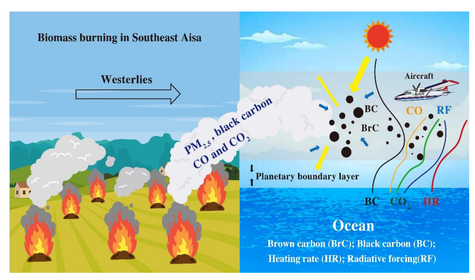
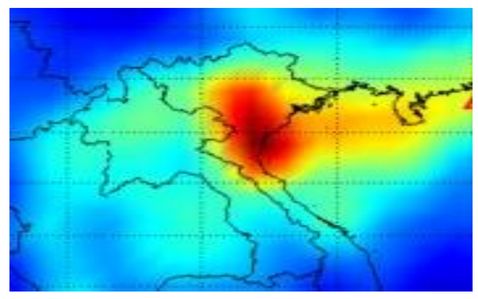
Impacts of springtime biomass burning in Southeast Asia on atmospheric carbonaceous components over the Beibu Gulf in China: Insights from aircraft observations

Dongsheng Ji, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China; and Y. X. Yang and J. W. Li

Introduction

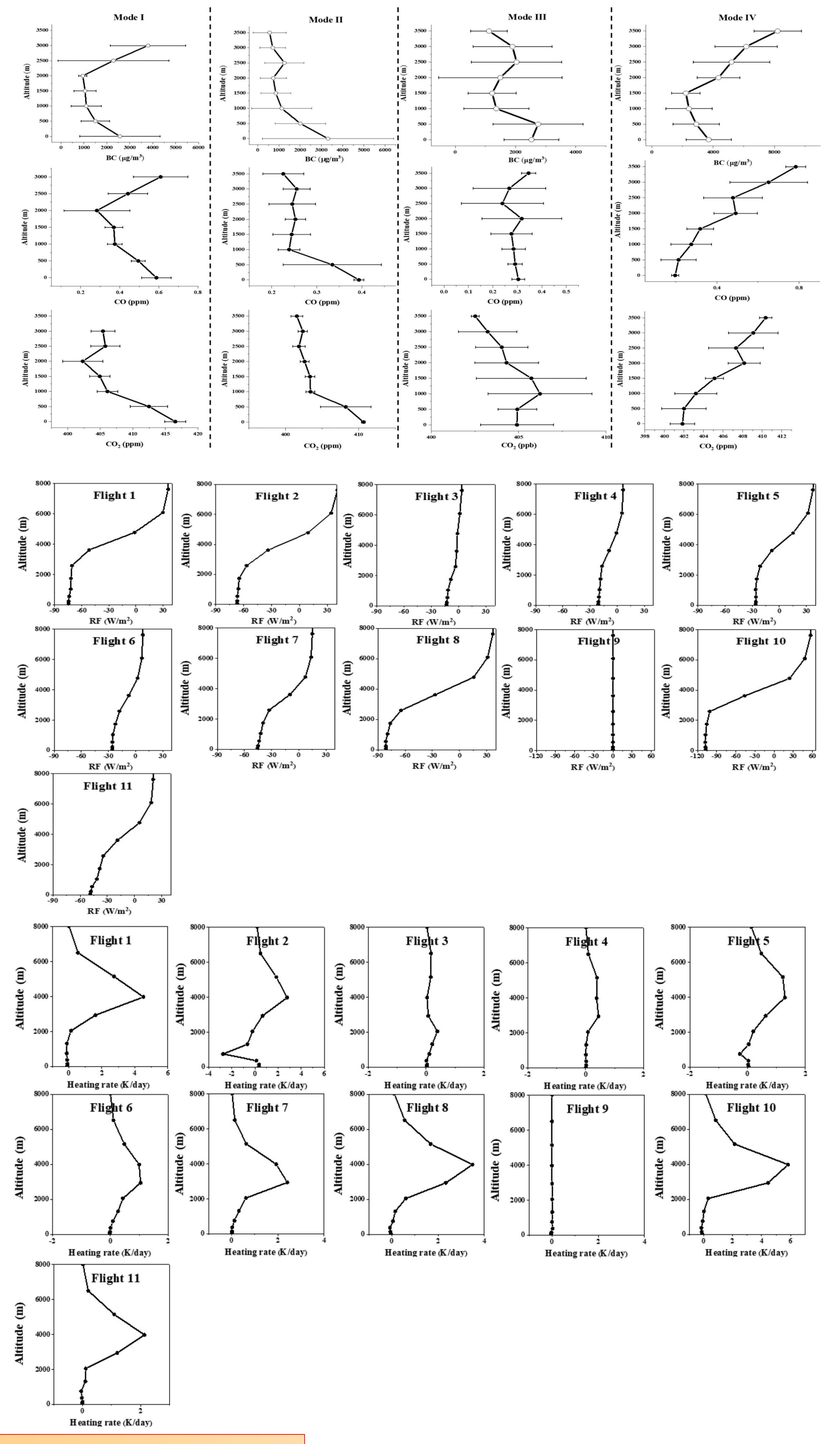
- Biomass burning, which greatly affects the air quality, atmospheric visibility, atmospheric processes, biogeochemical cycles and Earth's radiation budget, frequently occurs in tropical regions of South America, Africa and Asia. Understanding how biomass burning episodes contribute to air pollution is fundamental to studying their effects on regional air quality, climate and the hydrosphere.
- Vertical BC, CO and CO_2 measurements can help capture their sources and explain their transport or scavenging processes; they can provide insight into BC, CO and CO_2 sources and their evolution.
- A limited understanding of the potential links between pollutant emissions and their presence/effects at receptor locations poses a major obstacle to resolving the multitude of challenges related to transboundary atmospheric pollution.





Vertical profiles of BC as well as CO and CO_2

- Aircraft observations were conducted on 11 research flights from March to April 2015. Ten days were selected during the intense biomass burning period, characterized by a high ambient temperature, cloud-free conditions, low relative humidity and weak winds.
- Four types of profiles were revealed: Mode I (from 2000 to 3000 m, the BC, CO and CO_2 concentrations were enhanced), Mode II (with increasing altitude, the BC, CO and CO_2 concentrations almost decreased), Mode III (inhomogeneous vertical BC, CO and CO_2 profiles with BC peaks were observed from 2500 to 3000 m) and Mode IV (the BC, CO and CO_2 concentrations increased above 1500 m).
- A larger BC distribution in the atmosphere resulted in a sharp RF change from negative to positive values, imposing a nonnegligible influence on the atmospheric temperature profile, with maximum HR values ranging from 0.4 to 5.8 K/day. The values of the absorption Ångström exponent (AAE) were 1.46 ± 0.11 and 1.48 ± 0.17 at altitudes from 1000 to 2000 and 2000–3000 m, respectively.
- The average BC light absorption coefficient at the 370 nm accounted for 50.3 %–76.8 % of the α(370), while the brown carbon light absorption coefficient at the 370 nm wavelength contributed 23.2 %–49.7 % to the α(370) at altitudes of 1000–2000 m. At altitudes of 2000–3000 m, α BC (370) and α BrC (370) contributed 43.8 %–88.2 % and 11.8 %–56.2 % to the α (370), respectively.



Conclusion

- The biomass combustion intensity, atmospheric thermodynamics and transport played important roles in the vertical BC, CO and CO_2 distributions. Four types of profiles were identified with high BC, CO and CO_2 concentrations observed at an altitude of approximately 3000 m attributable to biomass burning.
- A larger BC distribution in the atmosphere could result in a sharp RF change from negative to positive values to warm the atmosphere, which could be crucial to influence the climate and atmospheric stability.

More detail can be found in Yang et al., 2023. Science of The Total Environment