The 4th China-ASEAN Meteorological Forum

共享共建人工智能技术，助推“全民早期预警”实现

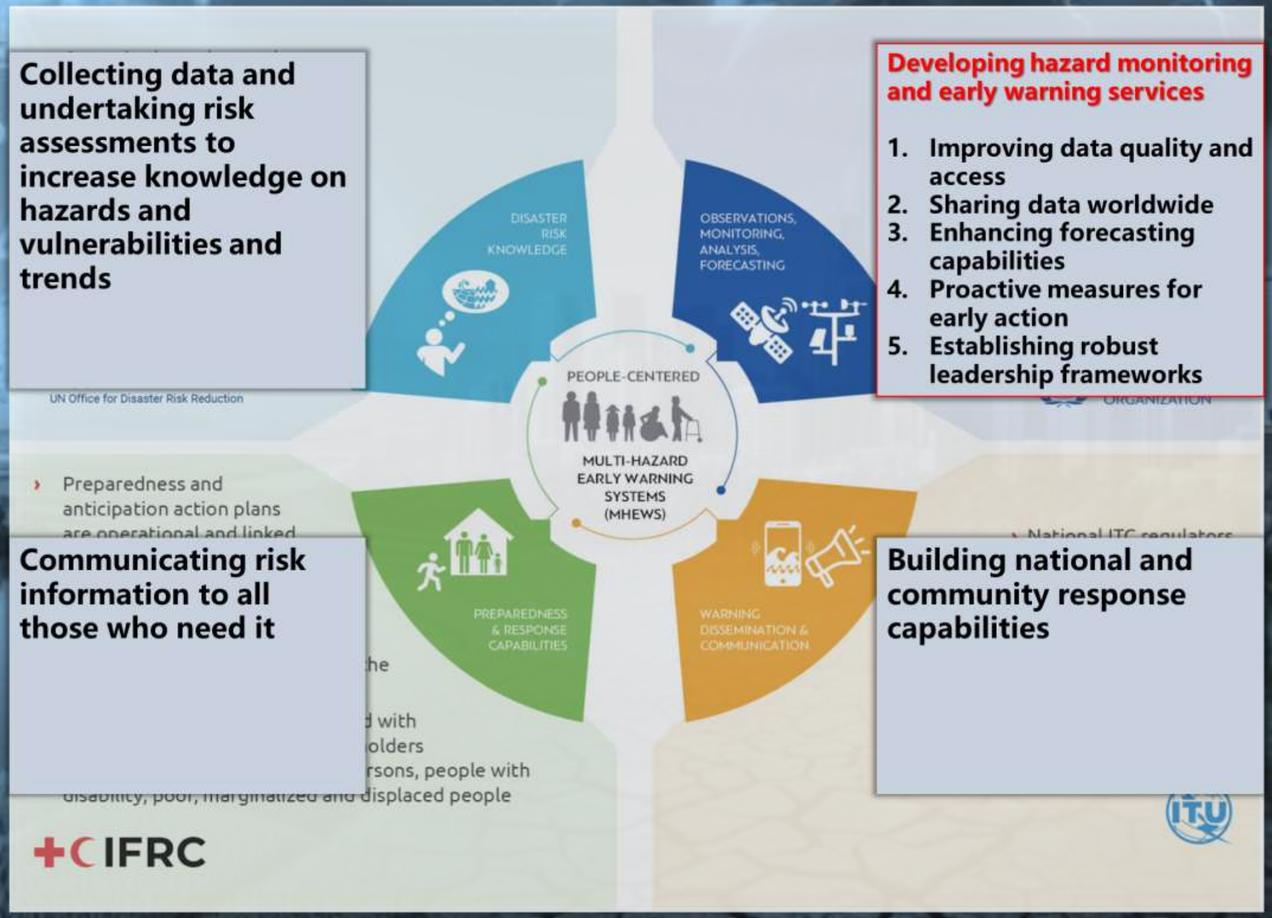
Sharing and Co-developing AI to Advance EW4ALL

Dai Kan
National Meteorological Center
China Meteorological Administration

共同的挑战，统一的目标
A Common Challenge, A United Goal

- **Linked by geography**: The Lancang-Mekong River connects our shared past and future. (地理相连：澜沧江-湄公河连接着我们的过去与未来。)
- **Facing shared climate risks**: We all face intensifying threats like typhoons, heavy rainfall, floods, and droughts. (风险共担：我们共同面临着日益严峻的台风、暴雨、洪水和干旱等威胁。)
- **Guided by a common framework**: The UN's "Early Warnings for All" (EW4ALL) initiative unites our efforts to protect everyone by 2027. (框架共识：“全民早期预警”倡议为我们的共同行动提供了统一框架。)

In 2022, UN Secretary-General António Guterres launched the **'Early Warnings for All'** initiative to ensure everyone is protected from hazardous weather, water, and climate events by **the end of 2027**



为何 AI 对现代气象服务至关重要
Why AI is Essential for Modern Weather Services

AI Tech Engine

- **AI is not just an upgrade; AI offers a fundamental change in how meteorological services operate.**

Faster: From Hours to Minutes

AI models generate forecasts much faster than traditional NWP, **increasing lead time for emergency response**.

More Accurate: Learning from Data

AI excels at identifying complex patterns in massive datasets, **improving forecast accuracy for key metrics**.

More Accessible: Lowering Barriers

AI reduces the need for massive computational resources, **making advanced forecasting capabilities available to more nations**.

More Integrated: From Forecast to Impact

AI can directly predict weather impacts, **connecting forecasts to sector-specific risks like agriculture and energy**.

中国气象局行动：远见卓识的 AI 发展蓝图
CMA's Visionary AI Blueprint: Strategy and Milestones

■ To translate the vision of supporting the EW4ALL initiative into action through AI technologies, CMA adopts a strategic, systematic, and action-oriented approach.

Strategic Foundation (战略布局)

- 2023.07: Released **AI Application Work Plan (2023-2030)**, setting a long-term vision.
- 2024.04: **Established CMA AI Steering Committee** for top-level coordination.
- 2024.07: Founded **Xiong'an AI Innovation Institute** as our R&D hub.

Tech Breakthrough (技术突破)

- 2024.06: Released **FengQing, FengLei, FengShun** AI models.
- 2025.07 (Shanghai): Released **FengYu** (Space Weather) & upgraded existing AI models.

Global Collaboration (全球合作):

- 2024.06: **Made 6 commitments** at WMO EC-78 to advance EW4ALL.
- 2024.11: **Launched China Early-Warning Action Plan** at COP29.
- 2025.07 (Shanghai): **Launched MAZU, CMA's new initiative for international meteorological services and partnerships.**

核心引擎 – “风”系列AI预报模型矩阵
Core Engines – The "Feng" Series AI Model Matrix

A comprehensive suite of AI models covering different forecast timescales, from nowcasting to sub-seasonal

1
FengLei 风雷
Nowcasting (0-3h)

- Convective storm & precipitation nowcasting
- Physics-informed AI for superior storm evolution prediction

2
FengQing 风清
Medium-Range (0-15 days)

- Global 3D atmosphere forecasting
- Physics-constrained deep learning on a global scale

3
FengShun 风顺
Sub-seasonal (Weeks-Months)

- Extended-range ensemble forecasting
- Flow-dependent AI for capturing long-term climate signals

4
FengYu 风宇
Space Weather

- Solar activity & space environment
- First AI model significantly outperforming traditional MHD

5
FengHe 风和
AI Agent

- LLM-based intelligent weather assistant
- Natural language interface for on-demand, impact-based services

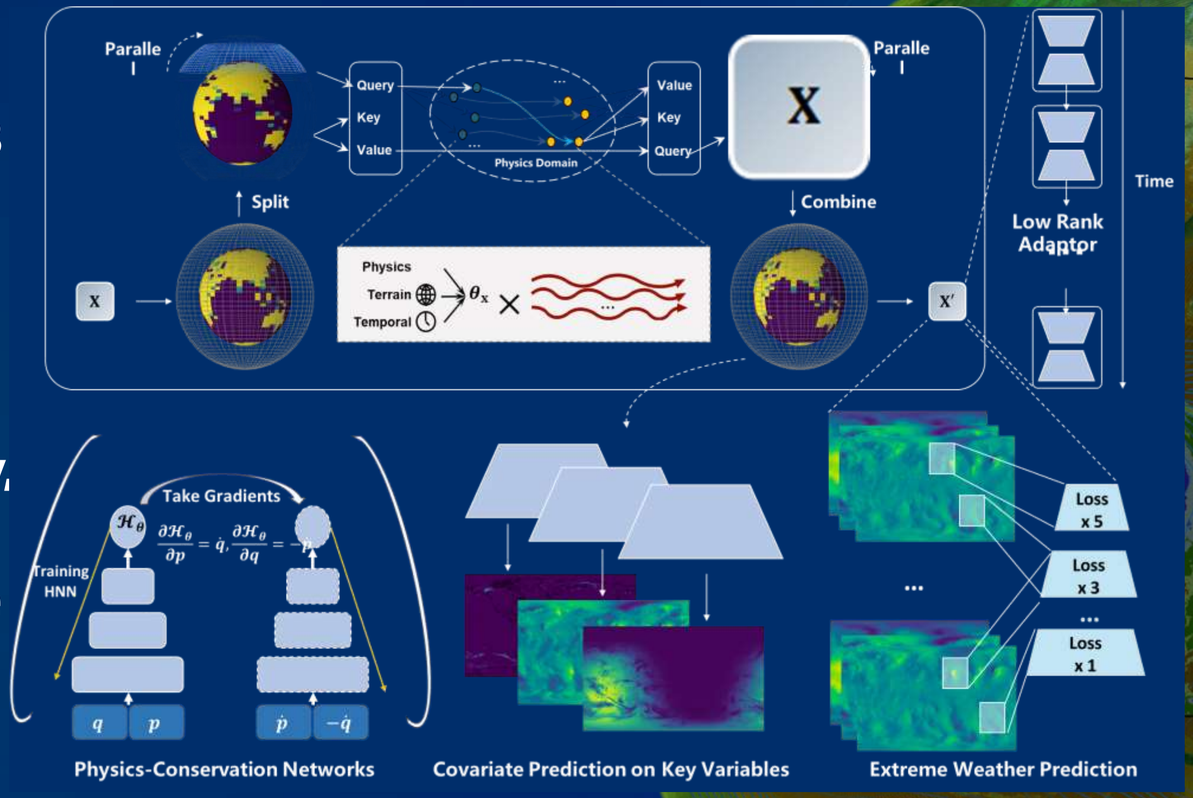
6
Future Systems

- FengYuan, End-to-End AI forecast model
- Regional High Resolution Model
- ……

风清：中国气象局的全球AI天气模型
FENGQING: CMA’s Flagship Global AI Weather Model

◆Key Capabilities:

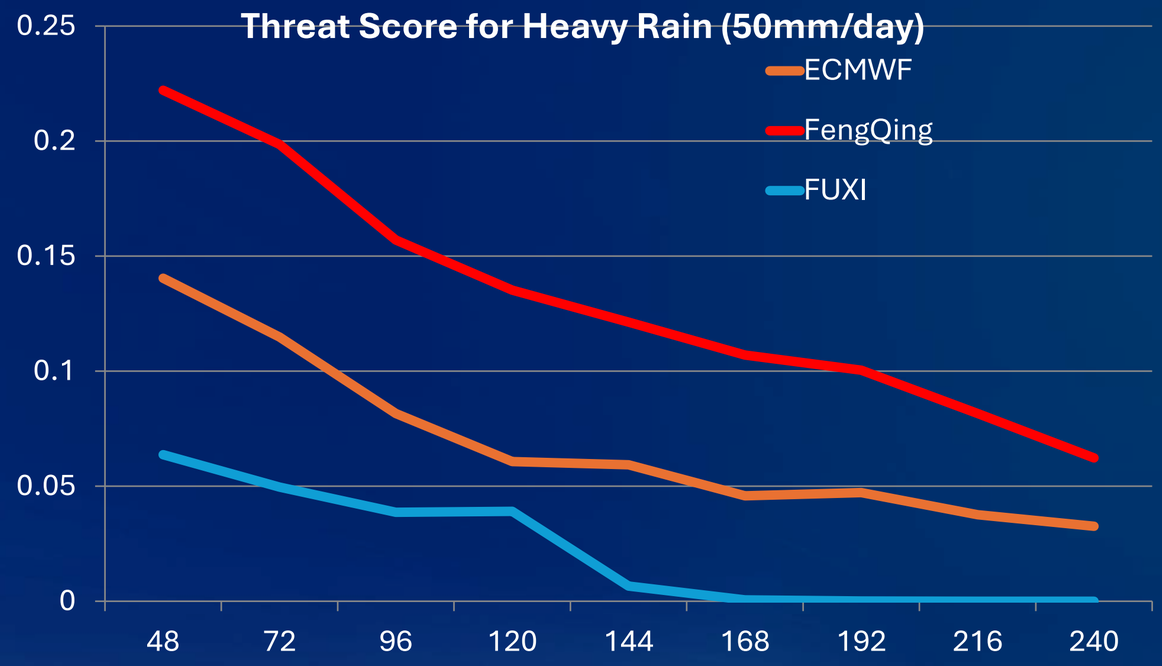
- **Fast & Efficient**: Delivers a 15-day global forecast in ~3 minutes on a single GPU.
- **Physics-Informed**: Integrates physical laws to improve model stability and reduce systematic errors.
- **Impact-Oriented**: Enhanced prediction of surface variables like precipitation and wind, critical for energy, agriculture, and water management.
- **Open & Accessible**: The model code is openly available on GitHub for research and use.
  https://github.com/nmcdev/CMA-AIM-GFS-Fengqing

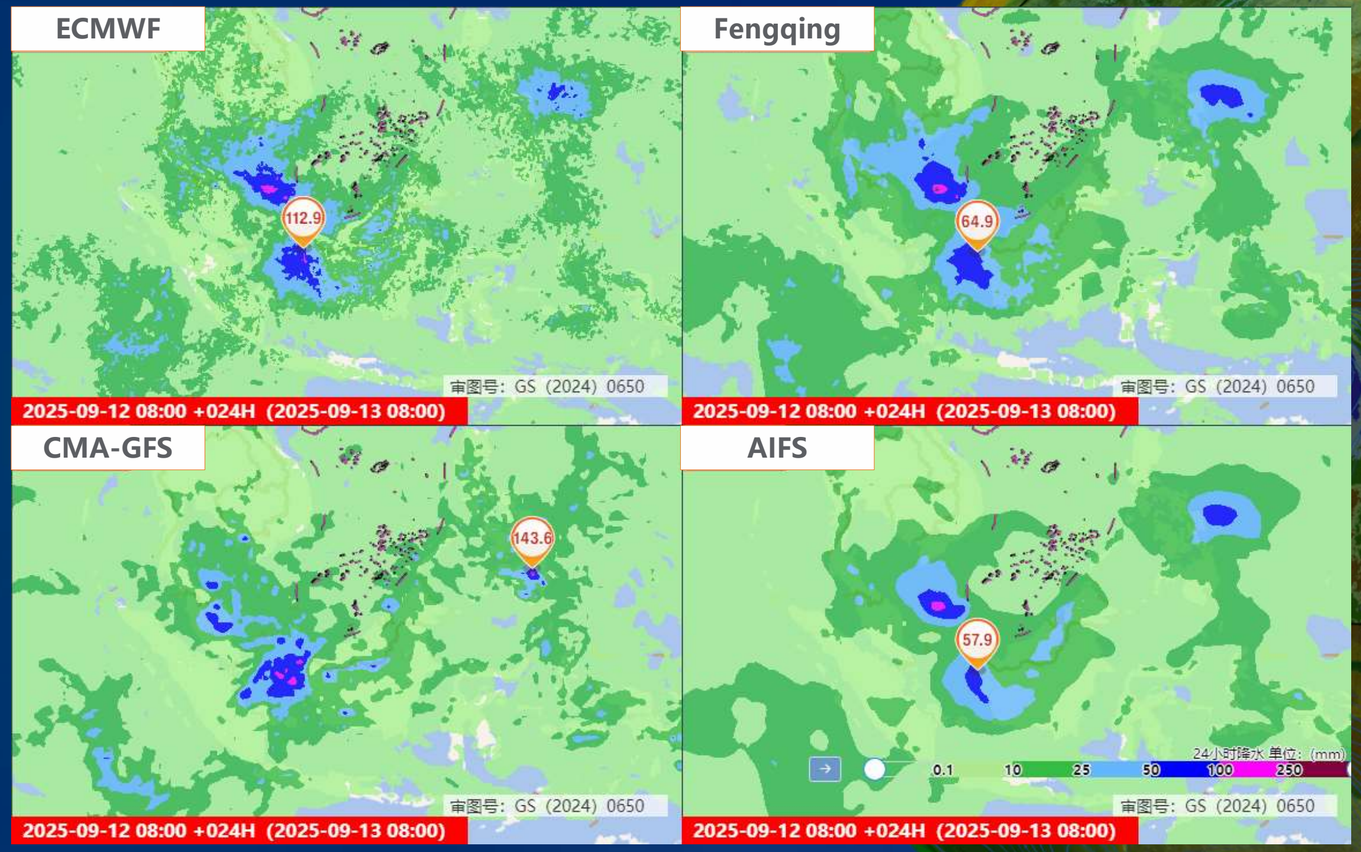


2023.1-2023.7	2023.7-2023.12	2024.1-2024.6	2024.7-2024.9	2025.1-2025.7
Pre-research work on data-driven models	**Early version development**	**FengQing V1.0 Official Release**	**Operational Application**	**Further Technological Breakthroughs**
Collaborate with Tsinghua University to initiate AI model R & D	Based on the Transitor architecture	2024 June: CMA officially launched the FengQing Model	2024 September: passed the operation access review by CMA	**FengQing 1.5 Physical-constrained AI model released**

风清：中国气象局的全球AI天气模型
FENGQING: CMA’s Flagship Global AI Weather Model

- **The covariate prediction strategy leads to improved precipitation forecasting, achieving gains in both accuracy and physical consistency, especially on heavy rains.**





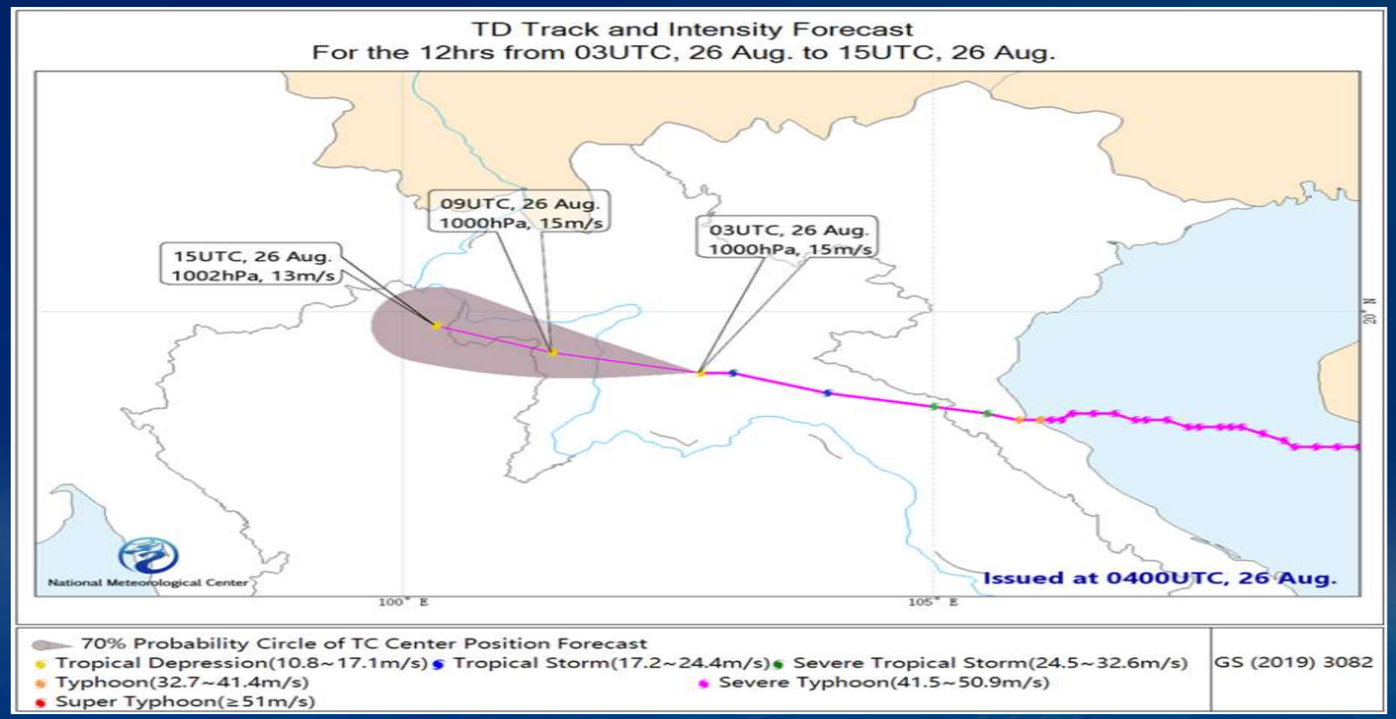
FengQing demonstrates strong performance, outscoring traditional models like ECMWF in heavy rain forecasts over key regions.

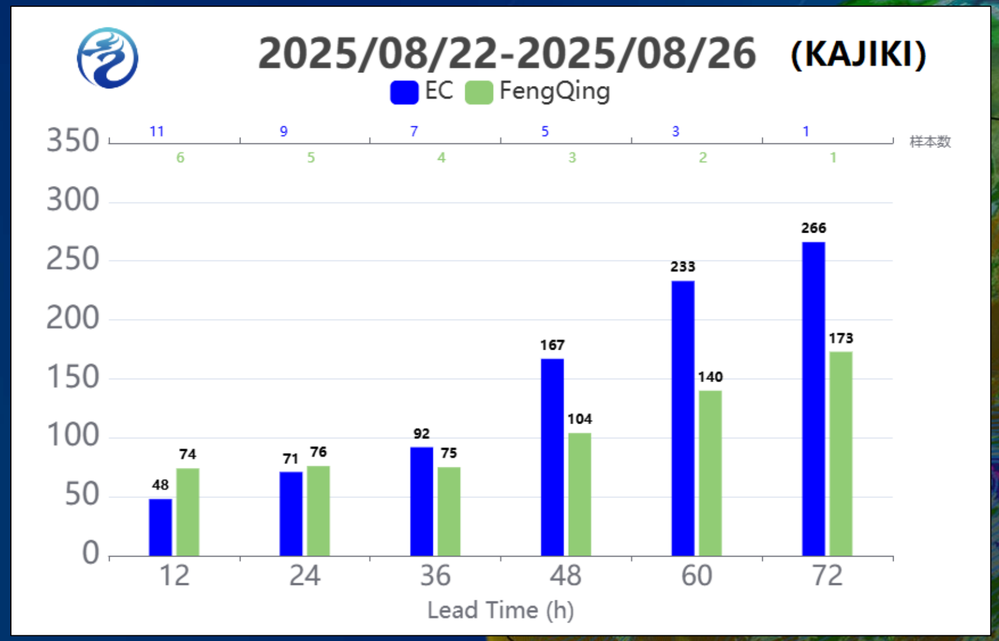
24 hours accumulated precipitation forecast for the Southeast Asia

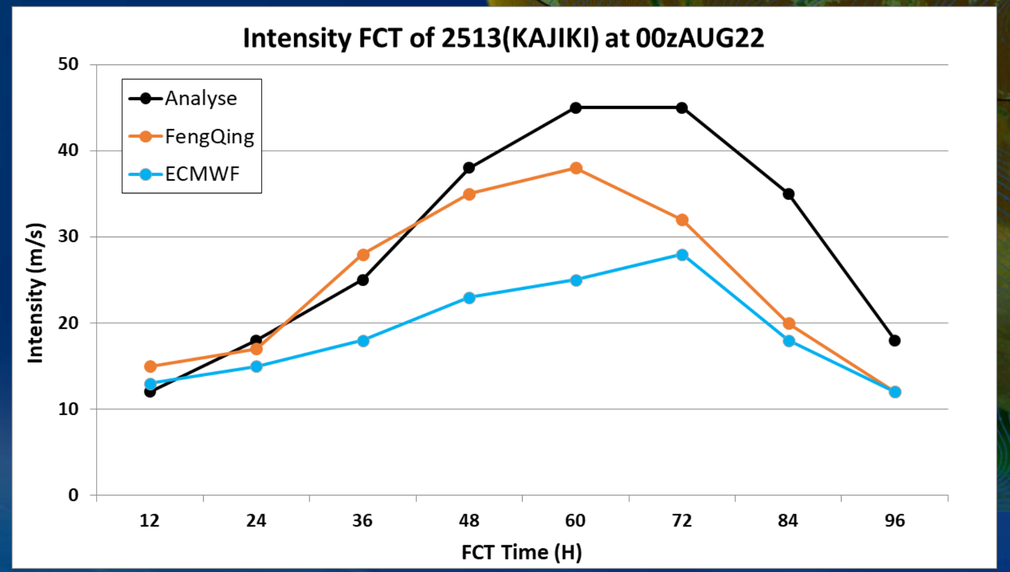
风清：中国气象局的全球AI天气模型
FENGQING: CMA’s Flagship Global AI Weather Model

FengQing improves Typhoon Prediction：

- KAJIKI was the 13th typhoon of 2025; it rapidly intensified into **a super typhoon and made landfall in northern Vietnam** on the evening of 25 August.
- FengQing provided **a stable track forecast**, reducing the 48-hour track error by **38 % relative to the ECMWF forecast**.
- The peak-intensity forecast of **38 m s^{-1} was closer to the observed 45 m s^{-1}** than the ECMWF forecast of 28 m s^{-1}.





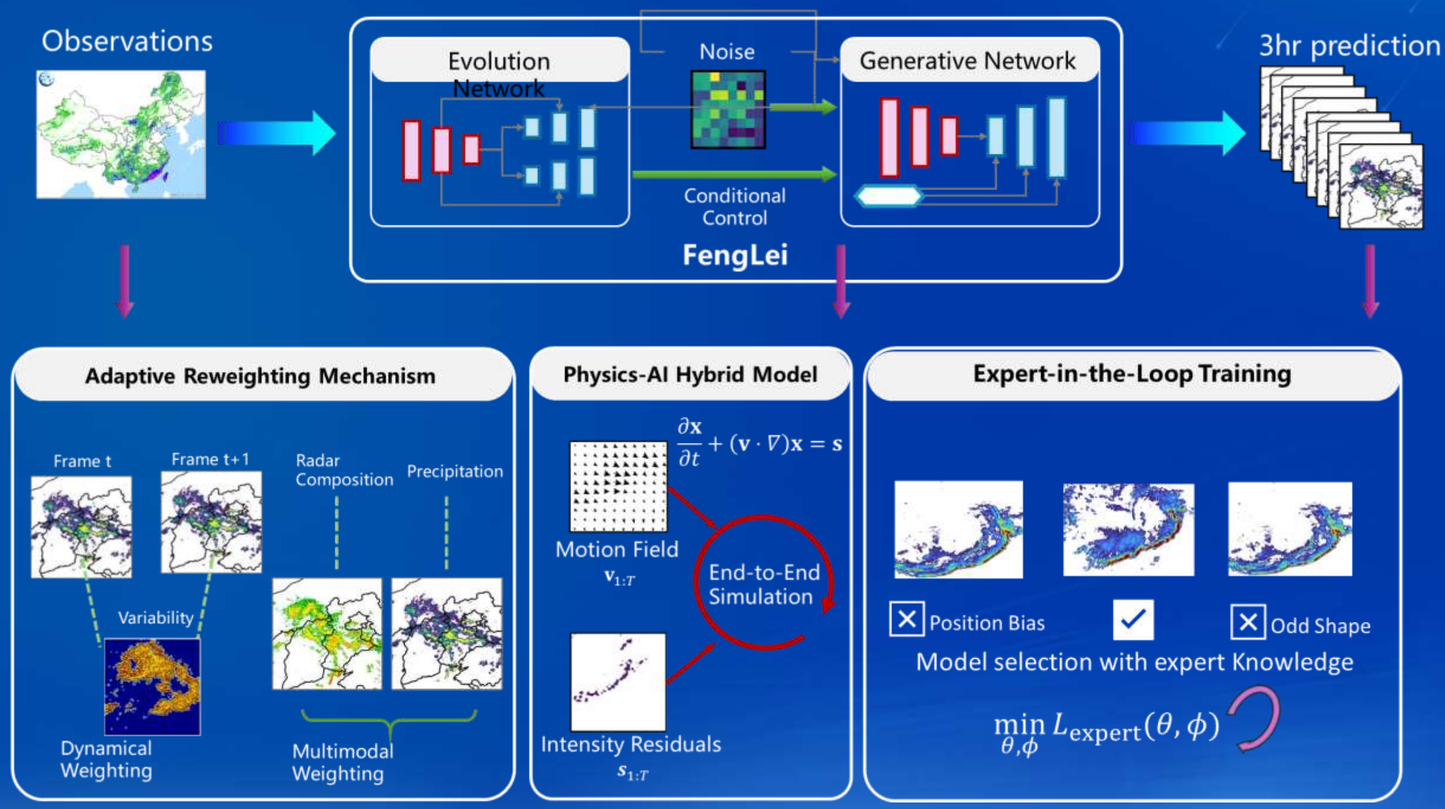


风雷：面向临近威胁的AI短时临近预报
FENGLEI: AI Nowcasting for Imminent Threats

Key Features:

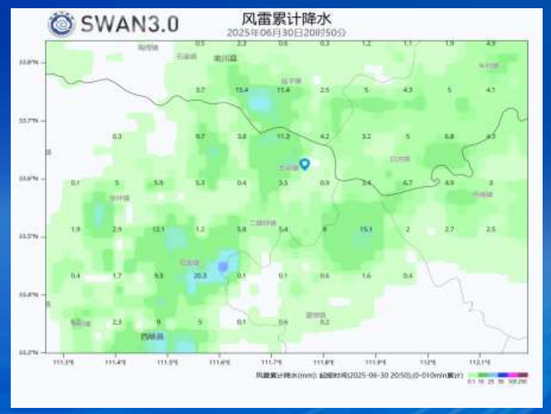
- **High-Resolution**: Provides 0-3h forecasts at 1km resolution, updated every 6-10 minutes.
- **Operationally Integrated**: Deployed nationwide in China on the SWAN platform, supporting forecasters at all levels.
- **Superior Storm Prediction**: Excels at forecasting storm initiation, evolution, and dissipation.
- **New Application**: Includes precipitation nowcasting for applications like flash flood and landslide warnings. (新增应用：支持山洪、滑坡等灾害预警的降水临近预报。).

1km-resolution precipitation forecast product with 10-min rolling updates



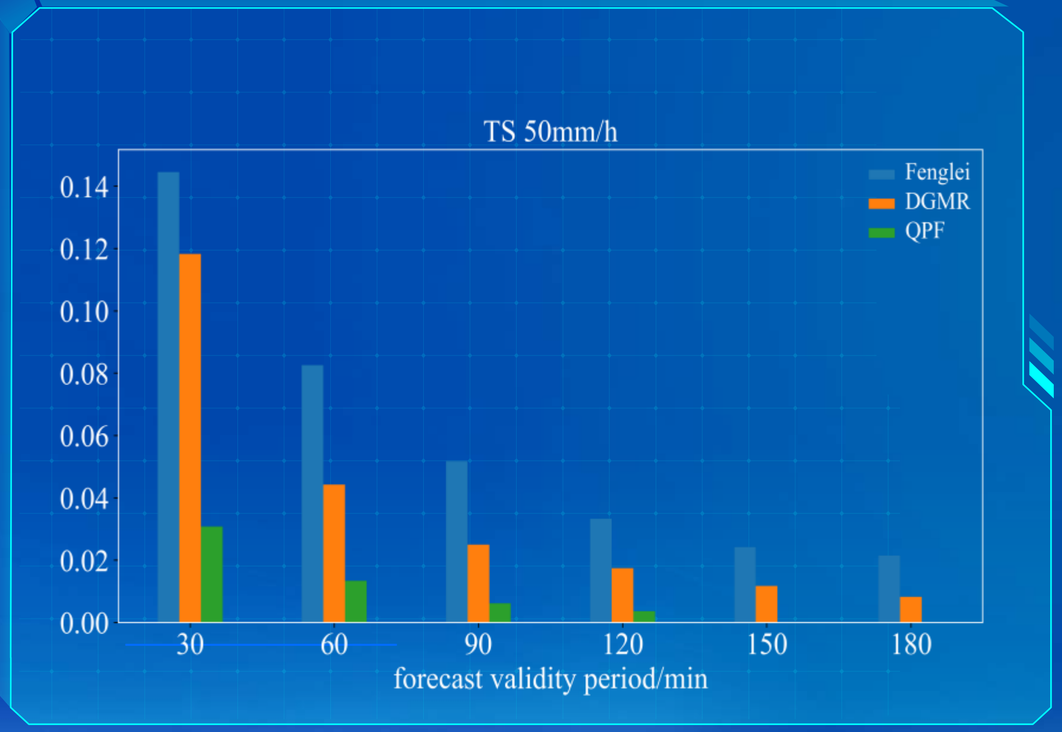
Rainstorm-induced geohazards

Fenglei's 10-min interval 3h precipitation forecast



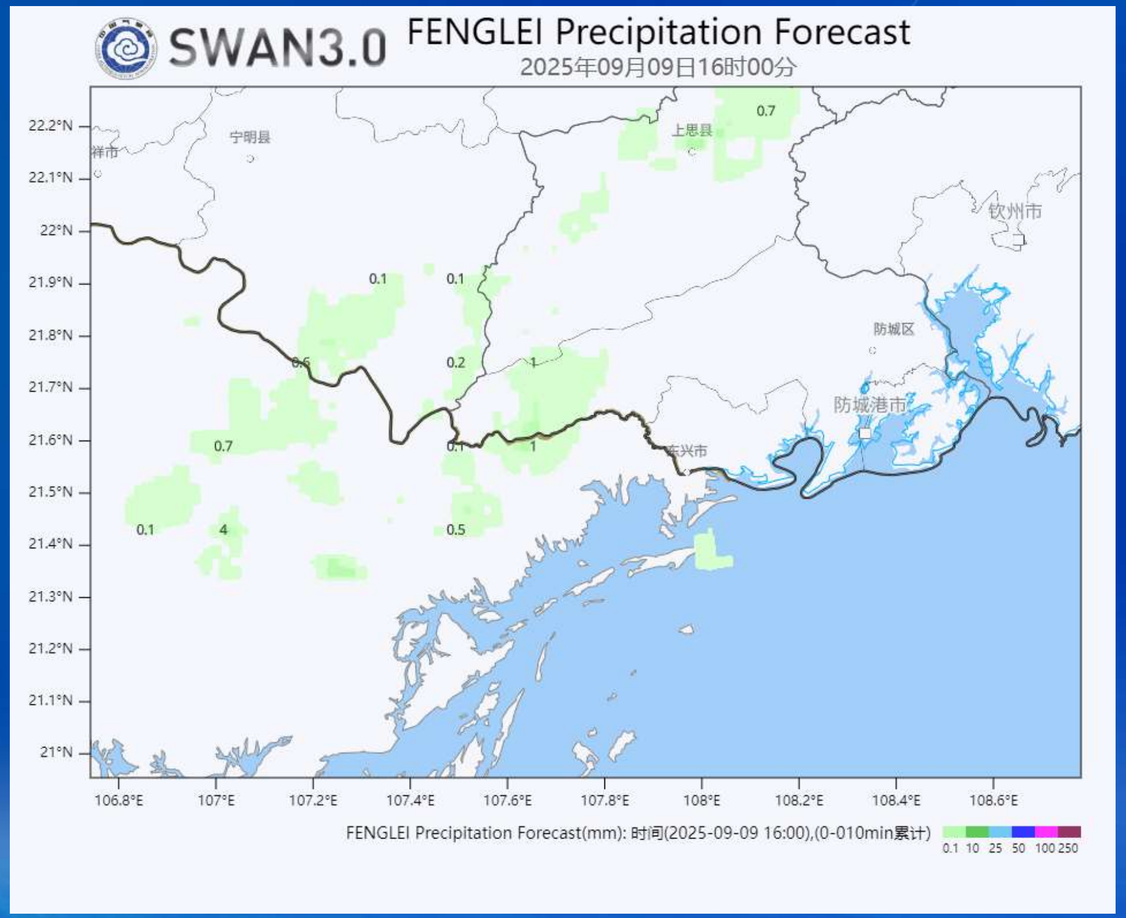
风雷：面向临近威胁的AI短时临近预报
FENGLEI: AI Nowcasting for Imminent Threats

Significant Improvement in Threat Score (TS) for Precipitation Forecasting



Compared to traditional methods, FengLei shows an **18% improvement** in accuracy, providing more reliable short-term warnings. (与传统方法相比，风雷的准确率提升了18%，能提供更可靠的短时预警。)

Fenglei supports regional adaptation to address diverse forecasting requirements



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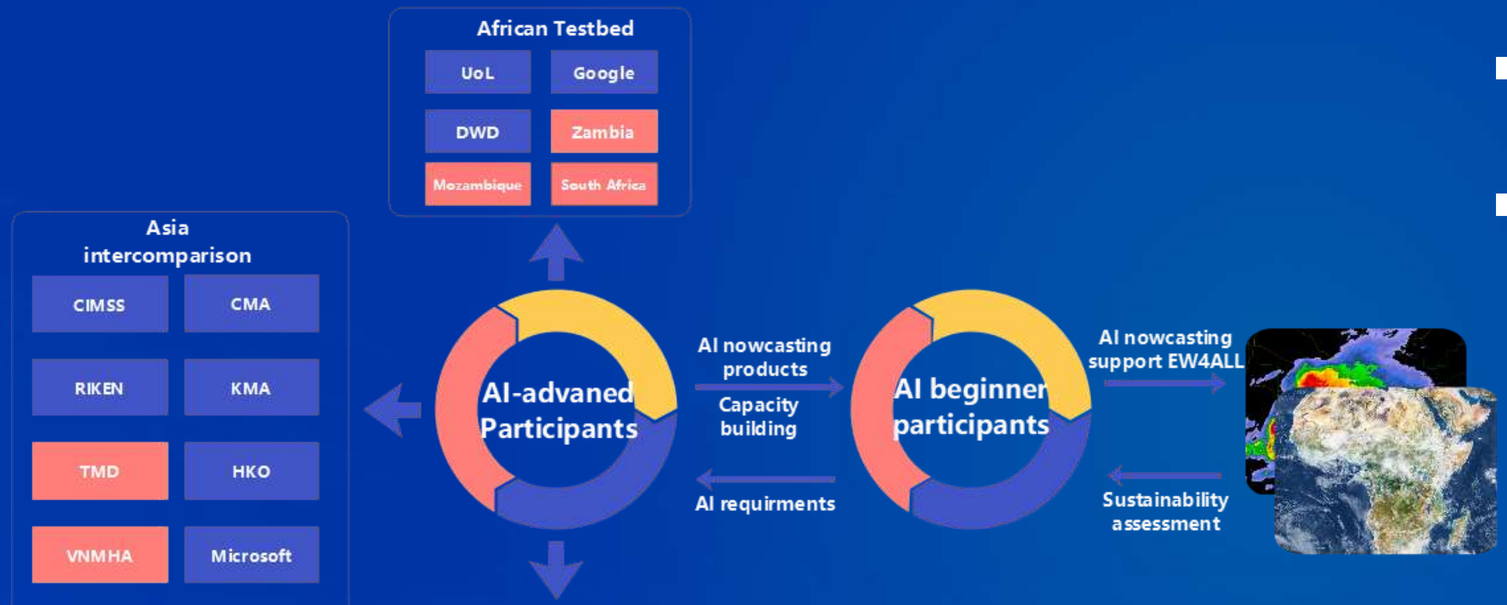
全球合作框架：WMO临近预报AI示范项目(AINPP)
Global Cooperation Framework: WMO AI for Nowcasting Pilot Project (AINPP)

AI for nowcasting pilot project (AINPP)



NHMS	Academia	Private Sectors	UN initiative
9	7	3	1
• DWD (German) • CMA (China) • HKO (Hong Kong, China) • NOAA(US) • KMA (South Korea) • VNMHA (Vietnam • TMD (Thailand) • NCM(UAE) • NCM(Saudi Arabia)	• 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

- CMA is actively contributing to the WMO AI for Nowcasting Pilot Project (AINPP).
- Our Goal: To support the EW4ALL initiative by **narrowing the AI capacity gap and promoting open science**.
- 2025 Initiative: **We are leading the development of the AINPP Asian Nowcasting Intercomparison Platform**, providing a neutral space for members to test and evaluate different AI models.

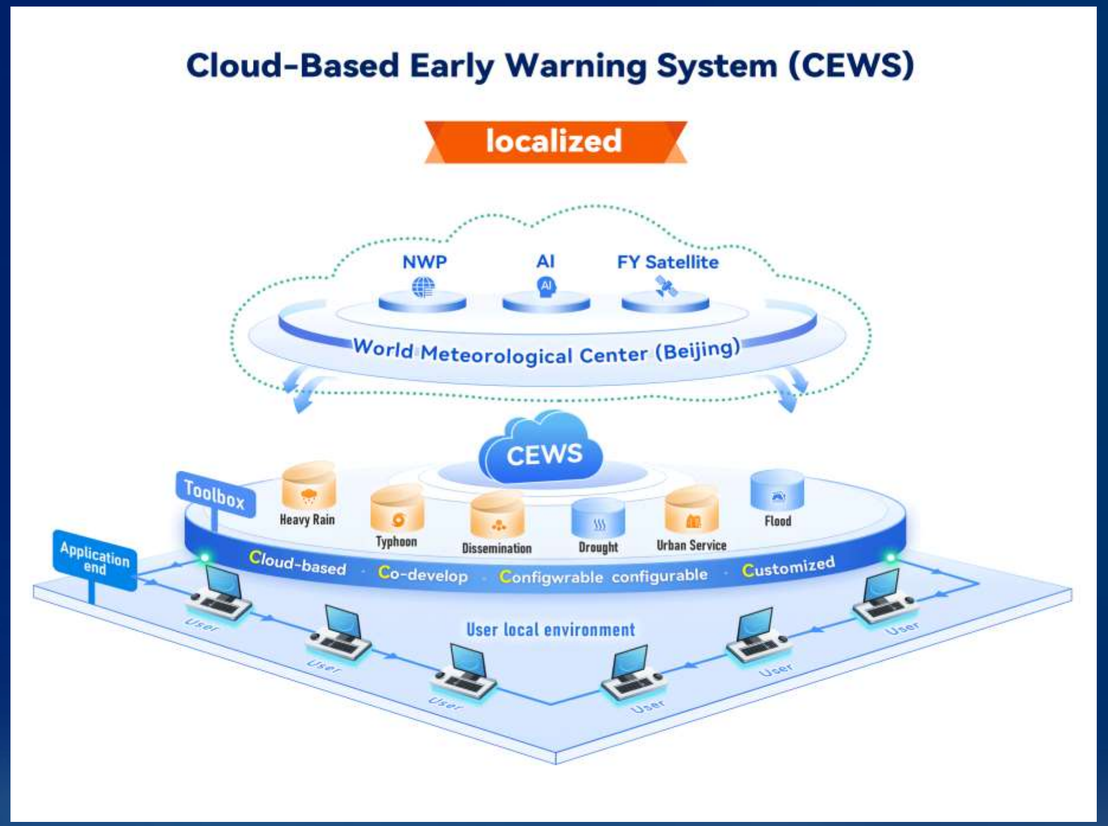
2025 AINPP Asian Nowcasting Intercomparison Platform

https://www.wmc-bj.net/ainpp/

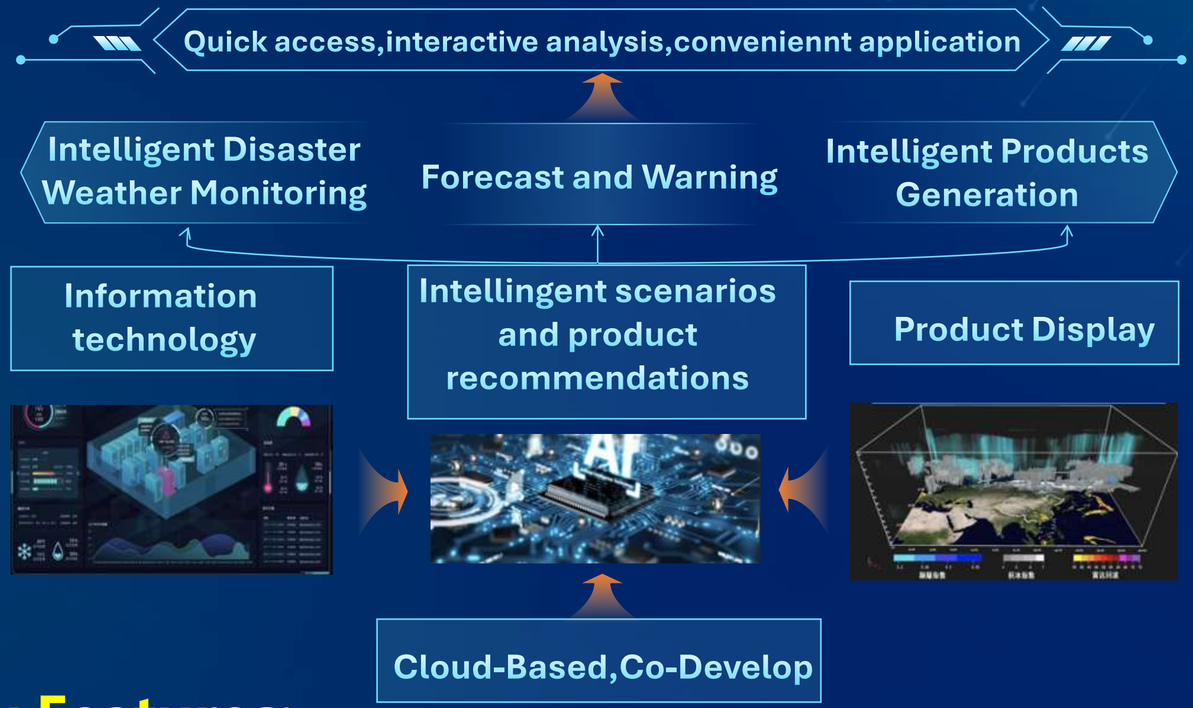
https://www.wmc-bj.net/

合作的桥梁：“云+端”国际预警平台
Bridging Cooperation: International Meteorological Early Warning Service Platform

This platform is a key component of our MAZU international service brand



http://ew4all.wmc-bj.net/EW4ALL/monitor



Key Features:

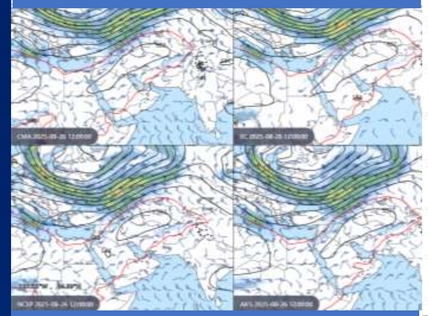
- **Cloud-Based**: Accessible anywhere, anytime with a web browser. No local installation required.
- **Modular**: A "plug-and-play" design allows countries to select and integrate the tools they need.
- **Powered by CMA's core technologies**: Integrates top AI models (like FengQing), Multiple NWP, satellite and warning products.

我们的方法：共同建设能力
Our Approach: Building Capacity Together

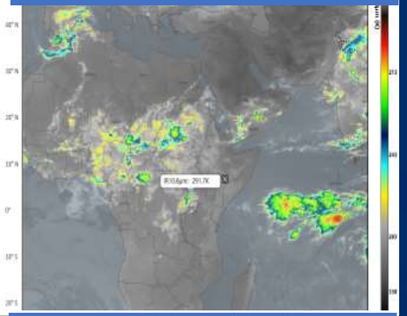
- **Core Philosophy**: We don't just provide forecasts. We provide the tools, data, and training for partner nations to build their own customized early warning systems.
- **Success Stories**: Customized platforms developed for Pakistan, Solomon Islands, and Ethiopia, tailored to their specific needs.

Provide Products

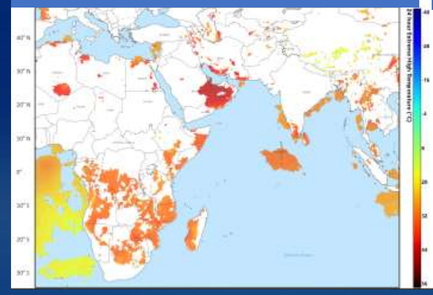
Multi NWP/AI model application



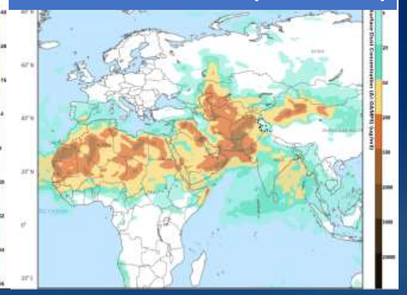
Convective Cloud Monitoring



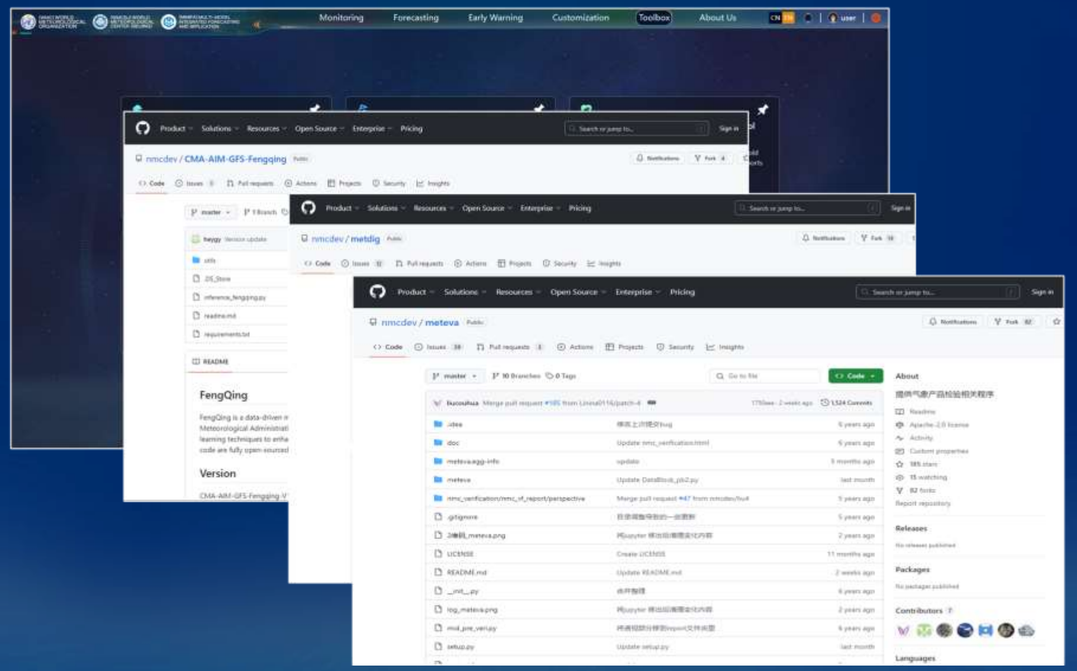
Extreme Heat Wave Forecast



Dust Concentration (AI-GAMFS)



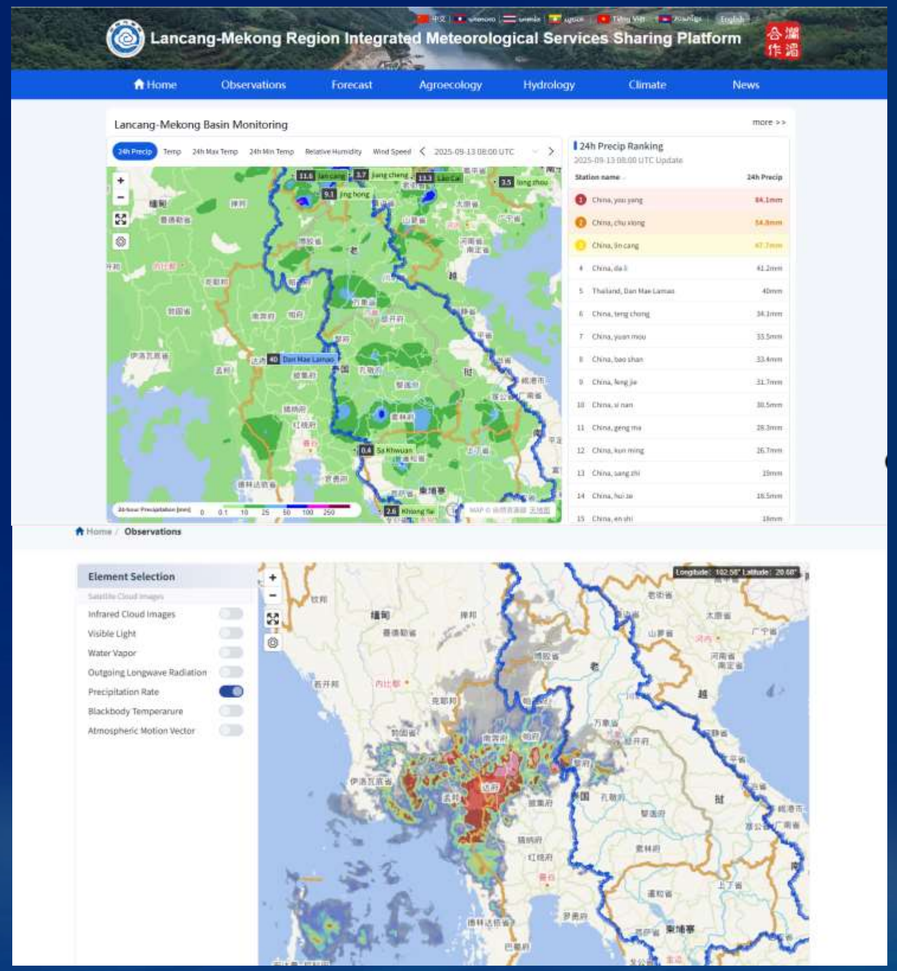
Empower with Tools



Co-develop Solutions

案例研究：为澜湄区域量身定制的平台
Case Study: A Tailored Platform for the Lancang-Mekong Region

- **Core Function**: A shared platform for data, technology, and products, built on CMA's core technologies. (一个基于中国气象局核心技术，集数据、技术、产品于一体的共享平台。)

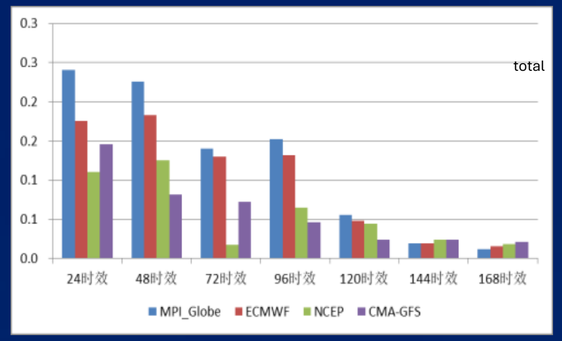


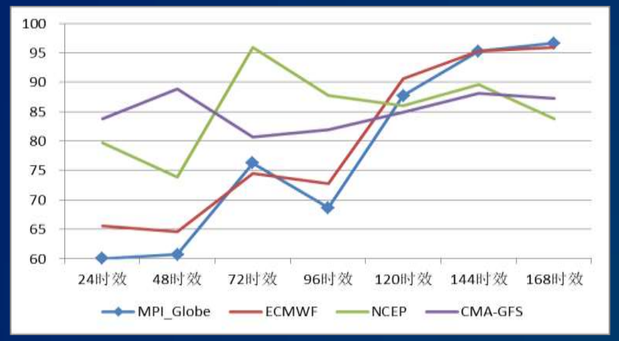
- Flood & Drought Monitoring
- Severe Weather Forecasts
- Disaster Risk Assessment
- Climate State Analyze
- Early Warning Services
- Agro-Ecological Met Services
- Operational Capacity Building

https://www.wmc-bj.net/lm-en/

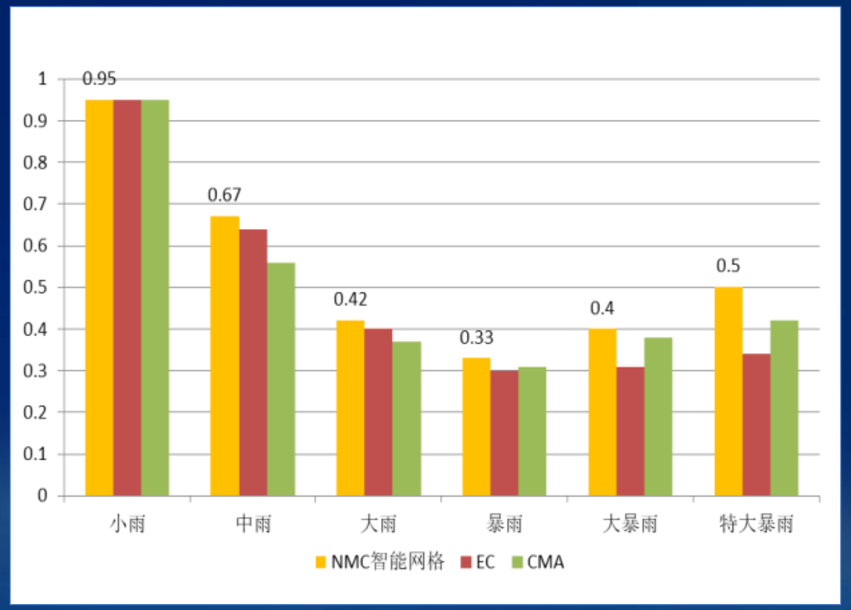
案例研究：为澜湄区域提供更优预报
Case Study: Delivering Better Forecasts for the Lancang-Mekong Region

- We developed intelligent grid forecasting for the Lancang-Mekong Region by integrating our NWP and AI models with local data.





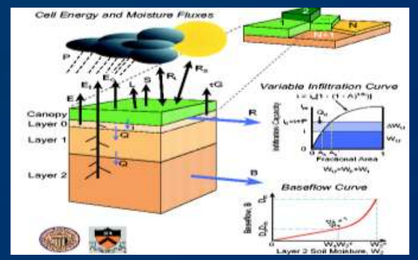
- Summer Rainfall Verification in 2024, Our **5-day rainfall forecast is now more accurate than leading numerical models**.
- This improved forecast directly feeds into hydrological and landslide models, **enhancing multi-hazard warning capabilities**.

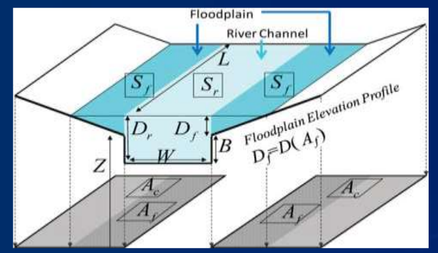


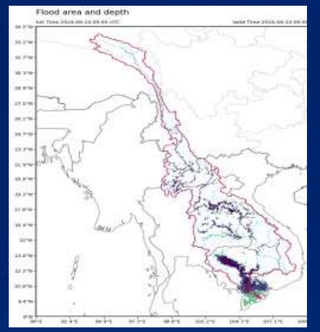
Forecast accuracy for heavy rainfall has significantly improved.

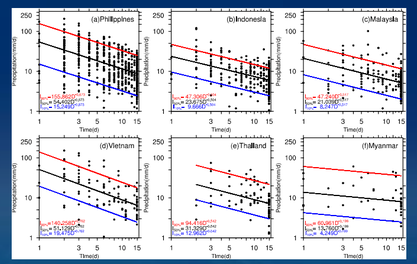
forcing

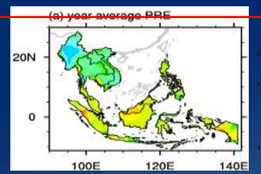
Hydrological-Hydrodynamic model

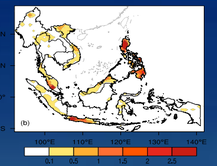


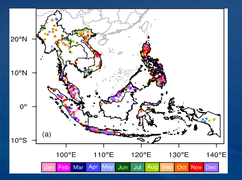


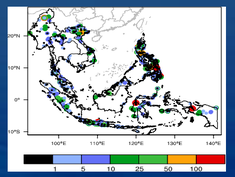






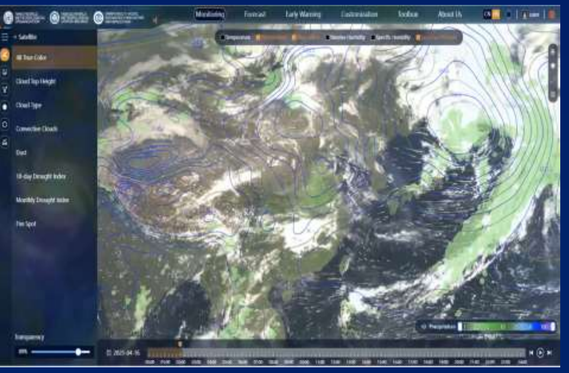


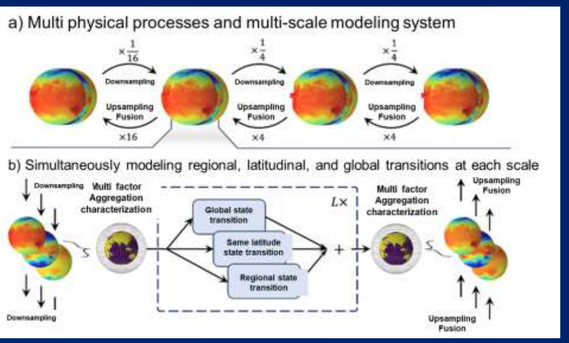


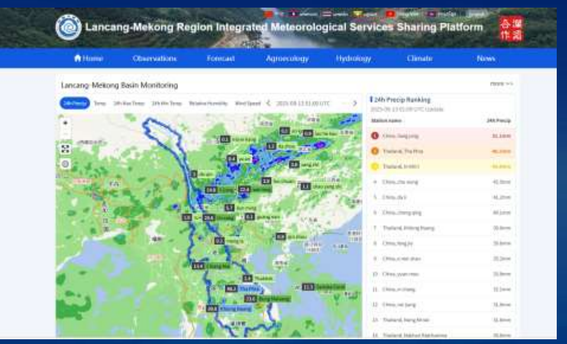


Geological Landslide Alert modle

开放合作与共享：以新技术和新产品全面支持“全民早期预警”倡议
Open collaboration and sharing: fully supporting EW4ALL with new technologies and products

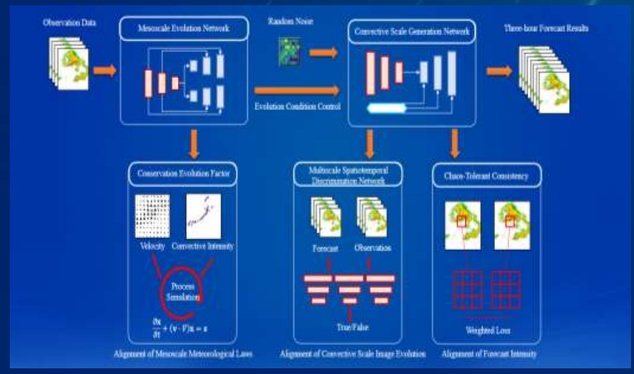


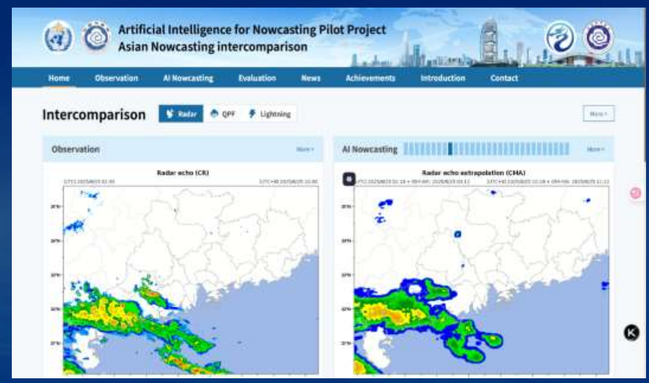




We invite our partners from ASEAN nations to join us in this mission:

- **Use Our Technology (使用我们的技术):**
  - Download and run the **open-source FengQing model** on your systems.
  - Explore our forecast products on the **WMC-BJ and CEWS platforms.**
- **Co-Develop Solutions (共建解决方案):**
  - Let's **adapt the FengLei model** using your local radar data to build a custom nowcasting system.
  - Let's **co-design new AI applications** for your specific needs, such as water resource management.
- **Join Global Initiatives (加入全球计划):**
  - Participate in WMO pilot projects **like AINPP** to shape the future of AI in meteorology.
  - Contribute to global benchmark datasets and **help establish best practices.**





Thank You!

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第4届中国—东盟气象合作论坛

THE 4TH CHINA-ASEAN METEOROLOGICAL COOPERATION FORUM

数智赋能气象合作 早期预警普惠民生

DIGITAL INTELLIGENCE EMPOWERS METEOROLOGICAL COOPERATION EARLY WARNINGS BENEFIT PEOPLE'S LIVELIHOODS

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中国气象局国际合作与培训中心
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广西壮族自治区大数据发展局
Big Data Development Bureau of Guangxi Zhuang Autonomous Region

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