DEVELOPMENT OF AN ADVANCED TECHNIQUE FOR MAPPING AND MONITORING SEA AND LAKE ICE FOR THE FUTURE GOES-R ADVANCED BASELINE IMAGER (ABI)

Rouzbeh Nazari, Marouane Temimi and Reza Khanbilvardi
Cooperative Remote Sensing Science & Technology Center, National Oceanic and Atmospheric Administration (NOAA- CREST) New York City, New York, USA
RNazari@gc.cuny.edu

Abstract

In recent years, the uniqueness of the Earth's ice covered regions and their importance to the world is being increasingly recognized. They are considered vital and valuable for a variety of economic, environmental, and social reasons. Ice information can also improve weather and climate predictions [1]. Observations show that Arctic ice is decreasing in both thickness and extent which will lead to the change in absorption of solar radiation and temperature of the earth. The increasing activity in ice-affected waters has led to a growing requirement for ice information and better mapping systems with improvements in both time and spatial resolution [2]. A variety of Earth Observation sensors are used to map ice covered areas. Visible-Infrared sensors at moderate-resolution from polar orbiting satellites (NOAA-AVHRR, MODIS Aqua/ Terra) have been used extensively because of their easy accessibility. However, cloud, fog and low time resolutions limit the use of this type of sensor to fully meet operational ice mapping requirements, particularly in cloud and fog ice zones. The primary objective of this research is to explore the potentials of mapping ice with the geostationary satellites which can provide a reasonably good time resolution and satisfactory spatial resolutions. The aim of this ongoing project is to develop an automated ice-mapping algorithm, which would make maximum use of GOES-R ABI's improved observing capabilities [3] and to be the pioneer of creating daily ice maps from a geostationary satellite. Data collected by SEVIRI instrument onboard of Meteosat Second Generation (MSG) satellite have been used as a prototype. In order to produce sea ice maps, an algorithm based on spectral bands value and Neural Network has been developed, optimized and validated. MSG SEVIRI images at 30 minutes interval have been routinely collected since December 2006 and being used for this project. Data from this instrument has been collected and preprocessed for this project. This data has been used in the development and validation of this technique which will be adapted for the future GOES-R. The algorithm will be tested over seas and

large lakes which receive substantial seasonal sea ice cover. The Northern region of the Caspian Sea has been selected for algorithm development and calibration. The choice of the study areas for this work was driven mainly by the availability of data and the unique location of Caspian Sea which is located in the Metosat domain [4]. Figure 1 illustrates the reflectance of 4 optical channels of MSG-SEVIRI and their capabilities in ice detection which will be used along with the Thermal Infrared (TIR) channels in the algorithm development.

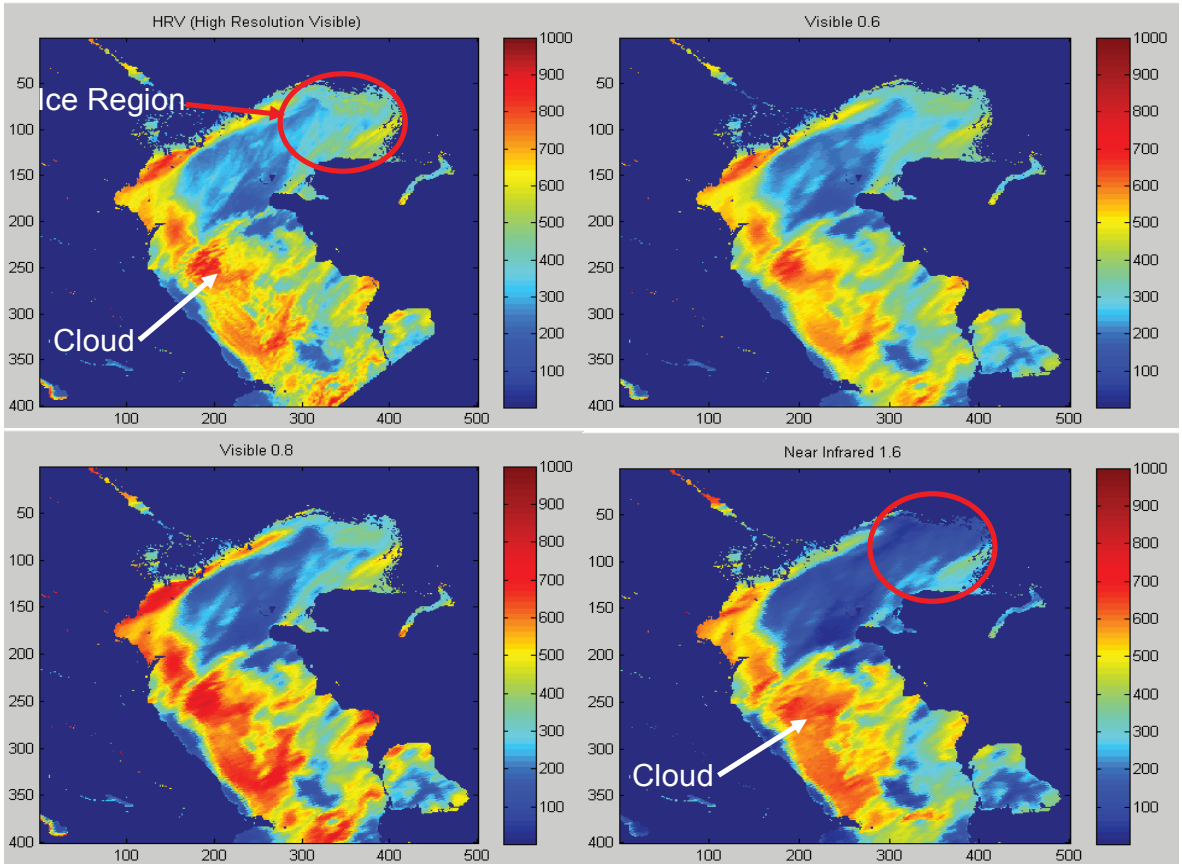

Figure 1: Reflectance of High Resolution Visible, 0.6, 0.8 and 1.6μ channels of MSG-SEVIRI

The approach used in the algorithm development includes daily cloud-clear image compositing as well as pixel-by-pixel image classification using spectral criteria. All available spectral channels (reflectance and temperature) have been tested and used in order to accurately classify Cloud, water and ice. The preliminary steps of the research focus on correcting the Bidirectional Reflectance Distribution Function (BRDF) effect of ice and developing a new ICE BRDF model to be used for such regions. In the next step the BRDF model will be used as a base for future classification and retrieval of cloud, water and ice pixels and addendum of other spectral bands. If a pixel remains unclassified

after the first round that model being run, it will be either tagged as cloudy pixel or assumed to have the class of the previous day (water/ice). Quality control flags for the pixels classified with the multi-date approach will be provided based on the number of days used to make the final decision. This research has no intention to develop the best sea ice product, however it will try to develop the most efficient sea ice mapping tool. The aim of this project is to explore the potentials of the future GOES-R Advanced Baseline Imager (ABI) in sea ice detection, mapping and monitoring. The final product of this project will be hourly, daily and multi day sea ice maps derived from daily composited images from the U.S. geostationary satellite by implying the ABI's new added bands such as 1.6μm.

References

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