Characteristics of atmospheric boundary layer studied using 206.5 MHz ST Radar over the central Himalayas: Preliminary results

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The atmospheric boundary layer (ABL) is the lowest part of the Earth's atmosphere that is affected by surface properties, viz., soil moisture and roughness. A better understanding of ABL's structure, evolution, and dynamics is needed as it plays a vital role in various atmospheric processes, such as the initialization of convection, turbulent transport, and monsoon dynamics. Different measurement techniques are used to study the boundary layer's characteristics. With the advent of remote sensing techniques, e.g., VHF and UHF wind profilers, SODAR, and boundary layer lidars, the characteristics of the boundaries can be studied with high temporal resolution. In this aspect, a state-of-the-art, indigenously developed stratosphere-troposphere (ST) radar operating at 206.5 MHz, which is a pulse-Doppler radar with a peak power aperture of 1 $x10^8$ Wm^2 at Nainital (29.35ºN; 79.45ºE) has been used to study the characteristics of ABL processes using radar reflectivity during the Asian Summer Monsoon (ASM) season. A methodology is developed to detect the ABL height using radar backscattering. Initially, radar data from June, July, and August 2023 are used for the analysis. The result shows that the boundary layer height varies between 1 and 1.5 km a.g.l. over Nainital during the ASM season. In addition, the height profile of virtual potential temperature derived from simultaneous radiosonde observation is used to deduce the ABL height. ABL height from both Radar & radiosonde compare well. Gaining confidence with this agreement, the radar technique is also used to study the diurnal evolution of ABL during the ASM period. Further, the turbulence refractive index structure constant, Cn^2, which is very important to understand the atmospheric turbulence and optical and radio wave propagation in the atmosphere, is estimated near ABL. Regional model simulations are also being made, and comparisons will be presented. These findings provide valuable insights into the turbulence mixing within the ABL over the Central Himalayan region, contributing to improved regional climate models and air quality research.