3rd European Nowcasting Conference
Madrid, Spain
24 – 26 April 2019
Poster 24

Deutscher Wetterdienst
Wetter und Klima aus einer Hand

Radar Nowcasting for the German Air Traffic Control

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The DWD (German National Meteorological Service) is the designated air navigation service provider for the DFS (German Air Control Service). Key among the products that the DWD already provides is a radar composite for the German airspace. In the project I-RADAR new innovative radar based products are created for the DFS. One goal of the project is to deal with the inhomogeneities of the available European radar data and to create a new combined composite. The presented work deals with the temporal aspects of the issue, that is, differences in validity times, production timings, as well as the delay time between production and delivery to DWD. The algorithm uses optical flow techniques with Lagrangian extrapolation. It is implemented in the DWD software framework POLARA.

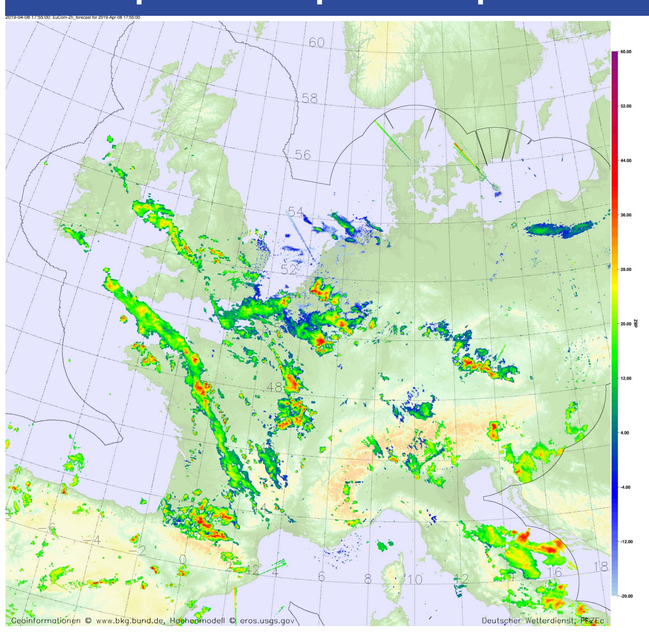
Product Specifications

- European radar composite that covers the german air space
- Forecasts up to +25 min with 1 min step size, updated every 5 min
- Filled composite with data from each contribution in each time step
- Fast production speed, comparable to approach without nowcasts

Available European radar data

- Contributions are delivered as national composites or single site data
- Individual grids and resolutions
- Different level of processing (e.g. clutter correction)
- Production timings (2.5/5/10/15/30 min)
- Scan strategies, validity times
- Severe delivery delay times for some contributions

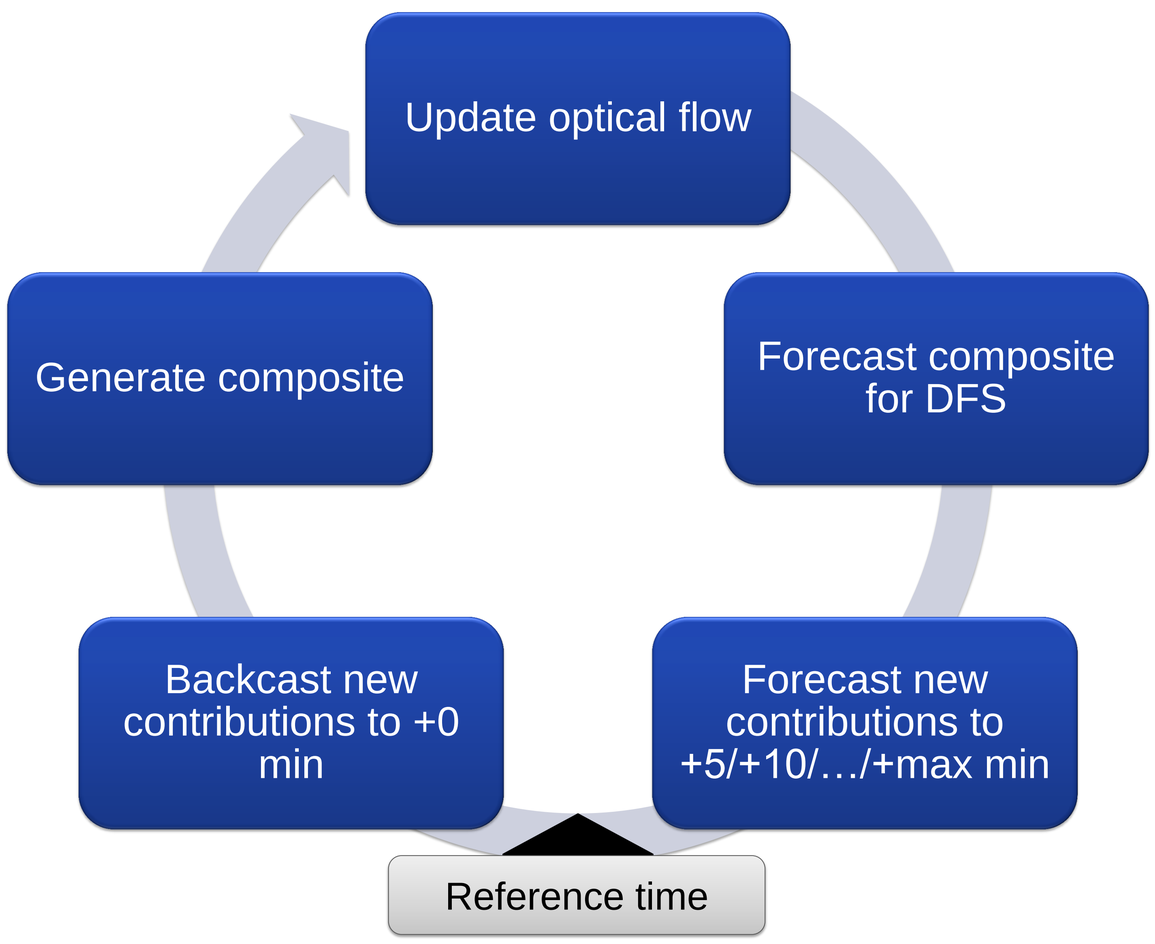
Example of European composite with temporal homogenization



European radar composite with temporal homogenization. The new product will undergo a thorough evaluation. However, non-temporal artifacts that were already present in the raw data carry over to the global composite. These artifacts seem to dominate over artifacts introduced by the temporal homogenization algorithm.

The algorithm

The production cycle of the proposed algorithm is organized along a time grid with a stepping size of 5 minutes. In each cycle each new contribution is casted with optical flow techniques to the time grid. This is done in two steps. First, contributions that are delivered prior to the scheduled time of composite generation are casted back in time to the nearest point on the temporal grid, the reference time. For the composite generation, each contributing site or national composite may be available as a backcast from the current production cycle and additionally as forecasts from the previous cycles. The newest data is selected for the composite. Next, the new composite is used to compute a new global flow field. Finally, each contribution that is produced in the current production cycle is cast forth in time individually using the updated flow information. The forecast times are aligned to the temporal grid, up to a maximum allowed range.



Other composition strategies

The most basic composition algorithm combines contributions directly. It is limited to data that is available in each production cycle. Different scan timings of the individual contributions are not considered.

Alternatively, it is possible to use a 5 minute forecast of the last available global composite as a „canvas“. In each production cycle the new contributions are inserted. This approach yields a filled composite and is stable against missing data. However, the composition strategy may yield artifacts. Further, there is no intrinsic concept of a maximal validity time of information. This may lead to artifacts at the boundary of the composite coverage area.

Conclusion and outlook

- We present a feasable approach for a temporal homogenized European radar composite.
- The new composite is robust against missing data, up to a specified temporal range.
- A preoperational production with data delivery to DFS has been established. Technical evaluation until September 2019.
- Next steps include code stabilization and optimization, balancing of production work load and parameter optimization.

Funding

Federal Ministry of Transport and Digital Infrastructure

POLARA software framework

POLARA
Polarimetric Radar Algorithms

POLARA is a software framework developed at DWD with focus on the development of new radar based algorithms. It contains the full spectrum from basic libraries, development tools up to a runtime environment to schedule, process and monitor algorithms. The new algorithm is developed in POLARA and uses state of the art nowcasting algorithms.

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