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## ***Interactive comment on “Airborne measurements of new particle formation in the free troposphere above the Mediterranean Sea during the HYMEX campaign” by C. Rose et al.***

### **Anonymous Referee #1**

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Paper “Airborne measurements of new particle formation in the free troposphere above the Mediterranean Sea during the HYMEX campaign” by Rose et. al. focuses on analysis of aerosol number density and size distribution over the NW Mediterranean. Airborne data from ATR42 research aircraft are analyzed with aim to describe new particle formation in lowermost free troposphere. At current stage I cannot recommend the manuscript for publication in ACP before following major comments are addressed by authors:

1) Main conclusion of the study is a claim that lower FT over the studied region is a region where new aerosol particles are observed. It is correct, but on my opinion

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authors misinterpret the observations. There is also another plausible explanation. Altitude range where they observe majority on new aerosol particles is also shallow cumulus convection cloud layer. It has been shown in several publications elsewhere that new particle are formed in vicinity of these clouds. Specific feature is that these particles are usually observed in a narrow size range with mode between 15 and 30 nm. The same mode as shown on Fig. 10. I wonder how authors can claim that they observe new particle formation if the shape of the size distributions is clearly “closed” with no particles below 10 nm. If authors observed new particle formation they should see, while flying through such region, also many “open size distributions” co-located with high N5-10 aerosol concentrations. No such data are shown. Also horizontal extend of NPF events in Fig. 3 indicates that these features are of limited extend. Thus I would like to ask authors to carefully analyze data with respect to presence and altitude range of clouds in vicinity of measurements.

2) Continuing from point 1), authors should use ATR core data, trace gas measurements and AMS data to show clearly that the air where they observed new aerosol particles is actually free tropospheric air and not the air recently transported by convection to the altitude where observations have been performed. Excluding the large scale advection the only mean of such transport is convection. If new particles are found in recently convectively lifted air which, then the results cannot be presented as nucleation in free troposphere, but it is additional observation on new particle formation associated with convective clouds and their outflow. Such air will have different chemical signature from FT air as well as different water vapor content. Without this rigorous analysis present conclusions are more of a speculation and not results of robust analysis.

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