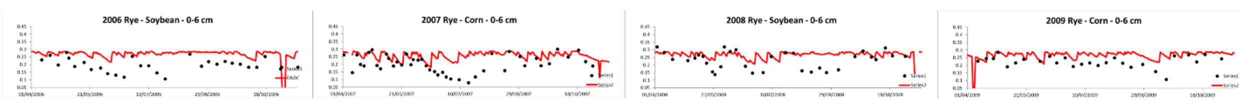
Improving the simulation of Surface Moisture Conditions in DNDCv.CAN

Current Issue: DNDC using a cascade tipping bucket approach to represent infiltration and water flux through the model framework. This approach is a simplified concept of water dynamics and can provide a reasonable representation of soil water dynamics across the profile to help represent water availability for crop transpiration and soil evaporation potential but the vertical stratification of soil moisture status could be improved. As a principle component of DNDC is the estimation of GHG fluxes from agricultural soils, the requirement of simulating a good estimate of surface soil moisture conditions is paramount.

An example of the pre-development estimation of surface water conditions for top surface layers

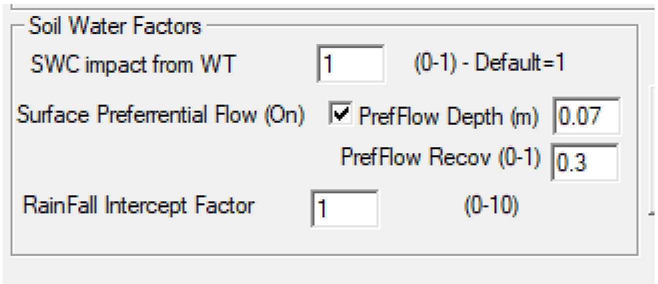


Potential Missing Mechanisms: High root density towards surface alters infiltration rate due to preferential channels. Evenly distributed Soil evaporation allocation in DNDC (Potential Evaporation demand is allocated evenly across top 20cm layers). Preferential soil channels formation due to soil shrinkage (fine textured soils). Hydrophobic characteristics of organic compounds (coarse textured soils → tends to lead to increased runoff but can also redirect water to other areas).

Conceptual Fixes

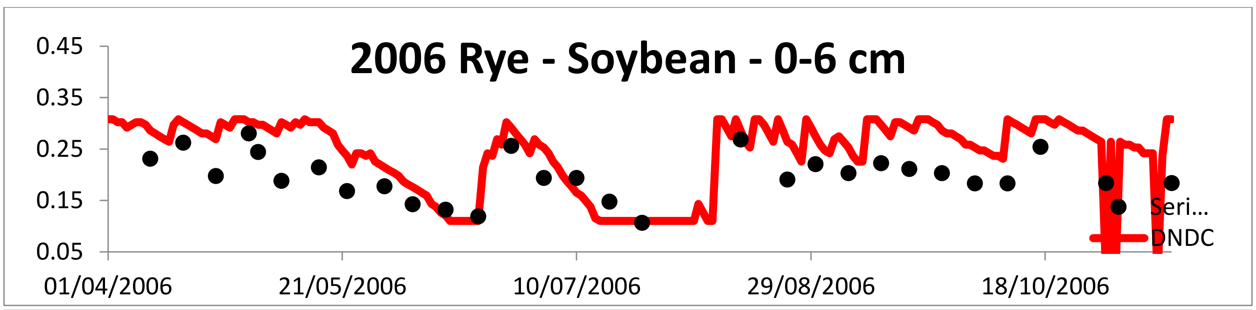
1st attempt. Introducing a calibratable approach to improving surface soil water estimation through the introduction of increased preferential flow as a response to prolonged drying out periods (f of soil texture). The concept is to improve the representation of surface soil water conditions in the DNDC model such that that it better represents the soil water moisture content and soil water flux that are highly influential in determining both nitrification/denitrification events tied to N2O formation along with the temporal dynamics of NO3- movement in the soil.

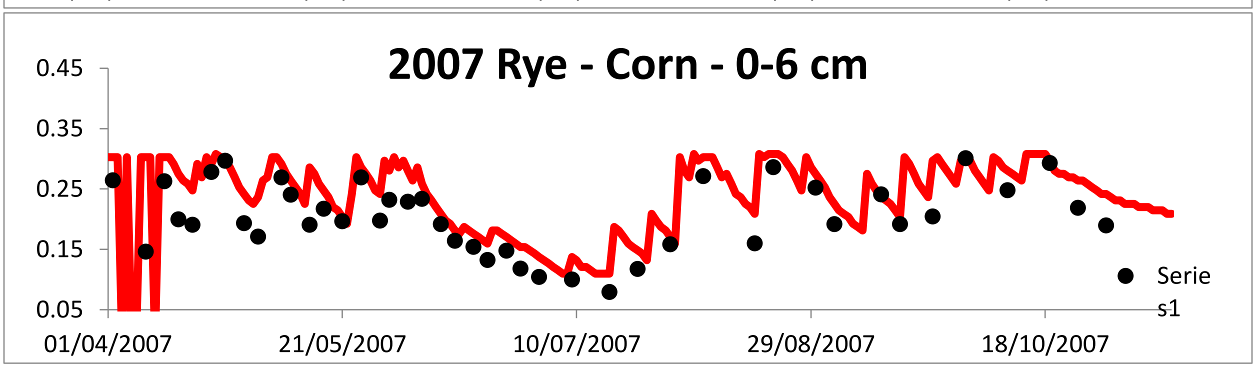
New DNDC parameters

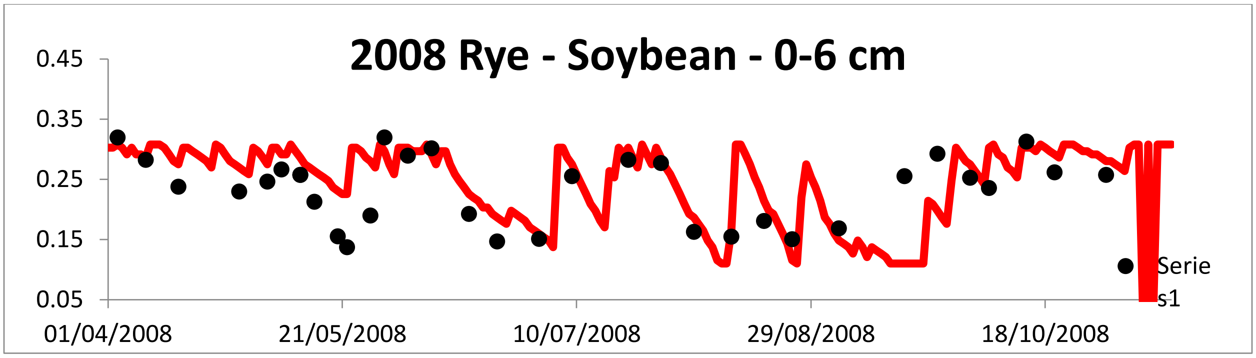


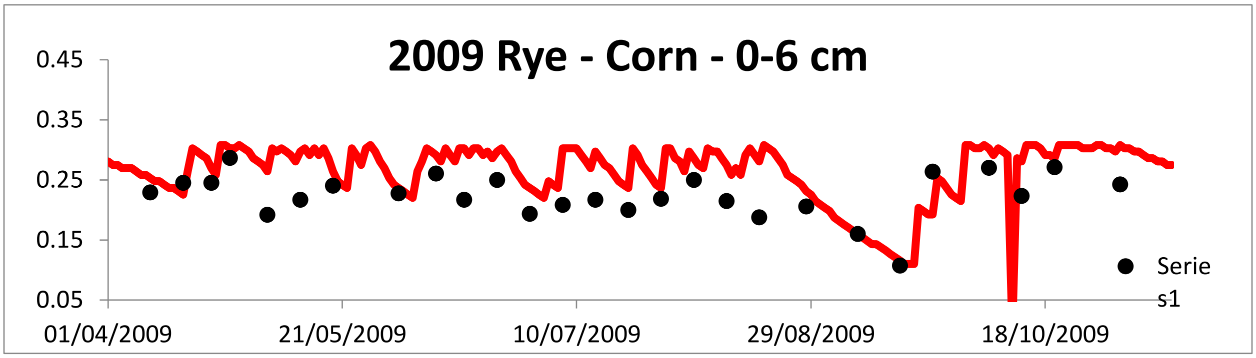
Results:

IOWA – Surface Soil Moisture

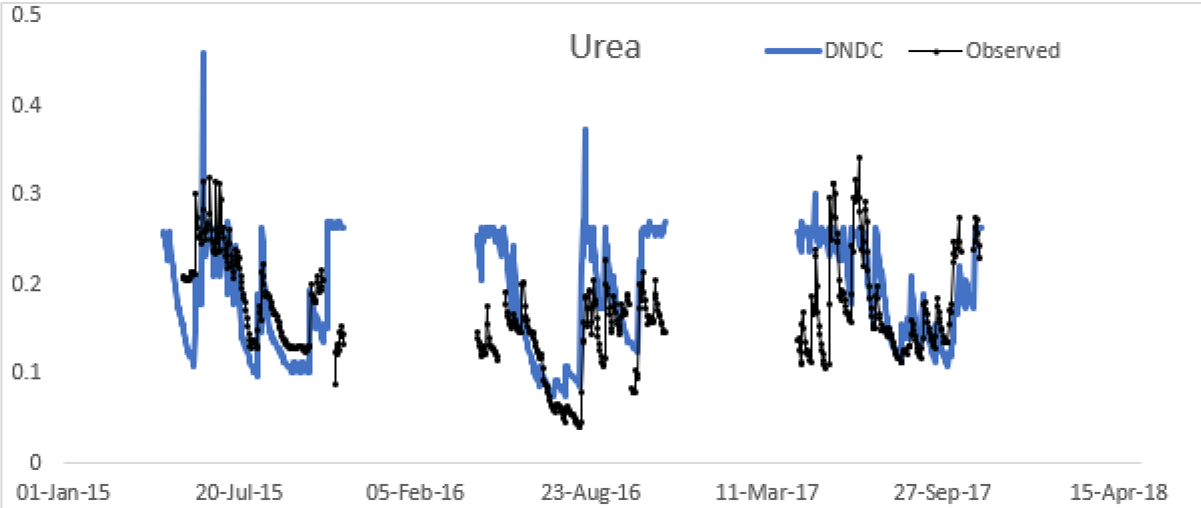


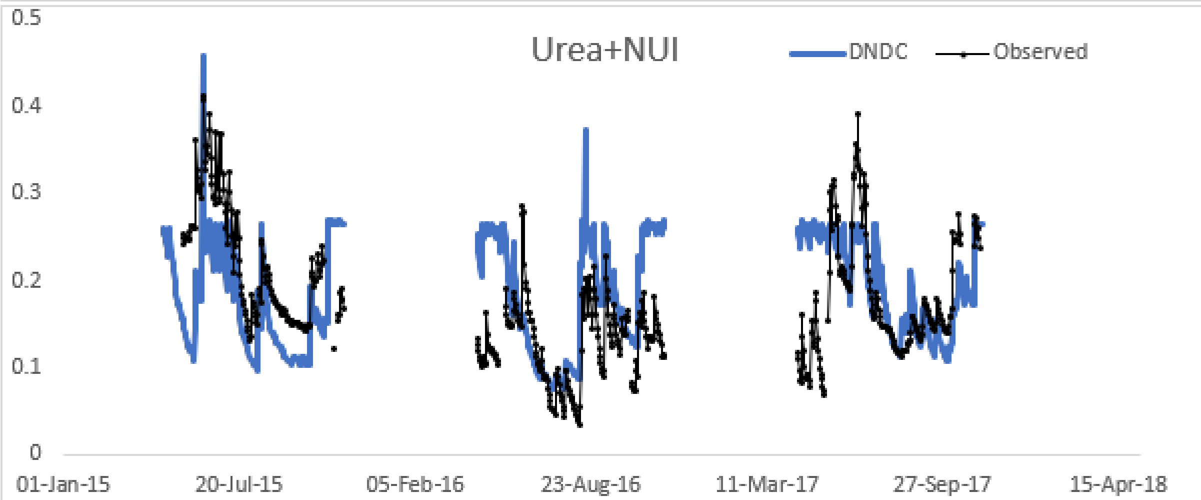






Elora Surface soil moisture





Conclusion: As a first attempt the introduction of clay induced preferential channels seems to allow for improved response of soil moisture conditions.

References:

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