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Resilience to Natural Hazards through AI Solutions
Global Initiative workshop

Empowering WMO Members to leverage AI

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WORLD METEOROLOGICAL ORGANIZATION

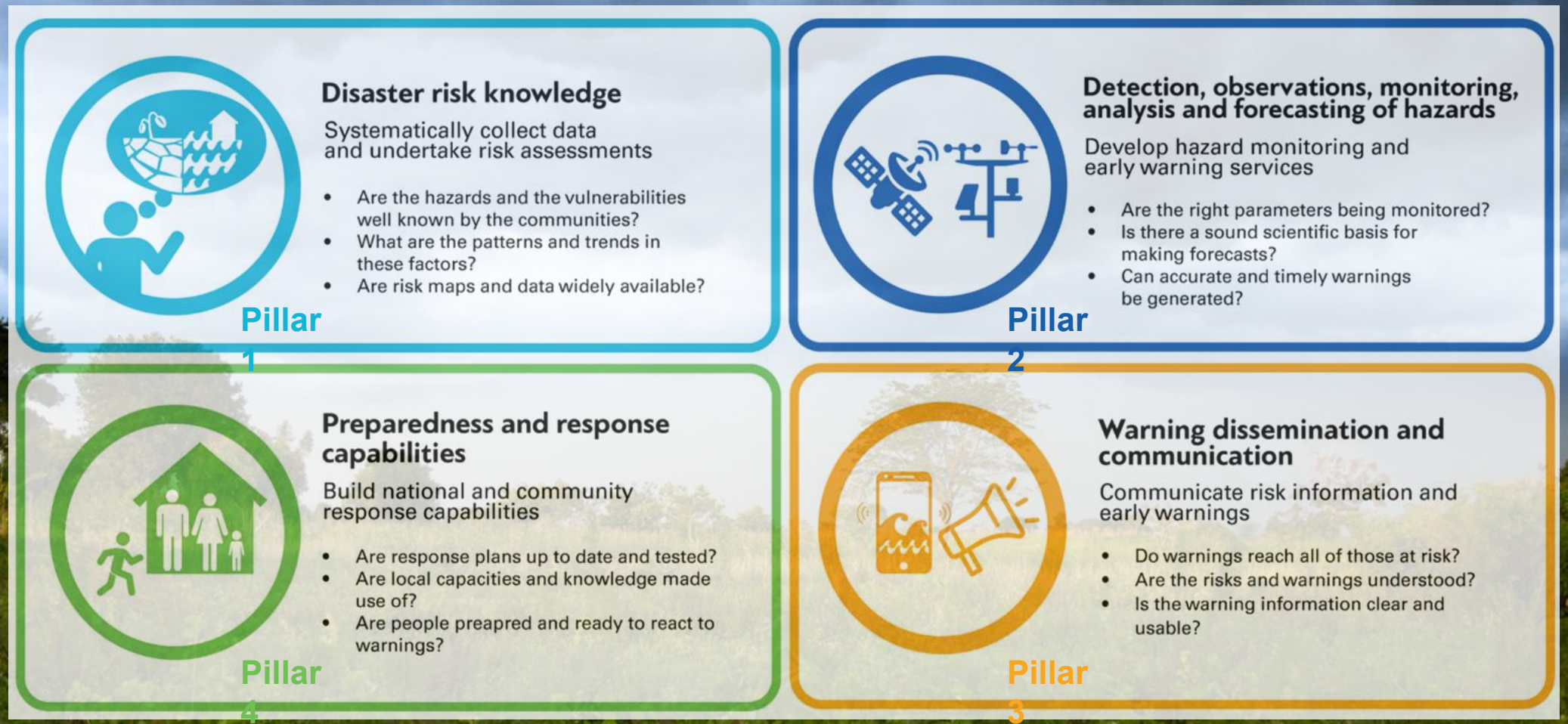
1950-2025 SCIENCE for ACTION

Early Warnings for All - Preparedness and Response

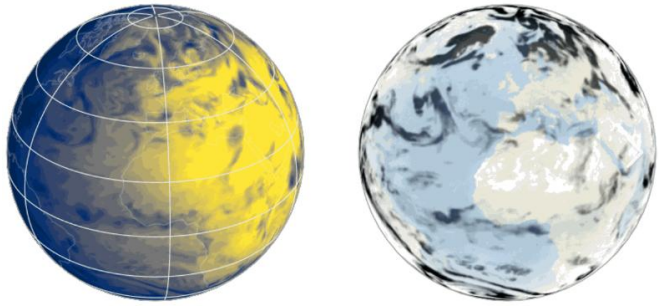
UNDRR | WORLD METEOROLOGICAL ORGANIZATION | ITU | IFRC

Early Warnings for All

Early Warnings for All: Structure & Objectives

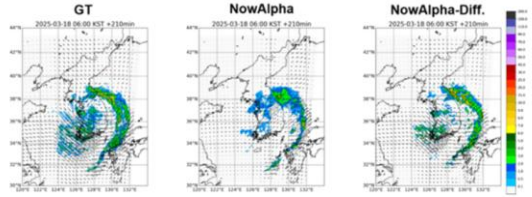


AI Innovations relevant to monitor, forecast and act on early warnings of hazards



Weather Prediction Emulators - ex:

- **Government** : AIFS – ECMWF, AICON – DWD, Bris – MetNorway (regional)
- **Private sector**: GraphCast, GenCAST – Google; FourCastNet – NVIDIA; Aurora – Microsoft, PanguWeather - Huawei
- **Academia**: FuXi - Fudan University; Aardvark - Cambridge



Curtesy of Hyun-Kyoung Lee, KMA

Satellites and Radar analyses and Nowcasting:

- Data sparse areas
- Very short term forecasting (next 6 hours)

Downscaling:

- Bringing global information to local scales
- Connecting to downstream applications (Agriculture, ...)

Curtesy of Zhang Wei, CMA

AI Agents:

- Based on combination of Predictive models and Large language Models (LLMs)

Data analyses, QA/QC, Data fusion:

- Treatment of Observations

Areas are at different levels of maturity and uptake. All are progressing rapidly.

The importance and availability of data is crucial to their development and use

AI for Nowcasting Pilot Project

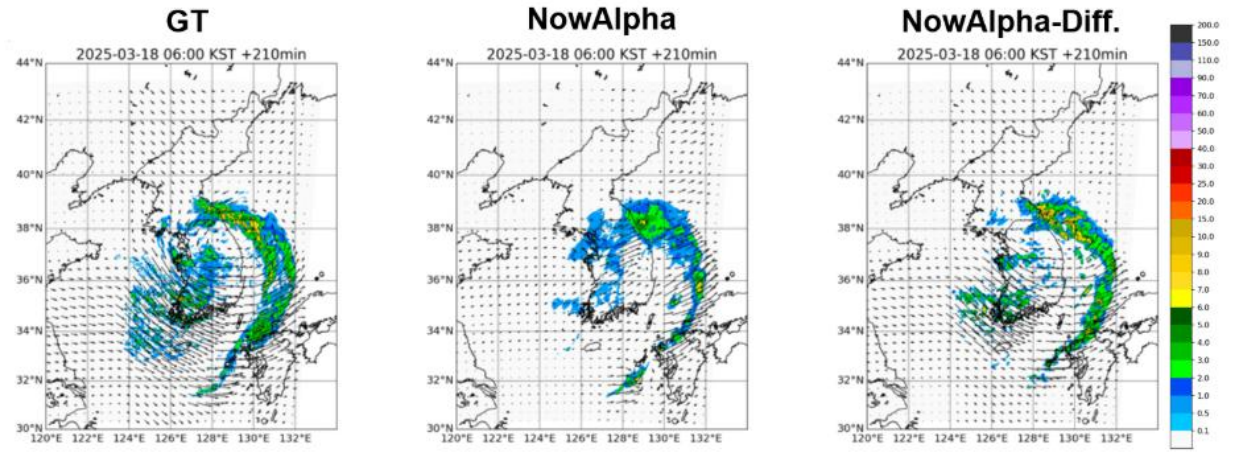
Summary/Purpose

- **Support EW4All**
- **Boost operational capacity with AI:** Post-project, AI-driven nowcasting tools for operational use to enhance seamless WIPPS.
- **Bridge Nowcasting Gaps:** AI with satellite data offers a cost-effective solution.
- **Share AI Successes:** Their simplicity and lower costs make them ideal for developing nations.
- **Build Capacity and Self-Reliance:** Promotes AI
- **Foster Public-Private Partnerships:** Collaboration between national services and private companies

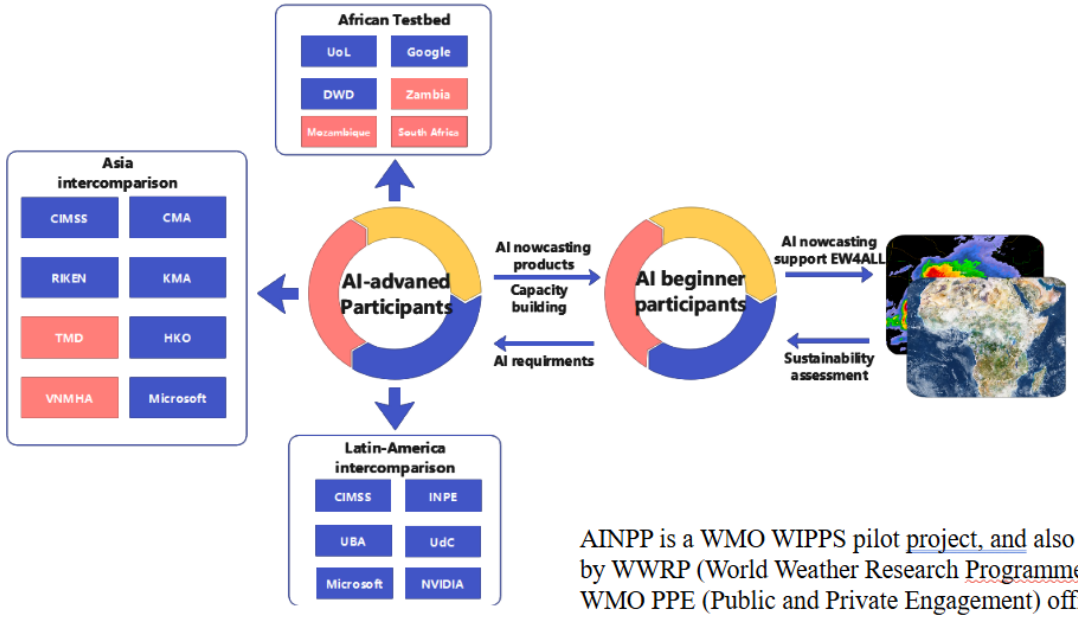
Participants

- AINPP Steering Group by David John Gagne and Kan Dai:

NHMS (6)	Academia (8)	Private Sectors (3)	UN initiative (1)
• DWD (German) • CMA (China) • HKO (Hong Kong, China) • KMA (South Korea) • VNMHA (Vietnam • TMD (Thailand)	• CIMSS (USA) • NSF NCAR (USA) • University of Leeds(UK) • RIKEN (Japan) • Universidad de Colima(México) Universidad de Buenos Aires(Argentina) • Universidade de São Paulo (Brazil) • INPE(Brazil)	• Microsoft • Google • NVIDIA	• Global Initiative on Resilience to Natural Hazards through AI Solutions



Courtesy of KMA



AINPP is a WMO WIPPS pilot project, and also supported by WWRP (World Weather Research Programme) and WMO PPE (Public and Private Engagement) office.

From David John Gagne (NCAR) at WMC Beijing Workshop

UNESCAP/WMO Typhoon Committee initiative on AI Applications in TC Analysis and Prediction

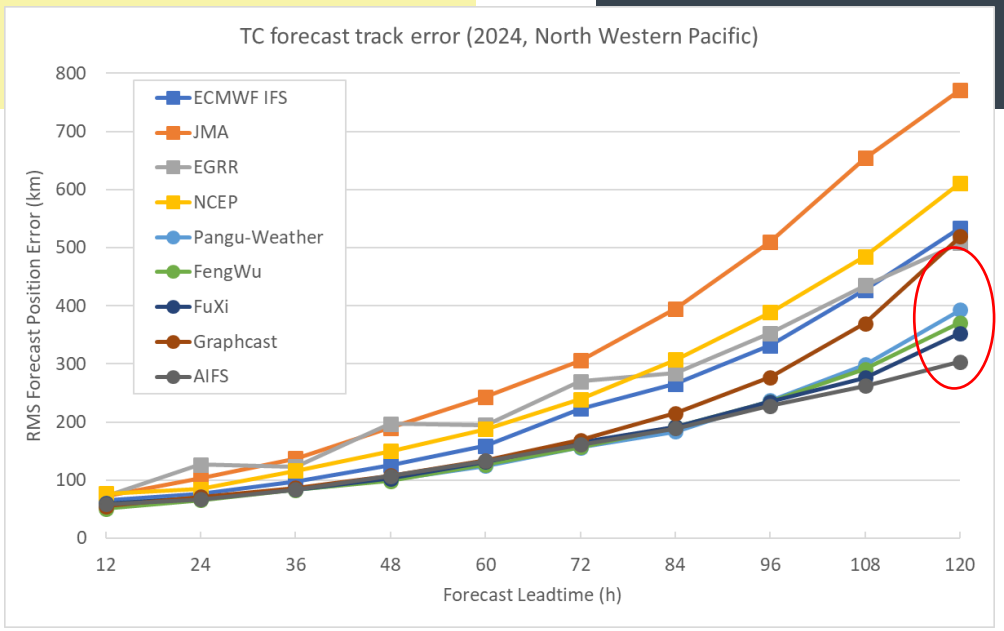
Summary/Purpose

A Research-to-Operation project to assess and review the applications of AI in tropical cyclone analysis and forecasting

- Primarily focusing on TC track forecasting in 2024-2025
- Coordinate data exchange
- Verification and inter-comparison
- Sharing experiences and good practices
- Explore the future operational use of AI-based tropical cyclone analysis and forecasting

Participants

- UNESCAP/WMO Typhoon Committee Members
- Initiative led collaboratively by an Expert Team under Typhoon Committee Working Group on Meteorology
- contributed by China; Hong Kong, China; Japan; Macao, China; Malaysia; the Philippines; Republic of Korea; Socialist Republic of Viet Nam and the United States of America

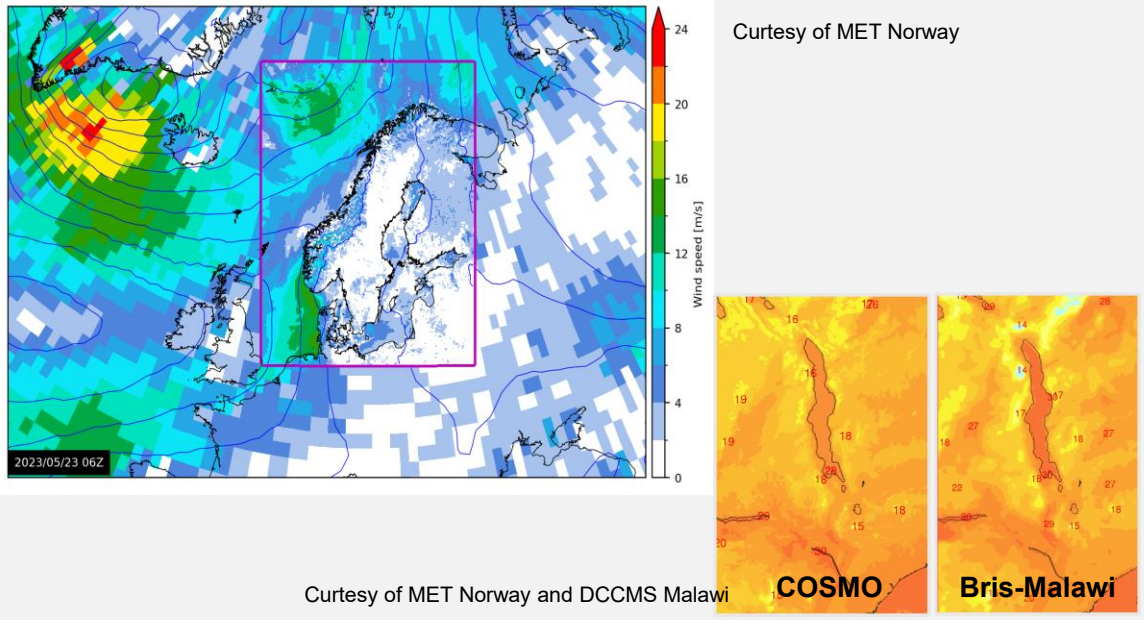


Data-driven models tracks generally outperformed traditional NWP.

Data-Driven Weather Forecasting for All

Summary/Purpose

- Approximately one-third of the global population lacks adequate multi-hazard early warning systems, with the greatest gaps in LDCs and SIDS. The proposed pilot project addresses this need by leveraging cutting-edge AI-based data-driven models, such as Bris and AIFS, to enhance forecasting capabilities.
- The project aligns with the EW4All initiative and aims to ensure that forecasting advancements benefit vulnerable communities. By tailoring models to local conditions and building capacity, the project strives for inclusivity and long-term impact.



Expected Outcomes

- Deployment of the "Forecast-in-a-Box" system for a selected region.
- Refined Bris model adapted to local geographical and climatological conditions.
- Training workshops for NMHS staff on using DDM-based forecasting systems as part of Sarepta.

Expected Benfits to NMHSs

- Improved capacity to provide accurate and reliable localized weather forecasts.
- Use of DDM-based forecasting systems and comparison with available global and limited area physical NWP models.
- Enhanced ability to support MHEWS.
- Increased resilience against climate risks
- Empowerment through training and knowledge sharing.
- Narrowing the gaps among NMHSs, LDC/SIDS in adopting advanced techniques using AI/ML in earth system prediction.

Participants

- WMO Members:
  MET Norway
  ECMWF
  Department of Climate Change and Meteorological Services (DCCMS; Malawi)

From Jørn Kristiansen (MET Norway) at WMC Beijing Workshop

Early Warning Connectivity Map (EWCM)

Developed the EWCM to see where and how many people are within coverage, and where connectivity 'coldspots' leave populations unreachable by mobile alerts.

By layering...

1. Connectivity Map

Based on mobile coverage and **crowdsourced** connectivity data, leveraging today's widespread digital networks to map 'near-live' connectivity

SPEEDCHECKER
GSMA Collins Bartholomew
OOKLA
unwiredlabs OpenCellid
Meta
CloudRF
masae ANALYTICS

2. Population Density Map

Based on **AI-powered** population estimates and satellite analysis through collaboration with tech partners

Microsoft
IHME Measuring what matters
planet.

3. Hazard Map

Based on **11 natural hazards**, from very low to high risk, to reveal population vulnerability

ThinkHazard!
Identify natural hazards in your project area and understand how to reduce their impact

EWCM Country Pilots

Sharing EWCM data

Mapping completed for 33 EW4All countries, scaling to more

Data validation

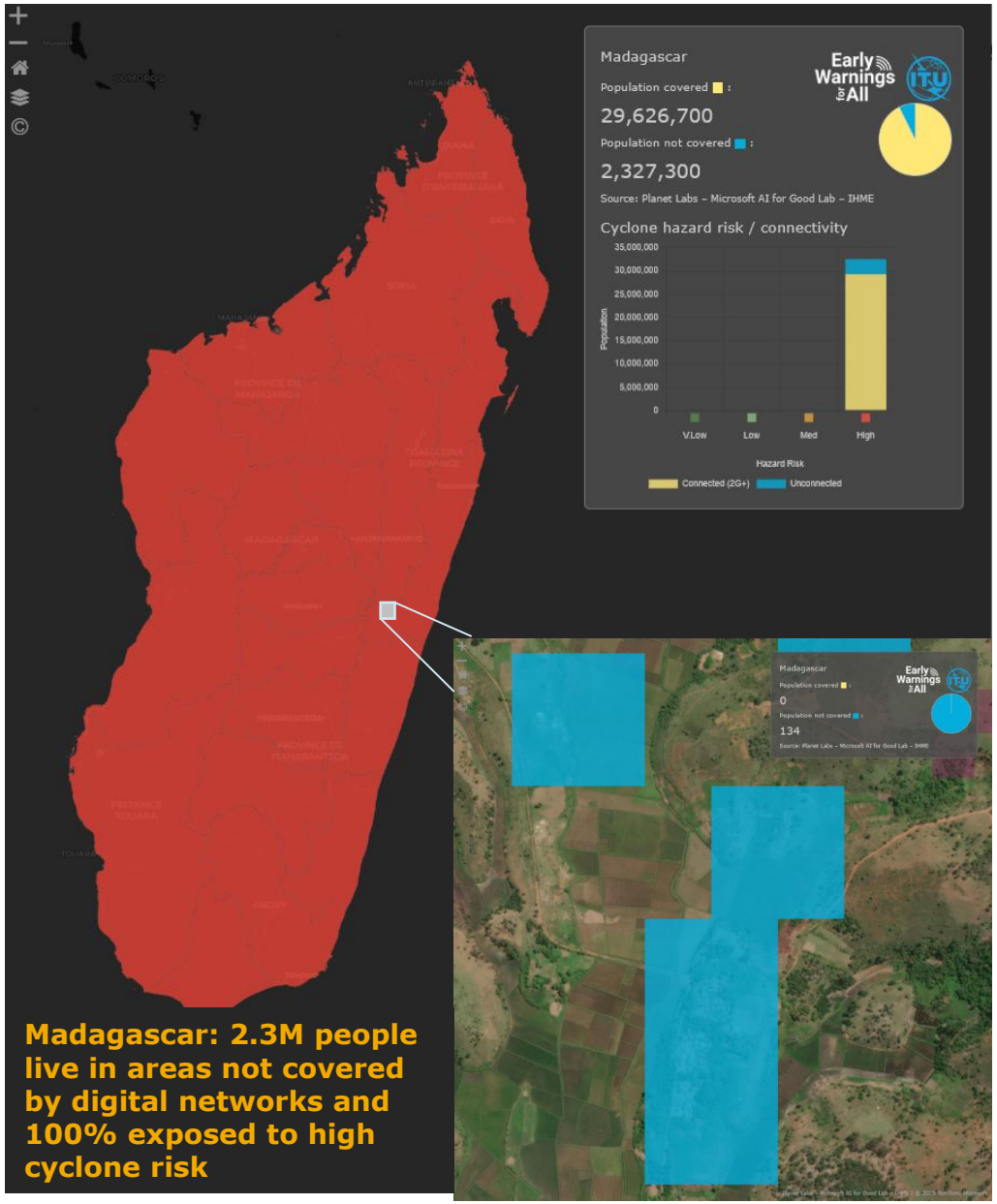
Collaborating with member states and mobile network operators during EW4All workshops to validate results

Capacity building

Training telecom regulators and relevant national stakeholders in geospatial data analysis to produce and use the EWCM data independently

Policy Applications

- Identify vulnerable populations
- Develop multi-channel approach
- Prioritize infrastructure investment



WMO pilot study of global riverine flood prediction

Summary/Purpose

- Floods are recognized as priority hazards under the Early Warnings for All (EW4All) initiative in many regions
- WMO aims to support Members' flood forecasting and warning services by providing them with global flood prediction products through WIPPS
- facilitate the contributions of non-traditional sources to the WIPPS

  (non-traditional sources are entities other than national governmental organizations such as private sectors or non-partner international/ intergovernmental organizations)

Expected Outcomes

- Suggestions for common forecast products and formats, operational practice, and verification approaches for operational global flood forecasting;
- Suggestions regarding the possibility, the pathway, the product specification and the requirements to include operational global flood forecasting into WIPPS; and
- Collection of Members' feedback regarding the usefulness of operational global flood prediction products.
- **Operational Phase**

Participants

- WMO Members:

  Australia, Belize, Bulgaria, Denmark, Hungary, India, Iran, Israel, Kazakhstan, Mauritius, Norway, Pakistan, South Africa, Thailand

- Global modelling centres:

  CEMS (ECMWF, JRC), Deltares, DHI, GEO, Google, NASA, SMHI, Univ. Tokyo/JAXA,

Weather Prediction Model Intercomparison Project

Purpose

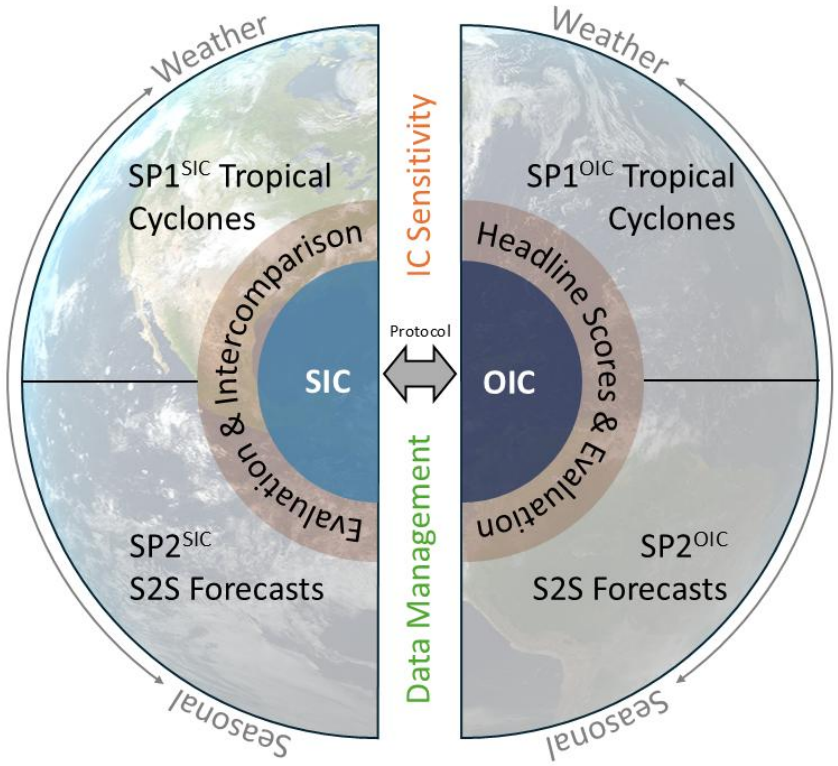
- The Weather Prediction Model Intercomparison Project (WP-MIP) aims to accelerate the development and integration of the next-generation of operational weather prediction systems.
- The project will create a public database of predictions from the full spectrum of artificial intelligence-based (AIWP), physically based (NWP) and hybrid systems using standard production pipelines. This centralized archive will be used for distributed diagnostics and model evaluation, with the goals of:
  - Identifying the strengths and weaknesses of the different prediction paradigms in an operational context;
  - Providing guidance to operational centres on metrics to use for fair evaluation and comparison of AIWP, NWP and hybrid systems; and,
  - Accelerating the development of the full spectrum of operational models.

Participants

- Project Co-Leads: Linus Mangusson and Ron McTaggart-cowan
- Subproject Leads:
  - SP1: Masashi Ujiie and Jan-Huey Chen
  - SP2: Debbie Hudson
- Participating WMO Groups: WIPPS, JWGFVR, PDEF, WGSIP
- Participating GPCs: BoM, CMC, DWD, ECMWF, JMA, NOAA, UKMO

Key Features

- Centralized Forecast Database (AIWP, NWP, Hybrid)
- Two Forecast Streams:
  - Same Initial Conditions (SIC) and
  - Own Initial Conditions (OIC)
- Optional Subprojects for deeper diagnostics
- Open Collaboration for submissions and diagnostics



Learn more: https://www.wcrp-esmo.org/activities/wp-mip

WMO AI Conference Statement

Outcomes and affirmed intentions:

AI plays a complimentary role to existing efforts in weather, climate and hydrological prediction, and there is opportunity to advance this together.

Respect for authoritative role of NMHSs in producing official warnings based on public trust and scientific rigor.

On-going dialogue on public and private datasets to fully realize opportunities afforded by AI, with greater openness at the national level in terms of additional observational and auxiliary data that will be needed.On-going

Investment in capacity and training, and expansion of AI-based pilot projects, focusing on regionally-based implementation and narrowing the digital divide.

Common principles to guide responsible and effective integration of AI into meteorological, climate, hydrological and environmental services that are grounded in transparency, collaboration, sustainability, innovation and ethics.

Continued dialogue at multiple levels and increased representation of the private sector and academia in relevant WMO working structures.

Moving from intentions to realizations: breakout sessions laid out initial directions to continue the dialogue and collaboration

WMO AI Conference: AI for Weather Prediction, Advances, Challenges & Future Outlook

WMO Call to All Stakeholders and WMO Governance

Engaging the broad community

- To announce that WMO will work collaboratively with stakeholders to meet awide variety of global needs by applying AI/ML technologies to strengthen theentire weather, climate, water and environment-related services value chain.
- Resolution 2.3(2)/1 – WMO Call to All Stakeholders to Collaborate on the Development of Artificial Intelligence (AI) and Machine Learning (ML) Environmental Monitoring and Prediction Technologies, Tools and Applications

Oversight of WMO activities through JAG-AI: Joint Advisory Group on Artificial Intelligence

- Reporting to INFCOM and RB, JAG-AI to provide advice, oversight, coordination and monitoring of WMO activities in relation to the development and implementation of artificial intelligence (AI) technologies to the meteorological and hydrological value cycle.
- To focus on promotion and acceleration of the integration of AI into the WMO infrastructure and research activities, supporting the development of weather, climate, hydrological, marine and related environmental services.

Thank you