AMSU-A background errors in HIRLAM 3D-VAR

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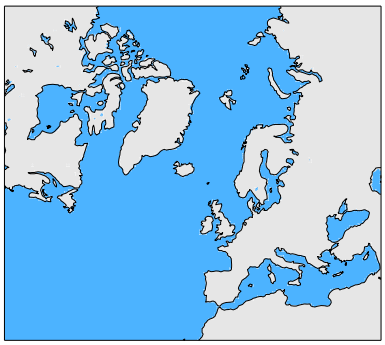
HIRLAM



- Limited area model
- Member states: DMI, FMI, VI, IMS, KNMI, DNMI, INM and SMHI
- 22 & 44 km at SMHI
- TOA 10 hPa (31 lev)
- Spectral version
- Cut off ≈ 2 hrs

Variational schemes allow observations (y) to be used for which model equivalents (Hx_b) can be computed. The optimal analysis increment is given by

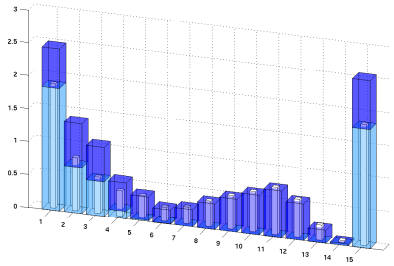
$$x_a - x_b = BH^T(HBH^T + R)^{-1}(y - Hx_b)$$

where HBH^T is the background error in observation space and R holds the observation error covariances.

Monte Carlo

$B = E\{\epsilon_b \epsilon_b^T\} \approx \hat{B}$
$= \frac{1}{N} \sum U\eta_i \eta_i^T U^T$

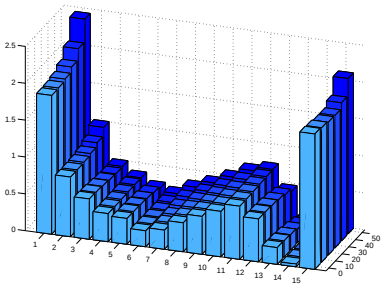
where η is $N(0, I)$ and U is the transform from control to model space.



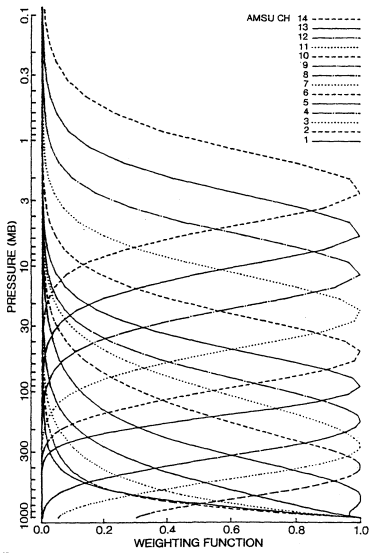
The diagonal bg error $\sigma_b = \sqrt{\text{diag}(HBH^T)}$ (white bars) with respect to AMSU-A channel number.
Error contribution of uncertainties in q (light blue) and T (dark blue) if assumed independent.

View Angle

The spatial error variation in the northern Atlantic is negligeble. However, there is a zenith view angle dependence for the channels sensitive to the surface (ch 1-4 & 15).



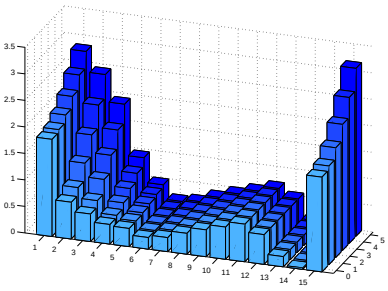
Background errors as a function of zenith view angles from 0 (light) to 50 (dark) degrees.



RTTOV-5

The RTTOV-5 model is used for the observation operator H.
It is linearized around a 6 hr forecast from December 1999.
The surface temperature is not in the control vector and its error was set to 1 K.
Only ice free sea points are used in this study.

Surface temperature



The background error variation with respect to the standard deviation of the surface temperature (0-5 K).

Background departure

Here the NEΔT (1) together with σ_b (2) and std$(y - Hx_b)$ (3) are shown.
With $d = y - Hx_b$, note that we have

$$E\{dd^T\} = R + HBH^T$$