Cézeaux-Aulnat-Opme-Puy De Dôme: A multi-site for the long term survey of the tropospheric composition and climate change

The article summarizes instrumentation, research and conceptual facility design built up at and around the Puy-du-Dome, central France, over the last decades, with historical roots reaching back to more than a century ago. Development, operations and future perspectives of an excellently equipped and integrated observatory are described and main findings shortly pointed out or cited, but often only mentioned. The site's relevance emerges from its frequent use by the scientific community for process dedicated campaigns, field deployment of new measurement techniques and strategies as well as its and the contributing institutions' important roles in national and international research infrastructures.

The description of the CO-PDD observatories, their relevance, concepts, aims and integration is comprehensive and useful to AMT readers. A broad selection of results, including many references, convinces that excellent scientific results have been inferred from the CO-PDD measurements. A review like this may, for brevity and clarity, discuss part of the results qualitatively, however, its added value develops from their combination and their synopsis. I'm missing a number of important figures either in the text, as table(s) or as plots in order to serve as a 'first stop' also for external readers aside the European atmospheric science community. To this end, it should be possible to find the basic numbers of characteristic atmospheric parameters for the CO-PDD network of stations already inside this article (without extensive literature search). You may therefore expand tables 1-3 to include e.g. mean values, trends/tendencies and seasonalities from the individual observations or supply this info by adding representative data sets to Figs. 8.

We think that it is difficult to include this specific scientific information in Tables 1 to 3 that are devoted to technical information. We prefer to discuss these features in the scientific section (6) and to present them in Figures 7 to 9.

Combine several measurements in the figures. Given the details of the instrument descriptions (370 lines), the corresponding results often stay unnecessarily vague (l 582, l 590, l 616, l 630,..) - covering only 227 lines. For example the article does not contain any value for basic aerosol parameters like number- or mass-concentration, absorption- or scattering coefficients and composition).

A new figure (Fig. 9) presenting long series of aerosol particles number has been added and discussed in the section 6.2 :

"The total particle number concentration (> 10 nm) currently measured at PUY is on average ~ $2\times10^{3}$ $cm^{-3}$, which corresponds to intermediate values compared to observations reported from neighboring mountain stations in Europe (Laj et al., 2020), such as for instance Montseny (Spain, 700 m a.s.l., ~ $3\times10^{3}$ $cm^{-3}$) or Jungfraujoch (Switzerland, 3578 m a.s.l, ~ $2\times10^{2}$ $cm^{-3}$). As illustrated on Figure 9, the aerosol number concentration tends to overall exhibit a slight decrease over the past 15 years at PUY, in the order of -9 ± 5 ×10² $cm^{-3}$/decade. Deeper investigation of this trend is currently performed and will include a more detailed discussion of these aspects."

The section 6.3 has also been completed.

"A median scattering coefficient of ~ 10 $Mm^{-1}$, in the range of values observed at other mountain sites, was obtained by Pandolfi et al. (2018) for the period 2007-2014 at PUY. Seasonal medians in the range 0.7 – 9 $Mm^{-1}$ were in addition more recently reported by Laj et al. (2020) for the year 2017, together with median absorption coefficients of 0.92 and 0.44 $Mm^{-1}$ for spring and autumn, respectively."

With these revisions I recommend publication in AMT.

Special comments:
Instrumental part: Though proper operation, calibration and traceability is guaranteed by EUSAAR and ACTRIS conformal sampling and audits, I miss specific information about dry/humid sampling of aerosols by the specific instruments.

Additional information is now provided at the beginning of section 5.1.1, in connection with the description of WAI: "With the exception of the (N)AIS and PSM, all the instruments described here are operated behind a WAI, in which the aerosol is dried due to the temperature difference between external and internal conditions . In contrast, (N)AIS and PSM, which are further described below, are dedicated to the monitoring of newly formed aerosol particles with diameters less than 10 nm, and are thus located on the roof of the station where they sample through a shorter inlet (~30 cm, non-heated) to limit diffusion losses."

L 247: Is the nephelometer sample dried? Why do you call this diffusion coefficient and distinguish it from the scattering coefficient? Also 'simple diffusion albedo' sounds 'very French' ! single scattering albedo

The nephelometer is operated in the station, behind a WAI, so, same as for all other instruments operated behind the WAI, the sample is dried in the WAI due to the temperature difference between external and internal conditions. We hope that our answer to the previous comment will help clarifying this aspect.
The use of "diffusion" was in fact an obvious French mistake and was banished from the revised version of manuscript!

L 336: The Picarro analyser: : : It seems that part of this sentence is missing.

The sentence has been modified.

L 360: Which consequences has the (commonly executed) change from molybdenum towards blue-light-converter for the consistency of the time series and the long-term trend at PDD?

As the molybdenum converter convert other nitrogen species ($NO_y$) than $NO_2$, the change from molybdenum towards blue-light-converter has an impact on measurement, and the $NO_2$ measured after this technical modification is “real” $NO_2$. Therefore the measured concentration was overestimated for $NO_2$ before December 2012. Thus, the trends have been discussed separately for the period 2003-2012 and 2012-present. We add a sentence to precise this point in the article.

L 614ff: Could you add some numbers for the inorganic aerosol (anions/cations) concentrations and fractionation?

Additional text has been included.
“Aerosol chemical composition monitored at PUY is highly variable but average concentration monitored at PUY over the period April 2015 – February 2016 exhibits the following values: organic 57% (2 µgm-3), followed by sulphate 16% (0.4 $\mu gm^{-3}$), nitrate 12% (0.3 $\mu gm^{-3}$), ammonium 10% (0.24 $\mu gm^{-3}$) and BC 5% (0.13 $\mu gm^{-3}$) (Farah et al., 2020).”

Fig 4: Is the linear model the appropriate approximation to the observed data over 140 years? Is there no change in the trend during the last decades?

The reviewer is right, the linear model is probably not appropriate for the best estimation of the temperature trend on 140 years. As shown on the figure below, each dataset can exhibit different linear trends. The objective of Fig. 4 is only to give a global overview of the long term temperature measurement including the historical period, but a study dedicated to long term trend estimation analysis could be interesting to perform.

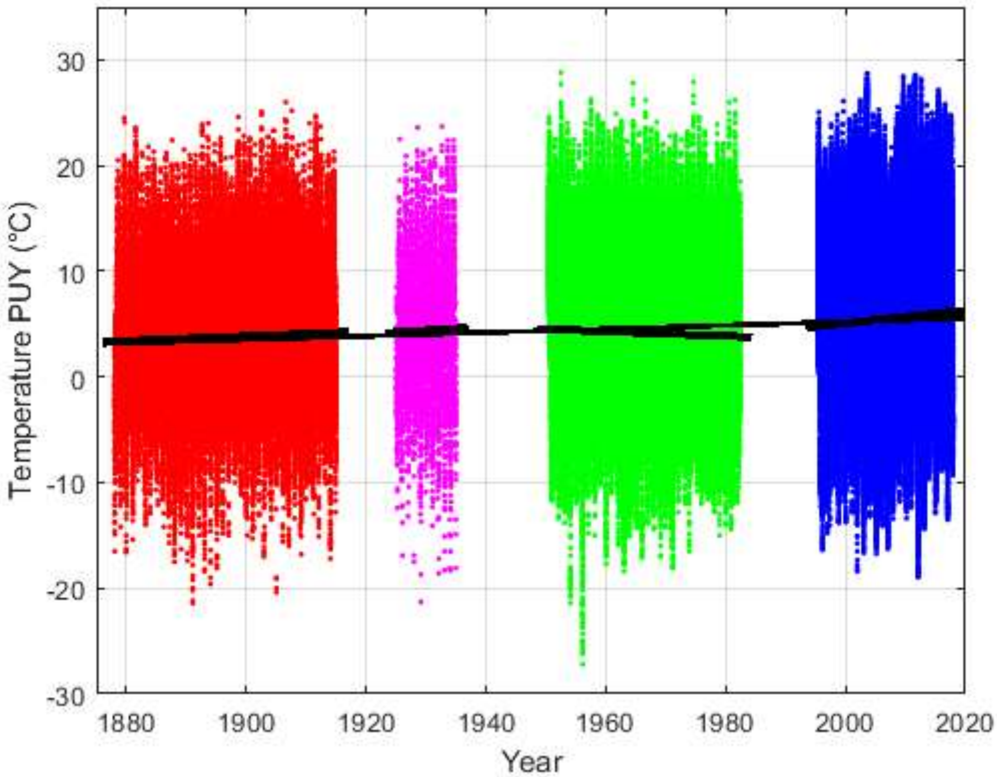


Fig. 8: If these were easily to extract from your database: Could you show several more quantities as box-and-whisker-plots or superimposed as monthly means with percentiles?

This is an interesting suggestion, but we did not successfully superimpose box-and whisker plots on Figures 7 to 9 without losing readability. So we prefer to keep these figures as they are.