Developing a Citizen Science Network to Validate Lake Water Storage Measurements from the SWOT Satellite Mission

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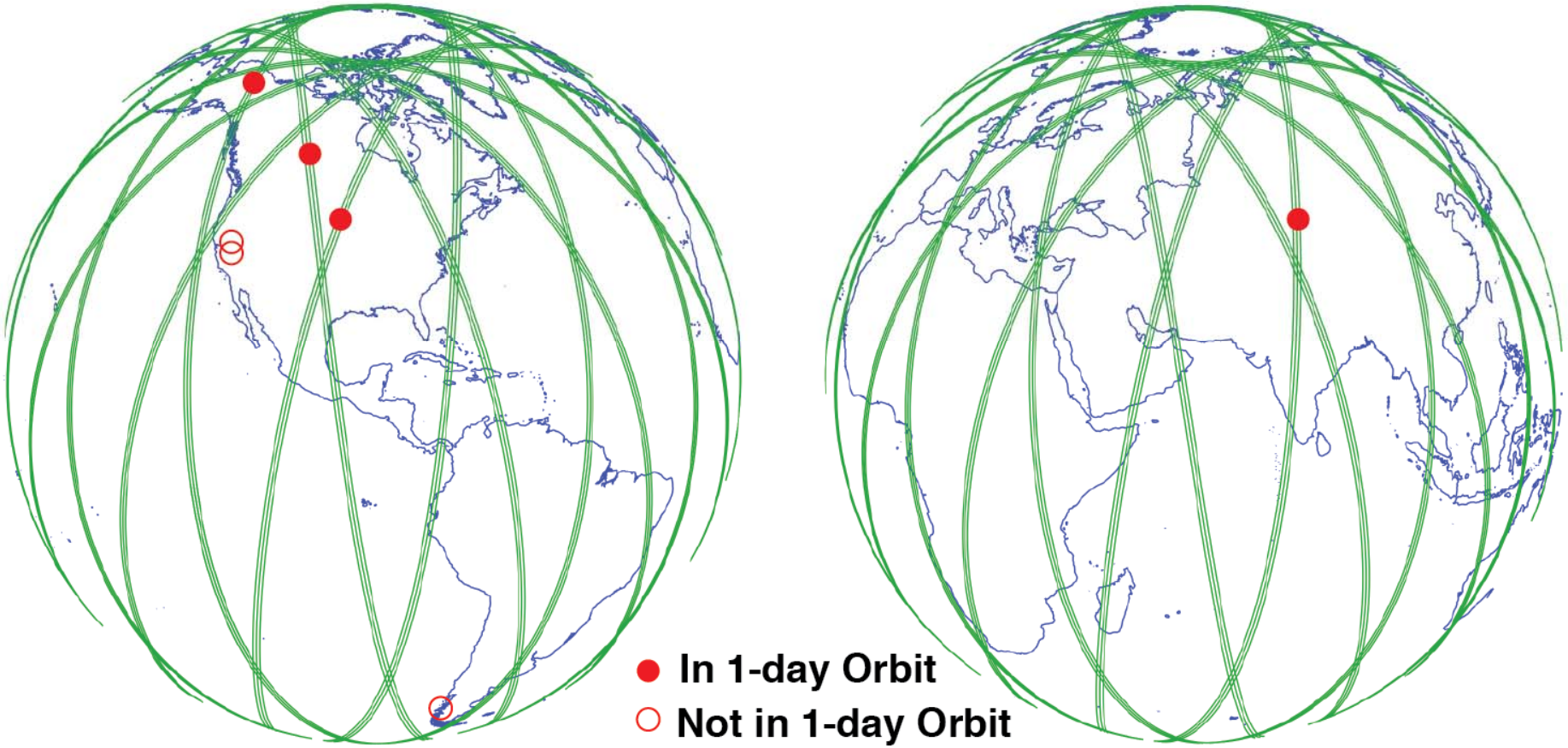
THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

Current SWOT Lake Validation Plans

According to the current SWOT cal/val plan, we will collect lake measurements in seven areas, including both large and small lakes. We would ideally like more, especially small lakes.

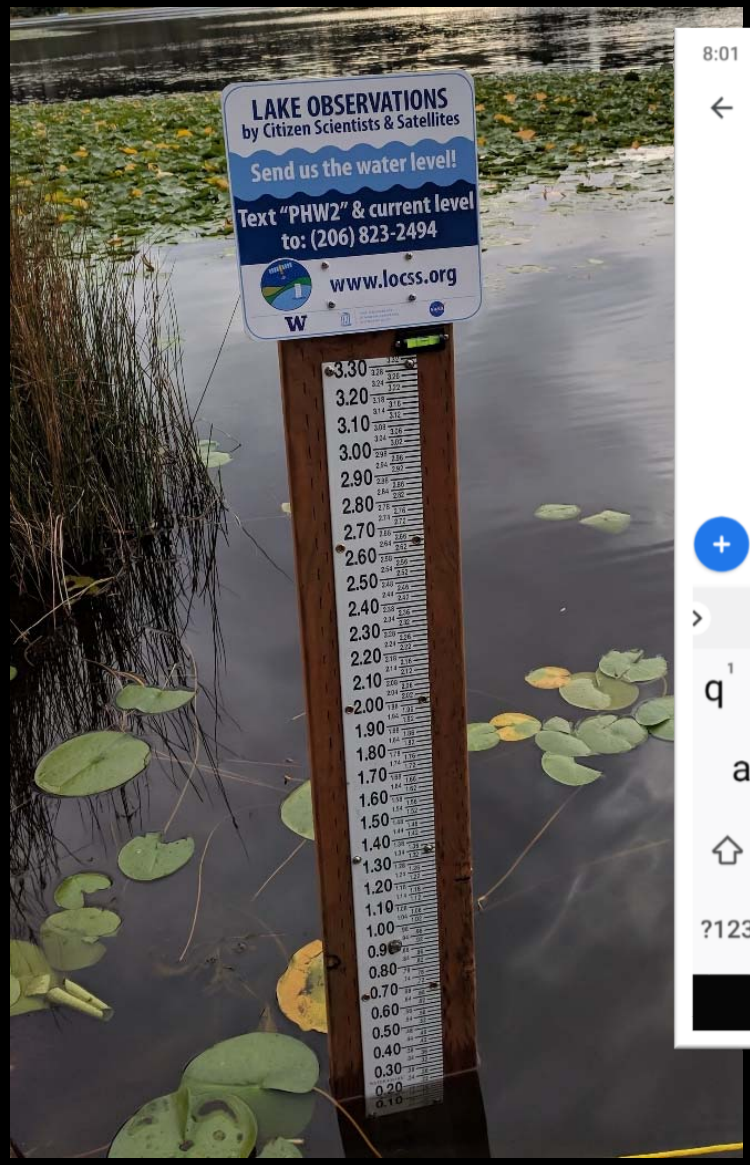
Core SWOT Lake Validation Sites

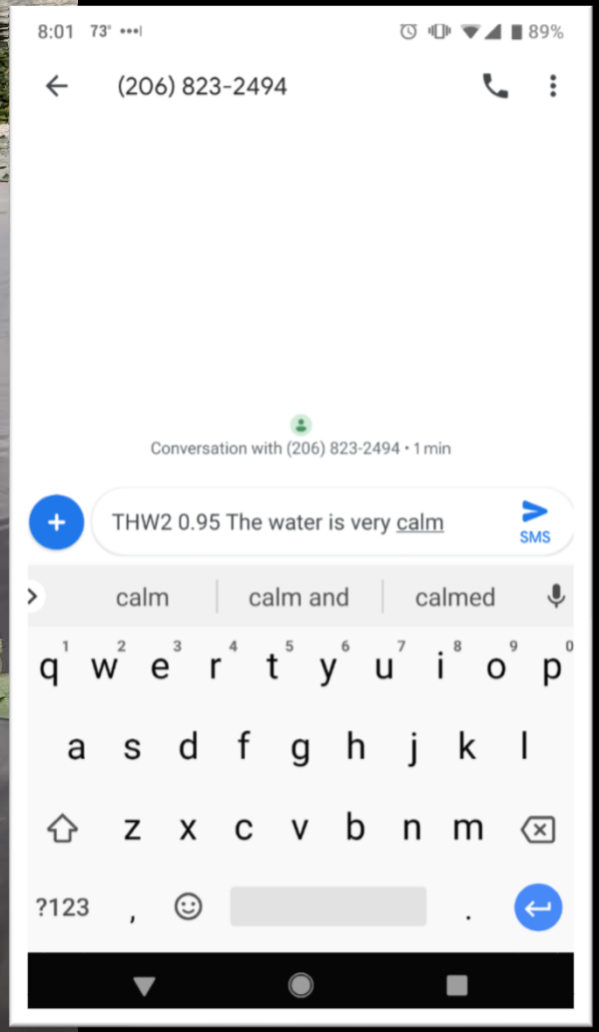


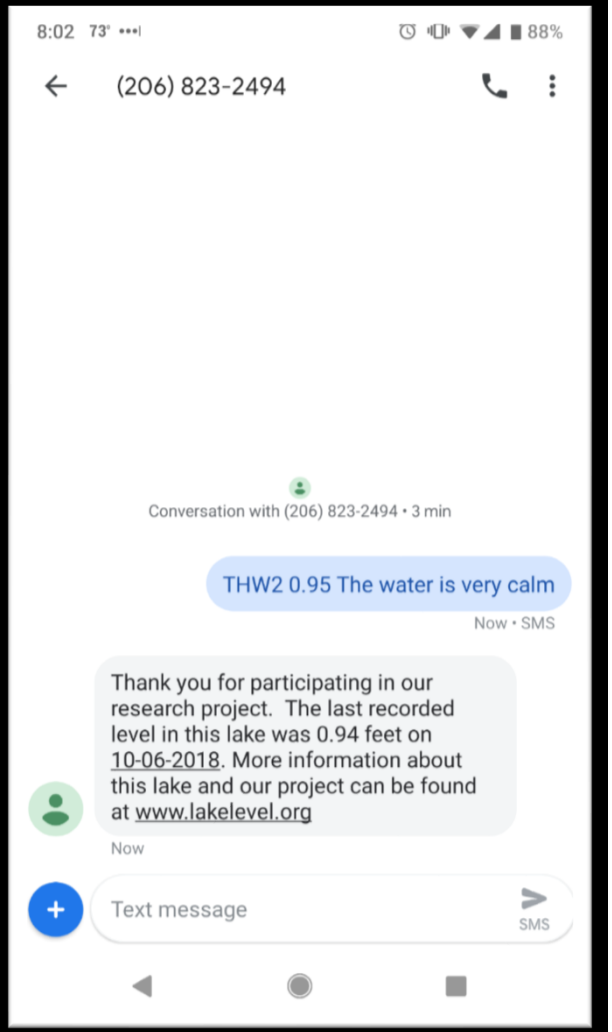
LOCSS: Lake Observations from Citizen Scientists and Satellites (locss.org)

- Lake levels measured by citizen scientists
- Lake areas measured using optical, radar satellites (Landsat, Sentinel-2, Sentinel 1)
- Combined, measurements of lake water storage change

Data Collection:
Water Levels from Citizen Scientists





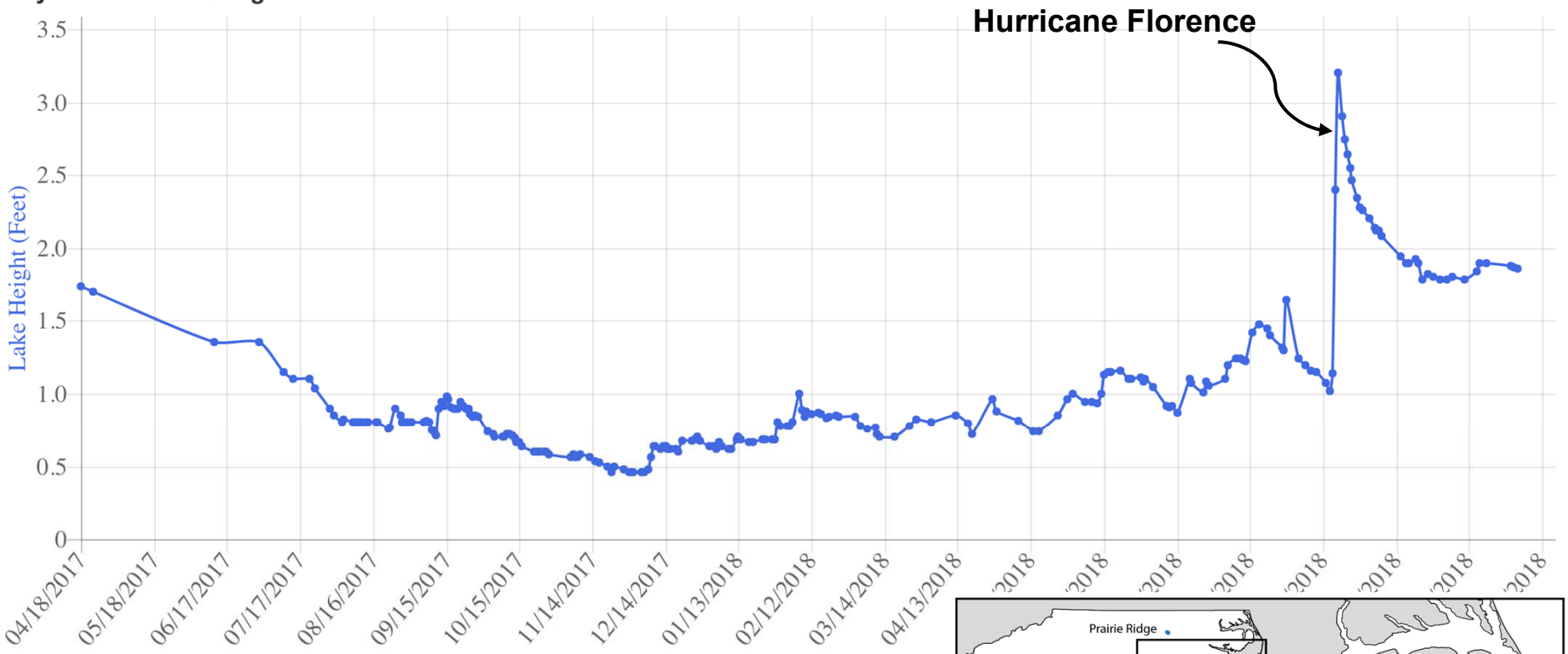


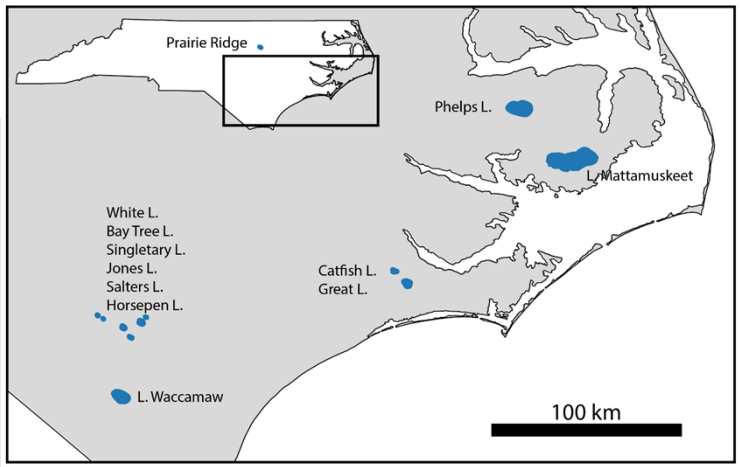
Data entry via other methods possible

Pilot Study: North Carolina Lakes

All Data | Last 1 Year | Last 6 Months | Last 3 Months | Last Month

Bay Tree Lake Gauge ID: NC1004





NC Metrics

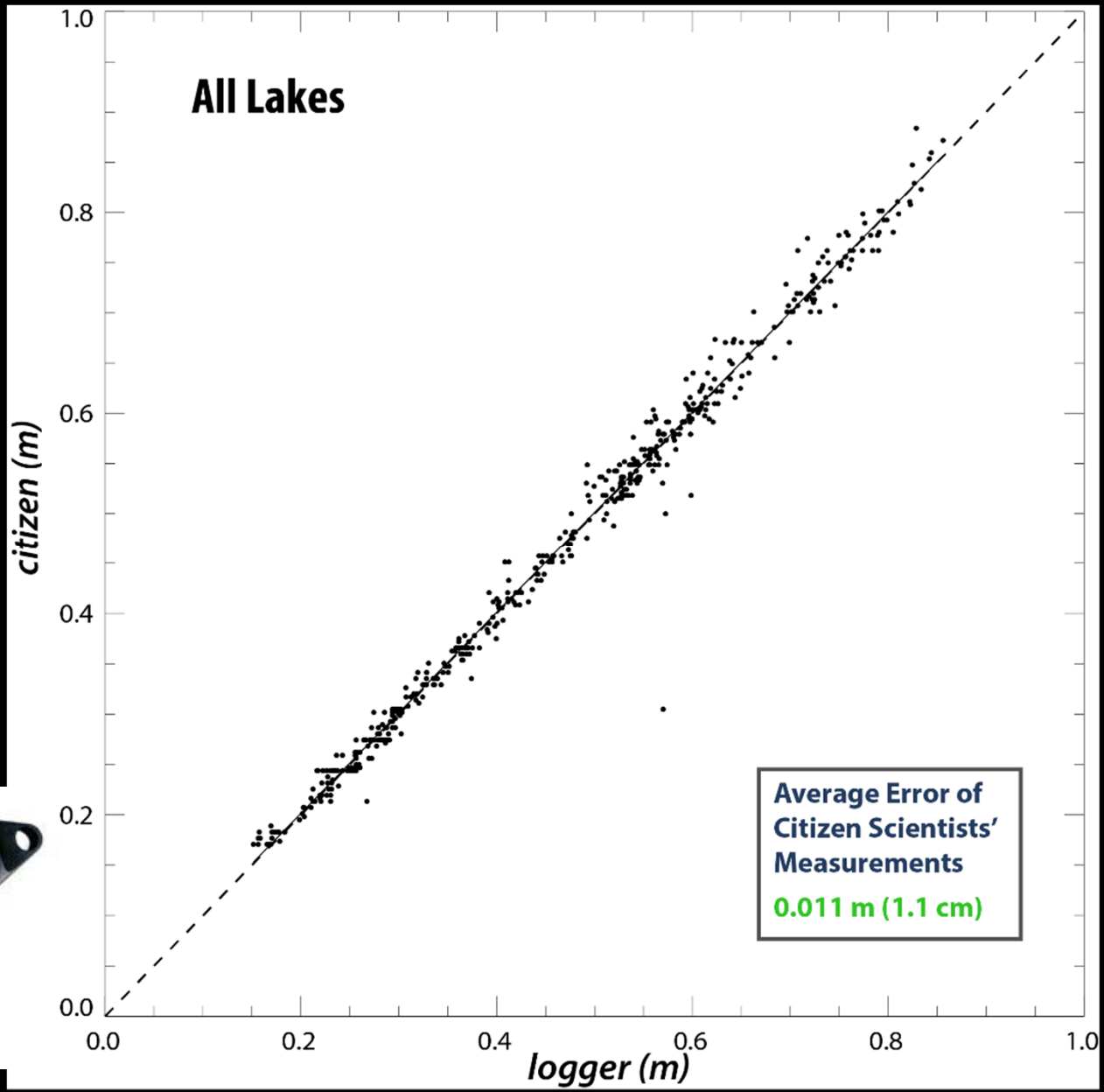
Lakes: 13
Scientists: ~180
Observations: 2096

Method

Text: 67%
Data Sheet: 20%
Website: 11%
Other: 2%

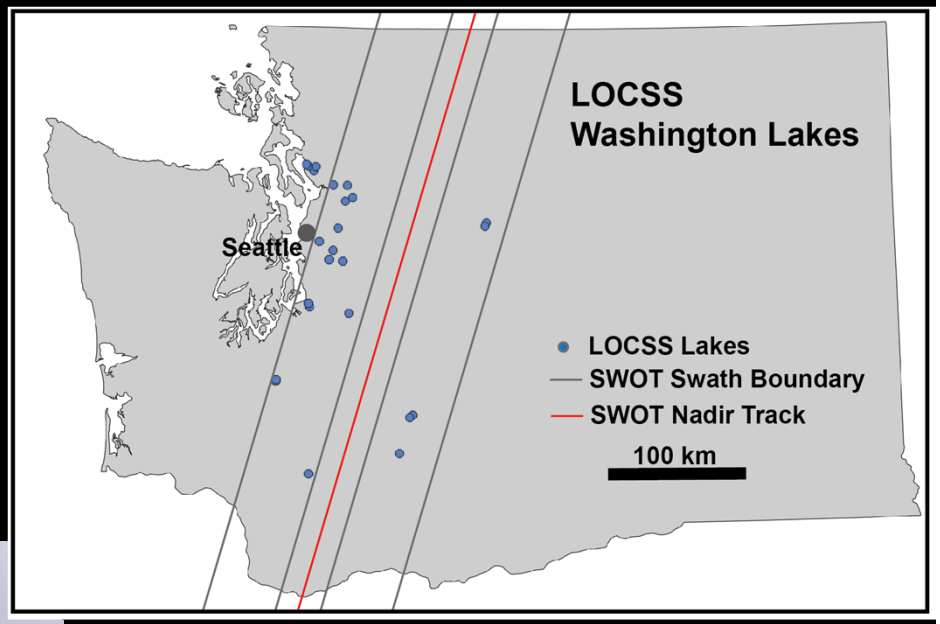
How Accurate are LOCSS Water Level Measurements?

- Pressure transducers installed in 10 lakes for 3-6 months.
- Logged water level every 15 minutes.
- Pressure transducer error is ~0.8 cm.
- Mean difference between LOCSS measurement and pressure transducer is 1.1 cm



LOCSS Field Site: Washington

- Gauges installed in 12 lakes in September 2018, 12 more in June 2019.
- ~80 volunteers, 570 observations so far.
- 20 of 24 lakes under 1-day repeat orbit.



Key Partners:

King County

Forest Service U.S. Department of Agriculture

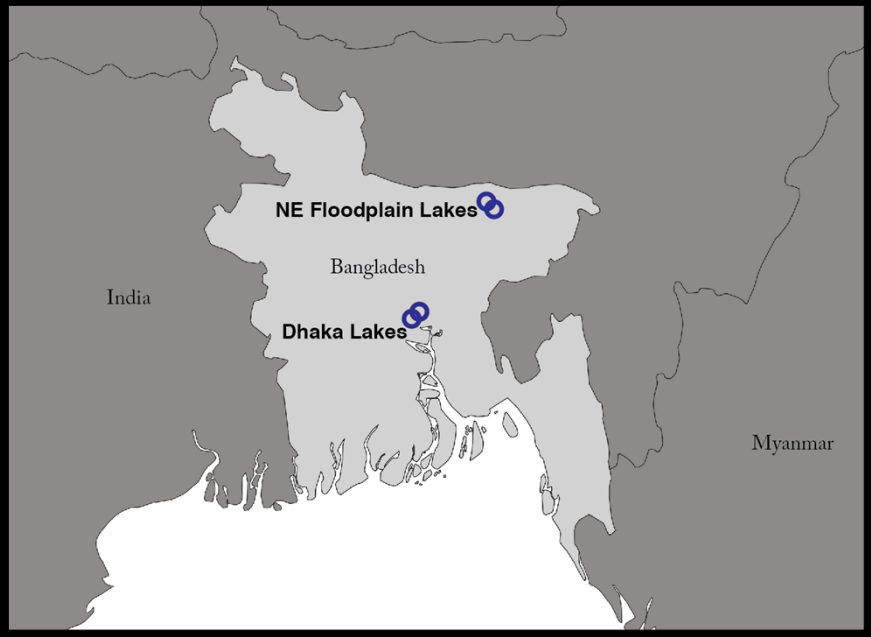
Washington State Parks

City of Sammamish Washington

City of Kirkland Washington

LOCSS Field Site: Bangladesh

- Reconnaissance trip led by Faisal Hossain in summer 2018
- Urban lakes near Dhaka, seasonal floodplain lakes in Northeast
- Gauge installation in February/March 2019 at three sites
- First data collected on May 17 (8 observations so far).

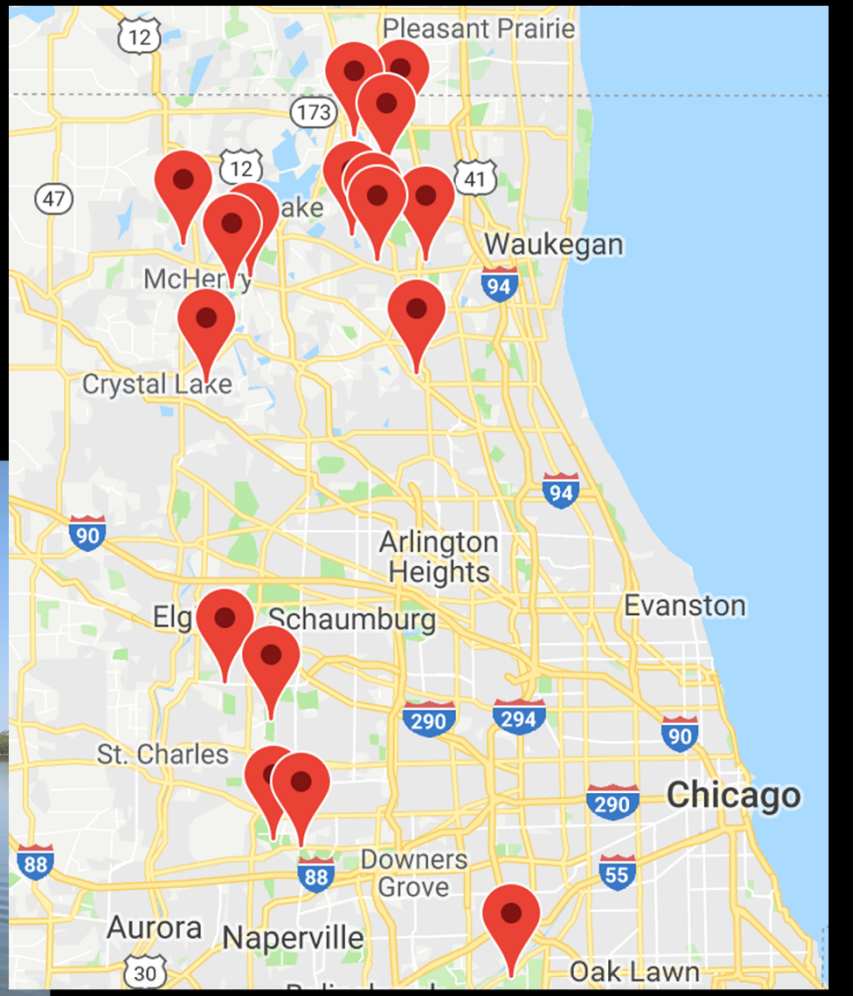


Key Partner:

Bangladesh Water Development Board

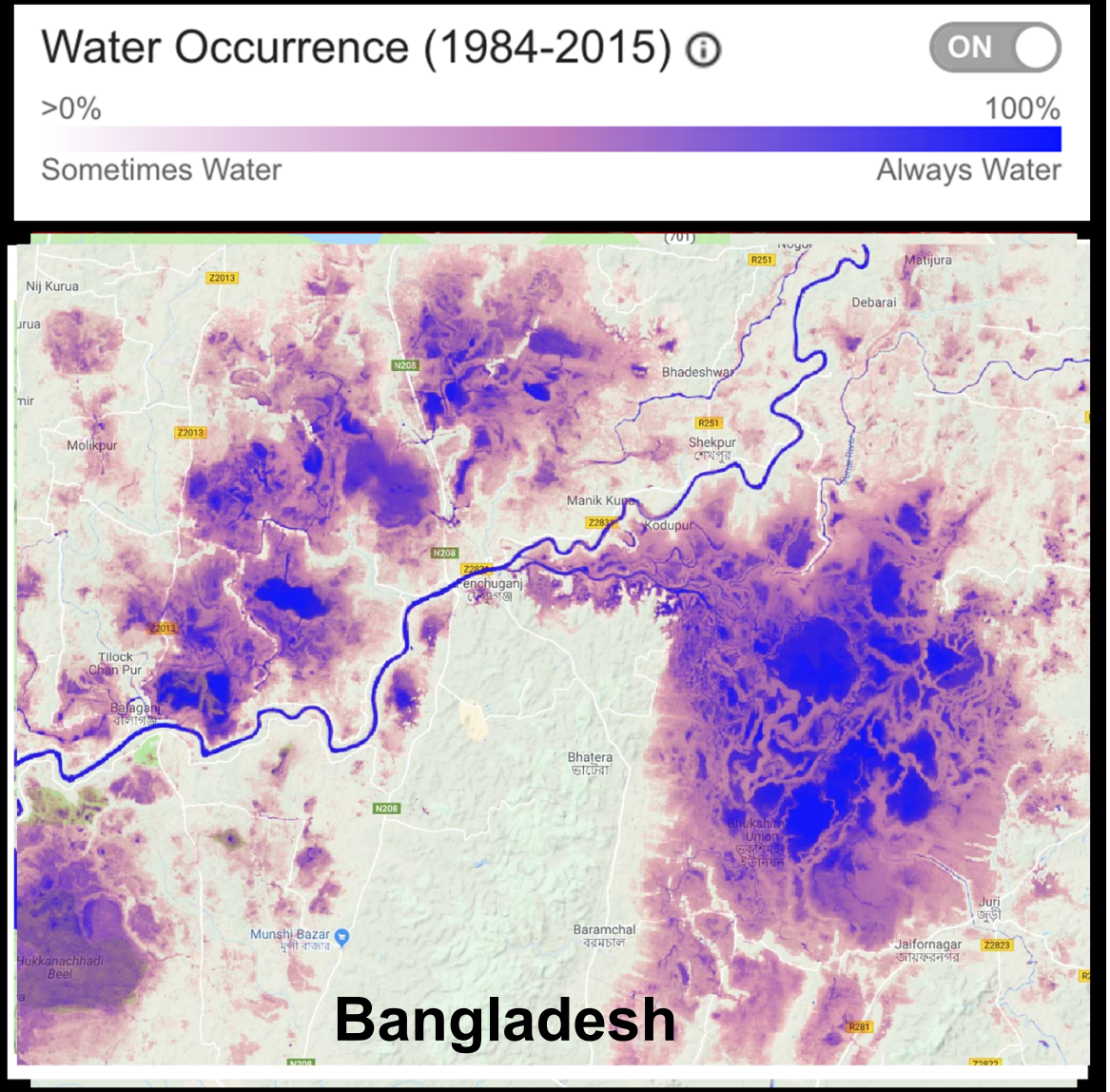
LOCSS Field Site: Illinois

- Gauges installed in 17 lakes in May, 2019.
- 129 observations thus far (~1 week/lake)
- Excellent local support.



LOCSS: Inundation Extent (U.S.)

- All clear-sky Landsat and Sentinel-2 satellite imagery matched with nearest Citizen Science observation.
- E-mails sent to volunteers on all satellite overpass days; 71% of lakes measured on requested days (+/-1 day)
- Can calculate lake volume change from citizen science and satellites.

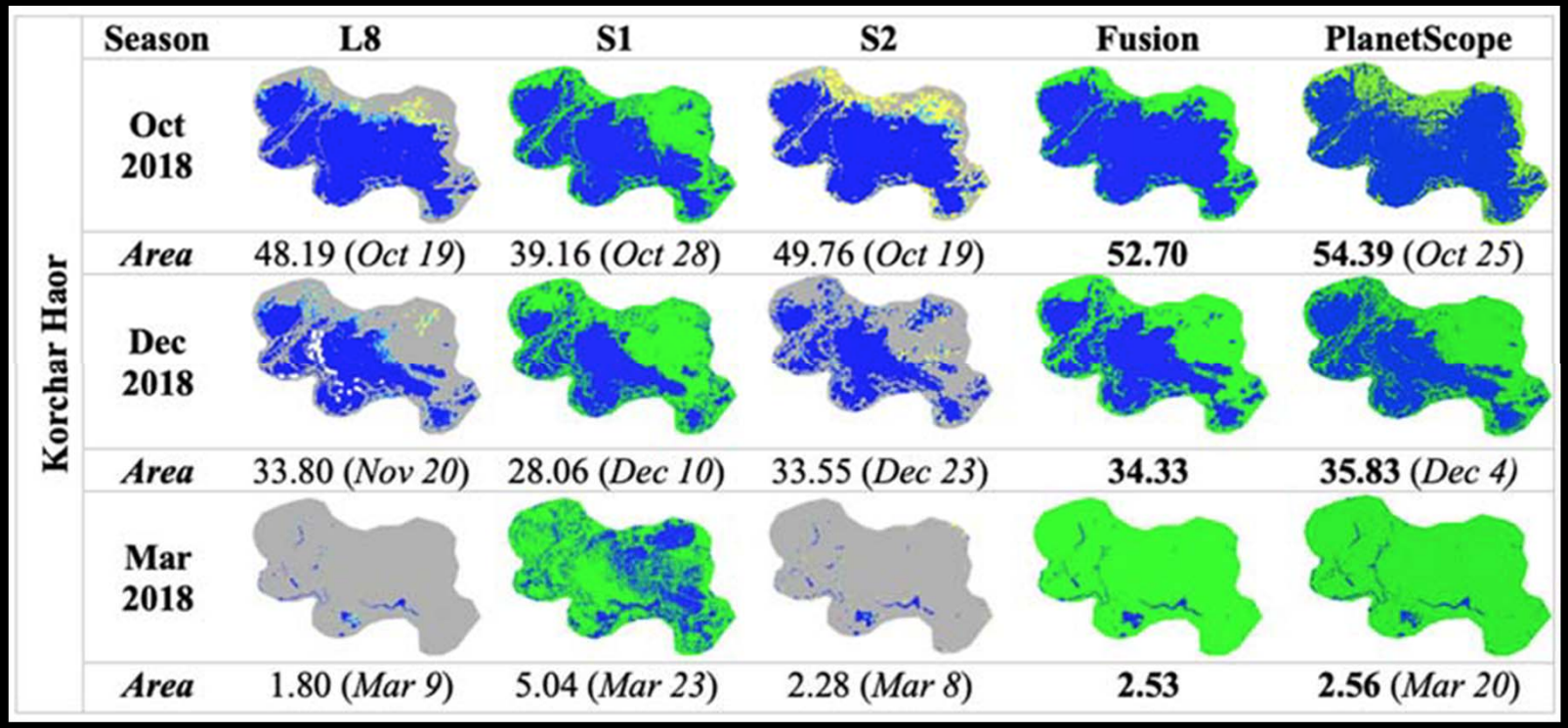


Landsat Record of Inundation Frequency

Pekel et al., *Nature*, 2016

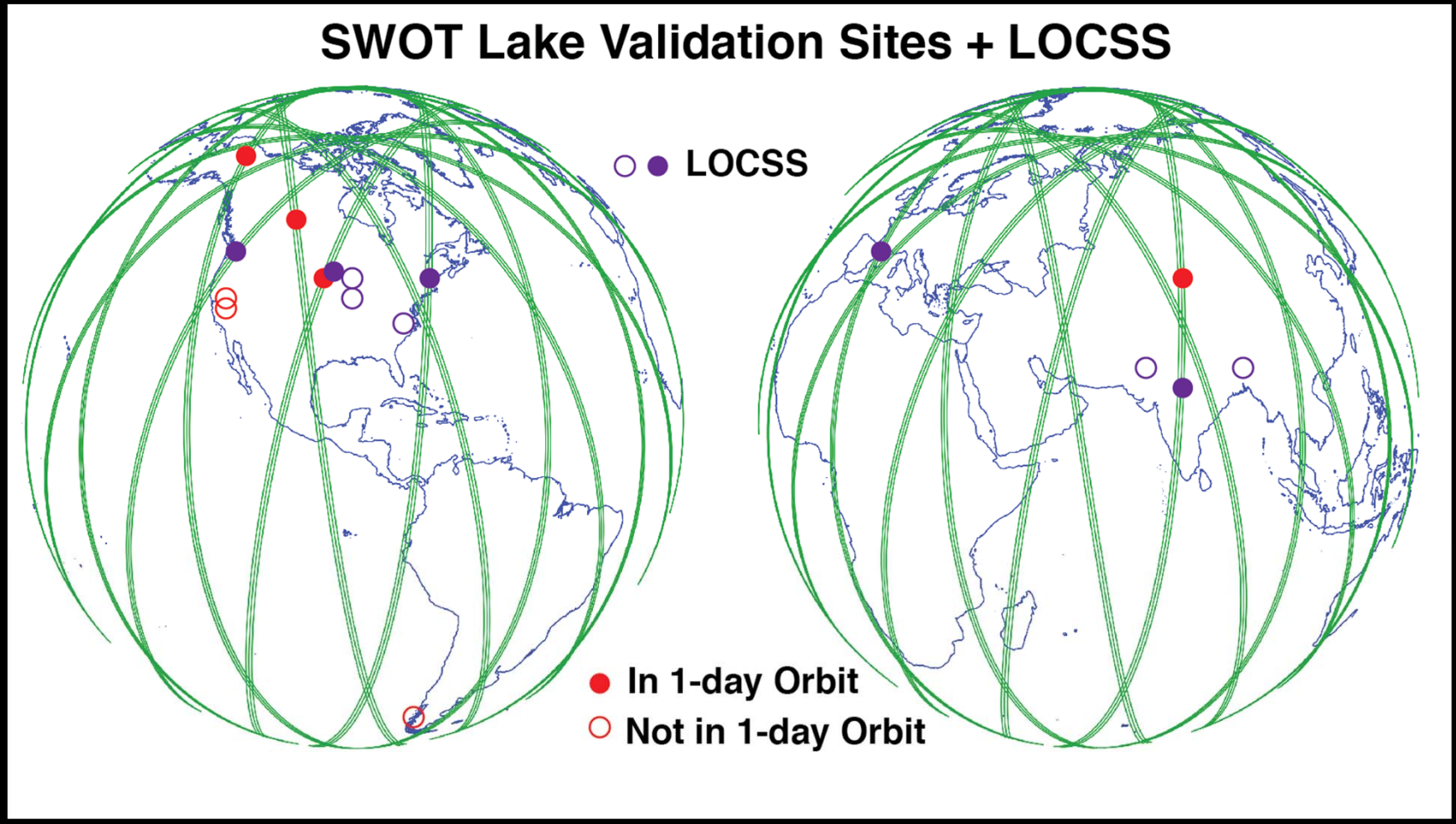
LOCSS: Inundation Extent (Bangladesh)

- Optical imagery not often viable during the monsoon
- Radar imagery (e.g. Sentinel 1) can help.
- Fusion algorithm for Landsat 8, Sentinel 1, Sentinel 2 provides relatively accurate monthly measurements of inundation extent in Bangladesh lakes.



Ahmad et al., In Review, *IEEE TGRS*

LOCSS Expansion: The Next Two Years



- Automatically merge Landsat, Sentinel 1/2 areas with water levels.
- Finalize an app that can be used in places where cell service isn't available.
- Expand measurements to additional lakes in existing study areas.
- Add planned study areas in U.S. and around the world.
- Work with partners to identify new places where gauges could be installed.

By SWOT Launch in late 2021, we hope to have a network of 100-200 regularly observed lakes worldwide that can be used for validation.

Website: http://locss.org

Questions?

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