

# A new observation error covariance matrix for IASI

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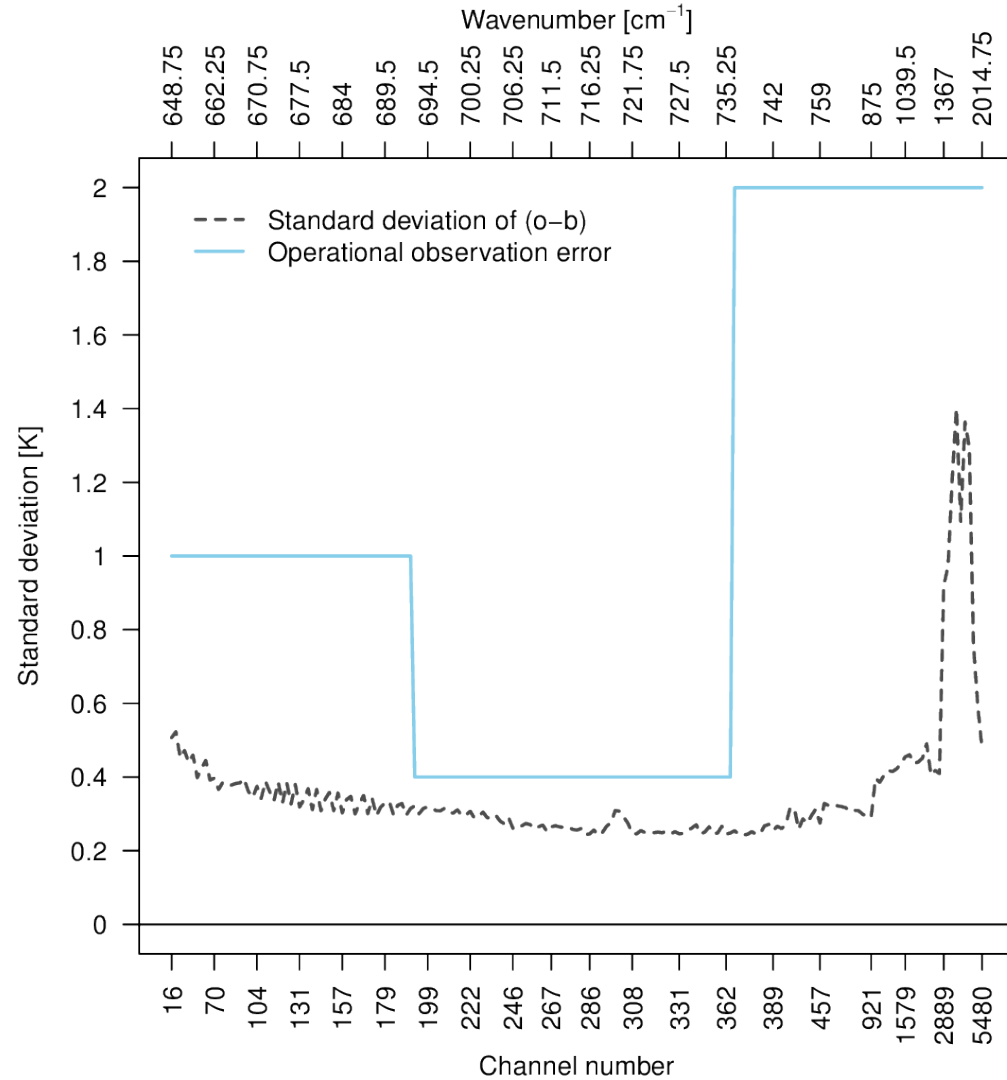
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# Motivation

The observation error covariance for IASI assigned operationally is fairly crude:

- 3 values over 3 wave-number bands
- No error correlations



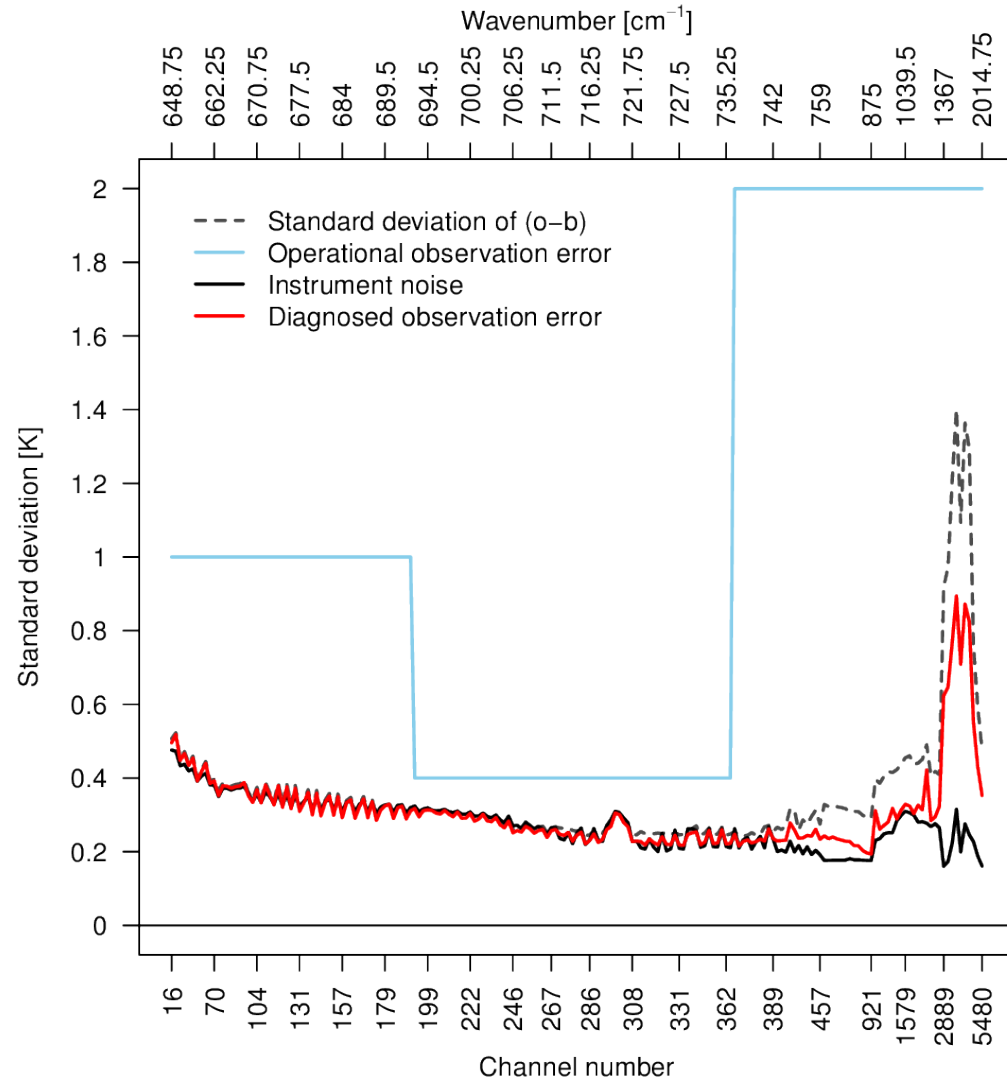
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Observation-space diagnostics (Hollingsworth/Loennberg/Desroziers) provide an estimate consistent with departure statistics:

- Lower errors for many channels



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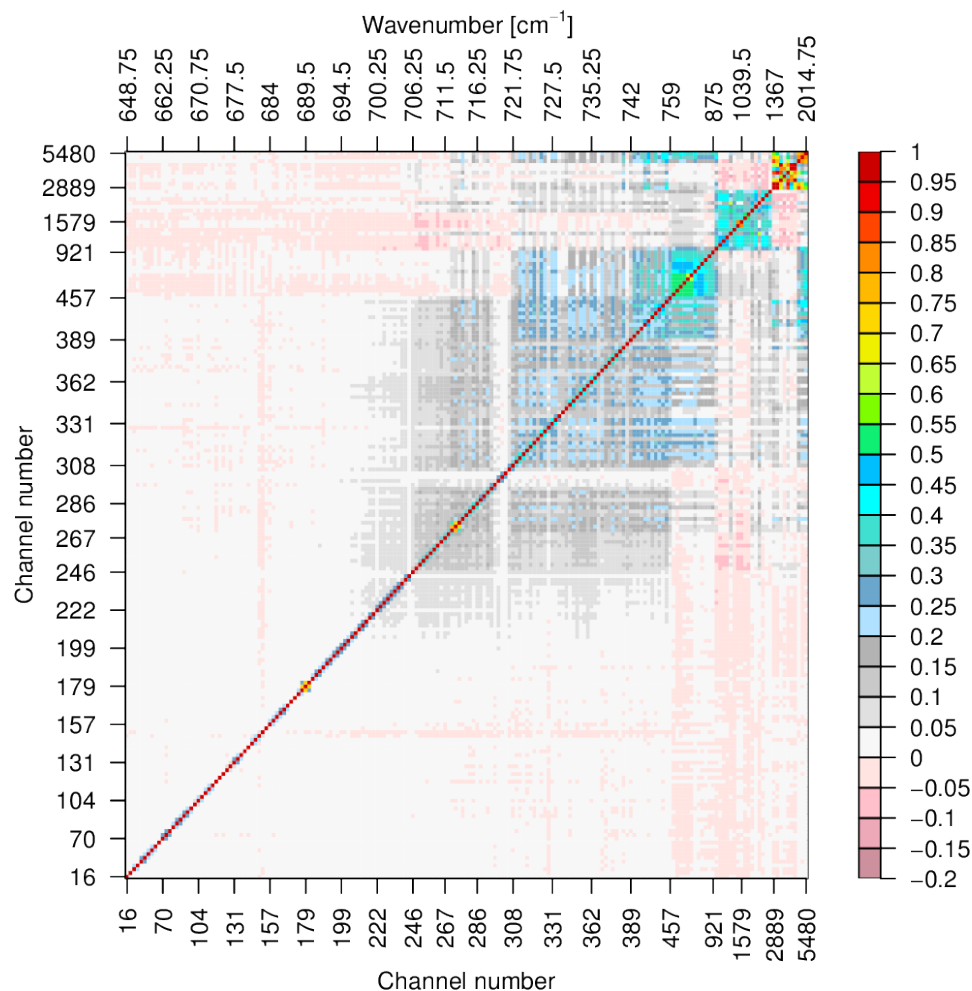
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Observation-space diagnostics (Hollingsworth/Loennberg/Desroziers) provide an estimate consistent with departure statistics:

- Lower errors for many channels
- But with error correlations
- Likely sources:
  - Cloud-screening errors
  - Representativeness errors
  - RT errors

See talk by Hyoung-Wook Chun.



# Can the diagnosed matrix be used to specify observation errors (and their correlations) in the assimilation system?

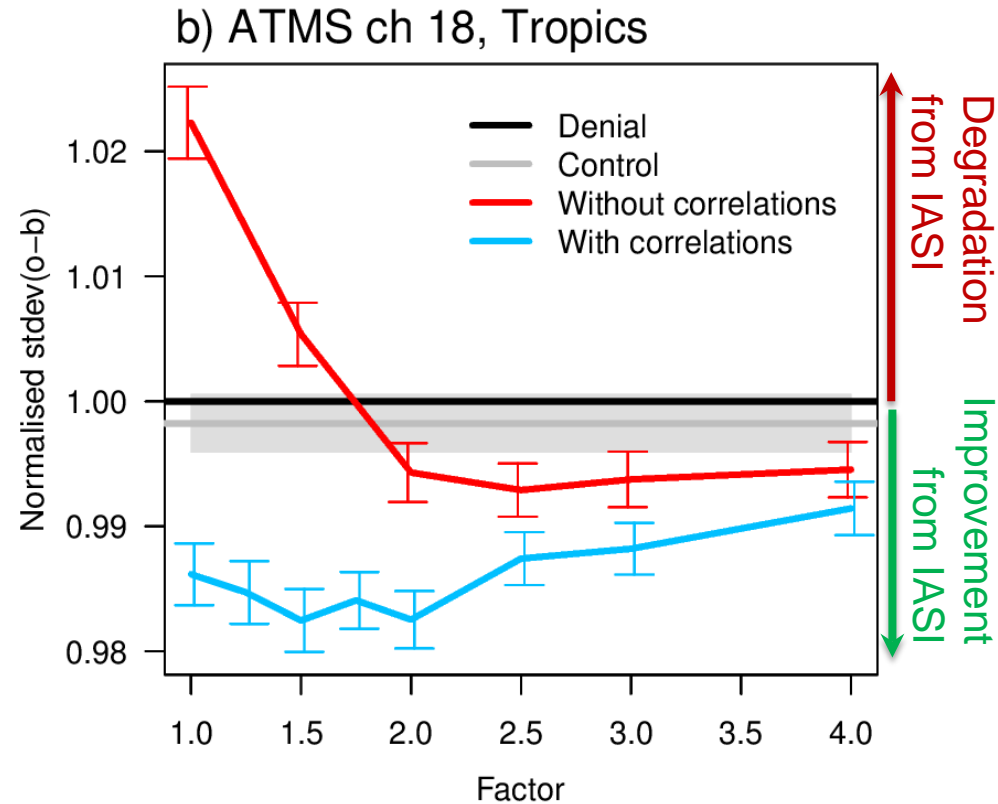
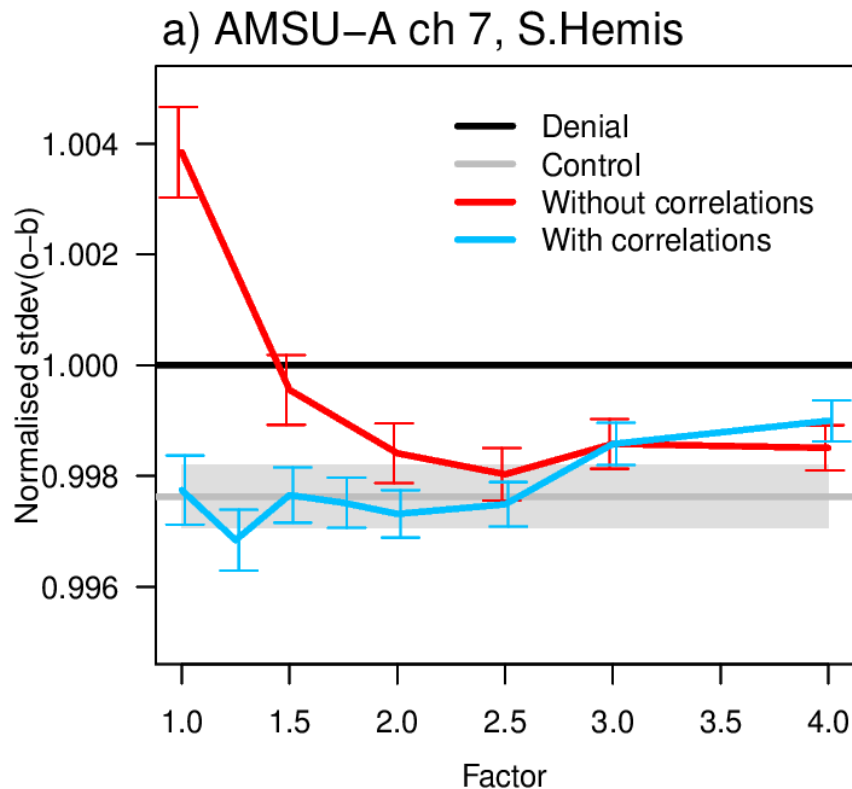
- 1) Role of error inflation vs accounting for inter-channel error correlations
- 2) Impact of error correlations from groups of channels
- 3) Impact on forecast performance

# Role of error inflation

- **Error inflation** is often used to counter-act neglected error correlations.
- Perform two series of experiments:
  1. Use **diagnosed errors without correlations**, and scale the diagnosed errors with a series of **inflation factors**.
  2. Use **diagnosed errors with inter-channel error correlations**, and scale the diagnosed errors with a series of **inflation factors**.
- Two further experiments:
  - **Denial:** No assimilation of IASI data
  - **Control:** Use operational observation error
- 3-month period 5 Feb – 4 May 2014

# Role of error inflation

Evaluate using other assimilated observations.  
Stdev(o-b) normalised by the Denial experiment:

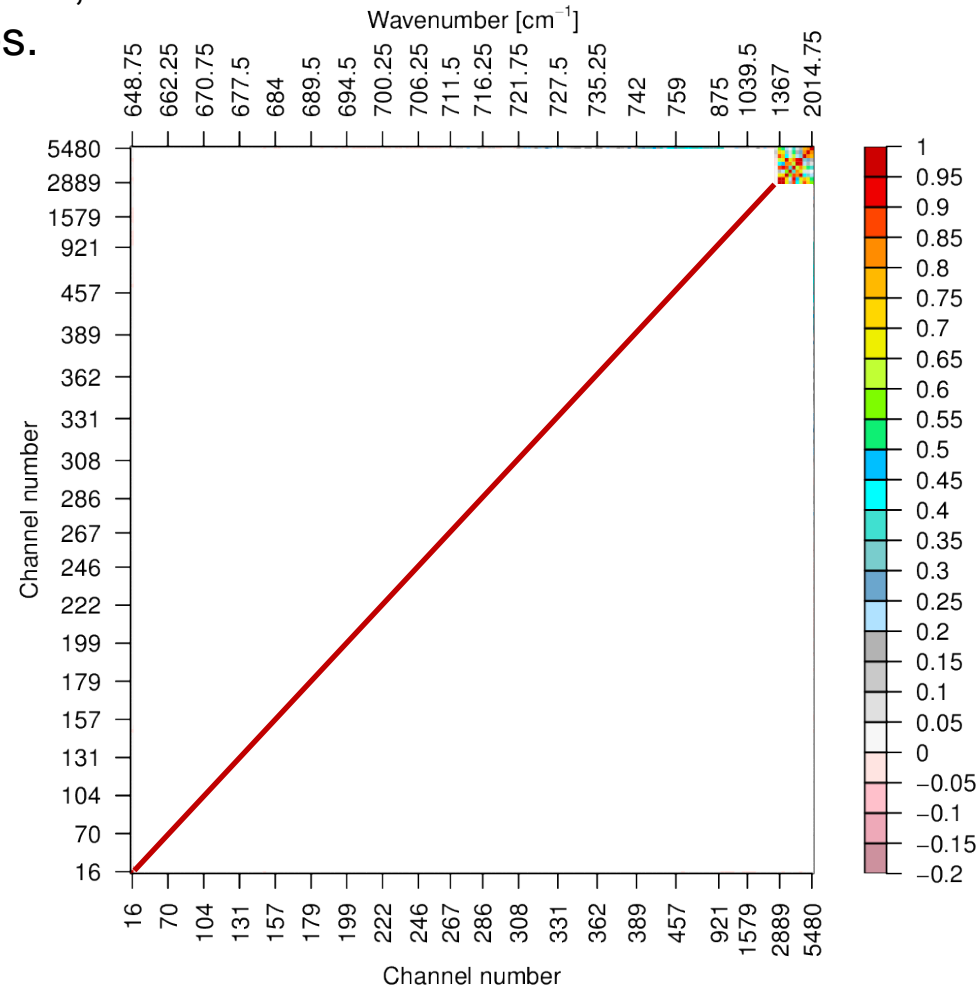
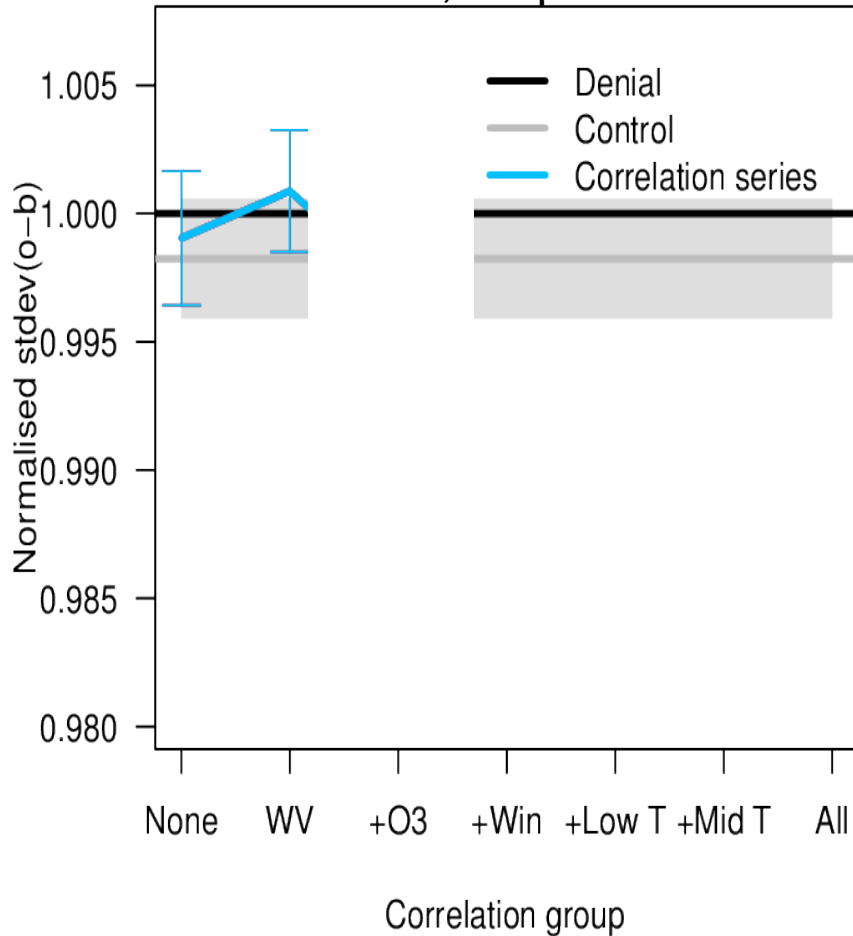


Similar results for a wide range of observations.

# Impact of groups of correlations

Use diagnosed  $\sigma_o * 1.75$  for all channels, but correlations only for certain groups.

ATMS ch 18, Tropics



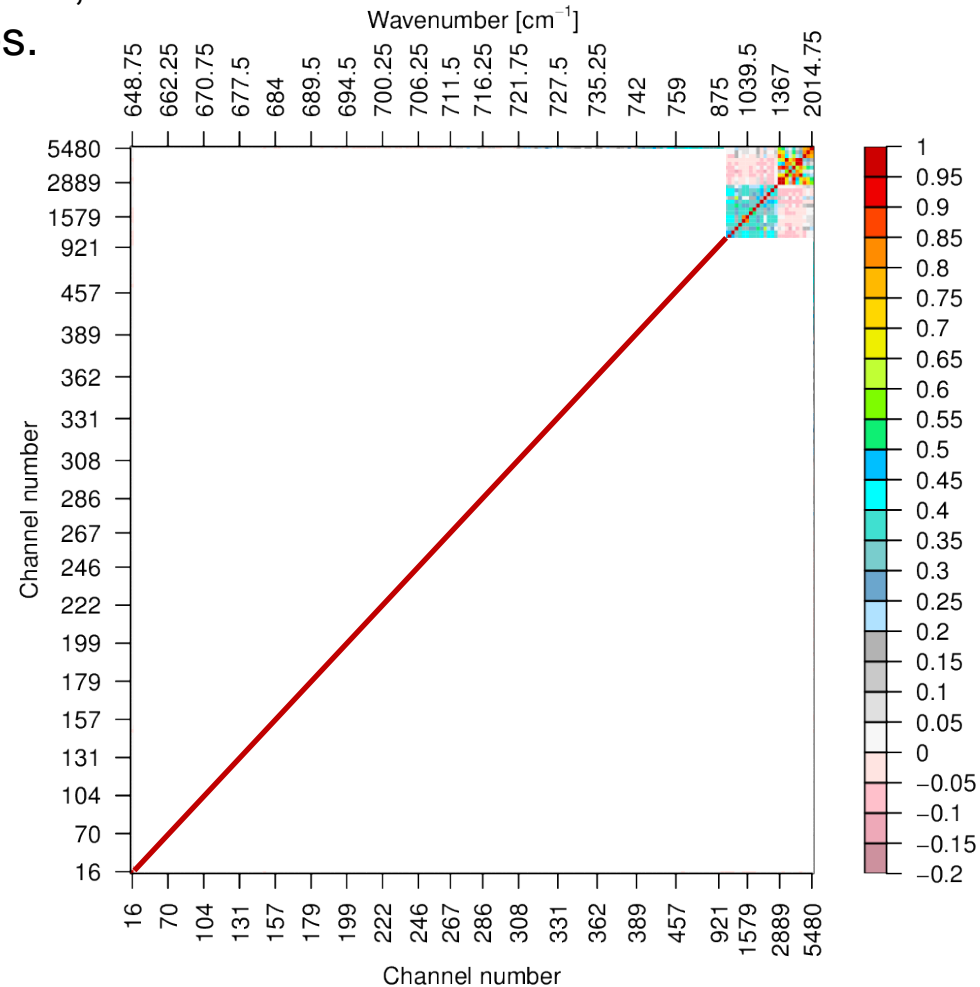
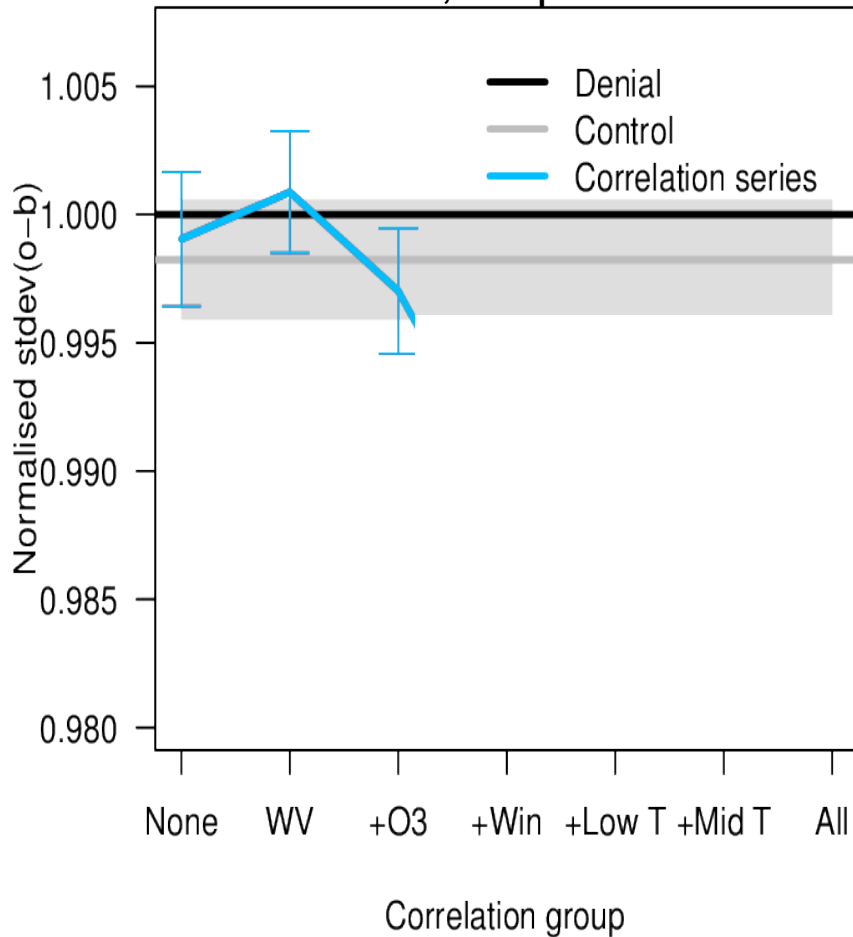
Assigned error correlations



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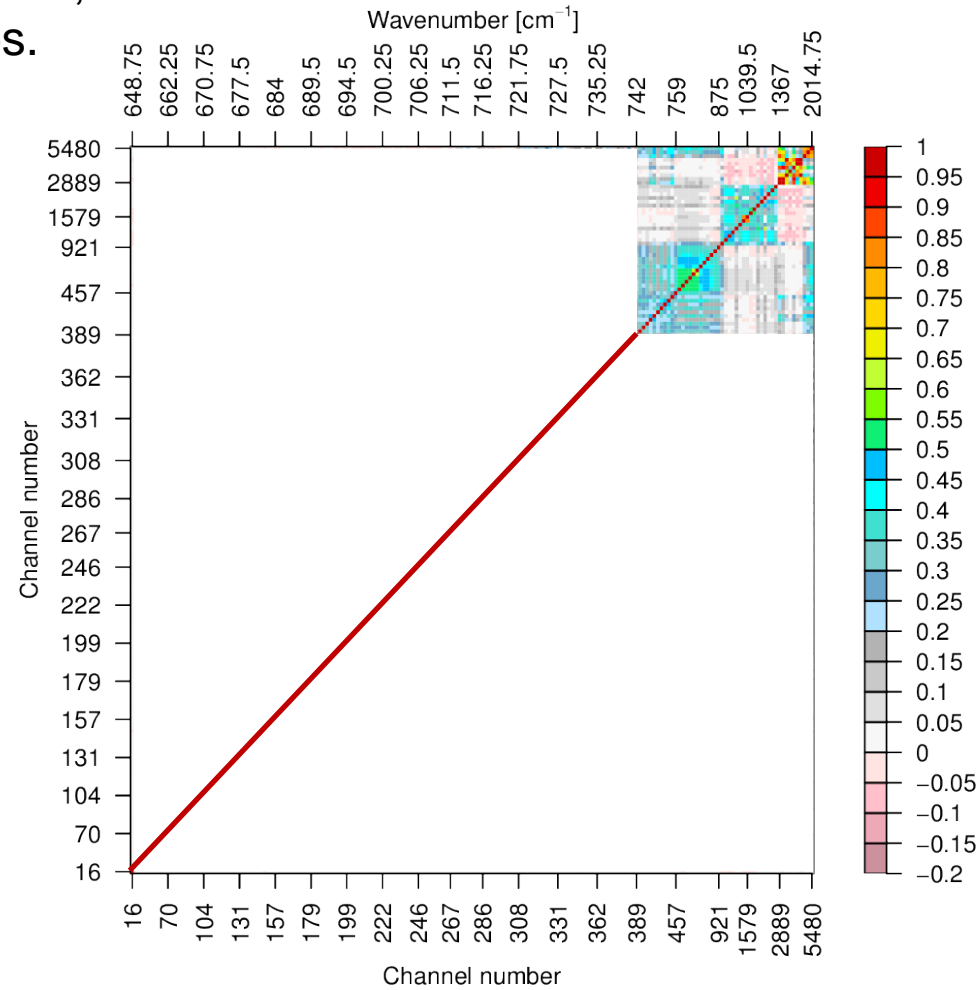
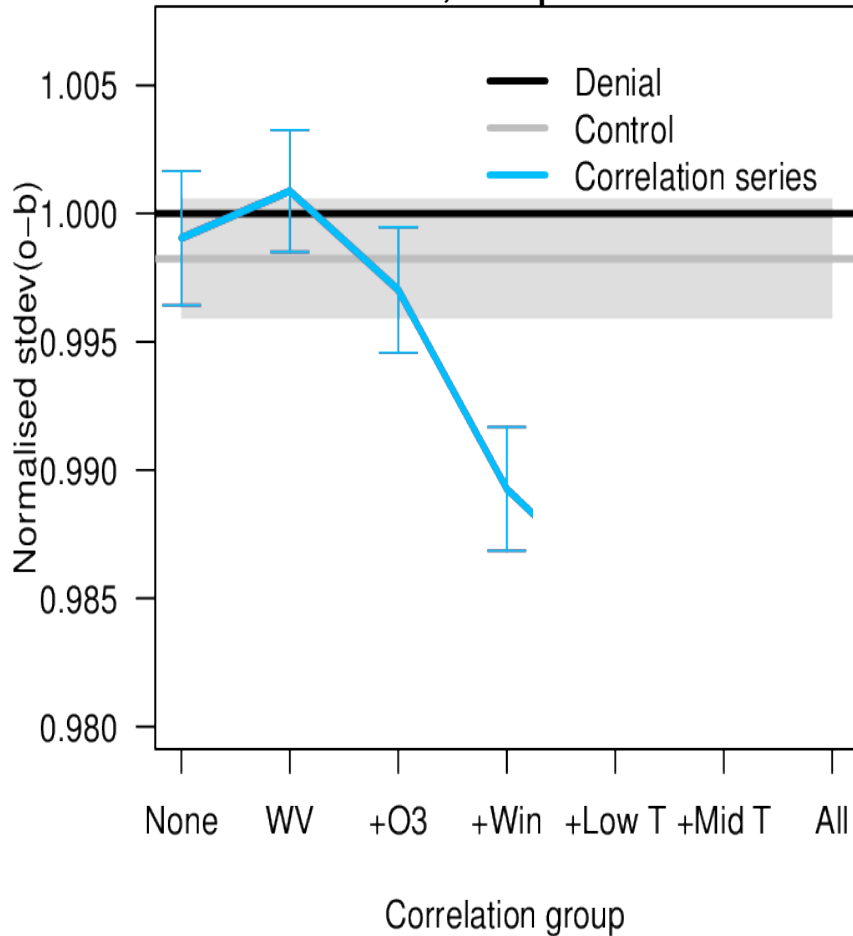


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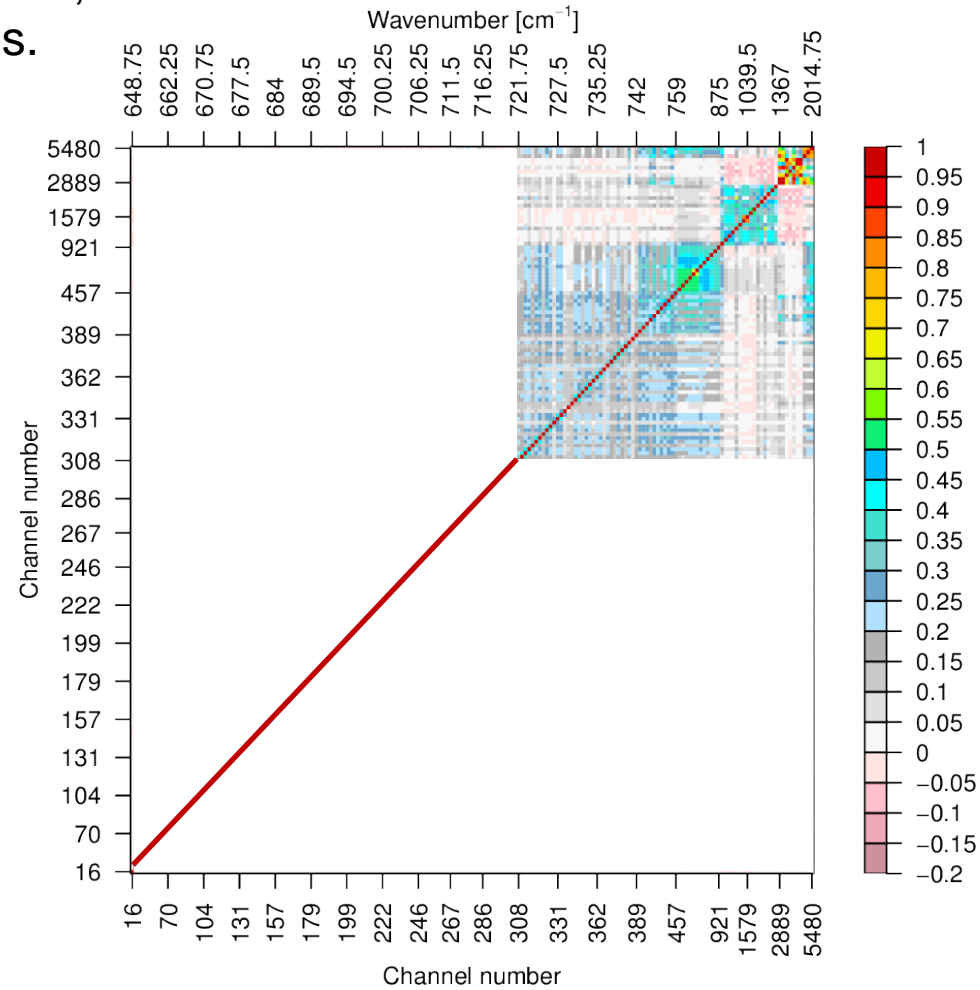
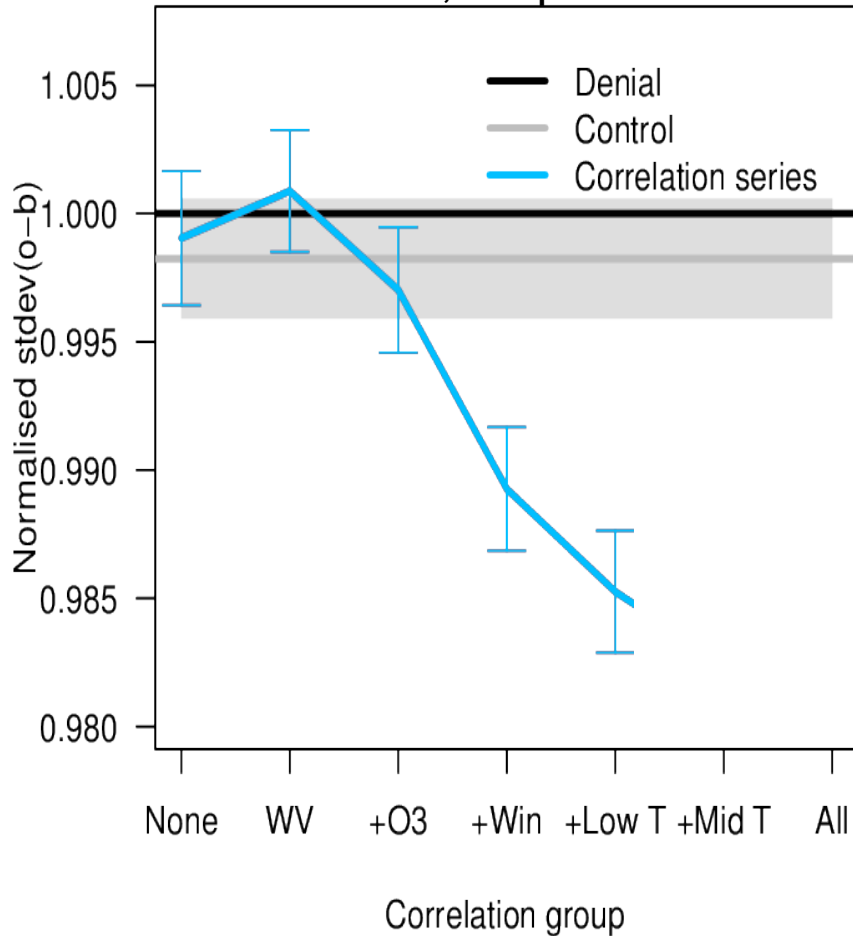


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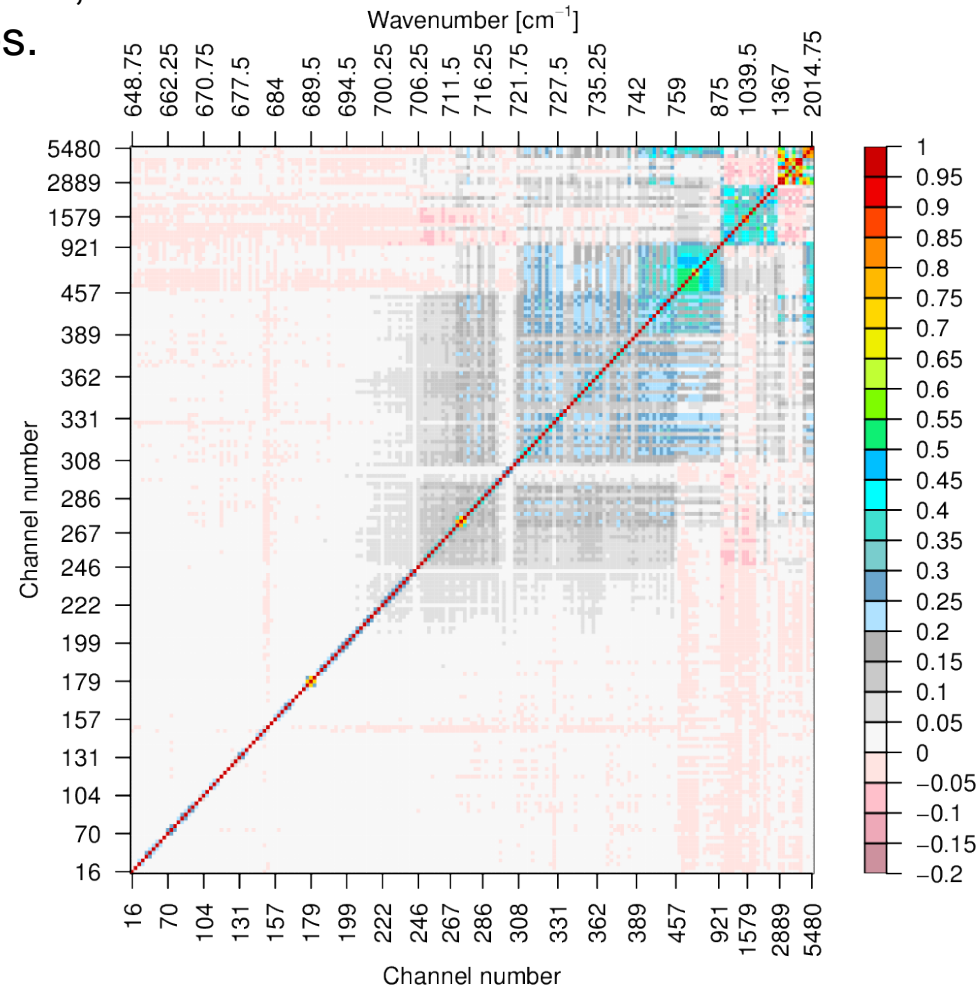
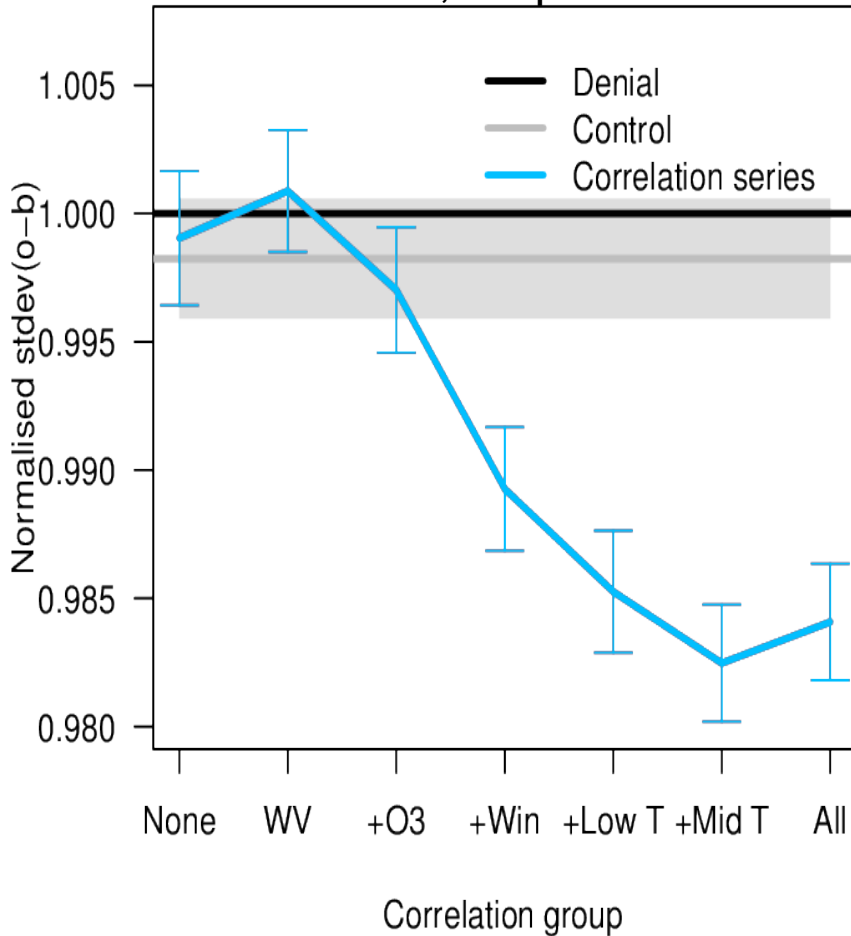


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# Extended trial

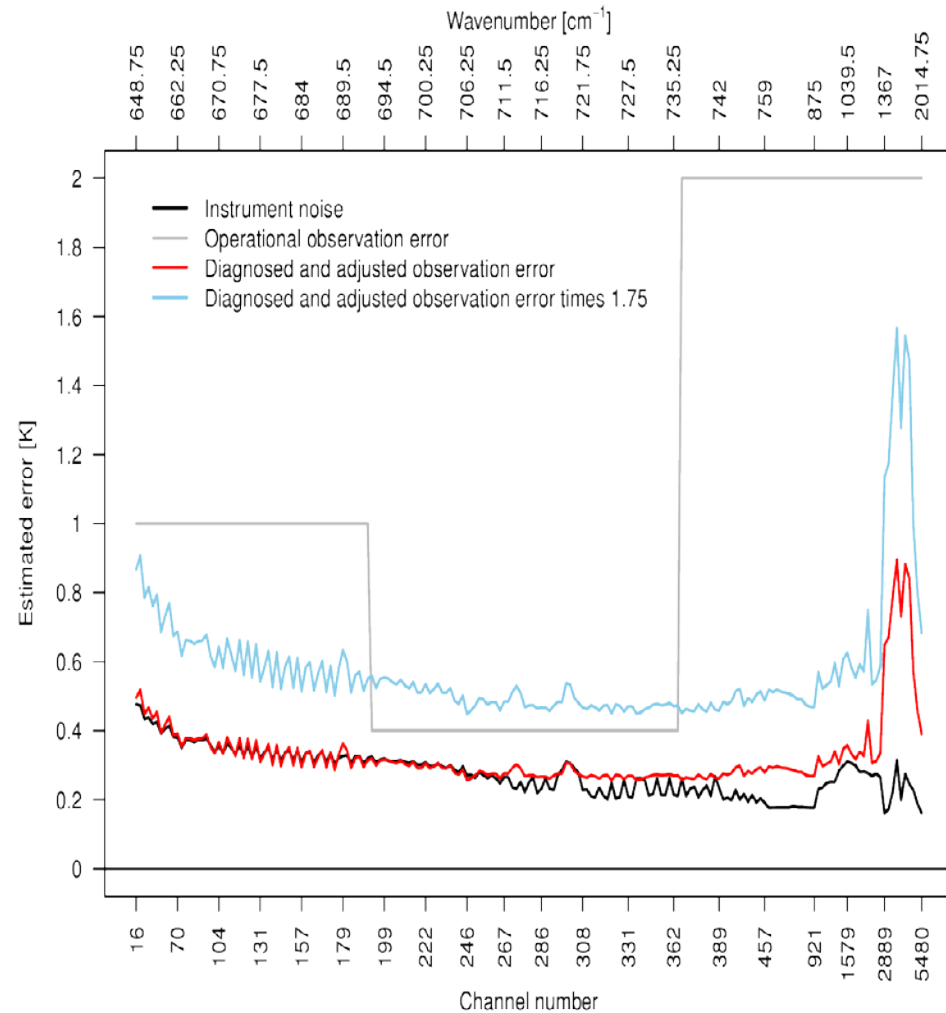
## Experiments:

**Denial:** No IASI

**Control:** IASI with operational observation error

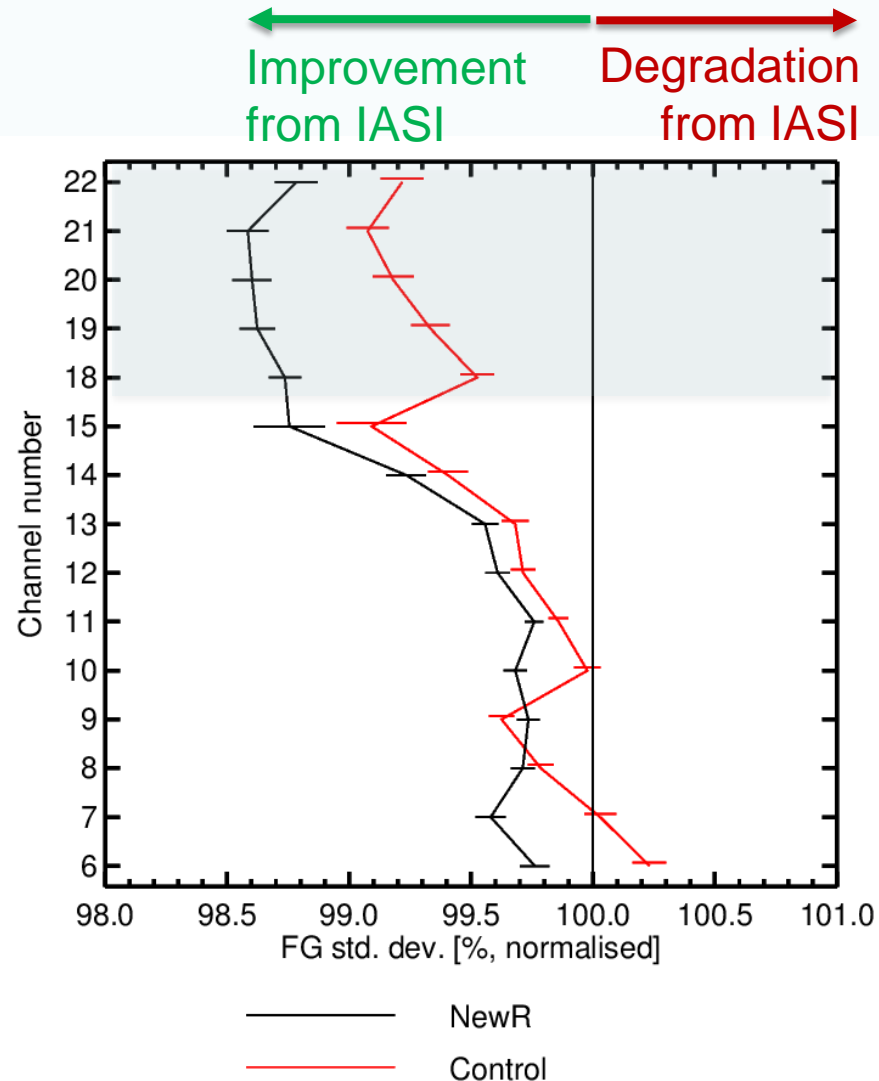
**NewR:** IASI with new observation error covariance **with inter-channel error correlations** and with inflation factor 1.75.

7 month period (5 Feb – 4 Sept 2014)



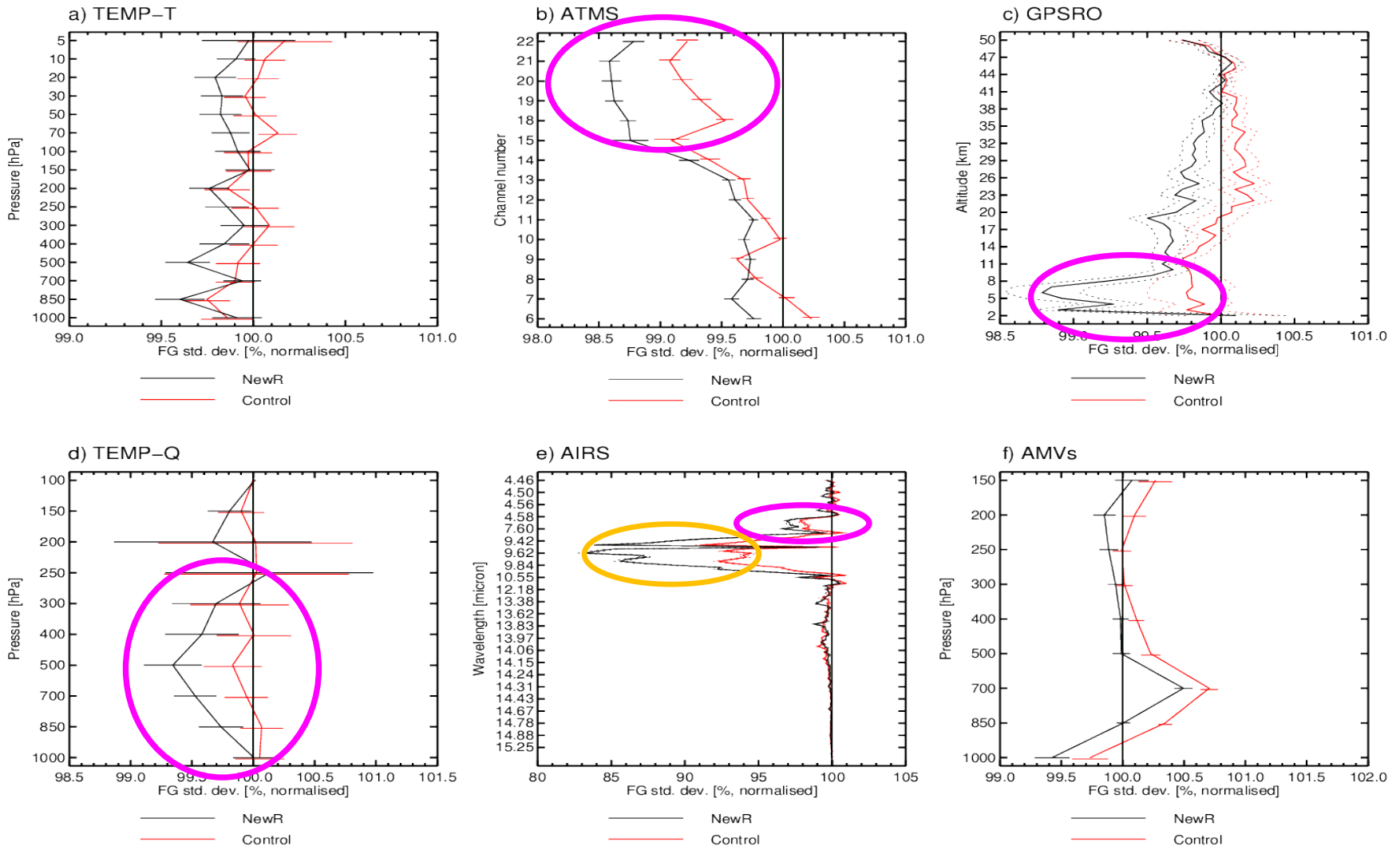
# Improved short-range forecasts

ATMS: Stdev(o-b) normalised by Denial; global; 7 months



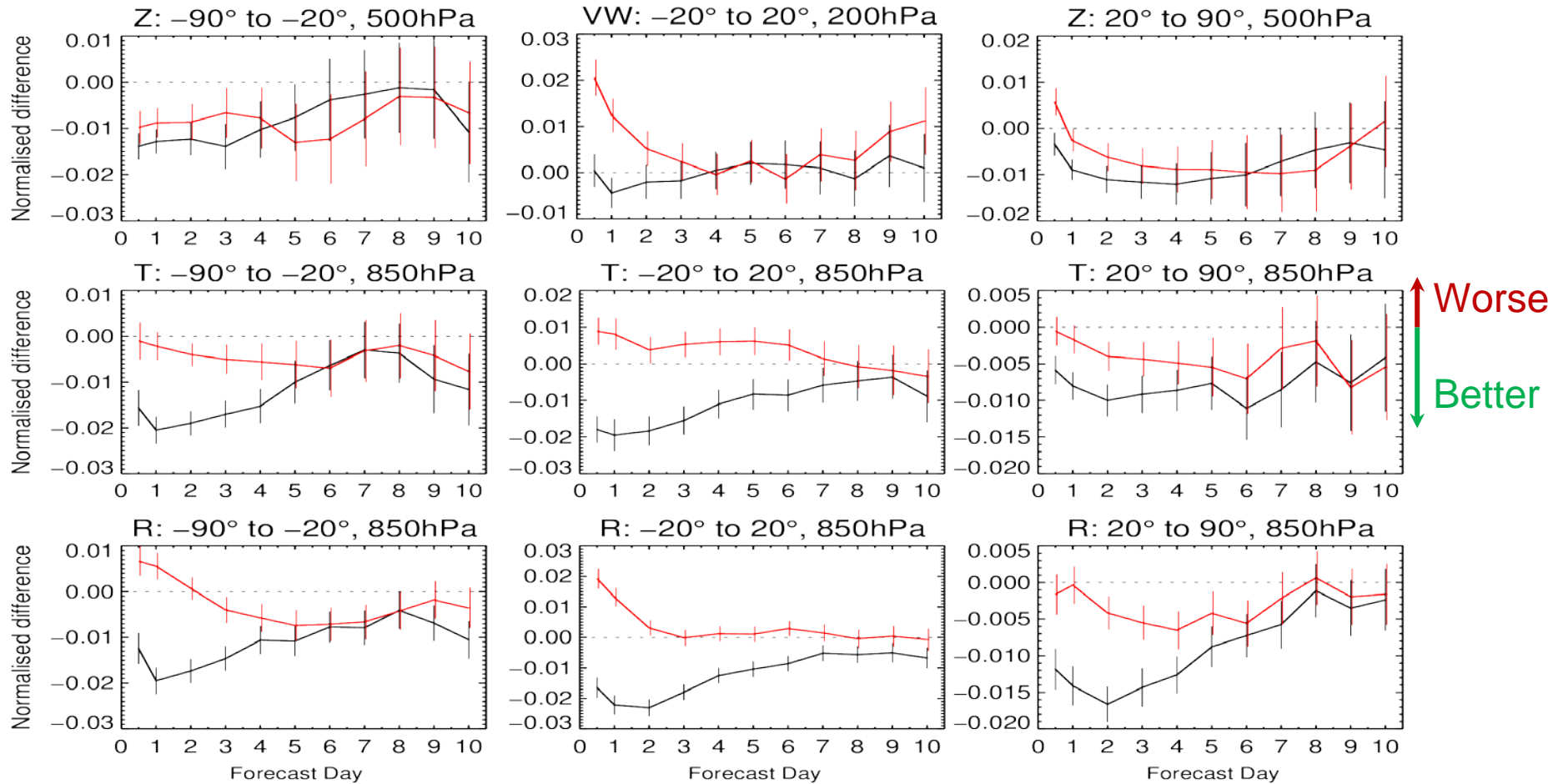
# Improved short-range forecasts

Stdev(o-b) normalised by Denial; global; 7 months



# Medium-range forecast impact

(7 months, normalised difference in RMSE, verification against own analysis)



— NewR – Denial

— Control – Denial



# Conclusions

- **A new diagnostic observation error covariance for IASI leads to significantly improved impact of IASI:**
  - Especially for temperature in the tropics, humidity, and ozone
  - Due to changes to the assumed error standard deviations and taking inter-channel error correlations into account.
  - Operational implementation expected in 2016.
- **More details: See Bormann et al. (2015), ECMWF Tech Memo 756**
- **The approach could be extended to AIRS and CrIS and other instruments.**
- **Observation-space diagnostics provide useful guidance, but inflation of the errors appears beneficial.**
  - Cf Weston et al (2014) who inflated by adding a diagonal error (“reconditioning”)
- **Better understanding of the sources of the error contributions will be beneficial, see the next talk.**