Hurricane Forecast Review

Atlantic Basin/US Landfall
2009 Predictions as of August

Summary

In 2007, Christopher Gross Consulting completed a review of the historical accuracy of seasonal hurricane forecasts. This study yielded two main results:

1. For the Atlantic Basin, seasonal forecasts issued prior to June do not offer much advantage over simply using a 10-year historical average.
2. For later forecasts, using a single forecast or a weighted average of several forecasts yields the prediction with the least error. The amount of weight depends upon the category being predicted.

We have updated our study for 2009 and find that the above conclusions still hold, with one notable exception. For the 2009 study we find that Colorado State University (CSU) has the best predictions for the categories of total number of storms and landfalling storms, but for the categories of hurricane and large hurricane predictions (especially as of the August forecast), TSR now has the most historical accuracy.

Predictions as of August

Our analysis evaluates the historical accuracy of Atlantic Basin hurricane forecasts and reviews whether the forecasts add value beyond simply using a historical average. We also determine, for each month that forecasts are issued, the best weights for an aggregate forecast. In many cases, using a weighted average of expert opinions (provided that the forecasts are created by groups who are knowledgeable about the subject matter and are created independently) can provide a superior forecast to using only one expert opinion.

2009 Atlantic Basin Predictions as of August	Forecasting Entity			Average Prev 10 yrs	Average Post 1950	CGC Weighted Forecast
	CSU	TSR	NOAA*			
Number of Named Storms	10.0	12.6	9.0	15.1	10.5	10.0
CGC weight	*100%*	*-*	*-*	*-*	*-*	
Number of Hurricanes	4.0	6.5	4.5	7.9	6.2	5.5
CGC weight	*41%*	*59%*	*-*	*-*	*-*	
Number of Large Hurricanes (cat 3-5)	2.0	2.8	1.5	3.9	2.7	2.8
CGC weight	*-*	*100%*	*-*	*-*	*-*	
Number of U.S. Landfalling Storms	3.0	3.8	na	4.9	3.1	3.1
Percent making landfall	*30%*	*30%*	*na*	*32%*	*30%*	*31%*
CGC weight (on number)	*81%*	*19%*	*-*	*-*	*-*	
Number of U.S. Landfalling Hurricanes	1.6	1.6	na	2.0	1.5	1.6
Percent making landfall	*39%*	*25%*	*na*	*25%*	*24%*	*29%*
CGC weight (on number)	*-*	*100%*	*-*	*-*	*-*	
Date of Forecast	8/3/09	8/4/09	8/6/09			

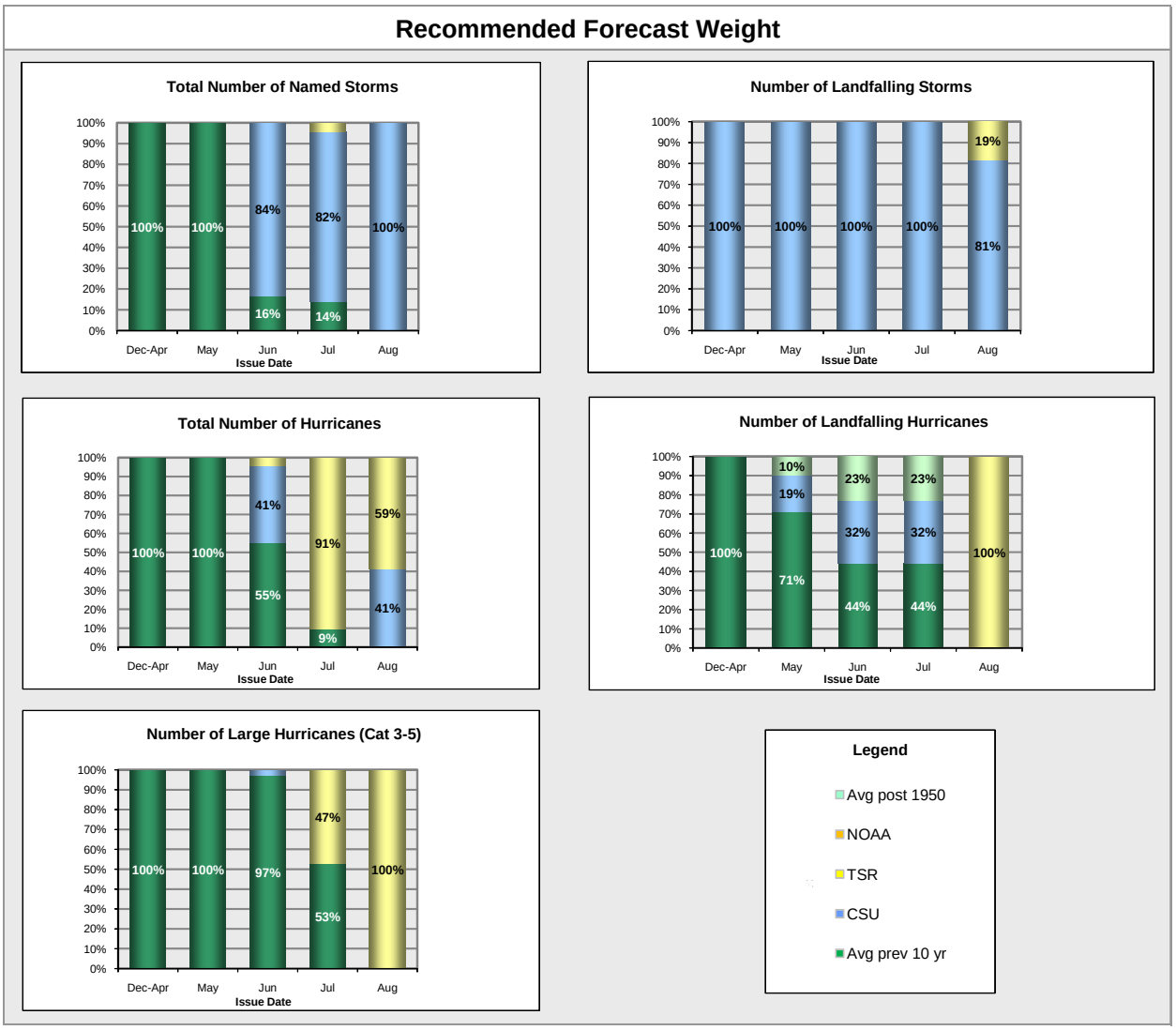
* midpoint of forecast range

Forecast Timing

We found that the optimal amount of weight given to each seasonal forecast varies based on the issue date of the predictions. Earlier in the season (prior to June), most of the forecasts issued by CSU, TSR and NOAA do not offer much predictive value. At this point, a 10-year rolling average would have been a better predictor than any individual group or weighting of the group forecasts.

It is also interesting to note that the 10-year average is nearly always a better predictor of the propensity for storm activity than a longer-term average. This could lend credence to the theory that a medium-term view of hurricane risk is appropriate for pricing.

During the summer, the picture changes somewhat as the climatological factors that influence the most active months of the hurricane season begin to take shape. Also for later forecasts, actual hurricane activity may have already occurred, providing additional data to be incorporated into the total season's forecast. For August forecasts, we find that CSU has the most historical accuracy for predicting tropical storms in aggregate, but TSR has had more accuracy in predicting the behavior of hurricanes and large hurricanes.



Forecast Value

Why look at seasonal forecasts? Isn't it too late to change your underwriting strategy by the time hurricane season starts?

A seasonal hurricane forecast will almost always be inaccurate. Also, in any given year, *where* actual events occur can be every bit as important as *how many* events occur. Add to this the fact that the forecasts with predictive value are generally not available in time to impact near-term underwriting strategy, and one may wonder whether seasonal hurricane forecasts have much value at all.

However, if year-to-year the forecasts are consistently higher or lower than long-term averages (reflecting a change in the underlying environment), it can have an impact on pricing levels. While seemingly small, a difference between an expectation of 2.0 landfalling hurricanes per year (10-year average) versus 1.5 per year (average since 1950) represents a 33% increase in expected loss costs, *all else being equal*.

Weighting the Forecasts

Christopher Gross Consulting determines a weight for each forecasting group, for each month that hurricane forecasts are issued. We calculate these weights using a process to determine the non-negative weightings that yield the lowest variance of the RMSE (root mean squared error). The more historical accuracy a group has had in predicting hurricane behavior, the higher the weight given to that group's forecast.

These weights can be helpful to provide increased understanding of which forecasting groups have had the most historical accuracy in predicting hurricane behavior, and in which cases none of the groups have been successful.

For more information about this analysis or other ways that Christopher Gross Consulting can help you manage your catastrophe risk, please contact:

Jennifer Nelson
Senior Vice President
651-293-8076
jennifer.nelson@cgconsult.com

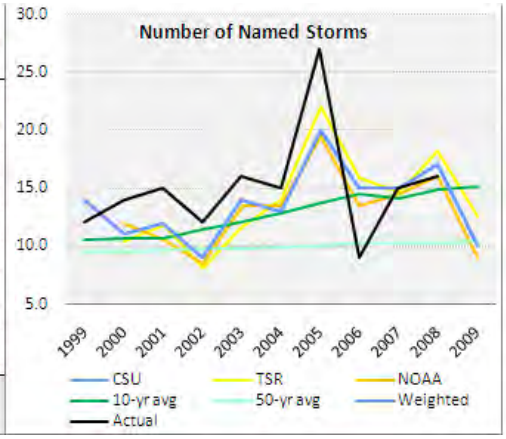
Results using Predictions as of August

For 2009, the forecasting groups are currently predicting values that are more similar to a long-term average than a 10-year average.

Number of Named Storms

For the number of named storms in the Atlantic basin, the forecast from CSU had the greatest historical accuracy.

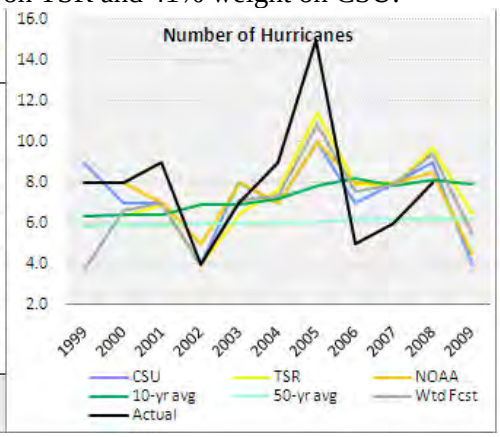
Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted	Actual
1999	14.0	na	na	10.6	9.5	14.0	12
2000	11.0	10.4	12.0	10.7	9.6	11.0	14
2001	12.0	11.8	10.5	10.7	9.6	12.0	15
2002	9.0	8.1	8.5	11.5	9.7	9.0	12
2003	14.0	11.7	13.5	12.1	9.8	14.0	16
2004	13.0	14.0	13.5	12.9	9.9	13.0	15
2005	20.0	22.1	19.5	13.7	10.0	20.0	27
2006	15.0	15.9	13.5	14.5	10.3	15.0	9
2007	15.0	14.7	14.5	14.1	10.3	15.0	15
2008	17.0	18.2	16.0	14.9	10.4	17.0	16
Pred 2009	**10.0**	**12.6**	**9.0**	**15.1**	**10.5**	**10.0**	
Weights	100%	-	-	-	-		



Number of Hurricanes

For the number of hurricanes we find that the CSU and TSR forecasts have better predictive value than the historical averages. As of August, we suggest 59% weight on TSR and 41% weight on CSU.

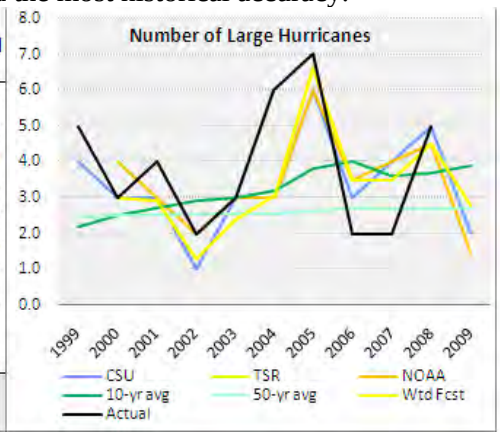
Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted	Actual
1999	9.0	na	na	6.3	5.9	3.7	8
2000	7.0	6.3	8.0	6.4	5.9	6.6	8
2001	7.0	6.9	7.0	6.4	5.9	6.9	9
2002	4.0	3.9	5.0	6.9	6.0	3.9	4
2003	8.0	6.5	8.0	6.9	6.0	7.1	7
2004	7.0	7.6	7.0	7.2	6.0	7.4	9
2005	10.0	11.4	10.0	7.8	6.0	10.8	15
2006	7.0	7.9	8.0	8.2	6.2	7.5	5
2007	8.0	7.8	8.0	7.8	6.2	7.9	6
2008	9.0	9.7	8.5	8.1	6.2	9.4	8
Pred 2009	**4.0**	**6.5**	**4.5**	**7.9**	**6.2**	**5.5**	
Weights	41%	59%	-	-	-		



Number of Large Hurricanes

For the number of large hurricanes the TSR forecasts have had the most historical accuracy.

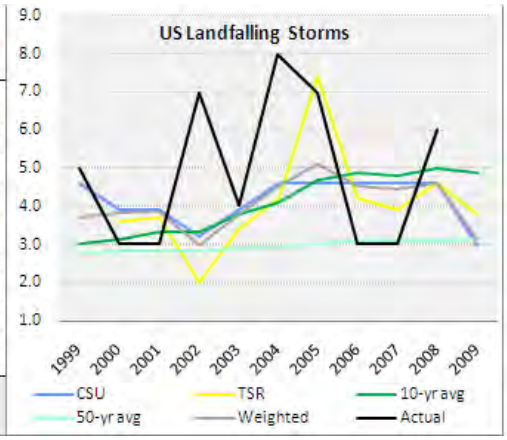
Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted	Actual
1999	4.0	na	na	2.2	2.5		5
2000	3.0	3.0	4.0	2.5	2.5	3.0	3
2001	3.0	2.9	3.0	2.7	2.5	2.9	4
2002	1.0	1.3	2.0	2.9	2.6	1.3	2
2003	3.0	2.4	3.0	3.0	2.6	2.4	3
2004	3.0	3.1	3.0	3.2	2.6	3.1	6
2005	6.0	6.6	6.0	3.8	2.6	6.6	7
2006	3.0	3.5	3.5	4.0	2.7	3.5	2
2007	4.0	3.5	4.0	3.6	2.7	3.5	2
2008	5.0	4.5	4.5	3.7	2.7	4.5	5
Pred 2009	**2.0**	**2.8**	**1.5**	**3.9**	**2.7**	**2.8**	
Weights	-	100%	-	-	-		



Number of Landfall Storms (U.S.)

For most months we find that using only the CSU forecast yielded the greatest historical accuracy. However, for August, using a blend of CSU and TSR predictions is a better forecast than CSU alone.

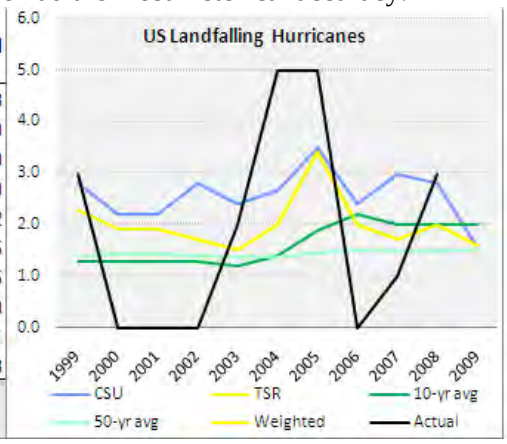
Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted	Actual
1999	4.6	na	na	3.0	2.8	3.7	5
2000	3.9	3.6	na	3.1	2.8	3.9	3
2001	3.9	3.7	na	3.3	2.8	3.9	3
2002	3.2	2.0	na	3.3	2.8	3.0	7
2003	3.9	3.4	na	3.8	2.9	3.8	4
2004	4.6	4.2	na	4.1	2.9	4.5	8
2005	4.6	7.4	na	4.7	3.0	5.1	7
2006	4.6	4.2	na	4.9	3.1	4.5	3
2007	4.6	3.9	na	4.8	3.1	4.5	3
2008	4.6	4.6	na	5.0	3.1	4.6	6
Pred 2009	**3.0**	**3.8**	**na**	**4.9**	**3.1**	**3.1**	
Weights	81%	19%	-	-	-		



Number of Landfall Hurricanes (U.S.)

For the number of landfalling hurricanes the TSR forecasts have had the most historical accuracy.

Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted	Actual
1999	2.8	na	na	1.3	1.4	2.3	3
2000	2.2	1.9	na	1.3	1.4	1.9	0
2001	2.2	1.9	na	1.3	1.4	1.9	0
2002	2.8	1.7	na	1.3	1.4	1.7	0
2003	2.4	1.5	na	1.2	1.4	1.5	2
2004	2.7	2.0	na	1.4	1.4	2.0	5
2005	3.5	3.4	na	1.9	1.4	3.4	5
2006	2.4	2.0	na	2.2	1.5	2.0	0
2007	3.0	1.7	na	2.0	1.5	1.7	1
2008	2.8	2.0	na	2.0	1.5	2.0	3
Pred 2009	**1.6**	**1.6**	**na**	**2.0**	**1.5**	**1.6**	
Weights	-	100%	-	-	-		



Note: NOAA does not issue a forecast for the number of landfalling storms.

Forecasting Groups

Our study analyzed the Atlantic basin forecasts from 1999 to 2008 issued by the following entities:

- **Colorado State University (CSU)**
  http://typhoon.atmos.colostate.edu/
  Headed by Dr. William Gray, forecasts issued as part of the Colorado State University's Tropical Meteorology Project. Since 2006, the primary responsibility for the forecasts has been assumed by Phil Klotzbach.

- **National Oceanic & Atmospheric Administration (NOAA)**
  http://www.nhc.noaa.gov/
  The Atlantic Hurricane Season outlook is a joint product of the scientists at NOAA's Climate Prediction Center, National Hurricane Center, Hurricane Research Division, and Hydrometeorological Prediction Center.

- **Tropical Storm Risk (TSR)**
  http://tropicalstormrisk.com/
  A consortium of experts in insurance, risk management, and seasonal climate forecasting. The sponsoring entities are Benfield, Benfield UCL Hazard Research Centre, Crawford, Royal & SunAlliance, UCL (University College London), and the UK Met Office.

We also included historical averages from two different timeframes (rolling 10-year and post-1950) to determine whether the forecasts issued by the above entities had predictive value over simply using historical data to forecast the current hurricane season.

Technical Notes

Process

We reviewed the historical accuracy of the Atlantic hurricanes season forecasts from CSU, TSR and NOAA for 1999 through 2008. We performed our process for each issue month separately to determine the best weights to assign each group's seasonal forecast. We also included two historical averages in the analysis — a previous 10-year average and an average post 1950.

Avg prev 10 year = a rolling average ending the previous year. For a 2008 forecast, the 10-year average would have been the average of years 1998-2007.

Avg post 1950 = the average from 1950 through the previous year. For a 2008 forecast, the 50-year average would have been 1950-2007.

Error Measurement

The statistic that we used to determine the forecast accuracy was the Root Mean Squared Error.

$$\text{RMSE} = \sqrt{\frac{(Actual - Forecast)^2}{Number\ of\ Years}}$$

Timing

One of our goals was to analyze the seasonal predictions at regular intervals during the hurricane season, to see if the updated forecasts provided additional forecasting skill.

Each forecasting entity issues predictions throughout the year on a fairly regular schedule. For the timing of the predictions, we used the most recent forecast that would have been available at that point in time. For example at the beginning of June, the most current forecast for each group would be CSU's forecast from early June, TSR's forecast as of early June, and NOAA's forecast as of May.

Data Adjustments

To put the forecasts on an even footing with each other, we needed to express each forecast as a single value rather than a range or a percentage. In the case of NOAA where a range of outcomes is forecast, we used the midpoint of the range. In the case of CSU landfall forecast, we converted the percentage likelihood to a value by assuming that that the number of events follows a Poisson distribution. The expected number of landfalling hurricanes is then –ln(1- probability of 1 or more landfalling hurricanes).

References

Philip J Klotzback and William M. Gray, 1999-2009. Forecast of Atlantic Seasonal Hurricane Activity and U.S. Landfall Strike Probability and Updates.

NOAA Press Release: 1999-2009. Atlantic Hurricane Season Outlook and Updates

Saunders, Mark and Dr Adam Lea. 1999-2009. Forecast for Atlantic Hurricane Activity and Updates. Benfield UCL Hazard Research Centre, UCL (University College London), UK