

This manuscript focuses on ultrafine particle growth events at a site influenced by both anthropogenic and biogenic sources. The WRF-Chem model is run with different nucleation and growth parameterizations and the predicted concentrations are compared with observations at the site. The authors conclude that anthropogenic SO₂ controls nucleation whereas condensation of monoterpene oxidation products controls the growth. Nucleation is estimated to contribute 65% of the CCN at 0.5% supersaturation at the site.

The scientific approach and applied methods seem valid, and the authors have done a good job in investigating several different aspects that may influence the growth events. However, for a manuscript to be published in ACP it needs to include “substantial new concepts, ideas, methods or data”. The authors need to state clearly in the introduction what is novel in their approach compared to the existing literature. The manuscript is reasonably well written in most sections, although some paragraphs need to be more clearly written or require more information.

Specific comments:

1. Page 5622, lines 13-17: Here it is mentioned that the correlation coefficient between N_{4-30 nm} and SO₂ is 0.8, and the authors state that “the inflow of anthropogenic pollutants impacts APEs at the MEFO site, and that the APEs are likely initiated by the products of SO₂ oxidation”. In Fig. S3 in the Supplementary material, data of NO₂ and CO are presented. It would be interesting to see the correlations of N_{4-30 nm} with NO_x and CO since these are tracers for primary emissions. Furthermore, I think NO_x and CO (or at least one of these) should be added to Fig. 3. If NO_x or CO is higher during APEs, it is likely that primary aerosol particles contribute to the “inflow of anthropogenic pollutants” and to the APEs.

2. One issue that needs to be discussed more thoughtfully throughout the manuscript is the increase in CCN concentration during the APE events. For instance on page 5624, lines 9-10, the authors write “that nucleated particles had a few hours to grow before arriving at the measurement site”. In the Conclusions section, the authors write “SO₂ plumes advected from the Colorado Front Range combined with biogenic monoterpenes significantly affect particle number concentrations and CCN during APEs”. It is very unlikely that aerosol particles, containing large amounts of organics, activate at a supersaturation of 0.5% if they are smaller than 50 nm (see e.g. Fig. 1 in Dusek et al. (2006)). Given the observed growth rates of 2.3 nm hr⁻¹, it would take ~22 hours for the particles to reach a diameter of 50 nm. Therefore, the increase in CCN concentration during the afternoons on APE days cannot be associated with the growth of particles that were nucleated only a few hours away. To me it seems that the higher CCN concentrations on APE days are not a result of the APEs themselves but rather a result of higher monoterpene and SO₂ concentrations on APE days (Figs. 3a-b) resulting in enhanced growth of pre-existing particles. In Fig. 3e it is clear that concentrations of particles larger than 70 nm are also higher on APE days than on Non-APE days.

3. Page 5623, line 28 to page 5624, line 3: This paragraph needs to be more clearly written. On page 5623, line 28 it is written: “Jung et al. (2013) compared APE burst time and particle number size distribution at an urban site and a forest site, and found that late APE burst time and broader particle number size distributions were observed at the forest site than at the urban site. Figure S1 shows similar results for this study.” To me it is not clear how you can observe in Fig. S1 what Jung observed. What time periods are the different size distributions in Fig. S1 averaged over? Do these size distributions represent the beginning of the APE events or the whole events? The following sentence: “These characteristics imply that several hours are needed for urban plumes to reach the site

and that new particle formation is happening most likely hours away from the site”. Are these conclusion drawn from Fig. S1?

4. Page 5622, lines 22-23: “Significantly higher mean values are observed during APE days for both monoterpenes and SO₂”. The authors link the higher SO₂ concentrations to “anthropogenic inflow” and on next page to air masses from industrial sources located in the Colorado Springs area, but what is the reason for the higher monoterpene concentrations when advection is from these areas?

5. Page 5629, lines 22-23: “clear difference in the relative abundance of sulfate during the APE (63%)...”. Was this the case also for other APE days than 10 August?

6. Page 5617, line 20: What instrument was used to measure the CCN concentrations?

Technical corrections:

Larger fonts are needed in Figs. 5, 6, 7, and 9.

Page 5630, line 12: should it be 10⁻⁶?

References:

Dusek et al.: Size matters more than chemistry for cloud-nucleating ability of aerosol particles, Science, 312, 1375-1378, 2006.