

High-Resolution Climate Change Projections for the City of Edmonton



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Deliverables

The proposed project will provide the City of Edmonton with

- Projections of future climate for key variables at a municipal scale
- Shifts in the probability of extreme hydrologic events
- Information on climate risks to municipal infrastructure and public services
- Guidelines for translating climate predictions and their uncertainty for engineering and planning applications
- A plain language summary to communicate concepts of climate change and variability, risk, uncertainty, resilience and adaptation

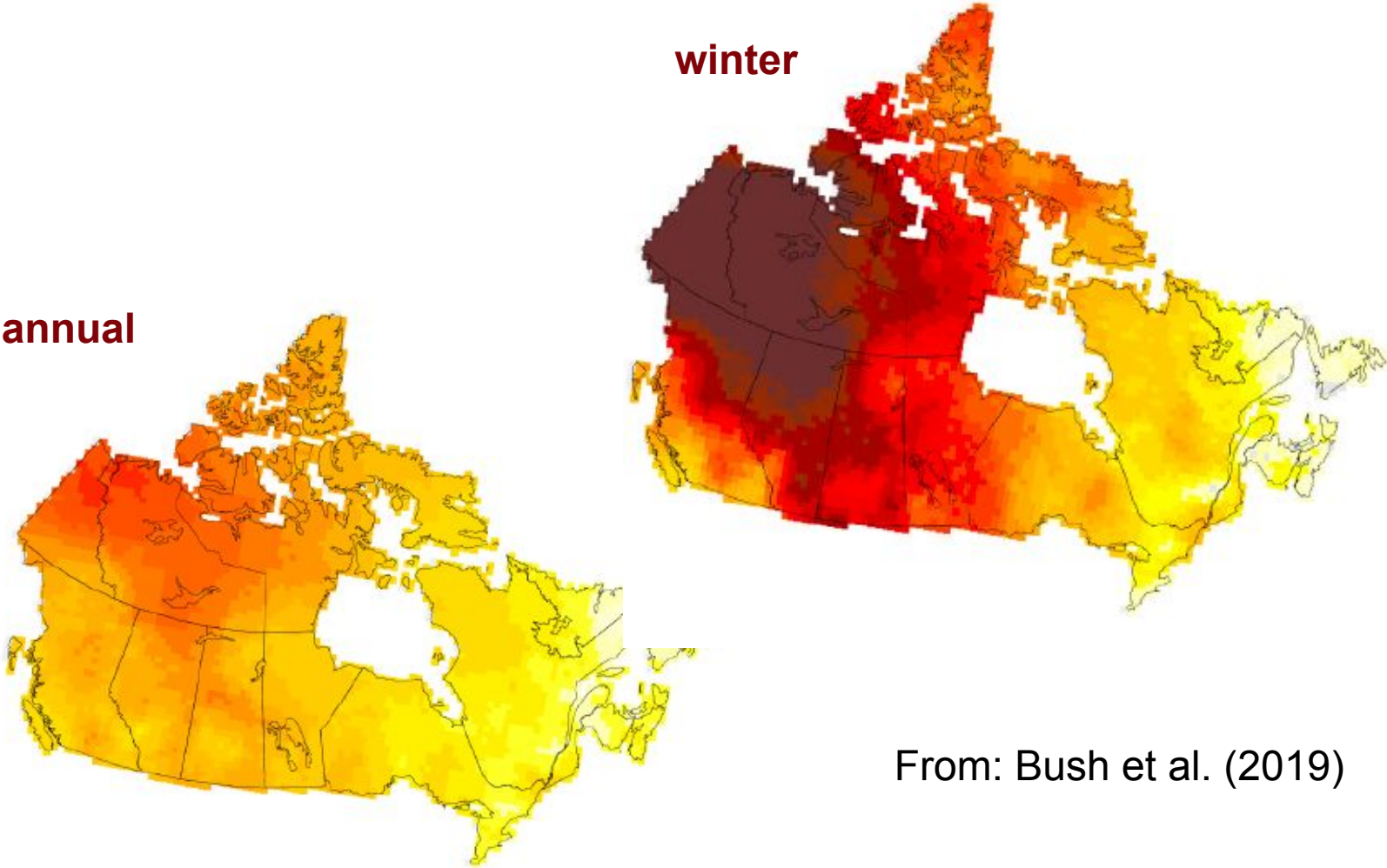


The Prairie Adaptation Research Collaborative (PARC) was **established in 2000** to undertake research on climate change science, impacts and adaptation in the Prairie Provinces. The aim of this applied research is to **support science-based adaptation** to current and future climate change. PARC also contributes to training in the emerging field of climate change adaptation and resilience planning.



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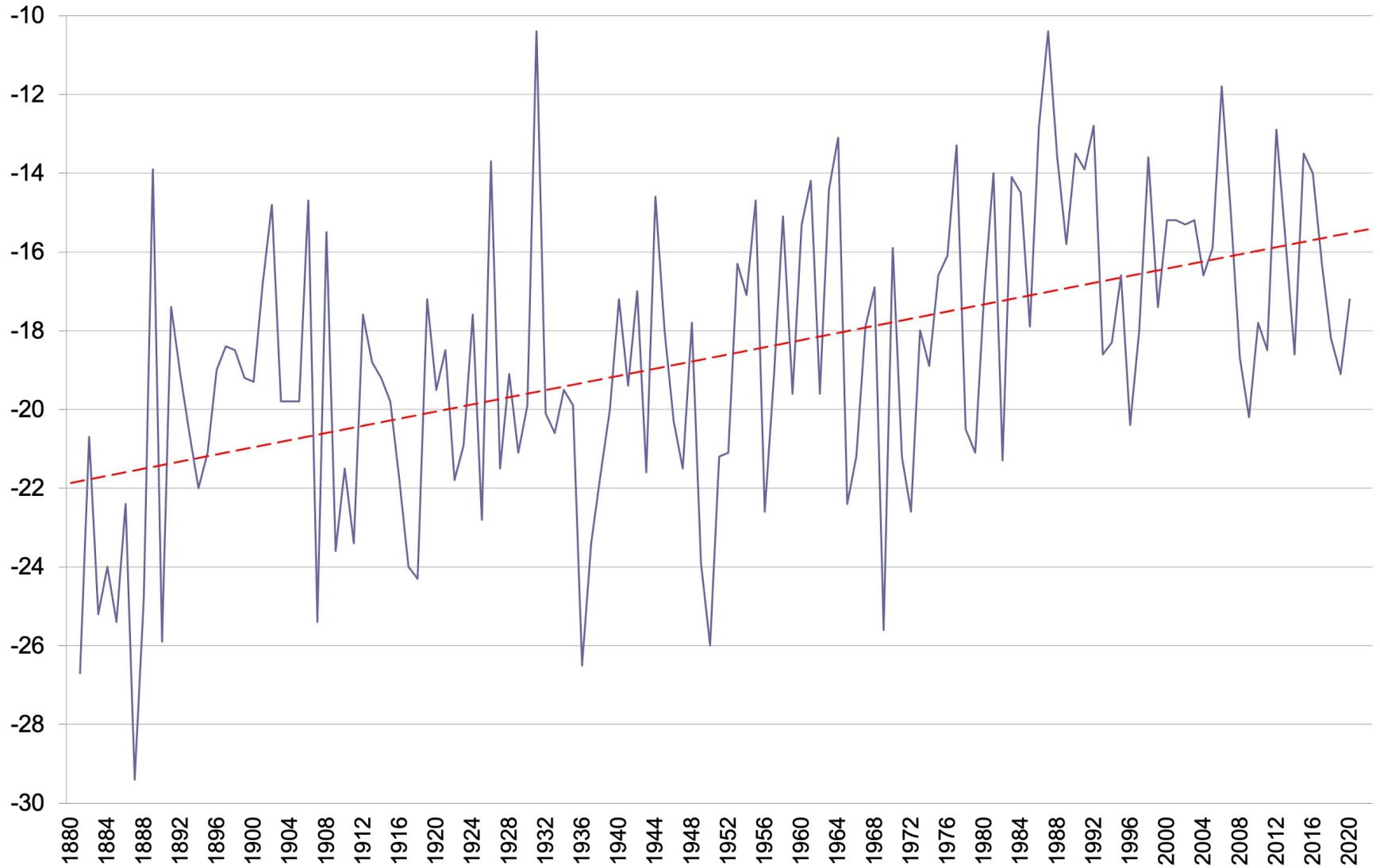
Temperature Trends across Canada, 1948-2016



From: Bush et al. (2019)



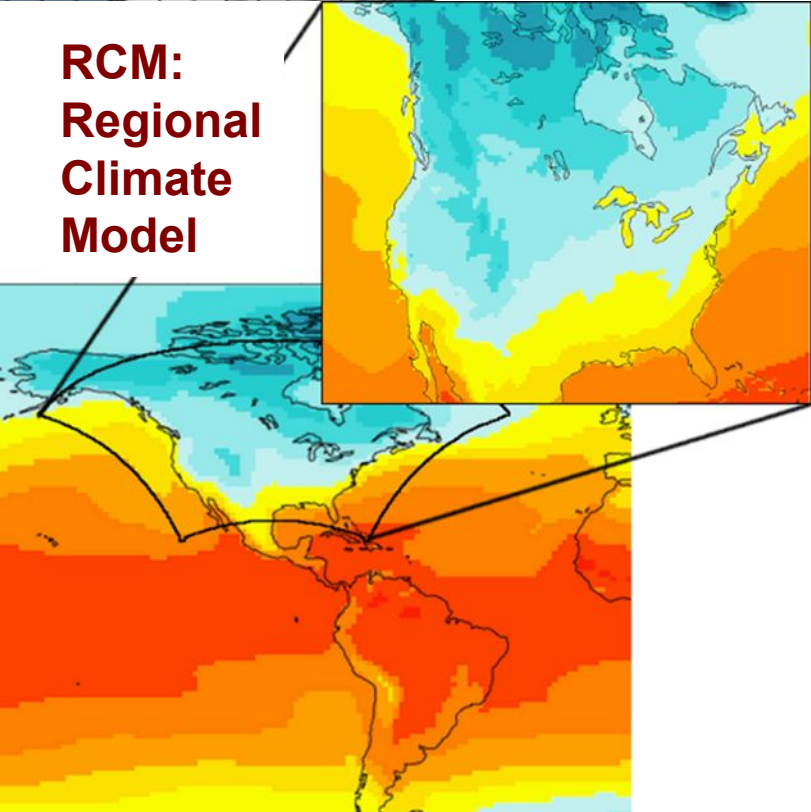
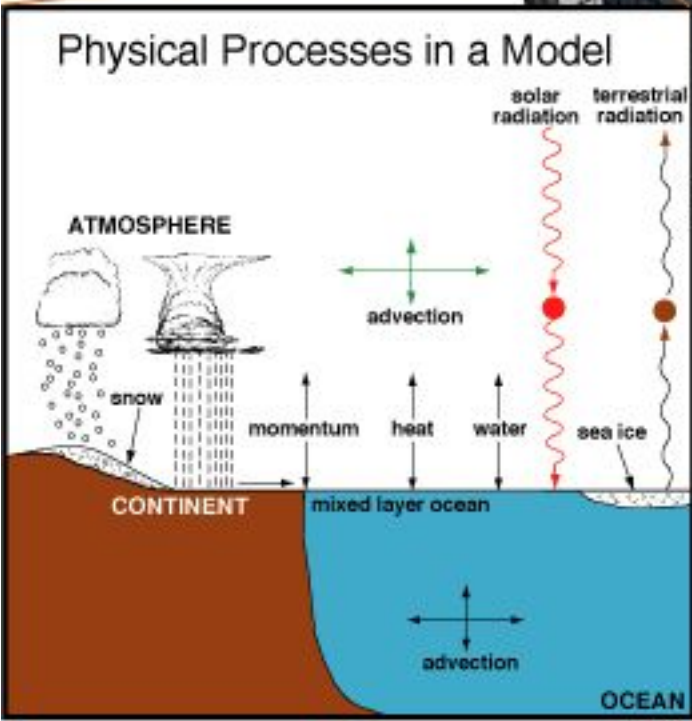
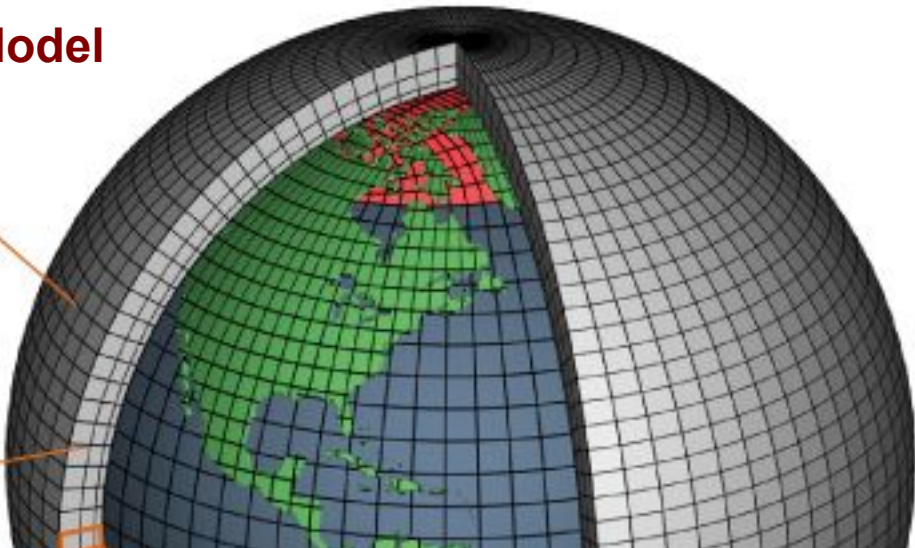
Average Daily Minimum Winter Temperature (°C) at Edmonton, 1880 to 2020



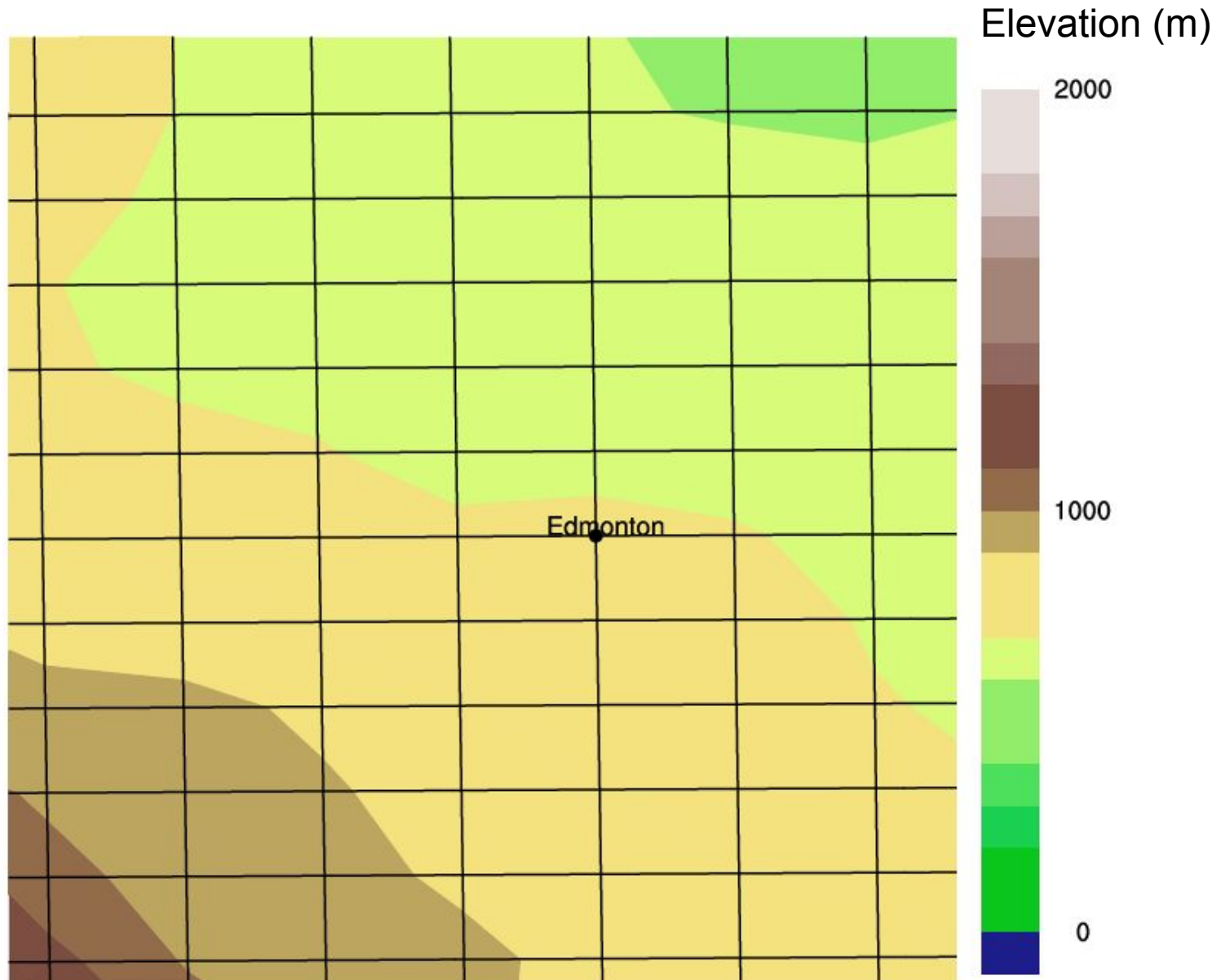
GCM: Global Climate Model

Horizontal Grid
(Latitude-Longitude)

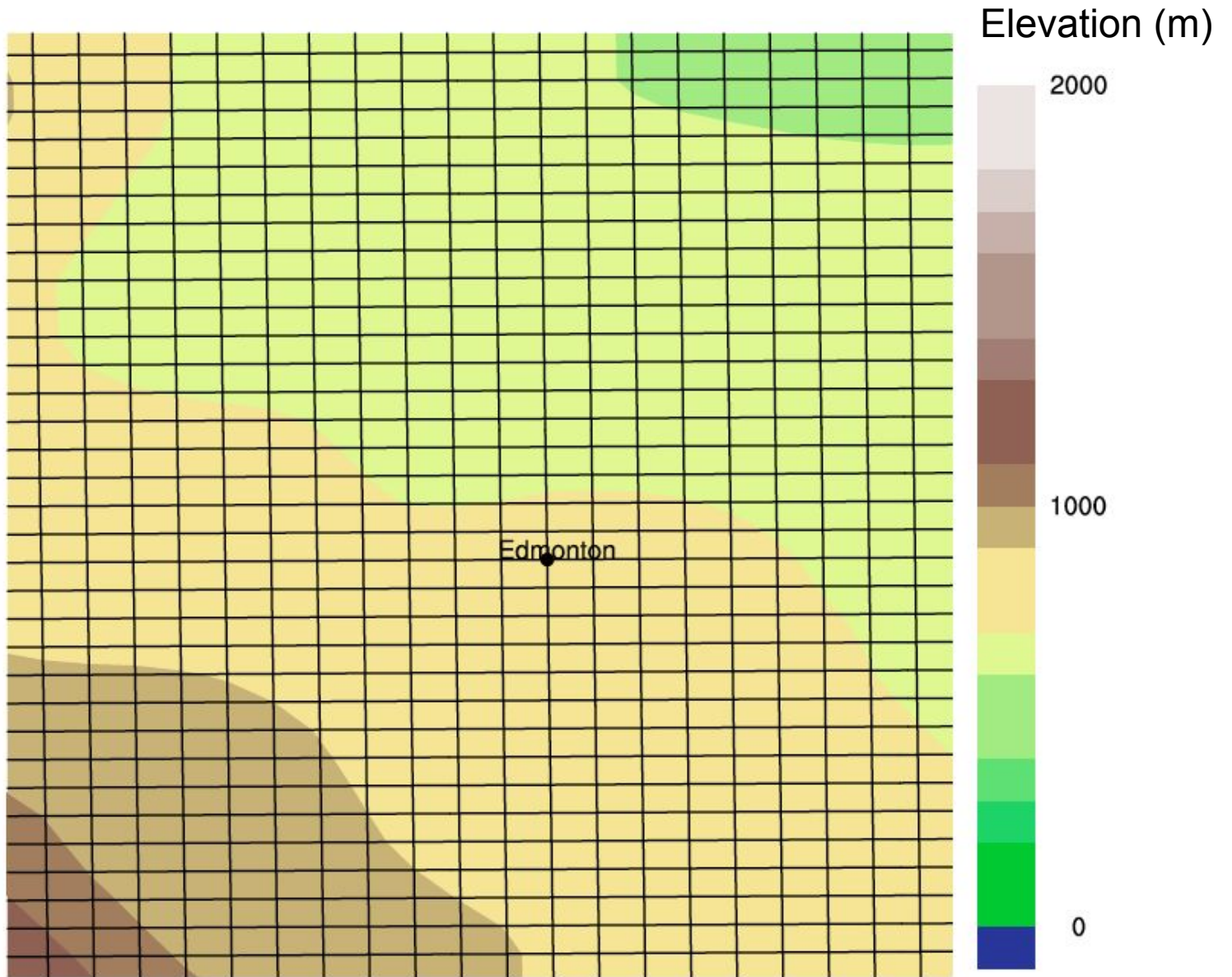
Vertical Grid
(Height or Pressure)



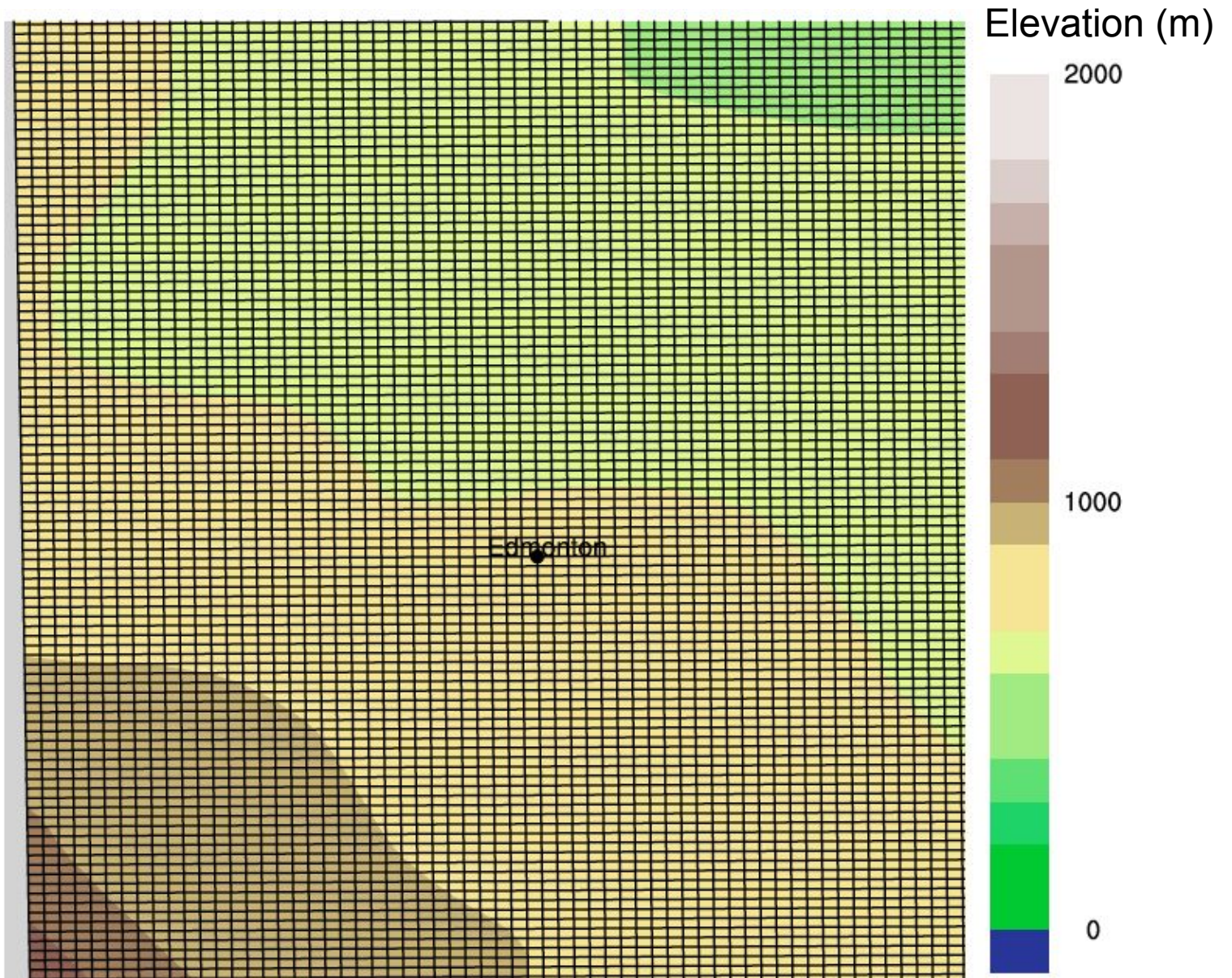
30 km grid



10 km grid



3.3 km grid

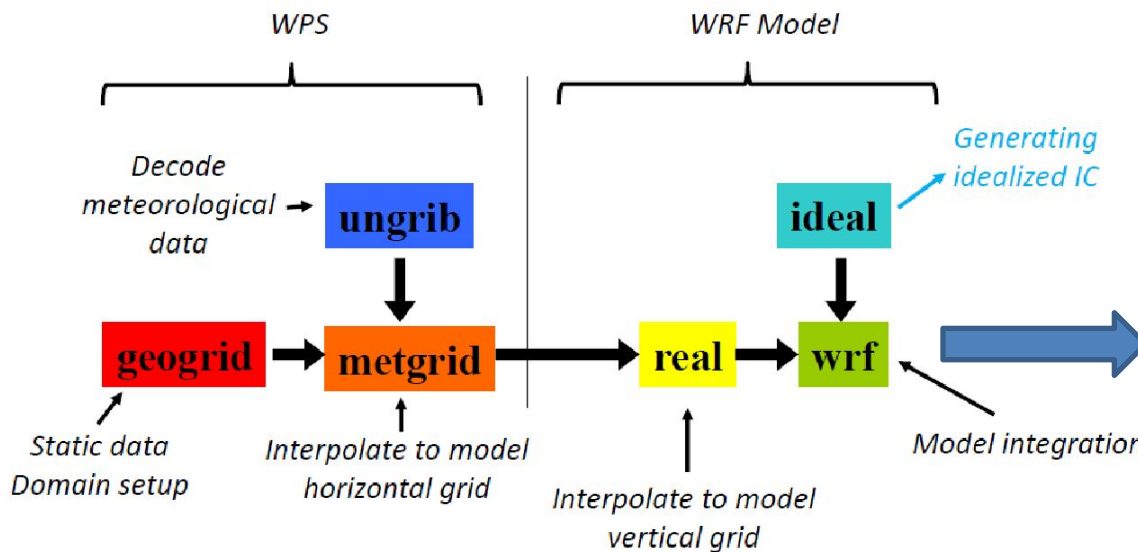


How Climate Model (WRF) works?

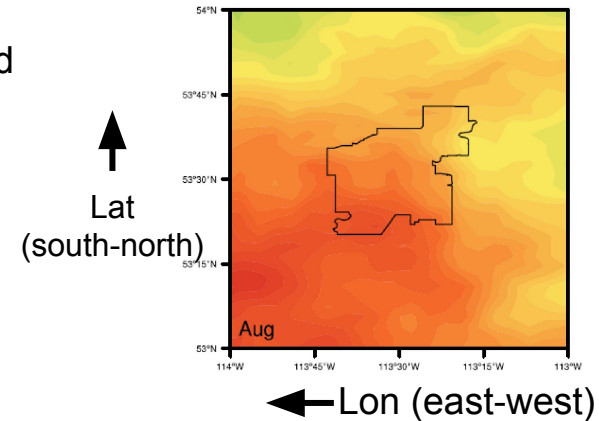
Weather Research and Forecasting Model (WRF)

- Mesoscale numerical weather prediction system designed for both atmospheric research and operational forecasting applications
- National Center for Atmospheric Research (NCAR), the National Oceanic and Atmospheric Administration (represented by the National Centers for Environmental Prediction (NCEP) and the Earth System Research Laboratory), the U.S. Air Force, the Naval Research Laboratory, the University of Oklahoma, and the Federal Aviation Administration (FAA)

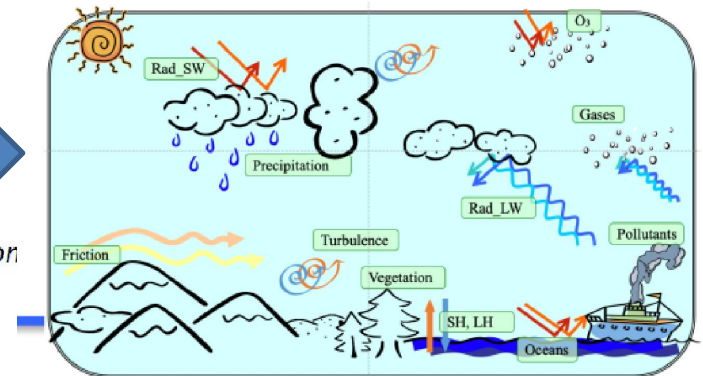
Most Important: Domain selection and input meteorological data



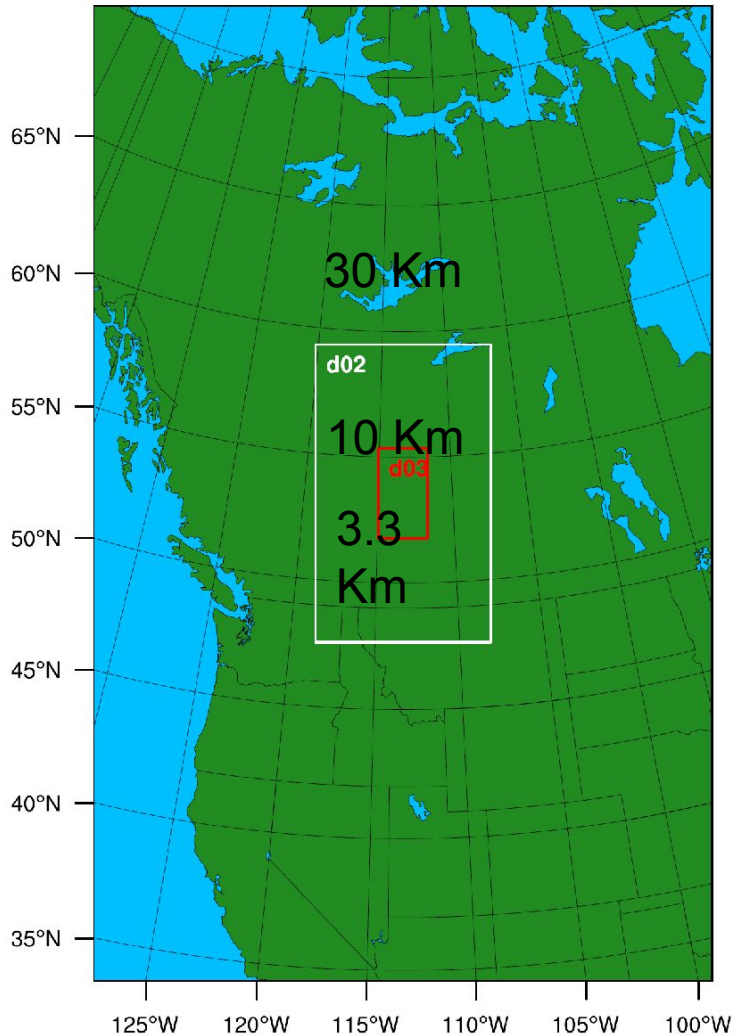
Model Outputs
3D (lat, lon, time) &
4D (lat, lon, level, time)
Visualize with plotting software



Model simulation for each grid point and each level (lots of equations)



Domain Setup



Input Dataset and Experiments

- **Data:** Bias-corrected climate model output data from version 1 of NCAR's Community Earth System Model (CESM1) (Monaghan et al., 2014)
- **Simulations:** Historical – 1st Jan 1975 to 31st Dec 2005
- Representative Concentration Pathway (RCP) future scenarios RCP8.5 – 1st Jan 2021 to 31st Dec 2080
- **Outputs:** 6-Hourly outputs from the model for many variables such as 2m temperature, precipitation, snowfall, snow depth, surface runoff, soil moisture, radiations, humidity, sea level pressure etc.

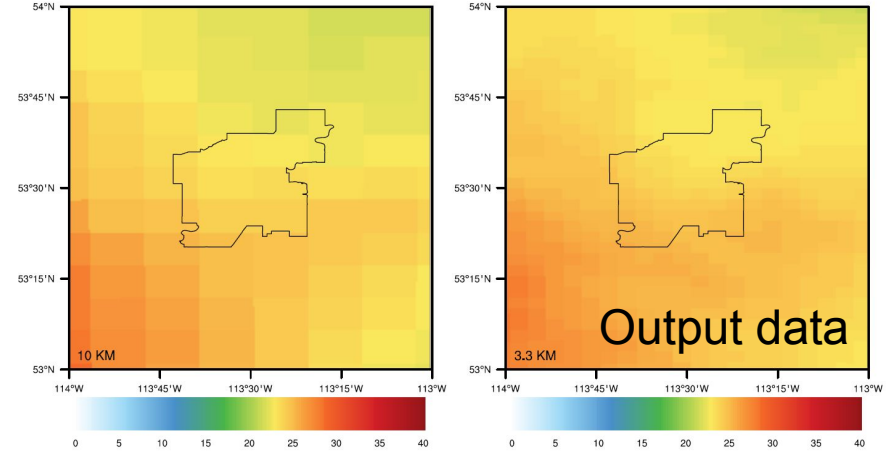
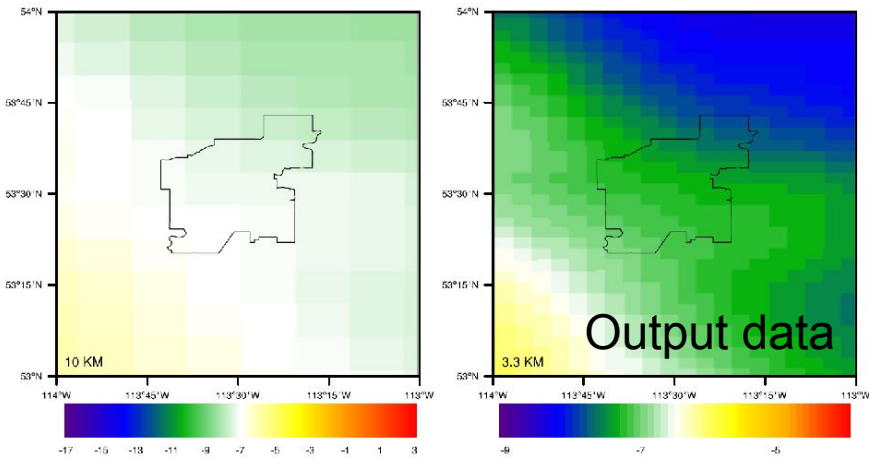
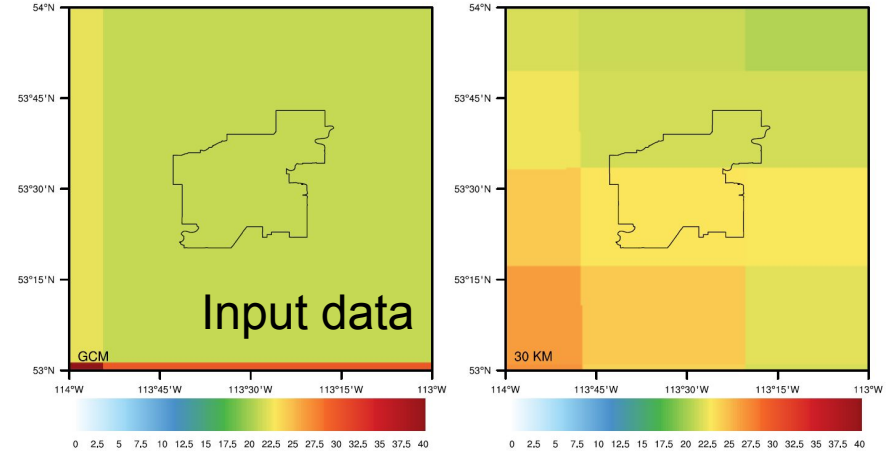
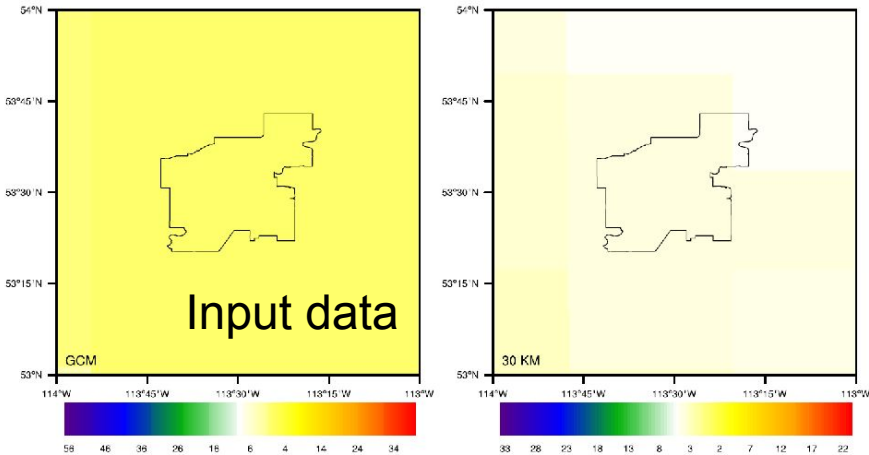
**Highest Resolution for
Edmonton climate simulation
– 3.3 Km**

Resolution got Better!!!

100 Km -> 30 Km -> 10 Km -> 3.3 Km

2m Air Temperature

Precipitation

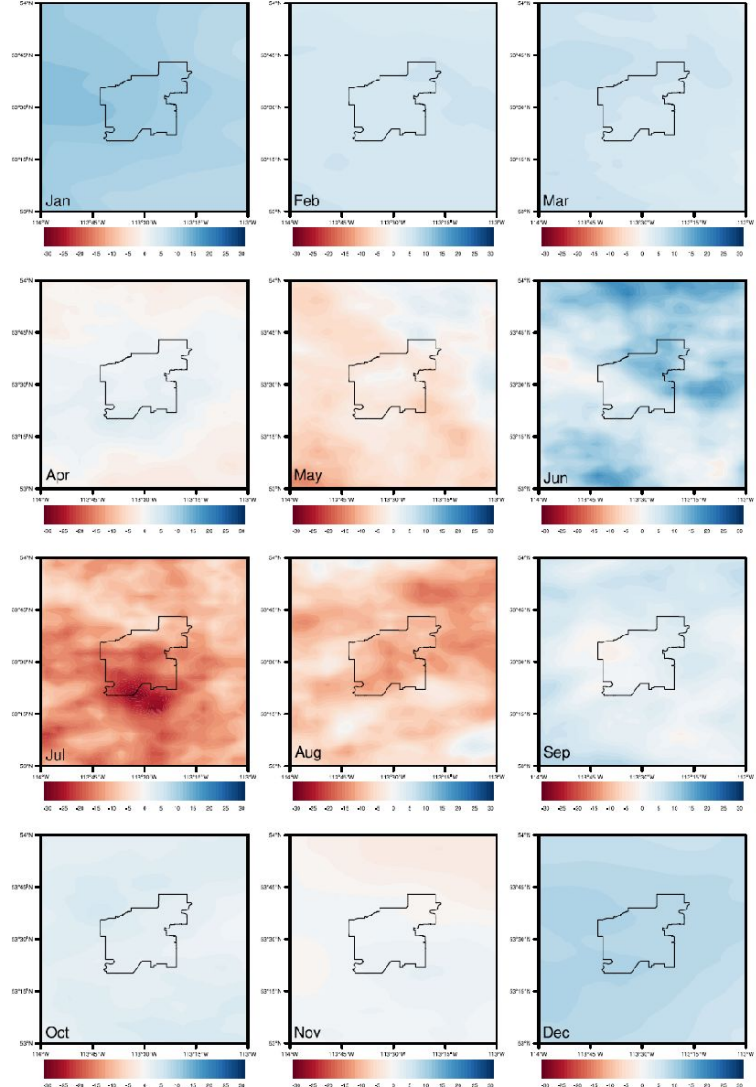
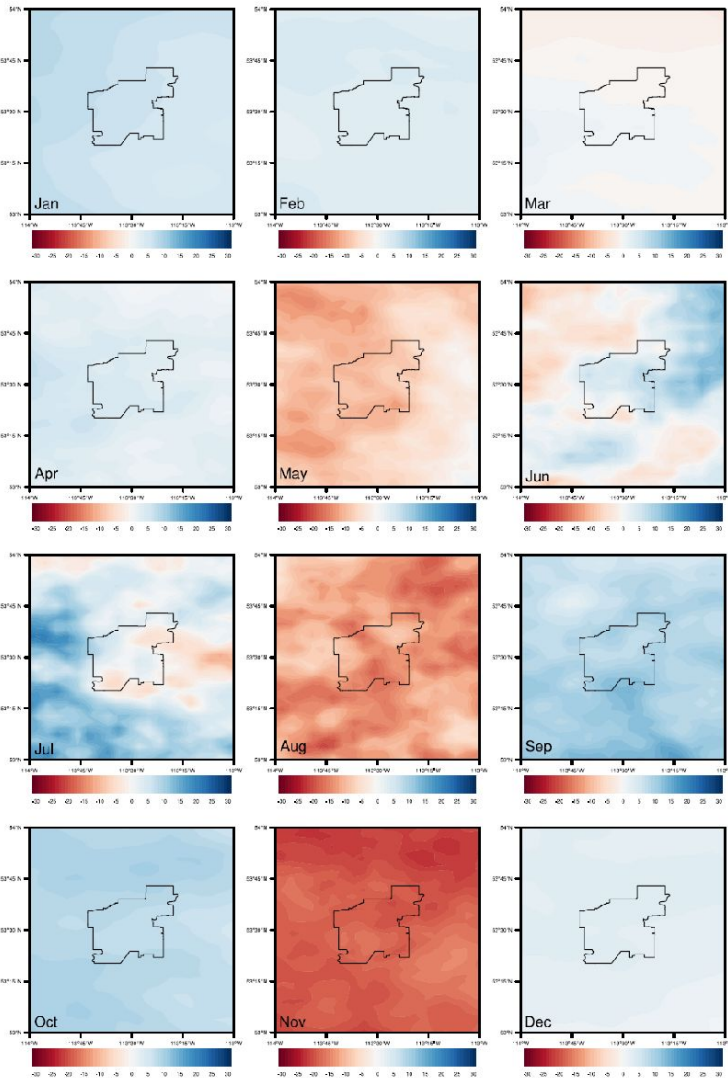


Finer details are visible – northeast corner of the city is colder

Long Term Monthly Mean Precipitation - Near Future (2021-2050) and Far Future (2051-2080)

RCP 8.5 (2021-2050) – Historical (1975-2005)

RCP 8.5 (2051-2080) – Historical (1975-2005)

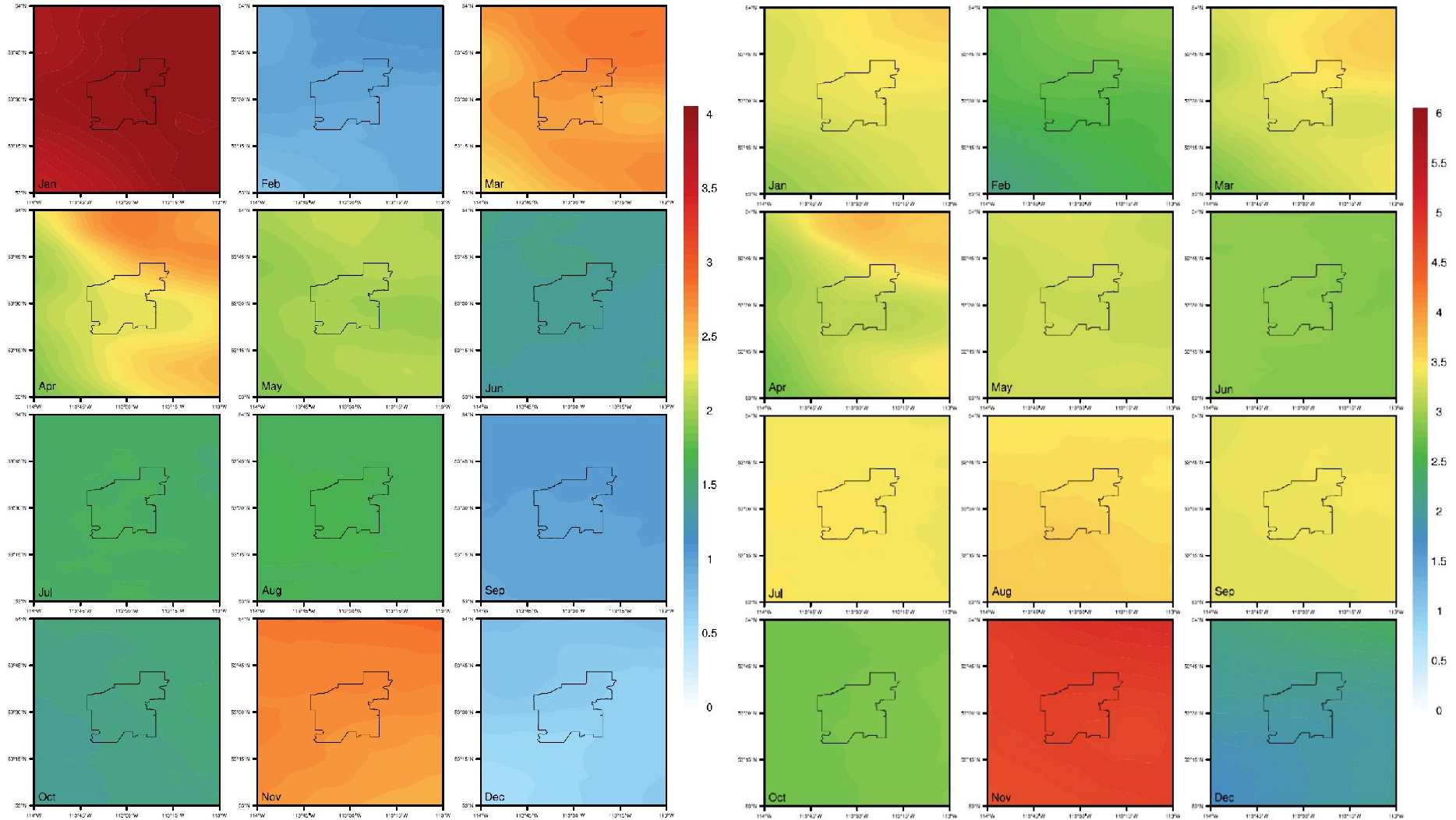


Summer months getting dryer and winter months getting wetter

Long Term Monthly Mean 2m Air Temperature- Near Future (2021-2050) and Far Future (2051-2080)

RCP 8.5 (2021-2050) – Historical (1975-2005)

RCP 8.5 (2051-2080) – Historical (1975-2005)



Warming in all months ranging from 1.5 °C to 5 °C

Conclusions

- We engaged in this research to provide the City of Edmonton with the best scientific information in support of adaptation to climate change.
- We were inspired to do the research in Edmonton because it is among the most progressive cities in dealing with climate change.
- This research is important to Edmontonians and Albertans because adaptation will prevent significant damage and losses from climate change. Municipal governments make decisions that affect our everyday lives.
- So far we are surprised to learn about the degree of variability in the climate of the Edmonton region, both geographically and over time.
- Edmonton serves as a model for responding to climate change; this research demonstrates science-based decision making to other municipalities.
- We hope the City and the citizens of Edmonton will find the results of our research useful and inform policies and practices that make Edmonton a more resilient city.