EGU23-649, updated on 17 Oct 2023
https://doi.org/10.5194/egusphere-egu23-649
EGU General Assembly 2023

Near Real-Time Depth Change Monitoring on Inland Water Bodies Using Sentinel-1 and Dynamic World Data

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Monitoring the depth changes in lakes is crucial to understanding hydrological dynamics and water quality changes. In developed countries, the authorities monitor the lake depths regularly; however, it might be different in developing and underdeveloped countries. In this study, we aim to develop a near-real-time SAR-based depth change monitoring system for lakes by focusing on shoreline pixels. For this purpose, we developed a framework using the Sentinel-1 GRD and Sentinel-2 Dynamic World land cover datasets available on the Google Earth Engine. Sentinel-1 data provides us with the necessary temporal resolution for frequent monitoring. For the initial development phase, we consider five ground monitoring stations in Sweden and one in Turkey. The approach starts by detecting water bodies within a selected area of interest using Sentinel-1. Then it extracts shoreline pixels to calculate the change in the VV and VH sigma naught and VV-VH and VV+VH Pauli vectors. Extracted differences are further classified according to the temporally closest Dynamic World data to handle the temporal difference for each land cover type. Next, we eliminate outlier values based on the percentiles, and from the remaining data, we sample each landcover class for modeling. From many of the tested frameworks, we obtained an R^2 of 0.79 with Gaussian Process Regression. Currently, in this framework, we observed an underestimation of higher values and an overestimation of lower values within a range of ±0.4 cm. Furthermore, considering the chosen six lakes, we observed a negative correlation between depth change and polarimetric features obtained from samples taken from land covers of grass and flooded vegetation, which is typical for natural lakes. In the second step of the development, we will increase the number of samples by including lakes from Switzerland and further develop the model.