Improved Use of AIRS Data at ECMWF

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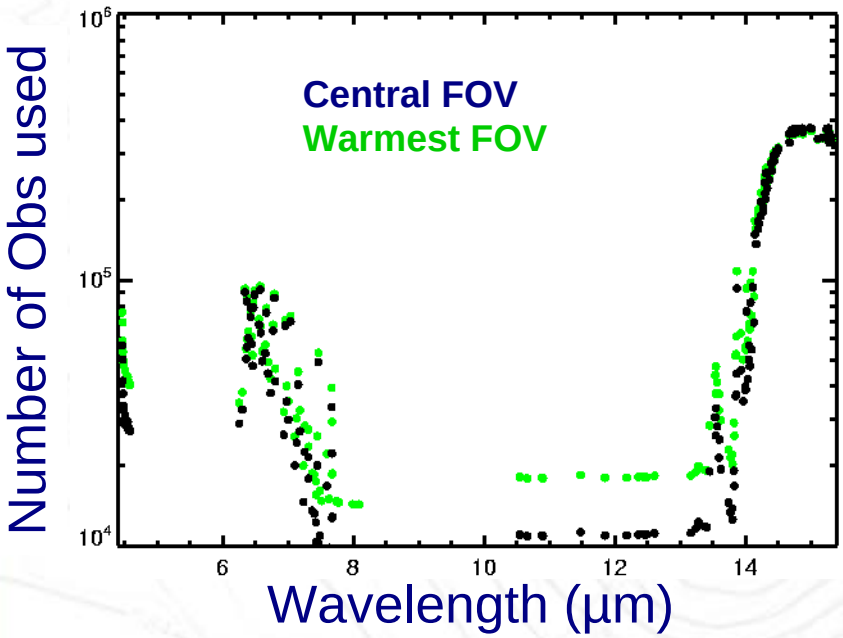
- Better Spatial Use of the data
  - Warmest FOV
- Better Spectral Use of the Data?
  - Reconstructed Radiances

- Bonus slide on IASI Channel Selection

Warmest Field of View Experiments

Warmest vs Central Field of View



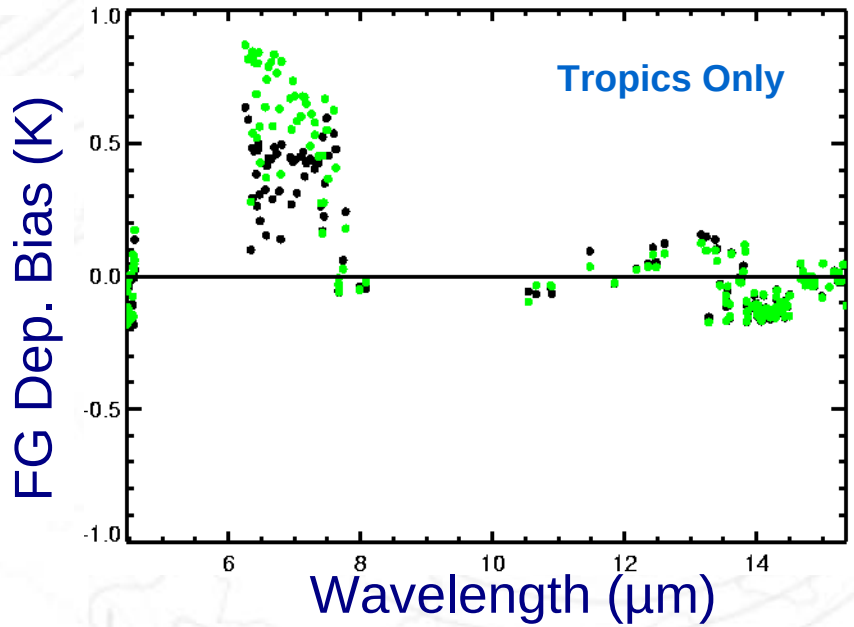
10 days' data.
22nd-31st December 2004

Many more observations used in low-peaking channels.

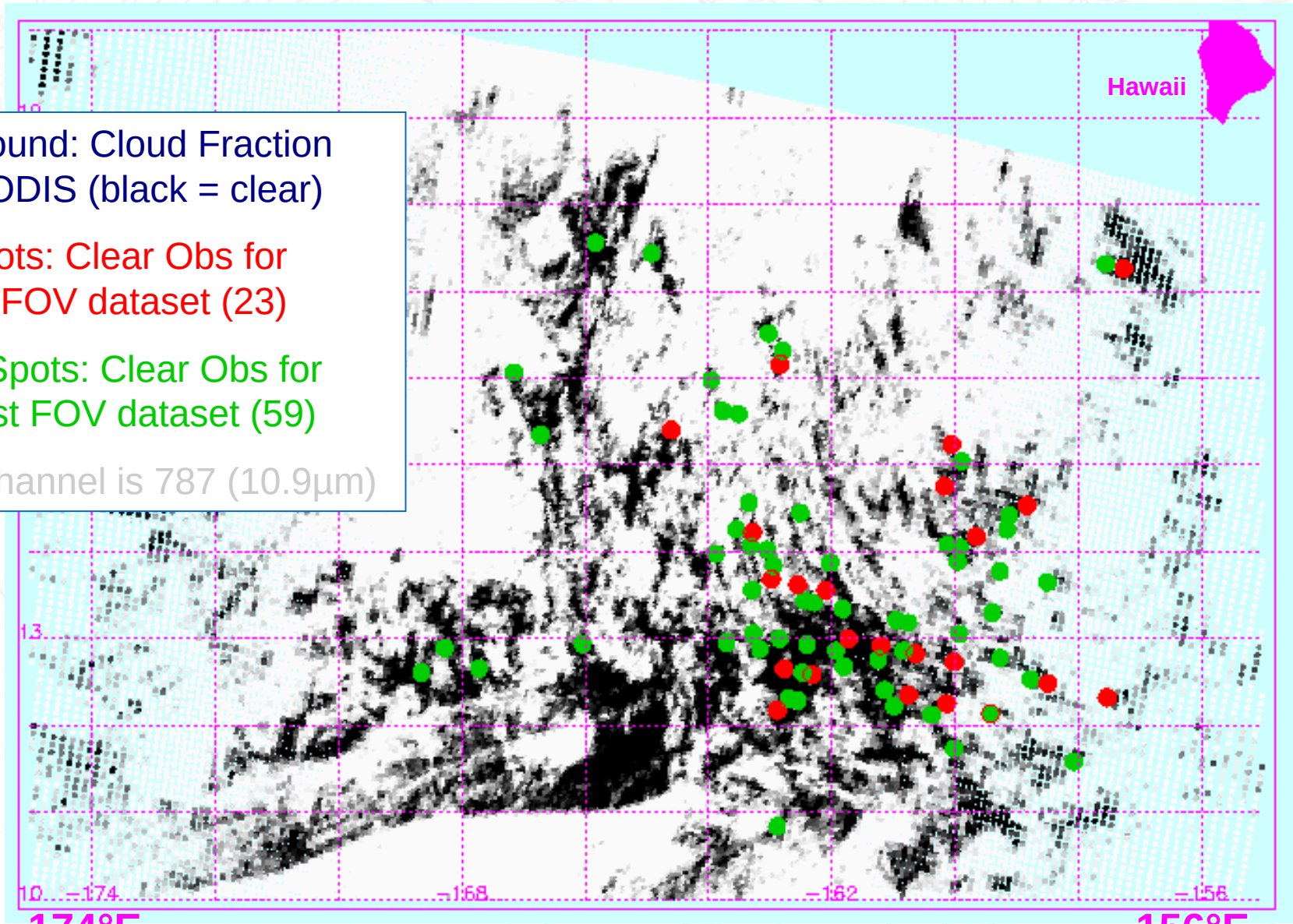
Upper channels almost unchanged.

Higher bias in water vapour channels

All other stats are very similar between the warmest and central FOVs



Increased Yield with Warmest FOV



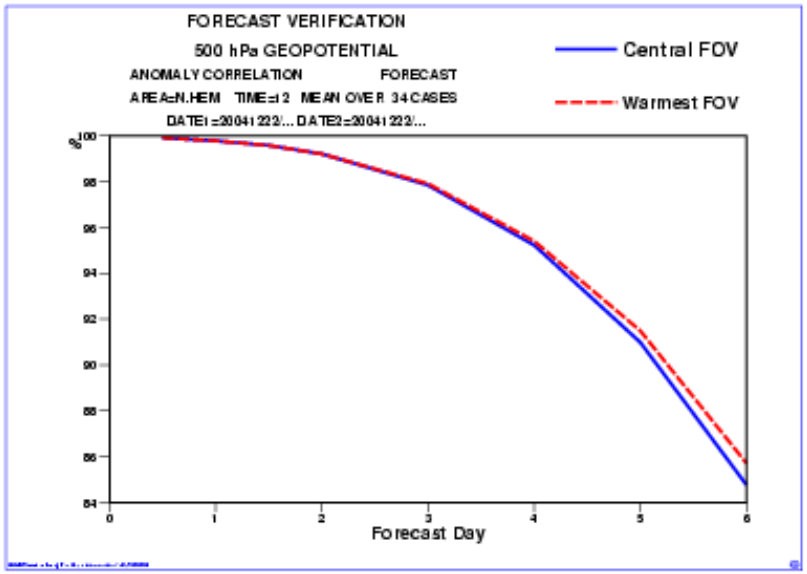
Background: Cloud Fraction from MODIS (black = clear)

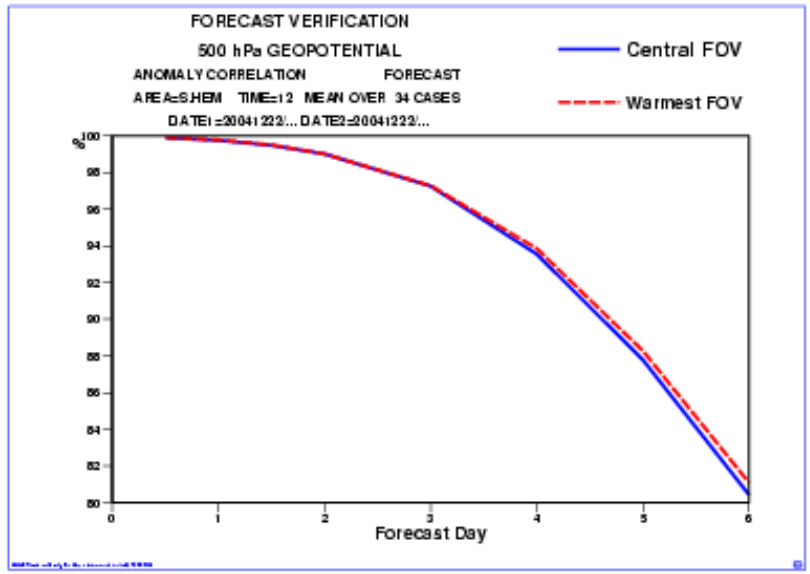
Red Spots: Clear Obs for Central FOV dataset (23)

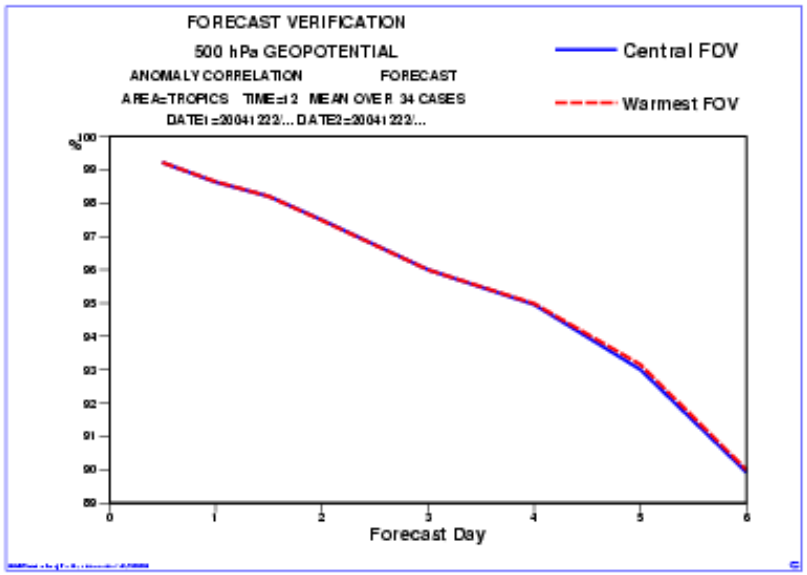
Green Spots: Clear Obs for Warmest FOV dataset (59)

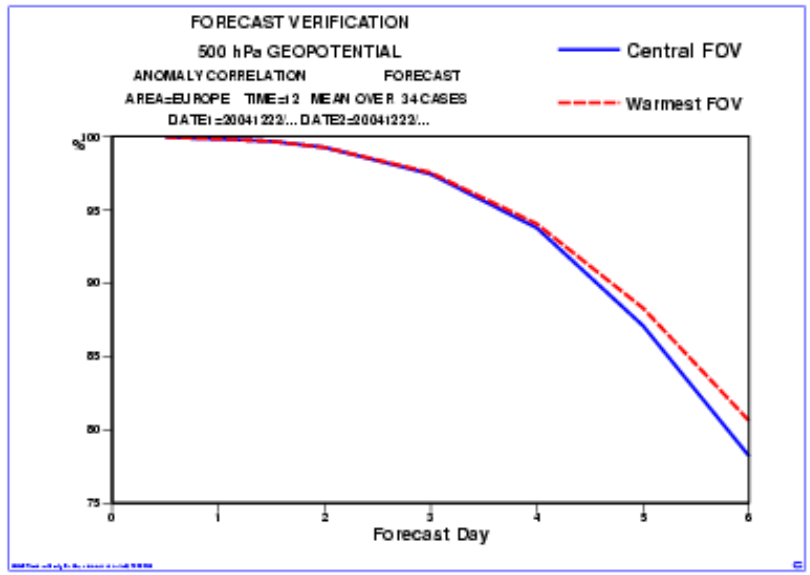
AIRS Channel is 787 (10.9μm)

Warmest FOV: Forecast Impact









Reconstructed Radiances

Spectral data compression with PCA*

The information content of the complete AIRS spectrum can be conveyed using a truncated principal component analysis (e.g. 200PCAs v 2300 rads)

Leading eigenvectors (200,say) of covariance of spectra from (large) training set

Mean spectrum

$$\mathbf{p} = \mathbf{V}^{T}(\mathbf{y} - \bar{\mathbf{y}})$$

Coefficients

Original Spectrum

- To use PCs in assimilation requires an efficient RT model to calculate PCs directly
- PCs are more difficult to interpret physically than radiances

N.B. This is usually performed in noise-normalised radiance space

*Principal Component Analysis

Reconstructed Radiances

The information content of the complete AIRS spectrum can be conveyed using a smaller number of *reconstructed radiances* from truncated principal components.

Leading eigenvectors (200,say) of covariance of spectra from (large) training set

Mean spectrum

Reconstructed spectrum

$$\mathbf{p} = \mathbf{V}^{\mathrm{T}}(\mathbf{y} - \bar{\mathbf{y}})$$

$$\mathbf{y}_{\mathrm{R}} = \bar{\mathbf{y}} + \mathbf{V}\mathbf{p}$$

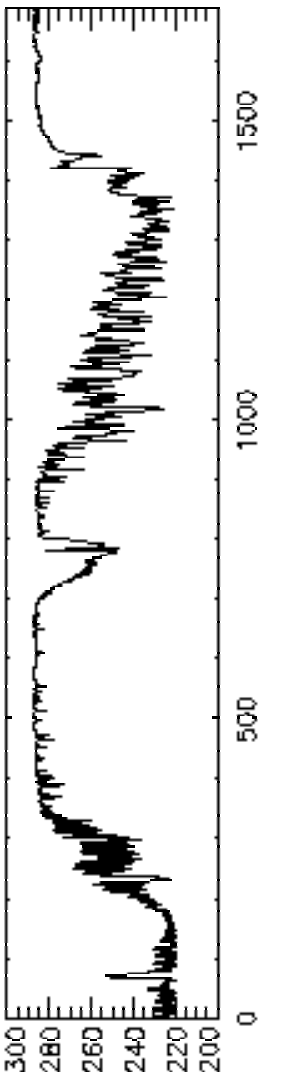
Coefficients

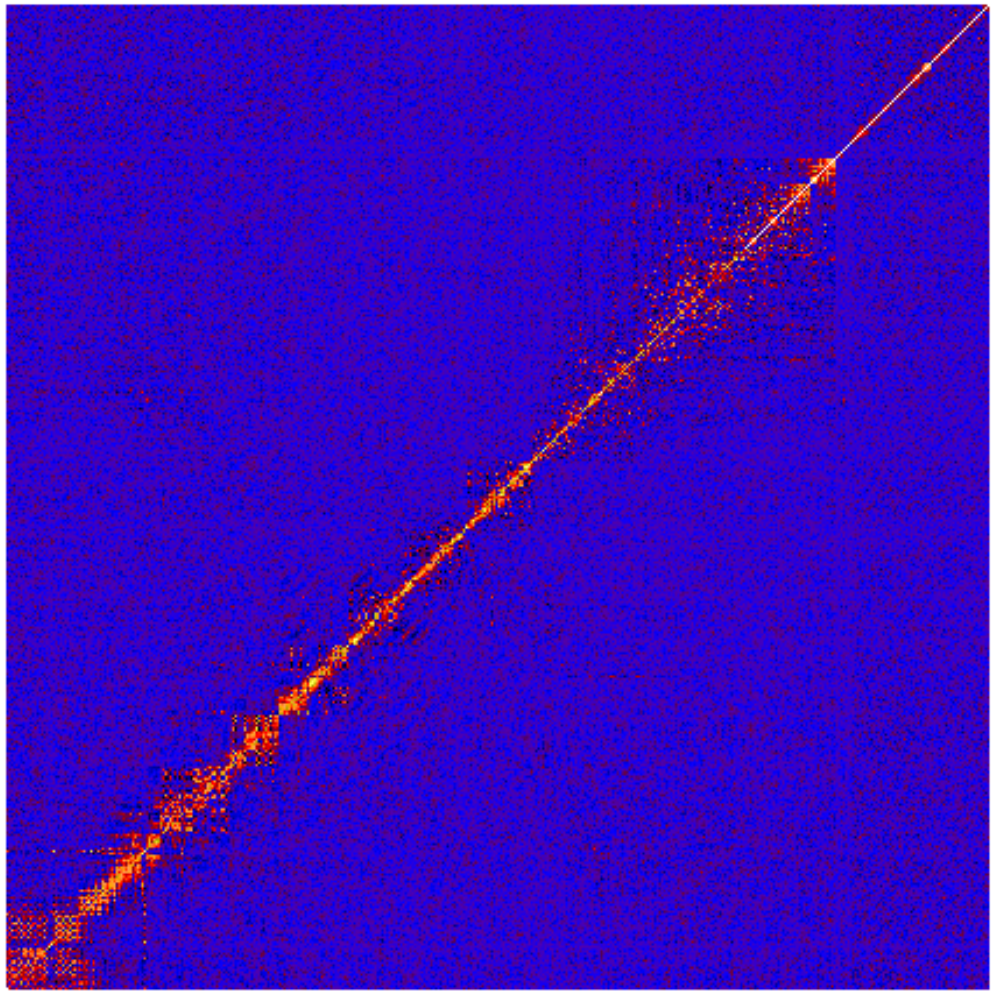
Original Spectrum

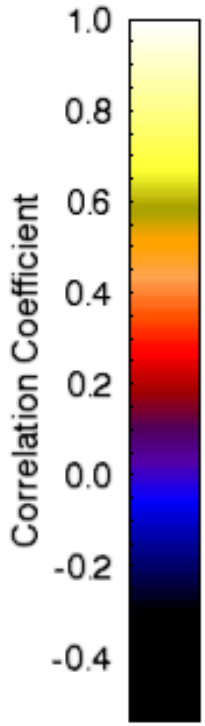
N.B. This is usually performed in noise-normalised radiance space

Each reconstructed channel is a linear combination of all the original channels with reduced noise **but** increased inter-channel correlations.

Reconstructed Radiances' Correlations

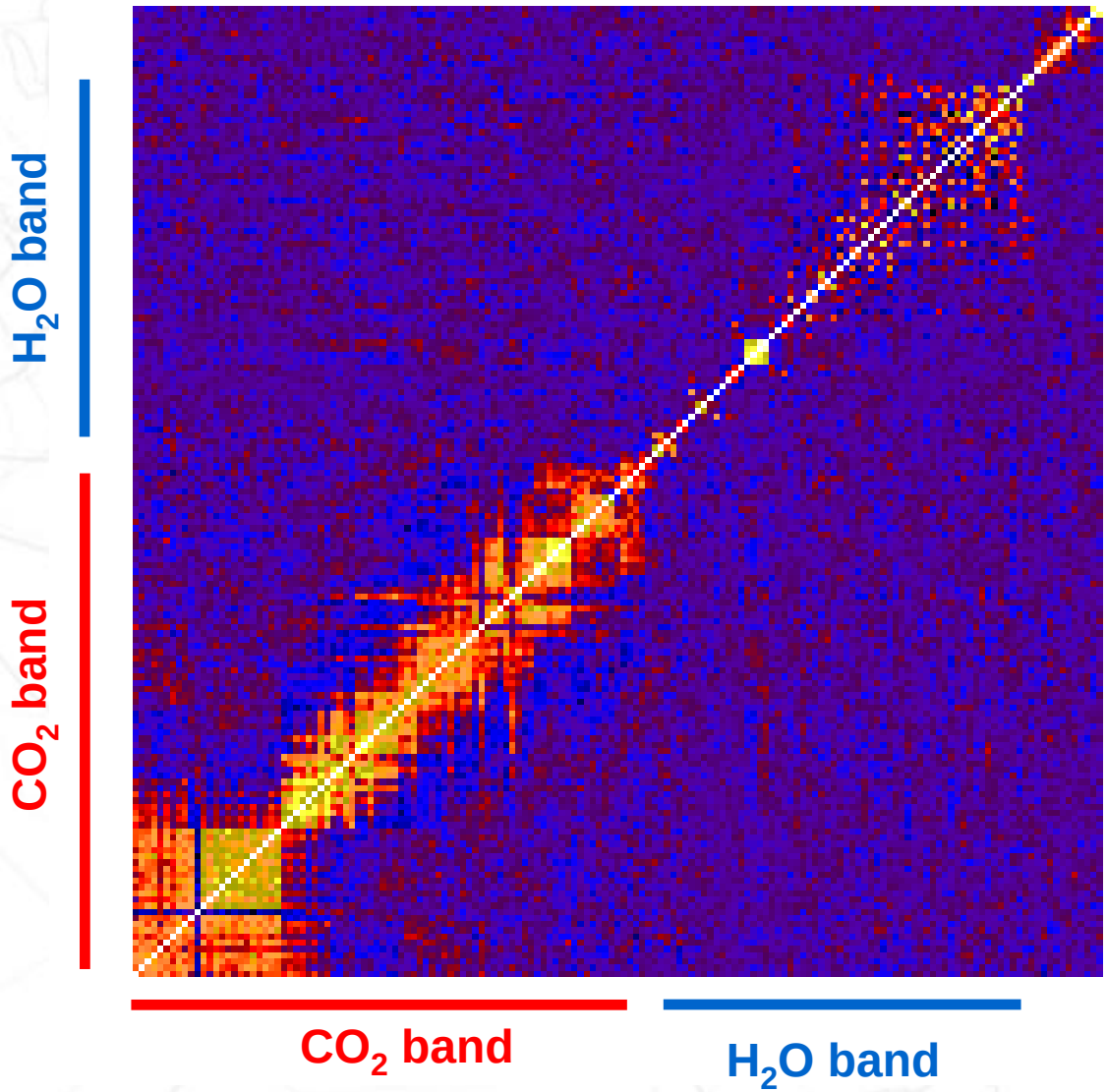




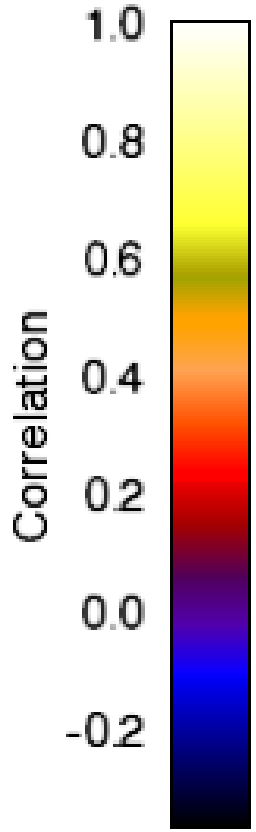


N.B.1688 out of 2378 Channels Used in RR calculation

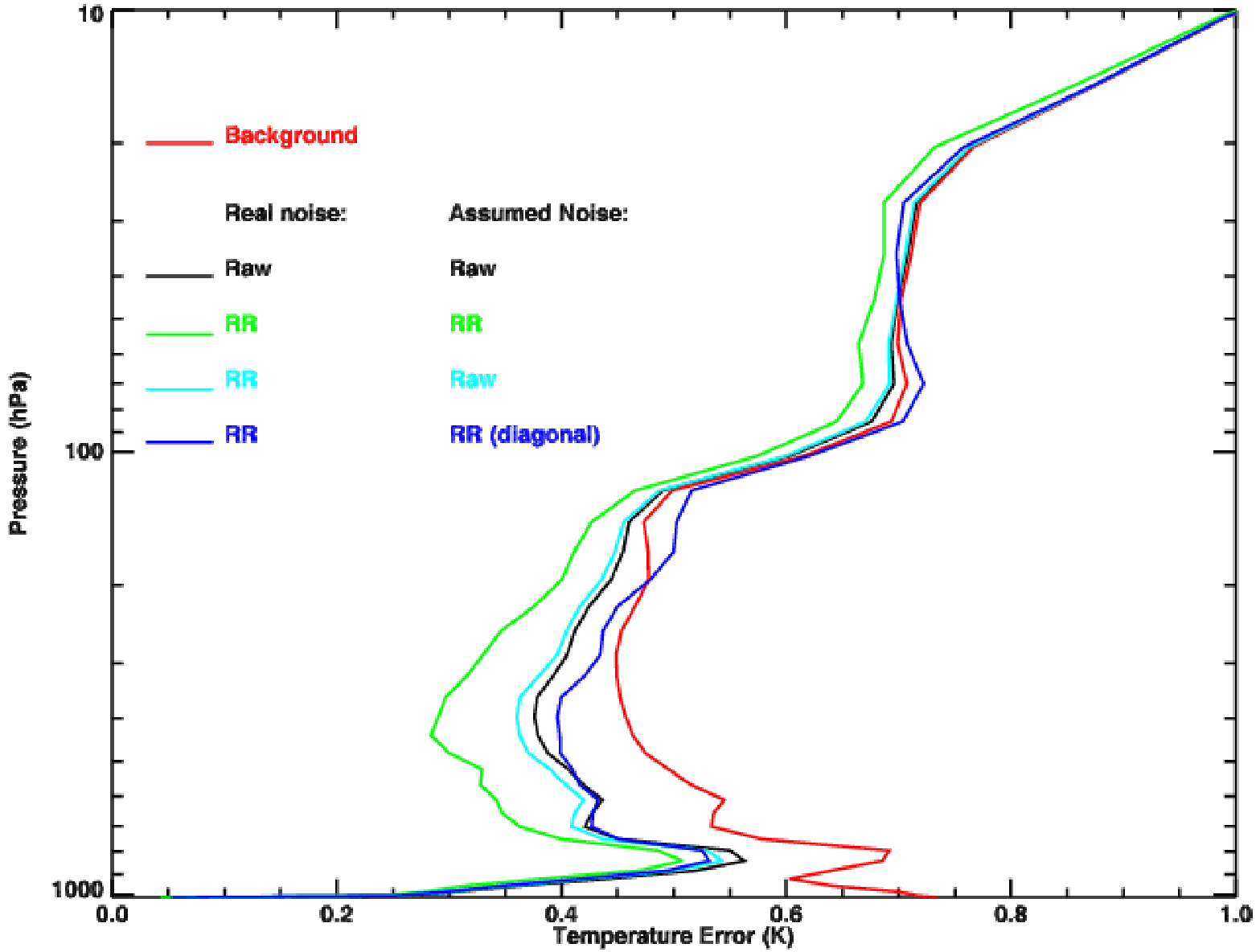
Reconstructed Radiances' Correlations



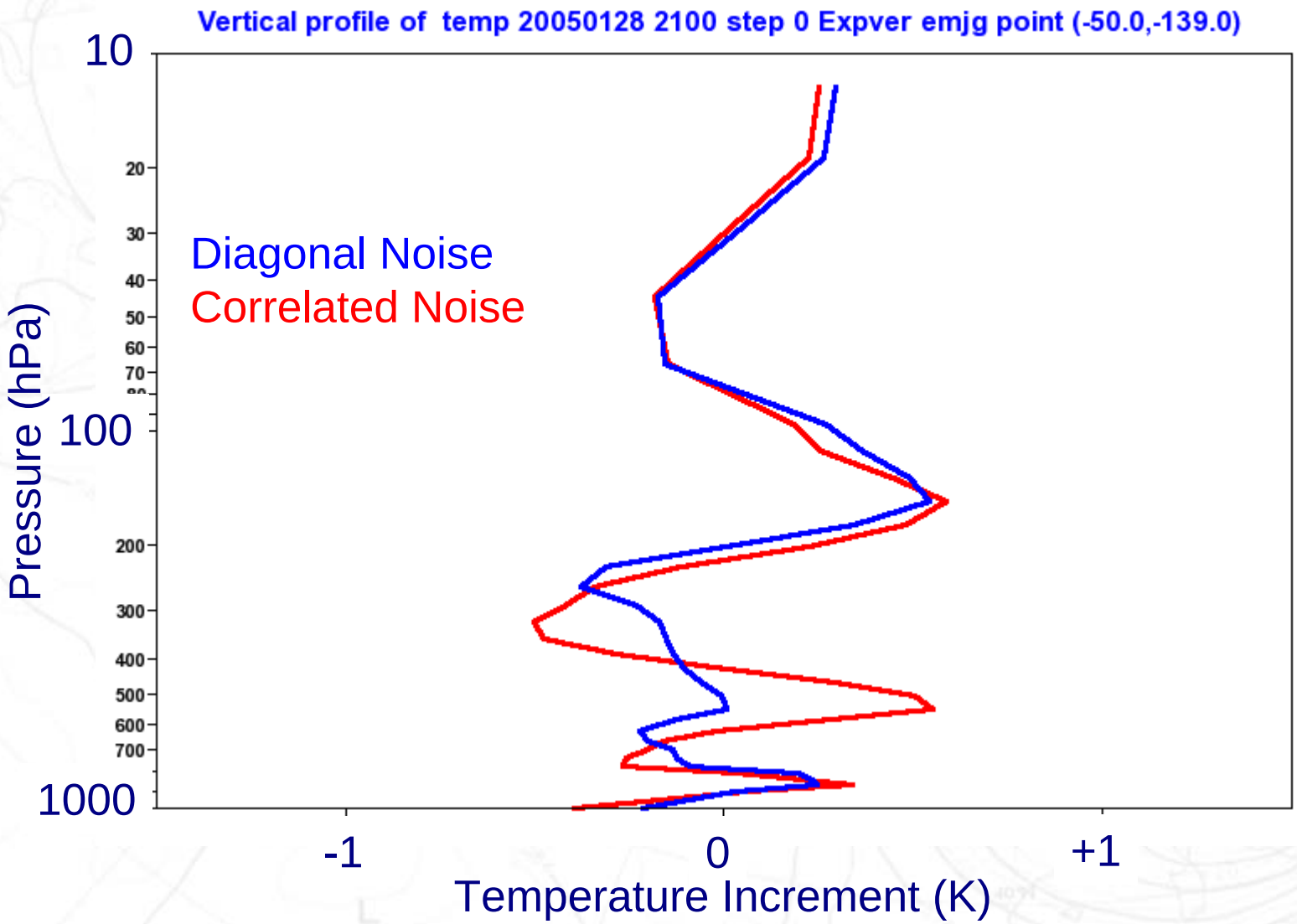
Channels assimilated at ECMWF (157)



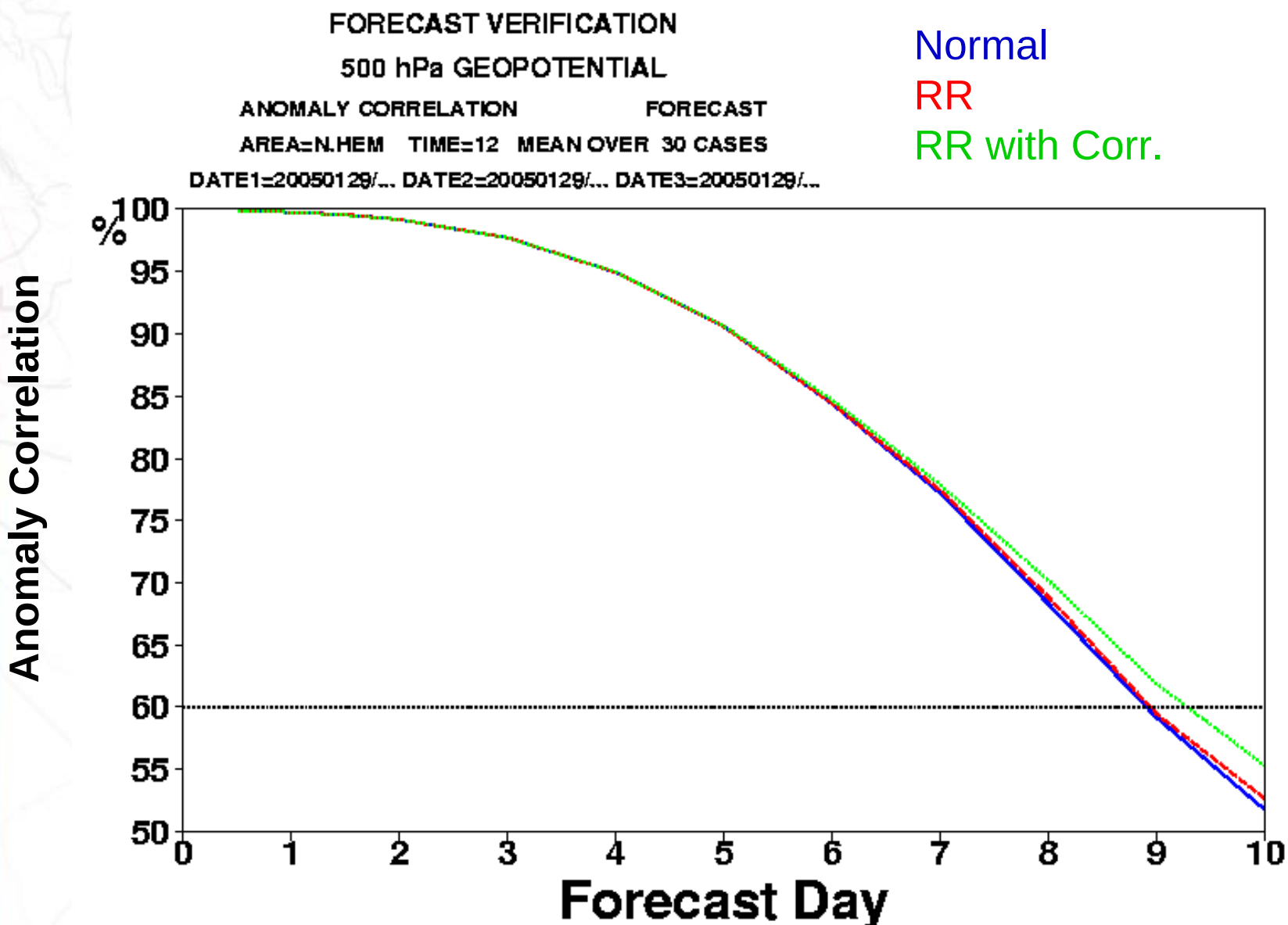
Assimilating Reconstructed Radiances – Linear Theory



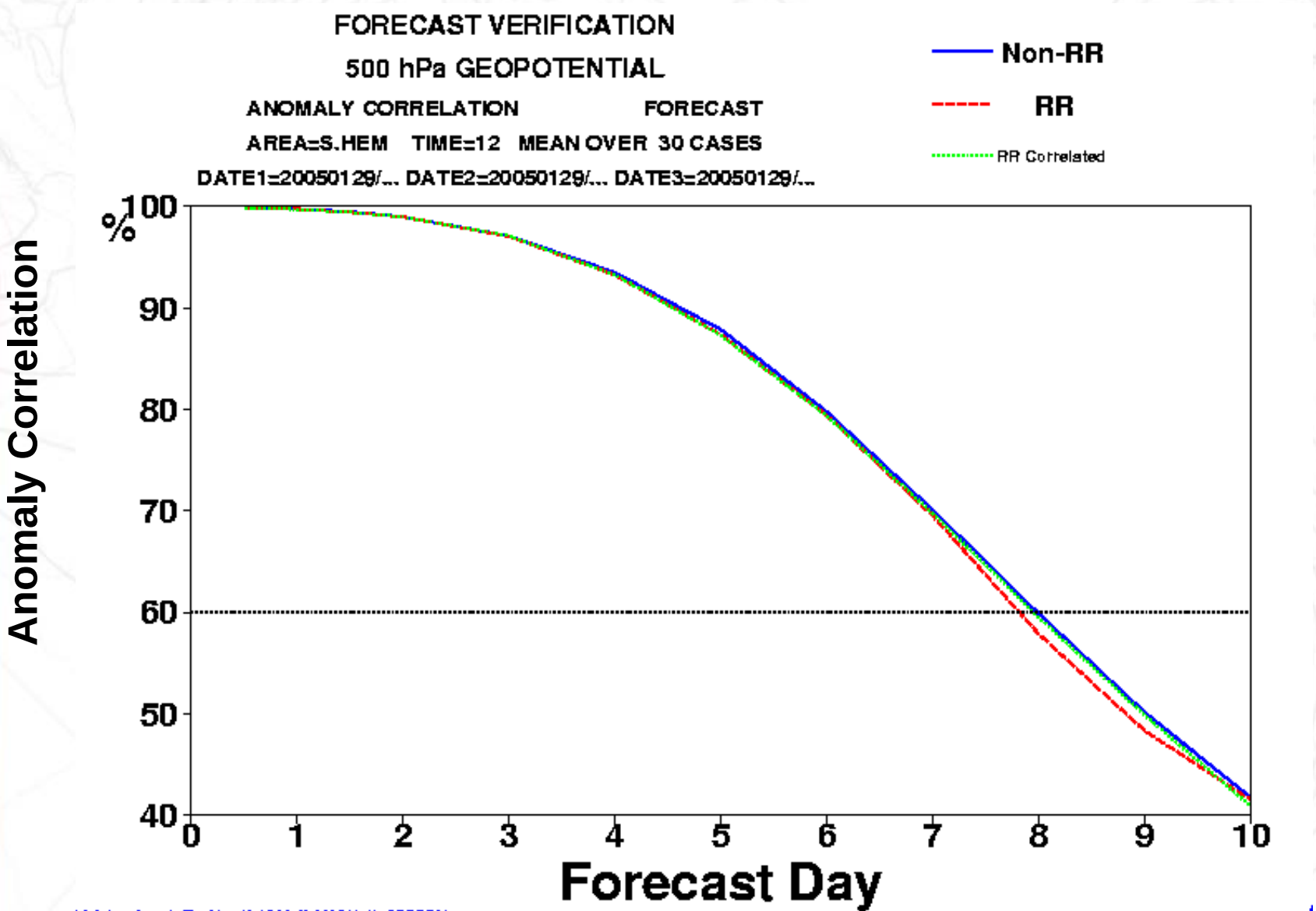
More structure when using correlations?



RR Forecast Impact – NH 500hPa Geopot.



RR Forecast Impact – SH 500hPa Geopot.



Conclusions

- AIRS impact can be improved through improved use of data
  - Spatial frequency
    - Allow more clear fields of view
  - More spectral information
    - Reconstructed radiances
      - Correlated Errors

- Other issues being addressed
  - Observation errors
  - Cloud detection
  - Bias correction (see talk by Thomas Auligné)

IASI Channel Selection for NRT Dissemination

- Full IASI Spectrum to be distributed to NWP Centres in Europe and the US
- Other users of near-real-time data will initially receive a subset of channels via GTS
- A channel selection method for this purpose is described in the poster by Collard and Matricardi.
- Main features:
  - Attempt to define a robust global data set
  - Pre-screening of channels with trace gas contamination and other forward modelling issues
  - Use Rogers's method of channel selection based on information content
    - *A priori* data from NWP 6 hour forecast