Transforming hazard datasets into actionable information

Protecting life and property during Tropical Hurricane events

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28 March 2024

Topics

- Introduction and Background
- Situational Awareness products: Hurricanes Ian and Idalia Surge analyses
- Transforming Hazard Datasets: Data Extractor Tool
- Case Study: Hurricane Idalia
- Summary
- Q/A

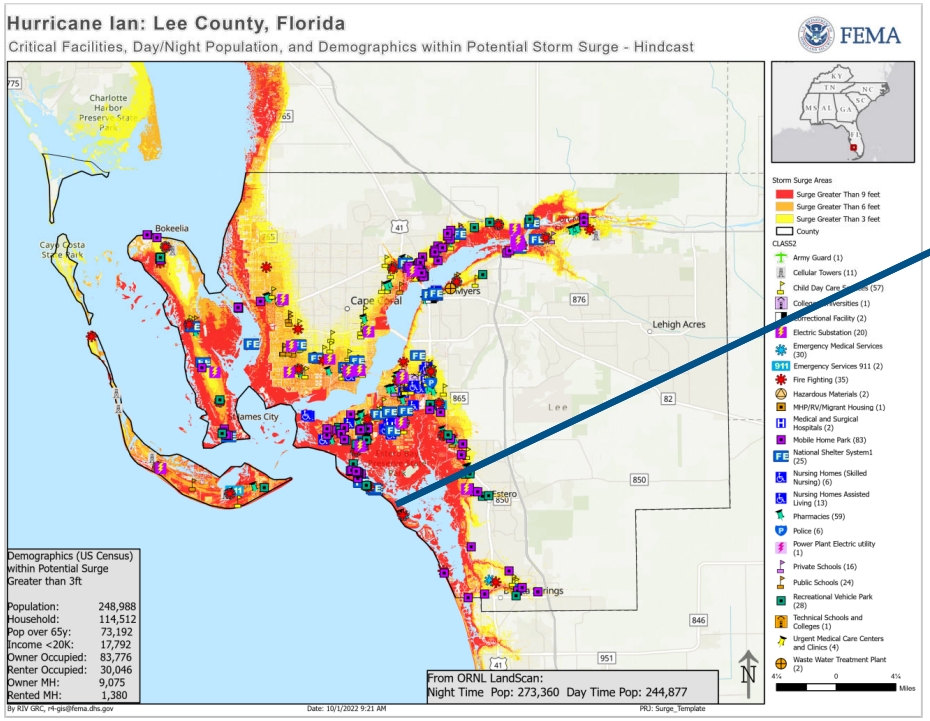
Introduction and Background

- **Situational Awareness** is important in disaster management.
  - Recent **advances in science** and **computing** enabled us to calculate risks.

- FEMA Region 4 uses **modeled data** from NOAA–NHC to create Situational Awareness (SA) products.
  - These help in making **well-informed** decisions.
  - Focus - deliver **timely**, **accurate**, and **actionable** insights.
  - SA products have a **quick turn around**.

Sample output: SA product from Hurricane Ian

- Output includes maps, spread sheets, and ArcGIS online dashboards.



Series of still images and the approximate local times from a remote camera that recoded a timelapse video of storm surge inundation and destruction in Fort Myers Beach. Credit: Max Olson. **Source: NOAA**

Sample output – Hurricane Idalia

Infrastructure exposed to >3ft surge. Hurricane Idalia, Adv 15.

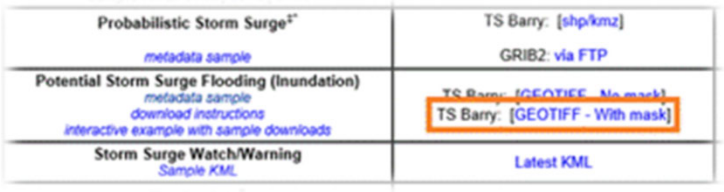
STATENAME	COUNTYNAME	CLASS1	CLASS2	FacCount	TotCount	Affected
Florida	Citrus	Cellular Communication	Cellular Towers	1	11	9%
Florida	Citrus	Education	Child Day Care Services	2	50	4%
Florida	Citrus	Education	Private Schools	1	7	14%
Florida	Citrus	Education	Public Schools	1	25	4%
Florida	Citrus	Emergency Services	Emergency Medical Services	3	24	12%
Florida	Citrus	Emergency Services	Fire Fighting	3	26	12%
Florida	Citrus	Health Facilities	Pharmacies	1	32	3%
Florida	Citrus	Law Enforcement	Police	1	6	17%

Buildings exposed to >3ft surge. Hurricane Idalia, Adv 15.

Row Labels	Agriculture	Assembly	Commercial	Education	Government	Industrial	Residential	Unclassified	Utility and Misc	Grand Total
Florida	**36**	**21**	**218**	**6**	**80**	**10**	**4,430**	**20**	**11**	**4,832**
Citrus		12	147	5	9	9	1,644	4		1,830
Dixie	3	5	21		15		1,258	5		1,307
Levy	24	1	31		16	1	447	1	3	524
Taylor	9	3	19	1	40		1,081	10	8	1,171
Georgia			**8**		**2**	**9**	**80**	**7**	**4**	**110**
Chatham			8			9	80	7	4	108
McIntosh					2					2
North Carolina			**2**				**10**			**12**
Brunswick							3			3
New Hanover			2				4			6
Pender							3			3
South Carolina	**1**	**9**	**26**	**1**	**3**		**1,036**	**20**	**3**	**1,099**
Beaufort		1	15	1	1		667	16	3	704
Charleston		1	10		2		181	3		197
Colleton		7	1				173			181
Horry							10			10
Jasper	1						5	1		7
Grand Total	**37**	**30**	**254**	**7**	**85**	**19**	**5,556**	**47**	**18**	**6,053**

Potential storm surge data

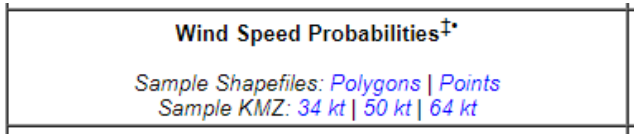
- NOAA's National Hurricane Center (NHC) provides advisories for storm surge.
- Based on Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model.
- Includes areas of Potential Surge inundation
  - http://www.nhc.noaa.gov/gis/
  - GEOTIFF – with mask.



Probabilistic Storm Surge[1*] *metadata sample*	TS Barry: [shp/kmz] GRIB2: via FTP
Potential Storm Surge Flooding (Inundation) *metadata sample* *download instructions* *interactive example with sample downloads*	TS Barry: [GEOTIFF - No mask] TS Barry: [GEOTIFF - With mask]
Storm Surge Watch/Warning *Sample KML*	Latest KML

Tropical storm force winds

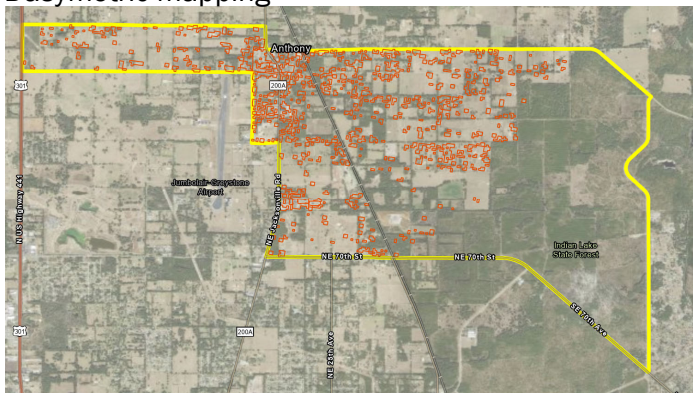
- Storm force wind probabilities are based on Global Deterministic and Ensemble models.
- Downloaded from the NHC website as polygon features.

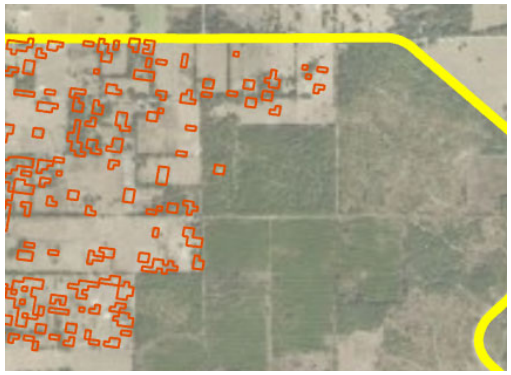


Demography and Infrastructure datasets

- Population / Demography data.
  - 2020 Census blocks.
  - Dasymetric block polygons – eliminates unpopulated areas.
- Critical Infrastructure – Sourced from HIFLD, USACE, RxOpen and ESRI.
  - 20 classes (Education, Law enforcement, Power, …)
  - Moving target – constantly updated.
  - Last updated in Nov 2023.

Dasymetric mapping





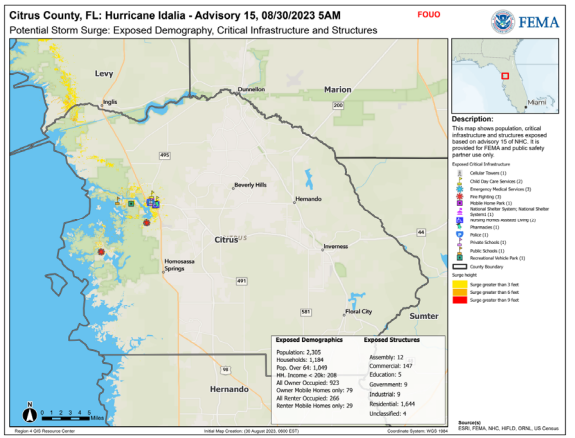
Zoomed-in view

Structure dataset

- Structures or buildings (Oak Ridge National Laboratory - ORNL)
  - Large dataset with about **28 million** structures for the 8 Region 4 states.
  - Preprocessed for performance – points with selected attributes.
  - Last updated in Sep 2023.

Data Extractor Tool

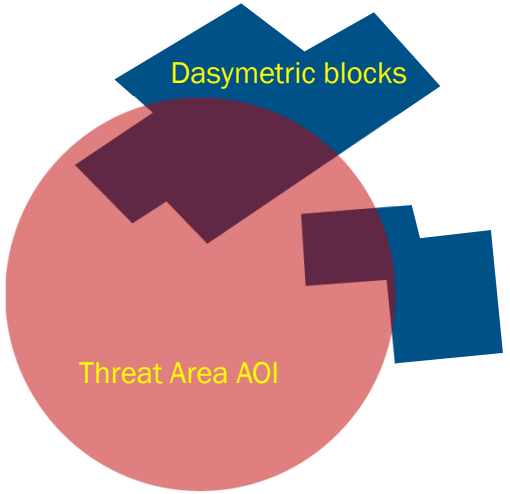
- DXT tool is a **geoprocessing routine** developed **in-house** at the Region 4 GRC.
- Written in python using ArcGIS geoprocessing api. Works within ArcGIS Pro.
- DXT tool provides estimates on potential impacts
  - Population and demography
  - Critical Infrastructure
  - Structures or buildings



DXT tool – Analysis method

- DXT tool helps to estimate potential impacts
  - Overlays environmental data over the demography and infrastructure to estimate exposure.

- Demography data - Clipping, apportioning and aggregation.
- CI and Structure data - Clipping and aggregation.
  - Percentage exposed within the County and State is included.



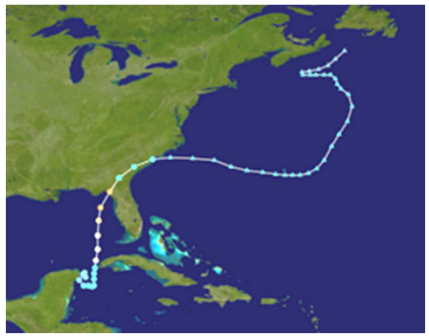
Population exposed = (Clip Area / Tot Area) x Total population

AOI – Area of Interest

Case study – Hurricane Idalia (Post event analysis)

Hurricane Idalia

- This **tenth** named storm formed in late August 2023.
- Landfall in FL on August 30, 2023, as a **category 4 hurricane** .
- Resulted in **10 fatalities** and **$3.6 billion** in damages.
- GRC started the potential surge and wind analysis on 08/27.
- Produced 19 products from NHC advisories 5 – 16.

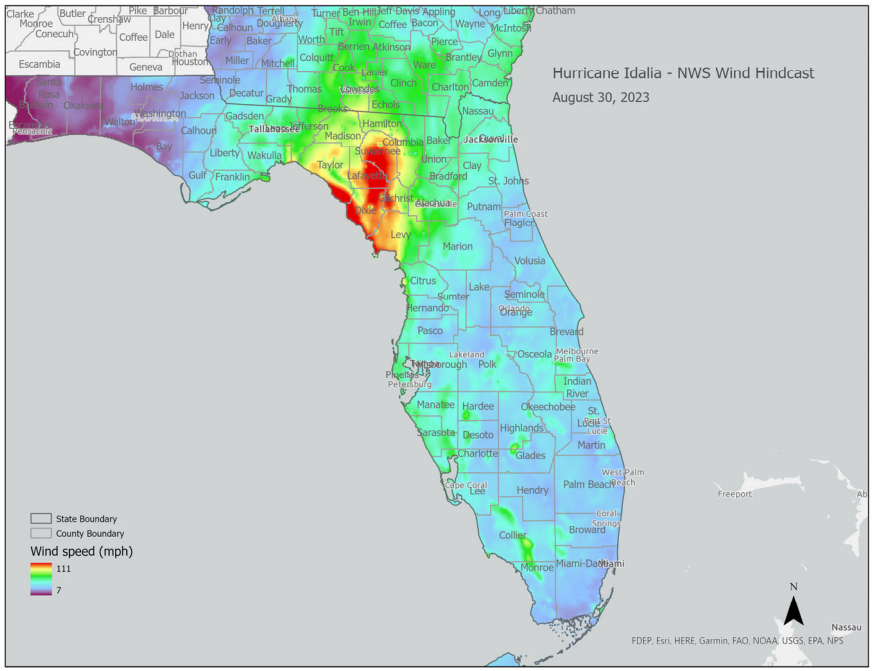


Source: wikipedia

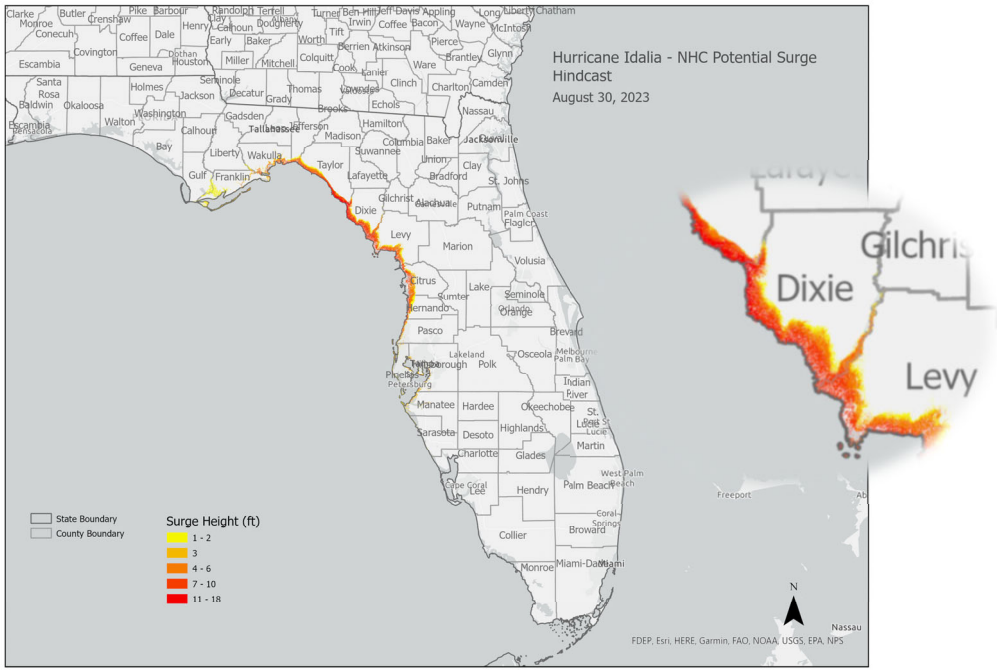
Methodology

- Goal – to evaluate the efficacy
  - Used Individual Assistance (IA) applications as an indicator of damage on the ground
  - Overlaid Surge and Wind hindcasts (observed), and IA locations
- Preliminary, and the first analysis after a hurricane.

Wind and surge hindcasts

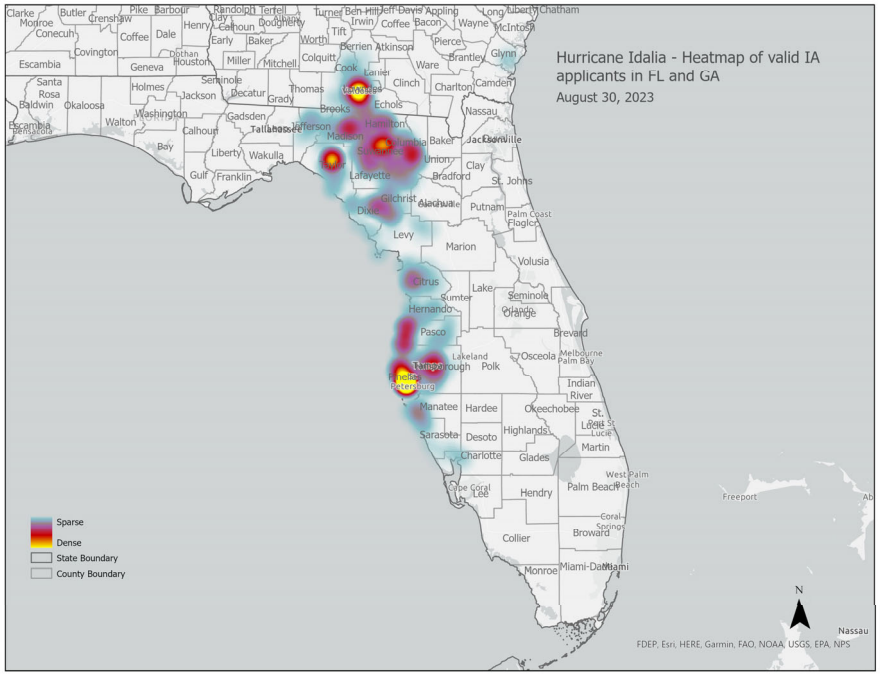


Wind hindcast from National Weather Service

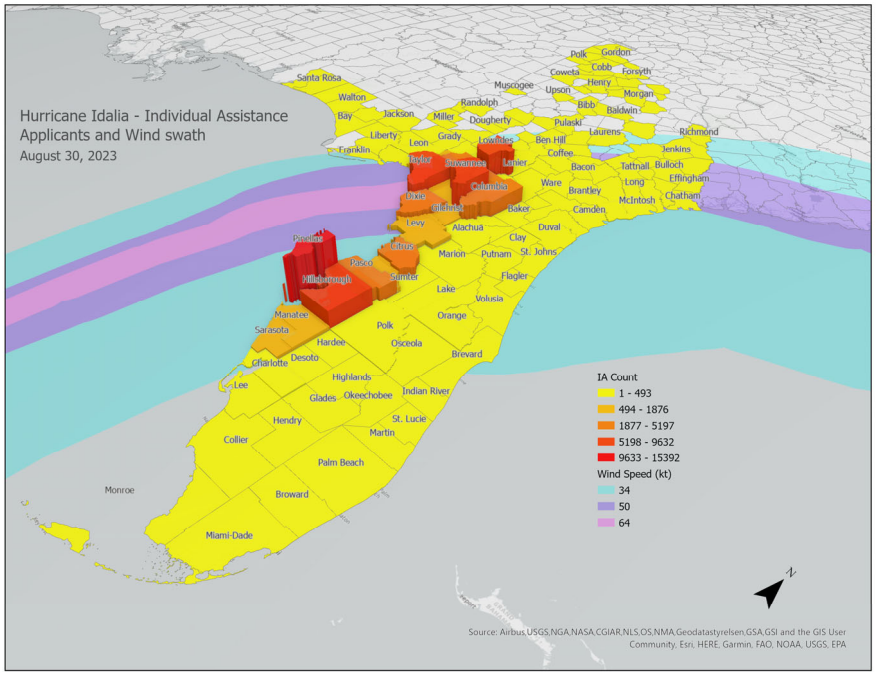


Potential surge hindcast from National Hurricane Center

Individual assistance applications



Heatmap of valid individual assistance applications



Counties with highest applicants and Wind speed (swath)

Surge and IA applicants

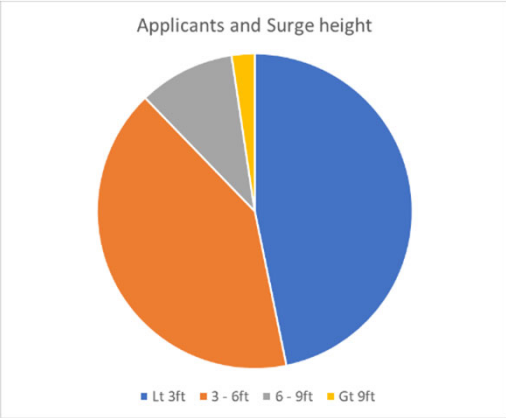
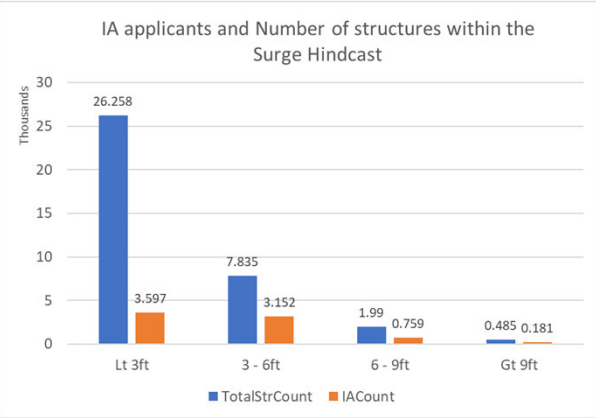


Chart showing the proportion of IA applicants within a certain surge category.



Total number of structures and the number of applicants within each category of surge.

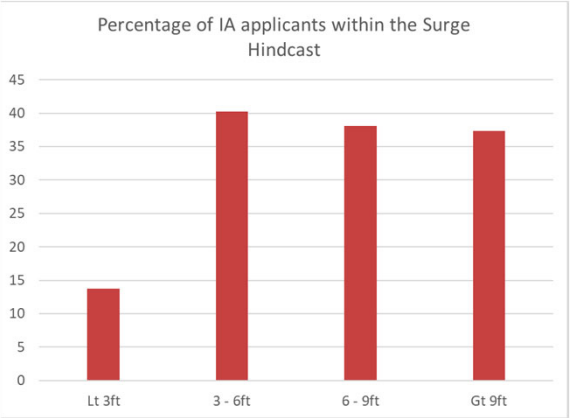
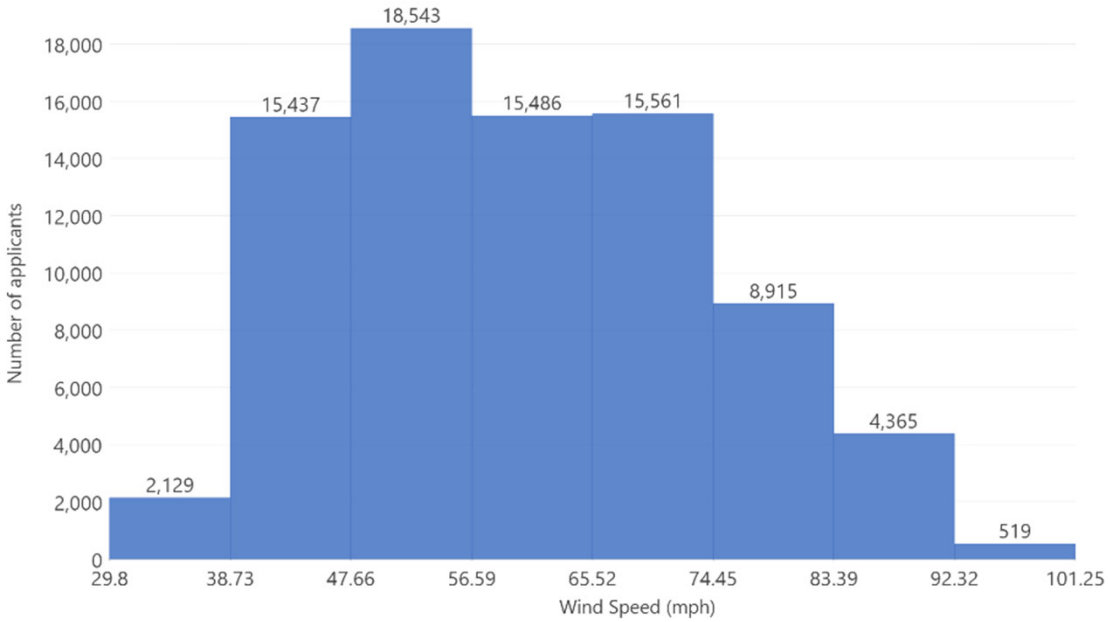


Chart showing the percentage of applicants within each category of surge. Less than 3ft areas cover more populated areas.

Data sources: FEMA, NHC

Wind and IA applicants



Data sources: FEMA, NHC

Demo

Summary

- **Data-driven** decision making makes emergency management efficient.
- GRC leverages **modeled wind** and **surge forecasts** to create situational awareness products.
- To transform **datasets** to **actionable** insights, GRC uses the **Data Extractor Tool**
  - Estimates exposed population, critical infrastructure and structures.
  - Utilize **dasymetric** analysis of population for better accuracy.
  - Output includes **maps, spreadsheets** and ArcGIS online **dashboards**.
- Post-event analysis shows that major impacts are within the primary threat areas we analyze.
- The GRC is working continuously to improve response planning by leveraging tools and data.

Questions?

Acknowledgements:
NOAA NHC.
GRC and OPB teams, FEMA.