Land Use Change and N and P export on the Coastal Plain of the Chesapeake Bay

P.I.: **T. R. Fisher**

University of Maryland

Horn Point laboratory

Grad. Students: **K.-Y. Lee**

J. A. Benitez

E. J. Rochelle-Newall

H. Berndt

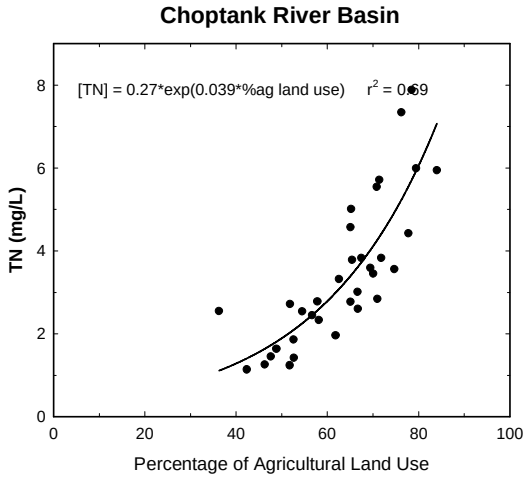
M. M. Norton

University of Maryland
CENTER FOR ENVIRONMENTAL SCIENCE
HORN POINT LABORATORY

Web Site: **http://www.hpl.umces.edu/gis_group/timescale1.html**

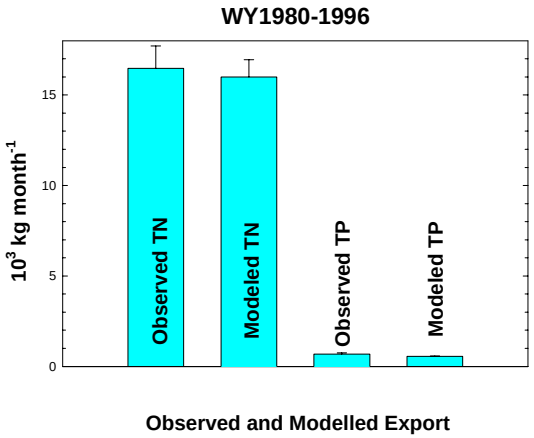
Introduction

- **Substitution of agriculture for forest leads to enhanced export of N and P on the Delmarva coastal plain, enhancing eutrophication of Chesapeake Bay.**
- **Hydrochemical modeling (GWLF) captures this effect with 15-30% errors on an annual basis, <10% errors at decadal time scales.**

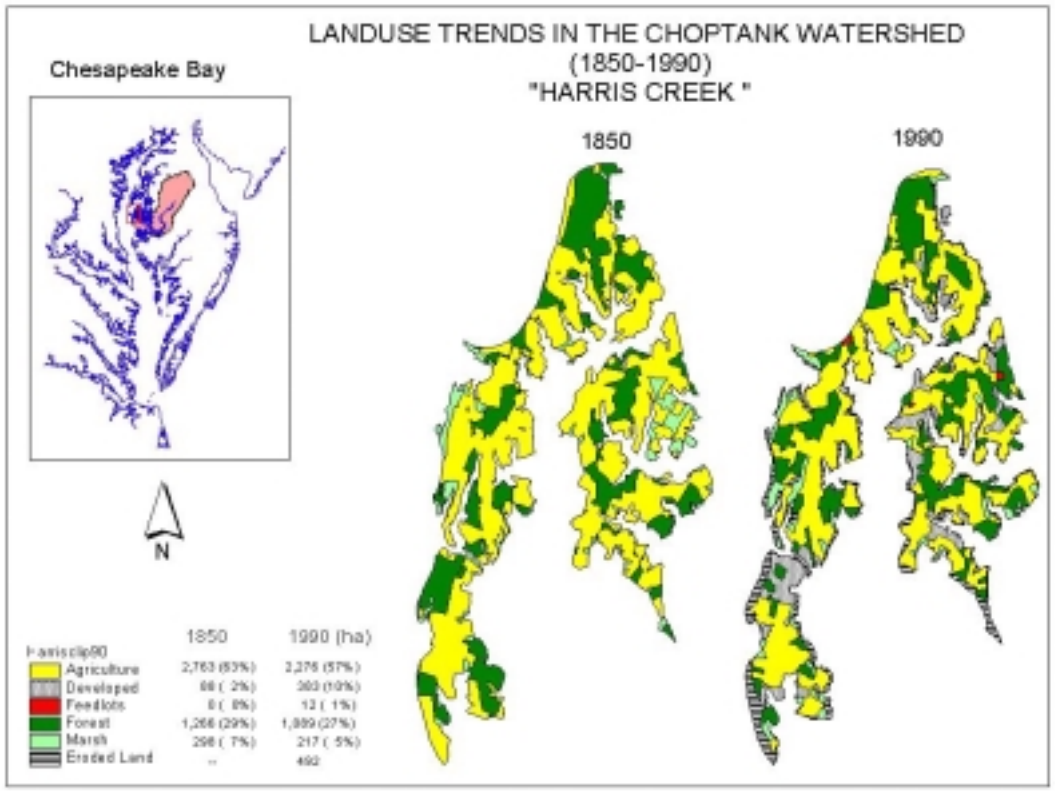


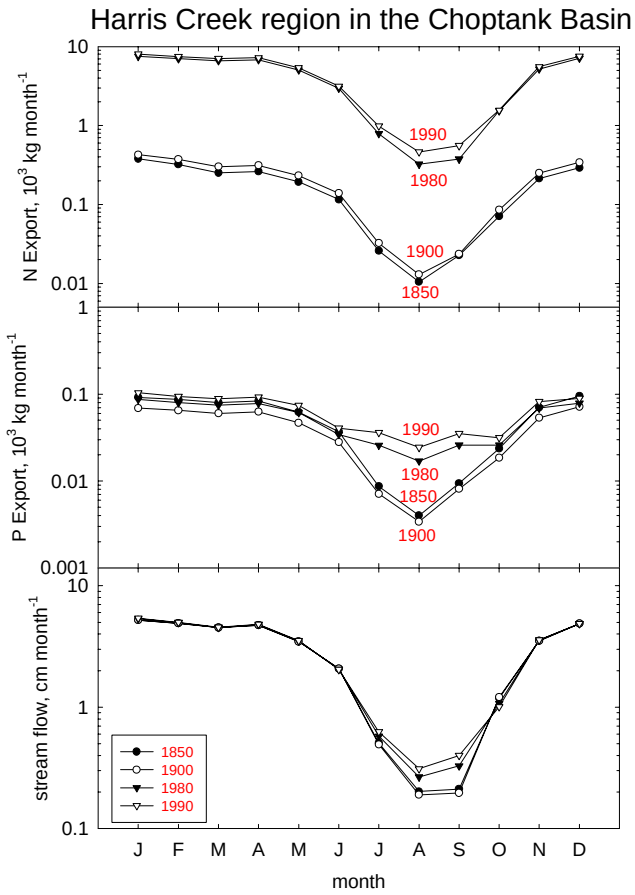
Goals

- **Reconstruct land use history in the Choptank basin over the last 150 y using maps, aerial photos, and Landsat imagery.**
- **Model rates of N and P export associated with the land use change using historical maps, aerial photos, and Landsat imagery.**



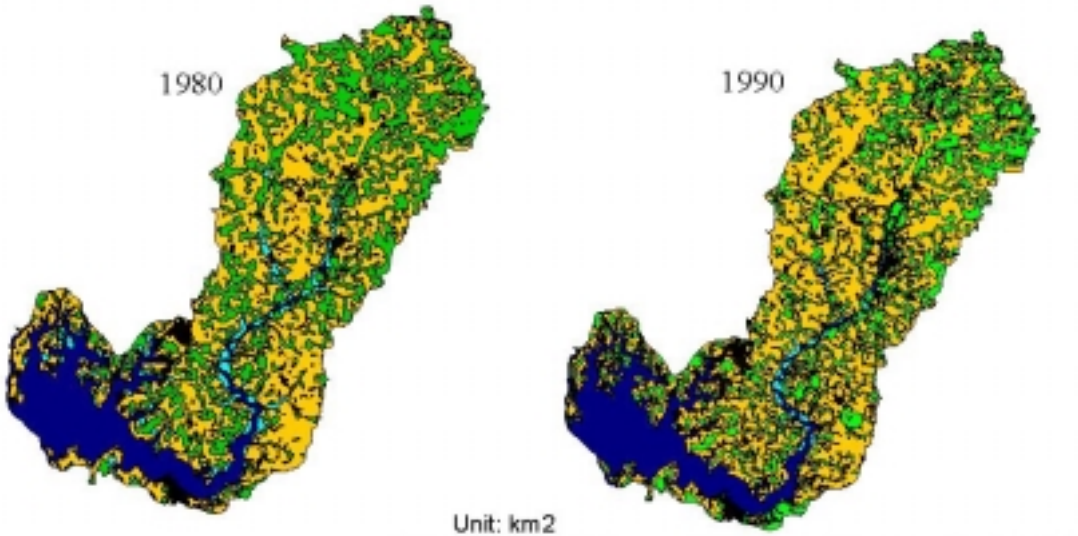
Results





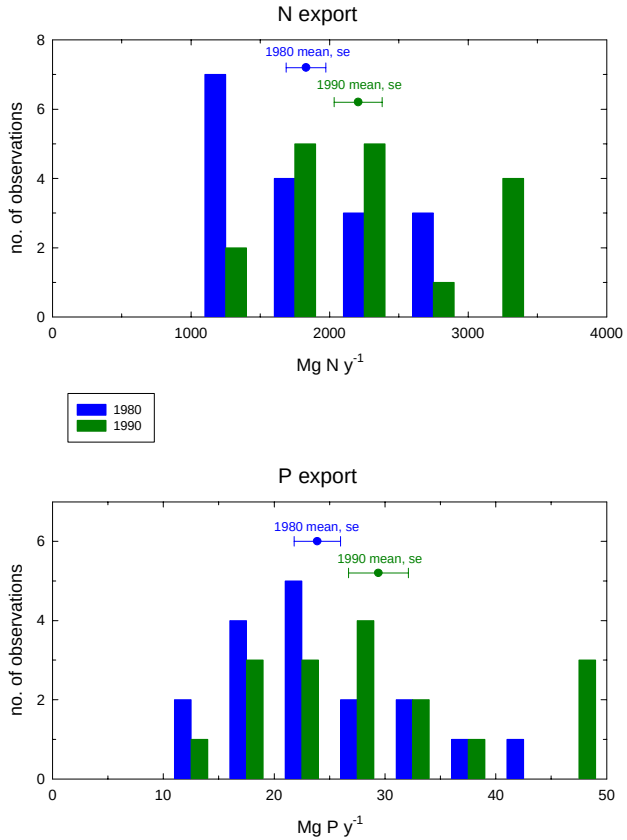
- By 1850, deforestation of arable land was already complete (left figure), but intensity of agriculture has increased due to application of fertilizers.
- Urbanization ("developed") has been the major land use change through 1990, and shoreline erosion due to land subsidence and sea level change was significant.
- Modeled environmental effects (right figure) are projected to be small for stream flow, modest for P export, and large for N export, consistent with observations.

Land use change in the Choptank River basin



Unit: km2

Land Use	1980	1990	% Change	%Error	Significant?
Agriculture	1001.55	1069.78	+7	6	N
Developed	64.33	94.57	+47	-	Y
Feedlots	9.35	11.20	+20	-	Y
Forest	594.38	542.07	-9	28	N
Unforested Wetlands	100.59	39.03	-61	50	Y
Water	286.71	300.23	-5	2	Y



- At the decadal time scale, significant fluctuations in land use were also observed (left).
- Between 1980 and 1990, urbanization and feedlots for animals increased at the expense of forested wetlands.
- Model results indicated increases in N and P export to Chesapeake Bay, with increasing frequency of high export years under the changed land use conditions (right).

Conclusions

- Historical changes in land use in the Choptank basin have been modest over the last 150 years.
- Intensity of land use (fertilizer application rates to agriculture, urban density) have strongly influenced modeled export of N and P over the last 150 years.
- P export from land to estuary increased by a factor of 2 due to loss of wetlands and increasing urbanization and feedlots.
- N export from land to estuary increased by a factor of 10 due to application of commercial fertilizers after 1950 and increased nitrate in ground waters.

Publications

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