Transformed Retrievals of IASI radiances

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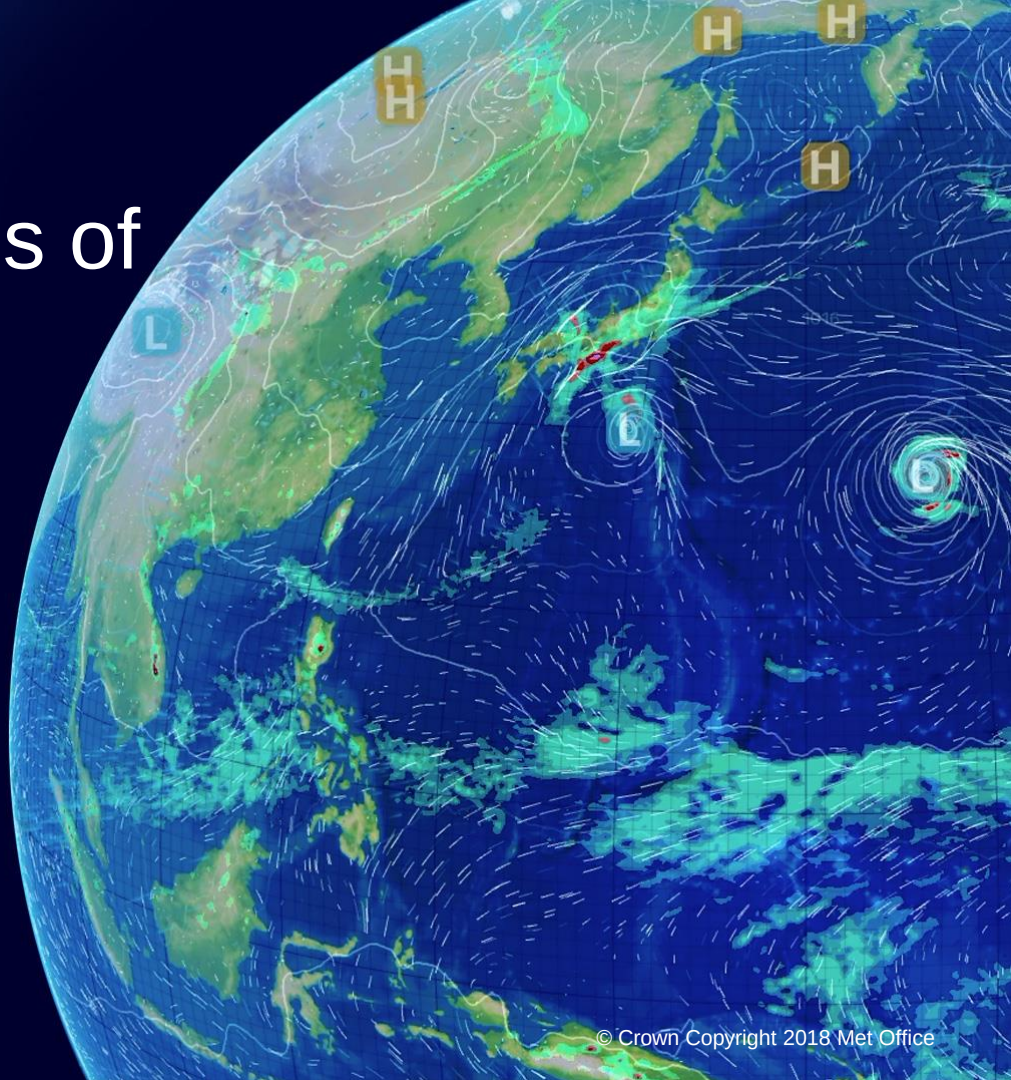
EUMETSAT fellowship



Met Office

Transformed Retrievals (TransRets)

- Assimilate radiances directly == Assimilate **transformed retrievals**
  - True if the same ***B*** and ***R*** matrices used for TransRet *creation* and their *assimilation*
  - True if observation operator approx. linear within retrieval errors
- Method makes use of **information content** of observations
- Uses signal-to-noise matrix, and normalised observations

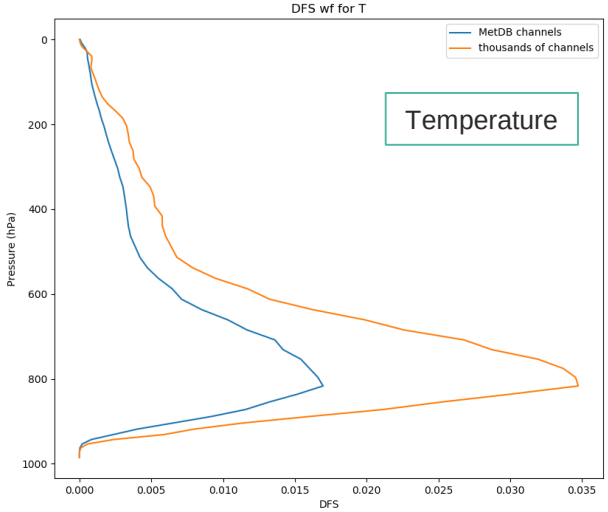
$$\boldsymbol{S} = \boldsymbol{R}^{-\frac{1}{2}}\boldsymbol{H}\boldsymbol{B}^{\frac{1}{2}} = \boldsymbol{H}'\boldsymbol{B}^{\frac{1}{2}} = \boldsymbol{U}_r\Lambda_r\boldsymbol{V}_r^T \qquad \boldsymbol{y}' \cong \boldsymbol{R}^{-\frac{1}{2}}\boldsymbol{H}\boldsymbol{x}^t + \boldsymbol{R}^{-\frac{1}{2}}\varepsilon^o \equiv \boldsymbol{H}'\boldsymbol{x}^t + \varepsilon'$$

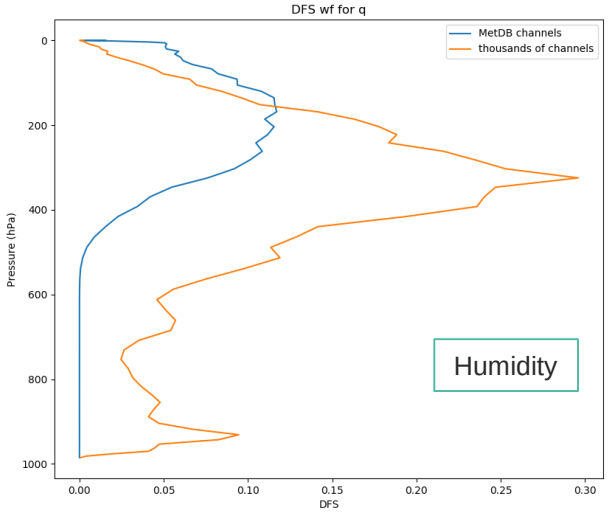
- Transformed retrieval: $\boldsymbol{y}_{\text{ret}} = \boldsymbol{U}_r^T\boldsymbol{y}'$
- TransRet obs. operator: $\boldsymbol{H}_{\text{ret}} = \boldsymbol{U}_r^T\boldsymbol{H}'$ … these can then be assimilated together!

see: Migliorini 2012

Using thousands of channels

- Plots show information content across state vector for operational channels *(static and flow dependent, cloud-free selection, ≤ 314 channels)* and thousands of IASI channels *(bands 1 and 2)*
- Increasing the number of channels translates to a **significant increase of information**
- Using transformed retrievals, we can assimilate that extra information in **fewer elements** than in current radiance assimilation
- Next generation instruments will provide many more channels than current instruments – TransRets provide a way to operationally use many thousands of channels





EUMETSAT Fellowship

- 3 year fellowship, currently over half way through (finishing Sept. 2022)
- Work so far:
  - Met Office Observation Processing System (OPS) – TransRet option for IASI implemented and tested their creation from operational channel list
  - TransRets created from thousands of IASI channels, information content vs. operational channel TransRets compared
  - Met Office VAR system – TransRets can now be assimilated, comparisons of increments between TransRets and radiance assimilation is on-going
- Aims of the project:
  - Prove equivalence of TransRet and radiance assimilation in practice for IASI
  - Investigate full spectrum TransRet assimilation, compare to operational increments