

Project information

Project title

Characterization of Arctic sea ice properties from remote sensing observations

Year

2011/2012

Project leader

Torbjørn Eltoft, UiT

Participants

- Prof. Torbjørn Eltoft, Department of Physics and Technology, UiT
- Research Scientist Sebastian Gerland, NPI
- Research Scientist Christina A. Pedersen, NPI
- Research Scientist Mats Granskog, NPI
- Engineer, Ola Brandt, NPI
- Postdoc Angelika H.H. Renner, NPI
- Senior Researcher Rune Stovold, Norut
- Senior Researcher Stian Solboe, Norut
- Postdoc Anthony Doulgeris, UiT
- PhD student Mari-Ann Moen, UiT
- PhD student Ane Fors, UiT

Flagship

Arctic ocean

Arctic ocean

Funding Source

Fram Centre, NRC, RDA, Ministry of Foreign Affairs, internal: NPI and UiT

Summary of Results

Satellite & in-situ:

- June: Land-based fieldwork at Barrow in May/June 2012 have been conducted, coordinated with high-resolution SAR scenes from Terra-SAR X and Radarsat-2

Two cruises with extensive fieldwork have been conducted in 2012.

- Juli-August: A summer – cruise north of Svalbard was done to study melt properties of sea ice.
- August-September: A late summer cruise in the Fram Strait was done to study sea ice properties and drift patterns.
- In both cruises Lance was used, EM-bird measurements and optical images were obtained from helicopter, and measurements were done on the ice.

In addition, images from a mast-mounted in Rijpfjorden (Nordaustlandet) has been retrieved, and they show interesting ground-truth information. This information will be compared to a series of TSX-images acquired from the same area in June 2011. This is a very interesting data set.

Data is currently being analyzed by 2 PhD students, in accordance with the objectives of the project.

UAS:

Norut has in 2012 acquired and integrated a precision (L1/L2) 2 antenna GPS system into the Cryowing UAS system. This system is capable of centimeter accuracy position and attitude (pitch and yaw). This accuracy is needed to be able to measure sea-ice thickness with reasonable accuracy. For measurements of distance from airplane to the ground we have integrated a FAE-1501 laser altimeter. This instrument has an RMS accuracy of 60 mm at 2kHz. The system was tested during this summer UAS campaign under the NFR Arctic EO project (July 9th –Aug 9th Ny-Ålesund Svalbard). Several flights (6) were performed to evaluate accuracy and operational limitations of the system.

This data is currently being analyzed but some preliminary findings are:

- The interference with the iridium satellite communication reduces the ability of the GPS system to track carrier phase.
- The laser altimeter range was shorter than expected based on the manufacturers specifications. Even over bright surfaces (glacier) the plane had to fly less than 200 meters above the surface to get optimal data quality.

So to achieve optimal accuracy on the sea-ice products Norut will investigate the problem by adding filters to the antennas as the frequencies are very close, searches on the internet has revealed that other groups has encountered the problem and stated that a distance between the antennas has to be 15-30 meters, if no special action is taken, to achieve phase locking on the GPS system.

Satellite & in-situ:

- June: Land-based fieldwork at Barrow in May/June 2012 have been conducted, coordinated with high-resolution SAR scenes from Terra-SAR X and Radarsat-2

Published Results/Planned Publications

- S. Gerland¹, J. Haapala, M. Lensu, M.A. Moen, A.H.H. Renner, M. Zygmuntowska, S. N. Anfinsen, O. Brandt, A. Doulgeris, M. Dumont, T. Eltoft, A. Fors, M.A. Granskog, V. Helm, S. Hendricks, S.R. Hudson, N.E. Hughes, Z. Li, S. Sandven, H. Skourup, and C. Wang, “Examples of in situ calibration and validation of satellite remote sensing observations over Arctic first year sea ice”, presented at *IAHR conference*, Dalian, China, June, 2012.
- T. Eltoft, Ane Fors, M-A. Moen, A. Renner, A. Doulgeris, Sebastian Gerland, Laurent Ferro-Famil, “A Multi-Polarization Study of Arctic Sea Ice in C-Band and X-Band”, presented at *SEASAR 2012*, Tromsø, June 2012.
- N. Hughes, Anthony Doulgeris, T. Eltoft, S. Gerland, R. Hall, M-A. Moen, A. Renner , “Integrated studies of multi-polarimetric SAR over sea ice”, presented at *SEASAR 2012*, Tromsø, June 2012.
- A. Doulgeris, “Re-thinking Statistical Based Segmentation of Sea Ice”, presented at *SEASAR 2012*, Tromsø, June 2012.

Submitted abstracts:

- M-A . Moen , A P Doulgeris, S N Anfinsen N Hughes, A H H Renner, S Gerland, T Eltoft, T. Robertsen, and v. Lund, ”Comparison of feature based segmentation of SAR satellite sea ice images with manually drawn ice-charts, submitted to *ESA workshop on Cryosphere*, Frascati, October, 2012.
- T. Kræmer, C. Brekke, T. Eltoft, “Estimation of discontinuous sea ice motion in the marginal ice zone using polarimetric SAR data” submitted to *ESA workshop on Cryosphere*, Frascati, October, 2012.

Communicated Results

- T. Eltoft, ” Havisovervåking ”, Lansering av Flaggskipet ”Havisen i Polhavet, teknologi og avtaleverk”, Oslo, februar, 2012.
- T. Eltoft, ” Hva skjer med havisen, betydning for navigasjon. Muligheter for å observere og forutsi endringer ”, presentasjon for Faggruppen vedrørende skipsfart i Polhavet.

Interdisciplinary Cooperation

The project will have links to “Olje i is”, managed by the Flagship “Hazardous substances – effects on ecosystems and human health”.

Budget in accordance to results

The FRAM Centre funding helped the project in

- Collecting co-located (in time and space) RS2 C-band scenes & TSX X-band scenes
- Collecting co-located (in time and space) multi-channel SAR data, and EM-bird measurements from helicopter, including automatised optical photography of the sea ice, which was simultaneously imaged by SAR.
- We were able to buy a significant amount of TSX-data.
- Allowed for extra UAS instrumentation for precision measurements of sea-ice thickness and roughness measurements.

In summary, the FRAM Centre funding definitely was of big value to the project, and enabled us to perform a much more comprehensive study.

It also has made the partners visible to industry (KSAT & Statoil) for future funding opportunities.

If Yes

As the shipping industry and oil and gas industry are moving northwards with the retreat of the sea-ice, the need for accurate mapping of ice cover and properties becomes important. The need for near real time monitoring and characterization of sea-ice properties provides a market where businesses like KSAT could sell these products, which have much more accurate and detailed information than what is obtainable from the free products provided currently by met.no.

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Conclusions

Future research will use data collected within this project to:

- study polarimetric properties of sea ice types
- produce improved sea ice type maps
- improve usability of satellite SAR data to monitor sea ice, which will benefit ship traffic and industrial activities in the Arctic Ocean.