Automated Analysis of Archival Data

During the last decade, the National Geophysical Data Center (NGDC) has been able to digitize a selection of archived ionogram films from various sites. While the overall format of the C-3/C-4 ionograms is consistent, the position, size, and exposure of the ionogram within the digitized image varies markedly from frame to frame due to the quirks of the mechanical camera, photographic developing, and the scanning process.

Analysis is focused on the Ft. Belvoir sounder (WA938, 38.7°N, -77.1°E) near Washington, DC. It was the original test site for the NBS sounders, with data going back to the late 1940s. During IGY, it was the primary site for issuing space weather bulletins for coordinating observing campaigns, and was the forecast center for Atlantic radio communications traffic.

Space Environment Corporation has developed software to analyze the scanned images, finding the boundaries, height and frequency markers, and contrast adjustment necessary to convert the images into a form which can be scaled by the Expert System for Ionogram Reduction (ESIR). The image above left is the original scanned ionogram, with the annotated ESIR ionogram shown on the middle left. At the bottom left is a version of this same ionogram which appeared in K. Davies’ Ionospheric Radio Propagation text (1965 edition); this figure confirms the general virtual height and frequency scales used for the digital conversion.

More detailed analysis of the virtual height coordinates is performed using multiple-hop sporadic E ionograms. Frequency coordinates are checked using broadcast band markers (such as the AM broadcast band on the left side of these examples) and specific reliable transmitters such as the 2.5 MHz WWV signal visible on these plots.

These conversion and analysis tools allow the digitized ionograms to be stored with proper virtual height and frequency coordinates, and to be scaled in a consistent manner with modern software.