Exploring How to Connect Disaster Exposure Data with Human Impacts Research

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Synoptic meteorology

Armistice Day Blizzard of 1940

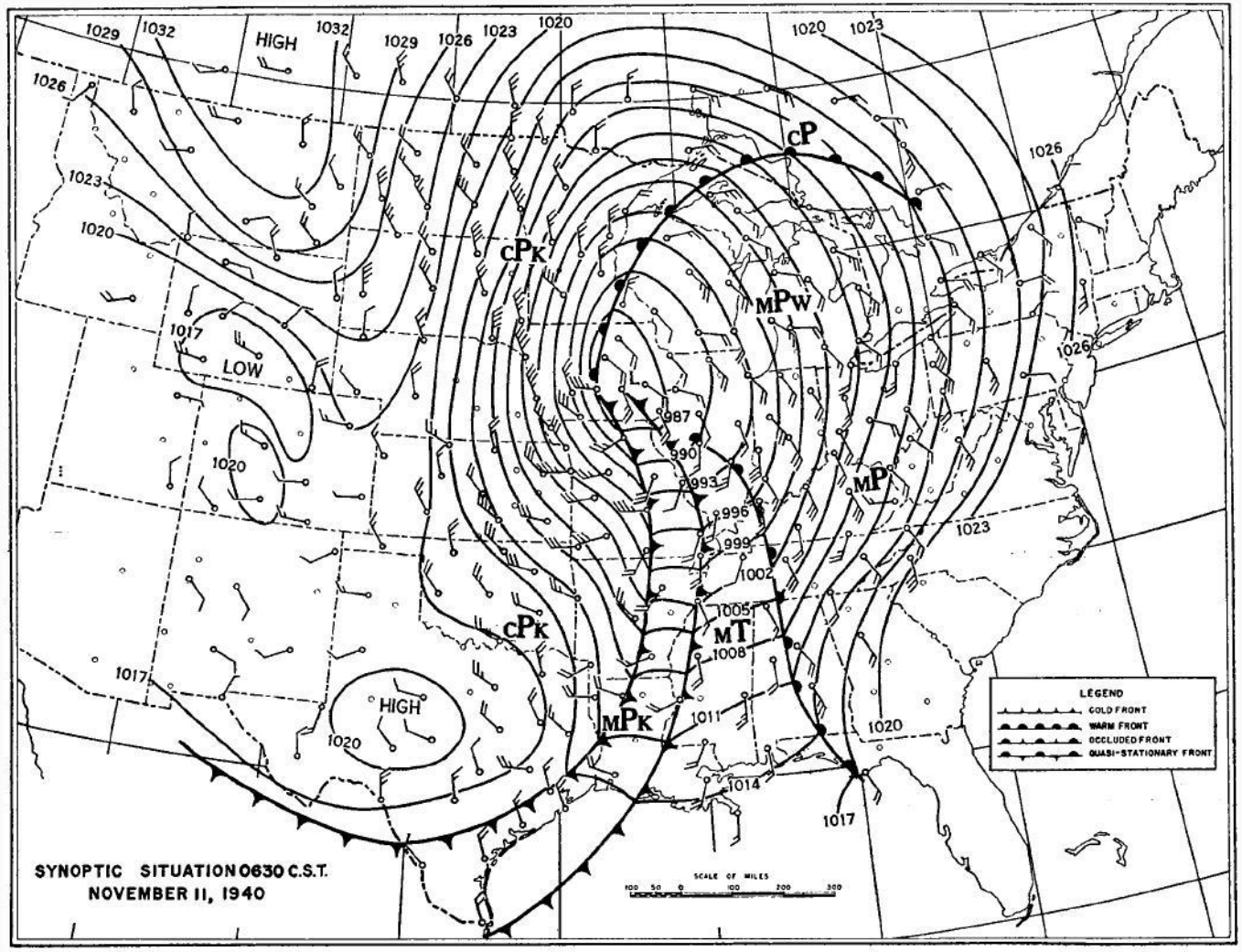


FIGURE 5.—Synoptic situation 0630 C. S. T., November 11, 1940.

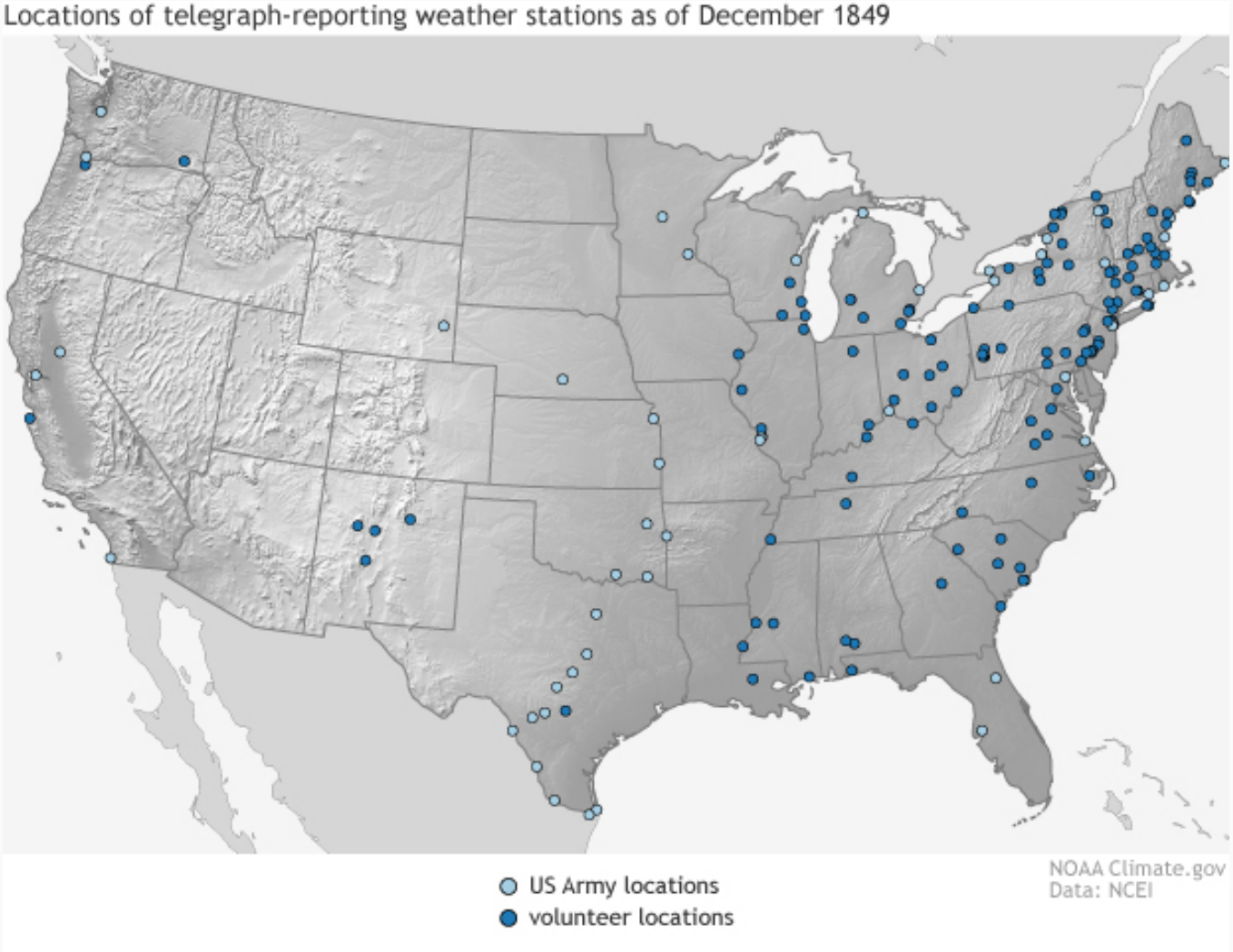
Source: US National Weather Service

Meteorology by telegraph

Creating synoptic charts in Bergen, Norway, November 1919.

Source: Jewell, 1981

Meteorology by telegraph



"To provide a picture of weather conditions across the country, the observers made their reports as nearly simultaneous as possible."

–Getting the Message Through, R.B. Raines

Synoptic times

Weather balloons are launched every day around the world **at the same time** (midnight and noon Zulu time).

Source: NOAA

NSF EAGER: Establishing Interface Standards for Physical Exposure and Human Impacts Data Collections and Publication in Rapid Response to Coastal Hazards

We are seeking to answer the questions:

1. For human impacts data, what are common scales of the data in **time** and **space**?
2. What are reasonable ways to **aggregate or extrapolate** exposure data to these scales?
3. What are pathways and potential for **bias** from this data integration?

Standards for human impact data integration

For human impacts data, what are common scales of the data in **time** and **space**?

1. Human impacts data are often aggregated by **geopolitical boundaries**.
2. Often, human impacts data has a time scale that requires **aggregation** of exposure time series.

Standards for human impact data integration

1. Human impacts data are often aggregated by **geopolitical boundaries**.

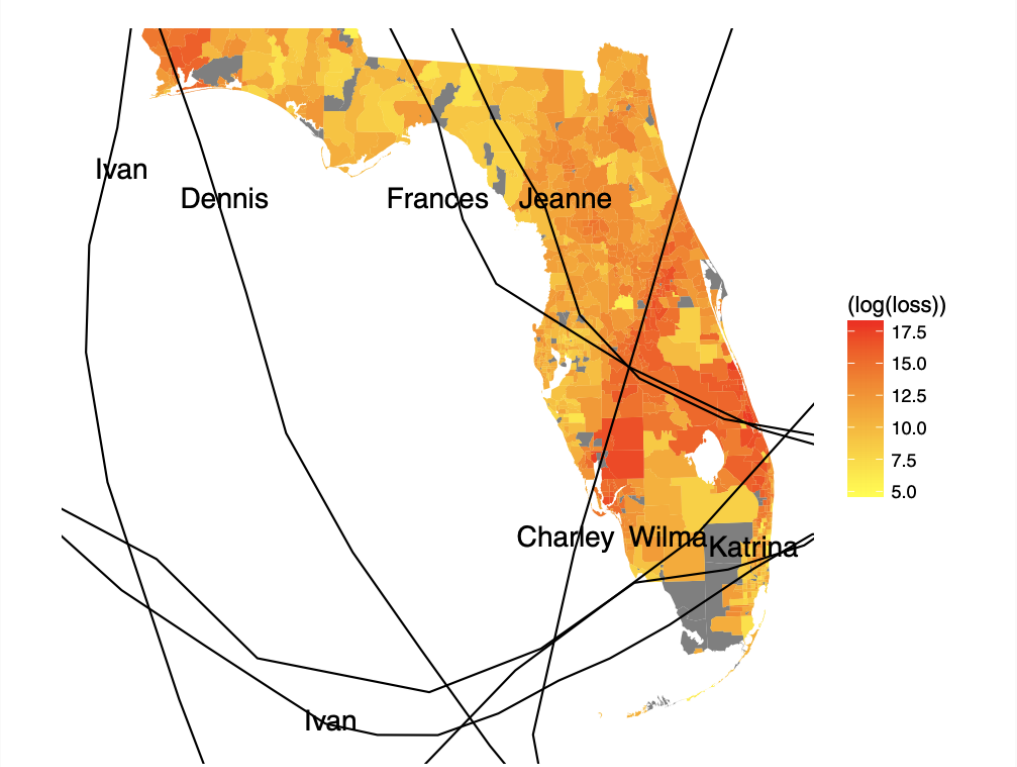
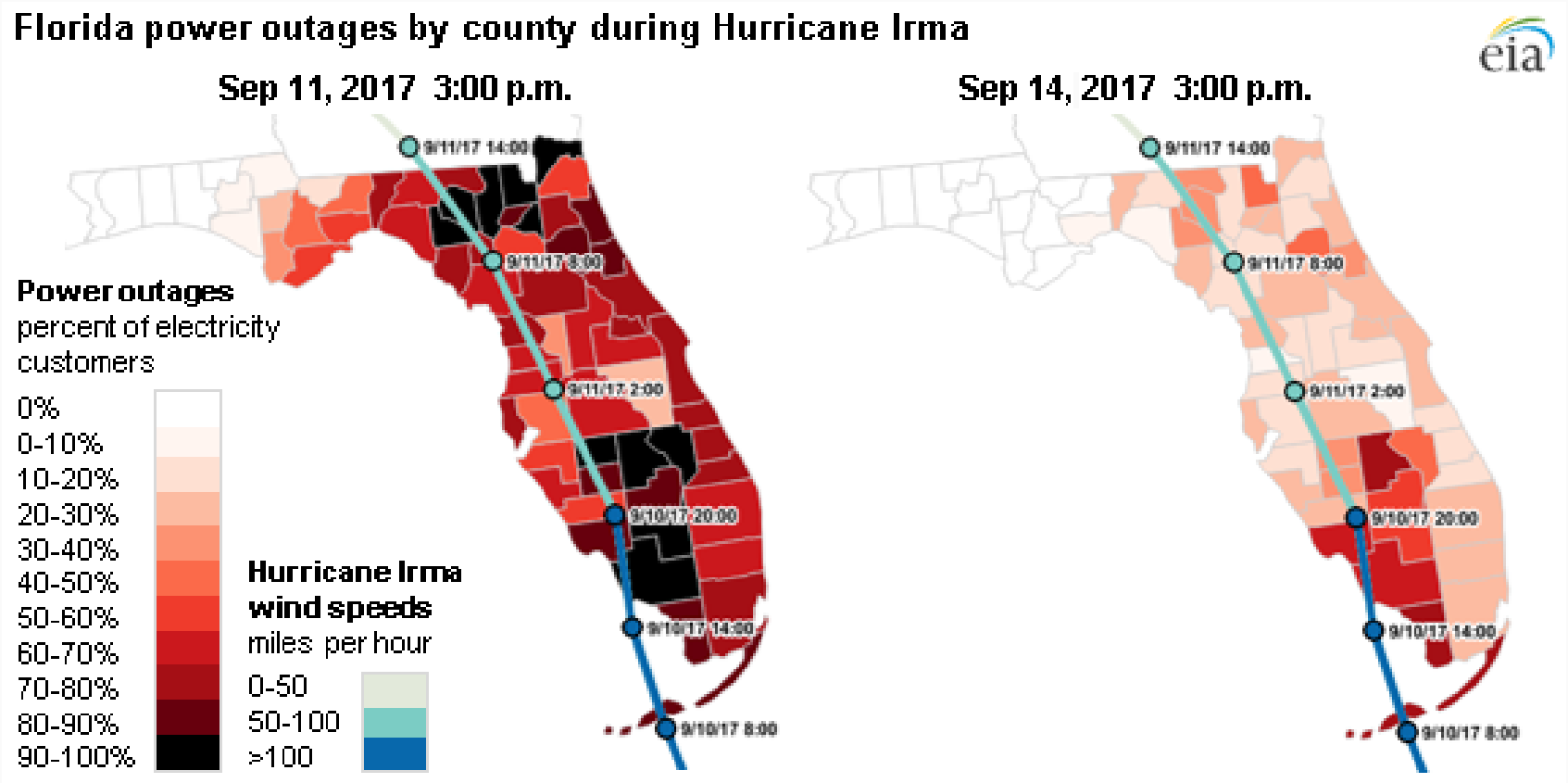


Fig. 1. Spatial distribution of log of total loss for seven historical hurricanes from 2004 to 2005 (Charley, Dennis, Frances, Ivan, Jeanne, Katrina, and Wilma); gray shading indicates zero losses; hurricane tracks are indicated

Source: Done et al., 2018

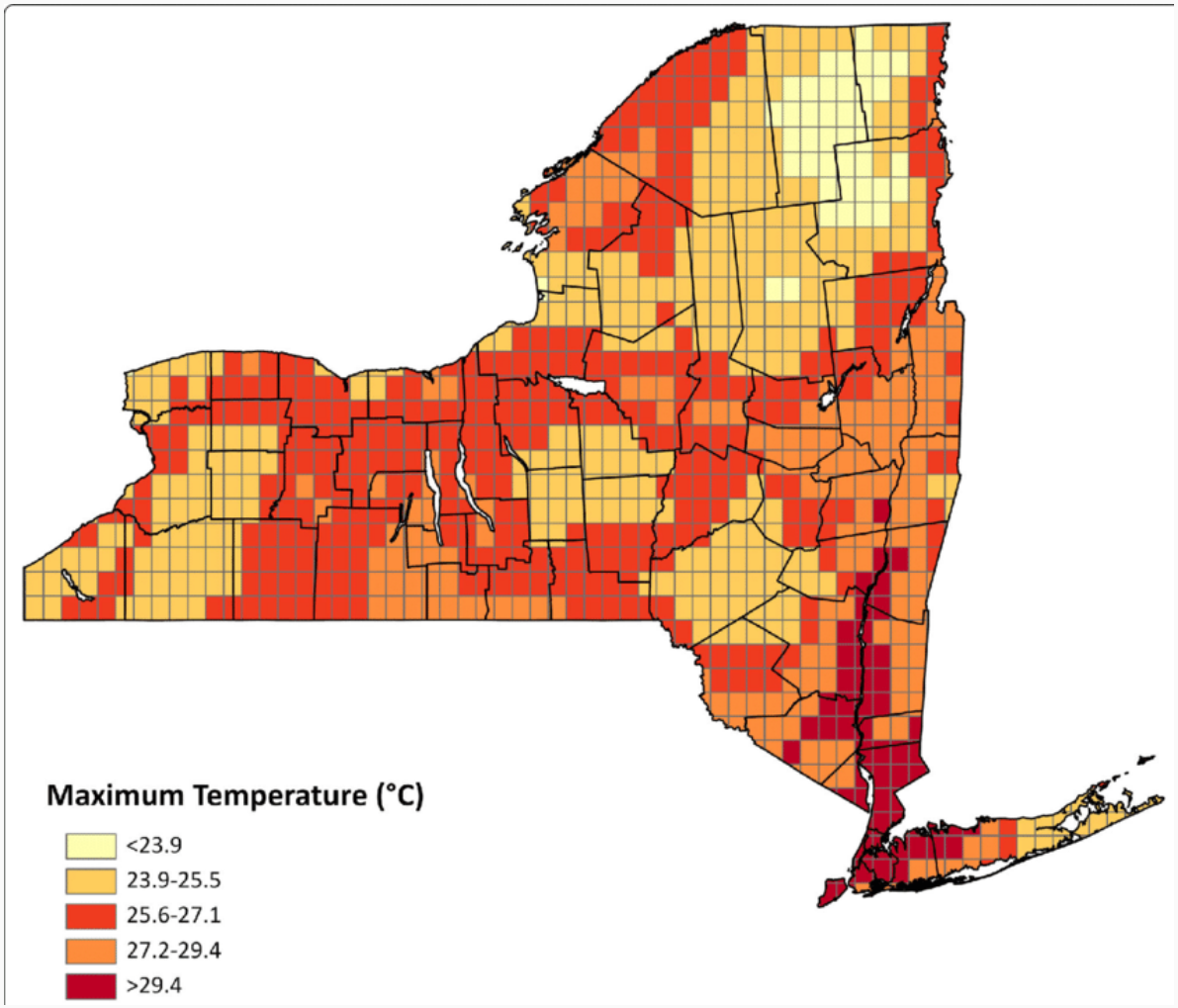
Standards for human impact data integration



Source: US Energy Information Administration

Spatial misalignment

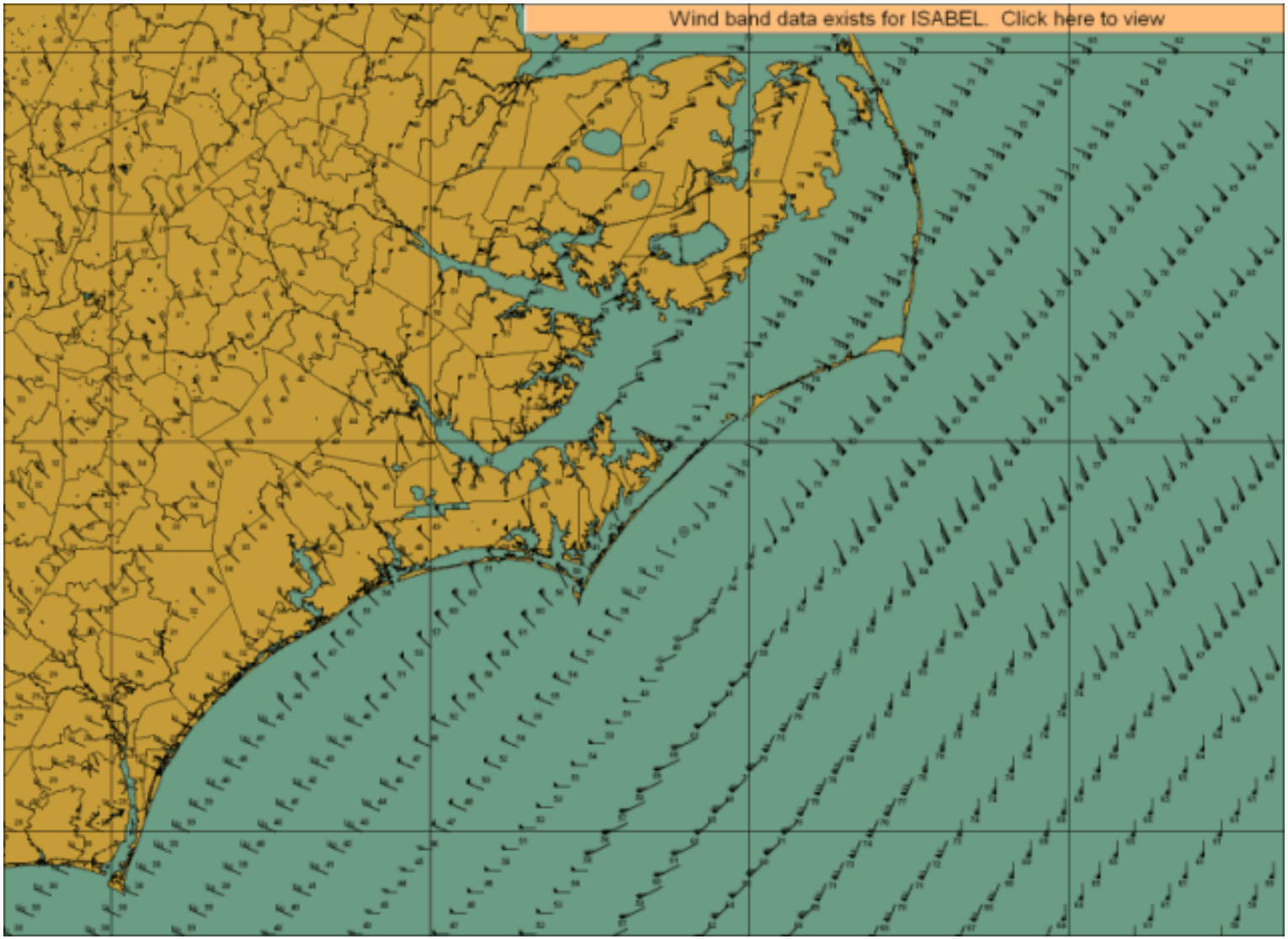
North American Land Data Assimilation System (NLDAS) 12-km grid of maximum temperature (C) in New York State for July 21, 2010.



Source: Adeyeye et al, 2019

Spatial misalignment

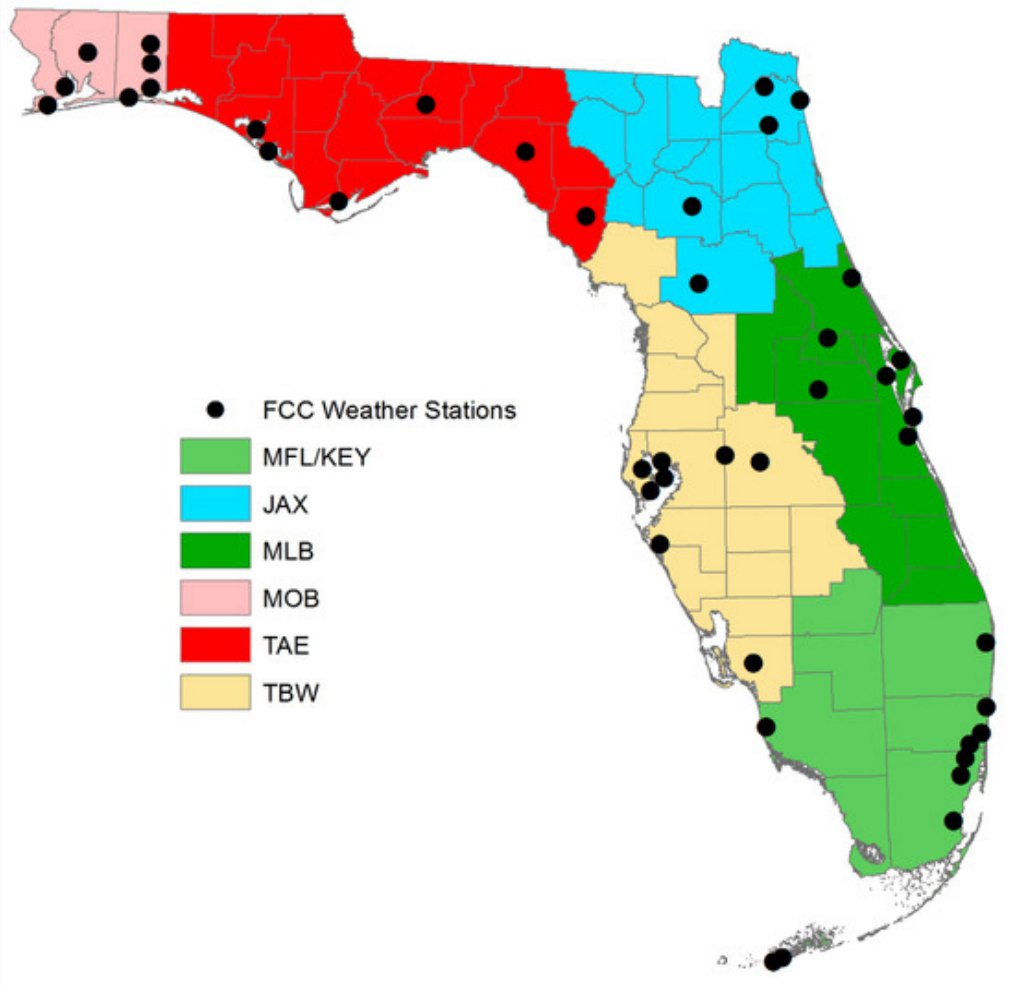
H*WIND wind band data for Hurricane Isabel.



Source: Atlantic Oceanographic and Meteorological Laboratory

Spatial misalignment

National Weather Service regions and locations of Florida Climate Center monitors within Florida.



Source: Learry et al., 2017

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Spatial misalignment

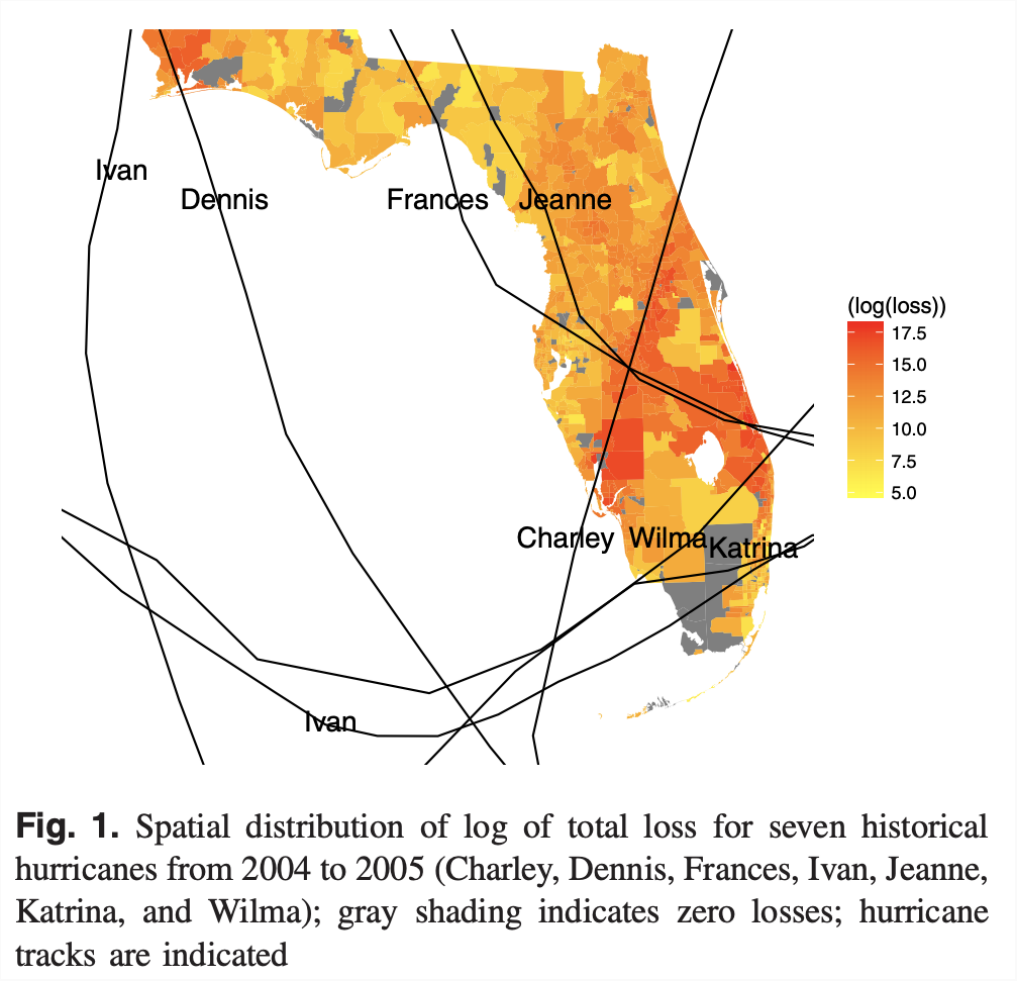
Types of change-of-support problems and associated strategies.

We observe or analyze	*But the nature of the process is*	*Examples*
Point	Point	Point kriging; prediction of undersampled variables
Area	Point	Ecological inference; quadrat counts
Point	Line	Contouring
Point	Area	Use of areal centroids; spatial smoothing; block kriging
Area	Area	The MAUP; areal interpolation; incompatible/misaligned zones
Point	Surface	Trend surface analysis; environmental monitoring; exposure assessment
Area	Surface	Remote sensing; multiresolution images; image analysis

Source: Gotway and Young, 2002.

Moving toward standards for human impact data integration

2. Often, human impacts data has a time scale that requires **aggregation** of exposure time series.



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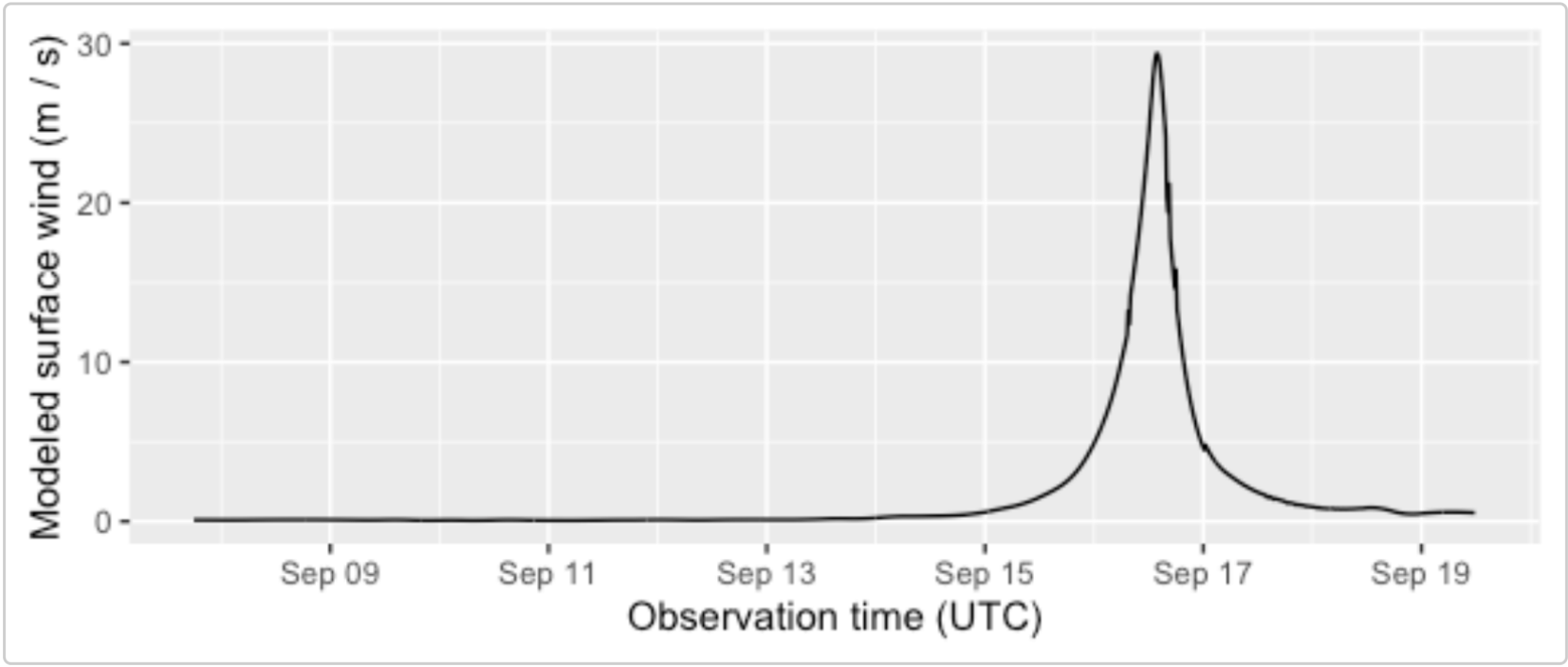
Source: Done et al., 2018

Aggregating exposure time series

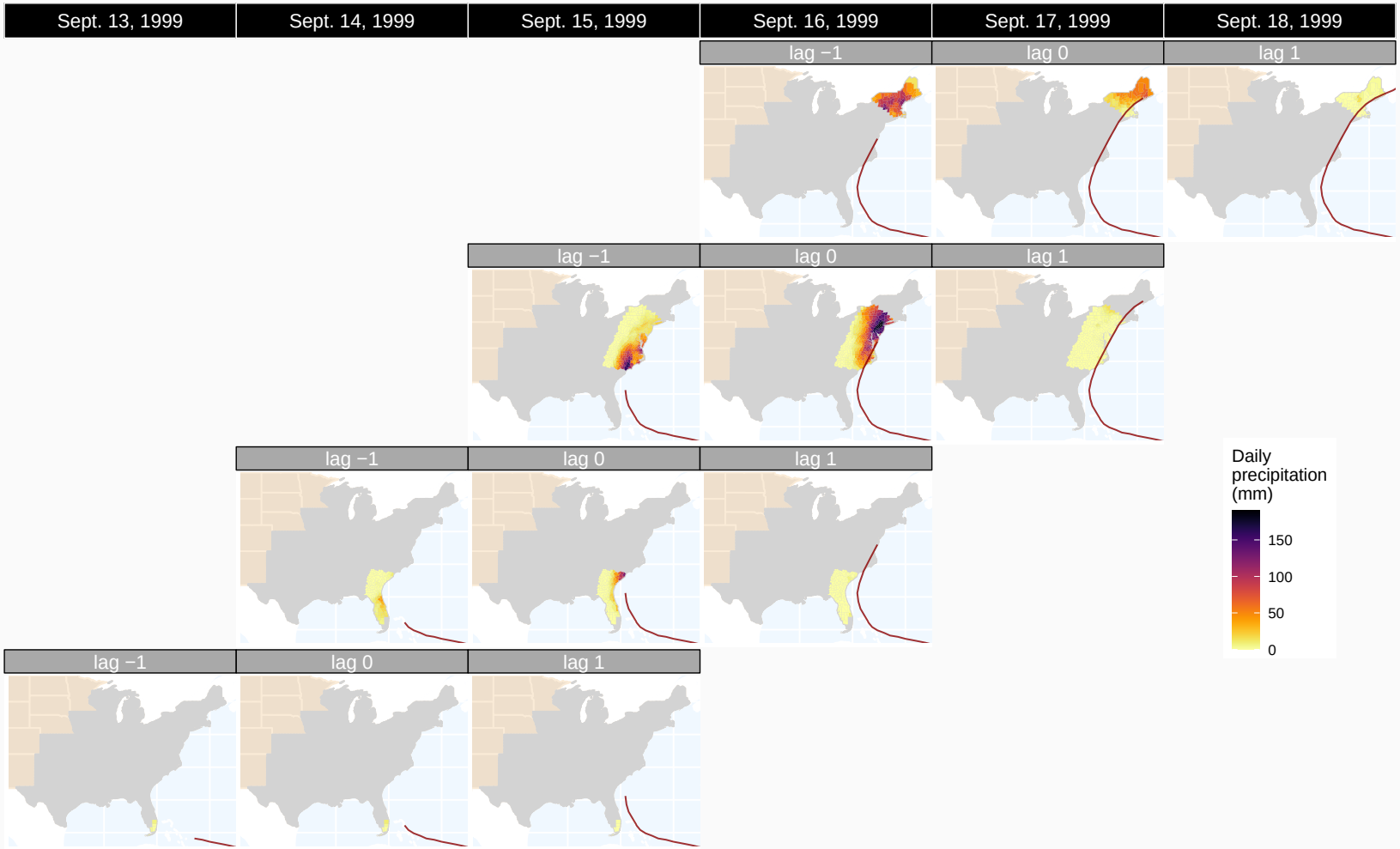
Local storm-associated winds at the population mean center of Dare County, NC, at 15-minute intervals throughout the tracking period of Hurricane Floyd, 1999.



Possible summaries: Peak winds; Duration of winds over 20 m/s.

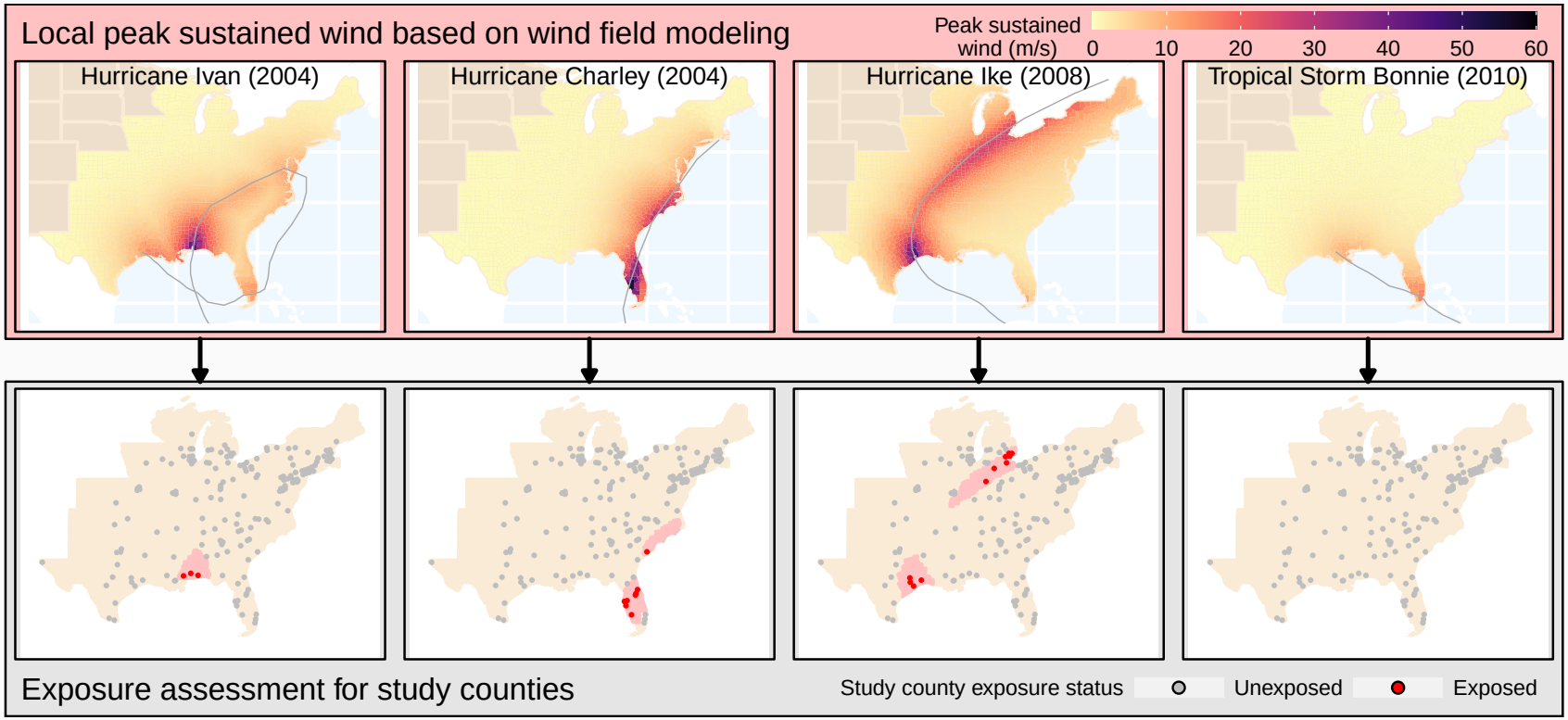
Aggregating exposure time series

Precipitation during Hurricane Floyd, 1999, for three day windows surrounding the storm's closest approach to each county.



County-level exposure assessment

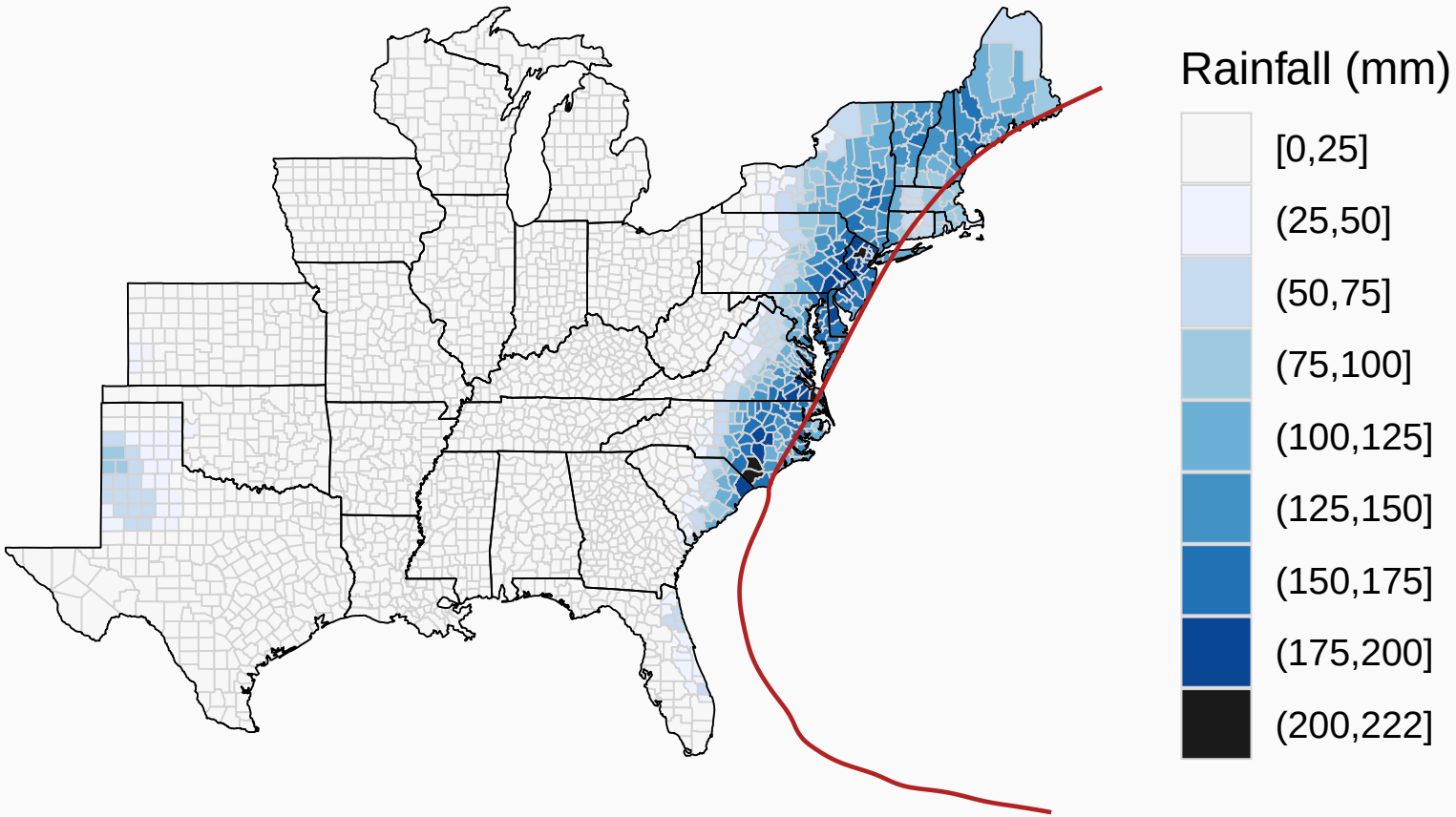
Developing county-level exposure assessment for local peak sustained winds associated with tropical cyclones, 1988–2019.



County-level exposure assessment

The `hurricaneexposure` package can be used to map exposures for specific storms:

```
map_counties(storm = "Floyd-1999", metric = "rainfall")
```



County-level exposure assessment

The `hurricaneexposure` package can also be used to identify all exposures meeting specific criteria:

```
county_rain(counties = c("22071", "51700"), rain_limit = 100,
            start_year = 1995, end_year = 2005, dist_limit = 100,
            days_included = c(-1, 0, 1))
```

```
##         storm_id  fips closest_date storm_dist tot_precip
## 1:    Bill-2003 22071   2003-06-30   47.74045      141.1
## 2: Charley-2004 51700   2004-08-14   55.58752      136.2
## 3:   Cindy-2005 22071   2005-07-06   26.62602      113.2
## 4:   Floyd-1999 51700   1999-09-16   49.43163      207.5
```

Recent and ongoing research with this exposure assessment data

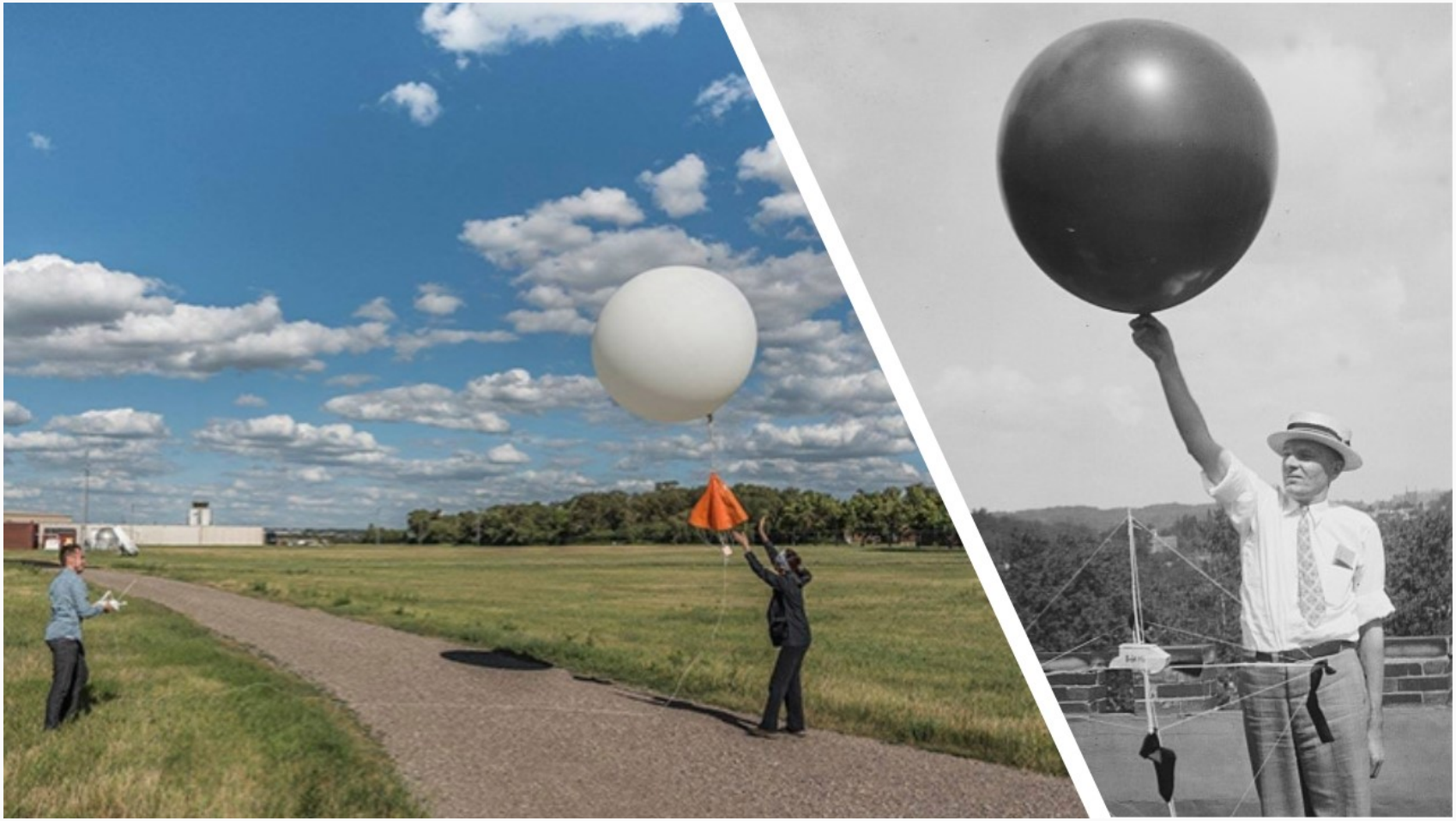
This tool is being used to study how tropical cyclone wind exposures are associated with:

1. Risk of pre-term birth
2. Risk of hospitalizations among Medicare beneficiaries
3. Risk of broad-cause mortality
4. Population migration from a community

Future directions

1. Creating exposure datasets for human impacts data at other geopolitical spatial scales (e.g., ZIP codes).
2. Explore more and better ways to aggregate exposure data on the time scale to provide relevant summary metrics to integrate with human impacts data.

Questions?



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