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An automated approach to estimate large-scale flood volumes based on SAR satellite imagery and different DEMs

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Flood depth and flood volume are usually outputs of hydraulic models which are difficult to parameterize. In this study we present a new approach which is based on the combination of 2-d flood masks and DEMs as well as additional information from altimetry and in-situ sensors. This work was carried out in the framework of the H2020 EGSIEM project, in which we want to investigate the correlation of gravity measurements from space with flood information derived from earth observation satellites. For this task 3-d information, i.e. flood volumes, are needed instead of 2-d flood masks. A workflow has been developed for the calculation of flood volumes for very large flood events based on the combination of SAR satellite scenes and a digital elevation model (DEM). First of all, the water mask of the flooded areas had to be extracted. Afterwards, a DEM is clipped so that only flooded pixels with their respective height information remain. Over those pixels a fishnet grid is laid in order to compute a histogram for each grid cell. For each of those histograms a threshold is calculated to separate flooded pixels and such pixels with unrealistic height information. Afterwards, pixels which are defined as flooded are summed up to receive the volume of water stored during flooding. The fine tuning of the threshold is done with altimetry or in-situ measurements of the corresponding water level. This workflow was tested with medium resolution ENVISAT ASAR scenes in combination with the SRTM DEM. Results are presented for seven ENVISAT-ASAR wide swath scenes which cover the large flood event in the Ganges-Brahmaputra delta (Bangladesh) during July-October 2007. The results showed that identifying a suitable threshold for flooded pixels strongly depends on DEM accuracy. Hence, the workflow has been tested also with higher resolution data such as Sentinel-1 flood masks and TanDEM-X elevation data in order to improve the accuracy of the flood volume calculation.