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Infrasound thunder detections across 15 years over Ivory Coast: localization, propagation, and link with the stratospheric semi-annual oscillation

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Every day, around one thousand thunderstorms occur around the world producing about 45 lightning flashes per second. One prominent infrasound station of the International Monitoring System of the Comprehensive Nuclear-Test-Ban Treaty Organization for studying lightning activity is IS17 in Ivory Coast where the lightning rate is relatively high. Infrasound is defined as acoustic waves with frequencies below 20 Hz, the lower limit of human hearing. Statistical results are presented in this paper based on infrasound measurements from 2004 to 2019. One-to-one association between infrasound detections from 0.5 to 5 Hz and lightning flashes detected by the World Wide Lightning Location Network within 500 km from the infrasound station is systematically investigated. Most of the infrasound signals detected at IS17 in this frequency band are due to thunder, even if the thunderstorms are located up to 500 km away from the station. A decay of the thunder amplitude with the flash distance, d , is found to scale as d to the power of -0.717 for flashes within 100 km from the station, which holds for direct and tropospheric waveguide propagation. Interestingly, the stratospheric detections reflect a pattern in the annual azimuth variation, which is consistent with the equatorial stratospheric Semi-Annual Oscillation.