

***Interactive comment on* “Transport of Po Valley aerosol pollution to the northwestern Alps. Part 1: phenomenology” by Henri Diémoz et al.**

Anonymous Referee #4

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General comments:

The paper analyzes the impact of pollutants transport from the Po Valley to the air quality on the Alpine region. Three selected cases studies of transport over the Aosta Valley are selected among a 3 years period and analyzed in detail by means of a wide-ranging set of observations and numerical simulations. Moreover, the observational data are used to evaluate the performances of the FARM chemical transport model. These results provide an interesting and comprehensive description of the complex phenomena of mountain-valley exchange and deserve therefore to be published. Even if the paper is well written, though, the large amount of data presented in both the main paper and the support material makes the manuscript dispersive and fragmented.

I would suggest to further select the figures that are useful to support their message

and eliminate redundancies. For example, I invite the authors to carefully evaluate if the section 4.1.5 is bringing any relevant information: the analysis seems not fully convincing, is limited to a single case and the information that intends to bring is already conveyed by the FARM model. Similarly, some figures can be just substituted by a short mention in the text (I would reconsider the relevance of fig. 3, S2c, S4e, S5, S12).

Specific comments:

Page 2, line 19-22: Basing on the results of the FARM comparison I would rather highlight that the paper aimed at an evaluation of the model and then mentioning that, despite its limitations, it still brought insights on the cases, supporting the observations. Similarly, I would rephrase the paragraph in the conclusions, accordingly (Page 35, line 14 onward)

Page 4, line.3: Do you really mean that is the partition between local and non-local sources that help to assess the impact of air pollutants on health, climate and ecosystem?

Page 14, line 21. "Therefore, to reduce errors in trajectories with increasing running time, we limit the computation to this duration". The sentence between commas, in this context, is misleading. Rewrite as "Therefore, we limit the computation to this duration"

Page 18, Figure 6. It would be more meaningful to show the trajectories at 18:00 UTC for this case, since at this time you observe the start of the intense layer arrival and the trajectories are also showing a larger impact from the Po Valley.

Page 16, line 14: Mention here that you see these surface impacts in your measurements (Fig.8). Also, what will happen if you average the hourly measurements of TEOM on a daily interval? Will it be consistent with the results of figure 8? Please note that the time interval shown in figure 4 seems to be, compared to figure 8, in the middle of the event (Starting from 26 August and ending at the end of 3 September), so that is not possible to identify any difference with the previous or following phase.

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Page 17, line 33: Do you mean here that the transport from the Po Valley persists at every hour along the following days? Indeed, considering the evolution of the layer as seen from the measurements, it would be useful to show which is the typical transport during the whole event at different hours, for example adding the average position of the trajectories (or the PDF of the position in case of large variability) on the considered period. If the authors want to still keep the trajectory of the first day of the episode as a reference for the layer arrival, I would suggest, to avoid burden the paper with additional plots, showing just the synoptic hours instead of a 3-hour time step; it should still be enough to demonstrate the transport evolution. This would also allow comparing the first and third transport type with the mean transport behaviour of the second case study, when the layer persists for the whole duration of the event.

Page 21, line 15: Can you add some reference for the typical Angstrom exponent for the Aosta valley in comparison?

Page 25, line 18 (but same for page 30, line 6): How do you estimate this residence time, is it an average of the time spent by each trajectory over the Po Valley at all levels? From the shown figure (even if it is difficult to distinguish), the transport, including the part outside the PBL, seems faster (around 20 hours or even less). Can you be more specific?

Page 25, line 33-35: How do you justify these affirmations?

Page 32, line 29: It would be interesting to see this comparison indeed since, from figure S1, it seems that the model has the tendency to see easterly winds more often and with higher intensity respect to the observations. Is this comparison limited just to the surface measurements? May it be that there are problems in the higher layers (where most of the pollution layer transport is coming from)? For example, in the case study 2, when the winds were weaker both at the ground and at higher layers, the time evolution of the FARM simulation of Figure 10d was in better agreement with the observations. Is also interesting to note that the time evolution of the vertical distribution

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of PM10 from FARM is in better agreement (especially the local contribution) with the surface TEOM measurements rather than with the elevated layers observations.

Technical corrections:

Page 4, line 10: “will be quantified in a companion. . .”

Page 4, line 28: For easier reading, specify which valley are you talking about. In the same paragraph, you are referring to both the Po valley and the Alpine valleys.

Figure 2: The dashed lines are not needed.

Page 9, line 21: “. . .altitude of the extinction coefficient.”

Page 21, line 22: Refer also to the figure S8.

Page 34, line 6: Add a “:” after “(see Introduction)”

Page 35, line 19: “. . .these issues may be partly attributed to. . .”

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