Objectives

• Purpose of Research
• Data and Methods Used
• Results and Conclusions
• Possible Sources of Error
• Future Research
Why do we care about rain?

- How much rain fell and where?
- Will our water reservoirs rise or fall?
- Where will flooding occur?
- Are there possible fire dangers from lack of rain?
Edwards Aquifer

General Flowpaths of the Edwards Aquifer

- Contributing Zone
- Recharge Zone
- Transition / Artesian Zone
- Artesian Zone

San Marcos Springs

Comal Springs

www.edwardsaquifer.net
Flash flooding

http://canoeman.com/canoe/docs/rebecca01.html
Radar

- NEXt generation weather RADar WSR-88D (NEXRAD)
- Deployed in 1988
- Wavelength: 10 cm
- Spatial Resolution: 4 km
- Temporal Resolution: 6-10 minutes
- Clear air mode: 5 scan levels in 10+ minutes
- Precipitation mode: 14 scan levels in 6 minutes
Radar Estimation

<table>
<thead>
<tr>
<th>Reflectivity (dBz)</th>
<th>Rainfall Rate (mm/hr)</th>
<th>Rainfall Rate (inches/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.0749</td>
<td>0.0029</td>
</tr>
<tr>
<td>10</td>
<td>0.1538</td>
<td>0.0059</td>
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<tr>
<td>15</td>
<td>0.3158</td>
<td>0.0123</td>
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<td>20</td>
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<td>25</td>
<td>1.332</td>
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<td>30</td>
<td>2.734</td>
<td>0.1066</td>
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<td>35</td>
<td>5.615</td>
<td>0.2190</td>
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<td>40</td>
<td>11.53</td>
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<td>45</td>
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<td>0.9235</td>
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<td>50</td>
<td>48.62</td>
<td>1.8963</td>
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<td>55</td>
<td>99.85</td>
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<td>60</td>
<td>205.05</td>
<td>7.9975</td>
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<td>65</td>
<td>401.07</td>
<td>15.6424</td>
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<tr>
<td>70</td>
<td>864.68</td>
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<td>75</td>
<td>1775.65</td>
<td>69.252</td>
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<tr>
<td>80</td>
<td>3646.33</td>
<td>142.21</td>
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</table>

- Rainfall rate is assigned according to the reflectivity.
Data

- November 1\textsuperscript{st} to 30\textsuperscript{th} 2004
- NEXRAD MPE (Multi-sensor precipitation estimator) Data
- All rain events were separated from dry days
- All locations were averaged together
Flooding in November 2004

http://earthobservatory.nasa.gov/NaturalHazards
## Gauge Locations and Total Precipitation

<table>
<thead>
<tr>
<th>SiteName</th>
<th>ID</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Total precip (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Antonio</td>
<td>SA</td>
<td>29.5337</td>
<td>-98.4698</td>
<td>9.46</td>
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<tr>
<td>Stinson</td>
<td>ST</td>
<td>29.3370</td>
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<td>Randolph</td>
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<tr>
<td>New Braunfels</td>
<td>NB</td>
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<td>-98.0422</td>
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<tr>
<td>Boerne</td>
<td>BN</td>
<td>29.7239</td>
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</tbody>
</table>
Statistical Comparison

- Average Radar Estimation: 0.694 in
- Average Rain Gauge amount: 0.528 in
- Average Difference: 0.166 in
- Standard Deviation: 0.915 in
Comparison Scatter Plot

Comparison Scatter Plot of Radar Estimation vs. Gauge Data

R^2 = 0.4098
Possible Sources of Contamination

- Ice or hail
- Bright band
- Low altitude nimbus clouds invisible to radar

Possible Sources of Error

- Bad data
- Malfunctioning radar
- Malfunctioning rain gauge
- Calculation error
Conclusions on Radar Estimation

- Over estimates rain fall rates in general
- More accurate for small rain events
- Not very accurate
- Useful in preventing deaths from floods
Extended Research Ideas

- Use more data – gauges and dates
- Analyze hourly rainfall rates
- Separate light rain and heavy rain events
- Look at graphical radar data to determine if hail may have been present
- Use other ways of averaging rainfall – such as the Theissson polygon method
Thank you – Any Questions?