Scheduling field operations in SWAT

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When?

Weather forecast

<table>
<thead>
<tr>
<th>Day</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thu</td>
<td>95</td>
<td>66</td>
</tr>
<tr>
<td>Fri</td>
<td>90</td>
<td>63</td>
</tr>
<tr>
<td>Sat</td>
<td>85</td>
<td>59</td>
</tr>
<tr>
<td>Sun</td>
<td>83</td>
<td>59</td>
</tr>
</tbody>
</table>

Warm or cool enough

Not too wet

Time, labor, and equipment resources

Not too dry
Current SWAT Scheduling

When?

Warm or cool enough
Objectives

• Implement code into SWAT to schedule operations using heat units, soil moisture, and available resources.
• Evaluate the ability of the model to simulate correct planting dates.
• Identify remaining limitations and next steps.
Outline

- Algorithm
- Study area and available data
- Evaluation Results
- Limitations and next steps
Algorithm for soil moisture

• Field operation occurs when
  – Heat unit index is high enough:
    • Current HUI ≥ Operation HUI
  – Soil moisture in correct range
    • Moisture (L2) ≤ Moisture factor * field capacity (L2)
    • Moisture (L2) ≥ Drought factor * wilting point (L2)
Quantification of resources

• Calculate total work area:
  – Any non urban HRU with at least one operation

• Maximum daily worked area: maximum daily resources
  – Total work area / 14
Algorithm for resources

Heat and moisture are right

- Resources available: HRU area ≤ available resources
  - Operation occurs
  - Subtract HRU area from available resources

- Resources not available: HRU area > available resources
  - Wait till next day
Final checks

- If dormant period starts, operation occurs
- If end of year happens, operation occurs
Study area

- Missouri
- Goodwater Creek Experimental Watershed
- Claypan Area MLRA 113
Available Data: MO crop reporting districts

- Planting
- Silking
- Harvesting

Corn planting dates in North East Missouri district
Corn planting results by year

fraction of corn acres planted

Apr 10       Apr 30         May 20          Jun 9           Jun 29        Jul 19


Simulated planting dates compared to planting record for corn

Difference (# days)

Percent corn crop planted (%)
Simulated planting dates compared to planting record for soybeans

Simulated later

Simulated earlier

Percent soybean crop planted (%)
Limitations

• For effective spatio-temporal distribution of field operations, HRUs need to be small enough.
• The moisture threshold is a global parameter: same for all crops of the watershed.
• HRUs are processed from the smallest to largest HRU ID: same HRUs are always planted first.
Future steps

• Additional testing throughout the world, especially for too dry or too wet conditions.

• Randomization of HRU processing.

• Abandon planting plans when conditions are not good for too long. Should we consider switching to other crops?

• Soil moisture as a function of the crop growing or to be planted.