Vertical Mixing of Suspended Sediment in Big Rivers using ADCP data and Machine Learning

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Sediment is an intrinsic component of the fluvial network, supplying material for floodplains and coastal landforms which provide resilience during flooding and storms. As a result, an understanding of the fluvial processes that control how much sediment moves through our river systems, and how this varies across the globe, is of fundamental importance.

For the purpose of estimating sediment delivery through the fluvial network, it is often assumed that rivers are well mixed through their vertical extent. However, empirical data reveals that there is frequently large variability in the concentration of sediment through the water column. Better understanding this variability is of interest to the geomorphological community to help explain variations in sediment transport and improve estimates of sediment flux.

In this research, we utilise a collection of Acoustic Doppler Current Profiler (ADCP) data from large rivers across the globe to investigate variations in the vertical distribution of suspended sediment. Calibrations of ADCP backscatter to Suspended Sediment Concentration (SSC) from the wider literature are used, alongside median grainsize and acoustic frequency, to create a Machine Learning (ML) model from which SSC from uncalibrated ADCPs can be estimated. This new ML model is subsequently implemented to explore the variations in the vertical mixing of suspended sediment both temporally and spatially. This variability is explored to identify the importance of catchment characteristics in determining variations in suspended sediment concentration within the water column. Comparison of multiple river systems and their catchment characteristics, both between sites and through time, enables the identification of key attributes which exert a greater control on this variation through the water column. Subsequently, this leads to an improved understanding of sediment flux through the river system, whereby knowing the variation in sediment concentration within the water column can help to better calibrate current methods of estimating flux.