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Daytime chamber measurements of methane flux from a boreal wetland miss substantial emission events during evening transition that are captured by a flux tower

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Methane emissions from natural wetlands are estimated to range from 105 to 278 Tg per year, making wetlands the Earth's largest natural source of methane to the atmosphere. It is well established that methane released from a wetland varies spatially and temporally with parameters such as topography, soil temperature, and soil moisture content. Numerous studies on methane emission from wetlands have been performed using static chamber measurements. While chambers measure methane emission directly from a known location, they are unlikely to capture spatial heterogeneity for the landscape of interest. Furthermore, these emission estimates are limited in their temporal resolution due to the time required to install and sample chambers for each discrete measurement. Few studies in wetlands have compared both static chamber methane flux measurements and continuous measurements from a flux tower. In this work we analyzed methane emissions based on both techniques using data from the 1996 BOREAS project. The mean daytime methane emission rate from chamber measurements was greater than the mean from the tower, which suggests that a small number of chambers (7-11) may be inadequate to describe spatial heterogeneity. Surprisingly, the evening methane emission events, measured by the flux tower, were often an order of magnitude greater than emissions recorded during the day by either method. Thus, the use of only daytime measurements would lead to a substantial underestimation of total methane emissions from the wetland. We will evaluate several potential explanations for heightened evening emissions and evaluate how this affects our efforts to reconcile static chamber measurements with ecosystem-wide estimates based on tower methods.