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SINFONY - the combination of Nowcasting and Numerical Weather Prediction on the convective scale at DWD

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There are different "optimal" forecast methods for different forecast lead times and different weather phenomena. Focusing on precipitation and convective events up to some hours ahead, radar extrapolation techniques (Nowcasting) show good skill up to about 2 h ahead (depending on the situation), while numerical weather prediction (NWP) outperforms Nowcasting only at later hours. Ensembles of both Nowcasting and NWP help to assess forecast uncertainties. "Optimally" combining precipitation forecasts from Nowcasting and NWP as function of lead time leads to seamless forecasts.

However, very often separate groups are working on these topics independently, even at the same center. Progress on all these fields could be enhanced by strengthening the coordination, feedback and exchange among the groups.

In 2017, DWD has taken this road when setting up a project to research, develop and establish its future Seamless INtegrated FOrecastiNg sYstem (SINFONY), which is intended to be the basis for DWD's future severe weather warning process from minutes to 12 h.

Different teams work closely together in developing
a) Radar Nowcasting ensembles for precipitation, reflectivity (ideas from STEPS) and convective cell objects (KONRAD3D),
b) hourly NWP rapid-update-cycle ensemble prediction system on the km-scale (SINFONY-RUC-EPS), assimilating high-resolution observations of 3D radar volume scans (radial wind, reflectivity, cell objects), Meteosat VIS channels and lightning,
c) optimal combination of Nowcasting and NWP ensemble forecasts in observation space (precipitation, radar reflectivity and cell objects),
d) systems for common Nowcasting and NWP verification of precipitation, reflectivity and objects. In particular the cell object based verification will provide new insights into the representation of deep convective cells in the model.

For b), New innovative and efficient forward operators for radar volume scans and visible satellite data enable direct operational assimilation of these data in an LETKF framework.

For c), the SINFONY-RUC-EPS outputs simulated reflectivity volume scan ensembles of the entire German radar network every 5' online during its forecast runs. Ensembles of composites and cell object tracks are generated by the same compositing and cell detection- and tracking methods/software packages which are applied to the observations.

To help evolve DWD's warning process for convective events towards a flexible "warn-on-objects", our Nowcasting- and NWP cell object ensemble forecasts are blended into a seamless forecast ("probability objects") in a pragmatic way. The gridded combined precipitation and reflectivity ensembles are targeted towards hydrologic warnings.

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