Abstract

In the mountainous western U.S. snow accumulation and melt are critical components of the water cycle. In this study we compare simulated and observed snow variables using traditional and new spatial similarity measures. We use the SNOW17 model within the Hydrology Laboratory Research Distributed Hydrologic Model (HL-RDHM) developed by NOAA-National Weather Service (NWS) to simulate distributed snow variables over the western U.S. area and consists of 108 Hydrologic Rainfall Analysis Project (HRAP) and SNODAS (1km resolution) grid simulations, and so on. 

Motivation

- Error functions for evaluating spatially distributed snow models
- Spatial patterns. HAUS considers various factors such as time, location, and elevation.

Methodology

- For better spatial pattern representation, two different similarity functions are employed in the process of error calculation.
- Traditional measurements: RMSE, NSE, R-squared, etc.
- New similarity functions: Hausdorff (HAUS) and Earth Mover’s Distance (EMD)

Data Sources & Study Area

- Gridded snow water equivalent simulations from SNOW17 (4km) grids
- Gridded snow water equivalent simulations from SNODAS (1km) grids
- Snow Depth Data from SNOTEL stations

Time-Series Comparison

- Traditional Measures: RMSE, NSE, R-squared, etc.
- Comparing only 1 vs. 1 for each data step

Spatially or Time & Spatial Comparisons

- HAUS distance
- Earth Mover’s Distance

Results

- Error values from traditional (RMSE, NSE, R-squared) and new similarity functions (HAUS and EMD) between SWE observations at 5 SNOTEL stations from SNOW17 and SNODAS vs. SWE observations from SNOW17 and SNODAS

- Time-Series Error Values
- Spatially or Time & Spatial Error Values

Table 1: Error Values for Each Spatial and Time Comparison

<table>
<thead>
<tr>
<th>Method</th>
<th>Error Values</th>
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<tbody>
<tr>
<td>RMSE</td>
<td>0.1997</td>
</tr>
<tr>
<td>NSE</td>
<td>0.6847</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.9536</td>
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<tr>
<td>HAUS</td>
<td>0.496</td>
</tr>
<tr>
<td>EMD</td>
<td>0.223</td>
</tr>
</tbody>
</table>

Table 2: Min, Max, and Average of HAUS error functions for each daily time step between SNOW17 and SNODAS

<table>
<thead>
<tr>
<th>Method</th>
<th>Min</th>
<th>Max</th>
<th>Ave</th>
</tr>
</thead>
<tbody>
<tr>
<td>HAUS</td>
<td>0.1886</td>
<td>0.6471</td>
<td>0.4261</td>
</tr>
</tbody>
</table>

Further Studies

- This study could be extended to larger regions containing SNOTEL stations to investigate overall error values.
- Other comparisons of some models could include the EMD and HAUS functions.

Acknowledgments

- Jongkwan Kim of NCEP/EMC for processing the NLDAS 2 data.
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Figures

- Figure 1: Scheme of Durango River Basin
- Figure 2: Error values with traditional (RMSE, NSE, R-squared) and new similarity functions (HAUS and EMD) between SWE observations at 5 SNOTEL stations from SNOW17 and SNODAS vs. SWE observations from SNOW17 and SNODAS
- Figure 3: HAUS Error values between 5 SNOTEL points vs. SNODAS and SNOW17 points for each SWE time step
- Table 1: Error Values for Each Spatial and Time Comparison
- Table 2: Min, Max, and Average of HAUS error functions for each daily time step between SNOW17 and SNODAS

References

- Jongkwan Kim et al., AGU 2013 Annual Meeting, San Francisco, CA
- From J. Kim et al., AGU 2013 Annual Meeting, San Francisco, CA
- Evaluation and Verification of a Distributed Snow Model with Time, Space, and Elevation Variables
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