Global water cycle constrained by the evolution of dynamic hypsometry

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The presence of liquid water on the surface is one of the important characteristics that make the Earth a unique planet, and it is usually considered to be critical for a planet to be habitable. Also, surface water is often believed to be essential for the operation of plate tectonics, which in turn enables the return of surface water to the planetary interior. The amount of surface water is thus a time-dependent variable that is controlled by the dynamics of Earth's interior. The Earth not only has surface water but also has just a right amount of it to allow the subaerial exposure of continental crust, which is important for the modulation of the atmospheric composition as well as various biogeochemical cycles. To better understand the role of water in the Earth history, therefore, we need to decipher how the distribution of water between the surface and the deep interior has changed with time and how it has affected the surface environment. In this contribution, we focus on reconstructing the history of surface water by assembling relevant observational constraints and theoretical considerations. It is now possible to derive a fairly robust constraint on the history of surface water, at least back to around 3 Ga, by examining the constancy of continental freeboard in light of the evolution of dynamic hypsometry. We also discuss its implications for the coevolution of Earth's interior and surface environment.

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