



Long-term observations of reactive gases at the puy de Dôme (PUY Global GAW) station (France, 1465 m a.s.l.)

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The puy de Dôme (pdD) altitude research station is located in the centre of France (45° 46' N, 2° 57' E, 1465 m altitude a.s.l), 16 km from the town of Clermont-Ferrand. This station is a global GAW station (PUY), and is part of the ACTRIS-2 integrating activities (H2020). Long series of meteorological parameters such as wind speed and direction, temperature, pressure, relative humidity and radiation, atmospheric trace gases (O₃, NO_x, SO₂, CO₂, CO), and physical, optical and chemical properties of aerosols (particle size, black carbon, mass,..) are available.

Cartridge sampling measurements are performed to link the observations of volatile organic compounds (VOCs) within ACTRIS and GAW. A selection of VOCs, including a large set of non-methane hydrocarbons and some terpenes (isoprene, α -pinene), was measured during summer 2010, spring and summer 2011, winter 2012, summer and winter 2013, summer 2015, and twice a week in 2017, 2018 and 2019. The analysis of VOCs collected off-line on Tenax/Carbosieve III or Tenax TA cartridges was carried out using gas chromatography coupled with thermo-desorption with mass spectrometry (GC-MS).

In August 2018, a new gas chromatography (GC-FID) system was installed at the station. It allows the acquisition of non-methane hydrocarbons (C₅-C₁₀) with a temporal resolution of two hours.

The reactive gas measurement series are analysed in terms of observed levels (i), diurnal and seasonal variability (ii), air mass origins (iii) and sources of these gaseous pollutants (iv).

(i) The level observed at the PUY station is discussed and compared with two other stations: Monte Cimone (mainly in the free troposphere) and Hohenpeissenberg (mainly in the planetary boundary layer PBL).

(ii) As the height of the PBL changes with a diurnal cycle and with the seasons, the PUY station is in the different layers of the troposphere during the year impacting the measured concentrations.

(iii) In order to determine the transport pathways of the air masses before their arrival at the pdD site, the HYSPLIT (Hybrid Single Particle Lagrangian Trajectory) model was used. Trajectories were classified according to their predominant transport direction prior to measurement, either

continental (C), marine (M), modified marine (Mod), Mediterranean (Med), or mixed according to their trajectories. In order to determine the influence of wind direction, the pollution wind rose was determined for the main pollutants.

(iv) Comparison with temperature, air mass origins, boundary layer height are used to identify the main parameters influencing the variability of VOCs. The Principal Component Analysis (PCA) has been performed to deduce correlations between the main atmospheric species and their main determinants.