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 are 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.
- A robust method is needed to account the climate change effects in the design of the stomwater facilities.

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.

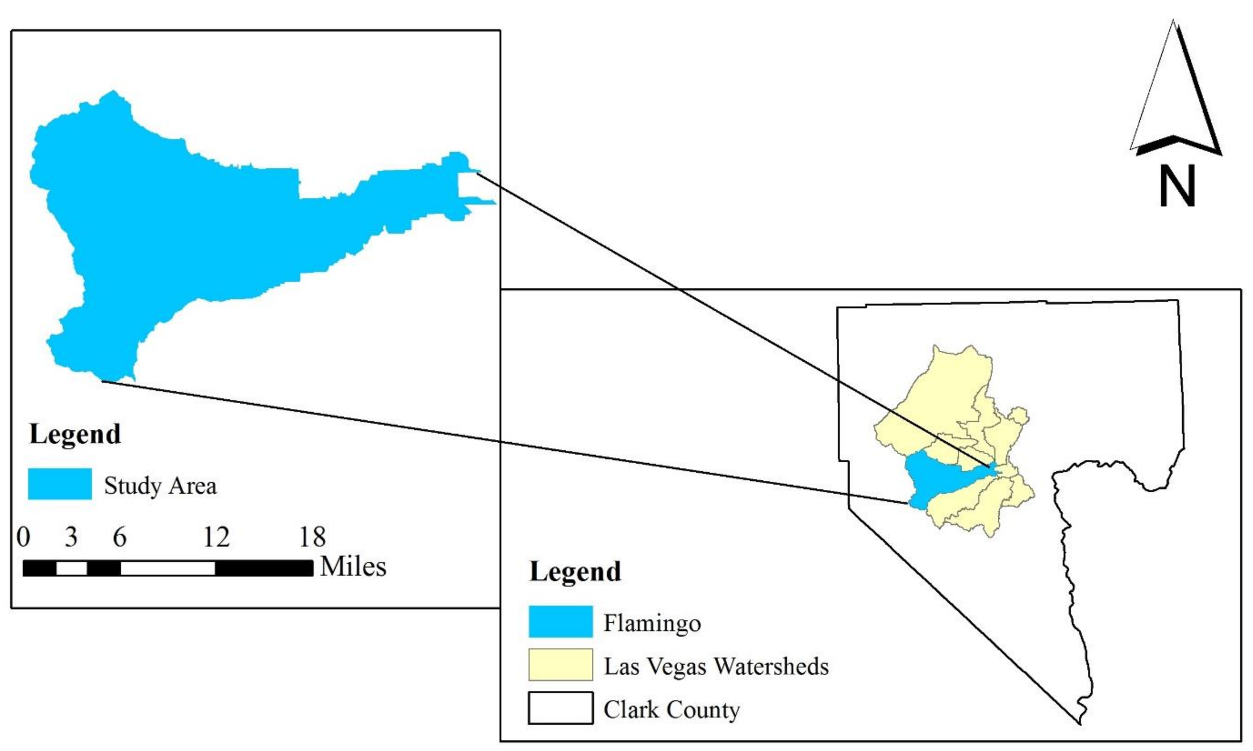


Figure 1: Map showing the Flamingo and Tropicana Watershed along with Las Vegas Valley

- 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.

④ Data and Model

NARCCAP data

- 13 combination of GCM and RCM
- Historic Data (1970-2000), Future Projection Data (2040-2070)
- 50 km spatial resolution

NARR data

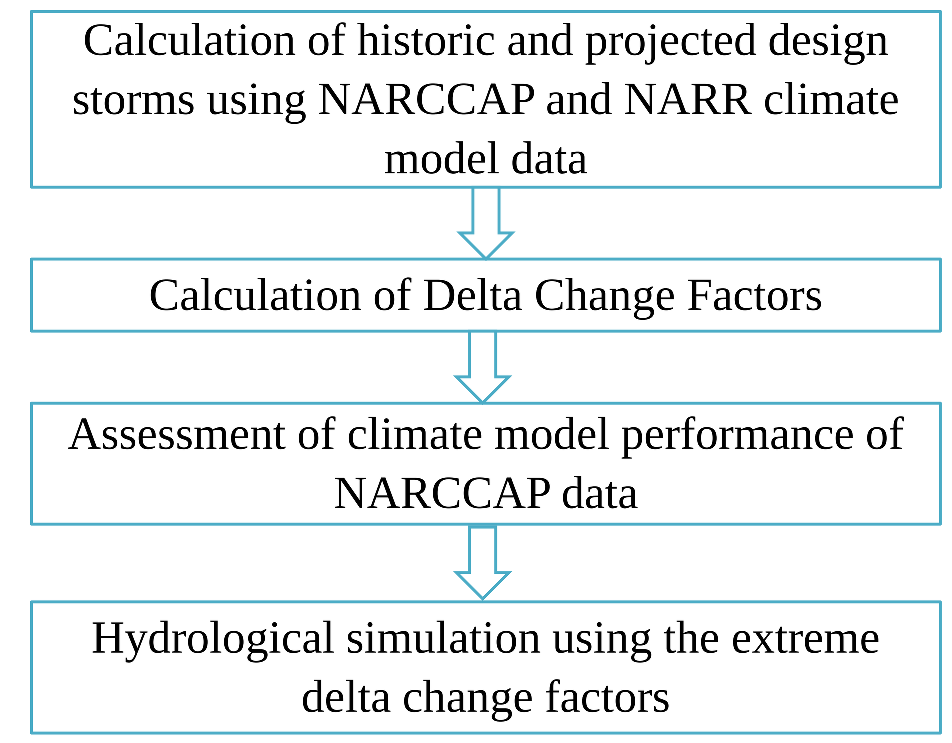
- Historic reanalyzed data (1979-2000)
- 32 km spatial resolution

Hydrological Model

- 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

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

Model Combination GCM/RCM	Historic 6hr-100yr depth (in)	Future 6hr-100y depth (in)	Delta Change Factor
NARR	1.17	-	-
CGCM3/CRCM	0.62	0.94	1.53
CGCM3/ RCM3	1.51	1.35	0.89
CGCM3/WRFG	1.07	1.47	1.37
CCSM/CRCM	0.81	0.91	1.12
CCSM/WRFG	1.46	1.54	1.06
CCSM/MM5I	1.40	1.64	1.17
HaDCM3/ HRM3	1.15	2.15	1.86
HaDCM3/ MM5I	1.63	2.17	1.33
GFDL/ HRM3	3.37	3.49	1.04
GFDL/ RCM3	2.10	2.33	1.11
GFDL/ECPC	2.37	3.10	1.30
Time slice GFDL	1.08	1.55	1.44
Time slice CCSM	0.95	0.99	1.05

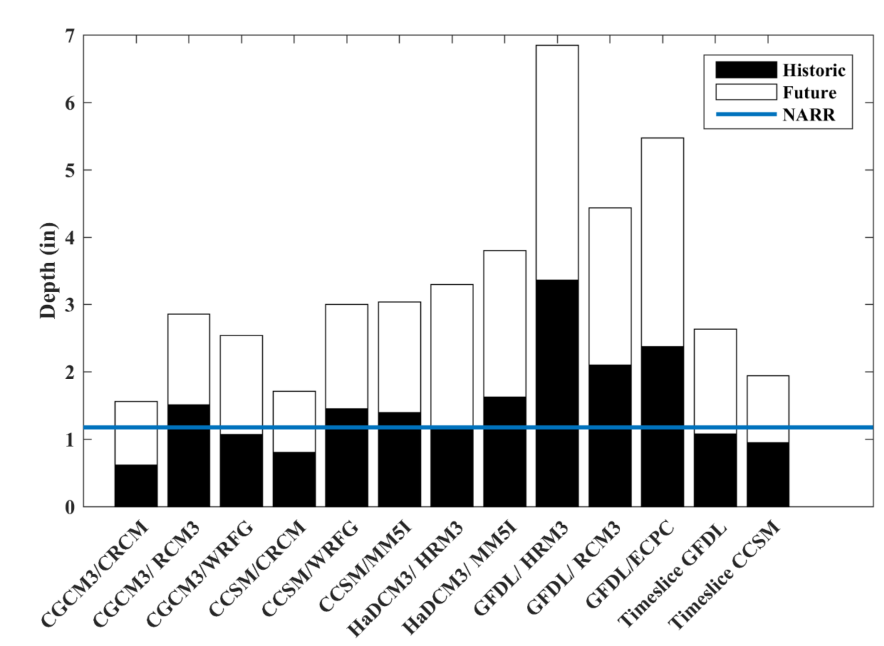


Figure 2: Assessment of Historic and Future 6h-100y storm depth from different NARCCAP model with NARR historic storm depth

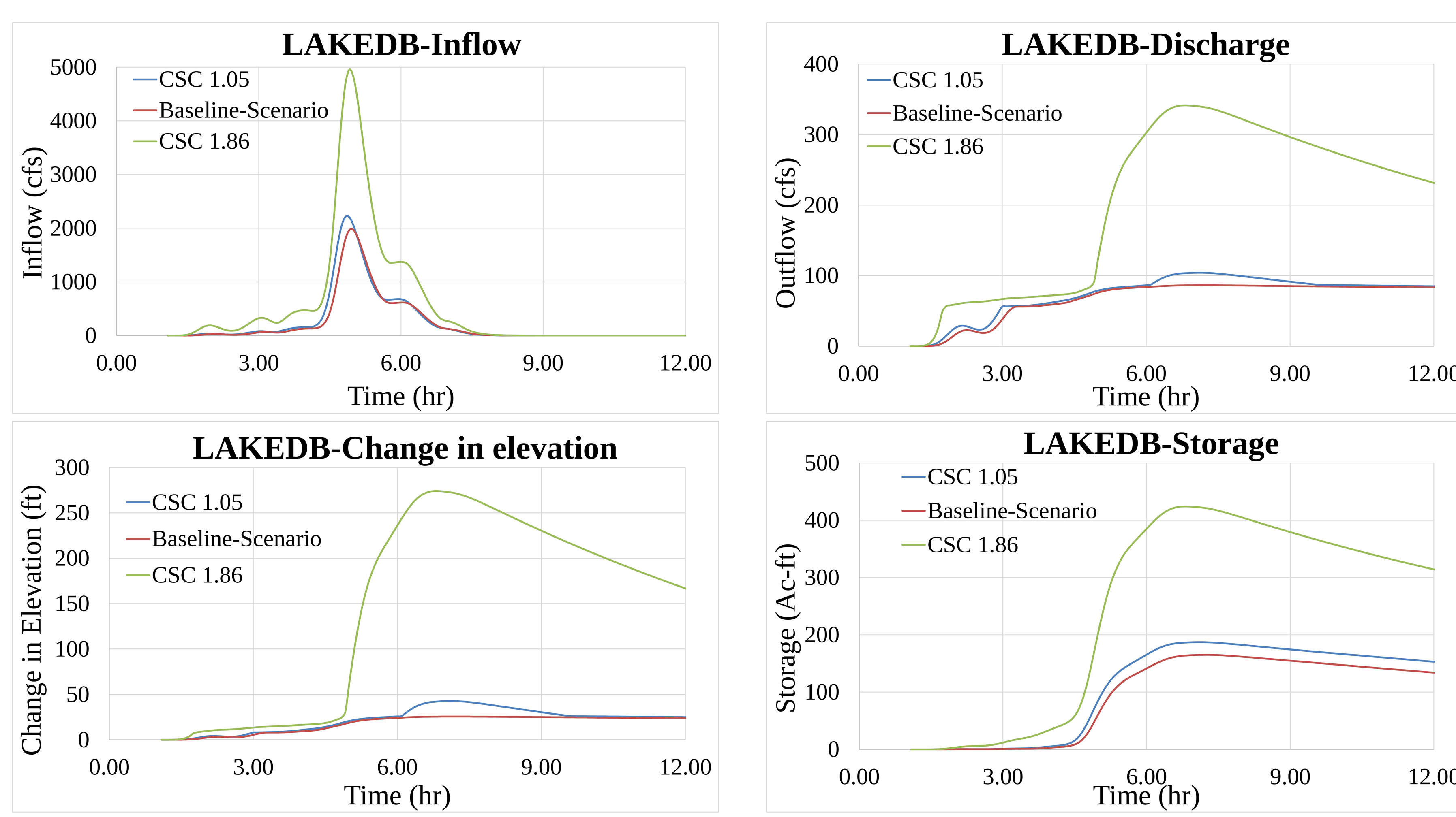


Figure 3: Hydrological Modeling outputs for Lake Detention Basin (LAKEDB) for different scenarios.

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

Scenario	Inflow (cfs)	Change in elevation (ft)	Outflow (cfs)	Storage (ac-ft)
Design	1975.86	25.69	96.06	165.00
Baseline	1968.09	25.69	86.52	165.20
CSC 1.05	2128.06	35.01	96.41	179.30
CSC 1.86	4792.56	259.51*	326.66	409.30

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.
- The finding and methods used in this study may be helpful for engineers and decision makers in designing, and evaluating stormwater infrastructure in response to climate change.

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.

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⑩ References

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