

THE NEW IONOSPHERIC STATION OF SAN MIGUEL DE TUCUMÁN

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At the end of August 2007 an Advanced Ionospheric Sounder (AIS), built at the Istituto Nazionale di Geofisica e Vulcanologia (INGV), Rome, Italy, was installed at San Miguel de Tucumán, Argentina (geographical coordinates: 26.9 S, 294.6 E; magnetic coordinates: 15.5 S, 003.8 E), particularly interesting for its location, near the southern peak of the equatorial anomaly (Figure 1).



Figure 1. Geographical location of the new ionospheric station of San Miguel de Tucumán.

AIS-INGV is a digital low-power pulse-compressed ionosonde. In order to reduce the transmitted power, weight, size, power consumption, and to have an excellent reliability, advanced HF-radar techniques were employed. The ionosonde is also equipped with Autoscala, a software able to perform an automatic scaling of the ionogram.

The antenna system was designed by INGV and built by engineers from the Facultad Regional Tucumán (FRT) of the Universidad Tecnológica Nacional (UTN). It is constituted by two crossed delta antennas 20 m high and 40 m wide (Figure 2). An iron framework sustains the radiating elements, and is fixed by a two orders backstays system. Baluns and resistor loads, also these built at UTN, complete the antenna system.



Figure 2. The delta antenna of the new ionospheric station of San Miguel de Tucumán.

The main characteristics of AIS-INGV ionosonde (Figure 3) can be summarized as follows:

Parameter	Requirement
Height range	90 ÷ 750 km
Distance resolution	4.5 km
Max. peak transmitted power (medium power)	500 W (5~10 W)
Receiver sensitivity	~ -85 dBm for 0 dB S/N
Dynamic range	~ 80 dB
Frequency range	1 ÷ 20 MHz
Frequency resolution (step)	25, 50, 100 kHz
Frequency scan duration (max.)	3 minutes (for 50 kHz step sounding)
Acquisition sampling rate	100 kHz
Acquisition quantization	8 bit
Storage data rate (max.)	60 kbytes per 50 kHz step sounding

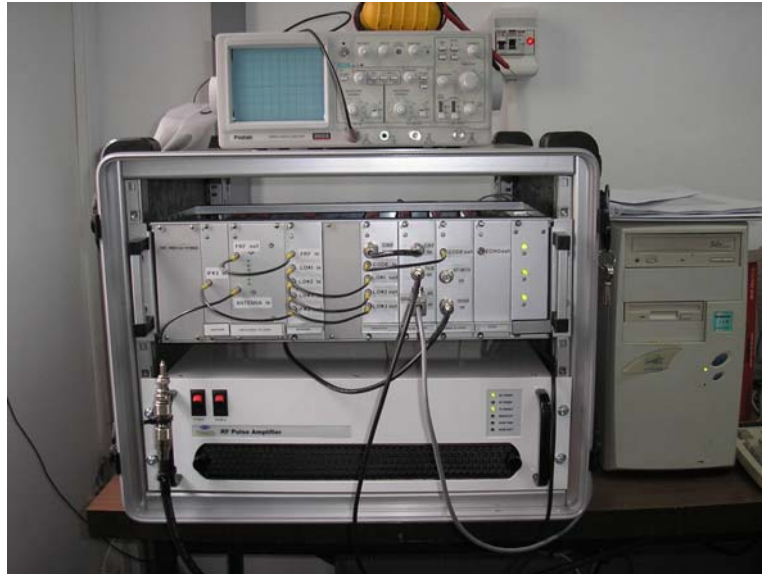


Figure 3. The AIS-INGV ionosonde installed at the new ionospheric station of San Miguel de Tucumán.

The sounding system is based on two computers, AIS-PC and Autoscala-PC; the former handles the sounding, stores ionograms and spreads raw data files to other computers.

Autoscala-PC receives the ionograms from AIS-PC, elaborates them and gives as output the following ionospheric characteristics: f_oF_2 , $MUF(3000)F_2$, $M(3000)F_2$, f_xI , f_oF1 , f_tE_s (the top frequency of the sporadic E layer), and hE_s . The outputs of Autoscala both in GIF and in TXT format are then sent to the internet and are accessible through the site <http://ionos.ingv.it/tucuman/latest.html> (Figure 4).

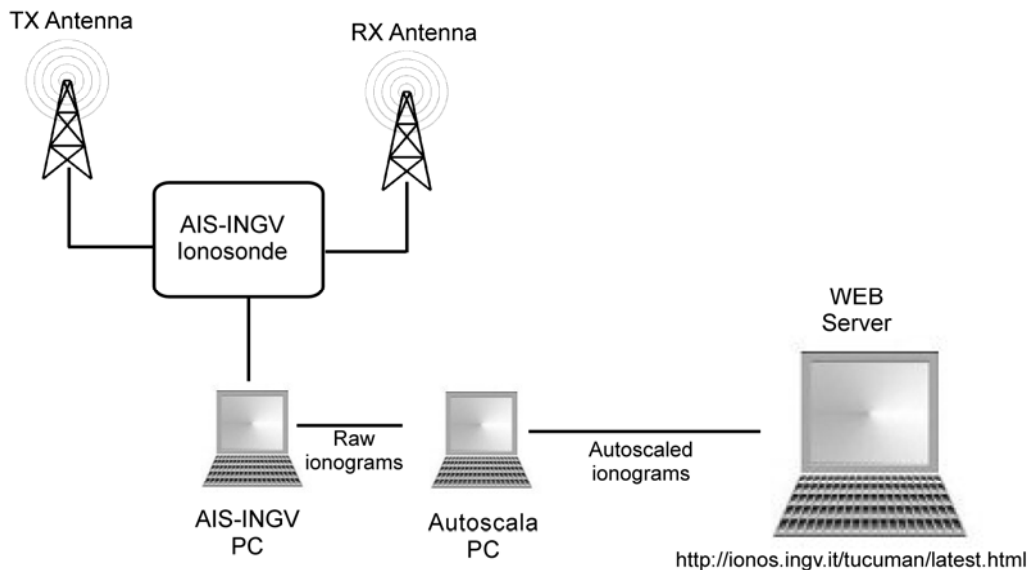


Figure 4. Diagram showing the AIS-INGV/Autoscala system data flow

The system is accessible remotely by FTP and RDP protocols to change parameters of the sounding as well as to add or modify programs.

Figures 5, 6, 7, 8 and 9 show examples of ionograms, as they appears on the web, respectively nocturnal, diurnal, with spread F condition, with sporadic E layer, and with a possible additional stratification, recorded by this new ionospheric station.

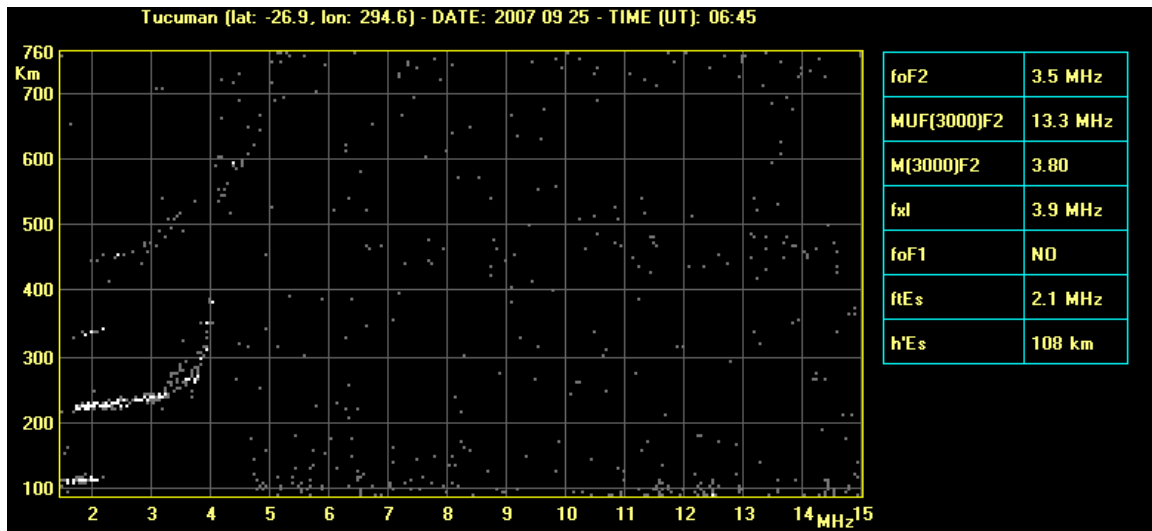


Figure 5. An example of a nocturnal ionogram recorded on 25 September 2007 at 06:45 UT by the AIS-INGV ionosonde installed at Tucumán, and autoscaled by Autoscala.

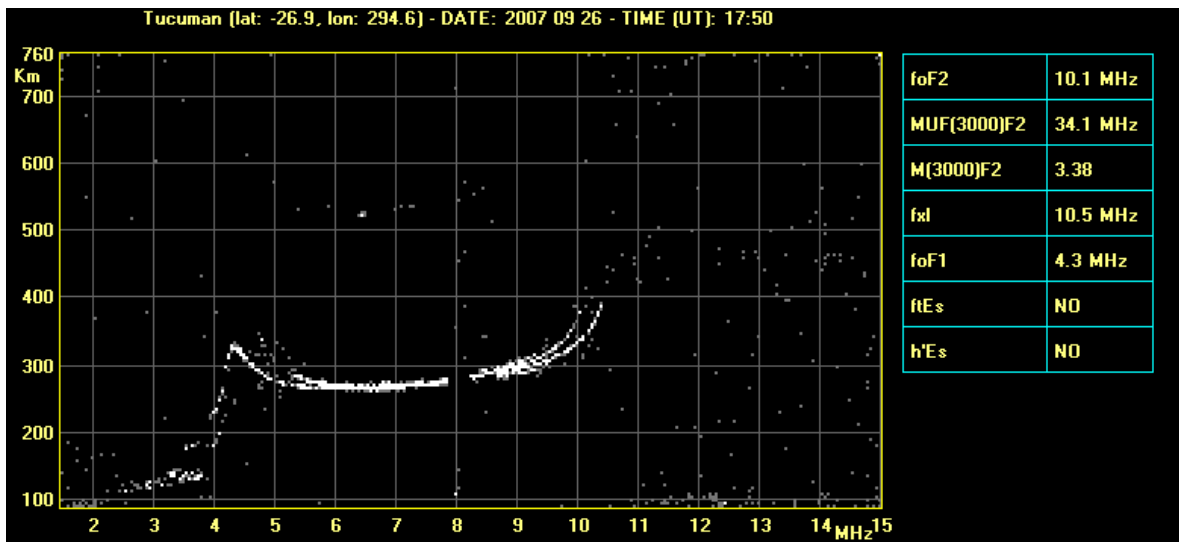


Figure 6. An example of a diurnal ionogram recorded on 26 September 2007 at 17:50 UT by the AIS-INGV ionosonde installed at Tucumán, and autoscaled by Autoscala.

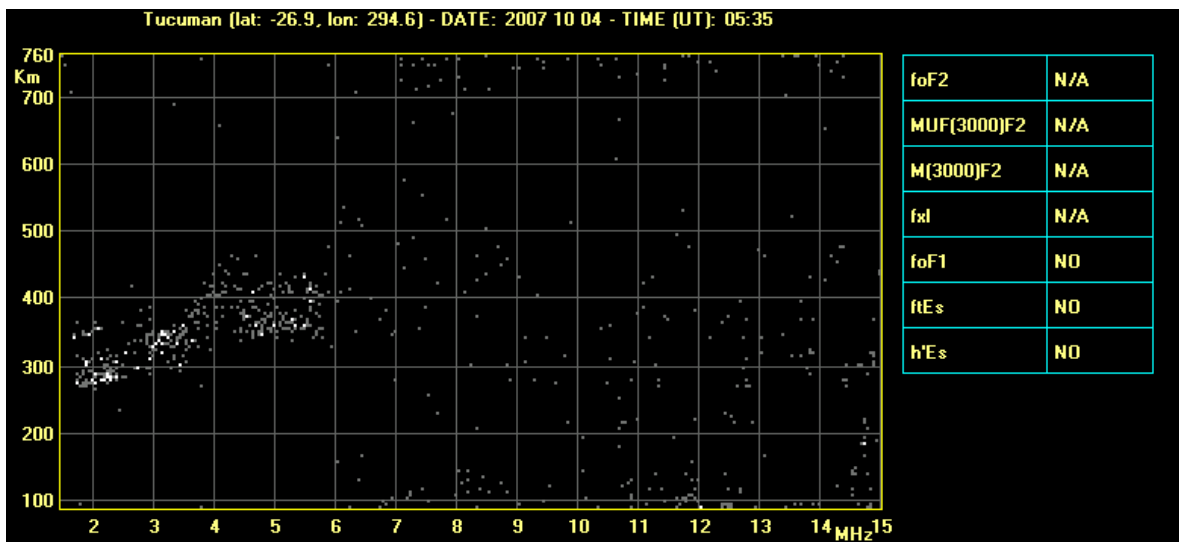


Figure 7. An example of an ionogram with spread F condition recorded on 04 October 2007 at 05:35 UT by the AIS-INGV ionosonde installed at Tucumán, for which Autoscala gave no autoscaled values as output.

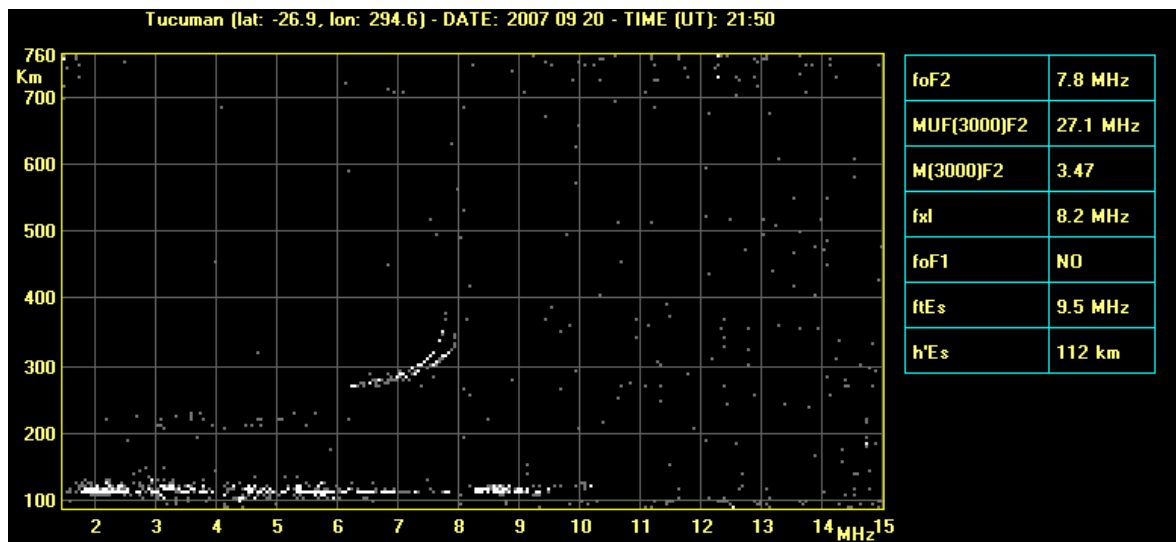


Figure 8. An example of an ionogram with sporadic E layer recorded on 20 September 2007 at 21:50 UT by the AIS-INGV ionosonde installed at Tucumán, and autoscaled by Autoscala.

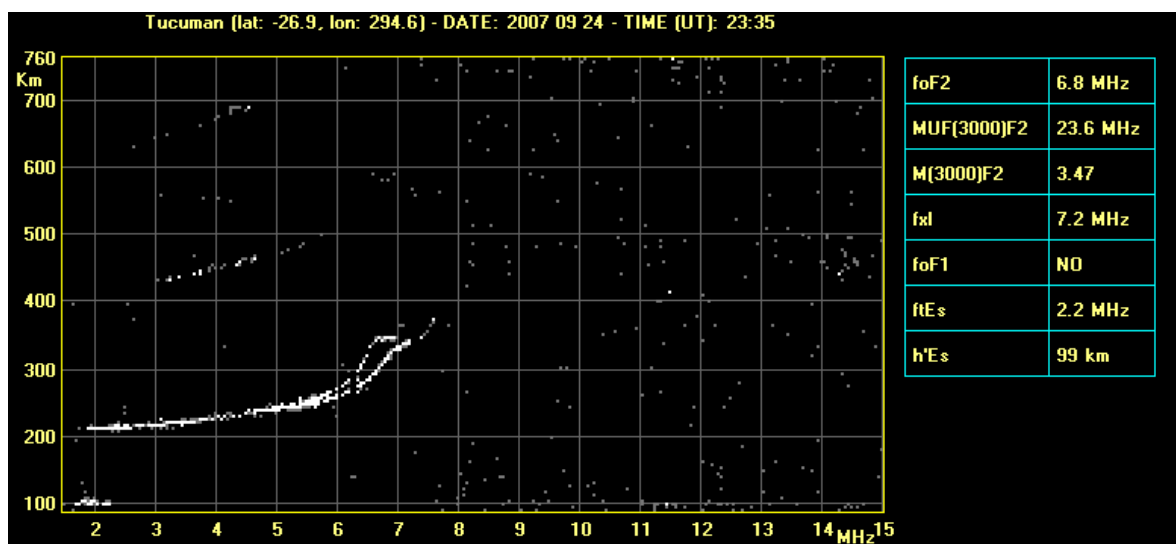


Figure 9. An example of an ionogram with a possible additional stratification layer, first called the G layer, and now renamed the F3 layer, recorded on 24 September 2007 at 23:35 UT by the AIS-INGV ionosonde installed at Tucumán, and autoscaled by Autoscala.

Through the site <http://ionos.ingv.it/tucuman/latest.html>, the user accesses the home page of this new ionospheric station where the latest ionogram recorded by the station is shown. From the home page the user has the possibility to view the previous ionograms, and the last six daily plots of $foF2$, $MUF(3000)F2$, $M(3000)F2$, $foF1$, and $ftEs$ (Figure 10).

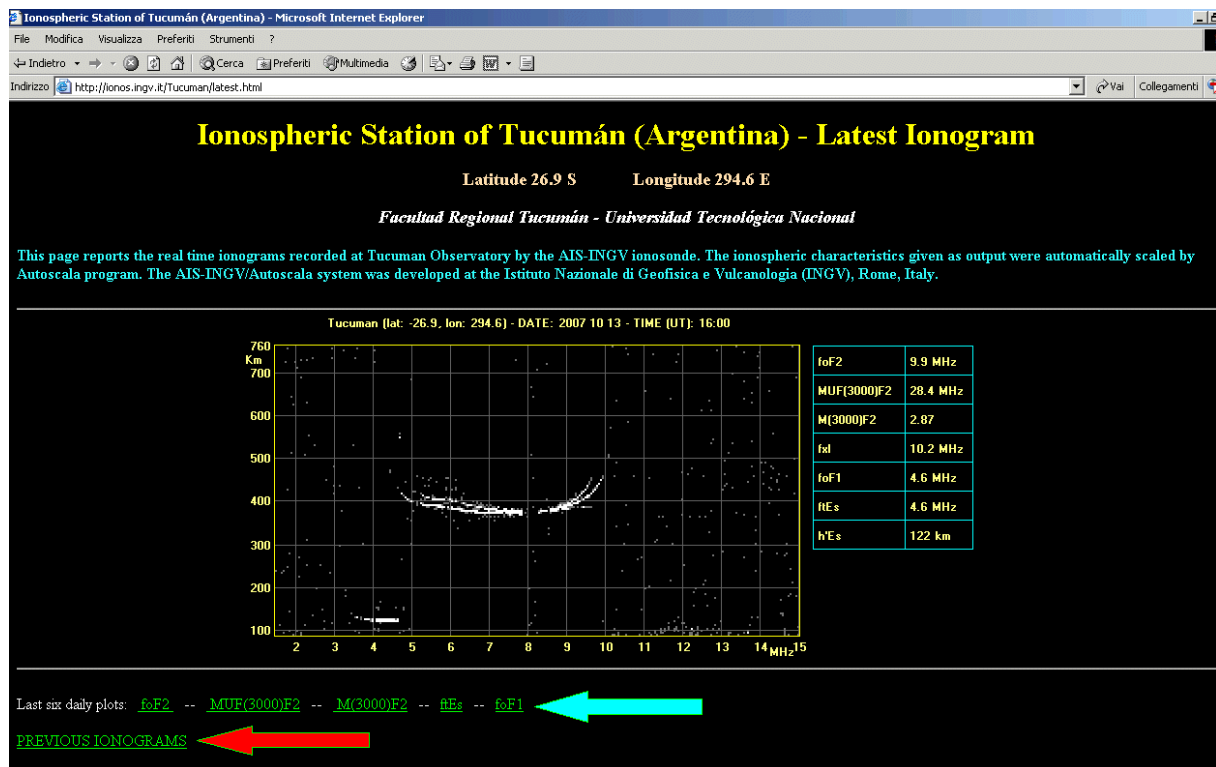


Figure 10. The home page of the new ionospheric station of San Miguel de Tucumán showing the latest ionogram recorded by the station. The red and the blue arrows indicate respectively the links using which it is possible to see the previous ionograms and the last six daily plots of some characteristics.

Figures 11, 12, and 13 show which are the plots of $foF2$, $foF1$, and fEs a user would see if he had connected to the site <http://ionos.ingv.it/tucuman/latest.html> the 13th of October 2007 at 16:00 UT.

Ionospheric Station of Tucumán (Argentina) - foF2 plots

Latitude 26.9 S Longitude 294.6 E

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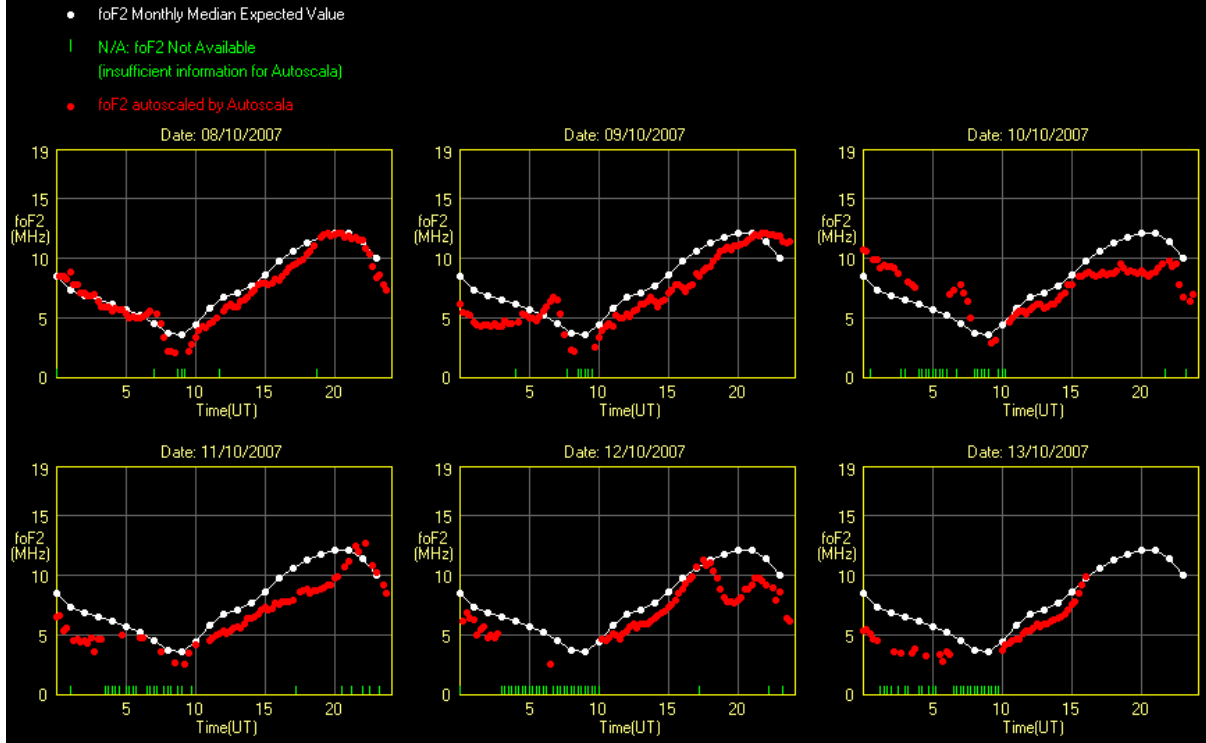


Figure 11. The foF2 plots visible the 13th of October 2007 at 16:00 UT.

Ionospheric Station of Tucumán (Argentina) - foF1 plots

Latitude 26.9 S Longitude 294.6 E

Facultad Regional Tucumán - Universidad Tecnológica Nacional

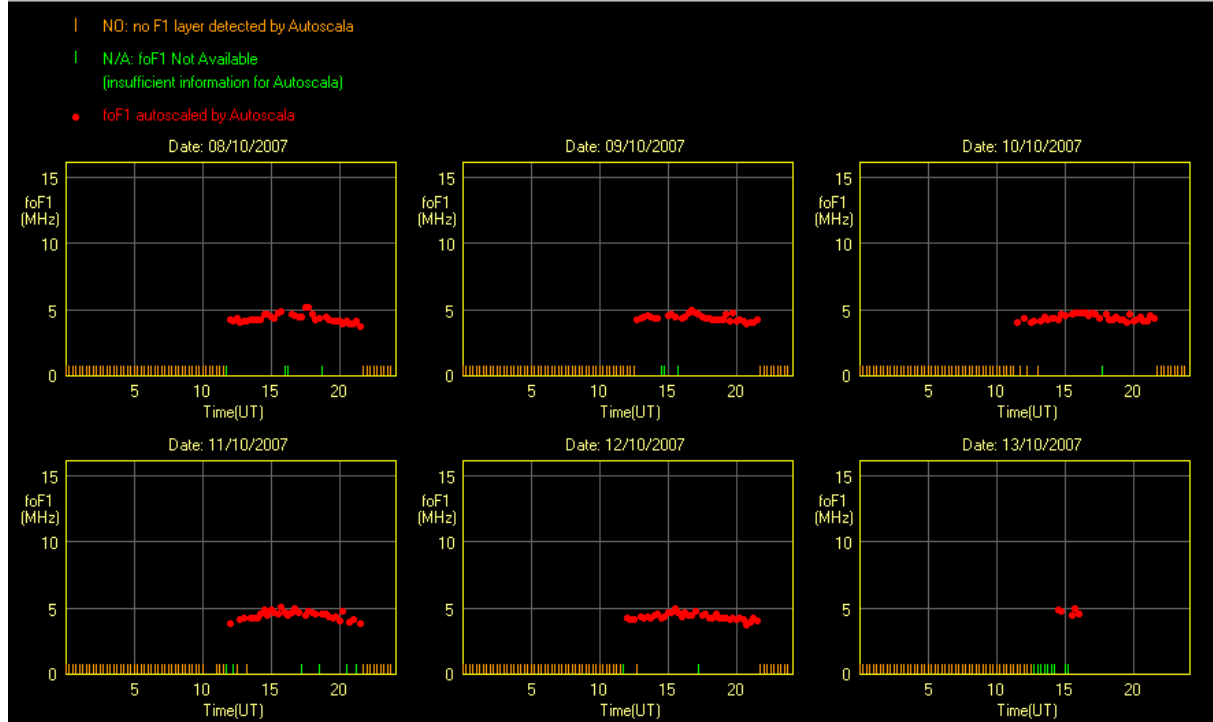


Figure 12. The foF1 plots visible the 13th of October 2007 at 16:00 UT.

Ionospheric Station of Tucumán (Argentina) - ftE_s plots

Latitude 26.9 S Longitude 294.6 E

Facultad Regional Tucumán - Universidad Tecnológica Nacional

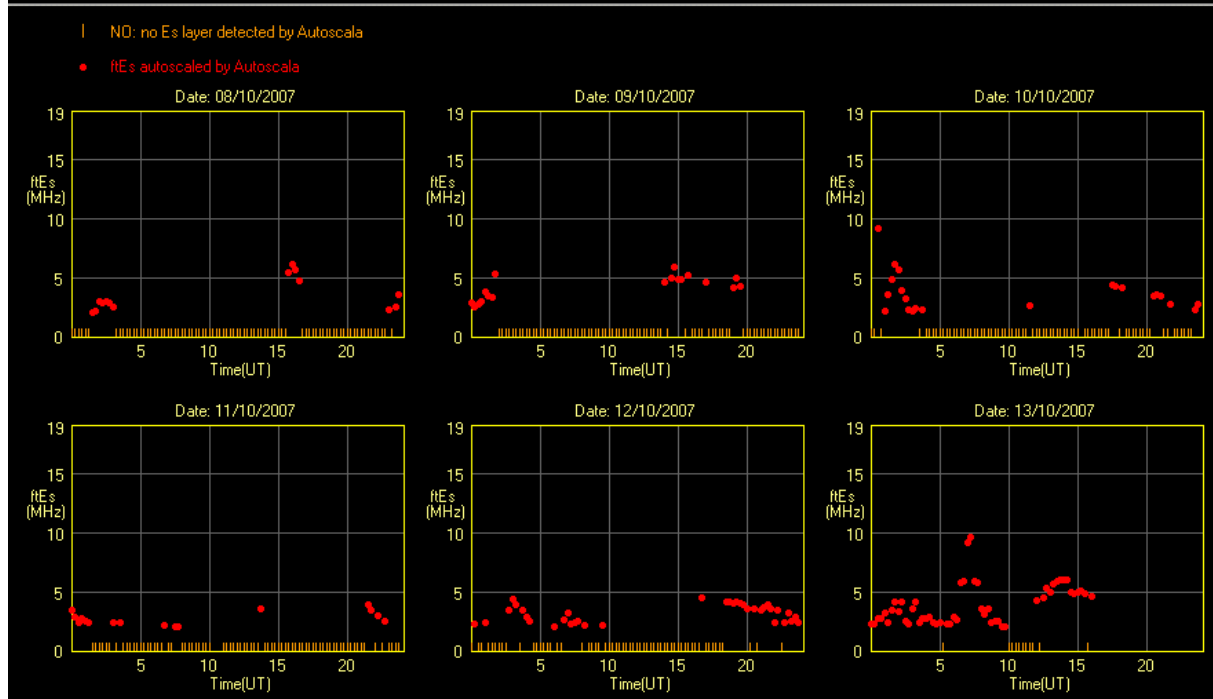


Figure 13. The ftE_s plots visible the 13th of October 2007 at 16:00 UT.

Summary: a new ionospheric station was installed at San Miguel de Tucumán. The station was equipped with an AIS-INGV/Autoscala system, able to give as output autoscaled ionospheric values. For this reason the station can contribute to the ionospheric database and can be a part of a possible net for space weather purposes.

References:

Zuccheretti E., G. Tutone, U. Sciacca, C. Bianchi and B. J. Arokiasamy (2003): The new AIS-INGV digital ionosonde, *Annals of Geophysics*, **46** (4), 647-659.

Pezzopane M. and C. Scotto (2007): The Automatic Scaling of Critical Frequency $foF2$ and $MUF(3000)F2$: a comparison between Autoscala and ARTIST 4.5 on Rome data, *Radio Science*, **42**, RS4003, doi:10.1029/2006RS003581.