

EGU2020-125

<https://doi.org/10.5194/egusphere-egu2020-125>

EGU General Assembly 2020

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Multitemporal Monitoring of the Morphodynamics of a Meandering River by UAV-Based Measurements

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Change detection analysis for monitoring and modeling riverine systems requires detailed spatiotemporal surveying of river morphology dynamics. An accurate high-resolution surface model of the river channel and floodplain enables a more comprehensive view of the riverbed evolution and allows monitoring the morphodynamics of the entire river channel more precisely compared to the traditional methods. Unmanned Aerial Vehicle (UAV) based Structure from Motion (SfM) techniques have renovated 3D topographic monitoring of earth surface, offering low-cost, rapid and reliable data acquisition and processing. Herein, the acquisition of repeated topographic surveys helps us to characterize the flow regime and to monitor the sediment dynamics. Multitemporal models of the river environment can be produced by autonomous operation to determine erosion, subsidence, landslide, soil transport and surface deformation in the riverbeds. The 'meandering' phenomenon takes its denomination from the Büyük Menderes River (BMR), which flows in a winding course in western Turkey, known as the Maiandros River in ancient times. Meandering rivers generally consist of a single, highly sinuous channel responding to erosion and sedimentation processes. This study presents the hydromorphological changes of the meandering structures by using multitemporal UAV surveys between 2017 and 2019 in the BMR. In the study, multitemporal topographic data were produced and morphodynamic processes in the lower course of the BMR were modelled by Digital Shoreline Analysis System (DSAS) and Digital Elevation Model of Difference (DoD) methods. These methods were employed to examine the changes in the shoreline and to analyse the size of geomorphological changes and spatial patterns. The results showed that the change in the shoreline of the meanders varied from 3 to 27 meters, and the water levels varied between approximately 0.3 and 3 meters. Although there was both sediment erosion and deposition along the shoreline, the predominant process was identified as deposition in the shoreline. Besides, major changes on the deposition rate were found to occur mostly after the summer season. Ultimately, a significant correlation was found between the deposited sediments and the sinuosity index values ($r=0.88$) according to the changes in water level over the months. This research showed that UAVs could provide a suitable measurement model for determining areal and volumetric eroded/deposited sediment quantities along the meandering fields.