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Use of Google Earth Engine to monitor surface water: A case study in water tanks located in the dry zone of Sri Lanka

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Water is a valuable and limited resource that needs to be managed properly. The amount of surface water changes over time due to a variety of reasons including rainfall, temperature, wind patterns and agricultural usage. Large scale surface water level monitoring is one of the most labour-intensive tasks in managing water resources. Satellite based remote sensing is a commonly used technique in such scenarios, where earth orbiting satellites are used to monitor the changes on the earth's surface using different types of sensors. A large amount of remote sensed data sets has been made available by different agencies. However, analysis of such data sets requires specialized computing systems with large storage, memory and processing power. With the public release of Landsat data in 2008, Google archived all the data sets and linked them to a cloud computing engine named, Google Earth Engine (GEE) providing a free and open source platform which handles all low-level data handling, allowing users to manipulate the data set at a much higher level. In the present study, GEE was used to evaluate the feasibility of surface water monitoring in water tanks located in the dry zone of Sri Lanka from January 2017 to December 2019. Sentinel-1 (S1), Synthetic-Aperture Radar (SAR) data and Sentinel-2 (S2) Multi-spectral Instruments were used to identify the surface water body coverage area. Normalized water index (NDWI) was calculated based on the B3 and B8 bands of S2 images. Due to significant local cloud coverage within the region of interest, most of the available data points had to be discarded. It was noted that NDWI based water level estimation was not suitable for analyzing temporal dynamics. S1-SAR Ground Range Detected (GRD) data was processed by segmenting the area using a K-means clustering algorithm. Image dilation and erosion operations were used to reduce the effect of speckle noise. The water level was estimated for the considered time period based on individually segmented images. Ground data was obtained, which corresponds to the satellite passes that were published online by the Department of Irrigation, Sri Lanka. The estimated water surface area for Kaudulla, Senanayaka Samudraya and Lunugamwehera tanks showed a good linear relationship against the reported water volume with coefficient of determinants of 0.73, 0.94 and 0.67 respectively. SAR-GRD measures backscatter and it depends on the surface flatness. Therefore, water quality or cloud cover has no effect on the detected water surface area estimation. Hence, SAR-GRD image-based classification is better suited to detect short time scale changes in water level in selected tanks even under uncooperative weather.

Keywords: Google Earth Engine, GEE, Sentinel-1, SAR-GRD, Surface water