

The new era of SAR time series: Tackling big EO data analysis and visualization with Pangeo tools

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EARTH BIG DATA LLC

PANGEO SHOWCASE Seminar Series
May 12th 2021

Currently featured at the NASA SAR DAAC
at the Alaska Satellite Facility

<https://asf.alaska.edu>

SAR Scientist Highlight



APR 2021 – Rod Boyce

Josef Kelindorfer, PhD

Josef Kelindorfer heartily remembers receiving computer hard drives in the mail containing the data he needed for his research in the 1990s.

Those hard drives came from the Alaska Satellite Facility (ASF), traveling the roughly 4,400 miles to Massachusetts, where he worked at the Woods Hole Research Center, now known as the Woodwell Climate Research Center. Today he is a distinguished visiting scientist at the center but maintaining a strong connection to the satellite facility.

Things have changed mightily since those hard-drive days. He now gets the data he needs from the ASF by tapping on his computer keyboard.

He has been an integral player over his years of official and unofficial connection to the ASF Distributed Active Archive Center (DAAC), which is funded by NASA and part of the University of Alaska Fairbanks Geophysical Institute. And it has shown in the sharp increase in the number of researchers acquiring the data. They tap in from around the globe.

Josef is among the people who they can thank for that.

[Click here to continue the story...](#)

[Read about other SAR scientists that have been featured in the past.](#)



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About Us

The Alaska Satellite Facility downlinks, processes, archives, and distributes remote-sensing data to scientific users around the world. ASF's mission is to make remote-sensing data accessible.

[Read More](#)

Contact Info

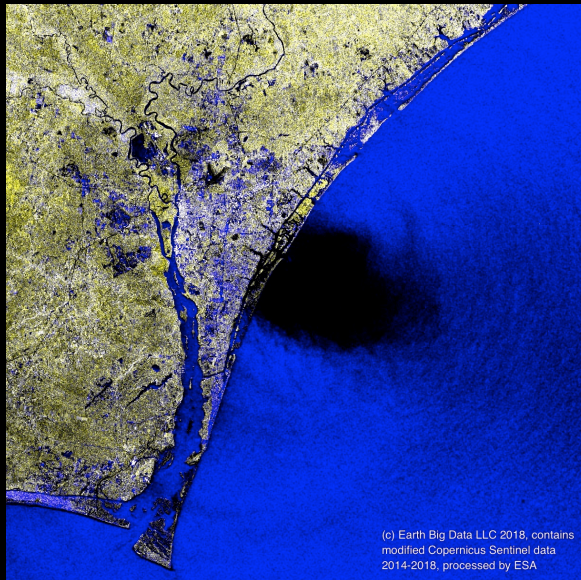
Alaska Satellite Facility
2156 Koyukuk Drive
Fairbanks, AK 99775
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uso@asf.alaska.edu

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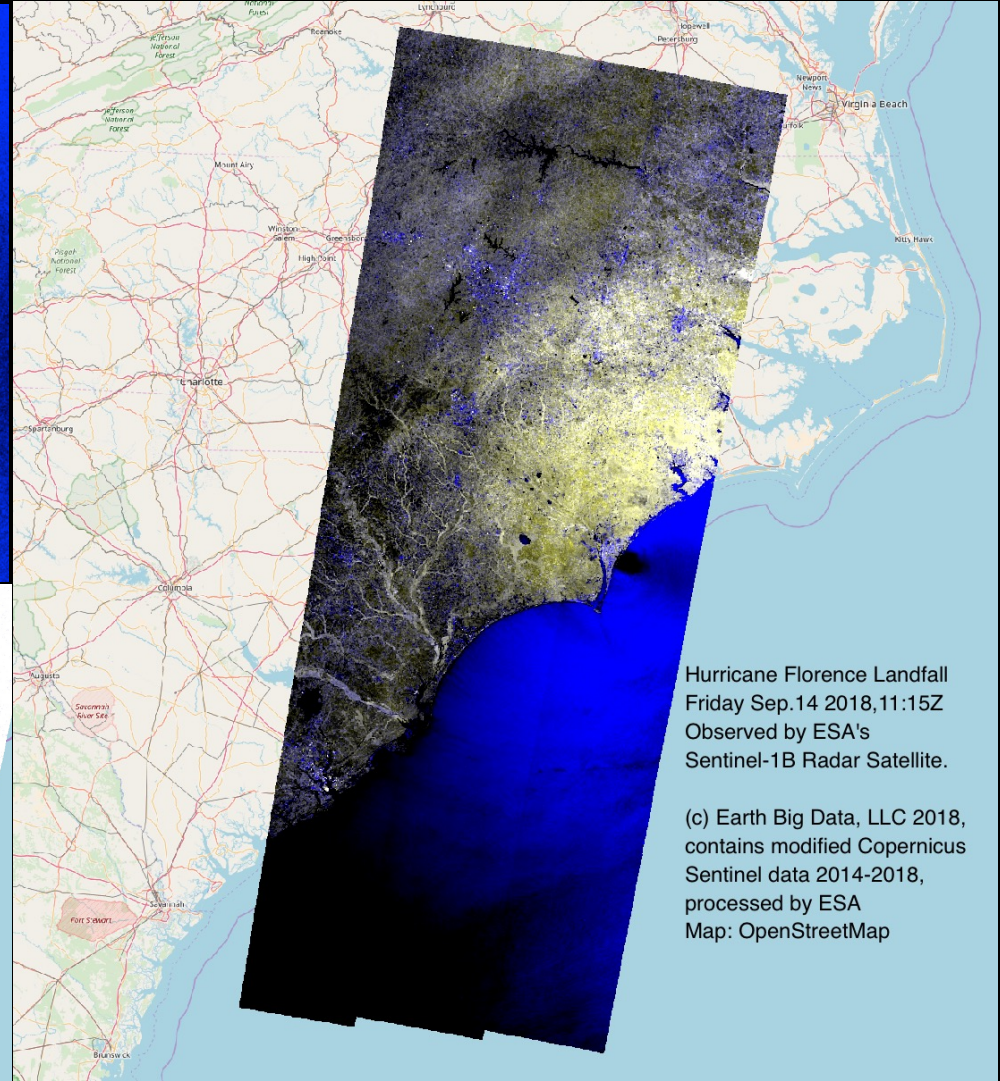
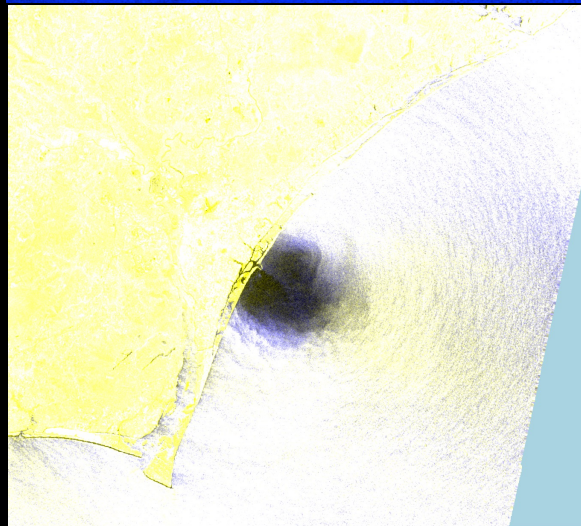
What makes SAR remote sensing so exciting?

- All-weather mapping of the planet (microwaves penetrate clouds)
- All-season monitoring (e.g., ice dynamics in Arctic and Antarctic winters)
- Fully coherent, active remote sensing technology:
 - Measurement of phase and magnitude of a signal -> interferometry, coherence, backscatter metrics
 - Can be accurately calibrated over space and time
- Consistency of measurements:
 - Signal changes relate to changes of the target, with same illumination geometry
 - Simplified: Changes in the signal are changes in **structure** or **moisture (dielectric)**
- **Invaluable tool for monitoring Earth. With applications in science, natural resource management, and policy decisions at local and global scale.**

Hurricane Florence Landfall Sep 14th 2018



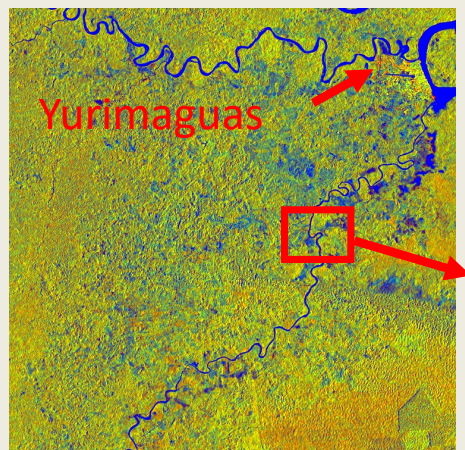
(c) Earth Big Data LLC 2018, contains modified Copernicus Sentinel data 2014-2018, processed by ESA



Hurricane Florence Landfall
Friday Sep.14 2018, 11:15Z
Observed by ESA's
Sentinel-1B Radar Satellite.

(c) Earth Big Data, LLC 2018,
contains modified Copernicus
Sentinel data 2014-2018,
processed by ESA
Map: OpenStreetMap

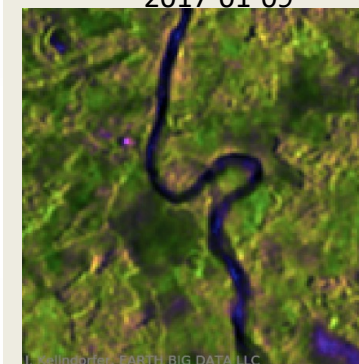
Birth of an Oxbow Lake in Yurimaguas, Peru, observed by Sentinel-1 (C-band)



Sentinel-1 C-VV/C-VH/Ratio Yurimaguas, Peru (Lon -76.1701 Lat -5.9906):
2017-01-09



2017-01-09

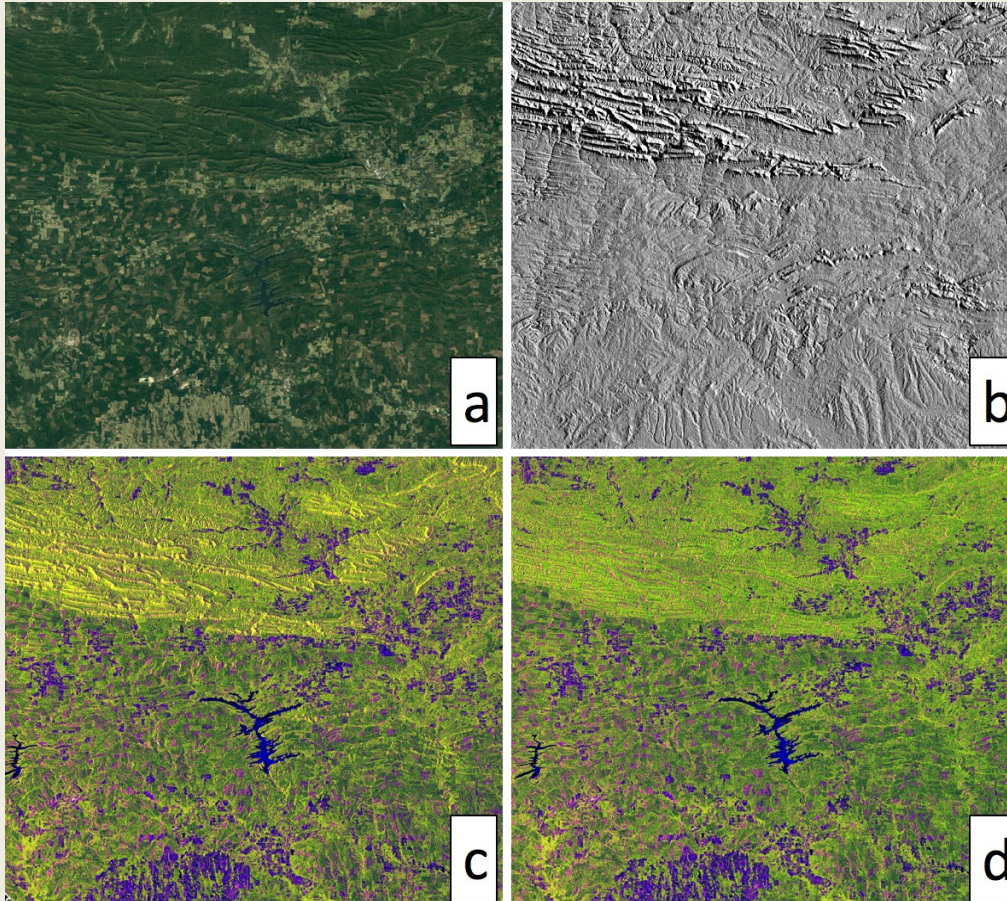


2019-10-02



SAR Radiometric Terrain Correction and Time Series Generation

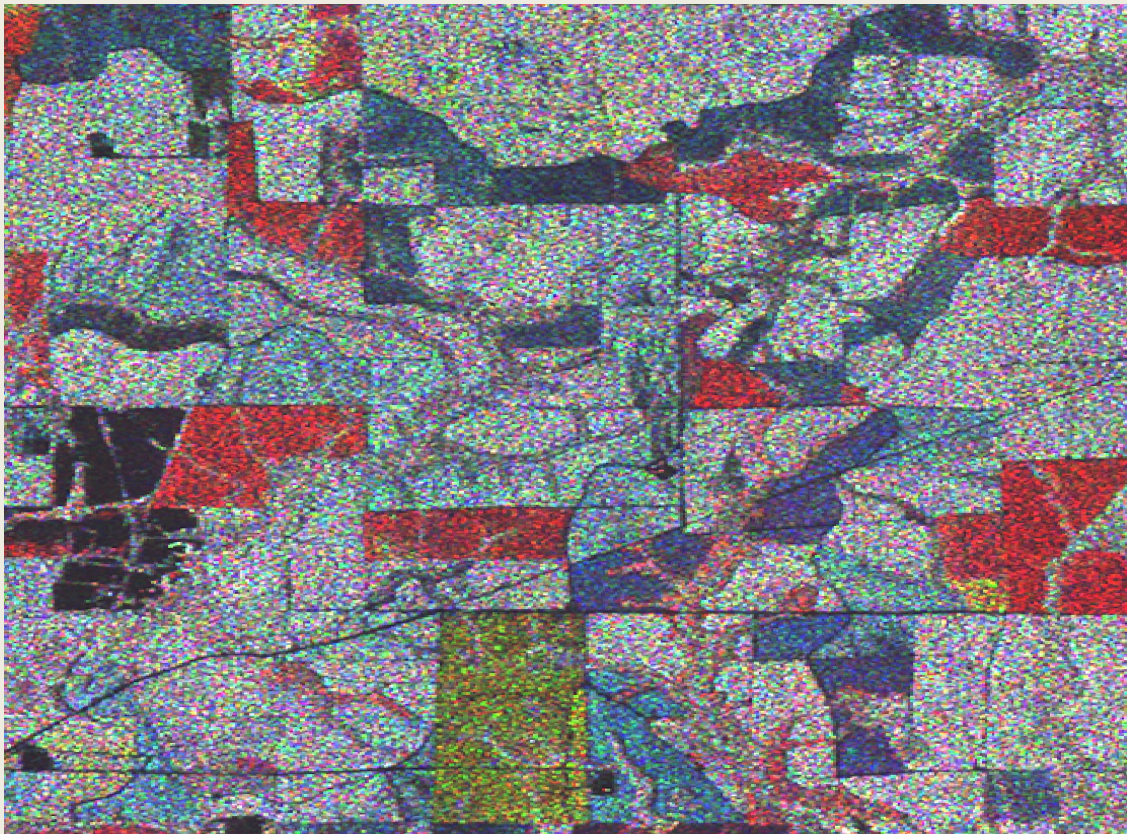
- a) Optical
- b) DEM
- c) Sigma0
- d) Gamma0 RTC



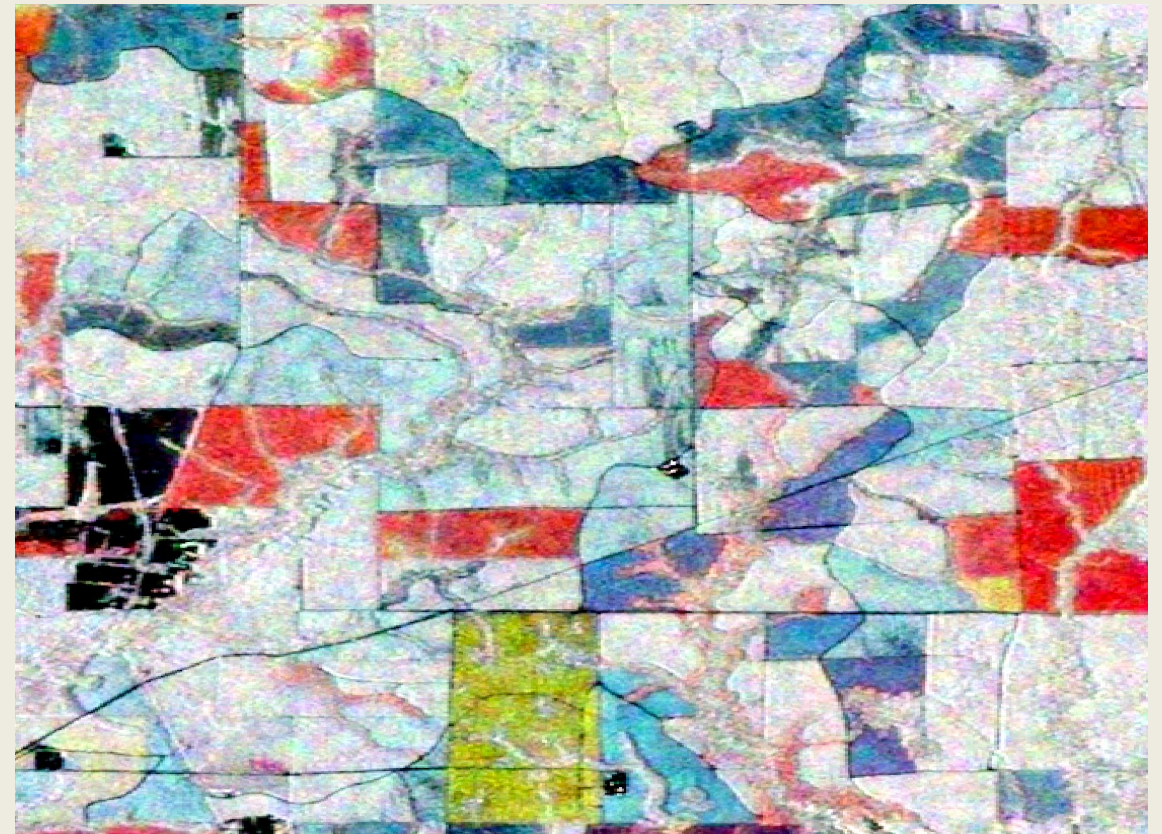
- Key to viable time series production:
 - Excellent geometric accuracy (processing with precision orbits and high quality DEMs)
Follow the real estate principle: 'Location, location, location'!
 - Excellent radiometric calibration (noise floor subtraction, scattering area-based pixel calibration, incidence angle dependency accounting)
- EBD has developed fully automated cloud-scalable processing chains addressing these criteria for all major Spaceborne and airborne SAR sensors

SAR Signal Enhancement: Multi-temporal Speckle Noise Filter

Before Filter Application

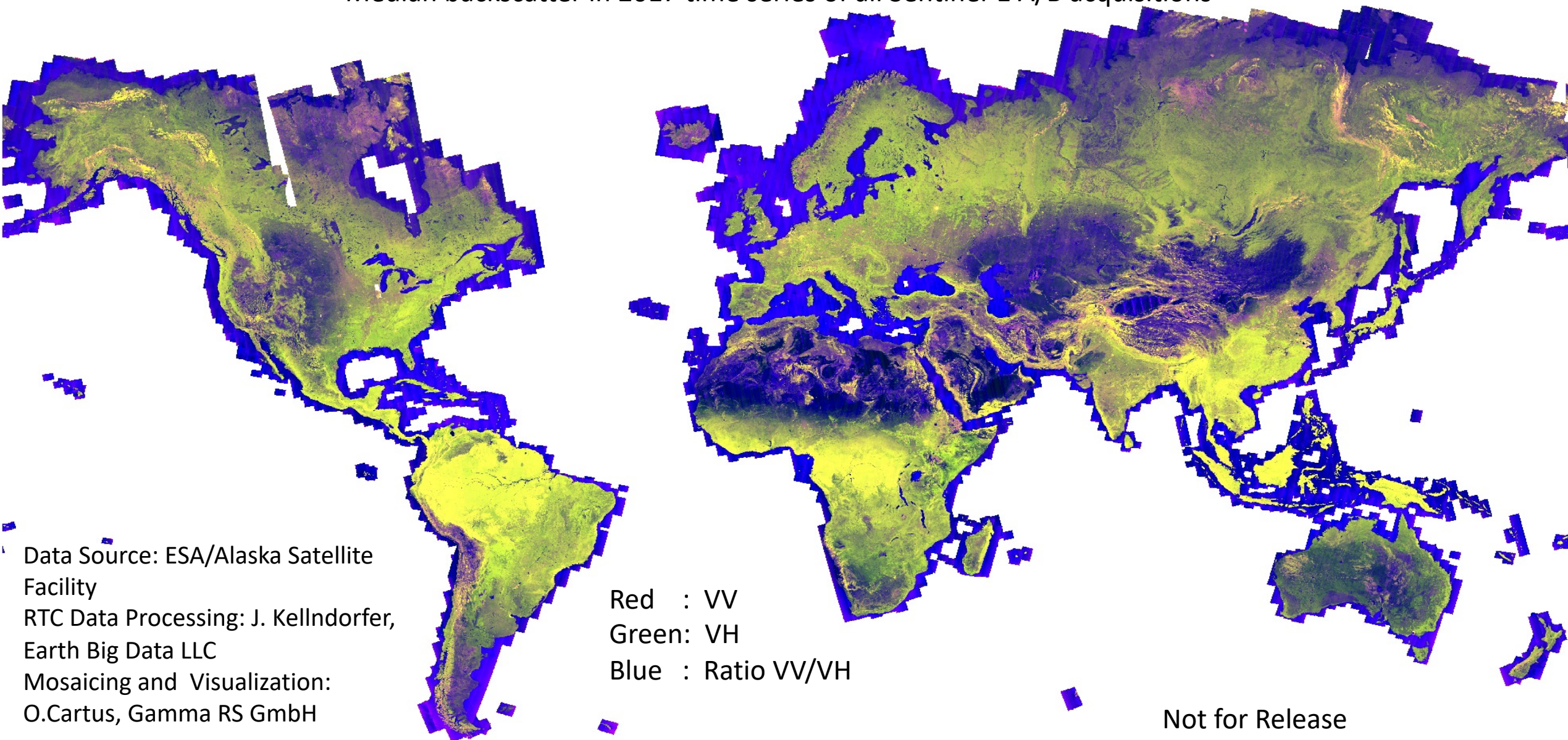


After Filter Application



2017 Sentinel-1 Backscatter of Earth

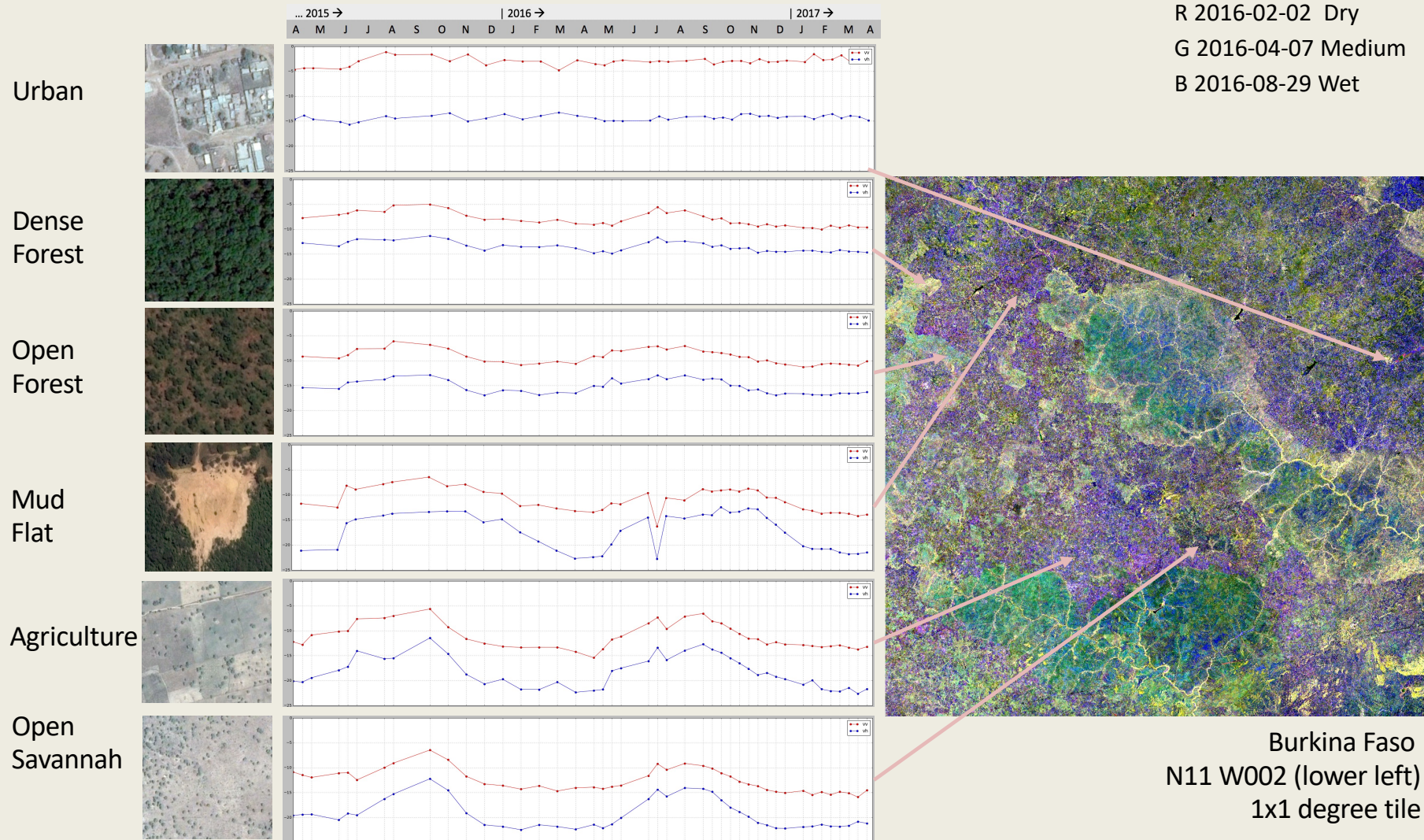
Median backscatter in 2017 time series of all Sentinel-1 A/B acquisitions



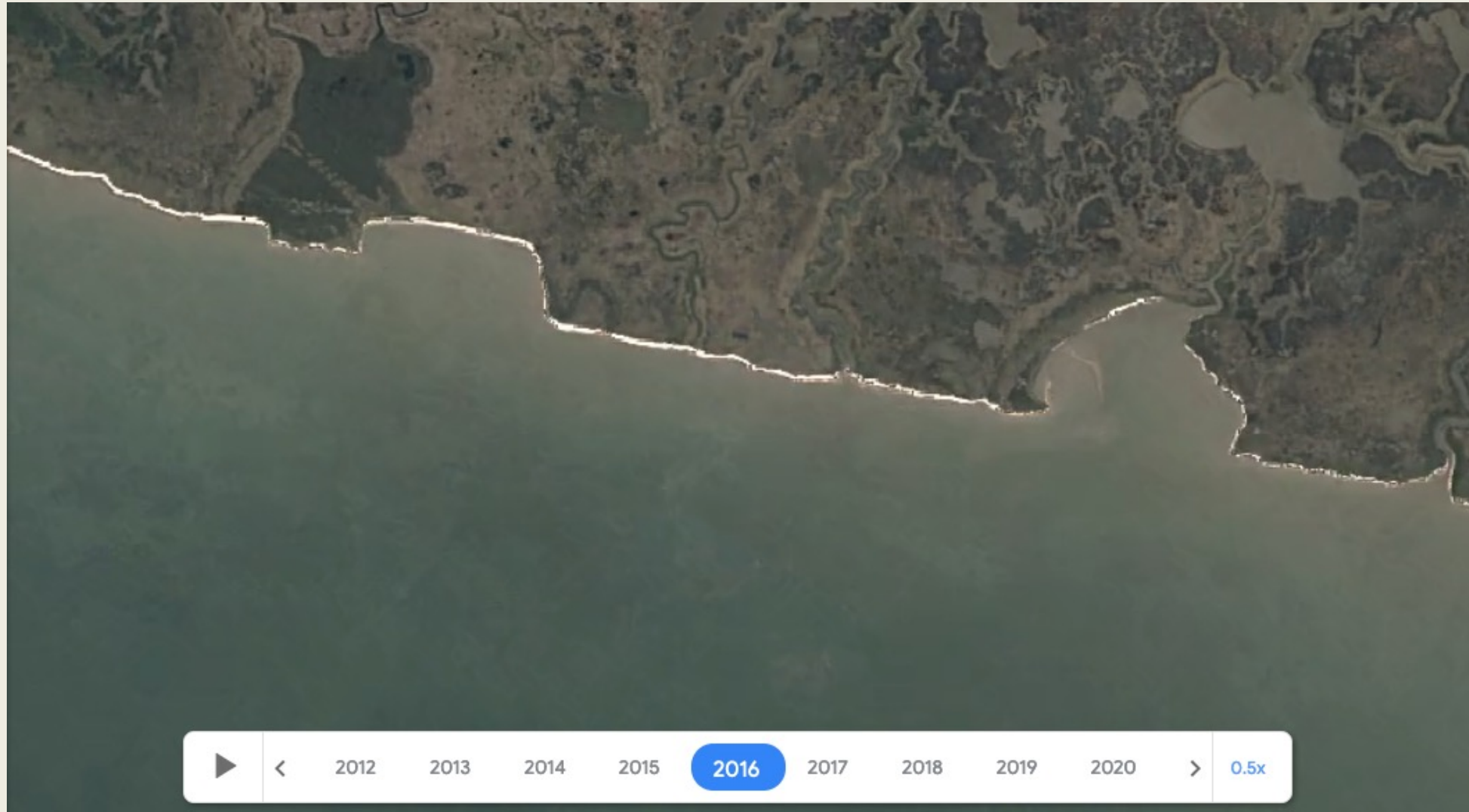
Data Source: ESA/Alaska Satellite
Facility
RTC Data Processing: J. Kellndorfer,
Earth Big Data LLC
Mosaicing and Visualization:
O.Cartus, Gamma RS GmbH

Not for Release

Sentinel-1 Time Series in Arid Environments

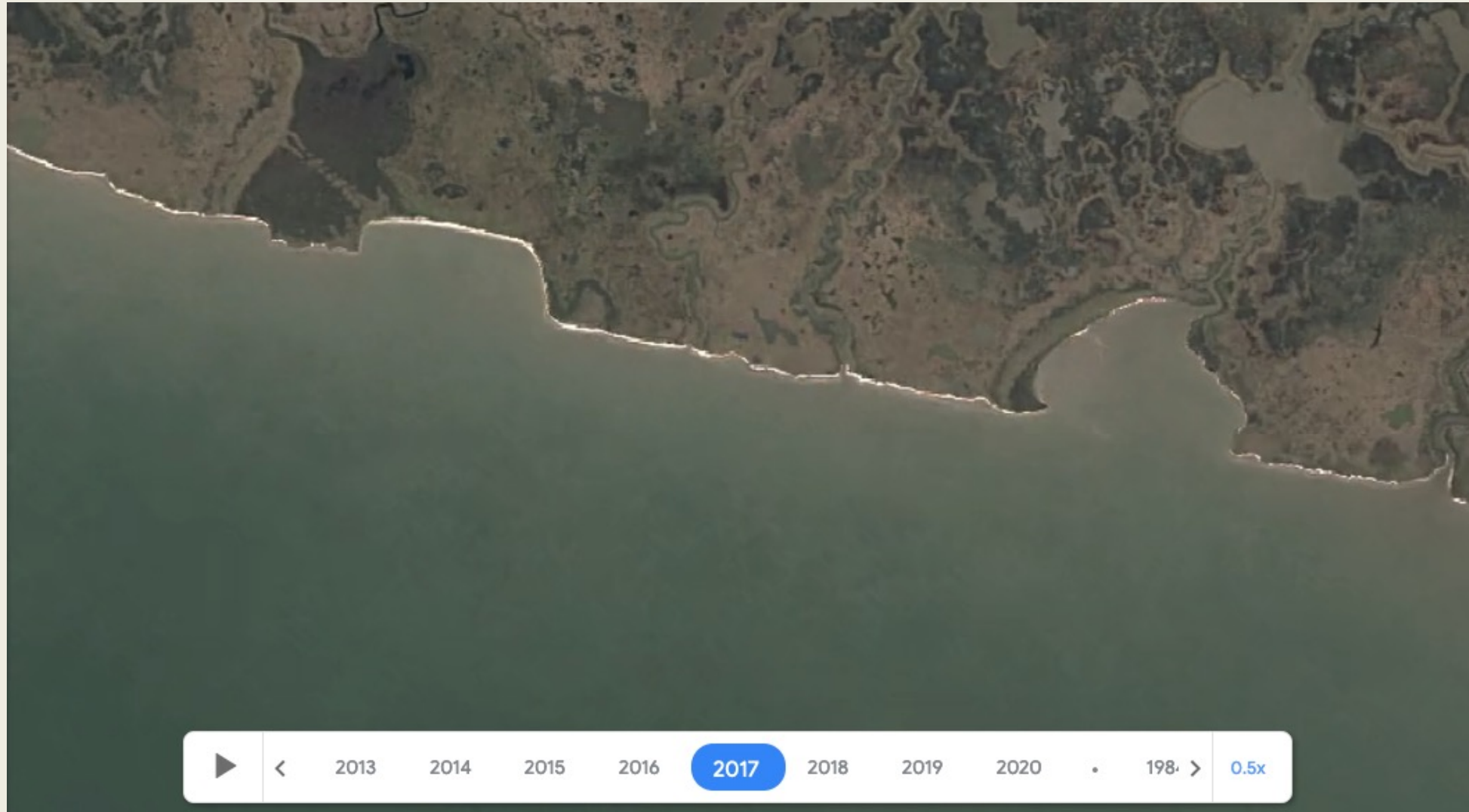


Gulf Coast Erosion



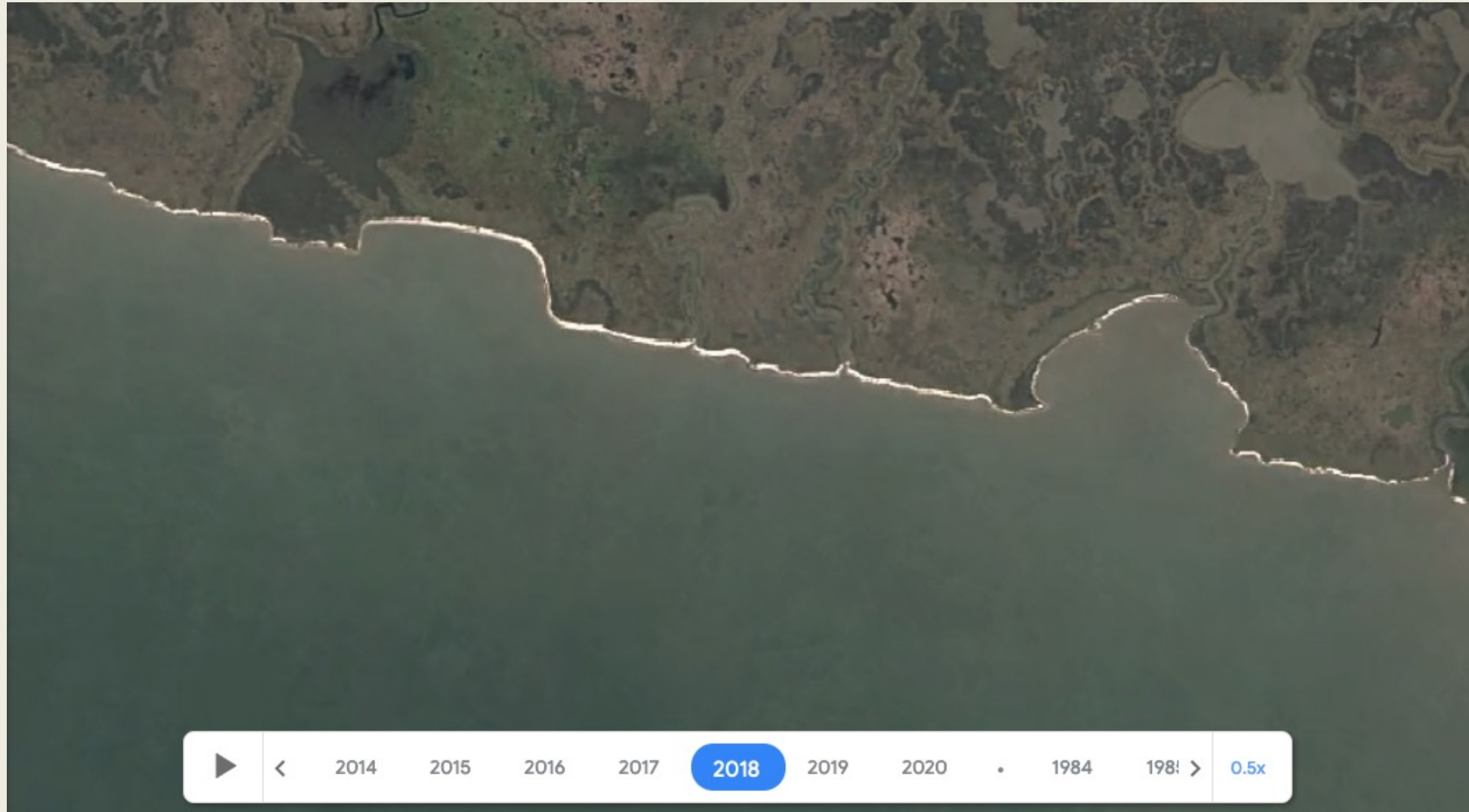
Source: <https://earthengine.google.com/timelapse/>

Gulf Coast Erosion



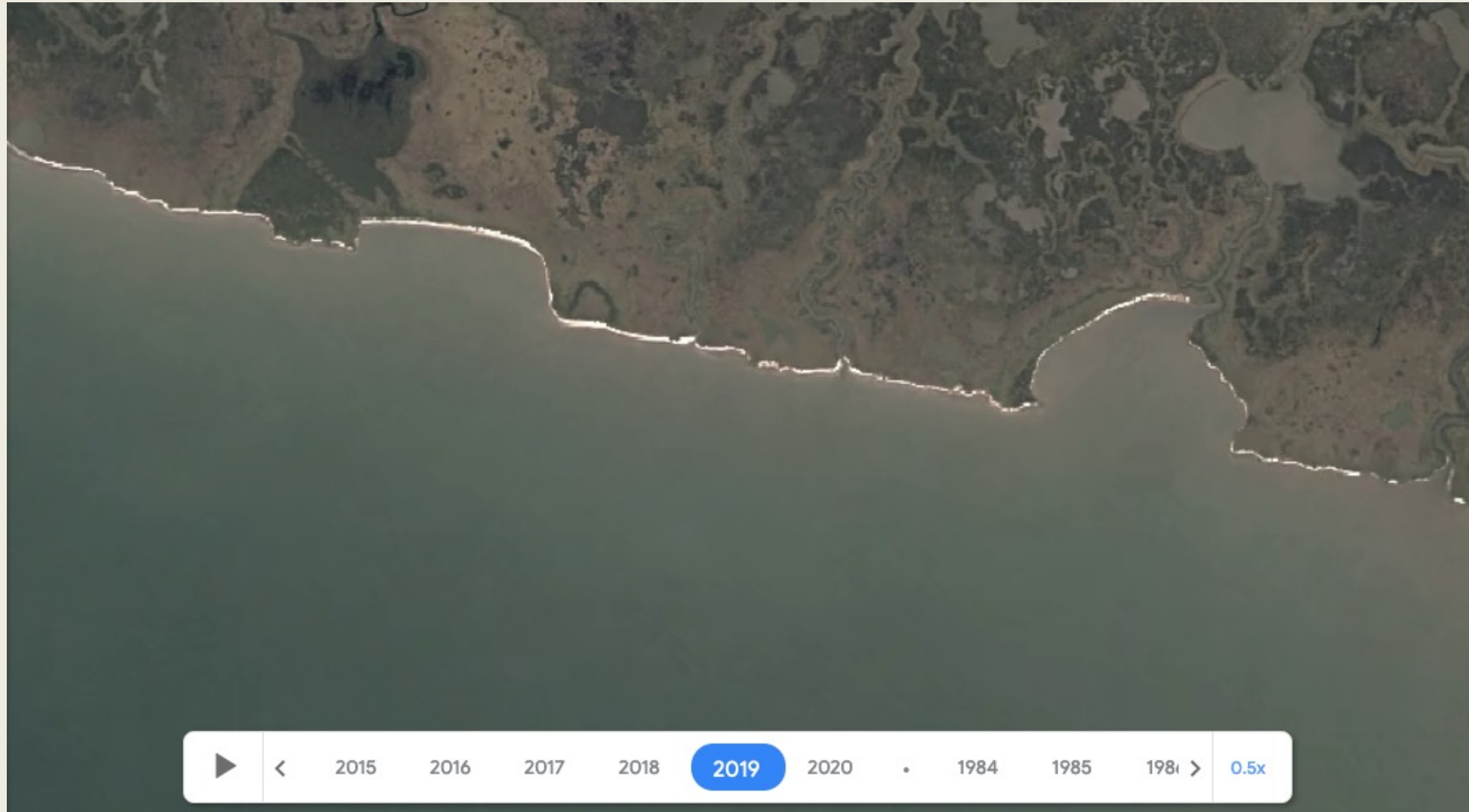
Source: <https://earthengine.google.com/timelapse/>

Gulf Coast Erosion



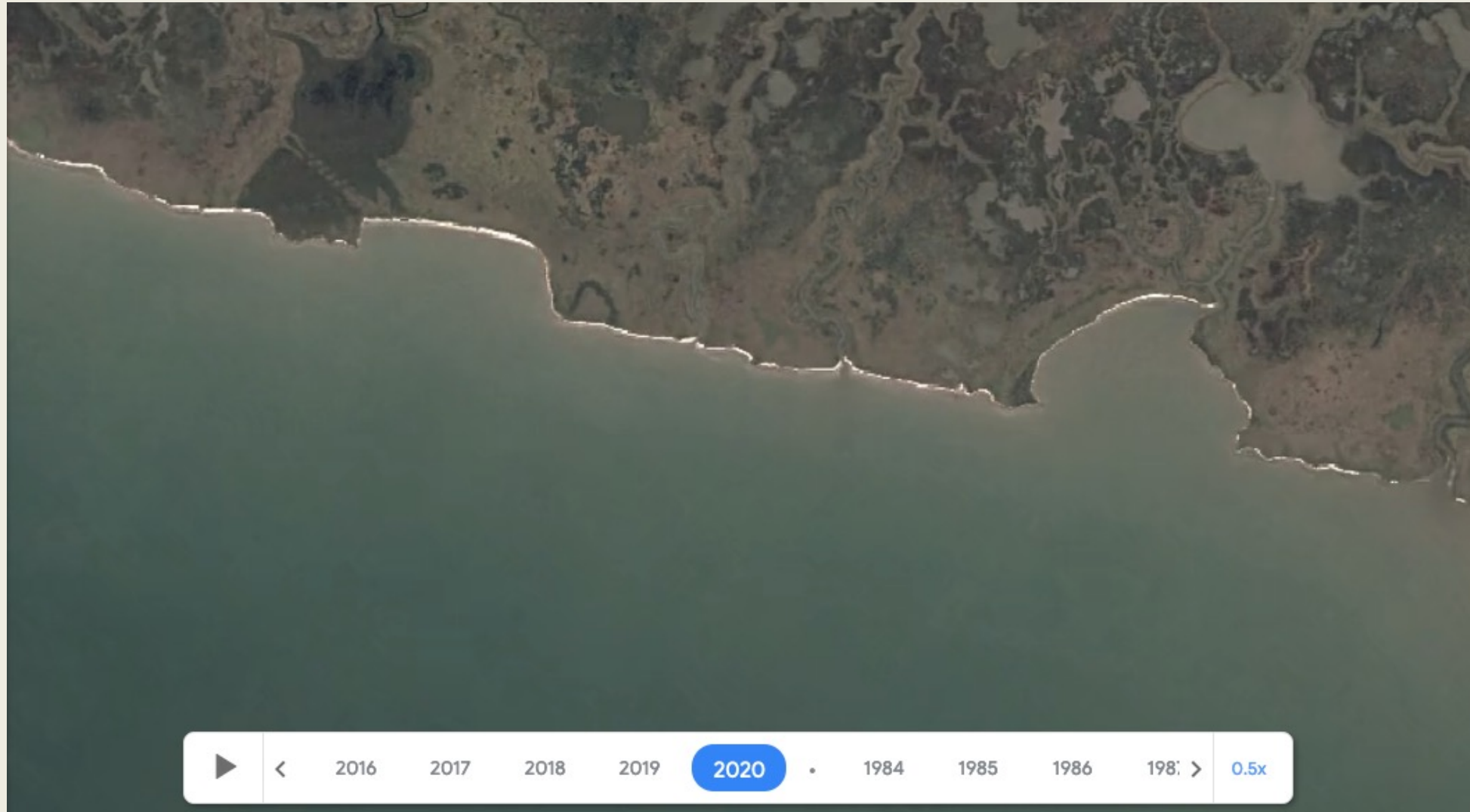
Source: <https://earthengine.google.com/timelapse/>

Gulf Coast Erosion



Source: <https://earthengine.google.com/timelapse/>

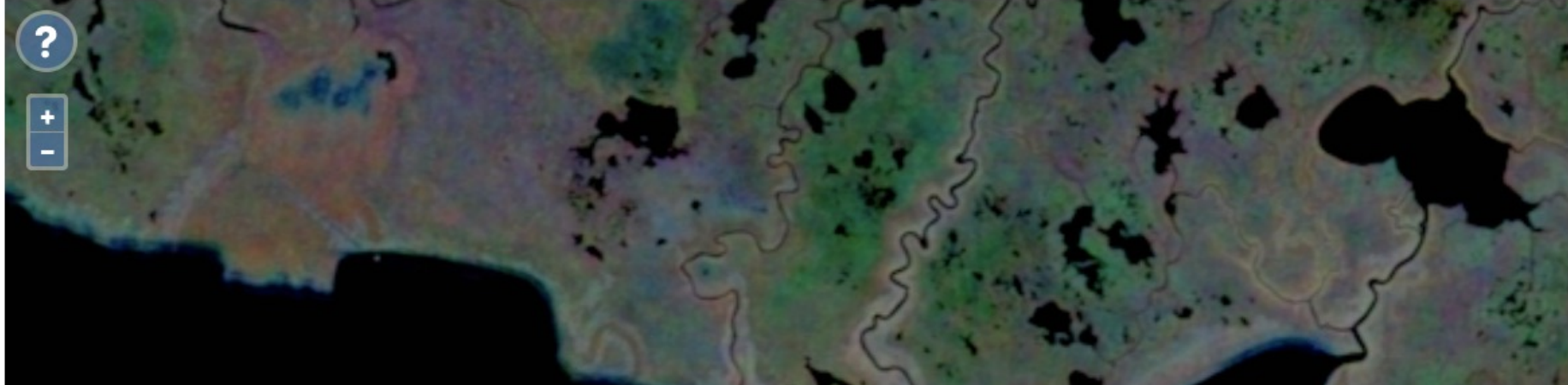
Gulf Coast Erosion



Source: <https://earthengine.google.com/timelapse/>

Sentinel-1 Observations

EARTH BIG DATA



Date Selection (UTC)

Range Year over Year

Start:

End:

Data Source

Sentinel-1

Flight Direction

ASC DESC ALL

Bands

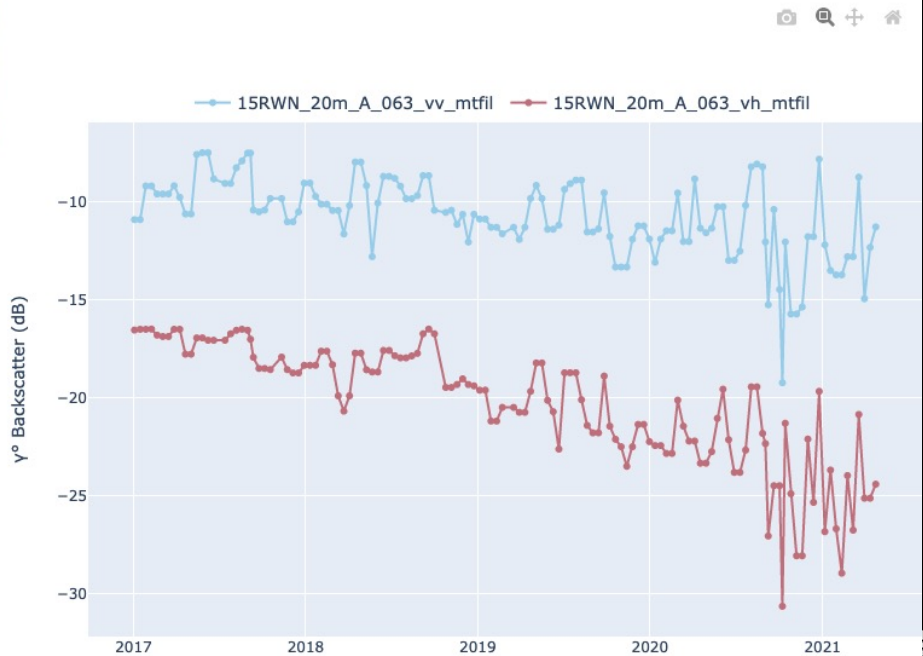
VV VH ALL

Generated Images

(-92.5885, 29.5823)

- 15RWN_20m_A_063_vh_mtfil @2021-04-24
- 15RWN_20m_A_063_vh_mtfil @2019-04-23
- 15RWN_20m_A_063_vh_mtfil @2017-04-21

Timeseries at (-92.5901W, 29.5826N)



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Our Challenge

- SAR data availability is exploding (thanks to open data policies)
 - Sentinel-1 since 2014 with 6 to 12 day repeat coverage of the planet (delivers about 1.5 Pbyte/year or 4 TB/day in single look complex SAR format)
 - NISAR mission (launch 2022/2023) slated to deliver 100TB/day of science data
- Need cloud-based strategies for raw SAR data processing into Analysis Ready Data (ARD) streams
- Need visualization and analytic tools to reduce the high-spatio-temporal resolution data streams into meaningful presentation online and offline

-> Harness the excellent suite of open source tools developed by PANGEO, Qhub, and friends.

SAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation

Published: Apr 09 2019

The SAR Handbook: Comprehensive Methodologies for Forest Monitoring and Biomass Estimation is the culmination of a two-year collaboration between NASA SERVIR and SilvaCarbon. Five trainings, led by six SAR subject matter experts, were held at hubs throughout the SERVIR network. The topics of these trainings included SAR basics, SAR for forest change detection, forest height estimation, biomass estimation, mangrove monitoring, and sampling design. Each of these training topics are covered in a SAR Handbook chapter, which includes the theoretical basics and applied exercises. You can download the entire SAR Handbook (PDF) below, or explore individual chapters, trainings and one-pagers.

SERVIR GLOBAL 



[Click the image above to download the entire SAR Handbook.](#)

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Chapter 1: Introduction and Rationale

Chapter 2: Spaceborne Synthetic Aperture Radar: Principles, Data Access, and Basic Processing Techniques

Chapter 3: Using SAR Data for Mapping Deforestation and Forest Degradation

Chapter 4: Forest Stand Height Estimation

Chapter 5: SAR Methods for Mapping and Monitoring Forest Biomass

Chapter 6: Radar Remote Sensing of Mangrove Forests

Chapter 7: Sampling Designs for SAR-Assisted Forest Biomass Surveys

Chapter 8: Perspectives on the Future Application of SAR in Forest and Environmental Monitoring

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