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Water and sediment yield during extreme events in mountainous marly catchments (Draix, Alpes-de-Haute-Provence, France)

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The floods generated in small mountainous basins are often devastating flash floods. The damages due to sediment transport are often more important than those due to the water itself. Predicting runoff, erosion and sediment yield presents a strategic interest due to the impact of these extreme events and the need for natural hazard mitigation engineering. In order to get field observations and data and to improve knowledge, four small watersheds (from 1000 m^2 up to 1 km^2) have been monitored by Cemagref since 1984 in Southern French Alps. The geology of the basins consists mainly in black marls which are very sensitive to runoff erosion. As a result, sediment production and transport are particularly high, reaching annual erosion rates over 10^7 kg km^{-2} $year^{-1}$. Most of the sediment delivery is due to a reduced number of flood events: for 20 years of records, the twenty highest floods represent 50 to 60 % of the total sediment yield. Therefore, the analysis of these extreme events is of primary interest. Very often, the water and sediment flows are difficult to measure due to monitoring problems: less accurate rating curves for high water levels, sediment concentration measuring sensors out of their range, and even for the highest flows destruction of the measuring devices.

The paper describes the measuring devices used in Draix and discusses the accuracy of the data for intense events. A record spanning of almost 20 years allows us to discuss the concept of extreme event analysing the complex non linear relationships between precipitation, runoff generation and sediment availability and transport capacity. Then,

the highest events registered on the Laval basin (0.86 km^2) during this period are analysed for their 3 components: water discharge, suspended sediment yield and bed load sediment yield. The observations and data collected from smaller basins (Roubine gully, 1330 m^2 and Moulin basin, 0.09 km^2) highlight the processes involved in these events at smaller scale. In addition a seasonal pattern in the sediment delivery at the outlet is observed which could explain part of the non linearity.