## Why is VIIRS Ice Thickness Important?

Sea ice thickness is important in the exchange of momentum, heat, and mass between the ocean and atmosphere. VIIRS Ice Thickness and Age estimates sea and lake ice thickness and age, which can distinguish between the following types of ice: nilas, grey white, first-year thin, first-year thick, second-year, multiyear smooth, and multiyear deformed ice. These categories are defined in terms of ice age. Current capabilities allow the algorithm to estimate ice thicknesses up to 6 meters thick under cloudy and clear-sky conditions during day and night.

VIIRS ice thickness over the Canadian Arctic on 23 March 2018
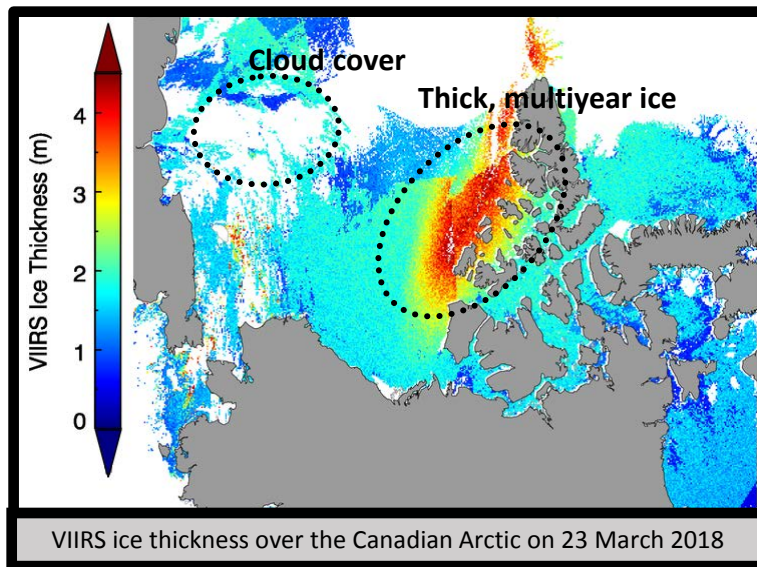
Categorization of Ice Age based on Ice Thickness:

The ice thickness and age algorithm uses a one–dimentional thermodynamic ice model (OTIM) developed by Wang and Key (2010). The OTIM is based on the surface energy balance; it does not directly use any VIIRS channel data. Instead, it takes into account variables such as VIIRS ice surface temperature and the VIIRS cloud mask to determine sea and lake ice thickness. Ice age is based on thickness as follows:

Ice Age Characterization	Free or Open Water	New	Grey	Grey-White	
Ice Thickness (m)	0	0.00- 0.10	0.10- 0.15	0.15- 0.30	
Ice Age Characterization	First year Thin	First Year Medium	First Year Thick	First Year	Older
Ice Thickness (m)	0.30- 0.70	0.70- 1.20	1.20-1.80	0.00- 1.80	≥ 1.80

Impact on Operations

Primary Application: The use of a computationally efficient method to produce daily ice thickness measurements characterizes the response of the cryosphere to oceanic and atmospheric changes. Sea ice thickness and characterization is very important for marine transportation and safety.

Application: Long-term records of ice thickness are valuable for studies in climate change and predictability.

Limitations

Limitation: Inaccurate determination of input parameters (e.g., cloud properties) or rapidly changing surface temperatures cause errors.

Limitation: Daytime retrieval is sensitive to ice optical properties and is less reliable than nighttime retrievals.

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Reference: Wang, X. and J. Key, 2010, A thermodynamic model for estimating sea and lake ice thickness with optical satellite data, *J. Geophys. Res*.