

Examining Hurricane Effects on Aquatic Phosphorus Levels in Chesapeake Bay

Jacob Larkin and Jessica Murray

Department of Biology – College of Science – Utah State University



Introduction

In the environment, substantial phosphorus is locked in minerals and in deep underwater sediments. This phosphorus can be released through erosion, or by an upturning of aquatic sediment. Numerous studies suggest that hurricanes provide sufficient disruption to release stored phosphorus and alter environments in a way that dramatically change phosphorus levels in estuary regions.^{1,2,3,5} increased P concentration is attributed to the re-suspension of phosphorus-rich sediments from the lake bottom and increased phosphorus (P) input from tributaries.¹ These studies are focused mainly on tropical equatorial regions, and there is little about northern coastal regions, which leads us to the following objective:

- Compare the pre- and post-hurricane aquatic P levels in Chesapeake Bay to determine if there is there is an overall positive or negative change.

Methods

To answer our question, we have analyzed a large climate data package titled: Ecosystem Responses to Hurricanes across North America, the Caribbean, and Taiwan; 1985 to 2018.⁴ Within this data set, changes in total soil phosphorus levels in Chesapeake Bay after a hurricane were examined.

Total P levels were collected over periods of around 30 days before and after the storm at multiple locations around the Chesapeake area. This data was then averaged in R, a statistical computing program, and compiled for each hurricane examined. Proportional change in phosphorus level was defined as the difference between the post-storm max/min and pre-storm baseline divided by the pre-storm baseline represented as a percentage.



Figure 1: Map showing Chesapeake Bay area.

Results

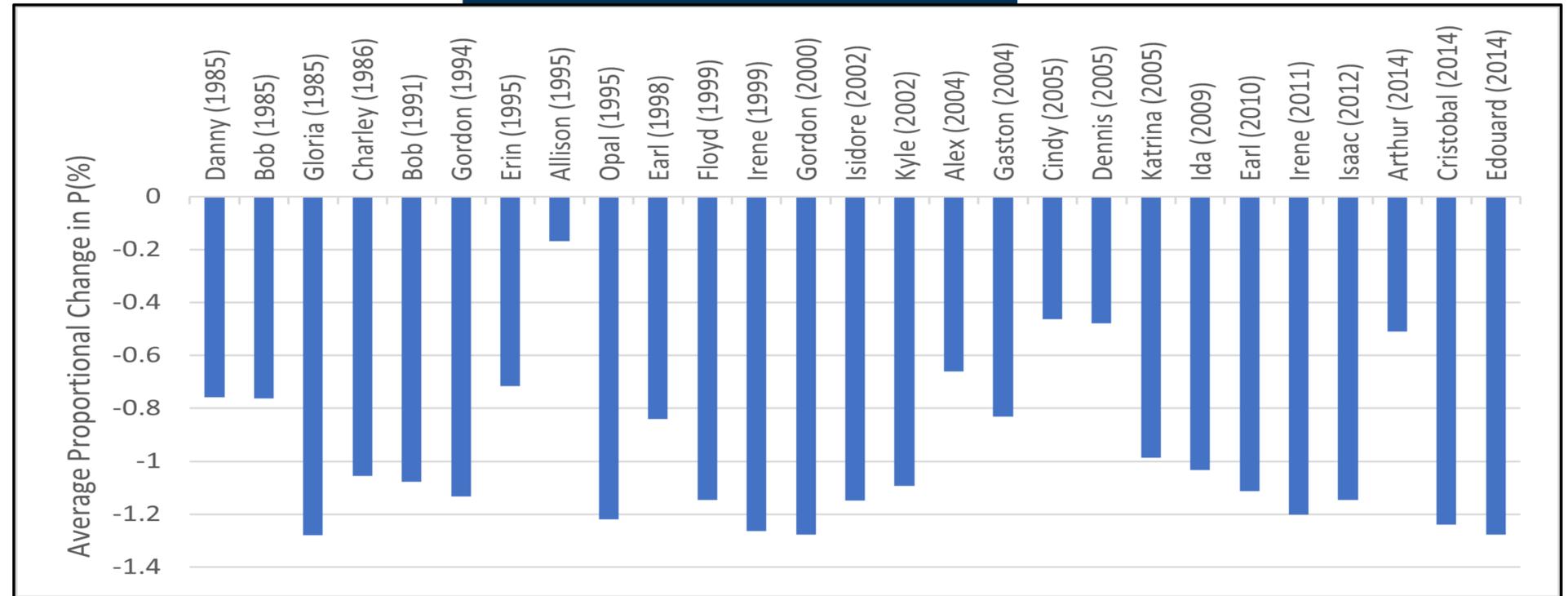


Figure 2: Bar graph visualizing the proportional change after hurricane of soil phosphorus levels in Chesapeake Bay. Note: Hurricanes are named with year on the horizontal axis.

Discussion

We hypothesize our results are not aligned with the findings of tropical regions because:

1. The hurricane's winds were not strong enough in the Chesapeake Bay area to upturn enough sediment and simply stripped and removed the top layer, reducing the total P levels in the water, while moving the sediment elsewhere.
2. The sediment was too dense to be fully upturned. Studies suggest that grain size and density of sediment contribute heavily to its ability to be upturned.² Unlike the loose mud in many coastal tropical regions, Chesapeake Bay sediment is relatively dense.

We suggest further research to determine the true reason aquatic P levels decreased in the hurricanes surveyed. In addition, a continuation of surveying hurricane disturbance will be vital to fully understanding the complex relationship between hurricanes and aquatic phosphorus levels. A potential route would be to investigate if a larger hurricane contributes to a larger change in aquatic P levels due to different magnitudes of sediment upturning.

Bibliography

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