THE CONCEPTUAL FRAMEWORK OF REACTIVE NITROGEN CALCULATION MODULE INTEGRATION IN CONCEPTUAL HYDROLOGICAL MODEL METQ

Jana Grave, Normunds Stivrins, Inga Grinfelde,
Latvia University of Life Sciences and Technologies, Latvia.

Introduction

The algorithms of conceptual hydrological model METQ are well documented and allow integration of nitrogen transformation (see.Fig.1) calculation modules. The aim of this paper is to explore various potential methods for better understanding and incorporating the nitrogen cycle and additional parameters into existing model METQ, focusing on those most suitable for the local Latvian environment.

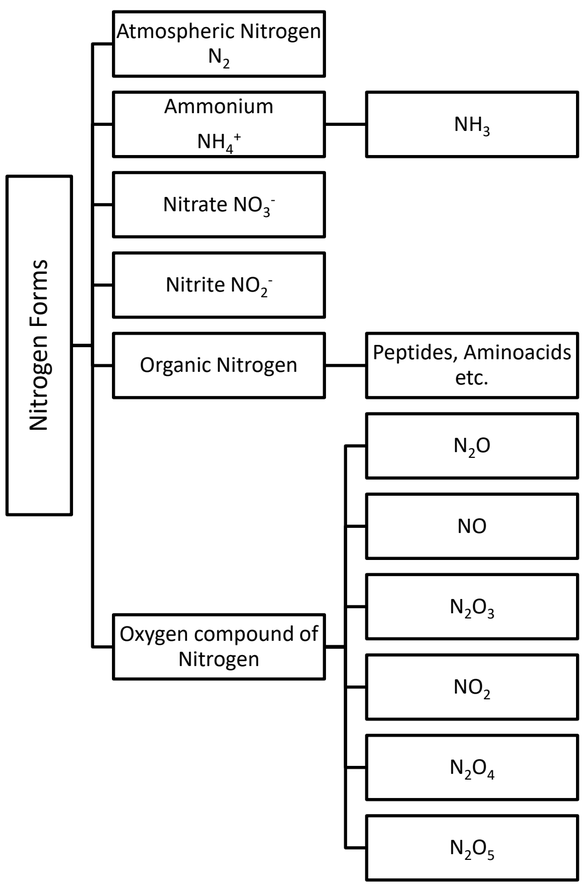

Fig. 1 The nitrogen forms included in research

Matherials and Methods

To achieve dynamic coupling, the nitrogen module was designed to utilize hydrological outputs from METQ as boundary conditions for nitrogen flux simulations:

Surface Runoff: Nitrogen transport via surface runoff was calculated based on flow rates and nitrogen concentrations in the upper soil layers.

Subsurface Flow: Nitrogen movement in shallow and deep drainage pathways was linked to lateral and vertical flow components.

Groundwater Interaction: Leached nitrogen was routed to the groundwater compartment, with delayed outflow to surface water bodies.

Each nitrogen transport process was expressed as a function of water flow, nitrogen concentration, and partition coefficients specific to the hydrological compartment.

Results

The reactive nitrogen module integrates into METQ using hydrological, nitrogen input, and environmental datasets. It employs algorithmic blocks for nitrogen inputs, transformations, and transport, dynamically coupling with METQ hydrological outputs (see. Fig.2).

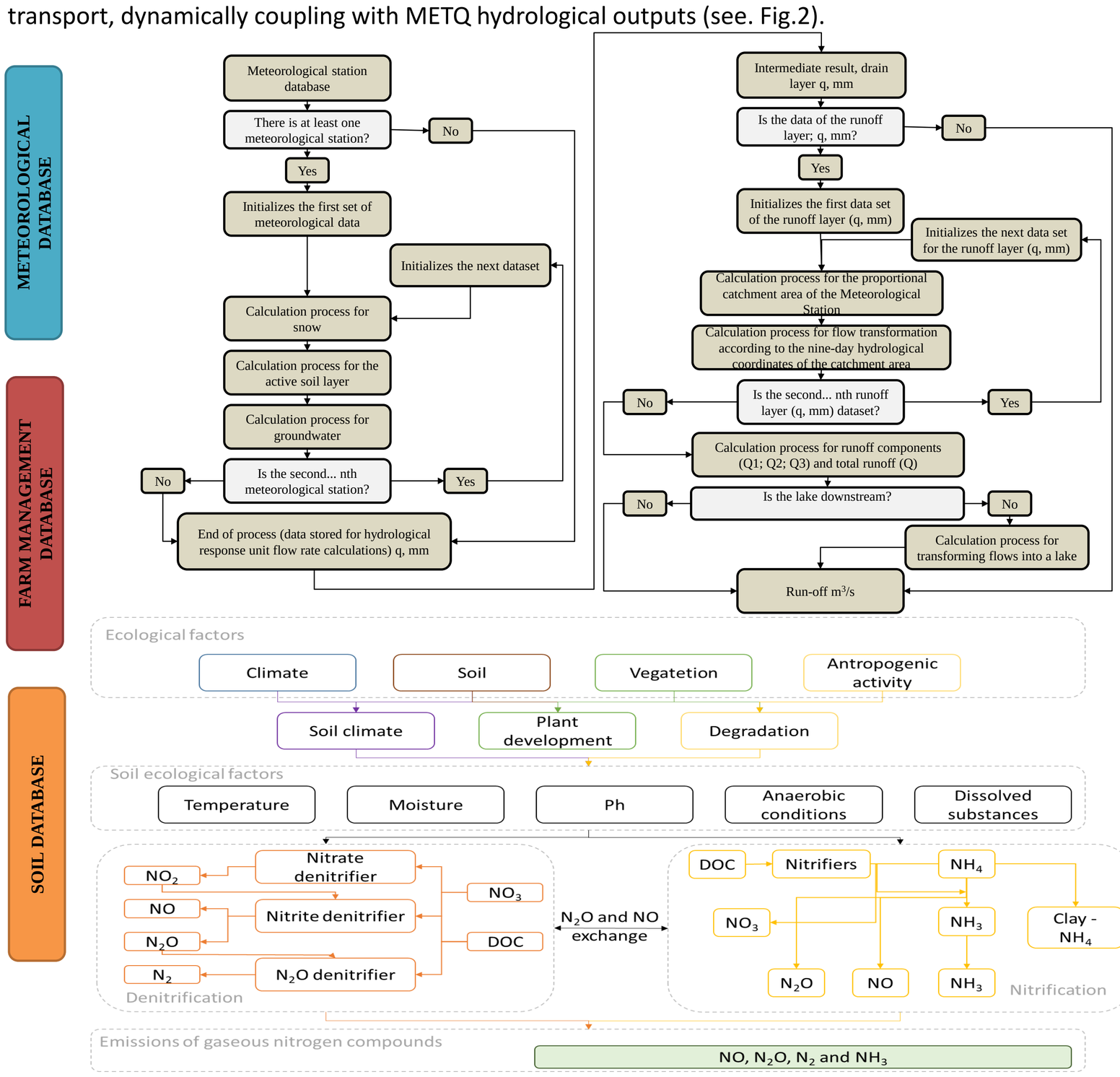

Fig. 2 Conceptual Framework of Reactive Nitrogen Calculation Module

Conclusion

This modular framework enhances METQ capability to simulate nitrogen dynamics, assess pollution, and support sustainable ecosystem and water resource management. The integration of nitrogen transformation calculations into the conceptual hydrological model METQ required reprogramming the platform into a modular, open framework. This transformation enables seamless addition of new functionalities. By coupling hydrological processes with nitrogen simulations, the extended METQ model provides a comprehensive tool for analyzing environmental impacts, including emissions from soils, water bodies, and land-atmosphere interactions. The modular approach improves computational efficiency, supports interdisciplinary research, and facilitates collaboration for further model development. The open-platform structure also enables the integration of additional environmental modules, such as nutrient cycles or sediment transport, broadening its applications for ecosystem and sustainability studies. These advancements position METQ as a cutting-edge tool for tackling global environmental challenges, such as climate change mitigation and sustainable water management, while encouraging innovation and cooperation within the scientific community.