

# The NASA Scatterometer Climate Record Pathfinder Project

J. Z. Miller<sup>1,2</sup> & D. G. Long<sup>3</sup>



<sup>1</sup>EarthSAR, LLC

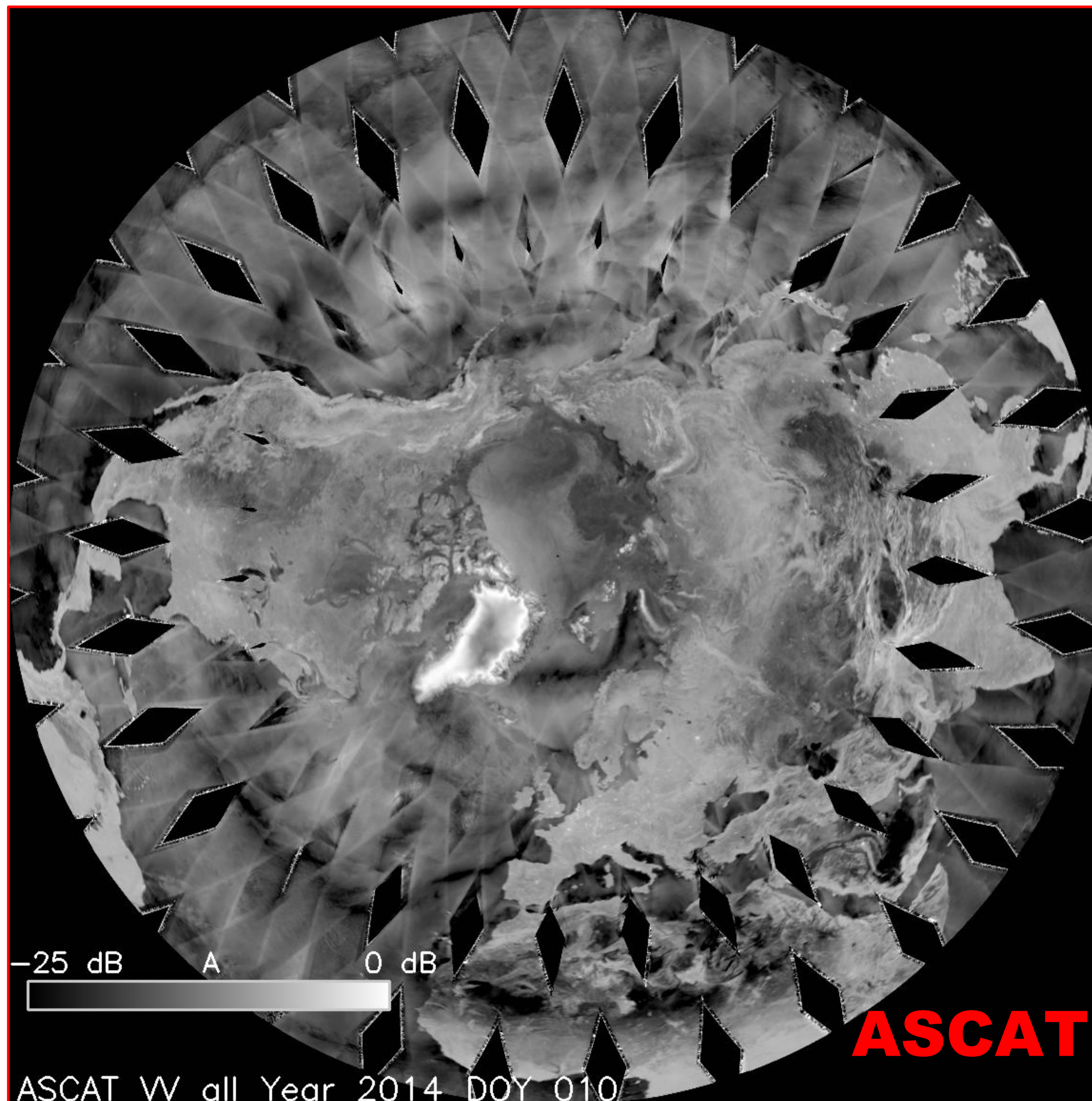
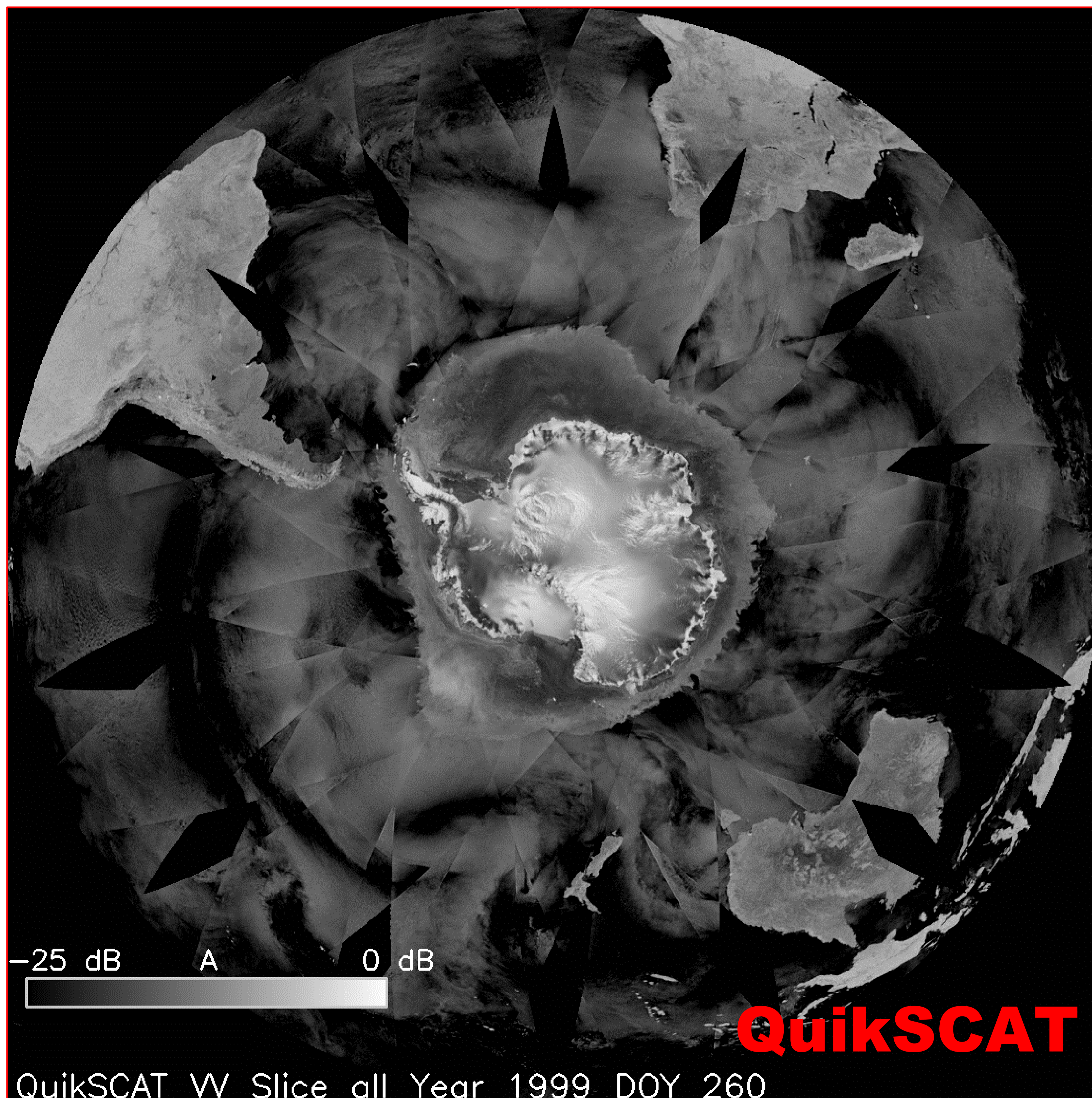
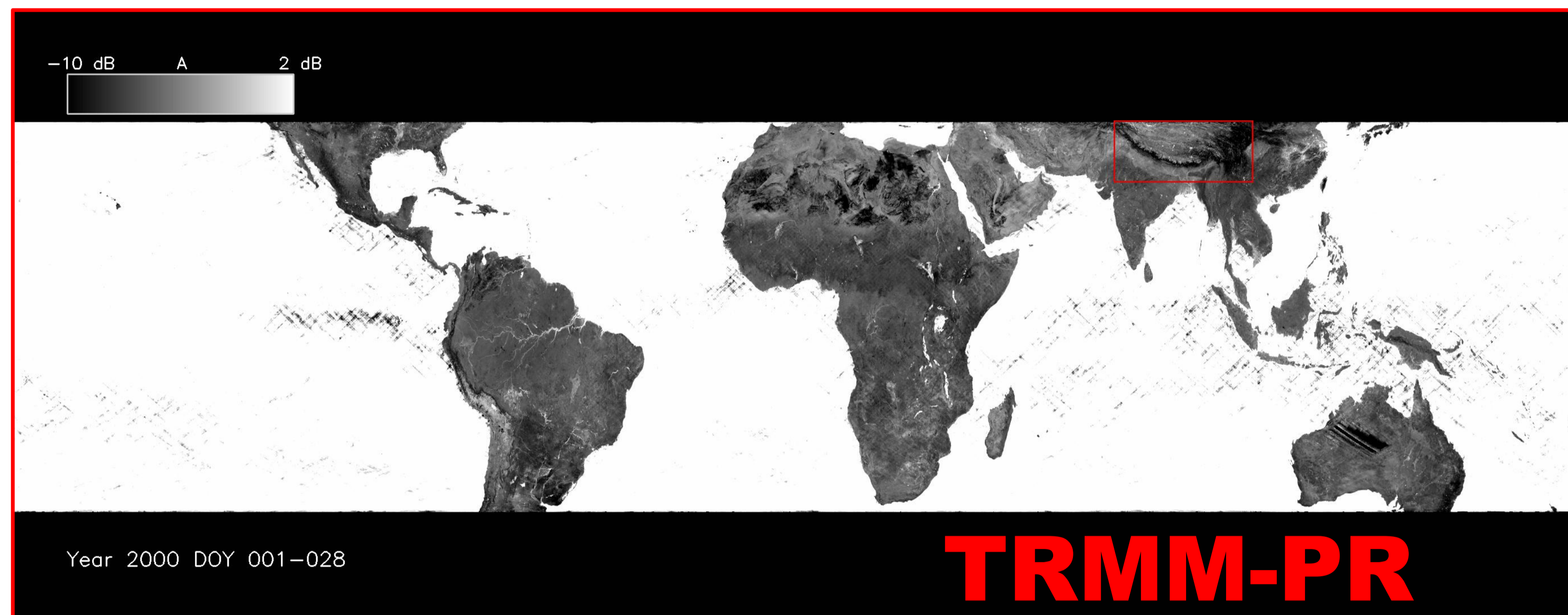
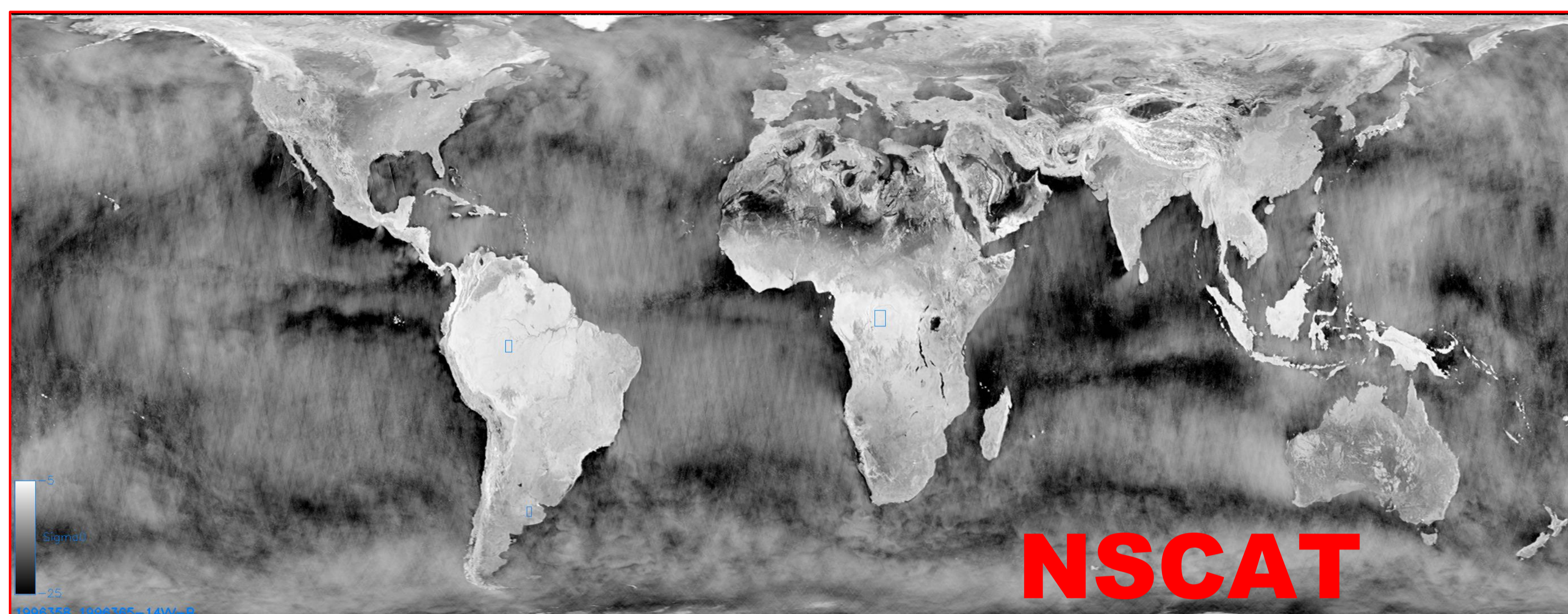
<sup>2</sup>Earth Science and Observation Center, CIRES, University of Colorado Boulder

<sup>3</sup>Department of Electrical and Computer Engineering, Brigham Young University

## ABSTRACT

Long-term studies of global climate can benefit from the combined analysis of past and current satellite missions. To support these we have developed new L-, C- and Ku-band enhanced-resolution radar backscatter ( $\sigma^\circ$ ) image products that are derived from seven satellite scatterometry missions: (1) the ESA European Remote Sensing (ERS) mission in scatterometer-mode 1992-2001; (2) the NASA/JAXA Tropical Rainfall Measuring Mission (TRMM) Precipitation Radar (TRMM-PR) (1997-2014); (3) the NASA Quick Scatterometer (QuikSCAT) and SeaWinds missions (1999-2010); (4) the ESA Advanced SCATterometer (ASCAT) mission (2008-present); (5) the ISRO OSCAT mission (2010-2014, 2016-present); (6) the NASA RapidScat mission (2014-2016), and the Soil Moisture Active Passive (SMAP) radar mission, operating at 5.3 GHz (C-band), 13.88 GHz (Ku-band), 13.4 GHz (Ku-band), 5.225 GHz (C-band), 13.515 GHz (Ku-band), 13.4 GHz (Ku-band), and 1.41 GHz (L-band), respectively. These multi-frequency, multi-polarization, satellite scatterometry missions

provide global  $\sigma^\circ$  measurements spanning nearly five decades that are unique benchmarks for studying climate change over the Earth's surface, particularly over rapidly warming ice-covered regions, such as Greenland, Antarctica, and High Mountain Asia. The new enhanced-resolution  $\sigma^\circ$  image products are consistently-processed using conventional gridding and the Scatterometer Image Reconstruction (SIR) algorithm. They are compatibly-gridded with existing enhanced-resolution  $\sigma^\circ$  and microwave brightness temperature (TB) image products on the Equal-Area Scalable Earth Grid (EASE-Grid 2.0) map projection. The enhanced-resolution radar backscatter ( $\sigma^\circ$ ) image products are currently published or forthcoming at the National Snow and Ice Data Center (NSIDC) Distributed Active Archive Center (DAAC) and include comprehensive Algorithm Theoretical Basis Documents (ATBDs) that describe the physical theory, mathematical procedures, and SIR algorithm assumptions. Images spanning multiple imaging periods, local time of day periods, resolutions, enhancement algorithm (DIB gridded, SIR-enhanced), and optional azimuth modulation estimation are included in the products.



Visualizations of example product images. (ul) NSCAT Ku-band 8 day VV-polarization  $\sigma^\circ$  at 54° incidence angle DOY 358-365, 1996. (ur) TRMM-PR Ku-band 28 day HH-polarization  $\sigma^\circ$  at 10° deg incidence angle, DOY 1-28, 2000. (ll) QuikSCAT Ku-band 1 day VV-polarization  $\sigma^\circ$  at 54° deg incidence angle DOY 260, 1999. (lr) ASCAT C-band 1 day VV-polarization  $\sigma^\circ$  at 40° deg incidence angle DOY 10, 2014.

## BIBLIOGRAPHY

- D.S. Early and D.G. Long, Image reconstruction and enhanced resolution imaging from irregular samples, *IEEE Trans. Geosci. Remote Sens.*, 39(2) 291–302, 2001.
- R.D. Lindsley, C. Anderson, J. Figa-Saldaña, and D.G. Long, A Parameterized ASCAT Measurement Spatial Response Function, *IEEE Trans. Geosci. Remote Sens.*, 54(8), 4570-4579, 2016.
- D.G. Long and J.Z. Miller, "Comparison of SeaWinds Backscatter Imaging Algorithms, IEEE J. Sel. Topics in Applied Earth Observations, 10(3), 2214-2231, 2017.
- D.G. Long and J.Z. Miller, "SASS twice-daily SIR-enhanced EASE-Grid 2.0 radar backscatter, version 1," 2024. Available: <http://nsidc.org/data/NSIDC-0787/versions/1>
- D.G. Long and J.Z. Miller, "NSCAT twice-daily SIR-enhanced EASE-Grid 2.0 radar backscatter, version 1," 2024. Available: <http://nsidc.org/data/NSIDC-0786/versions/1>
- D. Long, J. Miller, M. J. Brodzik, and M. Hardman, "SMAP radar twice-daily SAR and SIR-enhanced scatterometer EASE-Grid 2.0 radar backscatter, version 1," 2023. Available: <http://nsidc.org/data/NSIDC-0774/versions/1>
- D.G. Long and J.Z. Miller, "ERS SIR-enhanced EASE-Grid 2.0 radar backscatter, version 1," 2026. Available: <http://nsidc.org/data/NSIDC-0808/versions/1>
- D.G. Long and J.Z. Miller, "TRMM Precipitation Radar SIR-enhanced EASE-Grid 2.0 surface radar backscatter, version 1," 2026. Available: <http://nsidc.org/data/NSIDC-0807/versions/1>
- D.G. Long and J.Z. Miller, "ASCAT twice-daily SIR-enhanced EASE-Grid 2.0 radar backscatter, version 1," 2026. Available: <http://nsidc.org/data/NSIDC-0811/versions/1>
- D.G. Long and J.Z. Miller, "QuikSCAT/SeaWinds twice-daily SIR-enhanced EASE-Grid 2.0 radar backscatter, version 1," 2024. Available: <http://nsidc.org/data/NSIDC-0810/versions/1>
- D.G. Long and J.Z. Miller, "RapidScAT twice-daily SIR-enhanced EASE-Grid 2.0 radar backscatter, version 1," 2024. Available: <http://nsidc.org/data/NSIDC-0809/versions/1>
- M.J. Brodzik, D.G. Long, M.A. Hardman, A. Paget, and R. L. Armstrong, "MEaSURES calibrated enhanced-resolution passive microwave daily EASE-Grid 2.0 brightness temperature ESDR, Version 1," National Snow and Ice Data Center, Boulder, CO USA, 2016, updated 2021, Available: <http://nsidc.org/data/nsidc-0630>.