ISDA-Online

March 3, 2023 07 – 09 UTC

“Operational Data Assimilation”

Session Chairs: Javier Amezcua, Lars Nerger, Nora Schenk, Tobias Necker, Zofia Stanley, James Taylor

Program:

07:00 – 07:05	**Welcome**
07:05 – 07:50	**Current status and Future Prospects of Data Assimilation Systems for Operational Numerical Weather Prediction Systems in Japan Meteorological Agency** Yoshiaki SATO
07:50 – 08:00	**Questions/Discussion**
08:00 – 08:45	**Developments and prospects for the ECMWF Data Assimilation system** Florence RABIER
08:45 – 08:50	**Questions/Discussion**
08:55 – 09:00	**Closing: Information on upcoming sessions**

Please note:

- The times in UTC are approximate. In case of technical problems, we might have to change the order of the presentations.
- **Time Zones**: 07 – 09 UTC
  07 – 09 am GMT (London) | 08 – 10 am CET (Berlin)
  03 – 05 pm CST (Shanghai) | 04 – 06 pm JST (Tokyo) | 06 – 08 pm AEDT (Sydney)
  11pm – 01 am PST (San Fran.) | 00 – 02 am MST (Denver) | 02 – 04 am EST (New York)

Developments and prospects for the ECMWF Data Assimilation system

Florence RABIER
Director General, European Centre for Medium-Range Weather Forecasts

Based on the ECMWF Strategy 2021-2030, the development of data assimilation in the next few years is driven by two main requirements. Firstly, to provide the most accurate and timely initial conditions for our rapidly evolving Earth system modelling activities and secondly to facilitate the maximal exploitation of current and future observing systems. Some of the expected outcomes are indicated below:

- Accurate initialisation of global forecasts using a convection-permitting model, in experimental mode
- Enhanced consistency of assimilation approach and optimal level of coupling between the various components of the Earth system
- Step change in information extracted from satellite data over land, snow and sea ice
- Efficient use of MTG, EPS-SG and Sentinel satellite data
- Enhanced use of observations linked to physical processes (clouds, rain, lightning)

The 4D-Var will remain at the core of our data assimilation system and to meet the demands of higher spatial resolution we are investing in an extending window technique to handle the increased nonlinearity associated with resolving smaller spatial scales. This offers significant computational efficiencies as well as being a natural evolution of our continuous approach to the integration of observations, possibly allowing more rapid updates of the analysis. The core 4D-Var algorithm is supported with uncertainty estimation from an Ensemble of Data Assimilations (EDA) and techniques to estimate observation error covariances. Here too we are developing innovative approaches to facilitate a successful evolution to higher spatial resolution.

ECMWF is accelerating efforts to move towards a more fully coupled approach to data assimilation. To justify the huge investment in observation systems (especially satellites) it is vital that, wherever possible, an observation delivers benefits across all components of the Earth system (atmosphere, land, ocean and cryosphere). Also, observations at the interface between Earth system components (e.g. surface sensing satellite window channels) are most effectively used in a consistent and simultaneous coupled data assimilation framework. A prime example of this is the development of our fully coupled SST analysis which is already showing promising results. A number of exciting other opportunities are being explored to use coupled data assimilation to extract completely new information from existing measurement systems (e.g. humidity from altimeters and SST from scatterometers).

As a logical step towards maximising our exploitation of available observations, a new target is the assimilation of visible radiances to inform upon clouds. These developments for the currently underexploited visible radiances are embedded in our long-term strategy to exploit complementary cloud information across the electromagnetic spectrum (including from MW and IR, passive and active sensors), for improved atmospheric analyses and to inform developments in the physics parameterisations.

Finally, we are deploying significant resources to expand the capability and autonomy of our observation handling, monitoring and alarm systems for all Earth system observations. Here we will seek to exploit opportunities of AI/ML to assist bias correction, anomaly detection and attribution of cause. This will improve our resilience and observation exploitation of the current network, but also begin to future-proof our observation handling facilities to position ECMWF at the forefront of the New Space small satellite exploitation.

Current status and Future Prospects of Data Assimilation Systems for Operational Numerical Weather Prediction Systems in Japan Meteorological Agency

Yoshiaki SATO
Head, Office of Numerical Prediction Modeling Fundamental Technology / Numerical Prediction Development Center / Japan Meteorological Agency

Over the years, Japan has suffered from various disasters such as land slide and flash flood caused by extreme weather events such as heavy rains and typhoons. Therefore, it is an urgent issue to improve the accuracy of weather forecasts in order to mitigate the damage. As Japan's national meteorological agency, the Japan Meteorological Agency (JMA) publishes official forecasts and to support the forecasts, JMA operates multiple numerical weather prediction (NWP) systems and continues working to improve their accuracy.

In 2018, the JMA formulated the JMA's NWP Strategic Plan Toward 2030 to prioritize the development targets. Among them, heavy rain forecast up to half a day ahead and typhoon forecast up to several days ahead are assumed to be the main issues for disaster mitigation. In order to improve the accuracy of these predictions, it is important not only to improve the accuracy of the NWP model itself, but also to improve the accuracy on its data assimilation (DA) systems.

For these purpose, the major deterministic NWP models operated by JMA are global spectral model (GSM), meso-scale model (MSM) and local forecast model (LFM), and the dedicated DA systems for each model are also operated. JMA implements efforts not only to incorporate available observation data as much as possible to the DA systems, but also to utilize future observations such as infrared sounders which are planned to be onboard the next generation Himawari satellite.

Moreover, to support sub-seasonal to seasonal forecast, JMA operates a coupled prediction system (CPS), which is the ensemble prediction system composed by an atmosphere ocean coupled NWP model. To prepare the initial condition for the ocean component of CPS, an ocean DA system is also operated, though the initial condition for atmospheric component is the same as GSM.

In the presentation, an overview of the DA systems for these NWP systems and the improvement plans will be introduced.