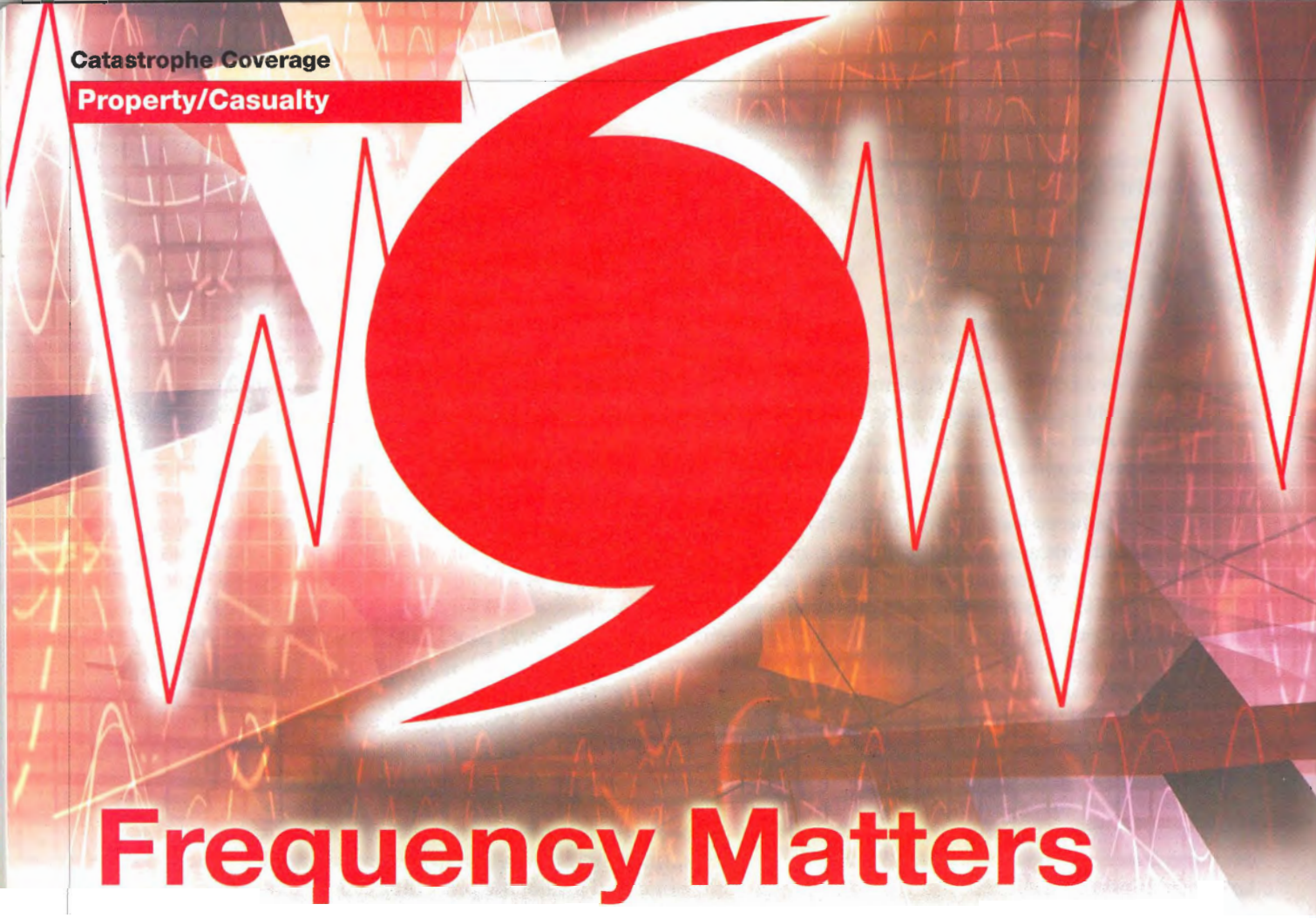


Frequency Matters

Measures taken after Hurricane Andrew helped as Florida endured four major hurricanes in 2004. But, it is still difficult to prepare for a season that catastrophic.

by Rade Musulin and John Rollins

Remember the last bad season? In 1992, Hurricane Andrew imparted many lessons and exposed several fundamental insurance problems. At the root of many issues was a failure to properly quantify the risk of major disasters. This shortfall manifested itself in many ways: inadequate rates, over-concentrations of exposure, shaky capital and catastrophe reinsurance structures, a vulnerable housing stock not attuned to the true cost of hurricane risk, and inadequate incentives to attract the capital required to back an insurance system exposed to tens of billions of dollars in possible catastrophic losses.

Photo illustration by Timothy Shay

Rade Musulin is Vice President-Operations for the Florida Farm Bureau Insurance Cos. John Rollins is a consulting actuary with Watson Wyatt Insurance & Financial Services in Gainesville, Fla.

Andrew literally blew this system apart, causing the insolvency of 11 insurers and serious capital shortfalls at many others. Close behind were price increases of more than 100% (more than 300% in some highly exposed areas) and a severe supply shortage of private residential property insurance. Florida's property residual markets mushroomed to well over a million risks. Private industry and public officials agreed that basic structural changes were needed.

Addressing the Problem

Fortunately for its citizens, in the 12 relatively quiet years between Andrew and the devastating quadruple blows of Charley, Frances, Ivan and Jeanne, Florida substantially shored up its insurance system. Important changes included:

- **Significant advances in catastrophe simulation tools.** The insurance system is built upon the ability to reasonably forecast both expected and possible losses; that is, the long-term

Key Points

- Post-Hurricane Andrew reforms improved the Florida insurance system's response to the storms of 2004.
- Insurance pricing must be transparent enough to withstand regulatory and public review.
- The 2004 season taught insurers that hurricane frequency must be considered along with severity in every aspect of the property insurance system.

average as well as the worst case scenario. Andrew exposed old methods, such as trending historical hurricane loss totals, as ill suited for managing and pricing hurricane exposure. Modern computer-based catastrophe simulation models provide big-picture and real-time information in support of ratemaking, exposure management and public policy decisions crucial to the insurance system. Prices have adjusted to the improved information, rising after Andrew in most areas of the state and remaining stable once in line with scientific indications.

• **The Florida Commission on Hurricane Loss Projection Methodology**. Insurance pricing must be transparent enough to withstand regulatory and public review, which poses an obstacle to the use of sophisticated, proprietary simulation programs. To validate catastrophe models, Florida chartered a commission comprising experts in statistics, meteorology, engineering and actuarial science. These professionals annually evaluate the models and formulate detailed standards for their output.

• **Improved solvency evaluation**. A.M. Best Co. and other rating agencies have begun questioning insurers more carefully about catastrophic exposure. In its Supplemental Rating Questionnaire, A.M. Best includes questions about the insurer's possible catastrophic losses and how they are funded by capital and reinsurance. For their part, insurers now use Geographic Information Systems technology to study and document aggregations of exposure in specific areas, which greatly improves the output of catastrophe models.

• **New sources of capital**. Created in 1993, the Florida Hurricane Catastrophe Fund is a public, tax-exempt, residential property reinsurer with the power to issue long-term debt to finance its obligations and to assess all Florida policyholders to service such debt. By 2004 it had grown to provide $15 billion of affordable reinsurance to the system. In addition, significant new sources of private capital have appeared, including traditional reinsurance enterprises in Bermuda and new "catastrophe bonds" sold directly to capital market investors.

• **Consolidation of residual markets**. Florida's two existing property residual markets were combined into a new tax-exempt entity called Citizens Property Insurance Corp., which also finances its obligations through premiums, debt and assessments.

• **Stronger building codes**. In 2001, Florida enacted some of the toughest building codes in the country in most parts of the state. The 2004 season vividly demonstrated that structures built to code withstood strong winds much better than older structures.

• **Risk-sharing between insurers and consumers**. In exchange for lower premiums, insurers replaced traditional $500 hurricane deductibles with percentages of insured value. For example, a 2% deductible on a $100,000 dwelling amounts to $2,000, but only applies in a hurricane-related loss. In the storms of 2004, about 15% to 20% of the loss was borne by consumers through deductibles. However, the fact that thousands of consumers incurred two or three deductibles in 2004 has led public officials to rethink the acceptable level of risk-sharing between insurers and consumers.

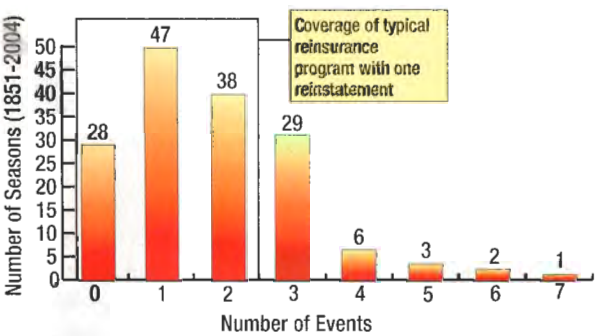
• **Formation of Florida subsidiaries**. Major national insurers realized after Andrew that it was not prudent to risk their national operations on a huge loss in Florida, particularly in a rate regulatory environment with return on capital strictly limited. Consequently, most insurers formed Florida subsidiaries with sufficient capital and reinsurance to withstand a 100-year event. These insurers tend to rely heavily on the FHCF.

Did the Changes Work?

The performance of the Florida insurance system in 2004 was mixed. There is no question that the system survived the four storms in far better shape than would have the pre-Andrew system. In fact, after the first two storms, each of which ranked in

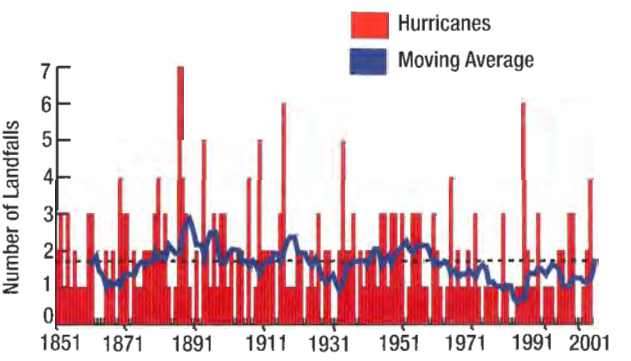
A History of U.S. Hurricane Landfalls

In 41 of 154 seasons (27%), an insurance program designed for three or more events would have been required to protect policyholders. A year like 2004 or worse happened in 12 of 154 (8%) seasons.



U.S. Hurricane Landfalls Year by Year

The 10-year moving average has lagged the long-term average of 1.74 landfalls per year since the early 1960's.



Source: Rade Musulin and John Rollins, National Hurricane Center Database

the worst 10 in U.S. history, insurers were saying that the system worked well, and were predicting few disruptions in 2005.

Ivan and Jeanne changed those forecasts. One insurer has entered state supervision, and several Florida subsidiaries of national insurers have suffered rating downgrades and/or will require capital infusions from their parent companies. A special session of the Florida Legislature was scheduled for December to address serious problems exposed in 2004, including the applicability of the state's hurricane fund to several moderate events, the effect on consumers of incurring multiple deductibles in a single year, and an ill-advised exemption from the strict building code for most of the Florida panhandle.

Photo courtesy of NOAA

FOUR'S A CROWD: Hurricane Jeanne, Hurricane Karl, Tropical Storm Lisa and Tropical Storm Ivan, previously a hurricane, were all visible on Sept. 23, 2004.

The Lesson of 2004: Frequency Matters

The post-Andrew system was designed with an eye toward managing the consequences of one severe event striking one area. The key object lesson from the 2004 season is that hurricane frequency must be considered along with severity in every aspect of the property insurance system. The salutary effects of all of the recent advances in catastrophe modeling, exposure management, public reinsurance and risk-sharing were muted in 2004 by an incomplete view of the danger. Insurers scrambled to replace private reinsurance in lower layers and protect their surplus after reinstatements ran out, while the Florida Hurricane Catastrophe Fund, designed to operate above a substantial retention per event, did not respond to the need for working capital. For their part, consumers were stunned by multiple per-event hurricane deductibles. And claims departments faced the logistical nightmare of dodging hurricanes while responding to millions of damaged properties in areas more than 700 miles apart.

Probable Maximum Loss

Quantitatively, many insurers focused too intently on managing a probable maximum loss—a worst-case scenario of a specified degree, for a specific event. For example, a 50-year probable maximum loss is the total loss for a single storm, where models indicate an event at least that severe will occur about 200 times in a 10,000 year simulation or one out of every 50 years. Note that the model does not imply it will occur with cyclical regularity—two 50-year storms may occur in back-to-back simulated years, without another for the next 200. The "return period" of 50 years represents only a long-term average frequency.

Probable maximum loss is an incomplete metric for managing risk over a time horizon because it ignores loss frequency. Its primacy as a risk metric led many insurers, rating agencies and public policy planners to focus their catastrophe management strategies on "another Andrew," rather than a combination of smaller events that generated a similar season loss total.

A simple example illustrates the problem. Consider the fictitious Industry Insurance Co., writing 100% of the residential property risk in Florida. Say it incurred the following losses in Charley, Frances, Ivan and Jeanne, respectively (based roughly on early November Property Claims Services estimates): $4.8 billion, $3.1 billion, $2.7 billion and $2 billion, for a total loss of $12.6 billion.

The Florida Hurricane Catastrophe Fund covers 90% of $15 billion excess of a $4.5 billion retention, with a 5% loss adjustment expenses benefit. In a single $12.6 billion event, Industry Insurance Co. would recover about $7.7 billion, leaving a net loss of $4.9 billion. But in the four actual events of 2004, the multiple per-event retentions would have limited its recovery to $0.3 billion, leaving $12.3 billion in retained losses. Managing by probable maximum loss, Industry Insurance Co. might have reasoned that $10 billion in surplus (in excess of statutory minimums) would let it withstand "two Andrews" in consecutive years. After 2004, Industry Insurance Co. would have been severely impaired, with net losses exceeding free capital.

Most insurers buy additional private reinsurance. The same flaw, however, exists with most traditional reinsurance designs, which provide relatively large vertical limits and usually a single "reinstatement." These covers leave insurers vulnerable to significant surplus losses in high-frequency periods due to accumulations of retentions and exhausted limits in lower layers. Many Florida insurers found themselves hemorrhaging capital in lower layers in 2004 while vertical limits below their probable maximum loss remained untouched.

Catastrophe models clearly show that many simulated years contain multiple events, a projection which squares with the historical record. Since 1851, there have been three or more landfalling hurricanes in Florida on six occasions, while for the United States as a whole this has occurred 41 times, over 25% of the years. (See "A History of U.S. Hurricane Landfalls" on page 69.) For Florida, the models consider the frequency of the storms that occurred during the 2004 season only about a 50-year phenomenon.

Probable Season Loss

A metric that incorporates frequency and severity of loss—call it a probable season loss—is a better tool for hurricane planning decisions. On a gross basis, an insurer should organize the catastrophe model output by season—or

some other time horizon—as well as event, focusing on the number of events and the total season losses impacting each layer of reinsurance in a worst-case scenario. Further, the insurer must convert each simulated season total from a gross to a net basis by applying all the parameters of its reinsurance program, including per-event retentions, coinsurance, limitations on reinstatement and reinstatement costs. This leads to a new ranking of worst-case scenarios by net season loss, which allows an insurer to determine the probable surplus loss to its bottom line.

We predict that most Florida insurers would find that a 50-year event looks a lot like Andrew, while the 50-year season on a probable season loss basis looks distressingly like 2004. We also predict that insurers will find that a diagram of the optimal reinsurance program looks less like the traditional "skyscraper" and more like a "pyramid," with more reinstatements available in lower layers and fewer in the higher layers covering "the big one."

The structure of the Florida Hurricane Catastrophe Fund makes probable season loss analysis particularly important for Florida insurers. In 2004, the state fund provided season aggregate cover of $15 billion in excess of a per event retention of $4.5 billion, allocated to an insurer based on its share of the total premiums paid to the state fund. There is no "reinstatement" of limit after an event as is customary with private market excess-of-loss contracts. An insurer managing its Florida exposure must consider the chances of the state fund being exhausted in one or more storms, and other capital must be available to cover shortfalls. Probable season loss helps insurers better understand the threats to the state fund's season aggregate cover and to plan accordingly.

It is important to note that probable season loss is far more sensitive to severe thunderstorm perils than is probable maximum loss. An insurer suffering two severe thunderstorm events and one hurricane might absorb three retentions (or worse, if a reinsurance program only had one reinstatement) and experience a large net season loss when its probable maximum loss depended almost solely upon the hurricane loss. This is possible; consider a 13-month period when Florida was hit with Central Florida tornadoes in early 1992, Hurricane Andrew in August 1992 and the "Storm of the Century" in early 1993.

For private reinsurance programs, probable season loss analysis will generally indicate the need for more low-layer limits, increased use of aggregate annual deductibles on lower layers, and use of aggregate stop-loss covers to supplement excess-of-loss covers. The latter, known as "top and drops," provide protection in either a single severe event exhausting excess-of-loss layers, or in an accumulation of retained losses from several events. These allow an insurer to set a "season retention" in relation to its free capital and control the chance of bottom-line losses in excess of its risk tolerance, with the probable season loss cover priced in an actuarially sound manner using catastrophe models.

The idea of using a probable season loss concept to manage exposure is not new; for many years it has been discussed in actuarial circles and incorporated into risk analysis by many sophisticated insurers and reinsurers. Just as it took Andrew to force widespread acceptance of catastrophe modeling, however, the events of 2004 will require that probable season loss become more strongly integrated into insurer risk management programs and public policy decisions.

Modeling Challenges

The intellectual shift to probable season loss exposes several outstanding challenges in catastrophe modeling. Models should:

- **Do more to reflect climatological data in short to mid-term forecasts.** There is a difference between simulating the next 10,000 years once and simulating "next year," given current meteorological conditions, 10,000 times. The latter is more useful in predicting next year's losses. For example, the probability of three or more storms in a year is heavily influenced by where we are in an acknowledged multidecade cyclical pattern of hurricane activity.
- **Adjust demand surge loadings to reflect multiple storms in a year.** For Hurricane Jeanne it seems obvious that a demand surge factor based on a $20 billion storm, not a $3.3 billion one, should have been used.
- **Handle better the interaction of storm damage estimates in a season.** Clearly, Frances and Jeanne were not independent events in terms of insured losses.
- **Facilitate the analysis of multiple perils (hurricane and severe thunderstorm) by improving output files and considering the correlation of these events due to long term climate cycles.**

Overall, post-Andrew reforms improved the Florida insurance system's response to the storms of 2004. The new building codes, public reinsurer, catastrophe modeling technology and residual market all performed reasonably well. Yet significant vulnerabilities remain. Challenges include:

- Replacing probable maximum loss with probable season loss as the accepted risk metric.
- Re-examining the Florida Hurricane Catastrophe Fund retention structure.
- Redesigning private reinsurance programs to properly manage probable season loss.
- Updating rating agency solvency tests to reflect probable season loss.
- Improving catastrophe modeling technology to address drivers of probable season loss, such as hurricane cycles, multievent demand surge and interaction of damage among storms.

Florida's insurance system required revolutionary change after Andrew. Today's challenges require an evolution in the intellectual basis for managing catastrophe risk which considers frequency in addition to severity. Then, the fundamentally sound reforms enacted after Andrew may work to their potential.

For more information: The authors wrote a technical paper in 2001 which discussed many of the issues in this article. See Musulin, Rade T., and Rollins, John W., "Optimizing a Multi-Season Catastrophe Reinsurance Program With Public and Private Components," *Casualty Actuarial Society Forum*, Summer 2001. BR