

## Project information

### Keywords

Research project

### Project title

Ecosystem modeling of the Arctic Ocean around Svalbard

### Year

2015

### Project leader

Pedro Duarte

### Participants

Haakon Hop, Harald Steen, Philipp Assmy, a Post-Doc / Norwegian Polar Institute

Ole Anders Nøst, Tore Hatterman / Akvaplan-niva (AKV)

Evgeniy Yakushev, Andre Staalstrøm / Norsk Institutt for vannforskning NIVA

Radovan Bast / Tromsø Arctic University (UiT)

E-mail to all participants/web site all institutions:

[Pedro.Duarte@npolar.no](mailto:Pedro.Duarte@npolar.no); [Haakon.hop@npolar.no](mailto:Haakon.hop@npolar.no); [Harald.Steen@npolar.no](mailto:Harald.Steen@npolar.no)

[Philipp.Assmy@npolar.no](mailto:Philipp.Assmy@npolar.no) / <http://www.npolar.no/no/>

[ole.anders.nost@akvaplan.niva.no](mailto:ole.anders.nost@akvaplan.niva.no); [tore.hattermann@akvaplan.niva.no](mailto:tore.hattermann@akvaplan.niva.no) / <http://www.akvaplan.niva.no>

[evgeniy.yakushev@niva.no](mailto:evgeniy.yakushev@niva.no); [andre.staalstrom@niva.no](mailto:andre.staalstrom@niva.no) / <http://www.niva.no/>

[radovan.bast@uit.no](mailto:radovan.bast@uit.no) / <http://uit.no/startside>

### Flagship

Arctic Ocean

### Funding Source

Fram Center - flagship Arctic Ocean

### Summary of Results

The main achievements of our project were (further details were presented in the previous two reports):

- (i) Collection of available data for model parameterization, calibration and validation during the N-ICE2015 Norwegian Polar Institute Research Cruise
- (ii) Implementation of biogeochemical subroutines with EcoDynamo, for ice algae and ice biogeochemistry;
- (iii) Coupling of EcoDynamo – an object oriented ecosystem modeling software – with ROMS;

(v) Start of model testing.

### For the Management

We managed to keep up with most of the activities and goals predicted at the beginning of the project (please refer project proposals submitted in 2014 and 2015). The main challenge here was to have an Arctic Ocean model coupling physical and biogeochemical processes, using a physical model implemented within other Fram Centre project of the same flagship (**Mesoscale modeling of ice, ocean and ecology of the Arctic Ocean**) and an ecosystem model software (**EcoDynamo**) developed over several years by the project leader. The technology to resolve this coupling was successfully implemented and we have now a fully coupled model that is working. We keep conducting test runs with the model in the Stallo supercomputer.

The next main challenge is to calibrate and validate this model so that it becomes a useful tool to forecast the evolution of the Arctic Ocean ecosystem. This is a very challenging task and it is very difficult to anticipate exactly the time it will take. One of the reasons for this uncertainty is related with the still ongoing validation of the physical model in the other project mentioned above. In fact, the validation of the biogeochemical component depends on the validation of the physical component. Apart from that, the whole process of calibrating/validating the full coupled system is very time consuming due to the long model running times that result from its complexity and from the size and resolution of the area being simulated. In spite of these difficulties we are committed in continuing the work to make sure that the efforts and investment done so far will produce the desired results in the near future.

### Published Results/Planned Publications

Published

Duarte, P., Assmy, P., Hop, H., Spreen, G., Gerland, S., Hudson, S.R., 2015a. The importance of vertical resolution in sea ice algae production models. *J Marine Syst* 145: 69-90. <http://dx.doi.org/10.1016/j.jmarsys.2014.12.004>.

Duarte, P., Hattermann, T., Juselius, J., Yakushev, E., 2015b. Ecosystem modeling of the Arctic Ocean around Svalbard (ArctisMod) a new ecosystem modeling project at the Fram Centre. *Fram Forum* 2015: 56-58.

Planned until February 2016

Duarte et al. A methodology for merging structured and object oriented modeling platforms.

#### Communicated Results

The following talks included a synthetic description of the modeling work developed during the ArctisMod project in relation to the N-ICE2015 project.

Duarte, P., Assmy, P., Hop, H., Kauko, H., Fernández-Méndez, M., Mork Olsen, L., Sandbu, M. and Wold, A. 2015. The Norwegian Young sea ICE cruise (N-ICE2015). 7a Portuguese Conference of Polar Sciences, 28-29 October 2015, Instituto de Ciências da Terra, Universidade de Évora

Duarte, P., Assmy, P., Hop, H., Kauko, H., Fernández-Méndez, M., Mork Olsen, L., Sandbu, M. and Wold, A. 2015. The ice associated-ecosystem studied during the Norwegian Young Sea Ice cruise (N-ICE2015) in the Arctic Ocean: preliminary results. FAMOS 2015 Meeting, 2-7 November 2015, Cape Codder Hotel, Hyannis, Massachusetts, USA.

#### Interdisciplinary Cooperation

This project benefits from inter-disciplinary cooperation. In fact, the modeling work done so far includes ice physicists and marine biologists. Therefore, the main disciplines involved in the project were Ice Physics and Marine Biology and Ecology. Furthermore, contacts were established with colleagues at the University of Alaska Fairbanks regarding biogeochemical modeling that, hopefully, may boost some important collaboration in the near future. Also, contacts were established with the CICE modeling team at the Los Alamos National Laboratory (USA) and the Finnish Environmental Institute.

#### Budget in accordance to results

Funding from the Fram Centre is fundamental to pay for the project expenses, with emphasis on labor and technical assistance. The project was not completed yet. Fram Centre funding for 2016 and 2017 is a necessary condition for completing the project. The Norwegian Polar Institute and its Centre for Ice Climate and Ecosystem have substantially contributed with in-house funding for this project. Following recommendations from the Fram Centre flagship financing this project, other sources of financing were and will be attempted.

Could results from the project be subject for any commercial utilization

No

#### Conclusions

The work developed so far suggests that the coupling methodology described in this report is a good solution to combine the community model ROMS with EcoDynamo, facilitating to a great extent the implementation of relatively complex ecosystem models. Also, the project work has been according to what was planned and proposed to the Fram Centre, except in what concerns the hiring of a post-doc. This was attempted last year and again this year but without success, due to the absence of qualified candidates. Therefore, we anticipate that, in case the project will be approved for following-up next year, efforts should be made to hire a technician as was done last year and also this year. This will boost our capacity to speed-up the immense technical tasks associated with the implementation of the ecosystem model. Also, giving the difficulties mentioned above with the calibration/validation process it would be nice to have the project end postponed until the summer of 2017 or consider the possibility of extending it to another full year, until the end of 2017.