

MEASURING F1 REGION ION COMPOSITION AND TEMPERATURES WITH PLASMA AND ION LINE DATA AT ARECIBO

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One particular problem of the incoherent scatter (IS) radar technique since its beginning has been measuring unambiguously the electron and ion temperature ( $T_e$  and  $T_i$ ) plus the molecular ion fraction in the F1 region during the day when  $T_e$  is greater than  $T_i$ . So far, pretty much all IS radars make some assumptions in order to routinely process IS autocorrelation functions to get at least some values for temperatures or ion composition. In this paper we show one solution to this problem, which is based in the combination of plasma line and ion line portions of the IS spectrum to obtain unambiguous  $T_e$ ,  $T_i$  and molecular ion fraction during the day. While the idea of combining plasma line and ion line information to study the F1 region was initially used in the early 1970s and again tested in the late 1990s, it is only recently that all the technology is in place to develop a technique that can be used routinely (as in World Day observations) to measure both parts of the spectrum with very high accuracy. Thus for this work, we will be using very accurate electron density measurements from the coded long-pulse plasma line experiment to reduce the number of parameters that need to be determined from the least-squares fitting of the F1 region ion line autocorrelation functions obtained from and a new version of the multiple-radar autocorrelation function (MRACF) experiment. The MRACF experiment is the standard mode to determine electron density, electron and ion temperatures, ion composition (above the F peak where there is atomic oxygen and possibly light ions) and ion velocities in the F region at Arecibo.

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