The 20th Workshop on High Performance Computing in Meteorology

New Generation HPC for CMA

Shuai Deng and many colleagues

National Meteorological Information Centre (NMIC)
China Meteorological Administration (CMA)

Who We Are

- We‘re a team from the Advanced Computing Division, National Meteorological Information Centre (NMIC) of China Meteorological Administration (CMA).

- The main responsibility includes :
  - Develop HPC systems capacity
  - Develop HPC-Supportive platforms
  - And so on

What “New Generation” Means

1. Updates for new HPC hardwares

2. Preparing for the Age of AI

Contents

CMA HPC Systems History (1990-2017)

Pi-Sugon HPC System
CMA Major Operational System
(2018-Now)

New HPC for CMA

Storage capability
5.8 times more than Pi

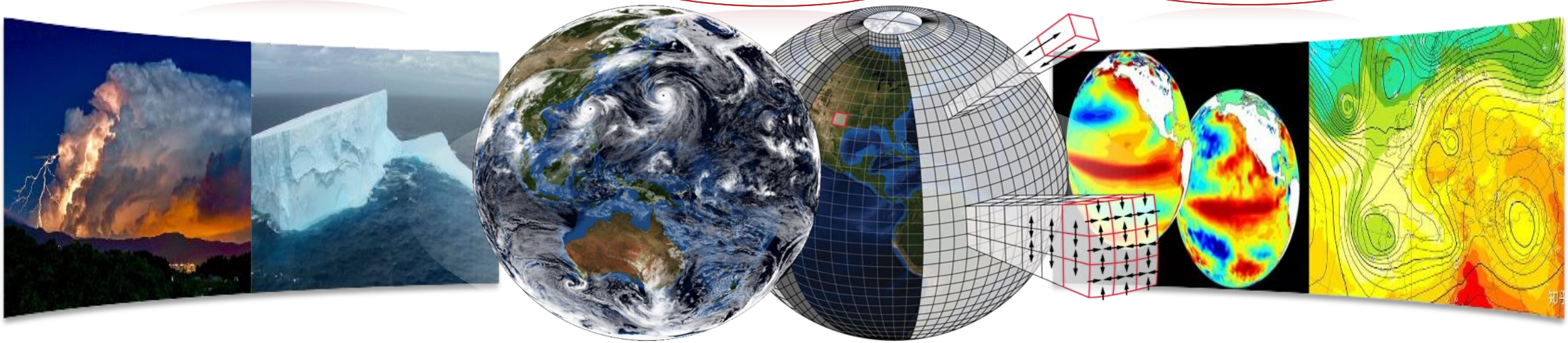
CloudStor

Computing Power
5.9 times more than Pi

Intel Sapphire Rapids CPU

Inner-Connection
2 times more then Pi

200GB IB



7600+ Nodes
460,000+ CPU Cores

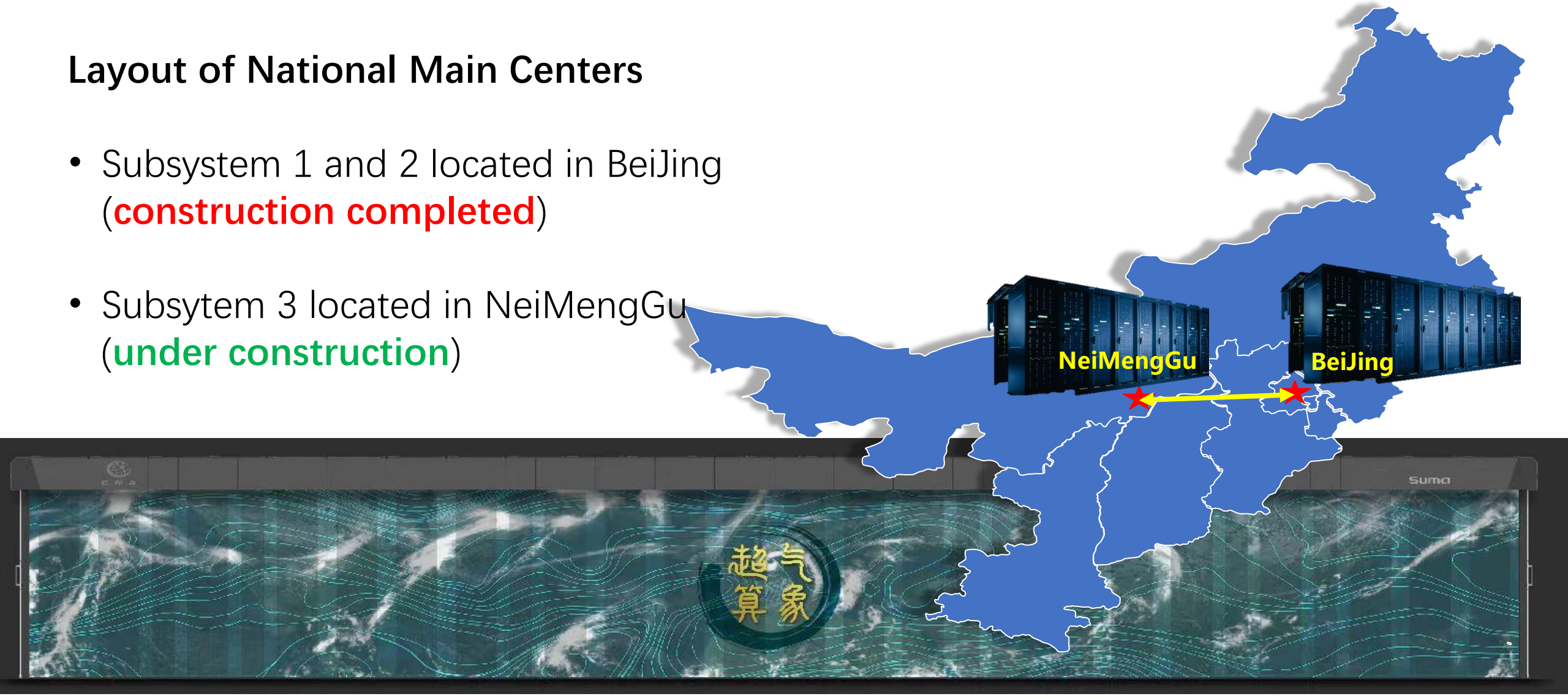
46P+ Flops Computing Powers

153PiB+ Parallel Storage Capability

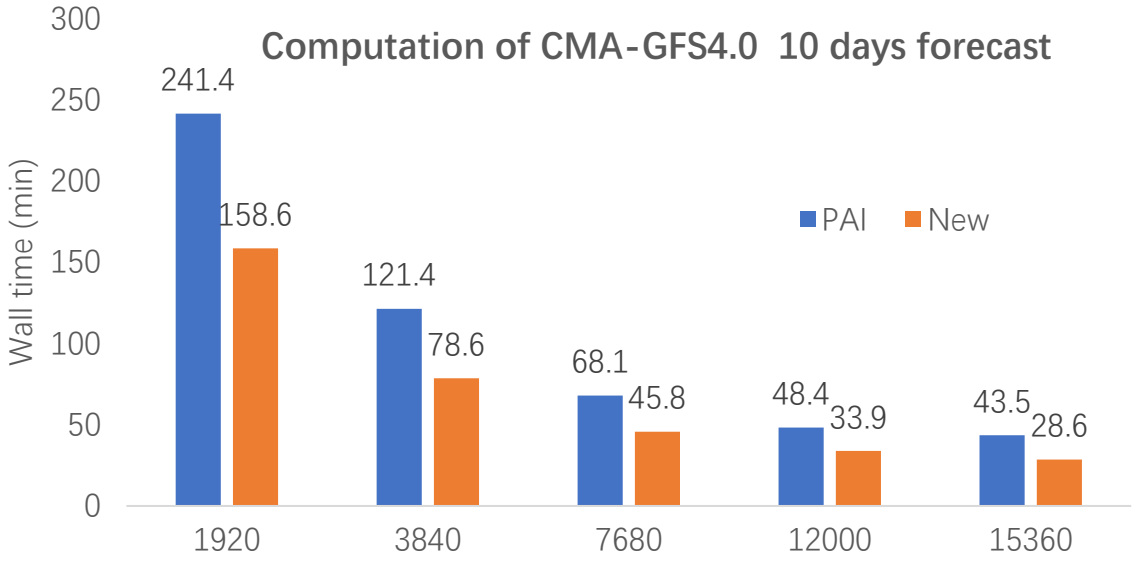
Layout of New HPC

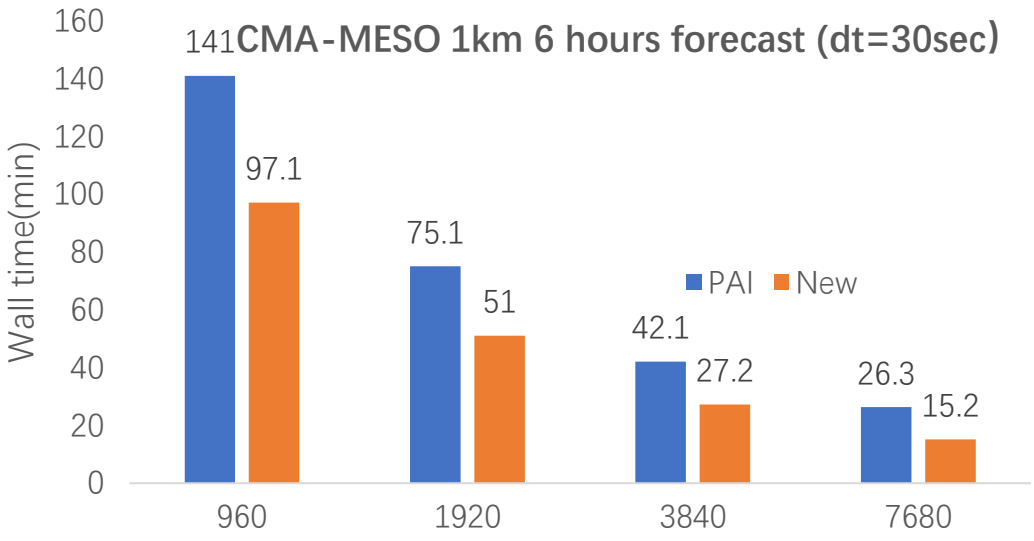
Layout of National Main Centers

- Subsystem 1 and 2 located in BeiJing (**construction completed**)
- Subsytem 3 located in NeiMengGu (**under construction**)



NWP Model Performance (Pi vs. New)





✓Performance boost at least 30% with the same number of cores.

Contents

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- AI for Meteorology
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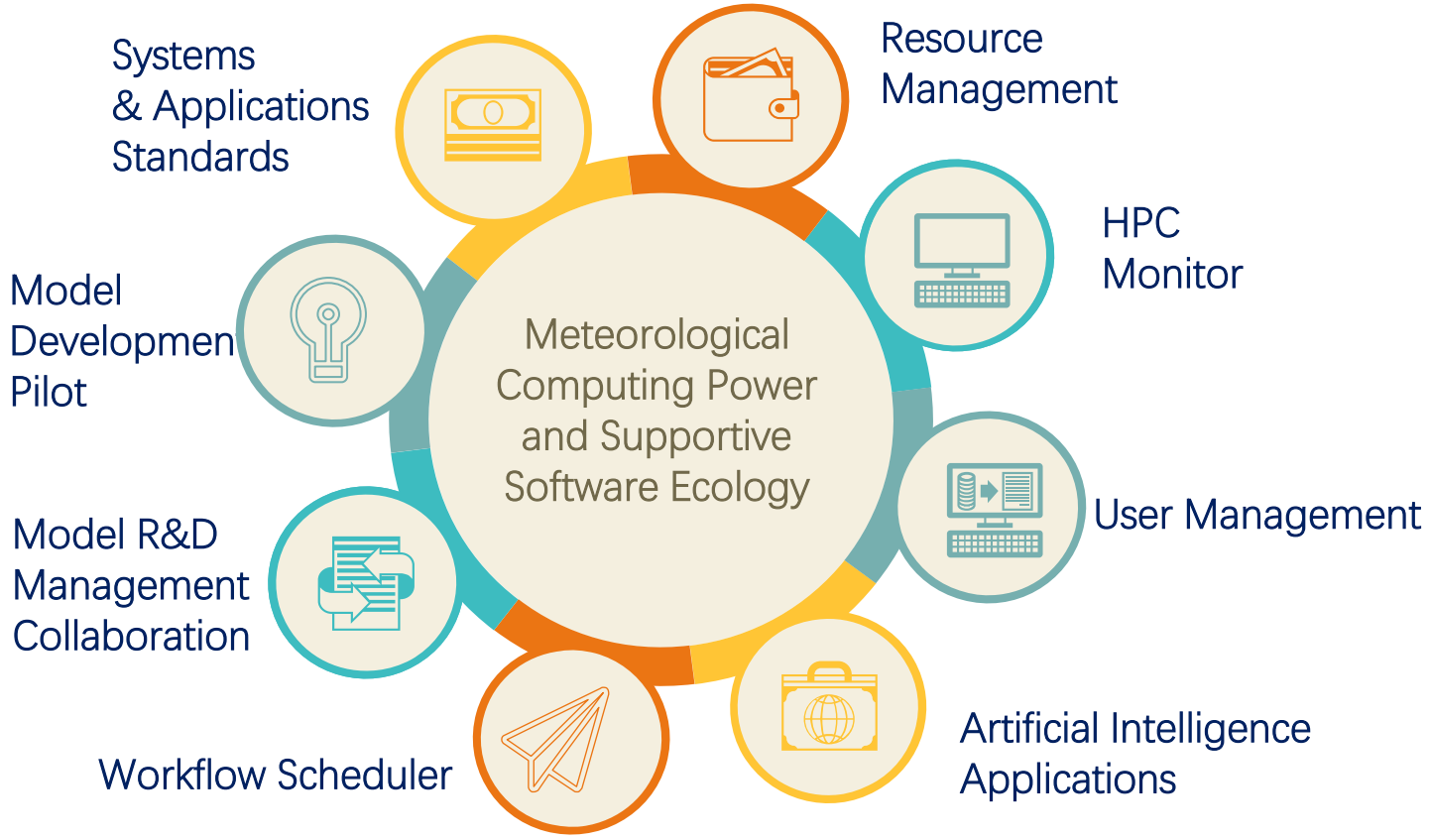
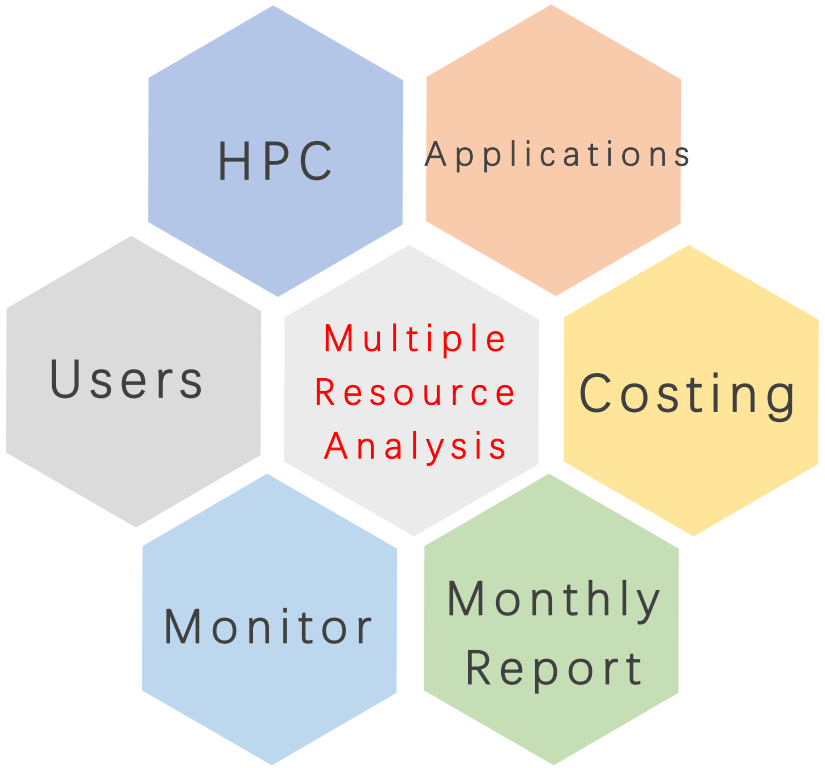
Meteorological Computing Power and Supportive Software Ecology

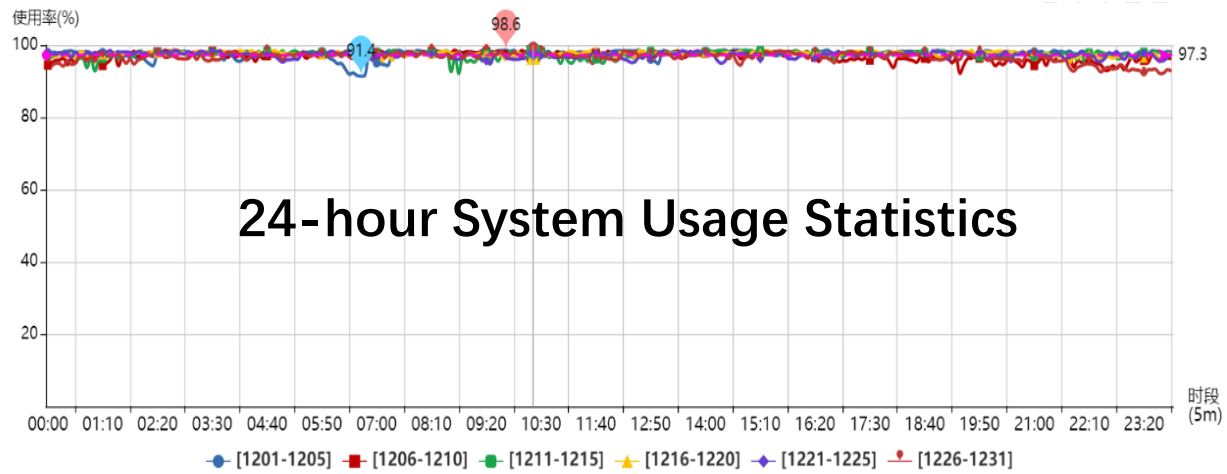
Preliminarily established the application support software ecology of meteorological computing power resources.

- ✓ System operation and management
- ✓ Model operation
- ✓ Scientific research support



Management Analysis of Computing Resource





Scientific management of supercomputing resources

Resource Allocation

Scheduling Strategy

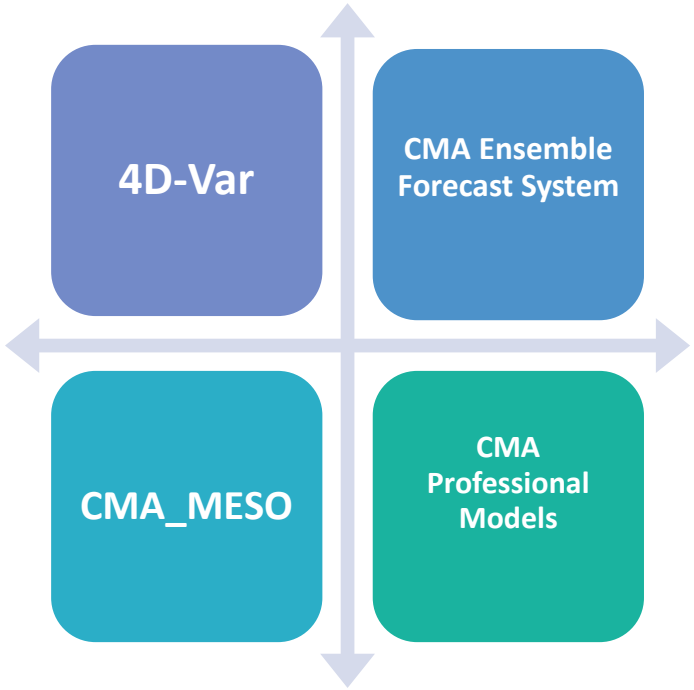
Behavioral Monitoring

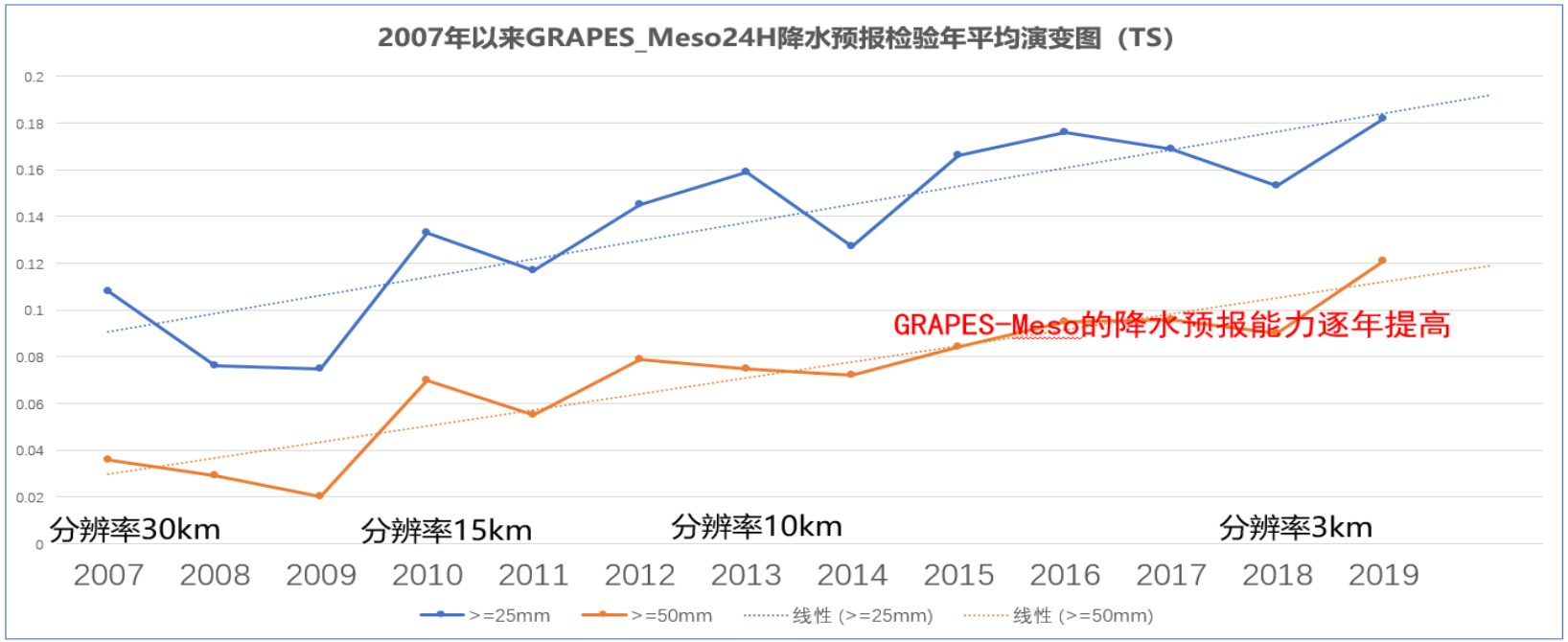
Optimization of Efficiency

Benefits Assessment

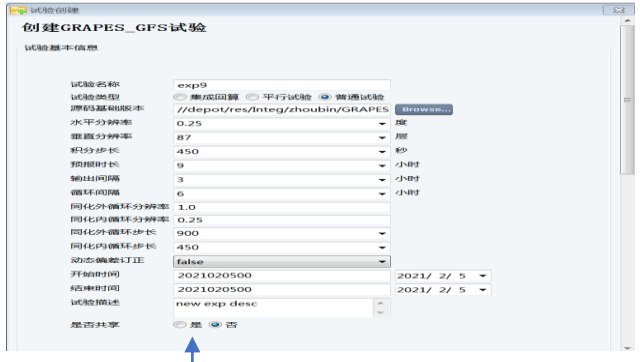
Support Continuous Upgrading of NWP Models

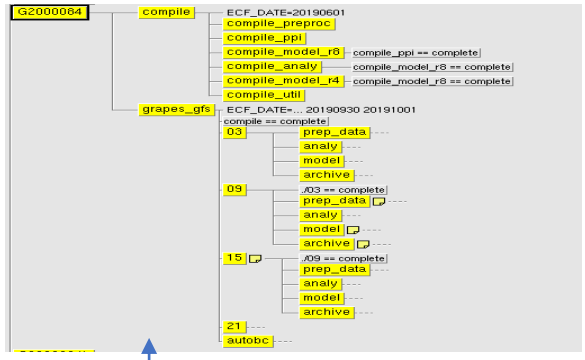
- ✓ Establishment of a complete CMA NWP operational system
- ✓ Evolution of Earth System Model

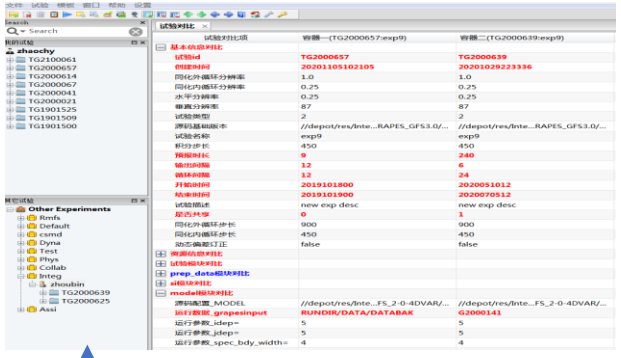




Model Pilot Platform







Experiment construction

Module Selection

Resource Allocation

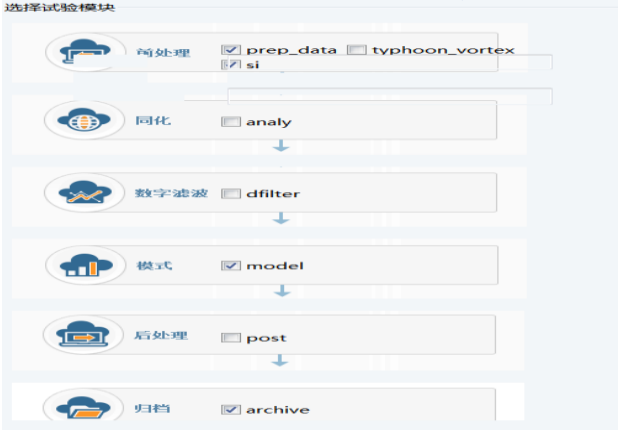
Parameter Configuration

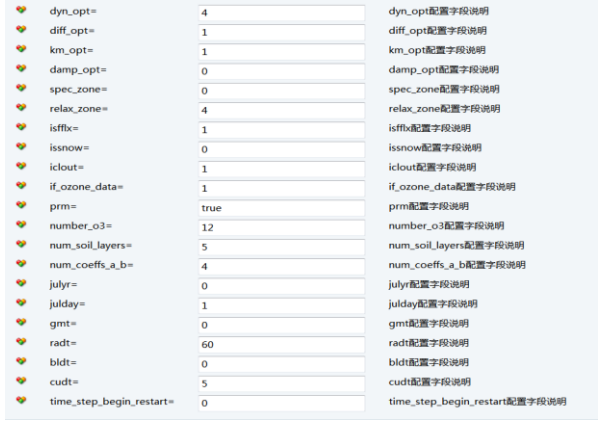
Operation Monitoring

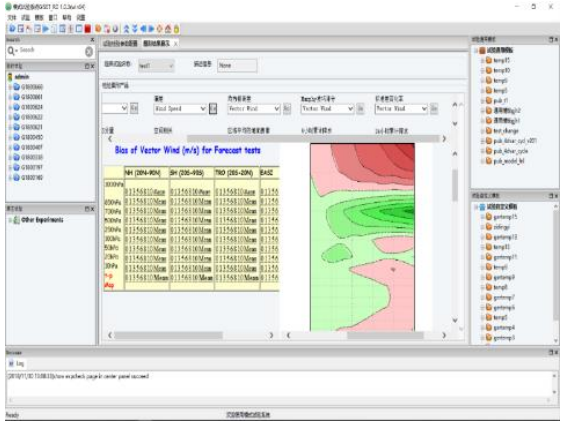
Result Analysis

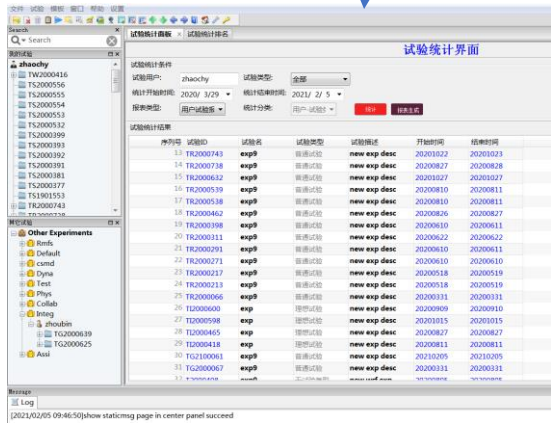
Experiment Comparison

Manage & Share

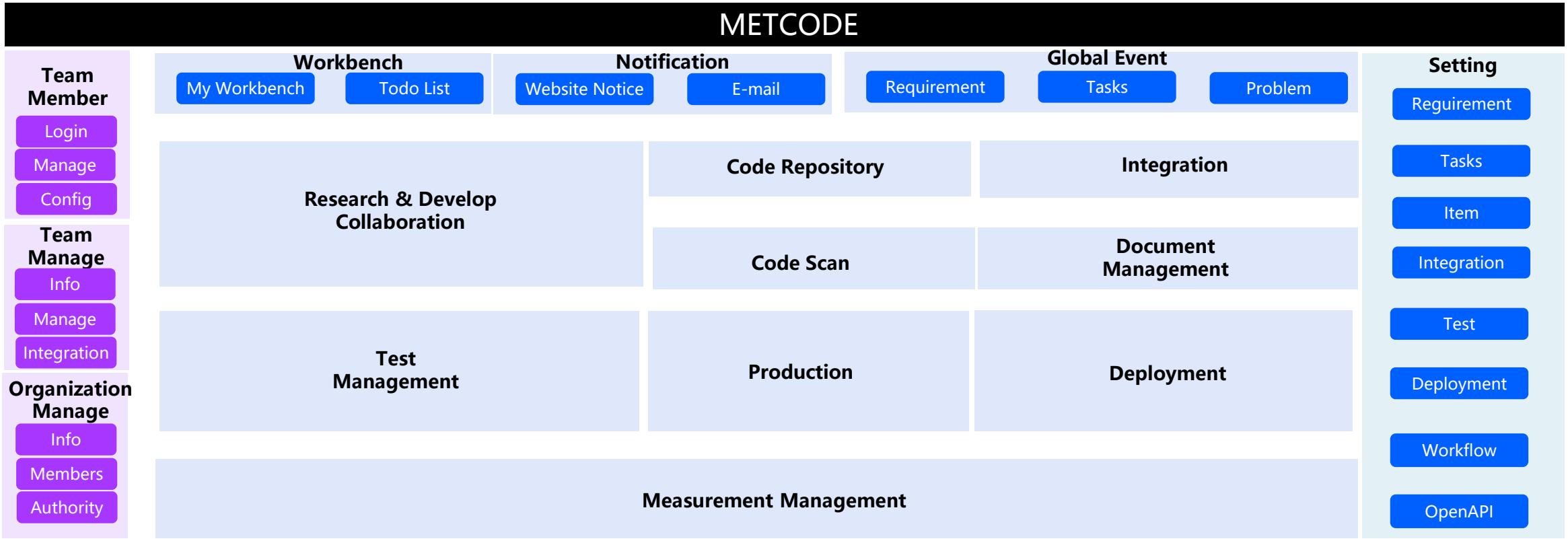








Model R&D Management Collaboration



Multiple Computing Power Resource Monitor

In the future, a monitoring platform for multiple computing power resources will provide all-around fine-grained monitoring at multiple levels.

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- HPC-Supportive Platforms
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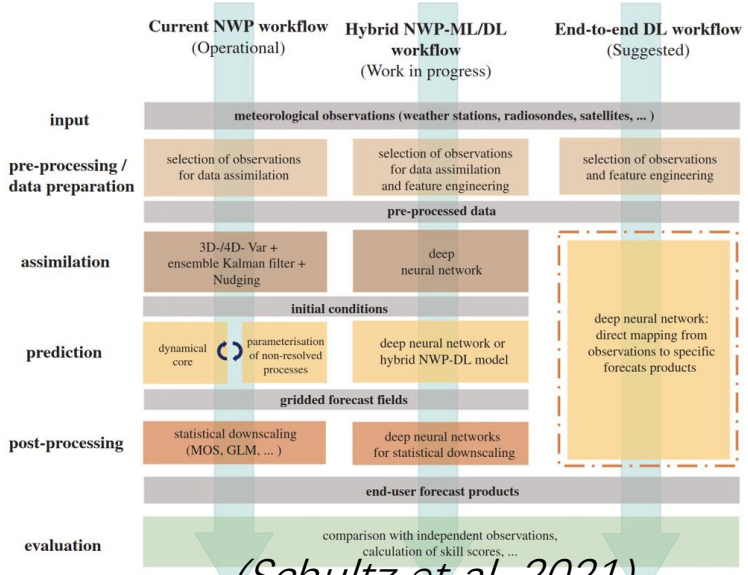
Weather Forecast System based on AI

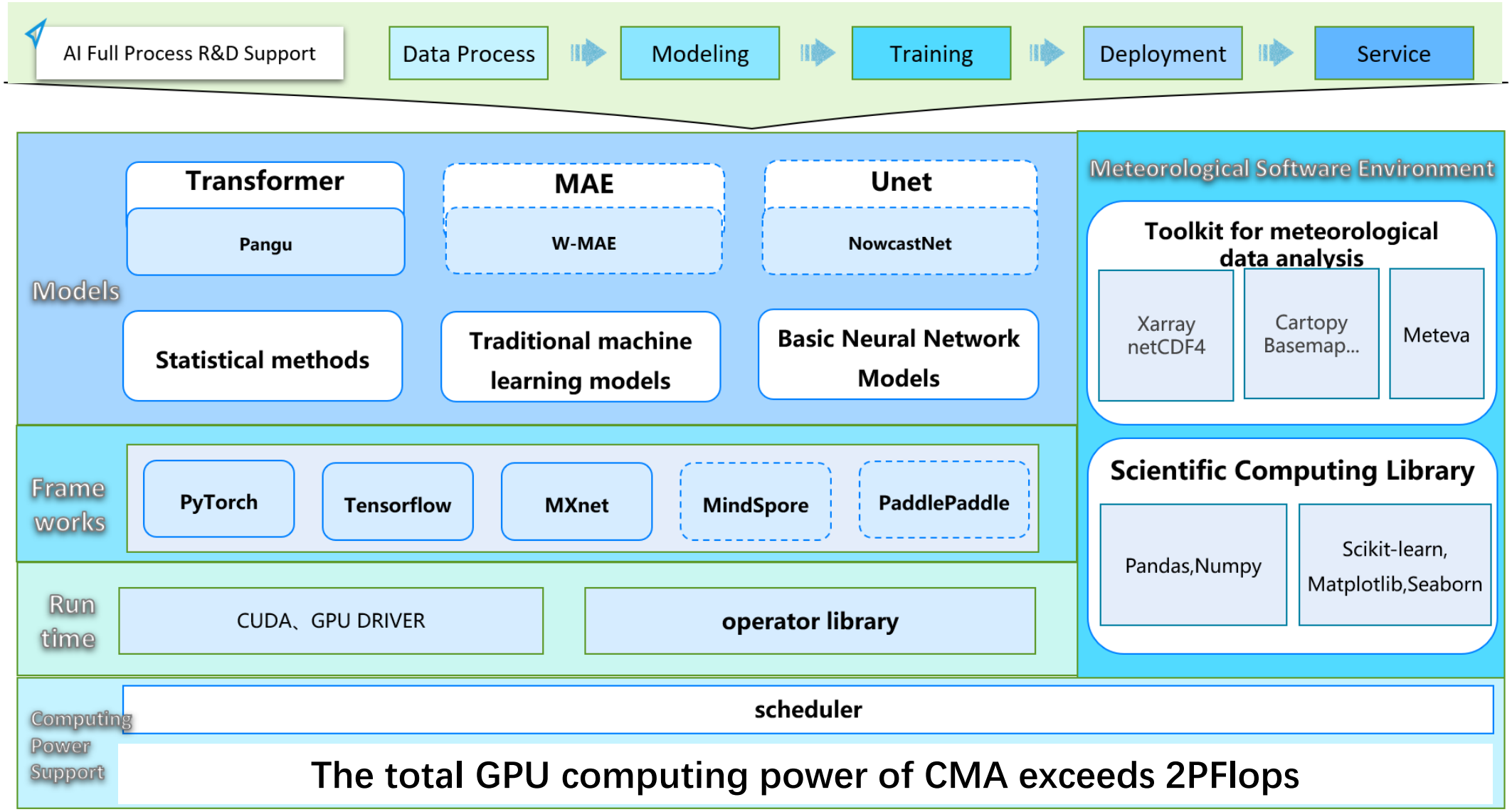
NAME	Authors	Framework	Training Cost	Forecast
Pangu	Huawei	Swin Transformer	15 days, 192*V100 GPU	7 days
Fengwu	Shanghai AI Laboratory	V-Transformer	17 days, 32*A100 GPU	14 days
Fuxi	Fudan University	U-Transformer	30 hours, 8* A100 GPU	15 days
NowcastNet	Tsinghua University & CMA	Physics-conditional deep generative model	-	3 houres 3 days

Pure data-driven deep learning techniques have become the current research hotspot in the field of weather forecasting.



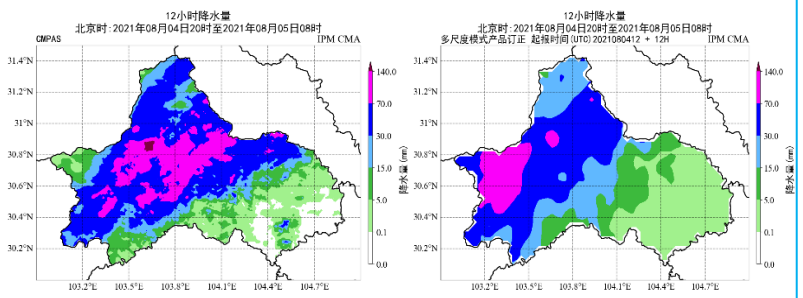
(Schultz et al. 2021)

AI Weather Support Platform



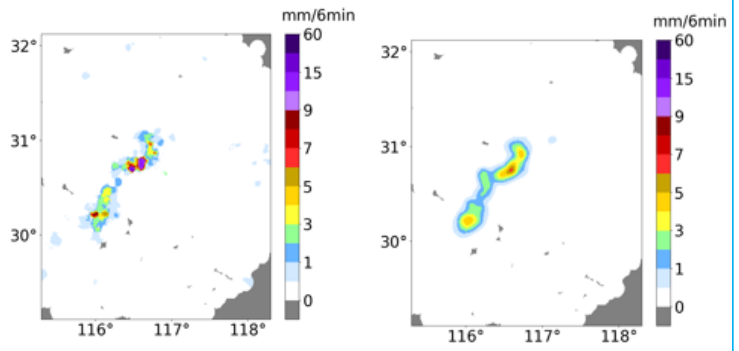
AI Weather Support Platform for Meteorology Service

Objectivized revision of precipitation products for multiscale numerical model forecasting

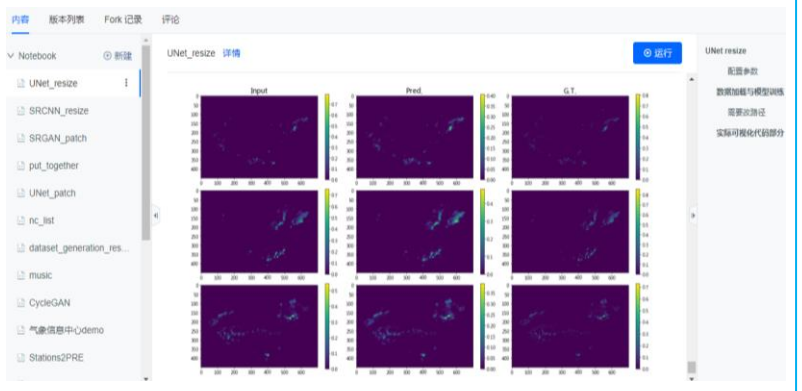


Conducting Chat Smart Q&A Model Run Tests

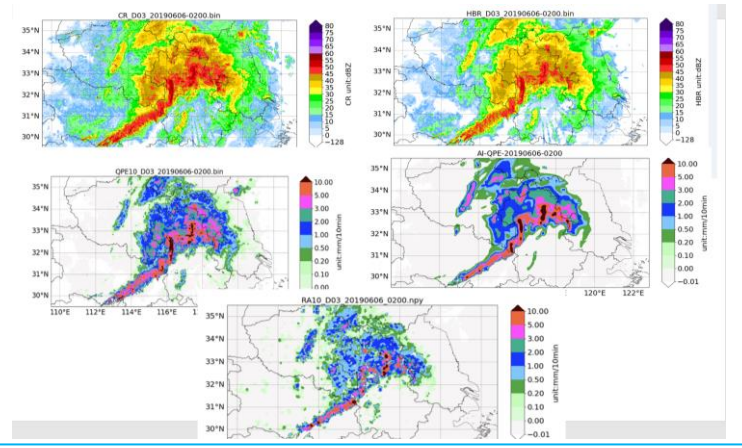
RREDNet



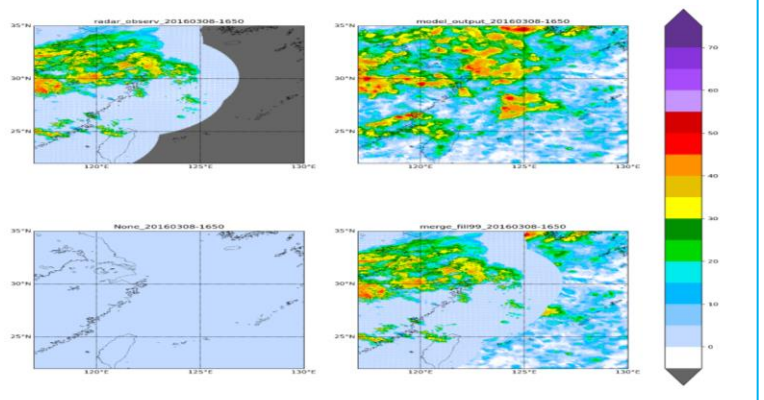
Conduct weather radar QPE downscaling product reconstruction and analysis



Conducting R&D runs of the National AI-QPE Quantitative Precipitation Estimation (QPE) model



Conducted research and development on radar reconstruction in East China



Contents

Conclusions

- New Generation for HPC
  - We have built a new generation of HPC system in CMA, which can better support the development of meteorological operations.
  - We have developed our HPC application support platform that can better support HPC systems.

- New Generation for Meteorology
  - Getting ready for the age of AI

Thank You for Listenning!

Thank you all for putting up with my broken English!

Please contact me (dengshuai@cma.gov.cn) if you have any questions!