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Using aerial photography to detect riparian vegetation change in an alpine braided river affected by streamflow regulation

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The aim of this paper is to use aerial photography to investigate the effects of an altered hydrological regime on the riparian vegetation of the Maggia River (South-Eastern Switzerland). The studied domain is a braided reach of the Maggia for which a historical record of georeferenced aerial photographs is available. A complex hydropower system built in the watershed transfers about 75% of the water away from the study reach.

The period of aerial photographs covers both pre- and post-dam conditions. In order to simplify the large variety of plant species present in the valley, a subdivision into four main classes (sediment+water, grass, shrubs, forest) was done by non-overlapping polygons. Changes from aerial photographs are recorded in terms of the evolution of each class, the transitional probabilities from one class to another and spatial persistence. This information is complemented by an analysis of the streamflow regimes over three main periods: the pre-dam natural regime, the immediate post-dam regime without minimum flow requirements, and the most recent post-dam period with imposed minimum releases.

The major goal of this work is to provide data-based evidence for the basic mechanisms which underlie river-vegetation dynamics in relation to the statistics of flood disturbances. We show that a likely consequence of water impoundments by dams is the gradual reduction of low vegetation, in favour of the establishment of high stage vegetation such as shrubs and riparian trees. The latter colonize surfaces that are not

flooded frequently, therefore the timescales of colonization and growth are in balance with inundation frequency. Overall, this effect is due to a drop in the variability of flow and to a decrease in the seasonality of the streamflow regime accompanied by changes in the river braiding index. The natural streamflow regime exhibited a pronounced seasonality governed by snowmelt in spring and early summer. The snowmelt season peak is missing in the post-dam period, when the upstream reservoirs are being filled. Comparisons of our observations with literature and field experiments are discussed.

In the outlook we show how the observed river-vegetation changes can be interpreted by means of a simple autoregressive model which is able to describe qualitatively the changes in the water-exposed sediment class driven by hydrological disturbances.