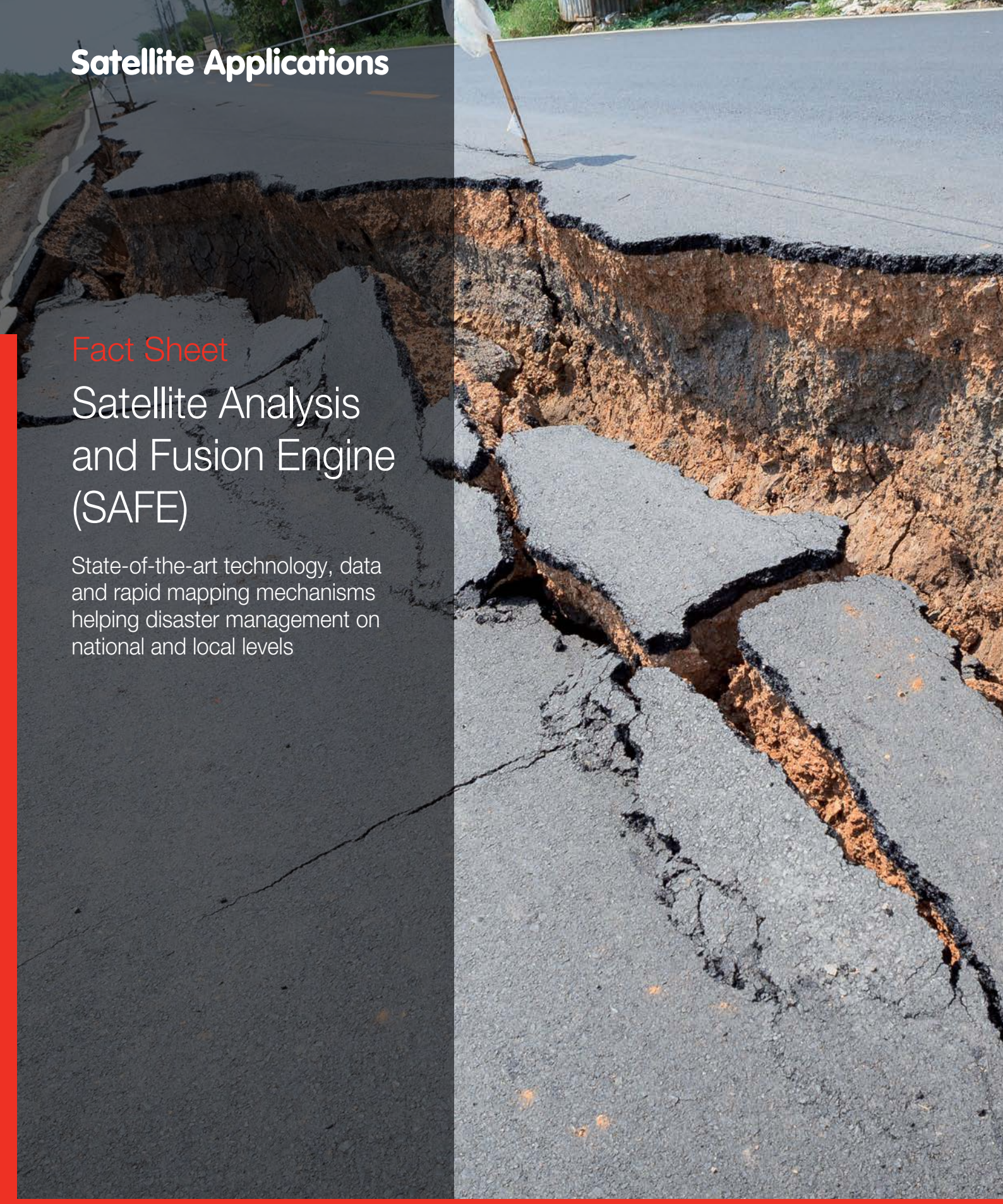
Satellite Applications



Fact Sheet

Satellite Analysis and Fusion Engine (SAFE)

State-of-the-art technology, data and rapid mapping mechanisms helping disaster management on national and local levels

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CATAPULT

Satellite Analysis and Fusion Engine (SAFE)

Chile has a growing population in a country which is constantly threatened by natural disasters, including potentially sizeable earthquakes. The Chilean Government therefore recognised that it needed to investigate ways of providing both swift and appropriate reactive response to such disasters and proactive planning and mitigation.

The Satellite Applications Catapult was asked to demonstrate how state-of-the-art technology employing a range of information, including Earth observation (EO) data, could be used for disaster management on national and local levels. With just three months to complete the project, the Catapult sought to address the challenge by bringing together existing expertise and technology from a consortium of suppliers. This included showing how frameworks used in Europe function and how some of these practices and methodologies could be integrated into Chile's existing disaster management systems. The project was funded by the Newton Fund.

Chile, with its growing population, is constantly threatened by natural disasters and sizeable earthquakes.

The Challenges

EO data offers clear advantages for disaster management applications. Analysis of optical satellite images taken before and after a disaster, such as an earthquake or flooding, can show changes to infrastructure including buildings and roads. Synthetic Aperture Radar (SAR) data provides excellent information about ground movement that can be used both for disaster response and for planning for potential future events.

Building after earthquake has struck

However, EO data is not well integrated or easily accessible over the Internet because of way data is stored and managed. It is not, therefore, straightforward to work with EO data, especially for non-expert users. Also, EO data is available from many disparate sources, making it hard to identify where to find pertinent information. Hence despite the clear benefits of using EO data within disaster management activities, it is rarely used to best effect.

The SAFE project aimed to tackle this challenge for Chile where the Government has historically been reliant on different, geographically dispersed organisations to provide disaster analysis and response. The aim was to make the right data more accessible and more usable by decision-makers without them having to be experts in data analysis, and to share data between geographically dispersed users so they could all contribute to any disaster management process but continue to work independently and within a local context.

The SAFE project aimed to tackle the challenge of disaster management from one source, rather than different organisations.

The project also included clarifying how Chile could best interact with various organisations that produce satellite data, noting that the provision of data is not the same as provision of information. For example, the International Charter for Space and Major Disasters (the Charter), created in 2000, offers a valuable unified system for multiple providers to offer satellite data free to relief organisations in the immediate aftermath of a disaster. In addition, the European Copernicus programme will provide geospatial information, not just raw data, though its Emergency Management Service (EMS), both immediately after an event and for risk assessment and longer term recovery.

Countries may want to buy EO data for continued post-emergency response and for long-term planning, including data from before the disaster in order to build baseline maps to show any change. However, finding such data can be time-consuming and it can be relatively costly for poorer nations.

The SAFE solution included a study presenting state-of-the-art technology, data and rapid mapping mechanisms.

After the 2010 earthquake in Chile, it took up to two weeks to identify where damage had occurred.

The Solution

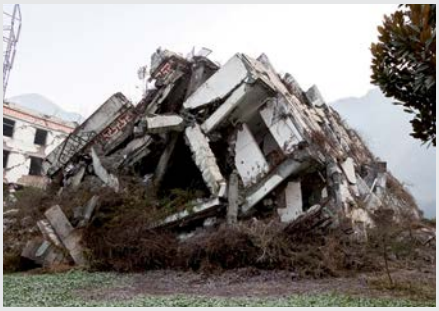
The SAFE project comprised three key elements:

- a study presenting the state-of-the-art in technology, data and rapid mapping mechanisms
- an analysis of how best to use the available satellite data and data processing techniques
- a web-based demonstrator application integrating the data and some of the highlighted technologies.

To fulfil these, the Catapult led a team that included Forum for the Future, RAL Space, Geocento, the University of Reading, Airbus Defence & Space, Newcastle University and DMCii.

Analysis

The analysis used the example of a magnitude 8.8 earthquake that occurred in February 2010 off the coast of Chile to show what could have been done differently had the proposed new application been in place. This was based on the standardised practice that the EU's Copernicus programme uses for producing maps for emergency response.



Ruins of a building after an earthquake

After the 2010 earthquake, it took up to two weeks to identify where damage had occurred. However, with EO data you can quickly compare two images before and after an event to show the changes. Hence by applying the right analysis to high resolution optical data, end-users receive immediately usable information, such as the impact of a disaster on road networks and the locations of damaged buildings marked on a Google Earth map. The generated data also provides a new baseline for future events.

Disruption after a tsunami

SAR data is excellent for showing ground movement, in this case horizontal movement that has occurred after an earthquake, allowing the extent of displacement to be measured and related to visible damage. For future planning, a wide area analysis could show not only where movements have occurred but also how that relates to population centres: in high-risk areas SAR data could be plotted regularly to show long-term changes.

Study

The study combined information from disaster response and recovery organisations and satellite imagery data providers with requirements from the Chilean organisations involved in the project:

- ONEMI – National Emergency Office of the Ministry of Interior and Public Safety
- CIGIDEN – National Research Center For Integrated Natural Hazards Management
- SNIT – National System for the Coordination of Territorial Information
- CIREN – Centre of Information on Natural Resources.

It also highlighted that since 2007 Chile has called on the Charter almost every year for data pertaining to one or more natural or manmade disasters, highlighting the real need for a coordinated approach that takes advantage of the latest technology to provide fast, efficient response anywhere in the country.

The SAFE project demonstrated how to bring existing capability from multiple organisations in a short space of time.

Technology Demonstrator

The SAFE technology demonstrator highlighted the benefits of four key aspects for any potential disaster recovery application:

- linked data and the semantic web
- natural language processing (NLP)
- geographic services
- acquisition planning.

'Linked data' is particularly valuable for disaster response and recovery as it allows you to search across all potentially relevant data as if it were a single dataset. It not only returns direct answers to queries but signposts other potentially relevant data as well. When NLP is added, it makes such a solution useful for non-experts too.

Although there was a focus on EO data in this project, complete datasets could include mapping data (which may be scans of paper maps), rainfall, land use and soil type which, when used together, may help inform decision-making.

The SAFE team designed tools that could help with data discovery and better storage for use with NLP searches and the overall result was presented in a web browser environment so that it was easy to use. This approach can help users to discover data they were not initially looking for but that could help with response and future planning.

Geographic data allows representation of data on maps through a website, which could be roads, lists of hospitals and so on, that can be searched manually and semantically. Its strength lies in being able to switch between layers and overlay information to give it more depth and meaning.

Finally, although the Charter and Copernicus EMS programmes provide data in the aftermath of a disaster, EO is disparate industry so there is no easy way to search for data or plan for future acquisition based on satellite movements. Instead, countries need to approach each individual provider separately. Acquisition planning is therefore a key skill.

The Benefits

The SAFE project demonstrated how to bring existing capability from multiple organisations together and co-ordinate a project in a short space of time. The Catapult led the SAFE project and managed liaison between companies and experts in different areas, as well as with ONEMI and other Chilean organisations. Overall, the project took just three months.

The key technical innovation was enabling the combination of linked data, web services and natural language processing in a single application that was usable by non-experts. The Catapult team provided technical expertise to the project, building the software in collaboration with Geocento and the University of Reading.

Although the final result was a demonstration of capability, not a working solution, it has allowed the Chilean Government and partner organisations to determine what they liked and what they didn't, and how such a solution could be integrated into their existing systems.

Status & Future Plans

Having proved the concept of the disaster management application through the demonstrator for Chile, the next stage would be to specify and build a final working application. The proposal also includes additional functionality enabled by web processing, thus providing an automated way of offering functions such as change detection without requiring experts to do any data analysis. The team would also like to add links to other sources of information, such as relevant web pages, academic papers, books, news feeds and social media data. This is currently at the funding application stage.

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