Understanding the temporal dynamics of carbon emission from fires in the Amazon-Cerrado transition zone

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ABSTRACT – Carbon emissions from fires (C fire) account for one-tenth of the global annual C emissions. Fires are the main source of emissions from land-use change. Recently, Werf et al. 2017, showed an 11% increase in global fire emissions during the 1997-2016 period. Savannas and Tropical Forests have shared almost the same fire-derived C emission values in the South America (Werf et al. 2017). Therefore, for this study we focused our analysis on a site representing the transition zone between Amazonia and Cerrado, located in Alta Floresta (ALF) in Mato Grosso State, Brazil. To understand the temporal dynamics of fire-derived C emission, we correlated fire counts (FC) within the influence area with fire-derived C emission directly measured in the atmosphere as CO concentration. CO and CO2 were collected monthly for 7 years from 2010 onwards using an aircraft flying up to 4.5 km altitude, totaling 153 vertical profiles. FC was extracted from influence areas weighted by the density of backward trajectories calculated quarterly. Trajectories starting from the flight location within a cell of one degree resolution were obtained using the Hysplit model at different heights. The average annual C emission from fire was 0.10 ± 0.04 Pg.C.yr^{-1}, which represents about 10% of the Amazon fire emissions (Aragão et al. 2018). The highest daily value of fire emission was observed in 2010 (drought year) and 2017 (0.47-0.51 gC.m².day^{-1}), although the years of 2011, 2016, and 2017 were the largest contributor to the total emission flux. This occurred because the influence area that belongs to the Amazon was lower in those years. Inter annually there is a typical behavior of the backward trajectories in ALF site whose 1st and 4th quarters have 80% of the air-streams coming from the Amazon, while during the 2nd and 3rd quarters this contribution is about 45%. However, emissions from fire and FC are higher in the 3rd quarter, outside the Amazon. The correlation between FC and fire emission was positively significant (ρ = 0.88, α = 0.05, p<0.001), meaning that an increase of 1,000 FC per quarter causes an increase of 0.074 gC.m².day^{-1} or, on average, an emission of 0.16 Pg.C.yr^{-1}.

Keywords: Climate change; fire emission; Amazon; Hysplit; rainforest; Cerrado

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