

HCN emissions from the explosive volcanic eruption of Mt. Pinatubo, Philippines, in June 1991

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In June 1991, Mt. Pinatubo explosively erupted magma and overlying rock, with ejecta reaching stratospheric altitudes. The sulphate aerosol burden resulting from the 1991 eruption was still measurable in 1992 and its complete removal took 5-6 years. Here we present new analyses of measurements by the ATMOS instrument on the Atlas-1 Space Shuttle mission and the MkIV balloon interferometer in 1992 that show about 40-50 ppt of unexpected excess HCN in the middle stratosphere. HCN has no stratospheric sources and a lifetime of several years. Multi-year runs with the GEOS-Chem Chemistry-Transport model have been performed in order to derive the most plausible HCN injection amounts. The overall structure of the modeled HCN agrees reasonably well with observations by MkIV and ATMOS. The current best estimate is an emission of about 6 kt of HCN into the stratosphere at an altitude of about 23 km. This compares to a total gas emission in the order of 70-700 Mt, based on an emission of 14 Mt SO₂ and an SO₂/total gas ratio of 2% - 20%. We will discuss possible sources and formation mechanisms of the HCN. These include abiotic formation during or prior to the eruption and may involve HCN accumulated in the subaerial volcanic-hydrothermal system of Mt. Pinatubo. We present results from thermochemical equilibrium calculations as well as photochemical plume modeling in order to provide plausibility constraints on the source of the HCN.