Assimilation of Principal Component-Compressed Reconstructed Radiances for NWP

Fiona Smith

Met Office, UK

The use of principal component (PC) scores in assimilation and retrieval systems has received much recent attention. As well as the potential for reduction in processing time brought about through increased efficiency in the forward model, PCs have an advantage over raw radiance data in that the random noise in the measurements has mostly been discarded by the compression process. An alternative to the assimilation of PC scores is to convert the data back into radiance form, yielding what are known as Reconstructed Radiances (RRs).

Reconstructed radiances hold the same advantages as PC scores, in that they are noise-reduced, and in theory it is possible to represent the full information content of n PC scores in n reconstructed radiances. RRs come with an additional advantage, in that one can employ existing quality control techniques in their assimilation: channels sensitive to clouds or surface properties that are poorly modelled can still be rejected. Assimilation trials with reconstructed radiances in the past have, however, shown little improvement from the use of RRs (e.g. Collard et al., 2010, Hilton and Collard, 2009). These early experiments, treating the RRs as though they were raw radiances, did not correctly model the error properties of the observation.

This talk will outline the mathematical framework for the assimilation of reconstructed radiances and their theoretical equivalence to principal components. It will then discuss the practical issue of the observation error covariance matrix, and present recent research into designing a channel selection specifically for reconstructed radiances.

Collard, A.D., McNally, A.P., Hilton, F.I., Healy, S.B. and Atkinson, N.C., 2010. The use of principal component analysis for the assimilation of high-resolution infrared sounder observations for numerical weather prediction. The Quarterly Journal of the Royal Meteorological Society, v.136 issue 653, p.2038-2050. DOI: 10.1002/qj.701

Hilton, F. and Collard, A., 2009. Recommendations for the use of principal component-compressed observations from infrared hyperspectral sounders Met Office Forecasting Research & Development Technical Report No.536 (available from the Met Office)