Working with the IGS network: The ESA/ESOC experience

I. Romero[1], C. Garcia[1], J. Dow

ESA/ESOC, Robert-Bosch-Str. 5, Darmstadt, Germany

[1]GMV at ESA/ESOC

Abstract

ESA/ESOC provides GPS data to the IGS from a small but world-wide network. At the same time ESOC is an IGS Analysis Center and contributes to all the IGS processed products. The IGS has undergone many changes in the last few years particularly in terms of latency of the data and products. These changes, together with the increase in product types and the increase in data file submissions have meant stricter requirements for all IGS analysis centre activities. Based on the particular nature of the ESA/ESOC set-up and its wide contributions to the IGS, an overall view of the experience of working with the IGS network will be presented.

Introduction

As an active Analysis Centre (AC) and a data contributor to the IGS, ESOC describes herein the multiple interactions with the IGS. On the one hand the ESOC data and metadata contributions from its own stations, additionally the required interaction to be able to use the IGS data in the regular IGS processing activities. This paper summarises the material presented in the Network Issues session at the IGS 10th Anniversary Workshop in Berne, Switzerland, from 1st –5th March 2004.

ESOC Data and Product contributions to the IGS

ESOC provide dual-frequency GPS data from 8 geodetic quality stations, Figure 1. All these stations provide GPS data at 30 second interval in hourly files, in daily files, and as 15-minute 1Hz files. The stations have been recently configured to relay their 1Hz data back to ESOC in Real-Time (RT), with the backup option of downloading the 15-min files directly from the stations a few minutes after they are closed. The backup option is used when there are missing epochs from the RT data stream at ESOC. The 30 second data files are based on the 1Hz data stream. The latency of each of the submitted files is only a few minutes under nominal conditions.

ESOC also have a meteorological station installed in Villafranca Spain (VILL) which relays ambient temperature, relative humidity and atmospheric pressure at the station. The data is stored with a 5 minute frequency and relayed to ESOC in the RT data stream . Finally ESOC operate a dual-system dual-frequency station in Kourou, French Guyana (KOU1) for the GLONASS IGLOS project which contributes 30 second data in daily files to the IGS Data centres.

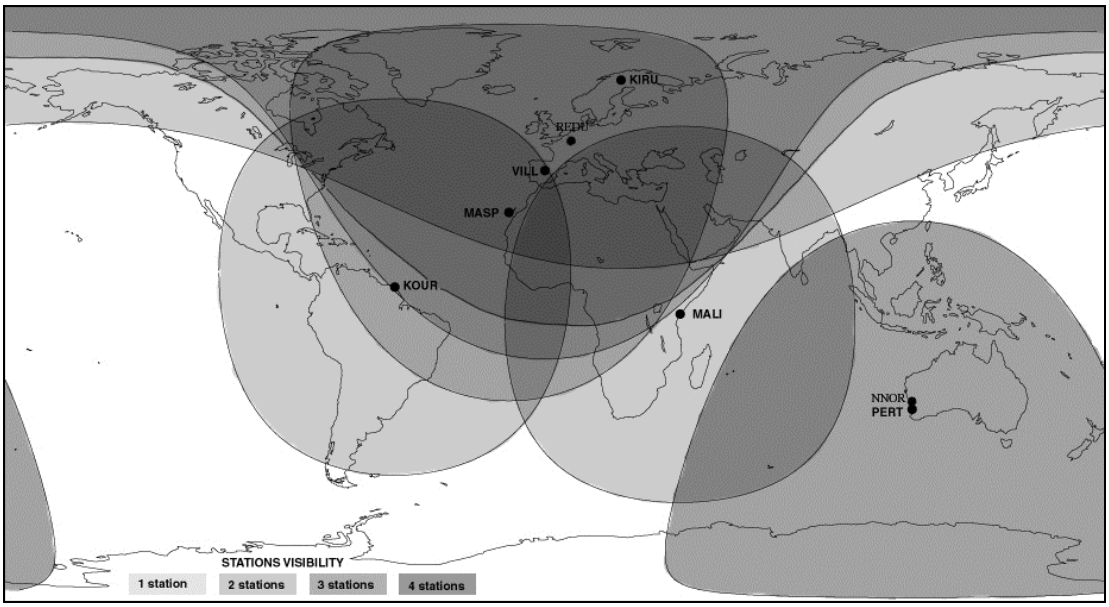

Figure 1: ESOC GPS stations

The ESA GPS sites are located at ESA tracking stations regularly used for ESA Space missions. As a results the sites are very secure and there is regular support staff to assist when help is needed, but the stations are normally monitored and controlled remotely from ESOC, requiring little local assistance. The data flows from the stations back to ESOC either via the dedicated lines already installed or using the open internet.

ESOC maintains a strict monumentation standard to mount the choke ring antenna, and every effort is made to select placements within the station's grounds that are away from roads, main buildings and where the horizon masks can be as good as possible. ESOC also has all the geodetic receivers connected to external frequency standards.

ESOC Data/Metadata handling and preparation

The station data relaying improvements described above have meant that ESA data is available sooner to the IGS ACs, which means there are more potential uses and users for the data. In addition to the RINEX data, ESOC are required to maintain supporting metadata and regular IGS communications to assist other users in identifying the station, the installed equipment and the changes.

The metadata maintained at ESOC involve manual updates when equipment changes take place. The Station Information Forms (SIF) are used to check the RINEX header of the ESA stations before submitting the files to the IGS.

An open issue for ESOC is the notification to users of planned or unplanned station outages. ESOC would favour an official notification system plus a record of the outage in the SIF.

IGS data/metadata uses and handling

ESOC require the IGS data/metadata for the AC processing to complement our own set of stations. The necessary file are the RINEX data files and the metadata (SIFs, igs.snx, and igs_01.pcv) All these files are downloaded as described in Figure 2. The RINEX data files from the IGS are stored in the ESOC RINEX archive and made available for the POD processes. The IGS metadata are used to generate two internal format files; the *station information file* and the *coordinate file*.

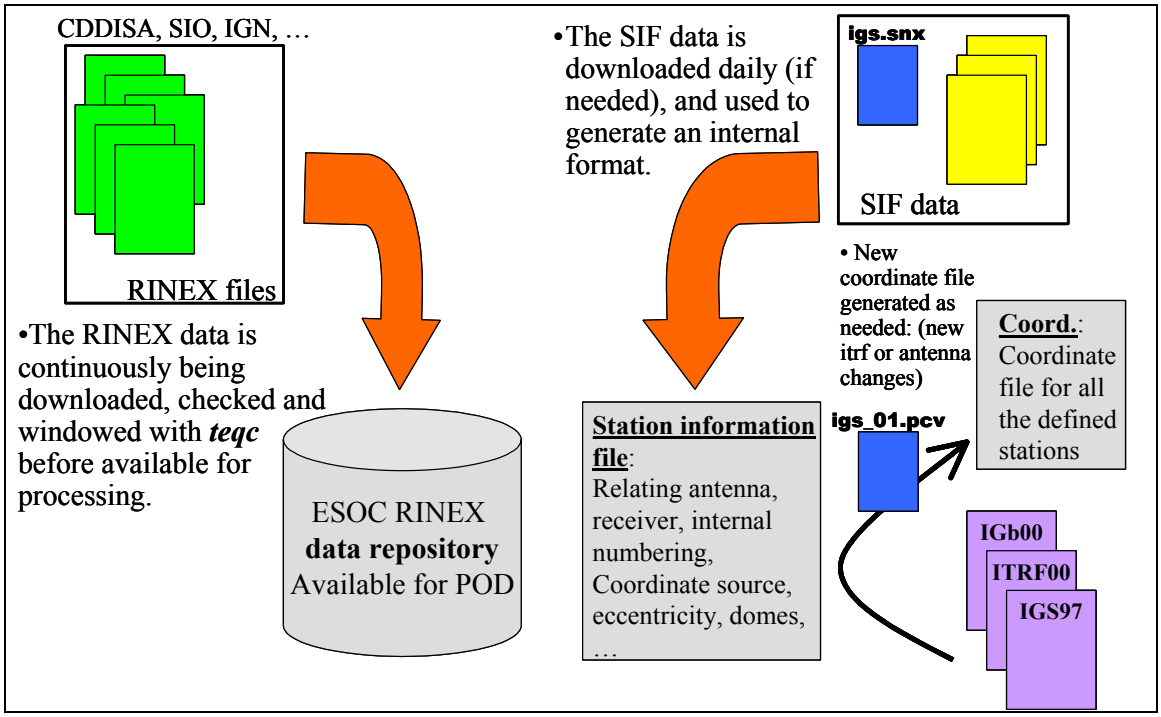

Figure 2: IGS data/metadata uses at ESOC

Currently it is not possible for ESOC to use all of the available RINEX data from the 300+ stations at the IGS Therefore the stations used in our regularly processing are mainly driven by the stations being part of the ITRF core set of stations so that it is possible to have very good apriori coordinates. Due to this limitation the large number of the SIFs downloaded are not generally included in ESOC's *station information file* or the stations included in the regular processing.

The number of stations used within ESOC's processing is about 65 for the GPS process and about 40 for the IGLOS (GLONASS) processing. In the case of the GPS data the set of stations is well defined as a subset of the ITRF GPS core stations, plus our stations, plus a few stations to cover specific holes. In Figure 3 the stations in uppercase belong to the ITRF core set, the lower case stations do not.

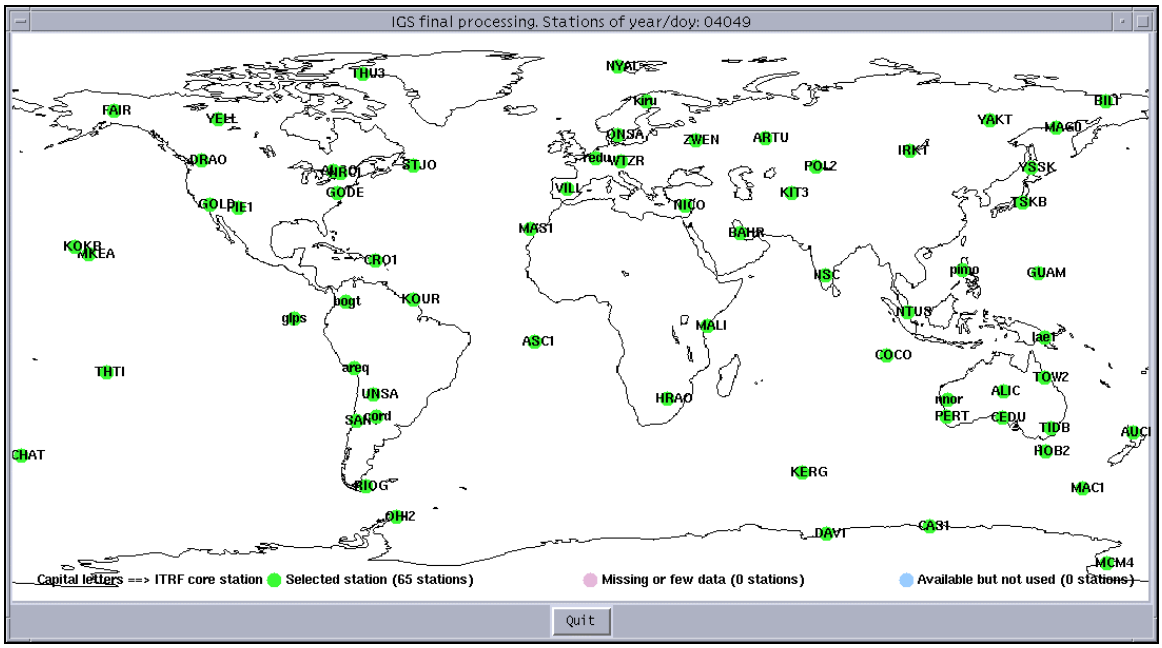

Figure 3: Sample station use for ESA Final solution for day 049 of 2004

For the IGLOS project any and all dual-system and dual-frequency data is used, which means that any station with GLONASS data is used. The problem, of course, is that as can be seen in Figure 4 the stations are not well distributed. Adding the overall number of stations from the GPS and GLONASS POD processing ESOC currently handle data of about 100 stations.

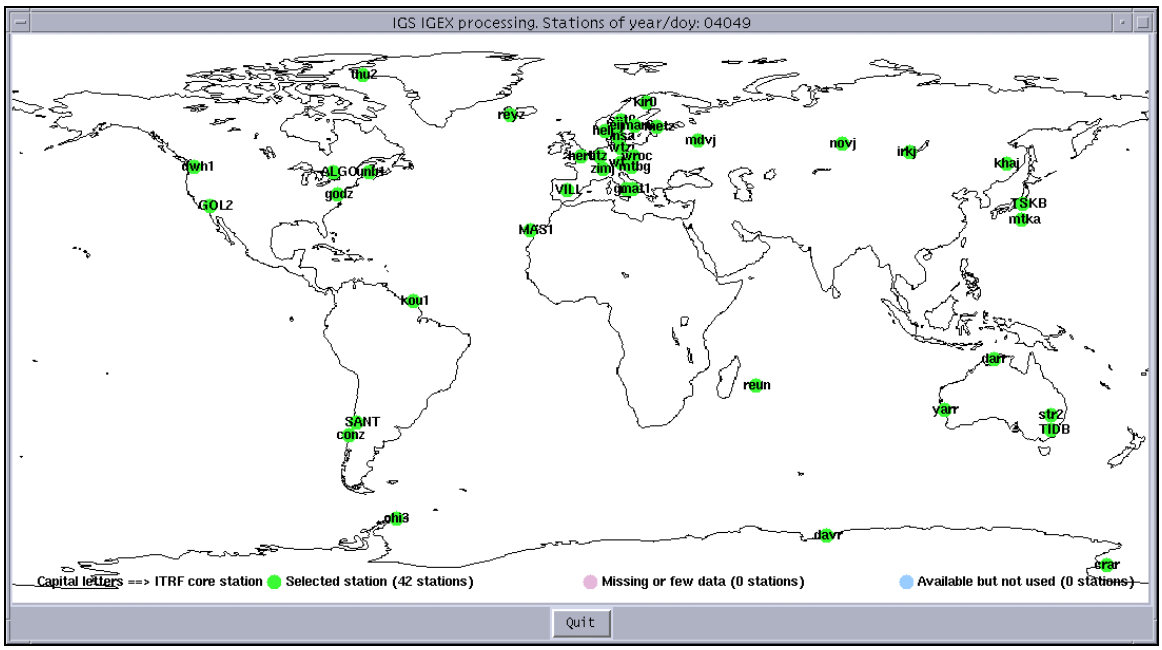

Figure 4: Sample station use for ESA IGLOS solution for day 049 of 2004

Of the 100 stations the use of the data is varied because they are included in all the ESOC processes (as needed), the dependency in terms of file types is as described in Figure 5. Summarised in the figure is the fact that the most important type of data is the 30-sec daily files which are used by default in all the processing unless not found which means the hourly data are then used. Therefore the 30 sec daily files from the IGS are archived within ESOC in an internal data repository, whereas the hourly files get eventually discarded. Highlighted in Figure 5 are the 1Hz data files which are currently only used for experimental POD runs.

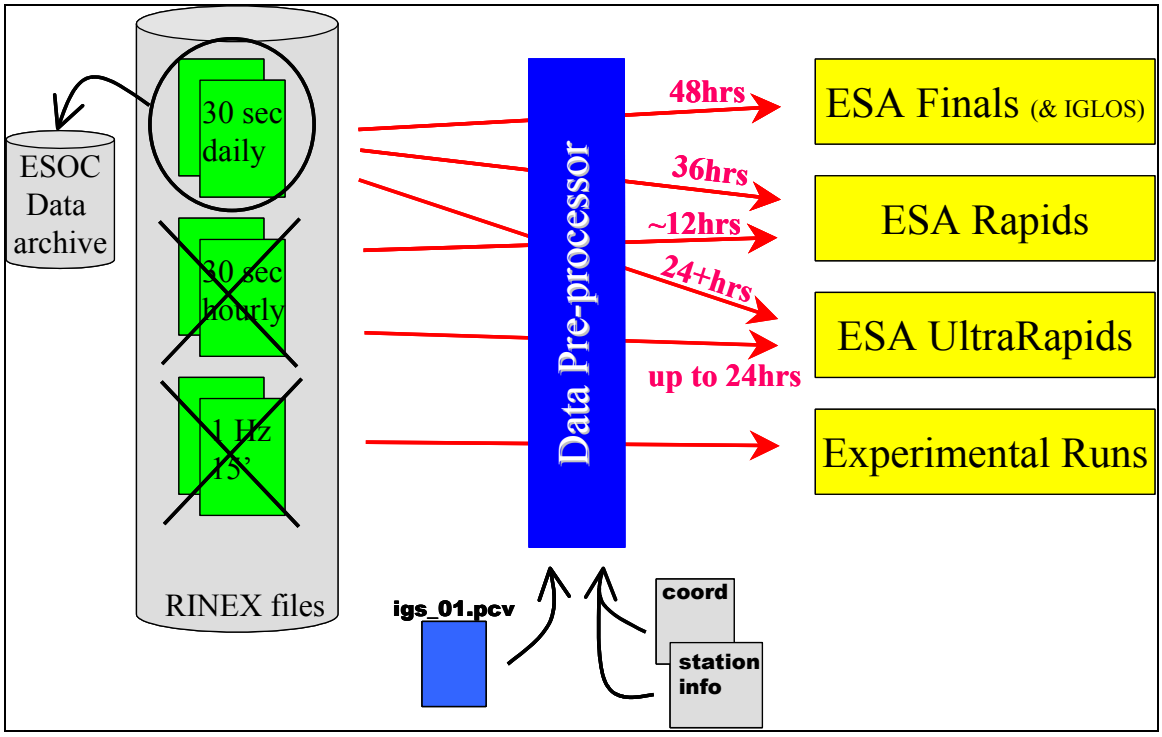

Figure 5: IGS data uses within the ESOC processing

Ionosphere Processing

ESOC processes RINEX data in both a Final and Rapid mode for Ionospheric map generations within the IGS Ionosphere Working Group. For this processing up to 180 stations may be used. As for the POD processing the data dependencies are as shown in Figure 5, with the Final ionosphere relaying entirely on 30 second daily files and the Rapid ionosphere relying on the daily and hourly 30 second files as needed. This requirement means that more data than needed is routinely downloaded from the IGS to satisfy both the POD and the Ionospheric processing needs.

Recent IGS improvements

At ESOC the recent IGS improvements are greatly appreciated. As mentioned above the increased number of stations is very good particularly in terms of increasing GLONASS data availability and ionospheric processing. The situation with the data centre backups has improved considerably and certain failures at CDDIS that in the past stopped the ESOC processing now do not even register as a

serious alarm, thus simplifying the AC operations. The metadata has also improved in quality and availability (SIFs, igs.snx, etc) which helps in the ingestion of the new data.

It is ESOC's conclusion that whereas for many years the processing has had to wait for the data to provide adequate POD results this is no longer the case. The very fast availability of the data is now pushing the processing requirements to ever decreasing latencies for precise products.

Conclusions/Next steps

ESOC has a very positive experience and outlook for the use of IGS data/metadata to continue AC activities. There are plenty of data available for the processing available on a timely fashion. The stations are well characterised by the supporting metadata with adequate equipment descriptions, etc. The IGS ITRF set of core stations is large and stable thus aiding in the POD processing.

ESOC can identify at this time a few open issues which are likely to be addressed satisfactorily during the IGS 10th Anniversary workshop,, and they are;

- Claryfing the data resubmission procedures both as a data originator and as a user of the data
- Clarify the feedback communication from the ACs to the station operators so as to provide relevant information which may improve the operations at particular stations, as well as to try to improve the data if possible.
- Implement a way to make users aware of stations with either planned or unplanned long term outages. It is also of interest to have a record of these historical outages and it would seem like the SIF would be the correct place to hold this information.