Urban Stormwater runoff under changing climatic conditions

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1 Introduction
- With the change in the global climate, the pattern and frequency of extreme precipitation are affected.
- In addition to this, population increase and urbanization has increased the impervious surface.
- Managing floods in urban areas is turning out to be more challenging for the water managers.
- Assumption of stationarity in the existing design standard of stormwater may no longer be valid.

2 Objective
- To determine the future design storm depth using different climate model projections.
- To evaluate the existing stormwater infrastructures considering the future climate information.

3 Study Area
- Flamingo and Tropicana Watershed is a watershed within the Las Vegas Valley which is managed by Clark County Regional Flood Control District.

4 Data and Model
   NARR data
   - 13 combination of GCM and RCM
   - Historic reanalyzed data (1979-2000)
   - 50 km spatial resolution

   NARCCAP data
   - 32 km spatial resolution
   - Existing HEC-HMS model from Clark County Regional Flood Control District (CCRFCD)

5 Methodology
- Statistical method (Calculation of 6h 100y design storm)
- Generalized Extreme Value (GEV) probability distribution
- L-Moments
- Regionalization: Probability weighted moment
- Delta change Method
- Alternative of complex downscaling methods
- Hydrological Modeling on HEC-HMS
  - to convert the rainfall to runoff

6 Result
- Calculation of historic and projected design storms using NARCCAP and NARR climate model data
- Calculation of Delta Change Factors
- Assessment of climate model performance of NARCCAP data
- Hydrological simulation using the extreme delta change factors

7 Conclusion
- Different combinations of GCMs and RCMs in the NARCCAP climate model with different projections were considered.
- A range of the potential projected future climate scenarios should be considered in the design and management of the stormwater infrastructures to address uncertainty.
- Current flood control facilities may not be able to convey the projected flow due to changing climate.
- Existing design standard for the stormwater may not be valid in the future climate.
- This study demonstrated a robust and simple method that accounts the effects of climate change on the urban stormwater infrastructure design.

8 Recommendation
- Comparison of the climate change factors with the recently observed storms
- Best fitting among the available frequency distribution underlying the project area.
- Assessment of the effectiveness of different techniques available for attenuation the peak flows.
- Finer horizontal resolution climate model data would be effective to minimize the probable downscaling error.

9 Acknowledgement
- We would like to thank the office of VCR (vice chancellor for research) at SIUC for providing support to conduct this research work.

10 References
- (assessed on October 2016)

Figure 1: Map showing the Flamingo and Tropicana Watershed along with Las Vegas Valley

The majority of this watershed lies within unincorporated Clark County with a small portion in the City of Las Vegas.

Clark County maintains jurisdiction of the Flamingo and Tropicana Watershed and is responsible for programming flood control funds.

The total area of the Flamingo and Tropicana Watershed is approximately 220 square miles.

Drainage facilities within the watershed consist primarily of detention basins connected by conveyance facilities.

Table 1: The Calculated Historic 6h-100y and Future 6h-100y depths along with delta change factor

<table>
<thead>
<tr>
<th>Model Combination</th>
<th>Historic 6h 100y depth (in)</th>
<th>Future 6h 100y depth (in)</th>
<th>Delta Change Factor</th>
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<tbody>
<tr>
<td>NARR</td>
<td>1.17</td>
<td>0.94</td>
<td>1.53</td>
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<tr>
<td>CGCM3/CRCM</td>
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<td>0.76</td>
<td>1.23</td>
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<tr>
<td>CGCM3/RCM</td>
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<td>0.89</td>
</tr>
<tr>
<td>CGCM3/WRF5</td>
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<tr>
<td>CSSM/CRCM</td>
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<tr>
<td>CSSM/WRF5</td>
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<td>1.54</td>
<td>1.06</td>
</tr>
<tr>
<td>CSSM/MM5I</td>
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<td>1.17</td>
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<tr>
<td>HADCM3/HRM3</td>
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<td>1.86</td>
</tr>
<tr>
<td>HADCM3/MM5I</td>
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<td>2.17</td>
<td>1.33</td>
</tr>
<tr>
<td>GFDL/HRM3</td>
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<td>1.04</td>
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<tr>
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<tr>
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<tr>
<td>Time slice CSSM</td>
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<td>0.99</td>
<td>1.05</td>
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</table>

Figure 2: Assessment of Historic and Future 6h-100y storm depth from different NARCCAP model with NARR historic storm depth

Figure 3: Hydrological Modeling outputs for Lake Detention Basin (LAKEDB) for different scenarios.

Table 2: Hydrological Modeling outputs for Lake Detention Basin (LAKEDB) for different scenarios.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Inflow (cfs)</th>
<th>Change in elevation (ft)</th>
<th>Outflow (cfs)</th>
<th>Storage (ac-ft)</th>
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<td>96.06</td>
<td>165.00</td>
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