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A new method for unsupervised flood mapping using Sentinel-1 SAR images

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Every year, floods cause serious damages to people, infrastructure, and economies throughout the world. The UN estimated that more than 50% of people affected by weather-related hazards is involved in flood-related issues. These events are critical especially in developing countries, but not limited to them. As an example, in US more than 225 people were killed and more than 3.5 billion dollars in property were damaged by heavy rainfall and flooding each year between 1993 and 1999 [1]. Effective response to floods requires timely information about the affected area.
Synthetic aperture radar (SAR) sensors represent a crucial tool for rapid flooding mapping due to their all-weather and all-time imaging characteristics, making them very well-suited for emergency situations. In this work, we present a novel method for unsupervised flood mapping exploiting Sentinel-1 ground range detected (GRD) images. A double innovation is introduced, both at product and at methodological level.
As for the product level, we propose to exploit Sentinel-1 GRD products, i.e. detected images pre-processed by ESA and made available to users for download through the Sentinels Data Hub. These products are today scarcely employed in literature, despite they are raising a more and more interest among end-users because they are available for cloud processing within the Google Earth Engine platform [2].
As for the methodological level, we propose two processing chains providing maps with increasing resolution. Chain-one is based on the analysis of a single GRD product. It exploits classic Haralick textural features [3] combined with reflectivity information in a fuzzy classification system avoiding the critical procedure of thresholding. The output is a low resolution map obtainable in few minutes processing.
Chain-two is based on change detection. It exploits the comparison between a couple of GRD products (pre and post-event image) acquired on the same area and combined in a fuzzy decision system. The output is map with the same resolution of the input GRD products, i.e. 10 meters.
The performed experiments highlighted that the proposed approach outperforms the past literature methods in terms of standard quality indicators, providing end-users with a new unsupervised tool for rapid and robust flood mapping to support decision-making and first response.

References
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