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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: A new mechanism of 15 µm emission in the mesosphere-lower thermosphere (MLT)" *by* R. D. Sharma

Anonymous Referee #4

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1. GENERAL COMMENTS

The paper deals with a long standing problem of discrepancy between excitation/quenching rate values for the bending mode of CO2 molecule, CO2(v2), obtained from laboratory measurements, on one hand, and from atmospheric retrievals, on the other hand. Accurate knowledge of the mechanism of excitation/quenching of the CO2(v2) state and rates of the corresponding processes is of crucial importance for understanding the MLT energy balance and also for interpretation of temperature retrievals from the 15 um CO2 emission. The dominant mechanism for the CO2(v2) excitation is currently believed to be thermal collisions between CO2 and O: CO2 +

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O -> CO2(v2) + O. However, the rate coefficients derived from the observed 15 um emission under this assumption are about 4 times larger than those obtained in laboratory conditions when all relevant processes are under control. Different authors have tried to explain the discrepancy between laboratory measurements and atmospheric retrievals, but the question is still open. The current paper suggests a new mechanism for excitation/quenching of the CO2(v2) state, which is expected to close the problem. It is proposed that thermal collisions of CO2 with N2, mediated by a near-resonant rotation to vibration energy transfer process, excite CO2(v2) state by transferring energy from high rotational levels of thermal N2. The reasoning suggested by the author is clear, the estimates for the CO2 - N2 energy exchange rate coeficient look valid and are shown to be able to completely explain the difference between laboratory measurements and atmospheric retrievals.

The papers certainly addresses scientific question which is relevant within the scope of ACP, it is well written and presents novel ideas which are important to be brought to the attention of the community. I have the only minor reservation about the current paper. As it is now, the mechanism suggested looks as a hypothesis rather than as a proven fact. This hypothesis still requires a detail investigation that also includes provision of the corresponding rate constants and their applications to modelling of the MLT region as well as to retrieval processes. However, taking into account the importance of the problem and the novelty of the idea proposed, I recommend publishing the paper in ACP after some minor revision as detailed below.

2. SPECIFIC COMMENTS

1. Abstract. It should be clearly indicated in the abstract that the proposed mechanism is a hypothesis (even if it looks very reasonable) and requires a further investigation.

2. pages 25087-25089. Temperature model used for the estimates should be referenced. In addition, since MLT temperature has a considerable (by tens degrees) horizontal variation, it would be useful to make estimates for different temperature profiles

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(e.g., global average, sub-arctic winter and sub-arctic summer).

3. pages 25087-25089. Graphic illustration of the vertical variation of the estimated rates for different temperature profiles would be useful.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 25083, 2014.