National Academy of Sciences: Data matters: ethics, data, and international research collaboration in a changing world

Domain-specific examples: Disasters

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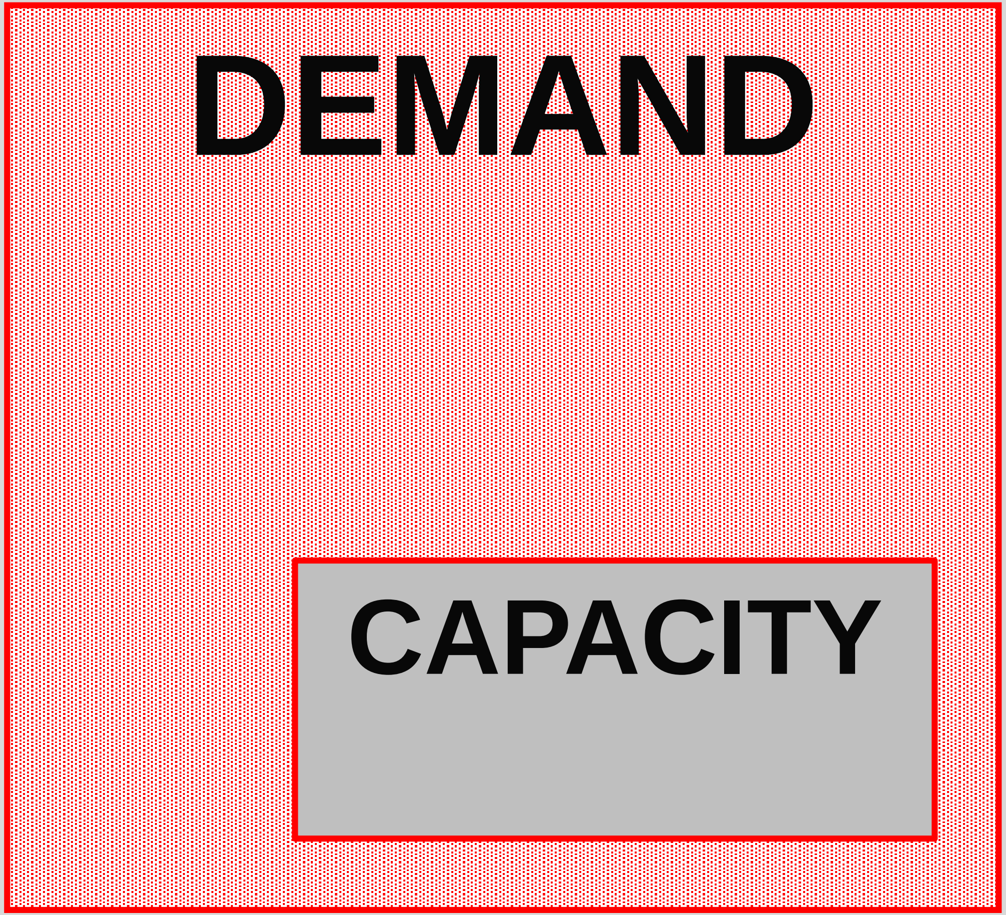
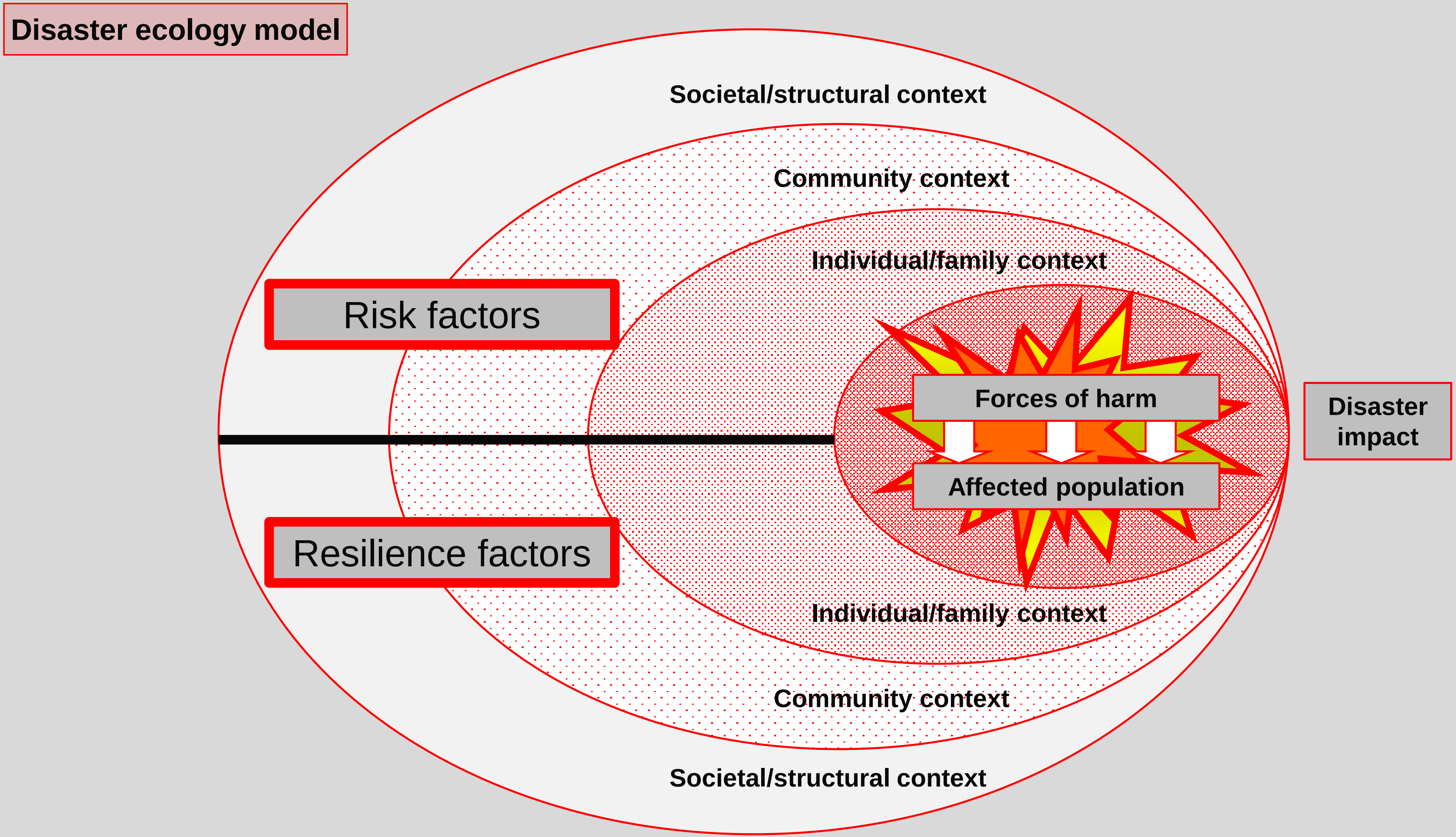
Disaster definition

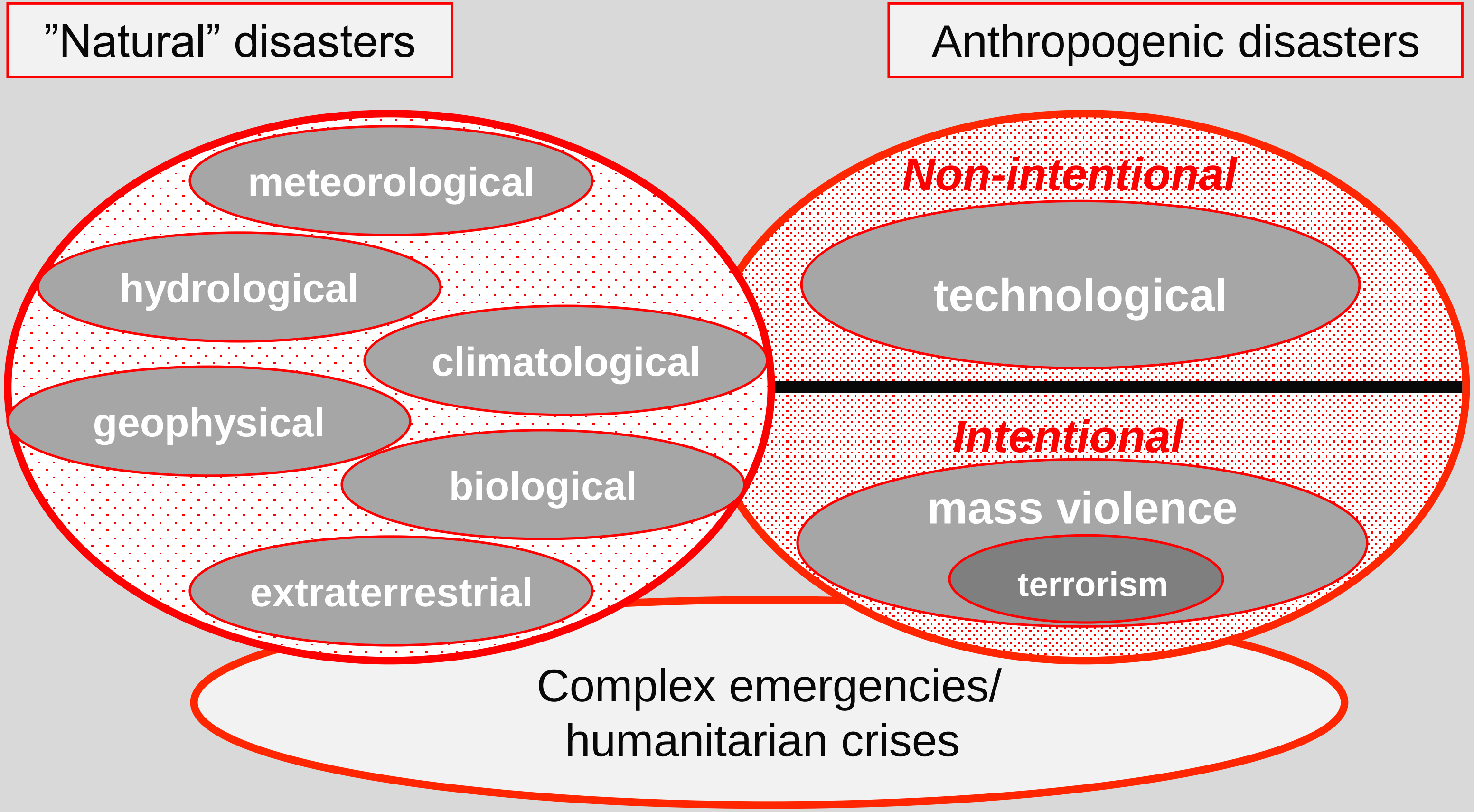
A ***disaster*** is characterized
as an encounter between "forces
of harm" (*hazard*)
and a human population
"in harms way" (*vulnerability*)
influenced by the
ecological context…

where the encounter
creates **demands** that **exceed**
the coping **capacity**
of the affected community

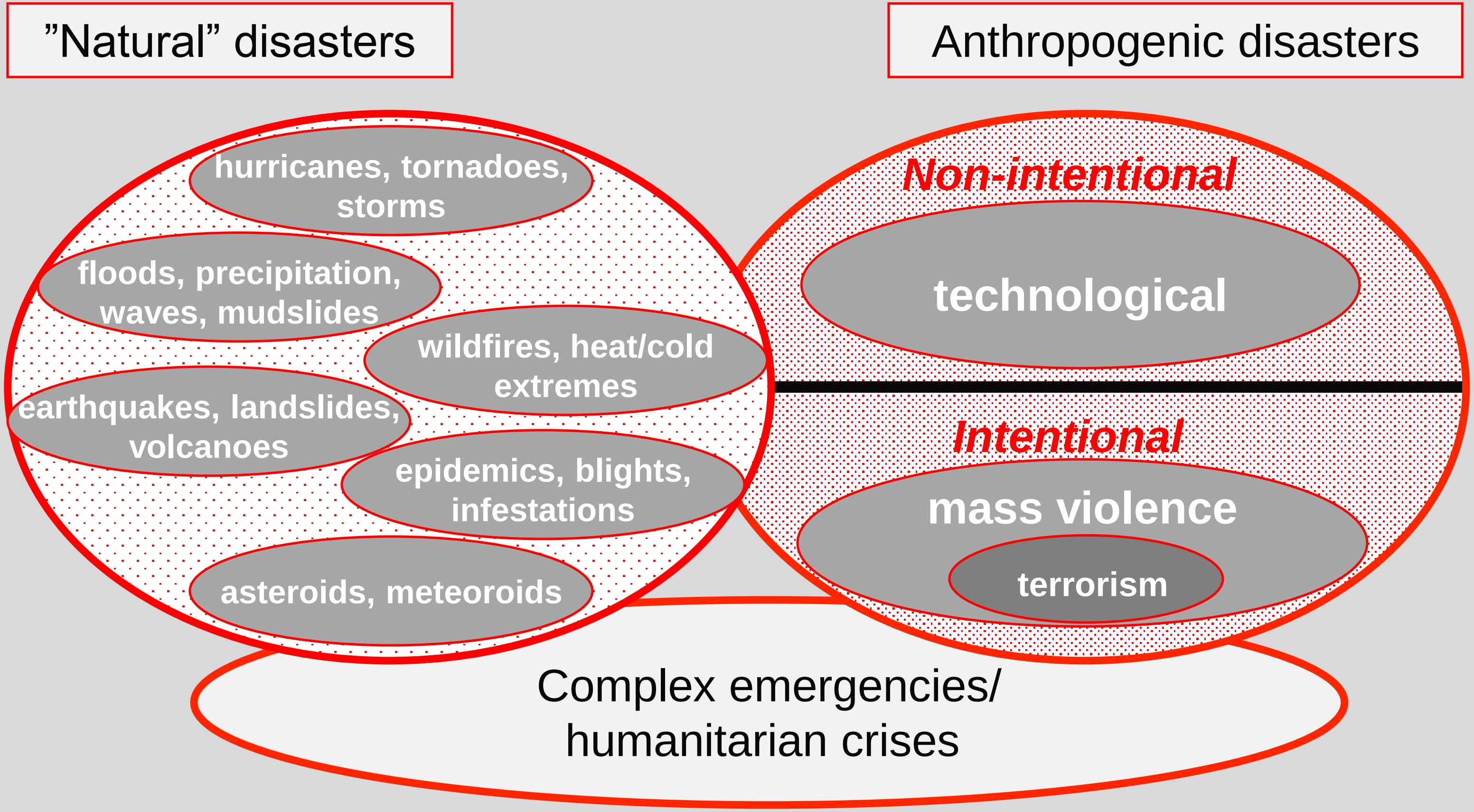



Disaster ecology model
Societal/structural context
Community context
Individual/family context
Risk factors
Forces of harm
Affected population
Disaster impact
Resilience factors
Individual/family context
Community context
Societal/structural context

Disaster taxonomy



Disaster taxonomy



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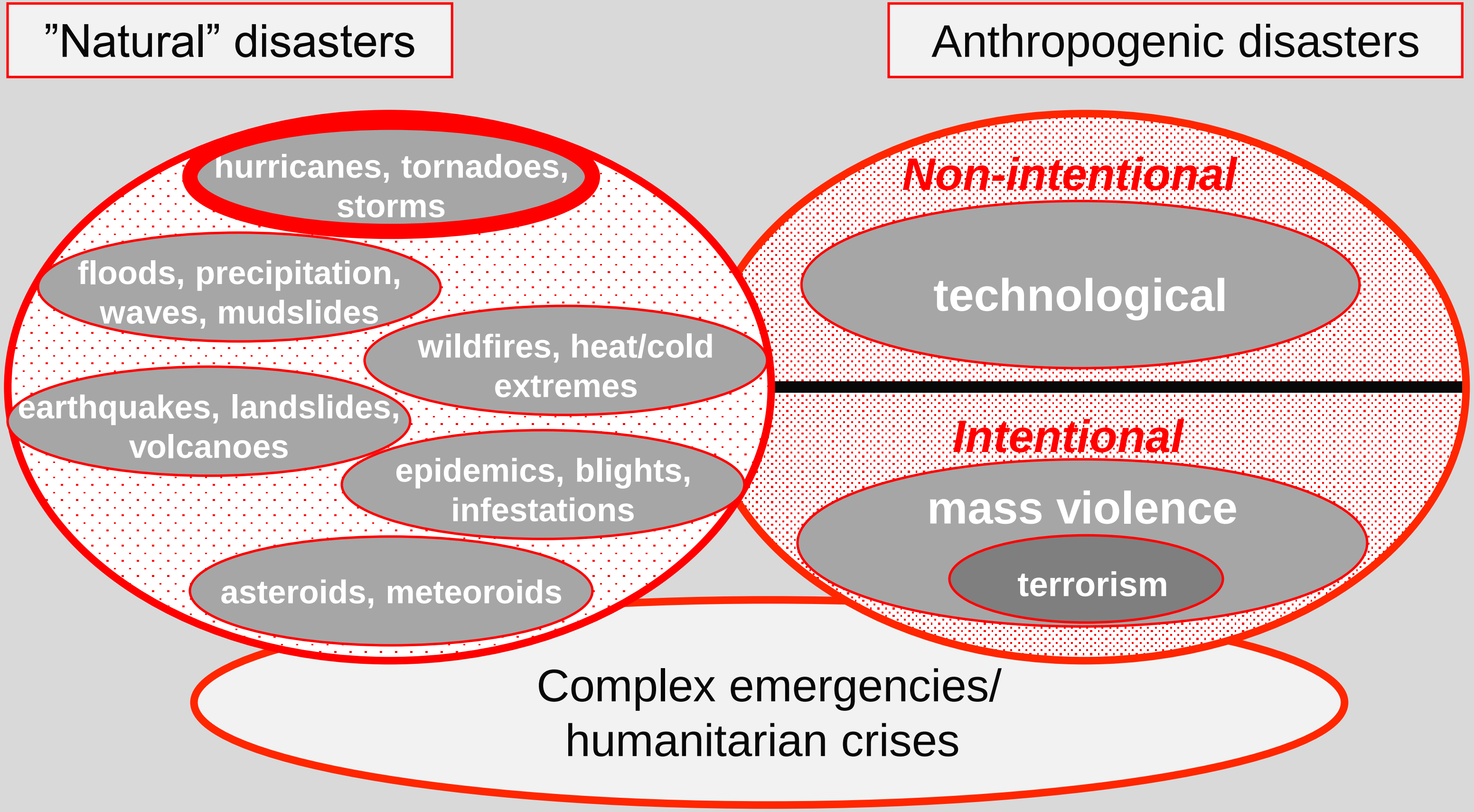

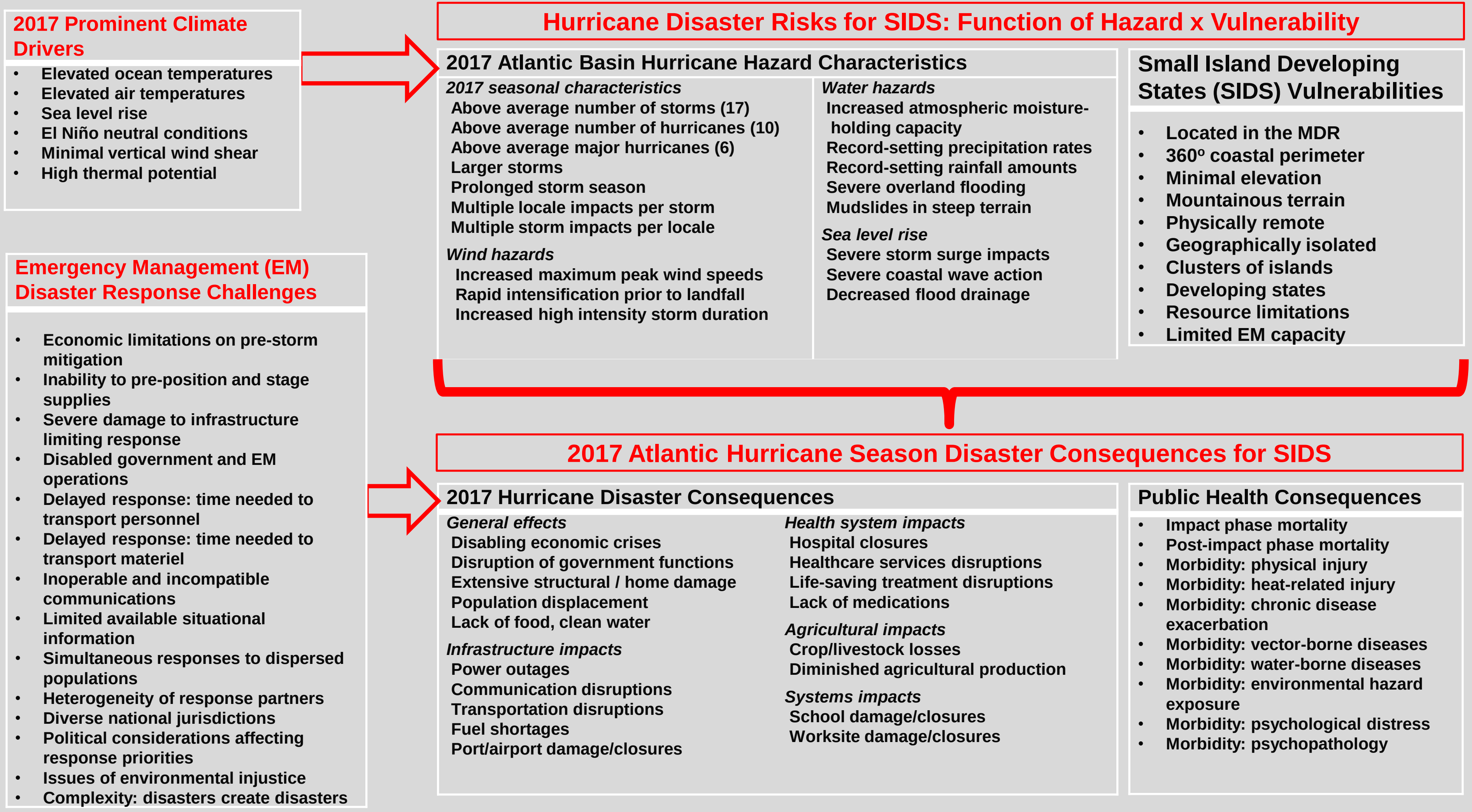

2017 Prominent Climate Drivers
Elevated ocean temperatures
Elevated air temperatures
Sea level rise
El Niño neutral conditions
Minimal vertical wind shear
High thermal potential
Hurricane Disaster Risks for SIDS: Function of Hazard x Vulnerability
2017 Atlantic Basin Hurricane Hazard Characteristics
2017 seasonal characteristics
Above average number of storms (17)
Above average number of hurricanes (10)
Above average major hurricanes (6)
Larger storms
Prolonged storm season
Multiple locale impacts per storm
Multiple storm impacts per locale
Wind hazards
Increased maximum peak wind speeds
Rapid intensification prior to landfall
Increased high intensity storm duration
Water hazards
Increased atmospheric moisture-holding capacity
Record-setting precipitation rates
Record-setting rainfall amounts
Severe overland flooding
Mudslides in steep terrain
Sea level rise
Severe storm surge impacts
Severe coastal wave action
Decreased flood drainage
Small Island Developing States (SIDS) Vulnerabilities
Located in the MDR
360º coastal perimeter
Minimal elevation
Mountainous terrain
Physically remote
Geographically isolated
Clusters of islands
Developing states
Resource limitations
Limited EM capacity
Emergency Management (EM) Disaster Response Challenges
Economic limitations on pre-storm mitigation
Inability to pre-position and stage supplies
Severe damage to infrastructure limiting response
Disabled government and EM operations
Delayed response: time needed to transport personnel
Delayed response: time needed to transport materiel
Inoperable and incompatible communications
Limited available situational information
Simultaneous responses to dispersed populations
Heterogeneity of response partners
Diverse national jurisdictions
Political considerations affecting response priorities
Issues of environmental injustice
Complexity: disasters create disasters
2017 Atlantic Hurricane Season Disaster Consequences for SIDS
2017 Hurricane Disaster Consequences
General effects
Disabling economic crises
Disruption of government functions
Extensive structural / home damage
Population displacement
Lack of food, clean water
Infrastructure impacts
Power outages
Communication disruptions
Transportation disruptions
Fuel shortages
Port/airport damage/closures
Health system impacts
Hospital closures
Healthcare services disruptions
Life-saving treatment disruptions
Lack of medications
Agricultural impacts
Crop/livestock losses
Diminished agricultural production
Systems impacts
School damage/closures
Worksite damage/closures
Public Health Consequences
Impact phase mortality
Post-impact phase mortality
Morbidity: physical injury
Morbidity: heat-related injury
Morbidity: chronic disease exacerbation
Morbidity: vector-borne diseases
Morbidity: water-borne diseases
Morbidity: environmental hazard exposure
Morbidity: psychological distress
Morbidity: psychopathology

Hurricane Disaster Risks for SIDS: Function of Hazard x Vulnerability

2017 Prominent Climate Drivers

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2017 Atlantic Basin Hurricane Hazard Characteristics

2017 seasonal characteristics

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Wind hazards

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Water hazards

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Record-setting precipitation rates
Record-setting rainfall amounts
Severe [illegible] flooding
Mudslides in steep terrain

Sea level rise

Severe storm surge impacts
Severe coastal wave action
Decreased flood drainage

Small Island Developing States (SIDS) Vulnerabilities

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- Diverse national jurisdictions
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- Issues of environmental injustice
- Complexity: disasters create disasters

2017 Atlantic Hurricane Season Disaster Consequences for SIDS

2017 Hurricane Disaster Consequences

General effects

Disabling economic crises
Disruption of government functions
Extensive structural / home damage
Population displacement
Lack of food, clean water

Infrastructure impacts

Power outages
Communication disruptions
Transportation disruptions
Fuel shortages
Port/airport damage/closures

Health system impacts

Hospital closures
Healthcare services disruptions
Life-saving treatment disruptions
Lack of medications

Agricultural impacts

Crop/livestock losses
Diminished agricultural production

Systems impacts

School damage/closures
Worksite damage/closures

Public Health Consequences

- Impact phase mortality
- Post-impact phase mortality
- Morbidity: physical injury
- Morbidity: heat-related injury
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- Morbidity: vector-borne diseases
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- Morbidity: psychological distress
- Morbidity: psychopathology

HAZARD: Climate influences on 2017 Atlantic basin hurricane hazard characteristics

2017 Prominent climate drivers

- Elevated ocean temperatures
- Elevated air temperatures
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- High thermal potential

2017 Atlantic basin hurricane hazard characteristics

2017 seasonal characteristics

Above average number of storms (17)
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Above average major hurricanes (6)
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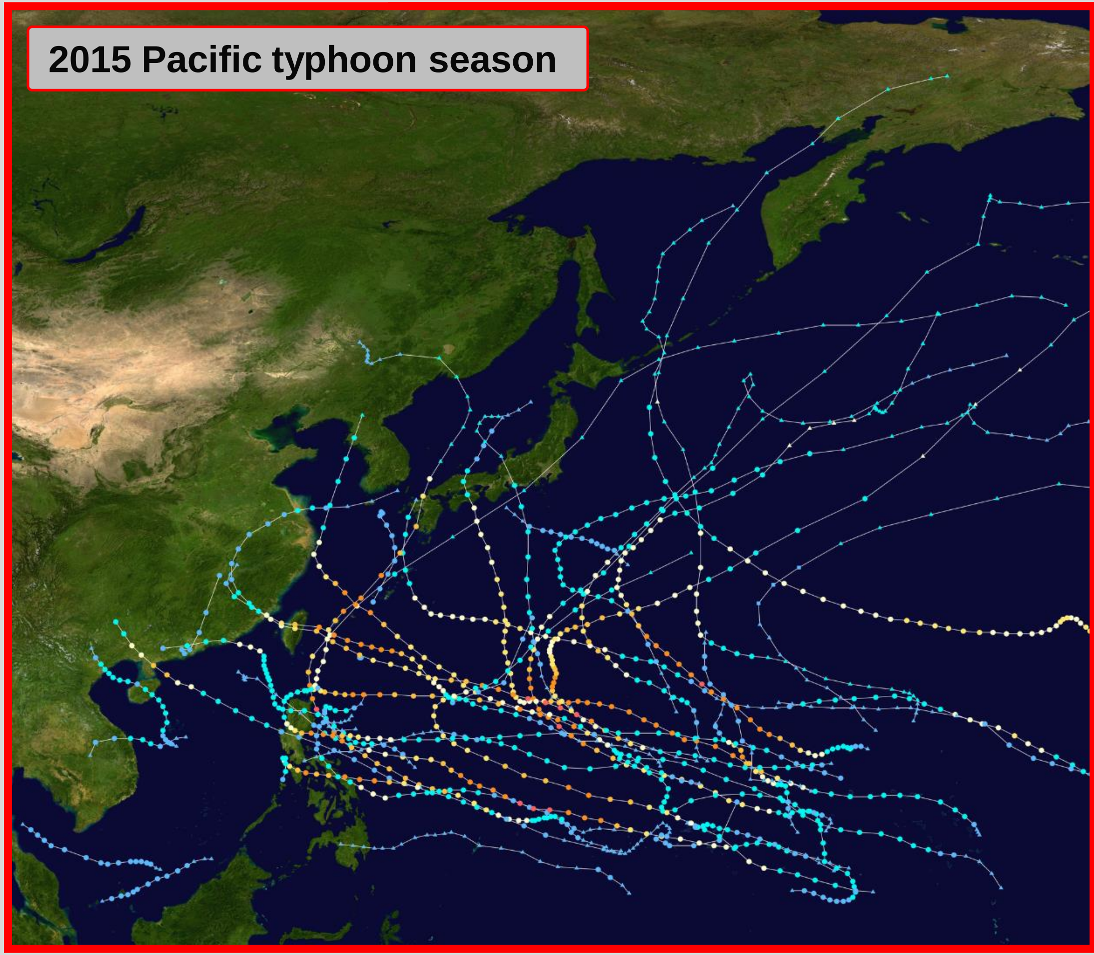
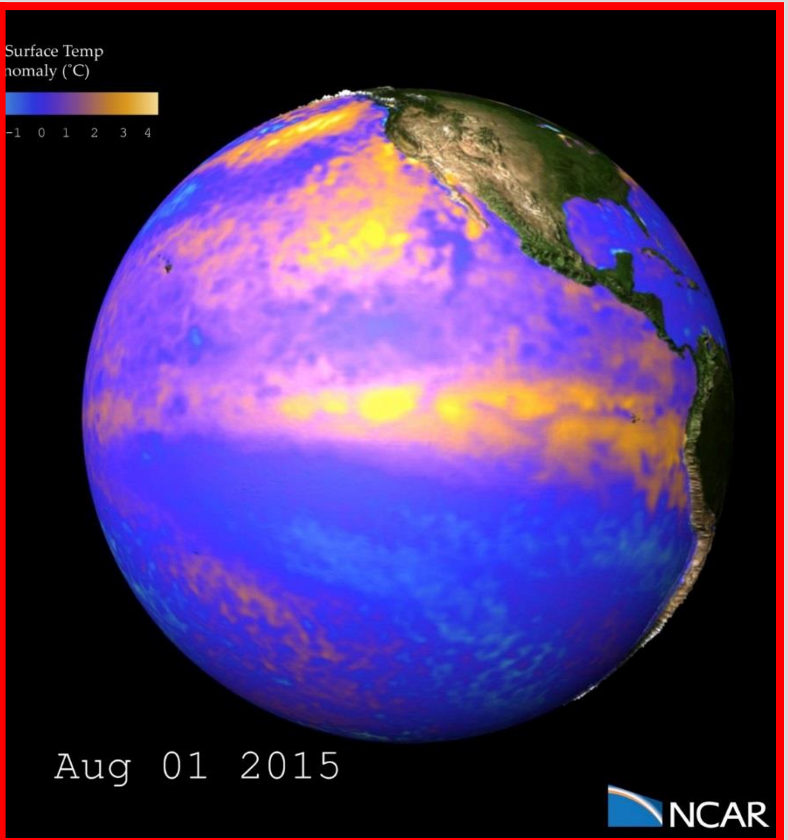
Severe coastal wave action
Decreased flood drainage

Increased frequency of disaster-generating climate events (tropical cyclones, heat waves, droughts, and floods)





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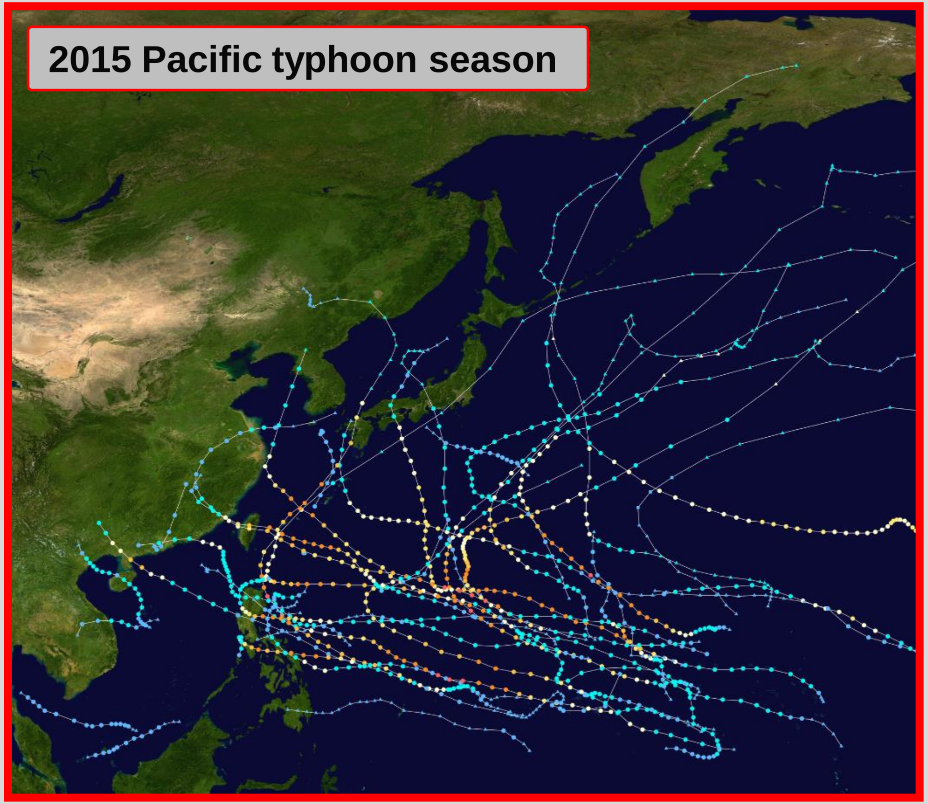

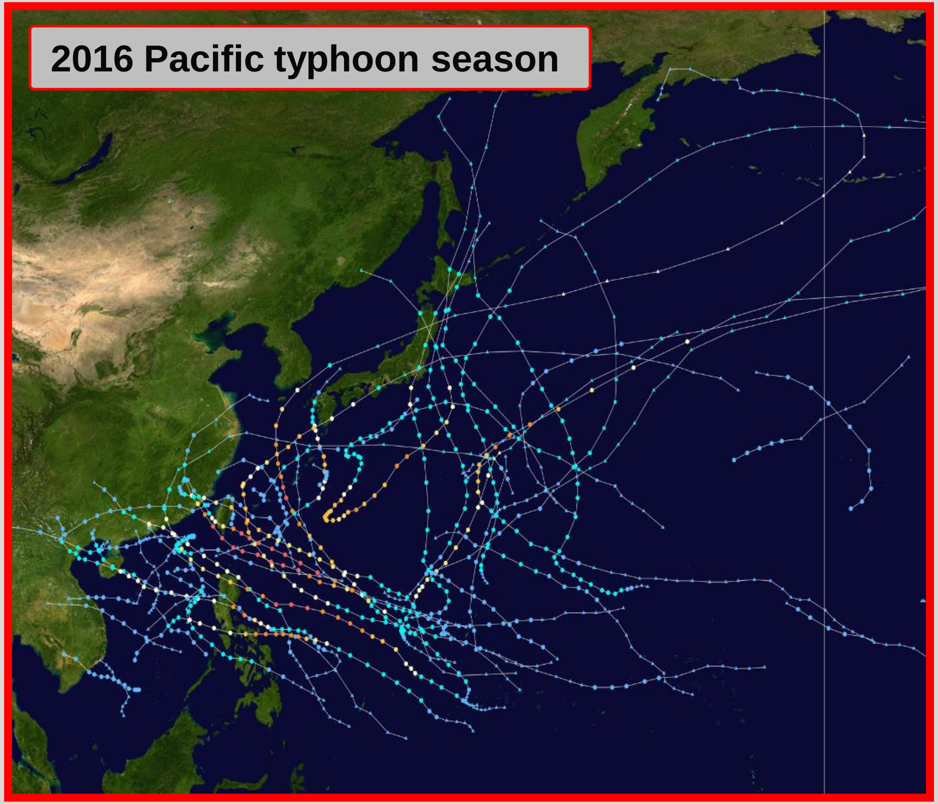

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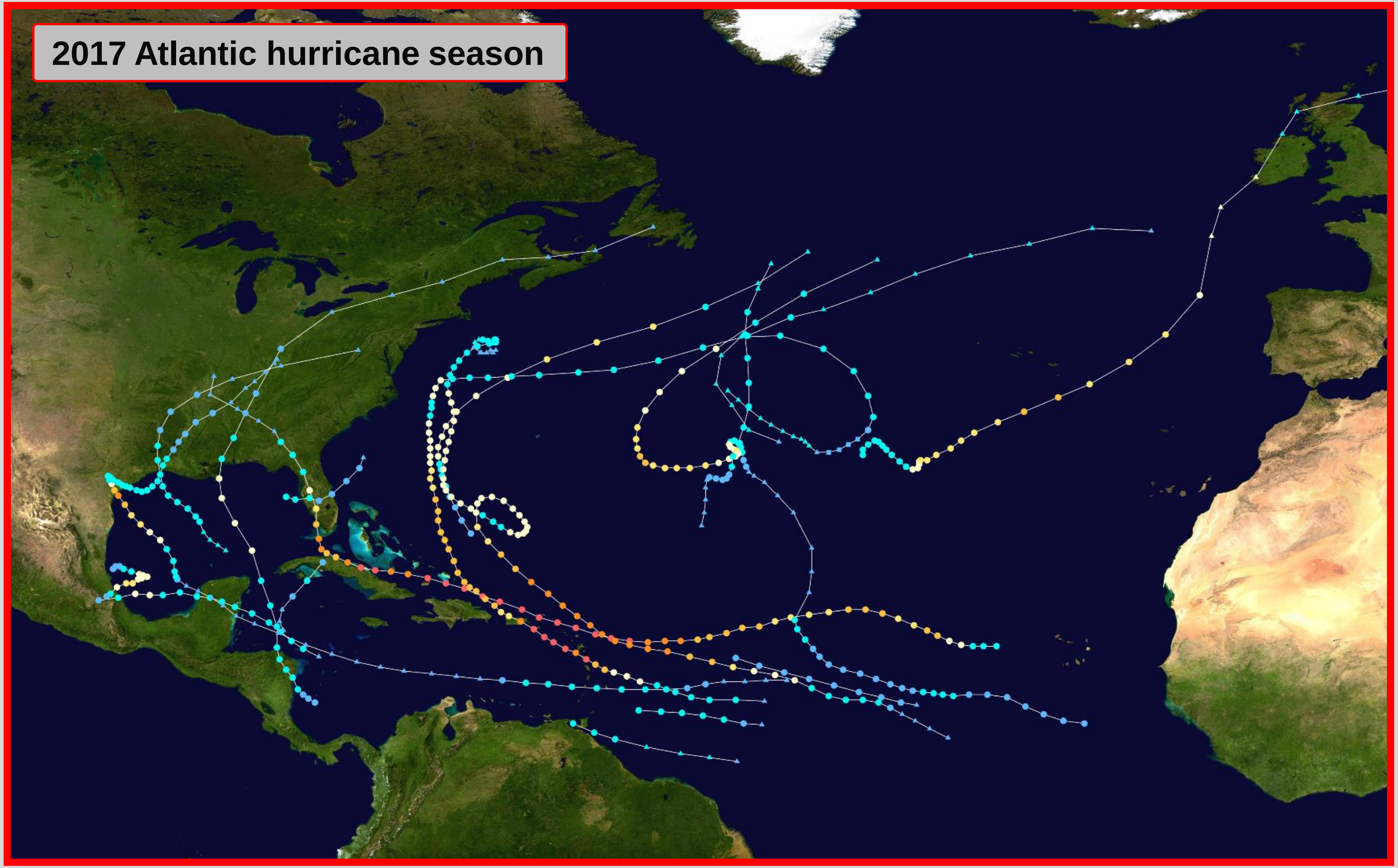
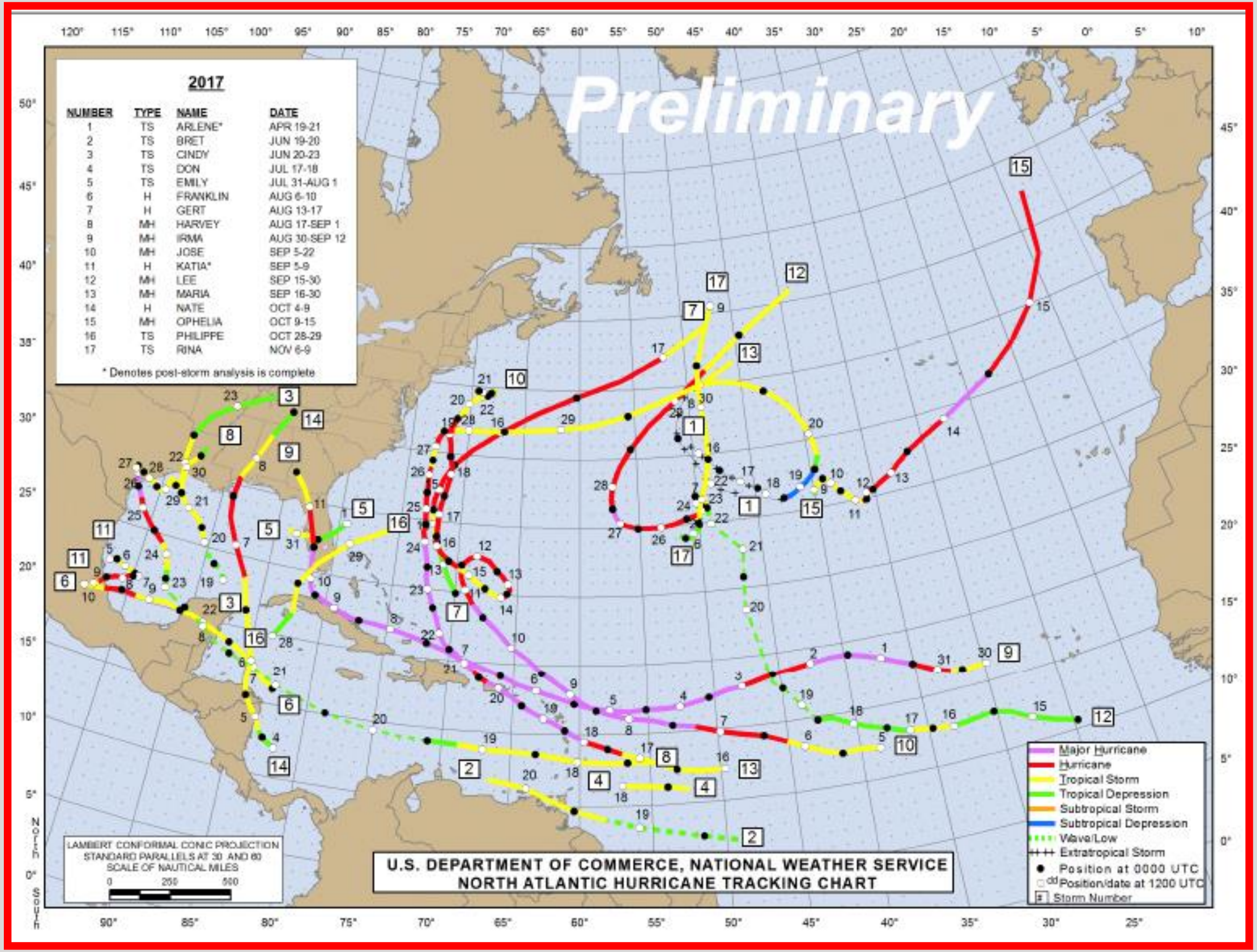


2017 Atlantic basin hurricane season: 17 named storms



2017 Atlantic basin hurricane season: publications

VIEWPOINT

Mitigating the Mental and Physical Health Consequences of Hurricane Harvey

James M. Shultz, MS, PhD
University of Miami Miller School of Medicine, Donald Soffer Clinical Research Center, Miami, Florida.

Sandro Galea, MD, DrPH
School of Public Health, Boston University, Boston, Massachusetts.

The complexity of the disaster risk landscape and the exposure of large human populations to prolonged and potentially traumatizing events were on full display during Hurricane Harvey. During the 5 days of Hurricane Harvey, more than 33 trillion gallons of rain fell on Texas and Louisiana and set a continental US record for rainfall at 51.88 in (131.78 cm). Among 13 million persons directly affected by the storm, more than 22 000 were rescued from floodwaters, an estimated 32 000 displaced survivors were temporarily housed in shelters, and at least 450 000 will apply for Federal Emergency Management Agency (FEMA) disaster assistance.[1] More than 100 000 homes were damaged and only 17% of the affected residents had flood insurance. Damage and recovery estimates are projected to exceed those incurred during Hurricane Katrina ($114.5 billion paid on an estimated $160 billion in damages). The usually circumspect National Weather Service tweeted, "This event is unprecedented & all impacts are unknown & beyond anything experienced."

During Hurricane Harvey, Texas and Louisiana residents experienced the full complement of hurricane hazards: cyclonic winds, tornadoes, storm surge along a concave coastline, deluging rains, and inland flooding.[2]

> ...what happens to populations in the months and years after large-scale traumatic events can have more substantial health consequences than the immediate disaster.

What made Harvey an exceptional hurricane was that water, rather than wind, was the major destructive force. Harvey will be forever remembered for the unrelenting inundation that resulted from rain bands that spiraled inland from the gulf, overflowing Houston's reservoirs and overtopping dams before moving on to submerge Port Arthur, Texas, and drench western Louisiana.

The Harvey disaster response has been expansive and televised. However, this response is typical of response to such events—early initial high-visibility rescue and response activities. The storm-affected region is currently receiving a massive injection of state and federal emergency personnel and resources. Yet history teaches that this outpouring of resources will be time-limited. Responder units will be repurposed and redeployed and the media focus is already shifting elsewhere, in this case, to the subsequent catastrophic storm (Hurricane Irma).

Public health officials and others know that what happens to populations in the months and years after large-scale traumatic events can have more substantial health consequences than the immediate disaster. The mental and physical health consequences of an event like Hurricane Harvey are long-lasting. Harvey's physical health consequences included mortality, primarily drowning deaths occurring in submerged vehicles and structures (63 storm-related fatalities were tallied through September 5)[3] and injuries including lacerations, puncture wounds, abrasions, fractures, and insect bites (floating fire ant colonies have been a particular hazard) that commonly occur during clean-up activities. Residents are actively gutting their homes to stave off mold. The health effects of widespread population exposures to contaminated floodwaters—an admixture of sewage, toxins, and other hazardous substances—filling homes, streets, and neighborhoods have not been evaluated.

The psychological consequences of Hurricane Harvey are associated with traumatic exposures to storm hazards during the event, losses and hardships in the aftermath, and disruption of vital care and essential medications for those with chronic and persistent mental illness and cognitive impairment.[4] Comprehensive reviews of the mental health consequences of natural and human-generated (anthropogenic) disasters have shown that, for hurricanes, up to half of those who survive being directly in the storm's path risk developing posttraumatic stress disorder (PTSD), and that 10% of those who live in the vicinity of the storm may also develop PTSD.[5,6] Scientific evidence gleaned from work with residents from areas that were directly affected by Hurricane Katrina showed that respondents experienced nearly universal exposure to hurricane stressors and a correspondingly high 30-day prevalence of anxiety-mood disorders (31.2%).[7] Ensuring that health care system managers and clinicians recognize these risks and implement appropriate screening and treatment systems is critical.

Available evidence suggests how emergency responders, clinicians, and health care system managers can meet the key challenge of mitigating health consequences. Early psychological intervention is already under way in the immediate postdisaster phase of Hurricane Harvey. Disaster behavioral health teams are integrated into the response, providing psychological first aid and assessing for urgent psychiatric needs at Houston's 2 large consolidated shelters. However, the reach of these brief-duration approaches is limited. In contrast, research has shown that replenishing social and economic resources that will restore living conditions for those affected by the hurricane will do as much, if not

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Perspective

Preparing for the Next Harvey, Irma, or Maria — Addressing Research Gaps

James M. Shultz, Ph.D., and Sandro Galea, M.D., Dr.P.H.

Extreme events often cast in bold relief what we do and don't know about medicine and public health. In recent weeks, three hurricanes, each characterized by "unprecedented" features, have illuminated our knowledge gaps regarding the consequences of disasters and their mitigation.

Hurricanes Harvey, Irma, and Maria affected large populations and caused widespread destruction, resulting in massive resource losses and economic costs. We know quite a bit about the likely consequences of these storms. As winds diminish and rescues proceed, the response focus rapidly shifts toward reestablishing essential infrastructure. Top mitigation priorities include distributing survival necessities, restoring power, and bringing hospitals back on line. These actions minimize short-term health threats such as patients with chronic health conditions decompensating or losing access to life-sustaining treatments and populations' exposure to deadly heat stress and waterborne and vectorborne diseases. Performed effectively, they also forestall longer-term mental health consequences.

We know that a substantial proportion of people who were directly exposed to life-threatening storm hazards, were physically injured, lost a loved one, or lost substantial resources may report increased symptoms of mental disorders in the coming months, with post-traumatic stress disorder (PTSD) as the sentinel condition.[1] PTSD and depression may also develop in storm-affected people who were not directly exposed, albeit at lower rates.

A stepped-care approach includes a number of phased elements. During the disaster impact, these include moving people to safety, providing survival needs, and reuniting separated family members. In the immediate aftermath, it's important to maintain or restore care, provide access to medications for persons with preexisting conditions, meet short-term practical needs, and assess hazard exposures and resource losses. Over the longer term, it's essential to maintain ongoing surveillance, and referral as needed, for the onset of psychopathology in persons who've been injured, bereaved, or experienced traumatic exposures or severe losses. Rapid restoration of social and economic function contributes substantially to population health and well-being after these events.[2]

The closeness in time and space of these storms has conflated them in the public narra-

VULNERABILITY: Small Island Developing States (SIDS)

Small Island Developing States (SIDS) Vulnerabilities

- Located in the MDR
- 360º coastal perimeter
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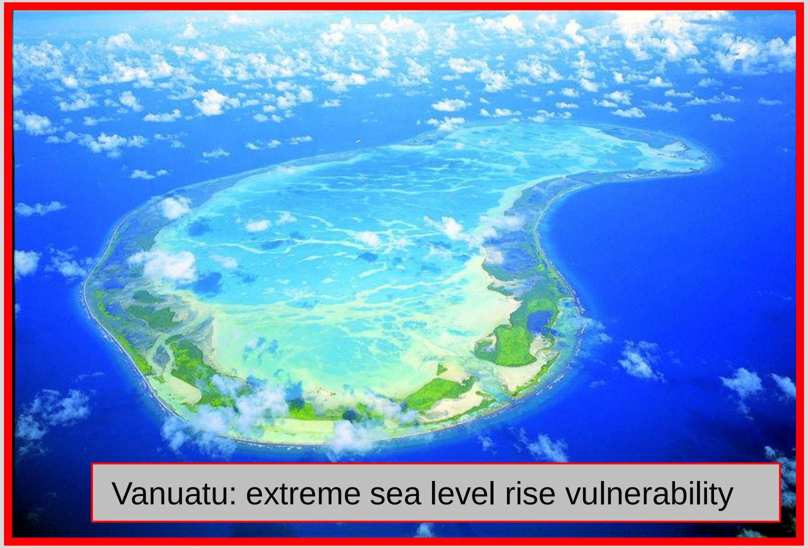
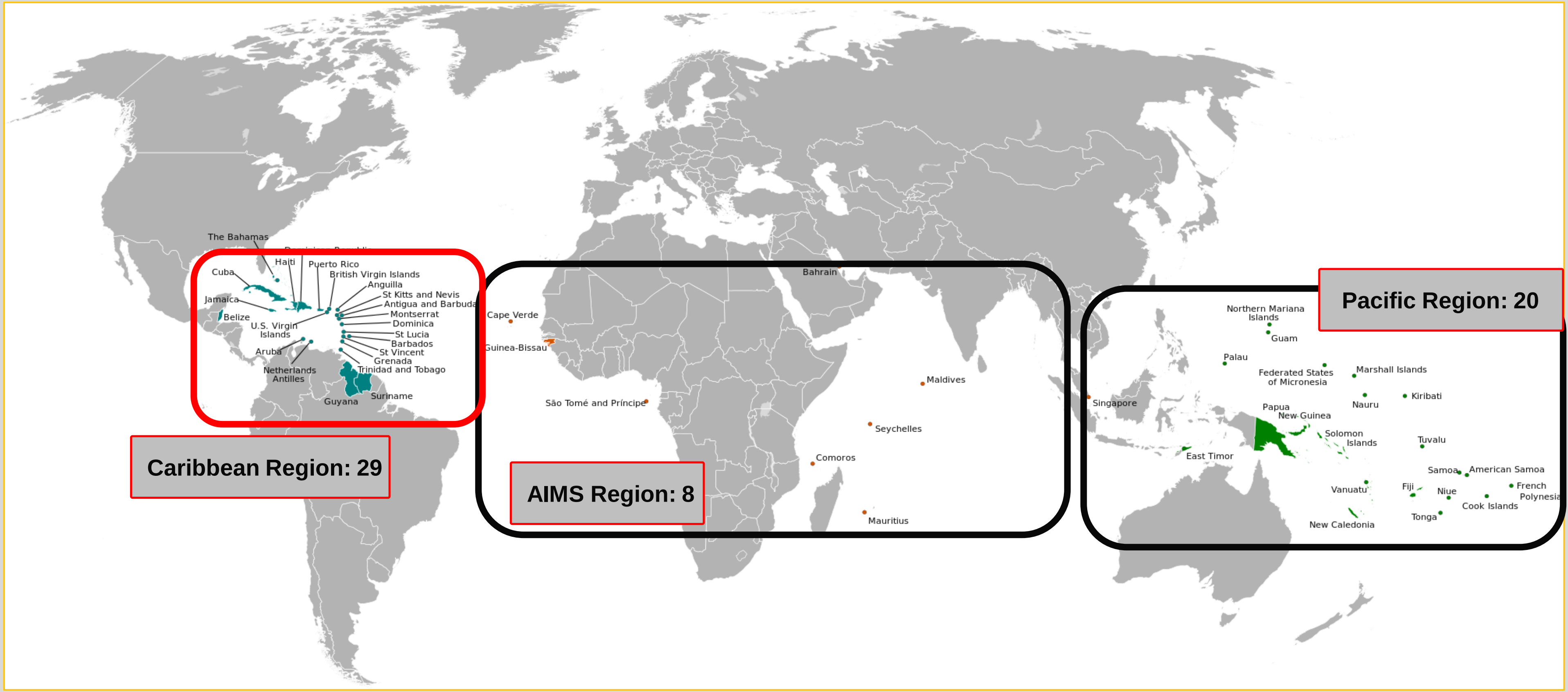
- Physically remote
- Geographically isolated
- Clusters of islands
- Developing states
- Resource limitations
- Limited emergency management capacity



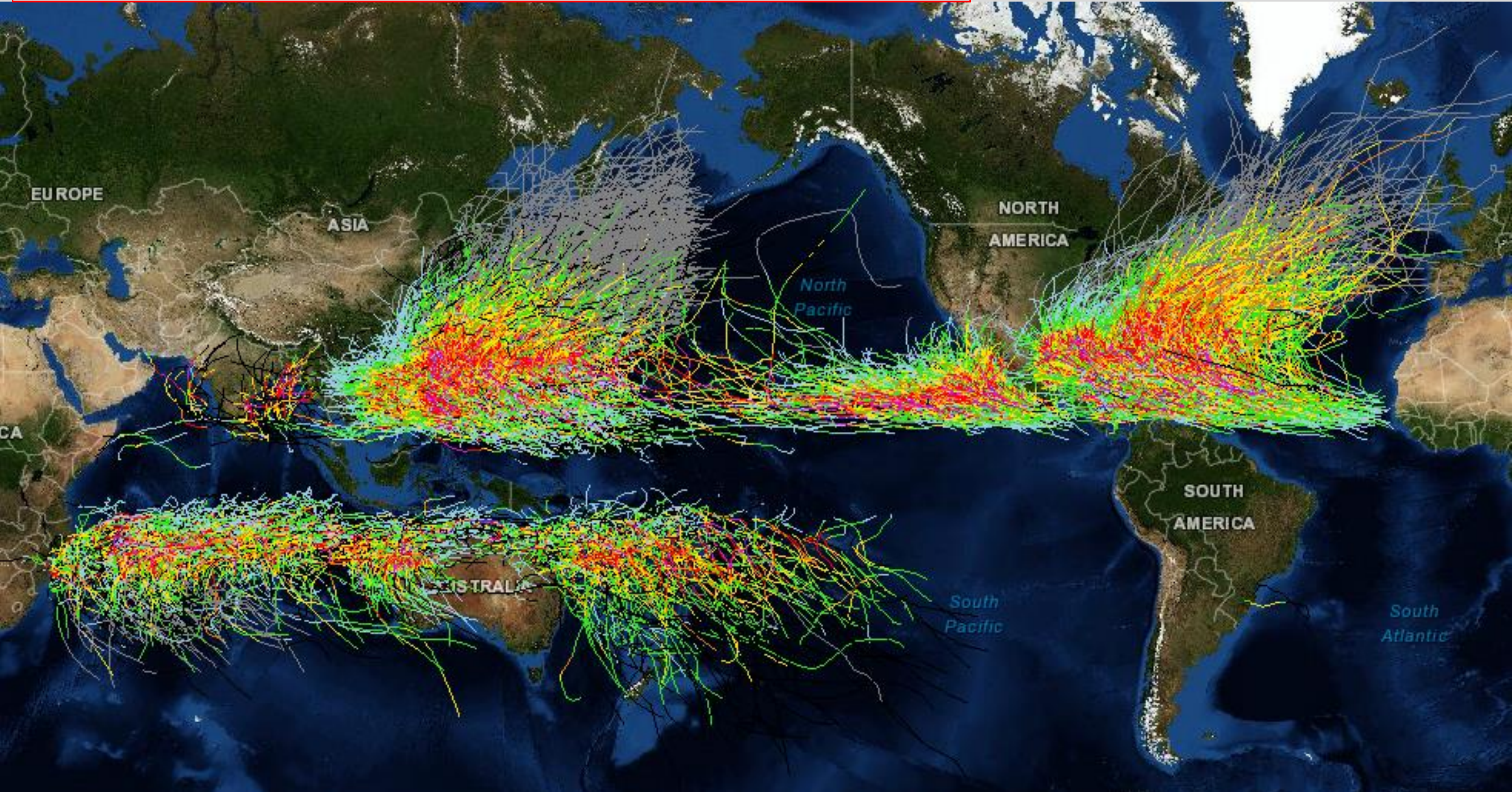
Vanuatu: extreme sea level rise vulnerability

Maldives: capital city of Male

VULNERABILITY: Small Island Developing States (SIDS)



VULNERABILITY: Worldwide distribution of tropical cyclone paths



2017 Atlantic basin hurricane season: publications

Mitigating tropical cyclone risks and health consequences: urgencies and innovations

The devastation wrought by human population exposure to the 2017 Atlantic basin hurricanes and the protracted health and social consequences of these storms highlight the destructive potential of tropical cyclones.[1–3] Two factors are contributing to the progressively increasing risk for weather-related disasters throughout the 21st century.[4] First, as the oceans warm and the sea levels rise, prominent tropical cyclone hazards are quantifiably increasing over time, especially peak storm intensity, maximum precipitation rate, frequency of the most intense cyclones, and areal extent of storm surge flooding.[5–7] Second, vulnerabilities are worsening, driven by population growth, urbanisation combined with increasing population density (particularly in coastal cities bordering the world's tropical cyclone basins), the disproportionate risk for small island developing states (SIDS)—22 of 29 SIDS in the Caribbean region were affected by at least one 2017 storm,[3] damaged ecosystems, fragile and failing infrastructure, and increasing socioeconomic disparities. The public health consequences of tropical cyclones will commensurately increase unless solutions are found to mitigate and adapt to increasing risk.[3] The 2017 Atlantic storms brought these risk dynamics into clear view.

After a lull of several years with few land-falling hurricanes in the Atlantic, the 2017 season has re-energised the conversation around disaster risk reduction and management. Unless action is taken to mitigate hazards and invest in adaptive capacity, losses could increase sharply throughout the 21st century as stronger storms encounter populations residing in environments with marked areas of vulnerability.[4–6] Therefore, 2017 could be a harbinger of things to come that require innovative solutions on multiple levels to match the complexity of effectively governing tropical cyclone risks and consequences. With these hazard and vulnerability patterns in mind, confronting tropical cyclone risks globally will require a reformulation of the approach on several scales.

Important contributors to future tropical cyclone risk are people's vulnerability along with erosion of the ecosystem's natural buffer function. The 2015–30 Sendai Framework[8] and the UN Sustainable Development Goals[9] recognise the primacy of disaster risk reduction, which prioritises the upstream elements of prevention, protection, and preparedness over the downstream focus on rescue and response.[10] Disaster risk reduction partners smoothly with climate change adaptation by fully encompassing it.[10]

Effective macro-level planning will rely on collaborations between atmospheric and oceanographic scientists, hydrologists, structural engineers, urban planners, legal scholars, and social scientists in active partnership with medical, public health, and health-care professionals; all dovetailing their expertise with emergency managers and disaster response personnel.[6] Also at the macro level, fragile infrastructure must be redesigned and renovated. As observed repeatedly throughout the 2017 season, long electrical power outages decapitate the emergency response, and are thus life threatening. Also, regional satellite and communications capabilities must be dramatically upgraded.

Fortunately, some model programmes worthy of emulation exist. The Atlantic storms reinforced the importance of the Pan American Health Organization initiative to create disaster-proof, safe, and green hospitals throughout the western hemisphere. The US public health preparedness approach of creating regional health-care coordination could be adapted to provide care for island-based populations and coastal communities that sustain damage to the point at which local health-care delivery is hindered or inoperable.

At the community level, local emergency management plans will need to be updated on the basis of lessons learned and redeveloped to prioritise disaster risk reduction approaches.[10] Evacuation procedures must be revisited in light of previous experiences, including assuring adequate fuel supplies along the designated routes and creatively using public transport options.[1] Post-storm damage assessment data can usefully guide enforcement of tougher building codes. Community shelter systems should be expanded, retrofitted, and fortified to withstand stronger storms.

During 2017, the need for mutual aid became a forefront issue. One component is maintaining and replenishing community or regional stockpiles of essential supplies and

POLICY ANALYSIS

Risks, Health Consequences, and Response Challenges for Small-Island-Based Populations: Observations From the 2017 Atlantic Hurricane Season

James M. Shultz, MS, PhD; James P. Kossin, PhD; J. Marshall Shepherd, PhD; Justine M. Ransdell; Rory Walshe; Ilan Kelman, PhD; Sandro Galea, MD, DrPH

ABSTRACT

The intensely active 2017 Atlantic basin hurricane season provided an opportunity to examine how climate drivers, including warming oceans and rising seas, exacerbated tropical cyclone hazards. The season also highlighted the unique vulnerabilities of populations residing on Small Island Developing States (SIDS) to the catastrophic potential of these storms. During 2017, 22 of the 29 Caribbean SIDS were affected by at least one named storm, and multiple SIDS experienced extreme damage. This paper aims to review the multiplicity of storm impacts on Caribbean SIDS throughout the 2017 season, to explicate the influences of climate drivers on storm formation and intensity, to explore the propensity of SIDS to sustain severe damage and prolonged disruption of essential services, to document the spectrum of public health consequences, and to delineate the daunting hurdles that challenged emergency response and recovery operations for island-based, disaster-affected populations. (*Disaster Med Public Health Preparedness*. 2018;0:1-13)

Key Words: climate change, climate driver, disaster, disaster response, hazard, health consequences, hurricane, risk, Small Island Developing States, tropical cyclone, tropical storm, vulnerability

The United Nations (UN) officially recognizes the precarious existence of 57 Small Island Developing States (SIDS), distributed across 3 vast ocean regions occupying the earth's tropical and subtropical beltline (Table 1).[1-3] Twenty-nine of the SIDS are in the Caribbean region. Throughout the highly active 2017 Atlantic basin hurricane season, a series of human population encounters with strong tropical cyclones underscored the vulnerabilities of SIDS to the impacts of climate-related storm hazards. The Caribbean SIDS sustained the brunt of human harm and public health consequences as well as structural damage and environmental devastation.

Aiming to advance our understanding of the particular burden faced by SIDS in the face of escalating vulnerabilities to hurricanes, we organized our discussion to (1) document the 2017 storm impacts on the Caribbean SIDS and then, in sequence, (2) describe the climate-related hazards that influenced the destructive capacity of the season's tropical cyclones, (3) outline the unique *disaster risk landscape* for SIDS, (4) summarize the cascades of hurricane health consequences, and (5) explore the constellation of challenges that impeded, and sometimes derailed, an effective disaster response.

2017 ATLANTIC HURRICANE IMPACTS ON CARIBBEAN REGION SIDS

Seventeen named tropical cyclones developed during the 2017 Atlantic basin hurricane season, beginning in April and extending into early November, along with two weaker systems (a tropical depression and a potential tropical cyclone) (Figure 1).[4] Worldwide, tropical cyclones are variably termed *hurricanes*, *typhoons*, or *cyclones*, depending upon their basin of origin.[5] Atlantic storms are classified according to their peak sustained wind speeds and corresponding wind-focused damage estimates, according to the Saffir-Simpson hurricane wind scale (SSHWS).[6] Tropical systems are named, using alphabetical lists, once they attain *tropical storm* force velocities (39-73 mph). If wind speeds increase to 74 mph or higher, the tropical storm graduates to a *hurricane* status. Hurricanes are further classified, based on ranges of wind speeds, into Categories 1 through 5. The top 3 categories (3-5) are *major* hurricanes.

Among the 17 named storms in 2017, 7 had their highest wind velocities in the tropical storm range, whereas the other 10 storms attained hurricane wind speeds. Six hurricanes reached *major* hurricane status, with winds in excess of 110 mph.

We analyzed the National Hurricane Center (NHC) 2017 storm archive files, examining the map sequences to identify the SIDS that experienced tropical storm and/or hurricane wind fields during the passage of each storm.[4] For each Atlantic basin named storm, the archive contains a series of maps, updated every 6 hours, displaying the path of the storm and the geographic center of circulation surrounded by a red

2017 Atlantic basin hurricane season: key findings

POLICY ANALYSIS

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9-of-17 named storms brought tropical storm or hurricane force winds to at least 1 SIDS

22-of-29 Caribbean Region SIDS were impacted by at least one of the 2017 Atlantic storms

4 SIDS were impacted by 1 storm; 13 SIDS were impacted by 2 storms; 5 SIDS were impacted by 3 storms

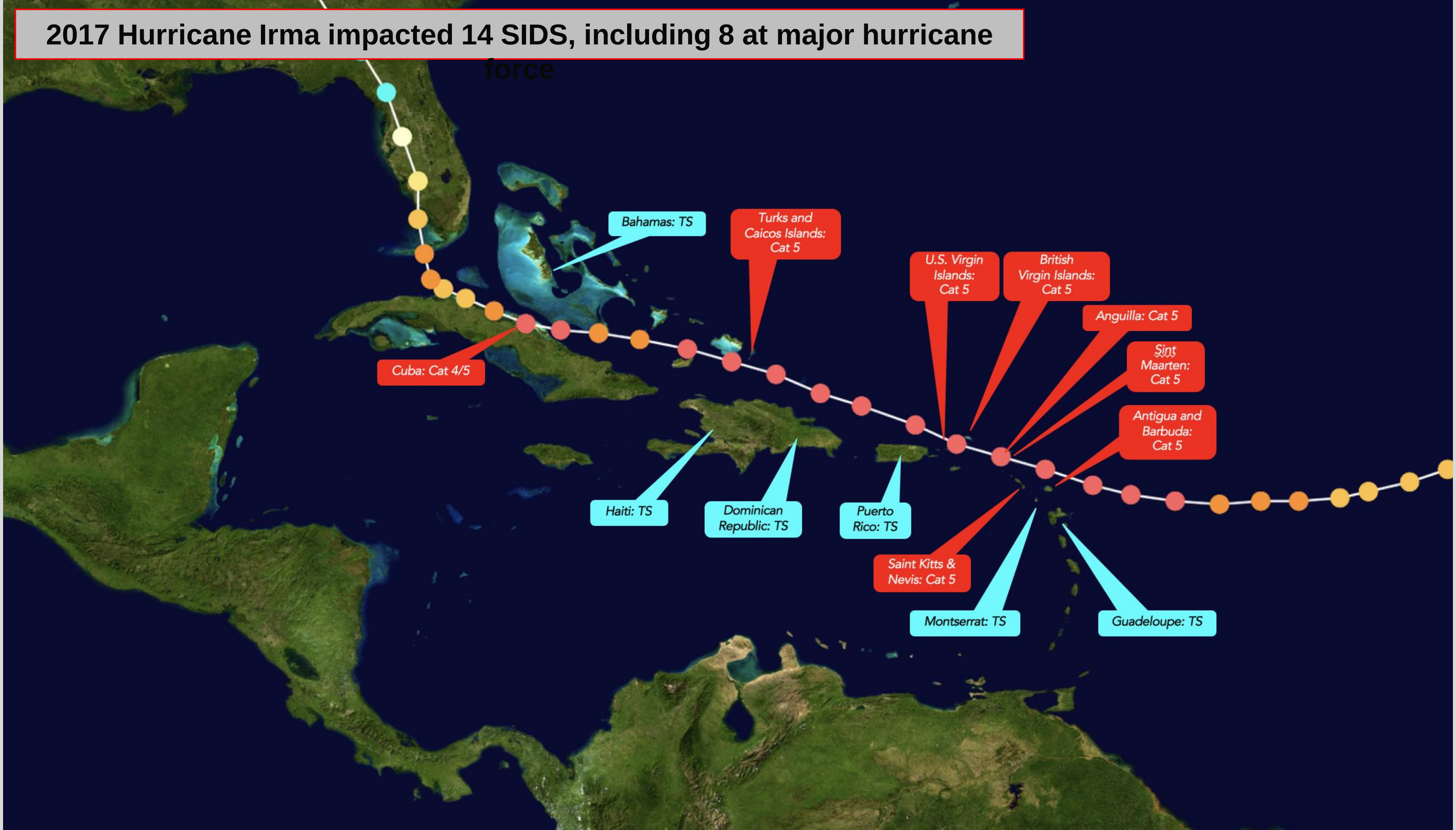
For 11 SIDS, maximal storm winds were tropical storm force

For 11 SIDS, maximal storm winds were major hurricane force

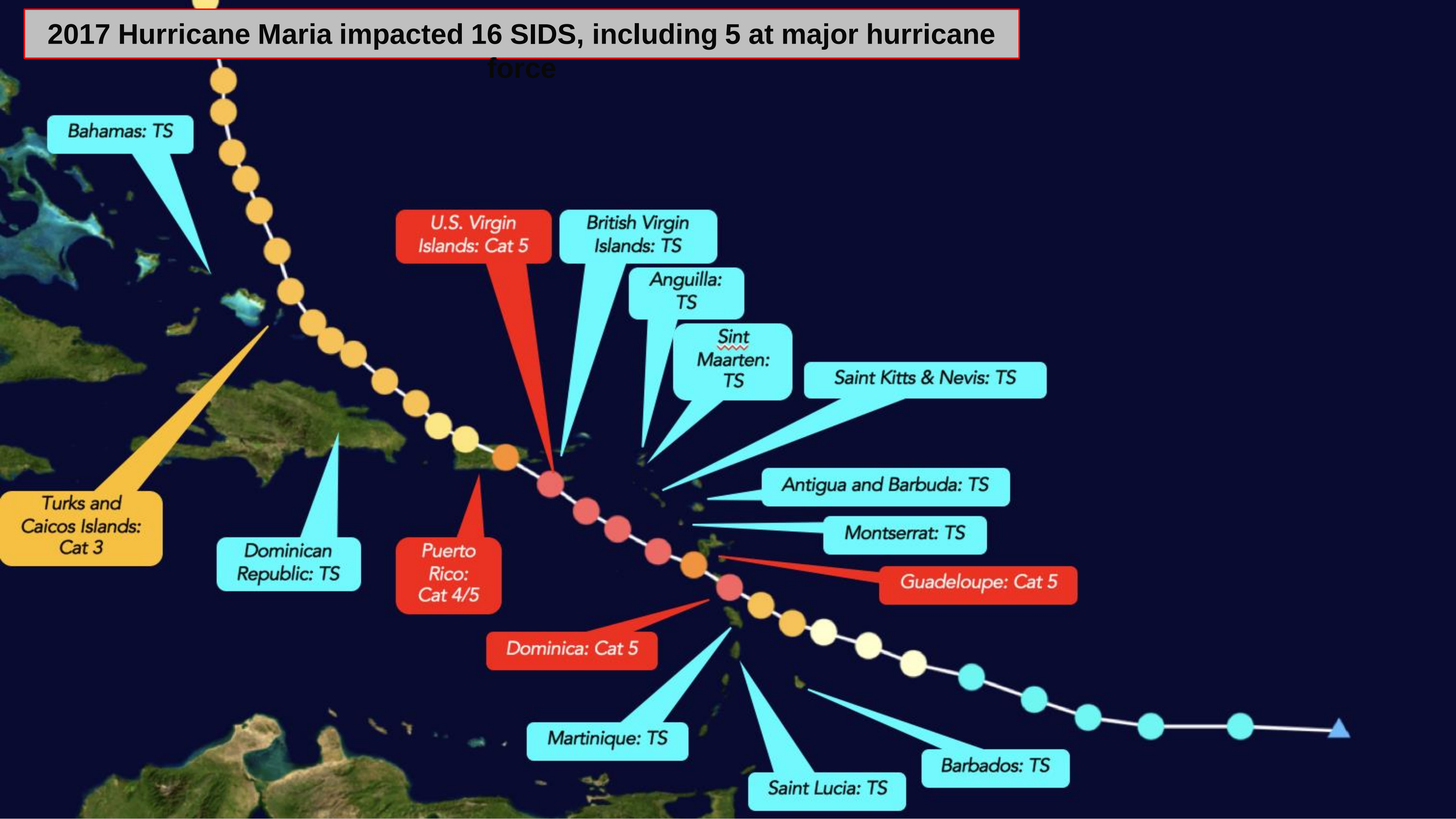
9 SIDS experienced the direct landfall of a major hurricane

ETHICS: Environmental injustice – SIDS contribute minimally to climate change and greenhouse gas emissions but are sentinels for the most severe impacts of rising temperatures, sea-level rise, climate-related disasters

2017 Hurricane Irma impacted 14 SIDS, including 8 at major hurricane force



2017 Hurricane Maria impacted 16 SIDS, including 5 at major hurricane force



HAZARD: Atlantic basin hurricane hazards

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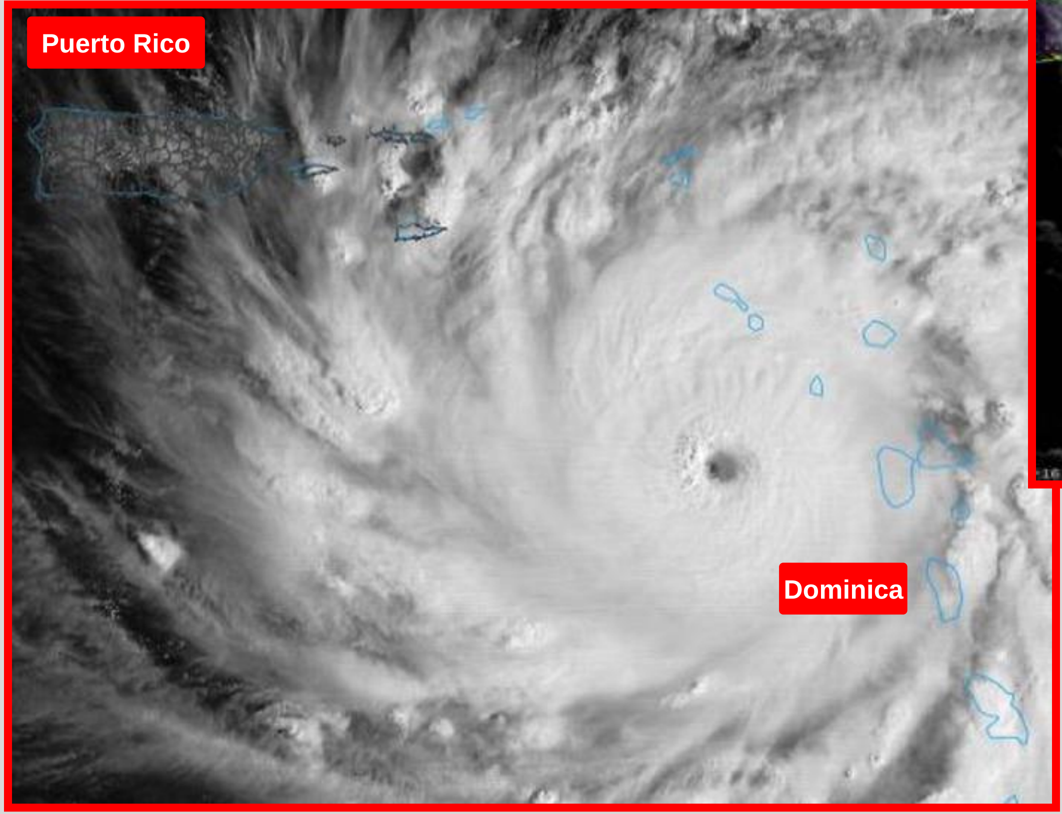
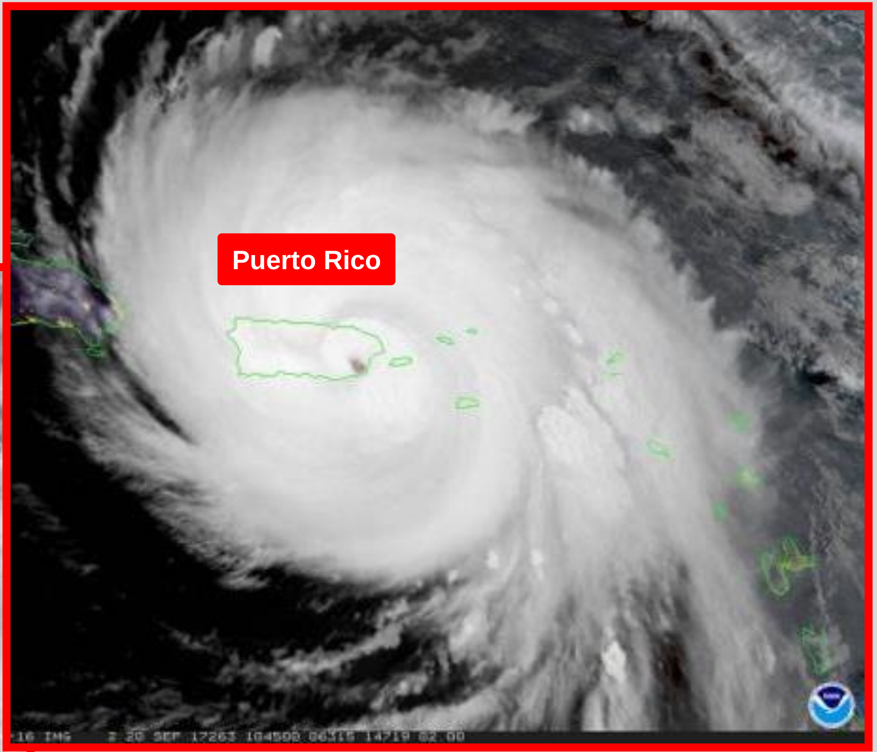
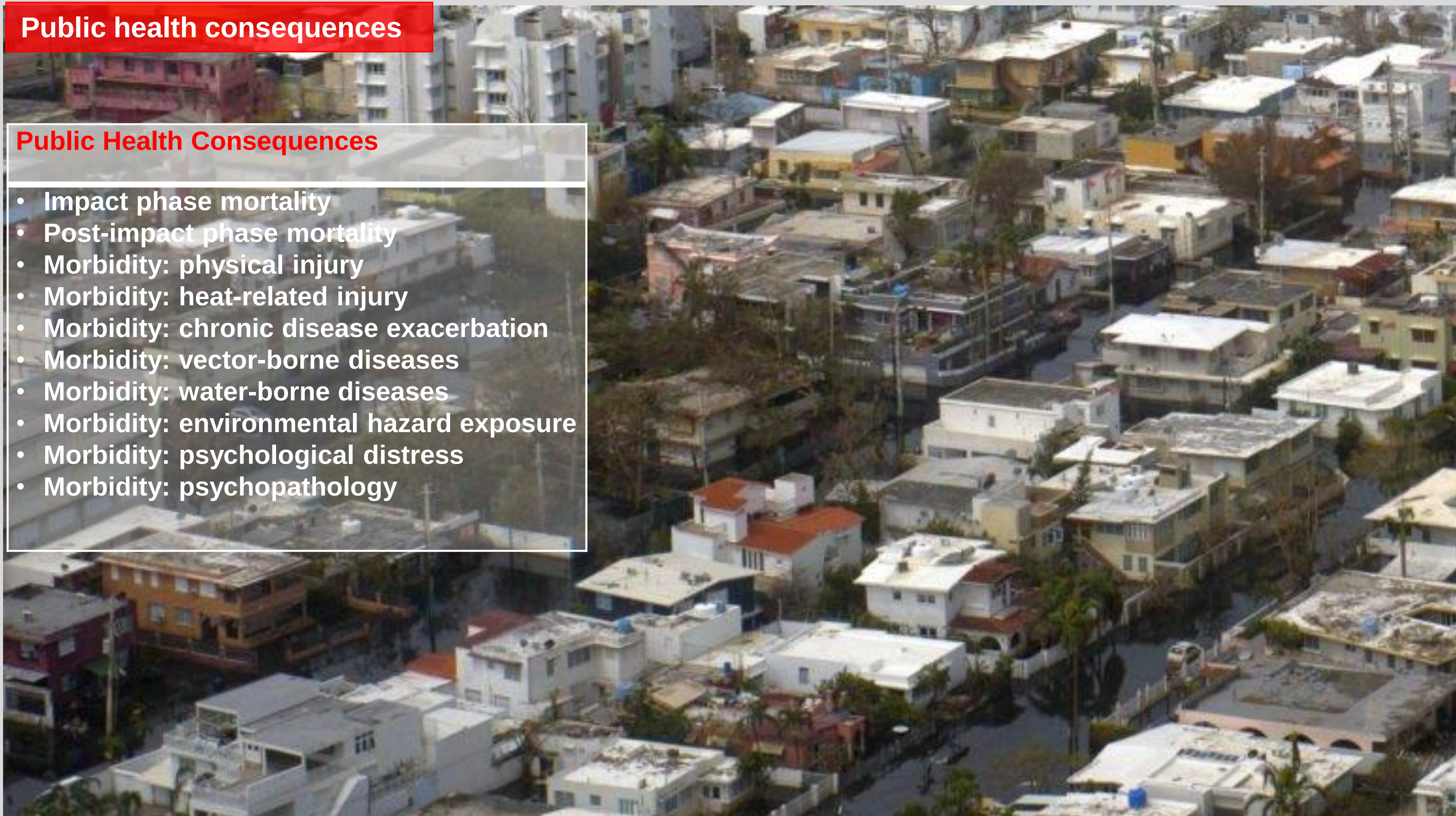




Public health consequences



Public Health Consequences

- Impact phase mortality
- Post-impact phase mortality
- Morbidity: physical injury
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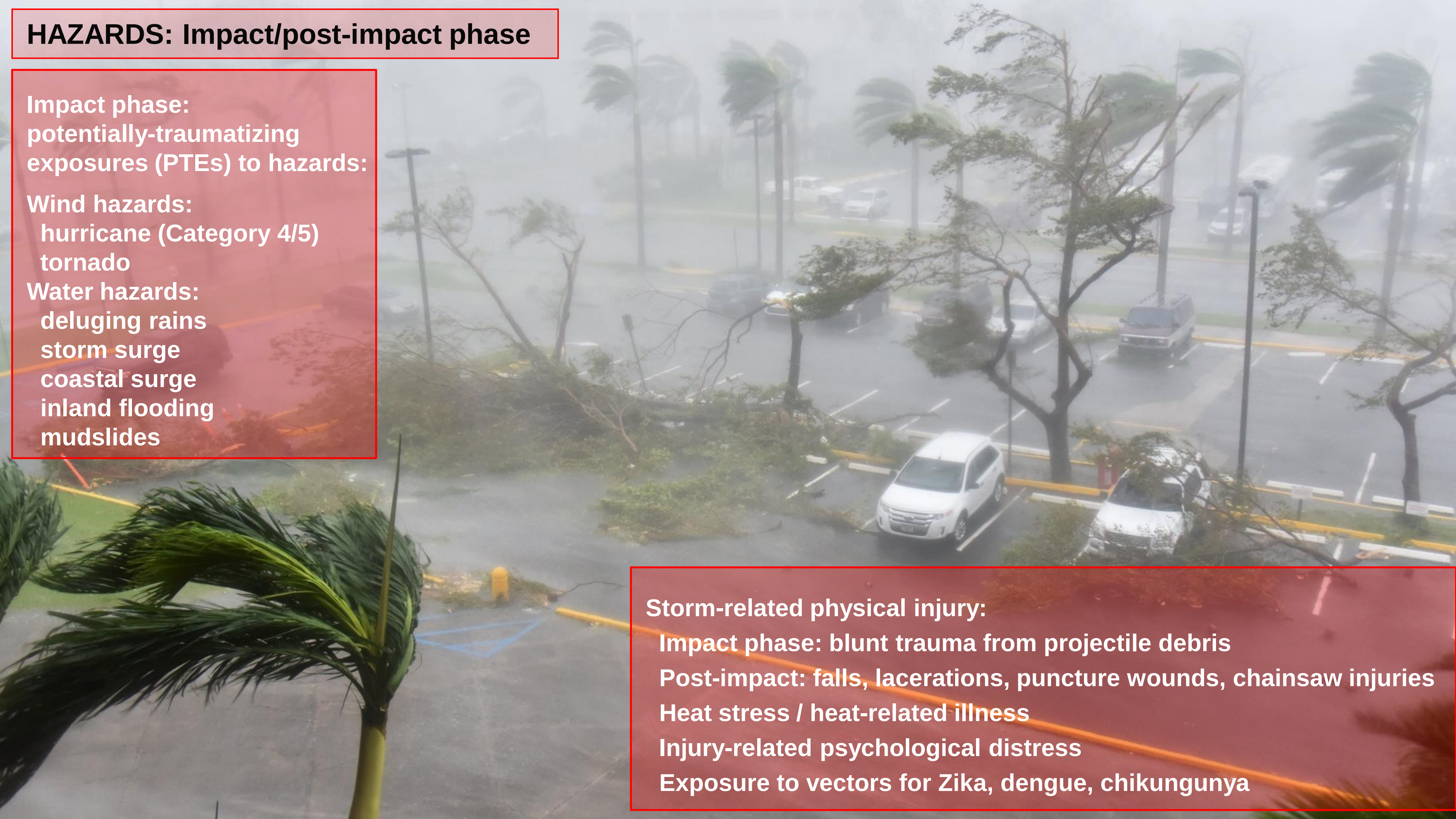
- Morbidity: chronic disease exacerbation
- Morbidity: vector-borne diseases
- Morbidity: water-borne diseases
- Morbidity: environmental hazard exposure
- Morbidity: psychological distress
- Morbidity: psychopathology

HAZARDS: Impact/post-impact phase



Impact phase: potentially-traumatizing exposures (PTEs) to hazards:

Wind hazards:
- hurricane (Category 4/5)
- tornado

Water hazards:
- deluging rains
- storm surge
- coastal surge
- inland flooding
- mudslides

Storm-related physical injury:
- Impact phase: blunt trauma from projectile debris
- Post-impact: falls, lacerations, puncture wounds, chainsaw injuries
- Heat stress / heat-related illness
- Injury-related psychological distress
- Exposure to vectors for Zika, dengue, chikungunya

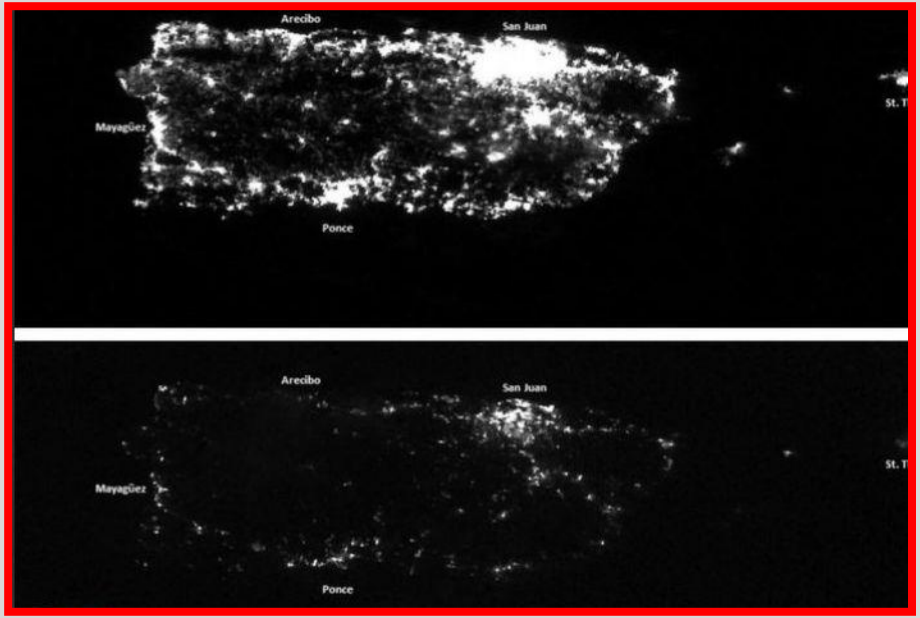
HAZARDS: Impact/post-impact phase

Storm destruction /
roof loss leading to:

- Exposure to the elements
- Exposure to mosquitoes/ vectors
- Elevated risks for Zika, dengue, chikungunya

HAZARDS: Impact/post-impact phase

Damage to infrastructure
- Island-wide power outages
  - heat stress/exhaustion/stroke
- Extreme water shortage
- Lack of communications
- Lack of information
- Lack of timely response



HAZARDS: Impact/post-impact phase

Inland flooding:

- Exposure to contaminated water and water-borne infectious diseases
- Enhanced breeding conditions for mosquitoes

Disaster behavioral health precepts

In a disaster, the size of the psychological footprint greatly exceeds the size of the medical footprint

Disaster behavioral health precepts

In a disaster, psychosocial consequences extend along a **spectrum of severity**.

Severity relates to the degree and intensity of exposure

Disaster behavioral health precepts

In a disaster, psychosocial consequences expand across a **range of duration**

Forces of harm

Affected population

Hazard

Resource/human losses

Enduring life changes

Disaster impact

Time from impact

2017 Prominent Climate Drivers

- Elevated ocean temperatures
- Elevated air temperatures
- Sea level rise
- El Niño neutral conditions
- Minimal vertical wind shear
- High thermal potential

Emergency Management (EM) Disaster Response Challenges

- Economic limitations on pre-storm mitigation
- Inability to pre-position and stage supplies
- Severe damage to infrastructure limiting response
- Disabled government and EM operations
- Delayed response: time needed to transport personnel
- Delayed response: time needed to transport materiel
- Inoperable and incompatible communications
- Limited available situational information
- Simultaneous responses to dispersed populations
- Heterogeneity of response partners
- Diverse national jurisdictions
- Political considerations affecting response priorities
- Issues of environmental injustice
- Complexity: disasters create disasters

Hurricane Disaster Risks for SIDS: Function of Hazard x Vulnerability

2017 Atlantic Basin Hurricane Hazard Characteristics

2017 seasonal characteristics

Above average number of storms (17)
Above average number of hurricanes (10)
Above average major hurricanes (6)
Larger storms
Prolonged storm season
Multiple locale impacts per storm
Multiple storm impacts per locale

Wind hazards

Increased maximum peak wind speeds
Rapid intensification prior to landfall
Increased high intensity storm duration

Water hazards

Increased atmospheric moisture-holding capacity
Record-setting precipitation rates
Record-setting rainfall amounts
Severe overland flooding
Mudslides in steep terrain

Sea level rise

Severe storm surge impacts
Severe coastal wave action
Decreased flood drainage

Small Island Developing States (SIDS) Vulnerabilities

- Located in the MDR
- 360º coastal perimeter
- Minimal elevation
- Mountainous terrain
- Physically remote
- Geographically isolated
- Clusters of islands
- Developing states
- Resource limitations
- Limited EM capacity

2017 Atlantic Hurricane Season Disaster Consequences for SIDS

2017 Hurricane Disaster Consequences

General effects

Disabling economic crises
Disruption of government functions
Extensive structural / home damage
Population displacement
Lack of food, clean water

Infrastructure impacts

Power outages
Communication disruptions
Transportation disruptions
Fuel shortages
Port/airport damage/closures

Health system impacts

Hospital closures
Healthcare services disruptions
Life-saving treatment disruptions
Lack of medications

Agricultural impacts

Crop/livestock losses
Diminished agricultural production

Systems impacts

School damage/closures
Worksite damage/closures

Public Health Consequences

- Impact phase mortality
- Post-impact phase mortality
- Morbidity: physical injury
- Morbidity: heat-related injury
- Morbidity: chronic disease exacerbation
- Morbidity: vector-borne diseases
- Morbidity: water-borne diseases
- Morbidity: environmental hazard exposure
- Morbidity: psychological distress
- Morbidity: psychopathology


National Academy of Sciences: Data matters: ethics, data, and international research collaboration in a changing world
Domain-specific examples: Disasters
Thank you very much.
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