

Executive Summary

Specific Contract under the Framework Service Contract 89/PP/ENT/2011 – LOT 3

**Assessing the Economic Value of Copernicus:
“The potential of Earth Observation and Copernicus Downstream
Services for the Non-Life Insurance Sector”**

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1 CONTEXT

This document represents an annex to the report of the “**European Earth Observation (EO) and GMES Downstream Services Market Study**”, performed under the first Specific Contract of the Framework Service Contract 89/PP/ENT/2011 – LOT 3 (“Support to GMES related policy measures”).

It contains a high-level summary of key findings of the analysis of the potential market value for European Earth Observation and GMES¹ downstream services for the Non-Life Insurance sector.

As highlighted in the main report, the study and sectorial analysis is subject to a set of key assumptions and enabling factors, reported in the following chapter.

2 KEY ASSUMPTIONS AND ENABLING FACTORS

The study is subject to the following **key assumptions**:

1. **Catalytic effect of free and open data provision²**: Copernicus services are expected to enable and stimulate the downstream sector by freely and openly providing access to basic pre-processed data and modelling outputs, more cheaply than would be the case if companies had to undertake such basic processing and modelling themselves. The business case for Copernicus is that the services improve the efficiency of the downstream sector, allowing the industry to offer better value for money in products and services to end users.
2. **Full and assured continuity of Copernicus**: In order for the potential of future markets for Earth Observation downstream services to be realised, the continued long-term availability of Copernicus data services is assumed. The investment incentives are crucially tied to both political and financial commitments at an institutional level. This continuity of services presupposes the continuity and evolution of Copernicus infrastructure providing the necessary data. Without continuity, the "raison d'être" of Copernicus is put into question, as users will only rely on Copernicus if a sustained flow of data is ensured. Without appropriate funding, existing services will cease their activities.

Furthermore, a set of **enabling factors** has been identified, on which action and associated investments are considered necessary for the realisation of downstream market potential. Certain institutional conditions are necessary to enable and accelerate the market dynamics foreseen in this study, linked, *inter alia*, to market development and capacity building. They are summarised below:

- a. **Regulation**: Free and open data policy; assurance of data continuity; quality assurance and standards-building.
- b. **Data Availability and Access**: Simplified access to Copernicus Sentinel datasets at ready-to-use processing levels (L1)³ for high-volume distribution, thereby responding to the needs of the value-adding industry, ideally avoiding the duplication of efforts at national level.

¹ GMES will hereafter be referred to as Copernicus, following the recent decision by the European Commission to change the name of the programme (as per http://europa.eu/rapid/press-release_IP-12-1345_en.htm).

² This refers, in the first instance, to data derived from the COPERNICUS family of dedicated satellites, the Sentinels. The transitory phenomenon of Contributing Mission data will be dealt with in a follow-on study on the midstream, scheduled for 2013.

³ Level 1 (L1) includes geometric and radiometric pre-processing.

- c. **Demand/Market:** Continued dissemination efforts; regional/local demand incubation and communication schemes aimed at commercial users; federation / consolidation of user needs and industry requirements; further integration of EO information as a supplement to traditional systems.

Examples of relevant enabling activities, which already exist in Europe, include:

- Tools for Copernicus Sentinel data pre-processing, which are already being piloted in selected Member States.
- The provision of support to the promotion of Space applications-related ideas (e.g. GMES Masters) and business incubators.
- Easy access to credit for entrepreneurs willing to invest in the value-added service sector.
- Support to training programmes in geospatial sciences to ensure availability of necessary talents for these applications.
- The building of networks and the organisation of dedicated events to consolidate user needs and industry requirements.

These activities should be built upon, extended and promoted in order for the full potential of the market to be realised. Under the EU's Horizon 2020 strategy, "*it is expected that around 15% of the total combined budget for all societal challenges and the enabling and industrial technologies will go to SMEs*"⁴.

3 INTRODUCTION TO SECTORAL ANALYSIS

More frequent extreme weather and catastrophic events are putting new requirements on the Non-Life Insurance industry in terms of pre- and post-event preparedness. The steadily increasing spatial and temporal coverage of satellite data could play an important role in saving costs and introducing efficiencies into insurance business processes. Remote sensing information can substantially improve the accuracy of catastrophe models and damage assessments, thus helping insurers to improve their risk management and claim management processes.

Insurance as a whole is a complex and multi-faceted sector, and whilst this report focuses only on the non-life (primary) insurance sector, it should be pointed out that many of the benefits of Earth Observation data are also relevant to re-insurance companies (see, for example, NERC (2012) and ESA (2004)).

The re-insurance sector tends to focus on peak risks⁵ underwritten by primary insurers (IAIS, 2012), which are purchased as portfolios ("books of business"), and seeks to pool uncorrelated and diversified risks in order to hedge against exposure to a single type of catastrophe or geographical region. The sector is therefore likely to be interested in data which are global in scope and which address a wide range of natural catastrophes. It is worth noting that primary insurers with wide geographical coverage will share these requirements.

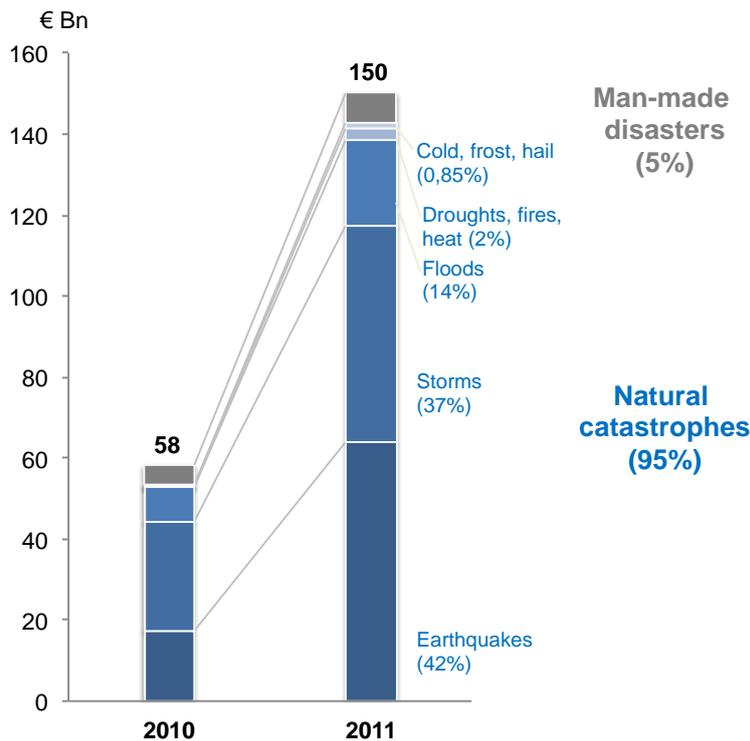
⁴ COM (2011) 808, final, p. 10.

⁵ Peak risks refer to high-impact, low-probability events such as hurricanes, earthquakes and tsunamis,

4 THE NON-LIFE INSURANCE INDUSTRY: TRENDS AND CHALLENGES

4.1 Recent trends

In recent years, natural catastrophes and man-made disasters have resulted in increasing losses for the Non-Life Insurance sector. In 2011, the earthquake in Japan, caused € 150 Bn insured losses, the second highest amount on record since 1970, according to annual industry data collected by Swiss Re.



Sources: Swiss Re (2012), STP Analysis

Figure 1: Total Insured Losses 2010-2011, World (Swiss Re, 2012a)

As far as Europe is concerned, the number of natural hazards has taken an upward trend since 1980, largely due to the continuous increase of meteorological and hydrological events. Technological accidents such as oil and toxic spills decreased significantly, partly because of stricter legislation and controls (EEA, 2011). From 1998 to 2009, natural disasters caused insured losses of more than € 35 Bn, most of which were caused by either floods or storms (Figure 2).

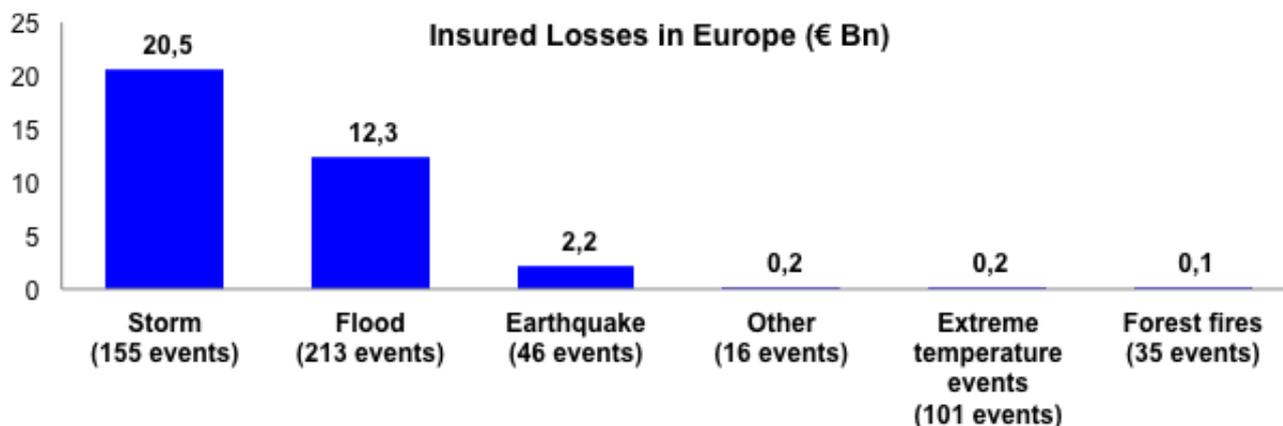


Figure 2: Insured Losses for Disastrous Events by Hazard Type, 1998-2009, Europe (EEA, 2011)

4.2 Challenges

There is some evidence that climate change is contributing to the increased frequency and intensity of weather-related natural catastrophes, and it is anticipated that these climate change effects could further intensify in the future (EEA, 2011).

Emerging countries, located in areas vulnerable to catastrophic events, are increasingly connected to the global economy. Simultaneously, they often have insufficient risk prevention and mitigation measures, a fact which implies higher economic damages in cases of crisis events. The 2011 flood in Thailand, for instance, triggered an estimated € 16 Bn in insurance claims, mainly on the basis of damage to commercial properties and interruption to commercial activity.

The Non-Life Insurance industry is faced with the challenge of assessing the risks associated with these systemic physical and social changes in a more holistic way. Global, continuous and reliable Earth Observation information can be crucial in integrating financial models with hazard models (event size and frequency), exposure information (distribution of exposed business / capital) and vulnerability models (expected behaviour given an event).

In addition, a new EU legislative framework (Solvency II) is due to come into effect in 2014. This directive concerns the amount of capital which EU insurance companies must hold, aiming to reduce the risk of insolvency. The implementation of this directive is a challenge across the industry.

5 THE POTENTIAL USE AND BENEFITS OF EO DOWNSTREAM SERVICES

5.1 Use of EO information along the value chain

The core functions of EO data in the Non-Life Insurance value chain (Figure 3) are:

1. **Calibration and validation** of existing risk models in the underwriting phase (pre-event);
2. **Supplementing and augmenting** existing information in the claims management phase (post-event).

Non-Life Insurance Value Chain and EO Contribution



Figure 3: The Role of EO Data in the Non-Life Insurance Value Chain

In the risk management phase, the insurance sector typically relies on Catastrophe (CAT) models to:

- Manage and evaluate the capacity to take risk;
- Rate the catastrophe exposure and price the catastrophe risks;
- Calculate the accumulation of risks on different perils and regions;
- Calculate the reserves in case of a loss, and check the capacities;
- Minimize the amount of capital required to cover portfolio risks, and transfer risk.

Insurance companies have to examine a wide range of scenarios and combine various forms of data in assessing the risk of future disasters, in an effort to identify potential hazards. The main components of a CAT model are illustrated in the following diagram:

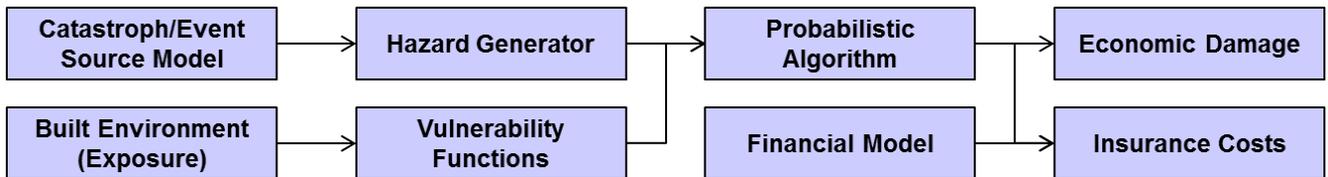


Figure 4: Components of a CAT Model

Examples of specific applications of EO information in the risk management phase are shown in the following table.

Insurance product	Measurements required
Flood risk and impact forecasting in the Property sector	<ul style="list-style-type: none"> • Digital elevation • Flood defences • Land use
Revenue Guarantee – Wind Volume Forecasting for the Renewable Energy sector (wind farms)	<ul style="list-style-type: none"> • Forecast of wind strengths exceeding threshold for maintenance • Forecast of wind strength that could result in physical loss or damage • Correlated historical records (10 years minimum)
Fire insurance for the Forestry sector	<ul style="list-style-type: none"> • Forest vigour and health • Hot spots / wildfires location intensity and extent • Soil and ground fuel moisture • Forestry boundary / location identification
Multi Peril Crop Insurance for the Agricultural sector (Loss forecasting and risk rating)	<ul style="list-style-type: none"> • Planted and harvested areas by crop/type • Crop development • Agronomic conditions • Soil moisture deficit • Weather events (hail, flood, drought, frost)

Table 1: Examples of EO Applications in the Risk Management Phase (AON, 2004)

In the claims management phase, it is important for the insurer to respond efficiently and quickly, completing the claims process in the minimum time. Any unnecessary delay in settling claims has cash flow implications for the insured, and complicates compliance procedures for insurers. The insurer therefore needs to perform timely post-event damage assessments. These assessments can be performed based on accurate and easily accessible EO maps covering the affected region. The following table shows examples of EO measurements that are useful in the claims management phase.

Insurance product	Measurements required
Earthquake –claims management in the Property sector	<ul style="list-style-type: none"> • Ground movement (pre and post event) • Building damage (by house / area) • Soil and vegetation movement
Fire loss or damage in the Forestry sector	<ul style="list-style-type: none"> • Exact time of fire that affects insured forest • Cause or source of fire • Damage boundaries / location identification • Damage rating by species • Salvage index
Multi Peril Crop Insurance for the Agricultural sector	<ul style="list-style-type: none"> • Cause of damage • Timing and duration of insured loss event • Estimation of loss (% yield or actual crop volume) • Harvested areas as well as planted areas
Oil / chemical spill – Pollution assessment in the Marine sector	<ul style="list-style-type: none"> • Cause, location and scale of spill • Nature of chemical(s) • Movement of spill • Location of coast line and threatened assets

Table 2: Examples of EO Applications in the Claims Management Phase (AON, 2004)

5.2 Benefits of EO information

The potential value of Earth Observation information for insurance applications is gradually beginning to be recognised within the sector. The key areas of potential benefit from the use of EO information within the insurance industry are summarised in the table below.

Cost and loss reduction	<ul style="list-style-type: none"> • Reduced insurer losses through improved forecasting of scale, frequency and intensity of natural events, and hence better pricing • Reduced administration and operational costs by providing better measurement and monitoring of exposure
Improved profitability	Reduced frictional costs of risk transfer and improved profitability of insurers by reducing fraudulent claims, post-event
Competitive advantage	Exposure and event loss data can be used to support portfolio optimisation, reinsurance purchasing and capital reallocation.
New markets and products	<ul style="list-style-type: none"> • Increased geographic penetration of insurance in developing countries • Expansion of the range of insurance products available

Table 3: Benefits of EO for the Insurance Industry (AON, 2004; Bally, 2012; PERILS, 2012)

Cost reductions are made possible by improved, more accurate exposure monitoring. Improved forecasting enables companies to set annual premiums with better accuracy, allowing losses incurred in one year to be recouped in the years which follow, and mitigating against future losses in the event of another catastrophe.

Earth Observation data can play a key role in enabling the development of new risk transfer products, such as catastrophe bonds and parametric insurance products. With these products, payout is based on modelled losses, measured parameters or calculated indices. Flood-related EO data, for example, has been cited as a high-potential enabler of such products, although there is currently a lack of reliable EO information on which indices and parameters can be based (Swiss Re, 2012b).

Another new market possibility is index-based insurance products, particularly for developing countries where ground-based weather measurements are scarce, inconsistent or difficult to maintain. Remotely-sensed data provides the potential for generating indexes (such as vegetation indices, rainfall estimates, soil moisture and evapotranspiration) over large geographical areas, to which index-based insurance products can be linked (IFAD, 2012).

6 DOWNSTREAM MARKET FORECAST

6.1 Relevant statistics and parameters

The present study used Eurostat's NACE⁶ taxonomy as a basis for the identification of potential industrial application areas for Copernicus downstream services. The relevant statistical data for the Non-Life Insurance sector was drawn from Eurostat's Structural Business Statistics.

The information available for the sector includes the number of enterprises, the number of employees, the industry turnover, and the purchases of goods and services. These formed key inputs to the study and are summarised in the table below (

Table).

A relevant measure of efficiency in risk management policies is the **claims ratio** (total claims and benefits disbursed over Gross Premium Written, or GPW). The lower this ratio, the better: higher claims ratio may indicate that an insurance company needs better risk management policies to guard against future possible insurance pay-outs. As far as Europe is concerned, the average claims ratio was 66% in 2007 (Eurostat). In the period 2006-2009, this ratio has been growing in the main European countries, both because Gross Written Premiums dropped due to the financial crisis, and because claims for natural disasters have been significant. In 2010, however, the claims ratio has decreased, because premium volumes grew and fewer natural disasters occurred overall (Capgemini, 2012).

Relevant sector figures are summarised in the table below.

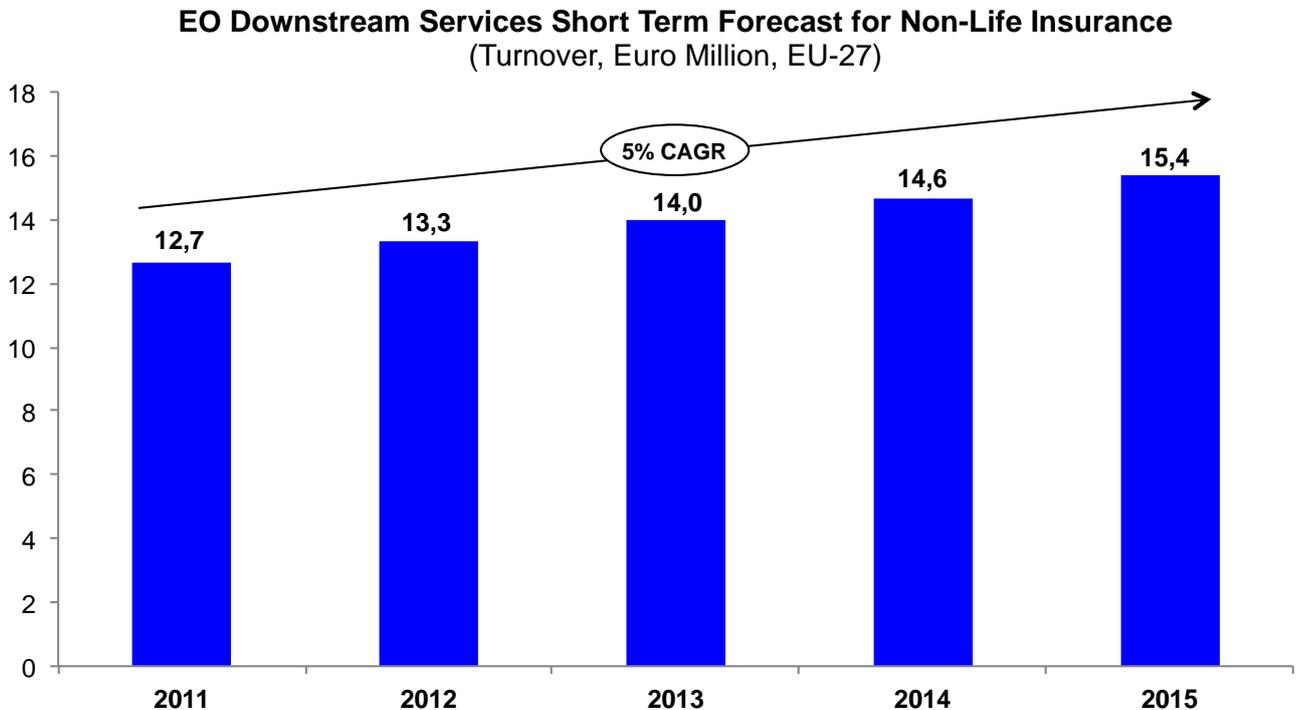
Number of enterprises	2.710
Number of employees	457.605
Turnover	€ 276 Bn
Purchase of goods and services	€ 36 Bn
Gross Premium Written	€ 264 Bn
Gross Claim Payments	€ 174 Bn
Average Claims ratio	66%

Table 4: Relevant Statistics for the Non-Life Insurance Sector in Europe (Eurostat, 2007)

⁶ NACE is a standardised classification system for describing economic sectors and their activities in the European Union. The second revision of the NACE taxonomy has been used in this study. The most recent information on this sector was available for the year 2007, for a subset of Member States. This was extrapolated to EU-27 by means of Member States' percentage contribution to total EU GDP.

6.2 Market forecasts

The European market for commercial applications of EO downstream services in the Non-Life Insurance sector is estimated to be approximately € 13 million in 2011 and € 15 million in 2015⁷.



Sources: Eurostat, VEGA, EC, Euroconsult, STP Analysis
Missing data for seven Member States were extrapolated using their relative GDP as a weighting

Figure 5: Short Term Market Forecasts for EO DS in the Non-Life Insurance Sector

The long-term market potential for the sector has been assessed through the concept of the Total Addressable Market (TAM). This concept expresses hypothesised market penetration, under specific assumptions and within certain limitations. It serves as a metric of the underlying revenue potential of a given opportunity, and should be treated as a “bounded theoretical maximum”.

The estimated EO Downstream Services Total Addressable Market for the Non-life Insurance sector amounts to approximately € 74 million⁸.

⁷ The 2011 market size has been computed using the Eurostat data on Total purchases of goods and services and by assuming that the 0,029% of these purchases consist of EO value-added services; this assumption is based on the current cross-sectoral average. The 2015 estimate is computed by applying a 5% Compound Annual Growth Rate (CAGR) to the 2011 market size (Euroconsult).

⁸ The TAM has been estimated using the following parameters: (Risk Management costs for the sector) x (Percentage of Risk Modelling costs spent) x (EO VAS potential adoption rate).

7 IMPACT OF COPERNICUS DATA AND SERVICES

The market for EO value-added services for the Non-Life Insurance sector is still limited. The Copernicus programme, by providing free, open and easily accessible EO information, can assist in overcoming some of the factors that inhibit the widespread use of EO information to improve risk modelling and claims management. The following table showcases the contribution of the Copernicus programme in enabling the development of the market for EO services in the sector.

Obstacle	Copernicus enabling capacity	
Data costs The cost of licensing sufficient data for an entire country or region at a high resolution is often prohibitive.	3	Copernicus will provide EO information according to an open, free and full data policy
Availability/coverage Consistent national data sets are not always available for every territory covered by a global insurance programme.	3	Copernicus will ensure timely and continuous monitoring of the entire planet
Accessibility There is lack of knowledge with regard to what data is available and where to access it. From a user perspective, it is difficult to know who to approach and what is being offered.	3	Copernicus will offer to users an integrated system of EO information easily accessible on web portals
User-oriented products Further research is needed to develop the tools to extract relevant information from EO data	3	Copernicus services develop mapping products and forecasting models
Industry conservatism Senior decision makers need to be convinced of the value of the purchase prior to purchase	2	Copernicus will raise awareness about EO opportunities through user uptake initiatives
Data quality/resolution Insurance applications of EO tend to make use of data from platforms designed for other purposes. High resolution and horizontal/vertical accuracy needed especially for flood insurance	2	Together, the Sentinels and national EO missions will provide extensive coverage, offering wide-field imagery with high temporal revisit and various resolution options.
Legend: 1 Low contribution; 2 Medium contribution; 3 Medium-high contribution; 4 High contribution		

Table 5: Obstacles (AON, 2004) and the Enabling Capacity of Copernicus

8 CASE STUDY

An interesting Copernicus downstream service with important implications for the insurance sector is the **PanGeo** service, a geohazard⁹ mapping service covering 52 European towns. The service, funded by the FP7 Space Programme, provides ground motion data along with expert interpretation of hazards, land cover information and population statistics.

Remote sensing maps can reveal the relative displacements to millimetre precision of millions of surface features (e.g. curb stones, sides of buildings, pylons). These movements can account for billions of euros of damage and costs to the economy each year (Capes, 2011).

Motion histories can be computed from 1991 (thanks to ESA's archive of radar images based on ERS-1 satellite). The archive's continuance is assured by the forthcoming Sentinel 1 radar satellite mission, scheduled for launch in 2013.

The example image below shows a map of the average movement of London over a 10 year period. The red colours indicate movement away from the satellite and blue colours movement towards the satellite. Green and yellow colours represent stability.

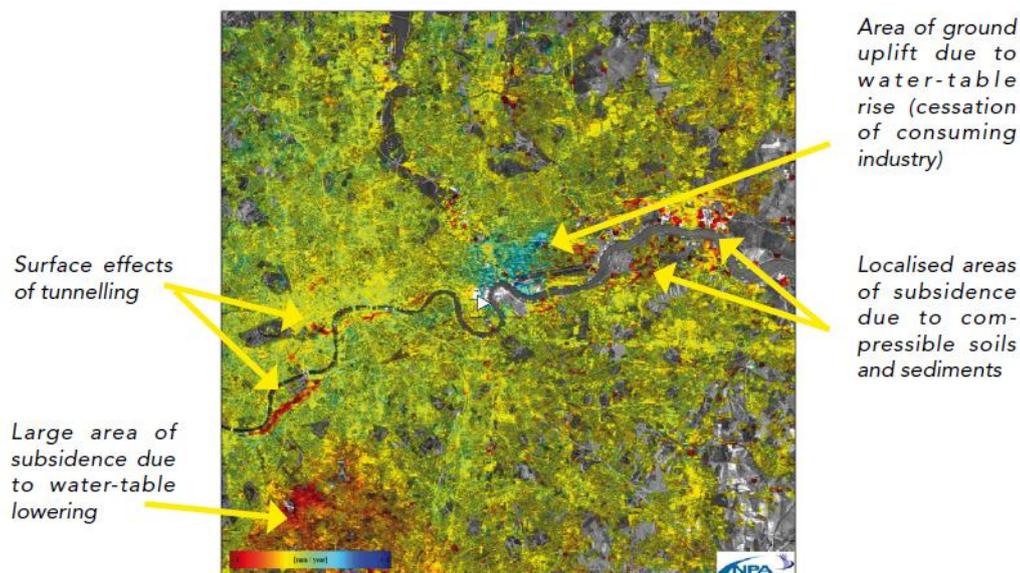


Figure 7: Average Annual Ground Movement, London (Fugro NPA)

The service is made available to users entirely free of charge for the duration of the PanGeo project, i.e. until February 2014. After this time, it is anticipated that sustainability will be achieved through Member State investment, as per the PanGeo website:

“It is trusted that sustainability of PanGeo will be achieved by attracting a proportion of the remaining 253 Urban Atlas towns to procure the PanGeo service for their towns. The service that will already be provided in their country will form the basis of the required promotional activity.”

(http://www.pangeoproject.eu/eng/project_overview)

⁹ Geohazards are natural or man-made phenomena that make the ground unstable.

The service comprises an online viewing tool showing where geohazards are located in each town. Geohazard location maps and interpretations are easily downloadable as stand-alone files to be used in the user's own Geographic Information System. The Figure 7 shows how PanGeo maps are made.

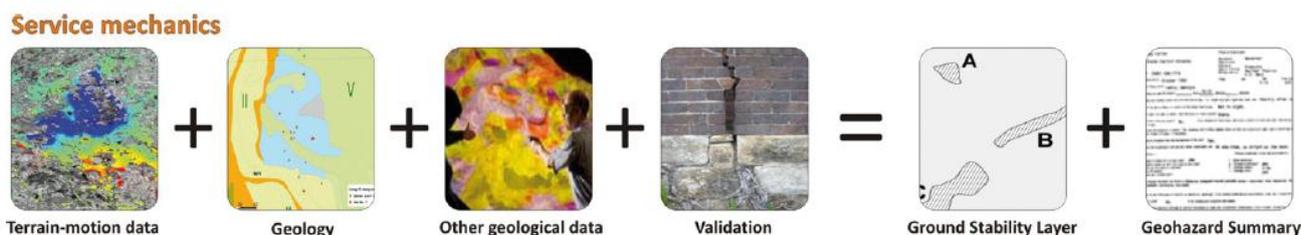


Figure 8: PanGeo Production Process (PanGeo project consortium)

9 CONCLUSIONS

More frequent extreme weather events are putting new requirements on the Non-Life Insurance industry in terms of pre- and post-event preparedness. Due largely to the earthquake in Japan in 2011, insured losses reached € 150 Bn, the second highest on record since 1970. As far as Europe is concerned, the number of natural hazards has followed an upward trend since 1980, largely due to the continuous increase of meteorological and hydrological events.

Earth Observation information has the potential reduce costs and losses, improve profitability and competitive advantage, and open up new markets and product lines for the insurance sector. EO information can substantially improve the accuracy of catastrophe models and damage assessments. The improvements to risk management and claim management have a direct cost reduction impact, both in reduced losses, in the longer-term, through improved forecasting (leading to more accurate premium-setting) and reduced administrative and operational costs. EO data can improve the profitability of insurers by reducing fraudulent claims post-event, and can increase the geographic penetration of insurers in developing countries. It can also play a key role in enabling the development of new risk transfer products, such as catastrophe bonds and parametric insurance products.

The European market for commercial applications of EO downstream services in the Non-Life Insurance sector is estimated to be approximately € 13 million in 2011 and € 15 million in 2015. The estimated EO Downstream Services Total Addressable Market for the Non-life Insurance sector amounts to approximately € 74 million. The fulfilment of market potential and the time required for this potential to be fulfilled are subject to a set of important enabling factors:

- Regulatory factors, including a free and open data policy and assurances of data continuity;
- Supply side factors such as data processing, access and availability;
- Market development activities, such as out-reach and user engagement and federation and consolidation of user needs and industry requirements.

The PanGeo project is a good example of how a service funded and developed under the Copernicus programme can have important downstream applications for the insurance sector.

10 RELEVANT LITERATURE

- AON (2004), Earth Observation Responses to Geo-information Market Drivers, Insurance Sector Summary Report (http://www.eomd.esa.int/files/docs/131-176-149-30_20041213142010.pdf)
- Bally (2012) (ed.), Scientific and Technical Memorandum of The International Forum on Satellite EO and Geohazards, 21-23 May 2012, Santorini Greece
- Capgemini (2012), World Insurance Report, (<http://www.capgemini.com/insights-and-resources/by-publication/world-insurance-report-2012/>)
- Capes R., (2011) PanGeo: monitoring ground instability for local authorities, Special Issue of Window on GMES (Discover what GMES can do for European regions and cities), p. 94 (http://copernicus4regions.eu/publications/window-on-gmes-en/at_download/file)
- EEA (2011), Mapping the impacts of natural hazards and technological accidents in Europe, Technical Report No 13/2010 (<http://www.eea.europa.eu/publications/mapping-the-impacts-of-natural>)
- ESA (2004) Risky Business - EO for Insurance and Reinsurance (<http://www.eomd.esa.int/news.php?id=195>)
- Euroconsult (2011) Satellite-based Earth Observation: Market prospects to 2020
- IAIS (2012) Reinsurance and Financial Stability (http://www.iaisweb.org/view/element_href.cfm?src=1/15854.pdf)
- IFAD (2012) Weather index-based insurance for agricultural development: Can satellite data advance the sector? Presentation given at European Space Solutions conference, London, 3-5th December 2012 (www.space-solutions.eu/index.php?anzeige=financial.php)
- NERC (2012) Transforming the insurance industry (<http://www.nerc.ac.uk/business/casestudies/documents/cs-insurance-industry.pdf>)
- PERILS (2012), Satellite Flood Footprints for the Insurance Industry. Presentation given at European Space Solutions conference, London, 3-5th December 2012 (www.space-solutions.eu/index.php?anzeige=financial.php)
- Swiss Re (2012a), Natural catastrophes and man-made disasters in 2011, Sigma No 2/2012 (<http://www.swissre.com/sigma/>)
- Swiss Re (2012b), Flood Footprint Product for the insurance industry: New business models and partnerships to grow the use of satellite data. Presentation given at European Space Solutions conference, London, 3-5th December 2012 (www.space-solutions.eu/index.php?anzeige=financial.php)