

Pre-industrial to industrial changes of fossil and non-fossil contributions to dissolved organic carbon from an Alpine ice core

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Alpine ice cores allow access to continuous records of atmospheric composition back to the pre-industrial era in the regions where the majority of humans live. Even though organic aerosols may have a significant effect on cloud formation and climate, to our knowledge no data has been published on long-term changes in the organic aerosol fraction. Here, we present a record of the dissolved organic carbon (DOC) concentration from Fiescherhorn ice core (Swiss Alps) over the period of 1680-1990. Correcting DOC for organic gases, taken up during snowfall, we retrieved the water-soluble organic carbon (WSOC), representing the major fraction of organic aerosols. Radiocarbon based source apportionment shows that WSOC was of non-fossil (WSOCnf) origin before 1850, with concentrations of about 75 ± 18 ppb. Anthropogenic fossil fuel input to WSOC (WSOCf) has increased since 1850 and reached non-fossil levels in the period 1960-1975. In contrast to WSOCf, WSOCnf decreased from 97 ppb in the 1870s to 44 ppb in the 1940s, after which it raised again to pre-industrial levels around 1970 and continued to increase until 1990. Our record suggests that fossil fuel emissions have significantly modified the organic aerosol since the 1850s, despite the fact that the non-fossil fraction dominated over the whole period. The overall increase of WSOCnf after 1940 is most likely related to enhanced biogenic emissions driven by the temperature increase, while the decrease after 1890 is so far unexplained.