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The role of the thickness of the regolith cover on the Earth climate stability

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For the past 50 years, chemical weathering of silicate rocks exposed at the surface of the continents has been considered as one of the major processes capable of stabilizing the carbon cycle and the Earth's climate on the geological time scale.

Since the early 1980s, this process has been included in numerical models simulating the long-term evolution of atmospheric CO2 by assuming that weathering increases with temperature and the amount of water that runs off the continents. This dependence of environmental parameters defines the existence of a powerful negative feedback, limiting climate fluctuations within limits acceptable to living organisms.

Over time, it became apparent that the climate dependence of rock weathering was more complex than previously thought. Field and modeling studies have shown the key role played by the presence of vegetation on the surface of continents, capable of accelerating the weathering of continental surfaces, while limiting their physical erosion. In the same way, the uplift of mountain ranges, accelerating physical erosion in restricted geographical areas, may have heavily modified the weathering of continental surfaces. Conversely, others have shown the importance of large areas of low relief where thick soils developed in the absence of significant physical erosion.To date, numerical models used to simulate the joint evolution of the carbon cycle, continental weathering and climate change are global models, blind to the continental configuration. But if we want to quantify the sensitivity of global weathering to CO2 in response to local modifications of the weathering processes by mountains or peneplains, it is essential to go through a spatialized approach.

We will present the sensitivity of continental weathering to variations in atmospheric CO2, for contrasting continental configurations, using the coupled biogeochemistry-climate-weathering model GEOCLIM. This model coupled three numerical components: the climate (FOAM), the global biogeochemical cycles (COMBINE) and the spatially resolved weathering and erosion rates.