

# Strategic Hazard Identification and Risk Assessment of Department of the Interior Resources (SHIRA) Project



**11/15/18**

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Kris Ludwig, Alice Pennaz, Dave Applegate, and Bill Leith **USGS Natural Hazards Mission Area**  
Nate Wood, Jeanne Jones, Kevin Henry, Jason Sherba, and Peter Ng **USGS Western Geographic Science Center**

# Project overview

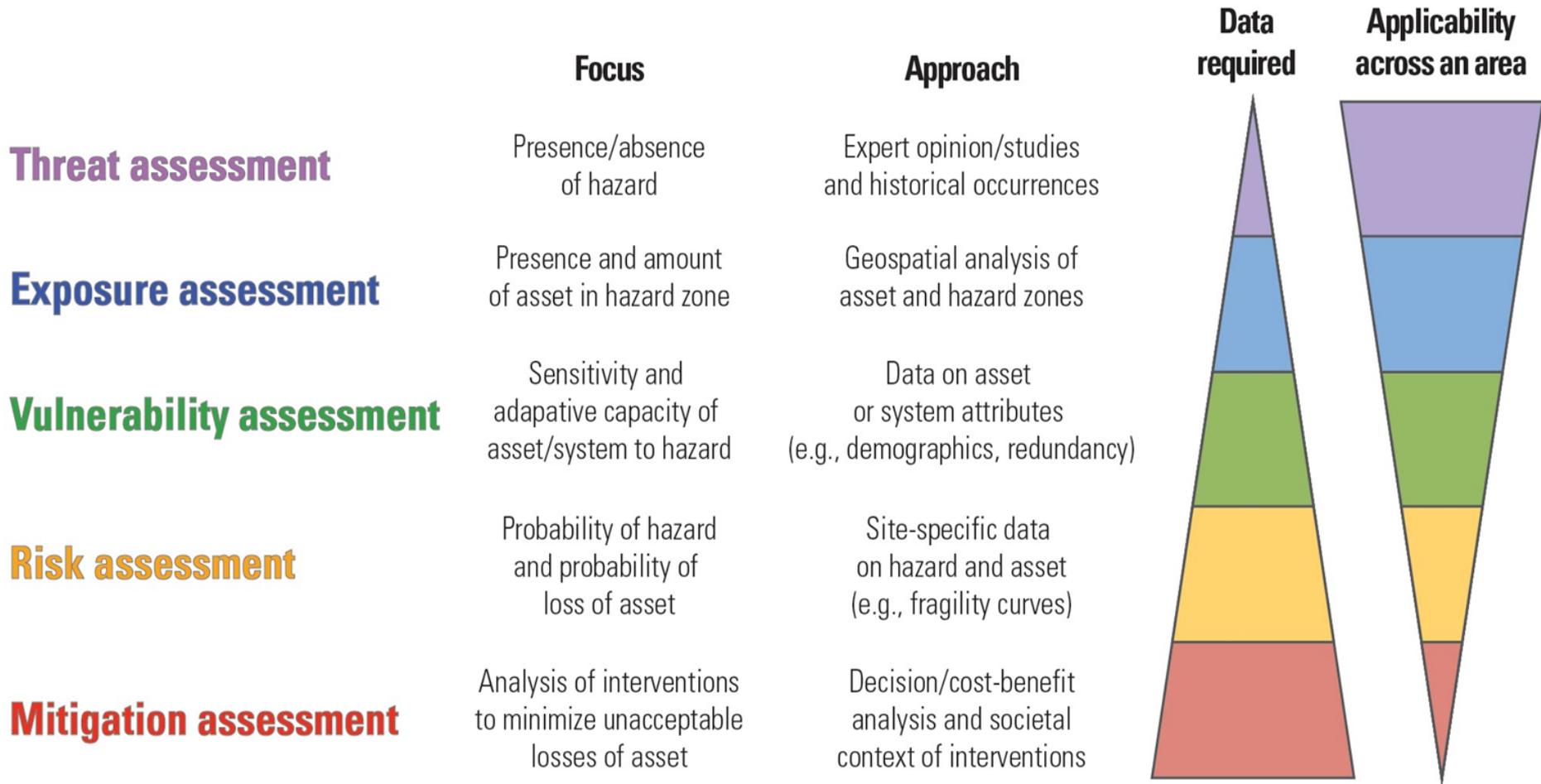
## What is SHIRA?

- Collaboration with DOI Office of Emergency Management
- Characterizing and quantifying hazard exposure to DOI assets
- Developing products that support local to national DOI planning
- Products include a (1) workshop report, (2) geospatial data of hazards and assets, (3) national summary of DOI hazard exposure, and (4) accessible data and workflows

## What are DOI benefits of SHIRA?

- Hazard-exposure data can be used for facility management, employee training, infrastructure planning, public outreach, spending priorities
- Helps identify new partnerships, analyses, and tools across DOI and with partners (including tribes, other federal agencies, state, industry)
- Has identified high interest within DOI for intra-department risk workgroup to continually identify needs and share lessons learned

# Characterizing DOI Risk



## Range in potential use of DOI risk information

- Primary use is for strategic planning at DOI OEM
- Other potential uses: monitoring, operational use, investment planning

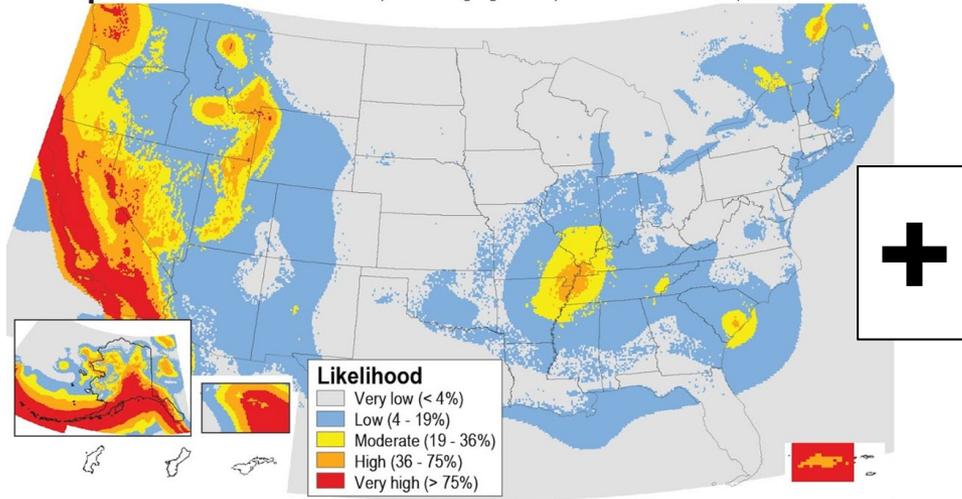
# DOI Risk Workshop - Feb. 27-28, 2018, Main Interior Building

- 48 participants from across DOI
- Interactive exercises to discuss:
  - Uses and audiences of risk information
  - Authoritative asset, land, and hazard data
  - Scale of relevant risk information
  - Frequency of relevant risk information
  - Format and delivery of information
  - Suggested next steps
- Key interests:
  - Accessible and customizable data
  - Education and engagement of DOI partners
  - Long-term sustainability
  - Tactical and real-time applications

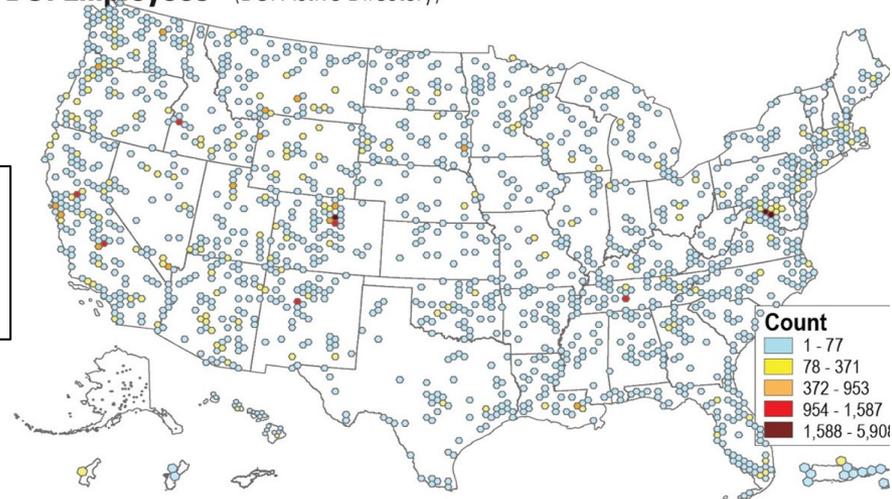


# Using GIS to visualize/quantify hazard exposure

**Earthquake hazards** - Probability of damaging earthquake in the next 100 years (USGS)



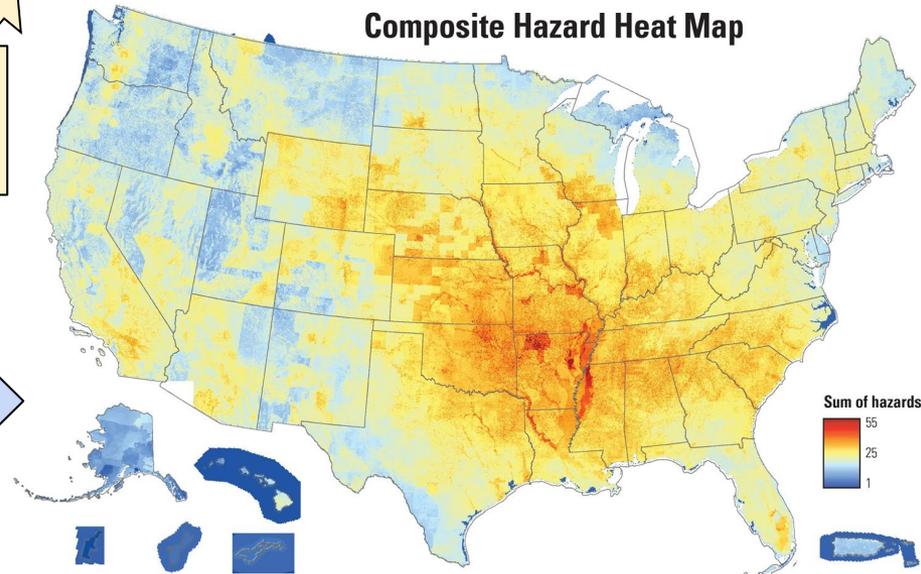
**DOI Employees** - (DOI Active Directory)



Combining hazard and asset data to quantify threat levels

Combining all hazard zones to identify hazard "hotspots"

**Composite Hazard Heat Map**





# Assets of DOI concern



## Human life safety

DOI employees  
Non-DOI employees on DOI land (e.g., contractors, concessionaires)  
NPS visitors  
Residents on DOI land  
Students at BIE tribal schools



## Natural resources

Critical habitats for threatened and endangered species  
Total land (by area)



## Facilities

DOI buildings (can be grouped by location or by type)  
DOI law enforcement offices  
Emergency Services  
Schools



## Cultural resources

National Register of Historic Places (non-sensitive)



## Infrastructure

Roads	Communication towers
Rail	BOR dams
Bridges	Transmission lines
Drinking water sources	Oil and gas pipelines
Wastewater treatment plants	



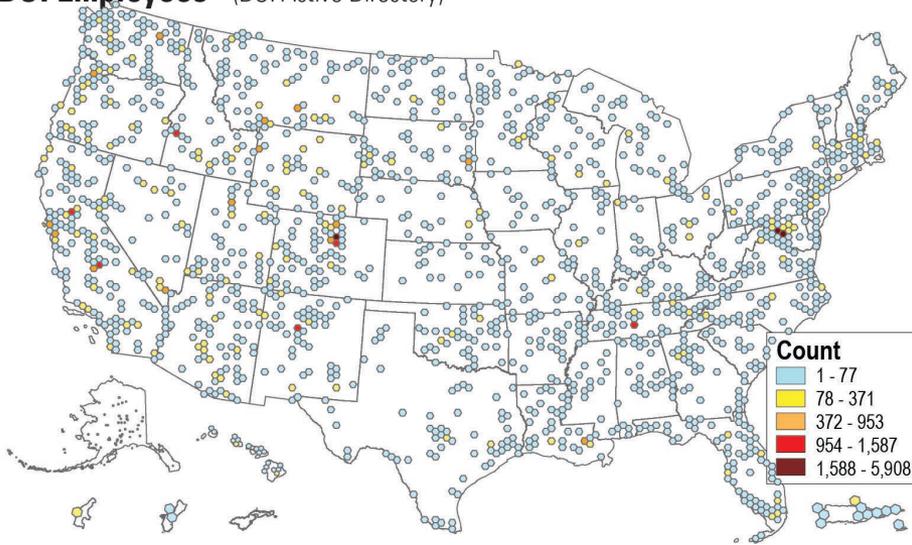
## Economic resources

Mining operations

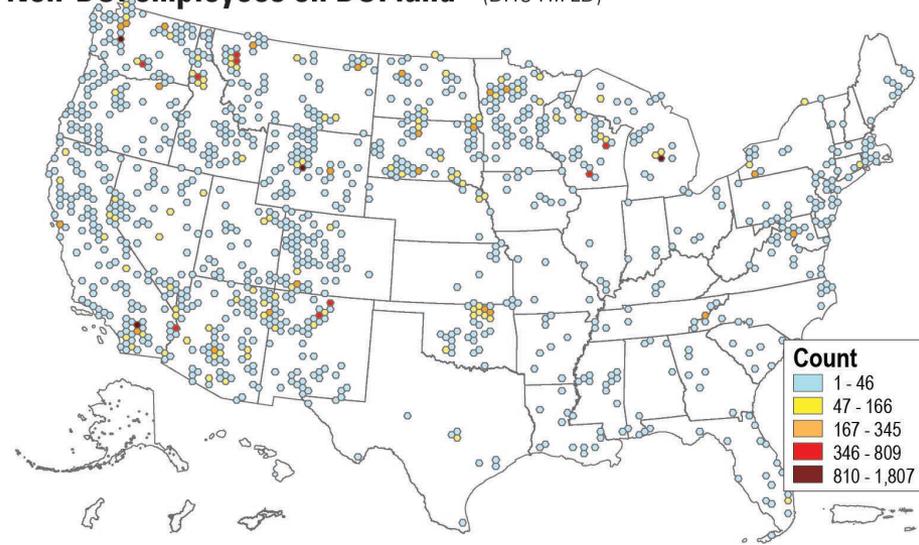
*\*Additional possible data - resource and visitor revenue available for park level or sector, but not useful for GIS analysis*

# Human populations on DOI land

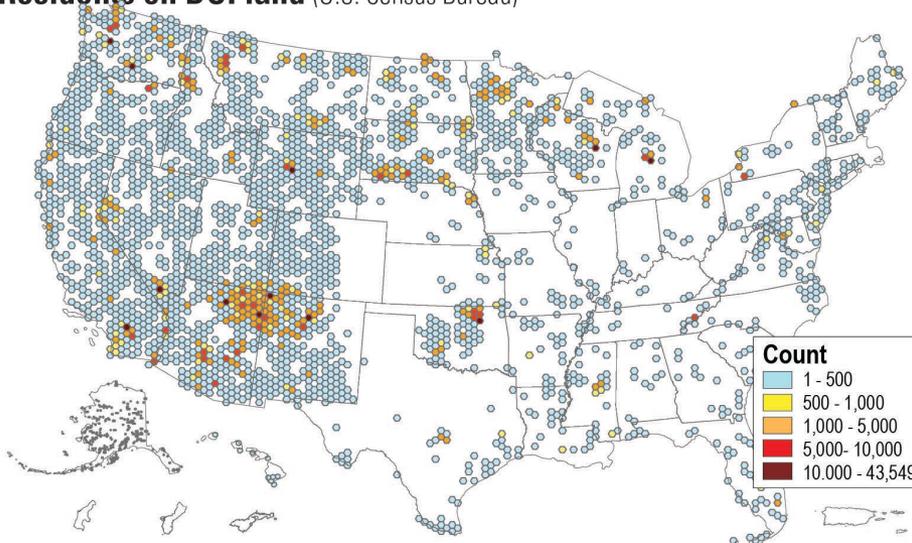
**DOI Employees - (DOI Active Directory)**



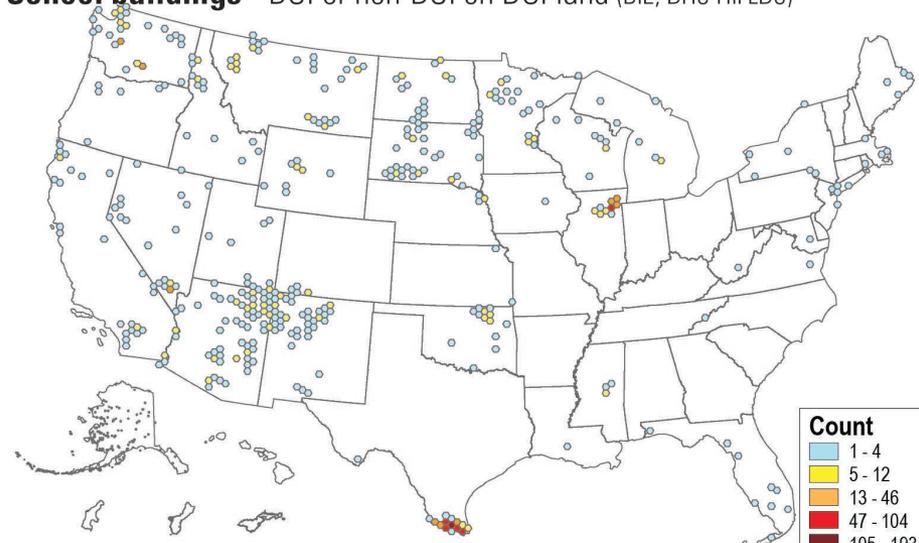
**Non-DOI employees on DOI land - (DHS HIFLD)**



**Residents on DOI land (U.S. Census Bureau)**

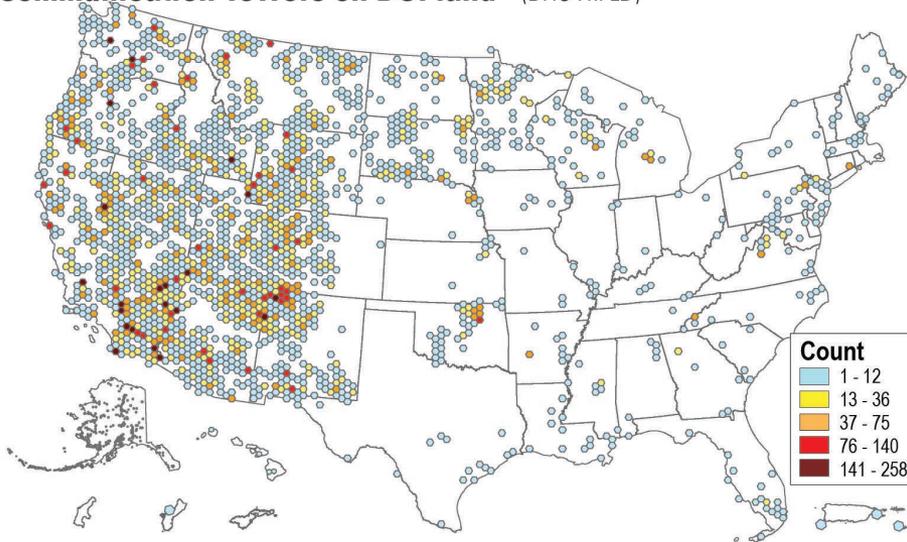


**School buildings - DOI or non-DOI on DOI land (BIE, DHS HIFLDS)**

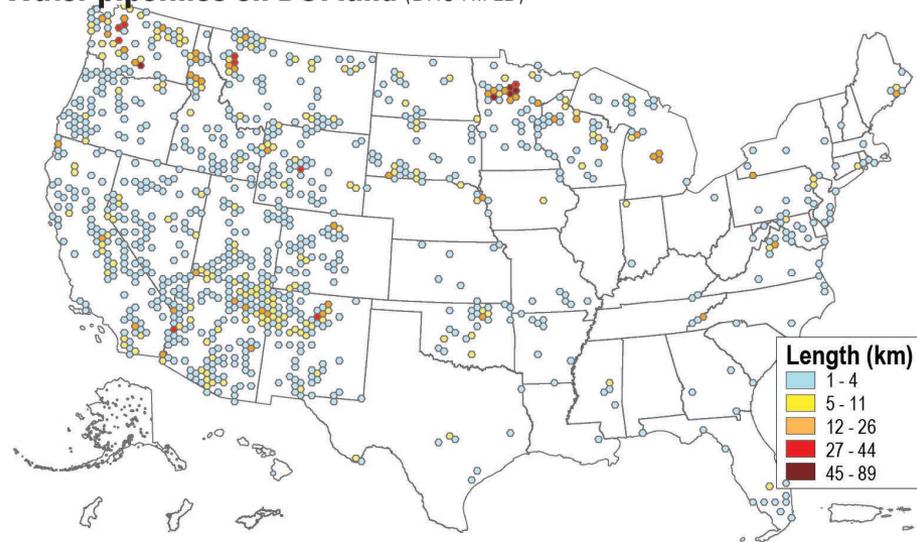


# Infrastructure on DOI land

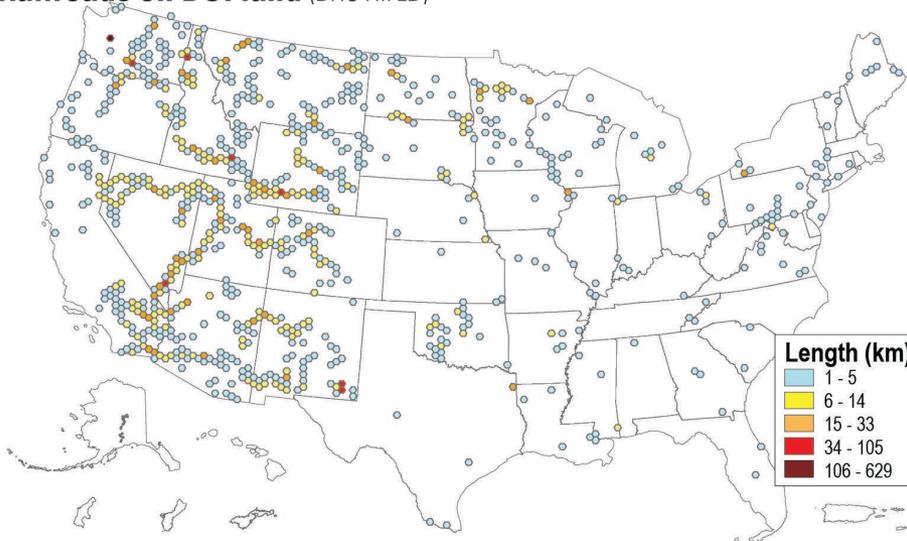
## Communication Towers on DOI land - (DHS HIFLD)



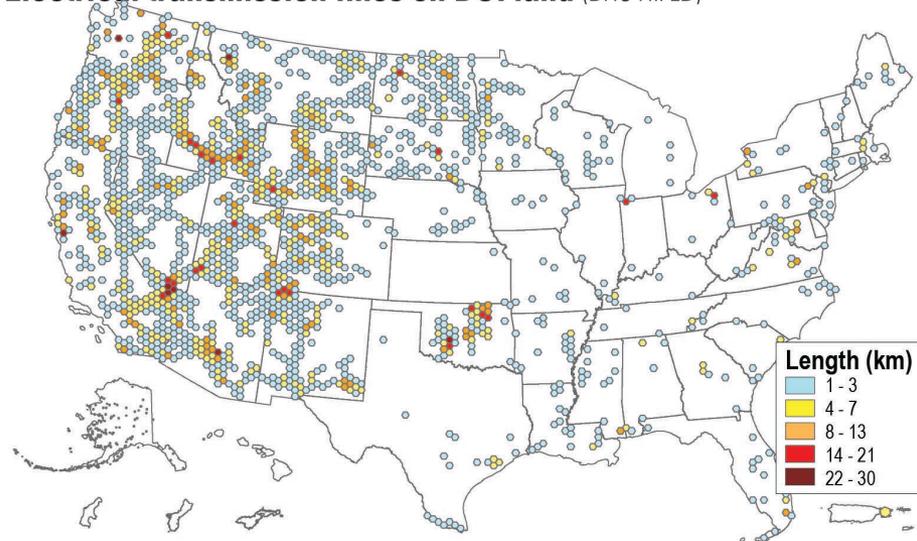
## Water pipelines on DOI land (DHS HIFLD)



## Railroads on DOI land (DHS HIFLD)



## Electrical transmission lines on DOI land (DHS HIFLD)

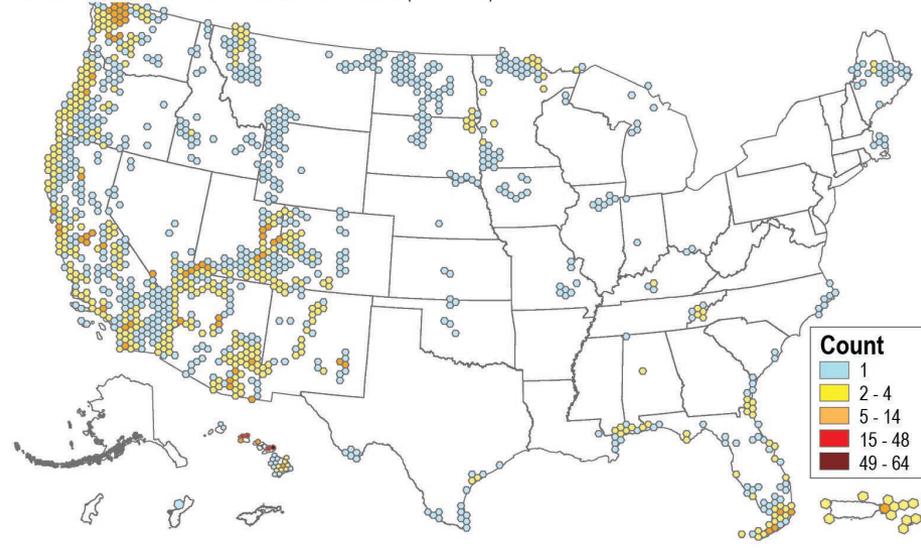


# Assets on DOI land

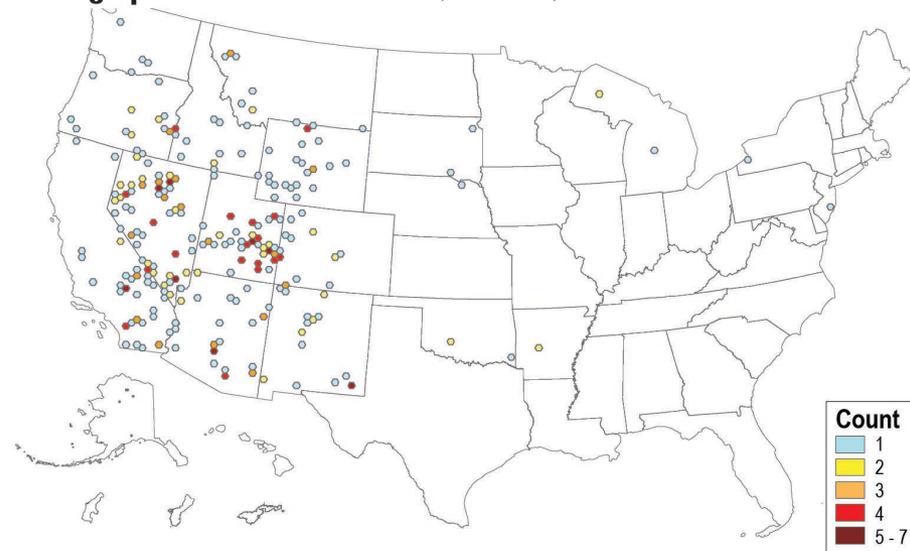
## DOI Facilities (DOI FBMS)



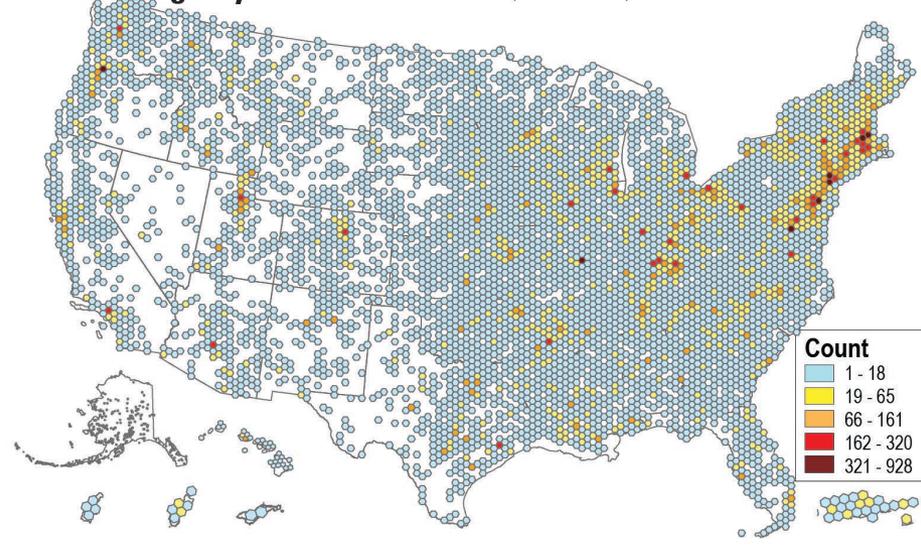
## Critical habitats on DOI land (USFWS)



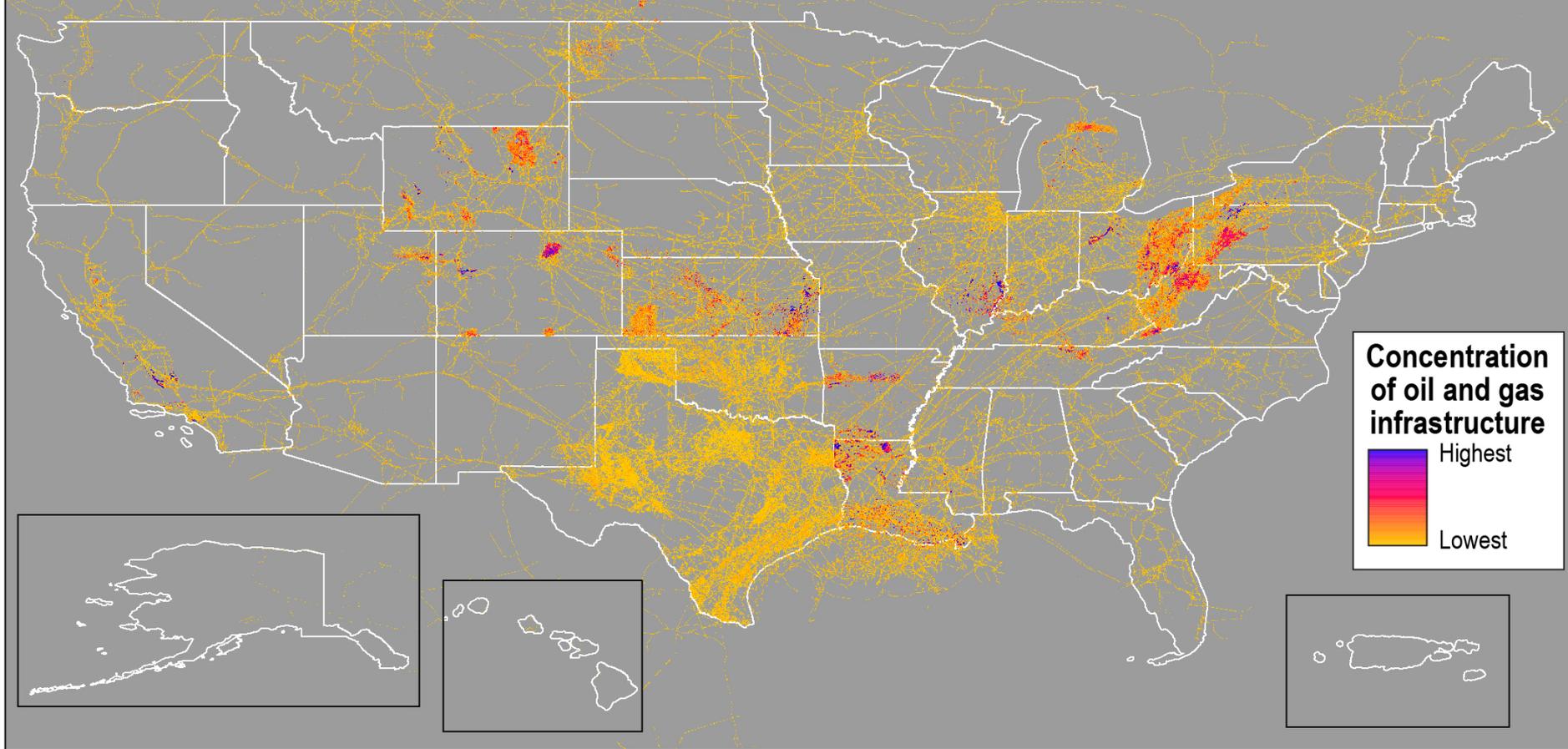
## Mining operations on DOI land (DHS HIFLD)



## National Registry of Historic Places (DHS HIFLD)



# Concentration of oil and gas infrastructure



## Petroleum facilities

Refineries  
Pipelines

## Oil and natural gas facilities

Platforms  
Interconnects  
Wells

## Natural gas facilities

Terminals  
Compressor stations  
Import and export sites

Pipelines  
Market hubs  
Processing plants

Receipt delivery points  
Storage facilities  
Alternative fueling stations

# Hazards of DOI concern

## Biological hazards (human health)

Zoonotic disease	past occurrence
Toxicological disease	hazard zone past occurrence
Human pandemic outbreak	past occurrence
Harmful algal blooms	past occurrence

## Biological hazards (ecosystem health)

Infestations	hazard zone
Invasive species	past occurrence
Wildlife disease	past occurrence
Water quality	identified sites

## Wildland fire hazards

hazard zone

## Geophysical hazards

Coastal erosion/inundation	hazard zone
Earthquake	hazard zone
Flooding	past occurrence
Marine geohazards	data identified but not developed
Landslide	hazard zone
Space weather	data identified but not developed
Subsidence (karst)	data identified but not developed
Tsunami	hazard zone
Volcano	hazard zone

## Meteorological hazards

Extreme heat	Lightning
Drought	Hurricane
Extreme cold	Storm surge
Snow hazard	Tornado
Ice storm	Hail
Wind hazard	

All past occurrence

## Technological hazards

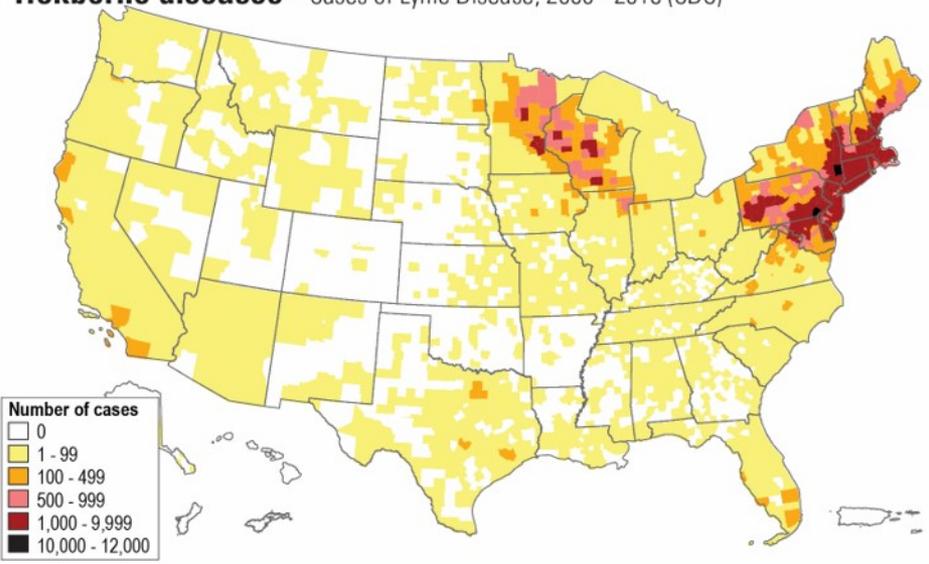
Hazardous substance release	identified sites
Oil spill, gas leaks, uncontrolled wells	identified sites
Radiological substance release	identified sites
Levee failure	hazard zone
Dam failure	hazard zone
Power grid failure	descriptive database
Bridge failure	identified sites
Tunnel failure	identified sites

## Adversarial hazards

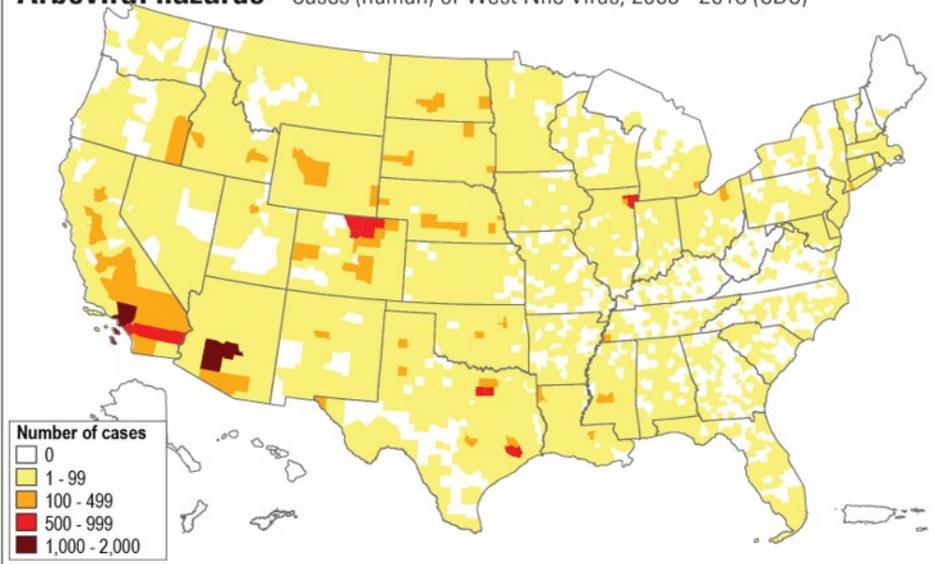
Armed assault / active shooter	past occurrence
Cyber attack (data)	descriptive database
Cyber attack (infrastructure)	descriptive database
Significant law enforcement incident	past occurrence
Cross border illegal activity	past occurrence
Terrorism (various types)	past occurrence

# Human health hazards of DOI concern

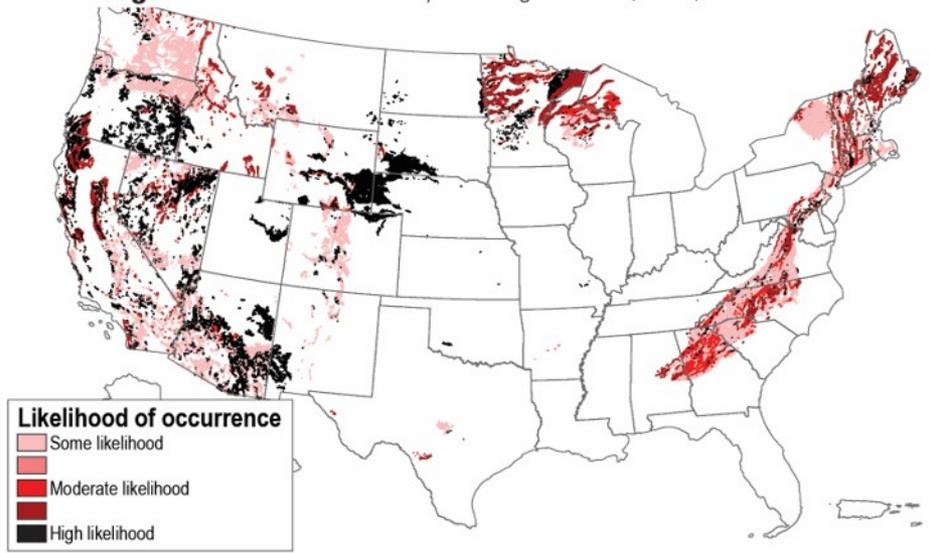
**Tickborne diseases** - Cases of Lyme Disease, 2000 - 2016 (CDC)



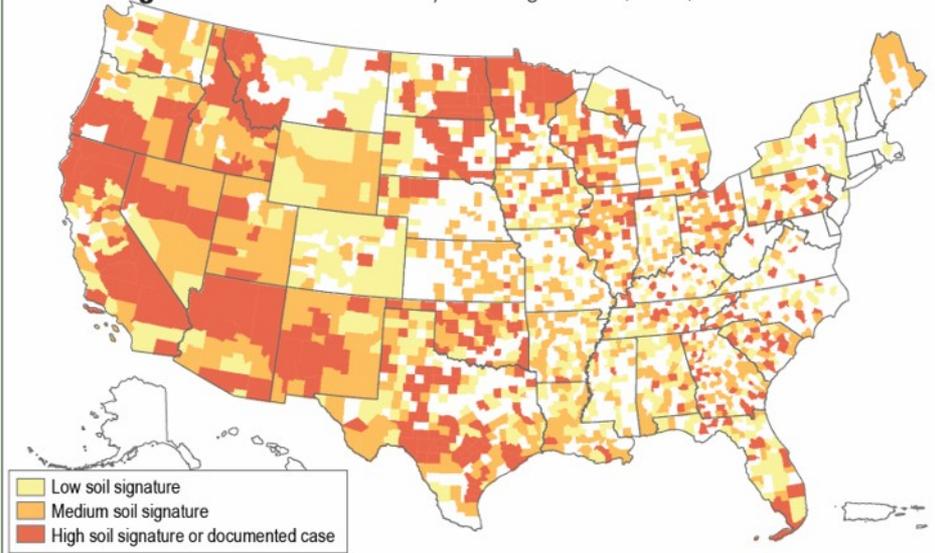
**Arboviral hazards** - Cases (human) of West Nile Virus, 2003 - 2018 (CDC)



**Toxicological disease** - Naturally occurring asbestos (USGS)

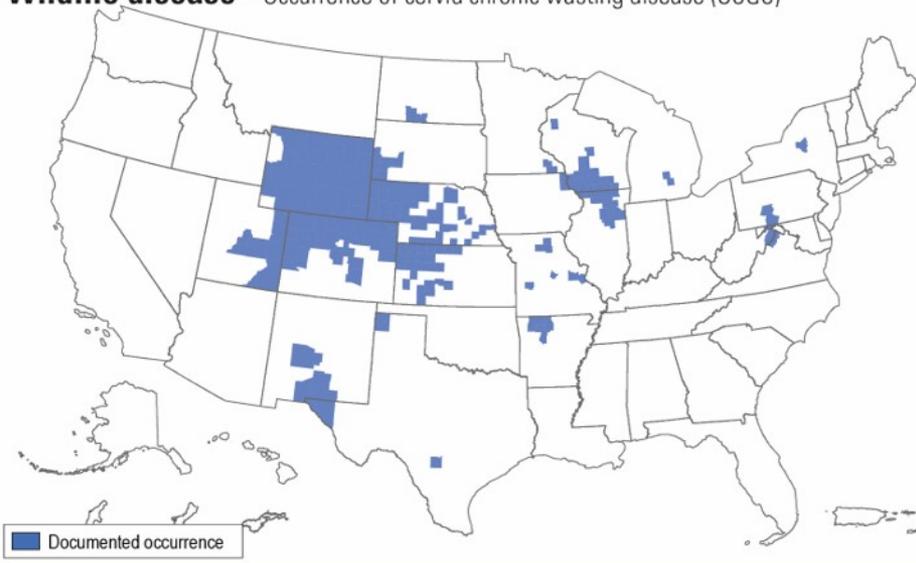


**Toxicological disease** - Naturally occurring anthrax (USGS)

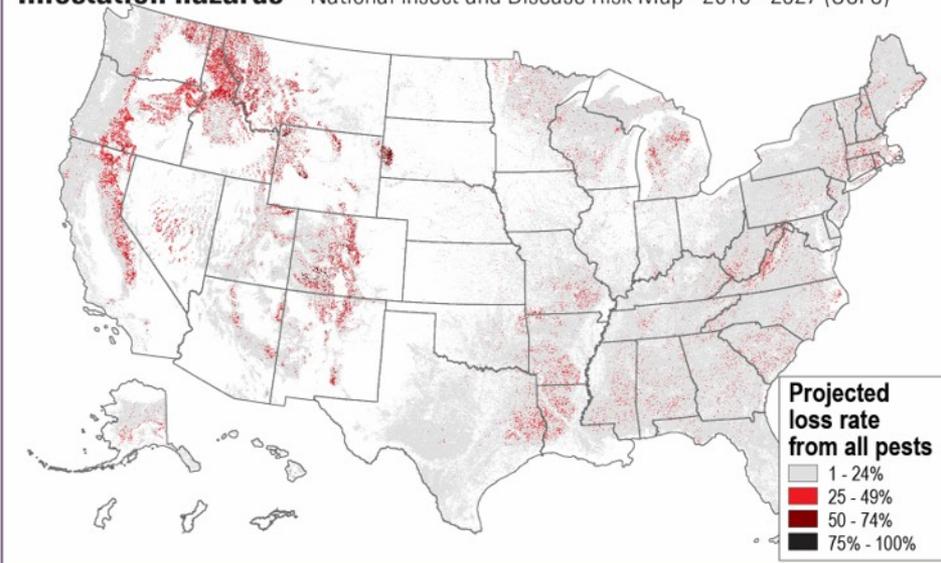


# Ecological hazards of DOI concern

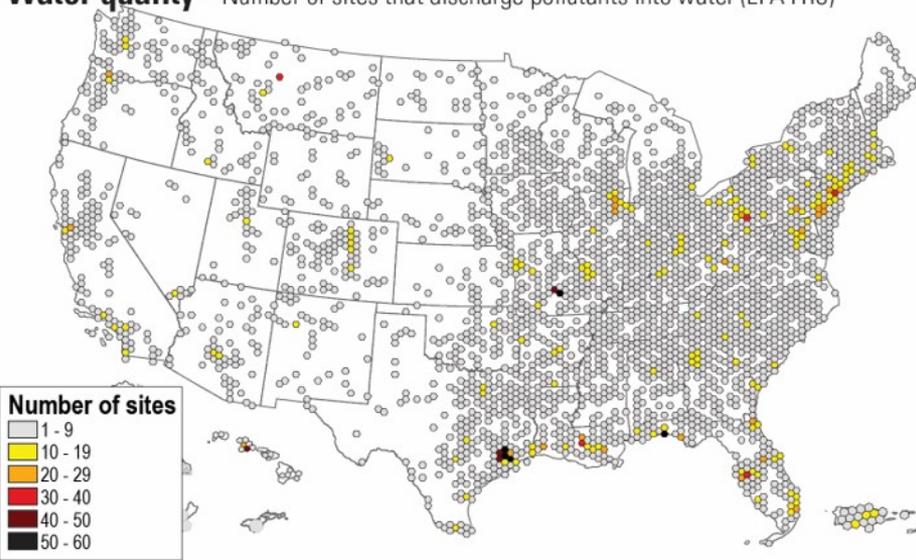
**Wildlife disease** - Occurrence of cervid chronic wasting disease (USGS)



**Infestation hazards** - National Insect and Disease Risk Map - 2013 - 2027 (USFS)



**Water quality** - Number of sites that discharge pollutants into water (EPA FRS)

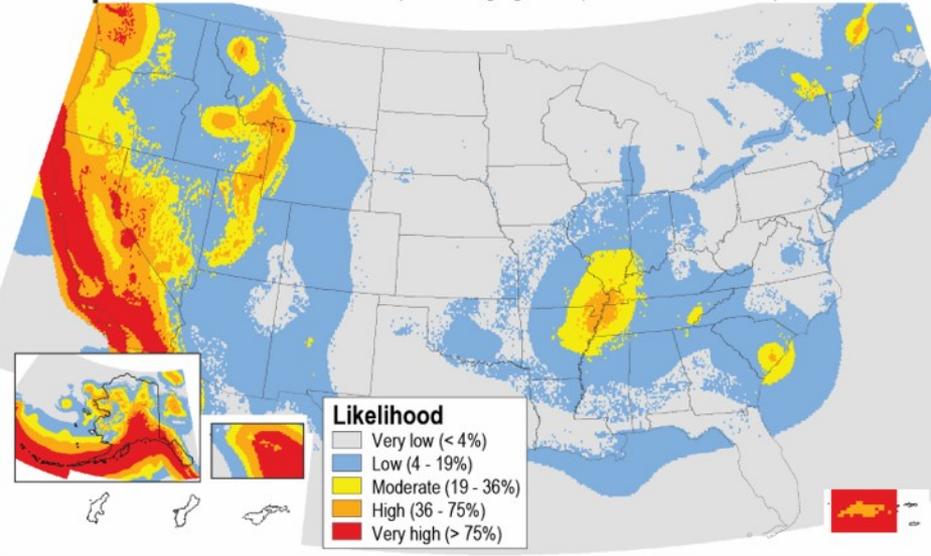


**Invasive species hazards** - Combined extents of seven susceptibility maps (USFS)



# Geophysical hazards of DOI concern

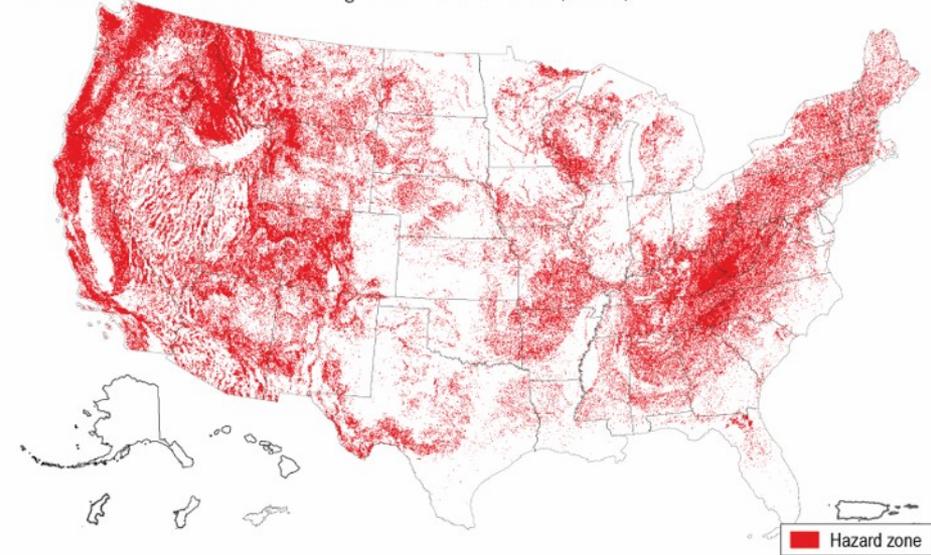
**Earthquake hazards** - Probability of damaging earthquake in the next 100 years (USGS)



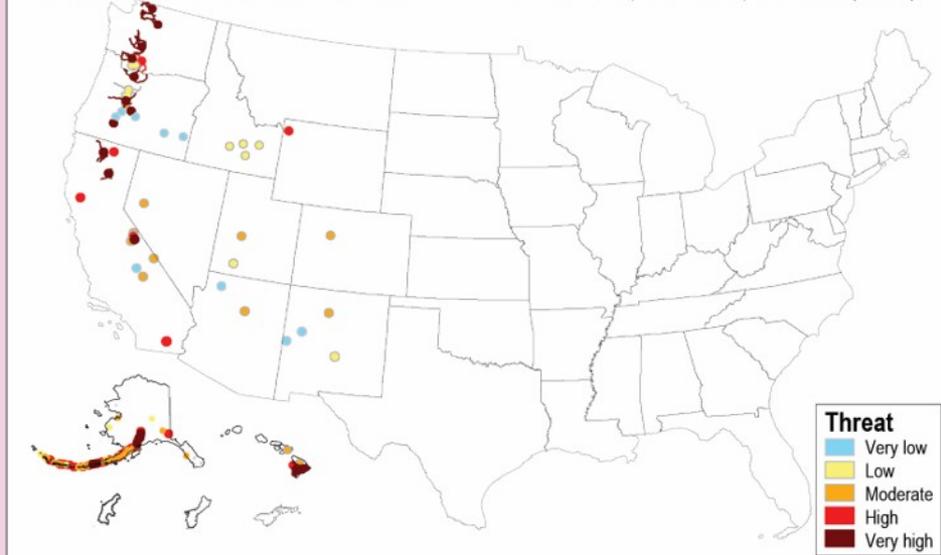
**Tsunami hazards** - Combination of potential tsunami-inundation scenarios (States, territories)



**Landslide hazards** - 1-km grid cell hazard zones (USGS)

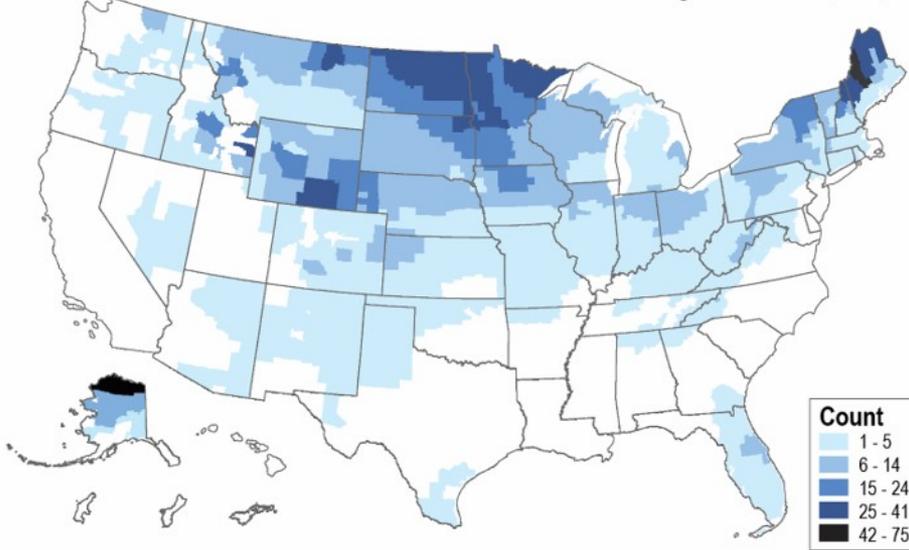


**Volcano hazards** - 30-km buffers with NVEWS threat level, lahar zones, lava zones (USGS)

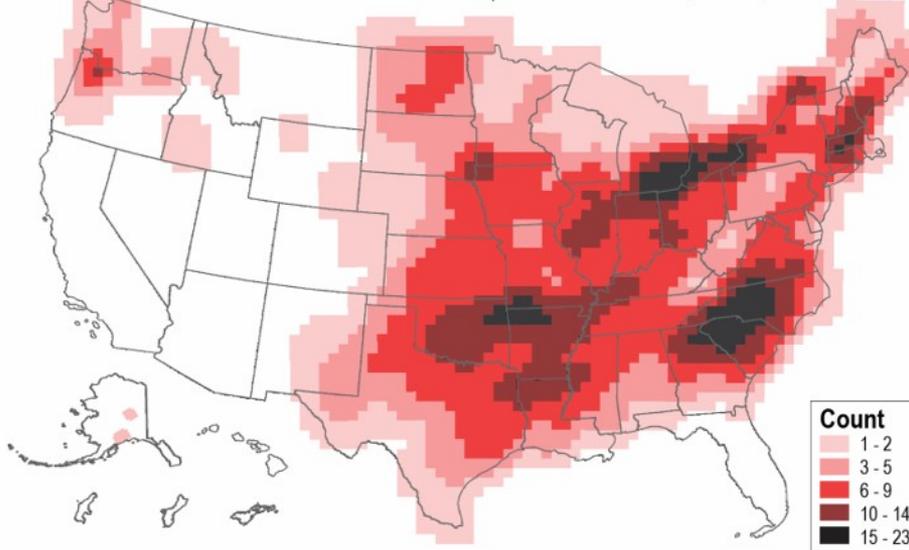


# Meteorological hazards of DOI concern (cold related)

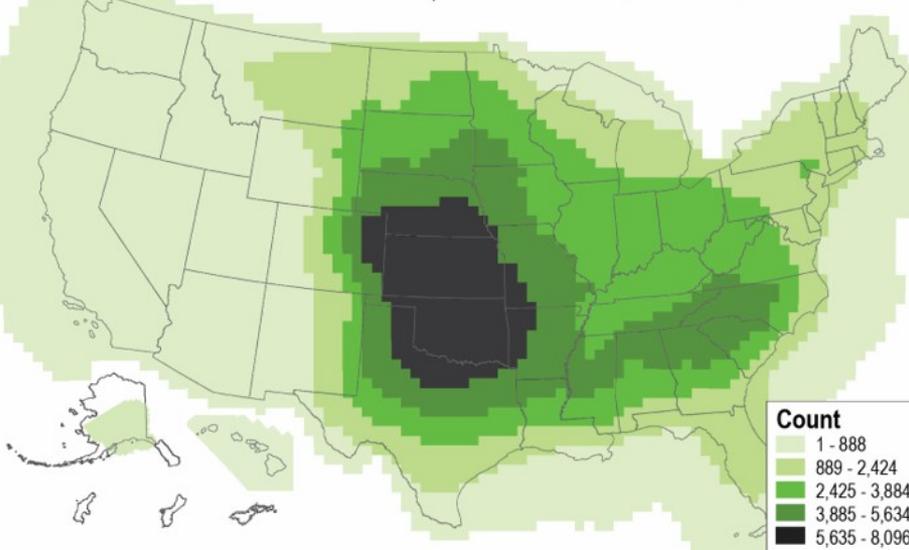
**Excessive cold hazards** - Number of NWS cold-related warnings - 2005 - 2017 (NWS)



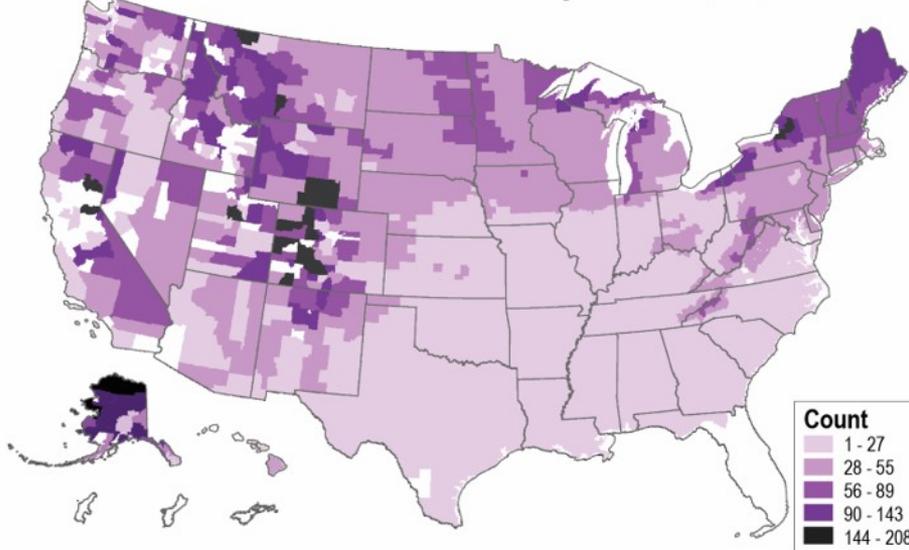
**Ice storm hazards** - Number of ice storm paths - 1940 - 2016 (USACE)



**Hail hazards** - Number of hail storm reports - 1986 - 2015 (NOAA SPC)

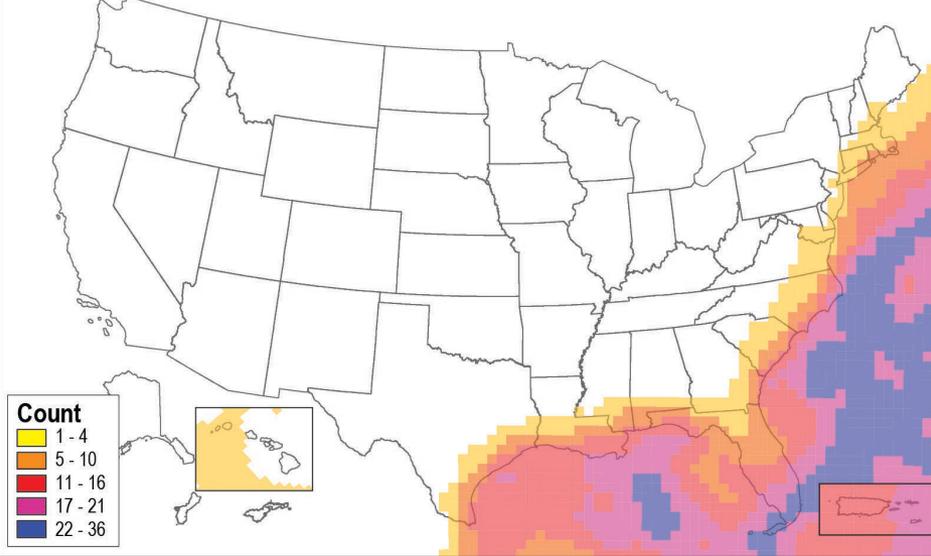


**Snow hazards** - Number of NWS snow-related warnings - 2005 - 2011 (NWS)



# Meteorological hazards of DOI concern (storms)

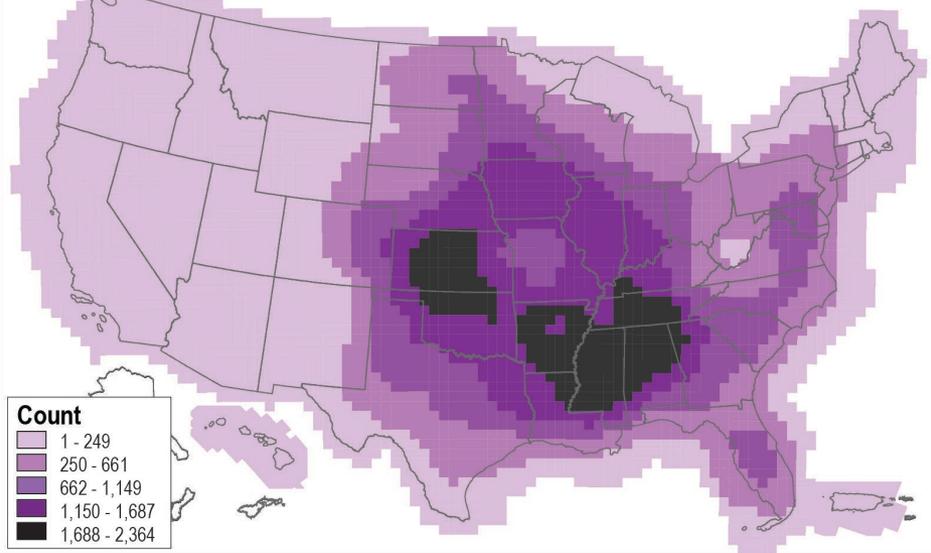
**Hurricane hazards** - Number of historic storm tracks - 1851 (A), 1949 (P) - 2015 (NOAA NHC)



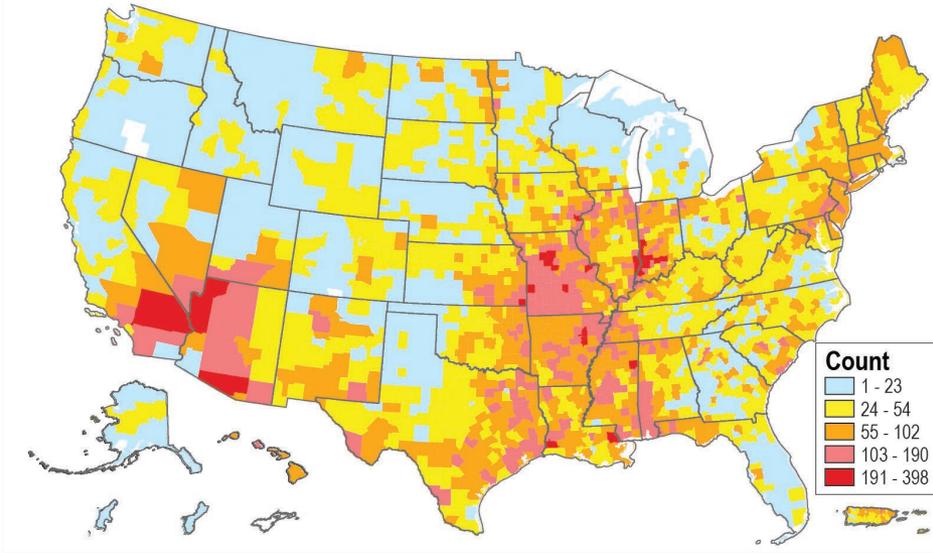
**Hurricane hazards** - Modeled SLOSH storm-surge inundation zones (NOAA NHC)



**Tornado hazards** - Number of historic tornado tracks - 1986 - 2015 (NOAA SPC)

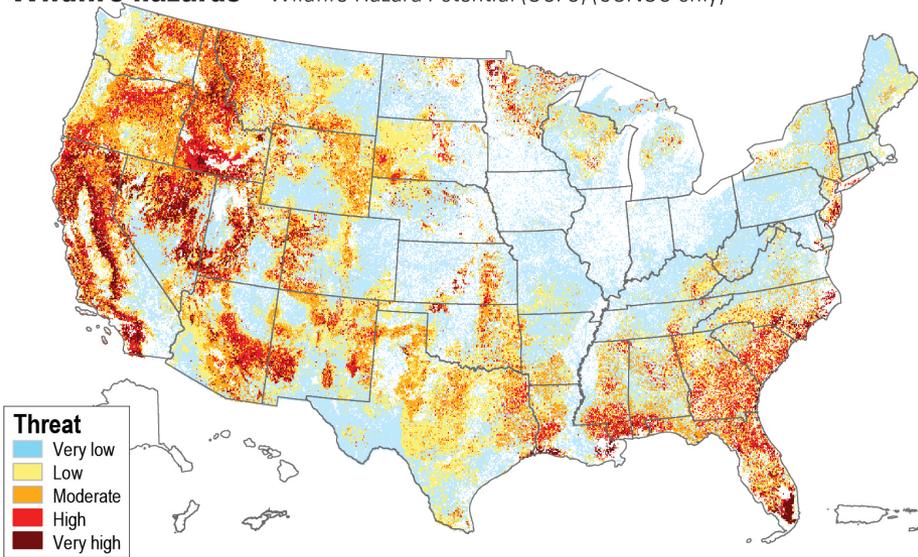


**Flood hazards** - Number of flood-related warnings - 2005 - 2017 (NWS)

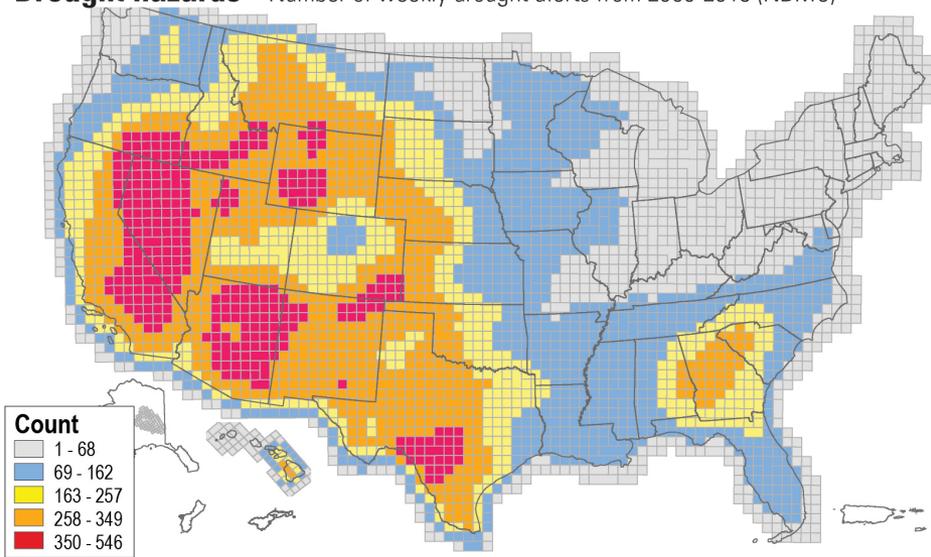


# Wildfire and heat hazards of DOI concern

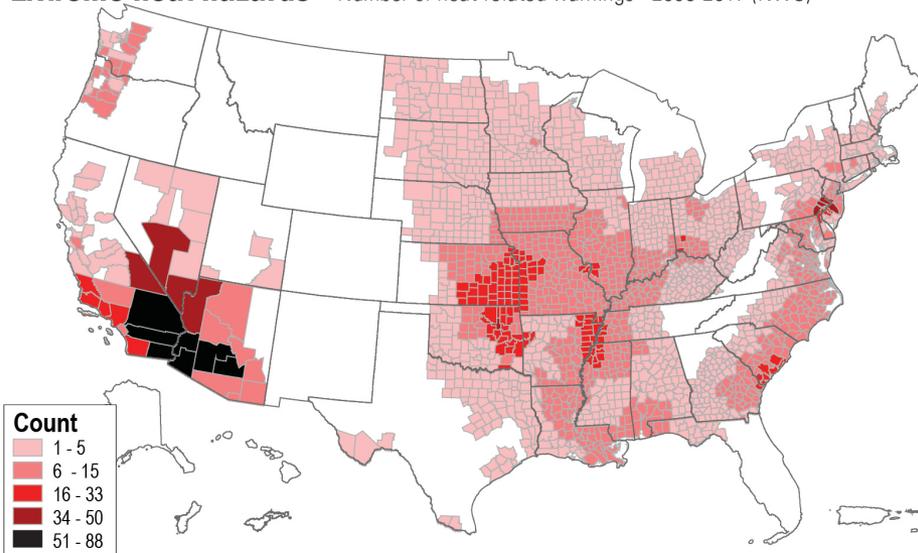
**Wildfire hazards** - Wildfire Hazard Potential (USFS) (CONUS only)



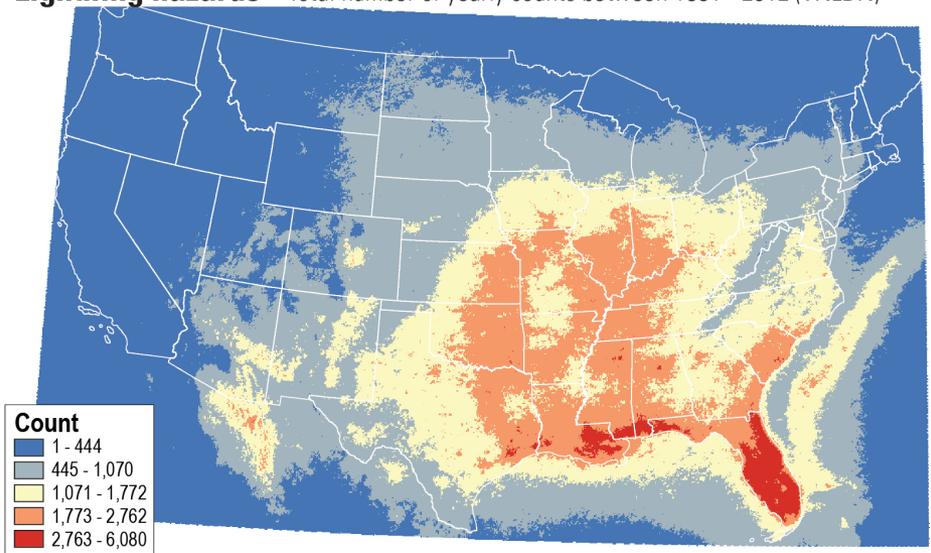
**Drought hazards** - Number of weekly drought alerts from 2000-2016 (NDMC)



**Extreme heat hazards** - Number of heat-related warnings - 2005-2017 (NWS)



**Lightning hazards** - Total number of yearly counts between 1991 - 2012 (VNLN)

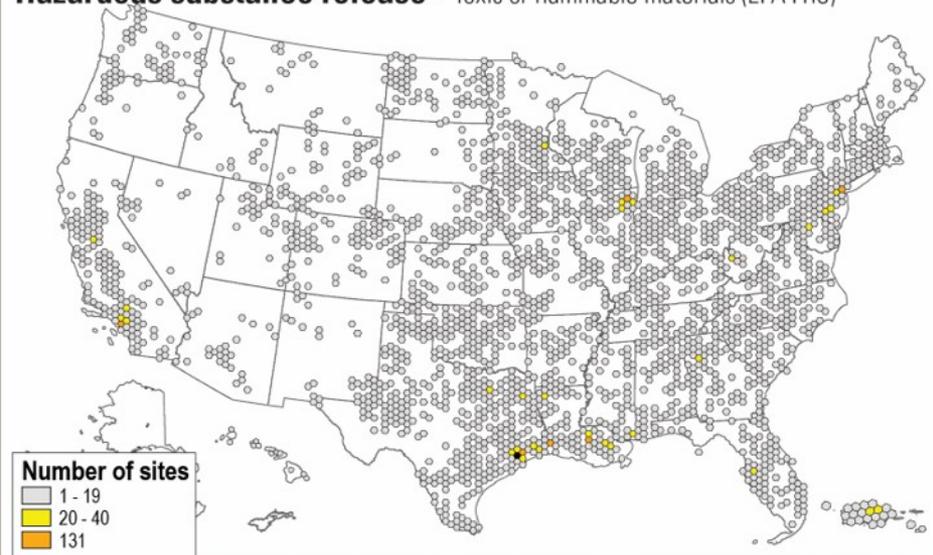


# Technological hazards of DOI concern

**Dam failure hazards** - Projected inundation areas based on breach scenarios (USACE)



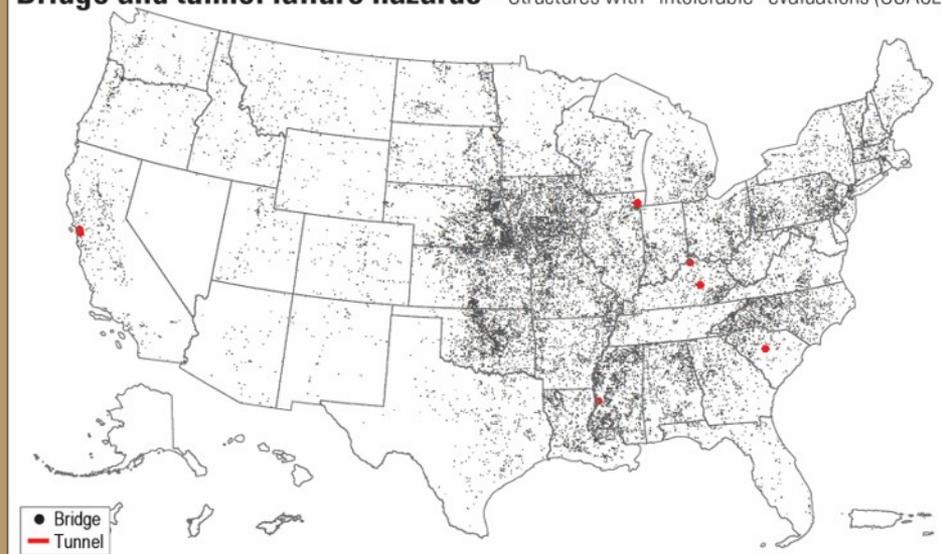
**Hazardous substance release** - Toxic or flammable materials (EPA FRS)



**Levee failure hazards** - Projected areas of inundation with failed levee (USACE)



**Bridge and tunnel failure hazards** - Structures with "intolerable" evaluations (USACE)

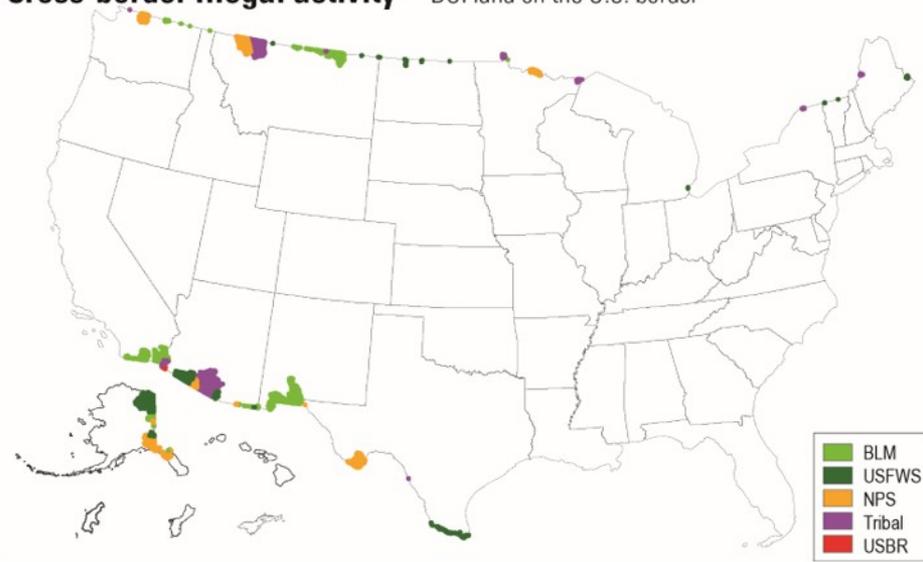


# Adversarial hazards of DOI concern

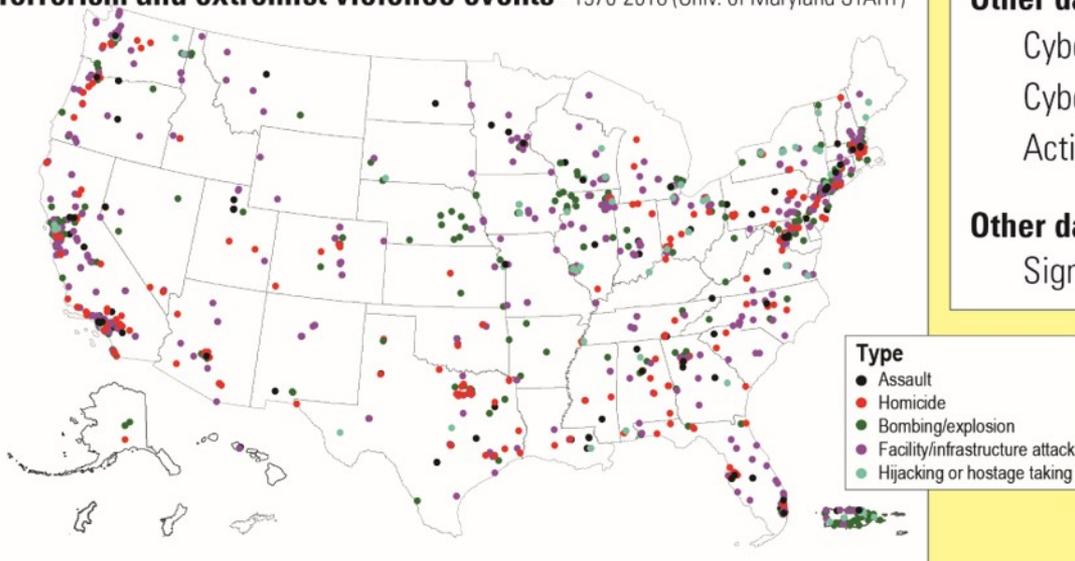
**Cross-border illegal activity - 2017 apprehensions by sector (U.S. Border Patrol)**



**Cross-border illegal activity - DOI land on the U.S. border**



**Terrorism and extremist violence events - 1970-2018 (Univ. of Maryland START)**



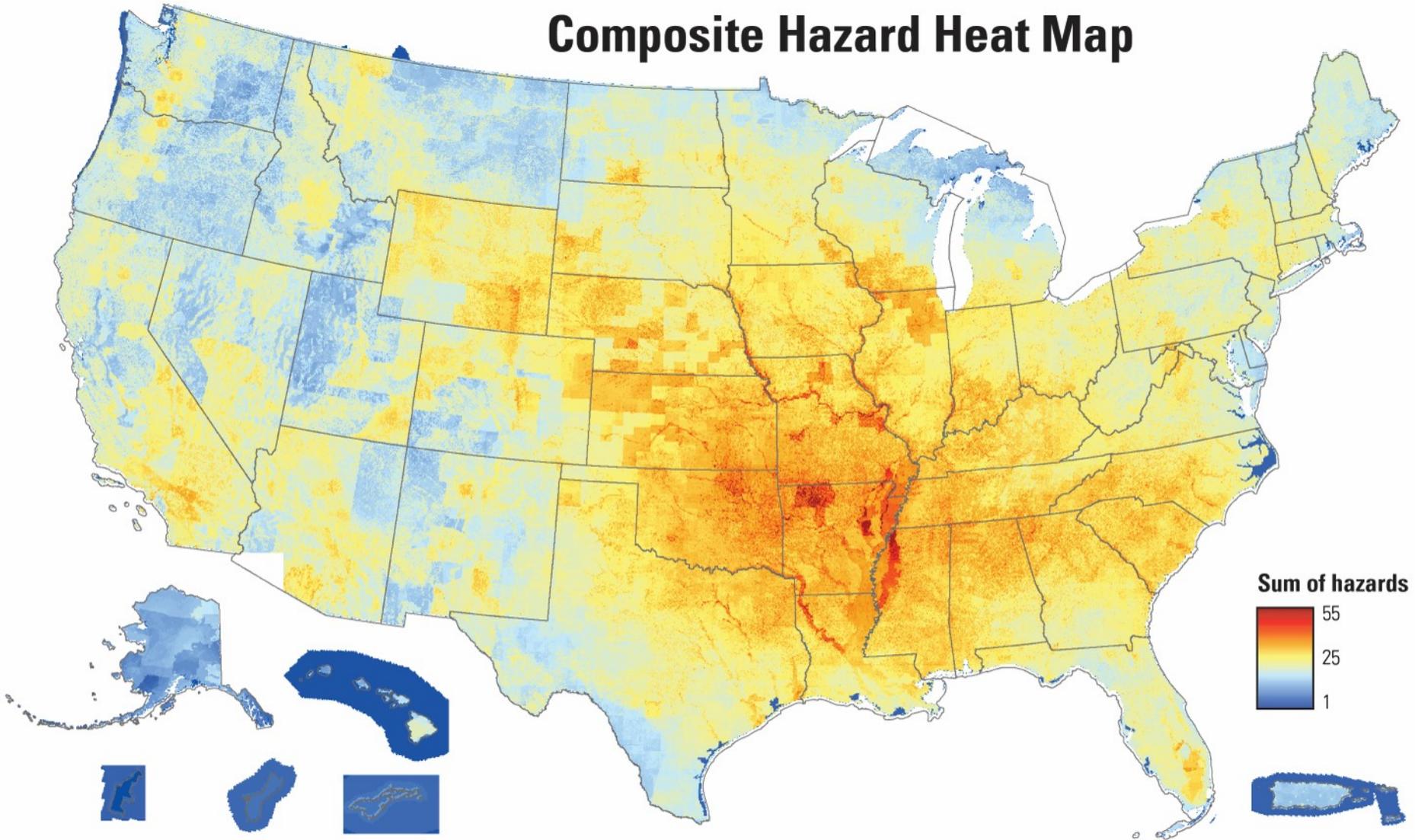
**Other databases acquired but not georeferenced for mapping**

- Cyber attacks (data)
- Cyber attacks (physical infrastructure)
- Active shooter (*could be mapped with additional work*)

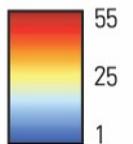
**Other databases to be acquired and mapped in FY18**

- Significant DOI law enforcement incidents

# Composite Hazard Heat Map



## Sum of hazards



**Adversarial:** border apprehensions, borderlands, terrorism

**Ecological:** chronic wasting disease

**Geophysical:** flood, landslides, volcano, tsunami, earthquake

**Meteorological:** cold wave, snow, tornado, heat waves, hail, hurricane tracks, drought, lightning, ice storm

**Technological:** dam inundation, dam lines, levee failure, bridge failure

**Wildfire**

## Composite hazard grid overview:

- 1) Each hazard grid reclassified into 5 bins
- 2) Reclassified bins added
- 3) Final grid shows spatial coincidence of hazards

# Communicating hazard exposure at the facility level

## Example of facility data having additional hazard-exposure attributes

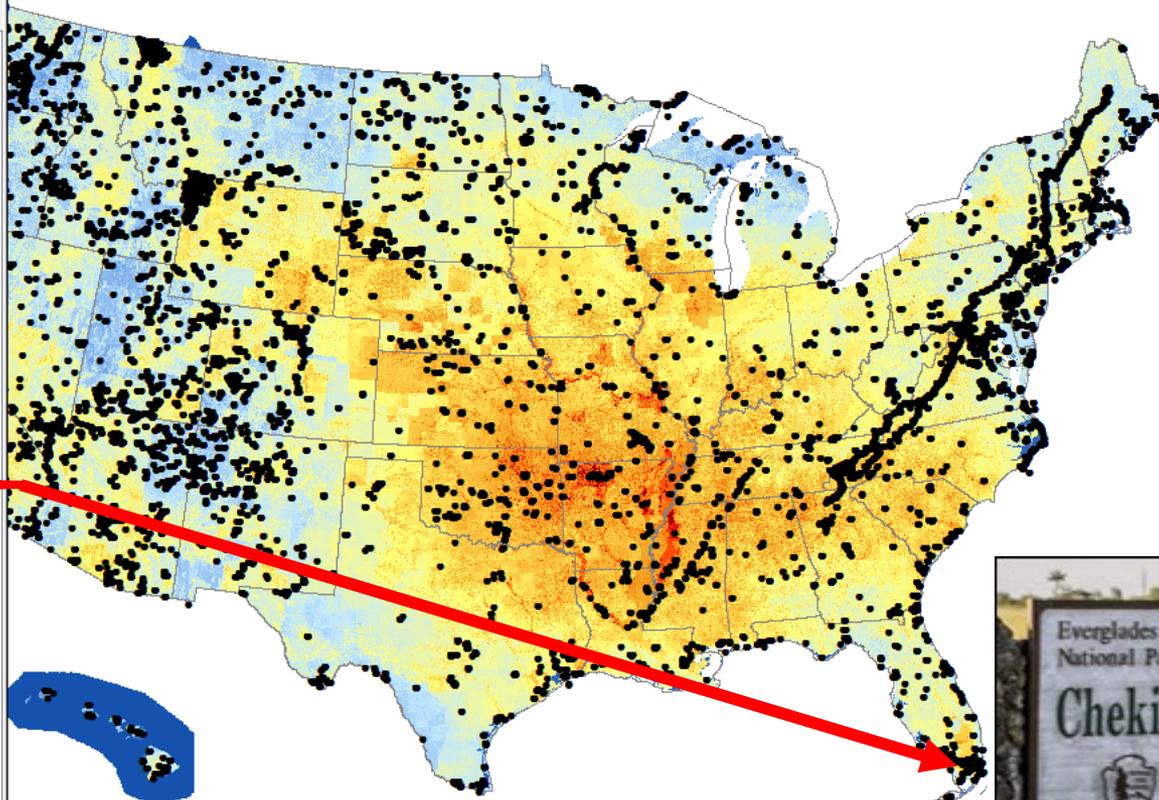
Identify

Identify from: <Top-most layer>

DOIBuildings\_asset  
R4 FLORIDA  
EVERGLADES NATIONAL PARK

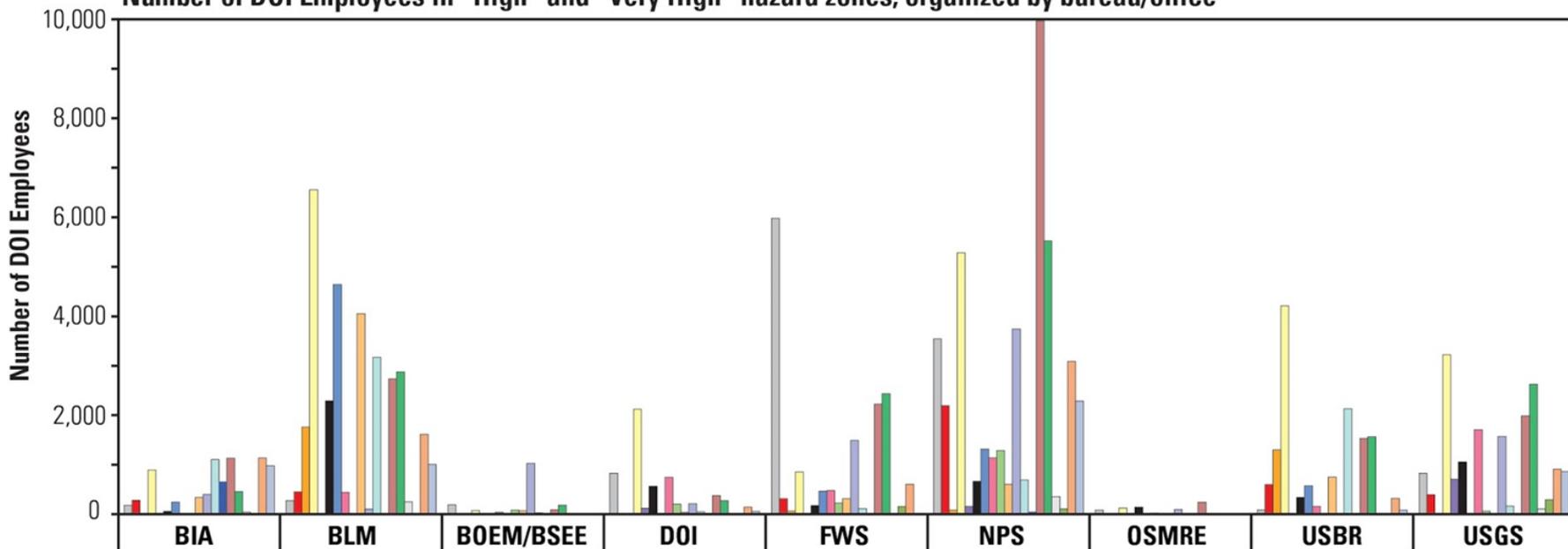
Location: 1,573,299.878 -1,355,353.838 Meters

Field	Value
Building Name	PICH 712 CHEKIKA PUMP HOUSE
Bureau	NATIONAL PARK SERVICE
COLD_WARNING	5
Condition	97
COUNTY_1	MIAMI-DADE
COUNTYFP	086
CWD	0
DAM_INUNDATION	0
DROUGHT_WARNING	79
EARTHQUAKE	1
FLOOD_WARNING	29
GSA Usage Description	BLDG PUMP HOUSE WELL HOUSE
GSA_Usage	35500200
HAIL	429
HEAT_WARNING	0
HURRICANE_EVENTS	22
HURRICANE_SURGE	4
ICESTORM	0
Installation Code	EVER
LANDSLIDES	0
Legal Status	G
Legal Status Description	OWNED
LEVEE_BREAK	5
LIGHTNING	2476
OBJECTID	3326
Office Code	10002182
Office Name	EVERGLADES NATIONAL PARK
RESTRICT	DOI RESTRICTED
RP_Type	35
Shape	Point
SNOW_WARNING	0
STATE_1	FLORIDA
STATEFP	12
TORNADO	287
TSUNAMI	0
VOLCANO	0
WILDFIRE	5
WIND_SPEED	200



# Communicating hazard exposure at national level

Number of DOI Employees in "High" and "Very High" hazard zones, organized by bureau/office



## Hazard-exposure results can be summarized by:

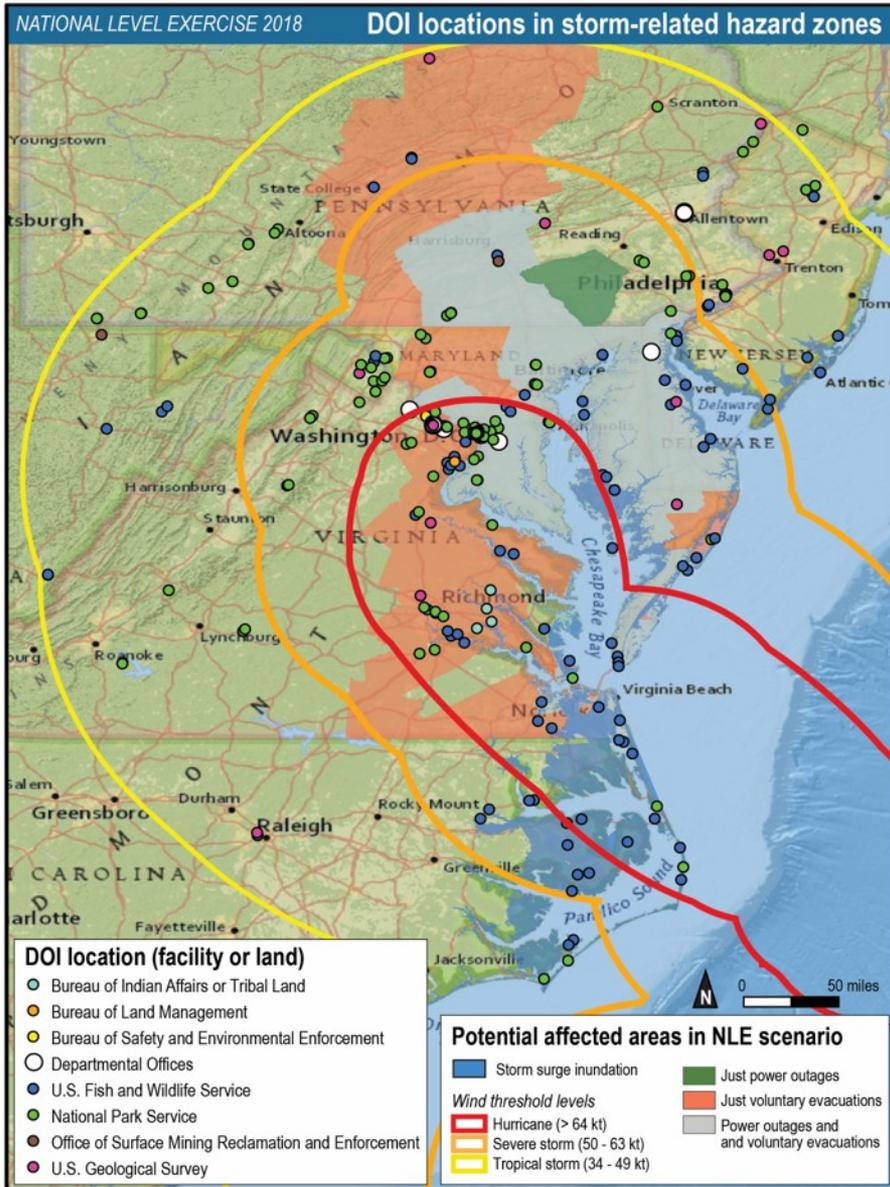
- Hazard or group of hazards
- Bureau
- DOI Unified Region
- State or territory
- Specific assets

### "High" and "Very High" hazard areas

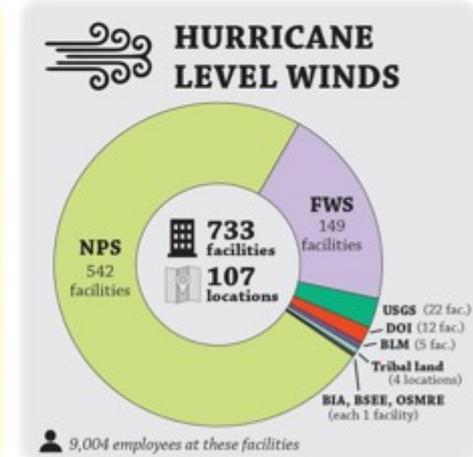
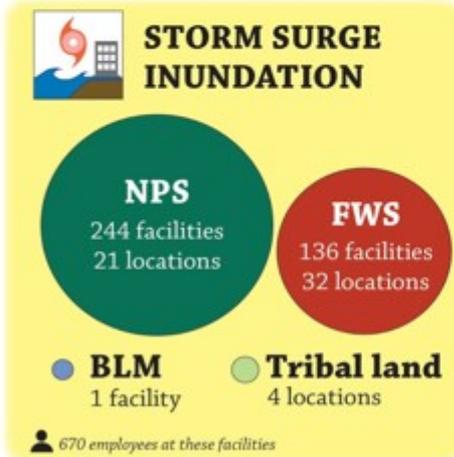
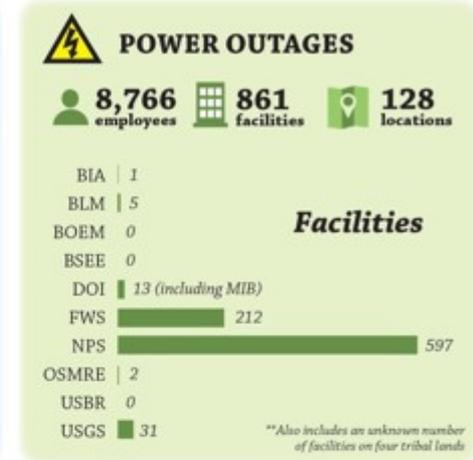
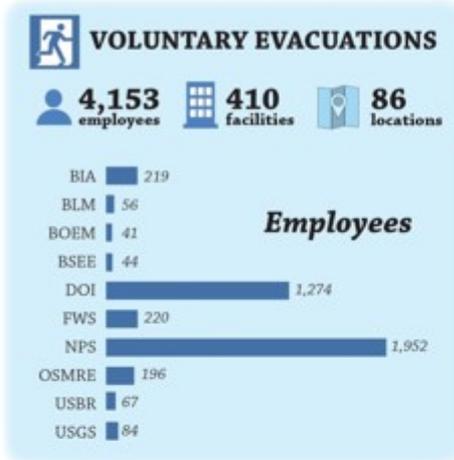
- Chronic wasting disease
- Wildfire
- Excessive heat warnings
- Drought warnings
- Cold warnings
- Ice storms
- Hail
- Snow warnings
- Hurricane tracks
- Tornado
- Lightning strikes
- Flood warnings
- Hurricane storm surge
- Landslides
- Earthquake
- Tsunami
- Volcano
- Dam inundation
- Levee inundation

# Communicating hazard exposure for exercises

Leveraging the DOI OEM risk project to support DOI's involvement in 2018 exercise



Results were generated by the USGS Western Geographic Science Center in collaboration with the DOI Office of Emergency Management



Results were generated by the USGS Western Geographic Science Center in collaboration with the DOI Office of Emergency Management



# Project timeline and next steps

## FY19 Efforts

- Finalize asset and hazard data collection
- Create web services and APIs for data
- Develop relative threat matrix
- Complete hazard-exposure analysis
- Write collaborator report and related products

## Long-term efforts to build capacity and sustainability

- Identifying next-step opportunities
- Managing expectations and interests
- Hosting of tech stack
- Maintenance of data and of tech stack
- Improving visualizations in modular tools

# Potential connections to NRDAR program

- National heat maps of oil and gas infrastructure
- Visualization of populations, resources, etc. that could be affected by spills
- Visualization of other hazards that could cause or amplify spills
- Development of decision tools to support response and recovery operations

The mission of the U.S. Department of the Interior's (DOI) Natural Resource Damage Assessment and Restoration Program (NRDAR Program) is to restore natural resources injured as a result of oil spills or hazardous substance releases into the environment. [Read More...](#)

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Keyword Search [clear] **MAP HELP**

Search NRDAR Cases... [x] [Q]

Category Search [clear]

- ▶ U.S. State or Territory
- ▶ Incident Type
- ▶ Status
- ▼ Affected DOI Resources
  - Anadromous Fish (49)
  - DOI Managed Lands (40)
  - Interjurisdictional Fish (94)
  - Marine Mammals (12)
  - Migratory Birds (244)
  - Other (9)
  - Recreational Use Loss (10)
  - Threatened and Endangered Species (93)
- ▶ Authority
- ▶ Contaminants of Concern
- ▶ Trustees

Show All Download Data Excel

Case	State	Type	Status	Zoom Map
<a href="#">102nd Street Landfill NPL Site</a>	New York	Chemical	Restoration	<a href="#">Zoom Map</a>
<a href="#">2015 Yellowstone River Oil Spill</a>	Montana	Oil	Assessment	<a href="#">Zoom Map</a>
<a href="#">Adak Petroleum</a>	Alaska	Oil	Restoration	<a href="#">Zoom Map</a>
<a href="#">Advanced Fuel Filtration Systems Inc. Tanker Truck Accident Fuel Oil Spill</a>	California	Oil	Closed	<a href="#">Zoom Map</a>
<a href="#">ALCOA (Point Comfort)/Lavaca Bay NPL Site</a>	Texas	Chemical	Closed	<a href="#">Zoom Map</a>
<a href="#">ALCOA/Reynolds Metals Site</a>	Oregon	Chemical	Closed	<a href="#">Zoom Map</a>
<a href="#">Allied Paper Inc./Portage Creek/Kalamazoo River NPL Site</a>	Michigan	Chemical	Assessment/Restoration	<a href="#">Zoom Map</a>
<a href="#">American Chemical Service Inc. NPL Site</a>	Indiana	Chemical	Closed	<a href="#">Zoom Map</a>
<a href="#">American Cyanamid NPL Site</a>	New Jersey	Chemical	Restoration	<a href="#">Zoom Map</a>
<a href="#">Amoco Pipeline Company</a>	Texas	Oil	Closed	<a href="#">Zoom Map</a>

# Thank you and for more information

## Hazard-exposure analysis

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