Use of software tool AMBER for modelling of Hg geochemical cycle in Soča River estuary

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Abstract: AMBER is a flexible software tool that allows the user to build their own dynamic compartment models to represent the migration and fate of contaminants in a system, for example in the water surface and sub-surface environment. The model considers three main forms of mercury that can be found in fresh and seawater environments (e.g., Hg^0, Hg^{2+}, and MeHg). Model was applied for Soča River estuary.

Key words: AMBER, modelling, geochemical cycle, Soča River estuary

INTRODUCTION

Some recent studies (FAGANELI ET AL., 2001; COVELLI ET AL., this issue; KOTNIK ET AL., this issue) have shown that Soča River even today after 10 years of closure of the Hg mine continues to supply high quantities of Hg the Gulf of Trieste. Recent estimates of the Hg mass balance in the Gulf of Trieste has shown that the annual Hg input through Soča river discharge is about one ton and a half (HORVAT ET AL., 1999). AMBER Hg mass balance model developed for freshwater lake (KOTNIK ET AL., 2000) was applied for Soča River estuary.

AMBER is a software tool that allows the user to build their own dynamic compartment models. Contaminants in solid, liquid and gas phases can be considered. In AMBER the materials of interest, referred to as contaminants, are assumed to be uniformly mixed in a series of compartments between which transfers can take place. Environmental compartments within and external to the aquatic system (such as air, water and sediment) were included. Outside (terrestrial and atmospheric) conditions were considered as boundary conditions that can change with time. Groundwater interactions were not considered since there is no or very little ground-

Figure 1. Sampling locations in Soča river estuary.

water inflow into the Gulf of Trieste and Soča river estuary. Abiotic compartments within the aquatic system include water and suspended solids.

RESULTS AND DISCUSSION

Data used for modeling purposes have been obtained during three sampling campaigns performed in 2002 and from literature. (COVELLI ET AL., this issue; COVELLI ET AL., 1999). Sampling locations in Soča river estuary are shown in Figure 1.

As the model is detailed presented elsewhere (KOTNIK ET AL., 2002), only short summary will be presented here. Mercury can be present in seawater in the dissolved form or bound to particulate matter. The model considers three main mercury forms that can be found in sea or fresh-water environments (e.g., Hg^0, Hg^{2+}, and MeHg). Hg^{2+} is dominant in water and in sediment, MeHg is the main form in aquatic organisms, and elemental mercury is the primary atmospheric species.

Environmental compartments within and external to the aquatic system (such as air, water and sediment) were included. Outside (terrestrial and atmospheric) conditions were considered as boundary conditions that can change with time. Groundwater interactions were not considered. Abiotic compartments within the aquatic system include water and suspended solids. The Hg geochemical cy-

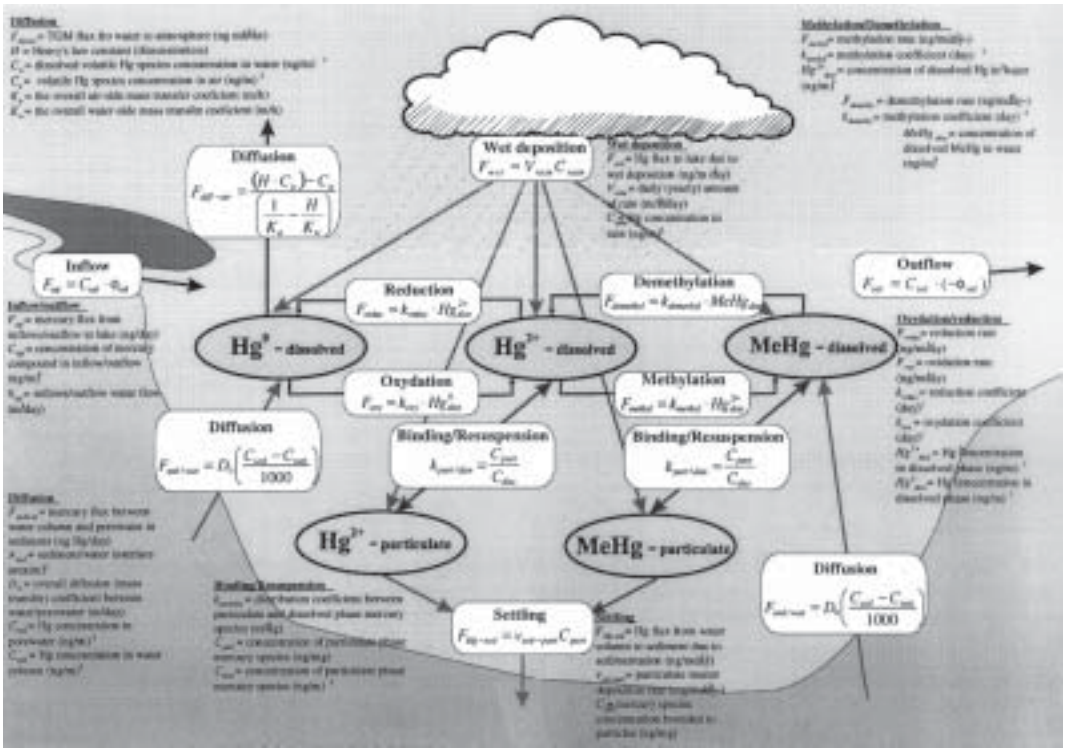

Figure 2. Conceptual diagram of the Gulf of Trieste and Soča River estuary mercury cycling model.

cling model for Soča River estuary simulate inflows, outflow, wet deposition from the atmosphere, volatilisation, sedimentation, and diffusion from/into the sediment. The model does not include uptake and interactions of different Hg species within the biocycle. The main reactions and transformations in freshwater systems assumed in the model are shown on Figure 2.

An example of modelling results for Hg inflow and Hg evaporation from Soča River estuary is given on Figure 3.

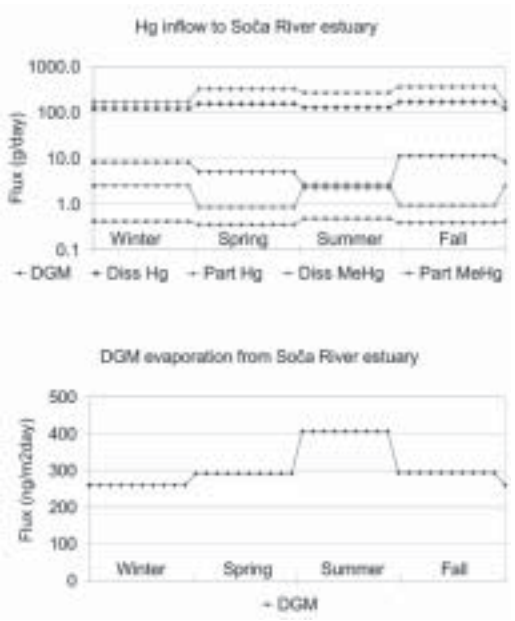

Figure 3. An example of modelling results performed by software tool AMBER.

CONCLUSIONS

AMBER is a simple software tool that allows the user simple and fast building of them own box models for different contaminants including Hg. Although simulated processes shows reasonable values, results must be regarded with caution. Model was not verified for this case. There is a large degree of uncertainty associated with the assumed transfer rates that are included into the model. Some processes and compartments such are resuspension and erosion and interaction of geochemistry with biota and other compartments should be included into a model in the future. However, AMBER offers the user quick and simple building of simple Hg mass balance models appropriate for simple and first estimation of certain processes that take place in aquatic environment.

Acknowledgement

We acknowledge the financial support of Ministry for Education, Science and Sport in the frame of the project Z2-3502-0106 and EU in the frame of EuroCat/IdriCat project.

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