Homer Radar Observations of Artificial *E* Region Field-Aligned Plasma Density Irregularities

D. L. Hysell* and E. Nossa

Earth and Atmospheric Sciences, Cornell University, Ithaca, NY, USA

ABSTRACT

We present observations of artificial *E* region field aligned plasma density irregularities created over HAARP and observed with a new 30 MHz coherent scatter radar imager. The radar is deployed on the southern tip of Alaska's Kenai Peninsula, across Kachemak Bay from Homer and near the small town of Seldovia. The radar is installed at the NOAA Kasitsna Bay Laboratory (KBL) (59.47 N, 151.55 W) where extensive infrastructure exists. Spaced receiver data from the radar are processed using the principles of synthetic aperture radar imaging. Radar imaging affords the possibility of examining spatial fine structure in the modified volume over HAARP relatively free of spatio-temporal ambiguity. The imaging algorithm in use can be considered a super-resolution method and is not diffraction limited.

By comparison to their *F* region counterparts, artificial FAIs created in the *E* region have seen relatively little investigation. Generating them necessitates either very low pump frequencies or, failing that, the presence of sporadic *E* layers or auroral precipitation. Planning experiments around these phenomena is challenging, and the latter can cause significant attenuation of the probing radar signal. The Platteville and Arecibo heaters operated at sufficiently low frequencies to generate *E* region FAIs under normal daytime conditions as well as during sporadic *E* events, as could the EISCAT facility in the early 1980s, but similar low-frequency heating capability has been absent until recently. Moreover, the geographic constraints for field-aligned radar backscatter from *E* region FAIs are difficult to meet at auroral latitudes due to the low elevation angles involved and the minimal role playable by refraction, and specialized radars dedicated to heater support, such as this one, must generally be used.

Data from a number of recent HAARP experiments and campaigns are presented. In particular, we investigate 1) effects of heating at zenith and magnetic zenith, 2) evidence for preconditioning and wave trapping, and 3) the behavior of the irregularities near the second double resonance, where $f_{uh} \sim 2\Omega_e$. We find in particular that the effects of collisions and of finite parallel wavenumbers must be considered when evaluating conditions for wave trapping.