

Interactive comment on “Diminished greenhouse warming from Archean methane due to solar absorption lines” by B. Byrne and C. Goldblatt

J. Haqq-Misra (Referee)

jacob@bmsis.org

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This paper demonstrates the effect of increased shortwave absorption by CH₄ when a radiative-convective model is updated from the HITRAN 2000 to the HITRAN 2012 database. This suggests that at CH₄ abundances of 10⁻³ or greater, the amount of greenhouse warming from CH₄ is reduced compared to previous studies. The authors have conducted a careful study with a clean presentation of their results, and I agree that comparing the HITRAN 2000 and 2012 database with line by line calculations is important for understanding the radiative balance that seemingly kept early Earth warm.

However, the greatest discrepancy between HITRAN 2000 and 2012 occurs for CH₄ abundances that are likely to form a stratospheric organic haze layer (Fig. 4b,c), which

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would absorb incoming solar radiation and cool the surface. Although previous studies may have overestimated CH₄ warming at these abundances as the authors argue, the significant cooling from the formation of organic haze would lower global temperature likely by much more than the difference between the two HITRAN databases.

Only when CO₂ abundances are high and organic haze does not form (Fig. 4a) does the difference between the HITRAN databases seem to matter. For the Archean, this suggests that the improvement in radiative transfer is most applicable to haze-free high-CO₂ environments. Possibly conditions like this may have been present in the Hadean or early Archean, which the authors may wish to discuss.

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