Extreme Weather Effects on Agriculture

The Effect of Changing Weather Patterns on Farming Operations

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The Question

- How will day to day farm operations be affected by changing weather patterns?
- Focus on seeding operations for cash crop farms.
- Corn/soy/cereal based rotations.
Study Area
Simulation model for Eastern Ontario
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.
Weather Data

Legend
- Red circle: representative weather stations
- Black circle: weather stations
- Red line: study area boundary

Ecodistricts:
- Glenngary Plain
- North Gower-Winchester Plains
- Ottawa Valley Plain
- Russell and Prescott Plains
- Smith Falls Plain
- Upper St. Lawrence Plain

Scale: 0 5 10 20 30 40 Kilometers
Farm Types

- Dairy
  - Dairy and Grain
  - Dairy and Hay
  - Dairy
- Beef
  - Cow Calf Feeder
  - Field Crop Feeder and Field Crop
- Field Crop
  - Field Crop and Dairy
  - Field Crop and Beef
  - Field Crop Cow Calf 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
Individual Farm
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.
Weather Impacts – Lost Days

10 mm rain delay rain day + 1 day
25 mm rain delay rain day + 2 days
Weather Impacts – Seeding date

- Increased yearly change in future
- Larger delays

30% increase in 7 day ppt over 30 year average = delay 1 day
Weather Impacts – Seeding Date

Average earliest corn seeding date

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

May 2

May 15

Increased yearly change in future

More frequent larger delays
Weather Impacts – Seeding Date

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

May 11

May 24

Increased yearly change in future

More frequent larger delays

Average earliest soybean seeding date

Day of year

Year

Historic
CanESM2
CCSM4
MPI-ESM-LR
Average Planting date - historic

- Kemptville
- Ottawa
- Russell
- Cornwall
- St Albert
- St. Anicet

May 1
Average Planting date - CCSM

May 10

Kemptville

Ottawa

Russell

Cornwall

St Albert

St. Anicet
Economic impact

• Yield reduction as a result of seeding delay,
  – Corn,
    • 1% yield reduction for every day of delay past May 10.
  – Soy,
    • 8% yield reduction for every day of delay past May 24
    • 15% delay of not planted by June 10
Discussion

• Agriculture is somewhat unique among industries
  – Resilience comes from numbers of small enterprises.
  • 1900 farmers seeding 100 acres/day = 190,000 acres seeded every favorable day.
• Farmers have learned how to farm these lands over generations adjusting old world patterns to new world realities
  – Weather patterns have been a big part of that adjustment.
• The vulnerability and perhaps opportunity may require rethinking of long standing norms or patterns of field operations
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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Questions

• Have you seen changes in weather patterns?
  – Are they better or worse, or both?

• What do you see as the biggest weather challenges on farm?
  – How have they impacted your operations?
  – What changes have you made to deal with these challenges?
    • example – crop types, change in timing, change in equipment, change in inputs (fertilizer, chemical)

• Does our model look like agriculture in Eastern Ontario?
  – How can we make more realistic? What changes need to be made?