

ESOC Station Network Status and Progress



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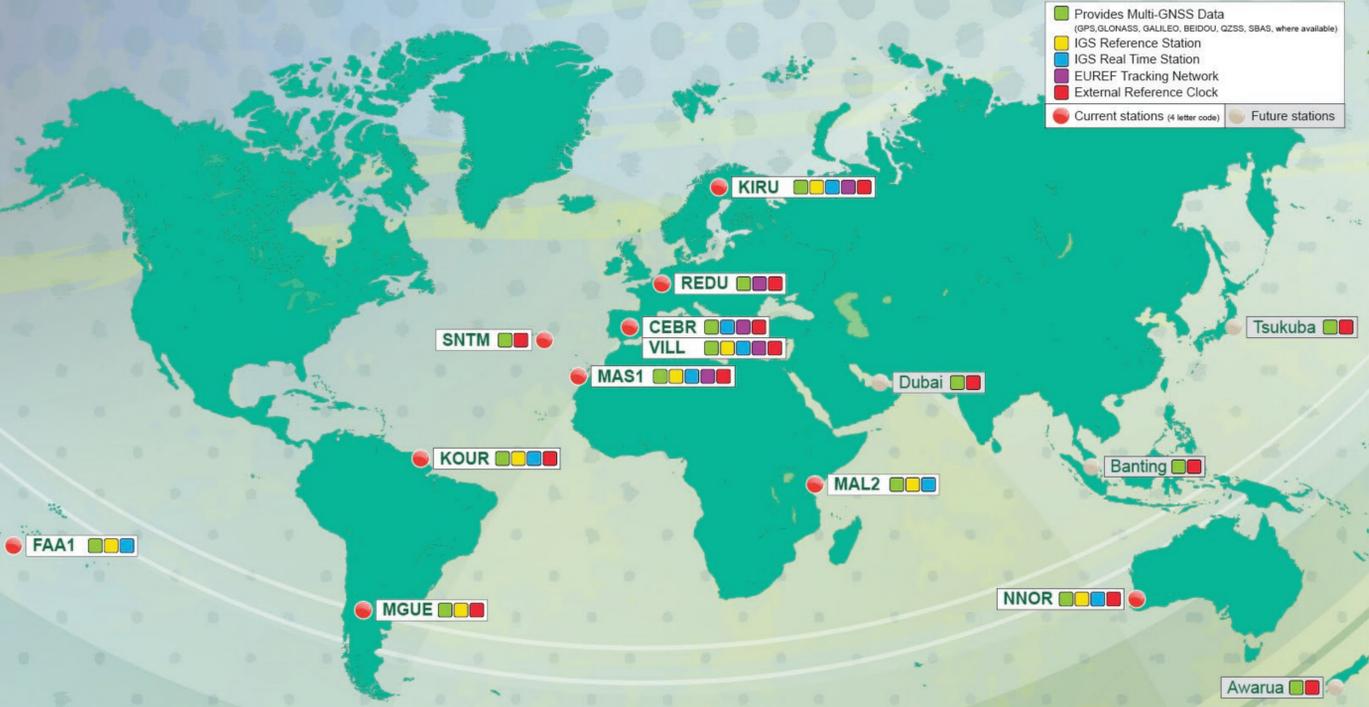
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Abstract

ESA/ESOC continues to maintain and improve a worldwide network of GNSS stations. This poster will cover the changes and the upcoming upgrades. The ESOC station network has completed the upgrade to full GNSS receivers and antennas over the last year, providing 15min, Hourly and Daily Rinex 2.11 and Rinex 3, as well as NBS (NavBits) to Eumetsat to support LEO satellite occultation processing, in an effort to continue to be a reliable provider of GNSS data for all the constellations. In addition, ESA/ESOC has advanced negotiations with several third parties in order to enhance its global coverage in the coming year.

ESA Station Network

The figure below shows the ESA GNSS station network, which currently comprises 10 stations at ESA ESTRACK core/cooperation locations; Kourou (KOUR), Redu (REDU), Maspalomas (MAS1), Cebreros (CEBR), Villafranca (VILL), Kiruna (KIRU), Malargue (MGUE), New Norcia (NNOR), Malindi (MAL2) and Santa Maria (SNTM), as well 1 station installed in Tahiti (FAA1) in close cooperation with Meteo France.



Over the first half of 2014, all stations displayed data availability figures close to 100%, with the exception of NNOR which required a receiver replacement due to a thunderstorm. Over 2013, available performance for all the upgraded stations was of similar high standards, the only exceptions here being outages at FAA1 and KIRU due to technical problems with the receivers. The data's arrival is monitored every 15 minutes and it is processed in the ESOC IGS processing (Ultras, Rapids and Finals) allowing for data quality and clock stability to be monitored, as shown in the plots below. The ESOC stations also stream data in real-time in support of the IGS Real-Time Pilot Project.

The high rate tracking data files and streams are transferred from the remote sites to the Navigation Facility at ESOC. At ESOC the 15 minute files are sampled and joined appropriately for the generation of the hourly and daily files. The transfer protocol UDP is used for the data transfer of the Real-Time streaming using RTIGS data format.

In order to perform routine operations, ESOC has developed a set of automated tools for monitoring the stations' availability and distribution, and to monitor the data quality such as data processing residuals, station clock Allan deviation, and GNSS satellite constellation tracking plots (picture below). With these tools, ESOC IGS team is able to react as soon as any anomaly appears in any station.

ESOC Station Network Upgrade 2013-2014

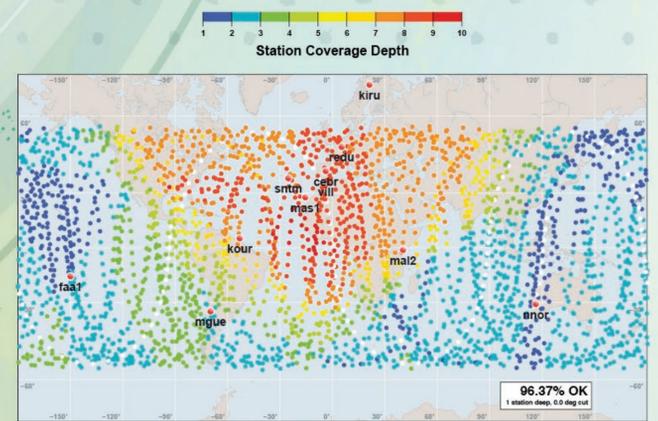
ESOC is committed to provide worldwide data for all GNSS constellations during this year as a result of having completed the upgrade of the equipment at all the current installations over the last year as well as focusing on the establishment of collaborations with third parties in order to install new stations at various new locations if agreements can be reached with the corresponding organizations.

Following the acquisition of a large number of Septentrio PolarRx4 receivers and Septentrio Chokering MC antennas plus 4 Leica AR25 rev.4 antennas in 2011-2012, the entire ESA GNSS network now operates these Septentrio receiver/antenna combinations, with the exception of MGUE, MAL2, MAS1 and FAA1 where the Leica antennas are used. The completion of the upgrades consisted of installing the Leica AR25 antenna at MAL2 in the 1st half of 2013, followed by installation of Septentrio receivers at MAL2, MGUE and REDU in the 2nd half of 2013, complemented by a Septentrio antenna for the latter. Finally, in February 2014 the network was completed

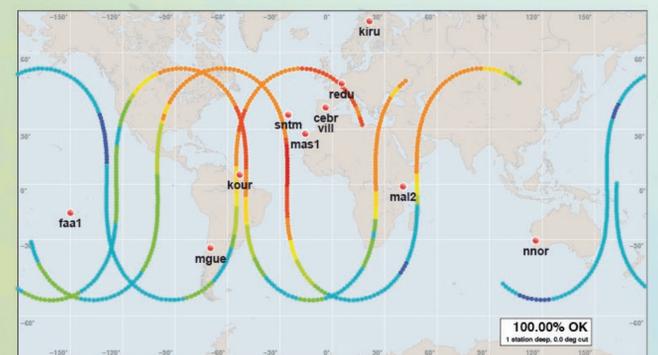
with the new station SNTM, which will remain for internal use for the foreseeable future.

The Polar Rx4 Septentrio receivers installed provide all the expected measurements for the GNSS constellations as available: GPS, GLONASS, Galileo, QZSS, Beidou and SBAS. As of mid-2013, ESOC has been contributing with daily, hourly and high rate multi-GNSS Rinex 3 data to the MGEX effort. Also, since the beginning of 2013, ESOC has been providing NBS (NavBits) data from this same set of stations to Eumetsat to support LEO satellite occultation processing.

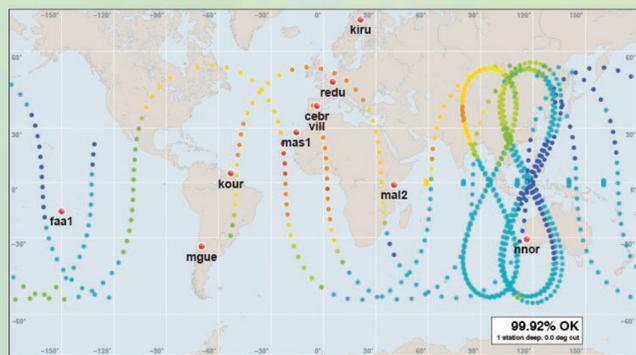
For the 2nd half of 2014 worldwide coverage is planned to be enhanced considerably with negotiations with third parties in Tsukuba (Japan), Awarua (New Zealand), Dubai (U.A.E) and Banting (Malaysia) in an advanced stage. The maps below show the current global data coverage for all the GNSS constellations.



ESOC Network GPS typical constellation coverage



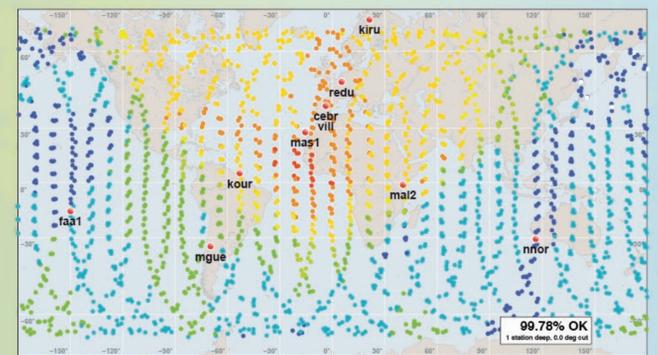
ESOC Network Galileo typical constellation coverage



ESOC Network Beidou typical constellation coverage



ESOC Network QZSS typical constellation coverage



ESOC Network Glonass typical constellation coverage

New ESA/ESOC station Santa Maria - SNTM

The Santa Maria S-band station, also known as 'Montes das Flores' (Hill of Flowers), is located 5 km from the town of Vila do Porto on the Portuguese island of Santa Maria, Azores. Following the general strategy of complementing each ESA ESTRACK core station with the installation of a multi-GNSS Septentrio PolarRx4 receiver and Septentrio ChokeRing MC antenna in the beginning of 2014, the station (SNTM) became fully operational on Feb 12th 2014, pending only the installation of a lightning rod and an upgrade of the communication lines in order to allow for a data throughput containing all the GNSS constellations, currently limited to only GPS and Galileo.

The monument was installed near –but superior in height to– the main station building to reduce cable length and optimise the open sky view in all directions around the antenna.



Septentrio PolarRx4 receiver and Septentrio ChokeRing MC antenna

Conclusions

ESA/ESOC is fully engaged in supporting the modernization of GNSS data formats and data transfers through our involvement in the RINEX Working Group and the IGS Infrastructure Committee. ESOC remains involved and committed to support the Rinex 3 data format and to the new Multi Signal Message RTCM real-time format, and in the upgraded ESOC station network we look forward to provide the upgraded data formats as part of the MGEX and the Real-Time pilot project.

The ESA/ESOC Navigation Support Office is also committed to providing the highest quality GNSS data by maintaining, improving and expanding the existing station network with modern Septentrio receivers and antennas, providing measurements for all GNSS-constellations.