A multidisciplinary data analysis approach for understanding the water masses distribution in the Uumannaq area fjords

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Arctic Amplification has intensified in the last two decades, being now reported to be about up to four times higher than the mean global warming. The related consequences for that are alarming both at regional and large scales. In Greenland, the landscape is changing with the intensified melting and retreat of the continental ice sheet. Fjords originally characterized by marine-terminating glaciers are now migrating to land-terminating systems. This has a direct impact on the nutrient input and dynamics of the fjords and, therefore, on the marine ecosystems. In the physical environment, the accelerated melting of the Greenlandic continental ice sheet, associated with the also increased sea ice melting, is expected to augment the freshwater content in the fjords and adjacent seas. Consequently, other ocean climate-related processes such as the water masses (trans)formation and the baroclinicity of ocean currents, and their associated natural variabilities, are predicted to respond to these changes.

In this context, the system of fjords located in the Uummannaq area, off Western Greenland, is an excellent natural proxy for studying the potential impact of climate-induced changes in the water mass distribution in the fjords and adjacent seas. The reason for that lies in the fact that the region is shaped by a complex system of interconnected fjords, which are characterized by fjords with land- and marine-terminating glaciers.

In this work, we employ a multidisciplinary data analysis approach for studying the trends and variabilities of the liquid and solid freshwater input into this fjord system, and the corresponding impact on the water masses structure into the fjords and adjacent continental shelf. To do so, we analyze historical oceanographic datasets collected in the region during the last decades, combined with model outputs of freshwater input provided by two state-of-the-art Regional Climate Models. Altogether, these historical datasets are put in perspective of data recently collected through an oceanographic cruise conducted in the region aboard the R/V Sanna, from 28/Jun to 10/Jul/2022. During that cruise, we performed 47 hydrographic stations of the entire water column into five different fjords - from their mouth to the innermost, ice-free accessible location. These stations are connected to an offshore transect from the mouth of the fjord system to the shelf edge.

More specifically, this work aims at addressing three following sets of questions:

(i) What are the trends and natural variabilities of liquid and solid freshwater input to the region? Are there differences between marine- and land-terminating fjords? (ii) By comparing our recently collected datasets against historical measurements, is it possible to identify changes in the water mass structure in the Uummannaq fjords and adjacent continental shelf? (iii) If water masses are indeed changing, are these changes linked with the trends and variability of freshwater input in the region? To which extent?