Batten down the hatches?

Karen Clark, of the eponymous firm, is a leading expert in catastrophe risk assessment and management, working for more than 25 years in the field. Clark developed the first hurricane catastrophe model and founded the first catastrophe modelling company, Applied Insurance Research (AIR), in 1987. She shares her thoughts on the 2010 hurricane forecasts…

1 June marked the official beginning of the Atlantic hurricane season as well as the first wave of hurricane predictions for 2010. Several organisations, such as the National Oceanic and Atmospheric Administration (NOAA), issue hurricane forecasts at the start of the season along with updates as the season progresses. The forecasts include named storm days, numbers of tropical storms, hurricanes and major (Category 3, 4, and 5) hurricanes.

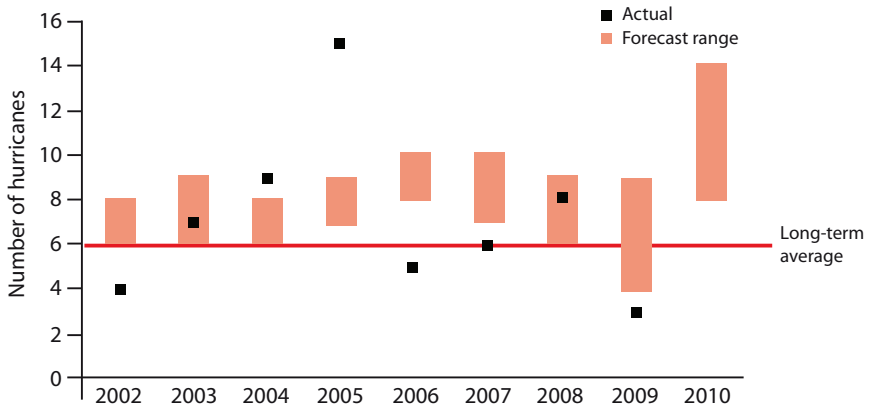
All forecasts this year point to an above average season with respect to hurricane activity. NOAA is predicting that up to 14 hurricanes will form in the Atlantic – more than twice the average number. The predicted range for major hurricanes is very wide – from just above average to nearly three times the average of 2.5. Climatological conditions seem ripe for a hurricane season that will rival or exceed the 2005 season, the most active on record.

Hurricanes can be thought of as giant heat engines fueled by warm water that provides the necessary atmospheric moisture to create a positive feedback loop. In order for a hurricane to form, a large body of water of at least 26.5°C to a depth of at least 50 metres is required. Currently, sea surface temperatures (SSTs) are at record high levels, and in the main development region of Atlantic hurricanes, SSTs are 1.5°C above normal. SSTs are expected to remain above average from August to October, the peak of the hurricane season. According to NOAA scientists, the relatively high sea surface temperatures are partly due to reduced trade winds across the tropical Atlantic associated with a multi-decadal oscillation that began in 1995.

Another important climate factor significantly impacting hurricane activity is the El Niño-Southern Oscillation (ENSO). The three phases of ENSO are El Niño, La Niña and Neutral, and the ENSO oscillates from La Niño to El Niño every few years. The El Niño phase is characterised by enhanced vertical wind shear over the western tropical Atlantic and conditions unfavourable for hurricane development. Hence hurricane activity tends to be suppressed in the El Niño phase, and more hurricanes form and develop in the La Niña phase. While conditions are currently tending toward Neutral, scientists are predicting that La Niña conditions are likely to return by the peak of the 2010 hurricane season.

Annual number of Atlantic hurricanes

Comparison of NOAA forecast range to actual



Source: NOAA

Annual number of major* Atlantic hurricanes

Comparison of NOAA forecast range to actual

*Category 3 or higher

Source: NOAA

Blown off course

While there is a lot of attention surrounding the forecasts, it is very difficult to credibly predict hurricane activity despite the extensive science underlying the forecasts. The graphs (see left) show that in every year since 2002, except 2009, NOAA's forecast range has indicated an above average number of hurricanes, but in half of the years, the hurricane activity has been average or below average. In only two years out of eight, or 25 percent of the years, was the

actual number of hurricanes within the forecast range.

For major hurricanes, the forecast skill appears a bit stronger. While the track record indicates that the actual number is within the forecast range 50 percent of the time, the forecast ranges are much wider on a percentage basis.

Why are the forecasts frequently so far off? While scientists understand very well the climatological factors underlying hurricane activity, these factors are themselves notoriously difficult to predict. For example, the ENSO is a climate pattern that is not regular but occurs over a period ranging from three to seven years. Its nature is chaotic so that even the most advanced supercomputers cannot accurately model when an El Niño will develop or what its intensity or duration will be. Nor can all of the complicated feedback mechanisms be captured adequately even by the most sophisticated models.

So even though the forecasts are for well above average hurricane activity, there is still a significant chance that hurricane activity will be average or even below average this year.

Blowing in the wind?

It's clear that reinsurers and cat bond investors cannot put too much faith in even the most sophisticated and complex models producing the annual hurricane forecasts. The next obvious question then is "How much faith can reinsurers and cat bond investors put into the 'near term' hurricane catastrophe models that attempt to project insured losses from hurricane activity in the US over a five year period?" These models are much less sophisticated than the models run by NOAA, but they attempt to capture the same climatological effects on hurricane frequency.

Each of the three major modeling companies – AIR, EQECAT, and RMS – introduced the near term hurricane models in 2006. The new models, based on short-term projections of the frequency of hurricanes, were intended to be reflective of expectations for the five year period 2006–2010. All three near term models initially projected Atlantic hurricane loss levels at least 35 percent above the long term average for the five year period.

"Even the most advanced supercomputers cannot accurately model when an El Niño will develop or what its intensity or duration will be"

While the near term models have been updated since 2006, projections from all three models have continued to indicate elevated levels of hurricane activity, well above the historical averages. In reality, for the four year period since 2006, hurricane activity has been average or below average every year except 2008. The chart (above) shows the actual number of hurricanes that formed in the Atlantic each year since 2006 along with the near term model projections. The chart (below left) shows the same information with respect to landfalling hurricanes. The chart (below right) shows actual insured losses versus the loss levels implied by the near term hurricane models. In all instances, the model projections greatly exceeded actual experience.

A silver lining

The evidence overwhelmingly supports the conclusion that it is exceedingly difficult to predict hurricane activity. The "good" news is that hurricane frequency and major hurricane losses are only loosely correlated.

Historically, many of the largest loss-producing hurricanes have occurred during relatively inactive hurricane seasons. The historical events that would cause the largest insured losses were they to occur today, are the Galveston Hurricane of 1900, the 1926 Miami Hurricane, the Great New England Hurricane of 1938, and Hurricanes Andrew (1992) and Katrina (2005). All of these storms, except the Miami Hurricane and Katrina, occurred in below average hurricane seasons. All of these events could cause insured losses exceeding $30bn. The 1926 Miami hurricane would likely cause insured losses in excess of $80bn and is the worst historical event in terms of likely losses today.

Cat bond triggers

Indemnity bonds on large nationwide companies trigger at low probability/high loss levels. It will typically take a hurricane causing an industry loss well in excess of $30bn to trigger many of the current cat bonds. This size industry loss would usually be caused by a major storm (Category 3 or higher) striking a highly populated area. The major cities at risk are Houston, New Orleans, Tampa, Miami, and New York.

The reinsurance industry is pretty well capitalised this year and could absorb significant hurricane losses if they do occur. If this does turn out to be a high frequency year, primary insurers may absorb the bulk of the losses below their reinsurance attachment points. This could lead to earnings rather than solvency impacts.

Models comprise one set of tools to help plan for catastrophe losses. However, the models are limited in the amount of credible information they can produce. Therefore, it is important for companies and investors with significant catastrophe exposure to make sure they are "thinking outside the black box" and conducting independent analyses to test the information that they use for decision-making.