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Remote sensing of the Earth-ionosphere waveguide properties based on cut-off frequency detection from DEMETER satellite measurements

S Toledo-Redondo (1,2), M Parrot (2), A Salinas (1), J. Portí (3), J. Fornieles (1), and J. A. Morente (3)

(1) Department of Electromagnetism and Matter Physics, University of Granada, Granada, Spain , (2) Laboratoire de Physique et Chimie de l'Environnement et de l'Espace, CNRS, Orléans, France, (3) Department of Applied Physics, University of Granada, Granada, Spain

The first cut-off frequency (1.6 - 1.8 kHz) of the Earth-ionosphere waveguide has been monitored during more than three years by means of DEMETER satellite electric field measurements. At this resonant frequency, most of the energy radiated by lightning remains trapped inside the cavity, and DEMETER (orbit at 700 km altitude) registers a minimum of energy at the cut-off frequency. Due to its polar orbit with 98° of inclination, DEMETER covers practically the whole Earth. Therefore it has been possible to draw maps of the cut-off with spatial dependence. These maps have shown a seasonal variation of the cut-off frequency in South Pacific, Indian and Atlantic Oceans. We have no clear proof for the connection between the Earth-ionosphere waveguide properties and the troposphere surface. That being said, we suggest sea-salt aerosol or changing conductivity of sea water as the responsible for these shifts. The cut-off frequency (f_1) value is directly related to effective height of the ionosphere (h) by the relation $f_1 = c/2h$, where c is the speed of light. Monitoring the first cut-off frequency from space can give additional information of the ionosphere D-region, since the effective height of the waveguide is directly related to the electron density in this region.