A new ionospheric station for Chile

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I. INTRODUCTION

A new ionospheric station for Chile (j3p) has been installed at Chillán ($36^o38'29''S$; $71^o59'41''W$) on the Universidad Adventista de Chile campus (Agüero, 2014). This follows decommission of the ionospheric station j3o on14 June 2012. The latter was installed at Concepción on the Universidad de Concepción campus ($36^o47'26''S$; $73^o02'01''W$) during the International Geophysical Year, 1957-1958 (Ramírez, 1962; Muzzioli, 1977). The distance between j3p and j3o stations is 91.1 km along a line $80^o09'21''$ East of North. The installation and operation of the j3p station have been possible under a framework academic agreement signed by the two universities, which includes a specific agreement for the measurement and analysis of the properties of the ionosphere. The aim of this specific agreement is to contribute to the determination of possible long term changes of the upper atmosphere over South American latitudes, by enlarging for at least a decade the long time series of ionospheric observations made using the j3o station (Foppiano et al., 1999). The j3p station started observations on 18 June 2012.

Photo 1: Ionospheric station j3p. Hut (foreground). Antennae mast (background).

II. SETTING AND EQUIPMENT

The ionospheric station is located on a flat roughly-square plot of land of some 2400 m^2 and is housed in a metallic air conditioned $2 \times 6 \times 2$ m hut placed on the north east corner of the plot of land (Photo 1). At the moment there are two ionosondes available. An Australian IPS 42 (IPS, 1983 - Photo 2) and a Canada manufactured CADI (CADI, 2003 - Photo 3). Only one is in operation at any given time. The operating ionosonde is connected to the transmitting and receiving antennae using RG8 and RG58 coaxial cables, respectively.

IPS-42 ionosonde specifications (IPS, 1983)

- Power output (peak pulse): 5 kW
- Frequency range: 1-22.6 MHz
- Frequency generation: digital synthesizer (576 frequencies)
- Frequency sweep configuration: logarithmic
- Frequency sweep time: 12 s
- Pulse width: 41.7 μs
- Pulse interval: 5.33 ms
- Height range: 90-800 km
- Frequency markers: 1.0, 1.4, 2.0, 2.8, 4.0, 5.6, 8.0, 11.3, 16.0 and 22.6 MHz
- Dimensions: height = 609 mm, depth = 457 mm, width = 520 mm
- Weight: 52 kg

CADI specifications (CADI, 2003)

- Power output : 600W (single pulse) or 7.8 kW (Baker 13 sequence)

Photo 2: Ionospheric Prediction Service ionosonde IPS-42.

Photo 3: Canadian Advanced Digital Ionosonde (CADI).

- Frequency range: 1 a 20 MHz
- Frequency generation: Direct Digital Synthesis synthesizer (95 frequencies)
- Frequency sweep configurations: 1-400 linear or logarithmic steps per sweep
- Frequency sweep time: 18 s
- Pulse width: 40 μs (single pulse) or 520 μs (Baker 13 sequence)
- Pulse interval: 25 ms
- Height range: 90 a 1024 km
- Frequency markers: 2.0, 4.0, 6.0,..., 20.0 MHz
- Dimensions: height = 89 mm, depth = 423 mm, width 381mm
- Weight: 8.2 kg

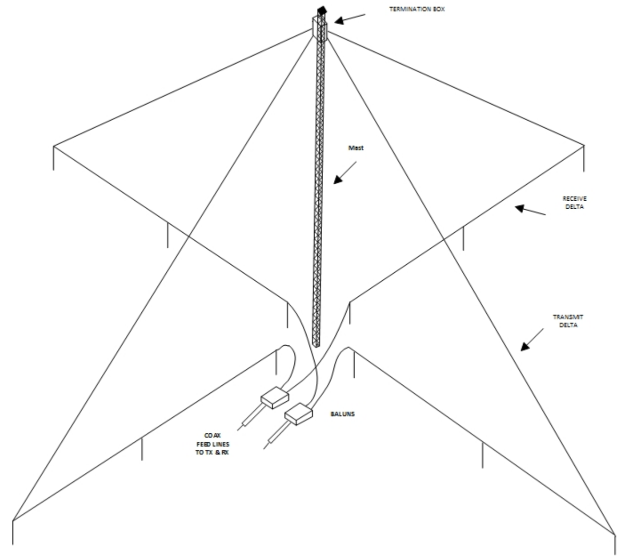

Figure 1: Antennae.

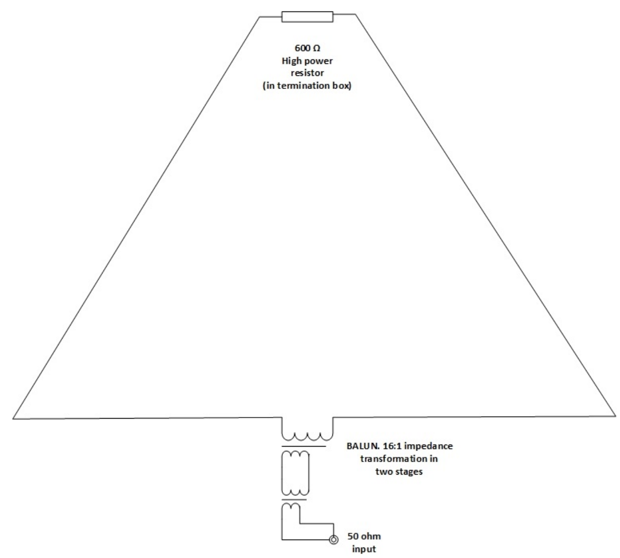

Figure 2: Delta antenna circuit diagram.

Antennae

Two mutually perpendicular vertical delta antennae are used for transmitting and receiving, respectively (Figure 1). The vertical plane of the transmitting antenna is at 45^oE from magnetic north. Two horizontal 27 m long segments form each of the delta bases and are at about 1.8 m above the ground. All four delta sides are 38 m long. The antenna side wires are hanged from a 30 m height mast and pulled together with the delta base wires from four auxiliary poles. A central pole pulls all four base wires. Each delta antenna is ended by a 600 radiation resistors and fed by unbalanced transmission/receiving 50 Ω coaxial cable using 16:1 impedance matching baluns (Figure 2).

III. OPERATION SCHEDULE

One of the two available ionosondes is routinely operated at 15 min intervals. Special campaign soundings are usually set at 5 min intervals. The use of one ionosonde or the other depends on which operates better at any given time, since both are relatively old and are prone to malfunction.

The last j3o station IPS 42 ionogram was recorded on 12 June 2012 and the first j3p station IPS 42 ionogram was recorded on 18 June 2012 at 14:45 LT (75^oW), see Figure 3. CADI operation started on 9 August 2012 at 16:18 LT (75^oW), see Figure 4. Only a few ionograms were recorded. Regular operation started by 29 August 2012 16:45 LT (75^oW). The log book (Villalobos and Agüero, private communication) indicates the sounding gaps and when the ionosondes were switched. Available CADI ionograms are at `www.dgeo.udec.cl/~eo/CADI/Estacion_Ionosferica_j3p.html`. A guest username and password can be requested (Elías Ovalle, eo@dgeo.udec.cl). Also, a very limited set of scaled values can be provided.

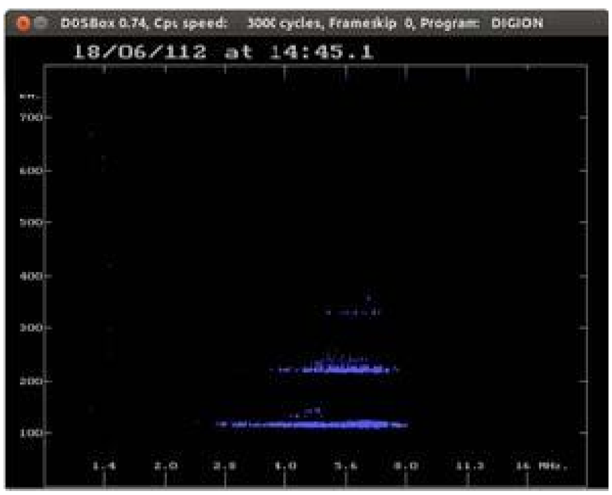

Figure 3: j3p first IPS-42 ionogram.

IV. COMPARISON OF SCALED VALUES FROM CADI AND IPS 42

Unfortunately, it was not possible to operate the IPS 42 and the CADI quasi simultaneously at Concepción or simultaneously at Concepción and Chillán, so as to determine eventual site/equipment associated differences. It is still hoped to be able to make quasi simultaneous soundings at Chillán in the near future.

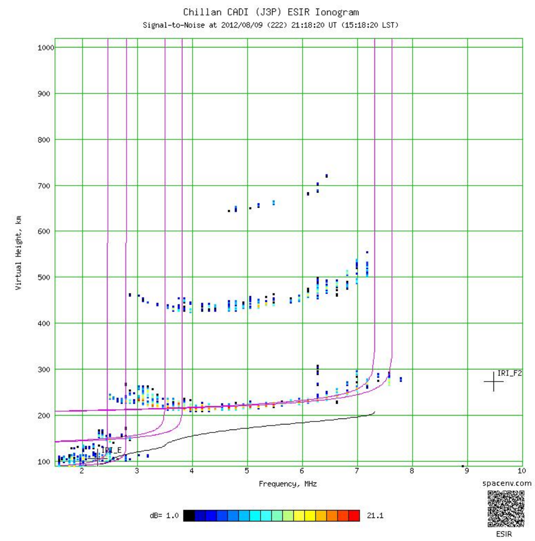

Figure 4: j3p first CADI ionogram. Although LT (75^oW) = UT - 5, the printed LST = UT - 6 due to a wrong configuration of the autoscaling programme.

Only a comparison between Chillán and Concepción soundings for a given month during two different years is offered below. January 2010 observations using the IPS 42 and January 2013 using the CADI were selected because observations were almost complete for these months (Agüero, 2014). In particular, all available ionograms for days 1, 9, 16 and 30 were scaled and tables of 15 min values of fmin, foEs, fbEs, foE, foF1, foF2, hE, hEs, hF1 y hF2 were prepared. During 9 January 2010 solar activity was low (F10.7 = 81) and the geomagnetic field was quiet (Dst between +3 and -13). Although on 9 January 2013 solar activity was almost twice as much (F10.7 = 160) the geomagnetic activity was again low (Dst between +4 and - 12). Diurnal variations of fmin, foE, foF1 and foF2 for 9 January 2010 and 2013 are shown in Figure 5.

There is a common general feature on the diurnal variations of three out the four characteristics depicted in Figure 5. The hour-to-hour variability is larger for the CADI ionograms than that for the IPS 42 ionograms. This is most likely due to the scaling procedure. CADI ionograms are autoscaled (ESIR software) while the IPS 42 are manually scaled using the DIGION programme. Furthermore, for all characteristics values are generally larger for CADI ionogram as it would be expected because solar activity is larger during 2013 than for 2010. In the case of foE, some CADI values are missing around noon due to absorption as indicated by the rather large fmin values. By contrast, the IPS 42 foE missing values before noon relate to some blanketing Es layers. The peculiar diurnal variation of both CADI and IPS 42 foF2, with rather lower values around midday, is typical of summer time conditions, sometimes referred to as the Weddell anomaly.

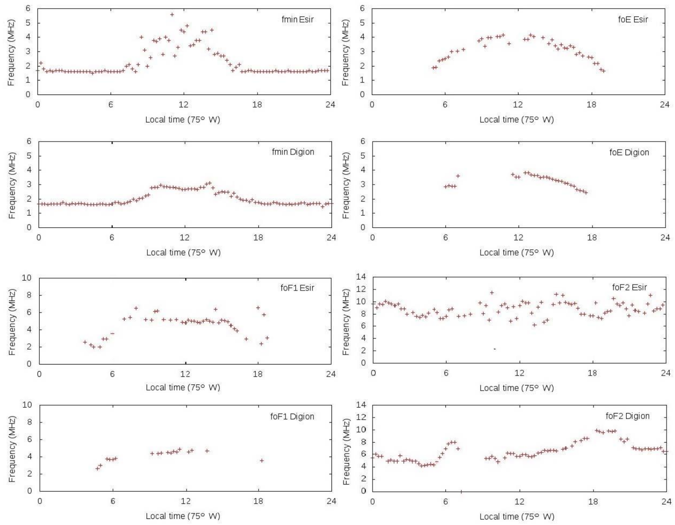

Figure 5: Diurnal variations of fmin, foE, foF1 and foF2 during 9 January 2010 determined using DIGION software from IPS 42 ionograms at Concepción ($36^o47'26''S$; $73^o02'01''W$) and 9 January 2013 using Esir software from CADI ionograms at Chillán ($36^o38'29''S$; $71^o59'41''W$).

V. CONCLUSIONS

A new ionospheric station for Chile has been installed in June 2012. This replaces the old station deployed during the IGY. The stations are separated by less than 9' of latitude and little more than 1^o of longitude.

The distance between the old and new Chile stations is considered of minor significance when ionospheric long term trends are to be determined using observations from both stations.

Unfortunately, it was not possible to operate simultaneously the old and new stations so as to determine eventual site associated differences. It is still hoped to be able to make quasi simultaneous observations at the new site to determine equipment associated differences.

New station ionograms are available at `www.dgeo.udec.cl/~eo/CADI/Estacion_Ionosferica_j3p.html`. A guest username and password can be requested (Elías Ovalle, eo@dgeo.udec.cl). Also, a very limited set of scaled values can be provided.

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