Adaptation to changing water in Alberta

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Picture source: https://teema.lv/tehnika/agro-masz-pov-serijas-arkli/
Adapting to Changing Water in Alberta

(AI, 3 years, on-going)

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

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

Water demand

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

Stakeholder meeting (Alberta WaterSMART)

Agro-hydrologic model
Water budget:

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

When?

Where?
**SWAT Input: temporal data**

- **Landuse:** CFS-AAFC
- **Soil:** SLC-CANSIS
- **Climate:**
- **Topography:** DEM
- **Agriculture:**
- **Hydrometric:**
- **Natural:**
- **Human:**
CO$_2$ driven climate change (anthropogenic)

IPCC global climate models
Temperature change (°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 are the main feed crops in AB.

<table>
<thead>
<tr>
<th>Country</th>
<th>Export (*1000) ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>218.504</td>
</tr>
<tr>
<td>Mexico</td>
<td>35.873</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>10.79</td>
</tr>
<tr>
<td>Japan</td>
<td>8.276</td>
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<tr>
<td>Russian Federation</td>
<td>4.378</td>
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<tr>
<td>Macao</td>
<td>2.271</td>
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<tr>
<td>Taiwan</td>
<td>1.576</td>
</tr>
<tr>
<td>Philippines</td>
<td>1.178</td>
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<tr>
<td>Indonesia</td>
<td>0.929</td>
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<tr>
<td>Egypt</td>
<td>0.619</td>
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<tr>
<td>Other countries</td>
<td>2.937</td>
</tr>
</tbody>
</table>

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)

<table>
<thead>
<tr>
<th>Historical</th>
<th>Future-RCP 2.6</th>
<th>Future-RCP 8.5</th>
<th>Change-RCP 2.6</th>
<th>Change-RCP 8.5</th>
</tr>
</thead>
</table>

Rainfed barley

Irrigated barley

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

- Rainfed barley
  - Historical
  - Future-RCP 2.6
  - Future-RCP 8.5
  - Change-RCP 2.6
  - Change-RCP 8.5

- Irrigated barley
  - Actual ET (mm)
  - Projected changes (%)

Annual yield projection

**Grand Prairie**

<table>
<thead>
<tr>
<th>Year</th>
<th>Historic</th>
<th>RCP2.6 (Env. friendly scen.)</th>
<th>RCP8.5 (Worst scen.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>1.0</td>
<td>2.0</td>
<td>3.0</td>
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<tr>
<td>2009</td>
<td>2.5</td>
<td>3.5</td>
<td>4.5</td>
</tr>
<tr>
<td>2040</td>
<td>3.0</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>2064</td>
<td>4.5</td>
<td>5.5</td>
<td>6.5</td>
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</tbody>
</table>

**Lethbridge**

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<td>7.0</td>
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</tbody>
</table>

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.
Watershed Science and Modelling Lab members and collaborators

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Danielle Loiselle (U of A)
Getahun Legesse (U of M)
Wes Lu (U of A)
Jannatul Fedrdous (U of A)
Hawley Campbell (U of A)
Marcos Cordeiro (L-AAFC)
PhD

Vic Adamowicz
Tim McAlister
David Sauchyn
Greg Goss
Jahan Kariyeva; and many more...
Thank you for your attention!