How can we reduce the impacts of severe weather?

Country experiences with role-playing exercises for weather and climate-ready nations (WCRN).

KATHY-ANN CAESAR

Caribbean Institute for Meteorology and Hydrology

Husbands, St. James, Barbados

WMO VLab & NOAA Train the Trainers Workshop
6 August 2022, Madison, Wisconsin, USA

We must be

ready responsive resilient

to extreme weather and climate events.

What does it mean to be weather and climate ready?

WCRNs:

- Evolve their weather forecasting to stress potential impacts
- Communicate impacts clearly to help people make smart decisions
- Engage community partners to spread the word

What steps were taken by Barbados?

- BMS and CIMH integrated new science and technology into National Weather Service operations to improve forecasts
- BMS and DEM improved their operations
- CIMH worked with DEM to improve the programming systems
- Forecasts now stress potential impacts to better support decision-making
- Primary hazards, their impacts, and appropriate responses have been summarized in risk, impact, and response matrices
- The Common Alerting Protocol was implemented to allow consistent alert messaging simultaneously across a variety of media

Our WCRNs partners:

Primary funding partner

USAID FROM THE AMERICAN PEOPLE

Kev Barbados partners

Barbados Meteorological Services

Caribbean Institute for Meteorology and Hydrology (CIMH)

DEM Barbados

Other partners

National Weather Service

CDEMA Caribbean Disaster Emergency Management Agency — Resilient States · Safer Lives

Coastal Zone Management Unit

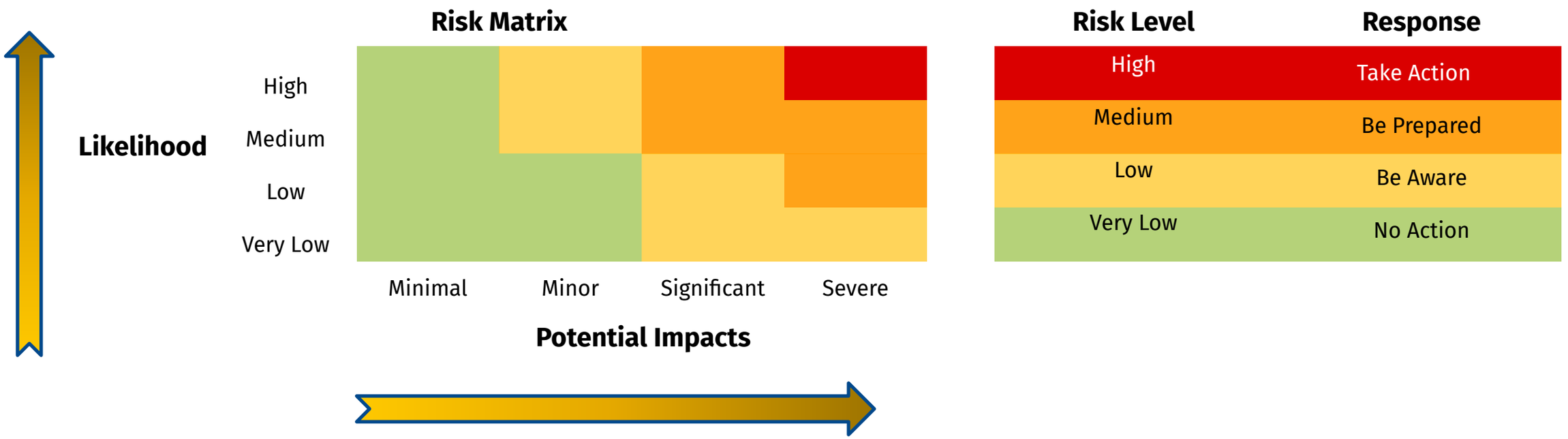
COMET IEPAS International Extension and Public Alert Systems

National Oceanic and Atmospheric Administration — U.S. Department of Commerce — NOAA

UCAR University Corporation for Atmospheric Research

New risk, impact and response matrices

Created for Barbados' primary hazards:
High winds, severe convection, heavy rain events, tropical cyclones, tsunamis, high temperatures, drought, and volcanic ash



Response Matrix

Very Low Risk	Low Risk	Medium Risk	High Risk
Message/response	Message/response	Message/response	Message/response

WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services, WMO- No. 1150

Event preparation example: Impact matrix

Heavy Rainfall

	Minimal Impacts	Moderate Impacts	Significant Impacts	Severe Impacts
Transportation	Wet roads and higher likelihood of accidents Localized disruption to traffic Limited impact to traffic signals	Localized pooling and flooding of roads Occasional accidents and associated disruptions; increased travel times Occasional traffic signal outage/flashing and traffic congestion Minor public transportation disruptions	Localized flooding and damage of roads with significant delays and disruption to traffic Accidents and associated Disruptions; increased travel times Frequent traffic signal outage/flashing; significant traffic congestion Significant disruptions to public transportations	Widespread flooding and damage of roads with dangerous driving conditions Multiple accidents and associated disruptions; increased travel times Most traffic signal outage/flashing – major traffic delays, accidents at intersections Most publication transportation delayed or not operational
Schools	Minor disruption of school activities	Localized disruption of school activities	Regional closure of schools	All schools closed
Landslides	Isolated land slippage	Localized land slippage – limited debris flow on roads	Localized land slippage resulting in road closures and property damage – significant debris flow (rocks and trees)	Land slippage resulting in road closures and property damage and communities cut off

Event preparation example: Response matrix

Heavy Rainfall

Very Low Risk: No Action	Low Risk: Be Aware	Medium Risk: Be Prepared	High Risk: Take Action
Monitor for changing weather conditions	Stay out of flood waters Evaluate inventory of emergency supplies (food, water, medical supplies); prepare to restock supplies at the beginning of season Be aware of localized flooding of roads and properties in [...locations...]. Impacts include occasional accidents, associated disruptions, increased travel times, land slippages could block roads. Be aware for possible traffic delays due to signal outages Be aware for possible delays in public transportation Be aware for possible localized flooding water course over flood prone areas Be aware for prepare for	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...]. Impacts include accidents, associated disruptions, increased travel times, land slippages could block roads. Prepare for traffic delays due to signal outages Prepare for possible delays or cancellation of public transportation routes Prepare for localized flooding in low-lying, flood prone areas Prepare for localized land slippage, debris flow and possible road closures	Stay out of flood waters Prepare to use emergency supplies, acquire additional supplies if possible, fill gas tanks, preposition food and emergency supplies for post Event Avoid walking or driving through moving water Seek safer/higher ground if in [...locations...]. Monitor for changing weather conditions Call emergency services if Impacted. Stay off roads especially in flood prone areas, streets with traffic signals, or areas with frequent land slippage/landslides Plan to shelter in place in non-

DEM Example of combined Heavy Rainfall: Impact, Hazard and Response Matrix *developed by forecasters, hydrologists, and disaster managers*

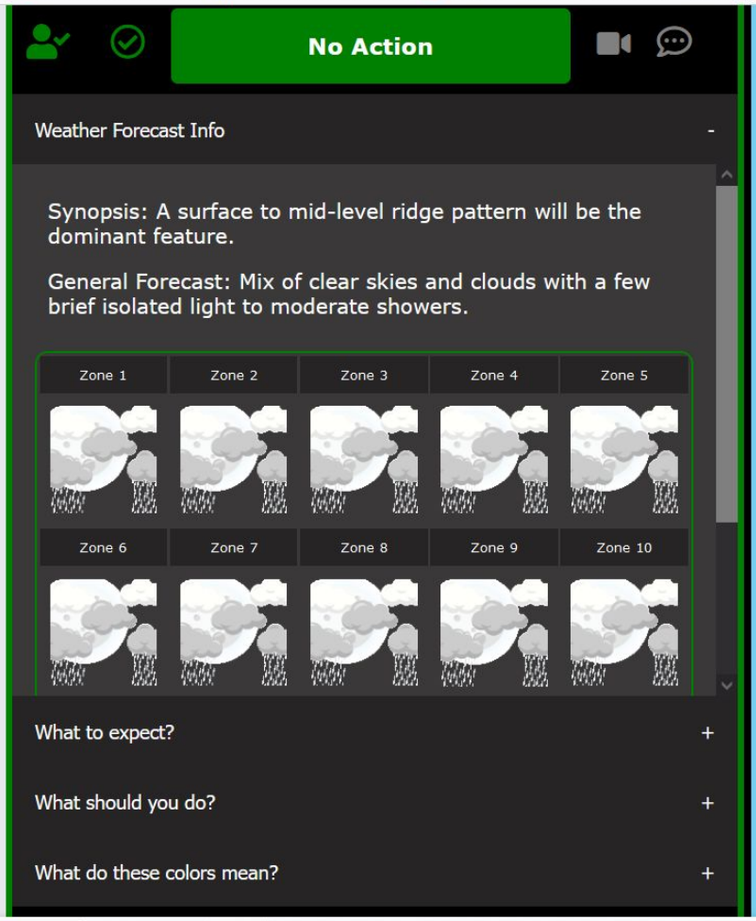
Minimal	Minor	Significant	Severe
Business as Usual	**Localized = Single District Municipality affected** **Business as usual**	**Localized = Single District Municipality affected** **Short term strain on emergency personnel**	**Widespread = Multiple Districts affected** **Prolonged strain on emergency personnel**
▪ Some pooling of water on roads or in informal settlements ▪ Day to day activities not disturbed ▪ Wet roads ▪ Minimal traffic congestion ▪ Isolated mudslides and rock falls	▪ Localized flooding of susceptible informal settlements or roads, low lying areas and bridges ▪ Localized and short-term disruption to municipal services (water, electricity, etc) ▪ Major roads affected but can be used, increased travel times ▪ Minor motor vehicle accidents due to slippery roads ▪ Closure of roads crossing low water bridges ▪ Localized mudslides and rock falls	▪ Flooding of roads and settlements (formal and informal) ▪ Disruption to municipal services (water, electricity, etc) ▪ Major disruption of traffic flow due to major roads being flooded or closed ▪ Possible damage to roads and bridges ▪ Danger to life (fast flowing streams I deep water) ▪ Some communities temporarily not accessible/ cut-off ▪ Displacement of affected communities ▪ Damage to property, infrastructure and loss of livelihood ▪ Mudslides and rock falls	▪ Widespread flooding of roads and settlements ▪ Widespread, prolonged disruption to municipal services (water, electricity, etc) ▪ Widespread transport routes and travel services severely affected ▪ Major roads and bridges damaged or washed away ▪ Danger to life (fast flowing streams I deep water) ▪ Large communities not accessible/cut-off for a prolonged period ▪ Widespread displacement of affected communities ▪ Widespread damage to property, buildings and loss of livelihoods ▪ Widespread mudslides and rock falls

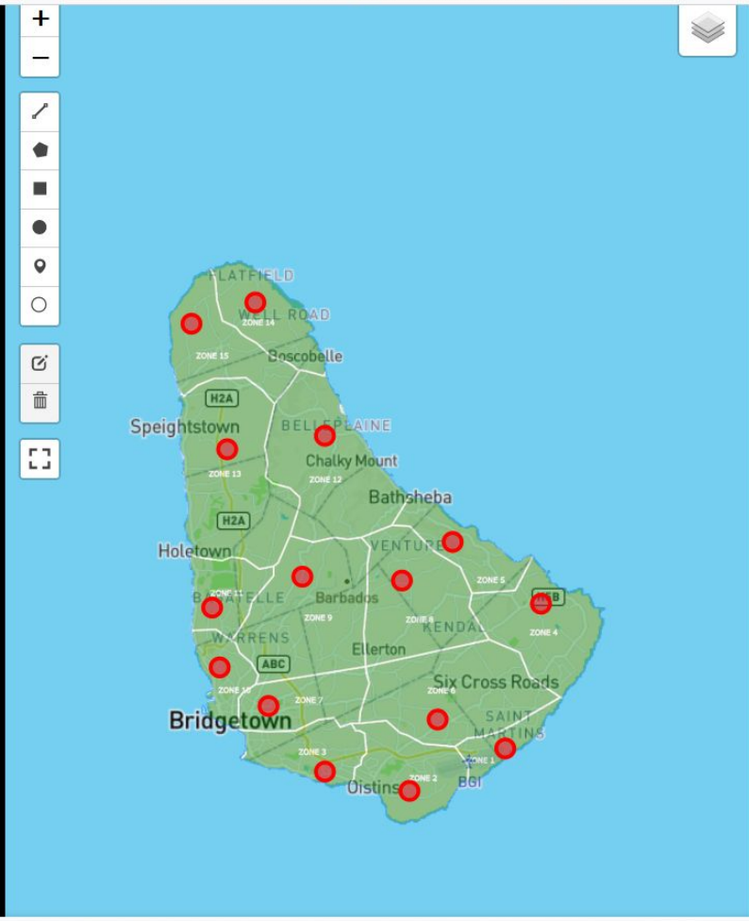
Barbados Meteorological Service Alert

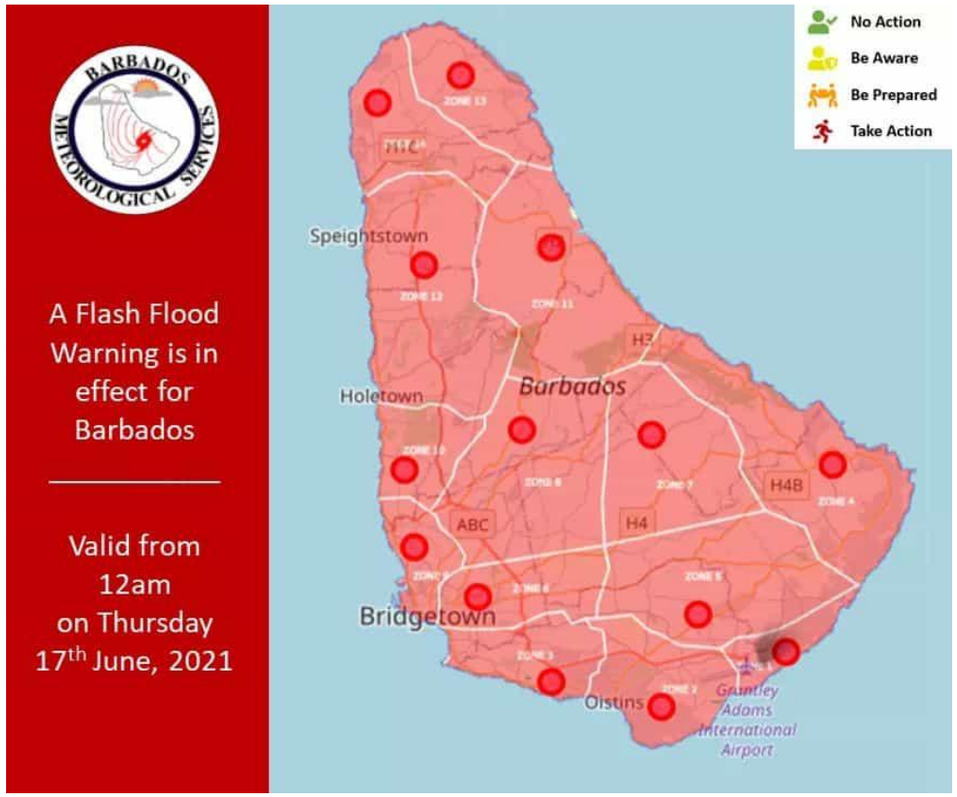
Different warnings are separated into separate matrices… https://barbadosweather.org/

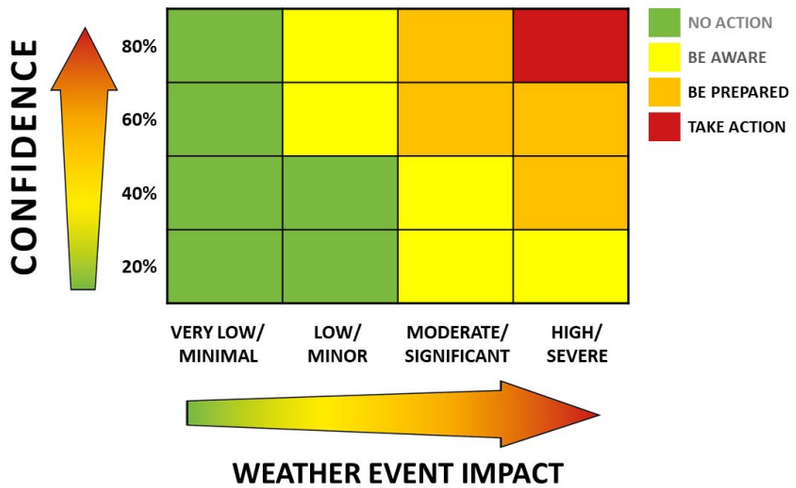
Currently, polygon-specific information is broken down by hazards, with standard risk matrices for each of the 6 hazards

There is messaging as to:
What to expect?
What should you do?





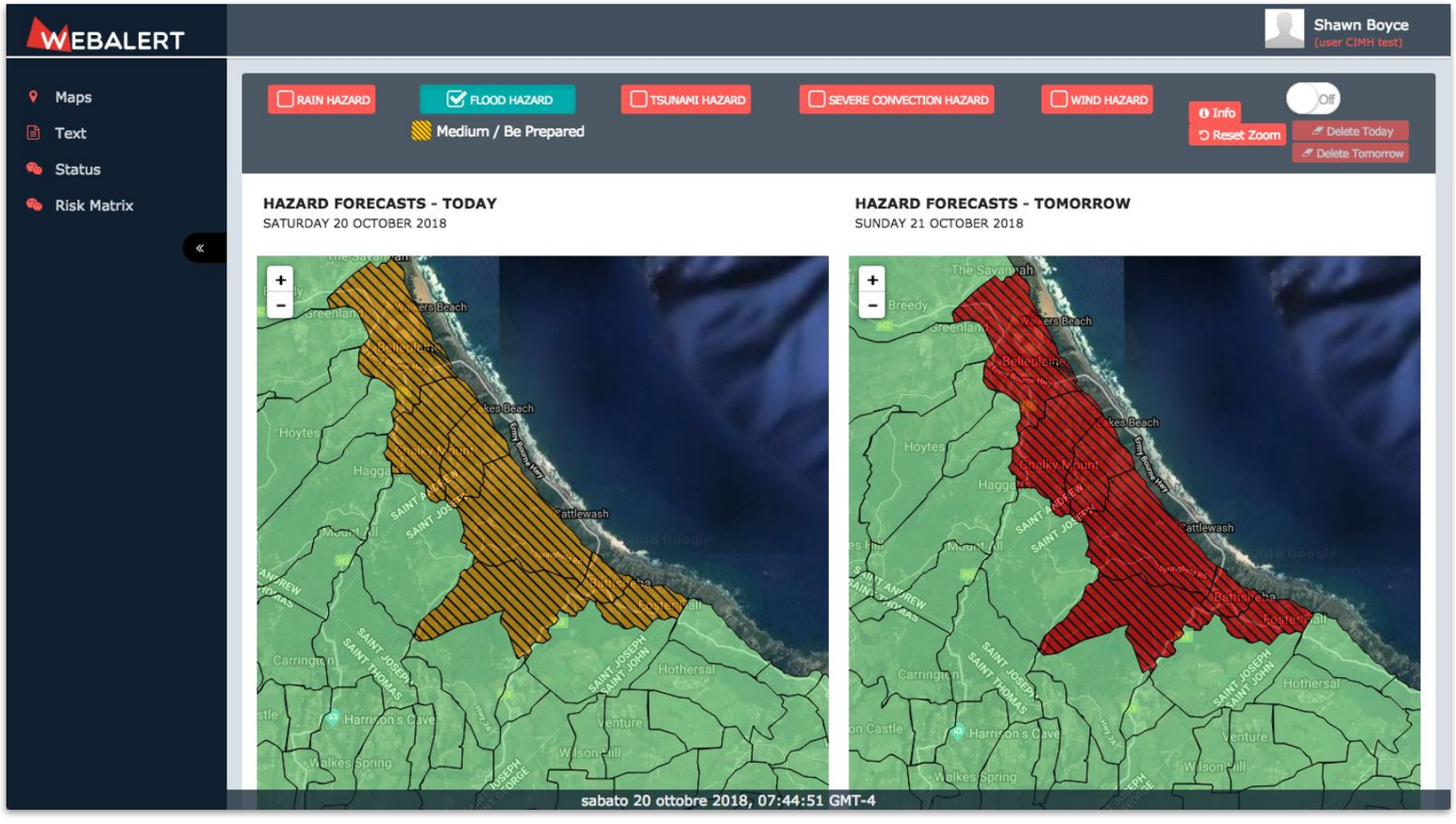




CIMH Dewetra Upgrades to Support WCRNs

Upgrading the DEWETRA software to generate WCRNs advisory and warning graphics.

- Utilizing GIS polygons to delineate expected impact zones
- Auto message generation techniques to produce impact forecast for WCRN stakeholders
- Multiple hazards can be included



Caribbean Dewetra Platform - WebAlert Application

We can’t do it alone.

We need **YOU** as a partner!

Ideas for promoting the WCRN effort

Here's what others have done in the past. Get more ideas at:
https://www.weather.gov/wrn/success-stories

- Created a video on flood safety
- Posted specific storm safety tips on the company website
- Held workshops promoting hydrologic warning best practices
- Donated emergency crank weather radios
- Posted preparedness links on company blogs
- Gotten constituents signed up on the county weather alert system
- Conducted storm spotter training sessions
- Evaluated schools' weather preparedness and made improvements

Using Multi-hazard, Impacts-based Forecast and Warning Services

https://www.youtube.com/watch?v=UaFFBg1opBU&t

- UCAR COMET worked with BMS and CIMH to produce a YouTube video in introduce IBFW to the public
- Using a heavy rain situation in Barbados, this video will demonstrate the use of Multi-hazard, Impacts-based Forecasts, and Warning Services. The demonstration will show an evolution of the forecast in the 3-, 2-, and 1-day lead time periods. The rainfall case is based loosely on 2018's Tropical Storm Kirk, although the name and specific details of the storm are not used.
- The BMS also employs the Barbados Weather App; and Social Media such as Facebook, Instagram, Twitter, and Youtube.

Questions?

KATHY-ANN CAESAR

kacaesar@cimh.edu.bb

Caribbean Institute for Meteorology and Hydrology

Husbands, St. James, Barbados

The Caribbean Institute for Meteorology and Hydrology
http://www.cimh.edu.bb
Husbands, St. James BB23006, Barbados
Tel: 246-425-1362 Fax: 246-424-4733

Weather Briefing

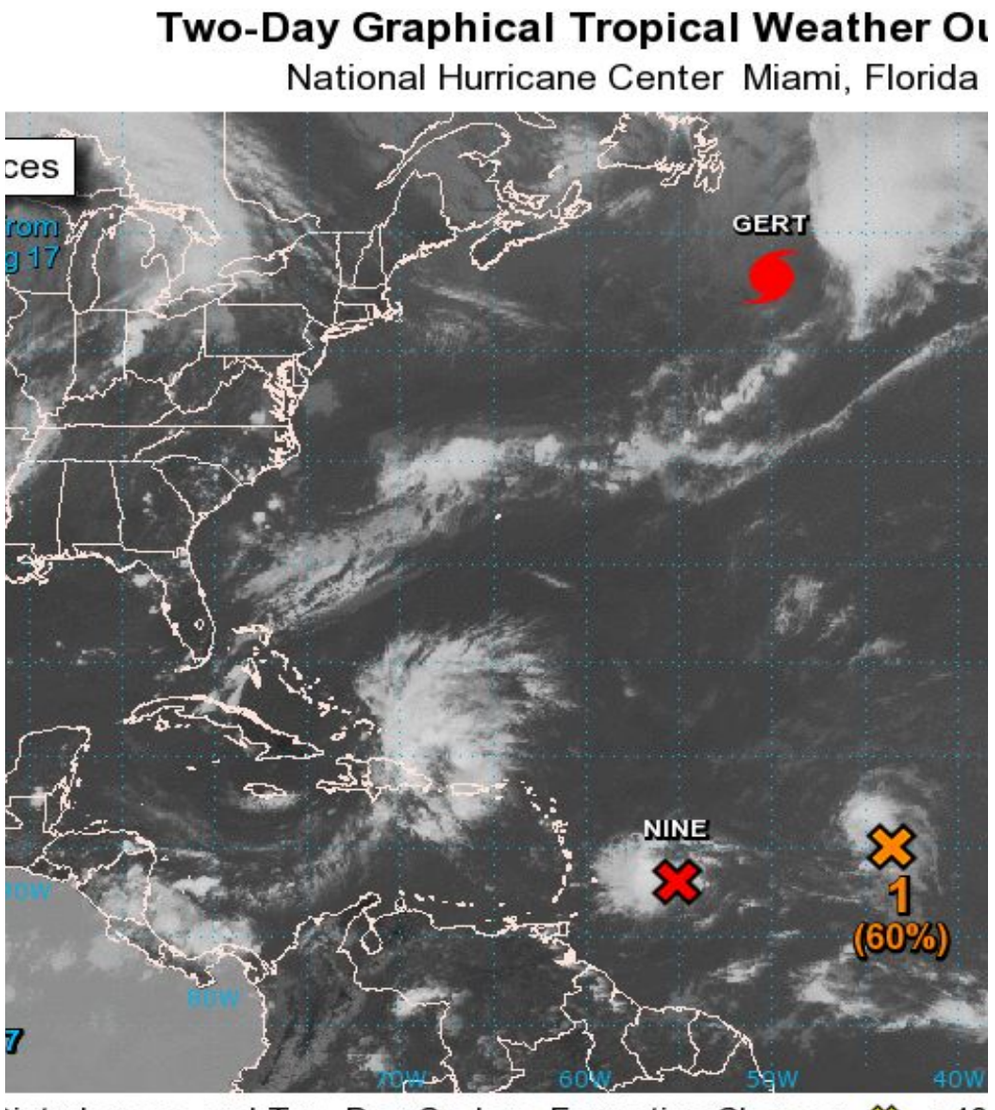
Potential Tropical Storm L91

Compiled by:
Kathy-Ann Caesar, Lawrence Pologne and
Shawn Boyce

For
Caribbean Disaster Emergency
Management Agency

Friday 08th September, 2017 12:15 UTC

Potential Tropical Storm L91- NHC Outlook



BULLETIN

Potential Tropical Cyclone Nine
Intermediate Advisory Number 1A...Corrected
NWS National Hurricane Center Miami FL AL092017
200 PM AST Thu Aug 17 2017

CORRECTED DUE TO PARTIAL RE-TRANSMISSION OF OLD ADVISORY...

...HURRICANE HUNTER AIRCRAFT ENROUTE TO INVESTIGATE THE DISTURBANCE...

SUMMARY OF 200 PM AST...1800 UTC...INFORMATION

LOCATION...**13.1N 55.1W**
ABOUT 295 MI...475 KM E OF BARBADOS
ABOUT 410 MI...660 KM E OF ST. LUCIA
MAXIMUM SUSTAINED WINDS...35 MPH...55 KM/H
PRESENT MOVEMENT...W OR 270 DEGREES AT 17 MPH...28 KM/H
MINIMUM CENTRAL PRESSURE...1007 MB...29.74 INCHES

WATCHES AND WARNINGS

SUMMARY OF WATCHES AND WARNINGS IN EFFECT:

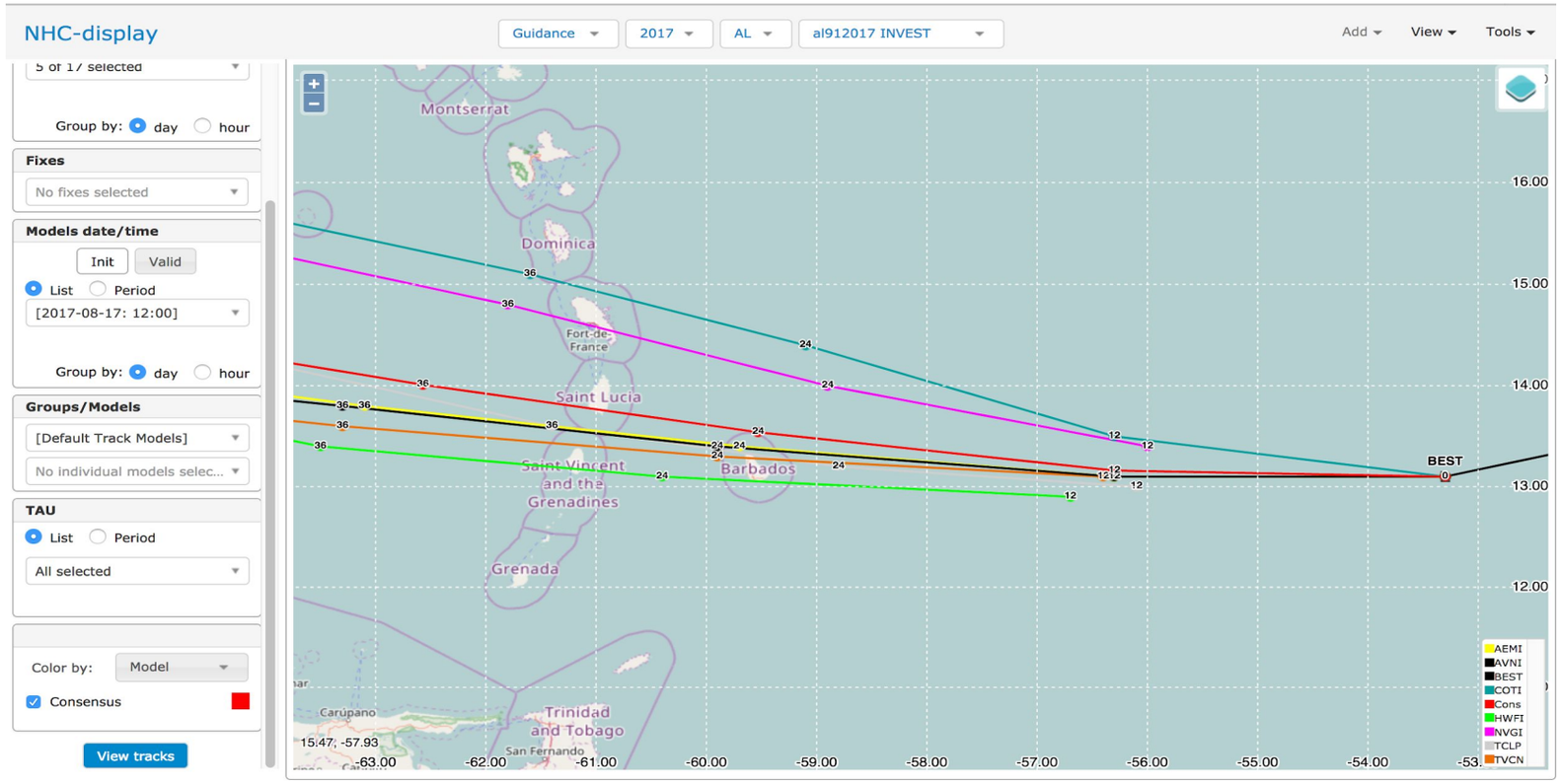
A Tropical Storm Warning is in effect for...
* Martinique
* St. Lucia
* **Barbados**
* St. Vincent and the Grenadines

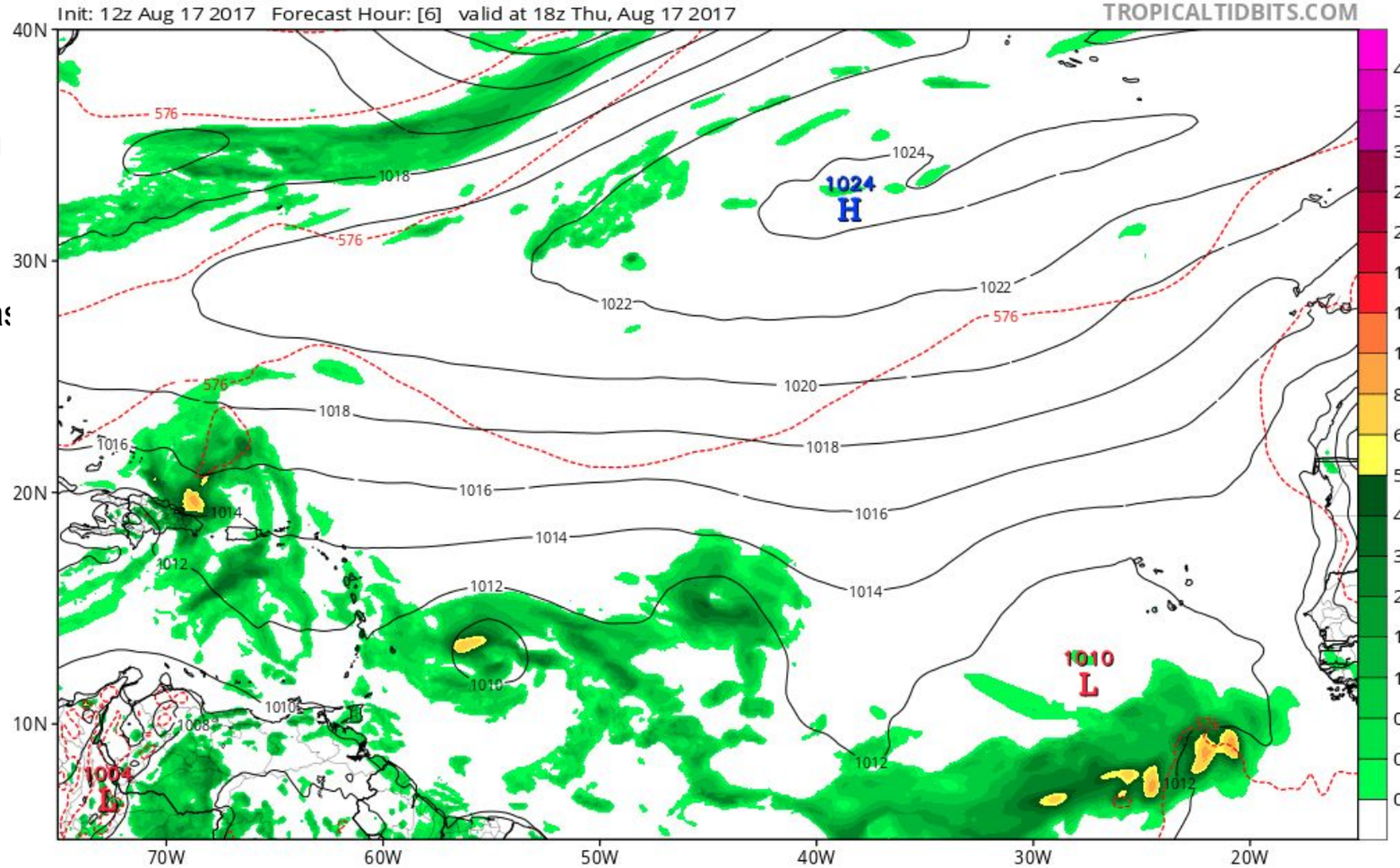
A Tropical Storm Watch is in effect for...
* Dominica

A Tropical Storm Warning means that tropical storm conditions are expected somewhere within the warning area, in this case within 24-36 hours.

A Tropical Storm Watch means that tropical storm conditions are possible within the watch area, in this cas within 24-36 hours.

WRF Model Loop at 2017/08/16 12:00 UTC – 48 hr OUTLOOK
GFS model suggests INVEST 91L will track towards the Lesser Antilles as a weak disturbance. Model guidance suggest the system could move into Barbados Thursday evening as strong disturbance/ weak Tropical Storm. Note more rapid development is indicated as it crosses Lesser Antilles





Expected Impacts – Barbados
Tropical Storm – High and Significant

Friday August 18th, 2017

Risk Matrix					
Likelihood	HIgh			X	
	Medium				
	Low				
	Very Low				
		Minimal	Minor	Significant	Severe
		Potential Impacts			

Risk Level
High
Medium
Low
Very Low

Response
Take Action
Be Prepared
Be Aware
No Action
x

Suggested likelihood (Tropical Storm Conditions): Moderate to occasionally strong winds;
Strong thunderstorms with lightning and heavy rains

Suggested potential impact (Tropical Storm Conditions): Tumbling and rolling of unsecured objects (e.g.: inflatable structures, tents, garbage cans)
Injury and danger to life from flying debris

Expected Impacts Flash floods – Barbados

Friday August 18th, 2017

Risk Matrix					
Likelihood	HIgh			X	
	Medium				
	Low				
	Very Low				
		Minimal	Minor	Significant	Severe
		Potential Impacts			

Risk Level
High
Medium
Low
Very Low

Response
Take Action
Be Prepared
Be Aware
No Action
x

Suggested likelihood (Flooding and Landslides): Flash Floods, Heavy to Severe -

Suggested potential impact (Flooding and Landslides): Localized flooding and damage of roads

Weather Outlook Barbados for Friday August 18th, 2017

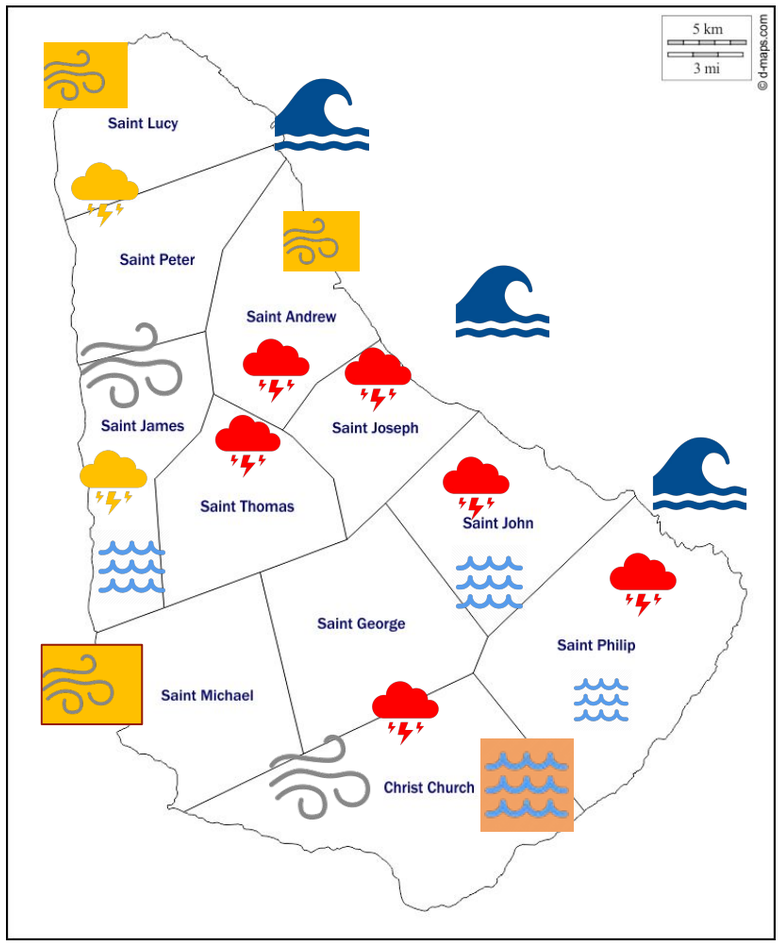
- **Thursday into Friday**

- The Tropical disturbance is developing expect a significant rain event with moderate winds

- Expect increasing tropical storm conditions tonight into tomorrow.

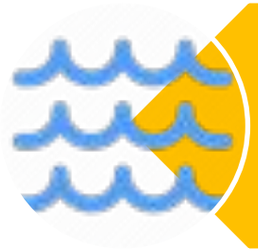
- Heavy Storm conditions will domination much of east, central and southern Barbados districts.

- Flash foods will follow heavy rain events



IMPACTS and SUMMARY

RAINFALL: Effects of the INVEST 91L is now surging ahead and it is expected that heavy showers and thundershowers will begin affecting Barbados this evening into tonight and St. Vincent north to Martinique within the next 6 - 12 hours. Rainfall amounts of 125 - 135 mm are likely with higher totals at elevated locations

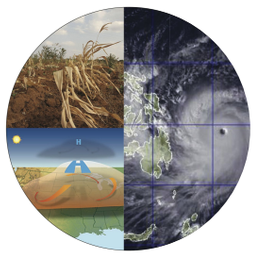


FLOOD/LANDSLIDE: The likelihood of swollen rivers, localised flooding and landslides in areas prone has increased due to antecedent soil conditions and projected rainfall

WIND: Winds likely to approach tropical storm force with stronger gusts in areas of thunderstorms

WAVES: Waves heights likely to approach 3.5 to 4 metres mainly in the area around Barbados north to Martinique. Near shore and marine operators should exercise caution

In summary: Disturbance INVEST 91L has continued to become more organized and thunderstorm activity has increased and extended ahead of the system. NHC may upgrade to a storm this evening as it approaches the islands.



The effects will be beginning to be felt in Barbados this evening into Friday morning. The system is expected to slow considerably over the islands. This could produce large rainfall accumulation over the islands of Barbados, and St. Vincent north to Martinique. It is expected to further develop as it moves in the Caribbean Sea.

ALERT FROM DEM

- **Residents in Barbados should continue to monitor the system and take all necessary precautions against heavy rainfall resulting in flash flooding and storm-force winds which may result in fallen trees, blocked roads and damage to property.**

- **There is also the potential for downed power lines and both water and electricity outages, therefore residents should begin to activate their Emergency Contingency Plans – stock-up on the emergency supplies, review emergency check-lists and check on the vulnerable within the community.**

- **Residents seeking shelter should continue to recognise the COVID-19 (deadly coronavirus) stipulations for the wearing of face masks, social distancing and good hygiene practices (bring sanitizing supplies).**

- **The following Emergency Shelters will be activated as of ……..hrs on ……..**

- **The DEM will continue to update the public on this situation.**

Disclaimer

CIMH is providing special weather interpretation of the current and forecasted tropical weather affecting the Caribbean region.

CIMH is not an official forecasting agency

End of Briefing

Caribbean Institute for Meteorology and Hydrology
https://cimh.edu.bb/

Tel: 246-425-1362/3/5, 246-538-0032 and 246-538-1360/1
Fax: 246-424-4733