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Mapping disturbance-dependent floodplain forests in the Naryn basin, Kyrgyzstan, using optical satellite imagery

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In the semiarid climate of Central Asia the rivers and their associated floodplain ecosystems have a high relevance as regional hotspots of biodiversity and for the provision of ecosystem services. One of these rivers is the Naryn River in Kyrgyzstan. Upstream of the Toktogul Reservoir, which is the first barrier in the river course, the Naryn is still in a nearly natural state. The floodplain forests in its corridor depend directly on the disturbance regime of this river. Despite their ecological relevance they have not been investigated yet in detail. In particular the role of natural disturbance and anthropogenic effects for succession trajectories are not yet understood. This is a crucial issue for biodiversity conservation as ongoing plans for dam construction will lead to heavy modification of the natural disturbance regime.
In this study, we contribute to fill this knowledge gap and use remote sensing to derive detailed ecological information for the entire central Naryn basin. We use multispectral satellite data of Sentinel-2 and digital elevation data from TanDEM-X to derive the floodplain forests in a supervised classification approach. The floodplain forests include among others pioneer vegetation, several classes of herbaceous vegetation and different forest types. 500 ground control points were collected in the field in 2019 and were complemented with additional points created based on high resolution rgb imagery. These points have been split into a training and validation data set to create a random forest classification model. As predictors, different multispectral indices like the NDVI and temporal metrics of them were used along with different terrain attributes like the distance to the river channel.
The results show that the random forest model with the combination of Sentinel-2 and TanDEM-X data can represent the complex structure of the floodplain forests along the Naryn river with high accuracies ranging from 62.4% for pioneer vegetation and 99.8% for open broad-leaved shrub. The forest structure shows a very heterogenous distribution along the longitudinal and lateral profile. The ecosystem response on the potential modification of the disturbance regime due to dam constructions is expected to be spatially heterogenous as well. Detailed forest habitat maps derived by remote sensing help to better understand natural processes and the potential effects of anthropogenic activities. Sentinel-2 data have high potentials for a efficient monitoring of forest habitats and their disturbance. Thus they are a very interesting data source for supporting forest conservation. Our forest habitat mapping for the Naryn floodplain provides a basis for further research, conservation planning and efficient monitoring.