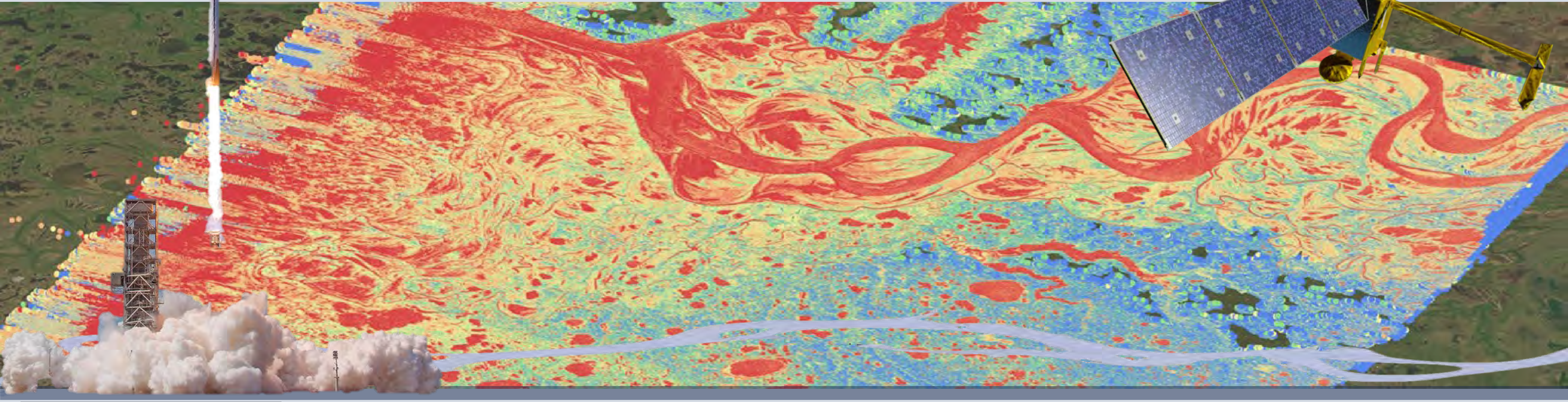
The Push for Global Hydrology:

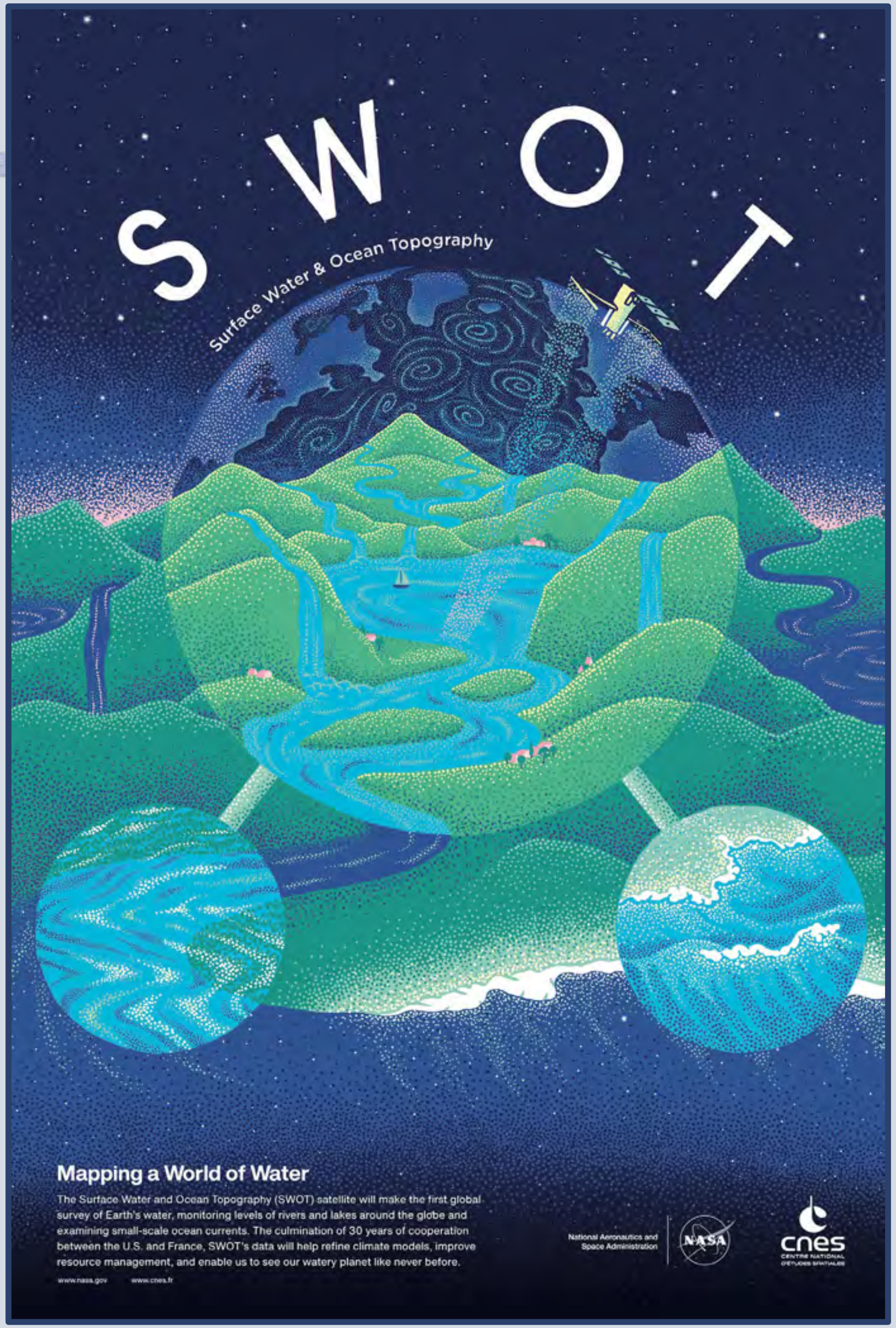
What can Montana's lakes gain from new NASA satellite?



Ryan Richardson PG
Senior Project Manager – Fluvial Geomorphologist
The Barn Group

PRESENTATION OVERVIEW

- What is Global Hydrology?
- Surface Water & Ocean Topography (SWOT) Overview
- How does SWOT work?
- What kind of data will SWOT provide?
- Potential Applications in Montana Lakes
- Discussion



BACKGROUND

Education

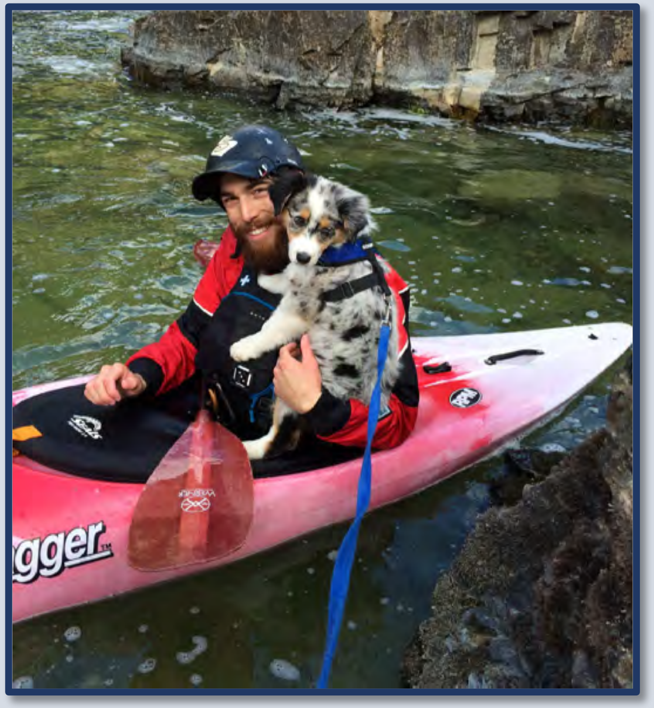
Furman University – Geology BS
University of Wyoming – Geography MS
Fluvial Remote Sensing Lab

Experience

USFS – Rocky Mountain Research Station
Geomorphic Technician
River Design Group
Fluvial Geomorphologist
The Barn Group
Senior Project Manager

License

Professional Geologist – ID
Wildland Hydrology Levels I-IV
FAA Remote Pilot
Swift Water Rescue



RYAN RICHARDSON PG

AUDIENCE QUESTIONS

Raise your hand for the following questions

- Who has used satellite data for any project?
- Who has used Landsat data?
- Who has heard of SWOT?
- Who wants to know more about water storage and climate impacts to ungauged lakes and river?

WHAT IS GLOBAL HYDROLOGY?

Global hydrology is the study of Earth's water cycle on a planetary scale, encompassing water's movement, distribution, and properties.

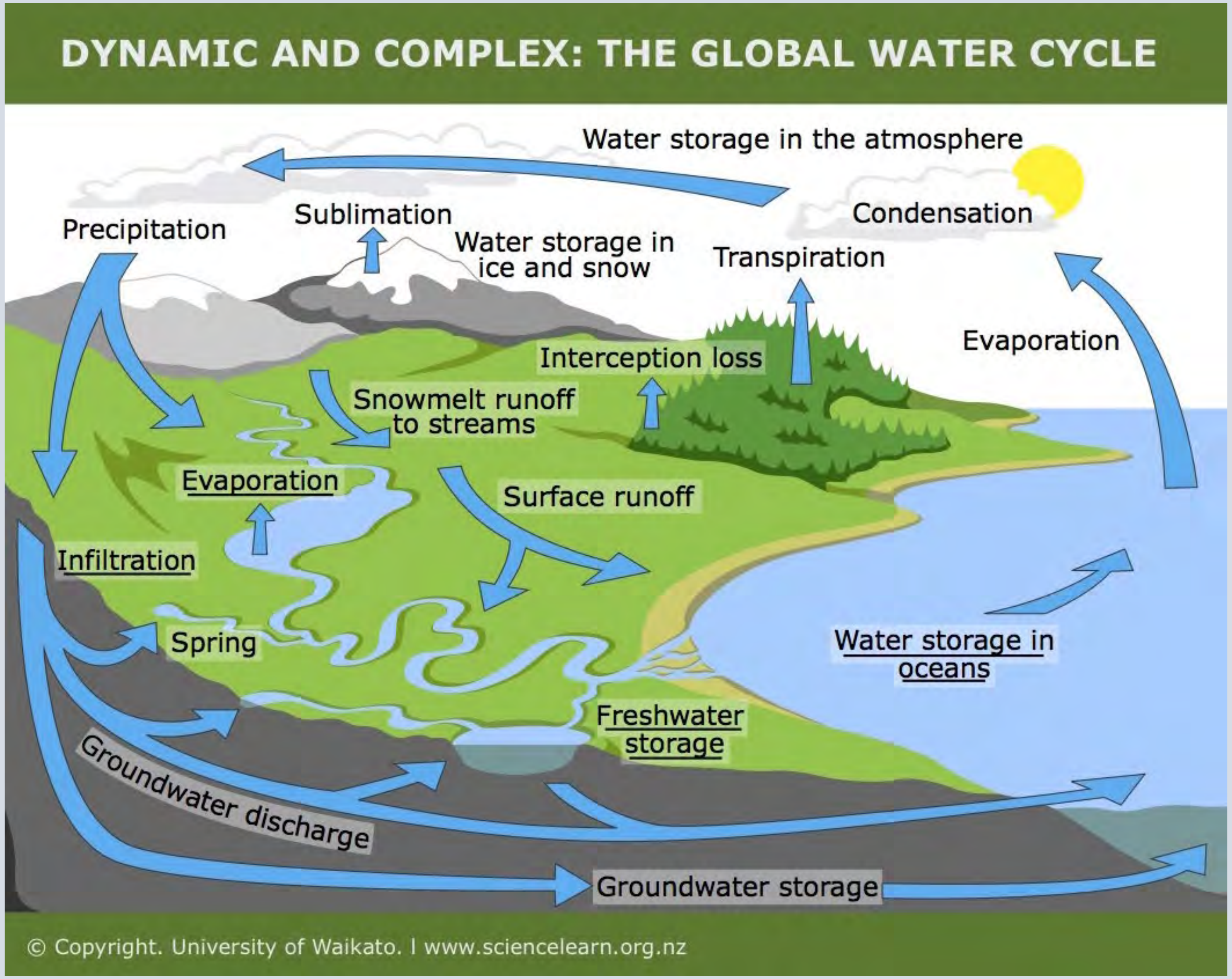
Hydrological Cycle: Involves water's continuous exchange between the atmosphere, land, and oceans.

Freshwater Resources: Includes rivers, lakes, and groundwater.

Ecosystem Impact: Affects biodiversity and ecological health.

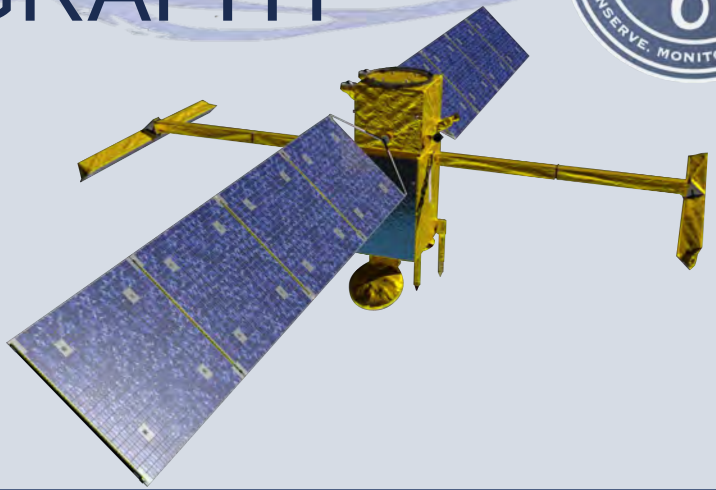
Sea Level Rise: Linked to melting ice caps and seawater expansion.

Extreme Events: Impacts floods, droughts, and hurricanes.



SURFACE WATER & OCEAN TOPOGRAPHY

SWOT is a NASA mission designed to provide the first global survey of Earth's surface water bodies and ocean topography.



High-Precision Mapping: SWOT uses advanced radar to measure water heights with unprecedented accuracy.

Global Coverage: It provides global coverage, monitoring both oceans and inland water bodies.

Hydrology: SWOT data aids in understanding the water cycle, helping manage freshwater resources and predict floods and droughts.

Oceanography: It contributes to ocean circulation studies and sea-level rise predictions.

Ecosystems: SWOT benefits aquatic ecosystem monitoring and conservation efforts.

MISSION TIMELINE

Mission concept accepted in 2012

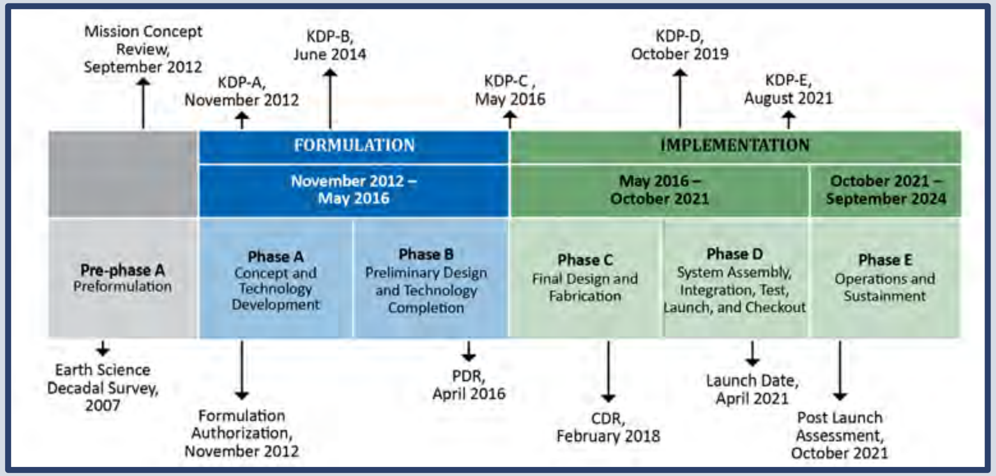
Sensor and satellite design and assembly 2013 - 2021

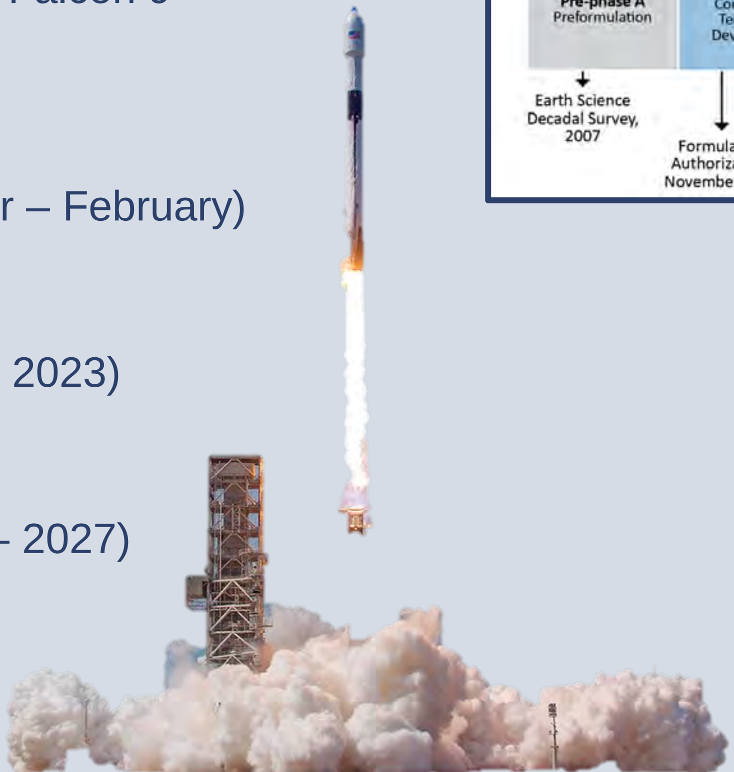
Launched from Vandenberg Space Force Base on Falcon 9 rocket (December 15th, 2022)

Orbit refinement and system unpacking (December – February)

Calibration and testing period (February – October 2023)

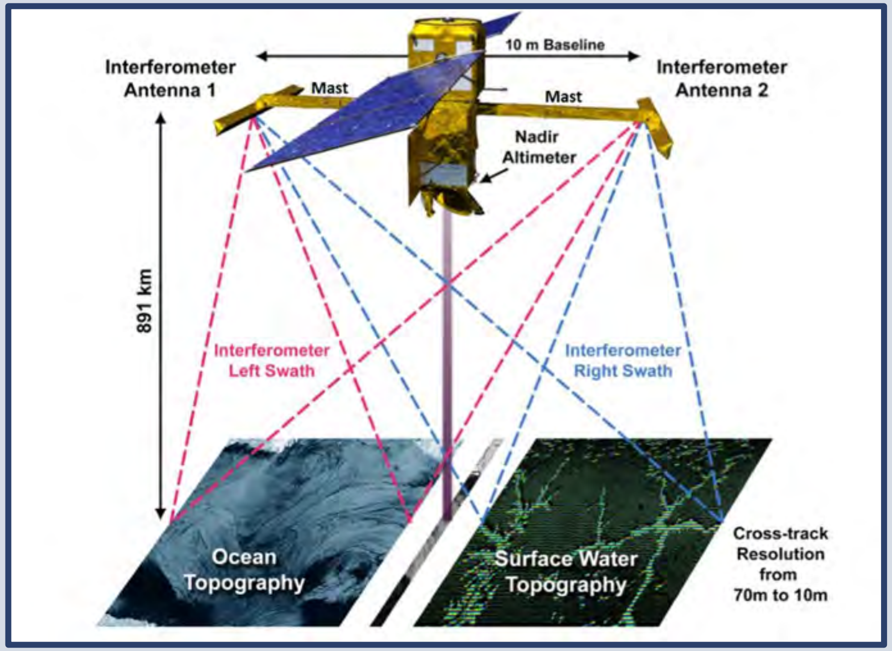
Operational with Level 2 & 3 data products (2024 – 2027)





HOW DOES SWOT WORK?

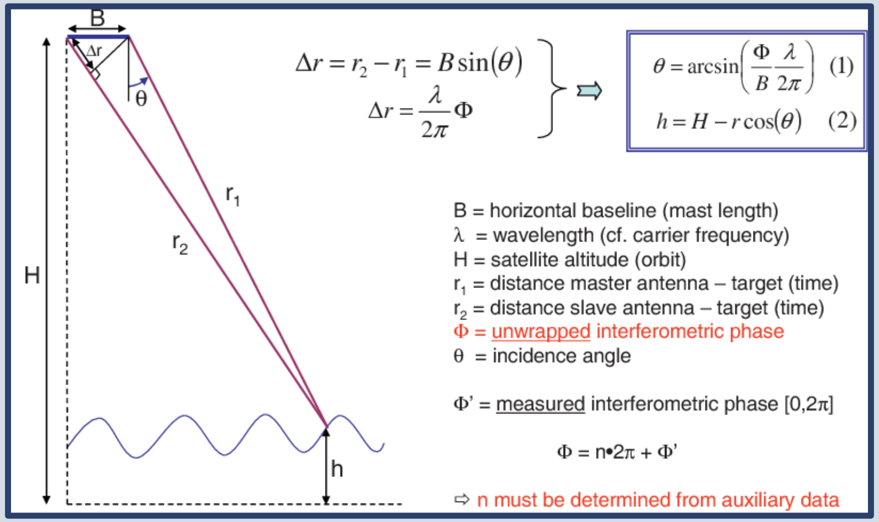
Radar Altimetry: SWOT employs radar altimetry to measure the height of water surfaces. This technique bounces radar signals off the Earth's surface, including water bodies, and measures the time it takes for the signals to return.



Dual Antennas: These antennas transmit and receive radar signals simultaneously, allowing the satellite to capture measurements from two directions.

Interferometric Technique: By comparing the signals from both antennas, SWOT creates an interference pattern, which helps calculate the surface's slope and elevation accurately.

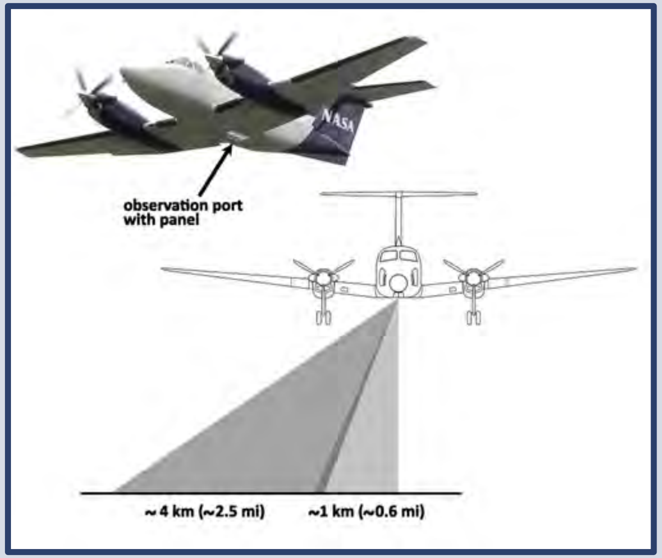
Orbit: The satellite operates in a near-polar orbit, covering the entire Earth's surface over a 14 to 21-day cycle.



ACCURACY AND CALIBRATION

Accuracy: The mission aims for an accuracy level of approximately 1 - 2 centimeters for water surface height measurements.

Precision: Not to exceed 0.5 cm, making it possible to detect small-scale variations in water height.



Calibration

Permanent stations in Crete allow for routine calibration of the sensor.

AIR SWOT

Tested the prototype miniature sensor via plane on rivers and lakes across the United States in partnership with the USGS and researchers.

DATA PRODUCTS - LAKES

6 Million Lakes in North America

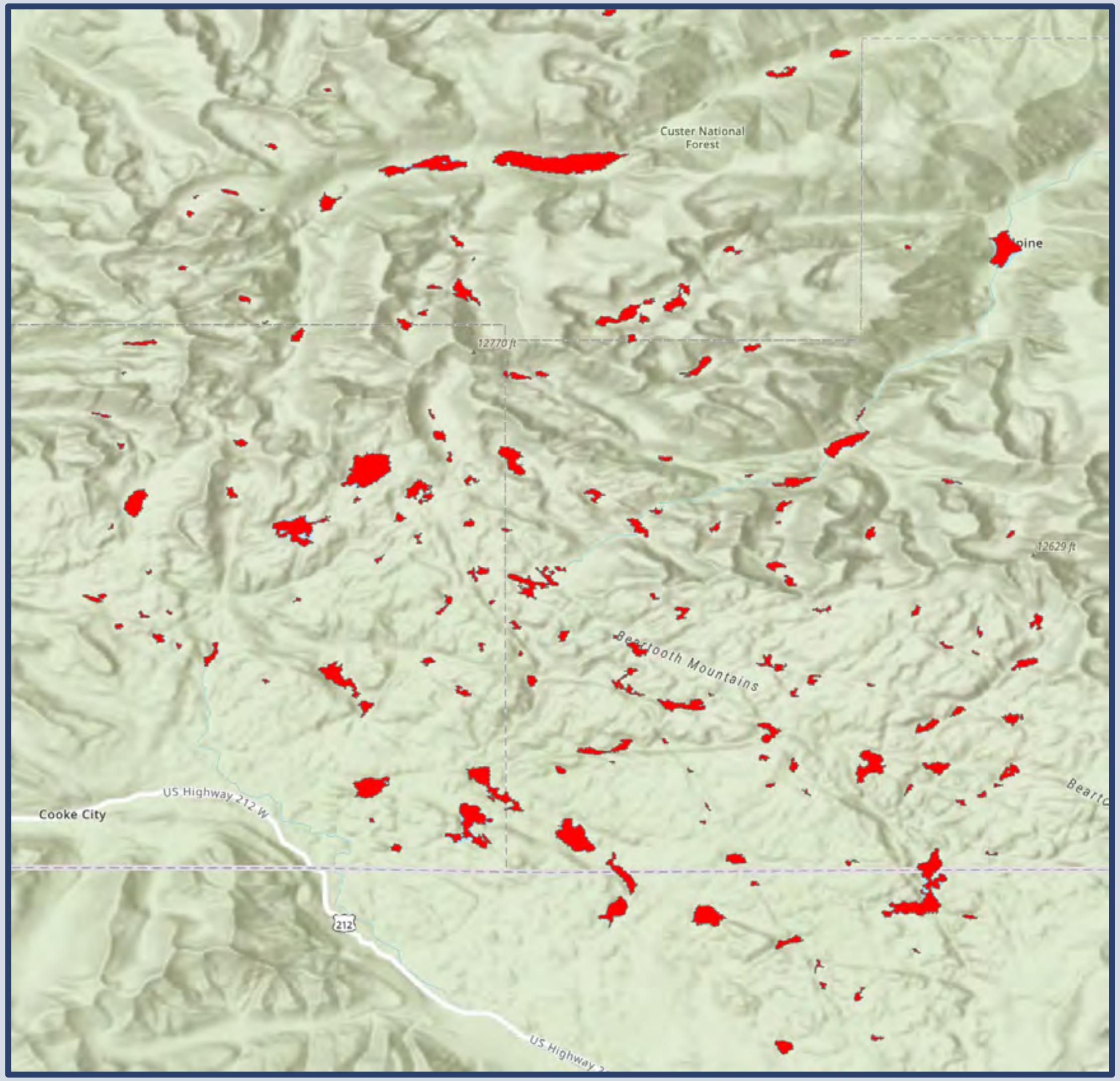
All water bodies <2.5 acres

Every 7 to 21 days (latitude)

Shapefile (GIS)

- Surface area
- Water surface elevation
- Volumetric change
- Percent ice coverage
- Error & uncertainty

BEARTOOTH MOUNTAINS EXAMPLE

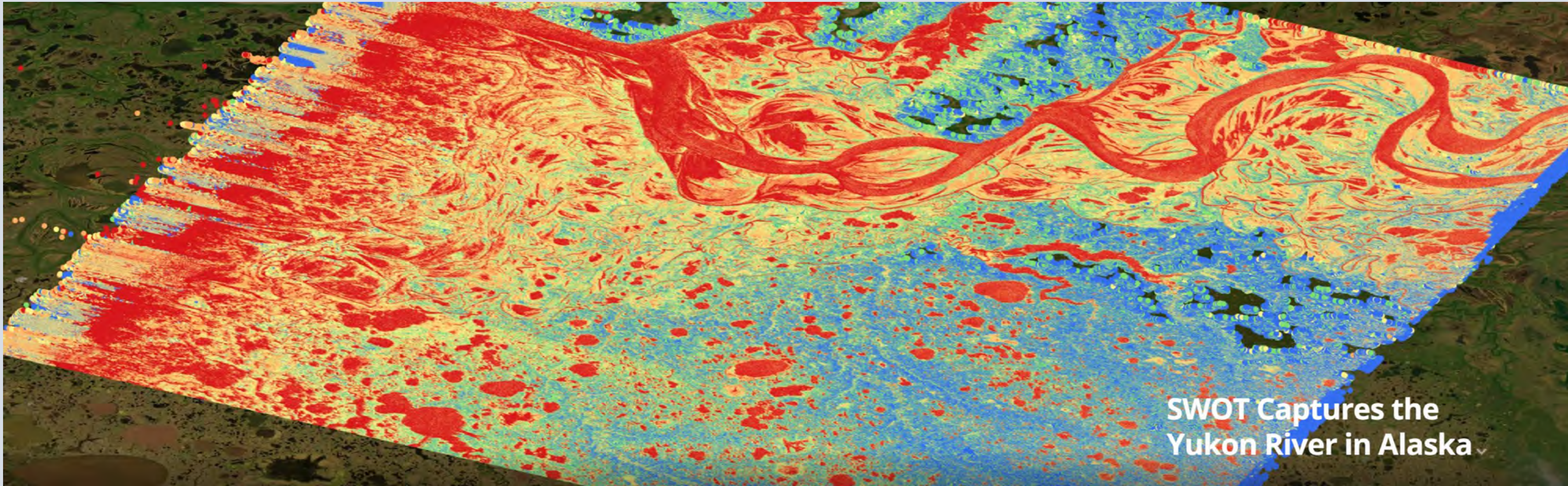


DATA PRODUCTS - RIVERS

Geodatabase - Water Surface Elevation, Width, and Slope

All rivers globally wider than 100 m (328 ft) every 200 m (656 ft)

Every 7 to 21 days (latitude)



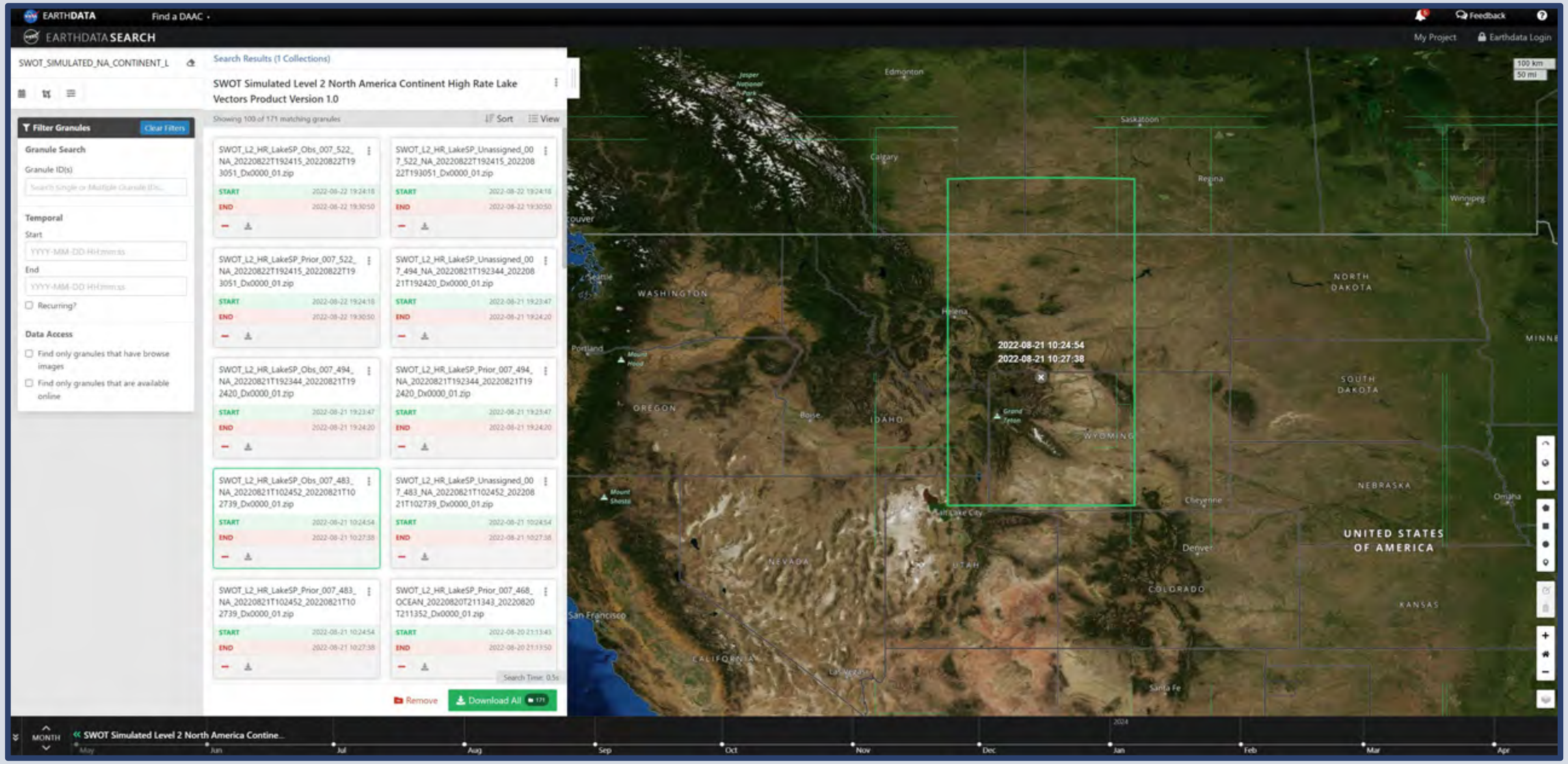
HOW TO ACCESS DATA?

Visit Earthdata: Go to earthdata.nasa.gov.

Create an Account: Sign up for a required account.

Select Dataset: Click on your chosen SWOT dataset.

Download Data: Individual files, bulk downloads, or API.



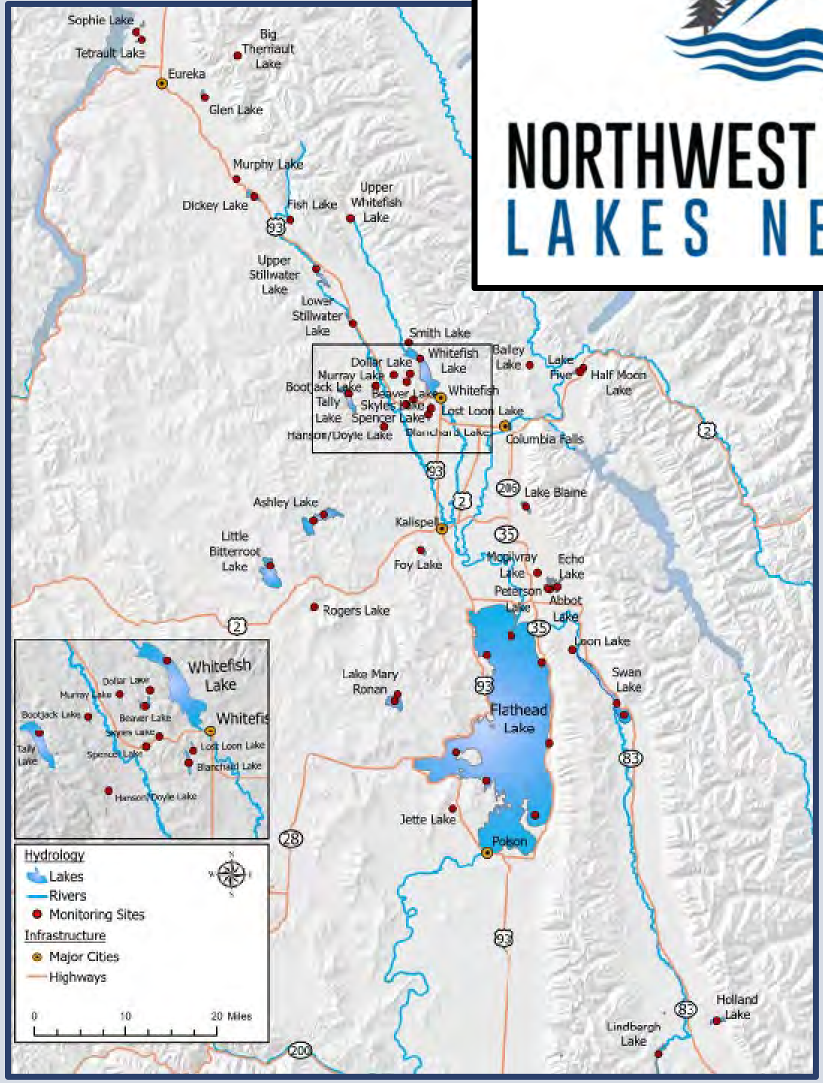
NORTHWEST MONTANA LAKES NETWORK

NORTHWEST MONTANA LAKES NETWORK

Montana Fish Wildlife and Parks and Whitefish Lake Institute partnership monitoring over 40 lakes.

SWOT data will allow monitoring data collected and analyzed in this program to be link to hydrology.

Cost effective…FREE!

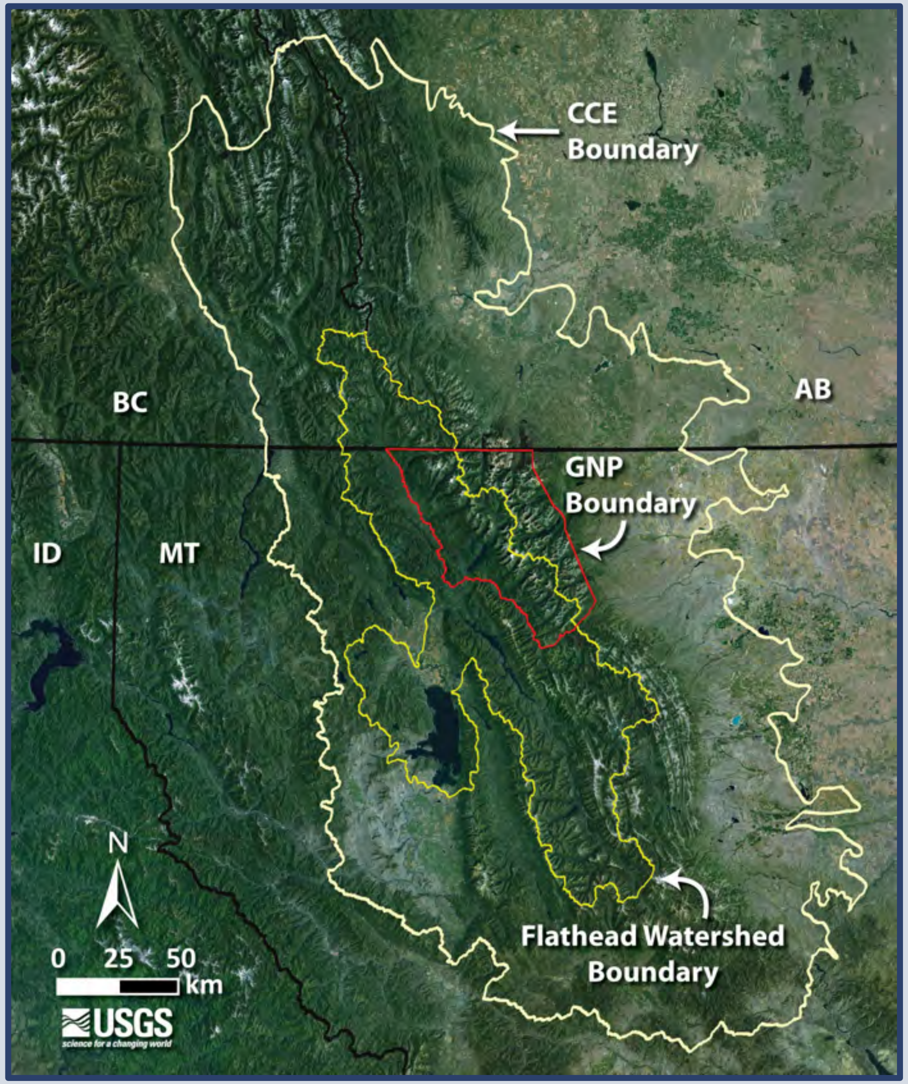


CROWN OF CONTINENT LAKES MODELING

Remote lakes in the Crown of the Continent are challenging to access and monitor.

Climate change impacts to snowpack and drought threaten high mountain lakes across the region.

Identifying which lakes are the most susceptible from SWOT data could allow for more targeted monitoring.



MONTANA LAKE ICE COVERAGE

Ice coverage on Montana lakes has limited documentation at landscape scale.

Lake ice impacts physical, chemical, and ecological characteristics.

Climate change is radically altering the cryosphere and rapidly decreasing the extent and duration of lake ice.

QUESTIONS & DISCUSSION


SOURCE Derek Wheaton

Threatened & Endangered Species documented on TBG conservation easements


SOURCE Alex Eberts

CONNECT


SOURCE Dave Herasimtschuk


SOURCE Emma Damm

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