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Atmospheric Chemistry and Physics Discussions

Interactive comment on "How to most effectively expand the global surface ozone observing network" *by* E. D. Sofen et al.

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We thank Ian for his detailed and thoughtful comments on our manuscript. His comments are below and our replies are highlighted in bold.

General comments.

This paper addresses a topic important to the development of atmospheric chemistry, how to improve the global coverage of surface ozone observations which are needed to more effectively constrain global atmospheric chemistry models. The paper is overall well-presented and appears to be without any significant scientific flaws and is appropriate for publication in ACP. A previous study addressed the more difficult issue of detecting trends in tropospheric ozone from ozonesondes and surface stations but with

less sophisticated methods (Prinn 1988).

Specific comments. There is one aspect of the logic of the paper that could do with a more explicit recognition, at least in my opinion. The purpose of the analyses is to determine where more surface ozone observations should be made including both for improved direct observations and improved testing of chemical transport models. The analyses the authors perform are based on the deseasonalized output of a chemical transport model. The level of skill of chemical transport models in determining the residual variations in surface ozone after the seasonal variations are removed is probably not well quantified. So this must have some influence on the results presented. I do not think any variation in method is required, just a specific acknowledgement of the circular nature of the process. A few lines would suffice.

The information in this paper is contained in one Table and 11 Figures. The information in the Figures should be of a quality that a reader can determine the plotted quantity from the figures for any area of the world of interest to them. As indicated in Technical corrections, I do not think this standard is met in a 4 of the Figures.

Technical corrections/suggestions.

Page 21026. Line 2, perhaps replace "almost 50 years" with "more than 40 years". The DASIBI UV photometer for surface ozone measurements in the global networks first appeared in the early 1970's. **Done**

Page 21026. Line 14 include coverage for the continent of Australia. **Done**

Page 21027. Line 16/17. The purpose of the GAW network is not primarily scientific, but rather to address key environmental issues (See WMO IGACO Plan). **Done**

Page 21030. Line 5/6 Is it "covariance" rather than "similar variability" that is being used?

"Covariance" and "similar variability" are equivalent. We prefer to begin with a common-language description and then provide a technical description of the

covariance calculation.

Page 21032 Line 4. As the authors acknowledge, the large footprints may be erroneous due to the missing initial ozone destruction in springtime and photochemical production in summertime.

We agree with the reviewer that the footprints may be smaller than indicated here and have highlighted the lack of ozone destruction during the spring as one issues.

Page 21033 Line 14-19. A more physically based explanation (a few lines) of what the k-mean cluster analysis is would be useful for most readers. **Done.**

Page 21043 lines 20-26. I find the conclusion of this discussion unsatisfac-tory for a scientific paper. The authors statement that the data is critical is right. They need to state that they know observations are being made in these areas, and come to the conclusion they do, or advocate increased observations in these areas. We have updated the text here based on the reviewer's comments.

Our approach did not identify additional sites in China or India due to the small area (short lifetime) of any observational site. However, observations are being made in these countries. For example, China has an extensive air quality monitoring network where current data is publicly available online as Air Quality Index (AQI) values (http://aqicn.org/, but there is no available archive of historical data or direct reporting of concentrations. Until these observations are generally available for scientific evaluation it is difficult to know where further observations capabilities are needed.

Page 21051 Figure 1. Include latitude and longitude, make the coastline bolder, mark Cape Verde Observatory more clearly.

We have included the latitude and longitude on the figure and the location of CVO in the figure caption and have attempted to improve the aesthetic of the plot.

Page 21054 Figure 4. I am puzzled that there is no desert in Australia in the Figure.

The classification is determined based on an automated clustering algorithm. We have named the cluster that is illustrated in grey "desert" but it is clearly not a perfect classification, as portions of India and Central Asia fall into that classification. The lack of grey "desert" region in Australia may point to deficiencies in the Australian emissions inventories. Also note that the Atacama and Kalahari are not classified as desert, so there may be less distinction in the atmospheric chemistry between Southern Hemisphere desert and other Southern Hemisphere land areas that leads to them being merged into a single cluster.

Page 21055 Figure 5. This figure is difficult to read with inadequate colour contrast.

We have attempted to improve the aesthetics of the plot by changing the colormap from continuous to discrete and darkening the footprint shading.

Page 21056 Figure 6 (a) and (b). These figures are difficult to read with inadequate colour contrast.

We have attempted to improve the aesthetics of the plot by using discrete colormaps. We have chosen to stick with the basic colormap as it is one of the few multi-color perceptually uniform sequential colormaps available and it does not pose a serious hindrance to those with common forms of color-blindness (none of these properties are satisfied by the "Jet" or "rainbow" colormaps).

Prinn, R.G., Toward an improved global network for determination of tropospheric ozone climatology and trends, J. Atmos. Chem., 6, 281-298, 1988.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 21025, 2015.