ABSTRACT: Forests dominate the global carbon cycle, but their role in methane (CH$_4$) biogeochemistry remains uncertain. Limitations in mesoscale sampling approaches have led to gaps in our knowledge of the CH$_4$ 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 CH$_4$ cycle. Because CH$_4$ is a more potent greenhouse gas than carbon dioxide, quantifying the role of various forests in global CH$_4$ biogeochemistry is necessary to determine their net climate influence. Recent improvements in laser CH$_4$ analyzers have allowed for their use in combination with eddy covariance (EC) techniques, giving us the ability to fill in this knowledge gap. We examine a time series of EC-derived CH$_4$ fluxes, obtained over 2 years from Howland Forest, a lowland evergreen forest in central Maine. During the summer months of both 2011 and 2012, this forest was a small positive source of CH$_4$ to the atmosphere, averaging between 1-3 nmol m$^{-2}$ s$^{-1}$. During 2011 (a wetter than average summer) positive fluxes continued through November, while in 2012 (a drier, more typical summer) the forest transitioned from source to sink for CH$_4$ during early August. Using both linear modeling and a neural network approach, we find gross primary productivity (GPP) and soil moisture at 10cm to have the strongest explanatory power over the trends in the CH$_4$ flux data. We observe that the relationship between CH$_4$ flux and its environmental drivers differs during high and low water table conditions, indicating threshold-type behavior. Wavelet analysis shows intermittent coherence between the CH$_4$ data and GPP data at approximately 24 hrs during the summer and fall, consistent with GPP being the strongest correlate of CH$_4$ emissions when water is not limiting. Overall, these results show that certain forest types, such as this lowland evergreen site, may be net sources of CH$_4$ to the atmosphere during wet years, while remaining weak sinks during average to dry years. This has important implications for assessing the forest’s net climate impact, and suggests that there may be a positive feedback with forest methane emissions and climate change at this site.