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13. ABSTRACT

This report describes a study of gun- and rocket-emplaced alkali plasma clouds in the 85-105 km altitude region of the ionosphere. The object of the investigation is to study the small-scale (tens-of-meters), short-term (fractions-of-seconds) irregular motion of the magnetofluid in the lower E layer. Motions on this spatial and temporal scale are known to be responsible for radiofrequency scattering at E-layer heights, and it has been suspected that they are important in the appearance and evolution of the sporadic-E layer. The resolution which is necessary to discern motions on the scale indicated was afforded by decameter- and meter-wavelength coherent-pulse-doppler radar.

A survey of possible instability mechanisms which can explain the spatial and temporal scales of the irregular motion observed in Phase III of plasma cloud evolution leads to the conclusion that a dissipative instability involving crossed electric and magnetic fields in the presence of a properly oriented plasma density gradient is the most likely candidate. It is found that the observed tens-of-meters instability wavelengths and tenths-of-seconds growth times are predicted by this mechanism, and curves of these parameters are presented for various altitudes, electrostatic field intensities, and wavelengths. A more sophisticated, two-dimensional, nonlinear instability analysis predicts a cyclic growth-and-decay process for the instability in the lower E layer and is in remarkable agreement with the Phase IV plasma cloud behavior. This circumstance is interpreted as strong evidence that the instability is instrumental in the formation of temperatelatitude nonblanketing sporadic E.

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