SEA ICE TYPE CLASSIFICATION FROM MULTICHANNEL PASSIVE MICROWAVE DATASETS

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1. INTRODUCTION

Passive microwave sensors have been described as the "workhorses" of sea ice observation as they provide daily synoptic monitoring of sea ice extent even during periods of winter darkness and cloud cover [1]. There are numerous algorithms for deriving area concentration which utilise a limited subset of the available channels, normally being based on two-channel frequency or polarization emissivity ratios [2-4]. These have problems with the filtering of weather effects, detection of new ice formation, and surface melt or wetness. These inaccuracies are greater during the summer melt period and for low ice concentrations, which are becoming increasingly prevalent with a more seasonal Arctic ice cover. Comparisons between the algorithms, against each other and in validation with independent data, have shown that some errors are algorithm specific and others are common to all the algorithms [5-7].

2. METHOD

Frequency and polarization dependent variations in microwave emissivity are a function of the ice thickness, age, salinity, temperature, structure, snow cover and overall surface conditions [8,9]. Whilst unsupervised classification schemes have been used successfully for terrestrial applications, their use on sea ice has been limited [10,11]. This paper examines a cluster analysis approach to automatic classification of the data and demonstrates that by clustering using emissivities from all channels it is possible to obtain classifications of the different ice regimes both in the seasonal and perennial ice cover. Figure 1 shows an example from the Beaufort Sea during spring 2007 showing the cluster map produced from SSM/I compared to nearly coincident MODIS infrared and Envisat ASAR images.

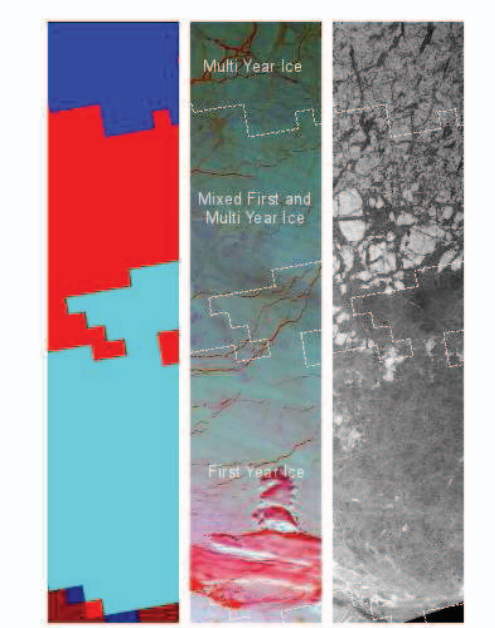

Figure 1: Comparison of images from 31 March 2007. From left to right: Cluster analysis of data from all 7-channels of SSM/I (NSIDC daily gridded brightness temperature data); MODIS false colour composite (infrared channels) from 21:20 UTC (NASA); and, Envisat ASAR WSM from 06:37 UTC (ESA)

3. RESULTS

The results from the cluster analysis technique are compared with observations of the SEDNA field campaign in 2007 and ice charts produced by Ice Service analysts [12,13]. Areas of new ice and the ice edge are detected with greater accuracy when using data from older sensors (SMMR and SSM/I) than is possible using standard ice concentration algorithms. The persistence of the classification throughout the seasons and its ability to handle the significant changes in ice cover during 2007 and other historical events is evaluated. The use of the classified sea ice type as a proxy for sea ice thickness is discussed. It is proposed that by using this method of classification that it will be possible to process the 30 year multi-channel passive microwave record to develop a record of sea ice volume.

4. REFERENCES

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