IDF analysis under changing climatic conditions

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Presentation outline

- Introduction
  - climate change, urban water systems
- Methodology
  - K-NN Weather Generator Model
  - Scenarios/IDF Curves
- Case study results
  - City of London, Ontario
- Conclusions

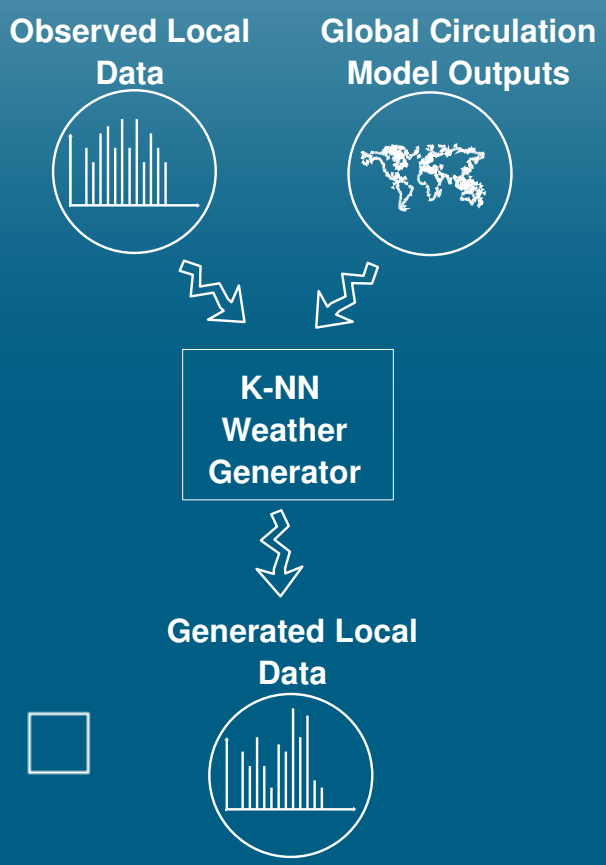
Introduction

- Implication of climate change to water resources management
  - increases and/or decreases water volume
  - peak streamflow will occur earlier
  - shifting/blending of seasons
  - flood frequency and magnitude will increase
- Conditions are changing faster than we can adapt (not previously encountered)

Introduction cont'd

- Objectives
  - Develop a weather generation model
  - Generate rainfall under different climates, and study their ***extremes***
  - Statistical analysis of model output
- Why?
  - Design of storm water infrastructure depends on extremes
  - Can not use historic information to make future designs when climate is changing

K-NN Weather generator



- Long time series records
- Preserve spacial and temporal correlations
- Shuffling and perturbation
- Ideal for studies of extremes
- Knowledge of probability distributions not required

K-NN Weather generator: steps

- Read current weather (temp, precipitation, solar radiation, humidity, etc.)
- Select from observed record a large set of potential neighbours
- Select only K Nearest Neighbours based on distance from current weather
- Randomly select one value (out of K)
- Perturb, if necessary

K-NN Modification

- Uses for-the-day-maximum rainfall data sets (5, 10, 15, 30 min, 1, 2, 6, 12, 24 hr)
- Multi-variable to multi-element resampling
- Missing data kept (no interpolation)
- Useful for generating IDF curves under changing climates

Rainfall IDF curves

- Statistically synthesize point rainfall characteristics (5, 10, 15, 30 min, 1, 2, 6, 12, 24 hr)
- Obtain rainfall values for various return periods (2, 5, 10, 25, 50, 100 yr)
- Used in design of municipal storm water infrastructure
  - storm sewers, ponds, conveyance systems, road drainage ditches, etc

Results

HISTORIC

Duration	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
5 min	9.9	13.1	15.3	17.9	19.9	21.9
10 min	15.0	20.4	24.0	28.6	31.9	35.3
15 min	18.8	25.7	30.4	36.2	40.6	44.9
30 min	24.9	34.9	41.5	49.9	56.1	62.2
1 hr	29.7	40.3	47.4	56.2	62.8	69.3
2 hr	35.2	47.0	54.9	64.8	72.1	79.4
6 hr	44.1	56.4	64.5	74.7	82.3	89.9
12 hr	48.6	62.4	71.6	83.2	91.9	100.4
24 hr	52.3	70.3	82.3	97.4	108.6	119.7

- Shuffled, perturbed
- No GCM forcing

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Duration	2 yr	5 yr	10 yr	25 yr	50 yr	100 yr
5 min	11.0	15.4	18.3	21.9	24.7	27.4
10 min	16.6	23.8	28.7	34.7	39.3	43.7
15 min	20.1	28.4	33.9	40.8	45.9	51.0
30 min	25.9	35.9	42.4	50.8	56.9	63.1
1 hr	31.6	43.4	51.3	61.2	68.6	75.9
2 hr	37.9	51.6	60.7	72.1	80.6	89.1
6 hr	46.3	60.3	69.6	81.2	89.9	98.5
12 hr	52.6	68.8	79.5	93.0	103.1	113.0
24 hr	57.4	77.4	90.6	107.2	119.6	131.9

- Shuffled, perturbed
- With GCM forcing

Implication$

- Design of municipal storm water infrastructure for the City of London
  - Sizes of minor systems (small storm drains, sewer overflows) to increase by 8-15%
  - Sizes of major systems to increase by 14-17%
  - Design of flood control facilities (ponds, detention basins) to increase by 10-23 % in volume

Questions?