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Atmospheric Chemistry and Physics Discussions

Interactive comment on "New-particle formation events in a continental boundary layer: First results from the SATURN experiment" *by* F. Stratmann et al.

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GENERAL

This study briefly reports on boundary layer new particle formation events in Germany. The topic of new particle formation is critically important to understanding aerosol sources and presents of the most difficult challenges in terms of under-pinning the fundamental processes driving this phenomenon. The work presents for the first time measurements throughout the boundary layer during a continental new particle formation event and should help elucidate the phenomenon, however, the results presented falls short of achieving this. The manuscript will require major revisions before being suitable for publication.

DETAIL

The main results indicate that, for a typical case study, around sunrise, and during the start of the new particle production event, the BL comprises a surface layer about 200 m deep, which contains nucleation mode particles, then above the surface layer inversion, there exists a 50 m layer in which no nucleation mode particles are observed, then, above this 50 m layer (i.e. in the main residual layer), more nucleation mode particles are observed.

Clearly the evolving surface layer and the 50 m layer are decoupled from the main residual layer. Two hours later the surface layer has evolved to 500 m, (incorporating into it the residual layer?) and nucleation mode particles are seen throughout this layer, but not above it. So, initially, there are two layers with new particle formation. In Figure 15, during the horizontal balloon run at 600 m, large changes are seen in the nucleation mode concentration and this is attributed to (1) there not being any new particles in the RL (which is contradictory to the previous statements) and (2) convective transport of the surface layer nucleation mode into the RL layer. Is this RL layer that the authors speak of really the FT? If not, is there any explanation of why there is no nucleation mode particles in the RL?

The new particle formation in the surface layer seems to be attributed to traffic emissions - is this really the case? If it is, why are these events linked to the break-up of the nocturnal boundary layer? Is it simply coincidence with rush hour?

Two peaks seem to appear almost simultaneously, one at 5 nm and the other at 15 nm, yet the 15 nm mode is attributed to downward mixing from the RL. By the way, it is stated that both modes grow but it is hard to see any growth in the 15 nm mode.

It is mentioned that growth rates are of the order of 6 nm per hour, however, this is taken from an unrelated study. Why not derive the actual growth rates from the data? I suspect it is smaller than this. The first main peak is seen at 8 am in the 5 nm size class and four hours later it is about 15 nm. This is a growth rate of 2.5-3 nm per hour. So, if the growth rate is 3 nm per hour, that puts nucleation of 1 nm particles before the

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break-up of the nocturnal surface layer! This section need more convincing analysis.

The 15 nm mode that is entrained from the RL layer is termed a newly-formed mode. If there is a similar growth rate in the RL (and I suspect it is actually lower than in the SL), this means that the particles in the RL were formed about 4-5 hours previously, which was probably before sunrise. So, where do these particles come from? Again, more convincing analysis is required rather than unsubstantiated statements.

One case was presented: can it be said that the same features are observed on other days, i.e. a thin sandwich layer without particle formation. This paper would be better focused if it characterised all the events during the project so the readers get an idea of how representative the current measurements are. Are there consistent features associated with the events? Is this just one random sample? Doing such a characterisation paper would set the scene for more detailed analysis in future work. In its present form it neither presents characterisation nor analysis of the events so we learn very little.

In summary, very little is elucidated on the new particle formation question in this work, and to be honest, after reading the manuscript a number of times, I am somewhat confused as to what the conclusions are:

Are there two sources of particles?

What are the sources?

Where does the nucleation occur - ML or RL or both or both at different times? What roles does the NBL break-up play? Does it dilute ML condensation sinks and promote nucleation or is the mixed layer nano-particle particle population sources from traffic emissions.

There is really very little analysis only speculative statements made which may or may not be true. If the authors do not wish to do a characterisation paper, then this work should be restructured to identify questions to be answered and then address the questions through a more rigorous analysis. There are sufficient contributors to this

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manuscript to make it more robust.

A detailed study on similar nucleation and growth events can be found in the Nilson et al Tellus/BIOFOR paper which is not referenced. They highlight a number of hypothesis regarding the source of the particles and then set about to try and address the hypotheses.

Major revisions are required to make this manuscript suitable for publication.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 1693, 2003.