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Area of whistler penetration to the ionosphere

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We present results of a study related to the penetration of electron whistlers induced by lightning to the ionosphere. Using automatic method, we identify the fractional hop whistlers in the VLF spectrograms computed from the data recorded with the ICE experiment onboard the DEMETER satellite. We get the information about times at which the whistlers were recorded and also estimate their average amplitudes. We compare the identified whistlers with lightning detected by the EUCLID detection network and, using statistical aproach, we find the pairs causative lightning-whistler. For each pair we can find the dependence of the whistler amplitude on the distance between the lightning and pretended wave penetration point to the ionosphere and also on the lightning current. Superposing data from large number of such pairs, we obtain information about the area over which the whistler waves penetrate to the ionosphere.

In our analysis, we processed data from 186 DEMETER passes over the European region and found $\sim$ 30,000 of pairs causative lightning-whistler. We find that mean whistler amplitude monotonically decreases with horizontal distance up to $\sim$1000 km from the lightning source. At larger distances, the mean whistler amplitude usually merges into the background noise and the whistlers become undetectable. The maximum of whistler intensities is shifted from the satellite magnetic footprint $\sim 1^\circ$ owing to the oblique propagation. The average amplitude of whistlers increases with the lightning current. At nighttime (late evening), the average amplitude of whistlers is about three times higher than during the daytime (late morning) for the same lightning current.