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Soil respiration flux in northern coastal temperate rainforest ecosystems

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Forest carbon budgets are of increasing concern because of their linkages with changing climate. The potential source strength of northern forested ecosystems is of great interest due to the large carbon stock of these systems, especially the extensive peatlands. Where very few long-term measurements of soil carbon cycles have been made, such as the North Pacific coastal temperate margin, peatlands have potentially large but largely unknown source strengths, particularly through soil respiration. The easily and widely measured factors that influence the metabolism of plants and microorganisms in soils, such as temperature, moisture and substrate quality, must be coupled with a network of plot-scale measurements of soil respiration fluxes in this region in order to produce reasonable models of soil respiration flux across gradients of climate, vegetation and soil types. We designed a study to address this issue and measured soil respiration across a hydrologic gradient to quantify the influence of soil temperature and moisture on the magnitude and seasonality of carbon fluxes in the coastal temperate rainforest biome. Replicated study sites were established in three common ecosystem types (peatlands, forested wetlands, and upland forest) within three coastal watersheds. In total, nine sites of the three ecosystem types were measured at monthly intervals during the snow-free period between May and November for two years. Soil respiration fluxes during the six-month measurement period were used to construct a respiration flux model for each landscape type. Soil respiration fluxes followed the seasonal temperature pattern in all ecosystem types and also varied with soil saturation as well in uplands. Temperature dependent models of soil respiration flux were best fit to intermediate drainage conditions in forested wetlands and explained up to 85% of the variation in this ecosystem type. Modeled soil respiration estimates were better at low temperatures with high water tables and increased in variability with increasing temperature and lower water tables, confirming an interaction with soil moisture.Despite this variability, we were able to predict soil respiration rates within 10% of the actual flux using temperature-dependent models. The soil respiration models we developed will be used to calibrate larger scale estimates of soil respiration flux and populate global change models to reduce the uncertainty in outcomes of ecosystem response to global change in the north pacific coastal temperate rainforest.