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Accounting for Changes in Air and Water Nitrogen Emissions from Thermochemical Conversion Processes

by
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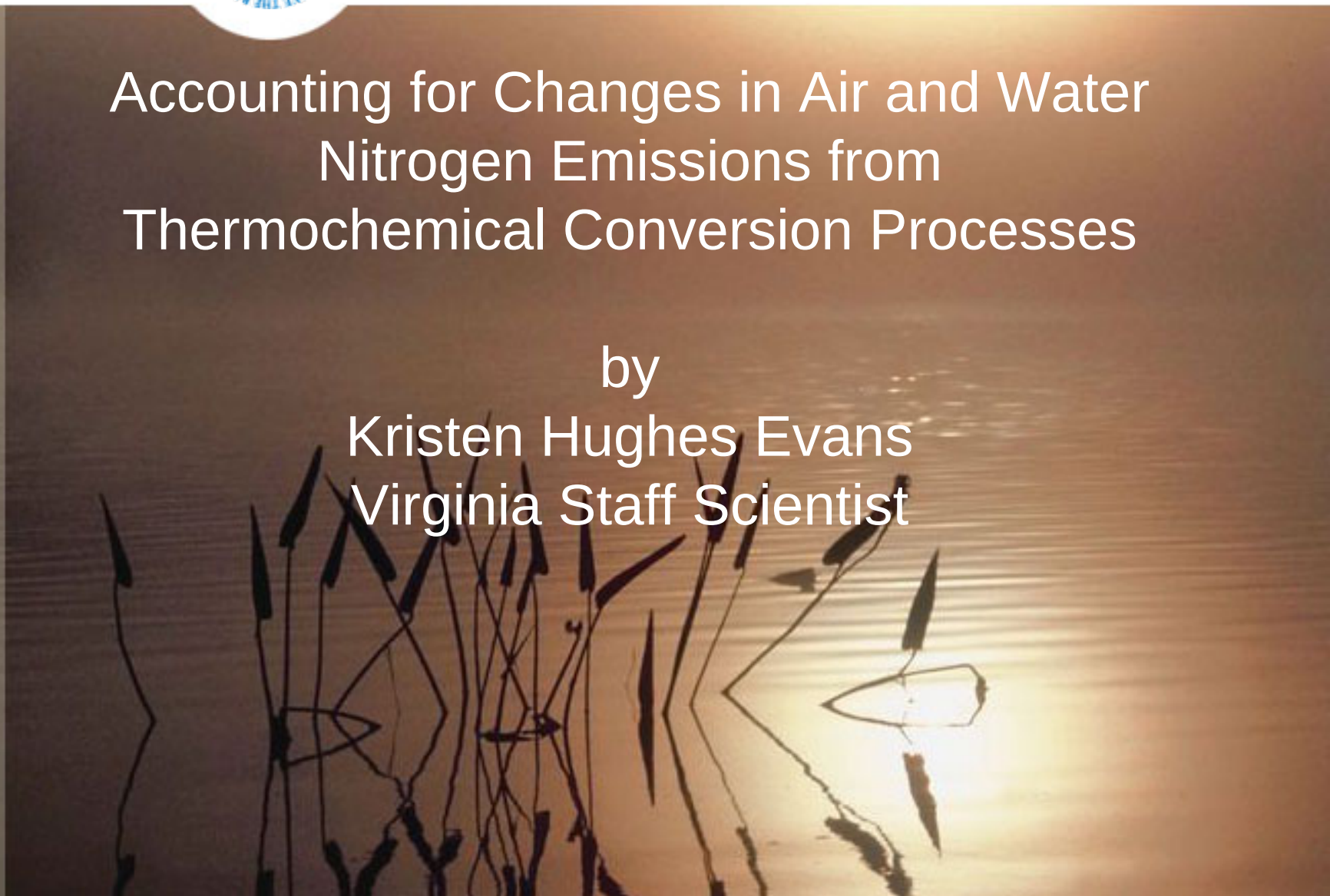

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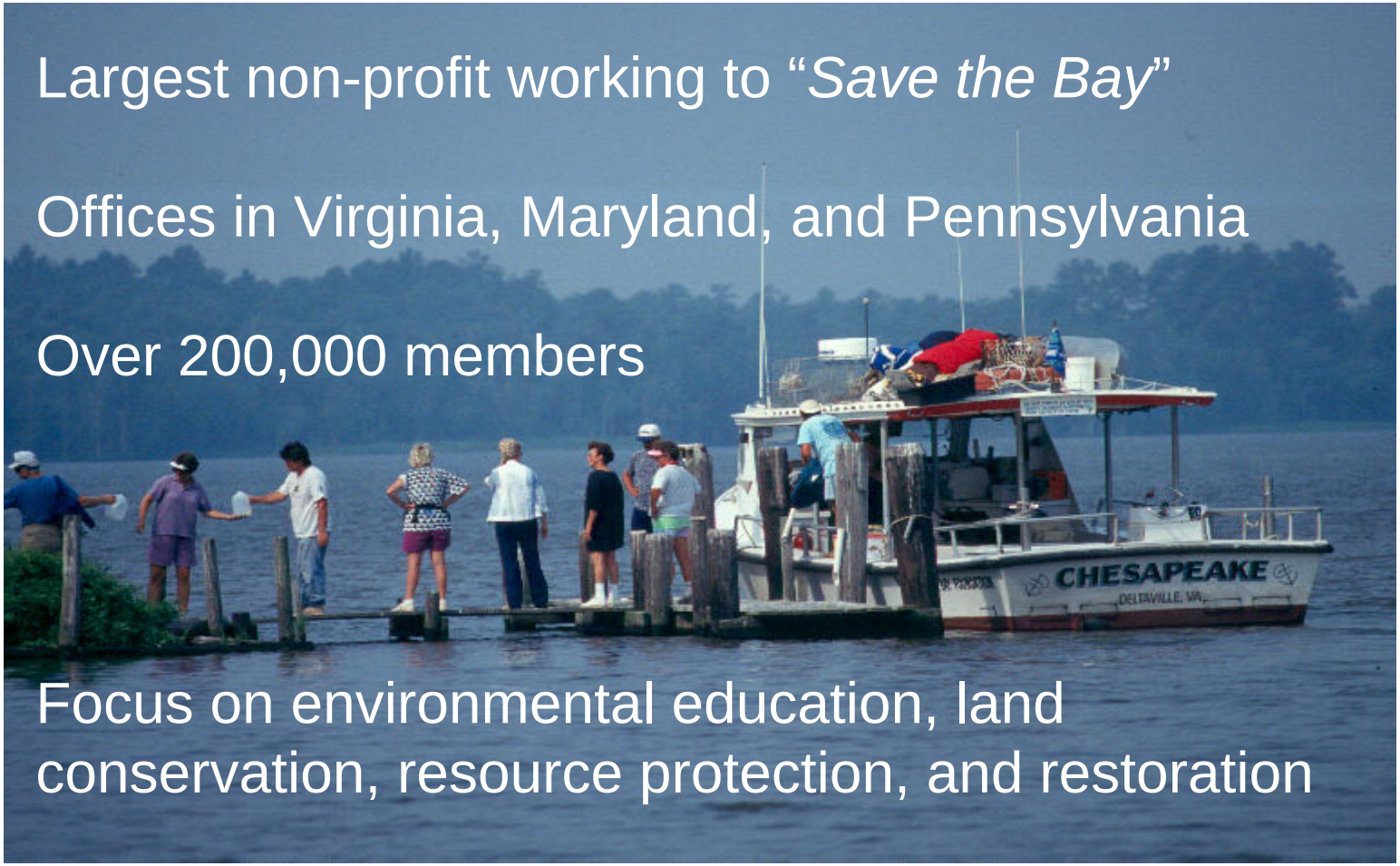
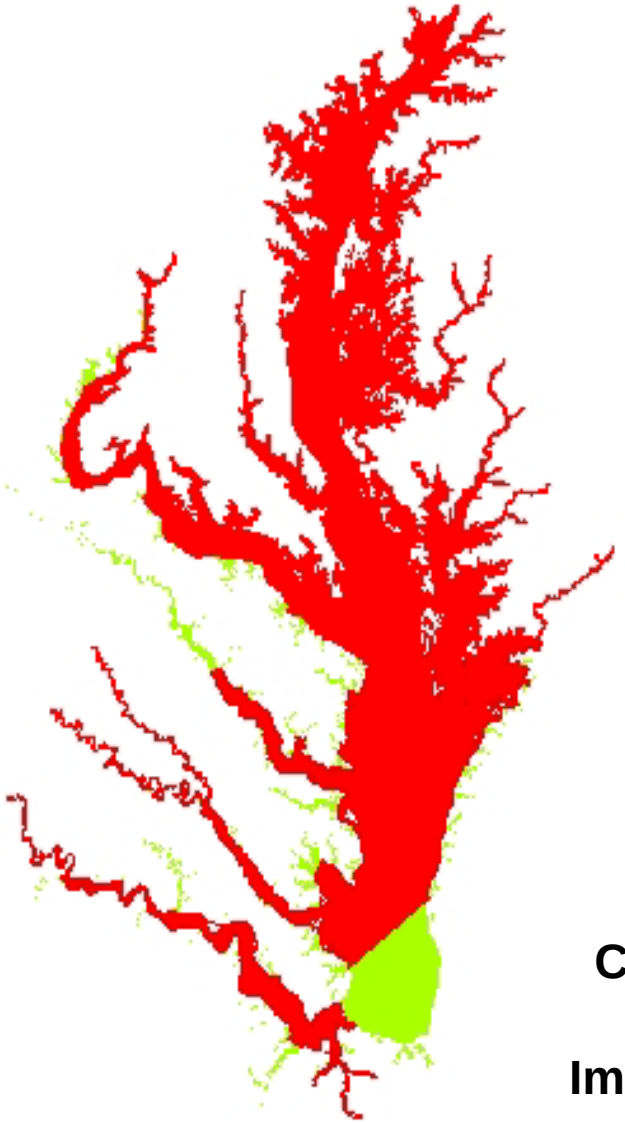


- 64,000 square miles
- Largest estuary in U.S.
- 14:1 Land to water ratio
- Population has tripled in last 100 years.



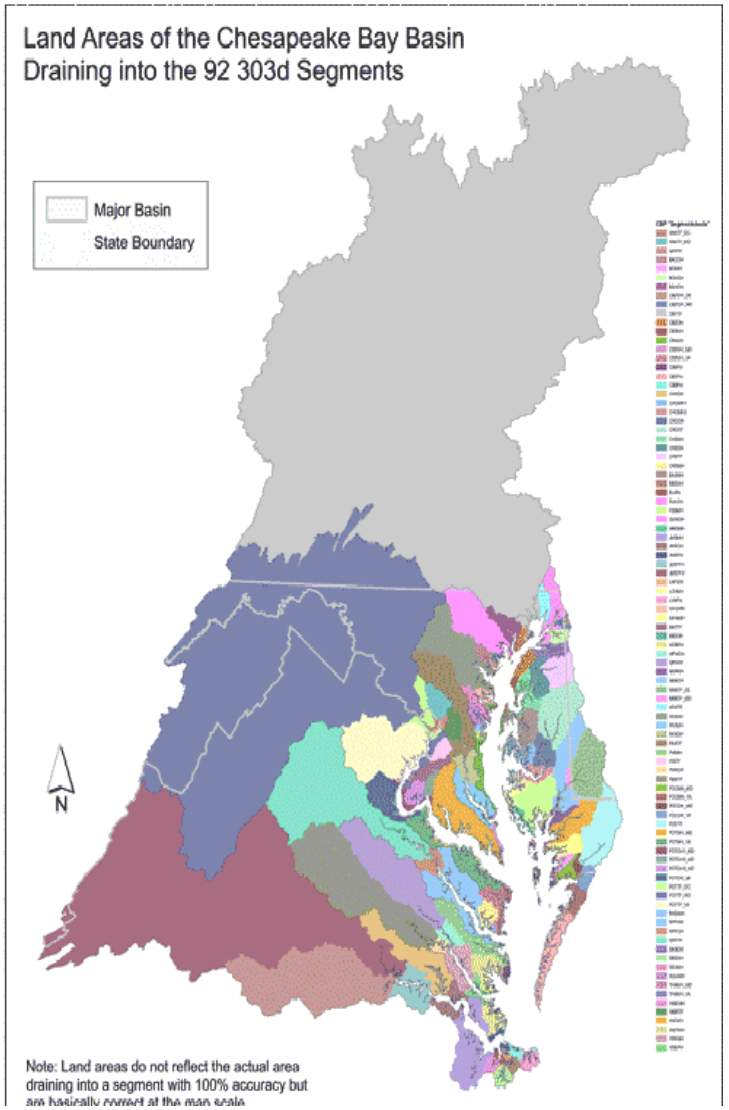
The Chesapeake Bay is not meeting its water quality standards for oxygen, water clarity, or chlorophyll a because it receives too much nitrogen, phosphorus, and sediment.

When a waterway does not meet its Water Quality Standard we call it **“impaired”.**

Chesapeake Bay and Tidal Tributaries Listed on the CWA 303 (d) List as Impaired for Nutrients and/or Sediments

Under existing federal law we have to put the Bay on a pollution diet.

Effort is underway to develop TMDLs for the Chesapeake.



A Total Maximum Daily Load **(TMDL)** = a pollution diet to return a waterway to good health.

A TMDL sets the maximum amount of a pollutant that a waterway can receive without exceeding its water quality standard.

TMDLs can be developed for nutrients, bacteria, toxic compounds sediment or other parameters.

Satellite image from April 2005 courtesy of NASA, MODIS Rapid Response at GSFC

80% of the Nitrogen, Phosphorus, and Sediment Pollution Comes from Non-Point Sources

How will the Conversion of Poultry Litter to Energy via Thermochemical Conversion Change Nitrogen Loading Rates to Air and Water?

	Combustion	Gasification	Pyrolysis
Definition	Complete oxidation of fuel in oxidizer-rich environment without producing useful intermediate fuel gases, liquids, or solids	Conversion of feedstock by direct internal heating provided by partial oxidation using limited air or oxygen to produce fuel gases	Thermochemical degradation without air or oxygen, usually optimized to produce fuel liquids
Temperature	1500 to 3000ºF	1300ºF and higher	750 to 1500ºF
Useful Products	Heat	Fuel gases can be combusted, used to produce methanol, Fischer-Tropsch liquids, etc.	Pyrolysis-oil, fuel gas, carbon-rich char (biochar)

Pyrolysis **Gasification** **Combustion**

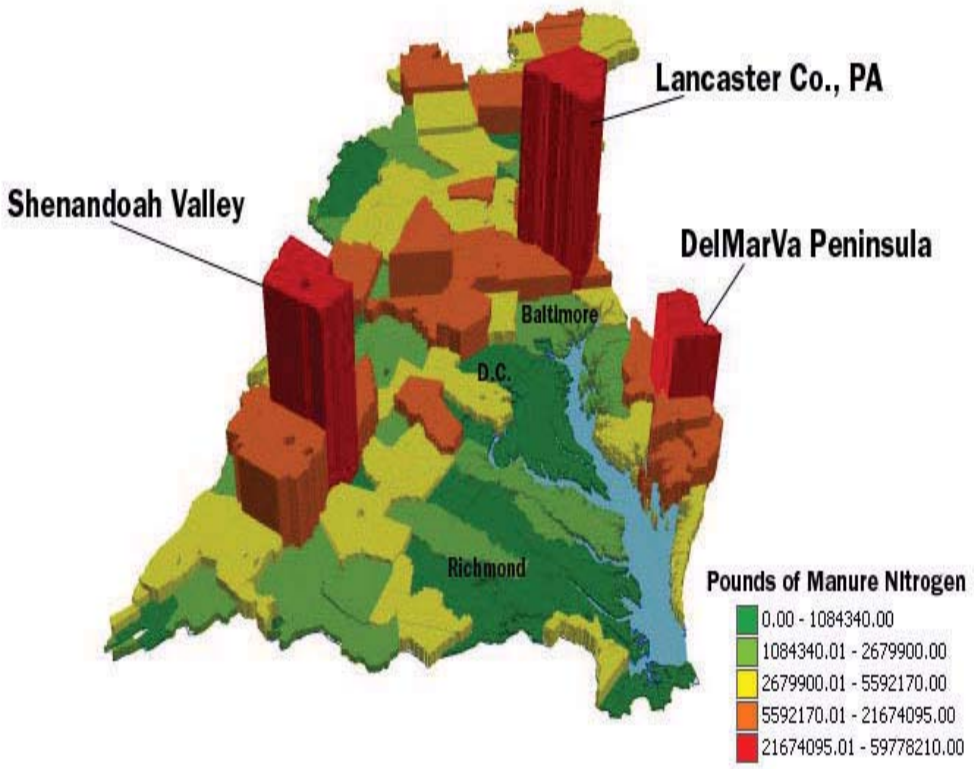
Lower Heat **High Heat**

No Oxygen **Abundant Oxygen**

What is the Status Quo?

- Most poultry litter is land applied
- Emissions sources:

Total Manure Nitrogen in Chesapeake Bay Watershed Counties



Source: EPA Chesapeake Bay Program

Nitrogen in Water Emissions – Status Quo

- NMPs required for all producers
- End users of poultry litter also required to use NM-based application (new in VA)
- P-based NMPs – new 590 standard?
- No surplus or stranding issues so far
- Poultry litter + sidedress fertilizer N

Nitrogen in Water Emissions Commercial N vs. Poultry Litter

- USDA-ARS Texas research– no detrimental water quality impacts from switching from commercial N to PL

- Research on MD Eastern Shore – switching from sidedress N to PL had major impact on N and P in runoff, particularly when it was surface applied.

Nitrogen in Water Emissions Switching from PL to Commercial N

- PA nutrient trading program – 5% credit in N reductions between commercial N and PL.

- Bay Model credits PL transport out of watershed as 0.27 lb N reduced for every lb N removed.

Nitrogen in Air Emissions – Status Quo

- 241 million broiler chickens in VA
  - 14 million lbs N (as NH3) lost from housing
  - 723,000 lbs N lost from storage (16 days)
  - 2.9 million lbs N lost from land application
  - Total N lost to air = 18 million lbs

Nitrogen in Air Emissions – Thermochemical Conversion

- Fibrominn – Combustion
  - <1% original turkey litter N released as NOx
- NC State evaluation of combustion/gasification unit
  - ~2% total poultry litter N released as NOx
- Assuming all of VA's broiler litter was gasified:
  - <500,000 lbs N released as NOx

Challenge

- TMDL means that we need to know how to credit nutrient reduction (especially N) associated with conversion of poultry litter to energy via thermochemical conversion.

Outstanding Questions

- Deposition of N in NOx versus NH3 from land application of PL versus commercial fertilizer N?
- Difference in N loading to surface and groundwater from poultry litter versus commercial fertilizer N?
- Need accurate air emissions data from thermochemical conversion technologies

Last but Not Least

- New EPA ozone standards – NAAQS for ozone between 0.06 and 0.07 ppm.

  0.08 ppm = 1987 standard

  0.075 ppm = 2008 standard

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