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ICEMAP250: Sea Ice Mapping At 250m Resolution Using Downscaled Modis Data

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IceMap250 is an automated and autonomous algorithm, focused on producing sea ice presence maps for any area covered by the MODIS Terra sensor at a 250m spatial resolution and on a daily basis. The IceMap250 algorithm, like its parent lower resolution version, uses data from reflective bands 2,4 & 6 and emissive bands 31 & 32 of the MODIS Terra sensor to build ancillary conditions dataset used to detect sea ice presence.

The first condition of ice presence is the detection of snow at the surface. This is done using a threshold of >0.4 on the Normalized Difference Snow Index (NDSI). The second condition, determined empirically during the development of the original IceMap algorithm, is a reflectance greater than 11% in MODIS Terra Band 2. The final condition, based on thermal information, is to detect an ice surface temperature (IST) lower than 271.4 K, which corresponds to the freezing point of sea salt water. If these three conditions are respected, ice is detected; otherwise, water is expected to be present.

To achieve a 250m spatial resolution in NDSI, Band 2 and IST, two downscaling approaches were used. To downscale bands 3-7 to a 250m spatial resolution, the Canadian Centre for Remote Sensing algorithm, based on focal regression, is used. An innovative method to downscale the IST to 250m, uses a KNN regression between cloud masked NDSI and IST at 1KM to, after the initial CCRS downscaling, injects 250m NDSI values into the KNN regression parameters therefore building a new, 250m downscaled IST.

Validation tests have been run on 5 days periods for each "season" of the ice regime; the freeze-up, the stable cover and the meltdown. The first results of the IceMap250 algorithm make it clear that adaptations have to be taken to correct the diverse seasonal effects due to cloud cover and the smoothing effect caused by the regression approaches. During the freeze-up season, the dense cloud cover makes it difficult to precisely distinguish ice and water from clouds with high accuracy. An important quantity of clouds isn't masked with the MODIS cloud-mask therefore causing the problem of cloud contamination in the classification result. During the stable cover season, the main issue comes from the fact that IST at 250m is a result of a downscaling approach that smooth the temperature pattern, therefore making it difficult to identify narrow ice zones that are the majority of the open water zones found during the stable cover period. As for the meltdown period, this is where the algorithm displays its best performance ($\sim$90% accuracy) since the cloud cover is rare and the water area is wide, making it clear for the algorithm to identify. Methods to improve the cloud masking and the IST smoothing issues are actually investigated.