Temperature estimation from OH Meinel (8,5) band around 1.3 μm and its quantitative evaluations

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The Upper Mesosphere and Lower Thermosphere (UMLT), extending from 80 to 120 km, is closely related to the global atmospheric circulation. Precise measurements of its thermal structure are important to understand the whole atmospheric system. For example, the recent global warming, related with the enhanced greenhouse gases, can induce a cooling effect in the UMLT region, and the effect is considered to be more severe in the polar region. Therefore, monitoring of the UMLT temperature in the polar region would be vitally important.

The nightglow observations of hydroxyl (OH) vibration-rotation emission bands, which have been discovered by Meinel, can be used for the remote sensing of the atmospheric temperature in the upper mesospheric region. Recent advances in indium gallium arsenide (InGaAs) focal plane array allow to measure strong intensity of OH Meinel bands in near infrared regions. However, there are only limited examples of such applications in the near infrared region, especially in the polar region, where aurora emissions can be a contamination of the nightglow observations. In fact, a previous work reported a difficulty of the temperature estimation using by the OH (3,1) band (~1.5 μm) during the aurora breakup. In order to estimate robustly OH rotational temperature in the auroral zone, it is essential to develop a method using OH bands which are less affected by aurora.

For more stable temperature observations, in this study, we have performed temperature estimation utilizing OH (8,5) band (~1.3 μm), which can be less affected by auroral emissions. Based on ground-based Near-InfraRed Aurora and airglow Spectrograph (NIRAS) observations at Syowa station, Antarctic (69.0ºS, 39.6ºE), analysis was done for 3 nights including 1 night when moderate aurora activity was seen. As a result of estimates of nightly mean temperatures based on Line-Pair-Ratio method and Boltzmann Plot, average one-sigma errors are 14 K and 6 K, respectively. In addition, we calculated temperature using Boltzmann Plot with a 120 min resolution, and the error is 13 K. We examined that no any aurora contaminations at aurora breakup, corresponding to -400 nT in H-component, on April 24, 2018 can be seen in the wavelength of OH (8,5) band. In this presentation, we will show these results in more detail, and discuss effectiveness of the temperature estimation method proposed in this study.

