EGU24-8642, updated on 24 Apr 2024
https://doi.org/10.5194/egusphere-egu24-8642
EGU General Assembly 2024

Scientific challenges when using SAR images for mapping of water bodies and floods everywhere and anytime

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Synthetic Aperture Radar (SAR) satellites have emerged as the predominant information source for large-scale flood mapping, owing to their ability to map the Earth's surface regardless of weather conditions. Additionally, the classification of permanent water bodies and inundated areas from SAR images appears to be relatively straightforward given that calm water surfaces show up as dark patches in SAR images. Yet, a naïve approach to water body and flood classification from single SAR images can be misleading for many reasons. Firstly, in most environments SAR sensors under-detect the surface water extent due to challenging land cover and rough water surfaces. Secondly, there are water-look-alike surfaces such as tarmac or grasslands that are misclassified as water. Last but not least, the definition of permanent water bodies, wetlands, and floods is not trivial and only possible when using historic observations as reference. Some of this challenges can be addressed by experts when classifying only a limited set of SAR images. However, the difficulty significantly increases when attempting to map water bodies and floods in a fully automatic manner without prior knowledge of the environmental conditions. This becomes essential, for instance, when investigating the dynamics of wetland areas or the recurrence of floods over extended time periods or regions, or when employing SAR data for near-real-time flood monitoring. In this presentation, I will provide an overview of these challenges, drawing on the outcomes of research on this topic carried out at TU Wien over the last two decades and the preliminary experiences gained from the operationalization of the new fully-automated Sentinel-1 based Global Flood Monitoring service, which is operated as one of the components of the Copernicus Emergency Management Service.