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Hydrological drivers of the spatial distribution of herbaceous wetland communities at Poyang Lake

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Hydrological processes are known as driving forces in structuring wetland plant communities, but still specific relationships are not always well understood. The dynamic, seasonally inundated wetland at Poyang Lake (less than 1000 km^2 in the dry season and more than 3000 km^2 in the wet season), the largest freshwater lake in China, underpinnes critical regional ecosystem services (e.g. flood water retention, water supply and biodiversity conservation). However, recent drier conditions of Poyang Lake are having a profound impact on its wetland vegetation leading to degradation of the entire wetland ecosystem, thereby also threatening the winter habitat of migratory birds. We aim to develop an integrated framework to quantitatively investigate the spatial distribution of major herbaceous communities that provide habitat for the migratory birds in response to Poyang Lake flood inundation. First, ground references are obtained from a combination of drone imagery and field surveys as an input for the wetland herbaceous community classification model. Our classification model is based on a machine learning technique applied to Sentinel-2 satellite data. This new search strategy provides an accurate classification based on the more optimal input variables and model parameters gained simultaneously. Secondly, based on the dynamic changes in water levels since 2000, we statistically evaluate the key environmental drivers of the hydrological regime on the spatial distribution of the wetland vegetation communities. This showed that: 1) different plant communities exhibited varying tolerance to flood inundation and 2) two key factors, i.e., average water depth and average duration of the inundation events, were found to be able to characterize the communities' tolerance independently. For example, *Carex cinerascens* Ass. which had the widest inundation stress tolerance, being adapted to an inundation duration of 120~230 d and depth of 1.5~1.7 m, accounted for the largest herbaceous community (>27% cover) within the entire study area. Different survival strategies to inundation stress, such as dormancy and morphological restructuring, can explain the varying tolerance of plant species/communities. Our

work elucidated the linkages between hydrological processes and herbaceous plants' distribution in wetlands, and the approach can be readily applied at small to large catchment scales and provides a straightforward practical tool to predict the possible responses of the lake wetland vegetations to potential hydrological changes.