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Peat forest disturbances in tropical regions: direct drivers and GHG emissions

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We estimated and compared driver-specific GHG (CO_2, CH_4, and N_2O) emissions from biomass and peat soil carbon loss caused by peat forest disturbances in Indonesia, Peru, and DRC over 2020 - 2021. We randomly sampled 1,000 disturbance events in each country to identify direct drivers, utilizing visual interpretation of 4.77 m Planet and 10 m Sentinel-2A satellite imagery. We estimated CO_2 emissions from AGB loss by utilizing pre-disturbance carbon stocks derived from the 2019 ESA CCI Biomass product for forest areas disturbed in 2020 and 2021. To estimate CH_4 and N_2O emissions from AGB burning, we employed a multiplication approach combining pre-disturbance biomass data, combustion factors, and emission factors (EF) data. GHG emissions from peat decomposition and peat burning were estimated using driver-specific EF and the corresponding disturbance area. Large-scale agriculture was the primary contributor to GHG emissions in Indonesia, accounting for 48% of emissions, followed by smallholder agriculture at 26%. While, smallholder agriculture emerged as the dominant driver in Peru and DRC, contributing over half of emissions in Peru and 94% in DRC. Fire-related emissions accounted for half of emissions and were predominantly linked to agriculture, comprising 80% in Indonesia, 75% in Peru, and 95% in DRC. CO_2 was the dominant GHG, accounting for 72% of emissions across the countries, followed by CH_4 at 20% and N_2O at 8%. CH_4 and N_2O emissions from AGB loss are minimal (10%) and are linked to biomass burning. However, these emissions from peat soils accounted for nearly half of soil emissions. Approximately 90% of soil emissions originated from peat burning. In Indonesia, Peru, and DRC, emissions from AGB, peat decomposition, and peat burning combined in the year of disturbance (2020) were 19–20 times higher than those in 2020 post-disturbance emissions from peat decomposition. This implies that cumulative post-disturbance emissions from peat decomposition will take nearly two decades to reach the emissions released in the year of disturbance from all three sources combined. Our findings provide valuable insights for designing policy measures to manage emissions from various drivers and sources in these countries. These insights are also useful for supporting country commitments to inform driver-specific emissions from peat forests to international platforms such as the Paris Agreement.

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