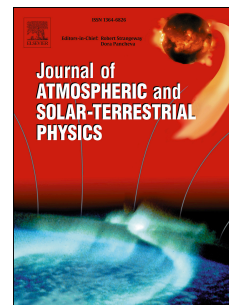


# Accepted Manuscript

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PII: S1364-6826(18)30052-X

DOI: [10.1016/j.jastp.2018.05.004](https://doi.org/10.1016/j.jastp.2018.05.004)

Reference: ATP 4850

To appear in: *Journal of Atmospheric and Solar-Terrestrial Physics*

Received Date: 26 January 2018

Revised Date: 4 May 2018

Accepted Date: 20 May 2018

Please cite this article as: Noll, S., Proxauf, B., Kausch, W., Kimeswenger, S., Mechanisms for varying non-LTE contributions to OH rotational temperatures from measurements and modelling. I. Climatology, *Journal of Atmospheric and Solar-Terrestrial Physics* (2018), doi: 10.1016/j.jastp.2018.05.004.

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# Mechanisms for varying non-LTE contributions to OH rotational temperatures from measurements and modelling. I. Climatology

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## Abstract

Rotational temperatures  $T_{\text{rot}}$  from OH line intensities are an important approach to study the Earth's mesopause region. However, the interpretation can be complicated as the resulting  $T_{\text{rot}}$  are effective values weighted for the varying OH emission layer. Moreover, the measured  $T_{\text{rot}}$  only equal kinetic temperatures  $T_{\text{kin}}$  if the rotational level population distribution for the considered OH lines is fully thermalised. In many cases, this basic condition of a local thermodynamic equilibrium (LTE) does not seem to be fulfilled. In order to better understand the non-LTE temperature excesses  $\Delta T_{\text{NLTE}}$  and their variations, we used  $T_{\text{rot}}$  measurements based on 1,526 high-resolution spectra of the UVES spectrograph at the Very Large Telescope at Cerro Paranal in Chile in combination with  $T_{\text{kin}}$  weighted for the OH emission layer based on 4,496 nighttime temperature and OH emission profiles from the SABER radiometer onboard TIMED taken at a similar location. Both data sets were linked via climatologies consisting of the nighttime and seasonal temperature variations. The study focusses on the non-LTE effects at the vibrational level  $v = 9$ , which is directly populated by the OH-producing hydrogen–ozone reaction and therefore especially prone to

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