Review article: Summertime tropospheric ozone source apportionment study in Madrid (Spain)

The paper describes a modeling study that investigates the source of summertime surface ozone (O_3) in Madrid, Spain, using an integrated source apportionment method within the Community Multiscale Air Quality model (CMAQv5.3.2). The paper highlights the importance of local sources (road traffic) in the build-up of O_3 during peak events, which tends to happen during anticyclonic stagnation conditions in summertime. Suggesting that local measurements aim to reduce O_3 precursors could have a positive effect during such periods. In general, the findings are valuable for the understanding of the O_3 build-up mechanism in the region and, consequently, for policy decision-making.

The narrative in the abstract suggests that the study focused on the source contributions to urban O_3 pollution. However, the results include the contribution to O_3 in different chemical environments (urban, suburban, and rural); therefore, I believe that the scope needs to be clearly stated in the document. Also, I feel that the source apportionment method is loosely defined in the methods session. Expanding the description of the method with an example of the mechanics would strengthen the paper. It also feels that the discussion of the model evaluation has been skipped, and something is missing in the paper to convince the reader of the model's capabilities to reproduce the meteorology and chemical environment of the period study. It would be helpful to show a time series of O_3 at some representative sites (urban, regional, and suburban) to show the diurnal and day-to-day variability (e.g., hourly ozone) and the model performance. This is important as it gives the reader a general idea of the O_3 evolution and the pollution episodes, which are investigated throughout the study. Once these issues have been addressed, along with the points below, the manuscript will be suitable for publication.

General Comments

When you say that the contribution from biogenic emissions is relatively small and therefore excluded from the analysis, are you referring to the contribution to regional scale O3? Could you consider including an evaluation of biogenic VOCs, e.g., a time series comparison of isoprene or a statement regarding the performance of the MEGAN model? Biogenic VOCs, in particular isoprene, are important contributors to O3 formation during photochemical O3 episodes, particularly in rural areas but also in urban environments (Dunker et al., 2016), due to their reactivity and abundance. You concluded that biogenic sources are responsible for 42.4% of the total VOCs domain-wide, so an important impact from this source should be expected.

Evaluation of the model is reported in the supplemental material and loosely mentioned in the manuscript. Please adjust section 3 and provide a quantitative statement of the model performance for meteorology and chemistry (especially O3) for the model domains, along with

some plots. This could be a spatial contour plot showing the model and observed mean or P95 of O3 or time series of O3 at some representative sites.

Specific Comments

Line 32:33: 'These measures, however, have failed to significantly improve ozone (O3) ambient concentration levels'. I feel this is a strong affirmation that needs to be re-phrased, taking into account the nonlinearity nature of O3 formation and the different aspects related to the concentrations observed in different chemical environments (e.g., urban, rural, and suburban) as well as the effects of emissions reductions such as the urban decrement.

Line 140: It would be helpful to have a paragraph describing how experiments were designed, for instance, how the chemical cycling is performed and how often the meteorology is restarted.

Line 249: The link provided does not work

Line 360: The link provided does not work

Dunker et al., 2016.https://doi.org/10.1016/j.atmosenv.2016.09.048