

Twenty-five years of narrowband metal resonance lidars and current trends

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Abstract

The feasibility of using atmospheric sodium layer as a tracer for temperature measurements in the mesopause [often termed Mesosphere and Lower Thermosphere (MLT)] region was first observationally demonstrated in England by Gibson, Thomas and Bhattachacharyya in 1979. In 1985, by scanning the transmitter frequency across NaD₂ transition, von Zahn's group in University of Bonn, Germany constructed a more robust sodium lidar and was immediately deployed in Andenes, Norway for MLT nocturnal temperature and Na density observations. Efforts in North America followed by a conceptually different transmitter development of my group at Colorado State University (CSU), USA, locking the transmitter to pre-selected 2 or 3 frequencies within the NaD₂ transition, permitting, respectively, temperature only, and temperature and line-of-sight wind measurements. Along with a lidar receiver and receiving electronics constructed by Gardner's group at the University of Illinois, the first MLT temperature measurements was carried out jointly in August 1999 at Fort Collins, CO (40.6N, 105W).

This talk will summarize the technical development of the CSU sodium lidar enabling Na density, and mesopause region temperature and wind measurements on 24-hour continuous basis, weather permitting, along with 20 years of enabled science and dynamics studies at different time scales with selected highlights from climatology to tidal perturbations and to gravity wave activities. At the end of this talk, recent trends and feasibilities of using continuous wave narrowband Na lidar transmitter and of using narrowband transmitter at ultraviolet iron transitions will be briefly discussed.

