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レイリー散乱ライダーによるつくば、陸別における気温の観測

Temperature measurement with Rayleigh lidars in Tsukuba and Rikubetsu

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Abstract

This paper is aimed at updating the Rayleigh lidar observations of temperature, conducted by the NIES, over Tsukuba and Rikubetsu. For Tsukuba since we have a better database for the winter season, an emphasis is given to the study of winter thermal structure. We have carried out a detailed validation/comparison studies of the lidar derived temperature with several other measurements/models. These studies illustrate a high degree of agreement between the lidar and other measurements/models, suggesting the potential of lidar measurements of absolute temperature of the atmosphere. Gravity wave analysis of the temperature profiles points out the dominant wave activities in the middle atmospheric region. A detailed observation at Rikubetsu is on schedule and using the data we hope to undertake an extensive study on various dynamical features.

1. Introduction

Laser remote sensing is one of the most advanced techniques for monitoring the Earth's atmosphere. Different types of lidars are now in practise and they apply a variety of scattering and absorption processes, providing a great deal of information about the atmosphere, its constituents and their changes in both time and space. Atmospheric temperature measurements achieved a big boost with the introduction of Rayleigh lidar systems, otherwise it was carried out with *in situ* soundings using balloon-borne instruments, rockets, and satellites. However, the *in situ* measurements often show many discrepancies and suffer deficiencies due to poor vertical resolution and sporadic nature of the observations. Rayleigh lidar, owing to its capability to make measurements with excellent space and time resolution, complements to the other techniques.

Temperature measurements over Tsukuba have been progressing using the ozone lidar system at the National Institute for Environmental Studies (NIES). This paper will update the temperature measurements and the ongoing related studies. We have conducted a validation/comparison study of lidar temperature profiles, employing various measurements/models including rocket, NMC analyses, SME spacecraft and CIRA 86 values. Using the temperature profiles we have initiated a study on gravity waves and it is in progress. Recently a new lidar system has been installed in Rikubetsu to measure the temperature and aerosol content in the middle atmosphere. The paper will also discuss the developmental details and preliminary temperature measurements at Rikubetsu.

2. Temperature Measurements over Tsukuba

Figure 1 presents a set of 6 sample temperature (nightly mean) profiles (solid lines) obtained by the NIES ozone lidar during the winter season of 1995. In the figure the successive profiles are shifted by 45 K and the profiles are noted with their date of observation. These profiles represent the typical pattern of winter variability. Stratopause is clearly evident at 44-50 km in all the profiles. During certain nights of observation there are indications of mesospheric inversion layer, which is usually observed above 60-65 km. This is a manifestation of gravity wave breaking within and above this altitude.

Also given in figure 1 (dashed line) is the temperature profiles for Tsukuba, obtained from the NMC analyses. NMC temperature profiles are given for 5 pressure levels. Except for the NMC value at the top level (approx. 55 km), it can be seen a reletively better agreement between the lidar and NMC analyses.

Validation results of lidar temperature profiles with the rocket measurements at Ryori are given in Figure 2. Existing database were checked and we were fortunate to have both lidar and rocket data for 5 days. Excellent agreement is evident in the four of the five cases. Comparison with other techniques also shows a satisfactory agreement in their trends.

3. Temperature Measurements Over Rikubetsu

Routine temperature measurements are about to begin with the recently installed lidar at Rikubetsu. This lidar is intended to provide stratospheric temperature and aerosol information and that would enable to clarify the dynamics related to the variabilities of the ozone layer. We conducted some trial runs of the lidar and the paper will discuss the preliminary results.

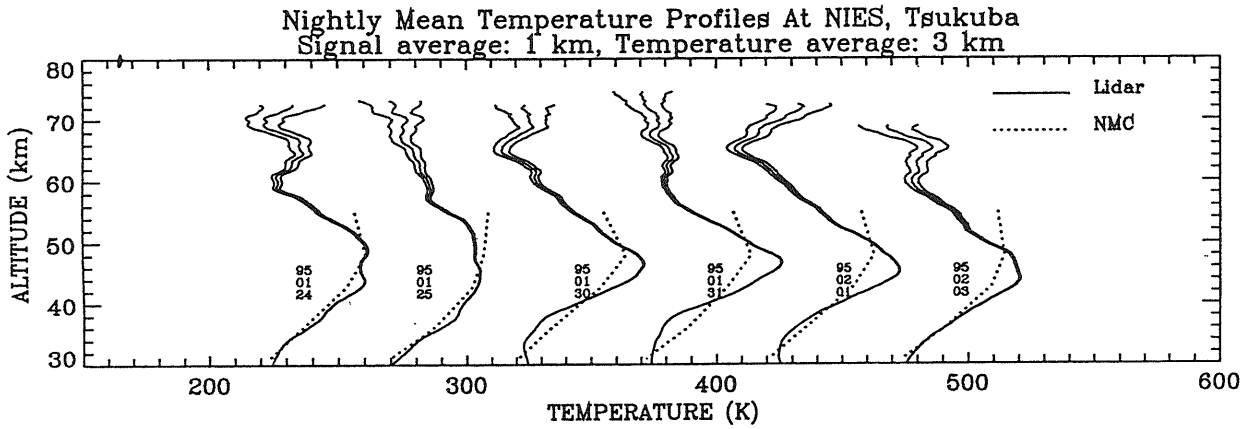

Figure 1

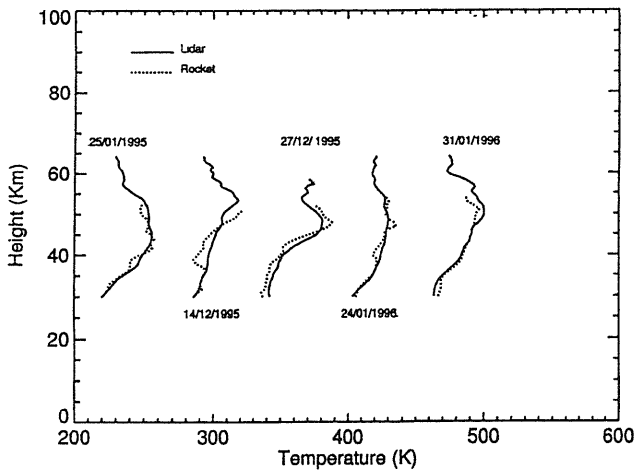

Figure 2. Lidar and rocket temperature profiles for 5 individual days.