Domain-specific examples: Disasters
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

Resilience factors

Forces of harm

Affected population

Disaster impact
Complex emergencies/humanitarian crises

"Natural" disasters
- meteorological
- hydrological
- climatological
- geophysical
- biological
- extraterrestrial

Anthropogenic disasters
- Non-intentional
  - technological
- Intentional
  - mass violence
  - terrorism

Disaster taxonomy
Complex emergencies/humanitarian crises

"Natural" disasters

- hurricanes, tornadoes, storms
- floods, precipitation, waves, mudslides
- earthquakes, landslides, volcanoes
- wildfires, heat/cold extremes
- epidemics, blights, infestations
- asteroids, meteoroids

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- 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

2017 Atlantic Basin Hurricane Hazard Characteristics

<table>
<thead>
<tr>
<th>2017 seasonal characteristics</th>
</tr>
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<tbody>
<tr>
<td>Above average number of storms (17)</td>
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<td>Multiple locale impacts per storm</td>
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<table>
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<tr>
<th>Water hazards</th>
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<tbody>
<tr>
<td>Increased atmospheric moisture-holding capacity</td>
</tr>
<tr>
<td>Record-setting precipitation rates</td>
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<tr>
<td>Record-setting rainfall amounts</td>
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<tbody>
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<td>Increased shoreline flooding</td>
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<tr>
<td>Severe coastal wave action</td>
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<tr>
<td>Decreased flood drainage</td>
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Small Island Developing States (SIDS) Vulnerabilities
- Located in the MDR
- 360° coastal perimeter
- Minimal elevation
- Mountainous terrain
- Physically remote
- Geographically isolated
- Clusters of islands
- Developing states
- Resource limitations
- Limited EM capacity

2017 Hurricane Disaster Consequences

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<th>General effects</th>
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<tbody>
<tr>
<td>Disabling economic crises</td>
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<tr>
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<td>Extensive structural / home damage</td>
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<th>Health system impacts</th>
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<tbody>
<tr>
<td>Hospital closures</td>
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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
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### Wind hazards
- Increased maximum peak wind speeds
- Rapid intensification prior to landfall
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- Severe storm surge impacts
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## 2017 Hurricane Season Disaster Consequences for SIDS
### General effects
- Disabling economic crises
- Disruption of government functions
- Extended personal / 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 loss
- Diminished agricultural production

### Systems impacts
- School damage/closures
- Worksite damage/closures

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**HAZARD: Climate influences on 2017 Atlantic basin hurricane hazard characteristics**
Increased frequency of disaster-generating climate events (tropical cyclones, heat waves, droughts, and floods)
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2017 Atlantic basin hurricane season: 17 named storms
Mitigating the Mental and Physical Health Consequences of Hurricane Harvey

The complexity of the disaster risk landscape and the exposure of large human populations to disaster potentially transforming environments in the path of Hurricane Harvey. During the 2017 season, more than 1 million people were displaced, and the storm affected the entire coastline of Texas, Louisiana, and Mississippi. At least 400,000 people were displaced, and at least 900,000 people were temporarily housed in shelters. The storm caused more than $110 billion in damages. The usually compact National Weather Service tweeted: “Phenomenon experienced. Full complement of hurricane hazards: iconic winds, storms, surge along coastline, road closures, evacuations, and power outages.

The psychological consequences of Hurricane Harvey are associated with severe public health and individual needs during an ongoing disaster. The immediate and long-term humanitarian needs and research questions for those with chronic and persistent mental illness are unprecedented. These severe mental health consequences of natural disasters have not been adequately addressed in the literature. Over 50% of those who have experienced a disaster may develop mental health disorders. Scientific evidence plunders from early with residents that are directly affected by Hurricane Harvey. Fewer experienced related mental health consequences, and the majority experience severe mental health disorders.

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

Extreme events often cause severe stress and public health in recent years, hurricanes, such as Harvey and Irma, have illustrated the knowledge gaps regarding the consequences of disasters and their mitigation. Hurricane Harvey, Irma, and Maria affected large populations and caused widespread destruction, reaching the maximum weather and economic costs. We know quite a bit about the likely consequences of these storms. As water diminishes and recreation, the response rapidly develops into escalating mental health consequences. People who were directly exposed to life-threatening situations are more likely to experience acute stress disorders, and people who were not directly exposed, albeit at lower rates.

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- Limited emergency management capacity

Vanuatu: extreme sea level rise vulnerability

Maldives: capital city of Male
VULNERABILITY: Small Island Developing States (SIDS)
Mitigating tropical cyclone risks and health consequences: urgencies and innovations

The devastation wrought by human population exposure to the 2017 Atlantic basin hurricane season and the associated health and social consequences of these storms highlight the destructive potential of tropical cyclones. Following the devastation wrought by hurricanes Maria, Irma, and Jose in the Caribbean region, the 2017 season has been characterized by an unprecedented number of major hurricanes making landfall in the region. This season, which started on June 1st and ended on November 30th, was marked by the formation of three major hurricanes: Harvey, Irma, and Maria. Harvey, which made landfall in Texas as a Category 4 storm, caused significant damage and loss of life. Irma, which made landfall in the U.S. Virgin Islands as a Category 5 storm, was one of the most powerful hurricanes to hit the region in recent memory. Maria, which made landfall in Puerto Rico as a Category 5 storm, caused extensive damage and loss of life. The 2017 season was one of the most destructive in recent history, with thousands of lives lost and billions of dollars in damages.

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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

- Increased frequency of “major” hurricanes
- Increased peak wind speeds
- Rapid intensification
- Increased atmospheric moisture content
- Increased precipitation rate
- Increased rainfall totals
- Rising sea levels: increased storm/tidal surge

2017: The “perfect storm season”
HAZARD: Atlantic basin hurricane hazards

Puerto Rico
Dominica
Public Health Consequences

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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
In a disaster, the size of the psychological footprint greatly exceeds the size of the medical footprint.
In a disaster, psychosocial consequences extend along a **spectrum of severity**. Severity relates to the degree and intensity of exposure.
In a disaster, psychosocial consequences expand across a range of duration.
# 2017 Atlantic Basin Hurricane Hazard Characteristics

## 2017 Atlantic Hurricane Season Characteristics
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## Hurricane Disaster Risks for SIDS: Function of Hazard x Vulnerability

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## 2017 Hurricane Disaster Consequences

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Thank you very much.

James M. Shultz

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