

# AJAE appendix B 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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Appendix B documents supplemental Principle Components Analyses (PCA) for the Pacific Northwest (PNW) and the inland Pacific Northwest (iPNW), to better understand the combined effects of differing damage causes, commodities, counties, and years on overall loss.

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- 2. Supplemental Inland Pacific Northwest(iPNW) Exploratory Data Analysis** Here we outline a multitude of PCA outputs for the 24 county iPNW Pacific Northwest region.
- 3. Supplemental Pacific Northwest (PNW) Principle Components Analysis** In this section we outline a multitude of PCA outputs for the entire three state Pacific Northwest region (Oregon, Idaho, and Washington).
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Table 1: USDA RMA insurance loss records that were acquired from the USDA Risk Management Agency (RMA). Each record represents an individual insurance claim.

year	state	county	commodity	damagecause	month	acres	loss	lossperacre	croppyear
2001	ID	Ada	All Other Crops	Drought	SEP	17.000	153.00	9.000000	2001
2001	ID	Ada	All Other Crops	Heat	AUG	105.200	5249.00	49.895437	2001
2001	ID	Ada	All Other Crops	Freeze	APR	125.000	4500.00	36.000000	2001
2001	ID	Ada	All Other Crops	Wind/Excess Wind	MAY	50.000	1800.00	36.000000	2001
2001	ID	Ada	All Other Crops	Wind/Excess Wind	APR	92.500	3330.00	36.000000	2001
2001	ID	Bannock	WHEAT	Drought	AUG	133.000	1212.00	9.112782	2001
2001	ID	Bannock	WHEAT	Drought	SEP	777.520	24807.00	31.905289	2001
2001	ID	Bannock	WHEAT	Drought	JUL	3529.754	54726.46	15.504327	2001
2001	ID	Bannock	WHEAT	Heat	JUL	19.796	2371.60	119.801980	2001

Table 2: USDA RMA aggregated dataset derived from the original insurance loss files. Here we have summarized claims by year, county, commodity, and damage cause. Each unique combination is summarized, which echos the total summarized loss, the number of claims, the total summarized acreage, loss per acre, loss per claim, and acres per claim. This dataset was the basis for our data examination.

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

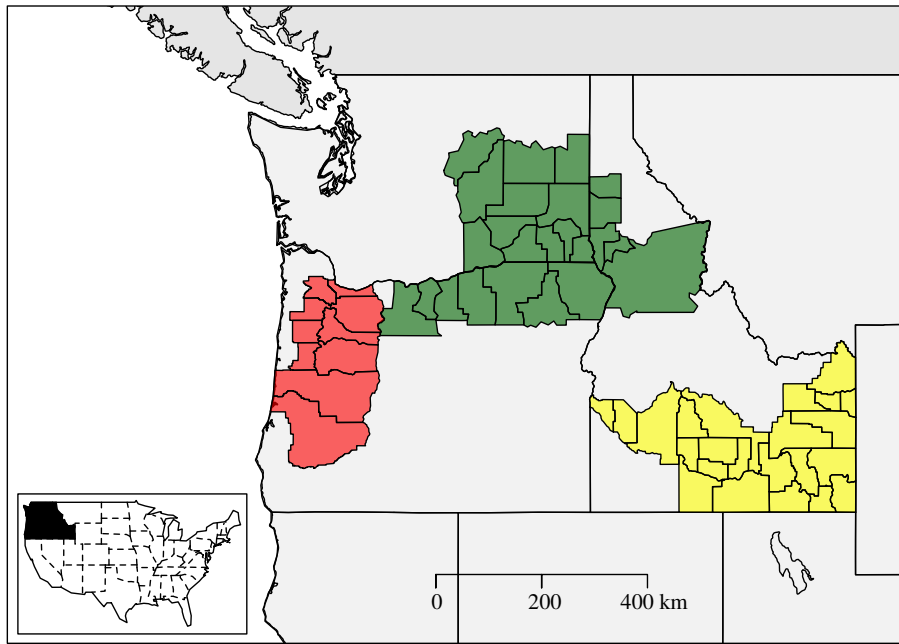


Figure 1: Pacific Northwest study area, which includes agricultural regions for the inland Pacific Northwest, the southern Idaho valley, and the Willamette valley.

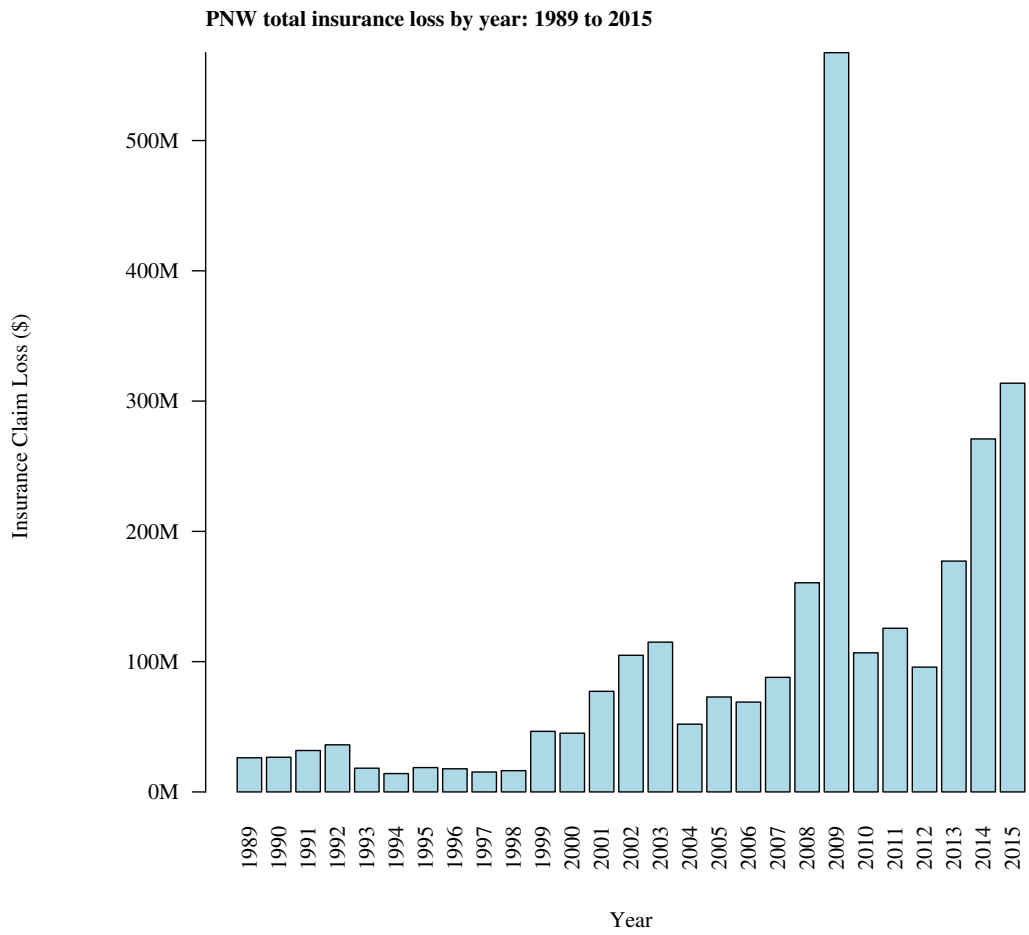


Figure 2: Pacific Northwest agricultural insurance loss by year, 1989 to 2015

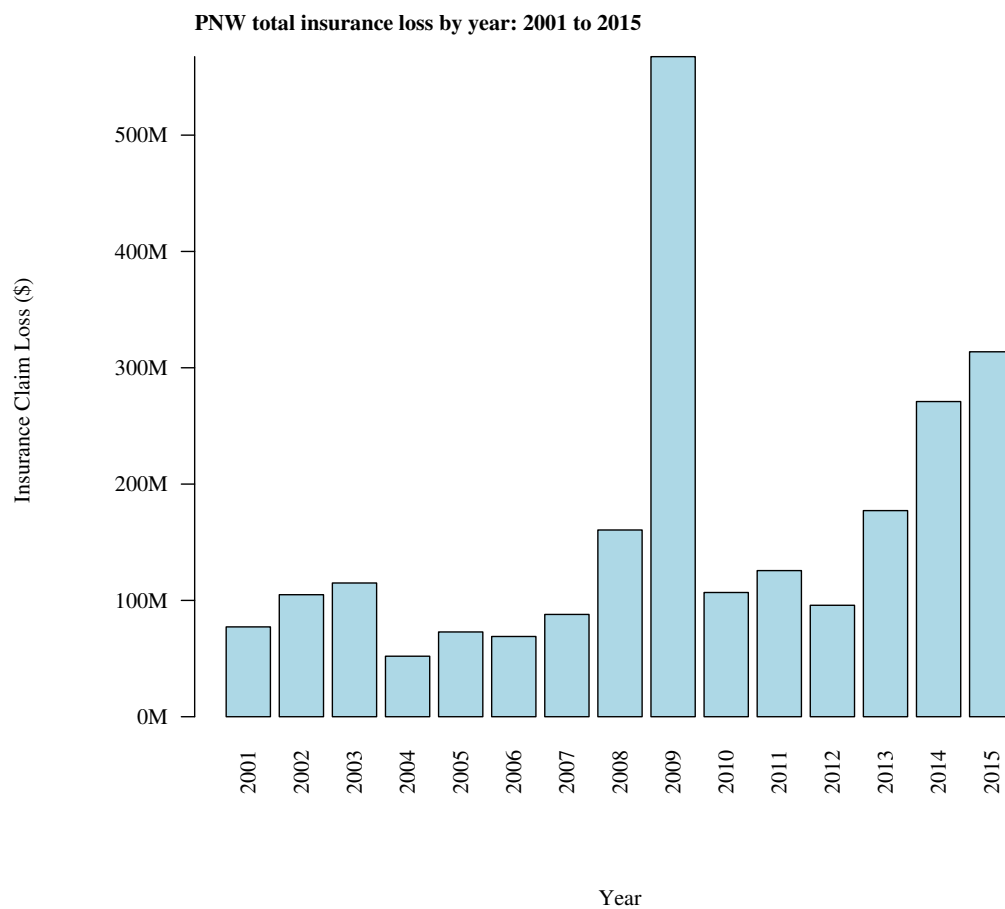


Figure 3: PNW total insurance loss by year: 2001 to 2015

```
## Error in `levels<-`(`*tmp*`, value = c(NA, NA, NA, NA, NA, NA, NA, NA, : factor level [2] is duplica
```

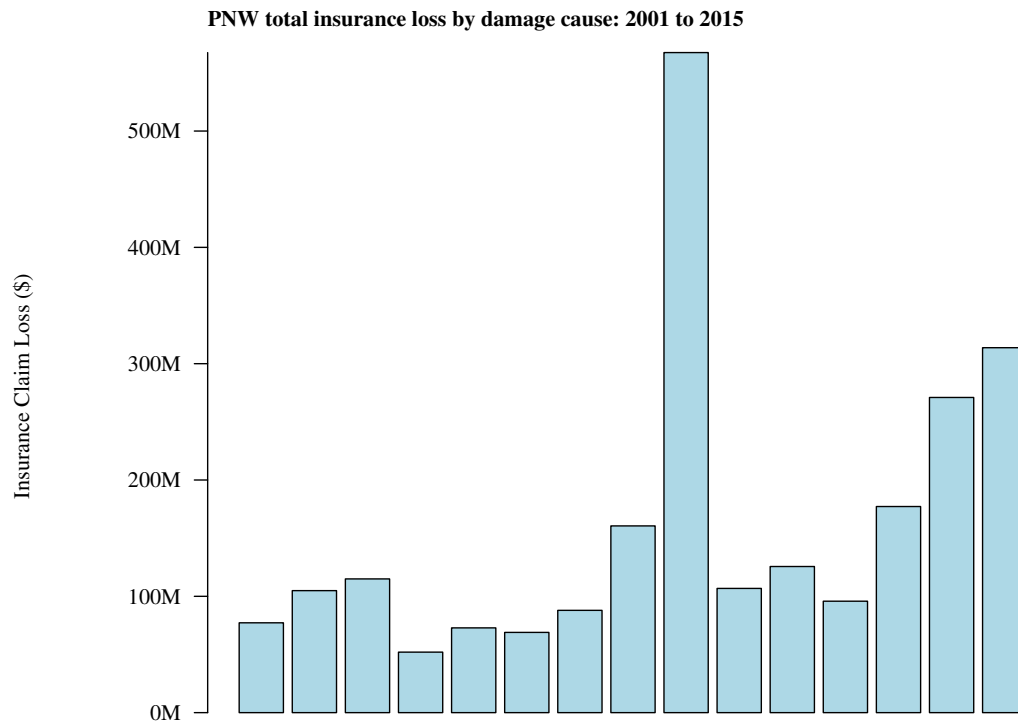


Figure 4: PNW total insurance loss by damage cause: 2001 to 2015.



```
## Error in eval(expr, envir, enclos): object 'c2' not found

## Error in `$$<-.data.frame`(`*tmp*`, commodity, value = character(0)): replacement has 0 rows, data has 1

## Error in stri_trans_general(YYY1$commodity, id = "Title"): could not find function "stri_trans_general"

## Error in `$$<-.data.frame`(`*tmp*`, commodity, value = structure(integer(0), .Label = character(0), class = c("integer", "numeric")), .Label = "integer"): replacement has length zero

## Error in levels(YYY1$commodity)[1] <- "Gross Revenue": attempt to set an attribute on NULL
```

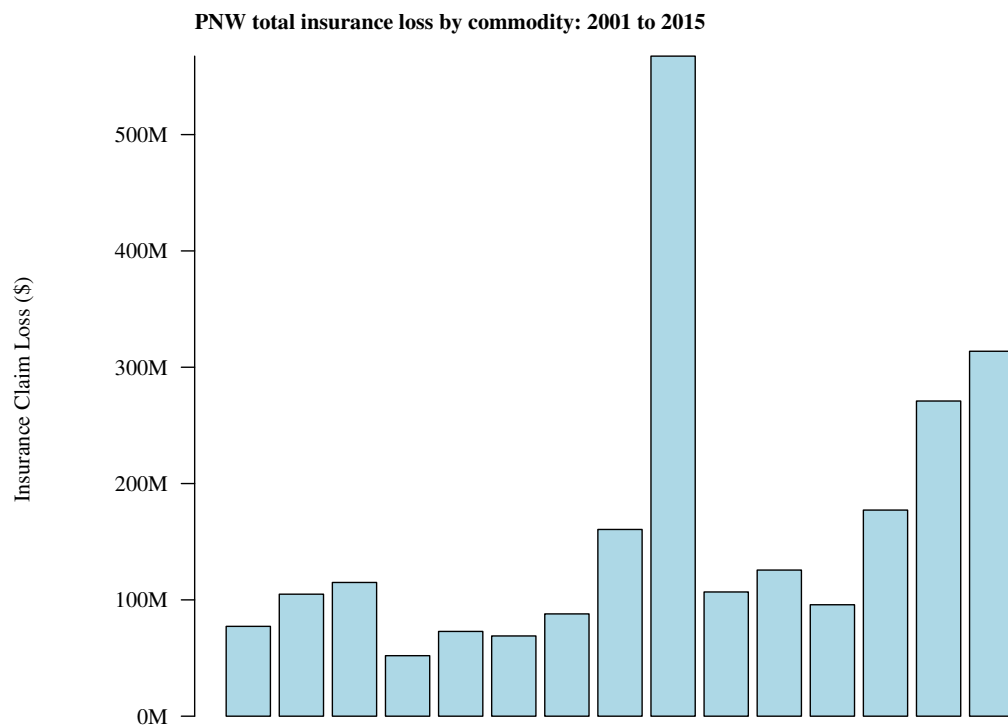


Figure 5: PNW total insurance loss by commodity: 2001 to 2015.

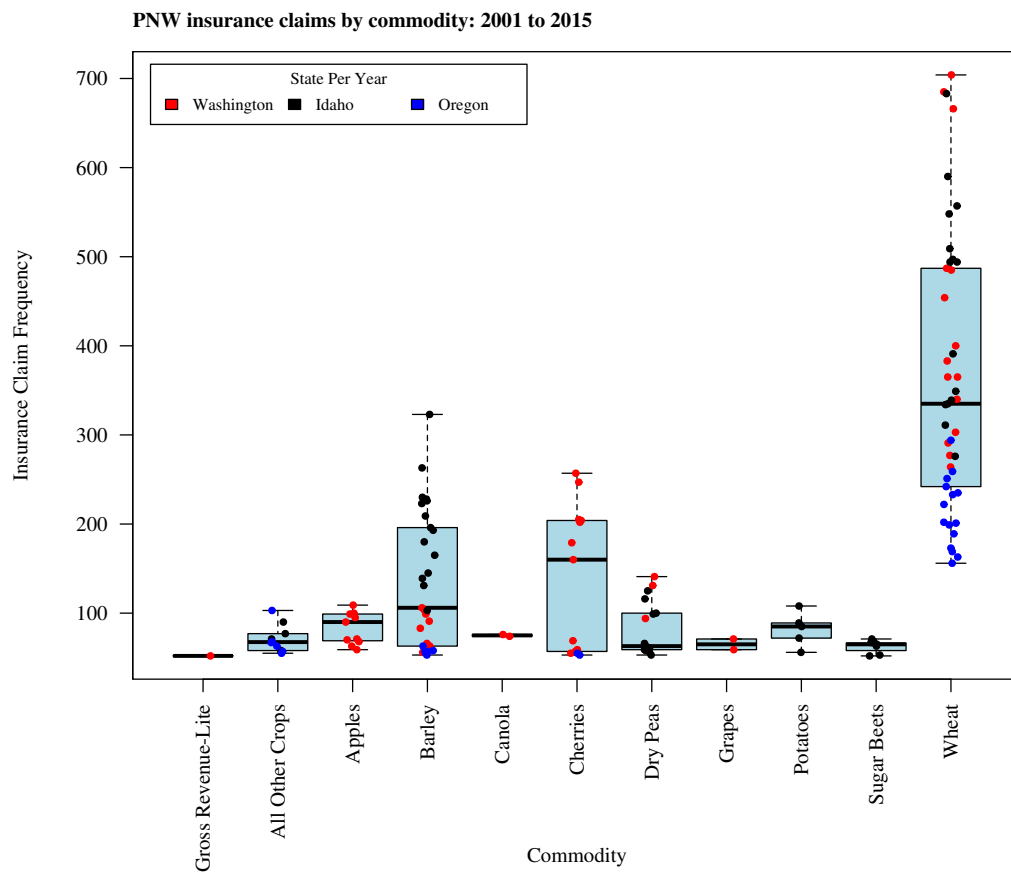


Figure 6: PNW total insurance loss by year: 2001 to 2015

PNW insurance claim counts by damage cause: 2001 to 2015

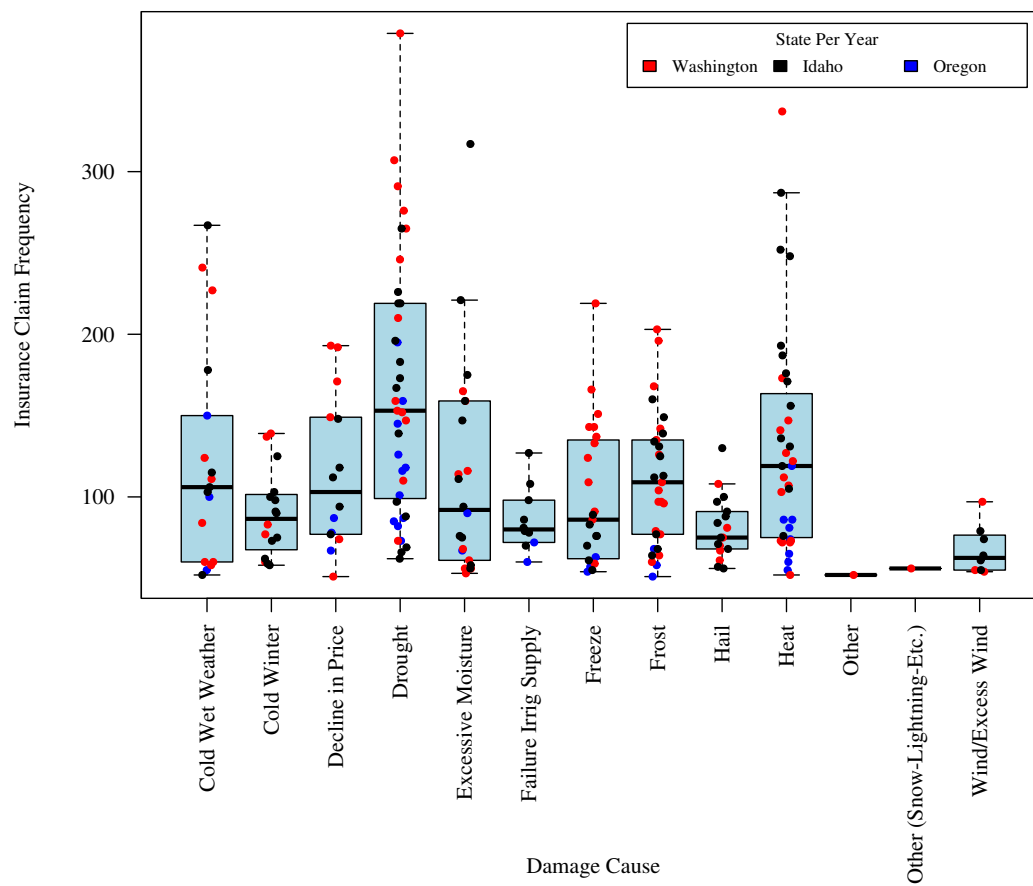


Figure 7: PNW total insurance loss by year: 2001 to 2015

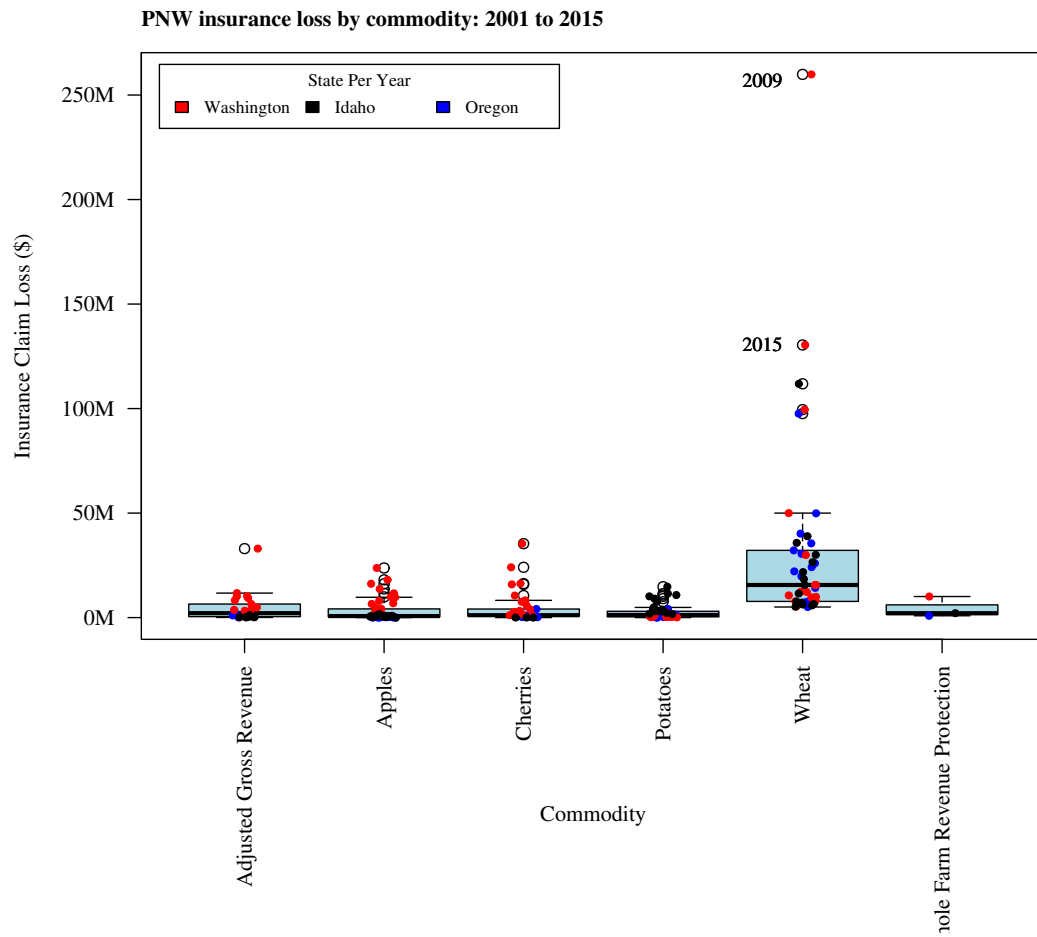


Figure 8: PNW total insurance loss by year: 2001 to 2015

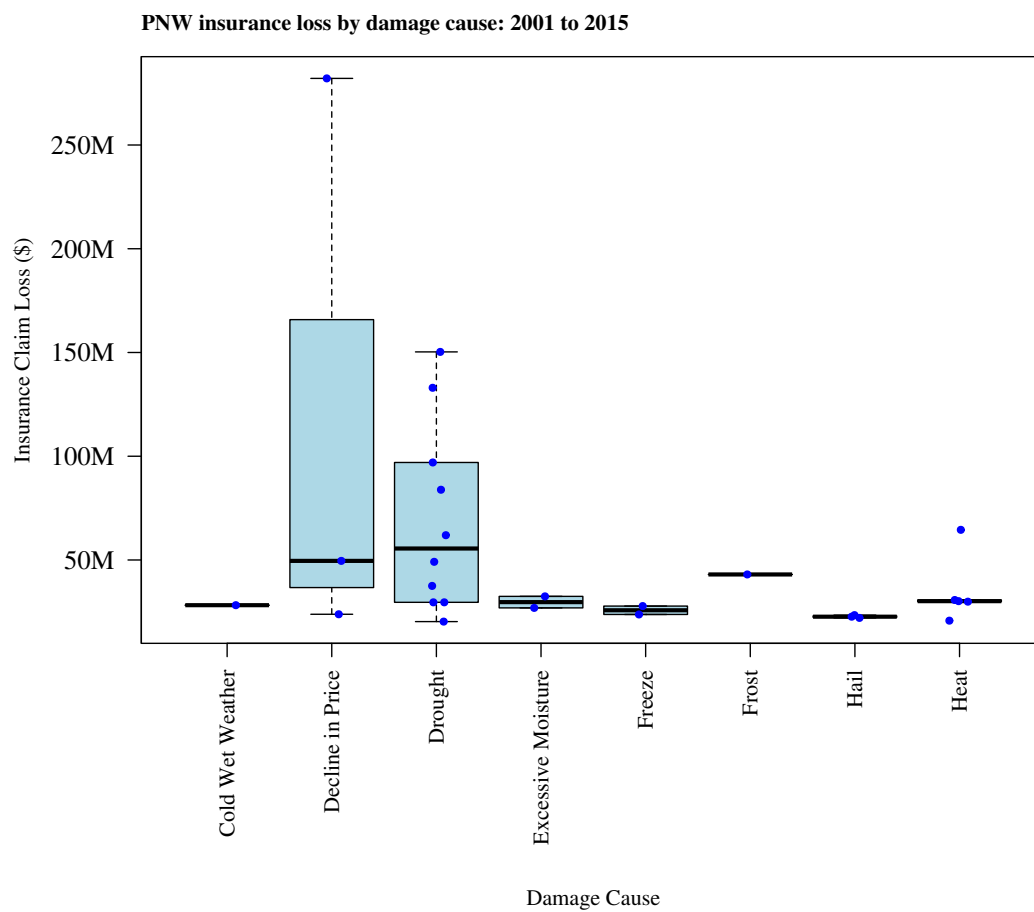


Figure 9: PNW total insurance loss by year: 2001 to 2015

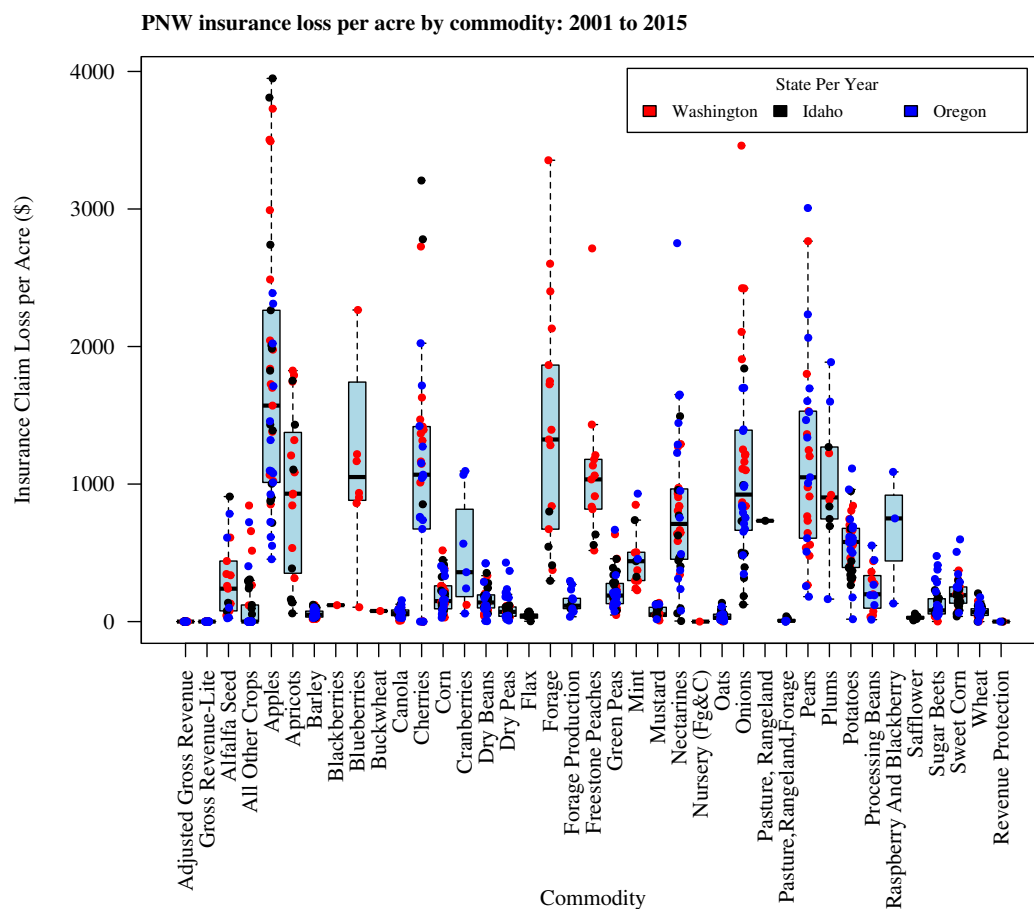


Figure 10: PNW total insurance loss by year: 2001 to 2015

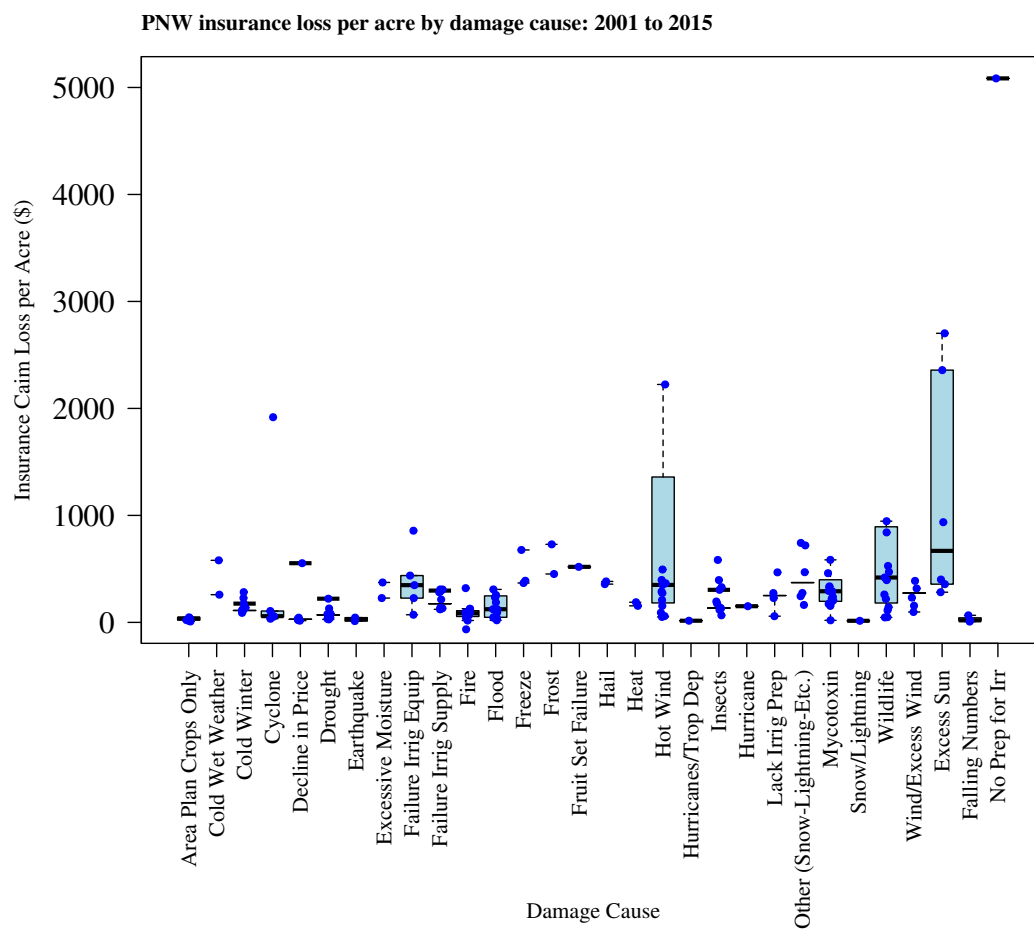


Figure 11: PNW total insurance loss by year: 2001 to 2015

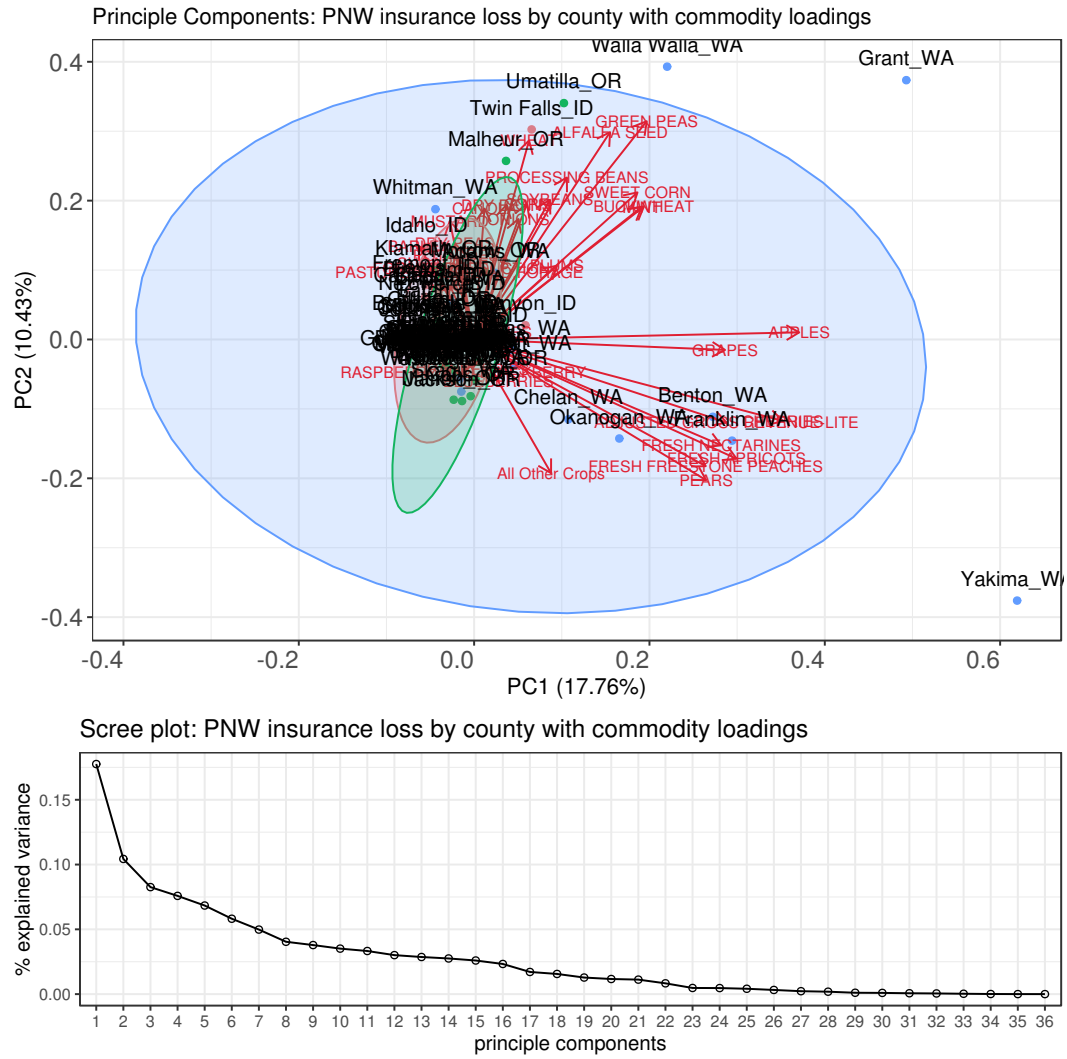


Figure 12: Top panel: Biplot of principle components for insurance loss for the entire PNW, by county, with commodity as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.



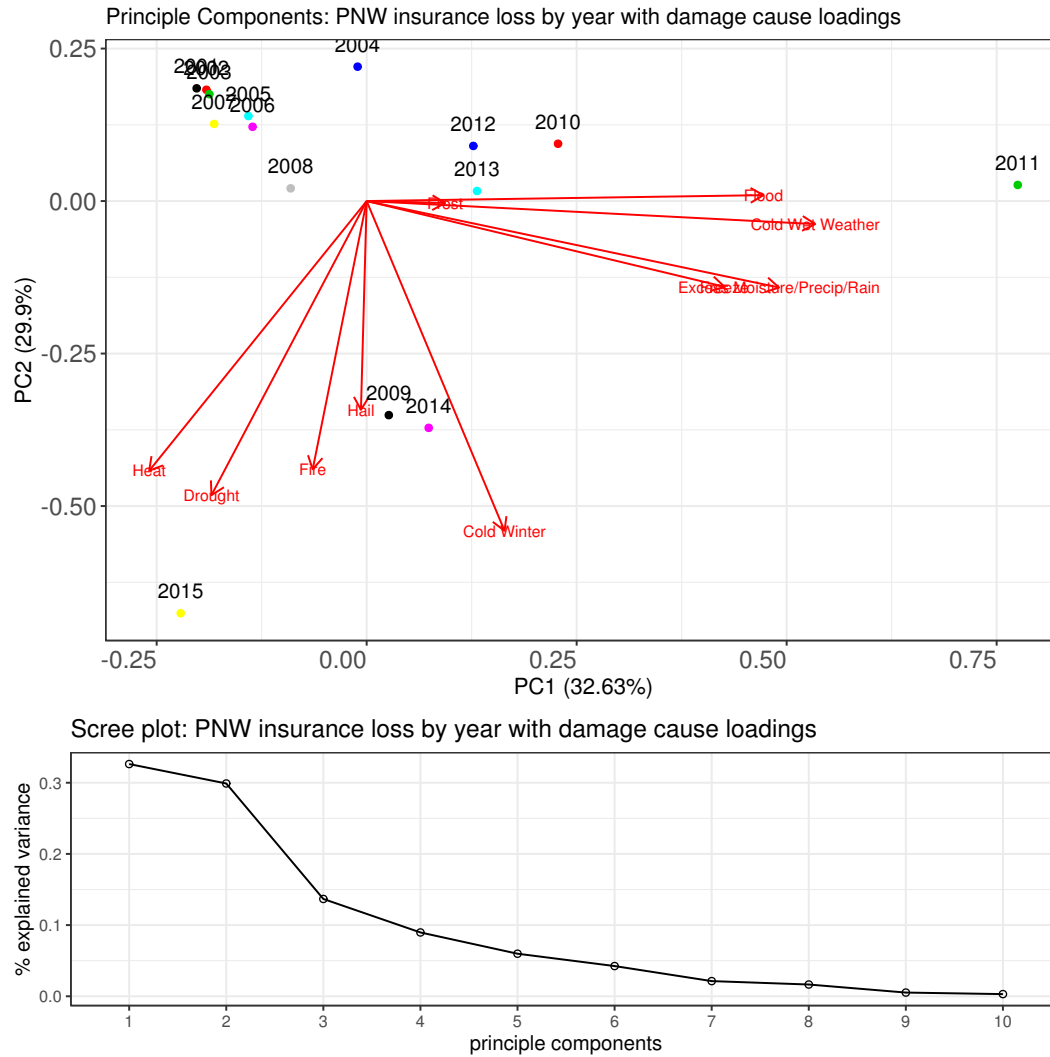


Figure 13: Top panel: biplot of principle components of insurance loss, for the entire PNW, for all commodities by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

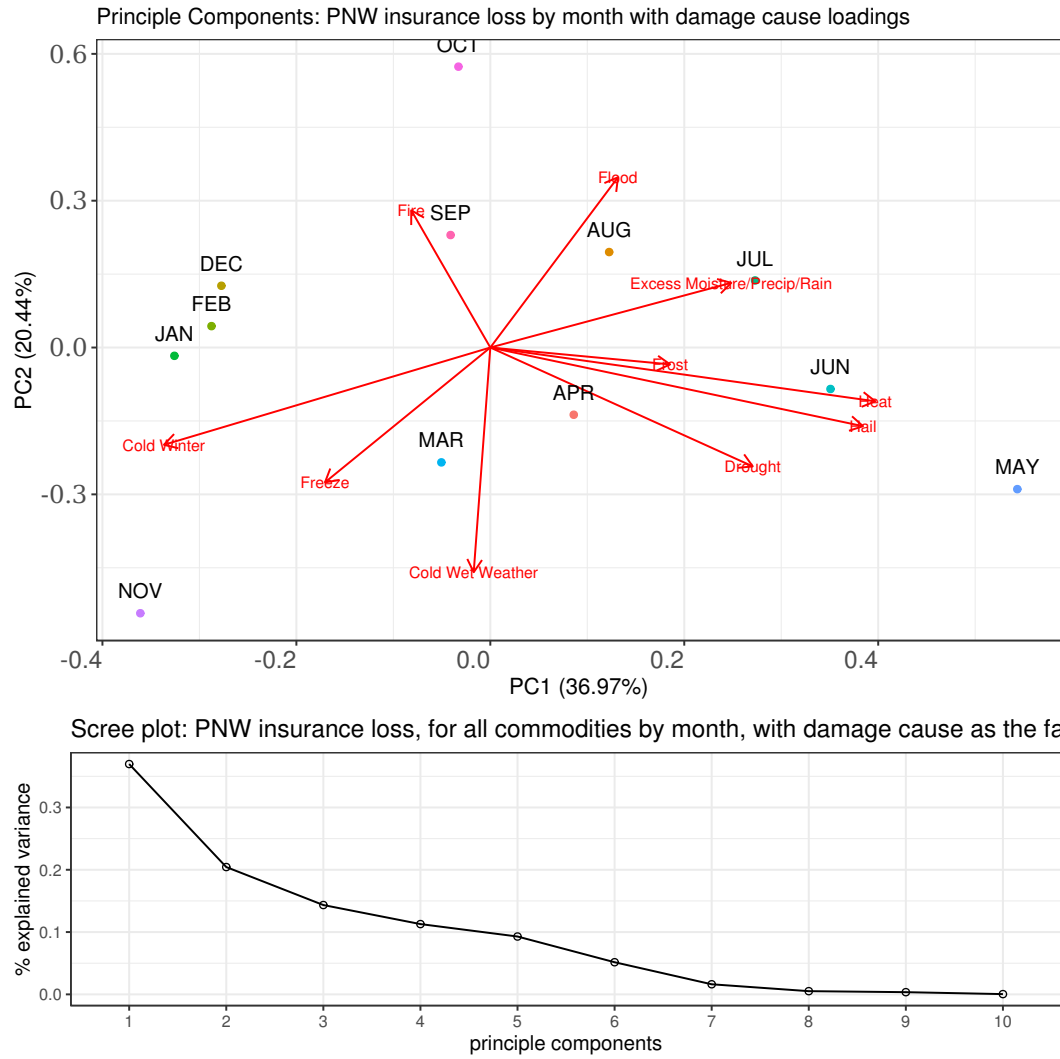


Figure 14: Top panel: biplot of principle components for insurance loss for the entire PNW, for all commodities by month, with damage cause as the factor loadings. Bottom panel: Scree plot Data from 2001 to 2015 is used.

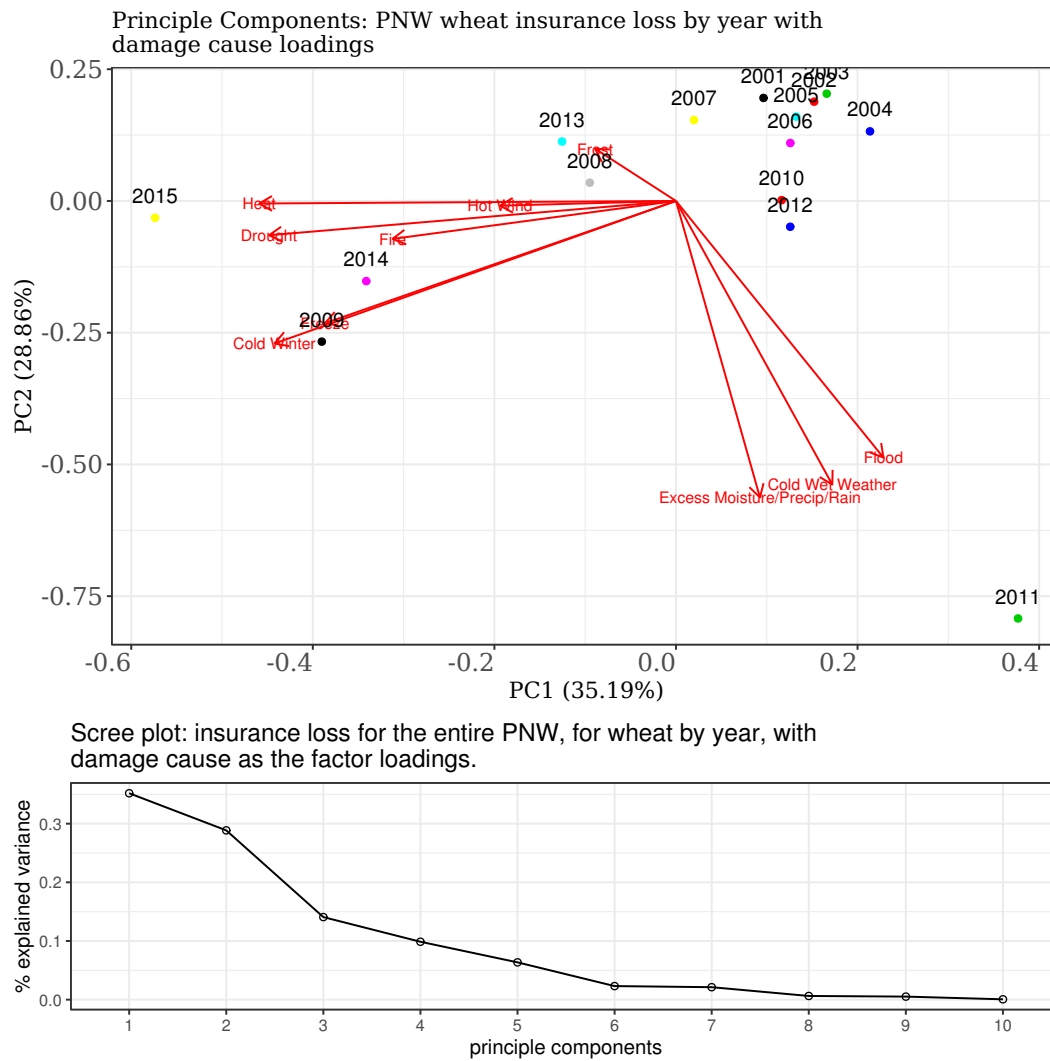


Figure 15: Top panel: biplot of insurance loss for the entire PNW, for wheat by year, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

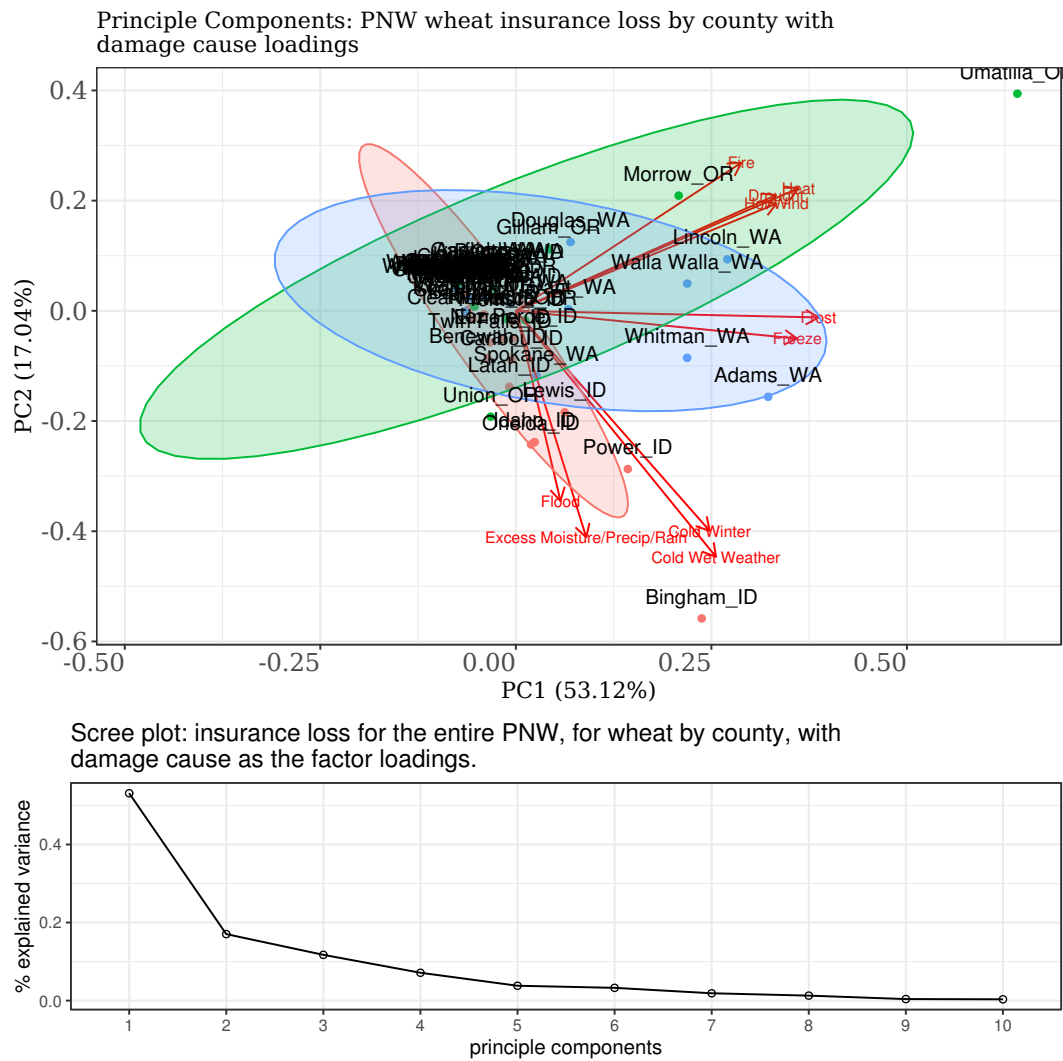


Figure 16: Top panel: biplot of insurance loss for the entire PNW, for wheat by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

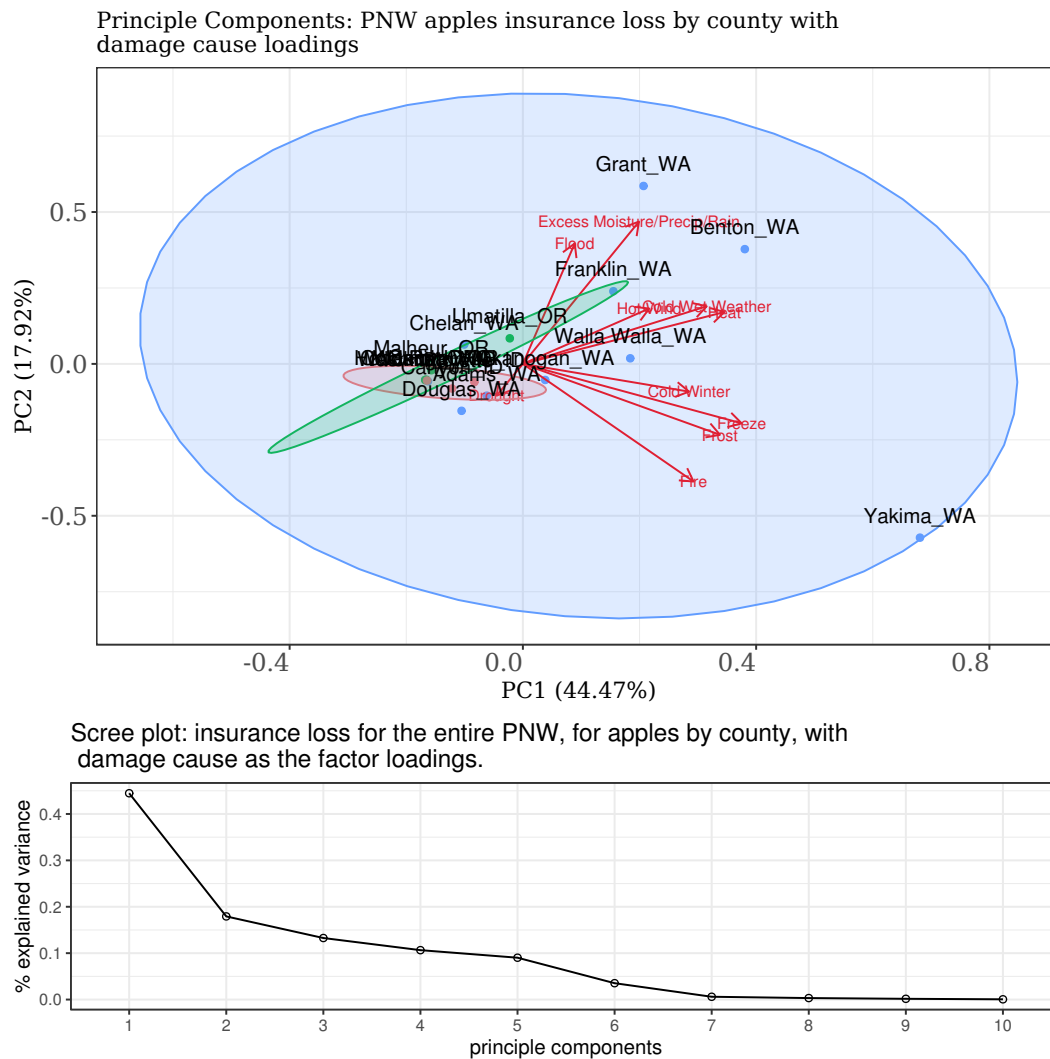


Figure 17: Top panel: biplot of insurance loss for the entire PNW, for apples by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is used.

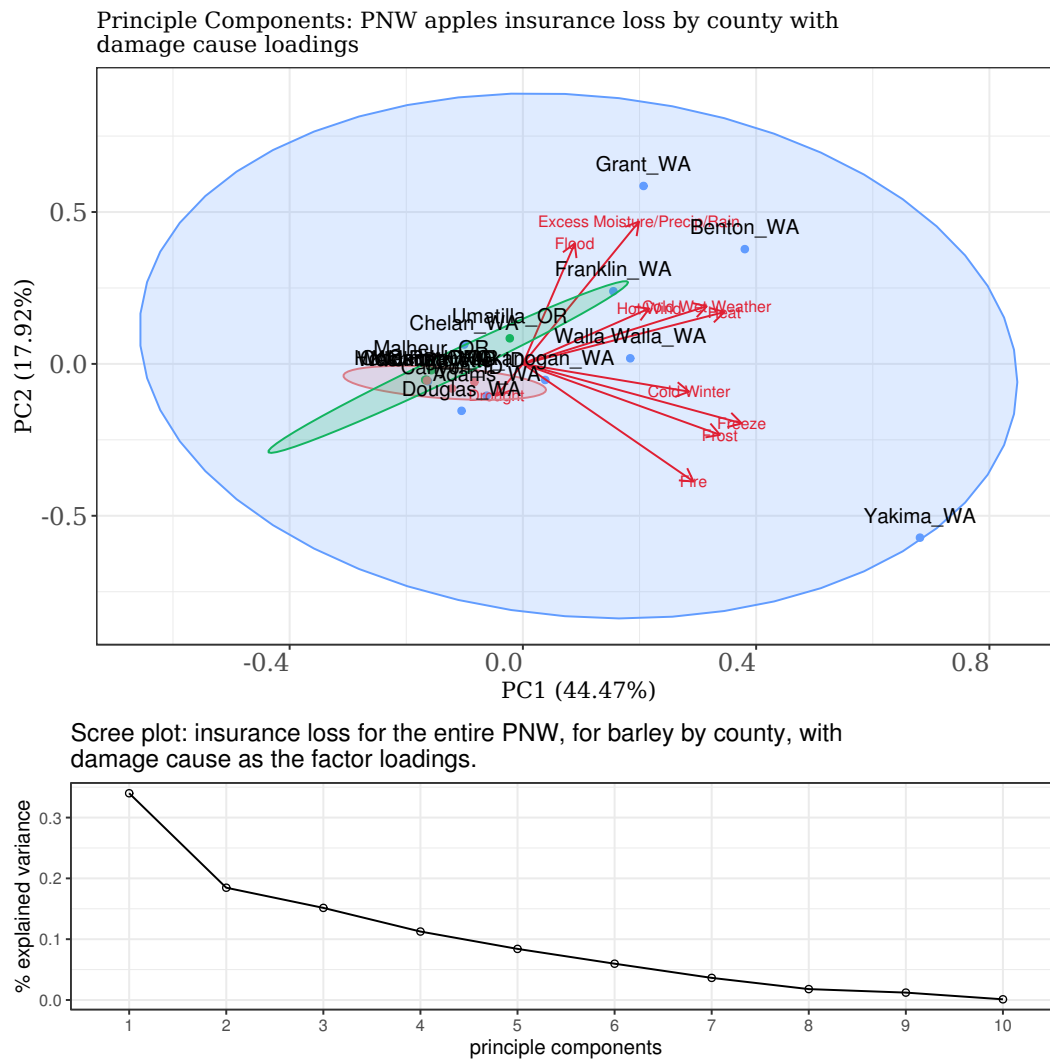


Figure 18: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is used.

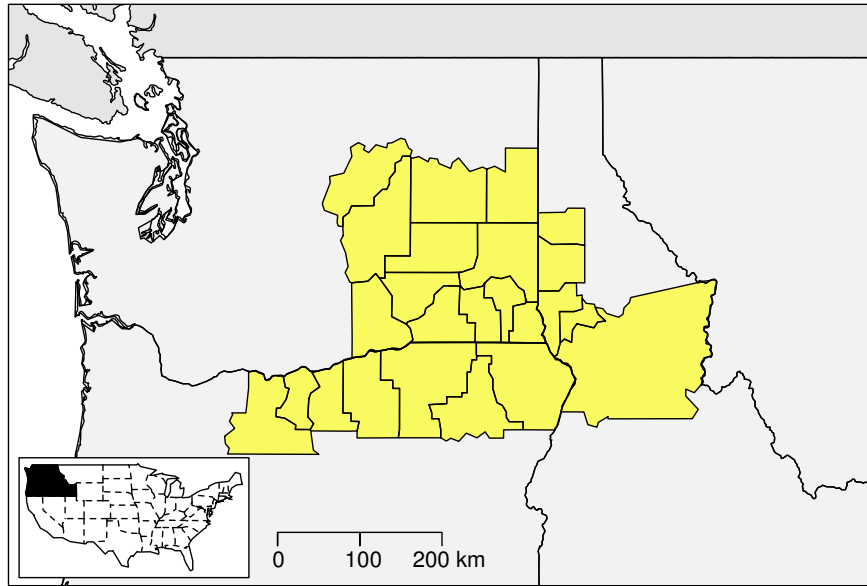


Figure 19: 24 county inland Pacific Northwest (iPNW) study area.

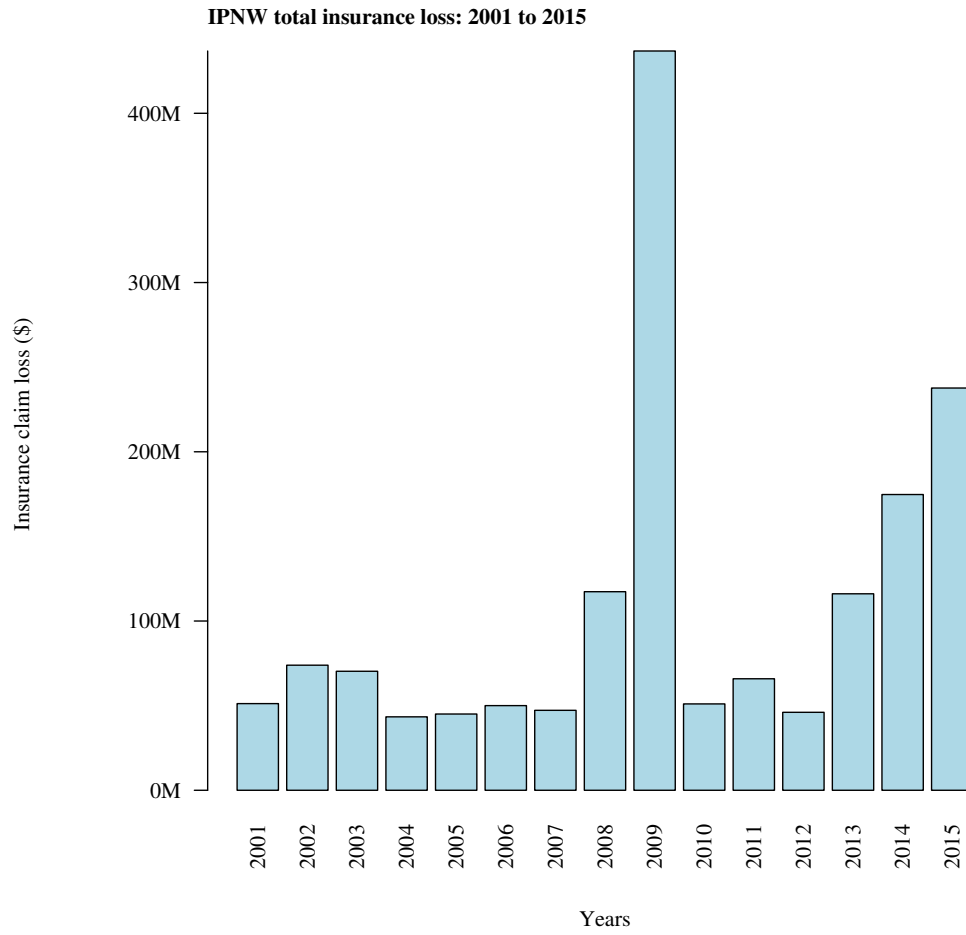


Figure 20: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.



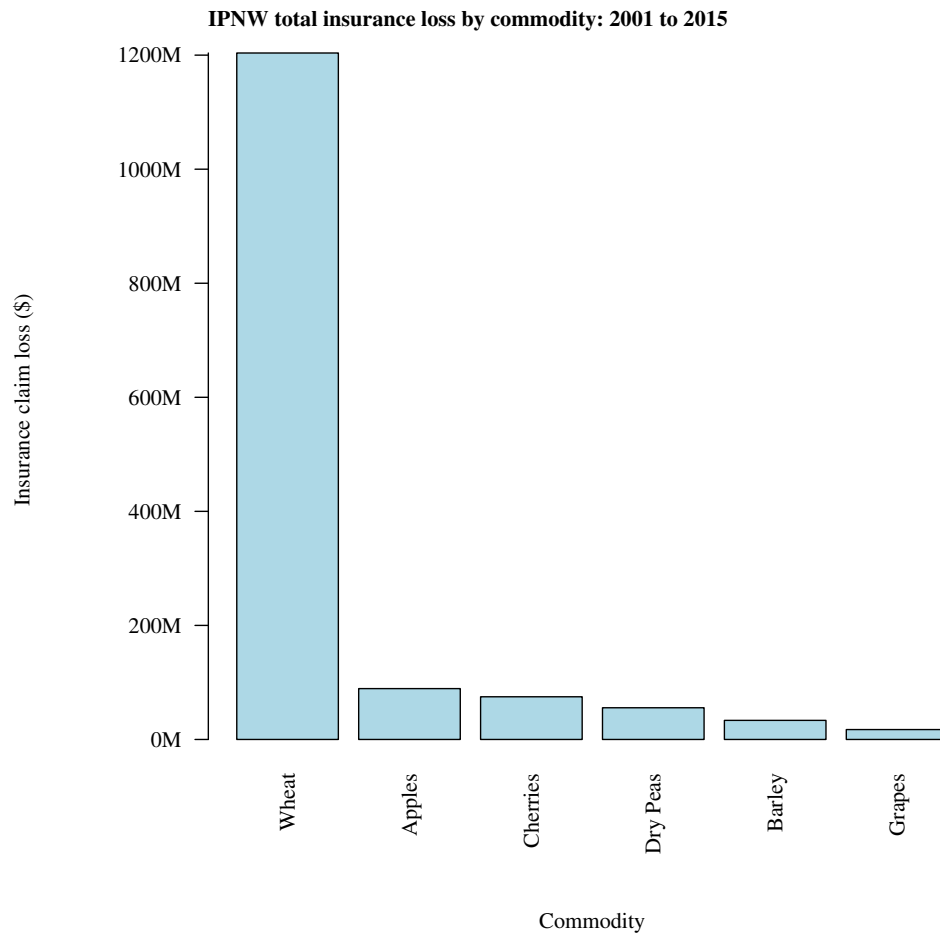


Figure 21: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

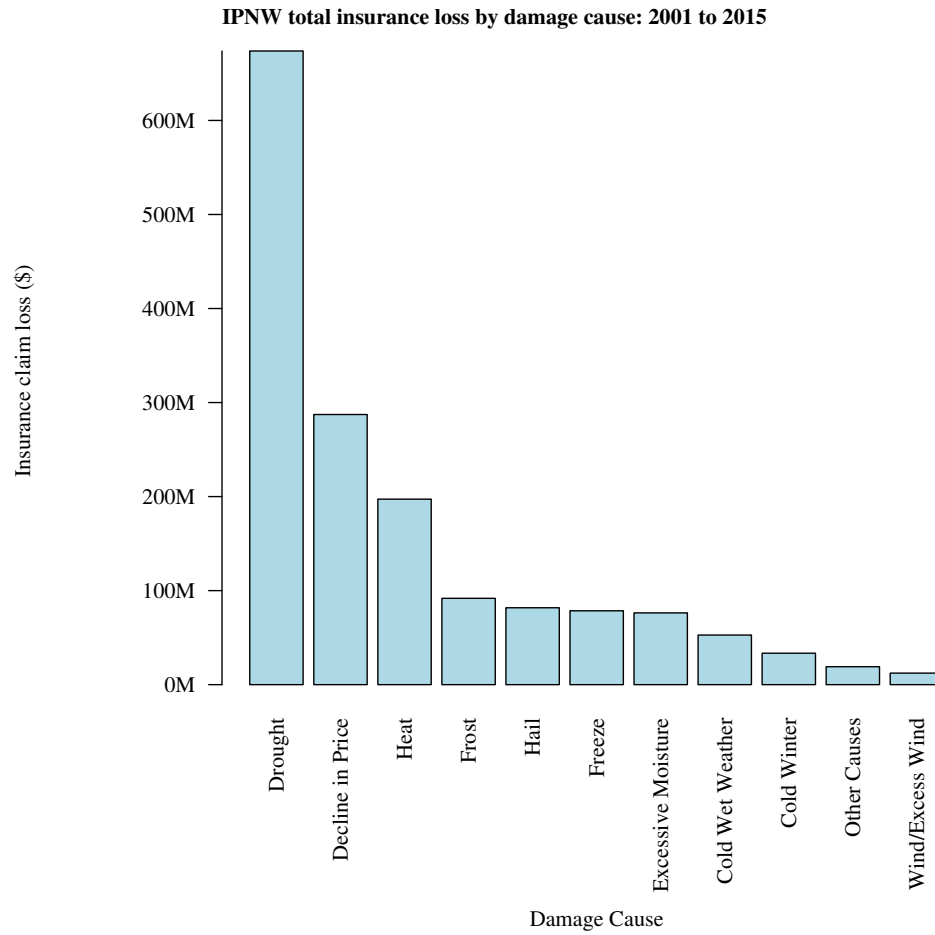


Figure 22: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

IPNW insurance claims by commodity: 2001 to 2015

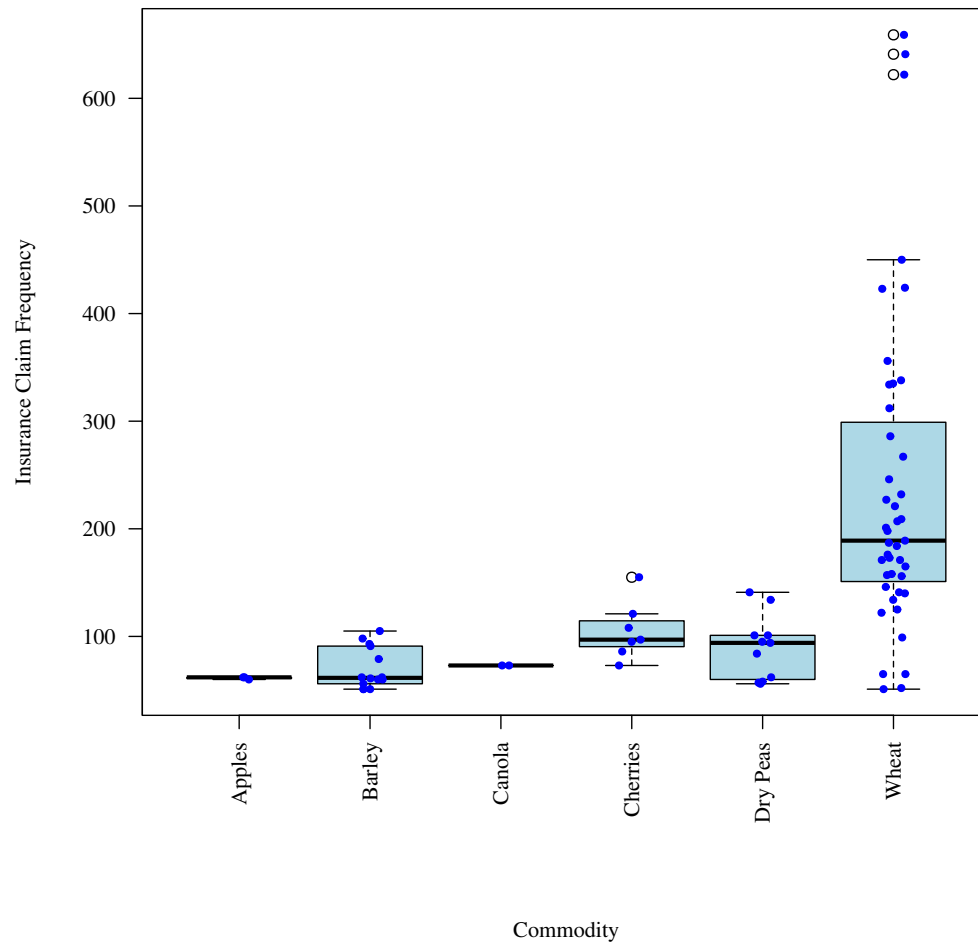


Figure 23: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

IPNW insurance claims by damage cause: 2001 to 2015

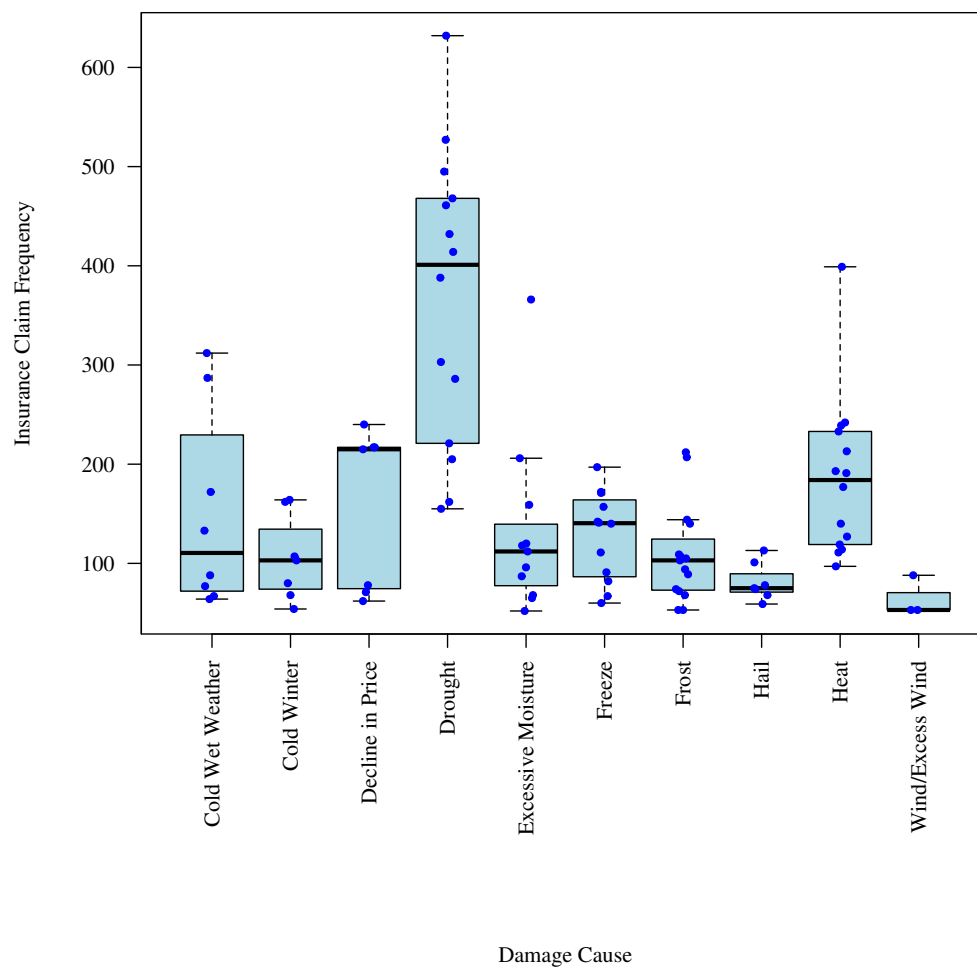


Figure 24: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

IPNW insurance loss by commodity: 2001 to 2015

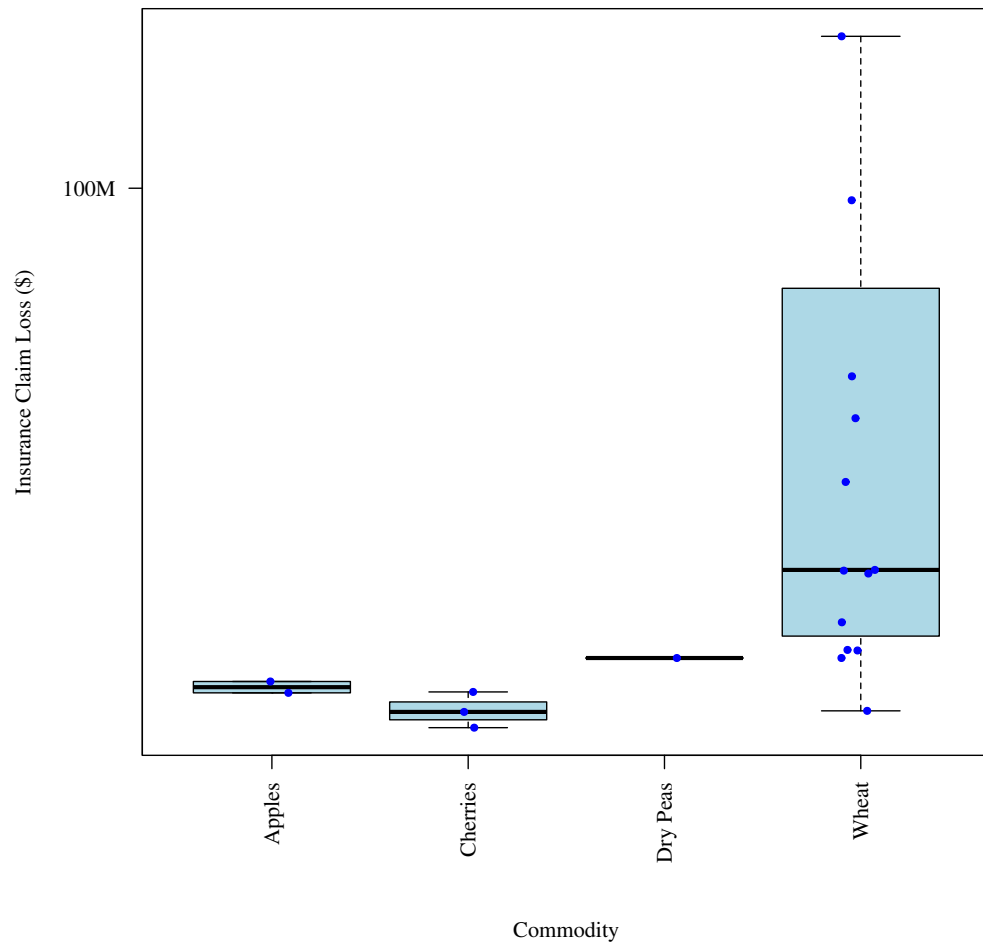


Figure 25: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

IPNW insurance loss by damage cause: 2001 to 2015

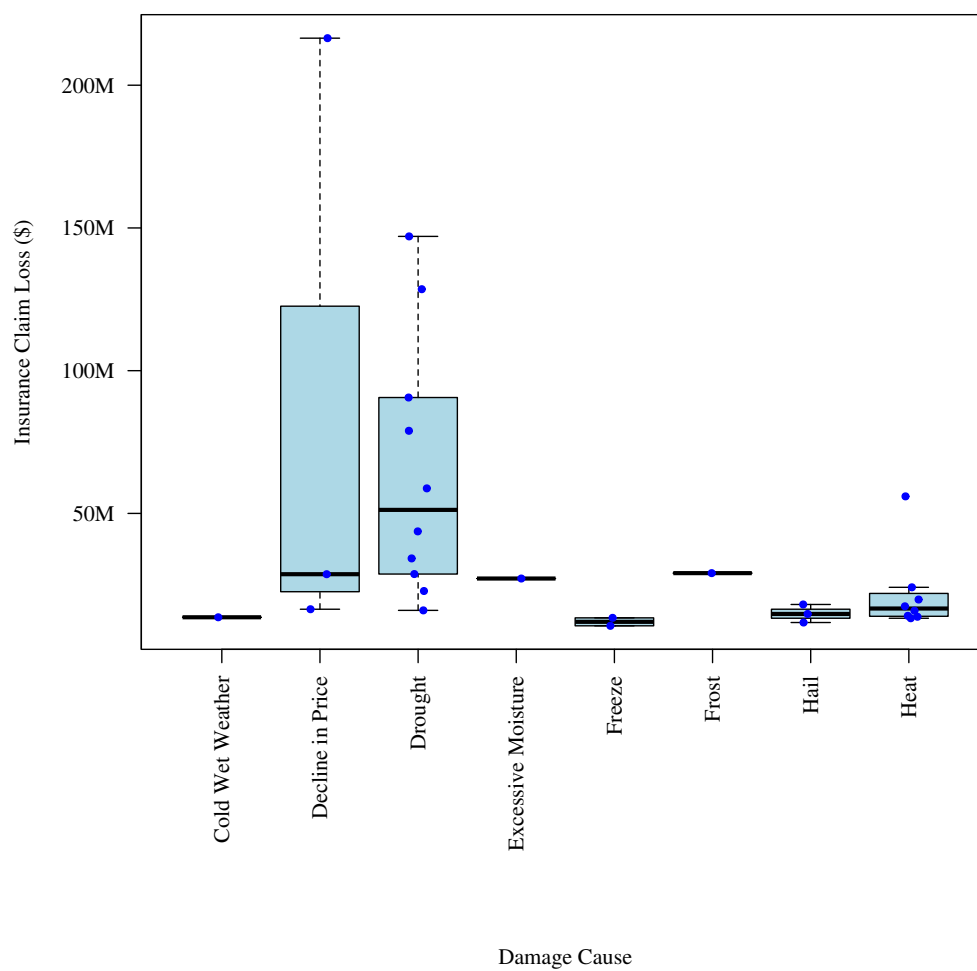


Figure 26: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

IPNW insurance loss per acre by commodity: 2001 to 2015

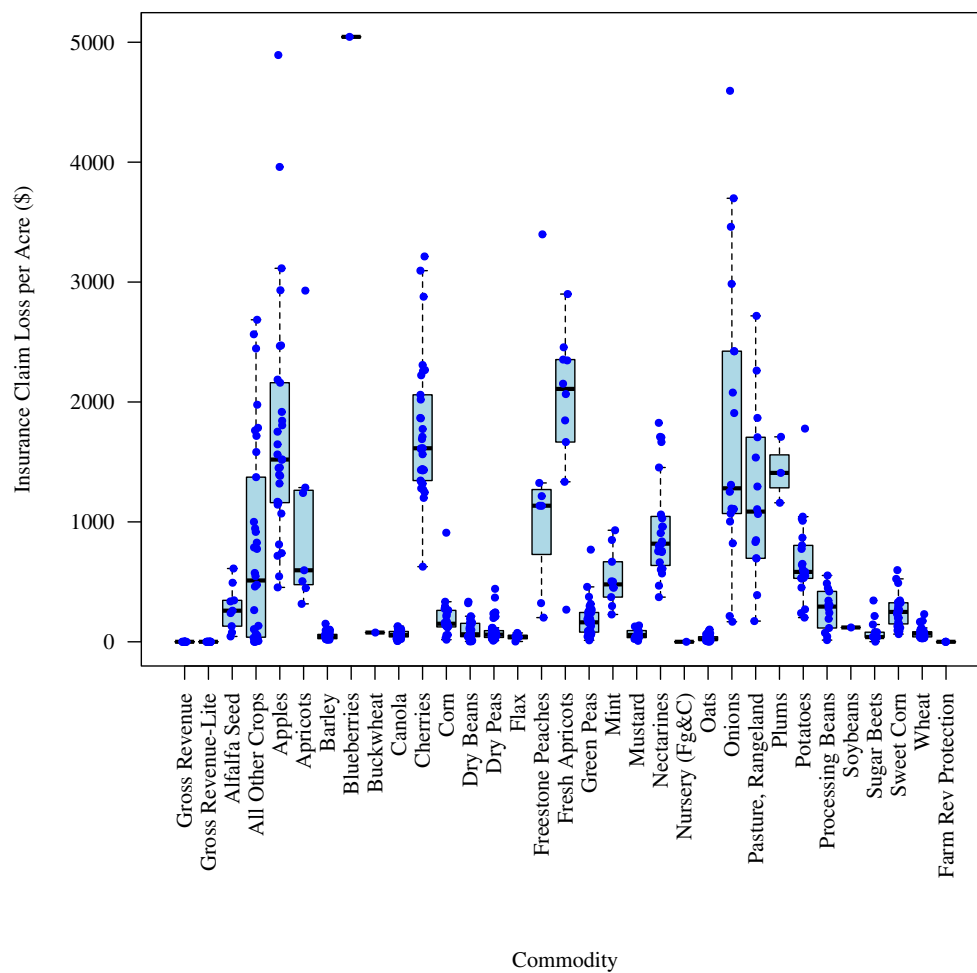


Figure 27: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.

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

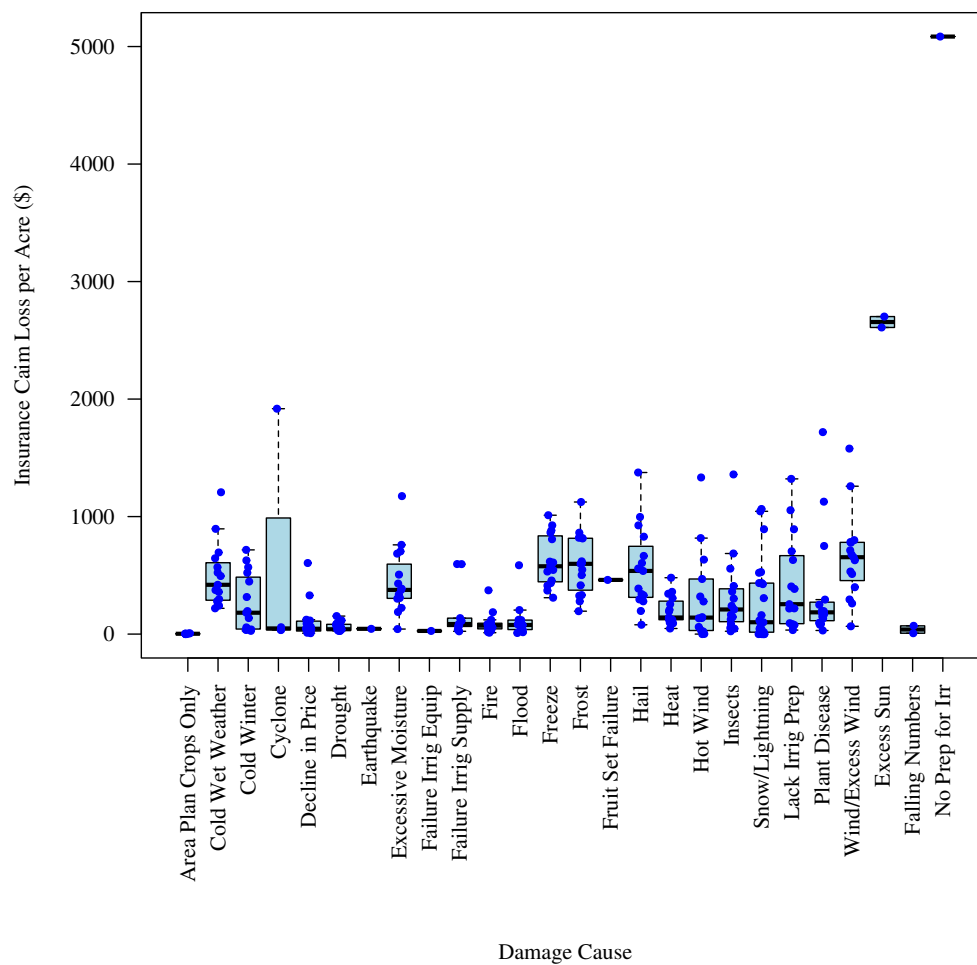


Figure 28: Top panel: biplot of insurance loss for the entire PNW, for barley by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.



PCA plot showing the first two principal components (PC1 and PC2) of 100 vineyard locations. The x-axis is PC1 (29.26%) and the y-axis is PC2 (11.4%). Locations are colored by county: Yakima (blue), Benton (red), Franklin (green), Okanogan (purple), Chelan (orange), Lincoln (pink), Grant (light blue), Adams (dark red), Bingham (brown), and Umatilla (dark green). Vectors represent environmental variables. Three overlapping ellipses (blue, green, red) group the locations.

A line graph showing the percentage of explained variance for 30 principal components. The x-axis is labeled 'principle components' and ranges from 1 to 30. The y-axis is labeled '% explained variance' and ranges from 0.0 to 0.3. The curve starts at approximately 0.29 for component 1, drops sharply to about 0.11 for component 2, and then continues to decrease more gradually, reaching approximately 0.00 for component 30.

principle components	% explained variance
1	0.29
2	0.11
3	0.08
4	0.07
5	0.07
6	0.06
7	0.05
8	0.04
9	0.04
10	0.04
11	0.04
12	0.03
13	0.02
14	0.02
15	0.02
16	0.01
17	0.01
18	0.01
19	0.01
20	0.01
21	0.01
22	0.01
23	0.01
24	0.01
25	0.01
26	0.01
27	0.01
28	0.01
29	0.01
30	0.01

33

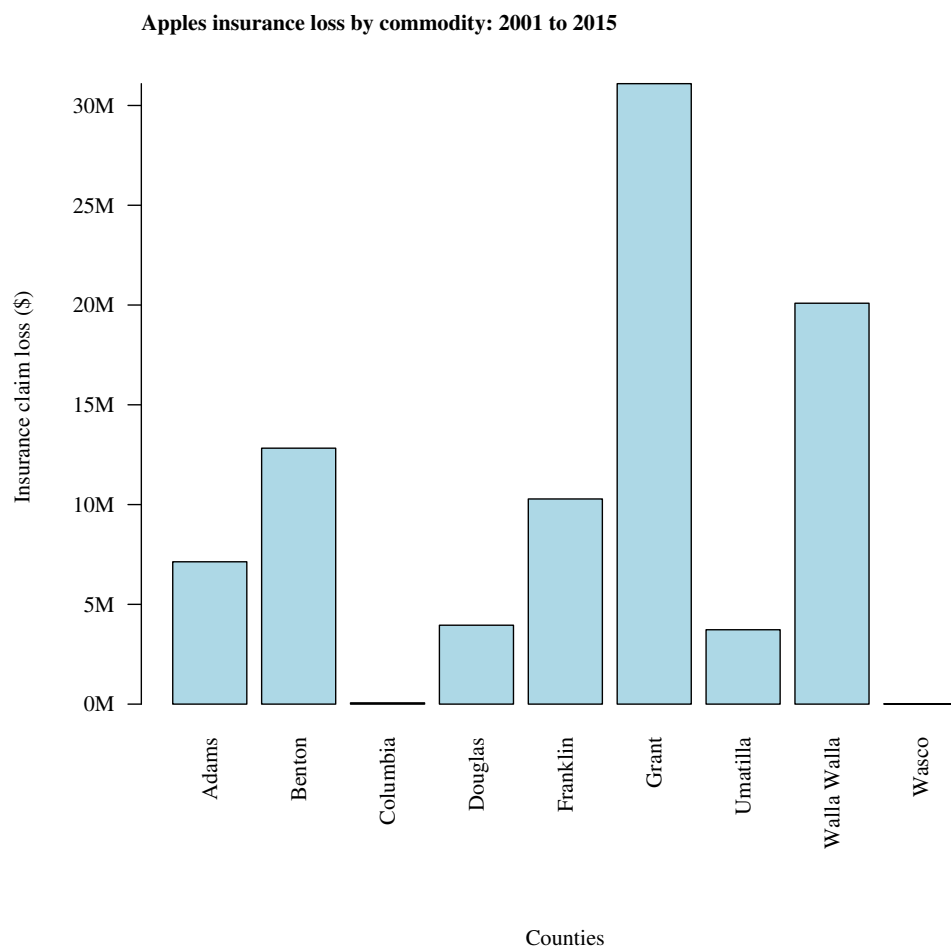


Figure 30: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

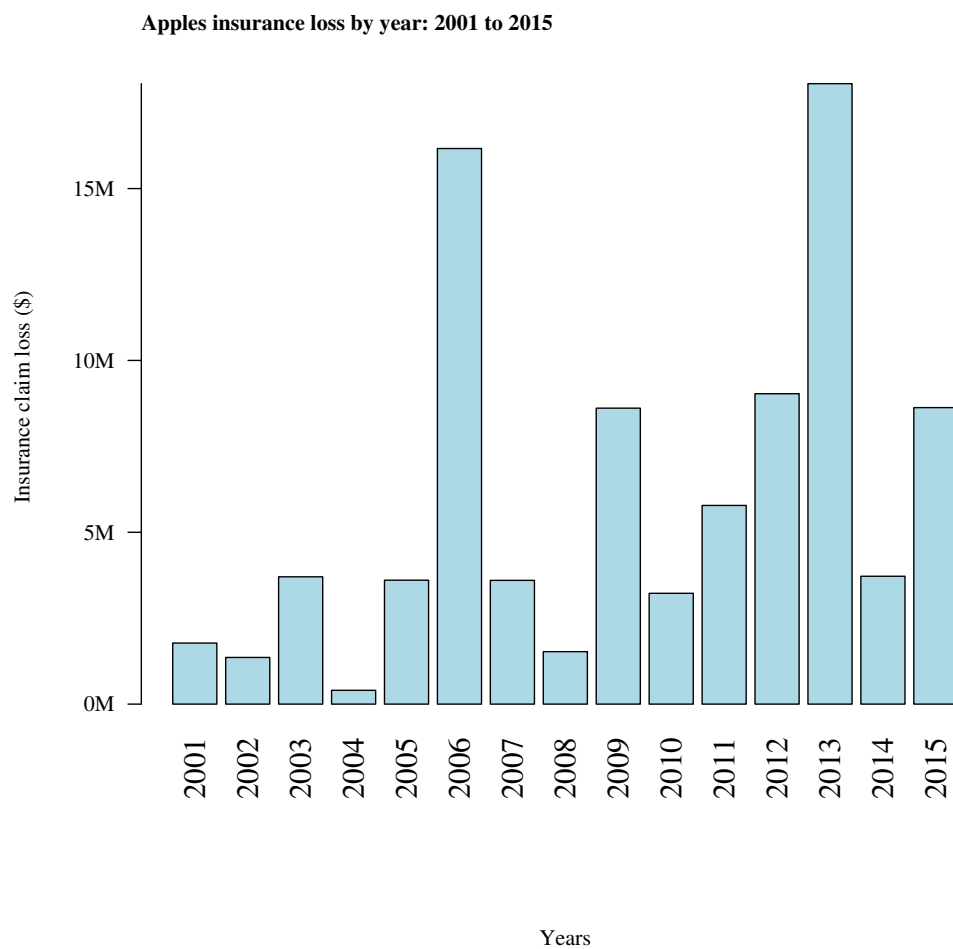


Figure 31: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

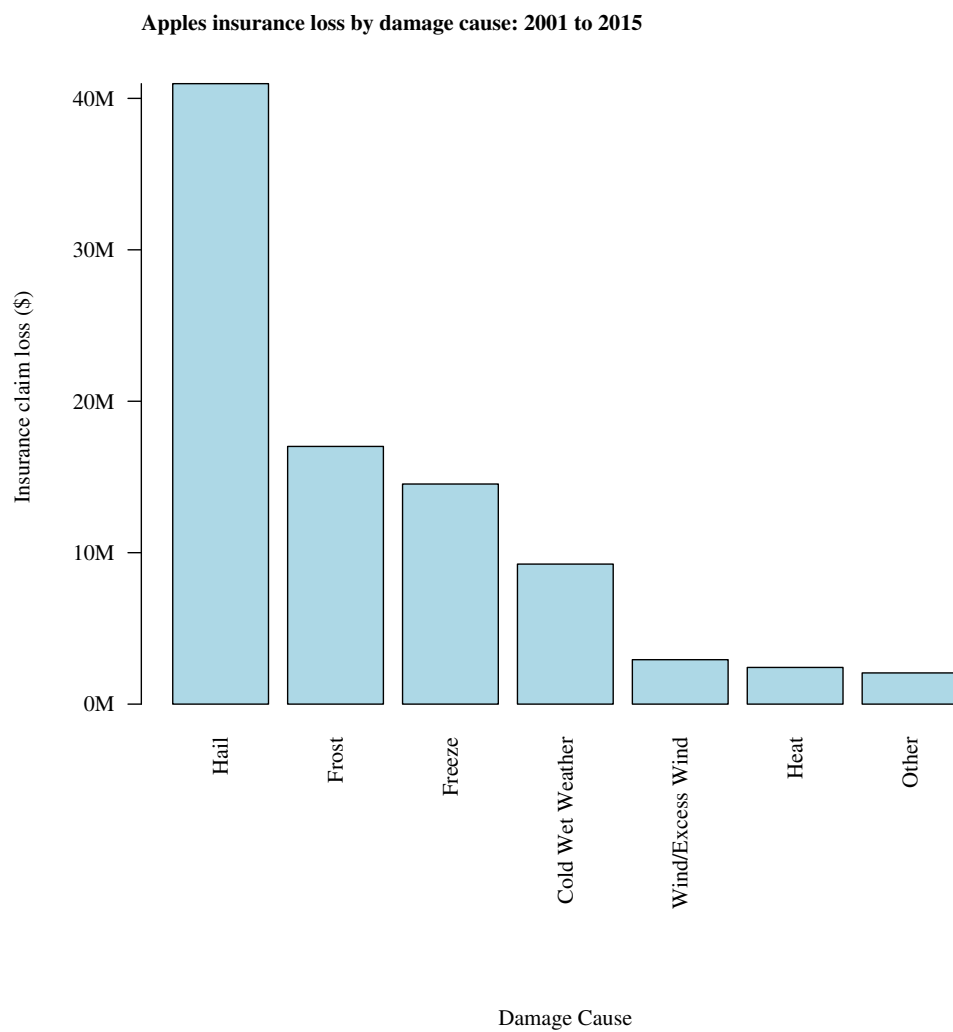


Figure 32: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

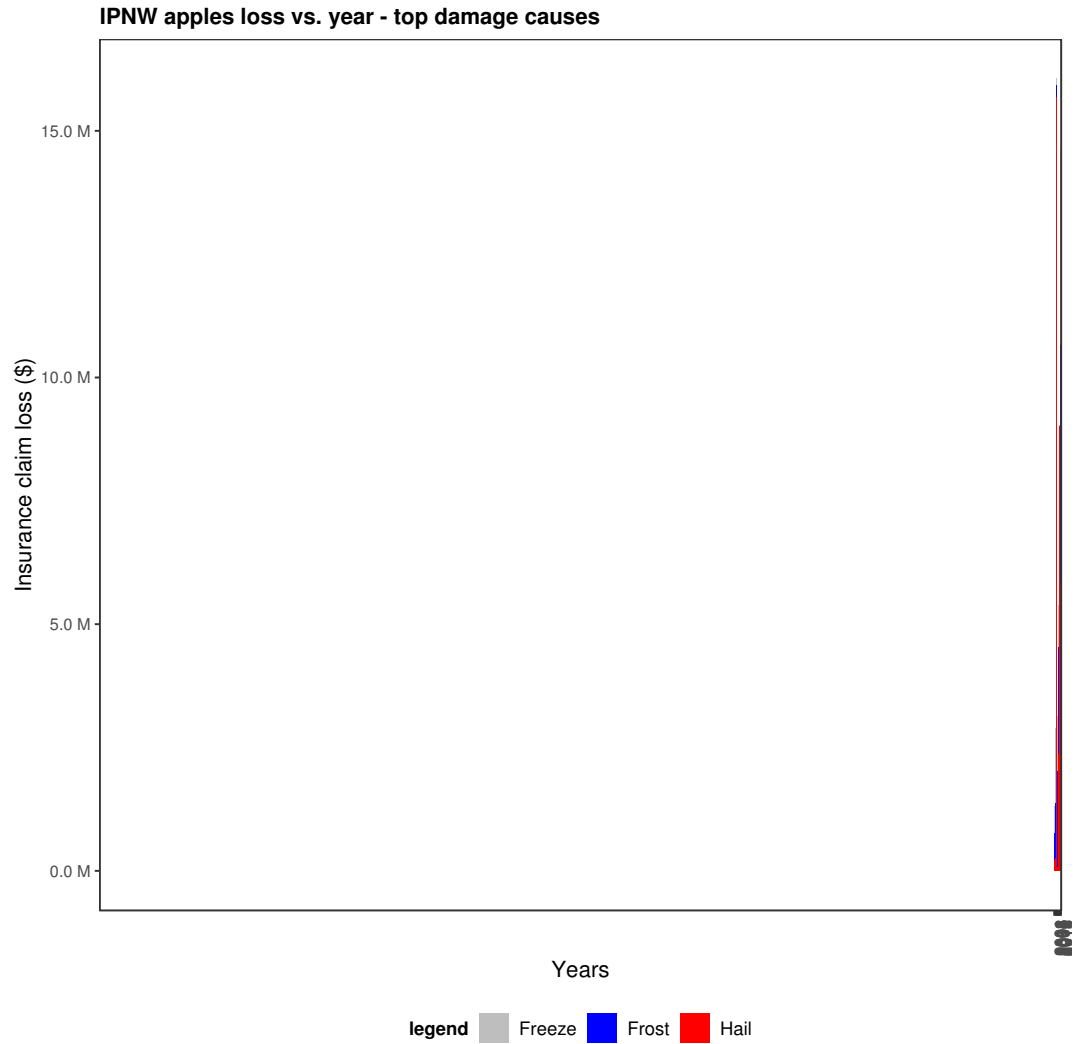


Figure 33: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

**Logrithmic transform: IPNW apples insurance loss by year**

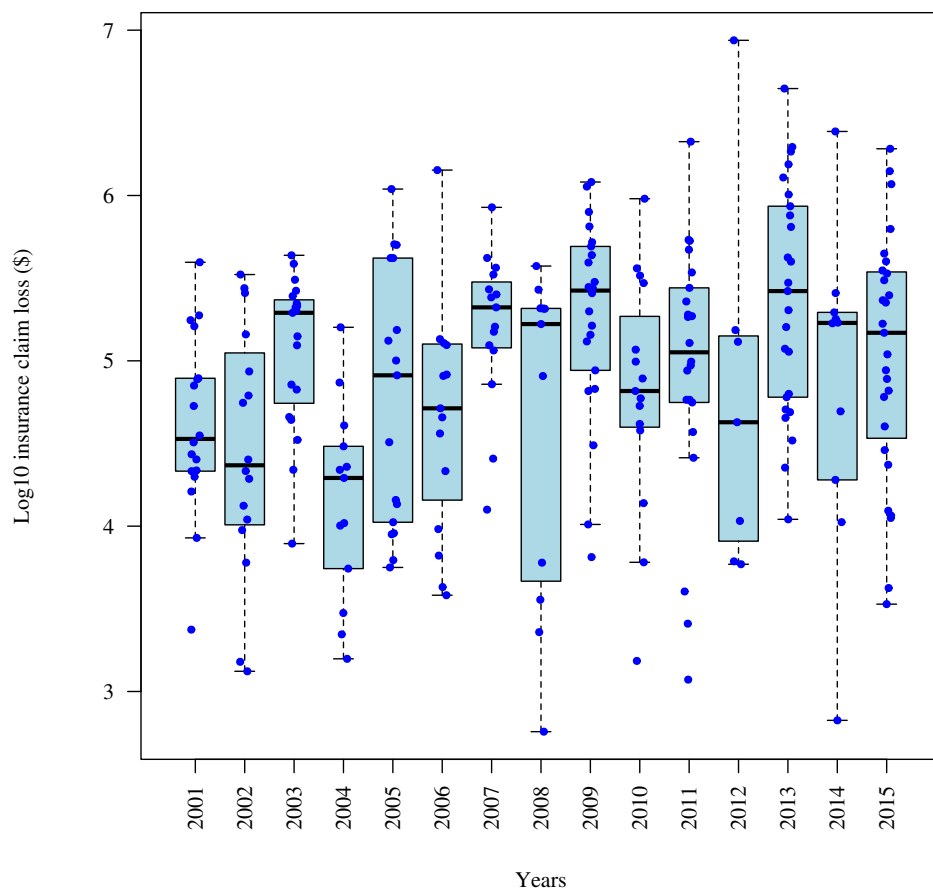


Figure 34: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

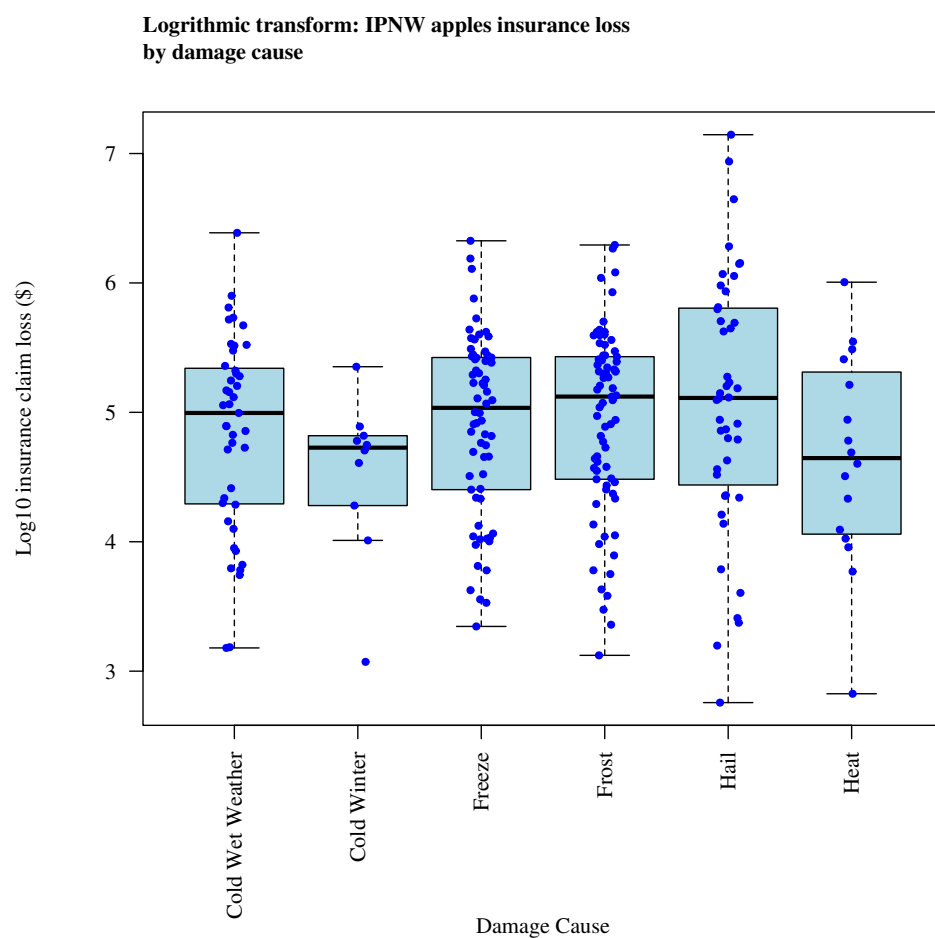


Figure 35: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

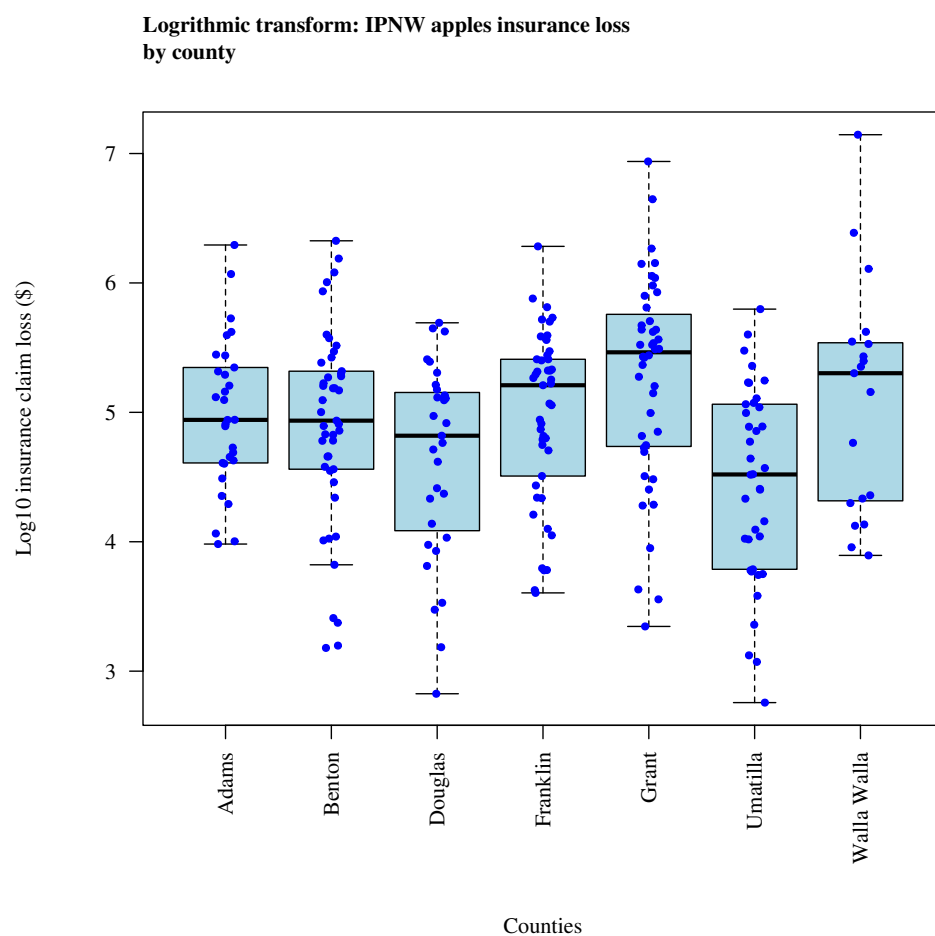


Figure 36: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used



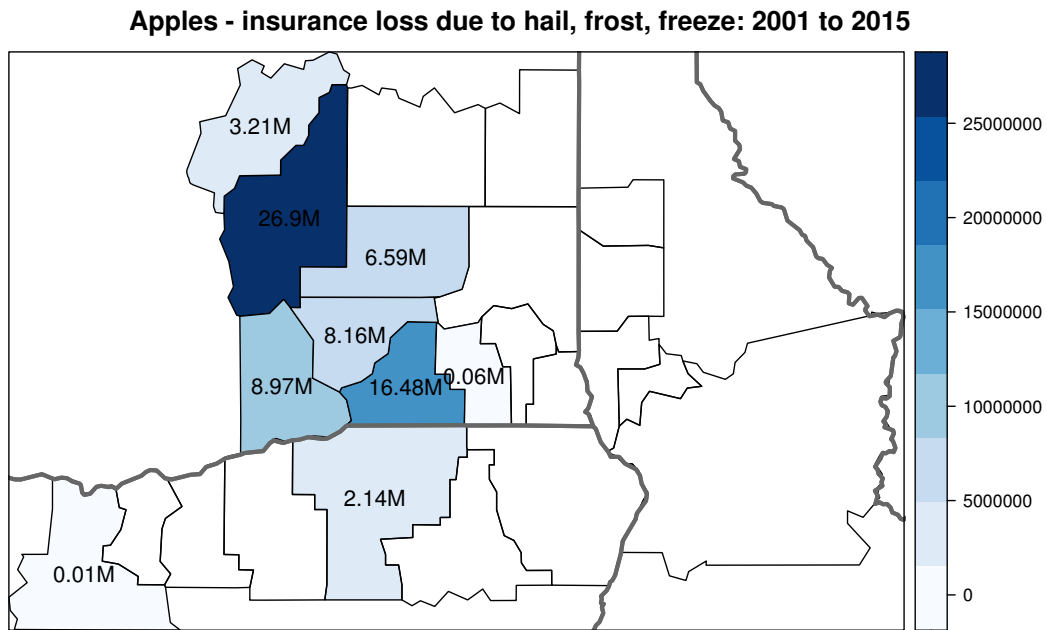


Figure 37: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

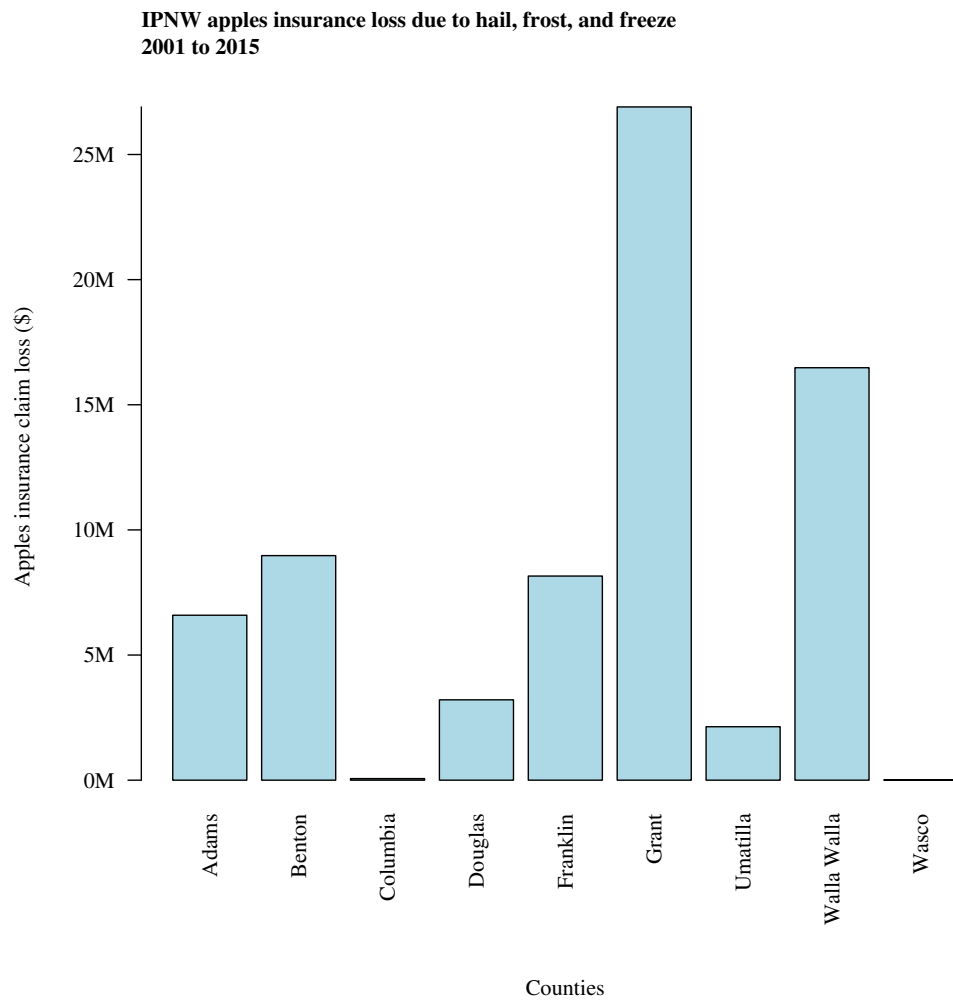


Figure 38: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is usedxx

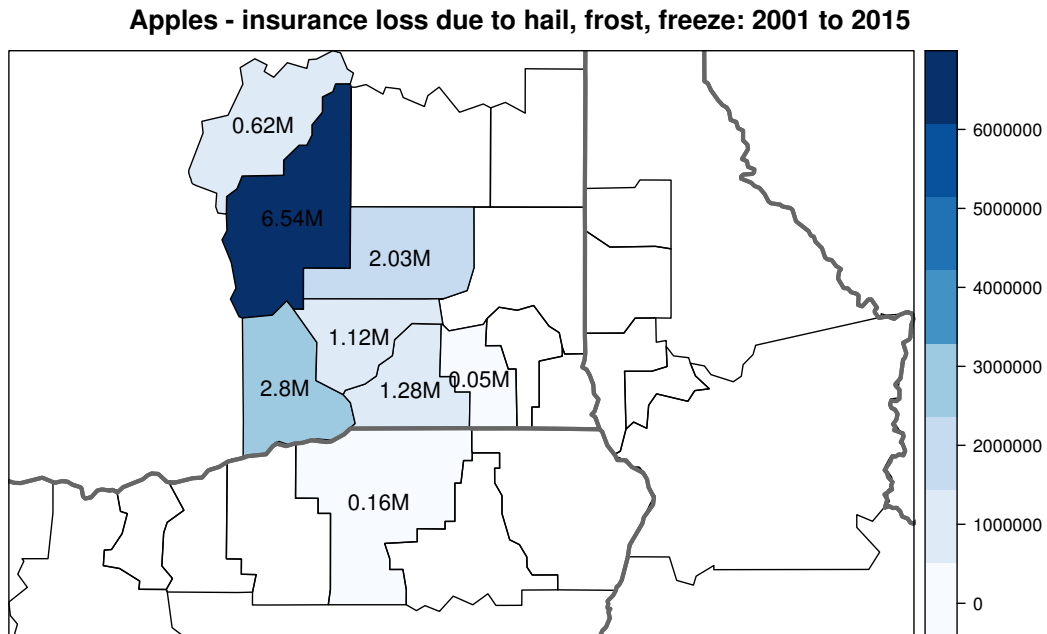


Figure 39: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

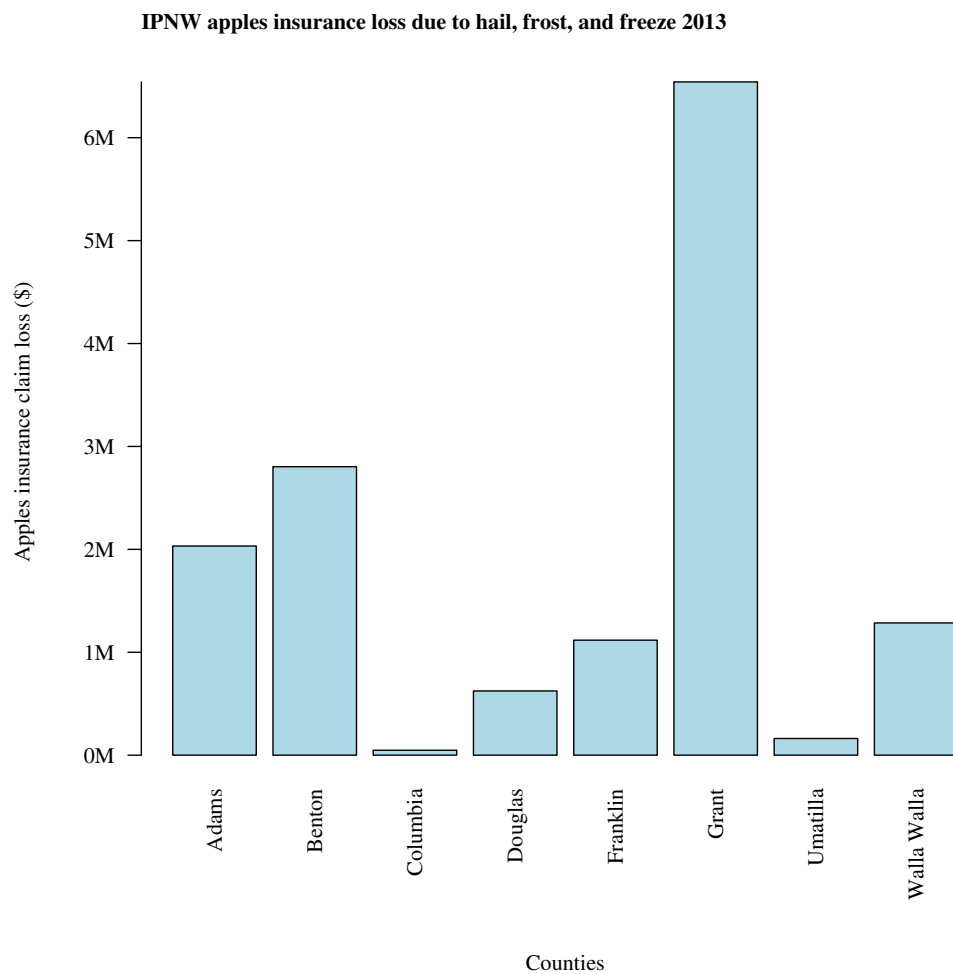


Figure 40: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

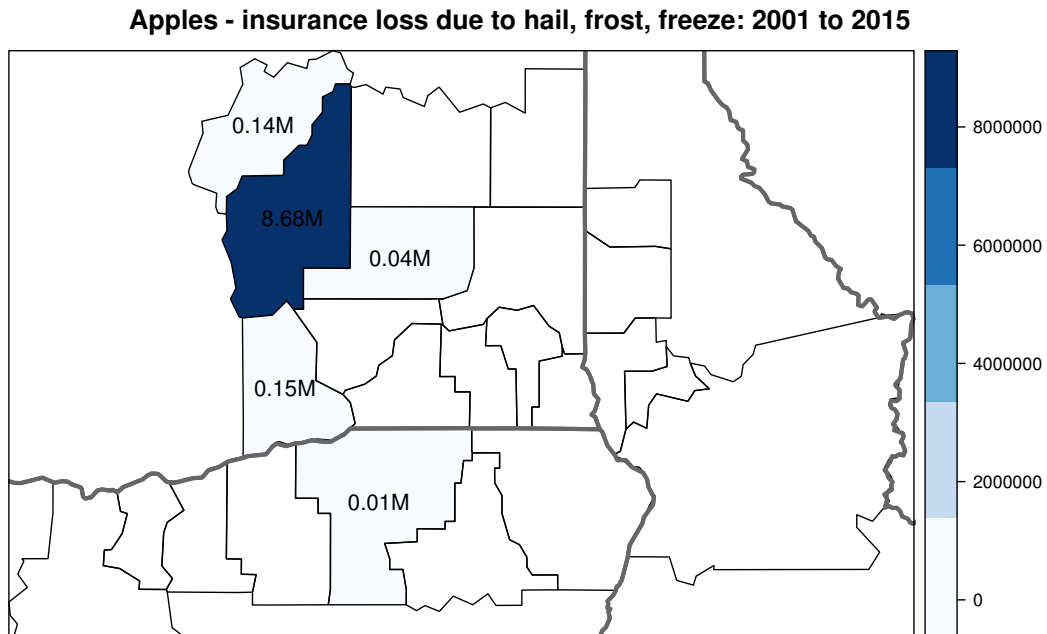


Figure 41: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

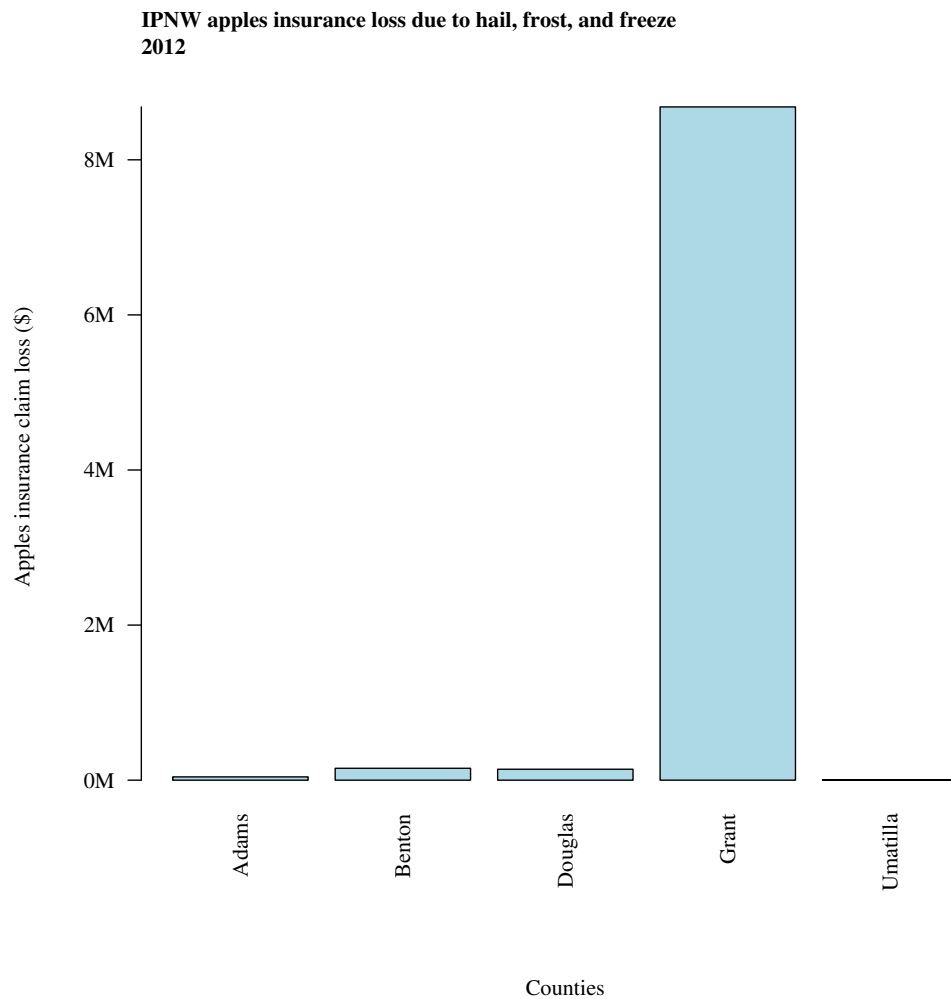


Figure 42: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

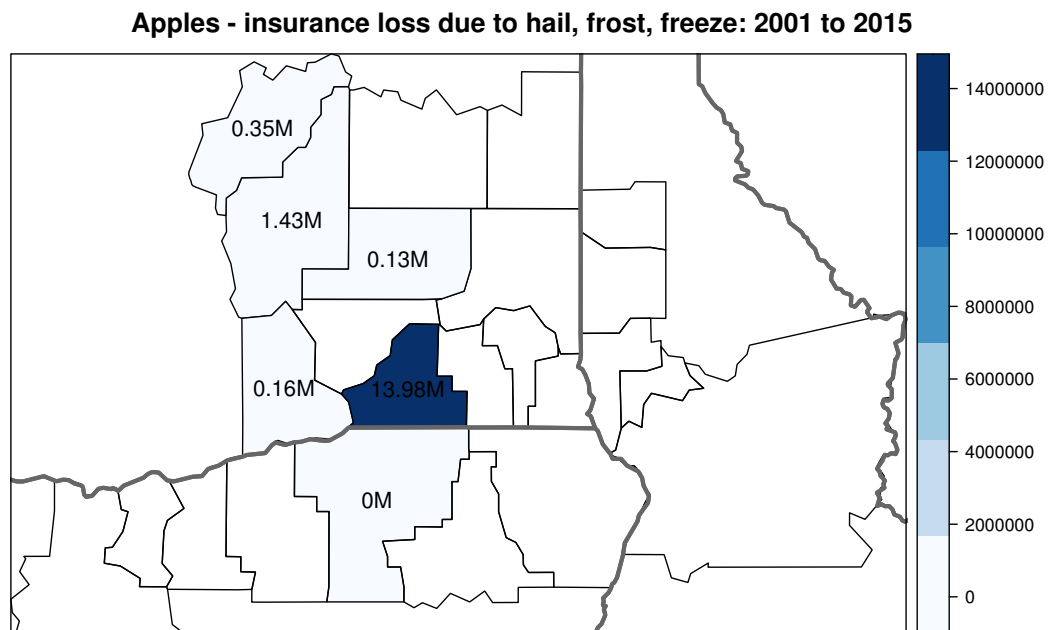


Figure 43: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

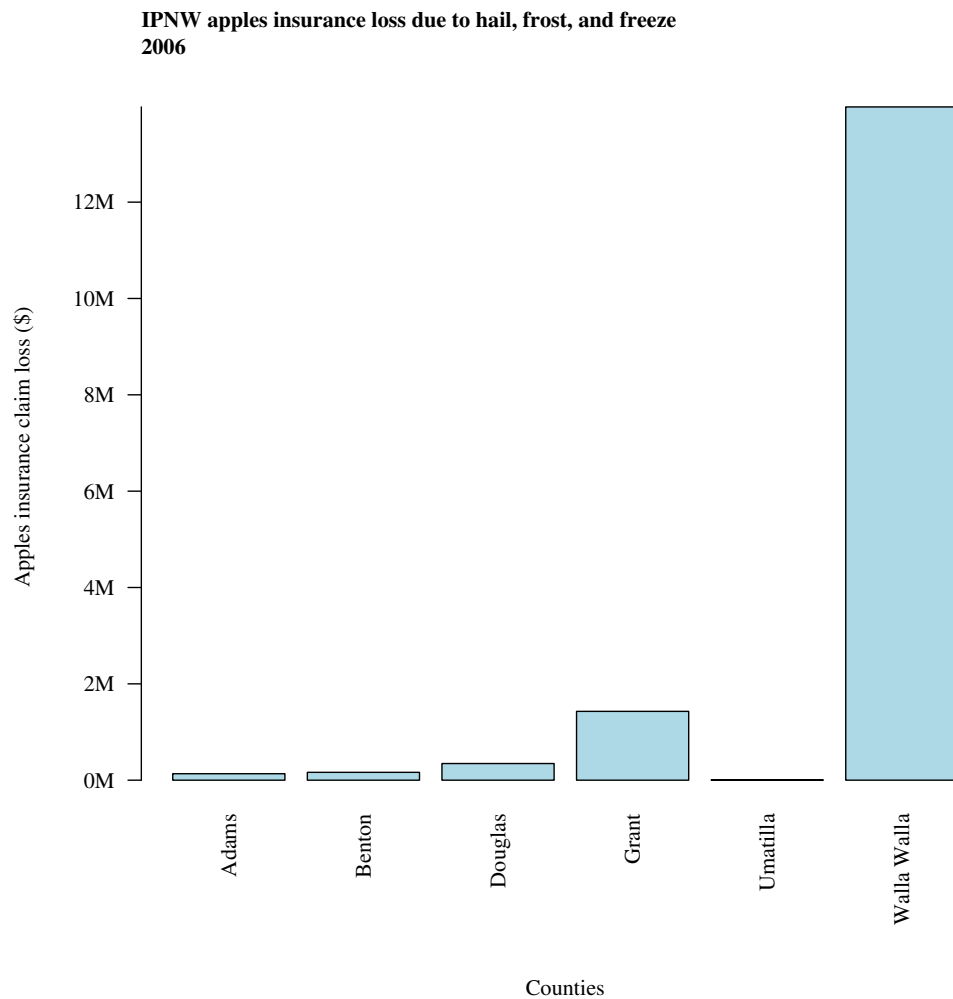


Figure 44: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used



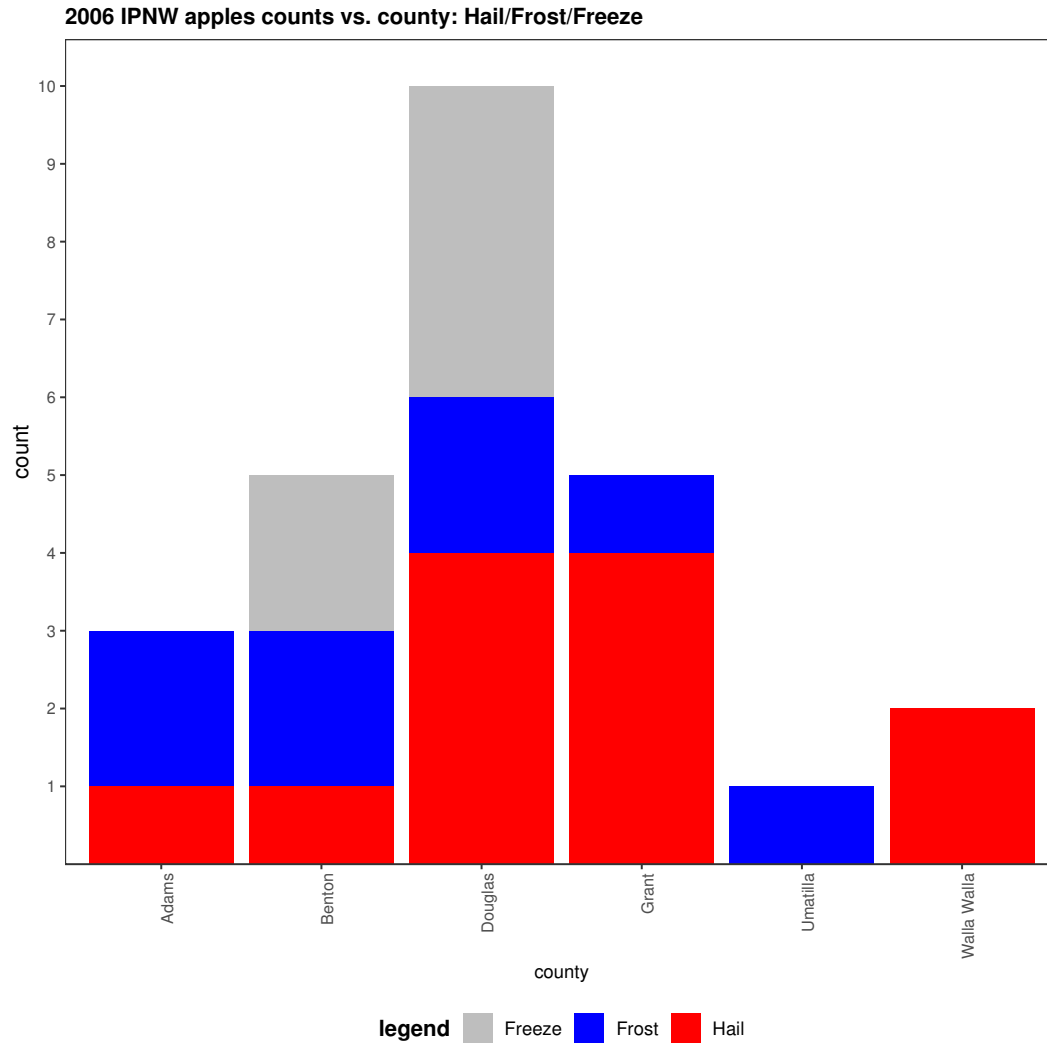


Figure 45: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

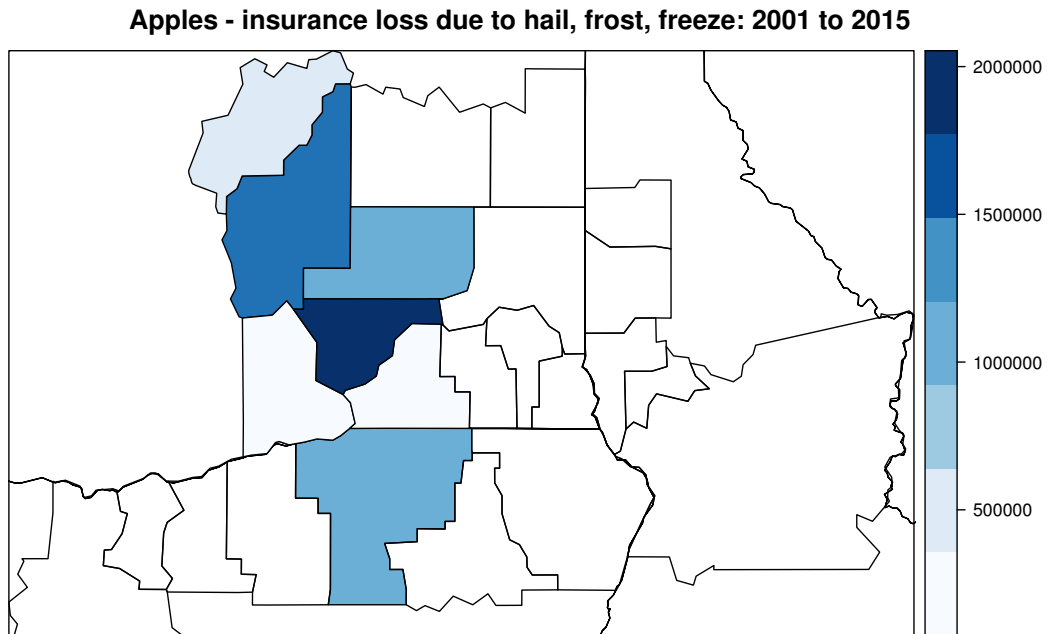


Figure 46: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used

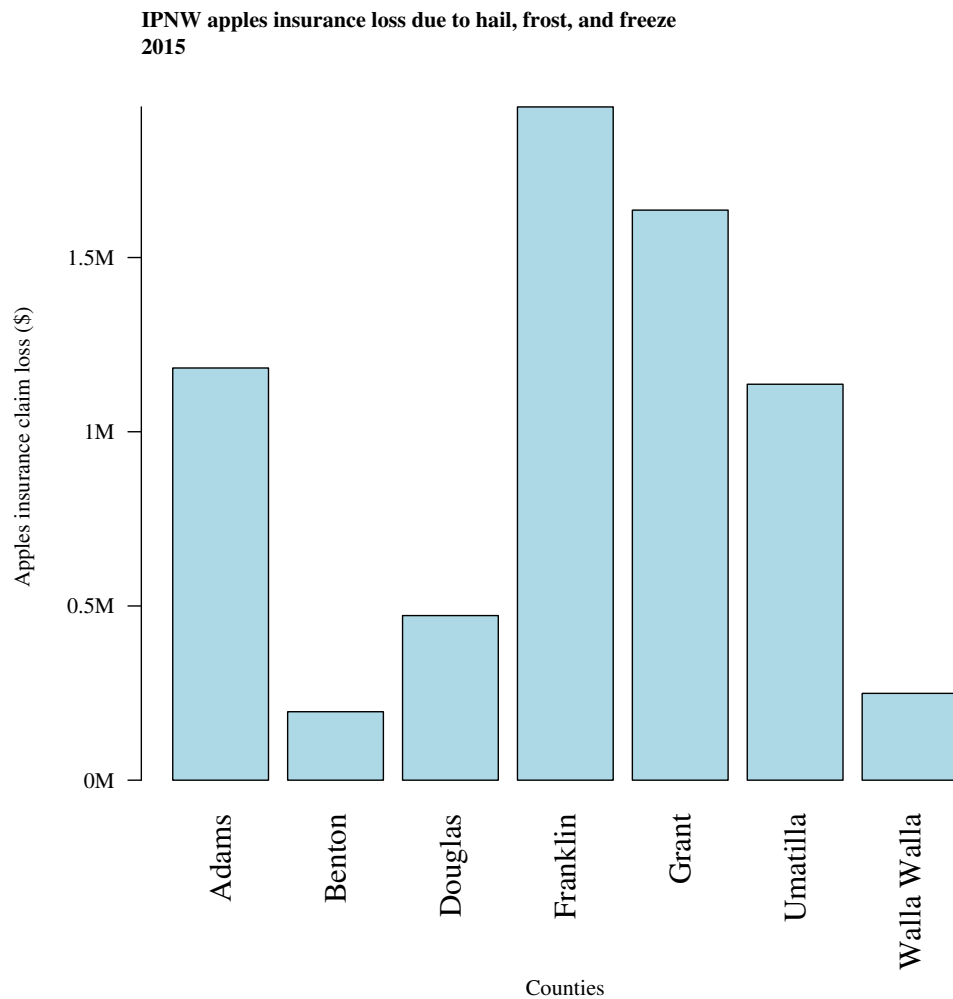
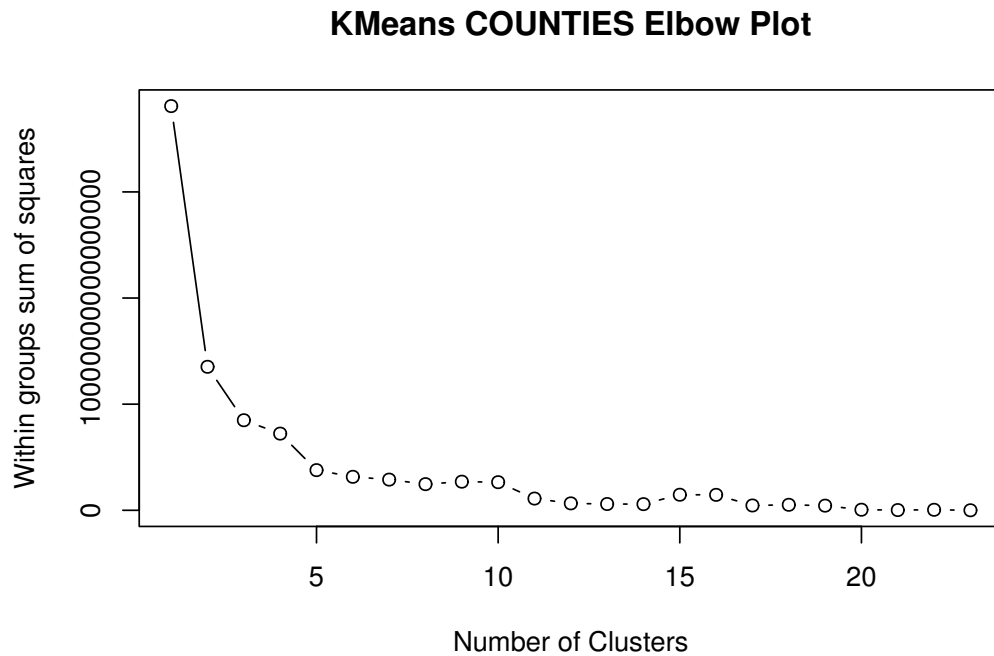


Figure 47: Top panel: biplot of insurance loss for the inland PNW, for all commodities by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 is 2015 is used

**Step 3c. PCA + KMEANS: WHEAT IPNW insurance loss, by COUNTY with DAMAGE CAUSE loadings: 2001 to 2015**

Here we perform a PCA for the insurance loss for the inland PNW, for wheat by county, with damage cause as the factor loadings. Data from 2001 to 2015 is used. We additionally have generated a scree plot that shows the proportion of variance explained by the individual components.



```

## *** : The Hubert index is a graphical method of determining the number of clusters.
##           In the plot of Hubert index, we seek a significant knee that corresponds to a
##           significant increase of the value of the measure i.e the significant peak in Hubert
##           index second differences plot.
##

## *** : The D index is a graphical method of determining the number of clusters.
##           In the plot of D index, we seek a significant knee (the significant peak in Dindex
##           second differences plot) that corresponds to a significant increase of the value of
##           the measure.
##

## *****
## * Among all indices:
## * 6 proposed 2 as the best number of clusters
## * 4 proposed 3 as the best number of clusters
## * 2 proposed 4 as the best number of clusters
## * 2 proposed 6 as the best number of clusters
## * 1 proposed 7 as the best number of clusters
## * 2 proposed 8 as the best number of clusters
## * 3 proposed 17 as the best number of clusters
## * 1 proposed 19 as the best number of clusters
## * 3 proposed 20 as the best number of clusters
##
##           ***** Conclusion *****
##
## * According to the majority rule, the best number of clusters is 2
##
## *****

```

```

## *** : The Hubert index is a graphical method of determining the number of clusters.
##           In the plot of Hubert index, we seek a significant knee that corresponds to a
##           significant increase of the value of the measure i.e the significant peak in Hubert
##           index second differences plot.
##

## *** : The D index is a graphical method of determining the number of clusters.
##           In the plot of D index, we seek a significant knee (the significant peak in Dindex
##           second differences plot) that corresponds to a significant increase of the value of
##           the measure.
##

## *****
## * Among all indices:
## * 6 proposed 2 as the best number of clusters
## * 4 proposed 3 as the best number of clusters
## * 2 proposed 4 as the best number of clusters
## * 2 proposed 6 as the best number of clusters
## * 1 proposed 7 as the best number of clusters
## * 2 proposed 8 as the best number of clusters
## * 3 proposed 17 as the best number of clusters
## * 1 proposed 19 as the best number of clusters
## * 3 proposed 20 as the best number of clusters
##
##           ***** Conclusion *****
##
## * According to the majority rule, the best number of clusters is  2
##
## *****

```

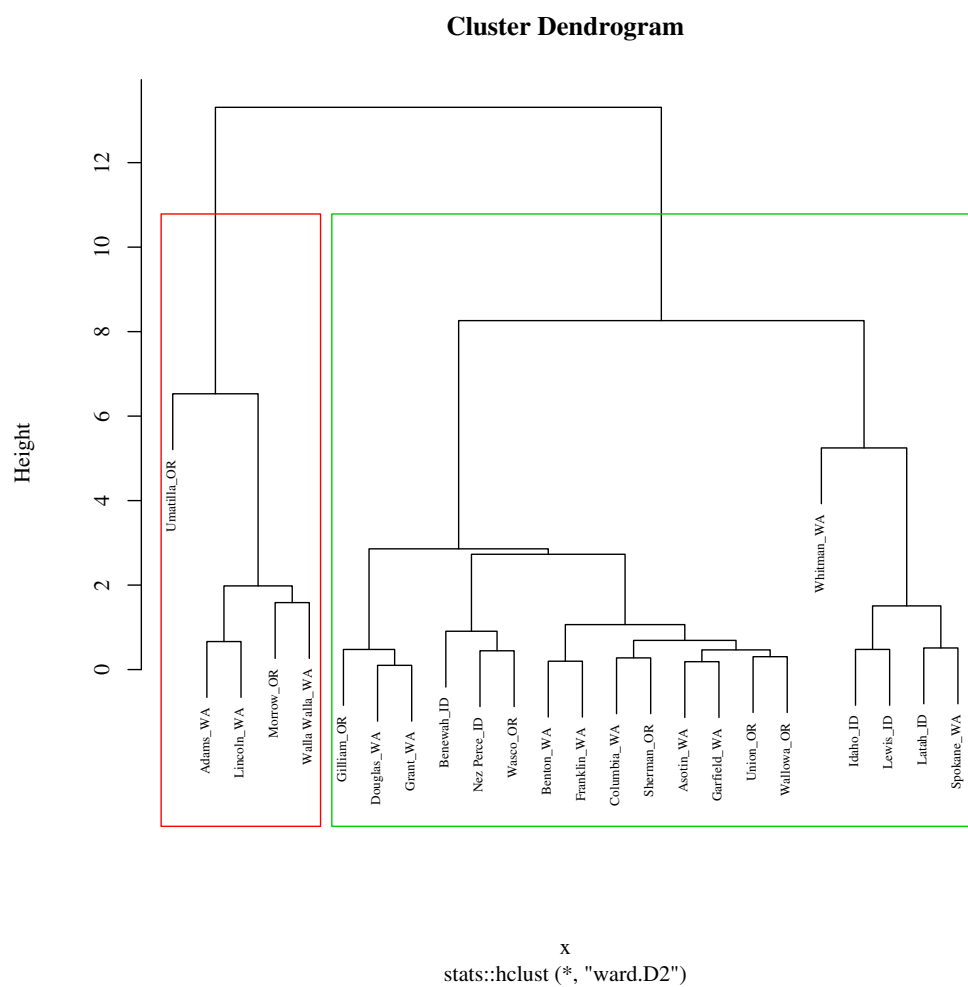


Figure 48: Hierarchical clustering dendrogram of iPNW counties, using principle components.

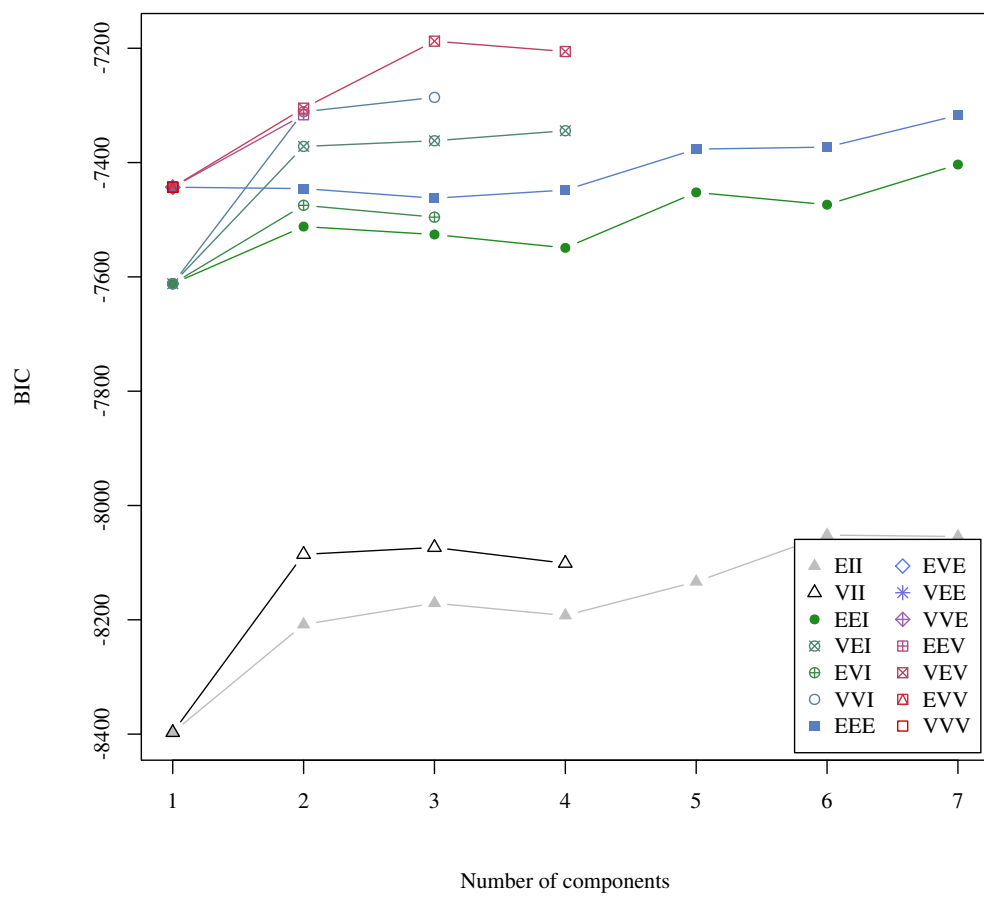


Figure 49: Hierarchical clustering dendrogram of iPNW counties, using principle components.



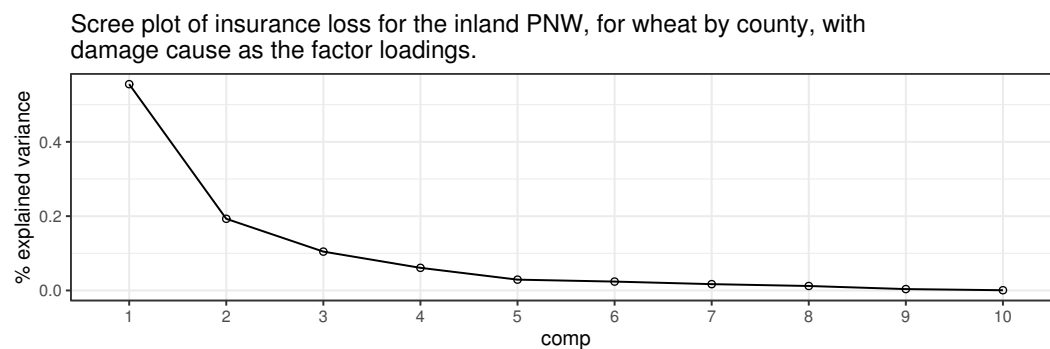
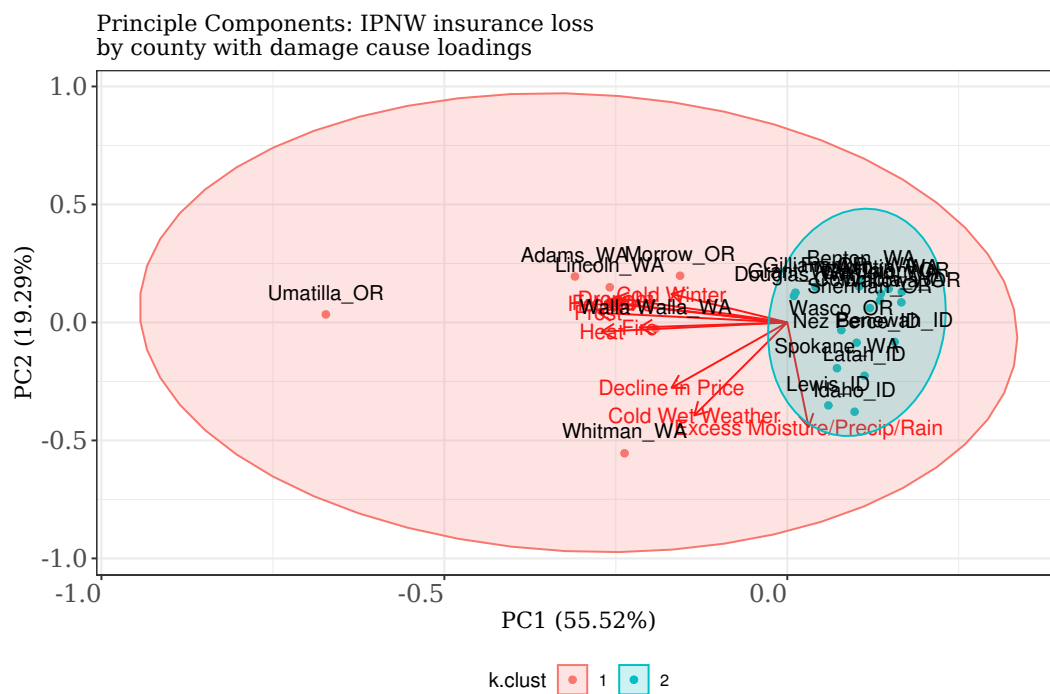


Figure 50: Top panel: biplot of insurance loss for the inland PNW, for wheat by county, with damage cause as the factor loadings. Bottom panel: Scree plot. Data from 2001 to 2015 is used.