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Stand van zaken en ontwikkelingen

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8 Summary

A major performance parameter of any urban water management system is the precipitation load. To explain or justify the occurrence of sewer overflows, road flooding, and water nuisance in general, municipal authorities require access to accurate precipitation figures. These figures should reflect both the precipitation's intensity at any given time and its geographical distribution.

Rain gauges
The standard method of measuring precipitation is by means of rain gauges. Reliable readings that comply with national and international standards require properly set up equipment and considerable free space. The latter is often at a premium in urban environments, which is one of the reasons why it is almost impossible to site urban rain gauges in accordance with the requirements of the World Meteorological Organisation (WMO). The resulting measuring errors can be considerable. Also, a high number of rain gauges may be required to accurately establish the geographical distribution of precipitation.

Radar
In recent years, radar as a means of measuring precipitation has become more popular. A radar antenna emits electromagnetic pulses of short duration as it rotates. Any radiated beam that hits a raindrop is partially reflected and received back by the radar system. The time between the transmission of a pulse and the reception of its reflected signal gives the distance between the raindrop and the radar set. The strength of the reflected signal is a measure of precipitation intensity. The radar system therefore measures precipitation indirectly and at a given level above ground. In the Netherlands, radar measurements are the responsibility of the Royal Netherlands Meteorological Institute (Koninklijk Nederlands Meteorologisch Instituut, KNMI). The institute operates two radar stations, located at De Bilt and at Den Helder. The KNMI consolidates the data into a single composite image giving the precipitation situation at 5-minute intervals for a grid with a resolution of 1 km . These are the uncalibrated (raw) radar images.

Calibration
Raw radar images contain inaccuracies caused by such factors as:
- wind dispersal of precipitation;
- the time that elapses between the detection of airborne precipitation and the moment raindrops hits the ground;
- attenuation of radar signals when obscured by heavy rainfall.
- indirect measurement (remote sensing) of an airborne precipitation volume

To enable the performance of an urban water or wastewater management system to be evaluated and assessed, the raw KNMI radar data will need to be calibrated using rain gauge readings. This combines the strength of radar (accurate geographical distribution data) with that of rain gauges (accurate ground-level readings). The calibration aims to ensure that the radar information matches the rain gauge readings to obtain a high-quality, geographically accurate precipitation image.

Calibration data can be provided by KNMI's 300+ daily measuring stations and its automatic weather stations, of which there are more than 30. However, this information is not always readily available, the daily stations releasing data with delays of up to 36 hours, while the automatic stations take approximately 10 minutes

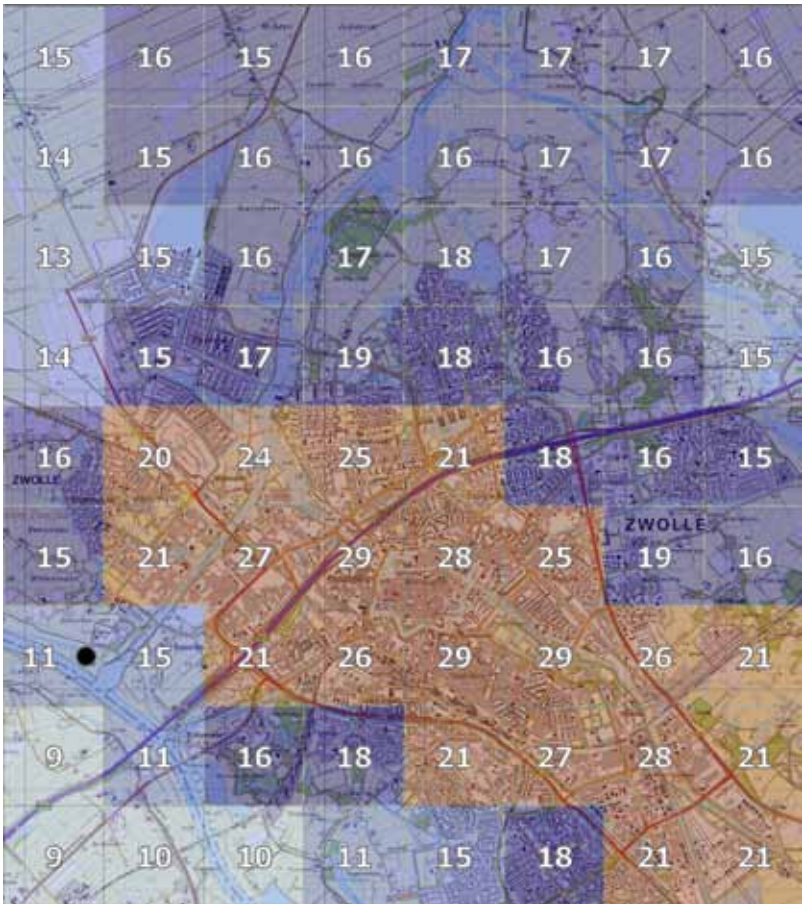

Figure 0 24-Hour aggregate precipitation distribution for the town of Zwolle (in mm). (Source: Lobbrecht, HydroLogic)

to provide their data. In time, additional rain gauge information becomes available, enabling the radar data to be further calibrated. Municipalities may choose to use other rain gauges, perhaps even systems of their own. In such cases it is of course important to ensure that the rain gauges are properly set up (preferably in compliance with the WMO standards).

Figure 0 gives an idea of the added value of calibrated radar data over the use of rain gauges alone. The figure shows the aggregate precipitation as measured over a 24-hour period in the town of Zwolle. The black dot indicates the location of a rain gauge, which measured 11 mm during this period. Using only the data provided by this rain gauge, an overall precipitation figure of 11 mm might have been arrived at. Thanks to the calibrated radar images however, it is clear that the precipitation reached much higher values in the centre of town, as high as 29 mm.

Precipitation information requirements
Precipitation information is useful in a number of urban water and wastewater management scenarios, each application having its own set of requirements regarding currentness and accuracy. Real-time system control, for example, requires up-to-date information that need not always be highly accurate. System performance analysis on the other hand requires highly accurate information that doesn't necessarily have to be current.

Combining radar and rain gauges
For most applications, a municipality will at least need reliable precipitation information with a resolution of 1 km and 5-minute intervals. This cannot be practically and economically achieved using only a traditional ground-level rain gauge network. In combination with radar information however, it becomes possible to obtain an accurate image of the precipitation distribution in time and space. Currently the combination of radar and rain gauges offers the best available source of precipitation information.

Developments
International research and developments in the weather radar field are showing rapid progress. One example is the installation in Europe of a new dual polarization radar system (C band), which offers more accurate precipitation imaging and improved powers of distinguishing between various types of precipitation over current C-band radar sets. Along our borders in particular, the integration of German and Belgian radar images in the Dutch composite is a major development. In addition, small-scale X-band radar sets are being developed that offer higher resolution in both time and space than C band radar does.