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Flexible Java based platform for integration of models and datasets in Earth Systems Science Prediction Systems: methodology and implementation for predicting spreading of radioactive contamination from accidents

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An important aspect of an Earth Systems Science Prediction Systems (ESSPS) is to describe and predict the behavior of contaminants in different environmental compartments following severe accidents at chemical and nuclear installations. Such an ESSPS could be designed as a platform allowing to integrate models describing atmospheric, hydrological, oceanographic processes, physical-chemical transformation of the pollutants in the environment, contamination of food chain, and finally the overall exposure of the population with harmful substances. Such a chain of connected simulation models needed to describe the consequences of severe accidents in the different phases of an emergency should use different input data ranging from real-time online meteorological to long-term numerical weather prediction or ocean data.

One example of an ESSPS is the Decision Support Systems JRODOS for off-site emergency management after nuclear emergencies. It integrates many different simulation models, real-time monitoring, regional GIS information, source term databases, and geospatial data for population and environmental characteristics.

The development of the system started in 1992 supported by European Commission's RTD Framework programs. Attracting more and more end users, the technical basis of the system had to be considerably improved. For this, Java has been selected as a high level software language suitable for development of distributed cross-platform enterprise quality applications. From the other hand, a great deal of scientific computational software is available only as C/C++/FORTRAN packages. Moreover, it is a common scenario when some outputs of model A should act as inputs of model B, but the two models do not share common exchange containers and/or are written in different programming languages.

To combine the flexibility of Java language and the speed and availability of scientific codes, and to be able to connect different computational codes into one chain of models, the notion of distributed wrapper objects (DWO) has been introduced. DWO provides logical, visual and technical means for the integration of computational models into the core of the system system, even if models and the system use different programming languages. The DWO technology allows various levels of interactivity including pull- and push driven chains, user interaction support, and sub-models calls. All the DWO data exchange is realized in memory and does not include IO disk operations, thus eliminating redundant reader/writer code and minimizing slow disk access. These features introduce more stability and performance of an ESSPS that is used for decision support.

The current status of the DWO realization in JRODOS is presented focusing on the added value compared to traditional integration of different simulation models into one system.