Climate and geochemical interaction control soil carbon dynamics

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Soils are important for carbon storage and thus for atmospheric CO_2 concentrations. Whether soils store or release carbon is in general related to climatic factors**,** as they control plant growth (i.e. carbon inputs), activity of soil microorganism as well as several chemical processes (e.g. weathering) in soils. However, we still do not fully understand the response of soil carbon to climate change because interactions between geochemistry and climate for soil carbon dynamics are not sufficiently studied; and hence it is not surprising that Earth system models are not (yet) capable to simulate current and future global soil carbon stocks. We showed that geochemical properties that contribute to stabilizing soil organic matter and can help explain variation in soil carbon stocks and sensitivity to temperature along a climatic gradient. In general, cool and moist climates show large soil carbon stocks. Climate change that warms soils could result in soil carbon loss but also enhances soil weathering enhancing adsorption and thus protecting soil organic carbon from enzymatic decomposition. Hence climate affects soil carbon dynamics in three ways: by changes in residue inputs, by affecting microbial activity/physiology, but also by altering geochemical properties. A specific caveat to quantify which soil carbon fraction is vulnerable to climate change may also lay in understanding specific stabilization mechanisms and efficiency of microbial residues in soils.