GROUND-BASED VLF TRANSMITTERS SEEN FROM THE PLASMASPHERE: MODELING AND VALIDATION

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Experiments studying wave-particle interactions involving very low frequency (VLF) radio waves suggest that ground-based transmitters may be useful tools to remediate enhanced radiation belts hazardous to spacecraft. To evaluate this potential, an integrated model has been created to simulate the illumination of the plasmasphere by existing Navy VLF transmitters.

The ground-based Navy transmitters are modeled using the LFCOM code, then projected into the lower ionosphere using a VLF penetration model. These results provide input to the central power tracing system, which propagates individual rays throughout the plasmasphere. The AFRL Space Weather Center of Excellences Next Generation Power Tracing Code tracks the input energy as it expands outward into the plasmasphere, using models of ionospheric and plasmaspheric particle densities and the geomagnetic field. A Volumetric Power Aggregator maps these results into a three-dimensional database of the aggregate power flux at any point in space.

The output of the model has been compared to VLF measurements during 47 benchmark night-time passes by NASAs IMAGE satellite over three Navy transmitters. The results of these comparisons drive model corrections to improve the overall accuracy. The models sensitivity to assumptions is estimated by varying the models and repeating the comparison.

Although the complexity and variability of ionospheric absorption, plasmaspheric dynamics and wave propagation preclude development of an instantaneously perfect model, the resulting simulation provides acceptable fidelity for modeling the illuminated region on average. By exploring variations in transmitter frequency and location, this model helps to gauge the potential effectiveness of ground-based radiation belt remediation efforts versus those conducted from space.

1. (a)
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2. H - Waves in Plasma

3. (a)

4. C - Contributed Paper

5. No special instructions