TRENDS OF SEA ICE DISTRIBUTION IN THE CANADIAN ARCHIPELAGO REGION

Mohammed Shokr and Tom Agnew
Science and Technology Branch, Environment Canad
4905 Dufferin St., Toronto, Ontario, Canada M3H 5T4
Email: mohammed.shoke@ec.gc.ca

With climate warming, one of the concerns is that the Canadian Archipelago, especially in the Queen Elizabeth Islands (QEI) region will be subject to more intrusions of multiyear pack ice from the Arctic Ocean as sea ice in the region becomes more mobile and does not consolidate or consolidates later and later during winter. Monitoring this using operational ice charts from the Canadian Ice Service (CIS) (produced only once a month in winter) is problematic since coverage during the winter is too sparse to determine intrusion events through the larger channels of the QEI. This can be monitored more effectively using historic the high resolution AMSR-E data which is available since mid-2002.

Previous algorithms such as NT (Cavalieri, 1984) and NT2 (Markus and Cavalieri, 2000) have difficulty in estimating partial concentrations of ice types in a regional setting such as the Canadian Archipelago because they use (1) the coarse resolution channels 19GHz and 37GHz (spatial resolution of a few tens of km) and (2) global tie points to radiometrically characterize the surface. This makes ice concentration estimates especially of partial ice concentrations for the Archipelago region, poor. The current study uses a new algorithm to determine sea ice types and concentrations, called Environment Canada Ice Concentration Extracor (ECICE) (Shokr et al., 2008) to estimate concentrations of first-year, second-year and multi-year ice. Instead of using a single tie point for each ice type, it uses a probability distribution of radiometric values for each type for the particular region. In this way the statistical nature of radiometric observations of the regional sea ice surface is incorporated into the method. In addition, the linear radiometric equations are not solved deterministically but solved using an optimization procedure with the constraint that all partial ice concentrations must be greater than zero and add up to 100%. The most important advantage of using ECICE is its successful application with the fine resolution 89GHz (resolution 6x6km^2). This makes it most suitable for narrow channels that exist in the Arctic Archipelago region.

The main objective of the work is to produce better and more frequent estimates of concentration of first-year, second-year and multi-year ice in the Canadian Archipelago during winters from 2002/03 to 2007/08 than are available from RADARSAT and CIS ice charts. Then analyze this data to determine any trend and pattern of ice motion through the channels over the 2002 to 2008 period.

Based on 2004/2005 winter data, results show that total ice concentration reaches 100% starting late October, with multi-year ice dominates the scene at latitudes above 80 deg. Less multi-year ice concentration exist in McLure Straight (a western passage to QEI) and other channels in the beginning of the ice formation season but it increases with time until it

reaches its peak by mid March. After that multi-year ice decreases and completely disappears by beginning of May. Coastal polynyas and thin ice areas are identified at fine-resolution scale. Statistical analysis is being conducted to identify spatial and temporal patterns of sea ice type distributions.

References:

[1] D.J. Cavalieri, P. Gloersen, and W. J. Campbell, “Determination of Sea Ice Parameters with the Nimbus-7 Scanning Multichannel Microwave Radiometer,” J. Geophy. Research, vol. 89, pp.5355-5369, 1984.

[2] T. Markus and D.J. Cavalieri, “An Enhancement of NASA Team Sea Ice Algorithm,” IEEE, Trans. Geosci. Remote Sens, vol. 38 no. 3, pp.1387-1396, 2000.

[3] M.E. Shokr, A. Lambe, and T. Agnew, **“**A New Algorithm (ECICE) to Estimate Ice Concentration From Remote Sensing Observations: An Application to 85-GHz Passive Microwave Data”, IEEE Trans. Geosci. Remote Sens., vol 46, no. 12, pp. 4104-4121, Dec. 2008.