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Status of and scientific results from the ISIS-I Topside Digital Ionogram Data Enhancement Project

Selected original analog telemetry tapes from three of the ionospheric topside-sounder satellites of the International Satellites for Ionospheric Studies (ISIS) program, namely Alouette 2, ISIS I, and ISIS II, were used in an earlier project to produce more than ½ million digital topside ionograms; the resulting digital topside ionograms from ISIS II were used to produce more than 100,000 globally-distributed vertical topside ionospheric electron density profiles Ne(h) over a time span of more than a solar cycle [Benson and Bilitza, Radio Sci., 2009]. These Ne(h) profiles were automatically produced using the Topside Ionogram Scaler with True height algorithm (TOPIST) [Huang et al., Ann. Geophys., 2002; Bilitza et al., Radio Sci., 2004].

Before attempting to use TOPIST to automatically process Alouette-2 or ISIS-I ionograms a data-enhancement project was initiated so as to increase the TOPIST success rate of producing Ne(h) profiles. These enhancements were mainly to correct problems that often occurred during the analog-to-digital conversion of the original telemetry tapes [Benson et al., Radio Sci., 2012].

Here we will present the status of this ongoing enhancement effort. First priority was given to ISIS I because of the large number of digital ionograms available, the long time span covered by these ionograms (1969 – 1982), and because of the similar ionogram format to that of ISIS II (a few seconds of fixed-frequency operation followed by swept-frequency operation up to either 10 or 20 MHz). ISIS I is a valuable complement to ISIS II because it includes altitudes up to 3,500 km (ISIS II was in a circular 1,400-km orbit) where predictions based on the International Reference Ionosphere (IRI) [Bilitza, Adv. Space Res., 2009] are in the greatest need of improvement. Most topside Ne(h) profiles available after 1969 are from ISIS II. These ISIS-II profiles are either from the hand-scaling of 35-mm film ionograms or from the auto TOPIST-processing of digital ionograms.

We are currently providing high-quality ISIS-I topside digital ionograms, and as many Ne(h) profiles as possible, for these later years. The goal of our data-enhancement project is to

significantly expand the topside-sounder digital ionogram database in the NASA Space Physics Data Facility (SPDF) and the NASA Heliophysics Virtual Wave Observatory (VWO), and the Ne(h) profile coverage in latitude, longitude, and epoch available from the NASA/SPDF. We will also illustrate scientific results from the ISIS-I topside ionograms including comparisons of the resulting Ne(h) profiles with those predicted by the IRI.