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CRL Rayleigh and Rayleigh Doppler Lidars in Alaska

K. Mizutani, T. Itabe, M. Yasui,
Communications Research Laboratory
Nukui-Kita 4-2-1, Koganei, Tokyo 184-8795, Japan
Tel:+81-42-327-6955,Fax:+81-42-327-6667;e-mail: mizutani@crl.go.jp
R. L. Collins
Geophysical Institute, University of Alaska Fairbanks
903 Koyukuk Drive, #713 ,Fairbanks, AK 99775-7320,USA
Tel:+1-907- 474-7607, Fax+1 -907-474-7290; e-mail: rlc@gi.alaska.edu

Abstract

A Rayleigh lidar system was developed and is now working well for temperature observations at PokerFlat near Fairbanks of Alaska. A Rayleigh Doppler lidar is under the phase of development. CRL will make observations of the winds in the middle atmosphere by a Rayleigh Doppler lidar.

Introduction

Measurements of the structure and dynamics of atmosphere are capable in the troposphere and the lower stratosphere by balloon sonde, Doppler radar,etc., and in the thermosphere by MF radar, spectroscopy of natural emission, etc.. However height profiles of wind and temperature of the middle atmosphere between 30km to 60km is observable only by Rayleigh lidar and Rayleigh Doppler lidar except for rocket soundings which is expensive and not used frequently. A Rayleigh lidar system was developed and is now working well for temperature observations at PokerFlat near Fairbanks. A Rayleigh Doppler lidar is under the phase of development. CRL will make observations of the winds in the middle atmosphere by a Rayleigh Doppler lidar at Fairbanks in cooperation with Geophysical Institute, UAF.

System of CRL Rayleigh lidar

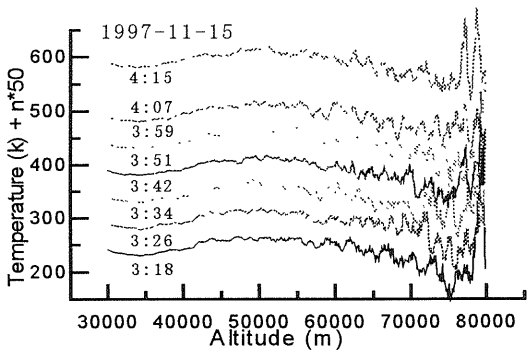
Rayleigh lidar detects the intensity of backscattering laser light by air molecules and temperature profiles between 35km and 80km can be derived from it. The system consists of a Nd:YAG laser and a 60cm Newtonian telescope. We installed it at PokerFlat on November 1997. The system is operated with Na lidar of GI which is used to observe Na layer in 80km-100km. Then we can observe the altitude range between 35km and 100km by both of the lidars. Examples of temperature profiles are shown in Fig.1.

System of CRL Rayleigh Doppler lidar

The Rayleigh Doppler lidar is an instrument to measure the winds and temperatures from the Doppler shift and the broadening of the Rayleigh scattering of the atmospheric molecules between 30km to 80km. A Nd:YAG laser with a seeder laser frequency stabilized against an Iodine molecular line emits its second harmonic wavelength pulse. The backscattering laser light from an inclined direction is collected with a 75cm Newtonian telescope and focused on a 24-channel ring detector after passing through a Fabry-Perot etalon. The etalon is capacitance-stabilized in a sealed mount. Its plate spacing of 2.5cm and reflectivity of 90% give a so-

called resolution of 200MHz. We have to measure one twentieth of it in a wavelength shift to realize a wind determination of 5m/s in the beam inclination of 30degree. The system characteristics are given in Table 1 and a blockdiagram is in Fig.2 . The system is now in test phase at CRL and will be transported to Poker Flat Research Range after the construction of new lidar building.

Fig.1 Temperature profiles by Rayleigh Lidar



Transmitter		
Laser	stabilized Nd:YAG	with SHG
Wavelength	532 nm	
Pulse energy	800 mJ	
Repetition	30 Hz	
Receiver Telescope		
Diameter	75 cm	
F-ratio	4 (1mm −> 0.6 mrad FOV)	
Fabry-Perot Spectrometer		
Type	Capacitance-stabilized Etalon	
Working aperture	15 cm	
Etalon gap	25 mm(6 GHz FSR)	
Reflectivity	90%	
Resolution	200 MHz	
Detector type	24-equal area ring detectors	
Height Resolution	200m	

Table 1. CRL Rayleigh Doppler Lidar

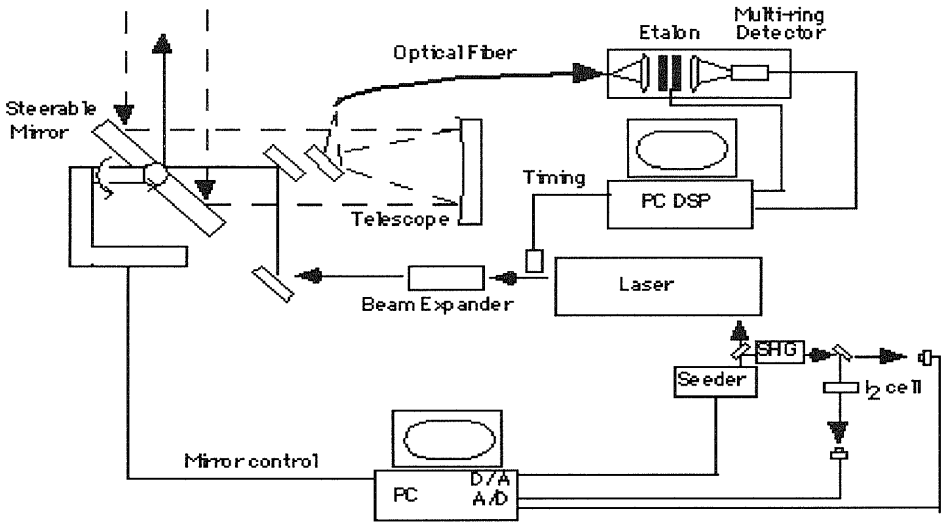


Fig.2 Block-diagram of Doppler Lidar