Project funded by the Norwegian Financial Mechanism 2014-2021
Grant agreement no. UMO-2019/34/H/ST10/00504

Comparison of sedimentation processes in coastal waters influenced by marine-terminating and land-based glaciers

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Background

- Change from a marine environment predominantly influenced by tidewater glaciers towards environment characterised by land-based glaciers may alter the input of organic and mineral matter into the fjord with possible implications to chemical properties and biological productivity.
- Coastal waters receiving freshwater and terrestrial material from a marine-terminating glacier Hansbreen and from a land-based glacier Gåsbreen are studied in Hornsund fjord.
- Seasonality of particulate organic and inorganic matter as well as sediment fluxes are monitored from May until October with bottom-moored sediment traps and water sampling in close proximity of glaciers.

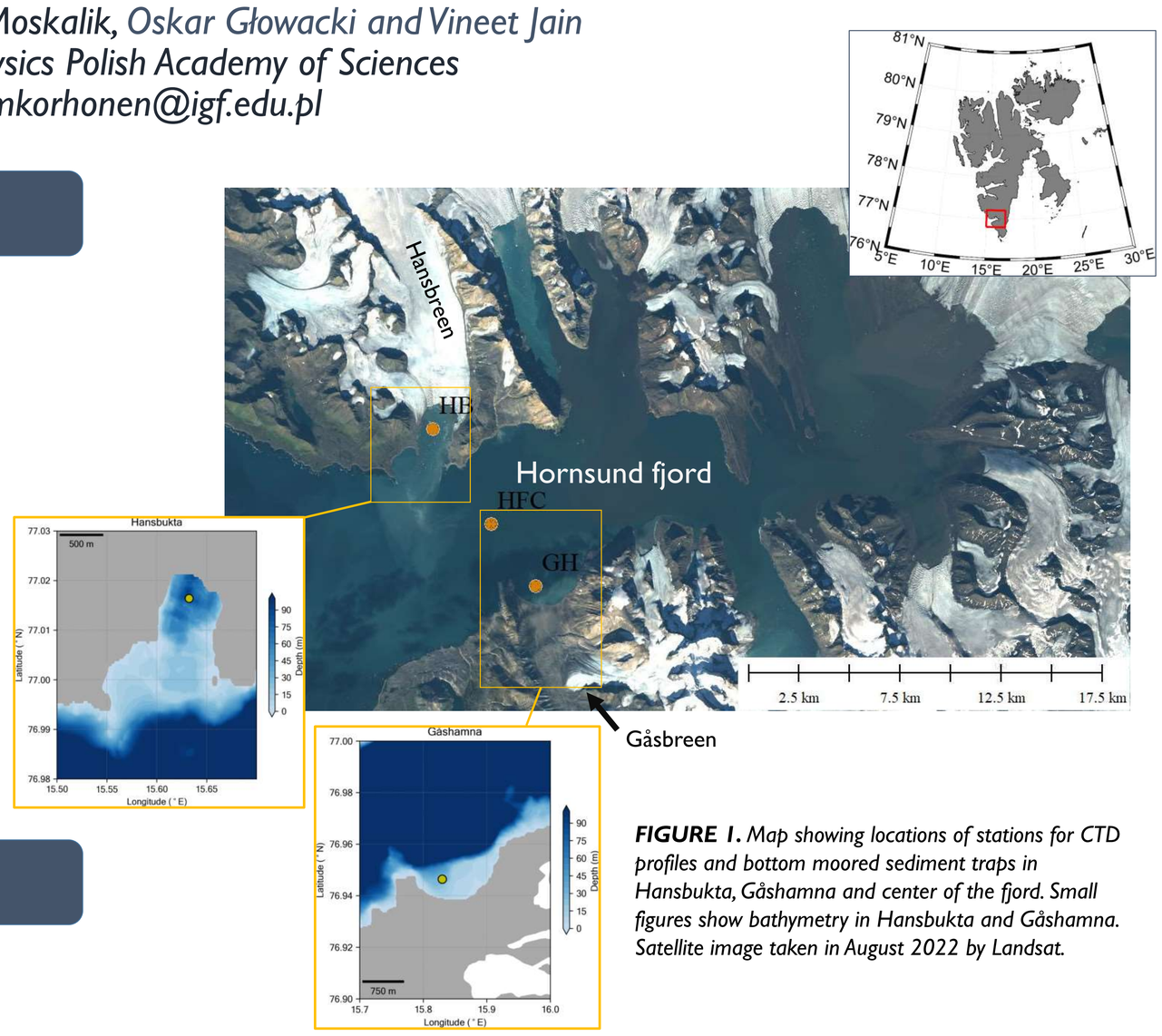

FIGURE 1. *Map showing locations of stations for CTD profiles and bottom moored sediment traps in Hansbukta, Gåshamna and center of the fjord. Small figures show bathymetry in Hansbukta and Gåshamna. Satellite image taken in August 2022 by Landsat.*

Hydrographic structure of the water column

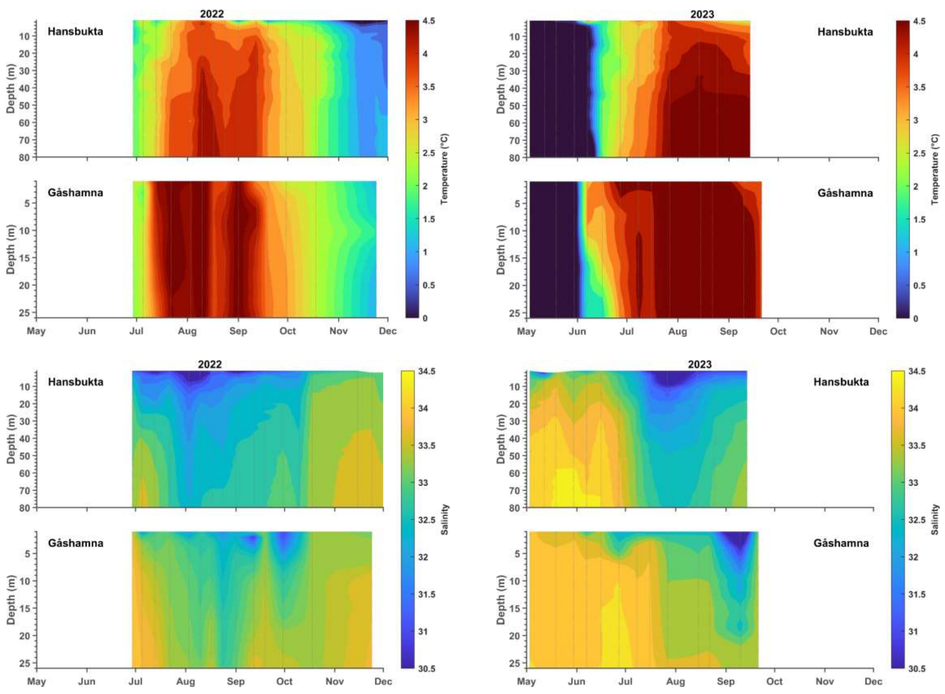

FIGURE 2. *Seasonal evolution of temperature (upper panels) and salinity (lower panels) in 2022 (left) and 2023 (right). Note the different depth scales for Hansbukta and Gåshamna.*

Distribution of turbidity within the water column

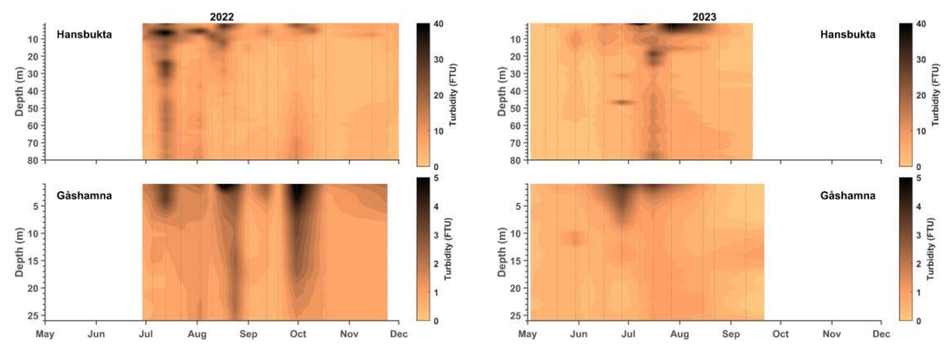

FIGURE 3. *Seasonal evolution of turbidity in 2022 (left) and 2023 (right). Note the different scales of depth and turbidity for Hansbukta and Gåshamna.*

Relationship between freshwater content, total suspended solids and sedimentation rate

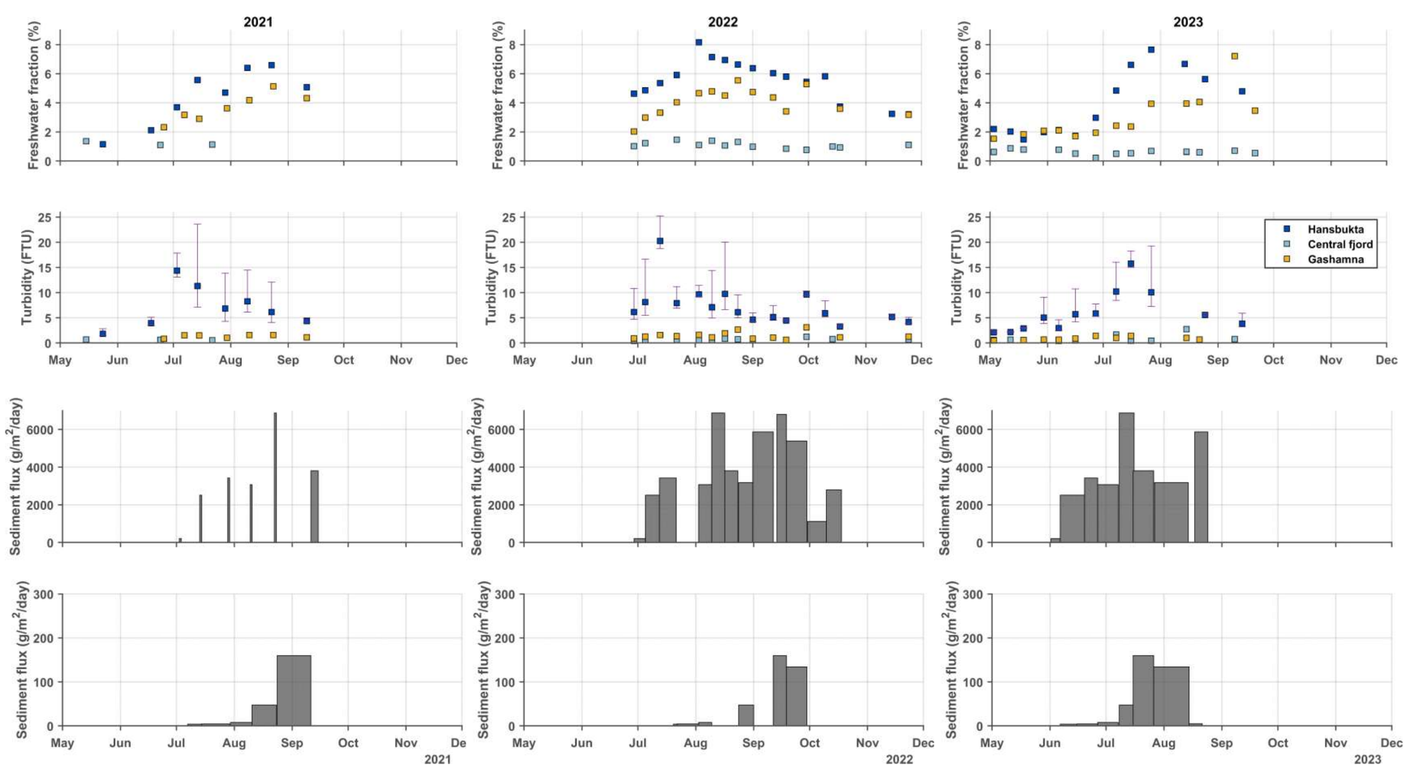

FIGURE 4.
Upper panel: *Freshwater fraction relative to salinity 34.7 in the whole water column.*
Upper middle panel: *Average turbidity in the whole water column. The upper and lower errorbars shown for Hansbukta represent turbidity above and below pycnocline (20 m), respectively.*
Lower middle panel: *Average sediment flux 5 m above bottom in Hansbukta (depth 88 m). The width of the bars represent the deployment time of the sediment trap over which the daily average has been calculated.*
Lower panel: *As above but for Gåshamna (depth 29 m). Note the different scale used for the sediment flux.*

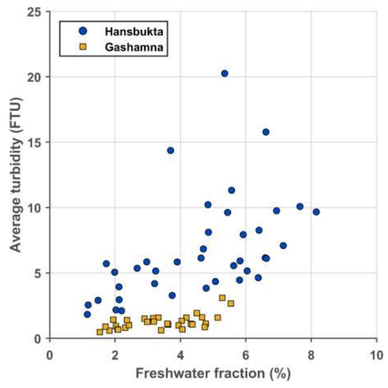

FIGURE 5.
Right: *Relationship between freshwater fraction and turbidity.*

- The amount of suspended solids, here measured as turbidity, reaches its maximum before mid-July whereas freshwater fraction is at the highest in late July or early August (Figs. 2, 3 and 4).
- In Hansbukta strong stratification keeps most of the suspended solids above the pycnocline in July and August, after which the suspended particulate matter is more evenly distributed through the water column. The more shallow Gåshamna is generally mixed down to the bottom, but in 2023 the presence of saline waters maintained stratification until late July (Figs. 2, 3 and 4).
- High sedimentation rate coincides with high turbidity in July and increases again in August/September when suspended matter starts to sink (Fig. 4, lower panels).
- In Hansbukta turbidity in the water column increases more rapidly with freshwater input. In Gåshamna the terrestrial matter transported by glacial meltwater is mainly deposited on land and does not reach the fjord in as large amounts (Fig. 5).

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