Towards modular modelling – a case study of utilizing discrete event specified systems (DEVS) to couple models of different languages and formalisms

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One of the biggest challenges in the setup of coupled models is the integration of models that have been developed in different simulation or programming languages and which use different time steps or model formalisms. One approach to deal with this problem is to use map models that are specified as discrete time specified systems (DTSS) or differential equation specified systems (DESS) to discrete event specified system (DEVS). The properties of the verifiable simulation correctness together with the straightforward mapping of the mathematical foundation of DEVS to a generic interface makes it a suitable tool for coupling heterogeneous models or simulation environments. In this contribution we present a case study of this DEVS based model coupling. A forest carbon balance model has been developed that is composed of a DTSS stand growth component model, a DESS soil carbon balance component model, and DEVS wood product carbon tracking component model. The component models have been implemented in JAVA and C++ respectively and were coupled via the Shared Abstract Model (SAM) approach and the CORBA middleware. We conclude the development of coupled models, which are composed of heterogeneous component models, in Earth system science can greatly benefit from the advances on the research of DEVS models in information science.