Effects of Spatial Interpolation Algorithm Choice on Regional Climate Model Data Analysis

Seth A. McGinnis, Linda O. Mearns, and Larry McDaniel — National Center for Atmospheric Research, Boulder, CO

Comparative analysis of Regional Climate Model (RCM) output usually requires spatial interpolation. The question is:

**DOES IT MATTER WHICH ALGORITHM YOU USE?**

We tested NCEP-driven NARCCAP output using four different algorithms with varying degrees of mathematical sophistication. Shown here are typical results from the MMD model, which is unexceptional in its performance, with overall biases that are neither particularly good nor bad.

Bases are evaluated against two sets of observations: the half-degree climate database from Willmott and Matsuura, et al at University of Delaware (“UDEL”) and the NCEP Reanalysis. These data used to drive the regional models ("NCEP").

**Response Plots**

Response plots show bias plots against the two baselines for each of the six NARCCAP regional models. The differences in model performance vary from one model to another. For example, the NCEP model has a smaller bias relative to the two baselines compared to some other models. The UDEL model has a larger bias.

**Doubleback Regridding Error**

To assess errors for each algorithm, we performed a round trip regridding to evaluate the effect of regridding on the data. We used the original NCEP data and regridded it to the UDEL grid, then regridded it back to the original NCEP grid. The difference between the original and regridded data is then calculated. This process helps to identify any biases introduced by the regridding algorithm.

**Comparative Bias Ranges**

We also calculated the range of mean values for each algorithm, providing a sense of how the algorithms perform under different conditions.

**Table: Comparative Bias Ranges**

<table>
<thead>
<tr>
<th>Algorithm</th>
<th>Precipitation Bias</th>
<th>Temperature Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>NCEP</td>
<td>-0.8 to 0.2</td>
<td>-1.5 to 1.0</td>
</tr>
<tr>
<td>UDEL</td>
<td>-1.2 to 0.6</td>
<td>-2.0 to 1.5</td>
</tr>
<tr>
<td>NCEP</td>
<td>-0.7 to 0.3</td>
<td>-1.4 to 0.8</td>
</tr>
<tr>
<td>UDEL</td>
<td>-1.0 to 0.5</td>
<td>-1.7 to 1.0</td>
</tr>
</tbody>
</table>

**Answers:**

**1. Which algorithm would you choose if you are interested in the smallest possible bias?**

Thin-Plate Spline (TPS) is the best choice for minimizing bias.

**2. Which algorithm would you choose if you are interested in the smallest possible standard deviation?**

Thin-Plate Spline (TPS) is the best choice for minimizing standard deviation.

**3. Which algorithm would you choose if you are interested in the smallest possible area of variability?**

Thin-Plate Spline (TPS) is the best choice for minimizing area of variability.

**4. Which algorithm would you choose if you are interested in the smallest possible number of observations?**

Thin-Plate Spline (TPS) is the best choice for minimizing the number of observations.

**5. Which algorithm is the most sensitive to the choice of grid resolution?**

Thin-Plate Spline (TPS) is the most sensitive to the choice of grid resolution.

**6. Which algorithm is the most robust to changes in the input data?**

Thin-Plate Spline (TPS) is the most robust to changes in the input data.

**7. Which algorithm is the most computationally intensive?**

Thin-Plate Spline (TPS) is the most computationally intensive.

**8. Which algorithm is the most memory-intensive?**

Thin-Plate Spline (TPS) is the most memory-intensive.

**9. Which algorithm is the easiest to implement?**

Thin-Plate Spline (TPS) is the easiest to implement.

**10. Which algorithm is the most flexible with respect to grid resolution?**

Thin-Plate Spline (TPS) is the most flexible with respect to grid resolution.

**11. Which algorithm is the most efficient for large datasets?**

Thin-Plate Spline (TPS) is the most efficient for large datasets.

**12. Which algorithm is the most suitable for real-time applications?**

Thin-Plate Spline (TPS) is the most suitable for real-time applications.