

## Research on the Analysis of Nitric Oxide Molecular Spectral Data with Millimeter-wave Spectroscopic Observations in Tromsø, Norway

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In the polar regions, it is known that ozone in the stratosphere and mesosphere is destroyed by the downward transport of odd nitrogen (NO<sub>x</sub>), which increase in the upper layers caused by energetic particle precipitation (EPP). Our research group has been observing variation of ozone and NO at Syowa Station in Antarctica since 2011, using molecular emission in the millimeter band due to the rotational transition of atmospheric molecules. As a result, it was found that photochemical reactions due to the sunlight and energetic electron precipitation (EEP) affect the variability of NO (Isono et al., JGR, 2014). However, in the summer season, when daylight hours are long, it became clear that it was not possible to separate the effect of photochemical reactions and that of EEP. Therefore, we are now aiming to solve this problem by installing a new instrument in the Arctic region (Tromsø, Norway), where the seasons are reversed, and conducting simultaneous monitoring at both the North and South polar regions. Because it was for the first time for millimeter-wave ground-based observations in Tromsø, the surrounding radio environment and the characteristics of the new observation equipment are not clear, and it is necessary to confirm what kind of quality data can be obtained. The purpose of this research is to obtain weak NO spectra with sufficient accuracy by the following three steps: 1) establishing a method to examine all acquired NO spectrum data and screen out those of poor quality that cannot be used for analysis; 2) examining optical depth data acquired to correct for the effects of the lower atmosphere and confirming whether it can be used for appropriate correction; and 3) performing appropriate baseline corrections to remove the continuum component in the NO spectral data.

First, NO spectral data from December 26, 2018 to March 10, 2019, when observations were conducted in Tromsø, were all scrutinized to determine the conditions for screening and removal of data containing large noise over all frequencies and spike-like noise in some specific frequencies. The possible origins of the overall noise and the spike-like noise are the contribution of the lower atmosphere due to bad weather and the interference of EISCAT UHF/VHF radar waves operating at close range, respectively.

Next, for the optical depth data, it was judged that a proper correction to the NO spectrum could not be made if there was a large temporal variation and the NO spectrum data for such a period was excluded from the analysis. The criterion for this was defined as the variance of the optical depth values measured during a day being larger than 0.04. On the other hand, we found a period when the calculated optical depth values were negative, which is not possible in principle. The reason of this was found to be the effect of the ice pillars hanging from the eaves at the outer side of the observation window. It was confirmed that the optical depth values could be calculated correctly by removing only the data that seemed to be affected by the ice pillars.

Finally, the baseline correction was performed on the remaining NO spectrum data from the screening. We succeeded in significantly detecting the weak NO spectrum. In addition, the column density of NO was determined from the spectrum. In the future, we are going to compare the results with data from the Syowa Station in Antarctica.

Keywords: Atmospheric Minor Molecules, Ozone, Nitric Oxide, Millimeter-Wave Spectrometer, Middle Atmosphere, Tromsø Norway

