BREAKTHROUGH IN HURRICANE PREDICTION

Hurricanes rank as the United States' most expensive natural disaster. These tempestuous storms afflict Florida, the eastern seaboard and the Gulf Coast and are responsible for eight of nation's 10 most costly catastrophes. The annual damage bill from hurricane strikes on the continental US between 1950 and 2004 is estimated at $5.6 billion (at 2004 prices). In 2004 – one of the worst hurricane seasons on record - four hurricanes struck Florida between mid-August and late September (Figure 1) leaving an estimated damage bill of $45 billion ($23 billion insured). The large year-on-year variability in the number of hurricanes making US landfall (numbers range from zero to six) means that skillful seasonal forecasts of damaging and quiet hurricane years would reduce the financial risk and uncertainty associated with each hurricane season.

For over two decades scientists have been attempting – with limited success – to deliver skillful seasonal predictions of hurricane activity reaching the coast of the United States. However, a recent break-through in hurricane forecasting at UCL is the first to offer forecast precision which is high enough to practically useful. This advance was reported in the 21st April 2005 issue of the journal *Nature* by UCL's Tropical Storm Risk (TSR) venture (Saunders, M.A. and A.S. Lea, Seasonal prediction of hurricane activity reaching the coast of the United States, *Nature*, 434, 1005-1008, 2005). The new forecast model will enable government, public emergency planning bodies and insurers with US interested to receive warning in early August of the likelihood of either high or low hurricane damage during the subsequent main hurricane season from August to October. This break-through offers the potential to significantly reduce financial risk and uncertainty.

The new prediction model uses wind patterns (at heights between 750 and 7,500 metres above sea level) from six regions over North America and the east Pacific and North Atlantic oceans during July to predict the wind energy of US striking hurricanes for the main hurricane season. The July height-averaged winds in these regions are indicative of atmospheric circulation patterns that either favour or hinder evolving hurricanes from reaching US shores. The model gives forecasts from 1 August. 97% of all intense hurricane strikes on the US and 87% of all hurricane hits on the US occur after this date. The TSR model correctly anticipates whether US hurricane losses are above-median or below-median in

Figure 1.

Figure 1. Composite satellite image showing hurricanes Charley, Frances, Ivan and Jeanne approaching Florida and US landfall in August and September 2004. Image is courtesy of the University of Wisconsin-Madison, Space Science and Engineering Center.

74% of the years between 1950 and 2003. It also performed well in 'real-time' operation in 2004, predicting US landfalling hurricane wind energy in the upper quartile for this active and damaging season.

The UCL breakthrough in hurricane prediction could benefit a range of industry whose returns are affected by hurricane damage. One such industry is the insurance industry. Figure 2 shows the financial benefit to the insurance industry of using the TSR new forecast model. The diagram displays the probability of a US hurricane season's total insured loss conditional on the TSR new forecast. The chance of a large

total loss is clearly much higher in those years when the forecast is high. For example, a total hurricane insured loss of $10bn is eight times more likely to occur when the forecast is high compared to when it is low. Clearly if extra reinsurance cover were purchased in the high forecast years a company's volatility in losses (or risk) would be reduced. One measure of volatility is the Expected Shortfall (ES) – the average loss than can be expected every, say, 100 years. For the 1 in 100 year loss ES has values of $20bn (low forecast), $40bn (medium forecast) and $100bn (high forecast).
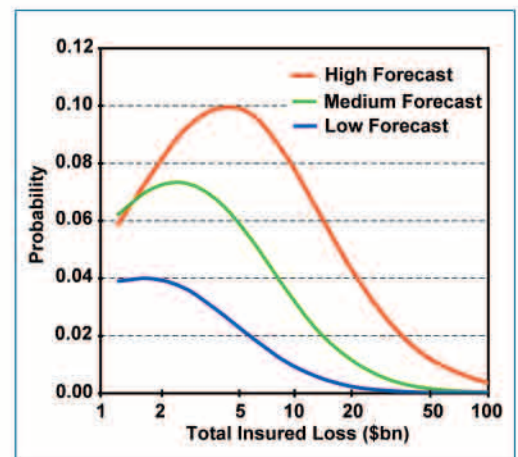

Figure 2. US hurricane total insured loss contingent on the TSR 1st August forecast.

For the damaging 2004 hurricane season TSR forecast US landfalling hurricane activity in the upper quartile. Thus TSR would have recommended that insurers purchase extra protection. By following this forecast guidance insurers (and others whose returns are affected by US hurricane damage) could have reduced their losses in 2004.

Early indications point to another active Atlantic hurricane season in 2005. TSR will release its forecast for US landfalling hurricane activity with the new model on the 5th August. The forecast will be available from **www.tropicalstormrisk.com.**

For further information please email **Professor Mark Saunders,** mas@mssl.ucl.ac.uk.

Tropical Storm Risk is a unit of the Benfield Hazard Research Centre at UCL and is co-sponsored by Benfield, Royal & Sun Alliance and Crawford & Company.