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Interactive comment on "Sunset–sunrise difference in solar occultation ozone measurements (SAGE II, HALOE, and ACE–FTS) and its relationship to tidal vertical winds" *by* T. Sakazaki et al.

Anonymous Referee #2

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This paper represents a careful comparison of various satellite and model estimates of sunrise/sunset differences in (SSD) equatorial ozone. It is well written and considering the number of satellites compared and the inclusion of a model comparison, a remarkably consistent picture emerges of the SSD. My major concern is the attribution of this variation primarily to vertical transport by the migrating diurnal tide.

General comment:

Sakazaki et al. [2012] show the vertical structure of the DW1 (their Figure 5). In the

tropics around 40 km the phase of the tide (time of maximum in T) is 1200 - which would imply zero diurnal temperature variation and vertical wind at 0600 and 1800. For a constituent with a vertical gradient and relatively long chemical lifetime we would expect it to roughly be in (or 180 degrees out of) phase with temperature variations (depending on the sign of the constituent vertical gradient – from eqn. 1). Why then do we see a maximum in the transport term when we expect there to be no difference in SR and SS from the DW1? In addition, the authors note that the ozone profile has a relative maximum at 32km (see eqn. 7), which implies the sign of the gradient changes below this level. The vertical wavelength of the tide is about 25 km (again Sakazaki et al. [2012]), so below this relative peak we would expect the same sign in the SR/SS difference - both gradient and wind direction have changed sign, but in Figure 5 we see the sign of SSD has changed.

The paper would be far more convincing if it showed both the amplitude and phase of the SD-WACCM DW1 vertical wind (identical to MERRA presumably) and the mean profile of ozone. In addition, the authors have compared these to SABER measurements (16066/12) so it would add to their case if they included those comparisons.

Specific comments:

16047/8: "the diurnal migrating tide...is dominant over other higher-order harmonics" This is only true at certain seasons, latitudes and heights. For example, the diurnal tide in temperature and vertical wind is nearly zero at 20 N/S.

16047/18: It is true that the vertical wind is small and difficult to measure, but the temperature signal is and has been easily observed and could also be used to infer the vertical wind. It might be worth noting the proposed method is only practical when there is a vertical gradient in the constituent.

16053/25: Can the authors estimate an uncertainty in the geometric altitude determination?

16054/10: what is the frequency of the MERRA data used to nudge SD-WACCM? Enough to resolve the diurnal tides?

16060/24: Without error bars on these differences, it is difficult to say how similar these results are. Can the authors estimate the uncertainties in SSD based on simple propagation of errors?

16062/27: Again, "quasi-observation evidence of seasonal variations in stratospheric vertical tidal winds" can be obtained directly from temperature observations - simply replace dO3/dz with dT/dz.

16065/13: see general comment - how can the sign change when the gradient in ozone changes sign but the 15 km difference in altitude is less than the vertical wavelength of the DW1 tide?

16066/12: How do the authors explain the good agreement in SSD between SD-WACCM and observations, when the tidal amplitudes in SD-WACCM/MERRA are a factor of two low?

16077/Figure 5: If this is SSDcorr the caption should reflect that.

16083/Figure 11: This only shows the amplitude, but to understand the transport, the phase of the migrating tide needs also to be shown.

References:

Sakazaki, T., M. Fujiwara, X. Zhang, M. E. Hagan, and J. M. Forbes (2012), Diurnal tides from the troposphere to the lower mesosphere as deduced from TIMED/SABER satellite data and six global reanalysis data sets, J. Geophys. Res., 117, D13108, doi:10.1029/2011JD017117.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 16043, 2014.