CRObriefing

Emerging Risk Initiative – Position Paper

Climate Change & Tropical Cyclones in the North Atlantic, Caribbean and Gulf of Mexico

June 2006

The Chief Risk Officer (CRO) Forum's Emerging Risk Initiative is committed to continuously improving risk management. This paper advocates as best practice a process whereby insurers and reinsurers re-examine their assumptions about frequency, severity, loss trends and how the risks in their portfolios are interconnected and generally stress test their internal processes for hitherto "unthinkable" dimensions of risks.

The paper seeks to address rating agencies, analysts, governments, regulators, intermediaries and risk modelling firms alike.

This study is non-binding and for reference purposes only.

Executive summary

Climate change has the potential to develop into the greatest environmental challenge of the 21st century. The recent period of intense tropical cyclone activity most likely reflects the effects of both natural climate variability and a superimposed global warming trend due to human causes. Chapter 2 of this document outlines the latest scientific knowledge on the subject.

As the 2006 hurricane season nears, the CRO Forum's Emerging Risk Initiative wants to share the lessons learned from past seasons (Chapter 3) and outline the insurance industry's response (Chapter 4).

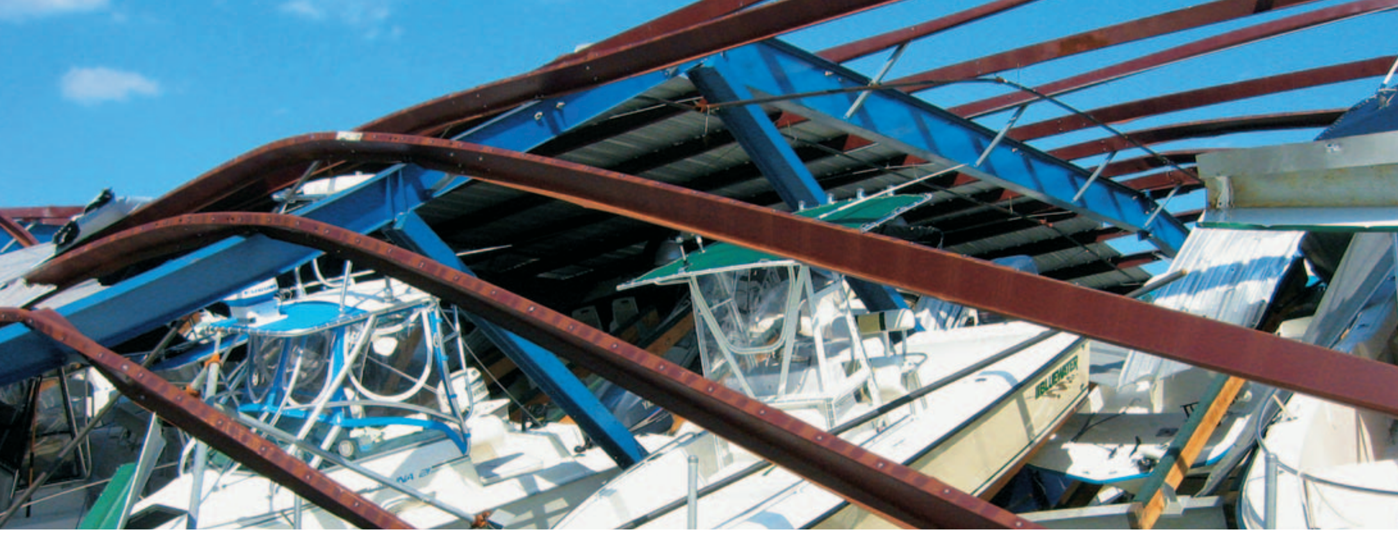
To maintain a sustainable insurance and reinsurance business model, the insurance industry needs to reflect changes in the frequency and severity of natural catastrophes and other loss-influencing factors in internal models, in determining the "cost of goods sold" and in risk management tools and processes.

Many insurance companies have been quick to adapt their models to the increased hurricane activity, which is expected to continue in coming years. The insurance industry has demanded increased transparency of third-party catastrophe models in order to better account for the underlying model assumptions, and it will continue to insist on improved quality and increased transparency of exposure data. The adoption of improved standardised formats when exchanging accumulation exposure data is a "must" and insurance intermediaries have an important role to play when collecting, formatting and exchanging underwriting data. Proliferation of automatic electronic exchange standards like ACORD will be promoted.

Overall, the industry has responded well to the challenge. By learning from the latest hurricane seasons, carefully limiting exposure, diversifying risks globally, using the full array of risk mitigation options available (reinsurance, portfolio swaps, insurance linked securities, etc) and ever-sophisticated modelling, the private insurance industry is in a position to weather the effects of an even more active hurricane season, too.

However, the sheer magnitude of climate change could in future impact a large number of industries to such an extent that sustainable insurability may ultimately be put into question.

This raises important issues for society as a whole and might require adaptation measures such as public-private partnerships and, of course, adequate public actions on climate change issues.



1 Climate change – a growing challenge

Climate change has the potential to develop into the greatest environmental challenge of the 21st century. The second unusual hurricane season in a row has fuelled public debate about climate change and its effect on tropical cyclones, and scientists are forecasting another above-average hurricane season in the North Atlantic in 2006.

The (re)insurance industry has been among the first groups to address this challenge. As an important stakeholder in the risk community, the Chief Risk Officers have decided, as part of the CRO Forum's Emerging Risk Initiative, to communicate their view of climate change and hurricane activity.

2 Climate change and tropical cyclones: the science

The 2004 hurricane season was unusually active with a record four hurricanes hitting Florida and the highest total insured loss from a tropical cyclone season ever seen. This record did not last long. 2005 surpassed the previous year on almost every count: 27 named tropical storms developed, of which 15 were hurricanes – including seven major ones – in the North Atlantic/Gulf of Mexico basins, setting an all-time record. Hurricane Katrina claimed the highest death toll (approximately 1350) of any hurricane in the US since 1928[1] and caused the greatest-ever insured loss for the private insurance industry at an estimated USD 45 billion. Total economic losses amounted to approximately USD 130 billion.

Clearly, it is not possible to claim that a single event is the result of climate change. However, the above-average frequency of intense storms in 2004 and 2005 – four of the ten strongest hurricanes ever recorded occurred in these two years – raises the issue of systemic change. The following sections provide an overview of current scientific knowledge.

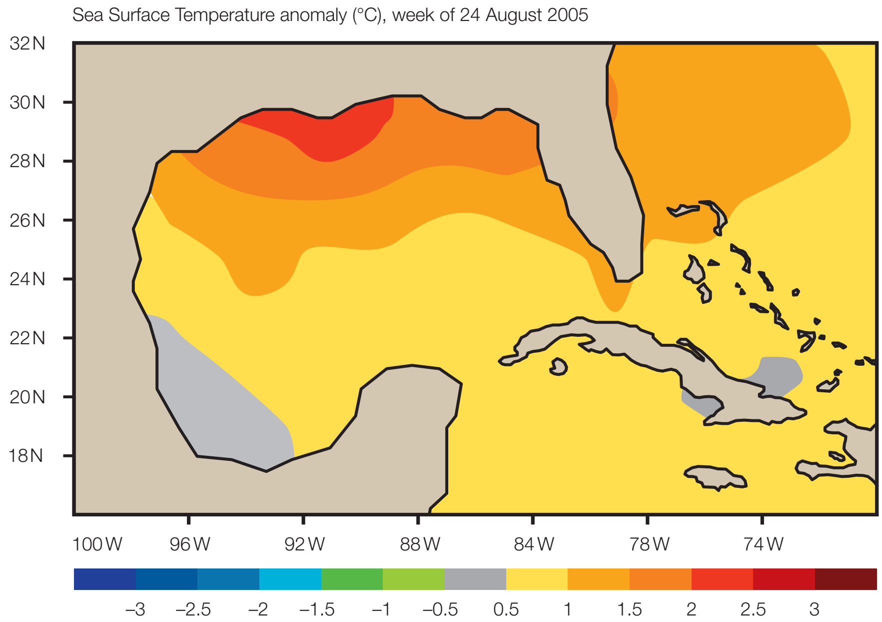
2.1 Factors influencing tropical cyclone activity

Tropical cyclone development (TC) is mainly influenced by the following factors[2]: a high Sea Surface Temperature (SST) as the primary source of energy and moisture; a high temperature gradient in the atmosphere; a pre-existing disturbance; and low vertical wind shear in the troposphere.

The SST and hurricane wind speeds are strongly correlated. Figure 1 shows a large SST anomaly in the Gulf of Mexico in the week that Hurricane Katrina formed. Shortly afterwards, Hurricane Wilma developed into the most powerful hurricane ever recorded.

[1] Source: NOAA tropical cyclone report on Hurricane Katrina
[2] Source: NOAA (National Oceanic & Atmospheric Administration)

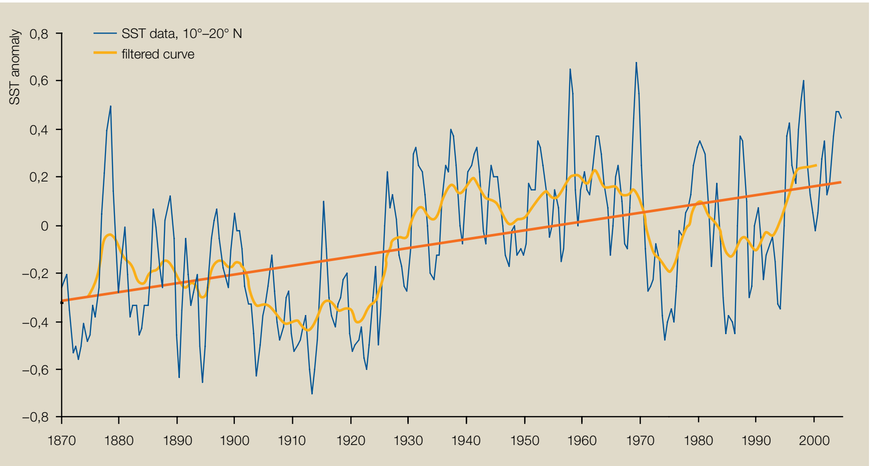
Figure 1
Sea Surface Temperature (SST) anomaly [°C] of the week of 24 August 2005 in the Gulf of Mexico, base period 1971–2000; anomalies of more than 2°C can be observed for the Gulf of Mexico especially in the northern part. Source: NOAA-NCDC.



2.2 Observed changes in tropical cyclone activity

The average global surface temperature rose by approximately 0.7°C over the last century. Global warming over the last few decades has mainly been attributed to man-made activity. The signal of human-induced climate change has also been detected in a global warming of the oceans[3]. It has been established that tropical Sea Surface Temperatures (SST) – one of the most important factors for the development and the intensity of Tropical Cyclones (TC) – have risen globally by about 0.5°C since 1970. In the North Atlantic, average temperatures rose by 0.4°C in the period 1870–1999 (Figure 2).

Figure 2
Sea Surface Temperatures 1870–2004 in the tropical North Atlantic 10°–20° N (excluding the area west of 80° W). Anomalies relative to 1961–1990. Data taken from Kevin Trenberth, "Uncertainty in Hurricanes and Global Warming", Science, 2005. Orange line: linear trend; thick yellow line: filtered curve.



Human-induced changes notwithstanding, the SST of ocean basins also fluctuates as a result of natural cycles. In the North Atlantic, this phenomenon is known as the "Atlantic Multidecadal Oscillation (AMO)", which in the 20th century showed a periodicity of about 65 years[4]. The associated cold and warm phases are characterised by a difference of approximately 0.5°C in the SST. The latest warm AMO phase started in 1995 and is expected to last for another 10 to 20 years[5].

Recent studies have found evidence of a correlation between the intensification of tropical cyclones (TC) and these changes in the SST. The number of category 4 and category 5 TCs in the North Atlantic increased from 16 in the period 1975–1989 to 25 in the period 1990–2004. Some studies claim that this increase can be explained by the AMO alone[6]. However, the number of category 4 and 5 TCs has increased across all ocean basins (Figure 3).

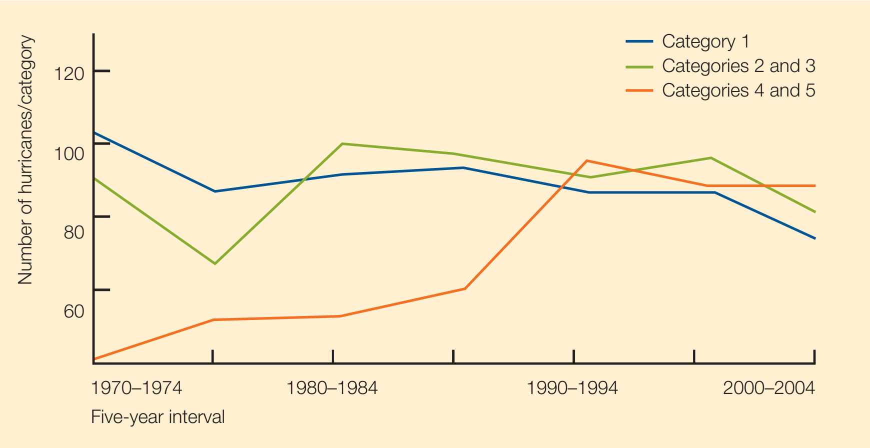
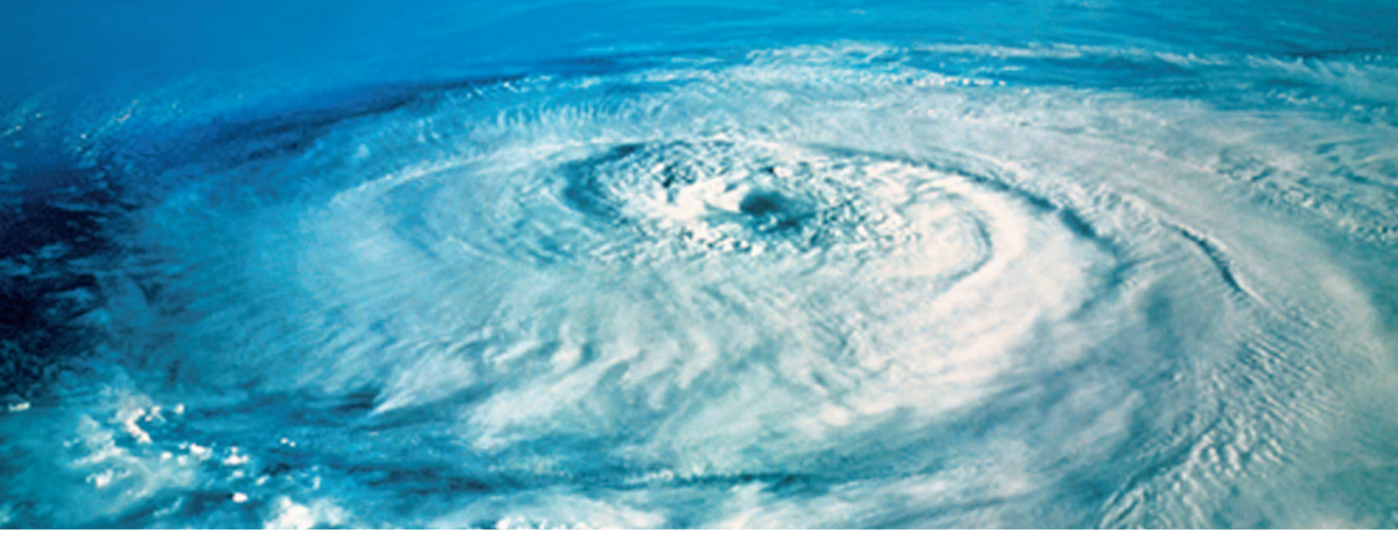


Figure 3
Hurricane intensity rising over the past 35 years. Throughout the world, intense tropical cyclones (categories 4 and 5 on the Saffir-Simpson scale) increased from 40 per five-year period (1970–1974) to 90 (2000–2004). While category 1 hurricanes slightly decreased over this 35-year period, the linear change in categories 2 and 3 is very small. The graph shows the total number of hurricanes per category over the last 35 years by five-year period[7].

A comparison of corresponding AMO phases since 1900 suggests that the average number of tropical cyclones in the North Atlantic has increased across cycles. The average number of major hurricanes rose slightly from 1.4 per year in the 1903–1925 cold phase to 1.5 per year in the 1971–1994 cold phase. A similar but more pronounced trend can be derived by comparing the 1926–1970 warm phase (average 2.6 major hurricanes per year) to the current warm phase, which started in 1995 (average 4.1 major hurricanes per year).

However, several caveats should be borne in mind. Over time, the methodologies and techniques used to observe tropical cyclones in the North Atlantic have improved. Major milestones were the introduction of systematic airborne monitoring after 1945 and satellite surveillance in the 1960s. In addition, the average value for the recent warm phase derives from just 11 years of data (from 1995) compared to 45 years of data for the 1926–1970 warm phase.

[3] Barnett et al., Science, 2005
[4] J.R. Knight et al., GRL, 2005
[5] The previous period of high activity was 1926–1970 and the previous periods of low activity were 1903–1925 and 1971–1994 (see Figure 2)
[6] Pielke, Landsea, Mayfield, Laver, Pasch, BAMS, 2005
[7] Webster et al., Science, 2005



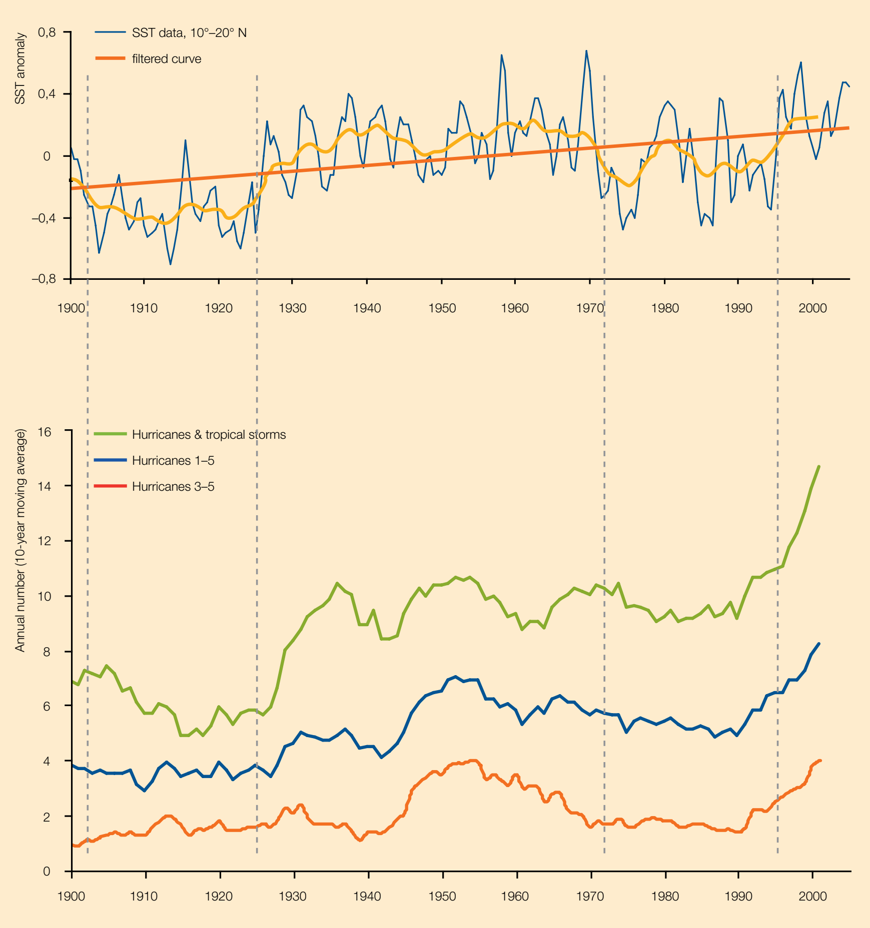


Figure 4
Annual number of tropical cyclones in the North Atlantic and Sea Surface Temperature (SST) anomaly. Upper graph: see Figure 2 for details. Lower graph: 10-year running mean curves for annual cyclone numbers: major hurricanes (orange); all hurricanes (blue); and all named tropical cyclones (green). Data from NOAA and UNISYS.

Science is currently not able to show the precise extent to which the current SST warming and increased hurricane activity can be attributed to the natural cycle and to what extent they are part of a human-induced trend.

In addition to interdecadal cycles, interannual variations of tropical cyclone tracks have also been observed. In the North Atlantic, for instance, tropical cyclones are influenced by the “El Niño Southern Oscillation (ENSO)” and the “North Atlantic Oscillation (NAO)”. ENSO influences the vertical wind shear and therefore the development of hurricanes. During El Niño events, the increased vertical wind shear reduces the number of hurricanes. At present a neutral ENSO state prevails. The NAO influences the track of the hurricanes and contributes to interannual hurricane landfall variation. A negative NAO index favours hurricane tracks towards the Caribbean Islands and the US mainland[8].

2.3 Predicted changes

Current understanding of tropical cyclone formation is still limited. Models are therefore not able to reliably predict future changes in the frequency of tropical cyclones owing to global warming. Nevertheless, it is plausible to expect that a continued rise in the SST will both increase the geographical area of TC formation and extend the development season. There is, however, much better scientific understanding of cyclone intensity and how global warming will affect this to an as yet unknown extent[8]. The SST is predicted to rise by a few degrees during the 21st century.

Regardless of any human-induced change, the current AMO warm phase is expected to continue for another 10 to 20 years. As a result, both the frequency and the intensity of tropical cyclones in the North Atlantic will continue at above-long-term levels.

2.4 Conclusions

The recent period of increased tropical cyclone activity most likely reflects the effects of both natural climate variability and a superimposed global warming trend due to human causes. At present, however, it is not possible to state precisely how much each of these factors have contributed to the increase.

Both of these factors imply that the current phase of increased Atlantic hurricane activity is set to continue for at least another 10 to 20 years. To maintain a sustainable business model, the insurance industry needs to reflect this development in its risk management models and in determining the "costs of goods sold".

3 Hurricane seasons 2004/2005 and the insurance industry

The insurance industry has coped well with two consecutive years of unprecedented catastrophe losses. This is proof of the industry's strong capital base and good risk management practice.

We must not, however, become complacent. Indeed, the last two hurricane seasons have highlighted areas where changes and improvements are needed:

- There has been enormous progress in the industry's ability to model natural catastrophes over the last few years. But models are by no means perfect; by design, they are a simplification of very complex processes. Prudent risk management requires underwriters to understand the key assumptions underlying the models, which ultimately determine the results. For instance, the industry had generally underestimated the US storm surge risk associated with the 2005 events. Underwriters tend to focus on recent experience in their assumptions, although history can always teach us something: in 1900, Galveston was

[8] Knutson et al., Journal of Climate, 2004

flooded by a storm surge which today would cause insured losses of several tens of billions of US dollars. Strong risk management requires a continuous "feedback process" that refines and adapts risk management models, assumptions and processes as new information emerges.

- The quality of exposure data for large corporate risks needs to improve significantly, in particular with regard to precise geographical coding, building structures and representation of actual values. In the case of Katrina, many insurance portfolios were coded with an average risk quality relying on generic, zonal geographic information. The CRO Forum believes that governments and regulators could play a more active role in promoting improved data standards.

- There is a non-linear size and time dependency for demand surge costs (loss inflation caused by the spiralling demand for construction material and other goods and services). The US wholesale price of CDX plywood jumped by 50% from USD 10 for August deliveries (prior to Katrina) to USD 15 per sheet for October deliveries (post-Katrina). Across all goods and services, Hurricane Katrina's demand surge was unusually high at an estimated 40%, compared to Hurricane Andrew's 10%. This was the result of the resource constraints arising from the 2004 hurricane season and the sheer size of Katrina (Katrina destroyed ten times as many houses as Andrew).

- The influence of man-made elements on natural disasters is bigger than previously thought. The quality of flood defence management (or lack thereof) increased the conditional probability of flooding, and the slow reaction of emergency management led to an increase of insured losses through looting and fire following. The non-enforcement of building codes resulted in low building quality and consequently higher vulnerability of the insured structures.

- Large natural catastrophes are likely to have a much greater multi-line component than previously experienced. In the case of Katrina, pollution has resulted in 15 claims notifications for OCIL (Oil Casualty Insurance Limited). Numerous professional malpractice claims have been filed, e.g. claiming that buildings were improperly designed and built. Even if coverage is ultimately denied and the litigant allegations are baseless, defence costs are reimbursable under comprehensive general liability insurance policies.

- Claimants from several states in the US are seeking payments from insurance companies for flood damage from Katrina, despite the fact that residential and small commercial policies have standard flood exclusions. Defendants are accused of intentionally causing injury to policyholders by wrongfully refusing to pay water-damage claims caused by Hurricane Katrina. This risk of (legal) change increases the difficulty for insurers in calculating their exposure correctly and in charging rates that are commensurate with the underlying risk.

4 How has the insurance industry responded?

As has been the case after each significant event, insurers have taken action and refined their underwriting approach and models in order to obtain a more accurate calculation of their exposure and determine the "cost of goods sold" in a way that is more commensurate with the underlying risk.

Natural climate variability and the superimposed effects of human-induced climate change have taken centre stage in the re-evaluation of current hurricane models. Many insurance companies were quick to adapt their internal models to take account of the increased hurricane activity in the North Atlantic and the better understanding of storm surge risk. The result has been substantially higher annual expected losses for the coming years. In addition, insurers have improved their methods to account for exposure-related elements, such as demand surge costs. Third party modellers have been requested to make explicit their assumptions on man-made factors, such as flood defence management and the quality of levees and dams. The industry has spoken out clearly on the degree of transparency it expects from modelling firms.

The insurance industry will continue to insist on improved quality and increased transparency of exposure data. Large corporate risks insurers have already dedicated a lot of effort and resources to data collection and the adoption of improved standardised formats when exchanging accumulation exposure data is a "must". The CRO Forum has reiterated the key role and responsibility of insurance intermediaries when collecting, formatting and exchanging underwriting data, but also believes that governments and regulators could play a more active role in promoting improved data standards. The proliferation of automatic electronic exchange standards (ACORD, CRESTA) will also be further advocated and supported.

Despite being the biggest insured loss event to date, Hurricane Katrina was by no means the worst case imaginable. A "perfect storm", expected to hit the Caribbean and the US mainland once every 200 years, could generate insured losses well above USD 100 billion. By learning from Katrina, carefully limiting exposure, diversifying risks globally, using the full array of risk mitigation options available (reinsurance, portfolio swaps, insurance linked securities, etc) and ever-sophisticated modelling, the private insurance industry is in a position to weather such an event, too.

However, the sheer magnitude of climate change could in future impact a large number of industries to such an extent that sustainable insurability may ultimately be put into question.

This raises important issues for society as a whole and might require adaptation measures such as public-private partnerships and, of course, adequate public actions on climate change issues.

The CRO Forum's Emerging Risk Initiative

This position paper is supported by the CRO Forum, which is an action-focused independent industry network of thirteen European insurance companies with the objective to identify concrete issues of some urgency and to finance research studies to clarify these issues. The results of these studies are made available to wider audiences through the ART of CROs meetings and the CRO Assemblies of The Geneva Association.

The Emerging Risk Initiative (ERI) was launched in 2005 to raise awareness of major emerging risks relevant to society and the insurance industry. Emerging risks are risks which may develop or which already exist that are difficult to quantify and may have a high loss potential. Further, emerging risks are marked by a high degree of uncertainty; even basic information, which would help adequately assess the frequency and severity of a given risk, is often lacking. Examples of such risks include climate change, asbestos liabilities, genetic engineering and nanotechnology.

Insurers have extensive experience in assessing risks. But the ever-faster changing risk landscape and its increasingly complex and interconnected risks are making new demands on all stakeholders – be they legislators, regulatory authorities, the scientific community, the private sector or civil society – to assume their respective responsibilities in the risk management process.

Governments bear key responsibility for risk mitigation in society, such as avoiding development in high-risk zones, building and maintaining flood defences, developing and enforcing construction codes or establishing emergency management organisations. Jointly with the regulatory authorities, they play a vital role in ensuring the viability of private insurance by creating appropriate legislative and regulatory frameworks. Yet, a systematic approach to risk management has, to date, often been lacking at governmental level, affecting a nation's ability to identify, assess and manage global risks. Professional and systematic risk management would enable governments to prioritise risk mitigation and response measures more adequately.

Individual or corporate insureds need to participate in sharing the risk of financial losses. A significant retention of potential loss is a powerful incentive to prevent or mitigate losses and reduces administrative costs by absorbing small, high-frequency losses. The insurance industry can create incentives for these mitigation measures by raising awareness of the cost of having undiversified peak exposures. Individuals who accumulate large values in exposed areas, such as along coastlines, should be aware of the cost of risks involved and be made to participate financially in the risk. The insurance industry can further add value by contributing risk analysis and management expertise to help ensure that entities and regulatory authorities handle their risks optimally.

By absorbing financial and insurance risk, the insurance industry plays an indispensable role in today's economic system. If this is to continue in the future, the industry must minimise surprises. It is therefore crucial to identify and communicate emerging risks to a broader community, thereby fostering a stakeholder dialogue with representatives of a community bound by a shared risk.

The International Risk Governance Council, IRGC (www.irgc.org) is one of the platforms designed to facilitate global debate. Established in 2003 as an independent foundation, the IRGC is a public-private partnership which focuses on a transsectoral and multidisciplinary approach to global governance issues.

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