

Impact Evaluation of AIRS and SSM/I Assimilation

D. Anselmo¹, J. Aparicio², A. Beaulne¹, J-M Belanger¹, M. Buehner², G. Deblonde², L. Garand², J. Halle¹,
P. Koclas¹, Y. Rochon², R. Sarrazin¹, and N. Wagneur¹

¹Meteorological Service of Canada & ²Science and Technology Branch, Environment Canada

Contact: David.Anselmo@ec.gc.ca



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A. Introduction

At the Meteorological Service of Canada, the current operational global analysis system is comprised of the following major elements:

- 4D-Var assimilation cycle (incremental approach, 2 outer iterations, simplified model)
- 0.9° resolution Global Environmental Multiscale (GEM) forecast model with 28 vertical levels to 10 hPa
- observation sources include RAOBS, surface stations, buoys, aircraft, profilers, atmospheric motion vectors (AMVs), ATOVS, and GOES.

Several upgrades are planned for this system in the spring of 2007. By this time the operational forecast model will be a new version of GEM with 0.45° x 0.3° horizontal resolution, 58 vertical levels to 10 hPa, and improved parameterizations (now running in parallel). The planned upgrades for 2007 are the following:

- 1) addition of data from extreme scan angles for AMSU-A, AMSU-B (currently filtered)
- 2) implementation of a dynamic bias correction scheme for satellite radiances
- 3) replacement of the vertical interpolator used to map the first-guess field to the 43 vertical levels of RTTOV (see presentation 11.9 by Yves Rochon)
- 4) upgrade from RTTOV.7.1 to RTTOV.8.7
- 5) addition of observations from new sources: AIRS, SSM/I, QuikSCAT, GPS-RO
- 6) increase in the amount of data assimilated from current sources:
 - RAOBS, AMVs, aircraft, surface stations
- 7) new formulation of error statistics

The results presented in this poster are from two experiments: the first measures the impact of **Package A**, and the second that of adding SSMI observations on top of **Package A**. Due to computational restraints, a 3D-Var/FGAT (First Guess at Appropriate Time) assimilation set-up is used to derive these results in lieu of the operational 4D-Var system. Results of an experiment testing **Package A** in a 4D-Var context are presented in the poster of Alain Beaulne.

B. Experiments

The experiments discussed in this poster are in **green**.
The experiments discussed in A. Beaulne's poster are in **blue**.

4D-Var Cycles:

CONTROL (4D-CNT): current operational system, except with improved GEM forecast model
EXPERIMENT (4D-EXP1): 4D-CNT + **Package A**

3D-Var/FGAT Cycles:

CONTROL (3D-CNT): 4D-CNT, except with 3D-Var/FGAT
EXPERIMENT (3D-EXP1): 3D-CNT + **Package A**
EXPERIMENT (3D-EXP2): 3D-CNT + **Package A** + SSMI + removal of AMSU-A CH3 + enhanced filtering of AMSU-B
EXPERIMENT (3D-EXP3): 3D-CNT + **Package A** + AIRS

Period of Evaluation:

For the 3D-Var/FGAT experiments presented in this poster, the analyses and forecasts were evaluated over the period December 15, 2004 to January 15, 2005.

Note: Other experiments are currently ongoing in 4D-Var and 3D-Var/FGAT cycles, however, the results are not yet ready for presentation.

C. 3D-EXP2

Addition of SSM/I (DMSP13, DMSP14, DMSP15**):

Channel	Frequency (GHz)	Condition	Observation Error (K)
1	19.35 V	Ocean/Clear Sky	2.39
2	19.35 H	Ocean/Clear Sky	4.27
3	22.235 V	Ocean/Clear Sky	3.82
4	37.0 V	Ocean/Clear Sky	2.02
5	37.0 H	Ocean/Clear Sky	3.98
6	85.5 V	Ocean/Clear Sky	2.54
7	85.5 H	Ocean/Clear Sky	5.90

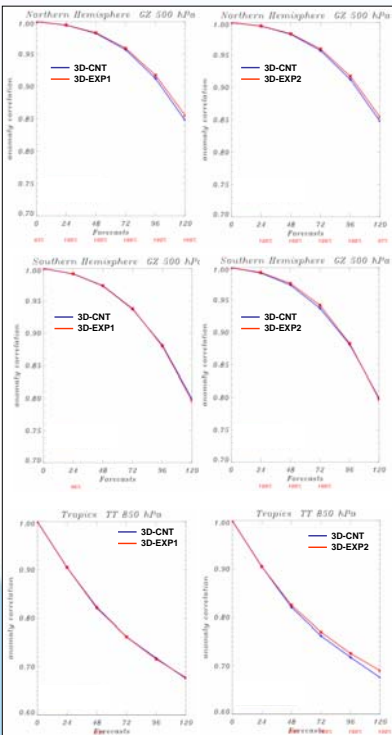
** not available after August 15, 2006

Enhanced filtering of AMSU:

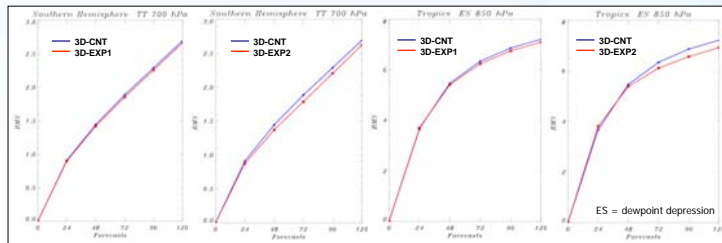
Instrument & Channel	Filter	Motivation
AMSU-A CH3	Removed	Sensitivity to clouds & humidity
AMSU-B CH2, 3, 4, 5	Remove obs where CH2 O-B > 5K	Fills role of a cloud filter where none was present

D. Results: 3D-EXP1 vs. 3D-CNT & 3D-EXP2 vs. 3D-CNT

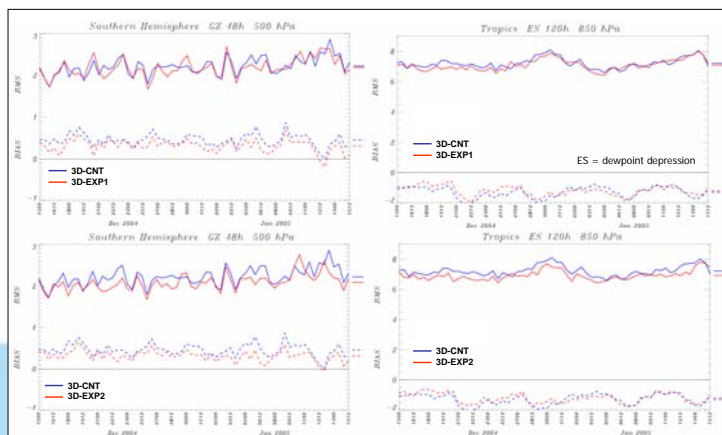
I. Anomaly Correlation



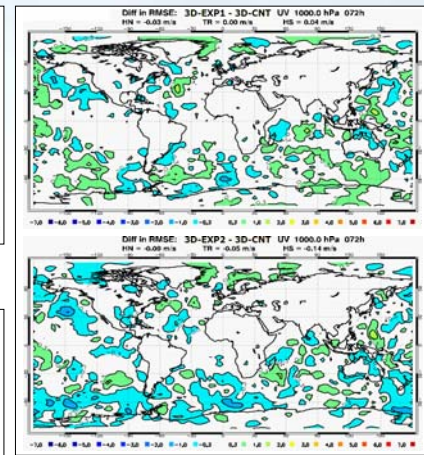
II. RMS



III. Time Series



IV. Reduction in RMSE



E. Summary

The results presented in this poster demonstrate positive impact after the installation of **Package A** into the Meteorological Service of Canada's global assimilation system in 3D-Var/FGAT mode. These gains are further augmented with the addition of SSMI data and an enhanced filtering of AMSU observations. This is evident in the geopotential height, temperature, dewpoint depression, and wind fields over various geographic locations and particularly at lower levels.

Work is ongoing to determine the full impact of these modifications, both individually and combined with the others described in the introduction, in the context of a 4D-Var system. The goal is to implement those changes that are positive into the operational global analysis system in the spring of 2007.