

# elevation

RMA EDITION Issue 3 Spring 2010

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## Advances in European Flood Modelling

Keeping up with the latest trends in computing and data availability

by Cressida Ford and Jane Toothill, JBA Consulting

Modelling the consequences of flooding is a notoriously tricky task, especially for insurers and reinsurers who require estimation of damage at a national scale. In the past, detailed flood mapping and modelling at this scale was impossible, not because of a deficiency in hydrological and hydrodynamic scientific expertise, but rather because of the lack of adequate computer power and widespread high-quality digital terrain data required for flood modelling. Even in localised areas where sufficiently detailed digital terrain data was available, the resulting level of detail demanded unrealistic timescales and processing requirements for modelling.

In the past decade, however, rapid developments in new technology have allowed modellers to achieve high-quality modelling results at a much wider scale. In Europe, a new collaboration between Intermap Technologies® and JBA Consulting, one of Europe's leading risk management consultancies and a world-recognised specialist in flood modelling, enables insurers to access the most advanced flood modelling techniques based on the most detailed international-scale digital terrain dataset available.

### Data Quality Available Today

The precision and resolution of digital terrain information is a critical component of any flood model. Put simply, the water depths output by flood models are directly dependent on the digital terrain model (DTM), and a good-quality model cannot be developed using poor-quality information. The potential quality of data available today is well-illustrated by Intermap's® NEXTMap® Europe dataset, which is provided in a consistent format at 5m resolution for all of Western Europe.

A series of automatic and manual techniques are required to prepare this detailed information for flood modelling. Automated processes developed by Intermap and JBA remove natural features such as trees and vegetation from the data. Subsequent careful checking and processing removes other structures such as bridges and viaducts. Since the NEXTMap® digital elevation data is created using aerial imaging techniques, structures across flow paths such as bridges or viaducts appear as solid barriers and must be edited manually to allow water to pass underneath. The result of this process is a high-quality, 5m resolution DTM,

*(See Flood Modelling on page 2)*

## Risk Assessment Portal

Address-specific underwriting and portfolio-based natural hazard risk estimation modelling

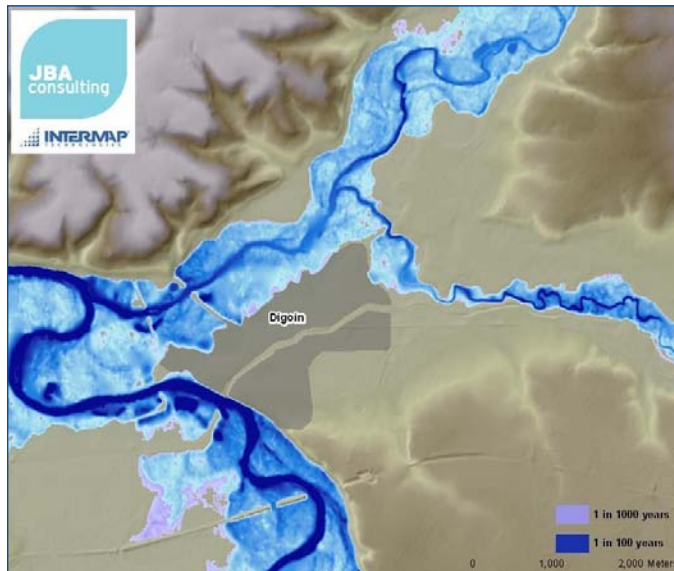
Intermap Technologies® Risk Assessment Portal serves as the central access point for Intermap's® Web-based risk management applications (RMA), allowing users to perform risk assessment of various natural hazards. The applications on the Risk Assessment Portal, available at risk.terrainondemand.com, support property-specific underwriting as well as portfolio-based accumulation control.

The applications are based on detailed and consistent hazard maps with a specific focus on flood risk.

*(See Portal on page 3)*



Home page of the Risk Assessment Portal.



Sample output from France's first national-scale river flood model developed using JFLOW-GPU and NEXTMap data. The floodplain maps are immediately available for licensing from Intermap or JBA. The project was developed in collaboration with Guy Carpenter.

custom-designed for suitability for flood processing. However, to be used to its maximum benefit in flood models, the dataset requires an extremely high level of processing capability.

## Gains in Processing Power

Flood modelling is a computationally demanding process, especially if the user wishes to take advantage of high-quality digital terrain data. In 2002, JBA was the first company worldwide to apply a grid of computers for solving complex 2D modelling tasks. At that time, a grid of 50 processors offered a processing capacity of 500 gigaFLOPS (GFLOPS) – a remarkable step forward. Further development followed in 2006, when JBA became the first company globally to dramatically upgrade its hydraulic processing capabilities by capitalising on new developments in computer gaming technology. The introduction of high-speed graphics cards, or graphical processing units (GPUs), provided a new source of processing capacity that, with advanced software programming work, could be redeployed for use within 2D hydrodynamic modelling. JBA coded its hydrodynamic flow model, JFLOW, an existing and scientifically proven 2D modelling solution, for use on GPU machines. This major transformation resulted in JFLOW-GPU, a modelling tool that exploits the new gaming technology and is capable of running simulations up to 1000 times faster than was previously possible. The new JFLOW-GPU enables JBA to run the latest flood modelling methodologies at high resolution and national scale with a degree of precision that was previously only accessible at a very localised level. Today, eight years from the start of its initiative to raise processing power, JBA routinely runs JFLOW-GPU on its grid of 36,000 processors, offering 150 teraFLOPS (TFLOPS) for processing national-scale flood models. Intermap's NEXTMap digital terrain model is the perfect dataset on which to run JFLOW-GPU for such projects; its 5m level of resolution corresponds well with the degree of resolution achievable at national scale using the GPU processing capabilities.

## New Developments with JFLOW-GPU and NEXTMap

The most recent example of use of JFLOW-GPU in conjunction with the NEXTMap DTM was the recent development of a river flood hazard map for all of France, developed in collaboration with reinsurance broker Guy Carpenter. The flood mapping data, now available for licensing from Intermap or JBA, is illustrated for the area surrounding Digoins in the figure. The model includes explicit modelling of 80,000 km of river in mainland France for six return periods in addition to a variety of additional defence scenarios in selected urban areas. JFLOW-GPU model runs were initiated every 400 m along the length of every river, totalling some 1.5 million analyses. Ongoing development work involving JFLOW-GPU and NEXTMap includes mapping the entire length of the Danube River and its major tributaries.

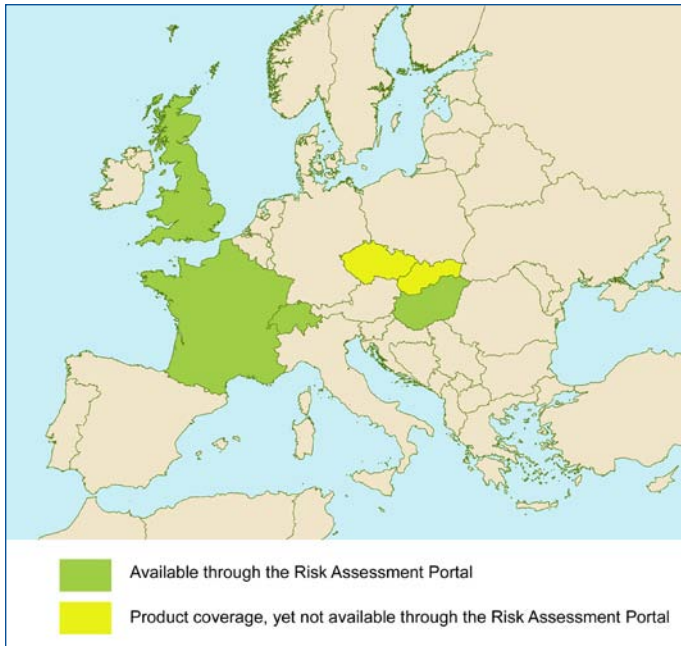
## Impacts for the Insurance and Reinsurance Industry

Developments such as these significantly advance the quality of national flood modelling solutions available to insurers in continental Europe. Previously, the best flood hazard models were at perhaps 25 or even 50m resolution; insurers can now access models at 5–10m resolution. The benefits for risk management and loss accumulation calculations are evident: For a peril such as flood, this enhanced resolution can help determine the difference between total destruction of a property and no damage being sustained.

High-resolution modelling is also a critical step toward meeting the growing demand for modelling of pluvial (surface water) flood risk. Pluvial flood refers to damage resulting directly from falling rain before it enters the river system. Recent events in both the United Kingdom (June/July 2007 floods) and continental Europe (2009 floods in Central Europe) have highlighted the importance of pluvial losses in severe rainfall events, which may account for up to 50 percent of insured damage costs. In the United Kingdom, the Environment Agency estimates that some 3.8 million properties are at risk from pluvial flood, compared to just 2.8 million from river flood. These properties cannot be identified using traditional river-based modelling approaches or using coarse (>20m) digital terrain mapping. However, good-quality information regarding properties at risk can now be obtained by insurers across Europe, thanks to JBA's modelling techniques and ability to apply those techniques at 5m resolution across a country.

Developments such as these offer insurers the ability to underwrite and manage flood risk at a level of accuracy not previously available and will lead to increases in the availability of quality flood models throughout Europe and elsewhere worldwide. Flood risk is likely to increase in the coming years due to a combination of factors including higher property values, increased development in floodplain areas, and the effects of a shifting climate. New high-resolution solutions eliminate reliance on coarse-resolution models to estimate potential flood losses; the reduction in uncertainty means that insurers will be able to manage growing exposures with confidence.

For more information about JBA Consulting, see page 4.



Toolkit availability by country.

Where applicable the underlying risk modelling is based on NEXTMap®, Intermap’s high-resolution and countrywide digital elevation database. Combined with state-of-the-art modelling techniques, NEXTMap elevation data enables the best-available and consistent hazard modelling across countries.

Application access, provided through the Internet, is available at any time required. The access is currently limited to Microsoft® Internet Explorer® users. Subscription to the available applications is based on an annual single-user license model.

### RMA Underwriting Toolkits

Supporting the property-specific risk assessment and underwriting, the RMA Underwriting Toolkits include an address search function to obtain the geo-location of an at-risk property. The location is then displayed on top of the hazard information and background maps. An onscreen report summarizes the results of the risk assessment, including the hazard risk zone and available additional information. The map window also offers interactive cursor-based querying of location-specific risks.

Peril availability by country.

Country	Perils	Details
France	Fluvial flood risk	RTPs 10, 25, 50, 100, 250, 1000 + water depth
U.K.	Pluvial flood risk	RTP 75 Flood Depth Bands
Switzerland	Fluvial flood risk	RTPs 50, 100, 250, 500
	Earthquake	RTPs 95, 475, 2475, 10000 years + Intensity maps (EMS98 scale)
Hungary	Fluvial flood risk	RTPs 100, 250, 1000
	Earthquake	RTPs 95, 475, 2475, 10000 years + Intensity maps (EMS98 scale)
Czech Republic	Fluvial flood risk	RTPs 20, 50, 100, 250, 500, 100, MFB (Maxim flood boundary)
Slovakia	Fluvial flood risk	RTPs 50, 100, 250, 500

Peril availability by country.

### RMA Accumulation Toolkits

Supporting risk accumulation control, the RMA Accumulation Toolkits provide portfolio upload functionality for validation of partial or entire geo-coded portfolios. The portfolios are visualized on top of the hazard information and background maps in a map viewer. Risk assessment for all available natural hazard risk data can be performed to generate a simple accumulation report, which is displayed onscreen and can be analyzed with provided drill-down functionality. The analyzed portfolios can be exported for use in other applications, kept in the application for further assessments, or deleted immediately.

### Access to the Risk Assessment Portal

Users can access free test applications after registering directly on risk.terrainondemand.com. Full access to specific applications requires acceptance of the Terms and Conditions of use and license agreement as well as a signed subscription contract with Intermap. Detailed information about accessing a specific application can also be found on the portal. [...](#)

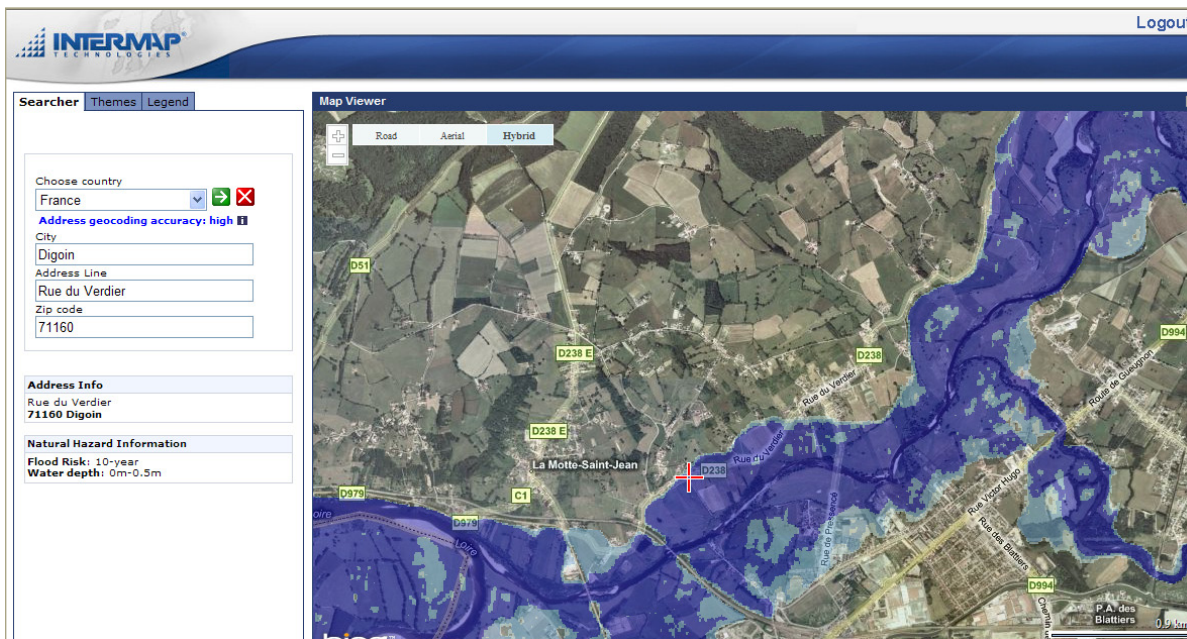
## River Flood Risk Assessment for France

### Comprehensive flood hazard maps used for risk underwriting and management

Recent flooding events in areas of Europe have devastated communities, causing damage to properties and loss of lives. As these types of catastrophes occur, the need for geospatially accurate and consistent flood risk management products on national scale is becoming increasingly apparent. Because France is at risk for major flooding, such risk assessment products are necessary.

Intermap Technologies® has responded to this need by collaborating with Guy Carpenter and JBA Consulting to produce accurate flood hazard maps to aid in river flood risk estimation. The comprehensive maps are the most detailed and homogenous that are available for the whole country. The maps are derived from Intermap’s NEXTMap® Europe digital elevation

*(See River Flood on page 4)*



Underwriting Toolkit user interface: Address input (top left), visualization of one river flood hazard map with water depth information (right), and presentation of the results of risk assessment (bottom left).

data, setting the industry standard in regards to uniformity, accuracy, and resolution on national and global scales. JBA Consulting modelled over 80,000 kilometres of French river networks using an immense set of historic data selected from more than 3,500 river gauge stations. The hazard maps have been generated afterwards by JBA with its scientifically recognized 2D hydraulic JFLOW-GPU model. The resulting river flood hazard maps include maximum water depths of the modelled river network for a range of return periods (10, 25, 50, 100, 250, and 1,000 years).

Intermap's Web-based RMA Underwriting Toolkit France provides access to flood hazard information to perform address-based property risk assessment for use in an office environment. Not only does the application support the flood risk underwriting process, but it also creates opportunities in developing new insurance products. The application can be accessed with a user-specific login and password via Intermap's Risk Assessment Portal.

The application includes an address search tool allowing users to obtain the geo-location of the property at risk and a map window containing the flood risk zone information and background maps for enhanced visualisation. Results of the risk assessment are summarized onscreen in an additional report.



## About Intermap Technologies

Intermap Technologies® is a digital mapping company that is creating uniform, high-resolution 3D digital models of the earth's surface.

Intermap has completed the remapping of entire countries and has built uniformly accurate national databases, called NEXTMap®. The company's digital elevation data and geometric imagery are enabling a wide variety of commercial applications, including risk management.

Intermap's® risk management applications improve the evaluation and controlling of hazard risks – and enable easy and immediate access to sophisticated, geospatially accurate risk management.

Headquartered in Denver, Colorado, USA, Intermap has additional offices in Munich, Prague, London, Paris, Jakarta, Bratislava, Ottawa, Detroit, and Washington D.C.



## About JBA Consulting

JBA Consulting is one of Europe's leading specialists in risk and environmental management and has a long history of quality consulting in flooding and water-related issues. In Europe, JBA works in partnership with companies who are able to provide the most detailed and highest quality information required for flood modelling and mapping.

A recent collaboration with Intermap Technologies and Guy Carpenter has resulted in the development of a suite of river floodplain maps for France, developed using Intermap's 5m NEXTMap dataset and JBA's hydrodynamic model, JFLOW-GPU.

JBA has recently been selected as the UK's Consultant of the Year.