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Distribution and air-sea exchange of mercury (Hg) in polluted marine environments

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Mercury (Hg) is emitted in the atmosphere by anthropogenic and natural sources, these last accounting for one third of the total emissions. Since the pre-industrial age, the atmospheric deposition of mercury have increased notably, while ocean emissions have doubled owing to the re-emission of anthropogenic mercury. Exchange between the atmosphere and ocean plays an important role in cycling and transport of mercury. We present the preliminary results from a study on the distribution and evasion flux of mercury at the atmosphere/sea interface in the Augusta basin (SE Sicily, southern Italy), a semi-enclosed marine area affected by a high degree of contamination (heavy metals and PHA) due to the oil refineries placed inside its commercial harbor. It seems that the intense industrial activity of the past have lead to an high Hg pollution in the bottom sediments of the basin, whose concentrations are far from the background mercury value found in most of the Sicily Strait sediments. The release of mercury into the harbor seawater and its dispersion by diffusion from sediments to the surface, make the Augusta basin a potential supplier of mercury both to the Mediterranean Sea and the atmosphere. Based on these considerations, mercury concentration and flux at the air-sea interface of the Bay have been estimated using a real-time atomic adsorption spectrometer ($LUMEX - RA915^{+}$) and an home-made accumulation chamber, respectively. Estimated Total Atmospheric Mercury (TGM) concentrations during the cruise on the bay were in the range of 1-3 $ng \cdot m^{-3}$, with a mean value of about 1.4 $ng \cdot m^{-3}$. These data well fit with the background Hg_{atm} concentration values detected on the land (1-2 $ng \cdot m^{-3}$, this work), and, more in general, with the background atmospheric TGM levels found in the North Hemisphere (1.5-1.7 $ng \cdot m^{-3}$)[a]. Besides, our measurements are in the range of those reported for other important polluted marine areas. The mercury evasion flux at the air-sea interface measured during the first cruise ranges from about 110 to 1500 $ng \cdot m^{-2} day^{-1}$. This range is 1-2 order of magnitude higher than most of marine environments (Pacific Ocean, Mediterranean Sea, Artic Ocean) and some important polluted marine areas, such as the Tokyo Bay (19-259 $ng \cdot m^{-2} day^{-1}$)[b] and the Yellow Sea (156-722 $ng \cdot m^{-2} day^{-1}$)[c]. Further estimates on Hg atmospheric deposition flux (wet and dry) and biomonitoring are required for finally assessing a mass balance of Hg in Augusta basin.

[a]Lindberg et al., 2007. A Journal of the Human Environment, 3, 19-33. [b]Narukawa et al., 2006. Journal of Oceanography, 62, 249-257. [c]Ci et al., 2011. Atmosphere Chemistry and Physics, 11, 2881-2892.