

# The LISN database: description and initial results

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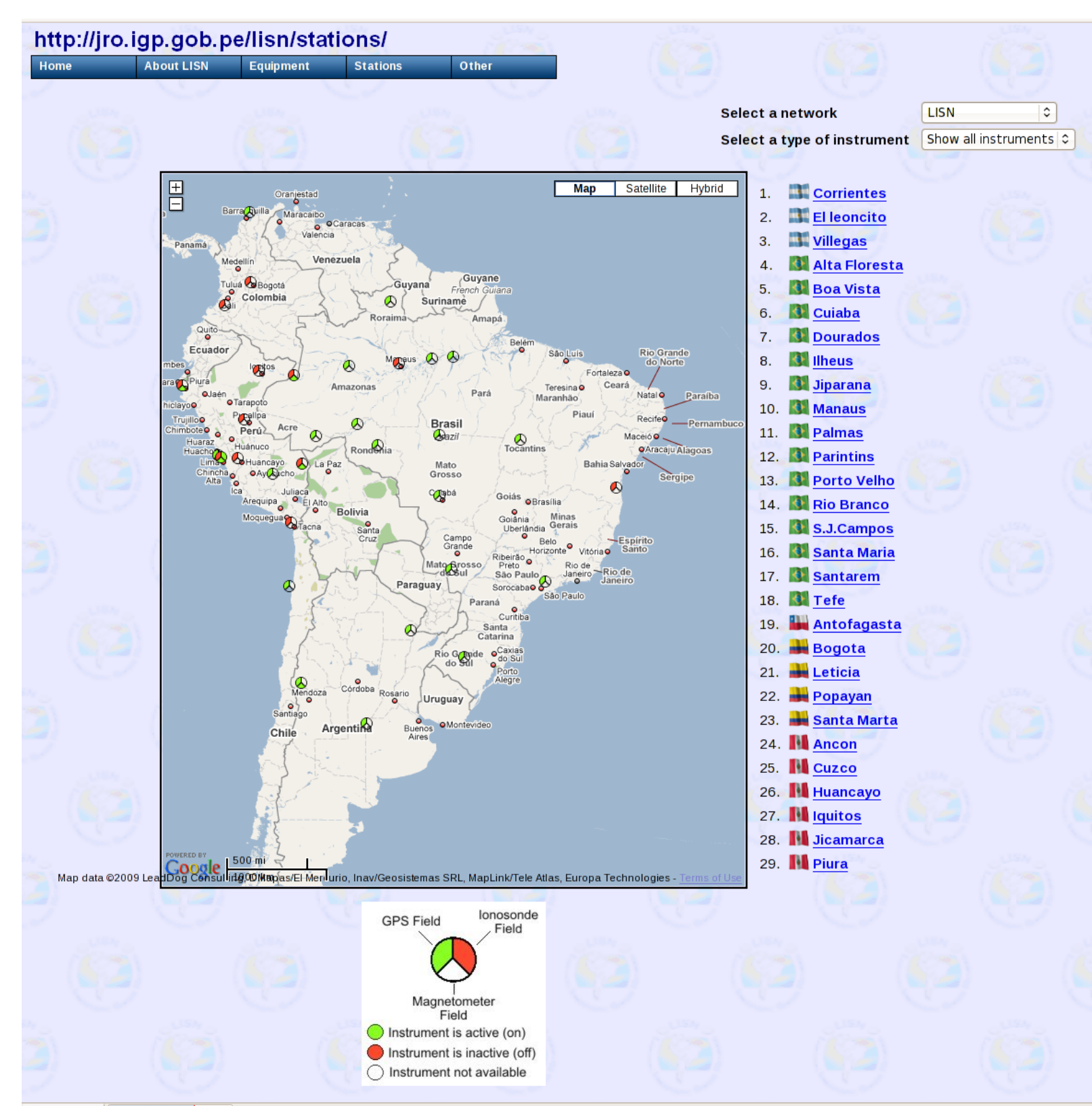
## Introduction

The heavy volume of data that GPS, ionosondes and magnetometers are continuously collecting is stored in the LISN server and managed using a set of rules that are intended to provide an efficiently way to manipulate the large data sets and also implement an adequate method to systematically transform all this information into knowledge.

LISN integrates multiple data sources and should provide security, integrity and availability in a multi-user environment.

Data from the remote stations arrives to the server continuously and is stored, processed and distributed. This data is easily available and in some cases freely accessible to the community promoting research and encouraging collaboration between users.

## Web GPS



An image displaying the position of the stations as they geographically spread over the continent is the the access point to the real time GPS data.

Figure 1: LISN stations distribution

In the web data base the station links leads to a different type of data file or data plot that are available for download.

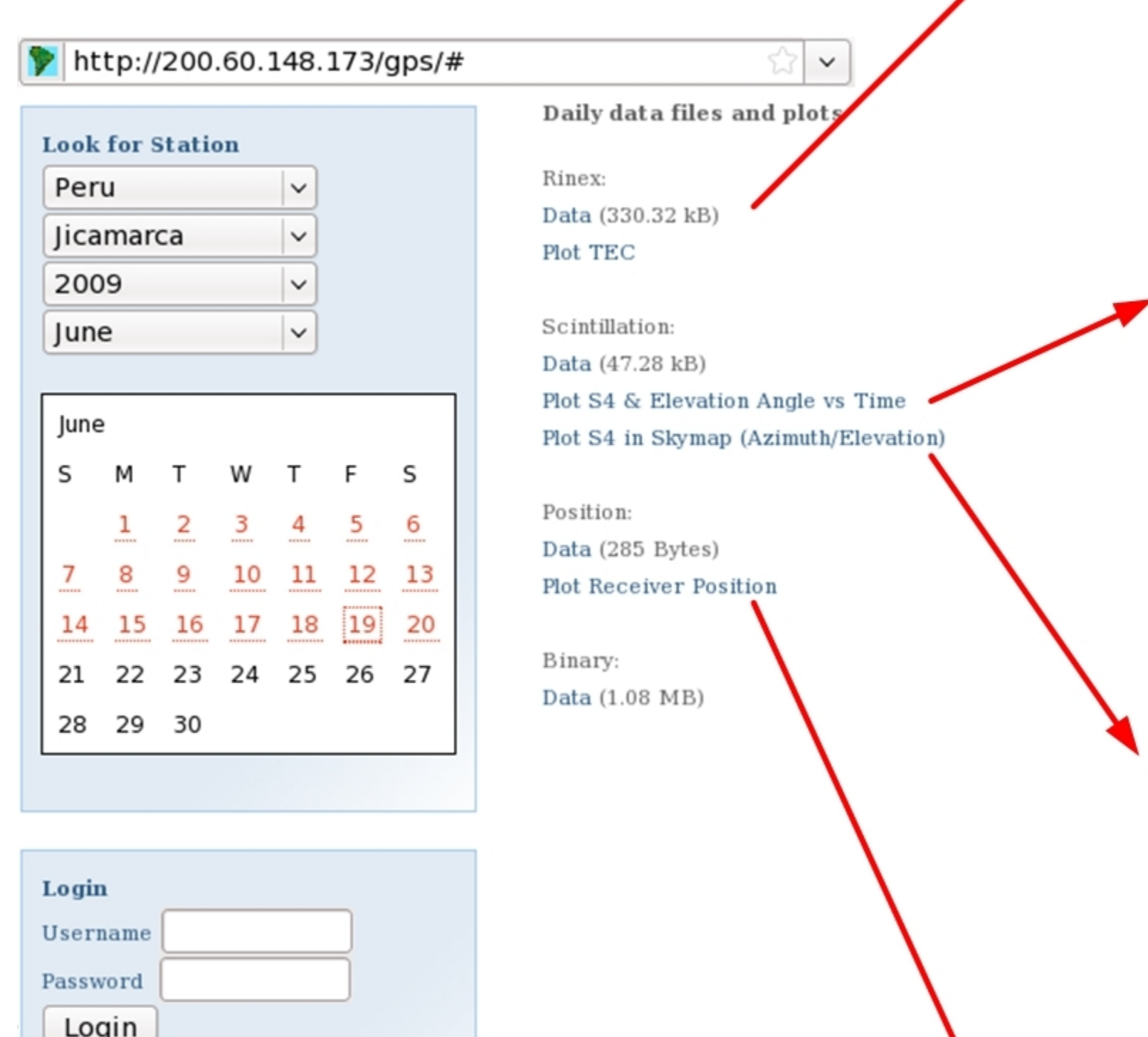


Figure 2: GPS data to download

The filename format of the data files currently used is:

**NNNN\_YYMMDD.XXX**

Name of the station

Year, month, day

Extension:

year compact rinex  
 Rinex files: **YYd.tar.gz**  
 Scintillation files: **scn.gz**  
 Position files: **pos.gz**  
 Binary files: **nvd.gz** or **lb2.gz**

Data that stations could not upload during the day due to internet problems are completed at the end of the day in the form of a rinex file.

## Near-real time station monitoring:

A program running in the server provides near-real time information of the current status of 40 remote stations in 6 countries.

Knowing the status of every station helps to improve the overall GPS data acquisition efficiency by reducing the occurrence of fails and is useful to diagnose potential problems before they occur.

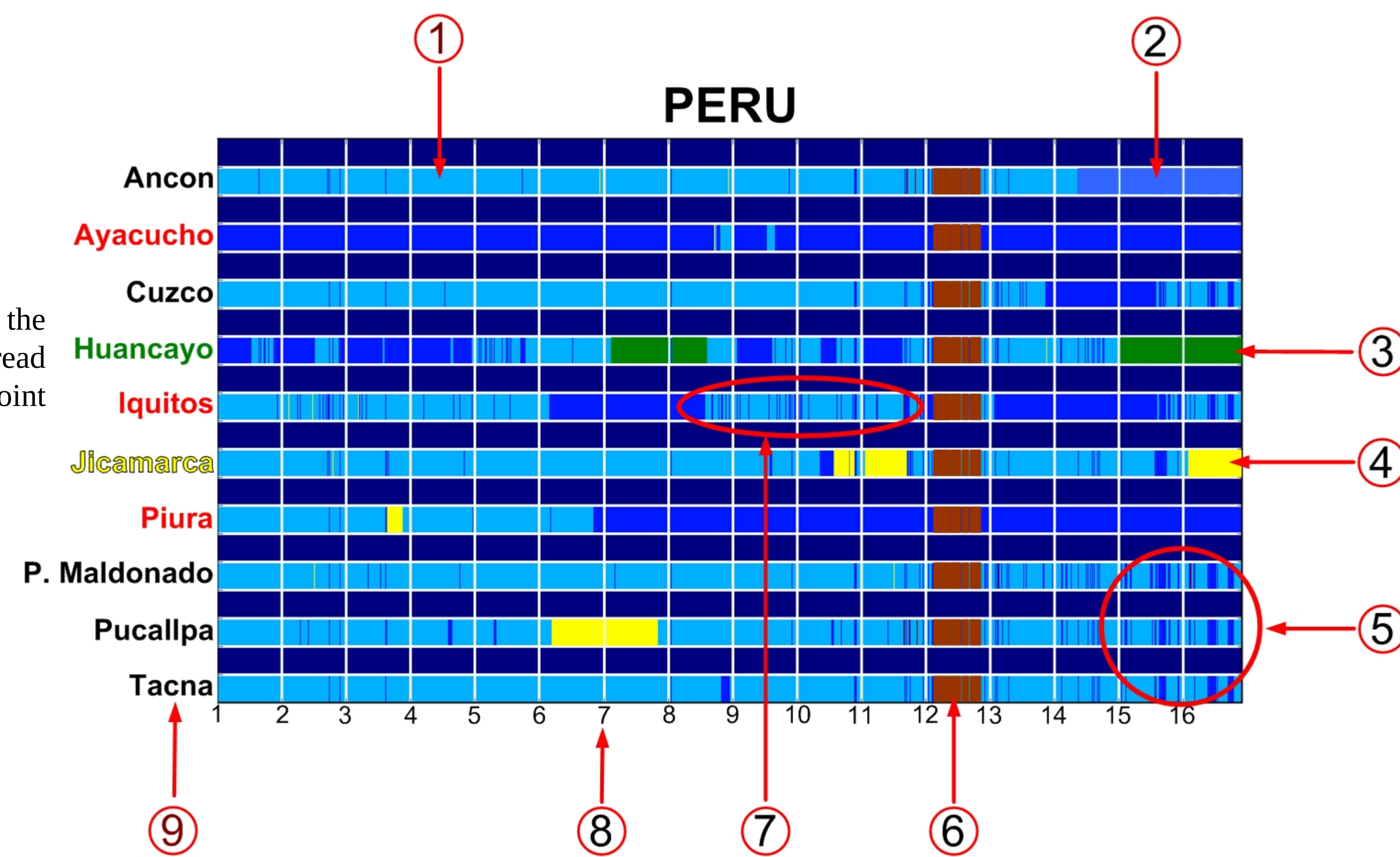


Figure 3: Stations monitoring plot

## Status indicators:

Five plots are available, each containing the monthly historic information of one or more countries (Peru, Brasil North, Brasil South, Argentina and Nigeria-Chile-Colombia).

The information that can be extracted from the plots is (figure 2):

- ① **Cyan:** The station sent data as expected.
- ② **Blue:** The station did not send data. Possible causes are a bad internet connection, a black out on the site, a GPS or computer malfunction, etc.
- ③ **Green:** The station sent data files of the same size for more than one hour. This happens when the acquisition program at the site hangs.
- ④ **Yellow:** The station sent data of an atypically smaller or zero size. This usually happens when the hard disk of the computer stations is full or the uploading time is too long.
- ⑤ **Several stations with simultaneous interruptions:** This is symptom of failure at the server side.
- ⑥ **Brown:** There is no information available about the stations. This happens when the monitoring program find an unexpected exception or when a problem in the server occurred.
- ⑦ **Recurrent short interruptions:** This happens when the internet connection at the site is not stable.
- ⑧ Time in days since the beginning of the month.
- ⑨ **Name of the station:** Usually the name of the city. The color reflects the current status of the station: Red, the station is not working. Black, the station is working. Yellow, the station sent zero size data. Green, The station sent same size data.

The program is complemented with an alarm system that send an email alert when a station has stopped sending data for more than 45 minutes, when is uploading data of an incorrect size, or when has sent same size data for more than one hour.

## Operation statistics:

A program running in the server generates cumulative statistics of the system performance. The parameters showed in the statistics are:

1. Percentage of correct data received (also indicated with bars on top of the figure).
2. Percentage of not received data.
3. Percentage of erroneous data (too short files).
4. Number of interruptions.
5. Frequency of the interruptions (number of interrupts per day).
6. Average duration of the interruptions (hours).
7. Maximum duration of one interruption (hours).
8. Maximum uninterrupted operation (hours).

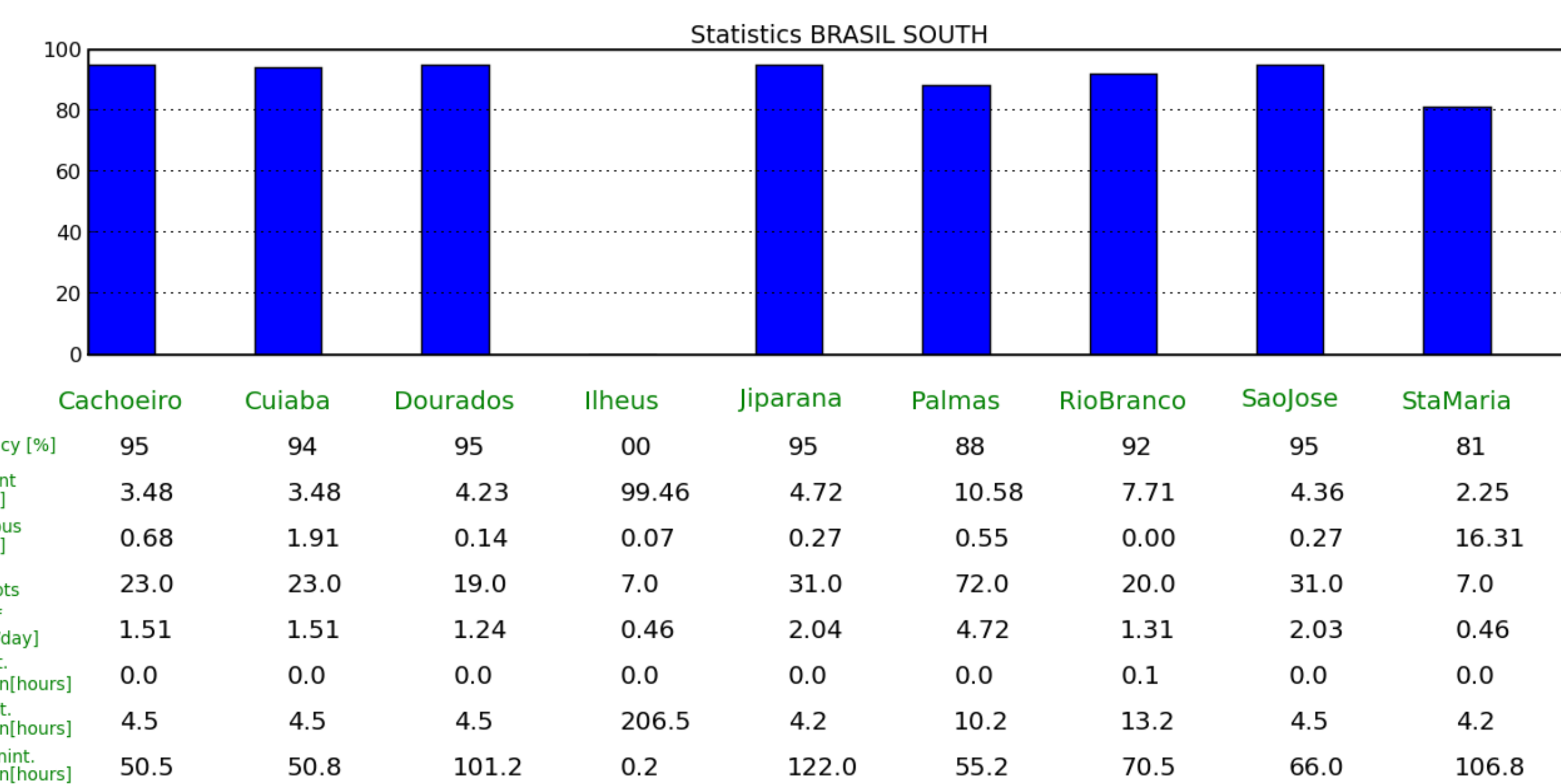


Figure 4: Stations statistics

## Ionosonde database

In its normal time/frequency configuration mode the Ionosonde generates an ionogram every 15 minutes, the raw data file created is almost 200 MB long, so large capacity hard drives are required to store the large amount of data generated. Online processing of this data is used to reduce the amount of space required to store the files, increasing the service life of the devices, and also making this data available to the community.

Each raw data file generated goes through 4 steps (as shown in figure 4):

1. NCDF files generation (readriq-2.02 by Terrence Bullet).
2. IDL SAV and OX plot generation.
3. Compression and verification of the raw file.
4. Upload of plot and NCDF files.

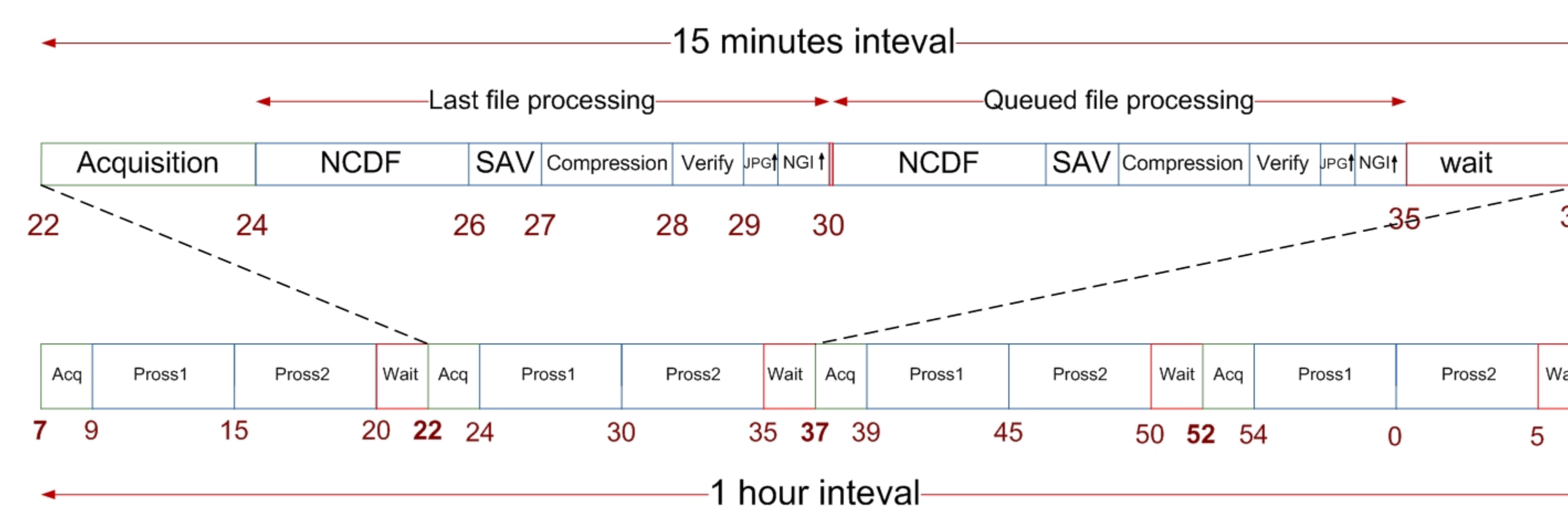


Figure 5: VIPIR data processing sequence

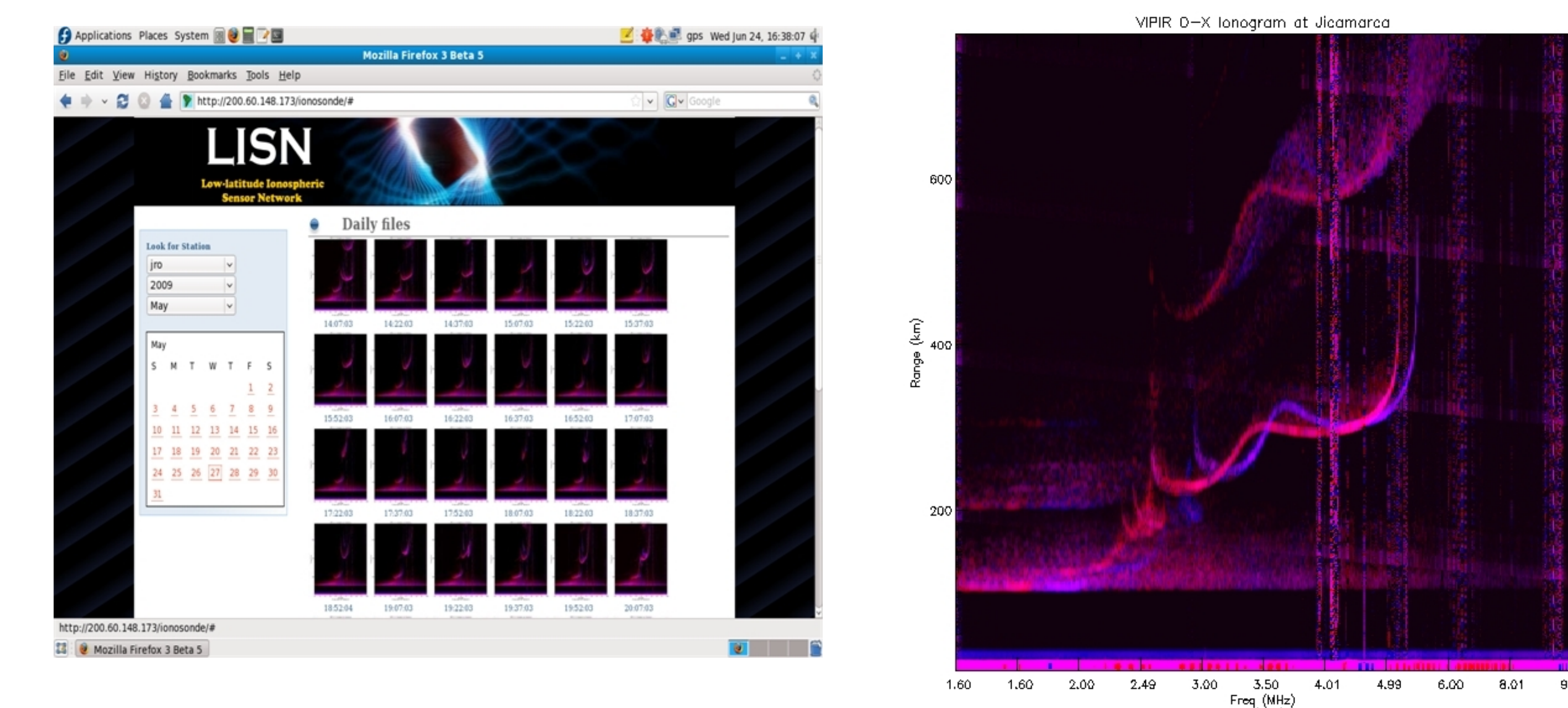


Figure 6: Ionosonde web

IDL SAV files are generated when modes different than the normal where run.

Compressing the RAW files reduces its size up to five times. Before deleting the source raw file an integrity verification is performed so no file is lost for fails during the compression process.

NCDF and plot files are uploaded to the server to be easily accessible.

## Future work:

Data base access: Unrestricted visualization of plots will be implemented, but downloading of the data files will require the user to log in. Data distribution policies will be applied by the creation of user accounts with different access privileges.

Plots of Total Electron Content and stations distribution will be available not only in the real time web but also in the database web.