A comparison of global temperature anomaly from NASA to the local Vancouver, BC precipitation total amount year-round and by season from the Vancouver Harbour weather station, over the 1950-2006 period.

Climate change

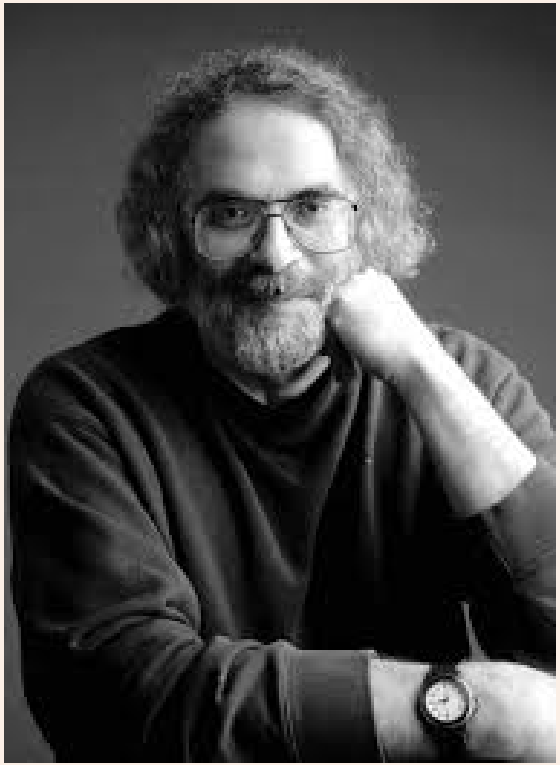
Problems:

1. This it an extremely broad issue with many angles
2. We wanted to focus on our local climate here in Vancouver

Introduction (Isaac)

- In 2005, Isaac Held and Brian Soden published a paper on the potential impact of global warming on the hydrological cycle

- In this paper, the researchers predict that warming will exacerbate precipitation on local scales (dry gets drier, wet gets wetter)



Held, I. M., & Soden, B. J. (2006). Robust Responses of the Hydrological Cycle to Global Warming. *Journal of Climate*, *19*(21), 5686–5699. doi: 10.1175/jcli3990.1

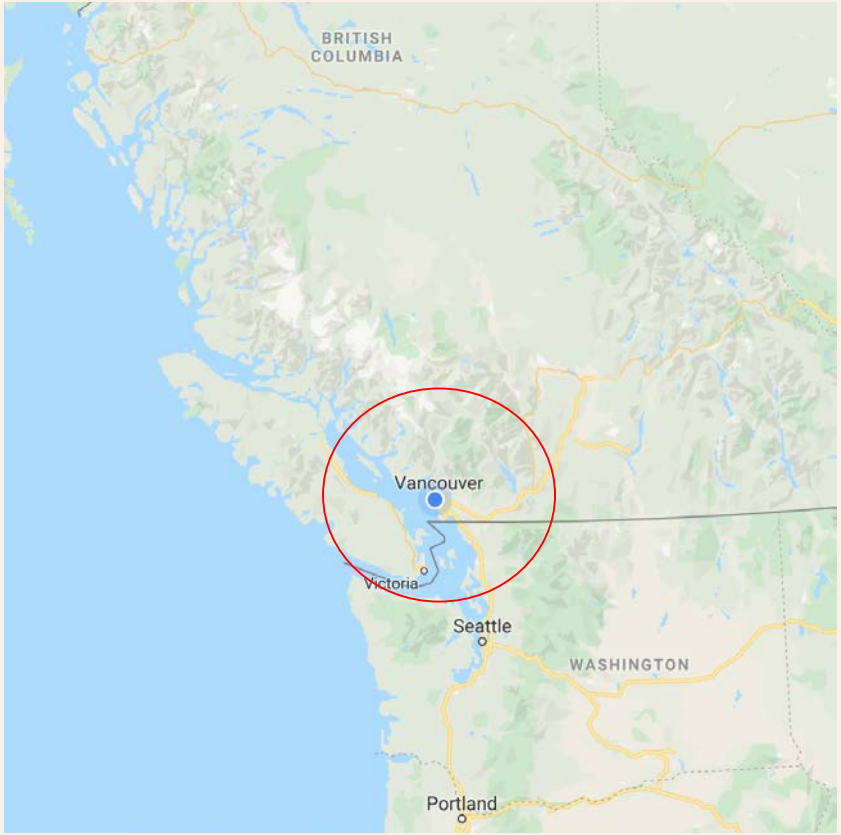
This begs the question: Can Vancouver get wetter?

- Vancouver is Canada’s 4th rainiest city behind Abbotsford, St.Johns, and Halifax

- Our group has chosen to investigate the extent to which rising global temperatures has increased precipitation in the Vancouver area

Research Questions

- In this study we answered the following questions:
  - Is there a significant change in the annual precipitation amount in Vancouver, BC over the 1950-2006 time period?
  - Is there a significant change in the seasonal precipitation amount in Vancouver, BC over the 1950-2006 time period?
  - Is there a correlation between Vancouver, BC precipitation anomaly and global temperature anomaly annually?
  - Is there a correlation between Vancouver, BC precipitation anomaly and global temperature anomaly seasonally?



Results: Raw Data

- Plotted to visualize dataset
- Can see large fluctuations, likely attributed to seasonal variation

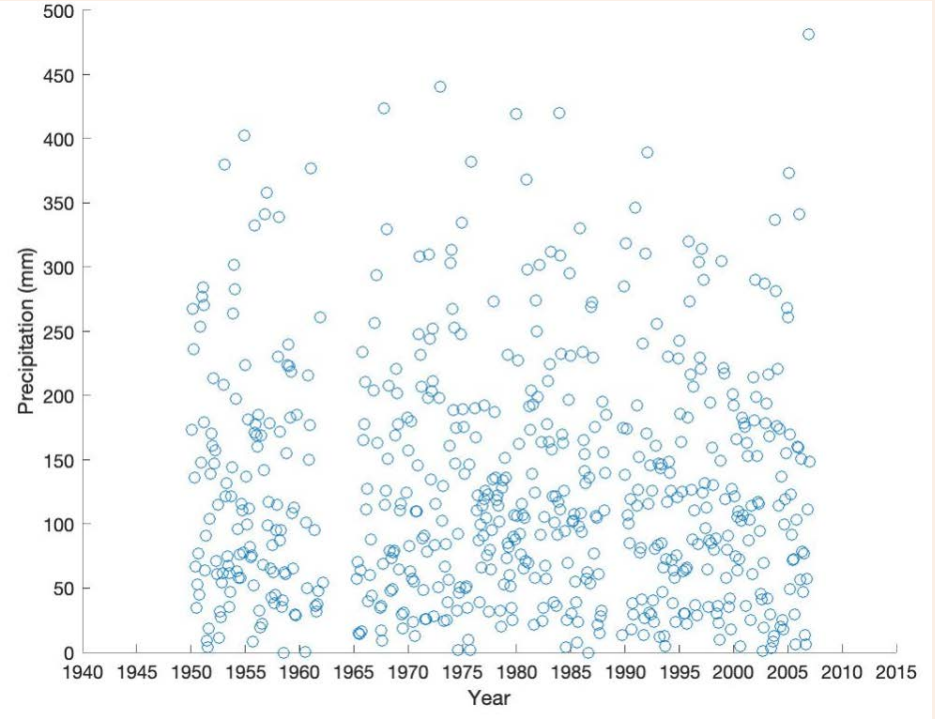


Figure 2. Precipitation (mm) against time (years) from the Vancouver Harbour weather station for the years 1950-2006.

Nest steps:

- Find year-round and seasonal precipitation anomaly
- Separate global temperature anomaly by season

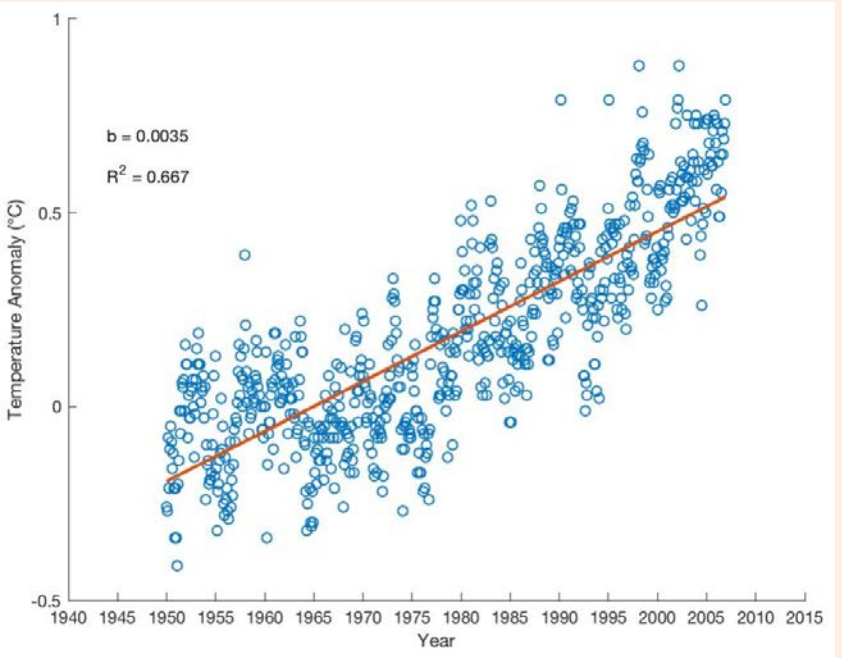


Figure 3. Global monthly temperature anomaly (˚C) against time (years) for the years 1950-2006 (p value < 0.01).

Results: Year-round

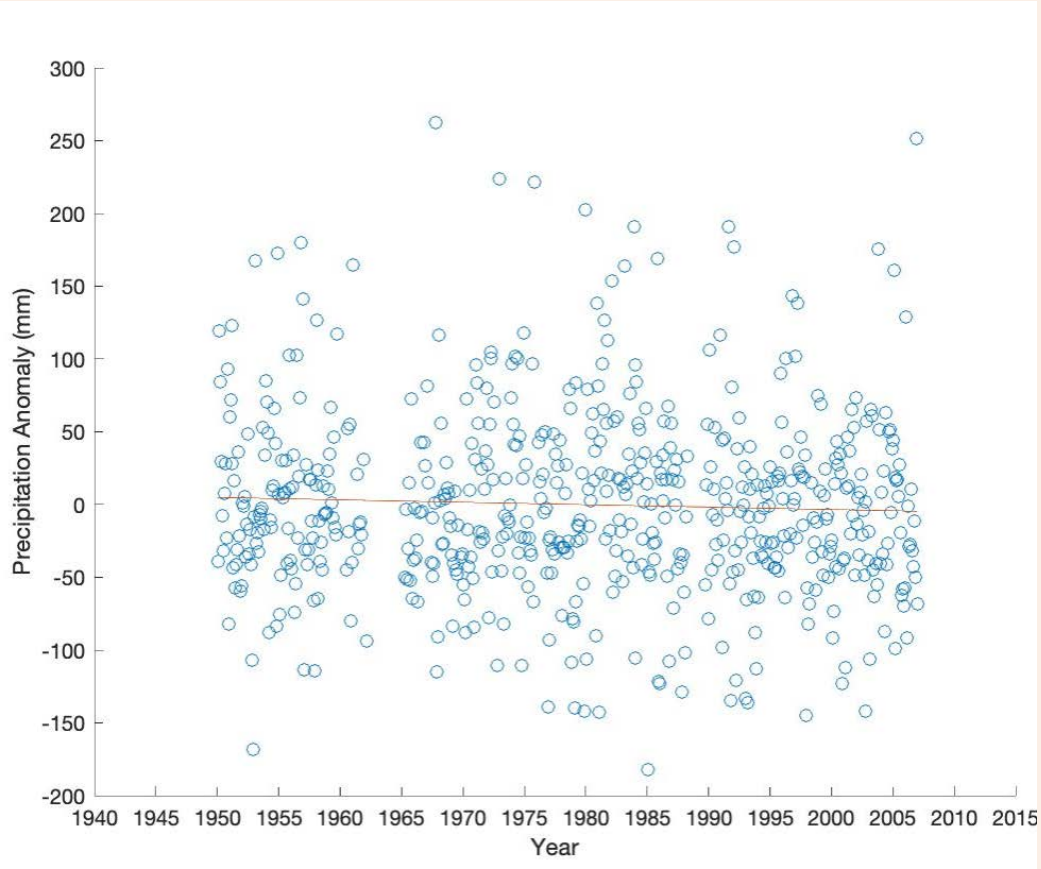


Figure 4. Precipitation anomaly (mm) from the Vancouver Harbour Weather Station against time (years) for the years 1950-2006 with linear regression

Q: Is there a significant change in the annual precipitation amount in Vancouver, BC over the 1950-2006 time period?

p-value > 0.05; R^2 = 0.0019

A: Linear regression model during this time period shows no significance in predicting the local precipitation anomaly.

Results: Year-round

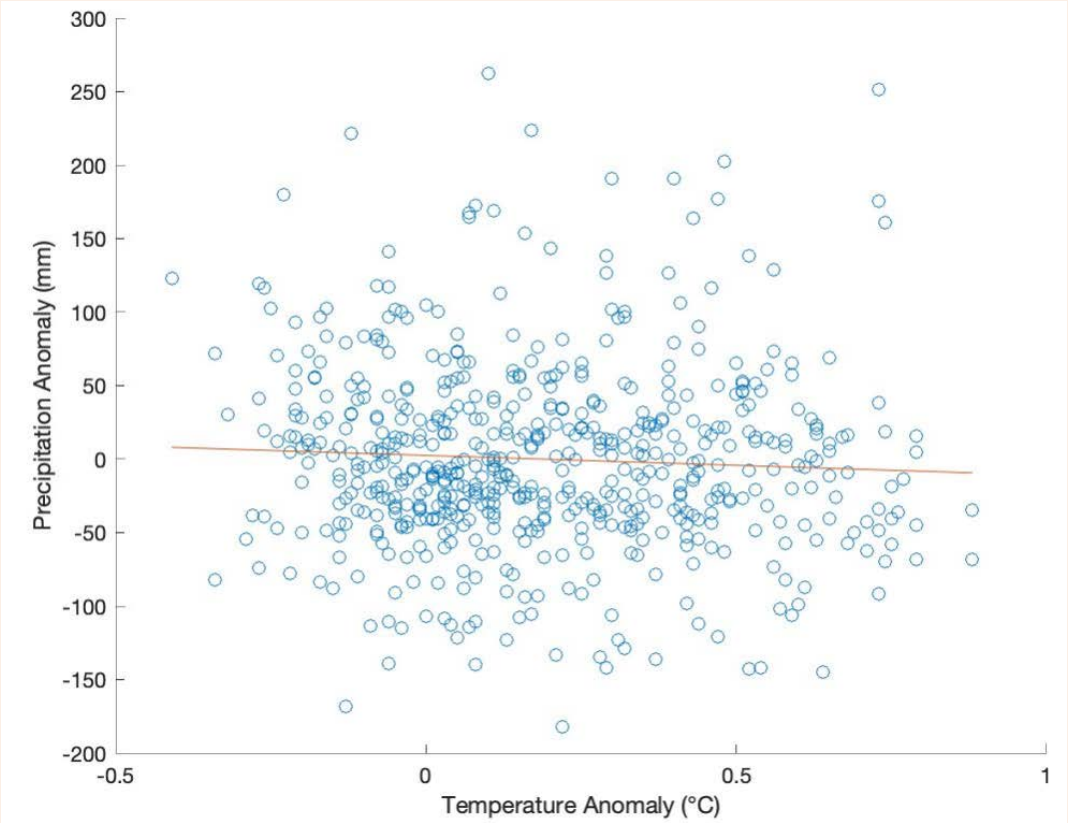


Figure 5. Precipitation anomaly (mm) at the Vancouver Harbour Weather Station against global temperature anomaly (˚C) for the years 1950-2006 with linear regression.

Q: Is there a correlation between Vancouver, BC precipitation anomaly and global temperature anomaly annually?

p value > 0.05, R^2 = 0.0031

A: Linear regression shows no significant correlation between the two variables.

What about seasonal trends?

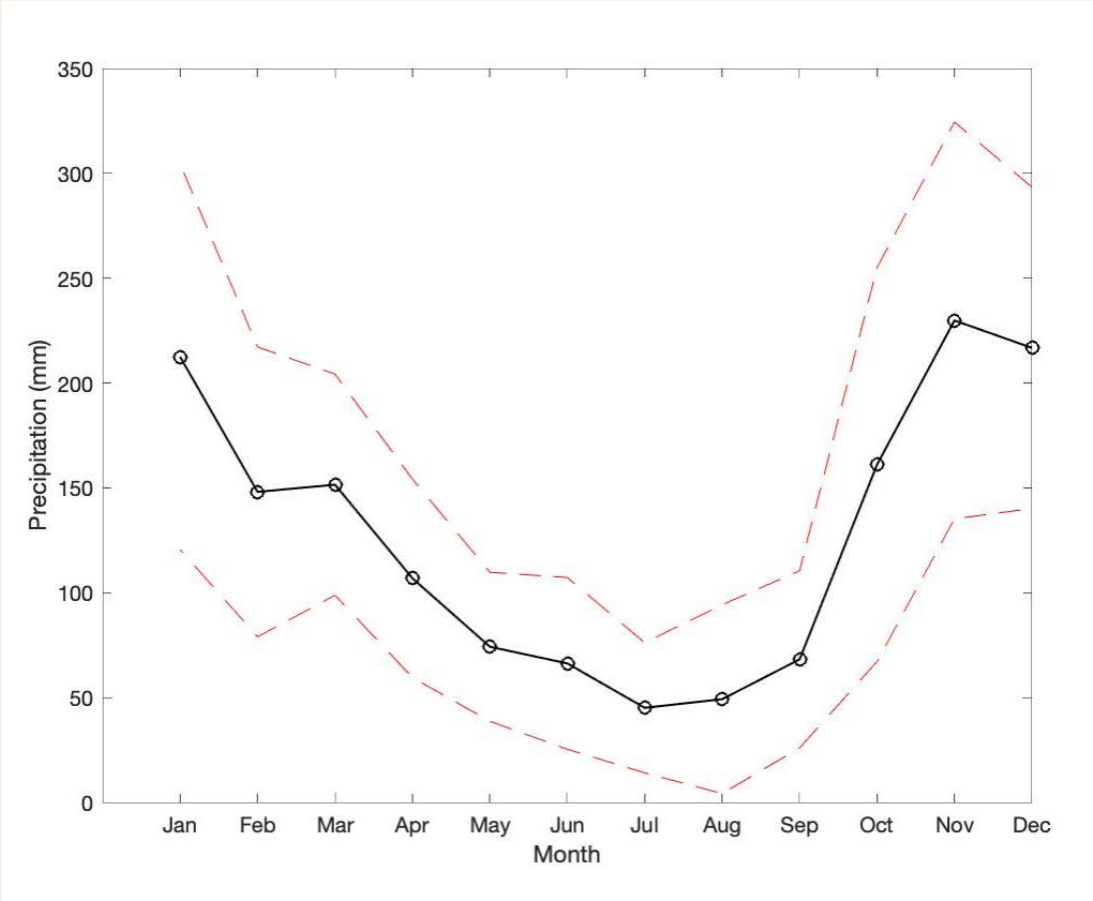


Figure 5. Mean monthly precipitation (black line) ± standard deviation (red dashed lines) averaged from the years 1950-2006.

Results: Seasonal

Q:Is there a significant change in the seasonal precipitation amount in Vancouver, BC over the 1950-2006 time period?

p-value > 0.05 for Spring, Summer, Fall;
p-value < 0.05 for Winter

A: Linear regression model during this time period for Winter only significantly predicts the local precipitation anomaly
The same analysis was insignificant for the other seasons.

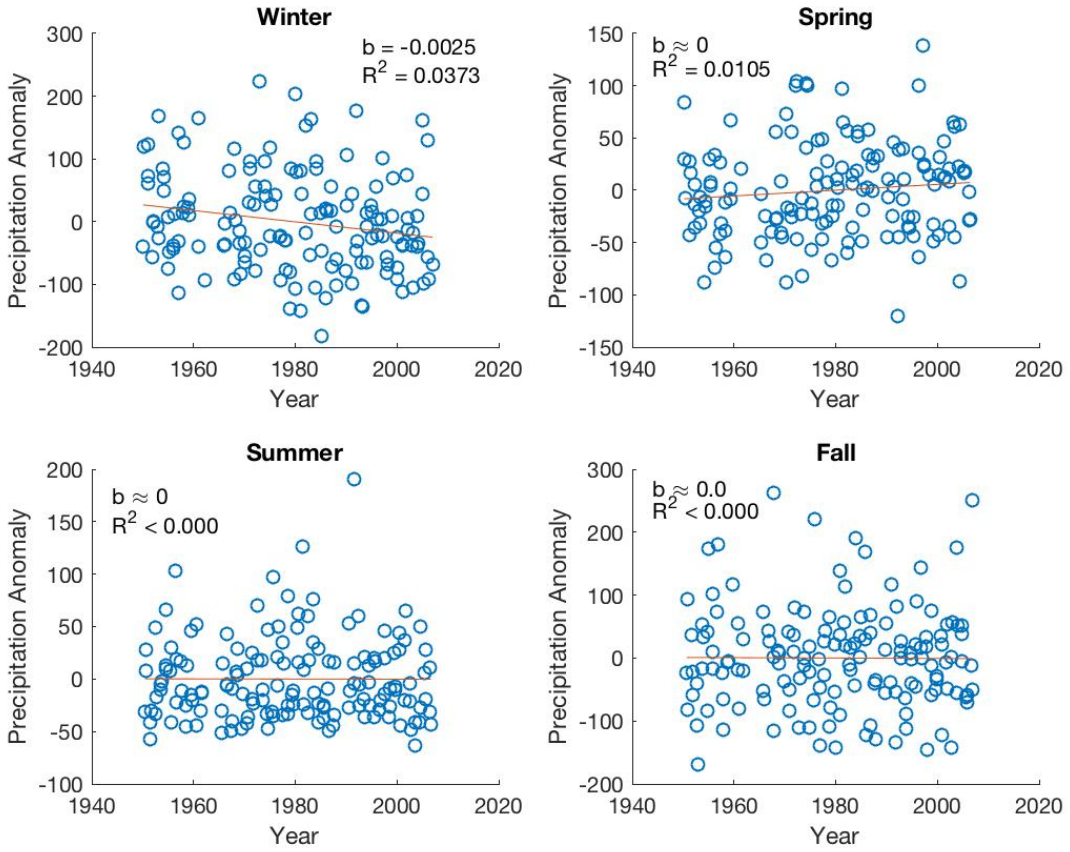


Figure 6. Seasonal precipitation anomaly time series over the 1950-2006 time period with linear regression lines

Results: Seasonal

Q: Is there a correlation between Vancouver, BC precipitation anomaly and global temperature anomaly seasonally?

p-value >0.05 for Spring, Summer,Fall
p-value<0.05 for Winter

A: Linear regression shows significant correlation between the two variables for Winter but not for the other seasons.

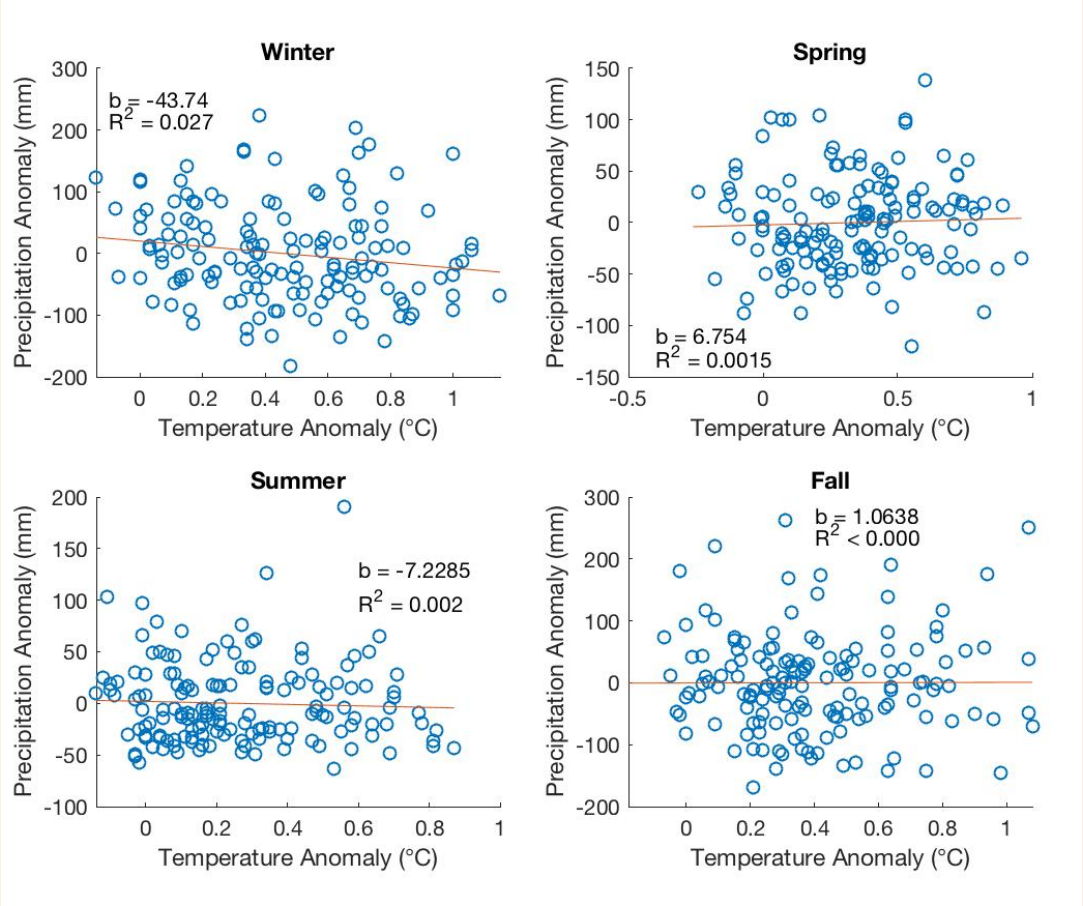


Figure 7. Precipitation anomaly against global temperature anomaly by season

Conclusion

Statistical summary of results:

Type	Slope (mm/°C)	R^2	Correlation	p-value
Year-round	-13.4707	0.0031	Negative	0.1777
Winter	**-43.73**	**0.027**	**Negative**	**0.0477**
Spring	6.754	0.0015	Positive	0.6399
Summer	-7.229	0.002	Negative	0.5833
Fall	1.0638	1.0638	Positive	0.9656

Most of our results were insignificant. Only the winter season resulted in statistical correlation of precipitation anomaly and temperature anomaly. Further investigation into seasonal anomalies would be needed in order to draw conclusions.

Possible causes of our time-series results

- Precipitation patterns are complex and involve multiple factors
- Besides temperature, precipitation anomaly is influenced by factors including cloud cover, wind patterns, and geographical features
- Our data set may have been too small - an analysis over multiple centuries may show different results

Possible causes of our anomaly correlation results

Year-round (no significance):

- Factors including the ENSO cycle and feedback patterns were not considered, which could impact our results
- Precipitation has much greater fluctuation annually than temperature

Seasonal (significance for winter only):

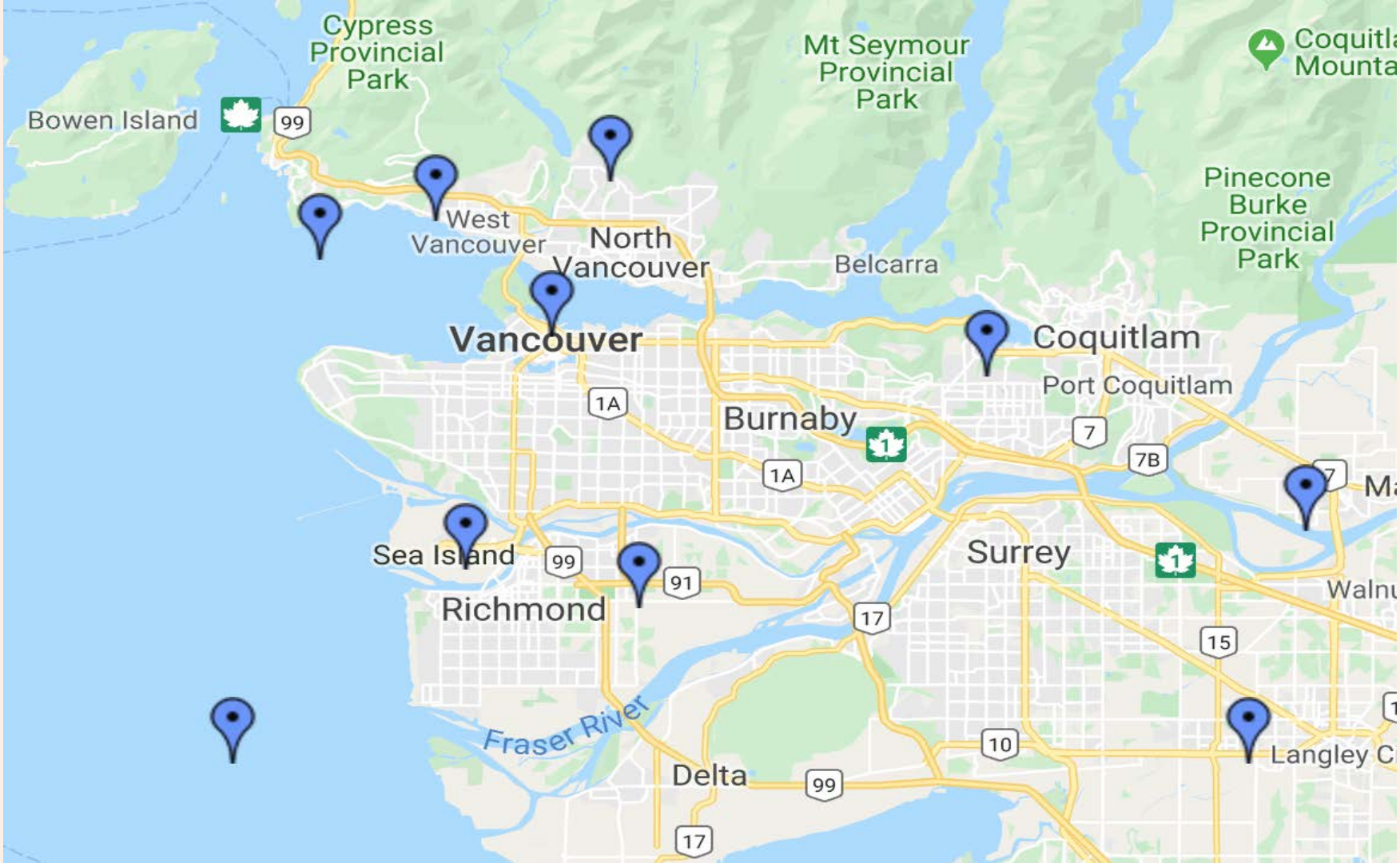
- Our results suggest that for the winter season, increased temperatures result in decreased precipitation
- This is opposite of the trend that we predicted
- This is likely a result of feedback affecting hydrological systems, such as albedo and cloud cover

Implication of the study

1. We used linear regression analysis on MATLAB software to investigate the relationships.
2. The result is a little unsatisfying, but overall it is reliable and can be use as a stepstone for further study.
3. Show the complexity of identify relationships between global temperature and local precipitation.
4. We find a critical point in winter that can be study later

How can we improve the study?

1. More data sets from different weather station instead of one (Vancouver Harbor).
2. Eliminate variables (ENSO cycle,current)
3. Focus on wider area and make comparisons(Abbotsford, St.Johns, and Halifax)
4. Using a different statistic method (multi-linear, exponential regression)


Cypress Provincial Park
Mt Seymour Provincial Park
Coquitla Mounta
Bowen Island
99
Pinecone Burke Provincial Park
West Vancouver
North Vancouver
Belcarra
Vancouver
Coquitlam
Port Coquitlam
1A
Burnaby
7
7B
1A
Sea Island
99
91
Richmond
Surrey
17
15
Fraser River
10
Delta
99
17

Further study...

1.The main emphasis is winter

2.Focus on precipitation!

3.Classify and study the complex weather condition.

4.Good luck

5.More field sampling and better matlab skills