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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Relation of air mass history to nucleation events in Po Valley, Italy, using back trajectories analysis" *by* L. Sogacheva et al.

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The authors would like to thank the Referee 1 for his/her constructive comments and suggestions that helped to improve the value of this manuscript.

Response to the General comments:

The aerosol sampling has been taken at 3m height above the ground. The accuracy of air masses back trajectories decreases over the complex terrain, to which the measurement site belongs. To keep the balance between the negative impact of the complex terrain to the back trajectories accuracy and the desire not to move far from the measurement point event in case of boundary layer weak mixing, the 100m arrival height for the air masses back trajectories has been chosen. Besides 100m, the air

masses back trajectories have been calculated for SPC at 1m and 250m arrival height. However, the difference in trajectories was minor and these results are not presented in the current manuscript. As it was mentioned by Hamed et al. (2007), the breeze between very populated and polluted plains and the Alps controls the concentration of trace gases and aerosols and henceforth affects the events frequency distribution. Thus the local terrain influence, which is less described by 500m and 1500m trajectories, might be the key point to the explanation of the difference in distribution of the nucleation events between the SPC, located 30 km northeast from the city of Bologna, and Ispra, located at a rural area in Lombardy region, northern Italy, close to Milan conurbation. Very few air masses arrived at SPC cross Milan conurbation, which, being much polluted area, may trigger new particle formation. Besides of the influence of the local conditions, the authors consider the origin and air masses history very important in new particle formation. The origin, which is regarded as a location of the air mass 96h before the arrival at the station, explains the main air masses properties, such as temperature and relative humidity, which, together with chemical composition, are the key parameters for the process of new particle formation. The history, which is presented in manuscript as the back points at 12h, 24h, 48h, and 72h, is important as well, because such an analysis allows us to estimate the potential influence of the underlying territory on the air masses properties. Such an influence is very important when air parcel travels within boundary layer. However, for air parcel, arrived at 1500m height over the measurement point, the influence of the underlying area is less important, because it travels to the recipient above mixing layer for the most part of the path and it is the author's opinion that the meteorological parameters at 1500m height are not the key parameters trigging or suppressing the increase of the aerosol particles close to the measurement height.

Meteorological parameters, as well as air parcel height, have been investigated along the whole path of the air parcel trajectory, 96 hours back in durations. The authors do not conclude about the priority role of the weather conditions at the point of air mass origin, 96 hours before the nucleation is observed at SPC. However, the tendency of

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the meteorological parameters, which shows how fast the properties of air masses change, seems to be important. The main conclusion was done about the difference in subsidence height, temperature, relative and absolute humidity between event and nonevent trajectories during 12 hours before the arrival at the station (Figures 3, 4). Authors agree with the Referee about the importance of the estimation of the thermodynamic conditions. The available data allow us to speculate about the intensity of the turbulent processes using the mixing layer height data along the trajectory and at the recipient. Unfortunately, the other data is out of our disposal and we are not able to give more detailed conclusion in present manuscript.

Response to the Specific Comments:

Section 2: "Site description" The paragraph of the typical synoptic conditions during winter time is moved to Section 6, where we describe the synoptic conditions for the rest seasons.

Section 4: "Classification of the new particle formation events". Nucleation event classification at SPC is described more detailed in Hamed et al., 2007, reference is given. However, we agree with the Referee that more detailed definition is needed in present manuscript as well. The explanation of the undefined days is replaced by: "The days which did not fulfill the criteria to be classified as event or nonevent days were combined into one group, called undefined days."

Section 7: "Meteorology along the trajectory" Authors agree with the Referee that the first part of Section 7 has to be moved to Section 5, where the Hysplit model is described. Authors agree, that the vertical wind speed can't describe the influence of the underlying area to air parcel properties. The last statement was implied to horizontal wind speed. We considered the vertical wind speed as a parameter to estimate the subsidence of air parcel. This will be clarified in manuscript.

p.11217, line 5 Authors agree to remove the statement about the local wind. However, typical conditions are described in Section 6 to explain the seasonality in air masses

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mobility and main transport directions, Figure 2. The air parcel height along the whole 96 hours trajectory is important because in comparison to the mixed layer depth we can estimate if the air parcel traveled within boundary layer or above and exclude from the emission sources analysis those cases when the influence of the underground surface was negligible.

p.11219, line 10 and following: Authors do not agree with the Referee 1 that "the discussion about the relative and absolute humidity and temperature is trivial since the all parameters are depending on each others". Relative Humidity, which is one of the key parameters, explaining the probability of nucleation events, and Absolute Humidity, or water content, being also the function of the ambient temperature, does not linearly depend on each other. Considering the absolute humidity to be the important parameter for nucleation as well, authors decided for more detailed description to present both Relative and Absolute humidity figures, especially since the Figure 4e gives additional information and does not overburden the manuscript.

Authors agree to remove the statement at line 15.

Authors agree with the Referee 1 that the general structure of the vertical velocity (fig. 5b) is similar. However, the main conclusion from that figure is not the 5mm/s difference between 4 cases during the last 6 hours before the arrival, but the strongest median vertical velocity for event class 1 trajectories, comparing to weakest nonevent cases for the period between 12 and 6 hours before the arrival. Even if the difference is not very high, the tendency in decreasing of vertical velocity from event class 1 to event classes 2 and 3 is observed.

Section 8: Authors agree with the Referee 1 that the analysis presented in that section is important. However, the aim of the manuscript was first of all to consider the history of the air masses from the point of view of meteorological conditions along the air mass back trajectories for different classes of new particle formation observed at SPC. The more detailed analysis on the emission sources for SPC we are planning to present in

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separate manuscript.

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