Fatality Prediction: Tornadoes USA

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OUTLINE

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  2. Data
  3. Plots
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INTRODUCTION: BIRTH OF A TORNADO

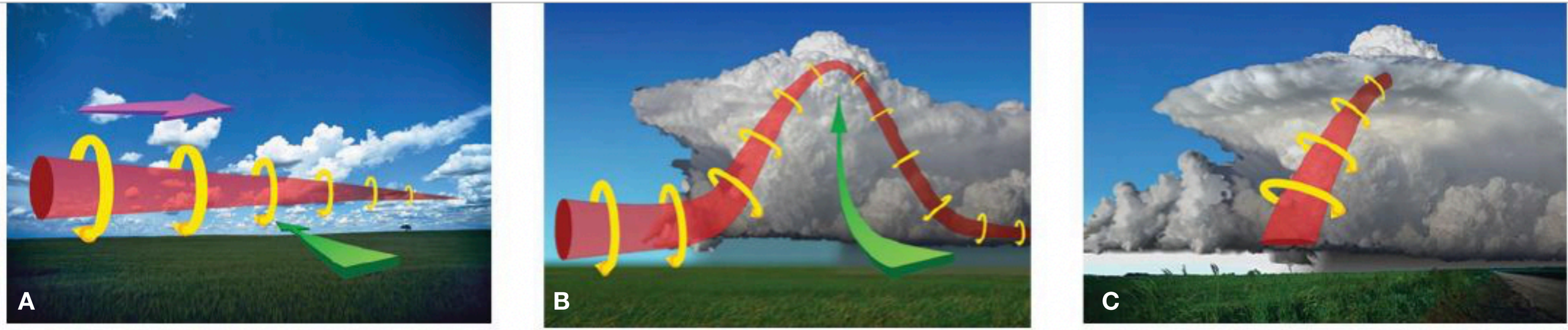


Figure 1

Before thunderstorms develop, winds change direction and increase in speed with altitude. This creates an invisible, horizontal spinning effect in the lower atmosphere.

Rising air within the thunderstorm updraft tilts the rotating air from horizontal to vertical.

An area of rotation, 3-10 km wide is created which extends through much of the storm. Most tornadoes form within this area of strong rotation.

1. https://www.lloyds.com/~/media/Lloyds/Reports/Emerging-Risk-Reports/Tornadoes-final-report.pdf

INTRODUCTION: MEASURING TORNADOES

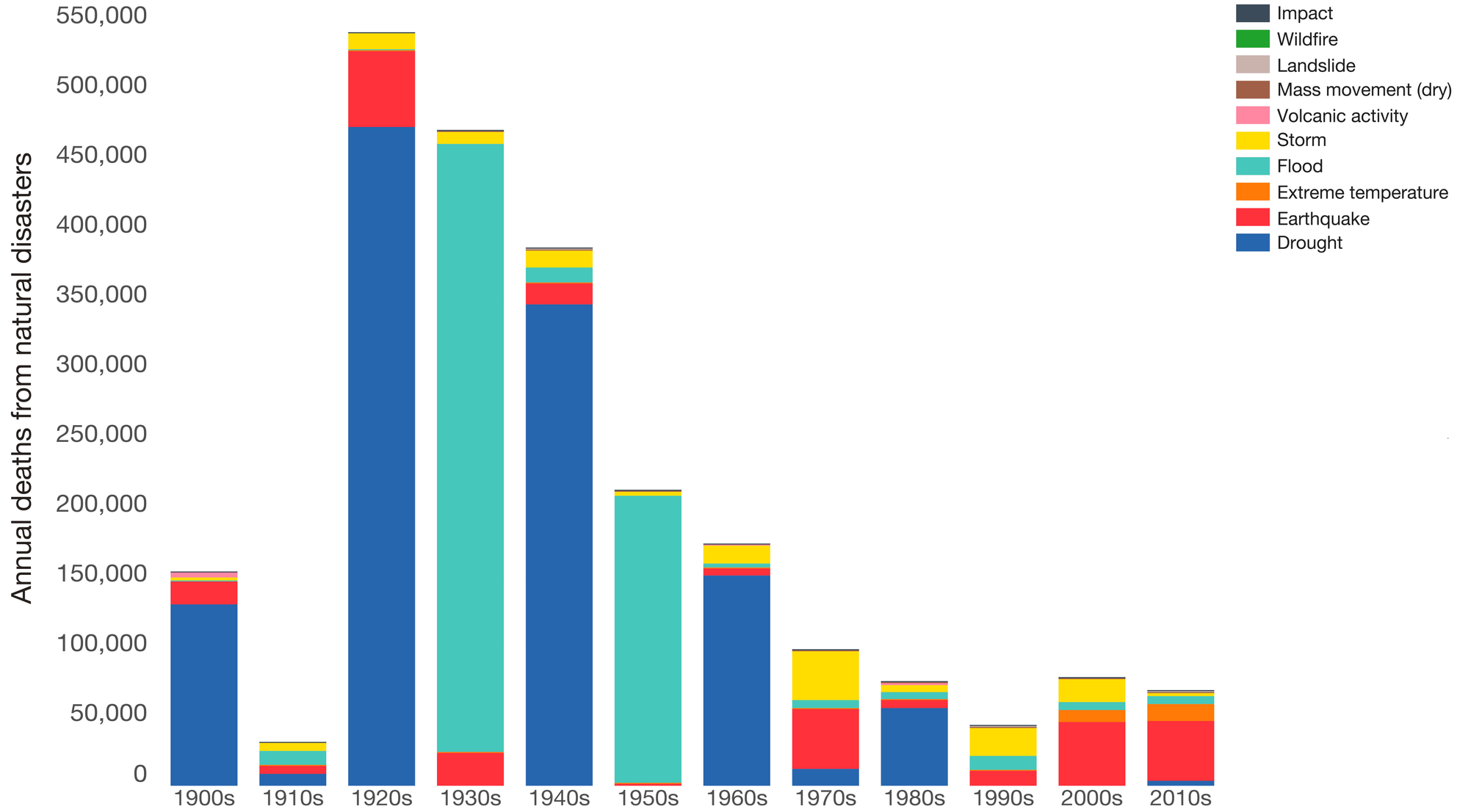
TABLE 1: The Enhanced Fujita (EF) Scale

EF Rating	*Wind Speed*	*Damage*
EFO	65-85mph, 105-137 km/h	Light damage: Peels surface off some roofs; some damage to gutters or siding; branches broken off trees; shallow-rooted trees pushed over.
EF1	86-110mph, 138-178 km/h	Moderate damage: Roofs severely stripped; mobile homes overturned or badly damaged; loss of exterior doors; windows and other glass broken.
EF2	111-135mph, 179-218 km/h	Considerable damage: Roofs torn off well-constructed houses; foundations of frame homes shifted; mobile homes completely destroyed; large trees snapped or uprooted; light object missiles generated; cars lifted off ground.
EF3	136-165mph, 219-266 km/h	Severe damage: Entire stories of well-constructed houses destroyed; severe damage to large buildings such as shopping malls; trains overturned; trees debarked; heavy cars lifted off the ground and thrown; structures with weak foundations blown away some distance.
EF4	166-200mph, 2 67-322 km/h	Devastating damage: Well-constructed houses and whole frame houses completely levelled; cars thrown and small missiles generated.
EF5	>200mph, >322 km/h	Incredible damage: Strong frame houses levelled off foundation and swept away; auto-mobile sized missiles fly through the air in excess of 100m; steel reinforced concrete structure badly damaged; high-rise buildings have significant structural deformation.

1. https://www.lloyds.com/~/media/Lloyds/Reports/Emerging-Risk-Reports/Tornadoes-final-report.pdf

Global annual deaths from natural disasters, by decade

Absolute number of global deaths from natural disasters, per year.
This is given as the annual average per decade (by decade 1900s to 2000s; and then six years from 2010-2015).

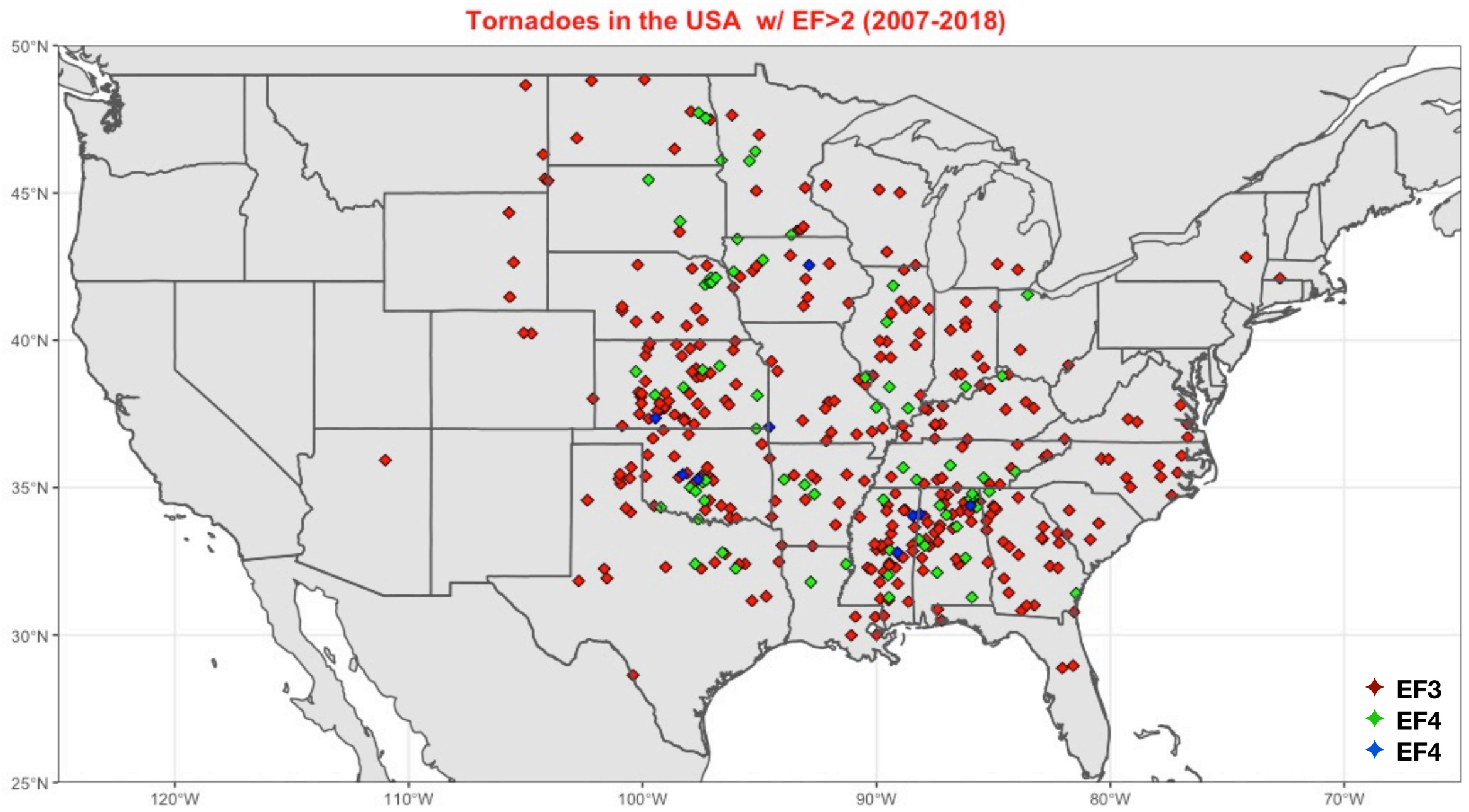


3. Ritchie, Hannah, and Max Roser. "Natural Disasters." Our World in Data, 3 June 2014, https://ourworldindata.org/natural-disasters.

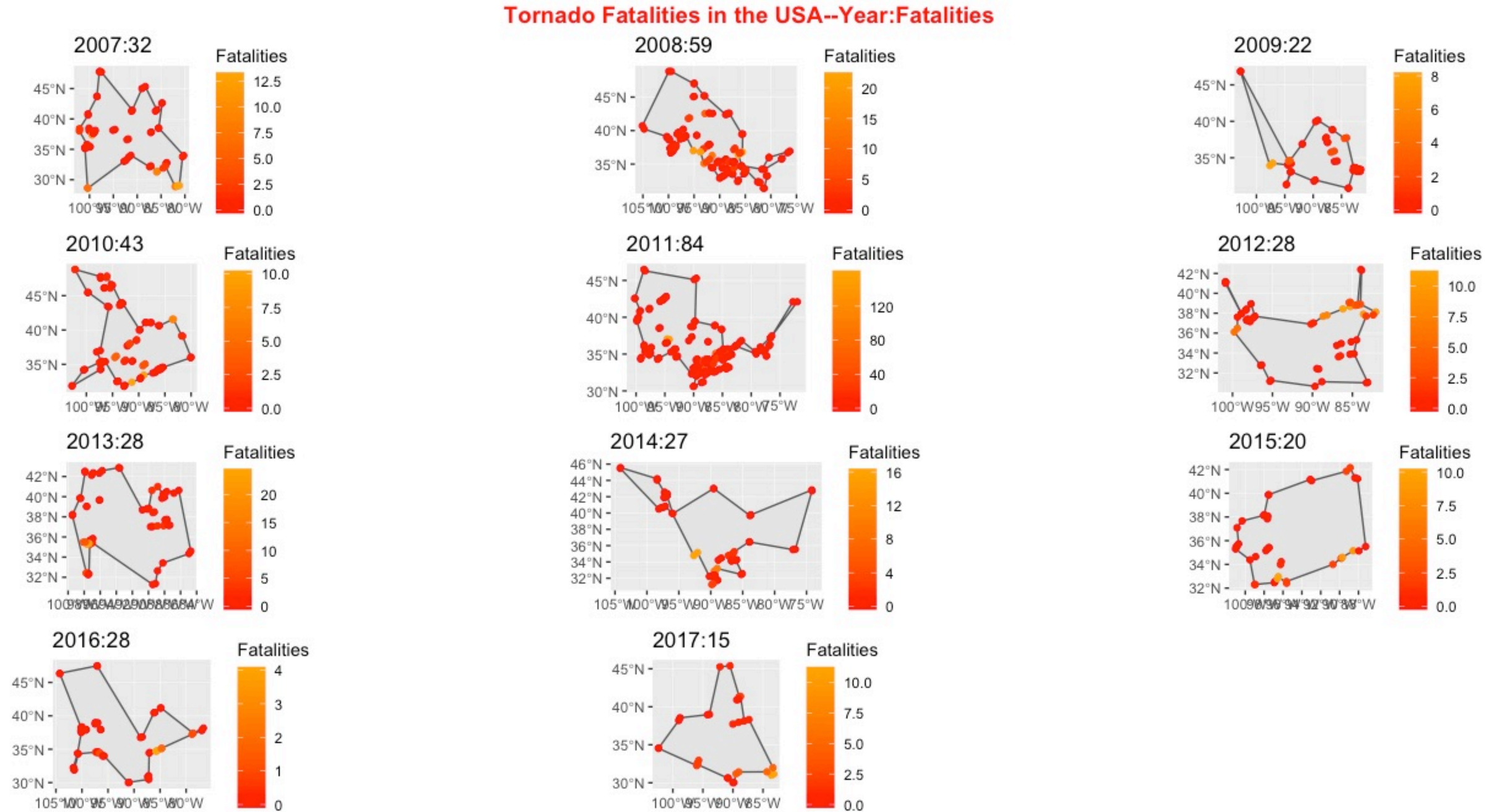
INTRODUCTION: DATA

- NOAA's National Weather Service: Storm Prediction Center
  - Python:Cleaning, wrangling and exploratory analysis
  - R:Statical application
- 401 observations from 01/01/2007–12/31/2018
  - "Mag" : EF rating
  - "Fat" : Fatalities
- Question
  - Can we predict fatalities for tornadoes with EF > 2 at locations in the USA?

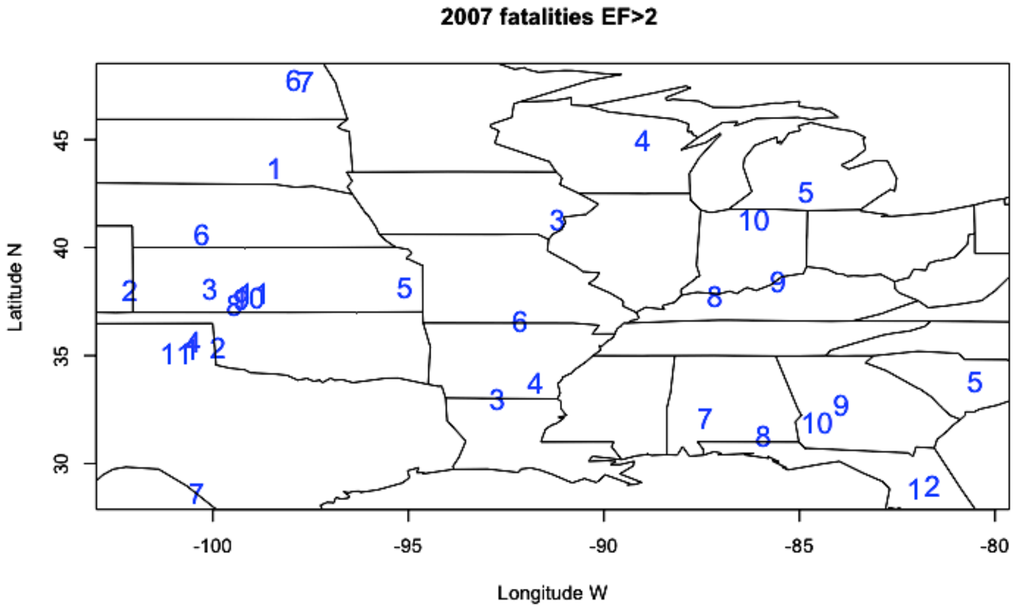
INTRODUCTION: PLOTS

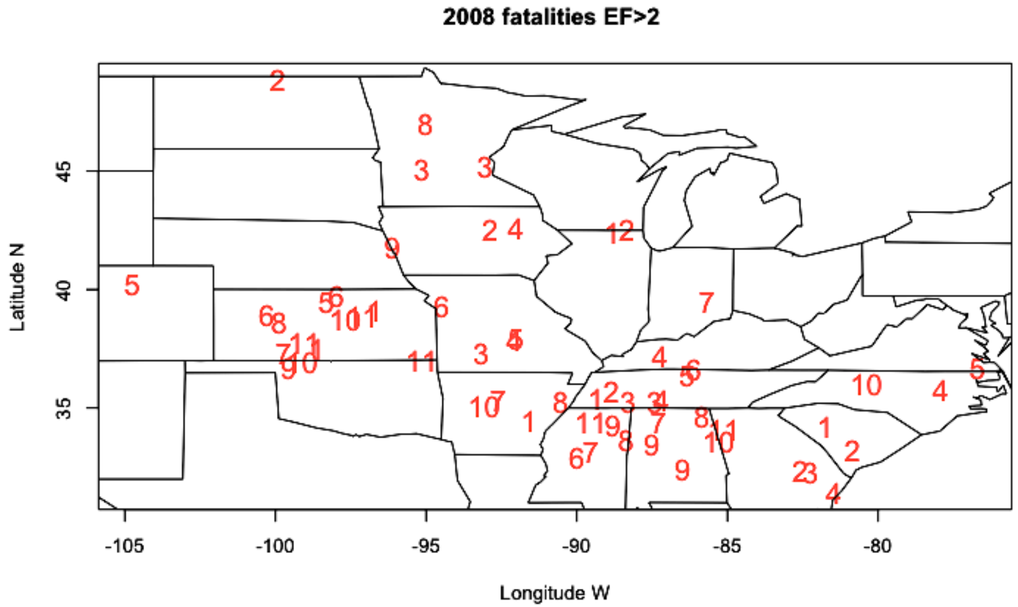


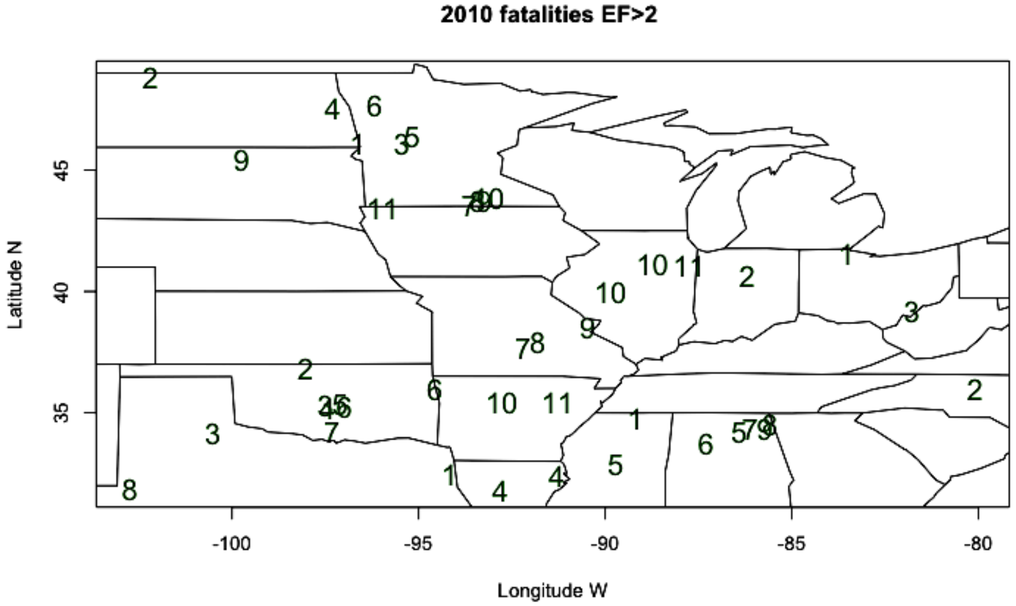
INTRODUCTION: PLOTS

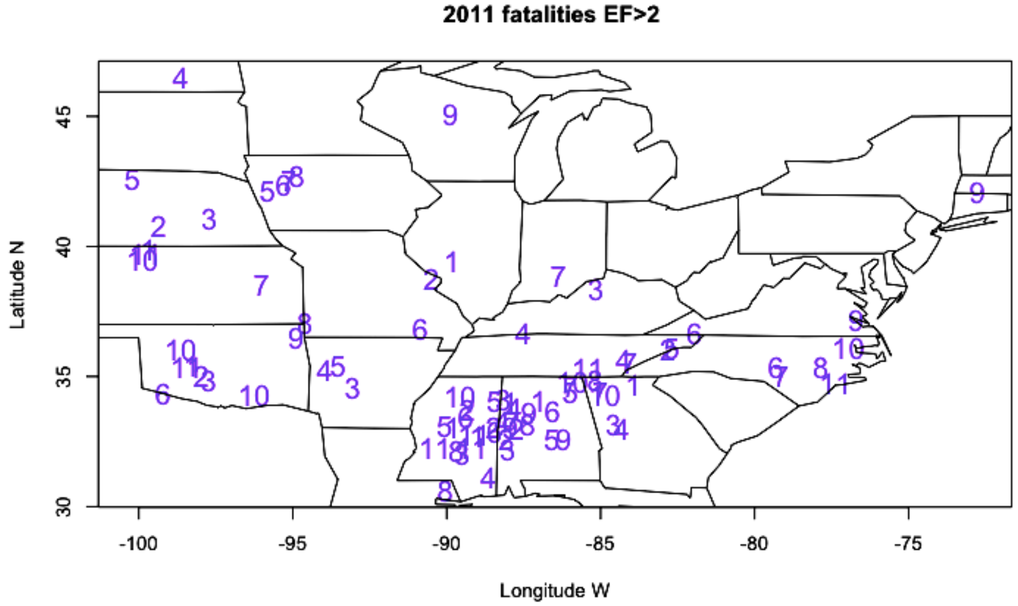


INTRODUCTION: PLOTS

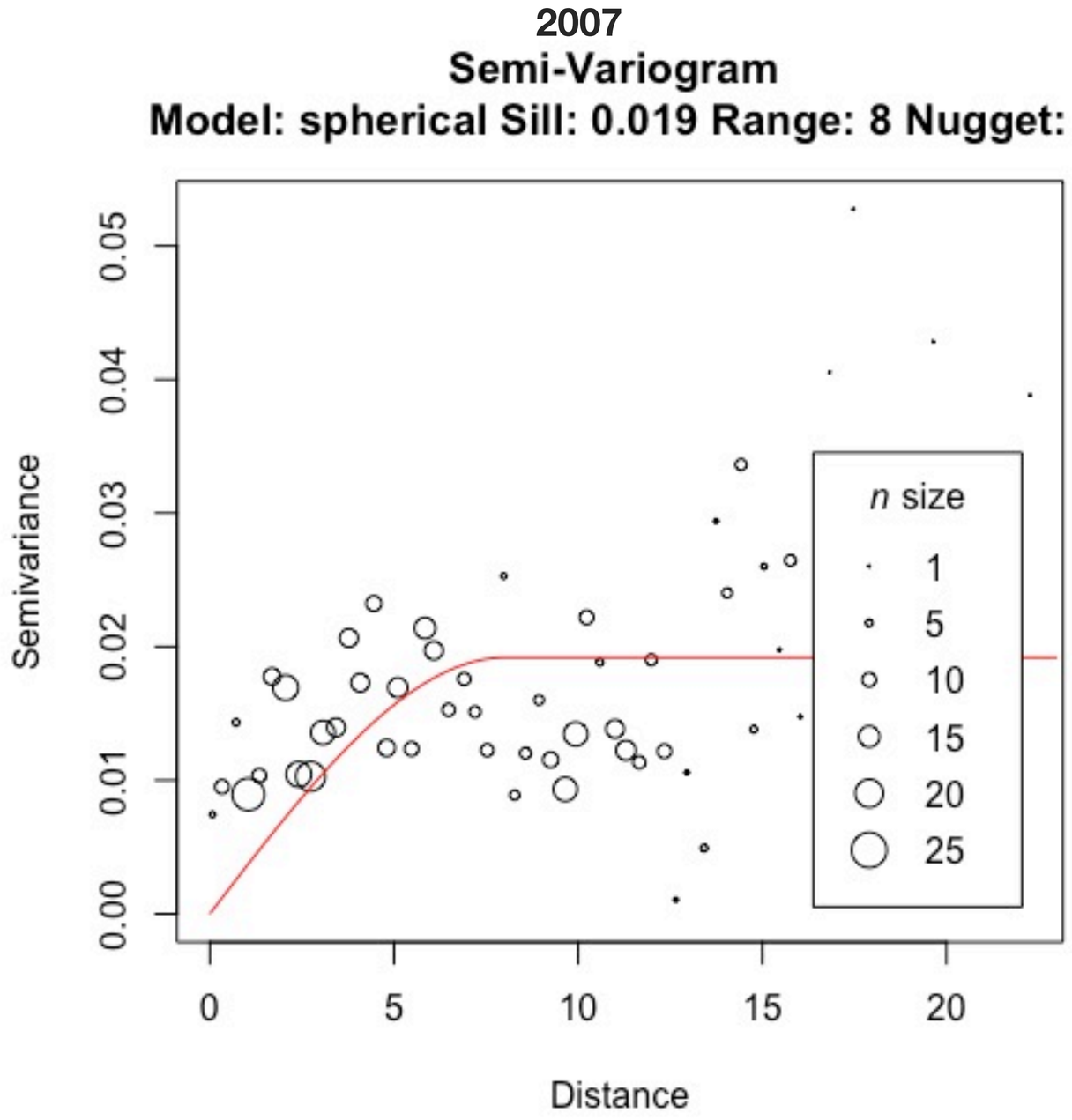


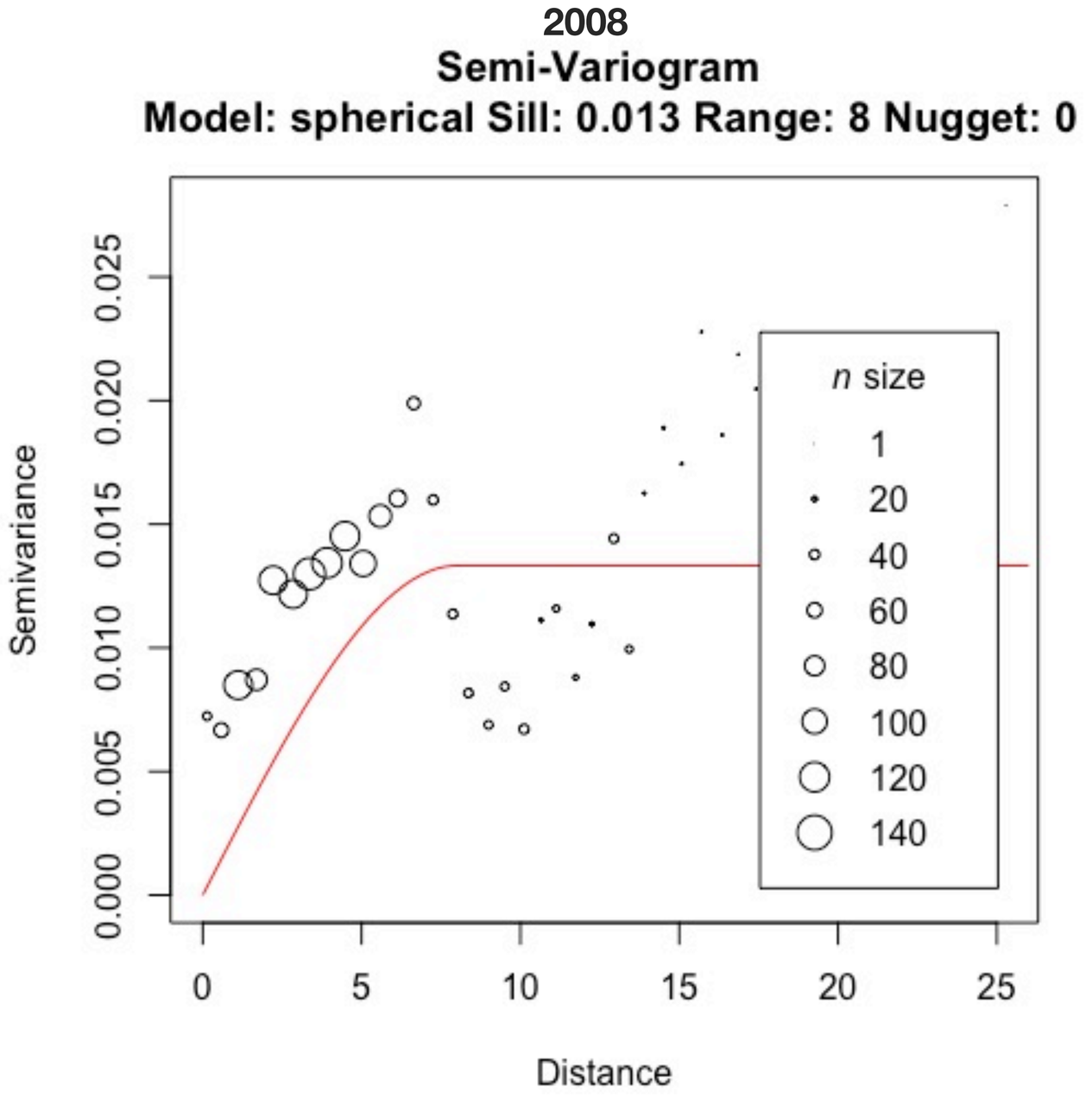






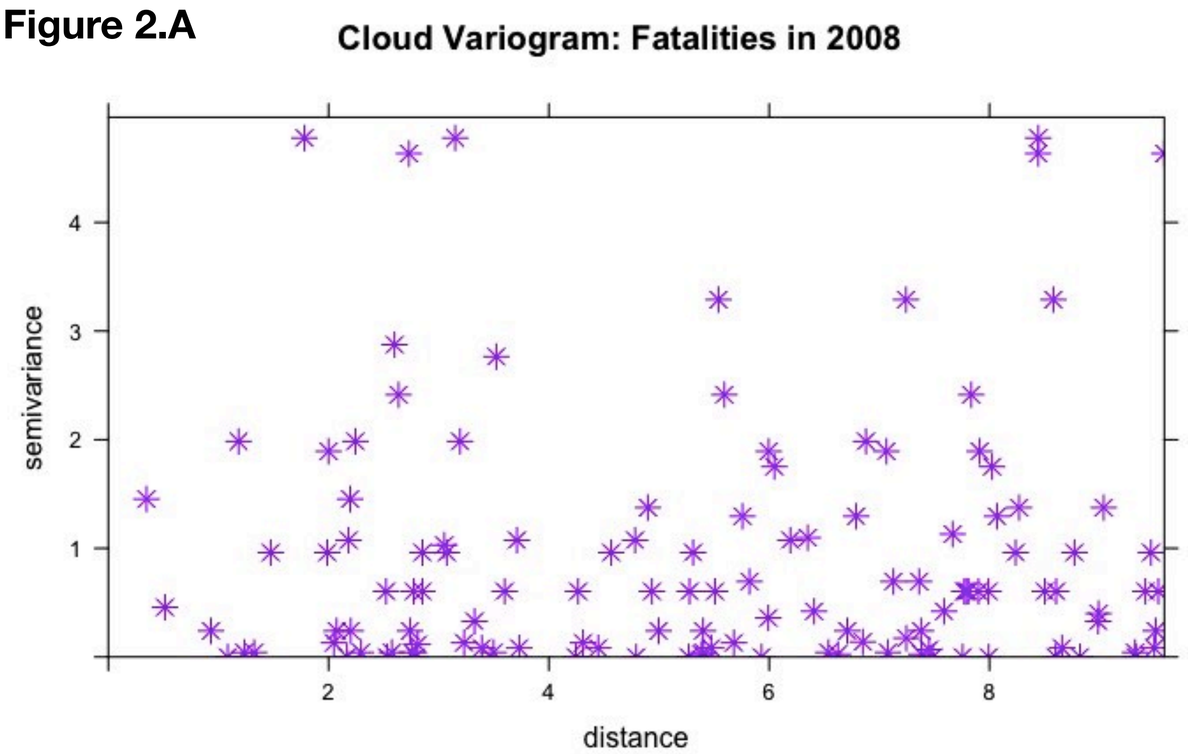
METHODS: VARIOGRAMS



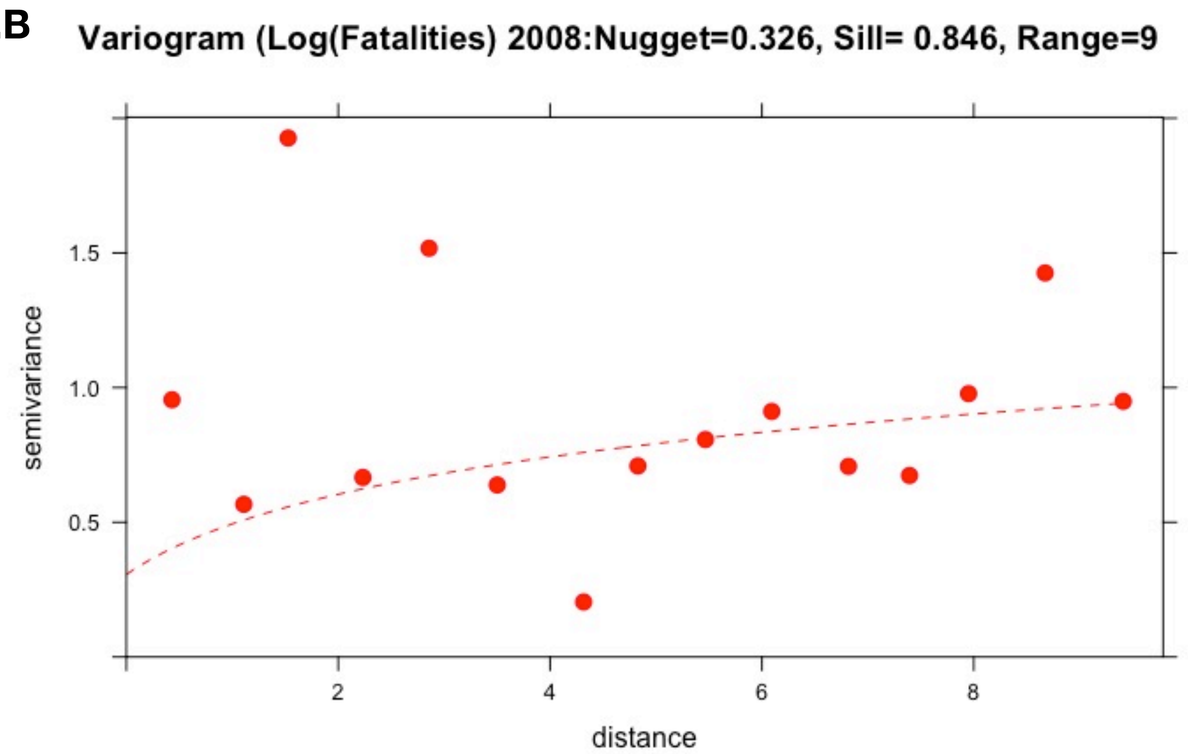


METHODS: VARIOGRAMS

Figure 2.A

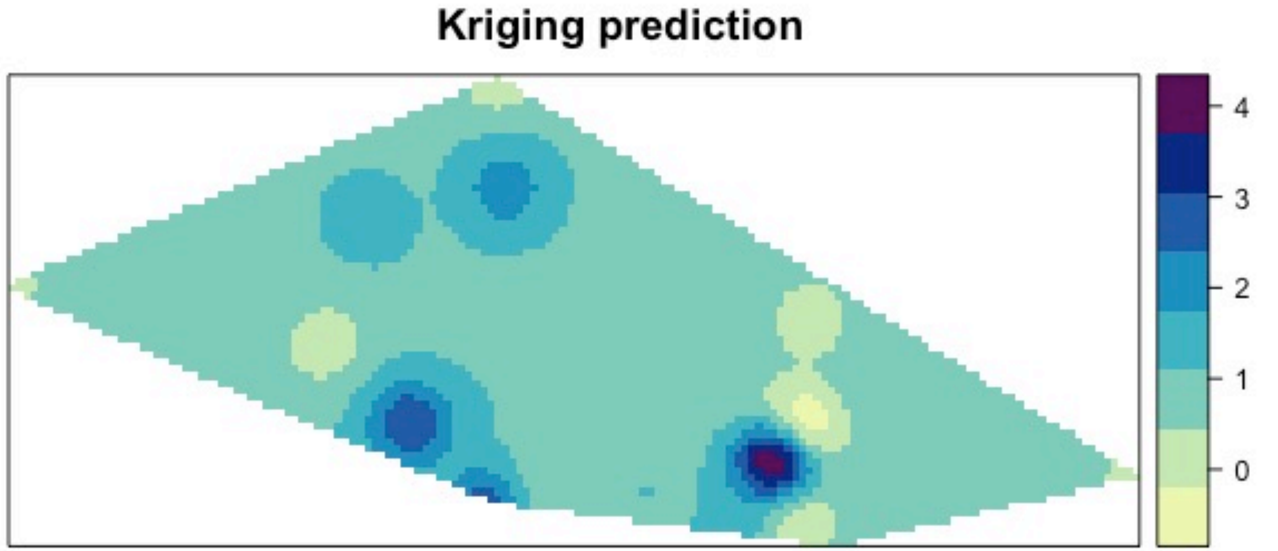


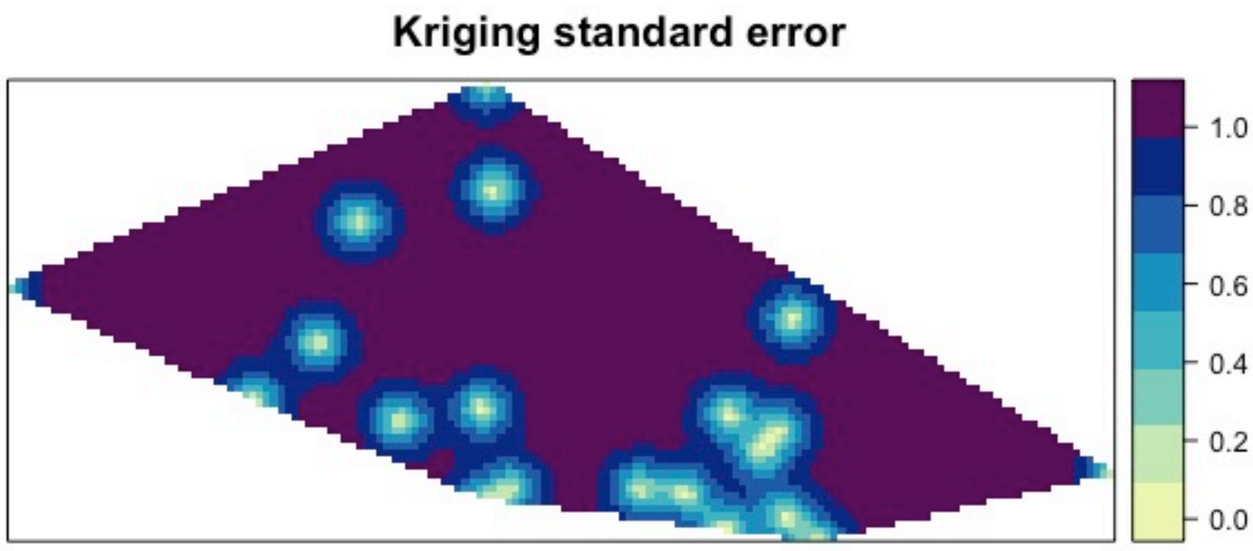
2.B

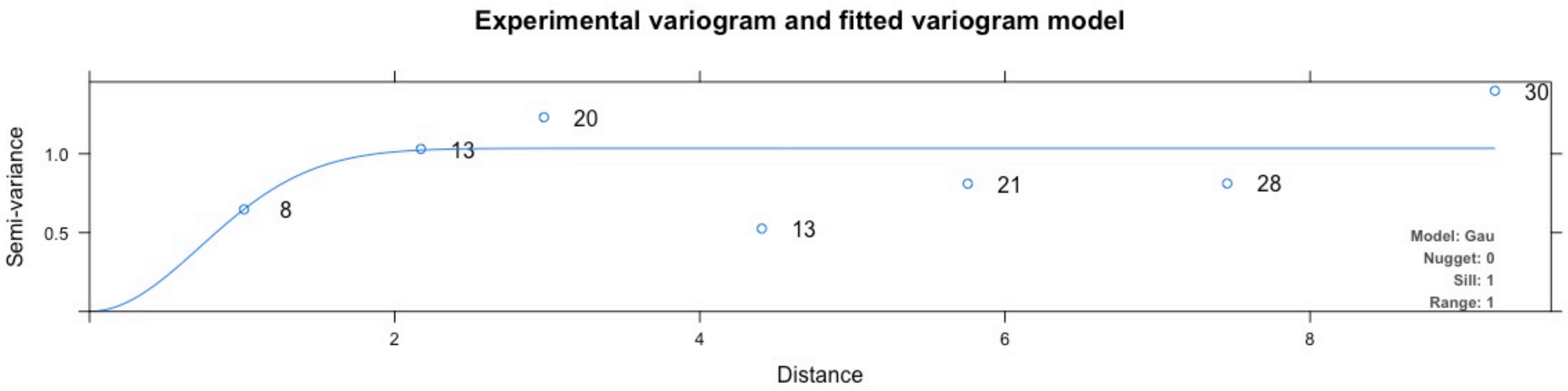


- **Figure 2.A** is a variogram cloud plot. It provides information about areas with unusual high or low variability.
  - I conclude the possibility of non-stationarity and decide on a Log-Transformation to remove this effect.
- **Figure 2.B** is a sample variogram plot.
  - I conclude that due to the sample size, distribution or spatial configuration, correlation maybe possibly be absent.

METHODS: KRIGING







CONCLUSION

- Fatality Prediction when Tornadoes w/ EF > 2 is complicated as a Geospatial problem

- Through model selection, 2007-2008 showed the most promise for spatial interpolation

- Further analysis needs to be done on the quality of the interpolation model by using train/test methods of CV

REFERENCES

1. “Telemundo. “Tornado: Cómo Estar Preparado Antes, Durante y Después.” *Telemundo Chicago*, Telemundo Chicago, 31 May 2019, https://www.telemundochicago.com/noticias/local/Tornado-como-estar-preparado--383847661.html.
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3. Ritchie, Hannah, and Max Roser. “Natural Disasters.” *Our World in Data*, 3 June 2014, https://ourworldindata.org/natural-disasters.
4. Zuur, Alain F., et al. Beginners Guide to Spatial, Temporal, and Spatial-Temporal Ecological Data Analysis with R-INLA. Highland Statistics Ltd., 2017.