Testing InSAR, unifying datums, plotting oil spills, quakes & cadastres. . .

. . . it was all at FIG Marrakech and more

The recent FIG working week heard several papers that should be of significant interest to surveyors. **Richard Groom** has delved into the FIG website and has come up with nine papers worth a closer look.

• *The full texts of all the papers presented at Marrakech are available on* **http://www.fig.net/fig2011/** *Click on "Proceedings" to see the "Technical Programme and Proceedings" and browse for the session numbers stated in this article. A .pdf file can be downloaded by clicking on "Paper".*

The FIG 2011 Working Week took place in Marrakech, Morocco, between 18th and 22nd May. *GW* was not there but we have searched the proceedings for articles that could be of most interest to surveyors. These are summarised below, whilst elsewhere in this issue of *GW*, we publish an abridged version of a paper on the African Geodetic Reference System (AFREF).

Subsidence: InSAR against independent data

An article in TS03e by **Maria João Henriques** et al entitled "Land Subsidence in Lisbon Area: Validation of PsInSAR Results" caught my eye because I do not recall ever having seen reports of scientific testing of InSAR against independent data. Their study covered a four square kilometre area of Lisbon that, according to InSAR observations, has been subsiding by 8mm per year. The researchers compared InSAR data from ERS and EnviSat scenes with the data from a continuously operating GNSS receiver located in the area of subsidence and two lines of precise levelling across the area. The study demonstrates broad agreement between the different techniques but, almost inevitably, the dates of survey do not match up precisely and the results suggest varying rates of subsidence. An interesting study, nevertheless.

GPS speeds up cadastral surveying

Up to last year, 46% of properties in Indonesia had been registered and the Indonesians see GPS as an opportunity to drive the percentage significantly higher. **Hasanuddin Z. Abidin** et al presented "On the Use of GPS CORS for Cadastral Survey in Indonesia" in TS03g. The Indonesian National Coordinating Agency for Surveys and Mapping (Bakosurtanal) has the responsibility for national mapping and also for establishing zero and first order geodetic networks. They started with three continuously operating reference stations (CORS) in 1999 and now operate 99. The National Land Agency of Indonesia (BPN) breaks down the GPS control to second and third order networks using GPS. Third order points are spaced on a rough 10km grid. This is further broken down using traversing to produce a 2km grid of stations. Up to 2010, 75% and 7% respectively of the second and third order networks had been completed. There is also a fourth order network that yields stations at 100m to 150m intervals.

Using static techniques or RTK using a nearby CORS as base station, surveyors can either observe boundary points directly or, if the sky view is inadequate, can establish GPS stations in clear areas and then observe boundary points by traversing.

Checking Google

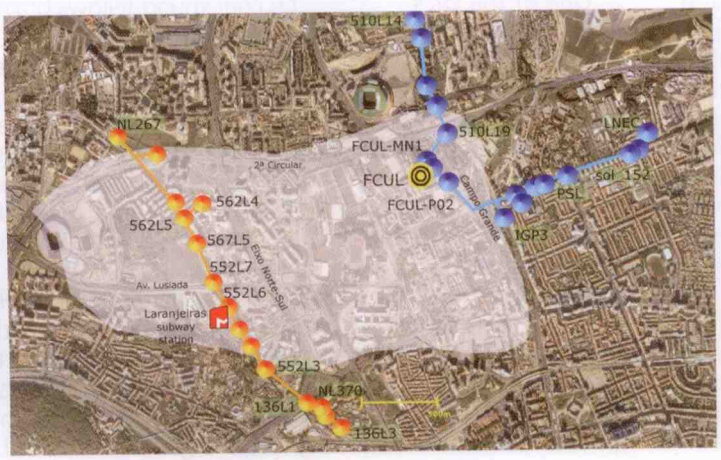
Google Earth imagery is perhaps too readily dismissed by surveyors as a toy, but just how inaccurate is it? **Kazimierz Becek** and **Ibrahim Khairunnisa** from Brunei Darussalam carried out some tests which they presented in their paper; "On the Positional Accuracy of the Google Earth Imagery" in TS05i. There are (approximately) 8235 airfield runways on the planet which have coordinated runways. Of these, the researchers selected 2000 spread around the globe. They extracted the positions of the airfields from a previous study and entered the points into Google Earth. They had previously used the same dataset to test Shuttle Radar Topography Mission data. The result was that around half the points they compared fell within 50m, although in some cases there were errors of over 1.5km.

Plotting oil spill plumes

The Gulf of Mexico oil spill disaster concentrated the minds of disaster planners around the world. In Session TS06j, **Olusegun Badejo** and **Peter Nwilo**, from Nigeria presented a paper "Oil Spill Model for Oil Pollution Control" that described their research into modelling the path and spread of oil from hypothetical spill points in the sea towards and along the Nigerian coast. The effects of the pollution on sensitive inter-tidal habitats are also included in the study. The modelling and mapping are stored in the ArcGIS environment, which also includes data on oil blocks, wells and bathymetry.

Unifying datums

To unify vertical datums requires knowledge of the fundamental parameter



Subsidence in Lisbon. Map showing the area of subsidence (shaded), level lines running through the area (blue and yellow) and a continuously operating GPS station (FCUL).

W0, which defines the Gauss-Listing geoid. **Nadim Dayoub** et al, presented a paper entitled "The Geoid Geopotential Value for Unification of Vertical Datums" in session TS07c. The researchers use two methods. Firstly, on a European scale, by studying sea level, mean dynamic topography (the difference between mean sea level and the geoid) and GNSS-level at tide gauges, they determined the geodetic coordinates of mean sea level. Then, by applying the EGM2008 geoid model, they can determine the geopotential value that defines the geoid at each tide gauge. They used this to connect the French, German and several UK vertical datums.

Secondly, at a global level, W0 can be determined using mean sea level determined through satellite altimetry, EGM2008 and oceanographic mean dynamic topography (ECCO-2). And the answer is 62636854.29 ± 0.5 m2s-2! Using this value the researchers were able to determine the relationship between the European datums and the global height system.

A century of sea level rise in NZ

There was another fascinating article on sea level in session TS07i. **John Hannah** et al presented "Auckland: A Case Study in the Regional Assessment of Long-Term Sea Level Change". Auckland is one of the few locations in the southern hemisphere with a tide gauge record extending over more than 100 years. The tide gauge is also co-located with a continuously operating GNSS receiver. The objective of the research was to study sea level changes and use that knowledge to estimate sea level over the next 100 years. A graph of the Auckland tide gauge data reveals a remarkably steady increase in sea level of 1.5mm per year, which is then increased to 1.8mm when taking into account modelled isostatic readjustment. Superimposed on this picture of rising sea level is a seasonal variation of ± 40mm and equally fascinating cycles caused by the Pacific Ocean El Niño – Southern Oscillation (± 0.1m) and a longer period Inter-decadal Pacific Oscillation (± 0.05m). The study's findings tie up with geological evidence in New Zealand and Australia.

Where's my control gone?

Staying down-under, **Mark Smith** et al gave a fascinating paper in session TS08b on the effects of the recent earthquakes in New Zealand on the cadastral system in the Christchurch area: "Re-establishment of Cadastral Boundaries following the 2010 Earthquake in Canterbury, New Zealand".

Readers will recall that in fact there were two earthquakes. The first, with a magnitude of 7.1 on the Richter scale took place on 4th September 2010 had its epicentre (more accurately) at Darfield. This was the first significant quake in New Zealand since 1931 and on that occasion, all the records were lost in a fire so in September 2010, NZ surveyors were working without the help of a precedent. They set to work immediately, following a three-point plan to find out what had happened to the survey control system. An initial deformation survey was undertaken of 70 control points in the area suspected to have been most affected by the quake and for which there were accurate pre-earthquake coordinates.

Next, the survey was taken to a regional level with a survey of a further 250 marks and finally a geodetic survey of the local areas worst affected by liquefaction and the fault rupture itself. The surveys were at an advanced stage when the second 6.8 magnitude earthquake hit Christchurch itself on 22nd February 2011. This set the work back to 'square one'. The article is fascinating and well worth reading in full. It covers the rules for re-establishing boundaries as well as the methods used to determine ground movements.

MEMS testing: a cheap inertial tool?

Microelectromechanical Systems (MEMS) are starting to appear everywhere. The most obvious application is the device within some smartphones that keeps the screen image upright. MEMS are already used in low performance IMUs. They are worth watching because, should their performance improve, they could turn IMUs into relatively inexpensive everyday survey equipment. In Session TS09a **Charles Toth** el al presented a paper entitled "Reference Data Set for Performance Evaluation of MEMS-based Integrated Navigation Solutions". The paper describes a series of tests on a sample of MEMS sensors that were carried out by a collaborative working group from the IAG and FIG. It is well worth a quick read through, particularly for those who are into mobile laser scanning.

Locata under test

Finally, in TS08e **Mazher Choudhury** and **Chris Rizos** presented a paper on "Locata". This is a positioning system invented by Locata Corporation which provides position solutions using a network, known as a "LocataNet" of time synchronised "LocataLite" transceivers. The transceivers can be installed almost anywhere in order to optimise network geometry. When a Locata receiver tracks four or more LocataLite signals it can compute a millimetre-level precise position completely independent of GPS.

One application for this technology is deformation monitoring but there is a potential problem because the Locata system operates in the licence-free 2.4Ghz Industry Scientific and Medical band, so other instruments using this band may cause degradation of Locata's positioning. The authors carried out tests firstly without interfering signals and then with partial interference from WiFi signals. The accuracy was affected by the interference but in both interfered and non-interfered scenarios Locata gave millimetre-level precision in the horizontal and centimetre-level precision in the vertical for all epochs.

"Auckland is one of the few locations in the southern hemisphere with a tide gauge record extending over more than 100 years."

"...should their performance improve, they could turn IMUs into relatively inexpensive everyday survey equipment."