Observing Lake Wind Patterns with Sentinel-1 Synthetic Aperture Radar (SAR) Products

Jessie Moore Torres
Global Science and Technology, Inc.
NOAA / NESDIS / STAR

Michael Soracco
Riva Solutions, Inc.
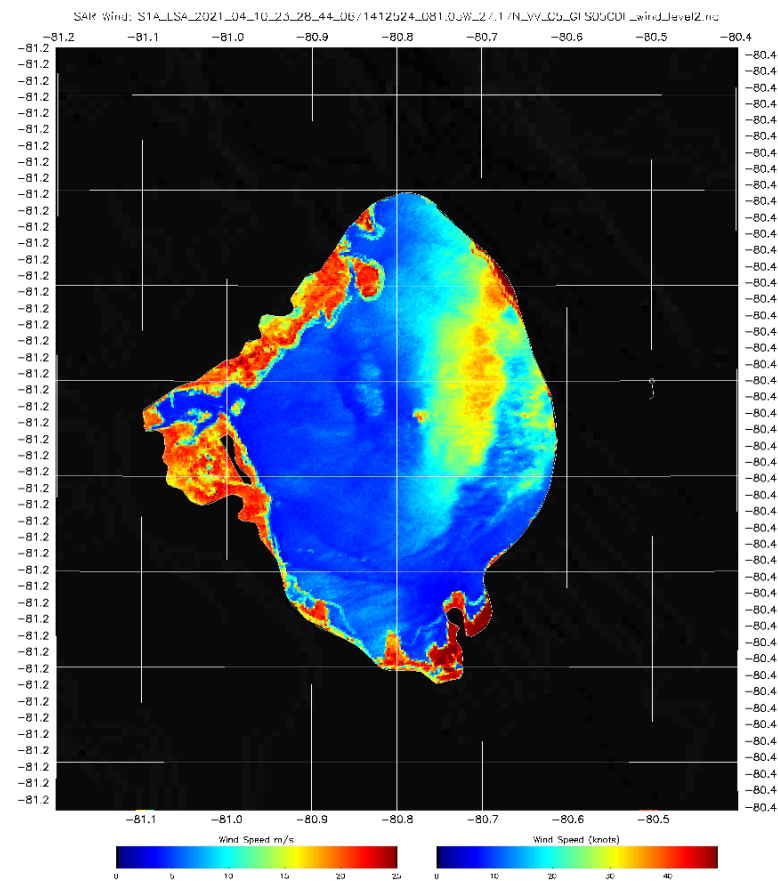NOAA / NESDIS / STAR

Sentinel-1 Satellite Information

- Sentinel-1A, in general, provides 200-250 images/day – 4 hour mean latency
- Sentinel-1B became inoperative on 23 Dec 2021 due to a power failure.
- Sentinel-1C is set for launch in April 2023 to replace Sentinel-1B

	Sentinel-1
Launch	2014 (A) / 2016 (B)
Altitude	693 km
Repeat	12 Day
LT Ascending Node	18:00
Center Frequency	5.405 GHz
Polarization	VV,VH
Swath Width	80,240,400
Resolution (Wideswath)	40/80 m

# Why are SAR Lake winds important to observe?

- SAR lake winds can provide information on several aspects of lake dynamics, including:
  - **Wind speed and direction:** This information is important for understanding the dynamics of lake water circulation and can be used to estimate the magnitude of surface waves. This information is also important for understanding the transport of water and sediment within the lake.
  - **Water level fluctuations:** Important for understanding lake water balance and potential flooding.
  - **Storm surge:** SAR lake wind data can be used to monitor the storm surge in lakes caused by high winds, which is important for disaster management and public safety.
  - **Lake ecosystem:** The wind-induced mixing of the water column can have a significant impact on the lake ecosystem. SAR lake wind data can be used to monitor the spatial and temporal variability of the water column mixing, which is important for understanding the health of the lake ecosystem.
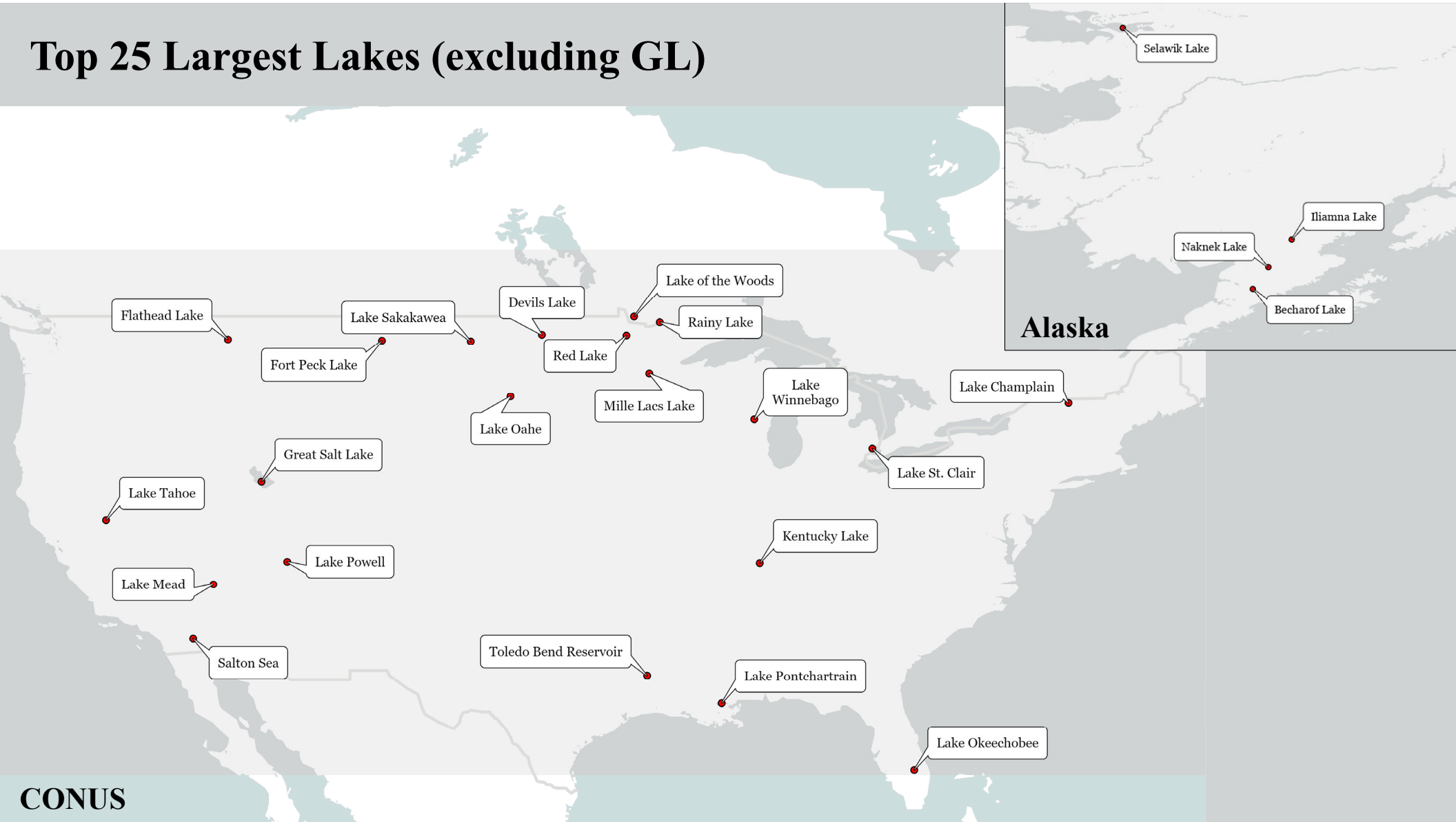
Lake Wind Products

- Coverage includes top 25 largest US lakes, including Alaska
- 250 m sampling
- Shortest repeat: Lake Tahoe
- Longest repeat: Toledo Bend Reservoir, Lake Pontchartrain, Lake Okeechobee
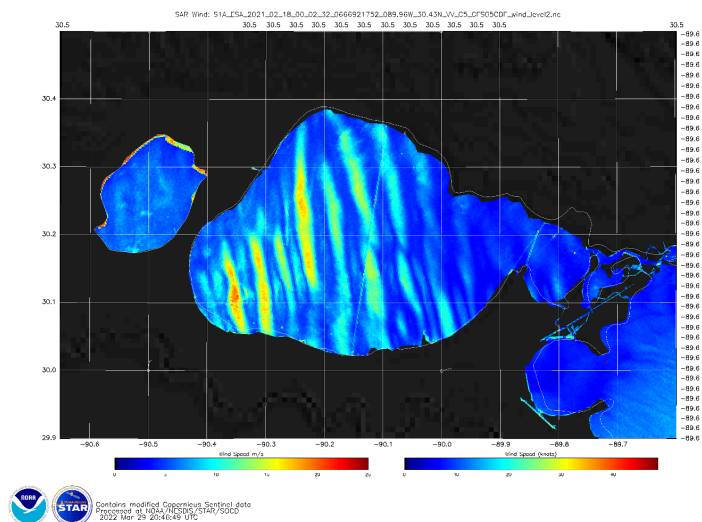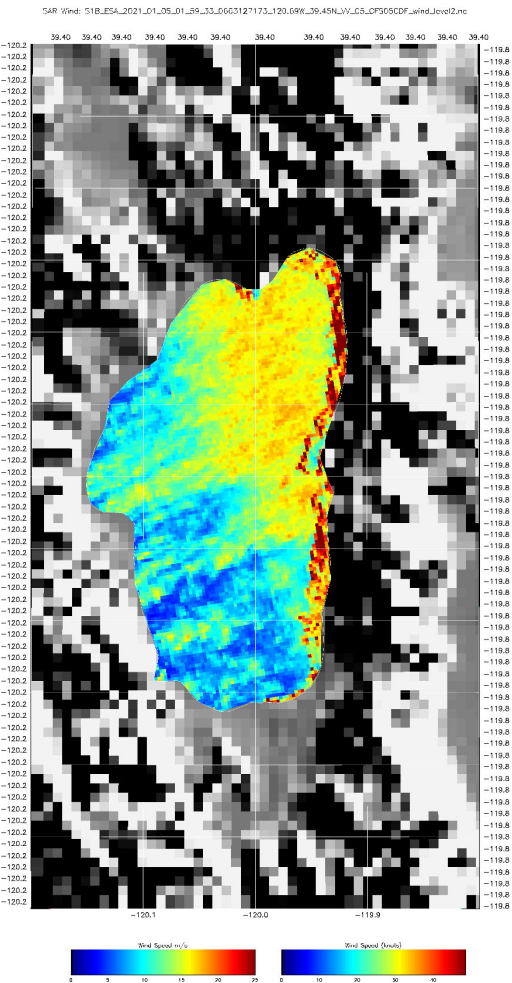

Lake	Area Sq. km
Great Salt Lake	5483
Lake of the Woods	4349
Iliamna Lake	2626
Lake Oahe (man-made)	1774
Lake Okeechobee	1715
Lake Pontchartrain (salt)	1634
Lake Sakakawea (man-made)	1347
Lake Champlain	1269
Becharof Lake	1173
Lake St. Clair	1140
Red Lake	1106
Selawik Lake	1046
Fort Peck Lake (man-made)	1018
Salton Sea (salt)	899
Rainy Lake	894
Devils Lake	777
Toledo Bend Reservoir (man-made)	736
Lake Powell (man-made)	650
Kentucky Lake (man-made)	650
Lake Mead (man-made)	640
Naknek Lake	627
Lake Winnebago	557
Mille Lacs Lake	536
Flathead Lake	497
Lake Tahoe	495

Top 25 Largest Lakes (excluding GL)

CONUS

Alaska

Selawik Lake
Iliamna Lake
Naknek Lake
Becharof Lake

Flathead Lake
Lake Sakakawea
Fort Peck Lake
Devils Lake
Lake of the Woods
Rainy Lake
Red Lake
Lake Winnebago
Lake Champlain
Mille Lacs Lake
Lake Oahe
Great Salt Lake
Lake St. Clair
Lake Tahoe
Kentucky Lake
Lake Powell
Lake Mead
Toledo Bend Reservoir
Salton Sea
Lake Pontchartrain
Lake Okeechobee

Lake Tahoe (California)

Lake Becharof (Alaska)
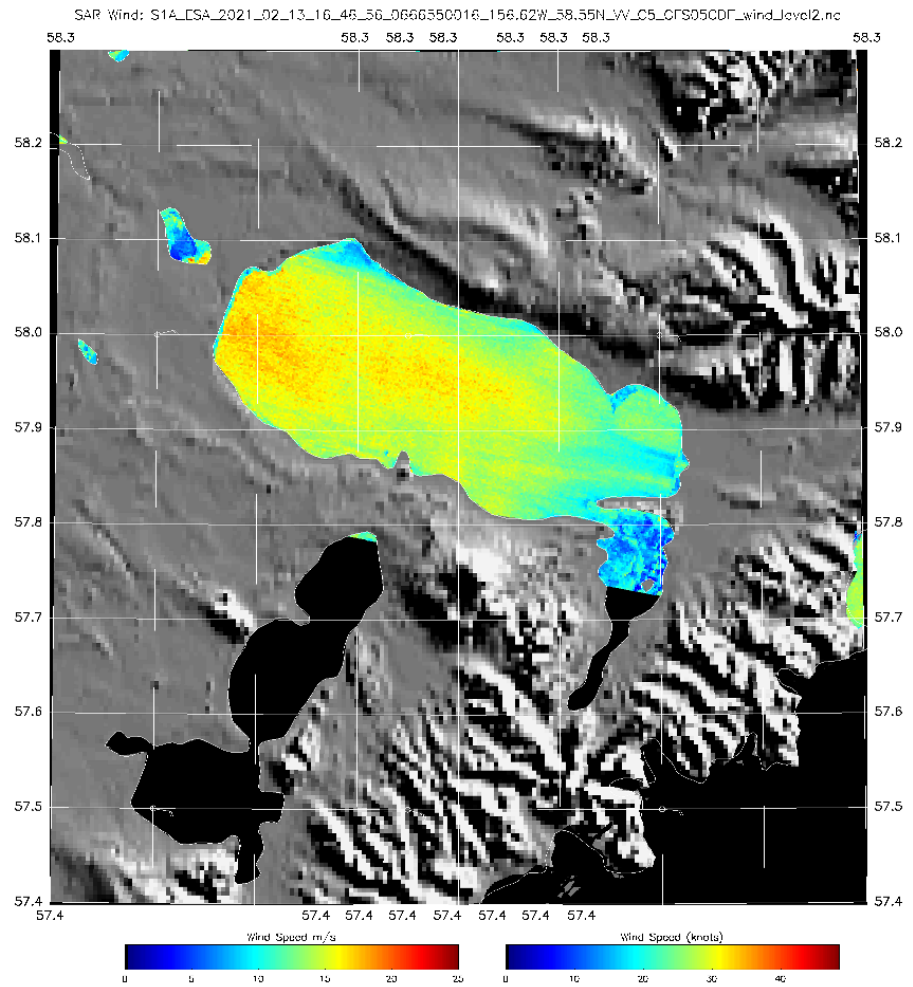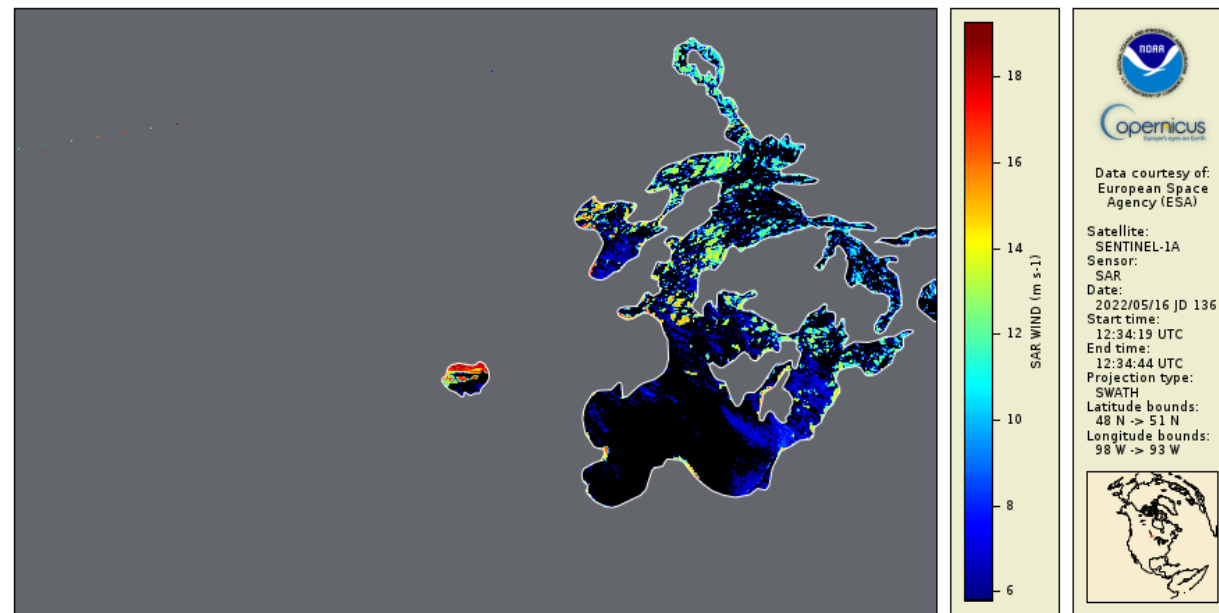
SAR in the CoastWatch Website

- There are future plans to integrate SAR lake wind products into the CoastWatch Data Portal.
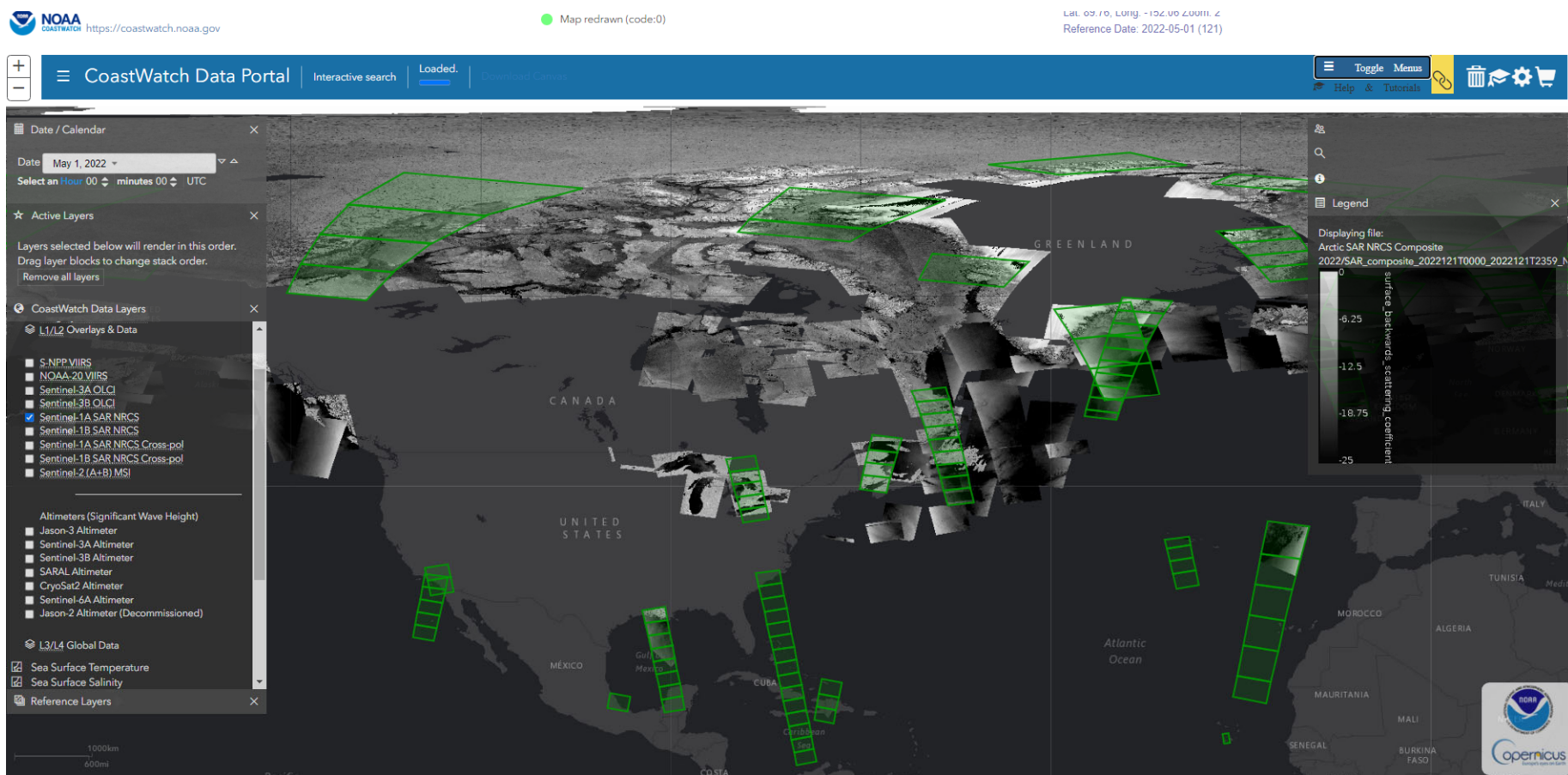
PNG image will provide surface wind speed of lakes with land mask and information about the data (date and time, sensor, etc)

KMLs used to georeferenced the data and direct user to wind image (left) and to NetCDF file download. Frame color varies depending on source.

Questions?