

The Agro-Ecological Zones of Southern Ontario:

The Expected Shifts Caused by Climate Change in the Medium and Long Term

M.Sc. Applied Modelling and Quantitative Methods Candidate Research

INTRODUCTION

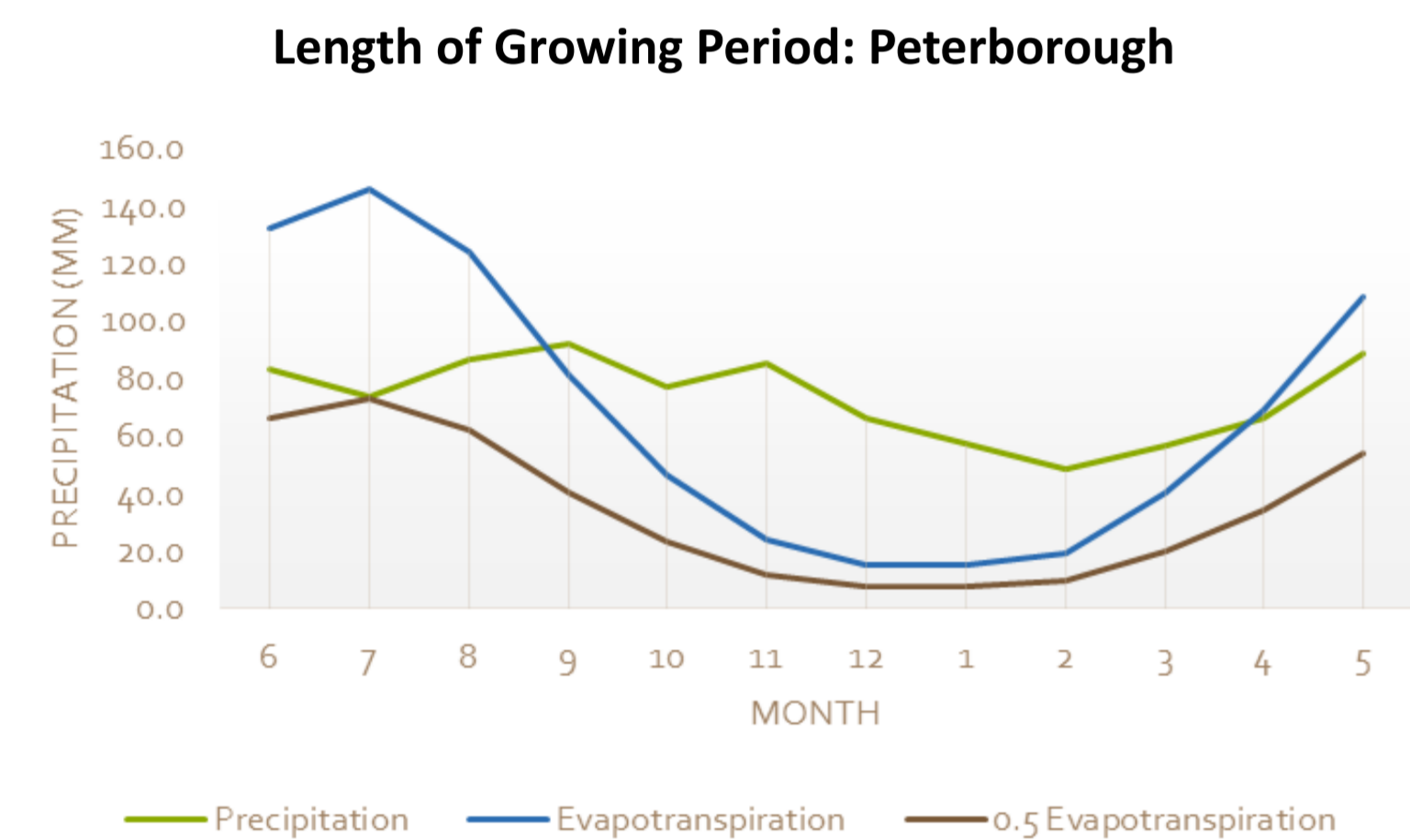
- Climate change is already influencing agricultural parameters that create new opportunities or risks to cropping systems (OMAFRA, 2016)
- Agro-Ecological Zones** combine soil, land, and climate characteristics into areas with similar potential and constraints for agricultural production (FAO, 1996)
- Under climate change scenarios Agro-Ecological Zones can determine:
 - Spatial and temporal changes in temperature and precipitation patterns
 - Changes to the moisture regime
 - Physical constrains to agricultural production

AEZ Climatology's

- Length of growing period
- Crop Heat Units
- Potential Evapotranspiration (PET)
- Deficit

Other AEZ Factors

- Soil Subtypes
- Underlying Substrates
- Slope
- Moraines



Number of continuous days per year a crop is productive based on a simple water balance, radiation and temperature budget model (FAO,2006).

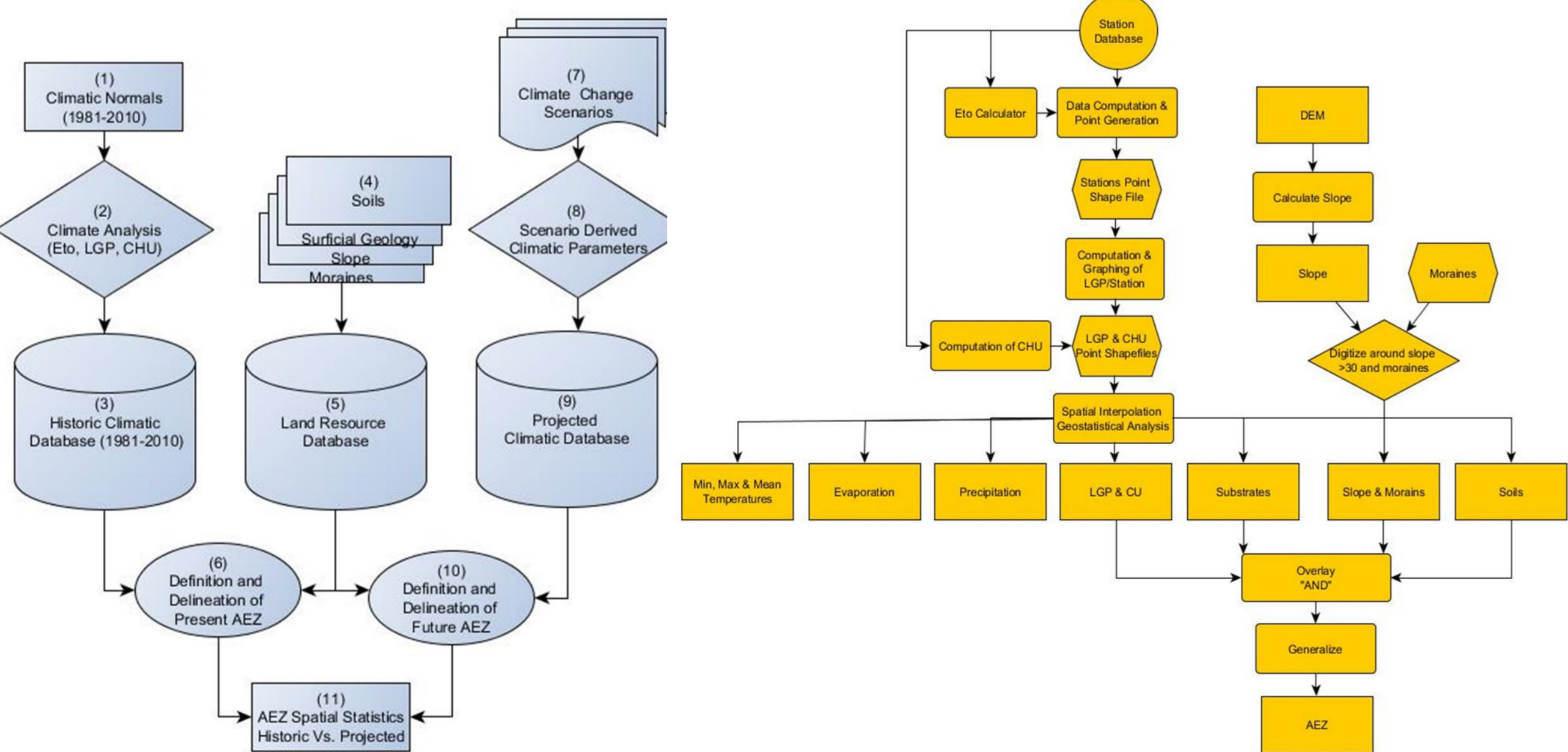
In Ontario, the growing period is more limited by heat than moisture.

Beginning of growing season ($P > 0.5 \text{ PET}$)
Beginning of Humid Period ($P > \text{PET}$)
End of humid Period ($P < \text{PET}$)
End of Rainy Season ($P < 0.5 \text{ PET}$)

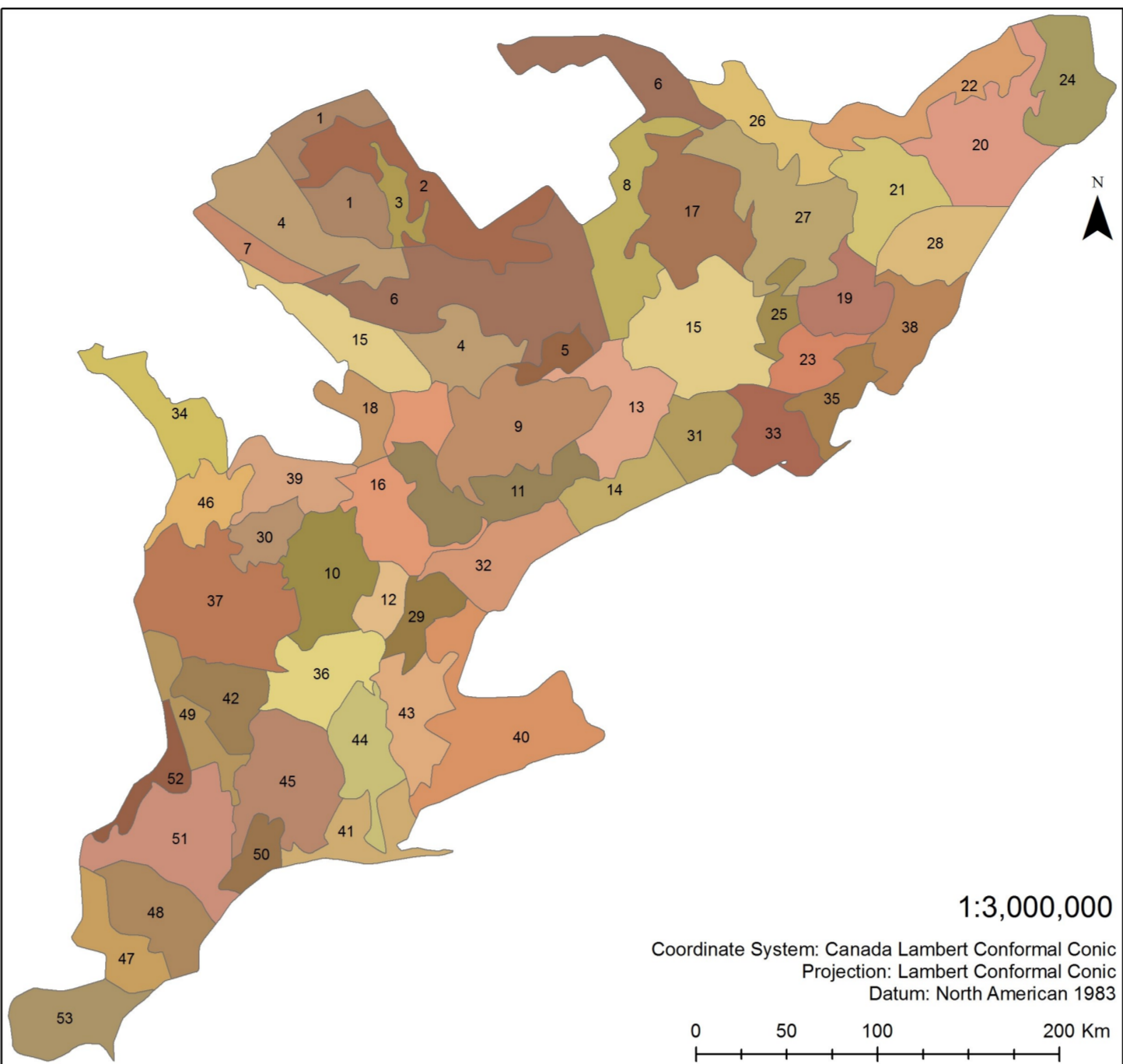
RESEARCH PROBLEM

- A detailed spatially-explicit AEZ framework, both procedural and mapping, is absent for the Province of Ontario.
- The purpose of the AEZ framework is to define areas with similar or comparable climate, soil, and landscape characteristics for multiple crop production using a spatial model approach
- The framework will help answer:
 - Where are the current and future AEZs?
 - How are the changes in climatology's affecting the changes to locations of zones ?
 - What are their attributes (LGP, CHU, soil type, soil depth, surficial geology)?

METHODS



Current Agro-Ecological Zones (1981-2010)

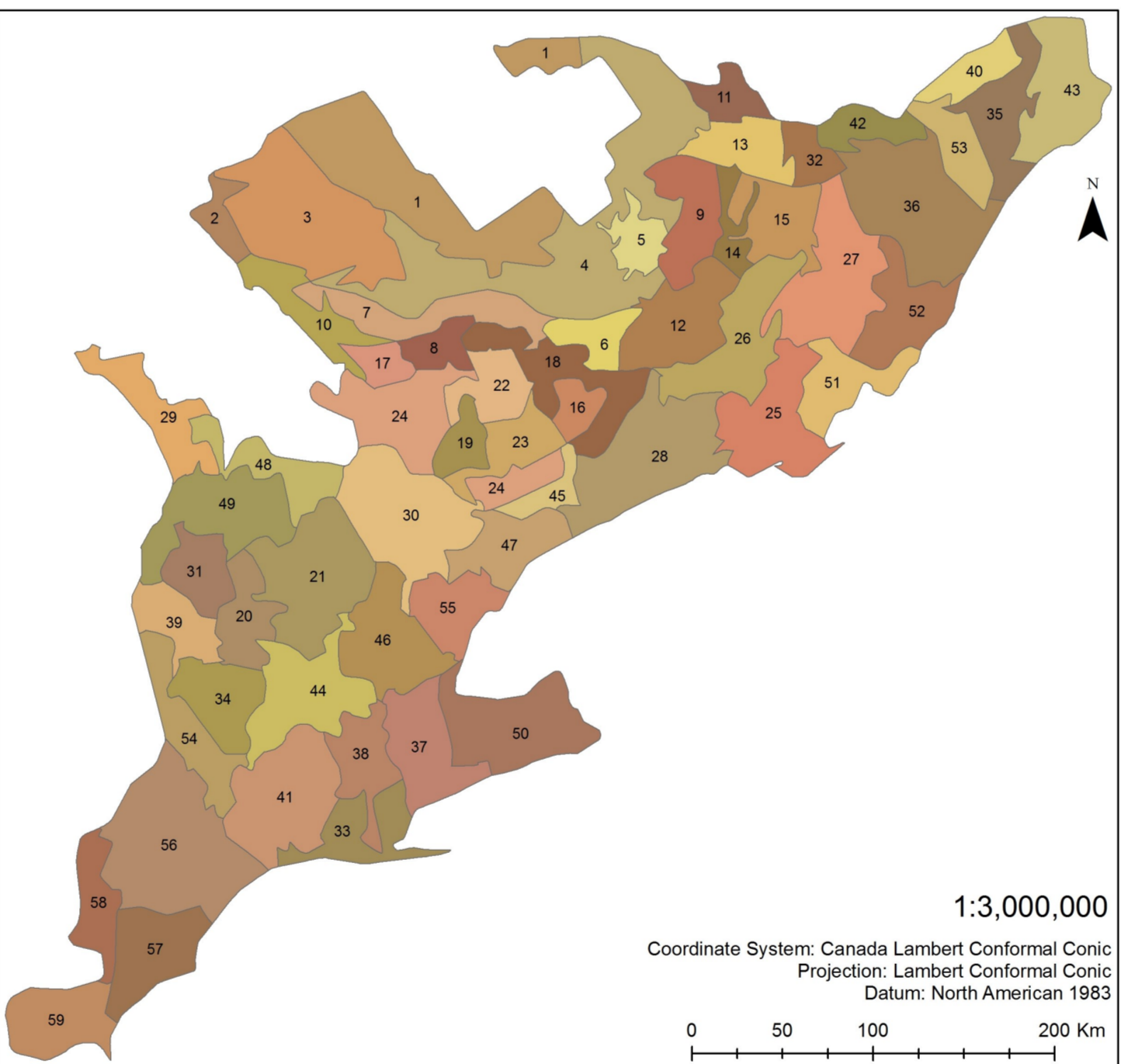


Example of the report on the Current Agro-Ecological Zones Attributes

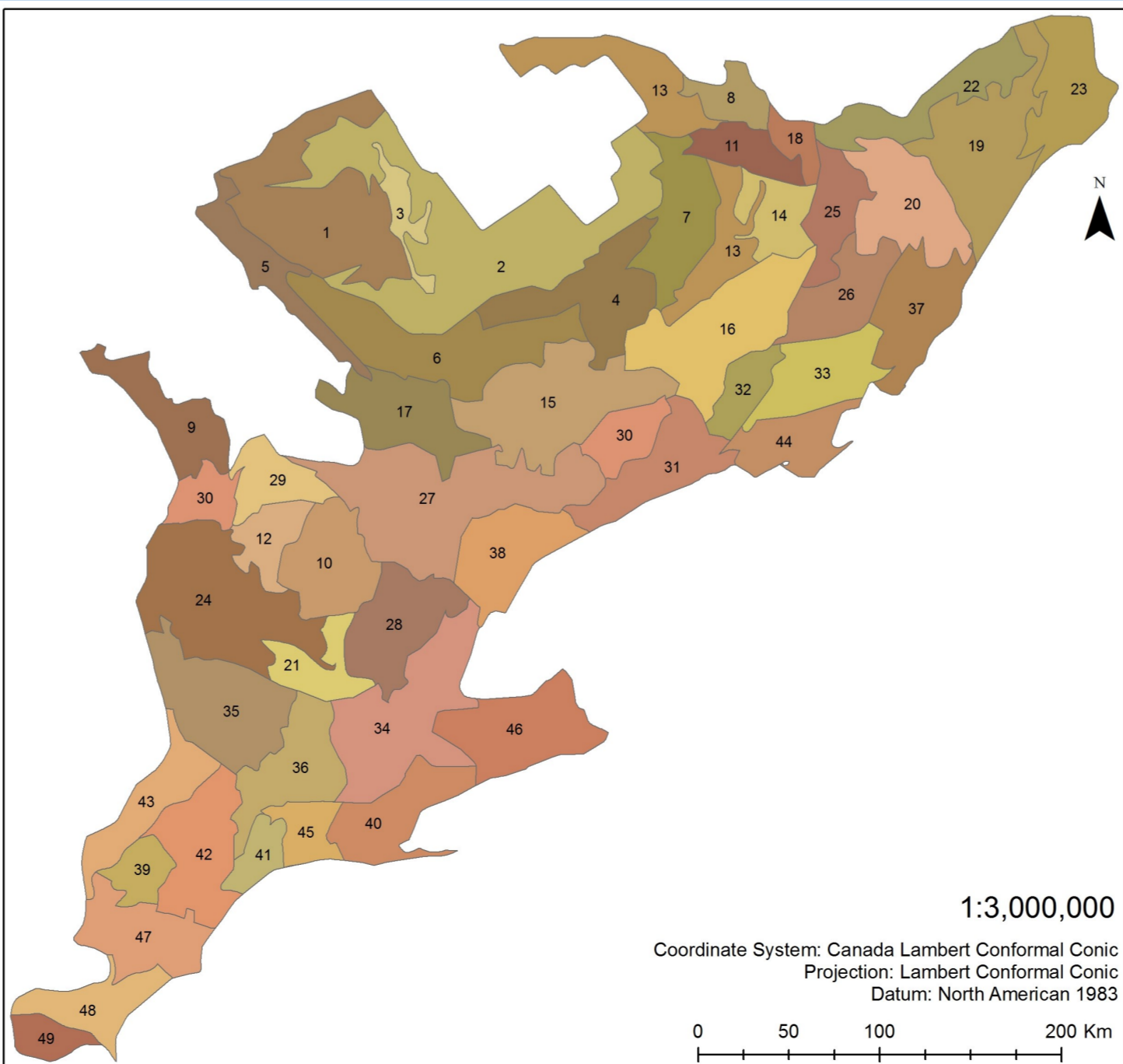
Current Agro-Ecological Zones Attributes

AEZ	LGP	CHU	Slope	Moraine	Soil	Primary Substrate	Secondary Substrate	Primary Census	Area Km2
1	190	2800	10 No	-	Precam	Till	Central	5572	
2	190	2800	60 No	-	Precam	Till	Central	8920	
3	190	2800	60 No	0	Precam	Till	Central	783	

Projected Agro-Ecological Zones (2011-2040)

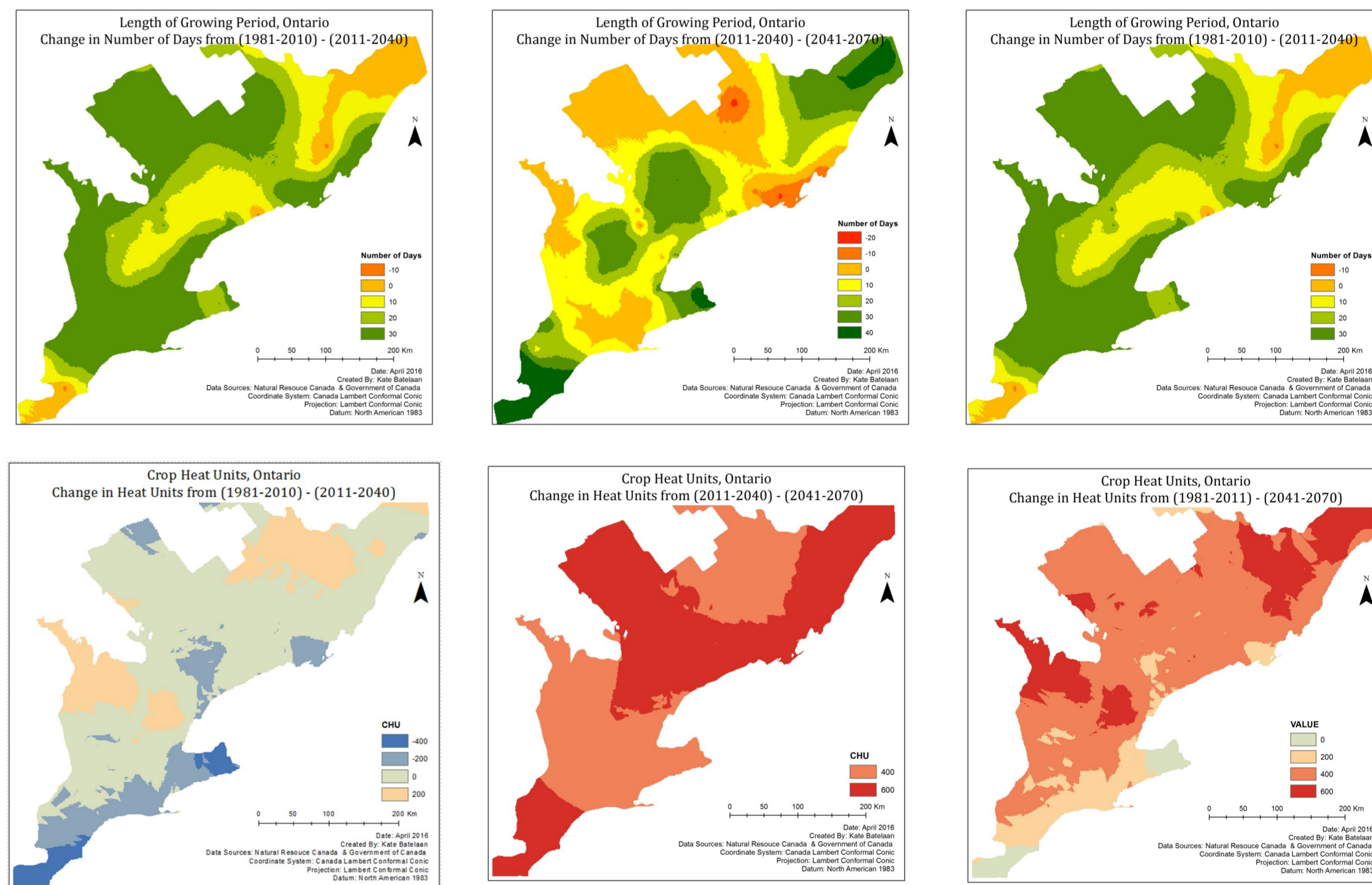
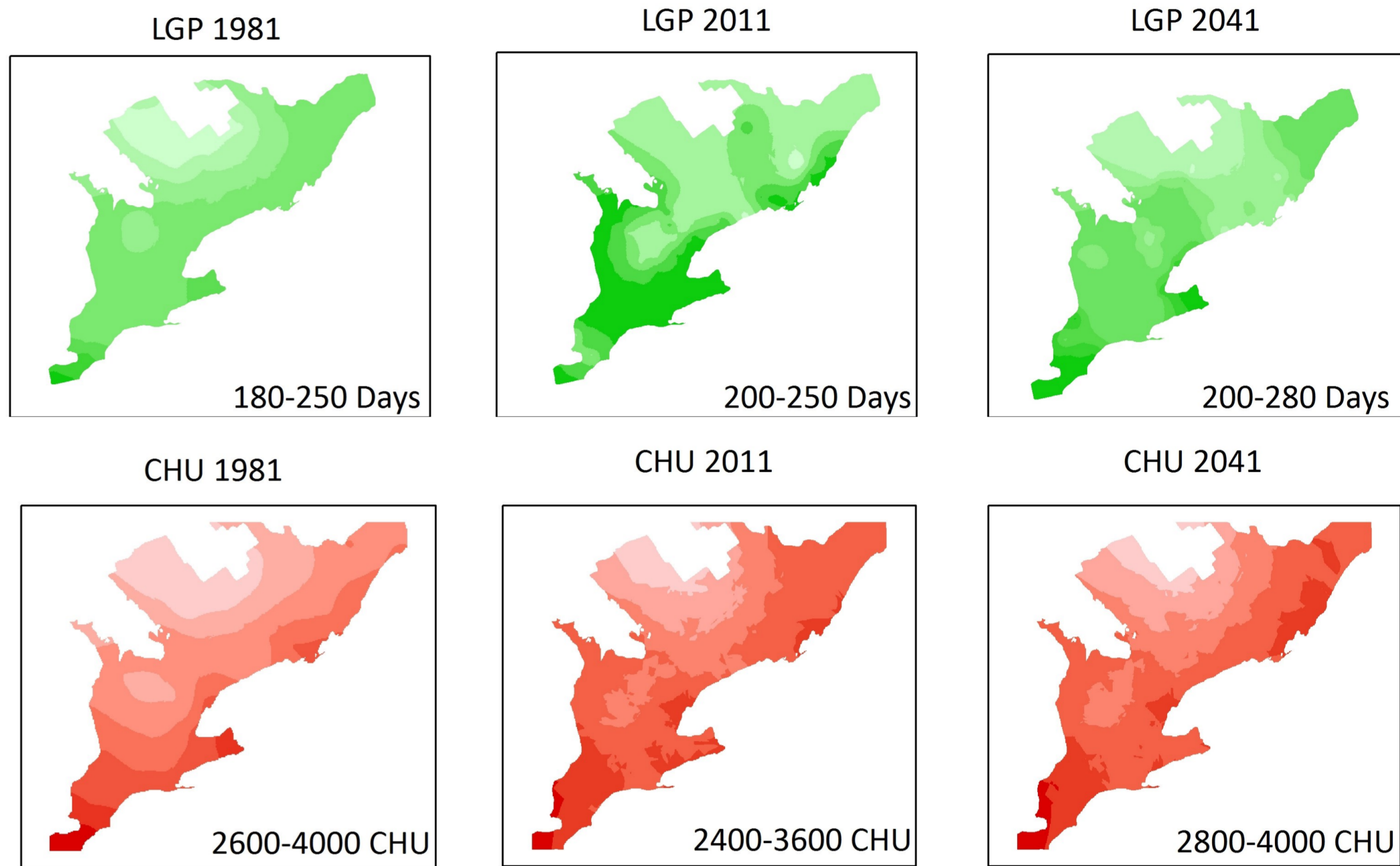


Projected Agro-Ecological Zones (2041-2070)



RESULTS

- The average Length of Growing Period :
 - ⇒ Historical (1981— 2010) - 213 days
 - ⇒ Projected (2011 — 2040)- 231 days
 - ⇒ Projected (2041 — 2070)- 244 days
- The average Crop Heat Unit
 - ⇒ Historical (1981— 2010) - 213 days
 - ⇒ Projected (2011 — 2040)- 231 days
 - ⇒ Projected (2041 — 2070)- 244 days



CONCLUSIONS

- That there will be shifts to the Agro-ecological zones due to the changes in values of the climatology's that determine the length of growing period and available crop heat units
- There is an observed trend in an increase in the number of growing days and accumulated heat units in the near future (2011-2041) and the long term (2041-2070) when compared to the present
- The greatest changes were observed in the South, South-West and Eastern regions of the province
- The long term future will have a greater amount of moisture deficit

Future research would include developing a comprehensive analysis of crop suitability for the province with inputs from present and future agro-ecological zones and based on decision trees and ANNs.

•OMAFRA. (2016, January 4). *Climate Change and Agriculture*. Retrieved from Ontario Ministry of Agriculture, Food, and Rural Affair: <http://www.omafra.gov.on.ca/english/engineer/facts/climatechange.htm>

•FAO. (1996). *Agro-Ecological Zoning Guidelines*. Retrieved from Food and Agriculture Organization of the United Nations: <http://www.fao.org/docrep/W2962E/W2962E00.htm>