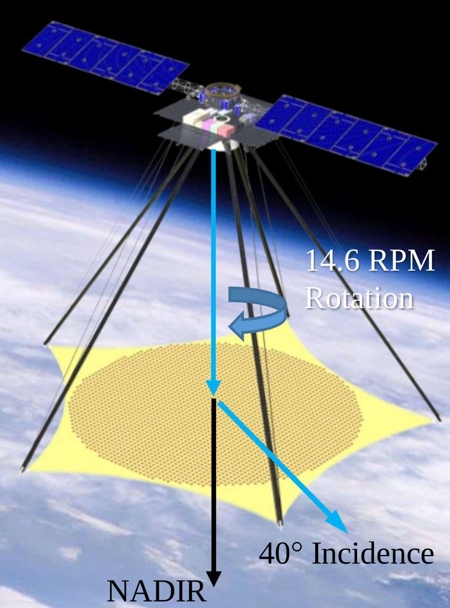
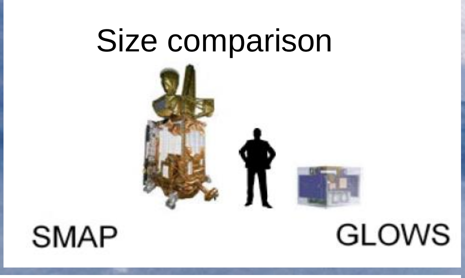
The Global L-band Observatory for Water Cycle Studies (GLOWS): High Resolution L-band Wind Speeds

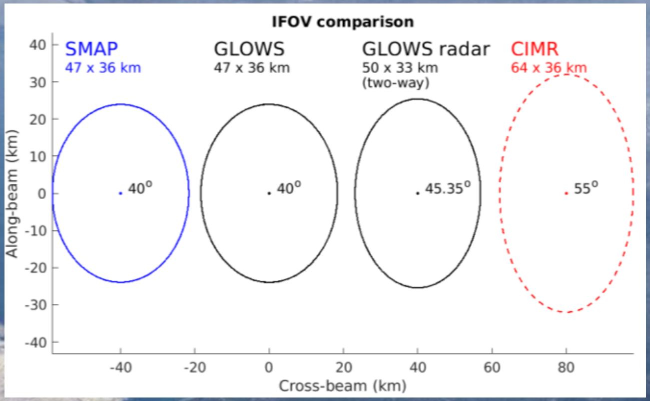
David G. Long, Rajat Bindlish, Jeffrey Piepmeier, and Mark Bailey

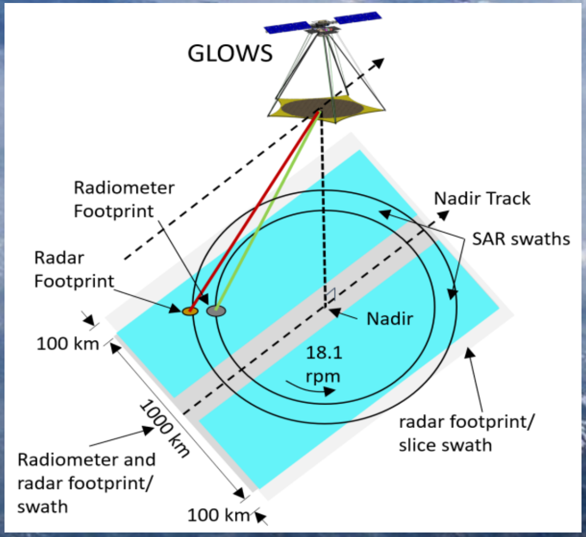
IOVWST Meeting May 2025

- **GLOWS is L-band follow-on to SMAP**
  - **Radiometer + High resolution Radar**
  - **2.6 km, 6 km, 36km quad-pol radar**
  - **Rain insensitive wind speed, salinity, sea ice**
- **Meta-material lens antenna**
- **Updated electronics**
- **Small, low-cost**
- **SMAP-like performance**









MICROWAVE EARTH REMOTE SENSING BRIGHAM YOUNG UNIVERSITY

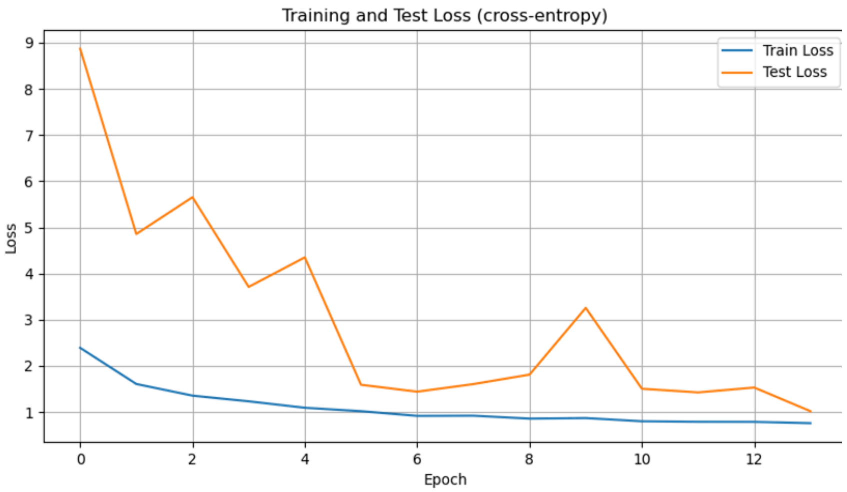
MMA Design

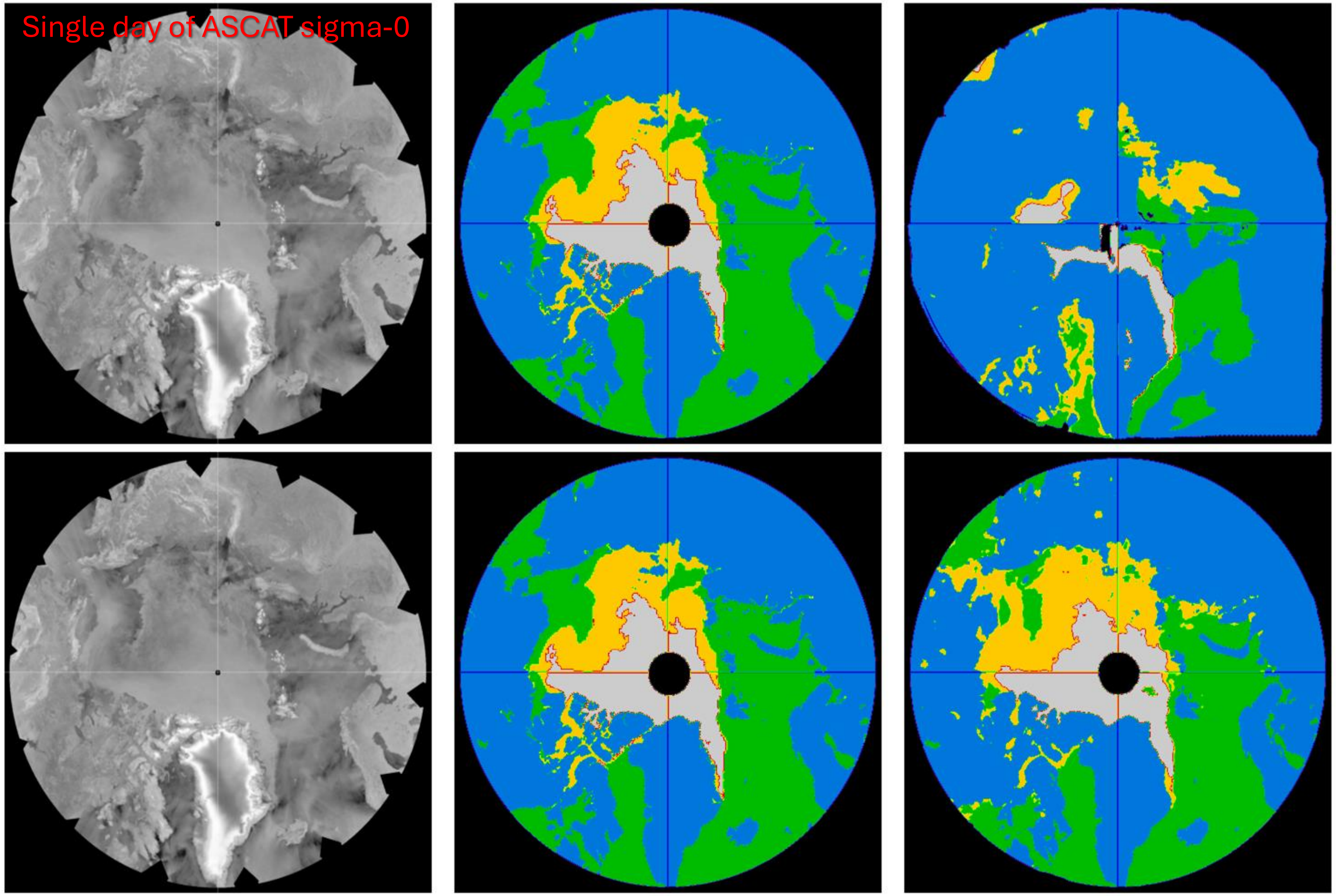
NASA

Arctic Sea Ice Extent Mapping Using Artificial Intelligence

Nathan Roberts, David G. Long
Brigham Young University

A combination of class classification and an AI UNet architecture convolutional neural networks has been successfully trained to map sea ice in ASCAT images. The UNet model effectively captures the primary spatial patterns of Arctic sea ice in ASCAT data without requiring further input.



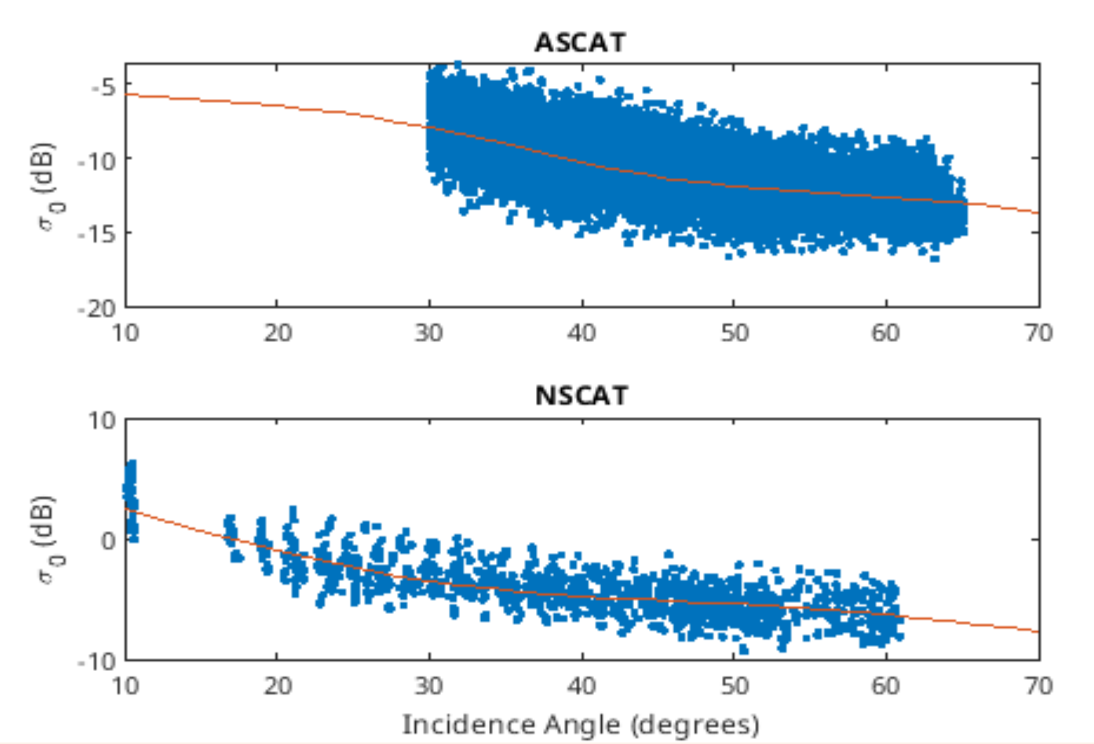


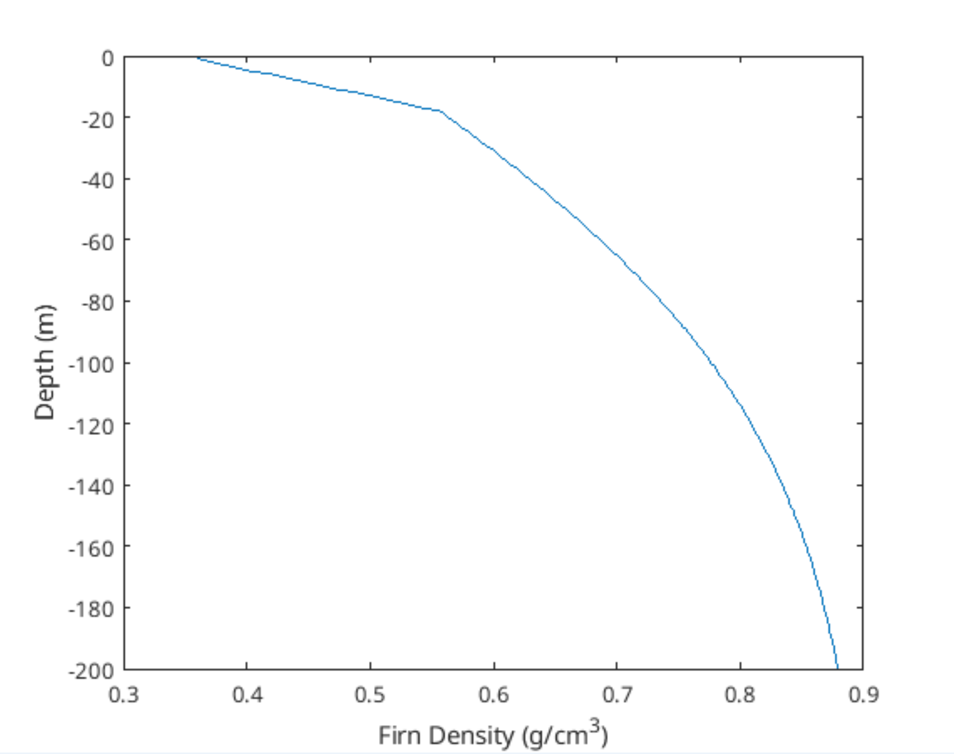
Left to right: original grayscale sigma-0 image, labelled image, and model result.
Top row: one epoch of training. Bottow row: 14 epochs of training

Antarctica Ice Modeling for Cross-Calibration

Volume Component — Surface Component

$$\sigma_0 = 10\log_{10}[\underbrace{\sigma_v(\theta_i)M_v(\theta_a)}_{\text{Volume Component}} + \underbrace{\sigma_s(\theta_i)M_s(\theta_a)}_{\text{Surface Component}}] + \mathbf{C}$$





Data denial experiments of scatterometer winds in the JMA's global data assimilation system

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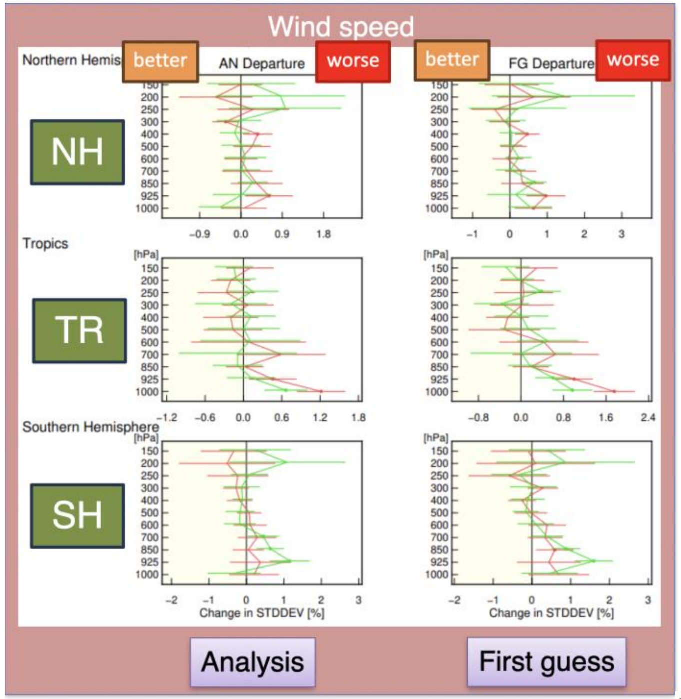
Objective:

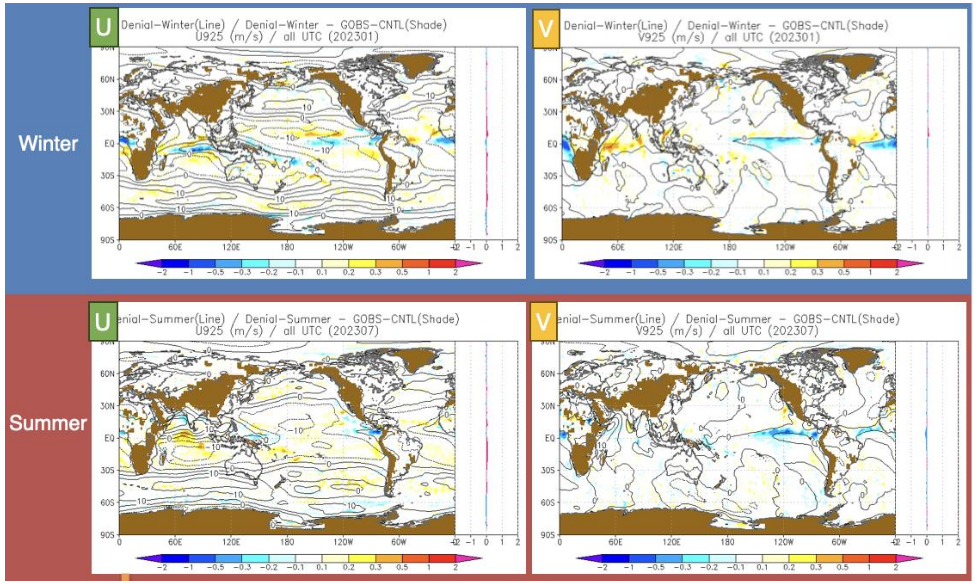
To estimate the contribution of scatterometer OVWs data in the current JMA global data assimilation system.

Presentation Overview:

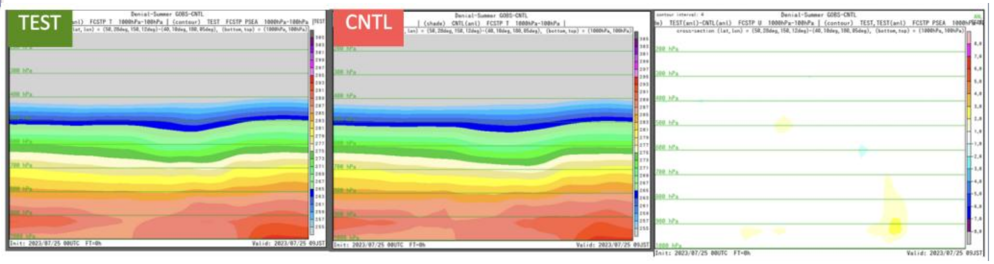
This study presents the impact of a denial experiment of scatterometer OVWs on both the analysis and forecasts within the JMA global data assimilation system.



Change in normalized standard deviation(STDDEV) of the analysis and first-guess departure.
$(STDDEV_{BASE}-STDDEV_{CNTL})/STDDEV_{CNTL}$) for AMV wind observations(Red: Summer, Green: Winter)
Error bars represent 95% confidence intervals, and dots are statistically significant.



Change in the mean analysis field of 925 hPa wind(U, V).



Vertical cross-section field of temperature(left, mid) and difference of U-component wind(TEST-CNTL) at 00UTC on 25th Jul. 2023(right).

Let Us Help Tell Your Research Story: In Two (Painless) Ways!

Annette deCharon, ODYSEA LLC, avdecharon@gmail.com
Mark Bourassa, Florida State University, bourassa@coaps.fsu.edu

Openly sharing data and findings allows researchers to build upon each other's work, potentially leading to new discoveries and better understanding of complex issues. – The National Academies

#1 We Can Help You Craft a One-pager Based on a Publication

- **The target audience is NASA HQ. While experts in their own fields, they may not be familiar with ocean vector winds (or even Earth science). The goal is to convey the *key outcomes* of your work in a *clear and concise* manner.**

Sharing research findings helps bridge the gap between scientific experts and the general public, promoting greater understanding and engagement with science. – The National Academies

#2 We Can Create an Interactive Story Based on a Publication or Other Topic

- **The target audience is the interested public. The goal is to convey the *societal relevance* of your work in an *engaging and interactive* way. These products have a lot of images, animations, and can include mapped data (e.g., on a rotatable globe).**

Our poster outlines the steps for creating these products & provides examples.

C- AND KU-BAND ENHANCED-RESOLUTION RADAR BACKSCATTER IMAGE PRODUCTS

J. Z. Miller[1] & D. G. Long[2]

[1]Earth Science and Observation Center, CIRES, University of Colorado Boulder; [2]Department of Electrical and Computer Engineering, Brigham Young University

Funded by: NASA Ocean Vectors Winds Science Team

Long-term studies of global climate can benefit from a retrospective analysis of past satellite missions.

We have developed new C- and Ku-band enhanced-resolution radar backscatter o° image products that are derived from five satellite scatterometry missions:

(1) ESA European Remote Sensing (ERS) mission in scatterometer-mode (ESCAT) (1992-2001), 5.3 GHz (C-band)

(2) NASA Quick Scatterometer (QuikSCAT) and SeaWinds (1999-2010) missions,13.995 GHz (Ku-band)

(3) NASA RapidScat (2014-2016) mission, 13.6 GHz (Ku-band)

(4) ESA Advanced SCATterometer (ASCAT) mission (2008-present), 5.225 GHz (C-band)

(5) the NASA/JAXA Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (TRMM-PR) (1997-2014), 13.88 GHz (Ku-band)

These multi-frequency satellite scatterometry missions provide global o° spanning more than three decades that are unique benchmarks for studying climate change over the Earth's surface, particularly over rapidly warming ice-covered surfaces, such as Greenland, Antarctica, and High Mountain Asia.

The new enhanced-resolution o° image products are consistently-processed and compatibly-gridded with existing enhanced-resolution o° and microwave brightness temperature (T^B) image products that date as far back as 1978.

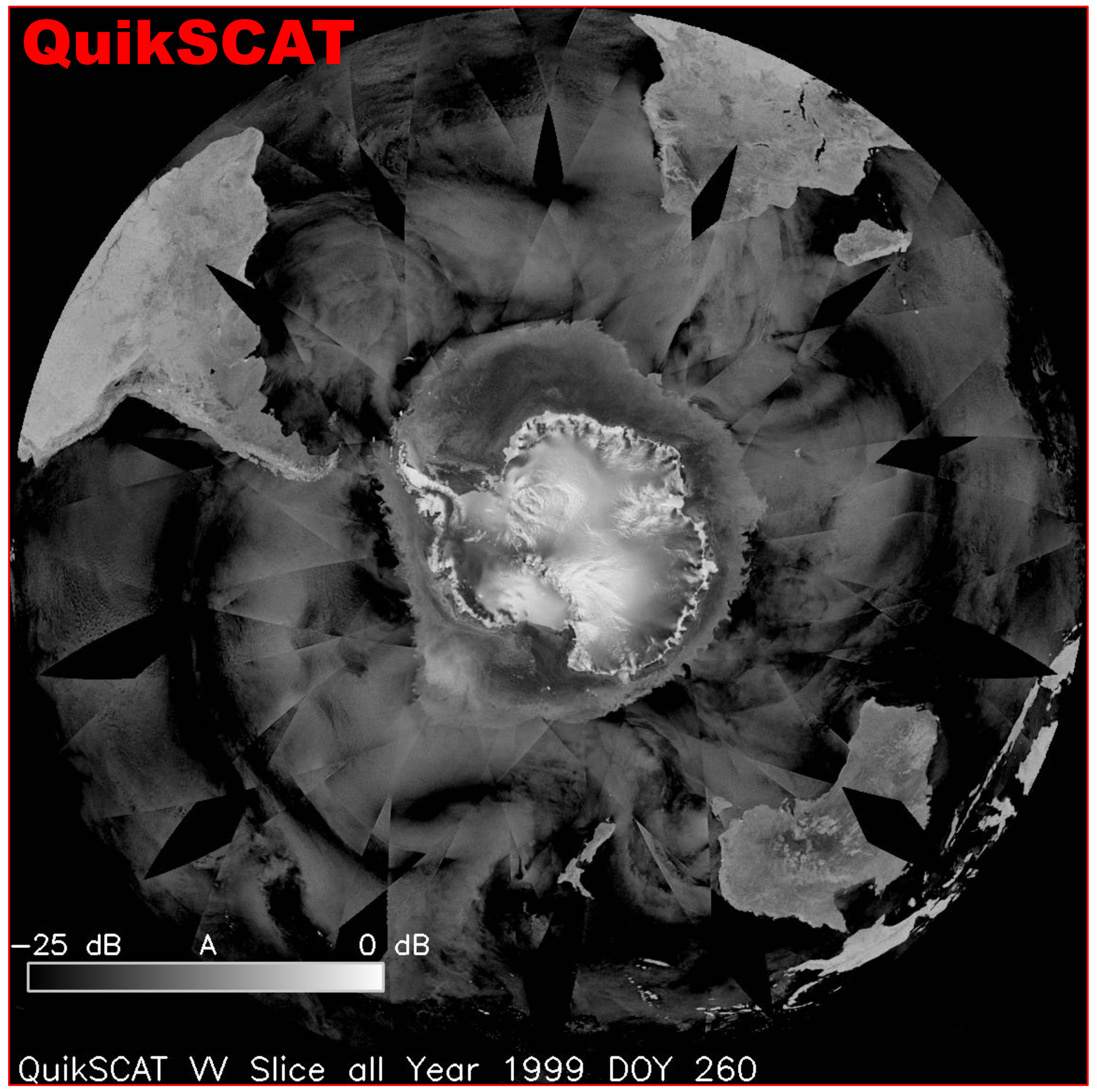


Figure 1: Visualization of an example VV-polarization QuikSCAT image of the Southern Hemisphere created from one day of QuikSCAT slice measurements collected on DOY 260, 1999.

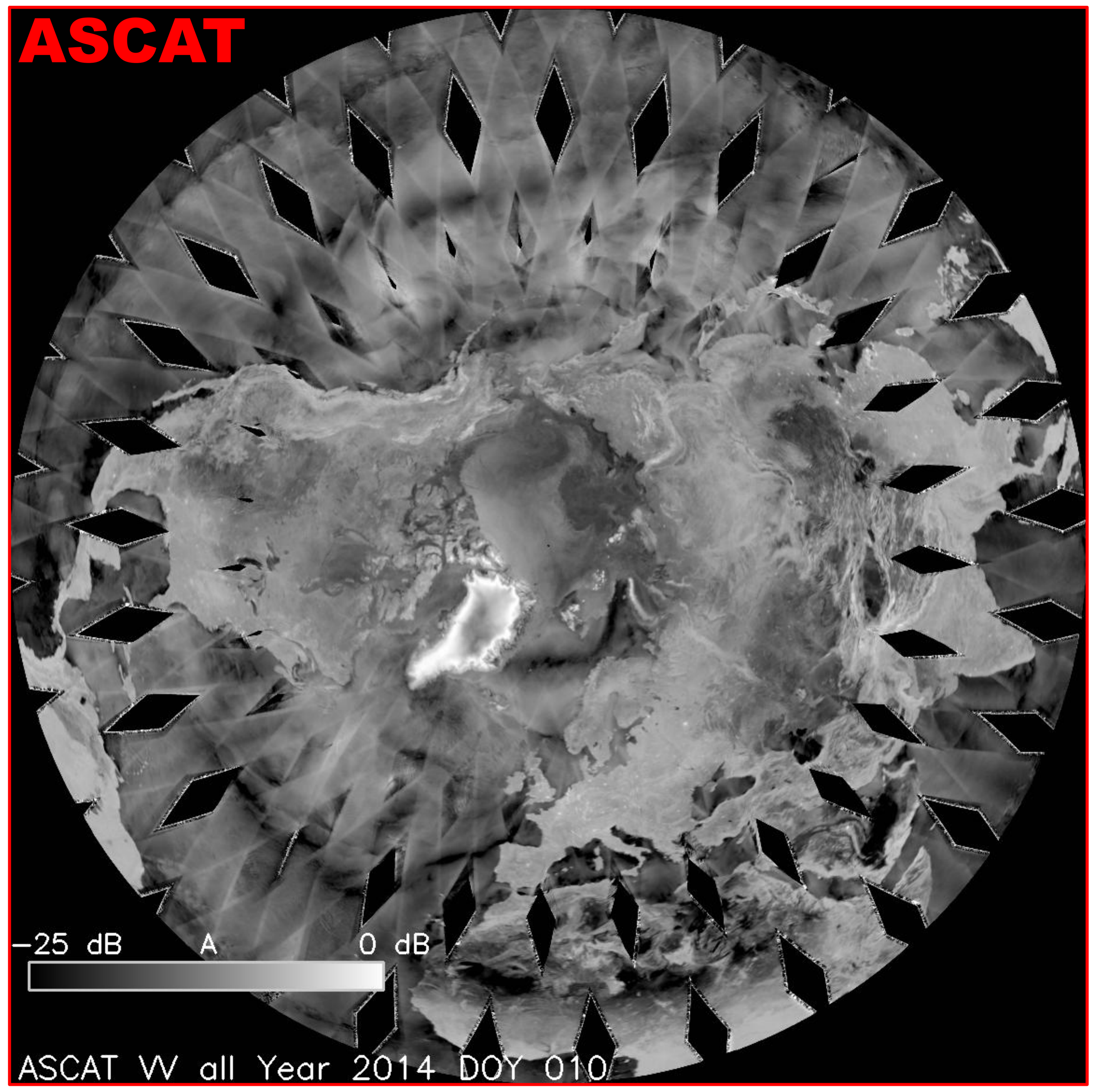


Figure 2: Visualization of an example VV-polarization ASCAT image of the Northern Hemisphere created from one day of combined ASCAT-A and ASCAT-B measurements collected on DOY 10, 2014.

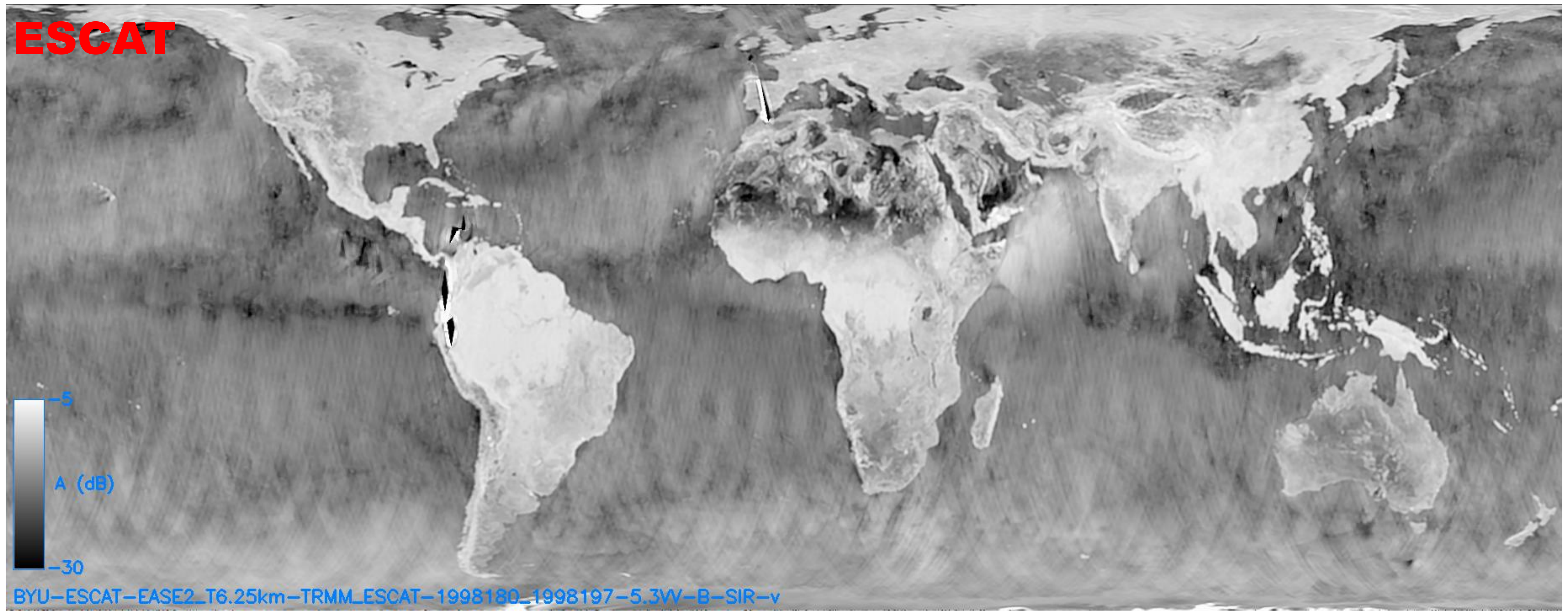


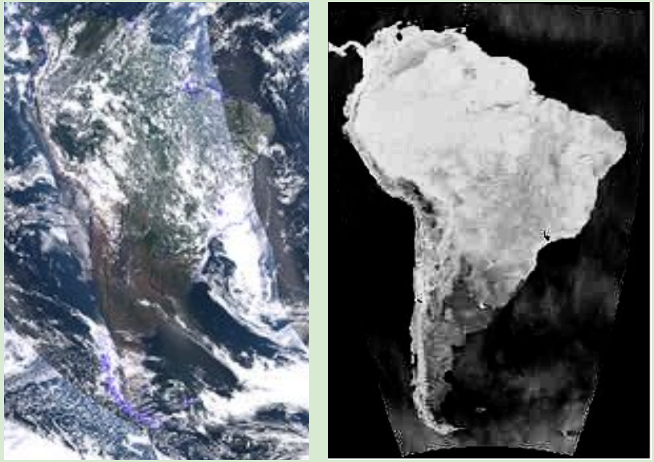
Figure 3: Visualization of an example of ESCAT image of the Tropical Region created from 18 days of ERS-2 measurements collected DOY 180-197, 1998.

Detecting Landscape Degradation in the Pantanal Using ASCAT Imaging

Alex McBride, David Long
Brigham Young University

Potential advantages of ASCAT over optical imaging :

- High passover frequency
- Insensitive to atmosphere
- May complement existing techniques

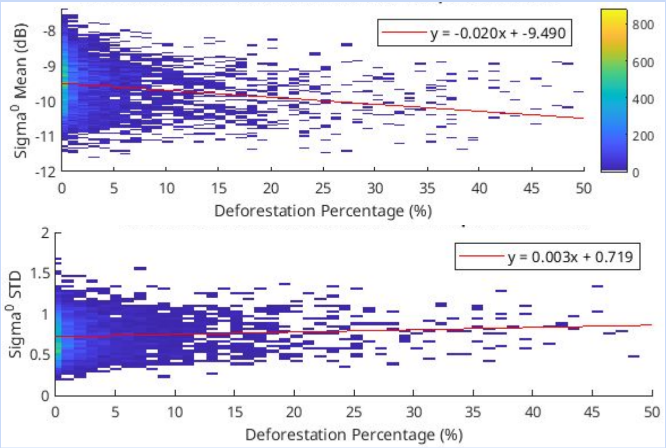


Left: MODIS images, Nov. 2022
Right: ASCAT SIR image, Nov. 2, 2022

Deforested pixels show:

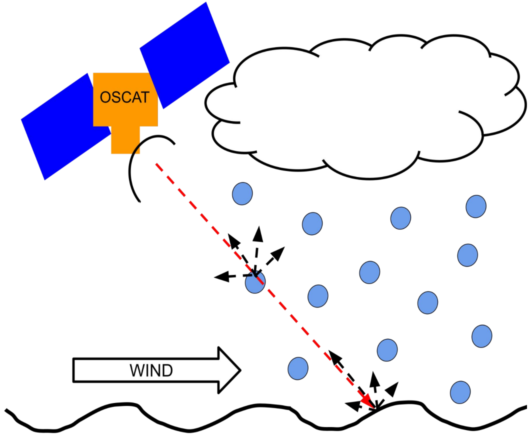
- Increased variance
- Decreased backscatter

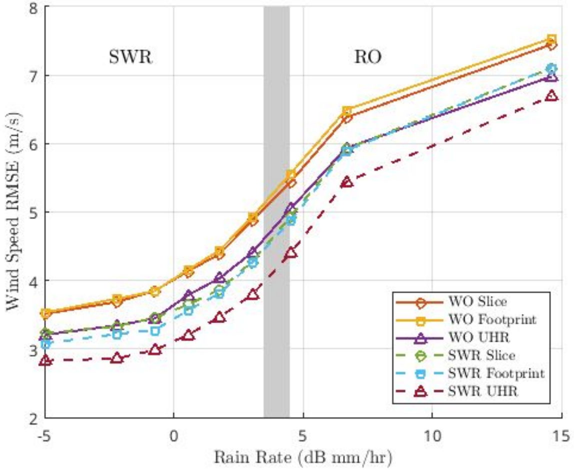
With detailed modeling, it may be possible to predict how much deforestation has occurred in an area in similar biomes.

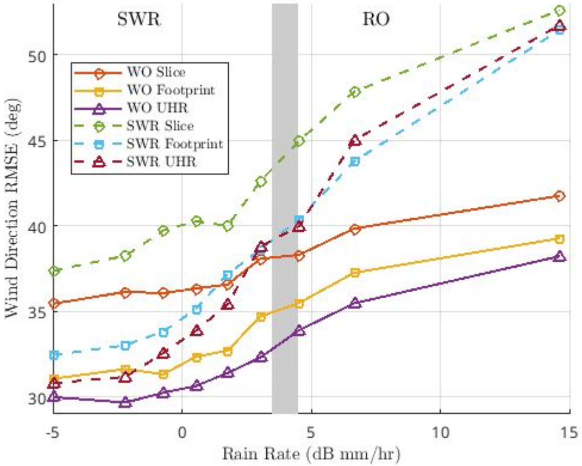


Simultaneous Wind/Rain Geophysical Model Function for OSCAT

- A SWR GMF created for OSCAT-1 (2011 - 2014)
  - Collocated OSCAT sigma0, TRMM RR, and ECMWF VW
  - Modeled phenomenologically
- In SWR Regime:
  - Wind Speed estimates improved over WO estimates
  - Wind Direction estimates are comparable to WO estimates

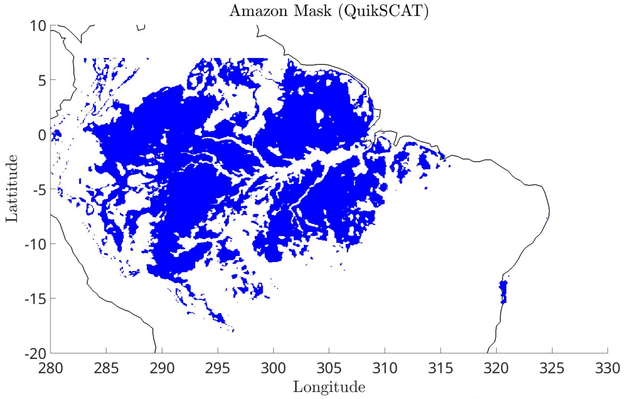


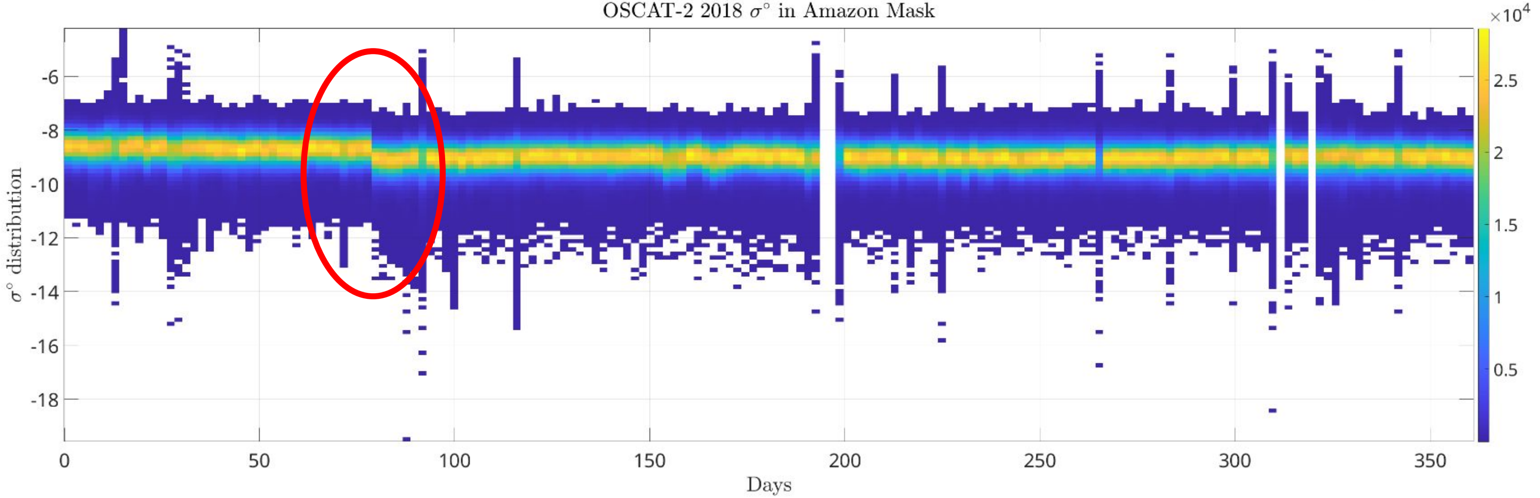




Multidecadal OSCAT Calibrated σ^o database using the Amazon

- OSCAT σ^o measurements calibration is inconsistent
  - Steps and discontinuities in OSCAT σ^o measurements in previously identified areas (Amazon) that are consistent for Ku-band scatterometer (QuikSCAT)
  - Create a consistent calibrated database of σ^o measurements for OSCAT-1,2,3





A Theory To Explain Tropical Cyclone Kinetic Energy Spectra

Boris Galperin(USF), Alexander K. Nickerson(USF),

Gregory P King(ATTIC) and Jun A. Zhang(NOAA)

OBJECTIVE: To develop a theory of TC turbulence that successfully explains observations of ***1D KE energy spectral*** slopes **and** amplitudes.

THEORY

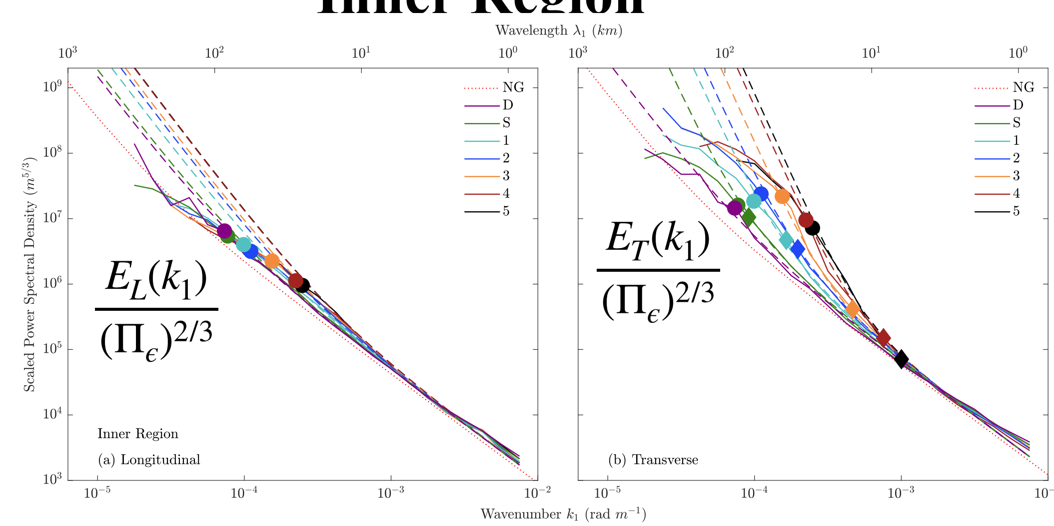
- Barotropic framework
- Rapidly spinning vortex ($\hat{f}$) in a planetary flow (f) …
  - ➡ $\hat{f}$: *cyclostrophic* Coriolis parameter
  - ➡ $\tilde{f}$: *effective* Coriolis parameter

$$\tilde{f} = f + \hat{f}$$

Principle of Least Action
(Landau & Lifshitz: *Mechanics*)

OBSERVATIONS

Inner Region



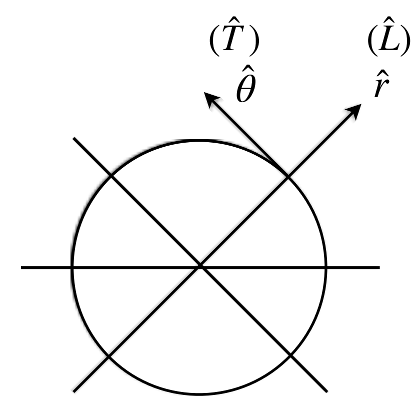
If $\tilde{f} \neq$ constant, there is a ***cyclostrophic*** ***β*-effect** — which generates Vortex Rossby Waves (**VRWs**) in the TC eyewall.

VRWs interact with turbulence and produce *anisotropic* 1D KE spectra …

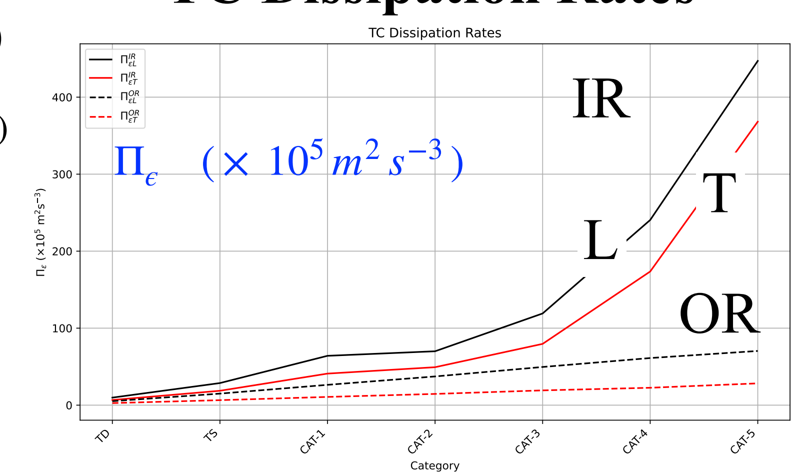
$$E_L(k_1) = C_{KL}\Pi_\epsilon^{2/3}\, k_1^{-5/3} + C_{fL}\,\tilde{f}^2\, k_1^{-3}$$

$$E_T(k_1) = C_{KT}\Pi_\epsilon^{2/3} k_1^{-5/3} + C_{fT}\,\tilde{f}^2\, k_1^{-3} + C_z\,\hat{\beta}^2\, k^{-5}$$

$$(u_r, u_\theta) \rightarrow (u_L, u_T)$$



TC Dissipation Rates



TC category