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Hydroclimatic control on global weathering regimes

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Chemical weathering strongly impacts the evolution of the Critical Zone and the climate system. The large number of factors affecting weathering rates, however, makes it difficult to interpret measurements across different climatic and geologic settings. Here, we use the π theorem of dimensional analysis to develop a theoretical framework for global datasets of chemical weathering rates. The analysis reveals the dominant role of wetness on the chemical depletion of parent materials and provides a functional relationship to estimate the chemical depletion fraction from readily available climatic variables. Based on this finding, we calculate the spatial distribution of chemical depletion fraction and identify the areas where weathering rates are limited by the supply of fresh minerals or by water availability, and the areas where they are susceptible to future shifts in wetness.