3rd International Conference on Earth System Modelling
Vol. , 3ICESM-270, 2012
3rd International Conference on Earth System Modelling

Modeling soil organic matter decomposition in the R environment: opportunities and limitations for earth system modeling

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We introduce SOILR, a modeling framework to represent the process of soil organic matter decomposition implemented in the R environment for computing. This R package facilitates forward modeling of stocks and fluxes of C and its isotopes for a large variety of model structures. It allows the inclusion of environmental effects such as temperature and moisture on the decomposition process. It also includes routines for calculation of transit times for different model structures. The package is targeted to field researches to compare different hypotheses of system structure with observed data. It includes routines for inverse parameter estimation of model parameters based on observed data. For more complex analyses, it is desirable to combine SOILR with large scale global models. Currently, it is only possible to use SOILR to post-process data computed by the large scale models or to pretest models that are candidates to be implemented in large scale models. However, to investigate possible feedback loops between climate and soil it is necessary to include the soil models dynamically into the large scale models. One important obstacle for this goal is related to the technical complexity of large scale simulations, mainly due to specific issues related to supercomputers, primarily parallelization. We see two opposite ways to overcome this problem. A - rather long term - hope is that the increasing attention that is presently paid to the issue of automatic parallelization by computer scientists will make it possible to achieve comparable performance with much simpler programs. For example, purely functional programming languages are candidates to replace the hardware specific C and Fortran code. Since R is conceptually a functional language, porting or adapting to cluster specific needs of SOILR is supposed to be easy. The other - intermediate - opportunity is to produce the code to be integrated in the large scale models automatically by SOILR. We would like to discuss other options and opinions concerning platforms for model integration.