

# COUNTRY HYDROMET DIAGNOSTICS

Informing policy and investment decisions for high-quality weather forecasts, early warning systems, and climate information in developing countries.



October 2024

## The Bahamas Peer Review Report

Reviewing Agency: Finnish Meteorological Institute

Authors: Ms. Anni Karttunen, Mr. Matti Eerikäinen, Mr. Juhana Hyrkkänen



**BAHAMAS**  
DEPARTMENT OF  
METEOROLOGY



ILMATIETEEN LAITOS  
METEOROLOGISKA INSTITUTET  
FINNISH METEOROLOGICAL INSTITUTE

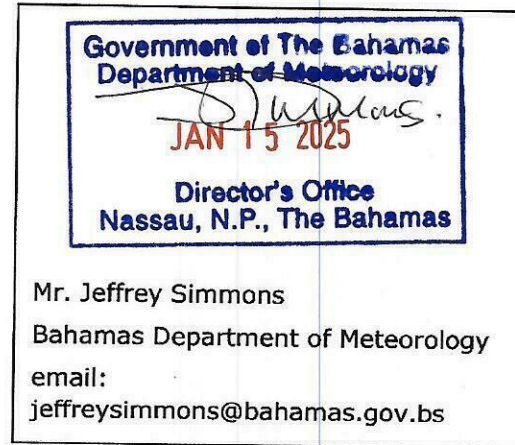


**S**  **FF**  
Systematic Observations Financing Facility

## Copyright

© FMI, 2024

The right of publication is reserved by FMI. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means, including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the FMI. Short extracts may be reproduced without authorization, provided that the complete source is clearly indicated. Editorial correspondence and requests to publish, reproduce or translate this publication in part or in whole should be addressed to:



The findings, interpretations and conclusions expressed are those of the named authors alone and do not necessarily reflect those of the agencies involved.

Authorisation for release of this report has been received from the Peer Reviewing Agency and the Country NMHS as of November 2024.

## Disclaimer

This report has been prepared based on information and analysis provided by FMI. While reasonable care and skill have been taken in preparing this report, no representation or warranty, expressed or implied, is made as to the accuracy, completeness, or suitability of the information and assumptions relied upon, and we do not accept any liability whatsoever for any direct or consequential loss arising from any use of this report or its contents.

## Acknowledgements

The SOFF programme is acknowledged for the financial support to carry out the work to prepare this national Country Hydromet Diagnostics report, and preceding workshops. Collaboration between the peer adviser, beneficiary, and implementing entity was very fruitful and open.

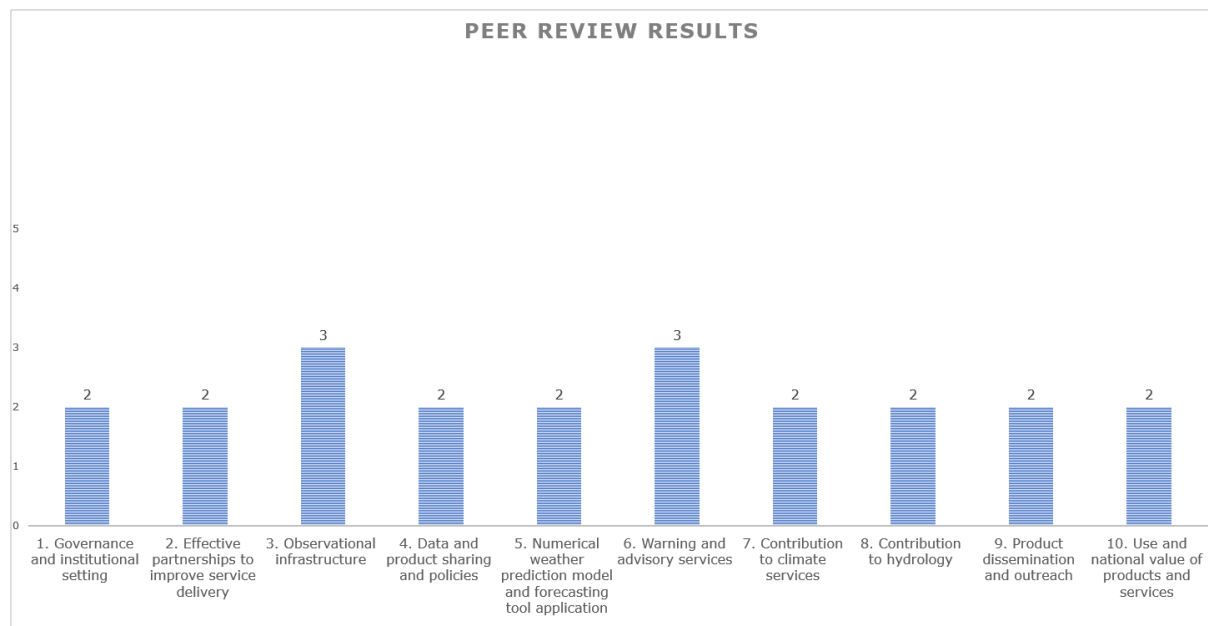
# Table of Contents

<b>COUNTRY HYDROMET DIAGNOSTICS.....</b>	<b>I</b>
COPYRIGHT.....	II
DISCLAIMER.....	II
ACKNOWLEDGEMENTS.....	II
TABLE OF CONTENTS.....	III
ABBREVIATIONS.....	IV
EXECUTIVE SUMMARY.....	1
CHAPTER 1: GENERAL INFORMATION.....	3
<i>Introduction.....</i>	<i>3</i>
<i>CHD methodology.....</i>	<i>4</i>
CHAPTER 2: COUNTRY HYDROMET DIAGNOSTICS.....	5
<i>Element 1: Governance and institutional setting.....</i>	<i>5</i>
<i>Element 2: Effective partnerships to improve service delivery.....</i>	<i>11</i>
<i>Element 3: Observational infrastructure.....</i>	<i>14</i>
<i>Element 4: Data and product sharing and policies.....</i>	<i>19</i>
<i>Element 5: Numerical model and forecasting tool application.....</i>	<i>21</i>
<i>Element 6: Warning and advisory services.....</i>	<i>23</i>
<i>Element 7: Contribution to Climate Services.....</i>	<i>27</i>
<i>Element 8: Contribution to hydrology.....</i>	<i>29</i>
<i>Element 9: Product dissemination and outreach.....</i>	<i>30</i>
<i>Element 10: Use and national value of products and services.....</i>	<i>37</i>
ANNEX 1 CONSULTATIONS (INCLUDING EXPERTS AND STAKEHOLDER CONSULTATIONS).....	39
ANNEX 2 URGENT NEEDS REPORTED.....	40
ANNEX 3 INFORMATION SUPPLIED THROUGH WMO.....	42
ANNEX 4 LIST OF MATERIALS USED.....	43

## Abbreviations

AWS	Automatic Weather Station
BASRA	Bahamas Air-Sea Rescue Association
BDM	Bahamas Department of Meteorology
CAP	Common Alerting Protocol
CariCOF	Caribbean Climate Outlook Forum
CCRIF	Caribbean Catastrophe Risk Insurance Facility
CHUAS	Cooperative Hurricane Upper Air Station
CMO	Caribbean Meteorological Organization
DRM	Disaster Risk Management
FMI	Finnish Meteorological Institute
GCF	Green Climate Fund
IDB	Inter-American Development Bank
NDC	National Determined Contribution
QA/QC	Quality Assurance/ Quality Control
QMS	Quality Management System
5C's	Caribbean Community Climate Change Center

# Executive Summary



Element	Maturity level score
1. Governance and institutional setting	2
2. Effective partnerships to improve service delivery	2
3. Observational infrastructure	3
4. Data and product sharing and policies	2
5. Numerical weather prediction model and forecasting tool application	2
6. Warning and advisory services	3
7. Contribution to climate services	2
8. Contribution to hydrology	2
9. Product dissemination and outreach	2
10. Use and national value of products and services	2

The BDM has been systematically developing its capabilities in recent years. The development has included investments in the observation infrastructure, working to achieve QMS certification and plans to recruit more staff to the department. To enable the development the BDM needs, support throughout the value chain is necessary.

The following critical gaps have been identified:

- There is no legal framework to govern and enforce the BDM status and tasks. Establishing a formal act would clearly stipulate the mandate and priority services of the BDM and allow for cost-recovery services. Cost-recovery would give additional resources to enable sustainability of operations and motivation to develop added value services based on end-user needs. Improving financial and strategic planning and customer-portfolio management is required to support this development.

- A critical gap that is being addressed, but will need further work, is strengthening the human capacity and staff resources in the BDM. The BDM is in the process of recruiting new staff that will need to be trained. The culture at the BDM should promote career and expertise development for young staff members and proactive succession planning for critical tasks.
- Although the co-operation with other governmental authorities is working very effectively, formalizing key partnerships at the national and international levels is encouraged. Enforcing the partnership with the US NWA CHUAS network is critical for GBON compliance.
- The main gaps related to the observation network in The Bahamas are: malfunctioning hydrogen generator for the upper-air station, uninstalled surface weather stations, lacking network management, disconnect for international observation dissemination, non-integrated data management system to store and process all observation data in one system allowing automated data processing, QA/QC and data dissemination for future use.
- Securing a budget or project funds to ship and install existing automatic weather stations is a priority.
- Station maintenance should be improved by formalizing key partnerships with private operators on the remote islands and securing an annual budget for related maintenance and travel. For newly procured systems, in-house capability of independently taking over maintenance should be evaluated, and current service contracts should be continued as necessary. Continuing calibration service agreements or seeking regional calibration services contracts should be pursued.
- Customer engagement process needs to be improved. The BDM does not collect user feedback regularly to improve its services, nor is there a co-creation process to develop tailored services based on user needs. Feedback gathering and product tailoring are done on an ad-hoc basis and there is no structured portfolio of management and prioritization. The customer process should be enhanced hand in hand when new services are developed.
- New products and services – strengthening the skills to fully utilize existing tools and systems: efficient use of weather radars and forecasting and service production system, model postprocessing, and creation of new products.
- The ongoing work with Quality Management System standardization and certification should be finalized and fully implemented.
- Product and service portfolio management should be improved and expended it with more user-friendly visual products and climate services. Current work on improving the BDM website should be continued, and consideration should be given to the development a mobile weather app to increase the reach of public weather services and warnings.

# Chapter 1: General information

## Introduction

The Bahamas is an archipelago of more than 700 islands and cays that spreads as a chain over some 800 km in the western Atlantic Ocean, covering a vast marine zone. Most islands are uninhabited with unique wildlife; the country is home to five percent of the world's coral as well as the world's third longest barrier reef.

The country lies in the Atlantic hurricane belt, which means that the islands are subject to regular hydrometeorological disasters such as hurricanes, storms, and cyclones, which occur most frequently between the months of June and November (also known as the hurricane season). Since 1990 there has been an increase in the frequency of tropical storms. In the last decade, three major tropical cyclones (category 3 or greater) have impacted the Bahamas: Hurricane Matthew (varying between category 3 and 4) in October 2016, Hurricane Irma (category 4) in September 2017, and Hurricane Dorian (category 5) in September 2019. According to the IDB Data assessment<sup>1</sup> The Bahamas has lost over 4.2 billion USD in damages and economic losses caused by hydrometeorological events in the past seven years. Dorian was the strongest storm in the Atlantic basin in recent times causing damages and losses worth 3.4 billion USD, 67 deaths and 200 plus individuals listed as missing.

The entire population lives within coastal zones. Due to the low relief of the lands (80% of the land lies less than 1-1.5m above sea level) the islands are particularly vulnerable to flooding caused by storm surges, torrential rainfall, and sea level rise.

The Bahamas is located on the boundary of the tropical and subtropical zones and has a semi-tropical or subtropical marine climate with warm, humid conditions year-round. Annual mean temperature has been observed to increase during the past century with an average rate of 0.11 degrees per decade.

Tourism accounts for approximately half of the gross domestic product and about half of the workforce. Other important economic sectors are financial services, agriculture, and fisheries.

The Bahamas Department of Meteorology (BDM) is responsible for providing weather and climate forecasts and warnings for the well-being and socio-economic development of the population. One of its core tasks is to provide accurate and reliable warnings to its stakeholders and the general population during the hurricane season and to contribute to regional hurricane cooperation. The BDM's weather observation and forecast services are key in supporting all key economic sectors such as tourism, transportation (both aviation and marine), and fisheries. Besides mitigating losses and improving national safety, the potential benefits of improved weather and climate services are huge as the country's main economic contributor is the service industry driven by tourism.

The mission of the BDM is to provide high-quality meteorological and climatological information on a timely basis to special interest agencies and the public at large for research, education, and the protection of lives and property.

The BDM has been actively developing its capabilities and services in the recent years. This has included investments in critical observation systems, human capacity building and ongoing Quality Management System development.

---

<sup>1</sup> [IDB Data Assessment - Synthesis](#)

## CHD methodology

The Country Hydromet Diagnostics (CHD) work was done as an additional output for the Systematic Observations Financing Facility (SOFF) project in The Bahamas and was preceded by the preparation of the SOFF National GBON Gap Analysis and Contribution Plan.

During the SOFF project's readiness phase, the following activities were organized:

- Remote workshop for the kick-off.
- A fact-finding mission to The Bahamas focusing discussions on the status of the observation network, gaps, and plans, including a trip to survey the surface weather stations in Nassau. The mission focused on the information required for the Gap Analysis report and the National Contribution Plan document.
- A mission focusing on the Country Hydromet Diagnostics. Workshop with the BDM to assess and evaluate all line-items on the CHD template. A half day key stakeholder engagement to collect input from the users. Invitees included representatives from the following agencies and institutions:
  - Ministry of Disaster Risk Management
  - Ministry of Economic Affairs
  - The Bahamas National Trust
  - Department of Agriculture
  - Department of Environmental Health Services
  - Department of Marine Resources
  - Bahamas Reef Environmental Education Foundation
  - Bahamas Power and Light Company
  - Cable Bahamas
  - University of the Bahamas
  - Department of Aviation
  - Civil Aviation Authority
  - Aircraft Accident Investigation Authority
  - BahamasAir
  - Odysseys Aviation
  - Nassau Flight Service
  - Nassau Airport Development Company
  - American Airlines
  - Port Authority
- Consultation with the US National Oceanic and Atmospheric Administration National Weather Service Office of Observations regarding the Cooperative Hurricane Upper-Air Station.
- Two visits to the Caribbean Meteorological and Hydrological Institute (CIMH) to discuss regional network support, plans, and the capacity of the regional calibration centre.
- Several remote meetings to prepare and comment on the findings and documents.



# Chapter 2: Country Hydromet Diagnostics

## Element 1: Governance and institutional setting

### 1.1 Existence of Act or Policy describing the NMHS legal mandate and its scope

Currently there is no act or policy governing the role and mandate of The Bahamas Department of Meteorology. An act titled “The Bahamas Department of Meteorology Bill” was initially drafted in 2013 with the assistance of the Attorney General’s Office and was updated by the BDM in 2019. The bill was drafted to formalize the Department as the authoritative weather entity of The Bahamas. The bill also provides a list of products and services provided by the Department including proposed cost retrieval services. The updated draft was resubmitted for approval by the Attorney General’s Office, however no further action was taken. The BDM is planning to update the act once again and resubmit it for review.

In the government hierarchy depicted in Figure 1, the BDM is located within the Ministry of Energy and Transport.

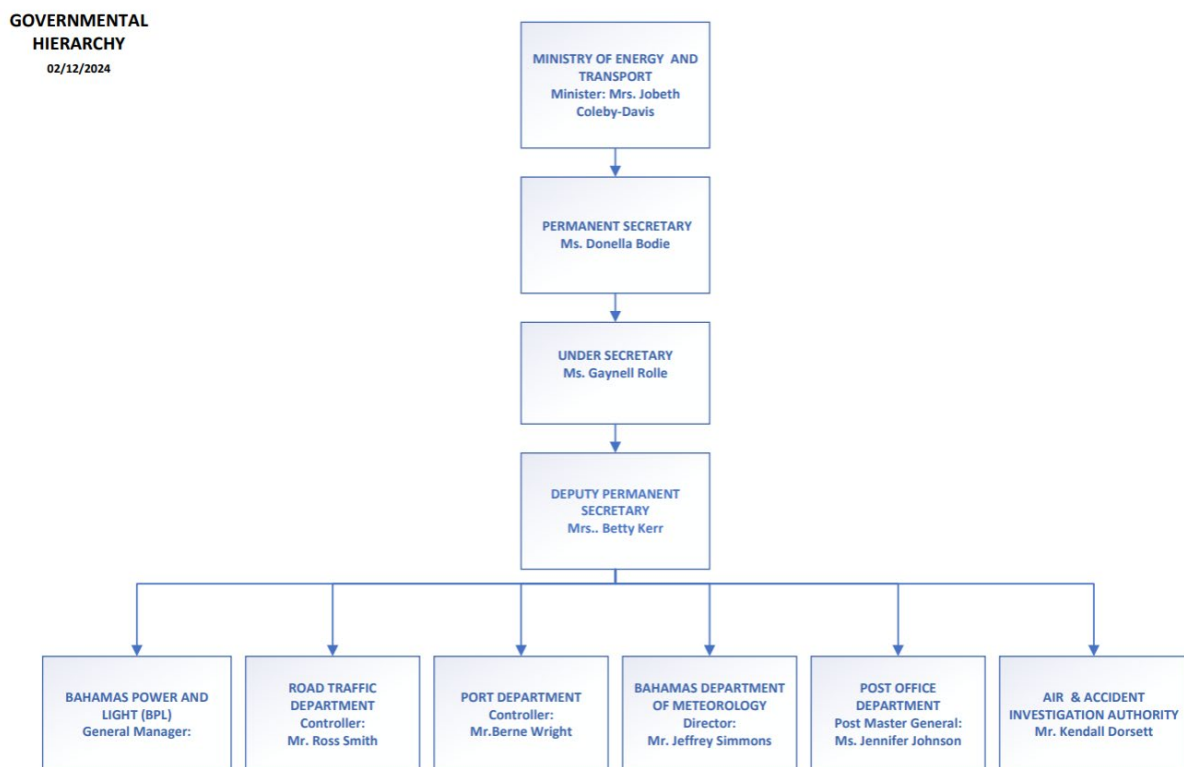


Figure 1 The Governmental hierarchy of the Ministry of Energy and Transport and how the BDM is situated.

Although there is no separate act or policy governing the BDM, authorities have been actively endorsing their capabilities and the reliability of weather and climate warnings and services provided by the BDM. There are established, undocumented best practices in place involving close cooperation between the BDM and the Disaster Risk Management Agency that is governed by the “Disaster Risk Management Act, 2022”. This act sets the framework for handling all phases of disaster management before and after events. The BDM follows this act even though it is not specifically mentioned in it.

While there is no official mandate for the BDM, it is considered as a critical service provider. The unofficial responsibility areas the BDM operates within include the following:

- Public weather services

- Weather and climate warning services
- Climate services
- Marine services
- Aviation weather services.
  - o the BDM is not the Meteorological Authority as per ICAO Annex 3, but the designated meteorological service provider for aviation.

Beyond these services, the BDM is considered the national point of contact for other topics e.g. air quality questions or in case of oil spills. The BDM is contributing to the warning of seismic activity and tsunamis. The BDM nationally shares tsunami warnings that they receive from the Regional Tsunami Warning Centre.

As a Member in the WMO, the Bahamas adheres to the responsibilities set by WMO conventions. The Permanent Representative of The Bahamas to WMO is the Director of the BDM.

According to an agreement between CMO and the Bahamas (non-CMO Member), The Bahamas' area of responsibility for forecasts and warnings includes the islands and coastal waters of the Turks and Caicos Islands (CMO Resolution 1, 2011)<sup>2</sup>.

### **1.2 Existence of Strategic, Operational and Risk Management plans and their reporting as part of oversight and management.**

Currently, there is no formal strategic plan for the BDM operations. The BDM has started the work on a 5-year strategy by identifying priorities and strategic statements for each priority but has not yet developed the action plans for them.

The BDM is currently working to upgrade its Quality Management System (QMS) to the ISO 9001:2015 standard. Its QMS was designed primarily around aviation service line and expand the scope to cover all lines of services of the department such as Public Weather Services, Marine, Early Warnings and Climatology. The target is to formalize the QMS with certified compliance by 2025. As part of this work, the first drafts of the strategic plan, mission and vision statement, and risk management plans are being developed. For the strategic plan, the BDM has selected priority areas to focus on, and the intention is to report on the status of its implementation biannually.

The selected priority areas for the strategy are:

- Full QMS implementation: increased quality of operations, customer focus and continuous improvement
- Increased capability to utilize forecaster tools: improve the capabilities to utilize the existing tools in a more versatile fashion to create new products and services for stakeholders. Improve the use of automatization.
- Increased web presence: strengthen the web page with tailored products, collect services centrally to the webpage and increase user activity
- Improve stakeholder engagement: formalize key stakeholder relations and improve stakeholder engagement and dialogue

---

<sup>2</sup> [CMO Resolutions](#)

- Staffing: address key shortages in staffing and proceed with organization restructuring to reflect the service needs
- Improved partnerships
- Improve weather surveillance and observation networks

**1.3 Government budget allocation consistently covers the needs of the NMHS in terms of its national, regional, and global responsibilities and based, among others, on cost-benefit analysis of the service. Evidence of sufficient staffing to cover core functions**

As the BDM’s annual budget is funded fully by the Government, it is recommended to allow cost-recovery for the BDM services to support long-term budget sustainability. The BDM’s annual budget is around USD 2.4 million, of which three quarters is spent on salaries and allowances.

*Table 1 The BDM budget for 2023/2024*

The BDM budget 2023/2024	<b>2.4 million BSD</b>
Amount of personal emoluments	76,3%
Upkeep and maintenance of instruments and apparatus	2,5%
Maintenance contract with private service provider	8,3%
Other goods and services	12,9%
Investments	0%

In 2022, The BDM’s budget was reported at around USD 2.1 million, and in 2023 around USD 2.79 million. The annual budget is insufficient to meet all costs for the operation and maintenance of the department. Spare parts, sensor replacements, maintenance visits, and other capital items have little budget and are mainly funded from projects or additional funds that can be requested in urgent cases. Investments in new equipment can only be made by separate or external project funding.

**It is recommended to strengthen the BDM’s annual budget planning with improved project fund management, lifecycle cost analysis for the sensors and network, and improved recognition of the socio-economic value the services bring.** Since no socio-economic benefit analysis has been done, it is recommended to conduct one on the BDM services considering the potential of cost-recovery services proposed in the draft legislation.

Currently a large portion of the operational budget is allocated for the external maintenance contract of weather radars and automated weather observing systems (AWOS) for aviation, which is provided by a selected system-provider. The service contract is part of the large modernization project that is a separate project funded by the Government of the Bahamas. The service contract will expire during the upcoming year. Besides these services, there is a very limited budget for any other operational expenses including maintenance visits or other capital items. Currently, the budget does not include travel expenses for maintenance calls - these have to be separately applied for from the Ministry, which adds to the lengthy bureaucracy, delays in getting to the sites, and unnecessary system downtime. **It is recommended to develop the annual budget to include funding for annual maintenance, calibration, and spare parts as well as a budget for maintenance calls.** As the service contract with the private supplier comes to an end, the BDM is recommended to allocate funding to the BDM maintenance unit and spare part stock and to upgrade service contracts for advanced technologies (weather radar maintenance) and calibration services.

The BDM is in the process of recruiting fifteen new employees as a response to the acute staff shortage. Once the recruitment has been done, efforts are needed to target junior staff capacity building. A number of the senior staff in key positions are expected to retire in the upcoming years, thus calling for active succession planning and career advancement. Attracting new staff is difficult as the BDM's salary scales are regarded as very modest and not competitive with comparable Departments in government or the private sector. Currently, ongoing QMS work will assess the BDM's organizational structure (Figure 2) and open vacancies.

**1.4 Proportion of staff (availability of in-house, seconded, contracted- out) with adequate training in relevant disciplines, including scientific, technical, and information and communication technologies (ICT). Institutional and policy arrangements in-country to support training needs of NMHS.**

The number of permanent staff in the BDM is currently 29 (Figure 2) that forms the BDM operational unit (technical personnel and meteorologists). Additionally, this figure includes staff attached to the administration section of the department and the Ministry. Three contract workers are working regularly in the BDM. The BDM has recently received Cabinet Approval to hire 15 new technical staff members. Interviews and selections have taken place and propositions have been submitted to Ministry of Public Service for completion of the hiring process. Hired individuals will be trained as Meteorological Observers and Meteorological Engineers.

The shortage of qualified staff has been a major limiting factor for the BDM to expand its service portfolio, dedicate time for internal process or system development or to engage more frequently with key stakeholders. The lack of staff is most pressing in the climatological services section, where only one dedicated person is working, and supporting the quality management and communication section of the entire department. Several senior experts in key positions are approaching retirement age and active succession planning and career advancement for young talent is required for a smooth transfer of knowledge and positions.

All of the BDM staff positions have predefined competency and skillset requirements and an affixed pay scale according to the Government's policy.

The current female to male ratio is 1:1 and is well reflected throughout the organizational tiers.

**HIERARCHY OF THE  
BAHAMAS  
DEPARTMENT OF  
METEOROLOGY (BDM)**  
22/5/2023

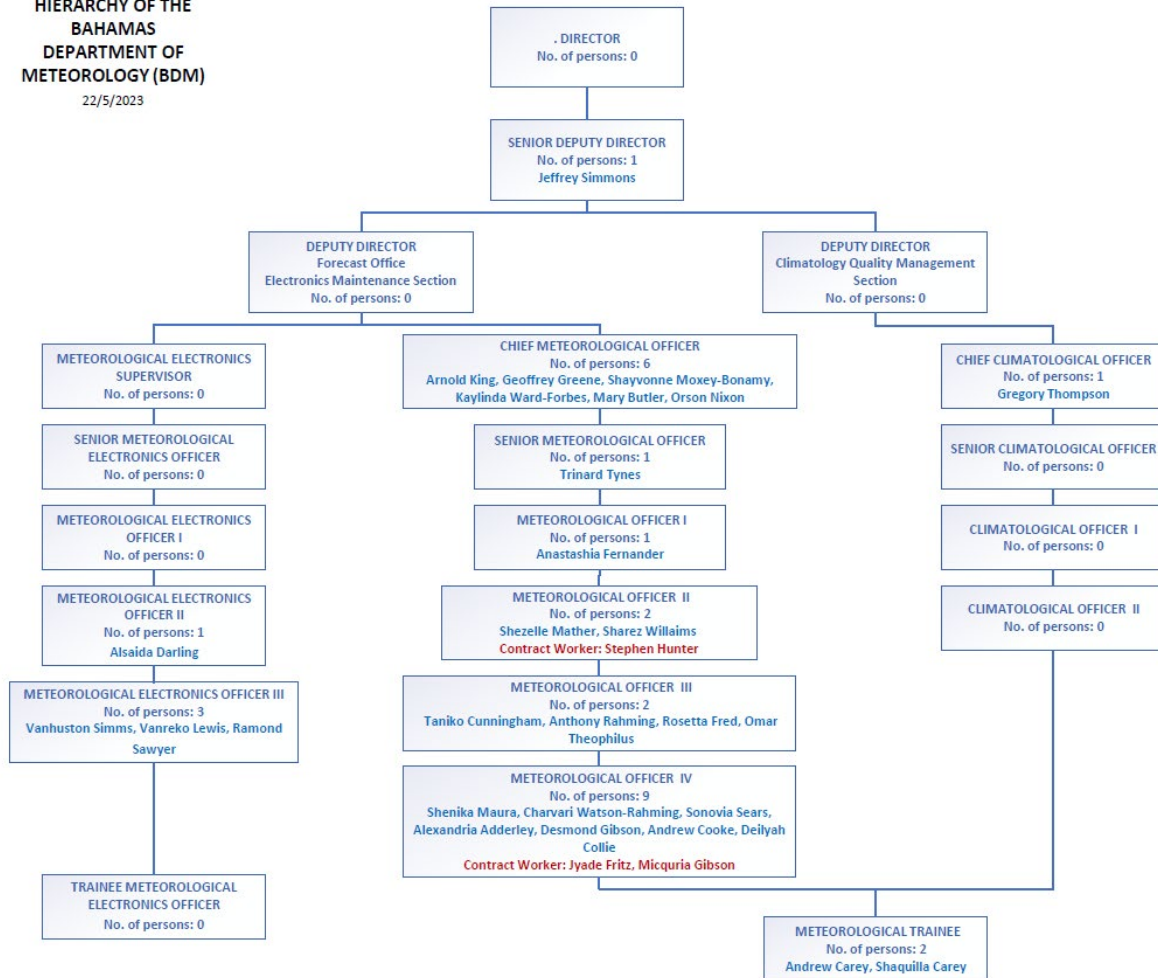


Figure 2 Organizational chart for the BDM staff and vacancies.

Most of the BDM's trained meteorological staff have been studying in the University of West Indies and Caribbean Institute for Meteorology and Hydrology (CIMH) joint meteorological program, consisting of the four WMO classified levels and have certified degrees from the programs (level 3 for technicians and level 4 for forecasters). Technical officers have educational backgrounds in engineering fields, with additional specific training in meteorological sensor maintenance typically done as courses by system manufacturers.

The BDM has a competency assessment plan for the forecasters and observers and is following the Competency Assessment framework<sup>3</sup> that is in place for the Aeronautical Meteorological Personnel. The BDM has a training process in place for its technical staff (BAHQMD44 – Training Of Meteorological Personnel). A training policy has been drafted as part of the ongoing QMS work.

The BDM is utilizing training and refresher courses organized by CIMH (WMO Regional Training Centre). Although not a member of CMO, the BDM participates in these courses but is required to pay the tuition. The collaboration is a well-established practice between the BDM and CIMH even though there is no formal agreement in place.

<sup>3</sup> Competency Assessment for Aeronautical Meteorological Personnel [BAHQMD009]

Ongoing QMS work will assess many of the key staff questions such as the organizational structure, open vacancies, and expanding the competency assessment framework to include other meteorological products and services.

### **1.5 Experience and track record in implementing internationally funded hydromet projects as well as research and development projects in general.**

The BDM has actively partaken in several development projects funded by different international agencies with many of these projects having a regional approach.

Recently the BDM successfully completed a large modernization project with Vaisala, a private company - funding for this project was provided by The Bahamas Government. Vaisala was contracted along with the Finnish Meteorological Institute who was a key subcontractor. This project established a national weather radar network, surface weather observation systems and modernization of the forecasting and service production system.

Recent and on-going projects in which the BDM has been involved:

- Creation of the Storm Surge Risk Model for entire Bahamas and Turks and Caicos Islands by National Hurricane Center and UCAR (fully funded by these). Lasted from May 2023 to August 2024.
  - Main output was to expand the storm surge model risk maps (work started in the previous project) to cover the entire area.
- Development of a Storm Surge Model, Atlas and Digital Platform for two islands of The Bahamas, namely Grand Bahamas and Eleuthera by the Green Climate Fund and Caribbean Community Climate Change Center. Lasted from March to July 2021 and had a budget of USD 200 000\$.
  - Main outputs where the creation of risk maps to forecast the expected amount of water inundation at any point in any island as a result of a passing hurricane. The maps take into consideration the category, size, and forward velocity of the hurricane.
- Enhancing Climate Resilience in CARIFORUM Countries by the European Union Commission (governed by Caribbean Community Climate Change Centre). The BDM received the stations and systems, but the budget was fully covered by the implementing entity.
  - Main outputs for the BDM were receiving four automatic weather stations (installed in New Providence (three of them) and one in the Bahamas Agricultural and Marine Science Institute in North Bahamas) and a Coral Reef Early Warning System.

Preliminary discussions between the BDM and the Caribbean Catastrophe Risk Insurance Facility (CCRIF) have been initiated. CCRIF is granting support to the national weather monitoring network in the region to increase the AWS network. The BDM is a planned recipient of some of these funds. the BDM is planning to use the potential funds to cover shipping and installation costs of existing AWSs or strengthen the data management system. Both actions will support the GBON efforts and improve the national network.

### **Summary score and recommendations for Element 1**

The summary score for the element is assessed as 2 "Effort ongoing to formalize mandate, introduce improved governance, management processes and address resource challenges."

**It is recommended to establish a formal act governing BDM that clearly stipulates the department's mandate and to allow cost-recovery services and revenue generating commercial services for BDM** to strengthen its budget and improve services. The BDM is recommended to seek assistance from the Ministry on updating and passing the act.

Currently all of the BDM's operating budget comes from the government which imposes a strain on its operational capacity. Most new investments are covered by external funding from donors thus possessing a risk to the sustainability of operations. To strengthen the financial sustainability of the BDM, it is **recommended to improve the financial planning of the department, hence enabling independent cost-recovery and commercial revenue generation from different service users. Training in active project and customer portfolio management is recommended to support these actions.**

**the BDM is recommended to finalize the strategic plan as part of the ongoing QMS work.** Based on the implementation plan, performance indicators will be developed which the BDM will start to follow and report on the progress.

There has never been a national socio-economic benefit assessment conducted in The Bahamas for the meteorological service. The assessment is necessary for the monitoring and evaluation of the services impact, guide the prioritization for new service development and render strong justification for the mandate of the service. **It is recommended to conduct a national socio-economic benefit assessment of the hydrometeorological services.**

The BDM has a shortage of qualified staff that needs to be addressed. The situation is made more acute as several expert level staff are approaching the retirement age. The BDM **is recommended to implement active succession planning for the critical posts and to actively promote the development of new employees.**

## Element 2: Effective partnerships to improve service delivery

### 2.1. Effective partnerships for service delivery in place with other government institutions.

The BDM is well connected with other government institutions with long standing partnerships and well-established practices of cooperation.

A key partnership is formed with the Disaster Risk Management Agency (DRM-Agency). The DRM-Agency is governed by the "Disaster Risk Management Act, 2022". One of its activities includes hosting a monthly meeting for all relevant national entities: public sector agencies, media, telecommunication providers, service providers and private sector to discuss and prepare for national emergency, especially focusing on the frequent tropical cyclones. BDM is essential in these meeting with a permanent slot to present the outlook on the weather and climate hazards. Besides the official DRM-Agency collaboration many of the stakeholders receive the BDM's warnings and alerts via email and use the input to guide actions, e.g. the Bahamas Utilities Department reported a dependency on the BDM hurricane alerts to determine if it should send field crews ahead of the storms.

Some key partnerships have been formalized with a Letter of Agreement: Bahamas Air Navigation Service Agency (BANSAs), and Turks and Caicos Civil Aviation Service (TCIAA). Letter of Agreement pending: Search and Rescue Agency<sup>4</sup> (a non-profit voluntary

---

<sup>4</sup> [BASRA website](#)

organization committed to rescuing lives of distressed seamen or airmen in The Bahamas) and the Airport Authority. There are two Memorandum of Understandings pending: one with the Aircraft Investigation Authority (AAIA) and one with the Royal Bahamas Defence Force (RBDF).

The BDM has good informal partnerships with most of the government departments working in the weather and climate critical sectors. A few collaborations are listed below.

- the Port Department and Department of Marine Resources, both use the warnings and alerts from the BDM to advise fishers and boaters on hazardous marine conditions and preventing marine instances.
- the Department of Environmental Health that routinely uses public weather forecasts to map areas with heightened risk for mosquito or pest outbreaks.
- The Bahamas National Trust utilized The BDM's weather information for the management of National Parks.
- The Bahamas Water and Sewerage Corporation is responsible for hydrology related service in the Bahamas. The BDM assists them based on requests for observation or forecast information.

The BDM is working as the main environmental information provider nationally and there is a practice of contacting the BDM in any and all cases of weather or environmental hazards or situations. The BDM is working within their staff capacity to facilitate the different requests. Most relations are informal and there is no clear mandate specifying which services are in the BDM's jurisdiction.

## **2.2. Effective partnerships in place at the national and international level with the private sector, research centres and academia, including joint research and innovation projects.**

By agreement between WMO and the Bahamas, The Bahamas area of responsibility for forecasts and warnings, which the BDM is responsible for, includes the islands and coastal waters of the Turks and Caicos Islands (CMO Resolution 1, 2011)<sup>5</sup>. Additionally, the BDM has a Letter of Agreement on service delivery with Turks and Caicos Civil Aviation Service.

The BDM is a part of the Cooperative Hurricane Upper Air Station (CHUAS) network program supported by the US National Oceanic and Atmospheric Administration (NOAA). The program's aim is to provide upper-air sounding data for hurricane forecasts from the most important regions along the hurricane tracks and area of formation. The cooperation is longstanding and based on a Memorandum of Agreement signed 1983.

After executing a large meteorological modernization project with a private company - Vaisala, the BDM has continued the partnership with a maintenance service agreement for the systems. Previous service agreements were in-cooperated in the modernization project, these agreements are about to expire shortly. The BDM is recommended to continue the collaboration with targeted services to maintain the more advanced systems (i.e. weather radar networks) and calibration services. Overall, the cooperation between the BDM and the company Vaisala has been very successful.

The BDM has some experience of outsourcing technical maintenance and service works to local private technical experts. The services have been used in urgent cases for the remote islands, but the BDM is seeking to formalize such relations to improve the uptime and

---

<sup>5</sup> [CMO Resolutions](#)



sustainability of the stations, thus reducing the delay and cost due to travel from head office.

Although not a member, the BDM has close discussions with Caribbean Meteorological Organization (CMO) and Caribbean Institute of Meteorology and Hydrology (CIMH) through the WMO Region IV activities and participates actively in regional projects and selected trainings.

The BDM has not been involved in any academic research or innovation projects. Collaboration with universities has been in specific projects for university students based on requests. Several potential opportunities for collaboration in research projects or new information sharing were identified in the Stakeholders' Workshop with the University of the Bahamas, BREEF and Department of Environmental Planning and Protection.

### **2.3. Effective partnerships in place with international climate and development finance partners.**

The Bahamas is member of the CARICOM Community and participates through it in Caribbean Community Climate Change Centre activities and projects utilizing international climate and development finance instruments and partners. Via these partnerships the BDM has successfully operated with Green Climate Fund and EU-funded projects. The BDM has also participated in several regional projects.

The BDM has not established direct contacts with any international climate and development financing partner and relies on implementing entities and regional organizations coordinating the projects.

### **2.4. New or enhanced products, services or dissemination techniques or new uses or applications of existing products and services that culminated from these relationships.**

Due to a very limited staff-capacity and budget resources, the BDM has not had opportunities in any systematic manner to improve their service offering. New products and services are done when requested and if the resources allow, thus mostly with manual labour and without a clear process. The current way of working and the limitations in staff capacity does not allow for systematic service development, follow-up and feed-back collection, or co-creation with stakeholders.

Stakeholder engagement and input has been very limited and mostly ad-hoc, but there seems to be a lot of interest from both sides to improve this. Especially weather information critical users such as the aviation, marine and agriculture industry are interested in participating in product and service development. Regular stakeholder engagement is recommended with targeted events for the different user sectors. All new service and product delivery should reflect the priorities of the BDM core functions and strategy. Active product and service management, co-creation and added value services needs to be highlighted if the BDM starts providing services utilizing cost-recovery or commercial mechanisms.

Based on the stakeholder engagement and discussions, a key partnership for the BDM to follow up on is the University of The Bahamas (UB). This partnership has a lot of potential for mutually beneficial research and development efforts with a potential topic related to a weather mobile app development.

One of the key strategic priorities the BDM has drafted in their plan is to enhance the BDM's web presence by focusing on the use of its website (increase the automatically updated products in user friendly formats), future mobile application, and actively following/reporting user statistics and feedback.

## Summary score, recommendations, and comments for Element 2

The summary score for the element is 2 “Limited partnerships and mostly excluded from relevant finance opportunities”.

The BDM has very good connections with major national stakeholders and is valued as an important national and regional department. **The partnerships are recommended to be strengthened with regular stakeholder engagement and formalizing key partnerships through Letters of Agreements/MOUs and by renewing the MOU with the US Federal Government (the CHUAS network).**

The BDM is recommended to **formalize maintenance partnerships in the remote islands** where it has established good experience using local private maintenance providers. This will significantly improve the response time to malfunctions thus improving the uptime of critical systems. It will also decrease the administrative burden of applying for travel permission and budget from the Ministry.

To ensure sustainability of recent investments, it is recommended for the BDM **to assess the internal capability of independently maintaining the systems**. In case the BDM is not fully confident with the capabilities, **it is recommended to seek continuation for the critical maintenance and service contracts**.

Many of the BDM’s key stakeholders have expressed their interest in increasing stakeholder engagement with **regular collaborations and discussions**. **It is recommended for the BDM to pursue increasing such activities and participate actively on platforms** they are invited. For example, increasing the collaboration with the academic community might prove to be beneficial for all parties involved.

## Element 3: Observational infrastructure

### 3.1. Average horizontal resolution in km of both synoptic surface and upper-air observations, including compliance with the Global Basic Observing Network (GBON) regulations.

The BDM operates a synoptic surface weather observation network consisting mostly of automatic stations. The BDM has an inventory of 15 automatic weather stations (AWS) but only 8 of these have been installed so far. All of these stations are WMO GBON compliant and have the capability to report all GBON parameters excluding snow-dept, which is not applicable in the country. Besides the new stations, the BDM’s network includes a few old stations that are reporting only some of the required parameter due to broken or obsolete sensors that have not been replaced because their spare parts have been discontinued. The BDM plans to replace the obsolete systems with new stations from the inventory and utilize the existing infrastructure that is in place on the sites. The plans to install the AWSs from the inventory has been set on hold due to budget constraints. Budget support is needed to ship the stations from the Nassau warehouse and to install the stations at the sites (concrete footings to anchor the systems have already been cast and are ready to be shipped with the systems from Nassau).

Recently the BDM received five stations in the “Enhancing Climate Resilience in CARIFORUM Countries” project. These stations are from a new system supplier and thus the BDM has decided to install them close to the central office (island of New Providence) for ease of testing and maintenance.

One of the operational AWSs, located near the Atlantis Paradise Island hotel, is owned by this establishment. However, the BDM has installed this equipment and has agreed to maintain it in return for receiving the observations from the site.

In many of the islands, the BDM operates airport observation stations (AWOS) to serve the needs of the aviation community. Unfortunately, these systems cannot cover the synoptic needs as they are not operational during hurricane events (masts are tipped to avoid damage from high winds). Separate automatic weather stations for synoptic purposes are needed for this. Currently there is seven AWOSs in operation.

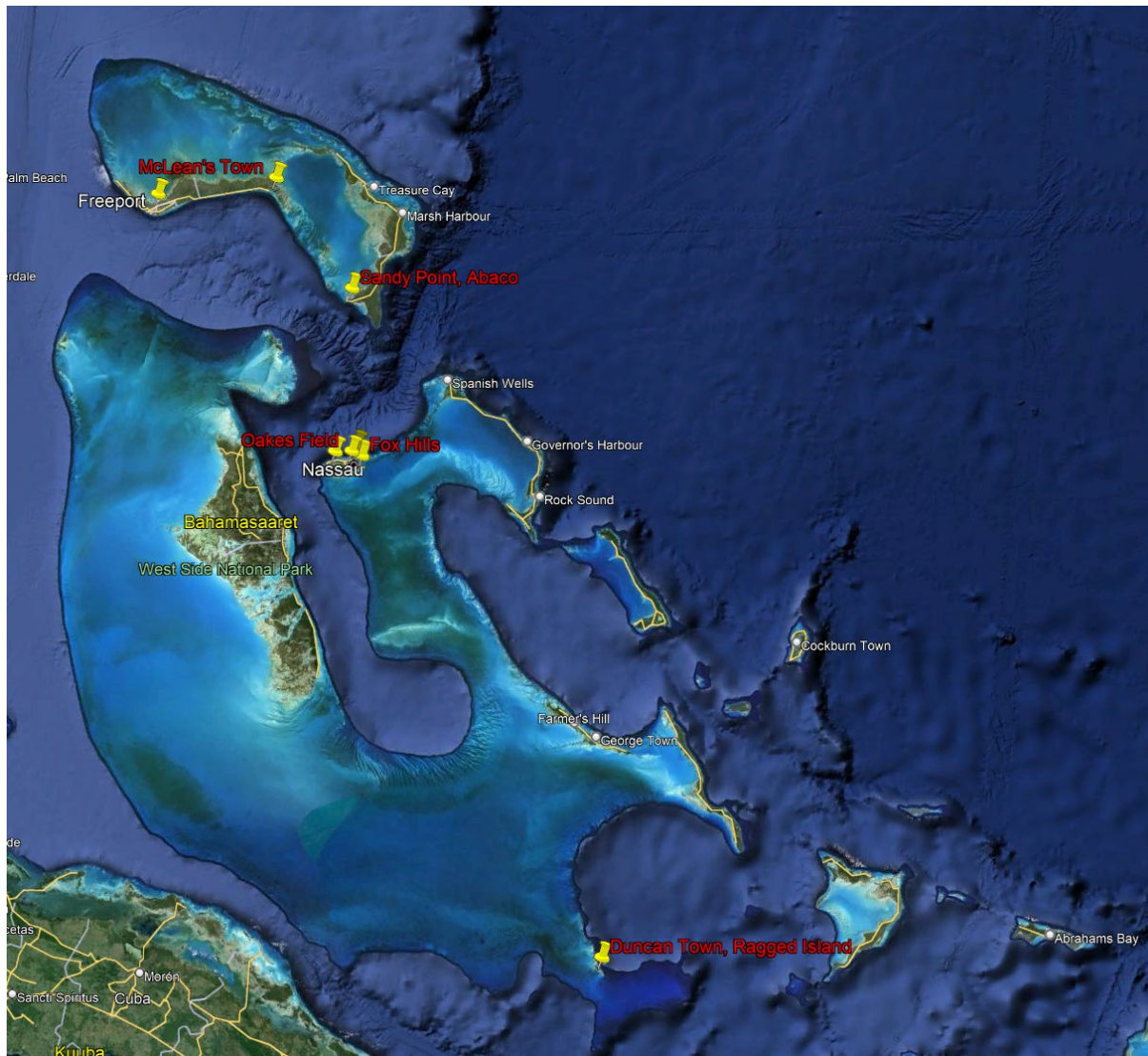


Figure 3. Map of the eight installed and operational AWSs. Four stations are located on the island of New Providence: Nassau – Lynden Pindling International Airport, Oakes Field, Fox Hill and Paradise Island. Other stations are Freeport and McLean's Town in Grand Bahama and Duncan Town in Ragged Island.

The BDM has registered five (5) surface observation stations to GBON. Only two of these are currently operational (Freeport and Nassau). The rest of the stations only have limited or no capabilities, replacements are necessary. Sites of the registered stations are presented in Figure 4. The BDM plans to install new stations from the existing inventory to these sites, but in order to do so they will require assistance to cover the shipping and installation costs.

The Bahamas has an area of 13 878 km<sup>2</sup> and a marine zone extending for 760 miles i.e. 1220 km from the coast of Florida in the north-west to Haiti in the south-east. According to WMO GBON requirements three surface weather stations are enough to cover the area with 500km resolution required for Small Island Developing States. However, this is assuming equal spacing between the stations and not providing coverage over the marine zone. The two operational GBON stations in Freeport and Nassau are situated only 200km from each other thus covering only the northern part of the islands chain (Figure 4). Adding one station will in theory fulfil GBON resolution requirements but will not provide full national coverage with the 500km resolution.

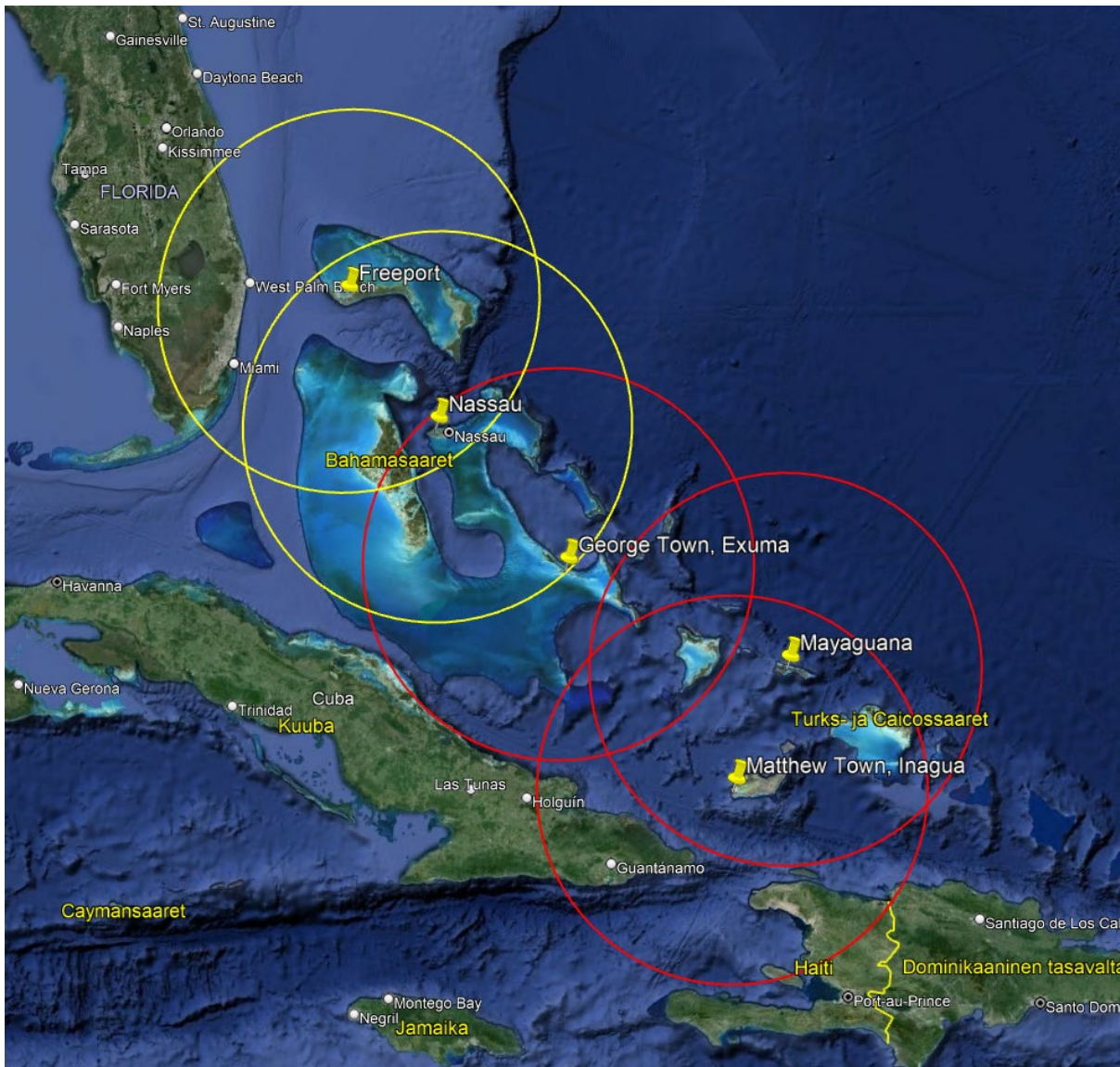


Figure 4. Locations of the five GBON nominated stations. Circles indicated with 250km radius to show horizontal resolution. Yellow circles surrounding existing GBON compliant stations in Freeport and Nassau. Red circles for Exuma, Mayaguana and Inagua sites that all need a new AWS to be installed.

The calibration of most of the new AWS sensors is currently done using manufacturer-provided calibration, comparison kits, and the manufacturer’s sensor calibration services. The calibration services have been included in a maintenance contract with the observation system provider, and the BDM is satisfied with the collaboration and efficiency of the services. Using the WMO regional calibration centre in CIMH has not been an option for

the BDM as CIMH only provides calibration services for limited parameters and from specific system manufacturers, which are non-compliant with most of the BDM's systems. This collaborative option will be relevant in the near future as the BDM's new systems from the "Enhancing Climate Resilience in CARIFORUM Countries" project are compatible with CIMH services.

The BDM is a part of the Cooperative Hurricane Upper Air Station network program supported by the National Oceanic and Atmospheric Administration of US. This is based on a Memorandum of Agreement signed 1983. Based on the agreement, NOAA provides the BDM with the upper-air sounding equipment and consumables for twice a day soundings (more soundings might be required during approaching hurricanes) and the BDM provides the housing and human resources to operate the station. The operations have been successfully run in the past but is currently on hold due to the malfunction of the hydrogen generator that needs to be replaced.

### **3.2. Additional observations used for nowcasting and specialized purposes.**

The BDM operates a national weather radar network consisting of 4 C-band dual-polarization weather radars, three of which are currently operational. The operational weather radars are located in: Abaco - Marsh Harbour, New Providence – Lynden Pindling International Airport and on Long Island – Millerton. Weather radar information is one of the most important observation sources during hurricane events especially to monitor and forecast the flooding related hazards.

Combined with the weather radar data, the BDM uses lightning observation information from a global lightning detection feed. The lightning information covers the entire area of the Bahamas thus providing valuable information on approaching storms before they reach the weather radar coverage.



Figure 5 Weather radar composite image over the Bahamas including global lightning information.

The BDM is currently operating seven Automatic Weather Observation System (AWOS) for aviation purposes and is planning to invest in several more to serve the aviation industry’s requirements.

Table 2 Sites of current operational AWOS systems

	Site Name	Island
1.	San Salvador International Airport	San Salvador
2.	The New Bight Airport	Cat Island
3.	Governor’s Harbour Airport	Eleuthera
4.	Matthew Town Airport	Great Inagua
5.	Fresh Creek Airport	Andros
6.	Lynden Pindling International Airport	New Providence
7.	North Eleuthera Airport	North Eleuthera

Currently the largest gap in the national weather observation network is the vast marine areas. The BDM has no marine stations available. It is recommended to support the expansion of the surface observation networks to cover the sea areas and to support the planning and development of such networks on a regional level.

**3.3. Standard Operating Practices in place for the deployment, maintenance, calibrations and quality assurance of the observational network.**

SOPs are reviewed or developed as a part of the ongoing work to implement and certify the quality management system to ISO 9001:2015 standards of all the BDM’s operations including the relevant SOPs for the GBON systems.

**3.4 Implementation of sustainable newer approaches to observations.**

The BDM is collaborating with a network of rainfall stations as part of the Community Collaborative Rain, Hail and Snow Network CoCoRaHS<sup>6</sup>. This network is a non-profit, community-based network of volunteers working together to measure and map precipitation. The approach is to use low-cost rain gauges and volunteers to fill in the observation network density and engage the public in weather observation.

**3.5. Percentage of the surface observations that depend on automatic techniques.**

The BDM’s network consists almost entirely of automatic surface observation stations and all new investments utilize data from these stations. Two manual synoptic stations are still in use, both the sites also have an automatic system close by.

**Summary score, recommendations, and comments for Element 3**

The summary score for the element is 3 “moderate network with some gaps with respect to WMO regulations and guidance and with some data quality issues”.

The BDM has been transitioning into fully automatized observation systems and are successfully operating a variety of technologies and observation solutions. Maintenance of many of the new systems has been covered with maintenance service agreement with the equipment vendor. This will soon transition to the responsibility of the BDM. The BDM has been trained to independently operate and maintain the systems. **The BDM is recommended to review their maintenance capability and to consider renewing**

<sup>6</sup> [CoCoRaHS website](#)

**the service agreement if the maintenance load including preventive maintenance cannot be met.**

Major recurring problems with the observation systems are: inability to secure continuous power supply, difficulty in accessing remote sites, inefficient knowledge of the operational status of the systems and damages due to hurricanes. To improve the situation, **it is recommended to improve the network management and maintenance plan including the budget for site visits and updating SOPs for the different observation systems.** Currently the budget only covers service contract and budgeted spares, but all travel expenses require a separate application, taking unnecessary time from the maintenance process. In several of the remote locations, the BDM has been using private maintenance service providers to assist in acute maintenance and repair work. **It is recommended to formalize such well-working relationships to ensure a fast response rate also in the future.**

Currently the BDM has a large stock of new automatic weather stations in its warehouse. The stations have not been shipped and installed at the intended locations due to the lack of funding. The BDM **is recommended to focus on installing the systems from the inventory before procuring any new systems and to actively seek funds to cover the shipment and installation costs.**

The BDM has been operating an upper-air sounding station, which is part of the US NWS supported CHUAS network. Previously the BDM was successfully operating the system, but due to the malfunction of the hydrogen generator, operations have ceased for some time. **It is recommended to upgrade the hydrogen generator as part of the SOFF program and the BDM continues the successful cooperation with NWS to support the continuous upper-air sounding operation. It is recommended for BDM to renew the Memorandum of Agreement with NOAA on the Cooperative Hurricane Upper Air Station.**

For the sustainable operation of the network **the BDM is recommended to continue to budget for the spares and calibration services.** Successful budgeting requires lifecycle planning for each system and SOPs that include a regular calibration cycle and spare stock. For the calibration of sensors, the BDM has mostly relied on calibration services provided by the sensor manufacturer. These services have been covered by a service contract. **It is recommended that the BDM continues the calibration service agreement or to seek a regional calibration laboratory that is capable of servicing the selected sensor types.**

## Element 4: Data and product sharing and policies

### **4.1. Percentage of GBON compliance – for how many prescribed surface and upper-air stations are observations exchanged internationally. Usage of regional WIGOS centres.**

Currently the BDM is 0% compliant with GBON upper-air requirements. The national requirement is for one station, which exists, but due to a malfunctioning hydrogen generator it is not in operation.

The BDM operates two GBON compliant surface weather stations. According to the WDQMS database the data from these stations have significantly improved after synoptic observations have been done every hour. According to WMO assessment one additional station is required for the GBON compliancy. Thus, currently the BDM is operating two thirds of the requirements.

The BDM has migrated to the WIS2.0 data sharing protocol for the surface weather station data dissemination and is actively working towards installing the SURFACE interface at both stations. Assistance for this endeavour was provided by the regional CMO-coordinated WIS2.0 support.

No national WIGOS partnership agreement is in place.

#### **4.2. A formal policy and practice for the free and open sharing of observational data.**

As a WMO Member The Bahamas is participating in the global data sharing framework articulated by the WMO Unified Data Policy. Data dissemination to WMO WIPPS Centres is done manually and is recommended to be updated to an automatic protocol. Currently the BDM is sharing all data freely, but only upon request and when human resources allow. No formal policy on data sharing is in place. There is a lot of room to improve the efficiency of data sharing by investing in a data platform with automatic quality control and possibilities to efficiently share data, e.g. through APIs and user portal.

The Quality Control (QC) process is currently manual and needs to be automatized to efficiently handle the increasing load of observation data from the automatic systems. The BDM is planning to include third party observation stations to the national observation pool thus increasing the need for effective QC. There is a need to enhance human capacity and upgrade the database management system to support sufficient and effective QC.

The BDM has an agreement with CIMH and CariCOF<sup>7</sup> to provide national observations from the Bahamas to this regional centre.

#### **4.3. Main data and products received from external sources in a national, regional and global context, such as model and satellite data.**

Global models (GFS, ECMWF) and satellite data (GOES) are routinely used in forecasting. The main channel for obtaining these is the internet. Data is received in all available forms, also gridded data is ingested in the forecaster's workstation. Other products frequently used by forecasters are figures and charts.

The BDM receives the regional climate outlook and drought forecasts from CariCOF in the form of outlooks, bulletins and datasets. These and other products such as the National Hurricane Centre Outlooks and tsunami warning products from the Pacific Disaster Centre are used in operational forecasting.

#### **Summary score, recommendations, and comments for Element 4**

The summary score for the element is 2 "A limited amount of GBON compliant data is shared internationally. The existing data sharing policies or practices or the existing infrastructure severely hamper two-way data sharing".

The BDM has migrated into WIS2.0 data sharing for the surface weather stations, although work to complete the SURFACE interface installation is still ongoing. This will allow the data to be disseminated via the data management system that can run the first quality checks before dissemination internationally. The implementation of upper-air WIS2.0 dissemination has not yet been developed. Currently the data is shared through US NWS. To support the efforts, it is recommended to **strengthen the BDM database so it can facilitate more advanced automatized observation quality control and assurance**

---

<sup>7</sup> [CariCOF - CIMH](#)



**and to facilitate data sharing** e.g. capability to communicate with APIs for importing and exporting data as needed.

It is **recommended that the BDM drafts a data policy**, which will be especially relevant once the meteorological bill is passed.

## Element 5: Numerical model and forecasting tool application

### **5.1. Model and remote sensed products form the primary source of products across the different forecasting timescales.**

The BDM has access to a wide range of satellite products and forecast products from RSMCs and institutes offering global Numerical Weather Prediction (NWP) model outputs (GFS, ECMWF, NAM, GEM). Key products are: tropical cyclone outlooks and forecasts from the National Hurricane Centre and regional drought forecasts provided by CariCOF. Most products are accessed through public weather sites.

The following models are used by the BDM in the daily forecasting duties:

- Global Forecast System (GFS) with 13 km spatial resolution and 6-hourly temporal resolution (00, 06, 12, 18 UTC updates)
- European Centre for Medium-Range Weather Forecasts (ECMWF) with 9 km spatial resolution and 12-hourly temporal resolution (00, 12 UTC updates)
- North American Mesoscale Model (NAM) with 12 km spatial resolution and 3km resolution in the nested high-resolution version and 3-hourly update (00, 03, 06, 09, 12, 15, 18, 21 UTC updates)
- Canadian Global Environmental Multiscale Model (GEM) with 10 km operational spatial resolution and 2.5 km nested high-resolution version and 1-hour updates.
- Additionally, the BDM is utilizing High-Resolution Rapid Refresh (HRRR), Weather Research and Forecasting Model (WRF), Mesoscale Numerical Weather Prediction (NWP) Models and hurricane specific models (HWRF, SHIPS, CMO, COAMPS, SPLASH)

There is a lack of a regional scale numerical weather models. A regional numerical model is run by CIMH, but the model data is not available to the regional meteorological services.

Gridded model data is utilized at the forecaster's workstation mainly for viewing and analysing. The workstation allows for data editing and post-processing of parameters, but these tools are not efficiently utilized in the BDM. It will require additional training for an active utilization. The BDM uses FMI-built meteorological forecaster workstation and forecast production system SmartMet.

The BDM has a weather radar network with four C-band dual-polarization weather radars and are using this as a key tool to monitor and forecast tropical cyclones and thunderstorms in the area.

The BDM offers forecast products from the daily forecasts in a seven-day forecast.

### **5.2. a) Models run internally (and sustainably), b) Data assimilation and verification performed, c) appropriateness of horizontal and vertical resolution.**

The BDM is not running any internal models.

### **5.3. Probabilistic forecasts produced and, if so, based on ensemble predictions.**

Forecasters are using readily available ensemble forecast products (GFS ensemble forecast system, ECMWF ensemble ENS, North American Ensemble Forecast System, Consensus forecast model, Hurricane Weather Research and Forecasting Model Ensemble) that are available free of charge to analyse and eventually produce warnings and forecast products. Currently all probabilistic products are used as image products. This information is used as a guide for the forecaster and the probabilistic approach is not reflected in the end-user products. No probabilistic forecasts are explicitly produced.

### Summary score, recommendations, and comments for Element 5

The summary score for the element is assessed as 2 “Basic use of external model output and remote sensed products in the form of maps and figures, covering only a limited forecast time range.”

The BDM has many good elements and practices in place utilizing the available model and remote sensed products, but the internal data processing skill, automatization of process and verifying of products need strengthening. Currently the BDM has no resources or plans to run limited area models thus it **is recommended to focus the efforts on improving the capability to use existing weather forecasting and post processing tools, improve model and gridded data use, and establishing an operational forecast verification system.** To support this, it is recommended to continue to strengthen the skills to utilize the existing forecaster workstation and forecast production system with training in topics such as model comparison, expert modification and service automatization, as well as training in ensemble forecasts use for different time frames in weather forecasting.

**It is recommended to share the regional numerical weather model for all regional meteorological services as free and open source.**



## Element 6: Warning and advisory services

### 6.1. Warning and alert service cover 24/7.

The Forecasting Office, in Nassau, operates on a 24/7 basis with the capability of issuing warnings and alerts. Warnings issued by the BDM are communicated to all key partners and stakeholders via email, posted on the social platforms and the website for public users (n.b. there is a plan to migrate from email lists into website and mobile application dissemination). The Common Alerting Protocol (CAP) is being used for warning dissemination. A Special Weather Statement or bulletin is published on the website with warning and alert information for the public and for the media to use in publications and broadcasts.

Though there are only policies for lead times for alerts and warnings for the aerodrome warnings (Annex 3. for Aerodrome Warning and WMO No. 782) and for Tropical Cyclones (Hazard priority 1), other events also have common practices in place. For tropical cyclones the BDM issues news items well in advance, an alert 60h before the event, watch 48h before and warning 36h before the event. Warnings are delivered via the BDM channels and the Emergency Management Agency send these out using multiple channels. The outreach of radio and TV warnings and alerts are assessed to be good. The BDM publishes cyclone track forecasts from the Hurricane Centre on their websites.

For thunderstorms the BDM follows the common practice of issuing a watch 24-30h before the event and a warning 24h before. In cases of e.g. occurrence of a strong cold front with thunderstorms and high seas the BDM might issue advisories 2 days or more in advance.

The BDM has the capacity to monitor several hazards simultaneously and to issue warnings on these at the same time. A typical example is issuing a tropical cyclone and maritime warning at the same time. The BDM can also warn on potential cascading impacts from multiple hazards, the most common case being several tropical cyclones approaching at the same time. In this case a forecast with the estimated impacts is sent out in text format.

The ongoing QMS development will evaluate warning and alerting practices and policy on minimum and maximum lead times.

### 6.2. Hydrometeorological hazards for which forecasting and warning capacity is available and whether feedback and lessons learned are included to improve warnings.

The BDM is providing all the national weather and climate warnings in The Bahamas or publishing all relevant warnings that they receive from regional or global centres. Warnings are provided for the following hazards:

- Tropical cyclones
- Severe weather warnings that include thunderstorms, tornadic activity, lightning and hail events.
- Heat waves (service started in 2023)
- Winds: gale force winds and marine wind warnings are issued
- Storm surge, swell and coastal flood warnings (typically conjoint with tropical cyclones)
- Flooding caused by heavy rainfall
- Dust events mainly originating from the Sahara.



**Bahamas Meteorology**

8 min · 🌐



**SEVERE WEATHER WARNING**

THE BAHAMAS DEPARTMENT OF METEOROLOGY HAS ISSUED A SEVERE THUNDERSTORM WARNING FROM 9:20 AM TO 10:50 AM SUNDAY 04TH AUGUST 2024.

A SEVERE THUNDERSTORM WARNING IS IN EFFECT FOR GRAND BAHAMA ALONG WITH ITS SURROUNDING WATERS.

AT 9:15 AM, LIGHTNING DETECTION, RADAR, AND SATELLITE IMAGERY DEPICTED AN ORGANIZED LINE OF SHOWERS AND THUNDERSTORMS MOVING EASTWARDS TOWARDS THE WARNING AREA. THESE SHOWERS AND THUNDERSTORMS ARE ASSOCIATED WITH RAINBANDS FROM TROPICAL STORM DEBBY, LOCATED OVER NORTHERN FLORIDA.

SOME OF THESE SHOWERS WILL BE LOCALLY HEAVY AND THUNDERSTORMS STRONG TO SEVERE AT TIMES CAUSING STRONG GUSTY WINDS, DANGEROUS LIGHTNING, HEAVY DOWNPOURS, HAIL, AND POSSIBLE WATERSPOUT OR TORNADIC ACTIVITY. LOCALIZED FLOODING IS ALSO POSSIBLE DURING THE PASSAGE OF THESE STORMS.

BOATERS IN THE WARNING AREA SHOULD SEEK SAFE HARBOUR. RESIDENTS IN THE WARNING AREA SHOULD REMAIN INDOORS AND AWAY FROM WINDOWS WHEN CONDITIONS WORSEN. RESIDENTS SHOULD NOT SEEK SHELTER UNDER TREES OR IN THE WATER AS THESE CAN BECOME LIGHTNING CONDUCTORS.

ISSUED BY FORECASTER: C. WATSON-RAHMING

ISSUED: MONDAY 5TH AUGUST 2024 @ 9:15 AM

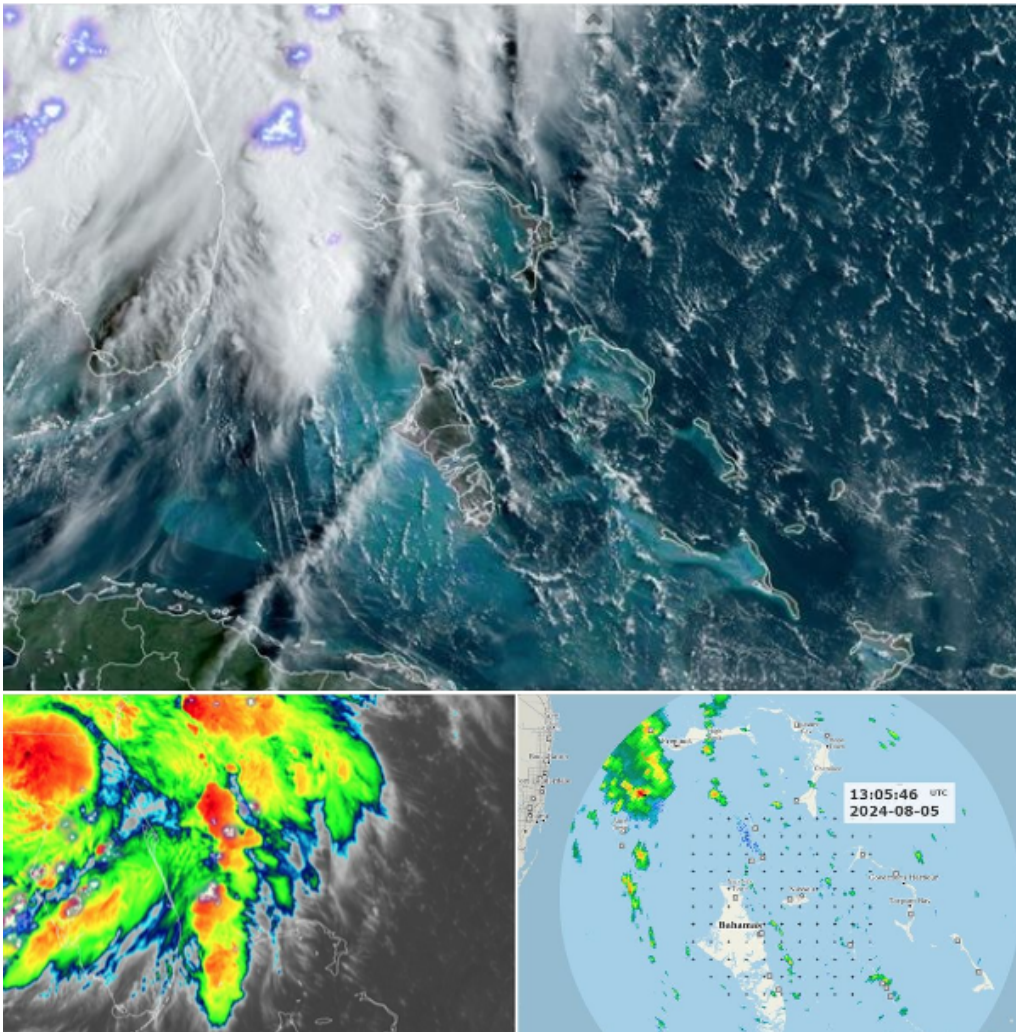


Figure 7 Severe weather warning on the BDM's facebook page (5.8.2024)

**HEAT ADVISORY**  
 Issued: Wednesday 31st July 2024 at 12:00 PM

A Heat Advisory remains in effect for Grand Bahama, Bimini and Abaco. Expect the Heat Index\* to be in the **MODERATE SEVERE** range (between 102F and 111F). The Heat Advisory for the remainder of the islands have been suspended.

**\*NOTE WELL:** The heat index is not the actual temperature, it is how the body will interpret the temperature... Please remain hydrated, and stay out of the sun for long periods.

**RESIDENTS IN AFFECTED AREAS ARE ADVISED TO:**

- KEEP HYDRATED
- LIMIT OUTDOOR ACTIVITIES

DURING PEAK AFTERNOON HOURS DUE TO HIGHER THAN USUAL TRIPLE DIGIT HEAT INDICES.

**Heat Health Bulletin**  
 Saturday 27th July 2024

**Region Affected**

Expect the Heat Index\* to be in the **MODERATE** range (between 102F and 111F) for the Bahamas, with Heat Index Values becoming **SEVERE** (between 112F - 121F) at times over New Providence, Grand Bahama, Andros, Bimini, Abaco, Eleuthera and the Berry Islands.

**\*Note:** The heat index is not the actual temperature, it is how the body will interpret the temperature.

**HEAT INDEX EFFECT-BASED CLASSIFICATION**

The Heat Index Classification Warning System categorizes levels of Heat index into different risk levels to inform the Bahamian public about potential health risks associated with high temperatures. It's essential for individuals to stay informed about current heat index conditions and take appropriate precautions to prevent heat-related illnesses.

<b>Low Risk (Caution):</b>	<b>Heat index below 102°F.</b>	No specific caution is typically issued, but individuals are advised to stay hydrated and take breaks if engaging in strenuous activities outdoors.
<b>Moderate Severe Risk (Extreme Caution):</b>	<b>Heat index 102°F to 111°F.</b>	People are advised to limit outdoor activities, stay hydrated, and seek shade or air conditioning when possible.
<b>Severe Risk (Danger):</b>	<b>Heat index between 112°F to 121°F.</b>	Outdoor activities are discouraged, and individuals are advised to stay indoors in air-conditioned spaces. Hydration is crucial, and special attention should be given to vulnerable populations such as children, the elderly, and those with certain medical conditions.
<b>Extreme Risk (Extreme Danger):</b>	<b>Heat index of (122°F) or higher.</b>	This level poses an extreme risk of heat-related illnesses such as heat stroke. Outdoor activities should be avoided entirely, and individuals should remain in air-conditioned environments. Hydration is critical, and emergency medical attention may be necessary for those exhibiting symptoms of heat-related illnesses.

**Heat Impacts**

During Heat Waves people are at risk of:

- Heat Cramps
- Heat Exhaustion
- Heat Stroke

**Heat Exhaustion**

**ACT FAST**

- Move to a cooler area
- Loosen clothing
- Sip cool water
- Seek medical help if symptoms don't improve

Symptoms may include:

- Heavy Sweating
- Confusion
- Dizziness
- Loss of consciousness
- Nausea
- Weakness and more

**Heat Stroke**

**ACT FAST**

- Move person to a cooler area
- Loosen clothing and remove extra layers
- Cool with water or ice

**CALL 911**

Heat stroke can cause death or permanent disability if emergency treatment is not given.

**Most Vulnerable Groups**

- Persons on prescription medications
- Pregnant
- Infants and Children
- Elderly
- Displaced Individuals
- Pets

**Recommendations**

- Stay Hydrated
- Protect yourself from heat
- Check on others
- Consult doctor if unwell

Figure 8 Example products for Heat waves including simple impact statements from the BDM's website (5.8.2024).

**SPECIAL WARNINGS**

A HEAT ADVISORY REMAINS IN EFFECT FOR THE ISLANDS AND UV INDICES WILL RANGE FROM HIGH TO EXTREME. HENCE RESIDENTS AND VISITORS ARE ADVISED TO REMAIN HYDRATED, AVOID EXTENDED OR RIGOROUS OUTDOOR ACTIVITIES, WEAR LOOSE FITTED CLOTHING AND SUNSCREEN AND SEEK SHADED AREAS WHERE POSSIBLE. HAZARDOUS BOATING AND BEACHING WILL IMPACT THE ISLANDS THEREFORE BOATERS AND BEACHGOERS ARE STRONGLY ADVISED TO AVOID ENTERING ATLANTIC WATERS DUE TO DANGEROUS RIP CURRENTS AND MODERATE TO LARGE EASTERLY SWELLS.

Figure 9 Example of a special warning message – heat advisory including simple impact and action statements from the BDM's Facebook (15.8.2024)

In addition to official warning products, the BDM has the capability to issue advisories on other weather events such as heavy fog events occurring on land. Besides in-house generated warnings and advisories, the BDM publishes the CariCOF-created drought and dry spell forecasts for The Bahamas, tsunami warnings from the Pacific Disaster Centre and volcanic ash warnings and advisories especially the aviation SIGMET product.

The BDM is currently warning on potential flooding due to heavy precipitation but are not warning of flash flood events. The existing infrastructure that includes a modern weather radar network operating with dual-polarization technology, access to lightning information and modern forecasting tools, will enable the BDM to expand in the area of flash flood

warning. The BDM is recommended to build the human capacity to use the existing tools and systems in an effective way for this purpose.

The BDM has the capability and history of issuing UV warnings, but the service has been discontinued. This would provide valuable information for the public and the large beach life driven tourism sector and complement the heat advisories the BDM has begun to provide. It is recommended to reinstate the UV warnings.

The BDM has SOPs for in-house products but not with any of the key stakeholders or other authorities. In case of tropical cyclones there are separate processes determined by the Disaster Risk Management Act.

The DRM-Agency hosts emergency platform case studies of hurricane events and emergency responses. The forecasts and warnings provided are analysed to ascertain the effectivity of the dissemination of the messages. In addition to case studies, a post hurricane season summary discussion is hosted including discussions on lessons learned. Based on these, the BDM may receive feedback on its services and mode of operation. Other than that, no feedback is collected on the warning services and currently all feedback is ad-hoc.

### **6.3. Common alerting procedures in place based on impact-based services and scenarios taking hazard, exposure and vulnerability information into account and with registered alerting authorities.**

As a part of the National Disaster Risk Emergency Act, the BDM participates in the development of the common alerting procedures with stakeholders such as the Police Force, Defence Force and organizations such as the Red Cross, to decide the design of the CAP. After the stakeholder engagement is done, the local CAP is tested and awaits the approval of the risk management team. The BDM has the capacity to deliver CAP formatted warnings using the alerting tools on the existing forecaster workstation.

The BDM has initiated Impact Based Forecast services. Currently these services are mostly simple predefined impact statements that are included in the warning and alert messages (e.g. for heat wave impact on Figure 8). More development and training is needed on the topic for effective utilization.

### **Summary score, recommendations, and comments for Element 6**

The summary score for the element is 3 “Weather-related warning service with modest public reach and informal engagement with relevant institutions, including disaster management agencies”.

National warning information has a very good reach to the public as the DRM-Agency has the capacity to push warnings through TV, radio and social media channels, also utilizing the local police force for dissemination. Additionally, the BDM publishes the information through their website, email chain and social media channels. Most of current warning products are text base bulletins and a few map products.

It is recommended that the BDM **improves the website and utilize more user-friendly products** (automatically updated products in text, figure and chart formats), redirect email users to the website, reserve additional email advisories only for selected stakeholder groups and **establish a mobile app** to improve public access. As the existing forecasting and service production system in the BDM can support the different formats for dissemination through different channels. It is recommended to improve the BDM's capability to fully utilize these tools and features for automatic updating.

**The BDM is also recommended to develop and start warning services related to flash flood events, restart UV warning services and to expand services into impact-based forecasting.** All services that will require human capacity building for the department. Looking forward it is recommended that the BDM defines its mandate in relation to air quality warning responsibilities and national cooperation related to the topic.

In order to improve warning services and processes it is recommended **to establish performance evaluation process and establish a stakeholder and user feedback loop**, incorporating these into the QMS system currently under development.

## Element 7: Contribution to Climate Services

### **7.1. Where relevant, contribution to climate services according to the established capacity for the provision of climate services.**

The BDM is responsible for providing climate services in The Bahamas, although not possessing an official mandate, it is recognized as the national authority for climate services. The BDM has participated in WMO meetings and workshops that support the national framework of climate services and had a designated focal point for WMO Commission for Climate Services.

Currently there is no formal climate database in the BDM. It is operating a central excel based database with Climsoft as the front end. Observations are manually downloaded to the database from the NOAA Data Collection System. Quality control is done manually and utilizing the threshold flagging provided by Climsoft. The solution has no advanced tools for automatic quality control, tools for climate analysis and indicators or metadata management. The system needs to be modernized to support the BDM's goals of expanding climate services and utilizing automatization to free up time for the climate experts to conduct more value-added work. The BDM is recommended to use systems based on open-source technologies and open protocols (e.g. OpenCDMS) to ensure sustainable operation for data management and implement more automatic quality control methods and tools.

As part of the Caribbean region, The Bahamas is covered by the Caribbean Climate Outlook Forum's (CariCOF) climate products, which are freely available to the region from their website. The products include outlooks of climate, precipitation, temperature, heat, wet days and wet spells, flash floods, dry spells and drought for a three-month period. The BDM does not have any direct access to the CariCOF database or model data.

The climate services the BDM provides are limited to the climate baseline, description of previous months events, recent special events, climatic reports from the manned stations, monthly and yearly precipitation reports from the rainfall network and weather summary reports from stations and the 3-month climate forecasts based on the CariCOF products. The following products are available from the BDM's website:

- General description of the climate for the previous month
- Monthly weather log
- Temperature and rainfall outlook. Based on CariCOF products.
- 30 year means and extremes
- Report on recent special events
- Weather graphs for Nassau

Products that are provided to stakeholders but are not available on the BDM's website are:

- Monthly climatic reports and messages for the two manned stations.
- Monthly and yearly precipitation reports from the rainfall network.
- Weather summary of elements from the automatic weather stations.

Beyond these routine services the BDM receives requests via email for specific climate services from some of the stakeholders. The email is not public and thus it is only used by some of the potential sectors that benefit from climate services. Typically, the requested services are climate records for a specific area, most commonly from the construction sector. In such a case, the BDM can provide the data series information but there are rarely any resources to provide climatological analysis for decision support on the information requested. The key bottleneck to providing these services is the lack of staff dedicated to climate services and the amount of work processed manually. When modernizing the climate database, it is recommended that the BDM establish an interface for users to independently query data series.

The National Determined Contribution (NDC<sup>8</sup>) has identified gaps in the availability of scientific data and research/information on the climate change vulnerability across all sectors as a hinderance to effective adaptation. Strengthening national climate services is key to filling these gaps. The BDM is identified as a key stakeholder in the national adaptation plan of the NDC.

Recently the BDM received funding from the Caribbean Community Climate Change Centre to help in the digitalization of vital historical climatological data. The digitalization work is still ongoing.

### **Summary score, recommendations, and comments for Element 7**

The summary score for the element is 2 "Basic capacity for climate service provision".

Climate services have not been a priority task for the BDM and are in need of development throughout the entire value chain. Support and development are needed to enhance essential infrastructure, increase staff capacity, create a service portfolio in collaboration with the stakeholders and evaluate the benefits of the services.

**It is recommended that the BDM finish the ongoing database digitalization. To support the BDM in modernizing its database and data management, it should embrace automatized solutions with automatic quality control features and possibilities of end-user product generation.**

**A user interface for the public and private users is needed** where the users can access the data independently, fostering interaction between service providers and users for co-creation and tailoring of services.

Most of the user specific climate services so far have been the provision of datasets for required periods. Little analysis of the data has been provided due to severe shortage of staff. **It is recommended that the BDM develops decision-support products and services that provide valuable insight and guidance to support informed decision-making process. The development of new services should involve main stakeholders and end-users from an early stage to help direct the BDM**

---

<sup>8</sup> [The Bahamas Updated NDC](#)



**resources to the most value-added work.** The socio-economic benefits of the new services should be monitored and evaluated to guide the development of the work.

Currently a major limitation in providing any new climate services is the lack of staff and **it is recommended that the BDM invests in more staff for climate services** and provide training programs to improve the capacity for both climate service provision and utilization.

It is recommended to improve the collaboration with the CariCOF and to be granted access to the regional climate database and model.

## Element 8: Contribution to hydrology

There is no dedicated organization for operational hydrology in The Bahamas. The Bahamas Water and Sewerage Corporation<sup>9</sup> under the jurisdiction of the Minister of Works & Urban Development is entrusted to manage, maintain, distribute and develop the water resources in The Bahamas.

Previously, the BDM provided rainfall information to the corporation but as the fresh water supply shifted from a well based system to reverse osmosis (i.e. desalination) technologies the rainfall information has not been requested.

### **8.1. Where relevant, standard products such as quantitative precipitation estimation and forecasts are produced on a routine basis according to the requirements of the hydrological community.**

There is no hydrological community as such in The Bahamas. The BDM previously provided monthly rainfall totals to the Water and Sewerage Corporation and could continue the service if requested. Rainfall forecasts (near future and 3-month outlooks) are freely available from The BDM's website.

### **8.2. SOPs in place to formalize the relation between the Meteorological Service and Hydrology Agency, showing evidence that the whole value chain is addressed.**

No SOPs are in place.

### **8.3. Data sharing agreements (between local and national agencies, and across international borders as required) on hydrological data in place or under development.**

No data sharing agreements are in place.

### **8.4 Joint projects/initiatives with hydrological community designed to build hydrometeorological cooperation.**

No joint projects or initiatives with hydrological community.

## **Summary score, recommendations, and comments for Element 8**

The summary score for the element is 2 "Meteorological input in hydrology and water resource management happens on an ad hoc basis and or during times of disaster".

The BDM has the capability to provide rainfall observations and forecasts to the hydrology community if needed. The service has not been used lately and there is no entity in the country responsible for hydrological data collection or forecasting. The BDM **is**

---

<sup>9</sup> [Water and Sewerage Corporation website](#)

**recommended to follow up on the development of flood management plans and hydrological disaster risk reduction activities.**

## Element 9: Product dissemination and outreach

### **9.1. Channels used for user-centred communication and ability to support those channels (for example, does the NMHS operate its own television, video or audio production facilities? Does it effectively use cutting-edge techniques?).**

The BDM's main communication channels are: a dedicated website<sup>10</sup>, email, and social media channels, mainly Facebook. Currently there is some 18 thousand followers on the BDM's Facebook page. Besides Facebook the BDM has tested other social media channels such as YouTube (TV-type weather forecast), X, TikTok and Instagram, but these have not remained in active use.

Facebook and email are mainly used to publish public forecasts (1, 2 and 3-day public forecast), warnings, weather outlooks and news items. On the webpage the BDM shares marine forecasts, 7-day forecast and climate outlooks, information on tides and other related products (e.g. heat advisory Figure 8). Besides forecast products, the BDM's website provides a view on real-time satellite and weather radar images and a view on the tropical cyclone mapping provided by the Hurricane Centre.

The public awareness of the BDM's website is currently not very good nor competitive with other large weather forecast and service providers. The BDM is not follows the metrics on the user activity and traction. The BDM is planning to modernize the website with a more user-friendly layout, versatility and interactive web products to increase public awareness of the service. Most of currently published products are text-based outlooks and bulletins in pdf format. Plans are afoot to increase the use of maps, figures, charts and other graphic products.

---

<sup>10</sup> [BDM website](#)

**Bahamas Meteorology**  
1 pv · 🌐

**SEVERE THUNDERSTORM WARNING**

THE BAHAMAS DEPARTMENT OF METEOROLOGY HAS ISSUED A SEVERE THUNDERSTORM WARNING FROM 1:20 PM TO 3:00 PM, WEDNESDAY 1ST MAY 2024.

A SEVERE THUNDERSTORM WARNING IS IN EFFECT FOR THE RAGGED ISLAND CHAIN, ALONG WITH THEIR ADJACENT WATERS.

A SEVERE WEATHER WATCH IS IN EFFECT FOR LONG ISLAND AND ITS ADJACENT WATERS.

AT 1:10 PM, LIGHTNING DETECTION, RADAR, AND SATELLITE IMAGERY DEPICTED A CLUSTER OF HEAVY SHOWERS AND THUNDERSTORMS MOVING NORTHEASTWARDS TOWARD AND ACROSS THE WARNING AND WATCH AREAS. THESE SHOWERS AND THUNDERSTORMS ARE ASSOCIATED WITH A MID TO UPPER LEVEL TROUGH, INTERACTING WITH A MOIST AIRMASS.

SOME OF THESE SHOWERS WILL BE LOCALLY HEAVY AND THUNDERSTORMS WILL BE STRONG TO SEVERE AT TIMES CAUSING STRONG GUSTY WINDS, DANGEROUS LIGHTNING, HEAVY DOWNPOURS, HAIL, AND POSSIBLE WATERSPOUT OR TORNADIC ACTIVITY. LOCALIZED FLOODING IS ALSO POSSIBLE DURING THESE STORMS.

BOATERS IN THE WARNING AREAS SHOULD SEEK SAFE HARBOUR AND RESIDENTS IN THE WARNING AREAS SHOULD REMAIN INDOORS AND AWAY FROM WINDOWS WHEN CONDITIONS WORSEN. RESIDENTS SHOULD NOT SEEK SHELTER UNDER TREES OR IN WATER AS THESE CAN BECOME LIGHTNING CONDUCTORS.

ISSUED BY: FORECASTER: C. WATSON-RAHMING  
ISSUED: 01/MAY2024 @ 1:15 PM

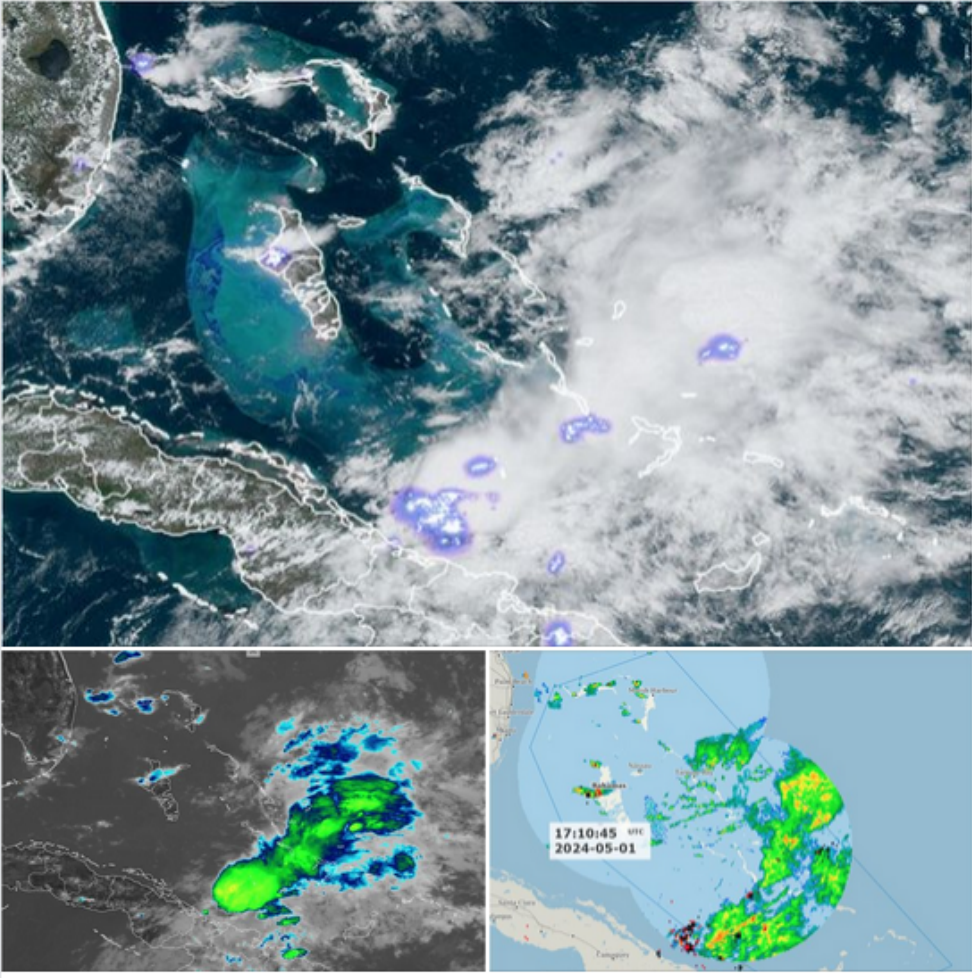


Figure 10 Severe thunderstorm warning from Bahamas Meteorological Department Facebook page



**Bahamas Department of Meteorology** @weather\_bahamas · Jun 11

A Flood Watch is currently in effect for the islands of Grand Bahama, Abaco and Bimini from Tuesday 11th June, until Friday 14th June, 2024. Rainfall totals will be 3 to 5 inches, with isolated values of 7 inches or higher through this period.

**FLOOD WATCH**

**EXTREME NORTHWEST BAHAMAS  
ABACO, GRAND BAHAMA AND BIMINI**

**Tuesday 11th June, 2024 until  
Friday (morning) 14th June, 2024**

**LOCALIZED FLOODING POSSIBLE DUE TO  
EXCESSIVE RAINFALL**  
**3 - 5 TOTAL inches of rain** is expected with  
isolated higher amounts.

Residents are advised to exercise caution.

Figure 11 Flood Watch issued on social media platform X.

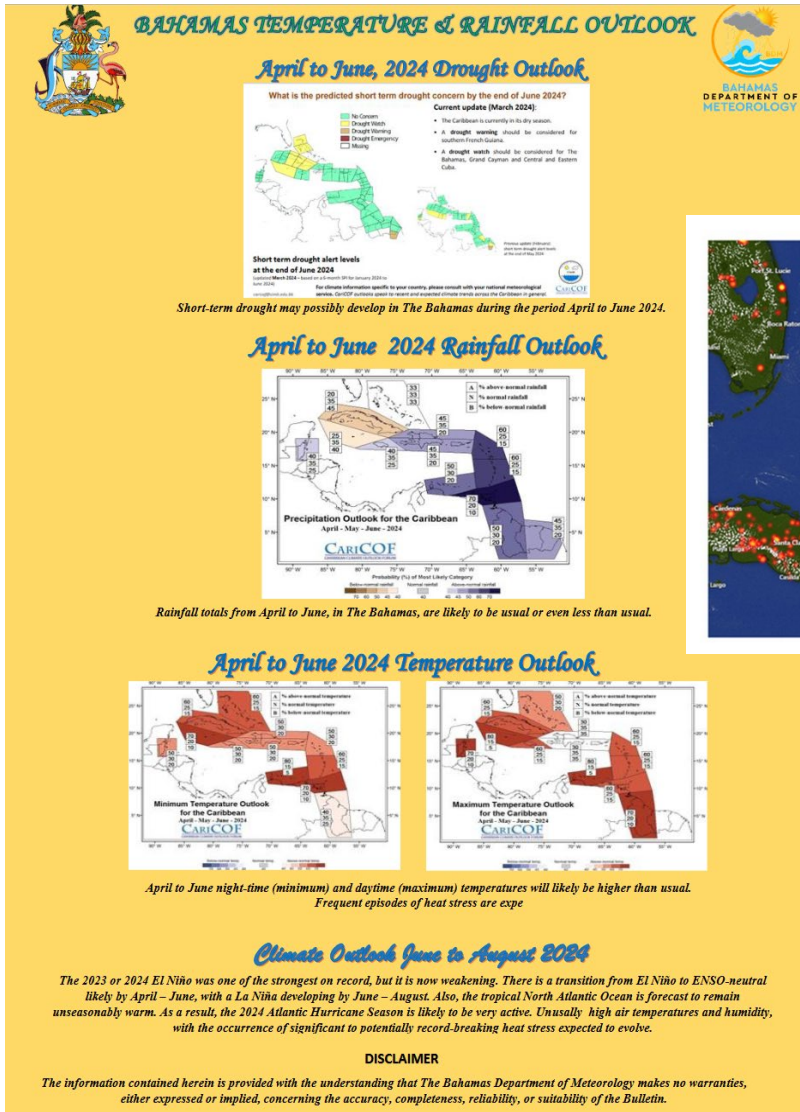


Figure 12 Drought outlook and active fire maps. Shared through the BDM Facebook page.



Lynden Pindling International Airport  
P.O. Box N-8330  
Nassau, the Bahamas

## DEPARTMENT OF METEOROLOGY

Telegrams Meteo Bahamas  
Telephone (242) 377-7040/377-7178  
Fax: (242) 377-5275

BAHMET 24/11

**Date:** 1<sup>st</sup> May, 2024

### SEVEN - DAY WEATHER FORECAST 1<sup>st</sup> to 7<sup>th</sup> May, 2024

*A mid to upper level trough coupled with rich tropical moisture shifting eastwards across the area will promote an unsettled weather pattern mainly across the Central and Southeast Bahamas. The system will move out of the area through Thursday with a few isolated showers and thunderstorms lingering across the Southern islands. A mid-level ridge of high pressure will build across the area leading to drier, more stable and conditions across the island chain through the end of the week and into early next week.*

**WEDNESDAY 1<sup>st</sup>** – Partly sunny and warm with isolated showers and thunderstorms across the NW Bahamas to partly cloudy to cloudy, warm and breezy with scattered showers and thunderstorms across the Cntrl and SE Bahamas. Partly cloudy and mild with isolated showers and thunderstorms mainly across the SE Bahamas at night. Maximum temperature 84°F and minimum temperature 72°F. *A small craft caution is in effect due to swells.* Winds: East to Southeast at 10 to 15 knots in the NW Bahamas and Easterly at 15 to 20 knots in the Cntrl and SE Bahamas. Seas: 2 to 4 feet in the NW Bahamas and 4 to 6 feet in the Cntrl and SE Bahamas in NE to E'ly swells.

**THURSDAY 2<sup>nd</sup>** – Partly sunny and warm with isolated showers and thunderstorms possible across the NW and Cntrl Bahamas to partly cloudy with scattered showers and isolated thunderstorms in the SE Bahamas. Mostly fair to partly cloudy conditions expected at night. Maximum temperature 83°F and minimum temperature 72°F. *Gusty winds and choppy seas can be expected in showers and thunderstorms.* Winds: Easterly at 10 to 15 knots. Seas: 2 to 4 feet over open waters.

**FRIDAY 3<sup>rd</sup>** – Partly sunny and warm with the chance of an occasional passing shower or two. Mostly fair and mild conditions expected at night. Maximum temperature 83°F and minimum temperature 72°F. *Gusty winds and slightly choppy can be expected in showers.* Winds: Northeast to East at 10 to 15 knots. Seas: 2 to 4 feet over open waters.

**SATURDAY 4<sup>th</sup>** – Partly sunny and warm with the chance of a few isolated showers. Mostly fair conditions expected at night. Maximum temperature 83°F and minimum temperature 73°F. *Gusty winds and slightly choppy can be expected in showers.* Winds: Northeast to East at 10 to 15 knots. Seas: 2 to 4 feet over open waters.

**SUNDAY 5<sup>th</sup>** – A mix of sun and clouds, warm and a bit breezy with the chance of a few isolated showers. Mostly fair conditions expected at night. Maximum temperature 83°F and minimum temperature 72°F. *Small craft operators in the Cntrl and SE Bahamas should exercise caution.* Winds: East-Northeast to East-Southeast at 10 to 15 knots in the NW Bahamas and 15 to 20 knots in the Cntrl and SE Bahamas. Seas: 2 to 4 feet over open waters in the NW Bahamas and 4 to 6 feet in the Cntrl and SE Bahamas.

**MONDAY 6<sup>th</sup>** – Variably cloudy, warm and breezy with the chance of a few scattered showers mainly across the Cntrl and SE Bahamas. Maximum temperature 83°F and minimum temperature 72°F. *Small craft operators in the Cntrl and SE Bahamas should exercise caution.* Winds: East-Northeast to East-Southeast at 10 to 15 knots in the NW Bahamas and 15 to 20 knots in the Cntrl and SE Bahamas. Seas: 2 to 4 feet over open waters in the NW Bahamas and 4 to 6 feet in the Cntrl and SE Bahamas.

**TUESDAY 7<sup>th</sup>** – Partly sunny and warm and a bit breezy with the chance of a few isolated showers. Mostly fair conditions expected at night. Maximum temperature 82°F and minimum temperature 72°F. *Gusty winds and slightly choppy can be expected in showers.* Winds: Easterly at 10 to 15 knots in the NW Bahamas and 15 knots in the Cntrl and SE Bahamas. Seas: 2 to 4 feet over open waters in the NW Bahamas and 3 to 5 feet in the Cntrl and SE Bahamas.

Figure 13 Seven-day weather forecast. Shared through BDM Facebook page.

There is a functioning video and audio production facility at the BDM offices. The studio has previously been used to create YouTube content such as weather forecasts, informative videos of meteorological topics for example specific phenomenon, topical weather systems or the meteorologist's work. YouTube content has been provided as additional products and not as one of the main communication channels. Due to limitations in human resources the channel has not been in active use.

Warnings are displayed as crawlers on TV-broadcasts, but otherwise local TV channels utilize weather information mainly from external sources. Warnings and forecasts by the

BDM are read on radio, text format weather forecasts for printed media are also provided. All services provided for the different media are currently done free of charge.

A popular way of receiving the warning and forecast information from the BDM has been by enrolling to their email list (freely available from the website). Due to heavy user traffic the lists have become increasingly difficult for the BDM to maintain. The plan is to migrate from the email platform to the website and possibly a dedicated app in the future.

Services for aviation such as METARs, TAFs, aerodrome forecasts and flight folders are separately shared via email to the user groups. Specialized services such as weather case studies for aircraft accident investigation are created separately when such a service request is received.

The BDM also provides services to key sectors such as tourism, hotels, agriculture, and marine users (small craft operators, yachters and commercial vessels). Most of the users receive the information through email but in some cases require specifically tailored services (directly contacting the BDM by phone or email) that can be provided when resources allow.

## 9.2. Education and awareness initiatives in place.

The BDM shares educational material related to weather and climate events and the preparedness for these on their website.

**BAHAMAS DEPARTMENT OF METEOROLOGY**

# HURRICANE PREPAREDNESS

## When a Storm Threatens, Get Moving!

- PROTECT YOUR HOME - COVER WINDOWS, SECURE DOORS, AND LOOSE ITEMS
- DETERMINE SHELTERING OPTIONS AND CONSIDER YOUR PETS
- PREPARE YOUR TRAVEL BAGS, MEDICINES, AND SUPPLIES, CHARGE YOUR PHONE, AND FILL UP OR CHARGE YOUR VEHICLES.
- HELP YOUR NEIGHBORS, SPECIFICALLY THE ELDERLY AND OTHER VULNERABLE PEOPLE
- FOLLOW EVACUATION ORDER, IF GIVEN

MET.GOV.BS      FACEBOOK.COM/242METSERVICE

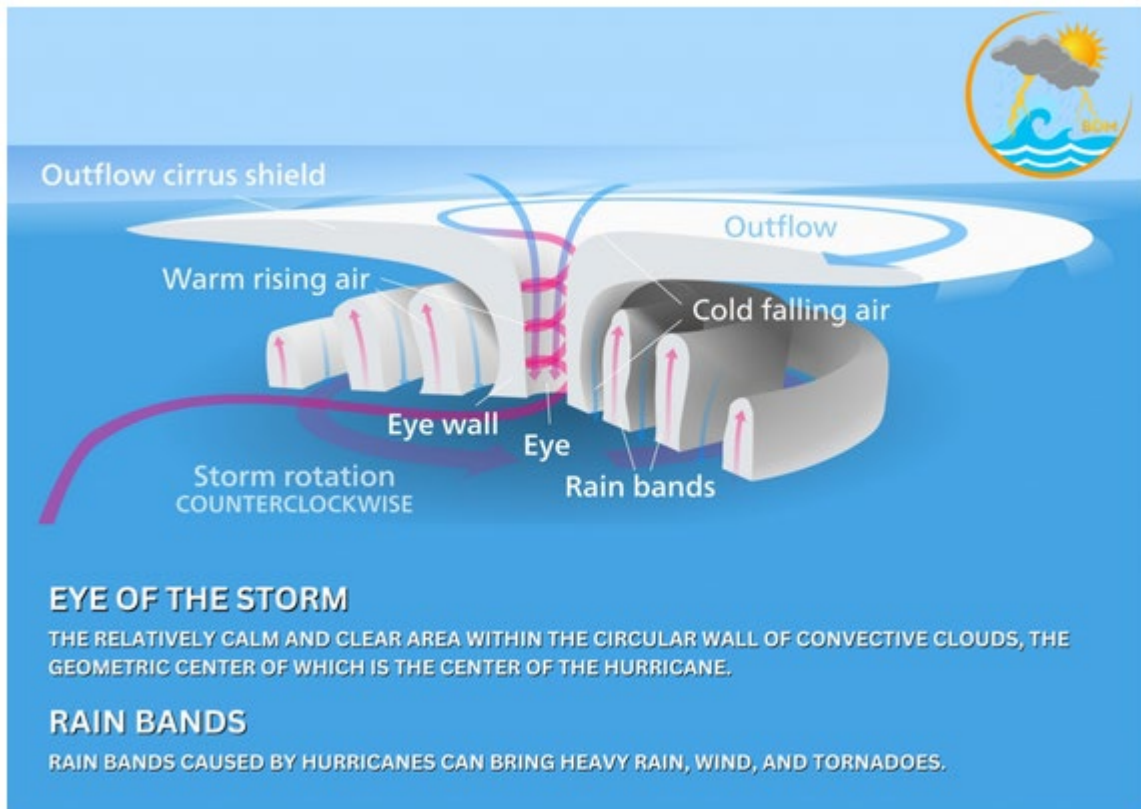


Figure 14 Examples of educational material related to Hurricane events from the BDM website.

Weather and climate information and their interpretation is part of the school curriculum in The Bahamas. The BDM has accommodated school visits and partake in career fairs. The BDM hosts a summer Cadet program targeted for high school and college students who wish to learn about the field and study weather and climate.

The BDM is actively participating in local forums such as town-hall and church meetings to increase public awareness, brief on upcoming events and to engage in public dialogue. Their participation on this level is highly valued and asked for especially before the hurricane season start.

**9.3. Special measures in place to reach marginalized communities and indigenous people.**

Warning outreach to remote areas has been led by the disaster risk officials and is considered very good. Most individuals have access to cell phones and internet connection and can access the news and warnings, or by other dissemination channels such as: TV and radio broadcasts.

As all individuals may not benefit from text-based products, the BDM is planning to enhance their product portfolio with other visual products. The BDM has very recently made some improvements to the website using accessibility tools. The toolset includes increasing and decreasing text size, using grayscale, high contrast or negative contrast for the site. The department aims to increase the website’s usability for different user groups.

Efforts in social media presence and testing new platforms are targeted specifically to reach younger user groups that are not using radio or TV as a primary source of information.



All products are published in English, but as it is the only official language and there is few or no other languages used, this has not been considered as an issue or limitation.

### **Summary score, recommendations, and comments for Element 9**

The summary score for the element is 2 “Traditional communication channels and basic dedicated website is used to disseminate forecasts and basic information”.

The BDM has started to improve the website to have more information available, accessibility tools and a clear sectioning of the information for an effective user experience. This work is recommended to be continued. The BDM **is recommended to develop more user-friendly and interactive products utilizing graphics and charts to complement traditional text-based forecasts**. The existing forecast and service production system at the BDM provides the tools for such products and the automatic dissemination and updating of the website. Therefore, the BDM **is recommended to improve their capacity to fully use the existing tools** to support the modernization of web services.

As a part of the website update **it is recommended to draft a communication strategy** that allows the BDM to prioritize focused attention and staff efforts to **follow user metrics and use the input for service development**. Identified areas for improvement are:

- Prioritizing warning products and including visual warning products
- Posting weather and climate products made for different stakeholders and sectors to the website. E.g. meteorological products for aviation.
- Redirecting public and stakeholders to the website as the main interface
- Start following the user metrics
- Include a feedback channel to the website.

In order for the BDM to improve the direct reach to the public, it is **recommended to support The BDM’s plans to develop or procure a weather app and develop tailored products targeted for the mobile format**.

## **Element 10: Use and national value of products and services**

### **10.1. Formalized platform to engage with users in order to co-design improved services.**

No formalized platform or process to engage stakeholder or co-design services exists. The BDM has very direct and good contacts with all key stakeholders, but the relations are informal and happen on an ad-hoc basis or during project specific engagements such as workshops.

As a member of the DRM-Agency platform, the BDM participates with a wide variety of national stakeholders to discuss and prepare for tropical cyclones, but collaboration is limited to these events.

The BDM key stakeholders, for example aviation and marine users, have expressed interest in establishing annual engagement for discussions and the development of services. Inviting the BDM as a partner to sector specific annual workshops would be advisable and for the BDM to actively promote such possibility of engagement.

As a part of the ongoing QMS work the BDM will establish a process for the design of new products and services including the potential interaction with stakeholders and co-design options.

**10.2. Independent user satisfaction surveys are conducted, and the results used to inform service improvement.**

Independent user satisfaction surveys have not been conducted for a long time. Previous user survey was done in 2018 for the aviation community.

All feedback is currently received on ad hoc basis. As part of the ongoing QMS work the BDM is planning to initiate voice of customer surveys. Based on the feedback from the surveys the BDM can draft targeted actions for improvements.

**10.3. Quality management processes that satisfy key user needs and support continuous improvement.**

The BDM is in the process of modernizing and certifying their Quality Management System up to ISO9001:2015 standards. The existing QMS was designed primarily around the aviation services and will be updated to the ISO9001:2015 standards, additionally the BDM will expand the scope of QMS to include all lines of services of the department such as Public, Marine, Warning and Climatology etc.

The BDM has engaged Alain R Boisvert to conduct a QMS Gap Analysis and to assist in the work towards certification. The work is on-going and anticipated to be completed the first half of 2025.

**Summary score, recommendations, and comments for Element 10**

The summary score for the element is 2 "Service development draws on informal stakeholder input and feedback".

**It is recommended that the BDM focus on completing the implementation of the Quality Management System ISO9001:2015 and certification.** As a part of this process, **it is recommended that the BDM conduct regular satisfactory surveys.**

The BDM key stakeholders all welcome the idea of having **regular stakeholder events** to discuss the products and co-design of new services. It is recommended that the aviation sector in The Bahamas engages the BDM in stakeholder workshops on an annual or biannual basis.

**As a part of the website and product portfolio, it is recommended that the BDM engages the different user sectors and stakeholders to co-design new products that best serve the users.**

## Annex 1 Consultations (including experts and stakeholder consultations)

The CHD was developed as part of the SOFF Readiness Phase. During this time FMI made two missions to The Bahamas. The following stakeholders were consulted:

- Staff and Director of the BDM
- Quality Management System expert Alain R Boisvert
- The following stakeholders participated in CHD workshop: Ministry of Disaster Risk Management, Ministry of Economic Affairs, The Bahamas National Trust, Department of Agriculture, Department of Environmental Health Services, Department of Marine Resources, Bahamas Reef Environmental Education Foundation, Bahamas Power and Light Company, Cable Bahamas, University of the Bahamas, Department of Aviation, Civil Aviation Authority, Aircraft Accident Investigation Authority, BahamasAir, Odysseys Aviation, Nassau Flight Service, Nassau Airport Development Company, American Airlines and Port Authority
- Consultation of CIMH on regional training and calibration capabilities.
- National Oceanic and Atmospheric Administration – Upper Air Program Manager.



Figure 15 CHD workshop.

## Annex 2 Urgent needs reported

The BDM has systematically developed its capabilities in recent years. This development included investments in the observation infrastructure, working to achieve QMS certification and plans to recruit more staff. To support its development, the BDM needs support throughout the value chain.

The critical gaps have been identified:

- There is no legal framework to govern and enforce The BDM's status and tasks. Establishing a formal act that clearly stipulates the mandate and priority services of the BDM and allows for cost-recovery. Cost-recovery would give additional resources to enable sustainability of the operations and motivation to develop added value services based on end-user needs. Improving financial and strategic planning and customer-portfolio management is required to support development.
- A critical gap that is being addressed, but will need further work, is strengthening the human capacity and staff resources in the BDM. The BDM is in the process of recruiting new staff who will need to be trained. The culture at the BDM should promote career and expertise development of its young staff members and proactively engaging in succession planning for critical tasks.
- Although the co-operation with other governmental authorities is working very effectively, formalizing key partnerships at national and international level is encouraged. Enforcing the partnership with the US NWA CHUAS network is critical for the GBON compliance.
- Main gaps related to the observation network in The Bahamas are: a malfunctioning hydrogen generator at the upper-air station, uninstalled surface weather stations, lack of network management, no integrated data management system to store and process all observation data in one system and allow automated data processing, QA/QC and data dissemination.
- Securing budget or project funds to ship and install existing automatic weather stations. Prioritizing this work.
- Improving station maintenance by formalizing key partnerships with private operators on the remote islands, securing annual budget for maintenance travel and evaluating the capability of independently taking over the maintenance of newly procured systems and continuing service contracts if necessary. Continuing calibration service agreement or seeking regional calibration services contracts.
- Customer engagement process needs to be improved. The BDM does not collect user feedback regularly to improve its services, nor is there a co-creation process to develop tailored services based on user needs. Feedback and tailoring is ad-hoc and there is no structured portfolio management and prioritization. The customer process should be enhanced hand in hand when new services are developed.
- New products and services – strengthening the skills to fully utilize existing tools and systems: efficient use of weather radars, forecasting, service production system, model post-processing and creation of new products.
- Complete the ongoing standardization work of the Quality Management System to obtain certification.

- Improve product and service portfolio management and expand it with more user-friendly visual products and more climate services. Continue the work to improve the website and develop a mobile weather app to increase the reach of public weather services and warnings.

## Annex 3 Information supplied through WMO

Peer adviser acknowledges the material and templates provided by SOFF throughout the Readiness phase.

## Annex 4 List of materials used

In addition to WMO guides, the following materials were utilized:

- Web page and network portal of BDM
- BDM shared material about their organization and draft reports with peer advisor.
  - Draft of The Bahamas Department of Meteorology Bill, 2019
  - List of accomplishments and future plans of the Bahamas Department of Meteorology
  - Letters of Agreements and Memorandum of Understanding with stakeholders.
  - Audit reports done for the MYNN and MYGF by the Air Navigation Services (ANS) of The Bahamas Air Navigation Services Authority
- CMO Resolution 1 – CMC51: Regional Arrangement For Meteorological Forecast and Warning Services Among CMO Member States
- Online material included as reference to this document