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Flood protection through management on Alpine lakes in Austria

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Alpine lakes form natural flood retention reservoirs with a large storage volume. In Austria the water level of most Alpine lakes is controlled by a weir structure at the lake outlet, which allows for an efficient flood management system.

The objective of this study was to develop a revised management strategy to reduce the impact of floods on both lakeside and downstream areas. The combination of a pre-flood drawdown of the lake water level to increase the storage volume and an inflow-dependent regulation of the weir structure to mitigate the flood peak was identified as an attractive alternative.

This study analyzed the characteristics of one of the largest Austrian lakes, the Attersee, where the water level is regulated for the benefit of tourism, boating and constant discharge for downstream use. The inflow to the lake is composed of gauged inflows from tributaries and estimated inflows from ungauged catchments. For the latter, precipitation-runoff-models were applied. The hydraulic characteristics of the existing weir structure were incorporated into a storage routing model, which was calibrated using recorded meteorological and hydrological data of historical flood events.

Different management strategies were investigated, and the following strategy was found to improve the flood protection around the lake and also in the downstream part. Within realistic meteorological forecasting periods of a few days the lake water level can be drawn down by about 20 cm below mean water level, which provides additional storage capacity. The subsequent weir management should be based on

both lake inflow and lake water level. The drawdown lake level is kept as long as the inflow is below a discharge equivalent of HQ5. Then the outflow is limited to HQ5 by weir manipulation, until a maximum lake water level is reached. After that the lake outflow corresponds to lake inflow.

The analysis shows that the provided storage volume due to pre-flood drawdown can fully absorb the inflow of floods smaller than HQ10. Compared to recent flood management strategies the lake water levels will be still 25 cm lower. For larger events the maximum lake water level will be similar to recent conditions. This revised strategy implies that downstream of the lake smaller events ($<$HQ5) will occur more frequently, while larger events (HQ10-HQ100) will be mitigated due to additional storage capacity of the lake.