WxFUSION

Weather Forecast User Oriented System Including Object Nowcasting

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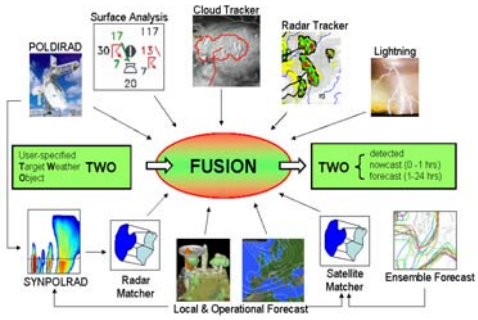
Motivation and goal

Severe weather has been identified as the primary reason for delays and disruptions in the air transport system. Moreover, it can cause severe floodings resulting from torrential rainfall which endanger the civil population and public facilities. There is a clear need for integrated systems that analyse and forecast weather hazards as precisely as possible in order to enable the mitigation of the hazard's effects. This poster presents such a system, the Weather Forecast User Oriented System Including Object Nowcasting (WxFUSION), which is currently under development at DLR.

Kloster Weltenburg in Bavaria, Germany, after severe rainfall in August 2005 (left) and a civil aircraft after a lightning stroke (right).

The concept of WxFUSION

WxFUSION aims at combining real-time observations from different data sources with nowcasting tools and numerical model simulations. This combination enables a more reliable interpretation of the future state of a weather system than only one data source or nowcasting tool could give. The system's core element "FUSION" will combine available data from the various sources accordingly in order to detect, nowcast (0-1hrs) and forecast (1-24 hrs) user-defined target weather objects (TWO) like thunderstorms, icing, and clear air turbulence. The fusion process will be based on fuzzy logic which allows to account for imprecise observations and forecasts and also deal with parameter ranges instead of fixed thresholds. New radar and satellite matchers will allow to estimate the forecast quality of models and select the numerical forecast that agrees best with the observations. This can be used to close the gap between nowcasting and forecasting.

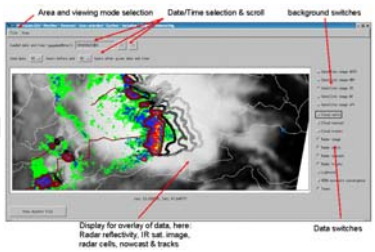


Schematic diagram of the WxFUSION concept. User specified target weather objects (TWO) are characterized by appropriate information through a fusion of selected observations and nowcasting information (upper half) and forecast products (lower half). The system is under development at present.

WxFUSION graphical user interface and functionalities

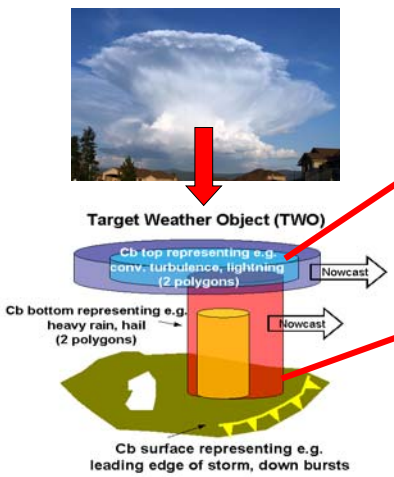
Textual output of TWO attributes

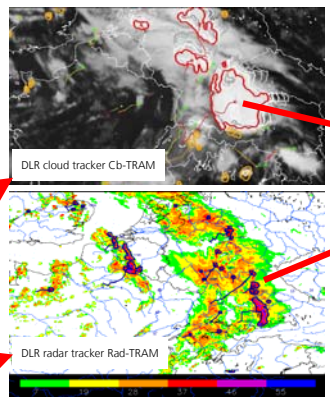
- object name/identifier
- coordinates of the affected areas: analysis & nowcast
- severity level (moderate/severe)
- propagation speed of centre
- precipitation rate
- hail occurrence
- lightning occurrence
- development stage (growing/decaying)
- ....



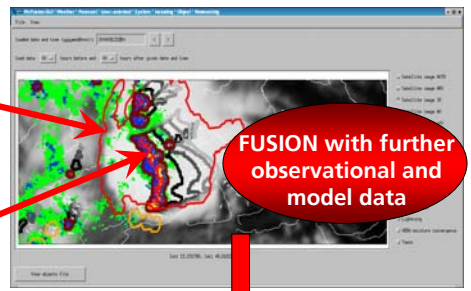
The data fusion takes place in the background of an IDL graphical user interface (GUI) that enables the overlay of the different observational data with the results of the nowcasting tools and the numerical forecasts. The system is set up in a way that it can be adjusted to local and operational constraints. The user can navigate in time and identify and track the TWOs. In order to provide short and precise information for quick decision making, the TWO's are described as idealized objects with individual weather attributes like moving speed, moving direction, developing stage, and severity level (moderate/severe). This information is dumped into XML files and can be visualized in an extra window or by mouse over displays. This helps the user assessing the risk and danger related to the TWOs.

Example thunderstorm (Cb) as TWO





Top: *METEOSAT-8 IR 10,8 µm on 12 August 2004 18 UTC. Superimposed are the tracks and the contours (red analysis, grey 15, 30, 45, 60 minutes nowcast) of cloud cells with IR temperatures exceeding a certain threshold and occupying regions with convective turbulence identified from the HRV.* ***Bottom****: Radar reflectivity (dBZ) on 12 August 2004 18 UTC. Superimposed are heavy precipitation cells (>37 dBZ) and their tracks.*



Cb top volume
- moving direction 89°
- propagation speed: 12 km/h
- lightning occurrence
- development: growing
- upper boundary: 12,3 km
- lower boundary: 9 km
- coordinates of polygon contours:
  48,2 10,4
  ... ...

Cb bottom volume
- moving direction: 85°
- propagation speed: 11,9 km/h
- hail occurrence
- development: growing
- upper boundary: 10,2 km
- coordinates of polygon contours:
  48,0 9,6
  ... ...

Current state of the system

A basic version of WxFUSION exists including
- nowcasting tools Cb-TRAM and Rad-TRAM
- lightning, radar and satellite data (HRV, IR, WV channels)
- overlay/combination of different data
- XML output of weather object attributes identified by Cb-TRAM and Rad-TRAM
- affected area output (e.g. terminal areas of airports)

Future development

- implementation of fuzzy logic
- implementation of radar and satellite matchers to estimate forecast quality
- closing the gap between nowcasting and forecasting (probabilistic methods)
- implementation for measurement campaigns, operational implementation
- XML write (user interaction with the system)
- graphical tools: e.g. weather object information with mouse over

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