



The Potential of Opportunistic Rainfall Sensing to Complement Conventional Sensors: The 2017 Flash Flood in Leghorn (Italy) as a Case Study

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Accurate weather forecasting, particularly in the field of nowcasting, plays a crucial role in a wide range of applications, including public safety, business services, and personal applications. The ability to provide real-time, reliable forecasts of hazardous weather conditions, such as intense rain and thunderstorms, is essential for mitigating risks to life and property through prompt emergency interventions.

Quantitative precipitation estimation can be obtained by several observing systems, each utilizing different measurement principles, offering varying time and spatial resolutions and accuracies. To be effective, estimation of precipitation on the ground should be provided through precipitation maps that must be characterized by accuracy in measuring precipitation rate, as well as completeness, continuity and high spatial-temporal resolution. In the last few decades, microwave (μ W) links have been investigated to opportunistically retrieve precipitation estimates, by correlating radio-frequency attenuation and precipitation along the propagation path. This includes satellite-based rain sensing devices, which typically exploit geosynchronous earth orbit (GEO) satellites for TV broadcasting at Ku-band ($10\div 13$ GHz).

The aim of this work is to demonstrate how an opportunistic satellite-based rain sensing network, deployed in Tuscany (Italy) for agricultural purposes within the INSIDERAIN project [1], can be effectively integrated with regional pluviometric network, in order to provide real-time 2D reconstruction of the distribution and movements of the precipitation field, increasing the accuracy and the resolution of rainfall maps [2].

As a case study to demonstrate the effectiveness of the integration of the two sensor networks, we take into account the extreme hydrological event that caused severe damage and deaths to the city of Leghorn (Italy) in September 2017 [3].

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