

Project information

Project title

Freshwater inputs to Svalbard's coastal waters: Fluxes, fate, and implications for coastal ecosystems (FreshFate)

Year

2020

Project leader

Amanda Poste

Geographical localization of the research project in decimal degrees (max 5 per project, ex. 70,662°N and 23,707°E)

Adventfjord, Svalbard (78.2 N, 15.6 E).

Participants

Project leader: Amanda Poste, NIVA, amanda.poste@niva.no

Project participants/institutions:

- NIVA (Helene Frigstad, Anne Deininger, Maeve McGovern, Andrew King);
- Akvaplan-niva (Alexey Pavlov, Eva Leu);
- UNIS (Janne Søreide);
- UiT The Arctic University of Norway (Tobias Vonnahme, Ulrike Dietrich);
- Institute of Oceanology Polish Academy of Sciences (IOPAS, Poland; Piotr Kowalczyk, Monika Zablocka)
- Administrative responsible: Tor-Petter Johnsen, NIVA, tor-petter.johnsen@niva.no

Flagship

Fjord and Coast

Funding Source

Fjord and coast flagship ("Effects of climate change on fjord and coast ecosystems")

Summary of Results

There have been some changes in our plans related to the ongoing pandemic, including moving some of the fieldwork planned from 2020 to 2021, however, we have ensured continued progress on the project in 2020, including: 1) increased focus on publication of results for WP1, 2) initiating a MSc internship project carrying out microbial community analysis of an existing sample set from Isfjorden, and 3) increased focus on field sampling for validation of remote sensing observations and analysis of *in situ* sensor data.

Our results to date have shown strong seasonal changes in river discharge, sediment load and river water chemistry as the melt season progresses from snowmelt, to increased glacial discharge to increased rainfall and deepening of the permafrost active layer (McGovern et al. 2020). We also have successfully established robust empirical relationships between sensor-based measurements of conductivity, turbidity and pH from NIVA's river monitoring station in Adventelva with field measurements of these parameters and correlated water chemistry parameters, and are working on using these high frequency sensor data (from 2017–2020) to gain insight into how river water chemistry and sediment load change throughout the season as well as on shorter time-scales in response to high flow events.

We observed strong spatial and temporal variability in fjord physicochemical parameters, where river inputs lead to strong gradients in water chemistry, temperature and light (McGovern et al. 2020). The river was a strong source of sediments (leading to high light attenuation) and nutrients to the fjord (with much higher concentrations of nitrate/nitrite, phosphate and silicate than the receiving marine waters). Based on 16s rRNA analysis of previously collected samples from Isfjorden (including samples from rivers, coastal waters, and coastal surface sediments), we also find that inputs from land are important drivers of bacterial community structure and function (Delpech et al. *submitted*).

Finally, we have used field data from Adventfjorden to develop a site-specific calibration for an algorithm to estimate SPM concentrations from remote sensing observations, allowing us to expand on this work in 2021 in order to use remote sensing to characterize SPM over broader spatial and temporal scales.

Master and PhD-students involved in the project

Several MSc and PhD students have been involved in the FreshFate project to date. Including:

1 BSc thesis project: Liv Sletten, University of Edinburgh

3 MSc thesis projects: Sebastian Andersen (UiT/UNIS), Ellie Handler (UiT/UNIS), Daniela Walch (Uni. Potsdam/UNIS)

1 MSc internship: Lisa-Marie Delpech (ENS de Lyon)

3 PhD students involved in research activities (Maeve McGovern, Tobias Vonnahme, Ulrike Dietrich)

For the Management

The FreshFate project aims to contribute essential information about the effects of freshwater runoff on Svalbard's coastal ecosystems and the services they provide, which is particularly relevant given projected future increases in freshwater inputs from land to sea. Our results so far indicate that seasonal changes as well as high river flow events can have strong impacts on fluxes of freshwater, sediments and nutrients from land to sea, and on the degree of freshwater influence on impacted coastal waters. Our results also indicate that inputs from land play an important role in structuring coastal bacterial communities in both the water column and sediments.

Physical and chemical conditions in this river-fjord system are highly variable in both space and time, pointing to a need for new technologies that can provide information about environmental conditions at higher frequency and/or with higher spatial resolution than is possible using traditional field sampling approaches. Our preliminary results suggest that sensor-based measurements can give important insight into how water chemistry and sediment loads change over short time scales, while remote sensing is a promising tool for determining the extent and duration of freshwater influence on coastal waters, both in Adventfjorden and elsewhere in Svalbard. These technologies, when paired with field sampling, offer new opportunities for understanding the pressures facing Arctic coastal waters.

Published Results/Planned Publications

To date the FreshFate project has resulted in one published, and one submitted paper:

McGovern, M., Pavlov, A., Deininger, A., Granskog, M.A., Leu, E., Søreide, J.E., Poste, A.E. Terrestrial inputs drive seasonality in organic matter and nutrient biogeochemistry in a high Arctic fjord system. *Frontiers in Marine Science*, 2020, doi: 10.3389/fmars.2020.542563.

Delpech, L.-M., Vonnahme, T.R., McGovern, M., Gradinger, R., Præbel, K. Poste, A. Terrestrial inputs shape coastal microbial communities in a high Arctic fjord (Isfjorden, Svalbard). *In review at Frontiers in Microbiology*.

Communicated Results

Conference/workshop presentations:

SIOS Online Conference on Remote Sensing on Svalbard. 2020. "Satellite remote sensing estimation of suspended particulate matter in the coastal waters of Svalbard". Daniela Walch (MSc student). Oral presentation (won early career presentation award).

Czech Polar Ecology Conference. České Budejovice, 2020. "Linking land and sea: Arctic coasts and the fate of terrigenous carbon." Amanda Poste. Keynote lecture.

Svalbard Science Conference. Oslo, 2019. "River transport of organic matter, nutrients and sediment to coastal zones on Svalbard." Leah Jackson-Blake, Amanda Poste, José-Luis Guerrero. Poster presentation.

ARCTOS workshop on freshwater influenced fjords. Tromsø, 2019. "Effects of terrestrial inputs on northern coastal ecosystems." Amanda Poste, Maeve McGovern. Oral presentation.

Other channels of communication:

In addition to the scientific papers and conference presentations/seminars listed above (aimed at the scientific community), preliminary results and project goals were presented in two Pecha-Kucha presentations during the Fjord & Coast flagship's annual meeting in 2019 (at the public library, and to management during the 'Dialogue Day'). We also presented the FreshFate project (and other linked research) to UNIS MSc/PhD students during a guest lecture in the Benthic Ecology Course in 2019.

Interdisciplinary Cooperation

This project is highly interdisciplinary, involving research related to catchment biogeochemistry, hydrology, marine biogeochemistry and ecology, and remote sensing. The project benefits strongly from this cooperation, since the goals of the project depend on taking a whole system approach linking land to sea making it absolutely necessary to involve researchers and students with broad expertise. This cooperation has been extremely positive and has led to increased contact between groups and people who don't often work together, and has also opened new avenues of cooperation, including through co-supervision of graduate students.

Budget in accordance to results

The budget and outputs for 2020 are in agreement with the timeline and budget of the project as outlined in the proposal. The funding from the Fram Centre has been crucial for being able to carry out the project. While this project is linked to an ongoing Norwegian Research Council project, which has been able to cover some of the costs of field work and lab analyses, the overwhelming majority of the work carried out in the FreshFate project is entirely dependent on the Fram Centre funding.

This funding has also allowed us to seek out opportunities for other value-added opportunities to extend and build on the ongoing/planned work in the FreshFate project. For example, several students based on Svalbard (1 BSc student, and 3 MSc students) have carried out/are carrying out their thesis work in association with the FreshFate project, allowing us to expand on the work planned by carrying out additional sampling and analysis, including related to impacts of high river flow events on the fjord, generating robust ground-truthing data for remote sensing observations of the Adventelva river plume, and additional work on microbial community responses to inputs from land. Two MSc students involved in the project have received Arctic Field Grants to further extend this work, and one additional student has applied for this grant for work in 2021. These additional sources of funding allow us to expand on and extend the work of the FreshFate project, creating opportunities for value-added research and additional deliverables in the form of datasets, publications, dissemination, networking and team-work opportunities for students and more generally an increased understanding of the impacts of freshwater on Svalbard's coastal waters.

Could results from the project be subject for any commercial utilization

No

Conclusions

Since this project is ongoing, we do not have any final conclusions to report at this time beyond the highlights, preliminary results, and potential future research perspectives outlined in the previous sections of the report.

The work outlined in the proposal for the third year of funding for this project (2021) will allow for the successful completion of the project and publication/dissemination of project results.