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Seasonal variations of the water soluble organic carbon mass fraction of aerosol in two valleys of the French Alps

J.-L. Jaffrezo¹, G. Aymoz¹, C. Delaval¹, and J. Cozic^{1,*}¹Laboratoire de Glaciologie et Géophysique de l'Environnement (LGGE), 54 rue Molière, 38 402 Saint Martin d'Hères Cedex, France

*now at: Laboratory for Atmospheric Chemistry, Paul Scherrer Institute, 5232 Villigen, PSI, Switzerland

Abstract. Concentrations of Water Soluble Organic Carbon (WSOC) and WSOC fraction to Organic Carbon (OC) were measured at two urban sites in valleys of the French Alps during a period of two and a half years.

Concentrations were as high as 10–15 µg C/m³ in winter, but there is a clear seasonal cycle of the WSOC fraction, with minima occurring during winter. This reflects a marked dependency on temperature, with the average WSOC fraction being stable at 54.8±7.7% and 75.9±6.3% for temperatures in the ranges –10 to +3°C and 12 to 24°C, respectively. Several points are noteworthy in this evolution. First, there are limiting factors that prevent lower mass fractions in the low temperature range and higher mass fractions in the high temperature range. Second, the mass fraction at the lower temperature is rather high, in apparent contradiction with OC being mainly insoluble close to the emission sources. Third, the range of 20% for the change of the WSOC fraction between these extreme conditions is indeed rather narrow when compared to evaluations of the secondary (and supposedly water soluble) OC fraction proposed in the literature, with most of the published values being in the range 40 to 70%. A comparison of the evolution of WSOC concentrations with that of dicarboxylic acids (DCA) clearly indicates the influence of two regimes in the formation of WSOC: one at higher temperatures classically linked with the increase of DCA concentrations and associated with oxidation processes, and another at lower temperatures involving a much lower increase of DCA concentrations. We proposed several hypotheses involving processes that could be responsible for the large concentrations of WSOC in the particulate phase at our sites during winter time.

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