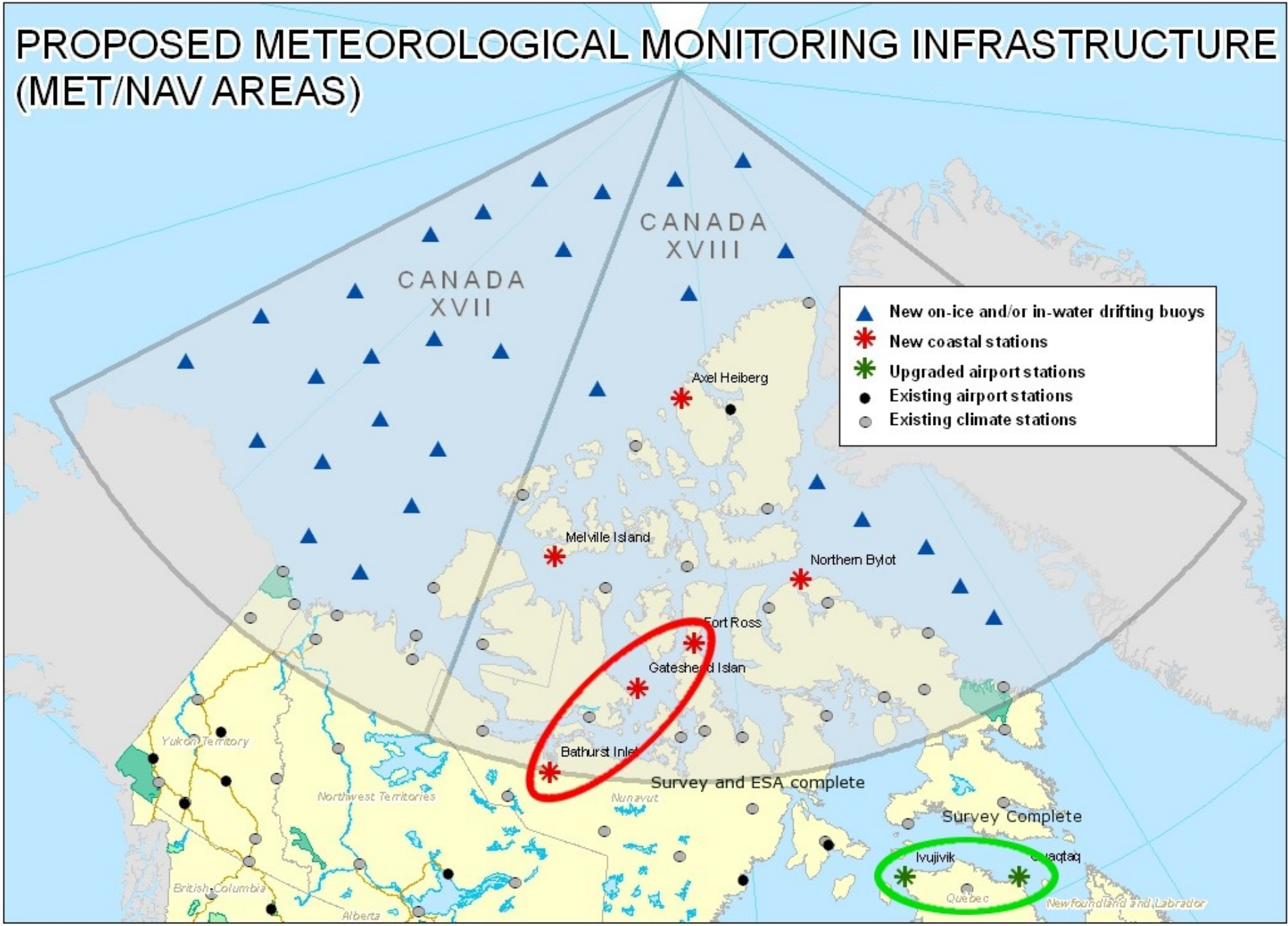
**48-h**

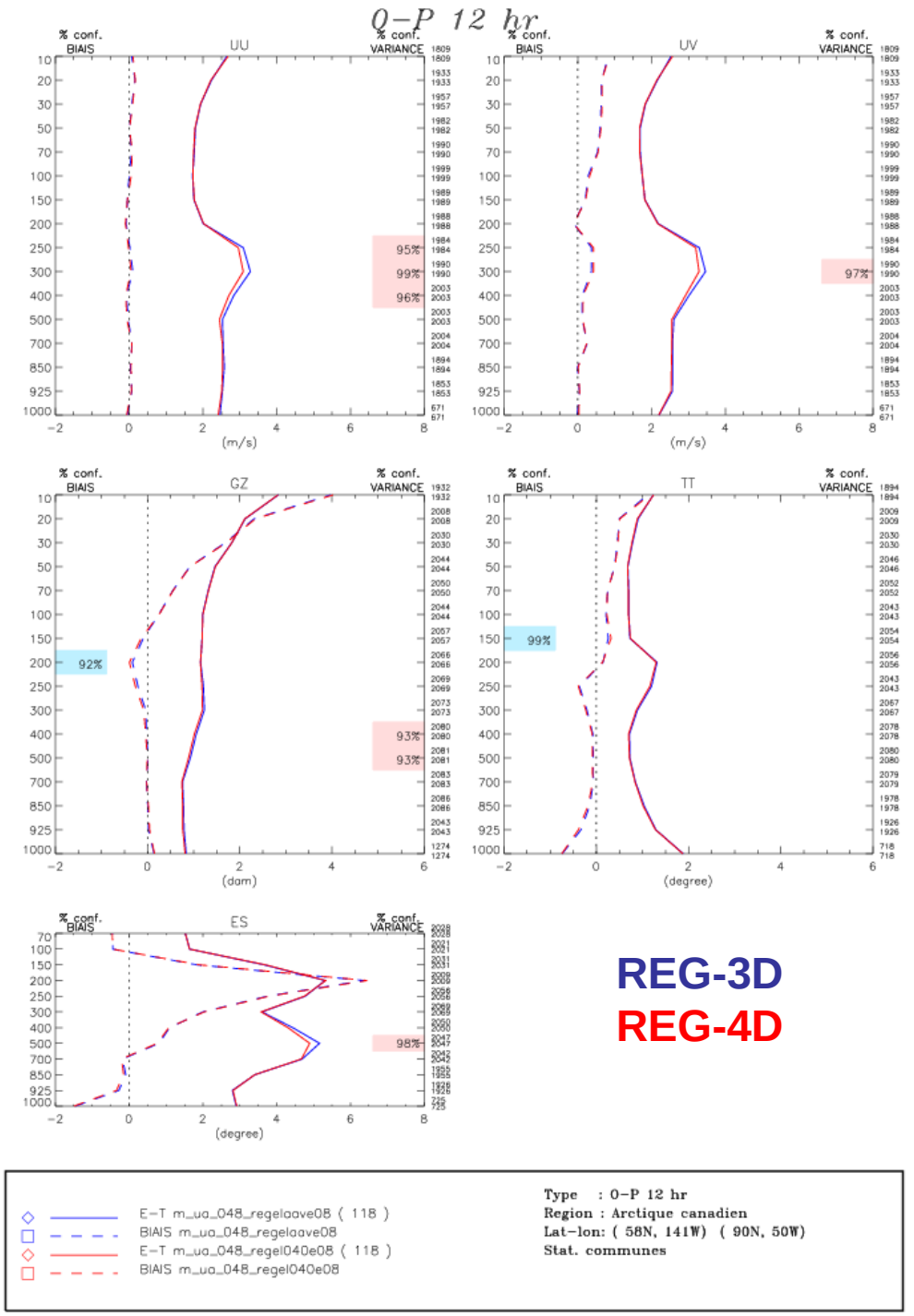
**NA+**




PROPOSED METEOROLOGICAL MONITORING INFRASTRUCTURE
(MET/NAV AREAS)
CANADA XVII
CANADA XVIII
New on-ice and/or in-water drifting buoys
New coastal stations
Upgraded airport stations
Existing airport stations
Existing climate stations
Axel Heiberg
Melville Island
Northern Bylot
Fort Ross
Gateshead Islan
Bathurst Inlet
Survey and ESA complete
Survey Complete
Ivujivik
Yukon Territory
Northwest Territories
Nunavut
British Columbia
Alberta
Quebec
Newfoundland and Labrador
Environment
Environnement
0 200 400 800 1,200 1,600
Map produced May 2010

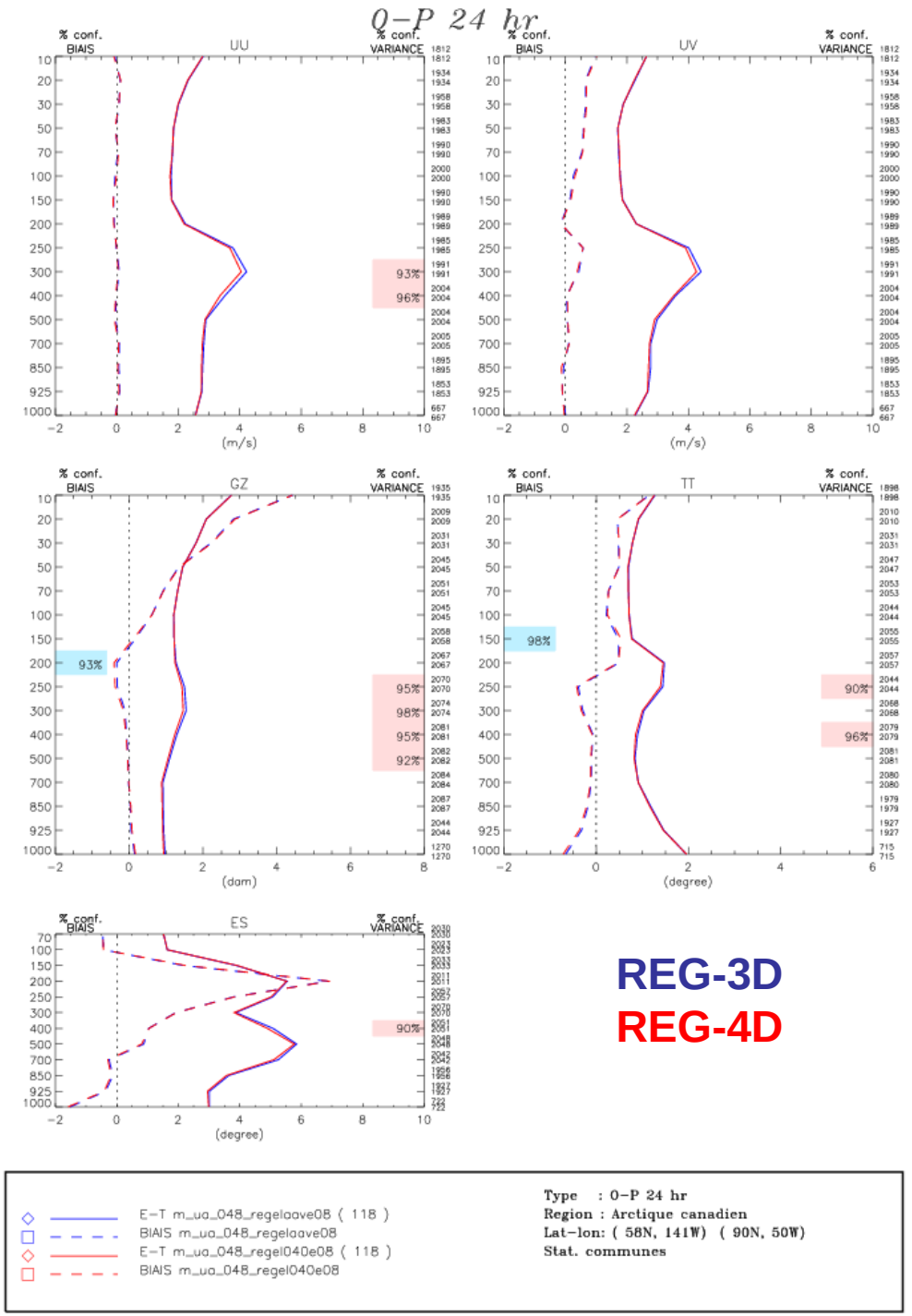
**Summer 2008 (118 cases)**
**12-h**

**Arctic**



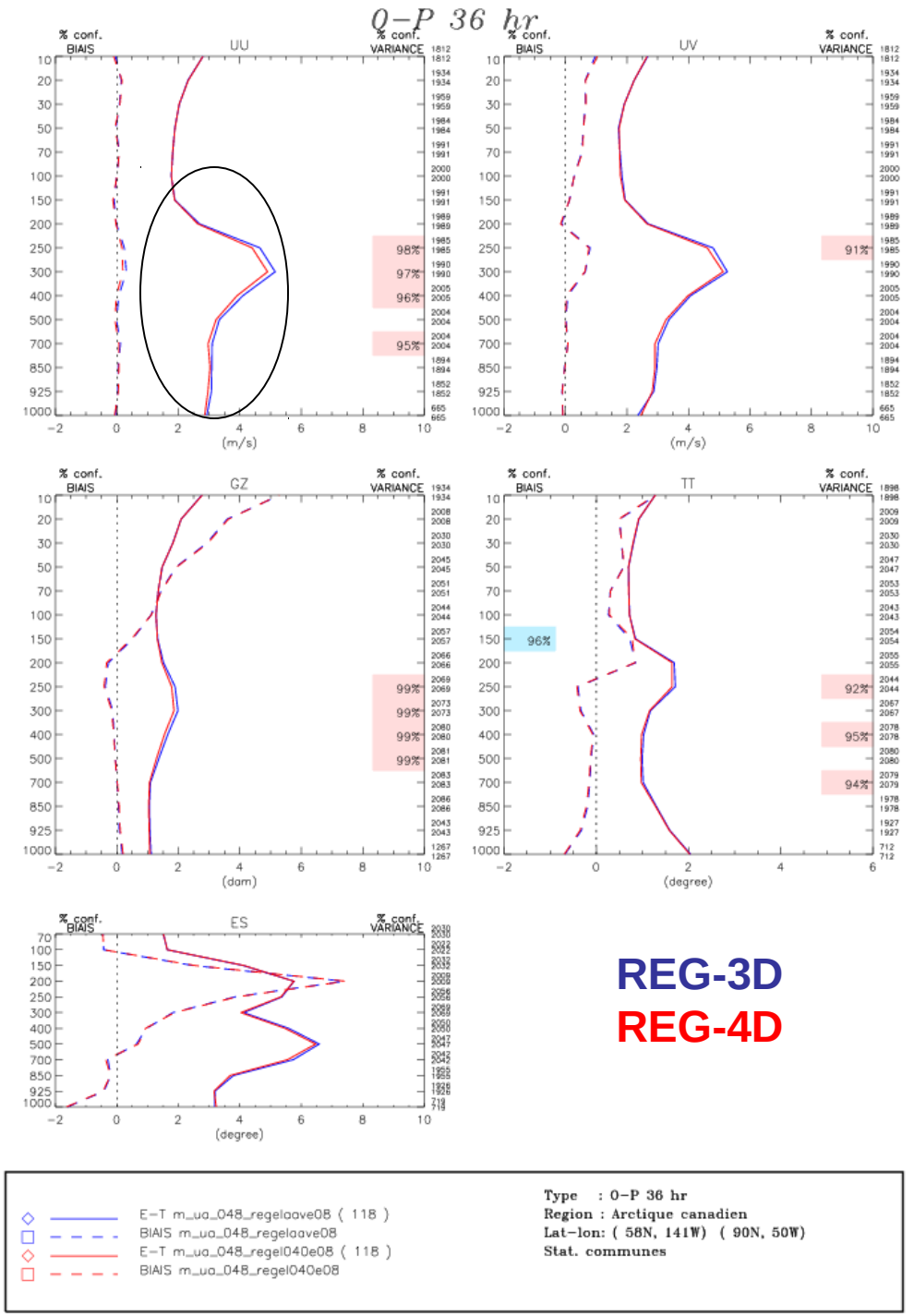
**Summer 2008 (118 cases)**
**24-h**

**Arctic**



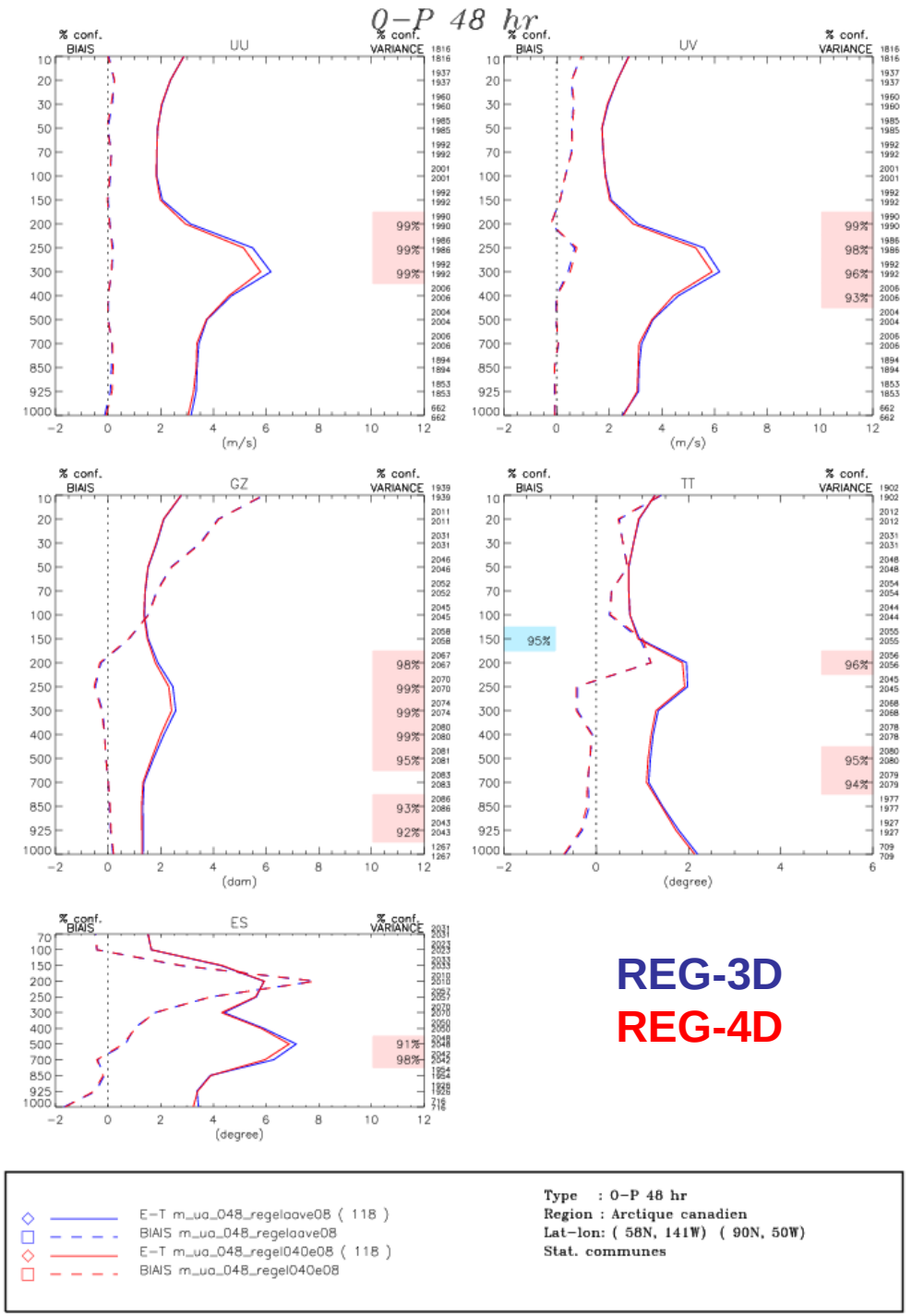
**Summer 2008 (118 cases)**
**36-h**

**Arctic**



**Summer 2008 (118 cases)**
**48-h**

**Arctic**

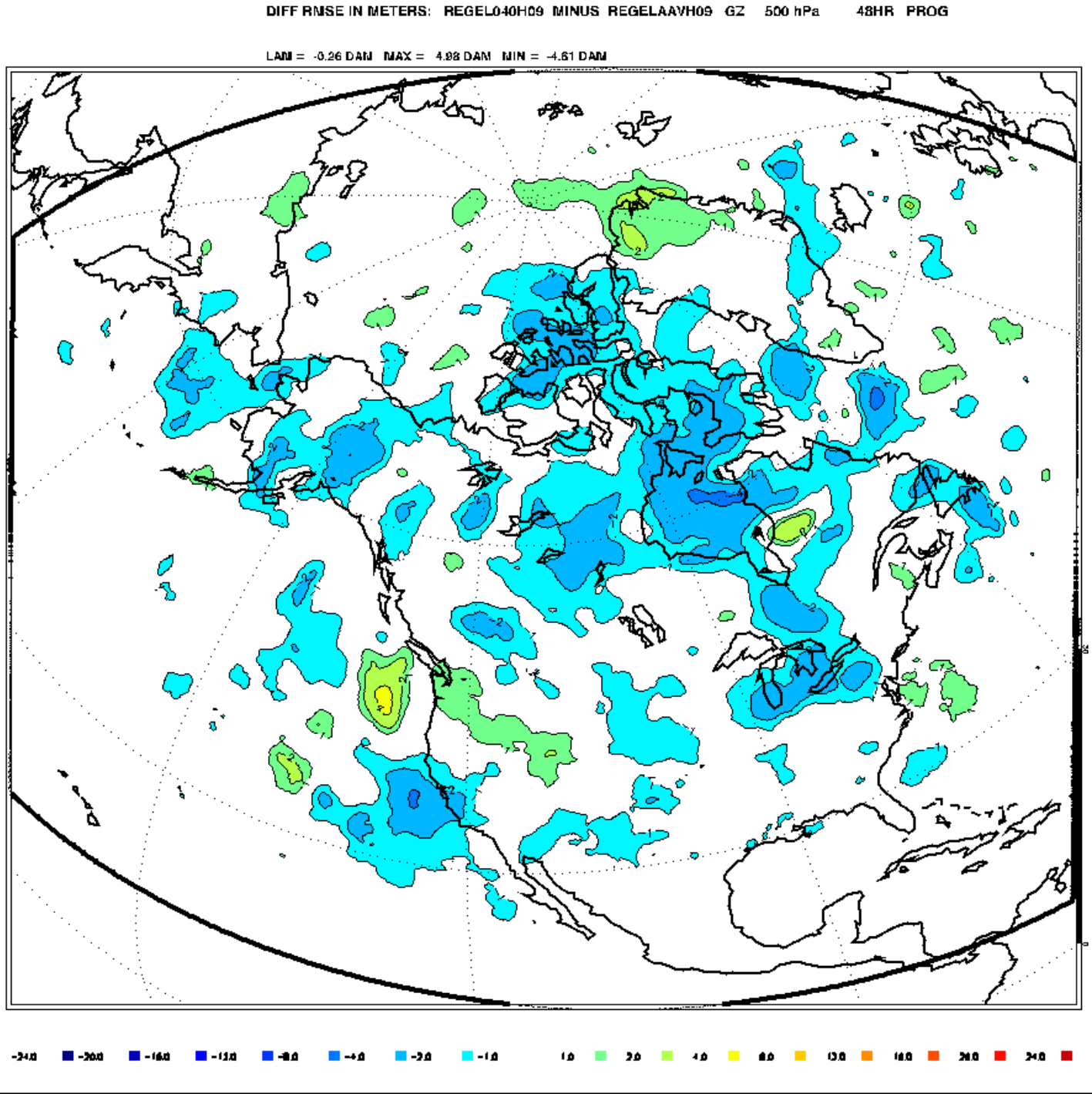


# Verifications against G2 4D-Var Analyses

48-h DIFF RMSE (m)
GZ-500 hPa

Winter-2009

**Blue:**
**4D-Var is better**

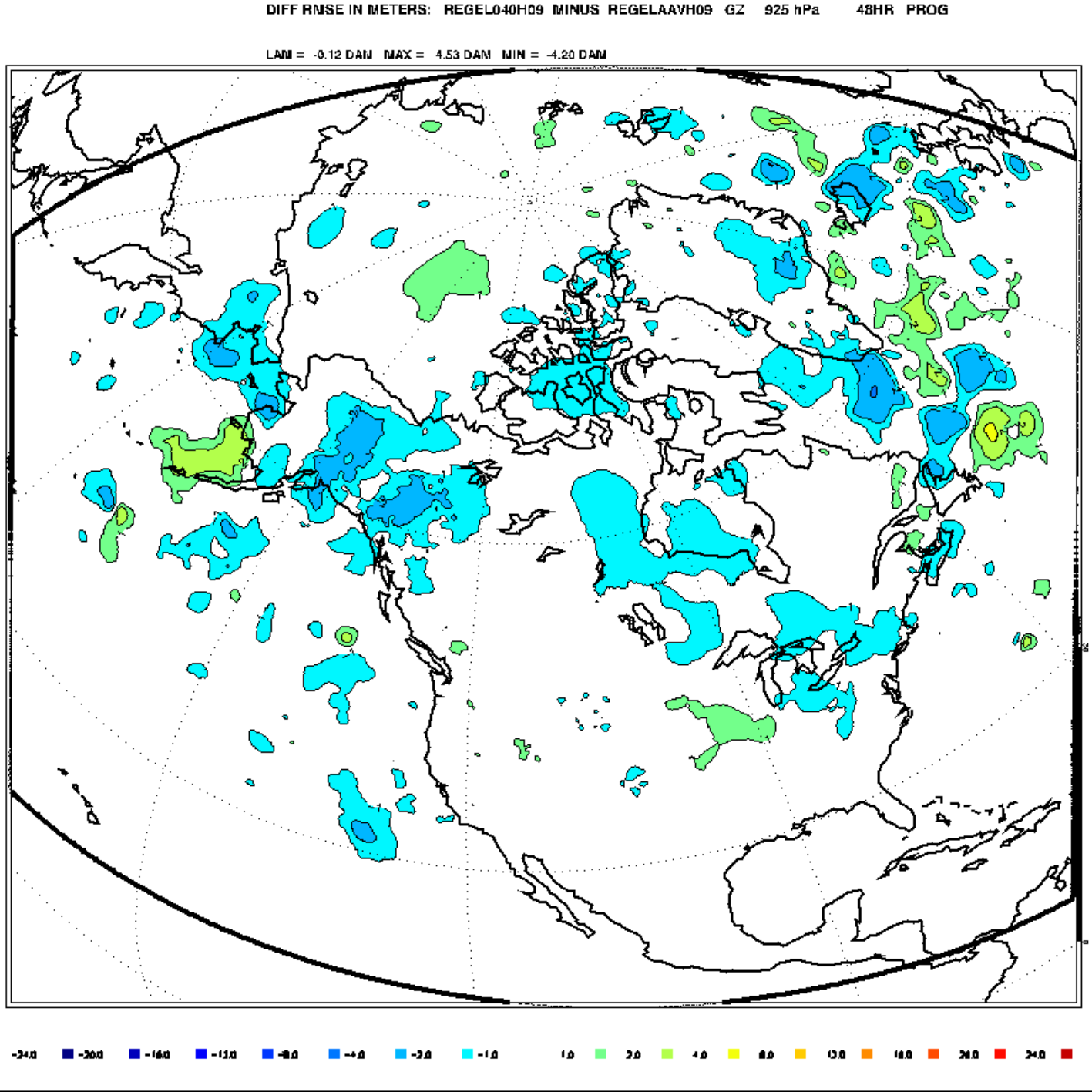


# Verifications against G2 4D-Var Analyses

48-h DIFF RMSE (m)
GZ-925 hPa

Winter-2009

**Blue:**
**4D-Var is better**



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Summer-2008

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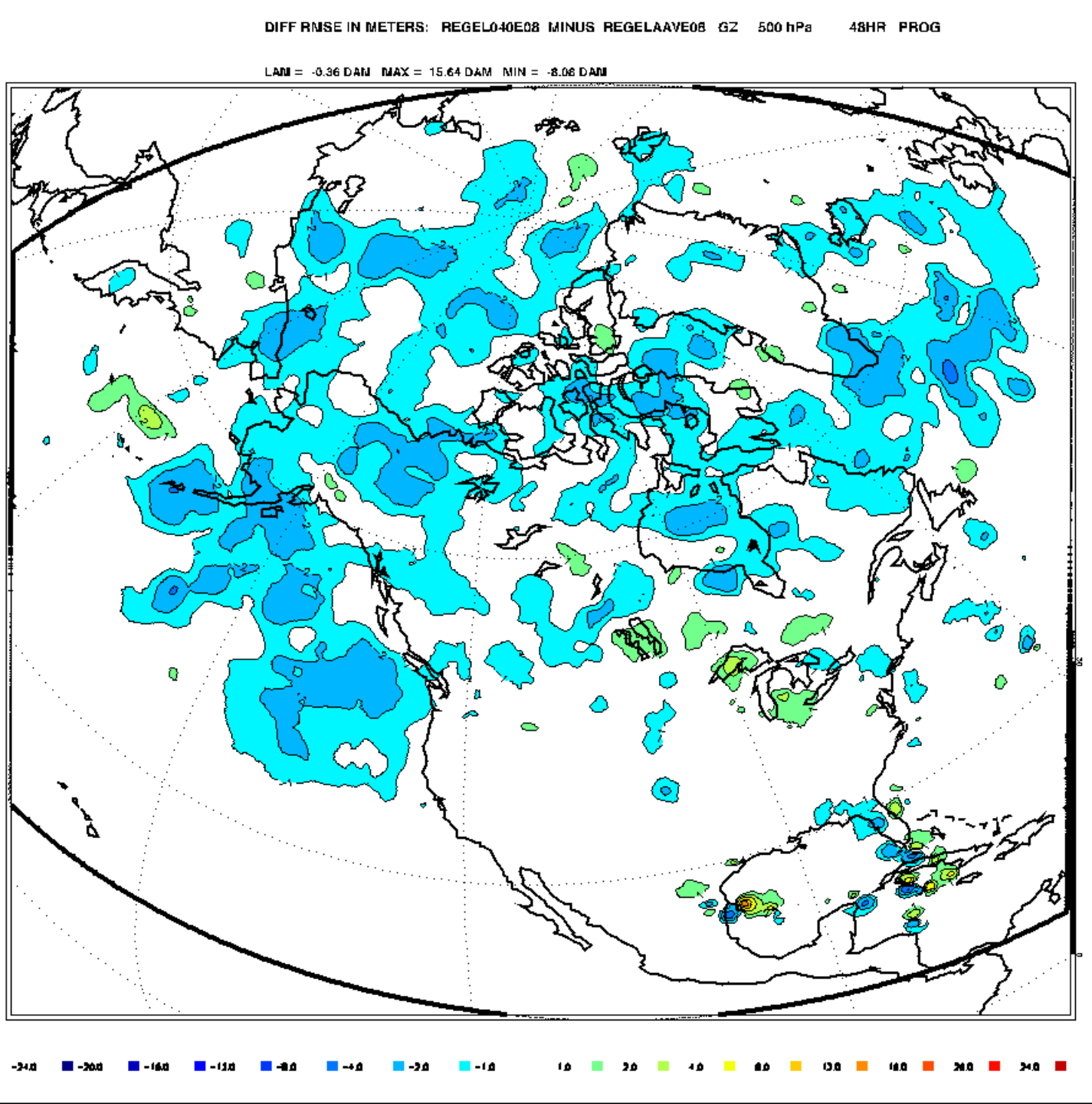

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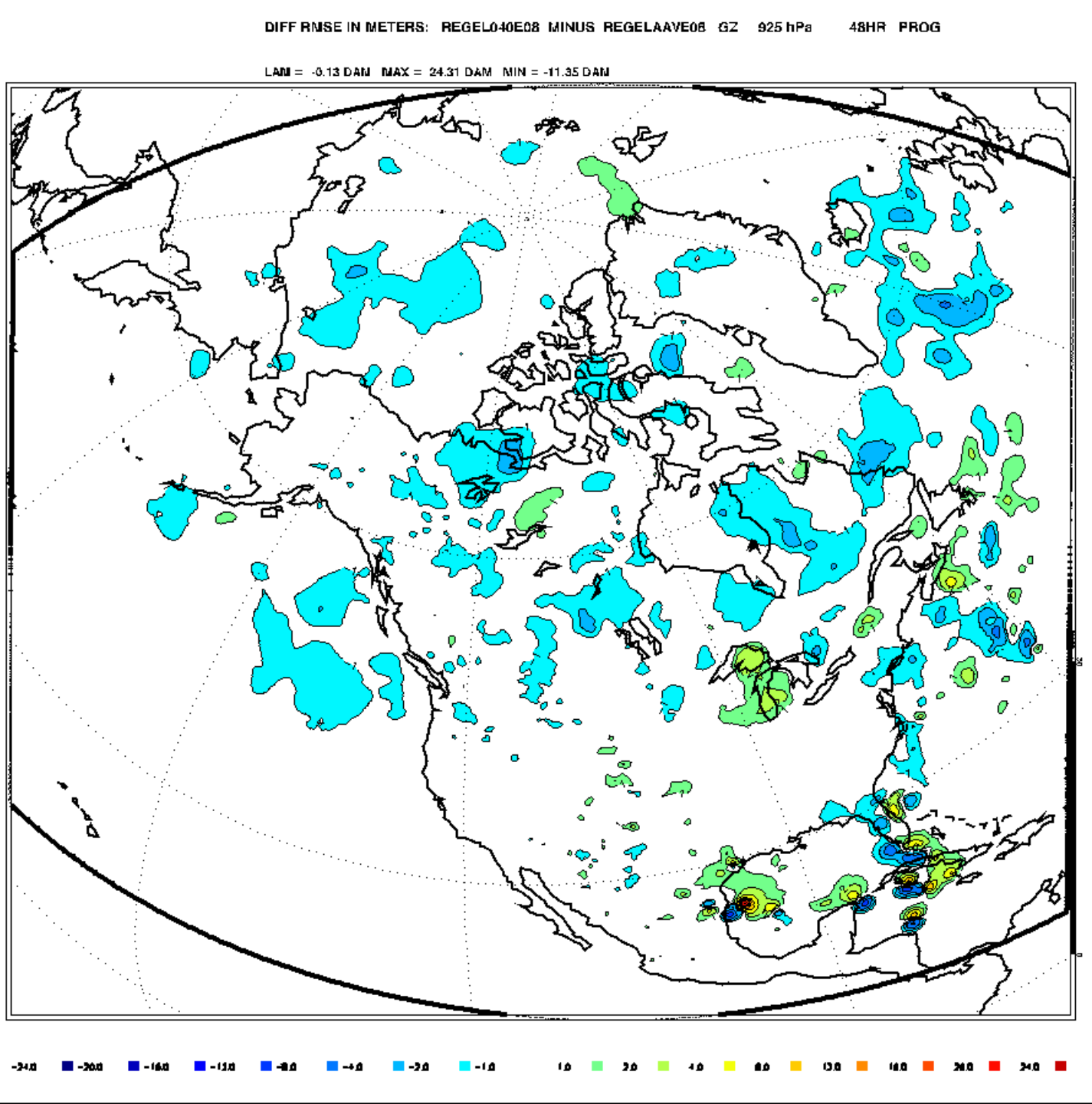
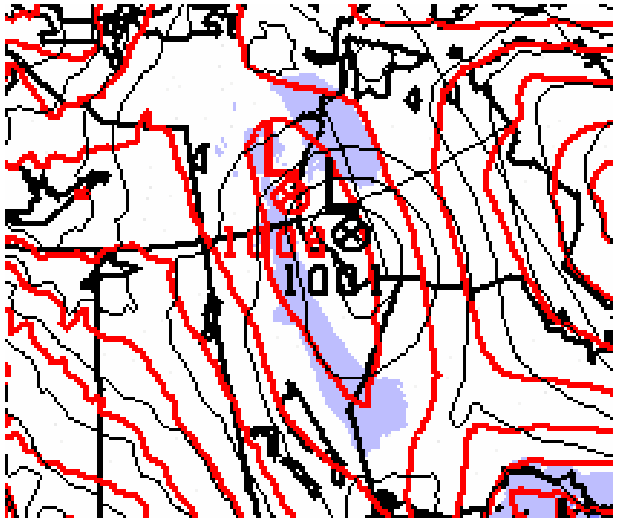
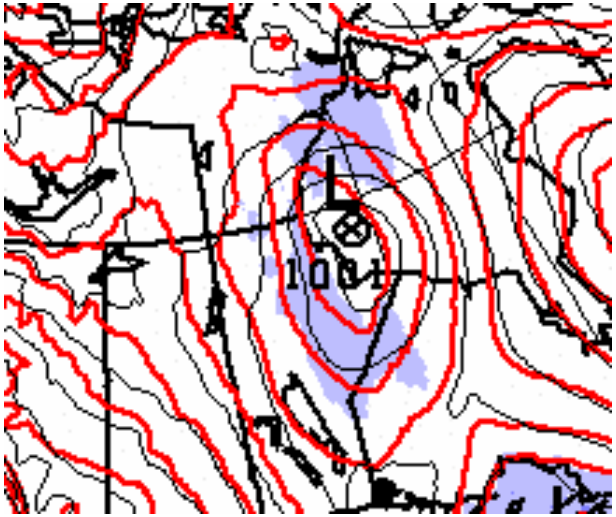


48h Forecast from 16 Jan 2009 Analysis

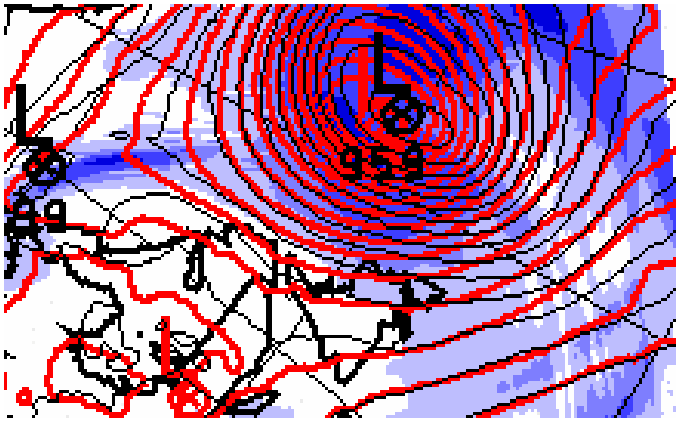
**REG-3D**

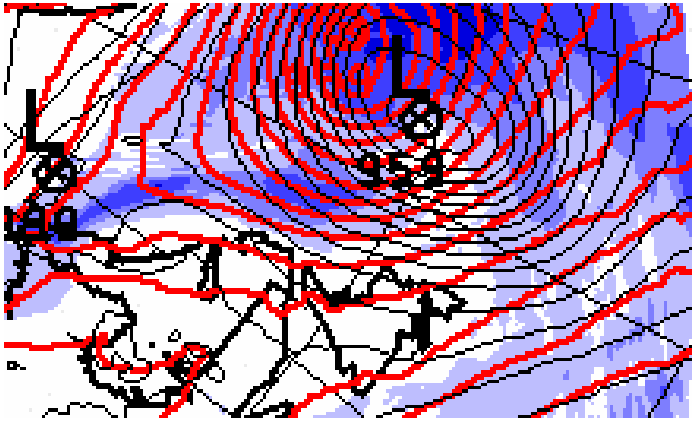



**REG-4D**



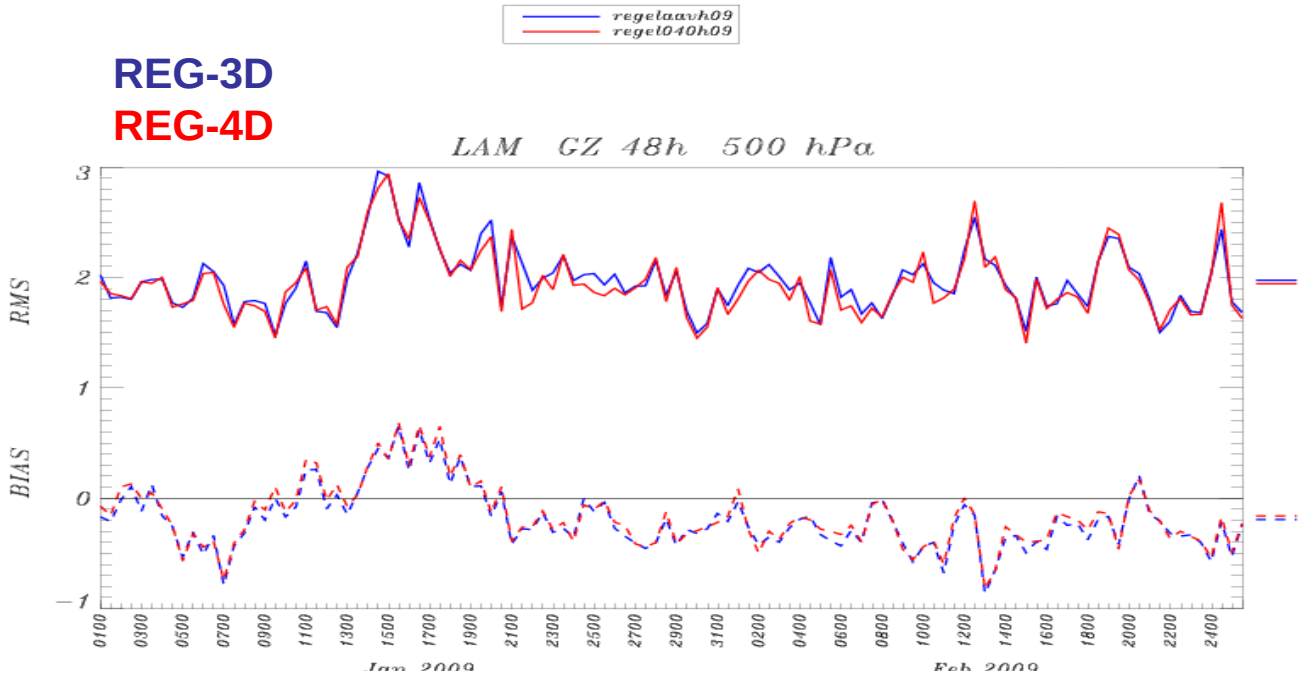

48h Forecast from 31 Jan 2009 Analysis



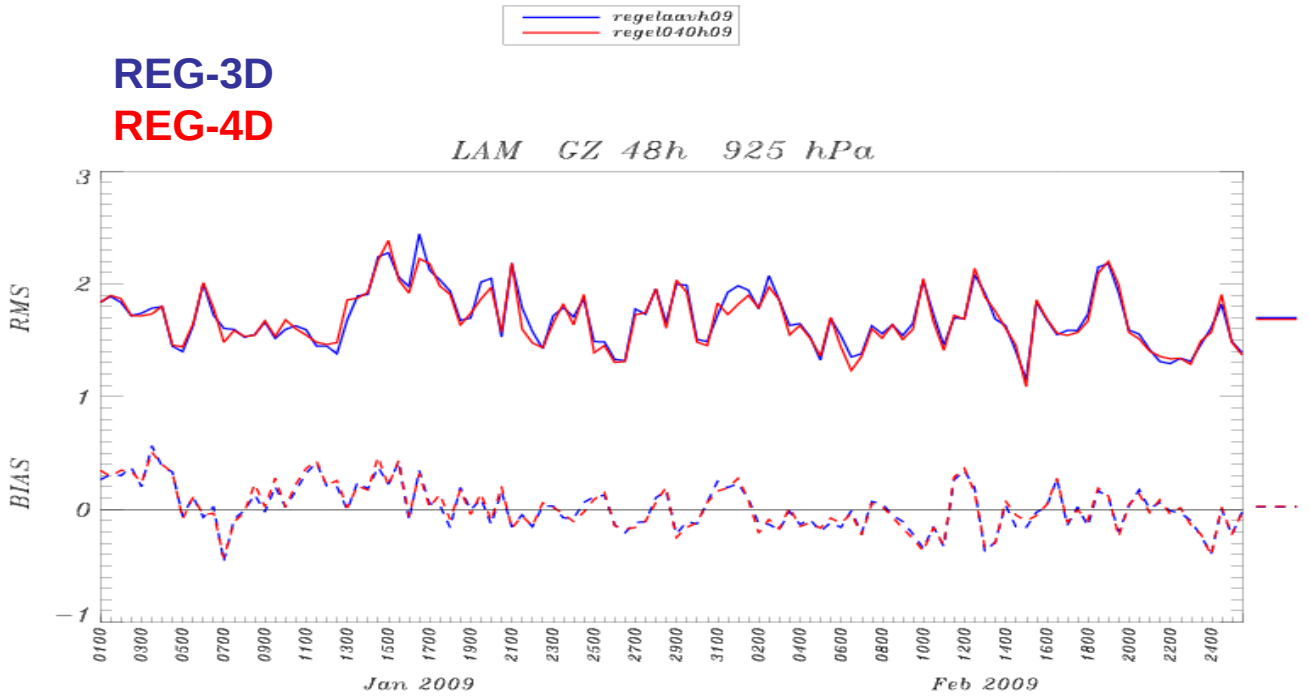



**Winter 2009**
**48h Forecast**

GZ-500 hPa

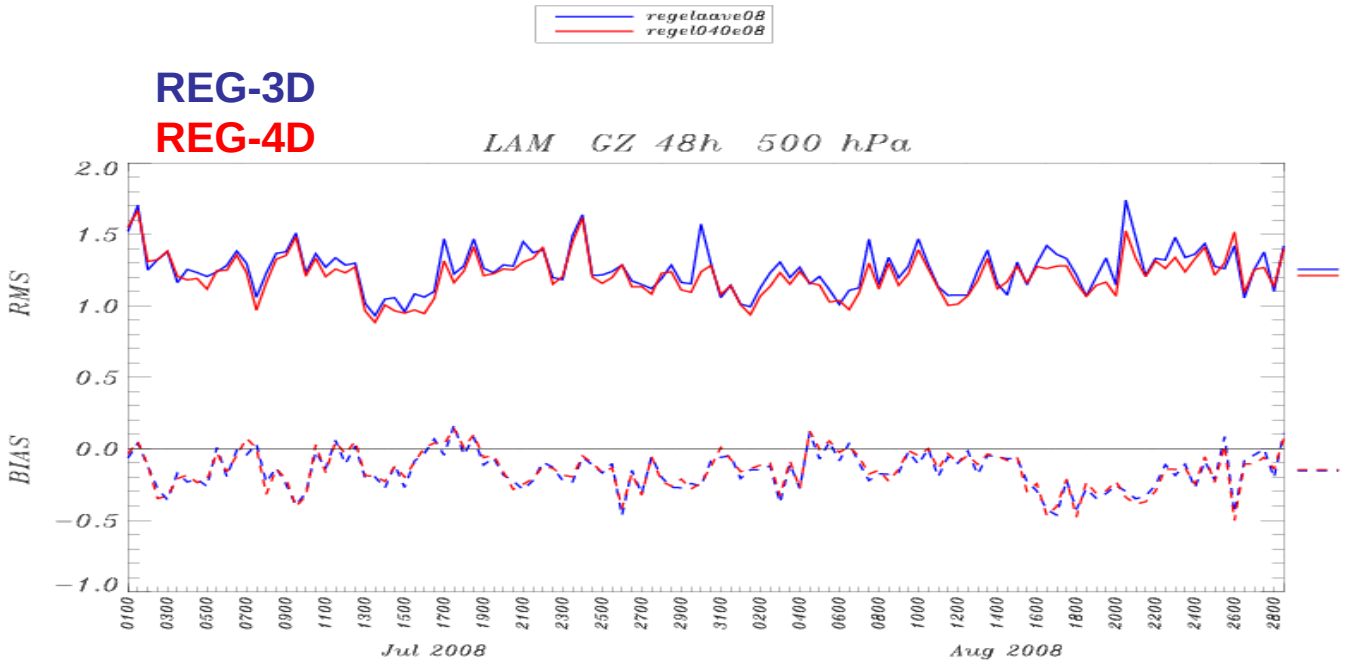



GZ-925 hPa

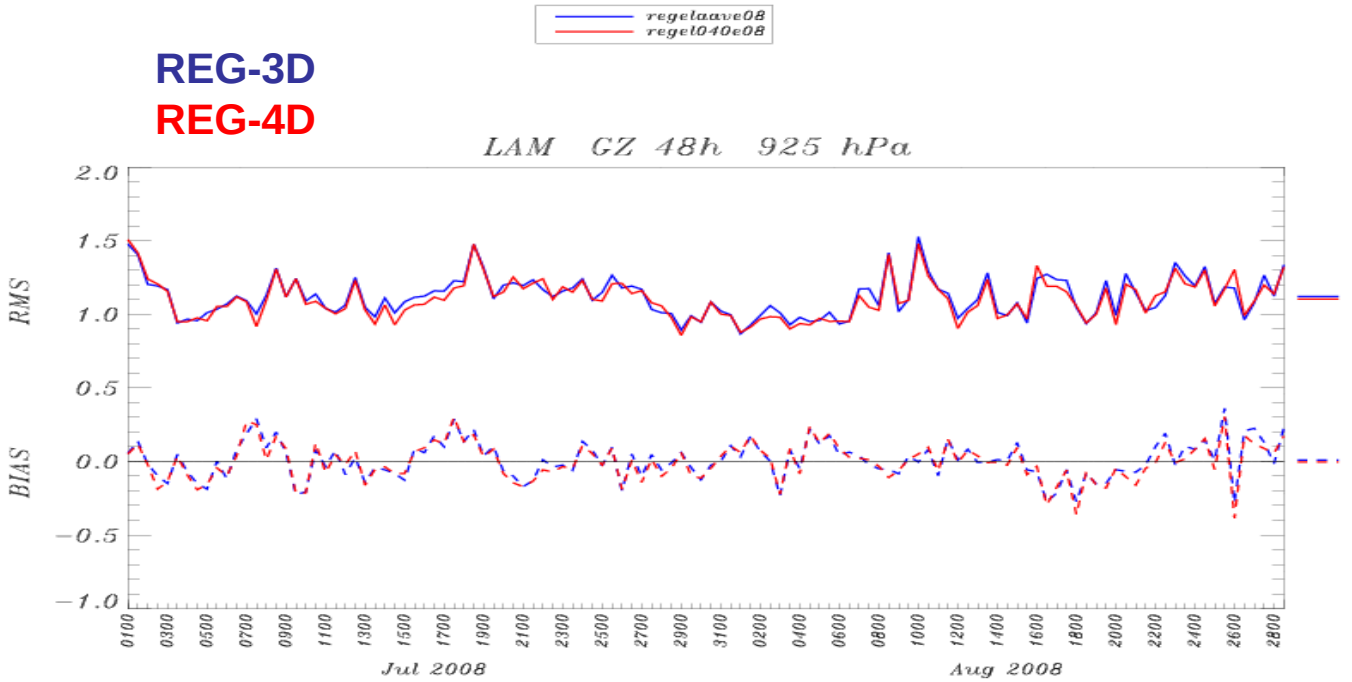


**Summer 2008**
**48h Forecast**

GZ-500 hPa



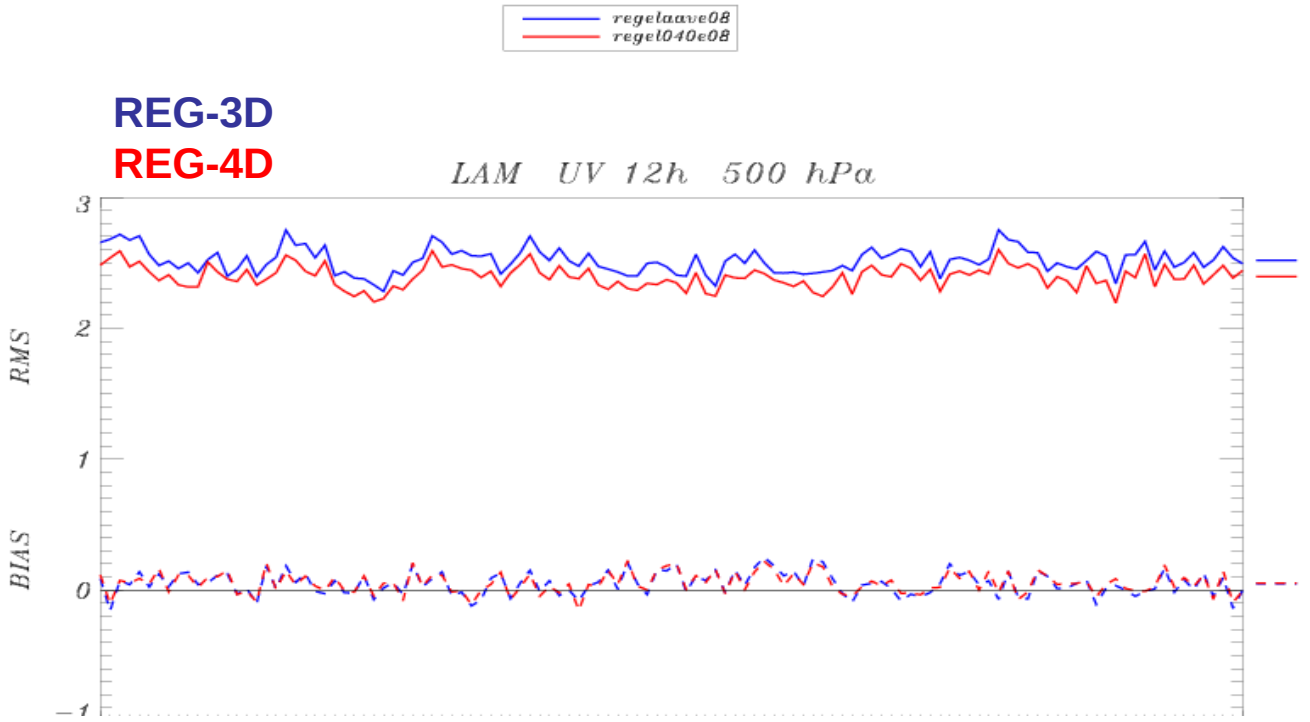

GZ-925 hPa



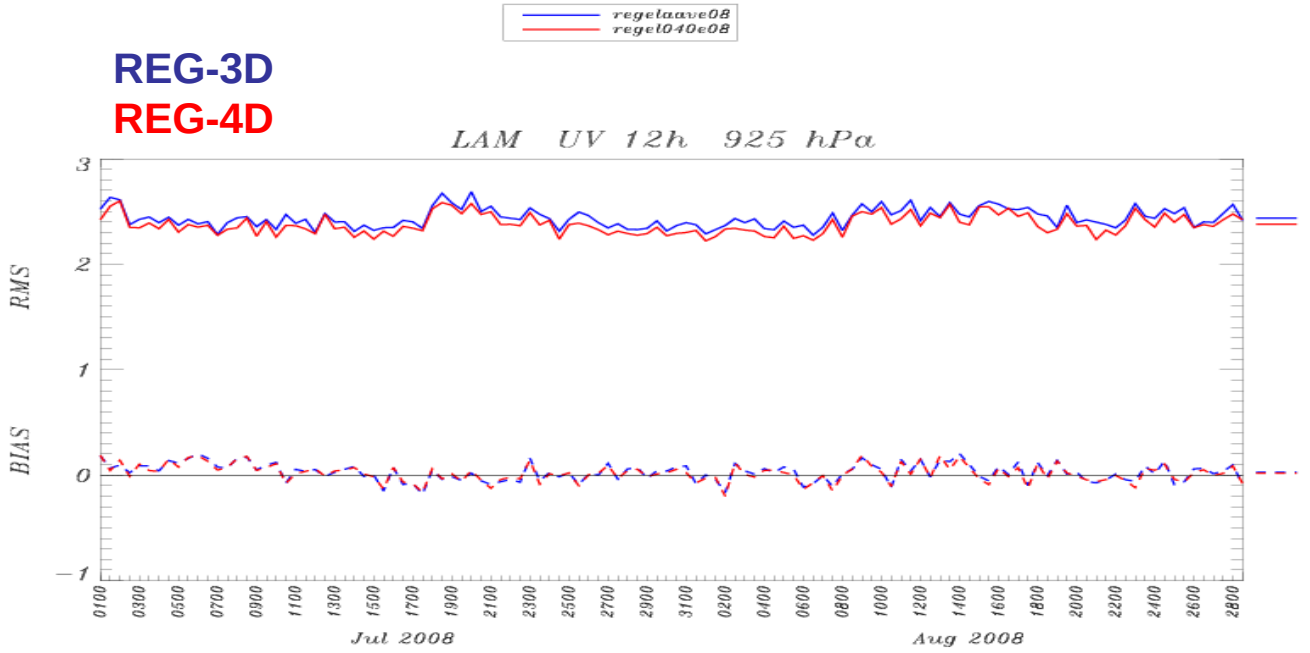
**SUMMER-2008**

**12h Forecast**

**UV-500 hPa**




**UV-925 hPa**



# SUMMER 2008 SHEF All of USA

00-24h

12-36h

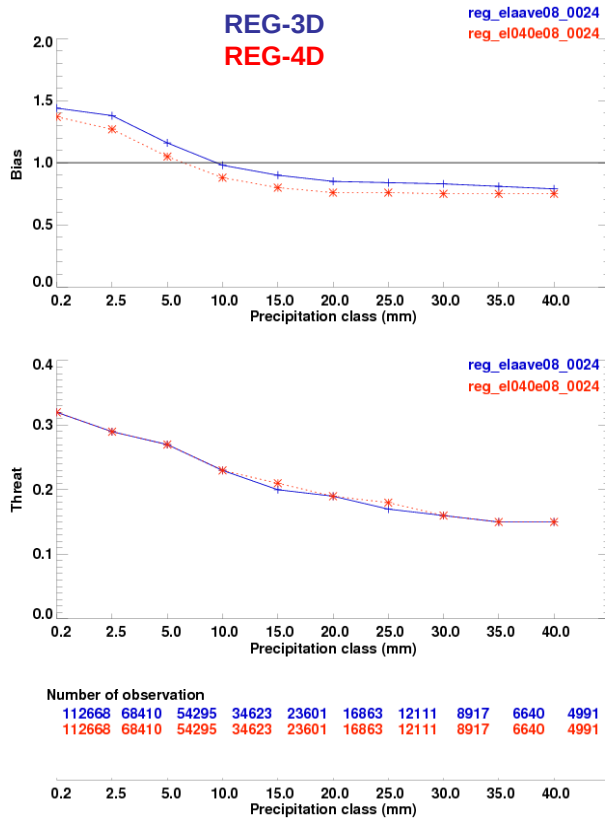
24-48h

24 hours precipitation forecast verification against observati

SHEF network data for valid time 12z

00 to 24 hours forecast fm 12Z run only All of USA

e08

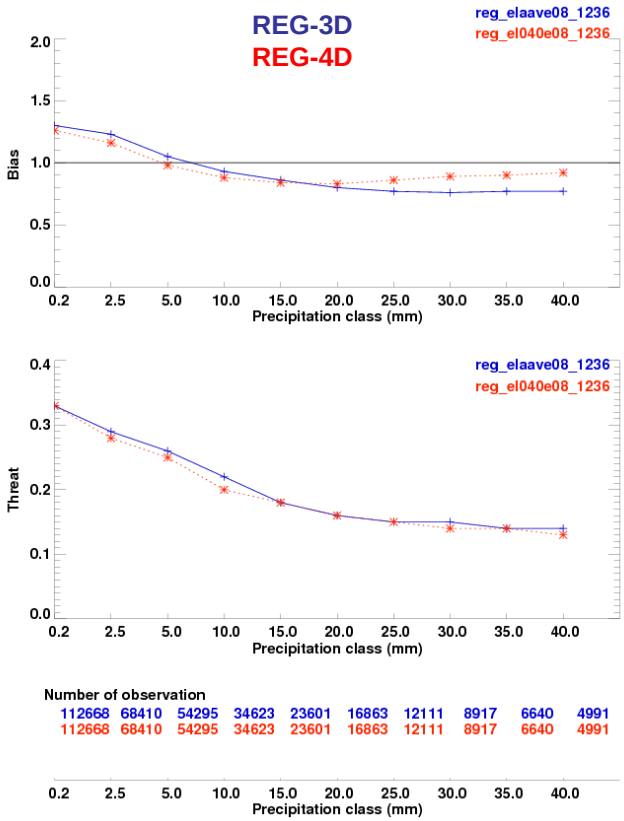



24 hours precipitation forecast verification against observation

SHEF network data for valid time 12z

12 to 36 hours forecast fm 00Z run only All of USA

e08

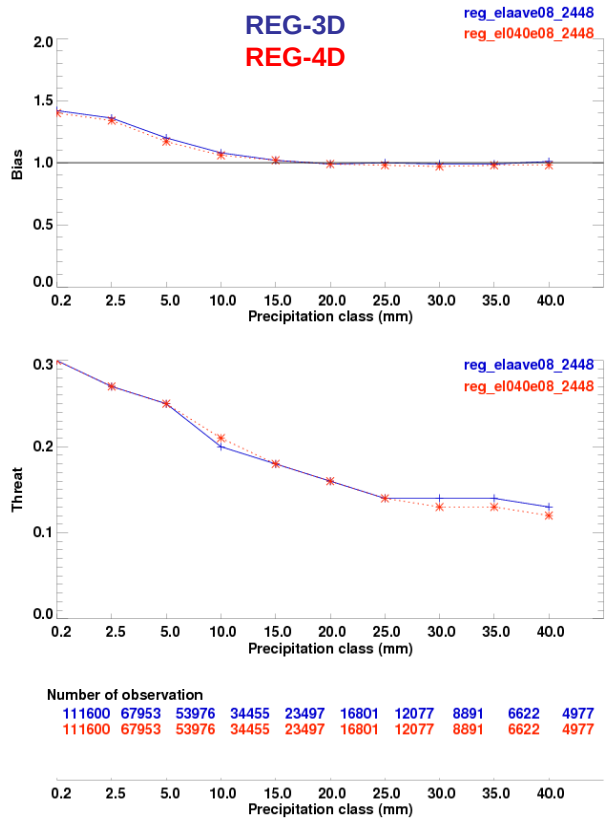



4 hours precipitation forecast verification against observation

SHEF network data for valid time 12z

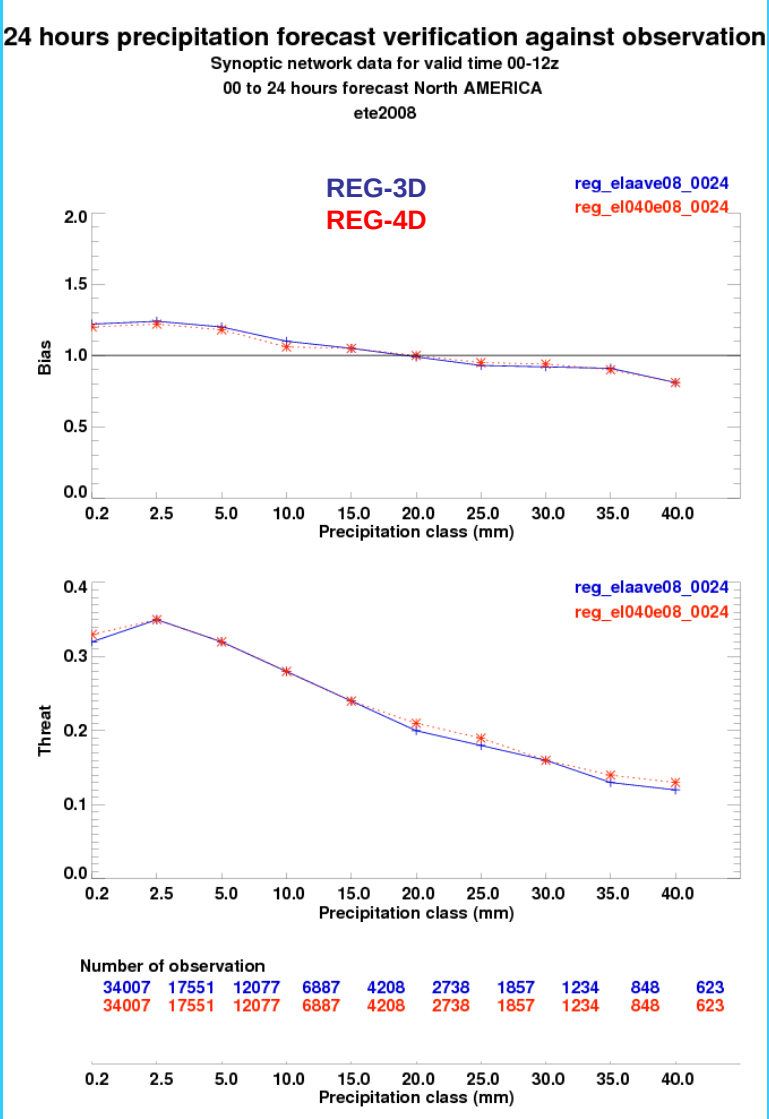
24 to 48 hours forecast fm 12Z run only All of USA

e08

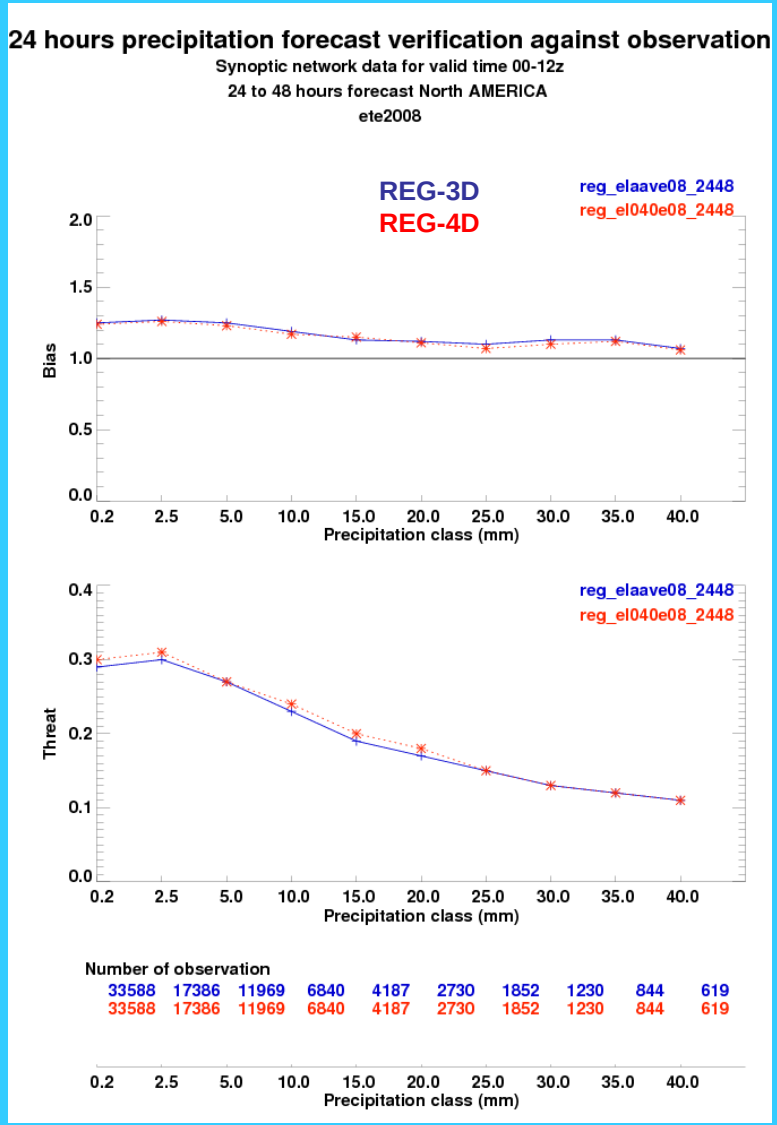


# SUMMER 2008 SYNOP North America

## 00-24h

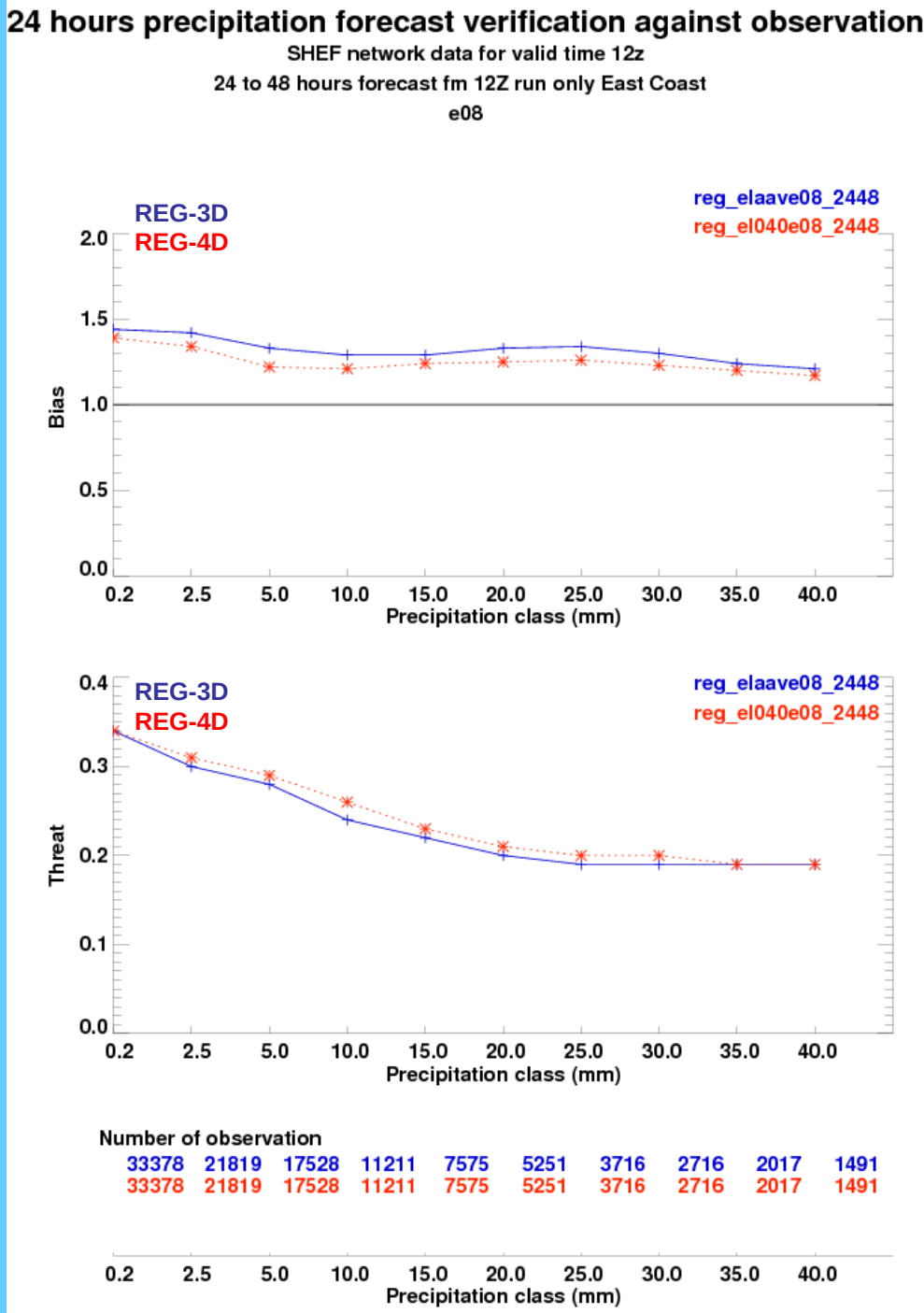



## 24-48h



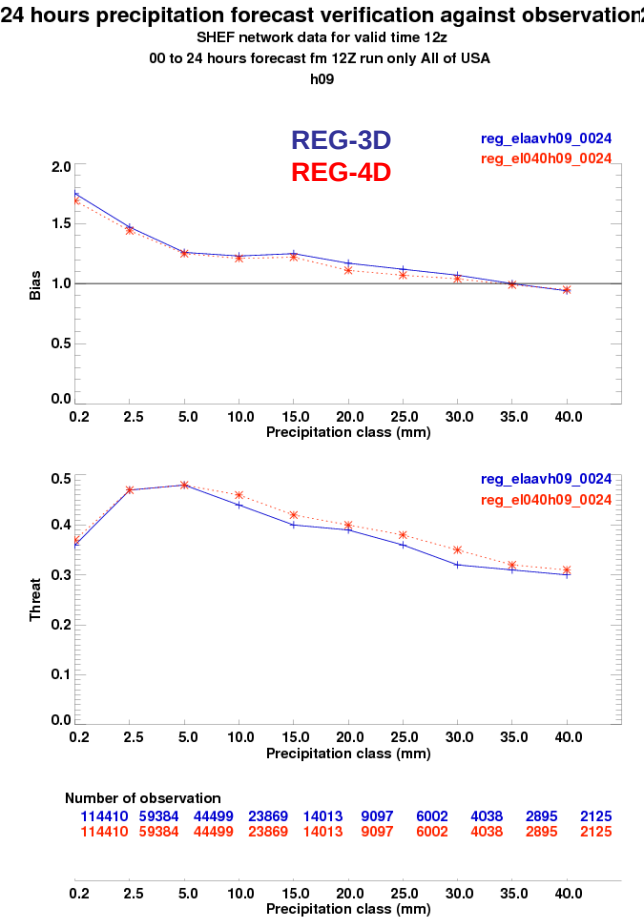
## SUMMER 2008 SHEF-East-Coast

**24-48h, (118 cases)**

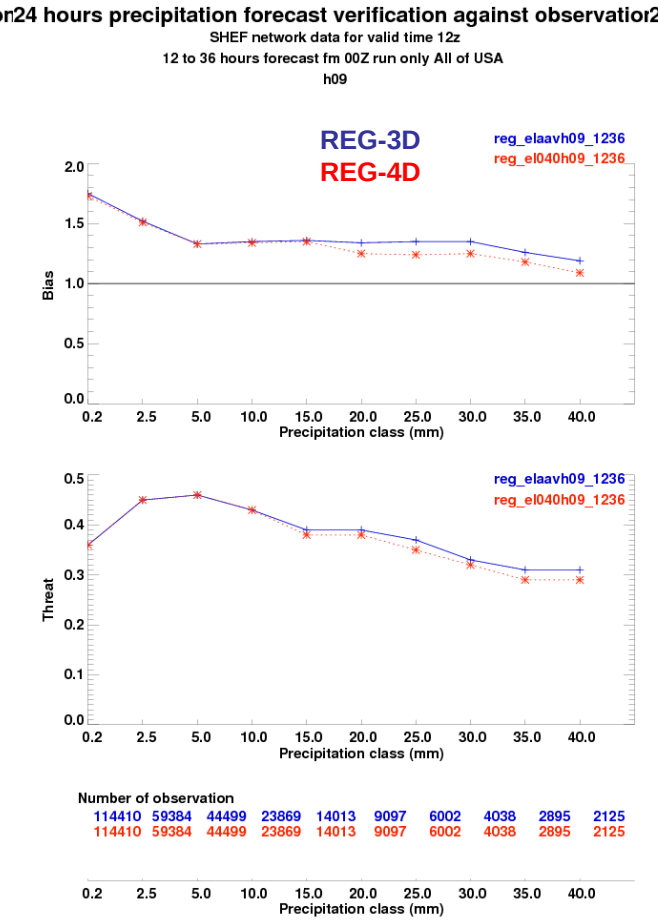


# WINTER 2009 SHEF All of USA

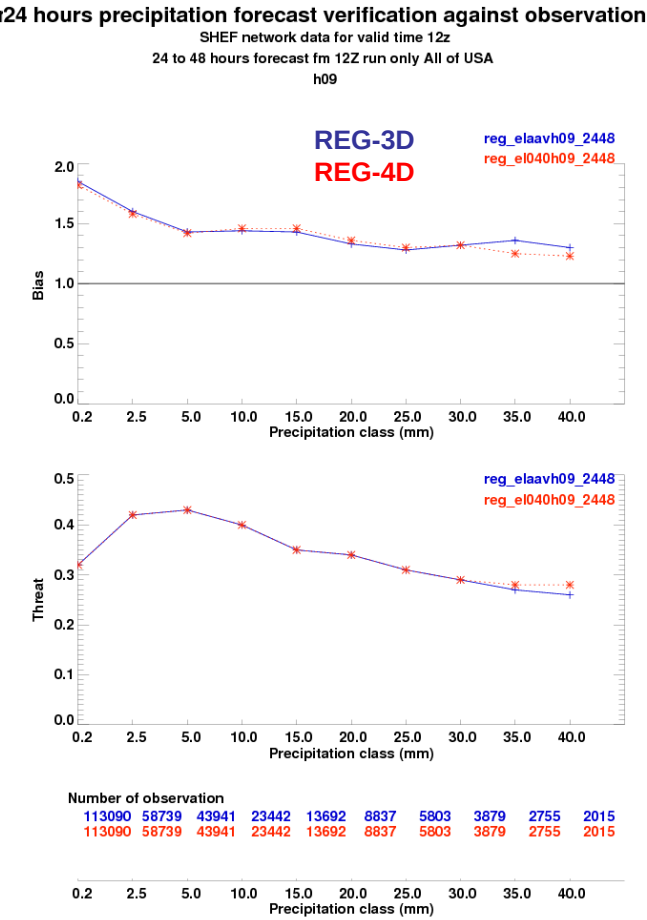
## 00-24h




## 12-36h




## 24-48h



# Temps d'exécution

- Le temps d'exécution de l'assimilation dans la passe parallèle régionale Strato-2B est de
  - 25 minutes
- Avec les optimisations que nous avons faites récemment au REG-4D, on arrive à un timing de
  - 30 minutes

– Le 4D-Var comme tel prend 17 minutes:
  - Utilisation de sous-répertoires dans le répertoire d'échange
  - Autres optimisations possibles par la suite

Il suffirait donc d'utiliser un cut-off 5 minutes plus court pour pouvoir tourner un REG-4D.

Il passerait de +2h05 à +2h.

Évidemment, ce ne sera plus un enjeu lors du passage à la nouvelle machine

# Enjeux pour l'implémentation

- Les changements à faire à la passe opérationnelle sont extrêmement simples.
- On peut voir ceci comme des changements de haut-niveau à la configuration.
- Le seul enjeu non-trivial est la modification au cut-off. Ceci se gère facilement.
- On estime le temps nécessaire pour l'implémentation de 1 à 2 semaines.

# Travaux en cours et a venir

**REG4D_V3 (2011-2012)**

- **Ground_based GPS (Stephen MacPherson, J. St-James, S. Laroche)**
- **MPI upgrades (Bin He, Ervig Lapalme, Monique Tanguay, Michel Valin)**
- **Vertical Staggering Analysis (Luc Fillion, Mat Reszka)**
- **GEM-4 (LAM+Driver) + GEM-10 km (Paul Vaillancourt et al.)**

**REn_KF (Luc Fillion, Mat Reszka, J. Someonelse, 2011) (METAREAS)**

**REG4D_V4**

- **TL-INMI-Diabatic (Fillion et al 2007) Amelioration de la precip 0-24h.**
- **Jb_Ens (Buehner 2008) Covariances d'erreur de previ ameliorees**
- **Analyse avec Pilotage Vertical a 35 hPa (McTaggart et al. 2010)**

**=> Augmentation de resolution verticale (Previ & Analyse)**

_____ FIN _____