United States Department of Agriculture
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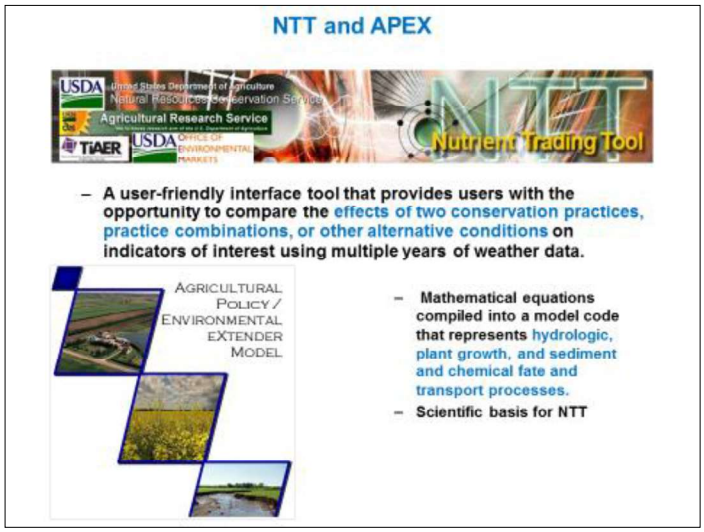
Framework to Parameterize and Validate APEX to Support Deployment of the Nutrient Tracking Tool

Grazinglands Research Laboratory, El Reno, Oklahoma May 2017

Rationale: The Agricultural Policy Environmental eXtender (APEX) model is the scientific basis for the Nutrient Tracking Tool (NTT). NTT is an enhanced version of the Nitrogen Trading Tool, a user-friendly web-based computer program originally developed by the USDA. NTT was developed to estimate reductions in nutrient losses to the environment associated with alternative practices. The accessibility and ease with which the interface can be used has provided opportunities to demonstrate NTT in locations throughout the country; however, the absence of a clearly defined, consistent approach to parameterization and validation has raised questions over the reliability and consistency of simulated results.



Objectives: Develop a framework to parameterize and validate APEX to support NTT.

What we did: We performed a comprehensive literature review of recent APEX, NTT, and other modeling studies to determine current parameterization and validation methods used. The findings from this literature review along with our personal experience were used to develop guidelines, which together with the Ohio watershed case study, constitute the framework.

Summary of framework: The developed guidelines are in the form of recommendations covering essential phases of model simulation studies as well as a clear interpretation of model performance evaluation criteria thresholds and model simulation performance results, scenario validation and documentation. These include:

- Clear definition of purpose of study, detailed description of study area, and identification of major processes.
- Model building: proper study site representation to ensure that all important physical features of the study area are included.
- Parameterization and validation approaches: Including model input and calibration/validation data. Utilize the input data from credible sources (QA/QC) while documenting the quality of data used for calibration and validation.

Step	Characteristic	Category		
		Ideal	Typical	Minimum Required
Parameterization	Calibration	not needed	needed	needed
	Source of values for sensitive parameters	a) direct measurement	a) direct measurement b) literature and/or recommended estimates c) calibration - using available measured data	a) literature and/or recommended estimates b) calibration - using study area or region long-term annual average budgets, information from intermittent data in study area, and recommended estimates from people familiar with area of study
Validation	Validation process	a) select appropriate performance measures and corresponding criteria b) process-based c) appropriate strategy d) determine output uncertainty and confidence interval e) if necessary; recheck quality of measured data used or make recommendation for pertinent process code modification f) detailed documentation and reporting of the sources of input data used and their corresponding accuracy	a) same as ideal b) also, discuss cases in which measured data or information for a given major process or several major processes were lacking and how this was addressed c) finally, make the case, as part of recommendations, for the need to collect the missing data in order to minimize uncertainty and, thereby, improve modeling results.	a) same as typical
	Good quality measured data to validate major process for constituent of interest	available for all major processes	available for some of major processes	none available
	Uncertainty of available measured validation data (Harmel et al., 2006)	best and typical case scenario data quality	hybrid - best, typical, worst case scenarios data quality	worst case scenario data quality

- Interpretation of statistical performance evaluation criteria and model performance results: Understanding is vital to accurate interpretation of the APEX parameterization and validation results.
- Validation of scenario results: Ensure scenario results are realistic
- Detailed documentation and reporting: Enable others to audit, reconstruct, repeat, and reproduce the modeling process and results.

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