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Atmospheric Chemistry and Physics Discussions

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

Anonymous Referee #3

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The paper analyses 3 cases of transport from the Po Valley to NW Alps with several in-situ (4 sites in Aosta and in pristine environment) and REM instruments from ground and space. All these measurements are extensively documented in the paper and in the supplement, allowing to have a broad view of the pollution events. After having validated the meteorological model COSMO, a chemical transport model (FARM) is evaluated. This paper is a clear documentation of middle range pollution events affecting the alps and the evaluation of model's performances under these conditions is very interesting.

General comments:

- Figures do not always allow to verify the descriptions or conclusions of the study. For example, higher aerosol concentrations are measured during the case studies (Fig.

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4e, Fig. 8, Fig. 13e Fig. S8,...), but the figures do allow to be sure that the increase in aerosol load is really specific and cannot be attributed to usual/local fluctuations. In other words, it is not possible to see the differences between the period of the case studies and the period without influence from the Po Valley. I do understand that figures similar to Fig. 4 cannot display longer period of time, but another solution should be found! The time period covered by Fig. 12 is fine.

- FARM leads to too low PM10 concentration in summer and in spring, but seems to work better (even if it does not reproduce the diurnal cycle correctly) in winter (case study 2). Is there an explanation for this difference between summer and winter?

- Why FARM regularly has time shift in its estimation (for example in Fig. 13 for case study 3)? Fig. S10 shows that modification of the PM concentration from the boundary conditions and the modification of the hygroscopic growth have no impact on the time of the aerosol increase. Minor comments:

- P. 1 line 14: "and hygroscopic": the begin of the sentence is a comparison, so that the meaning of this last 2 words is not obvious.

- P. 1-2, lines 22-1: for clarity purpose I would add a TO: "likely owing to deficiencies in the emission inventory and TO particle water uptake not fully taken into account"

- Figure 4d + p. 19 lines 2-7: 1) "PM concentration from non-local sources is represented by the coloured background and the effect of local sources by the contour line, at logarithmic steps;" The logarithmic steps are hardly visible on Fig. 4d (I had to discover that they exist on Fig. 10 to find them on Fig. 4). Could you perhaps use a color scheme with a legend ? Without this, it is not evident that the non-local sources exceed the local ones.

- P. 16 line11: delete the "," after "scattering ratio" + give some indication on the altitude of the described layer.

- P. 16 lines 12-19: I do not really understand your description: from the end of 26th of

September, the lowest layer measured by ALC already shows a SR of about 6, so that the “lower levels, with potential consequences on the surface air quality” are already impacted before sunrise on the 27th of September. Your description does not really describes why the SR decrease in the middle of the days. Is the aerosol rich layer entering the ML and contributes then to higher aerosol load in this ML (not observed in Fig 4a), is it dispersed to higher altitude due to the thermal convection or dispersed horizontally ? Please clarify.

- P. 19: is it possible that the observed shift (from some hours to $\frac{1}{4}$ of a day) of the maximum concentration between FARM and ALC can be due to an overestimation of the local effects in comparison to the non-local ones ?

- Figure 8 and p. 6 lines 18-20 + p. 20 lines 13-15: the measured PM2.5 and PM10 during the case study are similar to the annual mean concentration (p.6). An increase of PM2.5 and PM10 is clearly visible from the 26th of August to the beginning of September (at least at Aosta), but the readers cannot be sure that this does not correspond to a usual fluctuations of the aerosol load. Similarly, it is not really visible that FARM predicts an increase of the PM10 concentration at Aosta during the case study.

- Fig. 4e + page 20 lines 8-9: : the PM10 daily cycle does not correspond to the Po Valley air masses transport seen by the ALC. The given explanation relates to the mass losses occurring in TEOM due to secondary aerosol volatility. Is it expected that this volatility should be different between nighttime and daytime (i.e. larger during the night) in order to explain the different diurnal cycles ?

- Fig S5 is cited before Fig. S4.

- P. 25 line 2: it has however to be mentioned (and perhaps explained) that the wind direction at Saint-Denis (Fig. S4e), after turning to the east during the afternoon of the 26th of January, turns again to west on the 27th in the morning and stay globally at west during the rest of the case study.

- P. 25 lines 10-12:the increase of the wind speed at Saint-Denis on the 29th is not very large (about 2 m/s on the 26th in the morning, increase to 4 m/s on the 26th in the afternoon, about 1 m/s until the end of the 28th, then 2 m/s), so that the correlation with the disappearance of the layer is not really explicit.

- Fig. S6 + p. 25 lines 13-15: the described transition (for the lowest levels I suppose) is quite difficult to see: too much backtrajectories, the lowest ones being represented under the highest ones. A figure allowing to see not only the trajectories but also the change of the altitude over the Po Valley (lines 15-29) would perhaps be more interesting)

- Fig. S4d: the particle number concentration increase during the case study is clearly visible. It is however not possible to determine if this is a peculiar or a normal event occurring regularly during winter.

- Fig. S9 is cited before fig. S8.

- P. 32-33, lines 31-6:The hygroscopic growth of the aerosol can clearly be a cause of the discrepancy between FARM and ALC, even if FARM is also not able to reproduce PM measurements and their diurnal cycles. The difference of the measured size fraction (TSP for ALC and PM10 for FARM does however not seem to be really relevant since: 1) Aerosol from the Po Valley are described as small ones in the paper, see for ex. Case study 2, where the increase in PM10 is similar to the one of PM2.5 (Fig. 12), 2) the size distribution measured by the OPC and sun photometer peak in the accumulation mode and do not show big particles,

- P. 33 lines 7:13: How good is the estimation of the PBL height in the CTM simulations ? Could a bad estimation of the PBL height be also a source of inaccuracies ?

- P. 34 line30-32: as explained previously, I do not see any evidence of a residual layer sinking towards the surface in this study.

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