

A Process-Oriented Model to Calculate Weathering Rates and CO₂ Consumption Over Large River Basins: Application to the Parana Basin

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A process-oriented model of rock weathering has been constructed. It calculates the rates of mineral dissolution and the chemical composition of the soil solution at a 1°×1° resolution in longitude-latitude. It uses as inputs monthly climatological data and a lithological map translated into mineralogical assemblages. A soil hydrological model determines the water flow in the soil layer where mineral weathering is assumed to occur. A carbon cycle model (CARAIB) provides vegetation NPP, heterotrophic respiration and organic carbon stores in the soil, which are used to estimate the CO₂ pressure and the concentration of dissolved organic carbon (DOC) in the soil. A set of cation exchange and liquid phase chemical reactions is used to estimate soil pH, which controls the dissolution rates of primary minerals.

An application to the Parana basin is presented. The runoff-weighted means over the basin of the soil solution major ion concentrations are compared with the measured concentrations in the Parana river, as a test of model performances. This new model is a powerful tool to calculate CO₂ consumption by rock weathering and the corresponding alkalinity transfer to the world ocean, as well as their potential variability with climate and atmospheric CO₂.