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How reliable are your readings?

GasData Ltd's new GFM 436 may be the solution to your problems...

Included in this month's issue:

- Review of Perfluorinated Compounds including PFOS and PFOA.
- PanGeo: A free Geohazard Information Service for Europe
- The Benefits of Automating Consolidation Testing

Issue No.
27
February 2014

Contents

Welcome

Welcome to the 27th Edition of **theGeotechnica** - the UK's fastest growing online geotechnically focussed e-magazine.

Firstly, we would like to wish our readers a Happy New Year from everyone here at **theGeotechnica**, and also our parent company the Equipe Group. We hope the first month of 2014 has been prosperous for you all and business is continuing to improve across all sectors of the industry.

The first article in this month's issue comes from one of our more regular and highly valued contributors - one of our resident Environmental and Laboratory experts, Geraint Williams of ALcontrol Laboratories. This month Geraint returns to write for **theGeotechnica** about perfluorinated compounds, with a particular focus on PFOA and PFOS.

Following on from Geraint's feature on perfluorinated compounds comes our cover article - an article from Willie Whitesmith of GasData Ltd. Writing for **theGeotechnica** for the first time Willie discusses the issue of erroneous readings from gas analysers on sites such as landfills and offers a possible solution in the form of GasData Ltd's own new product, the GFM 436.

Also included this month is a highly comprehensive introduction to PanGeo, a free geohazard information service for Europe that is achieved through the generation of validated geohazard data layers. The article is penned by another regular contributor to theGeotechnica, Professor David Norbury, who this month writes on behalf of the European Federation of Geologists.

Our final article of this month's issue is highly insightful and comes from Adrian Rose. Writing on behalf of VJ Tech, Adrian discusses the benefits of automatic consolidation testing and can be found on page 23 of this month's issue.

As with every new edition of the magazine, the Editorial Team here at **theGeotechnica** will be on the lookout for even more new, original and interesting content from all corners of the sector, and would actively encourage all readers to come forward with even the slightest bit of appropriate and relevant content - whether it be a small news item or a detailed case study of works recently completed or being undertaken. If this content is media rich and interactive, then all the better. We are looking to increase the already large readership of the magazine through better social media integration and promotion, as well as improving content month on month.

Finally, for any content that is submitted we will ensure that advertising space, proportionate to the quality of content provided, is available for that single edition of the magazine. From then on, if you have submitted content, you will receive a discount on all further advertisements placed within **theGeotechnica**. We hope you enjoy this month's edition of the magazine and are inspired to contribute your own content for the coming editions of **theGeotechnica**.

Editorial Team,
theGeotechnica

REVIEW OF PERFLUORINATED COMPOUNDS INCLUDING PFOS AND PFOA

Returning to write for theGeotechnica this month is one of our highly valued environmental and laboratory experts Geraint Williams of ALcontrol Laboratories. This month Geraint turns his attention to perfluorinated compounds including PFOS and PFOA.

Perfluorinated compounds (PFCs) have attracted increased scientific interest because of the findings that some sulfonates and carboxylates, notably PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoic acid) are present in human blood and in the environment.

"Perfluorinated compounds (PFCs) have attracted increased scientific interest because of the findings that some sulfonates and carboxylates, notably PFOS and PFOA are present in human blood and in the environment."

PFOS and PFOA are often used as a reference or key substances for the sulfonate and carboxylates groups as their toxicology have been most intensively studied.

PFOS refers to fully fluorinated (eight-carbon chain length) sulfonate containing substances (OECD 2007). PFOS is a member of a large family of perfluoroalkyl sulphonate (PFAS) based chemicals. PFOS is commonly used as a simple salt such as potassium, sodium or ammonium or incorporated into larger polymers (EFSA 2008; USEPA 2009). PFOS-related substances are any substance which contain the PFOS moiety (C8F17 SO2) and may break down in the environment to give PFOS.

PFOA is anthropogenic compound with a chain length of eight carbons, seven of which are perfluorinated. It belongs to the broad class of chemical known as perfluorocarboxylic acids (PFCAs) which, in turn, belong to the broader class of PFAS substances.

PFOS has become recognised as a contaminant of concern due to its persistence, toxicity and potential to bioaccumulate.

"PFOS has become recognised as contaminant of concern due to its persistence, toxicity and potential to bioaccumulate."

In 2008, under EU Directive 2006/122/EC, restrictions were placed on the marketing and use of PFOS. PFOS, it's salts and perfluorooctane sulfonyl fluoride (POSF) have been listed under Annex B of the Stockholm Convention since

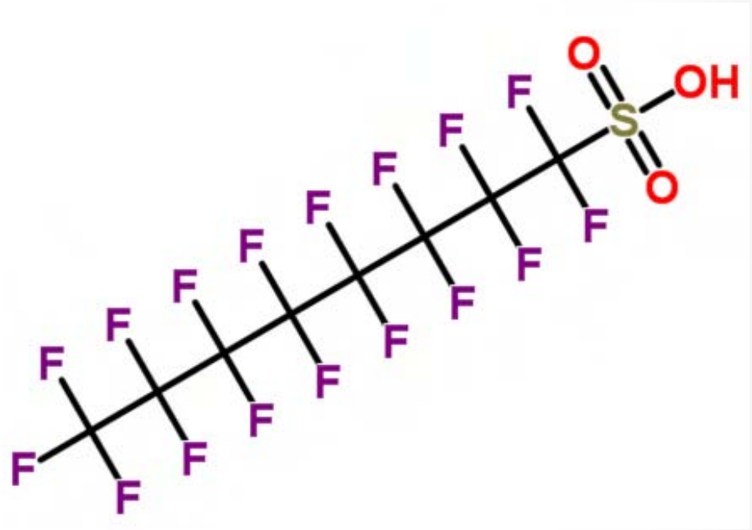

Fig 1 PFOS CAS Number: 1763-23-1; Common Synonyms: Perfluorooctane sulfonic acid, Perfluorooctylsulfonic acid; 1-Octanesulfonic acid

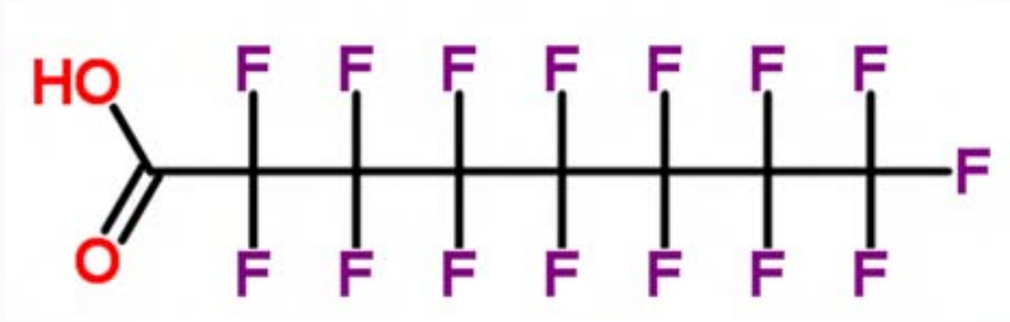

Fig 2 PFOA CAS Number: 335-67-1; Common Synonyms: Pentadecafluorooctanoic acid; Perfluoroheptanecarboxylic acid

2009. More recently, PFOS was listed as a priority substance in EU Directive 2013/39/EU (AA-EQS Inland surface water 0.65 ng/l). As part of the USEPA's PFOA stewardship program, eight companies committed to reduce global facility emission and product content of PFOA and related chemicals by 95 percent in 2010 and eliminating emission and product content by 2015 (ASTDR 2009; USEPA 2012).

Physical properties

As a result of the chemical stability of PFOS and PFOA and the low volatility of these substances in ionic form, they are persistent in water and soil. PFS with long chains, are both lipid-repellent and water-repellent. Therefore, PFOS-related substances are used as surface-active agents in different applications.

It is the very strong carbon-fluorine bindings that cause persistence of PFCs. The carbon atoms of the perfluoroalkyl chain are protected from attack by the shielding effect of the fluorine atoms. Environmental degradation processes generally do not possess the energy needed to break apart the strong C-F bonds (USEPA 2009). Perfluoroalkyl compounds are resistant to biodegradation, direct photolysis, atmospheric photooxidation and hydrolysis (OECD 2002). More complex PFOS-related chemicals will degrade to PFOS structure during use or presence in the environment.

PFOS has a solubility of 519 mg/l in pure water at 24°C and 570 mg/l at 20°C. The solubility decreases significantly with increased salt content, for example the potassium salt of PFOS has a solubility in fresh water of 370 mg/l and 25 mg/l in filtered sea water. PFOA has a water solubility of 3.4 g/l (Public Health England 2009)

"PFOS and it derivates are used in numerous manufacturing processes because of their non-reactive properties, low surface tension, chemical stability, resistance to acids and high temperature."

Production and Uses

PFOS and it derivates are used in numerous manufacturing processes because of their non-reactive properties, low surface tension, chemical stability, resistance to acids and high temperature.

Two major production processes exist for production of PFAS – electrochemical fluorination (ECF) and telomerisation (TM). The ECF was used extensively by 3M (the principal global producer based in the United States) in the production of PFOS. 3M voluntarily phased out PFOS production in 2002 and changed to production of shorter-chain PFCs.

PFOS and PFOA are man made substances that do not occur naturally in the environment. These substances can be released into the environment during their production. PFOS and PFOA have been detected in surface waters and sediments downstream of production facilities, wastewater treatment plant effluent, sewage sludge and landfill leachate (OECD 2002).

PFOS and its related substances were used in fire fighting foam stock; photographic industry; photolithography and semiconductors; and hydraulic fluids and metal plating. Historically, PFOS and

its related substances have been used in applications as fire fighting foams, protective coatings form materials such as carpets, textiles and leather. It was also used in various household and industrial cleaning products.

Similarly, PFOA has been used as polymerisation aid in the manufacturing of fluoropolymers such as polytetrafluoroethylene (i.e. Teflon) and in aqueous fluoropolymer dispersions, which have been used for paints and photographic film additives.

"PFOS exhibits similar properties and, like PFOA, has been used in a variety of consumer products..."

PFOS exhibits similar properties and, like PFOA, has been used in a variety of consumer products (e.g. Scotgard, Zonyl, Foraperle) for its stain, grease and water-resistant properties. Before 2000 these were the most important uses of PFOS derivatives. Since it was banned in many countries PFOS has been replaced with shorter-chain analogues and fluorotelomers but also with non-fluorinated chemicals. The trade names have been retained.

Fire Fighting Foams

Several classes of PFCs that are potential precursors to the perfluorinated carboxylates and sulfonates have been used in aqueous film-forming foams (AFFF). AFFFs are complex mixtures of hydrocarbon and fluorocarbon surfactants that have been used since the 1960's to extinguish hydrocarbon-fuel based fires. Where these foams have been deployed, high concentrations of poly- and perfluorinated substances have been detected in groundwater. In addition to PFOA, PFOS, and their shorter chained homologues, AFFF formulations contain more complex PFCs that could be transformed into perfluorinated acids by microbes.

There are different types of fire fighting foams and agents containing PFCs:

- Fluoroprotein foams - used for hydrocarbon storage tank protection and marine applications.
- AFFF - used for aviation, marine and shallow spill fires; developed in the 1960s.
- Film-forming fluoroprotein foams (FFFP) - used for aviation and shallow spill fires.
- Alcohol-resistant aqueous film-forming foams (AR-AFFF) - multi-purpose foams.
- Alcohol-resistant film-forming fluoroprotein foams (AR-FFFP) - multipurpose foams; developed in the 1970s.

Foams that contained PFOS were stocked for emergency response at operational sites including chemical and petroleum plants, pharmaceutical manufacturers, military sites and off-shore drilling platforms as well as merchant ships. They were used by Fire and Rescue Services. A mixture of fluorinated surfactant and a hydrocarbon-based surfactant is used in AFFF, as this combination is more cost-effective and performs better than either surfactant separately. The concentration of perfluorinated compounds in fire-fighting foams was

"Today most fire fighting foams are manufactured without PFOS, which has been replaced by fluorochemical/ telomers based on a perfluorohexane (C6) chain."

about 0.9–1.5%. Today most fire fighting foams are manufactured without PFOS, which has been replaced by fluorochemical/telomers based on a perfluorohexane (C6) chain.

The fire at Buncefield oil depot in 2005 increased concerns over the potential for PFOS to enter drinking water supplies as a result of discharges from fire-fighting activities. However, data from the Drinking Water Inspectorate indicted that the presence of levels in drinking water would not give rise to any concerns to human health.

Field et al. (2003) showed the presence of PFOS, PFOA and telomer sulfonate (from AFFFs used for training) in groundwater at three military sites in the USA (Naval Air Station Fallon Nevada, Tyndall Air Force Base Florida and Wurtsmith Air Force Base Michigan). At one of the sites where an aircraft had crashed and AFFF had been used, PFOS, PFOA and telomer sulfonate were still detected in the groundwater even after 10 years; as only a one-time application of AFFF had taken place this finding indicates the extreme persistence of these chemical in groundwater. Moody et. al. (2003) showed the occurrence and persistence of PFOS (as well as PFOA and 6:2 FTS) in groundwater at the Wurtsmith Air Force Base in north eastern Michigan as a result of fire-training exercises conducted from the 1950s until the air force base was decommissioned in 1993. Furthermore, Schultz et. al. (2004) reported high concentrations of 6:2 FTS, PFOS and PFOA in groundwater at training areas at Tyndall Air Force Base. Awad et al. (2011)

"... even a decade after an accidental release of fire fighting foam containing PFOS at Toronto International Airport, Canada, the presence of PFOS in water, sediments and fish were still detectable..."

showed that even a decade after an accidental release of fire fighting foam containing PFOS at Toronto International Airport, Canada, the presence of PFOS in water, sediments and fish were still detectable and, at some sampling locations, remained at elevated levels.

Exposure and Toxicological Overview

The main routes of exposure to PFOS and PFOA are via

Fig 3 The fire at Buncefield oil depot in 2005

inhalation of contaminated air or by ingestion of contaminated water or food. Both compounds are essentially non-volatile and the general public would not expect to be exposed via inhalation (Public Health England 2009). Potential pathways, which may lead to widespread exposure, include ingestion of food and water, use of commercial products

or inhalation from long-range transport (ATSDR 2009). Dietary intake is an important pathway of exposure to the general public to PFOS and

"They are well absorbed via the oral route and are very slowly eliminated from the body in humans."

PFOA. They are well absorbed via the oral route and are very slowly eliminated from the body in humans. The estimated half-lives for PFOS and PFOA in humans are 8.7 and 3.8-4.4 years respectively (OECD 2002). Toxicology studies show that PFOS and PFOA are readily absorbed after oral exposure and accumulate primarily in the serum, kidney and liver (EFSA 2008).

A range of toxic effects has been seen in animals following chronic exposure including effects on the liver, gastrointestinal tract and thyroid hormone levels. Neither PFOS or PFOA have any mutagenic properties. They have both shown to induce tumours in studies in animals at relatively high doses. A threshold can be assumed for the carcinogenic effects. There are no data available on the reproductive and developmental effects of PFOS or PFOA in humans. Developmental effects have been reported in the offspring of animals exposed to PFOS and PFOA (Public Health England 2009).

"Acute and intermediate duration oral studies in rodents raised concerns about potential developmental, reproductive and other systematic effects of PFOS and PFOA (ATSDR 2009). "

Acute and intermediate duration oral studies in rodents raised concerns about potential developmental, reproductive and other systematic effects of PFOS and PFOA (ATSDR 2009). Results of a study indicate that exposure to PFOS can affect the neuroendocrine system

"Both PFOS and PFOA have a high affinity for binding to B-lipoproteins and liver fatty acid-binding protein. Several studies have shown that these compounds can interfere with fatty acid metabolism and deregulate metabolism of lipids and lipoproteins."

in rats. Both PFOS and PFOA have a high affinity for binding to B-lipoproteins and liver fatty acid-binding protein. Several studies have shown that these compounds can interfere with fatty acid metabolism and deregulate metabolism of lipids and lipoproteins. The USEPA has not classified PFOS or PFOA as to carcinogenicity. The chronic exposure to PFOS and PFOA can lead to the development of tumours in the liver of rats; however more research is needed to determine if there are similar cancer risks for humans (USEPA 2012).

" ALcontrol Laboratories has expanded its testing services and can analyse 14 separate compounds, analysis can take place for both soil and water."

Laboratory Analysis

ALcontrol Laboratories has expanded its testing services and can analyse 14 separate compounds, analysis can take place for both soil and water. Testing can be ordered as a range of PFS compounds or as a reduced suite containing just PFOS and PFOA. In both cases analysis is by Liquid Chromatography, coupled to Triple Quadruple Mass Spectrometer (LC-QQQ) for accurate identification and quantification.

Future Research

In recent years, numerous publications appeared in which properties of PFCs are described; however these are generally limited to PFOS and PFOA. Data on short-chain PFCs that are apparently being substituted for longer chain molecules in industrial processes are limited. Because of their solubility in water and the increasing application and volume of use, these short-chain PFCs deserve further evaluation. ■

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USEPA 2012 Emerging contaminants PFOS and PFOA – Emerging contaminants fact sheet

*Writing for **theGeotechnica** this month is Willie Whitesmith of Gas Data Ltd. Gas Data Ltd design and produce portable and fixed gas analysis instrumentation. Here Willie introduces the new GFM 436.*

THE ANSWER TO ERRONEOUS READINGS FROM LANDFILL GAS ANALYSERS?

There are many gas monitoring devices available for engineers to measure the amount and type of gases which might be present in a landfill. A new device, the GFM 436 recently launched by Coventry based Gas Data, has introduced some exciting new features to measure the gasses present in the ground and also to check to ensure the information is not being corrupted by hydrocarbons.

The GFM436, has been designed to resolve a number of important questions posed during gas monitoring in the geoenvironmental industry, including interference by hydrocarbons which can produce erroneous results. It can monitor for methane (by vol and LEL), carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide.

The meter has the advantage of attempting to answer the question of unexpectedly high methane results being recorded when the Phase 1 desk study, and possibly the Phase 2 investigation suggests that methane should not be present. The GFM 436 allows the operator to switch to a second infra-red scale referenced to hexane.

Hexane closely matches the infra-red absorption characteristics of fuel and oil. Should significant readings be obtained on the hexane scale then the erroneous methane record might be explained by the presence of fuel. This can be verified using a PID meter on site with a head space test or by obtaining a bag sample for lab analysis to either confirm or exclude the presence of methane and/or hydrocarbons.

Conversely the GFM436 can also assist the use of conventional PID meters. PID meters have an inherent weakness in that their calibration is greatly affected by the presence of methane. The GFM436 can be used to arrive at a PID Compensation Factor which can then be applied to the PID readings to have them accurately compensated for the error caused by the presence of methane. This ability is of great benefit where PID meters are used in the control or remediation of fuel spills and the cleanup of petrol station forecourt sites.

”This ability is of great benefit where PID meters are used in the control or remediation of fuel spills…”

Like its predecessors the GFM436 can also define the physical parameters of the gas such as its pressure, flow rate and temperature. The flow can be measured either into or out of the monitoring borehole (bi-directional flow) and is displayed as two readings, one the instantaneous value, the other the peak value. A further function is the ability to indicate the precise difference between the gas pressure inside the borehole and Atmospheric Pressure, down to just a few pascals, this being measured whilst the gas is still flowing.

When monitoring on gas extraction sites there is sometimes a need to take readings from the vacuum pipes. For this, a high range static pressure channel is incorporated in the device to measure the vacuum at different points in the gas extraction system. Results obtained in this way can be used to assist in the setting of control valves and gas pumps, and enabling gas balancing.

It is often essential to measure other parameters. Using the connection port located on the top of the instrument optional external sensors can be added which can include a temperature sensor to measure the gas temperature, or, alternatively a vane anemometer to measure the velocity in a gas extraction system. These added sensors greatly improve the

versatility of the instrument and avoids the need of using several different instruments to record the required parameters.

A further very simple addition (requested by the industry) is the inclusion of a simple and basic system to manually enter other physical data required during the monitoring process, such as the water level within the monitoring point.

"Data and an alphanumeric identifying location codes are stored in the meter and using Gas Data's SiteMan 5..."

Data and an alphanumeric identifying location codes are stored in the meter and using Gas Data's SiteMan 5 software this can easily be transferred to a PC via a USB. Data can be exported in CSV or AGS format. In the field, data storage can be triggered manually or, the internal real-time clock can be programmed to take and store readings automatically whilst the instrument is left unattended to monitor gas levels round the clock in enclosed areas.

For ease of operator use the battery is user-exchangeable with the rechargeable Nickel Metal Hydride battery pack providing up to either hours field use and can be charged through a standard in-car 12V charger.

The GFM436 is the most compact and versatile gas meter of its type. The lightweight, small and robustly constructed meter is supplied with a weather resistant case and its features are highly focused to resolve site investigation problems relating to gases and hydrocarbons in the soil. The result is an instrument that gives the owner accurate measurements across many different parameters as quickly and as easily as possible. Gas Data have over 20 years' experience in producing gas analysers for both the Site Investigation and Waste to Energy markets. The similar GFM426, designed specifically for the Waste to Energy Sector, is soon to be launched. ■

PanGeo:

A FREE GEOHAZARD INFORMATION SERVICE FOR EUROPE

*Writing for **theGeotechnica** this month on behalf of the European Federation of Geologists is Professor David Norbury, Director of David Norbury Ltd. This month, Professor Norbury introduces PanGeo, a free geohazard information service for Europe that is achieved through the generation of validated geohazard data layers.*

PanGeo is a new remote sensing service which provides geohazard information in the urban environment. The unique service is already available online and is freely accessible to anyone with an interest in the effects of geohazards on the urban environment. The objective of PanGeo is to enable free and open access to geo-hazard information which is being achieved by the generation of a validated Geohazard Data Layer supported by a Geohazard Summary for 52 of the largest towns listed in the GMES Land Theme's Urban Atlas.

"The objective of PanGeo is to enable free and open access to geo-hazard information which is being achieved by the generation of a validated Geohazard Data Layer..."

The PanGeo project started in February 2011 and is scheduled to complete in February 2014 and will cover fifty two of the largest European cities across all 27 countries of the EU and covers approximately 13% of the EU population.

Which towns?

Any user can visit the PanGeo web-portal and see the cities for which attributed geo-hazard data with the Urban Atlas to highlight the polygons influenced is available, and view that information. Additionally, anyone who thinks that their city should have such a geo-hazard layer compiled should click on the 'PanGeo my town' button on the PanGeo web site and submit their request.

Which Geohazards?

Natural and man-made geohazards include high profile events as well as the long term effects of natural and man-made processes.

Figure 1 - Map of PanGeo towns and cities available (Green flags represent datasets complete and available).

"Geological conditions capable of causing damage, or loss of property and life, are called geological hazards..."

Geological conditions capable of causing damage, or loss of property and life, are called geological hazards and commonly referred to as "geohazards". PanGeo is specifically focused on geohazards relating to ground instability and mapping phenomena in the urban environment where there effect is most damaging. Ground movements (upwards, sideways or downwards) can be caused by a wide range of natural and manmade processes with some processes being so slow as to be imperceptible to the naked eye whilst others may cause large scale obvious movement in the ground. Whatever the "geohazard" they have the potential to severely damage urban infrastructure and buildings.

"... with some processes being so slow as to be imperceptible to the naked eye whilst others may cause large scale obvious movement..."

"In PanGeo ground stability geohazards are grouped into common classification themes..."

In PanGeo ground stability geohazards are grouped into common classification themes describing the broad scale processes at work:

1) Deep ground motions
- Earthquake (seismic) hazard
- Tectonic movements
- Salt Tectonics
- Volcanic Inflation/ deflation

2) Natural ground instability
- Landslide
- Soil Creep
- Ground Dissolution
- Collapsible Ground
- Running Sand/ Liquefaction

3) Natural ground movement
- Shrink-swell clays
- Compressible Ground

4) Man-made ground instability
- Ground water management - Shallow compaction
- Ground water management - Peat oxidation
- Groundwater abstraction

- Mining
- Underground construction
- Made ground
- Oil and Gas Production

"...information about these natural and man-made phenomena and their effects can be difficult to obtain."

5) Other
Geohazards in the built environment can be dangerous and costly, yet information about these natural and man-made phenomena and their effects can be difficult to obtain. PanGeo aims to improve this by making geohazard information available online.

Development of the geohazard layer in PanGeo uses interpreted InSAR terrain-motion data, geological information, and the landcover and land use data contained within the Urban Atlas. This is presented as Ground Stability Layer (GSL) maps, using vector polygons, which covers all areas of a given town that are affected by terrain motion. This is supported by a Geohazard Description document (GHD) which describes the geological reasons for the perceived motions. The products are based on information provided by European radar satellites detecting terrain motions over whole cities to millimetric precision using Persistent Scatterer Interferometry (PSI). The imagery is expertly interpreted by satellite data providers and analysed by the individual geological surveys who incorporate geological and any other available topographic, hydrological and infrastructure data to validate the satellite information.

"The imagery is expertly interpreted by satellite data providers and analysed by the individual geological surveys..."

"PanGeo provides a unique and widely available service."

What output?
PanGeo provides a unique and widely available service. A number of examples with a range of geological hazards such as mining, underground tunnelling, Made Ground, ground water abstraction, compressible ground and volcanic uplift have been identified and emphasise the importance of the service and how the products have improved knowledge in local areas. Examples from London and Rome are shown below.

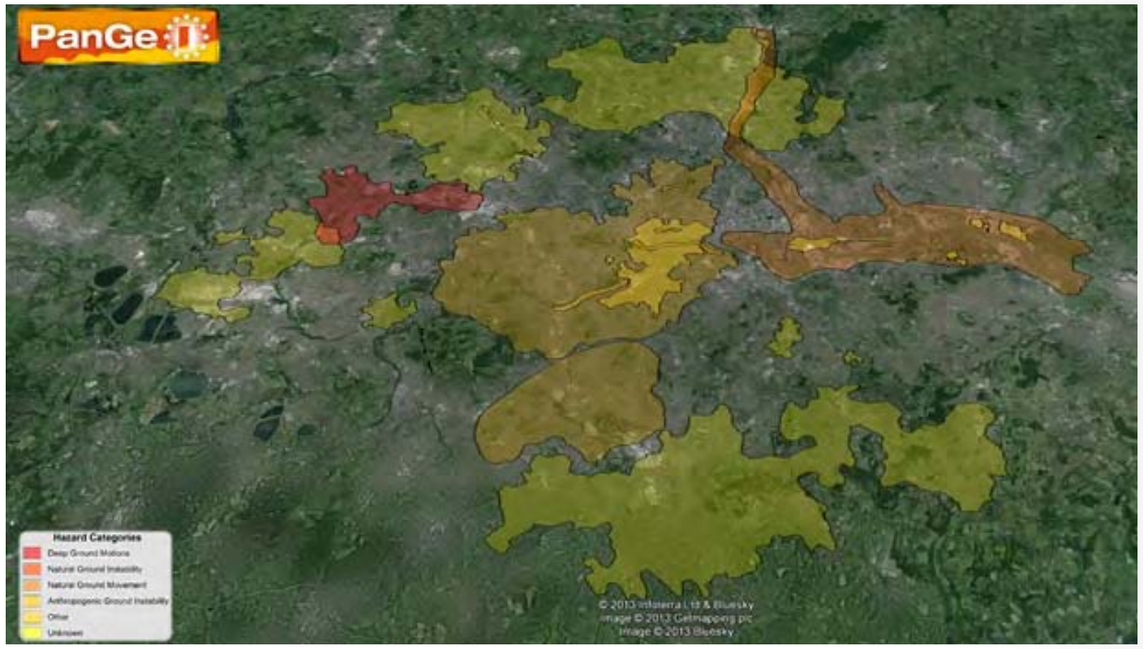

Figure 2 Ground Stability Layer for London.

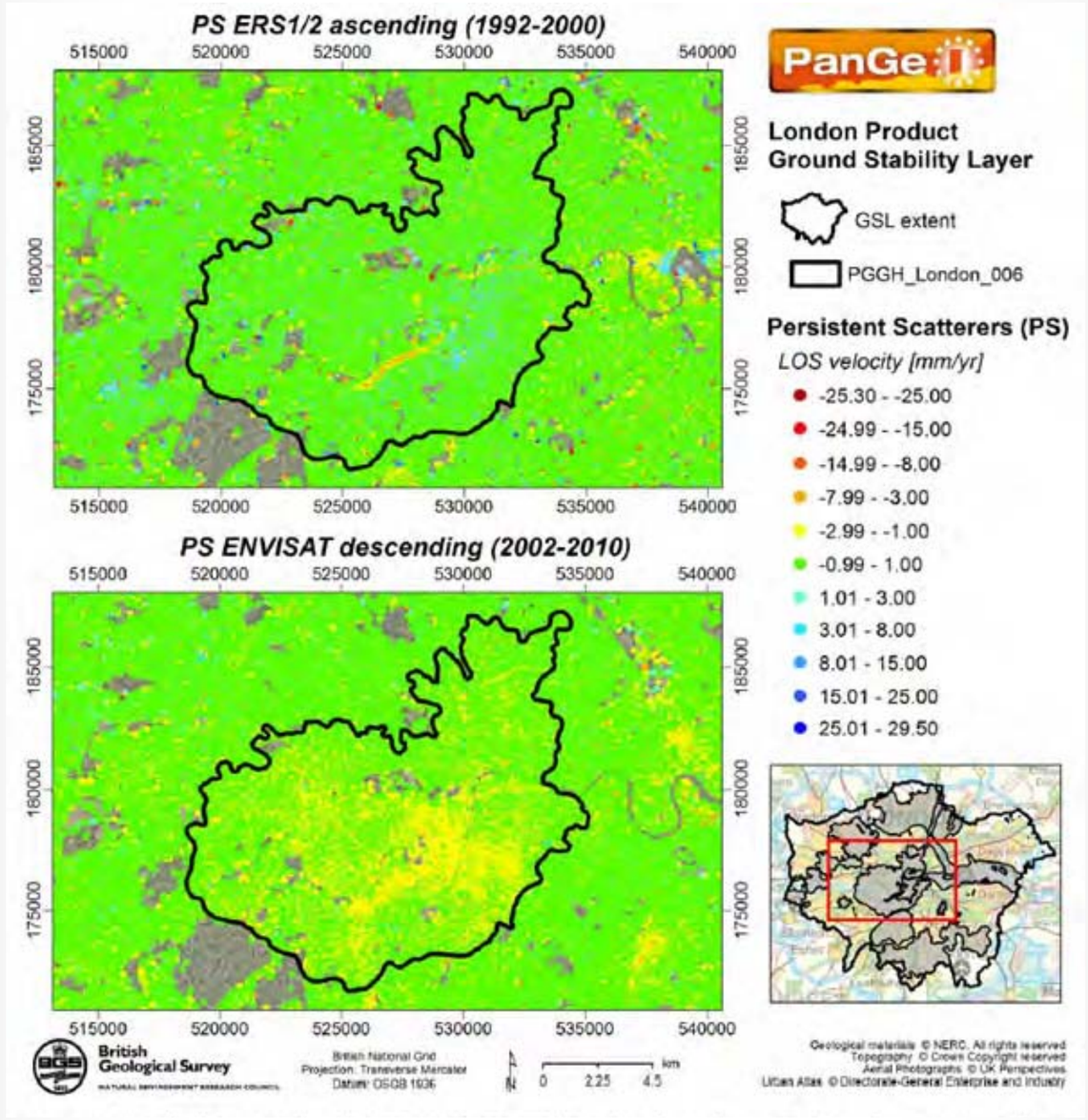

Figure 3 Extract from GHD layer showing measured ground movements in London

To see more coverage and to zoom in on the results, visit the project web site.

"Access to the information in PanGeo has been designed to be simple, intuitive and useful..."

Access to the information in PanGeo has been designed to be simple, intuitive and useful to both the non-specialist and expert alike. The products are made available on the PanGeo website (www.pangeoproject.eu) and can be viewed using Google™Earth visualisation.

In Rome, the Geological Survey of Italy (ISPRA) in collaboration with the Urban Planning Department of Roma Capitale has developed a detailed geohazard map of Rome. Thirty one areas of geological hazard, divided between observed and potentially dangerous geological hazards have been identified which have improved the knowledge

"Thirty one areas of geological hazard... have been identified..."

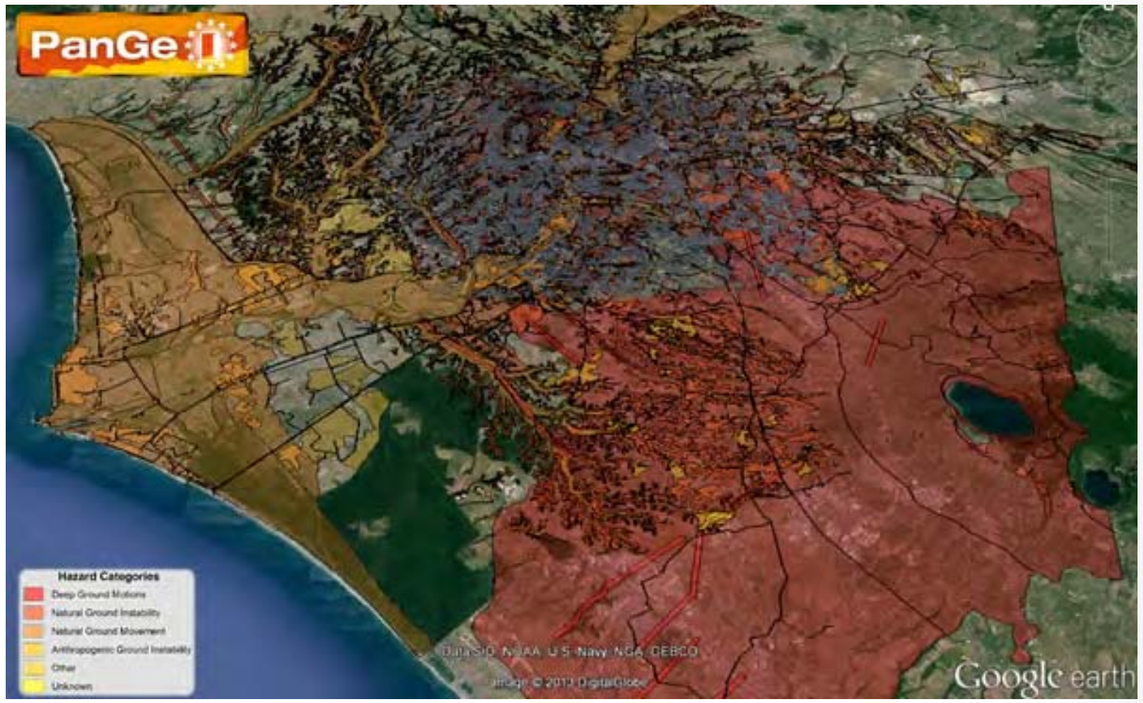

Figure 4 Ground Stability Layer for Rome.

"PanGeo has provided a positive stimulus for developing critical knowledge of geohazards and the practical applications for better management of the urban environment."

of geohazards within the Roma territorial municipality. A quote from Roma Capitale states that "PanGeo has provided a positive stimulus for developing critical knowledge of geohazards and the practical applications for better management of the urban environment."

Who benefits?
The standardised Pan European online geohazard information service benefits people in many different ways:

- Citizens will be better informed as to the stability of the ground in these areas;
- Local Authority departments, who are responsible for building and development, will have the capability of making better informed decisions with building controls;
- Policy makers will gain a better understanding of the Social-Economic effects of geohazards across Europe in general;
- Geological surveys benefit from increased collaboration with local authorities and associated geotechnical services departments.
- Within Commerce, Insurance and Property Conveyancing organisations

"These requirements become more onerous as Cities expand..."

are likely to be drawn to using PanGeo as the service licence, unusually, allows free commercial use of the product. These requirements become more onerous as Cities expand, resources become scarce and people are forced to live in hitherto unstable environments.

For more information visit the project site www.pangeoproject.eu.

Acknowledgement - This study is part of the PanGeo project funded within the 7th European Framework Programme (FP7-SPACE-2010-1 Grant agreement: 262371).

THE BENEFITS OF AUTOMATING CONSOLIDATION TESTING

*Writing for **theGeotechnica** for the first time this month is VJ Tech's Adrian Rose. In his debut article Adrian discusses the benefits of automatic consolidation testing.*

The traditional method of consolidation testing involved a Manual Oedometer with a yoke assembly and one of three alternative beam ratios. Consolidation readings are made visually and recorded against time for each of the required loading stages. This method required the laboratory technician to be on hand to add the loading weights, and record the consolidation data when required throughout the test. The weights are required to be identifiable and calibrated periodically.

Semi-Automation

With the advent of electronic data loggers and the Clisp Studio csODO software module, consolidation data could be recorded automatically at specified intervals throughout the test, however this still required the laboratory technician to be present to add or remove the loading weights when necessary.

Full Automation

VJ Tech have now introduced the ACONS (Automatic Consolidation System) to the market, full automation is achievable because the loading is applied pneumatically rather than using dead weights. The entire test can be set up in the Clisp Studio csODO software and once the ACONS system has been configured for the required loading increments, the test can be started and run to completion. As many load increments as required can be set up and run unattended thus reducing testing times, without the intervention of the Laboratory Technician.

"With Clisp Studio, a number of ACONS can be daisy chained together so that multiple Tests can be run simultaneously and independently."

With Clisp Studio, a number of ACONS can be daisy chained together so that multiple tests can be run simultaneously and independently. The ACONS has a smaller footprint than conventional dead weight systems thus saving space in the laboratory. Health and Safety issues in the laboratory are improved because there is no requirement for heavy weights to be lifted. This is of huge benefit to commercial laboratories because tests can be run much more quickly and efficiently, without the laborious addition of weights. Because no intervention is required, the laboratory technician(s) are free to perform other duties.

The consolidation readings can be recorded automatically using a data logger or a junction box connected to the computer running Clisp Studio. Live Data Views, graphs of time settlement can be viewed and tables of results may be compiled. Values for t50 and t90 can be calculated on the final graphs either using the computer generated analysis or if required by the operator choosing the best curve fit. The results can be output in standard presentation reports and/or exported in various formats for manipulation in external data manipulation packages. The entire test setup can also be saved and rerun at a later date if required. The programme has full flexibility allowing either an assumed Particle Density to be used to calculate the voids ratio or the user may enter the calculated value for greater accuracy.

"Values for t50 and t90 can be calculated on the final graphs..."

The ACONS has a large LCD graphics display, a simple 16 keypad panel and on-board calibration and linearisation for Local control if required. Multiple loading (and unloading) sequences can be set up and data logged at user specified intervals.

Recent Developments

The ACONS2 launched recently, was specifically designed by VJ Tech to make things even easier for completely automated consolidation testing by using a stepper motor to generate the loading, thus removing the need of a compressed air supply. The ACONS2 also supports Constant Rate of Strain (CRS) testing by using the stepper motor to control the strain rate. The principal asset of the ACONS2 is that it is Wi-Fi enabled, thus permitting remote control from a PC or laptop, running Clisp Studio csODO software and by avoiding lengthy cables the quality of sensor readings is improved. The optional 7" touchscreen colour display comes pre-loaded with an App, allowing remote control of the ACONS2 (via Wi-Fi) and can be attached magnetically to the instrument for control and status readout. ■

"The principal asset of the ACONS2 is that it is Wi-Fi enabled..."

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