Changes in the operational use of passive sounding data in the ECMWF NWP system since ITSC-21

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Configuration of the high-resolution global NWP system

Spatial resolution: T_21729 (=96km)
Incremental analysis resolution: T_399 (=60km)
Vertical resolution: 137 levels, up to 0.01 hPa.
Assimilation system: 12h 4D-Var with early delivery window; background errors of the day from the 50-member Ensemble of Data Assimilations (EDA)

Major system upgrades since ITSC-21:
• Cycle 45r1 – 5 June 2016
• Cycle 46r1 – 11 June 2019

For full details see https://www.ecmwf.int/en/forecasts/documentation-and-support/changes-ecmwf-model

Only changes most relevant to ITWG are summarised on this poster.

Radiative transfer

Main changes
• Upgrade to RTTOV version 12 (in 45r1) and 12.2 (in 46r1) – Sp. 12 (Lupu)
• Update of the permitivity model in RTTOV-SICAT to Rosenberg (2015) (46r1) – Sp. 07 (Lonitz)
• Updated RTTOV coefficient files for MW instruments (46r1)

MW sounders and imagers

Main changes
• Activation of constrained variational bias correction for the top-most temperature sounding channel on AMSU-A and ATMS (45r1)
• Observation error upgrade for S-NPP ATMS, including inter-channel error correlations (46r1)

• Addition of SSSMIS-F17 150 MHz and GMI 166 v Hz channels (46r1) – Sp. 04 (Lonitz)
• Improved use of land/sea-mask in the field of view for microwave imagers (46r1)

Assimilation configuration

Main changes (46r1):
• Continuous data assimilation (use of late-arriving observations, 4 outer loops, 8h early-delivery window) → 12p, 13 (Lean)
• 50 members in the Ensemble of Data Assimilations (EDA), enabled through significant reductions in computational cost.
• Weakly coupled data assimilation for sea-surface temperature in the tropics

Fig. (top): Normalised difference in RMSE of 72h wind forecasts resulting from the assimilation of additional data assimilation. Experimentation covered 6 months over two seasons.

Fig. (right): Normalised difference in RMSE of 72h wind forecasts resulting from the assimilation of additional data assimilation. Experimentation covered 6 months over two seasons.

Fig. (left): Coverage at given wave-number after the introduction of hyper-spectral IR data over land.

Fig. (right): Normalised change in RMSE for the 500 hPa geopotential (right), resulting from the assimilation of hyper-spectral IR instruments before (blue) and after (red) the introduction of hyper-spectral IR channels over land. Experimentation covered 6 months over two seasons.

Fig. (left): Coverage at given wave-number after the introduction of hyper-spectral IR data over land.

Fig. (right): Normalised change in RMSE for the 500 hPa geopotential (right), resulting from the assimilation of hyper-spectral IR instruments before (blue) and after (red) the introduction of hyper-spectral IR channels over land. Experimentation covered 6 months over two seasons.

Main changes (continued)
• Assimilation of more WV channels from IASI (39 instead of 10; 46r1) → 9.82 (Salonen)
• Improved assimilation of geostationary radiances (extended disk, slant path, correlated observation error, 46r1)

Main changes
• Assimilation of non-surface-sensitive IR channels over land (45r1)

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