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Unraveling Himalayan terrain convective characteristics using vertical wind

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Vertical wind velocity is a crucial and challenging metric to measure in order to understand convective dynamics. The vertical wind is a key dynamic that regulates the development of deep convection, viz., thunderstorms, mesoscale convective systems, and cloud electrification. The unique meteorological conditions of highly elevated and complex terrains, such as the Himalayas, provide an opportunity to explore the diverse and contrasting weather patterns shaped by orography. This study focuses on vertical wind characteristics under diverse convection conditions from 2019 to 2022 using Stratosphere-Troposphere (ST) wind profiling radar located in the Himalayas. The ST radar operates at a high VHF frequency of 206.5 MHz and is situated in Nainital at an altitude of approximately 1793 meters above mean sea level. The Indian Summer Monsoon (ISM) significantly influences the region, increasing humidity in the atmospheric column causing elevated temperature isotherms. Strong mid-tropospheric (10-15 km) westerlies of the order of 56 m s-1 are observed in the vertical structure, except during the monsoon. During the ISM, these westerlies are replaced by elevated easterlies (above 15 km) with lesser magnitudes. The tri-model cloud fractions are predominantly observed from July to September. The highest rainfall of the year occurs in July during the ISM, followed by August. Analyzing the vertical structure of upward and downward motion separately, the mean convective profile of vertical wind shows that updraft motion gradually increases from the surface, reaching its maximum value at 10.5 km. In contrast, the profile of downward motion shows little variation. Significant differences exist among the various types of convection, primarily shallow, congestus, and deep convective cores. This clustered convective core analysis confirms a greater number of downdraft cores (359) compared to updraft cores (201). Over 60% of updrafts and 91% of downdrafts have maximum values below 5 m s^{-1}, indicating that updraft cores are more intense than downdrafts. Most of the convective cores are short-lived, with only 17 % having a time duration of more than 15 min in both updrafts and downdrafts. Among the various types of convection, shallow convection is predominant, making up nearly 80% in both downdrafts and updrafts. A broad distribution is observed in the case of congestus convection. The updrafts and downdrafts display increasing core length and maximum intensity from shallow to deep convective cores. The comprehensive analysis of vertical wind profiles highlights the intricate Himalaya's complex terrain influenced convective dynamics that will be discussed in the forthcoming URSI conference.