INTEGRATING WEPP INTO THE WEPS INFRASTRUCTURE

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WEPS – Wind Erosion Prediction System

❖Wind emission and transport of soil
❖Threshold: dryness, roughness, small particles
❖Detachment: dry stability, abrasion

WEPP – Water Erosion Prediction Project

✓Rainfall/ runoff detachment and transport of soil
✓ Threshold : infiltration /runoff, slope, detention
✓Detachment: wet stability, shear, abrasion

WEPP Hydrology in WEPS

WEPP hydrology routines were previously integrated into WEPS to reduce the computational requirements for WEPS simulations. Testing has shown that the runoff, infiltration, evaporation, and winter hydrology between this code and the original WEPP code are significantly different. Using a fallow soil test scenario, the factors causing these differences have been isolated to include random roughness, hydraulic conductivity, soil matric potential, reference evapotranspiration, soil layering, snowfall and snow melt processes. It is expected that test scenarios with growing crops will lead to an additional set of difference factors.

Comparison Simulations

WEPP and WEPS (with WEPP hydrology) simulations were run with "identical" input data sets.
➢15 years simulated weather, Cimarron, KS
➢Annual tillage "Disk, Single Gang", no growing crop
➢Eudora Silt Loam - 12% sand ,19% clay,1.7% OM

Synchronization of Inputs

THE WEPP operation database differs from that of WEPS. Also, in WEPS, like in RUSLE2, implement nominal random roughness is adjusted based on soil texture and residue conditions. The WEPP ridge height and spacing and random roughness were adjusted to match WEPS values immediately after tillage.

Process Based Modeling

WEPP and WEPS share many of the same processes.

Weather Conditions: Temperature; Humidity; Solar Radiation; Rainfall; Wind

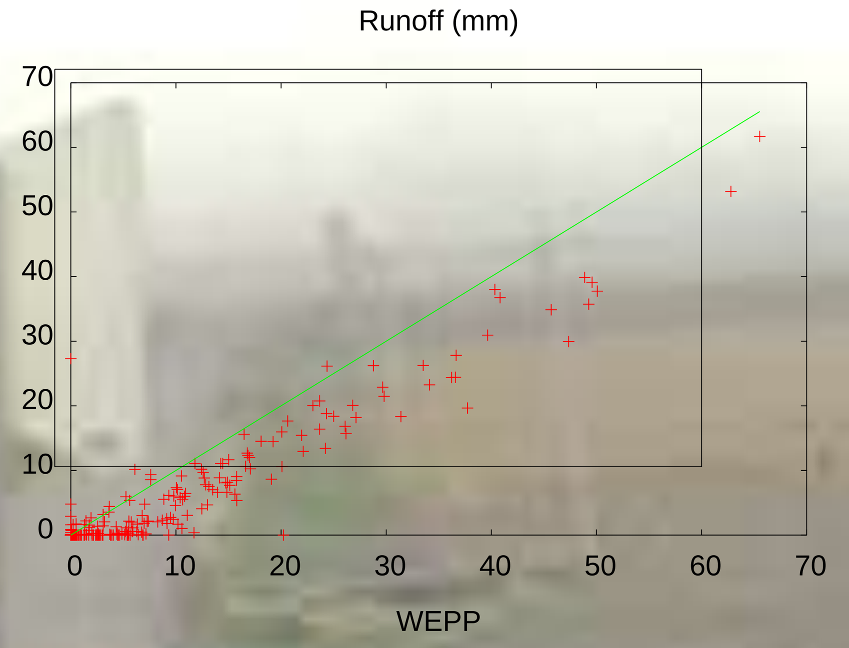
Processes: Crop Growth; Residue Decomposition; Soil Water Movement; Soil surface/matrix; Management Operations

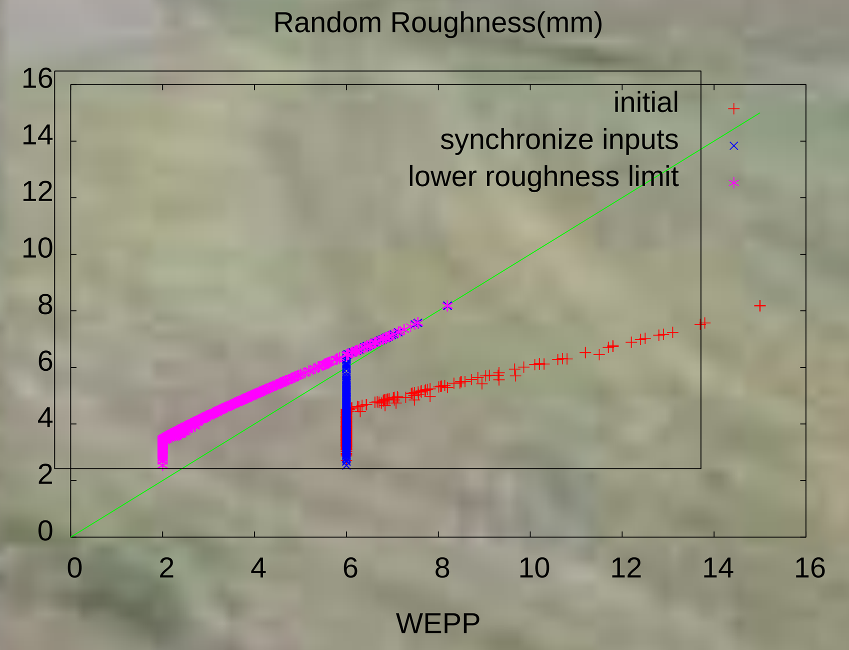
System State: Crop Biomass; Residue Biomass; Soil Water; Soil - roughness, aggregation, crusting, loose material.

Erosion of Soil: By Wind – creep, saltation, abrasion, suspension. By Water – raindrop impact, runoff, shear, rill formation.

Comparison Count of Events / Depth of Runoff

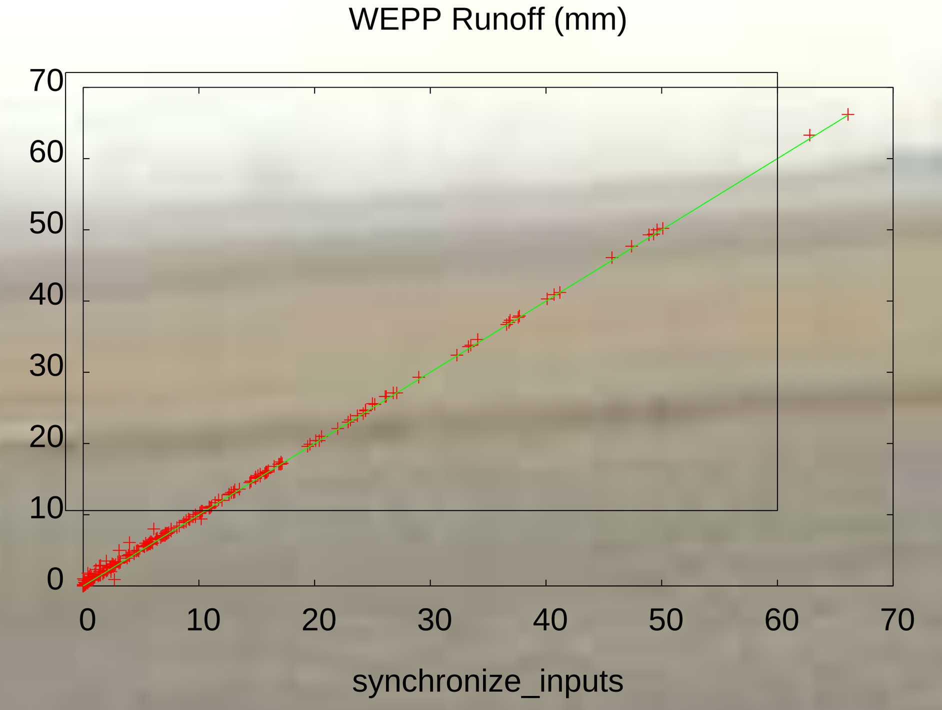
Event Model	Precip.	Runoff	Snowfall	Snow Melt	Snow versus Rain in other	Runoff/rainfall (mm/mm)
WEPS	832	822	61	61	11	0.047
WEPP	832	838	78	84	28	0.086

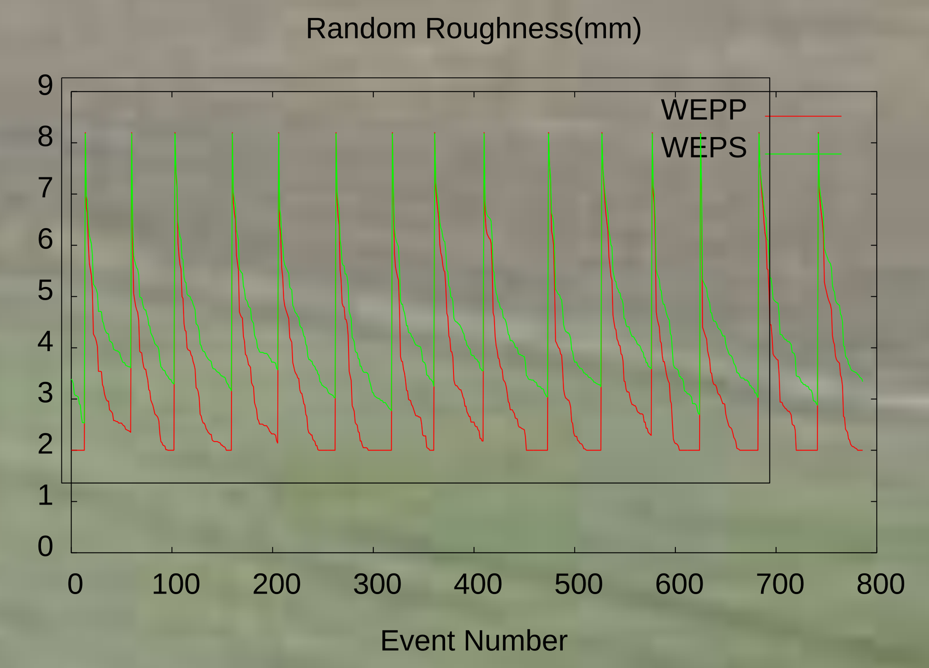




Comparison of runoff depth for each precipitation event confirmed the table above. Differences in infiltration and surface detention are likely causes for the difference. This led to an examination of surface detention and it's factors, ridges and random roughness.

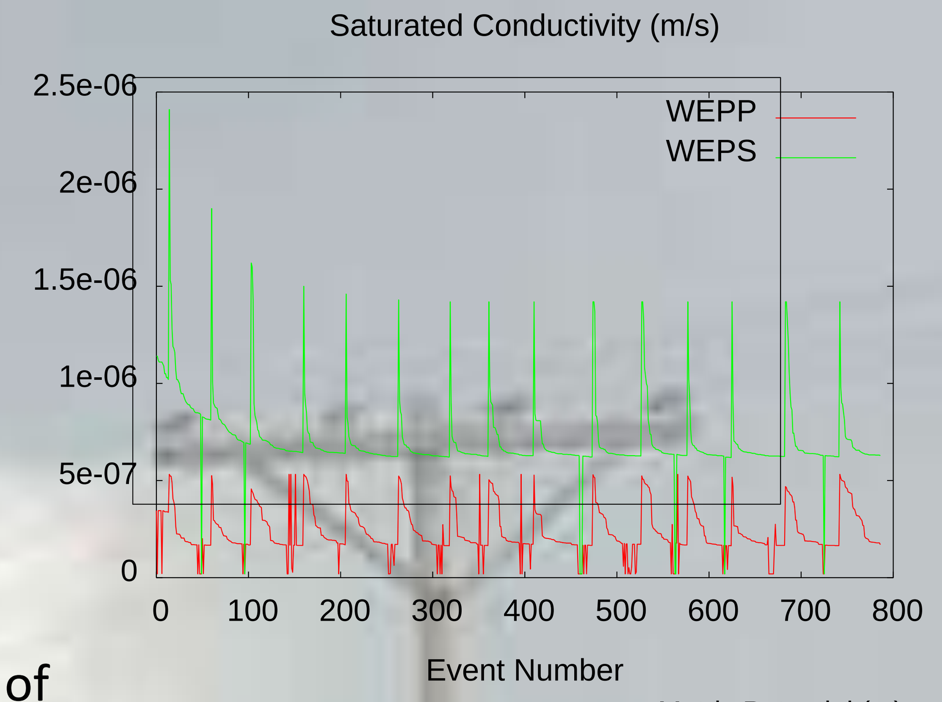
With synchronized inputs, it became clear that WEPP has a lower limit on random roughness. The WEPP code was modified to use the same limit as WEPS, 2mm. This modification changes the depression storage and the runoff, and revealed the different equations used for random roughness decay (figure to right).





Calculation of effective Hydraulic Conductivity

In WEPP, the effective hydraulic conductivity used for infiltration is aggregated from the baseline hydraulic conductivity of the tilled soil layers, found by fitting model runs to rainfall/runoff plot data for freshly tilled fallow plots. Additional adjustments to account for crust development, vegetation effects and frozen soil are applied to arrive at the effective value. When the WEPP infiltration routines were inserted into WEPS, the baseline hydraulic conductivity was directly estimated from the saturated hydraulic conductivity. The difference between the two is seen in the figure to the right. This likely explains much of the difference in runoff between the two models.

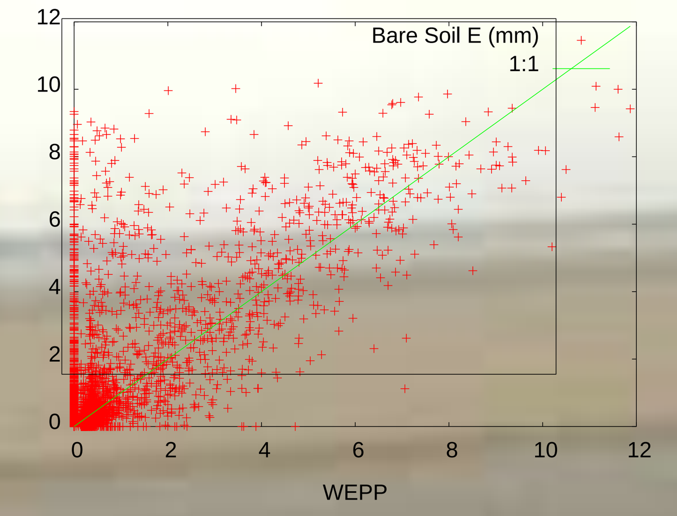


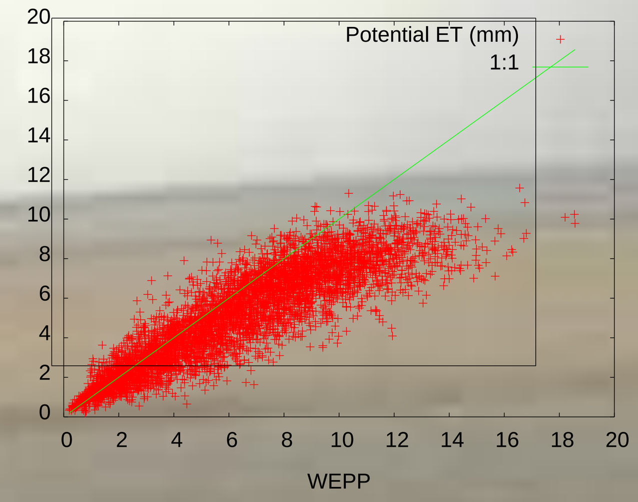
Necessary Modifications

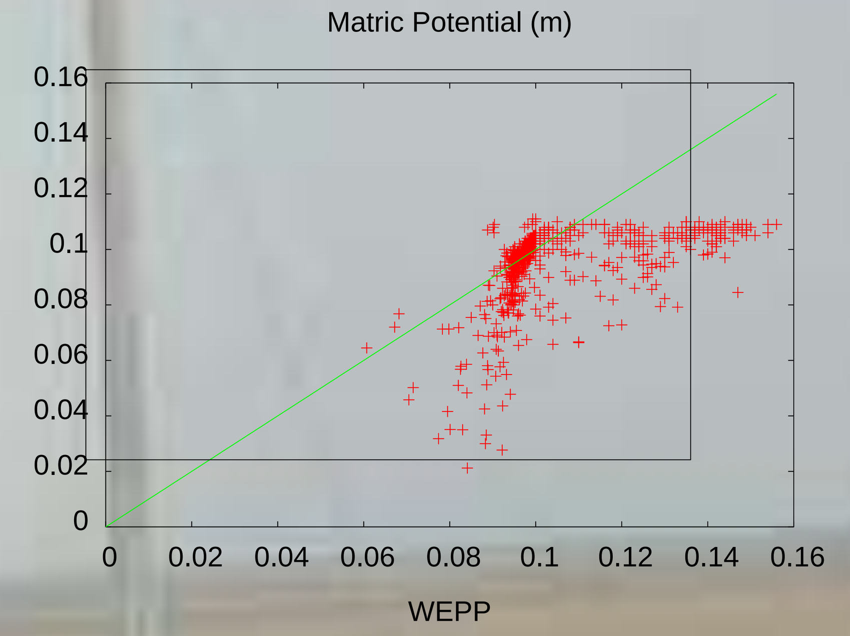
Making changes requires careful monitoring of the effects in the model being modified. Calibration data sets are available for both for comparison purposes. Changing the lower limit of random roughness in WEPP changed the runoff amounts for small events.

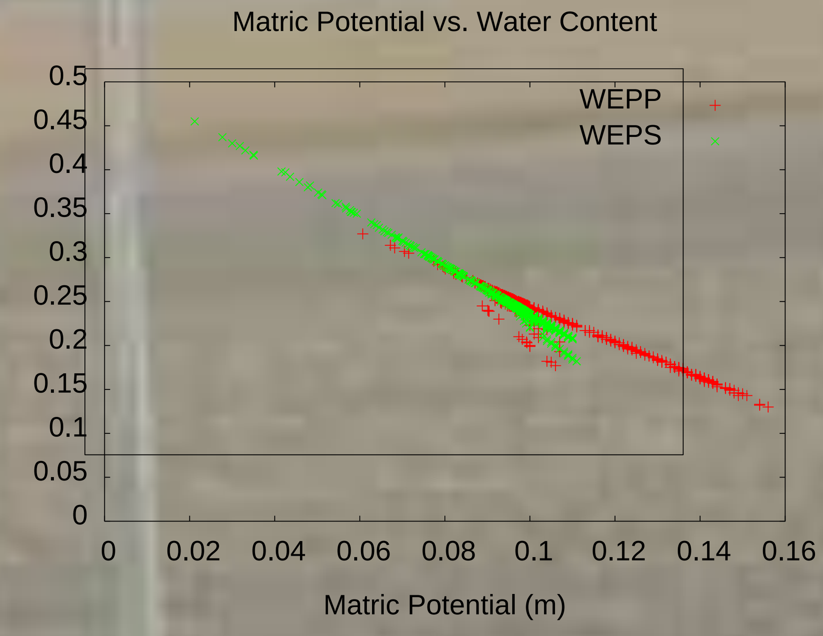
Soil Matric Potential and Water Balance

Soil Matric potential (figure to right) is also a primary driver of the infiltration rate and therefore runoff. Soil water content and a soil water release curve are used to find this value. A plot of that relationship (to right below) shows differences. Soil water content also varies between the two, possibly related to a difference in the bare soil evaporation or the method used to find potential evapo-transpiration.



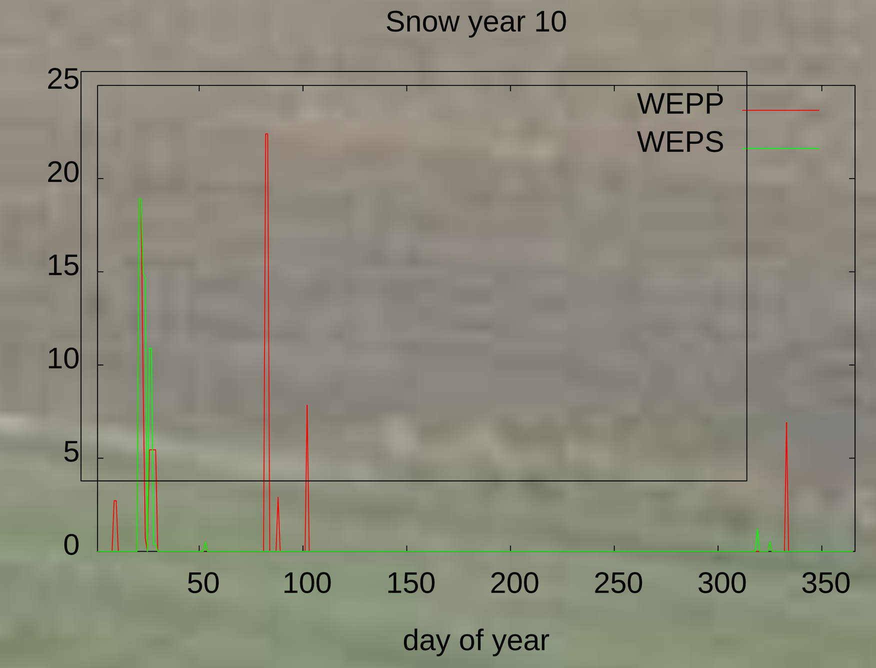






Winter Routines

Independently developed systems for determining when precipitation is snow and finding the energy balance for snow melt show as snow on the ground for different periods of time.



Conclusions

The two models were developed to model very different types of erosion processes. Resolving the differences requires retaining the process sub-models from both that are critical to modeling their specific erosion type while monitoring the changes made against the original calibration data.