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# Effects of the Atmospheric Temperature Structure on the Rotational Distribution of the High Vibrational Levels of the Hydroxyl Airglow

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Spectroscopic measurements of the hydroxyl (OH) nightglow emissions have been used to infer neutral temperatures near the mesospause. Recent work, which showed abnormally large populations in the higher rotational levels, has called into question whether the OH molecule has completely thermalized with the surrounding neutral atmosphere. This effect is most notable in emissions from the highest vibrational levels that have the shortest lifetimes, lending credence to this interpretation. However, the OH emissions span an altitude range where the neutral temperature structure has steep and changing lapse rates across the mesopause. Additionally, waves propagating from the lower atmosphere grow to large amplitudes and break in this region, creating strong perturbations to these steady-state lapse rates. Both the large gradients and their variability can also create anomalies in the rotational population, and these could change with the length of time the signal is integrated. Using dedicated airglow observations from the Nordic Optical Telescope, short-integration (approximately 10 and 20) spectra of the OH Meinel (9,7) band have been obtained for approximate one hour of continuous measurements on two nights. Wave structures are apparent in the observation time series. Here we present an analysis of the rotational populations of the OH M(9,7) band as a function of integration period and wave activity on these two nights to examine whether the population anomalies can be related to wave-induced gradient changes in the neutral temperature profile.