

J. Tegedor⁽²⁾, P. Alfaro⁽²⁾, N. Romero⁽³⁾, C. Garcia Martinez⁽²⁾, F. Dilssner⁽⁴⁾, J. Dow⁽¹⁾

⁽¹⁾ESOC, Robert-Bosch-Str. 5, D-64293 Darmstadt, Germany, ⁽²⁾ESOC GMV, ⁽³⁾ESOC Canary Advanced Solutions (SAC), ⁽⁴⁾ESOC Logica
javier.tegedor@esa.int, pedro.alfaro@esa.int, nacho@canaryadvancedsolutions.com, Carlos.Garcia-Martinez@esa.int, Florian.Dilssner@esa.int, John.Down@esa.int

Introduction

During several years, ESOC has been providing the IGS community with valuable GNSS tracking data from a group of sensor stations located worldwide, providing daily, hourly and high-rate observations files. Additionally, ESOC has gained experience in the operation of Real-Time stations playing a meaningful role within the IGS-RT project, as well as the installation, operations and maintenance of seven Galileo Experimental Sensor Stations, which allow to track the new GIOVE-A/B satellites.

ESA GNSS Stations Network

ESA's GNSS network currently comprises stations at ESA ESTRACK locations (Kourou, Redu, Malindi, Maspalomas, Cebreros, Villafranca, Kiruna, Perth and New Norcia), as well as a station installed in Tahiti in close cooperation with Meteo France. The next figure contains the location and main characteristics of the stations. It must be highlighted that several are equipped with an external reference system, and ESOC has been putting a great effort into installing GLONASS capable receivers.

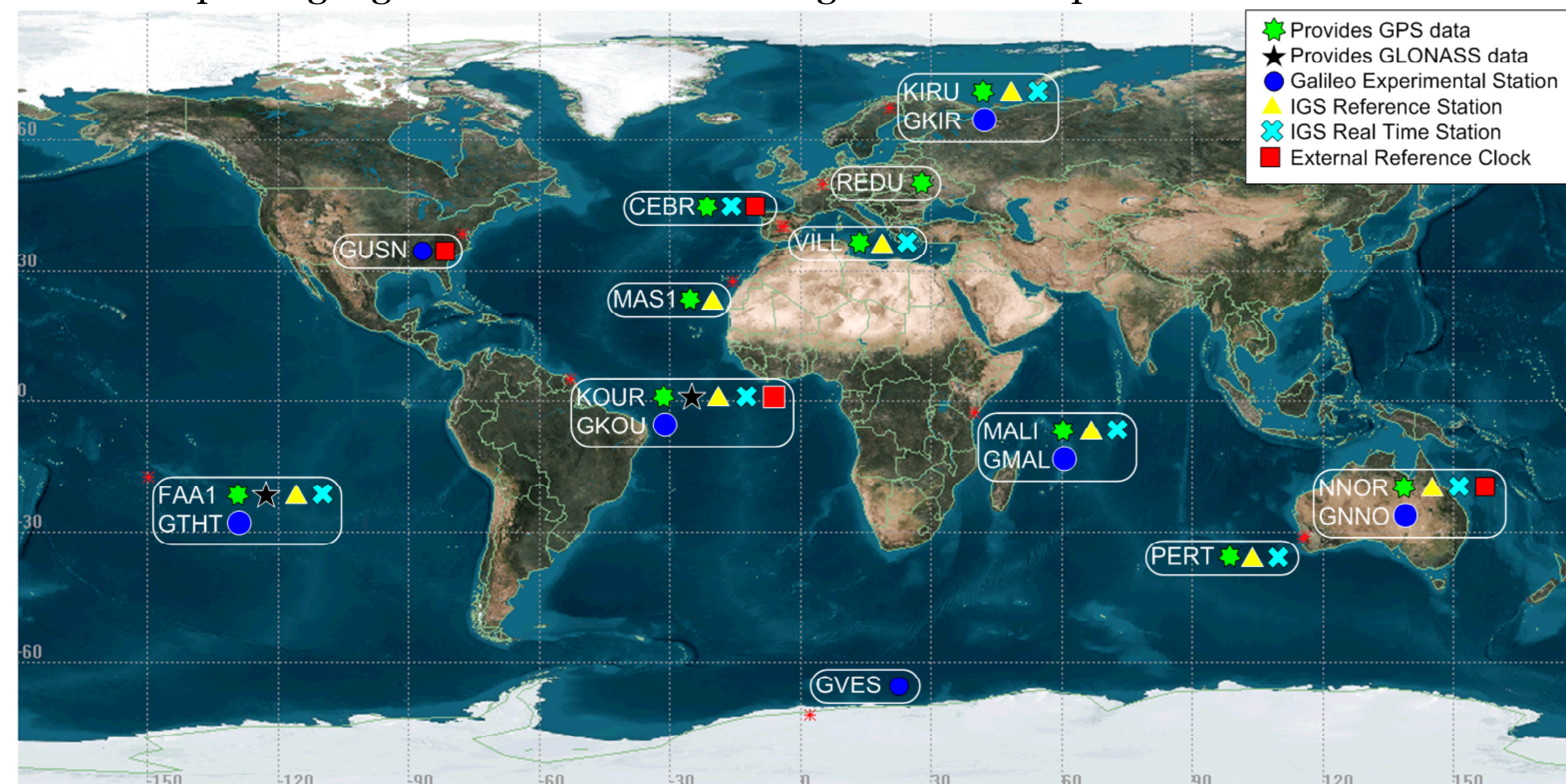


Figure 1: Location of ESOC GNSS stations

Data retrieval/delivery process

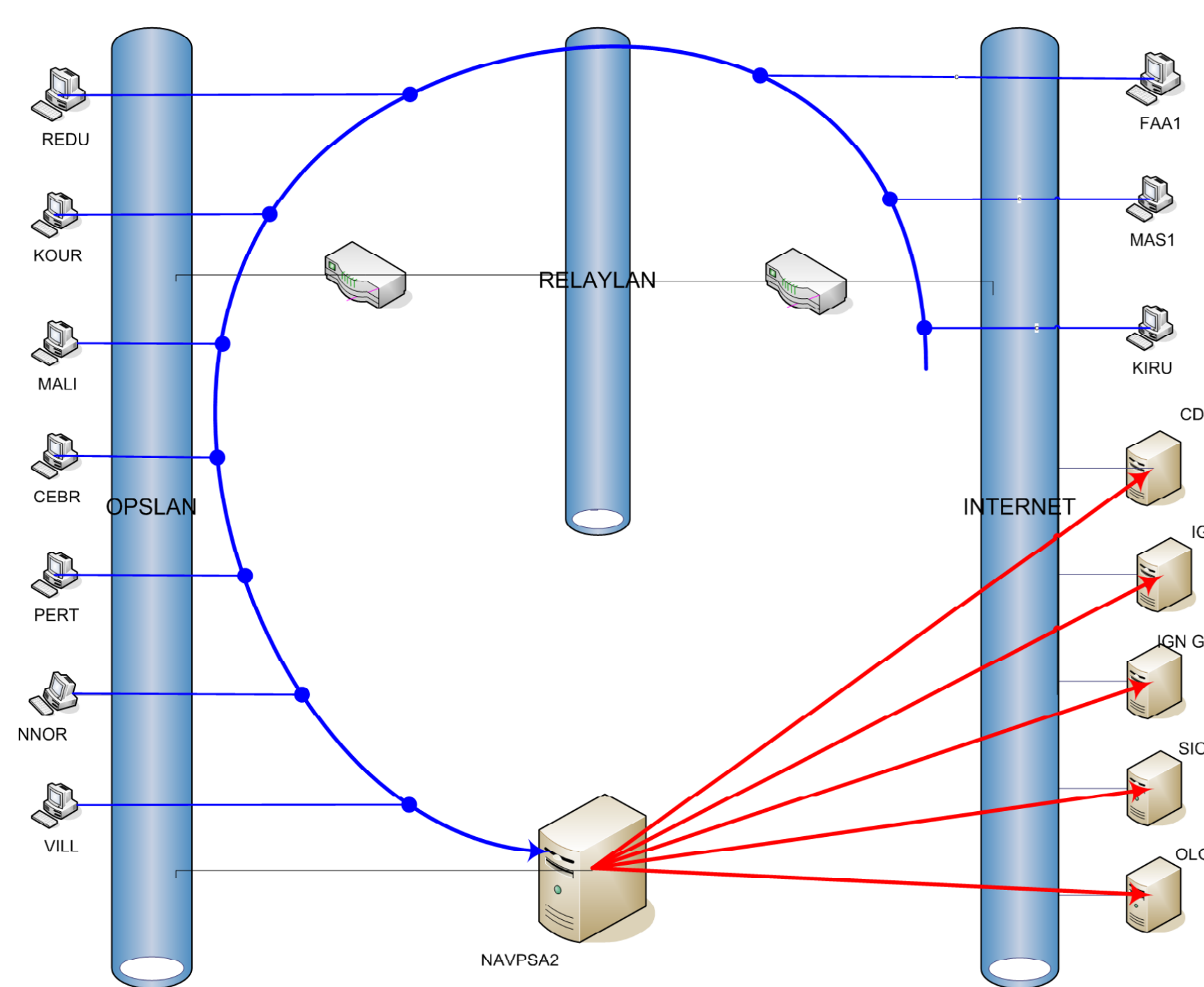


Figure 2: Stations data flow

The high rate tracking data files are transferred from the remote sites to the Navigation Facility at ESOC. At ESOC these files are sampled and joined appropriately for the generation of the hourly and daily files.

Additionally, UDP is used for the data transfer of the RT streaming using RTIGS data format.

The figure on the left shows the data flow from the remote sites to the official delivery servers where the data is made public.

| Station | Data distributed to: | | | | | | | | | |
|---------|----------------------|---------|------------------|----------------|-------|-----|--------|-----|-----|------------------------|
| | IGS Ref Sta | GLONASS | IGS Real Time Pp | External Clock | CCDIS | IGN | IGMGDC | SIO | OLG | ftp://nng.esoc.esa.int |
| FAA1 | X | X | X | | | | | | | |
| KIRU | X | X | X | | | | | | | |
| MAS1 | X | X | X | | | | | | | |
| REDU | | | | X | | | | | | |
| CEBR | | | | X | | | | | | |
| PERT | X | | X | | | | | | | |
| NNOR | X | | X | X | | | | | | |
| VILL | X | | X | | | | | | | |
| KOUR | X | X | X | X | | | | | | |
| MALI | X | X | X | | | | | | | |

Figure 3: Data centres distribution

Stations monitoring

In order to perform routine operations, ESOC has developed a set of automated tools for monitoring the stations availability and the data quality. With these tools, ESOC IGS team is able to react as soon as any anomaly appears in any station. The real time data flow of high-rate and hourly files is available at:

<http://nng.esoc.esa.int/ESASTations/stationsDataCurrent.html>

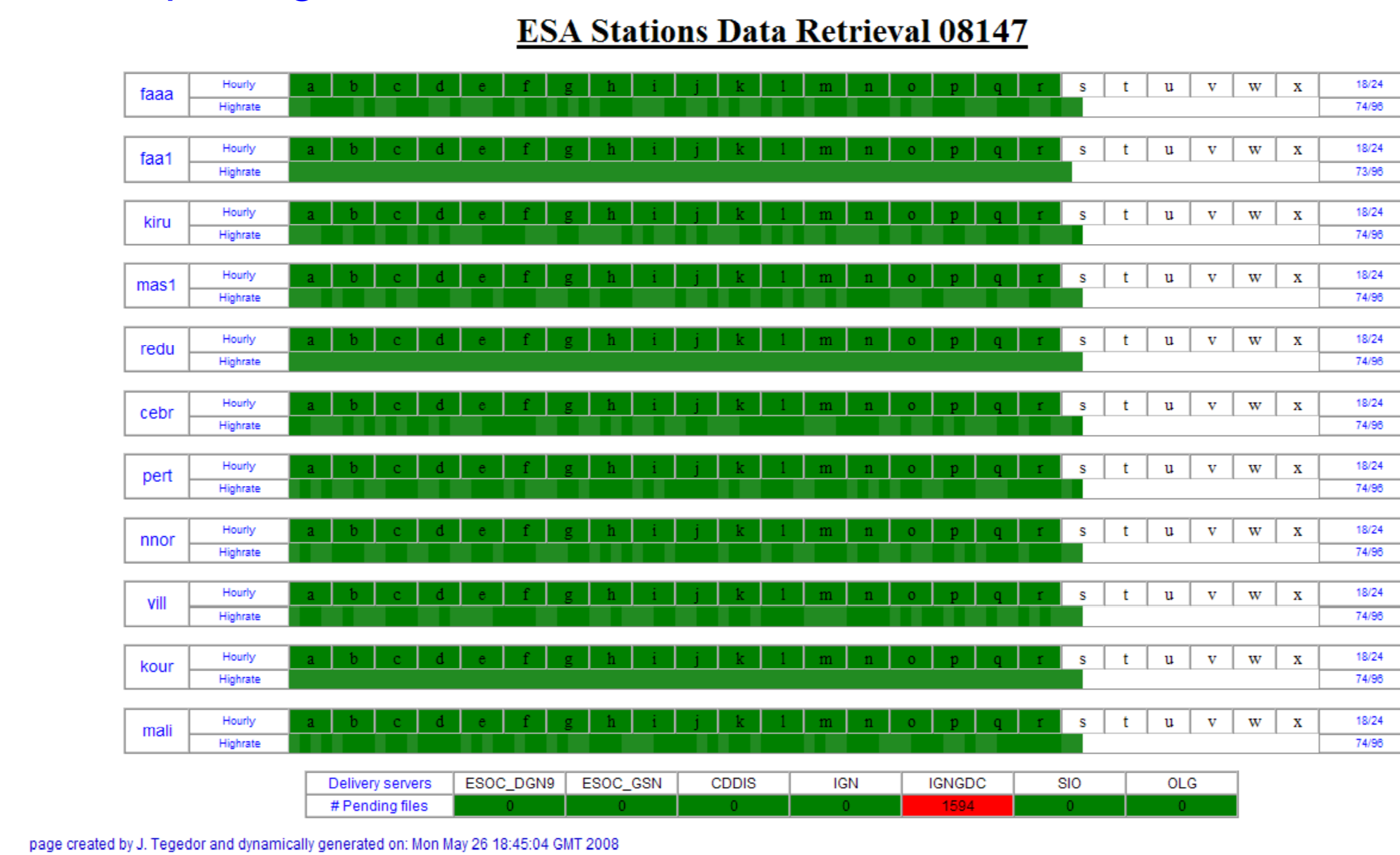


Figure 4: Routine data availability monitoring

The tracking quality is checked daily through the automated generations of plots. These graphics are generated for each station and published under:

http://nng.esoc.esa.int/cgi-bin/gps/dat_coll.cgi

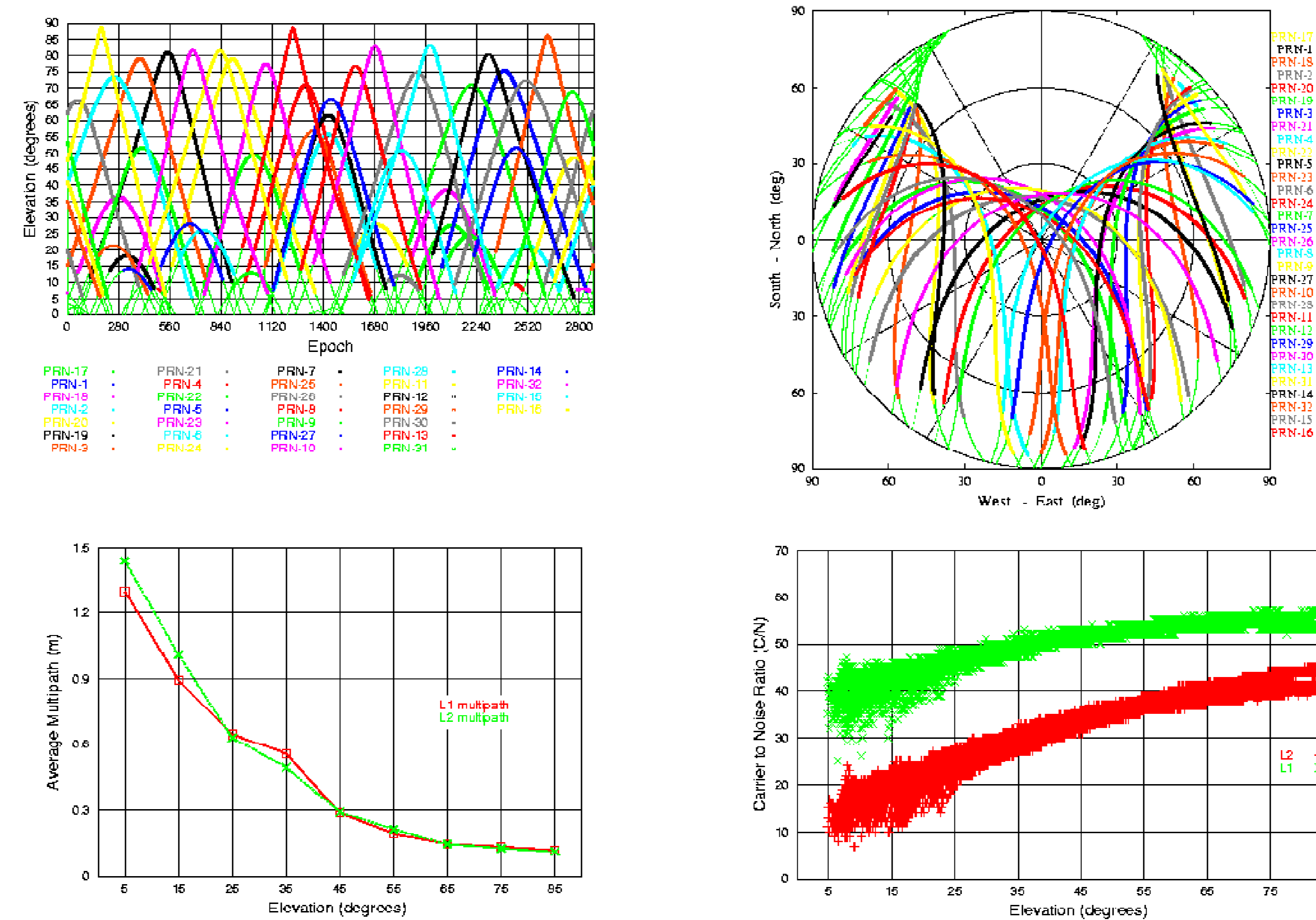


Figure 5: VILL tracking plots for DOY 08144

ESOC also generates a weekly report of the stations quality, including all high-rate, hourly and daily files. Some examples of the contents of the weekly report are shown below:

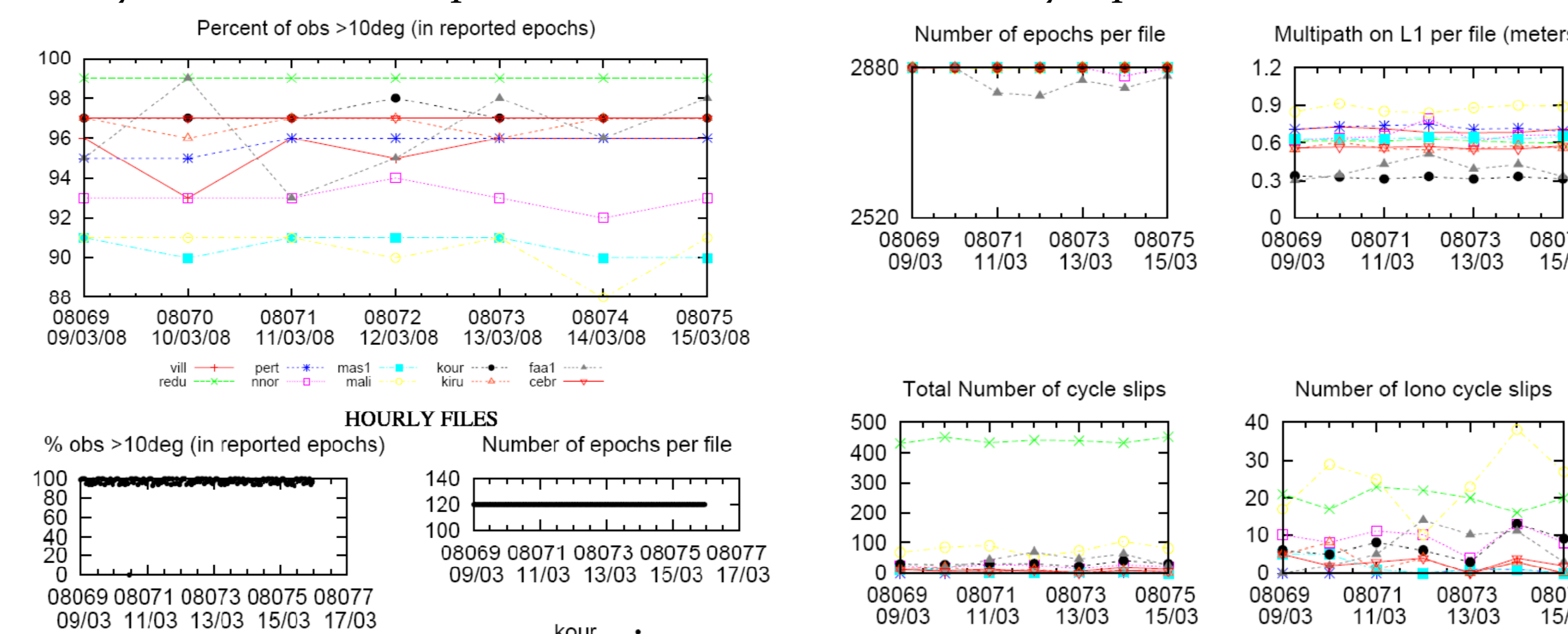


Figure 6: Weekly summary plots of the data quality

Data analysis

Additionally, ESOC has put in place several mechanisms to control the data quality in the existing processing chains, mainly from the IGS Ultra/Rapid/Final processing. As example, the phase observations residuals from some ESOC stations are shown below:

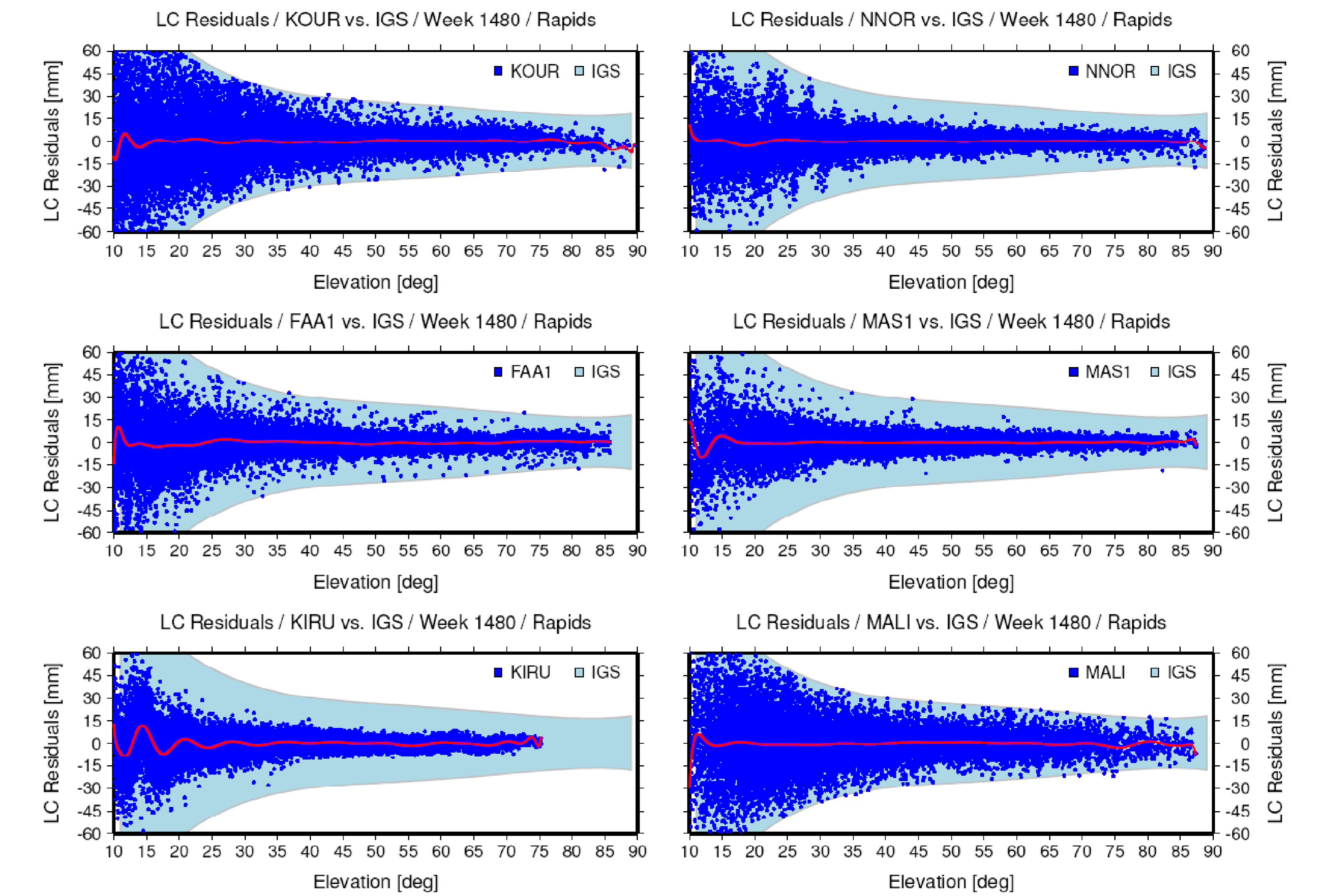


Figure 7: Phase residuals vs Elevations plots, from the IGS Rapid Processing (week 1480)

The figure on the right shows the Allan Variance computed from ESOC Rapid clocks product (ALGO is included as reference). At the end of every run, an automatic system checks the stations performance (residuals/clock stability), and sends an e-mail to the operators in case these values fall out of the expected range.

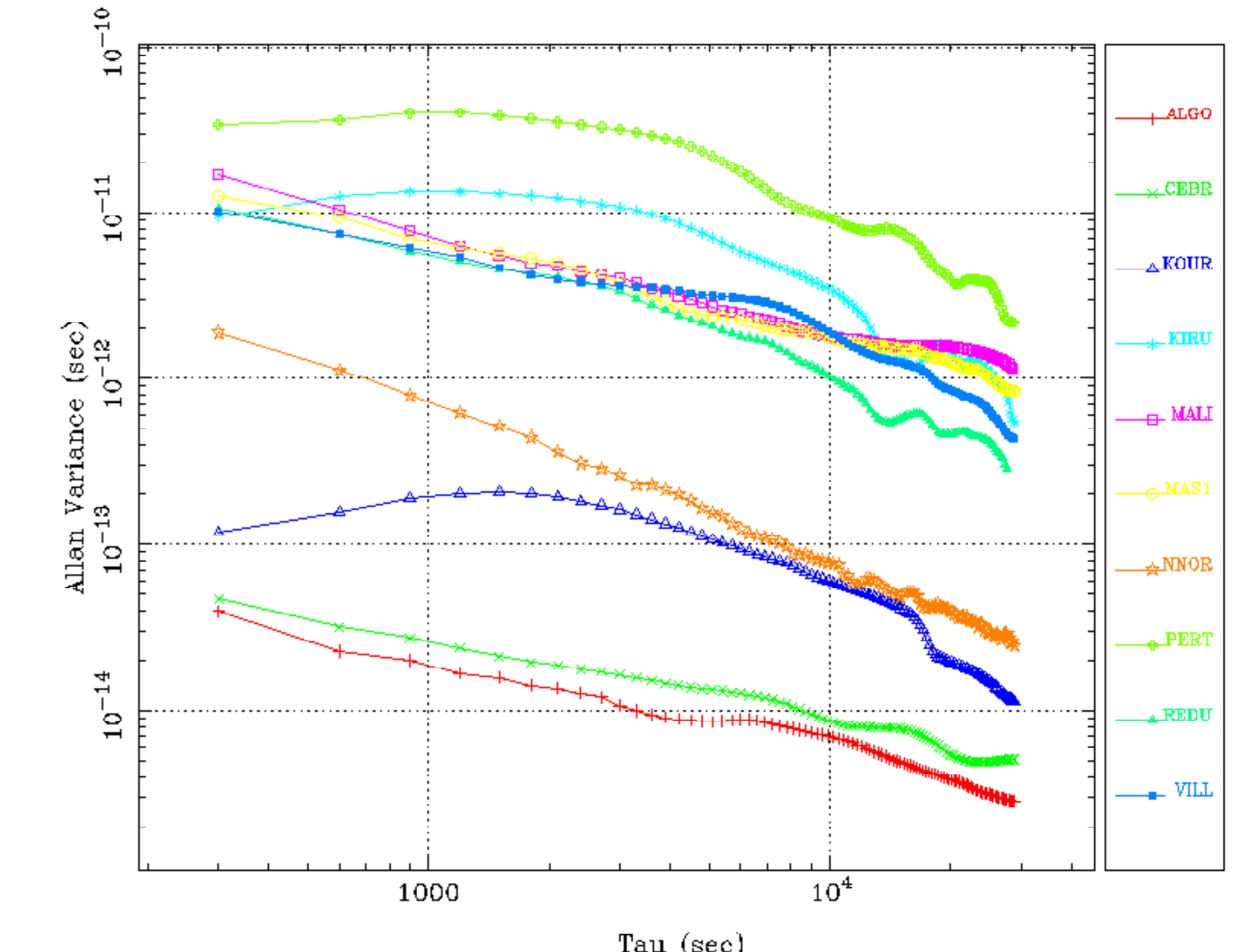


Figure 8: Station clock stability computed from IGS Rapid processing DOY 08145

Furthermore, ESOC has put in place similar monitoring systems for the 1 Hz data processing and Real-Time processing.

ESOC monitoring capability could be easily extended to another networks, and provided to external entities under request.

Conclusions and future developments

ESOC has an important commitment within the IGS to keep a high-level data quality and availability of the existing stations network. This is achieved by a robust monitoring capability based on ESOC experience, that allows a timely detection and solution of anomalies. Additionally, further network improvements are envisaged, as follows:

- In the short term, ESOC will install new GPS+GLONASS receivers in sensitive places, such as MAS1 and MALI. In MALI, a new monument is already under construction.
- In order to improve real-time and GLONASS coverage, ESOC is considering to include several new sites, mainly in Africa and Asia.
- ESOC team is contributing to the installation of new Galileo Sensor Stations (GSS) and EGNOS RIMS (Ranging and Integrity Monitoring Stations)