Comments by referees are in blue.
Our replies are in black.
Changes to the manuscript are highlighted in red both here and in the revised manuscript.

Reply to referee #2

Nitryl chloride ($ClNO_2$) is an important precursor of atmospheric chloride radical, which influences the atmospheric oxidation and regulates the fate of air pollutants. This work conducted a comprehensive lab study of $ClNO_2$ formation from N_2O_5 uptake on eight kinds of saline mineral dust samples collected from different regions in China. The result shows that the $ClNO_2$ yield largely impacted by the chloride contents in the saline mineral dust, but the relative humidity seems have no consistent rule in influencing the yield, indicating a complicated relationship between RH and the yield. Further simulation by GEOS-CHEM model demonstrates that the heterogeneous uptake of N_2O_5 on saline mineral dusts acted as an important source for the atmospheric $ClNO_2$ during the dust event over China. Overall, this topic is interesting and within the scope of ACP, the data analysis is sound and the manuscript is well written. It can be considered to accept after addressing the following several minor comments.

Reply: We would like to thank ref#2 for reviewing our manuscript and recommending it for publication after minor revision. We have carefully addressed all the comments and revised our manuscript accordingly, as detailed below.

Line 40, suggest adding a phrase such like "in addition" before the sentence "Assuming a uniform φ(ClNO2)…", to make clear that the subsequent contents have no relationship with the previous sentence "We further found that current parameterizations significantly overestimated φ(ClNO2)…".

Reply: We agree with the referee, and the following change has been made in the revised manuscript (page 3): "In addition, assuming a uniform $\varphi(ClNO_2)$ value of 0.10 for N_2O_5 uptake onto mineral dust…"

Line 214, in Fig. 2, the RH values are not completely consistent with those listed in Table 2, pleased confirm them.

Reply: Although we would like to keep RH very constant, the actual RH fluctuated in different experiments by ±2%, as we stated in the title of Table 2. Considering the uncertainties in RH, RH values in Figure 2 are consistent with those in Table 2.

Line 244, in Fig. 3(b), the value of m_w (wet particle mass) to m_0 (dry particle mass) under different humidity should be usually in the range from 1 to more than 1 due to the hygroscopic effect. The current values can be deltam/m_0 (the ratio of mass difference to the dry mass). Suggest correcting it if there is any mistake. Same comment is put forward for Fig. 4 and 5.

Reply: In work m_w/m_0 represents the relative mass of water, equal to the relative mass increase due to hygroscopic growth. In the revised manuscript (page 14) we have modified the caption of Figure 3 to better define m_w/m_0: "Measured $ClNO_2$ yields (black symbol) and m_w/m_0 (red line) as a function of RH for (a) H1 and (b) H2. The error bar represents standard deviation, and m_w/m_0 represents normalized mass of particulate water (normalized to the mass of dry particles), which was measured as the relative increase in particle mass at a given RH compared to <1% RH." In addition, we have also modified the captions for Figure 4 and 5 accordingly.

Line 310, Figure 6 shows that when the mass ratio of Cl to total less than 0.1, the increase in $ClNO_2$ yield with respect to the increasing Cl content seems more significant at high RH condition (56% and 75%), is it possible that high RH promote the dissolution of chloride into the aerosol liquid water?

Reply: This is a very good point. In the revised manuscript (page 18) we have added two sentences to mention and discuss this issue: "Furthermore, Figure 6 suggests that when mass fractions of chloride were <10%, the dependence of $\varphi(ClNO_2)$ on Cl contents was stronger at higher RH. This is because increase in RH would promote dissolution of chloride to aqueous water and thus enhance $ClNO_2$ formation."

Line 348, here the inconsistent results between measurement and calculation may be due to the overestimated $[Cl^-]/[H_2O(aq)]$, but another possibility is that compounds suppressed the formation of $ClNO_2$ or compete with Cl^- to react with NO_2^+. I encourage the authors to do some discussion.

Reply: In the revised manuscript (page 20) we have made the following changes to explain further why the presence of insoluble minerals could suppress $ClNO_2$ formation: "Second, perhaps more importantly, saline mineral dust samples contain substantial amounts of insoluble minerals, and some of these minerals, such as clays, are very reactive towards N_2O_5 (Tang et al., 2017), and only nitrate but no $ClNO_2$ was formed (Seisel et al., 2005; Karagulian et al., 2006; Tang et al., 2012)."

Line 355-357, the sentence is not very clear. Nonhomogeneous chloride distribution across road salt aerosol particles during the field observation resulted in higher $ClNO_2$ yield than the theory prediction, right?

Reply: The observed yields are lower than the predicted values. In the revised manuscript (page 21) we have made the following modification for better clarity: "…showed that due to nonhomogeneous chloride distribution across road salt aerosol particles, observed $\varphi(ClNO_2)$ were significantly smaller than predicted values."