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Data Services Upgrade: Perfecting the ISIS-I Topside Digital Ionogram Database

Abstract:
The ionospheric topside sounder on the ISIS-1 satellite was designed as an analog system, as were the other ionospheric radio sounders included in the International Satellites for Ionospheric Studies (ISIS) program. The plan was to display the data on 35-mm film for analysis by visual inspection. The long operational lifetime of ISIS 1 (21 years) and cost considerations, however, prevented all of the sounder data from being converted to such film records. After the termination of the ISIS program in 1990, a selection of the original telemetry tapes from three of the topside-sounder satellites (Alouette 2, ISIS 1, and ISIS 2) were converted directly into digital records. The goal was to select a large number of telemetry tapes that were never processed to produce 35-mm film topside ionograms and to use them to produce topside digital ionograms suitable for modern analysis techniques, thus essentially creating new satellite missions with old data [Benson and Bilitza, Radio Sci., 44, RS0A04, 2009]. Based on experience gained with ISIS II, the analog-to-digital (A/D) conversion process was modified for ISIS 1 in an attempt to increase the number of digital topside ionograms that could be successfully auto-processed to produce topside vertical electron-density profiles Ne(h). The TOPIST algorithm (TOPside Ionogram Scaler with True-height) [Huang et al., Ann. Geophys., 45(1), 125, 2002; Bilitza et al., Radio Sci., 39, RS1S27, 2004], developed for the ISIS-2 digital topside ionograms, was modified so as to be able to automatically process the more recently produced ISIS-1 digital topside ionograms. As with ISIS 2, however, many of the digital ISIS-1 topside ionogram files could not be auto-processed by TOPIST to produce topside Ne(h) profiles because of problems with the digital files. Software has been written to resolve these problems, which originated during the earlier A/D process as described in Benson et al. [Radio Sci., 47, RS0L04, 2012], and here we report on
(1) the first application of this software to a significant portion of the ISIS-1 digital topside-ionogram database,
(2) software improvements motivated by this activity,
(3) Ne(h) profiles automatically produced by the application of the TOPIST software to these corrected ISIS 1 digital ionogram files, and
(4) the availability via the Virtual Wave Observatory (VWO) of the corrected ISIS 1 digital topside ionogram files for research.

We will also demonstrate the use of these Ne(h) profiles for making refinements in the International Reference Ionosphere (IRI) and in the determination of transition heights from O+ to H+.