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The impact of the Westerlies on the PBL growth and land surface energy balance on the north of the central Himalaya

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The spatial-temporal structure of the Planetary Boundary Layer (PBL) over mountainous areas can be strongly modified by topography. The PBL over the mountainous terrain of the Tibetan Plateau (TP) is more complex than that observed over its flat areas. To date, there have been no detailed analyses which have taken into account the topography effects exerted on PBL growth over the Tibetan Plateau (TP). A clear understanding of the processes involved in the PBL growth and depth over the TP's mountainous areas is therefore long overdue.
The PBL in the Himalayan region of the Tibetan Plateau (TP) is important to the study of interaction between the area's topography and synoptic circulation. This study used radiosonde, in-situ measurements and ECMWF ERA5 reanalysis dataset to investigate the vertical structure of the PBL and the land surface energy balance in the Rongbuk Valley on the north of the central Himalaya, and their association with the Westerlies, which control the climate of the Himalaya in winters. Measurements show that the altitude of the PBL's top in November was the highest of three intensive observation periods (i.e., June, August and November). The PBLs in November appeared to have been influenced by the Westerlies which prevails in this region during the non-monsoon season. We discovered that the deep PBLs seen in November correlate with the downward transmission of the Westerlies to the valley floor (DTWTV). It was found that DTWTV happened in the direction of southwest when the synoptic wind above the valley ridges height blow from southwest, which is parallel to the valley axis. DTWTV happened in the direction of southwest promotes a stronger near-surface wind, smaller aerodynamic resistance, and larger sensible heat flux, which cause PBLs grow high.