Simulation of long-term changes in SOC and N_2O emissions from permanent grass silage using the DNDC model

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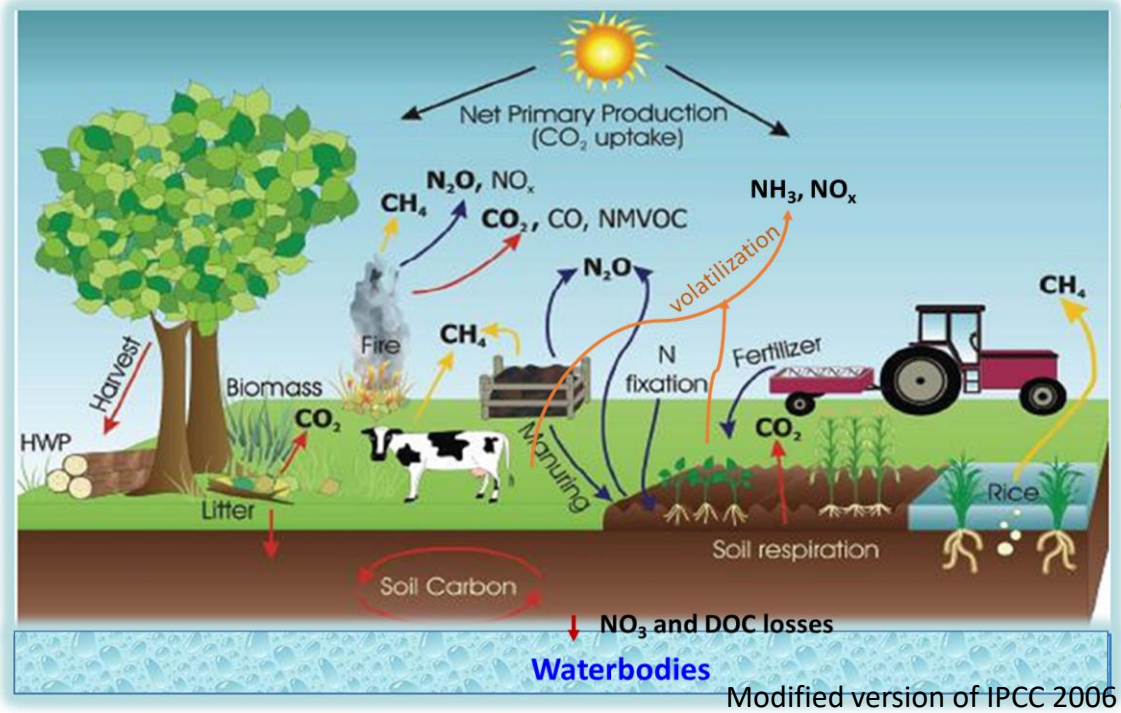
Biogeochemistry of C & N Cycles: SOC storage and GHG emissions



Modified version of IPCC 2006

- **Quantification and reporting of SOCρ changes and N_2O emissions from agricultural soils remain a key challenge.**

- **The main constraints are: (i) short-term measurements, (ii) limited measured data and (iii) inadequate area coverage.**
- **Model can provide largescale land use and management coverage whilst minimizing spatial and temporal variability.**

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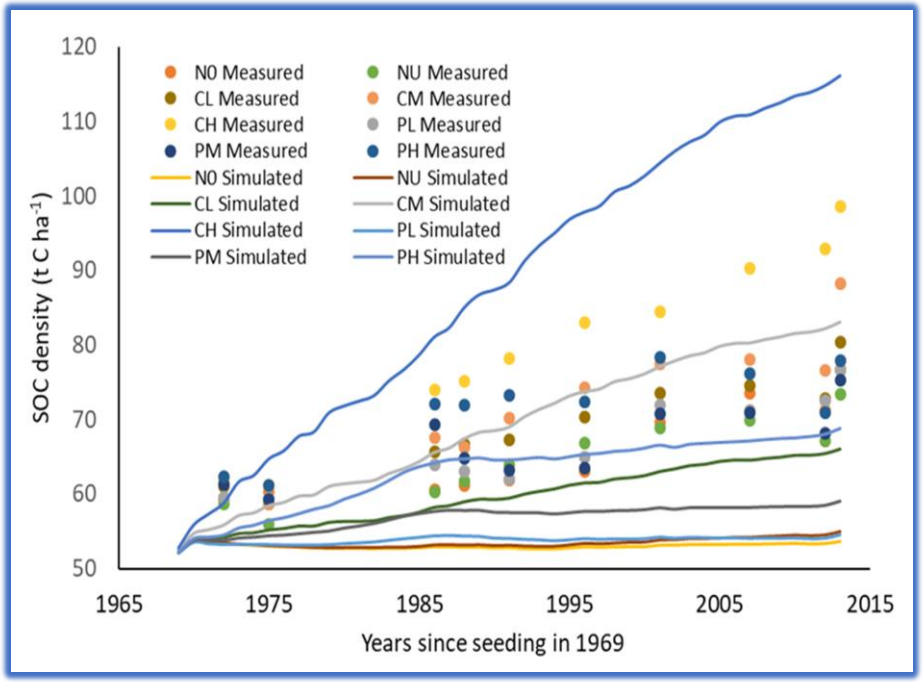
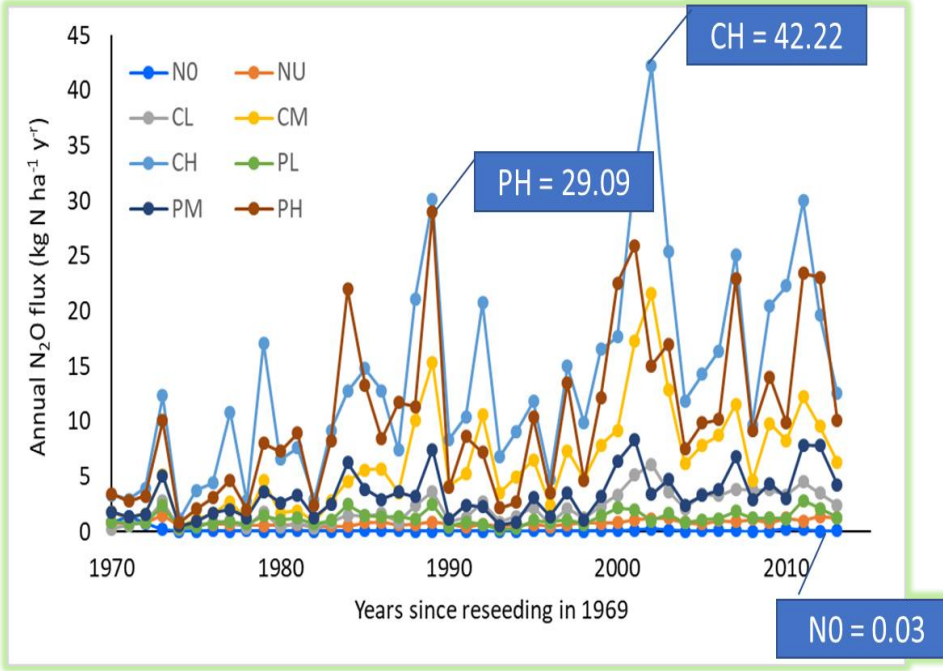
Treats: Unfertilized control (N0)

- NPK @ 200 kg N (as urea); 32 kg P, and 160 kg K, ha^{-1} yr^{-1} (NU)
- Pig slurry (m^3 ha^{-1} yr^{-1}): low (PL) = 50; medium (PM) = 100 & high (PH) = 200
- Cattle slurry at the same rate: CL, CM and CH.



Measured & simulated SOCρ at 0-15 depth under grass silage treated with inorganic & organic fertilizers over 45 years.



Simulated annual N_2O flux under grass silage treated with inorganic & organic fertilizers over 45 years.

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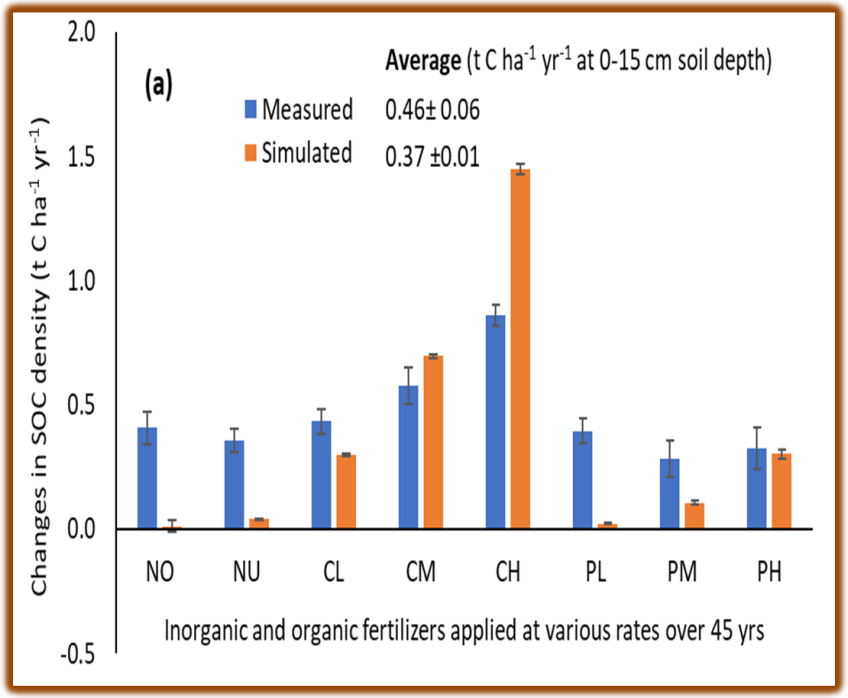
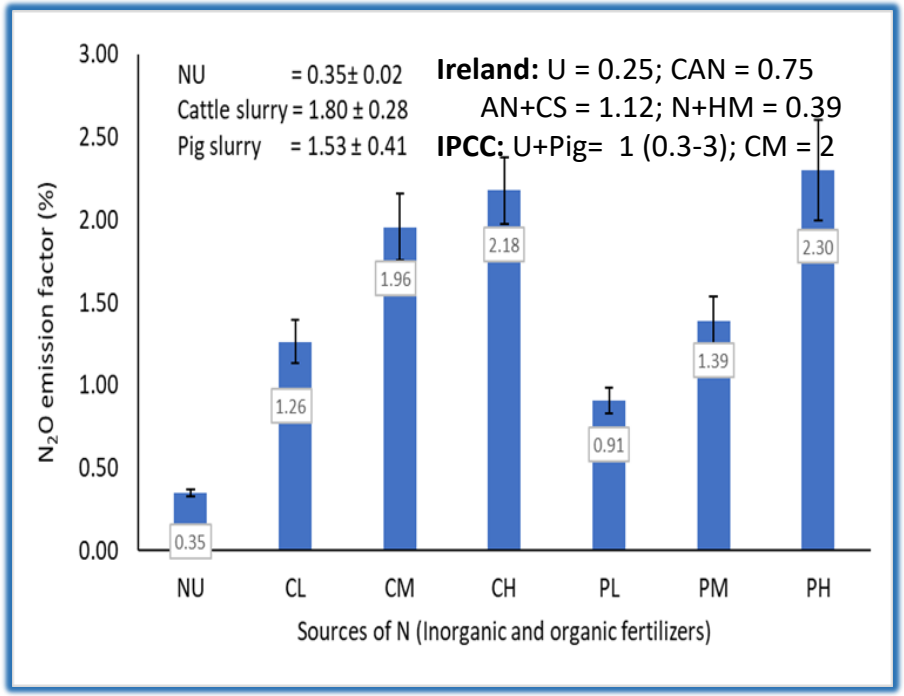
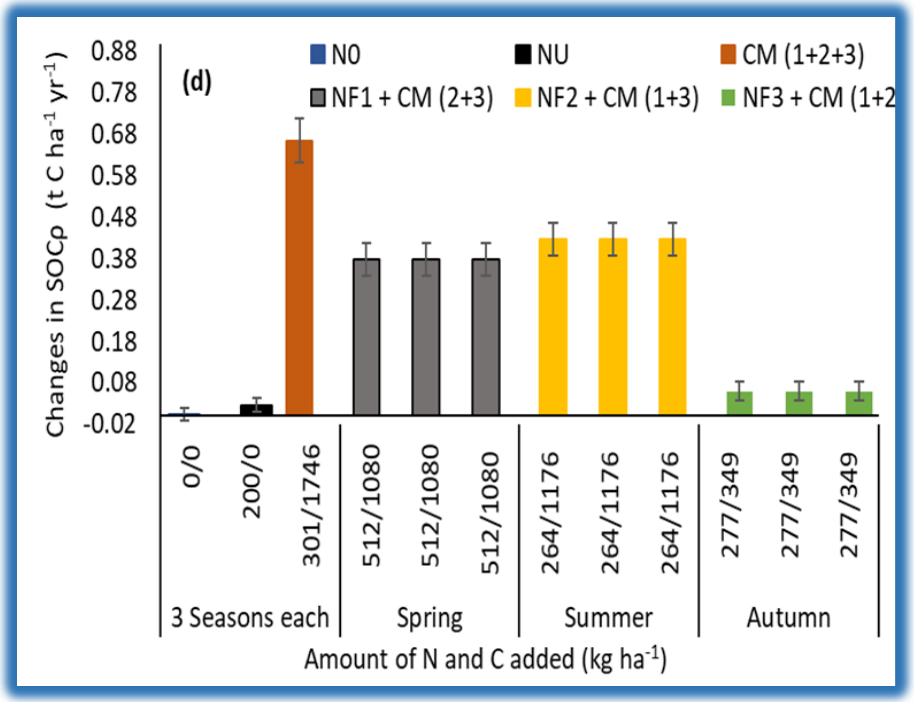
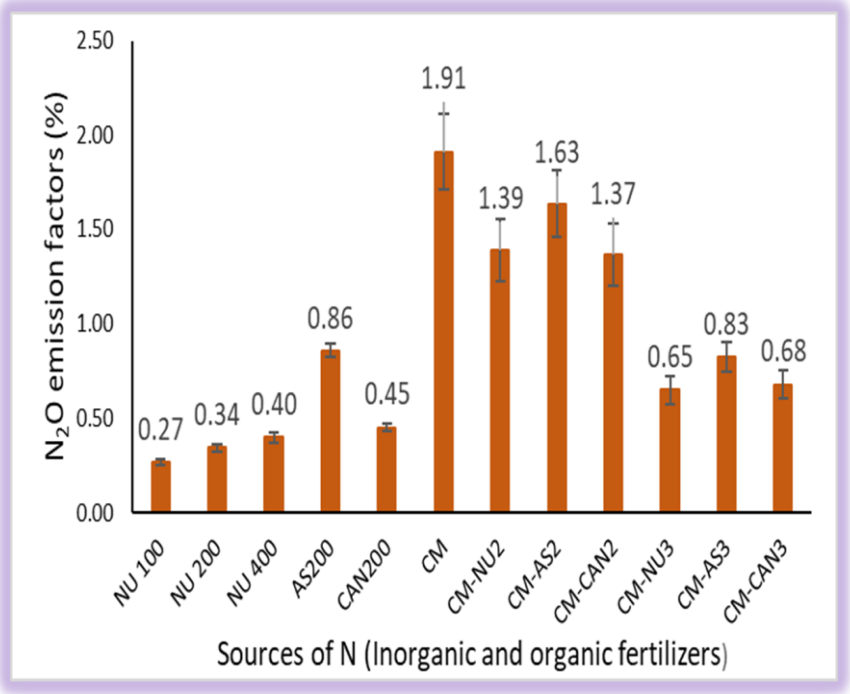


Measured and simulated changes in SOCρ at the 0-15 soil depth under grass silage over 45 years.



Simulated N_2O emission factors under grass silage over 45 years.





Sensitivity of DNDC95 for changes in SOCρ and N_2O EFs (%) of a permanent grassland to inorganic and organic N fertilizers.

NU2/AS2/CAN2 = 1/3rd of Urea, ammonium sulphate (AS) and calcium ammonium nitrate (CAN) applied by replacing the 2nd split of cattle slurry.

NU3/AS3/CAN3 = Similarly the 3rd split.

Conclusions

- A new SOC equilibrium had not been reached in these grassland soils after ~45 years.
- The DNDC95 could respond well to soils, climate and management practices on ΔSOCρ and N_2O EFs, comparable to measured values.
- Strategic replacement of slurry either at the 2nd or 3rd silage cuts by 1/3 decreased N_2O-EFs significantly while sequestering SOC at a smaller rate.
- The DNDC95 could provide an accurate representation of the key drivers affecting both SOCρ and N_2O fluxes in temperate grass silage.

Acknowledgements

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