



Comparison between Monthly Median foF2 Values Derived from Manually and Automatically Scaled Data over Rome from 2006 to 2022

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Monthly median values of the F2-layer critical frequency (foF2) derived from manually and automatically scaled data at the ionospheric observatory of Rome (41.8° N; 12.5° E) from 2006 to 2022 were considered in this study. The data were analyzed for each hour between 00:00 and 23:00 UT, employing two methods: one using only exact hour data and another incorporating the observations a quarter-hour before and after the hour sharp. ARTIST [1] and Autoscala [2] software is used for automatic interpretation of the ionograms. Statistical significance of the differences between automatic and manual values was determined using Student's t-tests, with a classical p-value threshold of 0.05.

The results showed statistically significant differences only in 10 and 7 out of 24 comparisons for Autoscala respectively using only exact hour data and when data from closest quarters-hour data were included, while for ARTIST in 15 out of 24 comparisons in both cases. These differences indicate a consistent tendency for both autoscaling software to underestimate the operator's values, with a slight improvement using quarters-hour data, the overall differences decreasing up to -0.026 MHz against -0.030 MHz obtained using only exact hour ones.

These findings indicate that the median values obtained from ARTIST and Autoscala can reliably substitute those manually derived for practical applications, given that the differences fall within acceptable error margins. This supports the adoption of automatic scaling tools for ionospheric data analysis, especially in observatories where manual scaling is impractical due to high labor costs and resource constraints, ensuring consistent and reliable monitoring of ionospheric conditions over time.

1. B. W. Reinisch, and X. Huang, 1983, "Automatic calculation of electron density profiles from digital ionograms, 3, Processing of bottomside ionograms," *Radio Science*, **18**, 3, May-June 1983, pp. 477–492, doi: [10.1029/RS018i003p00477](https://doi.org/10.1029/RS018i003p00477).

2. C. Scotto, and M. Pezzopane, "A software for automatic scaling of foF2 and MUF (3000) F2 from ionograms," URSI XXVIIIth General Assembly *Conference Proceedings*, August 2002, Maastricht, Holland.