WMO Integrated Processing and Prediction System (WIPPS) update

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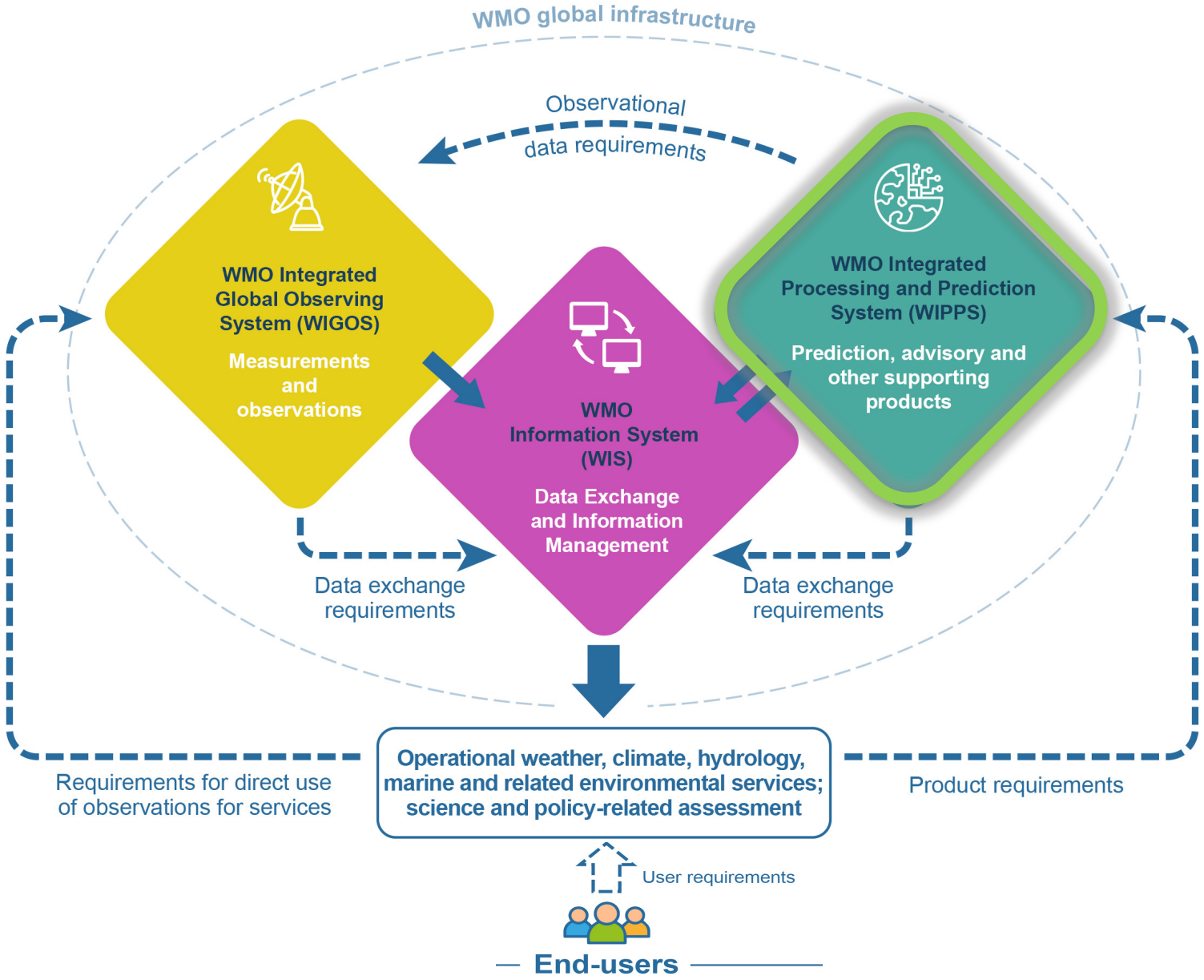
WMO Integrated Processing and Prediction System in WMO Global Infrastructure



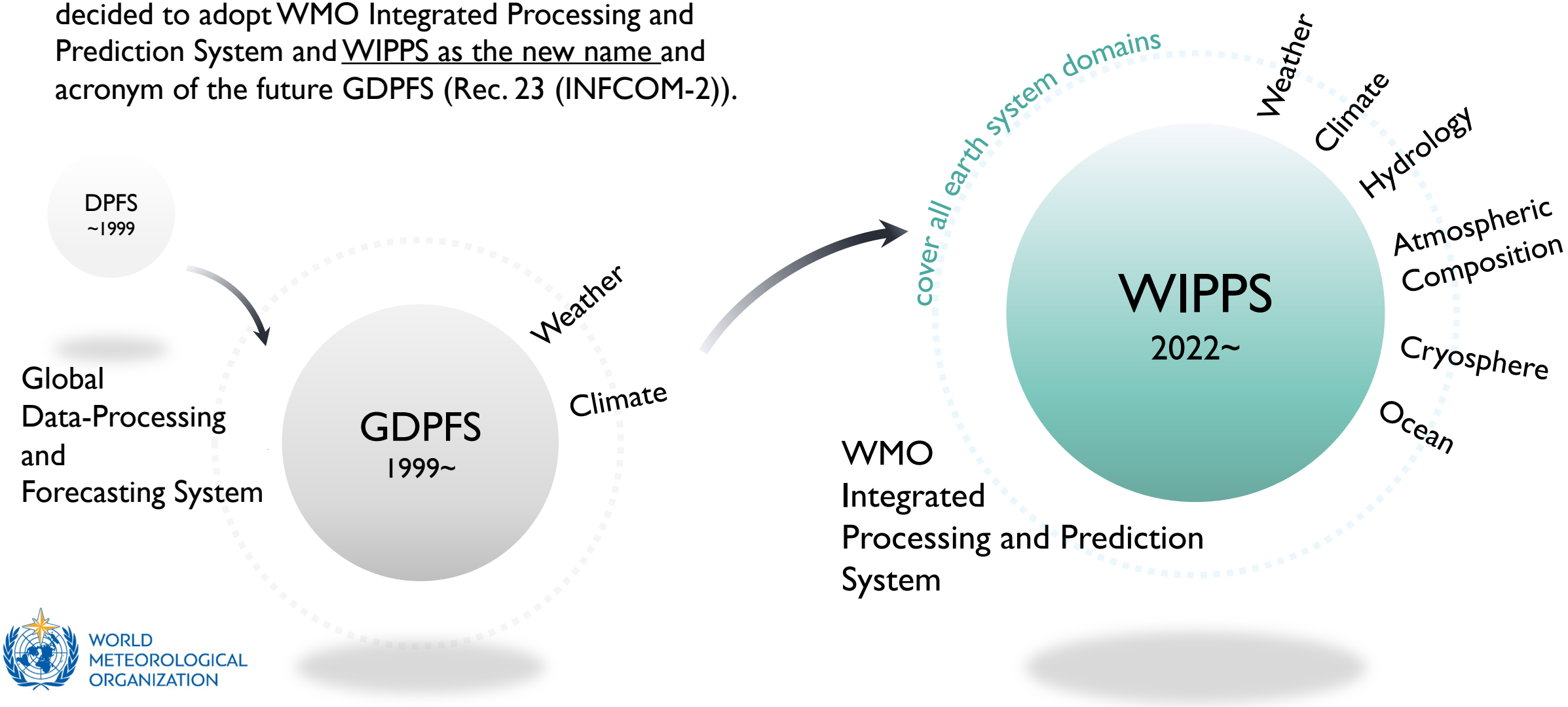
WIPPS is a worldwide network of modelling centres operated by WMO Members.

Its purpose is to make operationally available defined products and services for applications related to weather, climate, water and environment among WMO Members and relevant operational organizations (***WMO Strategic Plan - Output 2.3***)

Its role is to process observation and generate analysis and prediction products based on science and technology to meet users' needs.

Evolution of GDPFS to WIPPS

In 2022, the Commission for Observation, Infrastructure and Information Systems (INFCOM) decided to adopt WMO Integrated Processing and Prediction System and WIPPS as the new name and acronym of the future GDPFS (Rec. 23 (INFCOM-2)).



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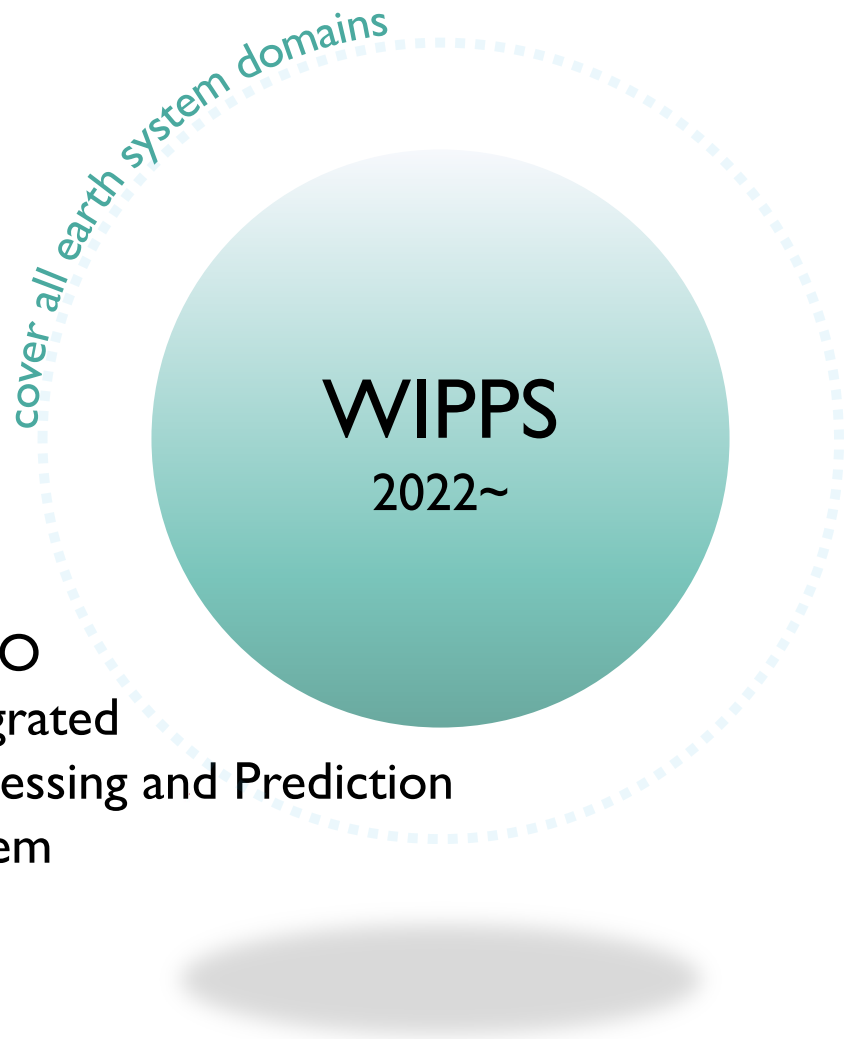
WIPPS and its subsidiaries



SC-WIPPS

Standing Committee on WIPPS

Weather	**ET-OWFS** (TT-NWPSV, TT-TCSV)
Climate	ET-OCPS
Hydrology	ET-OHPS
Atmospheric Composition	ET-ACPS
Ocean	ETOOFS (under GOOS)
Cryosphere – AG-GCW	ET-ERA (nuclear&non-nuclear)
Space Weather	ET-ODQMS (obs data quality)
	TT-NWPMD (metadata)
	TT-G3W-Modelling

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WIPPS Activities: How is WIPPS structured?

1_General purpose activities
to encompass essential data processing required for a wide range of end-usage

2_Specialized activities
to make forecasting products, which may include guidance based on human interpretation, tailored for a specific type of application or user community.

3_Non-real-time activities
mainly for verification

- ✓ The activity specifications are defined for each type of WIPPS activities.
- ✓ The minimum list of mandatory products is defined for each type of WIPPS activities (If defined).
- ✓ A Centre that can fulfil the responsibilities of one of WIPPS activities is designated as a WIPPS Designated Centre (WIPPS-DC).

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WIPPS Activities

General purpose activities (14)

- Global deterministic numerical weather prediction
- Limited area deterministic numerical weather prediction
- Global ensemble numerical weather prediction
- Limited area ensemble numerical weather prediction
- Global numerical long-range prediction
- Global numerical sub-seasonal forecasts
- Annual to decadal climate prediction
- Global Climate Reanalysis
- Numerical ocean wave prediction
- Global numerical ocean prediction
- Global numerical storm surge prediction
- Nowcasting
- Sub-seasonal to seasonal hydrological prediction
- Snow cover prediction

Specialized activities (15)

- Regional climate prediction and monitoring
- Coordination of multi-model ensemble prediction for long-range forecasts
- Coordination of multi-model ensemble for sub-seasonal forecasts
- Coordination of annual to decadal climate prediction
- Coordination of assessment of multiple climate reanalysis
- Regional severe weather forecasting
- Tropical cyclone forecasting, including marine-related hazards
- Nuclear environmental emergency response
- Non-nuclear environmental emergency response
- Atmospheric sand and dust storm forecasts
- Volcano watch services for international air navigation
- Marine meteorological services
- Marine environmental emergency response
- Flash flood forecasting
- Vegetation fire and smoke pollution forecasts

Non-real-time activities (5)

- Coordination of deterministic numerical weather prediction (NWP) verification
- Coordination of ensemble prediction system (EPS) verification
- Coordination of wave forecast verification
- Coordination of tropical cyclone forecast verification
- Coordination of observation monitoring

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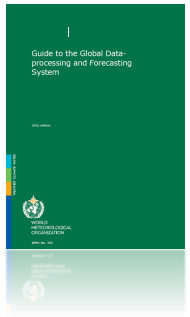
34 activities

SEP 2024 updated

Key WIPPS Documents: Manual, Guide, and Guideline

The **Manual** provides detailed information on WIPPS activities: mandatory/recommended functions including production, verification and documentation etc.

Manual on the WMO Integrated Processing and Prediction System (WMO-No. 485) (2023 edition, updated in 2024) - available in English, French, Russian, Spanish, Chinese



Guide to the WMO Integrated Processing and Prediction System (WMO-No. 305) (2023 edition, updated in 2024) - available in English (2023 edition is available in French, Russian, Spanish, Arabic, Chinese)

Guidelines on/for

- Ensemble Prediction Systems and Forecasting (WMO-No. 1091)
- Ensemble Prediction System Postprocessing (WMO-No. 1254)
- Nowcasting Techniques (WMO-No. 1198)
- Operational Practices for Objective Seasonal Forecasting (WMO-No. 1246)
- Verification of Operational Seasonal Climate Forecasts (WMO- No. 1220)
- Satellite-based Nowcasting in Africa (WMO-No. 1309)
- High-resolution Numerical Weather Prediction (WMO-No. 1311)

World Meteorological Centres (WMCs)

- 10 WMCs produce a set of mandatory products from short to seasonal time range and disseminate through WIS.
- Most Centres operate numerical Earth system models coupling atmospheric and ocean models

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				

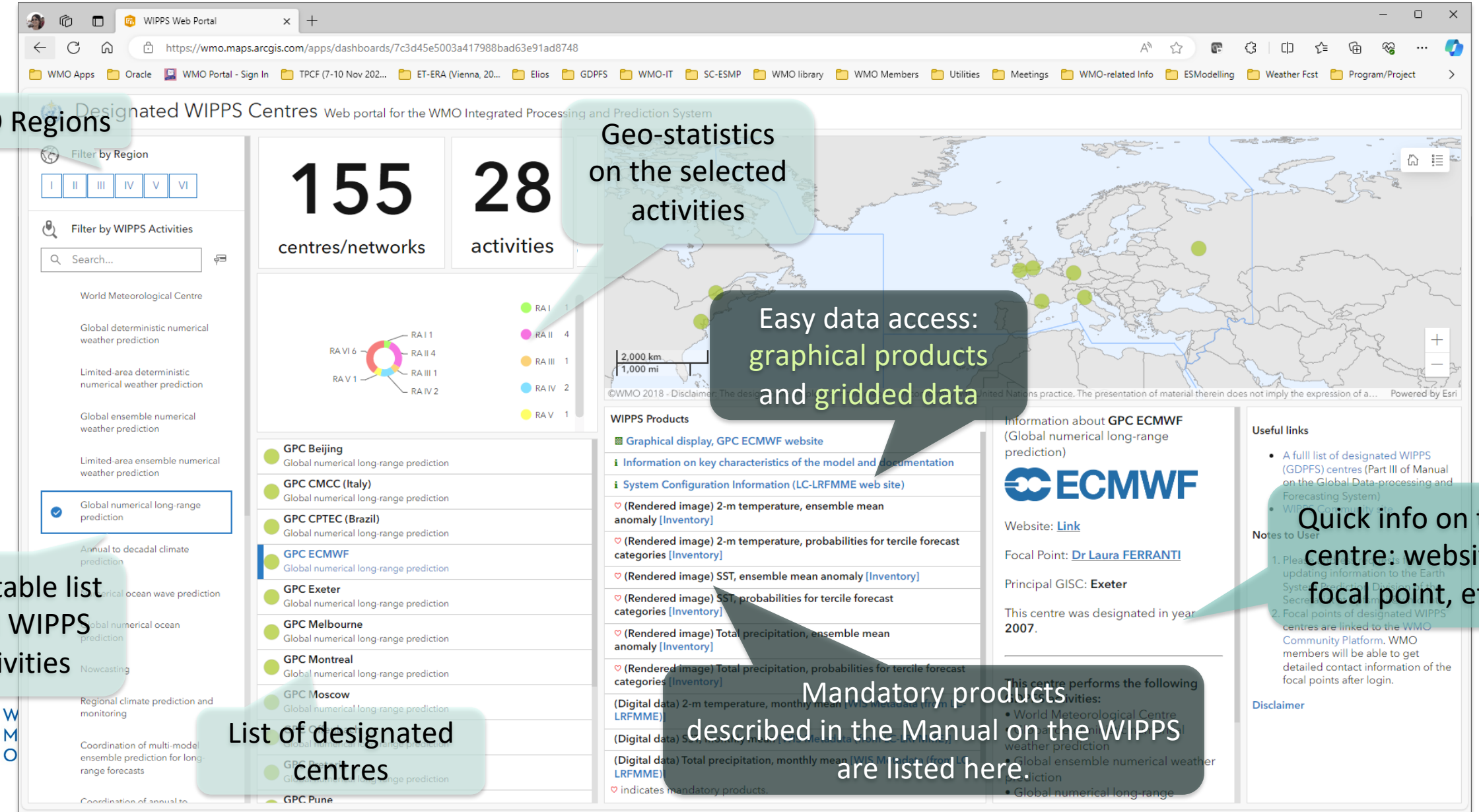
Additional recommended products:
- ~~Tropical storm tracks (latitudinal/longitudinal locations, maximum sustained wind speed, MSLP).~~
- More fields describing precipitation type
- Mid-level CAPE
- 1-hour accumulated total precipitation
- Snow depth
- Divergence and vorticity (925/850/700/500/250/200 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.

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

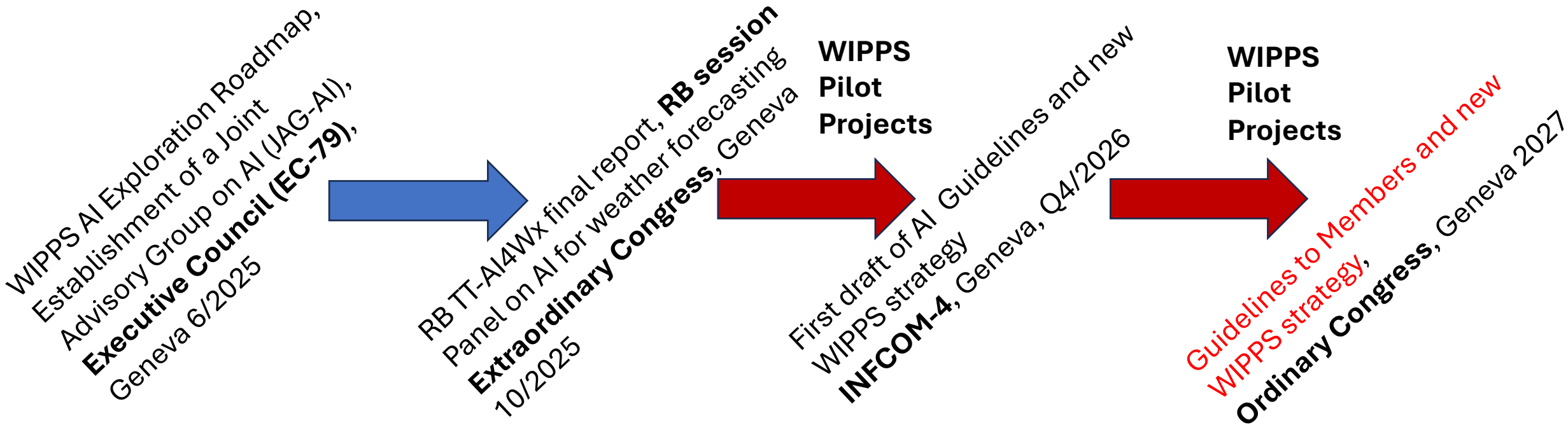
Global ensemble NWP for short to medium range (1/2)

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				

WIPPS Web Portal: Exploring WIPPS Designated Centres



Incorporation of AI/ML into the WMO Integrated Processing & Prediction System (WIPPS)



Issues and Challenges for AI use

by NMHSs and WIPPS-DCs, particularly in the context of EW4All

1. Data Availability and Quality
   1. Provision of long-term observation/analysis dataset for AI training and verification
   2. Observation requirements for high-impact forecasting
   3. Quality control of observations
2. Prediction and post-processing
   1. Benefit and applicability of AI-ESP for nowcasting and forecasting
   2. High-resolution AI-based forecasts for local area
   3. Compatibility between initial fields and training dataset
   4. High-resolution data-driven models
   5. Benefit and necessity of post-processing
3. Verification
   1. WIPPS standard verification of AI-ESP model outputs
   2. Verification of AI-ESP model outputs for local weather elements and extremes
   3. Verification of meteorological consistency between variables of AI-ESP model outputs
   4. Verification of forecast scenarios
4. NMHS infrastructure and capacity requirements
   1. Use of AI-ESP model outputs in operational forecasting and warning
   2. Implementation and maintenance of AI-based systems
5. Model Explainability and Transparency
   1. Guidelines on the use and interpretation of AI-ESP model outputs
   2. Guidelines on developing explainable AI-ESP
6. WIPPS Framework and Technical Regulations
   1. Expansion of WIPPS activities to accommodate AI-ESP model outputs
   2. Impact of AI on the WIPPS cascading process

6 categories
18 sub-categories and
52 questions

EC-79-INF04-1(2)-ISSUES-CHALLENGES-AI-ESP-INTO-WIPPS

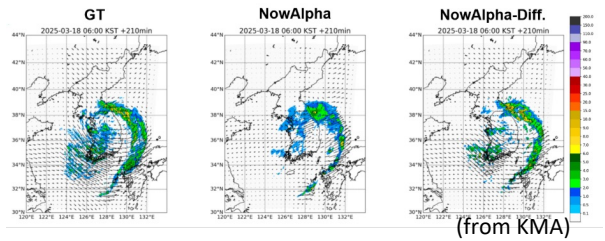
AI-related WIPPS Pilot Projects and other WMO activities

Testing through WIPPS Pilot Projects https://community.wmo.int/en/wipps-pilot-project

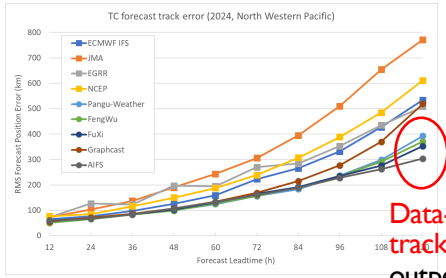
Key issues and challenges identified will be addressed through pilot projects. Each of these pilot projects will serve as a proof of concept for broader AI integration into WIPPS and will be designed to test the scalability and effectiveness of AI solutions in operational settings.

Nowcast | Short to Medium | Sub- to Seasonal

AI for Nowcasting Pilot Project

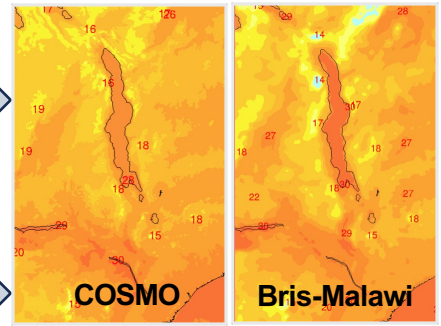


(from KMA)



Data-driven models tracks generally outperformed traditional NWP.

Data-Driven Weather Forecasting for All

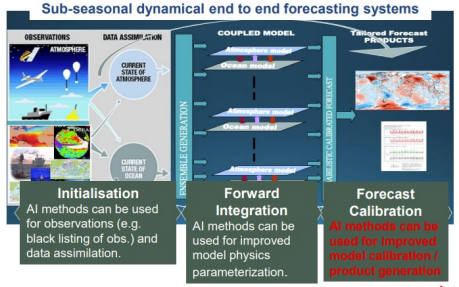


(from MET Norway and DCCMS Malawi)

AI in TC Analysis and Prediction

AI Weather Quest

Weather Prediction Model Intercomparison Project



(from AI Weather Quest website)

Global Riverine Flood Prediction Pilot

Cg-Ext 2025 Request:

- **INFCOM** to develop a draft new WIPPS strategy, including the incorporation of Artificial Intelligence into WIPPS, to replace WIPPS Collaborative Framework and WIPPS Roadmap (2022-2026)
- **INFCOM**, in coordination with SERCOM, RB and EC/CDP with the contribution of RTCs, to enhance the capacity development on the use of AI
- **JAG-AI** to coordinate the development of ethical and date-integrity guidelines
- **Secretary-General** to provide the support needed for LDCs and SIDSs to develop pilot projects to incorporate AI in their forecasting system
- **Regional Association** to contribute to JAG-AI, especially by sharing lessons learnt from regional initiatives and efforts, and reflecting on regional needs

Invite:

- **Members** to develop new WIPPS pilot projects to address issues and challenges identified in AI Roadmap for WIPPS
- **Members** to initiate conferences, webinars and training events
- **Members** to contribute to the WIPPS Trust Fund

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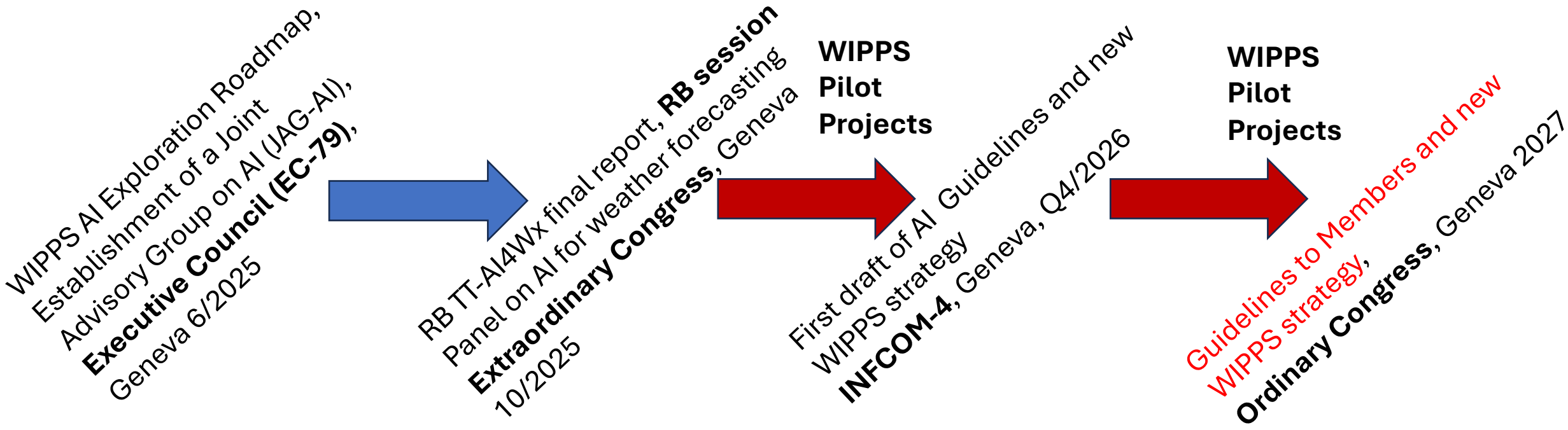

Thank you.

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