NASA SWOT SDT
USGS
La Jolla California

John Fulton and Dave Bjerklie
Recent Developments
USGS Discharge Measurement Data

Assembled over 27,500 quality controlled discharge measurement data records (from a raw data set of 200,000) at unobstructed cross-­‐sections using ADCP measurement technology.

A data record includes flow width, mean depth, maximum depth, mean velocity, maximum velocity, station location (latitude and longitude), discharge, contributing watershed area and other supporting information.
USGS Discharge Measurement Data

Data compilation underway will also compile data from flow tracker discharge measurements.

The data will be filtered through a QA/QC process to insure complete data records and accurate information, and including minimal data analysis.

The data will made available through a USGS data report.
ADCP Records – Summary Table

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<th>max_vel</th>
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Legend

Hydraulic_data
Ymax_Ymean
- 1.016279 - 1.456661
- 1.458852 - 1.730392
- 1.730393 - 2.163364
- 2.163365 - 12.471074
USGS Hydroacoustic Data
ymax vs ymin (n = 55,446)

$R^2 = 0.9333$
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Legend

**Hydraulic_data**

- **Vmax/Vmean**
  - 1.000000 - 2.000000
  - 2.000001 - 5.000000
  - 5.000001 - 10.000000
  - 10.000001 - 73.097919

max_vel va

Mean Velocity, ft/s

0 2 4 6 8 10 12

Max Velocity, ft/s

0 10 20 30 40 50 60 70 80 90
USGS Hydroacoustic Data
umax vs uavg (n = 1,799)

$R^2 = 0.9854$
USGS Hydroacoustic Data

top width vs area (n = 371,748)

\[ R^2 = 0.6263 \]
USGS Hydroacoustic Data

top width vs ymax (n = 55,191)

$R^2 = 0.4905$
Analysis of Landsat Imagery to Obtain Channel water Surface Area and Channel Morphology Information

Surface water extent in Landsat Image measured using methods and procedures developed at the USGS EROS Data Center (Jennifer Rover, personal communication).

River surface water extent isolated as a polygon from image using a river mask, and minor manual editing. Over time, this procedure could be fully automated.
Provisional Dynamic Surface Water Extent

Overview

Provisional data have not been validated. These data may be subject to significant change and are not citeable until reviewed and approved by the U.S. Geological Survey.

A broad spectrum of scientists and resource managers require information on the dynamics of surface water extent, that is, the amount of non-ocean area covered by water through time. Surface water extent both reflects and affects climate, hydrology, land use, ecosystem conditions, ecosystem services and the impact of natural hazards. For example, precipitation influences the presence of surface water, while that presence in turn affects local temperature and humidity. The periodic absence of surface water in wetland areas fosters the release of carbon to the atmosphere. Data on the extent and duration of surface water informs watershed hydrology and wetland ecosystem science. Better information on the extent of past and current flood water aids hazard mitigation and recovery.

The USGS is developing a dynamic surface water extent ECV product to support the requirements of the Department of Interior, their collaborating agencies and the scientific/resource management sectors as a whole. The DSWE product will be based on Landsat imagery, allowing relatively high spatial and temporal monitoring of surface water extent over the entire period of the Landsat Archive.

Prototype algorithms are undergoing testing and evaluation using existing and derived reference datasets. Key collaborators are being enlisted to evaluate the product’s fitness for use. Derivative USGS research on surface water dynamics will follow the DSWE ECV product.
Analysis of Landsat Imagery to Obtain Channel water Surface Area and Channel Morphology Information

Allows assessment of variation down the channel and optimum reach length for assigning and applying average hydraulic variables to one dimensional discharge models.

Allows use of channel morphology to help estimate flow resistance and hydraulic relations in the channel reach.

SWOT will also provide information to assess water surface slope in relation to channel morphology.
Reach Analysis – Yukon River near Eagle, Alaska. Landsat image analysis of width variation and meander length.
Leverage USGS and F Hossain’s hydroacoustic data

Requires QA/QC review and filtering

Compute Manning’s $n$ and hydraulic parameters using the Probability Concept

Compute $Q_s$ based on a control volume equal to a river reach defined by $dx/dy$

Validate $Q_s$ using ground-based apps

$CV \sim \text{Reach length}$

$\Phi = \text{Entropy parameter}$

$n = \text{Manning’s } n$

$D = \text{Maximum flow depth}$

$H_m = \text{Mean flow depth}$

$A = \text{Area}$

$L = \text{Top width}$

$\frac{H_m}{D} = \left( \frac{e^W}{e^W - 1} - \frac{1}{W} \right) = \Theta(W)$

$A = H_mL = \Theta(W)DL$

Moramarco, Corato, Melone, Singh (2013)
IceSat Heights

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no USGS stage during ice covered periods (Oct - Apr)  
usgs gage datum 850 ft NGVD29

Water Surface Height, m

Track 251 Upstream

Julian Day

Water Surface Height, m

Track 204 Downstream

Julian Day
Tracking Water Surface Slope

![Water Surface Slope Graph]

The graph shows the variation of water surface slope over Julian Days from 18000 to 21000. The y-axis represents the water surface slope in m/m, ranging from 0.0001 to 0.0006, while the x-axis represents Julian Days. The graph displays a fluctuating trend in the slope value.
Estimating Discharge from Width, Slope, and Stage
Analysis of Landsat Imagery to Obtain Channel water Surface Area and Channel Morphology Information

Landsat Dynamic Surface Water Extent (DSWE) –

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Tel: 703-648-5543
Eastern Geographic Science Center  
Cell: 703-994-3224
521 National Center
U.S. Geological Survey
Reston, VA 20192

Project Status:
-Implementing the current version of the prototype algorithm at this time.

-Comprehensive system in place for product evaluation, willing to add others given motivated collaborators.

-Anyone interested in evaluating data from the current version of the algorithm should feel welcome to contact John Jones.

-Link to the current version: http://remotesensing.usgs.gov/ecv/SWE_overview.php