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Infrasound from lightning measured in Ivory Coast from 2004 to 2014

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It is well established that more than 2,000 thunderstorms occur continuously around the world and that about 45 lightning flashes are produced per second over the globe. 80 % of the infrasound stations of the International Monitoring System (IMS) of the CTBTO (Comprehensive nuclear Test Ban Treaty Organisation) are now certified and routinely measure signals due to natural activity (e.g., airflow over mountains, aurora, microbaroms, surf, volcanoes, severe weather including lightning flashes ...). Some of the IMS stations are located where lightning activity is high (e.g. Africa, South America). These infrasound stations are well localised to study lightning flash activity and its disparity, which is a good proxy for global warming.

Progress in infrasound array data processing over the past ten years makes such lightning studies possible. Assink et al. (2008) and Farges and Blanc (2010) show clearly that it is possible to measure lightning infrasound from thunderstorms within 300 km. One-to-one correlation is possible when the thunderstorm is within about 75 km from the station. When the lightning flash occurs within 20 km, it is also possible to rebuild the 3D geometry of the discharges when the network size is less than 100 m (Arechiga et al., 2011; Gallin, 2014).

An IMS infrasound station has been installed in Ivory Coast since 2002. The lightning rate of this region is 10-20 flashes/km^2/year from space-based instrument OTD (Christian et al., 2003). Ivory Coast is therefore a good place to study infrasound data associated with lightning activity and its temporal variation. First statistical results will be presented in this paper based on 10 years of data (2005-2014). Correlation between infrasound having a mean frequency higher than 1 Hz and lightning flashes detected by the World Wide Lightning Location Network (WWLLN) is systematically looked for. One-to-one correlation is obtained for flashes occurring within about 100 km. An exponential decrease of the infrasound amplitude with the distance of one order of magnitude per 50 km is found. The detection variability with the arrival azimuth is examined. A non-negligible number of events coming from the shadow zone (30 – 200 km) is found. It is also interesting to note that most of the infrasound related to lightning flashes is due to thunderstorm which occurred more than 200 km away from the station. However, it is hard to deduce any precise characteristics in those cases.