2004 – 2005 Hurricanes
Impact on U.S. General Aviation Insurance

PartnerRe

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The seven major hurricanes of the last two seasons have produced substantial losses to the General Aviation insurance industry.

With news pictures of the aftermath of Katrina still vividly on our minds, we all remember the enormous devastations created by hurricanes when making landfall, particularly in populated areas. Whilst relatively rare events for the overall insurance industry, one must get the impression that there has been a marked increase of incidents during the past two years in terms of frequency as well as severity. Contrary to historical experience, the General Aviation (GA) insurance industry has begun to suffer above-average losses from such events despite the fact that aircraft are basically movable property. The question therefore arises whether recent history should be considered as a one-time exception or be taken into account when assessing future exposure within this class of business.

If a hurricane is lined up to make landfall, the majority of aircraft are usually flown out of the area where the storm is suspected to hit. This is particularly true for large aircraft but will normally be done with small GA aircraft as well. Apart from the occasional aircraft loss by accident during or following evacuation, the aviation community generally used to escape unscathed. However, the seven major hurricanes of the last two seasons have produced substantial losses to the GA insurance industry, notably in the Private, Business and Pleasure (PB&P) segment, the vast majority of which consists of single-engined, piston-powered aircraft.

In an effort to incorporate and view the current climatic situation and hurricane activity in a long-term context, this brochure attempts to evaluate the impact of the last two years' hurricanes on the PB&P segment. It is our intention to continue monitoring and analyzing hurricane losses to the GA industry in order to assess future loss potential.

Background

2004 was already an exceptional year in terms of frequency, with 9 hurricanes in the Atlantic basin compared to a seasonal average of 6 over the last 50 years. More remarkably, the U.S. East Coast was pounded by 6 hurricanes, a number widely surpassing the long-term average of 1.6 landfalls per annum. If this were not enough, 2005 produced even more storms than did the preceding year, breaking several of the all-time records relating to hurricane activity in a single season. During 2005, 15 hurricanes spawned in the Atlantic basin (previous record was 12 set in 1969) and 4 intense hurricanes (category 3 or greater) made landfall in Mainland U.S. (previous record was 3) .

Note 1
Intense landfalling hurricanes:
2004: Charley, Ivan, Jeanne. The intensity of hurricane Frances was just below category 3. However, Frances caused considerable aviation losses and is considered in the loss analysis presented later.
2005: Dennis, Katrina, Rita, Wilma. Contrary to Frances, Dennis caused almost no losses to the aviation industry.

What does this recent history tell us? Is it an indication of what we can expect in the forthcoming five or ten years? The following section seeks to outline why the frequency and severity of Atlantic hurricanes fluctuates over time, and what the insurance industry should anticipate in terms of hurricane activity in the upcoming seasons.

Climatic Factors Influencing Hurricanes

Several climate related signals are assumed to have an impact on the variability in hurricane activity. Their impact results from their effect on the heat content of the ocean, wind shear phenomena or large-scale weather patterns. They exhibit variability over different time periods, from short intra-annual variations to longer-term changes stretching over decades. The most cited climatic signals are the Atlantic Multidecadal Oscillation, the El Niño Southern Oscillation, the North Atlantic Oscillation and the Quasi Biannual Oscillation.

The Atlantic Multidecadal Oscillation (AMO) is often named as an important signal impacting hurricane variability over decades. It consists of an irregular oscillation in sea-surface temperature over the North Atlantic. In a warm phase, hurricane activity is enhanced as the sea surface provides more energy for the formation and intensification of hurricanes. Figure 1 shows the historical record of AMO with a fluctuation of warm and cold phases. In a warm phase, the sea-surface temperature is above normal climate values, which is reflected in the figure as a positive temperature anomaly. The signal shows a tendency for oscillations over several decades. For instance, the period from about 1965 to 1995 was a cold phase, while we have now experienced a warm phase for the last ten years.

Figure 1

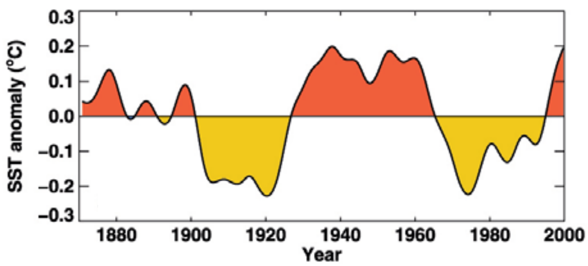

Figure 1
North Atlantic sea-surface temperature anomalies related to the AMO index (Source: Knight et al., 2005)

The AMO, however, only explains part of the variability in Atlantic hurricane activity (Shapiro and Goldenberg (1998) suggest only 10%).

The El Niño Southern Oscillation (ENSO) is another climatic signal believed to influence tropical cyclogenesis. Correlated with increased dry air over the tropical North Atlantic, which tends to hinder hurricane formation, the variation in the ocean-atmospheric system of the Pacific Ocean operates as a remote control on North Atlantic hurricane activity. It impacts mostly the year-to-year variability in tropical storm activity.

The North Atlantic Oscillation (NAO) is a third signal said to determine the number of landfalls in the U.S. According to some scientists, a positive NAO is accompanied by a trough along the U.S. East Coast, which serves to deflect hurricanes away from the coast. This situation has prevailed over the period 1995 to 2003 and led to fewer landfalling hurricanes despite the strong underlying activity in the Atlantic basin. In a negative NAO phase, however, the trough moves further to the north, leaving the way open for hurricanes to move straight towards Florida and the Gulf of Mexico. It is worth noting that the NAO is an extremely noisy signal that is currently unpredictable.

The Quasi Biannual Oscillation (QBO) is a measure of wind speed in the tropical stratosphere. These winds shift from westerly to easterly about every two years or so. When blowing from the west there is a tendency that tropical storm growth is enhanced.

The exact interplay between all these factors is still uncertain and hence the prediction of hurricane activity for future seasons is very difficult. Even if we assume that the AMO is the major factor, researchers have little understanding of the physics behind the oscillation to know how long the current warm phase could last. The other climatic signals (i.e. ENSO, NAO and QBO) have differing periods of oscillation and may either counteract the effect of the AMO or, conversely, work to further enhance hurricane activity.

Post 2005 Outlook for Atlantic Hurricane Activity

One approach to estimate the level of Atlantic hurricane activity in upcoming years is through a statistical analysis of past patterns. Table 1 shows statistics of U.S. hurricane landfalls for the last 135 years for both warm and cold AMO phases, together with the overall averages.

Table 1

AMO Phase	Category 1 or more	Category 3 or more
Warm	2 ± 0.2	0.78 ± 0.1
Cold	1.5 ± 0.2	0.49 ± 0.1
Average	1.8 ± 0.2	0.65 ± 0.1

Table 1
Statistics of Mainland U.S. landfalling hurricanes (1871-2005).

Most scientists assume that over at least the next five years, the North Atlantic Ocean will continue in an AMO warm phase. Thus, for planning purposes, it makes sense for the insurance industry to expect enhanced hurricane activity in the Atlantic basin over this time horizon compared to the long-term average. For example, category 3 hurricanes making landfall in the U.S. are expected to be about 20% more frequent in the upcoming years compared to the long-term average. This frequency is also perceived to increase by some 59% compared to the 30-year period prior to 1995, when an AMO cold phase persisted. A note worth re-emphasizing, however, is that during any single upcoming season, other climatic signals (such as ENSO, NAO, QBO), and further effects from global warming, may either counteract or further enhance the anticipated levels of activity.

In addition, the rising sea surface temperature observed in recent years, which goes beyond the level reached in previous cycles, may further exacerbate this increase in frequency. The above mentioned scenario does not consider this recent trend.

Hurricane Losses

The focus here will be on the PB&P segment, which, in our view, faces the biggest hurricane exposure within the Aviation insurance industry. Large aircraft are usually flown out of potentially affected areas. Small aircraft, however, can be exposed in cases where owner pilots may either not be in a position to take care of their mobile property in time, or where hurricanes change their path in an unexpected direction (e.g. Charley in 2004). As can be seen from Figure 2, small aircraft exposed to intense hurricanes may suffer severe hull damage.

Figure 2

Figure 2
Punta Gorda Air Terminal following Hurricane Charley - (Source: http://www.avweb.com/news/features/187931-1.html).

Table 2

	Number of intense land-falling hurricanes (category 3 or more)	U.S. PB&P Market Est. Premium Income (in USD million)	U.S. PB&P Market Loss caused by all hurricanes (in USD million)[2]	U.S. PB&P Losses in % of premium income of the respective year(s)
2004	3	405	25.5	6.3%
2005	4	426	55.5	13.0%
Total 2004 & 2005	7	831	81	9.7%

Table 2
Estimated market premium and losses in the U.S. PB&P segment caused by 2004 and 2005 hurricanes (Source: PartnerRe internal research).

Note 2
Total aviation related losses caused by 2004 and 2005 hurricanes are higher than the figures in Table 2. For example, a handful of business jets also suffered damage and collapsing hangars damaged some aircraft. However, for the purpose of this study, these losses have been excluded.

From the information collected and analyzed by PartnerRe, the premium income of the U.S. PB&P segment for 2004 and 2005 is estimated at USD 831 million combined. In the same period, the segment incurred hurricane-related losses amounting to approx. USD 81 million, roughly 10% of the respective premium income for the period.

Table 3 on page 7 shows the geographical distribution of all GA aircraft within the U.S., i.e. including higher valued turbine aircraft and business jets. However, given the fact that more than 80% of all aircraft units are single-engine piston powered, the relative distribution for PB&P should not differ significantly from the overall GA aircraft population. The table shows that only 26% of the U.S. GA-fleet is based in states effectively exposed to hurricane activity. Contrary to large jet aircraft flying all around the U.S., the segment of PB&P aircraft will usually be flown within relatively close proximity of their home bases. Therefore it is fair to assume that all aircraft registered in any one of those states may be subject to hurricane exposure – although we are fully aware that an aircraft based in Florida or along the “standard” hurricane path up the U.S. East Coast states, is more susceptible to damage than one based in Northern Texas where the likelihood of hurricane-related losses is remote.

This implies that the exposure of a given portfolio depends largely on the geographical diversification of the respective book of business. This factor has to be taken into account when assessing the perceived exposure to hurricane activity.

Table 3
Statistics of all General Aviation aircraft in hurricane exposed states
(Source: General Aviation Manufacturers Association – Statistical Yearbook 2005).

Table 3

Main hurricane exposed states	No. of General Aviation Aircraft 2004	% of exposed states	% of U.S.
Alabama	3'712	6.6%	
Florida	15'385	27.4%	
Georgia	5'490	9.8%	
Louisiana	2'721	4.9%	
Mississippi	2'563	4.6%	
North Carolina	5'602	10.0%	
Puerto Rico	319	0.6%	
South Carolina	2'271	4.1%	
Texas	17'999	32.1%	
Total	56'062	100%	26%
Rest of the U.S.	163'364		74%
Grand Total	219'426		100.0%

Assessment of Future Loss Potential

Below we present two different ways of assessing the future loss potential for the U.S. PB&P portfolio. It should be noted that the loss ratio is calculated on the total estimated U.S. PB&P premium as of today, i.e. including premium income of aircraft based in states that do not have any hurricane exposure at all. However, states not exposed to hurricanes might be susceptible to other natural perils, such as hail or tornadoes.

Perspective 1 – Normal Expected Annual Loss:
Assuming a warm AMO phase to persist in the upcoming years, the expected loss ratio for PB&P aircraft with respect to U.S. landfalling hurricanes is estimated at 1.1% (Table 4). This calculation is based on the observed 10% loss ratio for the seven intense hurricanes of 2004 and 2005 and an expectation of 0.78 intense hurricanes making landfall in the U.S. per year (see Table 1).

Perspective 2 – Extreme Expected Annual Loss:
To further explore the potential of future PB&B losses, we examine the return periods associated with having multiple intense hurricanes making U.S. landfall in a single season. This can be seen as a "stress test", i.e. how a certain scenario could potentially impact an insurer's balance sheet.

To achieve this, we estimate the probability for a given number of landfalling hurricanes in warm-AMO periods using a negative binomial distribution. This results in a 5.2 % annual probability (1 in 19 years) of having at least three U.S. intense landfalling hurricanes in a single season, which is what occurred in 2004. Likewise, the chance of repeating a season like 2005 with four intense hurricanes making landfall in the U.S. is estimated to be 1.2 % (1 in 80 years).

The loss ratios in Table 5 are calculated as follows: We estimate on average 0.78 landfalling hurricanes per year, which results in an estimated annual loss ratio of 1.1%. This means that three landfalling hurricanes would result in a 4.3% loss ratio and four landfalling hurricanes in a 5.7% loss ratio.

Table 4
Estimates of PB&P loss ratio – AMO warm-phase.

Table 4

Measure	Number of intense landfalling hurricanes	Country-wide Basis	Hurricane-exposed States only (26% of aircraft population)
Annual Average	0.78	1.1%	4.2%

Table 5
Potential future PB&P catastrophe loss ratio scenarios ("stress test") - AMO warm phase.

Table 5

Measure	Number of intense landfalling hurricanes	Country-wide Basis	Hurricane-exposed States only (26% of aircraft population)
19-year Return Period	3	4.3%	17.9%
80-year Return Period	4	5.7%	23.8%

Irrespective of the scenario used, researchers around the world currently expect Atlantic hurricane frequency to remain above the long-term average, thus providing reasonable grounds for insurers to pay attention to this particular exposure within the Aviation sector.

An individual insurers' measures for coping with this specific kind of risk depend on portfolio size and market share within the exposed states. Possible actions might, for example, include the following:
- Premium levy (hurricane-exposure surcharge for annual average losses)
- Strict exposure control by reducing or excluding risks based in hazardous areas
- Loss prevention by incentive payments (e.g. paying a fixed sum to indemnify the owner for costs associated with aircraft evacuation).

The accumulated storm losses incurred by the Aviation insurance industry during the last two years has – in our opinion – reached alert level. We therefore believe it is of paramount importance to closely monitor developments and to take appropriate steps to smooth out the anticipated effects of future hurricane losses in the PB&P segment of General Aviation.

References

General Aviation Manufacturers Association – Statistical Yearbook 2005, pages 20 – 21 http://www.gama.aero/dloads/2005GAMAStatisticalDatabook.pdf

Knight, J.R., et al., 2005. A signature of persistent natural thermohaline circulation cycles in observed climate. Geophysical Research Letters, doi: 10.1029/2005GL024233

Shapiro, L.J., and Goldenberg. S.B., 1998. Atlantic Sea Surface Temperatures and Tropical Cyclone Formation. Journal of Climate. Vol. II.

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