Inorganic Nitrogen in the Lake-Superior North Watershed, Minnesota

Purpose

This project explores the change in inorganic nitrogen samples taken from the Lake-Superior North Watershed, also known as the Baptism-Brule Watershed, between 1980 to present compared to agricultural and urban landuse in the watershed.

Background

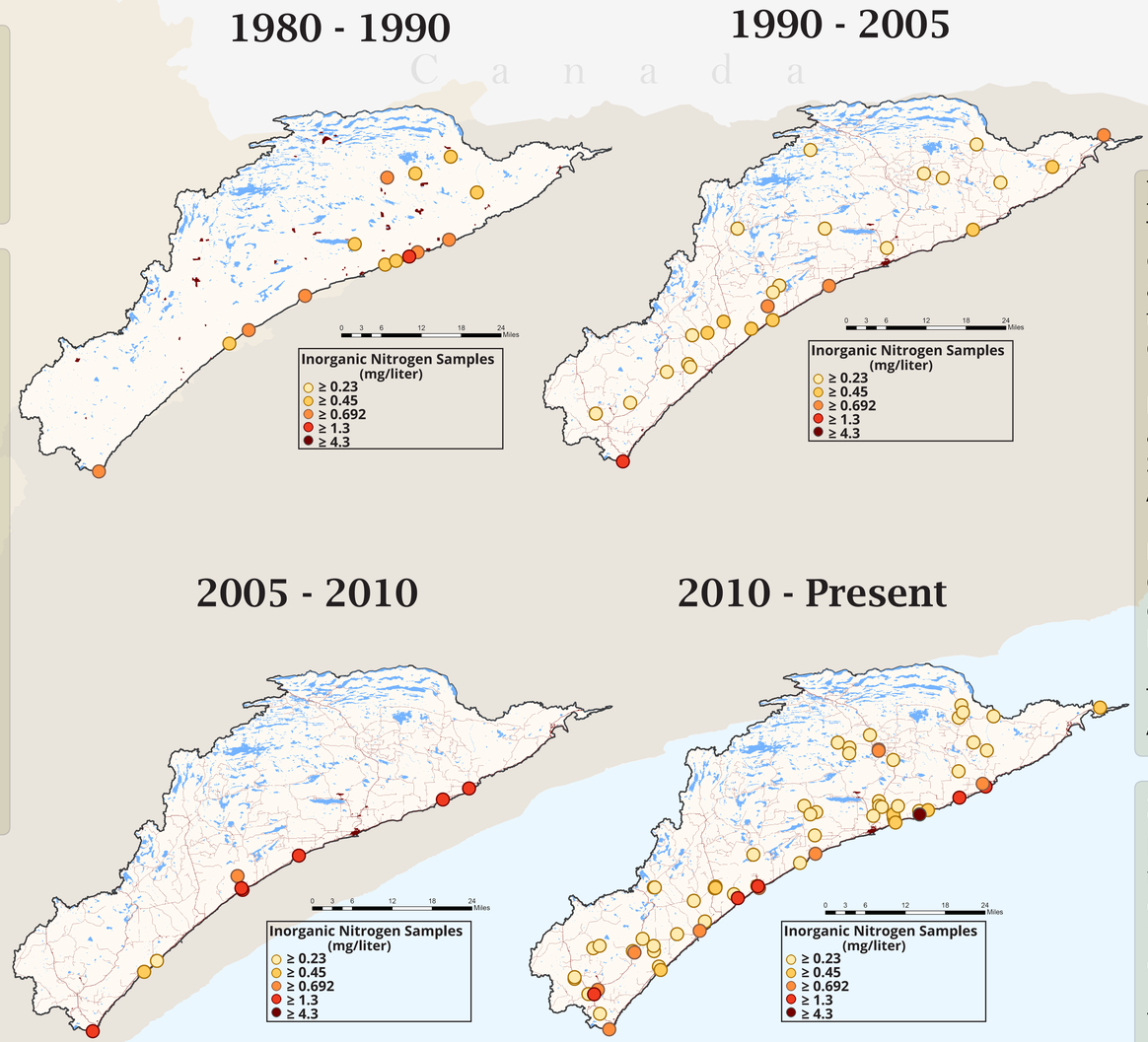
Nitrogen is a common element that exists vitually everywhere on earth. ***The primary forms of inorganic nitrogen are ammonia, ammonium, nitrate, and nitrite.*** These forms of nitrogen can be organically occuring, but elevated levels are associated with human activities. Particularly agriculture and urban development.

The Lake-Superior South watershed, located south of the Lake-Superior North watershed, is also known as Minnesota's North shore and is one of the state's biggest recreation attractions. The Lake-Superior South watershed has seen seven new impaired streams in recent years. The change is attributed to increasing development, altered drainage, forests and vegetation, according to the Minnesota Pollution Control Agency. The Lake-Superior North watershed flows into the Lake-Superior South watershed. Has agriculture and urban development increased, contributing to more pollution downstream?

Minnesota Drinking Water Standards	
Nitrate - N (NO_3)	Drinking Water: **10 milligrams per Liter (mg/l)** in groundwater and Class 2A cold water streams. Standards under development foraquatic life toxicity in MN surfacewaters
Nitrite - N (NO_2)	Drinking Water: **1 milligrams per Liter (mg/l)** in groundwater and Class 2A cold water streams. Standards under development for aquatic life toxicity in MN surface waters.
Ammonia - N (NH_3)	**0.016 mg/l** in Class 2A cold water streams (trout protection) 0.040 in most other streams (Class 2B).

Sample Points

Water sample points include inorganic nitrogen (NO_3, NO_2, NH_3, NH_4) and Kjeldahl nitrogen. Inorganic-N in waters is predominantly the sum of the nitrite, nitrate, ammonia, and ammonium-N. Kjedahl nitrogen (TKN) includes N from organic-N and ammonia+ammonium-N.



Water Sample Date Range	Landcover Data Used
January 1, 2010 - Present	National Land Cover Database 2011
January 1, 2005 - January 1, 2010	National Land Cover Database 2006
January 1, 1990 - January 1, 2005	National Land Cover Database 2001
1980 - January 1, 1990	USGS Historic Landuse Polygons

Land Cover Types

- Water
- Developed Land or Agriculture

Method

The base maps show land use through four time periods, emphasizing the combination of developed land and agricultural land shown in dark red. The data sources for the base maps and time ranges for water samples are detailed in the table below the maps.

Each water sample with inorganic nitrogen detected is associated with the date the sample was taken. Water Samples were taken by the Minnesota Pollution Control Agency.

Land Cover types were derived from raster landcover datasets. Developed Land or agriculture refers to developed open space, low-intensity, medium-intensity, and high-intesity developed land, and cultivated crops.

The maps for this project were created using Esri's ArcGIS Pro.

Summary

Displaying sample points with inorganic nitrogen is less fine grain data than showing the level of Nitrate, Nitrite, or Ammonia in water samples as those are forms on inorganice nitrogen which have measurable Minnesota drinking water standars in mg/liter.

There is an increase in urban land-use overtime in cities located in the watershed. Water sample points located near urban areas with cluster of developed land are more likely to have a higher concentration of inorganic nitrogen.

The sample of points from 2010 to present includes the only water sample with more than 4.3 mg/liter of inorganic nitrogen.

Lauren Strug
MGIS Candidate '19, Univeristy of Minnesota
GIS 5572 ArcGIS II

Projection & Coordinate System: Transverse Mercator, NAD UTM Zone 15N
Scale: 1:200,000
Data Sources: National Land-cover Database 2001, 2006, and 2011, USGS Enhanced -Historical Land-use and Land-cover Datasets, Minnesota Pollution Control Agency