JAVA Newhall Simulation Model (JNSM) and

Traditional Soil Climate Simulation Modeling in a Digital Geospatial World

2011 NCSS National Conference
New Technology and Research Agenda Forums
Asheville, NC  May 23, 2011
Soil climate simulation models allow the study of soils in the 4th dimension – Time…..

MLRA 127 – Eastern Allegheny Plateau & Mountains (Typic Udic, Mesic, long term record)

Growing wetter
Java Newhall Simulation Model (jNSM)

Douglas A. Miller and Brian Bills

CESU 68-7482-9-527
Enhanced Newhall Simulation Model Project
$20,000 FY 2010

presentation by S. W. Waltman

May 23, 2011
Goal

Improve access and usability of the Newhall Simulation Model (NSM; VanWambeke, 1992) to understand soil climate—in particular soil moisture and temperature regimes determined from long-term climate records.
Objectives

- Port NSM program from Basic to modern language (Java)
- Provide intuitive graphical user interface for setting up model runs and visualizing results
- Enable batch processing (input/output)
Van Wambeke Basic Version (1992)

Station: Williamsport PA  Country: USA  Latit: 41 14  N  Longit: 76 55  W
Elevation: 520

Annual rainfall 703 mm  Waterholding capacity: 200 mm
Temperature regime: mesic  Moisture regime: Ustic

SOIL CLIMATIC REGIME ACCORDING TO NEWALL COMPUTATION
<soil temp.=air temp.+1.8 C; amplit. reduced by 1/3>

Jan  Feb  Mar  Apr  May  Jun  Jul  Aug  Sep  Oct  Nov  Dec
Monthly rainfall (mm)  44.2  40.4  133.5  96.8  95.0  98.6  66.0  13.5  54.9  6.4  17.5  56.4
Monthly air temperatures (Celsius)  -2.2  2.7  9.1  16.3  24.1  25.3  20.9  19.8  10.5  5.3  11.1  -1.1
Monthly evapotranspiration (Thorntwaite), mm  0.0  1.5  11.4  38.6  99.9  127.6  142.1  126.6  76.7  39.9  14.4  0.0

TEMPERATURE CALENDAR  MOISTURE CALENDAR
< - : 1(5) <5 : 5(10) <8 : T>8>  1 = DRY ; 2 = M/D ; 3 = MOIST
1-------------------30-------------------1-------------------15-------------------30

Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

= Computed by BASIC program FLEXSM (FEB 1991).

Tentative subdivision: Wet Tempustic for a waterholding capacity of 200 mm
jNSM System Components
Newhall Model Run Inputs

- **Metadata** (user information, climate network, start/end years, date of model run, source units – English/Metric, etc.)

- 12 monthly precipitation values*

- 12 monthly air temperature values*

- Elevation

- Latitude/Longitude

- Configurable parameters
  - MAAT-MAST relationship
  - Water holding capacity

* Requires Serially Complete Input Data Records
3 Types of jNSM Jobs

- Single station - single run
- Multiple stations - single run
- Single station - multiple run

Interactive
Batch via file
row = 1 model run
Newhall Model Run Outputs

- Soil moisture regime classification
- Soil subgroup modifier
- Soil temperature regime classification
- Annual water balance
- Summer water balance
- Estimated potential evapotranspiration
- Soil moisture and temperature calendars
- Soil Moisture Control Section ‘state’ summaries (cumulative & consecutive days)
Calendar Report

Station: WILLIAMSPORT
Period of Record: 1930 - 1930
Period Type: normal
Mean Annual Precipitation: 703 mm
Soil Temperature Regime: Mesic

Latitude: 41.24°
Longitude: -75.92°
Elevation: 153 m
Waterholding Capacity: 200 mm
Soil Moisture Regime: Ustic
Subgroup Modifier*: Wet Tempustic

Soil Climate Regime--Newhall Simulation Model
(MAST = MAAT + 1.2 °C; Amplitude 3.66°)

<table>
<thead>
<tr>
<th>JAN</th>
<th>FEB</th>
<th>MAR</th>
<th>APR</th>
<th>MAY</th>
<th>JUN</th>
<th>JUL</th>
<th>AUG</th>
<th>SEP</th>
<th>OCT</th>
<th>NOV</th>
<th>DEC</th>
<th>Annual</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.17</td>
<td>0.89</td>
<td>3.72</td>
<td>9.11</td>
<td>16.28</td>
<td>21.11</td>
<td>22.83</td>
<td>21.94</td>
<td>19.78</td>
<td>10.50</td>
<td>5.33</td>
<td>-1.06</td>
<td>10.70</td>
</tr>
</tbody>
</table>

Mean Monthly Soil Temperature (°C at 50 cm depth)

Mean Monthly Precipitation (mm)

Mean Monthly Evapotranspiration (mm)

Soil Temperature Calendar

Soil Moisture Calendar

*Soil climate terms include Subgroup criteria as defined in Soil Taxonomy (1999) and keys to Soil Taxonomy (2010) and those proposed in Newhall source code (VanWambeke et al, 1992)
Climograph

Station: WILLIAMSPORT
Period of Record: 1930 - 1950
Period Type: normal
Mean Annual Precipitation: 703 mm
Soil Temperature Regime: Meso

Latitude: 41.24°
Longitude: -76.92°
Elevation: 158 m
Waterholding Capacity: 200 mm
Soil Moisture Regime: Ustic
Subgroup Modifier: Wet Tempustic

* Soil climate terms include Subgroup criteria as defined in Soil Taxonomy (1999) and keys to Soil Taxonomy (2010) and those proposed in Newhall source code (VanWambeke et al, 1992)
MODEL RUN SUMMARY

INSM version 1.4.6
Insm version 1.4.4
Model Run Date: 20110331

STATION
Name: MUSKAYSPORT
Network Type: HCII
Latitude: 41.24 Longitude: -76.92
Elevation: 158 ft
Country: US
StateProvince: 42

CONTACT
Last Name: Sloan
First Name: Jim
Title:
Organization:
Address:
City:
StateProvince:
Postal Code:
Country:
Email:
Phone:

Period of Record: 1930 - 1990
Period Type: normal

INPUT3 in original source units (english):
Air-Soil Temperature Offset (°F): 2.2
Waterholding Capacity (in): 7.9
Mean Monthly Precipitation (in): 1.74, 1.59, 4.47, 3.81, 3.74, 3.88, 2.00, 0.63, 2.16, 0.25, 0.69, 2.22
Mean Monthly Air Temperature (°F): 28.09, 33.60, 38.70, 48.40, 61.30, 70.00, 73.09, 71.49, 67.50, 59.98, 41.59, 30.09

Summary
Model Run XML File

- Encapsulates all information in a model run
- Enables sharing and preserving runs
- Easily parsed with programming tools (data mining)

```xml
<?xml version="1.0"?>
<model>
  <metadata>
    <stninfo>
      <nettype>HCN</nettype>
      <stnname>ALLENTOWN LEHIGH VLY AP</stnname>
      <stnid>0</stnid>
      <stnelev>119.0</stnelev>
      <stateprov>PA</stateprov>
      <country>US</country>
    </stninfo>
    + <mlra>
    + <cntinfo>
    + <notes>
      <rundate>20110505</rundate>
      <nsmver>1.4.4</nsmver>
      <srcunitsys>metric</srcunitsys>
    </notes>
  </metadata>
  <input>
    <location>
      <lat>40.65</lat>
      <lon>-75.45</lon>
      <usercoordfmt>DD</usercoordfmt>
    </location>
    <recordpd>
      <pdtype>normal</pdtype>
      <pdbegin>1971</pdbegin>
      <pddend>2000</pddend>
    </recordpd>
    <precepts>
      <precip id="Jan">88.9</precip>
      <precip id="Feb">69.85</precip>
      <precip id="Mar">90.42</precip>
      <precip id="Apr">88.65</precip>
    </precepts>
  </input>
</model>
```
Package Contents

- jNSM_installer.exe
- jNSM_UserGuide.pdf
- Template Batch Metric.xlsx
- All PA jNSM Example Batch Metric.xlsx/csv
- Williamsport PA jNSM Example Batch English.xlsx/csv
- WILLIAMSPORT_1930_1930.xml

- Currently collecting Peer Review comments
- Preparing submission for USDA CCE Certification
Proposed Next Phase

- Web browser application
- Central model run repository
- Repository query and exploration tools; for example:
  - Find all Mesic, Typic Udic model runs
  - Find model runs within MLRA 147
  - Map model runs with soil climate regimes similar to Berks series
  - Map model runs where estimated PET > 640mm
jNSM inputs gathered through geospatial overlay of (28) map layers
END