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A revised model for silicate weathering

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Silicate weathering has long been considered an important sink for the carbon cycle and a thermostat for the earth habitability. Many factors including climate, tectonic, and biology affect this process and their interaction makes it complex to study. Although the observations provide some local interrelationships between silicate weathering rate and these factors, most of the two-dimensional weathering models perform poorly, especially in the equatorial region. We start from a theoretical model published by Park and Maffre [1], which implements the model of Gabet and Mudd [2] for the development of a chemically weathered profile. Using high-resolution climatic and topographic data, we found that the areas where the model simulations were overestimated largely coincided with areas where lacustrine soils existed. A simple parameterization scheme for modifying the erosion rate or the mineral concentration in the rocks for a limited area to improve the model overestimation problem is presented in this paper. The modified model results show a significant improvement in the agreement with observations. Our model offers a reasonable and simple way to simulate the weathering fluxes in paleo time, where only climate and topography are available from the climate system model.

[1] Emergence of the Southeast Asian islands as a driver for Neogene cooling, Park et al (2020), Proceedings of the National Academy of Sciences of the United States of America117.

[2] A theoretical model coupling chemical weathering rates with denudation rates, Gabet & Mudd (2009), Geology37, 151-154.