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# Temporal variability of particle fluxes in Kongsfjorden, Svalbard

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## Abstract

Over the last 3 decades the Arctic area has experienced heavier environmental changing than any other region on Earth, due to climate warming. 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 (fig.1). All glaciers reaching *Kongsfjorden* are rapidly retreating. There is ample evidence that land-to-ocean fluxes of particulate material along the Arctic coasts are changing, too.

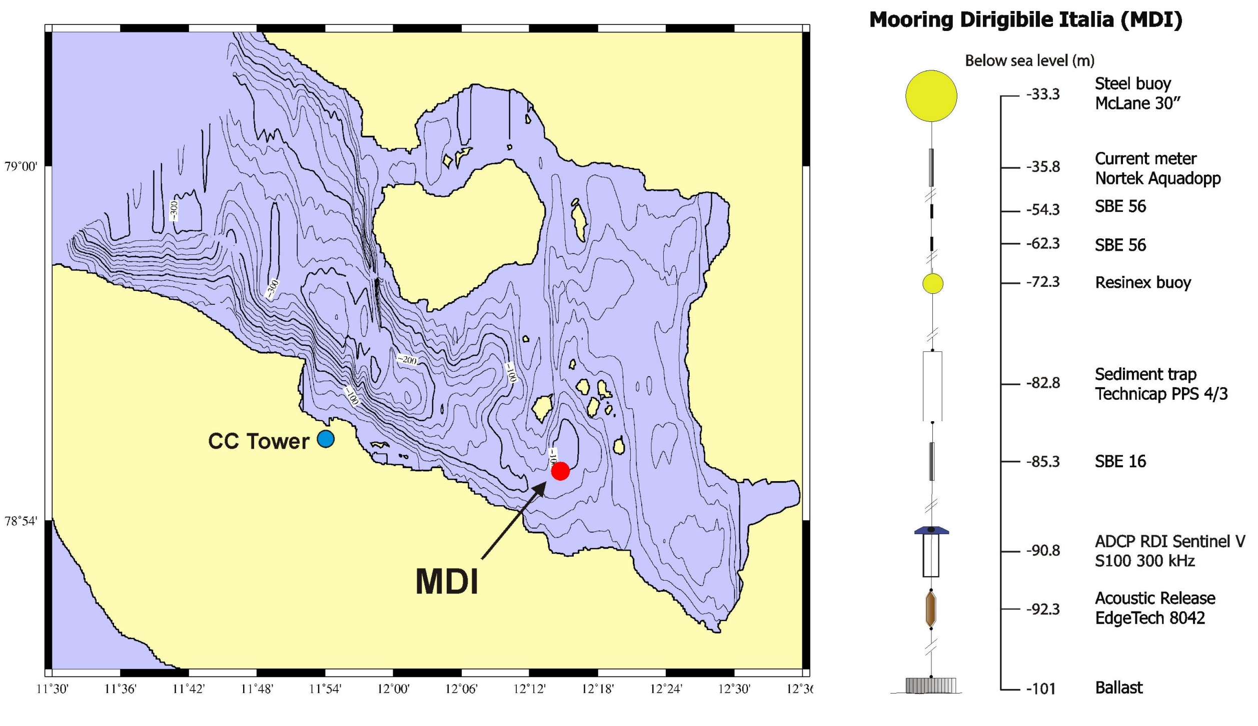


***Figure 1:*** Kongsfjorden *map and Mooring Dirigibile Italia configuration*

The aim of this research is to highlight the present-day environmental evolution of the fjord, detecting the main contribute of particle flux into *Kongsfjorden* waters and its provenance. The highest terrestrial input is due to the melting of glaciers termination that generates an increasing of the detrital pathways, or to the surface runoff that introduces debris into the sea from the permafrost surface layer erosion. Lastly, the main marine particle input is due to the biological pump activity occurred in the photic layer of the water column.
To verify the temporal variability of particle fluxes and composition on long time-scale, an instrumented mooring, named Mooring Dirigibile Italia, equipped with an automatic sediment trap,

a temperature and salinity recorder and two current meters (Fig. 1), was deployed in September 2010 in the inner fjord at ~100m water depth. Sediment trap samples have been processed in order to measure the mass flux and split into quantities suitable for laboratory analyses following the procedure of *Chiarini et al.* (2014): to separate the coarse and fine fractions by a sieve with a mesh of 580µm, to pick out and count the swimming zooplankton (*swimmers*) at order level. For total and organic carbon (OC), total nitrogen (TN) contents and the stable isotope compositions was used a Finnigan DeltaPlus XP mass spectrometer directly coupled to a ThermoFisher Scientific Flash 2000 IRMS Element Analyzer via a Conflo III interface for continuous flow measurements. OC freeze-dried samples were first decarbonated after acid treatment (HCl, 1.5M) (Tesi et al., 2007). The first five years (from Sept. 2010 to June 2015) of the Total Mass Flux are presented together with four years (2010 – 2014) of organic and inorganic Carbon and stable isotope composition. The average fluxes for the whole period is about 20 g $m^{-2}$ $day^{-1}$. The highest peaks of TMF have been recorded in the end of summer (Fig 2) with average summer values of about 100 g $m^{-2}$ $day^{-1}$, followed by reduced fluxes during the fall and wintertime (average flux in winter 6.8 g $m^{-2}$ $day^{-1}$). During spring and summer the maximum content of organic matter, due to the primary production, has been recorded, values up to 5% has been measured in warm seasons; also the $\delta^{13}C$ values show a higher quantity of marine organic matter, while, in the same periods, the values of total mass flux are the lowest ones. In general, the %OC content peaks, as result of the seasonal algal bloom, seem to anticipate the TMF peaks by a few weeks. Furthermore, the solar radiation data (Fig. 3) seem to be in according to the organic carbon content because sunlight supports photosynthesis processes. During the summer 2013, the TMF reached the maximum value of ~330 g $m^{-2}$ $day^{-1}$ (fig.2) and on this date it has been observed also the maximum value of inorganic C (IC, 3.78%)) and the minimum values of OC (0.21%).

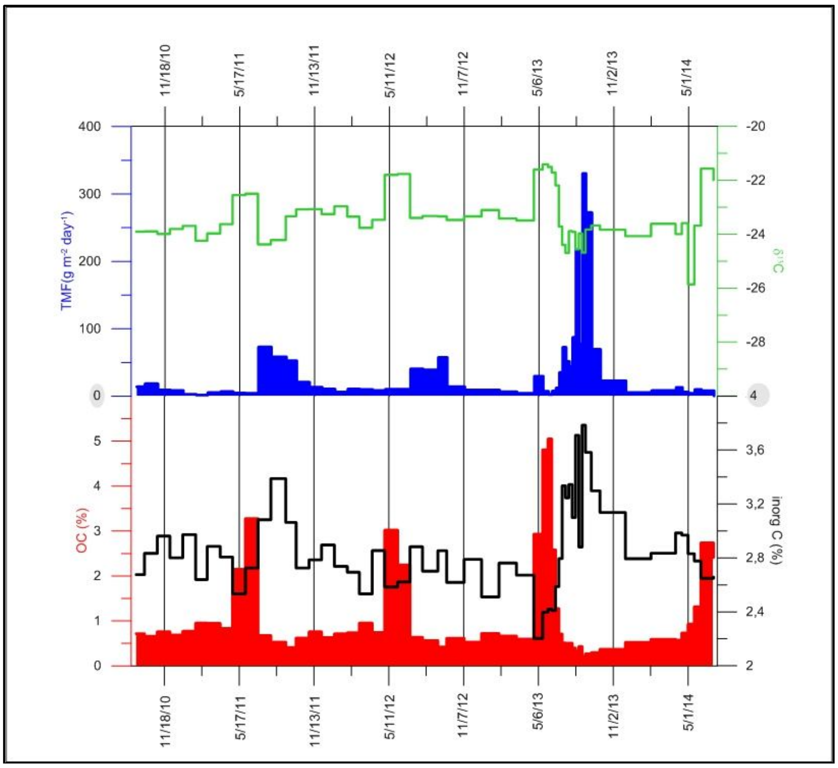


***Figure 2:*** *Time series of OC, IC, TMF, $\delta^{13}C$*

During late-summer and fall, low values of organic matter content with $\delta^{13}C$ more negative values (it means that the terrestrial organic fraction is greater) occurred. Furthermore, are also recorded high peaks of total mass flux due to the increasing of precipitations (runoff input) and melting of glacier terminations (Figs. 2 and 3).
The temporal variability of mooring data is discussed concurrently with meteorological parameters recorded by the Amundsen-Nobile CCTower of CNR in Ny-Ålesund (Fig.1); the rain precipitation, for example, is used as a runoff proxy and this is compared with TMF pattern.
We can observe that the greater input of particles appear to derive from the rainfall particle erosion, in particular in late summer.

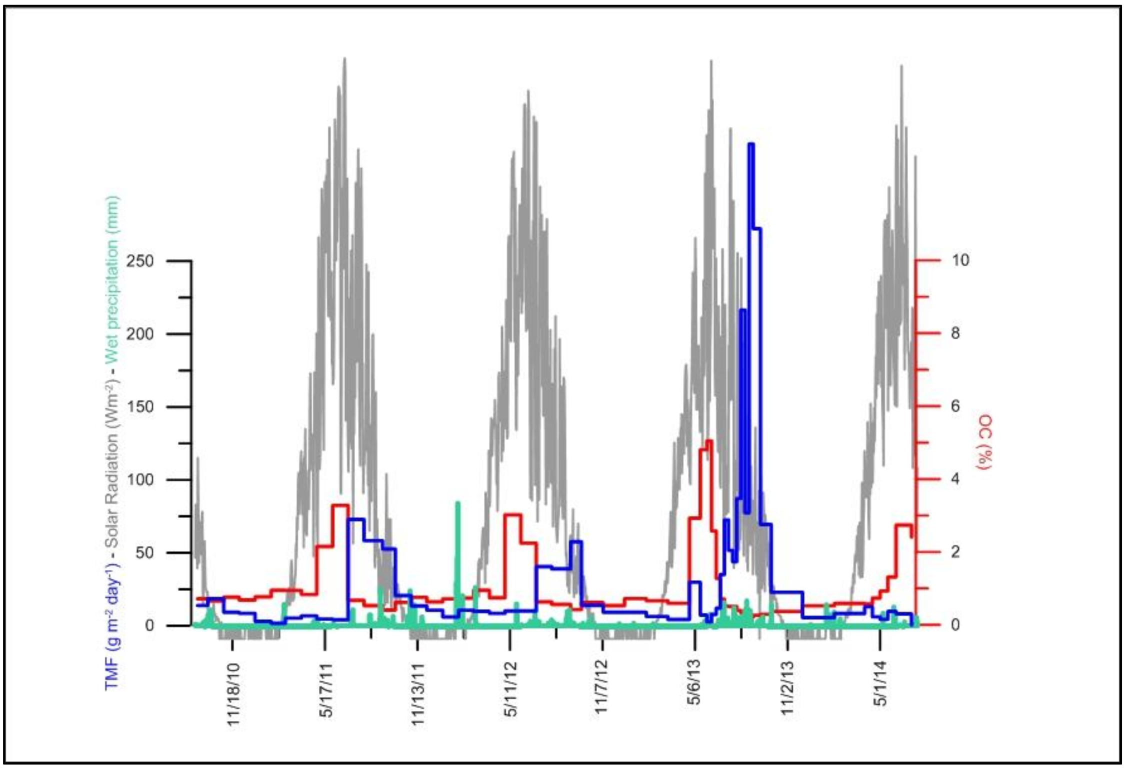


***Figure 3:*** *OC and TMF profiles correlated with atmospheric parameters*

In conclusion, five years of sediment fluxes has been presented, four of which in terms of both organic and inorganic parameters. In summer and fall seasons were recorded the highest peaks of TMF but the maximum content of organic matter occur during spring and summertime. Finally, our data suggest that atmospheric forcing play a key role in controlling the particles fluxes.

**References:**


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- Tesi, T., Miserocchi, S., Goñi, M.A., Langone, L., Boldrin, A., Turchetto, M., 2007. Organic matter origin and distribution in suspended particulate materials and surficial sediments from the western Adriatic Sea (Italy). *Estuar. Coast. Shelf Sci.* 73, 431–446.