

Resonance Lidar observations of Mesospheric Sodium over Gadanki (13.5°N, 79.2° E), India

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Measurements of the nighttime atmospheric sodium layer have been performed using a newly developed resonance lidar system at Gadanki (13.5° N 79.2° E), a low latitude site in the tropical part of India. The lidar system employs a flash lamp pumped dye laser, tuned to the sodium D₂ line at 589.0 nm, as a transmitter. The Sodium lidar is being operated to measure atmospheric Sodium density in the height range of 80 to 110 km, where scattering from aerosols and even atmospheric molecules can be ignored with respect to resonance scattering. The lidar observations of mesospheric Na were conducted for 290 h during 68 nights in January through December 2005. The observations of mesospheric sodium over this site have been accomplished with a spatial resolution of 300 m and a temporal resolution of 120 s. These are the first atmospheric sodium measurements to be reported from India. Lidar observations of mesospheric sodium layer show distinctly organized structure in the vertical distribution of sodium. Sequence of profiles over a night observation normally showed a wavelike structure which descended through the layer with time. Wave like structures in the sodium layer have been observed with characteristics similar to propagating gravity waves. 36 events of short lived sporadic Na layers were observed over 24 nights. The layers were very narrow and very dense with maximum densities exceeding 60,000 cm⁻³. The layers formed in the early hours at altitudes between 90 and 98 km. Most of the layers move rapidly and downward. Several times multiple sporadic layers were observed. Dynamical effects associated with tides, gravity waves and turbulence could be contributing to the formulation of these sporadic layers. The sodium density measurements during 2005 show peak sodium concentrations found to appear at 95 km altitude, however a secondary peak some times seen around 87 km. A significant variation in the nocturnal Na column abundance has been observed. The semi-diurnal tide is primarily responsible for such large variation in the Na column abundance. A strong wave activity has been clearly seen in mesospheric sodium profiles whose origin could be tidal influenced. The measurements of Mesospheric Na during 2005 have shown the feature of winter enhancement during February 2005. A strong semiannual oscillation has been seen at the altitudes of peak Na concentration.