Hurricane Forecast Review

Atlantic Basin/US Landfall
2007 Predictions as of August

Summary

Not surprisingly, the accuracy of Atlantic seasonal hurricane forecasts varies based on the month that the forecast was issued. Forecasts issued prior to June each year do not offer much advantage over simply using historical averages. For seasonal forecasts as of the beginning of August, Colorado State University has had the most historical accuracy in predicting the number of named storms and landfalling storms. For predictions of hurricanes and large hurricanes, a weighted average of one or more forecasts yields a better predictor than any single forecast.

Predictions as of August

At many points during the year, several groups provide a forecast of the upcoming hurricane season. We set out to evaluate the accuracy of these forecasts and to determine whether the forecasts add value beyond simply using a historical average. We also wanted to 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) provides a superior forecast to using only one expert opinion.

In the case of hurricane forecasting, there is a tendency for all of the forecasts to be inaccurate in the same direction for any given year (i.e. all groups underpredicted or all groups overpredicted). The weighted forecast will tend to be wrong in the same direction as the other forecasts for any *given* year, but may provide a better indication of the underlying hazard, which is more important for general business strategy.

For 2007, the forecast number of named storms, hurricanes, and large hurricanes are fairly consistent with each other and with the average of the past ten years. The forecasts for the number of landfalling storms and hurricanes are not as consistent.

2007 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	15.0	14.7	14.5	14.1	10.3	15.0
CGC weight	*100%*	-	-	-	-	
Number of Hurricanes	8.0	7.8	8.0	7.8	6.2	7.8
CGC weight	*11%*	*89%*	-	-	-	
Number of Large Hurricanes (cat 3-5)	4.0	3.5	4.0	3.6	2.7	3.9
CGC weight	*80%*	*20%*	-	-	-	
Number of U.S. Landfalling Storms	4.6	3.9	na	4.8	3.1	4.6
Percent making landfall	*31%*	*27%*	*na*	*34%*	*30%*	*31%*
CGC weight (on number)	*100%*	-	-	-	-	
Number of U.S. Landfalling Hurricanes	3.0	1.7	na	2.0	1.5	2.1
Percent making landfall	*37%*	*22%*	*na*	*26%*	*24%*	*26%*
CGC weight (on number)	*28%*	*72%*	-	-	-	
Date of Forecast	8/3/07	8/6/07	8/9/07			

* midpoint of forecast range

Forecasting Groups

Our study analyzed the Atlantic basin forecasts from 1999 to 2006 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 2007 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://tsr.mssl.ucl.ac.uk/
  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.

Forecast Value

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 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.

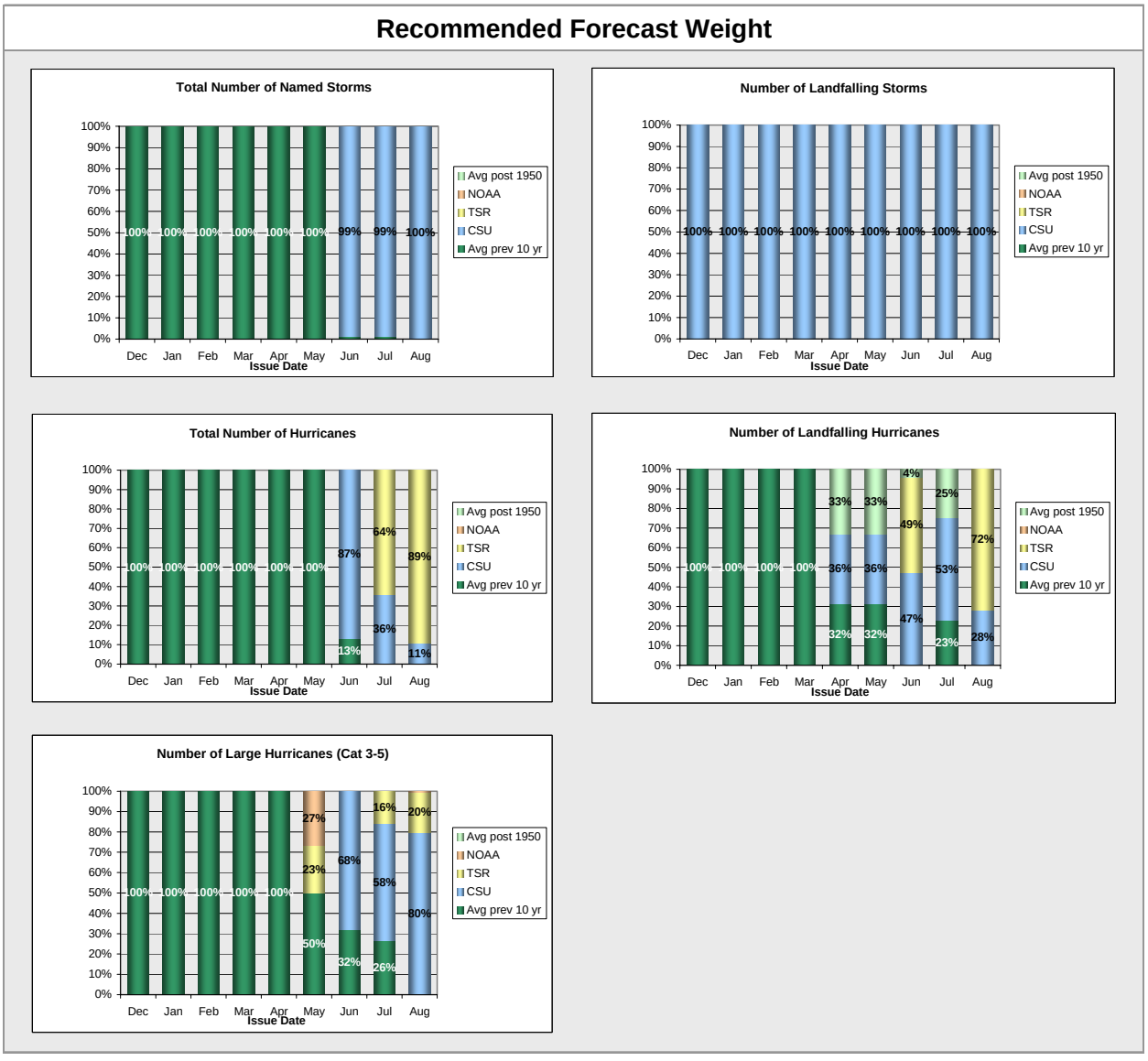
However, if year-to-year the forecasts are consistently higher or lower than long-term averages (reflecting a change in the underlying environment), it can have an impact on pricing levels. While seemingly small, a difference between an expectation of 2.0 landfalling hurricanes per year (10-year average)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

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 predictions issued by CSU, TSR and NOAA do not offer much predictive value, and a 10-year rolling average would have been a better predictor. The exception is the prediction of landfalling storms — in this case the CSU predictions alone yielded the most historical accuracy.

By June and July, the picture changes somewhat as the climatological factors that will influence the most active months of the hurricane season begin to take shape. For August, we find that the CSU forecast has the most accuracy for predicting number of storms and landfalling storms. For the number of hurricanes, landfalling hurricanes, and large hurricanes, we find that a weighted average of the CSU and TSR forecasts yields the forecast with the lowest error.

An average of the prior 10 years was nearly always a better predictor of the propensity for hurricane 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.



Results using Predictions as of August

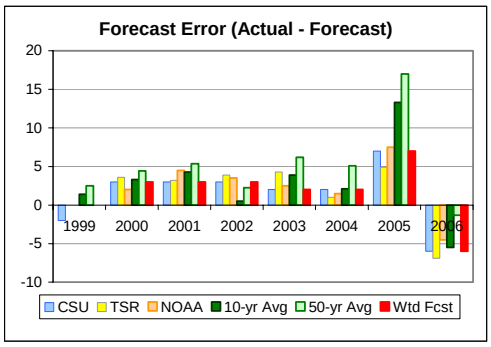
For 2007, the forecasting groups are currently predicting very similar values for the number of storms and hurricanes.

Number of Named Storms

For the number of named storms forecast in the Atlantic basin, we find that the forecast from CSU had the greatest historical accuracy. It is interesting to note that for 6 of the past 8 years, this value has been under predicted by all forecasting groups.

Annual Predictions as of August

Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted Forecast	Actual
1999	14.0	na	na	10.6	9.5	na	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
Pred 2007	**15.0**	**14.7**	**14.5**	**14.1**	**10.3**	**15.0**	
Weights	100.0%	-	-	-	-		

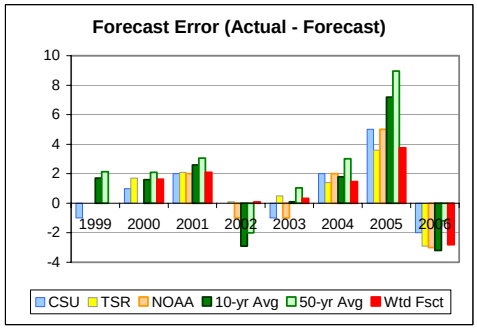


Number of Hurricanes

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 89% weight on TSR and 11% weight on CSU.

Annual Predictions as of August

Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted Forecast	Actual
1999	9.0	na	na	6.3	5.9	na	8
2000	7.0	6.3	8.0	6.4	5.9	6.4	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	6.7	7
2004	7.0	7.6	7.0	7.2	6.0	7.5	9
2005	10.0	11.4	10.0	7.8	6.0	11.2	15
2006	7.0	7.9	8.0	8.2	6.2	7.8	5
Pred 2007	**8.0**	**7.8**	**8.0**	**7.8**	**6.2**	**7.8**	
Weights	10.9%	89.1%	-	-	-		

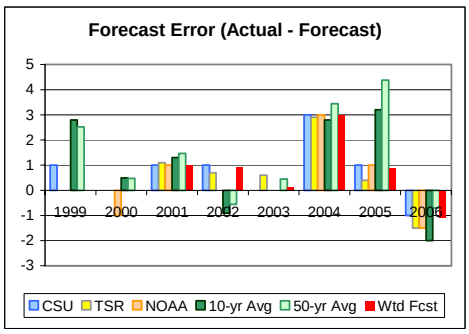


Number of Large Hurricanes

For the number of large hurricanes we also find that the CSU and TSR forecasts have better predictive value than the historical averages. However, for this category the CSU forecast receives more weight than the TSR forecast.

Annual Predictions as of August

Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted Forecast	Actual
1999	4.0	na	na	2.2	2.5	na	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	3.0	4
2002	1.0	1.3	2.0	2.9	2.6	1.1	2
2003	3.0	2.4	3.0	3.0	2.6	2.9	3
2004	3.0	3.1	3.0	3.2	2.6	3.0	6
2005	6.0	6.6	6.0	3.8	2.6	6.1	7
2006	3.0	3.5	3.5	4.0	2.7	3.1	2
Pred 2007	**4.0**	**3.5**	**4.0**	**3.6**	**2.7**	**3.9**	
Weights	79.6%	19.9%	0.5%	-	-		

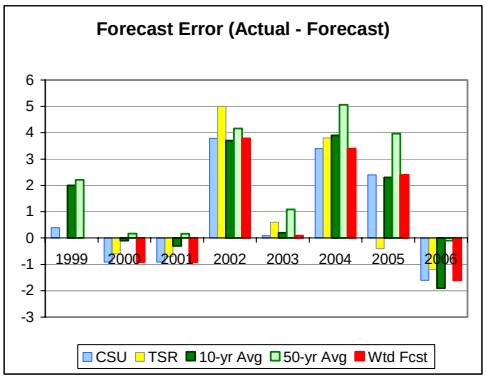


Number of Landfall Storms (U.S.)

For the number of U.S. landfalling storms, we find that using only the CSU forecast yielded the greatest historical accuracy. Incidentally, this tends to be true throughout the entire forecasting season.

Annual Predictions as of August

Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted Forecast	Actual
1999	4.6	na	na	3.0	2.8	na	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	3.2	7
2003	3.9	3.4	na	3.8	2.9	3.9	4
2004	4.6	4.2	na	4.1	2.9	4.6	8
2005	4.6	7.4	na	4.7	3.0	4.6	7
2006	4.6	4.2	na	4.9	3.1	4.6	3
Pred 2007	**4.6**	**3.9**	**na**	**4.8**	**3.1**	**4.6**	
Weights	100.0%	-	na	-	-		

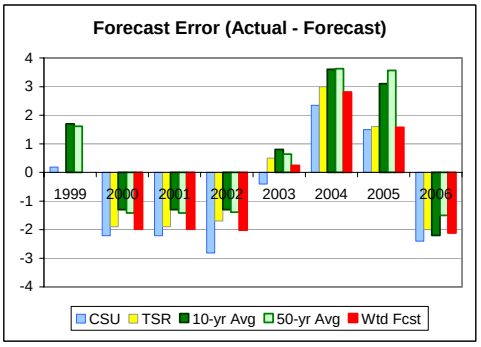


Number of Landfall Hurricanes (U.S.)

For the number of hurricanes making landfall in the U.S., we suggest a blend of 28% CSU and 72% TSR for the August seasonal forecasts.

Annual Predictions as of August

Year	CSU	TSR	NOAA	Average Prev 10 yr	Average Post 1950	Weighted Forecast	Actual
1999	2.8	na	na	1.3	1.4	na	3
2000	2.2	1.9	na	1.3	1.4	2.0	0
2001	2.2	1.9	na	1.3	1.4	2.0	0
2002	2.8	1.7	na	1.3	1.4	2.0	0
2003	2.4	1.5	na	1.2	1.4	1.8	2
2004	2.7	2.0	na	1.4	1.4	2.2	5
2005	3.5	3.4	na	1.9	1.4	3.4	5
2006	2.4	2.0	na	2.2	1.5	2.1	0
Prediction	**3.0**	**1.7**	**na**	**2.0**	**1.5**	**2.1**	
Weights	28.3%	71.7%	na	-	-		



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

Technical Notes

Process

We reviewed the historical accuracy of the Atlantic hurricanes season forecasts from CSU, TSR and NOAA for 1999 through 2006. 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 2006 forecast, the 10-year average would have been the average of years 1996-2005.

Avg post 1950 = the average from 1950 through the previous year. For a 2006 forecast, the 50-year average would have been 1950-2005.

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 July, the most current forecast for each group would be CSU's forecast from early May/late June, TSR's forecast as of early July, 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

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