

Mercury is an element present in the earth crust as well as a component in the atmosphere. During centuries mercury has been released by natural sources, e.g. volcanic eruptions, evasion from water surfaces and degassing from soil. However, during the industrial revolution the anthropogenic emissions of mercury increased drastically. Today, mercury is considered to be a global pollutant, affecting our environment and living species.

Monitoring of some airborne mercury species has been carried out for several years and the understanding of the cycling of mercury has increased. However, the mercury species in the oceans are more challenging to investigate and the available data is limited.

In this thesis measurement of dissolved gaseous mercury (DGM) in surface waters and calculations of gas-exchange between the oceanic surface and the atmosphere are presented. The investigations have been conducted at several locations in the northern hemisphere i.e. the Mediterranean Sea, the North Atlantic Ocean and the Arctic Ocean. These measurements contribute to increase the understanding of transport of volatile mercury, which is an important part of the overall assessment of the biogeochemical cycle of mercury.

In order to perform gas-exchange estimations of volatile mercury, knowledge of the DGM concentration in water, total gaseous mercury (TGM) concentration in air, wind speed, water temperature and the Henry's Law constant (k_H) are needed. TGM, wind speed and water temperature can be measured continuously and at high time resolution. However, for DGM measurements no such system has earlier been available, therefore a continuous system for high time resolution DGM measurements was developed during this work. The values for the k_H were not in agreement in previously published investigations, thus a re-determination of the constant was needed and is presented in this thesis.

Several expeditions were undertaken at the Mediterranean Sea to conduct measurements. Using data from these expeditions an annual evasion of 77 ton was estimated. Results from the expedition carried out in the North Atlantic and Arctic Oceans show that the concentrations of DGM are up to 10 times higher in the Arctic Ocean than in the North Atlantic Ocean. This finding suggests that mercury is accumulated in the Arctic Ocean. Furthermore, the measurements from the Arctic Ocean indicate that the sea ice may act as a barrier and prevent volatile mercury from evading from the sea surface.

Keywords: Mercury, dissolved gaseous mercury, elemental mercury, evasion, flux, Mediterranean Sea, North Atlantic Ocean, Arctic Ocean, accumulation, *in-situ* measurements, on-line measurements