Mairi MacDonald checks out what the boffins at the modelling companies have learned since their major test in 2005.

Modelling companies had to salvage their reputations from the wreckage left by the hurricanes of 2005. For some insurers, the reality of their actual losses accumulated in disaster-struck New Orleans and beyond compared to modelled estimates was a catastrophic blow, and under-fire modelling companies were faced with looking at why models had failed to account for the range of hazards and the domino effect on losses caused by the windstorms. Despite this, demand for catastrophe models is increasing, driven by a requirement for more stringent risk management to cope with future uncertainties from climate change to terror risk.

Two years after hurricanes *Katrina*, *Rita* and *Wilma*, the leading companies, AIR Worldwide, Eqecat and RMS, have updated previous models and are focusing as much on those risks that were not modelled as those that were.

Bob Healy, senior vice president for marketing at Eqecat, admits most catastrophe models were unprepared for a storm of *Katrina*'s magnitude and failed to model all the hazardous outcomes, from the scale of the damage to commercial property, through to flooding and business interruption.

Mr Healy comments: "Ours was a wind model and we were not unhappy about the way the model performed on wind damage but certainly most of the losses were driven by flooding and storm surge, which we didn't capture."

A hurricane wake-up call

When *Katrina* losses are sliced and diced, the amount of commercial losses was surprising, admits Jayanta Guin, senior vice president for modelling and research at AIR. He says: "*Katrina* had business interruption losses estimated between $5bn and $7bn. Several other lines of business were hit hard by *Katrina*, including offshore assets like oil platforms in the Gulf of Mexico and inland marine. It showed there were lots of areas where we had to enhance our modelling capabilities."

Mr Guin adds: "Absolute loss amounts should not have been a major surprise for the insurance industry, although *Katrina* was the largest insured loss without accounting for growth in the number and value of insured properties.

"*Katrina* really showed the potential power of a strong storm surge from a hurricane and the kind of devastation it can cause; and the fact we can have very large hurricanes, which are very intense at the same time."

Katrina was a wake-up call to the industry, says Dickie Whitaker, managing director of the London office of global broker Guy Carpenter, which runs the analytical service Instrat. "Some people in the marketplace didn't appreciate that not all perils or business were covered and therefore underestimated the impact of *Katrina* on their own business," he says.

In the aftermath of the 2005 hurricane season, modelling companies turned their attention on storm surge and modelling the size and shape of waves hitting a particular coastline, and the vulnerability of the coastline, explains Mr Healy.

"We started looking at the storms further out in the Gulf, because that determines the storm surge," he remarks. "Even if it weakens from a wind perspective when it reaches

the landfall point, the waves are still going to be representative of what the storm was prior to that."

Post-*Katrina*, Eqecat adjusted its models' loss amplification (demand surge) up by 10%-12% beyond what it already calculated. "As more rain fell there was more damage than one expected, mainly because of the extended delay of getting to the homes to begin the repair process," he says.

"If we were to rerun the portfolios like *Katrina* now with the improvements we've made we would be a great deal closer to the full losses that were caused by those multiple perils."

Executive vice president of RMS, Paul VanderMarck admits capturing all the necessary data relating to 'supercats' — large events that impact urban areas and/or trigger major consequential hazards — is challenging.

"Before *Katrina* we didn't model flood in New Orleans; many of our clients didn't technically insure flood for residential properties but, after all, it's part of the risk and something clients need as part of a comprehensive solution." An example of this might have been the recent earthquake in Japan that damaged a nuclear power plant, which could have escalated disastrously, leading to release of radiation, human casualties and long-term evacuation of an area.

Mr VanderMarck adds: "We have to help clients understand the full range of potential consequences of major events. When consequential hazards are triggered by an event they have the potential to be catastrophic and add substantially to the total loss."

Modelling companies have pointed out poor quality data fed into models significantly contributed to the underestimation of total losses from *Katrina*. Some have suggested it took the disastrous outcome for catastrophe model users to learn that blind faith in models' estimations is perilous.

Mr Guin of AIR says: "Exposure data being fed into the models was inadequate. If you have to boil that down to one particular issue it is the underestimation of the true replacement costs of these insured properties. After much research using insurers' claims data, our conclusion has been overall there was a high degree of under-estimation, particularly for commercial properties."

According to Ian Branagan, senior vice president of Renaisssance Re, catastrophe model users must be comfortable with uncertainty and ranges of outcomes as opposed to individual estimates.

He comments: "By the end of 2005, many people were over-relying on the input of catastrophe models in their underwriting pricing and risk assessment of their portfolio risk, which is why so many people were surprised by 2004 and 2005 hurricanes losses — and some people will be surprised again with other events, regions or perils in the future.

"My experience tells me that as time passes from a very large individual loss, people tend to have very short memories and some will get into bad habits again.

"Getting into the details and understanding what's happening in these complex models is time consuming and expensive, so many can only rely on what comes out the box as opposed to being able to independently critique what's going on."

More than any historical event, *Katrina* highlighted the importance of data quality and how far the industry is from getting it right after a large-scale catastrophe.

Mr VanderMarck saw *Katrina* as a rallying cry to the industry to modernise its approach to risk modelling. "You're never going to get as much data as you'd like or be entirely certain of its reliability, so a significant challenge is to validate the data you receive and enhance it with other data sources."

One such enhancement is a database of building attribute information that allow RMS' clients to access information on a particular building, including its size, material or date, by entering an address onto the system, even if the insured was unable to provide any data.

> Since 2005, modelling companies have had copious amounts of new data to help improve their old models, but new versions remain untested by a major event.

Mr Whitaker of Guy Carpenter says: "There's a continual upgrade process for models. In most of Europe and the US, these models have developed over a long period of time so they're always getting better, but in countries that don't yet have a model, we have to start from scratch."

New perils to analyse

Since catastrophe modelling got seriously underway 20 years ago, beginning with hurricane risk modelling in the US, then in the UK and Japan, models have been continually reworked. Since 2005, modelling companies have had copious amounts of new data to help improve their old models, but new versions remain untested by a major event. Modelling companies have sought out new perils like terrorism, pandemics and nanotechnology to analyse.

Growth in modelling mirrors the path of the expanding insurance industry, so modelling companies' coverage of eastern Europe, Latin America and Asia-Pacific is growing, with earthquake risk models launched in China and India this year, for example.

New models are decided on commercial viability but a growing number of other organisations — modelling companies, university departments, insurers and brokers — are also building specialist models in developing markets. Mr Healy says: "In the case of Eqecat's Germany and Austria flood models, Guy Carpenter was keenly interested in that area and funded it. If there's someone who will sponsor it and it makes sense strategically for us we will undertake that as a priority."

Until recently, flood modelling has not been big on modelling companies' radars, although broker Benfield took an early lead in the difficult area of European flood modelling.

Mr Branagan says: "Increased computing power and better understanding of some of the physical processes is beginning to allow better physical modelling of the global climate. Given the input criteria of where we are in 2007, models can now better simulate likely outcomes of the global climate

THE TROUBLE WITH TERRORISM

Modelling human-induced risks throws up a whole range of problems.

RMS' Paul VanderMarck says: "It's a different type of challenge to model event frequency and assess the probability of events when the causes are not geological or meteorological mechanisms."

Mr VanderMarck says RMS uses similar methodology and discipline applied to building natural peril models to terrorism models . "There is a robust scientific process you can apply to understanding the rationale terrorists use for prioritising targets, to assessing the frequency of attack attempts and to simulating the expected impacts of a range of potential events."

Probabilistic terror modelling does not appeal to some insurance companies.

Rob Caton of Hiscox believes modelled output infers too much accuracy. "We don't use the probabilistic terrorism modelling but we do manage our accumulations using software that ensures the level of risk in a given area doesn't exceed a certain threshold," he says.

Ian Branagan of Renaissance Re adds: "We can do a good job of modelling the impact of a certain type of bomb in a certain type of built-in environment. What we can't do a good job of is estimating when someone is going to get on a plane and fly it into the World Trade Centre. Being able to probabilistically answer the 'when' question is almost impossible."

To build its terrorism model, RMS relied on more than 30 experts from fields such as weapons systems, nuclear engineering and infectious diseases, and uses a quantitative process to translate the experts' assessment of the development of threat and of national defences in different countries.

RMS models a range of 35 potential attack modes including conventional weapons and weapons of mass destruction. These include improvised explosive devices; aircraft impact (similar to the 11 September 2001 attacks); conflagration (using an oil tanker to cause a fire and explosion); industrial plant sabotage; and chemical, biological, radiological and nuclear weapons.

The severity of each attack mode will vary depending on the location and the time of day. It is expected attacks will occur when the human exposure is greatest. Manhattan has the highest exposure in the US in terms of property values and population density.

The attack modes listed above could cause the following losses to the property and workers comp lines of business:

ATTACK MODE	MODELLED INSURED LOSS
600lb car bomb	$2bn
2 ton truck bomb	$6bn
10 ton truck bomb	$15bn
Dirty bomb	$65bn
Outdoor anthrax release	$293bn
5kt nuclear bomb	$575bn

By way of comparison, RMS models potential hurricane events that could cause much larger insured losses than have ever previously been experienced. Here are three examples from more than 15 000 simulated hurricanes included in RMS' US hurricane model:

HURRICANE LOCATION AND MAGNITUDE	MODELLED INSURED LOSS
New York CAT 4	$120bn
Houston/Galveston CAT 5	$180bn
Miami CAT 5 (single landfall event)	$215bn

over the next 100 years through the use of global circulation models — the large scale global climate models.

"But in part because of the computing power required to run these models, it is at present not possible to obtain detailed, localised climate information at all points on the globe simultaneously. For example, the global models may be able to get a decent estimate that global sea surface temperature might go up by an average of X degrees, but it is more difficult to say, within the same level of certainty, that in the local waters off the south east coast of the UK, the sea surface temperature will increase by X degrees."

A reliance on vendor models

UK-based risk management company Ambiental has been providing detailed flood risk information to the insurance industry for years. Managing director, Dr Justin Butler, says: "The three modelling companies have their own approaches to national-scale country-wide flood risk modelling and we don't compete against them. We provide higher detail and accuracy flood risk information. While the modelling companies might build a flood risk model for Germany, normally we look at detailed flood risk in urban areas." Dr Butler explains Ambiental uses high-resolution light detecting and ranging (Lidar) data to model river and coastal areas in detail, on a grid scale of normally one to five metres, whereas the larger modelling companies use a much larger scale and a probabilistic approach to estimating losses at national scale.

"Windstorm can be looked at on a smaller scale over larger areas, whereas flooding is very complex and must be looked at in much more detail to get reliable results," he explains. "But it's better to have something over a large area than nothing at all."

Martyn Starkey, senior analyst at Lloyd's reinsurance broker Alwen Hough Johnson (AHJ), which built in-house catastrophe models for the Caribbean, explains that where once providing modelling analysis to clients was a useful marketing tool to impress clients, it has become a requirement amongst reinsurers choosing what to underwrite.

AHJ analysts developed a probability model for hurricane and typhoon, which is used to look at historic events and clash scenarios in the Caribbean. Mr Starkey says: "You could pick Jamaica and Cayman and see how many hurricanes have gone through both in last 20 years. Some reinsurers like that, rather than being given tens of thousands of scenarios and we wanted to provide a different view."

He adds: "There is greater reliance on vendor models, not because the results are correct but because they are a benchmark to go on. If you developed your own model, you've got to prove that model and have academics prove that model."

Models' capabilities are improving inline with technological developments. Mr VanderMarck says: "In some cases our reinsurance clients run hundreds of servers enabling them to receive and analyse high-resolution portfolio data from their ceding companies during the renewal season. Running every cedant portfolio through our models as part of the underwriting process is a staggering amount of analytics to be executing. It's a dramatic change from a few years ago when reinsurers struggled to analyse their ceding companies' portfolios at that level of detail, when they typically ran simpler models using more aggregated data."

As modelling becomes more robust and computer processing power becomes more available, data quality from insurance buyers also improves. Rob Caton, head of risk modelling at specialist insurer Hiscox, London, says: "Modelling is becoming a more integral part of how insurers do business. As models get better, the data gets better and the external regulatory environment requires more things to get modelled. If there is a way of modelling a risk, and it's perceived to be significant for that organisation, for the regulators to say you should have a model so they can go and audit it is an easy way for them to be seen to be doing their jobs adequately. It forces modelling into the core of how insurers operate. and is becoming the key decision making process."

With the implementation of new legislation, Solvency II, in the European Union by 2012, companies' need to understand risk becomes more defined.

According to Mr Whitaker, credit risk and reserve risk modelling are two areas where Solvency II is driving interest.

He adds: "If you can't get a rating from the rating agencies you have a problem, and they've been saying that the same sorts of requirements in Solvency II are required to get a rating from the rating agencies in the US."

Driven in part by concerns over climate change, more collaboration between modelling companies, the insurance industry, academia and government is expected in the future. According to Dr Butler licensing restrictions on the free transfer of data is holding development back somewhat.

Ian Branagan of RenRe adds: "I do see increasingly bringing academia into business driven research to build commercially available natural hazard models as something that will need to happen much more over the coming years."

Increasing focus on enterprise risk management, where risk modelling is increasingly viewed as a core confidence of the insurance industry and part of sound enterprise-wide risk management practice, is driving the use of catastrophe modelling. Whether through necessity or for commercial advantage modelling is set to become increasingly indispensable to the insurance industry. re