Weather radar and IoT sensor networks: which information from which source?

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Optical IoT IR sensors

In four cities, 50 sensors have been installed at the end of summer 2023 in order to better know the coincidence of ground rainfall and radar rainfall. The low-cost sensors (Figure 1) have been mounted in Lübeck on lamp posts. They measure rainfall in 8 classes, far less classes than radar – but they are a dense network at the ground.

Figure 1 – This is one of the optical IoT IR sensors

Individual laboratory test

Three IoT sensors have been tested in the laboratory in order to see how well they function. The tests were on the location where rain is hitting the sensor cone and on the direction from where wind is pushing rain drops onto the cone (canting angle). The results were that first, the three **sensors** all showed **different behaviour**, and that second, both items, hit location and canting angle matter and give different results for different setups.
Thus, our expectations were not too high any more …

Is swarm intelligence smarter?

Nevertheless, we pursued our two research questions:

- Does rainfall from radar hit the ground mostly vertically? If not, are there hints on the locations?
- Can the sensors give information on sub-pixel rainfall variability?

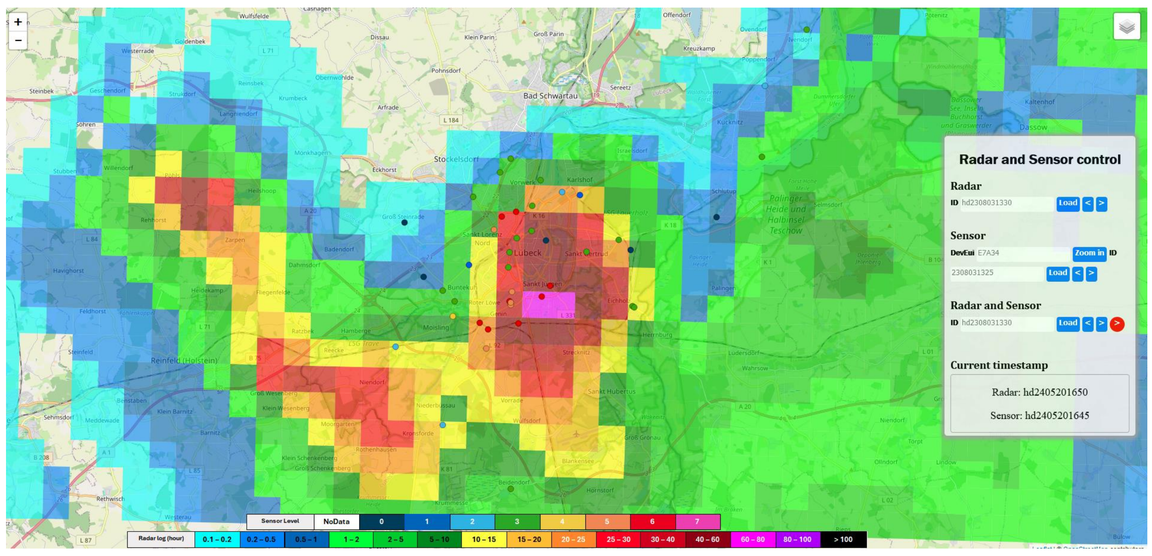

Figure 2 – Our new web tool shows the concurrent measurements of radar (pixels) and sensors (individual points)

Our current observations (Figure 2) show that sensors are at times measuring relatively high rainfall **off the main cell track** which is provided by the radar. Is this a regular effect? We are still working on hypotheses …
In parallel, we are working on the **sub-pixel variability** and want to find out if this value is comparable to the inter-pixel variability of radar data only. This may then be linked to more or less convective activity and help to better quantify the data. Having started after the convective season 2023, data are still sparse.
We will collect more data during summer 2024.
A side effect of the installation was that a **site classification scheme** has been defined which extends the WMO site classification scheme for less favourable places.

Conclusions

Low cost IoT sensors provide the means to go beyond previous rainfall studies due to a moderate budget required for the devices. Such measurements can be linked to Smart City concepts – but they only provide moderate measurement quality at each individual point. However, as a group they help to collect more rainfall information at the ground, also on radar pixel location aspects.

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