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Combined ground and space-borne lightning detection over a mountainous region

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Typical features of lightning distribution in the mountain area of Mt. Cimone (2165 m a.s.l. - Northern-Central Italy) have been studied through detections provided by the ground-based LIghtning NETwork data (LINET) and the Lightning Imaging Sensor (LIS) onboard the International Space Station (ISS-LIS). The study was performed within the context of lightning implications as natural hazard, and its role in a changing climate. Of particular interest are mountain regions because of their orographic impact, which determine most lightning hotspots around the globe. LINET VLF/LF radio measurements allowed the characterization of both cloud-to-ground (CG) and intra-cloud (IC) strokes' geographical distribution and altitude of occurrence over 2012 through 2020. The lightning distribution showed a remarkable clustering of CGs at the mountain top in contrast to a homogeneous distribution of ICs, highlighting the likely impact of orography. IC strokes peaked around 4 to 6 km altitude, consistency with the observed typical cloud range. The joint exploitation of LIS-ISS optical observations of LINET detections extended the study to further features of flashes not seen in radio wavelengths and stands as cross-validation of the two detection methods over such a complex orography. These results give an example of mountain-driven changes in lightning occurrence. The clustering at the Cimone mountain top induced by the orography replicates a general feature of the dependence of global lightning hot-spots from elevation and is of great interest in the understanding of the lighting-climate relationship, considering known effects of elevation-depedent climate change.