Multi-scale methane fluxes from Howland Forest: merging tower and chamber flux measurements.

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Forests dominate the global carbon cycle, but their role in methane (CH4) biogeochemistry remains uncertain. Limitations in mesoscale sampling approaches have led to gaps in our knowledge of the CH4 uptake and release dynamics from forested ecosystems and the environmental drivers that control them. These gaps have allowed for speculation over the potential contribution of forests, whether the soils or the trees themselves, to the global CH4 cycle. Building on our previous two years of work, published in Shoemaker et al. (2014), we have added a full year of CH4 flux data from 2013 to our analysis. The first two years lacked data from the late winter and spring (January through May), but now we show that measured spring fluxes from 2013 are consistent with the predictions we made using a neural network approach for 2011 and 2012. Precipitation and water table data from Howland forest in 2013 show that the summer months were significantly wetter than average, similar to 2011 conditions. We estimate that 2013 was a net positive source of CH4 to the atmosphere, consistent with our conclusion that rainy summers lead to positive annual emissions. During 2013, methane fluxes were also quantified at the level of the soil surface using multiple automatic chambers within the footprint of the tower. Ongoing analysis is focused on merging these data streams to build a more complete understanding of forest CH4 biogeochemistry, as well as constructing an appropriate scaling model. Thus far, we find no evidence to suggest that trees themselves play any significant role in CH4 cycling at Howland Forest. Overall, we find the fluxes from 2013 show a similar annual pattern to that observed during 2011 and 2012 supporting conclusions that Howland forest is a net source of methane during wetter years and net sink for CH4 during drier years. These results have important implications for understanding forest methane emissions and building appropriate models for methane emissions from similar forested ecosystems.