Geophysical Research Abstracts
Vol. 14, EGU2012-2165, 2012
EGU General Assembly 2012

Changes in carbon balance after insect disturbance in Western U.S. forests

N.A. Trahan (1), D.J.P. Moore (2), P. Wilkes (3), T. Quaife (4), A.R. Desai (5), J. Negron (6), B.B. Stephens (7), K. Elder (6), B.H. Brayden (8), R.K. Monson (1,2)

(1) Department of Ecology and Evolutionary Biology, University of Colorado, Boulder, CO United States (nicole.trahan@colorado.edu), (2) School of Natural Resources and the Environment, University of Arizona, Tucson, AZ United States, (3) Department of Geography, King's College London, Strand, London, United Kingdom, (4) College of Life and Environmental Sciences and National Centre for Earth Observation, University of Exeter, Cornwall Campus, Cornwall, United Kingdom, (5) Department of Atmospheric & Oceanic Sciences, University of Wisconsin, Madison, WI United States, (6) US Forest Service, Rocky Mountain Research Station, Fort Collins, CO United States , (7) National Center for Atmospheric Research, Boulder, CO United States, (8) Department of Geography, University of Colorado, Boulder CO United States

Large scale tree mortality changes the balance between gross primary productivity (GPP) and total ecosystem respiration (TER). Mountain pine beetles (Dendroctonus ponderosae) have infested more than 86 million hectares of forest in the U.S.A. since 2000, leading to extensive tree mortality which is predicted to have important carbon, water and energy balance feedbacks on the Earth system. Current projections, based on models linked to changes in live tree stocks, suggest a sharp and prolonged transition of forest ecosystems from carbon sinks to significant carbon sources. We compared 9-year records of GPP and TER fluxes, and parallel disturbance chronosequences in two high elevation lodgepole pine forests in Colorado U.S.A., one impacted by the beetle (Fraser Experimental Forest) and a forest free of the outbreak (Niwot Ridge). We show that on a decadal scale the impact of this tree mortality on the carbon cycle is significantly less pronounced than these predictions because of a sustained suppression of respiration after mortality. We detect no increase in respiration after mortality from scales of several square meters up to an 84 km2 valley; rather we find a decline in both GPP and respiration suggesting a dampening of the carbon cycle. The sharp decline in respiration with GPP reflects the loss of autotrophic respiration and rhizodeposition occurring with tree mortality. We find a partial and transitory recovery of respiration 5-6 years after mortality, de-coupling respiration from concurrent GPP and associated with increased incorporation of C into soil organic matter. At the same time, trees that survive beetle outbreak undergo competitive release, allocating more carbon to growth in response to enhanced resource availability. In contrast to other disturbances like fire or logging, the impact of tree mortality caused by these biotic disturbances in Western North America is likely to have a subtle, long lasting impact on the carbon cycle which will require more mechanistic linkages between GPP and respiration to be incorporated into land surface models.