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Christian Neuwirth
*University of Munich (LMU)*, christian.neuwirth@lmu.de

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‘Plain-view’ earth system simulation

Christian Neuwirth*
Department of Geography, University of Munich (LMU), Germany, christian.neuwirth@lmu.de

Abstract: Hard-coded models of the earth system are typically perceived as ‘black boxes’, which are unserviceable by anyone other than those who developed the model. This constitutes a constraint to open innovation and cross-disciplinary model building. Likewise, the use of icon-based solutions is restricted by inappropriate performance on a larger spatial scale. This contribution introduces a middleware program for the synchronization of icon-based software with GIS software. Parallel programming is used to boost simulation performance. In contrast to mainstream modeling environments such as SIMILE or NOVA, spatiotemporal modeling capabilities are supported by GIS interoperability. This enables interactive spatial analyses, access to GIS data models and input of large scale spatial real-world data. Performance is illustrated through the simulation of prehistoric land use effects on global energy budgets (10000 B.C. – 2005 A.D.) using yearly temporal resolution and spatial resolution of 10km. Variations in snow and ice cover as well as positive temperature feedbacks are modeled through bidirectional interaction of platforms. A previous study revealed minor overhead attributed to platform context switch. The presented embedding of middleware into parallel structures reduces computational overhead to a reasonable level and thus enables the application to large scale systems.

Keywords: software coupling; icon-based modelling; spatio-temporal modelling; global systems