PA7201 - Analysis of CO in 6 regions around the World

Analysis

Carbon monoxide (CO) is a poisonous gas, released from incomplete combustion. The major source of CO is burnt fuel, originating from car exhausts or fire.

Eastern Australia displays maximum CO column density (CD) in January (0.045 mol/m^2) and October (0.039 mol/m^2) (figure 1). January 2020 brought a series of bushfires throughout Australia, leading to increased CO throughout the region (Filkov *et al.*, 2020). Bushfire season for 2020-2021 begins again in September and this is apparent due to increased CO CD during this period. Burning occurred in a concentrated region in South East Australia between Canberra and Melbourne.

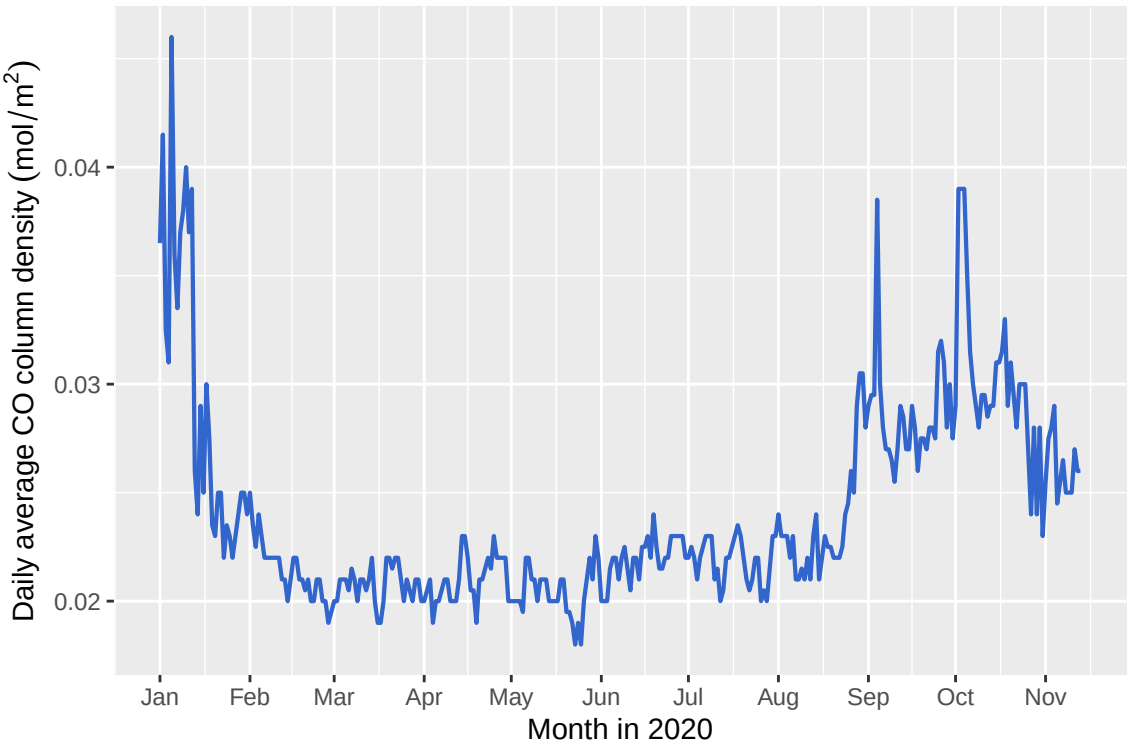
Forest fires have raged throughout 2020 in Brazil (IPAM, 2020), but the most extreme events occurred in September and October as CO increased to 0.1 mol/m^2 (figure 2). Outside these events, Brazil has a CO CD of approximately 0.03 mol/m^2. Increased CO CD coincides with the Amazon basin to the west, further suggesting that wildfires were the source of the CO (IPAM, 2020). The surrounding coastline to the east displays significantly lower C0 levels (0.2-0.4 mol/m^2), suggesting a lack of wildfires in this region.

The Congo basin displays a unique signal of CO CD (figure 3). CO rises gradually from May to August before decreasing rapidly. The DRC does not show a 'baseline' density as CO changes sporadically throughout 2020. The cause of this CO is identical to that of Brazil, wildfires (Jenner, 2020). Interestingly, that also brings about similar levels of CO that were present in Brazil (~0.04-0.1 mol/m^2). Increased CO CD to the West (0.7-0.8 mol/m^2) suggests this was the location of the wildfires. CO decreases eastward throughout the region, until a minimum (0.02 mol/m^2) is found at the eastern border.

CO CD in the Indonesian peatland region of Kalimantan is highlighted by a trough from May to September (figure 4), possibly due to lockdowns enforced for the COVID-19 pandemic. Presence of localised fires throughout Kalimantan in July (Reuters, 2020) raised CO CD from 0.024 to 0.028 mol/m^2. Maximum CO CD is around Singapore and Jakarta, possibly demonstrating the effect of increased urbanization on CO levels (Dewi *et al.*, 2019).

Northern India presents a noisy dataset. CO CD falls within the range 0.03 to 0.04 mol/m^2 though outliers consistently fall below 0.03 mol/m^2 (figure 5). CO CD has increased to 0.045 mol/m^2 since October with outliers increasing it >0.05 mol/m^2 due to forest fires in Uttarakhand and Uttar Pradesh (Azad, 2020). This signal is reflected in the area-averaged map, where elevated CO CD occurs in North India.

CO CD in Kampala and Jinja, Uganda ranges from 0.03 to 0.05 mol/m^2 (figure 6). COVID-19 may have caused a decrease below 0.03 mol/m^2 from May to June. Uganda's maximum CO CD is on the western border, suggesting that DRC may be responsible for a fraction of Uganda's CO CD. An outlier within the region is Kampala as an increased concentration of wood stoves and cooking fires release excess carbon monoxide into atmosphere (Bede-Ojimadu *et al.*, 2020). Minimum CO CD in the region coincides with Bokoro Wildlife Reserve and Mount Elgon National Park to the east and South east respectively.



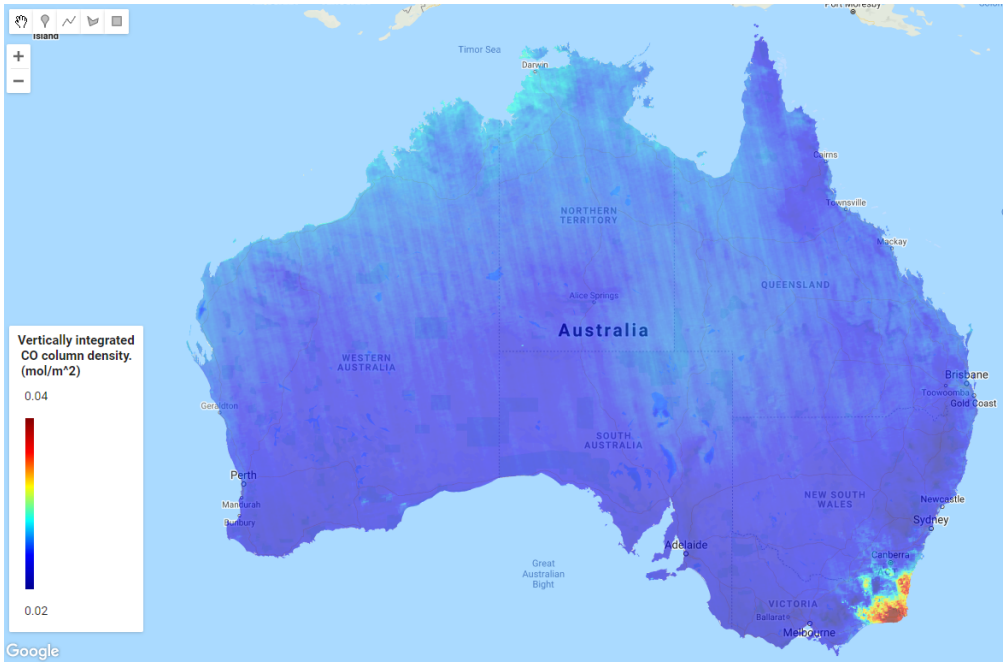
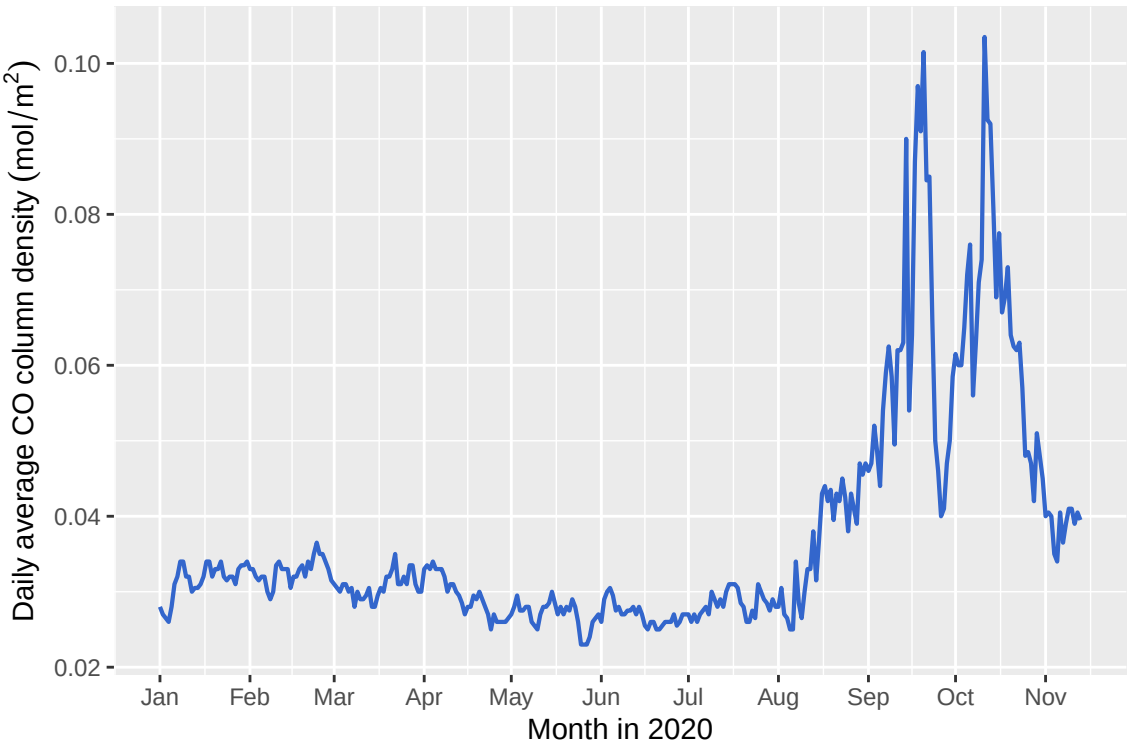


Figure 1: Time series of CO column density (mol/m^2) throughout 2020 in eastern Australia (147.00 LON, -35.00 LAT, 154.00 LON, -22.00 LAT) (top) Area averaged map of CO column density (mol/m^2) throughout 2020 in Australia (bottom)



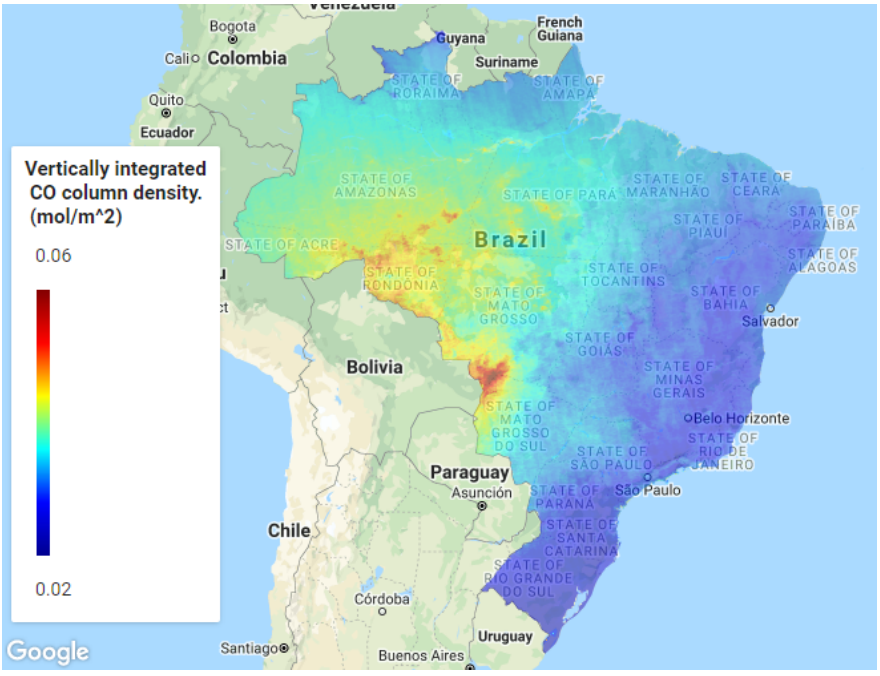
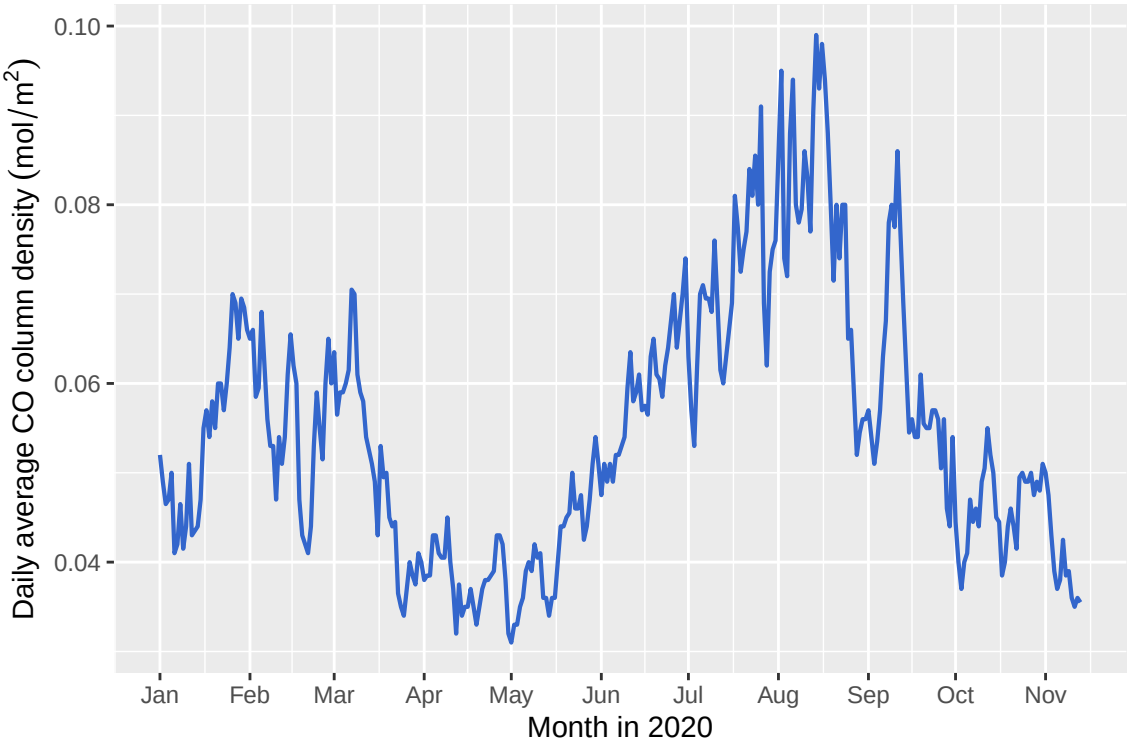


Figure 2: Time series of CO column density (mol/m^2) throughout 2020 in Pantanal, Brazil (-60.00 LON, -20.00 LAT, -50.00 LON, -10.00 LAT) (top) Area averaged map of CO column density (mol/m^2) throughout 2020 in Brazil (bottom)



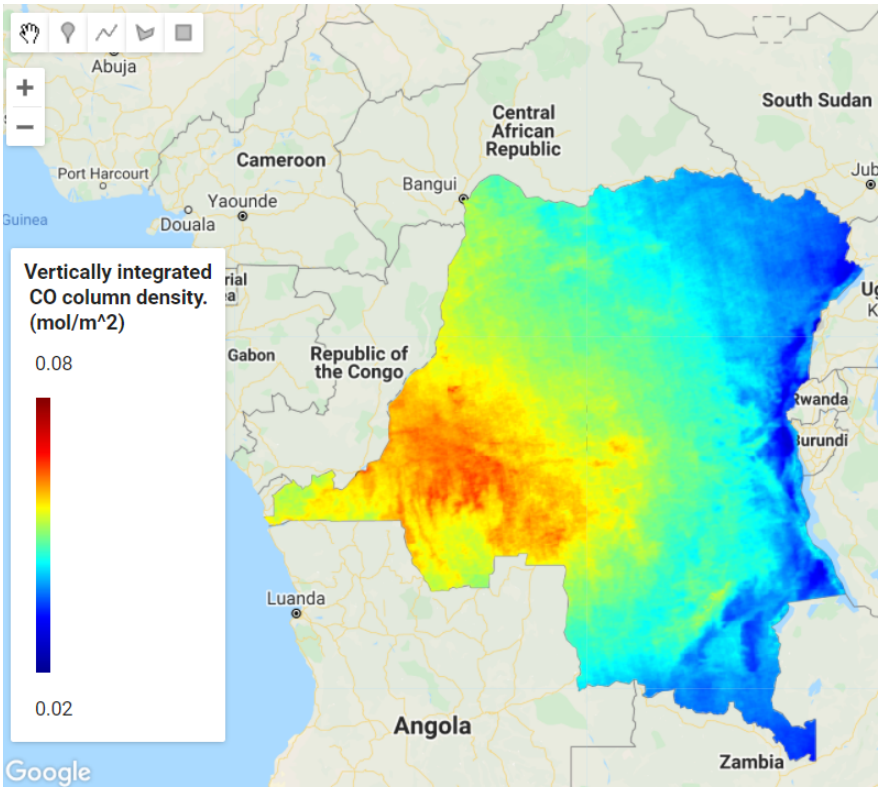
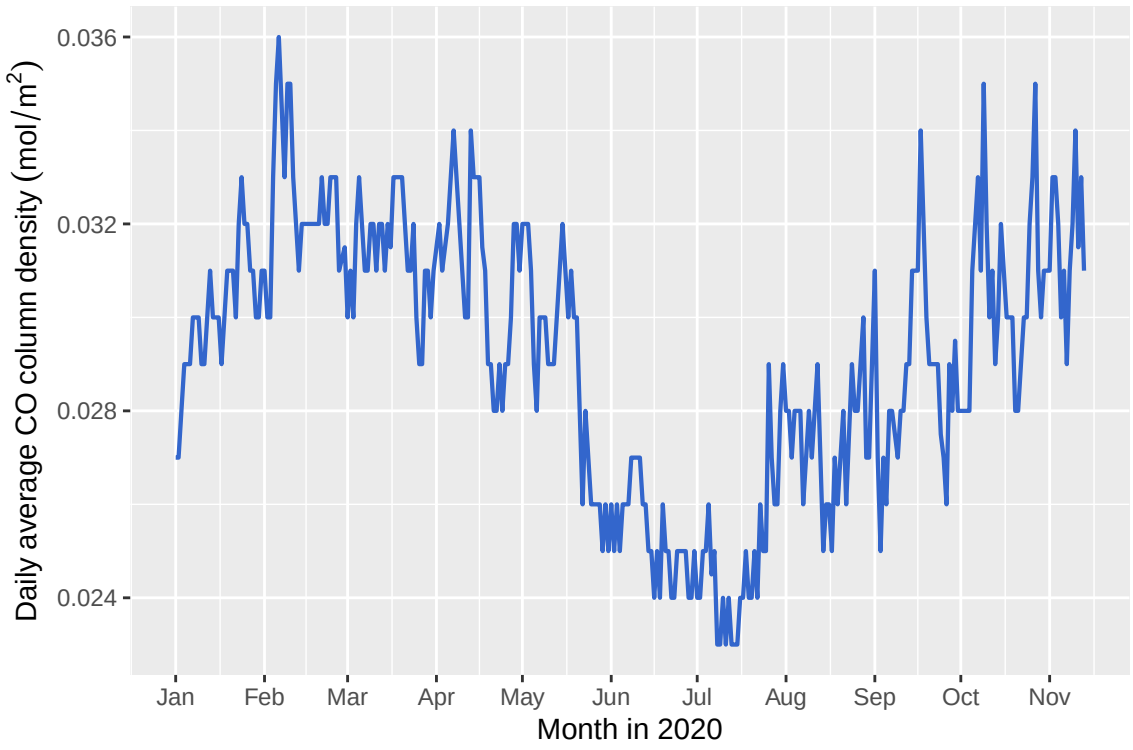


Figure 3: Time series of CO column density (mol/m^2) throughout 2020 in the Congo Basin (15.0 LON, -6.0 LAT, 25.0 LON, 0.0 LAT) (top) Area averaged map of CO column density (mol/m^2) throughout 2020 in DRC (bottom)



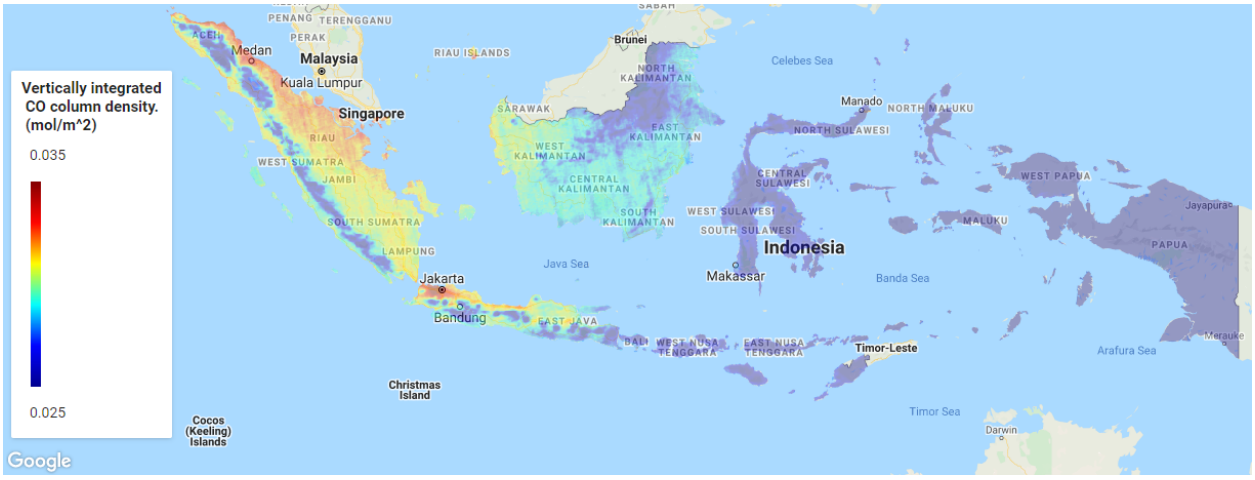
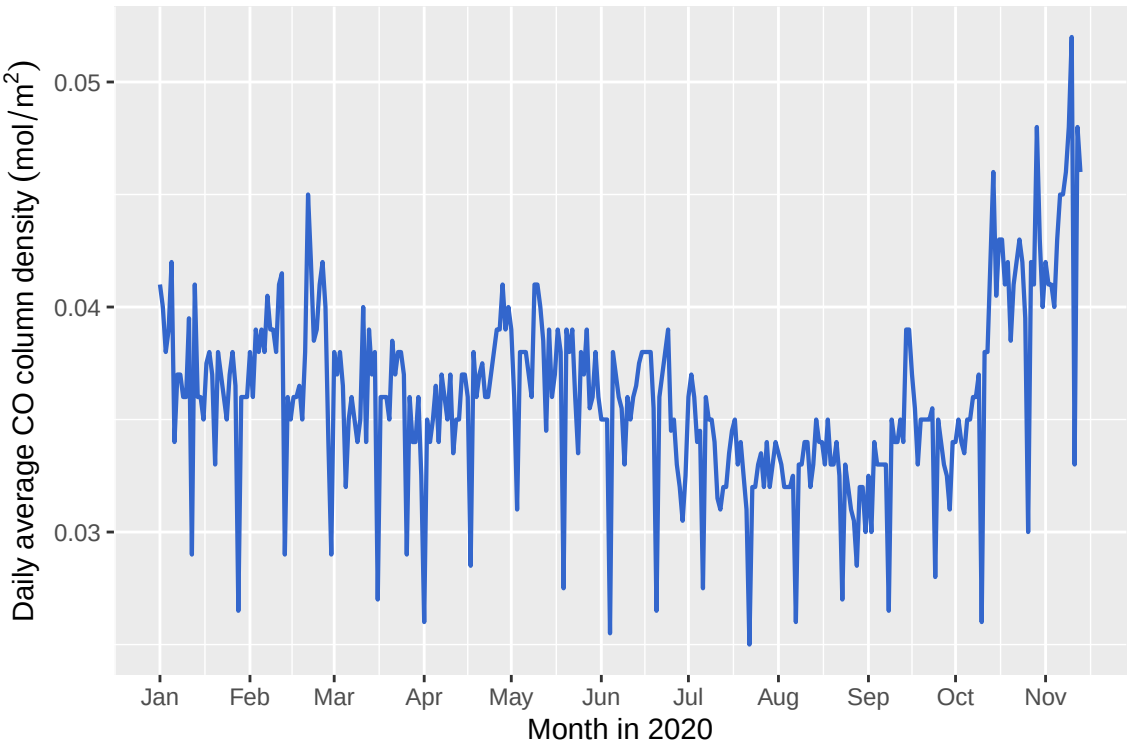


Figure 4: Time series of CO column density (mol/m^2) throughout 2020 in the Indonesian Peatlands (112.0 LON, -3.00 LAT,115.0 LON, 0.00 LAT) (top) Area averaged map of CO column density (mol/m^2) throughout 2020 in Indonesia (bottom)



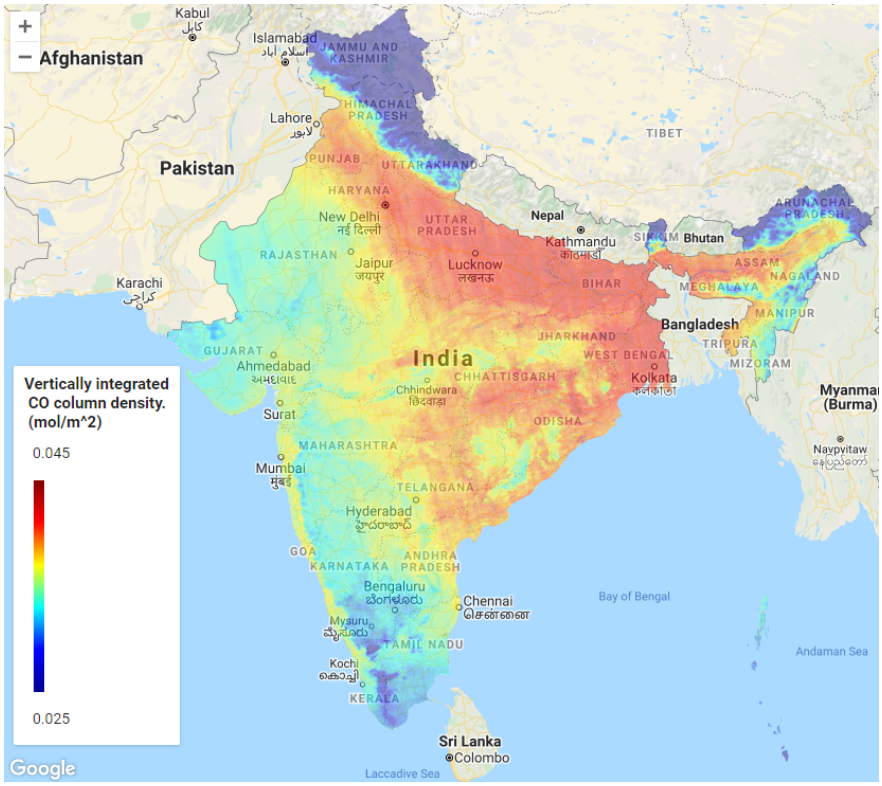
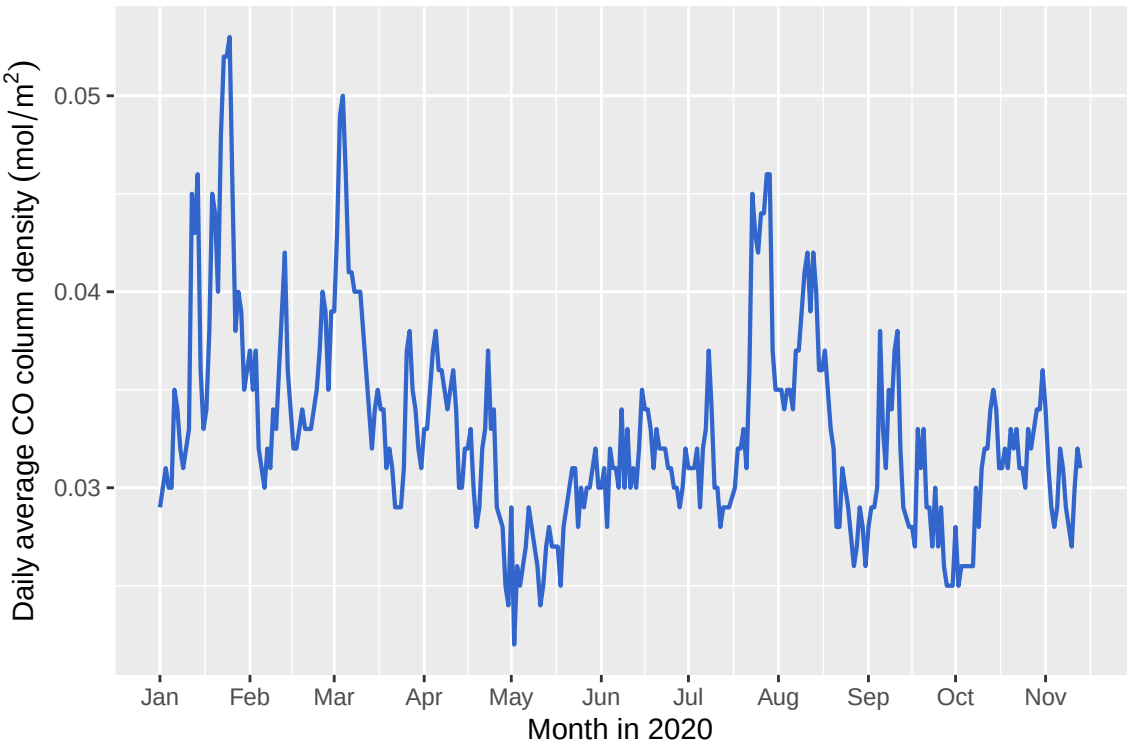


Figure 5: Time series of CO column density (mol/m^2) throughout 2020 in North India (73.00 LON, 26.00 LAT, 79.00 LON, 32.00 LAT) (top) Area averaged map of CO column density (mol/m^2) throughout 2020 in India (bottom)



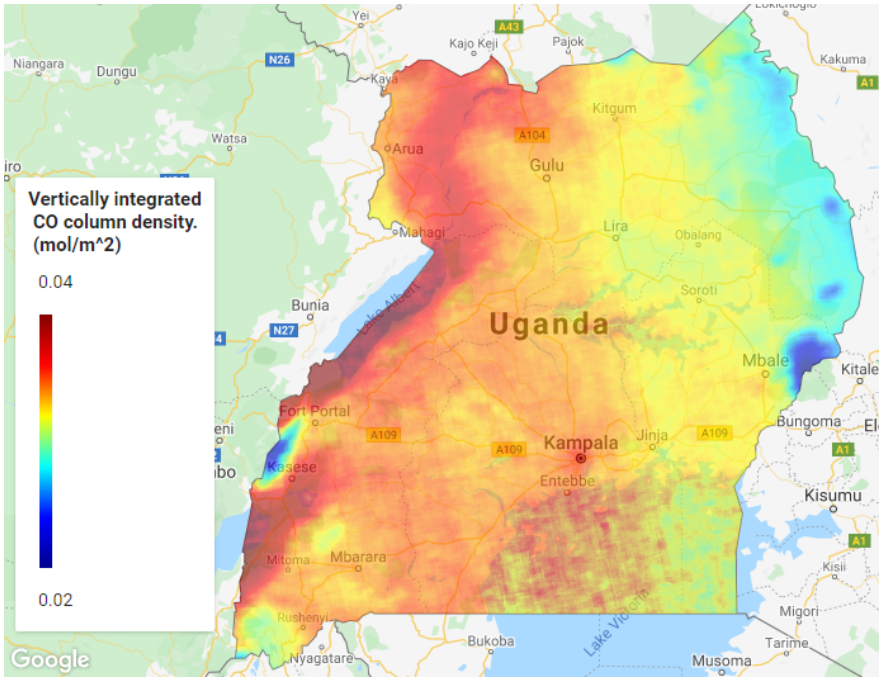


Figure 6: Time series of CO column density (mol/m^2) throughout 2020 in Kampala and Jinja, Uganda (32.0 LON, 0.0 LAT, 34.0 LON, 2.0 LAT) (top) Area averaged map of CO column density (mol/m^2) throughout 2020 in Uganda (bottom)

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