

DEPARTMENT OF NATURAL RESOURCE PROTECTION

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PRECIPITATION IN BROWARD COUNTY

Environmental Monitoring Division
Planning and Evaluation Section

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EXECUTIVE SUMMARY

The Department of Natural Resource Protection has been monitoring the rainfall in Broward County since 1983, when a sample collection site was established at a centrally located site on the grounds of the University of Florida Agricultural Research Center in Davie. Between 1983 and 1987 the pH and total precipitation were determined from weekly samples. In 1987, the analyses of conductivity, sodium, ammonium, potassium, magnesium, calcium, chloride, nitrate, sulfate, hydrogen ion and carbonate ion were added. This parameter list was maintained until 1993, when sufficient baseline data was established. Currently the Department monitors pH, conductivity and total accumulation as a long term monitoring program.

Analysis of the data suggests that Broward County is not experiencing a significant problem associated with acid rain. Normal, carbon dioxide saturated rainfall has been reported to have a pH of 5.7. States with an average monthly rainfall pH below 5.0 are considered to have "acid" rain. The average annual precipitation pH in Broward County between 1983 and 1993 was 5.18. There is also no significant downward trend in the pH over the last ten years. Therefore, though Broward's rainfall is below neutral, there is no indication that an acid rain condition exists.

The analysis of major ions in precipitation samples reveals that the primary ions found are chloride, sodium and sulfate. The chloride and sodium can be attributed to marine aerosols due to Broward's coastal environment. Sulfate is present in the form of very dilute sulfuric acid, as is indicated by the slightly reduced precipitation pH. Also of interest when examining the data is the presence of nitrate and ammonia at detectable levels. Though the concentrations are not sufficiently elevated to cause concern, they are present at levels significant enough to contribute to nutrient levels in the environment.

PROJECT DESCRIPTION

Background

The scientific community generally considers acid rain a serious environmental concern throughout the industrialized world. Within the United States the problem is most profound in the Northeast, where many aquatic ecosystems have been affected. Acid deposition is primarily caused by the burning of fossil fuels, which produces nitrogen and sulfur dioxides. These gases react with moisture in the atmosphere, forming nitric and sulfuric acid in rain water. In Florida, where heavy industry is not as prevalent as in other portions of the nation, as much as 40 percent of the sulfur dioxide is received from weather systems transported from other regions. In 1983 the Broward County Department of Natural Resource Protection initiated a precipitation monitoring program. A site was selected on the grounds of the University of Florida Agricultural Research Center in Davie, and equipment was installed to monitor rainfall accumulation and collect precipitation samples.

Sample Collection

Precipitation measurements are conducted using a Belfort Instrument Company 12 inch Dual Transverse 192 Hour Universal Rain Gauge. Samples are collected for chemical analysis using an Aerochem Metric Automatic Sensing Wet/Dry Precipitation Collector. This unit prevents the accumulation of foreign particles in the rain sample during dry periods. The sample site is visited weekly by Environmental Monitoring Division technicians who replace the chart paper in the rain gauge and retrieve the precipitation sample if any rainfall occurred during the week.

Methodology

Between the period of 1983 to 1987, pH was the only analysis performed on the precipitation samples. In 1987 the agency acquired a Dionex Ion Chromatograph and expanded the project to include the analysis of conductivity, sodium, ammonium, potassium, magnesium, calcium, chloride, nitrate, sulfate, hydrogen ion and carbonate ion. The purpose of this phase of the project was to chemically categorize the precipitation of Broward County. In 1993 the analysis of major ions was discontinued, when sufficient baseline data was acquired. The department currently measures daily and weekly precipitation totals, and monitors pH and conductivity on weekly samples.

DISCUSSION

Analysis of the data indicates that Broward County is not experiencing a significant problem associated with acid rain. Normal, carbon dioxide saturated rainfall has been reported to have a pH of 5.7. States with an average monthly rainfall pH below 5.0 to are considered to have "acid" rain. Fourteen states in the northeast that are most affected by acid rain have average precipitation pH values below 4.0. The average annual precipitation pH in Broward County between 1983 and 1993 was 5.18. Figure 1 illustrates the annual average pH values.

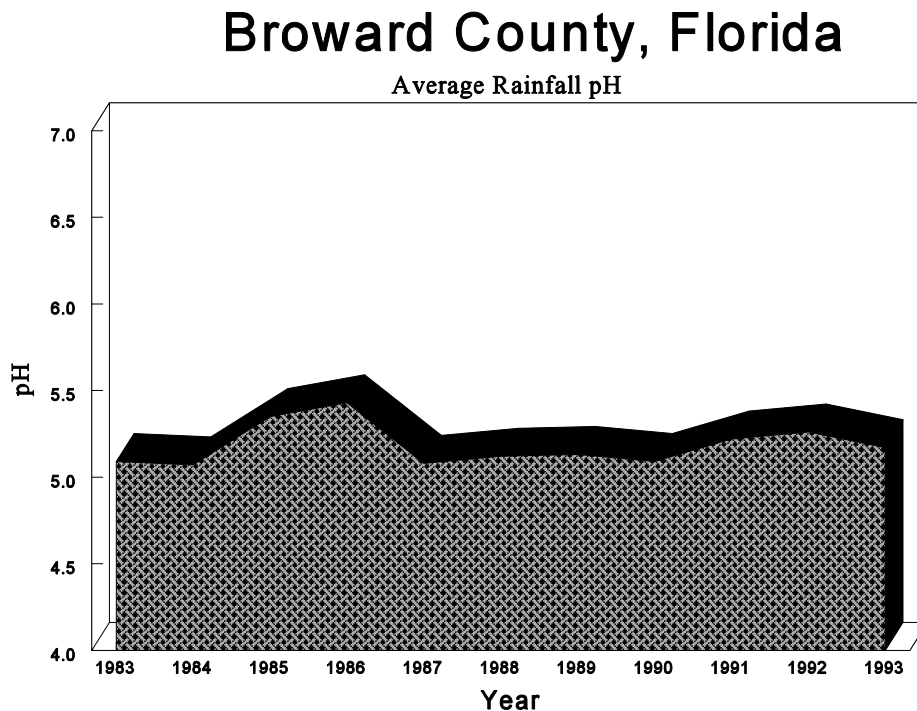


Figure 1 - Average Rainfall pH

South Florida's lack of heavy industry and prevalent sea breezes can be credited for keeping pH values within safe ranges. The data also indicates that there is no significant trend toward decreasing pH values over the past ten years.

The analysis of major ions in precipitation samples reveals that the primary ions found are chloride, sulfate and sodium. The chloride and sodium can be attributed to marine aerosols due to Broward's close proximity to the ocean. Analysis of the data indicates that the highest sodium and chloride concentrations are generally associated with the weeks with the least rainfall. During these periods, marine aerosols are subjected to less dilution from atmospheric deposition. The presence of sulfate in the data is indicative that sulfur dioxide is the primary cause of the slightly below normal pH values in the precipitation samples. Broward County's primary source of sulfur dioxide is from power production facilities. The Davie sample site is located west of the Florida

Power and Light power plants in Ft. Lauderdale and Port Everglades. The sulfate values in the precipitation, though not of significant concern, may be partially attributed to these sources.

Also of interest when examining the data is the presence of nitrate and ammonia at detectable levels. Though the concentrations are not sufficiently elevated to cause concern, they are present at levels significant enough to contribute to nutrient loading in the environment. Though most of these nutrients are probably rapidly consumed by plants, they can potentially result in elevated nutrient levels in surface water due to storm water runoff. Figure 2 illustrates the average concentrations of various ions between 1989 and 1993.

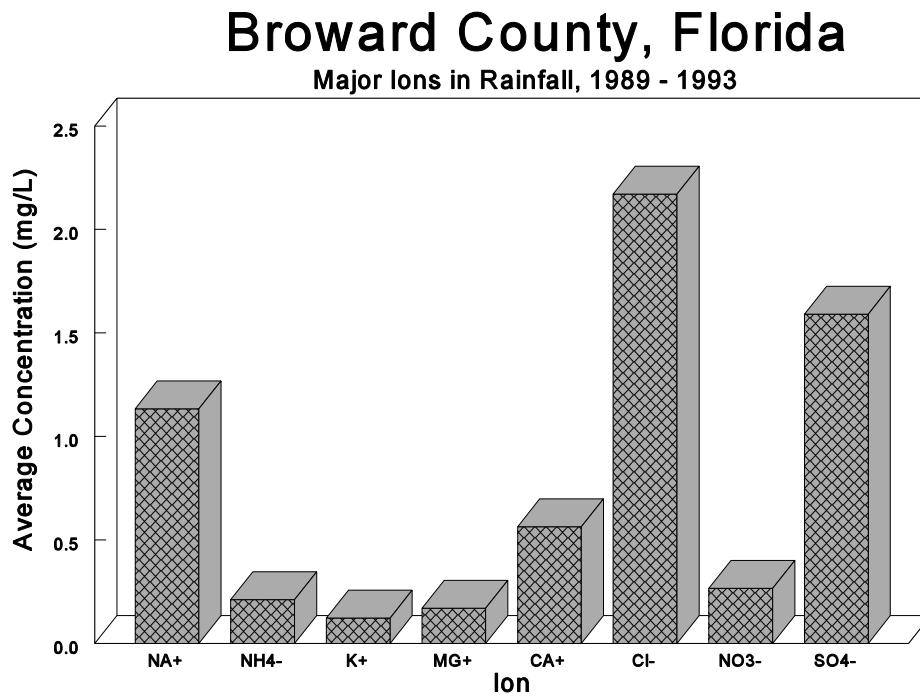


Figure 2 - Major Ions in Rainfall

Weekly total precipitation data follows the generally expected trend of increased rainfall in the summer months. Figure 3 shows weekly total precipitation for 1989 to 1993.

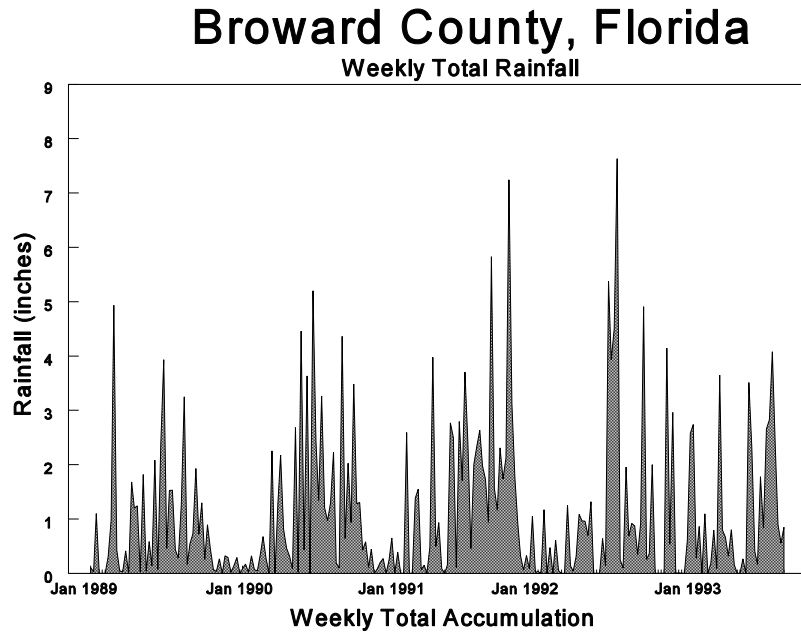


Figure 3 - Weekly Total Precipitation

Annual total accumulation for 1989 through 1993 is shown in figure 4.

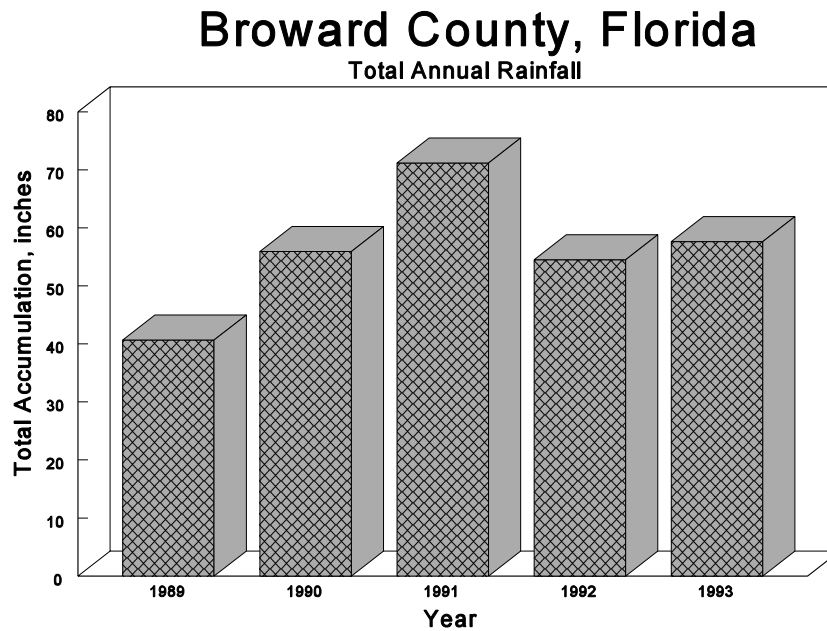


Figure 4 - Total Annual Rainfall

CONCLUSIONS AND RECOMMENDATIONS

Historical data indicates that Broward County is not experiencing a significant problem with acid rain. There does not appear to be any trend toward decreasing pH values in precipitation. The Department of Natural Resource Protection should continue long term monitoring efforts for weekly rainfall accumulation and average weekly precipitation pH to ensure that Broward County can assess future trends.