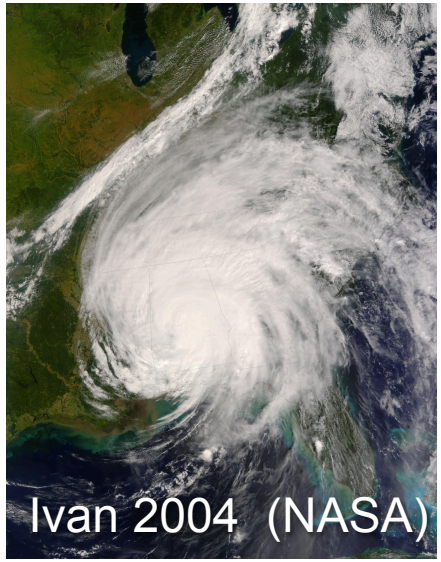
Assessing Tropical Cyclone Losses at Local Scales



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Take Home Messages

- Losses extend far inland beyond coastal counties and losses are spread across business lines.

- Wind duration, directional change and maximum speed are statistically significant drivers of local hurricane losses.

- It is likely that storm size explains a large portion of the loss:
  - size of the impacted area;
  - distributions wind speed, wind duration and wind directional change.

- Qualitative evidence that exposure factors may further improve loss estimation.

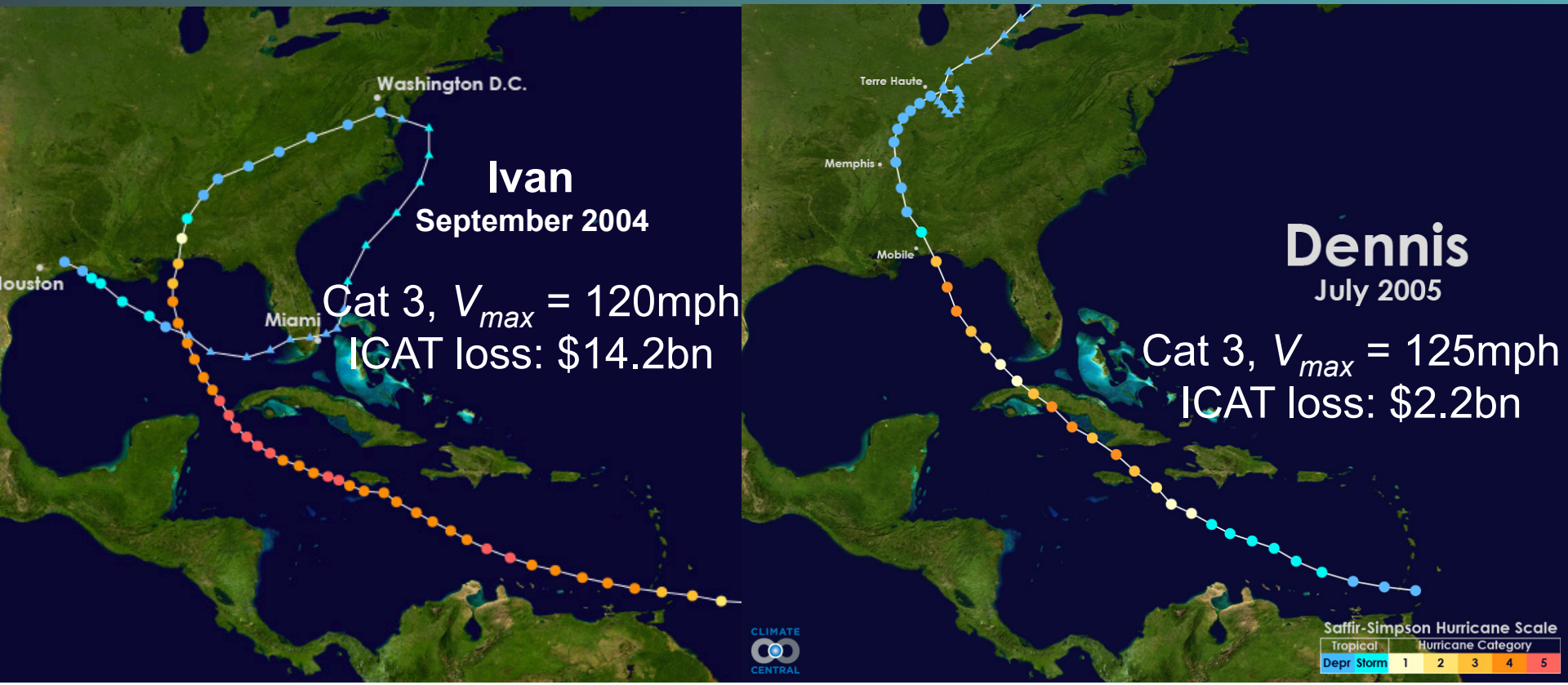
Introduction

- To effectively reduce Tropical Cyclone (TC) losses a better understanding of the local drivers of loss is needed.

- Most studies assess TC loss at an aggregate level over many storms where normalized losses are assumed to be confined to coastal counties, and maximum wind speed is found to explain the greatest loss variance.

- What is the relative importance of maximum wind speed compared to other potential loss drivers at local scales?

Ivan vs. Dennis



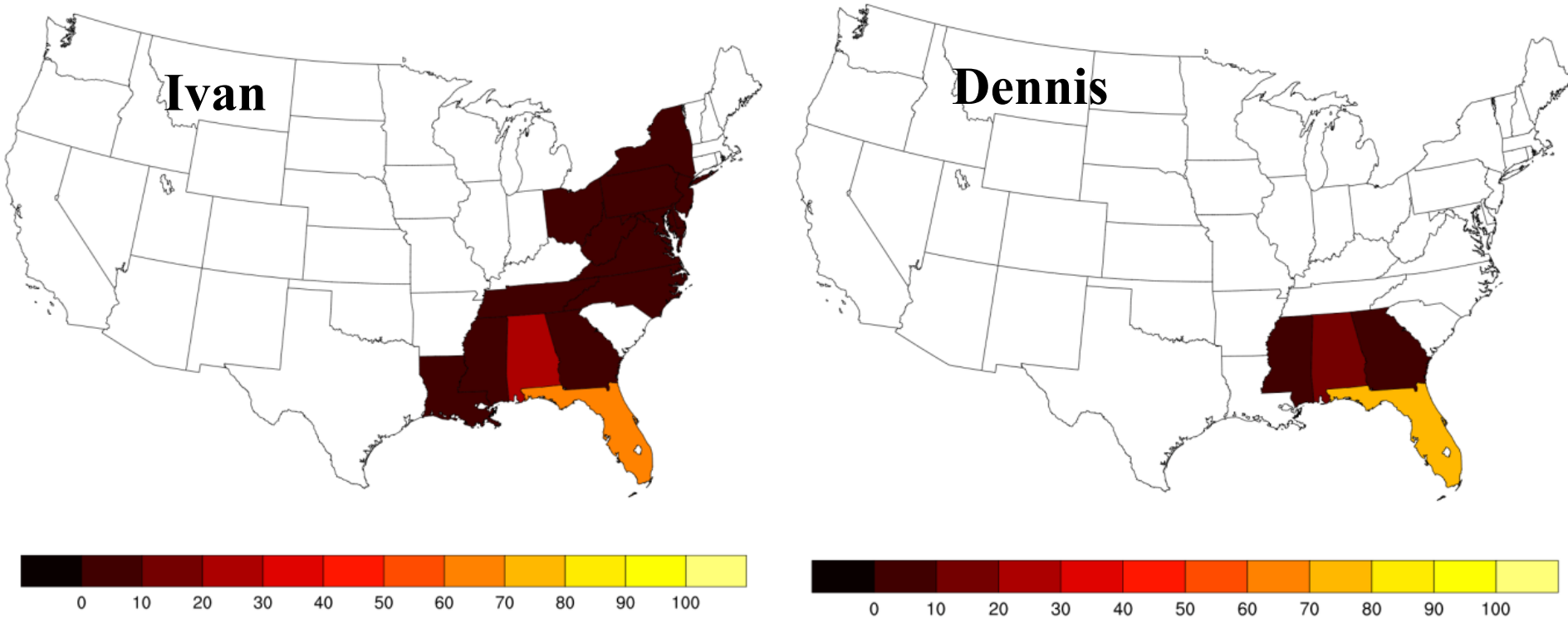
Aim: Understand difference in loss.

Approach: Use raw loss data to explore relationships with:

- physical characteristics of the hurricane;
- exposure and vulnerability attributes within the impacted area.

Loss Data

Losses are not confined to coastal states.

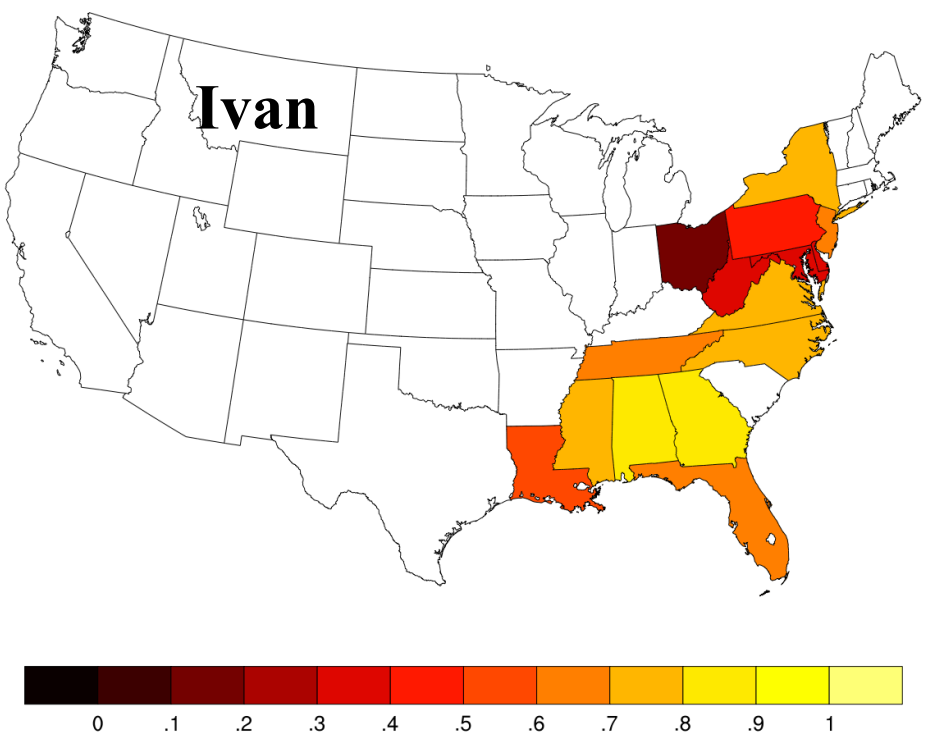


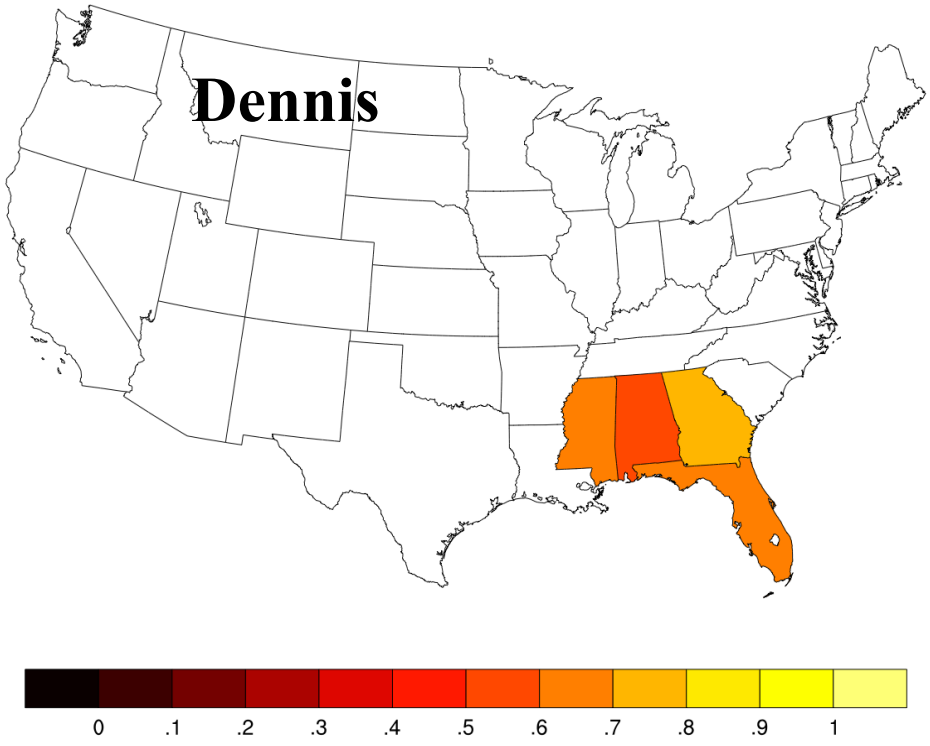
State loss/total loss (%)

Data: State-level losses provided by Property Claim Services

Loss Data

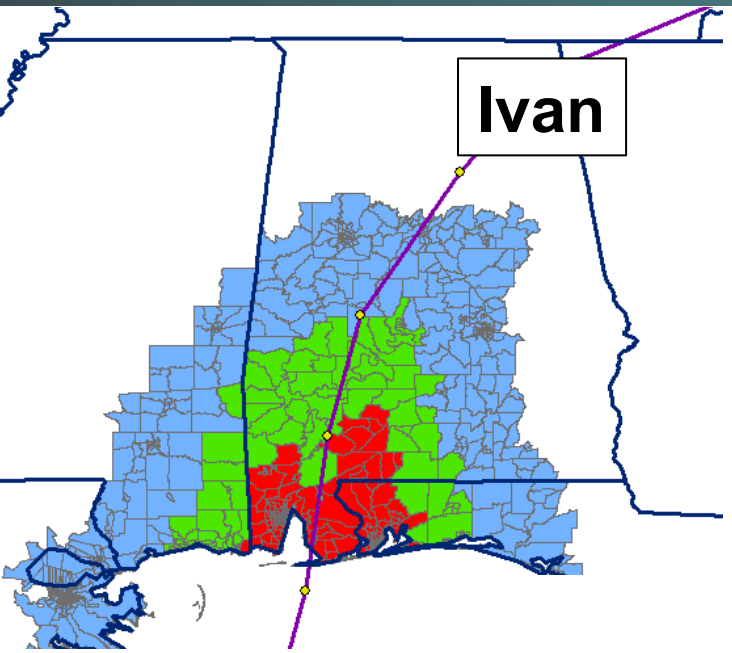
Losses are spread across business lines with the breakdown varying by state and TC.



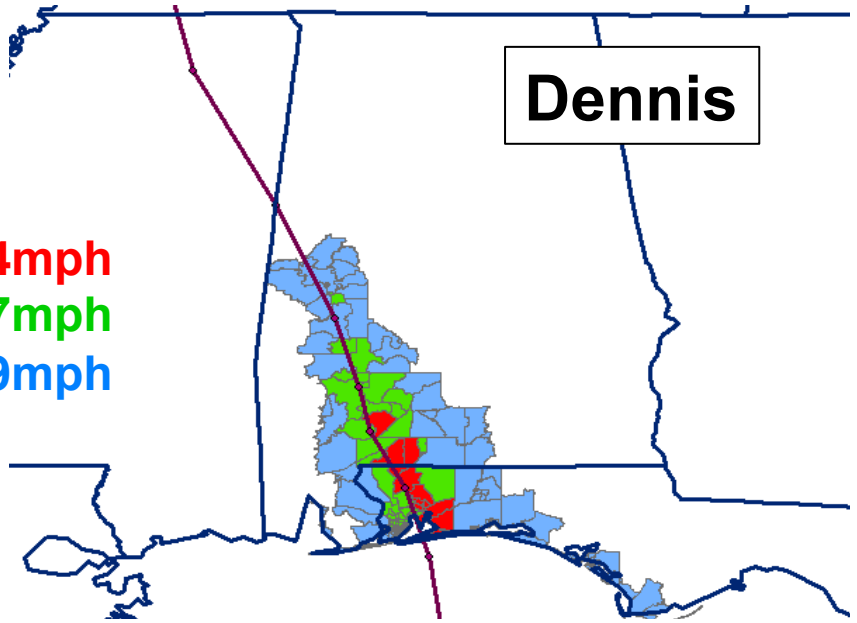


State residential loss/state total loss

Defining the Impacted Area



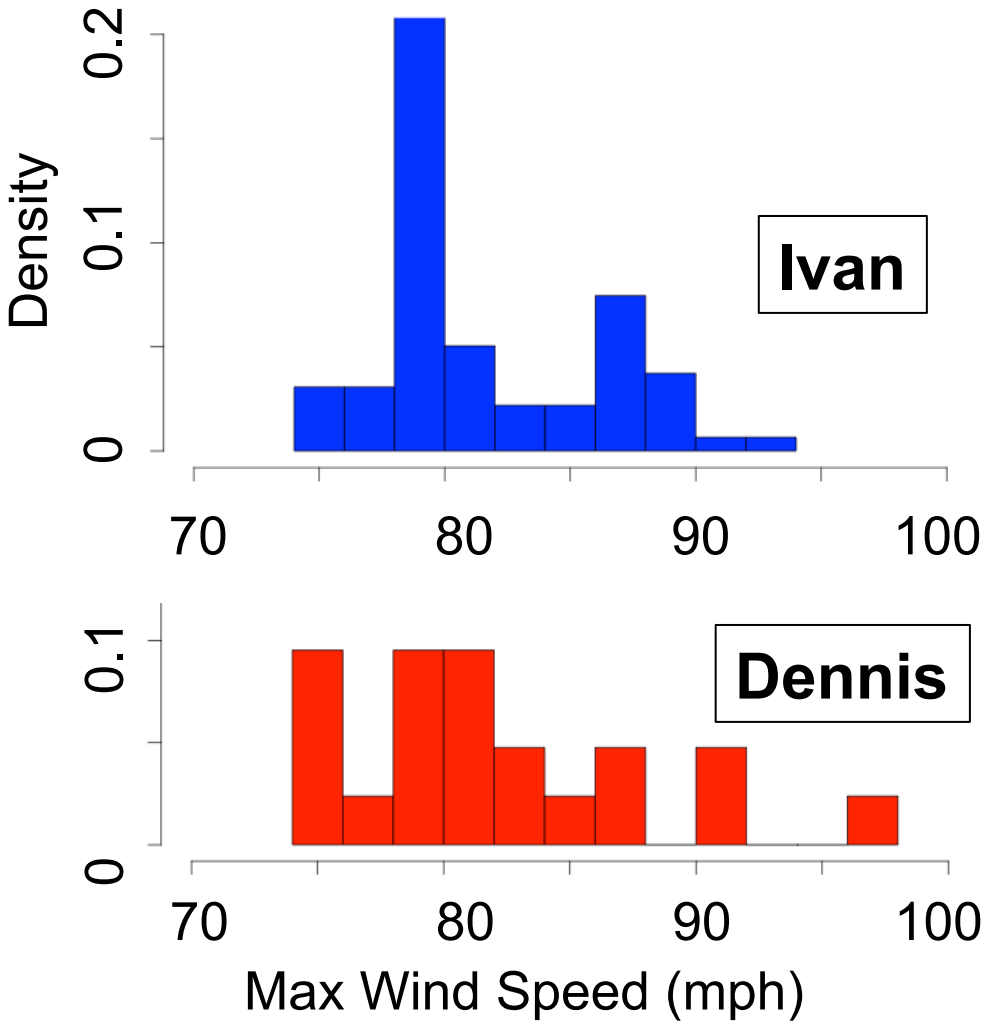
V_{thres} = 74mph
V_{thres} = 57mph
V_{thres} = 39mph



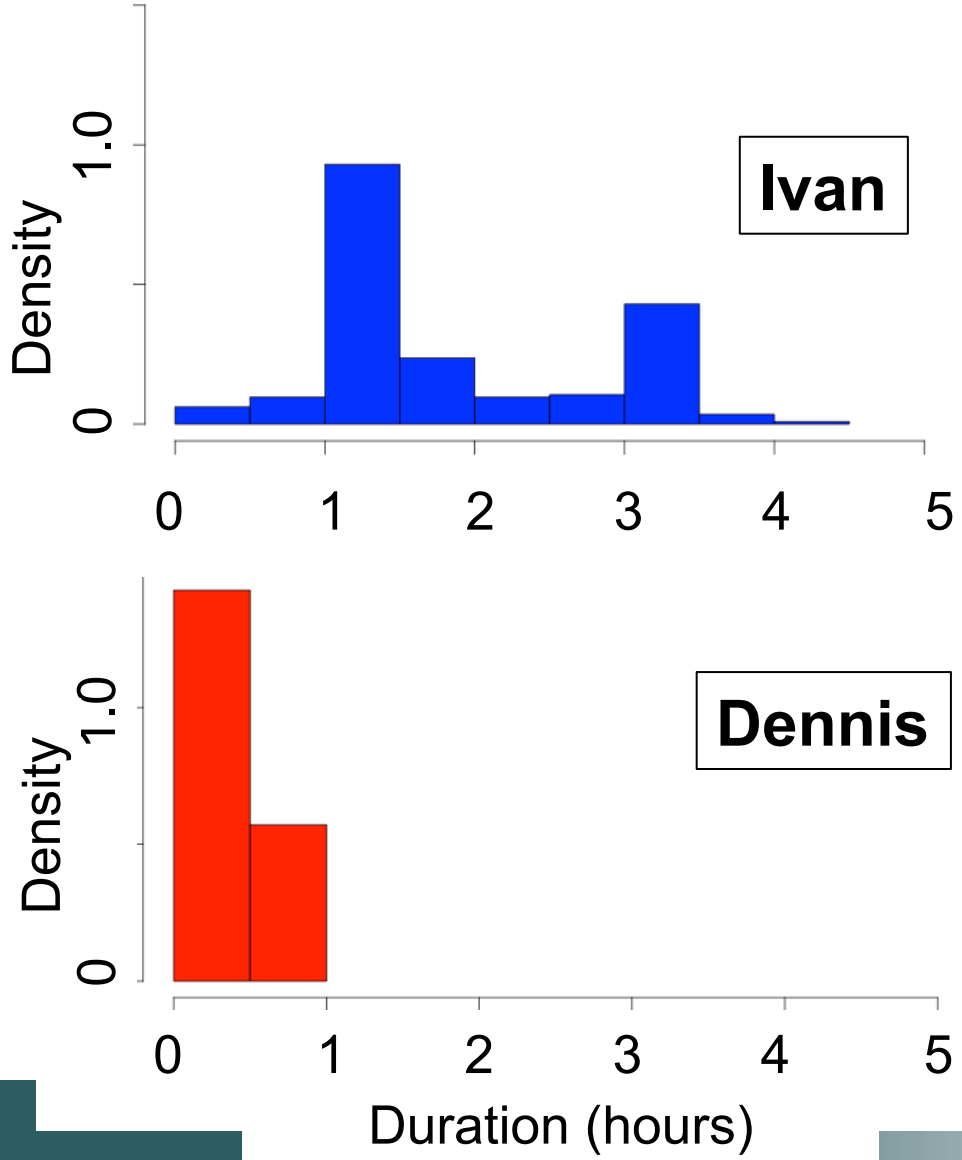
Ivan impacted 5 times the area and 11 times the number of tracts of Dennis.

*Wind Data: Gridded observed surface wind field data from NOAA's H*Wind Project (Powell et al. 1998).*

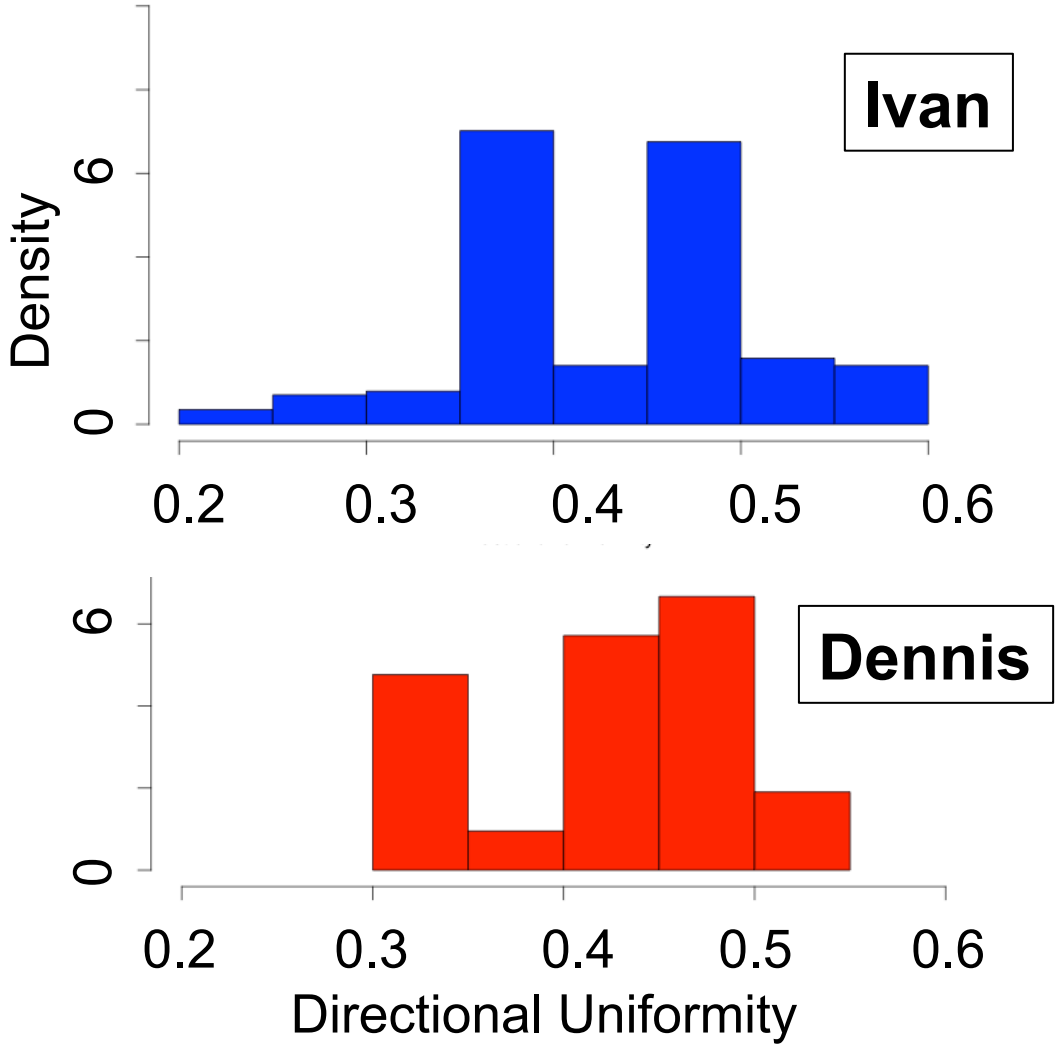
Distribution of Maximum Wind Speed



Distribution of Wind Duration

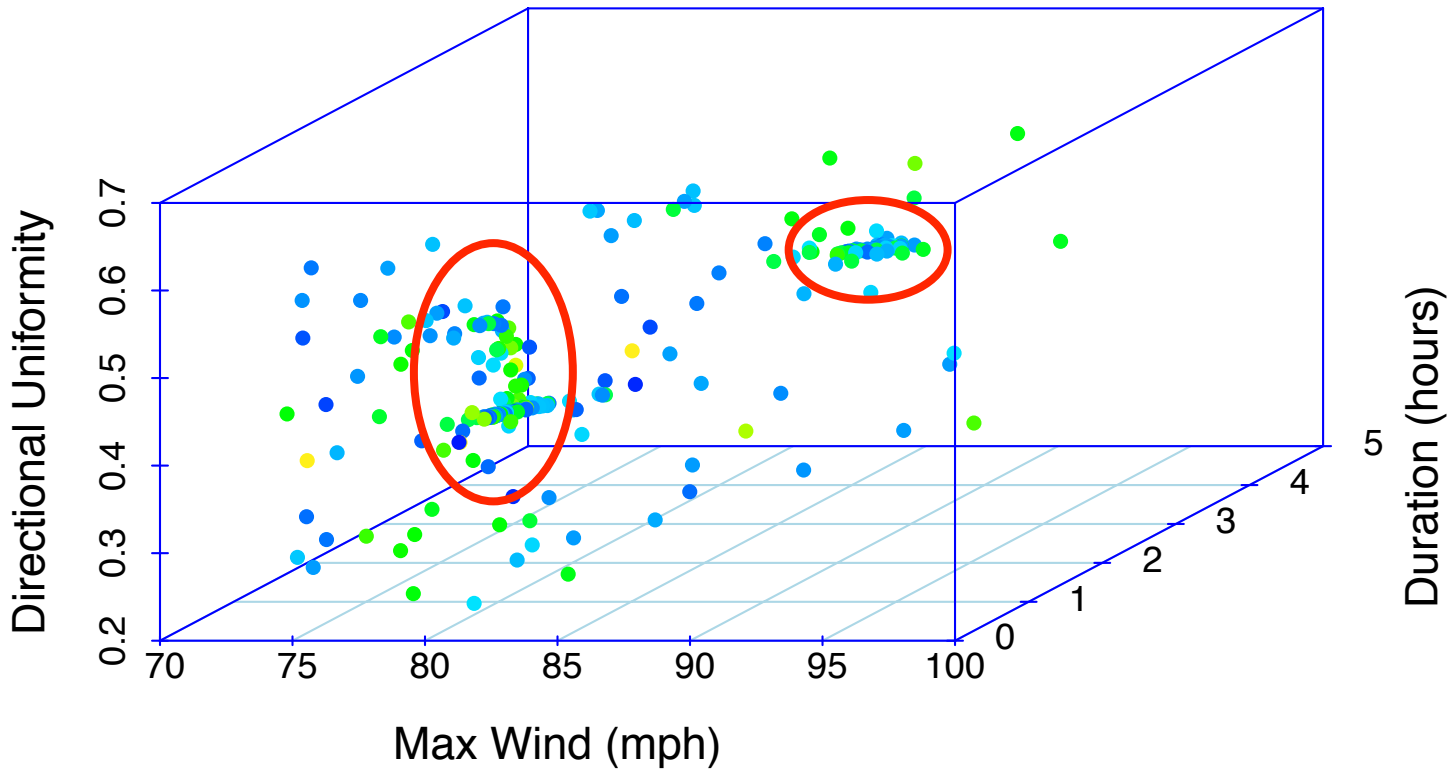


Distribution of Wind Directional Change



Hazard – Exposure Relationship

Census tract average wind characteristics colored by mean residential exposure value for Ivan and Dennis hurricane force impacted tracts.



Exposure Data: HAZUS-MH 2.1 based on US Census.

Quantitative Analysis

Conduct a Multivariate Regression Analysis:

Domain: Census tracts impacted by hurricane force winds for Ivan and Dennis.

Dependent variable: Log of census tract residential wind losses. Pseudo losses are generated two ways:
1) assume state loss is spread uniformly;
2) spread is weighted by proportion of total impacted housing units (HU).

Independent variables: Hazard and socio-economic variables selected based on physical reasoning.

Wind characteristics are highly correlated, and so are discretized into high and low categories.

Quantitative Analysis

Variable	Uniform Weights	HU Weights
Population per square mile	.000026	.000055
Total Housing Units	-2.8e-06	-
Percentage Owner Occupied	.062	.73
Avg. Single Family Dwelling Exposure Value	.00095	.0083**
Avg. Manufactured Housing Exposure Value	-.00017	.010**
Avg. Duplex Exposure Value	-.00039	4.9e-06
Avg. Other Residential Exposure Value	.000041*	.000056*
Age of Median Yr. Housing Built	-.0016	-.0071
High Wind speed	.39***	.44***
High Duration	.55***	.68***
Low Directional Uniformity	-.31***	-.064
Constant	16.4***	14.5***
Number of Observations	249	249
R-squared	0.65	0.54
Adjusted R-squared	0.64	0.53

*p<.1; ** p<.05; *** p<.01*

Hazard characteristics of high wind speed and high duration are significant for both uniform and HU weighted losses.

Significance of exposure/ vulnerability variables is sensitive to how the losses are spread.

Conclusions

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