

Adaptation to changing water in Alberta

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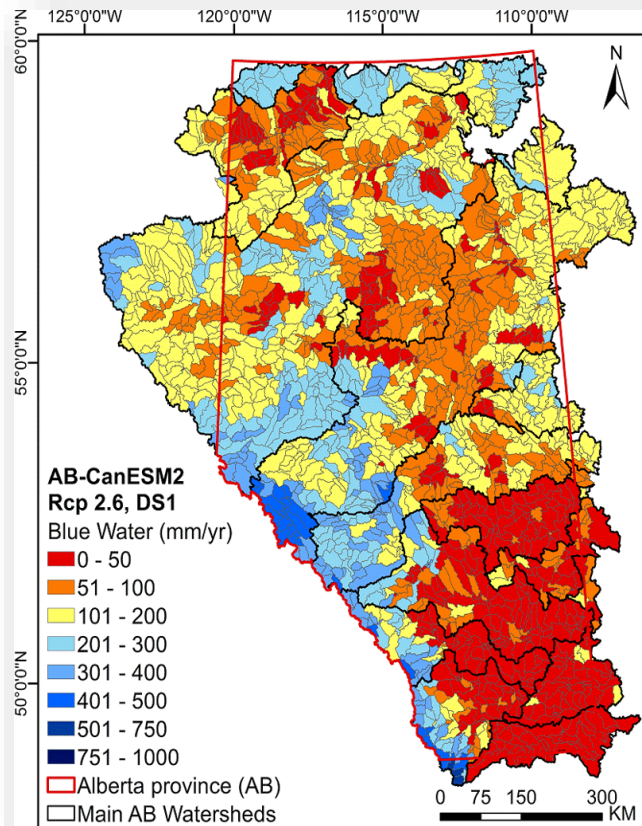
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Adapting to Changing Water in Alberta

(**AI**, 3 years, on-going)

Agro-hydrologic model



Water demand

Predicting Water Related Risks and Opportunities for Albert's Beef Industry (**AAF**, 3 years, on-going)

Water related risks and opportunities to wetlands (**ABMI**, 3 years, on-going)

Water supply

Predicting Alberta's Water Future (**AI**, 3 years, completed)

Stakeholder meeting

(**Alberta WaterSMART**)

Water budget:

- **Blue:** *liquid renewable*
- **Green:** *ET/SW*
- **Fossil:** *Glacier/Groundwater*
- **Virtual:** *Consumptive in production*

When?
Where?



Topography: DEM

SWAT Input: temporal data

Landuse: CFS-AAFC

Soil: SLC-CANSIS

Climate

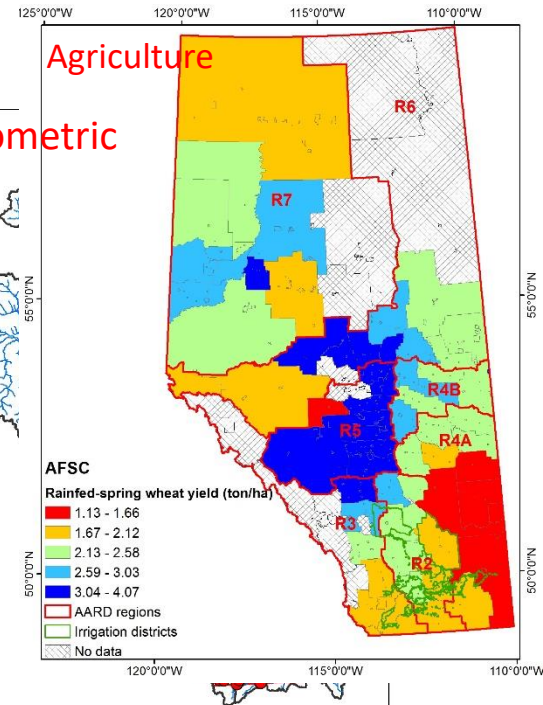
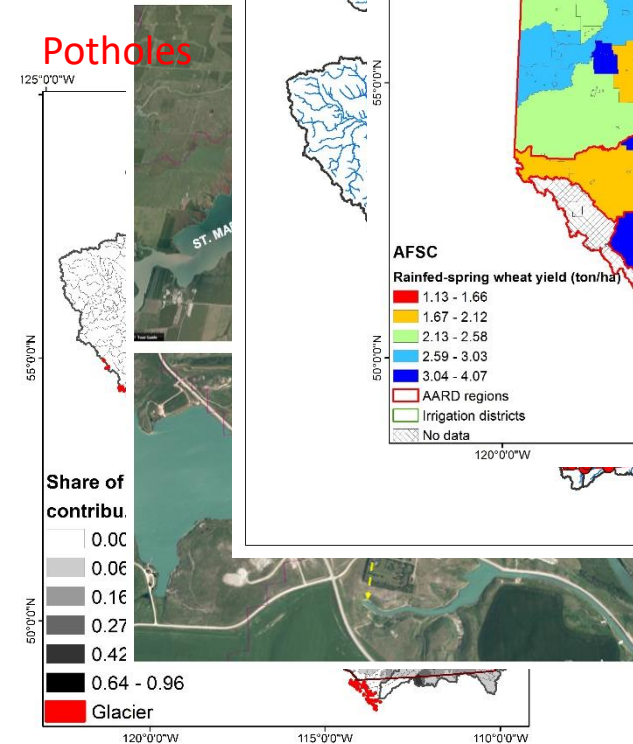
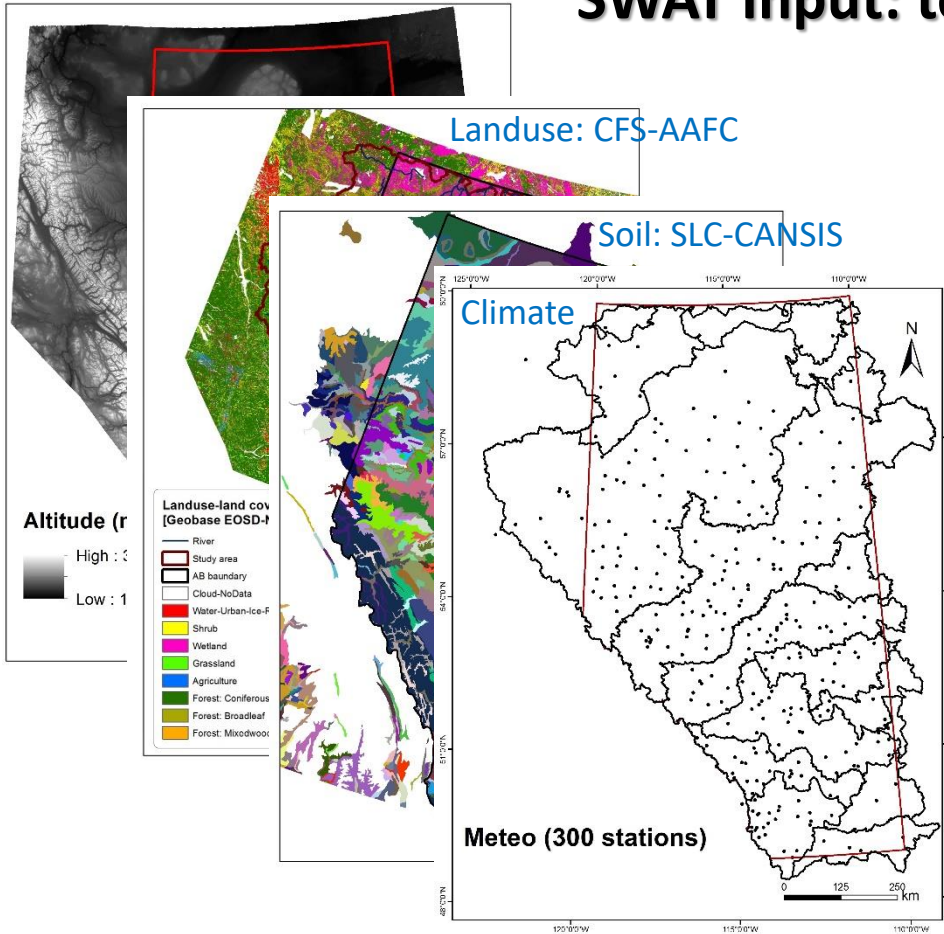
Meteo (300 stations)

Dams

Potholes

Hydrometric

Agriculture



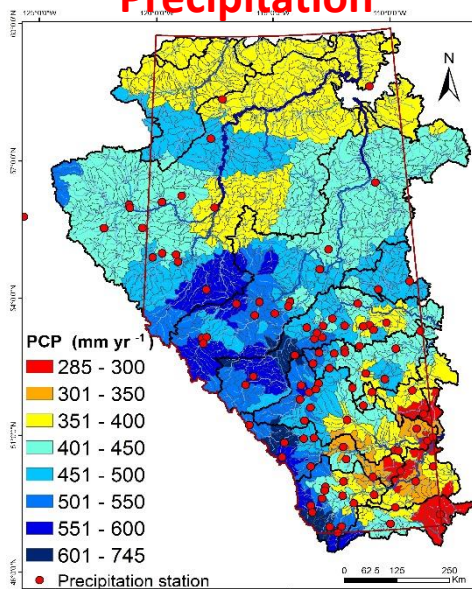
Natural

Human

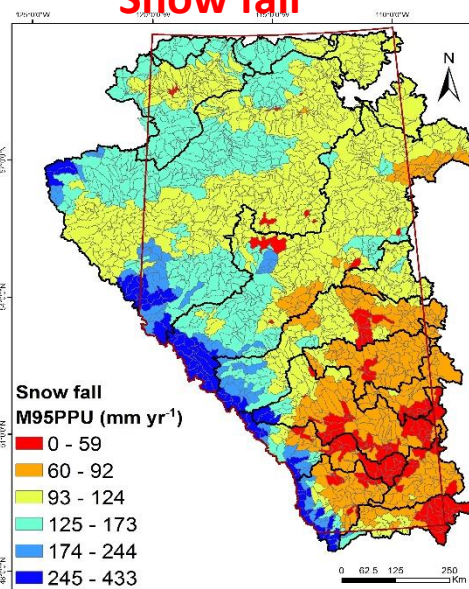


Long term average: 1986-2007

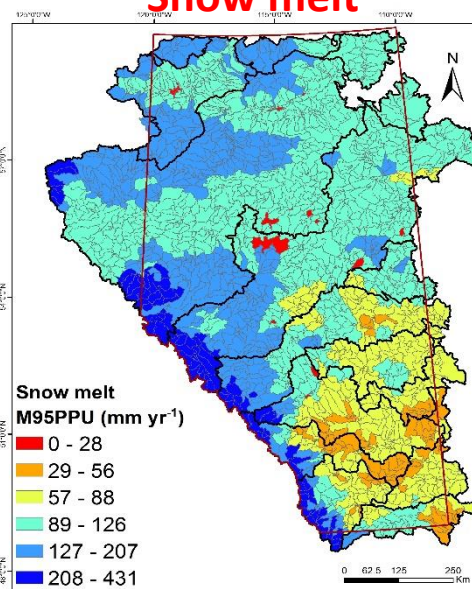
Precipitation



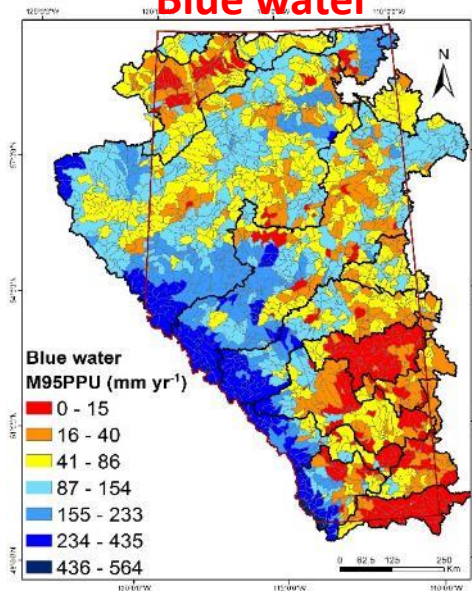
Snow fall



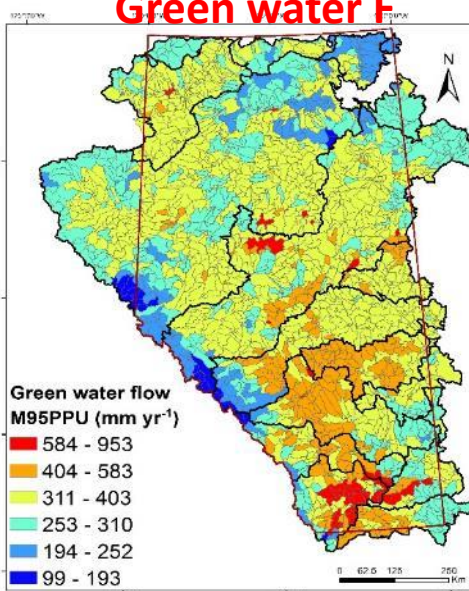
Snow melt



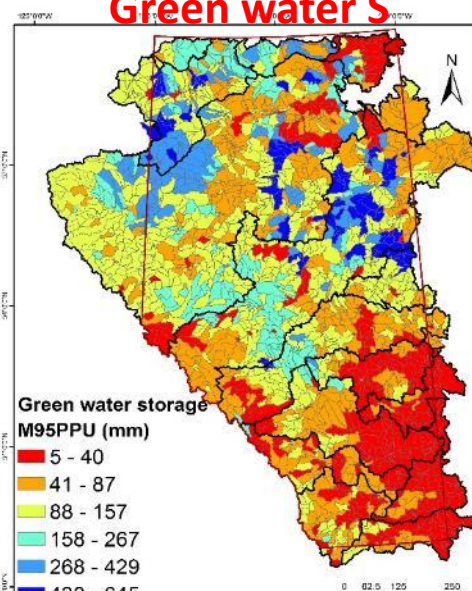
Blue water



Green water F



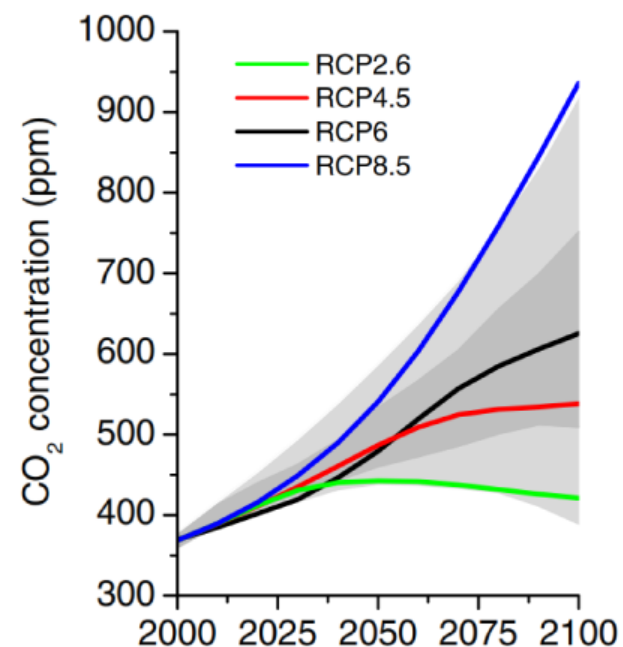
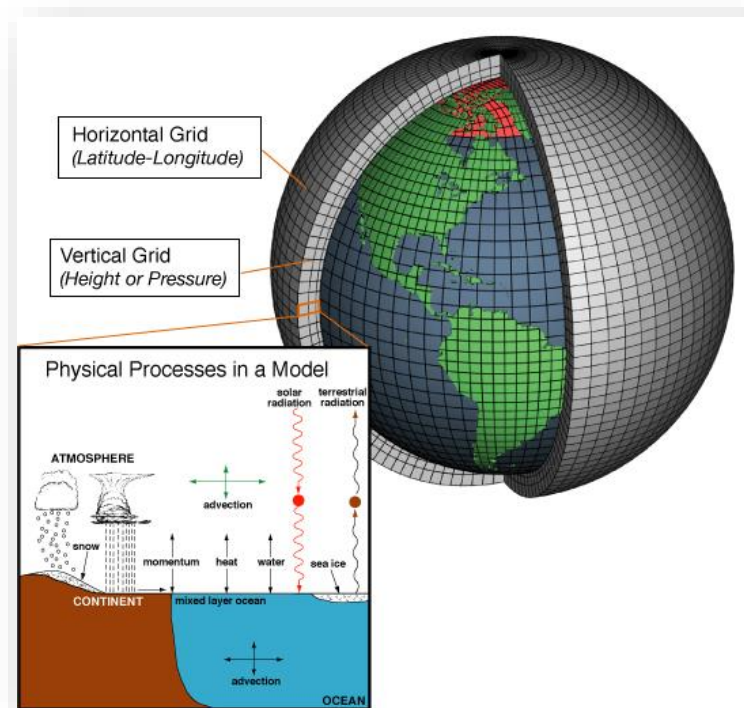
Green water S





CO₂ driven climate change (anthropogenic)

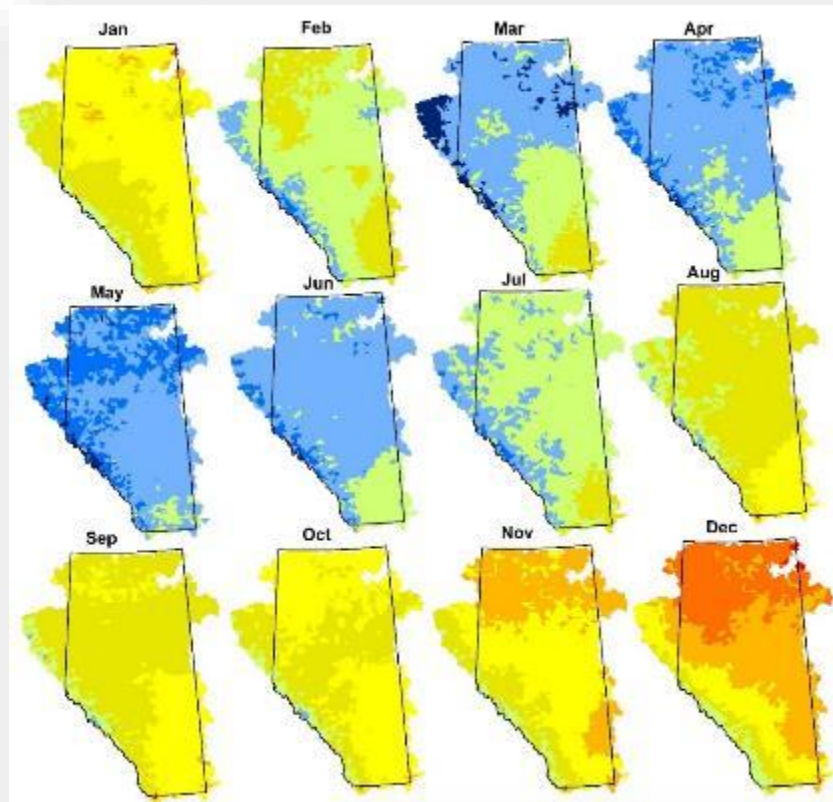
IPCC global climate models



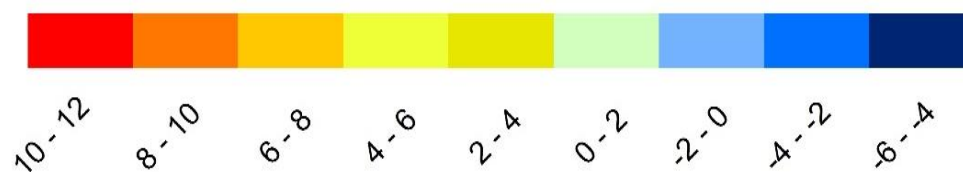
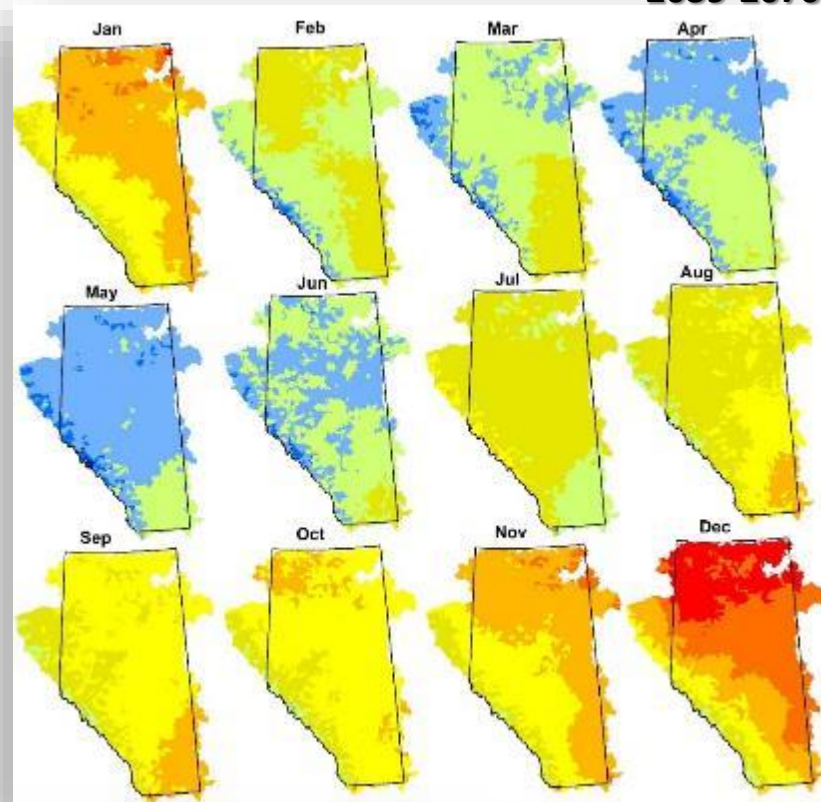


Temperature change ($^{\circ}\text{C}$)

2011-2040

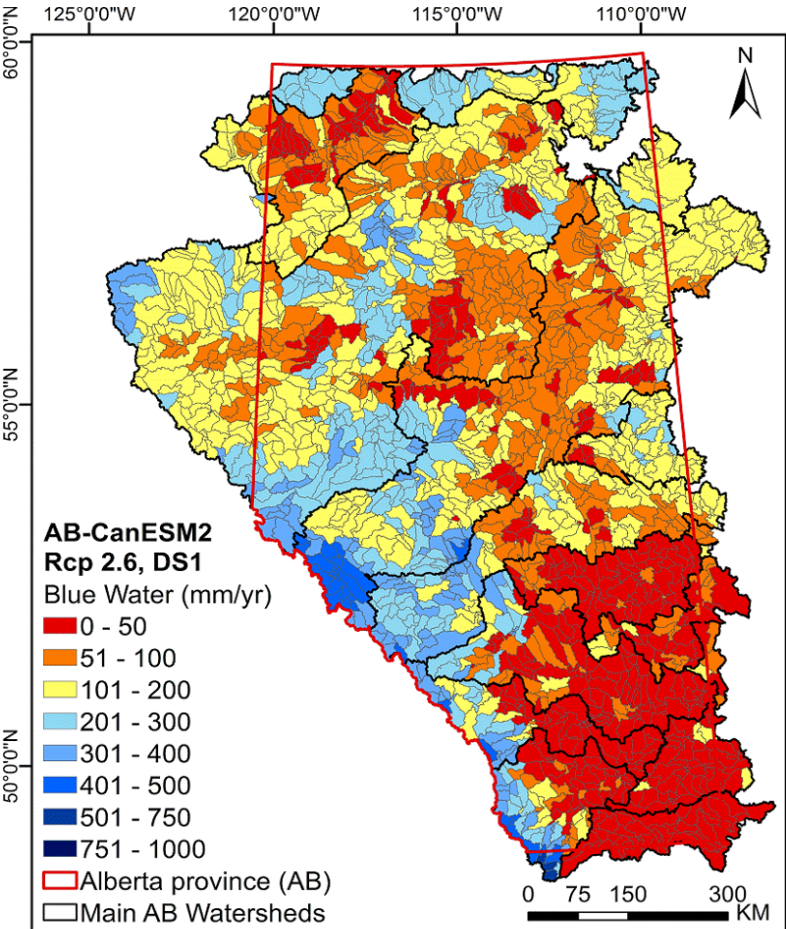


2039-2070

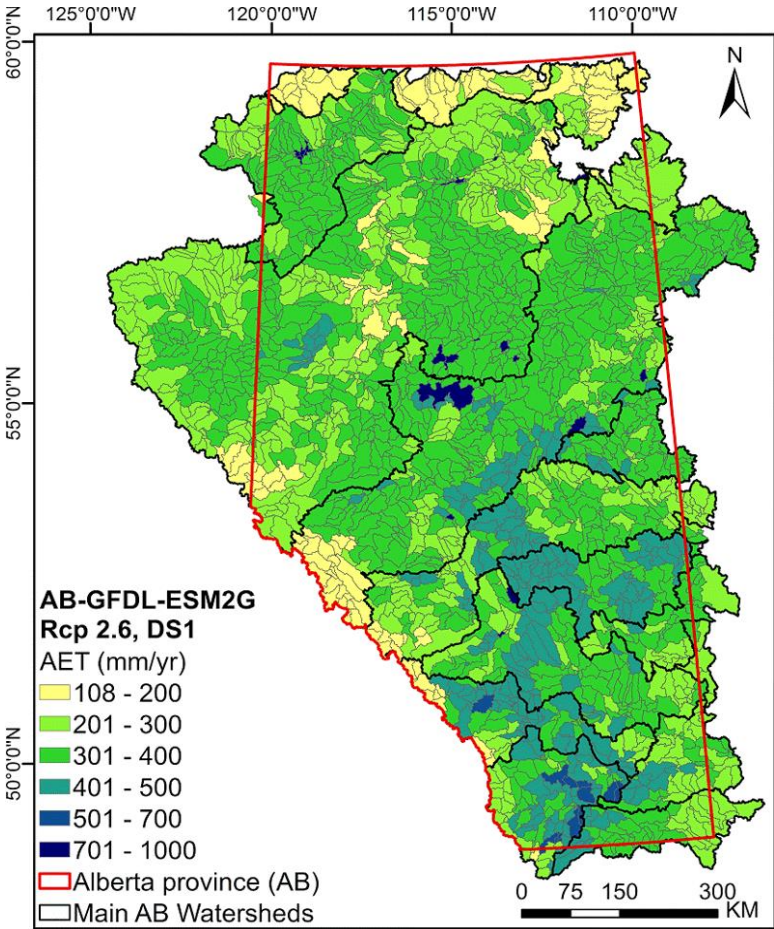


Multi-model projections: total annual variability in model projections

Blue Water:
surface+groundwater



Green water:
Actual evapotranspiration



Water demand:

1. **Agriculture-beef-crops**
2. **Environment-wetlands**

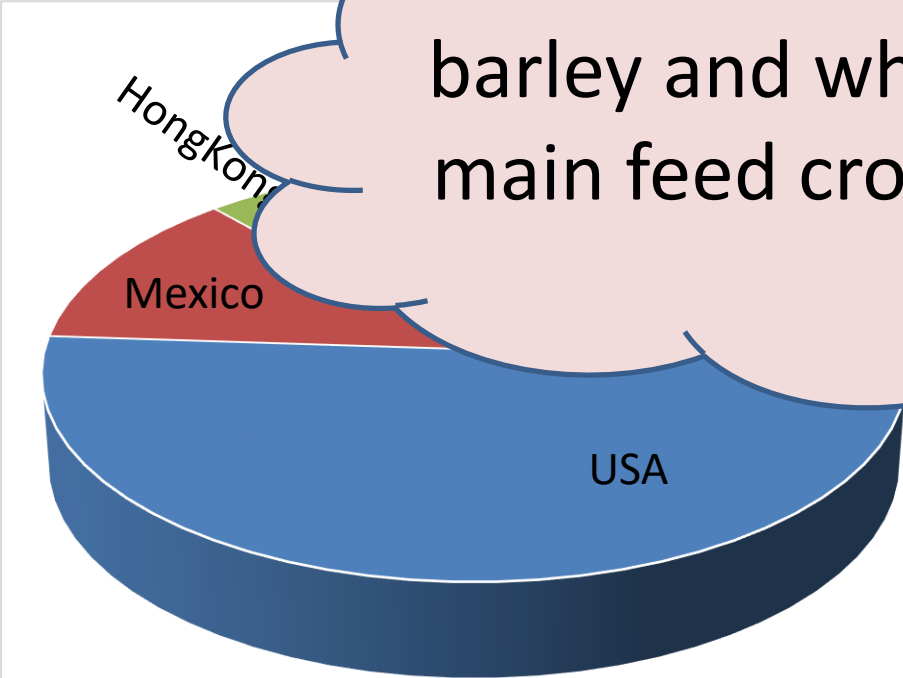


1. Water demand of major crops-beef

Canada is home to ~12 million head of cattle with majority of beef production occurring in Alberta



barley and wheat: the main feed crops in AB



	Export (*1000) ton
	218.504
	35.873
HongKong	10.79
Japan	8.276
Russian Federation	4.378
Macao	2.271
Taiwan	1.576
Philippines	1.178
Indonesia	0.929
Egypt	0.619
Other countries	2.937

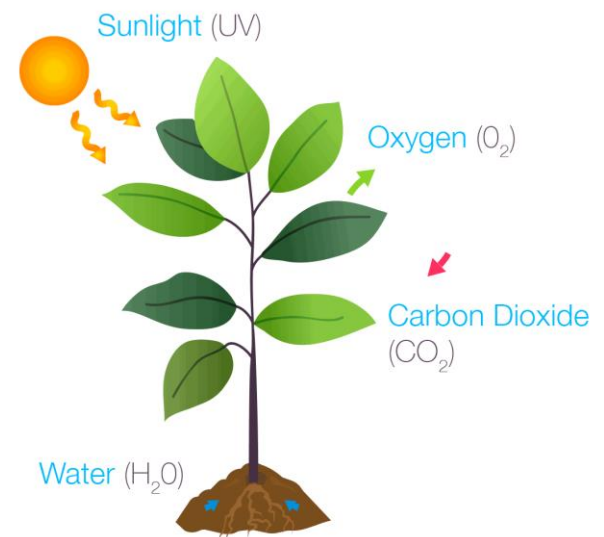
Source: Stat Canada, 2011

Factors affecting **Crop Yield, Production, Water Requirements**

- Water
- Temperature
- Solar radiation
- Air humidity
- CO₂
- Soil type

Management factors:

- Soil nutrients, tillage operation
- Planting
- Harvesting
- Irrigation
- etc.

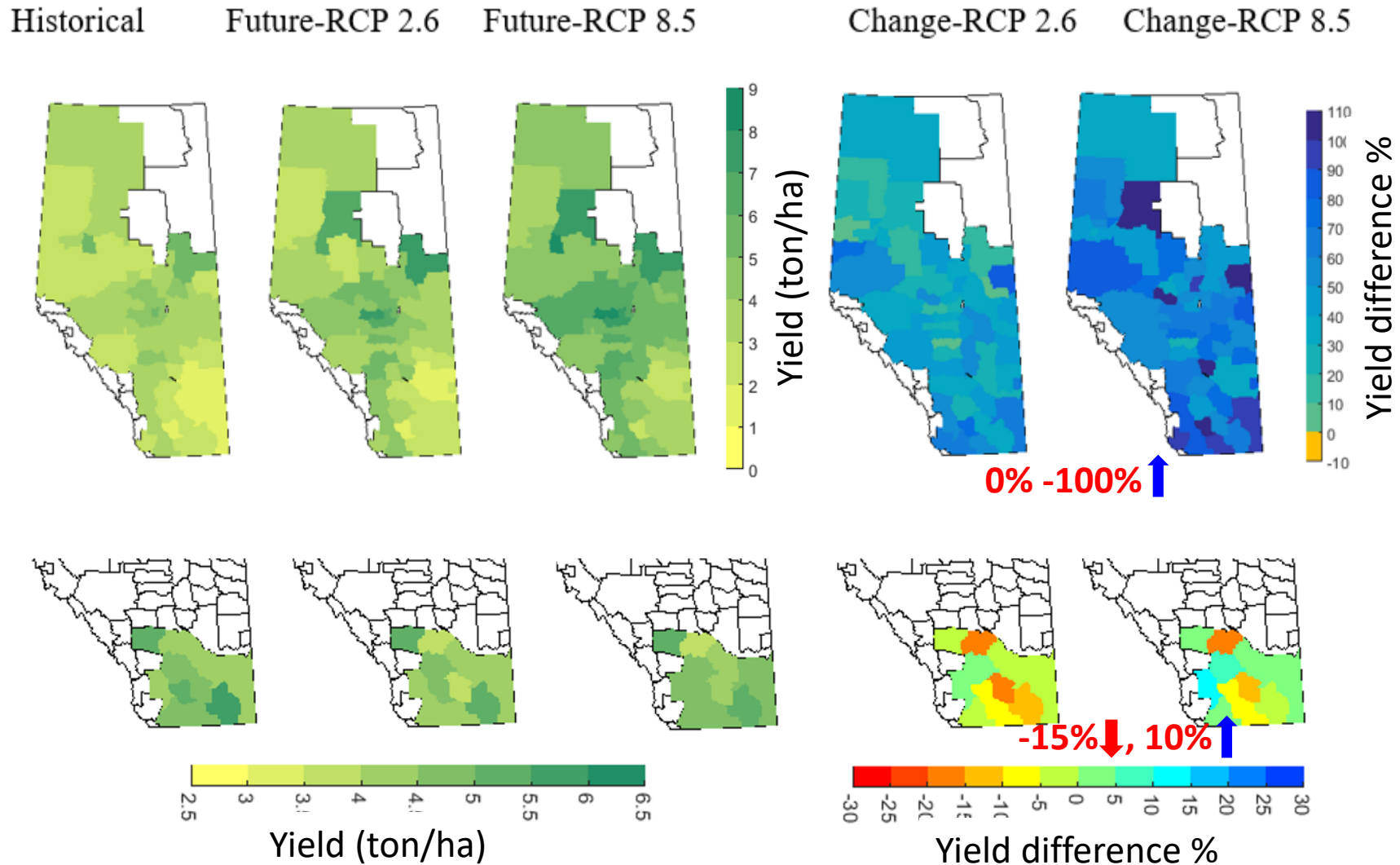




Projected changes in rainfed barley yield (2040-2064)

Rainfed barley

Irrigated barley



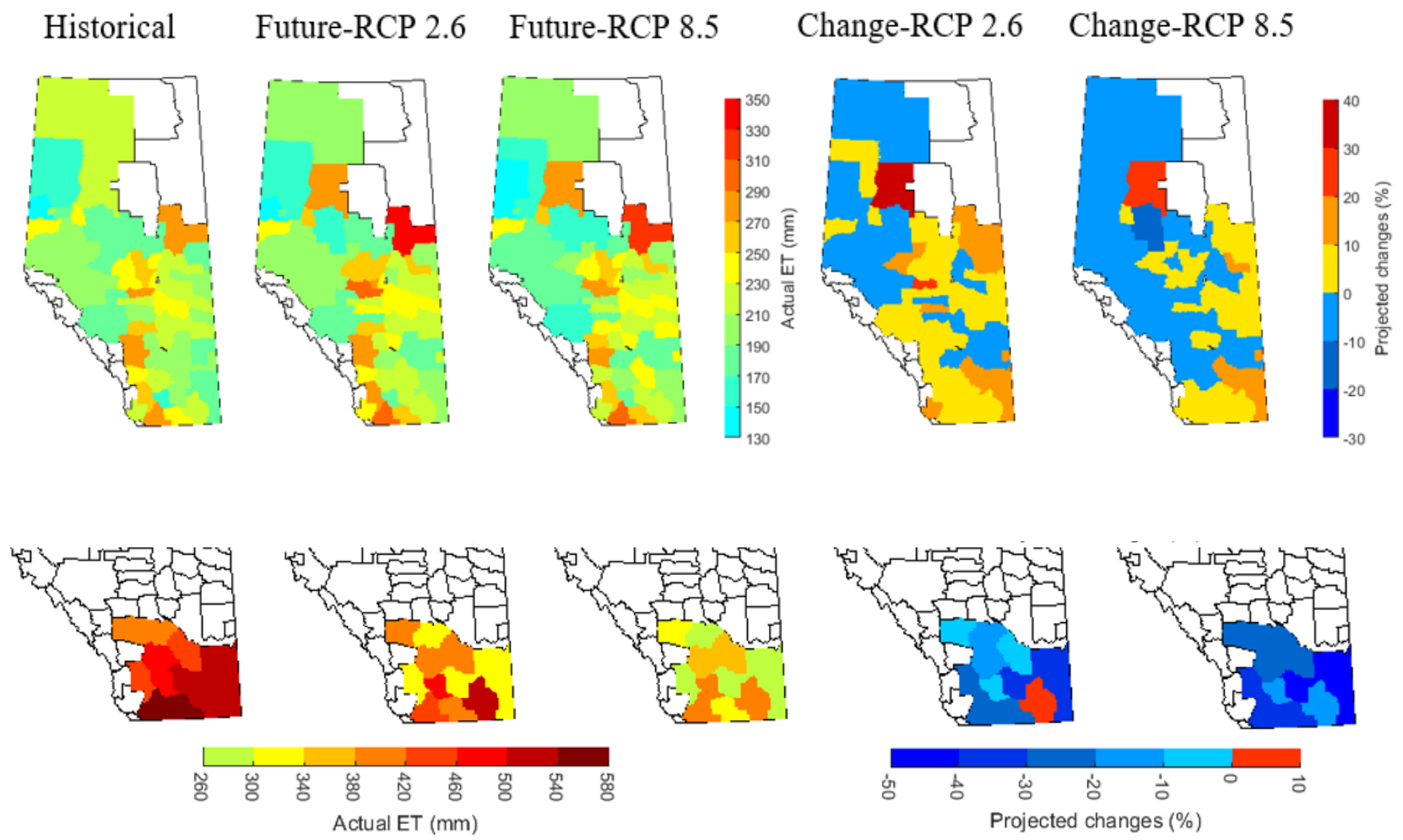
Source: Masud, M.B., McAllister, T., Cordeiro, M.R.C., Faramarzi, M., Modeling future water footprint of barley production in Alberta, Canada: Implications for water use and yields to 2064, **Science of the Total Environment** 616-617: 208-222. DOI: [10.1016/j.scitotenv.2017.11.004](https://doi.org/10.1016/j.scitotenv.2017.11.004).



Projected changes in crop water use CWU (2040-2064)

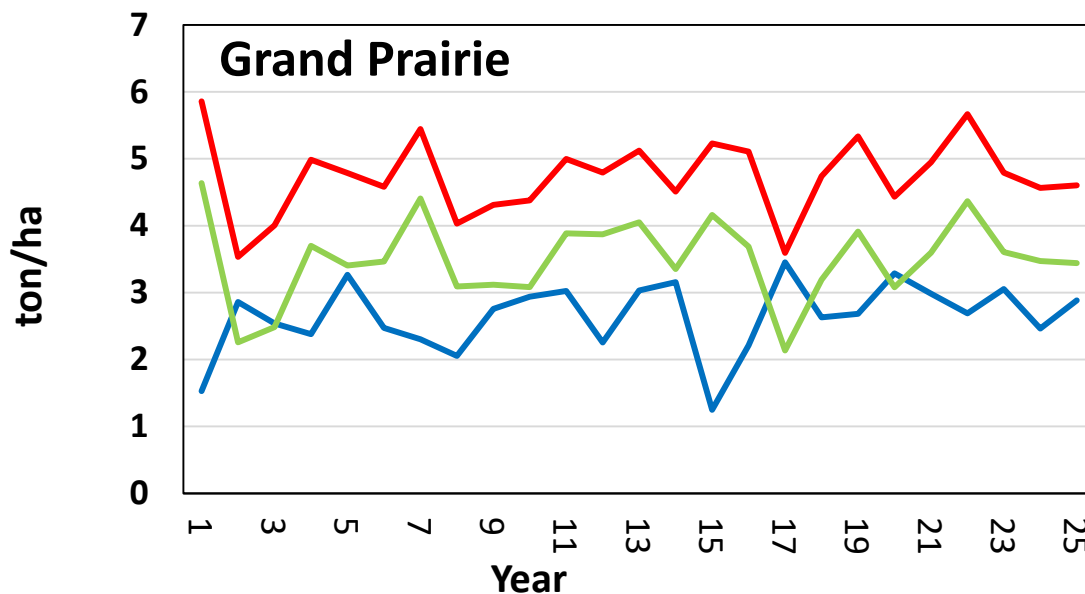
Rainfed barley

Irrigated barley



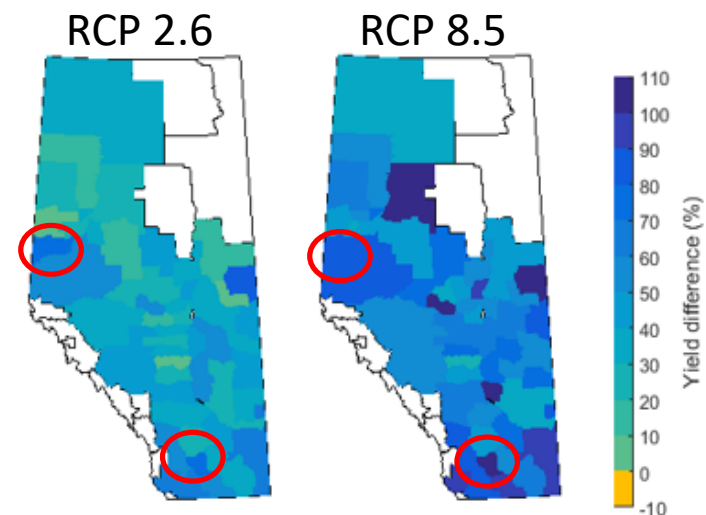
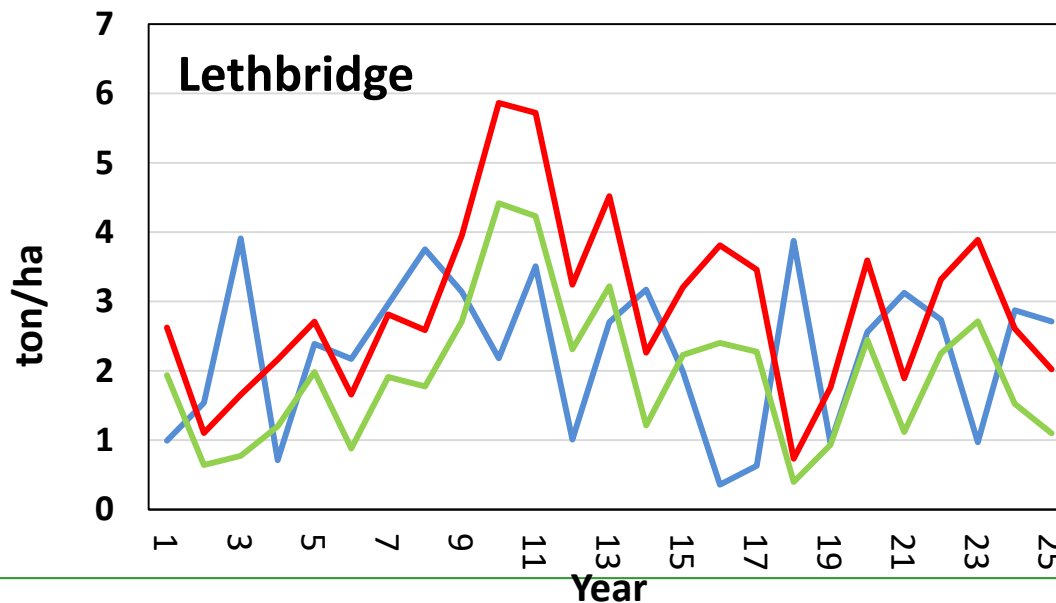


Annual yield projection



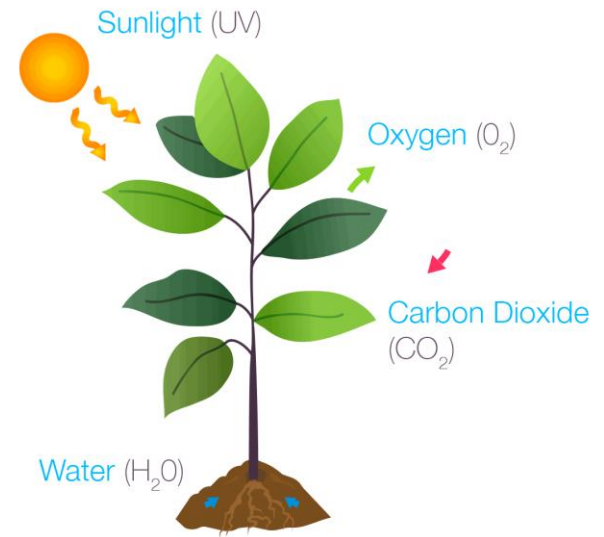
- Historic
- RCP2.6 (Env. friendly scen.)
- RCP8.5 (Worst scen.)

Historic: 1985-2009
Future: 2040-2064



Higher CO₂ concentration boost crop yields by:

1. Increasing the rate of photosynthesis, which spurs growth
2. Reduce the amount of water crops lose through transpiration.





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Setting up a hydrological model of Alberta: Data discrimination analyses prior to calibration

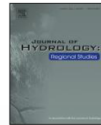
Journal of Hydrology: Regional Studies 9 (2017) 48–68

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Uncertainty in semi-empirical models of crop yield response to climate variables

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Modeling future water footprint of barley production in Alberta: Implications for water use and yields to 2064

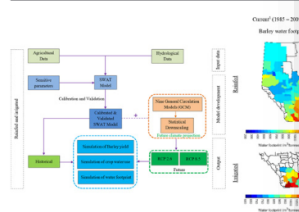
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HIGHLIGHTS

- A framework is developed to model barley yield, water use and water footprint.
- Yield and water footprint of barley is assessed under climate change.
- Rainfed yield is projected to increase and irrigated yield is expected to remain unchanged.
- Water footprint is projected to decrease in future.
- Water footprint is adjusted based on water-stress conditions.

GRAPHICAL ABSTRACT



Article

Assessment of the Combined Effects of Threshold Selection and Parameter Estimation of Generalized Pareto Distribution with Applications to Flood Frequency Analysis

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Crop Yield Response to Climate Variables on Dryland versus Irrigated Lands

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1 Regionalization and parameterization of a hydrologic model significantly affect the cascade of uncertainty in climate-impact projections

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In review: Climate Dynamics

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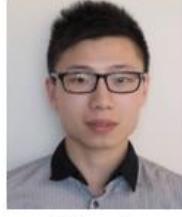
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Wes Lu
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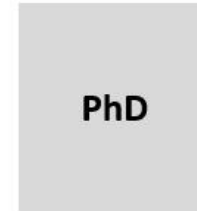
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(U of A)

Vic Adamowicz

Tim McAlister

David Sauchyn

Greg Goss

Jahan Kariyeva; and many more...

**Thank you for your
attention!**