GGOS: An Observing System for the Geosciences

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What sets geodesy apart from other geosciences? One answer is the fact that the International Association of Geodesy (IAG) from the very beginning – established 150 years ago in Central Europe – has fostered the establishment of "services" to provide fundamental products for end-users. However, there are several reasons why this trend has accelerated in the last two decades.

Firstly, modern geodesy relies on space technology, and enormous strides have been made in accuracy, resolution and coverage due to advances in satellite sensors and an expanding portfolio of satellite missions. Secondly, geodetic techniques can now measure earth parameters that no other remote sensing technique can, such as the position and velocity of points on the surface of the earth, changes of sea level and the shape of the earth's ocean, ice and land surfaces, and map the spatial and temporal features of the gravity field. These geodetic parameters are in effect the "fingerprints" of many dynamic earth phenomena, including those that we now associate with global change, as well as those responsible for devastating events such as earthquakes, tsunamis and volcanoes. Finally what relentlessly drives geodesy into the future is the innovative use of signals transmitted by Global Navigation Satellite Systems (GNSS) such as the U.S.'s GPS and Russia's GLONASS – the E.U.'s Galileo, and China's BeiDou will be fully deployed over the coming decade.

GNSS today is used for an enormous range of applications, from mass market uses such as car navigation and location-based services, to professional applications such as machine automation, emergency services, military operations, rapid mapping, surveying, transport management, and many more. However it is the special ultra-high accuracy form that is of geodetic interest. The IAG's International GNSS Service (IGS) was established in 1994 for the computation of high accuracy GPS and GLONASS satellite orbit and clock error information, as well as to provide open access to measurements made by a ground network of GNSS tracking stations. These hundreds of GNSS receivers operating continuously around the world also function as precise monitoring systems for ground movement due to tectonic motion, local subsidence due to fluid extraction or underground mining, uplift due to volcanism or post-glacial rebound, etc. GNSS is nowadays an indispensible tool for the geosciences. Furthermore the IGS plays a vital role in the maintenance of the International Terrestrial Reference Frame (ITRF), and provides the direct means of generating coordinates in this frame via high precision GNSS positioning techniques.

Coordinating the operations of all the IAG Services is one of the goals of the Global Geodetic Observing System (GGOS). GGOS is evolving to a synoptic, continuous, high accuracy observing system, with distributed sensors and analysis centres, that will support studies into those dynamic earth phenomena that only reveal themselves through subtle changes in geometric and gravimetric signatures. A critical mission of the IAG services, and GGOS in particular, is maintain a highly accurate and stable ITRF, without which it would not be possible to reliably measure sea level rise of 2-3 mm/yr; or ground displacements in near real-time and deformations over decades. Many other phenomena can also be studied using geodetic methodologies supported by GGOS services and infrastructure. In summary, GGOS is an observing system at the service of all geosciences.