



**MEMORANDUM FOR:** The JPSS Program Record  
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**SUBJECT:** NOAA-21 ice products Beta maturity status  
**DATE:** 10/26/2023

**Provisional maturity status declaration for Sea Ice Concentration and Ice Surface Temperature.**

**Maturity Review Date:** 10/26/2023  
**Effective Date:** 10/26/2023  
**Operational System:** NCCF, V3R2

The JPSS Algorithm Maturity Readiness Review Board approved the release of the Sea Ice product to the public with a Provisional Maturity level quality for sea ice surface temperature and ice concentration as of 05/01/2023 (effective date), based on JPSS Provisional Maturity Review held on 10/26/2023.

**Beta Maturity Definition**

Beta data quality is defined as:

- Early release product.
- Minimally validated.
- May still contain significant errors.
- Versioning not established until a baseline is determined.
- Available to allow users to gain familiarity with data formats and parameters.
- Product is not appropriate as the basis for quantitative scientific publication studies and applications.

**Provisional Maturity Definition**

Provisional Maturity stage definition: Product performance has been demonstrated through analysis of a large, but still limited (i.e., not necessarily globally or seasonally representative) number of independent measurements obtained from selected locations, time periods, or field campaign efforts. Product analyses are sufficient for qualitative, and limited quantitative, determination of product fitness-for-purpose. Documentation of product performance, testing involving product fixes, identified product performance anomalies, including recommended remediation strategies, exists. Product is recommended for potential operational use (user decision) and in scientific publications after consulting product status documents.

The Definition of Beta Maturity and Provisional Maturity stage is available at the JPSS Algorithm Maturity Matrix webpage: <http://www.star.nesdis.noaa.gov/jpss/AlgorithmMaturity.php>

### Algorithm and Product Information

Ice surface temperature is retrieved using brightness temperatures at split window channels at 10 and 11  $\mu\text{m}$ , and satellite sensor scan angle derived from sensor zenith angle. The retrieval algorithm is from the work of Key et al. (1997).

Ice cover is detected at the pixel level over water under clear-sky conditions. Clear-sky is determined from the cloud mask. Ice cover is first determined by a group-criteria technique by using Normalized Difference Snow Index (NDSI) for daytime and threshold surface temperature for nighttime. Then ice concentration is retrieved based on the determined normalized reflectance/BT of pure ice and pure water through the application of a tie point algorithm, which determines “pure” ice pixels. Ice concentration for each pixel is then calculated by interpolating between pure ice and pure, unfrozen water.

Additional information is available in the Sea Ice algorithm theoretical basis document (ATBD) and validation maturity review briefing, which can be accessed at:

<http://www.star.nesdis.noaa.gov/jpss/Docs.php>.

#### List of Products:

EDR Output	Description	Unit
Ice surface temperature (IST)	Skin temperature at ice surface	Kelvin
Ice cover (IC)	A pixel is ice covered or not. Value 1: ice detected using daytime tests 2: ice detected using nighttime tests 0: cloud -1: land -2: water surface -3: non-retrievable due to sunglint, cloud shadow, and missing pixels	Unitless
Ice concentration (SIC)	The fraction (in tenths or percentage) of the sea or lake surface covered by ice, 0 ~ 100%	Unitless

#### Product requirements/Exclusions (LIRDS):

EDR Attribute	Threshold	Objective

Applicable conditions	Delivered under "clear sky" conditions	Delivered under "all sky" conditions
Horizontal cell size	1 km	1 km
Mapping uncertainty, 3 sigma	1 km	1 km
Measurement range	213-275 K for IST 0 or 1 for IC (0=ice free, 1=ice covered) 0-100% for SIC 0-5 m for IT 1-8 for IA	213-275 K for IST 0 or 1 for IC 0-100% for SIC 0-8 m for IT 1-8 for IA
Measurement uncertainty	1.5 K precision for IST 80% correct identification for IC 25% uncertainty for SIC	1 K precision for IST 90% correct identification for IC 10% uncertainty for SIC
Refresh	At least 90% coverage of the globe about every 24 hours (monthly average)	Not Specified

Quality flags (bitwise):

Table 1. Ice Cover and Concentration Quality Information (4 bytes)

Byte	Bit	Quality Flag Name	Description	Meaning
1	0	QC_output	Output product quality	00 - normal
	1			01 - uncertain
	2	QC_INPUT_CLD	Input cloud mask	10 - non-retrievable
	3			11 - bad data
	4			00 - clear
	5	QC_INPUT_DAY	Day/Night	01 - probably clear
	6	QC_INPUT_SUNGLINT	Sunglint or not	10 - probably cloudy
7	QC_INPUT_CLDSHADOW	Cloud shadow or not	11 - cloudy	
2	0	QC_INPUT_DAY	Day/Night	0-Day 1-Night
	1	QC_INPUT_SUNGLINT	Sunglint or not	0-Yes 1-No
	2	QC_INPUT_CLDSHADOW	Cloud shadow or not	0-Yes 1-No
	3	QC_INPUT_SOLZEN	Valid solar zenith angle (0-180 degree)	0-Yes 1-No
	4	QC_INPUT_SATZEN	Valid satellite zenith angle (0-180 degree)	0-Yes 1-No
	5	QC_INPUT_REFL	Valid reflectance at 0.47 μm (0.0-1.0)	0-Yes 1-No
		QC_INPUT_REFL	Valid reflectance at 0.64 μm (0.0-1.0)	0-Yes 1-No
		QC_INPUT_REFL	Valid reflectance at 0.86 μm (0.0-1.0)	0-Yes 1-No
		QC_INPUT_REFL	Valid reflectance at 1.6 μm (0.0-1.0)	0-Yes 1-No

	6	QC_INPUT_THERMAL	Valid brightness temperature at 10 μm (100-390 k)	0-Yes 1-No
	7		Valid brightness temperature at 11 μm (100-390 k)	0-Yes 1-No
3	0	QC_INPUT_SURFACE	Surface type flag	00 - in-land water 01 - sea water 10- land 11 - others
	1			
	2	QC_TEST_REFL	Success of reflectance test in ice cover detection	0-Yes 1-No
	3	QC_TEST_NDSI	Success of NDSI test in ice cover detection	0-Yes 1-No
	4	QC_TEST_SKINTEMP	Success of skin temperature test in ice cover detection	0-Yes 1-No
	5	QC_TIE_REFL	Success of visible band tie-point algorithm	0-Yes 1-No
	6	QC_TIE_SKINTEMP	Success of skin temperature tie-point algorithm	0-Yes 1-No
	7	empty		
4	0	QC_READ_INPUT	Success in reading input	0-Yes 1-No
	1			
	2			
	3			
	4			
	5			
	6			
	7			

**Product evaluation/validation**

The ice surface temperature product has been validated against similar products from Suomi-NPP and NOAA-20, and meets the accuracy and precision specifications. Ice concentration has been validated against lower-resolution passive microwave ice concentration and against higher-resolution Landsat data, and meets the accuracy and precision specifications.

**Product Availability/Reliability**

NOAA-21 VIIRS ice products are available from the NDE I&T processing string.

**Known errors/issues/limitations**

Cloud contamination from errors in the cloud mask cause errors in ice temperature, ice cover, ice concentration, ice thickness, and ice age. Cloud detection is more difficult at night than in sunlit conditions, so errors in the ice products are likely to be more numerous for nighttime data.



Ice concentration is not retrieved if less than 10% of all pixels surrounding the target pixel are covered by ice, in which case the ice concentration cannot be determined because of lack of information. However, the ice cover (binary identification of ice/not-ice) can still be identified. Quality flags are set in the final ice concentration product for this condition. Furthermore, the assumption that completely ice-covered pixels are the majority of pixels surrounding the target pixel can be violated under some conditions, which results in larger uncertainties in the retrievals.

### **Changes since last maturity stage**

None

### **Review board recommendations**

TBD

### **Path Forward/Future Plans**

Continue evaluation/validation of the product with similar products from NOAA-20, and independent data sets. Prepare for Provisional Maturity Review of ice thickness and age. Prepare for Validated Maturity Review of all ice products.

### **Additional items to note**

None

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