Coupling Methods in Climate Models

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ABSTRACT

A modern climate model is the quintessential example of a heterogeneous numerical model that involves several interacting components each with their own solver. They are also coupled systems that require solving several different coupled problems at once. Within the atmosphere component, there is a coupled problem between the fluid dynamics solver and the various parameterizations for non-fluid, but strongly interacting, phenomena such as radiative transfer and cloud microphysics. The atmosphere is strongly coupled to the surface of the earth that can be covered by land, sea ice, ice sheets or ocean. Each of these elements of the climate system have their own numerical model and unique coupling problem at the atmosphere-surface interface. Recently, climate models have started to become models of the earth system as they include new couplings to atmospheric chemistry solvers and numerical models of the surface and sub-surface carbon cycle.

Because each element of an earth system model constitutes its own sub-field of study, modern large-scale earth system models referenced in reports by the International Panel on Climate Change [1] are developed by teams of dozens to hundreds of researchers and most countries only have the resources to develop one or two. To help create these coupled models from their disparate pieces, a slightly smaller set of software tools have been developed [2]. This presentation will survey the coupled problems in Earth System Models and the software used to construct and solve them.

REFERENCES

[1] Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp, (2013).

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