

## **First observations of ionospheric scintillations from SANAE by means of the DemoGRAPE scintillation receivers.**

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### **ABSTRACT**

The accuracy of satellite navigation in Antarctica is of paramount importance since there is always the danger that people and vehicles can fall into a crevasse during a snowstorm, when visibility is limited and travel is restricted to following well-demarcated routes using satellite navigation systems. SANSA (South Africa) and INPE (Brazil) are key collaborators on an international project DemoGRAPE which is designed to improve satellite navigation in Antarctica. In 2013 SANSA and INPE agreed to support the DemoGRAPE proposal led by Istituto Nazionale di Geofisica e Vulcanologia, in partnership with Politecnico di Torino and Istituto Superiore Mario Boella in Italy. The project is funded by PNRA (the Italian National Program for Antarctic Research). The proposal was to build a demonstrator of cutting edge technology for the empirical assessment of the ionospheric delay and ionospheric scintillations in the polar regions which affect the accuracy of satellite navigation. The demonstrator will include new monitoring equipment to be installed at the South African and Brazilian bases in Antarctica, and the exchange of data via the Cloud computing infrastructure.

SANSA and INPE manage ionospheric scintillation receivers and GPS receivers at SANAE and EACF in Antarctica (since 2006). Between November and December 2015 SANSA and INPE

assisted INGV and the DemoGRAPE team with the installation at SANAE and EACF of two pairs of GNSS receivers. Each Antarctic station is now equipped with a Septentrio PolaRxS receiver and a new-concept of data acquisition system exploiting GNSS software receivers, which provide access to ionospheric delay and related measurements from not only the GPS (US) system of navigation satellites, but also to the Russian GLONASS and European Galileo satellites. The deployment of the new-concept of GNSS data acquisition is also supported by the Joint Research Centre of the European Commission (JRC). The first data recorded during two moderate geomagnetic storms which occurred on January 2016 is now available to give evidence of the advantages of the new instrumentation.

The new instruments will provide new research opportunities at international level in Antarctica, and will further global partnerships in Space Research.

**Key words:** Ionosphere, GNSS, Scintillation, DemoGRAPE.



Figure 1. Co-located GNSS receivers at SANAE, the South African Polar Research base in Antarctica. In the foreground is the antennas of the GPS and Novatel Scintillation receivers, and on the roof of the base (insert) is the antenna shared by the Septentrio PolaRxS PRO GNSS receiver and the software-based GNSS data acquisition system.

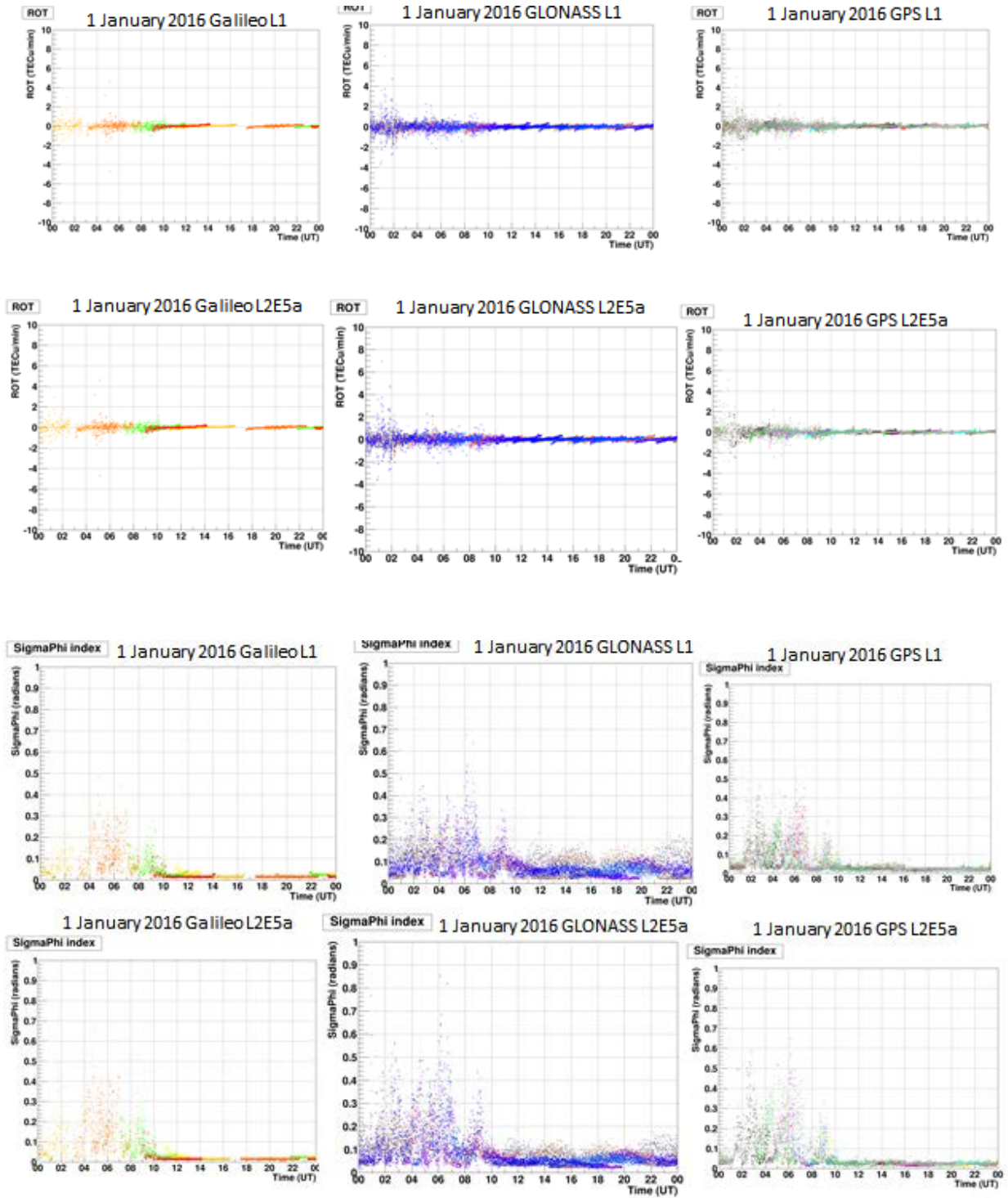


Figure 2. First observations of an ionospheric storm using the suite of scintillation receivers deployed by the DemoGRAPE project at SANA-IV. There is a clear enhancement of both the rate of change of TEC (ROT) and phase scintillation (SigmaPhi) visible on all three GNSS constellations received at SANA-IV on 2016-01-01, which was a day with a moderate geomagnetic storm.