

SAMCoT News Letter 02/2015 (June-Nov. 2015)

Work Package Adm.: Administrative reporting

Briefing on Activities:
The final report 'SAMCoT SFI midway evaluation' from the Research Council of Norway is not available with a positive result for our Centre for Research-based Innovation. Report available at the SAMCoT e-room: R_R-MTE_EvaluationRCNFINAL_SAMCoT
The Centre Management Group and other governing bodies from the centre take the recommendations form the RCN very seriously.

Hence, the following actions are now in place:

1. The SAMCoT Exploitation and Innovation Advisory Committee is working to evolve in its role to better capture SAMCoT success stories related to innovation:
    a. In doing so EIAC is taking a more structured approach to intellectual property.
    b. EIAC is in the process of defining exploitation and innovation KPIs.
    c. Innovation workshops are now being planned with the purposse of further expanding to educational workshops for Students and post-docs to provide them with a more commercial perspective.
2. Gender equality strategies and processes used by others are being studied and the communication plans for 2016 will include actions to promote access of female researchers to the Centre.
3. The Centre leadership, Board and EIAC will design and strategy to focus to the future of the capability at the end of the SFI funding. Hence, the EIAC has started the necessary business planning by gathering evidence of added value.

Over 60 participants from different SAMCoT's 21 Partners gathered in Trondheim to discuss the Centre activities and strategic future at the SAMCoT Technical Workshop.

In addition to the two days workshop on October 22nd and 23rd, the Centre organized a Workshop in Ice Rubble and on WP6 Activities on the 21st. Also the IVOS associated project had an informative meeting for those SAMCoT partners involved in the projects.
Furthermore, the EIAC and GA met:

The EIAC meeting resulted in a clear definition of a strategy towards a more dedicated and hands on approach to capture, monitor and promote deliverables with potential for innovation and exploitation and their further utilization at company level.

The GA took a partial decision regarding the entry of a new partner to the SAMCoT Consortium Agreement. The voting process that the Centre management hopes to conclude in the near future (deadline November 16th), if positive, will imply the accession of the Swedish Polar Research Secretariat.

Photo: Group picture of participants to the SAMCoT Technical Workshop (October 2015)

Photo: Øyvind Buljo

Achievements:

- Final Midway Evaluation - Research Council of Norway. SAMCoT has a green light to continue its activities to 2019! In addition, the Centre management and other decision bodies have started a process to take into account the recommendations from the RCN.
- SAMCoT Technical Workshop October 2015
- SAMCoT GA and EIAC Meetings Sept./Oct./Nov. 2015
- Communication achievements:
    - Updated SAMCoT Webpage
    - NRK interview with Åse Ervik at NRK 'God ettermiddag Trøndelag' 09.11.2015
    - GEMINI articles followed by different mass media: Petro.no; Forskning.no; TekniskUkeblad, etc.
    - New VIDEOS

Notifications:

- *SAMCoT 2nd Board Meeting 2015:* November 12th, Statoil. Kontoradresse, Fornebu, Oslo Martin Linges vei 33, 1364 Fornebu.
- *1st December 2015:* Annual Reporting Research Council of Norway.
- *6th January 2016:* VeriArc Meeting: NTNU Technology Transfer Project – All SAMCoT Parties Welcome
- *EIAC Gap assessment workshop 2nd & 3rd February 2016:* Trondheim, EIAC and WP Leaders will be expected to participate.
- *SAMCoT 1st Board Meeting 2016:* April 28th & 29th suggested location, Longyearbyen UNIS.
- *SAMCoT Scientific Seminar 2016:* May 4th & 5th Trondheim, NTNU.
- *SAMCoT Technical Workshop 2015:* October 19th & 20th Trondheim, NTNU.
- *SAMCoT General Assembly 2015:* October 20th Trondheim, NTNU
- *SAMCoT 2nd Board Meeting 2015:* November 11th Trondheim, location to be define.

Briefing on Activities:

Studies of ice drift in the north-west Barents Sea

Characteristics of ice drift and surface currents in the north-west Barents Sea and Svalbard region are investigated and compared using the data from ice trackers deployed on drift ice and icebergs, and the data of floating buoys provided by NOAA. Ice trackers deployed by a UNIS group provide GPS data with small sampling intervals of 10 or 20 minutes while NOAA buoys deliver the data with a six hour sampling interval. The influence of the sampling interval on statistical characteristics of ice drift speed and direction is analysed and compared with statistical characteristics of surface water motion. It is shown that maximal speed of drift ice decreases 20-30% when the sampling interval of GPS data increases from 10 minutes to six hours.

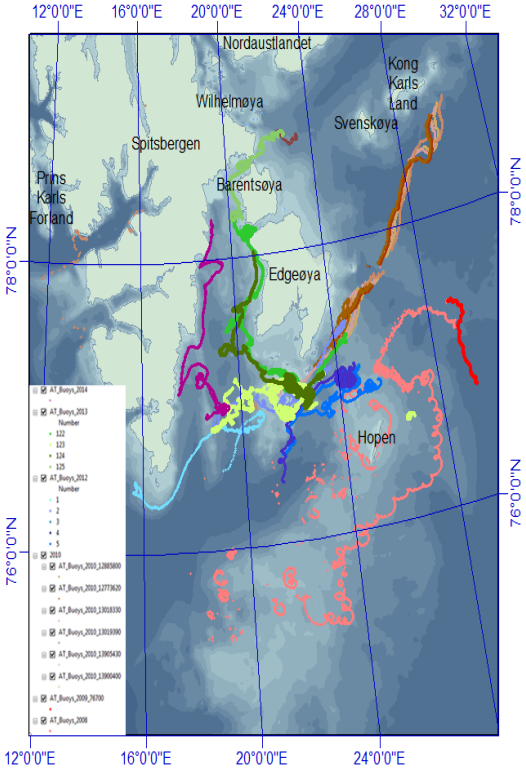
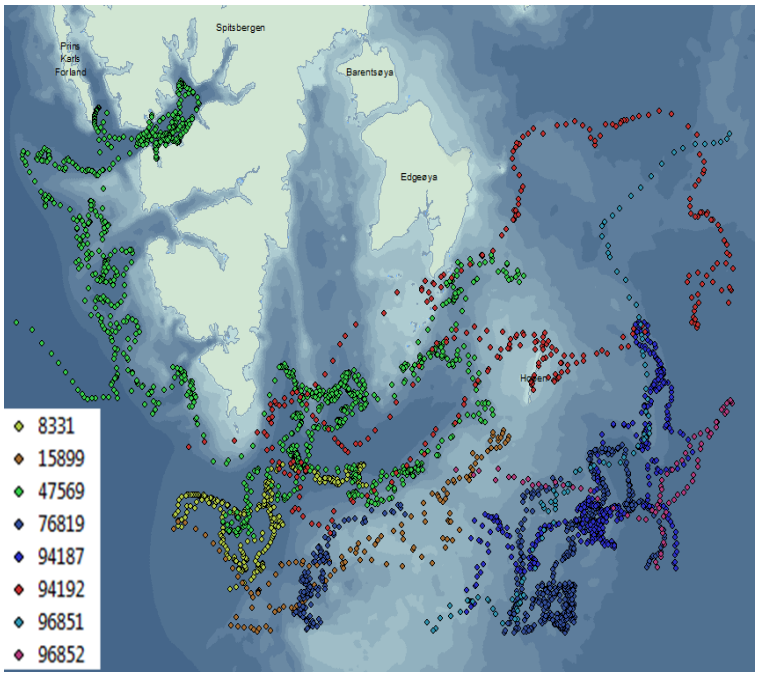
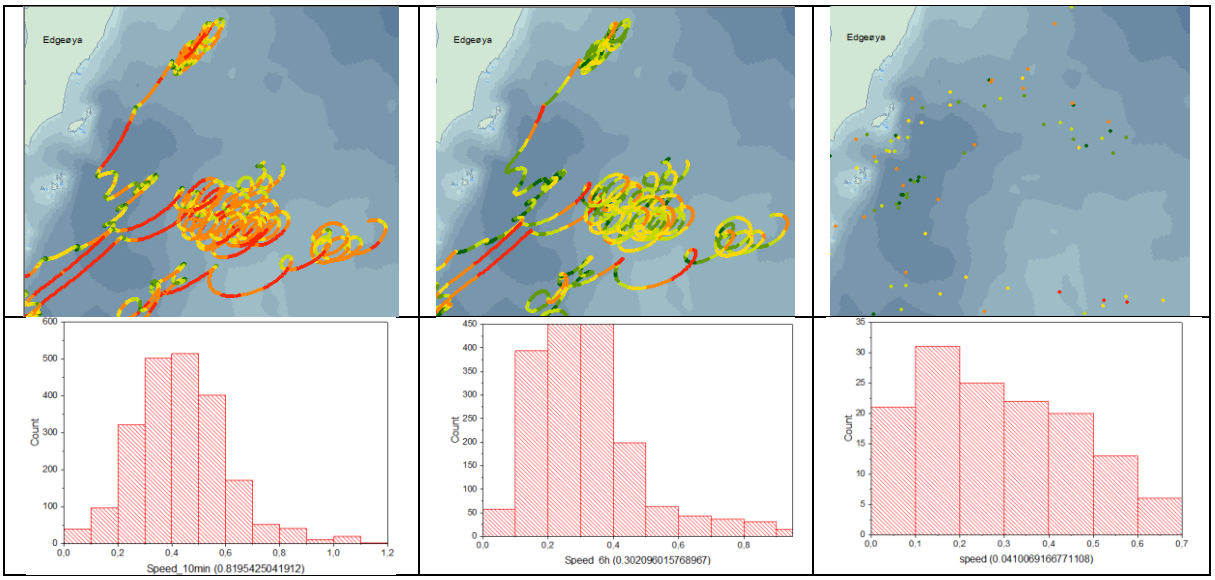
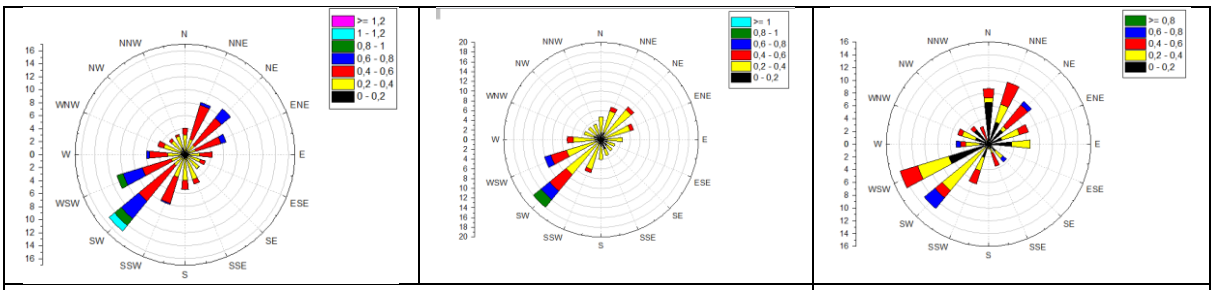


Figure 1. Trajectories of ice trackers deployed since 2008 and NOAA drifters for the same time period.







Ice trackers (ITs)		NOAA buoys (FBs)
a) 10 min sampling interval	b) six hour sampling interval	b) six hour sampling interval

Figure 2. Comparison of buoys speed in the region with tidal loops for different sampling interval of GPS data

Studies of Drifting Ice Ridges in the Arctic Ocean during May-June 2015

Data collection on drifting ice ridges during summer season was performed during scientific cruise N-ICE2015. N-ICE2015 is a multidisciplinary the project of Norwegian Polar Institute. The primary objective of the project is to understand the effects of the new thin, first year, sea ice regime in the Arctic on energy flux, ice dynamics and the ice associated ecosystem, and local and global climate. The expedition took place on the research vessel RV Lance frozen in and drifting with the young sea ice in the Arctic Ocean over six legs from 11th of January to 23rd of June 2015. A SAMCoT research team of Postdoc Aleksey Shestov and Ph.D. student Åse Ervik was invited to perform studies of drifting ice ridges. From May 21st to June 23rd four ice ridges were subjected to morphology mapping and coring for mechanical and physical properties. In addition, thermistor buoys were deployed and studies on melt ponds development were carried out. Such data collection during summer season and observation of changes in physical properties in dynamic are unique and should bring a new knowledge to the field of ridge keel thermodynamic and mechanics.

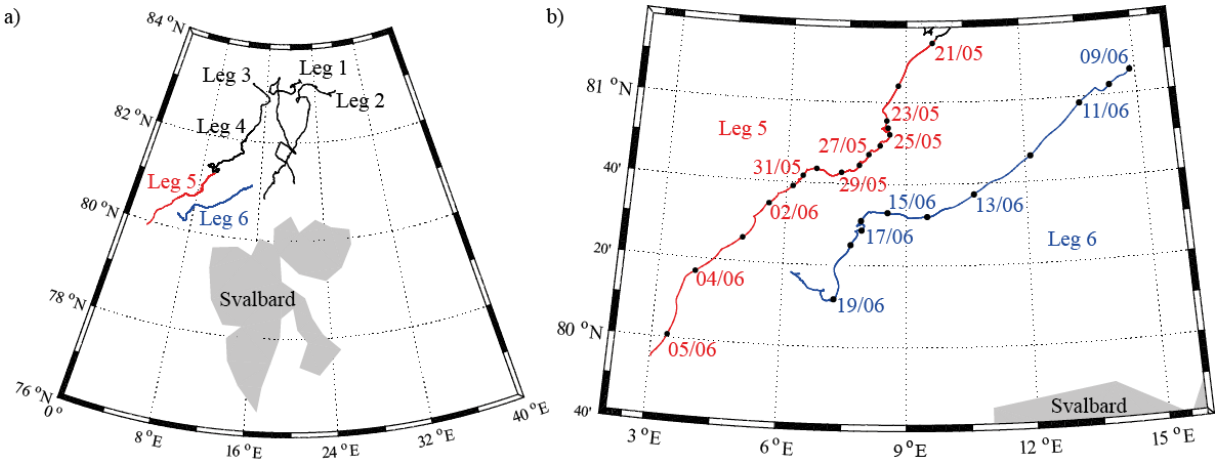


Figure 3. Drift trajectories of all six legs of the N-ICE2015 expedition (a), and drift trajectories of last two legs, leg 5 and 6, where ice ridge studies were performed.

Modelling of thermodynamic consolidation of drifting ice ridges in the north-west Barents Sea

3D FEM model of thermodynamic consolidation of ice ridges was realized in Comsol Multiphysics. The model was used for simulations of thermodynamic consolidation of ice ridges drifting in the north-west Barents Sea from Olga strait region to the South. Two types of drift trajectories and air-water characteristics along the trajectories were considered. The first type trajectories were calculated with a model of ocean circulation developed in the Institute of numerical mathematics of Russian Academy of Science (INMOM) and realized in the State oceanographic institute (Moscow). Numerical simulations reproduced well the trajectories of ice trackers deployed in 2010 and provided data on air and water temperature in ice adjacent layers in March-June 2010. The second type trajectories and sea water temperature at 10 m depth were reconstructed with climatic data of Arctic and Antarctic Research Institute (St'Petersburg) in case when ice ridge drifts to the Bear Island region from Olga strait region. Air temperature was reconstructed from NCEP/NCAR archive. It was shown that keels of model ice ridges melt significantly during their drift by the second type trajectories, and practically don't melt if ice ridges drift by Spitsbergen banken to the west coast of Spitsbergen. In both of the cases practically full consolidation of ridge keels was calculated.

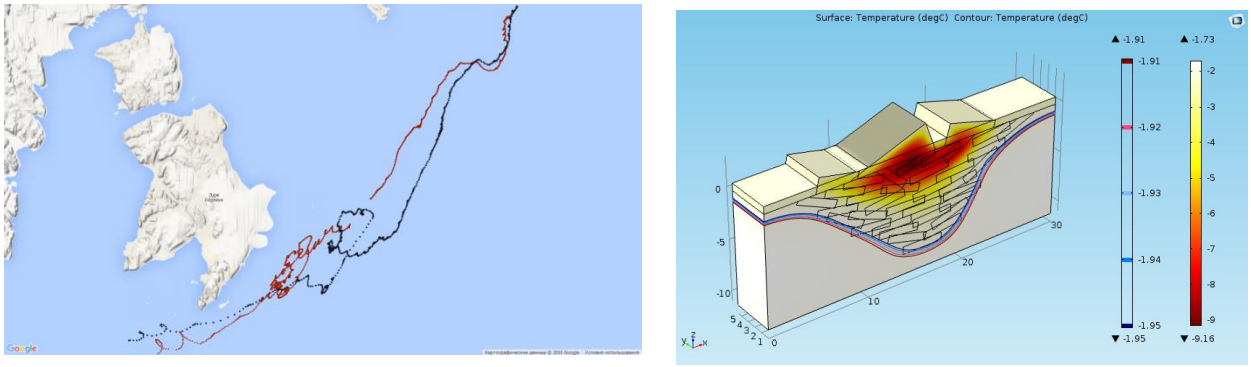


Figure 4. Trajectory of ice tracker (red line) and simulated trajectory (blue line). Structural map of model ice ridge after 4 months consolidation.

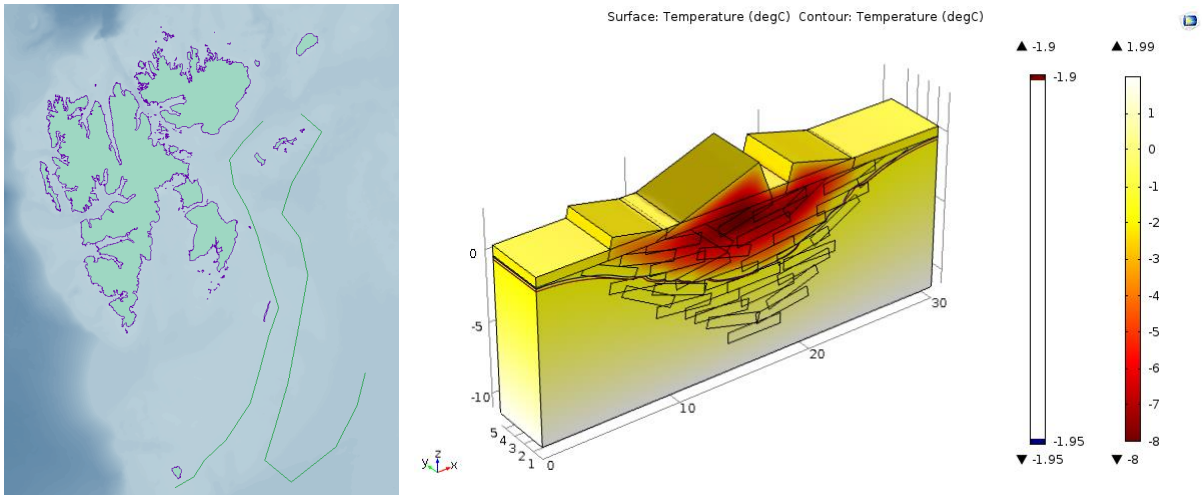


Figure 5. Trajectories of ice drift reconstructed with AARI climatic data. Structural map of model ice ridge after 3 months consolidation and melting.

Analytical modelling of passive turn of turret moored vessel in close drift ice

A model of passive turn of a vessel with internal turret in conditions of close drift ice is formulated using the method of limit stress analysis in plasticity and theory of granular materials. Model equations consist of kinematic and dynamic equations describing movements of the vessel and ice loads on the vessel hull when solid ice drifts against the vessel. It is shown that movements of the vessel before it will take final position parallel to the ice drift consist of translational displacements, rotation without axial displacement and rotation with axial displacement. On the last stage of the turn the vessel rotates as a whole together with the effective mooring line around the elasticity center of the mooring system. Tension of mooring line reaches maximum on this stage. Characteristics of the effective mooring line tension, typical times, and spatial orientation of the vessel relatively drift ice during passive turn are discussed in the paper.

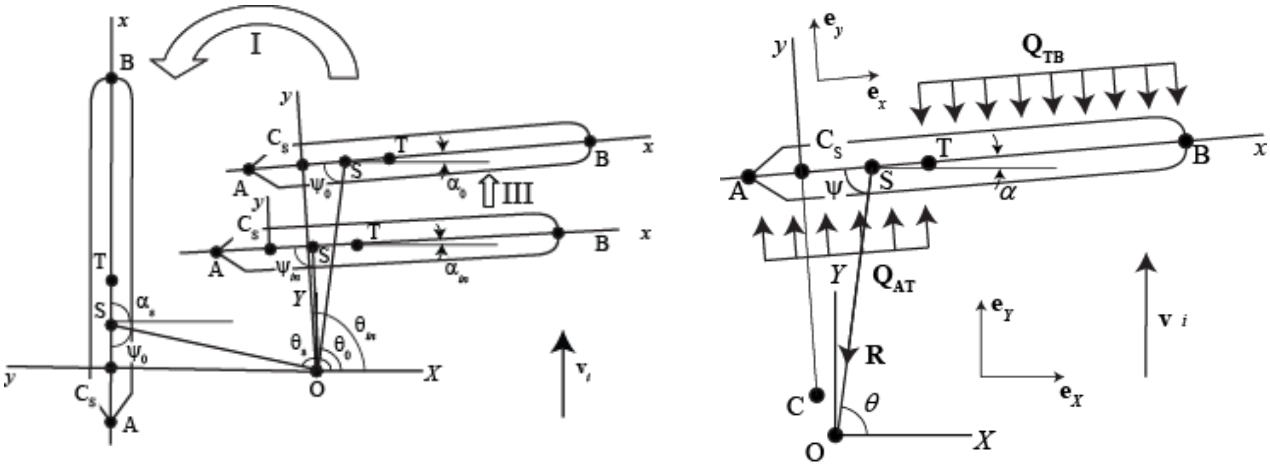


Figure 6. Scheme of the rotation of turret moored vessel under the action of ice drift in the y-direction. Stages of passive turn of the vessel.

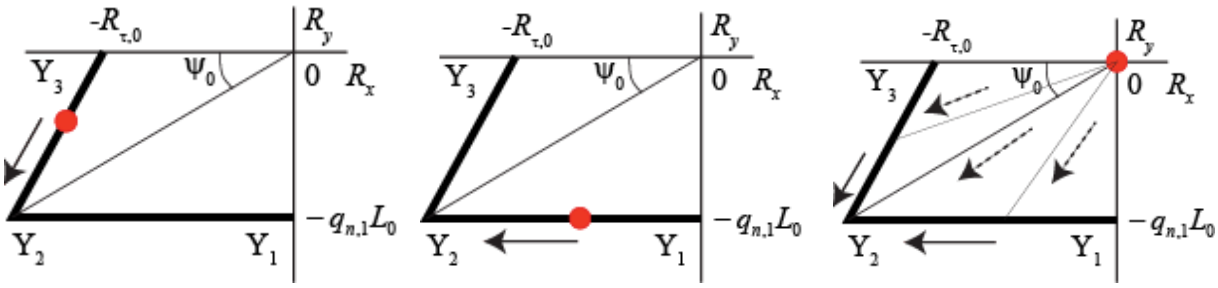


Figure 7. Scheme of variations of mooring line tension with components Rx and Ry in the vessel-fixed coordinates during the passive turn of the vessel. Thick line shows the yield curve of the mooring line tension.

Work Package 2: Material Modelling

Briefing on Activities:

In October Anna Pustogvar submitted one journal paper to Cold Region Science and Technology devoted to analytical and physical modeling of ice rubble volumetric porosity. The paper summarizes results of analytical modeling of ice rubble porosity with respect to the laboratory tests on ice rubble packing performed in spring this year. Currently she is working on two other papers. One is dealing with methods of sea ice density measurements and their uncertainties. This paper is based on the measurements performed in the Fram Straight during OATRC2013 research cruise and laboratory experiments conducted in the cold laboratory at UNIS in August this year. Another paper is focused on current difficulties to obtain the true porosity of ice ridges in the field. It is discussing linear porosity, the data on which currently come from drilling, and volumetric porosity, or the true porosity, which stands behind the drilling data.

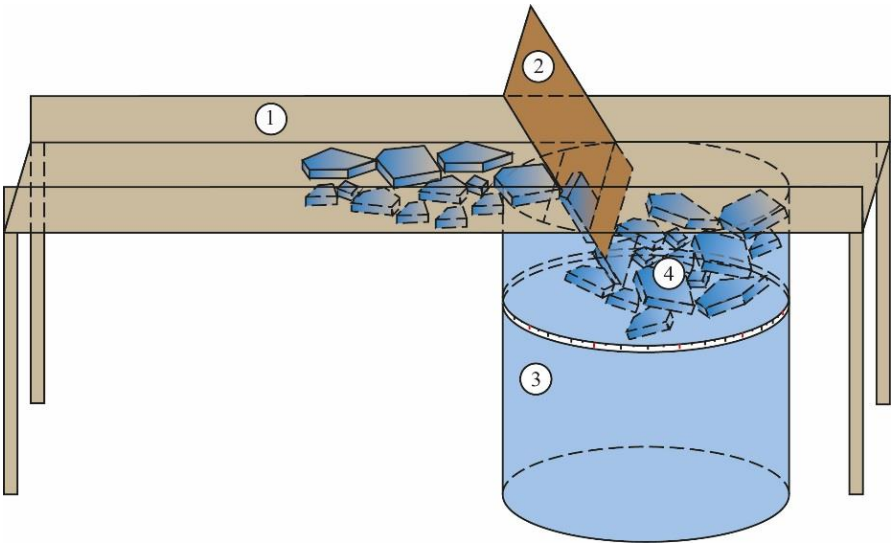


Figure 1. Test set up for the packing experiment:

1 – packing table

2 – guiding plank,

3 – plexiglass cylinder filled with saline water,

4 – ice rubble

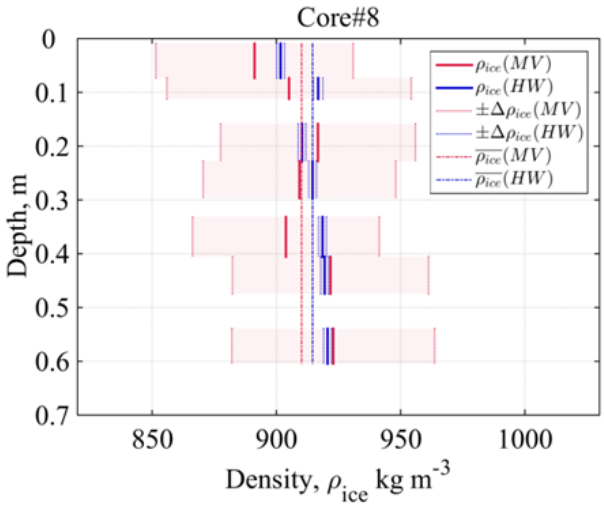


Figure 2.
Density profile of level ice in the Van Mijen fjord, Spitsbergen, sampled in March 2015.

MV – measurements performed by mass/volume method

HW – measurements done by hydrostatic weighing; dash dotted lines correspond to the density averaged throughout the ice thickness; dotted lines show the limiting measurement uncertainties

Sergey Kulyakhtin has recently published a journal paper in Cold Regions Science and Technology (CRST) which discusses the ice rubble shear resistance when it undergoes volumetric changes. Two more papers are planned to be submitted before the next year. One paper describes the ice rubble model which was developed based on breakage mechanics concept and its application to the modelling of ice rubble-structure interaction tests performed during RITAS project (Fig. RITAS). Another paper describes the calculation of average stresses and strains from the discrete element simulations of bi-axial compression test (Fig. FEM_DEM). His thesis is planned for submission early next year.

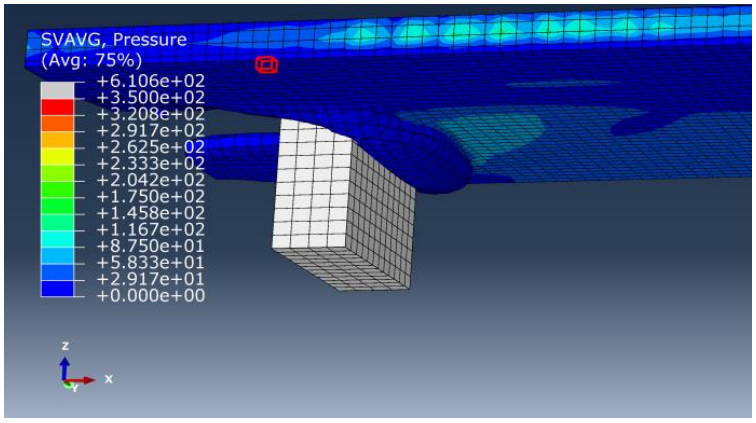


Figure 3.
RITAS. Numerical simulations of the Ice rubble interaction experiments at HSVA in 2012 (RITAS project)

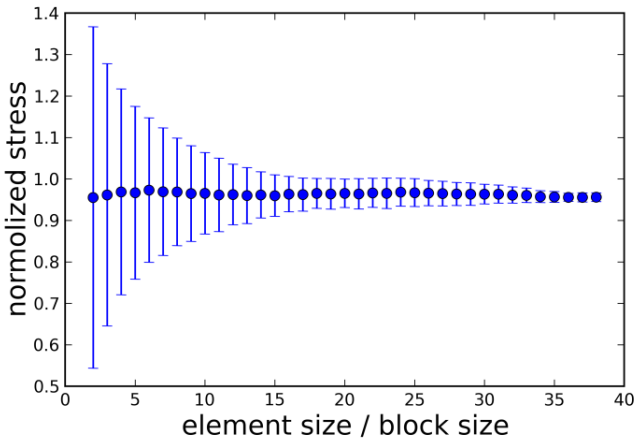
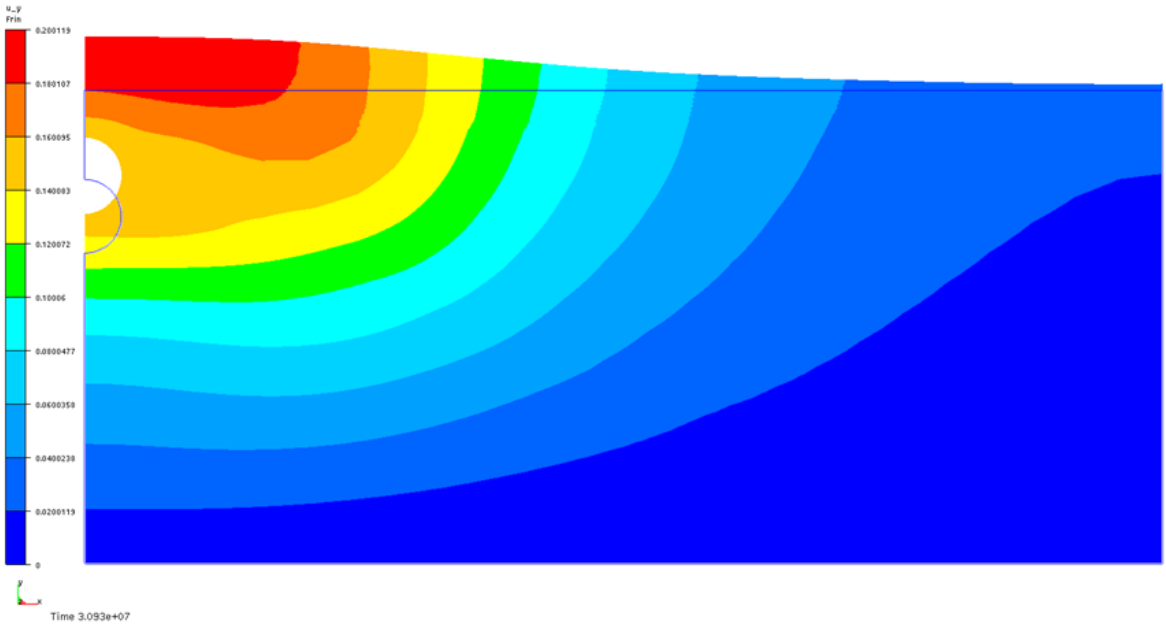


Figure 4.
FEM_DEM. The precision in normalized stress in simulations with different element size to block size ratio.

Yared has completed the development of a fully coupled thermo-hydro-mechanical (THM) finite element model for frozen soil. The numerical tool developed has the following important features:

- Isogeometric analysis with B-splines used as a numerical solution method leading to a local mass and energy conserving simulation, unlike the standard finite element method
- Full nonlinear implementation using Newton-Raphson iterations with implicit time stepping
- Volume expansion and contraction incorporated into the governing equations

The developed numerical tool is used to simulate frost heave where a field-scale experimental data is available; see Smith and Patterson (1989). The experiment was performed on a pipeline buried in silt with an initial temperature of +4ºC and transporting chilled gas at -5ºC. The external environment also has a subzero temperature of -0.75ºC. Freezing is thus initiated from two fronts. The frost heave simulation using the developed THM numerical tool resulted in heave displacements that are in good agreement with the experimental data. A heave displacement of about 20 cm is observed at the centerline of the pipe. See the initial and final configurations shown below.



Status:

- One journal paper published
- Two journal papers to be submitted by the end of this month, November 2015

Arttu Polojärvi has continue to work with the model for freeze bonded rubble using 3D DEM. Also he has continued to work with Janne Ranta on statistics of ice loads. Recently they have looked into error estimates for peak ice loads using simulations on ice stucture interaction. The work on homogenization of ice rubble with Sergey Kulyathkin is also still ongoing and Arttu supervised a master's thesis on ice-structure interaction. He also participated in three conference papers for POAC. Finally, Arttu will become Assistant Professor at Aalto from 1 January 2016 when his SAMCoT sponsored POST-Doc ends.

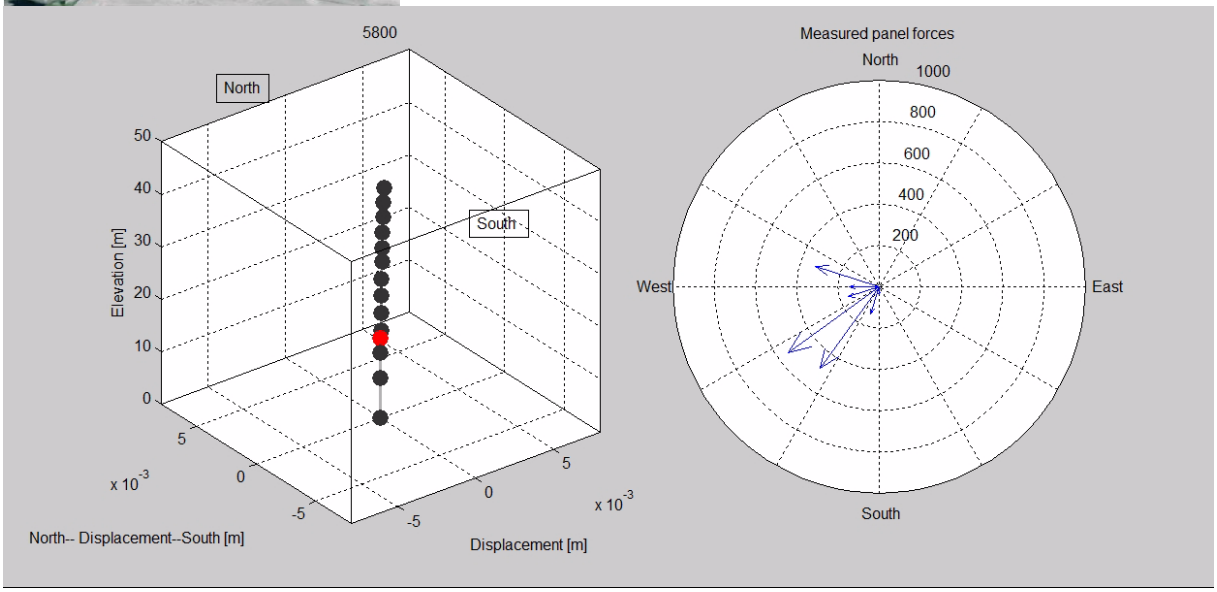
Accepted papers:

- Bekele,Y., Kvamsdal, T., Kvarving, A.M., and Nordal, S. (2015) Adaptive isogeometric finite element analysis of steady-state groundwater flow, Int. J. Numerical and Analytical Methods in Geomechanics.
- Heinicke, Christiane; Polojärvi, Arttu; Tuhkuri, Jukka. Preliminary results of 3D simulations of a failing ice sheet. 23rd International Conference on Port and Ocean Engineering under Arctic Conditions (POAC), Trondheim, 14–18 June 2015
- Kulyakhtin, S. and Høyland, K.V. (2015) Ice rubble frictional resistance by critical state theories. Journal of Cold Regions Science and Technology 119, pp 145-150.
- Lishman, B. and Polojärvi, A. (2015) 2D DEM of ice rubble: The effect of rate-dependent friction. . 23rd International Conference on Port and Ocean Engineering under Arctic (POAC), Trondheim, 14–18 June 2015
- Polojärvi, A., Tuhkuri, J. and Pustogvar, A. (2015) Why simulate ice rubble shear box tests? Proceedings of the XII Finnish Mechanics Days
- Pustogvar, A. and Høyland, K.V. (2015) Density measurements of saline ice by hydrostatic weighing, . 23rd International Conference on Port and Ocean Engineering under Arctic (POAC), Trondheim, 14–18 June 2015.

Work Package 3: Fixed Structures in Ice

Briefing on Activities:

Torodd Nord got his second paper accepted. It was further analysis of the DIIV experiments carried out in HSVA in 2011. Torodd also submitted his PhD thesis and will defend it 20 November. The Hanko channel maker was instrumented to monitor ice loads the coming winter. After his PhD Torodd will become a Post-Doc within SAMCoT. He has also accepted the position as Adjunct Associated Professor at UNIS. His third journal deals with force identification on the Nordströmsgrund lighthouse (see figures below). It was submitted and reviewed, and Torodd now addresses the reviewers' comments so that the paper will be in print in 2016.



Hayo Hendrikse got his first journal paper about *Numerical modelling of IIV considering the contact are between ice and structure* accepted and work on finalizing his Phd. Two more papers are on the way and they deal with a) A detailed analysis of the forced vibration experiments from 2011 and b) Scaling and dimensionless parameters. These three papers will make up the core of his PhD.

Janne Ranta has continued to work on statistics of ice loads with Arttu Polojärvi in Aalto ice mechanics group. Janne's recent work has been considering an error estimation of simulated 2D ice-structure interaction peak loads. Achieved data will be next used in order to describe related ice-structure interaction processes in more detail. Few of the observations have already been published in POAC'15.

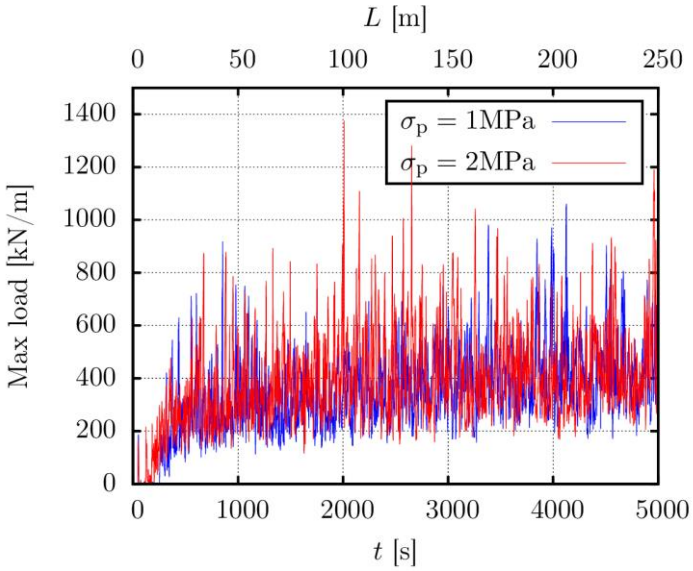


Figure 1.
Temporal max. ice load over 50 replicate 2D FEM-DEM simulations with two different plastic limit parameter values (ice thickness is 1.25m).

Åse Ervik presented a paper at POAC this spring, about actions from first year ridges on fixed structures. She spent the winter and spring on Svalbard where she took part in field works, together with Aleksey Shestov (WP1). They took part in the Norwegian Young Sea Ice expedition (N-ICE) studying drifting first year ice ridges. Together they are preparing three papers from this expedition for the IAHR conference next summer.

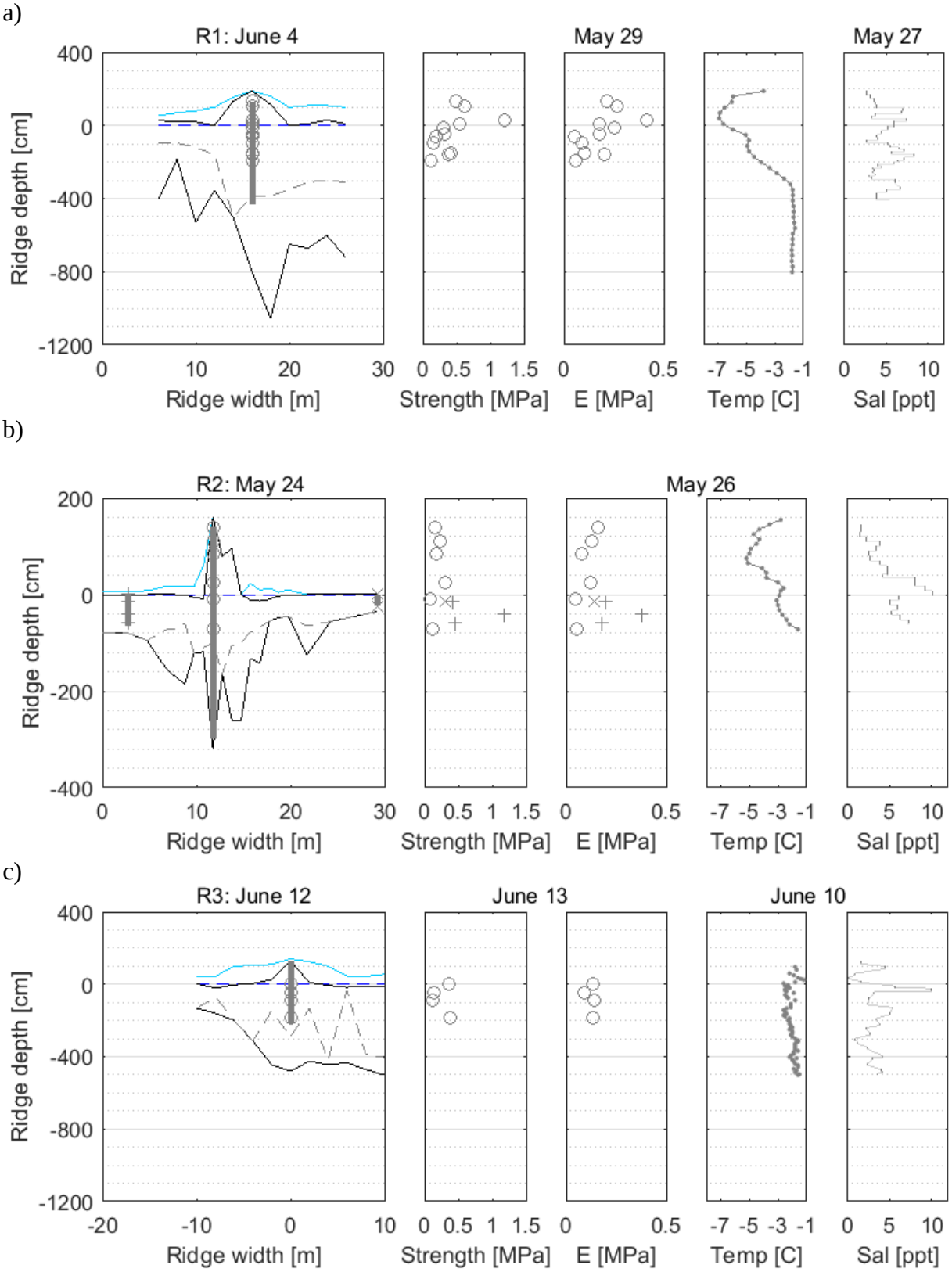
Researchers playing football at the RV Lance during the N-ICE 2015 cruise, funded by the Norwegian Polar Institute, the Fram Centre, and the Norwegian Ministry of Climate and Environment.

Åse especially studied the evolution of ridge strength and structure during the ridge decay phase, seen in the figure below. She also took part as an assistant in the new UNIS course AT-334 Arctic Marine Measurements Techniques, Operations and Transport.

a)

b)

c)



Vertical uniaxial compression tests and temperature profiles. In a) the temperature is taken from a thermistor string and average for the whole day, in b) and c) temperatures were measured in cores sampled from the ridge. The depth scale is not the same in a),c) and b)

Accepted papers:

- Nord, T., Lourens, E-M., Määttänen, M., Øiseth, O. and Høyland, K.V. (2015) Laboratory experiments to study ice-induced vibrations of scaled model structures during their interaction with level ice at different ice velocities. Journal of Cold Regions Science and Technology 119, pp. 1-15.
- Hendrikse, H. and Metrikine, A. (2015) Interpretation and prediction of ice induced vibrations based on contact area variation. Int. Journal of Solids and Structures 75-76, pp. 336-348.
- Ervik, (2015) Full scale actions from first year ridge interactions with fixed structures Proceedings of the 23rd International Conference on Port and Ocean Engineering under Arctic Conditions, Trondheim 14-18 June 2015.
- Nord, T., Øiseth, O., Wiig Pettersen, Ø. and Lourens, E-M. (2015) Sensor network for dynamic ice-force identification: The Hanko-1 channel marker case study. 23rd International Conference on Port and Ocean Engineering under Arctic (POAC), Trondheim, 14–18 June 2015.
- Ranta, Janne; Polojärvi, Arttu; Tuhkuri, Jukka. Ice load estimation through combined finite-discrete element simulations. 23rd International Conference on Port and Ocean Engineering under Arctic (POAC), Trondheim, 14–18 June 2015

Work Package 4: Floating Structures in Ice

Briefing on Activities:

Hydrodynamics

In the past five months, PhD candidate Andrei Tsarau has been mainly focused on finalizing his publications and writing his thesis "*Numerical Modelling of the Hydrodynamic Effects of Marine Operations in Broken Ice*", which will be defended 15 December, 2015. At POAC 2015 in June, Andrei presented a paper on recent achievements in hydrodynamic modelling. In September/October, Andrei also participated in the OATRC2015 expedition north of Svalbard, where he performed several full-scale experiments to study the propeller-wash effect on managed ice (Figure 1).

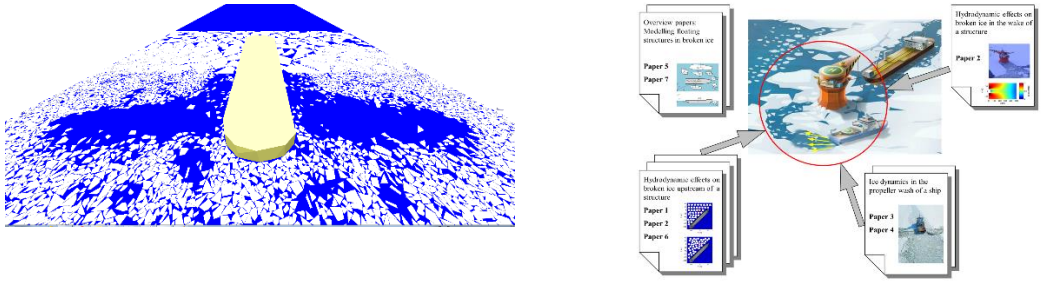


Figure 1. a) Simulation of propeller wash effects. b) Illustration of content in Tsarau's Thesis.

Local ice loads

In order to bridge the gap between local ice loads used for design of ice-going vessels and offshore structures, analysis of the IACS and RMRS models have been performed. A summary of the analysis can be found in the POAC paper "Understanding the effect of assumptions on shell plate thickness for Arctic ships", whereas the detailed analysis including derivations of the rule formulae and uncertainty quantifications has been published in the International Journal of Ocean Engineering (see paper "Discussion of assumptions behind rule-based ice loads due ice crushing"). Results of this study have been used to extend the ice failure maps developed earlier by Wenjun Lu. An updated formulation includes localized ice edge crushing (see POAC paper "Toward a holistic load model for structures in broken ice").

Within the context of local ice loads due to an extreme ice event, our group has been addressing two effects: first –*an effect of structural deformations* (coupled behavior of ice and the structure during an impact event) and second – *an effect of surrounding water*.

Results of ice and structure collision experiments where both the ice and the impacted structure undergo permanent damage have been presented at POAC, for detailed information refer to the paper entitled "Pilot study of ice-structure interaction in a pendulum accelerator". We highlight that further investigations of this coupled interaction are vital to improve the understanding of ice loads in a realistic impact scenario, and to establish additional requirements to limit catastrophic damage on vessels with design loads with high probabilities (less than 100 year return period).

In the analysis of ice-vessel collisions, hydrodynamic effects from the surrounding water may also be important because they affect the motions of the ice and the vessel before and after the collision (e.g. see Figure 2).

Figure 2. Pictures extracted from a high-speed video of the tests at the Aalto Ice Basin.

To check whether or not the fluid-structure-interaction technique (FSI) of LS-DYNA can be applied for the analysis of vessel-ice collisions, numerical simulations of collision experiments at Aalto Ice Basin have been carried out. In the POAC paper we address verification issues of fluid modelling that uses an equation of state. The first results indicate that simulations using FSI technique is able to roughly predict the maximum sway acceleration of the struck vessel and the peak impact force; see our POAC paper "Fluid-structure interaction analysis of an ice block structure collision". A comparison between the conventional constant added mass approach and the FSI analysis is currently in progress.
Furthermore, in collaboration with WP2 we are investigating specific energy absorption capacity of ice during crushing. A part of this work includes re-analysis of Pond Inlet tests together with National Research Council of Canada (Robert Gagnon).

Martin Storheim is defending his PhD Thesis "*Structural response in ship-platform and ship-ice collisions*" on 19.01.2016.

Martin's impact tests at high speed.

Discovery Channels Koula Bouloukos interviews Martin Storheim.

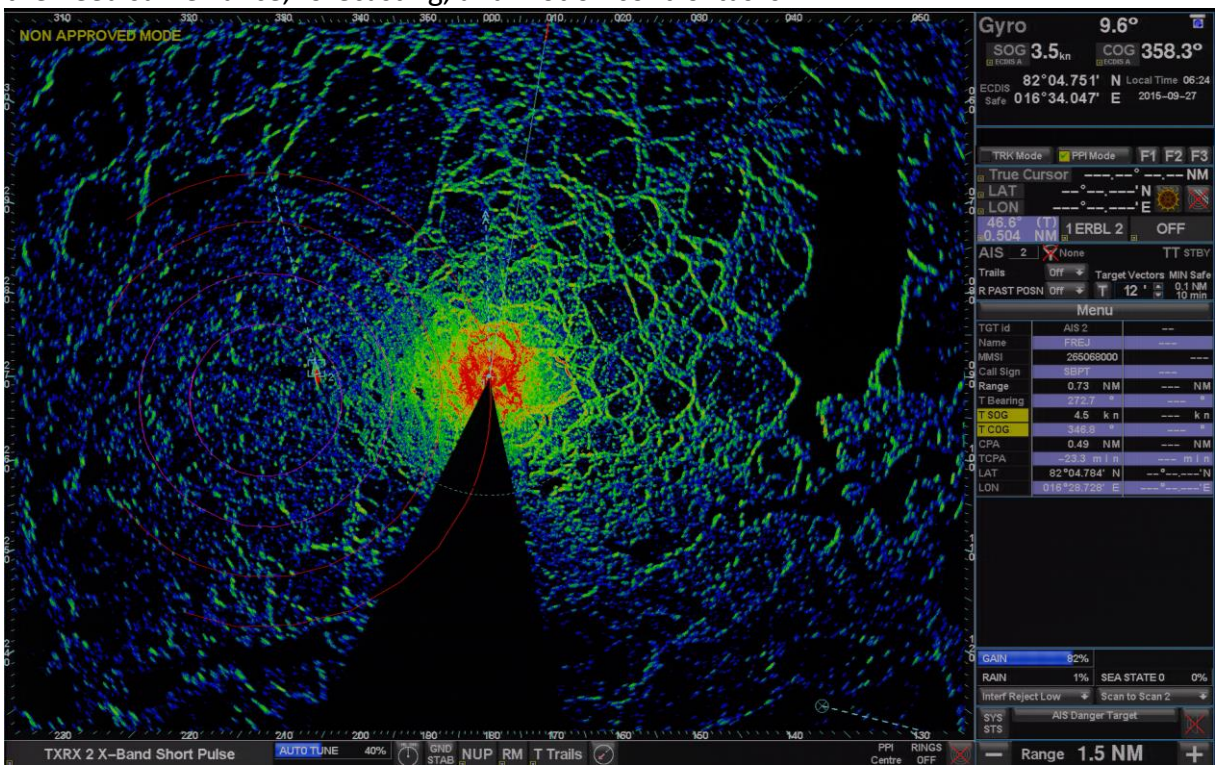
Achievements:
In 2015 WP4 has published 5 journal papers, 16 conference papers and given 9 presentations, and 2 PhD theses are accepted for defense.

Photo(Øyvind Buljo): Wenjun Lu receiving the Chorafas price 2015

Work Package 5: Ice Management and Design Philosophy

Briefing on Activities:

By Øivind Kåre Kjerstad: Researching technology for Arctic marine operations is exciting and allows us to pursuit the next generation motion control systems. This will be more reactive to complex environments and able to "see" and act on its surrounding environment. In a short perspective, if successful, the research will lead to automation of some of the needed surveillance tasks of ice management. In particular, global load monitoring remote ice drift tracking and forecasting with hazard detection. The first enables more reactive motion control of the vessel and improved understanding of the ice conditions. The second reduces the number of helicopter flights and disposal of electronics with batteries to the ocean since physically placing tracking buoys on the ice will not be needed. On a long perspective we aim for a system integrating a variety of onboard and remote sensing systems performing most of the need surveillance, forecasting, and motion control tasks.



By Hans-Martin Heyn:
A measurement setup for monitoring ice drift changes with low-cost intertial measurement units
Aim of experiment and setup

The aim of the task was the measurement of ship motions caused by ship-ice interaction. This data will be used to get a deeper understanding in the ice breaking process and to develop observers for the ice drift. Therefore a time-frequency decomposition method has been developed and detection algorithms will be used to identify unusal ship-ice interaction events and the ice drift direction.

Four inertial measurement units (IMUs) were placed on each ship, eight devices in total. Each IMU contains six sensors, three accelerometers and three gyros, measuring six degrees of freedom for the motion of the ship. Each sensor was controlled by an embedded computer,

which was connected to the ship's network and contained a real time clock for synchronization of measurements from different systems (e.g. the camera system).

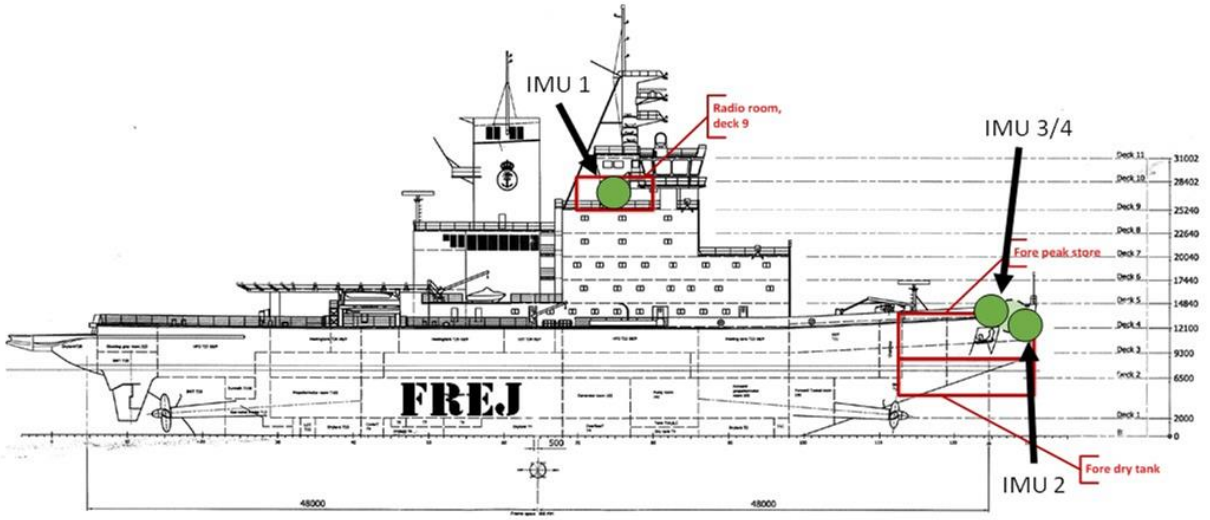


Figure 1: Positions of the IMU sensors

Execution of experiment

The system worked mostly automatically. The sampling rate was about 300 Hz. Each day between six to ten hours of motion measurements were taken. The motion data was synchronized with data from a ship wide camera system and ship propulsion and position data, which eases post processing and correlation of data.

The camera system

A camera system containing five to seven cameras on each ship provides images and movies of the ship-ice events, which will be used as reference during data analysis.

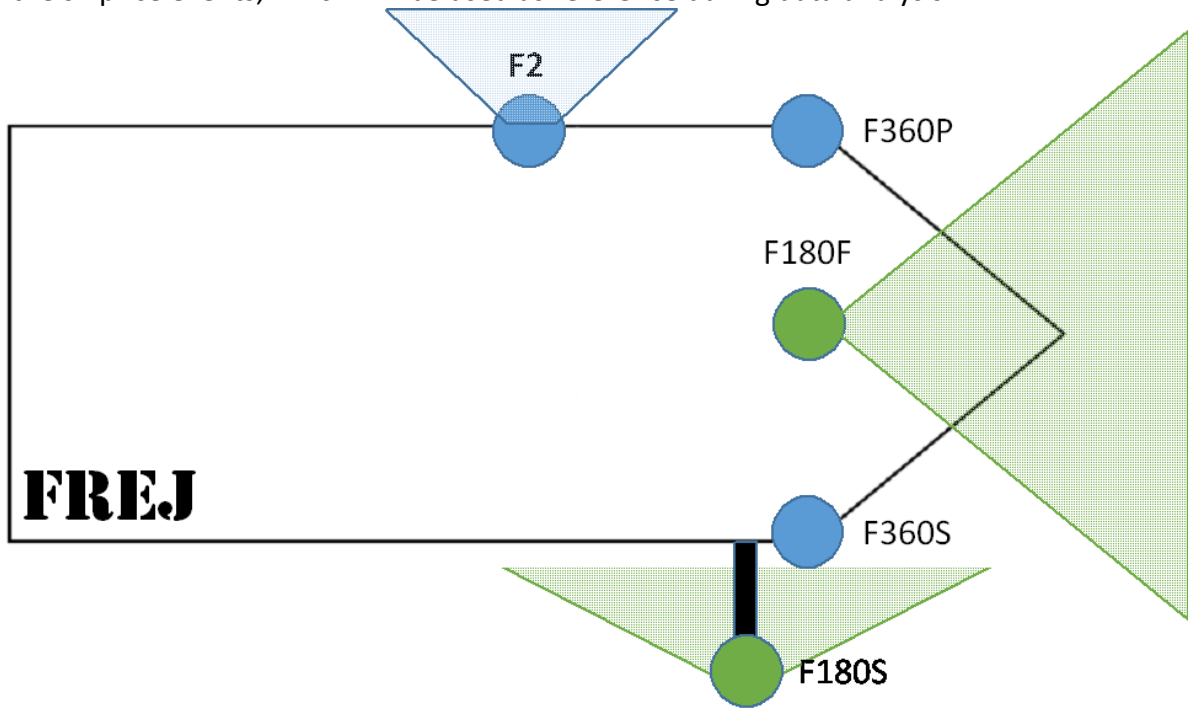


Figure 2: Camera positions

Two cameras produce a 360° images of the ice conditions around the vessel, one camera produces a 180° panorama of the ice conditions ahead of the vessel, one camera monitors the ice interaction at the bow of the vessel and one additional camera monitors the ice thickness. The data was automatically collected onto a network server on the ship.

SEE VIDEOS: VIDEO 1 & VIDEO 2

Outcomes

Two main objectives are followed. First a deeper understanding of the ship-ice interaction will be gained by analysising the ship's motions in the frequency domain for different ship-ice interactione events. Especially the interaction with ice ridges and multi-year ice create high global loads, which can be identified. The second objective is the detection of the ice drift direction for a vessel being stationary in ice. A detection algorithm based on statistical signal processing will be developed, which uses all four IMU sensors to decide on the possible ice drift direction.

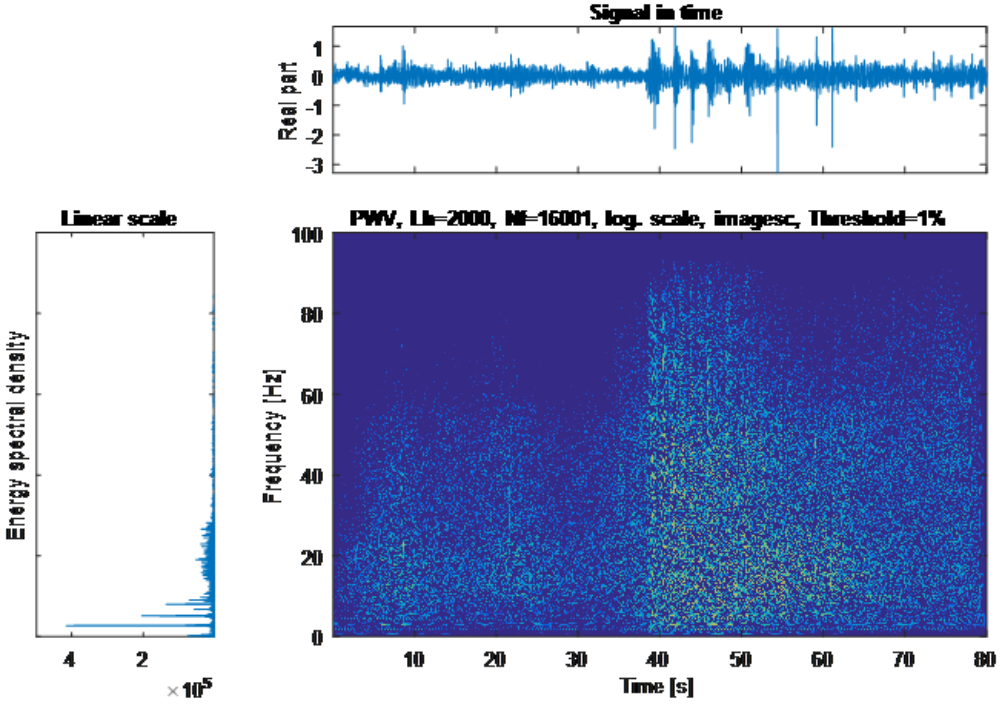


Figure 4: Time-Frequency analysis of moving from managed ice to unbroken ice at t=38s

By Petter Norgren: Northernmost shipwreck mapped with AUV and ROV

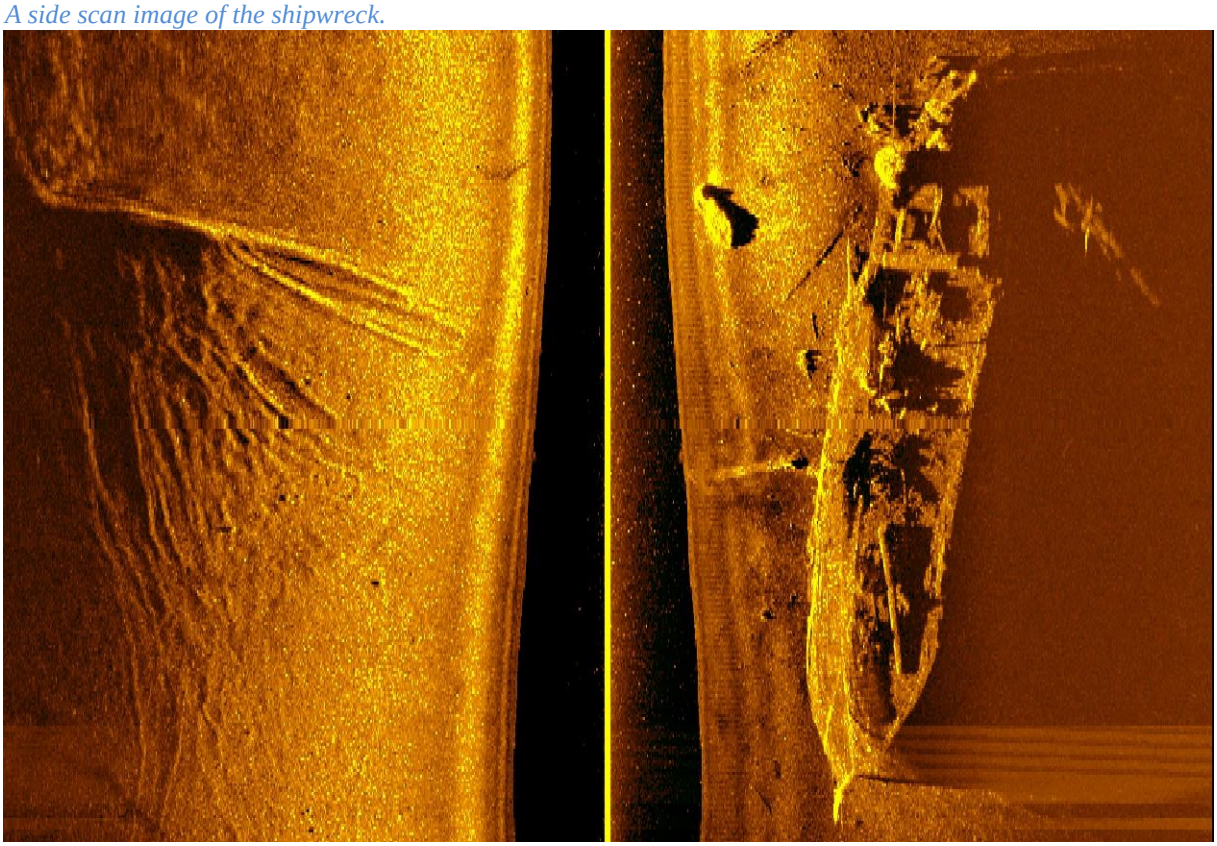
In the period between August 31th and September 6th I participated as a field assistant on a UNIS course, AT334, that, in addition to teaching students about marine arctic operations, also combined underwater robotics and underwater archeological surveys.

During the course, we conducted a survey in Tryghamna, close to the inlet of Isfjorden, where a previous multi-beam survey indicated a high probability of an unmapped shipwreck.

The NTNU Remus 100 AUV was first used to verify the position and presence of a shipwreck by mapping the area with sidescan sonar, before a small size ROV was used to capture video images of the shipwreck. Further information about the finding can be found clicking on this LINK (available only in Norwegian).

In addition to the survey in Tryghamna, several surveys wer conducted in Adventsfjorden in an attempt to uncover more objects of interest. None where found, but the mapping of Advendtfjorden will continue the next time AT334 is held. A picture of the REMUS 100 AUV in Advendtfjorden can be seen in the photos, with KNM Thor Heyerdahl seen in the background.

A side scan image of the shipwreck.



Work Package 6: Coastal Technology

Briefing on Activities:

There are 3 field study sites in WP6. The characteristics of each of them are the following:

Vestpynten:

- Good insight on processes triggering erosion
- Highlight the importance of thermodenudation and nivation
- Specific type of coasts with bedrock and gravel.

Varandey:

- Wide variation in erosion rates: Spatially and temporally
- Warm permafrost
- Diversity of soils
- Erosion mode switch between:

Fairweather condition….. Thermo-denudation

Storm event …. Thermo-abrasion.

Baydaratskaya Bay:

- Importance of thermo-denudation and nivation processes.

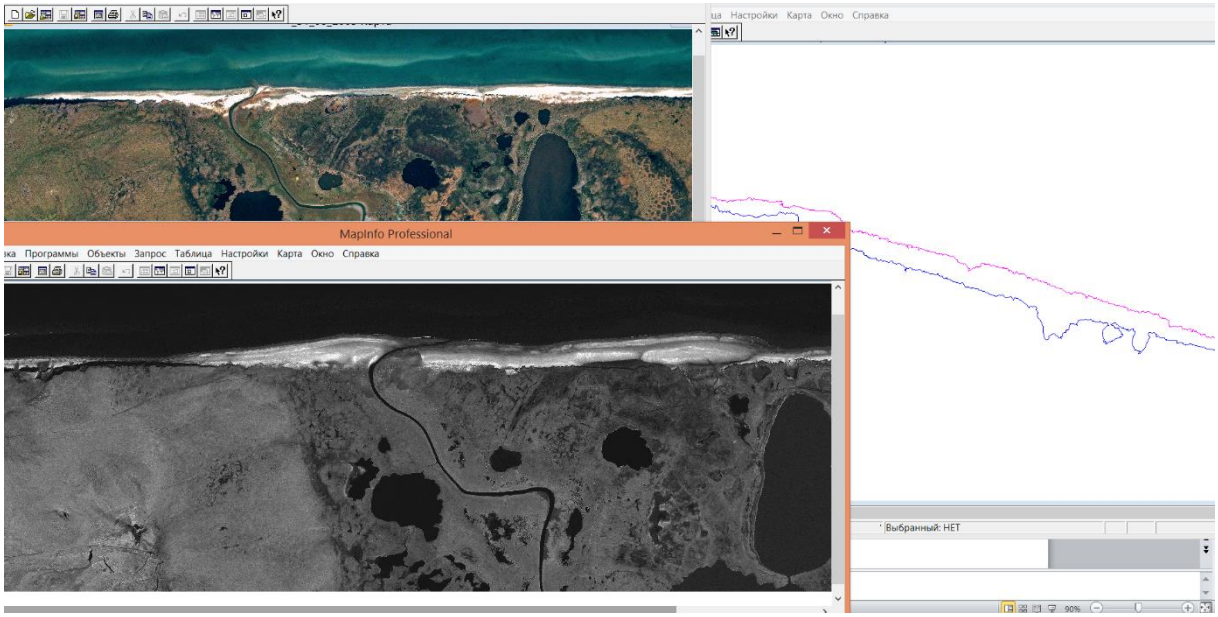
(Guegan, 2014)

Daria Aleksyutina (Moscow State University) is one of the PhD students in the programme.

The applied approaches in her study includes the following:

- Field investigations (geological and cryological observations, drilling, field measurements of soil properties et.al.);
- Laboratory study of physical, mechanical and thermal properties (including: moisture, density, plasticity, soil salinity, organic content, thermal diffusivity, unfrozen water, freezing point et.al);
- Investigations of coastline retreat based on space images comparison and geodetic survey.

Here also shown examples from Aleksyutina on the use of satellite images to study coast line retreat in Varanday.



An unnormal erosion happen in Bjørndalen (close to the Vestpynten site) early October 2015 (see the picture below). The erosion was caused by a combination of high water level and waves caused by a storm.

Emilie Guegan is defending her PhD dissertation entitled: *Erosion of permafrost affected coasts: rates, mechanisms and modelling* on 10 Dec. 2015, at NTNU.

Achievements:
In 2015 WP6 has published 3 journal papers, 6 conference papers and given 5 presentations, and 1 PhD thesis is accepted for defense.