



## Measuring River Flow by Satellite in Alaska

### Project Overview

The NASA Applied Sciences Program is helping establish an operational river gaging system in Alaska that uses satellites to measure river levels and flow. This system will support water resources management for the benefit of water supplies, navigation, transportation infrastructure, hydropower plants, flood response, and rare and important river ecosystems. Scientists from the US Geological Survey, NASA, and the University of Ohio are collaborating with Alaska agencies that depend on river monitoring data, including the Alaska Dept. of Transportation, Alaska Dept. of Fish & Game, US Fish & Wildlife Service, and National Weather Service. The primary goal is to provide objective, accurate, and timely assessments of river water levels and flows in remote areas

### Need for More Streamflow Data

In many parts of the world, including Alaska, more stream monitoring is needed. Ground-based stream gaging is expensive and, in remote areas such as Alaska, potentially dangerous. A system for measuring stream levels and flows by satellite could lower costs, improve safety, and vastly expand the number of rivers being monitored.



Satellite radar altimeters, such as shown here on the Jason-3 satellite, are used to measure the altitude and slope of river surfaces. Satellite laser altimeters, such as on the ICESat-2 mission (not shown) use lasers operating with a 532 nm wavelength to measure water surface altitudes and water body depths. Both of these satellites are used in this project to measure Alaskan rivers. River stage (or surface water altitude) is used by the National Weather Service to define flood stages and generate flood warnings and in this effort will be converted to rates of stream flow using hydraulic equations.

### How New NASA Satellites Will Help River Monitoring

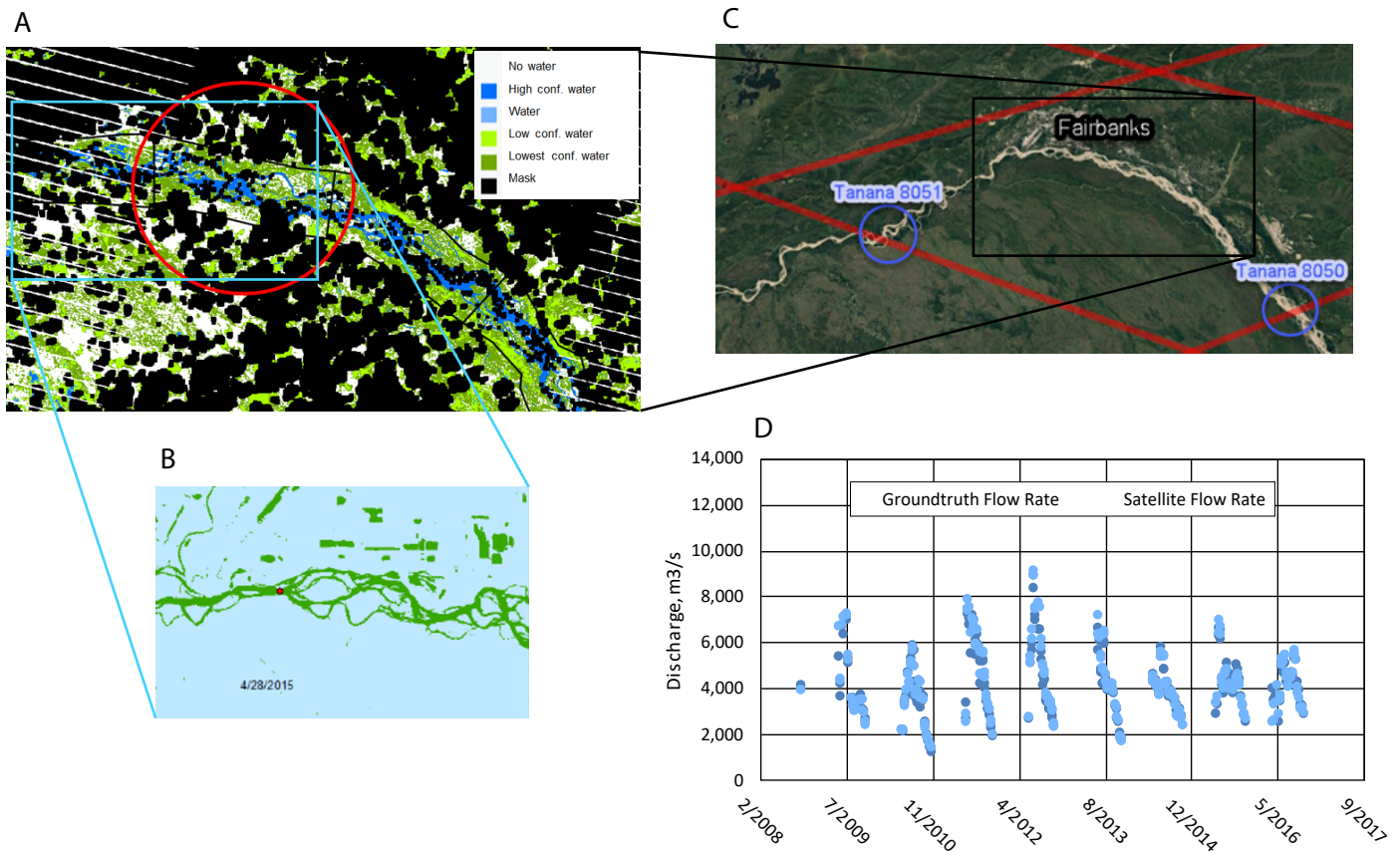
Two new satellites to be launched by NASA and international partners, the SWOT and NISAR missions, will provide more frequent radar data that can be used to monitor rivers, in Alaska and around the globe.

### Project Highlights

- **Measuring water levels and flows in Alaskan rivers**
- **Satellite observations will improve flood response and forecasting and management of transportation, fisheries, and ecosystems**
- **A goal of the project is to enable increases in the number of river monitoring sites and monitoring of remote rivers**
- **The project will operationalize and streamline data production and improve accuracy of satellite river monitoring data**

## Using Multiple Satellite Data Sources to Increase River Monitoring Frequency and Accuracy

When a satellite passes over a river monitoring site, a new flow estimate can be made, based on either measured river width or river surface altitude. By using data from multiple satellites, more frequent measurements are made and accuracy is improved. Currently orbiting satellites used in the project are Landsat 7 and 8, Sentinel 2, Jason-3, and ICESat-2. When data from NASA's SWOT and NISAR missions become available (expected in 2022), those data will be added to the river monitoring system.



The figures above show maps and data for the Tanana River at Fairbanks, Alaska. In the upper left (A), a Landsat-7 scene has been analyzed to map surface water using Dynamic Surface Water Extent algorithms (DSWE), with water mapped as dark blue (high confidence water), light blue (water), light green (low confidence water), and dark green (lowest confidence water), while black areas are masked out due to clouds or cloud shadows; in the lower left (B) the final water extent used to calculate river width is shown in green; in the upper right (C) Jason satellite tracks are shown (red lines) crossing the Tanana River (blue circles); in the lower right (D) ground-measured and satellite-measured river flows.

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