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Interactive comment on "Forcing mechanisms of the quarterdiurnal tide" *by* Christoph Geißler et al.

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We thank the referee for the comments. We will add additional descriptions and clarifications to the points raised. We repeat the concerns here, and add our response in italics.

Description of the model need to improve, mainly about gravity wave routine.

The model has been extensively described, e.g., in Lilienthal et al. (2018), Samtleben et al. (2019), Fröhlich et al. (2003a, 2007), Jacobi et al. (2006). We will add more details and the respective references.

Page 3, line 23 - Information about the tidal forcing needs to be supplemented. Was the model run with DT, SDT, TDT and QDT modes on?

In the model, all tidal waves are forced through the diurnal absorption of solar radiation. We will add the following to clarify this: The diurnal cycle of solar radiation absorption leads to self-consistent forcing of tidal harmonics such as DT, SDT, TDT, and QDT.

Page 5, line 2 - from Fig 1 it possible to see that largest amplitudes in the NH are found in February and October for meridional wind component whilst for zonal wind the largest amplitude appear in October for temperature in February, October and November. For the southern hemisphere, the largest amplitudes appear between April and October, being worthy of discussion.

We will specify this as following: For an overview of the seasonal cycle of the QDT, Fig. 1 shows the QDT temperature and wind amplitudes at about 101km height. The amplitudes in the Northern Hemisphere show larger amplitudes in autumn and winter between $20°N - 40°N$ *and* $50°N - 70°N$*, respectively. Maxima of QDT amplitudes are seen in the Northern Hemisphere in February and October for the meridional wind, for the zonal wind in October and for temperature in February. Larger amplitudes in the Southern Hemisphere appears also during autumn and winter (April to October) between* $20°S-40°S$ *and* $50°S-70°S$ *with maxima in August for temperature and winds.*

Page 5, lines 11-12 - Please change this sentence - "The largest QDT amplitudes in the southern midlatitudes derived from the satellite data do not show agreement with the MUAM results in Fig. 1 (a)." - In fact, the model does not reproduce the observed amplitudes.

We will change this sentence to: The model results do not reproduce the amplitudes observed by satellites.

Page 7 (lines 33 and 34) and page 8 (lines 1-6): it would be interesting to separate the description NO_LIN from the description NO_GW.

We will change this to: In addition, a NO_NLIN run was performed in which only quarterdiurnal nonlinear interactions have been removed. The amplitudes of the NO_NLIN simulation are partly even larger than the ones in the REF simulation. This fact is also seen for the SOL simulations compared to the REF run. Larger amplitudes are also partly visible for the NO_GW simulation, with only removed interactions between tides and gravity waves in the model tendency terms.

Page 8, lines 19-21 and 34 - The sentences about Figs 9 and 10 are confused. Please rewrite more clearly. Are the authors dealing with the NLIN or NO_LIN case?

We will add some sentences t o this description to make it clearer: In Fig. 9, we present QDT amplitude differences between the NO_NLIN and REF simulation, which are scaled by the growth rate of the tides with altitude to highlight the actual source region of the waves. Here, the red (blue) areas denote larger amplitudes in NO_NLIN (REF) simulations. This means that in red areas the run with one removed forcing has larger amplitudes than the REF run. The removed nonlinear forcing (which is visible in the NLIN simulation) must interact with other QDT from other forcings (like solar or gravity wave forcing).

The NLIN run (only nonlinear forcing) case should be show small QDT amplitudes because of the weak nonlinear forcing. The NO_NLIN (without nonlinear forcing)

simulation should show larger amplitudes than the NLIN run, but smaller than the REF run, because one forcing (nonlinear) is missing.

In Fig 1 QDT amplitudes in HS are higher than in HN (mainly in zonal wind). Could the authors discuss these differences considering the different forcing mechanisms ?

This is difficult to say. The wave propagation depends on the background circulation, which of course differs between northern and southern hemisphere (temperature, and especially wind jet strength and distribution). It may be possible that the propagation conditions are better in southern hemisphere winter than in northern hemisphere winter, which leads to larger QDT amplitudes. The solar forcing depends on the ozone concentration in the respective hemisphere and these changes are small. The differences from nonlinear und gravity wave forcing between both hemispheres are also small, so that the differences in forcing cannot have the large impact that is seen in the amplitudes.

Minor/Technical comments: Page 5, line 22 - change “bySmith et al.” for “by Smith et al.”

Will be changed.

Page 5, lines 32-33 - Please provide compound term on first appearance of acronyms.

We will add this.

Page 5, line 22- change “(Fig. 7 g, h the amplitudes” for “(Fig. 7 g, h) the amplitudes” In some sentences the word “model” is used insted “modeling”. Please, check.

That's right, we will correct this.

We will correct also another mistake on page 3, line 19-21:

*Old: In the ensemble runs, the **ozone mixing ratio** is chosen according to the Mauna Loa Observatory data for 2005 (e.g., 380 ppm for February 2005, [. . .]), because we do not intend to perform an **ozone** dependent trend analysis.*

*New: In the ensemble runs, the **CO_2 concentration** is chosen according to the Mauna Loa Observatory data for 2005 **as global constant** (e.g., 380 ppm for February 2005, [. . .]), because we do not intend to perform an **ozone and CO_2** dependent trend analysis.*

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