**Model-Data Fusion Approaches for Retrospective and Predictive Assessment of the Pan-Arctic Scale Permafrost Carbon Feedback to Global Climate**

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Land areas spanning the northern high latitudes currently store enormous quantities of carbon as frozen organic matter in the region's soils and peatlands. The long-term fate of this carbon will be determined by changing temperatures already observed in these environments. These same environments are projected to warm faster than most other places on Earth over the next century. Rising temperatures will result in more and faster thawing of frozen organic matter. Once thawed, this carbon-rich material is subject to degradation by microbial organisms and/or transport through runoff to aquatic systems. Coupled with these anticipated changes is the role of disturbance from fire, invasive species, and the changing land surface resulting from soil thaw. The combination of global change and disturbance will alter historic patterns of carbon cycling with potentially large additions of greenhouse gasses to the atmosphere, thereby further increasing temperatures. The current scientific understanding of these processes in northern environments is quite limited and the existing knowledge is not consolidated in any one place or system. Data and information exist in different forms and in different places, ranging from satellite-based measurements to individual cores of soils taken for various research purposes. This project intends to survey, integrate, model and evaluate existing information on key processes that control the transfer of carbon from frozen organic material to atmospheric greenhouse gasses (mostly carbon dioxide and methane). The increased understanding that is expected from this project will help to design and implement future state-of-the-art scientific activities by providing priorities to different research areas and also will inform future decisions regarding energy and natural resources of the Arctic.

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