The Eastern Ontario Farm Model

Modelling The Effect of Changing Weather Patterns on Farming Operations

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Getting past generalization

- Temperature is increasing
  - Longer growing seasons,
    - Earlier spring?
    - Earlier seeding?
    - Later falls?
- Precipitation is increasing, becoming more variable.
  - Better growing conditions??
- More extremes
  - ????

All this equals Changing weather patterns.

The Question

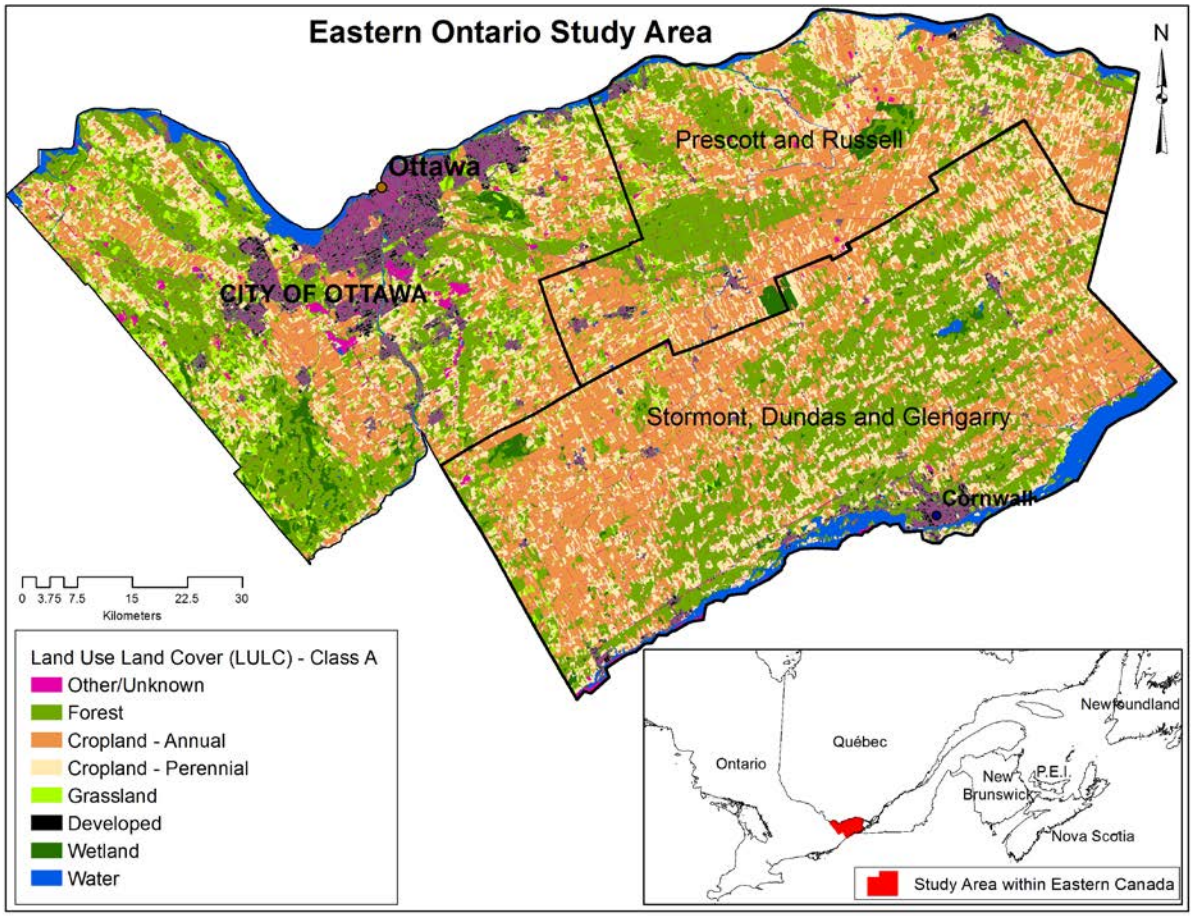
- How do we look critically at what a change in weather patterns does to individual farms?

First day of the growing season!!

- Crop specific = Corn, Soy, alfalfa
- Spatially explicit = varied weather across the region
- Operationally sensitive = individual farms, varied seeding dates, impacted by weather.

Simulation model for Eastern Ontario

Study Area


Eastern Ontario Study Area
N
Ottawa
Prescott and Russell
CITY OF OTTAWA
Stormont, Dundas and Glengarry
Cornwall
0 3.75 7.5 15 22.5 30
Kilometers
Land Use Land Cover (LULC) - Class A
Other/Unknown
Forest
Cropland - Annual
Cropland - Perennial
Grassland
Developed
Wetland
Water
Ontario
Québec
Newfoundland
New Brunswick
P.E.I.
Nova Scotia
Study Area within Eastern Canada

Agricultural Systems in Eastern Ontario

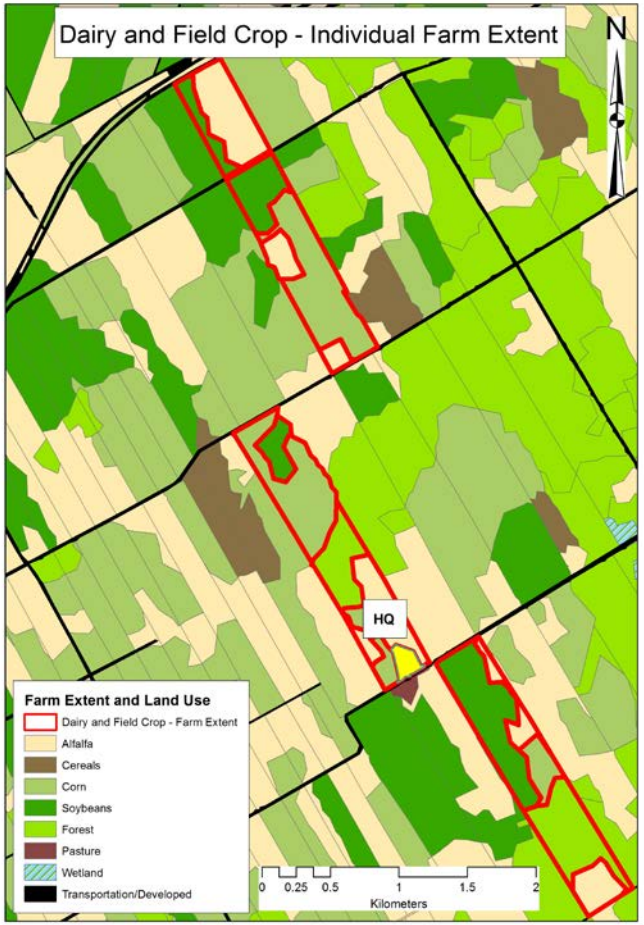
- Agricultural operations are primarily dairy, field or cash crop, beef with some pig and poultry production.
- The principal crops are corn, soy, cereals and perennial hay.

Envision Eastern Ontario Model

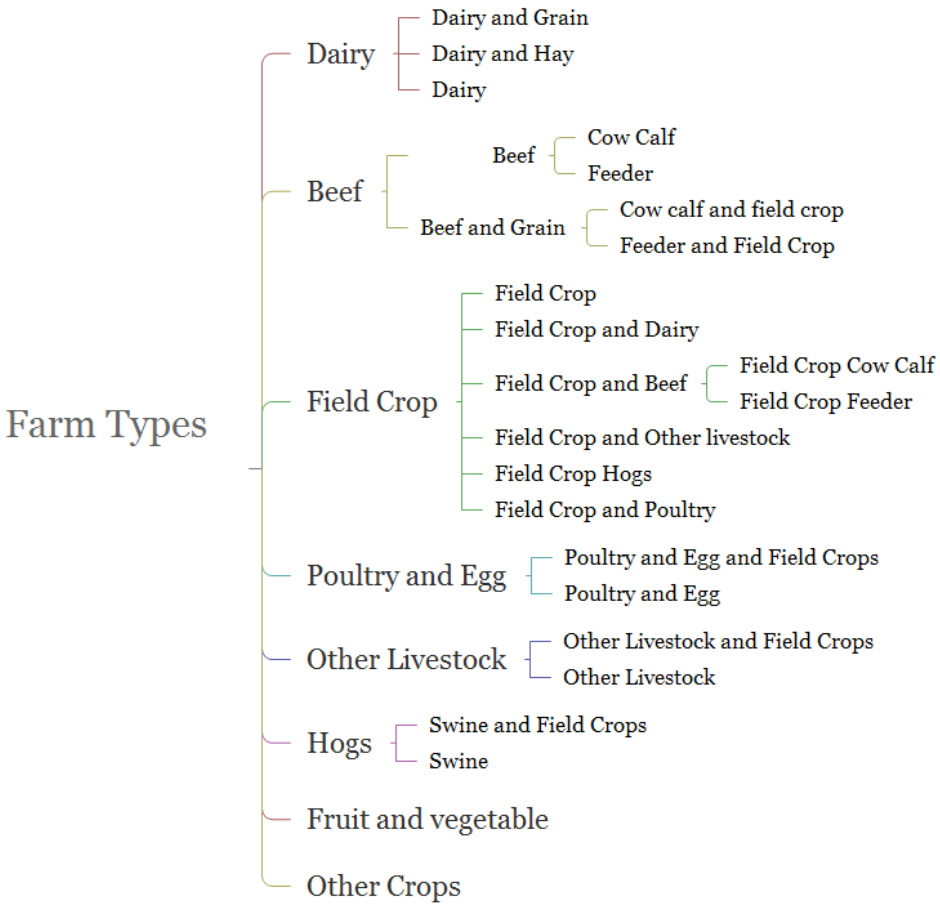
- 2844 farms of 22 farm types
  - Based on census of agriculture statistics
  - Spatially distributed on the landscape
    - Average farm size, not their real locations
- Weather and farming operations follow a daily time step.
  - Maximum and minimum temperature and precipitation.
- Crops development - heat unit based growth curves.

Envision Eastern Ontario Model

- Two data classes, Field and farm
  - Fields = Integrated Decision Units (IDU)
    - AAFC Crop cover (2011)
    - Grouped in legal survey (cadastre) polygons
  - Farms = Collection of cadastre polygons



Farm Types


Farm Types
Dairy
Dairy and Grain
Dairy and Hay
Dairy
Beef
Beef
Cow Calf
Feeder
Beef and Grain
Cow calf and field crop
Feeder and Field Crop
Field Crop
Field Crop
Field Crop and Dairy
Field Crop and Beef
Field Crop Cow Calf
Field Crop Feeder
Field Crop and Other livestock
Field Crop Hogs
Field Crop and Poultry
Poultry and Egg
Poultry and Egg and Field Crops
Poultry and Egg
Other Livestock
Other Livestock and Field Crops
Other Livestock
Hogs
Swine and Field Crops
Swine
Fruit and vegetable
Other Crops

Separating classes

Total Field Crop (FC) Farms	725	
FC farms reporting Dairy Cows	29	29 Field Crop Dairy Farms
FC farms reporting Hogs (Sows + Weiner + Grower)	7	7 Field Crop Hog

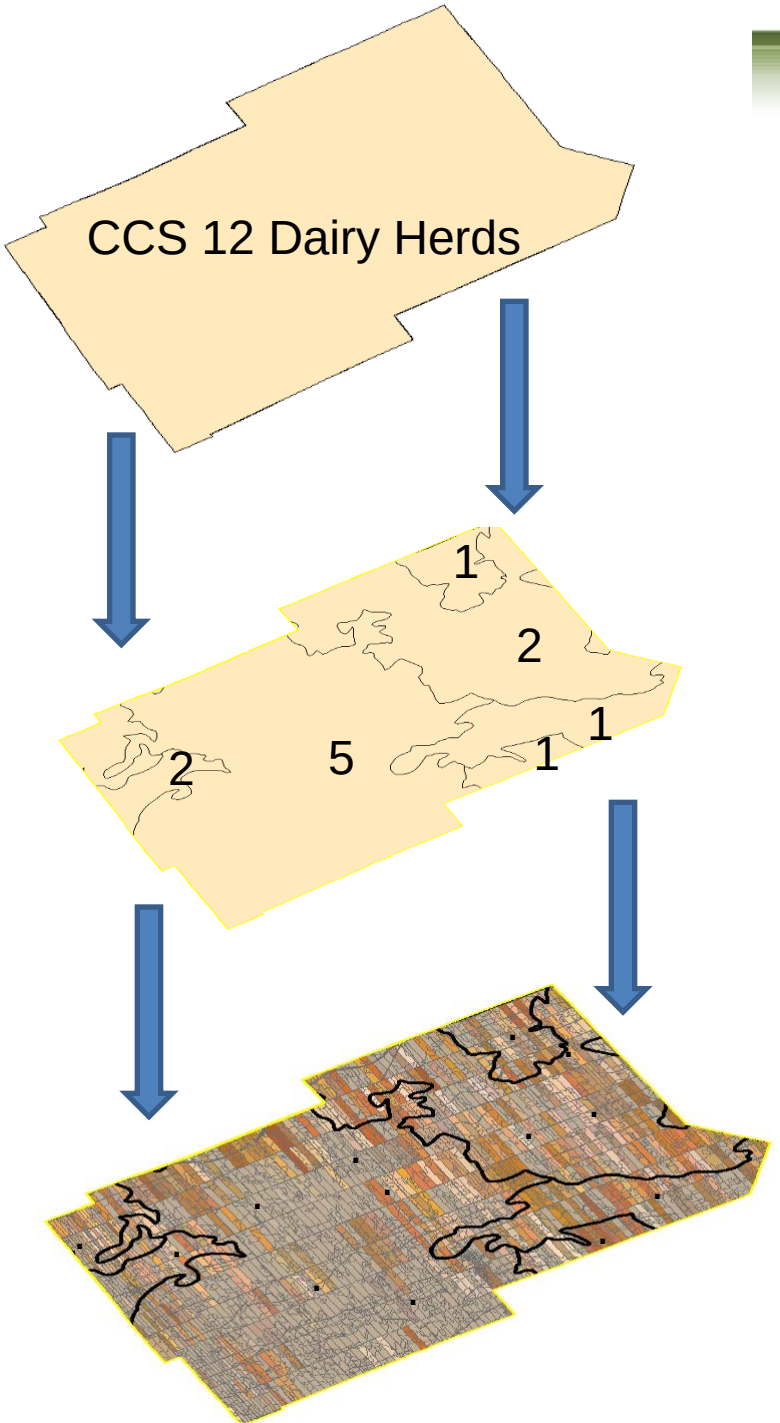
CCS - Consolidated Census Subdivision

Farm Types

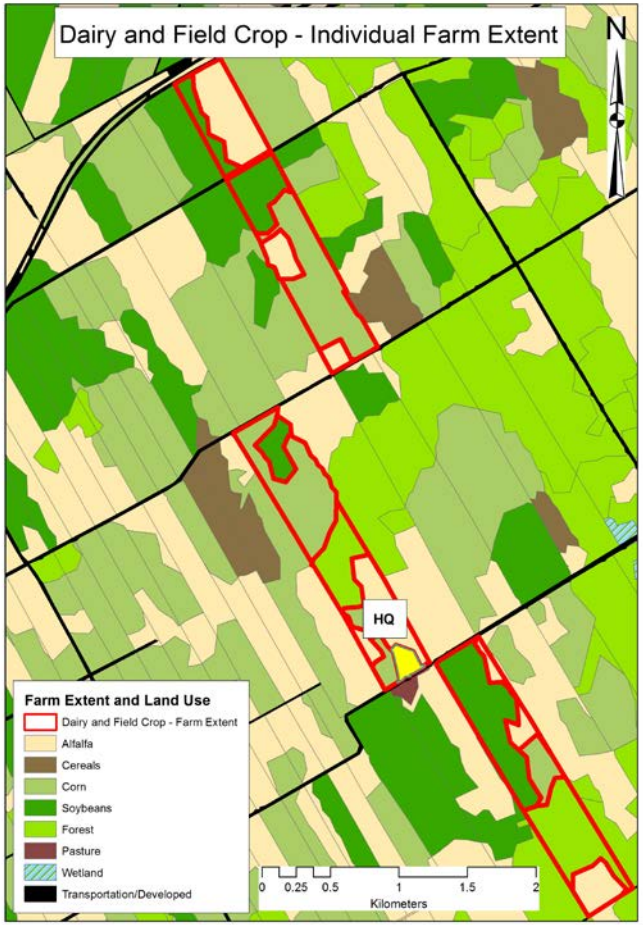
Ag Census SLC Regions

Derived from Soil Landscapes of Canada

IDU - Integrated Decision Unit

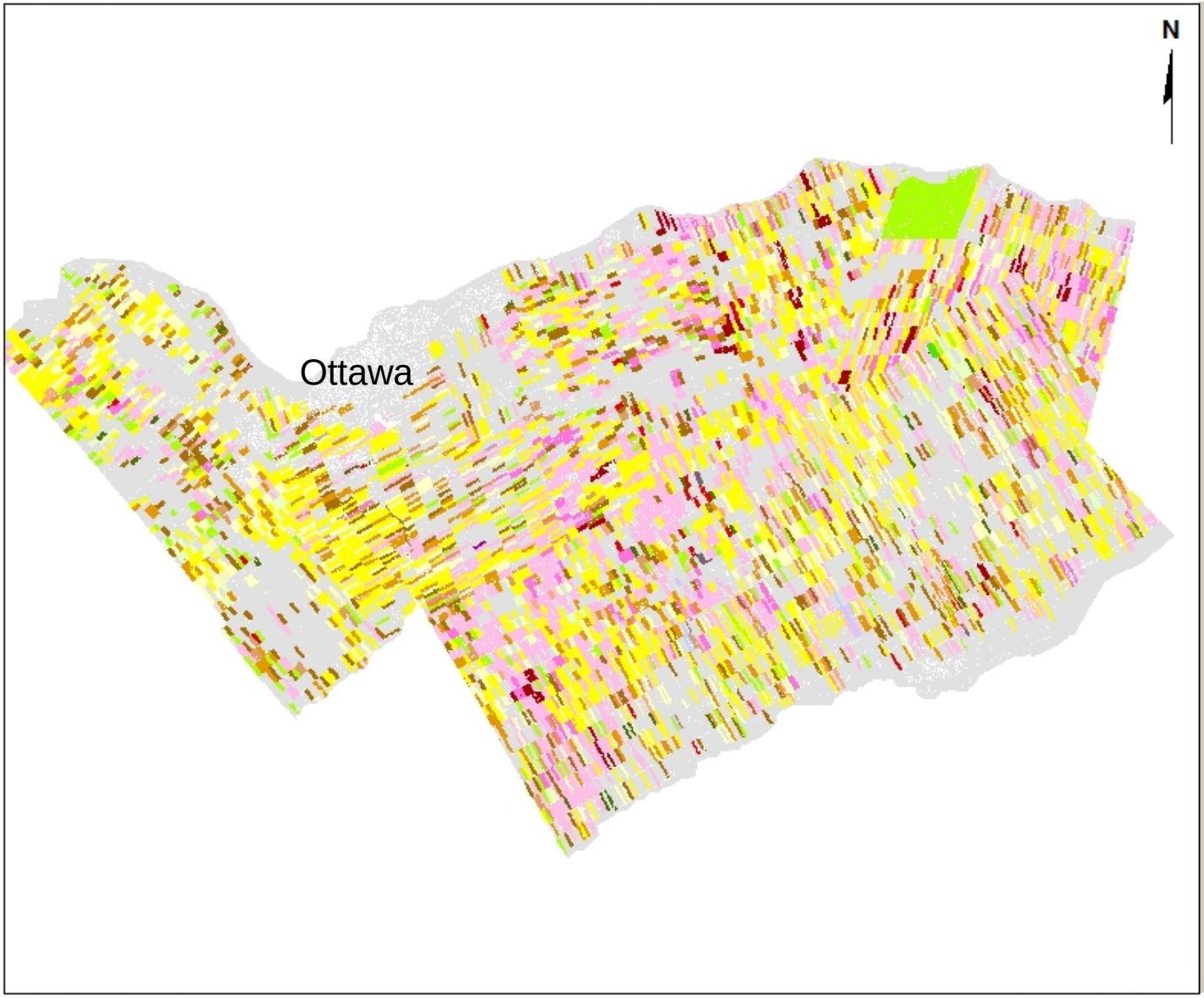


Individual Farm



Eastern Ontario Farm Types

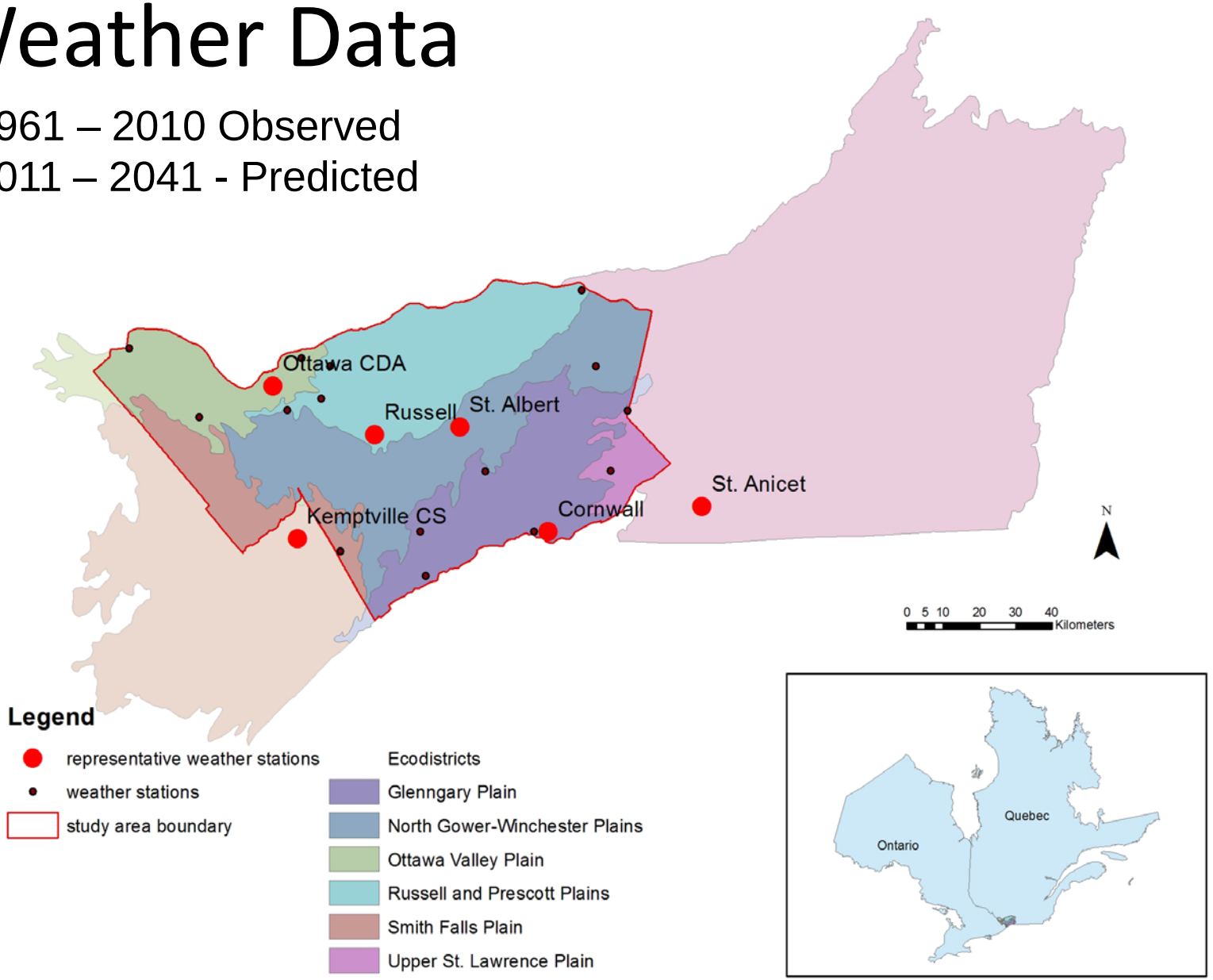
Census of Ag 2011



Produced by Agriculture and Agri-Food Canada
Agri-Environment Services Branch, Agri-Geomatics

Weather Data

- 1961 – 2010 Observed
- 2011 – 2041 - Predicted

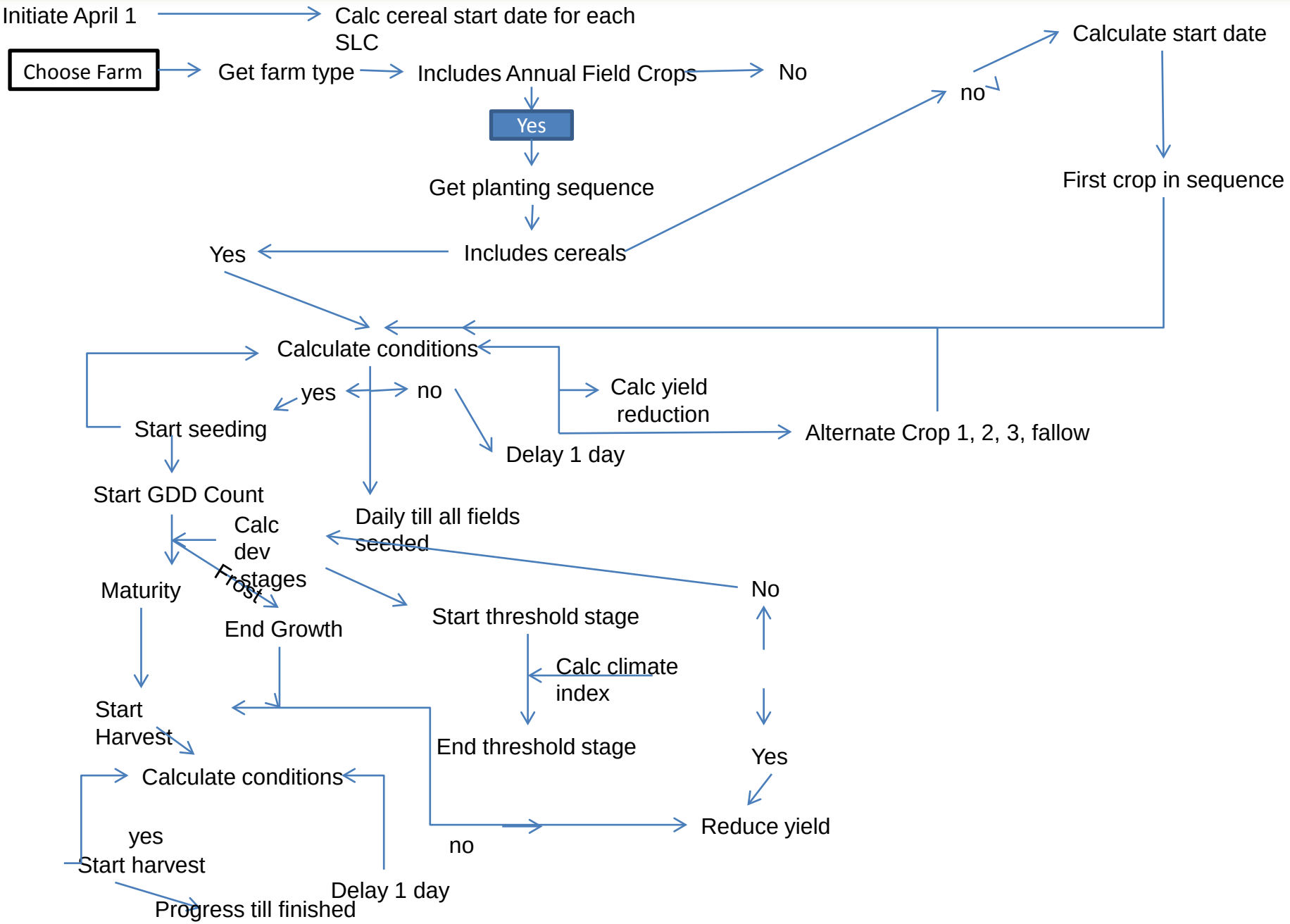


Eastern Ontario seeding patterns

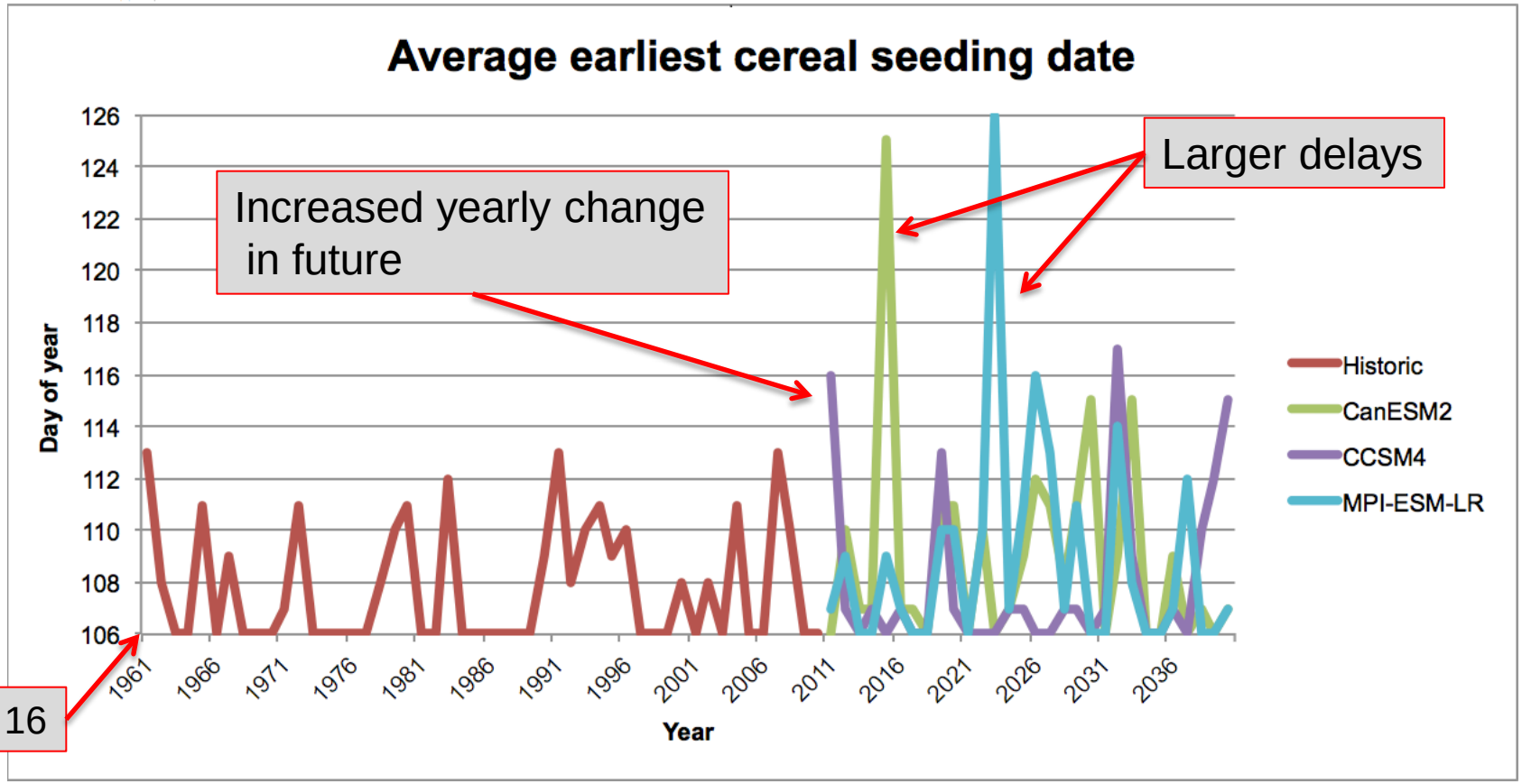
- Target Planting dates for crops
  - Cereal – April 15
  - Corn – May 1
  - Soy – May 10
- Planting is delayed by weather events (wet weather, late green up)
- Start date for the next crop is the last date for seeding of the previous crop.
- Farmers can seed 100 acres per day.

Critical Periods during seeding season

- Green-up, start of operations
- Seeding delays
  - Lost days of operations
    - During seeding, Change in intended crop as a result of delays
- Reseeding
  - Late frost, flood, etc.

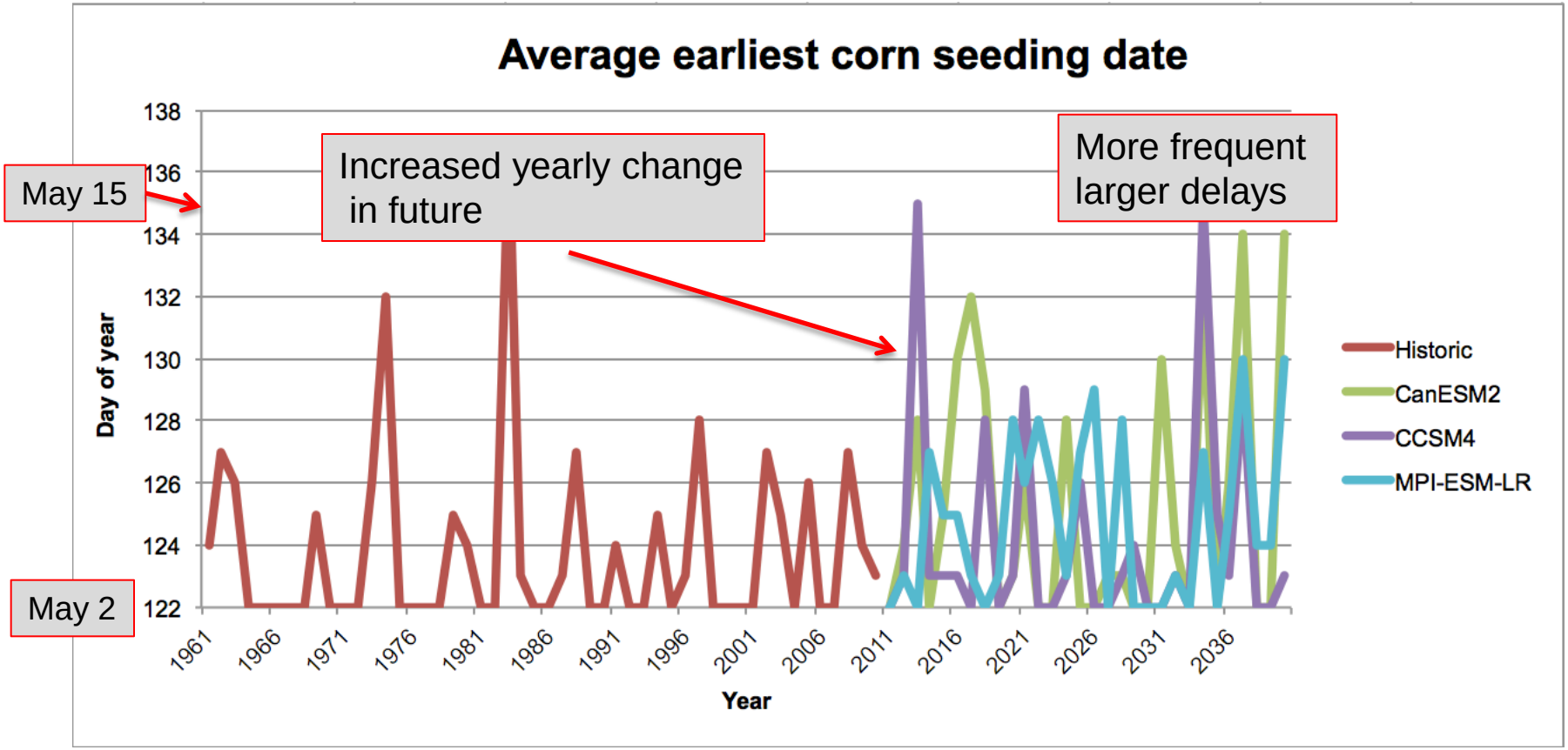

Initiate April 1
Calc cereal start date for each SLC
Choose Farm
Get farm type
Includes Annual Field Crops
No
Yes
Get planting sequence
Includes cereals
Yes
no
Calculate start date
First crop in sequence
Calculate conditions
yes
no
Start seeding
Delay 1 day
Calc yield reduction
Alternate Crop 1, 2, 3, fallow
Start GDD Count
Calc dev stages
Frost
Maturity
End Growth
Daily till all fields seeded
No
Start threshold stage
Calc climate index
End threshold stage
Start Harvest
Calculate conditions
yes
Start harvest
Progress till finished
Delay 1 day
no
Yes
Reduce yield

Weather Impacts – Seeding date



30% increase in 7 day ppt over 30 year average = delay 1 day

Weather Impacts – Seeding Date



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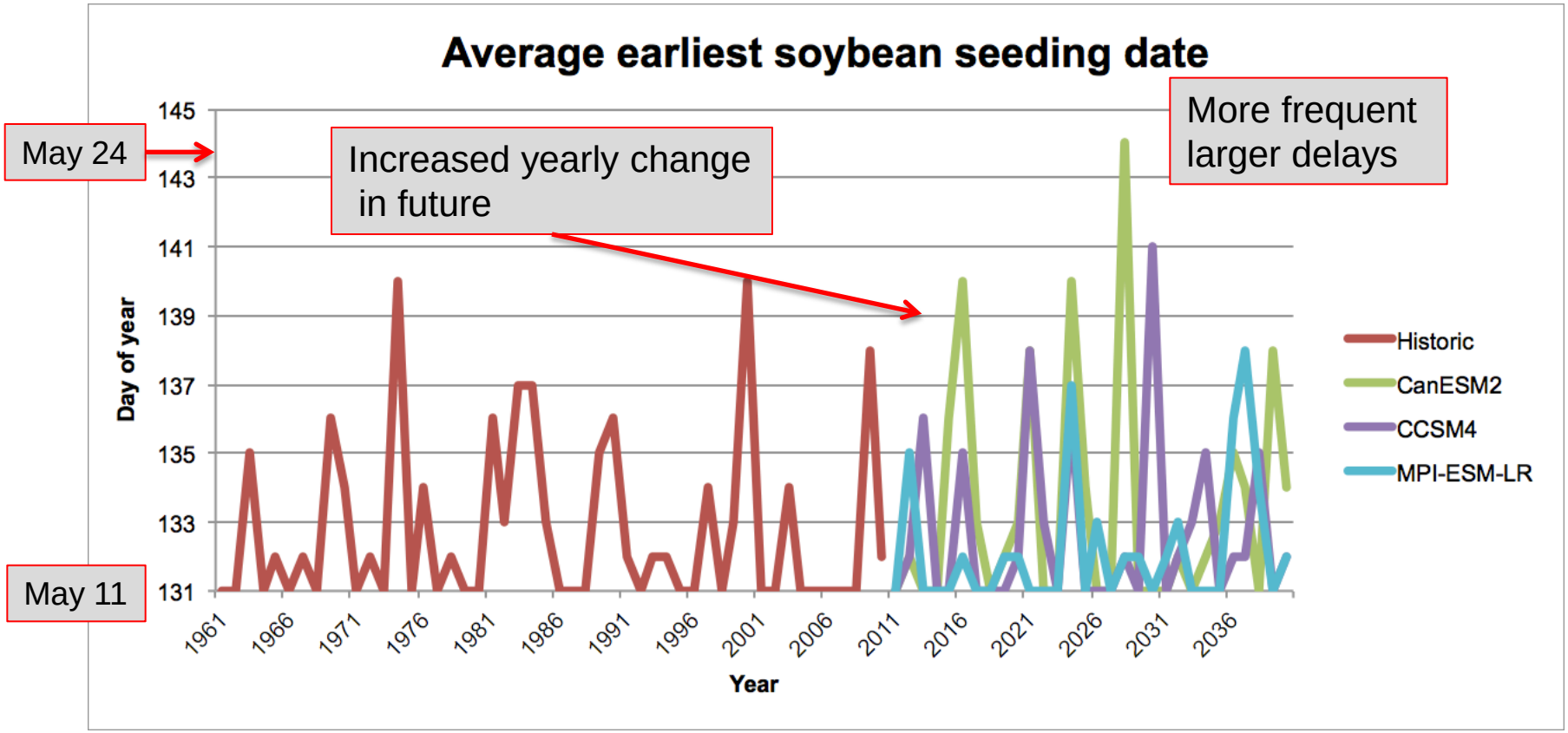
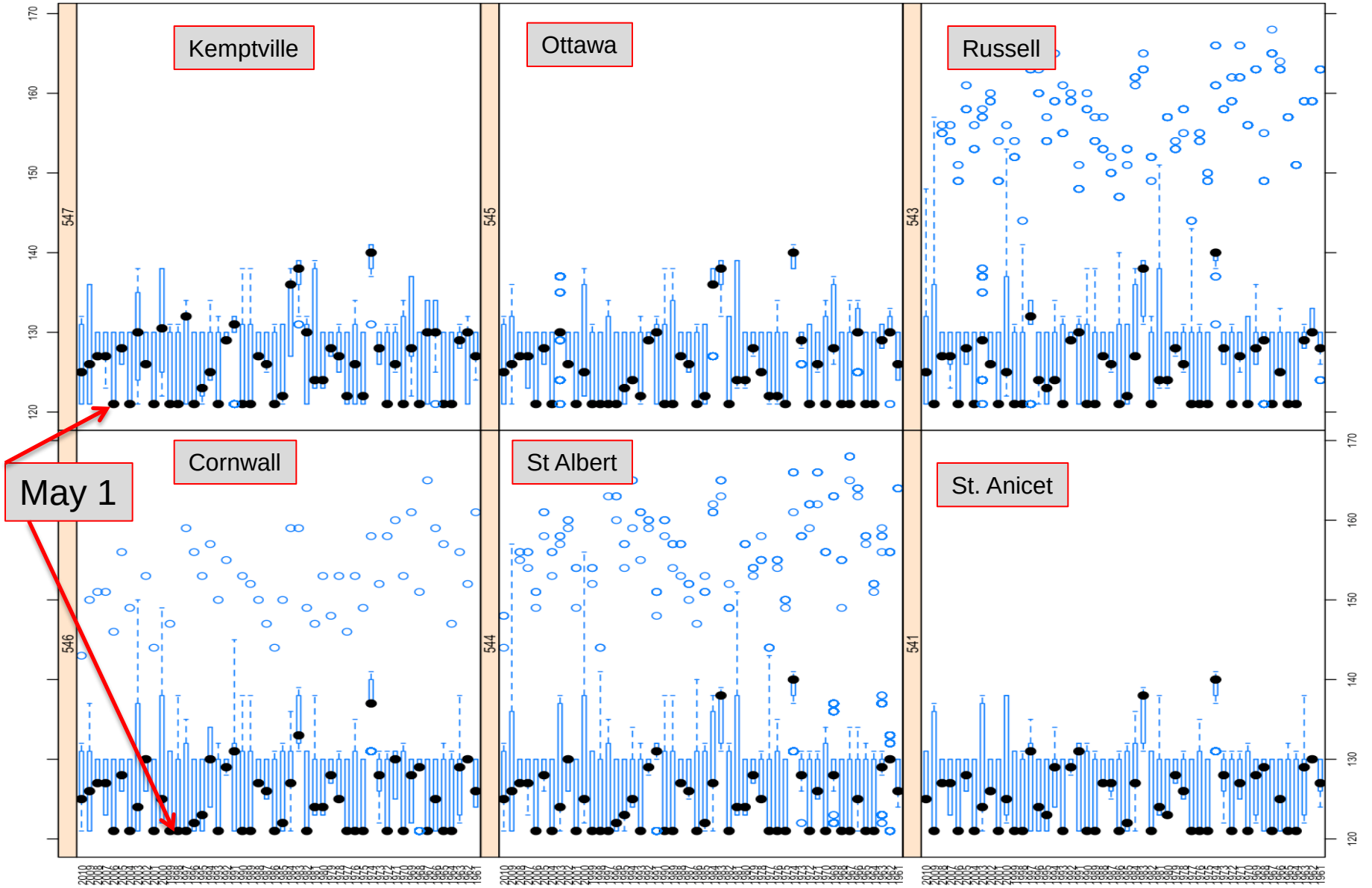
Weather Impacts – Seeding Date

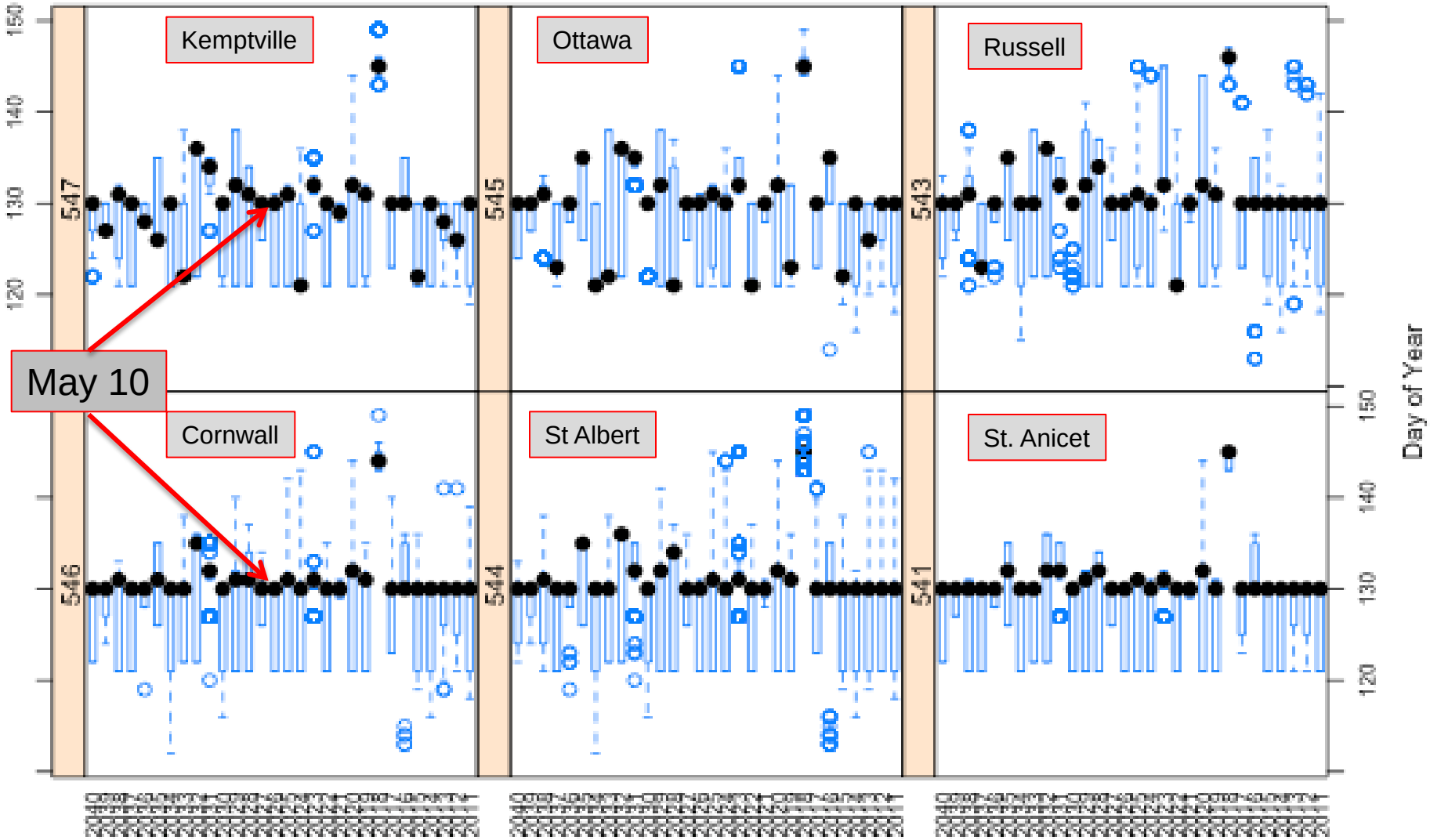


30% increase in 7 day rain over 30 year average = delay 1 day

Average Planting date - historic



Average Planting date - CCSM



Future direction

- Look at livestock impacts - Grazing, hay production, heat stress…
- Improve how we deal with wet soil.
- Improving weather data.
- Improve how we seed. Include cultivation operations.
- Calculate soil erosion.
- Better yield information.

Questions, comments?

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