WEATHER CLIMATE WATER
TEMPS CLIMAT EAU

WMO WIPPS Weather Forecast Data Supporting Early Warnings for ALL

Ken Mylne

Met Office, UK

Chair ET-OWFS (Expert Team on Operational Weather Forecast Systems)

Co-authors: David Richardson, Hamza Kabelwa, Yuhei Takaya, Stephanie Landman, Arun Kumar, Caio Coelho, Wai-Kin Wong, Francois Engelbrecht, Julia Keller and Yuki Honda

WMO OMM

World Meteorological Organization
Organisation météorologique mondiale

Early Warnings for All

The Early Warnings for All initiative is a groundbreaking effort to ensure everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027.

How?

UNDRR
UN Office for Disaster Risk Reduction

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Disaster risk knowledge
Systematically collect data and undertake risk assessments

- Are the hazards and the vulnerabilities well known by the communities?
- What are the patterns and trends in these factors?
- Are risk maps and data widely available?

Detection, observations, monitoring, analysis and forecasting of hazards
Develop hazard monitoring and early warning services

- Are the right parameters being monitored?
- Is there a sound scientific basis for making forecasts?
- Can accurate and timely warnings be generated?

Preparedness and response capabilities
Build national and community response capabilities

- Are response plans up to date and tested?
- Are local capacities and knowledge made use of?
- Are people preapred and ready to react to warnings?

Warning dissemination and communication
Communicate risk information and early warnings

- Do warnings reach all of those at risk?
- Are the risks and warnings understood?
- Is the warning information clear and usable?

IFRC

ITU

ADAPTATION FUND

GREEN CLIMATE FUND

CREWS CLIMATE RISK & EARLY WARNING SYSTEMS

SOFF
Systematic Observations Financing Facility

USAID
UNITED STATES AGENCY INTERNATIONAL DEVELOPMENT

Pillar 2 is focused on delivering 5 outcomes:

- **Increased availability of quality observation data** to assess and monitor priority hazards.
- **Enhanced data exchange and access for forecasting and warning systems**.
- **Increased capabilities to forecast** all priority hydrometeorological hazards.
- **Impact-based forecasts and warnings are produced** for all priority hazards.
- **Strengthened relevant policy, institutional mechanisms**, and stakeholder engagement processes in place to support MHEWSs

Delivery of Early Warnings for All requires scaled up and coordinated investments and action across four essential pillars of Multi-Hazard Early Warning Systems



Component systems of the World Weather Watch:

WIGOS – Observations
WIS – Data Exchange
WIPPS – Prediction

Sharing of **"essential"** prediction data to enable WMO Members to issue basic forecast and warning services in their countries.

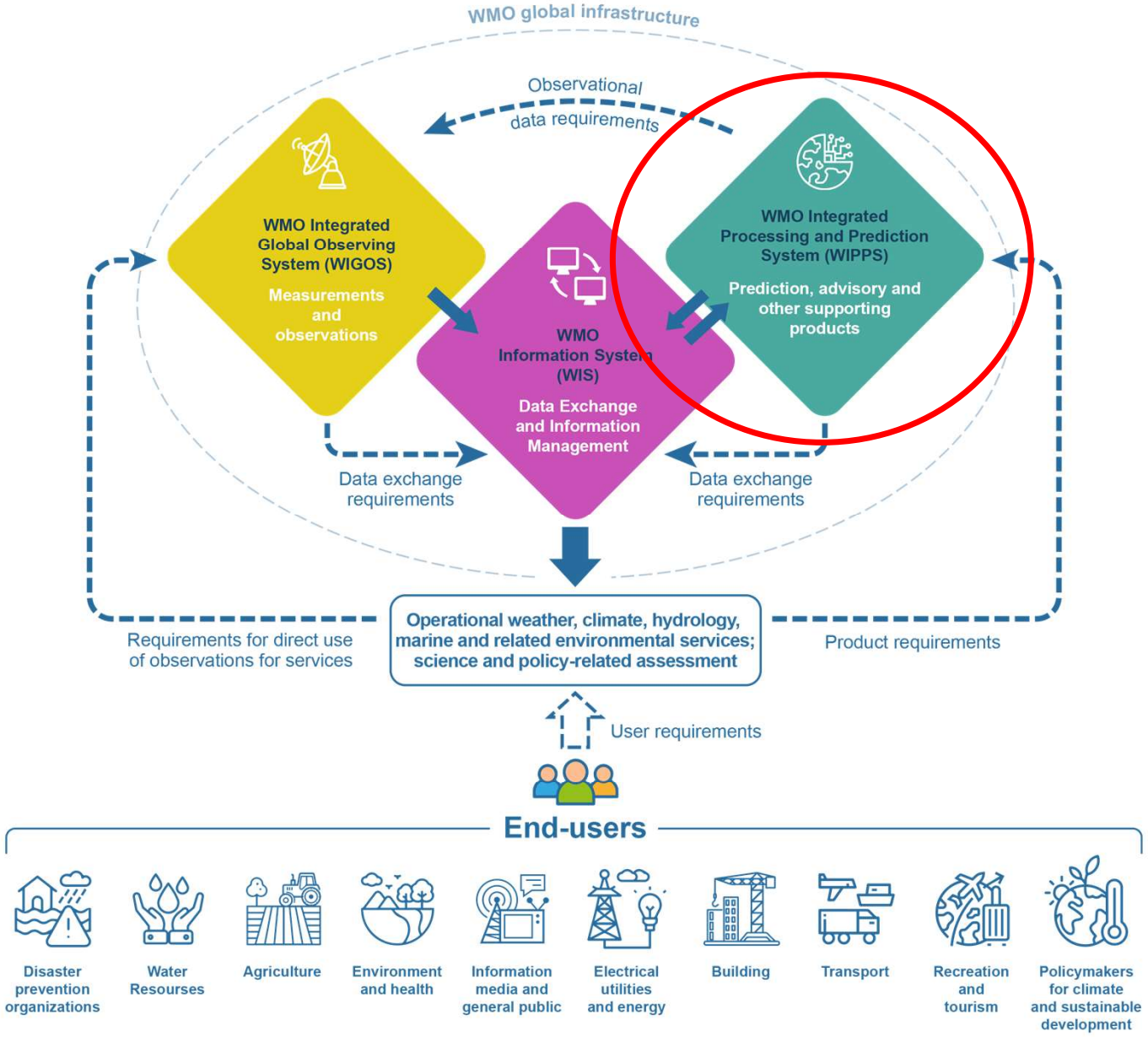
Many countries have advanced prediction capabilities –

WIPPS is about supporting those that may not. Often:

- Developing countries
- Vulnerable populations

Core to EW4All

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Early Warnings for All

The Early Warnings for All initiative is a groundbreaking effort to ensure everyone on Earth is protected from hazardous weather, water, or climate events through life-saving early warning systems by the end of 2027.

ADAPTATION FUND

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CREWS CLIMATE RISK & EARLY WARNING SYSTEMS

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USAID UNITED STATES AGENCY INTERNATIONAL DEVELOPMENT

WIPPS – Prediction

How?

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Detection, observations, monitoring, analysis and forecasting of hazards

Develop hazard monitoring and early warning services

- Are the right parameters being monitored?
- Is there a sound scientific basis for making forecasts?
- Can accurate and timely warnings be generated?

Pillar 2 is focused on:

- **Quality observation**
- **Enhanced data exchange and access for forecasting and warning systems.**
- **Increased capabilities to forecast.**
- **Impact-based forecasts and warnings**



WMCs and WIPPS Designated Centres

WIPPS Designated Centres (RSMCs)

(1) **general purpose**: essential data e.g. NWP

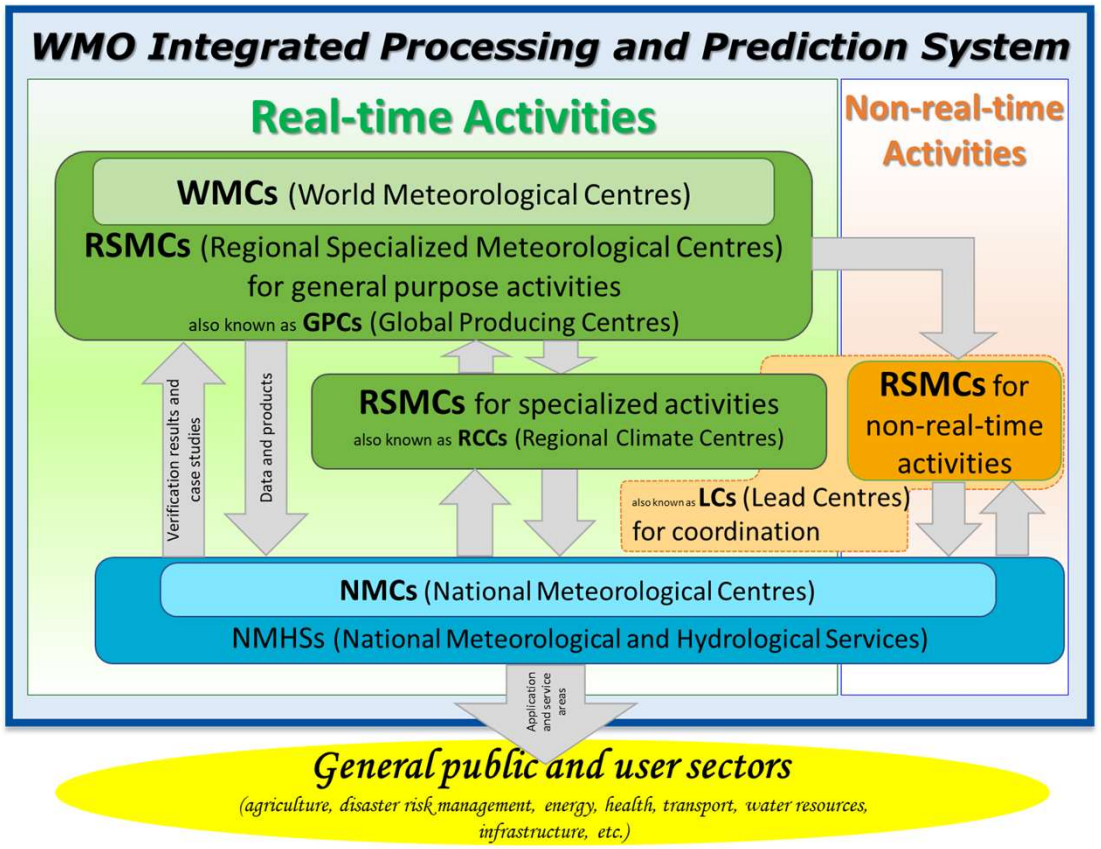
(2) **specialized activities**: for specific types of application e.g. dispersion emergencies, Regional Severe Weather Guidance

(1) **non-real-time**: verification

WMCs are advanced NWP centres that do:
- Global deterministic NWP;
- Global ensemble NWP;
- Global numerical long-range prediction.

NMCs forecasting and warning services.

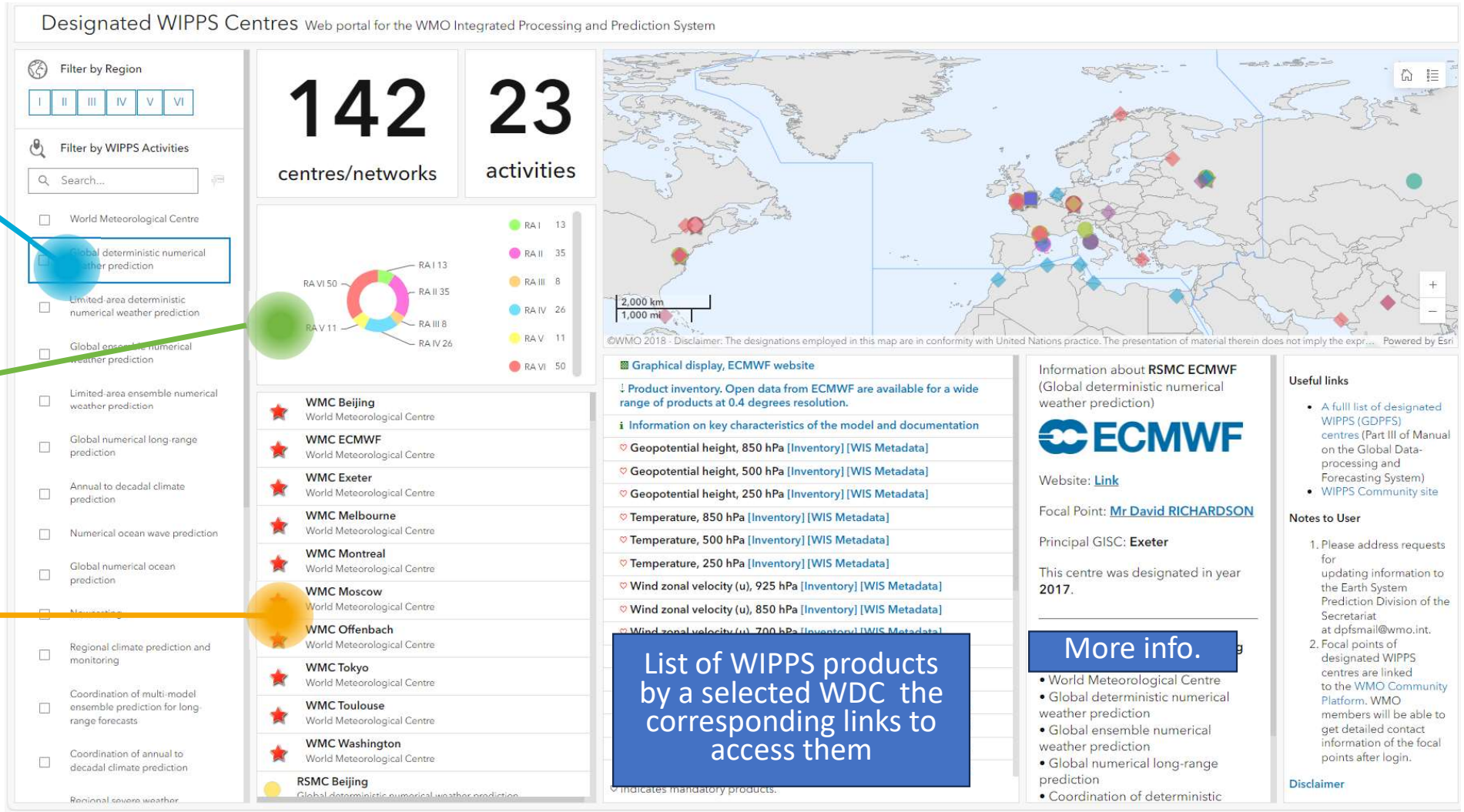
Key for EW4ALL



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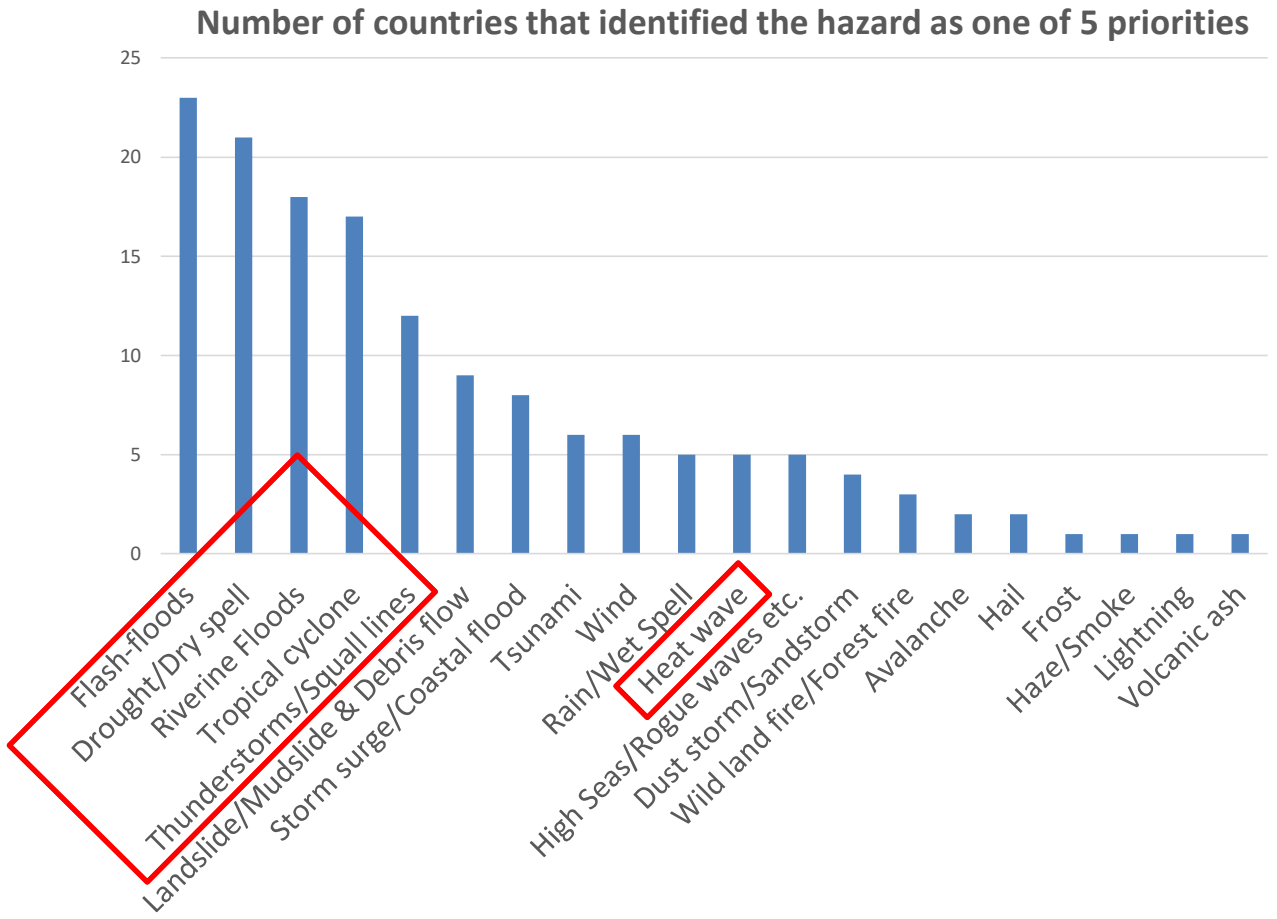
WIPPS Designated Centres (WDCs)

- WIPPS Web Portal: WIPPS Web Portal | World Meteorological Organization (wmo.int)



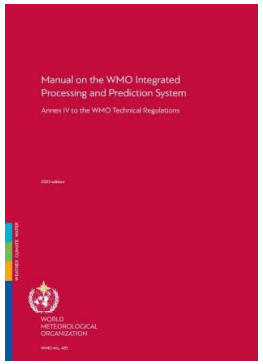
Priority hazards

- Priority hazards need to be decided by each country.
- For the short-term actions, identified
  - Flood
  - Drought
  - TC
  - Heatwave
  - Thunderstorm/squall lines.



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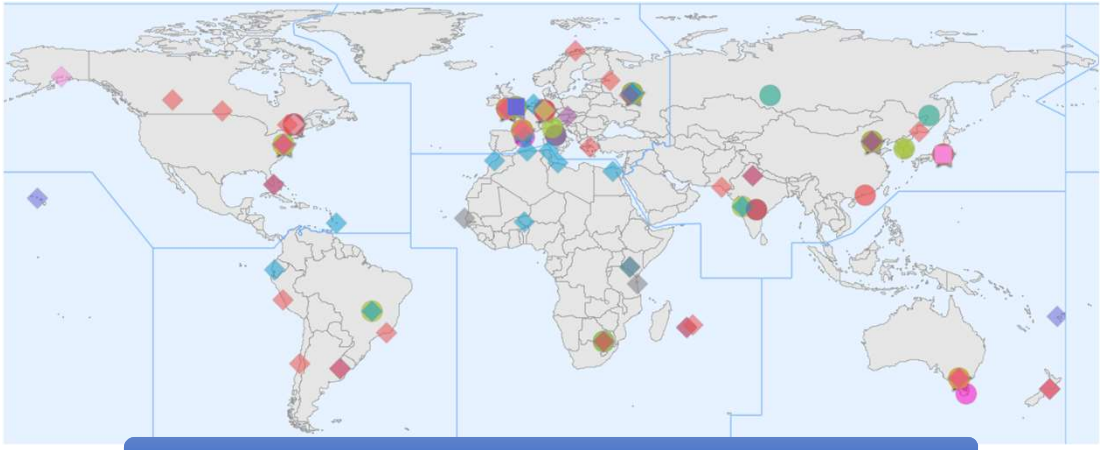
WIPPS Manual and Guide



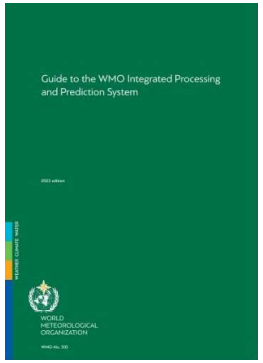
Manual on WIPPS (WMO-No.485)

Regulatory – specifies the obligations for Designated Centres

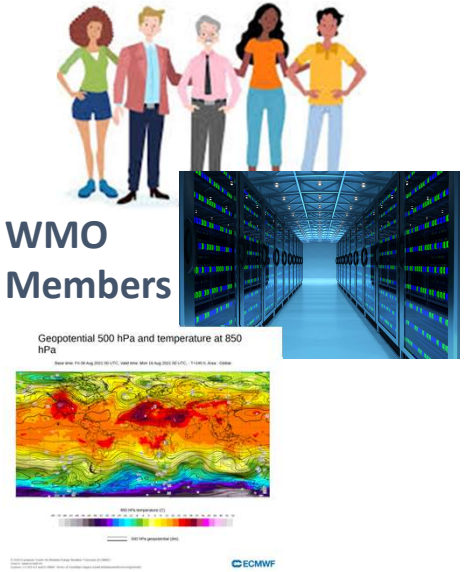
- Mandatory (Core) data
- Recommended – optional but encouraged!



WIPPS Designated Centres



Guide to WIPPS (WMO-No.305) - detailed explanation of WIPPS and how to implement and utilize it.



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2024 Upgrades to Mandatory Sharing of Deterministic NWP Data

Upgrades focused on support for severe, high-impact weather

Global deterministic NWP for short to medium range

Parameter	*Level (hPa)*	*Resolution*	*Forecast range*	*Time steps*	*Frequency*
Geopotential height	850/500/250/200	~~1.5~~0.5°× ~~1.5~~0.5°	Up to 3 days/ Beyond 3 days up to 6 days	Every ~~6~~3 hours/ Every ~~12~~6 hours	Twice a day ~~(0000 and 1200 UTC)~~/ ~~Once a day~~
Temperature	850/500/250/200				
Wind zonal velocity (u) and meridional velocity (v)	925/850/700/500/250/200				
Relative humidity	850/700/500/200				
~~Divergence, vorticity~~	~~925/700/250~~				
MSLP	Surface				
2-m temperature 2-m minimum and maximum temperatures in the periods of the last 3/6 hours 2-m dewpoint temperature 10-m u, 10-m v 10-m wind gusts[1] Total precipitation Total Solid precipitation[2] CAPE[3] Total precipitable water Total cloud cover	Surface				

Notes:

1. Wind gusts are the maximum gusts in the pe
2. Water equivalent of total solid precipitation,
3. Recommended most unstable CAPE (MUCAPE model characteristics web page

Additional recommended products:

- ~~Tropical storm tracks (latitudinal/longitudinal locations, maximum sustained wind speed, MSLP).~~
- More fields describing precipitation type
- Mid-level CAPE
- 1-hour accumulated total precipitation
- Snow depth
- Divergence and vorticity (925/850/700/500/250/200 hPa)
- Downward solar radiation at surface
- Outgoing longwave radiation at surface
- Heatwave Index
- Wind u and v at additional heights 80m, 100m, 120m or 150m above ground
- Option to access high-resolution data (up to full model resolution).
- Provide data additionally in form of map layers, graphics or visualization.

Core Data upgrade

- Increase horizontal resolution and time steps
- Add more variables and levels
- **Add TC Vortex Tracks and Intensities**

Recommended

- Further impact-related variables
- Higher resolution
- **Visualization**

Similar for Ensemble Data

Core Data upgrade

- Increase horizontal resolution and time steps
- Add more variables and levels
- **Add ensemble TC Vortex Tracks and Intensities**
- **Mean/spread replaced by Quantiles and Probabilities**

Recommended

- Further impact-related variables
- Higher resolution
- **Visualization**

Global ensemble NWP for short to medium range (1/2)

Parameter	*Level ~~(hPa)~~*	*Thresholds* [1]	*Resolution (lat/lon grid)*	*Forecast range*	*Time steps*	*Frequency*
Probability of total precipitation in the last 6 hours and 24 hours	Surface	1, 5, 10, 25, 50 and 100 mm/24 hours; 1, 5, 10, 25 and 50 mm/6 hours	~~1.5~~0.5° × ~~1.5~~0.5°	~~10~~14 days (or the maximum range if less)	~~Every 12 hours~~ Every 3 hours to 72 hours, then every 6 hours.	~~Once~~Twice a day
Percentiles for total precipitation in the last 6 hours and 24 hours	Surface	25th, 50th, 75th, max				
Percentiles for total solid precipitation [2] in the last 6 hours	Surface	25th, 50th, 75th, max				
Percentiles for temperature	2 m, 850 hPa	min, 25th, 50th, 75th, max				
Probability of 10-m sustained wind ~~and gusts~~	~~Surface~~10 m	10, 15, 20 and 25 m s^{-1}				
Probability of 10-m wind gusts [3]	10 m	15, 25 and 35 m s^{-1}				
Percentiles for 10-m wind speed	10 m, 850 hPa, 250 hPa	min, 25th, 50th, 75th, max				
Percentiles for 10-m wind gusts [3]	10 m	min, 25th, 50th, 75th, max				
Percentiles for CAPE[4]	Surface	25th, 50th, 75th, max				

MASSIVE increase in data volumes to be exchanged – deemed essential to support warnings of high-impact weather

Tropical low/cyclone vortex variables

Mandatory Products:

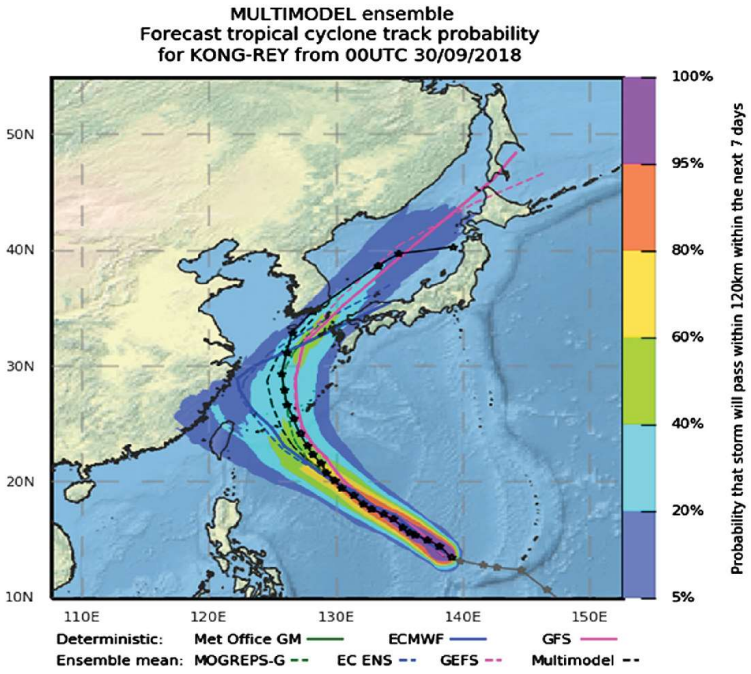
Parameter	*Unit*	*Forecast range*	*Time steps*	*Frequency*
Location (latitude and longitude) of the vortex centre	[degree]	Up to 6 days [3]	Every 6 hours	Twice a day[4]
Maximum sustained 10 m wind speed	[m/s]			
Location[1] (latitude and longitude) of maximum sustained 10 m wind	[degree]			
Minimum mean sea level pressure (MSLP)	[hPa]			
Quadrant radii of sustained 10 m winds of 28/34/50[2]/64 kt	[km]			

14 days for ensemble

Recommended Products:

Parameter	*Unit*	*Forecast range*	*Time steps*	*Frequency*
Average steering wind zonal velocity (u) and meridional velocity (v)[1] at 850/500/200 hPa	[m/s]	Up to 6 days[2]	Every 6 hours	Twice a day[3]

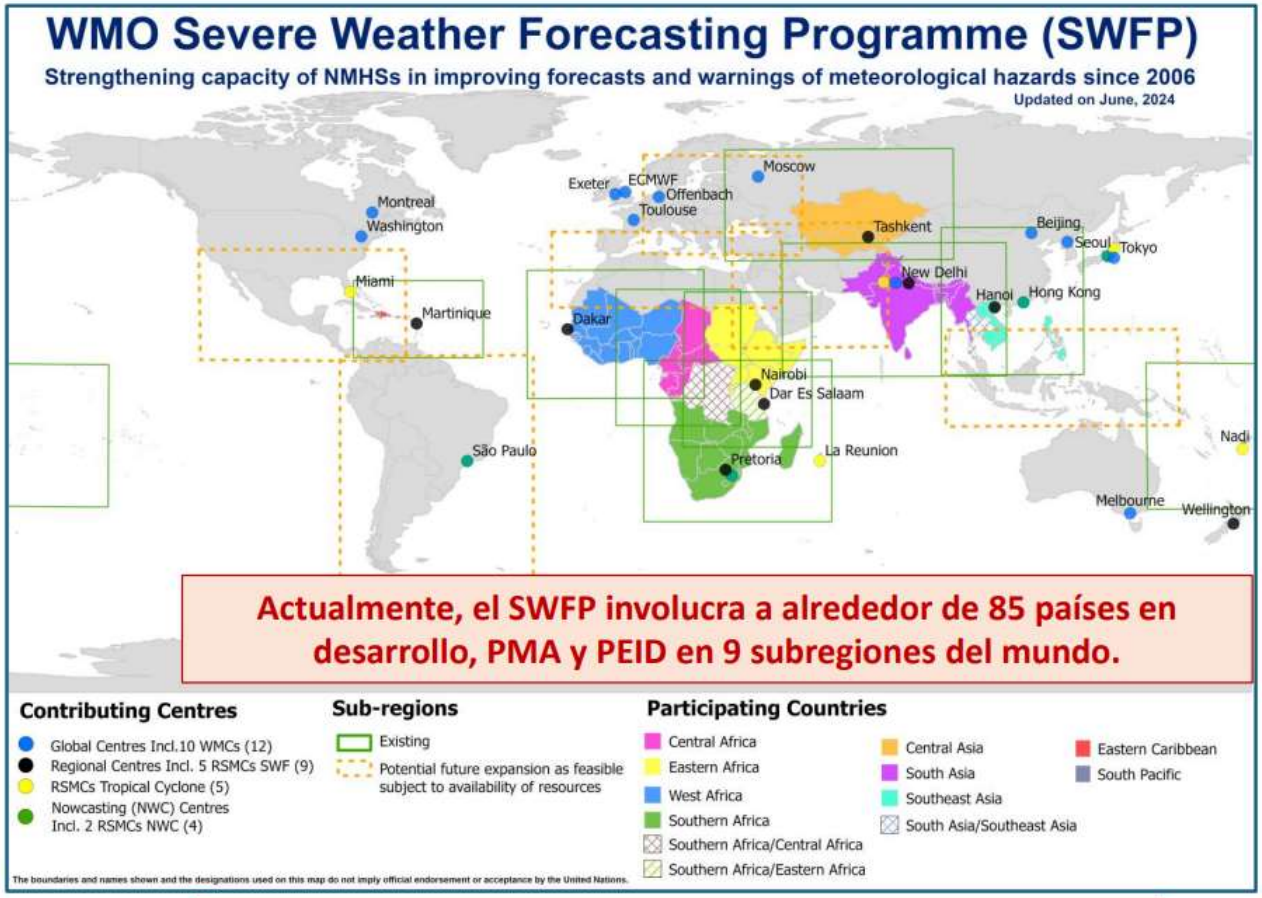
The same set of variables are mandatory products of RSMCs for global deterministic and ensemble NWP.



From Titley, H.A., et al (2019)
https://doi.org/10.1002/qj.3712

Subprogramas regionales del SWFP/ SWFP Regional Subrogrammes

1. **SWFP-Southern Africa** ***(16 countries):***
   RSMC-SWF Pretoria, RSMC-TC La Réunion
3. **SWFP-Eastern Africa** ***(7+3=10 countries)***:
   RSMC-SWF Nairobi, RSMC SWF Dar Es Salaam
4. **SWFP-West Africa** ***(15+1=16 countries):***
   RSMC-SWF Dakar
5. **SWFP-Central Africa** ***(7 countries):***
   RSMC-SWF Dakar
6. **SWFP-Southeast Asia** ***(5 countries)***:
   RFSC Ha Noi, RSMCs-TC (Tokyo & New Delhi), RSMC-NWC (Hong Kong & Tokyo)
5. **SWFP-South Asia** ***(9 countries):***
   IMD/RSMC New Delhi, RSMC-TC New Delhi
6. **SWFP-Central Asia** ***(5 countries):***
   Roshydromet, RSMC Tashkent
8. **SWFP-Eastern Caribbean** ***(19 SIDS and territories):***
   RFSF Martinique, RSMC-TC Miami
9. **SWFP-South Pacific Islands** ***(10 Pacific SIDS):***
   RSMC SWF Wellington, RSMC-TC Fiji
10. **SWFP-Central America?**
    (Introductory Scoping meeting held on 25 June 2024, and Technical planning meeting in Costa Rica during 21-25 October 2024)
11. **SWFP-Southeastern Asia-Oceania?**
    (Meeting with SWFP FPs on 27 August 2024, and Technical planning meeting planned in Indonesia, during 10-14 February 2025)



Actualmente, el SWFP involucra a alrededor de 85 países en desarrollo, PMA y PEID en 9 subregiones del mundo.

Currently, SWFP involves around 85 developing countries, LDCs and SIDS in 9 subregions of the world.

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RSMC SWF Pretoria

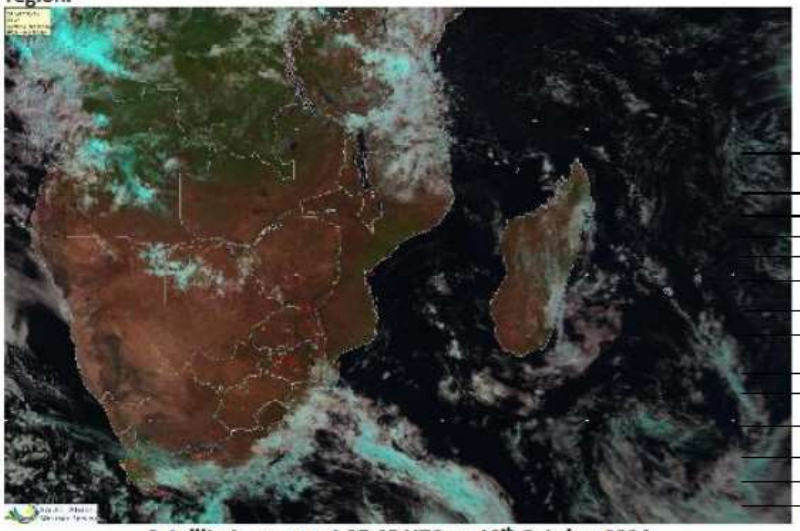
South African Weather Service

Private Bag X097, Pretoria, 0001 • Tel: + 27 (0) 12 367 6000 • www.weathersa.co.za • USSD: *120*7297#

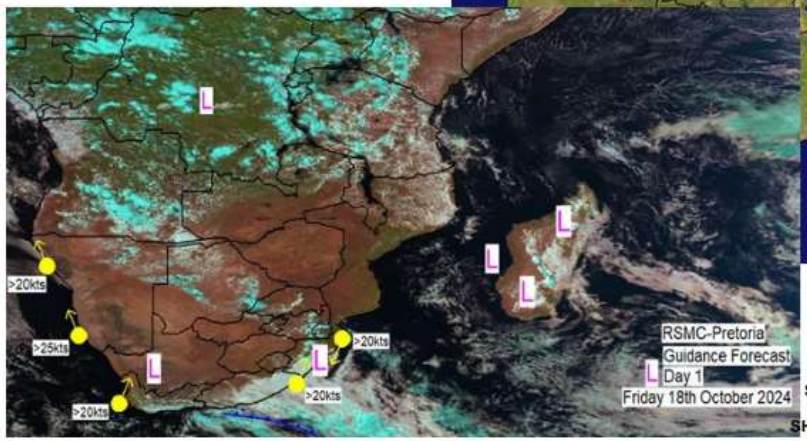
RSMC-PETORIA
SWFP GUIDANCE PRODUCTS
SHORT-RANGE (DAYS 1 and 2)
Issued Date: 19th October 2024
SYNOPSIS OF EXPECTED WEATHER PATERNS

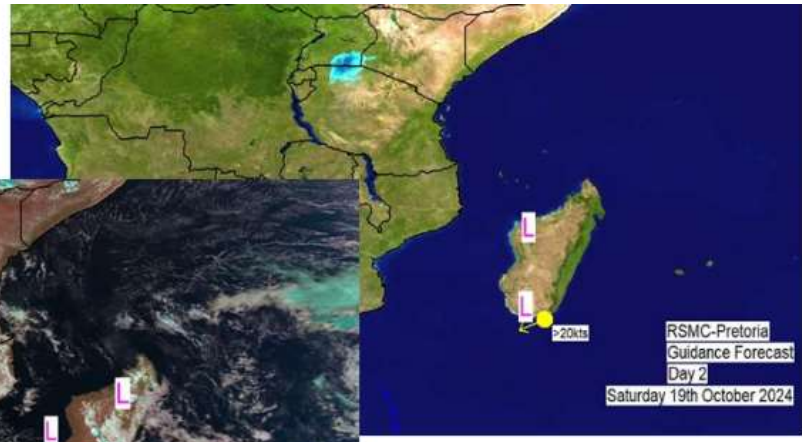
Day 1: Saturday 19th October 2024

Medium chance of heavy rain with possible localized flooding expected along the south-east coast of RSA. Strong wind expected along the south coast of Namibia and west coast of RSA as well as along the south and north-east coats of Madagascar. Otherwise, no severe or significant weather in the other areas of the region.



Satellite Image as at 07:45 UTC on 19th October 2024





RSMC-PRETORIA
SWFP GUIDANCE PRODUCTS
PROBABILITY TABLES
SHORT RANGE (DAY 1 TO DAY 2)

Issue Date: 19th October 2024

In order to provide more information about the geographical location of the severe event the following convention 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 and E for the eastern parts.

Day 2: Sunday 20th October 2024

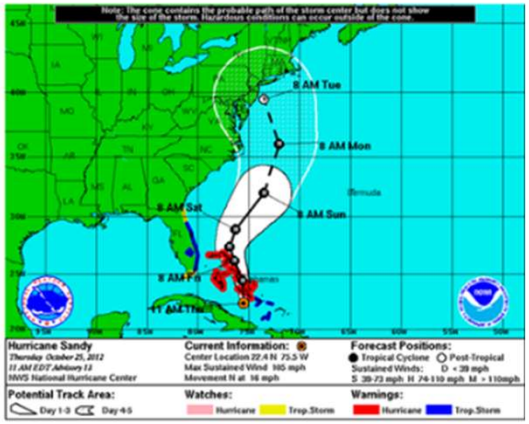
RISK	No risk	Low risk	Medium risk	High risk	No risk	Low risk	Medium risk	High risk
	Heavy Rain				Strong Winds			
Angola	X				X			
Botswana	X				X			
DRC	X				X			
Comoros	X				X			
Lesotho	X				X			
Madagascar	X						S&NE coast	
Malawi	X				X			
Mauritius	X				X			
Mozambique	X				X			
Namibia	X						Coast	
Seychelles	X				X			
South Africa			SE coast&E parts				SW&W coast	
eSwatini	X				X			
Tanzania	X				X			
Zambia	X				X			
Zimbabwe	X				X			

Day 1: Saturday 19th October 2024

RISK	No risk	Low risk	Medium risk	High risk	No risk	Low risk	Medium risk	High risk
	Heavy Rain				Strong Winds			
Angola	X				X			
Botswana	X				X			
DRC	X				X			
Comoros	X				X			
Lesotho	X				X			
Madagascar	X						S&NE coasts	
Malawi	X				X			
Mauritius	X				X			
Mozambique	X				X			
Namibia	X					S coast		
Seychelles	X				X			
South Africa		SE coast				W coast		
eSwatini	X				X			
Tanzania	X				X			
Zambia	X				X			
Zimbabwe	X				X			

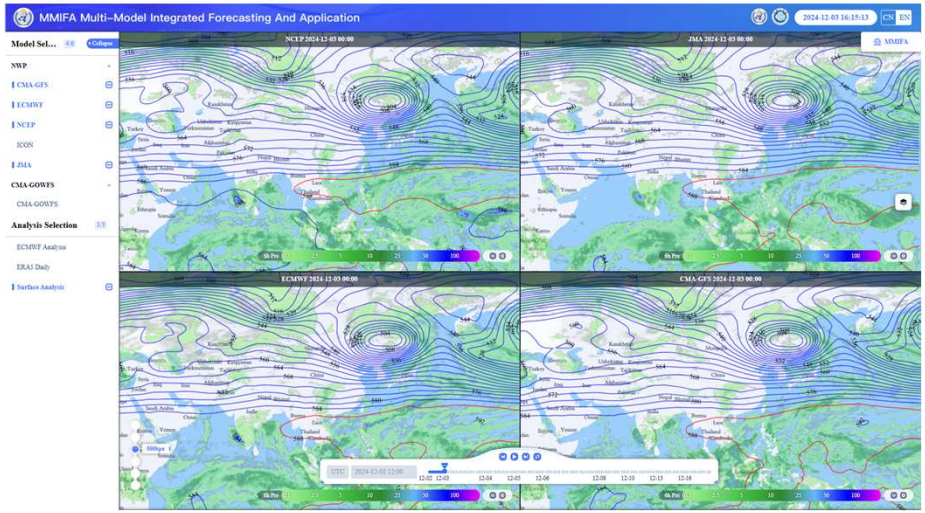
Future Development - WIPPS Pilot Projects

- Tropical Cyclone-Probabilistic Forecast Products
  - Exploiting ensembles for better TC cones of uncertainty



- AI for Nowcasting Pilot Project
  - Operational AI-based Nowcasting Products
  - Focus on Africa, S. America and S.E. Asia

- Multi-Model Integrated Forecasting and Application
  - Visualization of NWP data for developing countries



- Global riverine flood (under development)

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Thank you



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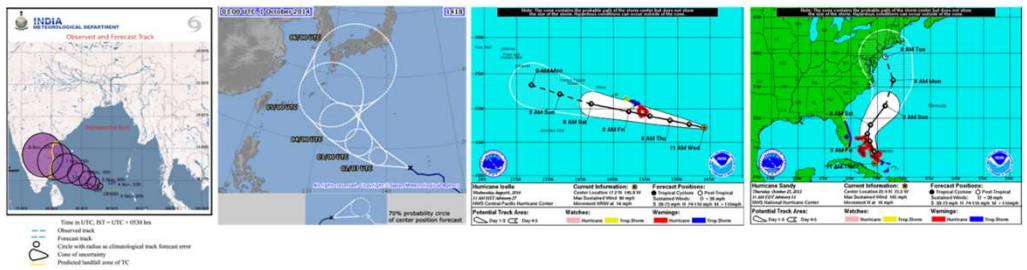
WMO/WWRP Project
Tropical Cyclone Probabilistic Forecast Products (TC-PFP)

Purpose:

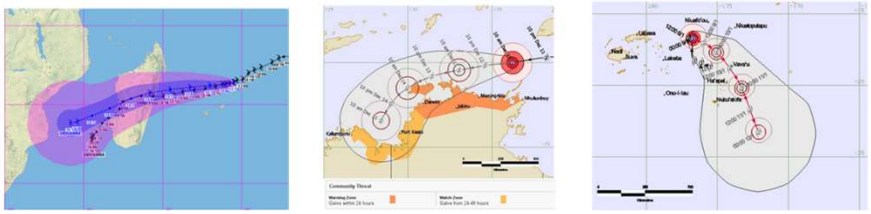
- To coordinate across RSMCs, TCWCs and other forecast & NWP centers to identify best practice guidance for probabilistic tropical cyclone forecasts, to **promote the transfer of research-to-operations and provide better services to users**.

Examples of operational
TC track forecast products

NIO WNP CNP ESP/ATL



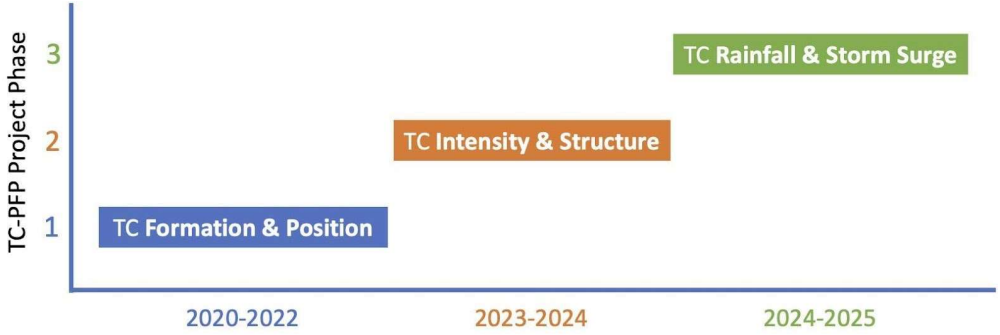
SIO AUS SPC



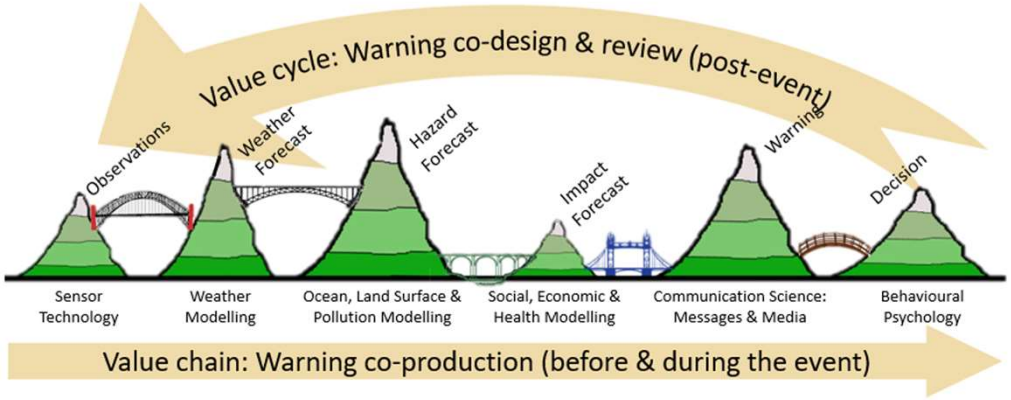
- All centers use cones/circles to express forecast uncertainty
- The size of the cones/circles are determined from historical forecast errors (i.e., static statistics)
- However, forecast uncertainty varies from one TC to another and from one initial time to another.

Three Phases of TC-PFP and Value Cycle Approach

- TC-PFP has 3 phases, each working with forecast centers to help identify best practices for probabilistic forecasts of:
  - **<u>Phase 1:</u> TC formation & position**
  - **<u>Phase 2:</u> TC intensity & structure**
  - **<u>Phase 3:</u> TC-related rainfall & storm surge**

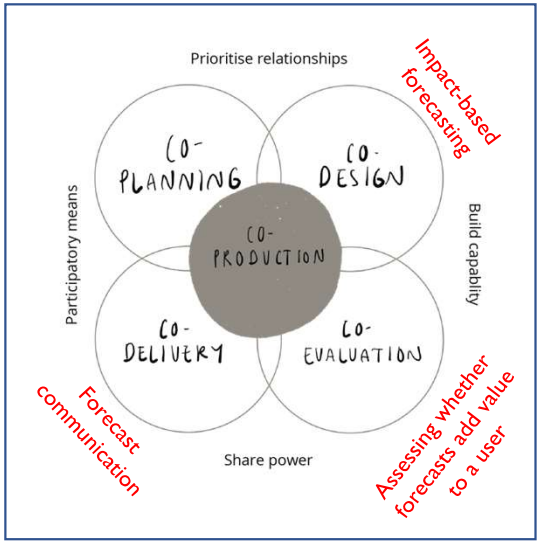


- TC-PFP Phase Topic Areas
  - Current & planned probabilistic forecast products
  - Understanding & communicating probabilistic forecasts
  - Resources for producing probabilistic forecasts



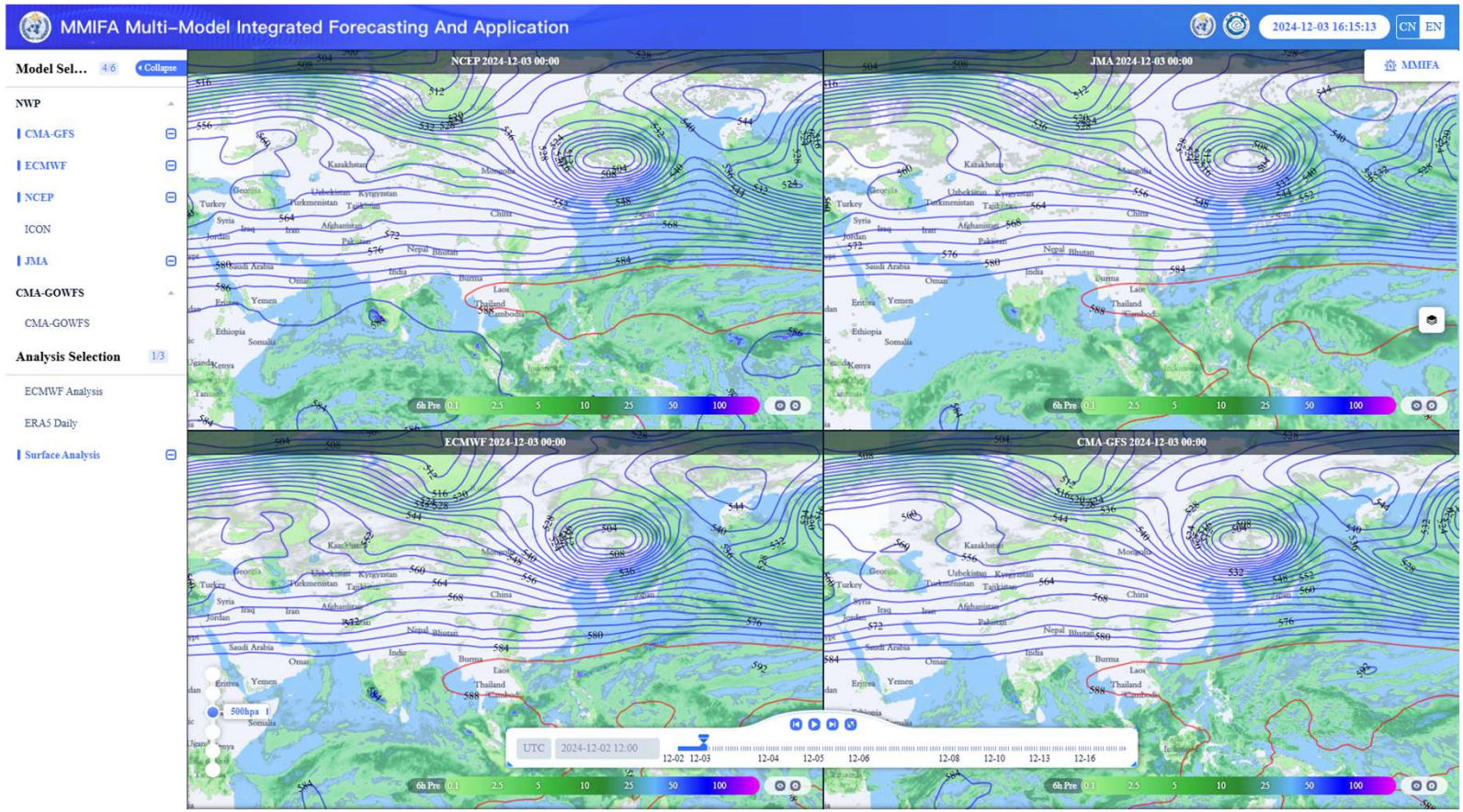
Value cycle approach

Users are not "end users" but rather valuable partners in co-designing product information that is useful for a variety of situations.



MMIFA Implementation - Highlights

- A prototype MMIFA platform has been developed
  - Five global deterministic NWP products available (CMA, ECMWF, NCEP, JMA, DWD)
  - Data are visualized in uniform style / format
  - Zoom-in / out, overlay of different fields on-the-fly and in an interactive way

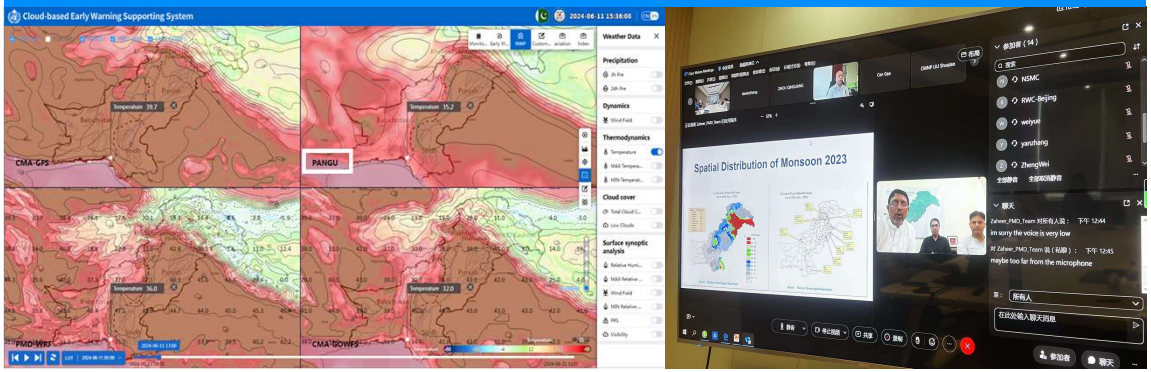


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MMIFA - Next steps

- Optimize the MMIFA platform and add more WIPPS core data from global centres which needs cloud-based environment for fast visualization.
- Promote application of MMIFA and collect requirements and feedbacks from participating members for effective visualization
- Conduct trainings on the MMIFA platform and products for forecasters
- Promote to WMO's RA II Members in joining the MMIFA to bring relevant experience, knowledge or further co-develop the customized tools to support the EW4A
  - MMIFA platform customized for application in CMA's Early Warning Support Platform, and it has been put in trial for supporting the Pakistan Meteorological Department and the Solomon Island Meteorological Service with additional localized application products.

Early Warning Support Platform customized for Pakistan Meteorological Department



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AI for nowcasting Pilot project (AINPP)

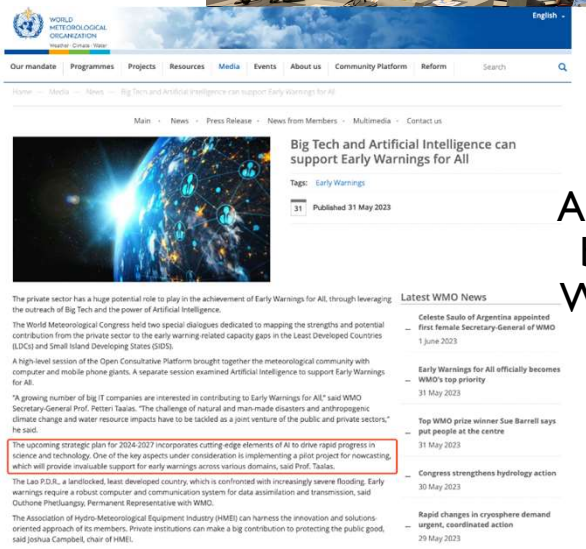
Motivation

- Support the EW4ALL Initiative
- Support and strengthen earth system prediction with AI
- Narrow the AI capacity gap between WMO Members
- Promote Public-Private Engagement (PPE) on AI

Expected Outcomes

- New WMO Regional nowcasting centers
- Operational AI-based Nowcasting Products, including satellite cloud prediction, rainfall, lightning, etc..
- Best practice cases of AI for nowcasting
- AI Guidelines and AI benchmark datasets

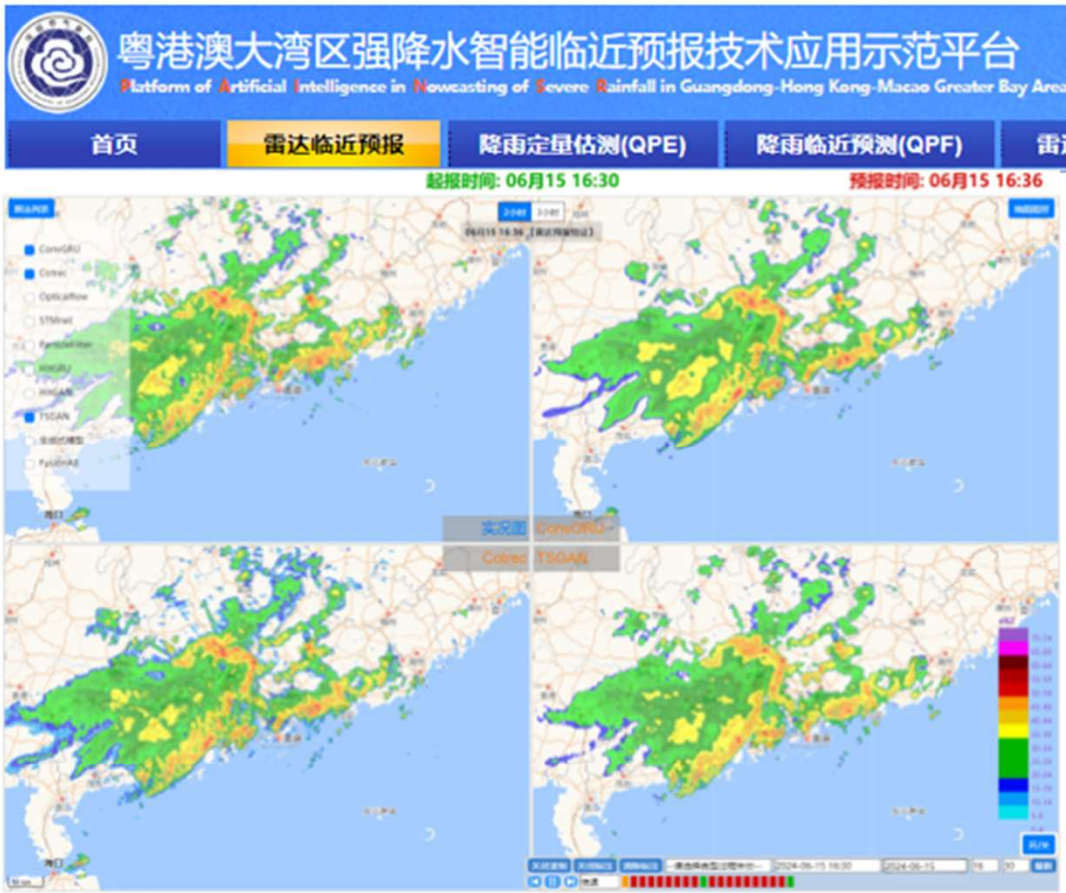




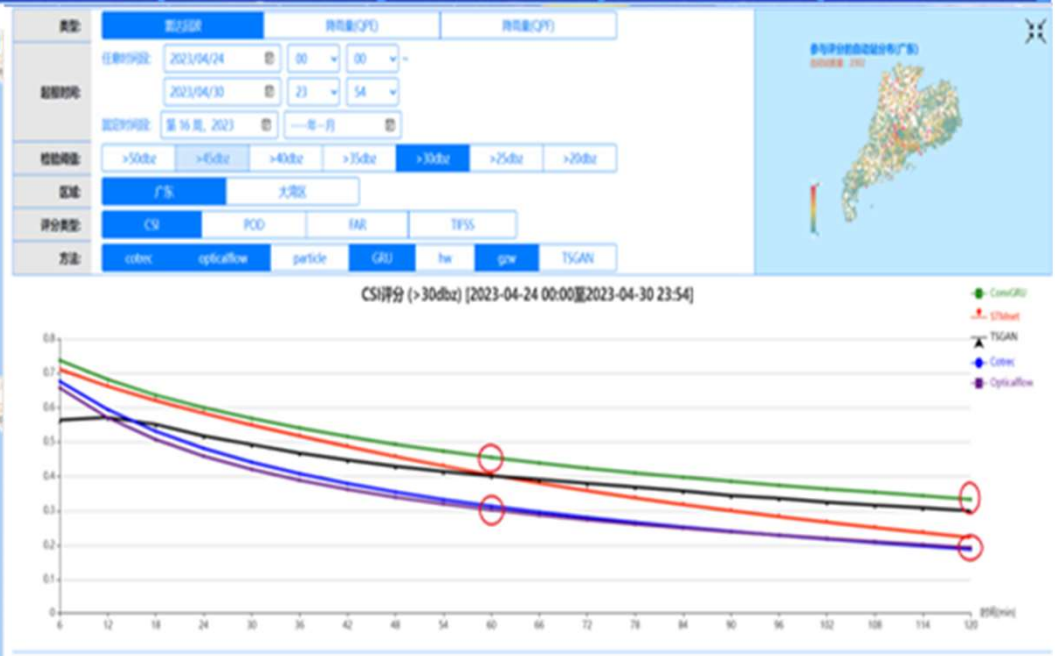
AINPP was highlighted by WMO SG during WMO Congress 19 in May 2023

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An integrated visualization platform hosted by CMA (Shenzhen) for AINPP Intercomparison



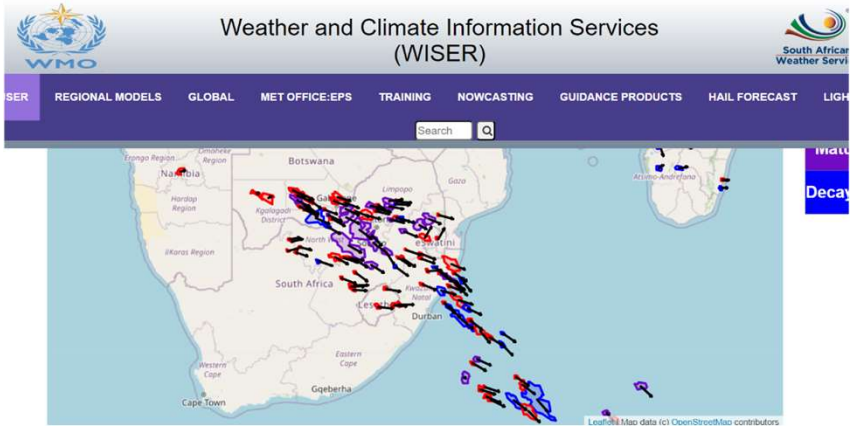
Visualization of different nowcast QPFs



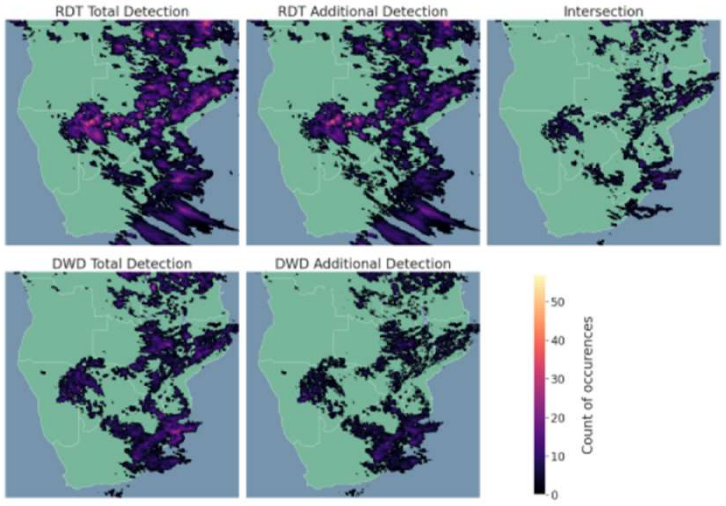
Real-time verification display

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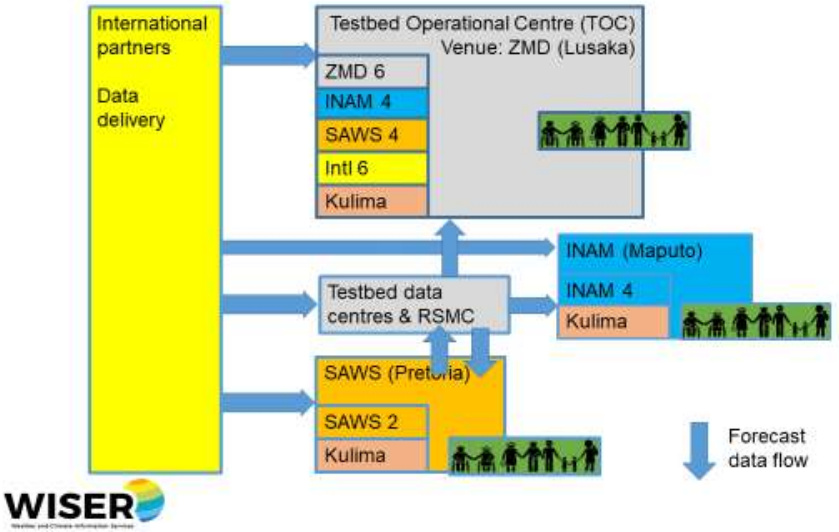
Testbed in Africa – Lusaka 29th Jan – 9th Feb 2024



The nowcasting products on the testbed website



DWD's thunderstorm nowcasting products in the testbed

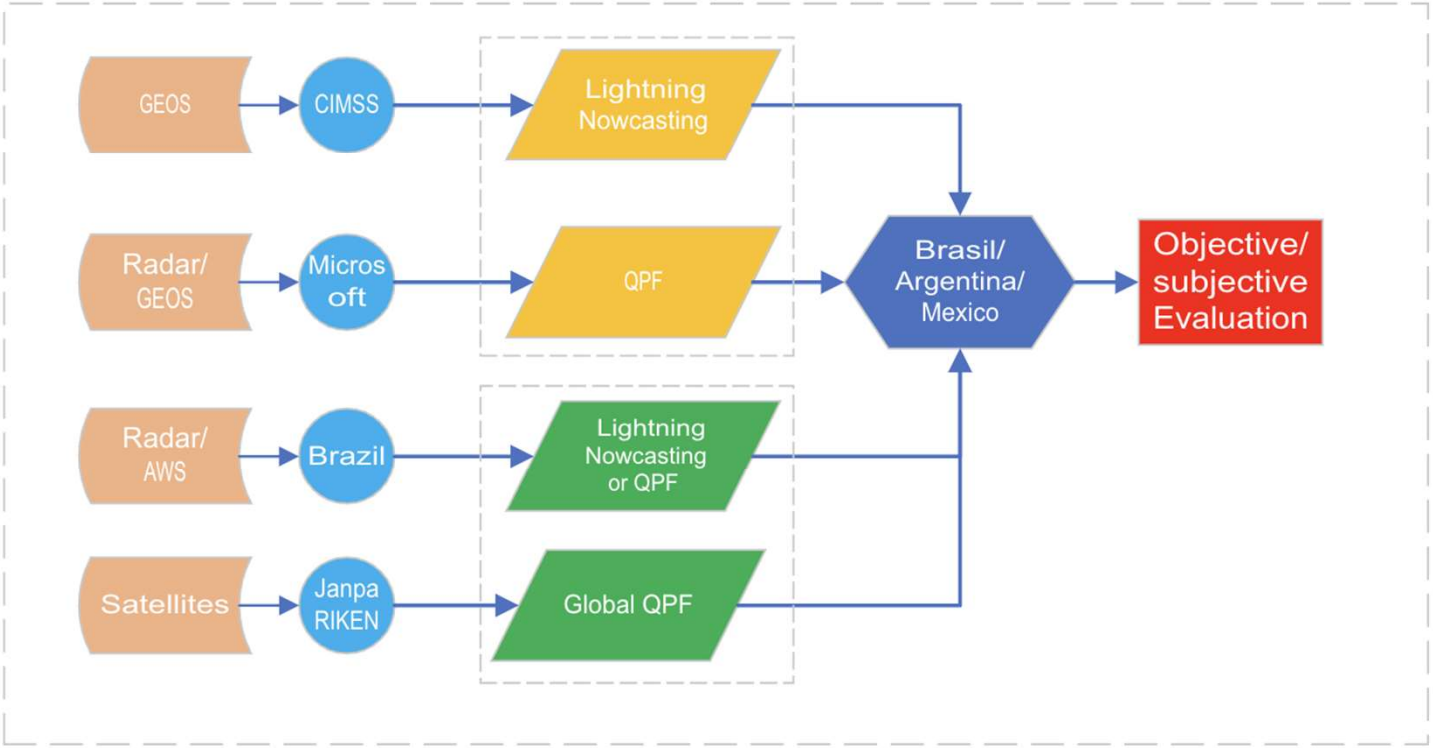


The overall workflow of the testbed

AINPP inclusion:

- NCAS-Leeds, WMO (partners)
- DWD (thunderstorm product)
- Google (active visitors)

Intercomparison in Latin America



Nowcasting Area 1



Nowcasting Area 2



Participants: CIMSS, Microsoft, RIKEN, INPE(Brazil), USP (Brazil), UBA (Argentina), Universidad de Colima (Mexico)

Hindcast:

- Lightning nowcasting: 30days from Sept 2023 ~ Feb 2024(South America) and 30days from April 2024~September 2024(Mexico).
- Rainfall nowcasting: Active season for Precipitation from El Nino 2023-2024;

Expected Outcomes of Pilot Projects

- Strengthen WIPPS as System (CF: System and Services; CF: Accessibility and Web Platform)
  - AINPP : AI-based nowcasting products, guidelines and benchmark datasets on AI for nowcasting, identify new potential WIPPS-DC on nowcasting
  - MMIFA : integrated visualization of core data and post-processed products in uniform graphical styles for easy comparison, support of forecasting and early warning
  - TC-PFP : new tropical low / cyclone vortex parameters (TT-TCPara), best practice guidance for probabilistic tropical cyclone forecasts, to promote the transfer of research-to-operations and provide better services to users

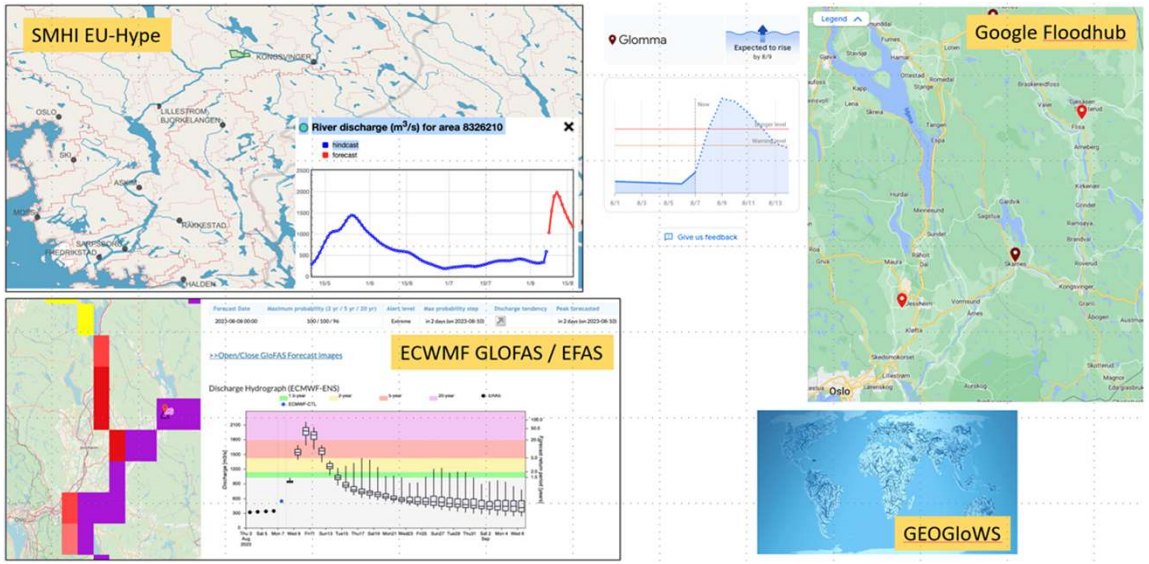
- Scientific Evolution of WIPPS (CF: Research and Innovation)
  - AINPP : New technologies in prediction data products using AI
  - MMIFA and TC-PFP : New techniques in applications of WIPPS data products, probabilistic forecasts in support of Members' forecast operation, warning and alerts for EW4A
  - Capacity building, training or outreach activities to narrow the gap among Members (esp. LDCs and SIDSs) regarding the latest technological advances / innovation and related applications in operation

WIPPS Pilot Projects (under development)
Global Riverine Flood Prediction

- Background
  - Flood is one of priority hazards in EW4All
  - No prediction products are disseminated to Members through WIPPS

- Purpose:
  - To make global riverine flood prediction products available to Members

- Activities:
  - Intercomparison of available global products
  - Define mandatory products to meet user requirements



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