ELF/VLF Wave Radiation Produced by an Equatorial Ionospheric Heater

Nikolai G. Lehtinen* and Umran S. Inan
STARLab, Stanford University, CA 94305

Intense HF radiation from a ground-based facility heats the D-region of the ionosphere. The heating modifies the electron energy distribution function, which is found by solving the kinetic equation at each spatial location. The solution self-consistently takes into account attenuation of HF radiation due to modified HF conductivity. A modulation HF radiation at ELF/VLF frequencies creates corresponding modulation of DC conductivity tensor and consequently modulation of currents flowing in the ionosphere. These modulated currents radiate ELF/VLF waves. In the previously studied case of high latitude can propagate both into the Earth-ionosphere waveguide and into the upper ionosphere in the form of whistler waves, where it can be detected by a satellite (D. Piddyachiy, U.S. Inan, T. F. Bell, N. G. Lehtinen and M. Parrot, *J. Geophys. Res.*, doi:10.1029/2008JA013208, in press).

We consider the specifics of an HF heater effects at the geomagnetic equator, with the ELF/VLF radiation produced by the modulation of the equatorial electrojet currents. The calculation of this radiation is performed using a new stable full-wave method for a horizontally-stratified arbitrary anisotropic medium, with arbitrary harmonically-varying current distribution (Lehtinen and Inan, *J. Geophys. Res.*, **113**, A06301, doi:10.1029/2007JA012911, 2008). This method is capable of calculating the radiation into both the ionosphere and the Earth-ionosphere waveguide. Unlike heating at high latitudes which is characterized by significant emission of whistlers, at the geomagnetic equator the radiation goes only into the Earth-ionosphere waveguide. The radiated energy flux is found to be in general higher than that for a similar high-latitude heater, and is also found to be anisotropic in the horizontal direction.