

We thank the referee for the constructive comments, which are added in full below (in black font). Our replies are given in blue font directly after the comments, text that has been added to the manuscript is shown in red font.

Referee #1:

Measurements of sulfuric acid, amines, ammonia, and VOC oxidation products are reported in connection with observations of atmospheric new particle formation (NPF) at a rural site in Germany. Focus of the manuscript is on showing that the nitrate CI-API-TOF instrument is capable of measuring in ambient conditions ammonia, amines and oxidation products of organic compounds. These have been identified in recent laboratory studies to enhance sulfuric acid–water nucleation rates to atmospheric levels, therefore detecting them in atmospheric measurements is highly relevant for the current nucleation research. The measurements of sulfuric acid are further evaluated by comparing to steady-state proxy concentration. Reporting the proxy coefficients for this environment provides valuable information, since ambient measurements of sulfuric acid are rare, and the proxies have been widely used in different environments.

The CI-API-TOF data is used to make comparisons between days with and without occurrence of NPF, in order to find out which precursor species affect NPF at this site. No definite participation of ammonia, amines or HOMs to nucleation at this site could be made, but the possible reasons for this are adequately discussed in the manuscript. Also comparisons to chamber measurements from the CLOUD experiment are made. The manuscript is well suited for publication in Atmos. Chem. Phys. I have listed some minor comments and correction/clarification suggestions below (in addition to those made by the anonymous referee 2).

Minor and technical comments:

(1) Line 35: "... a larger fraction ..." should be "... a large fraction ..."

Done.

(2) Line 78: Please add the abbreviation HOM here, as it is used later in the text.

Done.

(3) Lines 208–210: What are the detection limits for the SO₂, O₃ and NO_x monitors? In section 3.2, the lowest SO₂ concentrations of 0.05 ppb sound quite low for a standard SO₂ monitor.

The detection limit for SO₂ is reported as 50 pptv (= 0.05 ppbv, for an integration time of 5 minutes) by the company. For the same instrument an even lower detection limit has been reported by Berresheim et al. (2014, ACP) for an integration time of 1 h. The information about the detection limits of the instruments have been added to the beginning of Section 2.4:

"The detection limits of the gas monitors are 0.05 ppbv for the SO₂ monitor (for a 5 minute integration time), approximately 0.5 ppbv for the NO_x monitor and 0.5 to 1 ppbv for the O₃ monitor."

(4) Line 202: Does this mean the reaction rate constants for the proton transfer reaction in the PTR-MS are similar for different monoterpenes, and therefore are detected with similar efficiency as alpha-pinene?

Yes, the different monoterpenes are detected with similar efficiency by the PTR-MS. Since they all have the same mass (they are mainly detected at a mass to charge ratio of 137 Th, i.e. C₁₀H₁₇⁺) the PTR-MS cannot distinguish between the different monoterpenes and therefore only the total monoterpene mixing

ratio can be reported. However, α -pinene generally accounts for the largest fraction among all the different monoterpenes. We feel that this is sufficiently explained in Section 2.3 and therefore did not make any adjustment to the text.

(5) Lines 242–244: Please check whether it was 6 or 7 NPF days during the campaign. In Section 3.9 (line 590) it is said 7 events and also Fig 9 shows seven J values.

NPF rates are reported for 6 campaign days. However on one campaign day there were 2 clear particle formation events; therefore 7 rates are reported. We have added this information to the text to avoid confusion. The following information was added to the beginning of Section 3.9:

“It should be noted that clear NPF was observed only on 6 days, however, for one day two NPF rates were derived, which results in a total of 7 NPF rates.”

(6) Line 600: Why is the condensational growth out from the 2.5–10 nm size range not considered in Equation 7? That is an additional loss term for particles in this size range, so the right hand side of Eq 7 should have an additional term $GR/(7.5 \text{ nm})^*N$ (see Kulmala et al. (Nature Protocols 7, 1651–1667, 2012), Equation 9).

The referee is correct. The growth term was accidentally neglected. Including this term does not change the formation rates significantly (on the order of a few tens of percent, only for two events by a factor of ~2). However, the term should of course be included and it was considered in the revised version of the manuscript. Regarding the interpretation of the NPF rates this modification does not lead to any different conclusion

In the context of this comment the reference to Kulmala et al. (2012, Nature Prot.) was added.

(7) Caption text of Figure 1: Please add a mention that the arrows in the bottom panel indicate NPF days. Also check whether there should be six or seven days marked as NPF days (Fig. 9 shows J rates for seven days).

Done (see also reply to comment (5)).

Additional changes made:

- Fig. 3, Fig. 5, and Fig. 8: x-axis has been changed to show actual times and not seconds.
- Section 3.6: the explanation for the formation mechanism of NDMA was revised because it is not via a gas-phase reaction between DMA and HONO; instead DMA reacts with OH and NO; the references Pitts et al. (1978), Glasson (1979) and Grosjean (1991) were replaced by the reference to Nielsen, Herrmann and Weller 2012)

References

Berresheim, H., Adam, M., Monahan, C., O’Dowd, C., Plane, J. M. C., Bohn, B., and Rohrer, F.: Missing SO₂ oxidant in the coastal atmosphere? – observations from high-resolution measurements of OH and atmospheric sulfur compounds, *Atmos. Chem. Phys.*, 14, 12209–12223, doi:10.5194/acp-14-12209-2014, 2014.

Kulmala, M., Petäjä, T., Nieminen, T., Sipilä, M., Manninen, H. E., Lehtipalo, K., Dal Maso, M., Aalto, P. P., Junninen, H., Paasonen, P., Riipinen, I., Lehtinen, K. E. J., Laaksonen, A., and Kerminen, V.-M.: Measurement of the nucleation of atmospheric aerosol particles, *Nature Prot.*, 7, 1651–1667, doi: 10.1038/nprot.2012.091, 2012.