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Spatial heterogeneity of soil organic carbon in the Kananaskis valley (Rocky Mountains, Canada)

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The carbon content in the mineral soil layer represents a major pool in the global carbon cycle. However, their behaviour in different ecosystems is far from fully understood. Soil organic Carbon (SOC) pools and turnover times are particularly sensitive to a range of factors, such as climate, vegetation, topography, soil properties, soil and crop management and other anthropogenic conditions. To elucidate our understanding of global carbon cycle, it is necessary to acquire regional estimates of soil carbon pools in all ecosystem types. Little attention has so far been given to mountain environments, which are strongly affected by and highly sensitive to climate change. Soils at high latitudes are expected to respond sensitively to climate change but still little is known about their spatial variability in carbon content.

The aim of this study is to examine the relationship between SOC-stocks climate, topography, forest stand-ages and land use along elevation transects at the Highwood Pass in the Kananaskis valley (Alberta, Canadian Rocky Mountains). We anticipate that the consideration of these issues will progress our understanding of the role of alpine environments in the global C cycle. For our analysis we use space-time analogies (by sampling SOC in forest stands of different known ages) to assess the potential impact of climate change on soil Carbon stocks, in particular the risks of additional Carbon release in response to global warming, natural landscape development and human induced changes of land use.

Soil samples were collected across a range of elevations, latitudes, soil texture, vegetation types, forest stand-ages and terrain positions. A hierarchical sampling-design is applied. We estimated soil carbon stocks based on extensive soil sampling and laboratory analysis. The inventories will extrapolated, based on a detailed statistical analysis of the local Carbon stocks with topographic variables to obtain regional inventories of SOC. We use land use scenarios to estimate temporal scenarios of regional SOC inventories.

The preliminary results indicate a large spatial variability of the carbon contents with interdependency to soil volume and soil depths transversely the landscape. The high spatial variability is associated to substrate and bed rock geology (lithology and soil type), topography and land use. Probably these factors exert a strong control on the carbon contents in the study site. In general our results designate that SOC in mountainous environments is controlled by a range of factors and that only some of them are affected by climate change. We therefore hypothesis, that carbon contents in dynamic environments are more affected and controlled by surface properties (soil volume) and geomorphic conditions than by climate. This survey revealed that expected climate is less important than surface geomorphic processes in mountainous regions.