WEPP Hillslope Calibrations
Goals

- Approximate runoff and possibly soil loss to measured values.
- Adjust WEPP inputs to minimize output differences compared to observed data.
- After parameters are adjusted for a subset of observed data apply model to other observed data for validation.
Is Calibration Needed?

- WEPP can be run without calibration...
  - If inputs are known for parameters.
  - Still have uncertainty in outputs

- In the real world...
  - Not all inputs are known
  - Uncertainty in measured values
  - Not all outputs are measured
  - Simulation areas are variable at small scales
General WEPP Inputs Needed

- Climate – Precipitation, storm durations, intensity, temperatures
- Soils – Basic layer information
- Slope – steepness, length
- Management – general plant growth characteristics, cover, residue, soil disturbances
What to Consider

- Running WEPP in single storm or continuous daily simulation.
  - Single storm requires accurate initial soil moisture, management initial conditions.
- Availability of detailed climate data.
  - Breakpoint data is best, 15 minutes or less.
Target Climate Parameters

- For Breakpoint format:
  - Precipitation, time, intensity

- For Cligen format:
  - Daily amount, duration, intensity
Target Soil Parameters

- Initial Saturation Level
- Rill Erodibility – Kr
- Critical Shear –
- Effective Hydraulic Conductivity – Ksat
Target Management

- Tillage Parameters:
  - Surface area disturbed
  - Tillage Depth
  - Residue buried

- Plant Parameters:
  - Biomass Energy Ratio
  - Maximum Root Depth
  - Maximum Canopy Height
  - Canopy cover coefficient

- Initial Conditions:
  - Initial Rill Cover
  - Initial Roughness
More slope points that describe the variations in the topography are preferred.
Water Balance Output

Corn, West Lafayette, IN

- OFE: 1 Area (m^2) = 108.74874 Length (m) = 39.02 Width (m) = 2.787
- Precip (mm): 838.20 91.15 (m^3)
- Runoff (mm): 112.70 12.26 (m^3) 10.87%
- Soil Evap (mm): 249.27 27.11 (m^3) 24.04%
- Plant Evap (mm): 475.25 51.68 (m^3) 45.84%
- Residue Evap (mm): 30.16 3.28 (m^3) 2.91%
- Deep seep (mm): 169.06 18.39 (m^3) 16.31%
- Lat Flow (mm): 0.00 0.00 (m^3) 0.00%
- Tile Drainage (mm): 0.00 0.00 (m^3) 0.00%
- Initial Soil Water (mm): 458.05 49.81 (m^3)
- Final Soil Water (mm): 257.79 28.03 (m^3)
- Initial Frozen Soil Water (mm): 0.00 0.00 (m^3)
- Final Frozen Soil Water (mm): 1.68 0.18 (m^3)
- Initial Snow Water (mm): 0.00 0.00 (m^3)
- Final Snow Water (mm): 0.00 0.00 (m^3)
- Upstream surface runon (mm): 0.00 0.00 (m^3)
  * above does not include baseflow
- Upstream subsurface runon (mm): 0.00 0.00 (m^3)
- Irrigation Water (mm): 0.00 0.00 (m^3)
- Initial Surface Storage (mm): 0.00 0.00 (m^3)
- Final Surface Storage (mm): 0.00 0.00 (m^3)
- Baseflow External (mm): 0.00 0.00 (m^3)
- Final Water Balance Error (mm): 0.34
- Maximum surplus balance error occurred on day 78-1: 2.51
- First day with surplus > 3mm: 0-0: 0.00
- Maximum missing balance error occurred on day 37-1: -0.02
- First day with missing > 3mm: 0-0: 0.00

Final Water Balance Error for OFE 1: 0.34 (mm) Use WEPP outputs as a guide to making parameter adjustments.
Water Balance Output

Forest, West Lafayette, IN

- OFE: 1 Area (m²) = 108.74874 Length (m) = 39.02 Width (m) = 2.787
- Precip (mm): 838.20 91.15 (m³)
- Runoff (mm): 15.88 1.73 (m³) 1.48%
- Soil Evap (mm): 0.00 0.00 (m³) 0.00%
- Plant Evap (mm): 975.40 106.07 (m³) 90.74%
- Residue Evap (mm): 0.00 0.00 (m³) 0.00%
- Deep seep (mm): 83.70 9.10 (m³) 7.79%
- Lat Flow (mm): 0.04 0.00 (m³) 0.00%
- Tile Drainage (mm): 0.00 0.00 (m³) 0.00%
- Initial Soil Water (mm): 458.04 49.81 (m³)
- Final Soil Water (mm): 207.73 22.59 (m³)
- Initial Frozen Soil Water (mm): 0.00 0.00 (m³)
- Final Frozen Soil Water (mm): 12.82 1.39 (m³)
- Initial Snow Water (mm): 0.00 0.00 (m³)
- Final Snow Water (mm): 0.73 0.08 (m³)
- Initial surface runon (mm): 0.00 0.00 (m³)
  * above does not include baseflow
- Initial subsurface runon (mm): 0.00 0.00 (m³)
- Irrigation Water (mm): 0.00 0.00 (m³)
- Initial Surface Storage (mm): 0.00 0.00 (m³)
- Final Surface Storage (mm): 0.00 0.00 (m³)
- Baseflow External (mm): 0.00 0.00 (m³)
- Final Water Balance Error (mm): -0.06
  Maximum surplus balance error occurred on day 83-1: 1.95
  First day with surplus > 3mm: 0-0: 0.00
  Maximum missing balance error occurred on day 355-1: -0.22
  First day with missing > 3mm: 0-0: 0.00

Final Water Balance Error for OFE 1: -0.06 (mm)
## Example Ksat Sensitivity

<table>
<thead>
<tr>
<th>Ksat (mm/h)</th>
<th>Runoff (mm/yr)</th>
<th>Soil Loss (kg/m²/yr)</th>
<th>Sediment Yield (t/ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0</td>
<td>258</td>
<td>2.532</td>
<td>25.3</td>
</tr>
<tr>
<td>4.62*</td>
<td>188</td>
<td>1.896</td>
<td>18.9</td>
</tr>
<tr>
<td>8.0</td>
<td>146</td>
<td>1.417</td>
<td>14.1</td>
</tr>
<tr>
<td>16.0</td>
<td>101</td>
<td>0.8</td>
<td>8.0</td>
</tr>
</tbody>
</table>

* – initial baseline 20 year run, West Lafayette, IN, Fallow, default slope, Duncanon soil
# Example Rill Erodibility (Kr) Sensitivity

<table>
<thead>
<tr>
<th>Kr</th>
<th>Runoff (mm/yr)</th>
<th>Soil Loss (kg/m²/yr)</th>
<th>Sediment Yield (t/ha/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.015</td>
<td>188</td>
<td>1.618</td>
<td>16.1</td>
</tr>
<tr>
<td>0.0202*</td>
<td>188</td>
<td>1.896</td>
<td>18.9</td>
</tr>
<tr>
<td>0.04</td>
<td>188</td>
<td>2.89</td>
<td>28.9</td>
</tr>
<tr>
<td>0.06</td>
<td>188</td>
<td>3.8</td>
<td>38.0</td>
</tr>
</tbody>
</table>

* – initial baseline 20 year run, West Lafayette, IN, Fallow, default slope, Duncanon soil
## Example, Biomass Energy Ratio

<table>
<thead>
<tr>
<th>Biomass Energy Ratio (kg/Mj)</th>
<th>Runoff (mm/yr)</th>
<th>Soil Loss (kg/m$^2$/yr)</th>
<th>Sediment Yield (t/ha/yr)</th>
<th>Peak Above ground biomass (kg/m$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>17.7</td>
<td>0.045</td>
<td>0.42</td>
<td>0.55</td>
</tr>
<tr>
<td>15*</td>
<td>15.9</td>
<td>0.037</td>
<td>0.32</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* – initial baseline 1 year run, West Lafayette, IN, Trees, default slope, Duncanon soil