Nutrient Sub-Model (NSM)

The Problem:

Non-point Source (NPS) runoff of pollutants from landscapes is viewed as one of the most important factors causing impaired water quality in freshwater and estuarine ecosystems and has been addressed as a national priority since the passage of the Clean Water Act, Section 319. Agricultural activities are a major NPS of pollution, contributing sediment, pesticides, and nutrients to aquatic ecosystems where nutrients can cause excessive plant growth, which reduces swimming and boating opportunities, creates a foul taste and odor in drinking water, and kills fish. Nutrient management plans can help maintain high yields and save money on the use of fertilizers while reducing NPS pollution. To assist in compliance with water quality regulations as well as long-term watershed planning and management for nutrients, there is a corresponding need in developing advanced water quality models which can predict the effects of agricultural activities that cause NPS pollution.

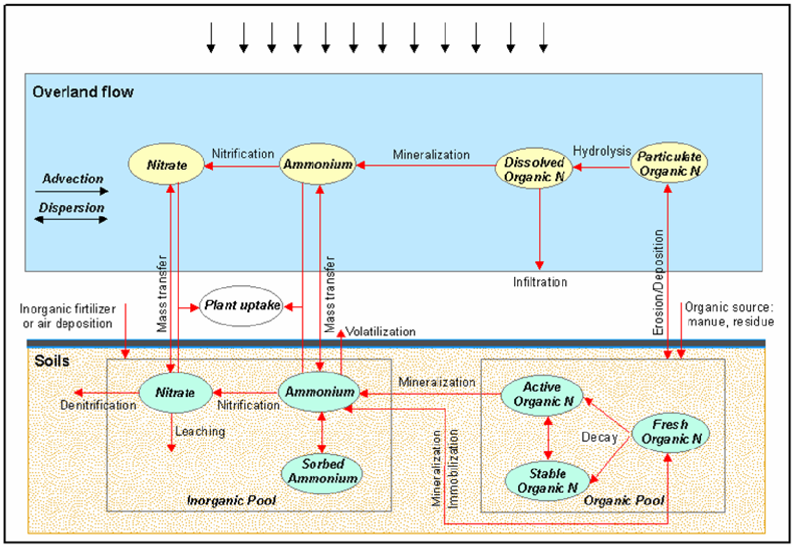
What is NSM?

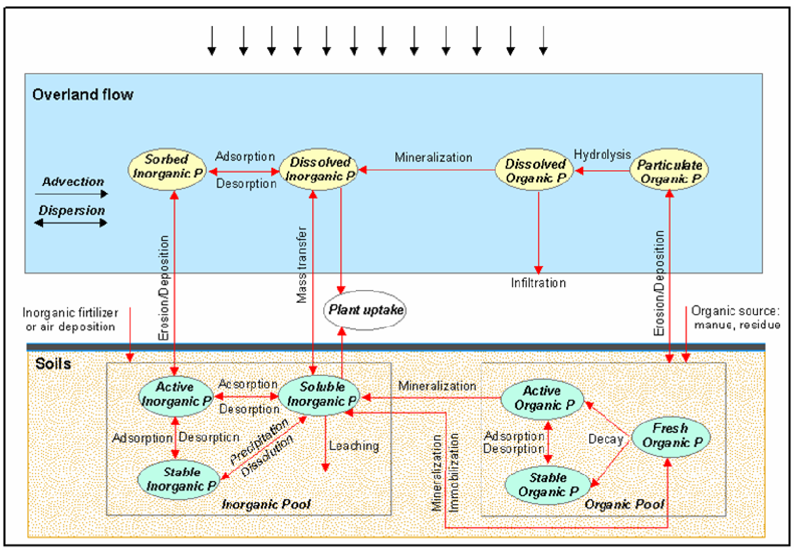
Nutrient Sub-Model (NSM), developed by the U.S. Army Engineer Research and Development Center (ERDC), describes changes in the water quality constituent concentrations that are due to biological, chemical, biochemical, and physical processes. Modeling of nutrients in NSM consists of three distinct parts. The first part deals with simulating the nitrogen (N) and the phosphorus (P) cycle in the soil, whereas the second part focuses on the transformation and loading of N and P species in the overland flow. The third part simulates the most important processes for N and P cycle, dissolved oxygen and phytoplankton kinetics and can be used as a basic in-stream water quality model. Current NSM capabilities include:

- Soil nitrogen module
  - Organic Nitrogen (fresh organic nitrogen, humic organic nitrogen)
  - Inorganic Nitrogen (particulate ammonium, dissolved ammonium, nitrate)
- Soil phosphorus module
  - Organic Phosphorus (fresh organic phosphorus, humic organic phosphorus)
  - Inorganic Phosphorus (particulate inorganic phosphorus, dissolved inorganic phosphorus)
- Overland flow nitrogen module
  - Organic Nitrogen (particulate organic nitrogen, dissolved organic nitrogen)
  - Inorganic Nitrogen (particulate ammonium, dissolved ammonium, nitrate)
- Overland flow phosphorus module
  - Organic Phosphorus (particulate organic phosphorus, dissolved organic phosphorus)
  - Inorganic Phosphorus (particulate inorganic phosphorus, dissolved inorganic phosphorus)
- In-stream water quality model
  - Nitrogen (particulate organic nitrogen, dissolved organic nitrogen, particulate ammonium, dissolved ammonium, nitrate)
  - Phosphorus (particulate organic phosphorus, dissolved organic phosphorus, particulate inorganic phosphorus, dissolved inorganic phosphorus)
  - Dissolved Oxygen
  - Phytoplankton

How Does NSM Work?

NSM is written in a modular/process structure. Any NSM module can be coupled with hydrologic and hydrodynamic (H&H) models (e.g., GSSHA, HEC-RAS, ADH, etc.) transport component, which means that NSM deals with transforming processes of water quality constituents in the overland plane and receiving waterbodies. The H&H model is used to simulate the simultaneous transport process.





Future NSM will be extended to include other nutrient cycling processes and water quality state variables.

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