Multi-Season Forecasts of Atlantic Basin Hurricane Activity: 2001–2005

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1. Forecast methods

Time-series analysis using the singular spectrum approach (SSA) and the maximum entropy method (MEM) reveal oscillatory behavior in the annual frequency of hurricanes over the North Atlantic basin. SSA produces filtered time records that capture the dominant modes of hurricane variability; and MEM identifies the particular frequencies in the relatively noise-free records. Dominant modes of hurricane variability occur at roughly 2.5, 5.6, and 7.4 years. The high frequency oscillation reflects the well-established, but ill-understood, association of hurricane activity with the stratospheric quasi-biennial oscillation (QBO), while the semi-decadal oscillation is likely tied to the El Niño - Southern Oscillation (ENSO) of the Pacific basin, which has a rather irregular fluctuation in the range of 4 to 6 years. The low frequency oscillation might be forced by sea surface temperature (SST) fluctuations in regions of the North Atlantic Ocean. Details of the analysis are given in Elsner et al. (1999).

Two prediction algorithms are used to forecast hurricane activity over the next five hurricane seasons. One algorithm is based on combining univariate autoregressive moving average (ARMA) models for each of the dominant singular spectral components of hurricane activity (3 oscillatory, plus a trend). A Bayesian criterion is used to select the order of each model. In a limited case study this algorithm maked better hindcasts than a similar model on the original series. The second algorithm is based on iterating the SSA procedure, starting with a random guess. A consensus of the two algorithms is our five-year forecast of seasonal hurricane activity. It is expected that the operational use of this forecast scheme will prove to be marginally skillful against climatology. Details of the forecast methodology are given in Elsner et al. (1998).

2. Predictions for the next five seasons

Applying the above algorithms on the hurricane record from 1886–2000 results in forecasts of the expected number of North Atlantic hurricanes for each year from 2001 through 2005 (see Table 1). The standard errors are computed from the ARMA model. A consensus forecast is obtained by averaging the forecasts. The number in parentheses represents the nearest whole number of the consensus forecast.

Overall, the outlook is for near normal activity to begin with the 2001 hurricane season (avg = 5.1 over the period 1886–2000) and continue for the next four years afterwhich a return

Table 1: **Five-season forecasts of the number of Atlantic basin hurricanes using the iterative and ARMA algorithms [see Elsner et al. (1998)]**

Year	Iterative	ARMA	Standard Error	Consensus
2001	4.6	6.6	1.25	5.6 (6)
2002	4.7	3.6	1.48	4.2 (4)
2003	5.9	5.9	1.56	5.9 (6)
2004	5.1	5.8	1.56	5.4 (5)
2005	13.1	8.7	1.60	10.9 (11)

to much above normal activity is projected for 2005. The forecast calling for 6 hurricanes during 2001 is consistent with our early December regression model forecast.

3. Performance of our previous multi-season forecasts

We began issuing multi-season forecasts starting with the 1997 season. Table 2 shows the performance of the forecasts over the past 4 seasons. With the exception of the forecasts for the 1998 season, the forecasts appear to have some skill. Beginning with forecasts for the 1999 season the algorithms were modified to include the trend component. We will examine measures of forecast skill on these results after several more forecast cycles have been completed.

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References

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Table 2: **Performance of the FSU multi-season forecast scheme.**

	Year forecast issued					
Year	1997	1998	1999	2000	2001	Actual
1997	5					3
1998	5	4				10
1999	5	5	8			8
2000	7	8	8	7		8
2001	6	6	5	5	6	
2002		5	4	4	4	
2003			9	6	6	
2004				6	5	
2005					11	