A Comparison of PRISM and CFSR precipitation data effects on calibration and uncertainty of SWAT Models  
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Introduction

- Precipitation is one of the most important drivers in watershed models
- A common source of precipitation data for SWAT models is the Climate Forecast System Reanalysis (CFSR) data
- This is an interpolated dataset on a 38-km grid based on the National Weather Service Global Forecast System
- Another source of interpolated daily weather data that has not been commonly used or tested in SWAT models is the Parameter-elevation Relationships on Independent Slopes Model (PRISM) data (Daly et al., 2008; Di Luzio et al., 2008) available with a grid spacing of 4 km covering the contiguous United States for the period from 1981-present

Objective

Our objective was to compare the effect of PRISM and CFSR data on the fit of a SWAT model of stormflow in the Big Hayes Creek watershed. To confirm the results, we also compared the effect on a watershed in Louisiana. To help understand the differences we found, we also looked at the effect of using the National Climate Data Center (NCDC) weather data which is not interpolated.

Study Area

Fig. 1. Big Hayes Creek watershed in Gwinnett County, GA, and the location of 6 PRISM interpolated weather stations (4 km grid), 1 CFSR interpolated weather stations (38 km grid), and 1 NCDC weather station.

Fig. 2. Big Creek watershed in Grant County, Louisiana and location of 10 PRISM interpolated weather stations (4 km grid), one CFSR interpolated weather station (38 km grid), and one NCDC weather station.

Methods

Models

- SWAT models were developed that differed only in source of weather data: PRISM, CFSR, or NCDC
- Models were run with 4 years warm up, 4 years calibration, and 4 years validation
- SWAT-CUP was used for calibration, starting with 22 parameters, and 1,000 runs per iteration
- Ended with 10-12 calibrated parameters

Conclusion

- We compared PRISM and CFSR interpolated climate data in SWAT models in 2 watersheds in the southern US
- In both locations PRISM data outperformed CFSR in simulating high and low flow periods
- The calibrated model using PRISM data resulted in a more responsive groundwater system in both watersheds
- PRISM models also outperformed models using NCDC gage data but the rain gages were outside the watersheds
- Scatter plots comparing CFSR and PRISM precipitation data showed that there was little agreement between estimated values (R² = 0.15)
- If the CFSR data was delayed by one day, the agreement was better and the fitted line was closer to the 1:1 line in the scatter plots (R² = 0.36)
- Model predictions of storms using CFSR data tended to precede the observed storm
- Overall, PRISM seemed to provide a better estimate of precipitation than CFSR resulting in more accurate simulations of stormflow
- Further testing comparing PRISM and CFSR data sets in other watersheds is needed

Results

Table 1. Fitting criteria for calibration and validation runs of the Big Hayes Creek watershed in GA and the Big Creek watershed in LA.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>GA</th>
<th>LA</th>
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<tbody>
<tr>
<td>CN2</td>
<td>0.56</td>
<td>0.36</td>
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<tr>
<td>CH_K2</td>
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<td>CH_K1</td>
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<td>CH_N2</td>
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<td>RES_EVOL</td>
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<tr>
<td>GW_REVAP</td>
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<td>0.55</td>
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<tr>
<td>GW_QMN</td>
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<td>0.50</td>
</tr>
<tr>
<td>GW_DELAY</td>
<td>0.56</td>
<td>0.48</td>
</tr>
</tbody>
</table>

Table 2. SWAT parameter definitions and calibrated values for CFSR and PRISM simulations in Big Hayes Creek watershed in GA. Simulations resulted in a similar list of parameters and values except for GW_DELAY, GW_QMN, and SOL_K. Calibrated values resulted in more rapid recharge of shallow aquifer and groundwater stream response with PRISM. Results were similar in LA.

- We used 6 PRISM interpolated stations, 1 CFSR interpolated station (4 km from watershed), or 1 NCDC gage station (20 km from watershed)
- SUFI-2 used for calibration
- Louisiana watershed was 85% forest, 15% wetland, 5% range/hay (Fig. 2)
- USGS gage station provided daily flow at outlet
- SWAT-CUP was used for calibration, starting with 22 parameters, and 1,000 runs per iteration
- Ended with 10-12 calibrated parameters

Fig. 3. PRISM (a) and CFSR (b) SWAT simulations for the full calibration period (1/1/2003 to 12/31/2006) and observed data for Big Hayes Creek in GA.

Fig. 4. PRISM (a) and CFSR (b) SWAT simulations for the first 300 days of the calibration period and observed data for Big Hayes Creek in GA.

Fig. 5. Comparison of streamflow simulated by a) PRISM, b) NCDC, and c) CFSR during a 100-day period in the Big Creek watershed in GA. PRISM simulation showed a more responsive groundwater system and better agreement with observed data.