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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "The Relationship between Lower Stratospheric Ozone in the Southern High Latitude and Sea Surface Temperature in the East Asia Marginal Seas" *by* Wenshou Tian et al.

**Anonymous Referee #2**

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General

In this study, the authors observed a correlation between sea surface temperature over East Asian marginal seas and ozone in the southern high latitude lower stratosphere (the targeted region) from assimilated MERRA data and a model simulation (SLIMCAT). Using the WACCM model (WACCM4) and a defined temperature index from the HadISST data, they separated warm and cold events over the East Asian marginal seas and found distinct differences between the two groups of the events in ozone concentrations in targeted region. The model simulation further reveals large differences,



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Discussion paper

generally in the opposite directions, between the warm and clod events in dynamic and chemical conditions that modulate transport and formation/depletion of stratospheric ozone. Finally, the impact of such a connection on the ozone trend in the targeted region was quantified with a series of numerical experiments using WACCM4. The authors attributed 17% of decreasing ozone trend in the targeted region to increasing SST over the marginal seas of East Asia.

The authors proposed a hypothesis that establishes the connection between SST variation over the marginal seas of East Asia and ozone in the targeted region (P12-13). The paper is well written in articulating the connection and explaining the hypothesis. The proposed connection is novel and important. I suggest that the authors use some additional datasets to confirm or adjust their proposal. These data include ozonesonde data (there are about 7 stations over the Antarctic region during different periods), the TOST data (the Trajectory-mapped Ozonesonde dataset for the Stratosphere and Troposphere), and satellite data (although satellite data quality usually decreases with latitude).

For the long-term ozone trend over the targeted region, the ozone concentrations from MERRA, SLIMCAT should be compared with the WACCM simulation. More importantly, all simulated or assimilated data can be compared with observations so the estimated 17% contribution of increasing SST over the marginal seas of East Asia to the ozone trend in the targeted region can be confirmed or refined.

The authors also looked into the seasonal variation of the proposed connection in some aspects (P13, L 20-22, Figures 5-6). Does removing the seasonal cycle enhance or smooth the signal of this connection? As some lags appear in the MERRA data (Figure 4), will the connection be more significant if the authors use monthly data with consideration of the lags?

Specific

P2, L2, no satellite data are directly used in this study.

P3, L2, in this and other places (e.g., P7, L8-9, P16, L7-9), the authors stated similar sentences like “Ozone variations over recent decades exhibit a strong decreasing trend. . .”. This may be the case for the Antarctic region, which is the focus of this study. It is not necessarily the case for other regions. In the Northern Hemisphere, stratospheric ozone recovery has been observed since the late 1990s after the Montreal Protocol and its amendments, although some surprising declines in ozone there were observed in recent years. So, please be specific.

P6, L4, what is the horizontal resolution for MERRA2 data used in this study, 2°x2.5°? How about SLIMCAT?

P8, L4-6, what is the significant level? 90%? 95%?

P8, L17, add “phi (using the Greek letter) is latitude”.

P13, L20-22, not shown?

P14, L4-6, please rephrase the sentence.

P11, L11, use “further support” to replace “validate”.

P18, L19, “observation”? No observation data are directly shown in this paper. The MERRA data may not be taken as “observation”.

Indicate whether boreal or austral seasons (including months) are referred earlier in the paper.

Figure 1, is the ozone variation the same as or different from ozone anomaly? Is this normalized ozone anomaly? Are the seasonal cycle and trend removed? If not, add a trend to the figure. Indicate if the trend is significant. The variation is not straightly downward. A slight increase in ozone appears during 2010-2015.

Figures 2, 6, and 10, what is the significant level?

Figure 4, the label for the x-axis is Lag (month). Is the long-term trend removed from

the data?

Figure 6, indicate these are boreal or austral spring, summer, autumn and winter, including months. Should the seasonal cycles be removed?

Figures 7-11, the y-axis is not in the same format. Some have no unit, and some no label.

Figure 9, the annotation for the arrow is too small to see clearly.

Figure 13, the unit for SST variation should be K as shown in an earlier version. Also, please provide label for the y-axes. Is the ozone variation the same as Figure 1? Or the ozone trend in Figure 1 is removed? Why are they different?

There are a few inconsistency in the reference format. For example, some capitalize each word, some not.

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