Measurements of Total Gaseous and Particulate Mercury in Mexico City During the MCMA-2006/MILAGRO Campaign

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Abstract

Mercury, a highly toxic chemical with a complex biogeochemical cycle, is widely distributed and can be found in gaseous and aqueous phases as well as particulate matter. According to the preliminary atmospheric emissions inventory of Hg in Mexico (1999 base), around 31 tons /year are emitted of which approximately 67/% are from gold/Hg mining and refining, followed by 16/% from chlor-alkali plants. TGM levels in two pristine environments in Mexico have been reported to be less than 2.5 $ng.m^{-3}$, while for urban sites in Mexico City a wider range has been found between 1.5 to 108 $ng.m^{-3}$.

Continuous mercury measurements were carried out within the Mexico City Metropolitan Area (MCMA) during the MCMA-2006/MILAGRO Campaign. Total gaseous mercury (TGM) was determined at two sites, and mercury in the particulate phase was determined at five sites.

TGM measurements were done in two supersites: the Northern (T0) and Northeastern (T1) parts of the Metropolitan area, using continuous Ultra-Trace Mercury Vapour Analyzers (Tekran Model 2537A) from March 1 until March 31 with a sampling resolution of 2 hours and 5 minutes, respectively. During two days, both analyzers were run with a 5 minute time resolution at T0 for inter-comparison showing a good correlation ($R^2 = 0.88$). A comparison with previous TGM measurements in Mexico City is also presented.

Particles were collected using Andersen and Wedding Hi-Vol samplers at T0, T1, at CENICA (in Southeastern Mexico City), at UNAM (in Southern Mexico), and at the Biznaga Ranch (T2) supersite, a semi-rural area located at the north east of T1. Particles chemical speciation included: Hg and other elements by ICP-MS; ions by ion chromatography; and total, elemental and organic carbon using thermal optical reflectance. In this work, only Hg analyses are reported, elemental composition is discussed elsewhere. Some samples were also analyzed for morphology and elemental analysis using electron microscopy with EDS.

Except for the UNAM and T2 sites, Hg in particles correlated with industrial elements possibly associated with the metal smelting industry, such as Pb, Zn, Cu, Cd, and As. Two episodes of possible regional transport of particles between T0, CENICA and T1, on the 3rd and 17th of March, were identified.

Lagrangian, stochastic, back-trajectories were simulated using FLEXPART together with mesoscale meteorological simulations from MM5 for T0 and T1 sites. Based on these, an analysis of TGM, Hg in particles and criteria pollutants is presented to identify potential sources of mercury emissions.