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The 3D Distribution of Artificial Aurora Induced by HF Radio Waves in the Ionosphere

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Understanding the wave-plasma process, where high frequency (HF) radio waves energizes electrons in the ionosphere, has been one of the major motivations for conducting heating experiments over the last four decades. It is known from IS radar and optical observations, that high power HF radio waves can produce supra-thermal electrons with enough energy to excite and even ionize ionospheric constituents. However, the mechanism of electron energization is not known in detail. Artificial aurora is enhanced when the excited constituents relaxes. The distribution, color and intensity of the artificial aurora is dependent on the supra-thermal electrons and is therefore of interest.
This poster presents 3D modeling of artificial aurora in the ionospheric F-layer, induced by HF radio waves from the EISCAT heating facility. Projections of the modeled volume emission distribution were compared to images of the artificial aurora, taken simultaneously at four separate ground based imaging stations. The simultaneous multi-station imaging permitted the use of tomographic inversion methods. The 3D reconstruction of the artificial aurora was done in the green line (5577 Å), the red line (6300 Å) and in the infra-red line (8446 Å). Three different auroral construction techniques were considered, theoretical, semi-theoretical and Gaussian. The theoretical aurora model was constructed using previously published excitation rate profiles from numerical simulations of supra-thermal electron energy distributions.
The projections of the semi-theoretical and Gaussian aurora models were in better agreement with the observed images than the theoretical aurora model projections. Inspection of the constructed models suggests that the emission distribution lies within a thinner horizontal layer than predicted by the theoretical excitation rate profiles.