Major Functional Differences with the Water Erosion Prediction Project (WEPP) Model vs. RUSLE2

Purpose: To summarize the major functional differences between WEPP and RUSLE2 to help users understand why they may observe differences in erosion, runoff, crop growth, and residue decomposition between the two models.

Introduction:
The NRCS WEPP Hillslope model is a distributed parameter, continuous simulation, event driven, erosion prediction model. The model inputs include rainfall amounts and intensity, soil textural qualities, plant growth parameters, residue decomposition parameters, effects of tillage implements on soil properties and residue amounts, slope shape, steepness, and orientation, and soil erodibility parameters.

Distributed parameter means that different spatial regions (i.e. strips) down a profile may have different soils, crops, and/or management practices, and each region must have unique inputs provided.

Continuous simulation means that the model simulates 100 years, with each day having a different set of input climatic data. Event driven means that on each simulation day a rain storm may occur, which then may or may not cause a runoff event. If runoff is predicted to occur, the soil loss, sediment deposition, sediment delivery, and the sediment enrichment for the event will be calculated and added to series of sum totals. At the end of the simulation period (100 years), average values for detachment and deposition are determined for each point down a profile, for each detachment and deposition section, and for all detachment and deposition sections. Average soil loss over all regions of net detachment is reported, as is the average sediment delivery and enrichment from the entire slope profile. The entire set of parameters important when predicting erosion are updated on a daily basis, including soil roughness, surface residue cover, canopy height, canopy cover, soil moisture, etc. WEPP is completely new and different technology from USLE/RUSLE/RUSLE2 and does not use any of the USLE/RUSLE/RUSLE2 factors (Rainfall/Runoff Erosivity factor (R), Soil Erodibility factor (K), conservation Practice factor (P), etc.).

Climate
WEPP uses statistics derived from 40 years (1974 thru 2013) of observed weather station data and a climate generator to produce a set of 100 years of synthetic daily climate for each simulation. An additional option is to utilize PRISM grid cell values to modify precipitation and temperature means to better represent weather for field locations at some distance away from weather stations.

Daily Climate over 100 Years Impacts:
• Soil water content
• Temperature (air and soil)
• Erodibility of the soil
• Growth of vegetation
• Precipitation and infiltration
• Water runoff
• Form of precipitation (rain, snow, snowmelt)
• Residue decomposition
• Soil surface conditions (soil roughness, frozen, saturated, etc.)

WEPP calculates the effect of snowmelt on rill erosion wherever snowmelt occurs.
WEPP has options to apply irrigation using a soil water depletion method or applied on given dates at set rates (sprinkler or furrow options). Irrigation impacts soil erodibility, biomass produced, residue decomposition, surface roughness, soil moisture, and runoff.

In some instances, irrigation can directly cause soil loss. However, this is very unlikely using default irrigation options in WEPP, that apply sprinkled water at very low intensities over an entire day.

**Plant Growth**
WEPP grows a crop (biomass) only when temperature (based on growing degree days) and water are available daily over 100 years. There is a different biomass growth/yield for each year. This results in:
- Different crop growth patterns and biomass amounts for 100 years of daily climate.
- Different canopy cover and canopy height for 100 years of daily climate.
- Different annual biomass at harvest that gets partitioned into flat and standing residues and yield biomass that is removed at harvest.

The results report the yield averages and variability over the 100-year simulation period.

WEPP calibrates yield/biomass of annual crops that allows a standard set of crop parameters to be used to adjust plant growth based on a target yield and location, soil, climate, soil water, and temperature.

**Erosion**
WEPP computes soil detachment on a slope profile, and if conditions exist which cause deposition (concavity, change in roughness due to vegetation, etc.), also determines sediment deposition. Calculates total sediment delivery to the end of the slope profile. If deposition occurs anywhere on the hillslope the deposition is subtracted from the sediment load and sediment delivery to the bottom of the slope. WEPP divides each slope profile into a minimum of 100 equally spaced segments.

**Soil**
Time invariant soil properties (e.g. sand content, silt content, etc.) are used to calculate baseline soil infiltration and erodibility parameters. Most baseline soil infiltration and erodibility parameters are calculated internal to the model using data read in from the soil input file. The baseline soil parameters are then adjusted through time, as a function of tillage operations, consolidation, surface and subsurface residue, roots, etc.

**Statistics**
WEPP produces numerous results with 100-year statistics. This allows one to compare ranges of values that can allow producers to make more informed decisions on management impacts e.g., soil erosion, sediment deposition, sediment delivery, water runoff, soil water evaporation, irrigation needed, crop yields, and precipitation. This has conservation planning impacts on water quality, water use efficiency, soil erosion, soil health, and future productivity. These long-time series of predicted event values can also be used to determine return periods, as well as report probability of exceeding certain levels of soil loss, sediment yield, etc.

RUSLE2 is an empirical model with some disaggregated annual and monthly values to daily values for temperature and precipitation. RUSLE2 is based on average annual values for climate, soil, crop biomass, and residue decomposition.
Why Vermont Offers a State CIG

- To increase partnerships and their Investments to further conservation
- To develop interim practices and enhancements
- To develop new inventory methods
- To explore new incentives for producers
- To improve conservation program development
Technical Service Providers

- The TSP Certification Criteria has been updated and posted to TechReg for FY2019.
- Start date for the new Criteria is October 15, 2018. Any TSPs that applied (new or renewal) for CAP Certification prior to 10/15 would be required to meet previous (FY18) certification requirements and any TSPs who apply (new or renewal) on or after 10/15 would be required to meet the new (posted) criteria.
- A few of the noted changes for most CAP Criteria include:
  - Three Certification Options for TSPs to become certified for the CAP including Professional Organization, Combination of Education and Experience and Experience alone.
  - Two sample plans are now required to be submitted for each CAP being applied for. More emphasis is now being placed on the TSPs plan review than on-line training for certification.

Any questions on the updated Certification Criteria can be directed to Sandra Primard and/or Joe D. Buford.
Transition to WEPP

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- To summarize the major functional differences between WEPP and RUSLE2 to help users understand why they may observe differences in erosion, runoff, crop growth, and residue decomposition between the two models.
- RUSLE2 Decommission Date dependent on CART release February 2019 (?)
October 29th thru November 2nd

Monday October 29th: Cultural Resource Training (Middlebury, VT)
   Training Instructor: Jake Clay
   Time: TBD
   Limit to 12 participants
   Audience: Planners, Engineers, Partners

Tuesday October 30th: Field portion of Basic Soils, Soil Survey & Web Soil Survey to Interpret Land Capabilities & Limitations (East Montpelier)
   Training Instructor: Al Alverill
   Time: 9:00 am to 3pm
   Limit to 12 participants
   Audience: Planners seeking or maintaining planner certification

Wednesday October 31st: FY 2019 Land Treatment Plans Overview
   Training Instructors: VACD (Jeff/Lauren and NRCS Resource Staff)
   Time: 9:00am to 3pm
   Limit: 80
   Audience: LTP Planners and all NRCS Employees
Technical Training Cont.

Thursday November 1st: NRCS-CPA-52 Training
Training Instructors: Don Riley and NRCS Resource Staff
Time: 9:00am to 4pm
Limit: 80
Audience: Partners, Planners, Engineers

Friday November 2nd: Training on Watering Systems, Understanding Practice Standards, Fence, (?)
Training Instructors: Bob Thompson, Joe Buford, Partners(?)
Time: 9:00am to 3pm
Limit: 80
Audience: Partners, Engineers, Planners

RSET/CART in the works
Questions and Answers
"To be effective, our research and programs need to be focused on finding solutions and providing state-of-the-art technologies to improve management decisions on farm and on forest lands."

-Agriculture Secretary Sonny Perdue