Support systems and frameworks for enhanced forecasting and early warning in East Africa

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

East Africa/Rwanda training course on Sustainable and Resilient Infrastructure

Adanna Robertson-Quimby
World Meteorological Organization
Disaster Risk Reduction and Public Service Branch

WMO OMM
World Meteorological Organization
Organisation météorologique mondiale

December 7th, 2021

Outline

- About the World Meteorological Organization
- WMO World Weather Watch and the Global Data-Processing and Forecasting System (GDPFS)
- Enhancing capacity in the National Meteorological and Hydrological Services (NMHSs)
  - The WMO Severe Weather Forecasting Programme (SWFP)
- Enhancing Early Warning Decision Support Systems
  - The WMO Global Multi-hazard Alert System (GMAS)
    - The Common Alerting Protocol (CAP)
  - Impacts-based Forecasting and Warning Services (IBFWS)
- Breakout Rooms Group Discussion and Conclusion.

About the World Meteorological Organization (WMO)

- Facilitate worldwide cooperation
  - The establishment and maintenance of systems for the rapid exchange of meteorological and related information
  - Standardisation of data to ensure the uniform publication of observations and statistics
  - Applications of meteorology to human activities and various sectors including aviation, shipping, water resources and agriculture
  - Promote activities in operational hydrology
  - Encourage research and training in meteorology and other related fields

WMO

(Responsibility/Mission)

- Training & Research
- Hydrology
- Applied Meteorology
- WWW
  - Global Observing System
  - Global Telecommunication System
  - Global Data Processing and Forecasting System

WMO OMM
https://public.wmo.int/en

WMO World Weather Watch

- Global Observing System
- Global Telecommunication System
- Global Data Processing and Forecasting System

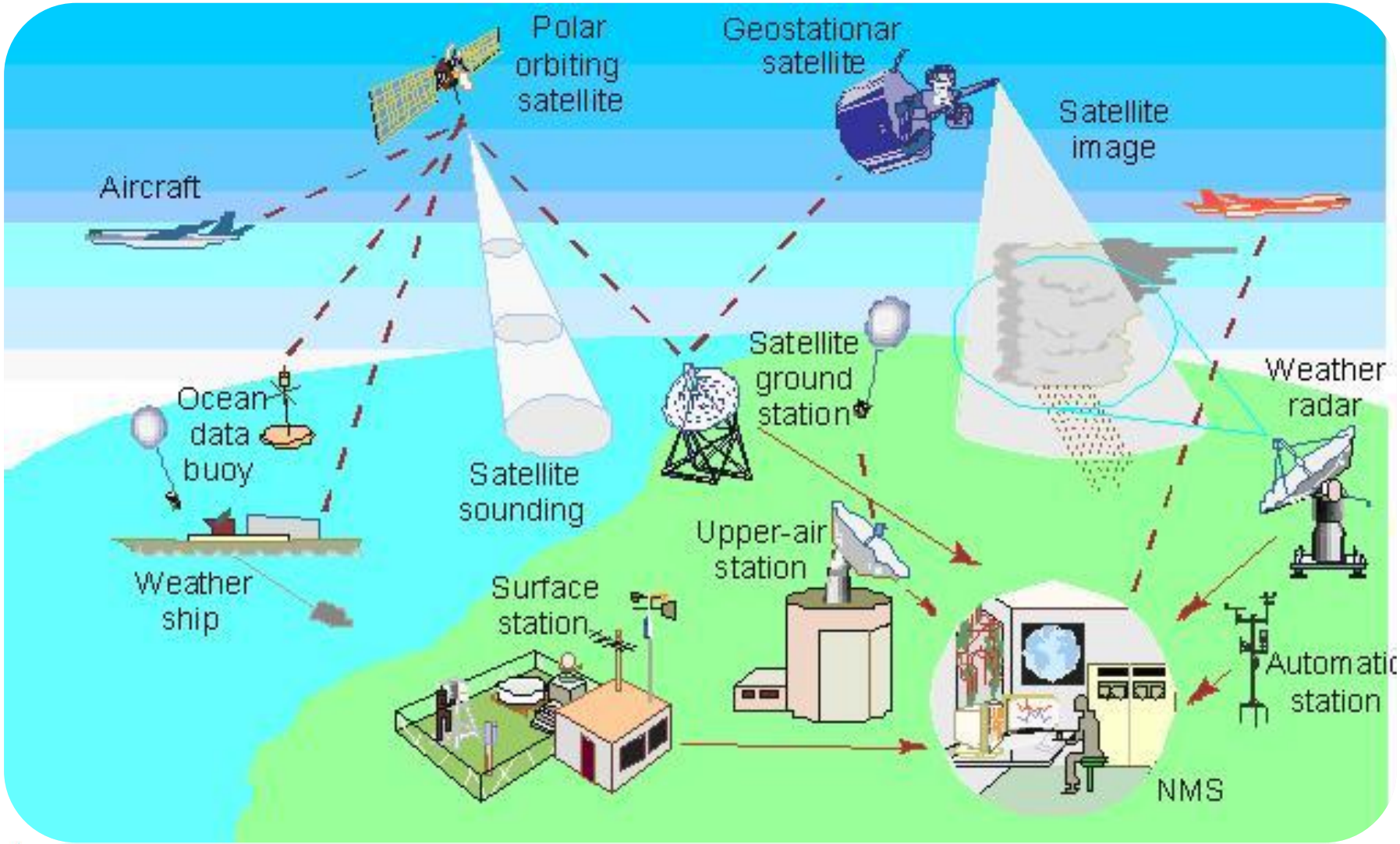
WMO OMM

https://public.wmo.int/en

Global Observing System

- The coordinated system of methods and facilities for making meteorological and other environmental observations on a global scale in support of all WMO Programmes
- It comprises observing facilities on land, at sea, in the air and in outer space
- Operated by the Member countries of WMO - all countries benefit from the consolidated efforts

Global Observing System



WMO OMM

Global Telecommunication System (GTS)

- Communications and data management component that allows the World Weather Watch (WWW) to collect and distribute information critical to its processes. It is a secured communication network for the real-time exchange of information, critical for forecasting and warnings of hydrometeorological hazards.
- WMO Information System (WIS) connects all National Meteorological and Hydrological Services and regions together for data exchange, management and processing.

The Global Data-Processing and Forecasting System (GDPFS)

- The main purpose of the Global Data-processing and Forecasting Systems is :
  - to prepare and make available to Members in the most cost-effective way meteorological analyses and forecast products.

- It is organized as a three-level system of:
  - ***World Meteorological Centres (WMCs)***
  - ***Regional Specialized Meteorological Centres (RSMCs)***
  - ***National Meteorological Centres (NMCs)***

The GDPFS Infrastructure

- ✓ ***WMCs/Global NWP Centres*** **-** Provide NWP/EPS products including probabilities, stability indices and satellite-based information and products as in-kind contributions.

- ✓ ***RSMCs/Regional Centres*** **-** Analyse and interpret the information provided by the WMC and prepare daily guidance products for NMHSs/NMCs. Run limited-area models to refine products, maintain RSMC web portal and liaise with the participating NMHSs/NMCs.

- ✓ ***NMHSs/NMCs*** **-** Access to all products and have responsibility and authority for national advisory and warning services. Liaise with users including DRR agencies and the public and provide feedback for regional subprogrammes.

Functions of the GDPFS

- Real-time functions
  - Pre-processing of data
  - Preparation of analyses and forecast products
  - Monitoring observational data quality
- Non-real-time functions
  - Preparation of special products for climate-related diagnosis
  - Intercomparison of analysis and forecast products
  - Conducting workshops and seminars on the preparation and use of GDPFS output products

GDPFS
Southern Africa

Global Centres

NCEP/NOAA WMC Washington
WMC ECMWF
Met. Office UK WMC Exeter
MeteoFrance
DWD WMC Offenbach
EUMETSAT

Regional Specialized Meteorological Centres

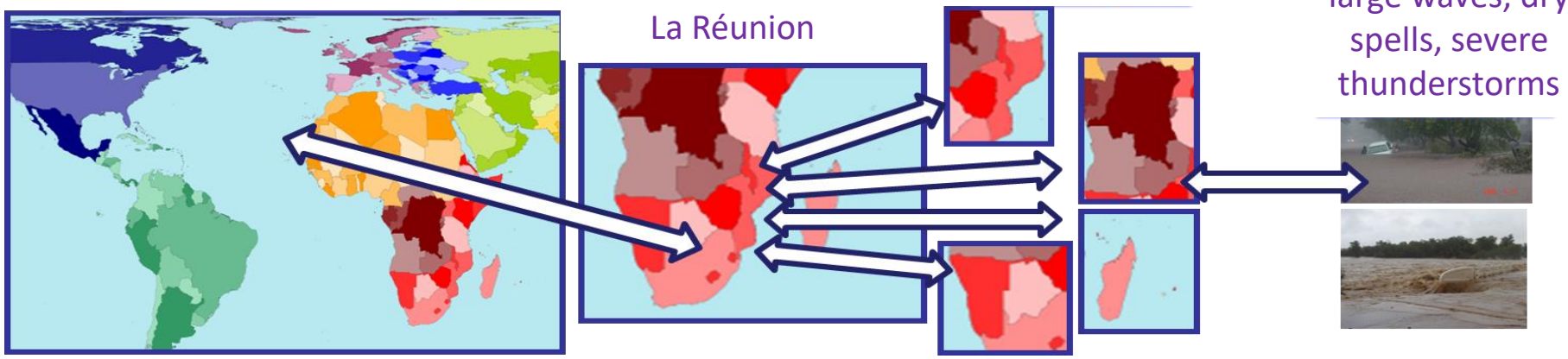
Pretoria
La Réunion

National Meteorological Centres

Angola, Botswana, Comoros, Democratic Republic of the Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, United Republic of Tanzania, Zambia and Zimbabwe

User communities focused

Heavy rain, strong winds, large waves, dry spells, severe thunderstorms



WMO OMM

GDPFS
Eastern Africa

Global Centres
-WMC ECMWF for Meteograms & Forecaster User Guide
-UKMO WMC Exeter
-NOAA/NCEP WMC Washington

Regional Specialized Meteorological Centres
-Nairobi for guidance for Eastern Africa
-Dar Es Salaam for guidance for the Lake Victoria basin

National Meteorological Centres
-Eastern Africa such as Burundi, Ethiopia, Kenya, Rwanda, South Sudan, Tanzania & Uganda

Users Communities with a focus on heavy rain, strong winds, large waves & dry spells

WMO OMM

Source WMO https://community.wmo.int/swfp-eastern-africa

Enhancing capacity in the National Meteorological and Hydrological Services (NMHSs)

The WMO Severe Weather Forecasting Programme (SWFP)

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

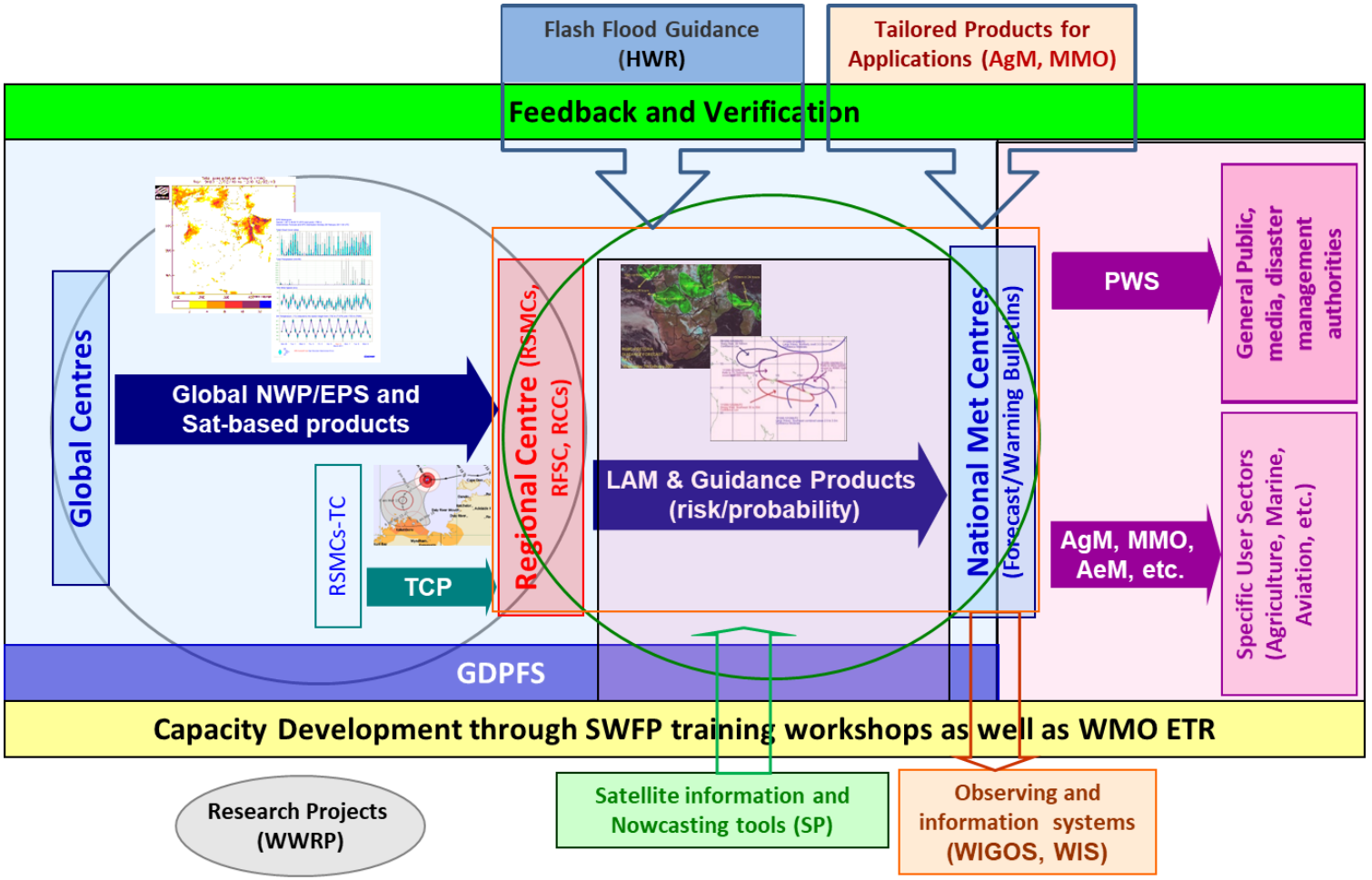
World Meteorological Organization
Organisation météorologique mondiale

Strengthen capacity in NMHSs through the WWW infrastructure

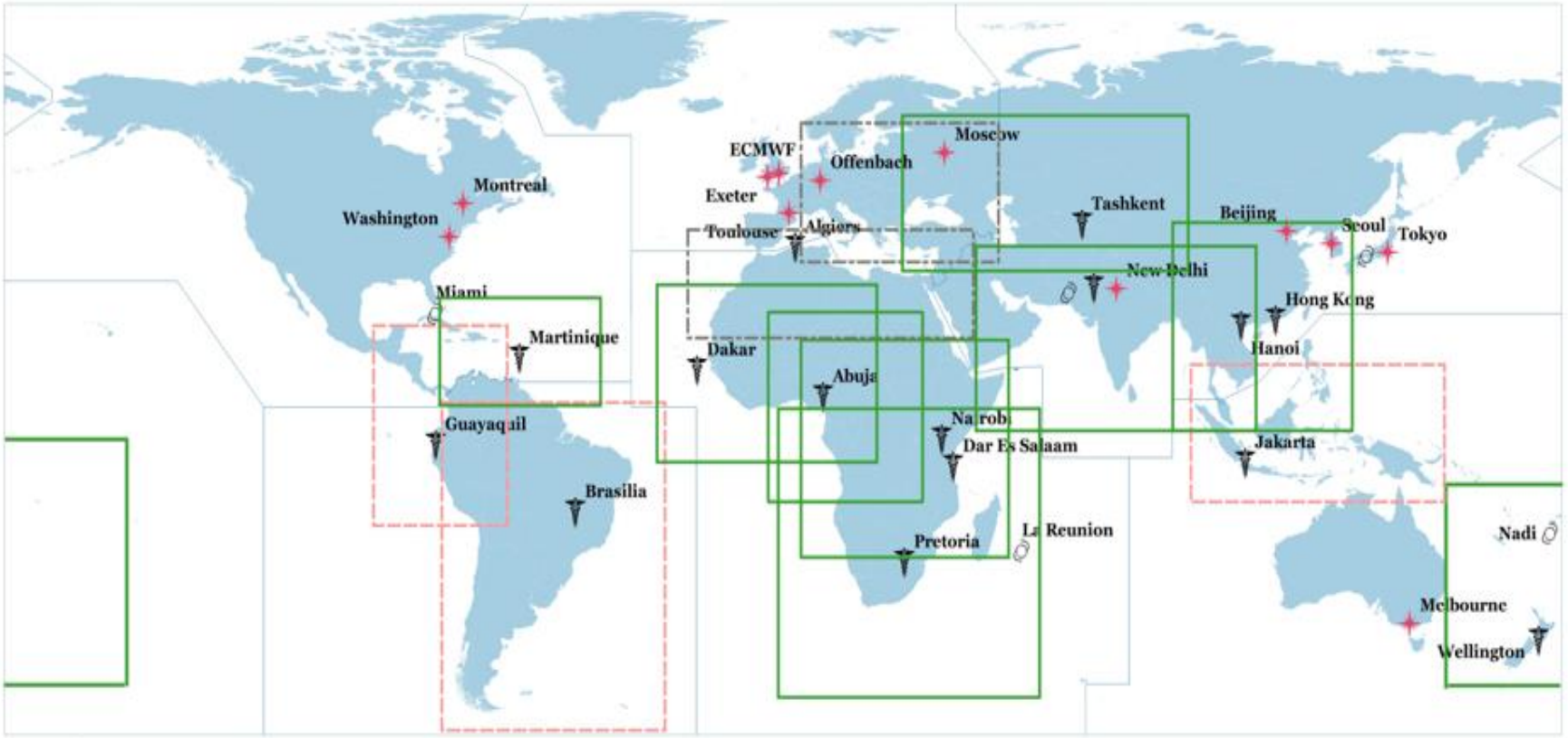
- WMO Severe Weather Forecasting Programme (SWFP)

To strengthen capacity of the NMHSs in developing countries, including Least Developed Countries (LDCs) and Small Island Developing States (SIDS) to deliver improved forecasts and warnings of severe weather to save lives and livelihoods and protect property and infrastructure.

SWFP started as a 'demonstration project' in 2006, currently involves over 80 developing countries, LDCs and SIDS in 9 sub-regions including 4 sub-regions in Africa & 3 sub-regions in Asia. The regional activities are mainly supported through extra-budgetary resources from development partners/donors such as Norway, Canada, UK, CREWS, ARRCC, World Bank, UN ESCAP/ RIMES & ASEAN.



WMO Severe Weather Forecasting Programme (SWFP) Outreach



Green (solid-line) color boxes represent the domains of existing SWFP sub-regional programmes. Pink (dash-line) and Brown (dash-dot-line) color boxes signify the regions for future SWFP sub-regional programmes which will be developed within next 1-2 years and 3-5 years respectively.

WMO OMM

Regional Specialised Meteorological Center (RSMC)

NAIROBI

RSMC Nairobi web portal (password protected)

NWP Models

Regional Products

- UK Met Office Tephigrams
- UK Met Office EPS
- Lake Victoria Products

Global Products

- NOAA NCEP African Desk
- UK Africa VCP
- TIGGE-GIFS East Africa products

Others

- RSMC Guidance Archive

Training Website Links

- Met E-Learning
- WMO Project Website

GUIDANCE PRODUCTS

Short Range Forecasts (1-2 days)

- Day 1
- Day 2
- Risk Table
- Discussion

Medium Range Forecasts (3-5 days)

- Day 3
- Day 4
- Day 5
- Risk Table
- Discussion

SWFP Evaluation

- Quartely Report Template
- Event Table

Regional and International Centers

- ECMWF
- NOAA NCEP African Desk
- UK MET Office
- DWD
- RSMC- Pretoria

Long Range Forecast Centers

- ACMAD
- KMA
- ICPAC

National Met Services

- Kenya
- Ethiopia
- Rwanda
- Tanzania
- Uganda
- Burundi

Contact RSMC

Log Out

Regional Specialized Meteorological Center(RSMC) - DAR ES SALAAM

RSMC Dar Es Salaam - web portal (password protected)

Guidance Model Products

Regional Products

- WRF TMA LVB 00Z
- WRF TMA LVB 12Z
- WRF TMA EAC 00Z
- WRF TMA EAC 12Z
- WW3 TMA LVB 00Z
- WW3 TMA IO 00Z
- COSMO TMA EAC 00Z
- COSMO TMA EAC 12Z

Global and Regional Products

- NOAA
- ECMWF ENS: Meteogram
- WMC ECMWF: Open Charts
- Met Office: Africa Web Viewer
- SAWS: EPS (NOAA)
- DWD: ICON NWP Data
- Met Office: EPS

Trainings

- Met-eLearning

Archives

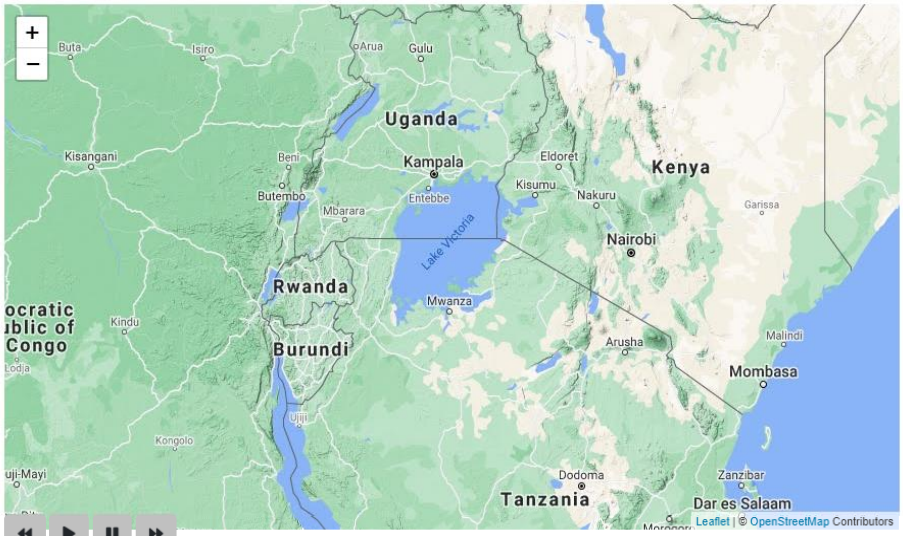
- 5 Days Guidance Maps
- Risk Tables
- Discussions
- Country Warnings
- Archived guidance

Feedback

Sign Out

Guidance Severe Products

DAY 2 (24/06/2021) - **No severe weather expected**



Short-range (1-2 Days)

DAY 1 DAY 2
Risk Tables
Discussion

Medium-range (3-5 Days)

DAY 3 DAY 4 DAY 5
Risk Tables
Discussion

Nowcasting Products

Satellite Products

Infrared Images (IR)

Radar Products

PPI
Cmax
Storm Track

Station Observations

METAR Reports

Country Specific Warning

BURUNDI
-NONE

KENYA
-NONE

RWANDA
-NONE

UGANDA
-NONE

TANZANIA
NORMAL: No severe weather expected Details
- 23/6/2021 3:11 PM

Read More... Report Alert

Regional and International Centers

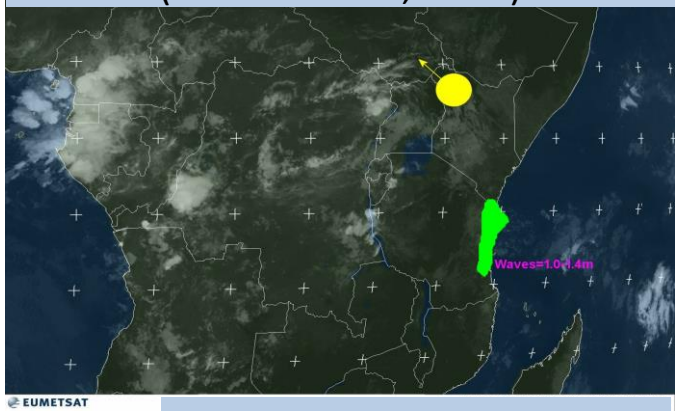
- WMO
- WMO:SWFDP
- WMO:SWFDP-EA
- ECMWF
- NCEP
- UK Met Office
- RSMC- Reunion
- RSMC- Nairobi
- ICPAC
- ACMAD

Upcoming Events

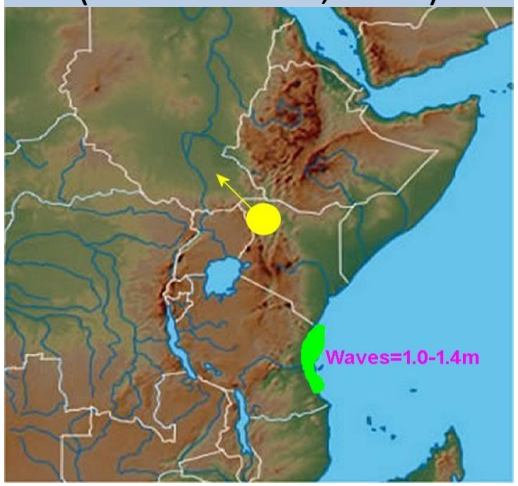
No Events available at the moment

RSMC Nairobi SWFP Guidance product issued daily to the NMHSs - Short Range Probability Tables

Map for Day-1 (3rd December, 2021)



Map for Day-2 (4th December, 2021)



Date issued: Thursday 2nd December,2021

In order to provide more information about the geographical location of the severe event the following convention is adopted when filling in the cells: X for the whole country, N for the northern part, S for the southern part, W for the western part, C for the Central part and E for the eastern part.

Day 1: Friday 3rd December,2021

COUNTRY	HEAVY RAIN				STRONG WINDS				LARGE WAVES			
	RISK				RISK				RISK			
	No	Low	Medium	High	No	Low	Medium	High	No	Low	Medium	High
BURUNDI	X				X				X			
KENYA	X					NW				E		
RWANDA	X				X				X			
TANZANIA		Coast			X					E		
UGANDA	X				X				X			
ETHIOPIA	X				X				X			
S SUDAN	X				X				X			

Day 2: Saturday 4th December,2021

COUNTRY	HEAVY RAIN				STRONG WINDS				LARGE WAVES			
	RISK				RISK				RISK			
	No	Low	Medium	High	No	Low	Medium	High	No	Low	Medium	High
BURUNDI	X				X				X			
KENYA	X					NW				E		
RWANDA	X				X				X			
TANZANIA			Coast		X					E		
UGANDA	X				X				X			
ETHIOPIA	X				X				X			
S SUDAN	X				X				X			

RISK = Probability x Impact

RISK Warnings:

Be aware

Be prepared

Take action

Recent SWFP Capacity Development Activities for NMHSs in Eastern Africa

- Implementation of HIGHWAY (HIGH Impact Weather lAke sYstem) project for lake Victoria region during 2017-2021 which aimed to:
  - Establish effective institutional frameworks & Early Warning Systems for East Africa
  - Improve access to all operational data/products sources supporting the generation & maintenance of Early Warning Services for the Region
  - Strengthen integration between producers and users to develop innovative, accurate tailor-made EWS products
  - Improve methods and strengthen capacity for communication and promoting understanding and use of EWS products

For more details: https://community.wmo.int/activity-areas/severe-weather-forecasting-programme-swfp

Recent SWFP Capacity Development Activities for NMHSs in Eastern Africa

- HIGHWAY/SWFP-Eastern Africa Regional Training Workshop on Severe weather and Delivery of Warning Services (Nairobi, 29 Jan.-8 Feb. 2019).

- Regional Sub-programme Management Team (RSMT) Meeting to review progress of SWFP-Eastern Africa (Online, 19 May 2020).

- HIGHWAY/SWFP-Eastern Africa Training Workshop on Severe Weather and Impact Based Forecasting and Warning Services (Online, 22-26 Feb. 2021)

For more details: https://community.wmo.int/activity-areas/severe-weather-forecasting-programme-swfp

Enhancing capacity in the National Meteorological and Hydrological Services (NMHSs)

The WMO Global Multi-hazard Alert System (GMAS)

The Common Alerting Protocol (CAP)

Impacts-based Forecasting and Warning Services (IBFWS)

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

WMO Global Multi-hazard Alert System (GMAS)

- Framework for substantially increasing and enhancing the availability of authoritative warnings and information related to extreme and/or potentially high-impact weather, water and climate events – regionally and globally.
- Enable NMHSs to make available and disseminate authoritative warnings and advice to all WMO Members and a global audience.

Enhancing Early Warning Decision Support Systems

- Common Altering Protocol (CAP)

The Common Alerting Protocol (CAP), is a digital format for exchanging emergency alerts which allows a consistent alert message to be disseminated simultaneously over multiple communications pathways.

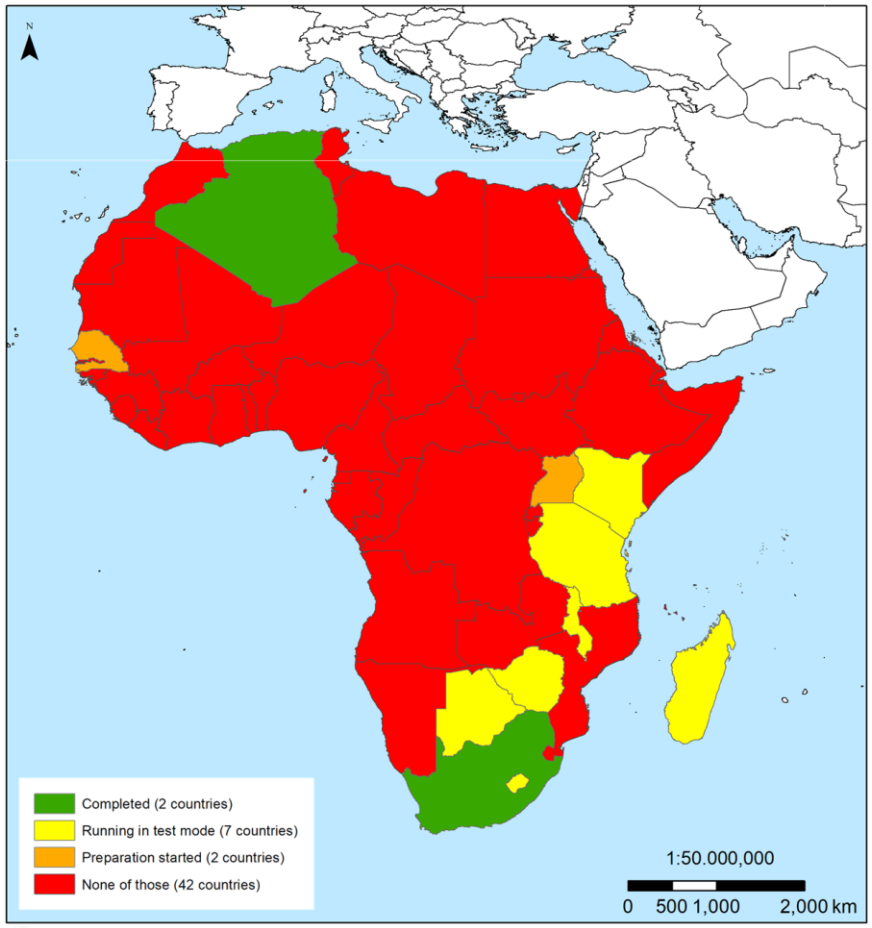
WMO OMM

Benefits of CAP

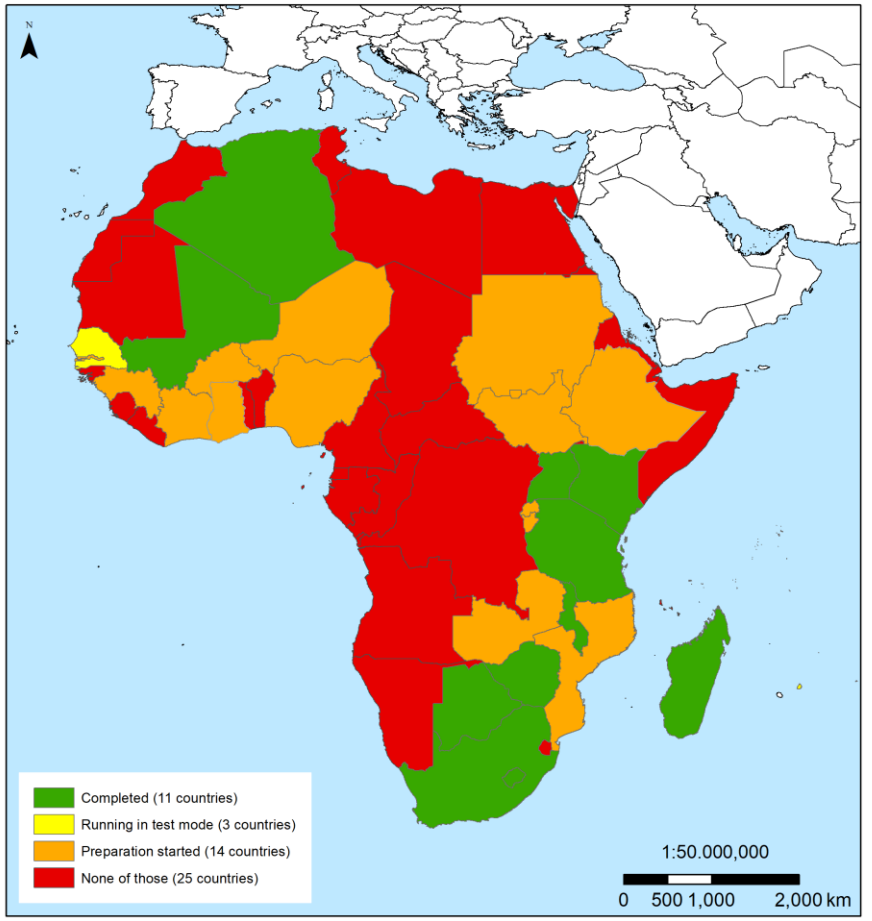
- Timely and effective warning information allows for better preparation and adaptation to hazardous events, hence reducing losses. Benefits of CAP include:
  - Ease and consistency at which alerts can be communicated to target users
  - Standardization of alerts from many sources for situational awareness and pattern detection
  - Compatibility with new technologies and existing formats
  - CAP is easy to implement at very little costs, especially given the training platform and the cloud-based CAP editor

Status of CAP Implementation

CAP implementation in RA I (Africa): work in progress: November 2020



CAP implementation in RA I (Africa): work in progress: November 2021



WMO OMM

WMO CAP Implementation in Africa

- **Recent In-country, Sub regional, Regional trainings:**
  - In-country CAP training in Burundi, Rwanda and Uganda (July, 2019)
  - Eastern African countries: Regional Training Workshop on Severe Weather Forecasting and Delivery of Warning Services, (under HIGHWAY project) (Kenya, Feb. 2019)
  - Western and Southern Africa during SWFDP Workshops
  - Annual International CAP Workshops

- **CAP free self-guided online Training Platform (2019)**
  - E-Platform Resource Access:
    - https://etrp.wmo.int/course/index.php?categoryid=51

Enhancing Early Warning Decision Support Systems

- Impact-based Forecasting and Warning Services (IBFWS)

Historically, NMHSs have featured forecasting of the weather as central to their mission.

Weather forecasts and warnings

what the weather **will be**

what the weather **will do**

WMO OMM

Impact-based Forecasting and Warning Services (IBFWS)

Heavy rainfall of over 40 mm (1.6 in) which can result in flash flooding is expected with the passage of the Cyclone.

FORECAST A

Extensive traffic delays in excess of 1 hour expected in south Ville at midday, due to flooded bridges and roads caused by heavy rainfall associated with the Cyclone.

FORECAST B

What do you notice about these forecast ?
Which do you think is more effective and why?

WMO OMM

Impact-based Forecasting and Warning Services (IBFWS)

"A hazard - a hydrometeorological-based, geophysical or human-induced element that poses a level of threat to life, property or the environment." **WMO- No. 1150**

Heavy rainfall of over 40 mm (1.6 in) which can result in flash flooding is expected with the passage of the Cyclone.

Extensive traffic delays in excess of 1 hour expected in south Ville at midday, due to flooded bridges and roads caused by heavy rainfall associated with the Cyclone.

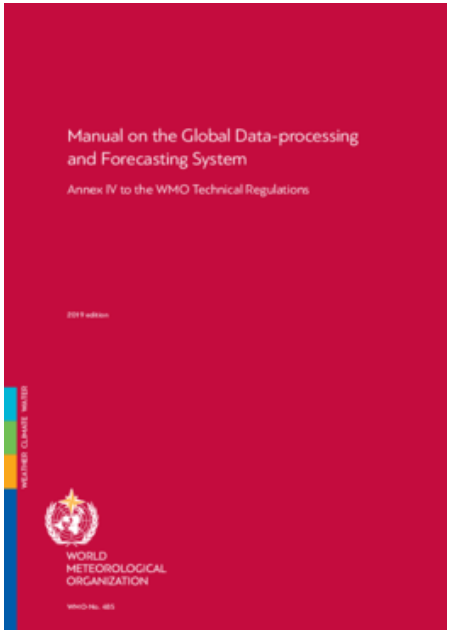
Focus is on forecasting weather-based hazards.

Detailed information down to the individual, activity or community level. Purview of partnering agencies rather than the role of the NMHS itself.

WMO OMM

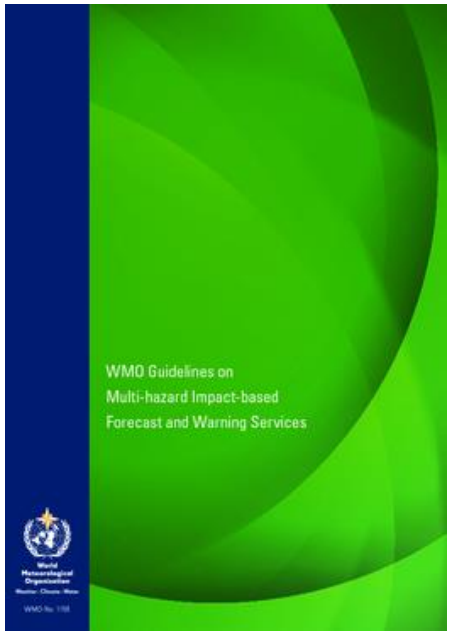
Enhancing Early Warning Decision Support Systems - Guidelines

WMO - No. 485



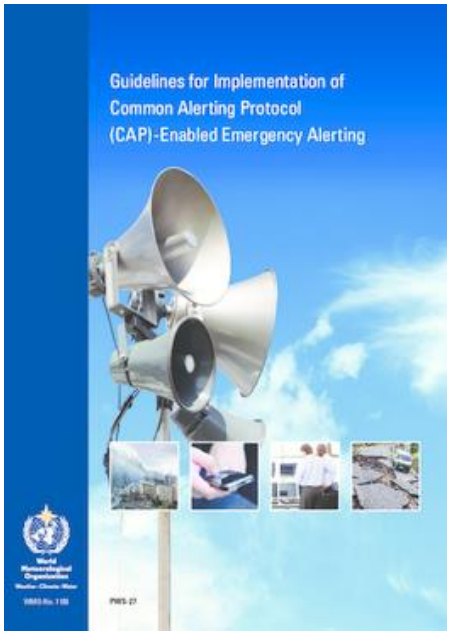
Manual on the Global Data-processing and Forecasting System: Annex IV to the WMO Technical Regulations

WMO - No. 1150



WMO Guidelines on Multi-hazard Impact-based Forecast and Warning Services

WMO - No. 1109



Guidelines for Implementation of Common Alerting Protocol (CAP)-Enabled Emergency Alerting

For further details: WMO Library Reference: https://library.wmo.int/

Actionable Warning - Partnerships and Data Sharing

- Enhanced collaboration and coordination between NMHSs and stakeholders to help people understand how hazards can affect them to ensure appropriate responses/actions.
  - Partnerships are important.

- Including the vulnerability of infrastructure to hydrometeorological multi-hazards and the likely behaviour of people during an emergency, NMHSs could help minimize the adverse impacts due to fatalities, damage and loss associated with these hazards.
  - Data sharing (demographic, GIS and mapping and economic) among NMHSs and stakeholder agencies are imperative.
  - Understanding the needs of stakeholder agencies is important to tailor services and products and to enhance service delivery.

Breakout Rooms Discussion and Conclusion

(Pre-assigned groups by sectors with 10 mins for breakout room collaborations and 10 mins for presentations and discussions)

- Your country has been experiencing reduced rainfall amounts and extreme heat in the past few consecutive years.
- Considering the situation, answer the following questions, collate responses and present.
  - What are the hazards associated with these conditions?
  - Do you think your sector can be impacted? In what ways?
  - Do you think your sector could provide data to enhance forecast into more impact-based forecast and early warning?
  - What data do you think could be useful?
  - In your opinion, in the present time how will the hazard(s) identified affect population & infrastructure as compared to 20 years ago?

WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

Thank you
Merci

arobertson@wmo.int

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale