First results of AIRS assimilation at

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AIRS (Atmospheric InfraRed Sounder) aboard AQUA platform:

2378 channels (3.74 → 15.4 µm)

1.1° FOV collocated with AMSU (golf ball)
Constant subset of 324 channels for center of every other golf ball (1/18 pixels)
Introduction

ARPEGE: global spectral model

T358, C2.4, 41 vertical levels

Associated grid: 23km (France) to 133km (antipodes)

Radiances / Tb observations
Introduction

EO
AQUA

NESDIS

Met Office

Météo-France D.R.

Radiance / 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

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Radiances / Tb observations

4D-Var Data Assimilation
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ARPEGE NWP operational model

Increments
Contents

A conservative assimilation suite
First impact study
Work under development
Conclusion and perspectives
Monitoring assimilation suite (a very conservative use of AIRS data)
✓ **Channel selection**

✓ Gross check: $150 < T_b < 350$ & $(\text{obs} - \text{fg}) < 20$

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

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

- LW window channel: $T_b(965.43\text{ cm}^{-1}) > 270 \text{ K}$
- 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)
**Bias correction**

Flat bias correction for each channel calculated over all active data.

**Observation error estimation**

Basic definition for $\sigma_o$:

- 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
Geopotential Temperature

VERIF = ECMWF analysis

Forecast range

RMS_{CTRL} - RMS_{EXP} =

Geopotential

Temperature
VERIF = TEMP observations

Geopotential Temperature Humidity
Work under development

- Bias correction

→ Neural Network

**PREDICTORS:**
- $P_s$
- $T_s$
- Land/Sea mask
- Sat zenith angle
- Latitude
- Obs → $T_b$
- $T$ 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
"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 & shallow convection diagnostic cloud scheme included: T, Q → Cloud Cover, Cloud Liquid Water & Ice

RTTOV-Cld radiative transfer model

✓ Investigate the benefit of cloud-cleared radiances in assimilation

✓ Data mining; usage/assimilation of PCA scores
Thank you for your attention