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Enhancing VELMA's Watershed Delineation and Performance with Ancillary Stream Data

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VELMA (Visualizing Ecosystems for Land Management Assessment) is a hydro-ecological landscape disturbance model developed to predict the effectiveness of alternative green infrastructure scenarios for protecting water quality, and also to estimate potential ecosystem service co-benefits and tradeoffs. VELMA spatially simulates the fate and transport of water and nutrients throughout a watershed at daily time steps.

VELMA's spatial framework is a uniform grid derived from elevation data. This framework is processed through an in-house hydrology tool called JPDEM which performs: flat processing, flow accumulation, and watershed delineation.

Research presented here aimed to enhance JPDEM to better represent stream flow in highly flat landscapes. In previous versions of JPDEM, stream flow in flat lands tended to deviate from reality, which would result in imprecise landscape and stream flow accumulation. To enhance VELMA's stream representation, the JPDEM framework was restructured to accept ancillary stream flow data. This stream flow data is derived from a sequential multi-polyline network representing both the up-stream sequential direction of each stream and the priority of each stream within the polyline network.

The ancillary stream network data greatly improved JPDEM's representation of stream flow in flatter landscapes. In addition, the extra step of forcing a stream network resulted in improved JPDEM flat processing time, the most expensive computation step of JPDEM, due to significantly reduced cell modifications to create a flat processed landscape.