Hazard of Hurricanes in the Caribbean.
Temporal Variation of the Activity in the Atlantic Basin.

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Based on statistical analysis of historical data, sophisticated models for the evaluation of natural hazards and risks, such as the wind speeds caused by tropical cyclones, have been developed by EQE International for many geographical regions. Wind hazard and risk maps for the Caribbean region obtained with these software models represent average cyclone activities over many years. The purpose of this project was to describe and explain the deviations from this average activity. Thus statistical models describing the temporal variation within a year and that from year to year have been developed based on the historical data from 1950 to 1996, which was considered to be the reliable record period. The most important results are summarised here.

An average of 9.5 Atlantic tropical cyclones per year reach storm strength, i.e. sustained wind speeds exceeding 17 m/s. A mean of almost 6 of them develop sustained wind speeds higher than 34 m/s and are classified as hurricanes. Almost every year some hurricanes (a mean of about 2.5) reach sustained wind speeds exceeding 50 m/s, which are the major or intense hurricanes. With a mean return period of about 4 years, sustained wind speeds higher than 69 m/s are observed in the Atlantic Basin.

The formation of tropical cyclones requires certain conditions. The rate of formation, the intensification and the duration of tropical cyclones are all sensitive to these conditions. The dependence increases with the strength of the cyclones; the activity of intense hurricanes is the characteristic which appears to be most sensitive to the existence of favourable conditions.

The parameters with greatest influence on activity are the water temperature, the general weather conditions and the position of the Intertropical Convergence Zone. At the end of summer, these conditions are normally the most favourable ones. As a consequence, cyclones have the longest life cycle towards the end of August; and in the first half of September the activity shows a very sharp maximum, especially for the stronger cyclones. Also, the tendency to intensify appears to be highest in this time of the year. Conversely, there is practically no tropical cyclone activity in winter and spring.

Global meteorological factors (such as the El Niño Southern Oscillation), which vary from year to year, also have a significant influence on the tropical cyclone activity in the Atlantic Basin. This leads to sharp contrasts in the activity in different years. For example, only 3 Atlantic hurricanes formed in 1983 with a total duration of 4 days, but 1950 and 1995 suffered 11 hurricanes each, with 60 and 62 days of total duration, respectively. The activity may change dramatically in successive years, as happened between 1993 and 1996, when a 2-year period with 7 hurricanes lasting 17 days altogether was followed by a 2-year period of 20 hurricanes lasting 107 days. This variability increases with the strength of the cyclones. Nevertheless, the maximum wind speed within each year in the Atlantic Basin does not seem to correlate with the general activity during the year. In fact, the strongest hurricanes (those with a return period of about 4 years and sustained wind speeds greater than 69 m/s) often happened during periods of low activity, as was the case of Andrew in 1992.

In general, the period between 1971 and 1994 showed a rather low hurricane activity in the Atlantic Basin. The mean number of hurricanes per year was 23% lower than between 1950 and 1970 and the total yearly duration of hurricanes was 44% lower. The extremely high activity of 1995 and 1996 could signal the beginning of a new period of high activity.

Dr Gray and his team at the Colorado State University have developed a statistical model for the prediction of the yearly cyclone activity in the Atlantic Basin. Their model, based on the meteorological factors of influence, was evaluated as well in the course of this project. The model generally predicts correctly whether the activity will be higher or lower than average, but appears to be inadequate for evaluating the amount of this deviation, especially for intense hurricanes. The model is particularly questionable in years which deviate strongly from the average activity. Dr Gray's predictions tend to lie between the average and the actual activity, generally closer to the average. However, they still seem to be a more reliable estimator for the activity than plain stationary averages. Future, more reliable prediction models of cyclone activity should be included in hazard and risk evolution models, such as those developed by EQE International, to allow calculating time variable hazard and risk maps.