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Data Fusion of Radarsat and MODIS Images for Arctic Sea Ice Mapping

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Introduction

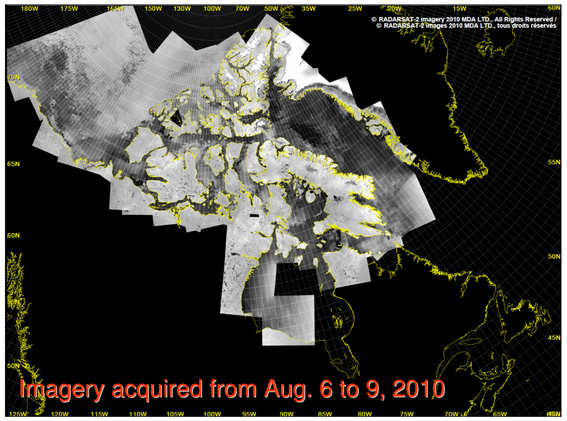
Mapping, tracking and forecasting Arctic sea ice is becoming increasingly important as human activity in the area increases. Understanding sea ice in the Arctic is also key to understanding the impact of climate change which is having on both the local and global environments. The recent advancements in remote sensing technologies mean there are now multiple sensors providing large volumes of data to the user community and this will only increase in the future. There appear to be two critical issues related to this increase in remote sensing data:

- How can users fully exploit the data from different sensors
- How to efficiently automate data processing and produce useful products

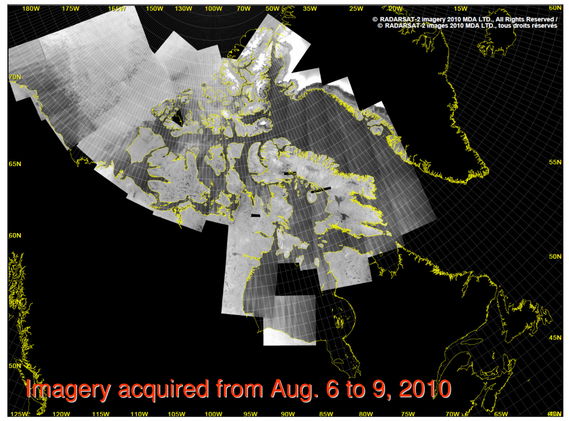
The Canadian Ice Service (CIS) intends to operationally implement ***automation*** and ***data fusion algorithms*** to take advantage of two of these data sets – RADARSAT-2 and MODIS.

Multi-scene RADARSAT-2 mosaic vs. multi-day and multi-band MODIS composite

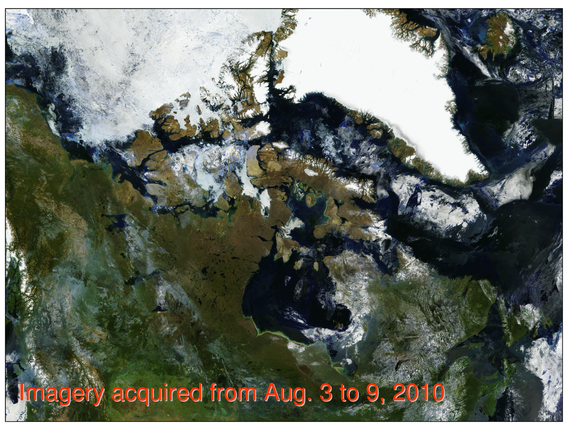
Radarsat mosaic for HH-polarization



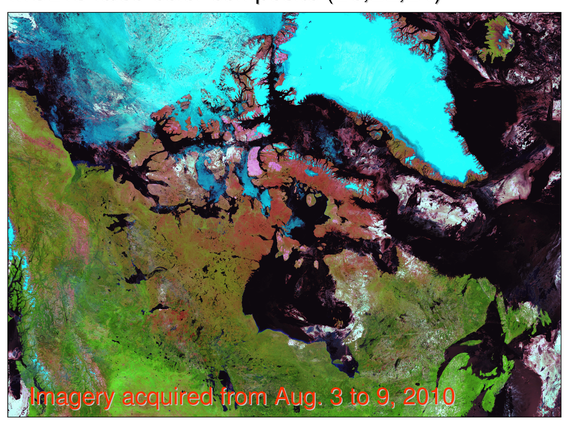
Radarsat mosaic for HV-polarization



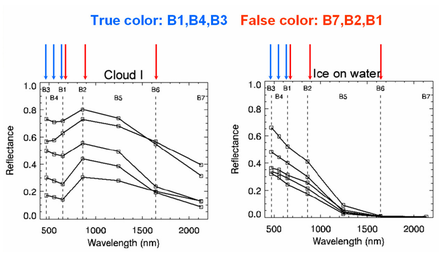
MODIS true-color composite (B1,B4,B3)



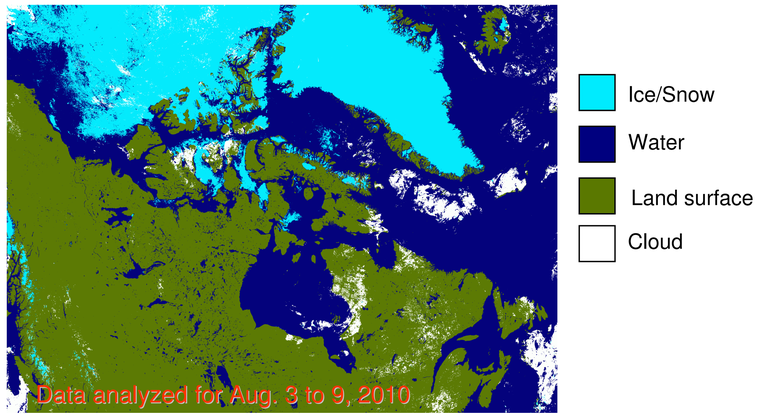
MODIS false-color composite (B6,B2,B1)



False color is much better than true color in distinguishing between clouds and ice according to their reflectance spectra

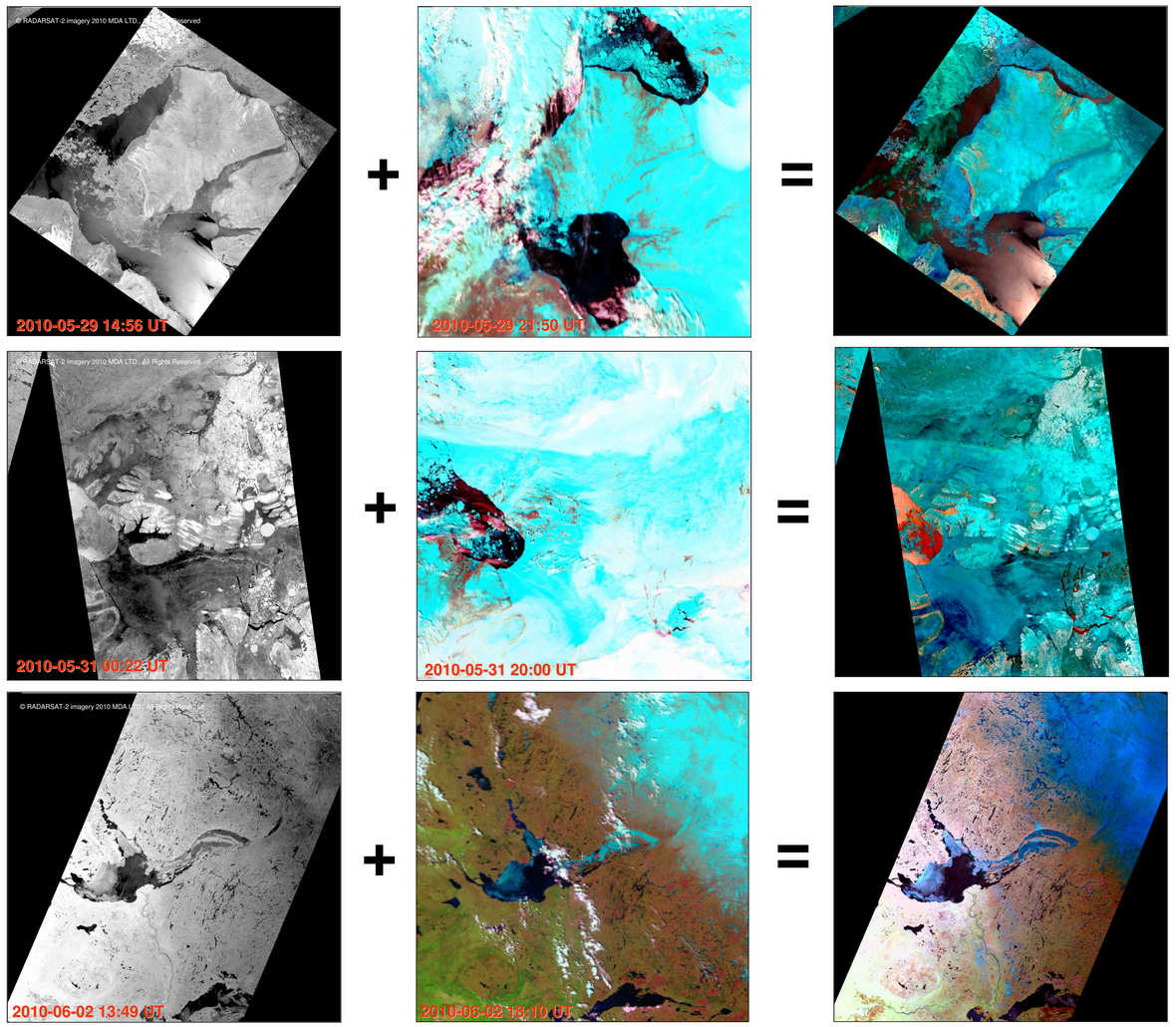


Surface types retrieved from MODIS multi-band composite



Data Fusion: RADARSAT-2 (HH) and MODIS (B1, B2, B6) - (IHS based method)

These two data sources have their specific advantages and limitations in terms of sea ice observation. The SAR imagery has higher spatial resolution, no influence from weather or atmospheric conditions, and images both day and night. SAR typically has sufficient brightness contrast between sea ice and open water, enabling accurate detection. However, when sea states are high and there is the onset of springtime melt, this contrast can be washed out and detection capabilities are compromised. MODIS data includes multiple visible and infrared bands that can easily distinguish between sea ice and open water. MODIS also has much wider scan swath and higher revisit frequency. However, its spatial resolution is relatively coarse and the presence of cloud or haze can block the surface radiance. Fusing RADARSAT-2 and MODIS imagery can take advantage of the benefits of each dataset in an efficient manner.



Current WWW Image products at the Canadian Ice Service

Radarsat / MODIS mosaic on weekly basis

Maximum and minimum Arctic sea ice extent from MODIS