

Variable soil thickness

The land surface is more complicated than the ocean surface because of its heterogeneous nature. There are variations in natural vegetation cover, lakes and other water bodies, and mountains and valleys. On top of this, humanity adds to this diversity. Humans plant crops. They also create reservoirs and divert water to irrigate their crops. They build towns and cities with variations in building size and density and landscaping.

That's the surface, but there are also variations below ground. Soil composition varies from place to place. The thickness of the soil varies spatially too. In most climate models, though, this variability in soil thickness is neglected, because there were no good estimates of the depth-to-bedrock. In 2016, we published a global estimate of this quantity in Pelletier et al. I used this dataset to implement a representation of variable soil thickness into the Community Land Model (CLM), the land model component of the Community Earth System Model (CESM). Variable soil thickness makes the soil column more realistic both hydrologically and thermodynamically. This represented was included in the newest version of this model, but this was not integrated before that model was branched off by the Department of Energy to form their own climate model, the Energy Exascale Earth System Model (E3SM). I have also implemented variable soil thickness in this model's land component to make it consistent with its parent model.

For more information on this research, check out:

Brunke, M. A., P. Broxton, J. Pelletier, D. Gochis, P. Hazenberg, D. M. Lawrence, L. R. Leung, G.-Y. Niu, P. A. Troch, and X. Zeng, 2016: Implementing and evaluating variable soil thickness in the Community Land Model version 4.5. *J. Climate*, **29**, 3441-3461.

Pelletier, J. D., P. D. Broxton, P. Hazenberg, X. Zeng, P. A. Troch, G.-Y. Niu, Z. Williams, M. A. Brunke, and D. Gochis, 2016: A gridded global data set of soil, intact regolith, and sedimentary deposit thicknesses for regional and global land surface modeling. *J. Advances Model. Earth Syst.*, **8**, 41-65.