Biome-BGC MuSo 1.2.2

Challenge: Ecosystem functioning, climate change, and the interaction between ecosystem biogeochemical cycles and the climate system are leading-edge topics in recent research projects. Computer based, state-of-the-art terrestrial ecosystem models are widely used to support these efforts. The widely known Biome-BGC model estimates the ecosystem scale storage and fluxes of energy, carbon, nitrogen and water, controlled by various physical and biological processes on a daily time-scale. Although to perform a single simulation is not a challenging task for a researcher, to carry out more elaborated workflows like model sensitivity analysis, model-data fusion or to perform extensive spatial modeling on a single desktop computer is unfeasible. Terrestrial ecosystem modeling is widely used to understand and predict ecosystem functioning and the effects of different environmental changes on growth, mortality and biogeochemical cycles of ecosystems. These models are complex and computationally demanding applications.
Biome-BGC MuSo 1.2.2 (MuSo is the abbreviation of multilayer soil module) is an extended version of Biome-BGC 4.1.1 ecosystem modelling software. The process-based Biome-BGC model is widely used to simulate the storage and flux of water, carbon, and nitrogen within the vegetation, litter, and soil of unmanaged terrestrial ecosystems. Considering herbaceous vegetation related simulations with Biome-BGC, soil moisture and growing season control on ecosystem functioning is inaccurate due to the simple soil hydrology and plant phenology representation within the model. Consequently, Biome-BGC has limited applicability in herbaceous ecosystems because (1) they are usually managed; (2) they are sensitive to soil processes, most of all hydrology; and (3) their carbon balance is closely connected with the growing season length. The aim of the development of MuSo was to improve the applicability of Biome-BGC for managed herbaceous ecosystems by implementing several new modules, including management. Modelling Multi layer soil processes and management increasing the computational requirement of the software by one magnitude, therefore running sensitivity analysis and data-model fusion is even more complicated than with the original Biome-BGC.

Solution: An integrated but flexible tool within the BioVeL consortium with the cooperation of SZTAKI is developed to resolve the computational resource problems of researchers and to provide simple and user friendly scientific workflow management solution. The BiomeBGC/ MuSo model is used as the base software in these workflows. In order to calibrate the model or to make data-model harmonization or spatially explicit simulations the model has to be executed typically thousands of times through a series of different data analysis steps. The integration of Taverna workflow management system, web services and desktop grid technology provide a powerful and sustainable service for biodiversity and ecosystem research (see Figure 5.2.3). The service is disseminated for scientific communities by the FP7 BioVel project. Researchers in the fields of ecology and climatology are the targeted user community.