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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling Trans-Pacific Transport using Hemispheric CMAQ during April 2010: Part 1. Model Evaluation and Air Mass Characterization for the Estimation of Stratospheric Intrusion on Tropospheric Ozone" *by* Syuichi Itahashi et al.

Anonymous Referee #1

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Itahashi et al. (2019) investigated the impacts of stratospheric intrusion on tropospheric ozone based on the relationship between potential vorticity and relative humidity. They found high surface O3 are often associated with emissions whereas stratospheric intrusion contribute to O3 at elevated sites. The manuscript is in general well written. Below are a few comments need to be addressed.

General comments:

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Discussion paper

Tropopause height

In this work, tropopause is determined at 2.0 PVU. How is the model performance in simulating PV? How different the tropopause height calculated in this work from the traditional approach (e.g., WMO 1992).

Tropospheric O3

O3 is underestimated in the free troposphere in the model. Does the model include lightning NOx emissions? If so, are they prescribed or on-line calculated? Underestimations in lightning NOx emissions could lead to the underestimations in O3.

Trans-pacific transport

Trans-pacific transport is not really discussed in this paper although it is shown in the title. When O3PV/O3 is used to characterize air masses, how do you distinguish air masses from trans-pacific transport?

Specific comments:

Figure 5, this is very complicated figure and includes a lot of information. Is there any way to evaluate PV?

Regarding O3PV and O3, should they be overlapping in stratosphere that you defined based on 2PVU? Note there are some differences between these two (e.g., at Huntsville site). Any explanations on that?

For observed RH profiles, in most cases, there is a steep decrease in RH from tropopause to upper layers. But at Wallops Island site, there is no such large decrease in RH, especially in early to middle April while the model shows a decreasing trend. Any explanations?

Figure 6, the profiles (row 5) are too small. On page 11, line 5, “flight #6 might be a case of STT because observed RH is less than 10% and observed O3 mixing ratios exceed 75 ppb”, where is the tropopause for this case, below or above 6km?

Figure 9, how do you distinguish the impacts of horizontal transport and stratospheric intrusion?

Other comments

There are a few places with grammar errors.

Page 3, line 13-16, “On one hand. . ., on the other hand. . .”, split into two sentences.

Page 10, line 26, “over 500 ppbv at around 8 km The profiles . . .” these are two sentences.

Page 11, line 16, “Europe, the, model . . .” need correct

Page 12, line 1, “ lower RH . . .at lower latitudes (<40N) higher RH at higher latitude. . .” need correct grammar error

Page 12, line 30-31, “. . .listed in Table 5 are based.”, based on what? Incomplete

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