Short introduction to the use of Matlab programs for the DCESS Earth System Model (reduced version)

These programs and associated files can be used to run various model simulations with the DCESS model as presented in Shaffer, Olsen and Pedersen (2008), (referred to below as S1) except that the programs here are simplified to exclude isotope calculations. The programs and files supplied here can be used, for example, to reproduce future projections of Earth System change presented in Shaffer, Olsen and Pedersen (2009) and Shaffer (2010), (referred to below as S2)

The executable program is Thilda_R.m. In this program initial conditions are called for the pre-industrial (AD 1765) steady state presented in S1 and parameters are set that control the simulation, for instance the length of a run, the time step for integration, and the time interval for saving results (The latter two should not be changed from standard values to assure numerical stability and direct applicability of the plot programs provided). Subsequently, a particular forcing can be chosen from a list within the program, a forcing to be used to reproduce a particular simulation in one of the above publications. When executed, Thilda_R.m performs a simple time stepping of the ocean sediment module and a fourth order Runge-Kutta integration of the atmosphere, ocean, land biosphere and lithosphere modules, using the program ODE_R.m that serves to couple these modules, and writes results to an output file, OutThilda_R.mat. In the supplied files, Thilda_R.m is set to make a simulation from AD 1765 to AD 7765 for the GS2 forcing/sequestration setup (Shaffer, 2010). An output file, OutThilda_R_test.mat, is also supplied for this particular simulation.

One program is supplied for plotting a forcing chosen from a list within the program (EvolForce_R.m) and three programs are supplied for plotting model results, Evol_R.m, Prof_R.m and EvolSeq_R.m. The program Evol_R.m plots time series of a number of key model variables. The program Prof_R.m provides an animation of the evolution of ocean and ocean sediment properties as a function of time and ocean depth. The program EvolSeq_R.m plots results that can be directly compared with those in Figure 2 of S2.

All these programs have been extensively tested and should work well for Matlab version 7.0 or higher. DCESS has very limited human resources and can not provide support for users downloading these programs. However the programs are sufficiently straightforward and sufficiently well documented for users with reasonable Matlab skills to find their way through them and to adapt them for their particular applications.

References

Shaffer. G. Long term effectiveness and consequences of carbon dioxide sequestration. *Nature Geoscience* , advance online publication, June 27, 2010 (doi: 10.1038/NGEO896).

Shaffer, G., Olsen, S. M. & Pedersen, J. O. P. Presentation, calibration and validation of the low-order, DCESS Earth System model. *Geosci. Model Dev.,* **1**, 17-51 (2008).

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