Observation selection for variational bias correction

Ruth Taylor
ITSC-22, Saint-Sauveur, Québec
5th November 2019
Motivation: use of observations in more situations, many of which are more challenging for radiative transfer.

- all-sky (Brett Candy 5.01; Stefano Migliorini 5p.01)
- wider variety of surface types (Stuart Newman 12p.07)
- IR radiances used above low cloud

Will extra observations adversely affect the bias correction?

→ *exclude affected observations when analysing bias correction coefficients*
VarBC: 
operational since 2016 (Global); 2017 (limited-area UKV)

\[ b(x) = s + \sum \beta p(x) : \text{sums over predictors } p(x) \text{ with coefficients } \beta \text{ for a channel} \]

**Predictors:**
- constant
- two air masses (850 - 300 hPa & 200 – 50 hPa thicknesses)
- scan bias
- orbital angle (SSMIS)

\[ J(\delta, \beta') = \frac{1}{2} \delta^T B_x^{-1} \delta + \frac{1}{2} \beta'^T B_\beta^{-1} \beta' + \frac{1}{2} (H(x_b + \delta) + \sum \beta' p - y)^T R^{-1} (H(x_b + \delta) + \sum \beta' p - y) \]
Default: every observation which is assimilated has a bias correction which can vary, and can influence the analysis.

\[ J(\delta, \beta') = \frac{1}{2} \delta^T B_x^{-1} \delta + \frac{1}{2} \beta'^T B_\beta^{-1} \beta' \]

\[ + \frac{1}{2} (H(x_b + \delta) + \sum \beta' p - y)^T R^{-1} (H(x_b + \delta) + \sum \beta' p - y) \]

Prevent bias of certain observations from adapting during minimisation:

→ drop terms in gradient calculation

Observations are still bias-corrected … and correction can be updated after analysis.

(Consider effect on \( B_\beta^{-1} \) …)
Single analysis:

Selection using same “all sky” test as used for AMSU-A channels 4 & 5

Changes to predictor coefficients during single analysis

- Constant term
- Lower thickness
- Upper thickness

AMSU-A channels

AMSUA-3  AMSUA-4  AMSUA-5  AMSUA-6  AMSUB-3  AMSUB-4  AMSUB-5
• Further diagnostic work needed
• Check influence on $B^{-1}_\beta$ (adaptation rate, preconditioning)
• Extend selection mechanisms currently using QC tests; consider variable thresholds
• Trial in conjunction with changes to observation use … watch this space!