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Air-biosphere exchange of elemental mercury determined with micrometeorological methods

J. Fritsche (1), M. Zeeman (2), D. Obrist (3), C. Alewell (1)

(1) Institute of Environmental Geosciences, University of Basel, Switzerland, (2) Institute of Plant Science, ETH Zurich, Switzerland, (3) Division of Atmospheric Sciences, Desert Research Institute, Reno, NV, USA (johannes.fritsche@unibas.ch / Phone: +41-61-2670483)

Various species of mercury have the power to bioaccumulate to levels toxic for humans. Elemental mercury (Hg^0) which represents about 99% of atmospheric mercury is, due to its high volatility, dispersed globally and eventually deposited to land and sea. Mercury exchange measurements have been strongly focused on polluted sites and arctic regions, where the ocean is near and fish consumption high. In contrast, uncontaminated, continental regions haven't received much attention and respective studies have been, for the most part, limited to flux chamber measurements. To obtain a comprehensive picture of elemental mercury exchange of background areas we performed measurements at a sub-alpine grassland site in central Switzerland and determined fluxes over an entire year with micrometeorological methods. We equipped our field site with a Tekran 2537A mercury vapour analyser and a LI-COR 6262 to determine Hg^0 and CO_2 profiles of five measurement heights. Elemental mercury fluxes were calculated by both, the flux gradient method and the modified Bowen ratio. In order to verify our procedure we also calculated CO_2 exchange rates with the flux gradient method and compared the results with the fluxes determined by eddy covariance (EC). It proofed to be extremely challenging to extract acceptable Hg^0-gradients in face of the low atmospheric concentrations of 1.5 ng/m^3. Carbon dioxide fluxes determined with the gradient method matched quite well the EC CO_2 values, which gave us confidence in the procedure applied. However, calculated Hg^0 fluxes were too small and spread too wide to deduce any clear deposition or emission pattern.