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Combined climatic and geochemical controls on stabilizing soil carbon along a large scale transect from the South American tropics to Antarctica

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The importance of climatic variables on biological processes that stabilize versus destabilize soil organic carbon (C), has been long studied and recognized. Also, the importance of geochemical factors controlling C stabilization, namely the composition of the reactive soil phase, has been studied extensively and different physical and geochemical mechanisms of soil C stabilization have been identified. However few studies have considered the combined effect of these two critical controls (climate and geology) on soil C stabilization.

We present the concept and the first results of a large scale project that aims to improve our understanding of the linkage between climatic and geochemical controls on soil C dynamics. For this, we study soils formed under grassland vegetation along a geo-climatic transect in Chile, Brazil and the Antarctic Peninsula. We cover in our experiments all major global climate zones under which grasses can thrive, including hot, temperate and cold humid or arid climates, and in each zone we study soils developed from contrasting geochemical substrate.

The focus of our study is to determine the physical and geochemical mechanisms which play a role in stabilizing carbon in different soil fractions under these various climates, and to determine the associated turnover times. On exemplary topsoil samples from our transect we combine a series of physical and chemical soil fractionation experiments with a medium-term incubation study using ^{13}C and ^{15}N labelled grass residues. In addition, we also determine the age of the respired C during the incubation using ^{14}C dating on soil C and CO_2. This combination of techniques helps trace microbial activity in certain parts of the soil and analyze the reactivity and abundance of various C fractions and, hence, the presence, effectiveness and interaction of different C stabilization mechanisms.