Wave-like disturbances have been observed in the ionospheric plasma for several decades using a wide range of remote sensing techniques. In this paper, the use of Dynasonde-derived ionospheric “tilt” measurements is demonstrated to determine the dominant features of the underlying Acoustic Gravity Wave Spectrum and its height variation. The diurnal ionospheric variability introduces data gaps of varying length and distribution at any constant height level. This excludes the use of conventional FFT techniques for spectral calculations. To obtain a complete and accurate image of the height variability of the wave activity in the thermosphere-ionosphere, a method is required that would provide physically comparable results at all altitudes, regardless of the variations in sampling. In addition, the true geophysical variability should be distinguished from overlapping noise. The proposed solution is a combination of the well-known Lomb-Scargle and Welch methods, with the dataset of interest being divided into several overlapping subintervals, and the mean spectrum calculated using results for those subintervals for which the Power Spectral Density integral equals the time-domain variance within a preset tolerance. Choice of the tolerance value is justified by means of numerical simulations using synthetic data similar to the tilt measurements. The proposed method is verified using a 10-day-long dataset obtained with the Wallops Island Dynasonde. Results obtained with this method are compared in this paper with those obtained with a basic implementation and with a filtering method based on the amount of available data. A considerable reduction in the number of artefacts is observed with the use of this innovative approach, allowing reliable conclusions to be derived regarding the Acoustic Gravity Wave spectrum and its height variability.