Working group 3: Treatment of observation errors I

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What tools do we have to estimate observation errors and how well do they cover our needs?

- Departure-based diagnostics, triple collocation, metrological approaches
- Adjustments to diagnostic observation error estimates: why do we need to make them? What do the adjustments tell us?
  - Mathematical (shrinkage, easier to invert), pragmatic (convergence) and physical (weighting of features) motivations
  - Eigenvectors may map onto physical signals or instrument effects (also seen in treatment of PCs), how to split them?
  - Unrealistic features (e.g. asymmetry, negative variances, very strong correlations) can be used to diagnose problems with assimilation system (e.g. QC, biases, B)
  - Easy to apply and resulting correlations are better than nothing but there are problems, can we do better?
- Uncertainty characterisation beyond departure-based diagnostics (e.g. metrological approaches):
  - Good progress on instrument errors and correlations (e.g. FIDUCEO), **can more instrument providers disseminate this information?**
  - Work on radiative transfer error characterisation but potentially not being effectively communicated to our field?
  - Difficult to use metrological approach to representativeness error, have to resort to departure-based diagnostics
  - **Recommend more work in this area to help unpick problems with departure based diagnostics**

Error correlations

- Status of spatial/temporal error correlations
  - They exist but most common approach is to thin the data (or inflate the errors) to avoid needing to specify them
  - Motivations are pragmatic (technical challenge to invert large matrix) but also scientific (mostly positive correlations, lead to down-weighting, simpler to thin/superob)
  - Will become more important for higher resolution models (convective scale models), allowing use of more data
  - Parametrised approach, easy to invert matrices, difference observations could all be ways forward
- When are they important
  - When we're interested in down or up-weighting differences between channels/in space/in time
- Correlations between background and observation errors
  - Perturbed observations feed into EDA which provides hybrid background error estimates and background fields used for QC could potentially introduce these
  - Should we pay more attention to them?

Situation-dependence of observation errors

- Current applications (all-sky, surface-based, winds etc.) are mostly with uncorrelated errors
- NCEP use different correlated error matrices over land/sea, other centres use fixed matrix and QC
- Meteo-France use different correlated error matrices in LAM and global models
- Work ongoing on combining all-sky and correlated error, promising eigenvalue/look-up approaches
- Potential to use ML to identify further predictors for situation dependence (e.g. latitude band)
- Potential problems with over-sophistication
  - Problems with sampling, are diagnostics accurate enough for estimates in different situations?
  - Model/background errors aliasing into observation errors
  - Maintenance overhead – changes to diagnosed errors with significant model or observing system changes

Future trends

- Coupled assimilation
  - Importance of background errors with cross-correlations across interfaces
  - Also observation error implications through improved surface parameters, radiative transfer etc. affecting representation error
- Small satellites and crowd sourced data
  - Need for more automation or online estimation of observation errors
  - Potentially more complex error structures due to poorer calibration
- Priorities
  - Improved or alternative estimation techniques – reduce ad-hoc adjustments we need to make
  - Understanding the influence of background and model error on diagnosed observation errors
  - More situation dependence and combining this with treatment of correlations
  - Spatial error correlations – when are they important, computational challenges, parametric approaches?
  - More automated or online estimation of observation errors