

## Project information

### Project title

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

### Year

2019

### Project leader

Amanda Poste, NIVA, amanda.poste@niva.no

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

This project is ongoing. The following milestones have been achieved to date:

Collected regular (and high-flow event) samples from the Adventelva river (n=10 dates) (WP1)

BSc student carried out a thesis project within FreshFate, focusing on response of river water chemistry to high flow events in Adventelva, as well as linking field data with sensor-data from NIVA's river monitoring station. This student will continue to build on this work in 2020 through a research-based MSc in the FreshFate project. (WP1, WP3)

Carried out two main field sampling campaigns in Adventfjord (in June and August) characterizing physicochemical conditions in the river plume. Carried out additional sampling along a mid-fjord transect in July. (WP1, WP2)

Tested all relevant experimental methods for WP2 during the main field campaigns.

Successfully collected ground-truthing data linked to satellite observations on two occasions (June and August, n=10 fjord stations) (WP3)

- We have recruited two additional MSc students who will carry out their thesis projects within the FreshFate project in 2019–2021. One will focus on linking field measurements to satellite observations (WP3), and one will focus on marine microbial responses to river inputs (WP2). The involvement of several students in the project creates opportunities for more frequent sampling, and since these students will be based on Svalbard during the 2020 field season, we are confident we will manage to capture seasonal as well as high flow event samples.

Our preliminary results 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. 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, pointing to the possibility of using these high frequency sensor data (from 2017–2019) to gain insight into how river water chemistry and sediment load change throughout the season as well as on fine time-scales in response to high flow events. We also have observed strong spatial and temporal variability in fjord physicochemical parameters, where river inputs lead to strong gradients in water chemistry, temperature and light. 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). In the next two years of the project we will build on this work by: 1) extending our river data set (with a strong focus on capturing high flow events and estimating fluxes from land to sea), 2) studying microbial community responses to freshwater inputs, and 3) carrying

out detailed work on using remote sensing to characterize the Adventelva river plume.

Master and PhD-students involved in the project

FreshFate has a strong focus on education. The project team includes three PhD students at UiT (McGovern, Vonnahme, Dietrich), and several students are carrying out their theses within the project. A BSc student (Liv Sletten, Edinburgh University) has carried out a thesis project within FreshFate, focusing on response of river water chemistry to high flow events in Adventelva, as well as linking field data with sensor-data from NIVA's river monitoring station. This student will continue to build on this work in 2020 in connection with a research-based MSc in the FreshFate project.

We have recruited two additional MSc students who will carry out their thesis projects within the FreshFate project in 2019–2021. One will focus on linking field measurements to satellite observations (Daniela Walch, University of Potsdam), and one will focus on marine microbial responses to river inputs (Sebastian Andersen, UiT).

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 preliminary results 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. This high degree of variability in both space and time suggests that in order to study these processes there is 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 show 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

Since this project is still in its early phase, we have not yet published the results in peer-reviewed publications, although one paper including FreshFate results will be submitted in early 2020.

We have presented preliminary results at the Svalbard Science Conference:

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

We also presented preliminary project results at an ARCTOS seminar on freshwater influenced fjords (November 2019; speaker Poste) and will present the preliminary results as part of a keynote lecture to be delivered at the Czech Polar Ecology Conference (speaker: Poste).

Communicated Results

In addition to the scientific conference presentations and seminars listed in section 7 (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 (at the public library, and to management during the 'Dialogue Day'). We also presented the FreshFate project (and other linked research) to students during a lecture in the UNIS Benthic Ecology Course.

We are currently working on an article related to the FreshFate project (and other linked projects related to land-ocean interactions on Svalbard) for the Svalbardposten, which targets the general public.

#### 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 2019 are in agreement with the timeline and budget of the project as outlined in the proposal. The funding from the Fram Centre has been entirely crucial for 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, by recruiting several students based on Svalbard during field seasons (1 BSc student in 2019, and 3 MSc students for 2019–2021), we will also be able to expand on the work planned, carrying out additional sampling and analysis, including more detailed sampling of the impacts of high river flow events on the fjord, and more detailed work on generating robust ground-truthing data for remote sensing observations of the Adventelva river plume. Two MSc students involved in the project have also applied for Arctic Field Grants from the Norwegian Research Council to further extend this work, while we also have received funding for a related project focusing on remote sensing and drone observations of Adventfjord from a recent SIOS Access call for proposals (PI: Søreide). 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, and last but not least, 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 and preliminary results outlined in section 5.

The work outlined in the proposal for the second and third year of funding for this project (2020 and 2021) will allow for the successful completion of the project and publication of project results.