

Global Water Monitor

Operational monitoring of lakes, wetlands, and river reaches for Natural Hazards and Regional Security

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- a) Integration of Remotely Sensed Streamflow Data into Alaska Water Resources Management Agency Operations
- b) Remotely Sensed Water Storage for Agriculture and Regional Security



End User Focus?

Include agriculture (crop production numbers/status) and fisheries (catch potential), but also natural hazards (drought and flood), and “stress indicators” associated with dwindling food, water, and power supply – highlighting the first stages of regional instability that may have national and international implications.

Data Requirements are variable Stakeholders also look for.....

A Long Heritage with Validated Techniques

Real Time to Archive Data

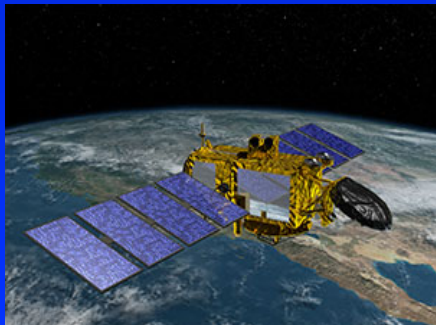
Monthly sampling or better

Continuous Global Monitoring

Fast response to data issues

&

Mission Continuity



Continuity and Enhanced Technology

← Continuity of Short-term Repeat →



Jason-3

2016-2021



Sentinel-3A

2016 (+2023)



Sentinel-3B

2018 (+2025)



Sen-6A/MF

2020 (+2025)

← Data Fusion - Mapping & Enhancements →



CryoSat-2

2010



ICESat-2

2018



GEDI

2018



SWOT

2021

GREALM

https://ipad.fas.usda.gov/cropexplorer/global_reservoir/

Global Water Monitor

<https://water-watch.sgt-inc.com/> (Temporary Location)



The screenshot shows the USDA Crop Explorer website. The header includes the USDA logo and the text "United States Department of Agriculture Foreign Agricultural Service". Below the header is a navigation bar with "Home", "Help", and "Contact Us". The main content area is titled "Crop Explorer" and "Global Food Supply Monitoring". It features a "Switch to CE Google Maps" button and a "Site Index" map. The map is divided into regions: North America (United States, Canada), Central America (Mexico, Central America and Caribbean), South America (Brazil, Northern South America, Southern South America), Europe (Europe), Middle East (Iran, Iraq, Syria and Turkey), Oceania (Australia), Former Soviet Union (Kazakhstan, Russia, Azerbaijan, Armenia and Georgia, Ukraine, Moldova, and Belarus), Africa (North Africa, Southern Africa, East Africa, West Africa), and Asia (Eastern China, South Asia, Southeast Asia, Central Asia, Korea). There is a "News & Events" section with links to "Tropical Cyclone Monitor", "Google Gadgets", "Iraq Operational Agricultural Monitoring Project", "RSS News Feeds", and "Speaker Presentations on Global Food Security Challenges". A "Related Sites" section lists "Agricultural Production", "Articles and Reports", "Explore by Crop", "Future of Land Imaging", "Geographic Search", "Global Climate Change", "Global Crop Production", "Global Reservoirs/Lakes" (highlighted with a red box), "Landsat GloVis", "MODIS Image Gallery", "MODIS Image Archive", "MODIS NDVI Gallery", "MODIS NDVI Time Series", "MPA Rainfall Maps", "Photo Gallery", and "USDA Satellite Imagery Archive". A "Commodity Intelligence Articles and Reports" section features an article titled "Pakistan: Rice and Cotton Production Regions Damaged by Floods." (Sep 13, 2010). The article text states: "From late July through August, Pakistan received abundant to excessive monsoon rainfall across the country including many of the major rice and cotton growing areas. The excessive precipitation triggered severe overland and river flooding. The impact of the floodwater is most severe in Khyber Pakhtunkhwa (N.W.F.P.), Baluchistan, Punjab, and the northern districts of Sindh. These provinces have experienced significant loss of cropland and damage to agricultural infrastructure. The major kharif season (June-November) crops are rice and cotton, but a substantial amount of corn, millet, and sorghum is grown during the kharif season as well. The floodwaters are receding in the mid- and upper reaches of the Indus Valley but continue to expand in the southern district of Sindh. The final extent of the floodwaters and the resulting damage to crops is still uncertain. The USDA's preliminary assessment, based primarily on satellite imagery, indicates significant crop damage in major rice and cotton areas along the Indus River in Punjab and Sindh provinces. The USDA forecasts 2010/11 Pakistan rice production at 5.3 million tons, down



Welcome to the Global Water Monitor

A prototype online source for satellite data products relevant to lakes, reservoirs, river channels, wetlands and global mean sea level.

(Main Contact: Charon.M.Birkett@nasa.gov)

Important Note

Water Monitor - Lakes and Reservoirs

Water Monitor - Rivers and Wetlands

Water Monitor - Global Mean Sea Level

The Satellite Radar Altimetry Processing Chains

Continental water and mean sea level products in parallel



Mean Sea Level – mm precision

1-2month Operational Deliveries to PO.DAAC

(Non-gridded) mission/cycle specific mean sea level anomalies.
Plus global mean sea level rise product

Project management, product queries, ATBD

25yr global mean sea level estimation (reference)

Glacial Isostatic Adjustments

Cross-validations, cf tide gauges for
instrument drift, upgrades

25yr co-linear mean sea surface
variations

GDR Flags for global ocean mask

Geo-referenced time-tagged altimetric
parameter databases for oceans

Sea State Bias

Global Ocean Tide Model (Richard Ray)

Marine Geoid Model (e.g. DTU15)

Radiometer Correction

1Hz GDR

(+Future Coastal retracking via ALES)

Ingestion of Satellite Data Sets
and Geophysical Parameters, and
parameter database creation

Lake Level Anomalies – cm accuracy

Archive and Weekly Operational
Delivery to USDA

Specific Lake/Reservoir Products

Project management, product
queries, ATBD, most task inputs

Software/Web development

Cross-validations, upgrades

25yr lake level variations

Satellite Pass identification

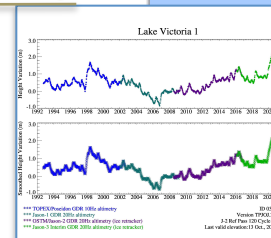
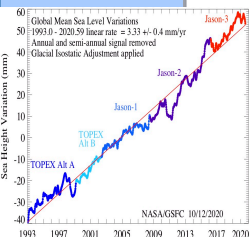
Lake identification

Geo-referenced time-tagged
altimetric parameter databases for
continents


RADS Atmospheric Corrections
Static Geoid Model e.g. NGA)


20Hz IGDR/GDR

(+Future Land retracking via SDR)



Lakes/Reservoirs: Additional Lake Extent Products as a standalone monitoring parameter or combined with altimetric elevation for storage changes


National Aeronautics and Space Administration



Data Viewer

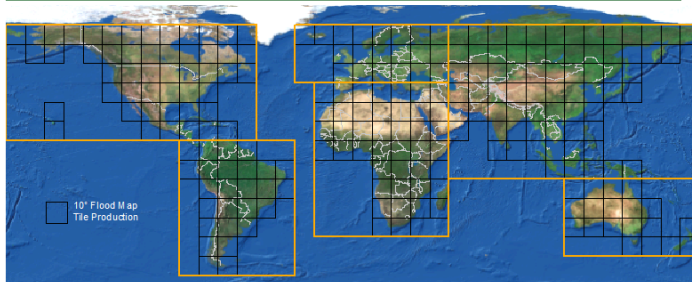
- Africa
- Asia
- Australia/NZ
- Europe
- North America
- South America

Product Description

- Documents
- Project Summary
- MODIS Product README
- Evaluation Report
- Presentations

Future Enhancements

- News/Status



10° Flood Map Tile Production

For more information, please contact floodmap@lists.nasa.gov
NOTE: THIS IS AN EXPERIMENTAL PRODUCT AND SYSTEM

Recent News/Status

06-Sep-2018: Production interrupted from Sep 3-6th, but now proceeding normally. Missing products will be processed over the next few days (omitting vector products unless requested).

12-Feb-2018: Production interrupted from Feb 6-12th, but now proceeding normally. Missing products will be processed over the next few days.

28-Sep-2017: Full production has resumed, with some continuing minor problems (randomly skipped tiles/products), which we hope to resolve shortly.

[Go to News/Status page](#)

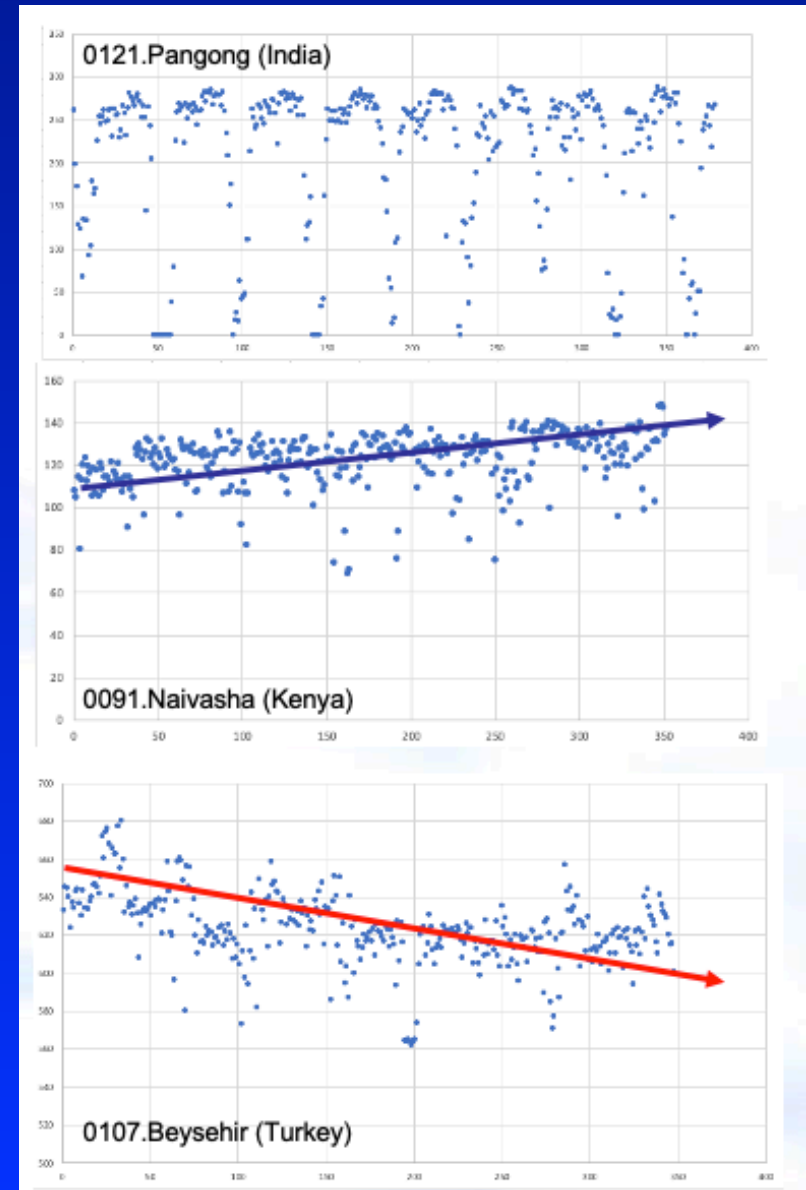
Mailing list

To subscribe to our mailing list to receive email notification of updates, please, click [here](#).

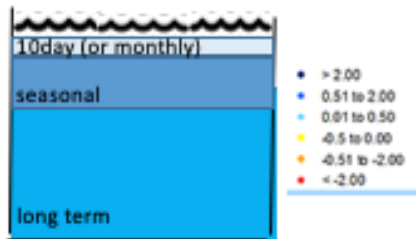
1st Phase

Moving forwards with the NASA Lance System
i.e. the MODIS processing chain behind the
NASA Near Real Time
Global Flood Mapping Tool.

MODIS 250m 8-day composites

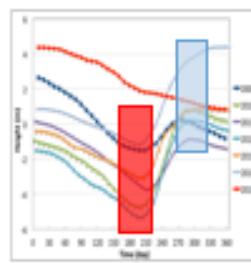


Status-1



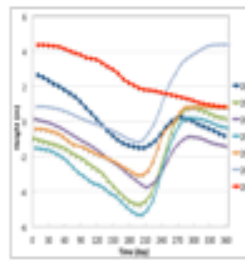
Status Source: Water Levels (or Extents)
Seasonal Baseline: March to May
Long-term Baseline: 1993-2000

Status-2



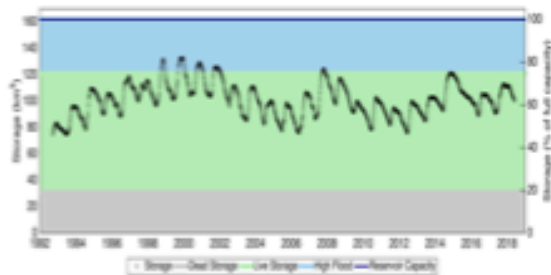
Day-to-day comparison
(Levels or Extents)

Status-3



Season-to-season comparison
(Levels or Extents)

Water Storage

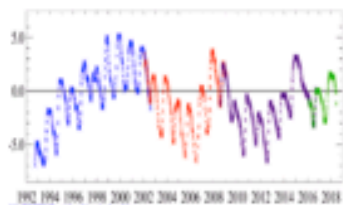


Reservoir Information

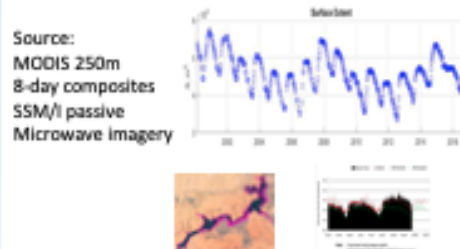


- (i) Satellite-derived water level and extents
- (ii) Published storage/Level relationship (Ref, 2020)

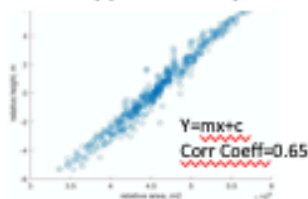
Water Level



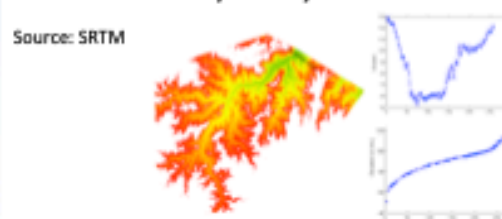
Water Extent



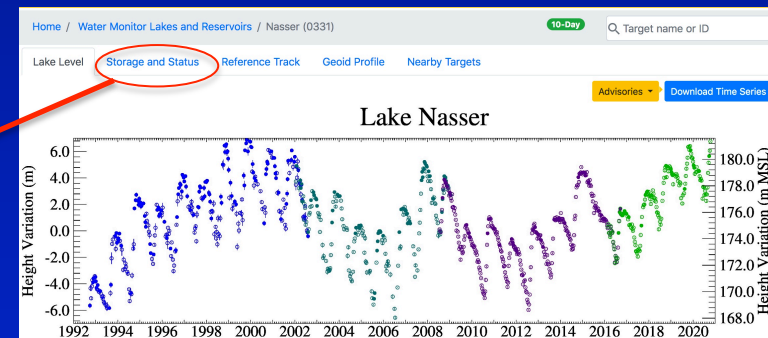
Hypsometry



Bathymetry



Example of the Global Water Monitor's new lake and reservoir Storage and Status Products.



Responding to stakeholder requirements.

Status indicators reveal current conditions in relation to previous time periods. Can be given with respect to water levels, extents, or storage.

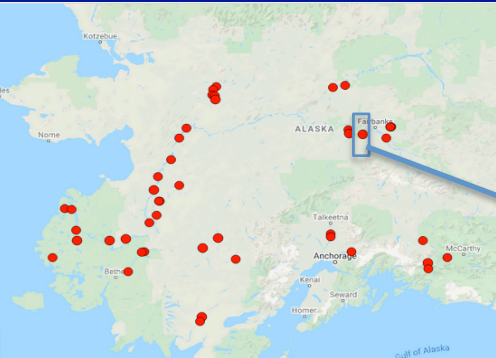
Storage or storage variations based on known or derived bathymetry.

For reservoirs, storage to be given in relation to known dead, live, at capacity, and flood storage values.



Global Water Monitor – Portal for River Surface Water Levels

Despite it's size Alaska has few permanent gauge sites. Near real time monitoring is required for flood hazard monitoring, and for wildlife and transport considerations.



Name	USGS Site ID	Latitude	Longitude	Width (m)	Drainage Area mi ²
Sites Collocated with Existing USGS Gaging Station					
Snow R. nr Seward	15243900	60.287	-149.337	50	150
Susitna R. at Gold Creek	15292000	62.774	-149.688	300	6,130
Tanana R. at Fairbanks	15485500	64.789	-147.837	900	21,000
Knik R. near Palmer	15281000	61.503	-149.030	400	1,220
Yukon R. near Stevens Village	15453500	65.872	-149.717	600	194,000
Chena R. at Fairbanks	15514000	64.840	-147.701	50	1,990
Un-gauged but with Project Field Data					
Copper R. at Chitna-Copper	NA	61.520	-144.410	200	NA
Yukon R. downstream of Koyukuk R.	NA	64.861	-157.856	1400	NA
Nushagak R. downstream of Ekwo	NA	59.288	-157.628	350	NA
Un-gauged, no ground/field data					
Koyukuk R. near Huslia	NA	65.773	-156.458	300	NA
Colville R. upstream of Umiat	NA	69.055	-153.785	1000	NA
Porcupine R. upstream of Fort Yukon	NA	66.989	-142.999	450	NA

Selection of Target Reaches

Home / Water Monitor Rivers and Wetlands / Tanana (8051)

Advisories

Download Time Series

Winter ice

Braided reach

10-Day

Target name or ID

Water Level

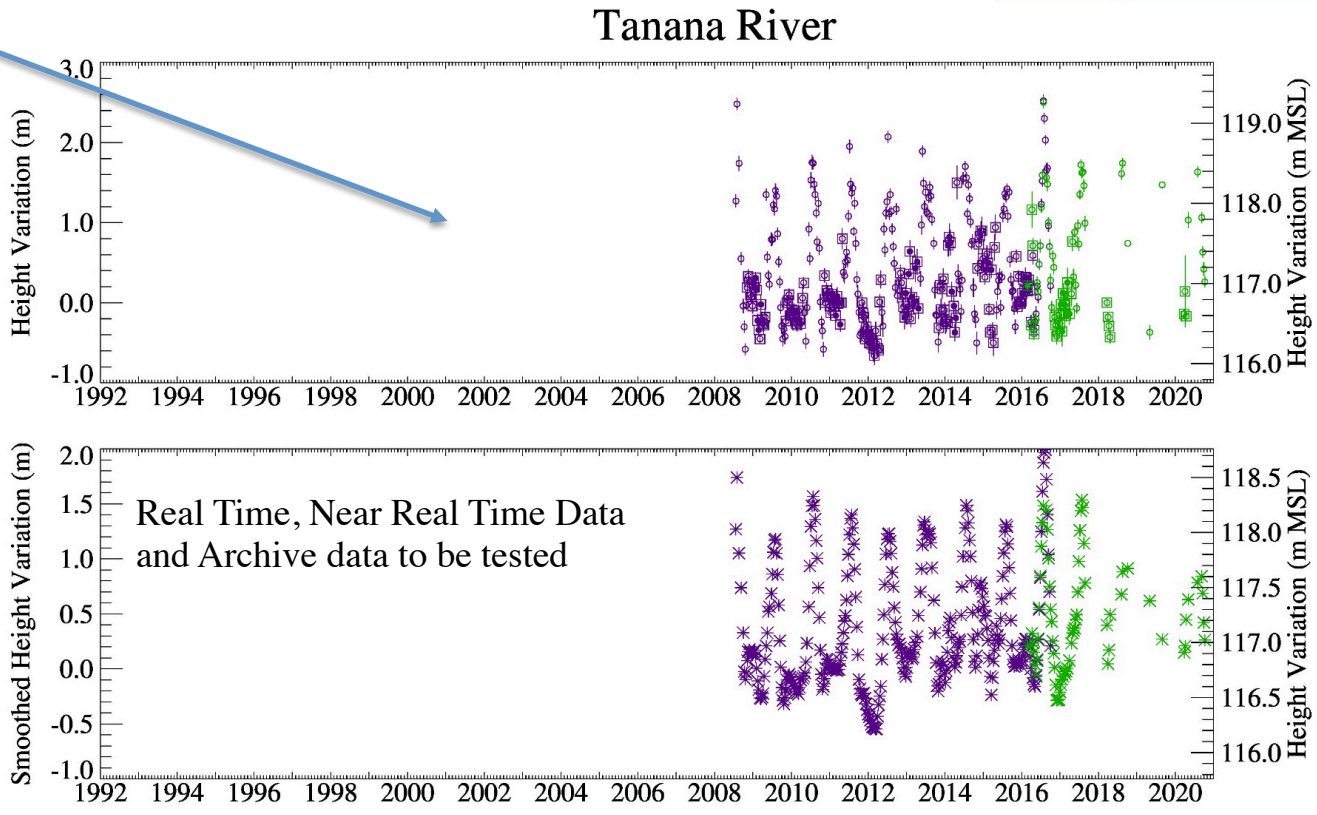
Reference Track

Geoid Profile

Nearby Targets

Advisories

Download Time Series



- *** TOPEX/Poseidon GDR 10Hz altimetry
 - *** Jason-1 GDR 20Hz altimetry
 - *** OSTM/Jason-2 GDR 20Hz altimetry (ice retracker)
 - *** Jason-3 Interim GDR 20Hz altimetry (ice retracker)
- ID 8051

Version TPJOJ.2.5.1

J-2 Ref Pass 230 Cycle 102

Last valid elevation: 8 Oct., 2020

Shown above are relative lake height variations computed from TOPEX/POSEIDON (T/P), Jason-1 and Jason-2/OSTM altimetry with respect to a datum that is based on a single fly-over date of the Jason-2/OSTM mission. The equivalent water elevation with respect to mean sea level (msl based on WGS84/EGM2008) is also provided. Near real time observations are being provided by Jason-3. The top graph are the processed results available for download. The bottom graph is a smoothed/filtered representation for general observation only. Open circle symbols in the top graph are potentially indicative of calm or frozen surface water. An additional square box highlights the typical freeze period based on general reports.

Multi-Decadal Timelines important for Historical Reconstruction

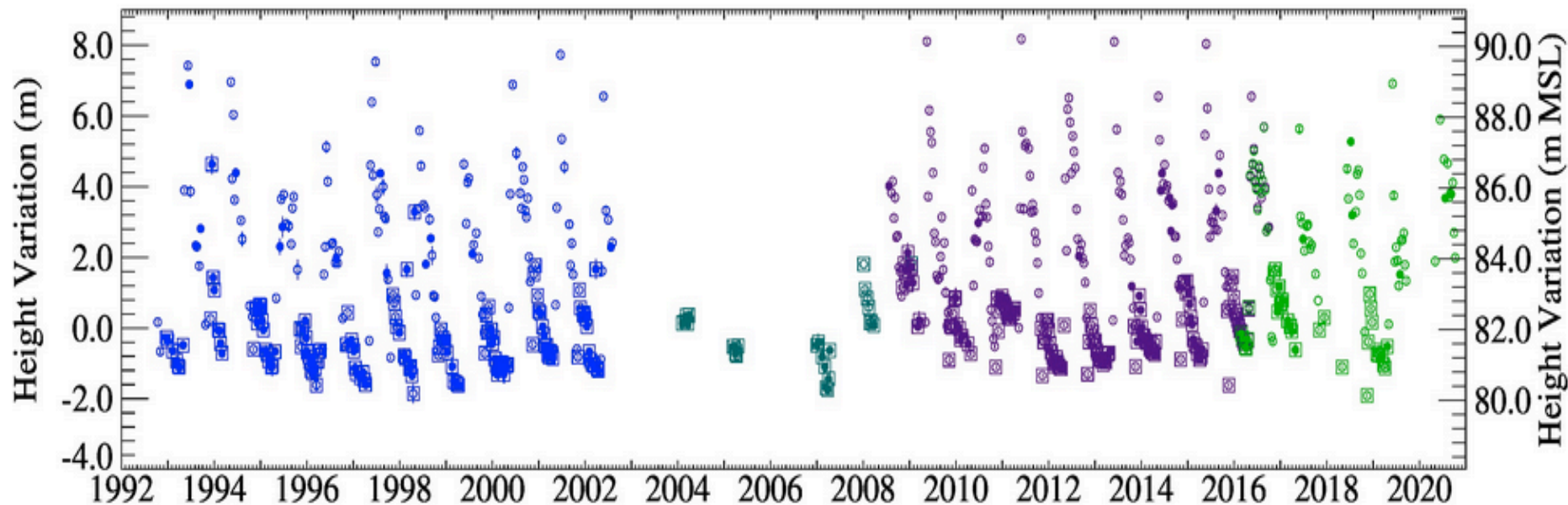


Current altimeters can be better than historical.

Some historical instruments had data collection issues (e.g. Jason-1)

Merging results from multiple platforms can be tricky especially during ice-on periods

Yukon River



*** TOPEX/Poseidon GDR 10Hz altimetry

*** Jason-1 GDR 20Hz altimetry

*** OSTM/Jason-2 GDR 20Hz altimetry (ice retracker)

*** Jason-3 Interim GDR 20Hz altimetry (ice retracker)

ID 8000

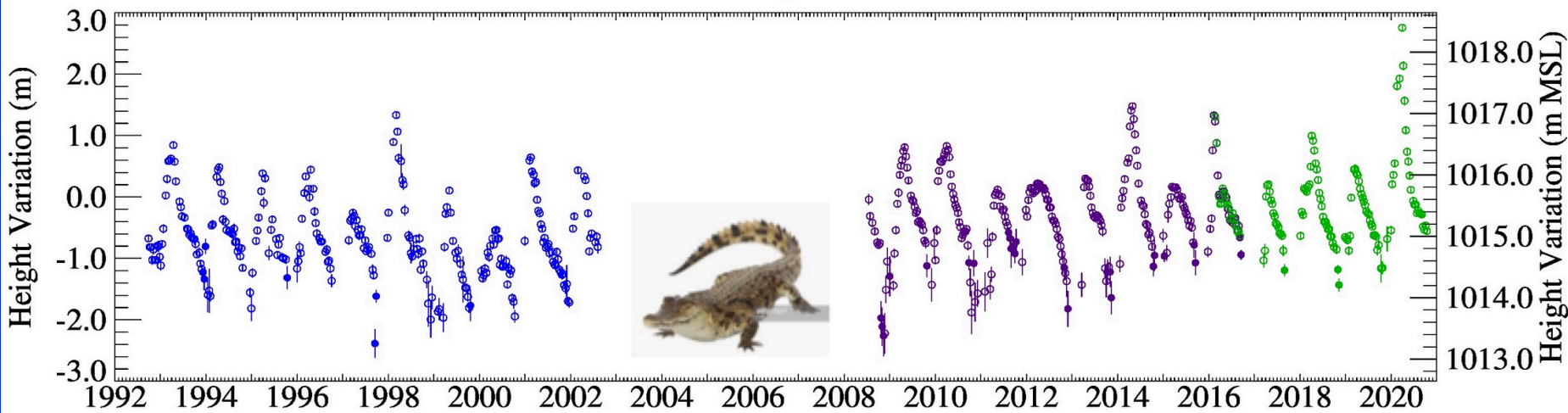
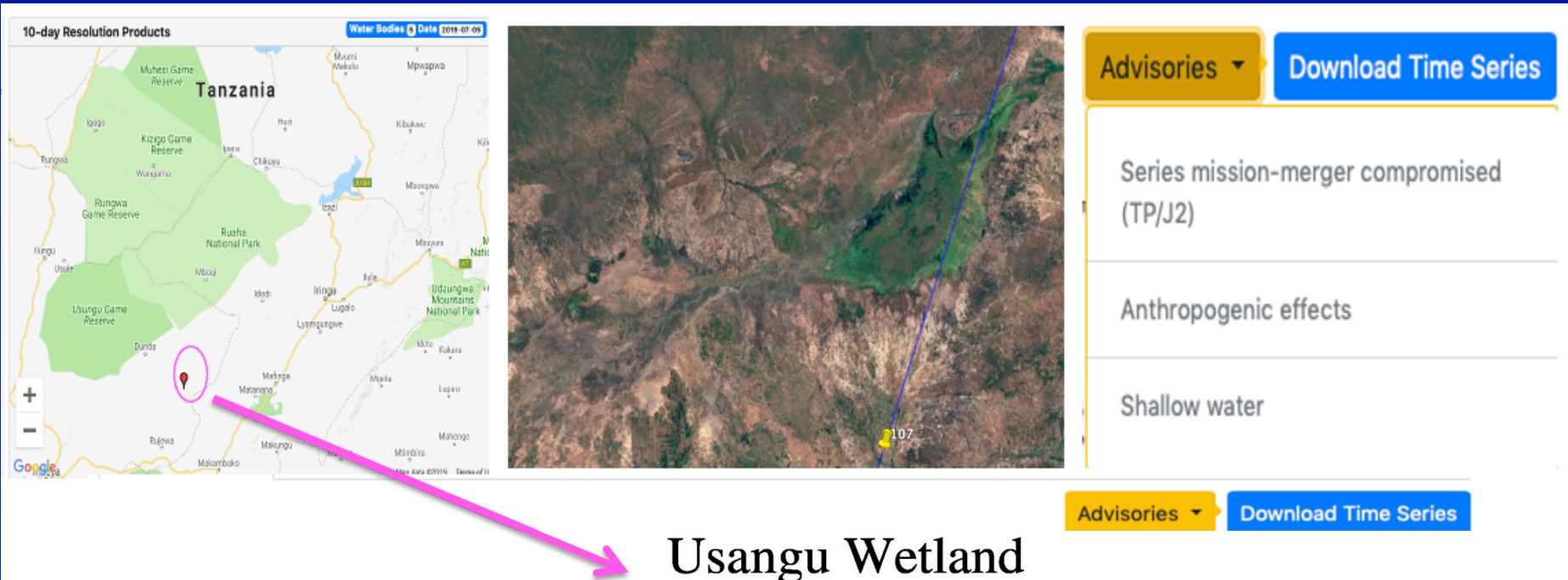
Version TPJOJ.2.5.1

J-2 Ref Pass 227 Cycle 199

Last valid elevation: 7 Oct., 2020

Global Water Monitor – Portal for Wetland Surface Water Levels

Monitoring of water variability in complex regions. In many places water resources for municipal and irrigation needs, and power supply generation, must all be addressed while maintaining conservation of these ecologically important regions. Example, Usangu Wetlands in Tanzania.

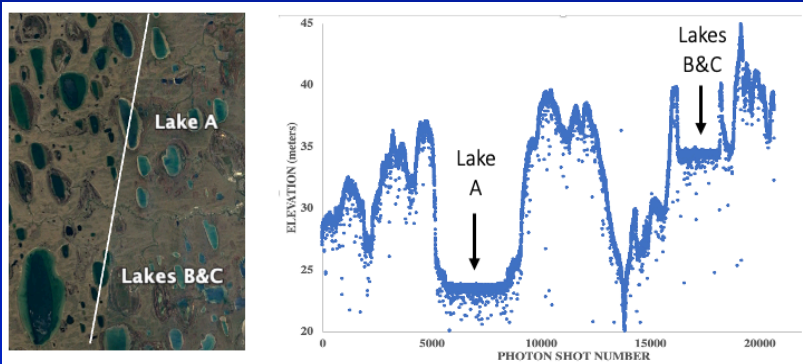


The Sentinel-6A Michael Freilich Mission

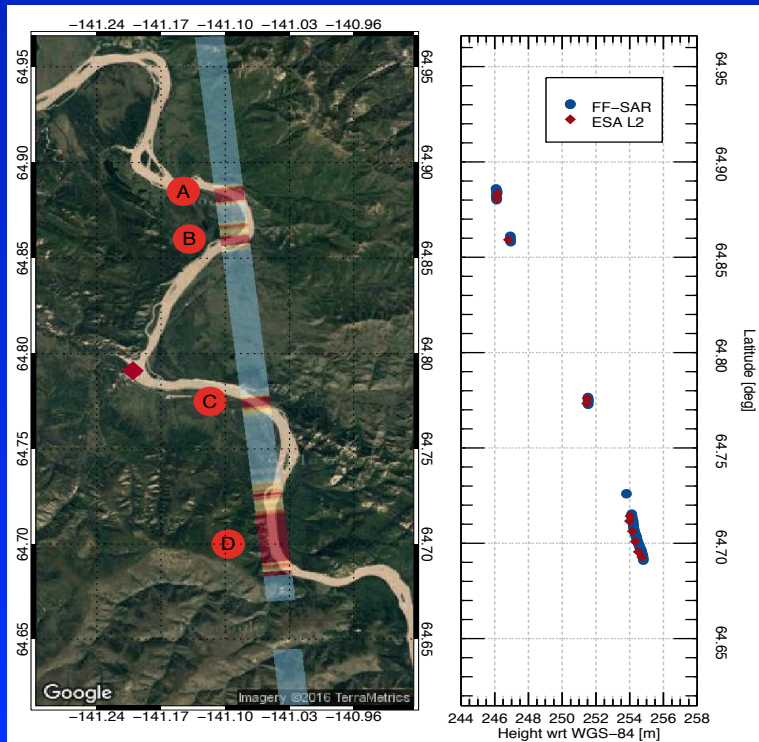


Looking to:

Enhanced **high-resolution information from ICESat-2** and GEDI to aid on-board DEM accuracy
And D-D SAR, FF-SAR, enhanced wet tropospheric Range Correction, enhanced retracers



On-board DEM enhancement. Laser altimeters are capable of acquiring very small water bodies. Such data will be utilized to enhance the Sen-6A/MF onboard DEM. Example shown is from ICESat-2 (11/17/2018, white ground track location). With an along-track spacing of 0.7m the surfaces of three small lakes on the Alaskan North Slope (0.5 to 1.5km overpass width) are captured. This region is an important fish habitat and the ability to acquire elevation measurements is of particular interest to USGS and NOAA.



Enhanced Spatial Resolution. Example from CryoSat-2 SAR data and the Yukon River Alaska near the USGS Eagle station, where reach widths at the satellite overpass crossing sites are 400-630m. (Top) The CryoSat-2 overpass (May 2015) samples two up- and two down-stream locations (Sites A to D). The color scale represents the normalized power for the improved (~84m along track) FF-SAR resolution cell after multi-looking. (Bottom) The FF-SAR application is successful with mean elevations (blue) similar to SAR (red) and provides a reach slope of 0.000293 comparable to USGS and Jason-2 estimates of 0.0003. However, FF-SAR provides ~4x the number of data points than SAR, does not have to be noise filtered, and provides an additional measurement location at the narrower north end of Site D. Similar improvements in along-track spatial resolution are expected for FF-SAR application to Sen6A/MF SAR data. FF-SAR processing courtesy of Alejandro Egido.