

The impact of hyperspectral infrared radiances in the ECMWF system

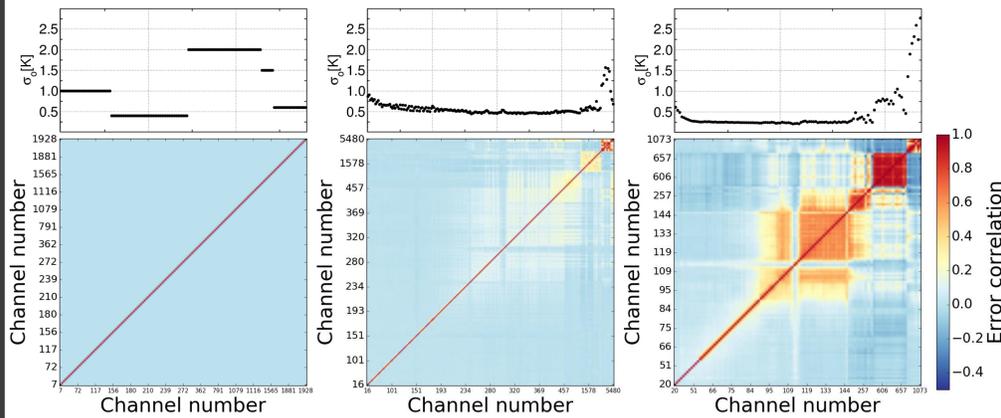
Reima Eresmaa and Cristina Lupu

ECMWF, Shinfield Park, Reading, United Kingdom



What's changed since ITSC-20?

- The number of active CrIS channels is increased from 78 to 118
- IASI and CrIS observation error covariance matrices are updated
- Detection schemes are activated to reject data contaminated by either aerosol or atmospheric hydrogen cyanide (HCN)
- The use of tropospheric-sensitive infrared (IR) channels over land will start in 2018



Observation-error covariance matrices for AIRS (left), IASI (middle), and CrIS (right). Top (bottom) panels show the assigned error standard deviation (correlation).

Summary

All infrared sounders produce a positive impact in short and medium ranges, although individual sounder impacts on headline forecast parameters are insignificant. The impact comes primarily from the use of stratospheric and upper-tropospheric channels in the long-wave infrared (LWIR) band and upper-tropospheric channels in the mid-wave infrared (MWIR) band.

	EOS-Aqua AIRS	S-NPP CrIS	Metop-A IASI	Metop-B IASI	Total
Long-wave stratospheric	43	36	80	80	239
Long-wave upper-tropospheric	31	37	50	50	168
Long-wave lower-tropospheric	16	22	35	35	108
Ozone absorption band	22	16	16	16	70
Mid-wave upper-tropospheric	4	5	5	5	19
Mid-wave lower-tropospheric	3	2	5	5	15
Short-wave	19	-	-	-	19
Total	138	118	191	191	638

Breakdown of the currently-used IR channels into sounders and channel groups.

Experiments

Denial runs are produced to assess the impact of each sounder and each of the seven distinct channel groups (listed in the Table above). Version 43r3 of the Integrated Forecasting System (IFS) is used with two modifications:

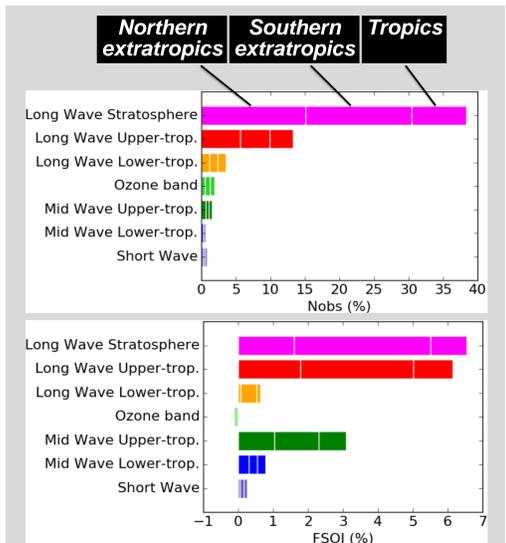
- We activate non-surface-sensitive IR radiances over land
- We apply a reduced horizontal grid resolution (TCO399)

Full operational observing system is made use of in the control run.

Sounder denial runs cover two four-month periods (June to September 2016 and November 2016 to February 2017). Channel group denial runs and Forecast Sensitivity to Observations Impact represent the former period only.

Channel group impact

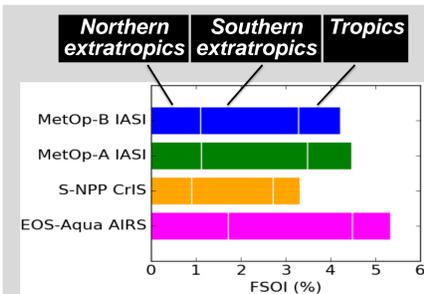
- Upper-tropospheric long-wave IR (LWIR) and mid-wave IR (MWIR) groups are consistent top performers in data fits
- Stratospheric and upper-tropospheric LWIR groups produce a significant forecast impact
- The impact of the upper-tropospheric MWIR group is remarkable given the relatively low data count
- FSOI over-emphasizes the significance of stratospheric LWIR group



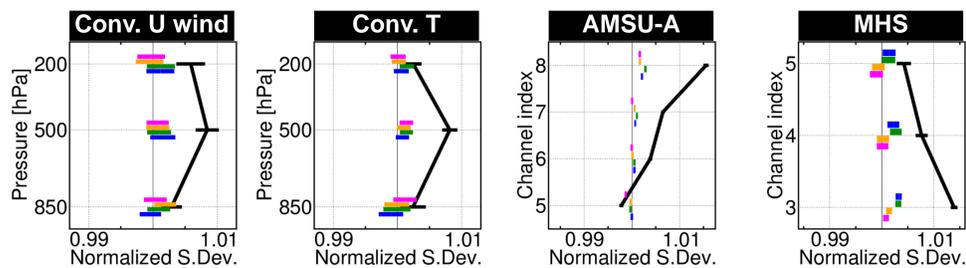
Relative observation count (top) and FSOI contribution (bottom) in each channel group.

Sounder impact

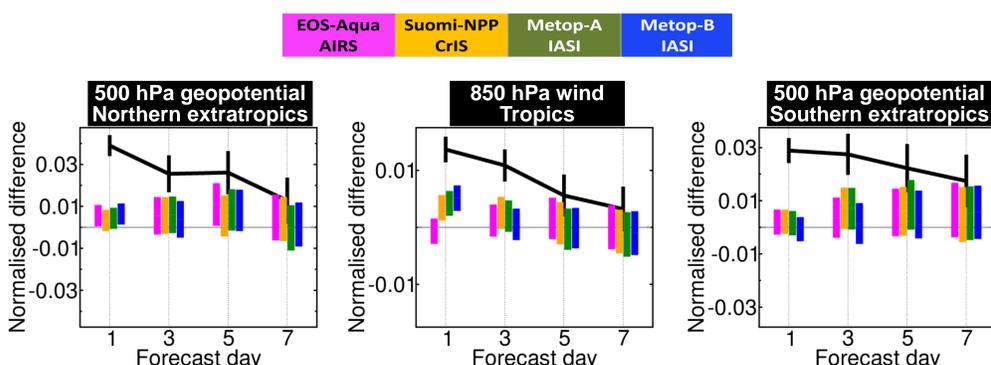
- All sounders contribute positively to conventional data fits and medium-range forecasts
- AIRS contributes the most to FSOI but has least impact on non-conventional data fits
- Non-significant forecast impacts of individual sounders combine to a significant (up to 3%) total impact



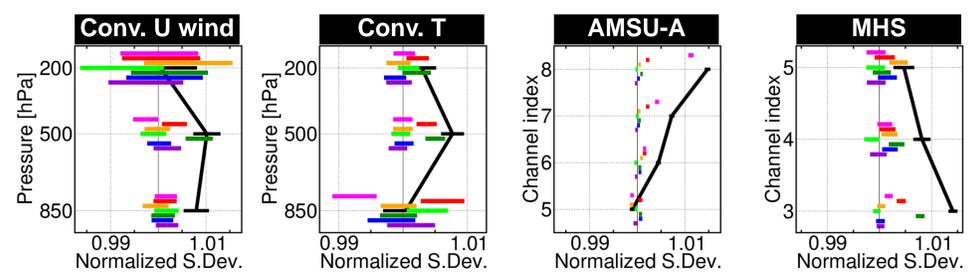
Forecast sensitivity (FSOI) to polar satellite IR radiance observations as a percentage of the total FSOI.



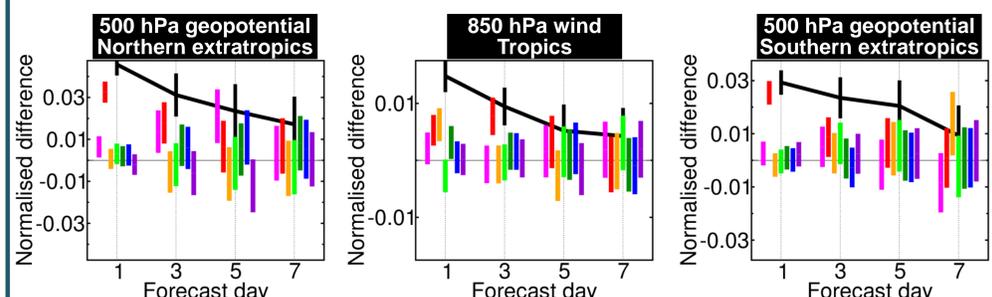
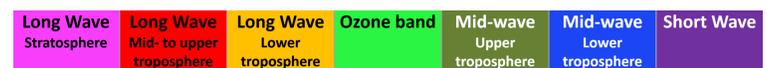
Sounder impact on global observation to background fit. Black line shows the total impact of all sounders, and bars indicate the 95% confidence intervals.



Sounder impact on forecast RMS error. Black line shows the combined impact, and bars indicate the 95% confidence intervals. Verified against each run's own analysis.



Channel group impact on global observation to background fit. Black line shows the combined impact of all groups, and bars indicate the 95% confidence intervals.



Channel group impact on forecast RMS error. Black line shows the combined impact. Bars indicate the 95% confidence intervals. Verified against each run's own analysis.

Acknowledgements

We thank EUMETSAT NWP SAF CDOP-3 program for providing funding for the work presented in this poster.