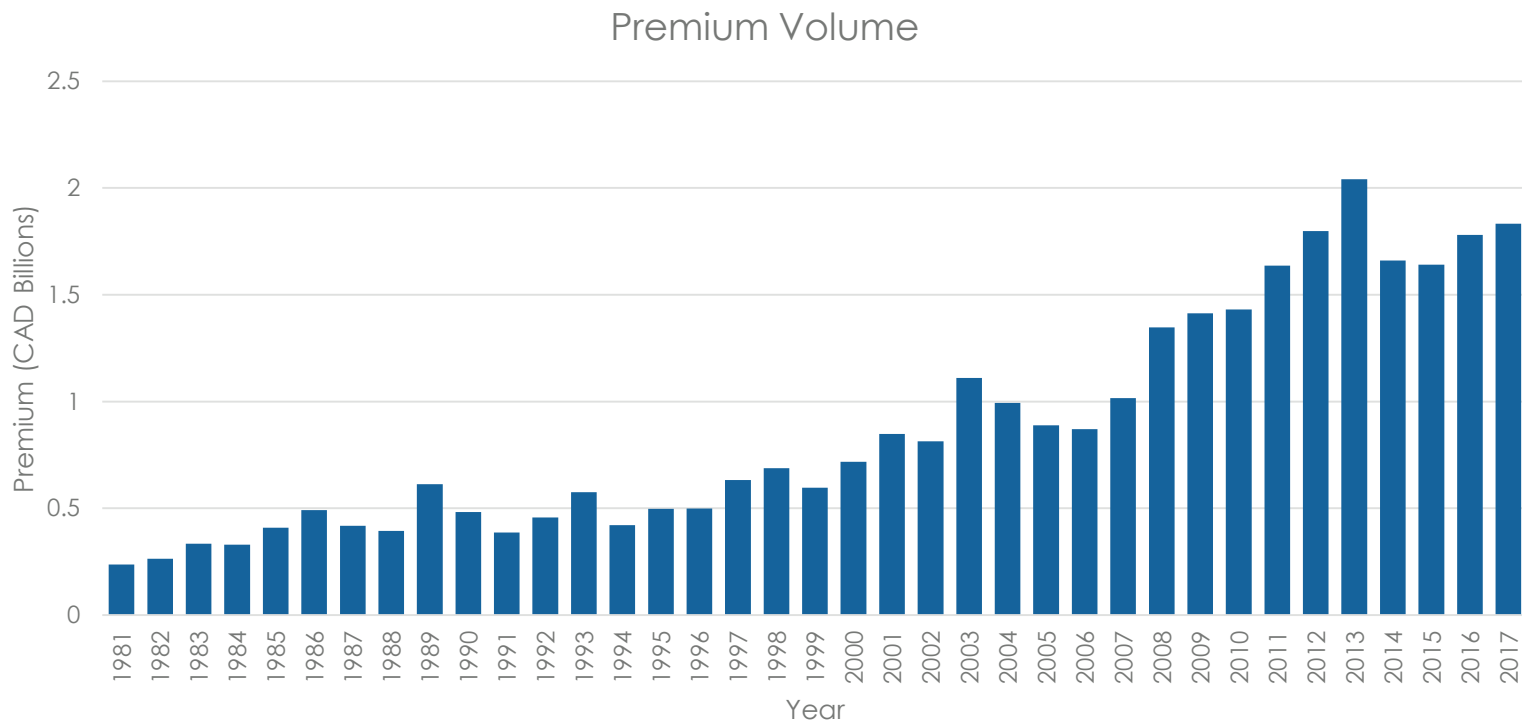


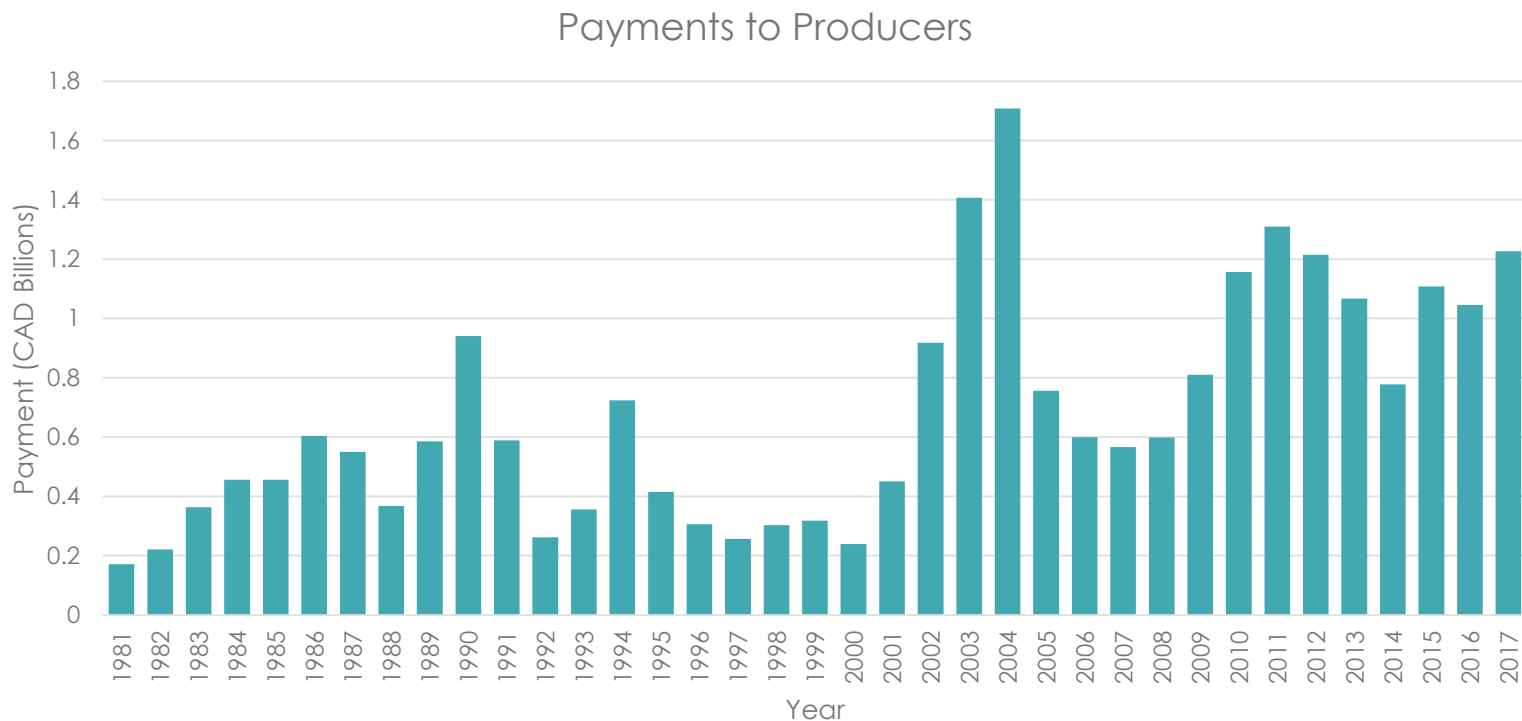
Introducing AIR's New MPCI Model for Canada

Jacqueline Chen, Ph.D.
Kara Crowley

Multiple Peril Crop Insurance in Canada



Multiple Peril Crop Insurance in Canada



Agenda

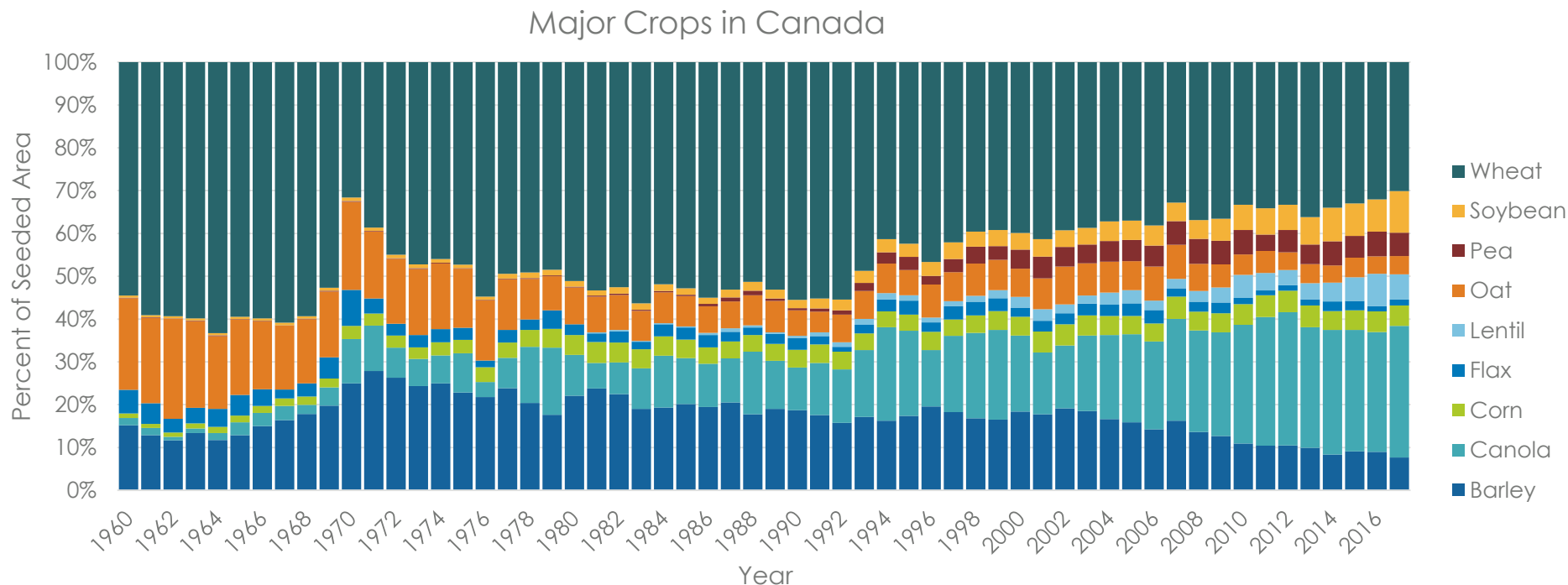
Benefits of Stochastic Modeling

Model Overview

Canada MPCl in CATRADER®

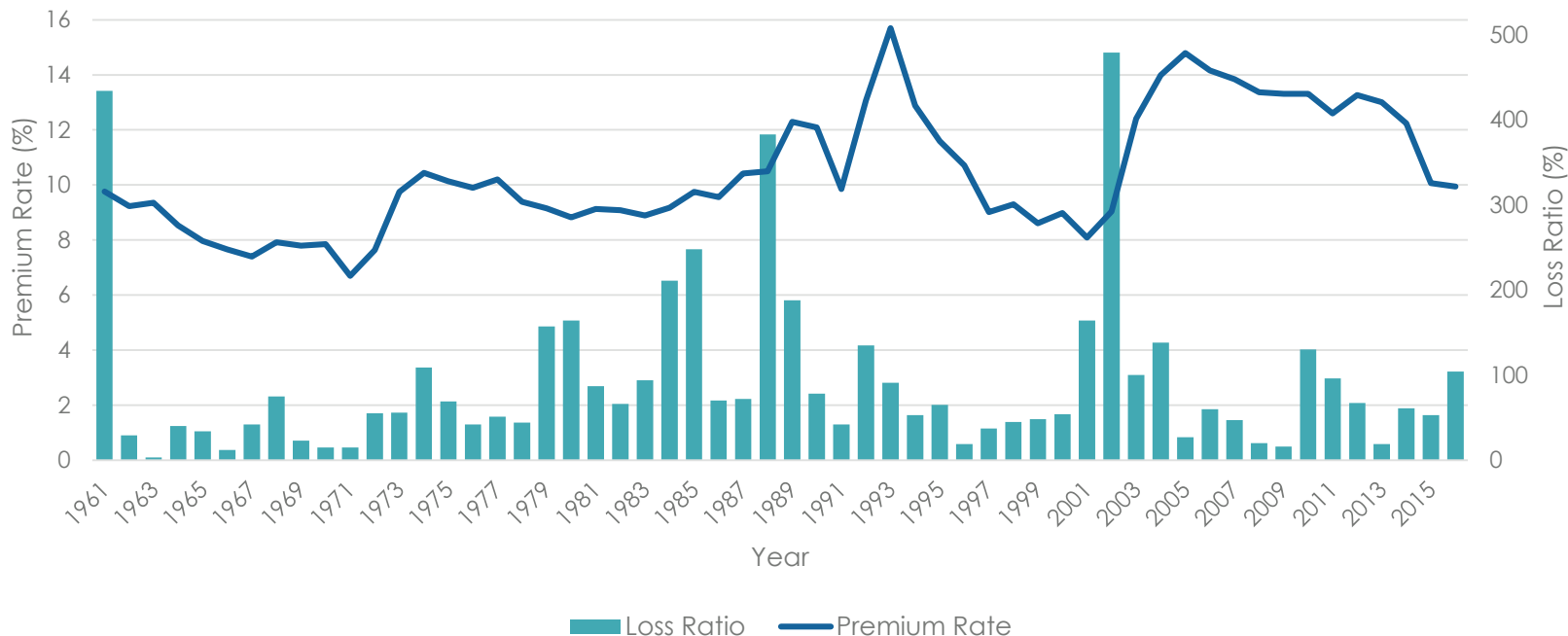
Benefits of Stochastic Modeling

Historical Data Is Insufficient to Estimate Future Risk



Historical Data Is Insufficient to Estimate Future Risk

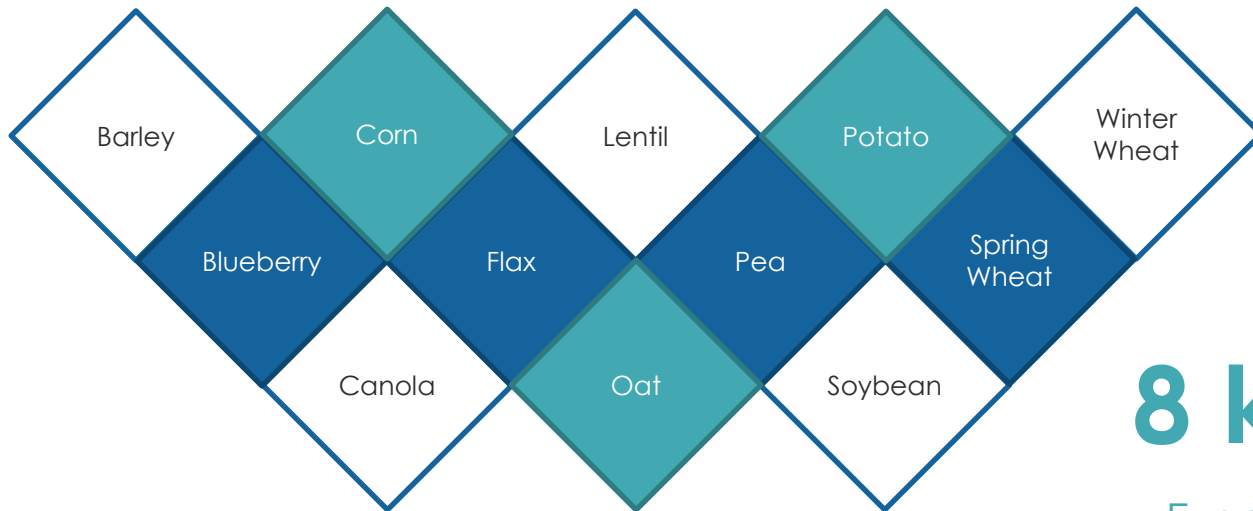
Saskatchewan Premium Rate And Loss Ratio



Model Overview

2018

Model
Release
Year



Province

Submission
Resolution

8 km

Exposure
Resolution

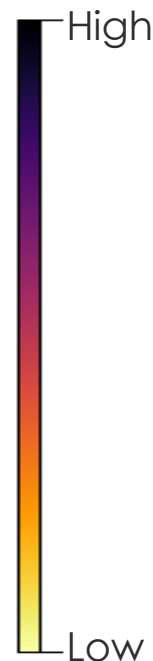
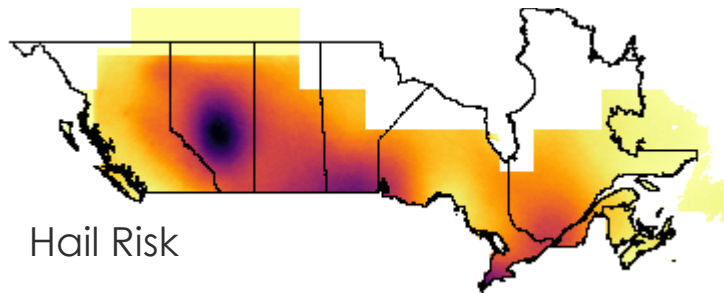
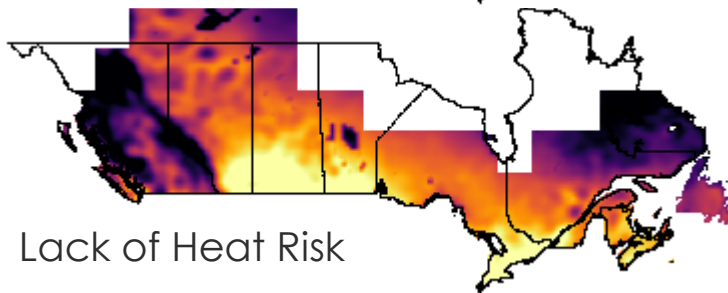
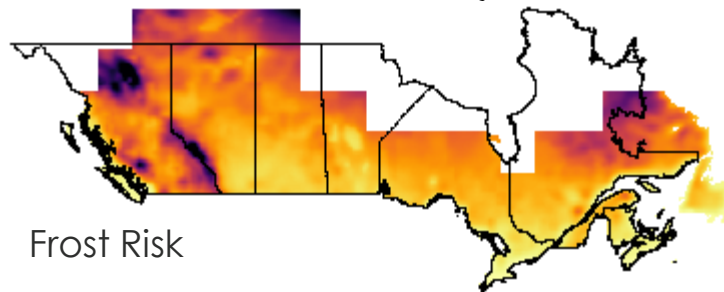
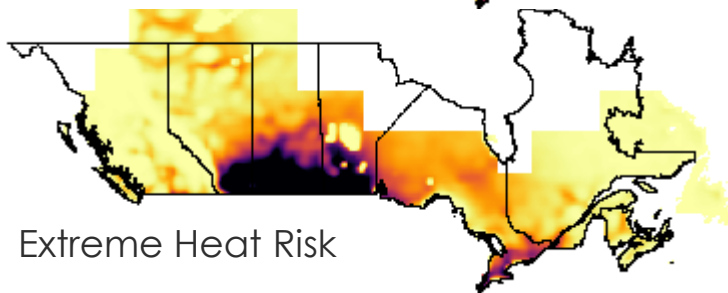
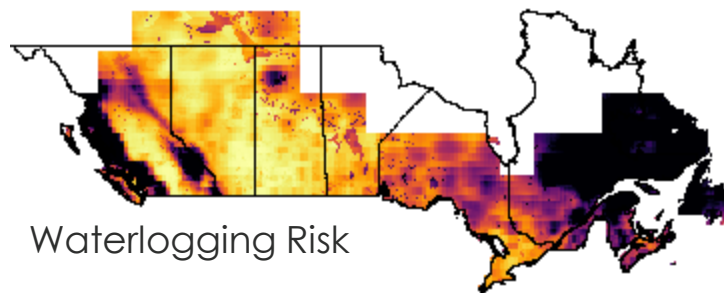
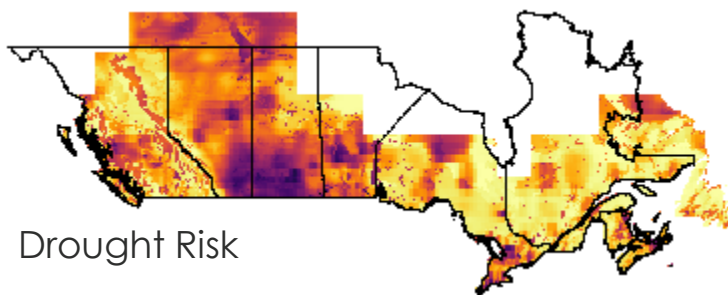


Model Domain Includes
Alberta, British Columbia,
Manitoba, New Brunswick,
Nova Scotia, Ontario,
Prince Edward Island,
Quebec, Saskatchewan

2016

Exposure
Year

Natural Hazards in Canada

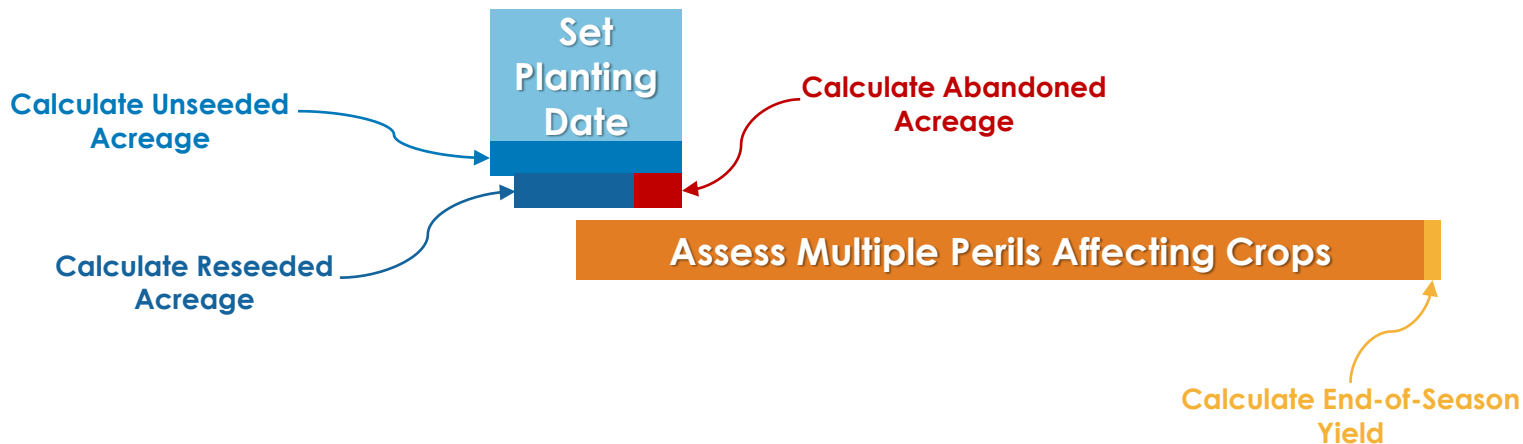


Crop Timeline

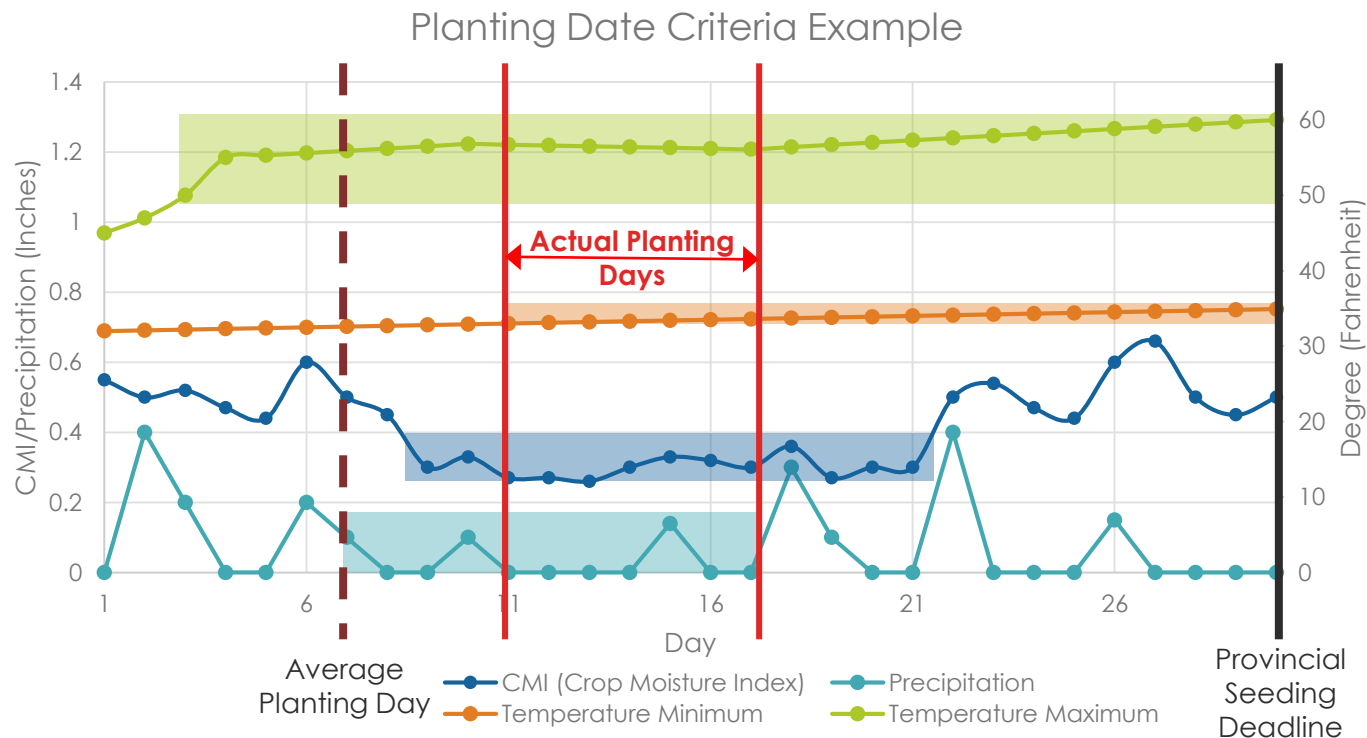
Crop Year



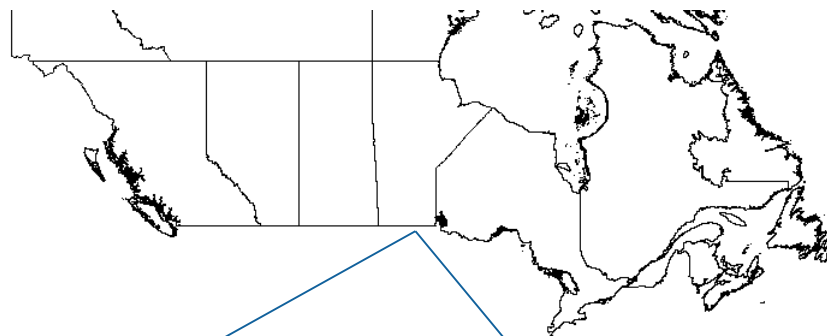
Assess Potential for Grasshopper Infestation



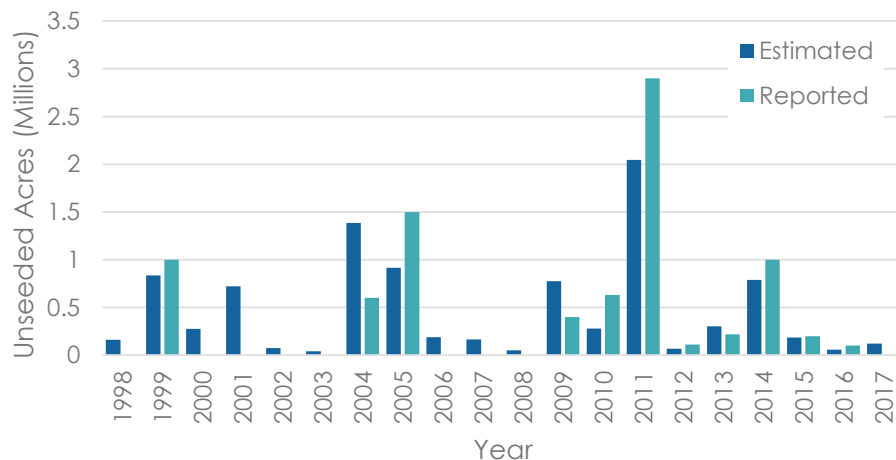
Determine the Planting Date



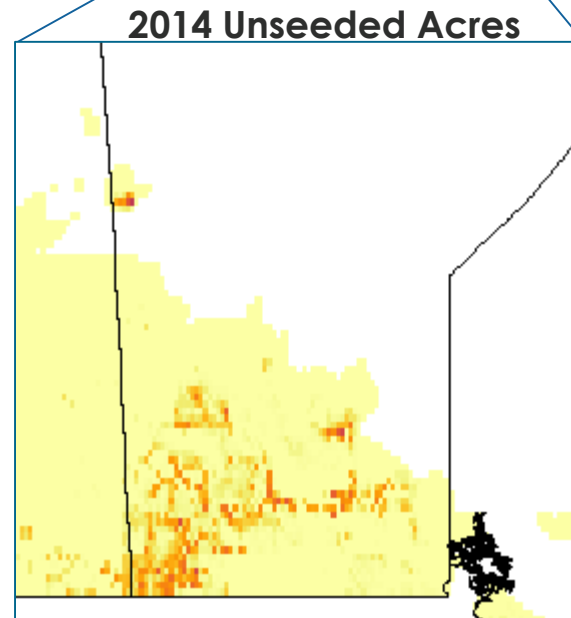
Estimating Unseeded Acreage



Manitoba Unseeded Acreage



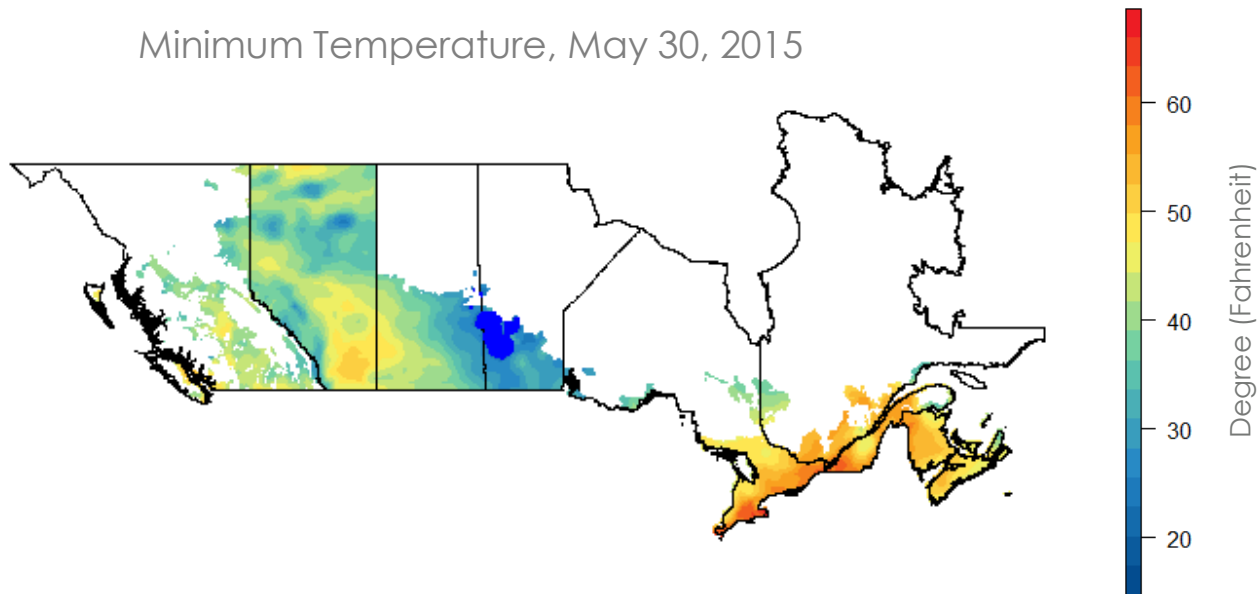
Source:
MASC annual report, 2009-2016
Yield Manitoba, 2006-2015



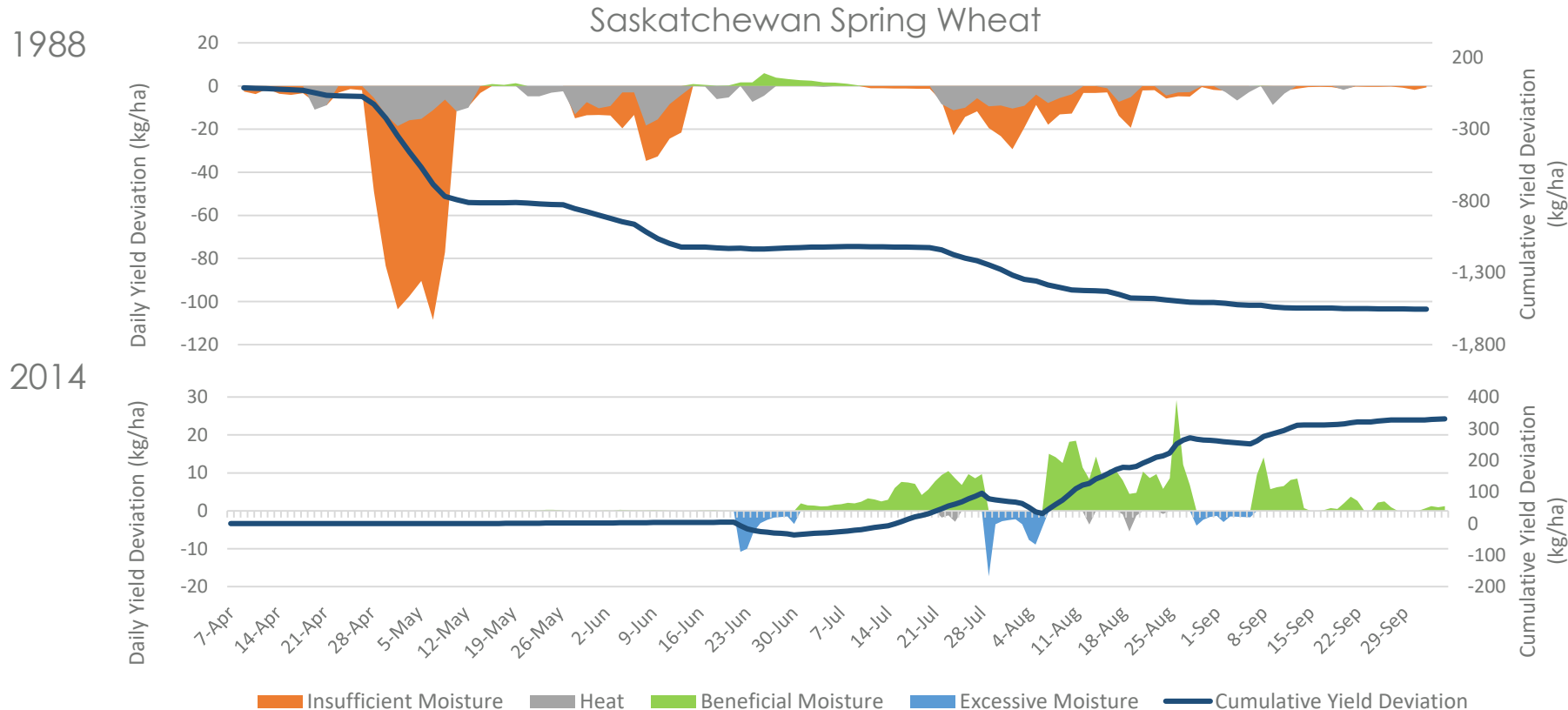
Estimating Reseeded Acreage

Frost damaged 1 million acres in western Manitoba on May 30, 2015

Minimum Temperature, May 30, 2015

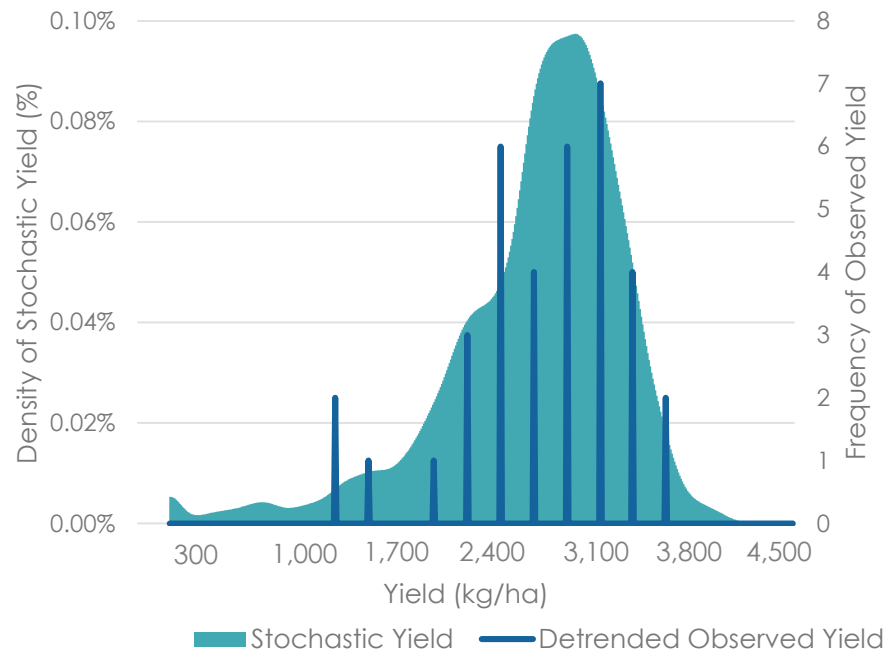
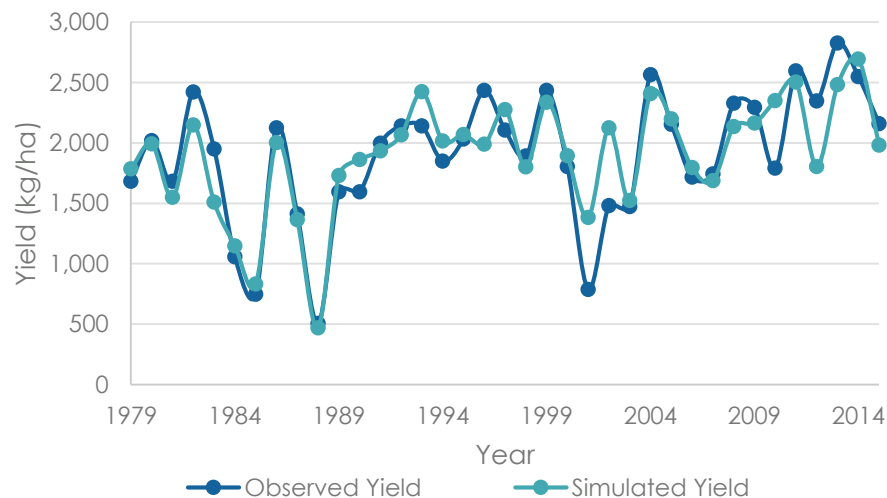


Yield Is the Combination of Many Effects that Occur During the Growing Season



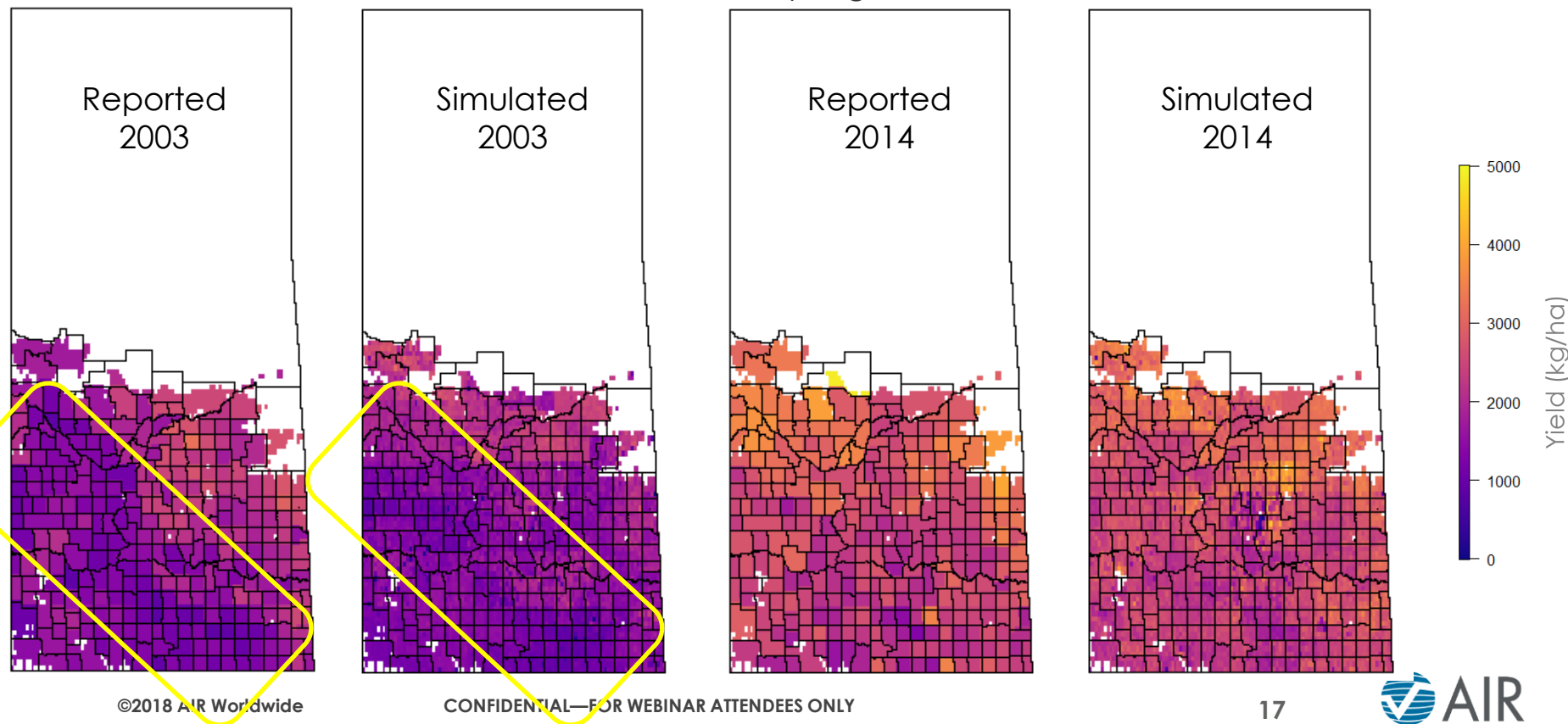
Estimated Stochastic Yield

Saskatchewan Spring Wheat



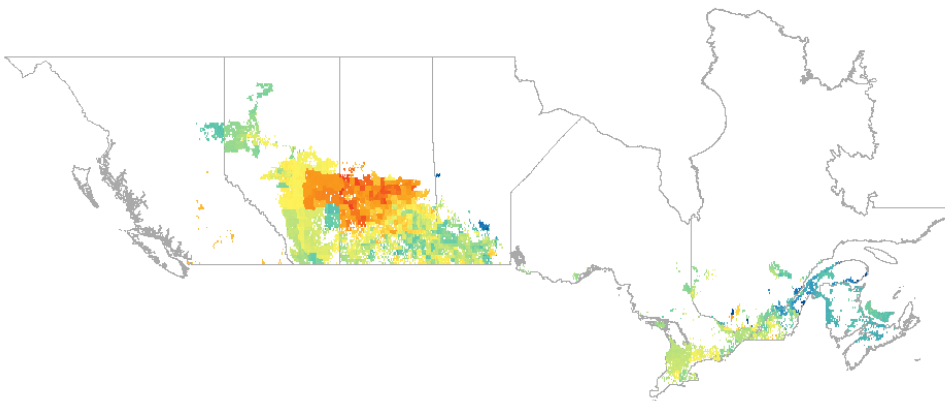
AIR Model Estimates Historical Yield Patterns

Saskatchewan Spring Wheat

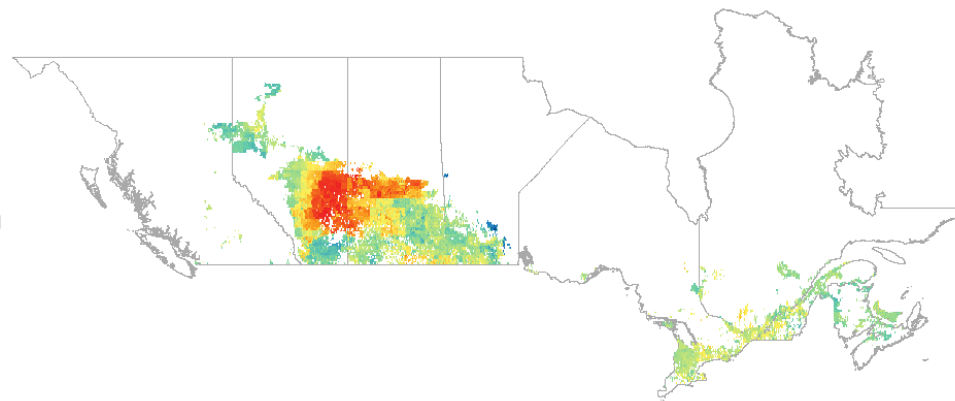


AIR Model Estimates Historical Yield Patterns

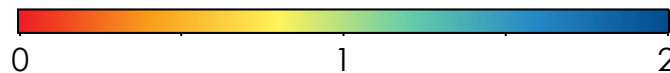
Reported Barley 2002



AIR Model Barley 2002

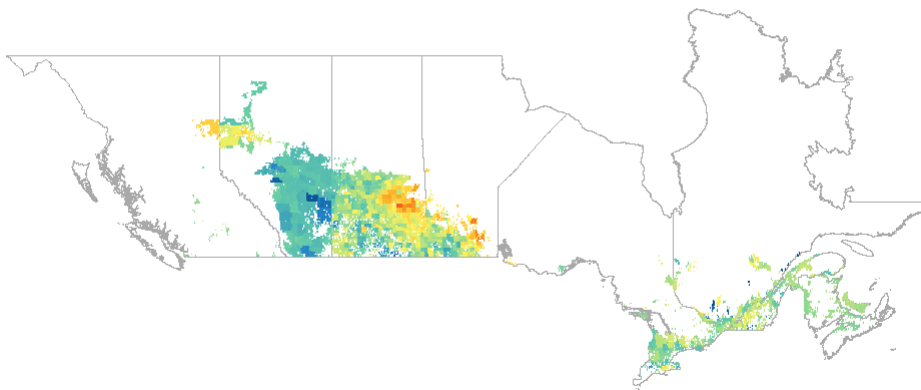


Yield Ratio

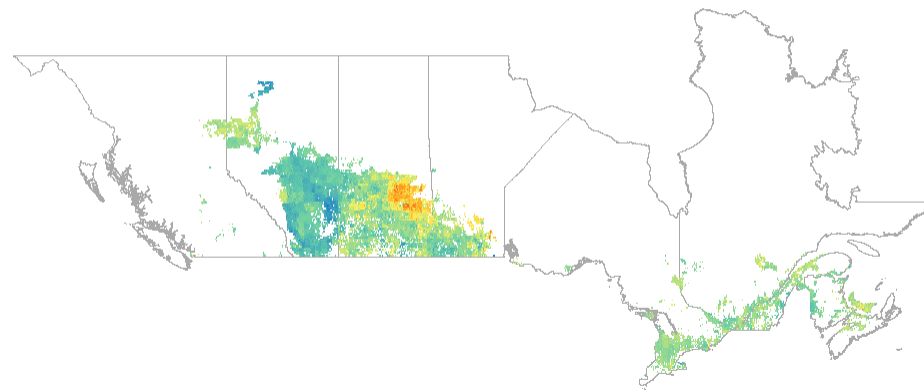


AIR Model Estimates Historical Yield Patterns

Reported Barley 2010



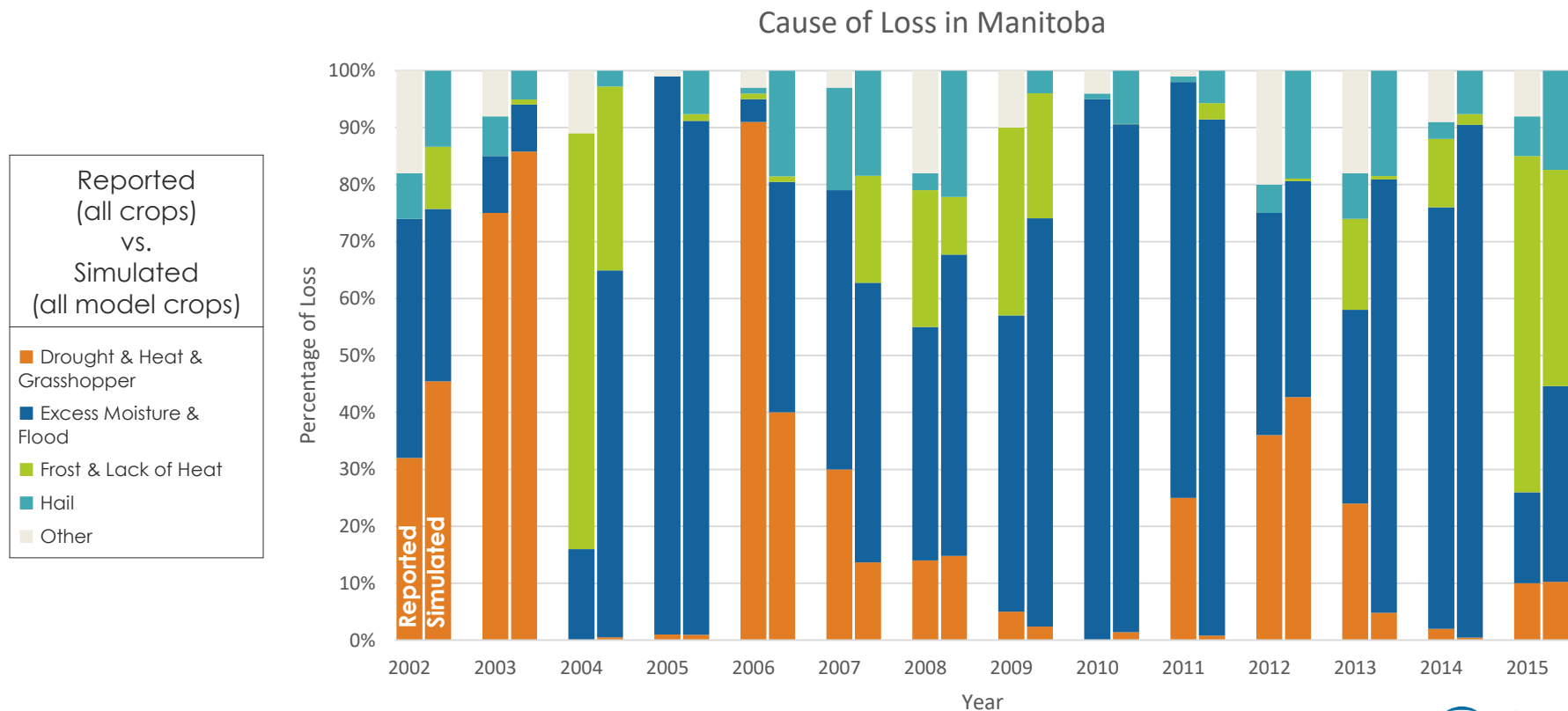
AIR Model Barley 2010



Yield Ratio



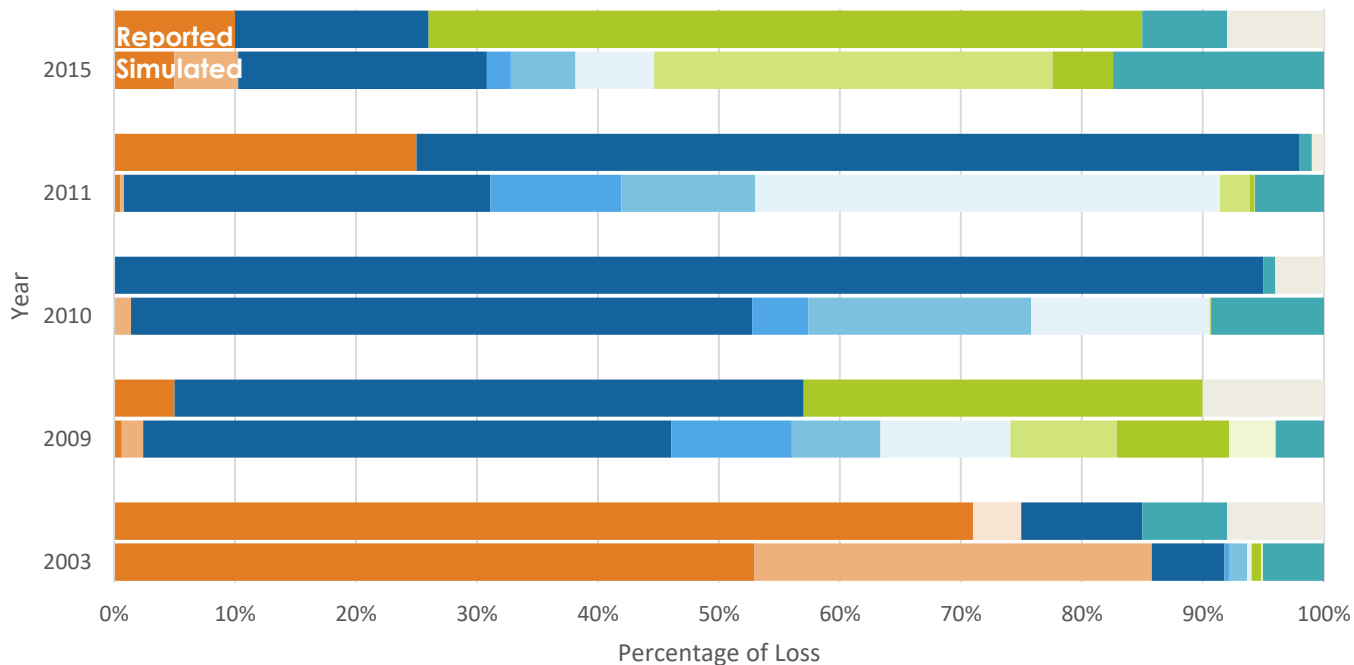
AIR Model Reflects Yields and Historical Events



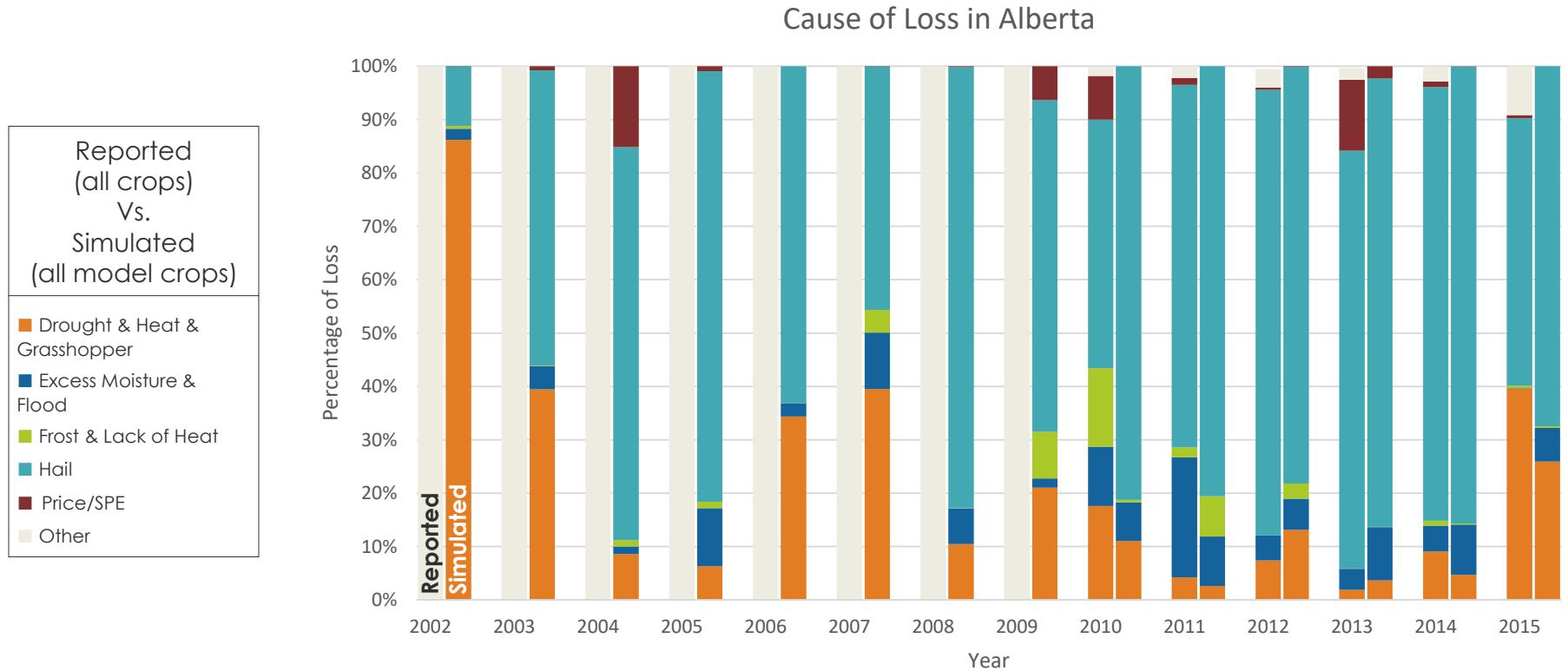
AIR Model Assesses Weather Impacts on Detailed Level

Cause of Loss in Manitoba

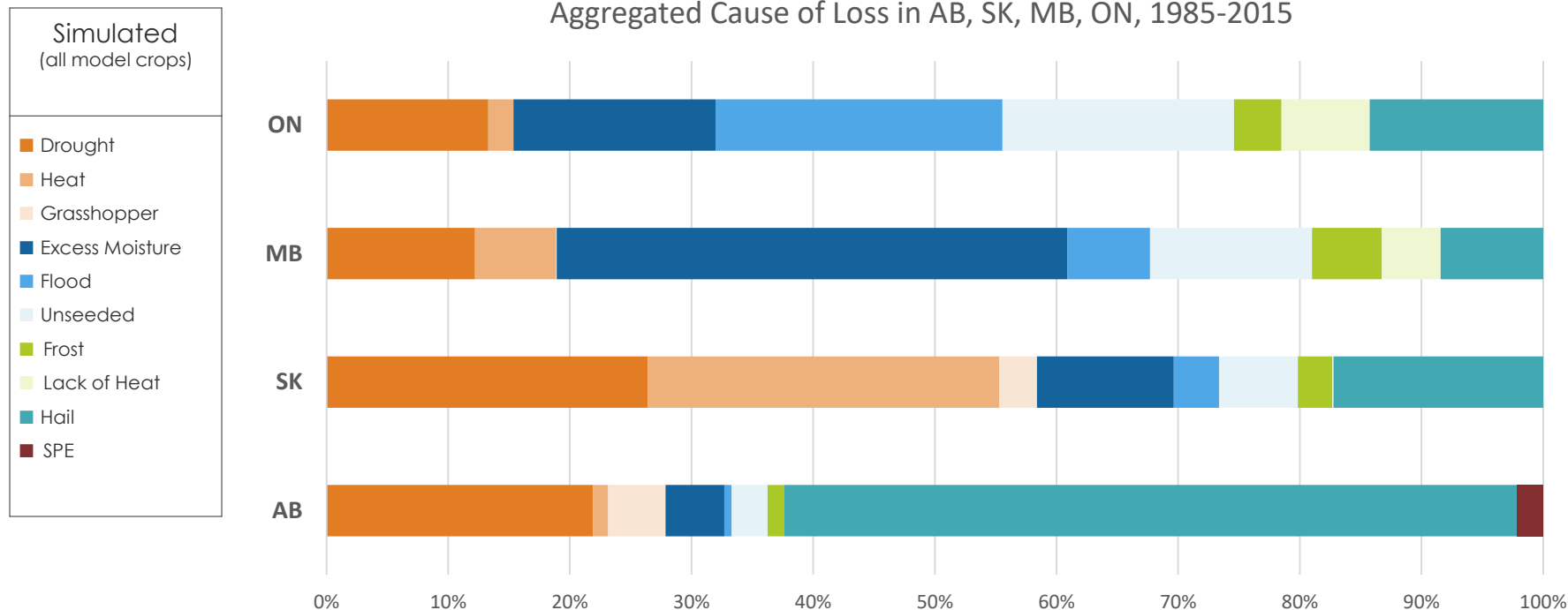
Reported (all crops)	Simulated (all model crops)
- Drought & Heat - Grasshopper - Excess Moisture & Flood - Frost - Lack of Heat - Hail - Other	- Drought - Heat - Grasshopper - Excess Moisture - Flood - Flood-Reseeded - Unseeded - Frost - Frost-Reseeded - Lack of Heat - Hail



Causes-of-Loss in Multiple Provinces Are Modeled Appropriately

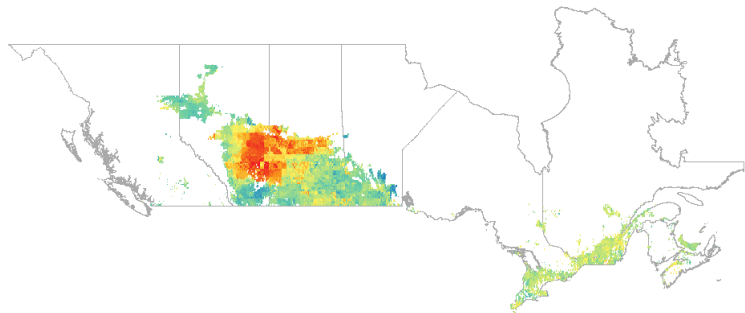


Causes-of-loss in Multiple Provinces Show Variations

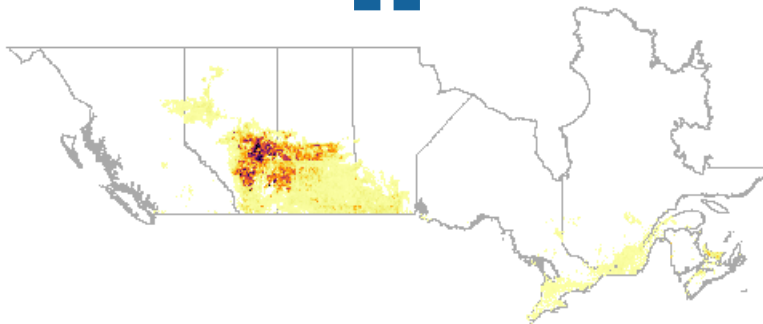
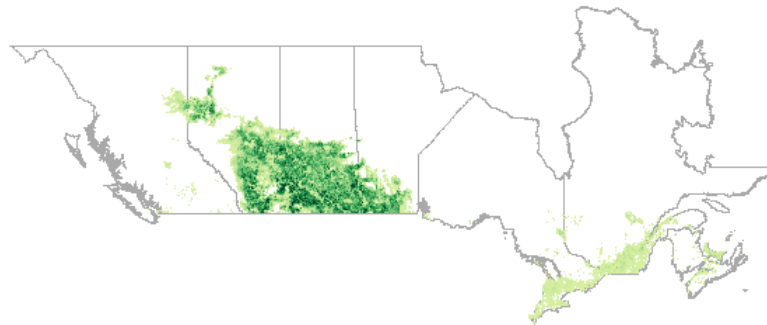


Damage Assessment Is Applied to Insurable Crop Area in order to Assess Loss

2002 Spring Wheat Yield

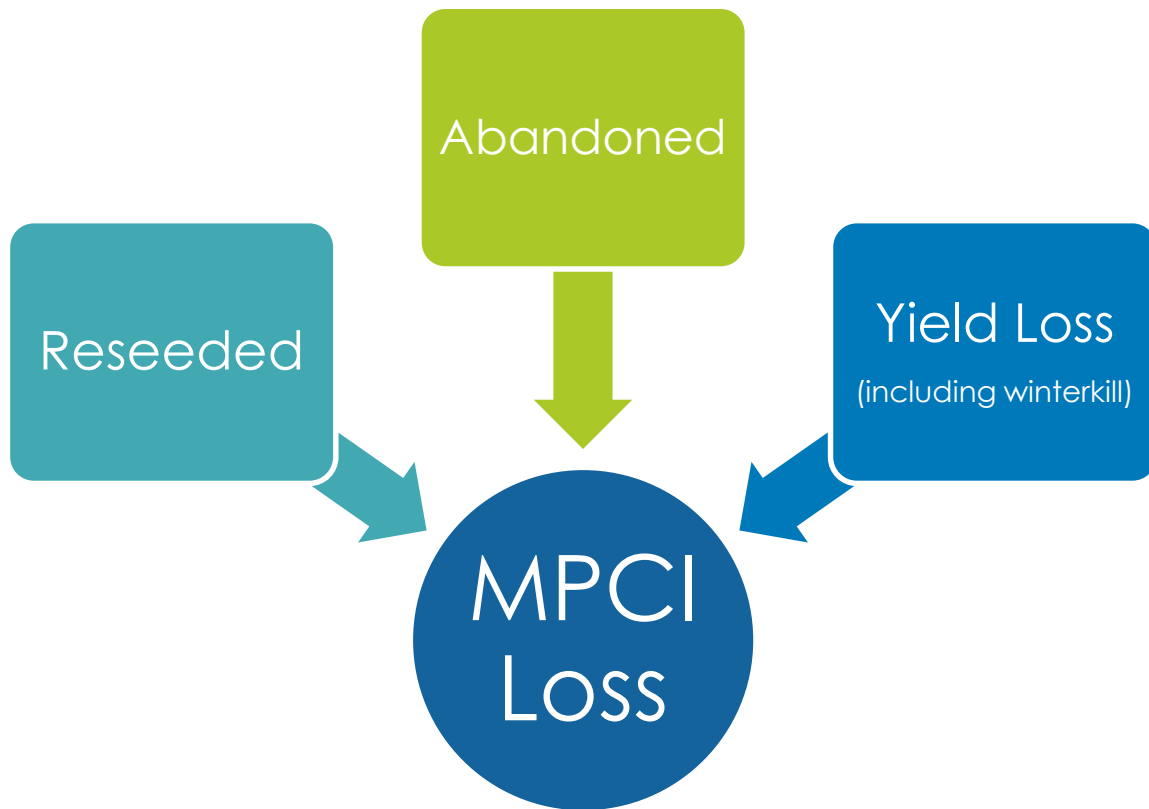


2016 Spring Wheat Insurable Area

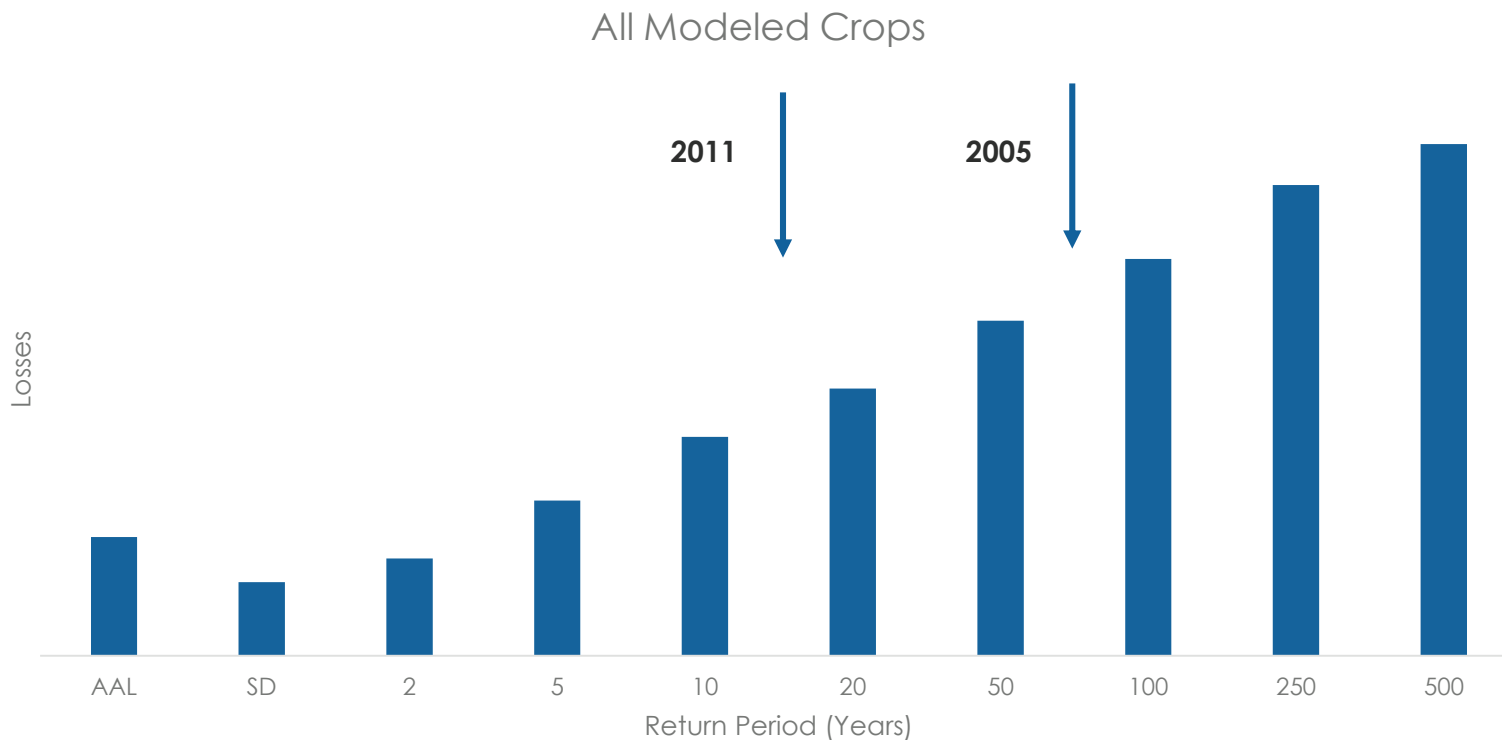


2002 Recast Spring Wheat Loss

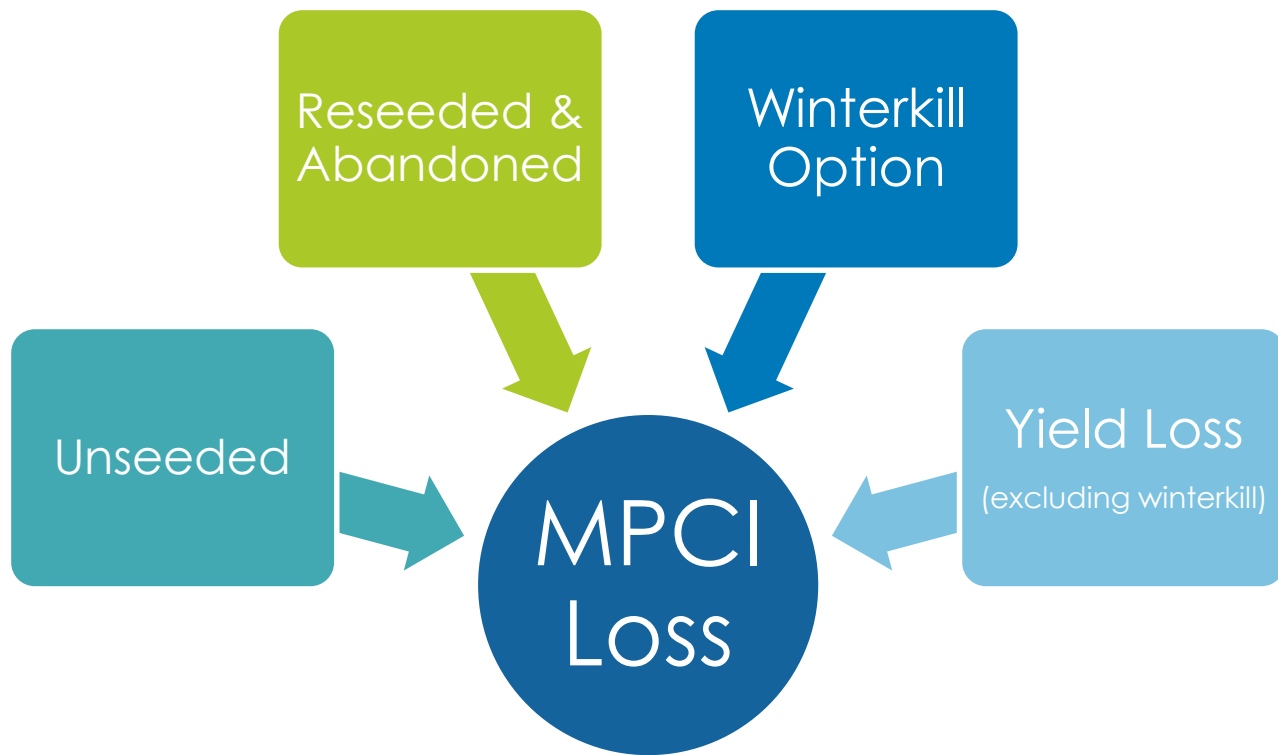
Modeled Loss Types for Manitoba



Modeled Loss Cost for Manitoba



Modeled Loss Types for Saskatchewan



Modeled Loss Cost for Saskatchewan



Canada MPCl in CATRADER

Exposure Input Is Straightforward

2018 MPC I Liability by Province (CAD)

Province	Barley	Blueberry	Canola	Corn	Flax	Lentil	Oat	Pea	Potato	Soybean	Wheat	OtherCrops
Alberta	351,502,484	-	1,937,849,150	7,306,966	25,446,499	30,691,465	22,036,951	131,603,722	150,028,499	-	991,164,051	187,474,423
Ontario	-	-	6,805,864	841,981,246	637,251	-	-	10,303,368	25,424,302	748,604,287	405,545,841	865,318,084
Prince Edward Island	7,197,201	2,332,722	67,106	3,958,096	-	-	320,659	-	170,716,759	17,243,366	6,344,964	8,355,746
Saskatchewan	141,491,154	-	1,286,293,966	2,154,438	60,124,736	258,593,444	86,352,446	120,592,448	3,195,627	348,323	620,813,275	291,243,290
Total	\$ 500,190,839	\$ 2,332,722	\$ 3,231,016,086	\$ 855,400,747	\$ 86,208,485	\$ 289,284,909	\$ 108,710,056	\$ 262,499,538	\$ 349,365,186	\$ 766,195,976	\$ 2,023,868,130	\$ 1,352,391,542

Exposure Input Is Straightforward

2018 MPCl Liability by Province (CAD)

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[illegible]

Exposure Input Is Straightforward

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[illegible]

Exposure Input Is Straightforward

2018 MPCl Liability by Province (CAD)

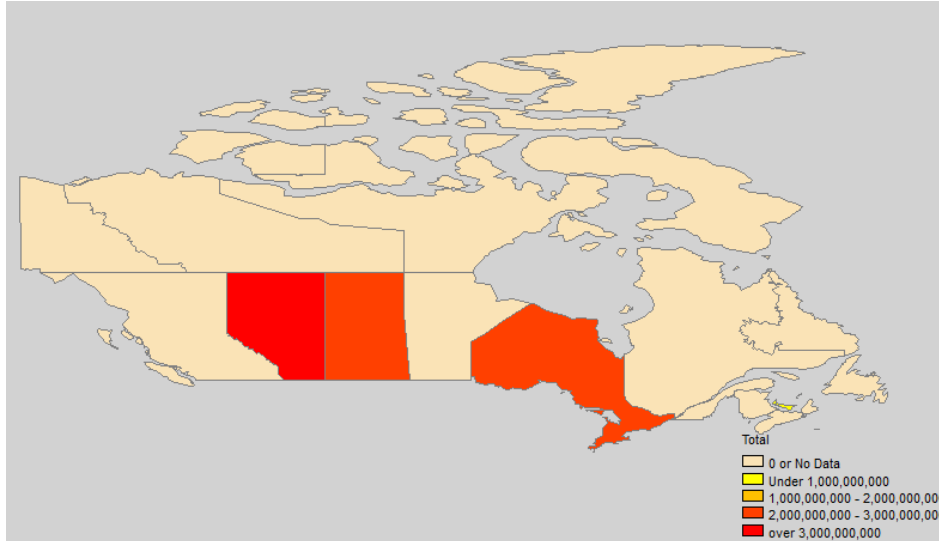
Province	Barley	Blueberry	Canola	Corn	Flax	Lentil	Oat	Pea	Potato	Soybean	Wheat	OtherCrops
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[illegible]

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Create Program: Ground Up

Programs | Exposures

Name	Type	Inception	Expiration
Add Program Type ☐ Catastrophe Excess of Loss ☐ Indexed Excess of Loss ☐ Aggregate Excess of Loss ☐ Indexed Prorata Loss ☐ Quota Share ☐ Catastrophe Bonds ☐ Surplus Share ☐ Industry Loss Warranty ☐ Per Risk ☒ Ground Up Losses			
OK Cancel Help			

Open **Add** Duplicate Delete

Terms		Premiums	Triggers	Options	UDCs	Inuring Progs	Source Progs	EP Adjustments				
Canadian Dollar	Ones	ESP: 0	Use Sums-Insured	High Area Detail (if availat)								
	Contract Name	Occ Limit	Occ Ret	Agg Limit	Agg Ret	Applies To Areas	Applies To Events	Rein-state	Status	Coin-surance	Gross Part.	Net Part.
Program	GroundUp	...				Canada	All		Submitted	100.00	0.00	0.00

Ground Up: Applies to Events

Terms		Premiums	Triggers	Options	UDCs	Inuring Progs	Source Progs	EP Adjustments				
Canadian Dollar	Ones	ESP: 0	Use Sums-Insured	High Area Detail (if availat								
	Contract Name	Occ Limit	Occ Ret	Agg Limit	Agg Ret	Applies To Areas	Applies To Events	Rein-state	Status	Coin-surance	Gross Part.	Net Part.
Program	GroundUp	...				... Canada	... All	...	Submitted	100.00	0.00	0.00



Parameter	Input Values
CAN-MPCI Loss Type	AB-Hail Endorsement
	AB-Spring Price
	MB-Excess Moisture
	MPCI
CAN-Barley Price	Percent
CAN-Barley Yield	Percent
MB-Unseeded Fraction	0-1

Ground Up: Applies to Events

Terms		Premiums		Triggers		Options		UDCs		Inuring Progs		Source Progs		EP Adjustments		
Canadian Dollar ▾		Ones ▾		ESP: 0		Use Sums-Insured ▾		High Area Detail (if availat ▾								
	Contract Name	Occ Limit		Occ Ret	Agg Limit	Agg Ret		Applies To Areas		Applies To Events		Rein-state	Status	Coin-surance	Gross Part.	Net Part.
Program	GroundUp		...				...	Canada	...	Some	...		Submitted ▾	100.00	0.00	0.00

Create Program: Stop Loss

Total Premium 515,291,168

Limit and Retention	Layer Name	Limit	Retained
100% of 20% xs 100%	Layer1	20%	100%
100% of 15% xs 120%	Layer2	15%	120%
100% of 10% xs 135%	Layer3	10%	135%



Limit	Retained
103,058,234	515,291,168
77,293,675	618,349,402
51,529,117	695,643,077

Terms Premiums Triggers Options UDCs Inuring Progs Source Progs EP Adjustments																
Canadian Dollar		Ones	ESP: 0		Use Sums-Insured		High Area Detail (if availab									
	Contract Name	Occ Limit		Occ Ret	Agg Limit	Agg Ret		Applies To Areas		Applies To Events		Rein-state	Status	Coin-surance	Gross Part.	Net Part.
Layer 1	Layer1	103,058,234	...	515,291,168			...	Canada	...	All	...	0	Submitted	100.00	0.00	0.00
Layer 2	Layer2	77,293,675	...	618,349,402			...	Canada	...	All	...	0	Submitted	100.00	0.00	0.00
Layer 3	Layer3	51,529,117	...	695,643,077			...	Canada	...	All	...	0	Submitted	100.00	0.00	0.00

Stop Loss: Applies to Area

Terms		Premiums		Triggers		Options		UDCs		Inuring Progs		Source Progs		EP Adjustments	
Canadian Dollar		Ones		ESP: 0		Use Sums-Insured		High Area Detail (if availat)							
	Contract Name	Occ Limit		Occ Ret	Agg Limit	Agg Ret		Applies To Areas	Applies To Events	Rein-state	Status	Coin-surance	Gross Part.	Net Part.	
Layer 1	Layer1	103,058,234	...	515,291,168			...	Canada	All	0	Submitted	100.00	0.00	0.00	
Layer 2	Layer2	77,293,675	...	618,349,402			...	Canada	All	0	Submitted	100.00	0.00	0.00	
Layer 3	Layer3	51,529,117	...	695,643,077			...	Canada	All	0	Submitted	100.00	0.00	0.00	

Applies To Areas

Alberta

World \ Canada

Include Province

☒ All Alberta

☐ None British Columbia

☐ None Manitoba

☐ None New Brunswick

☐ None Newfoundland

☐ None North West Territories

☐ None Nova Scotia

☐ None Nunavut

☐ None Ontario

☐ None Prince Edward Island

☐ None Quebec

☐ None Saskatchewan

☐ None Yukon

< >

Include All Exclude All

Map Set As Default OK Cancel Help

Stop Loss: Applies to Area

Terms		Premiums		Triggers		Options		UDCs		Inuring Progs		Source Progs		EP Adjustments		
Canadian Dollar		Ones		ESP: 0		Use Sums-Insured		High Area Detail (if availat)								
	Contract Name	Occ Limit		Occ Ret	Agg Limit	Agg Ret		Applies To Areas		Applies To Events		Rein-state	Status	Coin-surance	Gross Part.	Net Part.
Layer 1	Layer1	103,058,234	...	515,291,168			...	Alberta	...	All	...	0	Submitted	100.00	0.00	0.00
Layer 2	Layer2	77,293,675	...	618,349,402			...	Canada	...	All	...	0	Submitted	100.00	0.00	0.00
Layer 3	Layer3	51,529,117	...	695,643,077			...	Canada	...	All	...	0	Submitted	100.00	0.00	0.00

Configure Analysis: Program

Pre-Analysis Configuration:

☐ Use Saved Results

Program(s)... GroundUp

Event Period... Program Specific

Mkt.Shares... Program Specific

Event Set... Canada Multi-Peril Crop Insurance (10K MPCl)

Zones..... None

Area Detail... Program Specific Program Loss Adj... Program Specific

Results Detail... Event Total Standard

Demand Surge Program Specific Adj Factor File Set... None

Currency Table... Default Custom LOBs..... Program Specific

Perils.....

☐ Earthquake ☐ Fire Following ☒ MPCl (Agri)

☐ Terrorism ☐ Wind ☐ Crop Hail

☐ Flood ☐ Wildfire ☐ Pandemic

Result set - Untitled

Configure Analysis: Event Set

Pre-Analysis Configuration:

☐ Use Saved Results

Program(s)... GroundUp

Event Period.. Program Specific

Mkt.Shares... Program Specific

Event Set... Canada Multi-Peril Crop Insurance (10K MPCl)

Zones..... None

Area Detail.. Program Specific Program Loss Adj... Program Specific

Results Detail.. Event Total Standard

Demand Surge Program Specific Adj Factor File Set... None

Currency Table.. Default Custom LOBs..... Program Specific

Perils.....

☐ Earthquake ☐ Fire Following ☒ MPCl (Agri)

☐ Terrorism ☐ Wind ☐ Crop Hail

☐ Flood ☐ Wildfire ☐ Pandemic

Result set - Untitled

Configure Analysis: Zones

Pre-Analysis Configuration:

☐ Use Saved Results

Program(s)... GroundUp

Event Period... Program Specific

Mkt.Shares... Program Specific

Event Set... Canada Multi-Peril Crop Insurance (10K MPC)

Zones..... None

Area Detail.. Program Specific Program Loss Adj... Program Specific

Results Detail.. Event Total Standard

Demand Surge Program Specific Adj Factor File Set... None

Currency Table.. Default Custom LOBs..... Program Specific

Perils.....

☐ Earthquake ☐ Fire Following ☒ MPC (Agri)

☐ Terrorism ☐ Wind ☐ Crop Hail

☐ Flood ☐ Wildfire ☐ Pandemic

Result set - Untitled

Zone Set

Select zones to include in the analysis

Name	Type
Alberta	S
Ontario	S
Prince Edward Island	S
Saskatchewan	S

Selected: None Total: 4

Open OK Cancel Help

Configure Analysis: Zones

Pre-Analysis Configuration:

☐ Use Saved Results

Program(s)... GroundUp

Event Period... Program Specific

Mkt.Shares... Program Specific

Event Set... Canada Multi-Peril Crop Insurance (10K MPC)

Zones..... None

Area Detail.. Program Specific Program Loss Adj... Program Specific

Results Detail.. Event Total Standard

Demand Surge Program Specific Adj Factor File Set... None

Currency Table.. Default Custom LOBs..... Program Specific

Perils.....

☐ Earthquake ☐ Fire Following ☒ MPC (Agri)

☐ Terrorism ☐ Wind ☐ Crop Hail

☐ Flood ☐ Wildfire ☐ Pandemic

Result set - Untitled

Zone Set

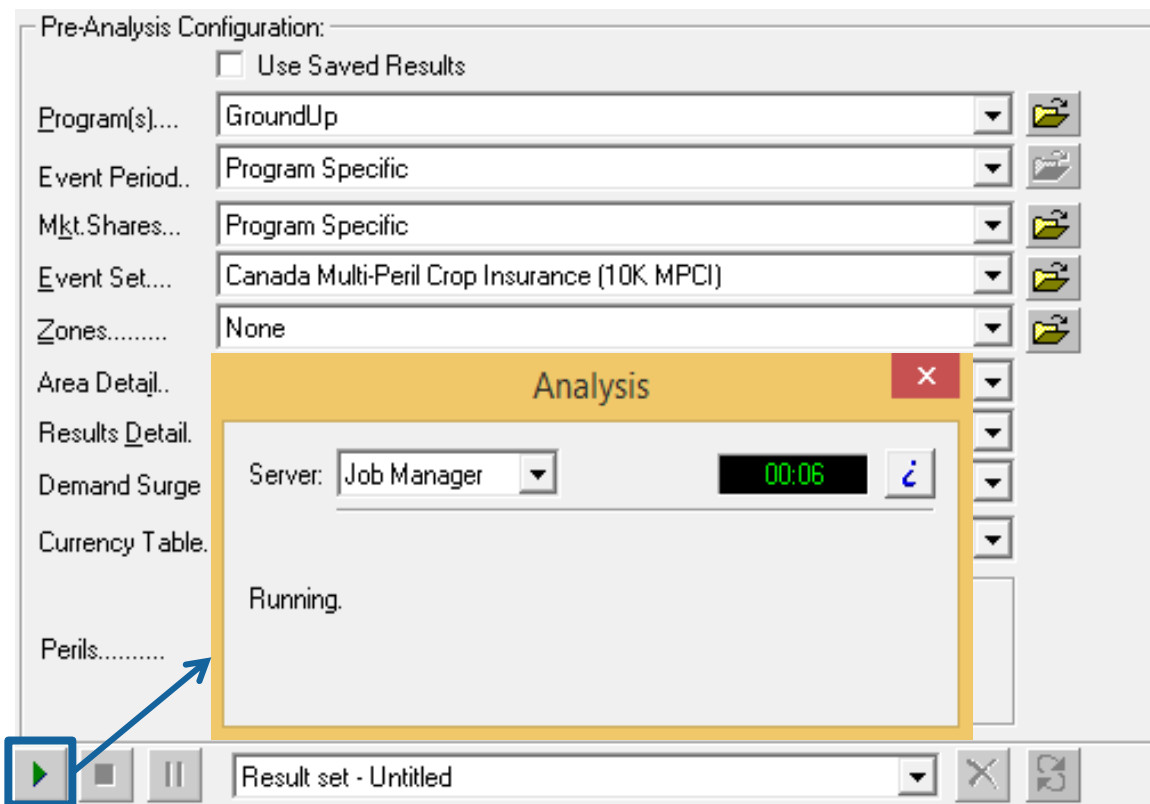
Select zones to include in the analysis

Name	Type
Alberta	S
Ontario	S
Prince Edward Island	S
Saskatchewan	S

Selected: All Total: 4

Open OK Cancel Help

Configure Analysis: Zones



Output: User Interface

Ground Up Program Losses by Zone

	Expected Value	Standard Deviation	20 yrs	50 yrs	100 yrs	250 yrs	500 yrs	1000 yrs
All Exposed Areas	24,047,519,258	27,094,336,255	88,535,938,281	115,775,653,326	130,186,124,622	136,902,907,116	140,689,789,311	142,917,109,288
Zone: "Alberta"	2,029,166,835	1,801,812,932	5,722,816,262	7,458,900,408	8,528,137,440	9,690,450,275	10,118,201,801	10,240,921,450
Zone: "Ontario"	19,861,558,500	26,636,459,180	84,248,563,864	111,164,848,767	124,380,007,267	132,475,941,064	134,659,644,426	136,179,177,168
Zone: "Prince Edward Island"	32,935,757	37,660,742	112,156,957	162,129,103	190,713,119	231,024,839	246,365,721	251,250,995
Zone: "Saskatchewan"	2,123,858,166	2,319,245,887	7,175,252,194	9,684,945,330	11,191,086,869	13,264,212,473	14,300,801,186	14,587,695,071

Stop Loss Program Losses by Layer

	Expected Value	Standard Deviation	20 yrs	50 yrs	100 yrs	250 yrs	500 yrs	1000 yrs
Program	213,873,492	52,010,619	231,881,026	231,881,026	231,881,026	231,881,026	231,881,026	231,881,026
Layer-1	98,573,904	19,252,894	103,058,234	103,058,234	103,058,234	103,058,234	103,058,234	103,058,234
Layer-2	70,669,704	20,519,821	77,293,675	77,293,675	77,293,675	77,293,675	77,293,675	77,293,675
Layer-3	44,629,883	16,966,677	51,529,117	51,529,117	51,529,117	51,529,117	51,529,117	51,529,117

Stop Loss Program Loss On Line (Loss/Limit) by Layer

	Expected Value	Standard Deviation	20 yrs	50 yrs	100 yrs	250 yrs	500 yrs	1000 yrs
Program								
Layer-1	95.65		100.00	100.00	100.00	100.00	100.00	100.00
Layer-2	91.43		100.00	100.00	100.00	100.00	100.00	100.00
Layer-3	86.61		100.00	100.00	100.00	100.00	100.00	100.00

Output: Pre-Packaged Exhibits

Event Loss Table

Event	Year	Contract Loss	IndInsured Loss Prop	Event Info
8900000001	1	171,283,156	1,384,183,175	MPCI; Barley Y 104.3 P 125.5; MB-Unseeded Fraction 0.07; SK MB
8900000002	1	26,094,206	104,398,850	AB-Hail Endorsement; Barley Y 104.3 P 125.5; MB-Unseeded Fraction 0.07; AB
8900000005	2	234,724,822	1,456,218,563	AB-Spring Price; Barley Y 104.3 P 125.5; MB-Unseeded Fraction 0.07; AB
8900000006	2	27,991,624	111,987,979	MB-Excess Moisture; Barley Y 104.3 P 125.5; MB-Unseeded Fraction 0.07; MB
8900000007	2	6,440	25,759	MPCI; Barley Y 107.3 P 101.7; MB-Unseeded Fraction 0.079; ON SK
8900000009	3	387,795,567	1,944,067,766	AB-Hail Endorsement; Barley Y 107.3 P 101.7; MB-Unseeded Fraction 0.079; AB
8900000010	3	54,955,350	219,843,683	AB-Spring Price; Barley Y 107.3 P 101.7; MB-Unseeded Fraction 0.079; AB
8900000013	4	358,236,298	1,906,725,570	MB-Excess Moisture; Barley Y 107.3 P 101.7; MB-Unseeded Fraction 0.079; MB
8900000014	4	30,369,956	121,500,685	MPCI; Barley Y 99.1 P 133.9; MB-Unseeded Fraction 0.045; ON SK
8900000015	4	4,851,939	19,407,756	AB-Hail Endorsement; Barley Y 99.1 P 133.9; MB-Unseeded Fraction 0.045; AB

Event Distribution

Loss Exceedance(%)	Ann Agg Loss	Ann Occ Loss	Agg Year	Occ Year	Occ EventID	Ann Occ Info
0.01	3,553,231,824	3,485,551,244	7699	7699	890030793	AB-Hail Endorsement; Barley Y 97.3 P 125.2; MB-Unseeded Fraction 0.044; AB
0.02	3,101,488,354	3,052,231,726	1087	1087	890004345	MB-Excess Moisture; Barley Y 97.3 P 125.2; MB-Unseeded Fraction 0.044; MB
0.03	3,051,232,425	2,992,096,435	2227	175	890000697	AB-Spring Price; Barley Y 99.1 P 133.9; MB-Unseeded Fraction 0.045; AB
0.04	3,042,683,484	2,991,237,595	175	2227	890008905	AB-Spring Price; Barley Y 100.4 P 96.8; MB-Unseeded Fraction 0.029; AB
0.05	2,997,038,164	2,942,446,701	289	289	890001153	MPCI; Barley Y 106.8 P 100.4; MB-Unseeded Fraction 0.012; AB SK

Summary

- Explicitly models losses to 11 major crops in Canada
- Covers nine southern provinces of Canada
- Presents losses for the entire range of possible weather scenarios
- Clients can model their exposure using AIR's CATRADER software

Thank You