

Kongsfjorden System Flagship Programme – Creating a network for further enhancement of marine related research and monitoring in Ny-Ålesund

This proposal has been prepared by a subgroup of the Kongsfjorden System flagship (Gabrielsen, Bishof, Hoppe, Hop, Jiminez, Duarte and Kovacs) on the behalf of the flagship.

Svalbard and especially Kongsfjorden is seen as a harbinger of the future Arctic in the light of climate change. The research conducted in Kongsfjorden will help understand the scope and impact of climate change on different departments of the ecosystem, and will illuminate on the capacity of organisms and ecosystems to adapt to those changes. Kongsfjorden is not only unique in regards to its ecology, but there is also a large body of data available. This in-depth understanding of the Kongsfjorden system and especially long-term monitoring which is conducted there is vital for policy makers and society at large to navigate between mitigation and adaptation to climate change.

The Kongsfjorden System Flagship Program (KFP) is one of four Ny-Ålesund flagship programs. Its main goal is to create a network to increase collaboration and coordination for marine research and related activities conducted by several institutes from many nations in and around Kongsfjorden and Ny-Ålesund. This proposal seeks to create a network for further enhancement of marine related research and monitoring in Ny-Ålesund and beyond. This will strengthen the KFP flagship and broaden the thematic coverage of scientific potential beyond the scope of what is individually achievable by single groups or institutes.

The Svalbard Strategic Grant funds will enable the KFP to facilitate a network to increase collaboration and cooperation between scientists working on the marine environment in Kongsfjorden. Anticipated outcome from the proposal is increased cooperation in terms of common data analysis, common field campaigns, inter comparison of methods, and common publications. The KFP would also investigate further possibilities for joint proposals either to the Research Council of Norway, or through the EU-system.

Relevance to the call

The marine activities in Ny-Ålesund have increased in both magnitude and scope over the last years. In addition to the long-term observations, much of the marine research is campaign- and project-based. Thus, a streamlined coordination of the research activities will contribute to join and use the full potential of knowledge and expertise available. Also in light of the increased pressure on the environment, it is essential to concentrate and coordinate efforts. Pulling forces together will create results beyond what individual institutes or groups can achieve alone, and the flagship network concept has shown to be increasingly successful over the years. The marine activities in Kongsfjorden are a focal point; however, it is essential to link observations from Kongsfjorden to other marine areas on Svalbard to broaden the picture and relevance of the activities. Hence, KFP will invite partners from the other three research settlements on Svalbard (Longyearbyen, Hornsund and Barentsburg) to take part in the proposed activities. The flagship initiatives are bottom-up, and the KFP network is open to all scientists interested in or working on marine science questions in Ny-Ålesund, on Svalbard, and beyond. These initiatives will also significantly contribute to the international recognition of Ny-Ålesund as the world-leading station for research and monitoring in the Arctic.

Recommendation from our two previous workshops (October 2016 and September 2018) are being followed with regard to the future tasks for the KFP. A report has been presented to the Norwegian Research Council from the workshop in 2016 and a new report to the Research Council will be delivered in October 2018. The conducted research as well as the workshops aim at minimizing the environmental impact in Kongsfjorden and Ny-Ålesund area.

Achievements and contributions of the Kongsfjorden marine Flagship Program during the last years

Proposals:

Nov 2015: SSG workshop proposal: “Adaptations to the environmental changes in the Arctic”

Nov 2016: SSG project proposal “Studying adaptive processes in the changing Arctic”

Ongoing: EU proposal to the Horizon 2020 programme

Workshops:

Oct 2016: Workshop “Adaptations to environmental changes in the Arctic”. Main achievements: building of KFPs six working groups, conceptualizing perspective paper and drafting recommendation letter to NySMAC.

Nov 2017: Svalbard Science Conference: back-to-back KFP sessions, project brainstorming and EU call

Sep 2018: KFP Workshop in Tromsø, Norway: networking within and across working groups, brainstorming for future collaborations and joint projects

May and Sep 2018 writing meetings in Tromsø for the EU proposal

Papers:

2019: Strategy paper: “Kongsfjorden as harbinger of the future Arctic: knowns, unknowns and research priorities” (Bischof et al. 2019)

2018 and 2019 Review papers from marine studies in Kongsfjorden (Eds. H.Hop and C.Wiencke)

Plans for further developments of the Kongsfjorden System Flagship Program during the project period

The KFP will continue to bring scientist together which seek to understand the marine systems of Kongsfjorden, also in comparison to other Arctic marine areas. The unique access of infrastructure and facilities permit highly coupled, multi-disciplinary approaches to key questions in Arctic marine research.

The work within KFP is now structured into seven thematic working groups:

WG 1: Physical, chemical and ecological observations (Finlo Cottier, SAMS, UK & UiT and Haakon Hop, NPI, Norway)

WG 2: Contaminant flow and deposition (Geir Wing Gabrielsen, NPI, Norway)

WG 3: Land-sea-atmosphere interactions (Kai Bischof, Univ. Bremen, Germany)

WG 4: Seasonal control of the nutrient regime (Carlos Jiminez, Univ. Malaga, Spain)

WG 5: Response to key environmental drivers and adaptive potential (Jean-Pierre Gattuso, CNRS, France and Clara Hoppe, AWI, Germany)

WG 6: Modelling the KF/Krossfjord ecosystems (Pedro Duarte, NPI, Norway)

WG 7: Kongsfjorden Top Trophics (Kit Kovacs, NPI, Norway)

WG 7 is new since 2018, and is set up to answer requests from the active scientists in the field of higher trophic species such as marine mammals. This working group will complement the other six working groups.

For KFP the working groups are not to be seen as rigid entities. They are flexible units where intersections and cross breeding is encouraged. Furthermore, the flagship structure is open to the redoing or establishing new working groups based on scientific needs at any time.

To facilitate and encourage the cooperation within KFP we plan to organise the following events:

- A cross flagship meeting, back-to-back with the Svalbard Symposium in November 2019 (in Oslo).
- KFP workshop in 2020 (in Tromsø)
- Visiting scientist funds. As a new feature of KFP we aim to have some funds available for individual scientists to visit other research groups. A condition to receive such funds are expectations on common output either as common data analyses, inter-comparison of data and/or common publications.

The main anticipated and quantifiable output of this proposal is:

- Establishment of one new working group
- Yearly meeting place
- Planning joint field work to minimize the environmental footprint
- Jointly published articles
- Delivering metadata to relevant systems, such as SIOS or RIS

Promoter of open data and metadata sharing

There is a strong request within the KFP to promote data sharing and open data access. KFP urges participants to work together with SIOS and SSF/RIS to get the information into the appropriate metadatabase system.

Anticipated work and activities for the working groups (WG)

WG 1: Physical, chemical and ecological observations (Finlo Cottier, SAMS, UK and Haakon Hop, NPI, Tromsø)

The long established marine observations and marine observatories (moorings) in Kongsfjorden and adjacent shelf have led to a wealth of data series covering the physical, chemical and ecological elements of the Kongsfjorden system. The priority activities of WG1 are to (i) consolidate the data availability (ii) provide oversight on future data collection and (iii) initiate cooperative analyses of the time series to establish the rate of change in the region and the coupled interactions between the component parts. In particular, the operation of long-term marine observatories is seen as providing essential supporting data for the variety of research projects identified in the 2018 workshop. Further, robotic systems become more prevalent in their application to science questions; there is considerable expectation to see their utilisation within Kongsfjorden.

WG 2: Contaminant flow and deposition (Geir Wing Gabrielsen, NPI, Norway)

The overall objective of WG2 is to understand the scope of pollution: (i) its distribution globally, within different departments of ecosystems, and through food webs. (ii) Its effects on biota and (iii) the effect of climate change on pollution (e.g. runoff from melting glaciers, changes in distribution routes and deposition, ecological changes).

The Arctic and especially Svalbard is exposed to both long-range transported and local pollution such as chemical contaminants, plastic, petroleum or pharmaceuticals. The distribution and fate of these pollutants is highly influenced by ecological factors and consequently climate change. Elevated temperature in the Arctic are expected to change the transport and deposition of contaminants to the Arctic. Furthermore, elevated temperatures might lead to secondary emissions of stored contaminants from melting sea ice, glaciers, and permafrost. Svalbard is more affected by climate change than most other places in the Arctic, and shows some of the highest levels of both legacy and emerging pollutants within the Arctic. Considering the large body of research on Kongsfjorden, it is vital to continue contaminant research in this area also in cooperation with other flagship programs, such as the atmospheric and the terrestrial flagship.

WG 3: Land-sea-atmosphere interactions (Kai Bischof, Univ. Bremen, Germany)

Climate change will exert considerable changes in the continuum of interactions between atmosphere-land-sea. Coastal parts of fjord systems like Kongsfjorden are very dynamic, while across Svalbard different fjord systems are under differing glacial and local geological influence, emphasising the value of comparative approaches, and possibility of using fjords at different stages of development as past/future analogies (e.g. Dicksonfjord as a future Kongsfjord). Consequently, the following overarching questions have been formulated as guidelines for upcoming activities in this research field: (1.) “Does terrestrial runoff and contained nutrients control the distribution of biodiversity in the marine fjord environment in the same way as it does on land on Svalbard?” and (2.) “How are runoff processes changing in the Kongsfjorden environment, as a paradigm for the physical and chemical impacts of land-sea interactions?”

Upcoming activities within WG3 will include a pilot study on downstream effects of terrestrial run-off (sediments and freshwater) in front of the Midtre Lovenbreen discharge delta. Related changes in light and nutrient availability, consequences to the coastal carbonate system and potential feed-back loops from sea to land are addressed. Members of the WG3 have agreed to prepare for this pilot study to be conducted during the summer season of 2019.

WG 4: Seasonal control of the nutrient regime (Carlos Jimenez, Univ. Malaga, Spain)

Our understanding on the effects of increased CO₂, temperature and UV radiation on Arctic marine primary producers is mainly restricted to the summer months. During this time, continuous solar

irradiation coincides with a nutrient-depleted and strongly stratified environment. Due to the combination of these factors, Arctic algae in summer are prone to regular or even chronic photoinhibition, which only disappears as the darkness progressively increases towards the autumn. However, increasing global temperature may lead to the release of different forms of inorganic nitrogen (N) and phosphorus (P), mainly from terrestrial sources and through Atlantic waters entering Kongsfjorden. We hypothesize that increased contribution to the N and P pools in the fjord in summer may affect growth and metabolic performances of phytoplankton as well as benthic micro- and macrophytes.

Key topics of WG 4: 1. How much of the organic N and P from the permafrost, and/or soil erosion is mobilized and mineralized and enters the fjord? 2. Influence of Atlantification. 3. Seasonality of the nutrients. 4. Phytoplankton blooms (time of the year and composition). 5. Macrophytes, possible blooming of nitrophylic species. 6. Role of microphytobenthos in nutrients cycling. 7. Changes in the structure of the communities (phytoplankton, microphytobenthos and macrophytes), and 8. Mismatch between primary producers and consumers.

WG 5: Response to key environmental drivers and adaptive potential (Jean-Pierre Gattuso, CNRS, France and Clara Hoppe, AWI, Germany)

The Arctic is one of the regions being most affected by global change, with rates of warming and ocean acidification occurring faster than anywhere else on the planet. The responses of biological communities to these on-going and futures changes in the Arctic are, however, very poorly understood. Thus, hypothesis-driven experimental studies are necessary to develop process-based understanding, which can then be fed into parametrizations of ecological and biogeochemical modelling approaches that aim at predicting future ecosystem services.

We aim at conducting experimental studies that will allow us to elucidate if, how and why Arctic coastal pelagic and benthic ecosystems will respond to multiple environmental drivers such as ocean acidification, warming and changes in light regimes. Experimental treatments will be partially determined by the environmental history experienced by organisms in Kongsfjorden as determined in WG 1-3, as well as projected future conditions (WG 6).

WG 6: Modelling the Kongsfjorden/Krossfjord ecosystems (Pedro Duarte, NPI, Norway)

Today there are models for Kongsfjorden, such as the 3D oceanographic model, which is now being coupled with a sea-ice and a biogeochemical sub-model within the scope of the project TIGRIF, financed by the Research Council of Norway. This model may be used as a framework to integrate more processes in close interaction with the remaining WGs.

Therefore, (i) implementing a sediment sub-model is one of the most urgent modelling tasks. Furthermore, (ii) it will be necessary to improve the land-sea model forcing. Whereas tidewater glacier forcing has been assessed in detail within the scope of the TIGRIF project, (iii) there is not so much knowledge about the forcing associated with the ephemeral drainage basins discharging water, nutrients and suspended matter to the fjord during summer. Improving the way this forcing may be incorporated in the mentioned model framework implies synergies with WG 3 and, possibly, with the Terrestrial flagship. Another line of work is related with (iv) the pollutants and their integration in ongoing model efforts and here we emphasize synergies with WG 2. Furthermore, the large concentrations of microplastic in sea ice is a matter of great debate that goes beyond the boundaries of Kongsfjorden. Available model tools at the Fram Centre in Tromsø, Norway, covering a large marine domain around Svalbard may be useful to get insight about how plastic may disperse within this area and become associated with the sea-ice.

WG 7: Kongsfjorden Top Trophics (Kit Kovacs, NPI, Norway)

Kongsfjorden has been a long-term monitoring site for seabird and eiders, and a region where a vast numbers of fish, seal and whale investigations have taken place. However, there is little to no coordination between research groups that work in this area with these animals. Given the vast environmental change that has taken place in this fjord system, which has undoubtedly impacted top trophic animals, it is time to have a top trophics working group within the KFP in order to: (i) enhance

activity regarding impacts of climate change on these animals. (ii) facilitate exchange of information among scientists already working with these animals. (iii) joint scientific field campaigns to minimize research impacts on our study populations, and (iv) to link to other KFP working groups in a coordinated fashion.

Key activities of the WG 7: 1. Determine status and trends of top trophic populations in Kongsfjorden (especially those breeding in the fjord). 2. Explore the impacts of climate drivers on the top trophic animal populations e.g. sea ice extent, snow characteristics (on ice), increased freshwater inputs to the Kongsfjorden. 3. Interface with modelling groups and lower trophic science teams to explore food web structure and changes. 4. Enhance information exchange with other Kongsfjorden working groups. 5. Increase the visibility of top trophic research (and time series) based in NyÅlesund.

Budget (direct costs)

Total work group meeting 2019 and 2020: $2 \times 187.5 \text{ kNOK} = 375 \text{ kNOK}$

- Coffee, lunch and dinner: $50 \text{ pax} \times 200 \text{ NOK} \times 5 \text{ days} + 50 \text{ pax} \times 750 \text{ NOK} = 87.5 \text{ kNOK}$

- Limited travel funds for those requesting it: $10 \text{ pax} \times 10 \text{ kNOK} = 100 \text{ kNOK}$

Travel for guest visits: $10 \text{ pax} \times 10 \text{ kNOK} = 100 \text{ kNOK}$

Total direct costs applied for in this application: 499 kNOK

Modest estimate in-kind contribution: 577 kNOK

- Venue costs WG meetings: $50 \text{ pax} \times 300 \text{ NOK} \times 5 \text{ days} \times 2 = 150 \text{ kNOK}$

- Worktime (WG leaders): $7 \text{ pax} \times 0.25 \text{ month} \times 84 \text{ kNOK/month} = 147 \text{ kNOK}$

- Travel to meetings (science committee): $7 \text{ pax} \times 20 \text{ kNOK} \times 2 = 280 \text{ kNOK}$