Analyzing CMIP5 Precipitation Data for Nationally-based Green Roofs

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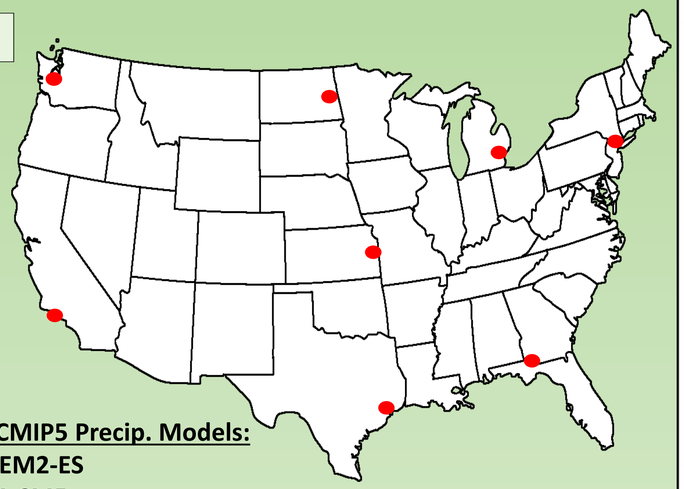
Introduction

Green roofs have become a topic of interest to create naturally suitable environments. They provide benefits to wildlife, cooling effects to urban heating, and suppress storm runoff. However, they also include added expenses of vegetation and maintenance that are not required of ordinary roofs. It is important for green-roof customers to receive long-lasting products if they are willing to pay the price for this eco-friendly infrastructure. To ensure the survival of these roofs for a long-term period, information about the climate they thrive in is vital. The main goal of this study was to compare precipitation rates for eight cities through ensemble modeling and statistical methodology. This was done using 4 models derived from CMIP5 were used to get an overall average of precipitation and were analyzed annually and seasonally. The ensemble model mean was also calculated since multiple model runs were available, however they are not included due to containing no statistically significant trends. Monthly projections from January 1950 to December 2099 was the overall time period. Results show very few trends that were statistically significant, and these occurred in the seasonal analysis. They only happened during the summer and fall months. This can assist the green roof company in understanding the types of products favorable for precipitation amount of the interest region.

Methods

Point latitude and longitude cities:

- Seattle Washington
- Los Angeles, California
- Houston, Texas
- Fargo, North Dakota
- Tallahassee, Florida
- New York City, New York
- Detroit, Michigan
- Kansas City, Kansas



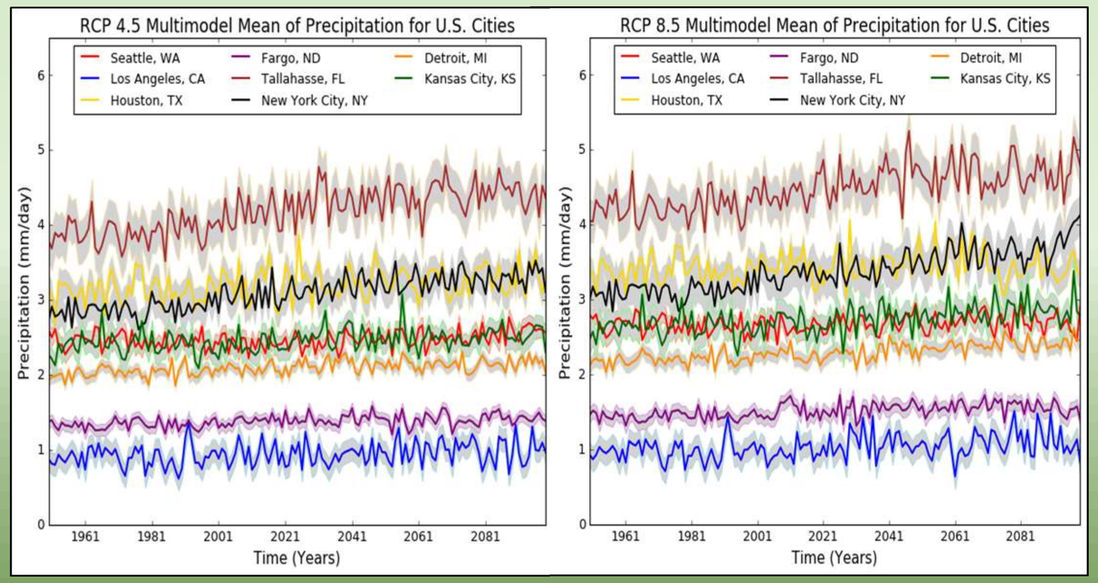
Model Adjustments:

- January 1950 – December 2099
- 1/8 degree resolution RCP 4.5 & 8.5

Chosen CMIP5 Precip. Models:

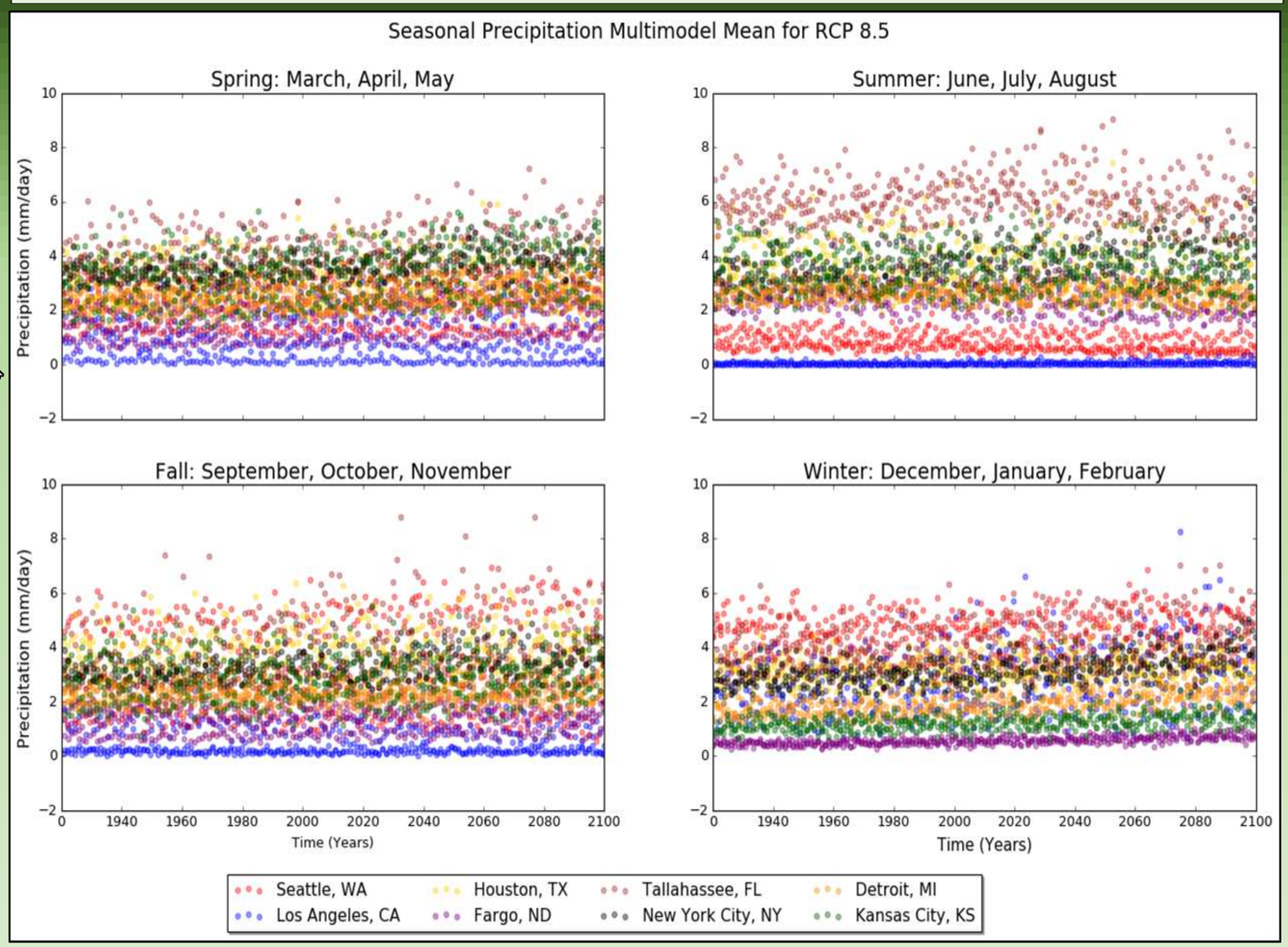
- HadGEM2-ES
- CNRM-CM5
- CESM1-CAM5
- CCSM4

Results: Part One



- Tallahassee receives the greatest amount of precipitation followed by Houston and New York City.
- Both RCPs were incredibly similar with a 0.88193 difference for New York City in 2099
- Grey areas of standard error were higher for regions with highest variability in precipitation amount – best seen in Tallahassee, Houston, and NYC

Results: Part Two



Location	Month	Slope Equation
Los Angeles, CA	Summer	y = 2.254+0.03898
Los Angeles, CA	Fall	y = -7.623+0.5526
Tallahassee, FL	Summer	y = 9.047+5.964
Detroit, MI	Summer	y = -7.473+2.672
Detroit, MI	Fall	y = 4.000+2.205

- All significant trends occurred in the warmer seasons
- Highest POSITIVE trend in Tallahassee, where most overall precipitation for summer is located
- Lowest NEGATIVE trend in Los Angeles, where the least overall precipitation for fall is located
- The regions of the city locations do not have a particular pattern or correlation

Conclusions and Future Work

- Overall, this data will be most helpful for LiveRoof Hybrid Green Roofs for comparing overall precipitation rates of each city, rather than studying their projected outcomes.
- Since Tallahassee, Florida received the maximum rainfall amounts throughout the period, they would be the best location for deep soil and water-conserving plants. Locations like Los Angeles would benefit most from drought-resistant planting, such as succulents and perennials.
- While a general point location was picked for this study, latitude and longitude bounds around the entire city will be applied in future work for better locational representation.
- The temperature variable will be added in the future, as it is also an important component of green roof sustainability.

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