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Aerosol deposition (trace elements and black carbon) over the highest glacier of the Eastern European Alps during the last centuries

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Ice cores are an archive of a wide variety of climatic and environmental information from the past, retaining them for hundreds of thousands of years. Anthropogenic pollutants, trace elements, heavy metals and major ions, are preserved as well providing insights on the past atmospheric circulations and allowing evaluating the human impact on the environment.

Several ice cores were drilled in glaciers at mid and low latitudes, as in the European Alps. The first ice cores drilled to bedrock in the Eastern Alps were retrieved during autumn 2011 on the "Alto dell'Ortles glacier", the uppermost glacier of the Ortles massif (3905m, South Tirol, Italy), in the frame of the "Ortles Project". A preliminary dating of the core suggests that it should cover at least 300-400 years. Despite the summer temperature increase of the last decades this glacier still contain cold ice. Indeed, O and H isotopes profiles well describe the atmospheric warming as well as the low temperatures recorded during the Little Ice Age (LIA). Moreover, this glacier is located close to densely populated and industrialized areas and can be used for reconstructing for the first time past and recent air pollution and the human impact in the Eastern European Alps.

The innermost part of the core is under analysis by means of a "Continuous Flow Analysis" system. This kind of analysis offers a high resolution in data profiles. The separation between the internal and the external parts of the core avoid any kind of contamination. An aluminum melting head melts the core at about 2.5 cm min-1. Simultaneous analyses of conductivity, dust concentration and size distribution (from 0.8 to 80 μm), trace elements with Inductive Coupled Plasma Mass Spectrometer (ICP-MS, Agilent 7500) and refractory black carbon (rBC) with the Single Particle Soot Photometer (SP2, Droplet Measurement Technologies) are performed. A fraction of the melt water is collected by an auto-sampler for further analysis.

The analyzed elements are Li, Na, Mg, Al, K, Ca, Ti, V, Mn, Fe, Ni, Cu, Zn, Rb, Ag, Cd, Sb, I, Ba, Pt, Tl, Pb and U. Trace elements concentrations in the Ortles snow are related to the emissions from the Po Valley, one of the most polluted region of Europe. The results show an increase in the concentration of many heavy metals due to anthropogenic emissions, mainly from the onset of the Industrial Revolution.

rBC is one of the most important aerosol species affecting the climate system, particularly the glaciers, by modifying the radiative energy balance. A significant increase of rBC was found in the ice identifying this kind of aerosol as a responsible in forcing the end of the LIA.