

Demonstration on Agricultural crop and land cover statistics

Gordon Reichert, Sylvie Michaud

Statistics Canada

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STATISTICS CANADA
ONE HUNDRED YEARS AND COUNTING

STATISTIQUE CANADA
CENT ANS BIEN COMPTÉS



Statistics
Canada

Statistique
Canada

Canada

Context

- Official statistics are asked to present more timely and more disaggregated data
- Satellite imagery offers opportunities for official statistics and for the Sustainable Development Goals
- Today's presentation will showcase what is being done in the agriculture program

A graphic in the top right corner featuring a blue globe with white lines, a large yellow and blue '100', and a background of faint data points and numbers.

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Context

- Motivation for Statistics Canada :
 - Field Crop Reporting Series - farm surveys
 - estimates seeded area, harvested area, expected yield and production
 - under increasing pressure to reduce response burden and cost of the traditional surveys
 - maintain relevance, accuracy, timeliness, accessibility, interpretability and coherence.
- **Objective: Develop a robust crop yield model for the principal field crops of Canada.**



Develop a robust crop yield model for the principal field crops of Canada

- Three data sources:

1. Coarse resolution satellite data

- 1km: AVHRR – NOAA (1987 – present)
- 250 m: MODIS (2000 – present)

2. Historical and current year statistical survey estimates

3. Agroclimatic data

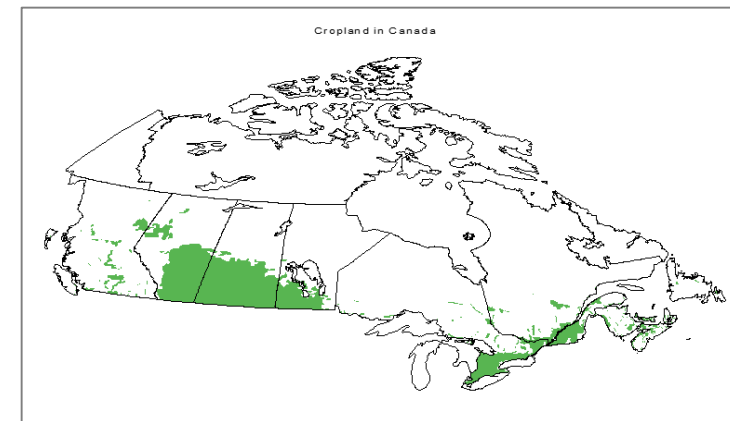


Partnerships

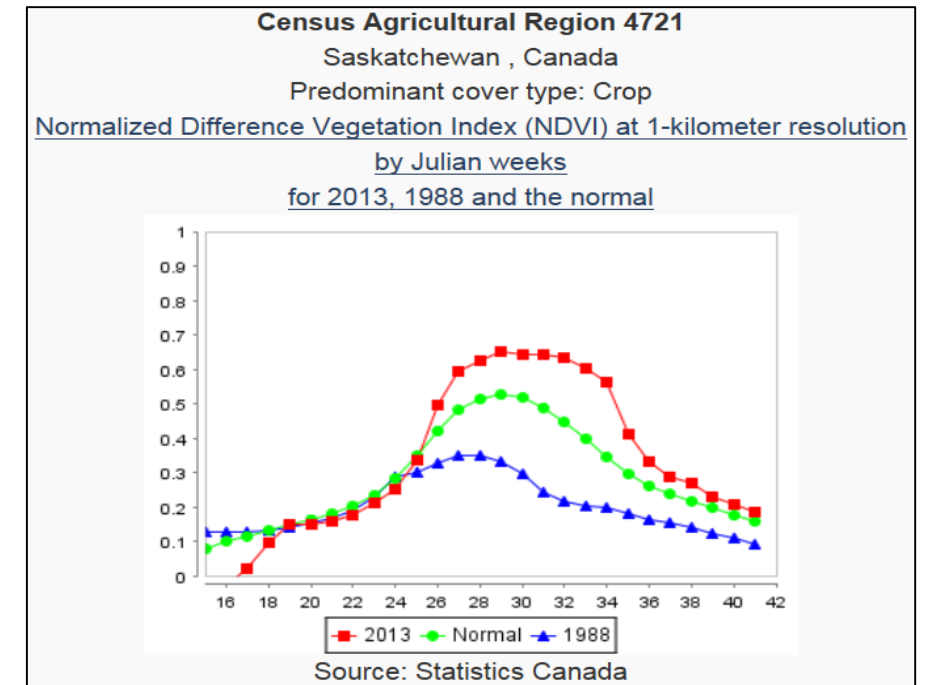
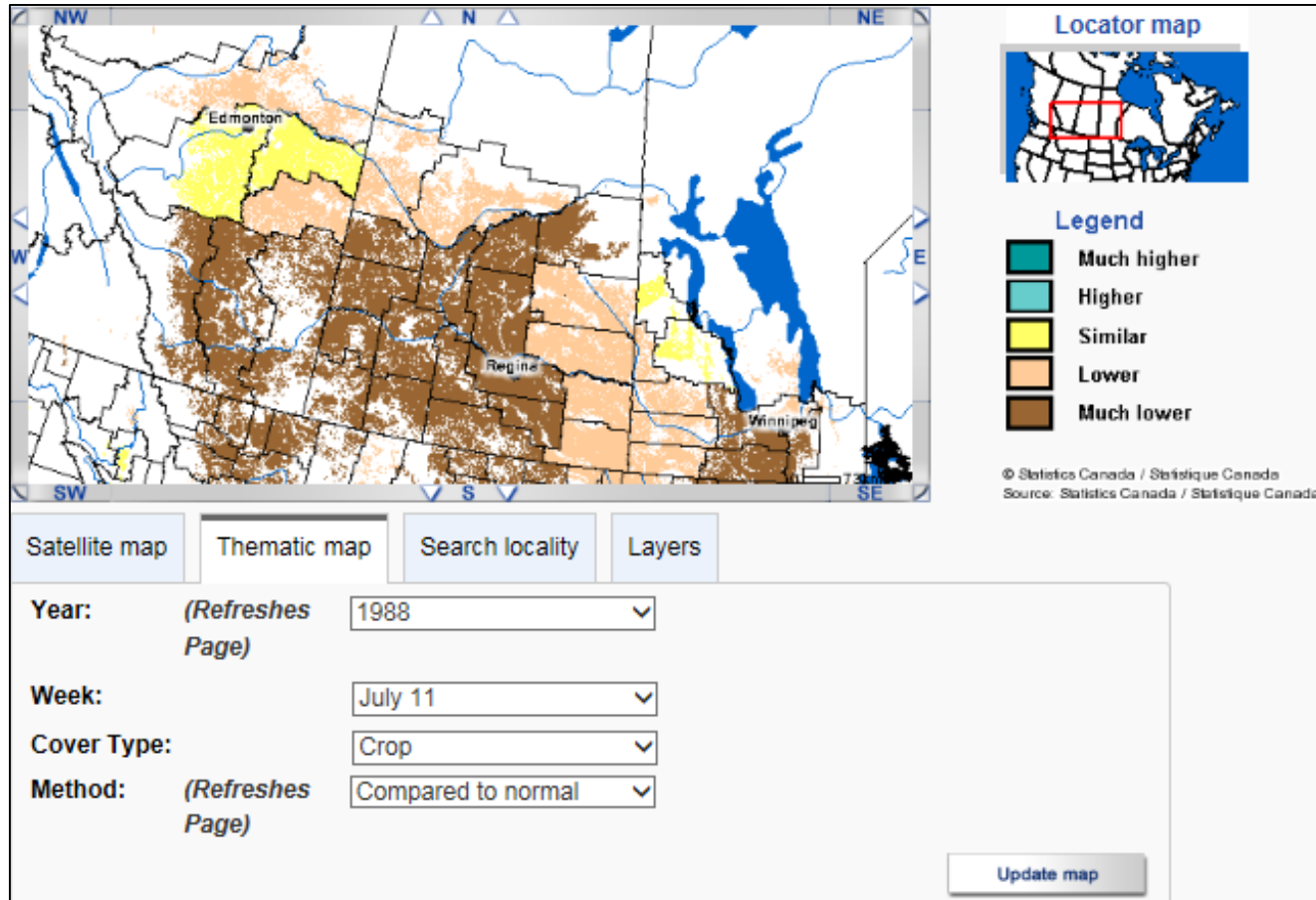
- Collaborative work
 - Statistics Canada and Agriculture and Agri-Food Canada
- Researched and evaluated existing models
 - Successful examples
 - European MARS Crop Yield Forecasting System
 - China Crop Watch
 - Regional yield forecasting products from Queensland,
 - Australia's Agricultural Production Systems Research Unit (APSRU)
- Material Transfer Agreement
 - Agriculture and Agri-Food Canada's yield model transferred to Statistics Canada

Develop a robust crop yield model

- StatCan modified the model within SAS
- Tested on 19 crops published within the September Farm Survey
 - Publication rules applied based on rules for data availability and quality
 - 15 crops published
- National Level
 - Provinces of Alberta, Saskatchewan, Manitoba, Ontario and Quebec
 - Accounts for about 98% of the agricultural land in Canada



First Data Source ; Normalized Difference Vegetation Index: 1987-2018



November Farm Survey
Spring Wheat Yield:

2013: 56.5 bu/ac (record yield)

Normal: 30.8 bu/ac

<http://geodepot.statcan.gc.ca/ccap-peec/start-debut-eng.jsp>



Second Data Source: Survey data

Crop survey data by Small Area Data Region:

- Harvested area
- Yield
- Production

Historical: November Farm Survey

Current year: June, July, November Farm Survey

Home > CANSIM

Table 001-0071 ^{1, 2, 9}

Estimated areas, yield and production of principal field crops by Small Area Data Regions, in metric and imperial units annual

Data table | Add/Remove data | Manipulate | Download | Related information | Help

The data below is a part of CANSIM table 001-0071. Use the [Add/Remove data](#) tab to customize your table.

Selected items [[Add/Remove data](#)]

Type of crop = Barley

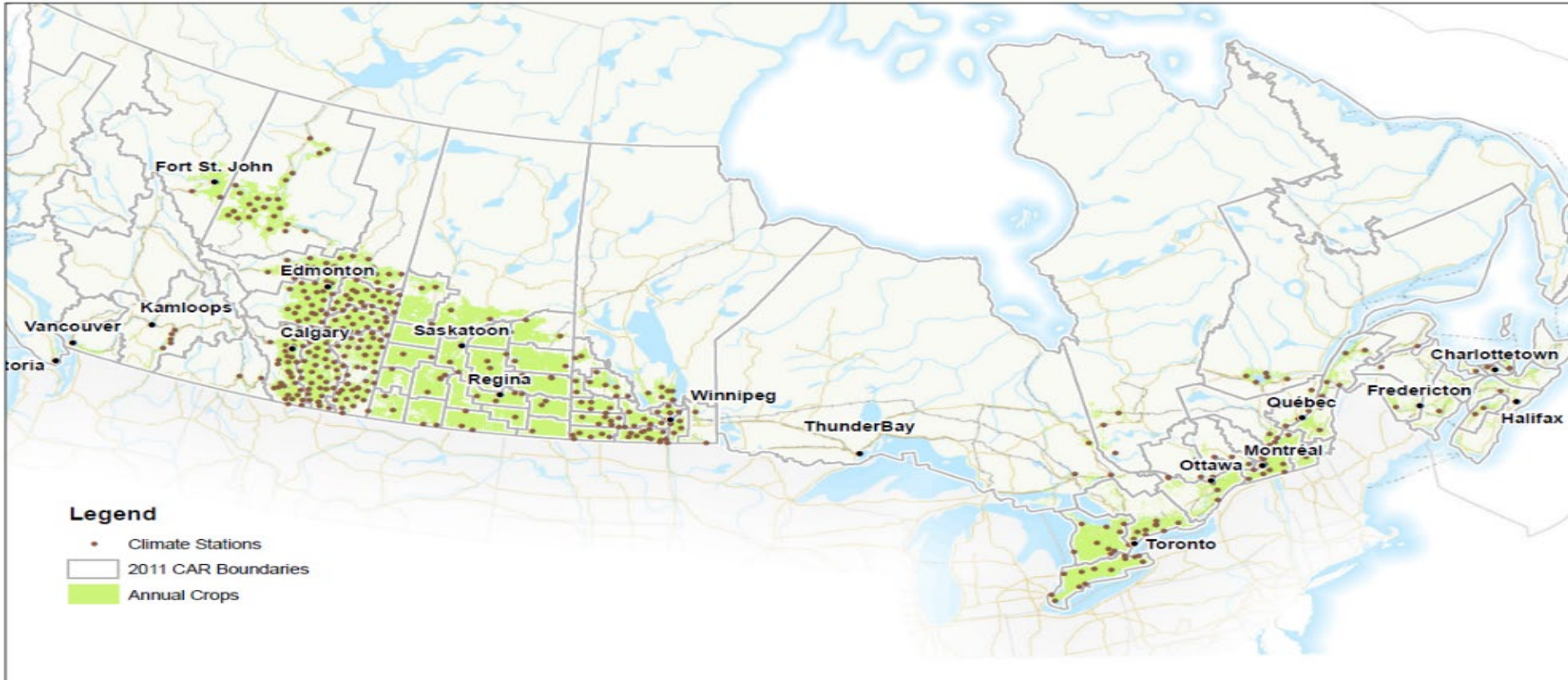
Geography	Harvest disposition	2011	2012	2013	2014	2015
Ontario ¹	Harvested area (acres)	120,000	118,000	105,000	102,000	110,000
	Average yield (bushels per acre)	61.7	64.4	58.9	68.1	66.4
	Production (metric tonnes)	161,100	165,500	134,600	151,300	158,900
Southern Ontario Region 1 - Ontario	Harvested area (acres)	3,200	4,700	6,400	2,300	4,000
	Average yield (bushels per acre)	43.7	61.5	27.8	40.3	64.7
	Production (metric tonnes)	3,000	6,300	3,900	2,000	5,600
Western Ontario Region 2 - Ontario	Harvested area (acres)	59,500	64,700	47,400	57,600	68,600
	Average yield (bushels per acre)	66.8	67.5	66.7	71.9	67.1

CANSIM Table 001-0071

<http://www5.statcan.gc.ca/cansim/a26?lang=eng&retrLang=eng&id=0010071&&pattern=&stByVal=1&p1=1&p2=50&tabMode=dataTable&csid>

Third Data Source: Agroclimatic data

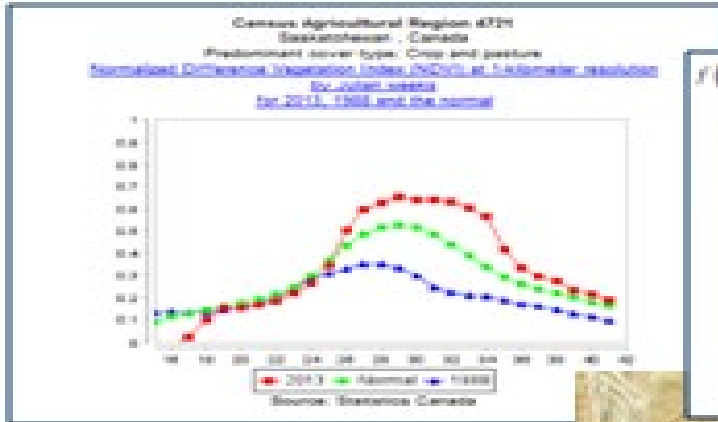
- 80 potential predictors ; maximum number of input variables set at five



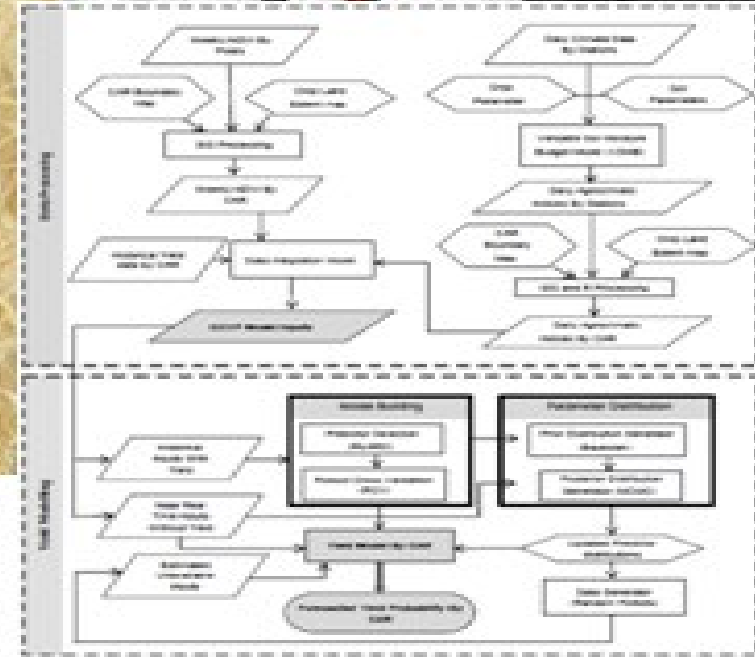
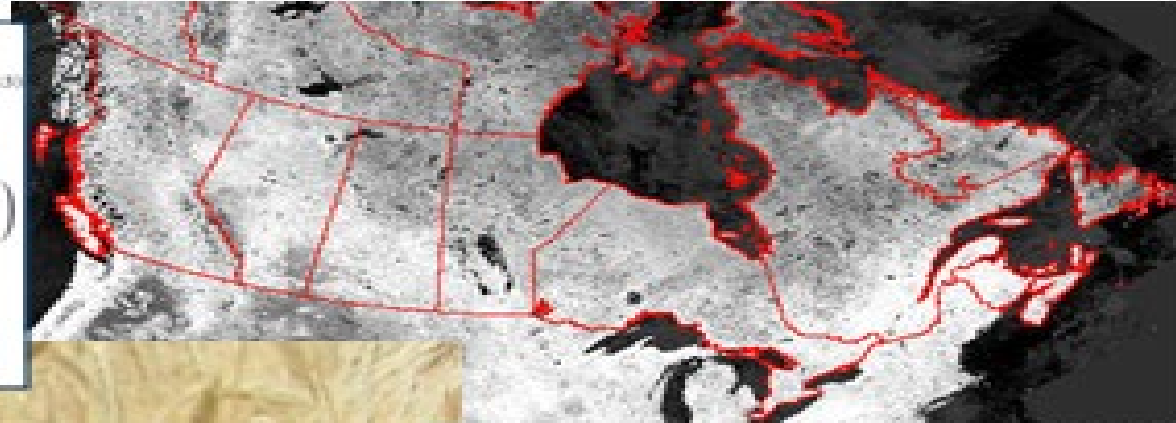
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Crop Yield Modelling



$$\begin{aligned}
 &f(p_0, \dots, p_n | p_0, \theta, D_{0,1}, \dots, D_{n-1}) \\
 &= f(p_0 | \theta) f(p_1 | p_0, \theta) \dots f(p_n | p_{n-1}, \theta) \quad (13) \\
 &= N \left(p_0 + 2p_1 + \sum_{i=1}^n \beta_i^{(0)} x_i^2 + \sum_{i=1}^n \beta_i^{(1)} x_i^2 + \sigma p_1, \sigma^2 \right) \\
 &= N \left(p_0 + 2p_1 + \sum_{i=1}^n \beta_i^{(0)} x_i^2 + \sum_{i=1}^n \beta_i^{(1)} x_i^2 + \sigma p_1, \sigma^2 \right) \\
 &\times \dots \times N \left(p_n + \sigma p_n + \sum_{i=1}^n \beta_i^{(0)} x_i^2 \right. \\
 &\quad \left. + \sum_{i=1}^n \beta_i^{(1)} x_i^2 + \sigma p_{n-1}, \sigma^2 \right).
 \end{aligned}$$

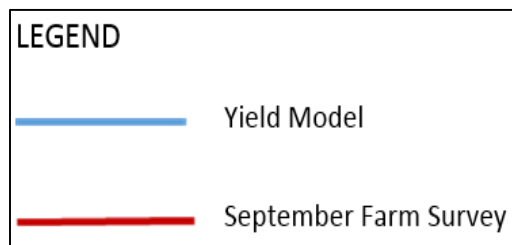
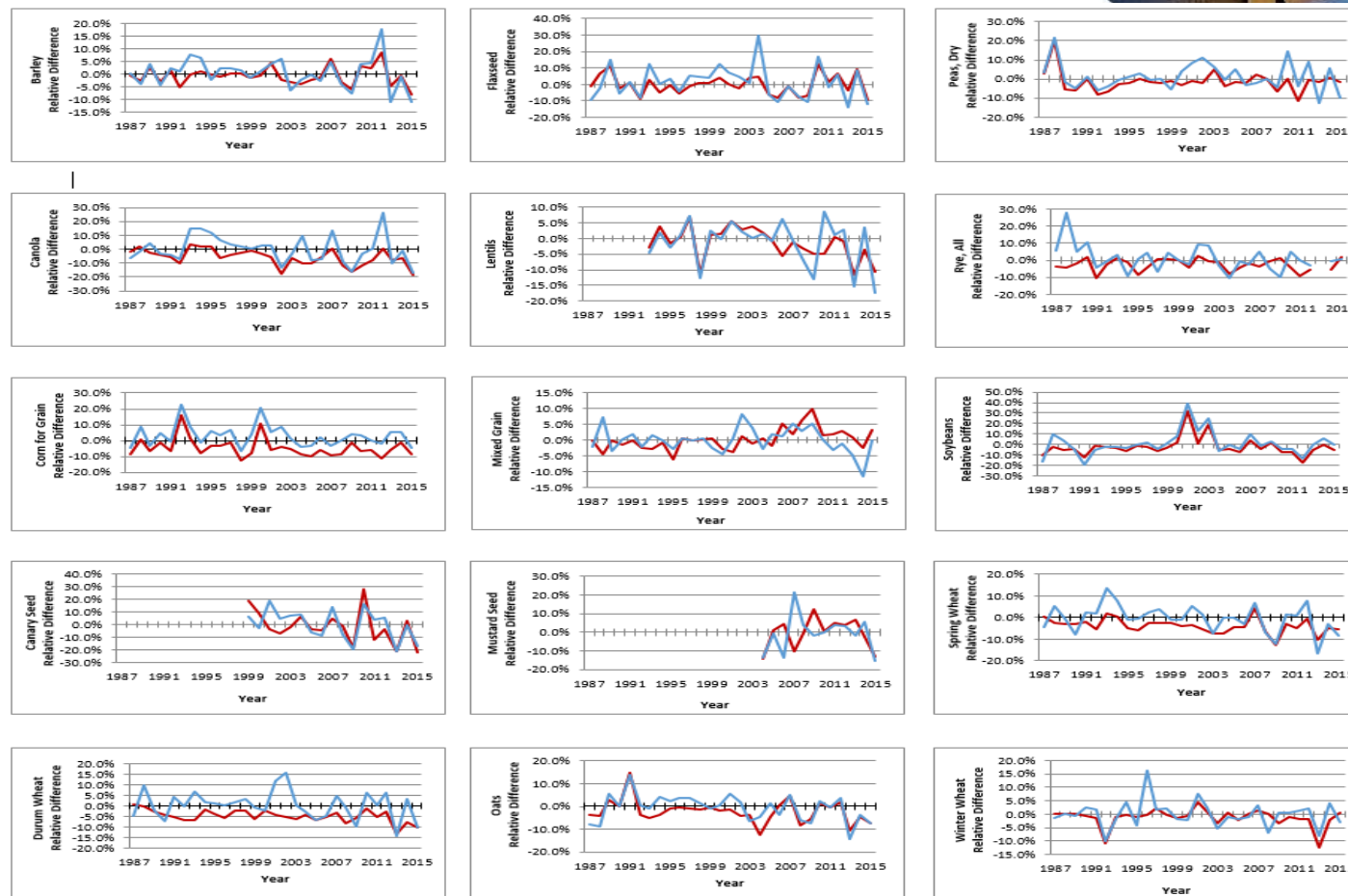


Leave One Out Cross Validation: 1987 - 2015



LOOCV completed by crop

- 19 crops (15 published)
 - Census of Agriculture Region (82)
 - Provincial level (10)
 - National level (1)
-
- Equal to 1767 comparisons



Yield model in the global data platform

- Description of the model
- Video: to facilitate learning (under development)
- Links to FCGEO platform (Canadian geospatial platform)
- Sample data

Way forward

The use of satellite imagery offers opportunities

There is a need to accelerate learning, provide an environment where people can experiment, assess quality

The benefits of a platform might be in facilitating collaboration using trusted:

- methods
- data
- partnerships



Global Platform Crops Yield Project

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https://developers.officialstatistics.org/projects/gri

Anaconda Enterprise 5.2.0-...

Projects Deployments Channels

Projects

Canadian Crops Yield...

Last modified: Oct 16, 2018, 2:20 PM
Owner: alexandreycyr

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Crops Yield Project

Projects / Canadian Crops Yield Model (CCYM) / Activity

Type	Status	Message	Owner	Created	Last modified ^
Open	Done	Session is running.	alexandre Cyr	Oct 16, 2018, 2:22:42 PM	Oct 16, 2018, 2:22:42 PM
Create	Done	Project created	alexandre Cyr	Oct 16, 2018, 2:20:34 PM	Oct 16, 2018, 2:20:34 PM

Crops Yield Project Files



Projects

Deployments

Channels



Projects / Canadian Crops Yield Model (CCYM) / View



Files

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1 /

Name

Last Modified

<input type="checkbox"/>	tmp	a day ago
<input type="checkbox"/>	anaconda-project.yml	a day ago
<input type="checkbox"/>	AVHRR1KM_2010to2014.zip	19 hours ago
<input type="checkbox"/>	AVHRR1KM_2015to2017.zip	19 hours ago
<input type="checkbox"/>	Bands_Weeks_AVHRR_Semaines_Bandes.xlsx	a day ago
<input checked="" type="checkbox"/>	StatCan_Yield_Model_2018_Dubai_final.pptx	a minute ago

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