Supplementary Information

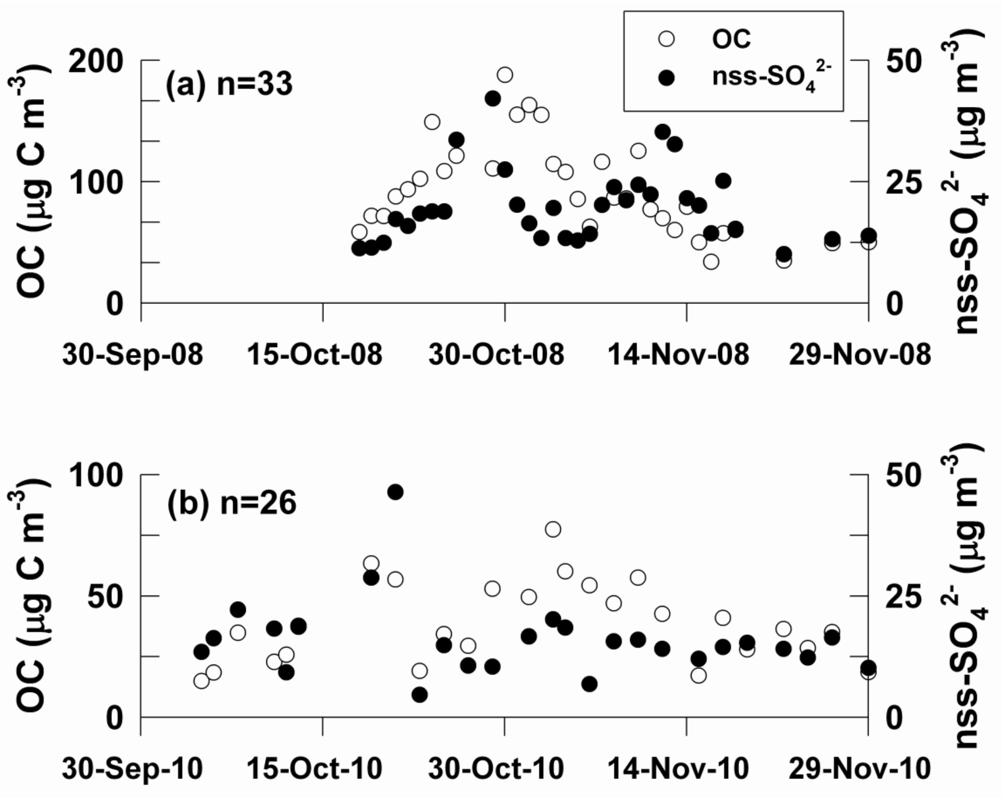

Fig. S1 The co-variability of OC and nss-SO_4^{2-} during paddy-residue burning emissions (October–November) in the Indo-Gangetic Plain (IGP) in: (a) 2008 and (b) 2010.

The farmers utilize Bentonite sulphur (pure elemental S ≈ 90%; a fertilizer) for high paddy-crop yield in the IGP. The OC is a major component from paddy-residue burning emission and its co-variability with nss-SO_4^{2-} (Supplementary Fig. S1) suggests the origin of SO_4^{2-} in ambient aerosols via rapid oxidation of sulphur dioxide gas (SO_2) involving heterogeneous reactions of aerosols as suggested by Lammel and Leip (2005) [1] following its emission from the paddy-residue (containing pure elemental S) burning. The ambient atmospheric conditions and chemical reactivity leading to the formation of SO_4^{2-} are in sharp contrast to the chamber-based experiments. It is, thus, relevant to study particulate concentrations of SO_4^{2-} in ambient aerosols and their impact on atmospheric chemistry and human health. This is a first comprehensive study, conducted from a site located in the Indo-Gangetic Plain, to assess the temporal variability and impact of agricultural-waste burning emissions on the concentrations of SO_4^{2-} under ambient atmospheric conditions.

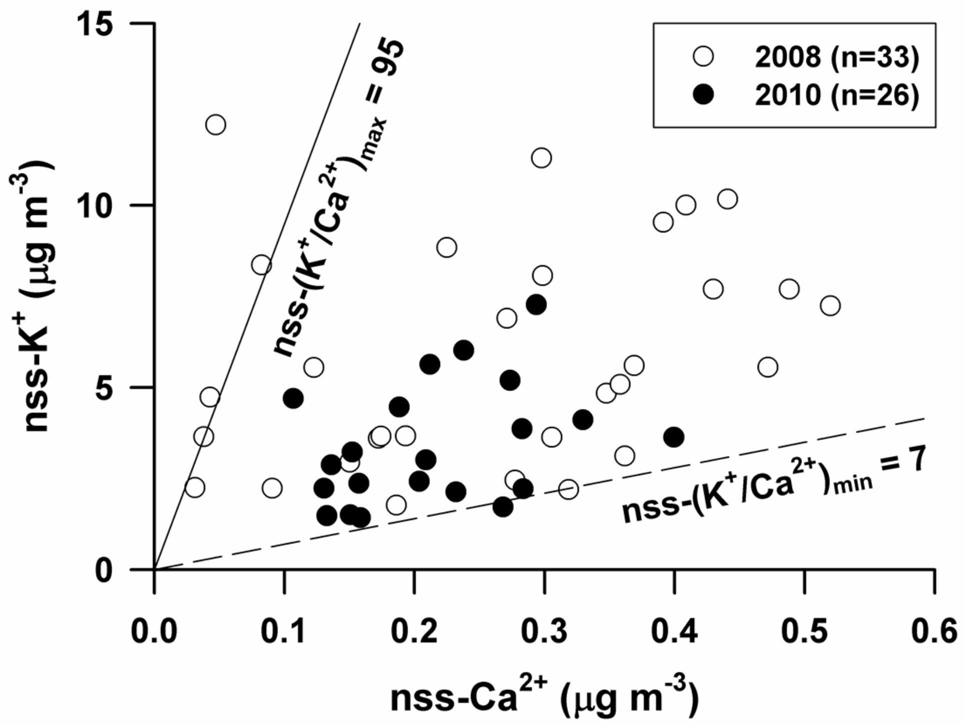

Fig. S2 Scatter plot between the nss-K$^+$ and nss-Ca^{2+} infers about the K$^+$ derived from paddy-residue burning emissions (K^+_{BB}) in the IGP.

The minimum nss-(K$^+$/Ca^{2+}) mass ratio of 7 (lower envelop) corresponds to crustal composition. However, the upper envelop (nss-K$^+$/nss-Ca^{2+} mass ratio of 95) corresponds to mixed contribution from the paddy-residue burning emissions and mineral dust. Thus, it can be inferred that the nss-(K$^+$/Ca^{2+}) mass ratio of 88 (= 95 – 7) is associated with the paddy-residue burning emissions in the IGP. It is important to state here that in an earlier study, the nss-(K$^+$/Ca^{2+}) maximum mass ratio of 10 was attributed for biomass burning emissions, owing to a negligible nss-(K$^+$/Ca^{2+}) minimum ratio of 0.12 (10 – 0.12 ≈ 10, two orders of magnitude difference). [2] In this study, the difference between maximum and minimum nss-(K$^+$/Ca^{2+}) mass ratio has been considered to represent the paddy-residue burning emissions.

The following equations have been used to determine the K^+_{BB}:

$$K^+_{BB} = (nss\text{ - }K^+)\text{ - }(K^+_{Dust}) \qquad (1)$$

$$nss\text{ - }K^+ = K^+_{aerosol}\text{ - }0.037 * Na^+_{aerosol} \qquad (2)$$

$$K_{Dust}^{+} = 7 * [(nss - Ca^{2+}) - Ca_{BB}^{2+}] \tag{3a}$$

$$Ca_{BB}^{2+} = \frac{nss\text{-}K^{+}}{88} \tag{3b}$$

$$nss\text{-}Ca^{2+} = Ca_{aerosol}^{2+} - 0.038 * Na_{aerosol}^{+} \tag{4}$$

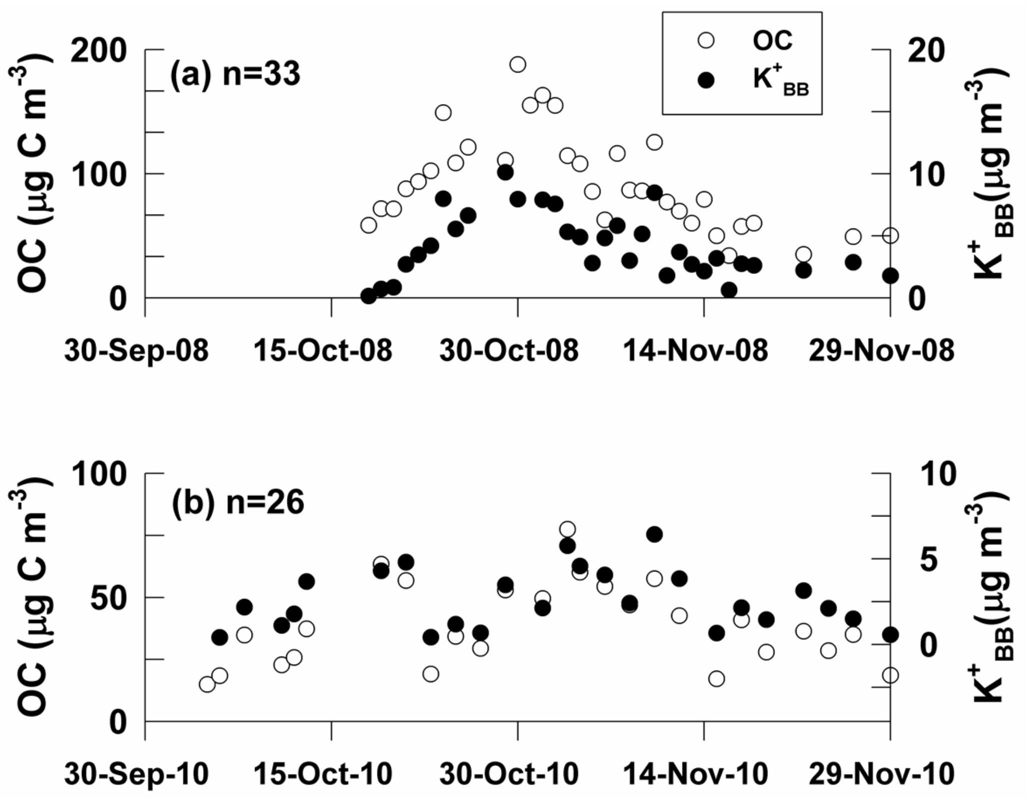

Fig. S3 The co-variability of OC and K$^+_{BB}$ during paddy-residue burning emissions (October–November) in the Indo-Gangetic Plain (IGP) in: (a) 2008 and (b) 2010. BB refers to biomass burning emissions.

Recently, it has been emphasized to assess the temporal co-variability of K$^+$ and OC to utilize the K$^+$/OC as a tracer of biomass burning emissions in atmospheric aerosols. [3, 4] In this study, the OC and K$^+_{BB}$ concentrations exhibit a temporal co-variability (Supplementary Fig. S3), suggesting the use of K$^+_{BB}$/OC ratio as a tracer of paddy-residue burning emission.

References

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