All-sky microwave radiance assimilation in the JMA global NWP system
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Current configuration of JMA global NWP system and satellite radiance data use
Forecast model (GSM: Global Spectral Model) and 4D-Var data assimilation (DA) system
• Outer model: TL959L100 (horizontal resol. 20km, top 0.01hPa)
• Inner model: TL319L100 (horizontal resol. 55km, top 0.01hPa)
• 6-hr assimilation window, incremental 4D-Var DA
• Analysis variables: Wind, surface pressure, specific humidity and temperature
• Climatological background error covariance matrix B in 4D-Var DA
• 11 day forecast from 12 UTC and 5.5 day forecast from 00, 06, 12 UTC initials.
• Radiative Transfer Model: RTTOV-10.2
• Bias correction Method for radiance data: VarBC

Satellite radiance data for operational use
• Microwave imager: AMSR2/GCOM
• Analysis variables: 
  - RAOB RH
  - Inner model: TL319L100
  - Improved TC track and intensity prediction.
• International TOVS Study Conference (ITSC)

• Microwave sounder: AMSU
  - Improved fits in FG departure
  - Bias correction: JyxHRyxHxxBxxxJ +−−+−−= −− ))(())((2
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Addition of outer-loop update in the DA system
4D-Var cost function:
\[ J(x) = \frac{1}{2} (x - x_0)^T B^{-1} (x - x_0) + \frac{1}{2} (H(x) - y)^T R^{-1} (H(x) - y) + J_c \]
x is the control variable, x_0 is the background state, y is the vector of observations.

Assimilation = Finding the minimum of J
Non-linear effects are considered from the addition of the outer-loop. Comparable convergence of the cost function was obtained at the end of the final minimization.

Current Ver.
QC 4D-Var Min. GSM Forecast
New Ver.
QC 4D-Var Min. GSM Forecast

Impact evaluation:
FG fits to Observations
Changes in Std. of FG departure
CNTL (same as operation)
TEST1: all-sky MW imager + sounder
TEST2: CNTL + outer-loop
TEST3: all-sky MW imager + sounder + outer-loop

RAOB Temperature FG Departure
RAOB RH FG Departure
AMV Wind Vector FG Departure

Results of DA experiments
Improved fits in FG departure
RAOB RH
Wind Vector

Improved TC track prediction

All-sky MW radiance assimilation improved TC track predictions.

Improved TC intensity Prediction (Hurricane Harvey case)

Summary and plans
Effects of all-sky MW radiance data assimilation with outer-loop introduction in JMA global DA system were evaluated.
• Positive impacts on temperature, moisture and wind analyses globally.
• Improved TC track and intensity prediction.

The operational implementation is planned in this November together with a hybrid background error covariances in the DA system. All-sky MW radiance assimilation for remaining MW sensors (ATMS, SSMIS 183, SAPHIR, MWHS-2) are planned in next year.

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