Supplement of

Spatial distribution and seasonal variability in atmospheric ammonia measured from ground-based FTIR observations at Hefei, China

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Identification of potential source areas of NH_3

The back trajectories of air masses and PSCF of NH_3 columns in different seasons are plotted in Figure S1 and S2. As shown in Figure S1 (a), in spring 42.4% of air masses arriving at the Hefei site were from the south-west, 31% from the north and 26.6 % from south-east. The air masses from the south-west brought NH_3 emitted by agriculture, as the south-west of Hefei is an area with intensive agricultural production. The northerly air masses originated from the Shangdong province, passing over the northern part of Jiangsu and Anhui provinces. These areas are part of the North China Plain, which is characterized by high NH_3 emission intensities due to fertilizer application and intensive livestock farming (Meng et al., 2018; Liu et al., 2017; Kang et al., 2016). Therefore 73.4% of air masses were from agricultural regions. The remaining 26.6% was south-east air masses, meaning the Hefei site was also affected by urban anthropogenic emissions. In short, in spring the air over Hefei site is impacted by the combination of agricultural and urban anthropogenic emission, with agriculture being the major contributing source. This is consistent with the results from the relation of NH_3 columns with temperature in section 3.5. Also, the PSCF of NH_3 columns over the Hefei site in spring indicates that the NH_3 columns were mainly influenced by sources in the local area and south-west of our site (Fig. S2 (a)), which means that local agricultural practice was the dominate factor emitting NH_3 in spring.

In summer, 47.8 % of the air mass impacting the Hefei site were from the south-west, 36.4% from south-east, and 15.8% from the north-east (Fig. S1 (b)). So approximately 52.2% of the air mass originating from the south-east and north-east, brought urban anthropogenic emissions of NH_3, while the remaining 47.8 % of the air mass came with agricultural emission from the south-west. The PSCF of the NH_3 columns indicates that they were affected by the local area near the site, as well as from the north-east and south-west area of Anhui province (Fig. S2 (b)). The urban anthropogenic emission of NH_3 explains the high correlation of NH_3 with atmospheric CO in summer shown in section 3.4.

In autumn, about 36.3 % of the air masses at the Hefei site were from the south-east, 35.7% from north-east, and 28% from the north-west (Fig. S1 (c)). The air mass from the north-east originated from the northern part of Jiangsu province, during the growing and harvesting time of late rice, emitting NH_3 from N-fertilized soil. The north-west air mass came from the north-west part of Anhui, where the area is characterized by agricultural intensification. In total, 63.7% of air mass (35.7 % NE and 28 % NW) originated from the agricultural areas, which agrees with the result from the relationship of NH_3 columns with temperature (section 3.5). At the same time, the remaining 36.3 % southeasterly air masses, came from the urban area. In addition, the PSCF of the NH_3 columns shows that NH_3 columns were mainly influenced by the central and north-east part of Anhui province (Fig. S2 (c)), meaning that agriculture is the main emission source of NH_3 over our site in autumn, similar to the pattern in spring.

Finally, in winter, 44.2 % of the air mass over the Hefei site was from the south-west, 28.3% from north-east, and 27.5% from the north (Fig. S1 (d)). The air mass from south-west originated from the western part of Anhui province, while the northerly air mass was from the Shandong province. The west part of Anhui province and the Shandong province are part of the North China Plain, which typically have intensive agriculture. In total, 71.7% of the air mass came from agricultural areas, and the remaining northeastly (28.3%) originated from the central part of Jiangsu province, which is an area that is a highly populated and polluted urban agglomeration. Thus, most NH_3 emissions in the winter were from agriculture, with a small fraction of the emissions from an urban anthropogenic source. The PSCF of the NH_3 columns also shows that the NH_3 columns were mainly influenced by central and north parts of Anhui, Shandong, as well as Henan provinces (Fig. S2 (d)), which are all characterized by intensive agriculture.

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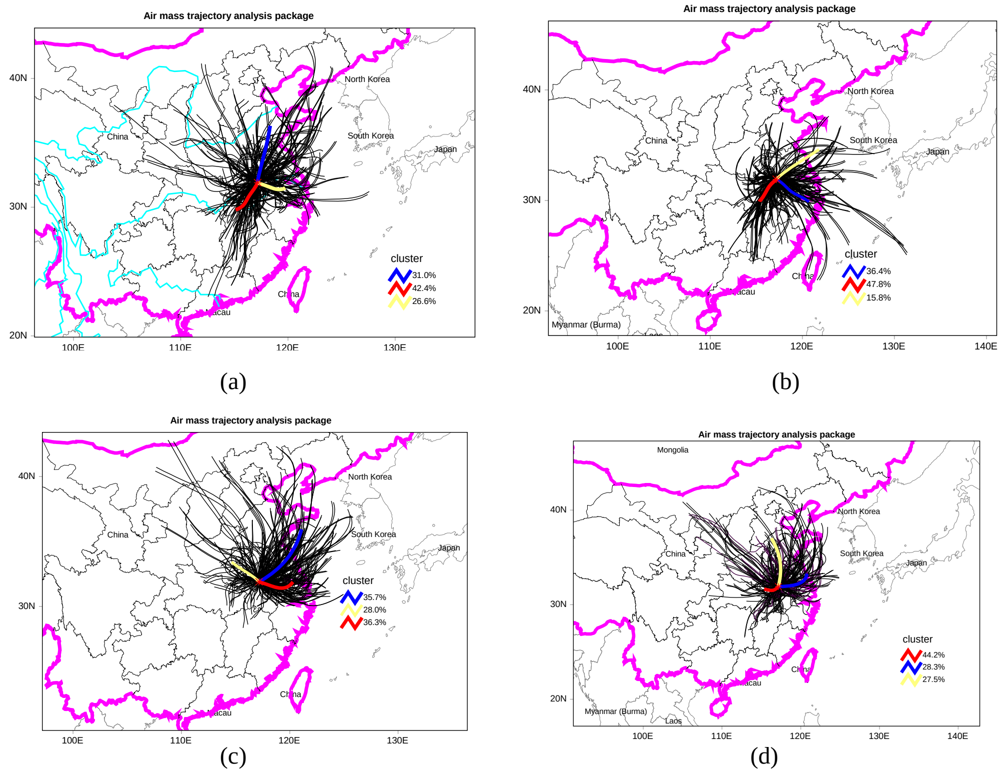

Figure S1. Backward trajectories from Hefei site during 2017 through 2018 period in (a) spring, (b) summer, (c) autumn, and (d) winter.

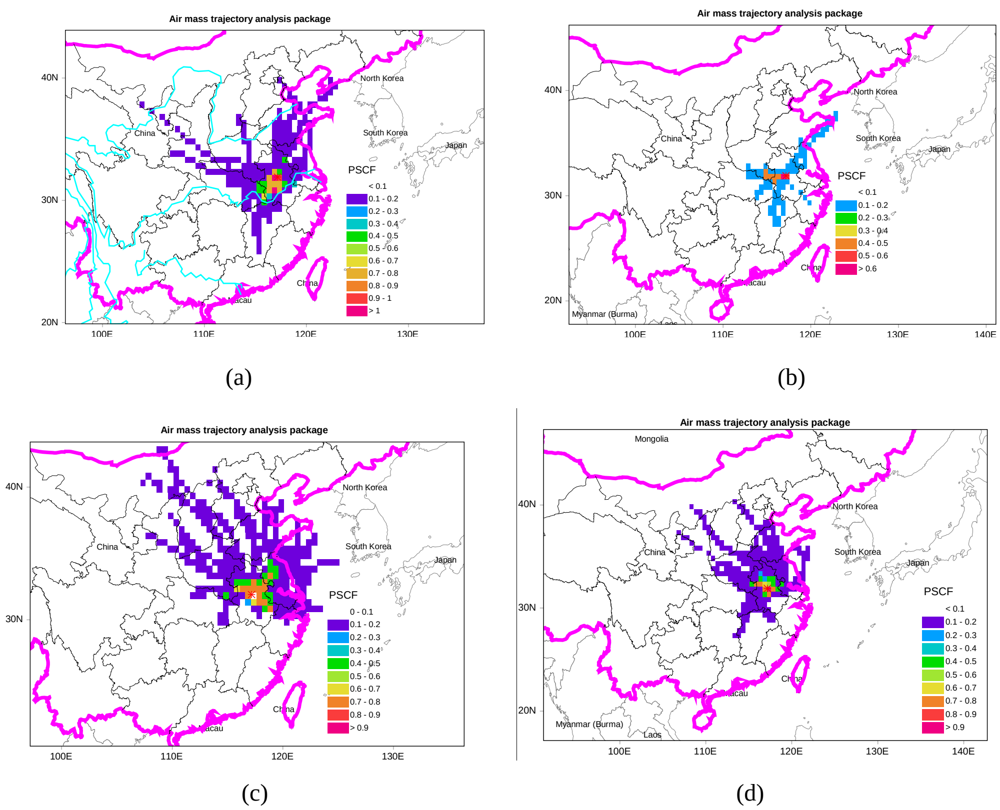

Figure S2. PSCF of NH_3 columns over Hefei site during 2017 through 2018 period in (a) spring, (b) summer, (c) autumn, and (d) winter.