Imaging of Sporadic E layers with the Poker Flat Incoherent Scatter Radar

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Metal ions of meteoric origin are frequently observed as sporadic-E layers under a number of ionospheric conditions. At high latitudes, sporadic E can be formed quite efficiently through the influence of properly directed DC electric fields. This can only occur, however, if the necessary horizontal distributions and densities of metal ions are present prior to the electric field onset. While the formation mechanism has been quite firmly established both theoretically and experimentally, the distribution and horizontal extent of these altitudinally thin layers have not yet been fully explained. Most previous studies have concentrated on the vertical compression of a horizontally uniform source of ions, arguing that the nearly constant flux of meteoric material would support that source. This, however, is somewhat at odds with the sporadic nature of sporadic E as well as with the impulsive nature of measurements of meteoric ablation phenomena.

In this talk we present measurements of the horizontal extent and dynamics of sporadic-E layers as measured with the Poker Flat Incoherent Scatter Radar (the first deployment of a fully-caopable AMISR face). A radar operating mode was implemented which emphasizes the detection of these layers at the cost of detailed spectral information about the returns. The advantage of this approach is that it greatly reduces the minimum detectable electron density levels and allows shorter time integrations for the more intense layers. The PFISR experiment furthermore uses the rapid beam steering capabilities of that system to produce a three dimensional picture of the formation and evolution of sporadic E layers. It also interleaves a pulse suitable for the estimation of F-region electric fields (ion drifts) which are thought to be instrumental in the formation of the layers. Finally, Sondrestrom Incoherent Scatter Radar data will also be presented showing the evolution of layers at a higher geomagnetic latitude.

The measurements to be presented cover both meteor shower times and times without major shower activity, with sporadic E present under both conditions. The data show large horizontal gradients in many of the sporadic E layers as well as significant horizontal motion. In addition, the formation and destruction of layers also appear to be observed. These measurements will be interpreted in the context of current theories.