Human Alteration of the Nitrogen Cycle

American Meteorological Society

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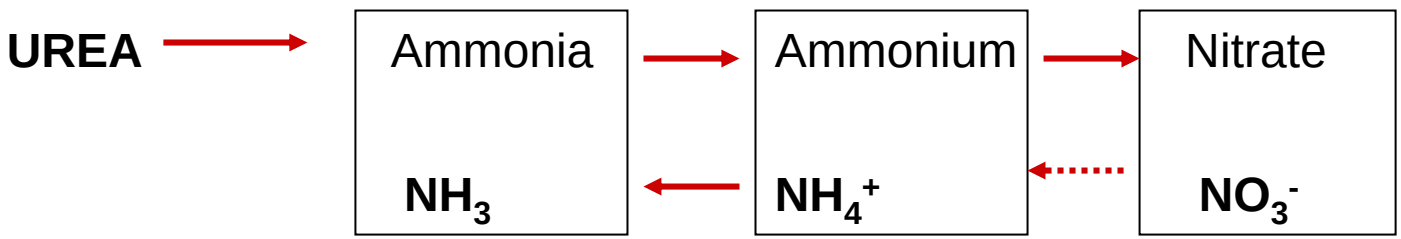
NICHOLAS SCHOOL OF THE ENVIRONMENT AND EARTH SCIENCES

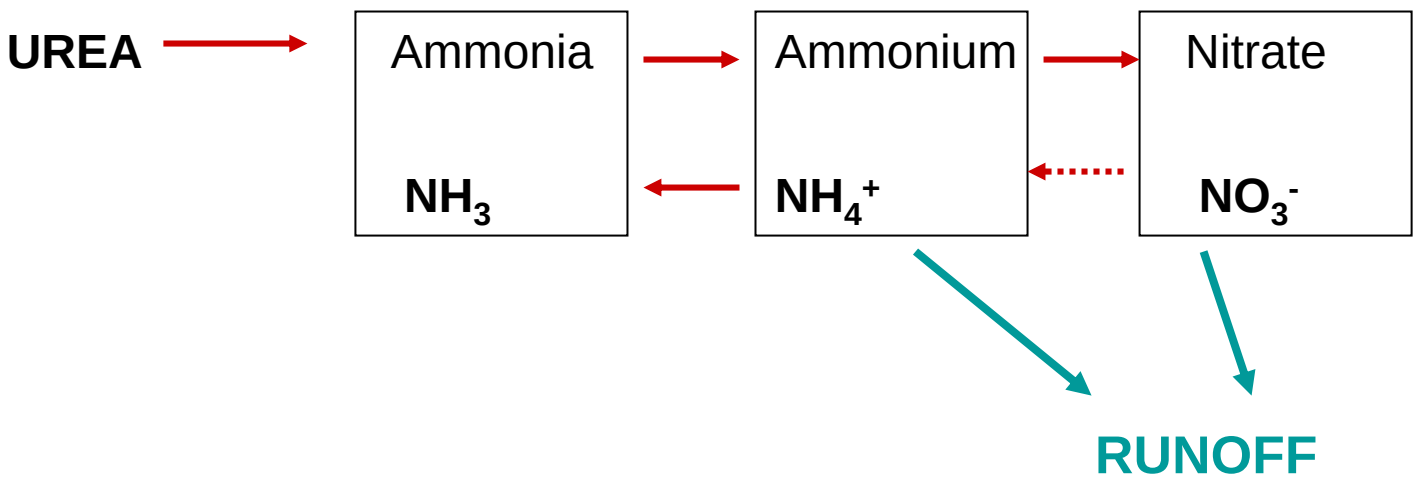
DUKE UNIVERSITY


Growers Special™
12-6-6
GUARANTEED ANALYSIS
Total Nitrogen (N) 12%
1.86% Nitrate Nitrogen
1.28% Ammoniacal Nitrogen
8.86% Urea Nitrogen*
Available Phosphate (P_2O_5) 6%
Soluble Potash (K_2O) 6%
Boron (B) 0.02%
Copper (Cu) 0.05%
Iron (Fe) 0.25%
Total Manganese (Mn) 0.05%
0.05% Soluble Manganese
Zinc (Zn) 0.05%
Derived From Primary Plant Nutrient Sources: Nitrate of Potash, Ammoniated Phosphate, Urea Formaldehyde.
Secondary Plant Nutrient Sources Derived From: Sodium Borate, Copper Sulphate, Iron Sulphate, Manganese Sulphate, Zinc Sulphate.
*7.34% Slowly Available Nitrogen From Urea Formaldehyde.
370-2305
DIRECTIONS FOR USE
Hi-Yield® Growers Special™ is designed for controlled feeding of container plants, trees, shrubs, and lawns. The slow release formula in Growers Special™ reduces the risk of nitrogen burn and is chlorine free.
CONTAINER PLANTS: Apply one teaspoonful per 6 inch pot and 2 tablespoons per square foot of soil surface in large containers

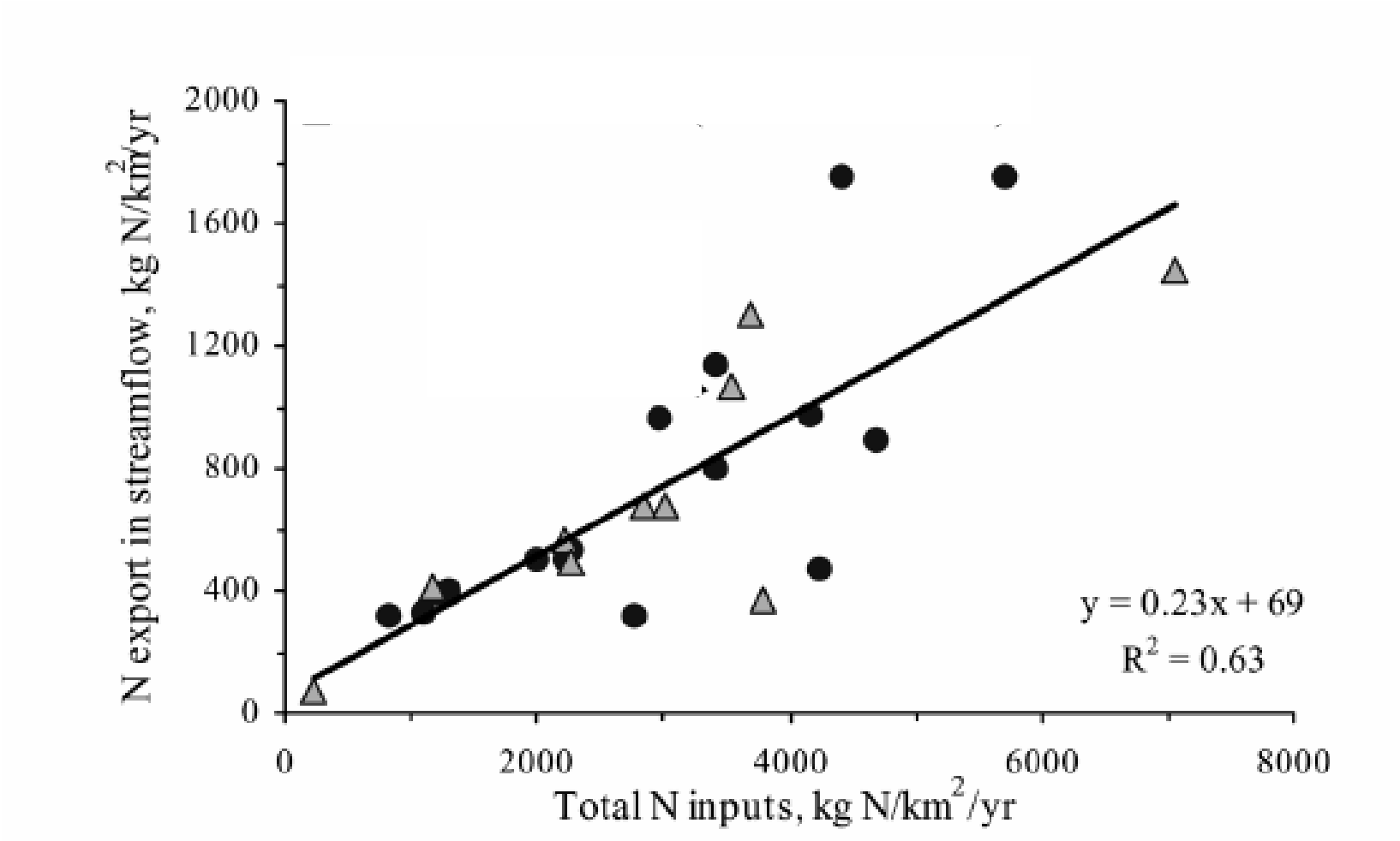
UREA

Ammonia	Ammonium	Nitrate
NH_3	NH_4^+	NO_3^-


UREA
Ammonia
NH_3
Ammonium
NH_4^+
Nitrate
NO_3^-


UREA
Ammonia
NH_3
Ammonium
NH_4^+
Nitrate
NO_3^-
RUNOFF

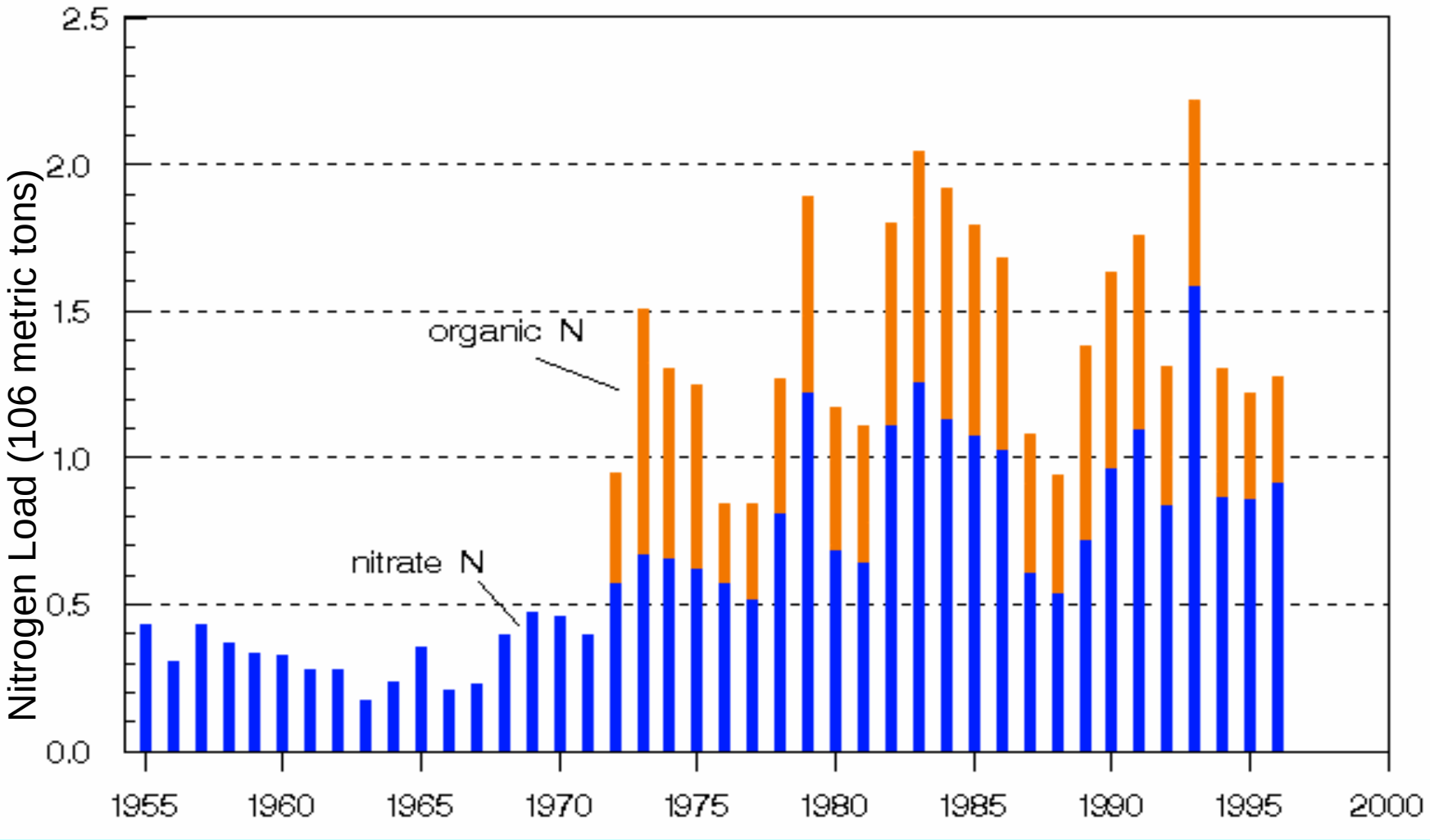
23% of the Nitrogen Applied to the Land Surface ends up in Streams



From Van Breeman et al 2002

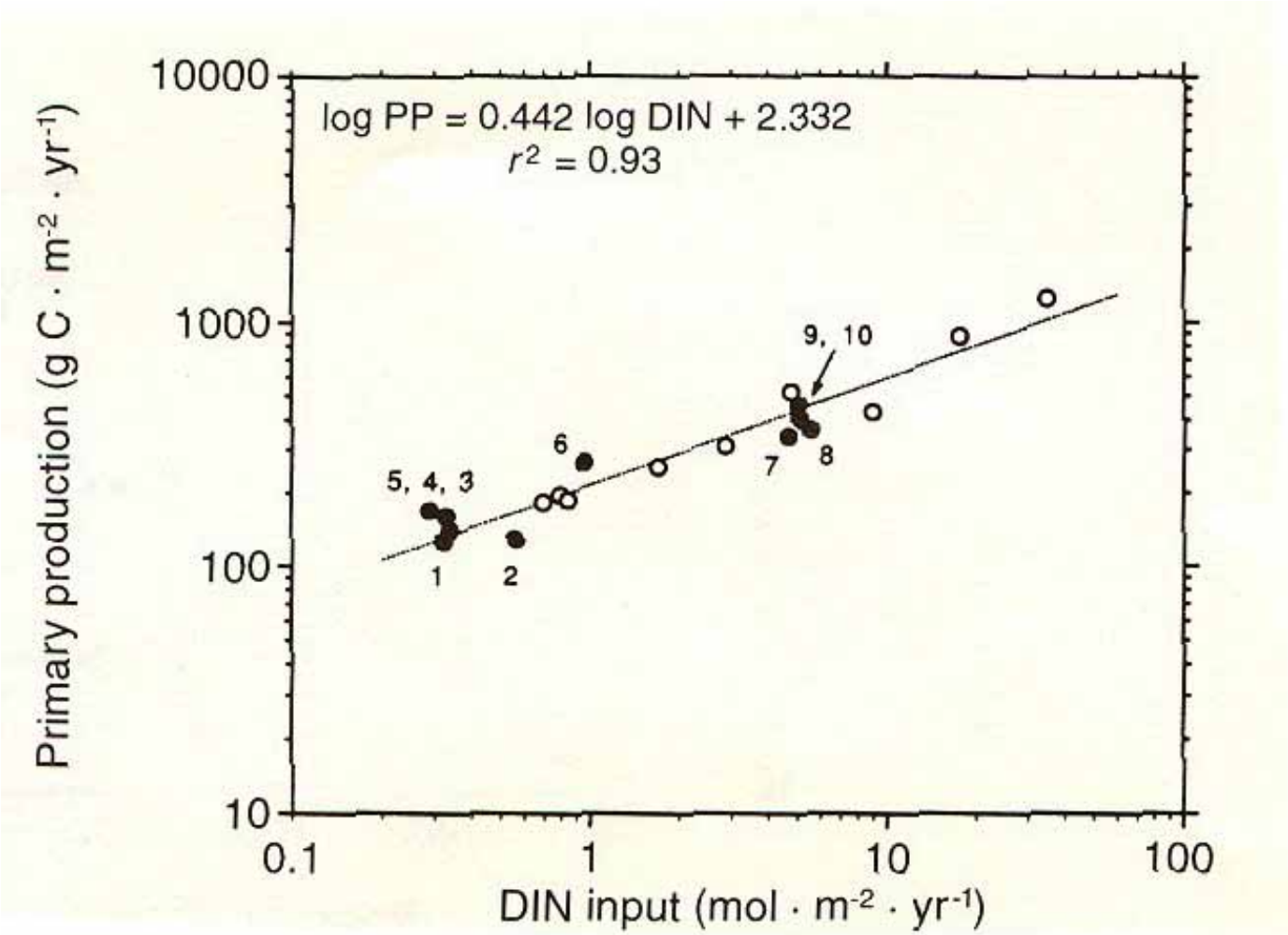
300% increase in N load

80% due to NO_3^- concentration ↑
20% due to discharge ↑

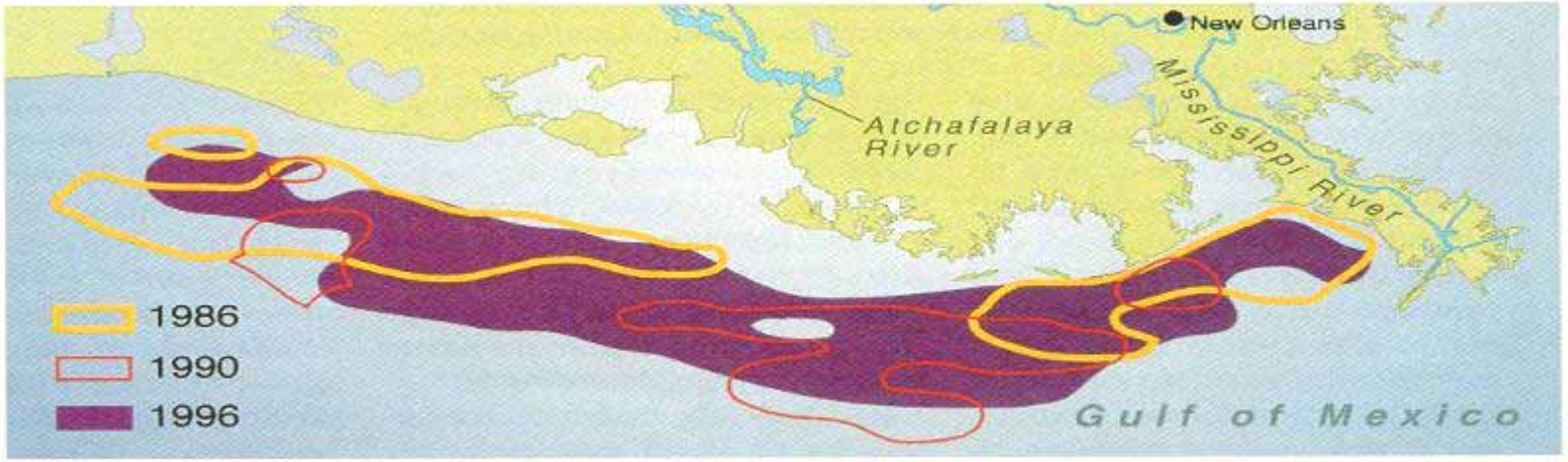


http:// wwwrcolka .cr. usgs .gov/midconherb /hypoxia.html

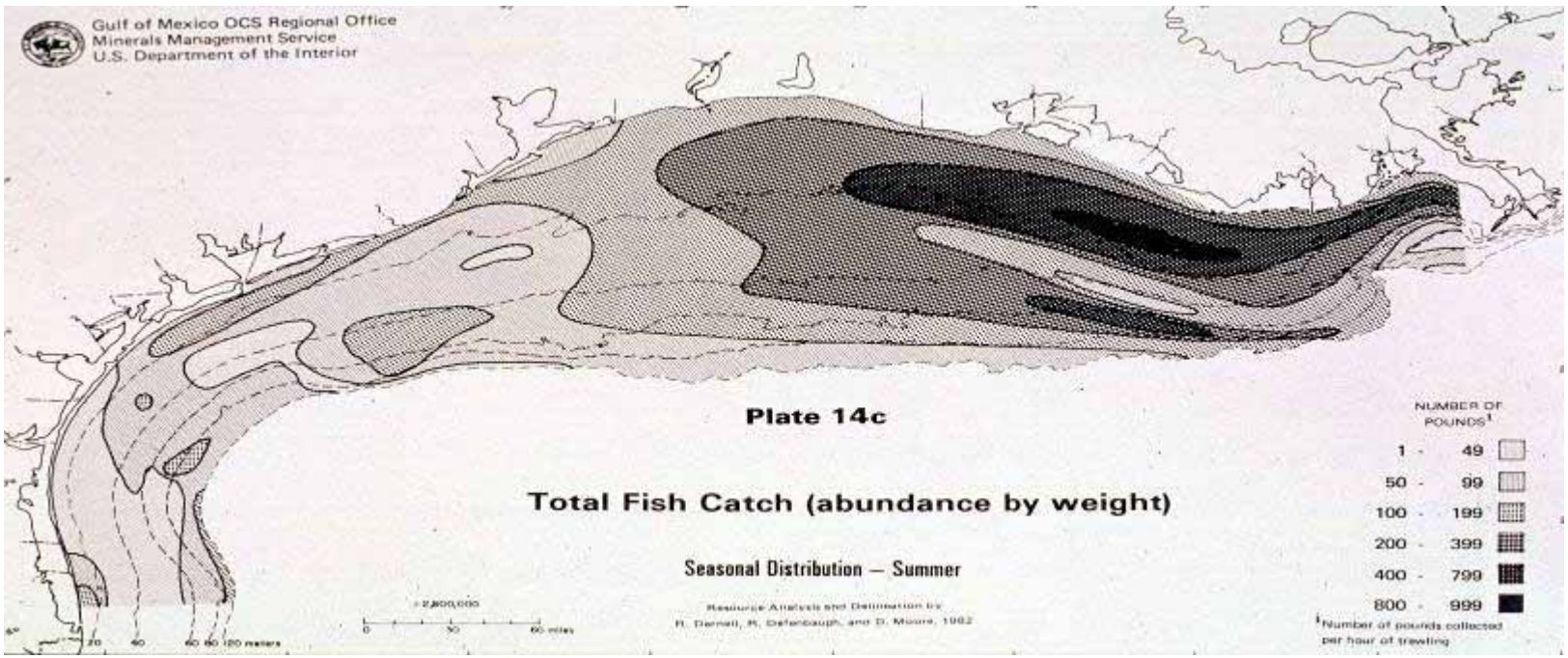
Nitrogen in rivers and streams stimulates algal growth in coastal waters



From Vitousek et al 1997

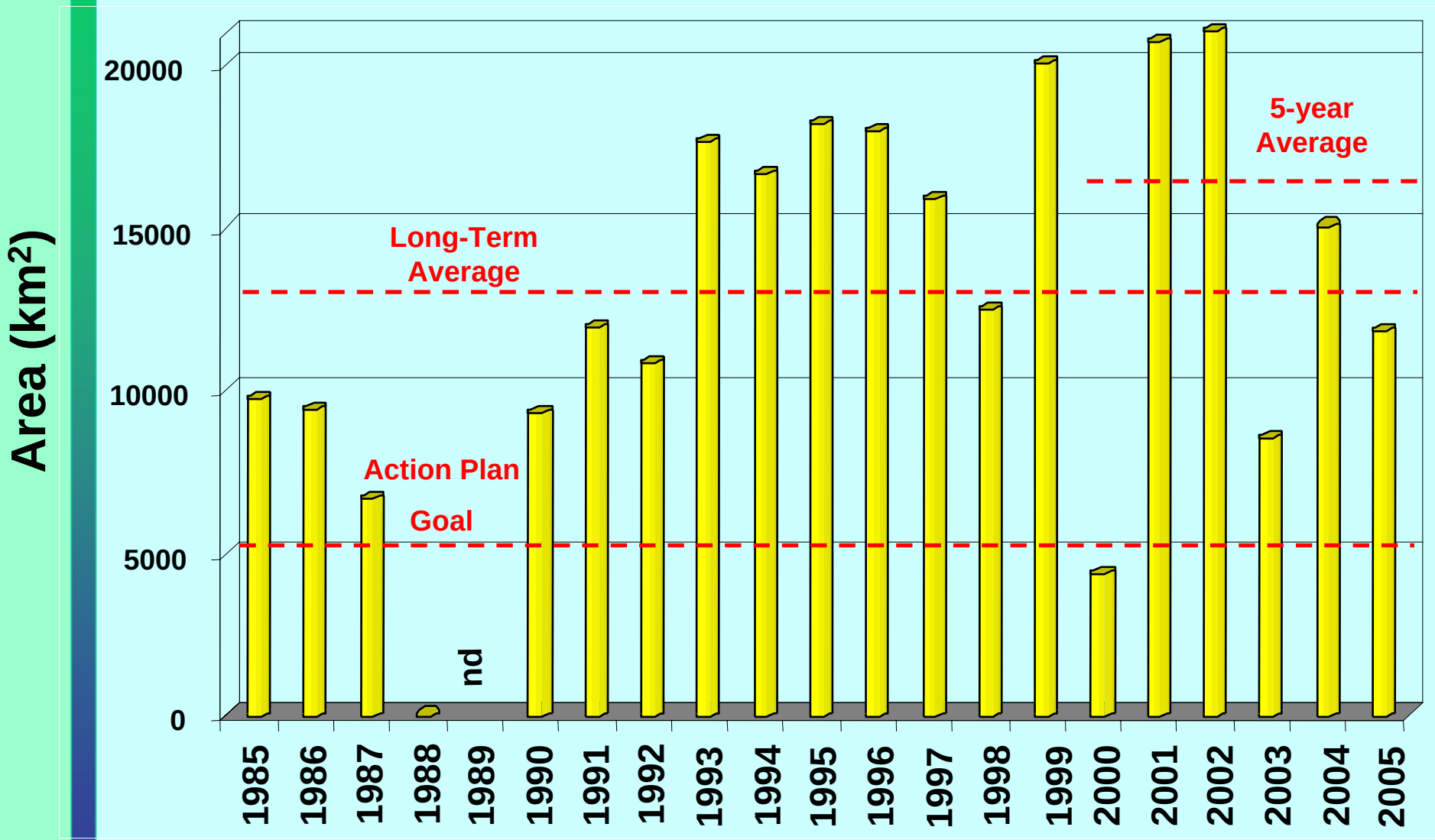


Hard to pin down. The dead zone encompasses different swaths of water from one summer to the next. Researchers are trying to find out which factors influence this shifting mosaic.



Darnell et al. (1983)

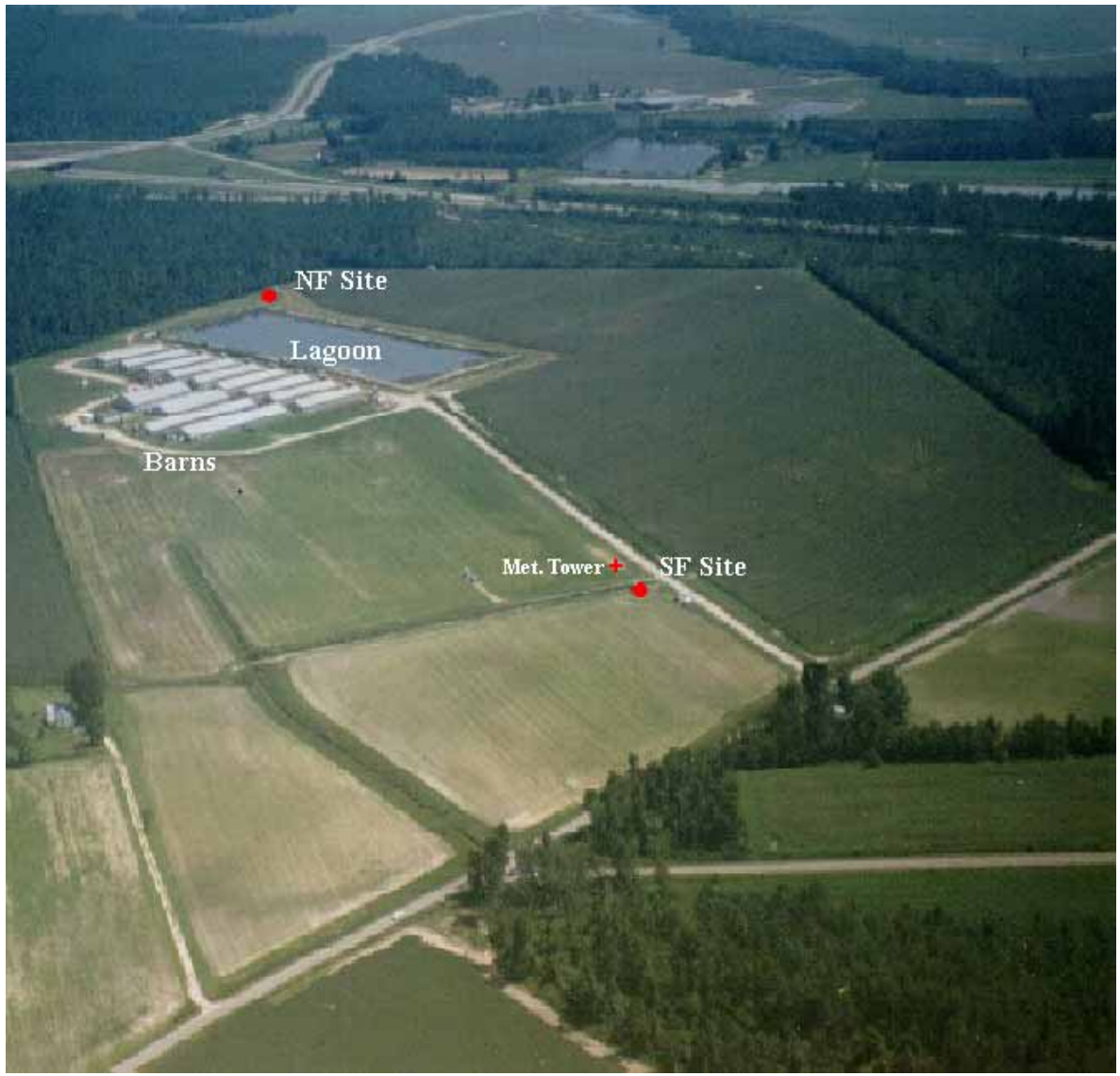
Estimated Size of Bottom-Water Hypoxia in Mid-Summer



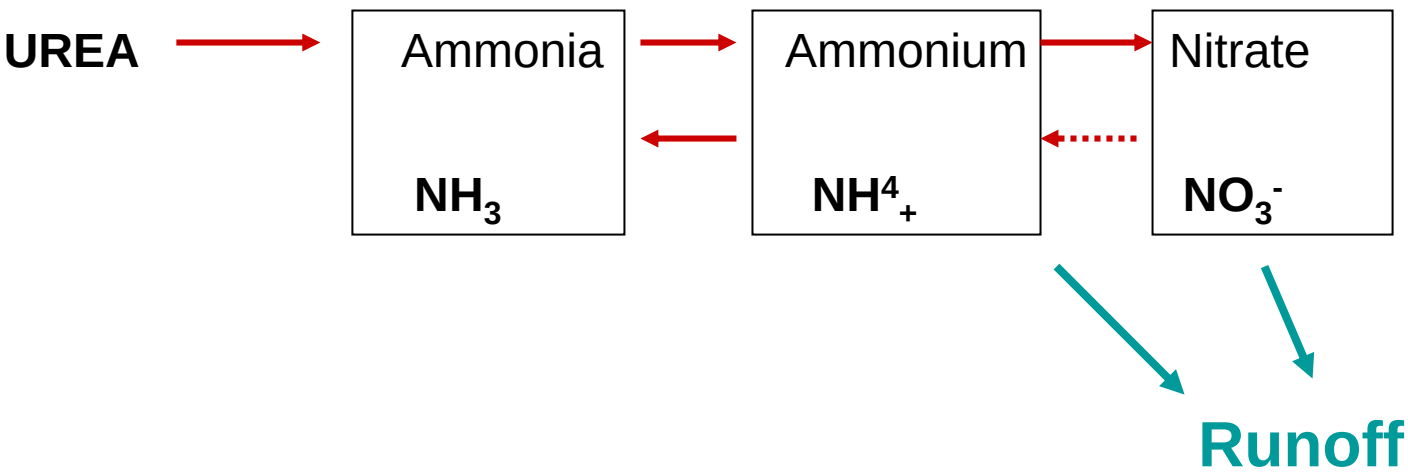
(updated from Rabalais et al. 2002)

Commercial Hog Farm in North Carolina

Sampling Sites



From V. Aneja, NC State University


UREA
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NH_3
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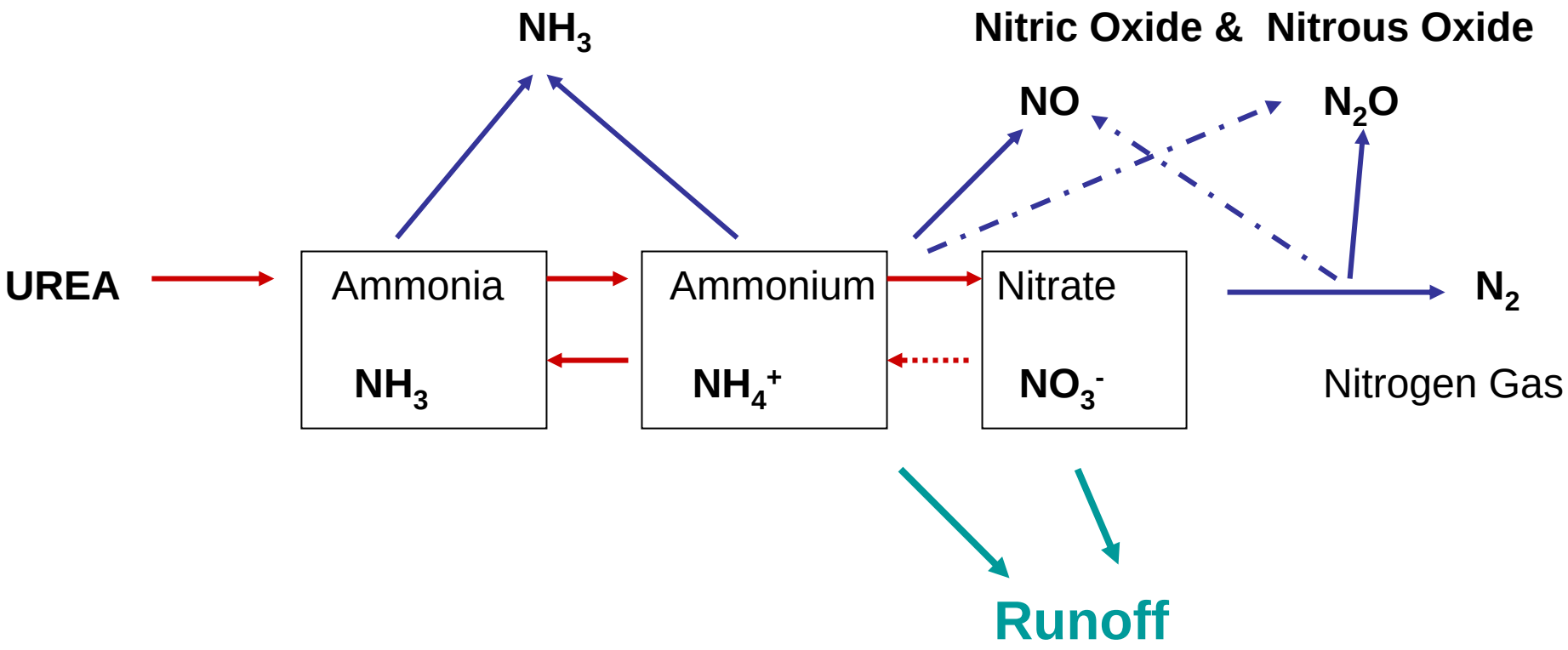
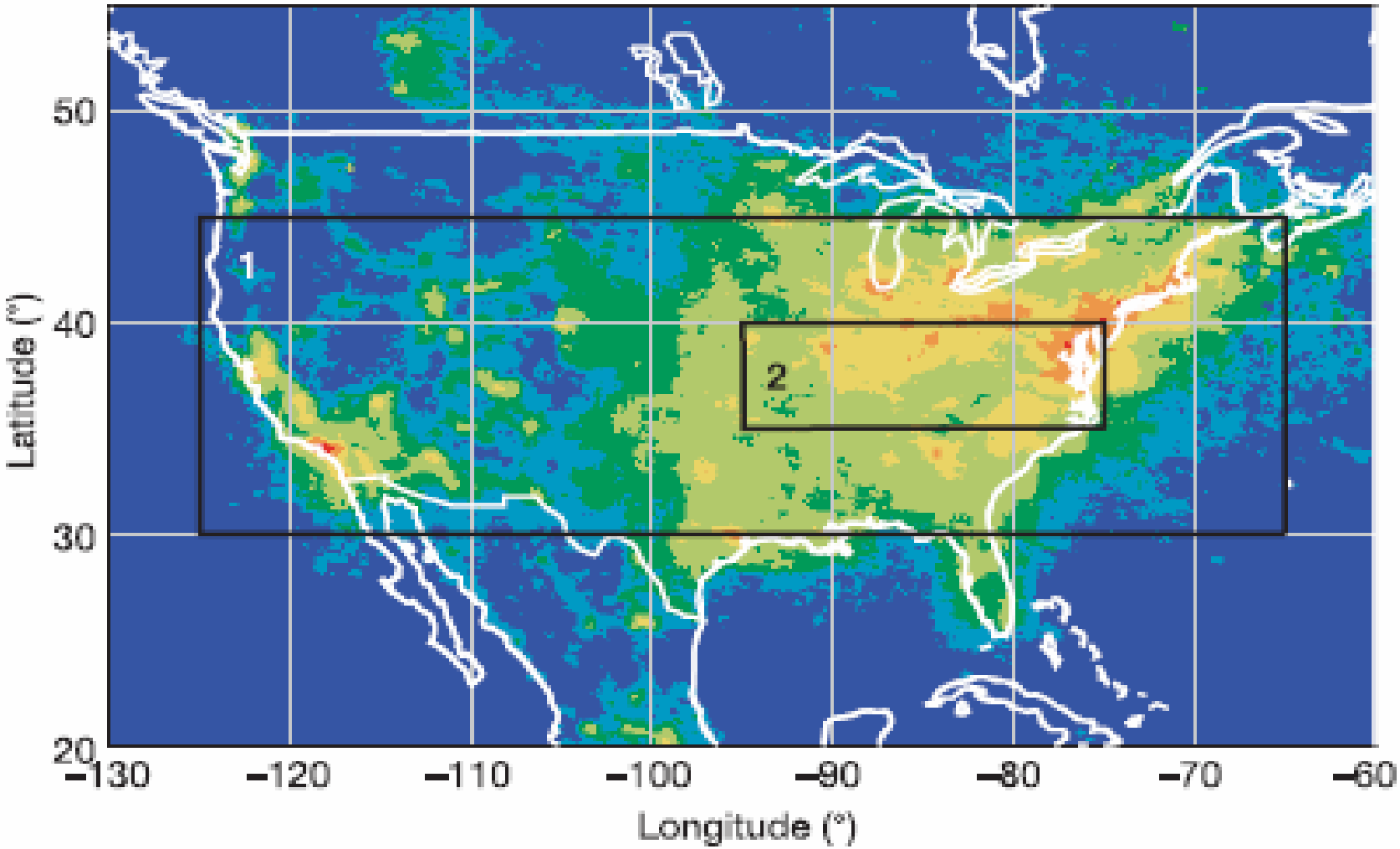
NH^4_+
Nitrate
NO_3^-
Runoff

Reactive Nitrogen Gases

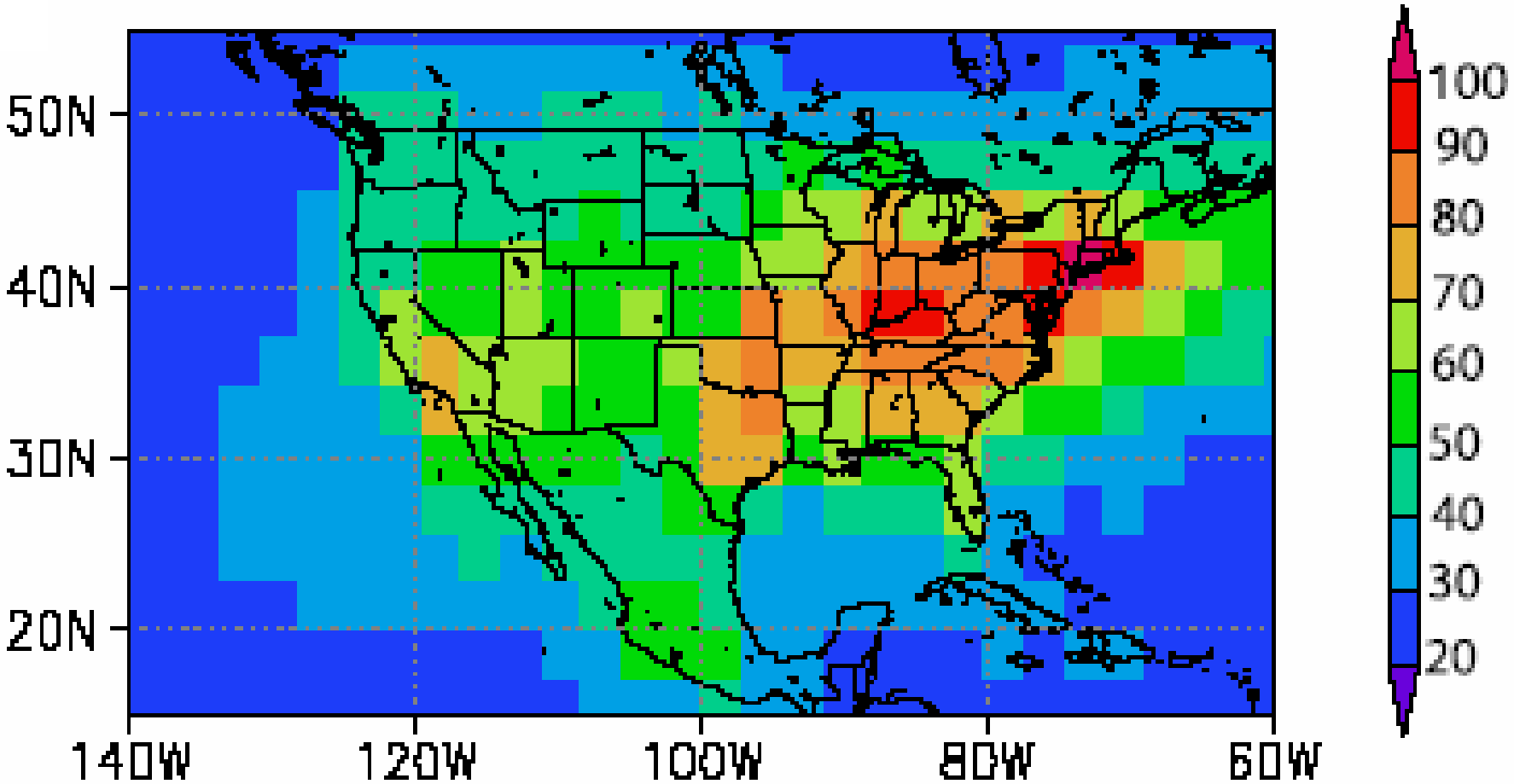


Concentration of Nitrogen Oxide

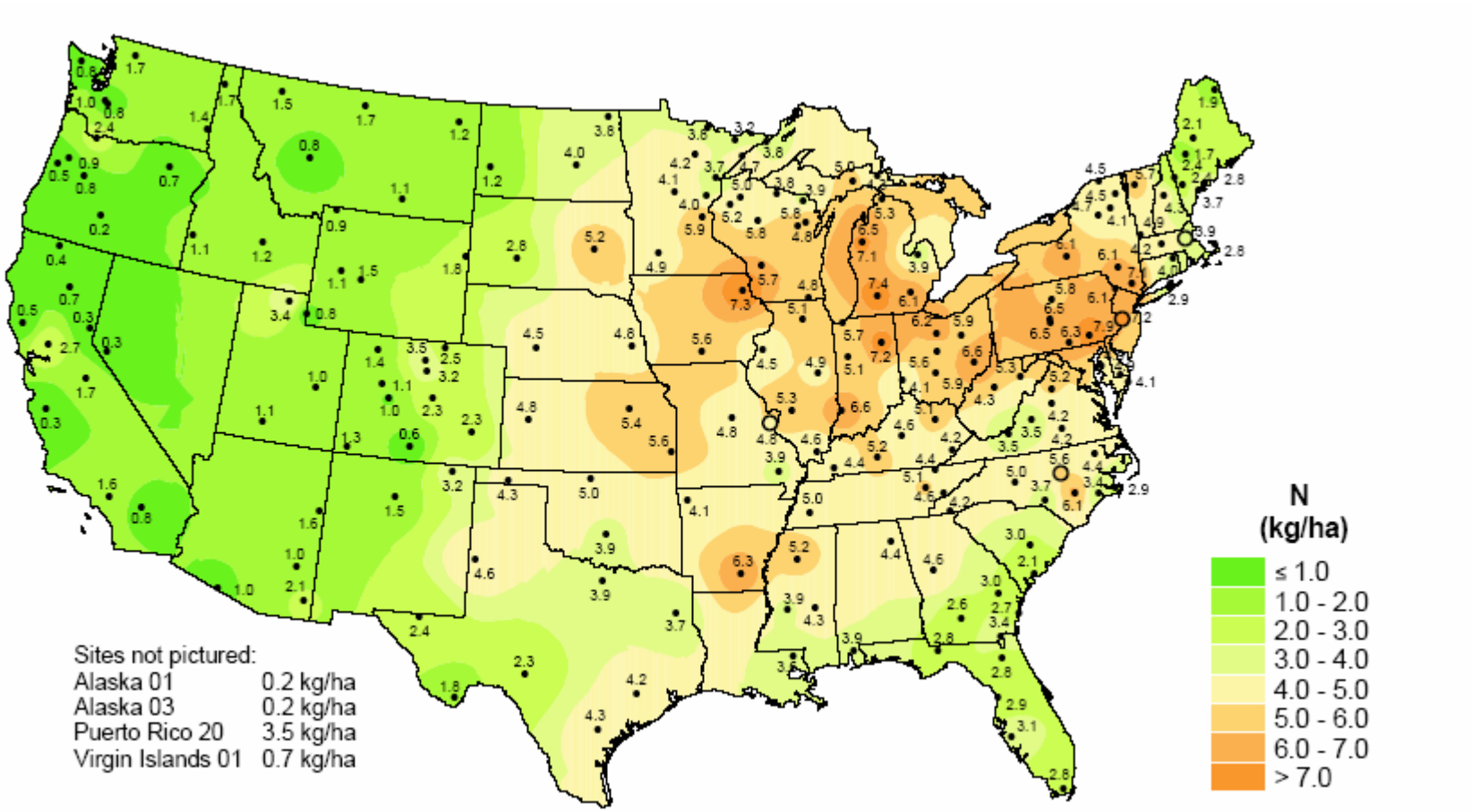


Richter et al, 2005

Summer Ozone (ppb)



Inorganic Nitrogen



National Atmospheric Deposition Program

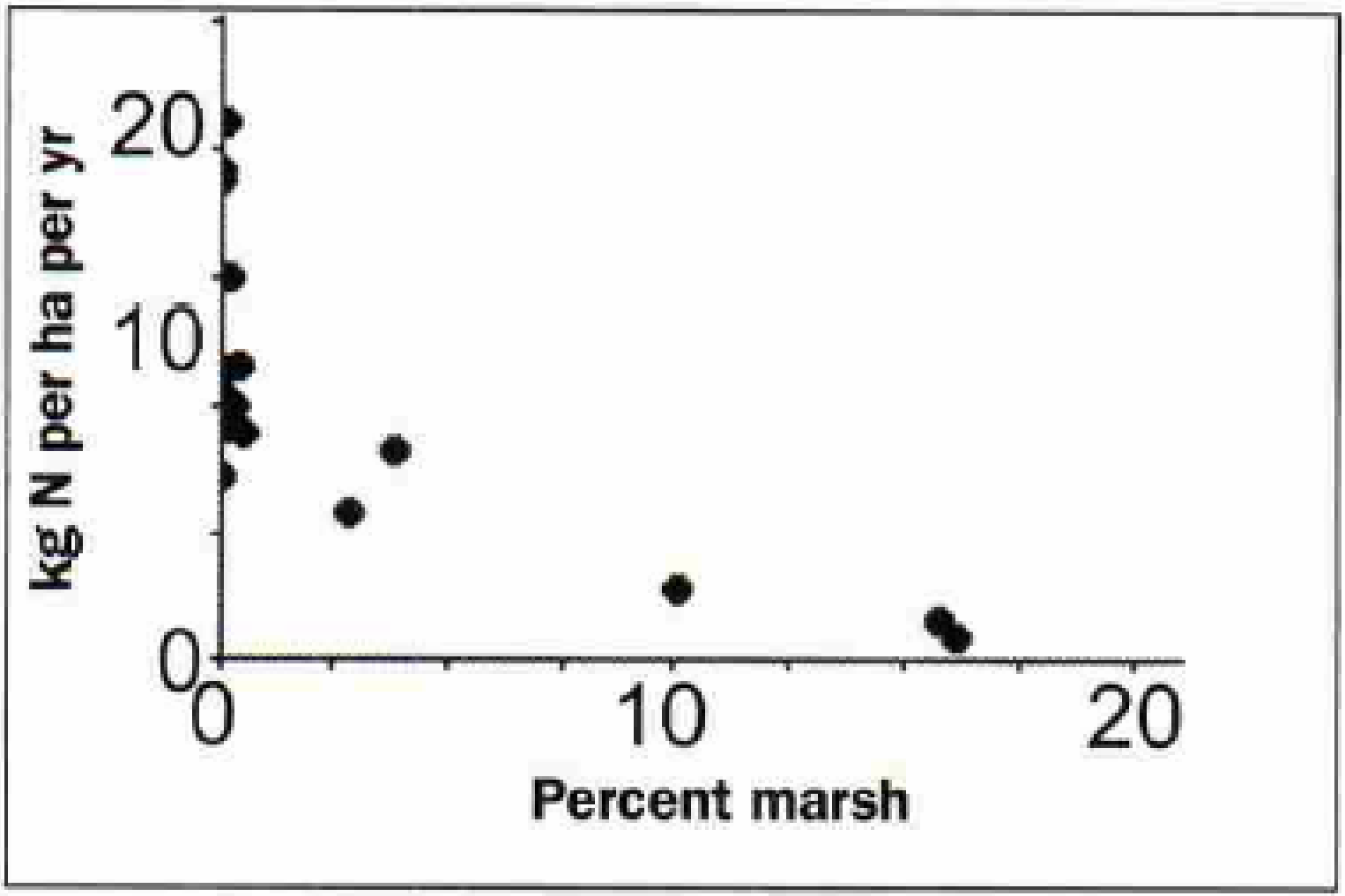
Table 4. The annual mass balance of total nitrogen and phosphorus in Chesapeake Bay, Maryland-Virginia.[1] during 1985–1986. Data from Boynton et al. (1995). Units are mmol m^{-2} y^{-1}.

	N	P
Inputs		
Direct atmospheric deposition[2]	113	2
Nitrogen fixation	?	0
Rivers (diffuse sources)	565	18
Direct sewage (point sources)	260	11
Coastal ocean[3]	0	10
	938	41
Changes in storage		
Accumulation in water	0	0
Accumulation in sediment	327	40
Outputs		
Denitrification	245	0
Fish landings	84	1.5
Coastal ocean[3]	282	0

[1] Area = 11 542 km^2, mean depth (MLW) = 6 m.
[2] Smullen et al. (1982); 1976–1981 mean TN and TP in wet deposition.
[3] P input and N output calculated by difference.

What might be done?

1) Reduce nitrogen application
2) Increase efficiency of nitrogen use
3) Preserve wetlands
4) Preserve and manage first-order streams



Jones et al, 1976

“Every vital phenomenon is due to some change in a nitrogen compound and indeed in the nitrogen atom of that compound.”

~Arthur Needham