Halogenated Trace Gases and Volatile Organic Compounds at the Global Atmospheric Watch Observatory Schneefernerhaus/Zugspitze, Germany

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Halocarbons and hydrocarbons (C_2 - C_8) are being monitored at the German Global Atmosphere Watch (GAW) Global Station Zugspitze/Hohenpeissenberg (2670 m a.s.l.), Germany. At the summit, atmospheric chemical measurements have been performed since the late 1970's. In 1998, measurements for the United Nation's GAW program moved to the environmental research station Schneefernerhaus, 300 m below the summit, where they support the study of greenhouse gases, reactive gases and aerosols. In 2013, an automated, remotely controlled gas chromatography/mass spectrometry (GC/MS) analytical system was installed for the monitoring of chlorofluorocarbon and other halocarbon trace gases. Monitoring of volatile organic compounds was added in 2015. Ambient samples are taken daily at 2:00 am local time, followed by measurements of a standard and zero air. 2.8-liter samples are dried to a dew point of -45°C and pre-concentrated onto an adsorbent trap of CarboxenÒ 1000 and 1016 at -40°C. Samples are then injected onto the GC column by flash heating the trap. Over 70 compounds are identified and routinely monitored; of these, 53 are quantified based on availability of standards. These include compounds regulated by the Montreal Protocol, such as CFC-11, CFC-12, carbon tetrachloride, HCFC-22, HFC-134a, and HFC-152a. Monitored volatile organic compounds include C_2-C_6 alkanes, alkenes, benzene, toluene, and o-xylene. Quantified results of selected compounds will be compared to the results from Advanced Global Atmospheric Gases Experiment (AGAGE) measurements, in particular those from the nearby Jungfraujoch, Switzerland.

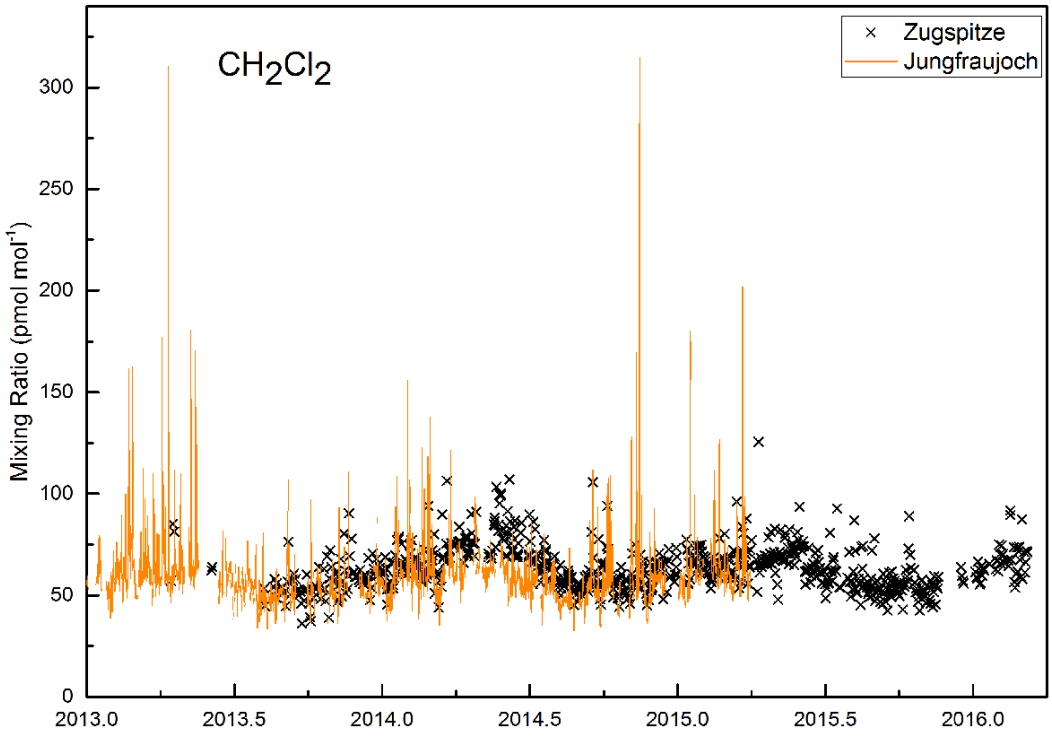

Figure 1. Ambient mixing ratio of dichloromethane (CH_2Cl_2) measured at Zugspitze from 2013 to early 2016. The results from AGAGE measurements at Jungfraujoch station are plotted for comparison (Jungfraujoch data, http://agage.eas.gatech.edu/data_archive/agage/gc-ms-medusa/complete/jungfraujoch/, curtesy of Martin Vollmer and Stefan Reimann).