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Preliminary Assessment of the Earth's Energy Budget within CMIP5 Historical Simulations

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The energetic imbalance at top-of-atmosphere over the last century has caused an accumulation of energy within the ocean, the continental subsurface, the atmosphere and the cryosphere. Although 93% of the energy gained by the climate system has been stored in the ocean, other components of the Earth's energy budget cannot be neglected because of associated climate feedback processes dependent on heat, such as soil carbon and permafrost stability.

Here, we explore the ability of thirty General Circulation Models from the Fifth phase of the Coupled Model Intercomparison Project (CMIP5) for simulating changes in heat content within the energy reservoirs during their Historical simulations. CMIP5 GCM simulations show net gains of heat in all subsystems during the second half of the 20th century in agreement with observations, although with large variability among model results. The temporal evolution of the Earth's heat content and the net top-of-atmosphere radiative imbalance are in agreement for these GCM simulations, but the simulated energy distribution changes with time, increasing for the ocean and the cryosphere, decreasing for the ground and the atmosphere. The land surface model depth appears to influence the distribution of energy among the different climate subsystems, although further work is needed to confirm this result.