Recent changes in the ECMWF NWP system

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New model cycles

Since ITSC-19, ECMWF implemented only one new model cycle (41R1 on 12 May 2015). This cycle gave a good positive impact. It comprised several data assimilation and model changes:

- Switch to all sky mode for the assimilation of MHS (see ITSC-19 item 0.01)
- Assimilation of SSMS moisture sounding channels over land and sea-ice
- Assimilation of surface-sensitive ATMS channels over land (see ITSC-19 item 1p:12)
- Upgrade of radiance observation operator with RTTOV-11 (see ITSC-19 item 4p:03)
- Assimilation of GPS-RO with two-dimensional observation operator
- Assimilation of ASCAT in soil moisture analysis
- Assimilation of AltiKa and Cryosat altimeter wave height data
- Assimilation of high-resolution radiances
- Upgrade of inner loop resolutions of 4D-Var to T265 for each of the three iterations of the outer loops.
- Changed calculation of background error covariances from using EDA samples of perturbations from last cycle (1/3) and climatology (2/3)
- Reduction of number of iterations in 1st inner loop and use of full linear physics package

Model changes:

- New surface climate fields (land-sea mask, sub-grid orography)
- New CO2/CH4 climatologies from latest MACC-II reanalysis produced at ECMWF.
- Revised semi-Lagrangian extrapolation reducing stratospheric noise (good impact on satellite data usage)
- Revised interpolation of moist variables in the upper-troposphere/lower stratosphere (UTLS).
- Activation of the lake model (FLAKE).
- Cloud scheme change of rain evaporation, auto-conversion/accretion, riming, precipitation fraction.
- Improved representation of super cooled “freezing” rain.
- Modified convective detrainment.
- Active use of wave modified stress in coupled mode.
- Revised sea-ice minimum threshold, sea-ice roughness length and consistency between SST and sea ice concentration.

Microwave imagers

- Three microwave imagers are currently active (using the all sky approach):
  - GCOM-W1/AMSR2 (channels 7 to 11 and 13) active since 12 August 2015
  - GPM/GMI (channels 3 to 6 and 8) active since 12 August 2015.
  - FY-3B/SSMI (channels 12–14 and 16–17)
- The addition of AMSR2 and GMI improve the fit to almost all other observations (except for AMSUA – the reasons are understood)
- Decrease of geopotential Standard deviation of forecast error up to day 4
- Forecast scores for humidity appear degraded for lower troposphere up to day 4 (however increments are larger and analysis more active).

Microwave sounders

- In Cycle 41R1, MHS is used in all sky mode allowing:
  - Doubling of the observation coverage in the mid-latitude storm tracks.
  - Improvement of mid-latitude dynamical forecasting

Table 1. Channels assimilated

<table>
<thead>
<tr>
<th>AMSUA</th>
<th>MHS (all sky mode)</th>
<th>ATMS</th>
<th>SSMS (all sky mode)</th>
<th>MWHS</th>
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<tbody>
<tr>
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<td>3-5</td>
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<td>NPP</td>
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<td>9-11</td>
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</tr>
</tbody>
</table>

Main upcoming satellite changes (cycle 41R2)

The upcoming ECMWF model cycle 41R2 (expected to be implemented in Q1/Q2 2016) will be mainly dedicated to a significant resolution increase affecting almost all model and data assimilation components (see table 2). The cycle will also include significant satellite data assimilation changes:

- Activation of F-18 humidity sounding channels over ocean and extend all-sky assimilation to snowy land surfaces
- Situation dependent observation errors for AMSUA (see posterior p.06 by Heather Lawrence)
- Improved IASI aerosol screening (see posterior p.04 by Reima Eresmaa for Julie Letertre-Danzack)
- 25% increase of GPSRO observation errors
- Update of RTTOV coefficient files for microwave instruments (see item 2.03 by Cristiana Lupu)
- Allow Meteosat mid-height IR AMVs

Infrared sounders

- Four infrared sounders are being used:
  - IASI from METOP-A and METOP-B (since February 2014)
  - AQUA (AIRS)
  - NPP/CRIS (78 channels) activated on 22 January 2015
  - One HIRS instrument (METOP-A)

The addition of GHS (with or without the presence of AIRS) shows:

- Positive to neutral impact on forecasts.
- Slightly better fit of the background to independent observations (except for some microwave sounding channels)

Operational changes of satellite data usage (radiiances only)

- METOP-BS/MHS decontamination (8 days outage)
- AMSU-A anomaly (6 days outage) METOP-AMHS outage (3 months outage)

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