

AMSR2 and AMSR3 at NSIDC

Current and planned
activities

Walt Meier

18-19 January 2022



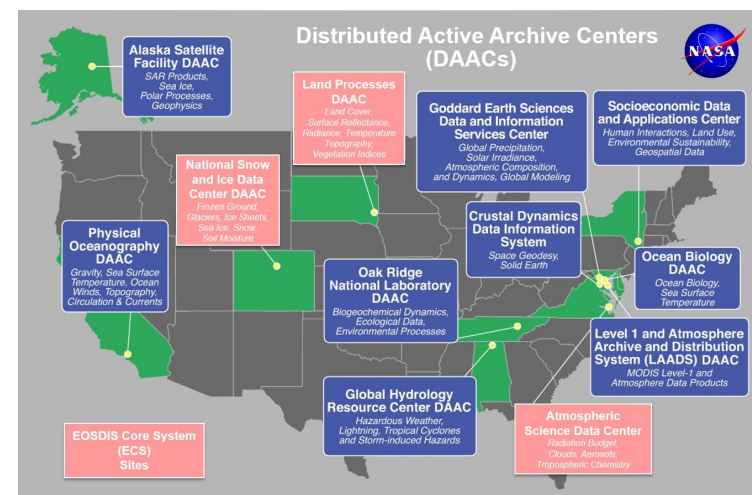
National Snow and Ice Data Center
Advancing knowledge of Earth's frozen regions



University of Colorado
Boulder

NASA Snow and Ice DAAC at NSIDC

- DAAC = Distributed Active Archive Center
- NSIDC DAAC archives snow and ice, and other related geophysical parameters, from NASA satellite, airborne, and field missions
 - Passive microwave: ESMR, SMMR-SSMI-SSMIS, AMSR-E/2/U
 - SMAP: soil moisture, freeze/thaw state, and carbon exchange
 - Altimetry: ICESat, ICESat-2, IceBridge
 - MODIS/VIIRS snow and sea ice products
 - SnowEx, Airborne Snow Observatory (ASO)
 - High Mountain Asia (HMA)
 - Ice sheet and glacier mass balance, velocities
- DAAC Scientist (me) provides science support for products – documentation, user questions, data issues, tools and services
- <https://nsidc.org/daac/>

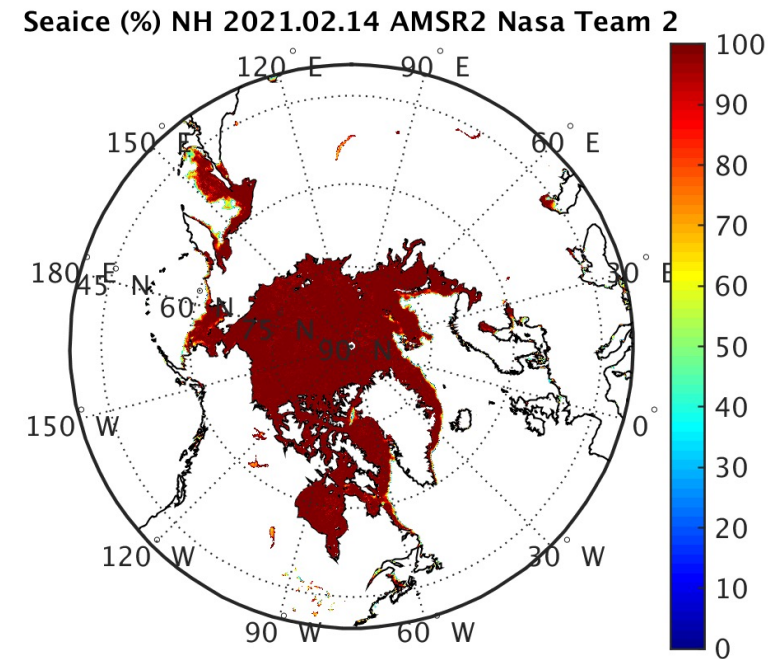


Ongoing AMSR2 Activities at NSIDC

- Archive and distribution of NASA DAAC AMSR-U products (consistent AMSR2 and AMSR-E), https://nsidc.org/data/AU_SI12/versions/1
- Production of backup data stream for long-term SMMR-SSMI-SSMIS brightness temperature and sea ice concentration climate records at NSIDC (unpublished)
- Continuing validation of NOAA standard AMSR2 sea ice products (NOAA NESDIS, Univ. Wisconsin),
- Continuing production of MASAM2 sea ice concentration fields
 - Combined MASIE (Multisensor Analyzed Sea Ice Extent) from U.S. National Ice Center and AMSR2
 - NOAA@NSIDC product, <https://nsidc.org/data/g10005>

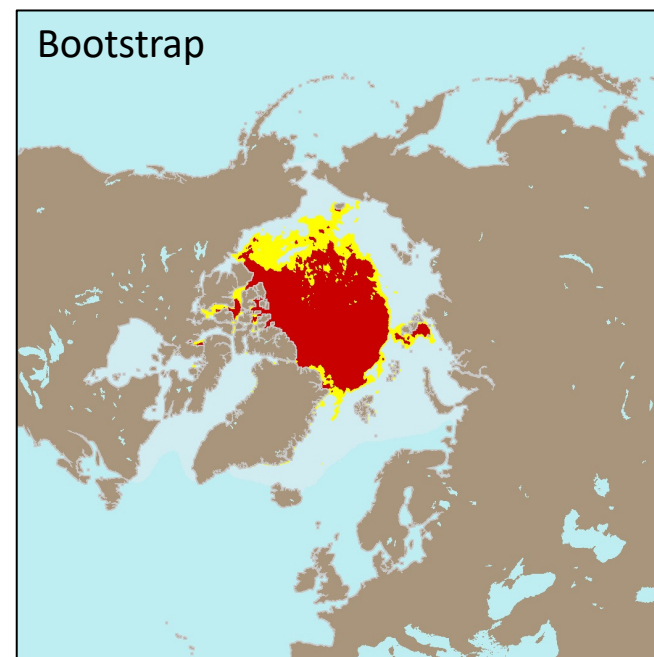
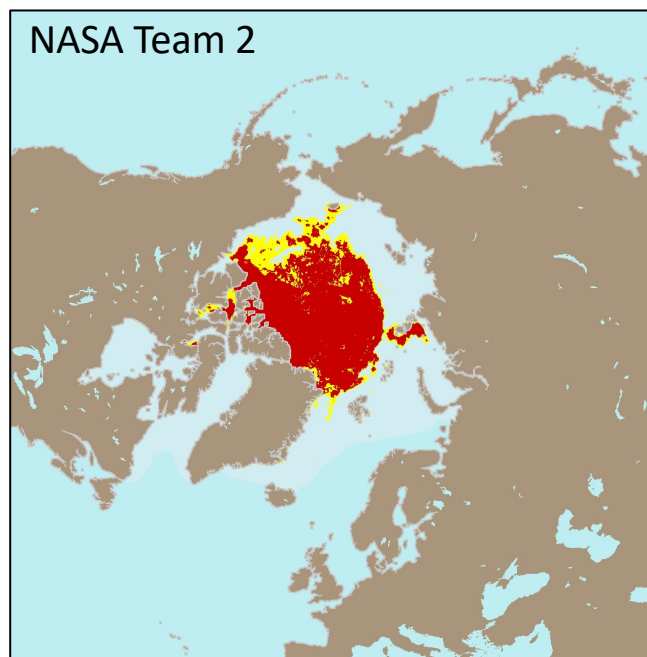
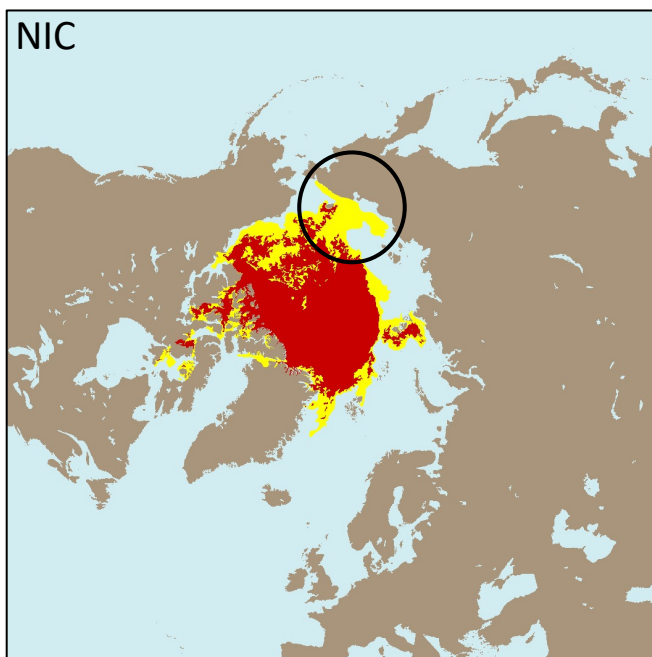
Validation of NOAA AMSR2 operational products

- Developed at NSIDC for NOAA NESDIS
- Running at NESDIS, plan to implement at NSIDC in the upcoming year
- NASA Team 2 and Bootstrap concentrations
- Multiyear ice concentration (L. Brucker, NASA Goddard)
- EASE2 grid
- 24-hour composite using most recent observation at each grid cell



Validation of NOAA AMSR2— comparison to U.S. Nat'l Ice Center Marginal Ice Zone fields

1 September 2021

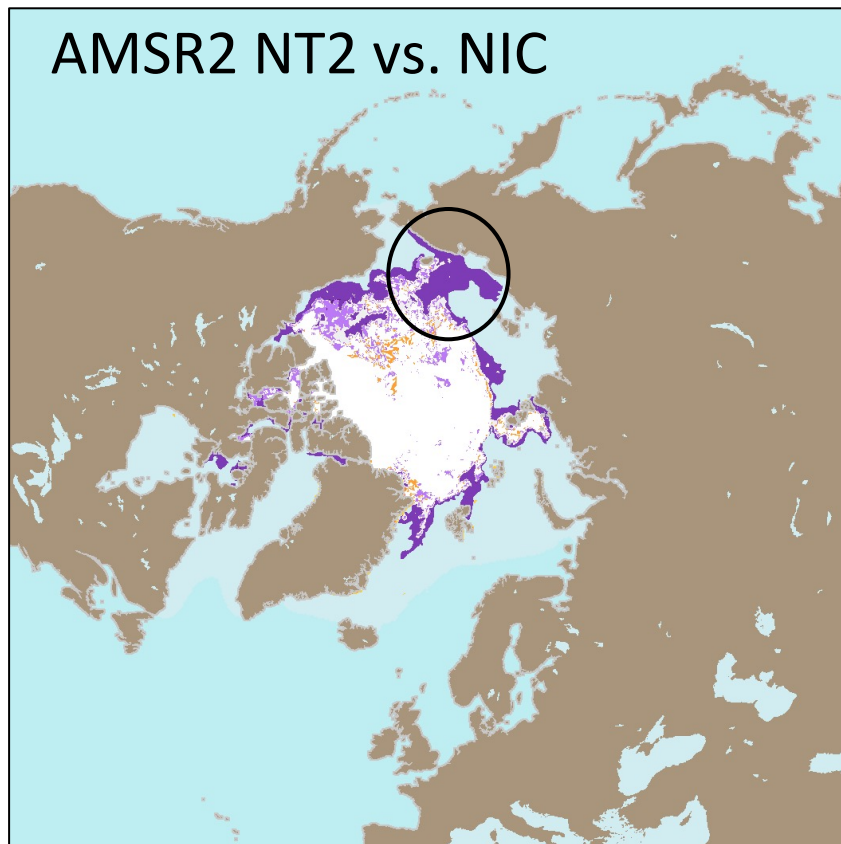


Marginal Ice Zone (10 – 80% concentration)



Consolidated Ice Zone (>80% concentration)

Validation of NOAA AMSR2– comparison to U.S. Nat’l Ice Center Marginal Ice Zone fields



1 September 2021

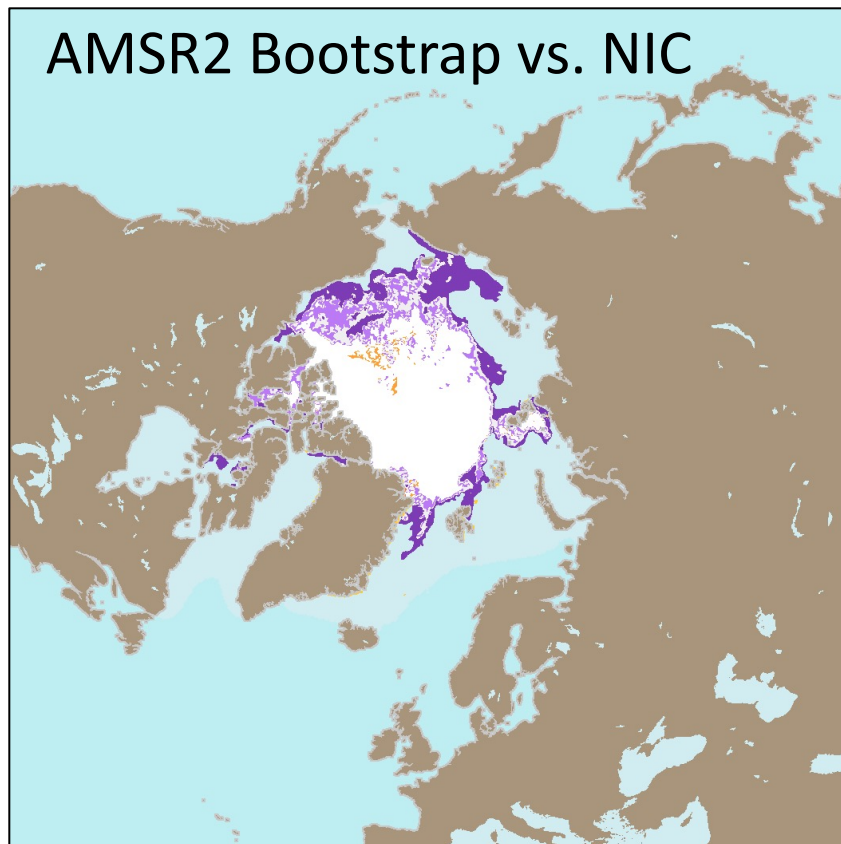
AMSR2 NT2

	0-10%	10-80%	80-100%
Correct cells			
0-10%	65826	153	18
10-80%	12618	4972	1482
80-100%	126	5072	34523

of 10 km grid cells

- Biggest error is AMSR2 missing NIC MIZ cells
- AMSR2 misses few NIC consolidated ice cells
- Some MIZ holes in central pack

Validation of NOAA AMSR2– comparison to U.S. Nat’l Ice Center Marginal Ice Zone fields



1 September 2021

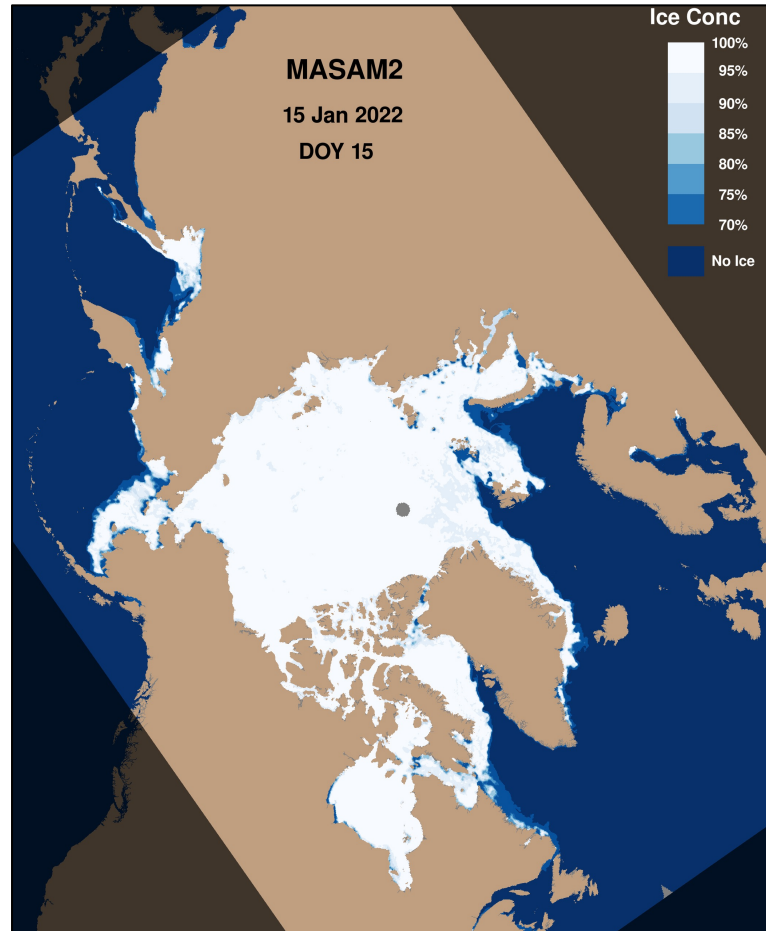
AMSR2 Bootstrap

NIC	Correct cells	0-10%	10-80%	80-100%
	0-10%	65760	226	11
	10-80%	11521	6953	598
	80-100%	31	6911	32779
# of 10 km grid cells				

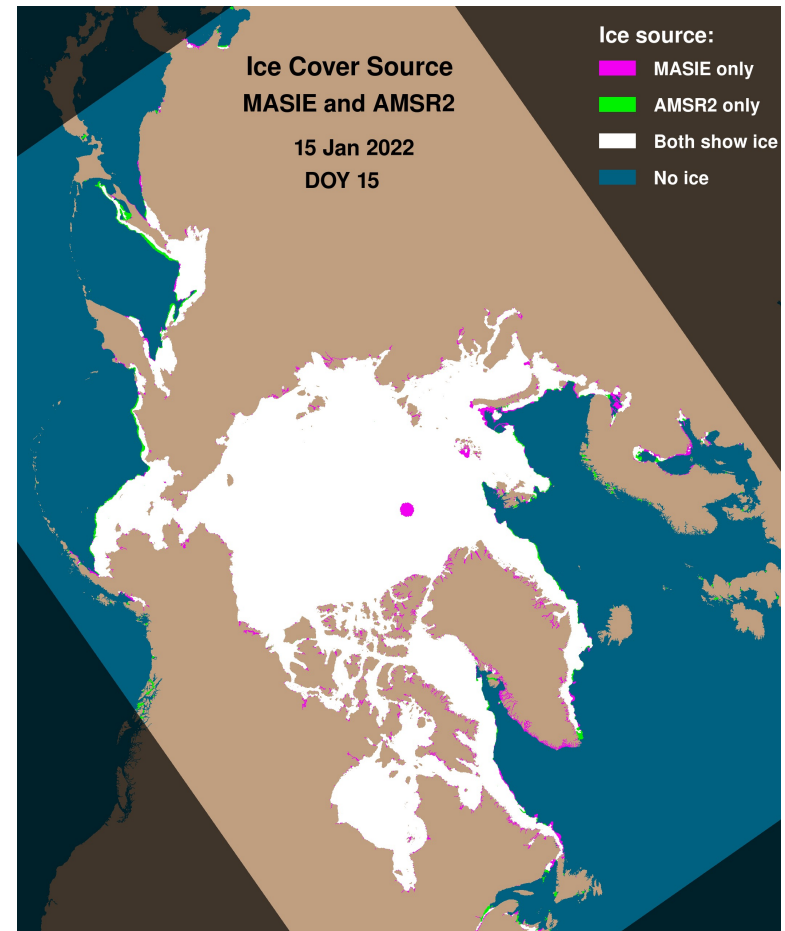
- Biggest error is AMSR2 missing NIC MIZ cells
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MASAM2 – combined NIC extent (MASIE) and AMSR2 concentration

MASAM2 concentration, 15 Jan 2022



MASAM2 source, 15 Jan 2022



New and imminent AMSR2 Activities at NSIDC

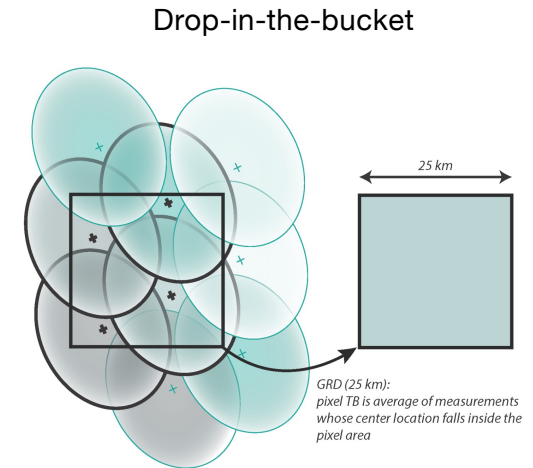
- Create AMSR2 near-real-time, T_B , sea ice concentration, and ice type products (NOAA, started in 2021)
- Add AMSR2 to enhanced resolution brightness temperature product (NASA MEaSUREs and DAAC, started in 2021)
- Add AMSR2 to sea ice motion and age climate record (NASA Cryospheric Sciences, started in 2021)
- Create standard AMSR2 sea ice images for Arctic Sea Ice News and Analysis (NASA Cryospheric Sciences, started in 2021)
- Add AMSR2 to Sea Ice Concentration Climate Data Record (NOAA CDR program, starting in 2022)

Near-real-time AMSR2 TBs and sea ice products

- PI: Tom Greenwald, NOAA CIMSS; Mary Jo Brodzik (NSIDC)
- Funded by NOAA Joint Polar Satellite System Proving Ground and Risk Reduction Program (JPSS PGRR), 2021-2024
- As of November 2021, ingesting T_B and processing near-real-time enhanced-resolution rSIR T_B fields
 - T_B source is NASA GPM Precipitation Processing System (PPS) L1C
 - All T_B (SSM/I, SSMIS, AMSR-E, AMSR2, etc.) inter-calibration to GPM GMI
- This year will start creating sea ice products for near-real-time support
- Coordinating with NOAA operational stakeholders (e.g., Alaska Ice Desk) to evaluate products

Calibrated Enhanced Brightness Temperatures

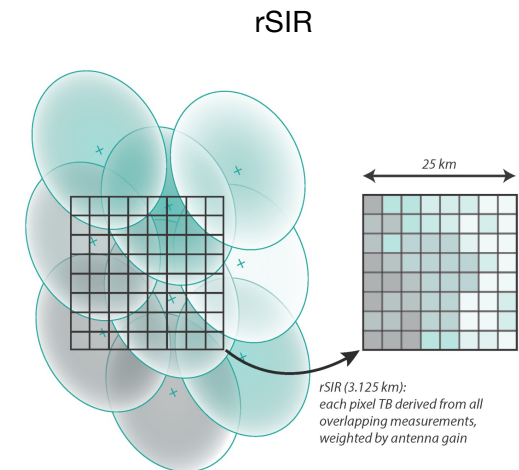
- Originally funded by NASA MEaSUREs, M.J. Brodzik (NSIDC) and D. Long (BYU)
 - Continuing via NASA DAAC support
- SIR enhanced resolution image reconstruction using multiple observations
- CSU FCDR swath T_{Bs}
- Future reprocessing with NASA GPM PPS L1C T_{Bs}
- SMMR, SSMI, SSMIS, AMSR-E
- SMAP product also



SSMIS Frequency	Native Sensor Footprint	Standard Gridded Resolution	rSIR Enhanced Resolution
19, 22 GHz	72 x 44 km	25 km	6.250 km
37 GHz	44 x 26 km	25 km	3.125 km

Calibrated Enhanced Brightness Temperatures

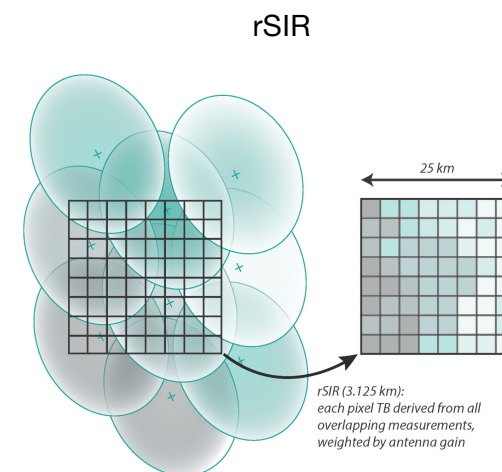
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AMSR2 CETB

- SIR enhanced resolution image reconstruction using multiple observations
- NASA GPM PPS L1C T_B s
 - Currently Version 5
 - Version 7 processing in 2022
- AMSR2 forward processing started
- Backward processing planned for the future

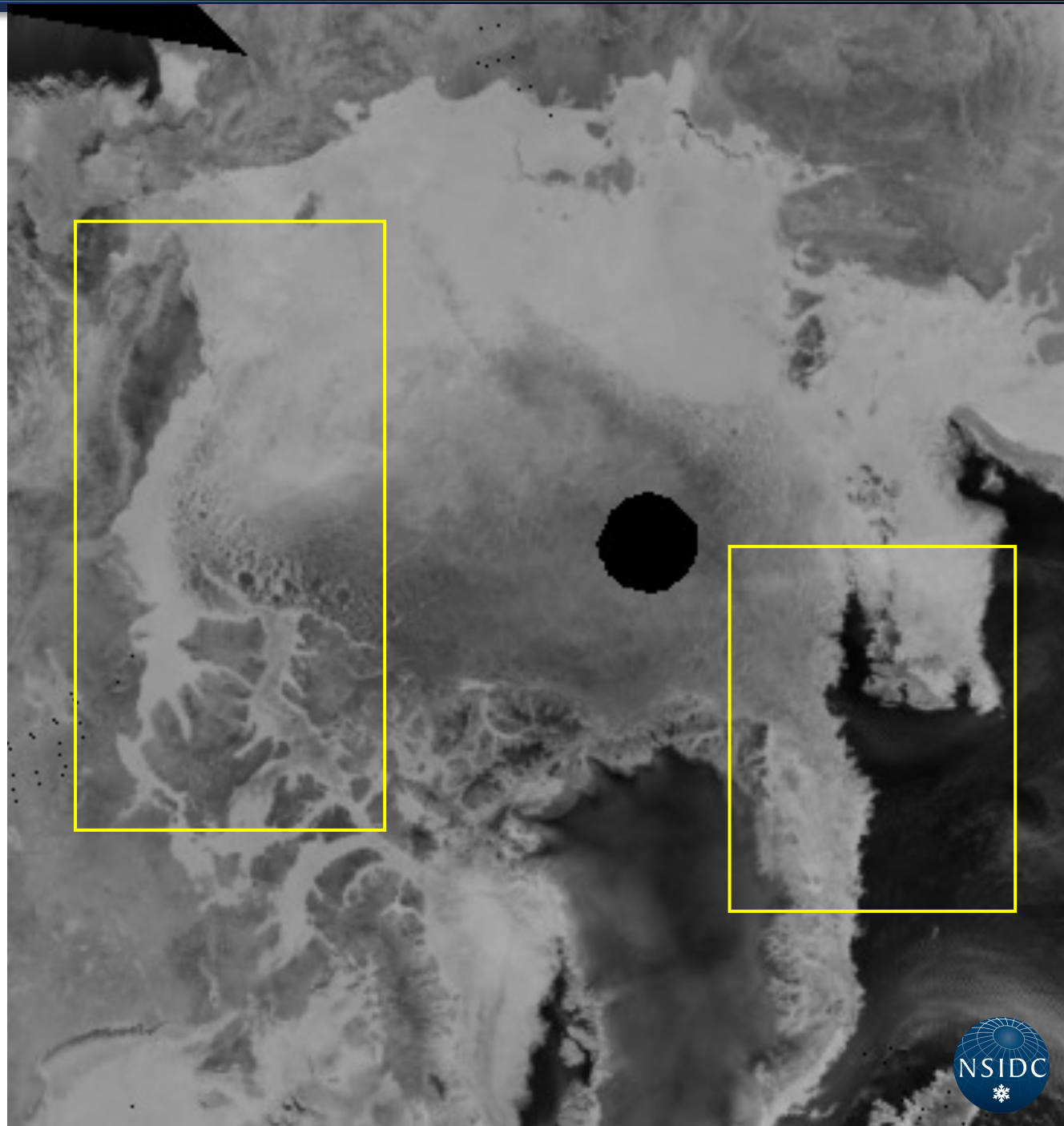


AMSR2 Frequency	Native Sensor Footprint	Standard Gridded Resolution	rSIR Enhanced Resolution
18.7 GHz	14 x 22 km	12.5 km	6.250 km
36.5 GHz	7 x 12 km	12.5 km	3.125 km
89.0 GHz	3 x 5 km	6.25 km	3.125 km

rSIR

10 January
2022

37 GHz H
Morning pass



Standard
10 January
2022

37H GHz
Ascending
12.5 km

Alaska

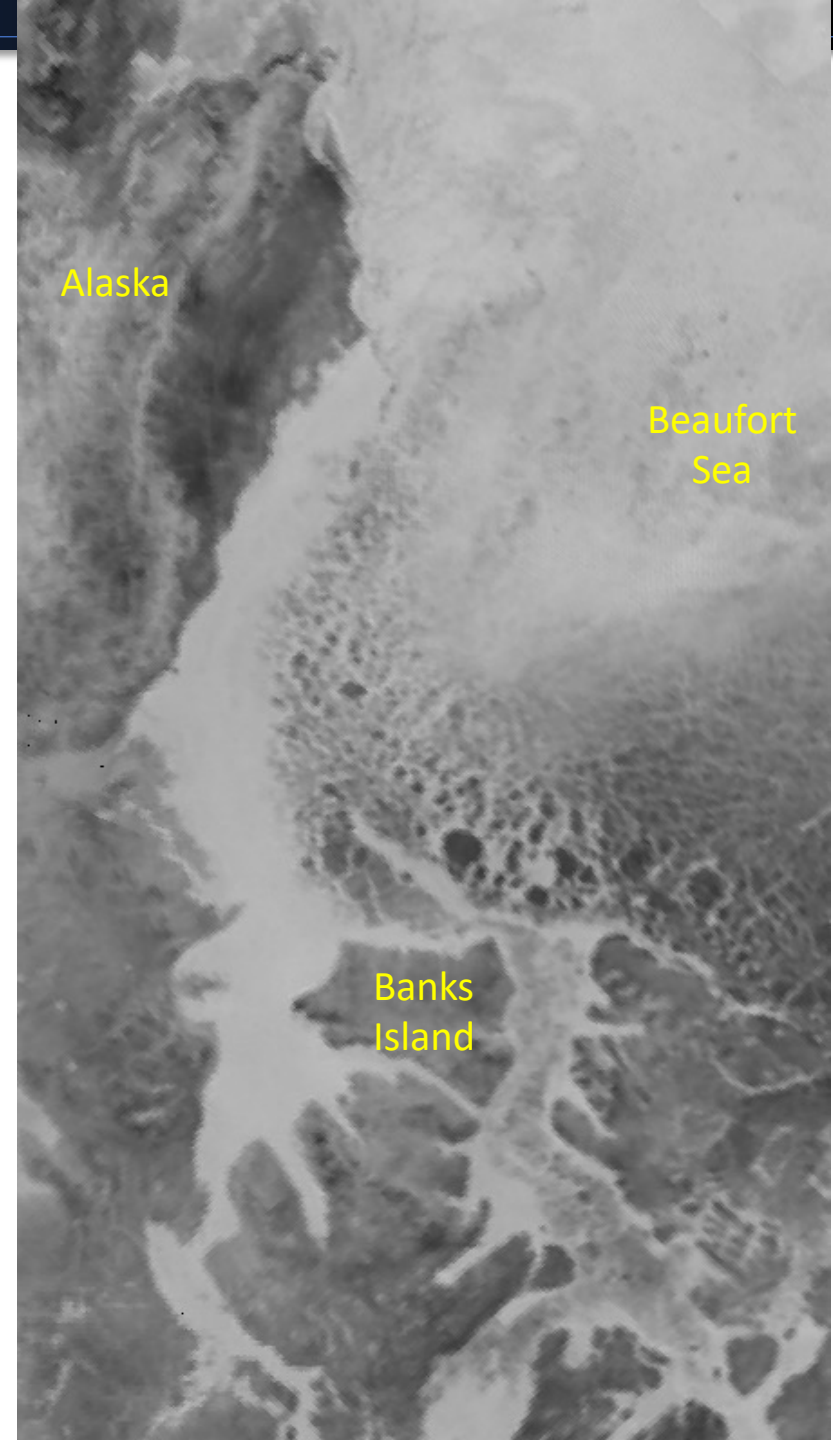
Beaufort
Sea

Banks
Island

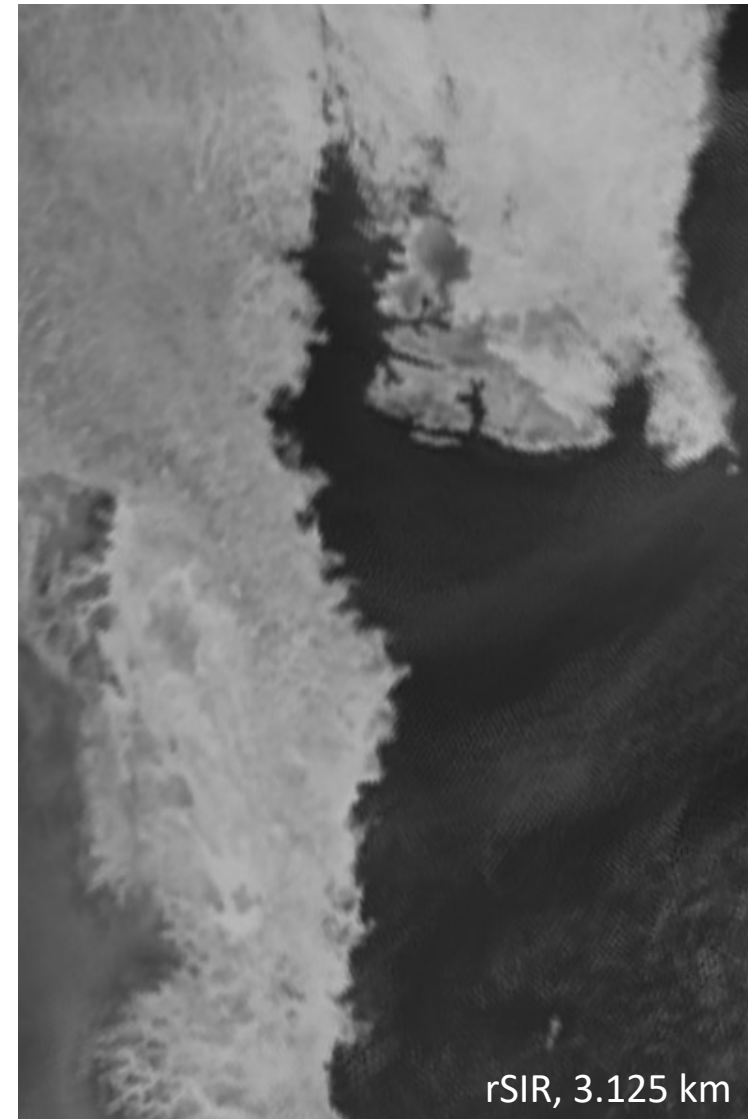
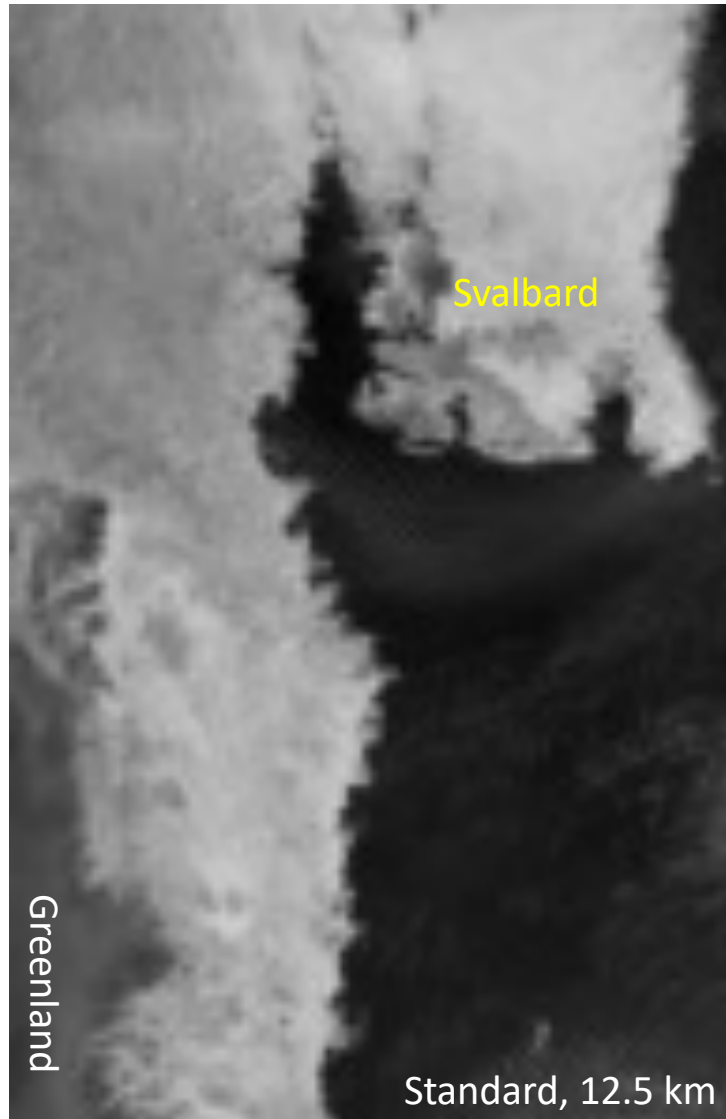
rSIR

10 January
2022

37H GHz
Ascending
3.125 km



10 January 2022, 37H GHz Morning



NASA AMSR Unified L3 Daily 12.5 km T_b
https://nsidc.org/data/AU_SI12/versions/1

Standard

10 January 2022

89H GHz Morning



rSIR

10 January 2022
89H GHz Morning



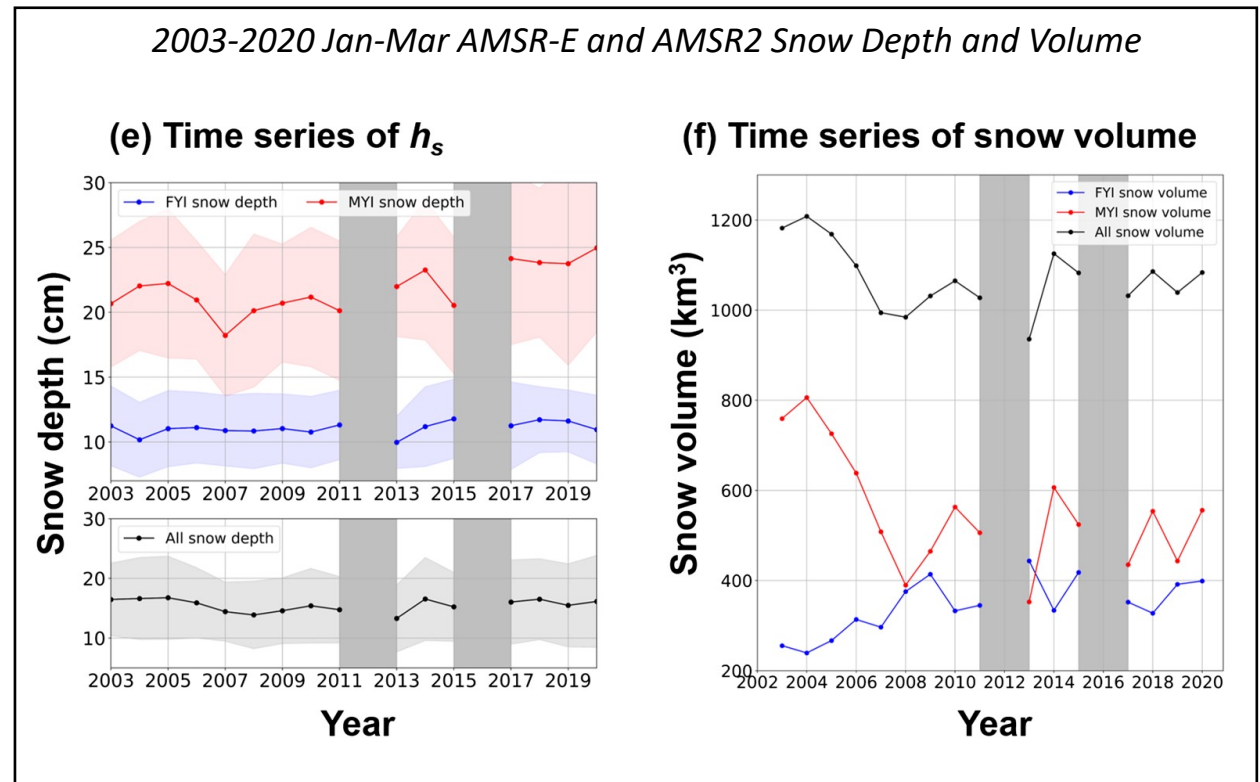
Products to be developed from rSIR AMSR2 for NOAA

- Sea ice concentration (Bootstrap algorithm)
- Sea ice type (FYI, MYI)
- Motion
- Ice thickness and snow depth (Sang-Moo Lee)

Snow depth on sea ice

New paper on passive microwave snow depth on sea ice published:

- Lee et al., GRL, 2021
- Scattering optical depth is proportional to the physical snow depth



Lee, S.-M., H. Shi, B.-J. Sohn, A.J. Gaskiewski, W.N. Meier, and G. Dybkjaer, 2021. Winter snow depth on Arctic sea ice from satellite radiometer measurements (2003-2020): Regional patterns and trends, *Geophys. Res. Lett.*, doi:10.1029/2021GL094541.

Plans for 2022 and beyond

- Use rSIR AMSR2 to develop sea ice products
- Integrate AMSR2 into NSIDC sea ice motion and age products
- Add AMSR2 to CETB climate record
 - NASA Snow and Ice DAAC will take over processing and regularly update the product (schedule TBD)
 - Addition of AMSR2 through new funded proposals
- Further validate NOAA AMSR2 sea ice products, particularly multi-year ice
 - Comparison with EUMETSAT OSI-SAF product
 - More comparisons with NIC charts
- Enhance MASAM2 product – adjust concentration threshold to use AMSR2 closer to the ice edge