



# METEOR

Modelling Exposure Through Earth Observation Routines

# Tanzania Scenario Walkthrough

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British  
Geological  
Survey



**NSET**  
Earthquake Safe Communities in Nepal



**Oxford Policy  
Management**



# Use of scenarios in disaster risk reduction

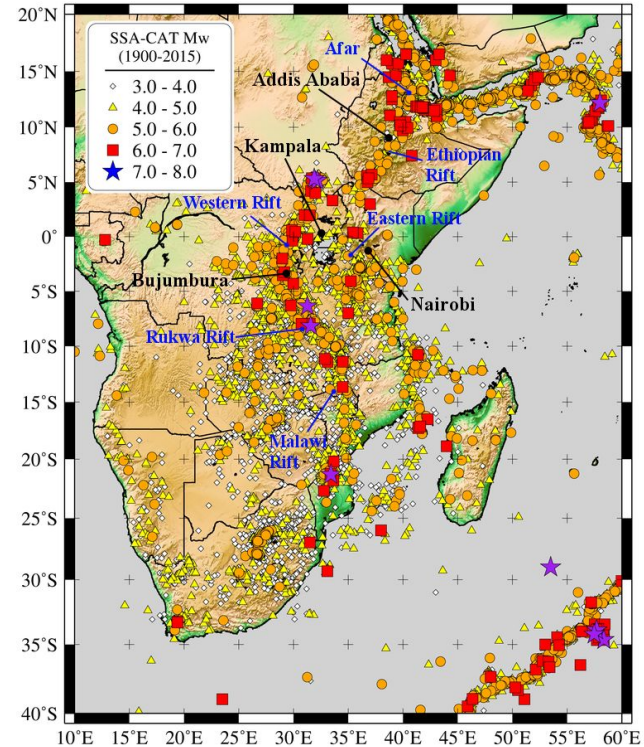
“Scenarios are stories about how the future might develop, aimed to stimulate exploration, understanding, and discussion” (Cambridge Centre for Risk Studies 2020)

We can use scenarios to help understand preparedness for certain risks, and how organizations or communities might adapt to or mitigate those risks

In this presentation, we'll specifically look at an earthquake scenario.

# Earthquakes in Sub-Saharan Africa

Earthquakes are prevalent throughout much of Sub-Saharan Africa, particularly along the **East African Rift System (EARS)** that spans from Ethiopia to Mozambique



Poggi, V., Durrheim, R., Mavonga Tuliuka, G., Weatherill, G., Gee, R., Pagani, M., Nyblade, A., Delvaux, D., 2017. Assessing Seismic Hazard of the East African Rift: a pilot study from GEM and AfricaArray. Bulletin of Earthquake Engineering. Volume 15, Issue 11, 4499–4529, DOI: 10.1007/s10518-017-0152-4

# Seismic Hazard in Tanzania

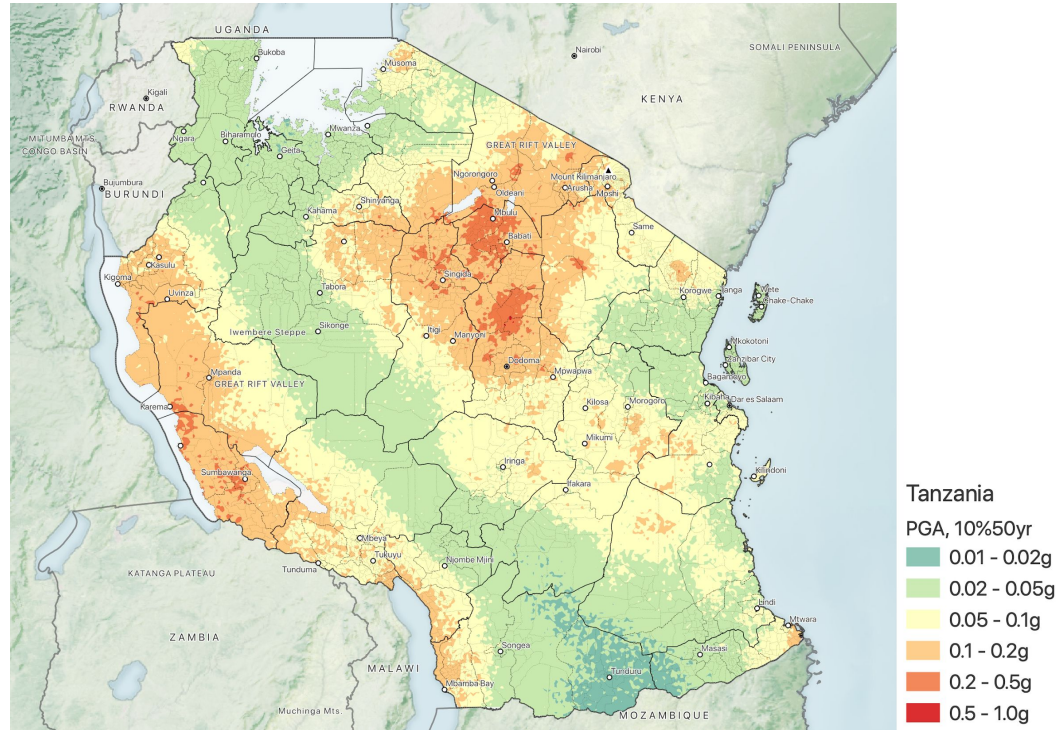
The seismic hazard in Tanzania is higher:

- Along the borders with the DRC and Zambia
- In the Central to Northeast

However, earthquakes can also occur elsewhere in the country.

For example:

- 2016 Lake Victoria earthquake
- 2020 Dar es Salaam earthquake



# Significant earthquakes in Tanzania

## 2016 Bukoba Earthquake, M5.9

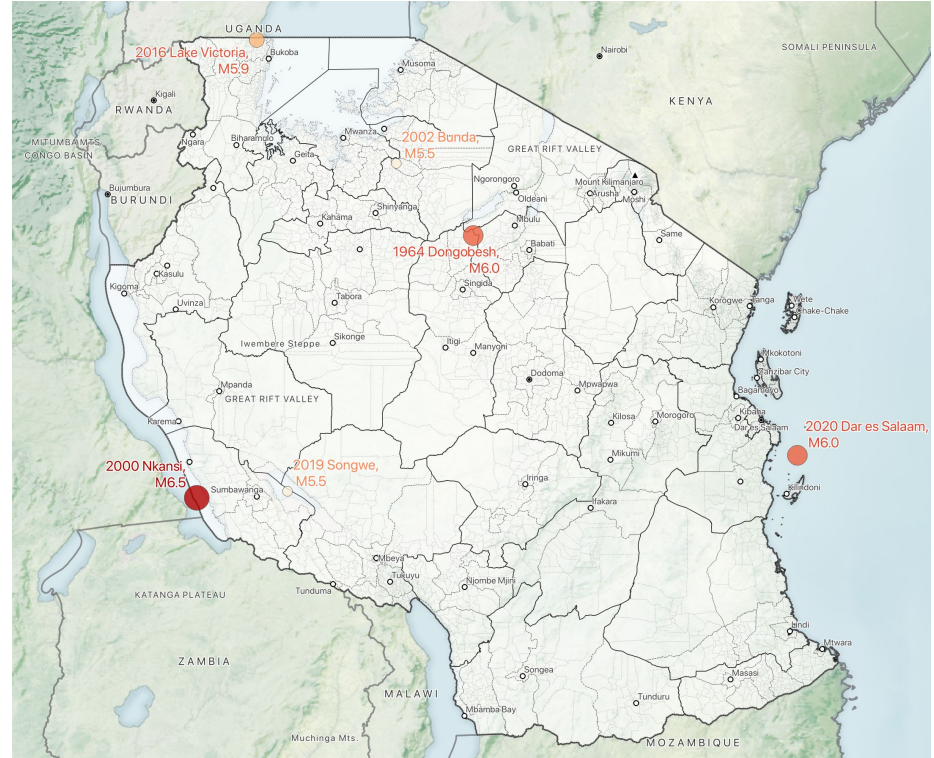
- Deadliest earthquake, resulting in 17 deaths and 440 injuries
- Most destructive earthquake, with 2,072 homes destroyed and 14,595 homes damaged

## 2000 Nkansi, M6.5

- Largest magnitude earthquake on Tanzania soil in recent history

## 2020 Dar es Salaam, M6.0

- Recent significant earthquake near highly populated area of Tanzania



# 2016 Bukoba earthquake

The M5.9 earthquake struck at 3:27pm local time, about 25 km from the town of Nsungu & 44 km from Bukoba

There were 17 reported fatalities and 440 injuries, with over 2,072 homes destroyed and over 14,595 homes damaged

Residents were fearful to re-enter their homes due to visible damage and cracks



A collapsed building in Bukoba town, following the earthquake. Source: TRCS



TRCS Kagera Branch volunteers doing an initial assessment of the impact of the earthquake in Bukoba, Kagera region. Source: TRCS

# 2016 Bukoba earthquake

The Tanzanian Red Cross Society and government responded to the event.

- Emergency search and rescue
- Emergency first aid and medical services to injured persons, with referral to the regional hospital
- Rapid damage and needs assessment
- Direct assistance to 1,000 families and indirect assistance to 1,124 families (including shelter relief, first aid, psychosocial support, & distribution of mosquito nets/buckets/blankets/kitchen sets/mattresses)



# 2016 Bukoba earthquake

Challenges to response included:

- Electricity and telecommunications were disrupted, making it difficult to understand potential damage to hospitals and essential infrastructure
- The regional hospital was stretched to be nearly full capacity, with a limited stock of medicine
- Many survivors were disoriented and panicked; many worried to return their already damaged homes, fearful of further damage in aftershocks
- Rain began the following day, and had the potential to intensify, thereby hampering response



# 2016 Bukoba earthquake: Survivor stories



*“I was... visiting my grandmother, Bibi, in Bukoba. We were in her house... when everything started shaking... Bibi told me to get out of the house quickly. And even though she is old, she... got outside quickly too... the land was shaking and it looked like grandmother’s house was moving into the road.*”

*Together with our neighbors, we left and slept outside for three days. It was very dangerous.”*

<https://ifrc.medium.com/tanzania-earthquake-survivor-stories-c845d9455a25>

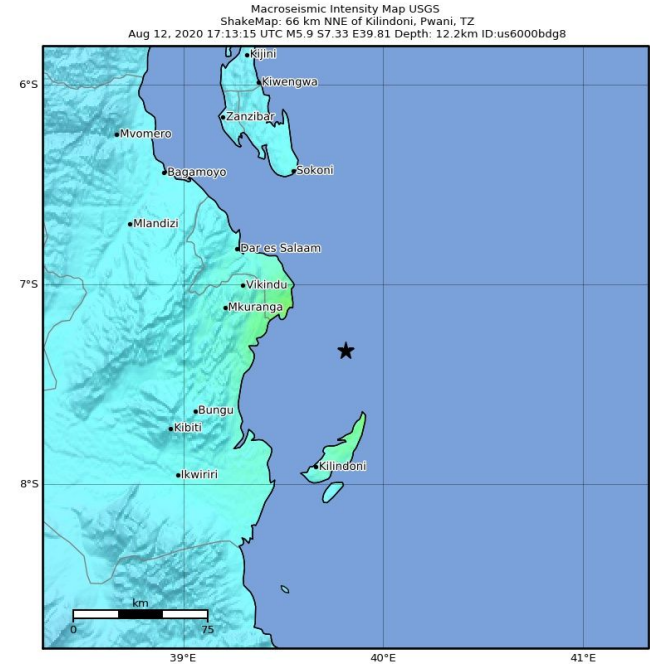
# 2020 Dar es Salaam earthquake

The M6.0 earthquake struck offshore, 88 km from Dar es Salaam

The event occurred far enough away, that the ground shaking was only light to moderate by the time it reached the Tanzanian coast

Fortunately, there was minimal damage

This seismic source could produce up to a M7.5 earthquake in the future

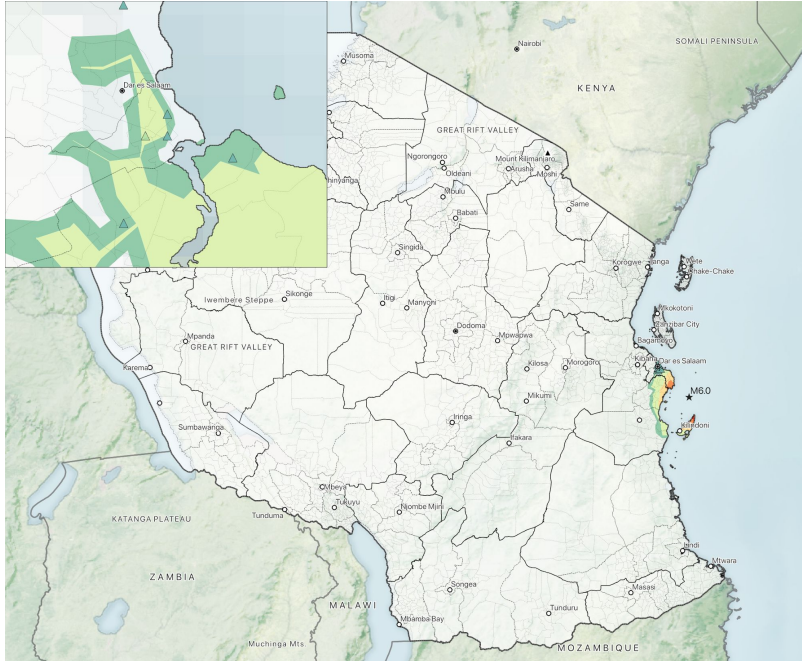


SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
DAMAGE	None	None	None	Very light	Light	Moderate	Moderate/heavy	Heavy	Very heavy
PGA(%g)	<0.0464	0.297	2.76	6.2	11.5	21.5	40.1	74.7	>139
PGV(cm/s)	<0.0215	0.135	1.41	4.65	9.64	20	41.4	85.8	>178
INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X-X+

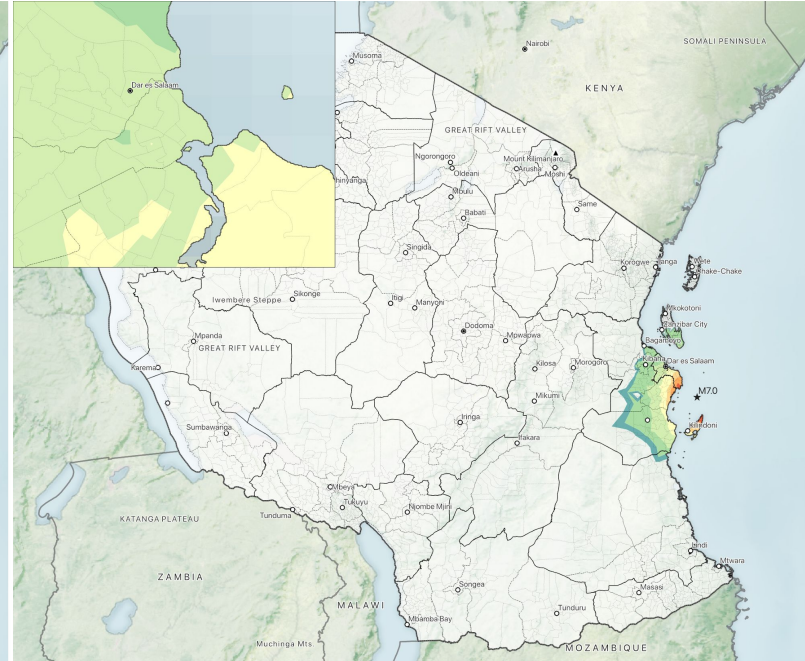
Scale based on Worden et al. (2012) Version 1: Processed 2020-08-12T17:33:09Z  
 △ Seismic Instrument ○ Reported Intensity ★ Epicenter

# What if the Dar es Salaam earthquake was stronger?

Magnitude 6.0 (Actual)



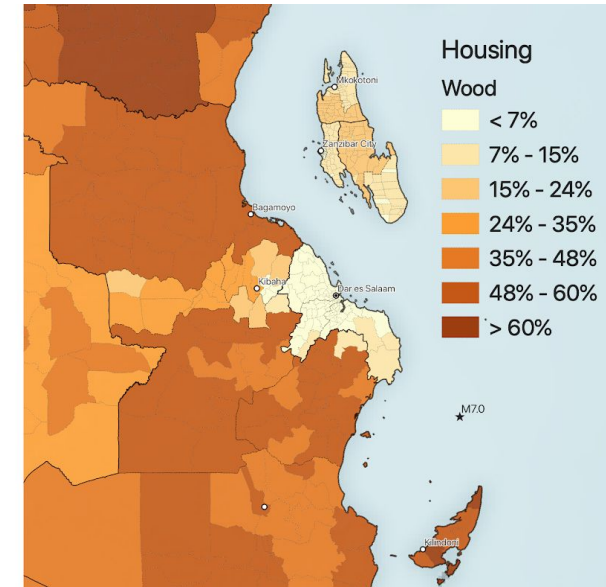
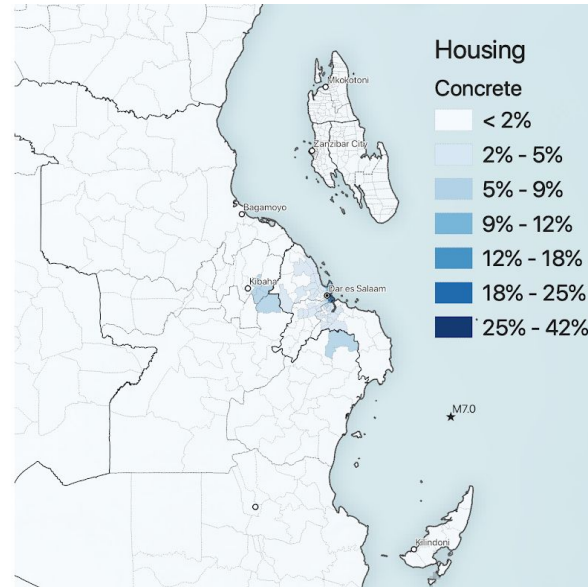
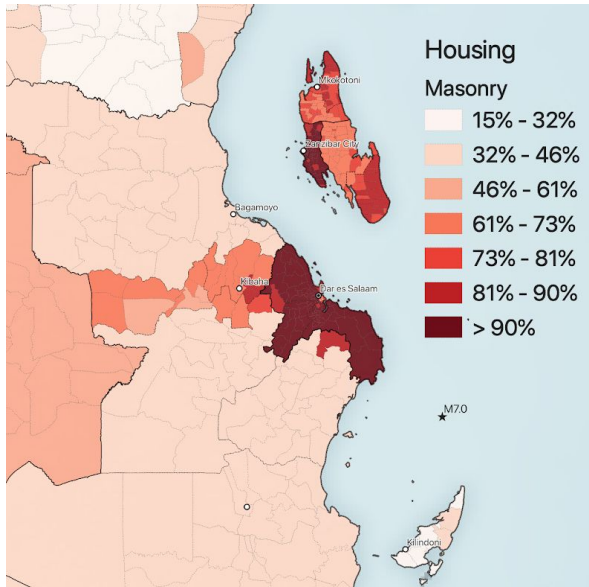
Magnitude 7.0 (Modified)



Dar es Salaam 2020

- \* Epicenter
- Estimated shaking, PGA
- 0.025 - 0.050g
- 0.050 - 0.075g
- 0.075 - 0.100g
- 0.100 - 0.125g
- 0.125 - 0.150g
- 0.150 - 0.175g
- 0.175 - 0.200g
- > 0.200g

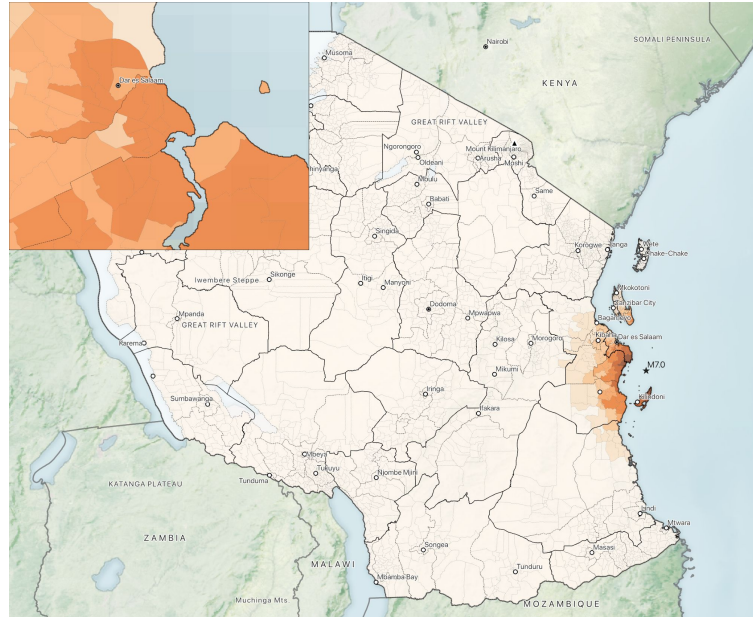
# What if the Dar es Salaam earthquake was stronger?



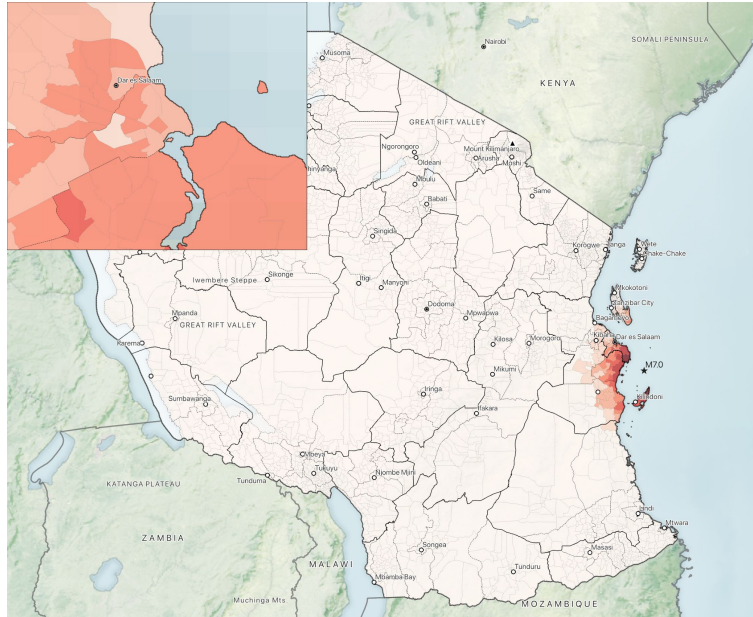
Different construction types are more likely to exhibit damage in the case of earthquakes. For example, masonry tends to become more heavily damaged than concrete or wood construction.

# What if the Dar es Salaam earthquake was stronger?

## Damaged residences



## Destroyed residences



# Potential impacts of a M7.0 earthquake near Dar

	Damaged residences	Destroyed residences	Most affected district
<b>Dar es Salaam</b>	270,000 (21%)	5,200 (0.4%)	Temeke
<b>Pwani</b>	39,000 (15%)	830 (0.3%)	Mafia Island
<b>Zanzibar</b>	11,900 (7%)	80 (<0.1%)	Kati

Low-rise masonry buildings disproportionately damaged relative to other construction types within the affected region

# Potential impacts of a M7.0 earthquake near Dar

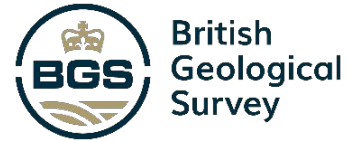
- \$1 billion USD in economic loss
- 500 to 2,000 fatalities; 5,000 to 20,000 injuries
- 100,000 to 300,000 displaced residents requiring shelter
- ½ to 1 weeks of electricity and telecommunications disruption
- Potential damage to hospitals, airport, ports
- Disruption to schools, offices, water and drainage systems
- Debris blocking roadways



# Questions for discussion

- Where is your ministry based, and what role would your ministry have in the response?
  - Would staff in your ministry have to relocate to Dar?
  - How might that travel occur if there was damage to the Julius Nyerere International Airport? What if there was a road blockage on the A7?
  - What might be impacted if the ferry port at Dar was disrupted due to damage?
- Who would the first responders be? What information might they need?
  - How would these requests for information be made?
  - How would information be exchanged with community responders?
- What would the strategy be to offer shelter for up to 300,000 people?
  - Who would coordinate this effort? Who would manage the operation on-the-ground?
  - What resources would they need?
  - Do the hospitals have the capacity for the number of injuries?
- What data might benefit the response? What are the protocols to gain access to that data?
- How would response to an earthquake differ from a response to floods? What areas of dar would be most impacted?

# Thank you!



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