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Modelling of mercury evasion in the Mediterranean Sea

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A comparison of evasion computation is given for the Mediterranean Sea in its entirety, conducted in the frame of the EU project MERCYMS, and the Gulf of Trieste, Northern Adriatic, where the River Soča brings about 1500 kg/ yr of mercury from a former mercury mine region in Idrija, Slovenia. On the basis of measurements and modelling results new annual mercury mass balances for both domains were calculated.

The quantity of mercury evasion from the Gulf of Trieste was calculated using two different principles. In both cases Wanninkhof's model was used as suggested by Gårdfeldt et al. (2003). As the Gulf covers a relatively small area of about 600 km^2, uniform wind was supposed over the whole Gulf. Both principles took into account hourly measurements of wind that were available for a typical year (1989). The first approach used ranges of wind-speed and corresponding seawater temperature as well as measured Hg concentrations in water and air throughout each season. Evasion was calculated for each wind range of each season and the quantities were summed for the entire year. Calculated in this way the quantity of outgoing Hg was about 130 kg/yr. In the second approach a 3D baroclinic hydrodynamic and transport / dispersion model PCFLOW3D (Rajar et al., 2000, 2004) upgraded with a biogeochemical Hg module was used. Seasonal circulation, transport and transformations of Hg were calculated and real-time wind data was used to calculate the evasion. The calculated evasion was about 75 kg/yr.

Similar approaches were used with the entire Mediterranean. The evasion calculation from measurements of Hg concentrations, water temperature and wind performed in the frame of the MERCYMS project by use of different gas exchange models (Liss and Merlivat 1986, Wanninkhof 1992, Wanninkhof and McGillis 1999, Nightingale et al., 2000) is described by Andersson et al. (2006). The calculated quantity of Hg evasion was about 75 t/yr. The modelling approach used a combined modelling tool: the PCFLOW3D model for the water compartment and the RAMS-Hg model (Kallos et al., 2001) for the atmospheric transport, transformations and deposition of Hg. Real-time meteorological data for the whole computational domain were not available, thus we used extrapolated wind fields form the RAMS model. The calculated mercury evasion was about 50 t/yr.

As at least in the case of the entire Mediterranean evasion represents the most significant sink of Hg (Rajar et al., in press), it is very important to correctly evaluate the amount of outgoing Hg. Further upgrades of the modelling tools and input data are necessary, as the difference between calculated values from measurements and modelled quantities is more than 50 %. Andersson et al. (2006) suggested that Nightingale's model could be the most appropriate tool to calculate Hg evasion. Therefore, the PCFLOW3D model is being upgraded with other gas exchange models. Another improvement represents the use of real-time meteorological data, provided by IASA (University of Athens; http://forecast.uoa.gr/mfstep/). High resolution measurements of wind-speed and water temperature are not available, thus the data from meteorological forecasts will be used for further calculations.

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References:

Andersson, M., Gardfeldt, K., Wangberg, I., Sprovieri, F., Pirrone, N., Lindquist, O., (2006). Evasion of mercury from the Mediterranean Sea. In: Eight International Conference on Mercury as a Global Pollutant, Madison, Wisconsin, August 6-11, 2006. Abstract. [Lanchaster]: DEStech Publications, 2006, p 53.

Gardfeldt, K., Sommar, J., Ferrara, R., Ceccarini, C., Lanzillotta, E., Munthe, J., Wangberg, I., Lindqvist, O., Pirrone, N., Sprovieri, F., Pesenti, E. and Stromberg, D. (2003). Evasion of mercury from coastal and open waters of the Atlantic Ocean and the Mediterranean Sea, *Atmospheric Environment 37 Supplement No. 1 (2003) S73–S84.*

Kallos, G., Voudouri, A., Pytharoulis, I. and Kakaliagou, O. (2001). Modelling Framework for Atmospheric Mercury over the Mediterranean Region: Model Development and Applications. In ICLSSC, LNSC 2179;. Eds.; S. Margenov, J. Wasniewski and P. Yalamov. Springer-Verlag Berlin Heidelberg, 281–290.

Rajar, R., Žagar, D., Širca, A. Horvat, M. (2000). “Three-dimensional modelling of mercury cycling in the Gulf of Trieste”, *The Science of the Total Environment 260, pp. 109-123.*

Rajar, R., Žagar, D., Četina, M., Akagi, H., Yano, S., Tomiyasu, T. Horvat M. (2004). Application of three-dimensional mercury cycling model to coastal seas, *Ecological Modelling 171*, *pp. 139-155.*

Rajar R., Četina M., Horvat, M., Žagar, D. (in press). Mass balance of mercury in the Mediterranean Sea. Marine Chemistry. doi: 10.1016/j.marchem.2006.10.001.