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Aspect sensitivity of VHF echoes from field aligned irregularities in meteor trails and thin ionization layers

Q. H. Zhou¹, Y. T. Morton¹, J. D. Mathews², and D. Janches^{2,3}

¹Electrical and Computer Engineering Department, Miami University, Oxford, OH, USA

²CSSL, Pennsylvania State University, University Park, PA, USA

³Arecibo Observatory, Arecibo, Puerto Rico

Abstract. The aspect sensitivity of VHF echoes from field aligned irregularities (FAI) within meteor trails and thin ionization layers is studied using numerical models. Although the maximum power is obtained when a radar is pointed perpendicular to the field line ($\perp B$), substantial power can be obtained off the $\perp B$ direction if the ionization trail/layer is thin. When the FAI length along B is 20 m, the power observed 6° off $\perp B$ is about 10 db below that perpendicular to the B direction. Meteoric FAI echoes can potentially be used to determine the diffusion rate in the mesopause region. Based on the aspect sensitivity analysis, we conclude that the range spread trail echoes far off $\perp B$ observed by powerful VHF radars are likely due to overdense meteors. Our simulation also shows that ionospheric FAI echoes can have an altitude smearing effect of about 4 km if the vertical extension of a FAI-layer is around 100 m, which has often been observed at Arecibo. The altitude smearing effect can account for the fact that the Es-layers observed by the Arecibo incoherent scatter radar are typically much narrower than FAI-layers and the occurrence of double spectral peaks around the Es-layer altitude in FAI echoes.

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