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Variability of NMHC sources at two high altitude GAW background sites in Germany

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Volatile organic compounds play a crucial role in the chemistry of the lower troposphere and the formation of ozone as well as in the OH-radical budget. Thus, a twelve year (1998 – 2009) and a ten year dataset (1999 – 2008) of measurements of 29 and 21 volatile C_2 – C_8 hydrocarbons, respectively, performed at the Meteorological Observatory Hohenpeißenberg (MOHp) and the Environmental Research Station Schneefernerhaus (UFS), were analyzed. Both sites are located in the northern Alpine region at an altitude of 1000 m a.s.l. (MOHp) and 2650 m a.s.l. (UFS) and part of the Global Atmosphere Watch program (GAW) of the WMO. The sites are exposed intermittently to air masses from the free troposphere or the polluted planetary boundary layer. The sample times at the UFS were selected to ensure the monitoring of mixing ratios associated with the European atmospheric background levels. Receptor modeling was performed at both sites by positive matrix factorization (PMF) following the method of Sauvage et al. (2009) accounting for transport and photochemical processing effects at background sites.

At both sites a number of seven main source categories of industrial, mobile, and biogenic emissions were identified. Some factors, e.g. aged combustion, solvents, and vehicular exhaust, show high resemblance at both sites. The most prevalent factors at the UFS in the order of mass contribution were aged combustion, solvents, and liquefied petroleum gas (LPG) while at the MOHp aged air from natural gas sources, aged combustion, and LPG showed the highest fraction. The aged combustion and the solvent sources exhibit a similar composition and seasonal behavior compared to source categories found by Lanz et al. (2009) for the Swiss site Jungfraujoch despite the fact that not exactly the same set of compounds had been investigated. With the exception of the biogenic source with summer maxima consisting mainly of isoprene, all other categories show maxima in the winter or early spring. The seasonal differences in the mixing ratios are in parts due to the seasonal variability of hydroxyl radical concentrations in the atmosphere and very different meteorological conditions in winter and summer that influence the atmospheric transport and vertical mixing of NMHCs. The strong enhancement of mixing ratios of LPG at the UFS at times might be linked to seasonally variable storage of LPG on the Zugspitze summit, but further analysis of the data is necessary for a more specific conclusion. The impact of local tourist activities in particular during the summer and winter seasons on the variation of different factors is still subject to further investigation.

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