Winds of change

Following a run of forecast successes, outlooks for the 2006 hurricane season proved less impressive. Mark Saunders assesses the precision of such forecasts.

The 2004 and 2005 North Atlantic and US landfalling tropical cyclone activity, Colorado State University, headed by William Gray and Philip Klotzbuch, Tropical Storm Risk, led by the Bedford (UK) Hazard Research Centre at University College London, the National Oceanic and Atmospheric Administration; and the Meteorological Institute, Cuba.

Each of these organisations varies in terms of the parameters forecast, whether US landfalling activity is predicted, the forecast issue times, the range of years for which forecasts are available, and whether forecasts are issued in deterministic and/or tercile probabilistic format (see table, p29). The CSU and TSR forecasts are available for the World Meteorological Organisation, the CSU and TSR, and the Tropical Storm Risk.

Forecast accuracy is presented for tropical storm numbers, hurricane numbers, intense hurricane numbers and for the total Atlantic Accumulated Cyclone Energy Index. The ACE index is sensitive to storm numbers, storm intensity and storm duration. Since the ACE index is sensitive to storm numbers, storm intensity and storm duration, this provides a better indication of overall activity than considering the numbers of tropical storms or hurricanes alone.

Forecast precision is assessed using the Mean Square Skill Score (MSSS). MSSS is the percentage improvement in mean square error over a climatological forecast. It is also the standard metric recommended by the World Meteorological Organization for verification of deterministic forecasts.

Positive skill indicates that the model performs better than a climatology forecast, while negative skill indicates that it performs worse than climatology. A running prior 10-year climate norm is employed for climatology as this forms the ‘behaviour’ skill measure to beat.

The precision of the TSR and CSU forecasts as a function of month of issue from the start of the peak hurricane season in early August back to the previous October is displayed in Figure 1 (below) for the two periods 1984 to 2005 and 1992 to 2003. The second period is included because 1992 marked the introduction of an increased suite of forecasts by CSU, including forecasts of intense hurricane numbers and forecasts from the previous December.

These graphs show that similar precision exists for each hurricane-related parameter at the same lead time. Precision increases from the previous October through to early August.

The CSU precision from early June and early August is similar to that of TSR for the period 1992 to 2005. However, TSR slightly outperforms CSU in early December and early August for the period 1992 to 2005. Forecast precision outperforms a prior 10-year climatology at all leads out to the previous November. Taking a ‘high’ definition of ‘good’ precision as an MSSS greater than 25%, then useful predictive skill exists for the Atlantic ACE index from early May for the years 1984 to 2005.

A positive link exists between the TSR forecasts for the Atlantic ACE index and US hurricane loss. In terms of rank correlation, this link explains 0.4% from early July for the period 1984 to 2005, and explains 0.1% from early May for the period 1992 to 2005.

So what happened in 2006? Forecasts for the 2006 hurricane season consistently pointed to another high activity season — although one notably less active than in 2005 and 2006. With this hurricane season now nearly over, and activity so far being below average, many are wondering what happened this year. The unexpected near and development of El Nino conditions from mid-September is likely to have been a contributory factor, especially for the very quiet second half of the season.

A further significant factor was the presence of considerable African dry air and Saharan dust over the hurricane season development region during August and September, which would have inhibited enhanced convection and thus tropical storm development. However, many other environmental conditions that have proved reliable indicators of overall activity in previous years were favourable for tropical storm development in 2006; therefore, it is surprising more activity did not occur.

Doozy year

The unusual nature of the 2006 hurricane season is evident from Figure 2. This graph for the Atlantic ACE index, colour-coded by tercile against the two environmental fields which underpin the TSR seasonal hurricane forecast model, demonstrates these points. The data covers the period between 1950 and 2006.

The two environmental fields are the upper tercile Atlantic Ocean sea surface temperature in the hurricane main development region, off the east coast of the USA, and the lower tercile August–September sea surface temperature in the hurricane main development region, off the east coast of the USA.

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