Interactive comment on “High occurrence of new particle formation events at the Maïdo high altitude observatory (2150 m), Reunion Island (Indian Ocean)” by Brice Foucart et al.

Manuscript published for discussion on 27 September 2017.

The authors would like to thank the reviewers for their very constructive and informative comments. These comments and suggestions have helped us to improve the quality of our manuscript, including strengthening our conclusions with additional evidences of likely precursors. Below we have responded to each of the reviewers comments. **The reviewers comments are in bold** and our responses are in normal text. Please, note that the structure of the article has been modified (especially for 4.1 and 4.6 sections), several figures had been replaced by others and we added new ones.

The new plan is as follow:

Abstract

----- 1 Introduction

----- 2 Characteristics of the Maïdo observatory

---------------- 2.1 Geographical location and networks

----------------- 2.2 Large and local scale atmospheric dynamics

----------------- 2.3 Potential gas-phase precursor sources

-------------------------- 2.3.1 Sulfur dioxide (SO_2) and sulfuric acid (H_2SO_4)

-------------------------- 2.3.2 Ammonia (NH_3) and amines

-------------------------- 2.3.3 Volatile Organic Components (VOCs)

-------------------------- 2.3.4 Phytoplankton

-------------------------- 2.3.5 Biomass burning

---------------- 2.4 Instrumentation used

----- 3 Calculations

----- 4 Results and discussion

----------------- 4.1 Dynamics of the NPF events at Maïdo observatory

----------------- 4.2 Nucleation and frequency analysis

----------------- 4.3 Particle formation, growth and nucleation rates

---------------- 4.4 Meteorological parameters and onset of NPF

---------------- 4.5 Condensation sink

---------------- 4.6 Black Carbon as a tracer of the anthropogenic contribution

5 Conclusions

Acknowledgments

Figures modifications:

The Figure 3 has been modified: We added the BC dataset

The Figure 4 is now composed of two figures with **a)** July 6th 2015 diurnal variation of negative ions (1-10 nm) and (10-700 nm) aerosol particle size distribution (note the different concentration scales for ion number and particle concentrations) and **b)** the BC concentration variation in $ng.m^{-3}$

The Figure 5 (DMPS spectra for 31 January and 25 March) has been displaced to the supplementary as **Figure A2**. **The Figure 5** is now "The average diurnal variation during winter and summer of the **a)** BC concentration, **(b)** number concentration of particles which diameter is larger than 100 nm (N_{100}) and **(c)** number concentration of particles which diameter is smaller than 30 nm (N_{30})".

We associated **Figure 11** to Figure **10** which is now composed of **a)** "The monthly CS_2 and event frequency" and **b)** "The monthly CS_{2prop} exceeding the average". The Figure 11 has been replaced by a new one.
We added a new **Table 2** which deals with "The R correlation coefficients giving the relationships between NPF parameters and influencing factors".

References modifications:

We added three new references which are:

- Mirme et al., 2007 at line 219
- Kulmala et al., 2001a at line 250
- Hermann et al., 2015 at line 304

Response to the public short comment (SC1):

Received and published on 17 October 2017,

SC1-1: Interesting paper about the occurrence and diurnal patterns of ultrafine particles at a high elevation tropical site.
However, the conclusions drawn about new particle formation and growth probably need to be revised with a more detailed discussion of diurnal advection processes.

The authors mention and discuss large and small scale atmospheric dynamics in section 2.2 and show picture of an advection pathways (fig. 1). That's important for this study. But, unfortunately the impact of the local diurnal advection processes on the aerosol composition at the site mentioned in sections 4.3 and 4.4 is not further discussed despite the clear statement in section 4.3: "It's noteworthy that, at high altitudes, the conditions of spatially homogeneous air masses and a steady state, necessary to calculate a realistic growth rate are not verified since air masses are progressively advected to the site from lower altitudes".
The site is located on top of a 12 km long and 700 m high concave volcanic ridge which is opening to the east. This is a perfect textbook location of an orographic structure for the production of early morning thermals. With these thermals air parcels from either Le Port or from St. Andre arrive at the station about two hours after sunrise, depending on the thermal intensity and well in agreement with the observation the appearance of particles at the site (fig. 10). The site is thus a perfect location for an advection study of particles produced elsewhere, most likely close to the coastline. But, that would require to characterize in more detail the thermal upwinds and to relate these to the aerosol and other meteorological data and also to discuss the sources and characteristics of ultrafine particles with the upwind areas.

AR1-1: We agree that the Maïdo Observatory is the perfect location for the production of early morning thermals. Unfortunately, we do not have the data to analyse in detail thermal upwinds, but we now added a BL tracer diurnal variations for different seasons, which allows us to further discuss the role of BL air advection to the site.

SC1-2: Sources for emissions of primary ultrafine particles in these locations besides traffic are shipping activities in the port (Le Port), a diesel fired power station in Le Port and probably emissions of a sugar refinery and thermal power station in St. Andre. It's well known that such sources emit particles in the nucleation mode sizes, not only from fossil fuel burning but also from sugar refining. New particle formation via gas to particle conversion during transport naturally cannot be excluded. However, according to Kulmala et al (2013) such a process would take several hours, most likely far more than the two hours of fig. 10 until these new particles would be visible in the SMPS data.

AR1-2: Because nucleation mode particles precede the accumulation particles that are representative of BL air parcels, we believe that nucleation is initiated during transport and it not already present in the BL before being advected to the site. This is now mentioned in the text. The origin of the precursors is still unknown though and would indeed need more investigations.

SC1-3: Comparing diurnal patterns of water vapor data from meteorological stations at Le Port or St. Andre and Maido and possibly potential temperature calculated from the in situ temperature at Maido could be helpful for further analysis.

AR1-3: This is a good suggestion, but we now use BC and N_{100} as tracers of BL air influence.