The NWP systems at Météo-France

MF global deterministic model: ARPEGE

CV42-op2, operational since December 5, 2017:
T1198 with c=2.2 and 105 levels. This gives a resolution of 7.5 km over France and 25 km at the antipode. The time step is 360s. The 4DVAR uses 2 outer loops. The first one is 40 iterations at T499 C=1 with a time step of 1350s, the second one is 40 iterations at T399 C=1 with a time step of 90s.

Current e-suite CV32z-op1, to be operational mid-2019:
T1198 with c=2.2 and 105 levels.

MF global short-range E.P.S.: PEARP

AROME-France Ensemble Data Assimilation

CV42-op3, operational since July 10th, 2018

The AROME-France EDA provides an ensemble of analyses and short-range forecasts to:
- initialize the AROME-France Ensemble Prediction System, in operations since July 2018
- provide flow-dependent background error variances to the AROME-France 3D-Var, proposed for the next e-suite at MF (Sept. 2019).
The implementation of the AROME-France EDA relies on 25 members of stochastic 3DVars that are performed at a reduced spatial resolution of 1.25 km to reduce the computational cost.

AROME-France E.P.S.

The configuration (operational production since October 2016):
Based on the deterministic AROME-France model with a 2.5km horizontal resolution (1.3km in AROME-France) and 90 vertical levels. Runs at 03, 09, 15 and 21 UTC, to provide forecasts up to a 45/75h range.

AROME-France EPS is a 12-member ensemble, designed in order to account for the main sources of uncertainty:
- Perturbed Lateral Boundary Conditions (LBCs) are provided by members from the last PEARP production, selected with a clustering technique (revised in 2018);
- Initial Conditions (ICs) are build by adding to the AROME deterministic analysis perturbations from the AROME-France EDA. Model error contributions are represented with a stochastic physics approach using the SPPT scheme, that simulates the effect of random errors due to the physical parametrizations; Random perturbations are added to various parameters of the SURFEX surface scheme, including sea surface temperature, soil moisture and temperature.

Applications: choice of best model by human forecasters, decision aid for severe weather events (e.g. heavy precipitation, convection, gusts, winter conditions), probabilistic weather forecasts, forcing of flood models, air traffic management.

Recent research results: Use of ensemble data assimilation (EDA) for initial perturbations or cheaper alternative (to add small-scale random noise to the initial conditions) leads to large improvement over the simple downscaling from a larger-scale ensemble; Comparison of ensemble resolution and size impacts indicates a larger impact of adding more members, especially as lead time (and uncertainty) increases.

Post-processing of ensemble outputs clearly needed to improve the value of EPS: the introduction of a tolerance in space and time when computing the precipitation probabilities improves the forecast scores, by filtering small-scale noise and increasing the apparent ensemble size; Object-based processing of quantitative precipitation forecasts may be useful to extract the signal at a larger, and more predictable, scale; The prediction of extreme weather events could benefit from an Extreme Forecast Index (EFI) calculation, even though the next model is computed from a small operational archive.

Future works: Increase of the ensemble size to 26 members planned by mid-2019; Combination of lagged EPS productions with objective weighting; Object-based processing to be extended to other variables (e.g., cloudiness, wind gusts); Investigation of deep learning methods to extract a relevant information from the ensemble; Work to be started on stochastic parameter perturbations.

AROME-NWC: high resolution model for nowcasting

operational since December 8, 2015

See also ALADIN-HIRLAM Newsletter n°9, Sep. 2017, AROME for Nowcasting, N. Merlet et al