Sea ice in the Weddell Sea: use of moderate resolution imagery to summarize inter-annual variation in conditions and support operational ship survey

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The distribution and concentration of sea ice presents a significant challenge to shipping and scientific expeditions in high-latitude regions. In addition to achieving safe navigation, information about likely sea ice conditions is needed for expedition planning, and the deployment and retrieval of scientific instruments and their data. In areas where time series of passive microwave data exist, broad-scale analysis of sea ice concentration can be readily achieved. However, the spatial resolution of these data does not permit detailed investigations of sea ice conditions, including near-shore lead development.

Here we present a new methodology for processing moderate resolution multispectral and thermal satellite imagery to summarise inter-annual differences in the probability of sea ice observation. By using multiple daily imagery sources (Terra and Aqua MODIS; Suomi-NPP VIIRS), and averaging resultant concentration maps over longer time periods, we reduce the impediment of cloud cover to characterising sea ice using this type of imagery. Our processing provides a higher-resolution depiction of sea ice conditions and their variability than that afforded by passive microwave data. By estimating a sub-pixel concentration for all pixels identified as 'Ice', we capture further nuances of narrower water/thin ice inclusions within the ice cover.

The utility of this new methodology to support operational ship survey in polar regions is demonstrated using examples from the Weddell Sea, Antarctica. Our description of sea ice cover agrees well with that derived from very high-resolution imagery from the Operation Ice Bridge DMS camera system, and with experience of the actual sea ice conditions encountered during the Weddell Sea Expedition in early 2019.