

## Review of: 'Wildfire smoke triggers cirrus formation: Lidar observations over the Eastern Mediterranean (Cyprus)' by Mamouri et al. (<https://doi.org/10.5194/egusphere-2023-988>)

### General comments

In this paper the effects of aged smoke particles on ice nucleation are discussed. The authors study the case of 27<sup>th</sup> November to 3<sup>rd</sup> November 2020, when a smoke layer was detected at the UTLS region over Cyprus. Based on their calculated backwards trajectories the authors find that this layer originated from wild fires over North America (California). Observations of cirrus formation, virga structures and cirrus originating from gravity waves are carried out by means of active remote sensing via lidar. Additionally, simulations of the gravity waves are carried out.

The topics discussed in this paper are in the scope of ACP and the interest of its readers. The authors tackle an interesting subject and manage to successfully answer the set scientific questions. Apart from the introductory part feeling a bit segmented the manuscript is well written. The reader is introduced to the topic and the subject at hand. The methodology can easily be followed. The results and discussion are clear and well accompanied by references. Nevertheless, a list of mostly minor and technical revisions is presented in the following.

### Specific comments

- Lines 25-27: At what altitudes did the measurements take place? Does this refer to the UTLS?
- Lines 41-47: It would be good if some papers are referenced regarding these claims.
- Lines 48-49: Are there any statistics supporting this assumption? An explanation could be added or a paper could be cited at this point supporting the claim.
- Line 65: A one-sentence explanation of the activation thresholds would be helpful before this statement.
- Line 67: 'Those INPs' refers to the minerals?
- Lines 139-141: Is there an estimation of this potential bias? Studies have shown high water supersaturations even at cirrus-free conditions. Maybe looking into the available water vapor on the measurement period at UTLS would strengthen or weaken this point especially since you have RH data from the radiosondes.
- Figure 1: The authors could specify what the uncertainty ranges are.
- Figure 1: Do the authors have an explanation to offer about the peak in PLDR at 13.5km altitude?
- Line 204: Is that the RH with respect to water or ice?
- Line 211 and Fig.3: Since the RH in Fig. 3 does not reach supersaturation I would expect that the authors are using relative humidity with respect to water (RH<sub>w</sub>). This is not necessarily wrong but would not be advisable for the study of ice crystals/cirrus. If available please use relative humidity over ice (RH<sub>i</sub>).
- Line 217: Strong ice nucleation is rather the explanation of the formation and evolution of the virga rather than an observation. Please rephrase accordingly.
- Line 240: A quantification of the good agreement would be helpful.
- Line 249: Same as Line 211, RH<sub>i</sub> would be preferable.
- Line 254: Same as Line 217
- Figure 4: Similar to above. 'Ice nucleation is expected at the top of the ice virga'.
- Figures 5, 6 & 7: Consider Using RH<sub>i</sub> instead or RH<sub>w</sub>
- Lines 268-269: How do the authors come to this conclusion?

- Line 270: Using the RH<sub>i</sub> and nucleation thresholds for the available INPs would strengthen this claim. Some INPs activate already at very low supersaturations while others need high values. Having the RH<sub>i</sub> as a reference would be beneficial.

## Technical corrections

- Line 3: Patterns instead of pattern
- Abstract: Sentence 'Our study... to Cyprus' could be moved one sentence earlier, before 'we found... cirrus layers'. Introducing first the study before referring to results.
- Line 18: 'was transported' instead of traveled
- Line 20: 'in the future'
- Line 22: 'fire storms'
- Line 23: 'source of smoke'
- Line 30: 'with in-depth'
- Lines 30-31: 'has already been shown'
- Line 39: aged smoke particles originating from fires'
- Line 55: 'INPs' not necessary
- Line 57: 'the'
- Line 57: Here it is probably meant 'When the smoke particles take up supercooled water'
- Line 59: 'completely dissolve and become liquid (and no insoluble material within the particles is left), homogeneous freezing will take place on the resulting aqueous solutions at temperatures below  $-38^{\circ}\text{C}$ '
- Line 58: warmer instead of higher temperatures to avoid potential confusion with negative values
- Line 75: Remove 'here'
- Line 75: Replace 'were generated' with 'formed'
- Lines 80-81: A new sentence for each section description. The first letter after the section number does not need to be capital
- Line 86: 'are presently'
- Line 156: Not clear what is meant. Please rephrase
- Line 178: Observations & Discussion
- Line 183: 'Figure 1 contains'
- Figure 1 legend: It would make it easier to define every panel separately
- Figure 1 legend: 'line in (f) represents the temperature'
- Line 228: remove 'of'
- Line 279: 50-100 m/s probably.
- Line 310: Does this still refer to RH<sub>ice</sub>?
- Figure 8: RH could be denoted as RH<sub>w</sub> for clarity
- Figure 8: Consider changing colors of naphthalene and fulvic acid. They are not easily distinguishable
- Line 321: remove 'now'
- Line 329: Remove 'not'
- Line 331: Clarify if RH<sub>ice</sub>
- Figures 9-11: Could be unified in one figure for easier intercomparison
- Line 352: 'Mediterranean basin'