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Tracking the sediment imprint of floods (in pre-Alpine Lake Mondsee) by a combined catchment and in-lake monitoring system

Philip Mueller (1), Lucas Kämpf (2), Heiko Thoss (1), Andreas Güntner (1), Bruno Merz (1), and Achim Brauer (2)

(1) Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences - Section 5.4 Hydrology , (2) Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences - Section 5.2 Climate Dynamics and Landscape Evolution

Lakes form ideal sediment traps in the landscape and continuously record land surface processes including extreme events. During floods, detrital sediment is transported via tributary streams and deposited at the lake floor as discrete layers, intercalated in autochthonous lake sediments. Lacustrine records of detrital layers are increasingly explored as flood archives for pre-instrumental periods. The annually laminated sediments of Lake Mondsee (486 m a.s.l., Upper Austria) contain a flood layer chronology over the past 7000 years with seasonal resolution. The interpretation of lacustrine flood layer records, however, requires detailed understanding of hydro-sedimentary transport and deposition processes of flood-related sediments from the catchment as a source to the lake as a sediment sink.

For this purpose, a comprehensive monitoring network was set up in the catchment of Lake Mondsee. Flood and sediment transport related variables like precipitation, runoff and turbidity as a surrogate for suspended sediment concentration (SSC) are monitored at five gauges along the main tributary, the Griesler Ache River. Gauge deployment follows a nested catchment approach ranging from the headwaters to the outlet to the lake. Four monitoring buoys on the lake recording meteorological parameters as well as limno-physical variables (water temperature, turbidity, current velocity) at multiple depths of the water column are used to explore the flood-related sediment dynamics in the lake. To retrieve event-specific data on sediment deposition, two sediment trap chains were deployed, one in a proximal position to the Griesler Ache inflow and another one in a distal position in the deepest part of lake basin where sedimentation is most continuous.

All units of the monitoring network collected data during the severe Central European summer flood event in June 2013. Suspended sediment concentrations could be derived from rating curves based on water samples taken automatically for the river gauges and manually for the monitoring buoys (during the time of maximum turbidity). The data show a fast runoff and sediment response to the extreme rain event as well as maximum sediment transport during the rising limb of the flood hydrograph. Within the lake, the sediment laden river plume gets strongly diluted and is distributed preferentially in the upper water column due to the density stratification of the lake. By linking catchment and lake dynamics, this study substantially improves the process understanding of flood layer generation and contributes to more robust flood reconstructions from lake sediments.