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Greenhouse gas balance of open peatlands is globally governed by soil water content and archaeal abundance

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There is a general consensus that peatlands are the source of about 10% of the global CO_2, CH_4 and N_2O greenhouse gas (GHG) emissions. Yet, our knowledge about underlying processes and environmental factors that regulate the GHG are limited. Here, we found that the GHG balance of CO_2, CH_4 and N_2O in 48 open peatland sites on five continents can be predicted by a model that incorporates soil water content (SWC) and archaeal abundance. We used our global database (2011–2019) on peat characteristics and field-measured soil respiration (ER), CH_4 and N_2O emissions. Furthermore, we used the gross primary productivity (GPP) dataset by Running, Mu & Zhao (2015) on the basis of satellite data from the Moderate Resolution Imaging Spectrometer (MODIS) sensors alongside the ER to derive net ecosystem exchange (NEE) of carbon. The GHG balance follows SWC along a bell-shaped curve and increases with archaeal abundance and decomposition rate of peat-forming plant species. Thus, the net GHG emission peaks at intermediate SWC. These factors combined explains 61.9% (adjusted R^2 = 0.587) of GHG balance and most of this variance is made up by the NEE of carbon (adjusted R^2 = 0.97).