Flat continents, weathering, and Climate regulation

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There is an ongoing debate about the role of mountain uplift on the Cenozoic climate cooling. Mountain ranges are thought to enhance silicate weathering, organic carbon burial, and the associated CO_2 consumption. Regolith formation at the interface between the atmosphere and the continental bedrock appears to be a key factor controlling silicate weathering [1]. Mountains landscapes are characterized by intense physical erosion, preventing the development of thick regolith layer (so-called weathering limited regime). A world with globally low orography, such as the one encountered during the lower Eocene, is propitious for a widespread development of thick regolith layers that shield continental crust against chemical weathering (transport limited regime). This low orography configuration may result in a stable warmer climate to compensate for the reduced weatherability. This scenario is also supported by lithium isotopic data that suggest high global regolith production rates around 55Ma [2].

The work presented here aims at quantifying, through numerical modeling, how regolith development affects climate regulation by silicate weathering and to what extent it can warm the Earth climate during the early Eocene. The GEOCLIM model (geoclimmodel.wordpress.com) couples a 3D Climate model (GCM), a box-model of the geochemical cycles, and a new 2D model for continental physical erosion, chemical weathering and regolith growth. This erosion/weathering model mixes a process-based mathematical description of the regolith growth (mass budgets in the regolith) and empirical laws for erosion and weathering rates. Sensitivity tests exploring the feedback between the climate and the regolith production rate will be presented, for the present day continental configuration and for the early Eocene.

[1] Maher & Chamberlain (2014), *Sciences* **343,** 1502-1504. [2] Vigier & Godderis (2015), *Clim. Past* **11,** 635-645.