AJAE appendix A for: Agricultural Insurance Loss and Relationships to Climate across the Inland Pacific Northwest Region of the United States

The material contained herein is supplementary to the article named in the title and published in the American Journal of Agricultural Economics (AJAE).

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September 2019

Appendix A documents the agricultural insurance loss exploratory data analysis process, examining the relationships of agricultural commodity loss, at a county level, from 1989-2015, across the three state region of the Pacific Northwest (Washington, Idaho, and Oregon). We then focus in on the 24 county region of the Inland Pacific Northwest (IPNW).

1. Supplemental Pacific Northwest (PNW) Exploratory Data Analysis In this section we outline a multitude of PCA outputs for the entire three state Pacific Norwest region (Oregon, Idaho, and Washington).

2. Supplemental Inland Pacific Northwest(iPNW) Exploratory Data Analysis Here we outline a multitude of PCA outputs for the 24 county iPNW Pacific Norwest region.

Figure List

Dissertation Appendix A

Chapter 1: Agricultural Insurance Loss Analysis of the Pacific Northwest, 2001 to 2015

Appendix A documents the Chapter 1 exploratory data analysis process, examining the relationships of agricultural commodity loss, at a county level, from 1989-2015, across the three state region of the Pacific Northwest (Washington, Idaho, and Oregon), and then focus in on the 24 county region of the Inland Pacific Northwest (IPNW).

We examine the entire range of commodities and damage causes for the IPNW study area, identifying the top revenue loss commodities and their most pertinent damage causes, as indicated from the USDA's agricultural commodity loss insurance archive. We also explore claim freqency, We fiinally zero in on the top 5 commodities for the region, and examine specific loss variation by year and damage cause.

Several steps were performed to examine the full set of data, and to narrow down factors to a usable form for further modeling analysis.

1. Data Preparation. Here we outline the approach to load agricultural insurance loss data from Github, and preparing it for PCA analysis. We also provide tables of the original insurance loss dataset, as well as an table of aggregated insurance loss values by county, year, commodity, and damage cause.

Step 4. Pacific Northwest (PNW) Overview. Here we examine overall commodity loss for the entire three state region of Washington, Idaho, and Oregon, which comes primarily from three primary agricultural regions - the IPNW (mostly Washington, with portions of northern Idaho and northeastern Oregon), the Southern Idaho Valley (Idaho), and the Willamette Valley (Oregon).

Step 5. PNW region overview of insurance loss by year, damage cause, and commodity, and county: 1989 to 2015. From the results of this examination, we narrow our time frame to 2001 to 2015.

Step 6. PNW region overview of insurance Loss claim counts by year, damage cause, commodity, and county: 2001-2015

Step 7. Refining our analysis to the 24-county inland Pacific Northwest (iPNW) Study Area.

Step 8. IPNW region overview of Insurance Loss by year, damage cause, commodity and county: 2001-2015

Step 9. IPNW region overview of Insurance Loss claim counts: 2001-2015

Step 10. APPLES: IPNW region overview of Insurance Loss 2001-2015

Step 11. BARLEY: IPNW region overview of Insurance Loss 2001-2015

Step 12. WHEAT: IPNW region overview of Insurance Loss 2001-2015

Step 13. CHERRIES: IPNW region overview of Insurance Loss 2001-2015

Step 14. PEAS: IPNW region overview of Insurance Loss 2001-2015

Step 1: Data Preparation

In order to generate any of the following tables and graphs, we download all data locally to your /tmp/seamon directory, from the seamon_dissertation_dataload.R file from the following location:

http://github.com/erichseamon/seamon_dissertation/data/

Then you will be able to re-generate any of the provided Rmarkdown files from:

http://github.com/erichseamon/seamon_dissertation/appendices/

the dataload.R file has a multitude of datasets, including: * climatology summary data by county for the study area examined (inland Pacific Northwest); * original RMA crop insurance data; * state polygon shapefile; * consumer price indexing; * wheat yields; and * wheat pricing

	year	state	county	commodity	damagecause	monthcode	month	acres	loss	lossperacre	cropyear
11338	2001	ID	Ada	All Other Crops	Drought	9	SEP	17.000	153.00	9.000000	2001
11339	2001	ID	Ada	All Other Crops	Heat	8	AUG	105.200	5249.00	49.895437	2001
11340	2001	ID	Ada	All Other Crops	Freeze	4	APR	125.000	4500.00	36.000000	2001
11341	2001	ID	Ada	All Other Crops	Wind/Excess Wind	5	MAY	50.000	1800.00	36.000000	2001
11342	2001	ID	Ada	All Other Crops	Wind/Excess Wind	4	APR	92.500	3330.00	36.000000	2001
11343	2001	ID	Bannock	WHEAT	Drought	8	AUG	133.000	1212.00	9.112782	2001
11344	2001	ID	Bannock	WHEAT	Drought	9	SEP	777.520	24807.00	31.905289	2001
11345	2001	ID	Bannock	WHEAT	Drought	7	JUL	3529.754	54726.46	15.504327	2001
11346	2001	ID	Bannock	WHEAT	Heat	7	JUL	19.796	2371.60	119.801980	2001
11347	2001	ID	Bannock	WHEAT	Heat	8	AUG	25.000	904.00	36.160000	2001

	year	state	county	commodity	damagecause	loss	count	acres	lossperacre	lossperclaim	acresperclaim
11	2014	ID	Ada	All Other Crops	Area Plan Crops Only	1398	1	0	0.0000000	1398.0	0
12	2015	ID	Ada	All Other Crops	Area Plan Crops Only	11810	1	0	0.0000000	11810.0	0
211	2008	OR	Baker	All Other Crops	Area Plan Crops Only	15292	2	5482	2.7894929	7646.0	2741
212	2010	OR	Baker	All Other Crops	Area Plan Crops Only	1819	2	2282	0.7971078	909.5	1141
215	2009	ID	Bannock	All Other Crops	Area Plan Crops Only	2284	1	600	3.8066667	2284.0	600
245	2008	ID	Bear Lake	All Other Crops	Area Plan Crops Only	8102	1	2468	3.2828201	8102.0	2468
246	2012	ID	Bear Lake	All Other Crops	Area Plan Crops Only	7459	1	2468	3.0222853	7459.0	2468
291	2010	ID	Bingham	All Other Crops	Area Plan Crops Only	4197	1	192	21.8593750	4197.0	192
292	2011	ID	Bingham	All Other Crops	Area Plan Crops Only	7769	1	240	32.3708333	7769.0	240
293	2012	ID	Bingham	All Other Crops	Area Plan Crops Only	6786	1	168	40.3928571	6786.0	168

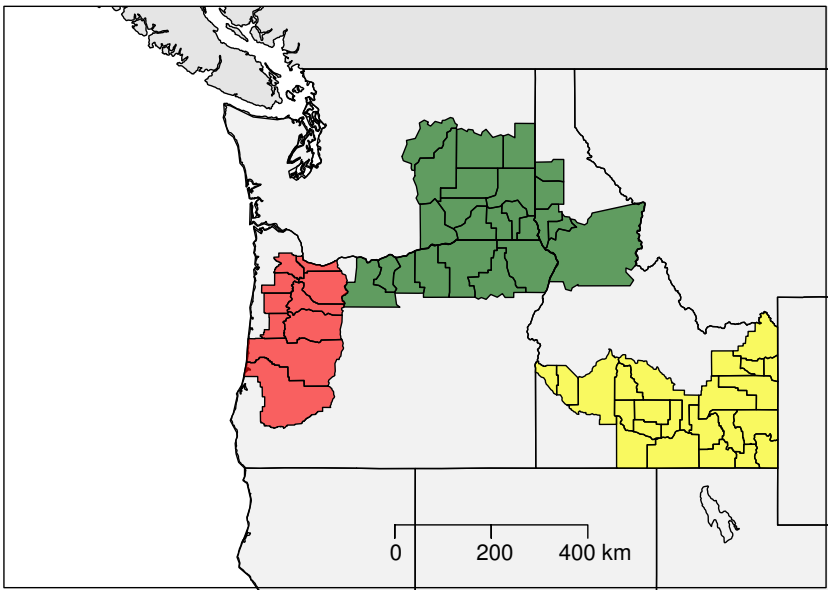
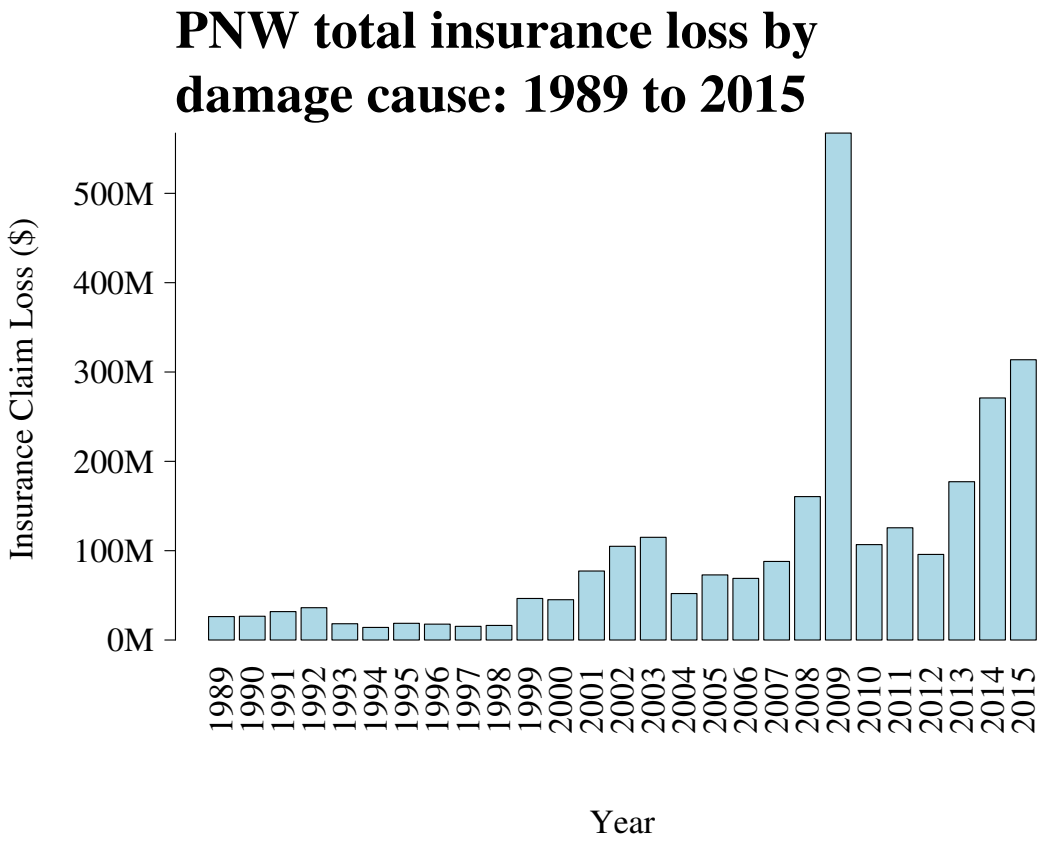
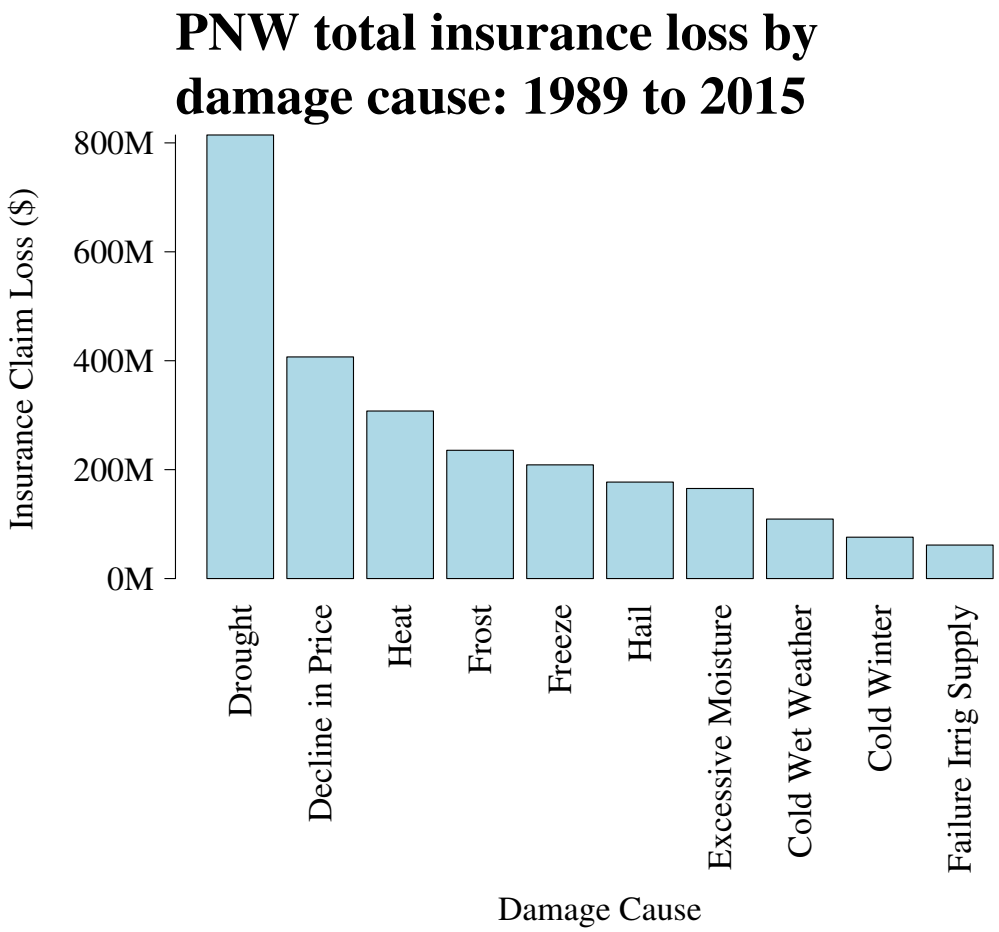


Figure 1: Pacific Northwest study area, which includes agricultural regions for the inland Pacific Northwest, the southern Idaho valley, and the Willamette valley.

Step 5: PNW insurance claim loss summary

Here we examine the PNW region's insurance loss by year, damage cause, and commodity, and county, from 1989 to 2015. From the results of this examination, we narrow our time frame to 2001 to 2015.





PNW total insurance loss by year, 1989-2015

1989-2015

damage cause

loss

Drought

814496893.53

Decline in Price

406959628.09

Heat

307635976.72

Frost

235527722.93

Freeze

208770819.89

Hail

177157029.63

Excessive Moisture

165391940.25

Cold Wet Weather

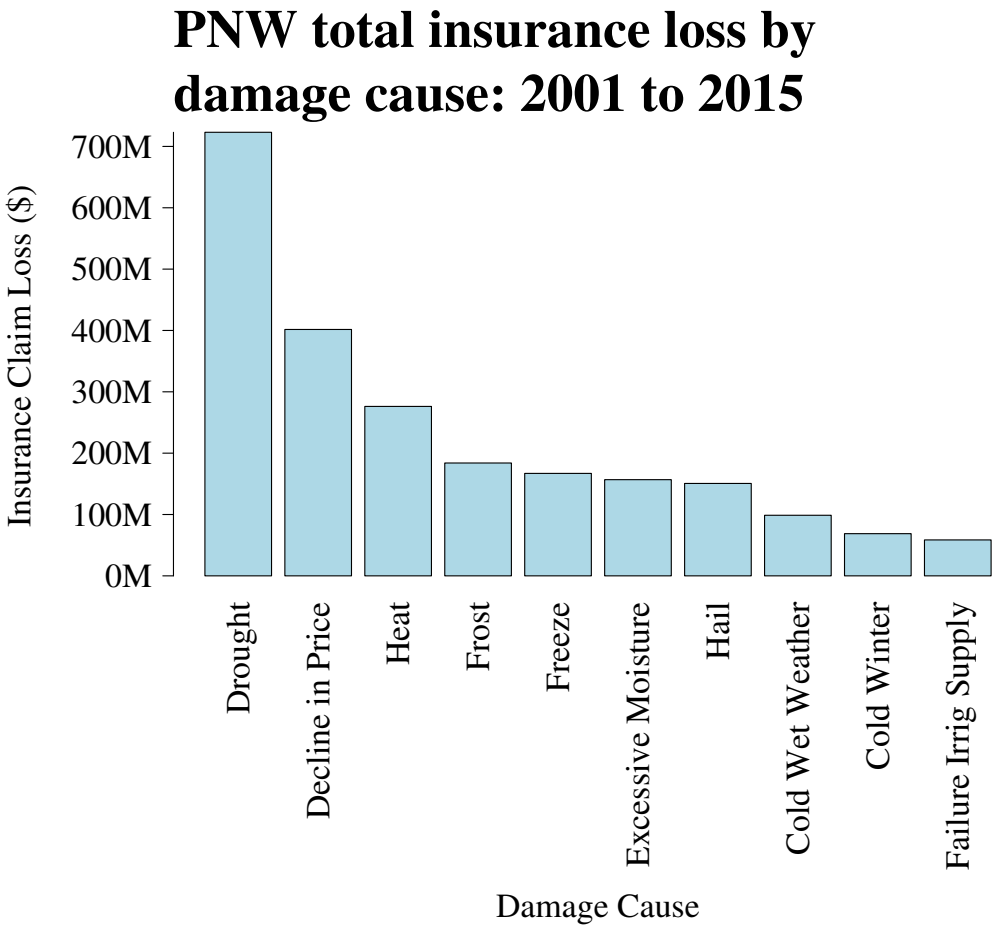
109229260.25

Cold Winter

75956007.78

Failure Irrig Supply

61515359.03



PNW total insurance loss by year, 2001-2015

2001-2015

damage cause

loss

Drought

$723,039,146

Decline in Price

$401,633,728

Heat

$276,188,676

Frost

$183,961,154

Freeze

$167,008,613

Excess Moisture/Precip/Rain

$156,789,247

Hail

$150,625,615

Cold Wet Weather

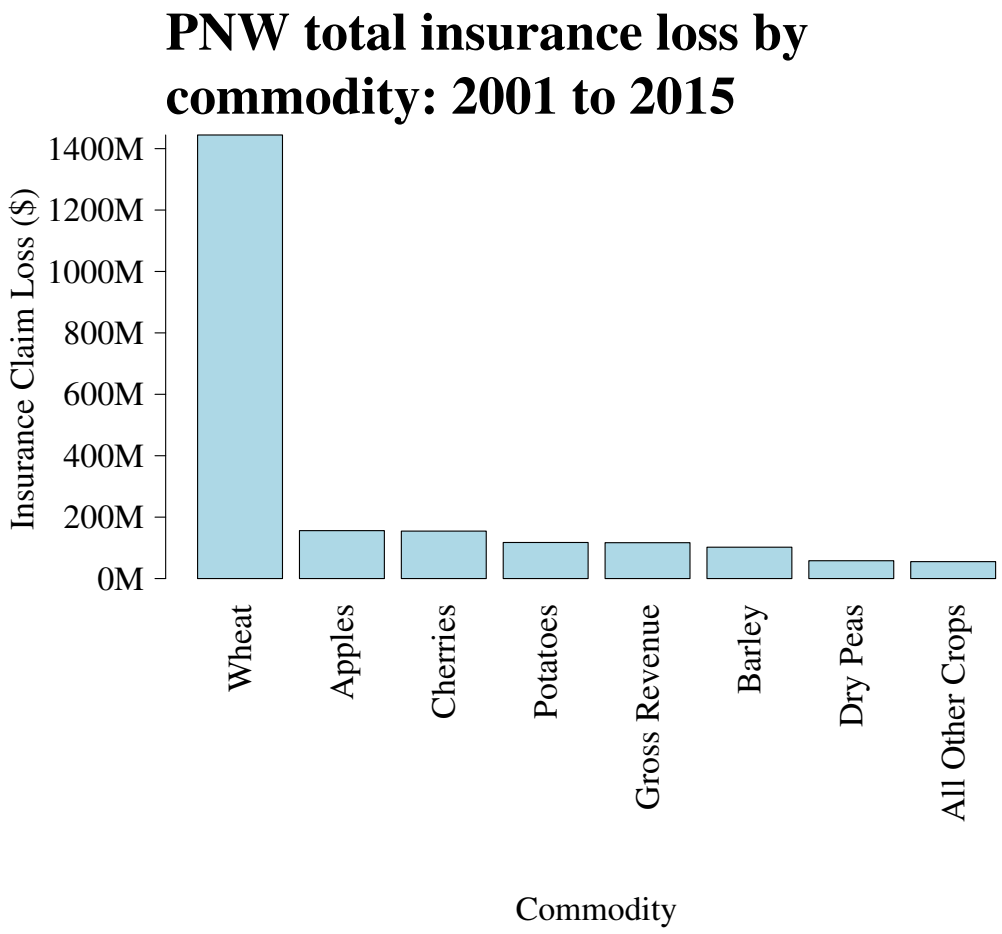
$98,760,529

Cold Winter

$68,763,872

Failure Irrig Supply

$58,570,602



PNW total insurance loss by year, 2001-2015

2001-2015

commodity

loss

WHEAT

$1,444,439,251

APPLES

$156,063,380

CHERRIES

$154,524,200

POTATOES

$117,459,400

ADJUSTED GROSS REVENUE

$116,781,042

BARLEY

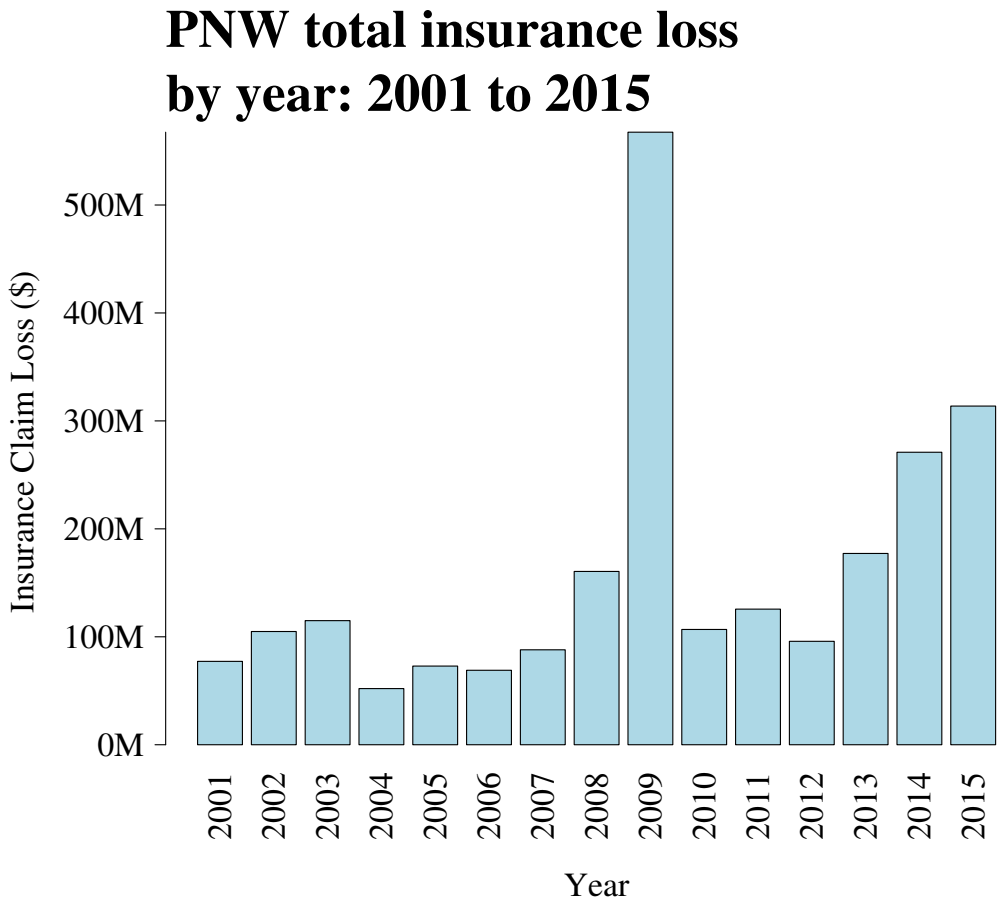
$102,125,046

DRY PEAS

$58,038,162

All Other Crops

$55,112,560



PNW total insurance loss by year, 2001-2015

2001-2015

year

loss

2001

$77,233,486

2002

$104,897,463

2003

$114,966,090

2004

$52,018,936

2005

$72,875,470

2006

$68,982,845

2007

$87,943,728

2008

$160,537,412

2009

$567,460,556

2010

$106,794,738

2011

$125,625,761

2012

$95,809,547

2013

$177,199,860

2014

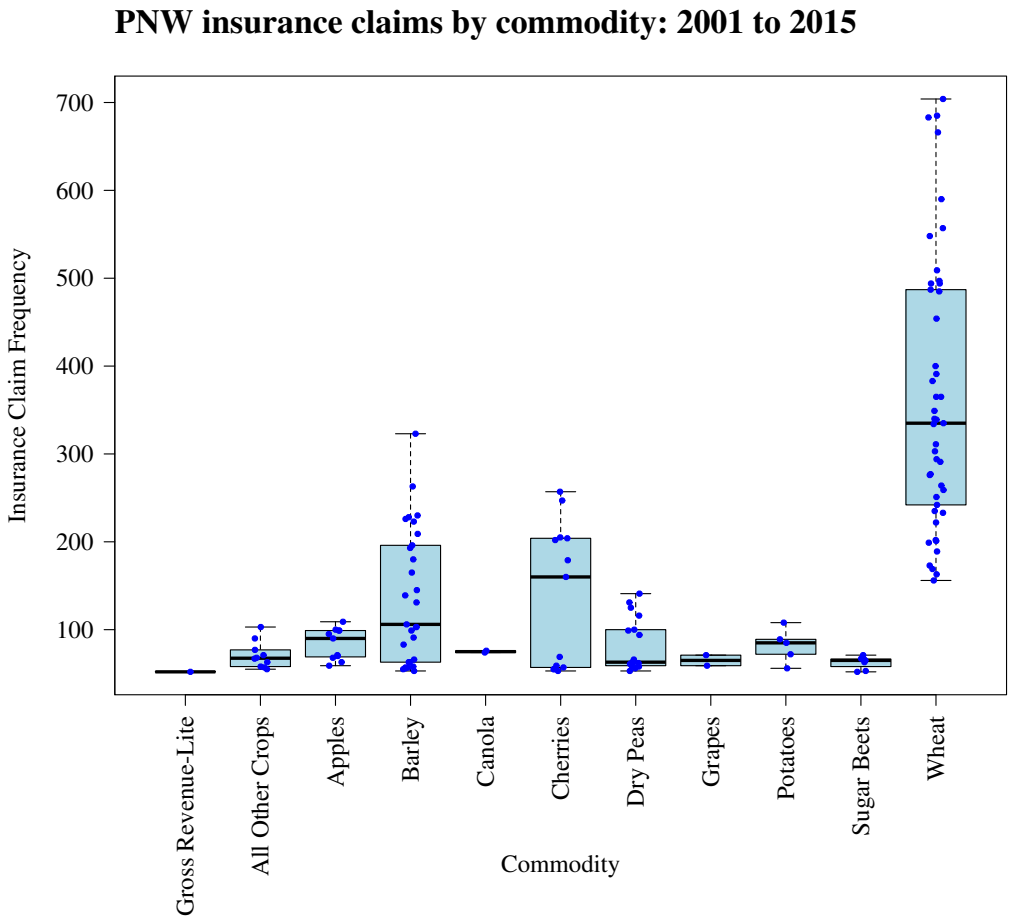
$270,956,814

2015

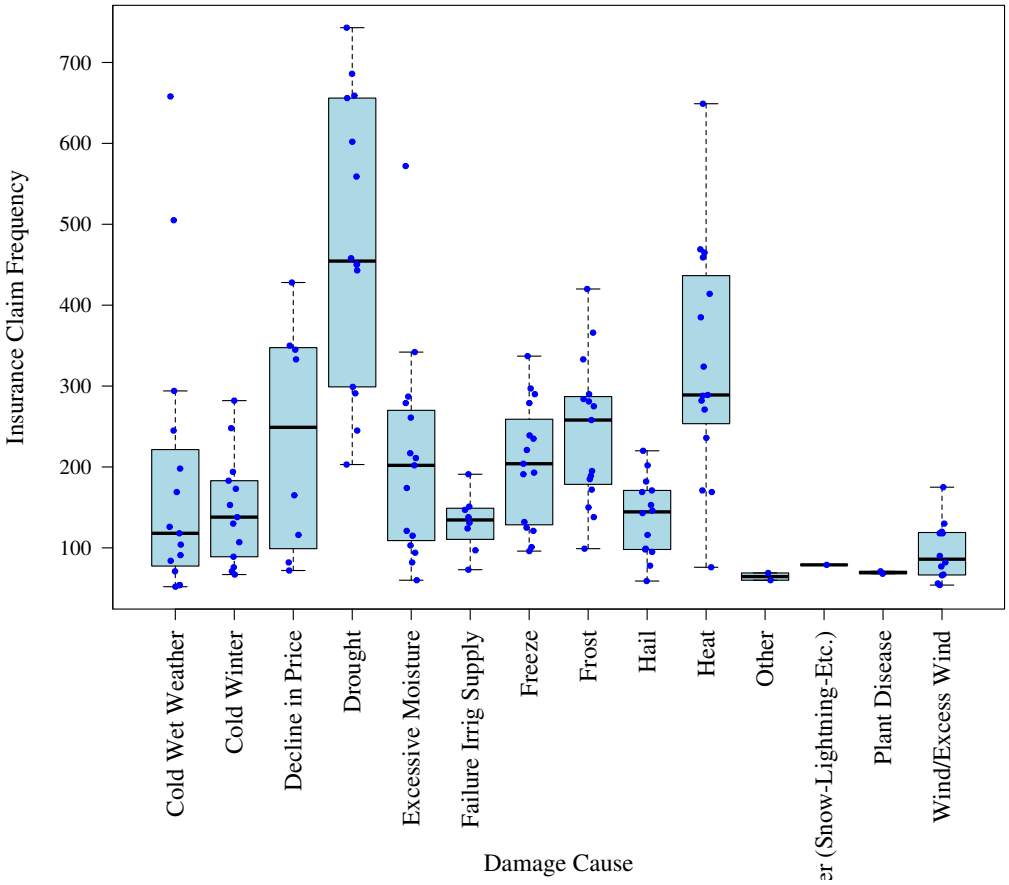
$313,739,035

Step 6: PNW insurance claim freqency summary

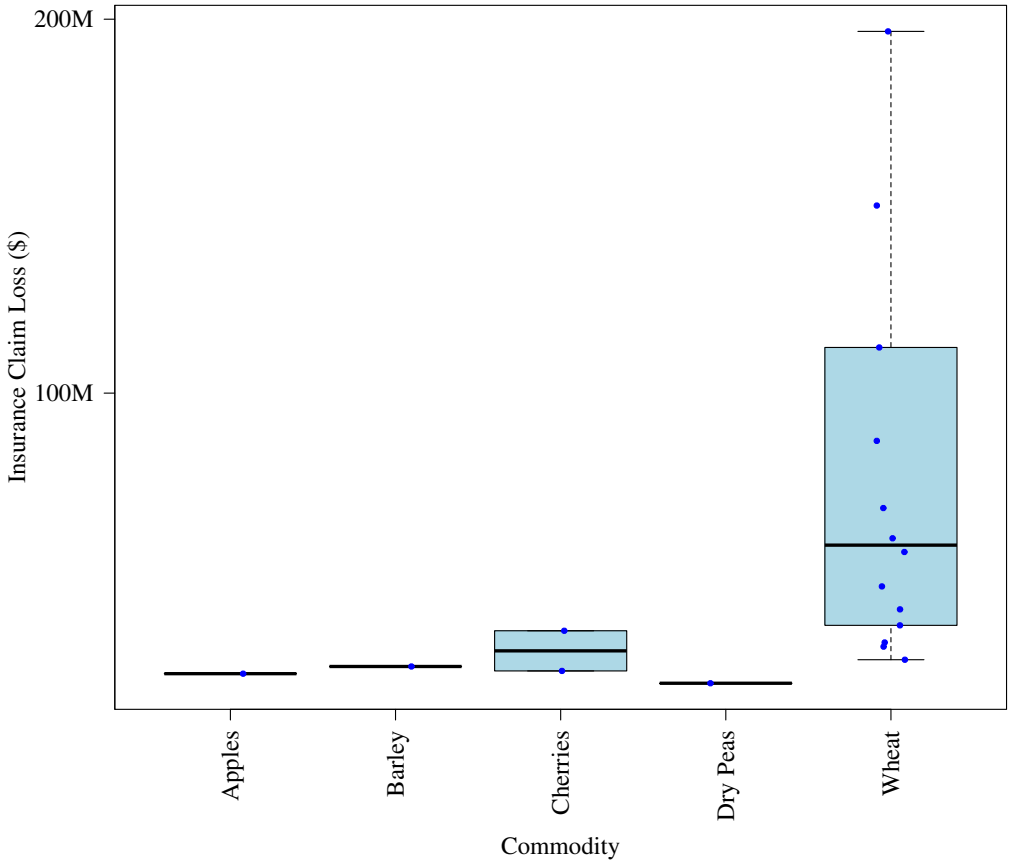
Below we examine the PNW insurance claim counts by the same factors: by commodity, damage cause, year, and county.



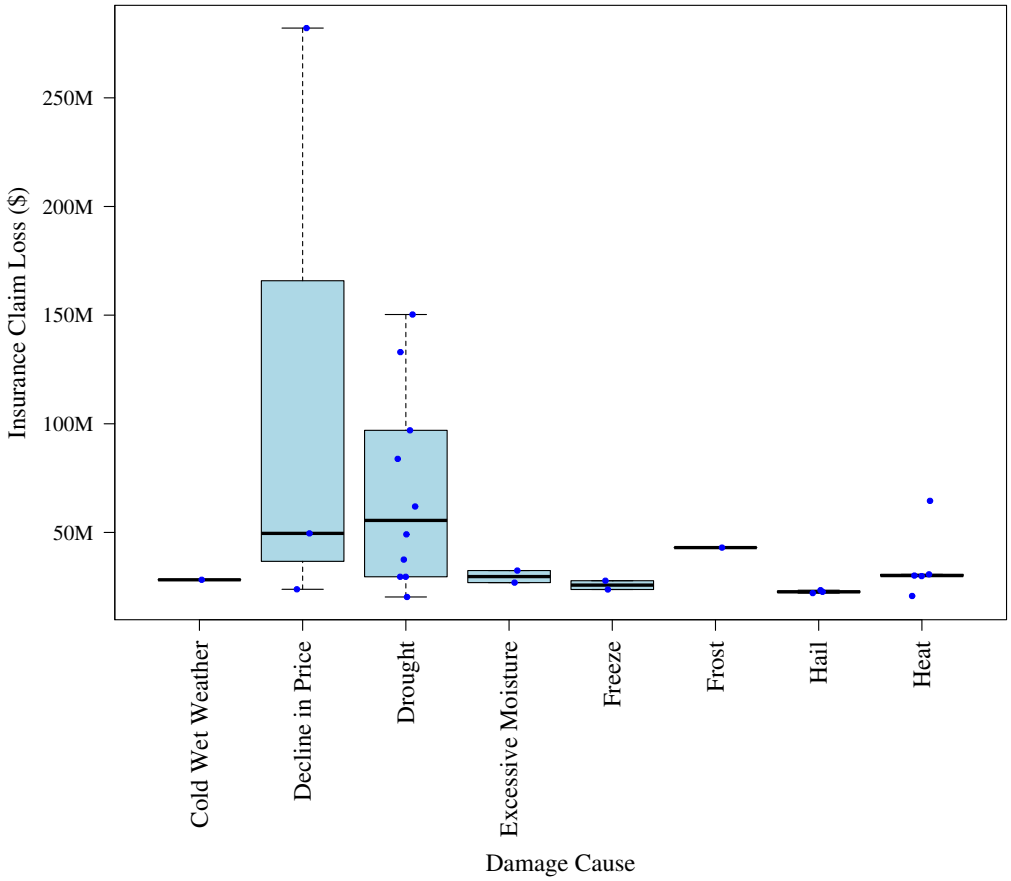
PNW insurance claims by damage cause: 2001 to 2015



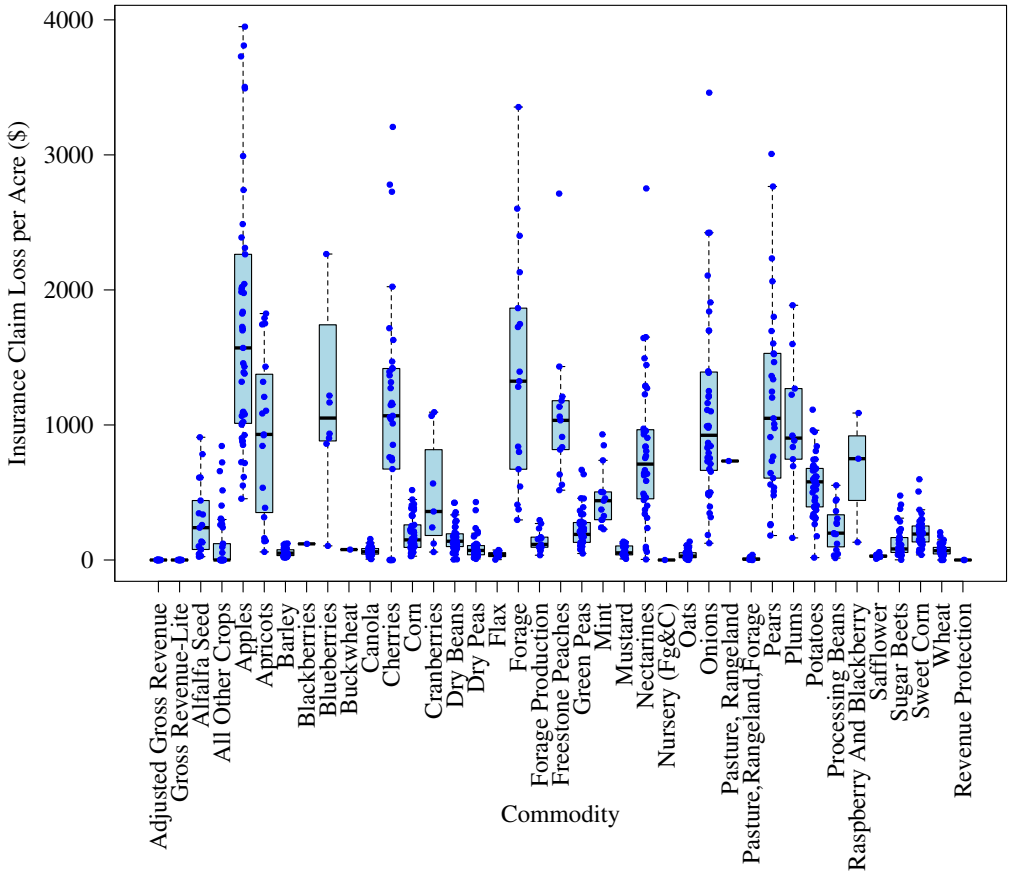
PNW insurance loss by commodity: 2001 to 2015



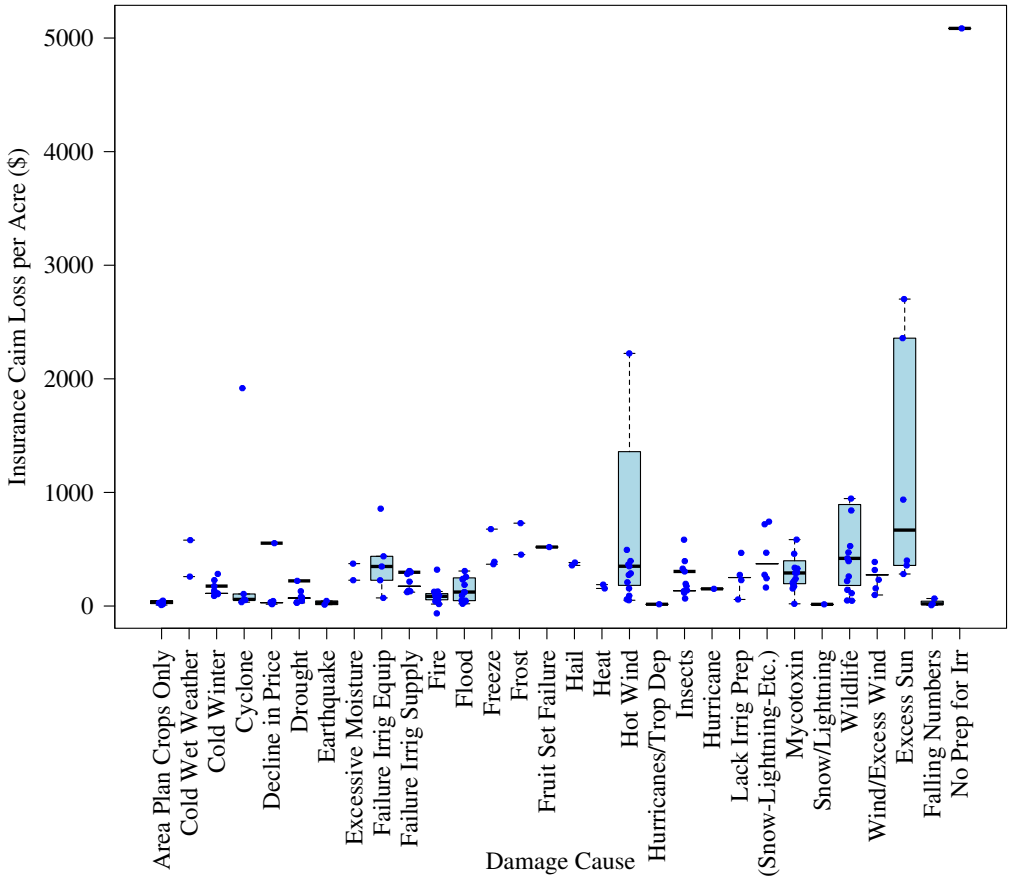
PNW insurance loss by damage cause: 2001 to 2015

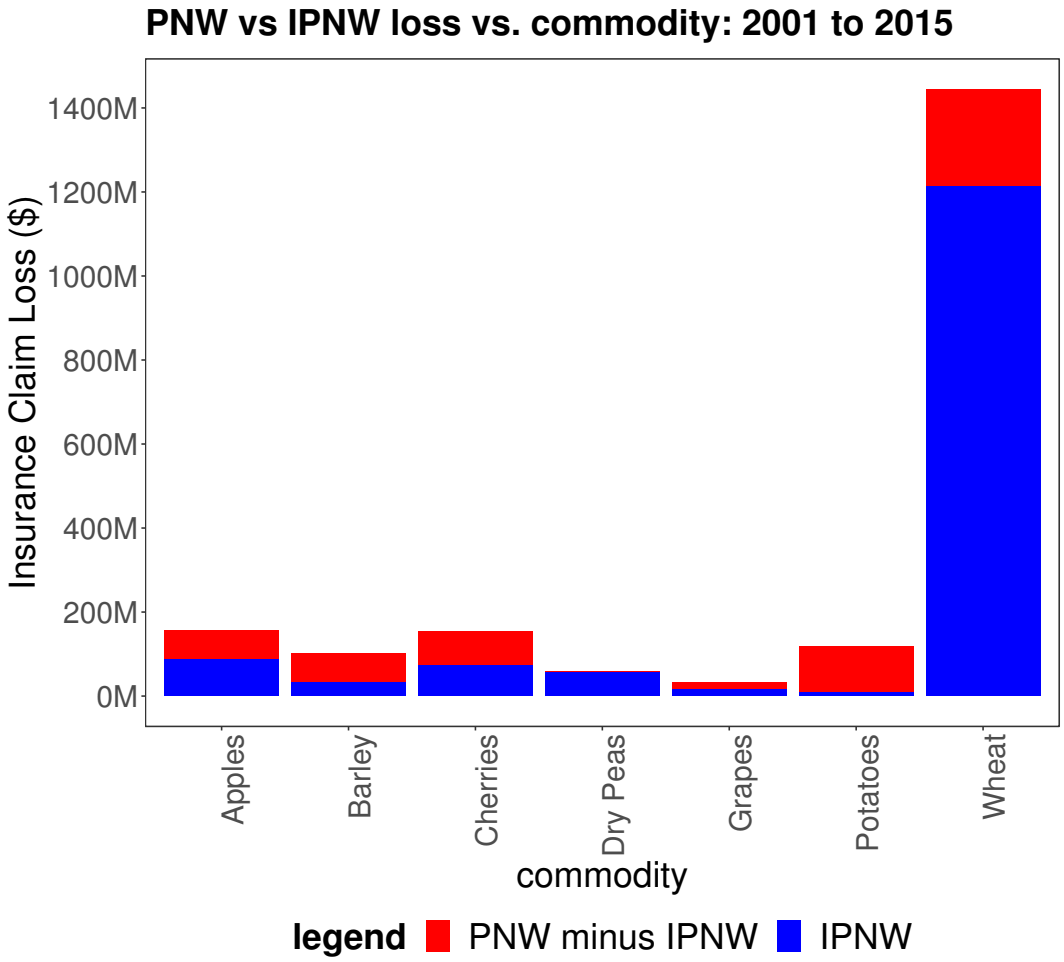


PNW insurance loss per acre by commodity: 2001 to 2015

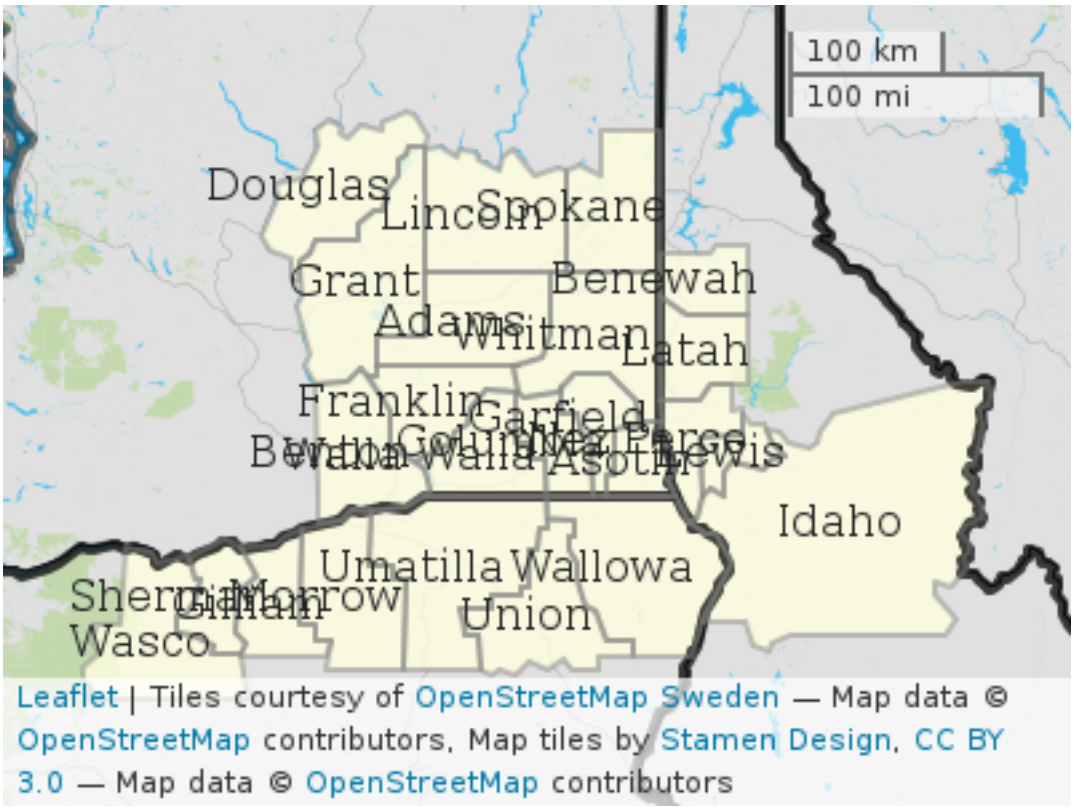


PNW insurance loss per acre by damage cause: 2001 to 2015

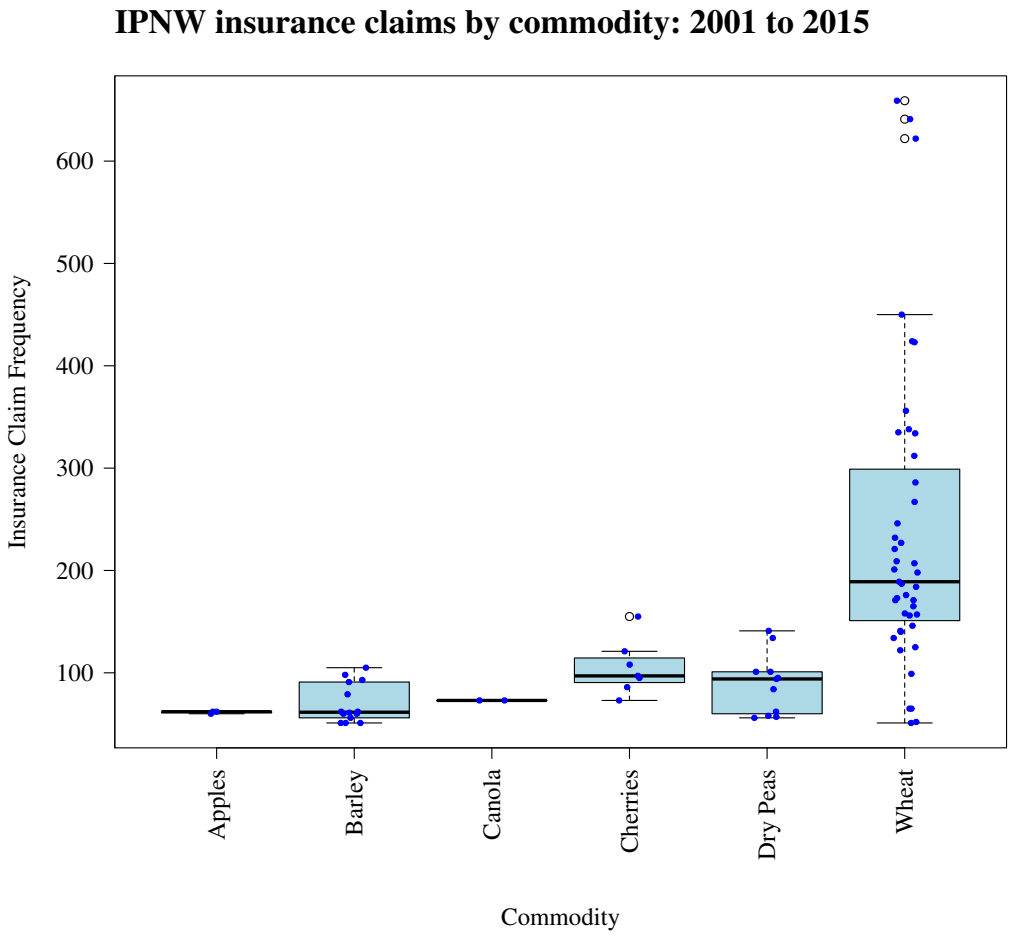



PNW vs IPNW loss vs. commodity: 2001 to 2015
Insurance Claim Loss ($)
1400M
1200M
1000M
800M
600M
400M
200M
0M
Apples
Barley
Cherries
Dry Peas
Grapes
Potatoes
Wheat
commodity
legend
PNW minus IPNW
IPNW

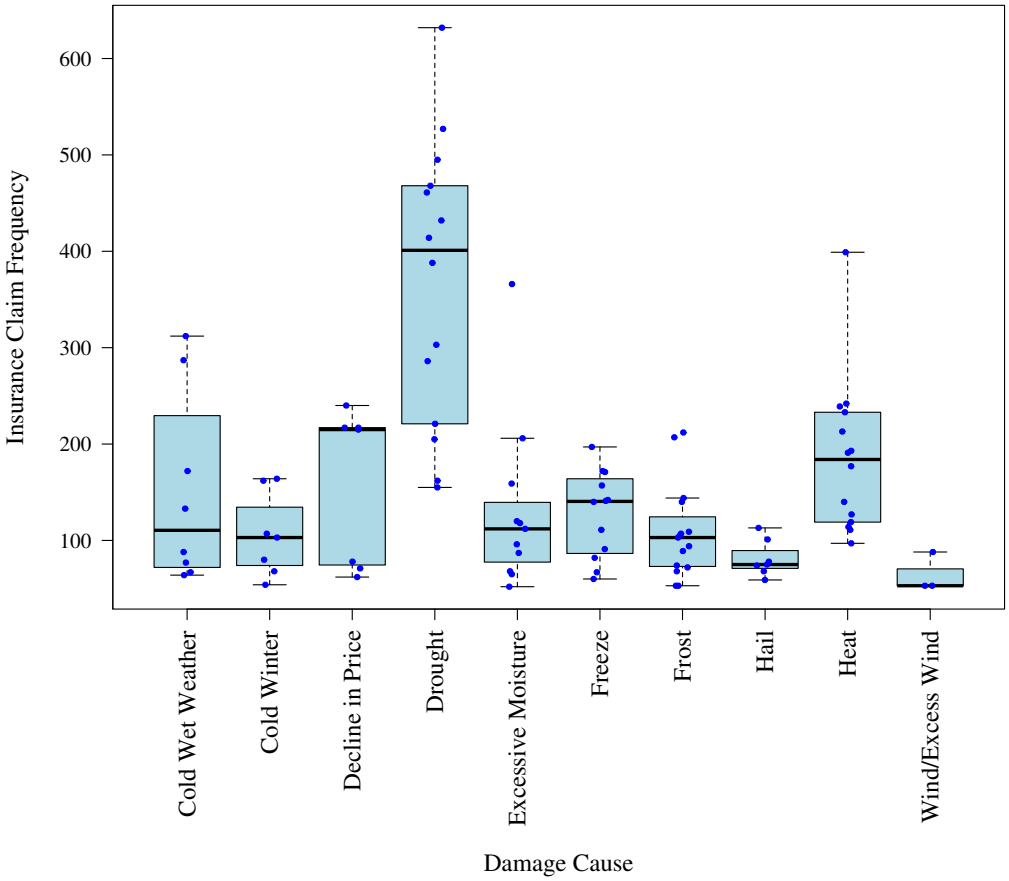
Step 7: IPNW Study Area



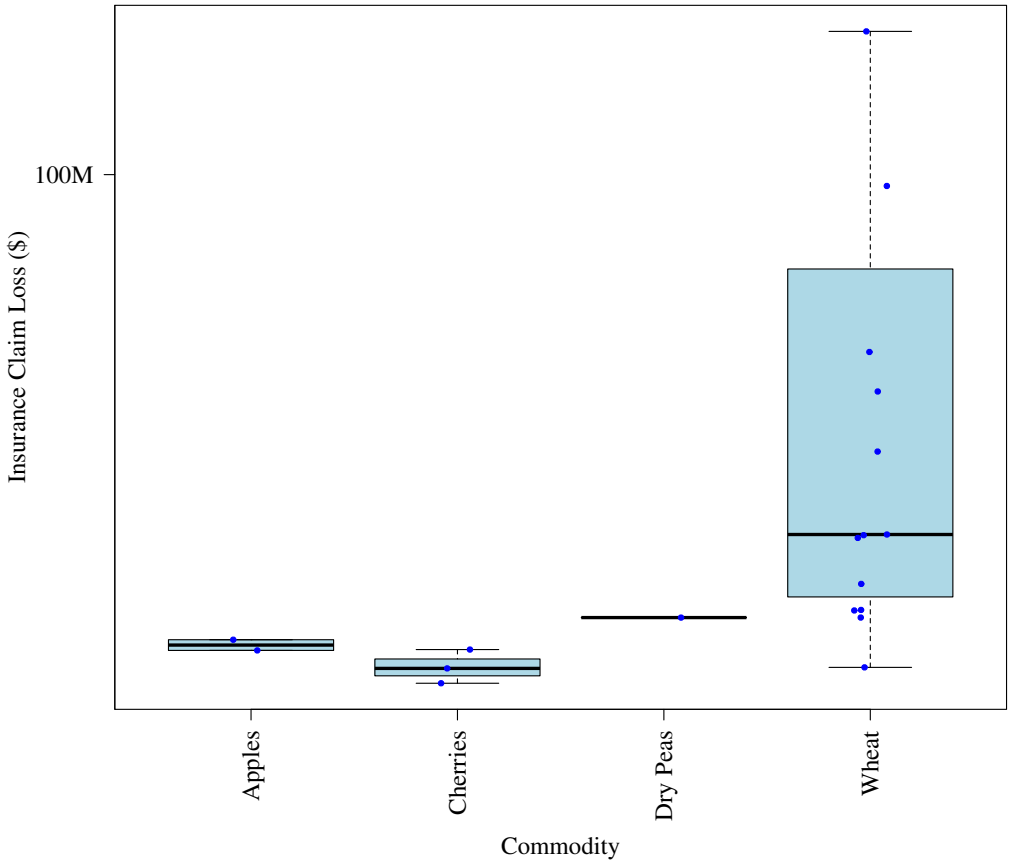
Step 8: IPNW insurance claim loss summary



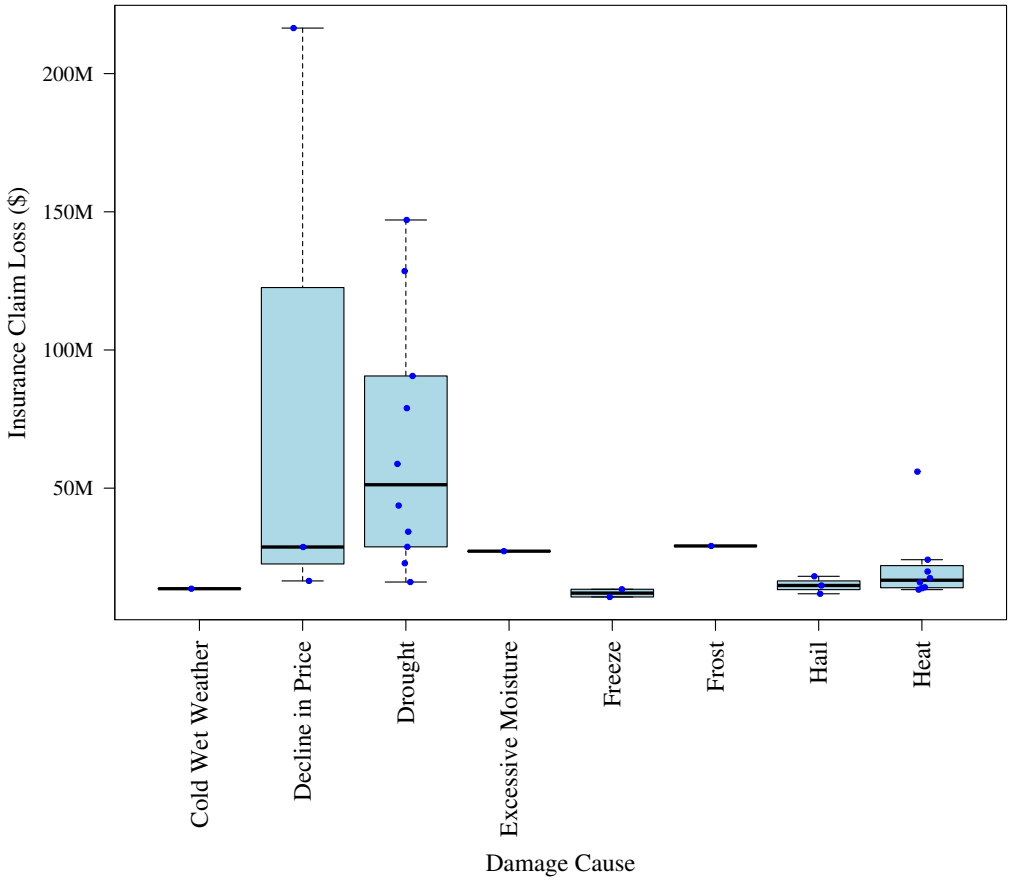
IPNW insurance claims by damage cause: 2001 to 2015



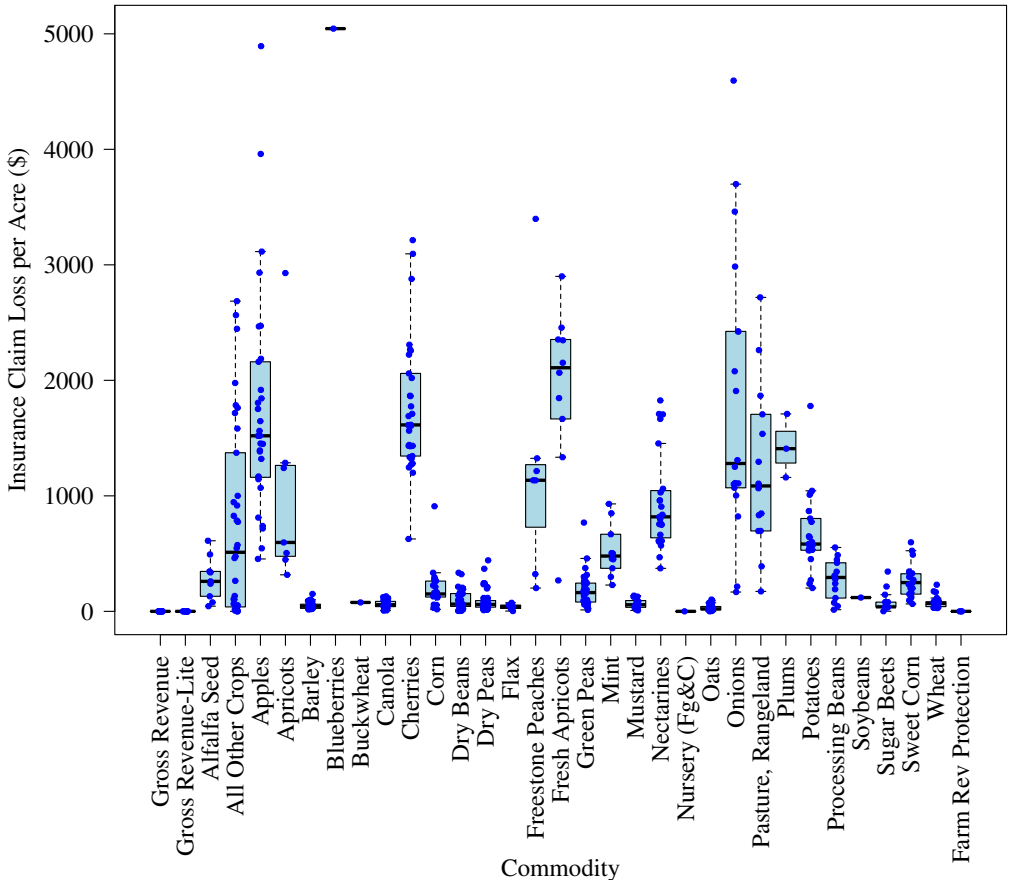
IPNW insurance loss by commodity: 2001 to 2015



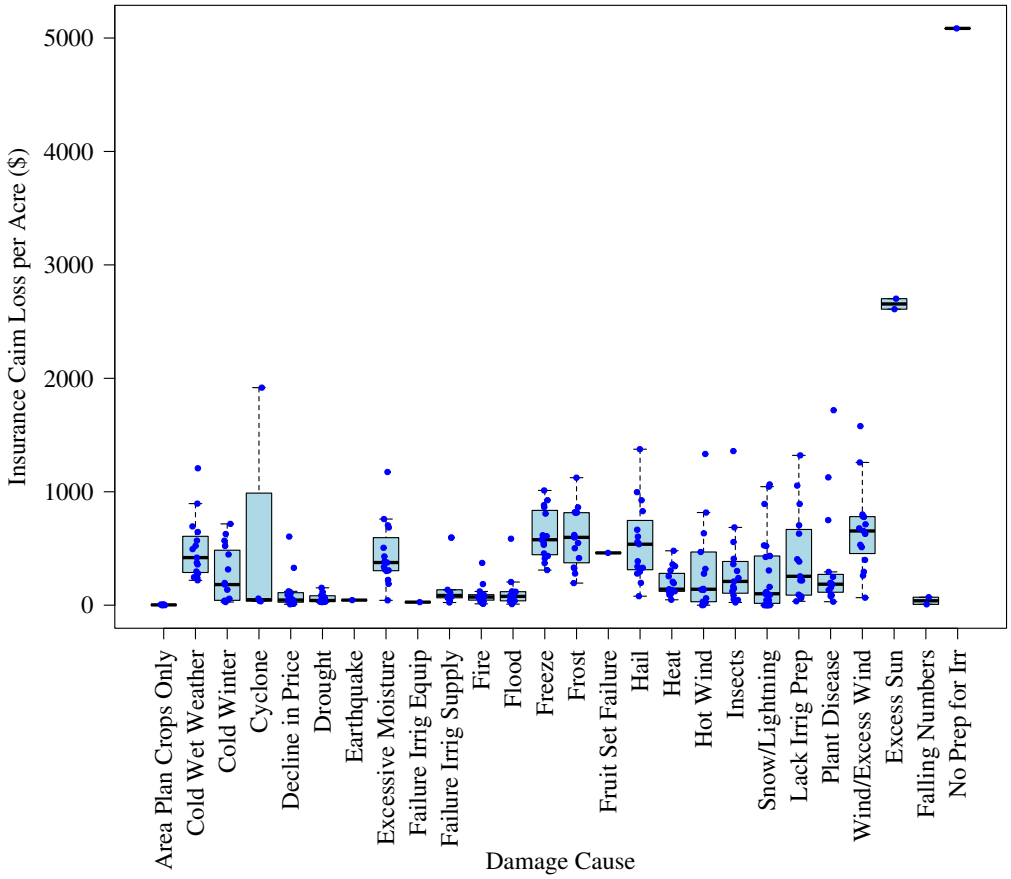
IPNW insurance loss by damage cause: 2001 to 2015



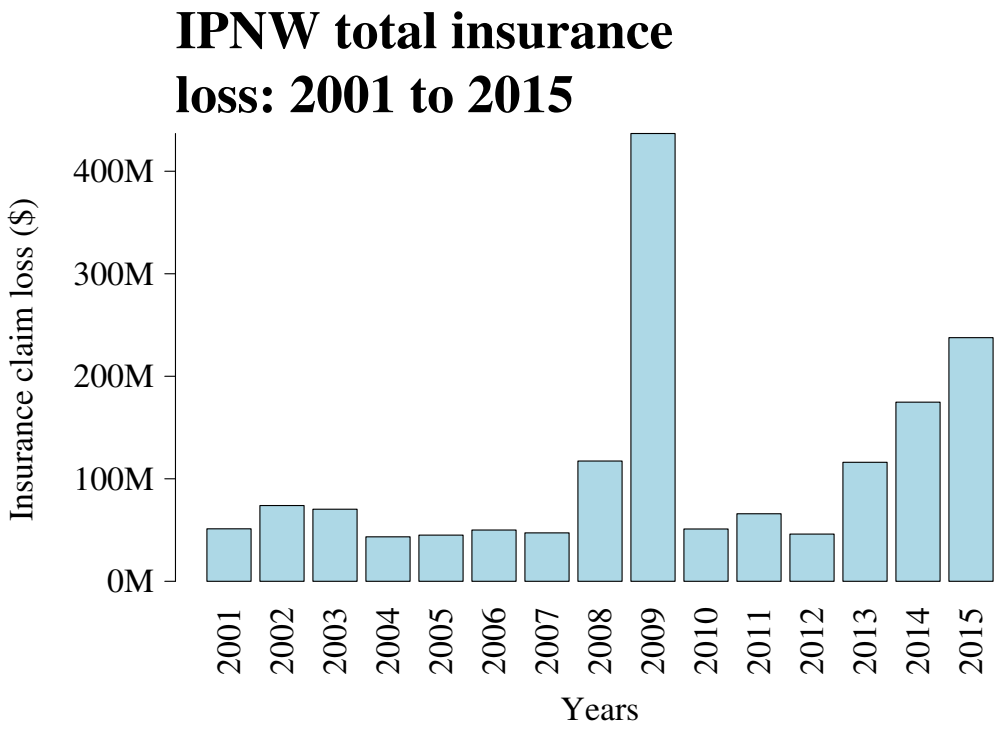
IPNW insurance loss per acre by commodity: 2001 to 2015



IPNW insurance loss per acre by damage cause: 2001 to 2015



Step 9: IPNW insurance claim count summary



IPNW region total insurance loss by year, 2001-2015

2001-2015

year

loss

2001

$51,203,203

2002

$73,905,306

2003

$70,314,803

2004

$43,387,412

2005

$45,054,042

2006

$50,022,732

2007

$47,237,969

2008

$117,324,601

2009

$436,808,728

2010

$51,023,916

2011

$65,883,241

2012

$46,062,127

2013

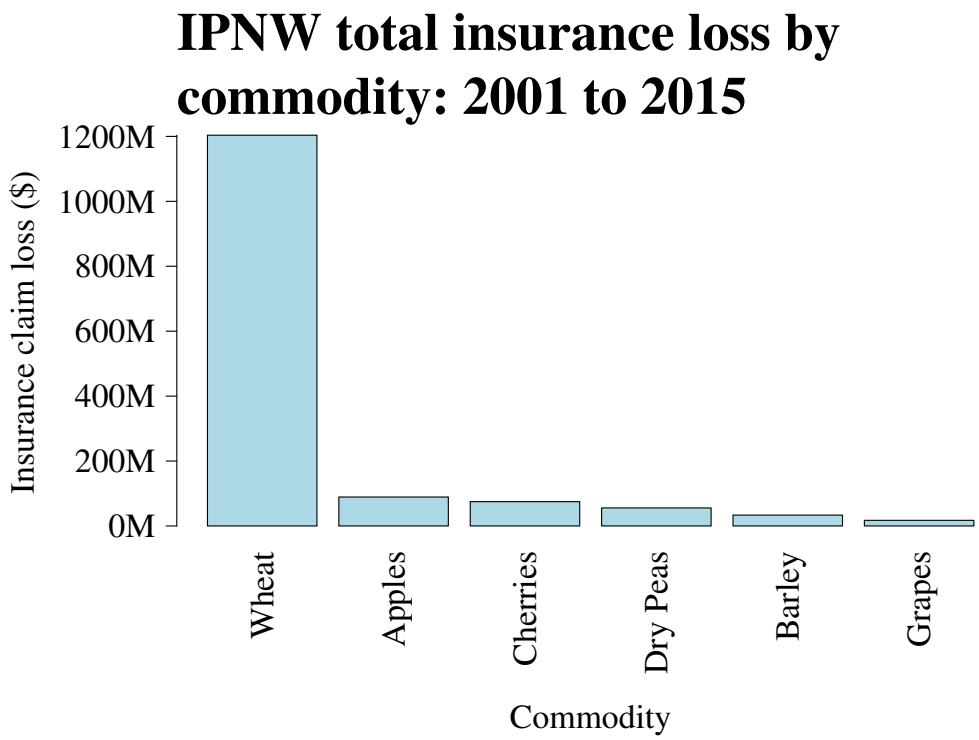
$116,089,278

2014

$174,745,874

2015

$237,671,277



IPNW region total insurance loss by commodity, 2001-2015

2001-2015

commodity

loss

WHEAT

$1,203,744,611

APPLES

$89,186,728

CHERRIES

$74,853,342

DRY PEAS

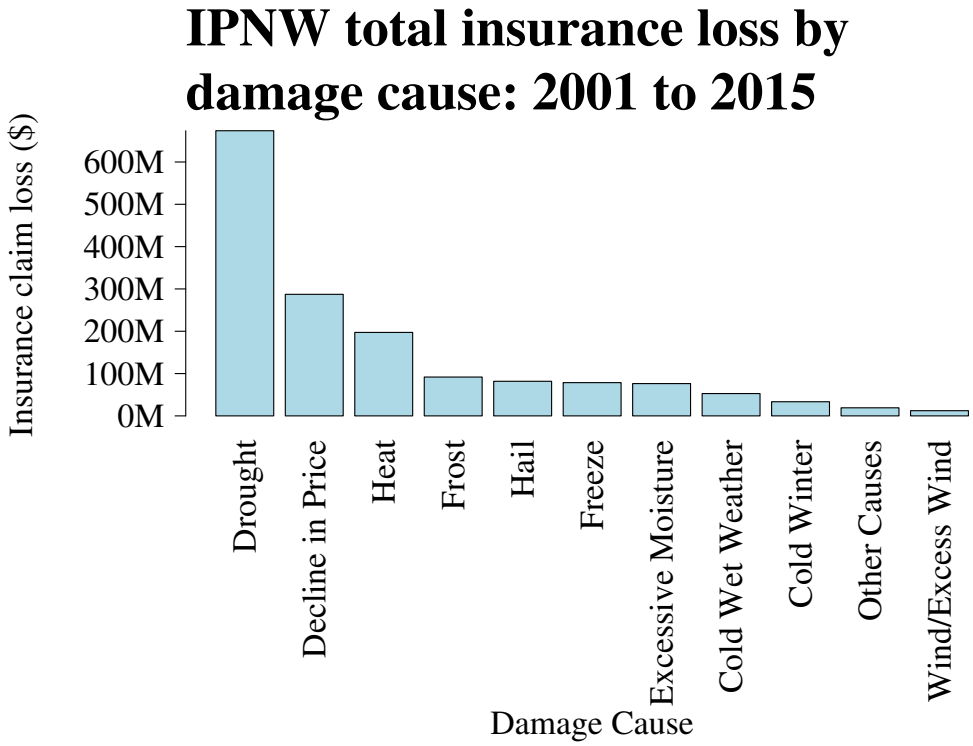
$55,590,740

BARLEY

$33,476,785

GRAPES

$17,370,434



IPNW region total insurance loss by damage cause, 2001-2015

2001-2015

damage cause

loss

Drought

$673,854,997

Decline in Price

$287,278,003

Heat

$197,275,538

Frost

$91,808,517

Hail

$81,776,579

Freeze

$78,563,950

Excessive Moisture

$76,325,319

Cold Wet Weather

$52,762,454

Cold Winter

$33,445,556

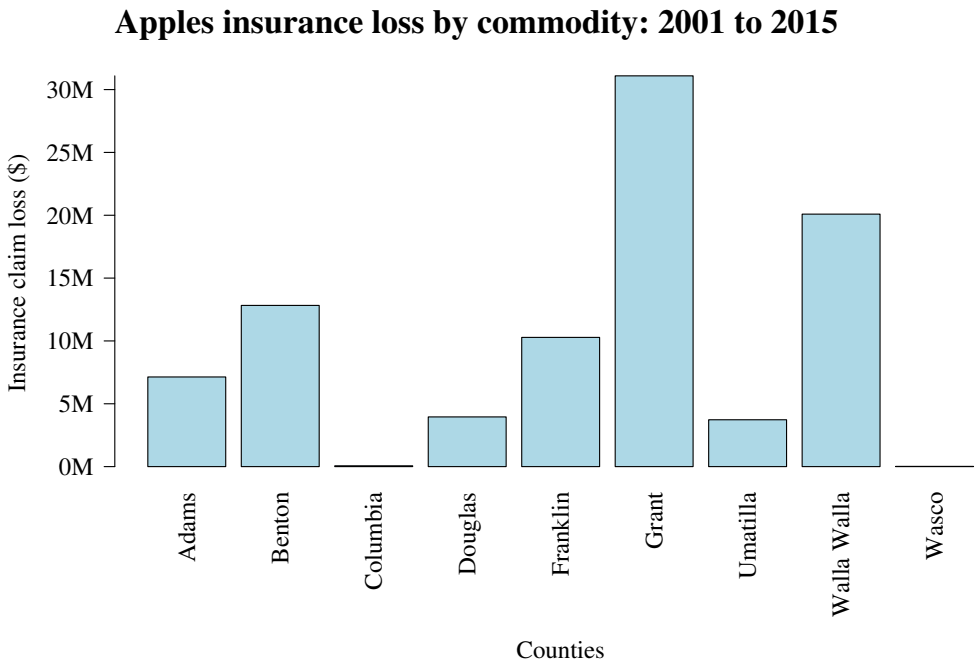
Other Causes

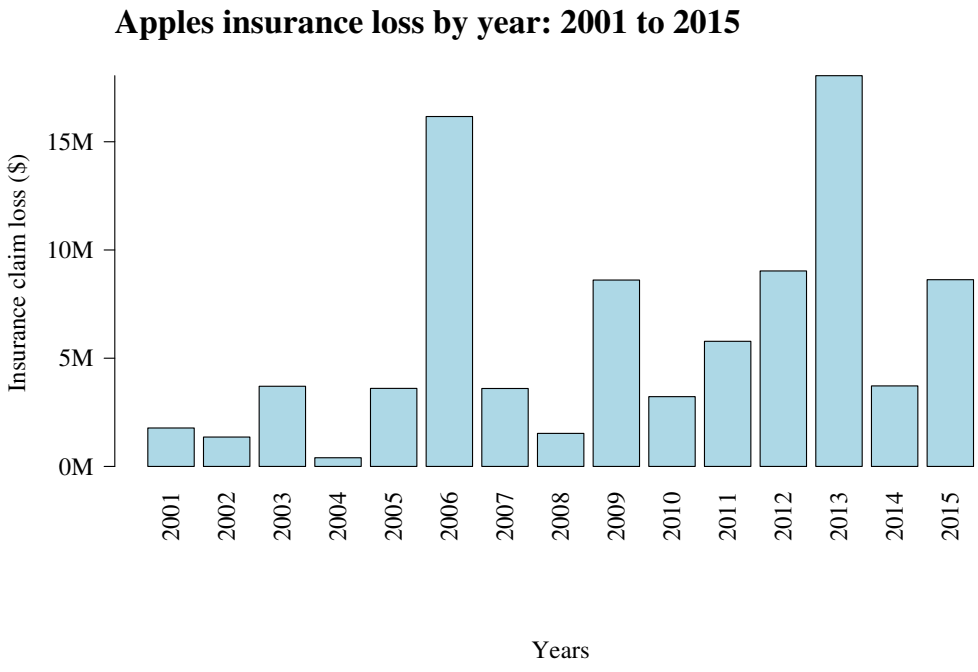
$19,094,006

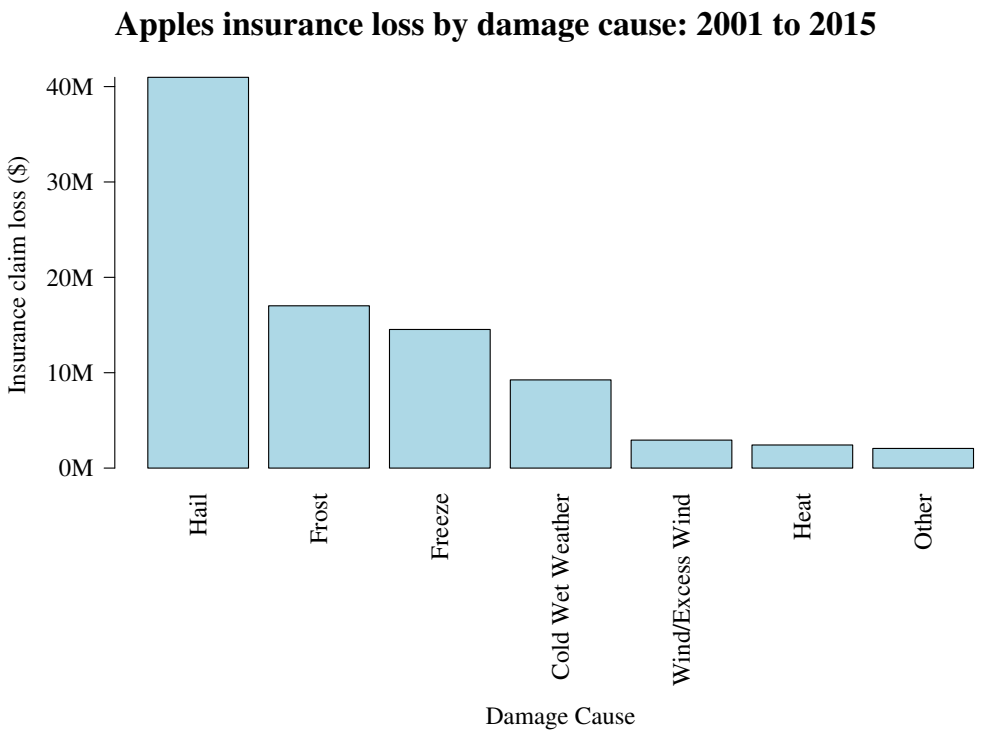
Wind/Excess Wind

$12,268,262

Step 10: APPLES, 2001-2015 for the IPNW







IPNW region APPLES total insurance loss by damage cause, 2001-2015

2001-2015

damagecause

loss

Hail

$40,971,994

Frost

$17,016,586

Freeze

$14,534,548

Cold Wet Weather

$9,246,848

Wind/Excess Wind

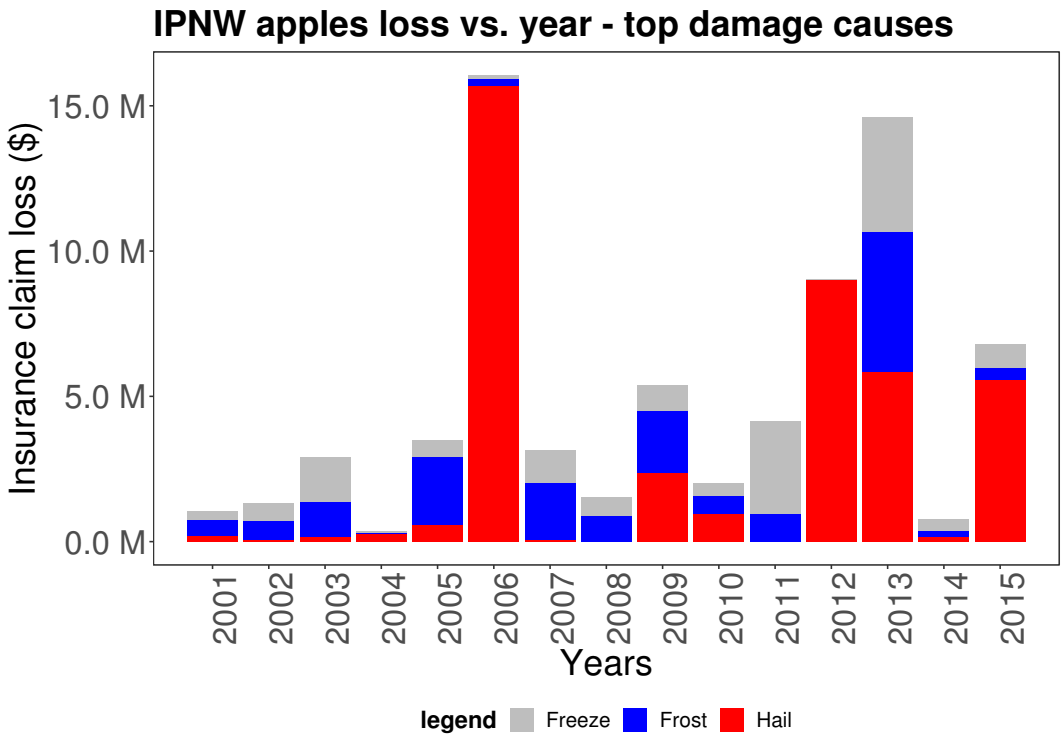
$2,934,044

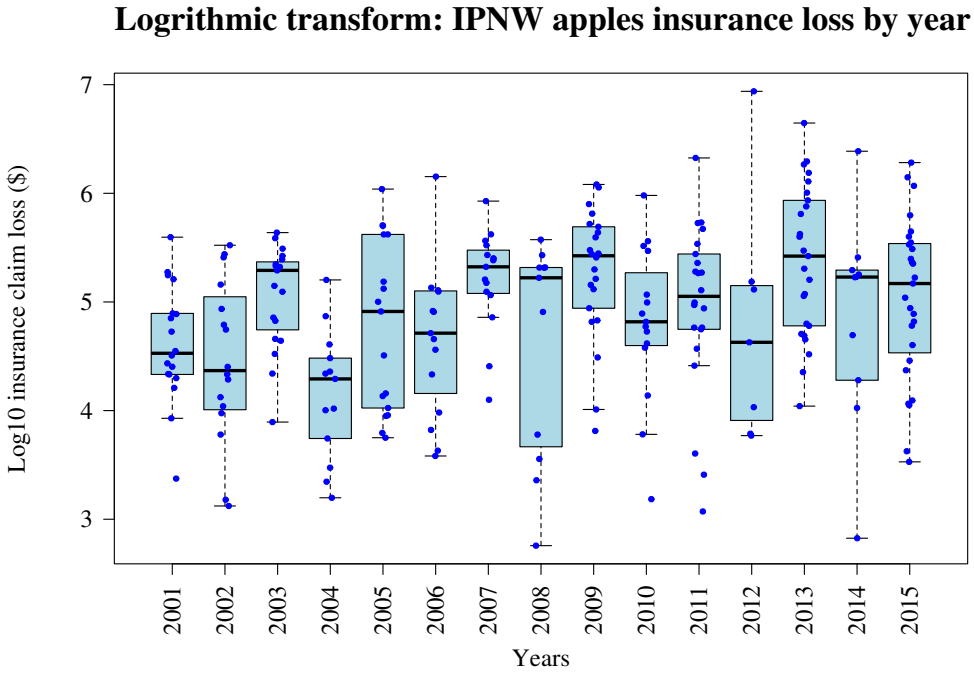
Heat

$2,422,480

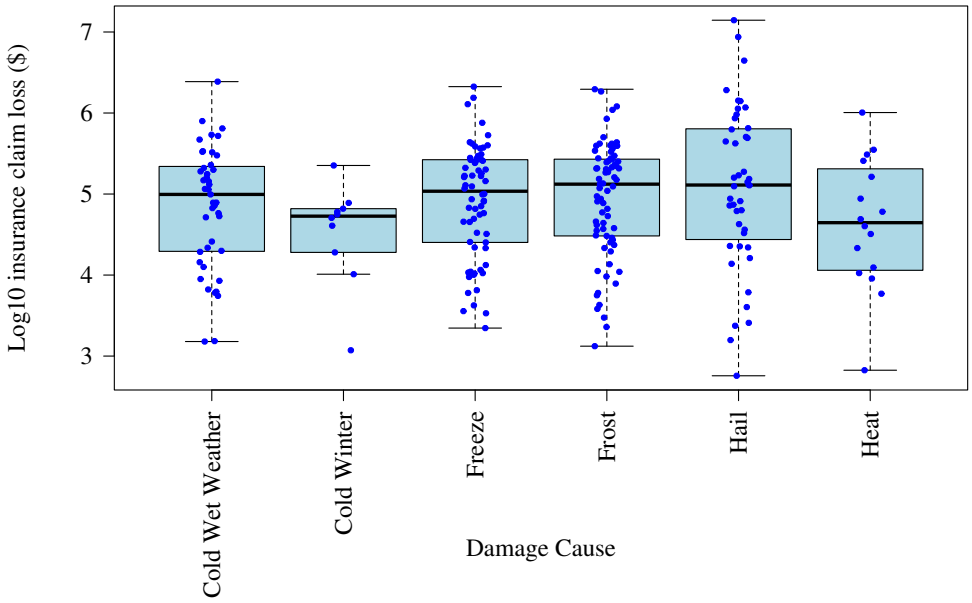
Other

$2,060,230

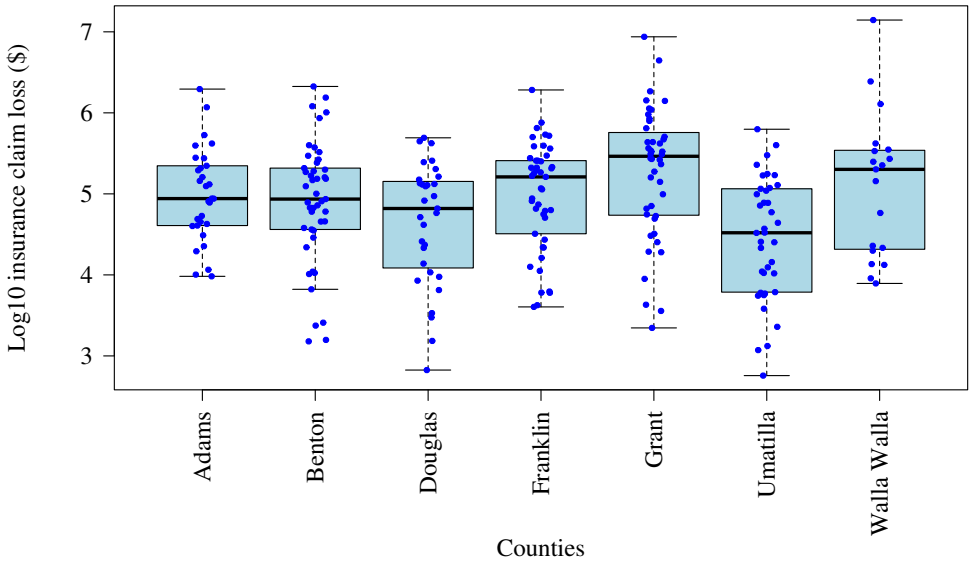

IPNW apples loss vs. year - top damage causes
Insurance claim loss ($)
15.0 M
10.0 M
5.0 M
0.0 M
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years
legend
Freeze
Frost
Hail

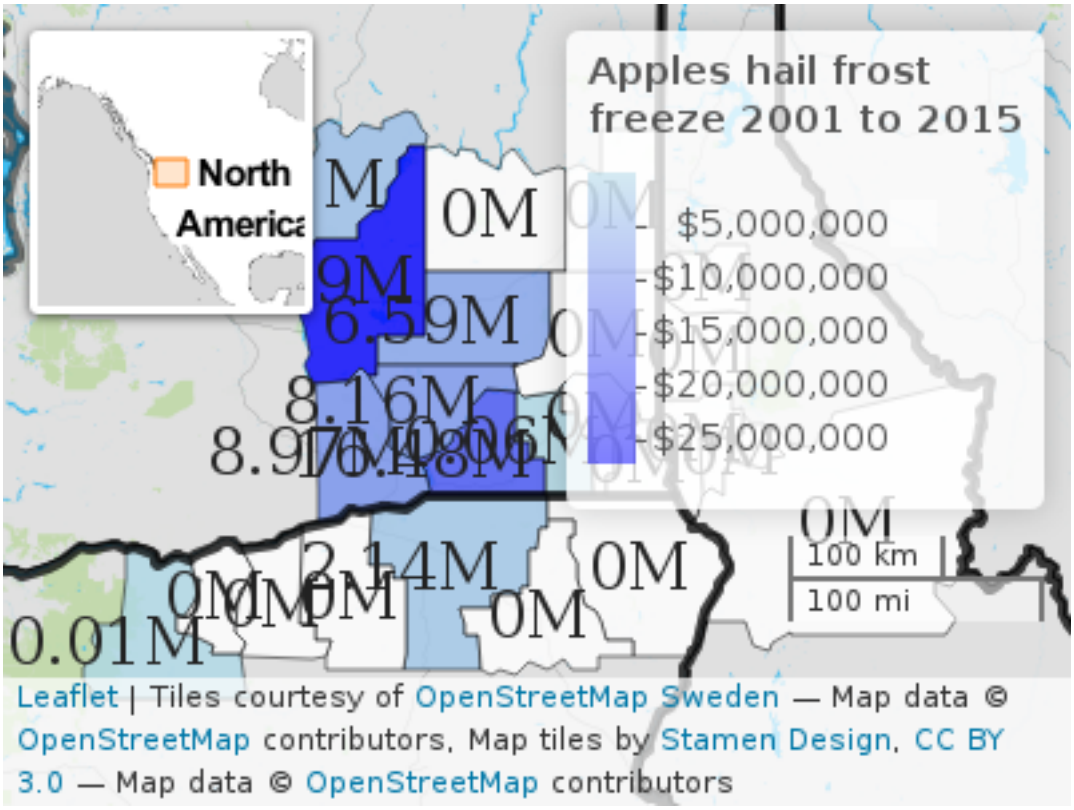

Logrithmic transform: IPNW apples insurance loss by year
Log10 insurance claim loss ($)
7
6
5
4
3
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years

Logrithmic transform: IPNW apples insurance loss by damage cause

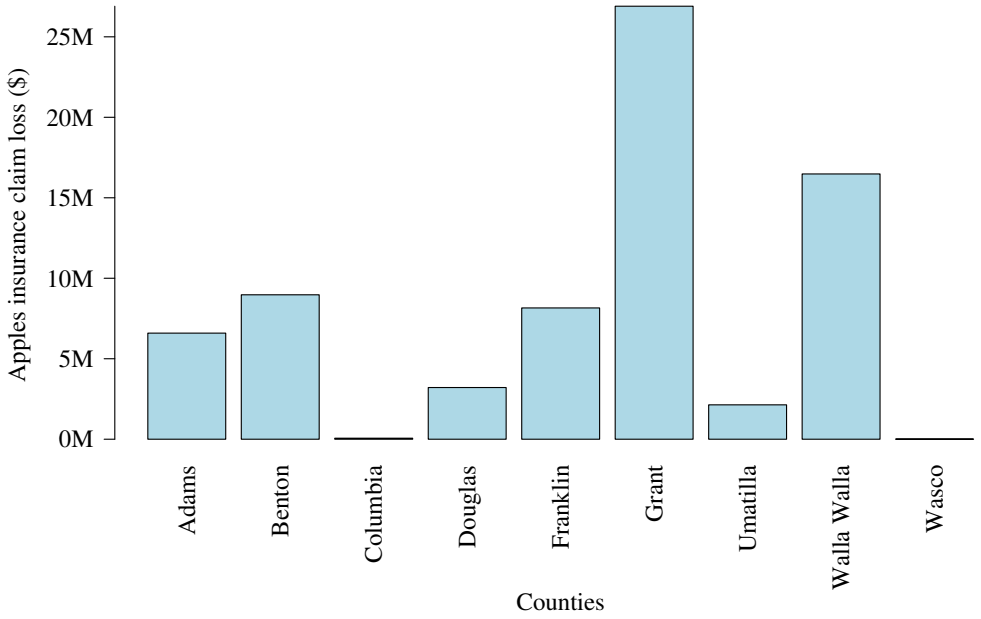


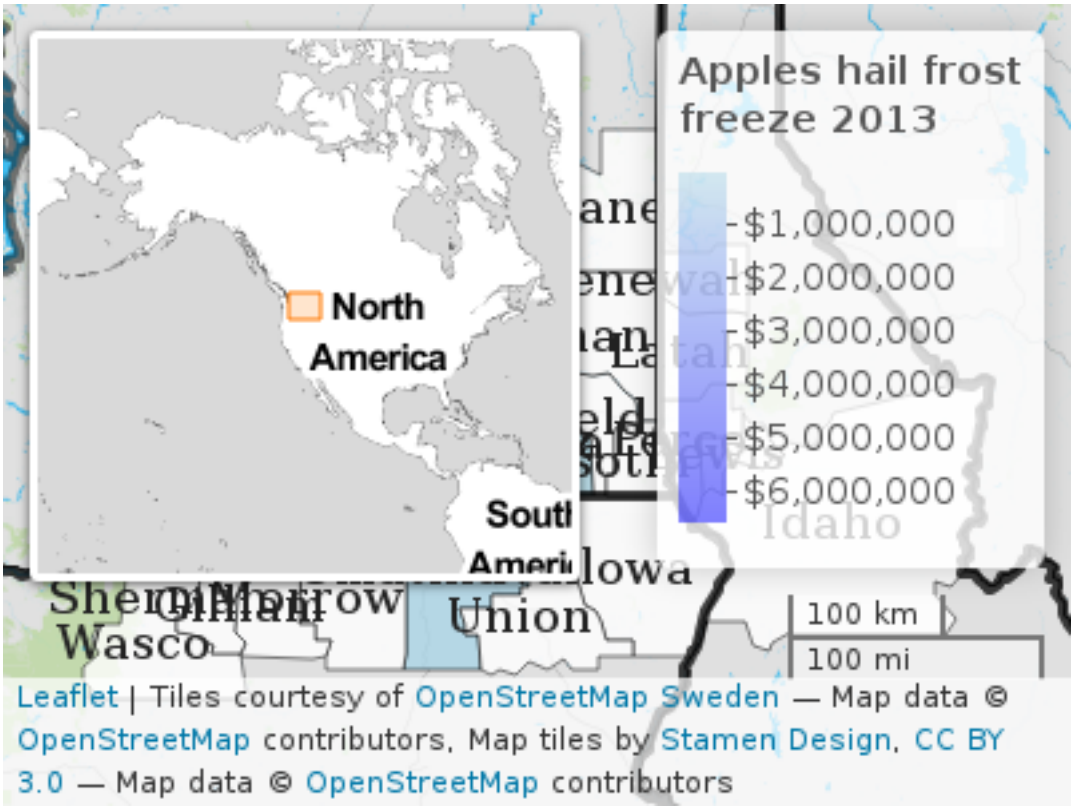
Logrithmic transform: IPNW apples insurance loss by county



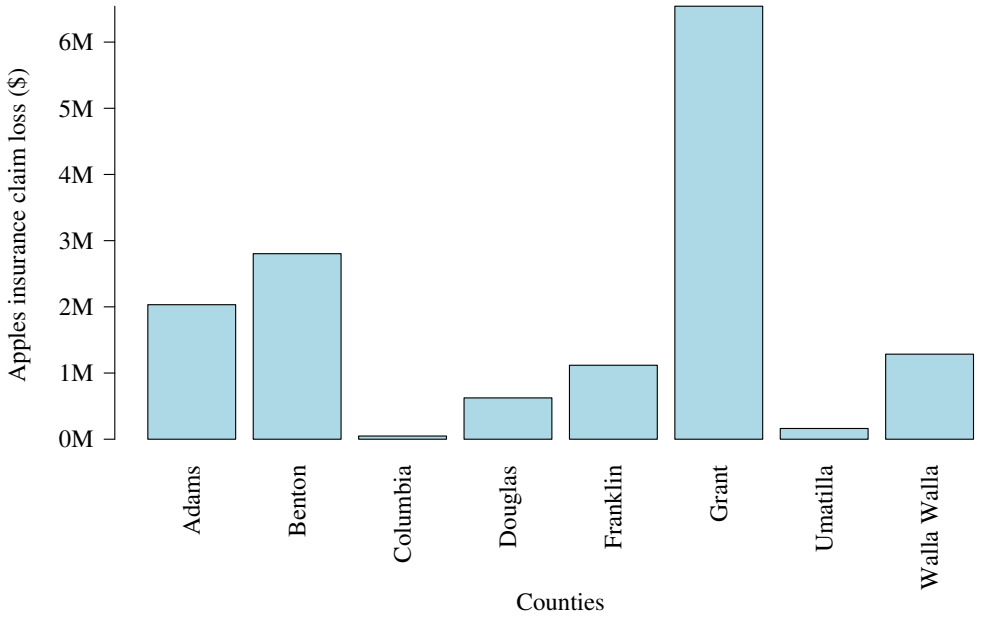


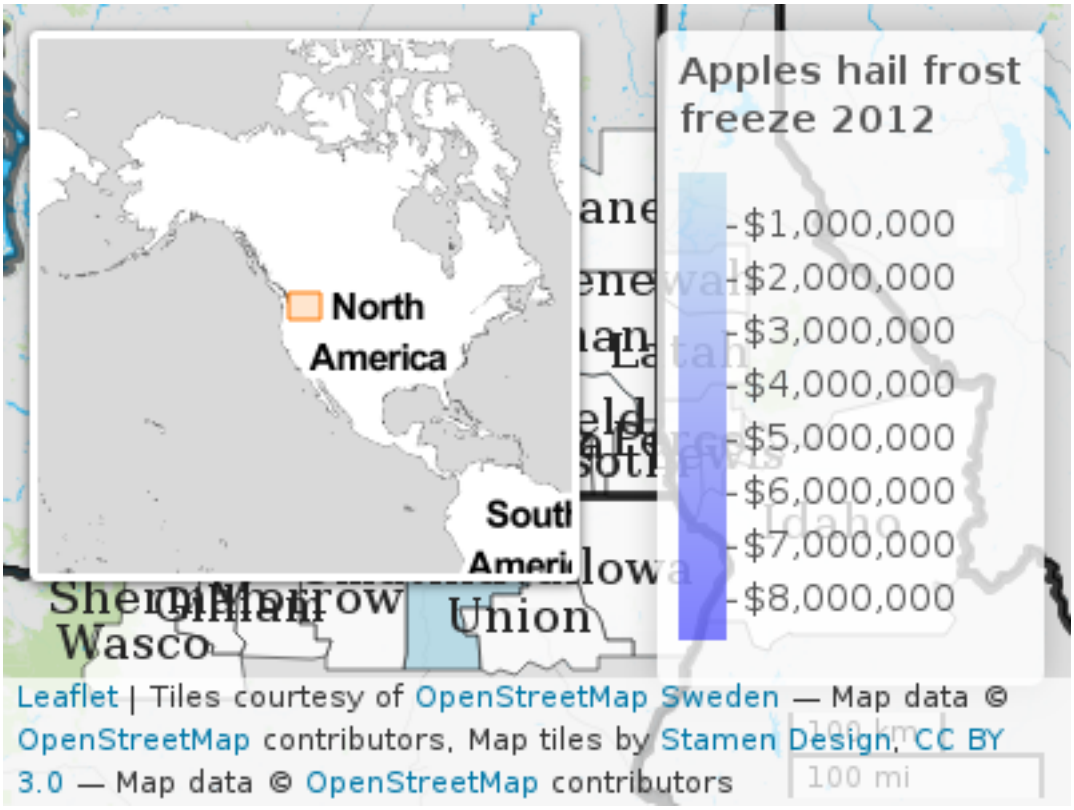
IPNW apples insurance loss due to hail, frost, and freeze 2001 to 2015



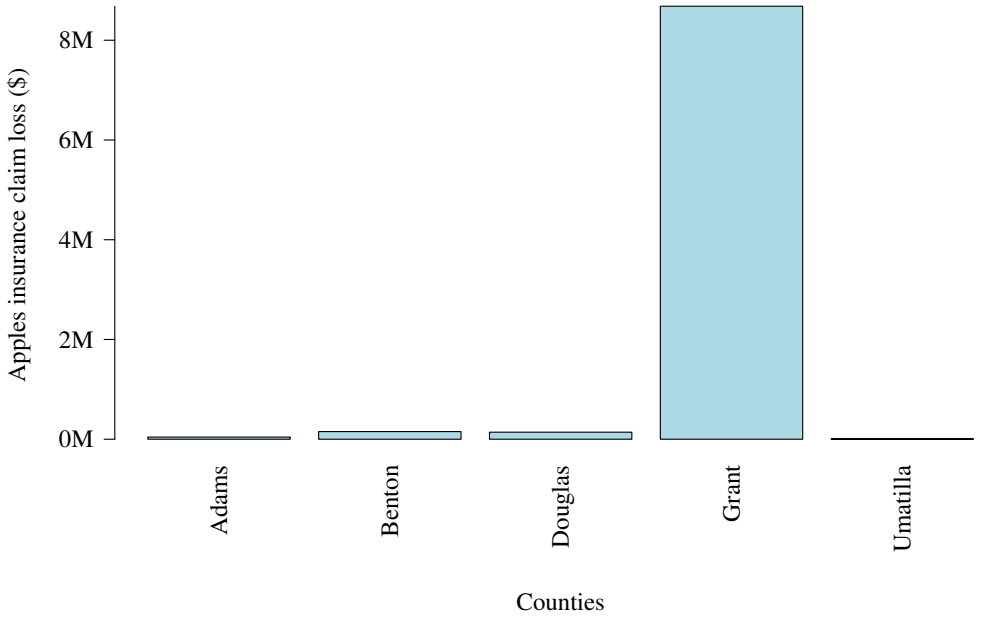


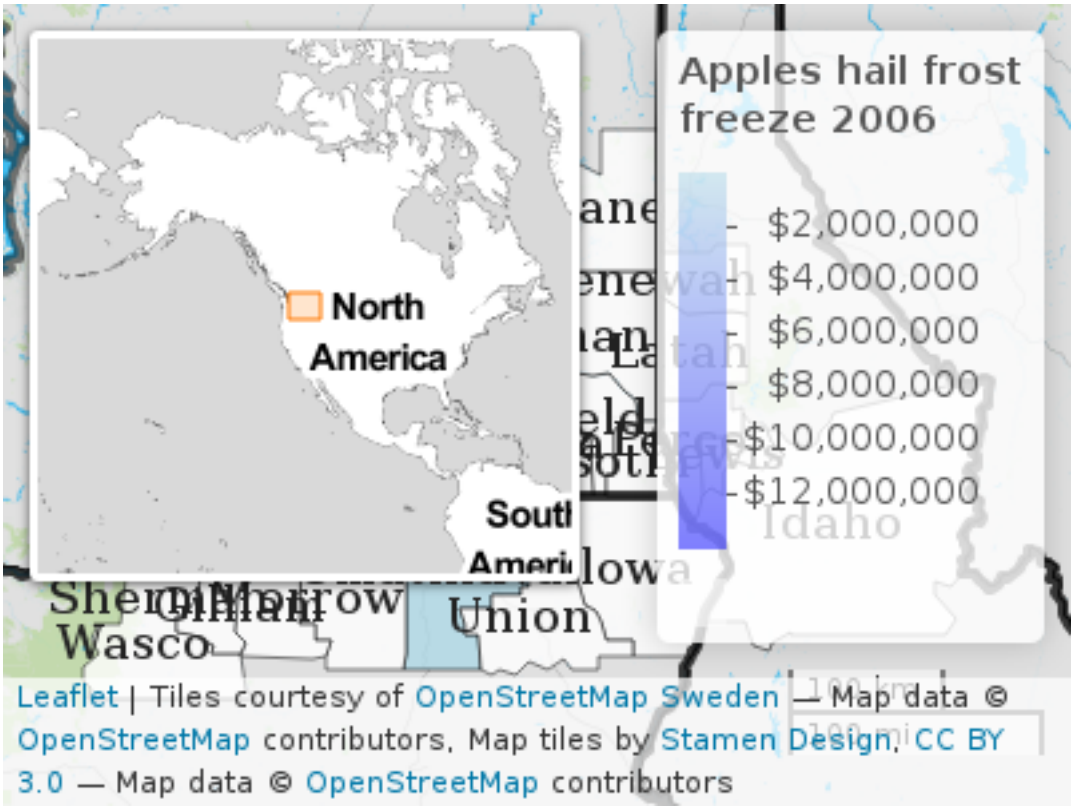
IPNW apples insurance loss due to hail, frost, and freeze 2013



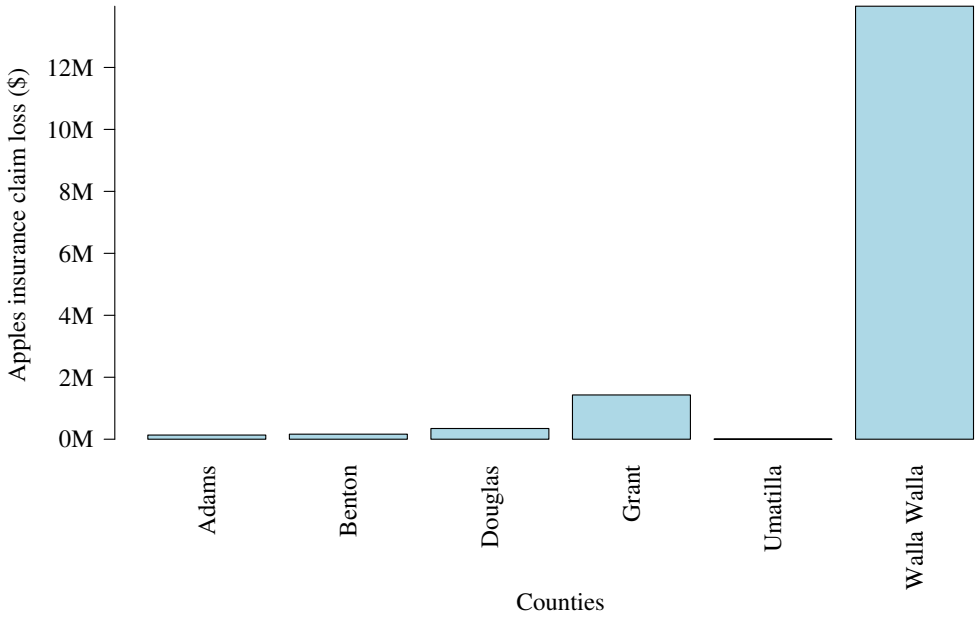


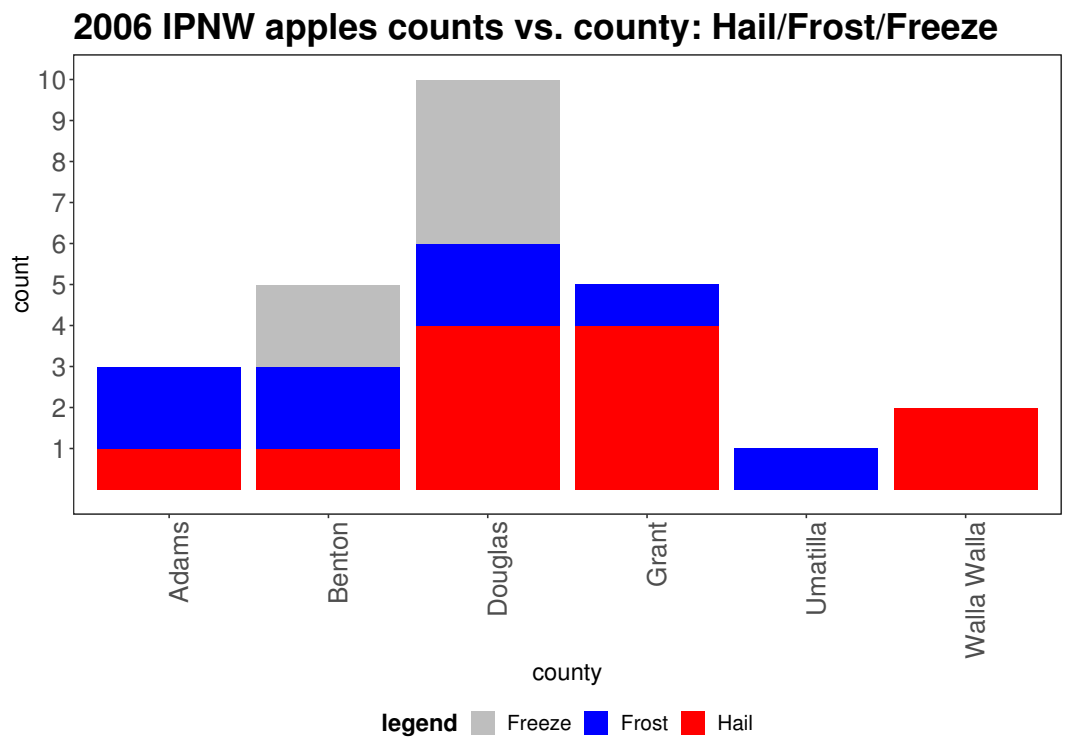
IPNW apples insurance loss due to hail, frost, and freeze 2012

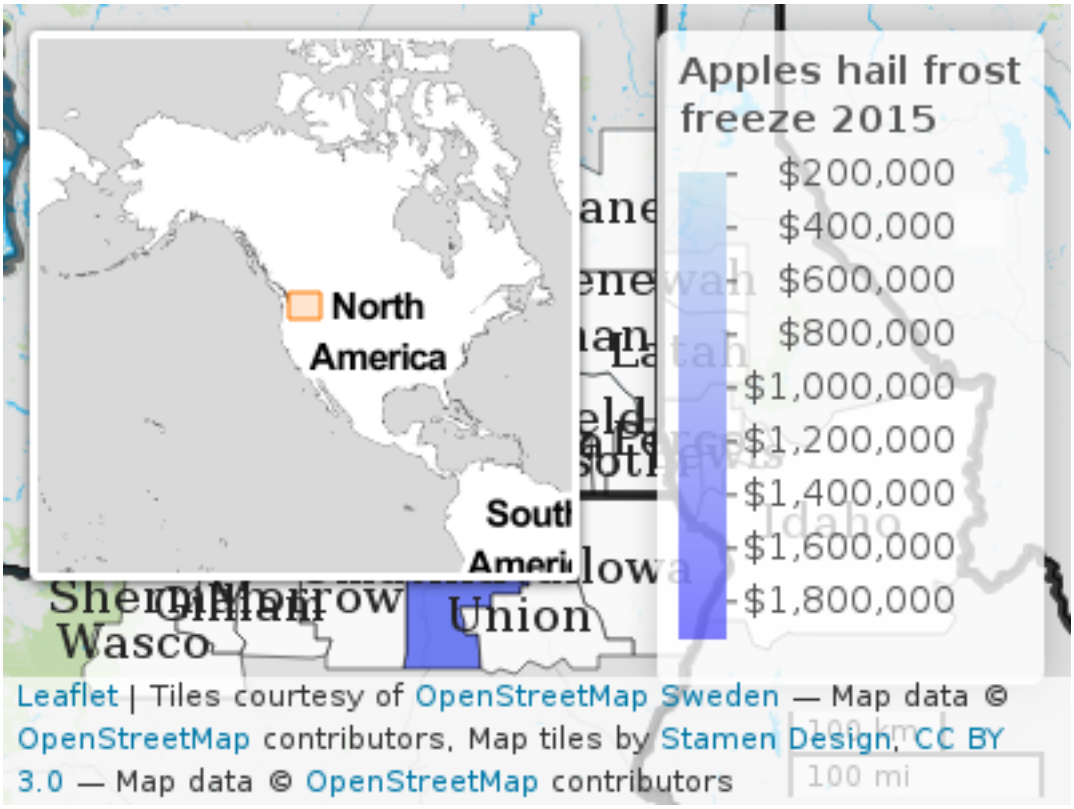


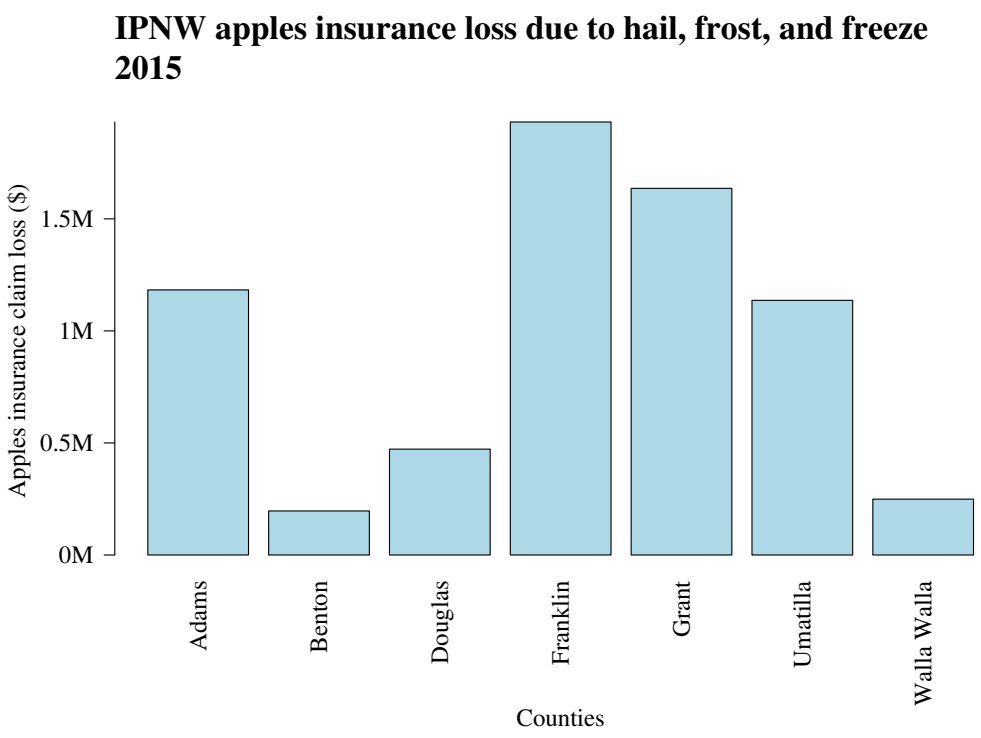


IPNW apples insurance loss due to hail, frost, and freeze 2006

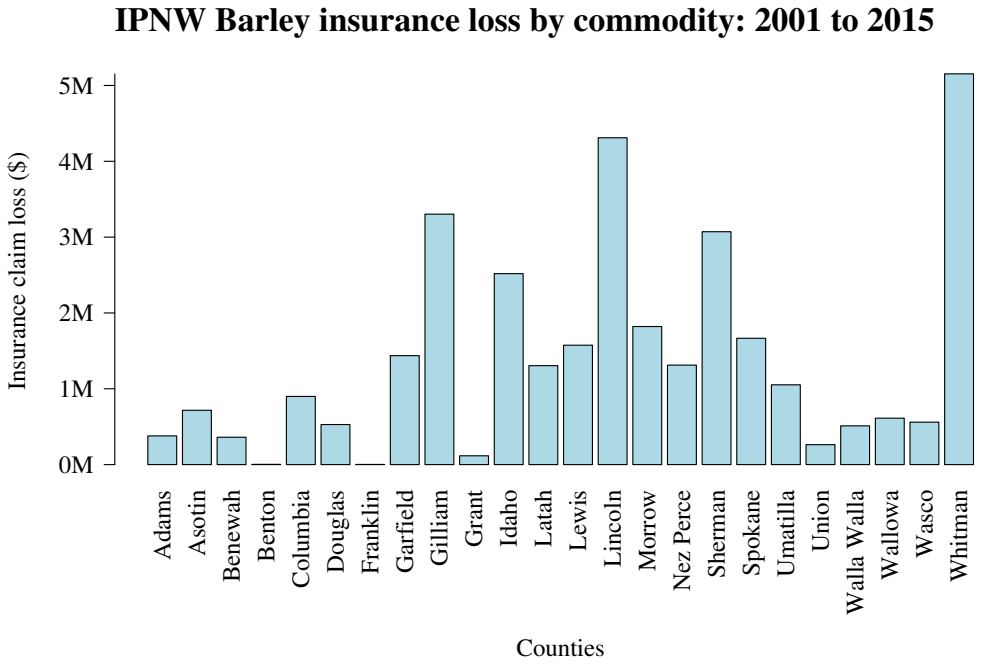


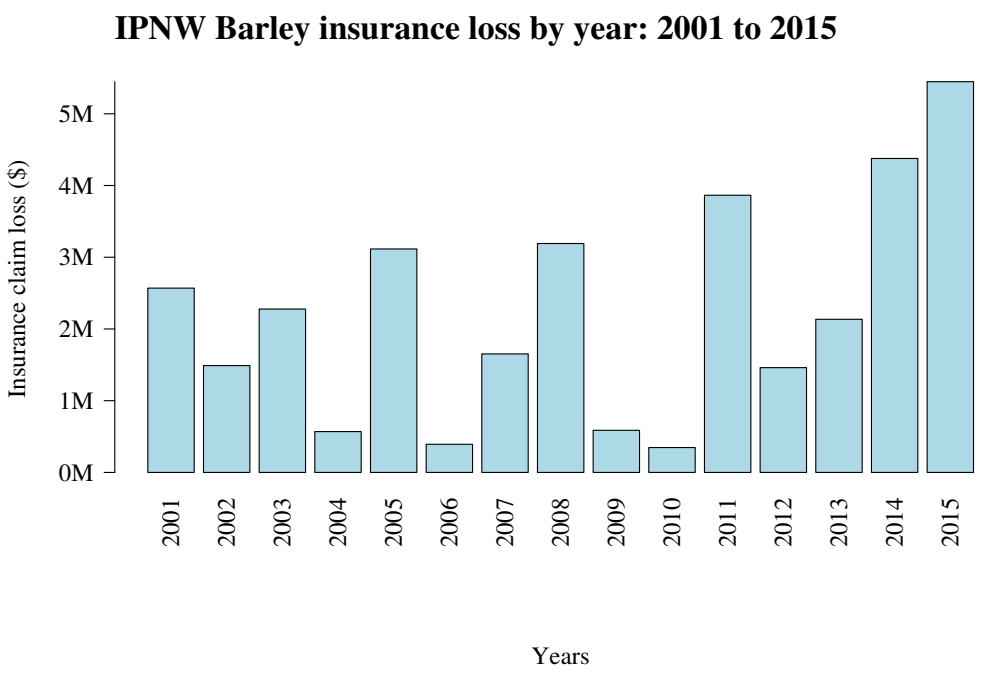

2006 IPNW apples counts vs. county: Hail/Frost/Freeze
count
10
9
8
7
6
5
4
3
2
1
Adams
Benton
Douglas
Grant
Umatilla
Walla Walla
county
legend
Freeze
Frost
Hail

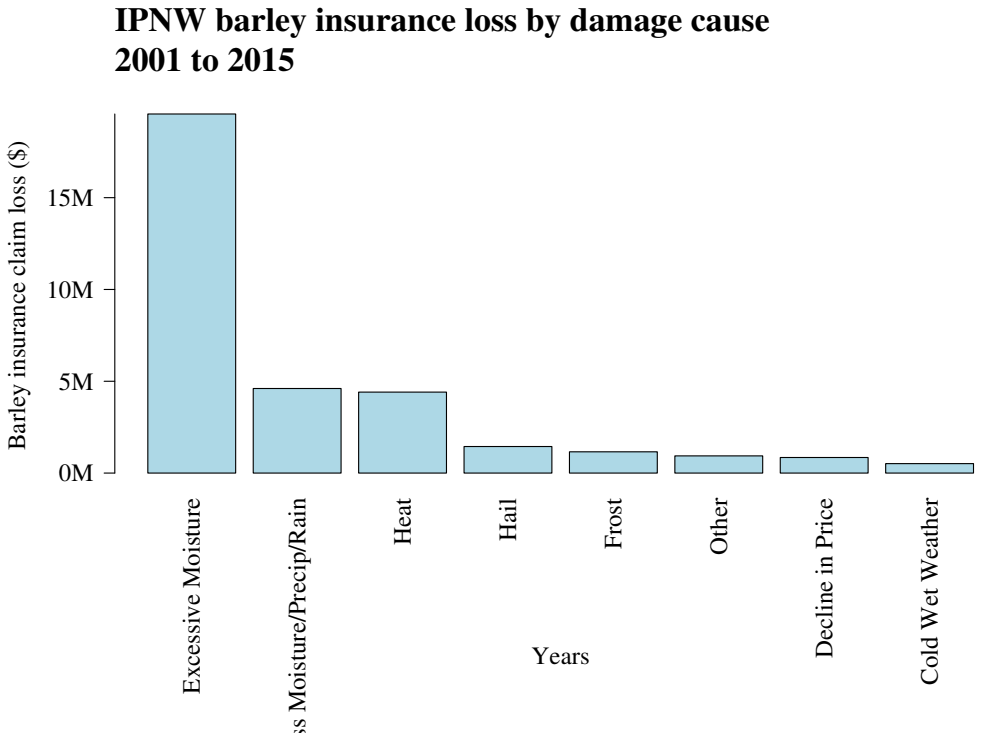

Apples hail frost freeze 2015
$200,000
$400,000
$600,000
$800,000
$1,000,000
$1,200,000
$1,400,000
$1,600,000
$1,800,000
North America
Union
Wasco
Leaflet | Tiles courtesy of OpenStreetMap Sweden — Map data © OpenStreetMap contributors, Map tiles by Stamen Design, CC BY 3.0 — Map data © OpenStreetMap contributors


IPNW apples insurance loss due to hail, frost, and freeze 2015
Apples insurance claim loss ($)
0M
0.5M
1M
1.5M
Adams
Benton
Douglas
Franklin
Grant
Umatilla
Walla Walla
Counties

Step 11: BARLEY, 2001-2015 for the IPNW







IPNW region BARLEY total insurance loss by damage cause, 2001-2015

2001-2015

damagecause

loss

Drought

$19,557,132

Excess Moisture/Precip/Rain

$4,606,318

Heat

$4,409,923

Hail

$1,446,047

Frost

$1,158,127

Other

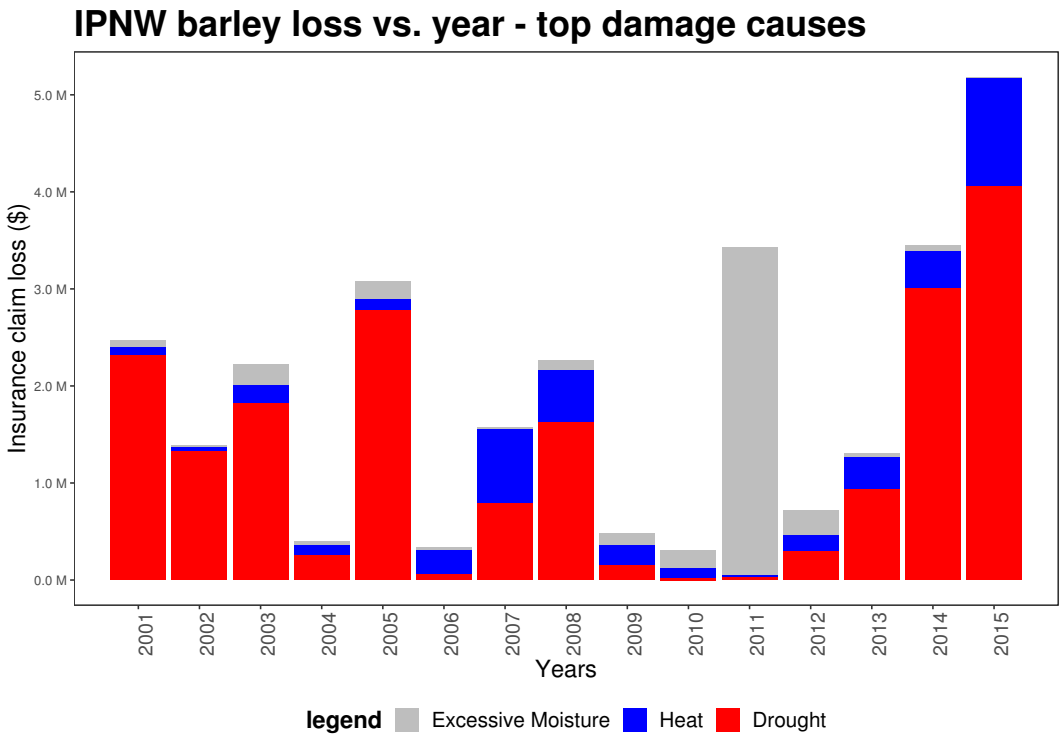
$936,234

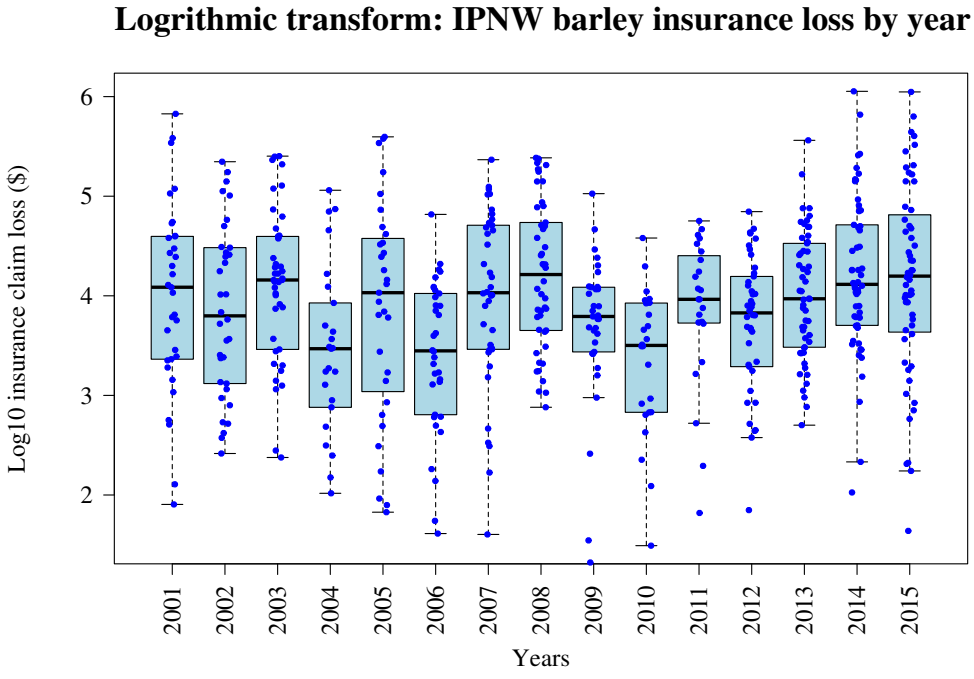
Decline in Price

$848,321

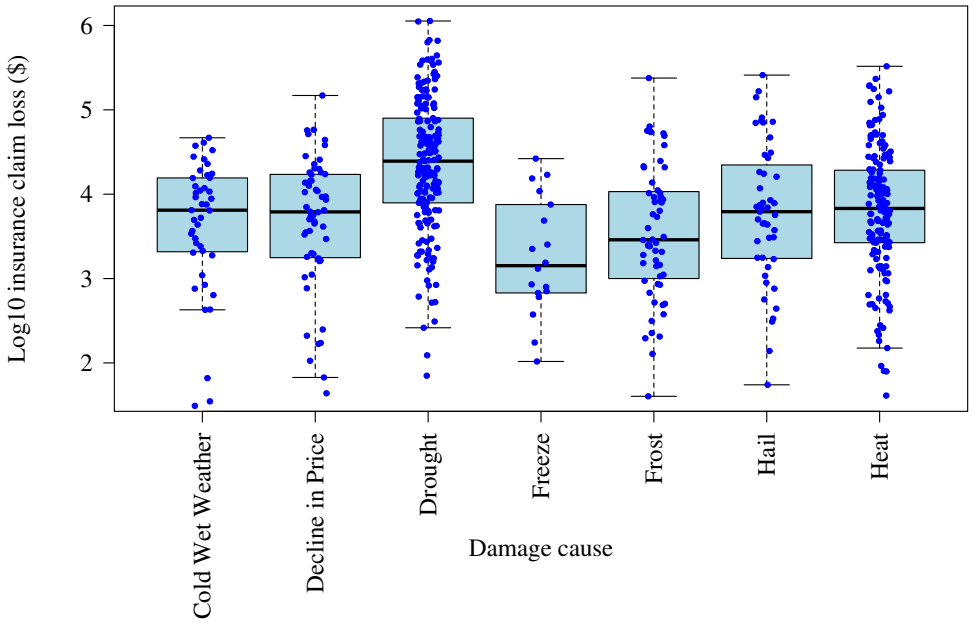
Cold Wet Weather

$514,682

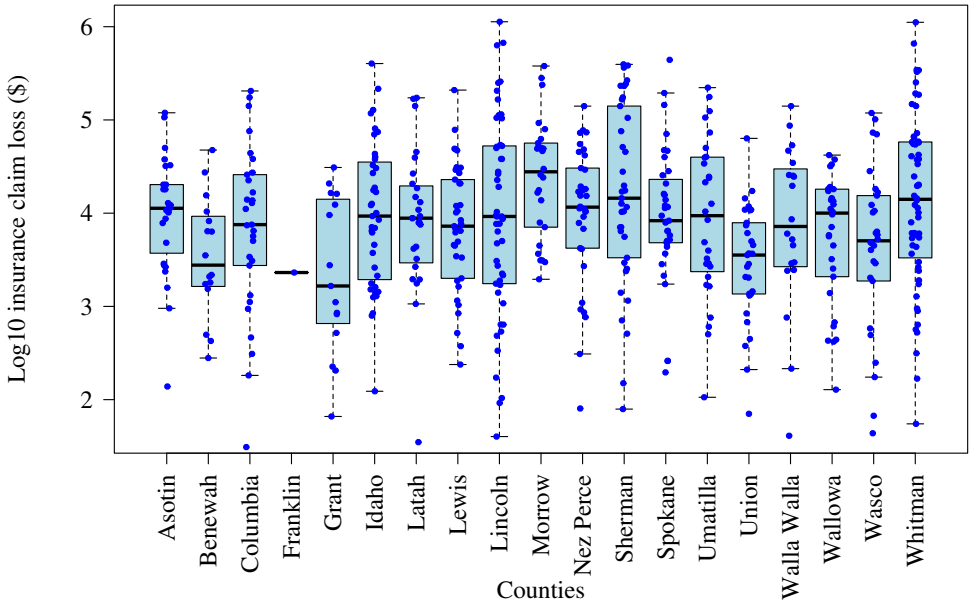

IPNW barley loss vs. year - top damage causes
Insurance claim loss ($)
5.0 M
4.0 M
3.0 M
2.0 M
1.0 M
0.0 M
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years
legend
Excessive Moisture
Heat
Drought

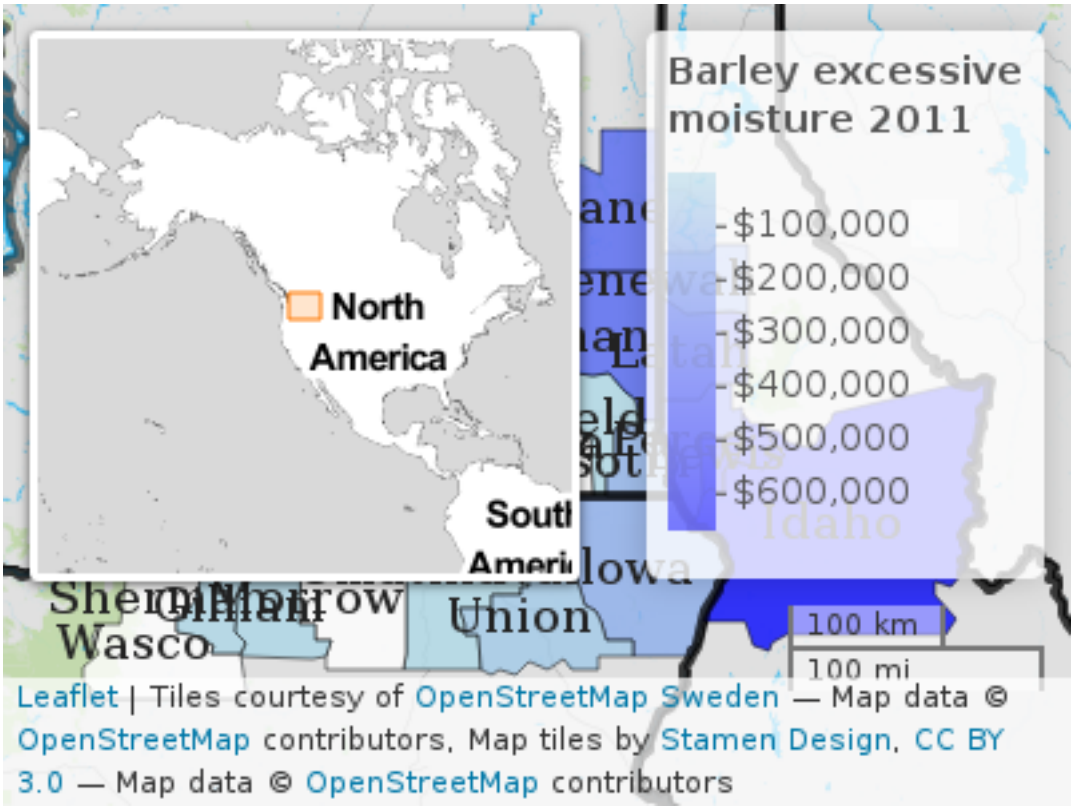

Logrithmic transform: IPNW barley insurance loss by year
Log10 insurance claim loss ($)
6
5
4
3
2
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years

Logrithmic transform: IPNW barley insurance loss by damage cause

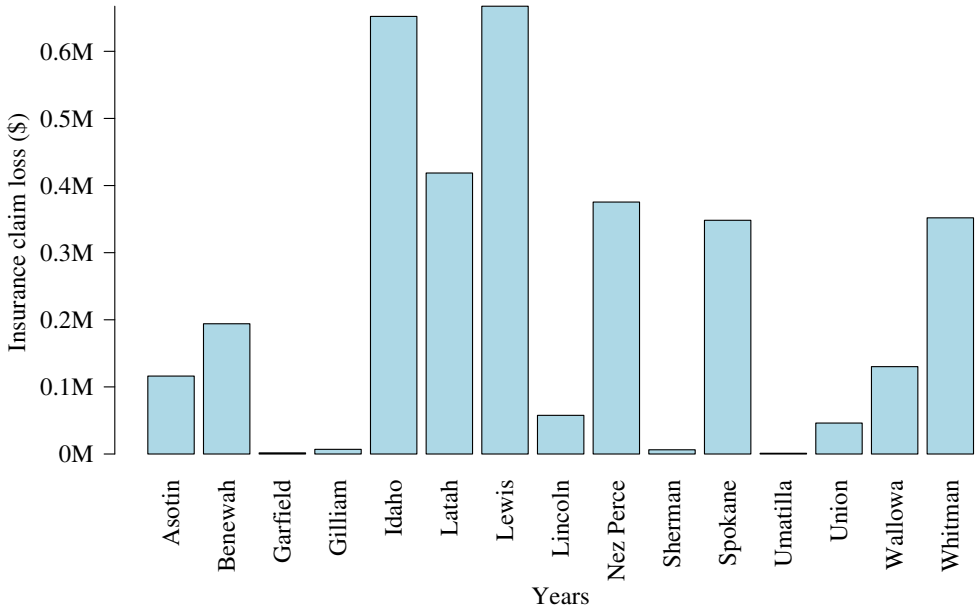


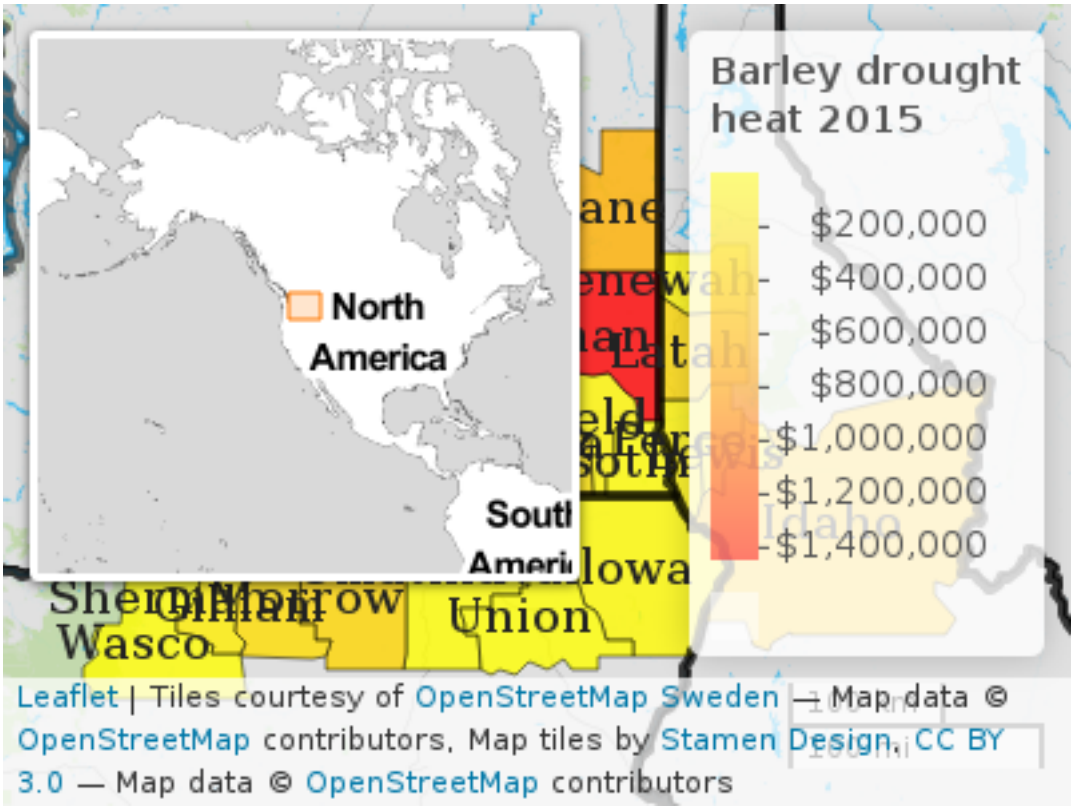
Logrithmic transform: IPNW barley insurance loss by county



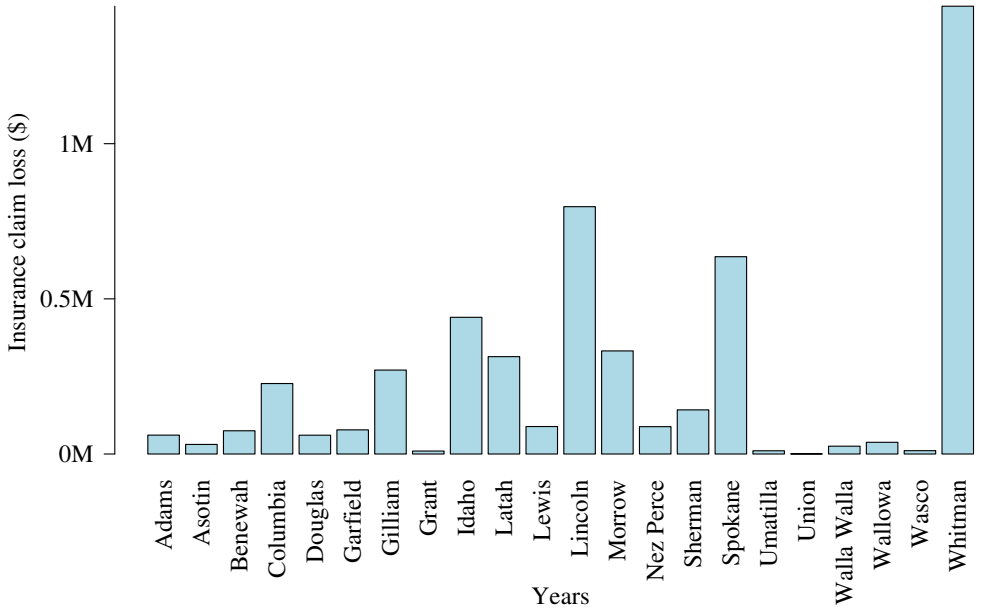


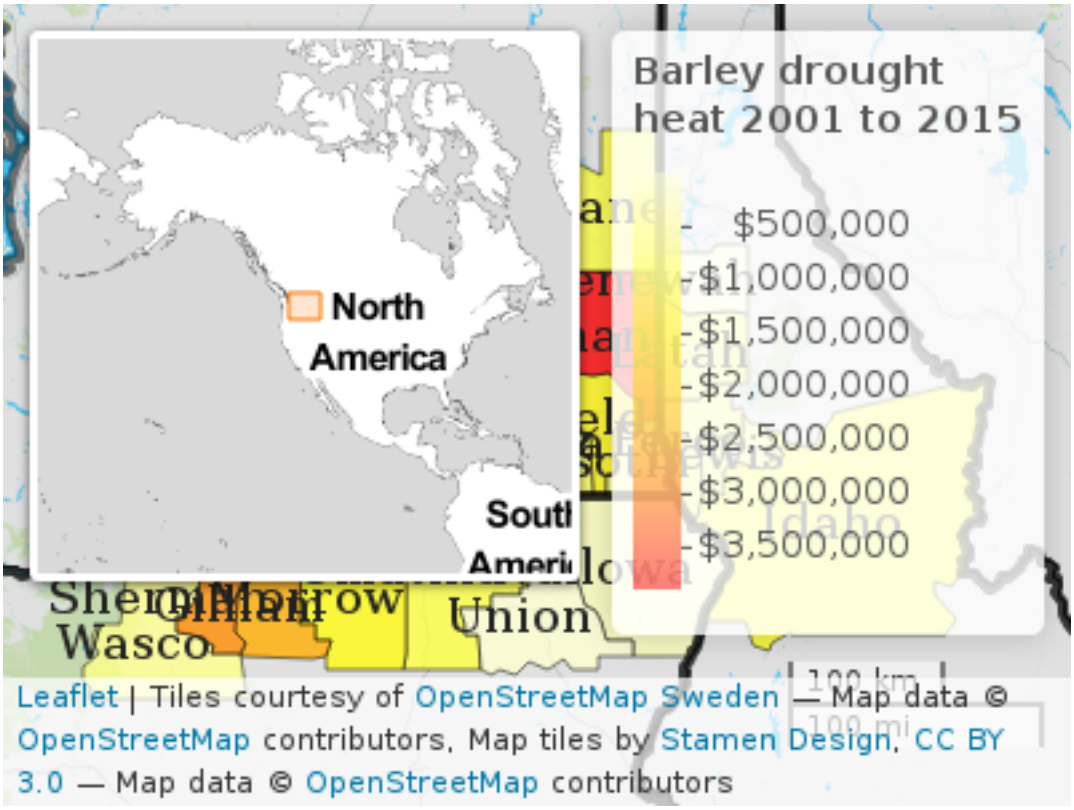
IPNW barley insurance loss due to excessive moisture 2011



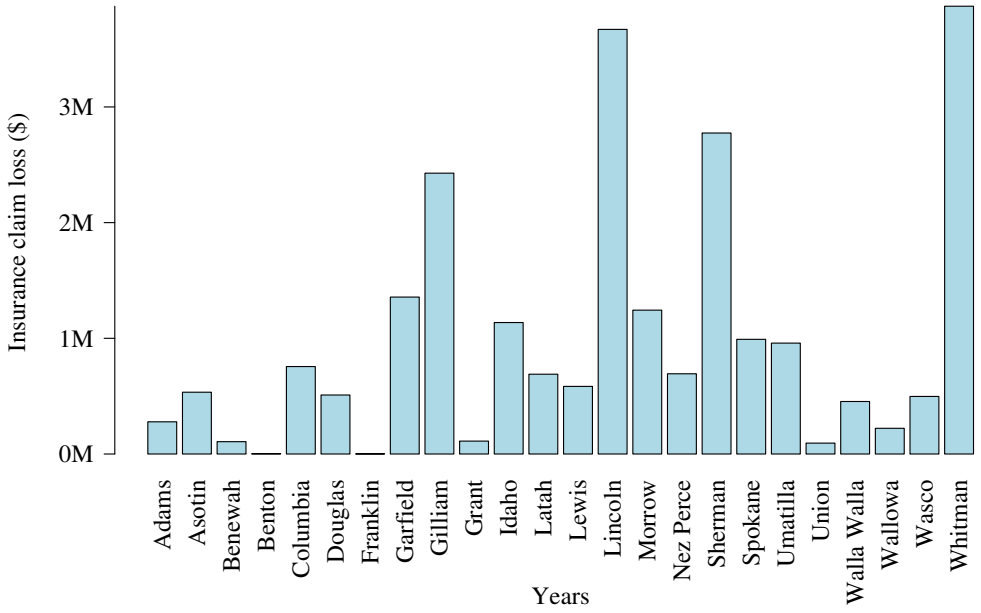


IPNW barley insurance loss due to drought and heat 2015

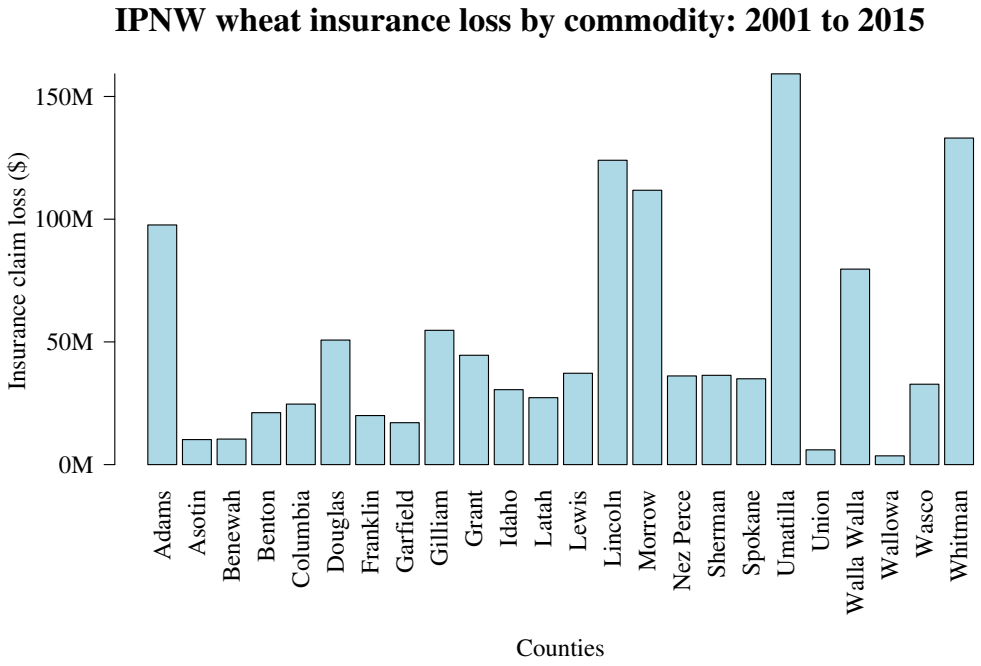


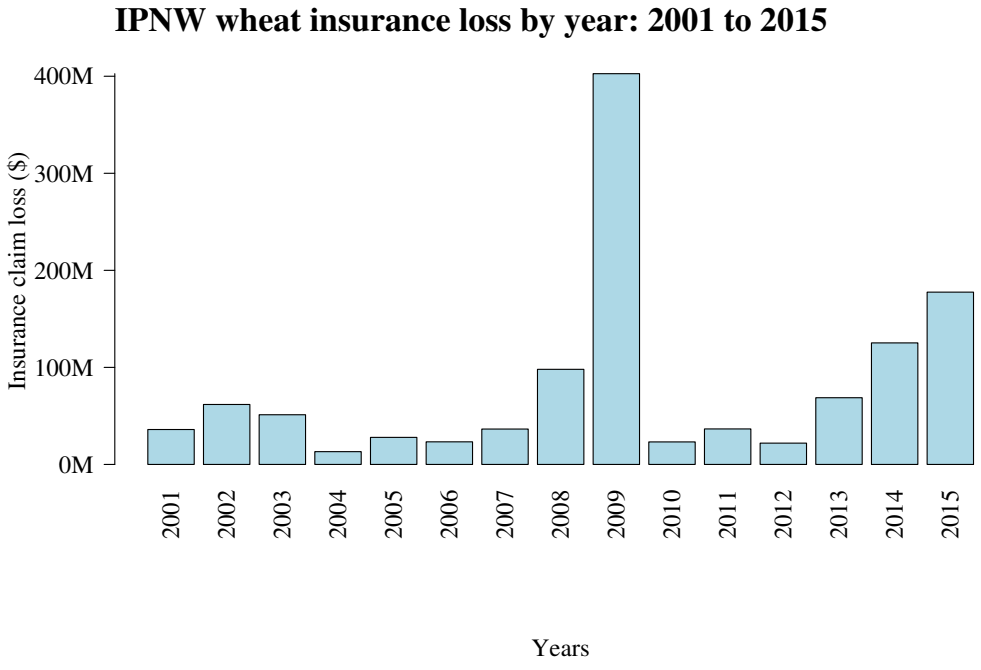


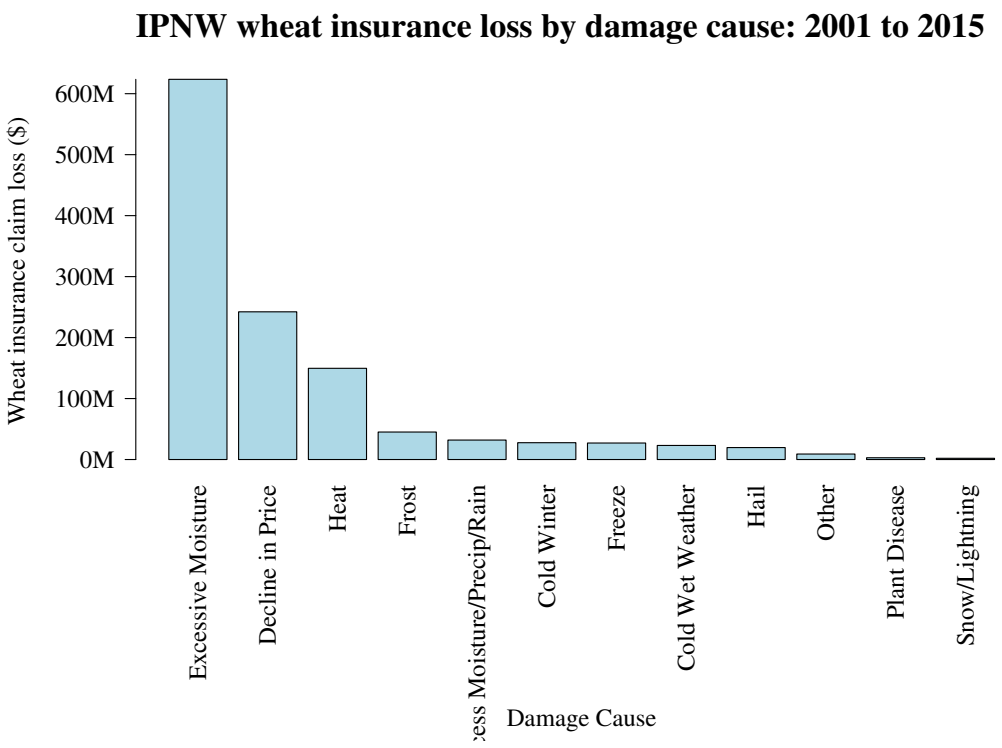
IPNW barley insurance loss due to drought and heat 2001 to 2015



Step 12: WHEAT, 2001-2015 for the IPNW







IPNW region WHEAT total insurance loss by damage cause, 2001-2015

2001-2015

damagecause

loss

Drought

$623,556,410

Decline in Price

$242,258,102

Heat

$149,599,349

Frost

$45,091,012

Excess Moisture/Precip/Rain

$31,923,877

Cold Winter

$27,596,223

Freeze

$27,064,747

Cold Wet Weather

$23,086,130

Hail

$19,621,554

Other

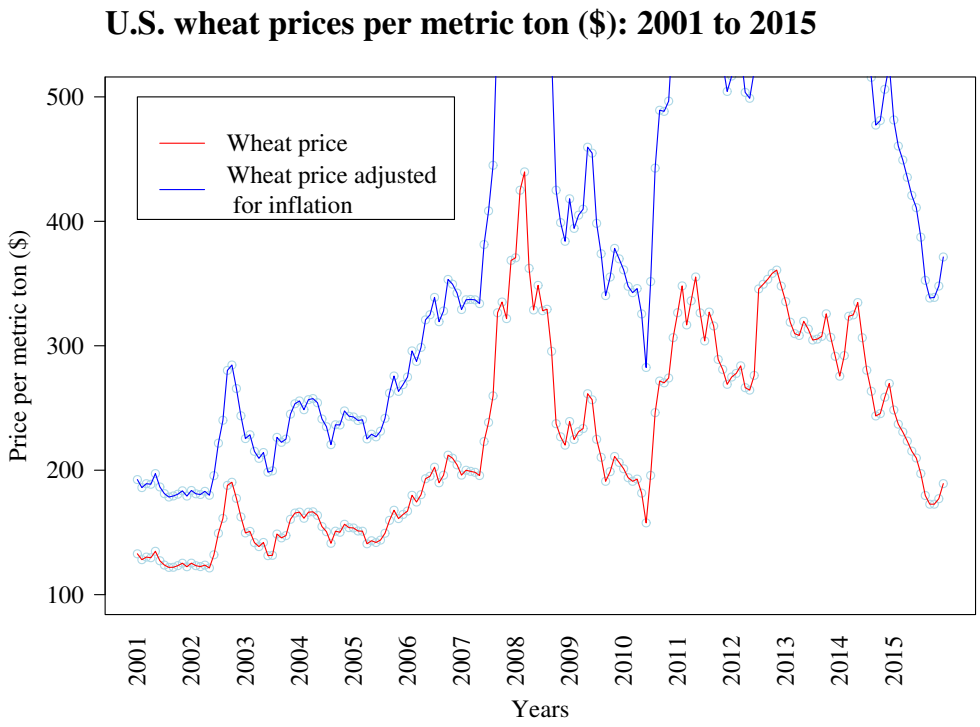
$9,008,705

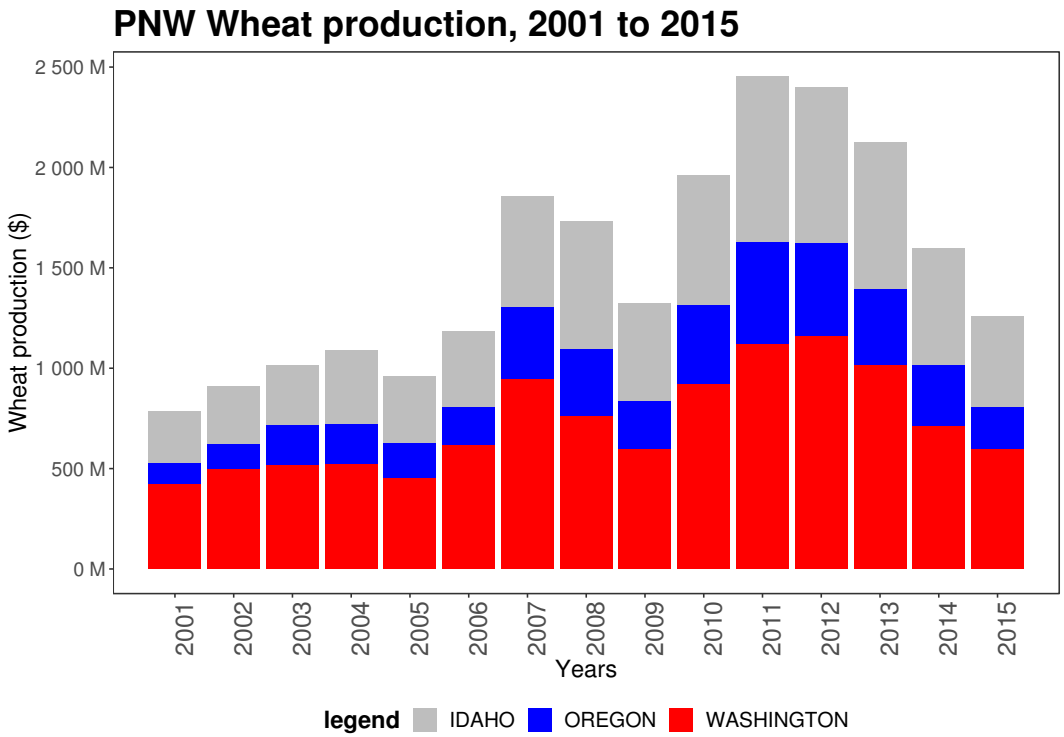
Plant Disease

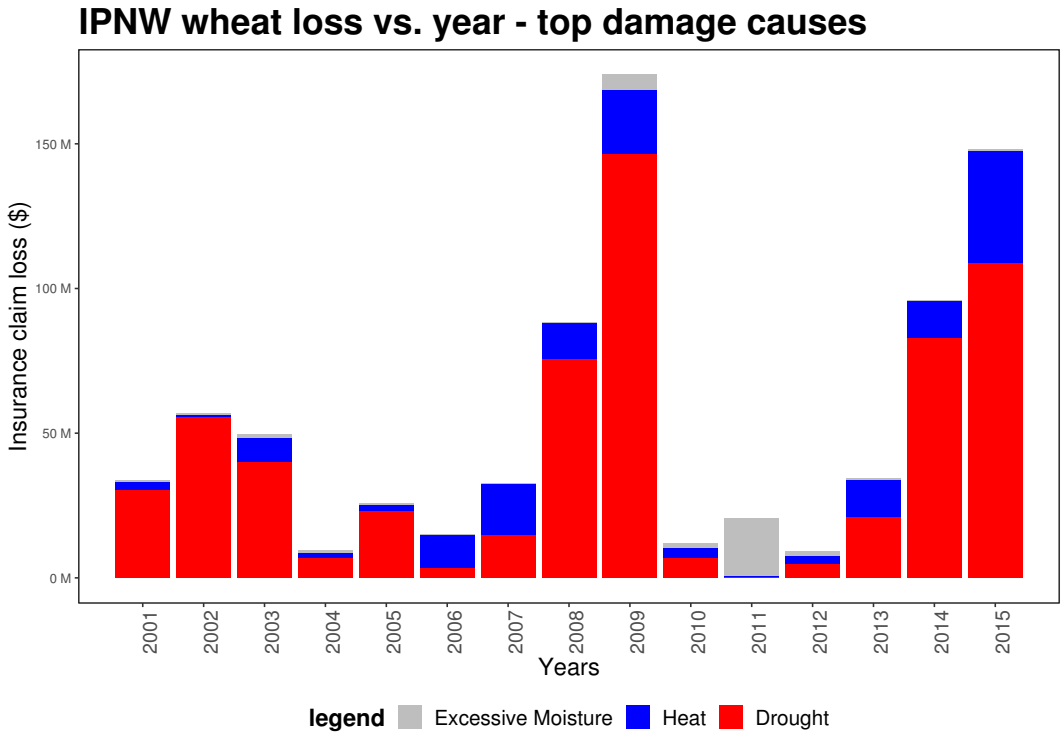
$2,925,149

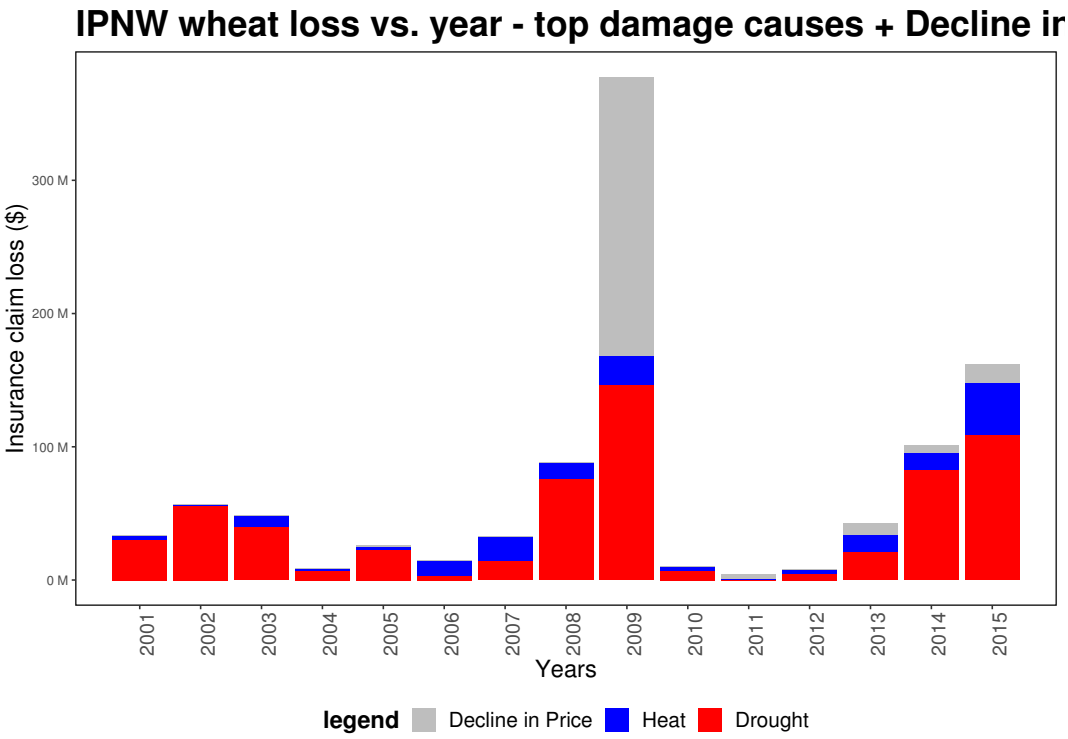
Other (Snow-Lightning-Etc.)

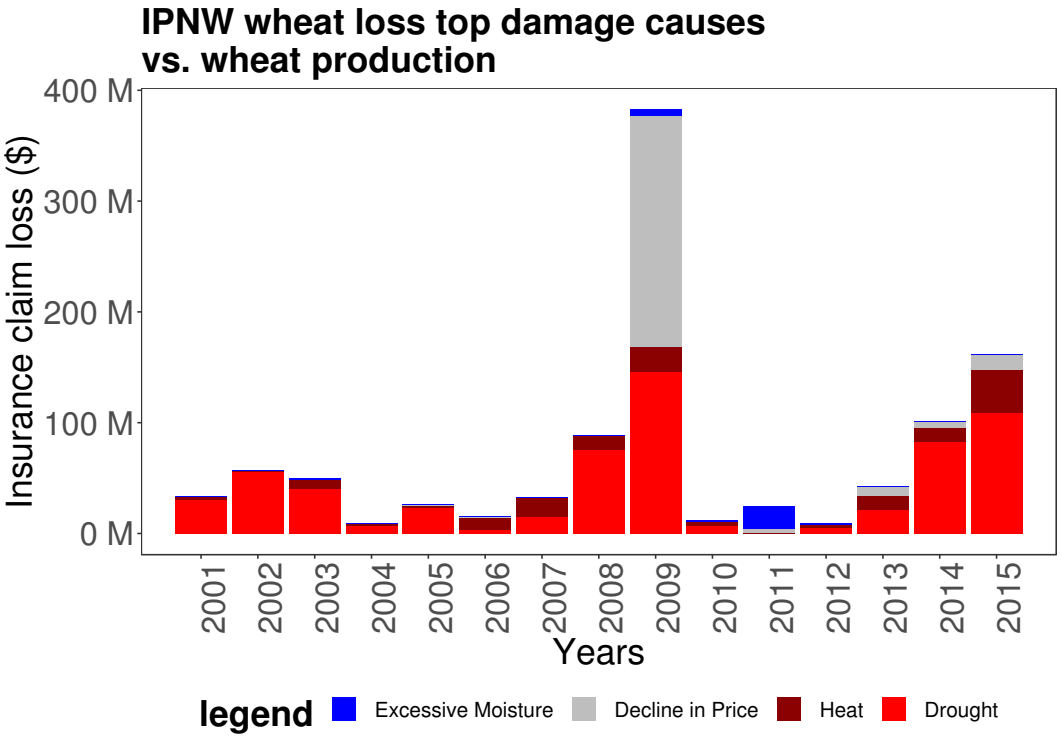
$2,013,353



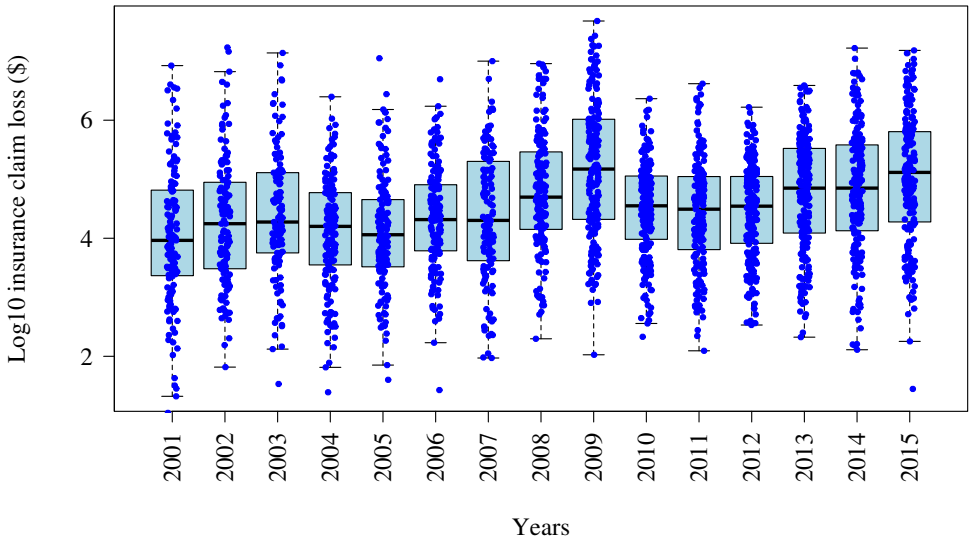

PNW Wheat production, 2001 to 2015
2 500 M
2 000 M
1 500 M
1 000 M
500 M
0 M
Wheat production ($)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years
legend
IDAHO
OREGON
WASHINGTON


IPNW wheat loss vs. year - top damage causes
150 M
100 M
50 M
0 M
Insurance claim loss ($)
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years
legend
Excessive Moisture
Heat
Drought

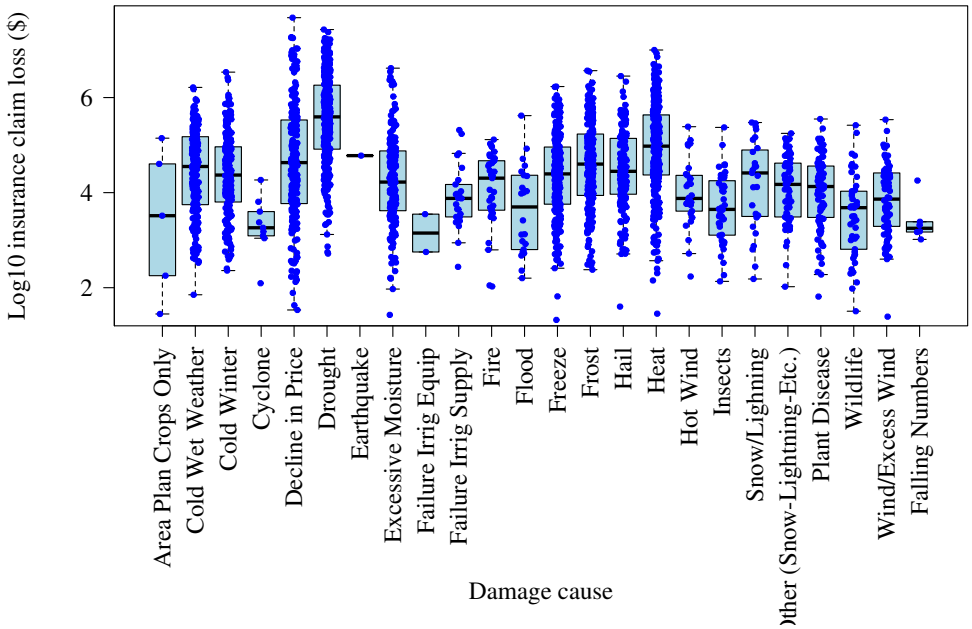

IPNW wheat loss vs. year - top damage causes + Decline ir
Insurance claim loss ($)
300 M
200 M
100 M
0 M
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years
legend
Decline in Price
Heat
Drought


IPNW wheat loss top damage causes
vs. wheat production
Insurance claim loss ($)
400 M
300 M
200 M
100 M
0 M
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Years
legend
Excessive Moisture
Decline in Price
Heat
Drought

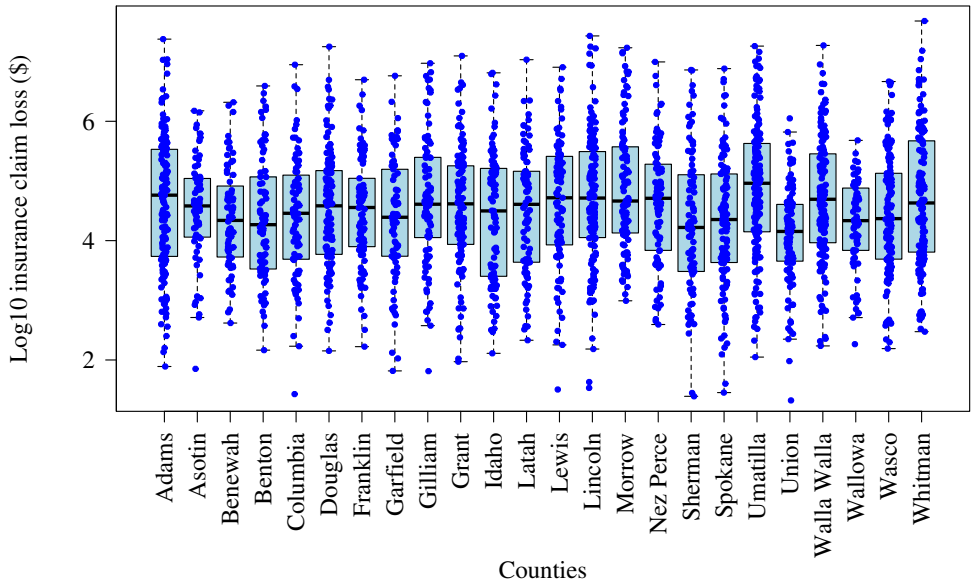
Logrithmic transform: IPNW wheat insurance loss by year

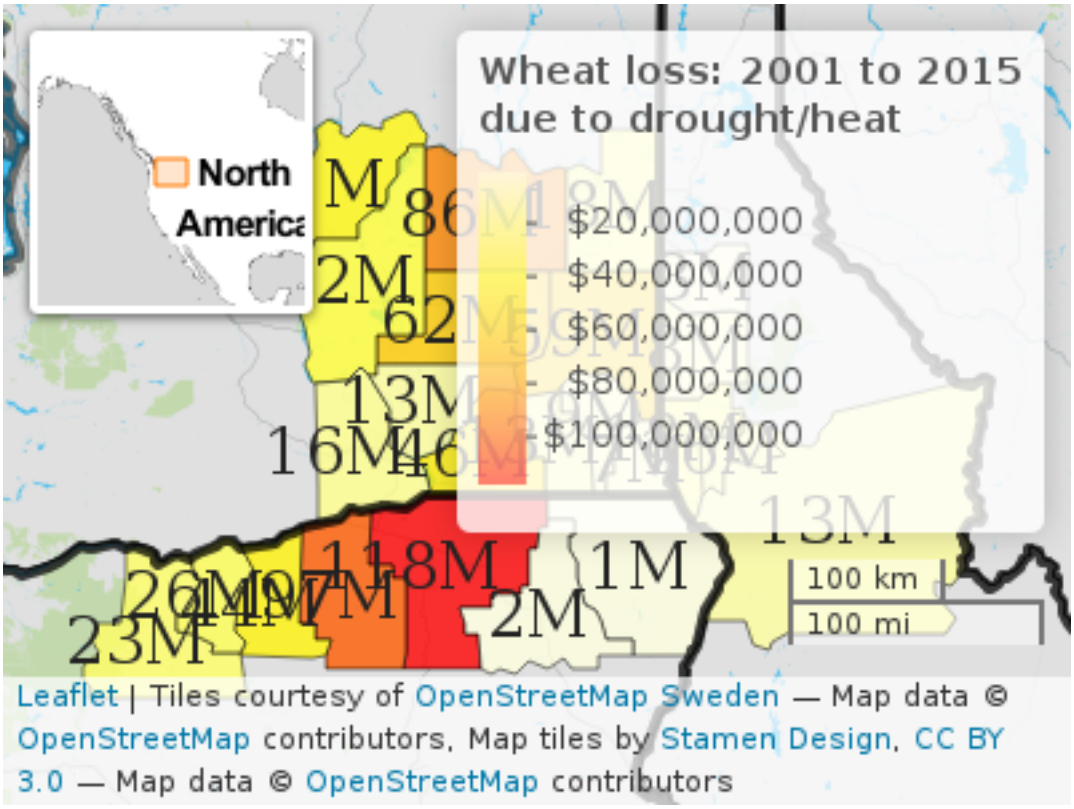


Logrithmic transform: IPNW wheat insurance loss by damage cause

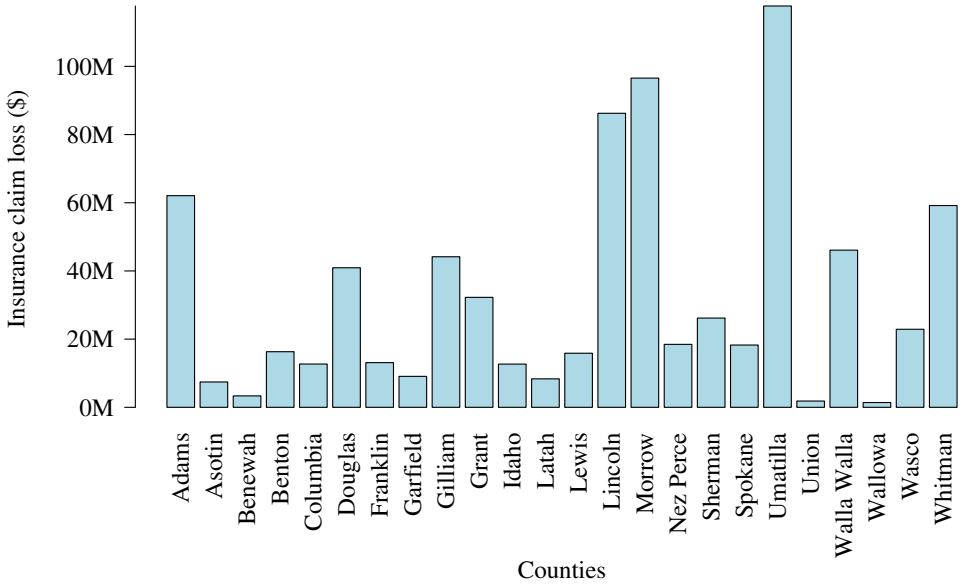


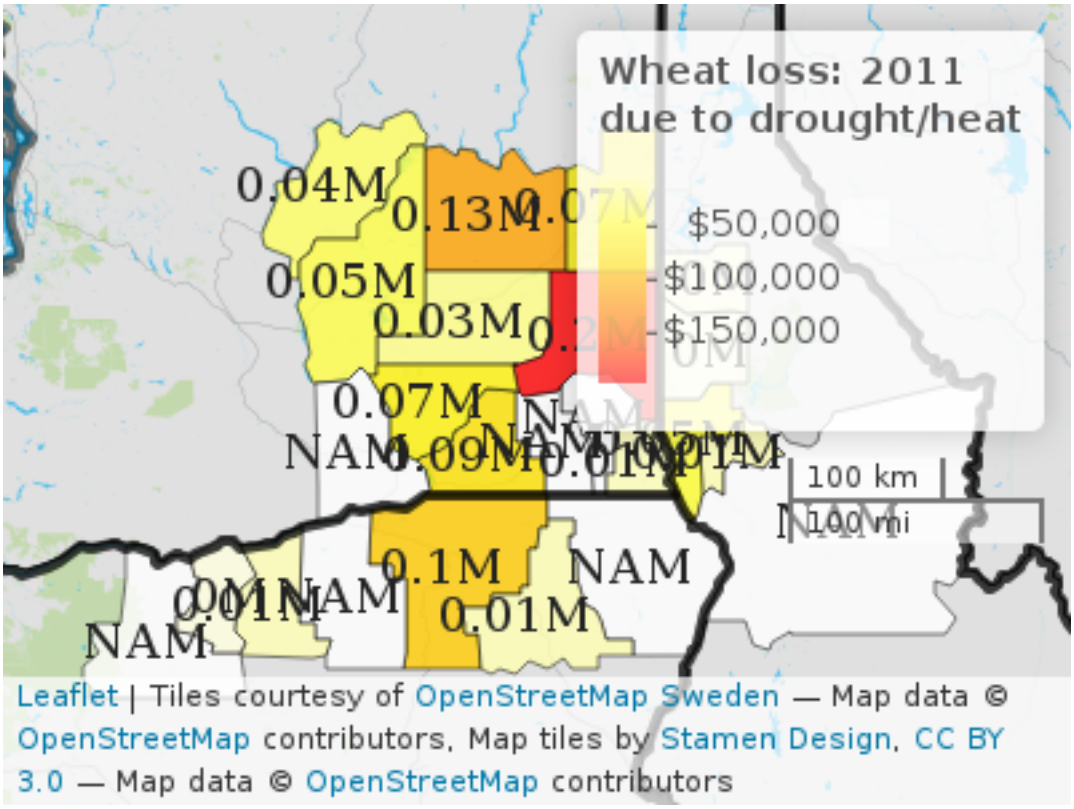
Logrithmic transform: IPNW wheat insurance loss by county



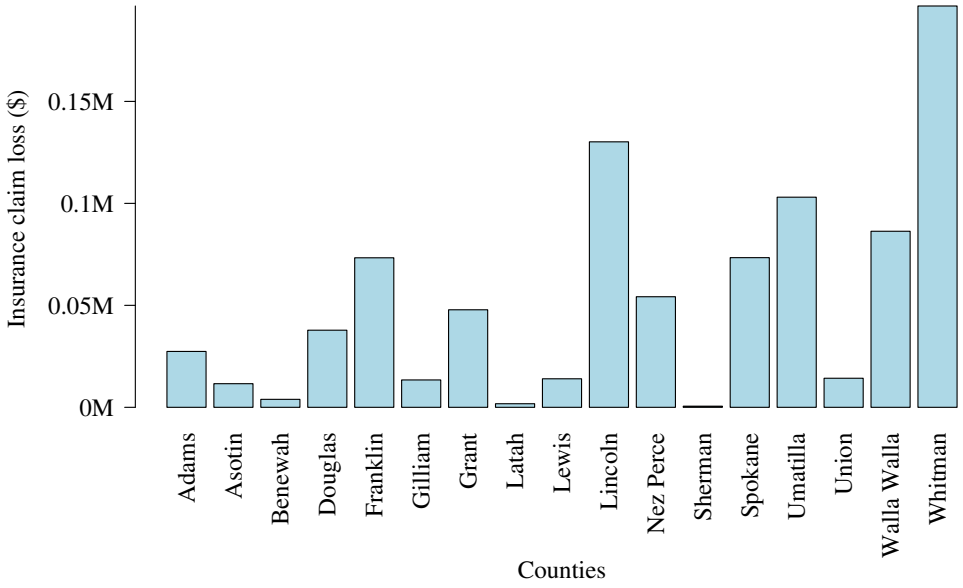


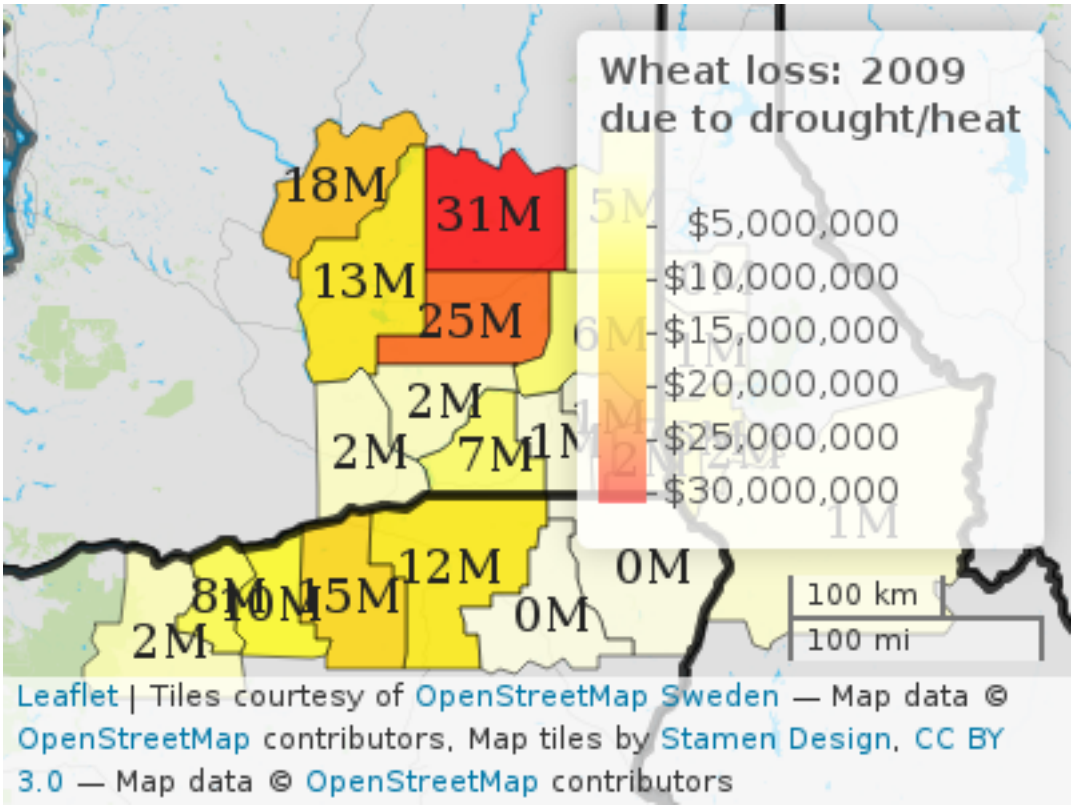
2001 to 2015 IPNW wheat insurance loss due to drought and heat by county



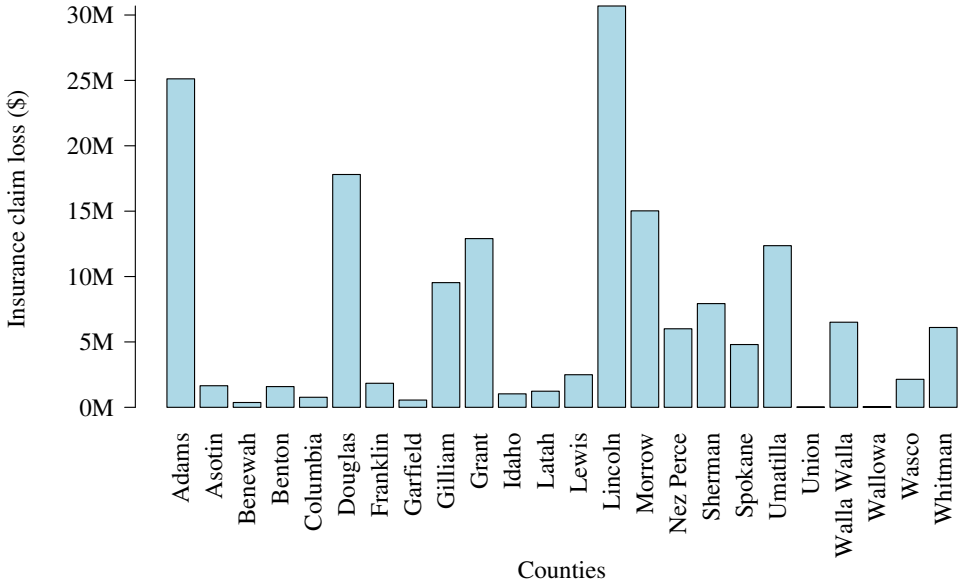


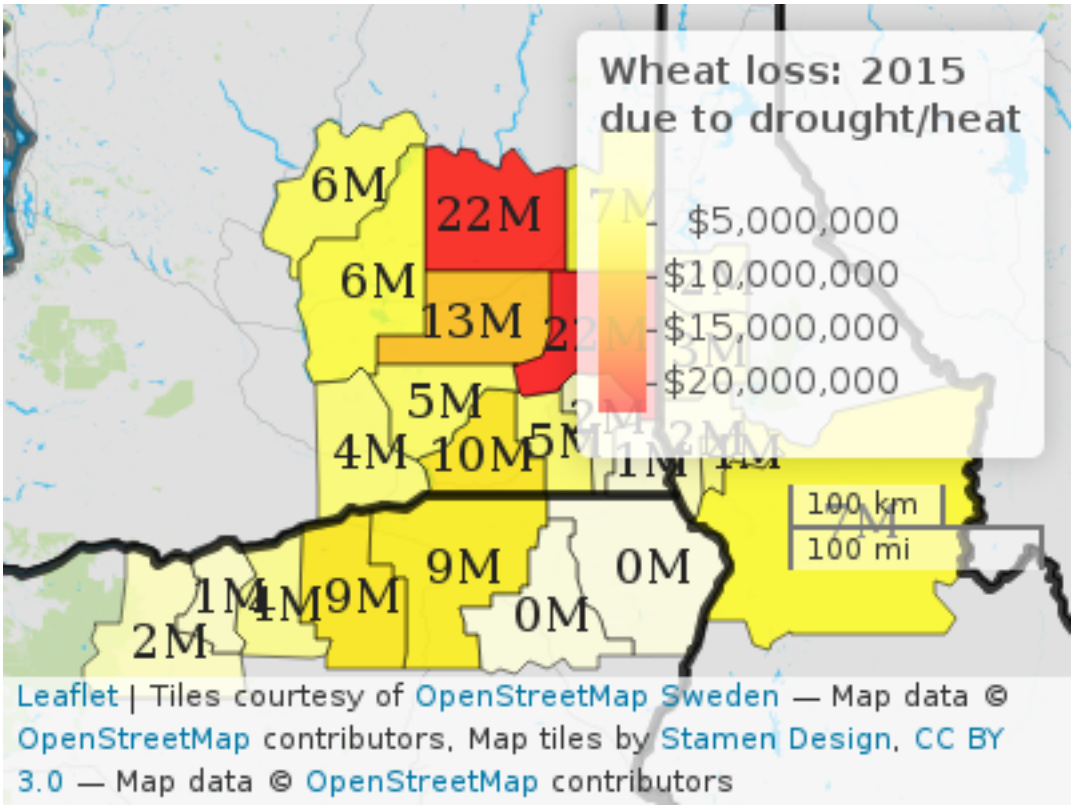
2011 IPNW wheat insurance loss due to drought and heat by county



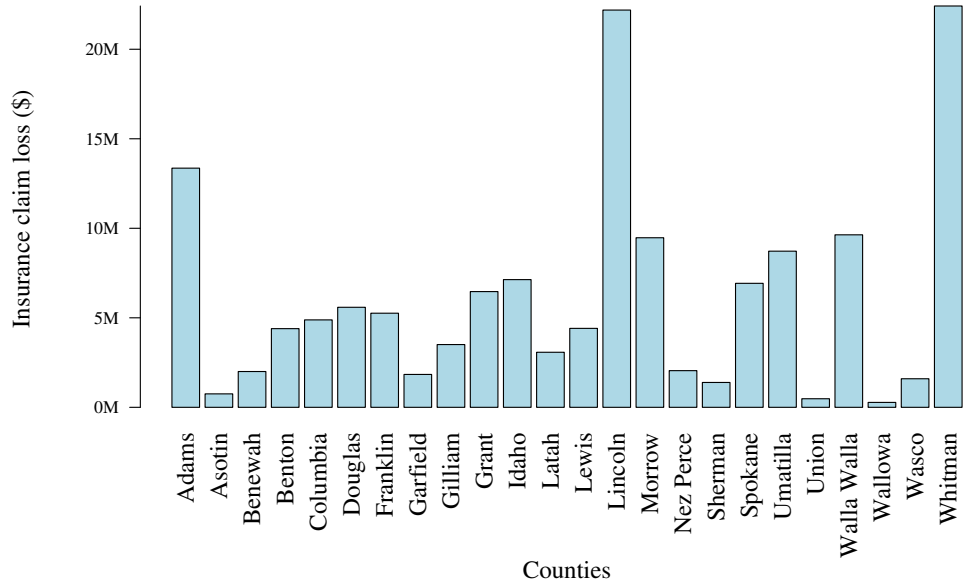


2009 IPNW wheat insurance loss due to drought and heat by county

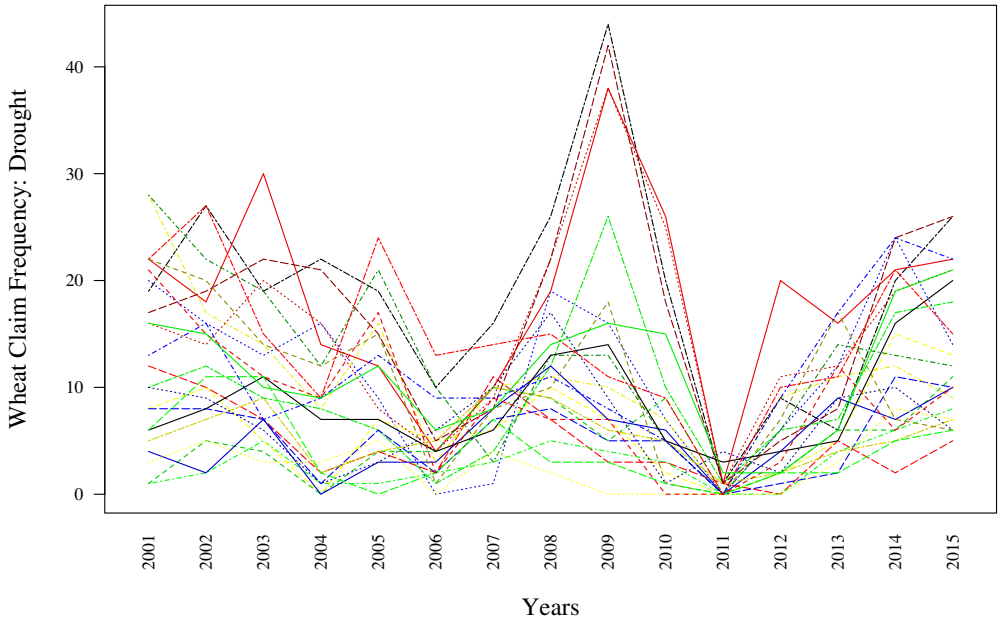




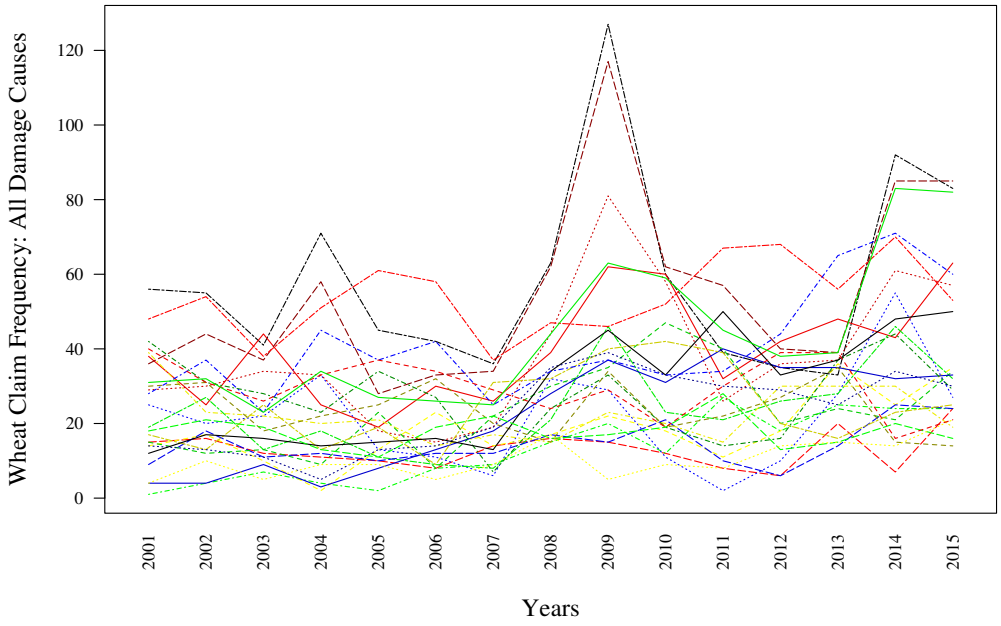
2015 IPNW wheat insurance loss due to drought and heat by county

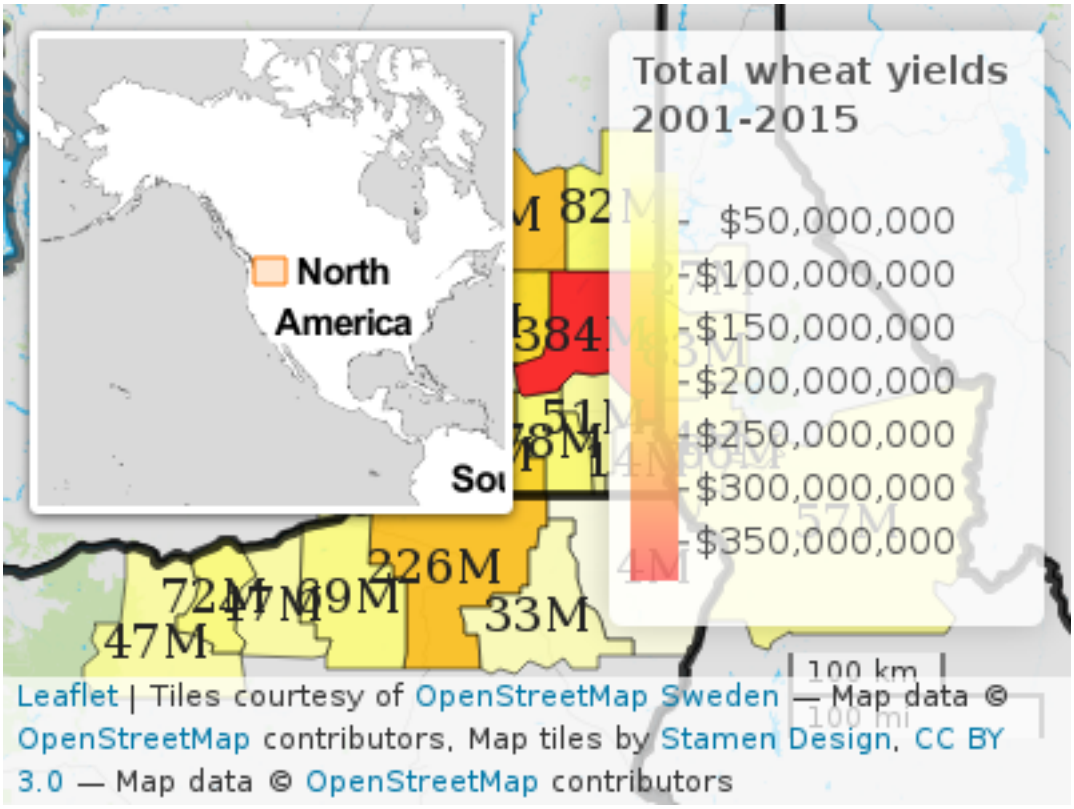


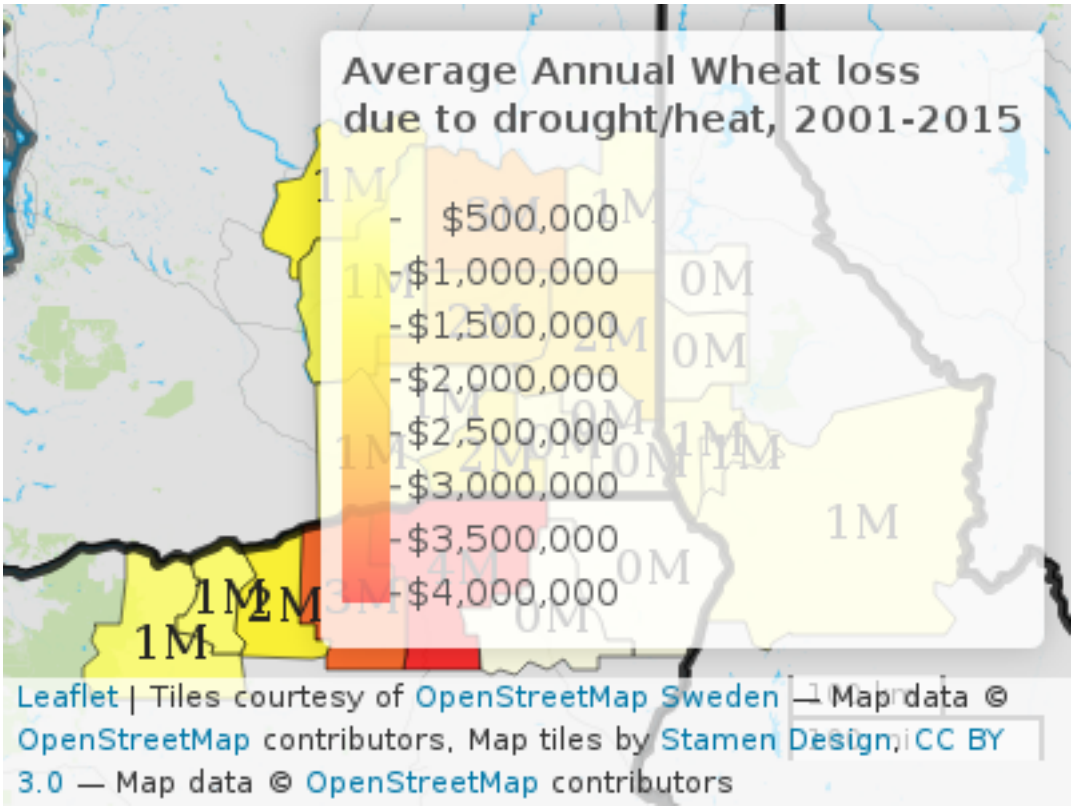
Annual IPNW Wheat Insurance Claim Frequency by county 2001-2015: Drought

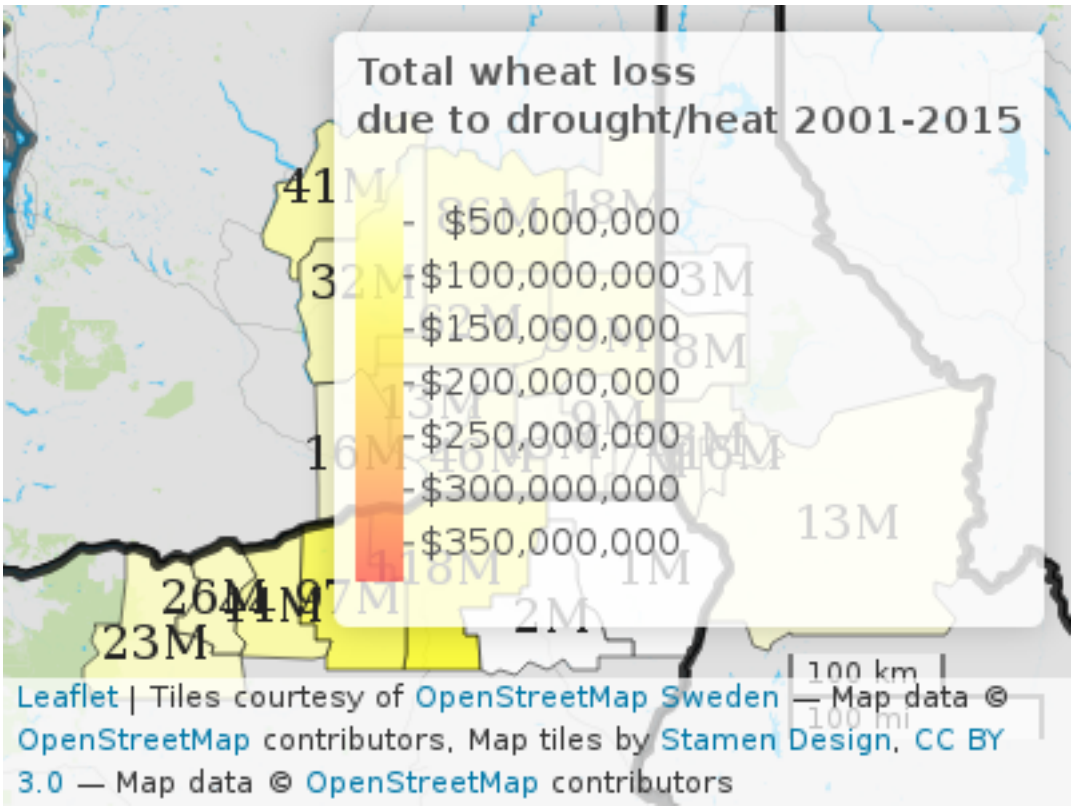


Annual IPNW Wheat Insurance Claim Frequency by county 2001-2015: All Damage Causes

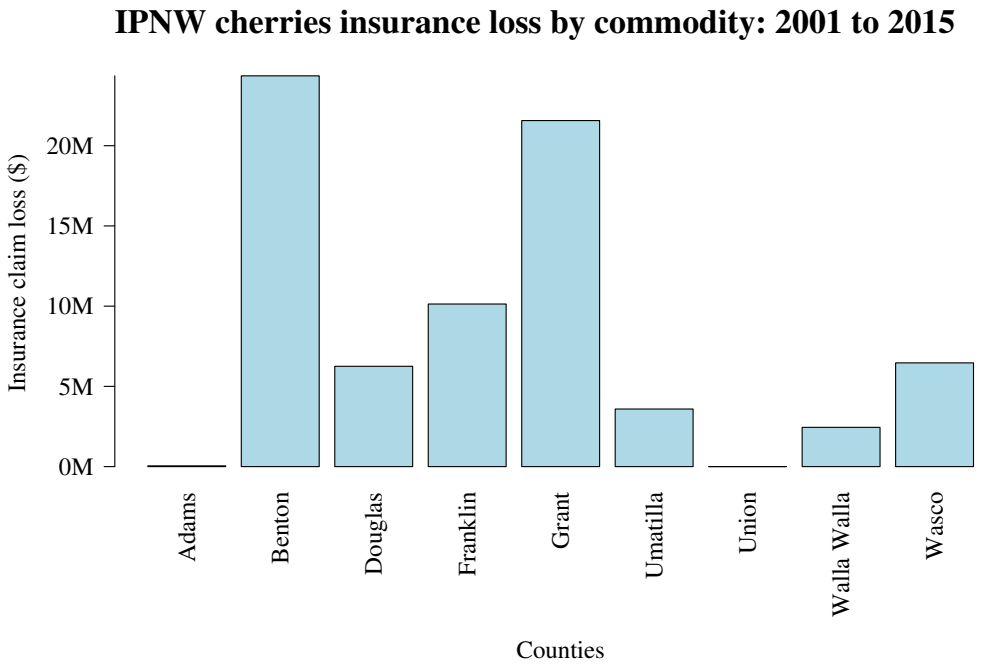


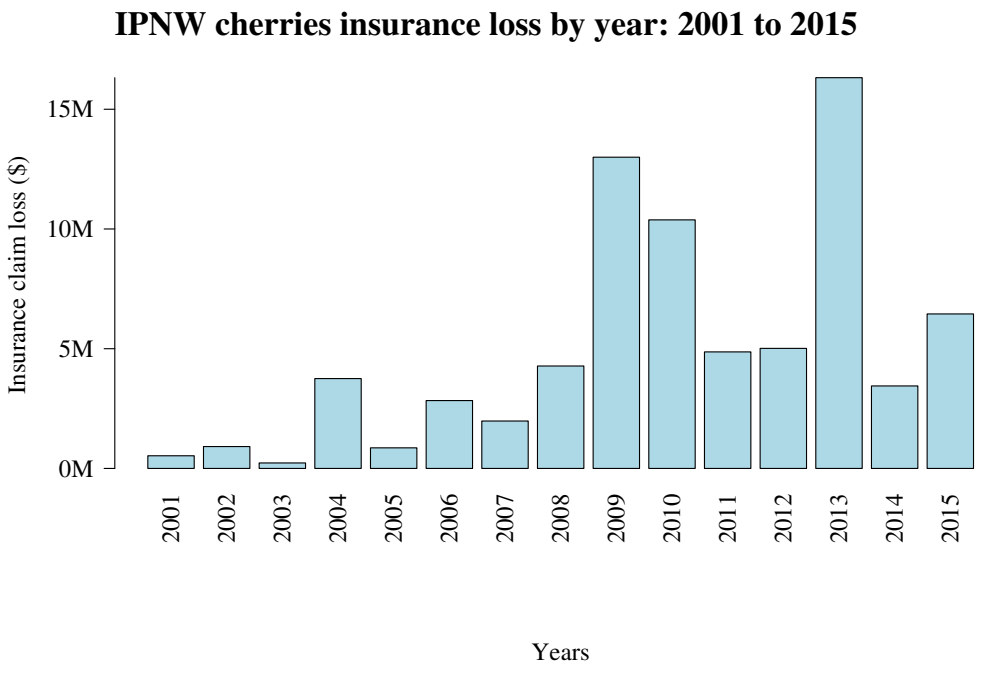


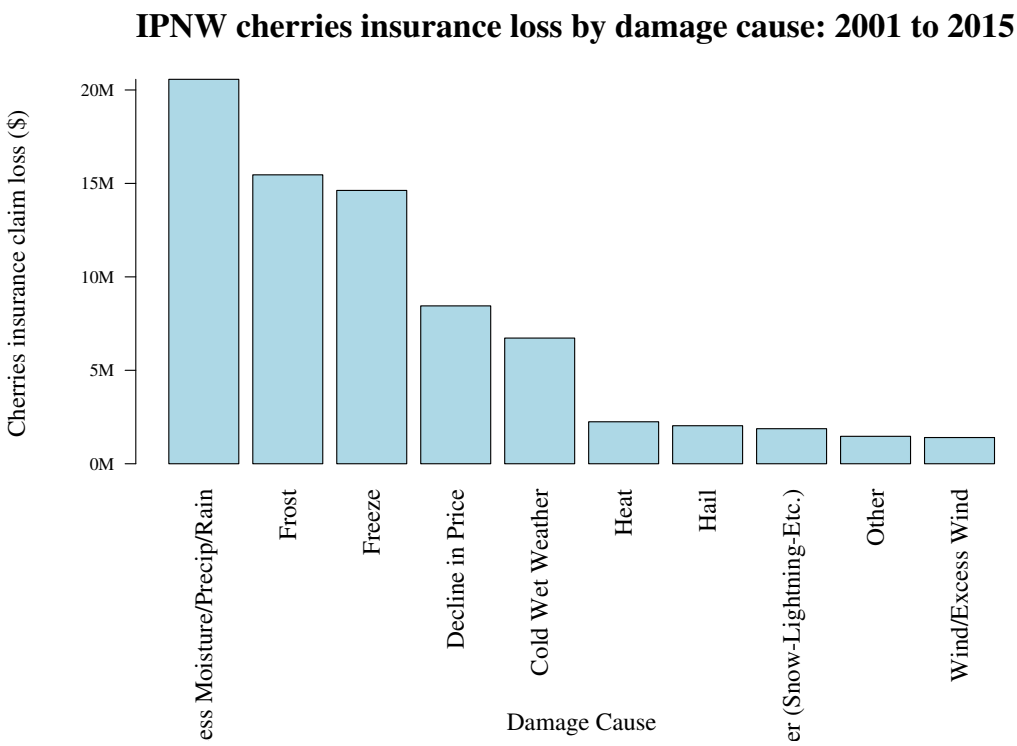

Average Annual Wheat loss
due to drought/heat, 2001-2015
- $500,000
-$1,000,000
-$1,500,000
-$2,000,000
-$2,500,000
-$3,000,000
-$3,500,000
-$4,000,000
1M
2M
1M
Leaflet | Tiles courtesy of OpenStreetMap Sweden — Map data © OpenStreetMap contributors, Map tiles by Stamen Design, CC BY 3.0 — Map data © OpenStreetMap contributors


Total wheat loss
due to drought/heat 2001-2015
- $50,000,000
-$100,000,000
-$150,000,000
-$200,000,000
-$250,000,000
-$300,000,000
-$350,000,000
41
3
1
26M
44M
23M
13M
100 km
Leaflet | Tiles courtesy of OpenStreetMap Sweden — Map data © OpenStreetMap contributors, Map tiles by Stamen Design, CC BY 3.0 — Map data © OpenStreetMap contributors

Step 13: CHERRIES, 2001-2015 for the IPNW







IPNW region CHERRIES total insurance loss by damage cause, 2001-2015

2001-2015

damagecause

loss

Excess Moisture/Precip/Rain

$20,569,890

Frost

$15,459,348

Freeze

$14,625,022

Decline in Price

$8,447,020

Cold Wet Weather

$6,724,754

Heat

$2,246,093

Hail

$2,034,613

Other (Snow-Lightning-Etc.)

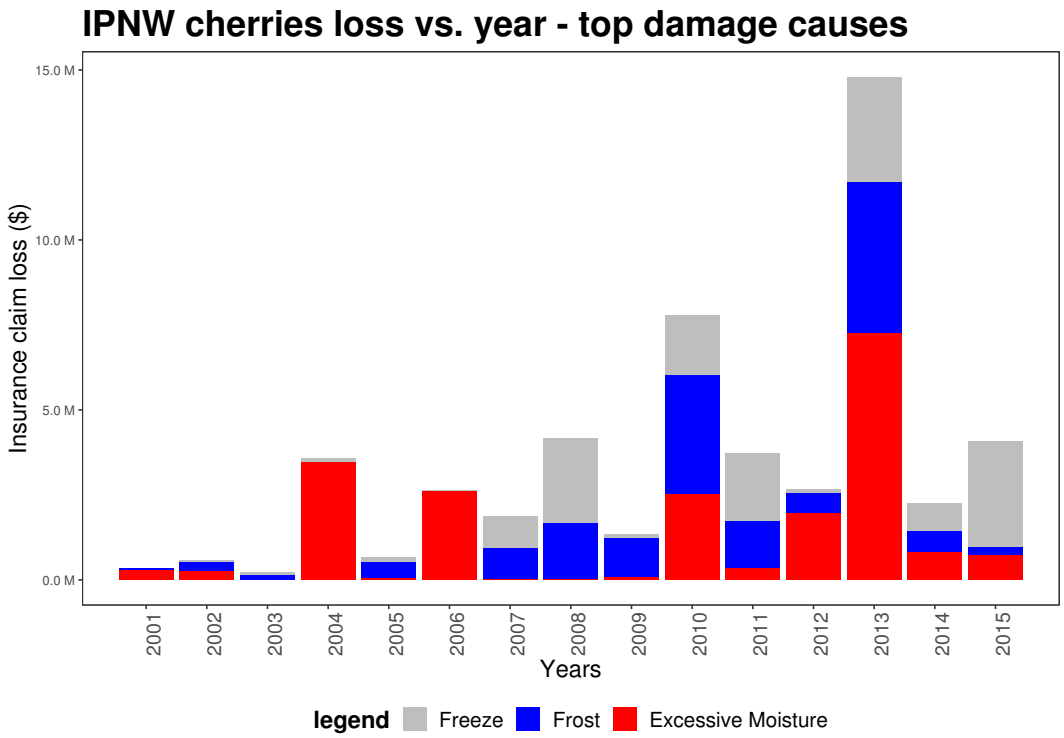
$1,876,035

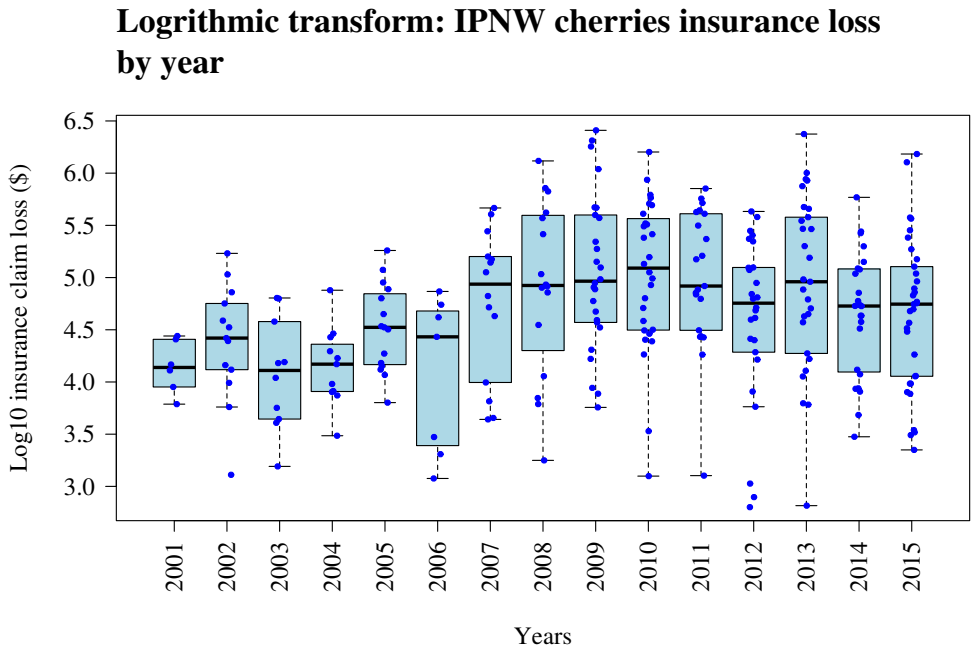
Other

$1,467,713

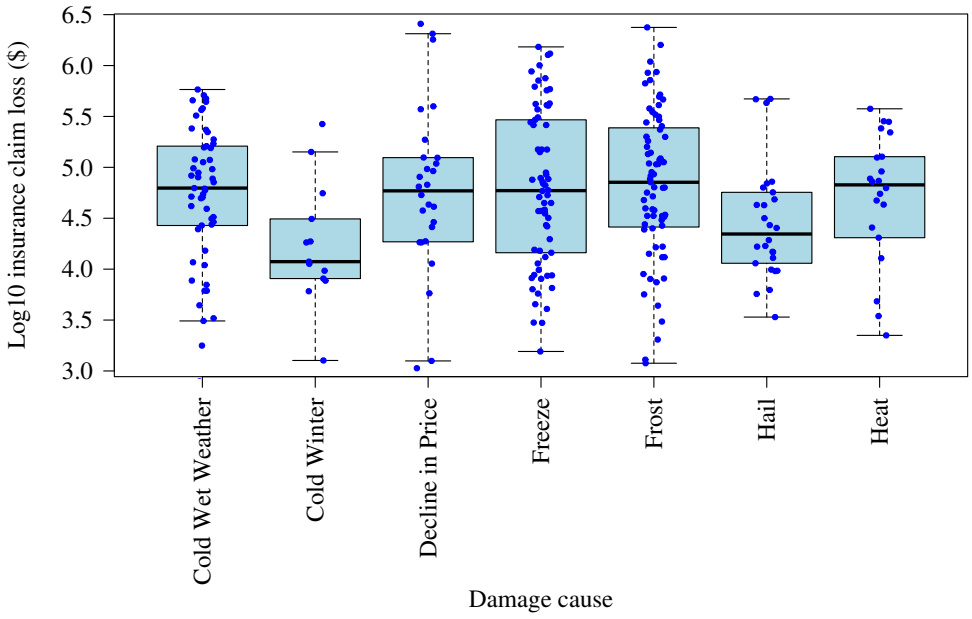
Wind/Excess Wind

$1,402,854

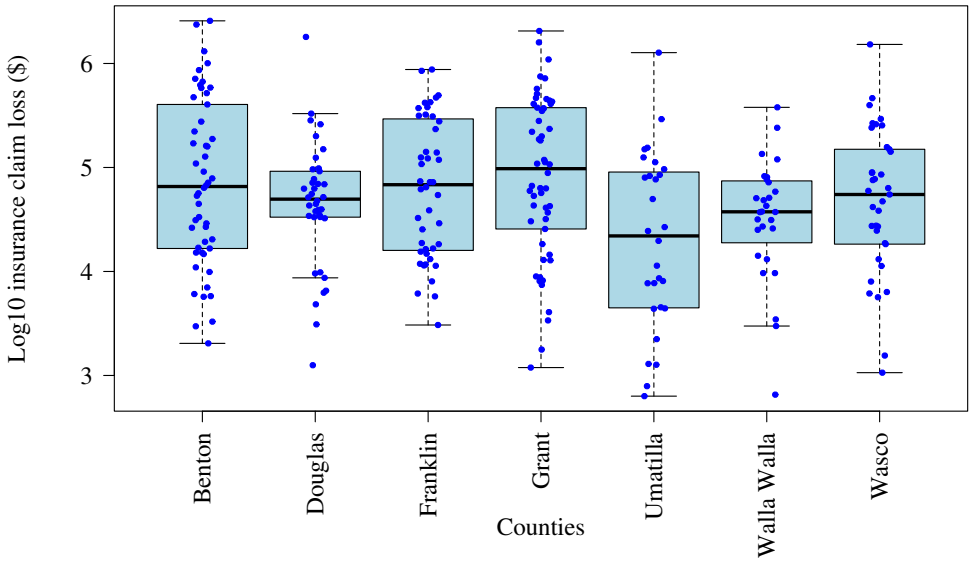


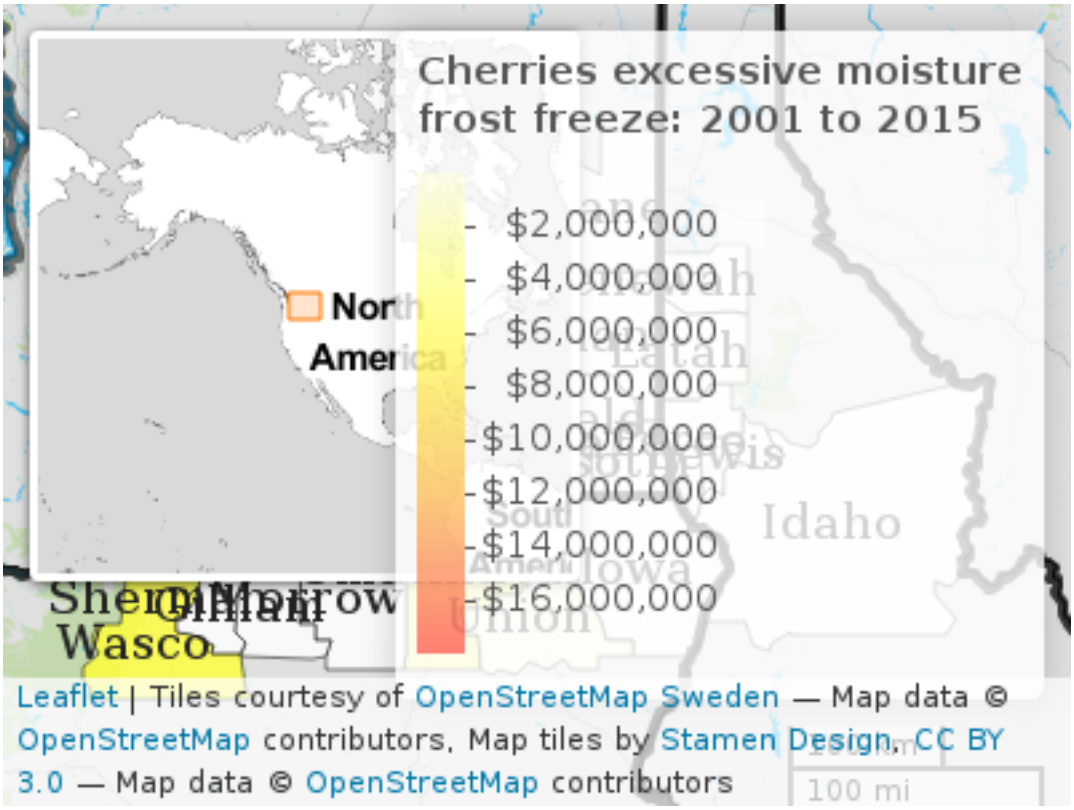


Logrithmic transform: IPNW cherries insurance loss by damage cause

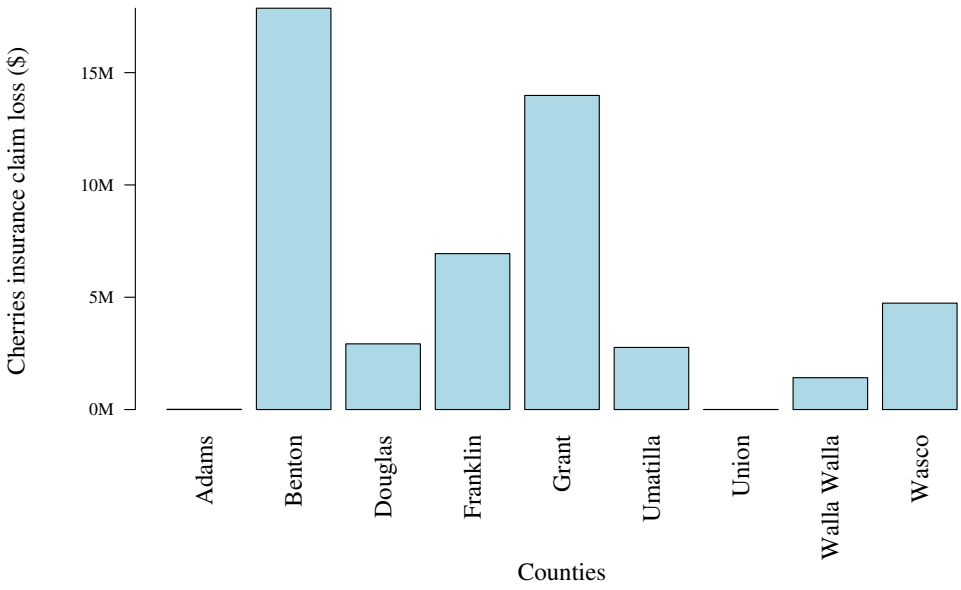


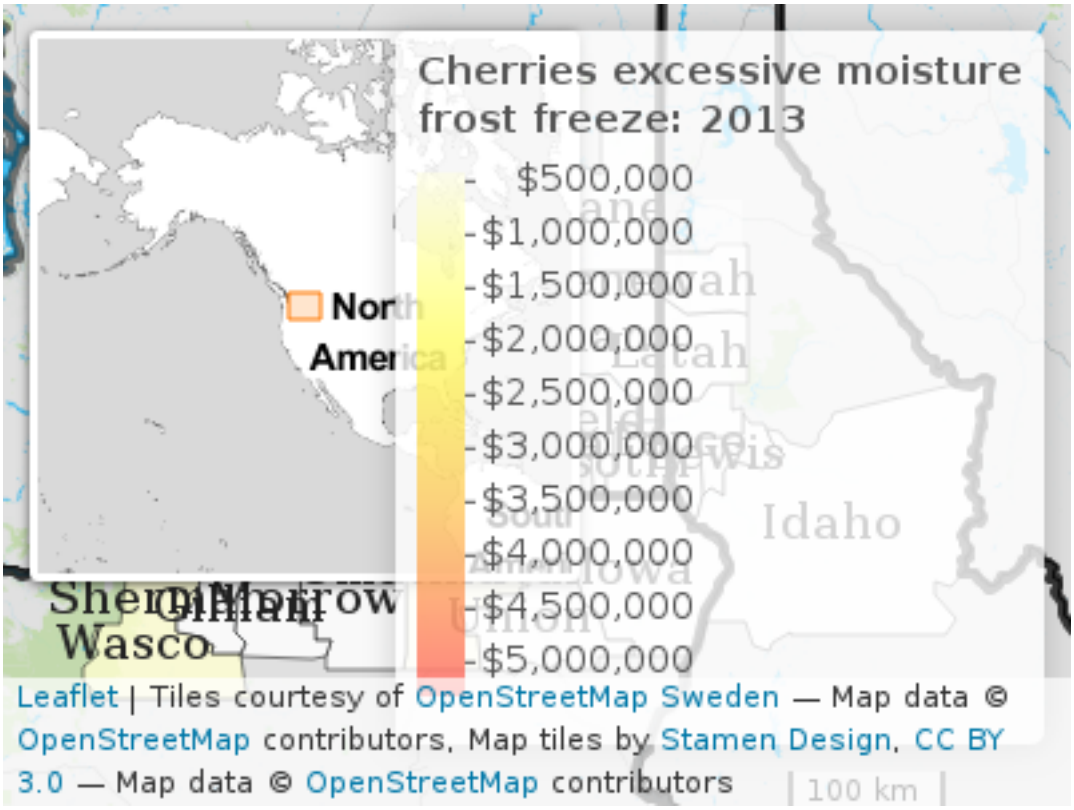
Logrithmic transform: IPNW cherries insurance loss by county



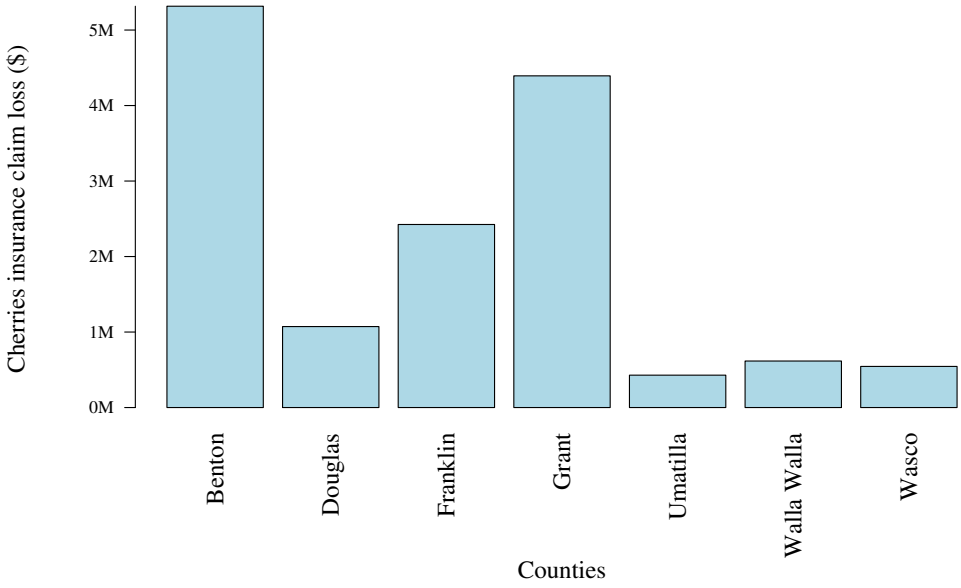


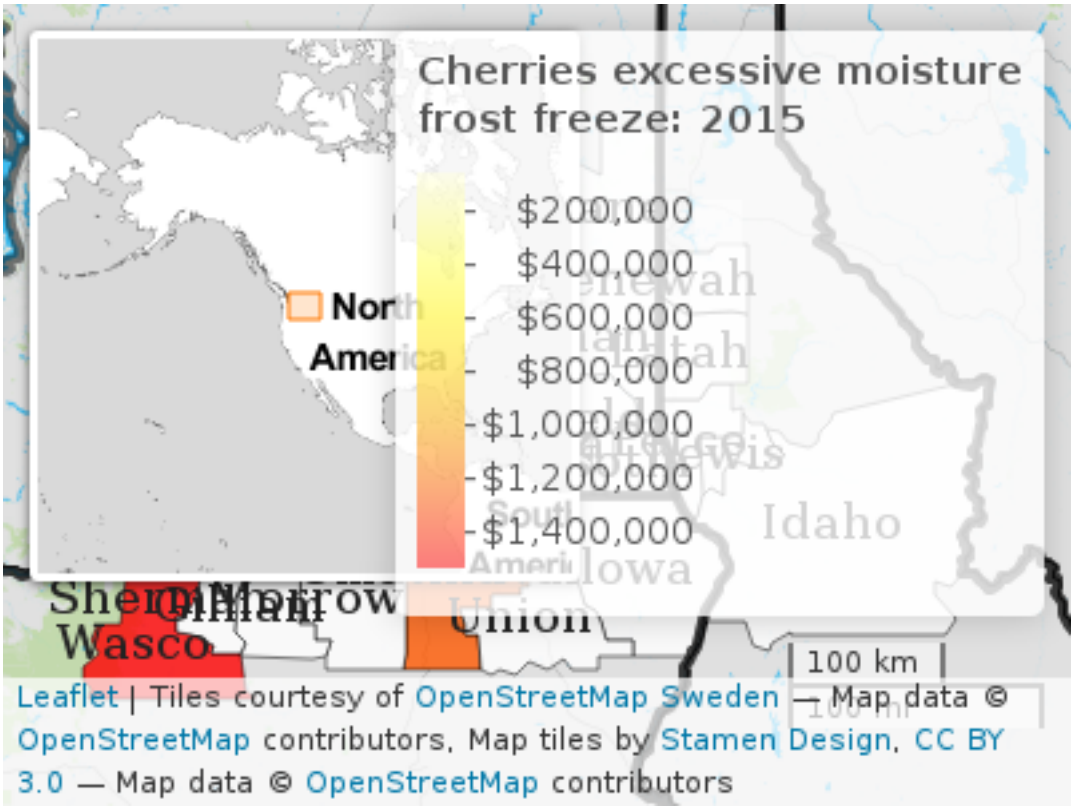
IPNW cherries insurance loss due to excessive moisture, frost, and freeze: 2001 to 2015



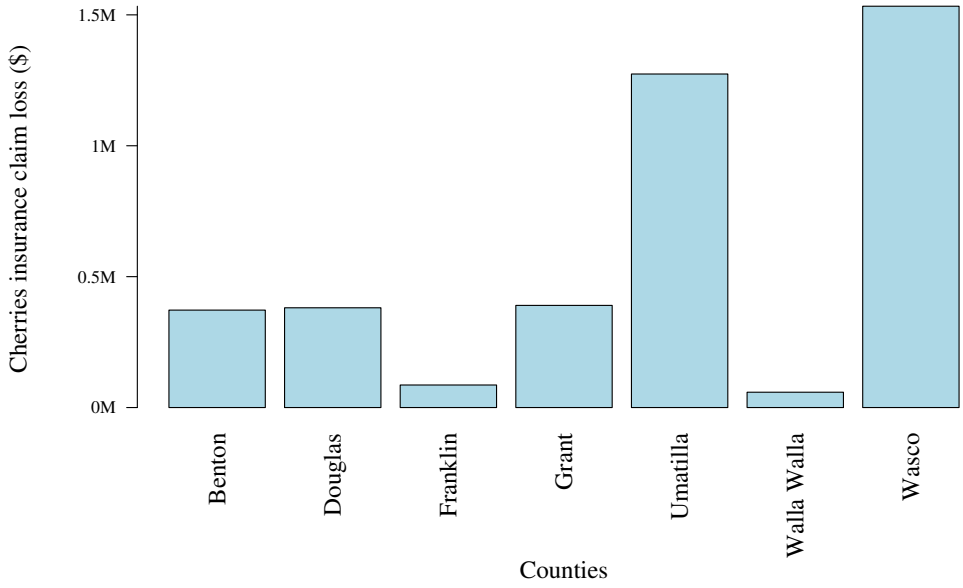


IPNW cherries insurance loss due to excessive moisture, frost, and freeze 2013



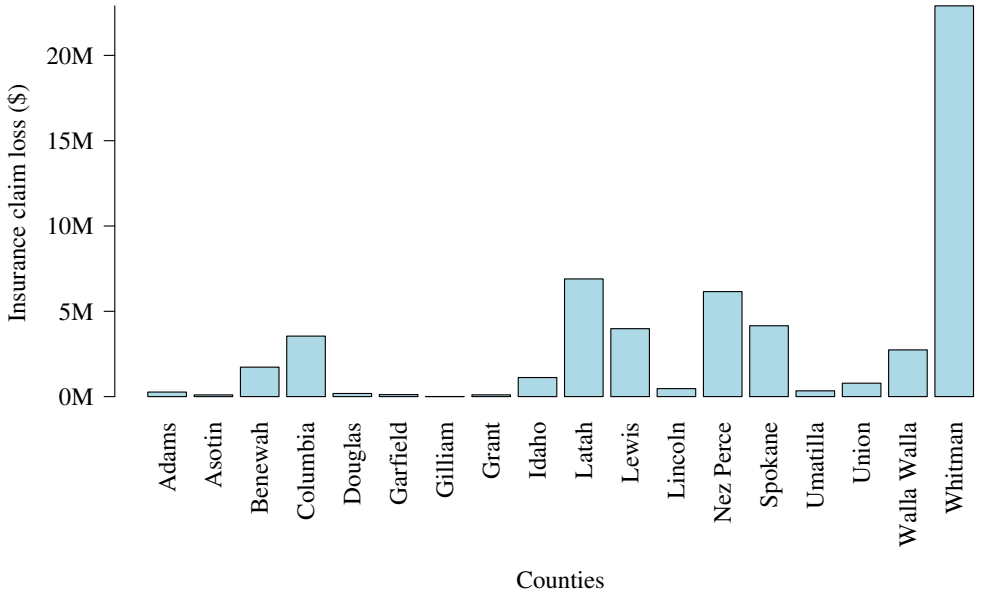


IPNW cherries insurance loss due to excessive moisture, frost, and freeze 2015

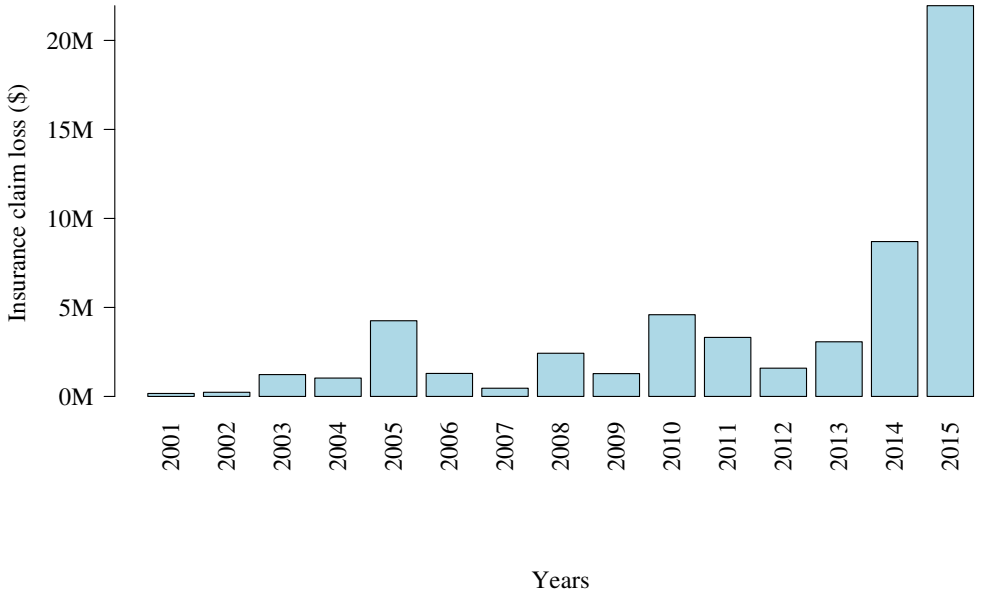


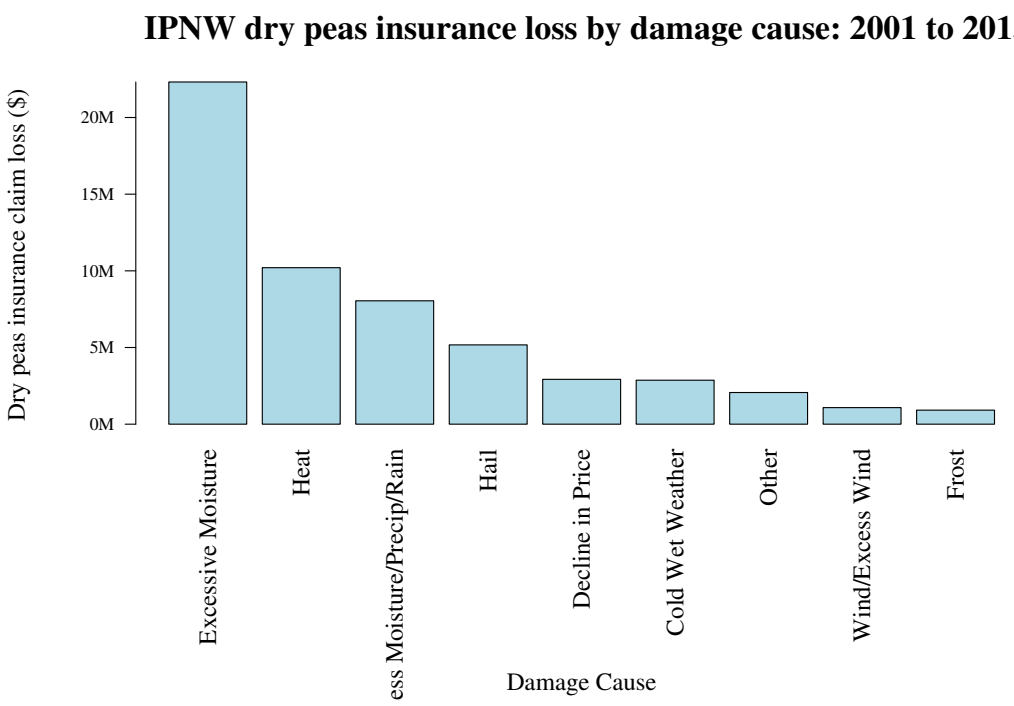
Step 14: DRY PEAS, 2001-2015 for the IPNW

IPNW dry peas insurance loss by commodity: 2001 to 2015



IPNW dry peas insurance loss by year: 2001 to 2015





IPNW region DRY PEAS total insurance loss by damage cause, 2001-2015

2001-2015

damagecause

loss

Excessive Moisture

$22,316,191

Heat

$10,205,657

Excess Moisture/Precip/Rain

$8,046,188

Hail

$5,171,205

Decline in Price

$2,924,900

Cold Wet Weather

$2,867,390

Other

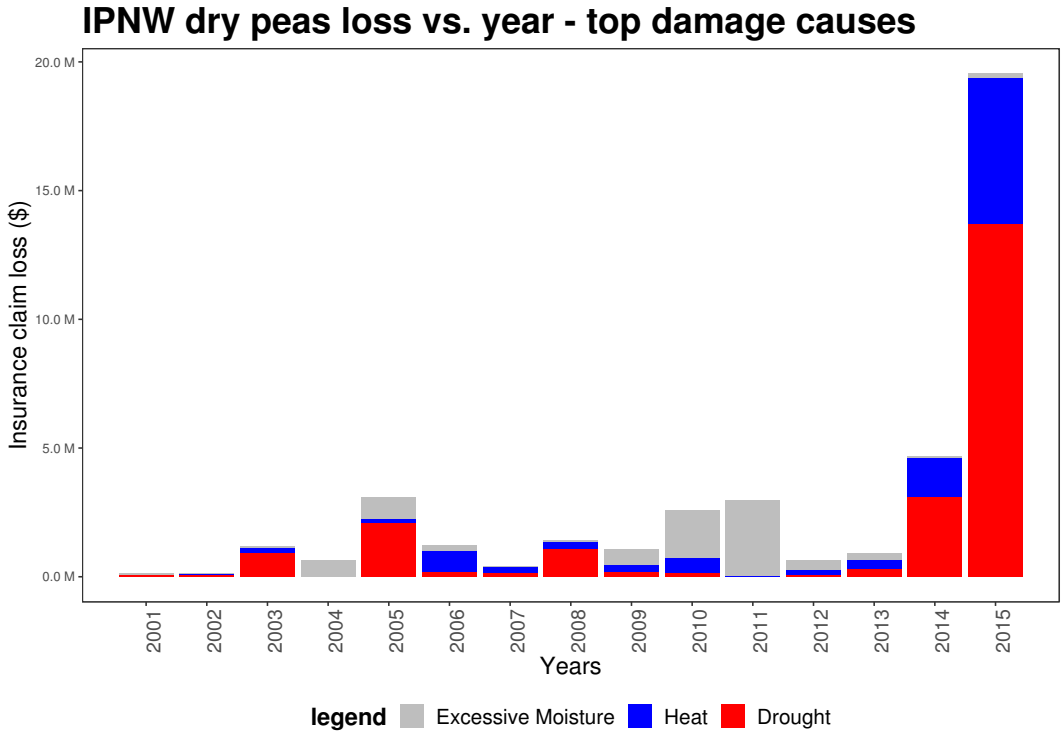
$2,064,864

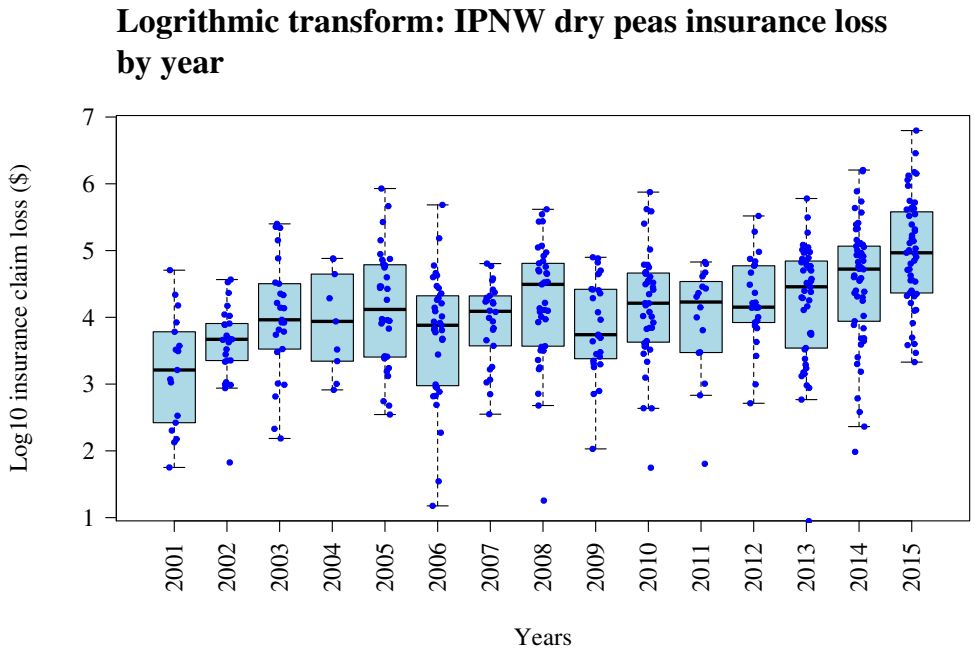
Wind/Excess Wind

$1,079,927

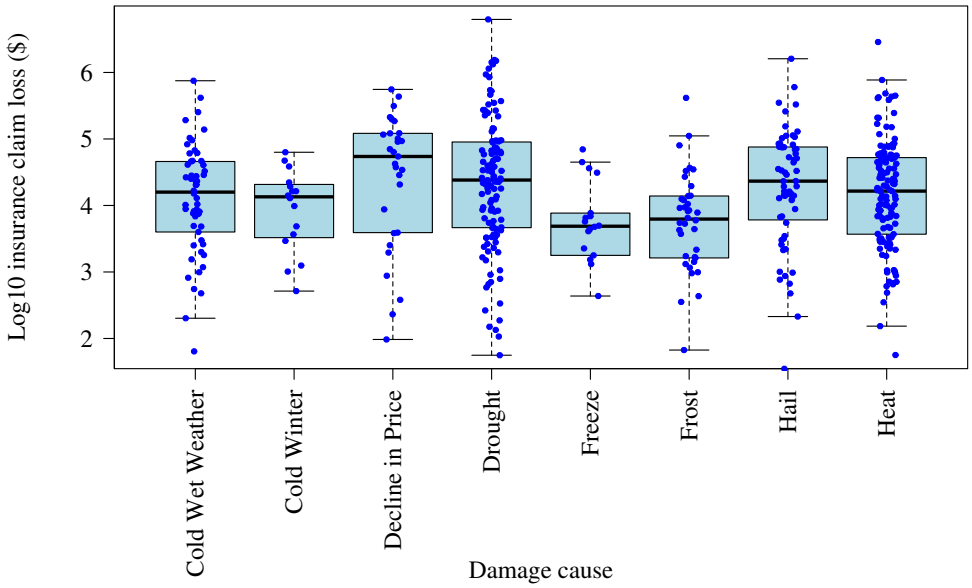
Frost

$914,417

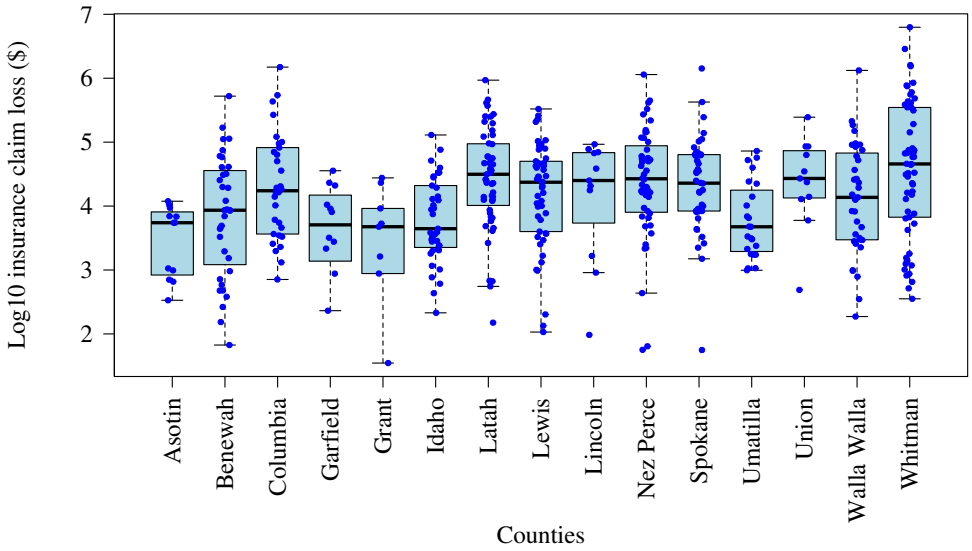


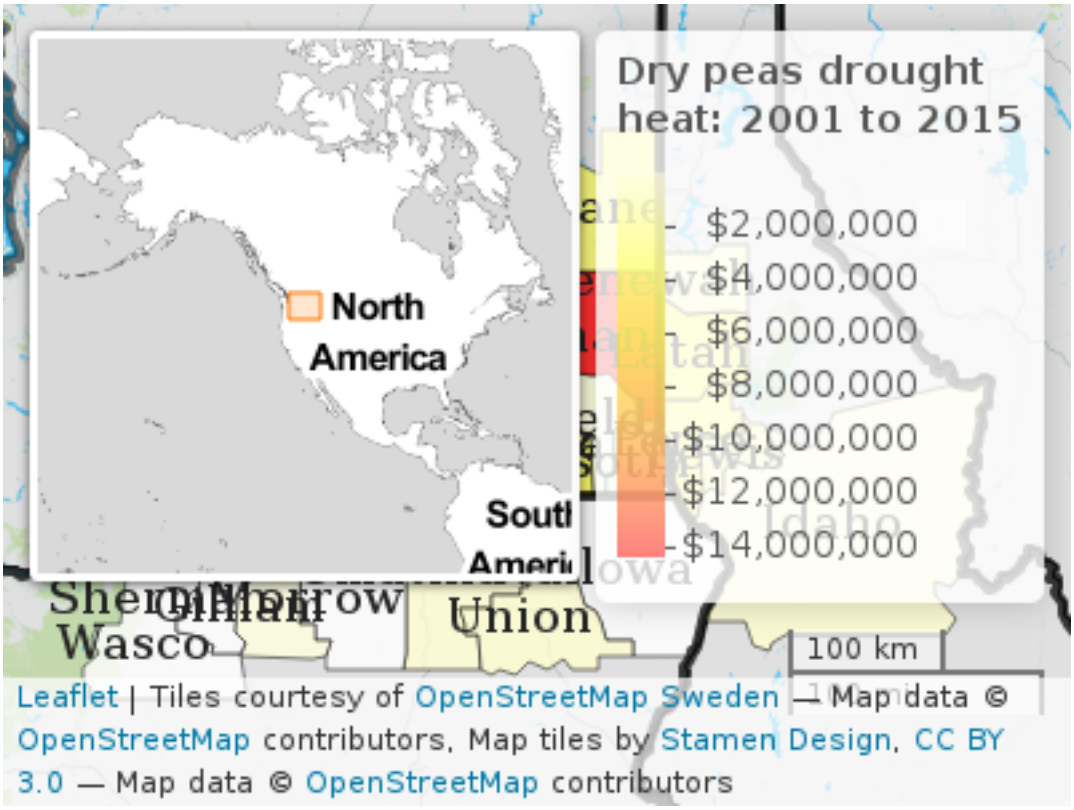


Logrithmic transform: IPNW dry peas insurance loss by damage cause

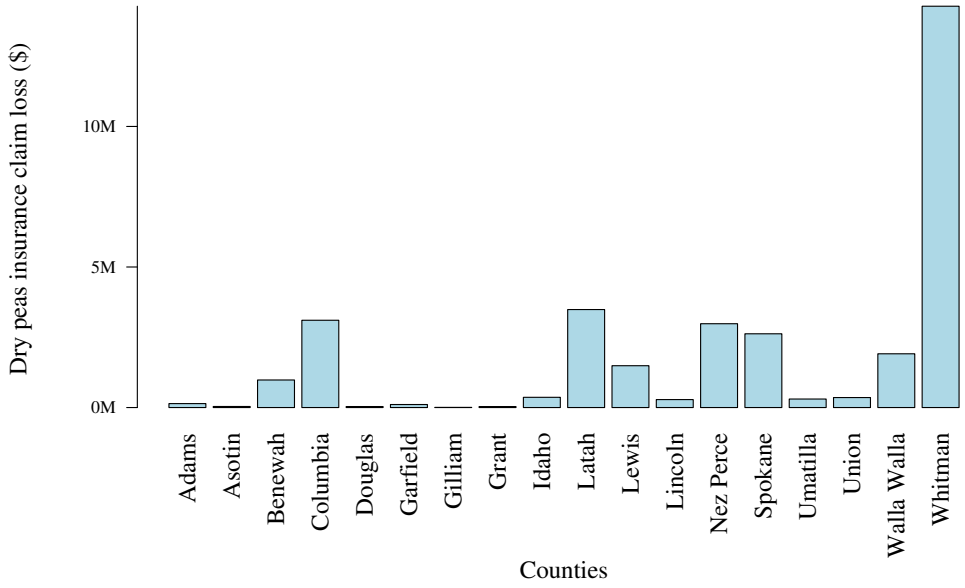


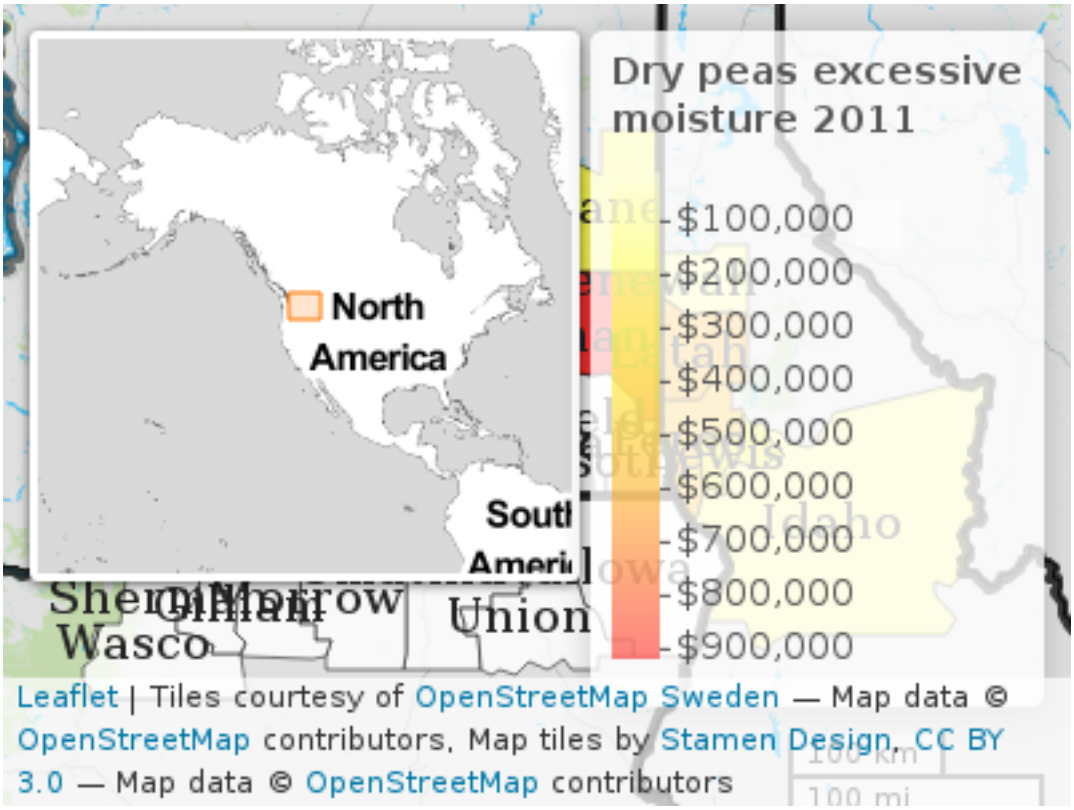
Logrithmic transform: IPNW dry peas insurance loss by damage cause



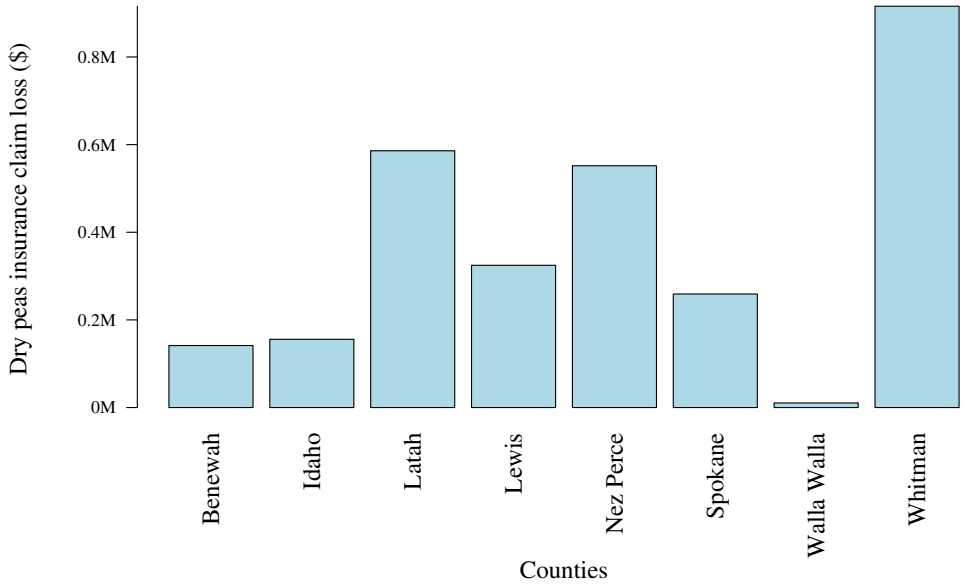


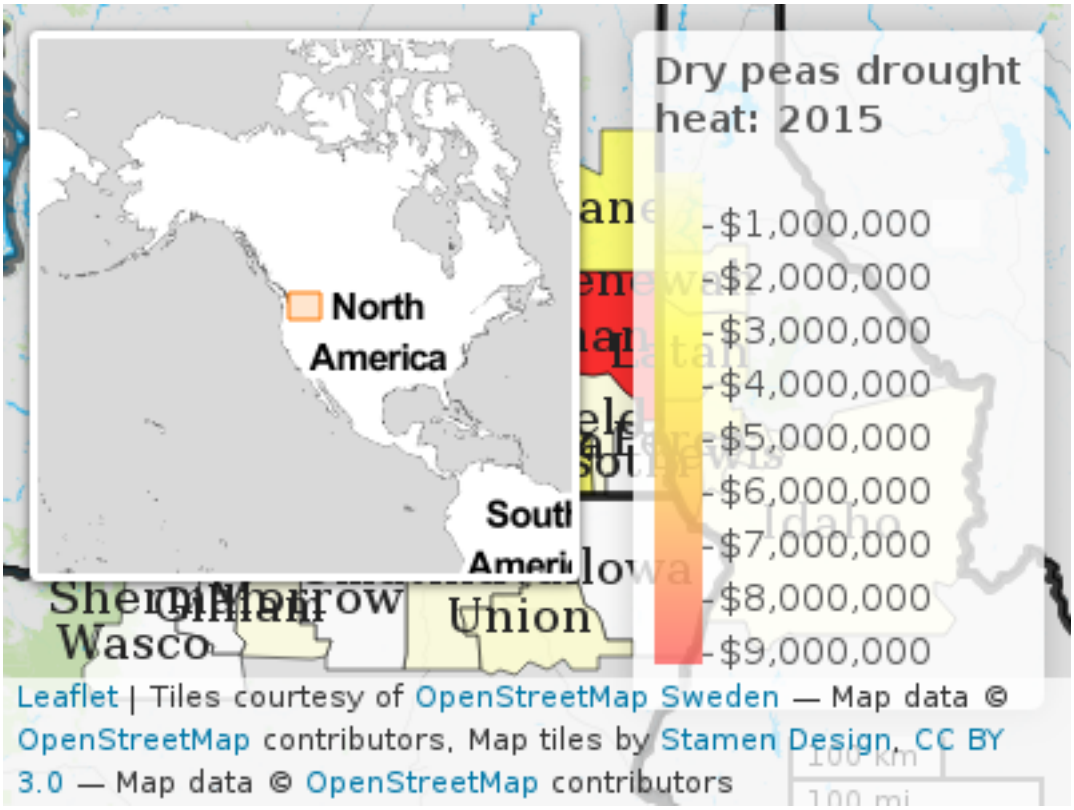
IPNW dry peas insurance loss due to drought and heat: 2001 to 2015





IPNW dry peas insurance loss due to excessive moisture: 2011





IPNW dry peas insurance loss due to drought and heat 2015