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Uncertainty Estimation for a Global Inland Surface Water Time-Series

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Fresh water is vital for life on the planet. Satellite remote sensing time-series are well suited to monitor global surface water dynamics. The DLR-DFD Global WaterPack (GWP) provides daily information on inland surface water. However, operating on diurnal- and global spatiotemporal resolution comes with certain drawbacks. As the time-series is primarily based on optical MODIS (Moderate Resolution Imaging Spectroradiometer) images, data gaps due to cloud coverage or invalid observations have to be interpolated. Furthermore, the moderate resolution of 250 m merely allows coarse pixel based areal estimations of surface water extent. To unlock the full potential of this dataset, information on associated uncertainty is essential. Therefore, we introduce several auxiliary layers aiming to address interpolation and quantification uncertainty. The probability of interpolated pixels to be covered by water is given by consideration of different temporal and spatial characteristics inherent to the time-series. Resulting temporal probability layers are evaluated by introducing artificial gaps in the original time-series and determining deviations to the known true state. To assess observational uncertainty in case of valid observations, relative datapoint (pixel) locations in feature space are utilized together with previously established temporal information in a linear mixture model. The hereby obtained classification probability also reveals sub-pixel information, which can enhance the product's quantitative capabilities. Functionality is evaluated in 32 regions of interest across the globe by comparison to reference data derived from Landsat 8 and Sentinel-2 images. Results show an improved accuracy for partially water covered pixels (6.21 %), and that by uncertainty consideration, more comprehensive and reliable time-series information is achieved.

Keywords: Fresh water, Landsat 8, MODIS, remote sensing, probability, Sentinel-2, sub-pixel scale, validation, water fraction.