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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Noctilucent clouds and the mesospheric water vapour: the past decade" *by* U. von Zahn et al.

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The focus of the paper is on quantitative relationships between noctilucent cloud (NLC) brightness and mesospheric water vapor. However, the inadequate discussion of the role of solar activity limits the value of the conclusions drawn from these data.

1. p. 3046, lines 23-26: This initial discussion of long-term variations in NLC properties seems to immediately rule out the idea of periodic variations, without having demonstrated why this should be true. In fact, a regular forcing mechanism (solar Lyman alpha flux) is available and well-known, as discussed in later comments.

2. p. 3048, lines 16-19: For a nadir-viewing instrument such as SBUV, the scattering geometry is fairly simple and the sampling volume is well-defined because the geographical location is known accurately.

3. p. 3055, lines 3-5: This statement concludes numerous instances in which the authors seem to be focused only on the possibility of linear long-term changes in mesospheric water vapor. A strong anti-correlation between water vapor abundances at the summer mesopause and solar Lyman alpha flux was proposed by Garcia [1989], based on 2-D model calculations. Marsh et al. [2003] explicitly states that the variations observed in HALOE mesospheric H_2O anomalies, which are observed to peak in 1995-1997, are likely to be related to the solar cycle. They then derive trends for 1992-2002 using a multiple linear regression model which uses UARS Lyman alpha flux to represent the solar activity term. Conclusions in this paper regarding "...the drastic change of the H_2O trend in the mid-1990s" are not appropriate unless the solar UV influence is also incorporated.

4. p. 3059, lines 18-21: These sentences represent the only discussion of solar activity influence on NLC in this paper, and do not adequately treat the subject. Plotting an annually-averaged solar activity parameter such as 10.7 cm flux on Figure 5 would clearly show that the periods of the solar variation and NLC occurrence frequency are in fact similar. A simple regression analysis would also demonstrate that the phases are consistent with an anti-correlation. The work of DeLand et al. [2003] clearly shows that this anti-correlation holds for both Northern and Southern Hemisphere satellite data over multiple solar cycles.

5. p. 3060, lines 20-23: Changes in NLC occurrence rate and brightness corresponding to a specified change in water vapor are not required to be identical. An increase in occurrence rate implies the creation of more new NLC particles, whereas an increase in NLC brightness suggests growth of the existing particles. Both mechanisms are likely to be operating over decadal time scales.

6. p. 3061, lines 5-10: While the NLC occurrence rate at 80° latitude is certainly higher than at 50°, the solar cycle variation is present at all latitudes. Analysis of the SBUV data set in restricted latitude bands shows occurrence frequency ratios F = 2-3 at 80-82° between solar minimum and solar maximum for both Northern Hemisphere and

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Southern Hemisphere data. A similar analysis for the 65-70° latitude region finds F = 4-5. Interannual variations in mesospheric dynamics make it more difficult to establish a specific magnitude for F in a latitude band over a solar cycle.

7. p. 3061, lines 24-29: The "...very limited dynamic range..." of the SBUV results does not represent an instrumental bias. The albedo threshold used by Shettle et al. [2003], which is in fact more conservative than the original analysis presented in DeLand et al. [2003], is a limit imposed to avoid "false positive" identifications caused by natural ozone fluctuations. Figure 8 of DeLand et al. [2003] shows that NLCs with brightnesses exceeding 30x10^{-6} are observed, representing a factor of 4 increase above the threshold value. The exponential distribution of the NLC population means that the seasonally averaged brightness will be dominated by the more frequent lower albedo values.

8. p. 3063, lines 16-18: DeLand et al. [2003] find clear positive long-term trends in NLC occurrence rate in both Northern Hemisphere and Southern Hemisphere satellite measurements over 23 years of data, even though the derived slopes are not significant at the 95% confidence level. An important feature of this analysis is the use of a multiple linear regression with a solar activity term, which removes the problem of evaluating a small trend in the presence of large amplitude variations that complicates the use of ground-based NLC data.

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