PRACTICE ABSTRACT NO. 35

SEA2LAND

NIBIO
NORWEGIAN INSTITUTE OF BIOECONOMY RESEARCH

Future evolution of the produced fertilisers effectiveness

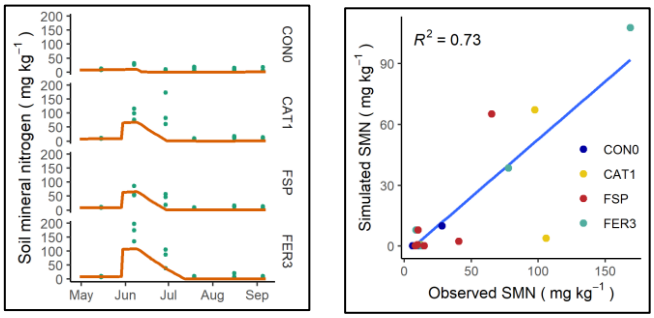
Main Results/ Outcomes

The DNDC model, a simulation tool designed to analyze nitrogen biogeochemistry within agricultural ecosystems, was utilized at five experimental locations throughout Europe to evaluate the impact of bio-based fertilizers (BBFs) on soil nitrogen dynamics. The model demonstrated varying levels of accuracy depending on the site. These results underscore the significance of site-specific calibration and the necessity for better model parameterization to improve predictive accuracy.

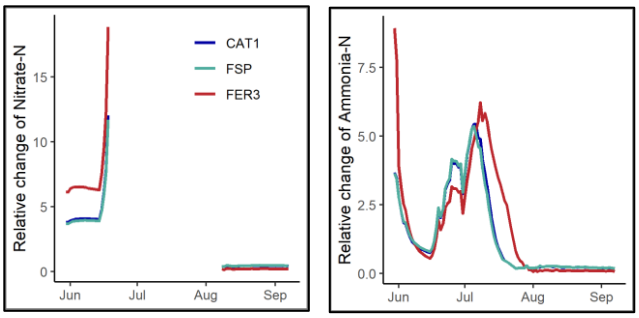
In all five countries, the DNDC model consistently predicted a swift rise in NO_3-N following fertilization, which was then followed by a seasonal decrease. The magnitude and timing of these changes were affected by initial soil conditions, the type of fertilizer used, and local climate factors.

Furthermore, the DNDC model indicated significantly higher emissions of NH_3, N_2O, and NO in fertilized treatments compared to unfertilized ones across all five experimental sites.

The effectiveness of the produced fertilizers was assessed under extreme weather conditions, including higher temperatures, more intense droughts or heavy rainfall, and varying atmospheric CO_2 levels. In such extreme weather scenarios, the amount of mineralized nitrogen increased, resulting in higher simulated emissions of nitrogen gases, and potential N-loss due to leaching.



Comparison of measured (dots) and simulated (line) soil mineral nitrogen (as a sum of NO_3-N and NH_4-N) at 10 cm depth plotted as a function of time on the left-hand side figure for the Apelsvoll experimental site.



Comparison of the dynamics of relative changes in simulated soil NO_3-N and NH_4-N content for the three BBFs, calculated with the unfertilized treatment set as the reference value at Jogeva experimental site.

Practical recommendations

To improve the effectiveness of the DNDC model, it is recommended to incorporate high-resolution environmental data alongside current soil monitoring systems. Additionally, further refinement of soil parameters is necessary, and a specialized DNDC module should be developed for bio-based fertilizers. These actions will enhance the comprehension of short-term dynamics and site-specific differences in soil properties, climate, and management strategies. Furthermore, for the modeling process to succeed, it is crucial that samples are consistently collected, processed, and analyzed, with results being delivered in a timely manner.

While the reliability of the models has its limitations, simulations related to soil nitrogen dynamics and nitrogen fluxes have highlighted the significance of selecting the fertilizer type that corresponds to specific climates and the optimal timing for fertilizer applications to minimize the potential loss of nutrients.

About this abstract

Authors: Iva Zivanovic, Astrid Solvåg Nesse, Csilla Farkas

Date: June 2025

SEA2LAND project is a collaborative Innovation Action(IA) funded by the EU in the frame of the Horizon 2020 programme. The project aims to provide solutions to help overcome challenges related to food production, climate change and waste reuse. Based on the circular economy model, SEA2LAND promotes the production of large-scale fertilisers in the EU from own raw materials. This solution is expected to reduce the soil nutrient imbalance in Europe.

The project is running from January 2021 to June 2025.

Website: www.sea2landproject.eu

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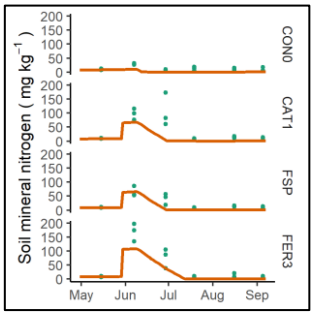
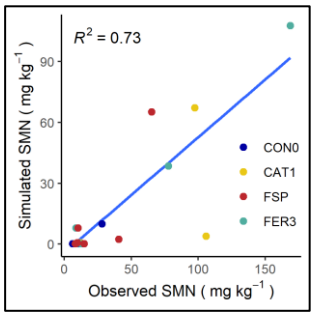
Fremtidig utvikling av effektiviteten til de produserte gjødselmidlene

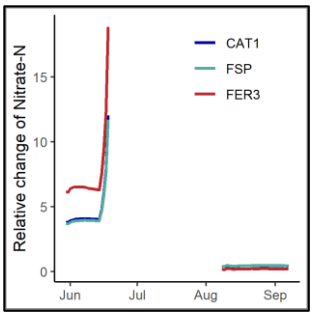
Hovedresultater / Utfall

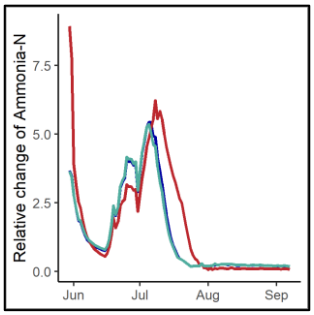
DNDC-modellen, et simuleringsverktøy utviklet for å analysere nitrogenets biogeokjemi i jordbruksøkosystemer, ble brukt ved fem forsøkssteder over hele Europa for å evaluere effekten av biobaserte gjødselmidler (BBFs) på nitrogenets dynamikk i jorden. Modellen viste varierende grad av nøyaktighet avhengig av stedet. Disse resultatene understreker viktigheten av stedsspesifikk kalibrering og behovet for bedre parameterisering av modellen for å forbedre den prediktive nøyaktigheten.I alle de fem landene forutså DNDC-modellen konsekvent en rask økning i NO_3-N etter gjødsling, etterfulgt av en sesongmessig nedgang. Omfanget og tidspunktet for disse endringene ble påvirket av opprinnelige jordforhold, typen gjødsel som ble brukt, og lokale klimafaktorer.Videre indikerte DNDC-modellen betydelig høyere utslipp av NH_3, N_2O og NO i gjødslede behandlinger sammenlignet med ugjødslede behandlinger ved alle fem forsøkssteder.Effektiviteten til de produserte gjødselmidlene ble vurdert under ekstreme værforhold, inkludert høyere temperaturer, mer intense tørkeperioder eller kraftig nedbør, samt varierende nivåer av atmosfærisk CO_2. Under slike ekstreme værscenarier økte mengden mineralisert nitrogen, noe som resulterte i høyere simulerte utslipp av nitrogenholdige gasser og potensiell N-tap på grunn av utvasking.





Sammenligning av målte (prikker) og simulerte (linje) verdier for mineralsk nitrogen i jord (som summen av NO_3-N og NH_4-N) i 10 cm dybde, plottet som en funksjon av tid i figuren til venstre for forsøksfeltet på Apelsvoll.





Sammenligning av dynamikken i relative endringer i simulert innhold av NO_3-N og NH_4-N i jord for de tre biobaserte gjødselmidlene (BBFs), beregnet med den ugjødslede behandlingen som referanseverdi ved forsøksfeltet i Jõgeva.

Praktiske anbefalinger

For å forbedre effektiviteten til DNDC-modellen anbefales det å integrere høyoppløselige miljødata sammen med eksisterende overvåkingssystemer for jord. I tillegg er det nødvendig med videre forbedring av jordparametere, og det bør utvikles en spesialisert DNDC-modul for biobaserte gjødselmidler. Disse tiltakene vil styrke forståelsen av kortsiktige dynamikker og stedsspesifikke forskjeller i jordegenskaper, klima og forvaltningsstrategier.Videre er det avgjørende for modelleringen at prøver samles inn, behandles og analyseres på en konsekvent måte, og at resultatene leveres innen rimelig tid.Selv om påliteligheten til modellene har sine begrensninger, har simuleringer knyttet til nitrogenets dynamikk i jord og nitrogenflukser fremhevet viktigheten av å velge riktig gjødseltype tilpasset spesifikke klimaforhold, samt optimal tidspunkt for gjødselanvendelse for å minimere potensielt næringstap.Preguntar a ChatGPT

Om dette sammendraget

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