I) Operational NWP system & satellite usage

Global:
- ICON - at 13 km global / 6.5 km Europe (two-way nest within global runs)
- EnVar ensemble DA, 40 members at 40/20 km (global/Europe), see II
- ICON – EPS global ensemble forecasts at 40/20 km (operational Dec 2017)

High-resolution:
- COSMO-DE: 2.8 km, 50 levels (non-hydrostatic)
- KENDA LETKF ensemble DA, 40 members at 2.8 km with latent heat nudging (LHN) for radar precipitation
- COSMO-DE-EPS ensemble forecasts at 2.8 km, 40 members

Satellite data / global ICON:
- AMSU-A: channel 3-14 everywhere, 5.6 km only over ATS (similar, 3/35 extrap.)
- HIRS (chan 4-7, 14, 15, over sea)
- GPS-RO bending angles
- AMVs (GEO, LEO), ASCAT winds
- MHS & IASI humidity channels pre-operational (for Q1, 2018, see III)
- Monitoring: further MW- & IR radiance assimilation for IASI (Q1, 2018), CrIS, Meteosat CSR, Jason-2/3 winds

Technical aspects:
- RTTOV-10 (update to RTTOV-12 for Q1 2018)
- Online bias correction
- Flexible satellite pre-processing & monitoring auto-alert packages

Current developments:
- Extended IASI usage, introduction of CrIS
- Operational introduction of VarBC
- MW and IR surface sensitive radiances (see IV)
- Use of IASI PC compressed data (see V)
- SEVIRI cloudy radiances (infrared water vapor and visible, see VI)
- Observation impact diagnostics in ensemble DA (see Poster 12p.09)

II) Operational Introduction of Ensemble DA

A fundamental upgrade of DWD’s operational NWP system has taken place over the last three years, consisting of:
1) Global model ICON model (IOchselmedieval non-hydrostatic modelling framework, developed in cooperation between DWD and the MPI Hamburg for climate research), operational since January 2015. The non-hydrostatic model is formulated on an icosahedral grid, runs currently at 13km resolution with 90 vertical z-levels (model top at 70km-2.6 Pa). Higher resolution forecasts are provided at 6.5km for a European domain using two-way nesting (ICON EU, see Fig. 1).
2) Global EnVar data assimilation, operational since January 2016: A global LETKF ensemble data assimilation (following Hunt et al. 2007) at lower resolution, providing flow dependent background errors, is coupled to a full resolution deterministic 3DVar. The current ensemble size is 40 members (to be increased in 2018). See Fig.1 for schematic illustration of the setup.
3) Global ensemble forecasts, the ICON-EPS, with 40 members based on the global ensemble will become operational in December 2017 and produce forecasts up to 120 h (0, 12 UTC) and additionally 3 hourly 24 h forecasts used as boundaries for the regional ensemble.

For the conversion-resolution KENDA system, projects are ongoing to assimilate cloudy IR radiance data as well as visible observations to improve forecasts of convective events as well as volume cloud levels (e.g. for renewable energy applications). The implementation of the fast forward operator MPASIS Schleder et al. (2016) simulating SEVIRI visible channels assimilated and tuned using OBS-ensemble statistics (Fig. 12, 13). The fit to observed reflectances at high solar zenith angles improves when some 3D effects are accounted for. The water content of subgrid-scale clouds has been to taken into account, but including snow/grapel gives no further improvement. First assimilation studies with the KENDA LETKF (in cooperation with Heitz at LMU/Munich) are very promising, resulting in improved cloud cover and also better fit of humidity fields to independent observations (remote sensing, aircraft).

References:
- Contact: Christina.Koepken-Watts@dwd.de

Data Assimilation Section, DWD (German Meteorological Service)