

2<sup>nd</sup> Small Island Developing States (SIDS) Internet Governance Forum (IGF)

# Enhancing Digital Resilience for Environmental Sustainability - a Hydro-Met Perspective

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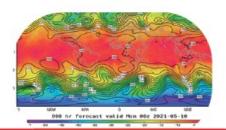
### Weather & Climate Value Chain



Observations from the entire globe



International exchange of **observations** 



Global Numerical Weather Prediction

Weather and climate-related infrastructure - must be designed and managed globally

Last-mile activities undertaken primarily at regional, national and local level

Effective decision-making and action



Delivery of weather and climate services



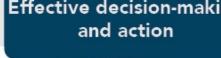
Local data processing, forecast, warning and advisory products



- Information for the benefit of society
- International data exchange in realtime (24/7)



Requires reliable, secure, robust information & communication technology (ICT) systems





WMO, 2021







#### Community connection and response Institutional arrangement · Two-way communication network · Regulatory framework Pre-impact assessment Mandate Local risk knowledge adopted Roles and responsibilities Public awareness Interagency collaboration Risk perception, knowledge Concept of operation and interpretation Appropriate response in place 01 Safe evacuation resourcing Earth data observation · Local hydro-met stations Local seismic networks Risk Communication Local tide gauge networks 10 DART buoys · Government notified AWS Public notified Doppler radars · Local community notified Upper air observation · Tourists notified · Satellite observation 09 Dissemination and notification methods Data and information · Siren towers People-centred collection Text message Internet · National information centre · Mash Box Satellite comms **Early Warning** Social Media Broadband and telephone Specialized networks · Global data · Media Information · Regional data TV · Radio · Others **Systems** Warnings and Hazard detection other infrastructure 07 Hardware products Operating system · Data analysis software Watches · Data Integration software Advisories Statements Impact based Hazard assessment forecasting/warning Observation · Hazard assessment Criteria Vulnerability information · Prediction models Impact & risk assessments Uncertainty assessment (Fakhruddin et al. 2021; ISC, 2023)

# Multi-Hazard Early Warning Systems

Governance & Institutional arrangements

Digital Resilience

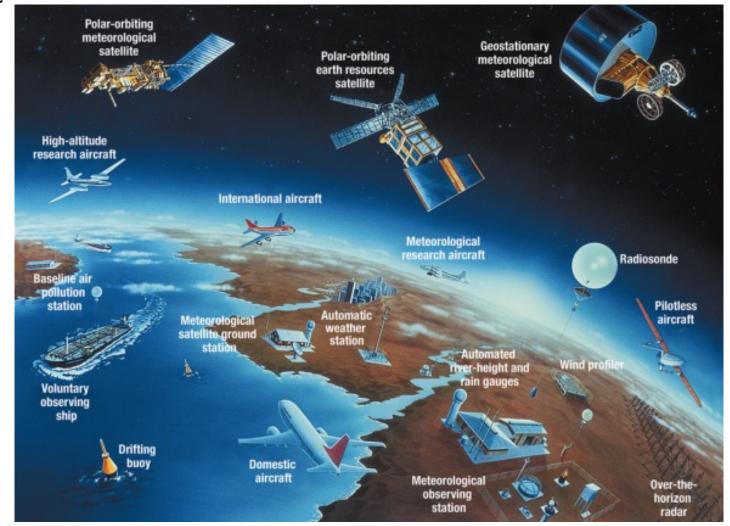
Target D of Sendai Framework reducing disaster risk through better critical infrastructure, including national weather, water and climate service infrastructure

### 1. Enhancing Resilience of Observations



- Standardization of network ease of calibration and maintenance (e.g., via WMO Regional Instrument Centre at CIMH)
- Backup data in geographically dispersed locations (CIMH climate data also on servers at CMO HQ and CCCCC)
- Severe weather case database, hosted at CIMH, mirrored at CMO HQ

WMO Integrated Global Observing System (WIGOS)





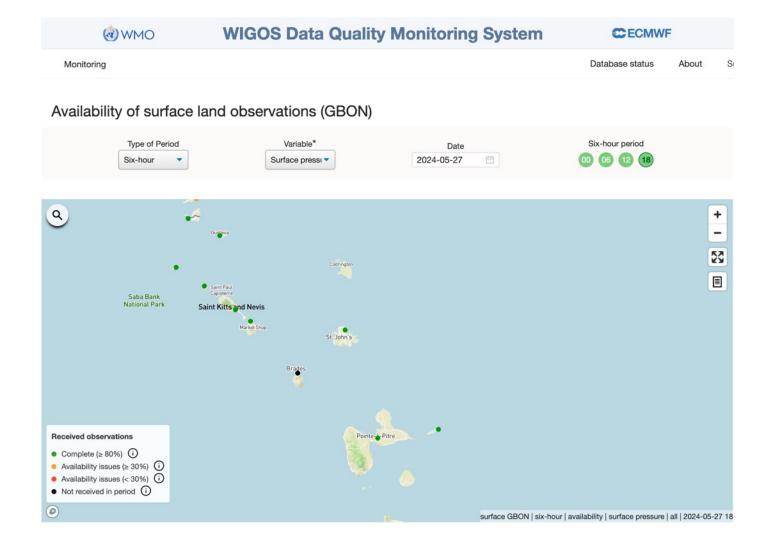
### **Enhancing Resilience of Observations**



# Global Basic Observation Network (GBON)

### Systematic Observations Financing Facility (SOFF)

- Sustain basic network for the public good
- Data Quality Management –
   Regional WIGOS Centre (US,
   Canada, CMO HQ & Trinidad & Tobago
   Met Service, Costa Rica)
- Organs of CMO are supporting SOFF implementation



# **Enhancing Resilience of Observations: CMO Operational Radar Group (CORG)**



Created centralized online repository to access shared information to aid capacity building & similar future projects

Cultivate Strong Relationships

Focused dialogue on common problems to generate feedback

**Built trust & cooperation among CMO radar** 

operators & invited neighbouring operators

Seek

**Feedback** 

Share Back

CORG
FEEDBACK
LOOP

Documented best practices, lessons learned, and solutions e.g., data archiving, retrieval, dissemination

Take Action Learn

Encouraged sharing of innovative solutions, know-how, best practices adopted

Courtesy, K Kerr)

# **Enhancing Resilience of Observations: Addressing Challenges to Satellite Earth Observations**

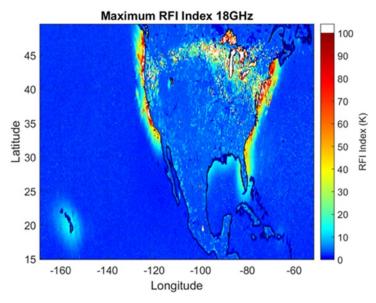


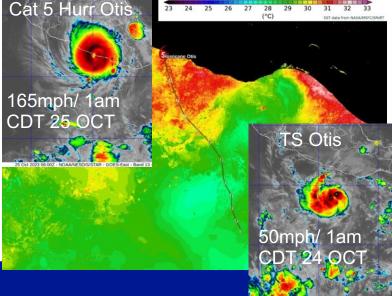
#### **Passive Bands**

- International mobile telecommunications (IMT) groups examining radio frequency spectrum above 6 GHz as part of 5G growth. **Degradation in ability to use passive bands is a growing concern for remote sensing.**
- Sea-surface temperature (SST) measurements at risk. Sea surface temperature monitoring vital to saving lives (e.g., tropical cyclones form when SST ≥ 26°C).

Innovation: 1st ever WMO training workshop on radio frequency spectrum management, (Regulators, Met Services, UWI, civil defense, other stakeholders), hosted by CMO with support of the Caribbean Telecommunications Union (CTU), February 2024





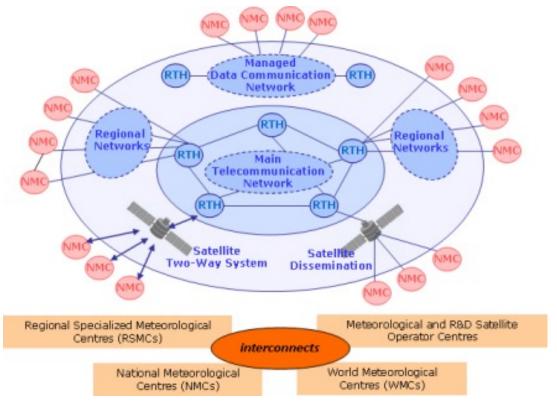




### 2. Enhancing International Data Exchange



#### Regional Meteorological Telecom Network



Special component carries meteorological data for aviation

 Reliable, secure ICT systems are fundamental to global weather and climate enterprise, which requires real-time (24/7) international data exchange to safeguard lives and property.

- WMO Unified Data Policy (free exchange of core and recommended data)
- Observation networks and dissemination of data and information via the internet are susceptible to cyberattacks. A radar was hacked last year.

Supports multi-hazard, multipurpose early warning systems, tsunamis

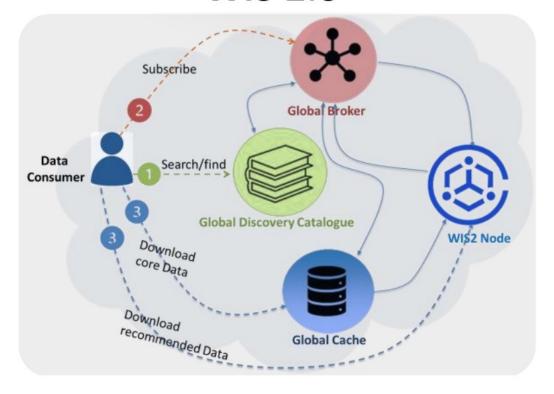
# Transitioning International Data Exchange to WMO Information System (WIS 2.0)



- WMO WIS 2.0 Training Workshop hosted by CMO HQ, June 2023
- Belize, T&T, Cayman led piloting of WIS2.0 after workshop
- CMO WIS2.0 Node established Oct 2023, with cloud services from WMO, pioneering with 12 Members.



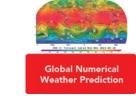
**WIS 2.0** 







# 3. Global & Regional Numerical Weather Prediction & Climate Prediction (seamless approach)



#### WMO Integrated Processing and Prediction System (WIPPS)

Quality, Relevance and Impact:

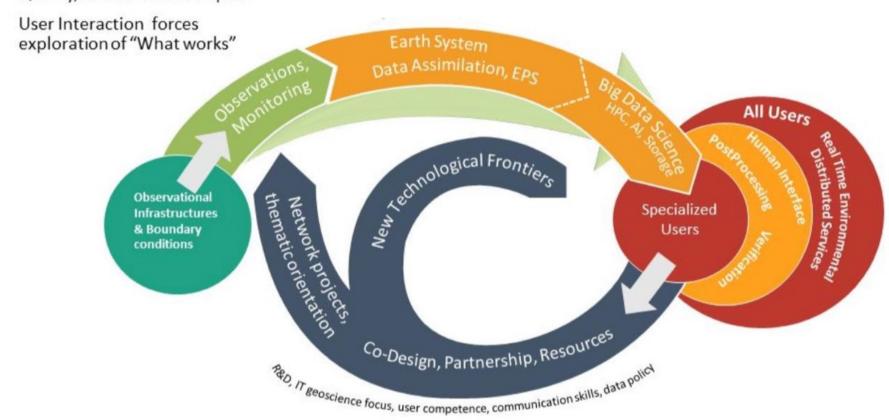
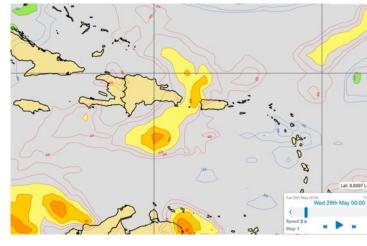


Figure 5. A value cycle approach encompasses the whole value chain from observations (green components), through production of forecasts and products (orange component), to the engagement of users (red components) and calls for a co-designed approach, featured through a feedback loop (grey components) to achieve scientific breakthroughs that serve society. From Ruti et al. (BAMS, 2019).



EPS ECMWF: Extreme Forecast Index for Rainfall



# 4. Local Data Processing, forecast, warning, & advisory products





National Framework for Weather, Water, and Climate & Ocean Services

- National Institutionalized mechanism to coordinate elements pertaining to entire value chain for the production, delivery and application of weather, water, and climate services (e.g., National Climate Outlook Forum, Hurricane Alerts, Drought Bulletins, etc....)
- Engage all national stakeholders in coproduction, tailoring, communication and utilization of weather, water, and climate services in a national dialogue

# Met Service & Disaster Office co-production, co-design, co-delivery



#### **Tropical Weather Advisory**



Valid until 0400 PM EDT 19 September 2022

...FIONA MAKES LANDFALL IN THE DOMINICAN REPUBLIC...
...HURRICANE WARNING IS IN EFFECT FOR THE TURKS AND CAICOS ISLANDS...

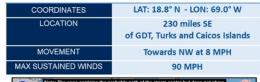
- As Fiona moves away from land, more significant strengthening is expected while it moves over the western Atlantic.
- The center of Fiona is forecast to pass near or to the east of the Turks and Caicos on Tuesday.

#### POSSIBLE IMPACTS

WINDS: Hurricane conditions are expected in the Turks and Caicos on Tuesday.

RAINFALL: 4 to 6 inches with isolated maximum of up to 8 inches. Rainfall is expected to be heavier in the more eastern islands. These rains will cause localized flooding of roads, properties, and communities.

SURF: Swells generated by Fiona are beginning to affect the Turks and Caicos Islands. These swells will continue to spread westward across the southwestern Atlantic toward the central and northwestern Bahamas and the US east coast through midweek. These conditions could cause life-threatening surf and rip current conditions.





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#BeProactive #BePrepared #BeInformed

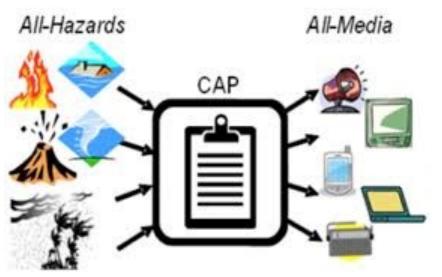


### 5. Delivery of Weather and Climate Services

Delivery of weather and climate services



### **Common Alerting Protocol (CAP)**



Mobile Cell Broadcast – key technology for public alerting with potential for geographic targeting of alert delivery



- \$\frac{1}{4}\$ Stations in all thirteen (13) parishes received below-normal rainfall.
- No parish experienced meteorological drought conditions.
- Near-normal to above-normal rainfall is forecast for February to April 2022.
- Near-normal temperatures are expected for the next three months.

#### What Happened: November 2021 - January 2022

Based on analysis (image to the right) very dry conditions were noted in sections of Trelawny, St. Ann, St. Mary, St. Thomas, St. Catherine and Clarendon. Sections of St. James, St. Elizabeth and Portland were experiencing mild levels of wetness.

The below-normal rainfall received across the island, during the early months the dry season (December, January) has resulted in continued dry conditions in many farming communities especially in central parishes.





# **Delivery of Climate Services:**

### Climate Services and Related Applications (ClimSA)





- Intra-ACP Climate Services and Related Applications Programme (ClimSA): Four-year project funded through European Union (EU) African, Caribbean, Pacific (ACP) Secretariat and being implemented by CIMH on behalf of CMO. Period extended.
- Advancing climate services value chains in the:
  - health sector of Dominica,
  - water sector of Jamaica and
  - agriculture and food security sector of Guyana





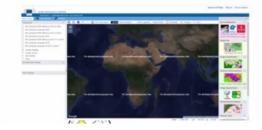


C-Station GUI – Analysis and IMPACT



Interactive Map view windows

Mapping a range of climate impacts



Courtesy, CIMH RCC



# Hydro-Met Services, Environmental Sustainability and Digital Resilience - Interconnected

- Desire for the Caribbean to become resilient to extreme weather and climate events
- Requires high quality weather, climate, water and related environmental information, effectively applied
- Weather and climate services built on ICT
- Extreme weather and climate intelligence can also inform cybersecurity matters, .e.g., understanding impact of hazardous weather on ICT system integrity

Thank you! <a href="http://www.cmo.org.tt">http://www.cmo.org.tt</a>

