Monitoring of sea-ice changes from Envisat altimetry records: 2003-2010

Potential of altimetry data within a sea-ice monitoring system

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Overview

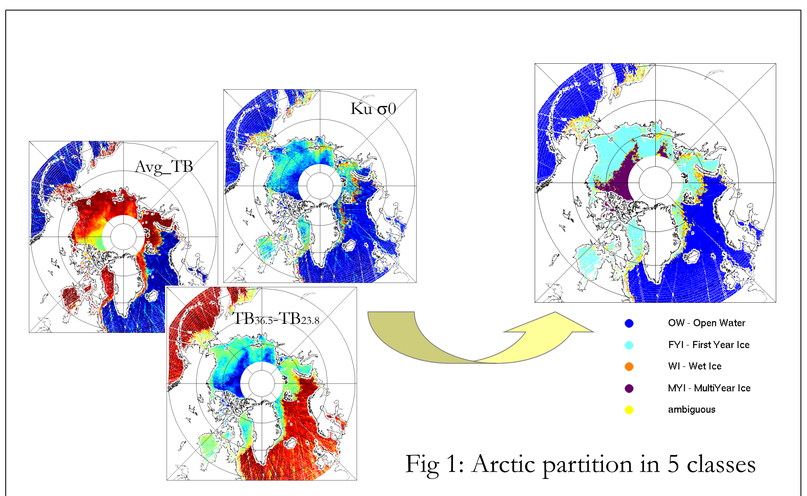

Fig 1: Arctic partition in 5 classes

We developed a sea-ice flag for Envisat altimetry mission. It main purpose is to detect sea-ice corrupted sea surface height data for editing within quality control processing for oceanography applications. The second objective was to analyze the potential of altimetry data to retrieve different types of sea-ice for cryosphere studies and their limitations. The developed algorithms took advantage of the availability of both passive and active microwave data on the same platform. The choice of the parameters has been dictated by the constraint to make such development applicable to all past and future altimetry missions (i.e. combination of mono-frequency altimeter and dual-frequency radiometer): ERS, Altika, and Sentinel-3 for instance. These results come from the WOOPI project.

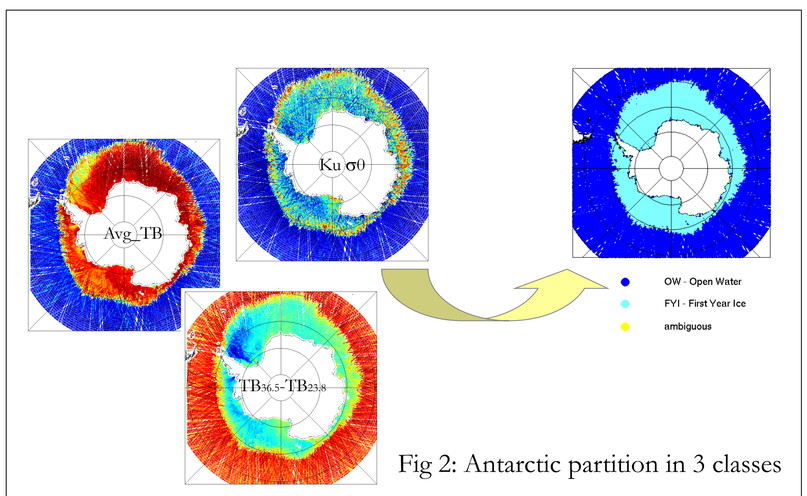

Fig 2: Antarctic partition in 3 classes

Arctic sea-ice monitoring

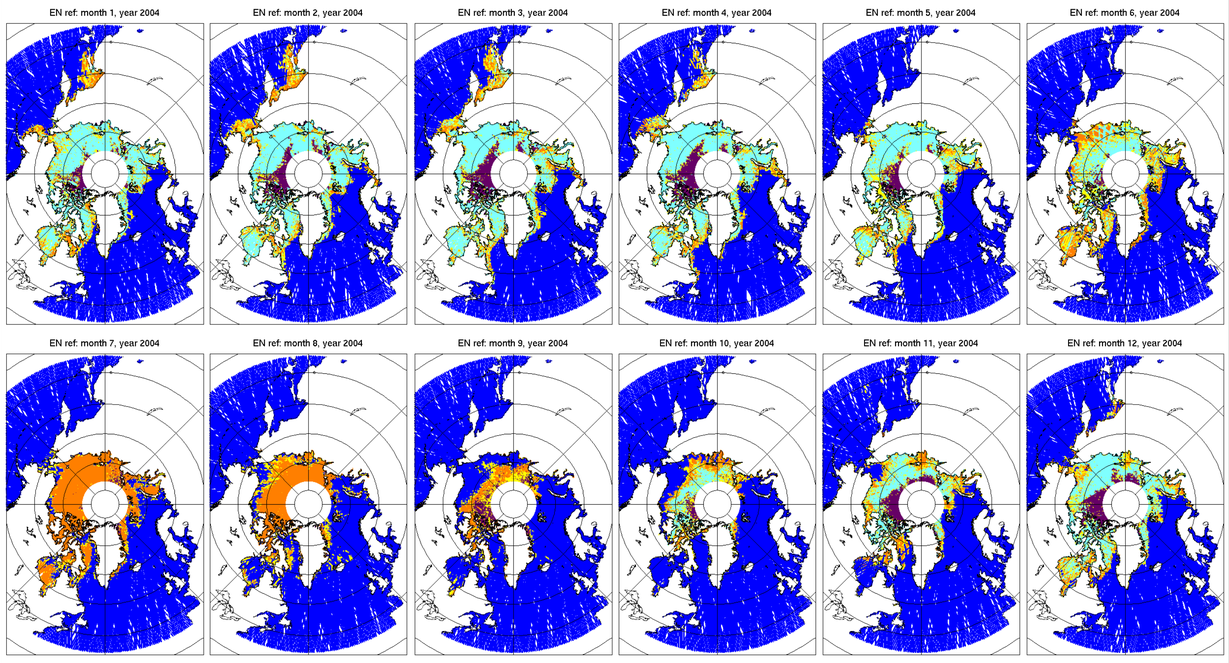

Fig 3: Monthly maps over 2004.

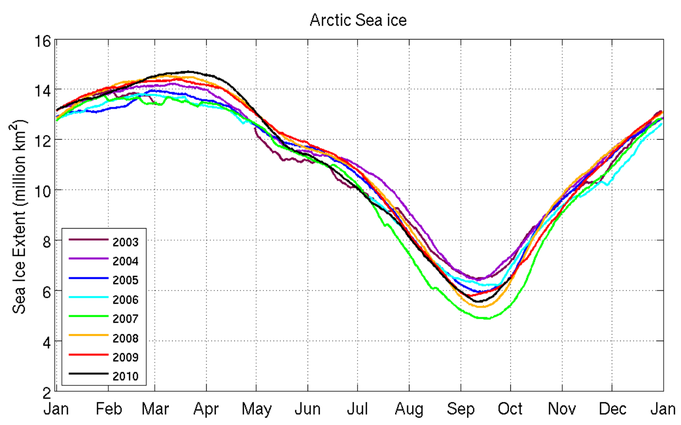

Fig 4: Seasonal and interannual variations (computed with a 35-day running window and the assumption of pole hole filled with sea-ice). Each winter the ice cover grows as the sun sets for several months and intense cold ensues. Some of the ice flow out of the Arctic. In the summer, wind and ocean currents cause some of the ice to flow out of the Arctic while much of it melts in place.

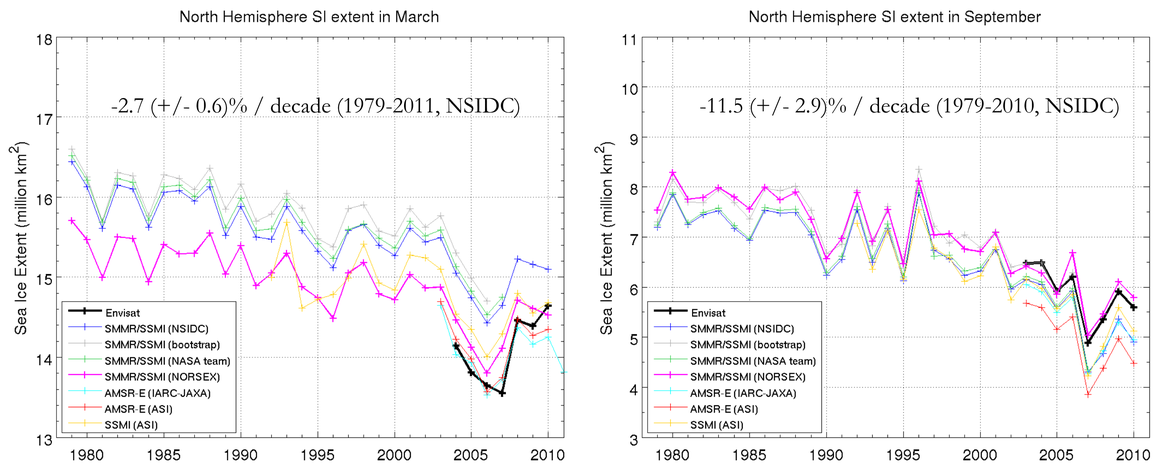

Fig 5: Monitoring of extents in March (maximum) and September (minimum) that define the annual cycle.

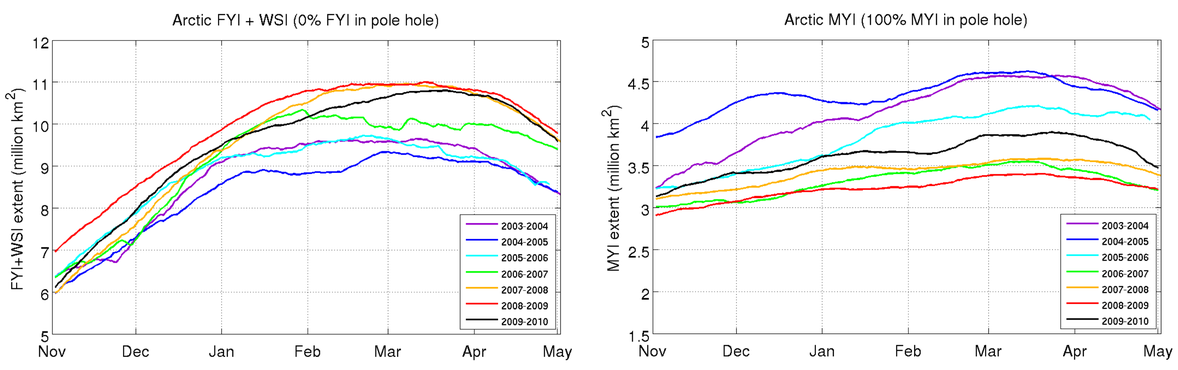

Fig 6: MYI and FYI extents variations during winter (preliminary results). The knowledge of the partition between FYI and MYI extents provides another view of the ongoing transformation of the Arctic's ice cover. Seasonal ice replaces thick older ice as the dominant type.

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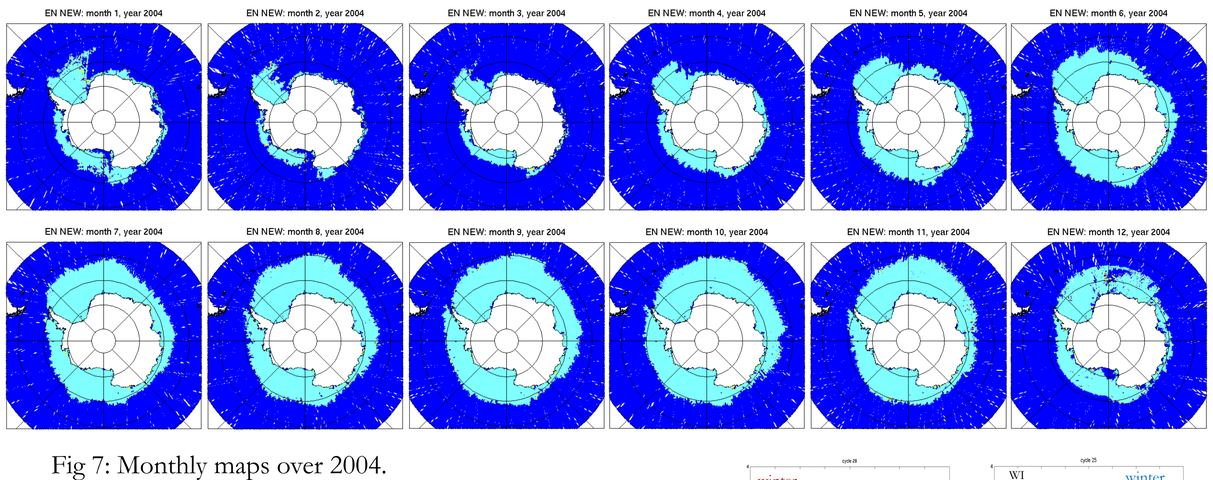
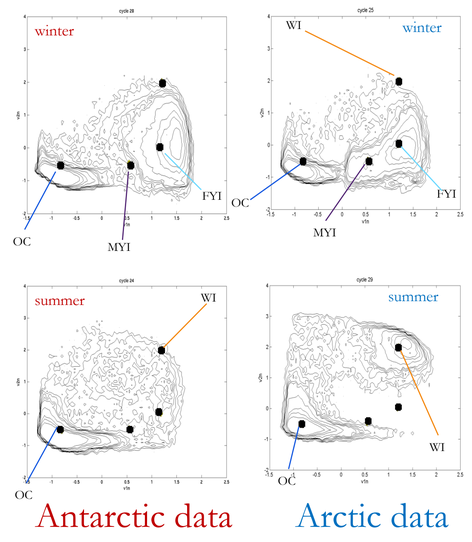


Fig 7: Monthly maps over 2004.

Fig 8: Comparison of clusters from Antarctic and Arctic data. The black dots indicates the tie-points from clustering of the Arctic data. The sea-ice characteristics are quite different between the two polar regions. We developed region-specific algorithms.



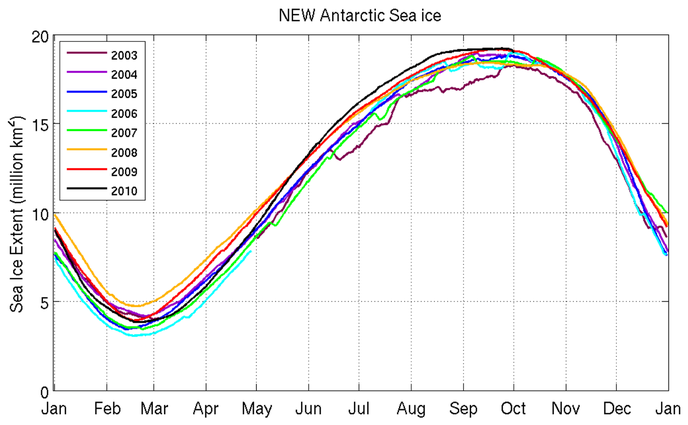


Fig 9: Seasonal and interannual variations (computed with a 35-day running window).

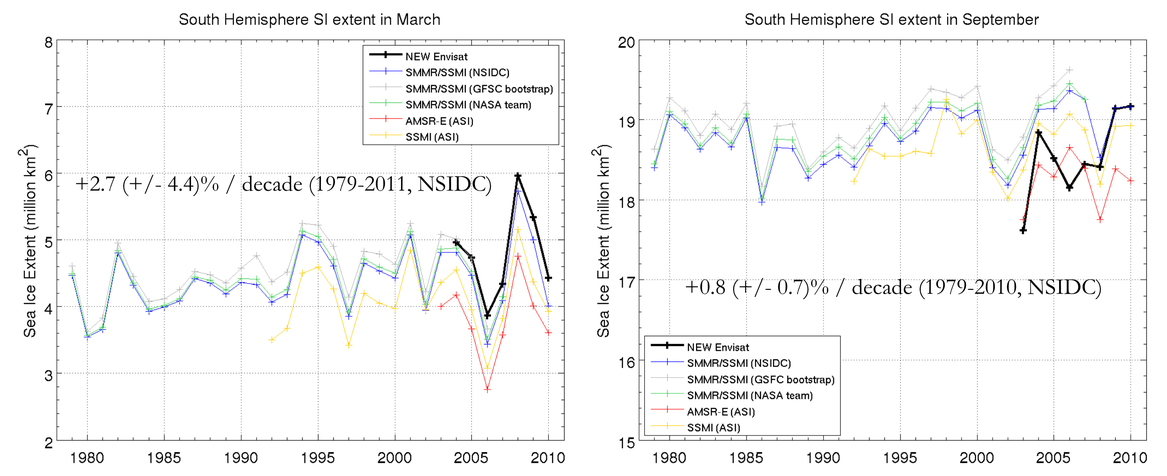


Fig 10: Monitoring of extents in March (minimum) and September (maximum) that define the annual cycle.

Conclusions

The most dramatic signals of the general Arctic-wide warming trend in recent years are (1) the continued significant reduction in the extent of the summer sea ice cover, (2) the decrease in the amount of relatively older, thicker ice and (3) its overall thinning. The results presented in this poster show the good potential of altimetry for use within a sea-ice monitoring system. We get information about (1) the sea-ice extent (independent validation of trends observed by passive radiometers possible), and (2) inter-annual variation of ratio between MYI & FYI contributions to total ice cover during winter.

The perspectives concern mostly the extension of this Envisat time-series with past ERS records and with future Sentinel-3 records.

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