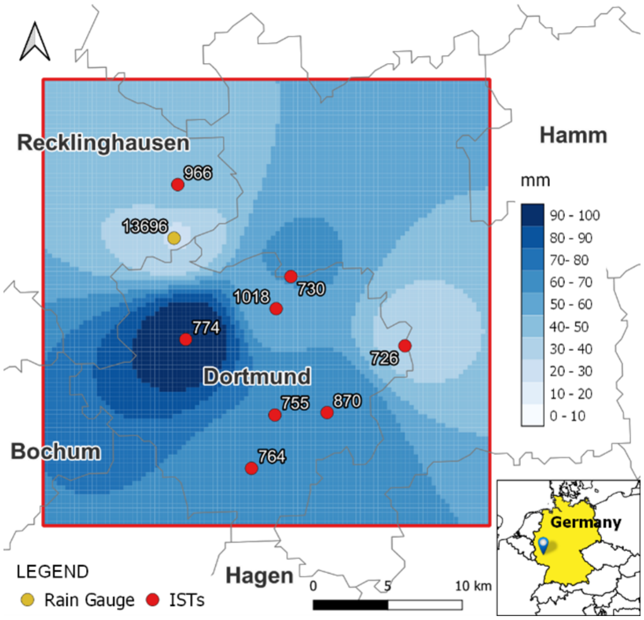

Fig. 7. Cumulated rain on the test area from July 14, 2021 05:50 UTC, to July 15, 2021 05:50 UTC, obtained from the signal attenuation measured by the network of ISTs plus the measurements of one RG.

Fig. 8. Cumulated rain on the test area (square box) from July 14, 2021 05:50 UTC, to July 15, 2021 05:50 UTC, obtained from a weather radar [14].

First, it is interesting to note that the RG id:13696, reported in Fig. 3 and whose measurements are shown in Fig. 6, is located marginally wrt the area affected by the most intense precipitation, as can be deduced from the radar map in Fig. 8. This is the reason why, in Fig. 6, the RG provides a cumulated rain value which is lower than those of the IST-based sensors.

Second, note that there is just one available RG in an area of 900 km^2 and, even worse, in this specific case study it seriously underestimates the rain event under observation. This fact dramatically highlights the limits of a pluviometric network made only of conventional RGs.

Finally, as apparent by comparing the rainfall maps of Figs. 7 and 8, the retrieval technique based on the opportunistic use of the ISTs yields the following benefits:

- *high accuracy*: the numerical estimates of the cumulated rain are in good agreement with weather radar measurements;
- *high reliability*: the spatial reconstruction of the precipitation field has a shape which is very similar to that detected by the weather radar;
- *high spatial resolution*: the retrieved map has a better resolution than the one provided by the weather radar (and, if needed, the resolution can be suitably scaled by deploying more terminals);
- *high temporal resolution*: the measurement of the satellite signal strength (and therefore the estimate of the rain rate, too) is typically provided at a rate of 1 or 2 readings per minute;
- *low cost*: only low-cost commercial-grade devices (already installed) were used and no installation of new equipment was required;
- *no electromagnetic emissions*: rain sensing is simply based on the reception of satellite broadcast signals.

V. Conclusions and Future Developments

The tests carried out for the extreme rain event in Germany demonstrated the feasibility and the potentials of a network of DTH satellite receive terminals for opportunistic rainfall estimation. These tests represent a preliminary phase of a broad experimental campaign to be carried out in the framework of the EU funded SCORE project [15], which aims to increase climate resilience in European coastal cities. The project is tackling specificc hallengesr elatedt os ealevels, coastal erosion and extreme weather events using an integrated solution of smart technologies and nature-based solutions to be developed and tested in ten selected European coastal cities. In the future, we also expect to investigate if and how similar data can be combined together and with satellite estimates of rainfall such as the NASA Imerg data [16] to produce improved precipitation monitoring over large areas.

Acknowledgment

This work was supported by the project InsideRain (INStruments for Intelligent Detection and Estimation of Rain for Agricultural INnovation) [17], funded by Tuscany regional administration (Italy), Decreto n. 21885, 18/12/2020, and by the project SCORE (Smart Control of the Climate Resilience in European Coastal Cities) [15], funded by European Commission's Horizon 2020 research and innovation programme under grant agreement no. 101003534. This article is also based upon work from COST Action CA20136 OpenSense, supported by COST (European Cooperation in Science and Technology).

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