Temporal variability of total mass fluxes in Kongfjorden (Svalbard) as driven by glacier melting and enhanced coastal erosion

Alessandra D'Angelo, Stefano Miserocchi, Federico Giglio, Leonardo Langone*
CNR-ISMAR, Italy

Over the last 2-3 decades, the Arctic area has experienced more warming than any other region on Earth. This Arctic amplification may be due to feedback mechanisms from loss of sea ice or changes in atmospheric and oceanic circulation.
Kongsfjorden is a small fiord at 79° N; 26 km long, 6-14 km wide, extended in SE-NW direction in the western part of Svalbard Islands. All glaciers reaching the Kongsfjorden are rapidly retreating. For example over the last 60 years the glacier front of the glaciers Kronebreen, Kongsvegen and Kongsbreen deceded ~6 km. There is ample evidence that land-to-ocean fluxes of particulate material along the Arctic coasts are changing, too. Recent studies suggest that the increase of the hydrologic regime observed in the last decades is mainly the consequence of recent climate warming and closely related to changes in permafrost conditions. The large quantities of heat carried north by the West Spitsbergen Current (WSC) influence the climate in the Arctic region as a whole. Arctic fjords may be regarded as an extreme variant of the "standard" fjord model as they are subjects to intense seasonality, high level of freshwater input, sea ice formation and melting. The water circulation inside the fjord is typically counterclockwise with water entering the fjord along the south side and exiting along the north. The WSC vein can pass the moraine thresholds in front of glaciers, reaching the inner part of the fjord where it interacts with the termination of the great glacier Kronebreen.
The aim of our research is to detect what is the main contribution of particle flux in Kongsfjorden and which is its origin:

- Terrestrial input
- Marine input

The terrestrial input could be due to the melting of glaciers that generates an increasing of submarine and surface melting, or to the surface runoff that generates debris into the sea from the permafrost surface layer erosion. Instead the marine input could be due to the biological pump activity.
To verify the temporal variability of particle fluxes and composition on long time-scale and monitoring variations of thermohaline characteristics, an instrumented mooring, equipped with an automatic sediment trap, a temperature and salinity recorder and two current meters, was deployed in September 2010 in the inner fjord at ~100m water depth.
The first 4 years of the total mass fluxes are here presented and the mass flux, together with the organic and inorganic elements are discussed.
The mass amount varied from year to year by a factor 5 according to the seasons. The highest peaks have been recorded in summer months, followed by reduced fluxes during winters; in particular, during the summer 2013 the TMF reached ~330 g m^{-2} day^{-1} and on this date it has been observed also the maximum value of %C inorg (3.78) and the minimum values of %OC (0.21). From the OC content the $\delta^{13}C$ was determined and the result is that in correspondence of %OC peak there's a $\delta^{13}C$ variation with higher marine contribute. Instead the more negative values of $\delta^{13}C$ correspond to the high peak of TMF during the end of summer. Meteorological parameters (wet precipitation and solar radiation), recorded by the Amundsen-Nobile CCTower of CNR in Ny-Ålesund, were overlapped with respectively TMF and %OC trends and they show that during constant and long raining days there's a high TMF peak and during the bright months there are the maximum values of OC content. It could be a confirmation of the hypothesis about the processes that origin terrestrial or marine particle flux.
The last results show the characterization of the water masses in the inner fjord, we used the *Cottier et al., 2005* classification that define: external, internal and local water masses.
*Email: alessandra.dangelo@bo.ismar.cnr.it