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Updated module of radionuclide hydrological dispersion of the Decision Support System RODOS

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The real-time on-line decision support system JRODOS for off-site emergency management of nuclear accidents is being developed under the auspices of the European Commission's RTD Framework programs since 1992. The system has been reengineered in the last decade as multiplatform software system in a Java environment. The Hydrological Dispersion Module (HDM) of JRODOS includes a chain of models describing the dynamics of radionuclides in rivers and reservoirs after wash-off (RETRACE_R model) of the radionuclide deposition from the watersheds to the river network. This HDM was also revised by integration of two models. RIVTOX_SV, a one dimensional model of river hydrodynamics, sediment and radionuclide transport is based on the equations and numerical algorithms that allows to calculated distributed river networks.

Modeling of the open water flow in multi-connected river networks based on numerical solution of the full 1D Saint Venant equations or its diffusive wave approximation. Now RIVTOX_SV provides user's choice between the Preissmann difference scheme and a central-upwind scheme for numerical solution of the Saint Venant equations, and positivity-preserving difference scheme for numerical solution of the diffusive wave equations. One of the disadvantages of the Preissmann scheme, unlike the central-upwind scheme, is that it does not provide positivity preserving of a numerical solution and therefore it cannot be applied to simulate water flow in drying channels.

The second model, the two dimensional model for shallow reservoirs and river floodplains COASTOX-UN demonstrates good computational performance due to the implementation of the unstructured mesh finite volume scheme and MPI (Message Passing Interface) parallelization.

The software architecture of JRODOS effectively organizes the dataflow between different sources and recipients (e.g. databases, numerical models, user interface etc.) via unified data objects. These objects (data items) are organized in an expandable hierarchal tree of Java-classes using benefits of object-oriented programming principles. Numerical model integration are carried out by distributed wrapper objects (DWO), which provides logical, visual and technical integration of computational models and the system core. The DWO technology supports a variety levels of interactivity, required by different computational models (including pull- and push driven chains, user interaction support, sub-models calls). Consequently, the updated models of the HDM were integrated into JRODOS on the basis of DWO technologies.

The updated model chain has been tested versus hydrological and radioactive contamination data for the multi-connected Pripyat-Dnieper river, including Chernobyl exclusion zone, and for lower part of the Danube river.