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Unraveling Gravity Wave Coupling from Surface to Stratosphere above La Réunion's Maïdo Observatory (21°S, 55.5°E) from Doppler and Rayleigh lidar observations

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The study investigates the vertical wave coupling from the Earth's surface to the middle atmosphere over the Maïdo Observatory at La Réunion (21°S, 55.5°E). Wind velocity and temperature profiles from the ground-based instruments, including the LiWind Doppler Rayleigh-Mie and Li1200 Rayleigh Lidars, in conjunction with other observations (radiosoundings, COSMIC-2 radio-occultation, SABER) and ERA5 reanalysis, are analyzed to characterize gravity waves (GW) and their vertical propagation during the period from November 20th to November 24th, 2023. Notably, a tropospheric subtropical westerly jet manifested above La Réunion during this period and jet instabilities contributed to enhance GW activity in the troposphere. Wavelet methods are employed for denoising purposes and for highlighting multiscale GW from raw wind and temperature profiles. In particular, our analysis reveals the existence of a GW with a 5-km vertical wavelength and approximately a 24-hour period, propagating upward from lower troposphere to the middle atmosphere above La Réunion's Maïdo Observatory. Among others, the horizontal distribution of this structure surrounding La Réunion is examined using COSMIC-2 radio-occultation and SABER data. In addition, the ERA5 analysis also provides supporting evidence of such structures and GW filtering in the stratosphere.