

# Recent upgrades in the use of satellite radiance observations within the Met Office global NWP system

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**Improvements in the assimilation of satellite radiance observations have led to significant performance gains in the Met Office global model over the last two years.** Upgrades in the treatment of satellite radiance data have occurred at model upgrades PS40 (Feb 2018), PS41 (Sep 2018), PS42 (Mar 2019) and PS43 (anticipated Nov 2019).

- **Significant increase in the use of AMSU-A Channels 4 and 5 due to all skies assimilation efforts.** This required development of an error model for liquid water effects on radiances in these channels. Retrievals of cloud liquid water are used within the Observation Processing System (OPS) to inflate the error on these channels used in assimilation. Increase in importance of AMSU-A seen in FSOI. Data coverage increases shown in plots on lower right.
- **Upgrade from RTTOV-11 to RTTOV-12.** This included the capability to treat scattering due to cloud and precipitation in the microwave via RTTOV-SCATT which is important for future development of the assimilation of 183 GHz humidity sounding data. Interfaces with HT-FRTC and PC-RTTOV were provided to enable trialling of their schemes based on principal components.
- **Use of RTTOV-12 on 70 model levels instead of 43 coefficient levels.** This eliminates the need to interpolate between coefficient levels and model levels within the assimilation system and provides a more consistent treatment of model fields therein.
- **Novel developments in the treatment of microwave humidity sounding data over land.** This required better techniques for detecting cloud over heterogeneous land surfaces and the development of a 1dvar retrieval scheme for land emissivities within OPS.
- **Introduction of new instruments including two new microwave imagers FY-3C MWRI and GPM GMI and the instruments on NOAA-20:** the microwave sounder ATMS and the hyperspectral IR sounder CrIS. These instruments provide redundancy to previous instrumental systems as well as giving better spatial and temporal coverage.
- **Improved quality control for cloud screening was applied to GMI, AMSR, and MWRI,** based a test on the background departure at 36H plus a new one based on anomaly difference between 36 and 89 GHz.
- **Assimilation of geostationary clear-sky radiances from GOES-16 ABI.** Replacement for GOES-13 allows continuity of these geostationary measurements on the eastern seaboard of the US as well as added value due to seven additional channels.

These upgrades were in addition to upgrades to the assimilation of products such as AMV's, scatterometer and Radio Occultation. There were also upgrades elsewhere in the NWP system including updates to the model as well as the data assimilation scheme. The land surface scheme was upgraded to GL8 which included a new multi-layer snow scheme and improved surface drag. The data assimilation upgrades included hourly cycling of background fields in 4DVar in order to obtain a more timely first guess. There was also an ensemble upgrade which yielded better information about the background covariances which had a positive impact on the assimilation.

