



SAMCoT News Letter 03/2014 (Jun. – Sept. 2014)

Work Package Adm.

Briefing on Activities:

SAMCoT is happy to announce the accession of three new Industry Partners and one research Partner in 2014 to the SAMCoT CA. Welcome to SAMCoT, we look forward to a fruitful collaboration.

New Partners:

Lundin Norway AS

Det norske oljeselskap ASA

University College London

ExxonMobile Upstream Research Company (URC)



On September 16th NTNU hosted the first SAMCoT Arctic HSE Workshop with more than 40 participants.

Ida Munkeby - NTNU Director of Organization, welcomed the participants underlying the great work done by SAMCoT in disseminating its unique knowledge on a topic of such importance as HSE and in an area as vulnerable and extreme as it is the Arctic.

The SAMCoT event on Arctic HSE and the topic in itself is in line with NTNU vision, "Knowledge for a better world" and a key element of all lab and field activities linked to the different research areas within SAMCoT.

Fig. 1 SAMCoT Arctic HSE Workshop Speeches of Ida Munkeby and Rune Gjeldnes



The SAMCoT Centre Coordinator presented the Mid-Term Evaluation Road Map of the Centre to all SAMCoT Partners in different occasions since May 2014. All partners are expected to provide feedback to the Research Council of Norway by filling in evaluation forms. See Notifications below for links and information deadlines.

Achievements:

- SAMCoT ½ Year report of Activities to the RCN successfully sent to the RCN in June.
- SAMCoT's collaboration with another SFI Centre SIMLab was covered by Discovery Channel and air in September with a viewing of more of 200000 people on its first live stream.
- 2nd SAMCoT EIAC Meeting celebrated in the beginning of September. The CMG presented a status report to the EIAC of each of the Research Areas.
- SAMCoT Technical Workshop successfully hosted in Trondheim with more than 60 participants from SAMCoT Industry, Research and Public Partners (September 17th and 18th, 2014)
- Successful first SAMCoT Arctic HSE Workshop.
- 4 new SAMCoT Partners joined SAMCoT Consortium Agreement in 2014. The new Addendum to the CA was presented to the General Assembly during its annual meeting on September 18th.
- SAMCoT's new e-room launched its new blog area as well as the online forms from the Research Council for the Mid-Term Evaluation.

Notifications:

- *SAMCoT 2nd Board Meeting 2014*: November 13th location Aalto, Helsinki.
- *November 7th*: The Research Council of Norway provided the final forms for evaluation that are now available on line at SAMCoT's e-room. All Partners will have until the 10th of November time to fill in the forms and contact the centre coordinator if they have any questions or comments. Each Partner representative will get a separate email with information on where to find the form.
- *Changes of WorkPackage Leaders and in the Centre Management Group*: Raed Lubbad is now the Work Package Leader for WP6 (Coastal Technology). Roger Skjetne has therefore taken his role as WP Leader in WP5 (Ice Management and Design Philosophy) and in doing so he is now also a new member to the Centre Management Group.
- *Withdrawal of SMSC*: SAMCoT Board has received a withdrawal notification before July 1st 2014 from the company Ship Modelling & Simulation Centre AS (SMSC). Following the SAMCoT CA this withdrawal will be effective from the end of this calendar year (31st Dec. 2014). We thank SMSC for their work and collaboration to the Centres Research.

Work Package 1: Data Collection and Process Modelling

Briefing on Activities:

In the period from June to September 2014 laboratory and field activities were performed following the approved CTR for WP1.

Field and laboratory works included:

- Measurements of tidal variations of sea level in narrow straits to the Dikson Fjord, near Longyearbyen and Barentsburg harbors (September),
- Measurements of soil characteristics and tidal variations of sea level near pipeline landfall in Longyearbyen (September)
- Measurements of the temperature and thermal expansion of saline ice induced by the increase of under ice water pressure in the UNIS ice tank (September)

Process modeling included:

- Numerical simulations of tidal currents and navigable windows in the Akselsundet strait to the Van Mijen Fjord (July-September)
- Numerical simulations of temporal variations of soil characteristics around pipeline landfall in Longyearbyen in Comsol Multiphysics (June)
- 3D modeling in Comsol Multiphysics of tests with cantilever and fixed-ends ice beams (July-August)

Data collection on sea state properties in the Spitsbergen bank and Barents Sea opening

Achievements:

Accepted:

Ervik, A., Høyland, K. V., Marchenko, A., Karulina, M., and Karulin, E. (2014). In-situ experimental investigations of the vertical stress distribution in sea ice covers; a comparison of tensile and flexural strength. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1125



Fig. 1 Field works in the Dikson Fjord.

Estimates of maximal speeds of water current in the Akselsundet strait and phase intervals of navigable window s.

Two papers were presented and published in the proceedings of OMAE conference

Presentation of A.Marchenko about UNIS and WP 1 activity on the seminar in Thayer School of Engineering, Dartmouth College, USA, June 17

Seven papers were presented and published in the proceedings of 22nd IAHR Ice Symposium, Singapur, 11-15 August



Fig. 2 Participants of WP1 on OMAE 2014 (top figure) & Aleksey Marchenko during his visit to Dartmouth College.

Work Package 2: Material Modelling

Briefing on Activities:

The researchers have visited several conferences; 7 papers were presented at the IAHR international Ice symposium and 2 papers at the OMAE, one at NUMGE2014 and one at IACMAG14. The master students have submitted their theses. A replacer for PhD student Stanislav Pavlov at UCL is announced and a new PhD student is expected to start his/her work early 2015. The other PhD students are in good progress.

Achievements:

Accepted publications:

Bekele, Y. and Kyokawa, H. (2014). On thermo-hydro-mechanically (THM) coupled finite element modeling of ground freezing and thawing. In Proc. of NUMGE2014, Paper #.

Høyland, K. V. and Møllegaard, A. (2014). Mechanical behaviour of laboratory made freeze-bonds as a function of submersion time, initial ice temperature and sample size. In Proc. of the 22 Int. Symposium on Ice (IAHR), Singapore, Paper #1202.

Kulyakhtin, S. (2014) Distribution of Ice Block Sizes in Sails of Pressure Ice Ridges In Proc. of the 22 Int. Symposium on Ice (IAHR), Singapore, Paper #1171.

Kulyakhtin, S. and Høyland, K. V. (2014). Study of the volumetric behaviour of ice rubble based on bi-axial compression data. In Proc. of the 33th Int. Conf. on Ocean, Offshore and Arctic Engineering (OMAE), San Francisco, USA, volume OMAE2014-23798.

Kyokawa, H. and Bekele, Y. (2014). Numerical simulation of thermo-hydro-mechanically coupled processes during ground freezing and thawing. In Proc. of IACMAG14, Paper #.

Pustogvar, A., Høyland, K. V., and Polojärvi, A. P. (2014a). Laboratory scale direct shear box experiments on ice rubble: The effect of block size to box size ratio. In Proc. of the 33th Int. Conf. on Ocean, Offshore and Arctic Engineering (OMAE), San Francisco, USA, volume OMAE2014-23646.

Pustogvar, A., Kulyakhtin, S., and Høyland, K. V. (2014b). Laboratory oedometer tests on rubble ice. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1166.

Polojärvi, A. P. and Tuhkuri, J. (2014a). 3D DEM for freeze bonded ice rubble consisting of polyhedral blocks. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1132.

Polojärvi, A. P. and Tuhkuri, J. (2014b). Preliminary results from a study on full scale freeze bond geometry and microstructure. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1131.

Sorsimo, A. and Heinonen, J. (2014). Modelling ice ridge punch tests with cohesive 3D discrete element method. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1217.

Tuhkuri, J. and Polojärvi, A. P. (2014). Preliminary results from a study on full scale freeze bond geometry and microstructure. In Proc. of the 22 Int. Symposium on Ice (IAHR), Singapore, Paper #1131.

Notifications:

Submitted:

Sorsimo, A. and Heinonen, J. (2014) Modelling ice ridge punch tests with cohesive 3D discrete element method, submitted to Cold Regions Science and Technology.

Work Package 3: Fixed Structures in Ice

Briefing on Activities:

The researchers have visited several conferences; 2 papers were presented at the IAHR international Ice symposium, one at EuroDyn and one paper at the OMAE. The master students have submitted their theses. The two PhD students Nord and Hendrikse are in good progress and expect to deliver their theses in the first half of 2015. Janne Ranta enters his second year and is in good progress. Åse Ervik started her PhD studies 1 September and her title is Numerical modelling of actions from first-year sea ice ridges.

Achievements:

Accepted:

Ekeberg, O.-C., Høyland, K. V., Hansen, E., and Tschudi, M. (2014). Reduction in the Number and Draft of Ridges in the Transpolar Drift in the Fram Strait during 2006-2011. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1226

Hendrikse, H., Renting, F. W., and Metrikine, A. V. (2014). Analysis of the fatigue life of offshore wind turbine generators under combined ice- and aerodynamic loading. In Proc. of the 33th Int. Conf. on Ocean, Offshore and Arctic Engineering (OMAE), San Francisco, USA, volume OMAE2014-23884.

Ranta, J., Tuhkuri, J., rvi, A. P., and Paavilainen, J. (2014). Statistical reconstruction of peak load data based on 2d _nite-discrete element method simulations of ice interactions against inclined wall. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1160.

Nord, T. S., Lourens, E-M, Øiseth, O. and Metrikine, A. Model-based force identification in experimental ice-structure interaction by means of Kalman filtering. Proceedings of the EuroDyn conference.



Fig. 1 SAMCoT representatives on the 22nd IAHR International Symposium on Ice in Singapore

Notifications:

Submitted:

Ekeberg, O-C, Høyland, K.V. and Hansen, E. (2014). Analysis of the shapes of ice ridges. Submitted to CRS&T.

Nord, T., Revised version submitted

Hendrikse et al., (2104) Interpretation and Prediction of Ice Induced Vibrations based on Contact Area Variation, submitted

Work Package 4: Floating Structures in Ice

Briefing on Activities:

WP4 has followed closely the original plans/timeline. The focus has been to develop theory for estimation of loads on and behaviour of floaters in different types of ice. The progress of theory development is good and the implementation into numerics/software is well underway. WP4 collaborates intensively with WP5 and WP1, and will now start using material models for ridges from WP2. Numerical models developed in WP4 are now supporting WP5.

In the past few months, PhD candidate Andrei Tsarau has been working on his paper, which is related to modelling the hydrodynamic effects on ice upstream and downstream of a floating structure. An innovative approach has been proposed to resolve the complex, alternating flow in the wake of the structure. In particular, the new simulations show that the fluid effect is important when considering the clogging of the wake by rubble. In August, A. Tsarau has also presented another article on the 22nd IAHR International Symposium on Ice in Singapore. This article focuses on the propeller wash effect in ice. Besides working on the publications, A. Tsarau is also involved in the integration of the developed models within one numerical tool.

Marnix van den Berg is engaged as PhD candidate at SAMCoT. His topic is Actions and action effects of ice ridges on floating structures and moorings.

In the past three months, PhD student Wenjun Lu reached his peak production period within his PhD journey. Two journal papers and one doctoral thesis have been submitted during this period of time. He spent most of his time establishing and completing analytical solutions for different failures of ice floes of varying sizes. He and his coauthors (i.e., Raed Lubbad and Sveinung Løset) have identified three types of out-of-plane failure scenarios depending on the size of the considered ice floe (see figures below).

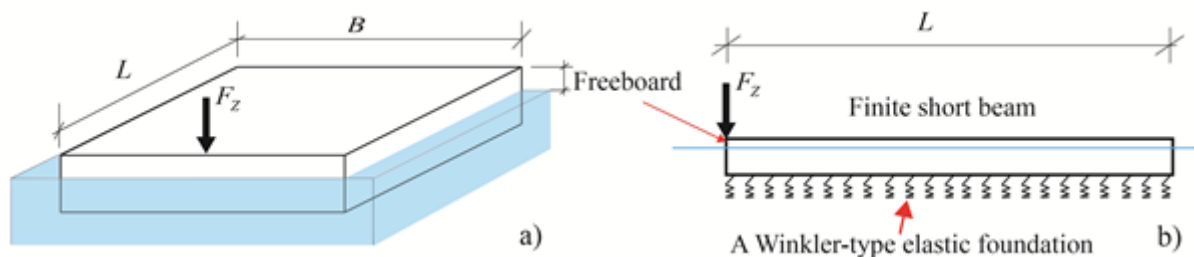


Fig. 1 Direct rotation of a small ice floe (i.e., typical size is smaller than about 13.5 times ice thickness)

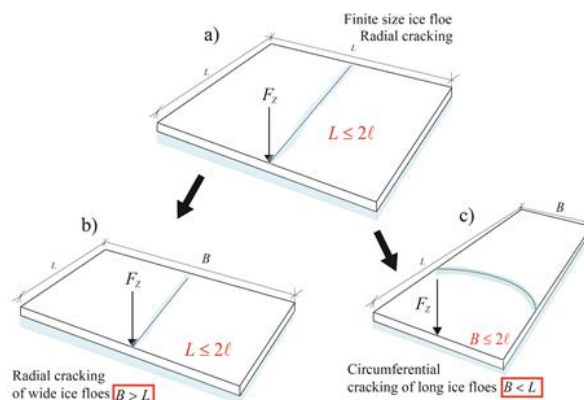


Fig. 2 Radial cracking or circumferential cracking of a mediate size ice floe (i.e., typical size is within 13.5 ~ 27 times ice thickness)

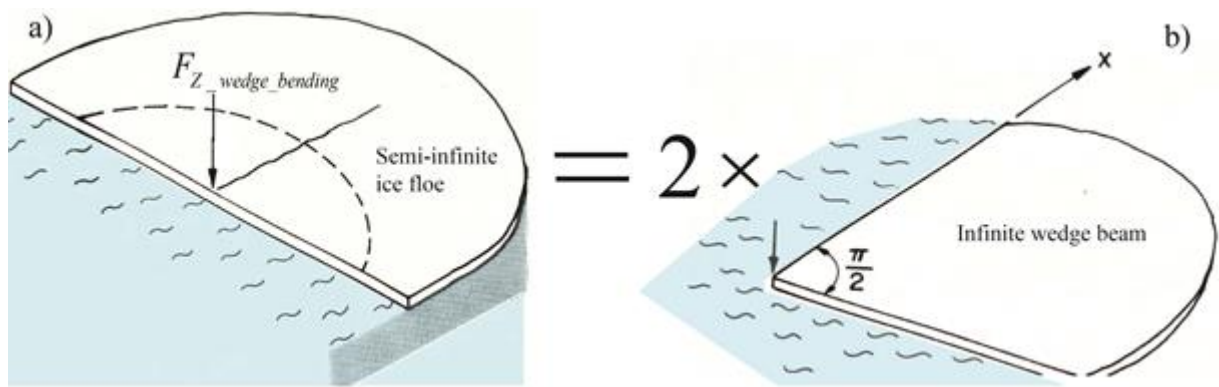


Fig. 3 Traditional failure (i.e., sequentially forming radial and circumferential cracks) of a large ice floe (i.e., typical size is larger than 27 times ice thickness)

With all these out-of-plane failure modes' analytical solutions available, the competition between different failure modes can thus be effectively quantified. Eventually, a failure map can be constructed depending on the geometric information and material properties of an encountered ice floe. These analytical solutions are beneficial for the development of the numerical toolbox in simulating different failure patterns of ice floes of varying size.

Achievements:

Accepted:

Tsarau, A., Lubbad, R. and Løset, S. (2014): A numerical model for simulation of the hydrodynamic interactions between a marine floater and fragmented sea ice. *Journal of Cold Regions Science and Technology*, Vol. 103, July 2014, pp. 1-14.

Storheim et al. (2014): Design of offshore structures against accidental ship collisions, *Journal of Marine Structures*.

Kim, E. and Høyland, K. V. (2014). Experimental investigations of the energy absorption capacity of ice during crushing: Is the specific energy scale-independent? In *Proc. of the 22 Int. Symp. on Ice (IAHR)*, Singapore, Paper#1116.

Grindstad, T.G., Lu, W., Scibilia, F., Lubbad, R. and Løset, S. (2014): Ice resistance to ODN: a comparative study of different calculation methods. In *Proc. of the 22nd IAHR International Symposium on Ice*, 11 – 15 August 2014, Singapore. (ID: 187).

Tsarau, A. and Løset, S. (2014): Propeller wash by an icebreaker. In *Proc. of the 22nd IAHR International Symposium on Ice*, 11 – 15 August 2014, Singapore.

Farid, F., Scibilia, F., Lubbad, R. and Løset, S. (2014): Sea Ice Management Trials during Oden Arctic Technology Research Cruise 2013 Offshore North East Greenland. In *Proc. of the 22nd IAHR International Symposium on Ice*, 11 – 15 August 2014, Singapore.

Lubbad, R. and Løset, S. (2014): Time-domain analysis of managed-ice actions on offshore structures. In *Proc. of the 22nd IAHR International Symposium on Ice*, 11 – 15 August 2014, Singapore.

Keijdener, C. and Metrikine, A. (2014): "The effect of ice velocity on the breaking length of level ice failing in downward bending". In *Proc. of the 22nd IAHR International Symposium on Ice*, 11 – 15 August 2014, Singapore.

Storheim et al. (2014): Non-conservative consequences of "conservative" assumptions in ship-platform collision analysis. *OMAE2014*.

Kim, E., Storheim, M., Amdahl, J. and Løset, S (2014): Findings and lessons learned from implementing ice-structure impact tests in water and air. *Proceedings of the HYDRALAB IV Joint User Meeting*, Lisbon, July 2014

Lu, W., Høyland, K., Serré, N. and Evers, K.-U., 2014. Ice Load Measurement by Tactile Sensor in Model Scale Test in Relation to Rubble Ice Transport on Arctic Offshore Structures (RITAS). *Proceedings of the HYDRALAB IV Joint User Meeting*, Lisbon.

Serré, N., Høyland, K.V., Lu, W., Bonnemaire, B. and Evers, K.-U., 2014. Rubble Ice Transport on Arctic Offshore Structures (RITAS), Scale Model Investigation of Level Ice Action. *Proceedings of the HYDRALAB IV Joint User Meeting*, Lisbon.

Notifications:

Submitted:

Tsarau, A., Lubbad, R. and Løset, S. (2014): A numerical model for simulation of the hydrodynamic interactions between a marine floater and fragmented sea ice. *Journal of Cold Regions Science and Technology*, Vol. 103, July 2014, pp. 1-14.

Lu, W., Lubbad, R. and Løset, S. (2014): Out-of-plane failure of an ice floe: radial-crack-initiation-controlled fracture. *Journal of CRST* (Submitted 17.07.2014).

Lu, W., Lubbad, R., Løset, S. and Kashafutdinov, M. (2014): Fracture of an ice floe: Local out-of-plane flexural failures versus global in-plane splitting failure. *Journal of CRST* (Submitted 27.09.2014).

Tsarau, A. and Løset, S. (2014): Modelling the hydrodynamic effects associated with station-keeping in broken ice. *Journal of CRST* (Submitted 22.09.2014).

Lu, W. (2014): Floe Ice – Sloping Structure Interactions. Doctoral Thesis Submitted (12.09.2014)

Work Package 5: Ice Management and Design Philosophy

Briefing on Activities:

The progress and future plans of WP5 were presented during SAMCoT technical workshops on the 18th of Sep., 2014. The previous leader of WP5, A/Prof. Raed Lubbad, stressed that WP5 was planned to have a slow start because of the strong dependency on WP4; but now it is about time to speed-up and increase research efforts in the work package. A/Prof. Lubbad announced that an additional PhD position will be granted to WP5 in 2015 to increase the research activities in the WP. The new leader of WP5, Prof. Roger Skjetne, presented three possible topics for the new PhD, i.e. PhD theme #1: Optimal icebreaker deployment and coordination of physical ice management effort; PhD theme #2: Online monitoring of icebreaking efficiency and situational awareness of physical IM operation; PhD theme #3: Fault-tolerant iceberg towing operations. The participants in the technical workshop gave a positive feedback on the overall progress of WP5. For future work, they recommended that WP5 should try to stay away from research areas better tackled by research environments other than SAMCoT.

All PhD candidates (R. Yulmetov, F. Farid-Afshin, P. Norgren, and M. Hassel) are in good progress with their courses and their scientific work.

Renat Yulmetov submitted his first journal paper to CRST describing a numerical model of iceberg drift and towing in broken ice. Lately, he has concentrated on validating the model using experimental data. In addition, Yulmetov performed number of simulations of iceberg towing in managed ice in the narrow channel. He found that the average towing force depends linearly on the concentration and the square of the towing velocity. Also it was noticed that ice accumulation can increase the towing force for very small towing velocities.

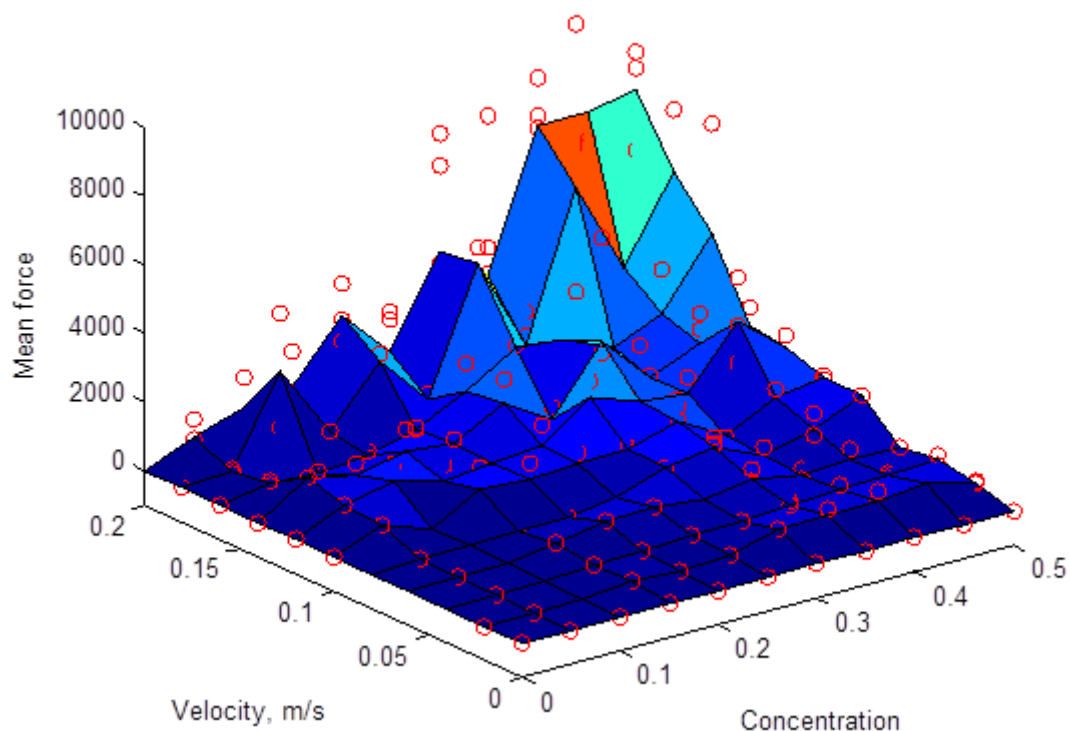


Fig. 1 Mean towing force as a function of towing velocity and ice concentration.

Yulmetov participated in IAHR'22 in Singapore and presented two papers there. The first paper was about a numerical model to generate a broken ice field, and the second paper presented iceberg drift analysis from OATRC'13. Yulmetov has been awarded the Best Student Paper Prize for the paper entitled "Kinematic Characteristics of Sea Ice and Iceberg Drift in the Greenland Sea" co-authored by Sveinung Løset.



Fig. 2 Yulmetov has been awarded the Best Student Paper Prize at IAHR'22

Farzad Farid-Afshin visited DNV-GL offices in July for a 1-week duration. In this period, he discussed his PhD project in more detail with researchers in DNV-GL. The discussions were around how an alternative non-probabilistic framework for design should be formulated, and what the general requirements for such an alternative are. The existing literature and some work done in this regard were discussed in detail. As a follow-up, in the past months, Farid-Afshin has worked on a number of simple examples from engineering mechanics in which he is illustrating the application of such methods, together with some comparisons with the conventional i.e. probabilistic approaches. This will be presented as part of a publication and in specific in his thesis. In the next stage, the knowledge gained is being applied to a number of Arctic examples which is quite exciting and at the same time challenging.

Farid-Afshin presented two conference papers at OAME and IAHR discussing his recent work and some of the findings of the ice management trials during OATRC 2013. There, he also got the chance to speak to several ice experts and researchers and discussed about his PhD project.

Petter Norgren presented a paper at IAHR about underwater vehicles in the Arctic, combined with some experiences from OATRC2013. Lately he operated the REMUS AUV for AUR-lab project where a total of 26 AUV missions were carried out. Norgren has designed a DeltaT MBES sensor cage for mounting on the REMUS AUV and the production of this cage is in progress. Norgren is also implementing a driver for interfacing the DeltaT MBES with the payload processor on REMUS.

Martin Hassel is in good progress with his courses. He presented an article at the PSAM conference in June "Analysis of the Main Challenges with the Current Risk Model for Collisions between Ships and Offshore Installations on the Norwegian Continental Shelf". Hassel is planning to submit an article to POAC 2015, and is working on a journal paper on qualitative collision risk model.

A new PhD student (Hans-Martin Heyn) joined WP5 in August, 2014. Heyn is supervised by Prof. Roger Skjetne and he will be studying Arctic TAPM control system with online ice surveillance by on-board sensors.

Achievements:

Accepted:

Yulmetov, R., Løset, S., and Lubbad R. (2014). An Effective Numerical Method for Generation of Broken Ice Fields, Consisting of a Large Number of Polygon-Shaped Distinct Floes. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1207.

Yulmetov, R., and Løset, S. (2014). Kinematic Characteristics of Sea Ice and Iceberg Drift in the Greenland Sea. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1208.

Farid, F., Scibilia, F., Lubbad R., and Løset, S. (2014). Sea Ice Management Trials during Oden Arctic Technology Research Cruise 2013 Offshore North East Greenland. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1129.

Farid, F., Lubbad R., and Eik, K. (2014). A HYBRID BAYESIAN BELIEF NETWORK MODEL FOR RISK MODELING OF ARCTIC MARINE OPERATIONS. In Proc. of the 33rd Int. Conf. on Ocean, Offshore and Arctic Engineering (OMAE), San Francisco, USA, volume OMAE2014-23926.

Norgren, P., Lubbad, R., and Skjetne, R. (2014). Unmanned Underwater Vehicles in Arctic Operations. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1146.

Orsten, A., Norgren, P., and Skjetne, R. (2014). LOS Guidance for Towing an Iceberg Along a Straight-Line Path. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1249.

Hassel M., Utne, I. B., and Vinnema, J. E. (2014). Analysis Of The Main Challenges With The Current Risk Model For Collisions Between Ships and Offshore Installations On The Norwegian Continental Shelf. Probabilistic Safety Assessment and Management PSAM 12, June 2014, Honolulu, Hawaii.

Tsarau, A., Løset, S., and Grindstad, T. C. (2014). Propeller Wash by an Icebreaker. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1120.

Lubbad, R., and Løset, S. (2014). Time-domain Analysis of Managed-Ice Actions on Offshore Structures. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper#1231.

Notifications:

Submitted:

Yulmetov, R., Løset, S., and Lubbad R. (2014). Planar multi-body model of iceberg free drift and towing in broken ice. Submitted to CRST.

Work Package 6: Coastal Technology

Briefing on Activities:

The progress and future plans of WP6 were presented during SAMCoT technical workshops on the 18th of Sep., 2014. The new leader of WP6, A/Prof. Raed Lubbad, stated that the objectives of WP6 are now refined to develop new knowledge, analytical and numerical models needed by the industry to improve the prediction of coastal erosion in the Arctic. A/Prof. Lubbad argued that the ongoing research in WP6 on understanding and modelling the geotechnical stability of an Arctic coast should be tied better to the research performed in WP2 and also supplemented by additional research on modelling the sediment transport in the Arctic. The presented plans were well received by participants in the technical workshop.

Several members of WP6 participated in the European Permafrost Conference (EUCOP 4th) in Portugal. PhD students Emilie Guegan and Daria Aleksuytina in collaboration with Dr. Anatoly Sinitsyn presented number posters and held oral presentations. Sinitsyn and Guegan joined also the subsea permafrost workshop organized during that event.



Fig. 1 UNIS delegation at EUCOP (photo by Hanne Christiansen) & Anatoly and the heat flux meter in Vestpynten (Photo by Emilie Guegan)

During July, Guegan worked intensively with Dr. Anteneh Tsegaye from WP2. They developed a sequentially coupled frozen soil model that they implemented in the Geo-studio package. Guegan tested and applied the model to WP6 investigation sites, i.e., Vestpynetn (Svalbard), Baydarskaya Bay (Russia) and Varandey (Russia). The model works now and can be used, but still a lot of efforts are needed for validation and calibration.

In August, Sinitsyn and Guegan performed fieldwork for one week in Longyearbyen. They maintained the Vestpynten site and downloaded its data. They relocated the heat-flux meter to the Adventdalen CALM site where heat flux is currently being recorded. At Adventdalen CALM site, on-site air and ground thermal measurements are available, as well as, thermal properties of the ground from laboratory experiments. The idea here is to compare the thermal conductivity values from the laboratory measurements to the ones extrapolated from on-site heat flux measurements. This will be very useful to test the validity of WP6 instrumentations.

Achievements:

Accepted:

Li, Z., Lubbad, R., and Høyland, K. V. (2014). Literature study: Development directions of coastal changes in Arctic under climate changes. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1168.

Linzbach, A., Sinitsyn, A., Wrangborg, D., Ganicheva, N., and Guegan, E. (2014). Investigations of Coastal Erosion by Means of Laser Scanner VZ-1000 in Vestpynten, Spitsbergen. In Proc. of the 22 Int. Symp. on Ice (IAHR), Singapore, Paper #1110.