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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Solar and lunar tides in noctilucent clouds as determined by ground-based lidar" *by* Jens Fiedler and Gerd Baumgarten

Anonymous Referee #1

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GENERAL COMMENTS

The present paper analyses a long-term time series of ground-based lidar data to derive properties of solar and lunar tides in noctilucent clouds. The properties of these weak features are difficult to extract out of all other components of atmospheric variability. Hence, long-term datasets are needed to be able to apply statistical methods. The present paper introduces a new and comparatively long dataset to this kind of research. This ground-based dataset has properties, which are complementary to those of the satellite datasets used before. It provides data for only one location but with a much better temporal resolution, which allows for a direct identification of tides on timescales of

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Discussion paper

hours to one day. Different properties of solar and lunar tides are successfully derived and, when possible, compared to previous results from other measurement techniques, showing agreement in many aspects. There are not many independent derivations of these properties in the literature and the comparison with this complementary dataset is very valuable. The paper is well-written and easy to understand. It fits well to the scope of ACP so that I recommend the publication after addressing some minor points listed below.

SPECIFIC COMMENTS

Page 2, line 22: “however, it takes one month to cover all lunar times”: It could be helpful for the reader to explain this by 2 or 3 more sentences.

Page 3, line 2: “the mean probability to observe NLC at this location is âĹij48 %”: Is this information really useful? The reference of 6400 measurement hours appears to be quite arbitrary, as it depends on weather conditions, etc. One could use the total number of possible measurement hours within the 21 seasons, but still I am not sure if this information is needed. Please explain or change accordingly.

Page 3, lines 5-8: “For details the reader is referred to Fiedler et al. (2009)”: I would find it useful to add some more sentences on the calculation method, although Fiedler et al. (2009) is referenced. This would make the article more self-contained and help to directly understand it for readers without a strong background in lidar remote sensing.

Page 3, line 15: “to the hourly mean values”: It might not directly be clear that the mean values from the epoch averaging are meant in contrast to, e.g., an hourly averaged time series (other approaches fit the sinusoidal functions directly to time series). Using other words like “epoch averages” could make this clearer.

Page 3, line 17: “The mean NLC parameters are randomly diversified within their error bars (1000 times for each hour)”: Which distribution function is used for this (e.g., are the random samples normally distributed with the standard deviation set to the error

bars or are they uniformly distributed with sharp edges at the error bar range)?

Page 3, line 23 and Figure 1, caption: “The plots contain 6400 hours of lidar measurements”: Is this really the average over all available measurement hours or the average over the 3100 hours, which contain NLC? If 6400 hours is correct: Is it useful to integrate the measurements without NLC in this plot? To my understanding, these measurements are not used in the rest of the analysis and I would have expected to apply the same filters as for the analysis here.

Page 4, line 22: “The plots contain 3450 measurement and 2030 NLC hours from 1997 to 2017”: a similar question here: Are the measurement hours without NLC averaged into to mean data? Or what does the differencing between measurement and NLC hours actually mean?

Page 5, line 1: “most intense for occurrence frequency”: According to the Delta-value in the plots, the total backscatter coefficient varies most. So, to which value is this statement related?

Page 5, line 19ff: You compare your values of the semidiurnal amplitudes A12 to those of the satellite studies. As you mention also in the introduction, it takes about one month for sun-synchronous satellites to sample all local lunar times. Hence, the satellites strictly observe a superposition of a semidiurnal and a semimonthly lunar tide and it is necessary for the interpretation to assume that the semidiurnal tide dominates over the semimonthly tide. This assumption is commonly made, but is sometimes still under debate. Could you comment on, first, to what extent the good matching of your results with the satellite results support this assumption and, second, if it could be possible in future to also extract the semimonthly tide from your data in order to cleanly separate both?

Page 6, Line 13: “the observed lunar tidal behavior, different for the NLC parameters”: the phrasing is not very clear to me. Maybe the sentence could be restructured to put emphasis on the “different” and not on “all. . .contribute”.

Page 8, Line 33: “The altitude structure of the lunar semidiurnal tide in layered phenomena of the summer mesopause region was never studied so far”: To my understanding, this is not true in this generality. E.g., von Savigny et al., 2017 shows the altitude structure of the semidiurnal lunar tide in MLS temperature up to 90km altitude and also Hoffmann et al., 2018 shows the altitude dependence of the semidiurnal lunar tide in several NLC related parameters. However, I agree that the phase progression has not been quantified and discussed in these studies as the authors do it here.

TECHNICAL CORRECTIONS

Page 1, line 25: “even when epoch averaging over many years and where attributed to impacts of atmospheric thermal tides”: A bit hard to understand. First, maybe: “when epoch averaging over many years is applied” and second, “where” has probably to be “were”. Page 4, line 22: “The plots contain 3450 measurement”, add “s” to measurement

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Hoffmann, C. G., von Savigny, C., Hervig, M. E., & Oberbremer, E. (2018). The lunar semidiurnal tide at the polar summer mesopause observed by SOFIE. Journal of Atmospheric and Solar-Terrestrial Physics, 167, 134–145. https://doi.org/10.1016/j.jastp.2017.11.014

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