Project Structure

Two hierarchical levels will be investigated: mezo level (operationally defined by the scale relevant for processes involving the soil â€“ individual plant systems), and macro level (operationally defined by the scale relevant for processes involving plant communities). The sites investigated will at Pantelimon (figure 1) and Braila (Fundu Mare Island, Danube floodplain). This pair of sites is useful for the project because: 1) the systems identification, a precondition for mathematical modeling was already done in previous projects, 2) the sites are different in terms of contamination, 3) the sites are different in terms of hydrological regimen, and 4) we already have an image on the background values of the metals and some of their control parameters. Cocerning point 4) one should notice that it was not possible by now to obtain the intensive data sets needed for modelling the biogeochemical cycles because of the financial constraints of the past projects. Consequently the production of these high quality data sets will be the target of this project. The activities will be grouped under the three objectives as described in the Gant-Pert diagram (table 1). Table 1 Gant-Pert diagram of project. The arrows show the relationships between the activities of the project. Dotted arrows indicate that a continuous transfer of information takes place starting from the moment where the arrows originateÂ

Â The design of the lysemeters experiment will follow the solution invented by McLarren (personal communication, figure 2). However, the set of parameters measured in the soil and groundwater will be different from those of McLarren, who used the experiments for the assessment of sludge ammendments on the quality of the leachate at the time scale of decades. What we intend to manipulate are the redox conditions, the quality and quantity of organic carbon, pH, and the quantity and forms of sulphur macronutrients (N, P, as we intend to look for the interactions between the soil biogeochemical processes specific to metals, N, P and S, especially at the level of the forms associated to the particulate and dissolved organic carbon). The experimental soil will be sampled undisturbed from the the two investigate landscapes and the lysimeters will be equiped with redox, pH, humity and ion probes at different soil depths, as well as with devices allowing the differential sampling of the percolated water at different depths. The basic parameters will be monitored using data loggers. In the first year only leachate and plants will be sampled. The water will be analysed for metals and a cluaster of physical and chemical control parameters potentially involved in the mobility of metals. The plants will be analysed by tissue for the metals content, macronutrients and a set of biochemical parameters reflecting the physiological status and the oxidative stress (Neagoe et al. 2007). The soil will be sampled distructively in the third year of the project and analysed by depth for an extended cluster of parameters including metals forms (by sequential extractions).

Â Figure 1 Overview of the Pantelimon area (left; satelite image and digital terrain model showing the location of the pollution source; colours in the DTM indicate an increase in altitude, from blue to orange; one can remark the presence of the drainage areas.) and of the location of the Fundu Mare Island in the Danube floodplain at Braila (right); H indicates the island.

Â Figure 2 Image of the lysemeters design that we will use in the project (with permission of R. G. McLarren, Lincoln University, New Zealand). The design of the field study will follow and extend the methods prezented by Iordache (2003). The main improvements will be the use of data loggers for in situ monitoring of several physical, physico-chemical and chemical parameters of the soil, the estimation of atmosferic deposition of metals the continuous monitoring of hydrological and climatic parameters by in situ station with data loggers , and the extension of chemical and biochemical parameters measured on the soil, undeground water, surface water and plant samples. As suggested in figure 3, the dataset produced as a result of the experiments will be characterized by a higher number of parameters, but a lower variability of parameters values, while the dataset produced from the field study will consist in a lower number of parameters but with much higher variability of values due to the natural space-time heterogeneity. These data sets with different characteristics will be used for the production of mathematical models following the scheme pictured in figure 3. In order to set up the nonlinear correlation model we will use the software MATLAB with the needed modules, and the software MARS. The models developed based on the experimental data will be extrapolated at field scale by a soft programmed in GIS and using maps of the basic control parameters distribution and eventually modular submodels of derived control parameters such as the redox potential in soil. The results obtained after the extrapolation will allow us to check the nonlinear correlation obtained from field data, and, to the extent that the fit between the two approaches will be good, to point out some of the mechanisms underlying the field correlations. A variety of other inter-comparisons between the models will be performed, as described in figure 3. The overall result will be a coherentised portfolio of models used finally for the simulation of metals mobility in different ecosystems types and degrees of metals contamination and under different scenarios of climatic changes.Once the above elements known, and taking into consideration the competences of the team members, as well as the existing facilities, we can say that from the costs point of view the risks are minimum. From a conceptual point of view the main unknown issue is whether the extrapolation of the experimental patterns at the site scale using intermediary models developed in GIS will produce or no the macro patterns of the field data. Anyway this issue can be regarded rather as a research hypotheses, namely that the top-down and bottom-up approaches will lead to results, if not similar, at least interpretable complementary, and thus to a refinement of the final portfolio of models.

Figure 3 Diagram showing the detailed structure of the modeling approach in the project.

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