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Studying Fluvial Tipping Points with Remotely Sensed Observations and Hydroclimatic Data in the Selenga River Delta

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Lake Baikal, located in eastern Russia, is the oldest (25 million years) and the deepest (~1800 meters) lake in the world. There are many rivers flowing into the Lake Baikal (~ 365 rivers), of which the Selenga River is the most important one being responsible for almost 55% of the runoff water into the system and also 60% of the transported sediments. As the hydrological changes of the river and its delta enormously alter the neighbouring area, it is of utmost importance to explore the dynamics of change in terms of flow magnitude, paths and fluvial geomorphology, and the related tipping points defining different states. The questions this study aims to answer are: What are the fluvial geomorphological and hydrological changes? What fluvial geomorphological tipping points can be identified during the last 34 years and what are the discharge and climatic conditions that induce them? In this study, we use the Global Surface Water Dataset (GSWD) to analyze the changes in the river's stream network. With these products, we assess changes in several fluvial geomorphological proxies (e.g., sinuosity, fractal dimension, meandering characteristics, planform information) and identify possible tipping points. We relate these changes to different hydrological and climatic conditions such as precipitation, river discharge and Lake Baikal water level. We find evident changes in the meandering behaviour and flow path of the Selenga River tributaries in the Delta. The number of oxbow lakes based and corresponding size distribution has varied in time, and evident flow path changes occur that seem to be related to flooding periods, and there appears to be a consistent relationship between meandering and the river discharge variability. These results enable policymakers to understand different contributing factors altering the Selenga River Delta and ultimately leading to better decisions to manage the effects of these changes in the area.