



Agriculture and
Agri-Food Canada

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Towards Increased Utilization of Weather Forecast Products in Agriculture

**¹Aston Chipanshi, ¹Mark Berry, ¹Marilee
Pregitzer and ²Hai Lin**

¹Agriculture and Agri-Food Canada

²Canadian Meteorological Centre, ECCC

Canada 

Outline

The background of the slide features a warm, golden-brown color palette. In the upper portion, there are several stalks of wheat, some standing upright and others scattered as individual grains. Below the wheat, a white bowl is partially visible, containing more wheat stalks. The overall aesthetic is clean and agricultural.

- **Motivation**
- **Methodology**
- **Sample products from the 2018 growing season**
- **The next steps**

Motivation for forecast products

- **Flooding and drainage impacts agriculture and other economic activities.**
- **Losing infrastructure is costly.**
- **The agricultural calendar is quite narrow across Canada (90 to 120 days).**
- **There are environmental implications from extreme weather events.**

Damage to Infrastructure: Sideslope Failure

200 mm of rain in 48 hours

August 17-19, 2007 (near Saskatoon)



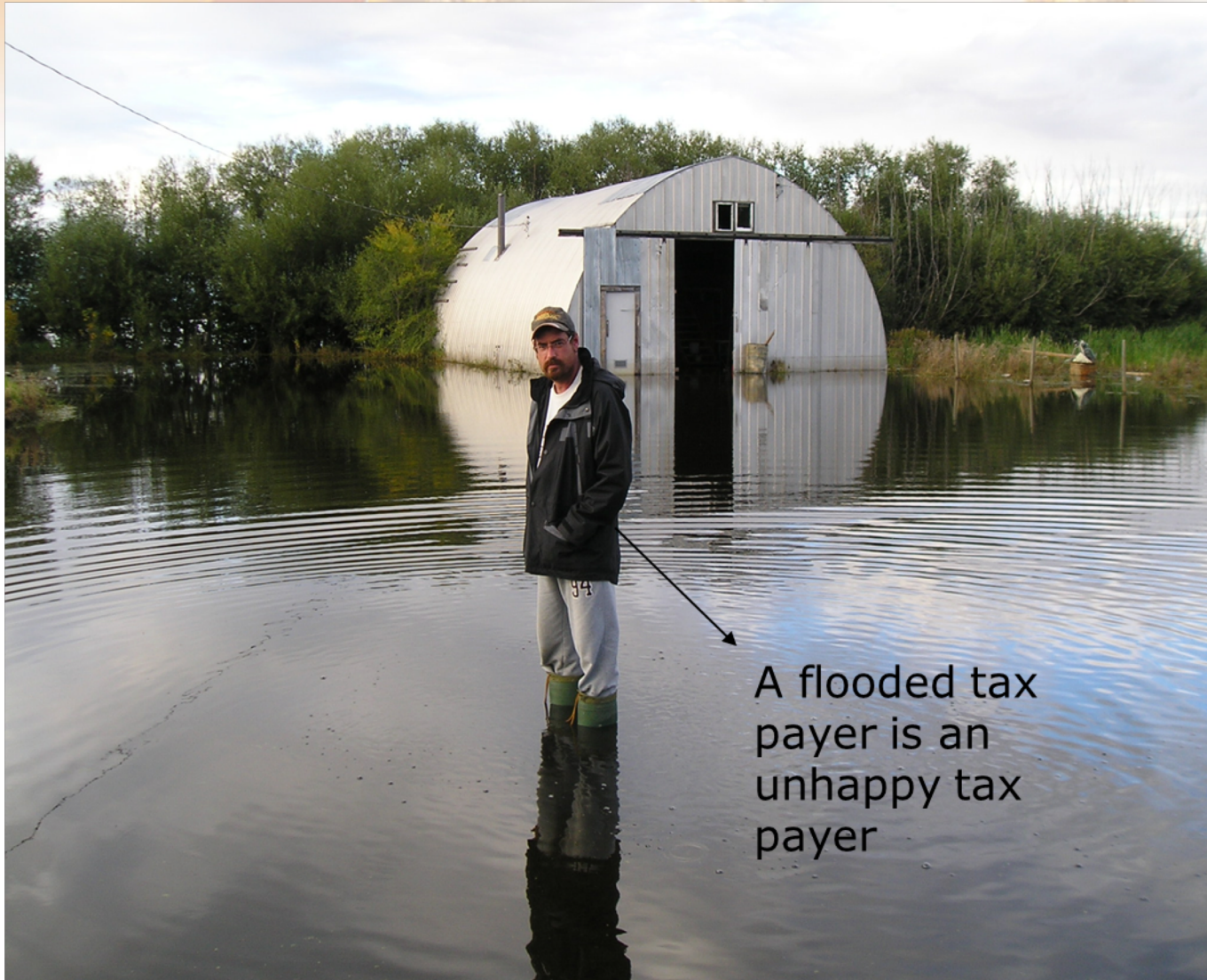
AAFC paid out at least \$15 dollars per acre for 2.9 million acres of flooded ag land in 2006. (Total = \$43 500 000): Red River MB



Rural Infrastructure failure (SK and BC)



Flooded Infrastructures have environmental implications



A flooded tax payer is an unhappy tax payer

High level features of the Global Ensemble Prediction System (source of data)

- **GEM model as the dynamical core**
- **Yin-Yang grid 0.35 x 0.35 (about 39 km)**
- **45 levels, top at 0.1 hPa**
- **Time step of 15 minutes**
- **16 day integration (32 day integration every Thursday)**
- **Disturbed physical parameterizations**
- **Kalman Filter initialization**
- **In operation since 1996, with many upgrades**
- **Is part of North American Ensemble Forecast System (NAEFS)**

Indices were developed for specific crop type

- **Cool season crops -- wheat (*Triticum aestivum* and *Triticum durum*), barley (*Hordeum* spp.), canola (*Brassica napus*), oat (*Avena* spp.), rye (*Secale cereale*), etc.**
- **Warm season crops -- bean (*Phaseolus* spp.), corn (*Zea mays*), pea (*Pisum* spp.), potato (*Solanum tuberosum*) and soybean (*Glycine max*), etc.**
- **Over-wintering crops-- biennial and perennial herbaceous plants (strawberry, alfalfa, timothy, and other forage crops) and woody fruit trees (apple, pear, peach, cherry, plum, apricot, chestnut, pecan, grape, etc.).**

Identified indices and indicators (1) ...

- **Temperature-based indices:**

- **Days of cool wave (DCW)- $f(\text{days}) < 5$ and 10°C ,**
- **Days of heat wave (DHW)- $f(\text{days}) > 30^{\circ}\text{c}$ and 35°C .**

- **Precipitation-based indices:**

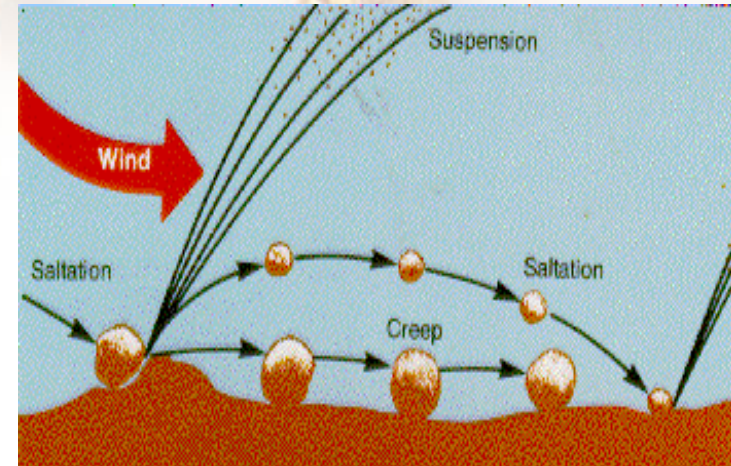
- **Greatest daily precipitation (P1D),**
- **Greatest 10-day precipitation(P10D);**



Identified indices and indicators (2) ...

- **Wind-based indices:**

- **Maximum daily wind speed (MDWS),**
- **Number of strong wind days (NSWD),**
 - **f(days) with wind speed $> 30\text{km hr}^{-1}$**
- **Number of Drying Days (NDD),**
 - **f(days) wind speed $> 30\text{km hr}^{-1}$ and $T_{\text{max}} > 30^{\circ}\text{C}$**



- **Freeze-based indices:**

- **Number of frost-free days (NFFD),**
 - **f(days) $> (-2^{\circ}\text{C}$ and 0°C)**
- **Number of ice-freeze days (NIFD);**
 - **f(days) $< (-2$ and $0^{\circ}\text{C})$**



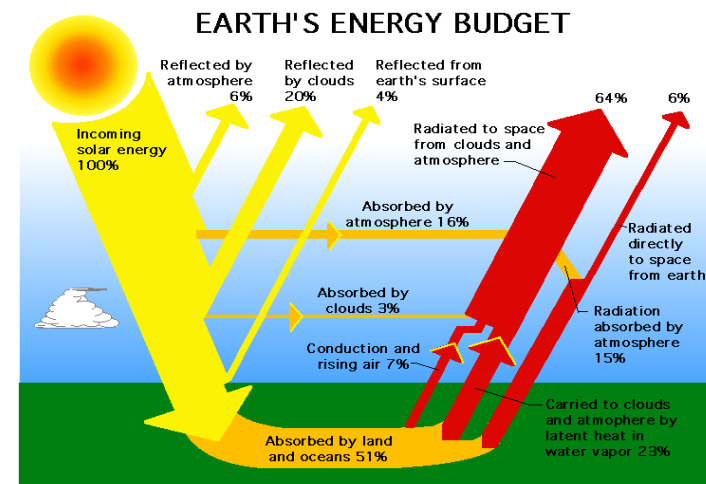
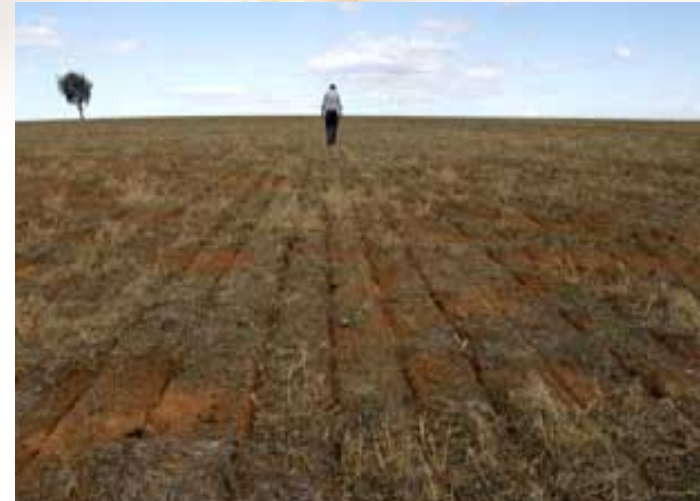
Identified indices and indicators (3) ...

- **Moisture-based indices:**

- **Standardized precipitation index (SPEI),**
- **Crop water deficit (CWD, i.e., P-PE);**

- **Heat energy-based indices:**

- **Effective growing degree days (EGDD)- Heat accumulation using 5° and 10° C T thresholds,**
- **Cumulative crop heat unit (CCHU).**

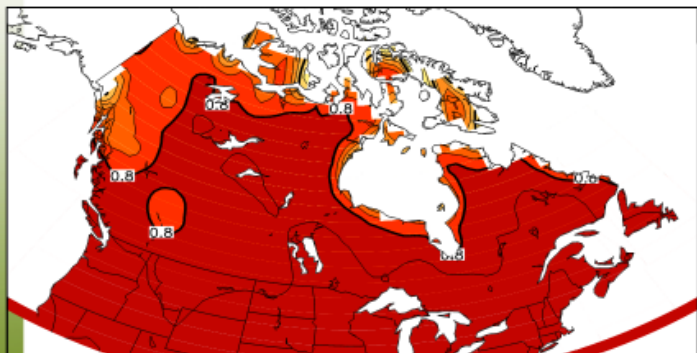


How skillful are these indices?

- **GEMS 384-hours real forecast for 2009-2011**
- **Era-interim daily reanalysis data**
- **Major crop growing season (April-September)**

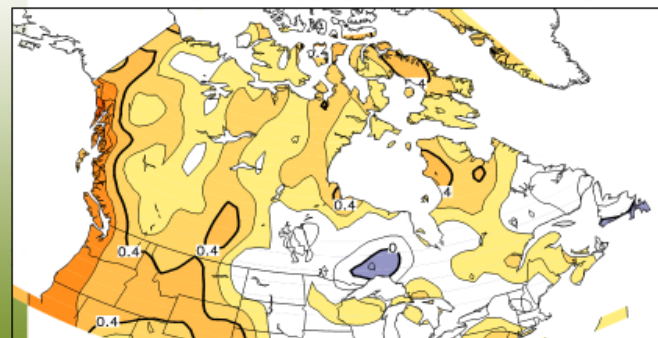
Skill for heat, water and wind based indices

Skill in effective growing degree days for warm season crops 16 days



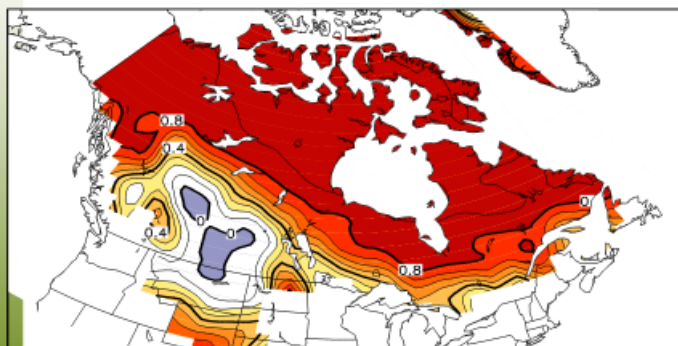
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Skill in greatest daily precipitation 16 days



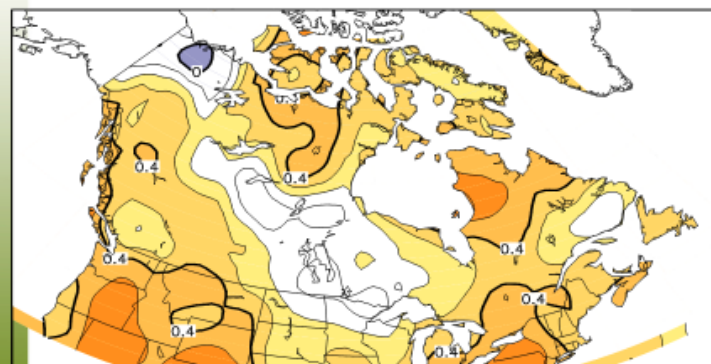
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Skill in ice freeze days for woody crops 16 days



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Skill in maximum daily wind speed 16 days

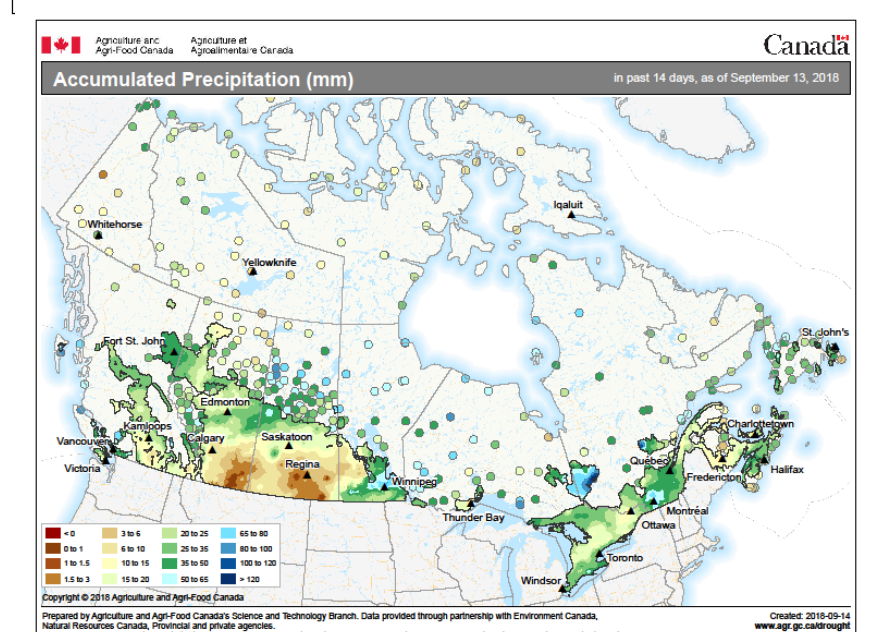
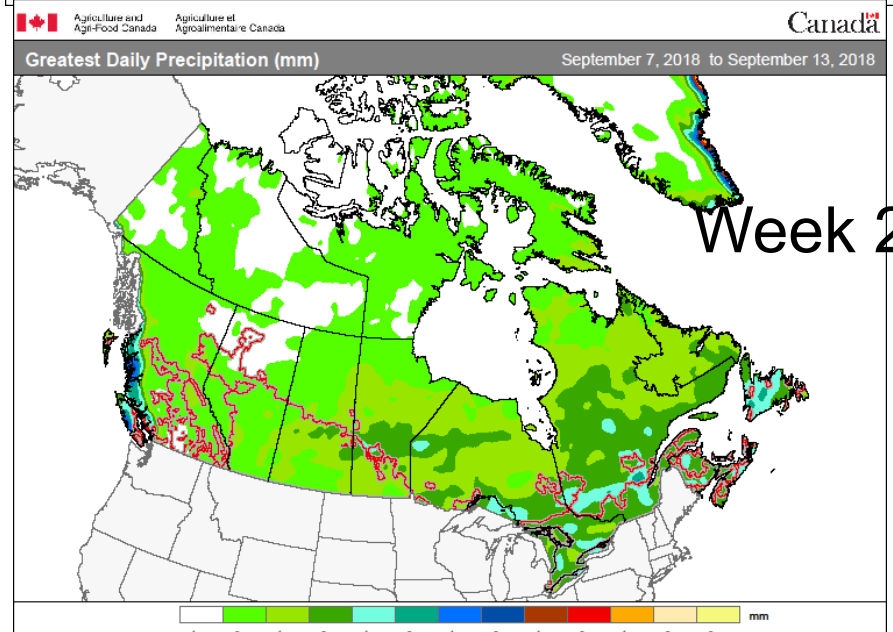
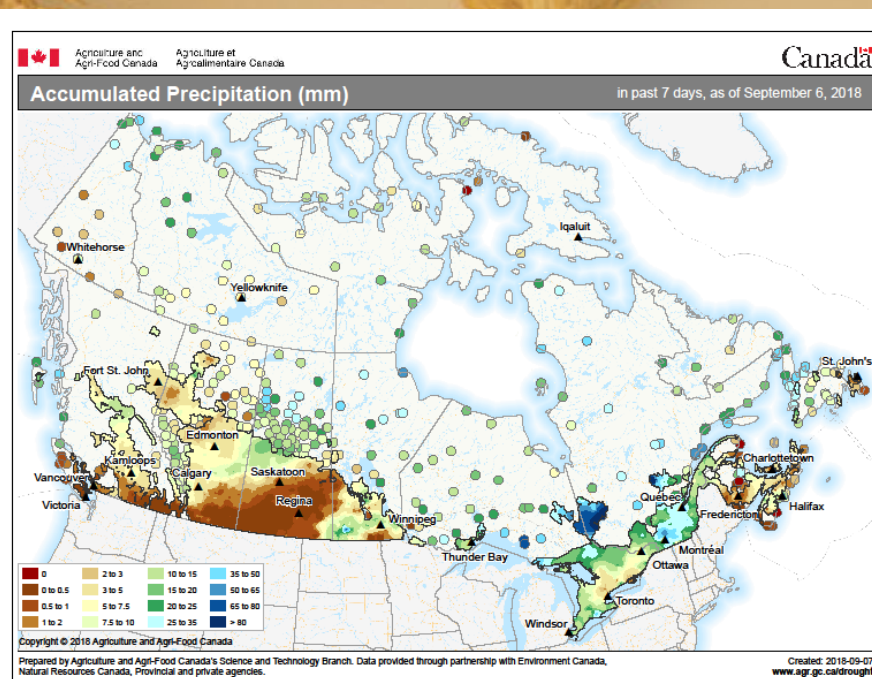
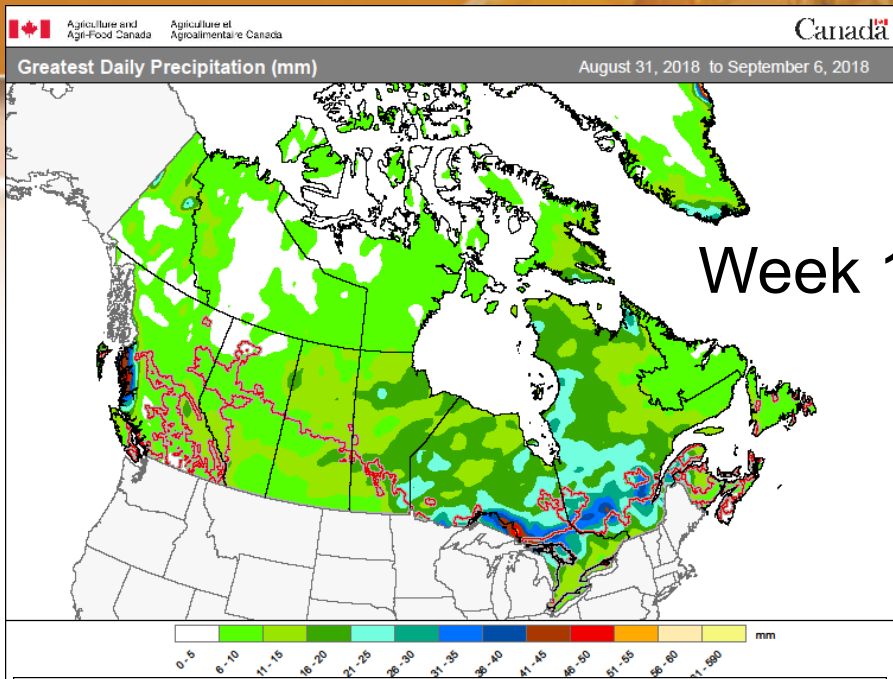


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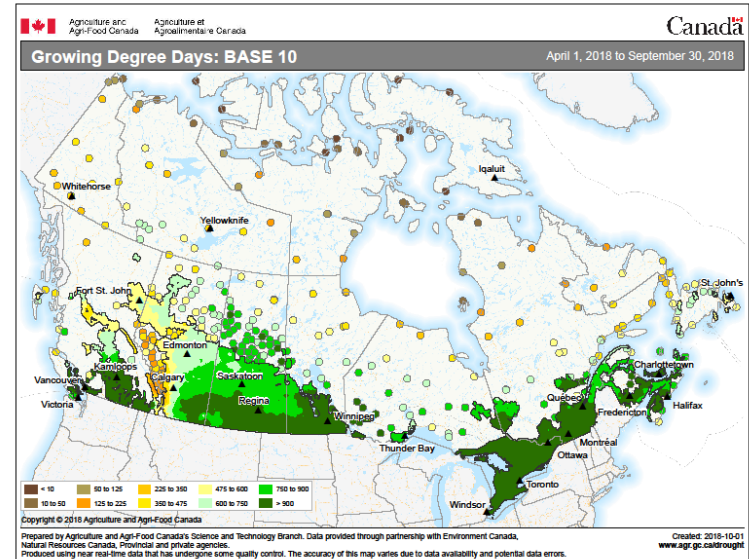
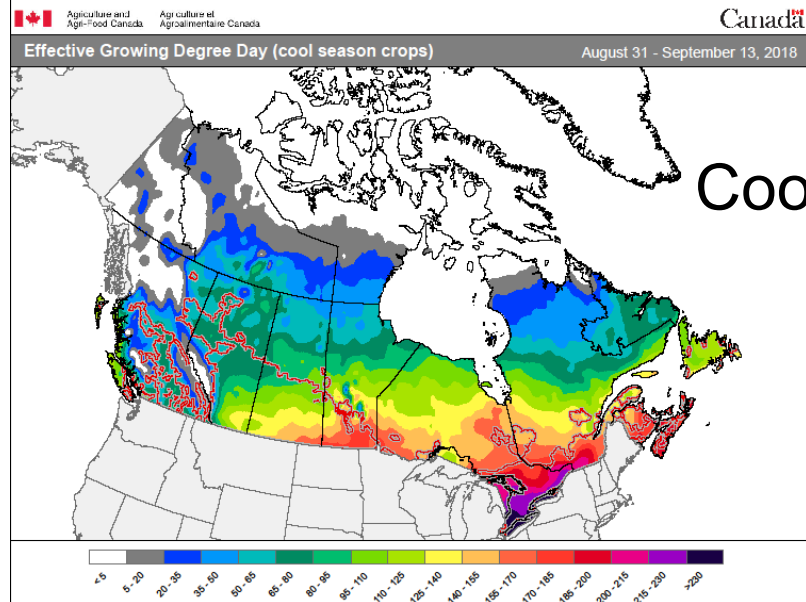
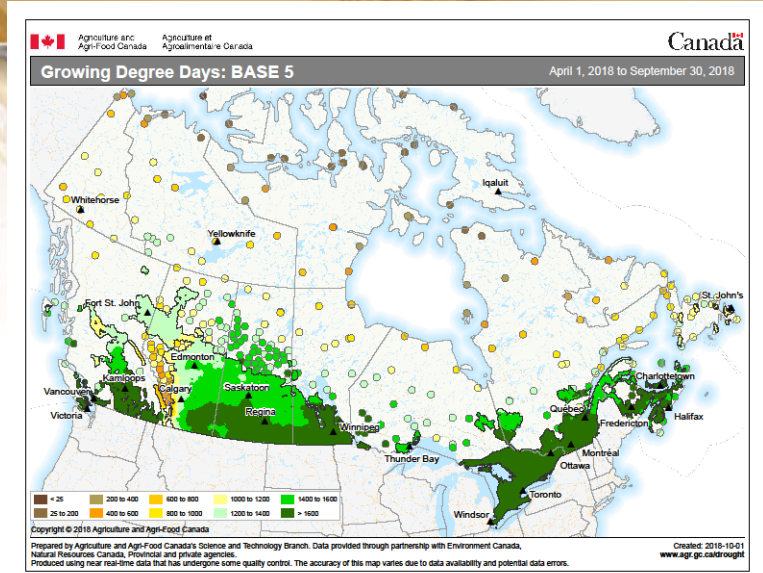
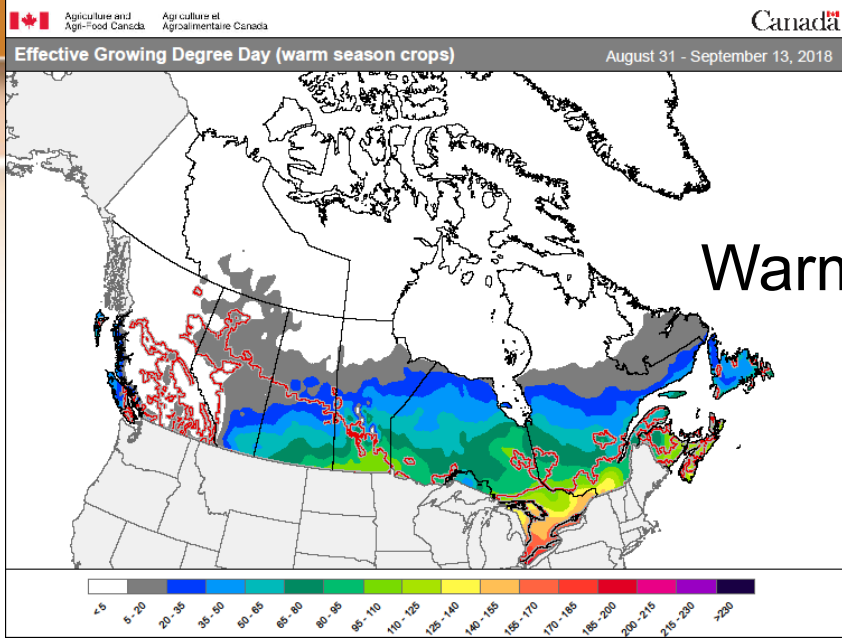
Index skill summary

- Energy and temperature-based indices are realistically forecast over Canada.
- Precipitation based indices exhibit a relatively high forecast skill in western Canada.
- Freeze-based indices are well forecast across Canada, except the Prairies.
- Wind-based indices had spatial differences: maximum daily wind speed is best forecast in western and eastern Canada, has low skill in central Canada; the number of strong wind days more skillful in eastern and central Canada, and low skill in western Canada.

Precipitation forecast and actual observations for Weeks 1 and 2 in September

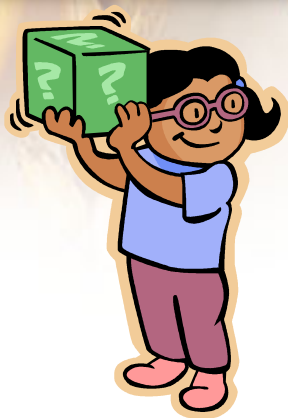


The 2018 Growing Season EGDDs by mid September



The next steps

- **Using the improved GEPS model, forecasts outputs will be provided at 1 to 4 week time steps.**
- **Forecast indices will be posted on a public website: <http://www.agr.gc.ca/eng/programs-and-services/drought-watch>.**
- **Additional indices based on multi-variable inputs from GEPS will be added.**
- **There will be an evaluation of indices with clients (users) that the selected indices are appropriate for agriculture.**



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