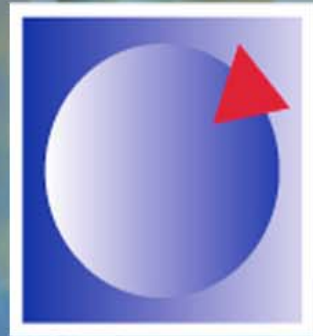# First results of AIRS assimilation at
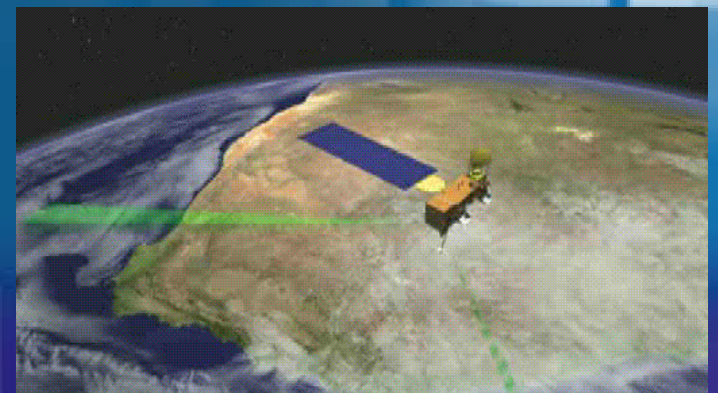

METEO FRANCE

Thomas Auligné
Florence Rabier, Lydie Lavanant, Mohamed Dahoui

Introduction

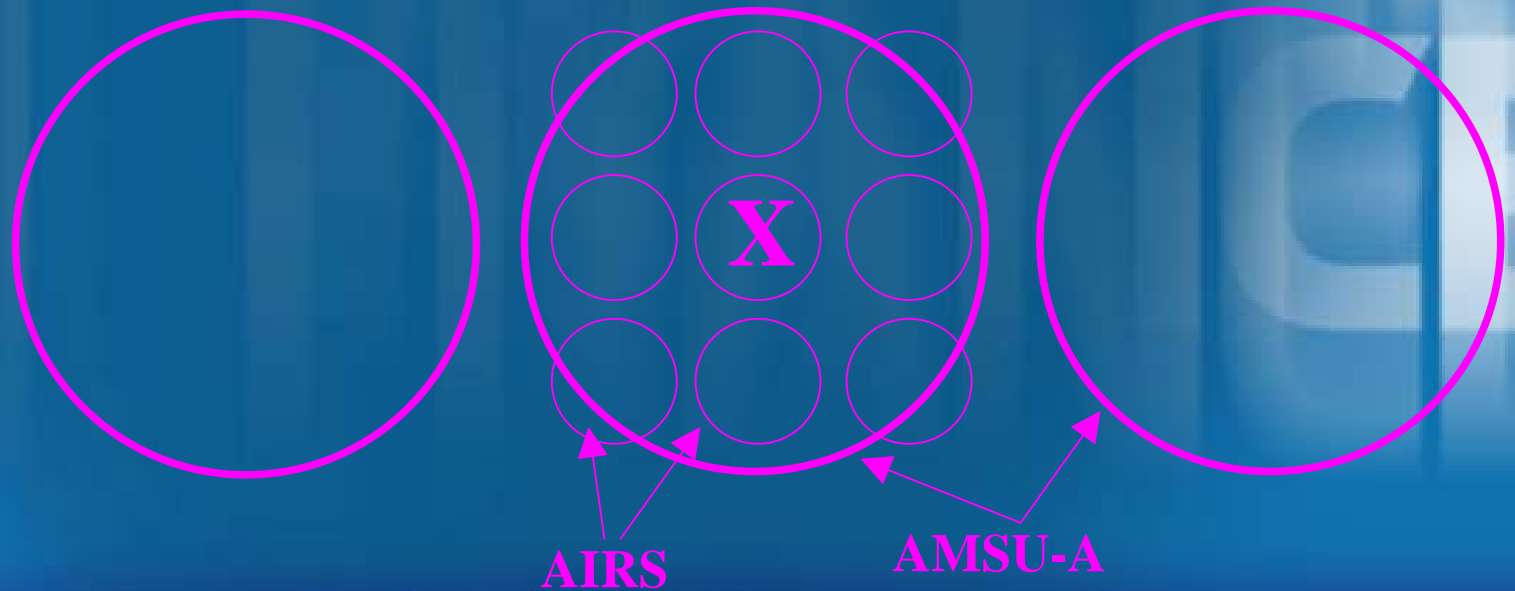AIRS (Atmospheric InfraRed Sounder) aboard

AQUA platforme:

2378 channels (3.74 -> 15.4 µm)

1.1° FOV collocated with AMSU(golf ball)

Introduction

Constant subset of 324 channels for

center of every other golf ball (1/18 pixels)

X

AIRS

AMSU-A

Introduction

EOS
AQUA

↓

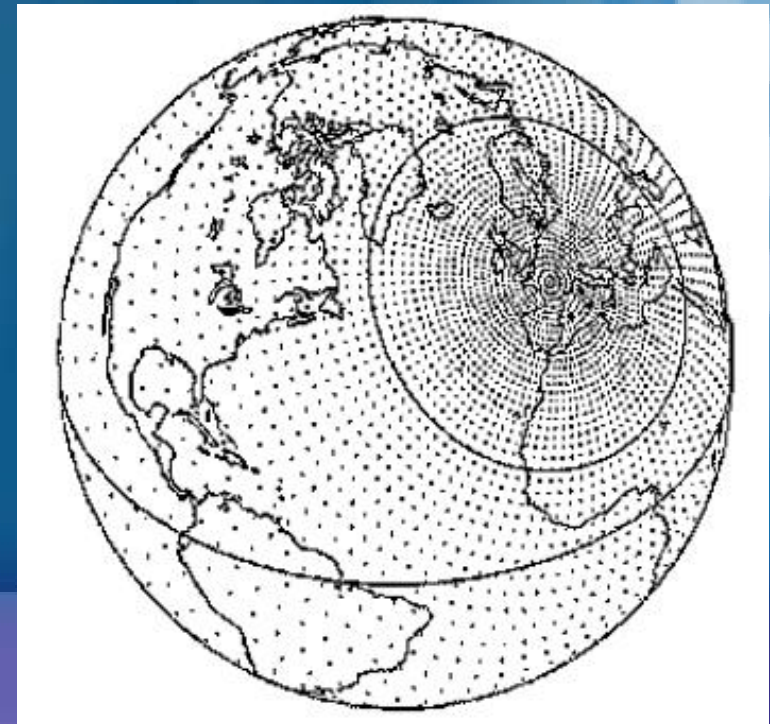NESDIS

↓

Met Office

↓

Météo-France D.B.

↓

Radiances / Tb observations

ARPEGE NWP
operational model

ARPEGE : global spectral model

T358, C2.4, 41 vertical levels

Associated grid: 23km (France) to 133km

(antipodes)

Introduction

EOS AQUA

↓

NESDIS

↓

Met Office

↓

Météo-France D.B.

↓

Radiances / Tb observations

4D-Var Data Assimilation

Screening (obs-fg)

Minimisation

↑

First Guess

ARPEGE NWP operational model

6-hour assimilation cycling:

00, 06, 12, 18 UTC

Multi-incremental 4D-Var:

T107 & T161, 41 L

Introduction

EOS
AQUA

↓

NESDIS

↓

Met Office

↓

Météo-France D.B.

↓

Radiances / Tb observations
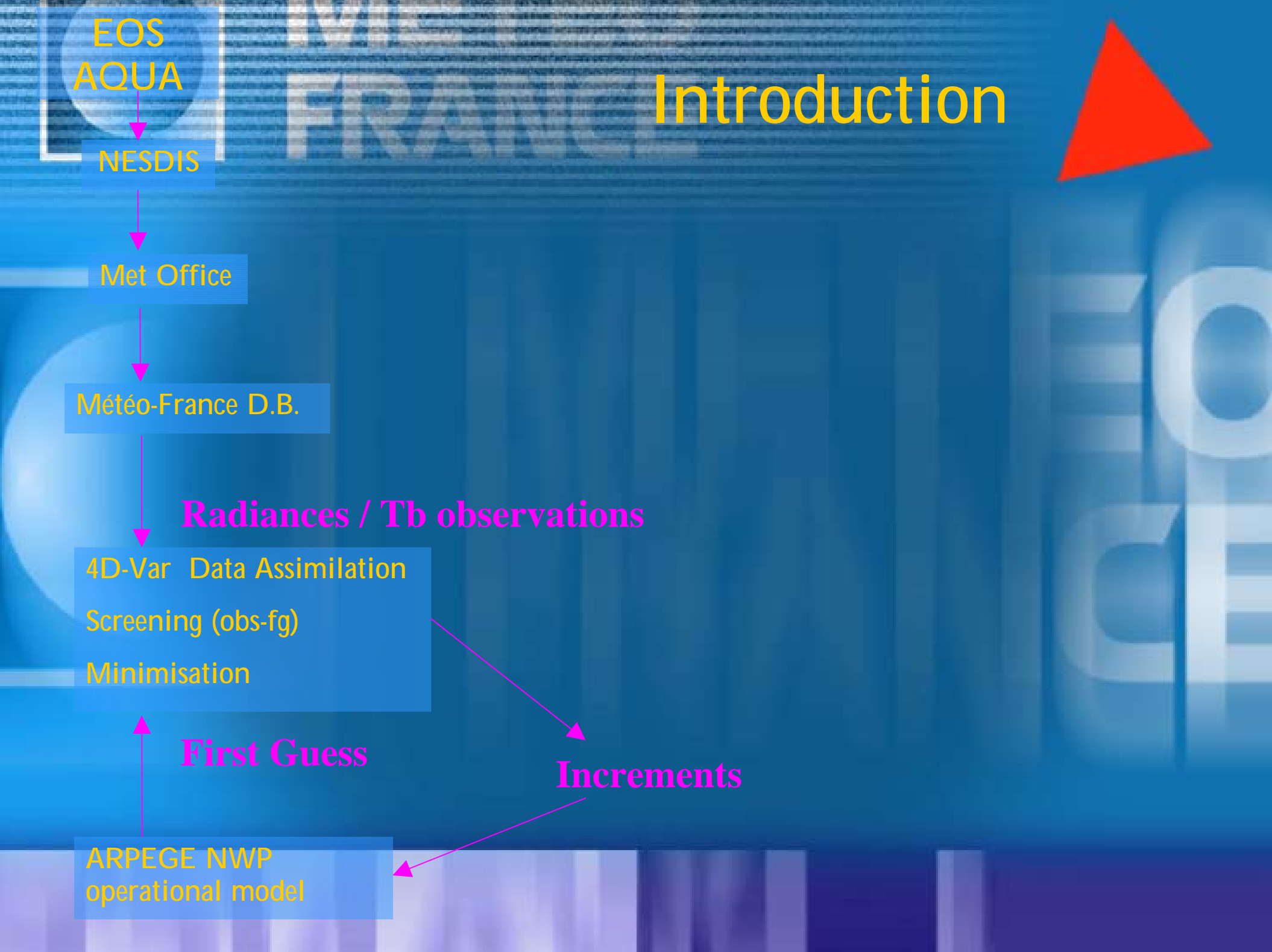
4D-Var Data Assimilation

Screening (obs-fg)

Minimisation

↑

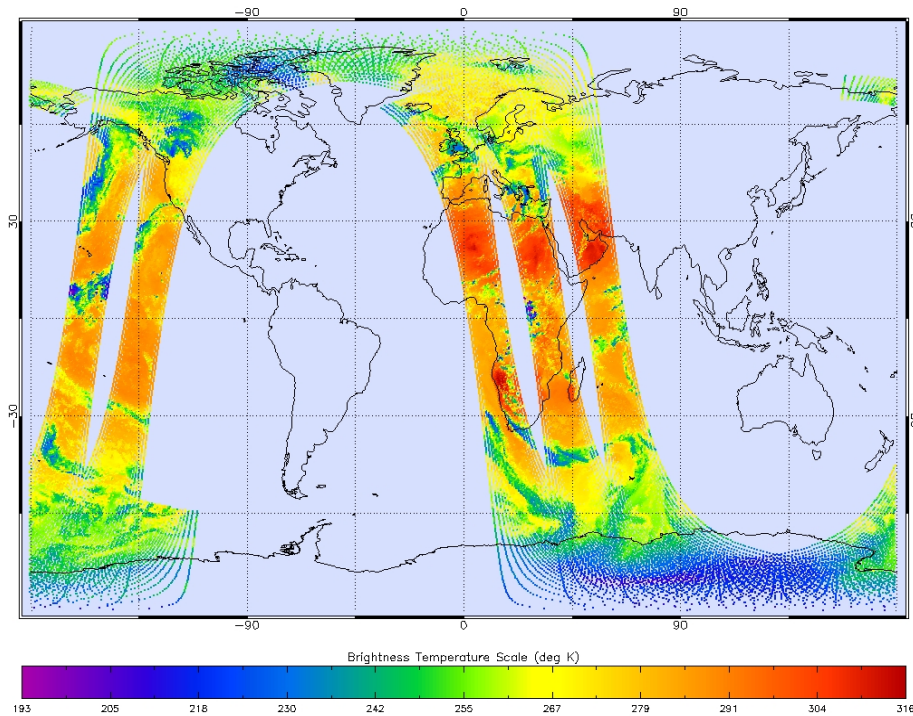**First Guess**
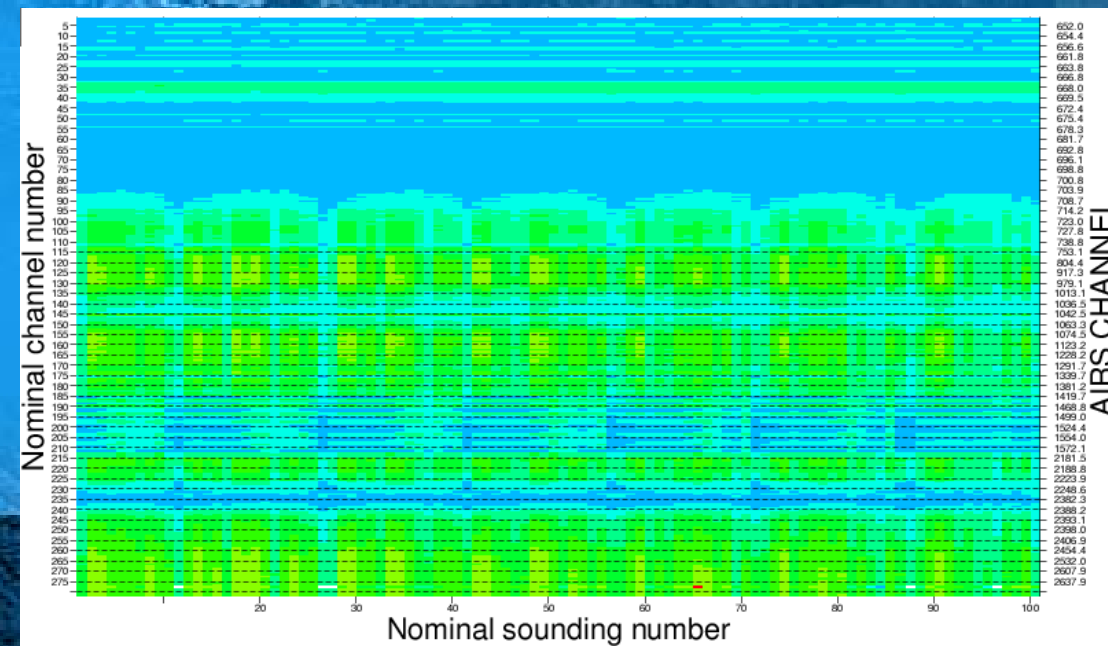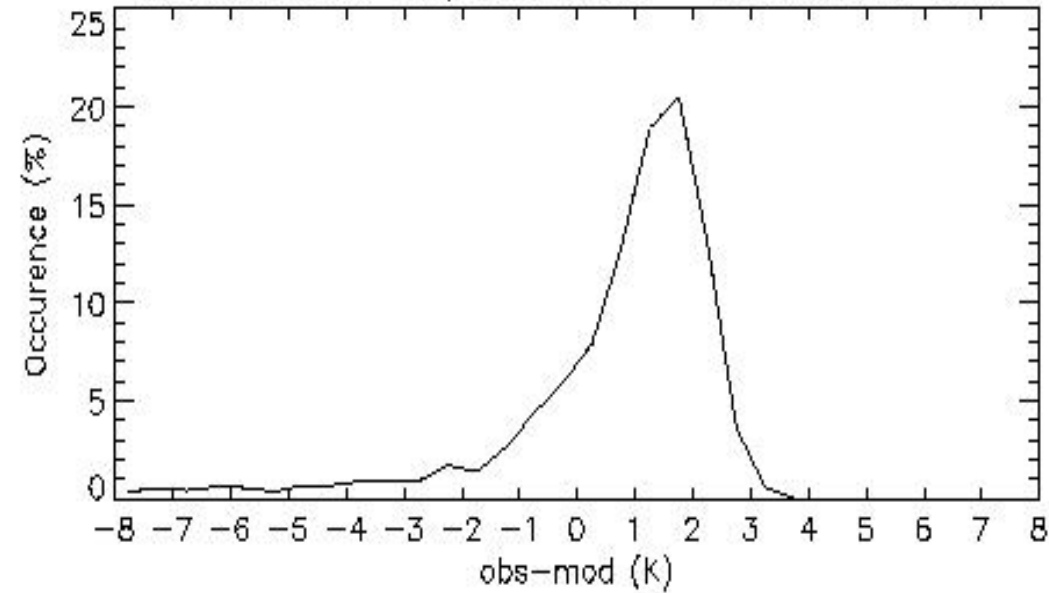
Increments

ARPEGE NWP
operational model

Contents

A conservative assimilation suite

First impact study

Work under development

Conclusion and perspectives

AIRS Level-1B Quicklook Image
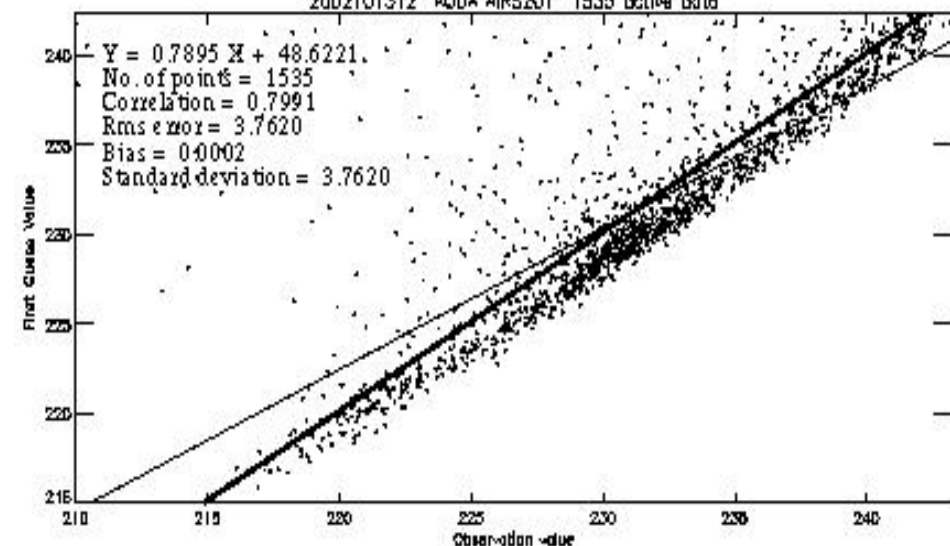
Brightness Temperature Scale (deg K)

2002101312   AQUA AIRS201   1535 active data

Y = 0.7895 X + 48.6221.
No. of points = 1535
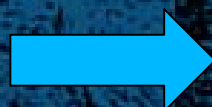Correlation = 0.7991
Rms error = 3.7620
Bias = 0.0002
Standard deviation = 3.7620

Assimilation suite

- ✓ **Channel selection**

- ✓ Gross check : $150 < Tb < 350$ & $(obs - fg) < 20$

- ✓ First-guess check : $(obs - fg)^2 < \alpha\,(\sigma_o^2 + \sigma_b^2)$

- ✓ Channels in O_3 and SW bands, over land, peaking above/near model cloud top (1hPa), at edges of scan are blacklisted

176 channels used

Assimilation suite

✓ **Cloud detection**

Mitch Goldberg cloud detection scheme:
based on thresholds recomputed for ARPEGE model

✓ LW window channel: $Tb(965.43 cm^{-1}) > 270$ K
✓ Model SST versus SW window channel $(2616.095 cm^{-1})$ (night only)
✓ Model SST versus predicted SST (from channels 918.65, 965.32, 1228.09, 1236.40 cm^{-1})

VIS/NIR imager: less than 10 % cloud in pixel (day only)
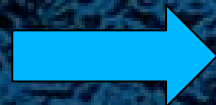
➡ **Information on a pixel basis**

Assimilation suite

✓ Bias correction

Flat bias correction for each channel calculated over all active data

✓ Observation error estimation

Basic definition for σ_o:

0.6 K for upper temperature channels
1 K for lower temperature channels
2 K for water-vapor channels

Impact study

Period of 19 days: 2003.08.01 → 2003.08.19

CTRL = latest ARPEGE suite (including HIRS)

EXP = CTRL + AIRS (all data in 6h assimilation window)
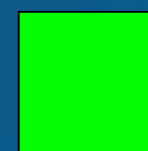
+ more iterations in the 2nd 4D-Var minimisation

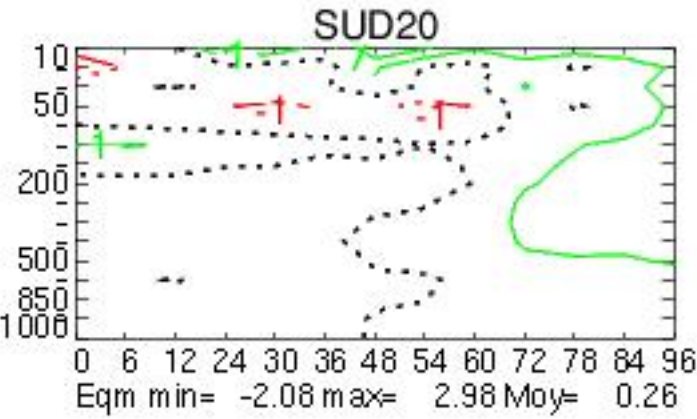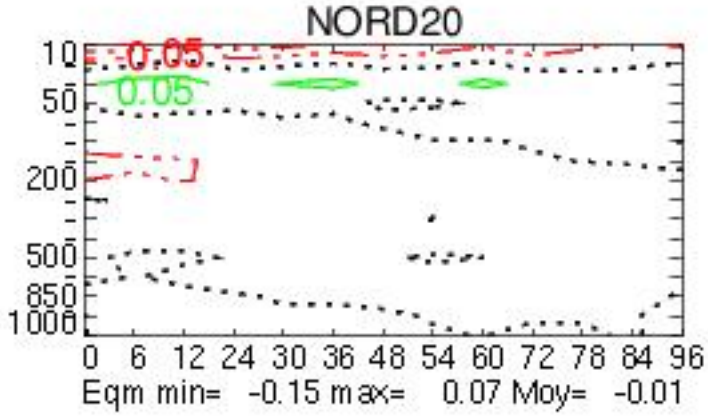Forecast range

Pressure

$RMS_{CTRL} - RMS_{EXP}$

VERIF = ECMWF analysis
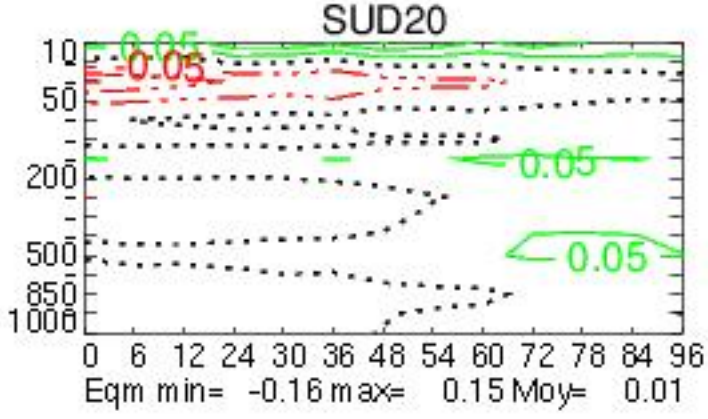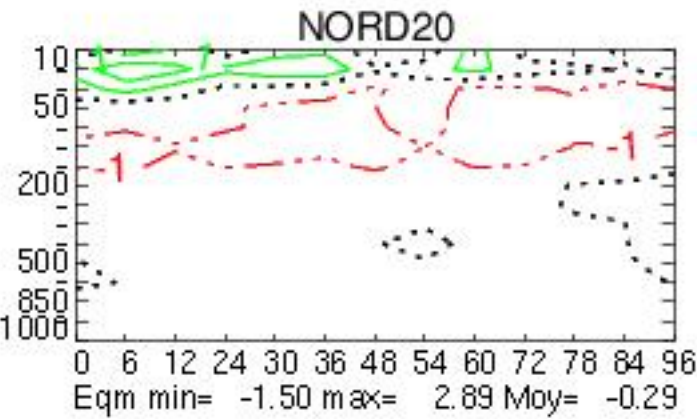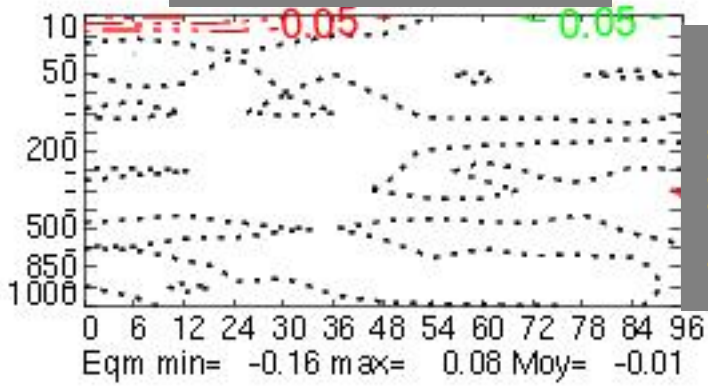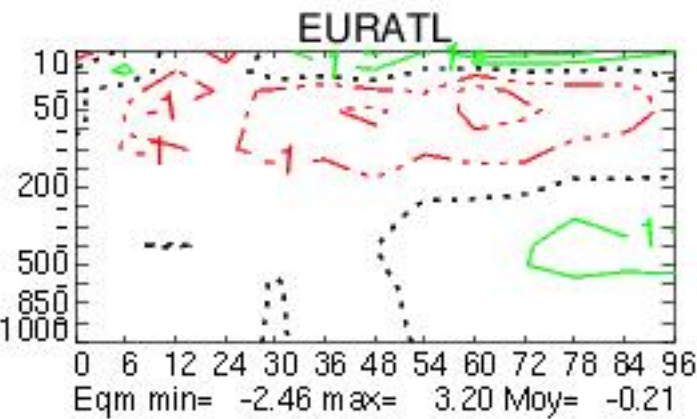
Geopotential   Temperature

VERIF = TEMP observations
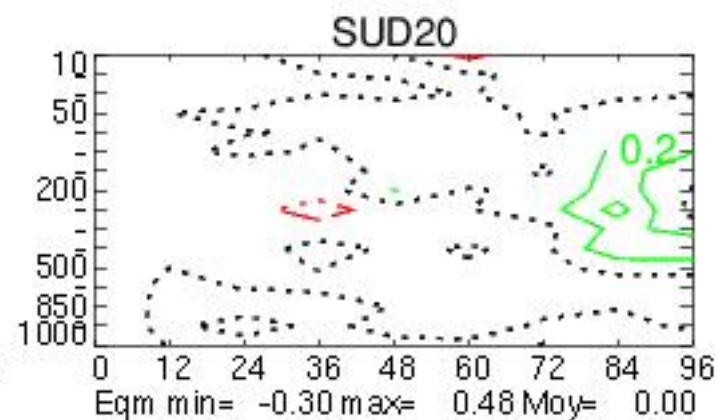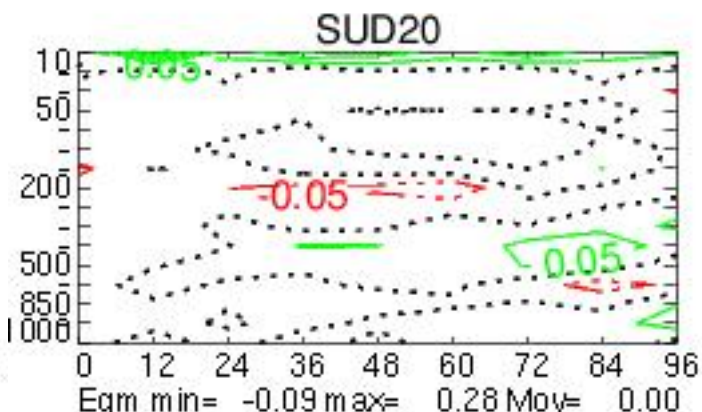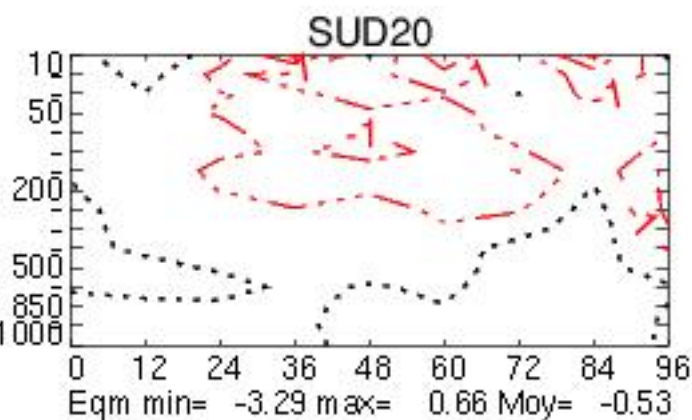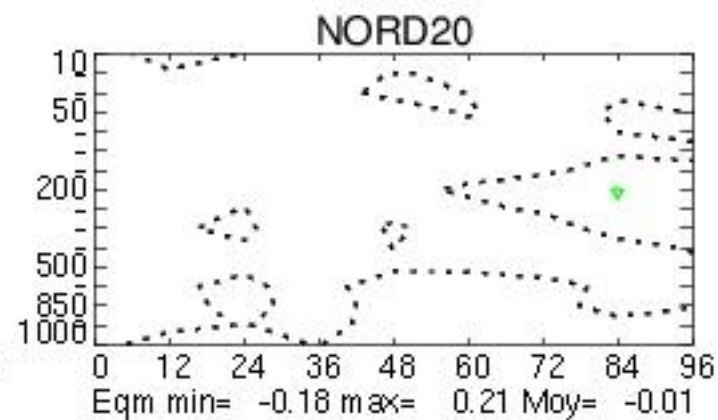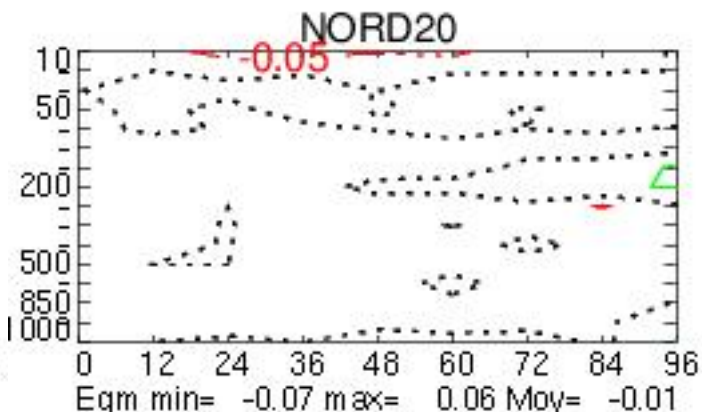
Geopotential   Temperature   Humidity

Work under development

✓ Bias correction

→ Neural Network

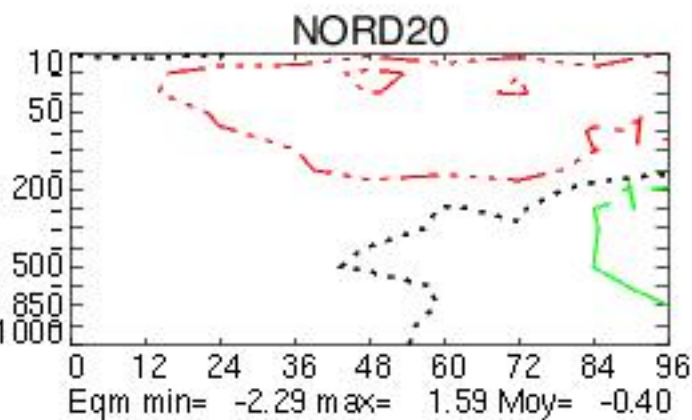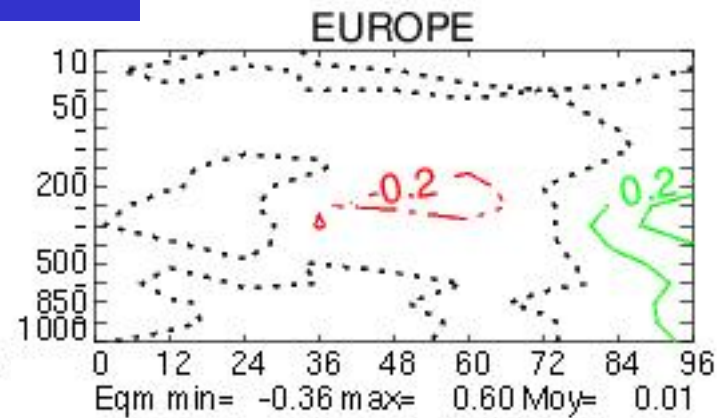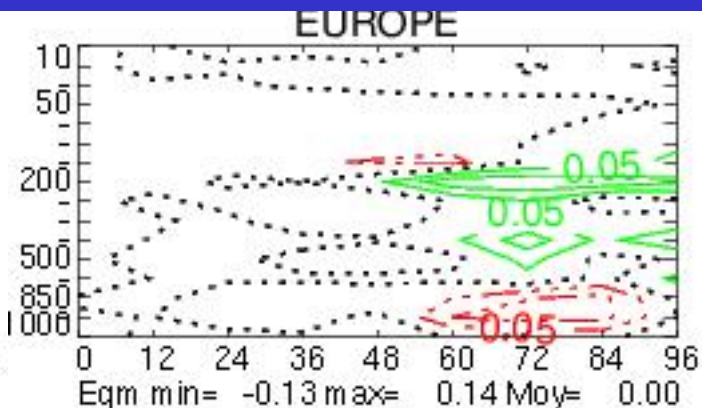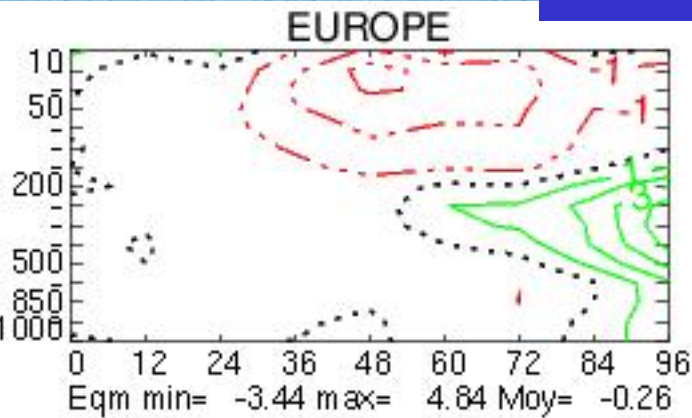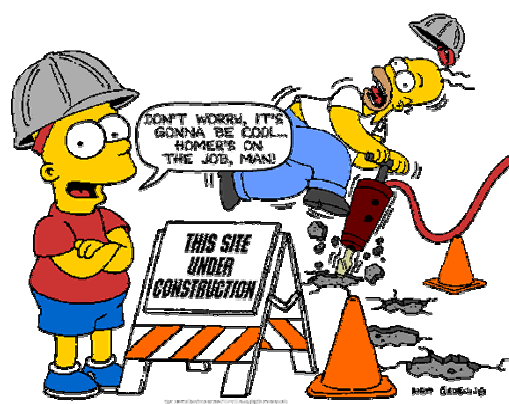**PREDICTORS:**

✓Ps
✓Ts
✓Land/Sea mask
✓Sat zenith angle
✓Latitude
✓Obs → Tb
✓T profile
✓Q profile
(43 RTTOV levels)

LEARNING PROCESS

NEURAL NETWORK:

Multi-layer perceptron

OBSERVED BIAS :

Obs-Guess

Work under development

- ✓ Bias correction

→ Neural Network

PREDICTORS:

- ✓ Ps
- ✓ Ts
- ✓ Land/Sea mask
- ✓ Sat zenith angle
- ✓ Latitude
- ✓ Obs → Tb
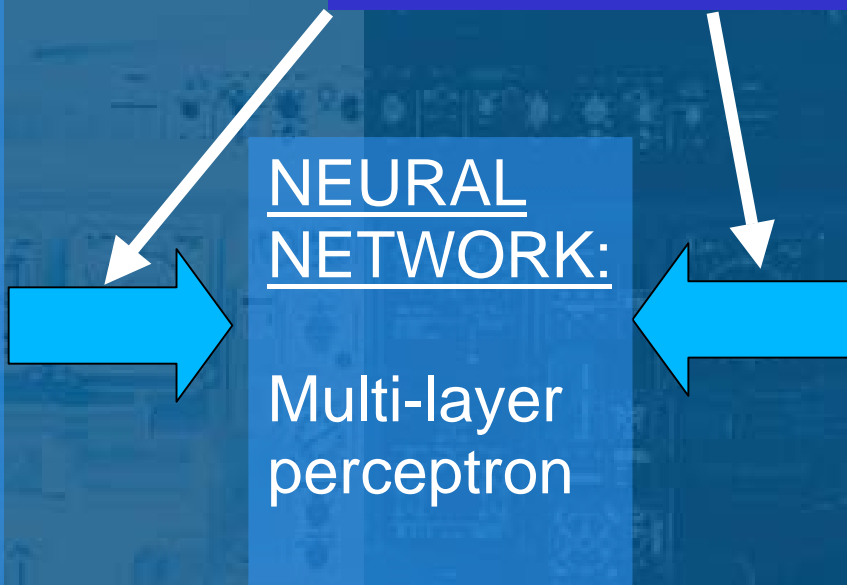- ✓ T profile
- ✓ Q profile

(43 RTTOV levels)

NEURAL NETWORK:
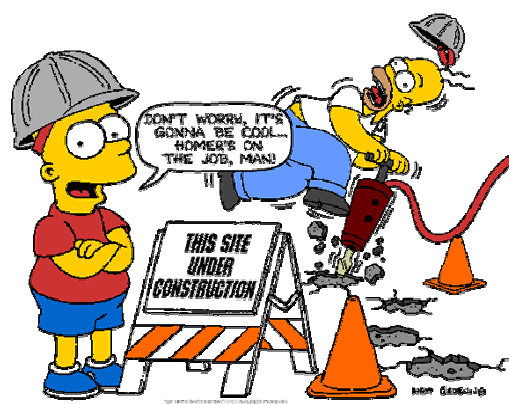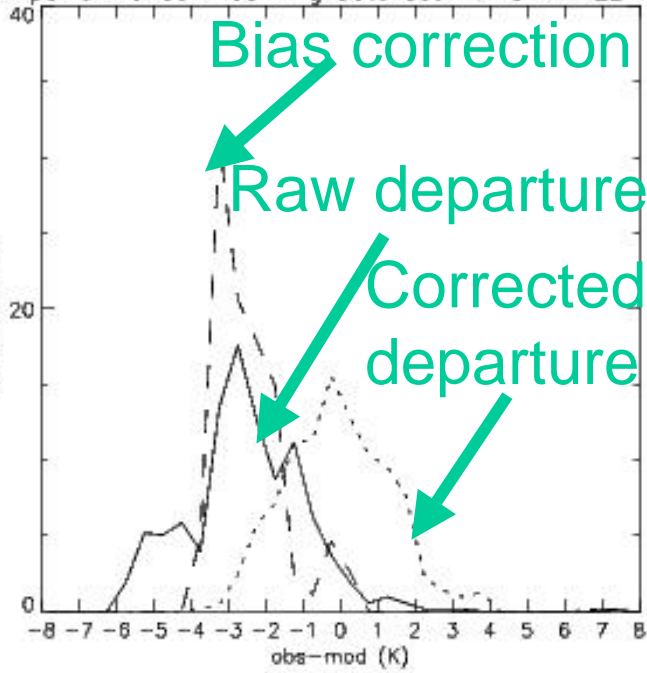
Multi-layer perceptron

PREDICTED BIAS :

Obs-Guess

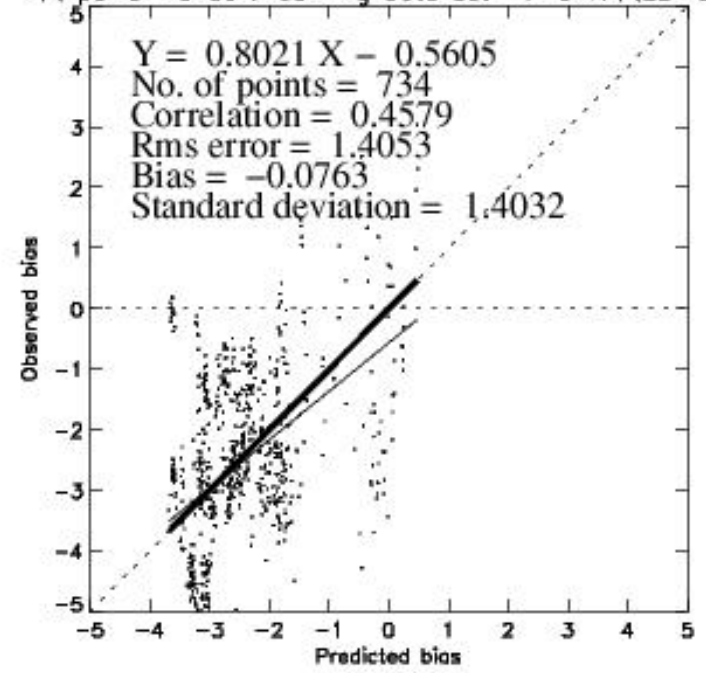**SENSITIVITY :**

For each predictor

LEARNING DATASET

TEST DATASET

NN performance : learning data set -> CHANNEL 1266

Bias correction

Raw departure

Corrected departure

NN performance : learning data set -> CHANNEL 1266

Y = 0.8021 X − 0.5605
No. of points = 734
Correlation = 0.4579
Rms error = 1.4053
Bias = −0.0763
Standard deviation = 1.4032

Neural Network performance : test data set

Neural Network performance : test data set

Y = 0.9221 X − 0.5448
No. of points = 734
Correlation = 0.4641
Rms error = 1.2573
Bias = −0.5061
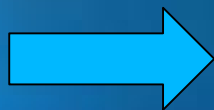Standard deviation = 1.1511
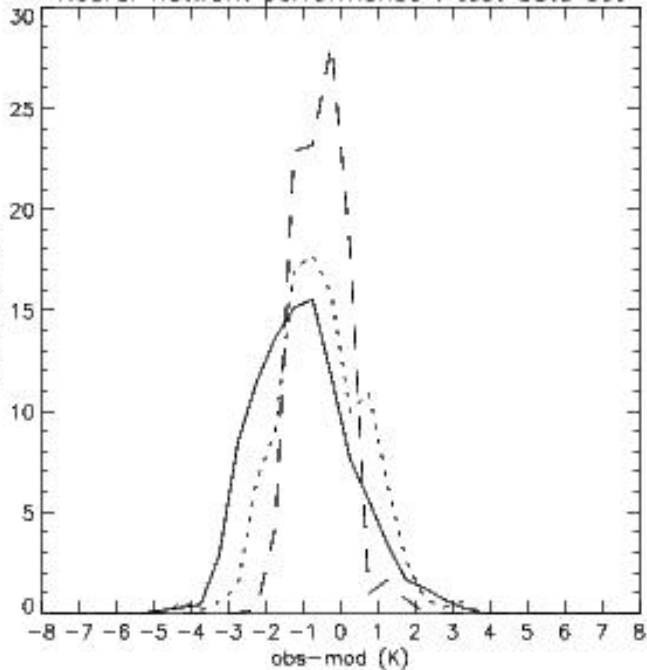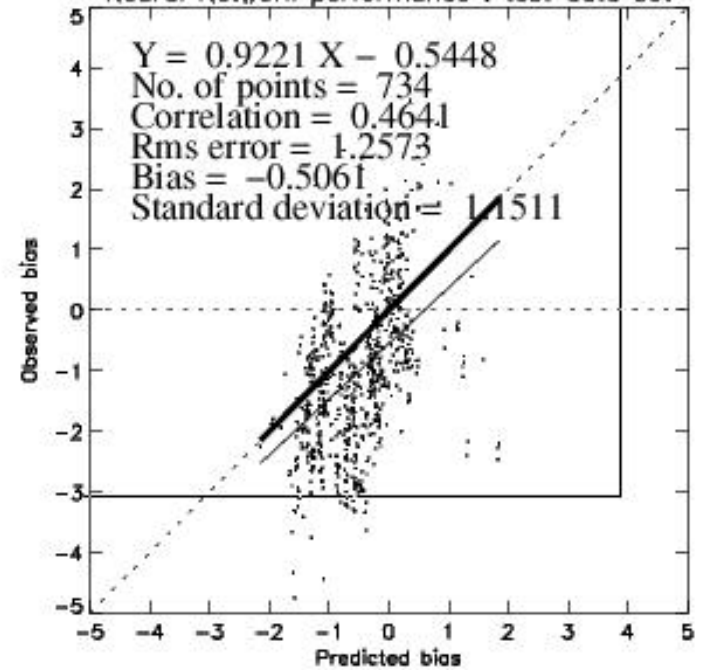
Conclusion

"Conservative" assimilation

(only 176 channels, over clear pixels, flat bias correction)

is neutral/slightly positive for summer experiment

→ To be confirmed/improved with more extensive testing

Pre-operational by spring 2004

Perspectives

✓New bias correction based on

observation-analysis statistics near Radiosondes

→ (Harris & Kelly or NN)

✓Cloud detection on a channel basis instead of pixel

(McNally & Watts, ECMWF)

→Validation of cloud detection schemes with MODIS

(Lydie Lavanant)

Perspectives

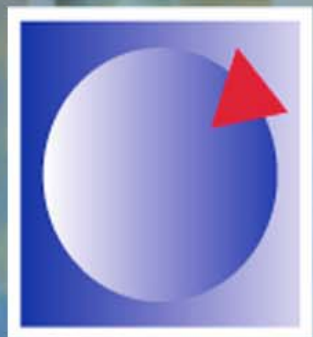✓ **1D-Var studies for assimilation of AIRS cloudy radiances**

ARPEGE stratiform & shalow convection diagnostic cloud scheme included: T, Q → Cloud Cover, Cloud Liquid Water & Ice

RTTOV-Cld radiative transfert model

✓ **Investigate the benefit of cloud-cleared radiances in assimilation**

✓ **Data mining: usage/assimilation of PCA scores**

Thank you for your attention

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