Testing the DAYCENT Model Using Crop Yield and N_2O Data from Irrigated Rotations in Colorado

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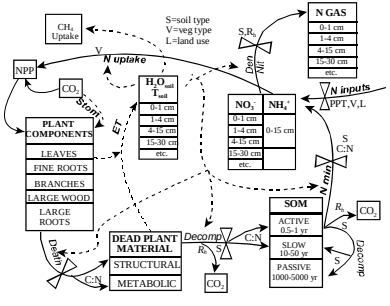
OBJECTIVES

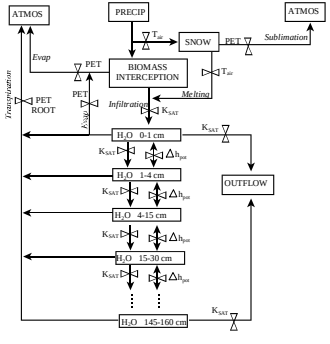
- Summarize the DAYCENT biogeochemical model and key submodels
- Test the ability of DAYCENT to simulate crop yields, soil water content, and N_2O emissions from irrigated fields in Colorado
- Identify weaknesses and suggest how the model may be improved

DAYCENT MODEL

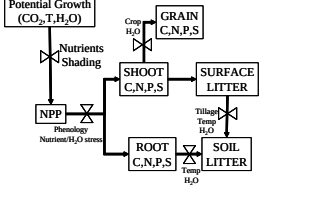


DAYCENT is a biogeochemical model of intermediate complexity. Key Submodels include plant growth and senescence of biomass, litter and soil organic matter decomposition, trace gas fluxes, and soil water and temperature by layer. Inputs are vegetation type, soil properties, daily weather, and land management. Model outputs include grain yields, soil organic carbon, greenhouse gas fluxes, and leaching of water, carbon, and nitrogen.

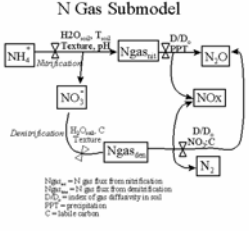
WATER FLOW SUBMODEL



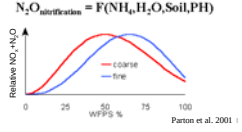
NPP Submodel



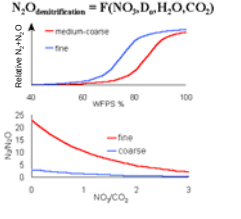
N Gas Submodel



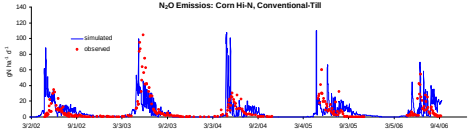
$N_2O_{nitrification} = F(NH_4, H_2O, Soil, PH)$

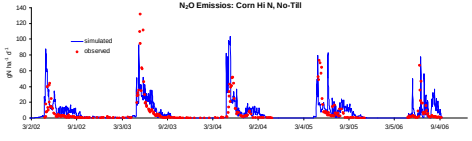


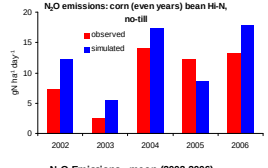
$N_2O_{denitrification} = F(NO_3, D_0, H_2O, CO_2)$

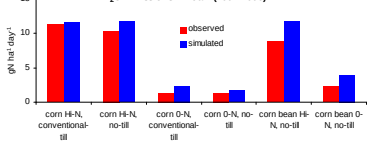


N_2O EMISSIONS

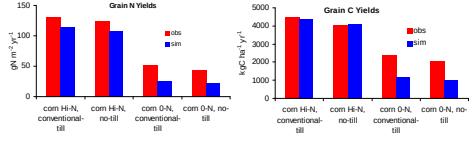




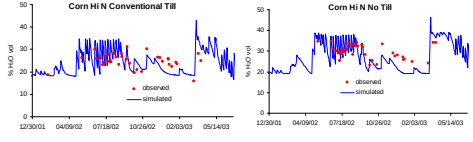




GRAIN YIELDS



SOIL WATER CONTENT



CONCLUSIONS

- DAYCENT reliably simulated most of the treatment effects on N_2O emissions, crop yields, and soil water content
- However, the model tended to overestimate N_2O emissions and underestimate N in grain, particularly for the 0 N treatments
- DAYCENT simulated much higher emissions than the data showed early in the growing season, especially for the conventionally tilled treatments
- DAYCENT overestimated emissions associated with application of polycoated urea (2005 and 2006)
- Currently, the model assumes that fertilizer N is evenly distributed throughout the top 15 cm soil layer immediately upon application
- The model could be improved by allowing for placement of fertilizer (e.g., surface broadcast vs. subsurface banding) and by simulating time released fertilizer