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Modeling suspended sediment concentration using artificial neural networks, an effort towards global sediment flux observations in rivers from space

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Harmonized Landsat Sentinel-2 (HLS) provides high-quality images every 2-3 days across Earth. However, HLS has not been widely used to measure Suspended Sediment Concentration (SSC) in rivers. Here, we used HLS to generate a fully open-source, open-architecture, and scalable image processing workflow and Neural Network algorithm to estimate SSC in global rivers. The extracted HLS surface reflectance was joined with global in-situ SSC measurements and used to train an ensemble of Artificial Neural Networks (ANN). Two ANNs were developed: one trained based on the lower SSC values (up to 20.08 mg/L) and the other one trained based on higher SSC values (up to 403.43 mg/L). The ANNs were able to achieve satisfactory performances for a global SSC model, with a median absolute error of 5.10 mg/L, pairwise correlation of 0.457, absolute E90 of 46.85 mg/L and absolute E95 of 84.9 mg/L. The preprocessing module and the ANN models were optimized to have few dependencies and finish execution within a reasonable timeframe (the ANN models are executed in approximately 1 second per node). These characteristics make the model suitable for implementation on Amazon Web Services (AWS) cloud, where they are planned to automatically generate SSC data on-the-fly. We will combine the global SSC model with Surface Water and Ocean Topography (SWOT) discharge data to generate a self-updating, global sediment flux dataset to be made available in the National Aeronautics and Space Administration (NASA) PO.DAAC portal.