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First results from a new analytical device to determine Dissolved Organic Carbon (DOC) concentrations in polar ice cores by Continuous Flow Analysis (CFA)

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Even though organic material is one of the major impurities in polar snow only very few measurements are available so far. Organic material has a significant impact on the radiation budget of the atmosphere, and better knowledge of the deposition of organics on polar ice sheets would help increase our understanding of the global carbon cycle. Terrestrial and marine biosphere emissions consist of large numbers of different chemical species, and only a small fraction of the Particulate or Dissolved Organic Carbon (POC, DOC, respectively) has been speciated so far and only in a few snow and ice samples. The goal of this work was therefore to develop a new analytical device to measure DOC concentrations in the meltwater of snow and ice cores by using Continuous Flow Analysis (CFA). While the latter method is extremely efficient with respect to sample throughput and depth and thus time resolution, it also minimizes contamination problems, which are critical for organics. An opto-electrical method is used to determine the DOC concentration. The organic material in the meltwater is oxidized to CO_2 with intense UV radiation. The CO_2 produced is subsequently quantized by a relative measurement of the electrical conductivity of the solution. The realized system features a measurement range of 0-1000 ppbC, with a resolution of 2.2 ppbC, a LOD of 6 ppbC (3σ of the background noise) and a good linear response to standard solutions (r^2=0.99). In order to keep the dispersion of the signal as small as possible, special attention was given to minimizing mixing volumes and flow path length, resulting in a time response of 64 seconds (10%-90% of the signal).First measurements on firn core samples show the ability of the realized system to determine DOC concentrations typical for Greenland and Antarctic snow and ice.