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A new methodological approach using grain shape to identify the sources of SPM (mineral, organic and biologic) in hydrosystems

David Viennet, Matthieu Fournier, Yoann Copard, and Jean-Paul Dupont
Normandie Univ UNIROUEN, UNICAEN CNRS, M2C, 76000 ROUEN France

Source to sink is one of the main concepts in Earth Sciences for a better knowledge of hydrosystems dynamics. Regarding this issue, one challenge consists in the characterization by in-situ measurements of the sources of Suspended Particles Matters (SPM) or sediment source fingerprinting (Collins 2016). Few methods can fully cover such requirements and among them, the methodology using the grain shape deserves to be developed.

Indeed, morphometry of particles is widely used in sedimentology to identify different sedimentary stocks, source-to-sink transport and sedimentation mechanisms. Currently, most grain shape analyses are carried out with a scanning electron microscope coupled to image analysis to measure various size and shape descriptors on particles like elongation, circularity, bluntness or fractal dimension. However, complexity and time of analysis are the main limitations of this technique for a long-term monitoring of SPM transfers.

Here we present an experimental morphometric approach using a morphogranulometer (a CCD camera coupled to a peristaltic pump). The camera takes pictures while the sample is circulating through a flow cell, leading to the analysis of numerous particles in a short time. The image analysis provides size and shape information discriminating various particles stocks according to their nature by statistical analyses.

Lab calibration measurements were carried out on international standard samples of particles commonly found in natural waters. The size and morphological distributions of the different mineral (clay, sand, oxides etc), biologic (microalgae, pollen, etc) and organic (peat, coal, soil organic matter, etc) samples are found statistically independent and can be discriminated on a 3D graph. Local pure samples were able to validate the calibration with 30% recombination. Mixing tests show that the morphogranulometer is able to predict proportions of sources in mixtures of the standard samples.

These results show the promising ability of morphogranulometers to identify the sources of particles. Such a development offers great perspectives to use the method for the characterisation of hydrosystems. The perspectives of the study are lab tests on natural samples, and then in-situ field measurements in a local spring for real time monitoring of the SPM sources.