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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Regional responses of surface ozone in Europe to the location of high-latitude blocks and subtropical ridges" *by* Carlos Ordóñez et al.

Anonymous Referee #2

Received and published: 26 November 2016

Ordóñez et al. present an analysis of the impacts of high-latitude blocks and subtropical ridges on surface air quality, particularly ozone, in Europe. The authors use a previously published catalog of these meteorological features to study spatial and temporal changes in ozone concentrations. The connections are made clear and the statistical analysis is sound. The manuscript is clear and pretty concise; in general it is very well-written. I believe the manuscript is high quality and requires limited revision. I recommend publication of this manuscript in ACP after the authors' address the following minor comments.

General Comments

- The most significant issue with this manuscript is the lack of a mechanistic discussion

and/or a clear explanation detailing the significance of the results. I disagree that the results are directly usable by modeling communities in assessing changes and validating CCMs. Much more quantitative metrics are necessary.

An attempt is made to broaden the results in the final section, but it is not overly convincing. Indeed, many of the relationships presented are not terribly surprising; the relationship between ridging/blocks and air pollution has been known for decades and even presented within this manuscript as a given. What is the significance of these results? Can a predictive model be developed? Can the results be used to better understand changes brought about by climate change? Can the seasonal frequency or intensity of the EUR blocks be used to summarize seasonal ozone statistics? How can all of this be related to meeting the ozone air quality target? These are the metrics that would make this work more useful to policymakers and model developers alike.

- Regarding the above comment, the authors provide a nice summary of prior meteorology-ozone research in the introduction. It would be very instructive to revisit those studies later in the manuscript since many of the previous connections can be recast or mechanistically explained using these prior studies.

- Why is the spatial aggregation of ozone data (the Schnell data) of better use than observations from individual sites? It seems that the averaging of the observations will mask out some variability and localized features, which may provide valuable mechanistic insights. This is also the case when discussing changes in the PDFs.

- The terminology used in the manuscript is generally spot-on, but I question the use of the terms "ridge" and "blocks". Blocks usually imply a long lasting atmospheric pattern (indeed, a ridge) that actually "block" and divert the normal flow of extratropical cyclones. The term block, in my experience, has a lot less to do with latitude (as used in this manuscript), but rather the persistence. The terminology of ridge vs. block does become cumbersome as the reader progresses.

Can one block or ridge migrate from one "box" to another? If so, how does that influ-

ence ozone?

- A number of negative anomalies, generally in the Iberian Peninsula and Italy. These areas have large values, but go unexplained. I recommend adding some discussion about these areas.

Specific Comments

Page 2, Line 11: The degree of significance used in the confidence intervals is unclear and should be specified.

Page 2, Lines 12-14: The identity of these indirect radiative effects are a mystery to the casual reader. Maybe add a few more descriptive words.

Page 2, Line 18: The more recent review by Fiore et al. [2015] may be a better inclusion.

Page 3, Line 3-5: A daily NAO index is generated and might prove useful. I cannot speak for the results in Sousa et al. (2016), but I would not discount the NAO index simply because of a perceived monthly timescale.

Page 5, Lines 1-4: How trustworthy is the NCEP/NCAR reanalysis I compared to more recent reanalysis projects? Why not use ECMWF-Interim? Or MERRA? Or JRA? All of these have higher spatial resolution and may provide a better picture of the meteorological landscape. Also, the placement of the description of met. data here is curious; it could be moved to the beginning of Section 2.2.

Page 5, Lines 9-11: This is curious. Why is this the case? It is interesting that effort is placed into the winter months since ozone levels are so comparatively low in that season, surely lower than in the autumn.

Page 5, Line 29-31: Low values of ozone do not necessarily indicate that there is a preferred mechanism (decreased formation, increased loss, or both of ozone). This sentence hints at attribution that is not described.

Page 6, Line 7: With all meteorological-air quality studies it is important to know the sensitivity of the meteorological metric to the assumed parameters. How important is this area requirement? What about a weaker, but persistent ridge, which may be missed by this algorithm? How is the “best” latitudinal break between ridges and blocks determined?

Page 6, Line 7: How long does the average block persist? This is important information for the later analysis of the buildup of ozone during an episode.

Page 6, Line 12: What happens if criteria ii is not met? Is it considered a block?

Page 6, Lines 23-25: What is the variability in the frequency of blocks and ridges?

Page 7, Line 23: Isn’t the requirement in Section 2.2 that the block must last at least 5 days? If the system is moving so rapidly through the region (< 3days), is it really a “block”?

Page 8, Line 15: The Scandinavian PDF with EUR blocks looks very similar to the climatology, perhaps even more so than Iberia. Is it really significantly different?

Page 8, Line 20: Why is this position of the block so efficient at increasing ozone in UK/N. France?

Page 10, 1st paragraph of section 4.: I think that this needs a bit more thought and discussion. The reason for anomalously low ozone values that is provided suggests the cut off of marine air that brings in background ozone. Yet, Figure 10 shows that locations susceptible to marine air (as indicated by arrows) have negative anomalies, particularly in the RUW case (bottom of Fig. 10).

Page 11, Line 11-13: As mentioned above, this is not what I am seeing. I agree that continental air is advected northward, but the largest anomalies appear to be receiving westerly wind from the Atlantic.

The contour lines within the figures containing maps are very hard to distinguish. I

recommend thickening them up before publication.

Reference

Fiore A. et al., Air quality and climate connections, J. Air Waste Management, 65 (6), 2015.

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