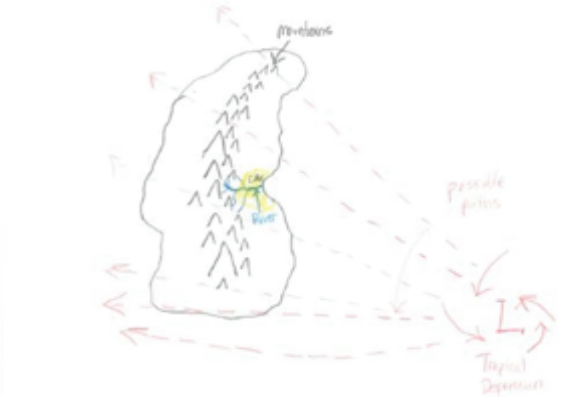
Impact-Based Forecasting (IBF) Simulation

Simulation Goals and Instructions

- The goal of this simulation is to better understand the impact-based forecasting process
- Work in forecast teams to select the hazards risks and response for the simulated storm event that will impact the island in the study
- Each forecast team will discuss their decisions and reason for their decisions to the group

IBF Case Study – Tropical Storm

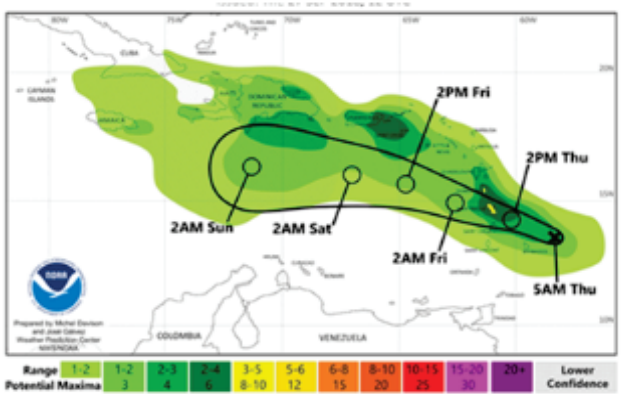
- It is August and a tropical storm is moving toward the island from the east and will likely pass over or nearby in the next 24 hours. You have just finished preparing the forecast for the area and you are concerned about tropical storm impacts from intense convective rains and damaging winds across 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 with 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 leading to widespread 100 mm rainfall (and locally up to 200 mm) in 6-hour period.



- This track would also increase the chance for tropical storm winds, 34-40 kts with stronger gusts). 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 and peak winds a bit, but 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.

Projected 5-day Rainfall in inches



IBF Case Study – Tropical Storm

Your first step is to identify which types of hazards are likely to accompany the storm, and which one may have the greatest impact. Town 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 risks could the incoming system pose to the town? Select the best answer.

- Intense showery rains over a 12-hour period beginning tonight 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 45 kts will cause damage to trees, power lines, and some structures, especially along the coast and in exposed high-elevation areas.
- Brief showery 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.
- Strong winds of 34-45 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.

Done

IBF Case Study – Tropical Storm

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Done

Answer A correctly states the rainfall impacts first and the wind impacts second, and gives a sense of when, where, and expected impacts.

Answer B correctly states the rain impacts first but expresses a large amount of uncertainty. It does not describe the important wind speed thresholds and understates potential vulnerabilities.

Answer C incorrectly emphasizes the wind threat over the rain threat and describes a magnitude of wind damage that is not consistent with the forecast wind speeds. It fails to give important rainfall thresholds and does not identify related vulnerabilities.

IBF Case Study – Tropical Storm

Review the wind forecast information and impact tables below.
This storm is a low end tropical storm with 34-40 kt sustained winds and gusts as high as 45 kts.

WIND

Very low/Minimal Impacts	Low/Minor Impacts	Medium/Significant Impacts	High/Severe Impacts
• Isolated trees blown over • Damage to billboards • Few transport routes affected	• More trees blown over in larger areas that block roads • Localized problems with high-sided vehicles on prone routes. Eg. van Reenens Pass • Localized transport routes affected and longer travel time needed	• 1-2 Local municipalities affected • Low-cost houses/vulnerable houses roofs blown off/houses collapse • Larger trees blown over, blocking roads • Localized loss of communication and electricity supply due to damaged power lines • Transport routes affected	• >2 Local municipalities affected • Widespread structural damage, roofs blown off, weak structures overturned/blown away • Falling trees and electric power lines blocking major routes • Houses collapse • Major transport routes severely affected • Widespread disruption to power supply and other services

What level of wind impacts do you anticipate during this event? Select the best answer.

- Wind impacts tonight and early tomorrow morning are likely to be structural damage, including roofs blown off of low-cost homes, large trees down, localized loss of power and communications. Impacts are expected area-wide, but are most likely along the immediate coast and at exposed high elevations.
- 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.
- Wind impacts are likely to include widespread structural damage, collapsed homes, and widespread and severe disruptions to power 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.

IBF Case Study – Tropical Storm

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Strong wind >20kts

Gale Force Wind >35kts

Strong Gale >41kts

What level of wind impacts do you anticipate during this event? Select the best answer.

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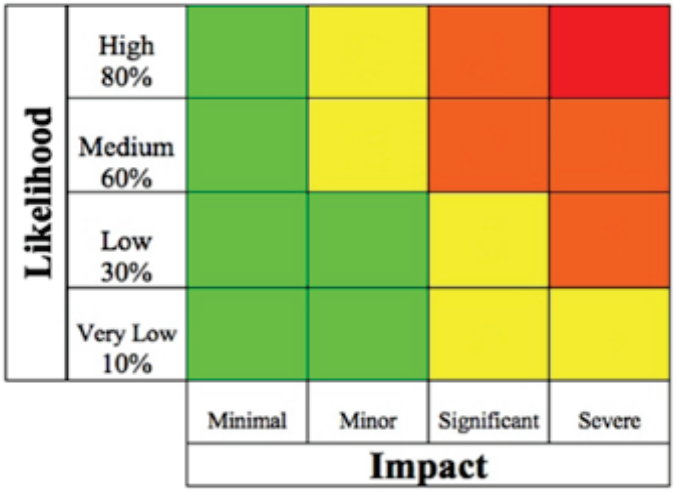
IBF Case Study – Tropical Storm

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. The strongest winds from this westward-moving storm will be 34-45 kts and 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.

Review the Risk Matrix table and forecast information.

Risk Matrix Table



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

- Medium probability.
- High probability.
- Low probability.

IBF Case Study – Tropical Storm

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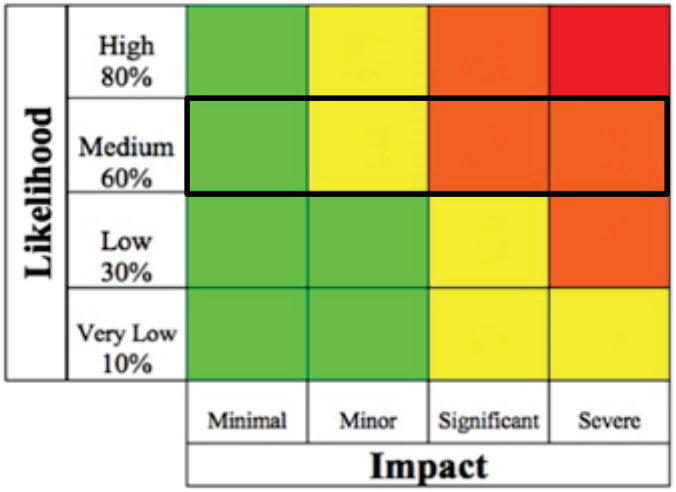

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IBF Case Study – Tropical Storm

What wording will you use to describe the wind impacts in your message to the public? Select the best answer.

Risk Matrix Table

Likelihood	Minimal	Minor	Significant	Severe
High 80%		2	6	10
Medium 60%		1	5	9
Low 30%			4	8
Very Low 10%			3	7
		Impact		

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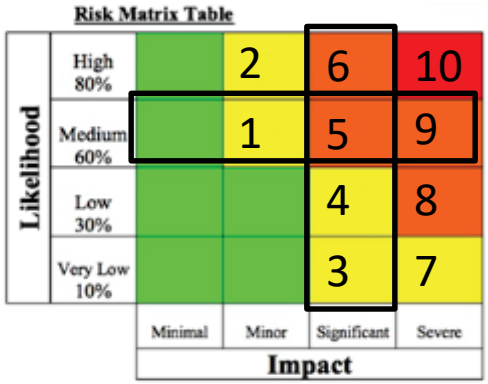
8	Be prepared for some very severe weather conditions with possible major disruption to daily life (particularly to……..)
9	Be prepared for some very severe weather conditions and major disruption to daily life (particularly to……..)
10	Very severe weather conditions are expected. Take action to remain safe and protect property

- Be prepared for moderate level disruptions from wind to normal daily life, particularly to include structural damage including roofs blown off of low-cost homes, large trees down, and localized loss of power and communications. Impacts will occur this evening through early tomorrow. Locations most likely to experience the worst impacts are the coast and exposed high-elevation areas.
- Be aware that some low level disruption from wind looks likely and will include longer travel times, some trees blown over, and localized driving hazards for high-profile vehicles. Location most likely to experience impacts are along the coast and in exposed high-elevation areas.
- Be prepared for some very severe winds and major disruption to daily life including widespread structural damage, collapsed homes, and widespread and severe disruptions to power and travel. A slight shift to the north would result in much lower levels of wind impact. Impacts will occur this evening through early tomorrow. Locations most likely to experience the worst impacts are the coast and exposed high-elevation areas.

IBF Case Study – Tropical Storm

What wording will you use to describe the wind impacts in your message to the public? Select the best answer.



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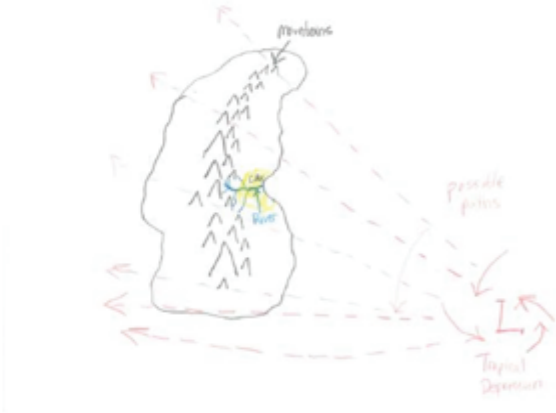
IBF Case Study – Tropical Storm

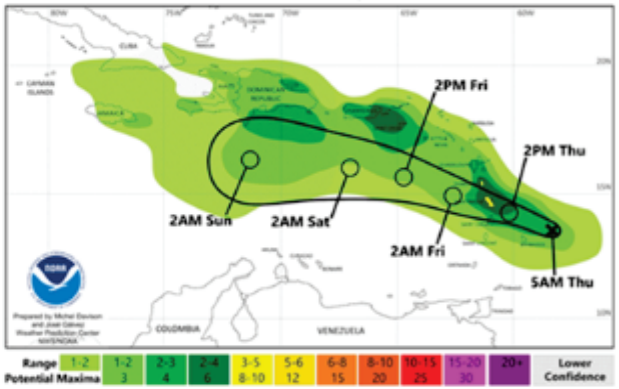
Now that you have prepared the wind hazard message, review the information for the rainfall hazard.

- You have just finished preparing the forecast for the area and you are concerned about the impact of the tropical depression as its convective rains and gusty winds begin impacting the island. The island's east slopes are where the population center is located, and rainfall rates of 50 mm per hour can have major impacts.

- The passage of the depression to the south can enhance the upslope component making intense rainfall rates quite likely in the 12-24 hour period. A storm track more directly over the urban area may reduce the enhancement of rainfall a bit, but the winds would likely be a little stronger in that scenario. If the storm tracks north of the urban area, both the rainfall and the maximum wind speed could be reduced.



Projected 5-day Rainfall in inches



IBF Case Study – Tropical Storm

Review the wind forecast information and impact tables below. The tropical storm is expected to bring intense rain with widespread 100 mm forecast in a 6-hour period. Local amounts of 200 mm are possible especially along east-facing slopes. Rainfall rates may exceed 50 mm/h, especially in spiral rainbands around the center of circulation.

RAIN

Very low/Minimal Impacts	Low/Minor Impacts	Medium/Significant Impacts	High/Severe Impacts
• Water on roads, driving conditions only affected by localized spray and some pooling • Isolated flooding of low-lying areas (areas on the flood plain) • Traffic congestion	• Some minor roads not passable • Low-lying bridges flooded • Major roads affected but can be used, increased travel times • Small/localized areas cut-off temporarily, but no danger expected • Flash-floods occurring over a few municipalities/basins	• 1-2 Local municipalities affected • Flooding of major roads, disrupting transport routes • Bridges not passable • Danger to life • Damage to roads • Some communities cut-off • Flash-floods affecting larger groups of people	• >2 Local municipalities affected • Danger to life from fast flowing/deep water • Loss of life • Roads not passable by small vehicles • Large scale damage to major and minor roads, widespread road closures • Widespread flash-floods • Large communities cut-off • Bridges washed away • Houses flooded

20mm ≤ 6hours and low ASM

20mm ≤ 6hours and High ASM

50mm ≤6hours and FFG red

ASM: Average Soil Moisture
FFG: Flash Flood Guidance

What level of rain impacts could affect the town? Select the best answer.

- High rainfall rates and accumulation are likely to result in widespread flash flooding of East River and its tributaries this evening into early tomorrow. There will be a 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. Slope failures and debris flows are likely in the steeper areas along the west side of the city and the east slopes of the mountains.
- 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 typical flood-prone areas beginning tonight and may temporarily cut-off sections of the city. Water on roads may increase travel times.
- 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.

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IBF Case Study – Tropical Storm

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 localize areas of over 200 mm in the bands.

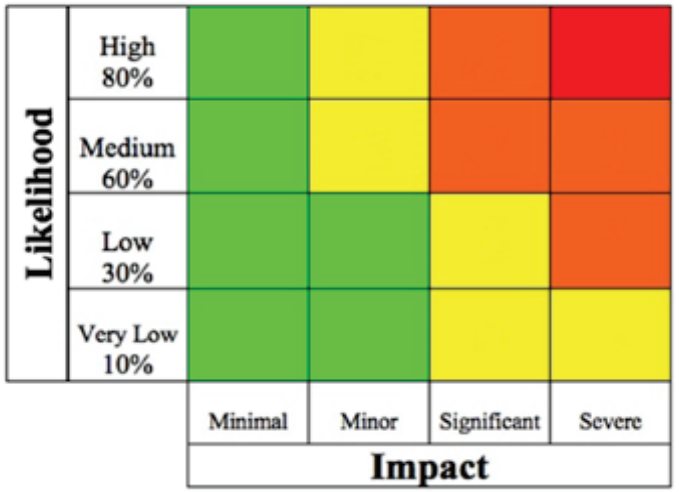
Four out of ten ensemble members don't have as much upslope enhancement and show brief heavy rainfall with total amounts mainly in the 20-50 mm range over a 6 hour period.

Review the Risk Matrix table and forecast information.

Based on the information above, what is the likelihood that the rain impacts from this event could occur? Select the best answer.

- Medium probability.
- High probability.
- Low probability.

Risk Matrix Table



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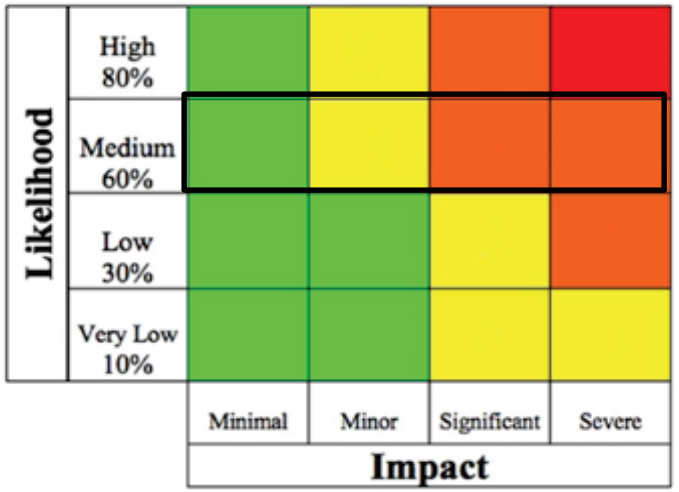
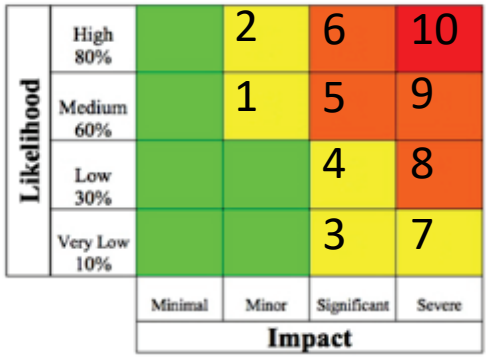


IBF Case Study – Tropical Storm

What wording will you use to describe the rainfall impacts in your message to the public? Select the best answer.

Risk Matrix Table



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10	Very severe weather conditions are expected. Take action to remain safe and protect property

- Be prepared for some very severe rainfall conditions and major disruption to daily life beginning tonight and continuing tomorrow. Expect there to be a 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. Landslides and debris flows are also possible in steeply sloped mountain areas
- Be aware that some low level disruption to daily life is highly likely beginning tonight and continuing tomorrow. You can expect localized flooding of low-lying areas, isolated closure of low bridge crossings, and minor roadways becoming temporarily impassable.
- Take action for some very severe flood conditions from storm surge and rainfall and major a moderate level of disruption to daily life beginning tonight and continuing tomorrow, mainly in coastal communities and at the mouth of the East River. Expect there to be a 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.

IBF Case Study – Tropical Storm

What wording will you use to describe the rainfall impacts in your message to the public? Select the best answer.

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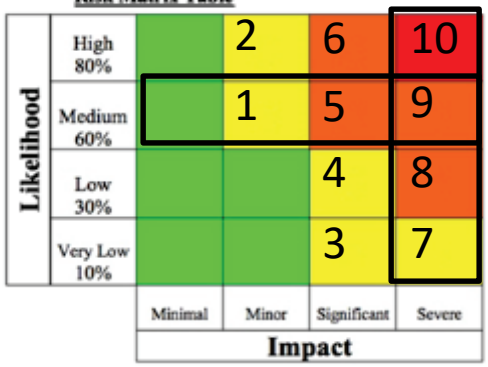

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IBF Case Study – Summary

- The center of the storm moved over the southern part of the island, about 50 km from the city.
- This enhanced the upslope component and resulted in intense rainfall over the East River watershed.
- Rainfall exceeded 50 mm over a 12-hour period, most fell in 6 hours.
- The precipitation produced flash flooding of the East River and slope failures along the west side of the city.
- Winds resulted in localized tree damage

Additional Resources

Additional simulations are available at the COMET MetEd Website (https://www.meted.ucar.edu)

- Fire Weather Situational Awareness Simulation: https://www.meted.ucar.edu/fire/sitrep/navmenu.php?tab=1&page=1-1-0&type=flash

- Fire Weather Communication Simulation: https://www.meted.ucar.edu/fire/s591/comms/navmenu.php?tab=1&page=simulation&type=flash

- Winter Weather Simulation: https://www.meted.ucar.edu/winter/sfc_impacts/navmenu.php?tab=1&page=2-0-0&type=flash