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Are transported soil aggregates prone to flocculation and/or disaggregation during a flood event?

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Particles eroded from hillslopes and exported to rivers are recognized to be composite particles of high internal complexity. Their structure and composition are known to influence their transport behaviour within the water column relative to discrete particles. However, to-date, hillslope erosion studies consider aggregates to be stable once they are detached from the soil matrix. Alternatively lowland rivers and estuaries studies often suggest that particle structure and dynamics are controlled by flocculation within the water column. These conceptualisations led to different modelling strategies. In order to improve the understanding of particles dynamics along the continuum from hillslopes to lowland rivers, soil particle behaviour was tested under controlled laboratory conditions. Seven flume erosion and deposition experiments, designed to simulate a natural erosive event, and five shear cell experiments were performed using three contrasting materials: two of them were ill-developed and as such cannot be considered as soils, whilst the third one was a calcareous brown soil. Particle size distributions were measured using a CILAS 930 laser sizer which allowed for the real-time assessment of aggregate breakdown dynamics. When applied to suspended particles sampled from the flume, it was found that soil aggregates were prone to flocculation. The combined used of an optical backscatter sensor, manual sampling and particle size measurement during the flume experiments also revealed that soil particles were prone to disaggregation. Flocculation and disaggregation were not previously demonstrated to be important for soil aggregates, and may have large consequences on suspended solids modelling. Moreover, large variations in particle size were found between soil types. Indeed, at the maximum applied bed shear stress, the median diameter was found to be three times higher for the well-developed soil than for the two others. Differences were smaller in the falling limb, suggesting that soil aggregates underwent structural changes during transport. However, characterization of particles strength parameters showed that these changes did not fully turn soil aggregates into flocs as defined in estuaries for instance, but rather into hybrid soil aggregates-flocs particles. While particle characteristics changed once introduced within the water column, there is still an underlying need to clearly define the way eroded soil aggregates may modify/integrate into riverine flocs during their transport.