Tracking carbon flows through the biosphere: a new capability for the simple climate model Hector

Skylar Gering¹, Benjamin Bond-Lamberty², and Dawn Woodard²

¹Harvey Mudd College, Claremont, CA, US (sgering@hmc.edu)
²Joint Global Change Research Institute, College Park, MD, US

Simple climate models focusing on the global climate and carbon cycle are valuable tools for large-ensemble sensitivity studies, model coupling experiments, and policy analyses. One example is Hector, an open-source model with multiple biomes, ocean chemistry, and a novel permafrost implementation. However, Hector does not currently have the capability to reconstruct the flow of carbon from one carbon pool (e.g., atmosphere and ocean) to another or report, at the end of a model run, the origin of the carbon within each pool. We developed a novel ‘trackedval’ C++ class and integrated it into Hector’s codebase. In addition to keeping track of a pool’s total carbon, the trackedval class also records the origin pools of the carbon, determined at the start of a run. If carbon tracking is enabled, this record is updated every timestep to reflect carbon fluxes (pool-to-pool transfers). To demonstrate this capability, we reconstruct and visualize the movement of carbon for several example model runs. Hector is the only simple climate model that we are aware of with the ability to reconstruct the carbon-cycle in detail through carbon tracking. The addition of the trackedval class to Hector opens up opportunities for deeper exploration of the effects of climate change on the global carbon cycle and can be used to track carbon isotopes or other elements in the future.