Seasonal Changes in Soil CO_2 Emission in the Forest Ecosystems of Central Siberia

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The evaluation of biospheric fluxes of carbon is of major importance in the context of increasing CO_2 concentration in the atmosphere and the related potential change in climate. Soil respiration is one of the main fluxes in the global carbon cycle, second in magnitude after gross primary production (Raich and Schlesinger, 1992; Schlesinger and Andrews, 2000). The boreal forests are weaker sinks for atmospheric CO_2 per unit area than are forests further south (Valentini et al., 2000), mainly as a result of high soil respiration in relation to net photosynthesis (Janssens et al., 2001). This could potentially reflect a disequilibrium, e.g., that decomposition currently occurs at a higher rate than before because of a warmer climate. Existing models typically use soil temperature, soil moisture for large scale soil respiration estimates. However, they are inadequate to explain the spatial variations of soil respiration between sites. Therefore, it is necessary to incorporate both temporal and spatial variation of soil respiration into the model in order to scale-up the chamber measurements of soil respiration to ecosystem level.

In this research we aimed: (1) to estimate the seasonal changes in soil respiration fluxes in Central Siberia; (2) to investigate the relation between the meteorological variables and soil CO_2 efflux; (3) to model the seasonal changes in soil CO_2 efflux for different underline surfaces. The research was carried out in the taiga forests in Central Siberia (60°N, 90°E), Russia with different underline surfaces: lichen, moss, mixed, destroyed surface.

The mixed forest contributed the biggest input to the seasonal soil CO_2 emission. Lichen and feathermoss pine forests are most resistant to the changes of meteorological conditions during the season. The dependence between soil respiration and meteorological variables can change during the year and growing season. Temperature is the factor effecting soil CO_2 fluxes until the 10 °C, than precipitation limited this process more (SWC>0.2). To model the seasonal efflux it was taken the simple exponential model and combined with direct measurements of meteorological parameters of each ecosystem (forest type) and the data from eddy covariance flux tower. Including the specific features for each forest type allowed to provide more reliable data about the changes there.

Key words: soil efflux, boreal forest, climate change, carbon cycle, soil meteorological conditions

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