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Title: Different characteristics of new particle formation between urban and deciduous forest sites in northern Japan during the summers of 2010–2011

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Responses to the reviewer's specific comments and questions;

Reviewer #1 (Comments):

The paper "Different characteristics of new particle formation between urban and deciduous forest sites in northern Japan during the summers of 2010–2011" by Jung et al. deals with the classical site-approach of the atmospheric new particle formation (NPF). The study is based on two different field campaigns conducted during summer time in 2010 and 2011 at two different sampling sites: a urban area (2011) and a mixed deciduous forest (2010) on the Hokkaido island, Japan. Authors compare NPF events in term of frequency, condensation sink, and growth rates. The key point of the paper is that the two sites are nearly located (2 km) and thus that the forest site could be under the influence of a urban pollution plume depending of the wind direction. Using this specific configuration, authors suggest that the interaction between a pollution plume (sulfur-rich & organic-rich) and an environment enriched with isoprene which would lead to produce a NPF event in acidic conditions. Another important point is that during urban NPF event authors pointed out the different role of sulfuric acid (nucleation) and organic compounds (growth). The work presented in this paper is suitable to be published in ACP after minor revisions.

Specific comments

p14046, lines 14 and further – Please include also in your analysis the work at high altitude site conducted by Boulon et al. (2010) and Boulon et al. (2011)

Response: The phrase "Boulon et al., 2010, 2011" has been added. Please see line 87 in page 4 in the revised MS.

Following phrases have been added. Please see lines 89-92 in page 4 in the revised MS.

"17.5% at Jungfraujoch (3580 m a.s.l.) in the Swiss Alps (Boulon et al., 2010), 20.8% at the Opme station (660 m a.s.l.) and 35.9% at the puy de Dôme research station (1465 m a.s.l.) in central France (Boulon et al., 2011)"

Two references have been added in the reference section.

"Boulon, J., Sellegri, K., Venzac, H., Picard, D., Weingartner, E., Wehrle, G., Collaud Coen, M., Bütikofer, R., Flückiger, E., Baltensperger, U., and Laj, P.: New particle formation and ultrafine aerosol climatology at a high altitude site in the Alps (Jungfraujoch, 3580m a.s.l., Switzerland), Atmos. Chem. Phys., 10, 9333 – 9349, 2010.

Boulon, J., Sellegri, K., Hervo, M., Picard, D., Pichon, J.-M., Fréville, P., and Laj, P.: Investigation of nucleation events vertical extent: a long term study at two different altitude sites, Atmos. Chem. Phys., 11, 5625–5639, 2011."

p14047, lines 0-5 – Author should also mention the work of Metzger et al. (2010) on organic & sulfuric acid nucleation experiments

Response: Following sentence has been added. Please see lines 108-110 in page 5 in the revised MS.

"Metzger et al. (2010) also reported that organic compounds together with sulfuric acid likely initiate the nucleation process."

One reference has been added in the reference section.

"Metzger, A., Verheggen, B., Dommen, J., Duplissy, J., Prevot, A. S., Weingartner, E., Riipinen, I., Kulmala, M., Spracklen, D. V., Carslaw, K. S., and Baltensperger, U.: Evidence for the role of organics in aerosol particle formation under atmospheric conditions, P. Natl. Acad. Sci. USA, 107, 6646–6651, 2010."

p14055, lines 14-15 – Having a GF of 1.1 – 1.2 is not exclusively the signature of organic aerosols. Actually a GF of ~1.2 is also the fingerprint of "sulfate" aerosols. To my knowledge, organic aerosols may have very wide range of GF values according to the chemical nature of the organic vapor, from non-hygroscopic (e.g. alkane) to highly hygroscopic (e.g. carboxylic acid). Therefore, I think this statement is a bit speculative and need more details.

Response: Following sentences have been added. Please see lines 340-344 in page 15 in the revised MS.

"Internal mixtures of sulfate with dominant fraction of organics are also possible at the urban site during the nucleation periods. The g(85%) (1.11–1.22) of freshly nucleated particles can be explained by internal mixtures of non-hygroscopic organic compounds with highly hygroscopic ammonium sulfate having g(85%) of 1.56 (Jung et al., 2010). "

A reference has been added in the reference section.

"Jung, J., Kim, Y. J., Aggarwal, S. G., and Kawamura, K.: Hygroscopic property of water-soluble organic-enriched aerosols in Ulaanbaatar, Mongolia during the cold winter of 2007, Atmos. Environ., 45, 2722–2729, 2011."

p14056, lines 5 and further – Authors describe events at both sites, urban and forest sites. Since SO2 data are available, authors could use the statistical proxy from Mikkonen et al. (2011) to estimate the sulfuric acid concentration. Therefore, they could conduct a deeper analysis on the conditions that promote the detection of NPF at both sites, at urban site only etc... It would allow to test whether or not sulfuric acid is enough to explain the observed growth assuming a kinetic regime or if another condensable vapor is needed to explain what is observed.

Response: Because total radiation was not measured during the measurement period in the forest site, the equation for the proxy calculation by Mikkonen et al. (2011) cannot be applied to our calculation. Instead, a proxy calculation equation by Petäjä et al. (2009) was used in this study using UV-B radiation data obtained at the forest site. Because radiation data was not available at the urban site, H_2SO_4 calculation was only conducted at the forest site.

Because calculated sulfuric acid concentrations in Fig. 10 represent the values at nearby urban observatory, a deeper analysis of NPF mechanism at the forest site is impossible. Thus, future field studies are needed for a deeper analysis of NPF mechanisms at both sites with additional observations of gases and meteorological parameters.

Following sentence has been added. Please see lines 492-495 in page 22 in the revised MS.

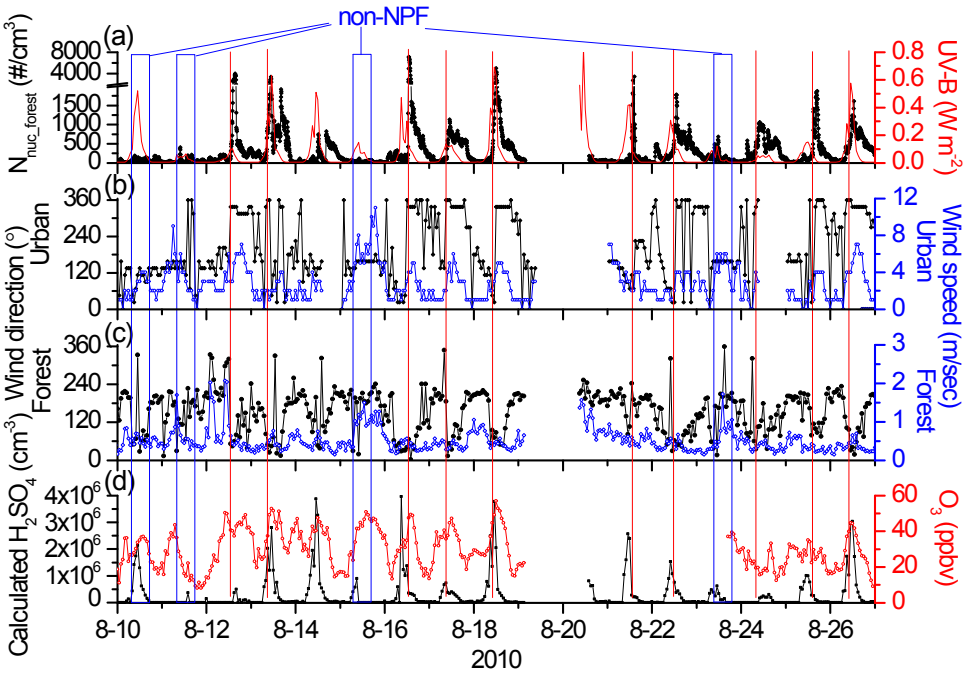
"H_2SO_4 concentration was calculated using the SO_2 concentration, CS, and UV-B radiation data based on an equation for the proxy calculation by Petäjä et al. (2009) (Fig. 10d). Increased H_2SO_4 concentrations were clearly observed during the NPF event periods at the forest site (Fig. 10d)."

A reference has been added in the reference section.

"Petäjä, T., Mauldin, III, R. L., Kosciuch, E., McGrath, J., Nieminen, T., Paasonen, P., Boy, M., Admov, A., Kotiaho, T., and Kulmala, M.: Sulfuric acid and OH concentrations in a boreal forest site, Atmos. Chem. Phys., 9, 7435–7448, 2009."

Figure 10 has been modified as below.

Fig. 10



Also, it would be meaningfull to follow the property of air masses at both site to track and confirm if the nucleation is triggered at the forest site when the polluted air mass form the urban area reach the forest measurement zone. Similar approach have been done to study the vertical extend of nucleation events in mountaneous area (see Boulon et al., 2011b)

Response: Because the forest site was located near urban Sapporo (<10 km south) and HYSPLIT backward trajectory has high uncertainty in small scale simulation, we did not use backward trajectory analysis. To trace movement of air mass over urban and forest sites, we used local wind direction and wind speed data as shown in Fig. 10b,c.

p14046, line 15 – misspelling "Mout Norikura"

Response: The phrase "Mout Norikura" in page 14046, line 15 has been changed to "Mount Norikura". Please see line 89 in page 4 in the revised MS.

Additionally, following reference has been added in the introduction section.

"Mikkonen, S., Lehtinen, K. E. J., Hamed, A., Joutsensaari, J., Facchini, M. C., and Laaksonen, A.: Using discriminant analysis as a nucleation event classification method, Atmos. Chem. Phys., 6, 5549–5557, 2006."