



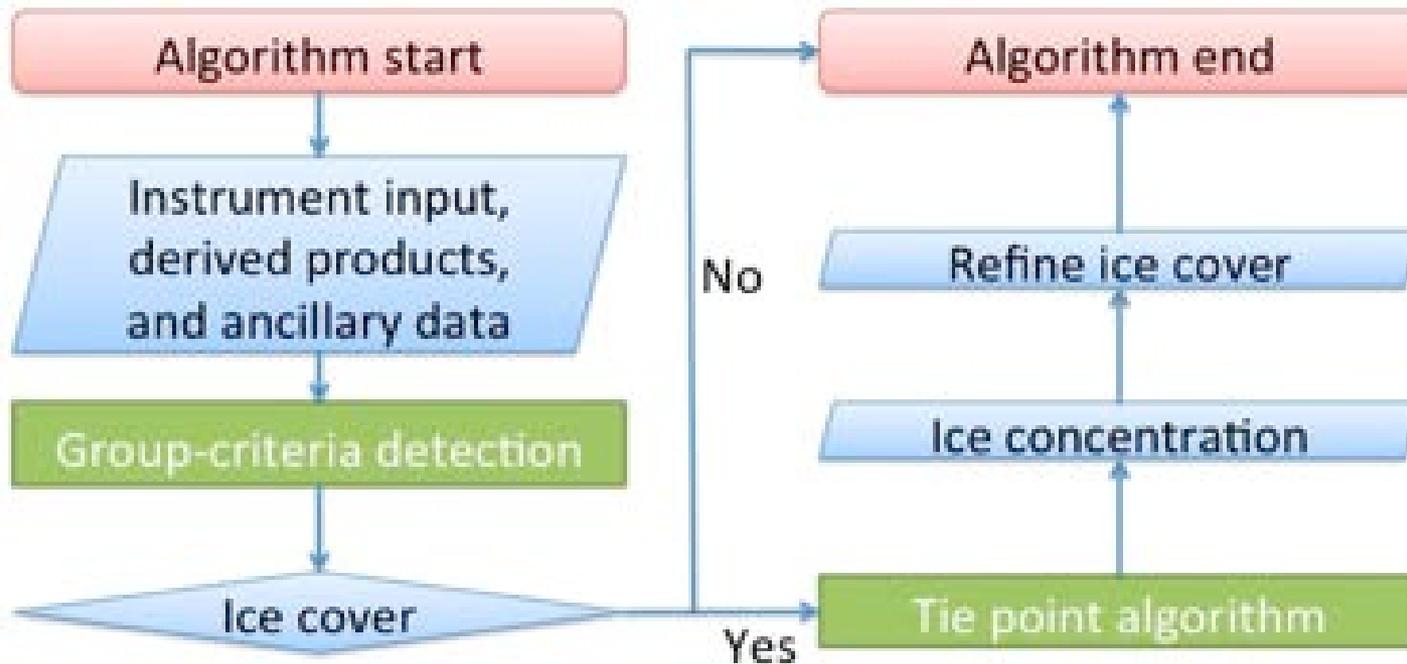
S-NPP ICE CONCENTRATION STATUS

**Yinghui Liu, CIMSS, University of Wisconsin at Madison
608-890-1893; yinghuiliu@wisc.edu**

**Collaborators: Jeff Key, Rich Dworak, Mark Tschudi, Dan Baldwin,
Robert Mahoney**

Ice Concentration Team

PI	Organization	Team Members	Roles and Responsibilities
J. Key	NESDIS	Y. Liu (UW/CIMSS) M. Tschudi (CU/CCAR) D. Baldwin (CCAR) R. Dworak (CIMSS) X. Wang (CIMSS)	Ice conc. cal/val and development Ice concentration cal/val Ice concentration cal/val Ice concentration data analysis Ice concentration application



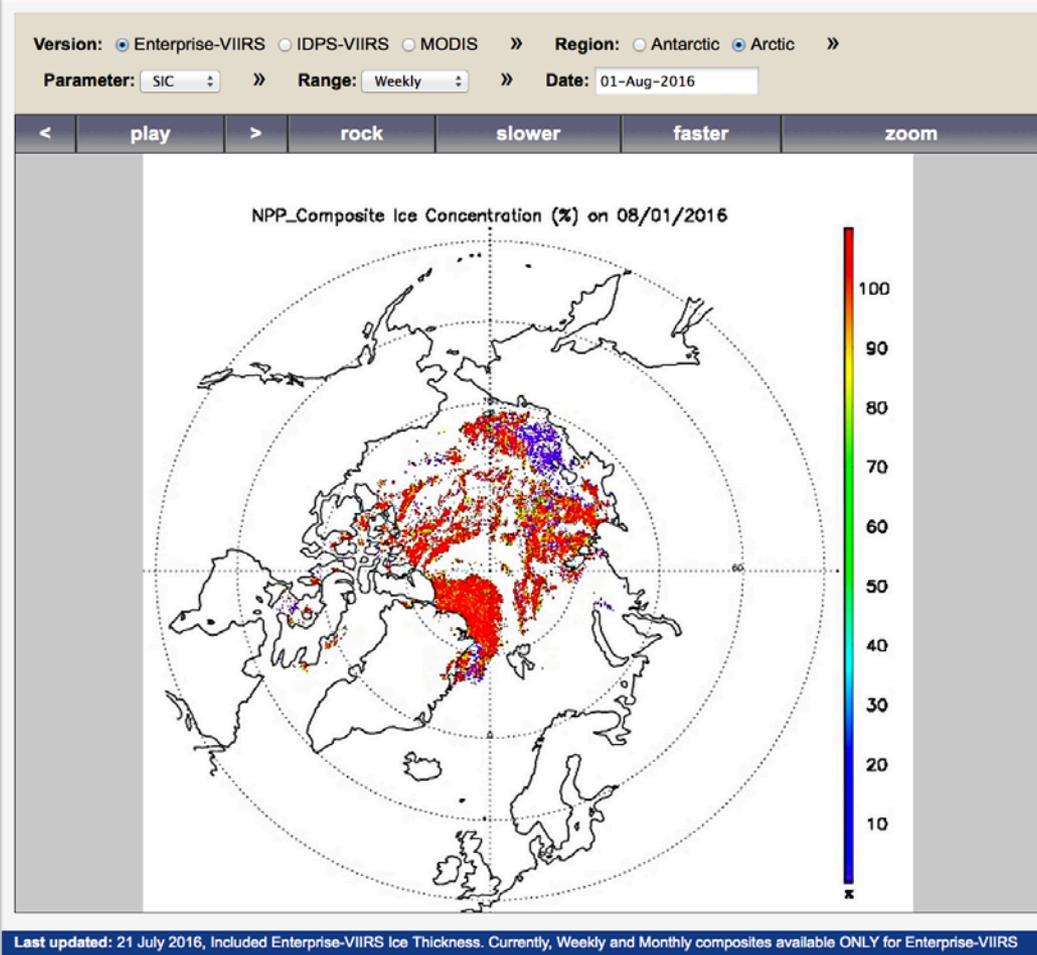
Difference with IDPS algorithm:

- ◆ Enterprise algorithm applies threshold method to identify ice covered pixels first with Normalized Difference Snow Index (NDSI) explicitly used;
- ◆ Retrieves Ice Concentration (IC) using tie-point algorithm on single band information of 0.64 μm reflectance at daytime and surface temperature at nighttime,
- ◆ Final ice identification is refined by the retrieved SIC;
- ◆ IDPS SIC algorithm applies band weighted ICs from tie point algorithm on multiple bands, with identification of ice covered pixels implicitly included.
- ◆ Enterprise IC is in M-band resolution, and IDPS product is in I-band resolution

Requirements

Attribute	Threshold	Performance
a. Vertical Coverage	Ice Surface	Ice Surface
b. Horizontal Cell Size		
1. Clear	1.0 km	1.0 km
2. All Weather	No capability	No capability
c. Mapping Uncertainty, 3 Sigma		
1. Clear	1 km at Nadir	1.0 km
2. Cloudy	No capability	No capability
d. Measurement Range		
2. Ice Concentration	0.0 – 1.0	0.0 – 1.0
e. Measurement Uncertainty		
2. Ice Concentration	10%	10%
f. Refresh	At least 90% coverage of the globe every 24 hours (monthly average)	At least 90% coverage of the globe every 24 hours (monthly average)
g. Geographic coverage	All ice-covered regions of the global ocean	All ice-covered regions of the global ocean

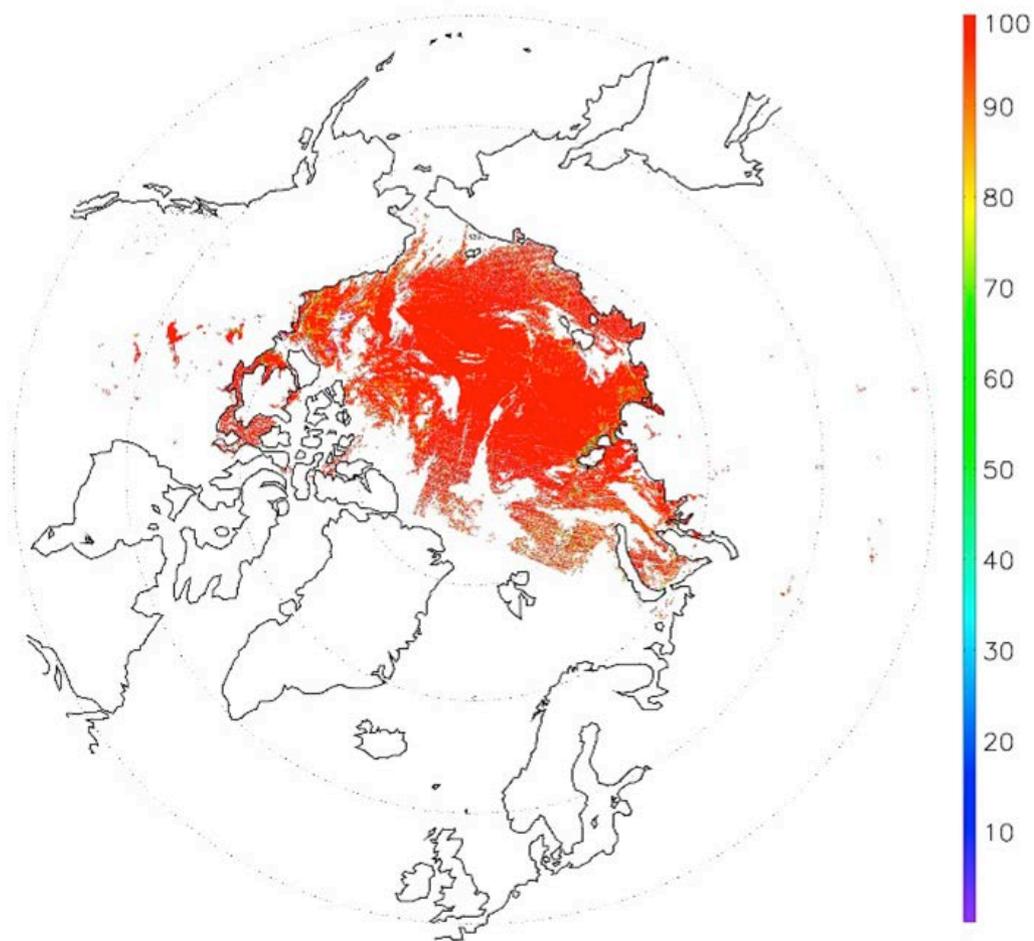
Suomi NPP VIIRS and MODIS Ice Products



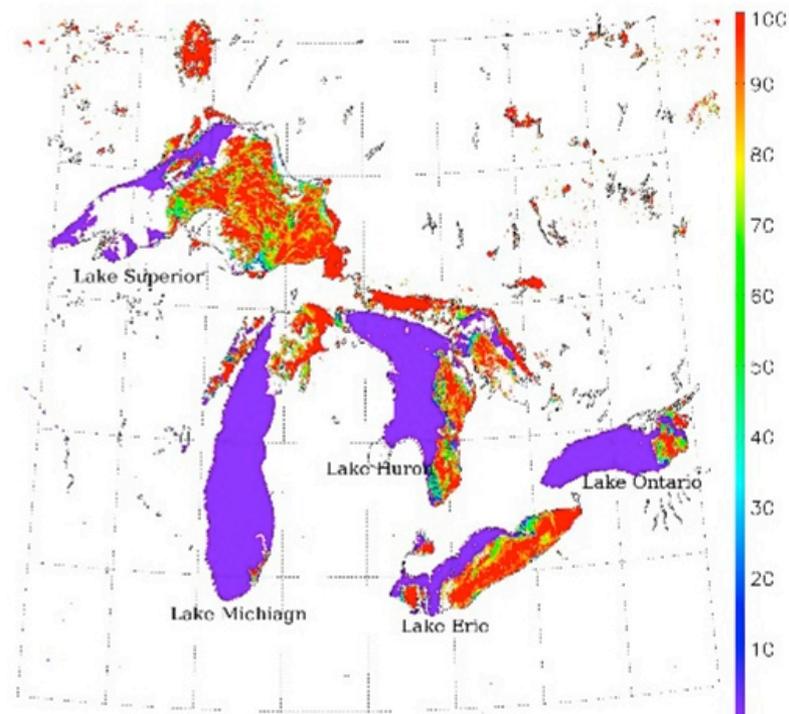
Ice concentration near real-time Enterprise product has been generated and monitored routinely, and figures have been archived and shown on CIMSS website at <http://stratus.ssec.wisc.edu/ice-products/anibrowser/index.php>, and at JPSS EDRs LTM site, http://www.star.nesdis.noaa.gov/jpss/EDRs/products_cryosphere.php

- ◆ Ice concentration is being archived by Naval Research Laboratory for applications in model simulation
- ◆ Ice concentration will be used by National Ice Center
- ◆ Ice concentration has been archived for Walt Meier of GSFC for comparison with microwave products
- ◆ Have been in contact with researchers on the possibility in using JPSS ice concentration product in the operational weather forecasting model

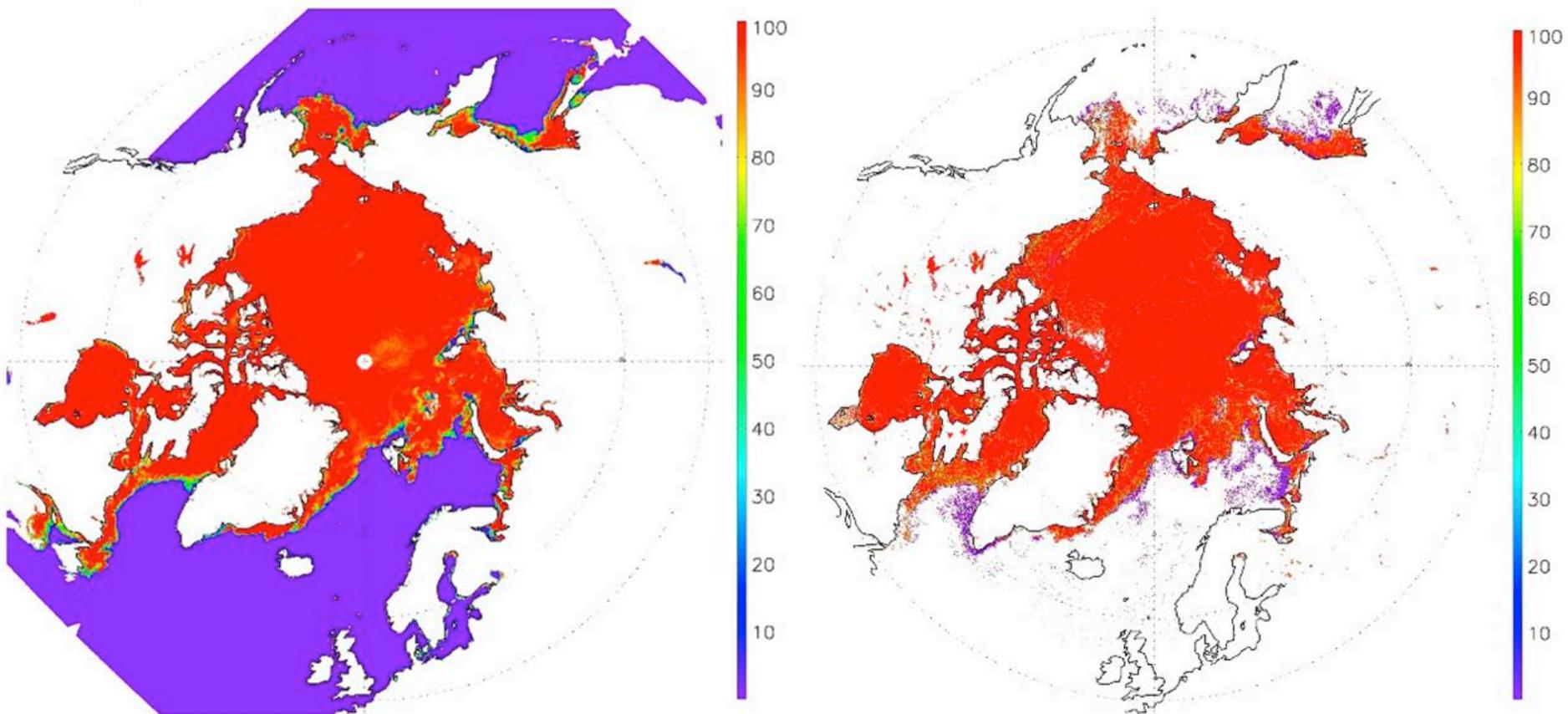
Product Example



Ice concentration over the Arctic Ocean from the VIIRS overpass 8:43 p.m. to 9:03 p.m. UTC on 20 February 2015. The cloud-covered areas are white.

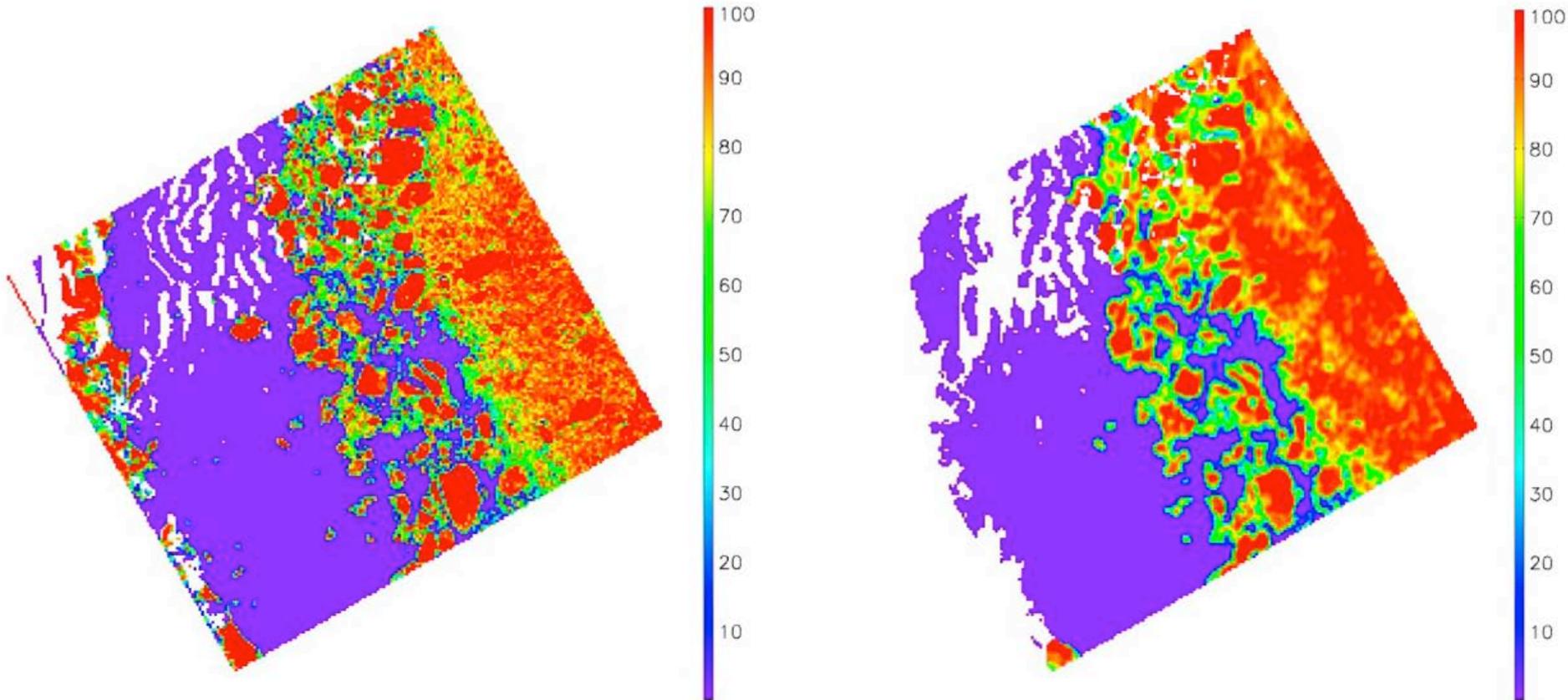


Aqua MODIS true-color image at 6:20 p.m. UTC on 28 March 2015 (**left**); and the corresponding ice concentration (**right**).

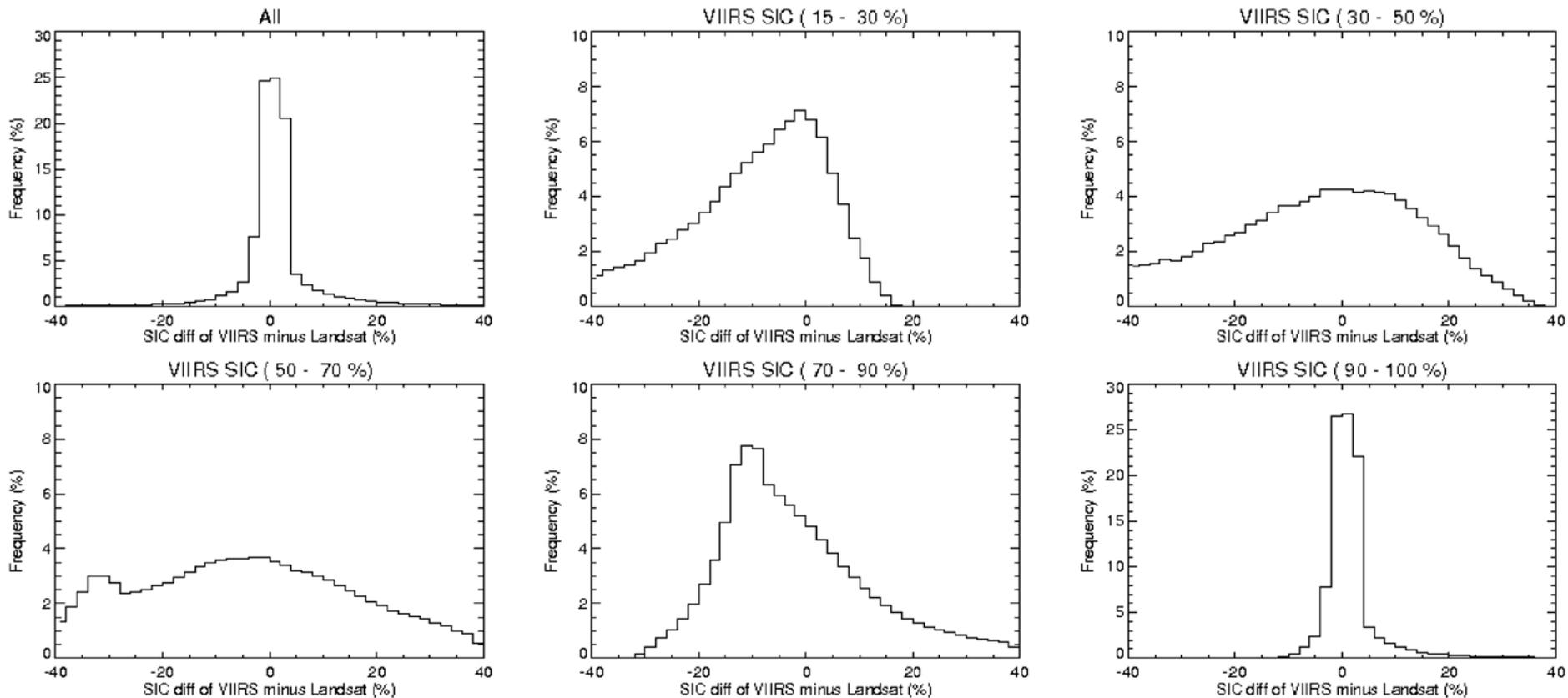


Ice concentration (IC) from SSMIS (**left**); and a daily IC composite from VIIRS (**right**) over the Arctic on 20 February 2015. White areas in the SSMIS image denote pixels flagged as either land or the area around the pole that is not covered by the instrument. White areas in the VIIRS data denote pixels flagged as land, ice-free ocean, or cloud.

Validation



(left) Ice concentration (IC) derived from the Landsat image (30 m resolution); and **(right)** the calculated IC using the Suomi NPP VIIRS. White areas denote pixels flagged out as either land or cloud.



Comparison of VIIRS and Landsat ice concentrations for different concentration ranges/bins when a tie point adjustment scheme is employed.

Table 8. Bias and RMSE with bias removed (precision) for comparisons of VIIRS minus Landsat ice concentrations for different concentration ranges/bins after tie point adjustment.

	Overall	VIIRS SIC 15%–30%	VIIRS SIC 30%–50%	VIIRS SIC 50%–70%	VIIRS SIC 70%–90%	VIIRS SIC 90%–100%
Case number	2,480,093	6055	16,559	34,428	168,009	2,255,042
Bias (%)	1.4	-12.6	-9.1	-4.5	0.3	1.6
RMSE (%)	8.9	17.4	22.4	21.7	17.2	7.2

Future plan:

- ◆ Algorithm can be improved with further evaluation to include the tie point adjustment approach.
- ◆ Algorithm can be improved to produce higher spatial resolution products of I-band spatial resolution, with ice surface temperature with I-band spatial resolution available.
- ◆ Blended VIIRS ice concentration with microwave ice concentration will be valuable.
- ◆ Validation will be expanded with more Landsat data, historical SAR data, C-band SAR onboard Sentinel-1, and high optical imagery onboard Sentinel-2.

Summary and Path Forward

- The Suomi NPP and JPSS VIIRS Enterprise Ice Concentration product has high potential to become an extremely useful JPSS product.
- Performance evaluation based on comparisons with microwave and Landsat indicate that the VIIRS Ice Concentration meets the performance requirements, and is an useful product for identifying ice extent for both day and night for clear sky conditions.
- Further evaluation is needed with new ice concentration products from sensors with very high spatial resolution onboard the newly launched European satellites.