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Two-Pronged Approach to Enhance the Utility and Science Value of SWOT River Products

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The highly intermittent and sparse nature of the Surface Water and Ocean Topography (SWOT) river observations in both space and time poses a major challenge to users for most applications. The locally restricted river information also hinders the realization of the mission's full value for hydrologic sciences. We tackle the challenges with a two-pronged approach:
First, a river discharge interpolation scheme is developed based on the Inverse Streamflow Routing (ISR) model, which assembles the discrete discharge estimates in a river basin into a spatially complete and temporally continuous data record. Through discharge-to-runoff inversion, the ISR interpolation propagates observed discharge information exhaustively across the reachable space/time within the river basin in both upstream and downstream directions.
Second, to further extend the propagation of SWOT information beyond basin boundaries and to improve gap-filling in space/time, the ISR model is updated to include spatiotemporal correlations in runoff errors. Such error correlations in runoff field, as an exponentially decayed isotropic function in space/time (beyond basins), allows us to propagate storm signals picked up by SWOT from one basin to its neighbors.
Synthetic experiments are conducted over the Ohio River basin, as well as 16 global river basins. Significant and robust improvements are found in these experiments with large SWOT observation gaps much better filled and higher KGE score in interpolated discharge records. Results suggest that we can boost the utility of SWOT river products and its value for hydrologic sciences by expanding a very local/intermittent observation platform into a far-reaching source of hydrologic information through both river hydrodynamics in channel networks and spatiotemporal coherence of weather systems in the atmosphere.