Inundation mapping in a dynamic, data-scarce environment using Ka-band passive microwave radiometry

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Developing countries in Africa and Asia are the regions expected to experience the largest increase in impact of inundations in the coming decades. Forecasts of fluvial inundations may assist in lowering the vulnerability of communities in these countries. The lack of observations in developing countries call for alternative methods to analyse and predict fluvial inundations that are more independent and make use of open source data and software.

This is researched focuses on the question: 'How can optical and passive microwave satellite remote sensing be used for fluvial inundation mapping in data scarce environments like the Ouémé Delta, Benin?'

To answer the research question, an Inundation Extent Mapping Model (IEMM) is developed, aimed at generating an estimated daily surface water fraction signal and inundation extent in the area of interest. The IEMM also works under cloudy conditions and relies on scaling Ka-band passive microwave brightness temperatures validated with optical imagery on cloud-free days, or in-situ location validation of inundation extent.

The potential contributions of IEMM to flood risk studies is wide-ranging. Compared to river discharge, the surface water fraction signal may suffer less from data gaps and is more sensitive to extreme inundation dynamics. Inundation stages such as bank-full flow and bank overtopping can be distinguished, where conventional discharge measurements become less accurate. Multi-annual analysis can be used to estimate lead times and return periods. Data is available since 1978, enabling trend analysis of extreme inundations. The (spatial) inundation extent estimate helps to distinguish vulnerable areas of high flood exposure.

In the case of the Ouémé delta this approach enabled inundation extent analysis between 1996 and 2016, which is combined with trend analysis in upstream precipitation and trend analysis of population present in flood prone areas to make a first step towards flood exposure analysis.