Fate and Transport of Metals and Sediment in Surface Waters

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Upland Erosion and Contaminant Transport

Introduction
and Deposition
STUDY OBJECTIVE

Develop computer modeling tools for the analysis of point source and non-point source metals and fine sediments in surface waters
• Use models like the 2-D hydrologic and erosion model CASC2D-SED to simulate the response of the watershed to different rainfall events
• Find a field site in collaboration with other members of the HSRC for the simulations and analysis.
UPLAND EROSION (2-D)

Modified Kilinc and Richardson equation for the overland:

\[ q_t \ (tons / m^* s) = 25,500 \ S_o^{1.66} \left( \frac{Q}{W} \right)^{2.035} \frac{K}{0.15} C P \]
Modified Kilinc and Richardson equation for the channels:

\[ q_t (m^3) = 8 \times S_o^{1.664} \left( \frac{Q}{W_{ch}} \right)^{2.035} \times W_{ch} \]
Goodwin Creek Watershed

- Location: Panola County (MS)
- Area: 21Km²
- Monitored by ARS-NSL (Oxford, MS)
  - 37 rain gages
  - 14 stream gages (water and sediment)
  - Channel surveys
  - GIS data
INPUT DATA (DEM)

Derive:
1. Channel Network
2. Slope distribution
### INPUT DATA (soil type)

#### Approach

<table>
<thead>
<tr>
<th>Soil Type</th>
<th>Soil Index</th>
<th>Hydr. Cond. [cm/h]</th>
<th>Suction Head [cm]</th>
<th>Moisture Deficit [cm/cm³]</th>
<th>Sand [%]</th>
<th>Silt [%]</th>
<th>Clay [%]</th>
<th>Kₚ [ - ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calloway</td>
<td>1</td>
<td>0.350</td>
<td>25</td>
<td>0.29</td>
<td>0.25</td>
<td>0.55</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Fallaya</td>
<td>2</td>
<td>0.350</td>
<td>25</td>
<td>0.29</td>
<td>0.3</td>
<td>0.6</td>
<td>0.1</td>
<td>1</td>
</tr>
<tr>
<td>Grenada</td>
<td>3</td>
<td>0.300</td>
<td>20</td>
<td>0.32</td>
<td>0.25</td>
<td>0.55</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Loring</td>
<td>4</td>
<td>0.300</td>
<td>25</td>
<td>0.3</td>
<td>0.25</td>
<td>0.55</td>
<td>0.2</td>
<td>0.4</td>
</tr>
<tr>
<td>Collins</td>
<td>5</td>
<td>0.200</td>
<td>20</td>
<td>0.29</td>
<td>0.3</td>
<td>0.6</td>
<td>0.1</td>
<td>0.3</td>
</tr>
<tr>
<td>Memphis</td>
<td>6</td>
<td>0.350</td>
<td>25</td>
<td>0.35</td>
<td>0.25</td>
<td>0.55</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>Gulled Land</td>
<td>7</td>
<td>0.200</td>
<td>15</td>
<td>0.29</td>
<td>0.25</td>
<td>0.55</td>
<td>0.2</td>
<td>0.1</td>
</tr>
</tbody>
</table>

Number of different soil types: 7
# INPUT DATA (land use)

## Approach

### Land Use

![Excel Spreadsheet](image)

**Land Use Parameters**

Number of different land use classes: 4

<table>
<thead>
<tr>
<th>Land Use Type</th>
<th>Land Use Index</th>
<th>Manning n [-]</th>
<th>Interception [mm]</th>
<th>C&lt;sub&gt;USLE&lt;/sub&gt; [-]</th>
<th>P&lt;sub&gt;USLE&lt;/sub&gt; [-]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forest</td>
<td>1</td>
<td>0.25</td>
<td>3</td>
<td>0.007</td>
<td>1</td>
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<tr>
<td>Water</td>
<td>2</td>
<td>0.01</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Cultivated</td>
<td>3</td>
<td>0.15</td>
<td>1</td>
<td>0.65</td>
<td>1</td>
</tr>
<tr>
<td>Pasture</td>
<td>4</td>
<td>0.2</td>
<td>1.5</td>
<td>0.07</td>
<td>1</td>
</tr>
</tbody>
</table>
10/17/81 event:
Duration: 3.5 hr.
Depth: 73 mm.
10/17/81 event:
Peak Flow: 6.7 mm/h
Time to peak: 278 min.
OBSERVED EVENT

Sediment peak flow: 7.2 tons/ha/day
Time to peak: 262 min.

10/17/81 event:
Peak Flow: 6.7 mm/h
Time to peak: 278 min.
Total erosion/deposition

- Erosion
+ Deposition

Output
CONCLUSION

- There is an opportunity to adapt CASC2D-SED to small mining watersheds for the analysis of the fate and transport of metals and sediment in surface waters.

- There is also an opportunity for multi-disciplinary research.