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Long term impacts of flow abstraction upon basin scale sedimentation processes in an Alpine valley system

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Flow abstraction and diversion to large water storage systems is a common element of Alpine hydro-electric power schemes. However, such systems are commonly associated with exceptionally high sediment production rates, necessitating very particular approaches to sediment management. Commonly, whilst water is abstracted, sediment (both coarse and fine fractions) is left behind. In order to avoid infrastructure failure, the latter is commonly designed to allow sediment to pass in short duration high magnitude sedimentary floods. The importance of such schemes aside, there has been relatively little investigation of the geomorphic impacts of such sediment management systems. In this paper, we present results from two spatio-temporal scales of analysis in order to establish these impacts. The first applies image processing to archival aerial photography to document the long-term impacts of flow abstraction and sedimentary floods in the Val d'Héréns, Switzerland. Results show that flow abstraction significantly reduces the time when the river was competent to transport sediment, and hence the total sediment transport capacity. The result has been a temporary disconnection of sediment flux through the system, and reflected in significantly reduced rates of sediment delivery to Lac Léman downstream. However, the image analysis also shows that whilst sedimentation was initially restricted to close to the abstraction sites, this sediment has been progressively reworked through a succession of sedimentary floods, causing deposition sites to move progressively further downstream. These deposition sites are themselves constrained by geomorphic forcing, centred on reaches of lower river bed slope and with sufficient lateral accommodation space. The implication of these observations is that the sediment flux will eventually reconnect with the main valley stems further downstream. The second scale sought to quantify this response in more detail by laser scanning on a 400 m river reach. This smaller scale of study explains this process of temporary disconnection showing that there is an autocyclic dynamic feedback between deposition in previous purges, extant morphology and the effects of the next purges which controls the timescale of sediment flux, and hence the disconnection rate,