

Aktypis et al analyzed particle number size distribution measurements from two summer campaigns in 11 sites in Greece. Their findings indicate that new particle formation (NPF) frequency in Greece is very heterogeneously divided, with areas in the northeast of Greece showing both higher average emissions and higher frequency of NPF than in the southern and western part of Greece. Their findings connect the higher NPF frequency with higher anthropogenic emissions in the prevailing air masses in the area and suggest that ammonia and/or amines could be the limiting factor for NPF in the area. This shines light into the possible NPF mechanisms in the Eastern Mediterranean and characterizing the spatial extent of NPF is an important new contribution into literature. The paper is well written, and the methodology is sound, but the paper would benefit from some clarifications regarding both terminology and conclusions. Therefore, I believe it can be recommended for publication in ACP after minor revisions.

General Comments

Line 40: “Atmospheric nucleation and...” (also other places, e.g. line 32, Fig 4 caption). Recent studies suggest that new particle formation may not technically always require nucleation (overcoming an energy barrier) as the initial cluster are already stable. Also, since your measurements start mainly at 14 nm, you cannot really conclude about the initial steps of particle formation. Therefore, I would generally be careful of using the term “nucleation” here and other places in the manuscript.

Line 103: “The sites were classified as urban, suburban, and rural according to the criteria proposed by Larssen et al. (1999)” This classification is not easily identifiable from the text. The classification could be added to Table 1.

Line 140: The assumption that Xanthi and Xylagani are both representative of the broader Thrace region is poorly explained. Wouldn't a location with a major road nearby and a peri-urban location have more anthropogenic influence in comparison to a smaller rural site?

Line 200: What is your criteria for a weak NPF event?

Line 241: You cannot observe the full nucleation mode if your measurements starts from 14 nm. Do you mean that when the observed geometric mean diameter started increasing? Note, that this might significantly differ from the actual starting time of the new particle formation process, as the growth rates are quite low.

Line 259 (and elsewhere e.g. 313). By word average, do you refer to mean or median? Over what time period was the average calculated?

Lines 266-269: I'm not sure if it is meaningful to calculate and compare the fractions of nucleation mode particles, since you are measuring only the upper part of the nucleation mode, and also because the upper limit of the measurements varies between sites. Have you estimated how does the different upper size limits for the DMPS/SMPS systems affect the N14 concentration?

Line 330: Do PM_{2.5} and CS correlate? Your calculated CS does not extend up to 2.5 micrometers.

Line 333: The average wind speed was low also in THR, with similar wind direction, yet the average CS is much lower. Why is the air stagnation only relevant to Ioannina?

Chapter 4.3. It is interesting that the GR varied so little, even though the NPF frequency varied considerably. Do the GRs show any dependency on meteorological conditions (e.g. temperature) at those sites where you have larger amount of data?

Line 367: “Emissions of amines in these areas may also be elevated” Could you elaborate on this?

Line 377: Do you think the warm temperatures during your measurement period could also affect the volatility distribution of the oxidized organics, preventing the formation of least volatile compounds that can form particles and participate in the early steps of growth (see e.g. doi.org/10.5194/acp-20-9183-2020)?

Line 416: Sifnos and Lesvos are mostly surrounded by sea. Considering that the sea likely contributes very little to the growth of particles and considering the time it takes for the airmass to travel between the two sites, it is not directly evident that you can call these events regional, even though they happen at the same time. I believe that whether these can be called regional events should be discussed more in the article.

Technical Comments

Line 52: ...the dominating ~~nucleation~~ new particle formation mechanisms....

Line 200: missing y (study)

Line 266: I do not understand how you have arrived at these numbers and variances. $12\%+9\%$ does not come to 35% , nor does $54\%+5\%$ come to 62% .

Line 386: Cluster analysis is a very general term and openAir is a big R package. Can you specify what kind of cluster analysis you did?

Line 447: “Unlike the NPF events...” This is an unclear sentence, please clarify. Do you mean that that outside NPF event days, the western pathway was not frequently traversed?

Figure 2: Describe what the whiskers mean.

Figure 3: Subplots a) and d) only have one value on the y-axis. It would be better to have at least two values visible for easier reading.

Figure 6: What is the difference between filled blue circles and unfilled blue circles? Please explain this in the caption.

Figure S2: The caption here appears to belong to Figure S1.