WHEN RAINFALL THREATENS

System created by the DLR Earth Observation Center warns of potential hazards

By Peter Fischer

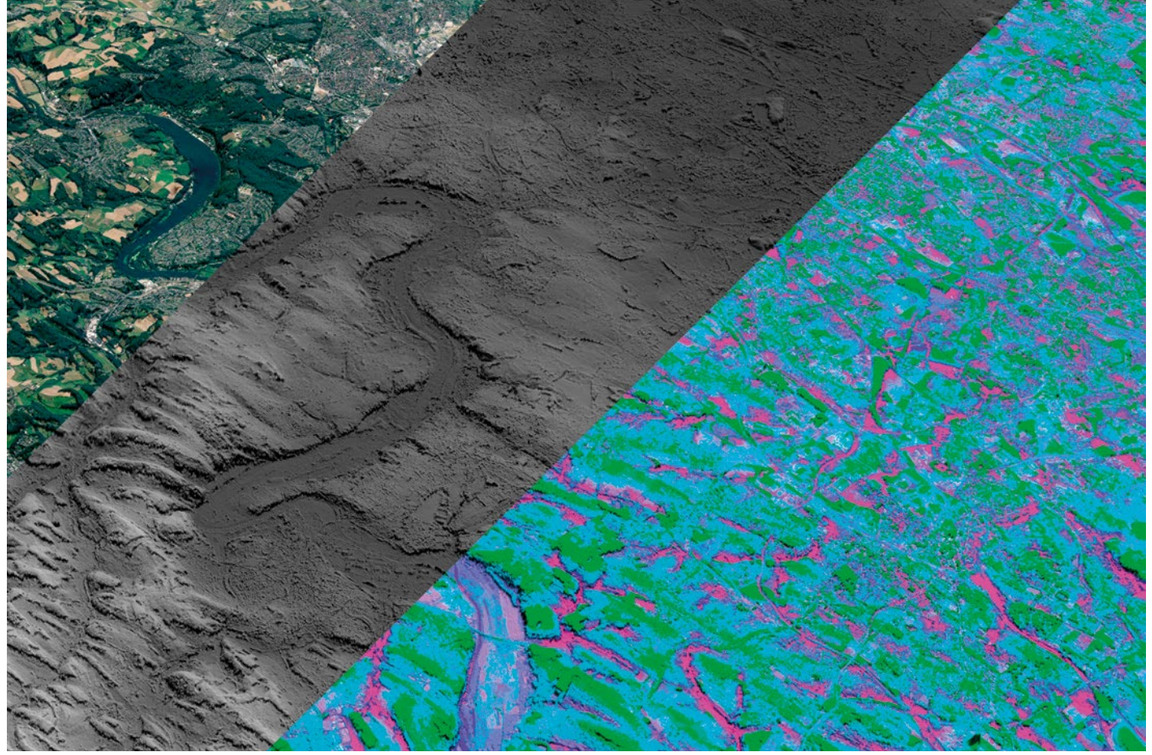
Monday, 28 July 2014 – the 'Quintia' storm system is shifting westwards, from the north of France towards Germany. This has serious implications for a number of regions in North Rhine-Westphalia, particularly for the residents of Münster and Greven. The torrential rain begins at 13:00 and continues for several hours, reaching historical proportions. Rainfall of up to 292 litres per square metre is measured in the space of seven hours. By way of comparison, the annual average expected rainfall for Münster is a little more than 750 litres per square metre. The impact on the city is devastating – more than 14,000 homes sustain damage, mainly due to flooded basements. The total damage is estimated at around 80 million euro. On this day in July, public life grinds to a halt in some places – roads are flooded, a number of people are injured and two lose their lives in accidents.

Events like this are tragic proof of the need for action – because they are set to become a more frequent occurrence. Time series analyses show a trend towards more rainfall in the last four decades, particularly in the autumn and winter months. However, it is not just more rain that is to be expected; there will also be an increase in extreme rainfall events. Reliable information of potential local hazards will therefore prove invaluable.

The existing systems used by German insurance companies accurately inform about the threat presented by flooding. A key element of this zoning is proximity to rivers. However, the assumption that, the greater the distance to the nearest river, the safer one is may prove to be complacent, as heavy rainfall has the potential to cause sudden and severe flooding away from rivers.

Image: Provinzial

Heavy rain can also cause flooding away from watercourses. Terrain models that make lower lying areas recognisable can indicate the location of vulnerable regions.



Superposition of images of a river – from left to right, a true colour satellite image, a terrain model and a hazard map (vulnerable zones are shown in pink and purple, safe areas in green).

This ever-increasing threat situation and the associated, difficult-to-estimate risk has been troubling the German insurance company Westfälische Provinzial Versicherung – an innovation partner of DLR – for a number of years. DLR Technology Marketing identified the right departmental matches at DLR and brought together representatives from the areas of science and industry. A collaborative project was launched in October 2013. The objective was to determine the potential threat caused by heavy rain – down to the level of individual buildings.

Unlike the tools currently available, the DLR system does not use hydrological databases, which are inadequate for predicting the risk of heavy rain. Instead, terrain models are statistically analysed and classified. The underlying idea is quite simple – as water always flows downhill, lower regions are potentially at greater risk than elevated areas. Even the need for meteorological data, such as precipitation measurements, can be eliminated. The precision of the model calculations has been demonstrated by comparing them with historical loss data recorded by Westfälische Provinzial Versicherung over a 10-year period.

Halfway through the project, the issue unfortunately became topical among the general public – Münster, the home of Westfälische Provinzial Versicherung, was hit by the heavy rainfall event described above. Although no generalisations can be made on the basis of such isolated events, it should nonetheless be possible to, at least approximately, depict the actual situation using the demonstrator that has been developed. Indeed, DLR's hazard map and the damage reported locally corresponded.

The simulation tool combines expertise in the area of 3D modelling and geo-statistics at the two institutes of the DLR Earth Observation Center (EOC) – the Remote Sensing Technology Institute and the German Remote Sensing Data Center. High-resolution terrain models – created using a procedure also developed at the EOC to use data from images captured by the Indian Cartosat-P5 satellites – were used for the demonstration. The risks can easily be modelled using any available terrain model. The EOC scientists tested their predictions against terrain models derived from radar data. As part of the TanDEM-X mission, the EOC is currently preparing a global terrain model with the highest resolution ever achieved, and which is ideal for such an application. With the aid of the new procedure and various elevation datasets, risk modelling is possible on various scales, from high-precision, local analyses through to global predictions.

The project, undertaken at the EOC, was completed in October 2015. Various organisations have expressed an interest in the results of the study. Heavy rain zoning is likely to be used in a similar form by insurers throughout Germany from the end of 2016 onwards.

The new risk analysis method is not only important for the insurance industry; the findings could also prove valuable in the planning and execution of construction and infrastructure projects, and might also be used by the public and private sector. In the real estate industry, properties could be revalued based on their risk exposure. Individual homeowners could also benefit from the findings – if, for instance, the information on risk zones were freely available on the Internet, people could, if necessary, take appropriate flood protection measures.

The hazard forecasting system developed at DLR also has the potential to be used for modelling risks of other natural events and weather phenomena, such as those associated with storms or severe ground frost. Geoinformation can be used to clarify a multitude of issues relating to civil security. In future, Westfälische Provinzial Versicherung AG plans to work closely with DLR researchers to optimise additional risk modelling processes.

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