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A Comparative Analysis on the Temporal and Spatial Distribution of Fire Characteristics in the Amazon and Equatorial Southern Africa Using Observations from Space

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Tropical forest fires significantly impact atmospheric composition and regional and global climate. In particular, fires in Equatorial Southern Africa (ESA) and Amazon comprise the two largest contributors to fire emissions of chemically and radiatively-active atmospheric constituents (such as CO, BC, CO_2) across the globe. Here, we investigate the spatiotemporal trends in fire characteristics between these regions using combustion signatures observed from space. Our main goals are: 1) To identify key relationships between the trends in co-emitted constituents across these regions, and, 2) To explore linkages of the observed trends in fire characteristics with the main drivers of change such as meteorology, fire practice, development patterns, and ecosystem feedbacks. We take advantage of the similarity in latitude and land area between these regions in understanding some of these drivers. Our approach begins with a multi-species analysis of trends in the observed abundance of CO, NO_2, and aerosols over these regions and across the time period 2004 to 2014. We use multi-spectral retrievals of CO from Measurements Of Pollution In The Troposphere (MOPITT), tropospheric column retrievals of NO_2 from Ozone Monitoring Instrument (OMI), and aerosol optical depth retrievals from Moderate Resolution Imaging Spectroradiometer (MODIS) instrument. The long records from these retrievals provide a unique opportunity to study atmospheric composition across the most recent decade. While several studies in the past have reported trends over these regions, most of these studies have focused on a particular constituent. A unique aspect of this work involves understanding covariations in co-emitted constituents to provide a more comprehensive look at fire characteristics and behavior, which are yet to be fully understood. Our initial results show that the annual average of CO for ESA ($\sim$115 ppbv) is greater than that of Amazon (110 ppbv). This pattern is also seen in NO_2 (ESA : $\sim$215 pptv ; Amazon : $\sim$155 pptv). The standard deviation of CO is higher in Amazon (50 ppbv) when compared to ESA (35 ppbv) whereas NO_2 shows similar standard deviation in Amazon and ESA (70-90 pptv). We also find changes in the timing patterns of the large fire events across these regions. Since this has important implications to changes in fire behavior (smoldering and flaming phase), we also investigated retrievals of fire radiative power (FRP) from MODIS and information on land cover change and deforestation. We find FRP patterns consistent with our results. Finally, we will explore other measurements available during this period (aircraft field campaigns and in-situ observations) and compare with current fire emission models, such as the Global Fire Emission Database (GFED) to test the robustness of our findings. We note that this exploratory work provides a unique perspective of fire characteristics that will be useful to improve predictive capability of fire emission and atmospheric models for the Amazon and ESA.