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An Interoperable Low-Code Modelling Framework for Integrated Spatial Modelling

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Modelling complex environmental systems, such as earth surface processes, requires the representation and quantification of multiple individual but connected processes. In the Smarter Targeting Erosion Control (STEC) research programme, we are looking to improve understanding of where erosion occurs, how much and what type of sediment is produced and by which processes, how sediment moves through catchments, and how erosion and sediment transport can be targeted and mitigated cost-effectively. Different research groups involved in the programme will develop different model components representing different processes. To be able to assess the impact of sediment on water quality attributes in the river and for develop effective erosion control measures, the individual models need to be integrated to a composite model.
In this paper we focus on the technical aspects and seamless integration of individual model components utilising the Basic Model Interface (BMI, Peckham et al. 2013) as interoperability standard and the extension of the LUMASS spatial modelling environment into a BMI-compliant model coupling framework. LUMASS provides a low-code visual development environment for building complex hierarchical system dynamics models that can be run in HPC environments and support sequential and parallel processing of large datasets. Each model developed in the framework can be exposed to other models and frameworks through the BMI-compliant LUMASS engine, without requiring any additional programming, thus greatly simplifying the development of interoperable model components. Here, we concentrate on the integration of BMI-compliant external model components and how they are coupled into the overall model structure.
In the STEC programme, we use LUMASS for both the implementation of model components representing individual soil erosion processes, such as landslides, earthflows, and surficial erosion and for the integration (i.e. coupling) of other (external) BMI-compliant model components into a composite model. Using available (prototype) models we will demonstrate how LUMASS' visual development environment can be used to build interoperable integrated component models with very little coding requirements.

Peckham SD, Hutton EWH, Boyana N 2013. A Component-based approach to integrated modelling in the geosciences: The design of CSDMS. Computers & Geosciences 53: 3—12.

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LUMASS: https://bitbucket.org/landcareresearch/lumass