IMPACT-BASED FORECASTING

DOST-PAGASA

Simulation of a Warning Generation Process

WMO PTC/GCC Workshop on Impact-based Forecast and Warning Services,
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Aim

- To better understand the IBF Warning process and outline the common steps of IBF approach through simulation exercises
- For participants to experience various roles involved in the IBF warning and decision-making process

Outline

1. Response Matrix Exercise
2. Simulation Exercise- Practice
3. IBF Game

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Response Matrix Exercise

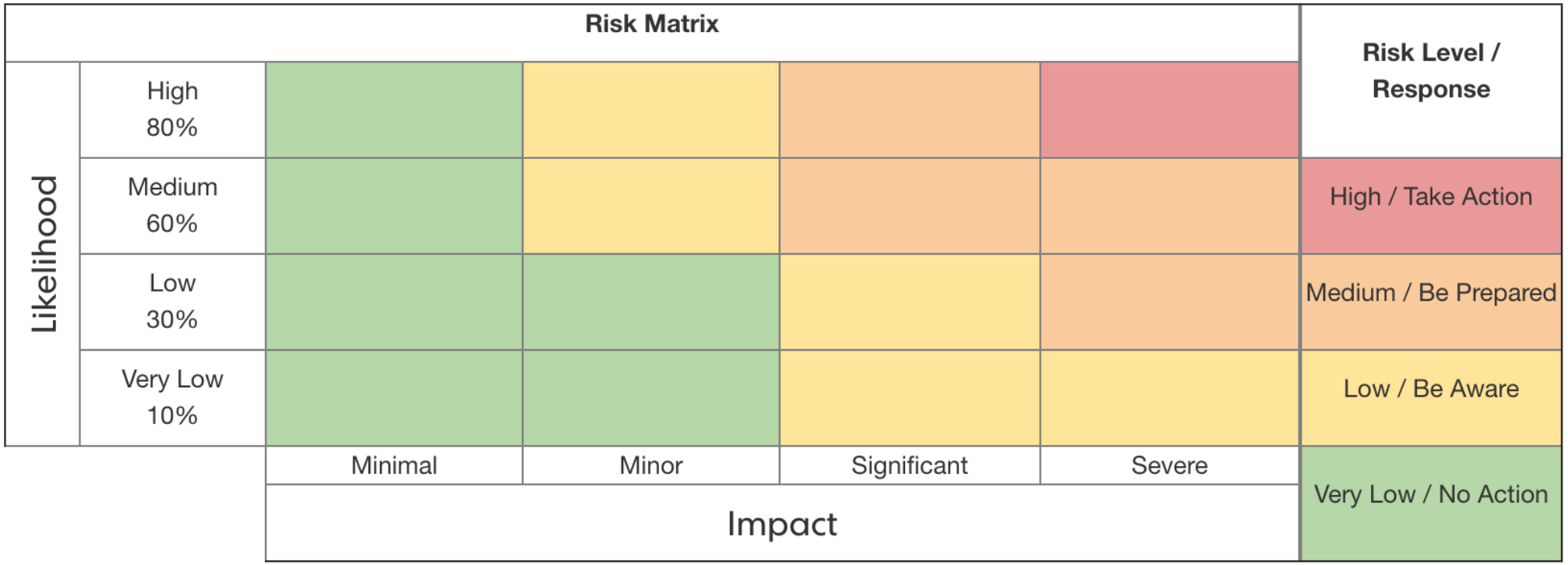
To start thinking about scenarios and how the impact tables and risk matrix can be used

Materials from The COMET® Program

Rain Impacts Table

Rainfall Impacts Table

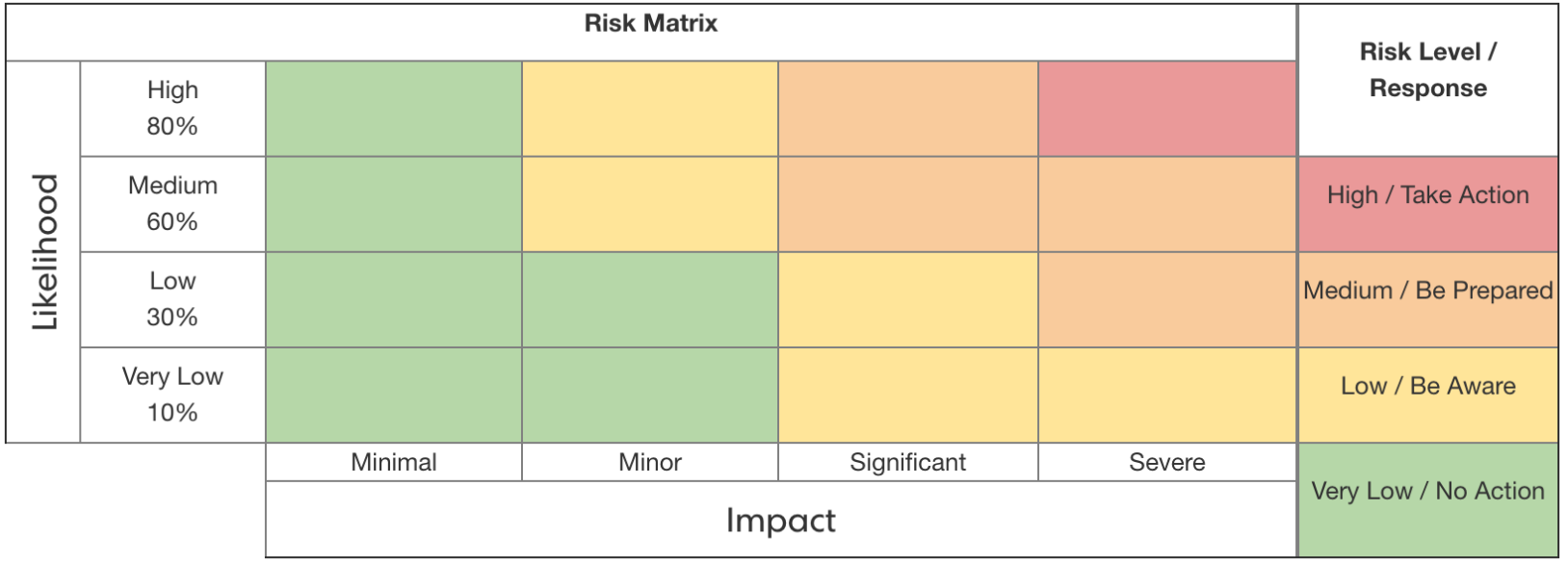
Minimal	Minor	Significant	Severe
• Water on roads, driving conditions affected by water • Isolated flooding of low-lying areas • Traffic congestion	• Some minor roads impassable • Low-lying bridges experience typical flooding • Major reads affected causing increased travel times • Areas cut off temporarily • Minor flooding occurring on some basins	• Flooding of major roads disrupting transport routes • Some minor route bridges impassable • Danger to life • Damage to roads • Communications and travel disrupted • Flash floods affecting many communities • One or two local municipalities affected	• Danger to life from fast flowing deep water • Evacuations and search and rescue operations may be needed • Roads impassable, road closures • Large-scale damage to major and minor roads • Widespread Flash floods • Large communities cut off • Bridges impassable or damaged • Houses flooded • More than two local municipalities affected
1-hour Rainfall > 25 mm (particularly sensitive areas like urban basins, steep slopes) 6-hour Rainfall > 75 mm			
	1-hour Rainfall > 50 mm (particularly sensitive areas like urban basins, steep slopes) 6-hour Rainfall > 150 mm		
		1-hour Rainfall > 100 mm 6-hour Rainfall > 200 mm	


Risk Matrix
Risk Level / Response
Likelihood
High 80%
Medium 60%
Low 30%
Very Low 10%
Minimal
Minor
Significant
Severe
Impact
High / Take Action
Medium / Be Prepared
Low / Be Aware
Very Low / No Action

Scenario 1

Early Morning

- Forecasters are evaluating the potential for heavy rain
- Currently, they are not confident that the event will occur
- If it does happen, major roads may be flooded and may cut people off from a residential area



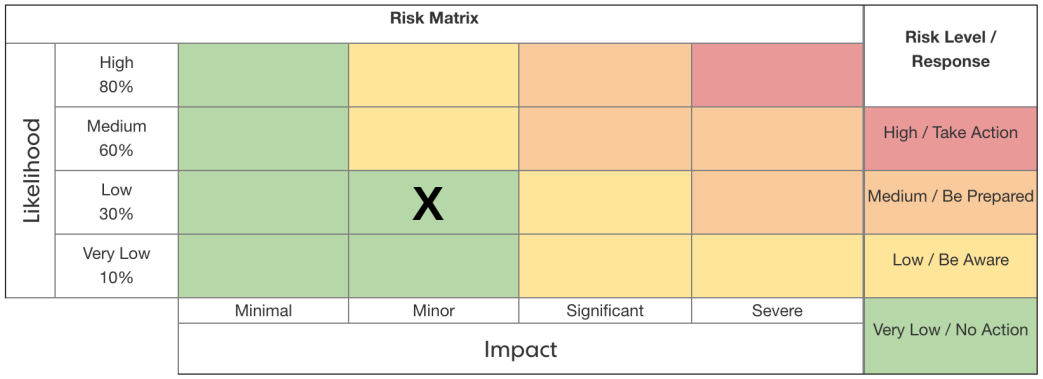
Where does this situation fall in the risk matrix?

Risk Matrix						Risk Level / Response
Likelihood	High 80%					
	Medium 60%					High / Take Action
	Low 30%					Medium / Be Prepared
	Very Low 10%					Low / Be Aware
		Minimal	Minor	Significant	Severe	Very Low / No Action
		Impact				

What is your advice?

Response Matrix: Rainfall			
Very Low - Business as usual	**Low - Be Aware**	**Medium - Be Prepared**	**High - Take Action**
The Met service will continue to monitor for any changing weather conditions.	Be aware of flooding and stay out of flood waters. Evaluate inventory of emergency supplies (food, water, medical supplies), restock supplies as needed. Monitor roads and properties for localized flooding and possible traffic and public transportation disruptions.	Be prepared for flooding and stay out of flood waters Check emergency supplies, purchase additional supplies if needed, fill gas tanks, etc. Be prepared for localized flooding of roads and properties in [...locations…],and land slippages that could block roads. Prepare for possible delays or cancellation of public transportation services	Stay out of flood waters and prepare to use emergency supplies. Avoid walking or driving through moving water and seek safer/higher ground if in [...locations…]. Don't drive and stay off roads in flood prone areas or areas with frequent land slippage/landslides. Plan to shelter in place in non-flood areas.

Where does this situation fall in the risk matrix?



- If it does happen, major roads may be flooded and may cut people off from a residential area
- Keep monitoring for updates

Rainfall Impacts Table

Minimal	Minor	Significant	Severe
• Water on roads, driving conditions affected by water • Isolated flooding of low-lying areas • Traffic congestion	• Some minor roads impassable • Low-lying bridges experience typical flooding • Major reads affected causing increased travel times • Areas cut off temporarily • Minor flooding occurring on some basins	• Flooding of major roads disrupting transport routes • Some minor route bridges impassable • Danger to life • Damage to roads • Communications and travel disrupted • Flash floods affecting many communities • One or two local municipalities affected	• Danger to life from fast flowing deep water • Evacuations and search and rescue operations may be needed • Roads impassable, road closures • Large-scale damage to major and minor roads • Widespread Flash floods • Large communities cut off • Bridges impassable or damaged • Houses flooded • More than two local municipalities affected
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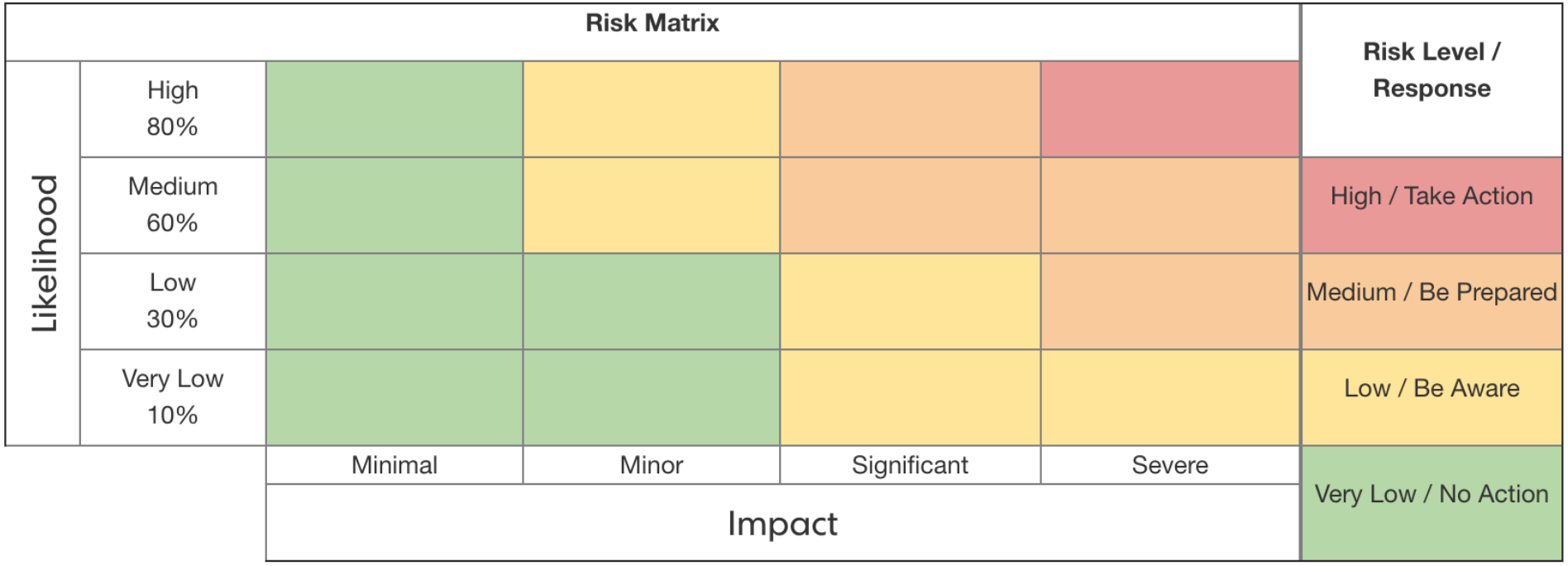
		1-hour Rainfall > 100 mm 6-hour Rainfall > 200 mm	

Scenario 1

Late Afternoon

- Heavy rain is more likely
- Children are traveling home from school
- People are beginning to leave work

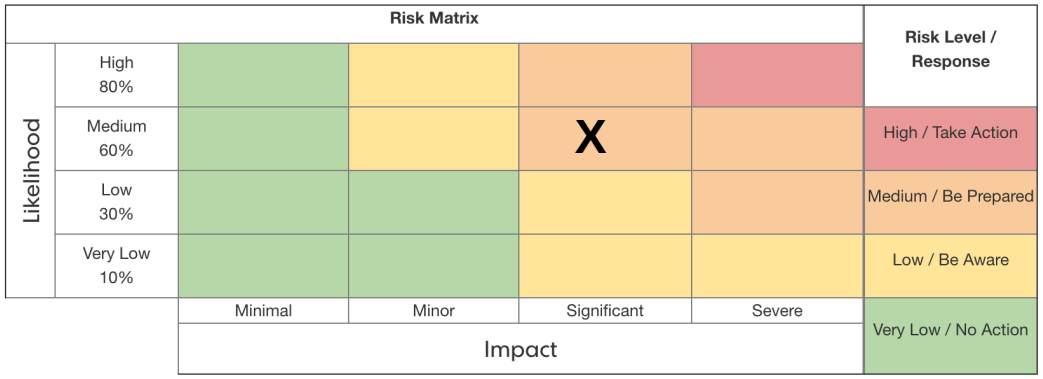
Where does this situation fall in the risk matrix?
How has it changed since the morning?



What is your advice?

Response Matrix: Rainfall			
Very Low - Business as usual	**Low - Be Aware**	**Medium - Be Prepared**	**High - Take Action**
The Met service will continue to monitor for any changing weather conditions.	Be aware of flooding and stay out of flood waters. Evaluate inventory of emergency supplies (food, water, medical supplies), restock supplies as needed. Monitor roads and properties for localized flooding and possible traffic and public transportation disruptions.	Be prepared for flooding and stay out of flood waters Check emergency supplies, purchase additional supplies if needed, fill gas tanks, etc. Be prepared for localized flooding of roads and properties in [...locations…],and land slippages that could block roads. Prepare for possible delays or cancellation of public transportation services	Stay out of flood waters and prepare to use emergency supplies. Avoid walking or driving through moving water and seek safer/higher ground if in [...locations…]. Don't drive and stay off roads in flood prone areas or areas with frequent land slippage/landslides. Plan to shelter in place in non-flood areas.

Where does this situation fall in the risk matrix?



- Children are traveling home from school; People are beginning to leave work – more people become vulnerable
- People should be prepared

Rainfall Impacts Table

Minimal	Minor	Significant	Severe
• Water on roads, driving conditions affected by water • Isolated flooding of low-lying areas • Traffic congestion	• Some minor roads impassable • Low-lying bridges experience typical flooding • Major reads affected causing increased travel times • Areas cut off temporarily • Minor flooding occurring on some basins	• Flooding of major roads disrupting transport routes • Some minor route bridges impassable • Danger to life • Damage to roads • Communications and travel disrupted • Flash floods affecting many communities • One or two local municipalities affected	• Danger to life from fast flowing deep water • Evacuations and search and rescue operations may be needed • Roads impassable, road closures • Large-scale damage to major and minor roads • Widespread Flash floods • Large communities cut off • Bridges impassable or damaged • Houses flooded • More than two local municipalities affected
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		1-hour Rainfall > 100 mm 6-hour Rainfall > 200 mm	

Scenario 2

- Strong winds up to 30 kts sustained are expected
- Winds will begin at 2200 and continue overnight

Wind Impacts Table

Minimal	Minor	Significant	Severe
• Isolated trees branches damaged • Few transport routes affected	• Localized tree damage blocking roads • Localized transport routes affected and longer travel times needed • Isolated loss of communication and electricity supply due to damaged power lines	• Weakly constructed houses suffer blown roofs or house collapse • Some trees blown over or damaged and blocking roads • Localized loss of communication and electricity supply due to damaged power lines • Transport routes affected • Localized problems with high profile vehicles on wind-prone routes • One to two local municipalities affected	• Widespread damage to structures, houses destroyed, roofs blown off, weak structures overturned or blown away • Falling trees and electrical power lines blocking major roads • Widespread and long duration disruption to power supply and other services • Dangerous driving conditions • More than two local municipalities affected
Strong winds 20-33 kts			
	Gale / Tropical storm force winds 34-50 kts		
		Strong Tropical storm > 50 kts	

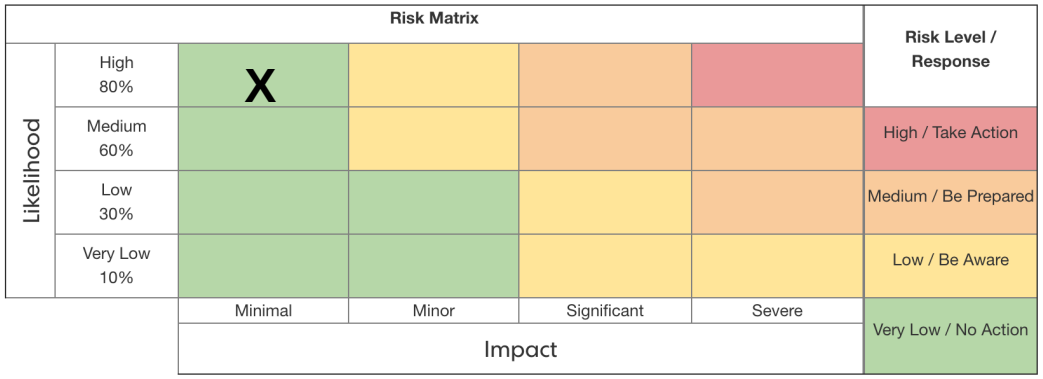
Where does this situation fall in the risk matrix?

Risk Matrix						Risk Level / Response
Likelihood	High 80%					
	Medium 60%					High / Take Action
	Low 30%					Medium / Be Prepared
	Very Low 10%					Low / Be Aware
		Minimal	Minor	Significant	Severe	Very Low / No Action
		Impact				

What is your advice?

Response Matrix: Wind			
Very Low - Business as usual	**Low - Be Aware**	**Medium - Be Prepared**	**High - Take Action**
We will notify you if weather conditions change.	Be aware of possible tumbling of unsecured objects, falling tree limbs, sea spray, and choppy seas in [...locations…]. Also be aware of possible traffic delays.	Be prepared for downed power lines, tumbling and rolling of unsecured objects, falling tree limbs and trees, sea spray, choppy seas and large breaking waves in [...locations…]. Also be prepared for road closures and traffic delays.	Expect downed power lines, tumbling and rolling of unsecured objects, falling tree limbs and trees, sea spray, choppy seas and large breaking waves in [..locations...]. Also expect road closures and traffic delays.

Where does this situation fall in the risk matrix?



Minimal	Minor	Significant	Severe
• Isolated trees branches damaged • Few transport routes affected	• Localized tree damage blocking roads • Localized transport routes affected and longer travel times needed • Isolated loss of communication and electricity supply due to damaged power lines	• Weakly constructed houses suffer blown roofs or house collapse • Some trees blown over or damaged and blocking roads • Localized loss of communication and electricity supply due to damaged power lines • Transport routes affected • Localized problems with high profile vehicles on wind-prone routes • One to two local municipalities affected	• Widespread damage to structures, houses destroyed, roofs blown off, weak structures overturned or blown away • Falling trees and electrical power lines blocking major roads • Widespread and long duration disruption to power supply and other services • Dangerous driving conditions • More than two local municipalities affected
Strong winds 20-33 kts			
	Gale / Tropical storm force winds 34-50 kts		
		Strong Tropical storm > 50 kts	

- Strong winds expected overnight- might lower vulnerability
- Business as usual

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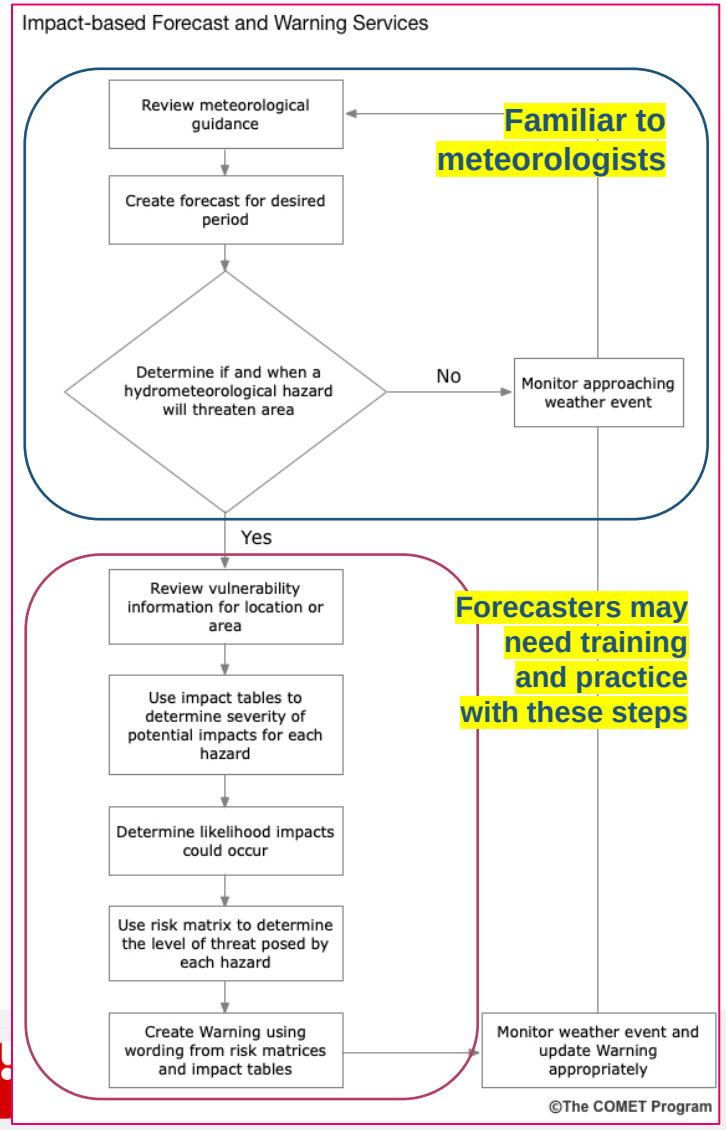
Simulation Exercise-Practice

The Impact-based Forecast and Warning Services Approach

Materials from The COMET® Program
[Communicating Risk: The Impact-based Forecast and Warning Services Approach (ucar.edu)]

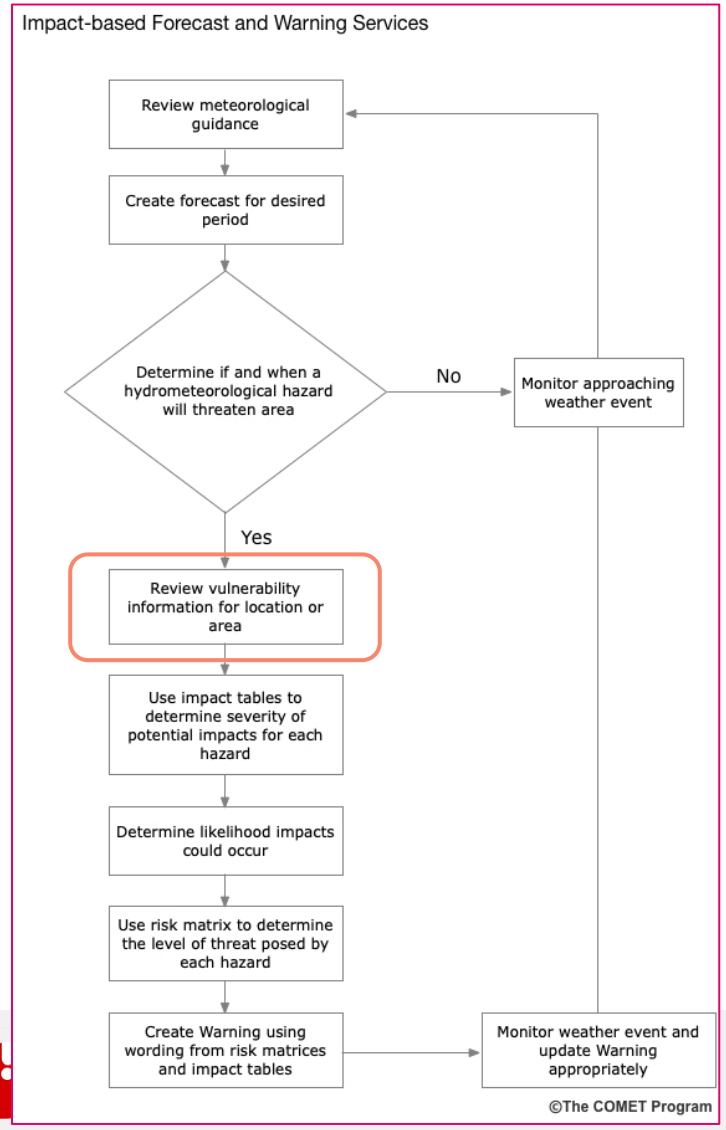
Impact-based Approach



The impact-based approach consists of nine steps:

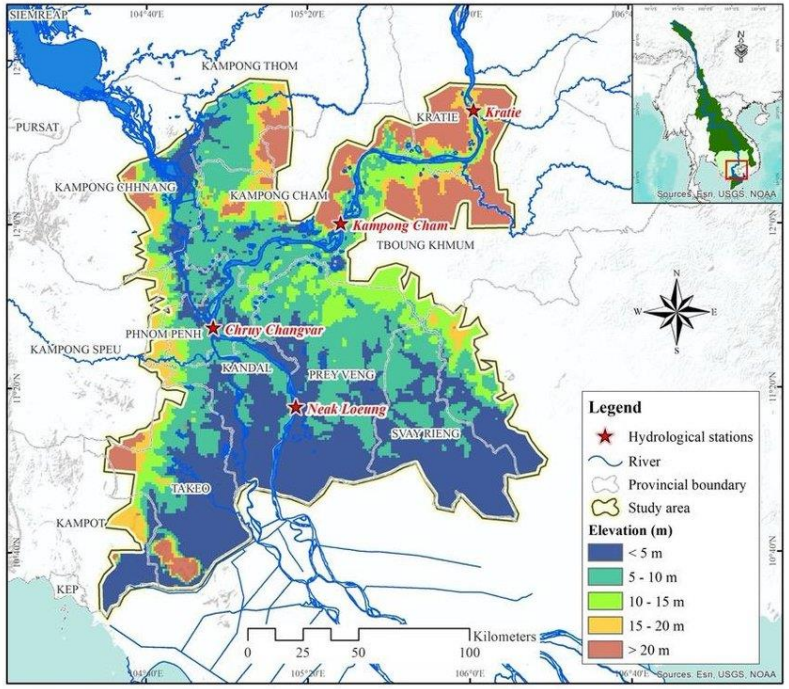
1. Review meteorological and hydrological guidance
2. Create forecast for desired period
3. Determine if and when hydrometeorological hazards will threaten an area
4. Review vulnerability information for location or area
5. Use impact tables to determine severity of potential impacts for each hazard
6. Determine likelihood impacts could occur
7. Use risk matrix to determine level of threat posed by each hazard
8. Create Alert Warning using wording from risk matrices and impact tables
9. Monitor weather event and update Alert Warning appropriately

Impact-based Approach



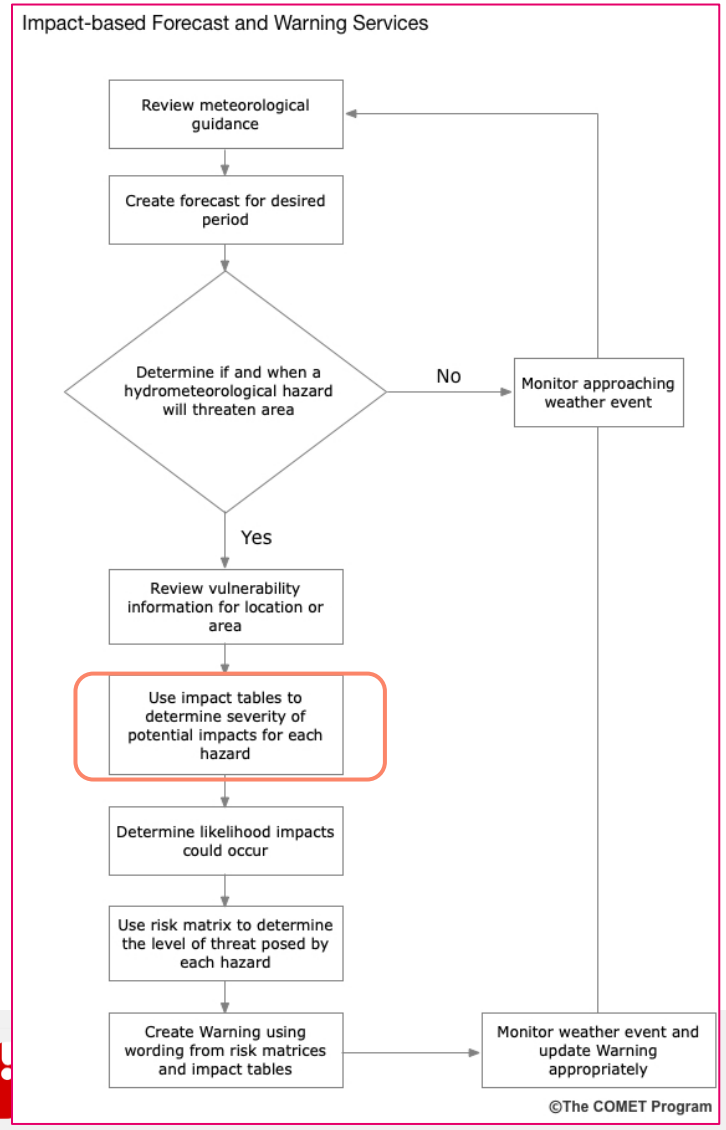
If a tropical cyclone is approaching and heavy rains are predicted, meteorologists need to review a flood plain map and identify vulnerable areas and communities.

Cambodian Mekong floodplain



Heng, Sokchhay & Horton, Alexander & Hok, Panha & Chung, Sarit & Koponen, Jorma & Kummu, Matti. (2021). The Cambodian Mekong floodplain under the future development plans and climate change. 10.5194/nhess-2021-65.

Impact-based Approach



An impact table for rainfall will show the potential damage and impacts that different rainfall rates could produce

Outputs from yesterday

Rainfall Impacts Table

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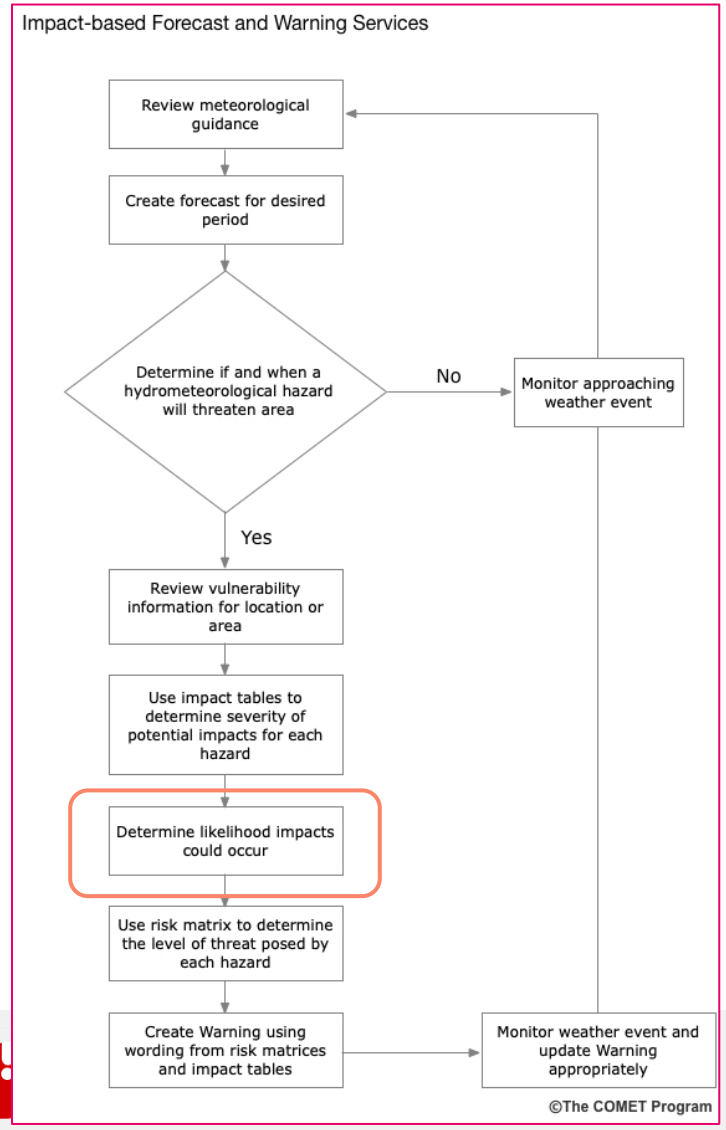
There may be several impact categories in one map due to

1) The hydrological conditions of the surface (for example, processes that influence how much rain will run off the surface).
2) The distribution of the rain (for example, widespread occurrence of 50 mm/h will have more overall impact that an isolated pocket of 50 mm/h).

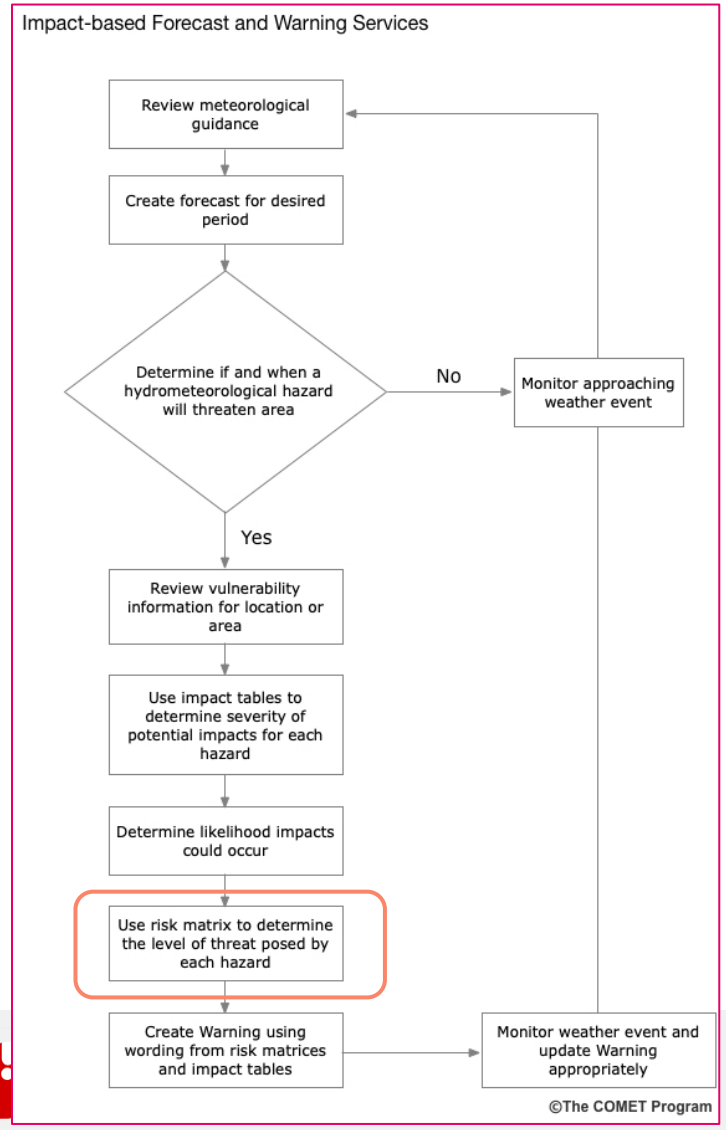
Impact-based Approach



Meteorologist use ensemble (probability) information from NWP guidance, climatology and their past experience to determine the likelihood of occurrence.

Likelihood	Descriptor
High	expect
Medium	likely
Low	possible
Very Low	small chance

Impact-based Approach



Combining vulnerability, severity and likelihood information, the risk matrix can be used to determine the level of threat posed by the weather hazard

For example, let's say that you have determined that the forecast rainfall will bring severe impacts to an area. The latest ensemble guidance suggests that there is a 90% chance that heavy rainfall will occur over the area.

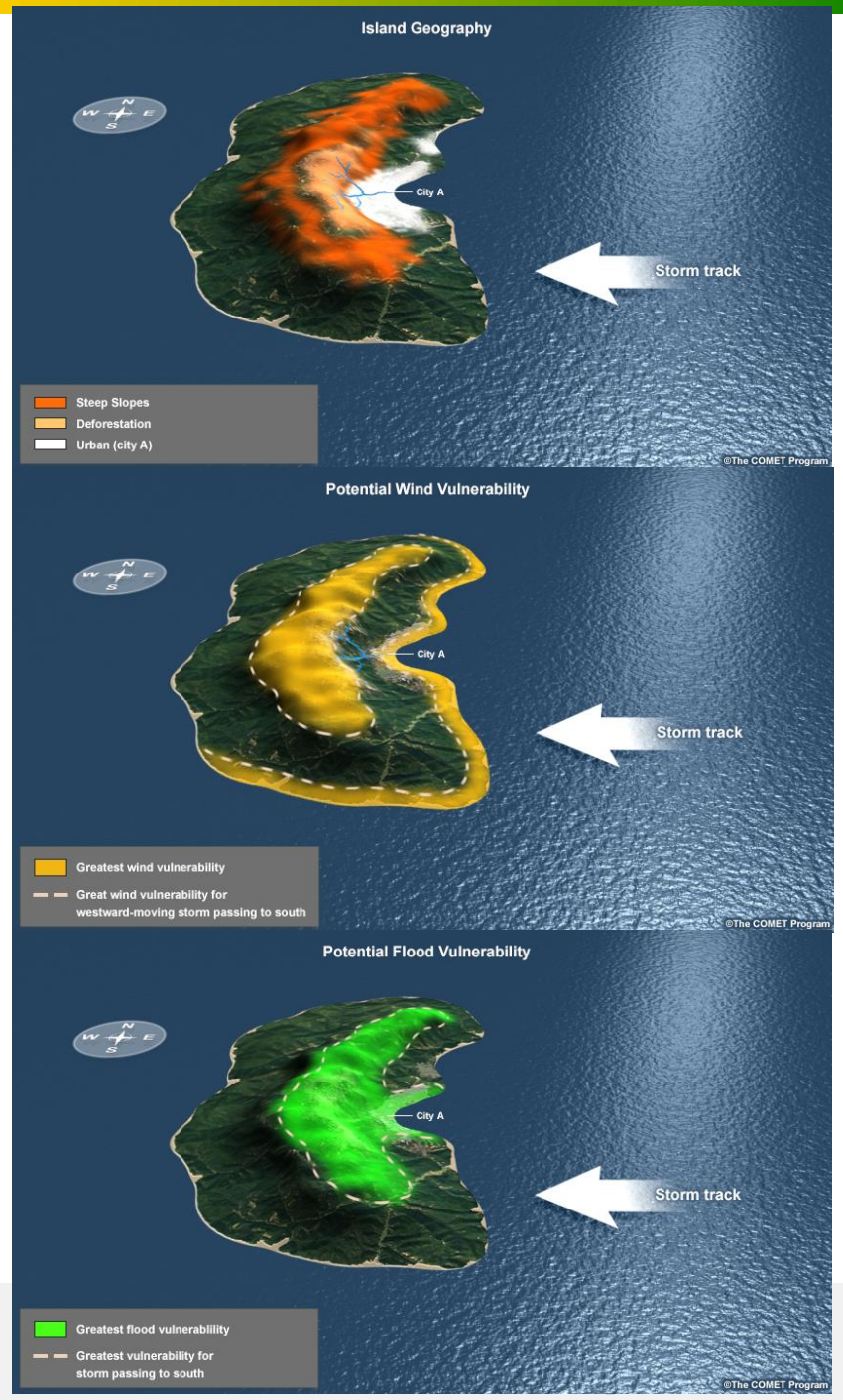
Question: What are the Risk and Response Levels?

Risk Matrix						Risk Level / Response
Likelihood	High 80%					High / Take Action
	Medium 60%					Medium / Be Prepared
	Low 30%					Low / Be Aware
	Very Low 10%					Very Low / No Action
		Minimal	Minor	Significant	Severe	
		Impact				

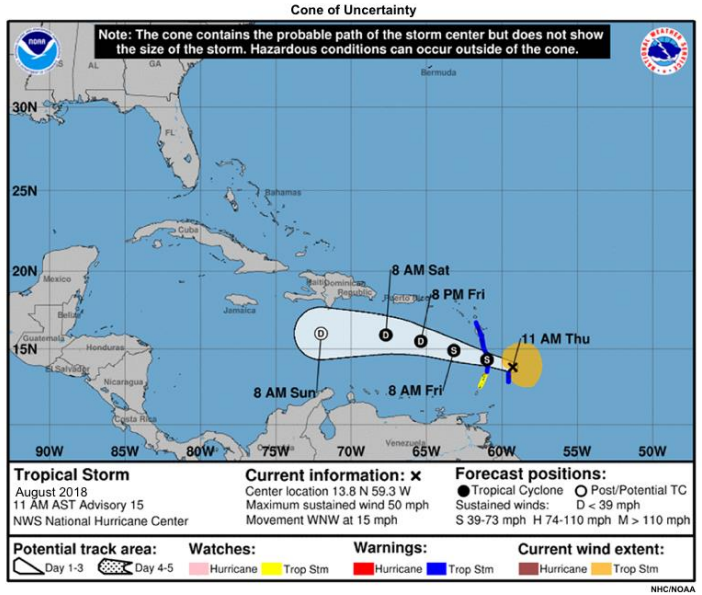
Scenario 1

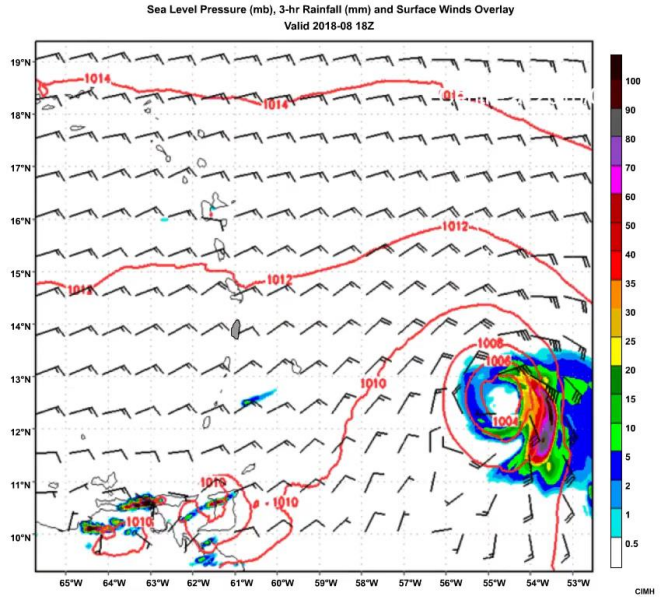
- It is August and a tropical storm is moving toward a hypothetical island (in the location of Martinique) from the east and will likely pass over or nearby in the next 24 hours. You have just finished preparing the forecast for the area and you are concerned about tropical storm impacts from intense convective rains and damaging winds across the island.

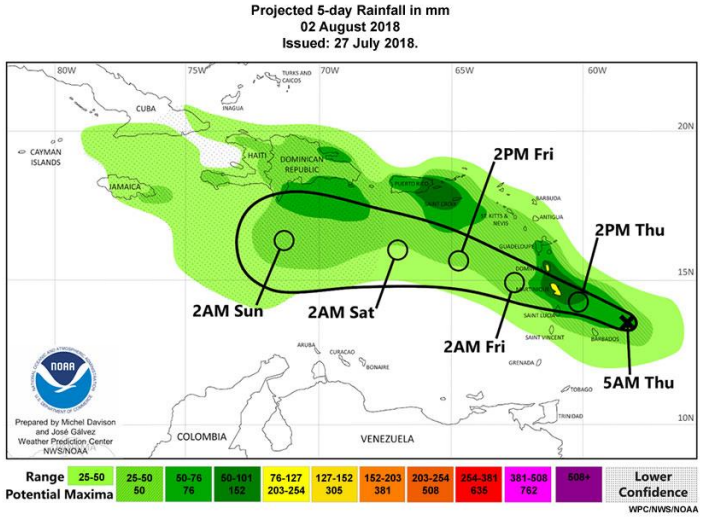
- The island's steep slopes and urban center can experience major impacts with rainfall rates of 25 mm/h, and all areas experience impacts when rainfall rates of 50 mm/h occur. Six-hour accumulations of 100 mm can lead to significant or severe impacts regardless of the peak rainfall rates. The passage of the storm center to the south can enhance the orographic component along the east slopes making intense rainfall rates of > 50 mm/h quite likely and leading to widespread 100 mm rainfall (and locally up to 200 mm) in a 6-hour period.

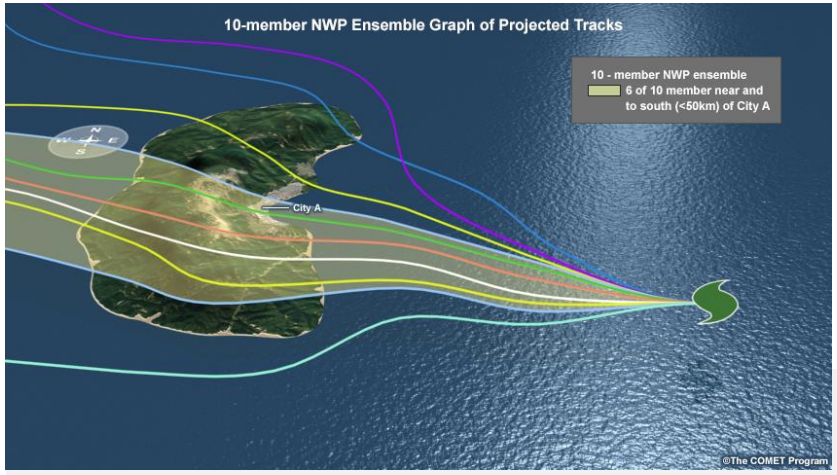


Meteorological Information









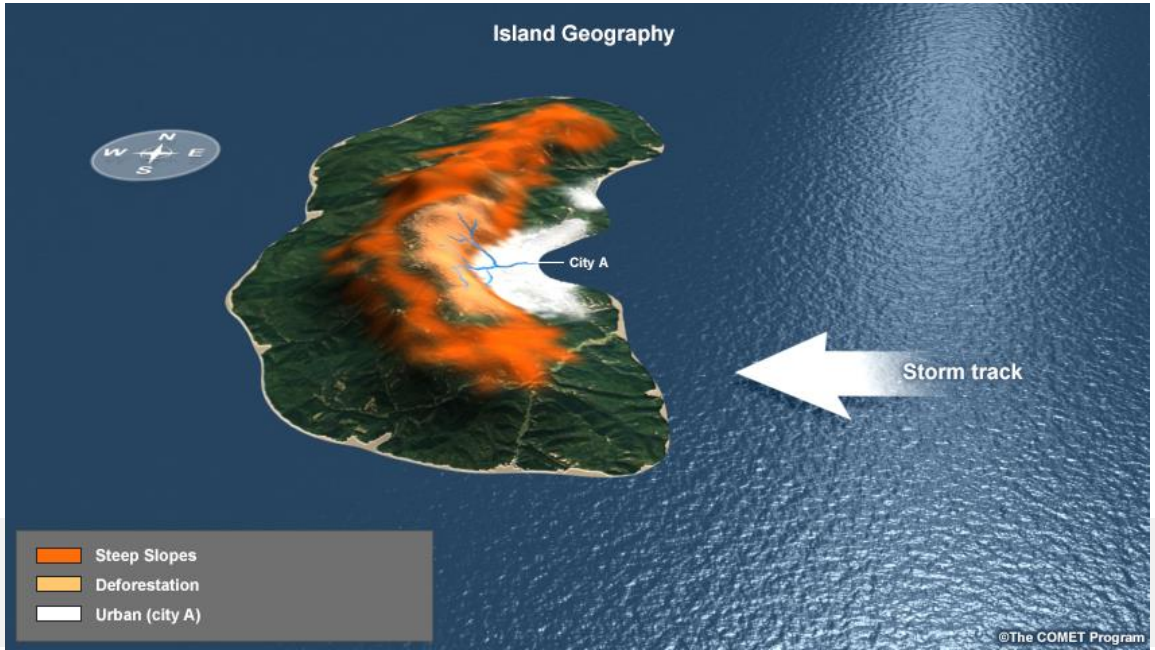
This track would also increase the chance for tropical storm winds of 34-40 kts with gusts of 50 kts. Areas especially vulnerable to the highest winds are along the coast and in the higher exposed terrain.

A storm track a little to the north of the island may reduce the enhancement of rainfall by more than 50%, reducing the potential for significant or severe impacts compared to a storm track to the south.

Forecasters may also notice that this storm is more asymmetric than usual. Current observations show a large area of intense rainfall following the storm center that would continue for several hours after the storm center and its strongest winds pass by.

Question

Your first step is to **identify which types of hazards are likely to accompany the storm**, and which one may have the greatest impact. City A is located on the coastal plain, but it extends nearly 300 m up the main mountain range of the island. There are some steep slopes along the western edges of town. East River runs through the center of town and is fed by several small, steep tributaries. Farther up the mountain, farming and other activities have resulted in the removal of native forests which could increase the chances for slope failure during heavy rainfall.



Based on the current forecast and location characteristics, what hazards could the incoming system pose to the town?

☑

a) Intense rains can result in flash flooding and debris flows, especially along the steep slopes of the island and in the urban areas. Rainfall rates may exceed 50 mm/h. Strong winds of 34-40 kts with gusts to 50 kts will cause damage to trees, power lines, and some structures, especially along the coast and in exposed high-elevation areas.

b) Brief (1-2 hours) rains may trigger some flash flooding beginning tonight. It is unclear if the main impacts will likely stay to the south of the city, occur over the city, or pass just to the north. If the showers pass over the city, there may be rainfall rates of 50 mm/h for a short time. Occasional wind gusts may cause some local tree damage and power failures.

c) Strong winds of 34-40 kts, with gusts to 50 kt, in association with the tropical storm will begin early this evening. They will cause widespread damage to buildings, structural failures, and numerous downed trees and power lines will block roads. Heavy showers will accompany the high winds.

Wind Hazard Simulation

The forecast model indicates peak winds of 35 kts sustained. The current strength of this intensifying storm is already 35 kts sustained with gusts nearing 50 kts. Areas especially vulnerable to the highest winds are along the coast and in the higher exposed terrain. Over the last 10 years, building requirements have made structures more resistant to tropical storm force winds.

Refer to the Wind Impact Table, Risk Matrix and Wind Response Matrix provided.

Question

What level of wind impacts do you anticipate from the winds during this event?

☑ a) Wind impacts are likely to include some structural damage to vulnerable homes, some trees blown down, and localized loss of power and communications. Impacts are expected area-wide, but are most likely along the immediate coast and at exposed high elevations.

b) Wind impacts will likely include longer travel times, some trees blown over, and localized driving hazards for high-profile vehicles. Impacts are expected area-wide, but are most likely along the immediate coast and at exposed high elevations.

c) Wind impacts are likely to include widespread structural damage, collapsed homes, and widespread and lengthy disruptions to power, communications and travel. The track of the storm will determine where the high winds hit. If the storm passes north of the island, there may be only very minor damage. If the storm strengthens and passes over or just south of the island, the impacts could be severe.

Question

The local mesoscale model ensemble shows that nearly 6 out of 10 ensemble members take the tropical storm over or within 50 km south of city A. Given that the current storm strength is 35 kts sustained, the strongest winds from this westward-moving storm will be 35-50 kts. These strong winds will be located around and north of the storm center and may extend about 50 km from the storm center.

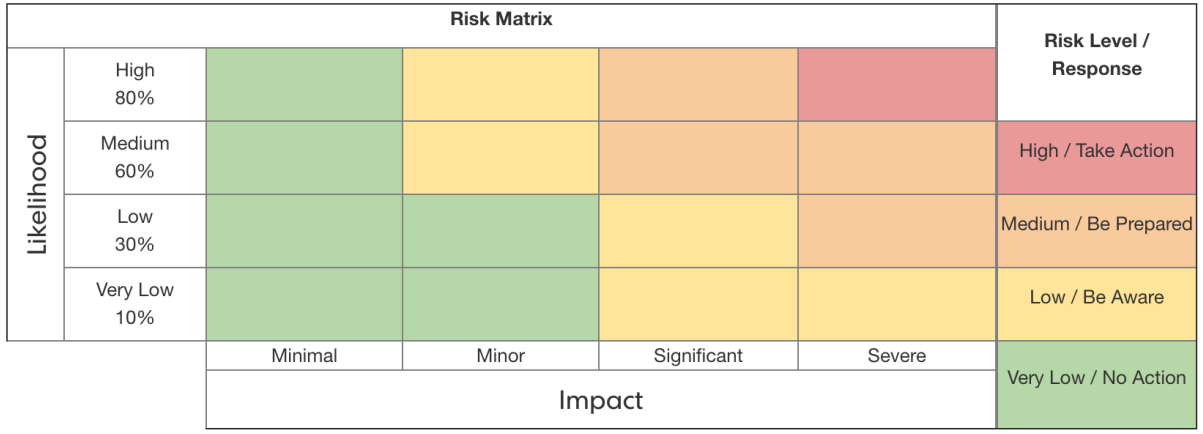
About 3 out of 10 ensemble members take the storm center north of city A. In this scenario the city A region will likely see winds of 25-33 kt. One ensemble member is more than 50 km to the south, so it would not likely result in winds greater than 33 kt.

Based on the information above, what is the likelihood that the wind impacts from this event could occur?

a) Low probability.

☑ b) Medium probability.

c) High probability.



Question

Use the Response Matrix and the Wind Impacts Table above to answer the following question.

What wording will you use to describe the wind impacts in your message to the public?

a) Expect some very severe winds and major disruptions to daily life including widespread structural damage, flying debris, and widespread and severe disruptions to power and travel. Protective actions are necessary. A slight shift to the north would result in much lower levels of wind impact. Locations most likely to experience the worst impacts are the coast and exposed high-elevation areas.

b) Some low level disruptions from wind are possible. This may include longer travel times, flying debris, some trees blown over, and localized driving hazards for high-profile vehicles. Locations most likely to experience impacts are along the coast and in exposed high-elevation areas. Remain aware of the latest forecast.

c) Moderate-level wind-caused disruptions to normal daily life are likely. Individuals and communities should prepare for structural damage to poorly constructed buildings, flying debris, some trees down, and localized loss of power and communications. Locations most likely to experience the worst impacts are the coast and exposed high-elevation areas.

Rainfall Hazard Simulation

The tropical storm is expected to bring intense rain with widespread 100 mm rainfall forecast in a 6-hour period. Local amounts of 200 mm are possible especially along east-facing slopes. Rainfall rates may exceed 100 mm/h, especially in spiral rainbands around the center of circulation.

Refer to the Rainfall Impact Table, Risk Matrix and Rainfall Response Matrix provided.

Question

What level of rain impacts could affect the town?

a) High rainfall rates and accumulation are likely to result in widespread flash flooding of East River and its tributaries. There will be a danger to life from fast flowing deep water, large scale road damage and road closures. Large communities will be cut off, bridges damaged, and homes flooded. Slope failures and landslides are likely in the steeper areas along the west side of the city and the east slopes of the mountains.

b) Brief heavy showers are likely to cause areas of localized flash flooding along the East River and its tributaries, but extreme rainfall appears unlikely. Street flooding is likely in typically flood-prone areas beginning tonight and may temporarily cut-off sections of the city. Water on roads may increase travel times.

c) Storm surge flooding will affect the coastal areas of the city beginning tonight and continuing until early tomorrow. When combined with high rainfall rates, flooding along the coast and especially near the mouth of the East River may lead to danger to life from fast flowing/deep water, large scale road damage and road closures, large communities cut off, bridges washed away, and homes flooded. Areas further from the coast will not experience significant impacts from the intense rainfall.

Question

The local mesoscale model ensemble shows that about 6 out of 10 ensemble members produce widespread rainfall amounts of 100 mm in a 6-hour period and localized areas of over 200 mm in the bands.

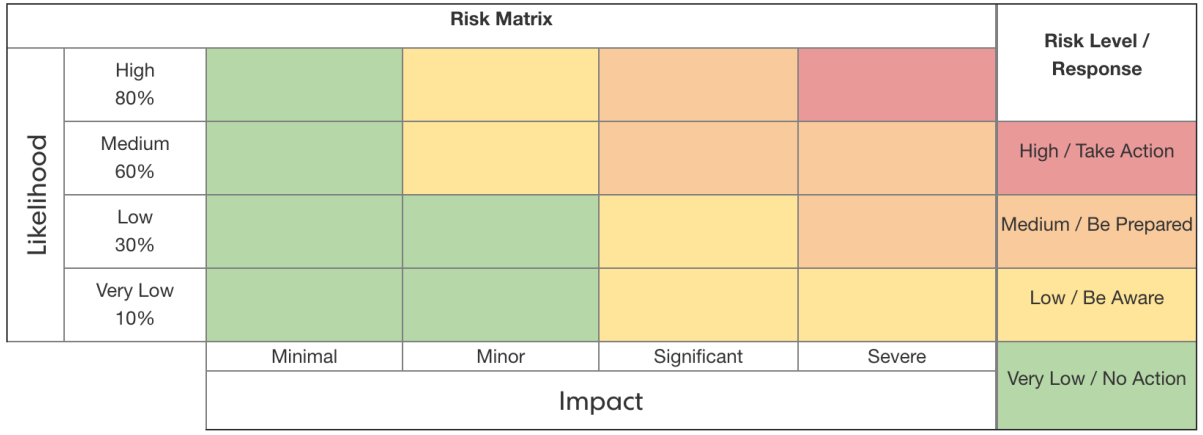
Four out of ten ensemble members don't have as much upslope enhancement and show brief heavy rainfall with total amounts mainly in the 25-50 mm range over a 6 hour period.

Based on the information above, what is the likelihood that the rainfall impacts from this event could occur?

a) Low probability.

☑ b) Medium probability.

c) High probability.



Question

Use the Response Matrix and the Wind Impacts Table above to answer the following question.

What wording will you use to describe the rainfall impacts in your message to the public?

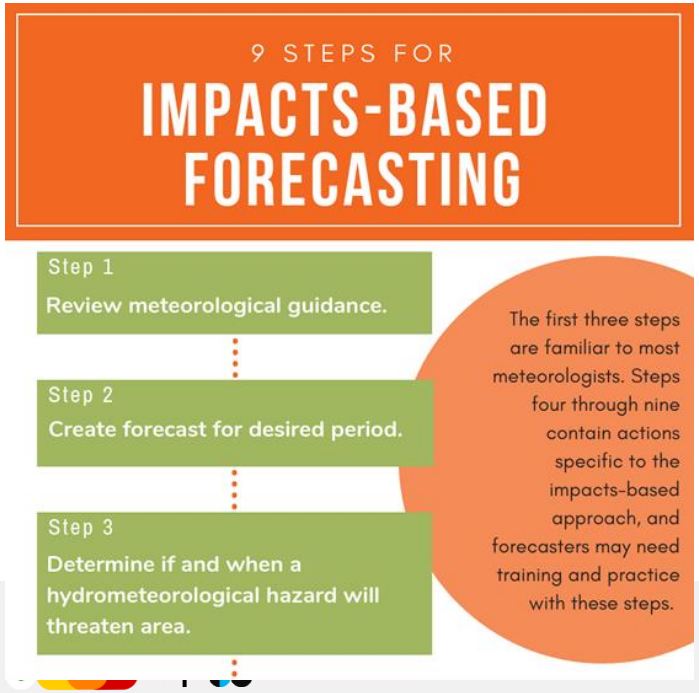
a) Some low level disruption to daily life is possible. Check your emergency supplies and be aware for localized flooding of low-lying areas, isolated closure at bridge crossings, and low-lying roadways becoming temporarily impassable.

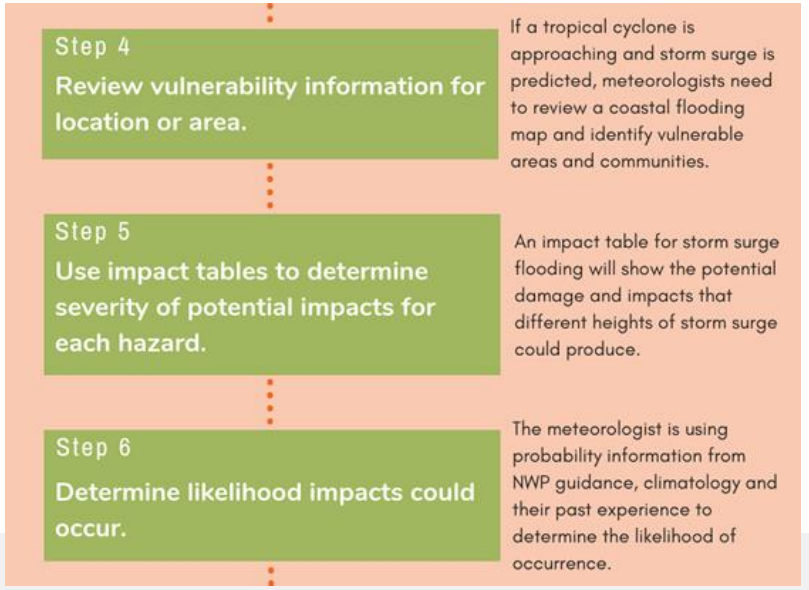
☑ b) Significant to severe rainfall impacts are likely. Check emergency supplies and stay out of fast flowing/deep water. Be prepared for large scale road damage and road closures, large communities cut off, bridges washed away, and homes flooded. Landslides are also possible in steeply sloped mountain areas.

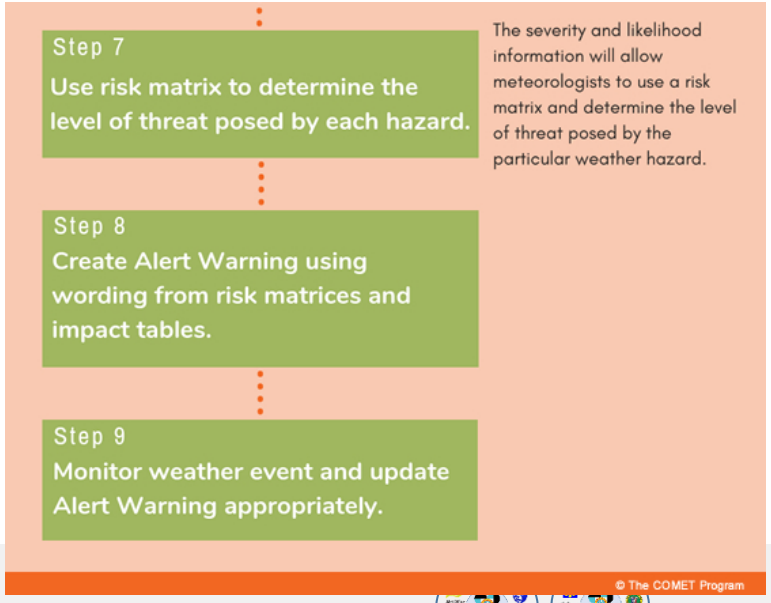
c) Very severe flood conditions from storm surge and rainfall are expected to bring significant to severe level of disruption to daily life. Actions should be taken mainly in coastal communities and at the mouth of the East River. Avoid walking or driving through fast flowing/deep water. Stay off the roads to avoid large scale road damage and road closures from land slippage, bridges washed away, and prepare for flooding of homes.

Summary

- When creating a forecast message in reality, you will need to combine all hazards into a single message to be shared with emergency preparedness organizations and individuals in your area.
- You will need to use your local knowledge and forecast expertise, and also to collaborate with various agencies, in order to assist with their preparedness decisions.







IMPACT-BASED FORECASTING

DOST-PAGASA

IBF Game

To simulate the IBFWS process using a past severe weather event

Instructions

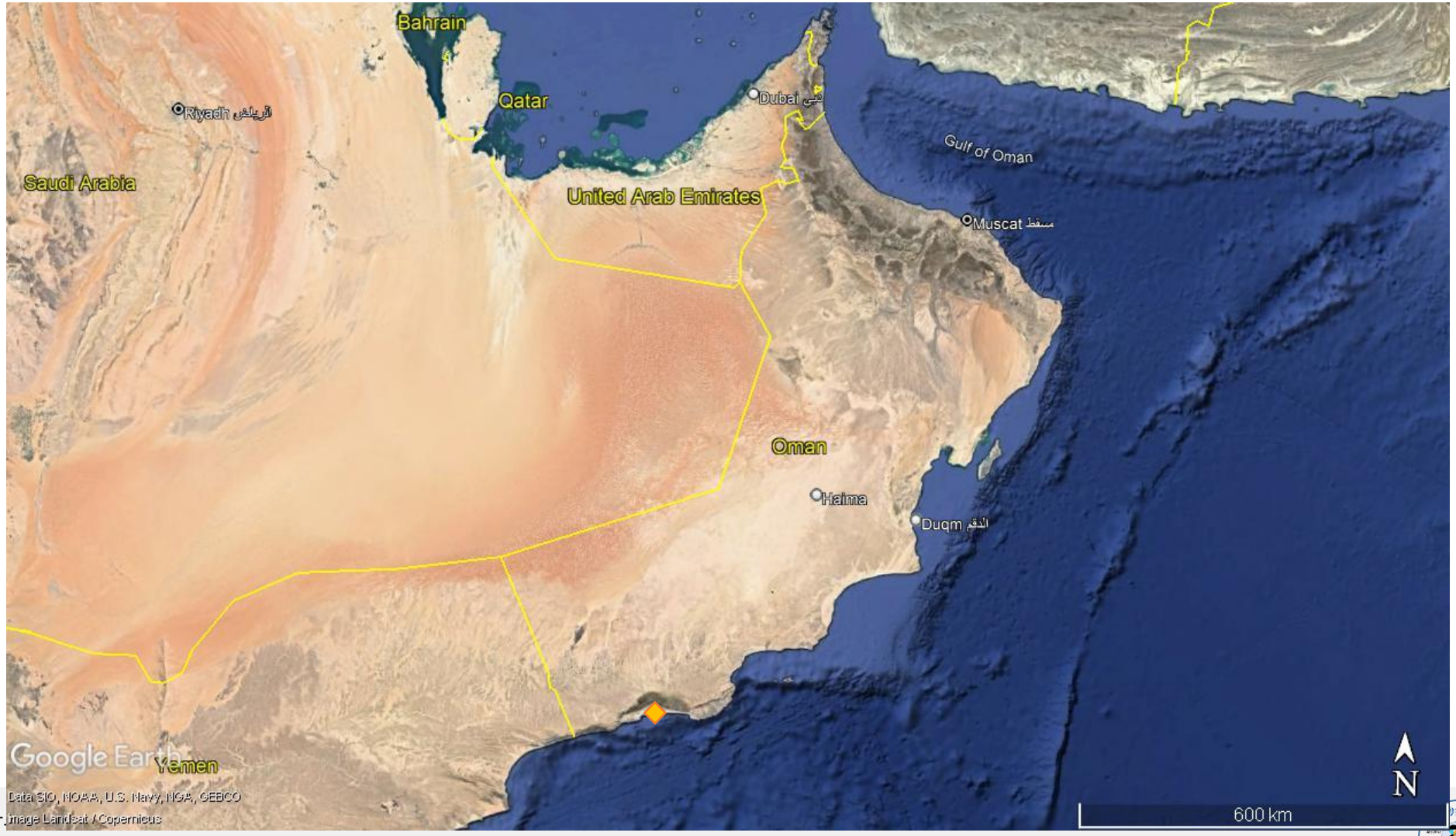
- Each group will be given a scenario (from 5-day to 1-day lead)
- Each member of the group will take different roles: Forecasters, Disaster Managers, Community leaders, Residents
- Discuss within groups the scenario for each day and create an impact-based warning for each day
- You may use the impact tables you generated and develop your own format for the warning
- Outputs of the exercise are:
  1) Risk Level for each day
  2) Associated Warning Message for each day
  3) Decisions Made/Actions Taken by each member of the community

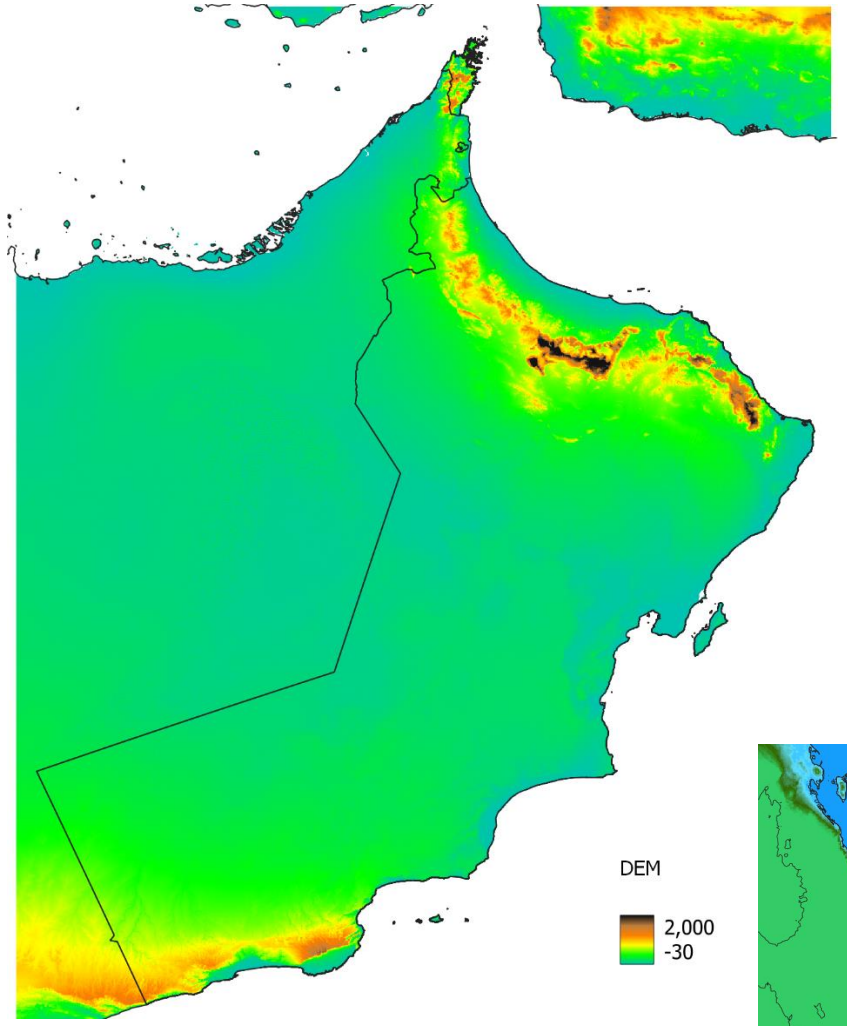
Go through the materials provided

Scenario

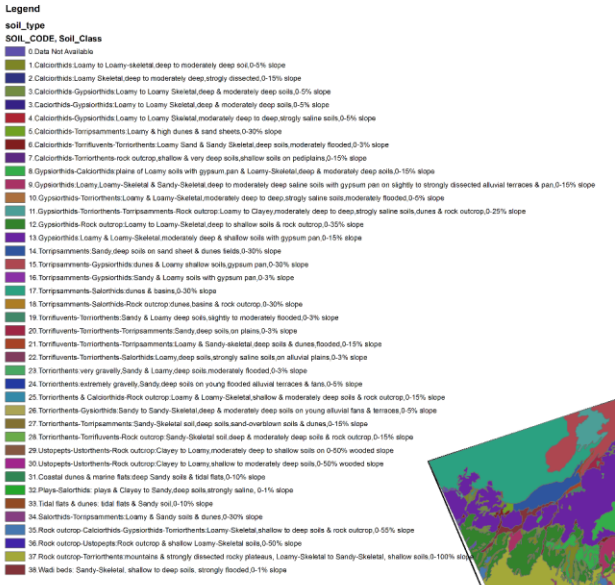
“A low-pressure area formed in the Southeast of the Arabian Sea, approximately 1440 kilometers from Oman's coast, and is expected to develop into a tropical depression within 48 hours. While there's no immediate impact on Oman's weather for the next four days, the system is gradually intensifying and is forecasted to bring heavy rainfall and cloud advection to Al Wusta and Dhofar governorates starting from Sunday afternoon. The situation may evolve into a tropical storm, potentially affecting the coasts of Dhofar Governorate and the Republic of Yemen.”

Your community

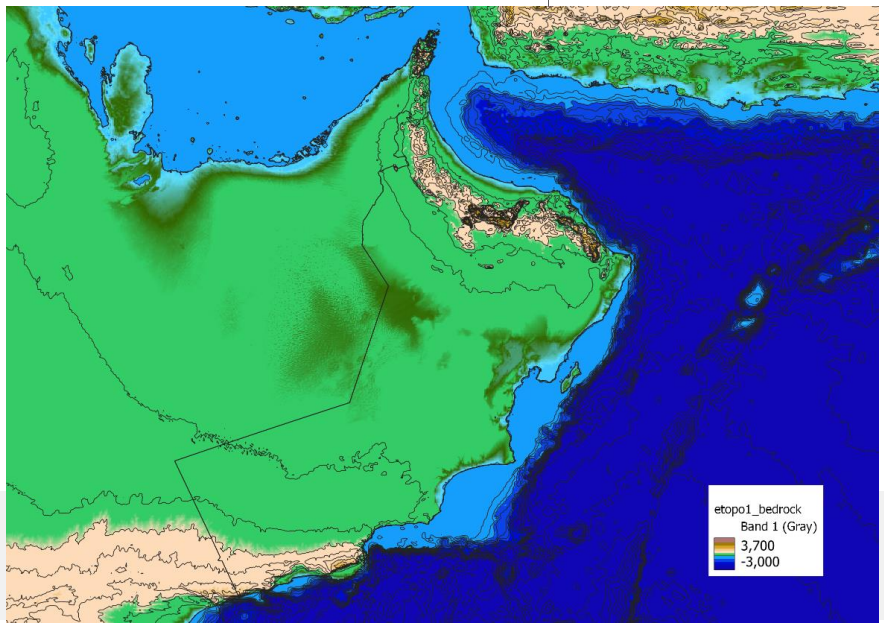




Soil Type of the Sultanate of Oman



Source from Ministry of Agriculture and Fisheries
Displayed by Early Warning Group@NWP

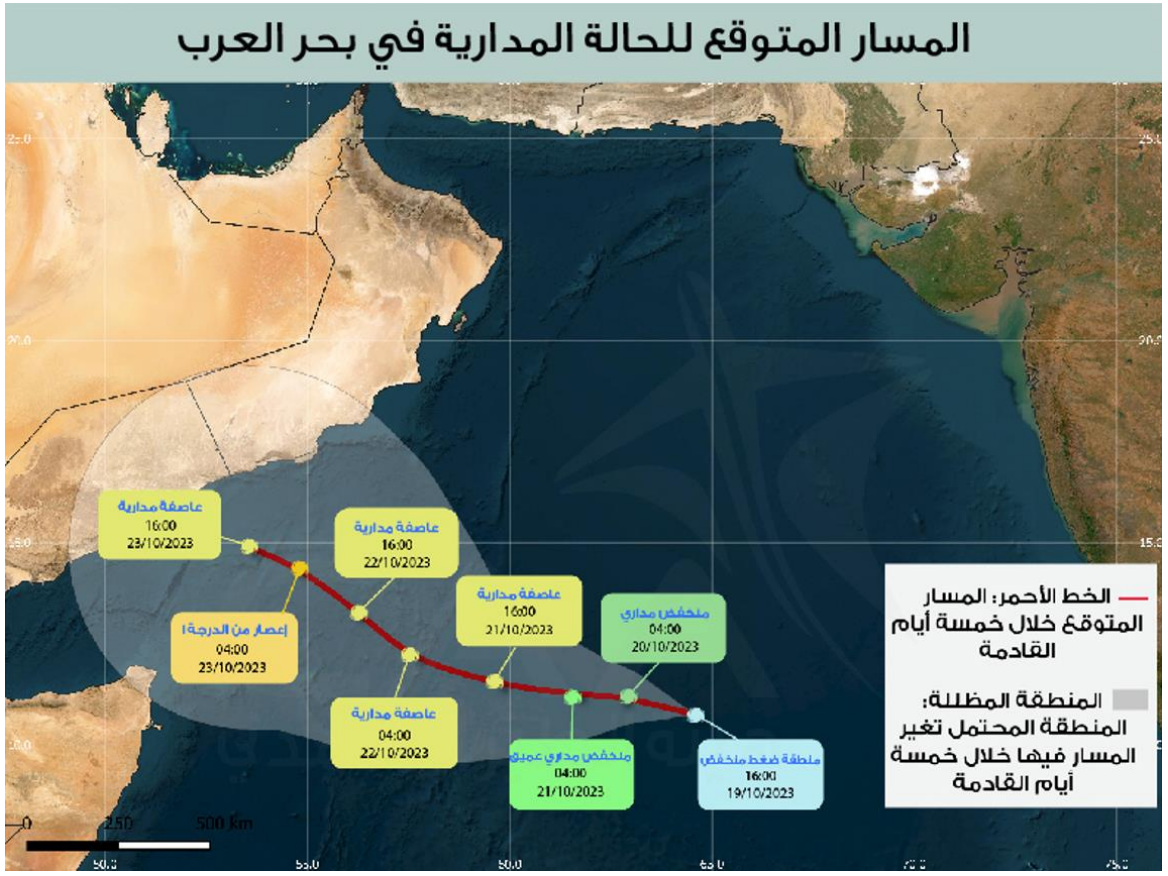


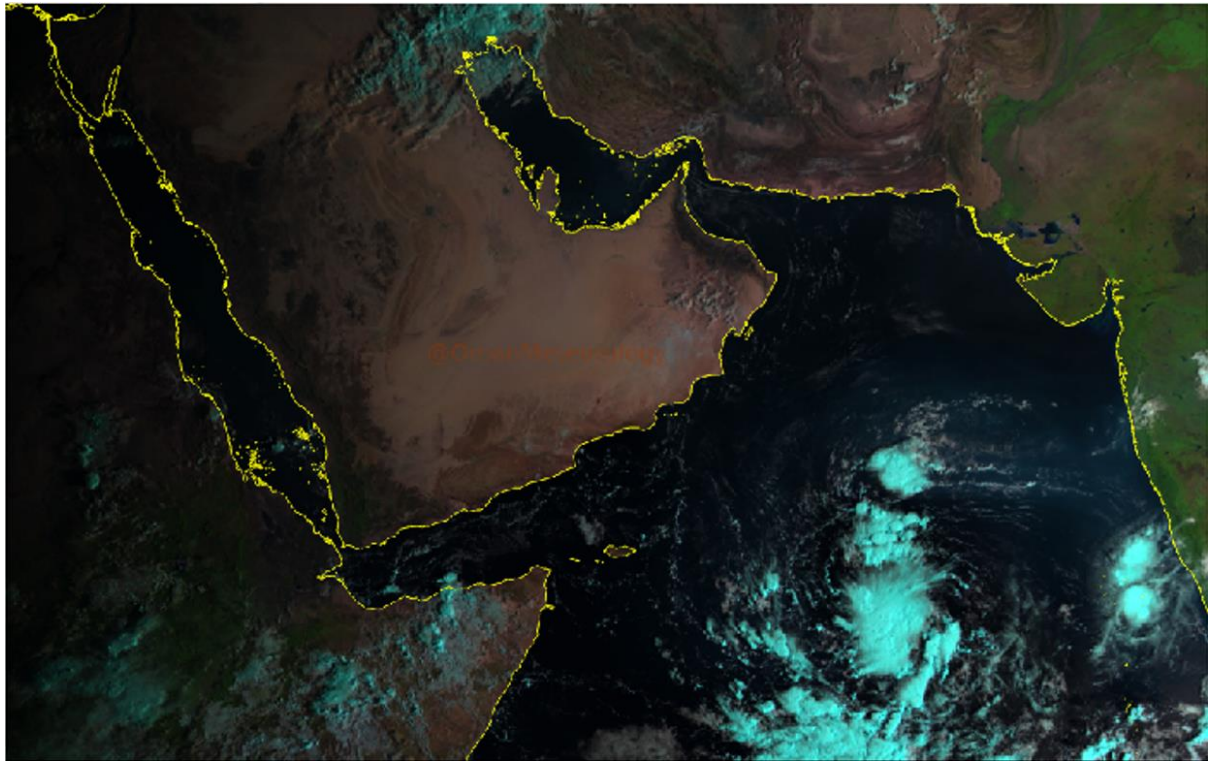
5-day lead

Condition on Thursday (19th)

“The latest satellite images and analysis show the low pressure area moving westward and is about 1400 km away from the coast of Sultanate of Oman. It is expected to develop into a tropical depression within the next 24 hours. Forecasts indicate chances of affecting the coasts of the Dhofar and Central Governorates and the Republic of Yemen with the possibility of the direct impact starting Sunday, October 22. Numerical models are showing possible intensification, but they are still in disagreement on the actual track.”

5-day lead


المسار المتوقع للحالة المدارية في بحر العرب
عاصفة مدارية
16:00
23/10/2023
عاصفة مدارية
16:00
22/10/2023
عاصفة مدارية
16:00
21/10/2023
منخفض مداري
04:00
20/10/2023
إعصار من الدرجة ا
04:00
23/10/2023
عاصفة مدارية
04:00
22/10/2023
منخفض مداري عميق
04:00
21/10/2023
منطقة ضغط منخفض
16:00
19/10/2023
الخط الأحمر: المسار المتوقع خلال خمسة أيام القادمة
المنطقة المظللة: المنطقة المحتمل تغير المسار فيها خلال خمسة أيام القادمة
500 km

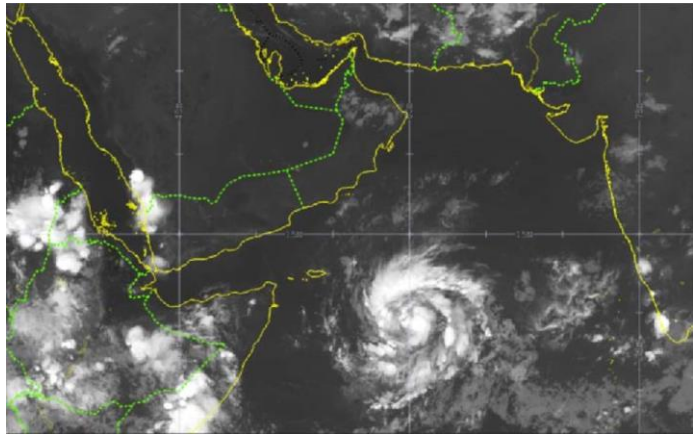


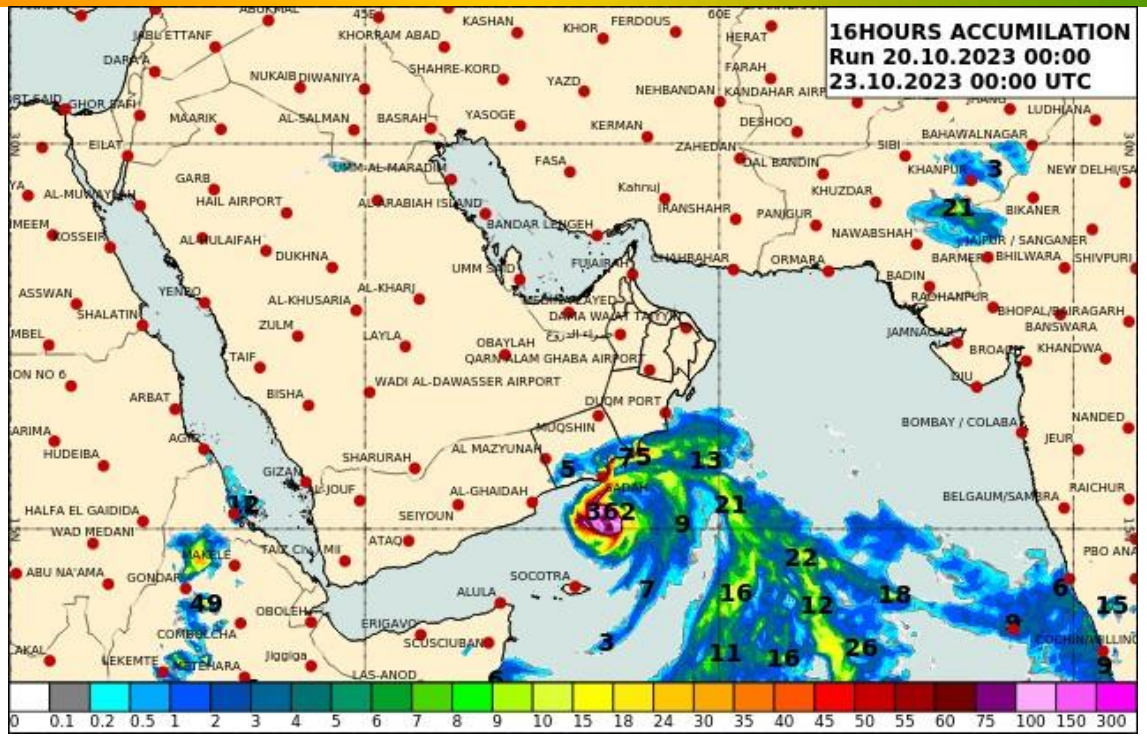
4-day Lead

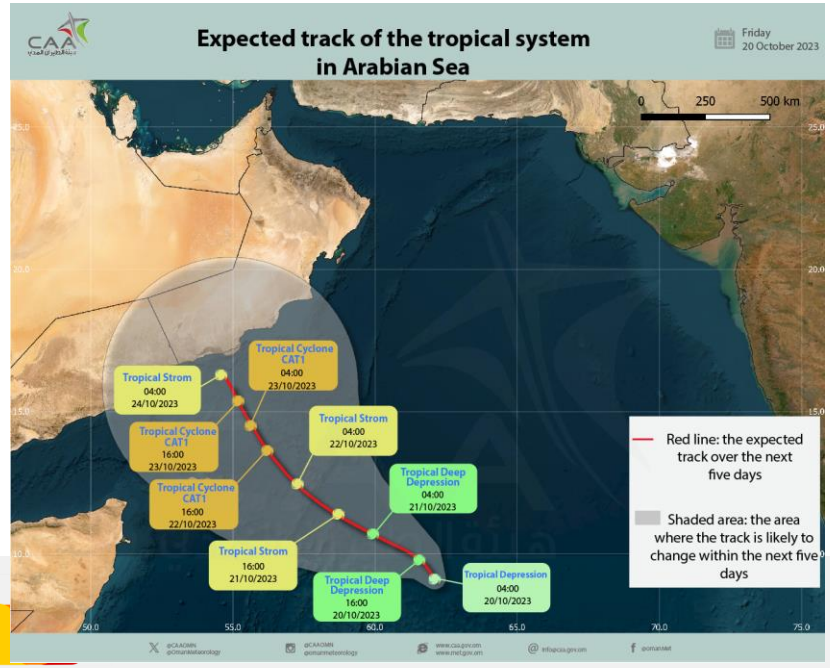
Condition on Friday (20th)

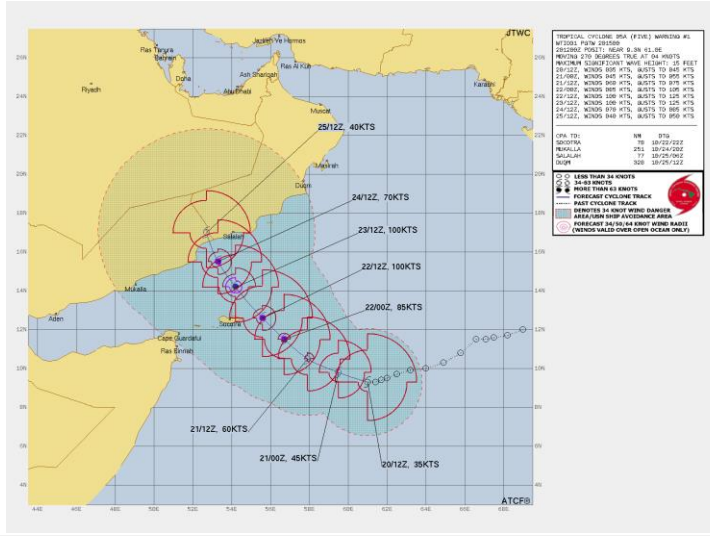
“The low pressure area has intensified to become a deep depression further intensifying into a cyclonic storm receiving the name Tej. It is moving west-northwest towards the Sultanate of Oman and Republic of Yemen and is about 1012 km from the coast of Oman. This system is likely to impact Dhofar and Al Wusta on Sunday, October 22, with the possibility of the center passing between midnight Monday and Tuesday morning between Dhofar Governorate and Yemen's Al-Mahra Governorate. Numerical models are showing possible intensification, but they are still in disagreement on the actual track.”

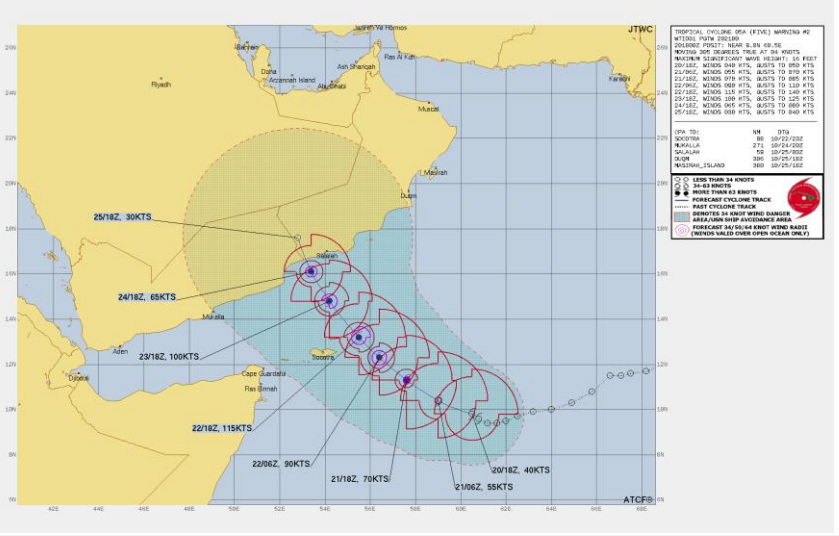
4-day lead




16HOURS ACCUMILATION
Run 20.10.2023 00:00
23.10.2023 00:00 UTC
0 0.1 0.2 0.5 1 2 3 4 5 6 7 8 9 10 15 18 24 30 35 40 45 50 55 60 75 100 150 300


Expected track of the tropical system in Arabian Sea
Friday 20 October 2023
0 250 500 km
Tropical Strom 04:00 24/10/2023
Tropical Cyclone CAT1 04:00 23/10/2023
Tropical Cyclone CAT1 16:00 23/10/2023
Tropical Strom 04:00 22/10/2023
Tropical Cyclone CAT1 16:00 22/10/2023
Tropical Deep Depression 04:00 21/10/2023
Tropical Strom 16:00 21/10/2023
Tropical Deep Depression 16:00 20/10/2023
Tropical Depression 04:00 20/10/2023
Red line: the expected track over the next five days
Shaded area: the area where the track is likely to change within the next five days


JTWC
25/12Z, 40KTS
24/12Z, 70KTS
23/12Z, 100KTS
22/12Z, 100KTS
22/00Z, 85KTS
21/12Z, 60KTS
21/00Z, 45KTS
20/12Z, 35KTS
ATCF®

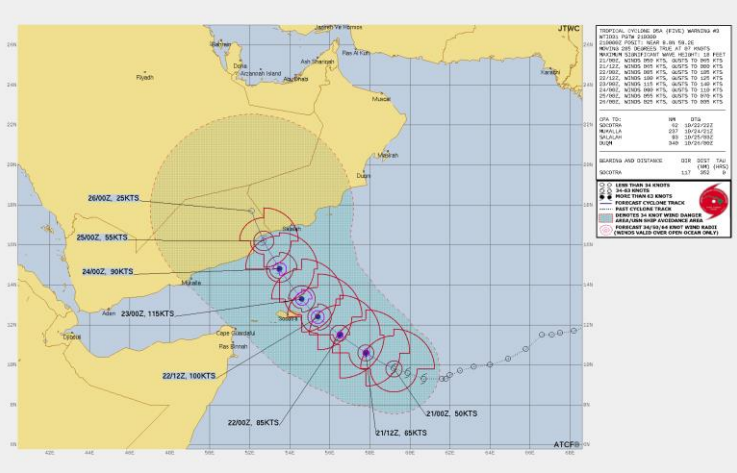

JTWC
25/18Z, 30KTS
24/18Z, 65KTS
23/18Z, 100KTS
22/18Z, 115KTS
22/06Z, 90KTS
21/18Z, 70KTS
21/06Z, 55KTS
20/18Z, 40KTS
ATCF®

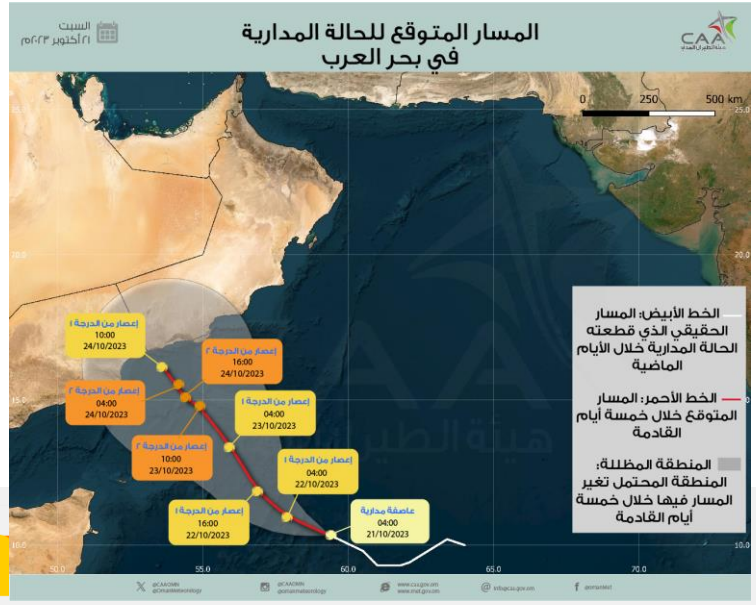
3-day Lead

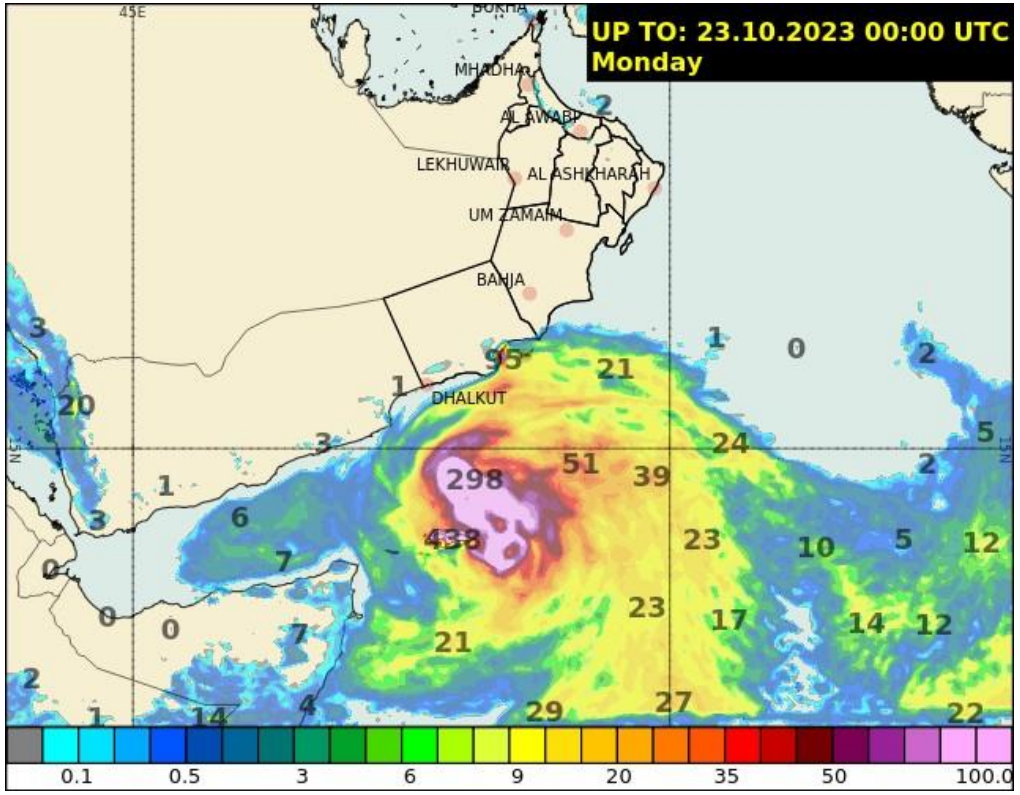
Condition on Saturday (21st)

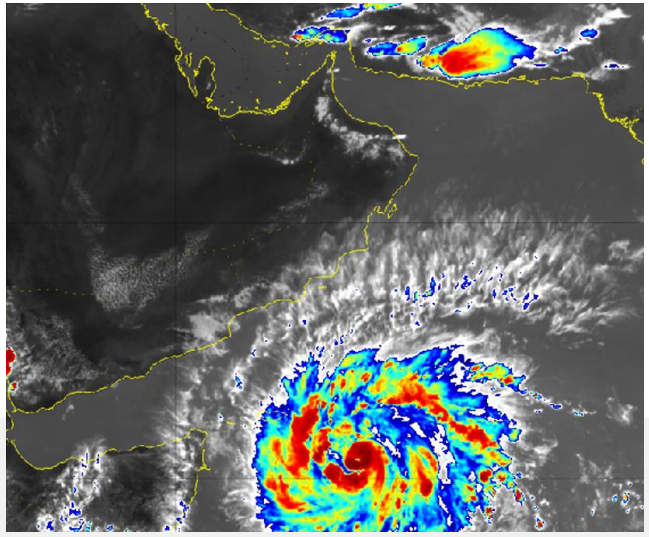
“Tropical Storm Tej, located southwest of the Arabian Sea, is now about 870 km away from the coast of Oman. The wind speeds around the center range from 50 to 63 knots. It is seen to continue to move west-northwestward approaching the coasts of Dhofar Governorate and Yemen’s Al-Mahra Governorate. Models show possible further intensification within the next 24 hours.”

3-day lead


JTWC
26/00Z, 25KTS
25/00Z, 55KTS
24/00Z, 90KTS
23/00Z, 115KTS
22/12Z, 100KTS
22/00Z, 85KTS
21/12Z, 65KTS
21/00Z, 50KTS
ATCF8


المسار المتوقع للحالة المدارية
في بحر العرب
CAA
0
250
500 km
إعصار من الدرجة ١
10:00
24/10/2023
إعصار من الدرجة ٢
16:00
24/10/2023
إعصار من الدرجة ٢
04:00
24/10/2023
إعصار من الدرجة ١
04:00
23/10/2023
إعصار من الدرجة ٢
10:00
23/10/2023
إعصار من الدرجة ١
04:00
22/10/2023
إعصار من الدرجة ١
16:00
22/10/2023
عاصفة مدارية
04:00
21/10/2023
الخط الأبيض: المسار الحقيقي الذي قطعته الحالة المدارية خلال الأيام الماضية
الخط الأحمر: المسار المتوقع خلال خمسة أيام القادمة
المنطقة المظللة: المنطقة المحتمل تغير المسار فيها خلال خمسة أيام القادمة


UP TO: 23.10.2023 00:00 UTC
Monday
MHADHAH
AL AWABI
LEKHUWAIR
AL ASHKHARAH
UM ZAMAM
BAHJA
DHALKUT
298
438
0.1
0.5
3
6
9
20
35
50
100.0

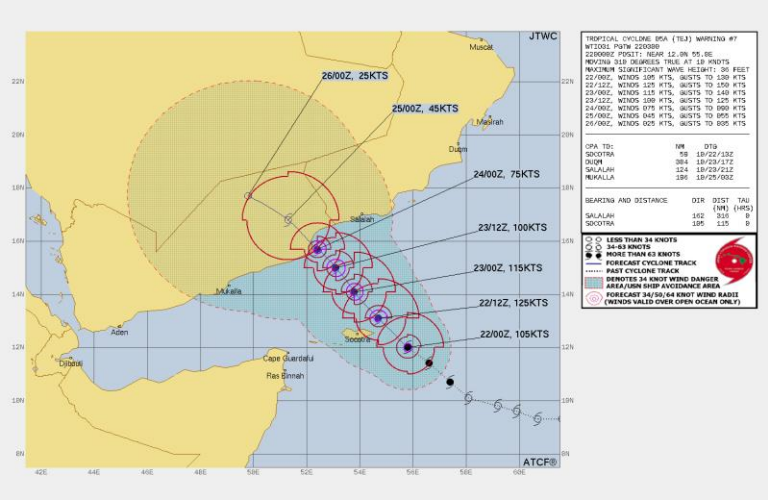


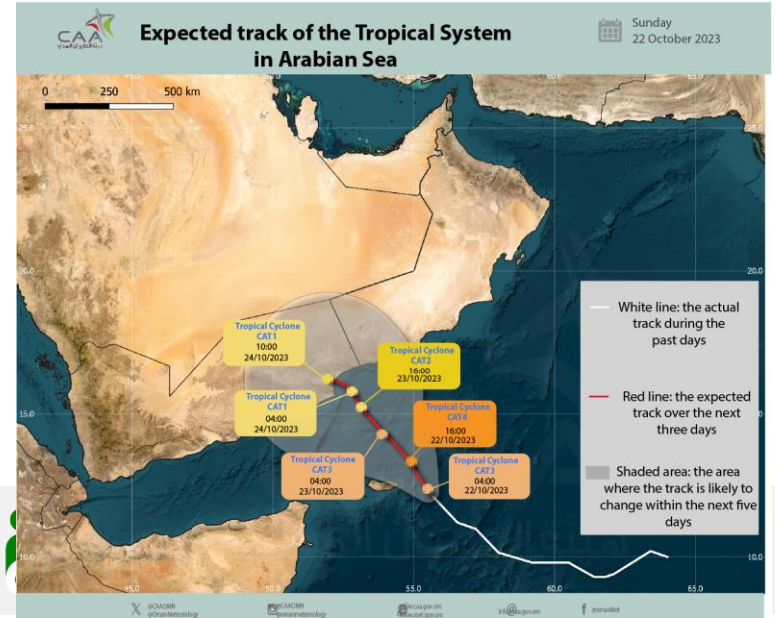
2-day Lead

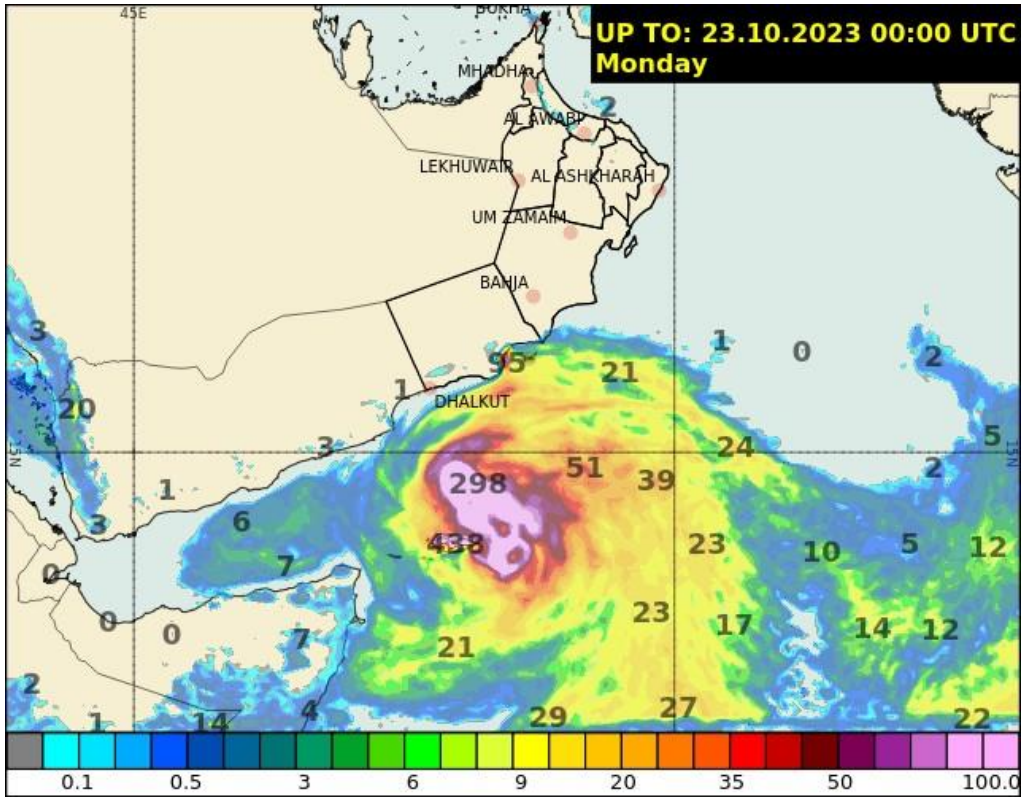
Condition on Sunday (22nd)

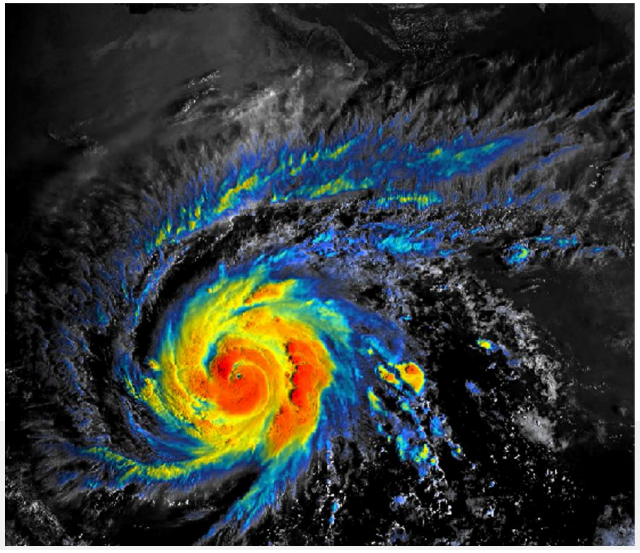
“Tropical Cyclone Tej has now intensified into Category 3 and is still over the Arabian Sea about 450 km away from the coasts of Oman. The wind speeds around the center range from 96 – 112 knots. It is seen to continue to move west-northwestward towards the coasts of Dhofar Governorate and Yemen’s Al-Mahra Governorate. Numerical models show possible intensification into Category 4 in the next 24 hours. Heavy rainfalls expected may range between 50 – 200 mm.”

2-day lead


JTWC
26/00Z, 25KTS
25/00Z, 45KTS
24/00Z, 75KTS
23/12Z, 100KTS
23/00Z, 115KTS
22/12Z, 125KTS
22/00Z, 105KTS
ATCF®


Expected track of the Tropical System in Arabian Sea
Sunday
22 October 2023
0 250 500 km
Tropical Cyclone CAT1 10:00 24/10/2023
Tropical Cyclone CAT2 16:00 23/10/2023
Tropical Cyclone CAT1 04:00 24/10/2023
Tropical Cyclone CAT4 16:00 22/10/2023
Tropical Cyclone CAT3 04:00 23/10/2023
Tropical Cyclone CAT3 04:00 22/10/2023
White line: the actual track during the past days
Red line: the expected track over the next three days
Shaded area: the area where the track is likely to change within the next five days


UP TO: 23.10.2023 00:00 UTC
Monday
MHADHAH
AL AWABI
LEKHUWAIR
AL ASHKHARAH
UM ZAMAIM
BAHJA
DHALKUT
0.1 0.5 3 6 9 20 35 50 100.0

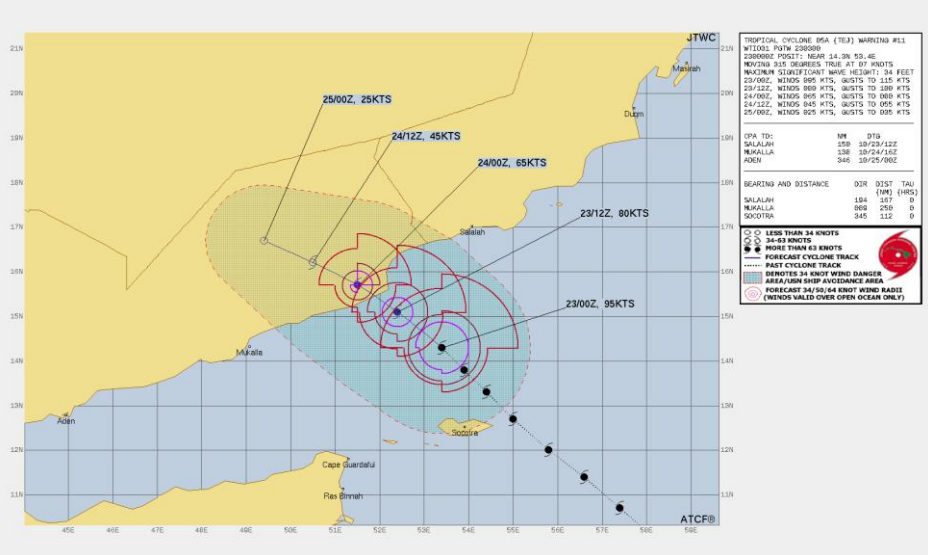


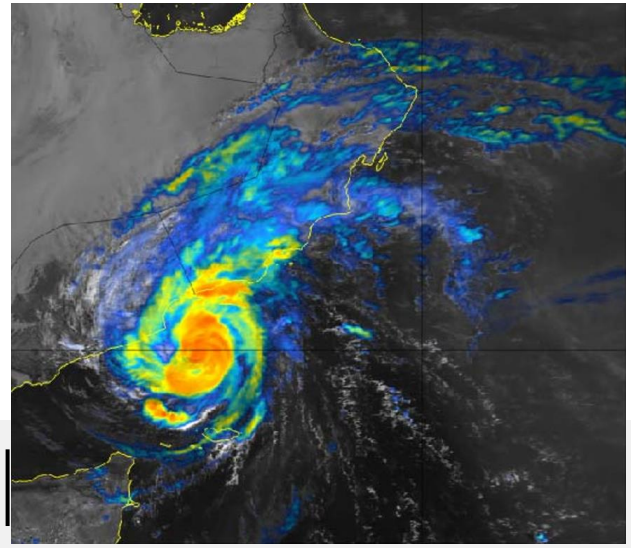
1-day Lead

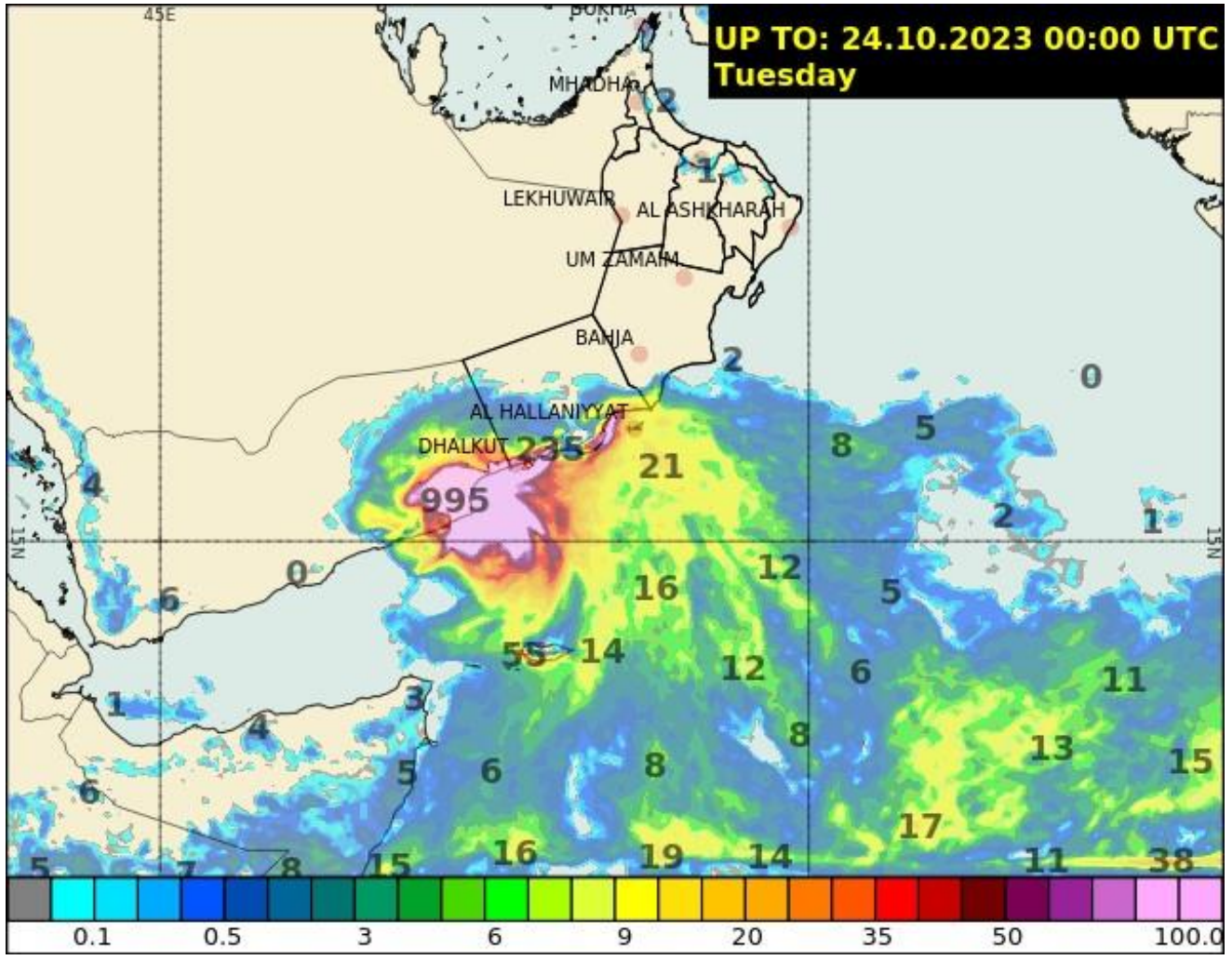
Condition on Monday (23rd)

“Tropical Cyclone Tej has weakened into a tropical storm with winds ranging from 34 to 63 knots. The center is now located approximately 50 – 150 km away from the coasts of Oman. Forecasts show possible landfall between midnight and Tuesday morning between Dhofar Governorate and Yemen’s Al-Mahra Governorate. Heavy rainfalls ranging 200 – 600 mm are expected in the following hours and day.”

1-day lead


JTWC
25/00Z, 25KTS
24/12Z, 45KTS
24/00Z, 65KTS
23/12Z, 80KTS
23/00Z, 95KTS
Masirah
Duqm
Salalah
Mukalla
Aden
Socotra
Cape Guardafui
Ras Binnah
ATCF®
TROPICAL CYCLONE 05A (TEJ) WARNING #11
WTIO31 PGTW 230300
230000Z POSIT: NEAR 14.3N 53.4E
MOVING 315 DEGREES TRUE AT 07 KNOTS
MAXIMUM SIGNIFICANT WAVE HEIGHT: 34 FEET
23/00Z, WINDS 095 KTS, GUSTS TO 115 KTS
23/12Z, WINDS 080 KTS, GUSTS TO 100 KTS
24/00Z, WINDS 065 KTS, GUSTS TO 080 KTS
24/12Z, WINDS 045 KTS, GUSTS TO 055 KTS
25/00Z, WINDS 025 KTS, GUSTS TO 035 KTS
CPA TO: NM DTG
SALALAH 158 10/23/12Z
MUKALLA 138 10/24/16Z
ADEN 346 10/25/00Z
BEARING AND DISTANCE DIR DIST (NM) TAU (HRS)
SALALAH 104 167 0
MUKALLA 060 250 0
SOCOTRA 345 112 0
LESS THAN 34 KNOTS
34-63 KNOTS
MORE THAN 63 KNOTS
FORECAST CYCLONE TRACK
PAST CYCLONE TRACK
DENOTES 34 KNOT WIND DANGER AREA/LRM SHIP AVOIDANCE AREA
FORECAST 34/50/64 KNOT WIND RADII (WINDS VALID OVER OPEN OCEAN ONLY)




UP TO: 24.10.2023 00:00 UTC
Tuesday
45E
MHADHAH
LEKHUWAIR
AL ASHKHARAH
UM ZAMAM
BAHJA
AL HALLANIYYAT
DHALKUT
995
15N
0.1
0.5
3
6
9
20
35
50
100.0

Discussion of Outputs

Summary

- The impact-based approach consists of several steps – some of which are familiar to meteorologists while for some, there is a need for collaboration and partnership with stakeholders
- Various considerations are put into creating and deciding on an IBF warning – thorough and thoughtful discussions might be needed
- Additional factors, which might change in the short term, can impact on the overall risk level.

Thank you very much for your attention!

"tracking the sky…helping the country"

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Metro Manila, Philippines 1100

Tel. No.: (+632) 8284-0800

Website: https://www.pagasa.dost.gov.ph/