Development and Application of a K-NN Weather Generator

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Outline

- Introduction
- Overview of Model Development
- Current Status/Results
- Future Work
Introduction

Objectives

- Develop a weather model that allows nearest neighbour resampling with perturbation of the observed data
- Simulate weather data conditioned upon alternative climate change scenarios for the Upper Thames River Basin
- Determine potential impacts of climate change on the occurrence of extreme events
- Create an ensemble of climate change scenarios for the basin and identify critical scenarios
Model Development

- **First Generation**
  - Weather generator based on resampling
    - Creates new sequences of data through “reshuffling” of observed data

- **Second Generation**
  - Produces “biased” weather sequences
    (warmer scenario, wetter scenario, etc.)
    - Done through strategic resampling
Model Development

- Third Generation
  - Able to generate events more extreme than those in the historical data
    - Added a perturbation component
- Fourth Generation
  - Able to use GCM scenarios to prescribe changes in P and T
    - Since this is done by altering the input files, this is not really another generation
Model Development

- A separate model was created to disaggregate daily data to hourly data
  - This is based on the method of fragments
    - Choose one “day” of hourly data to best match the set of daily data across the entire watershed
      - Follows similar logic to K-NN resampling
    - Use the hours of this day to determine the pattern of rainfall at each station across the watershed
Current Status

- All modelling has been completed
  - Results for two climate scenarios have been completed
  - Disaggregation has been applied to “large” precipitation events
    - Results have been provided to Pat
The following slides summarize some of the results from our work.
The diagram shows the intensity of precipitation (in mm/h) for each month over a year. The data is represented for two categories:

- **CSIROM2kb B11 Data**
- **Historical Generated Data**

The intensity values are indicated by box plots for each month, with the box representing the interquartile range, the whiskers extending to 1.5 times the interquartile range, and any points outside this range being considered outliers.

The x-axis represents the months of the year: January (J), February (F), March (M), April (A), May (M), June (J), July (J), August (A), September (S), October (O), November (N), and December (D).

The y-axis represents the intensity of precipitation (in mm/h), ranging from 0 to 8.
Results

- Several large storms generated by the two models were examined in greater detail
  - This was done on both a temporal and spatial basis
    - The following image shows the hyetograph for a storm at Woodstock followed by the spatial distribution of precipitation at one point during this storm
Storm Hyetograph at Woodstock
Future Work

- Further documentation of the work is ongoing
  - One chapter of the book will summarize all aspects of the weather generator
  - We are currently working on a paper that will summarize the various phases of the weather generator development