ABSTRACT

Rivers are constantly undergoing change due to erosion and sedimentation along their banks. Although these processes generally occur gradually, flood events can significantly accelerate river migration, creating a risk for human life and infrastructure. As a result, it is important to identify river reaches that are prone to channel migration and determine the extent of migration. However, detailed information about river migration across entire river networks is not readily available. This study seeks to develop a Python-based tool that can generate river migration rasters across large watersheds using Landsat imagery. The methodology involves extracting the centerlines of river features in Landsat imagery using the Modified Normalized Difference Water Index (MNDWI) and the Skeletonize function available in the scikit-image library, followed by the application of the Particle Image Velocimetry (PIV) algorithm to compute the river channel migration. The PIV algorithm generates a set of migration rasters that are analyzed to extract the long-term migration of each of the reaches. The tool also creates intermediate outputs, such as the MNDWI raster, binary land-water raster, and skeletonized river centerlines, which can be further analyzed to gain insights into the river's behavior. The methodology is implemented in the Wabash and Lower Mississippi River Basins, and the tool's effectiveness is validated against manual measurements of the river migration available for the Wabash Basin. In addition, this study analyzes the correlation between long-term migration and various factors, such as reach sinuosity, drainage area, geology, and streamflow. The results of the analysis show that drainage area is highly correlated with river migration. The correlation results are compared with the prior literature, thereby serving to validate the developed framework. This framework has the potential to aid decision-makers and policymakers in identifying the long-term patterns of river channel migration, facilitating their efforts to plan for infrastructure resilience. By utilizing this methodology, river managers and other stakeholders can gain insights into river migration across large watersheds and identify areas that require further monitoring and management.