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Sediment transport observation in the Draix field laboratory: monitoring procedures and uncertainties analysis

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The experimental basins of Draix in the southern French Alps have been monitored since 1984 in order to quantify the erosion in the badlands developed on Black Marl formations. Four small watersheds, from 1 000 m2 to 1 km^2 are equipped to study and quantify runoff and erosion processes, according to the vegetation cover and basin size. The substratum of the basins is black marls, a very erodible ground which yield a high level of solid transport during floods, especially during the high intensity rainfalls in summer.
For all the basins, coarse sediments are stopped by a filter dam and stocked in a sediment trap. After each flood, a topographical survey is conducted with a tacheometer or a rule. The data are used to build a DEM. When the smallest basin (Roubine, 1330 m^2) yields small volumes, they are measured with a calibrated bucket. The difference between two successive DEM gives the volume of the transported sediments. The volumes are converted into weight using the bulk density of the deposits.
Suspended sediments which flow through the filter dam are sampled with an automatic ISCO sampler. The Suspended Sediment Concentration (SSC) is also measured continuously with optical backscattering sensors. Due to the sensor sensitivity to the grain size distribution, the sensor calibration must be verified for each flood and may be corrected with the concentration obtained from drying and weighting of the samples. The suspended sediment yield of a flood is determined by integrating the sediment concentration value for the whole hydrograph.

Uncertainties are encountered at each step of the measurement procedure. They may be summarized in five classes regarding the origin of the errors:
- Material. The errors are linked to the variability of the monitored parameter. For example the bulk densities of the Roubine sediment trap deposits vary from 1.3 to 1.6.
- Measuring Device. The uncertainties are given by the device manufacturer or obtained from the sensor calibration. The optical sensor is calibrated for concentration between 30 to 1000 g/l, but gives poor results under 100 g/l.
- Measurement Environment. The accuracy of the data depends on climatic context, sequence of flood events and season. The winter floods are less measured than the summer flood because of the low temperatures, the icing of the gauging flumes...
- Data collection and validation. For suspended sediment load estimation, the programming of the data-logger introduces uncertainty on the original data, and the interpolation between concentration measurements for the whole hydrograph introduces other uncertainties. Uncertainties on the stage-discharge rating curve increase the errors in the sediment flux estimation.
- Operator competence. For example, the choice and the density of points for the topographical survey, the precision for reading ruler and filling up bucket induce uncertainties in the volume calculation.

Different approaches are conducted to evaluate the uncertainties on the final results. All the sources of uncertainties are not identified and some uncertainties remain unpredictable.