

Using Time Series Analysis Models to Explore the Present and Potential Impacts of Climate Change on Canada's Economy

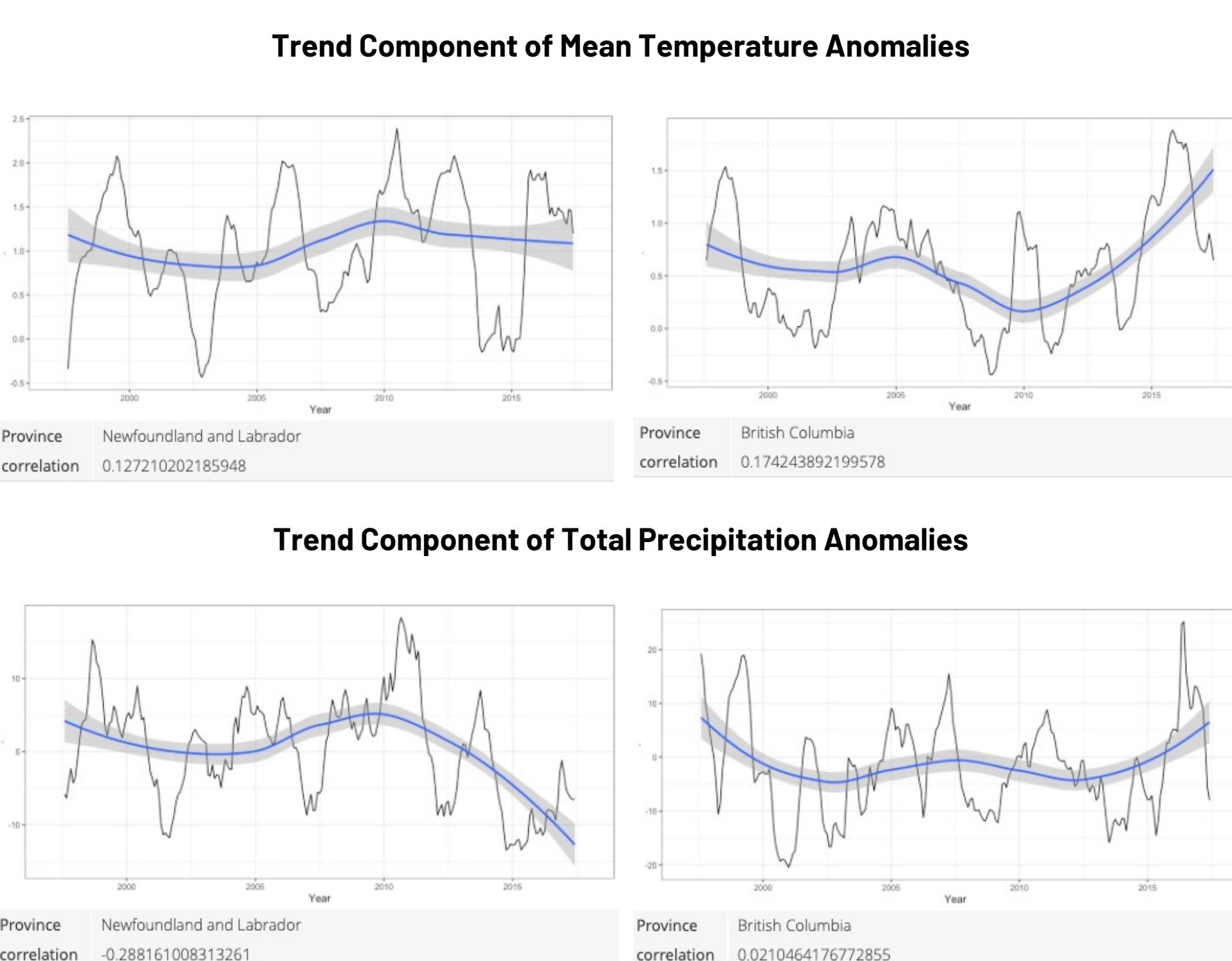
Minh Chau Nguyen, David Awosoga, and Alireza Ghaffartehrani

Provided Data

- Monthly economic productivity per industrial class per census subdivision
- Geographies of census subdivisions according to 2016 census GeoUIDs
- Historical weather readings from Environment and Climate Change Canada

Exploratory Data Analysis

- Missing values, measurement inconsistencies, and uneven spatial and temporal dimensions of weather stations were detrimental to data quality.
- Many subdivisions with low populations had missing productivity data, perhaps by design to prevent residual disclosure.
- Climate anomalies were used in place of absolute weather measurements, with 1971-2000 used as the base normal.
- Carbon dioxide concentration anomalies were added as exogenous variables.
- Granular anomaly calculations were computed using inverse distance weighted (IDW) spatial interpolation.



Methodology

- Objective 1: Visually compare correlation magnitudes and variances in the trend component of seasonal trend decompositions for each climate anomaly, faceted by province
- Objective 2: Perform parameter inference on coefficients from multivariate fixed-effects entity-demeaned OLS regressions on each industry, with scaled climate anomalies as explanatory variables and productivity proportion as the response

Climate Anomaly Trends

- Minimum, maximum, and mean temperature anomalies follow similar upwards patterns and exhibit increasing variances from East to West
- Total precipitation anomalies display decreasing trends in Atlantic Canada but gradually increase to become slightly positive on the West Coast. The volatility also smoothens out further inland

Introduction and Objective

There have been considerable efforts to understand the effects of climate change and evaluate associated governmental regulations throughout the world, especially in economic and financial markets. The objectives of this project are to:

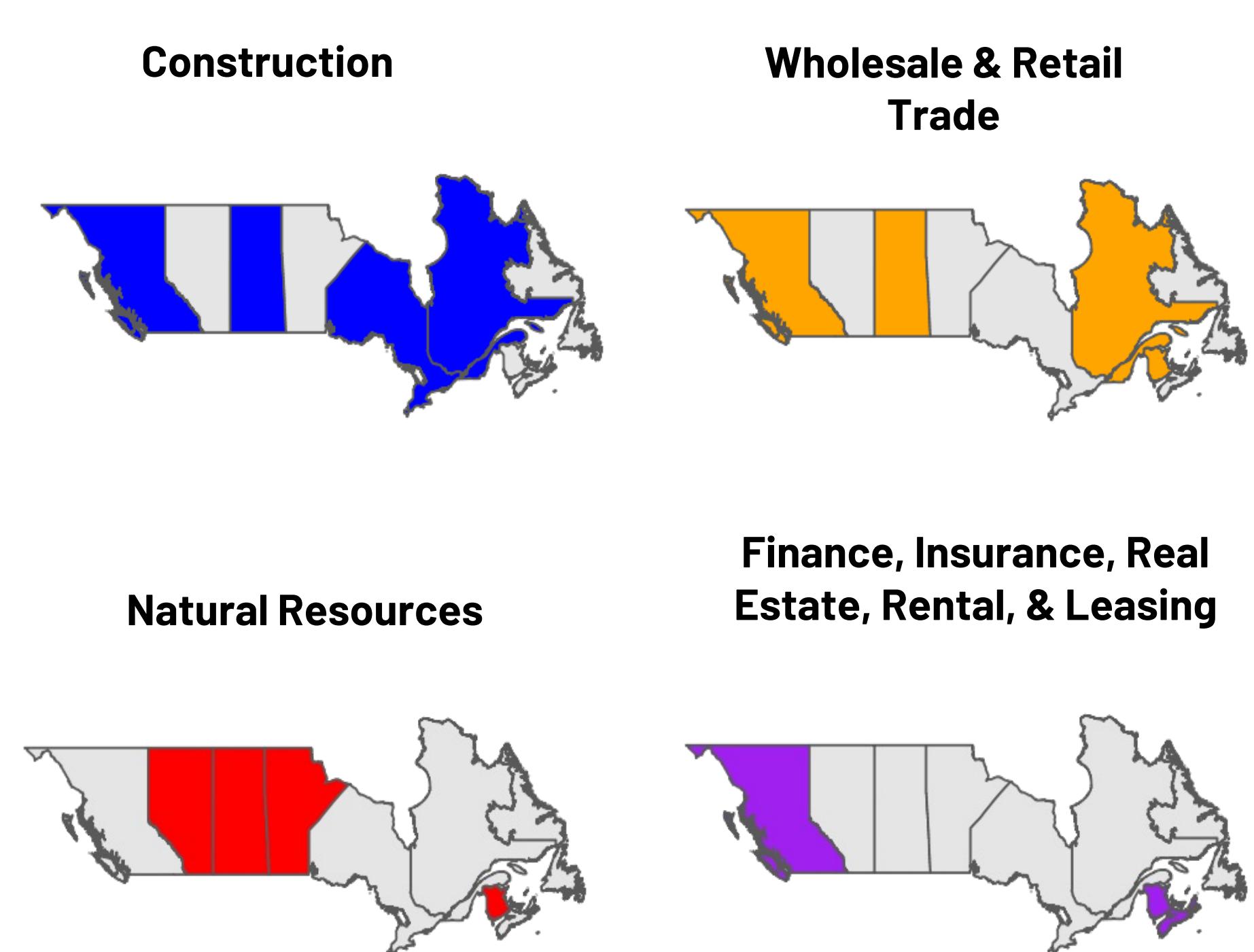
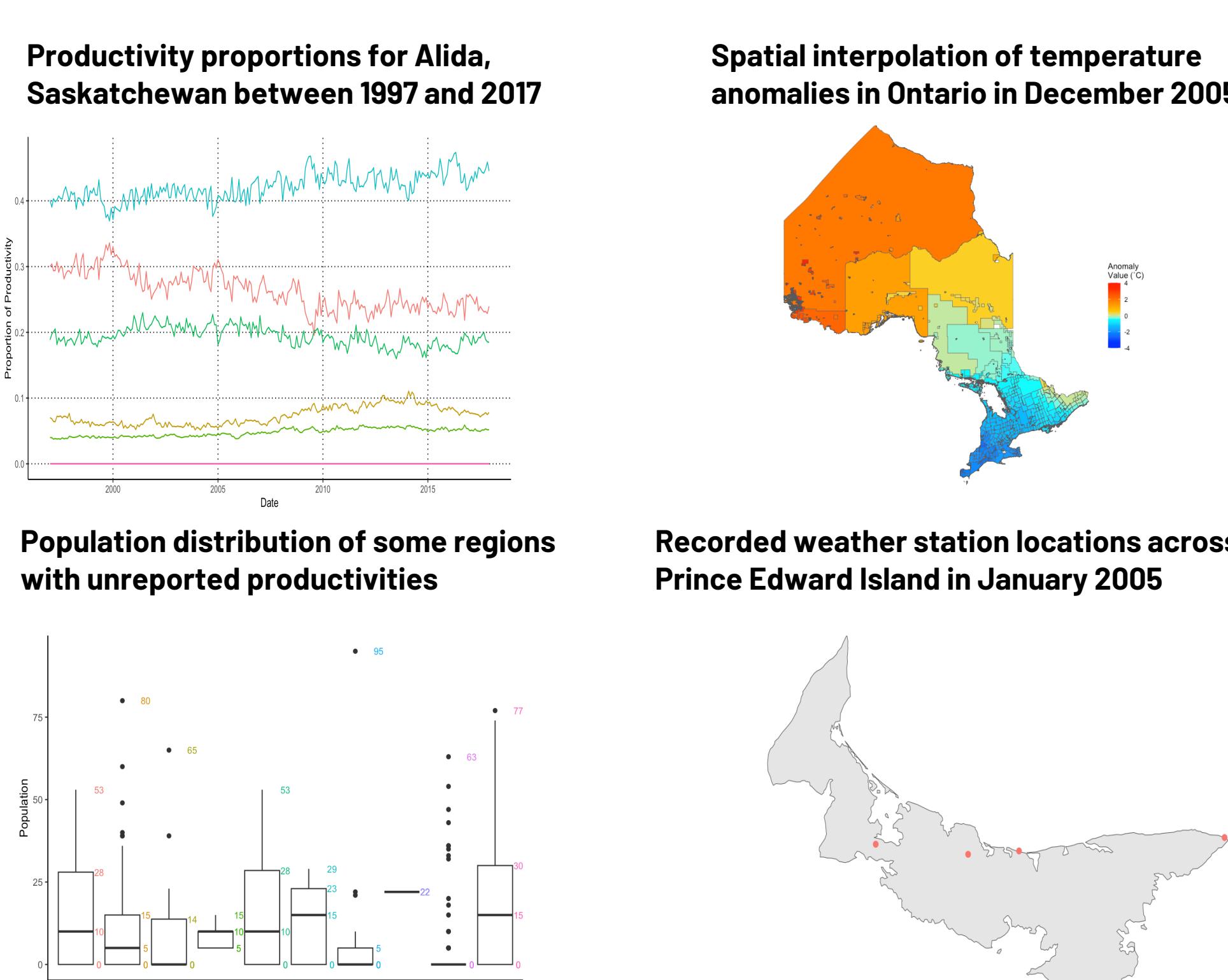
- Determine which regions in Canada are experiencing the fastest changing climate, and
- Assess which economic industries have already experienced observable impacts from changing climate

Affected Industries

- Industries impacted by climate anomalies varied between regions but were similar within them
- The construction industry and the financial sector are negatively affected, potentially due to physical risk
- Climate anomalies had mixed impacts on natural resource industries: agriculture in the Prairies benefitted from increased growing degree days, while aquaculture in Atlantic Canada expressed vulnerability
- Wholesale and retail trade demonstrated a positive response to increasing temperature anomalies across Canada

Limitations

- Economic shocks were not accounted for and could result in omitted variable bias.
- Future works could incorporate spatiotemporal correlation in predictions and penalize multicollinearity in exogenous variables.



Acknowledgements

The authors would like to thank Dr. Tony Wirjanto, Dr. Bruce Fang, Dr. Fan Yang, and Joshua Awosoga for their support.



Supplementary Information

References, complete source code, and extended analysis can be found at our GitHub repository.