Customizing and Understanding Wavelet Stats

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Options for Handling Missing data

- Points with valid forecasts.  $F \cap O$
- Points with valid observations.
- Points with both valid forecasts and observations.  $F \cap O$
- All points.  $F \cup O$

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## Thresholds

<table>
<thead>
<tr>
<th>Forecast</th>
<th>Threshold</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.05</td>
<td>&lt;</td>
<td>0.2</td>
</tr>
<tr>
<td>0.17</td>
<td>&lt;</td>
<td>0.2</td>
</tr>
<tr>
<td>0.45</td>
<td>&gt;</td>
<td>0.2</td>
</tr>
<tr>
<td>2.15</td>
<td>&gt;</td>
<td>0.2</td>
</tr>
<tr>
<td>0.05</td>
<td>&lt;</td>
<td>1</td>
</tr>
<tr>
<td>0.17</td>
<td>&lt;</td>
<td>1</td>
</tr>
<tr>
<td>0.45</td>
<td>&lt;</td>
<td>1</td>
</tr>
<tr>
<td>2.15</td>
<td>&gt;</td>
<td>1</td>
</tr>
</tbody>
</table>
Tiles – Grid must be $2^n \times 2^n$

- Cut down – user selected subset (square)
- Tiles – automated selection of subset(s)
- Pad with zeros – not recommended unless adds very small number of points.
Wavelets

- Haar
- Centered Haar
- Daubechies
- Centered Daubechies
- B spline
- Centered B spline
Output

• **Text files**
  – Options
  – Statistics
  – Can be read into stat analysis tool.

• **PostScript files**
  – Graphics
  – Options
  – Statistics
Wavelet-Stat: APCP at A24

Forecast

Observation

Model Name: WRF

Init Time: Aug 7, 2005 00:00:00
Valid Time: Aug 8, 2005 00:00:00
Lead Time: 24:00:00
Accum Time: 24:00:00

Tile Method: User-Defined
Tile Count: 1
Tile Dim: 64 x 64
Tile Corner: (45, 45)

Mask Missing: Fcst/Obs
Wavelet(k): Haar (2)
Overall forecast has skill (ISS > 0)

Errors at this scale account for nearly half of the MSE.

At this scale, forecast does not have skill (ISS < 0)
Wavelet-Stat: APCP at A24, Tile 1, >1.000, Scale 2

Difference (F-0)

Forecast transitions from no skill to skill at scale 3.
Wavelet-Stat: APCP at A24, Tile 1, >1.000, Scale 4

Difference (F-0)

<table>
<thead>
<tr>
<th>Frequency Bias:</th>
<th>1.61235</th>
<th>Intensity Skill Score:</th>
<th>0.70019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Rate:</td>
<td>0.14233</td>
<td>Freq Energy Squared (%):</td>
<td>0.02332 (10.16)</td>
</tr>
<tr>
<td>Mean-Squared Error (%):</td>
<td>0.01313 (6.83)</td>
<td>Obs Energy Squared (%):</td>
<td>0.00954 (6.70)</td>
</tr>
</tbody>
</table>

Wavelet-Stat: APCP at A24, Tile 1, >1.000, Scale 5

Difference (F-0)

<table>
<thead>
<tr>
<th>Frequency Bias:</th>
<th>1.61235</th>
<th>Intensity Skill Score:</th>
<th>0.87362</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Rate:</td>
<td>0.14233</td>
<td>Freq Energy Squared (%):</td>
<td>0.02745 (11.96)</td>
</tr>
<tr>
<td>Mean-Squared Error (%):</td>
<td>0.00553 (2.88)</td>
<td>Obs Energy Squared (%):</td>
<td>0.01600 (11.24)</td>
</tr>
</tbody>
</table>
Wavelet-Stat: APCP at A24, Tile 1, >1.000, Scale 6

Difference (F-0)

Frequency Bias: 1.61235  Intensity Skill Score: 0.75764
Base Rate: 0.14233  Fest Energy Squared (%): 0.03646 (15.89)
Mean-Squared Error (%): 0.01061 (5.52)  Obs Energy Squared (%): 0.00815 (5.72)

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Wavelet-Stat: APCP at A24, Tile 1, >1.000, Scale 7

Difference (F-0)

Frequency Bias: 1.61235  Intensity Skill Score: 0.82650
Base Rate: 0.14233  Fest Energy Squared (%): 0.05267 (22.95)
Mean-Squared Error (%): 0.00760 (3.95)  Obs Energy Squared (%): 0.02026 (14.23)
Summary

- Wavelet tool provides a flexible method for decomposing spatial fields into different scales.
- Once decomposed, verification measures at each physical scale can be examined and compared.