TRANSBOUNDARY PRECIPITATION FOR DIGITAL SEWER SYSTEM

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Extreme precipitation events pose an important challenge for sewer system management. In order to better understand and to be able to simulate the sewer system, a digital version of the sewer system of a pilot area of the city of Flensburg (Germany) was built as part of the Interreg Deutschland-Danmark project Neptun. This sewer system model together with radar-based precipitation observations and nowcasts form the backbone of an operational early warning system and enable network simulations. Major goals associated with this newly developed asset are to improve the management of combined sewer basins and to investigate the creation of natural retention areas.

Data sets

The operational system uses data from the German Weather Service (DWD) radar located in Boostedt (Schleswig-Holstein) and from the Danish Meteorological Institute (DMI) radar located on Römö (Denmark) as well as station data of both Organizations as visualized in Figure 1.

- **Boostedt radar:** precipitation scan; spatial resolution 1° x 250 m; variable elevation angle ~0.8°; range 150 km ; temporal resolution 5 min
- **Römö radar:** volume data; spatial resolution 1° x 500 m; constant elevation angle ~0.50°; range 237.5 km; temporal resolution 10 min
- **Rain gauge time series** from 29 Danish and 32 German locations

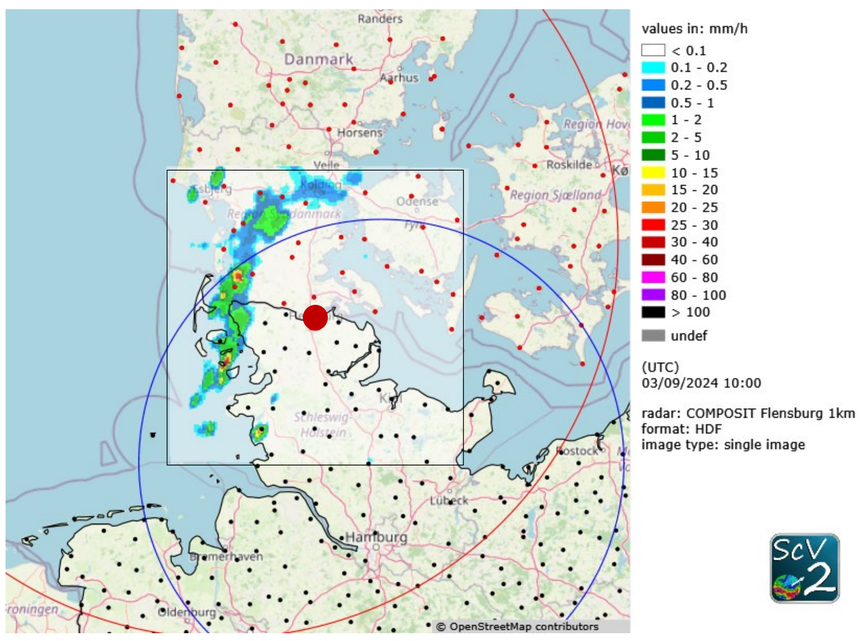

Figure 1: Summary of the input data for the precipitation product for Flensburg. Shown are the spatial extent and the location of the input data, radar Römö (red circle), radar Boostedt (blue circle), the Danish rain gauges (red dots) and the German rain gauges (black dots). The spatial extent of the output data is shown as a black rectangle and the location of the city of Flensburg is shown as a big red dot.

Data preparation

A careful preparation of both radar data sets:

- **Quality enhancement of both radar datasets by data quality control algorithms**
  - ground clutter / beam blockage / attenuation / anomalous propagation / advection correction
- **Adapt temporal resolution of the Danisch radar (10 min) data to the German radar data (5 min)**
  - Nowcast algorithms are used to derive 5 minute forecast to fill the gaps of radar Römö (every second image from Römö going into the composite is a nowcast)
- **Derive homogeneous composite using both radar datasets**
  - Spatial mapping and weighted interpolation of both datasets to create a homogenous radar image with a spatial resolution of 1 km and a temporal resolution of 5 minutes (shown in Figure 1 inside the black rectangle)
- **Adjust radar composite using Danish and German station data**
  - **Q1:** available in near real time ; spatially and temporally variable factor field is calculated every 5 minutes over the past 3 hours using the available (station) data
  - **Q3**: latency of ~24 hours; daily factor field is calculated over a period of 24 hours and applied to the same period benefiting from the higher availability of station data and the better temporal overlap of radar and station data
- **Radar nowcasts for the next 2 hours derived from Q1 data**

Results

The radar observations and nowcasts are provided in near real time as an input to the model and are displayed and stored in HydroNET[1], a cloud-based decision support system whose key feature is to bring together and visualize different data sources that facilitate operational water management. The model results are also fed into HydroNET and are displayed on customized maps that can provide visual alerts to water managers allowing them to react fast on potentially threatening situations.

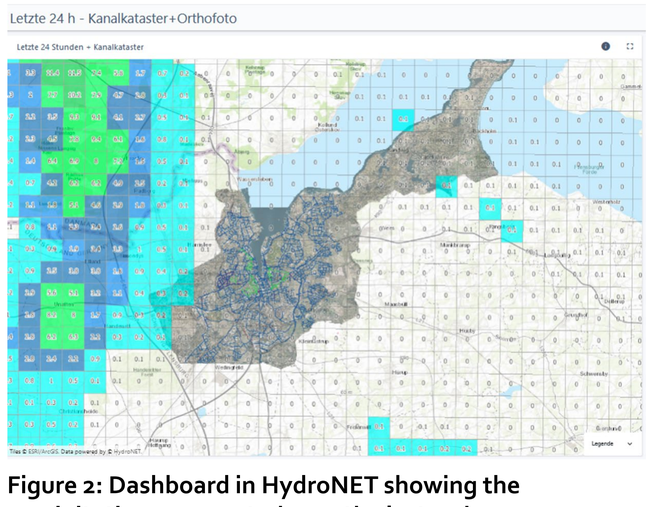

Figure 2: Dashboard in HydroNET showing the precipitation aggregated over the last 24 hours overlayed over aerial photography and the sewer system network.

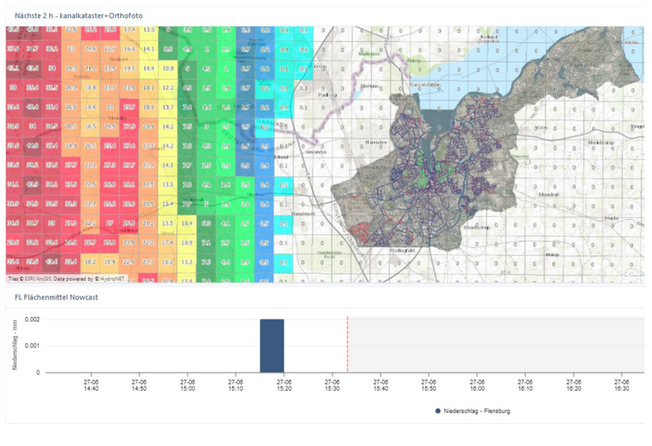

Figure 3: Dashboard in HydroNET showing the precipitation nowcast aggregated over the next 2 hours overlayed over aerial photography and the sewer system network.

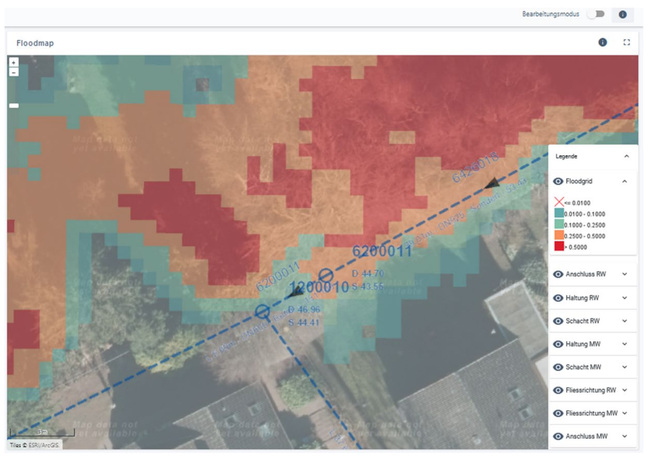

Figure 4: Dashboard in HydroNET showing a Floodmap generated with radar nowcasts as input data.

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References: 1 - Lobbrecht, A., Einfalt, T., REICHARD, L., & POORTINGA, I. (2011). Decision support for urban drainage using radar data of HydroNET-SCOUT. International Association of Hydrological Sciences Publications, (351), 626-631..