极端天气气候与健康风险互联和治理国际卓越中心
IRDR ICoE Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health (RIG-WECEIPHE)
Integrated Research on Disaster Risk International Centre of Excellence

IRDR Integrated Research on Disaster Risk | UNDRR UN Office for Disaster Risk Reduction | International Science Council

Integrated Research on Disaster Risks ICoE Research and Educational Activities: Adaptation for Climate Resilience

(10:00-10:10, CET)

Xu Tang, Executive Director

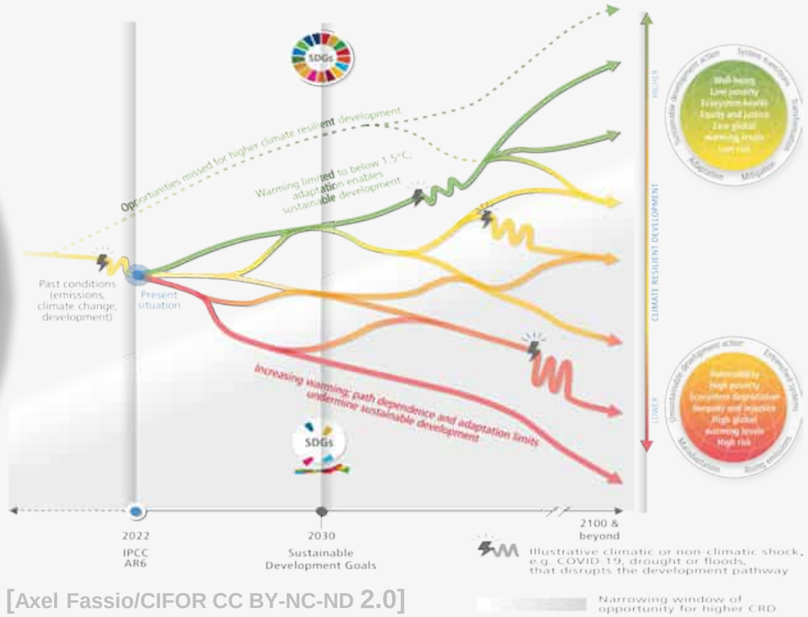
IRDR ICoE, Fudan University

https://helsinki.zoom.us/j/261041646

08:00-11:00 (CET),PEEX SEMINAR, ACCC IMPACT, Helsinki University

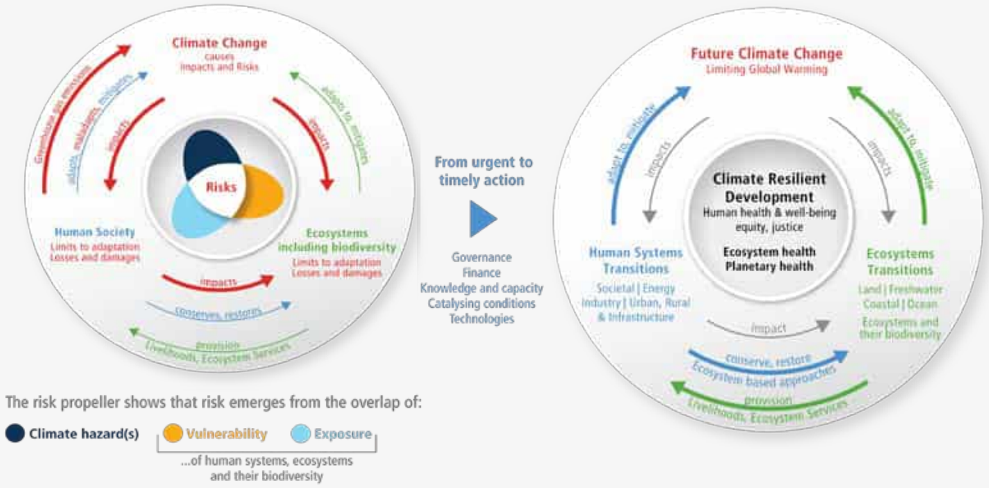
MAP-AQ 亚洲区域办公室
ASIAN OFFICE SHANGHAI
Monitoring, Analysis, and Prediction of Air Quality

Climate Resilient Development in action



The solutions framework

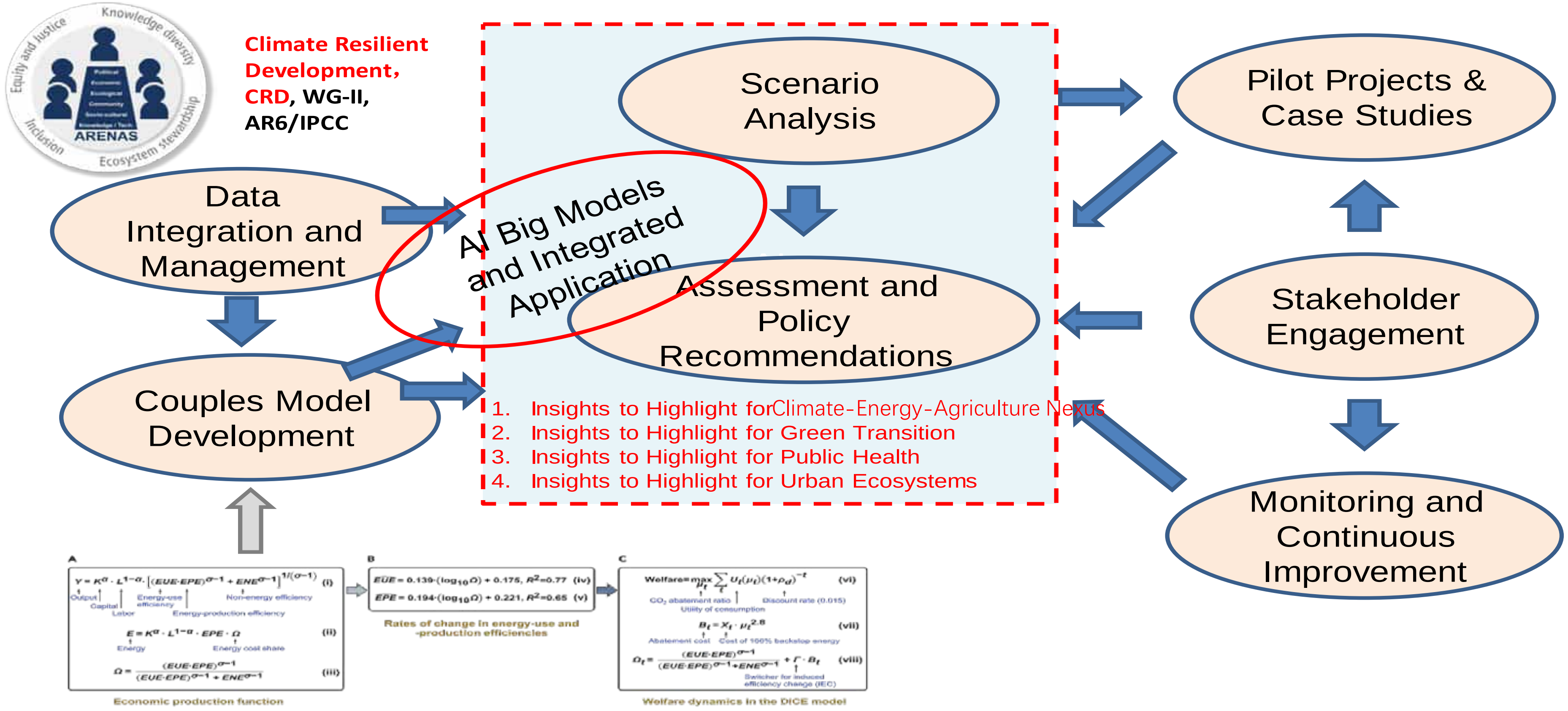
Current imbalance ……a sustainable future?



- CRD is considered across government and all of civil society and Involves everyone – forming ***partnerships***
- It draws on ***wide-ranging knowledge*** (scientific, Indigenous, local, practical)
- It conserves and restores ecosystems
- Involves marginalized groups, ***Prioritizes equity and justice***, and Reconciles different interests, values and world views
- ***Requires scaled-up investment and international cooperation***

- Reduced climate risks – adaptation/mitigation
- Reduced greenhouse gas emissions – mitigation
- Enhanced biodiversity
- Achieved the SDGs, e.g.indicators: poverty, hunger, health and well-being, clean water and sanitation.
- Equality and Justice

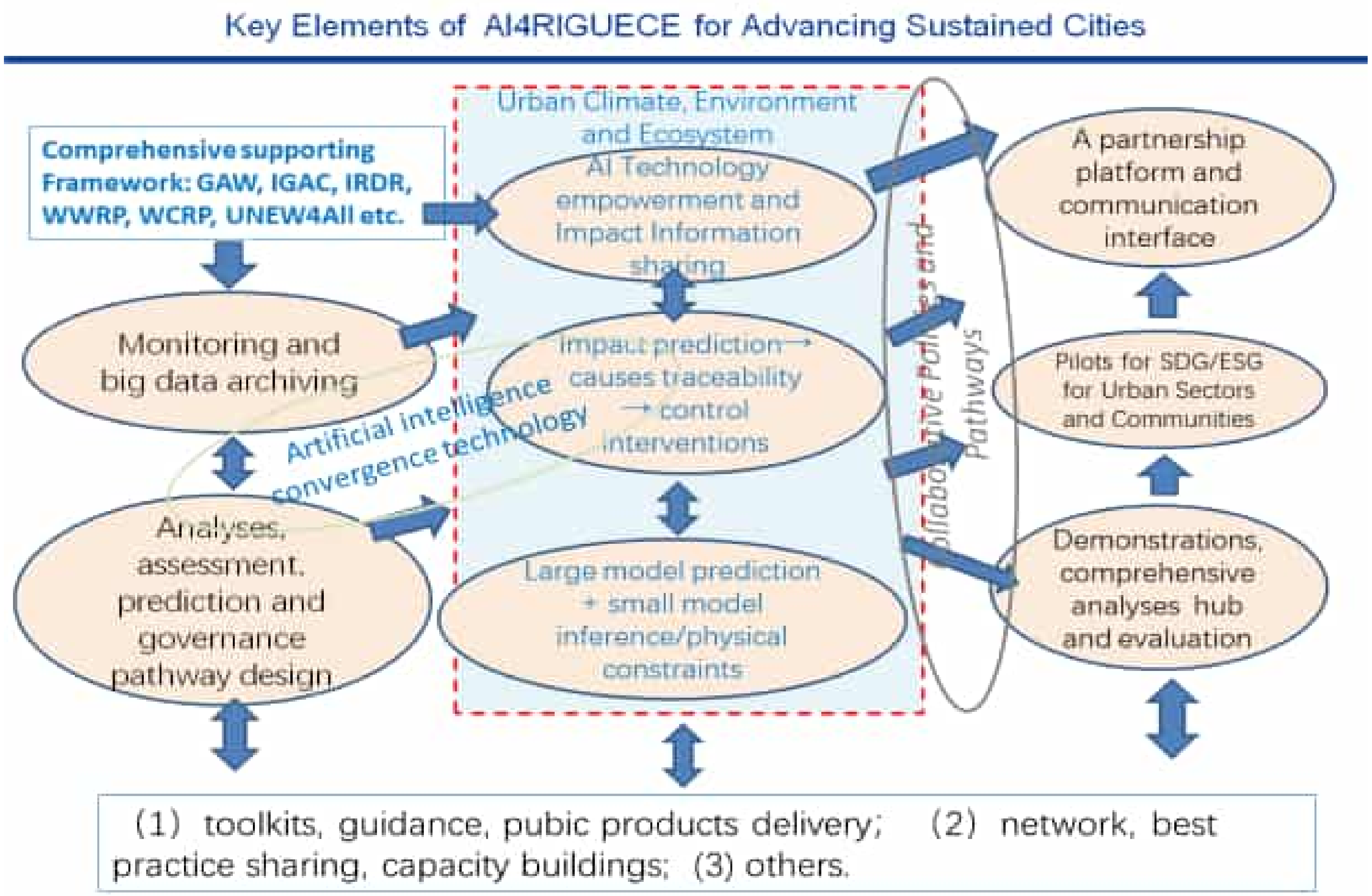
Integrated Climate Adaptation Assessment Initiative developed



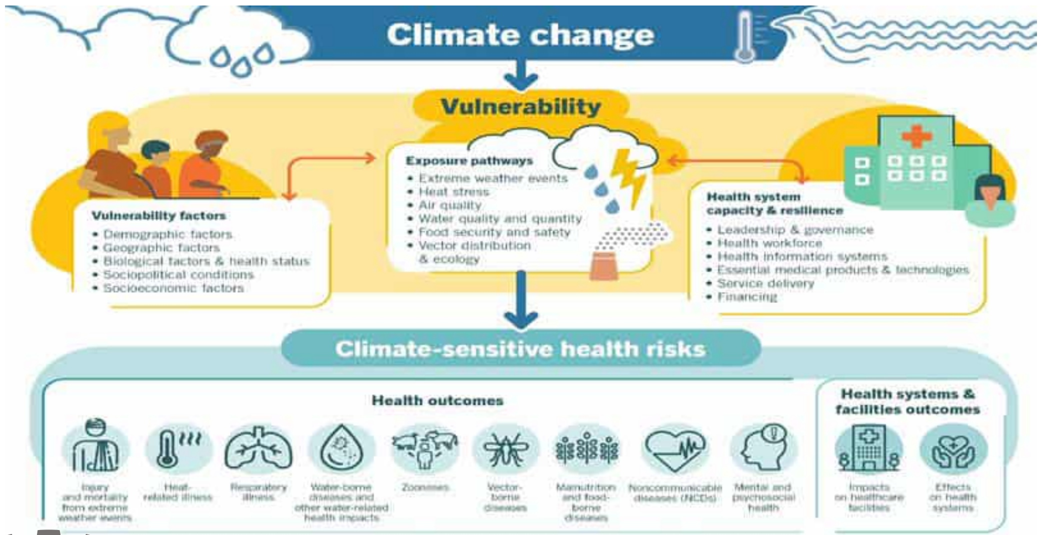
Vision: ICAAI is to develop *a robust, integrated assessment initiative* that informs climate adaptation strategies by *coupling climate and atmospheric environment system models with socio-economic models*, providing *comprehensive insights* into *the impacts of climate change and the effectiveness of adaptation measures.*

Fig.4. Technical Framework for Integrated CAA

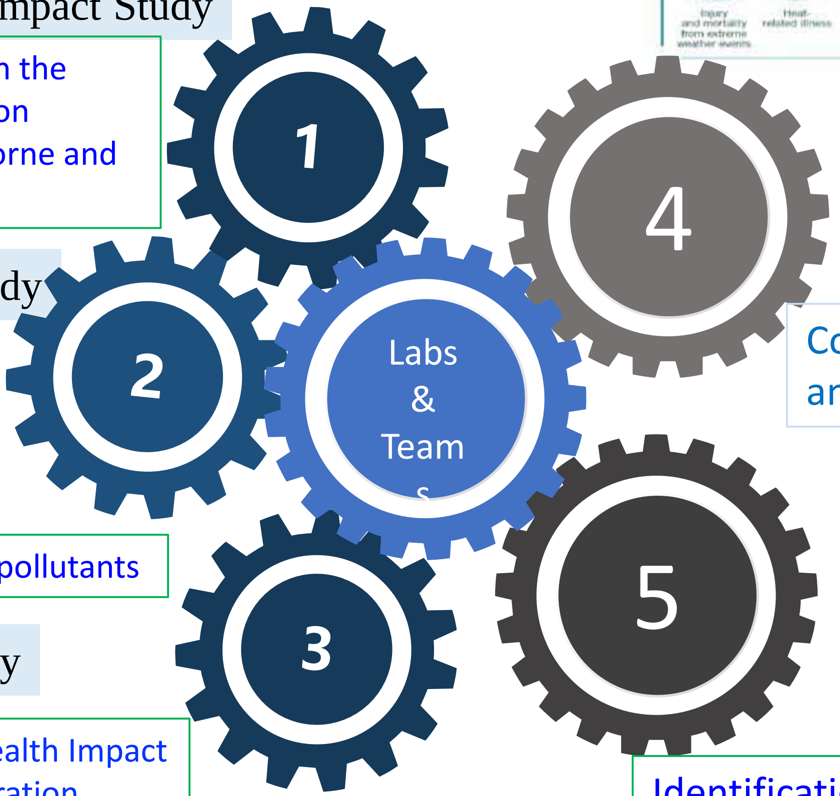
Fig.9. The Integrated Framework and its key elements for Building Climate Resilience and Sustainability



Research Directions: Focus on the impacts study and responses to extreme weather/climate: on Air pollution, Ecosystem, Health, Urban, Energy, and their risk interconnection and governance.



Atmospheric composition, carbon budget, its interaction, and impact on the chain of people's living-economic production-human health-ecology safety



1. Global Warming and its Impact Study

Climate change and One health: regional changes in the spread of infectious diseases and chronic distribution diseases (morbidity, mortality). Air-borne, water-borne and insect-borne diseases

2. Extreme Weather/Climate and its Impact Study

the health effects of extreme temperature, its variability, and humidity changes; Climate risk assessment of health impacts of extreme weather

Health risk assessment and index forecasting of pollutants

3. Air pollution and health study

Shanghai Urban Environmental Health Impact Assessment System and Demonstration

Syndrome of risk interconnectivity Study

4. Risk interconnection analysis and multi-risk modelling and ML modeling

Complex Model System with coupled earth system and economic development; Modelling and ML

Regional/Urban early identification of risks and resilience building

5. Public policy and decision-making advisory

Identification and early warning, public governance and integration demonstration of systemic risk tipping points

Part I: Climate change and Public Health

Part II: International Conference on Chemical Weather and Chemical Climate (CWCC) and Regional Capacity Building

Part III: Earth System Coupling for Building Science-based Climate Governance

Part IV: Adaptation for Building Climate Resilient and Sustained Cities

Part V: AI for Integration

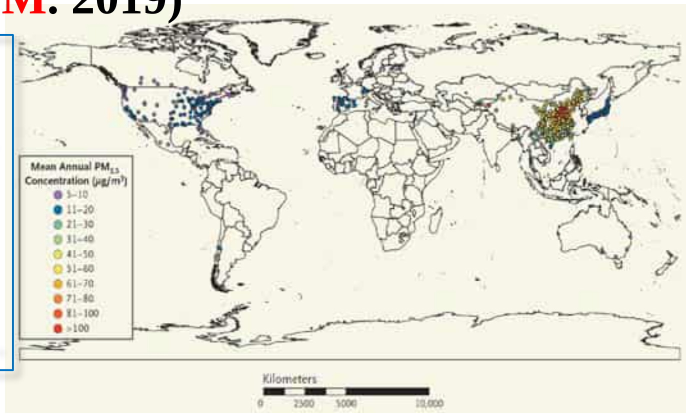
Part VI: Building a reciprocity structured consortium for sustained Research Infrastructure

Environment and Health Risk Studies: global impact of PM2.5 and associated Mortality

Ambient particulate air pollution and daily mortality in 652 cities

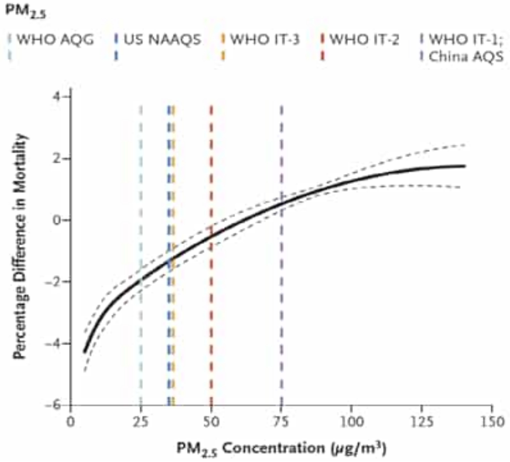
(Liu C. et al. NEJM. 2019)

Elected as one of the best papers in 2019, by NEJM and contributed to the development of new WHO AQGs 2021.



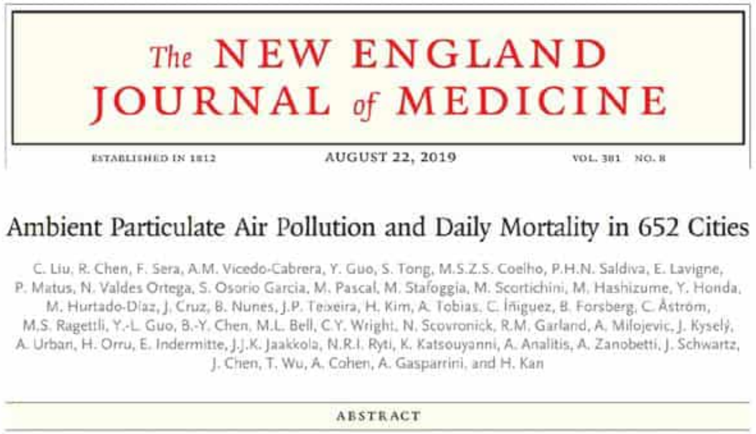
PM2.5数据城市分布图

Distribution of cities with data on PM2.5



PM2.5暴露反应关系曲线

Pooled PM2.5 Concentration–Response Curve



The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 AUGUST 22, 2019 VOL. 381 NO. 8

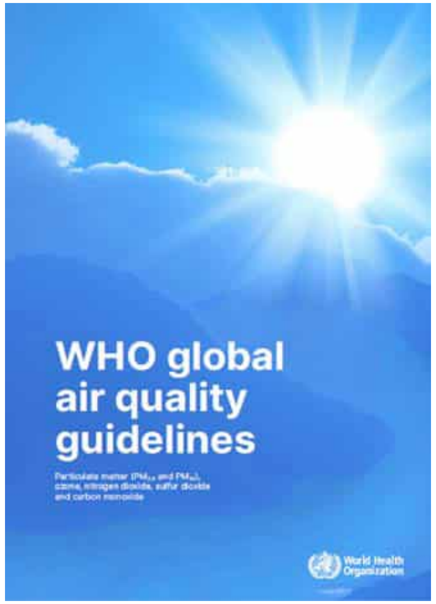
Ambient Particulate Air Pollution and Daily Mortality in 652 Cities

C. Liu, R. Chen, F. Sera, A.M. Vicedo-Cabrera, Y. Guo, S. Tong, M.S.Z.S. Coelho, P.H.N. Saldiva, E. Lavigne, P. Matus, N. Valdes Ortega, S. Osorio Garcia, M. Pascal, M. Stafoggia, M. Scortichini, M. Hashizume, Y. Honda, M. Hurtado-Díaz, J. Cruz, B. Nunes, J.P. Teixeira, H. Kim, A. Tobias, C. Íñiguez, B. Forsberg, C. Åström, M.S. Ragettli, Y.-L. Guo, B.-Y. Chen, M.L. Bell, C.Y. Wright, N. Scovronick, R.M. Garland, A. Milojevic, J. Kyselý, A. Urban, H. Orru, E. Indermitte, J.J.K. Jaakkola, N.R.I. Ryti, K. Katsouyanni, A. Analitis, A. Zanobetti, J. Schwartz, J. Chen, T. Wu, A. Cohen, A. Gasparrini, and H. Kan

ABSTRACT

- 24 countries/regions including 652 Cities worldwide selected
- Exposure of aerosol particular and mortality of citizens linked to risks of cardiovascular and respiratory system analyzed and identified
- Nearly liner relation of exposure of PM 2.5 and response curve found
- An clear evidence for WHO to set up an ambitious baseline threshold on global air quality/health impact (2021)

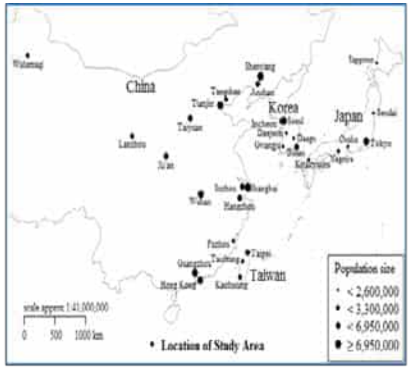
WHO Air Quality and Health Guideline (WHO, 2021) acknowledged members of the steering group, guideline development group including Prof. Haidong Kan, deputy director of the FDU ICoE, systematic review team and external review group for their invaluable contributions in the guideline development process.

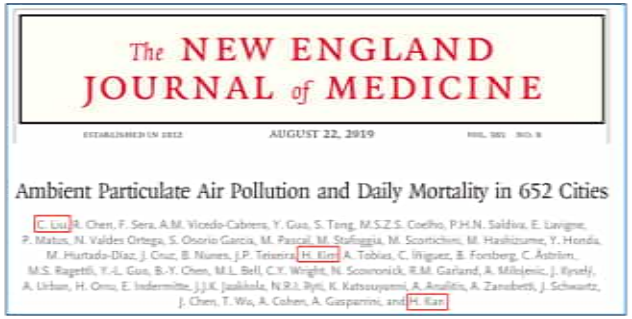


The research outcomes of the Asia-Pacific's first multi-center air pollution, climate and health have been extended

例： 亞太地區首個多中心空氣污染、氣候與健康研究并扩展到全球研究

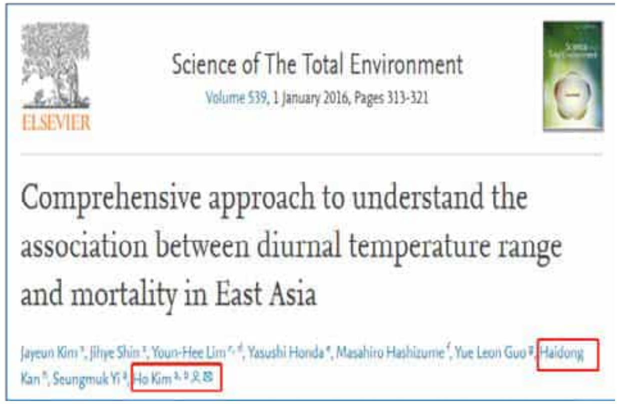
Fudan IRDR ICoE on Risk Interconnectivity and Governance





《NEJM》杂志2019年度最佳论文

为WHO全球空气质量基准(2021)提供了直接证据



Example: Asia-Pacific's first multi-centre air pollution, climate and health research demonstration

MAP-AQ and its Partnership in Asia

GLOBAL ATMOSPHERE WATCH

Monitoring, Analysis and Prediction of Air Quality (MAP-AQ)

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MAP-AQ Steering Committee

- AQ-WATCH
- Clean Air Catalyst
- PAPILA project
- India air quality forecasting Project
- Air quality forecasting project for eastern and southern Africa
- Air quality forecasting project for Lower Mekong Region
- Early Career Scientist Program

Regional Offices

Asian Office MAP-AQ Shanghai

WMO · World Health Organization · EANET · Environment and Humanitarian Action Network (EHAN) · UN environment programme · OCHA · JOINT ENVIRONMENT UNIT · TOGETHER FOR A BETTER RESPONSE

IRDR Integrated Research on Disaster Risk · IRDR ICoE

极端天气气候与健康风险互联和治理国际卓越中心
IRDR ICoE Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health (RIG-WECEIPHE)

SUMMER SCHOOL

Regional Joint Lab

A Joint Lab established with 6 Asian countries in 2022

Centralized and decentralized collaboration, joint teams' work through online/offline; Programmes on visiting scholarship, PhD & Post-doctorial degree, joint publication and workshop planning etc.

Mechanisms of climate change and WCEs in the Asia-Pacific region under the goal of carbon neutrality

Co-benefit Study on synergies in reduction of industrial CO2 emission and air pollution control in the Asia-Pacific region under the carbon neutrality goal

Environment and health risk assessment under different scenarios of climate change and pathways of carbon emission reduction in the Asia-Pacific region

Study on environmental resilience building and science-based governance under different scenarios of climate change and pathways of carbon emission reduction in the Asia-Pacific region

LAP

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上海市科学技术委员会
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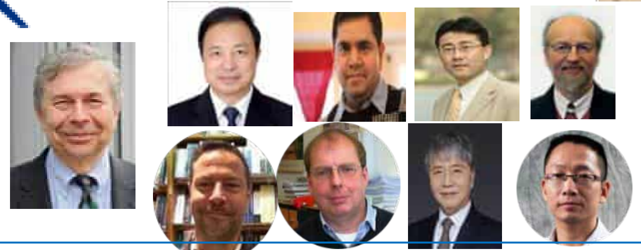
BRIN

SNU

FDU Team

Regional Team

SSC/Joint Lab



Guy Brasseur (Chair), Huadong Guo (CAS), Rajesh Kumar (NCAR), George Fu Gao (NCDC), Alexander Baklanov (Copenhagen U.), Christian Alain George (CNRS-IRCELYON), Hartmut Herrmann (Leibniz Institute for Tropospheric Research), Qunli Han (IRDR), Xiaohui Xu (Texas A&M U., School of Public Health)

Implementation strategy designed for implementing WHO AQGs 2021

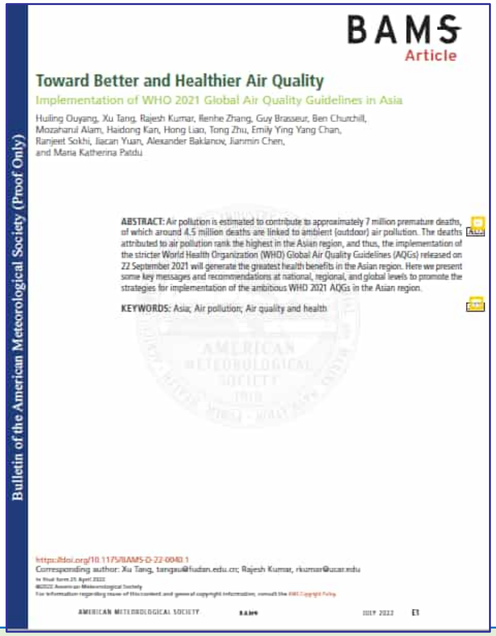
1. there needs to be *a commitment from governments and stakeholders* to prioritize air quality monitoring and regulation. This can be achieved through *policy development, investment in infrastructure, and partnerships* with international organizations.
2. there needs to be *a focus on increasing public awareness and education* about the health risks of air pollution. This can be done through *campaigns, workshops, and outreach programs* targeted at schools, communities, and the general public.
3. there needs to be a focus on *continuing implementing effective air quality management strategies*. This could include the development and enforcement of *air quality standards, the use of clean energy sources, and the adoption of sustainable transport systems*.
4. there needs to be a focus *on collaboration and knowledge-sharing* between countries in the region, as well as with international organizations such as the WHO. This will help to *build capacity, share best practices, and accelerate progress* towards achieving the goals of the WHO Air Quality Guideline 2021 in the regions.

A Paper Published in BAMS, July 2022

Towards Better and Healthier Air Quality: Implementation of WHO 2021 Global Air Quality Guidelines in Asia

Huiling Ouyang[a], Xu Tang[a], Rajesh Kumar[b], Renhe Zhang[a], Guy Brasseur[c], Ben Churchill[d], Mozaharul Alam[e], Haidong Kan[a], Hong Liao[f], Tong Zhu[g], Emily Ying Yang Chan[h], Ranjeet Sokhi[i], Jiacan Yuan[a], Alexander Baklanov[j], Jianmin Chen[a], Maria Katherina Patdu[e]

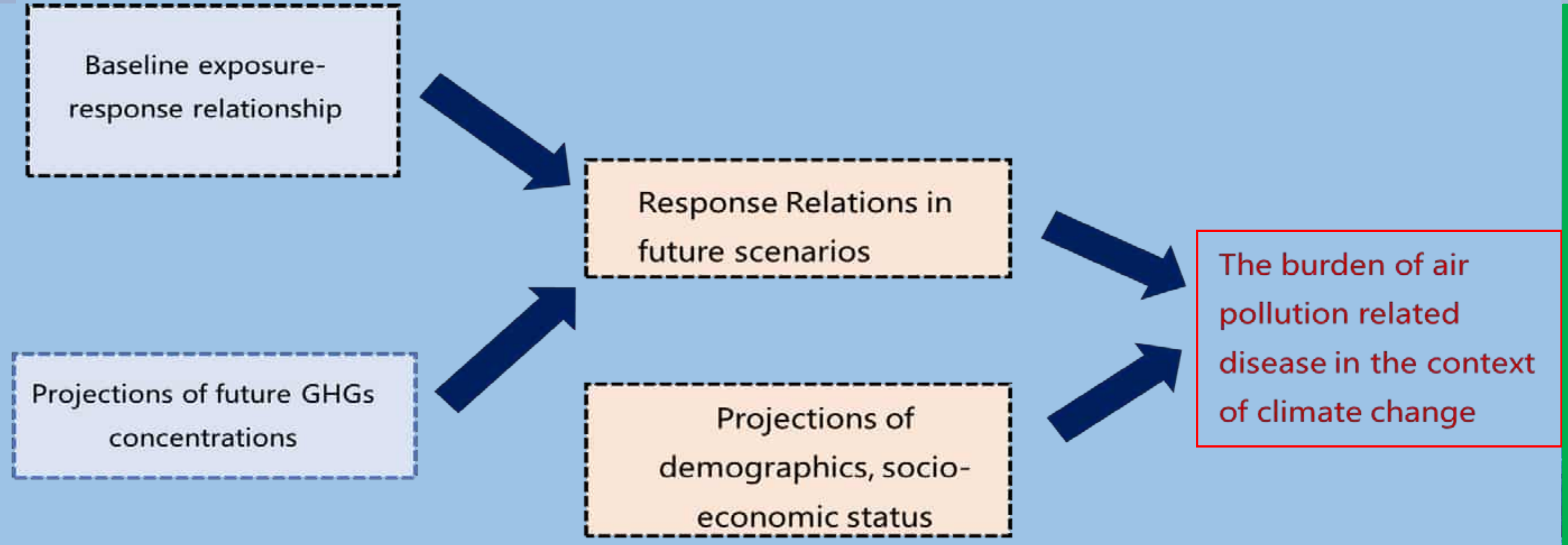
https://doi.org/10.1175/BAMS-D-22-0040.1


BAMS
Article
Toward Better and Healthier Air Quality
Implementation of WHO 2021 Global Air Quality Guidelines in Asia
Bulletin of the American Meteorological Society (Proof Only)

5 Key messages and recommendations from experts in epidemiology, public health, atmospheric sciences, climatology, environmental sciences, and policy development, to promote the implementation of the ambitious WHO 2021 AQGs at national, regional, and global levels to promote the strategies, specifically in the Asian region are as follows:

1. Take immediate action to reduce health burden
2. Need policy integration with climate actions toward co-health benefits
3. Take a step forward: towards a better health-impact-based governance for the control of particulate matter (PM)
4. Need urgent efforts to implement AQGs in Asia and Pacific
5. Make sure no one is left behind for a fairer world

All-cause Atlas on Climate Change-Atmospheric Environment-Public Health nexus 2023-2024 (with 16 Chapters）

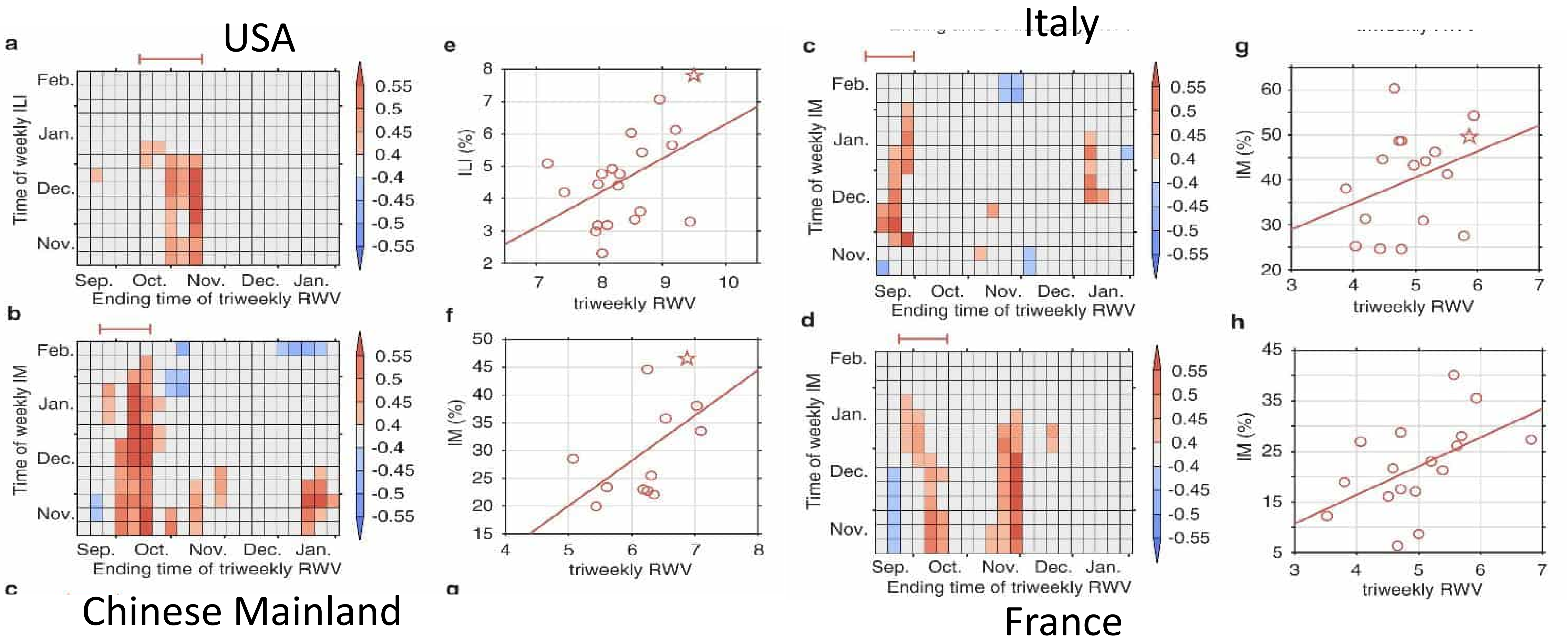


《气候变化-大气环境-健康全因谱报告 2024》

复旦大学 IRDR 国际卓越中心

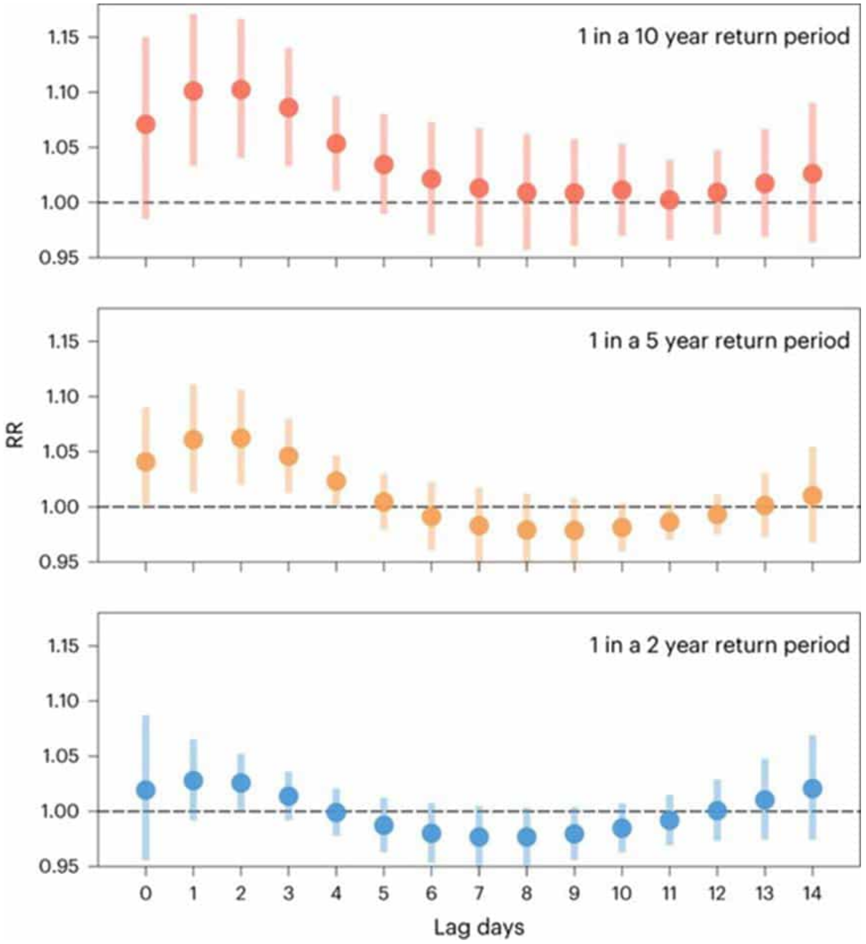
2025 年 3 月发布

Example-1 Changing rapid weather variability increases influenza epidemic risk



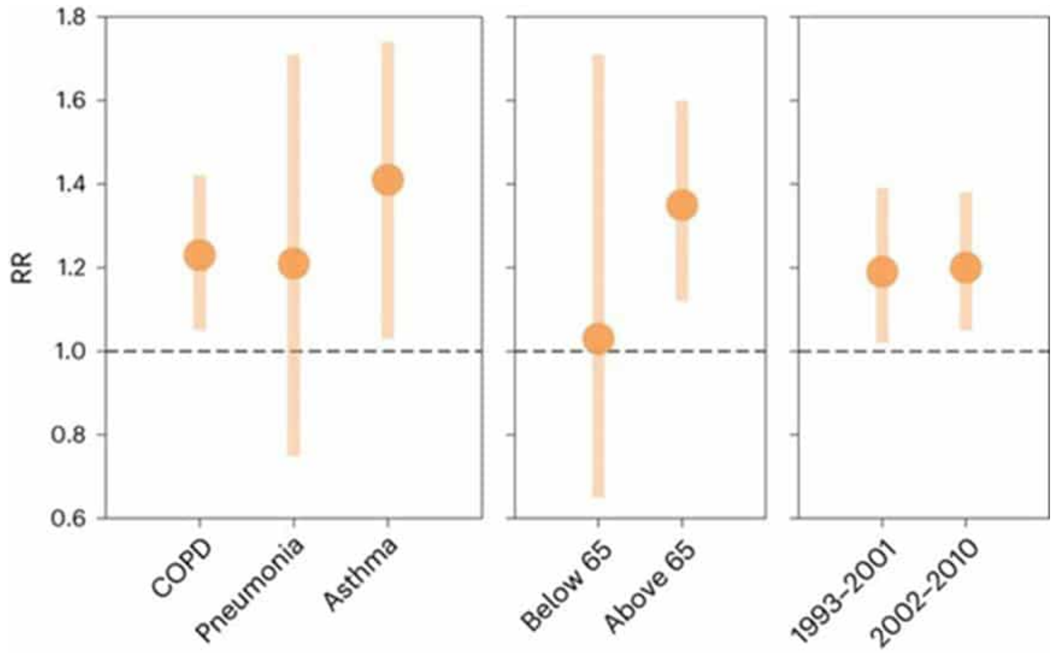
(Liu et al. ERL, 2020)

Example - 2 Extreme rainfall events elevate mortality risks for respiratory diseases



Significant associations were found between respiratory deaths and extreme rainfall events with 5 or 10 year return periods, but not for the events with a 1 or 2 year return period.

Extreme rainfall events significantly elevated mortality risks for asthma and chronic obstructive pulmonary disease, but not for pneumonia.



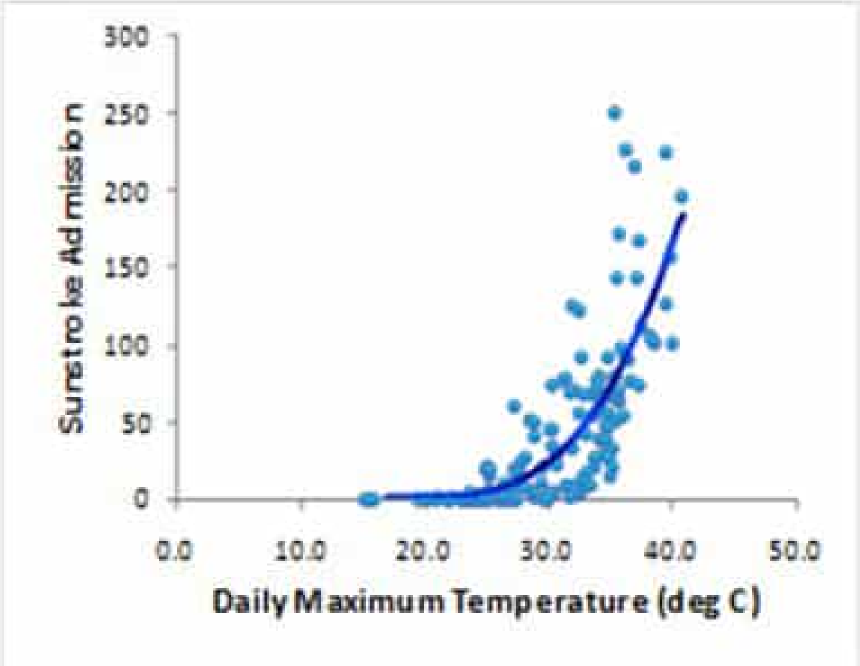
(He et al. NS, 2024)

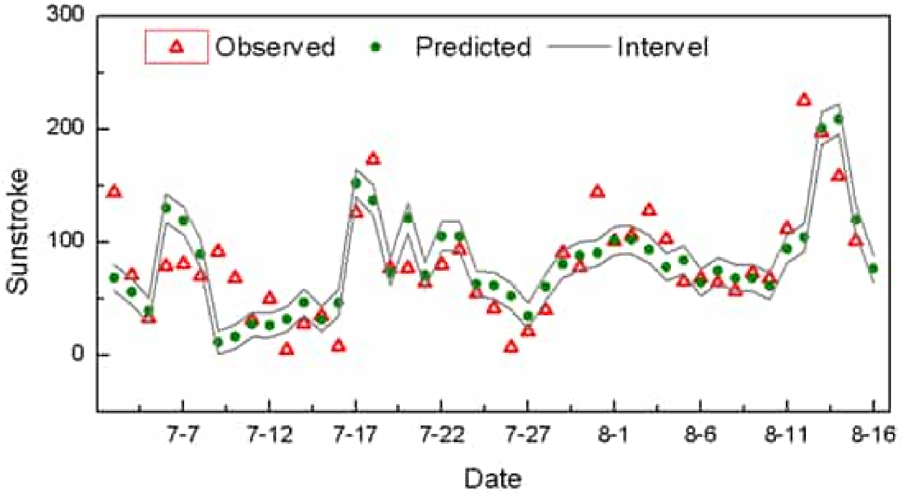
Example – 4 Impact of Temperature on Mortality in Three Major Chinese Cities

Age	Baseline	1 °C increase	
		Projection	Difference
Beijing			
0-64 years	13.1	13.9	0.9
	(13.5,12.6)	(13.5,14.4)	(0.9,0.9)
≥65 years	28.3	30.5	2.2
	(27.2,29.4)	(29.4,31.7)	(2.1,2.3)
Total	41.4	44.5	3.1
	(39.9,42.9)	(42.9,46.0)	(3.0,3.2)
Shanghai			
0-64 years	5.8	6.4	0.5
	(5.5,6.2)	(6.1,6.9)	(0.4,0.6)
≥65 years	33.4	37.5	4.1
	(31.2,35.6)	(35.3,40.1)	(3.8,4.4)
Total	39.2	43.9	4.5
	(36.7,41.9)	(41.4,46.9)	(4.2,5.1)
Guangzhou			
0-64 years	3.3	3.8	0.5
	(3.1,3.4)	(3.6,4.0)	(0.5,0.6)
≥65 years	44.4	50.9	6.5
	(42.0,46.2)	(48.5,52.7)	(6.2,6.8)
Total	47.6	54.7	7.1
	(45.0,49.6)	(52.1,56.6)	(6.8,7.4)

An increase of 1 degree will result in an average increase of deaths (per 100 thousand)

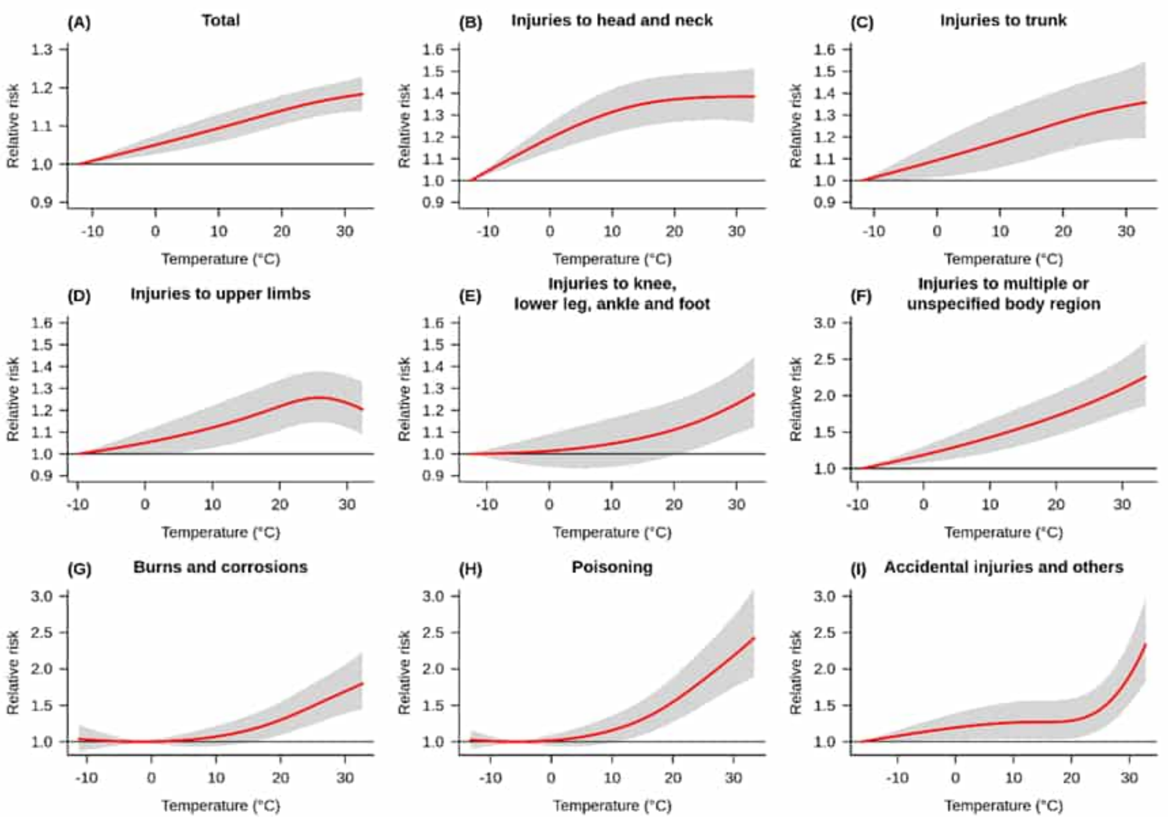
- Beijing：3.1
- Shanghai：4.5
- Guangzhou：7.1



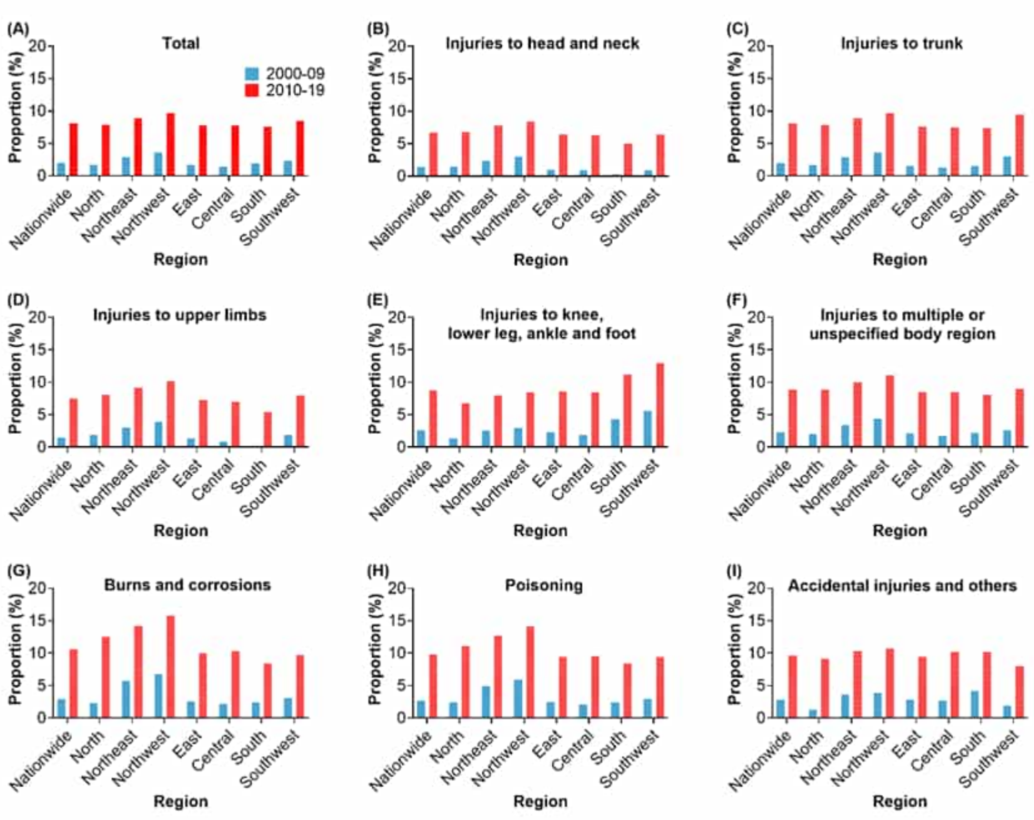


(Zhang et al. BES, 2014)

Example – 5 Climate change exacerbates heat-related risk and burden of hospitalization



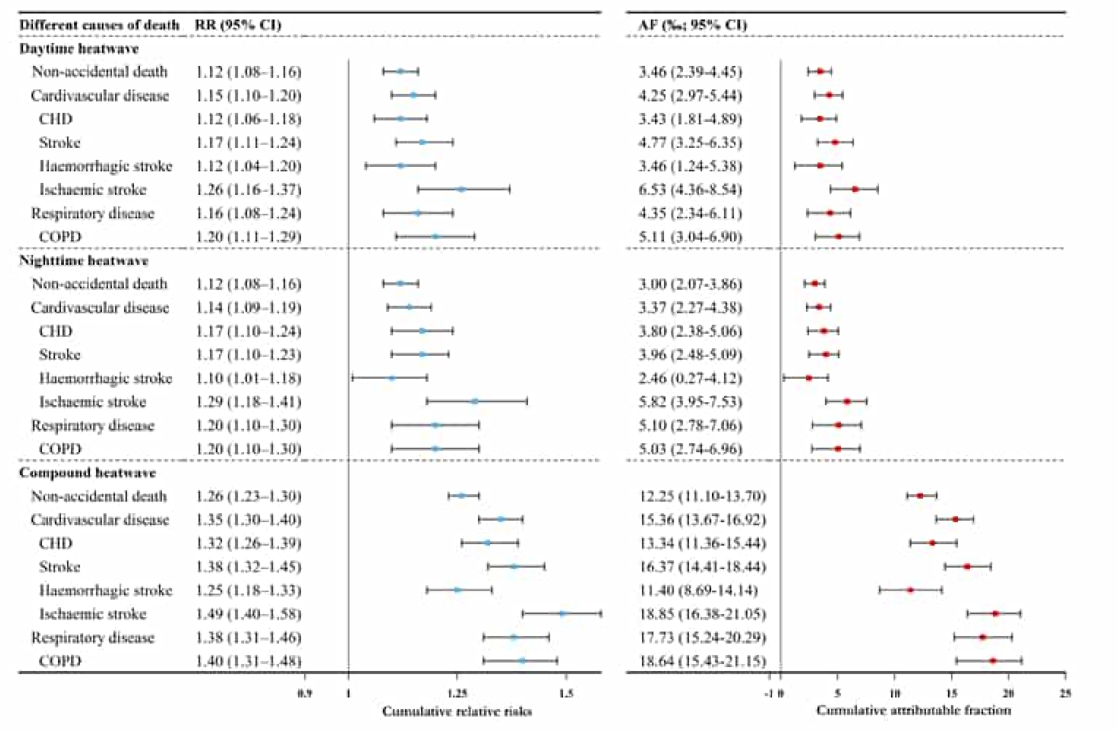
Relationship between temperature and heat-related risks



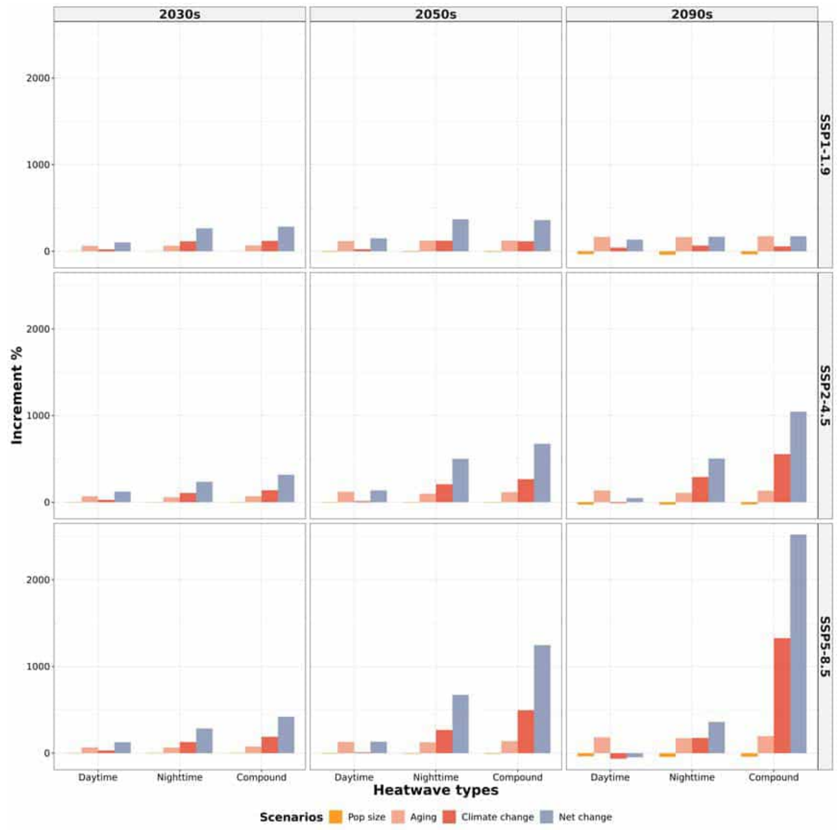
Changes in the burden of hospitalization

(Zhou et al. NCC, 2024)

Example – 6 Rising mortality risk and burden of compound heatwaves



Substantial increases in compound heatwave-related mortality (4.0–7.6-fold) by the 2090s relative to the 2010s under medium and high greenhouse gas emission scenarios, outpacing nighttime-only heatwaves (0.7–1.9-fold) and contrasting with decreasing daytime heatwave-related mortality (0.3–0.8-fold).



The cumulative relative risks of compound heatwave is much higher than the daytime heatwave or nighttime heatwave.

(Liu et al. NCC, 2024)

IRDR Workstream on CC & Public Health-Implementation Steps

Steps

01 Conduct a comprehensive review

02 Develop a research programme and international network

03 Promote original research in an innovative way

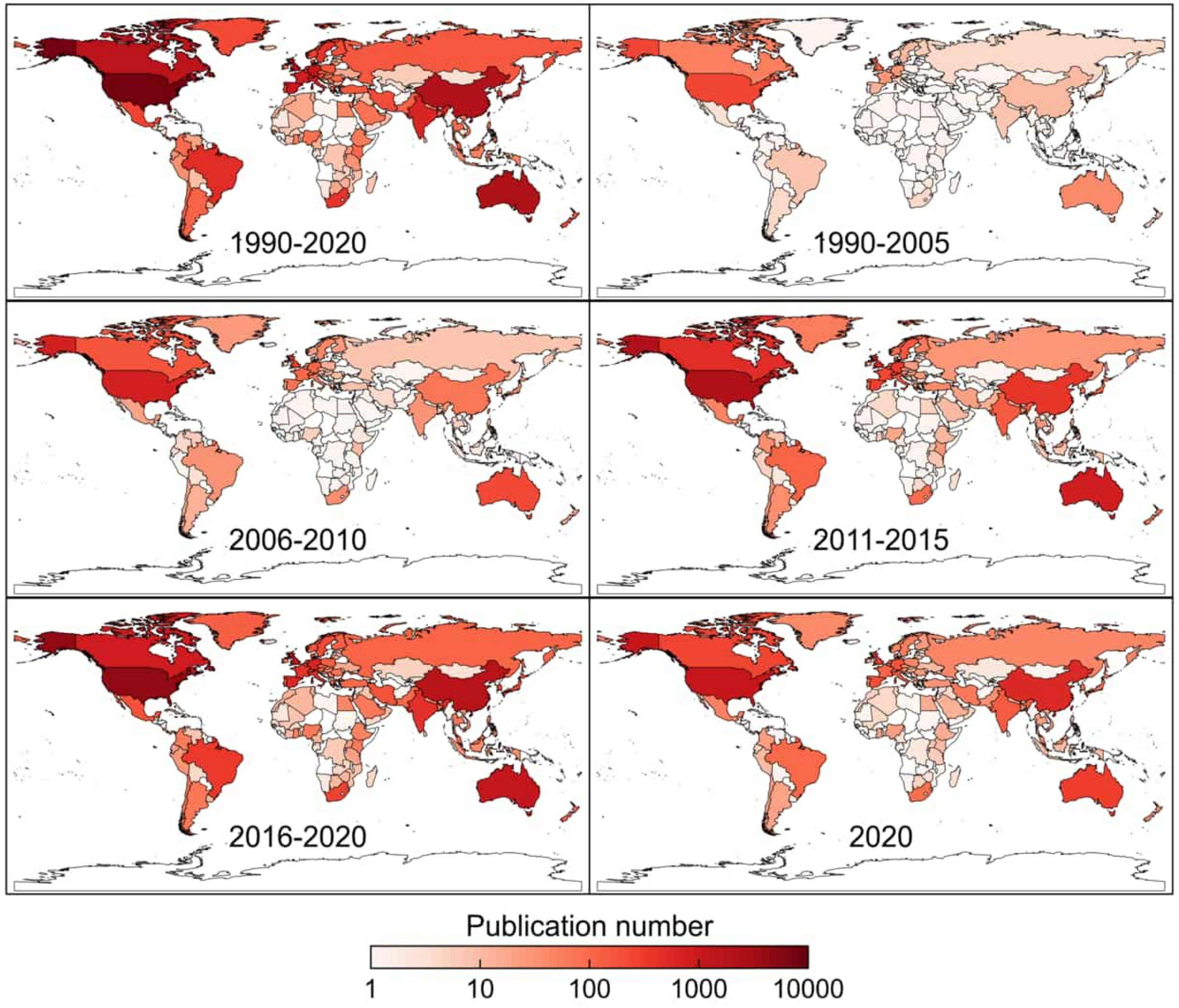
04 Generate science- and evidence-based recommendations

05 Produce educational materials and training programs

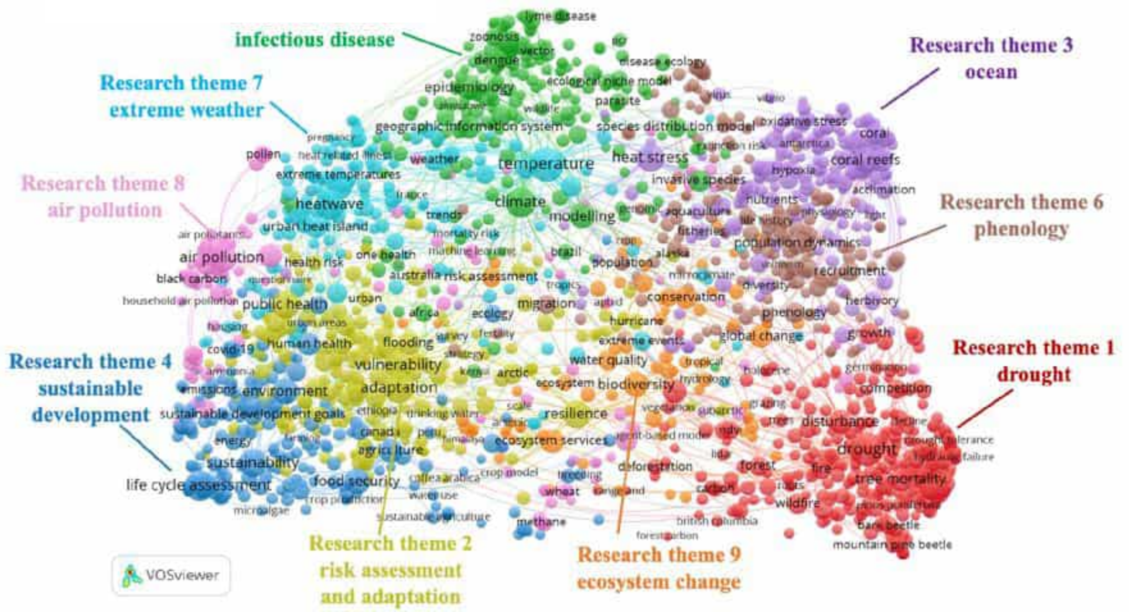
06 Establish partnerships with multi-organizations/stakeholders

07 Monitor and evaluate regularly, and make adjustments where necessary

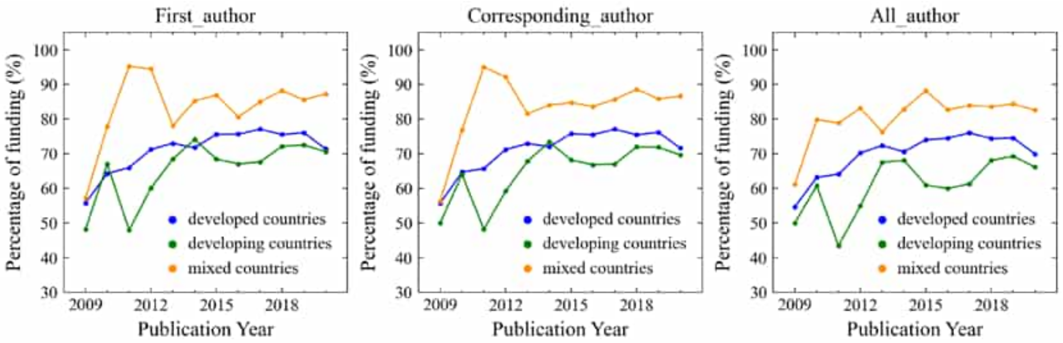
Overall Scientific outputs, themes and funding in Climate Change and Health investigated



Geographical distribution of studies related to climate change and health between 1990 and 2020. Corresponding authors are accounted only. (Ouyang et al. unpublished data)



Research themes derived from climate change and health studies (Ouyang et al. 2022, IRDR Working Paper)



Difference in percentage of funding between developed and developing countries (Ouyang et al. unpublished data)

Critical Issues and Approached

01 Understanding Climate Extremes

Investigate the underlying mechanisms and drivers of weather and climate extremes, for reliable prediction and projection.

02 Assessing Health Impacts

Conduct comprehensive assessment of health impact, both direct and indirect effects.

03 Vulnerable Populations and Health Inequities

Identify vulnerable populations and address health disparities and inequities in preparedness, response and recovery efforts.

04 Interdisciplinary Approaches

Foster interdisciplinary research collaborations (e.g. climatologists, epidemiologists, public health experts, and social scientists) to understand the complex interactions and to generate actionable insights.

05 Enhancing Early Warning Systems

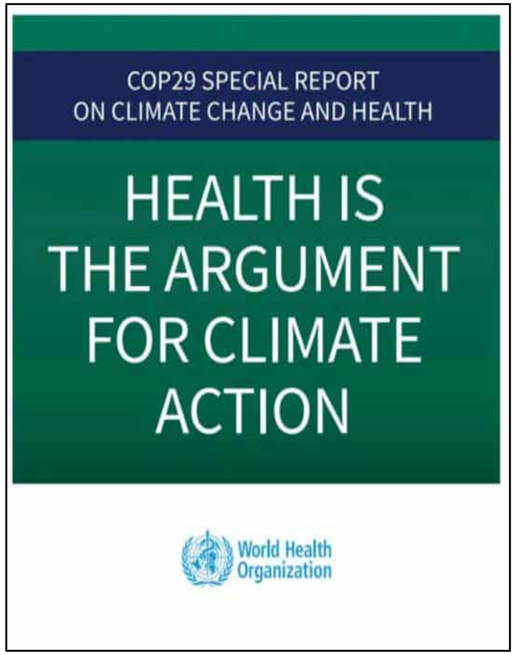
Improve the accuracy, timeliness, and accessibility of early warning systems for weather and climate extremes. Develop rapid and proactive dissemination and response measures.

06 Health as the Core of Policies and Strategies

Place health as the core when developing adaptive measure, preparedness plans, community-based intervention, public health strategies and governmental policies.

Evaluation of the effects of adaptive actions

- **The Shanghai Health Weather Forecast Service was selected as an excellent case of the Healthy Shanghai Initiative.**
- **During the COP29/UNFCCC, WHO released the COP29 Special Report on Climate and Health**, which highlighted four cases at the city level, of which **Shanghai was selected as a case study from China**, demonstrating the results of climate health action at the city level.



Case study

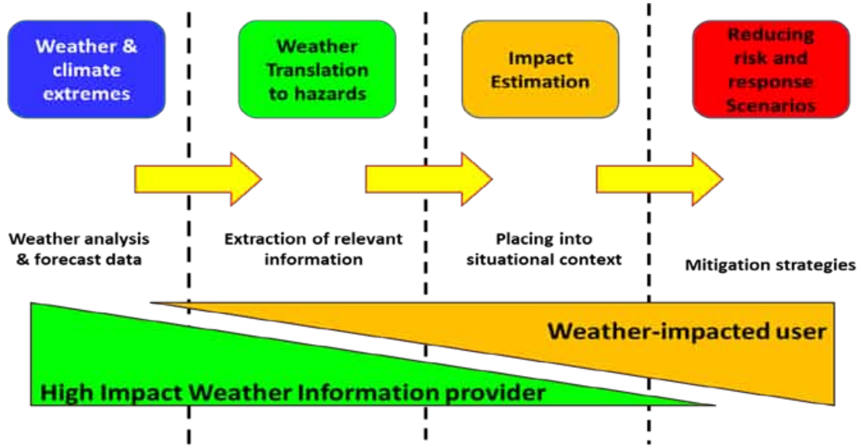
Shanghai's health risk forecasting – a model for climate resilience in cities *(113)*

Shanghai has developed a health risk forecasting system to address the growing impacts of climate change, particularly heatwaves, cold spells, and typhoons. Integrated with the city's "One Net For All" digital platform, the system combines meteorological and health data to issue timely warnings to vulnerable groups, such as the elderly and those with chronic illnesses.

One key success has been the **whole-chain service model** for chronic disease management, which reduced chronic lung disease patient consultations by **17.6%** and lowered medical costs by 2.5%. Automated health alerts and cooling centres have proven effective in preventing heat-related illnesses.

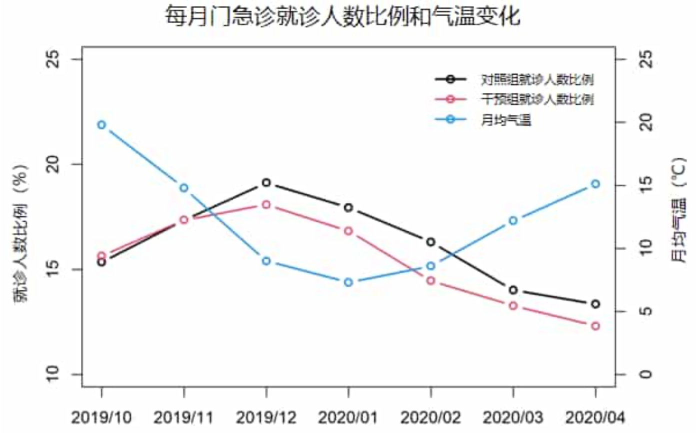
Cross-sectoral collaboration and digital integration have enhanced emergency responses, making Shanghai a model for climate health risk management. Future plans include improving personalized warnings and expanding the system to rural areas and other cities.

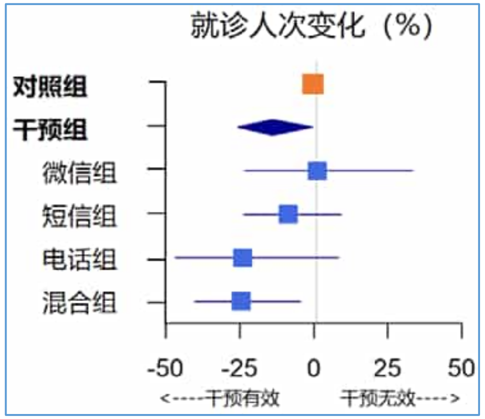
Shanghai Demonstration for Biulding Community Resilience :
Chronic Obstructive Pulmonary Disease (COPD) Risk informed Weather Prediction



Science in service to society: Impact-based forecasting and specialized services COPD risk prediction products and its service delivery supported by impact-based weather and environment forecast

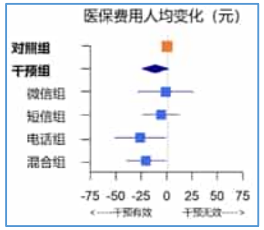
Risk levels, vulnerable groups, prevention guidance with Intervention Group and Control Group

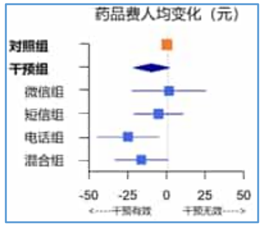


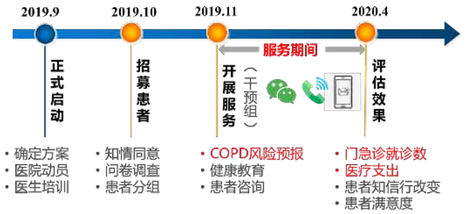


- The number of patients in the intervention group visiting the emergency department decreased by 17.6% compared with the control group (95% confidence interval, 1.0% ~ 31.4%)
- Patients in the intervention group saw a 13.9% reduction in the number of visits compared with the control group (95% confidence interval, CI: 0.5% to 25.6%)

Based on the Analysis, at least 1.5 million COPD patients in Shanghai. It is expected to reduce COPD outpatient and emergency medical insurance costs by 17 to 39 million yuan within half a year.

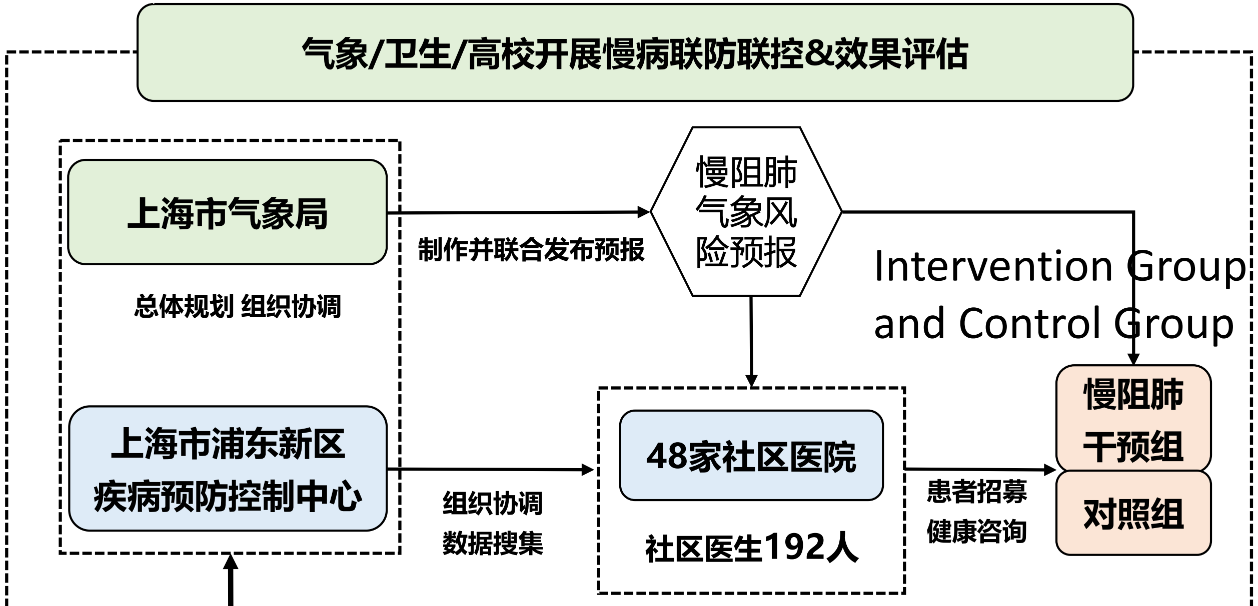






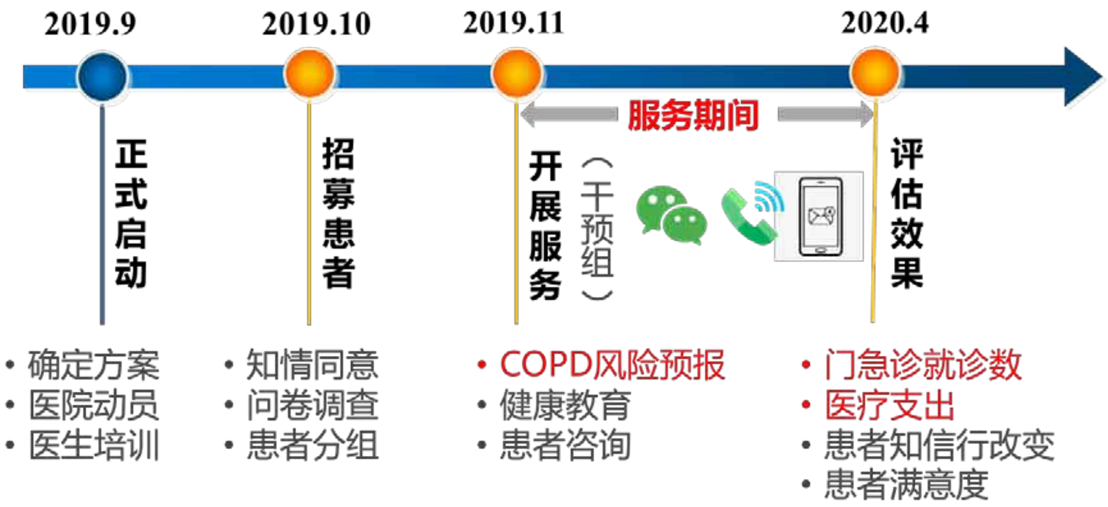
上海案例，研究與服務：COPD風險評估先導與示範

Shanghai case and Demonstration for better H-EDRM: Pilot and Demonstration: COPD Risk Assessment Analyses



- 上海市唯一COPD慢性病社區綜合管理
- 覆蓋全區，納入6000+患者 Patients

選擇浦東疾控作為合作單位



Work procedure in Autumn/Winter

秋冬季節是COPD的高發季節工作流程

Joint action: Met Service, Health authority, Universities, and targeted district – Pudong District: 48 Community-level Hospitals

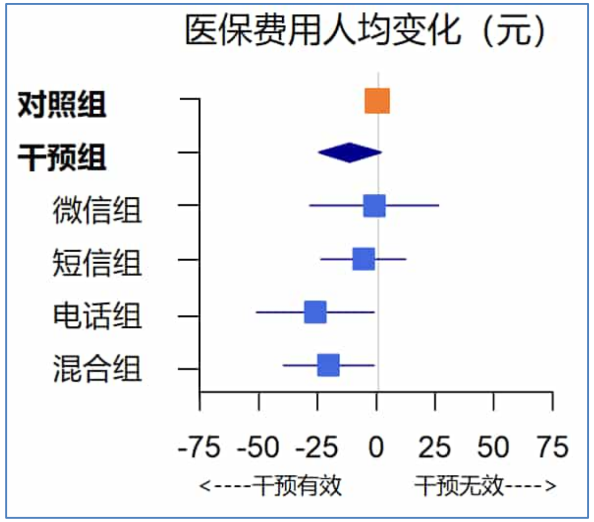
The only community based integrated H-EDRM of COPD chronic diseases in Shanghai

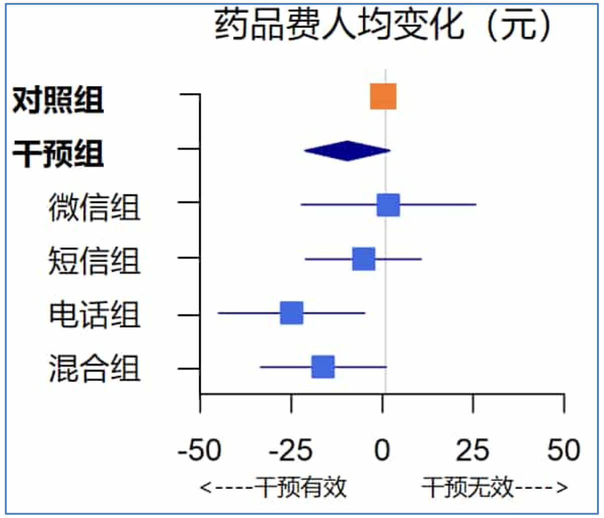
Shanghai case: Demonstration for better H-EDRM: Analysis on Medical Expenditure 對醫療支出的影響分析

Reduced medical insurance costs for COPD patients 減少了患者的醫保費用

- 2019年11月-2020年4月，干預組和對照組（共2698例）由於COPD就醫的門急診醫保費用支出總計118.3萬元，其中藥品費支出最多（82.9%），總計98.1萬元。
- 干預組患者比對照組患者的人均醫保費用減少11.2元（2.5%），
- 其中人均藥品費減少9.5元（2.6%）
- 電話服務的效果最好，人均醫保費用可減少25.9元（5.8%）。
- 以上海市全市至少150萬慢阻肺患者計算，可望在半年内減少門急診醫保費用1700~3900萬元。

Based on the Analysis, at least 1.5 million COPD patients in Shanghai. it is expected to reduce COPD outpatient and emergency medical insurance costs by 17 to 39 million yuan within half a year.





(CCDC Weekly, 2021)

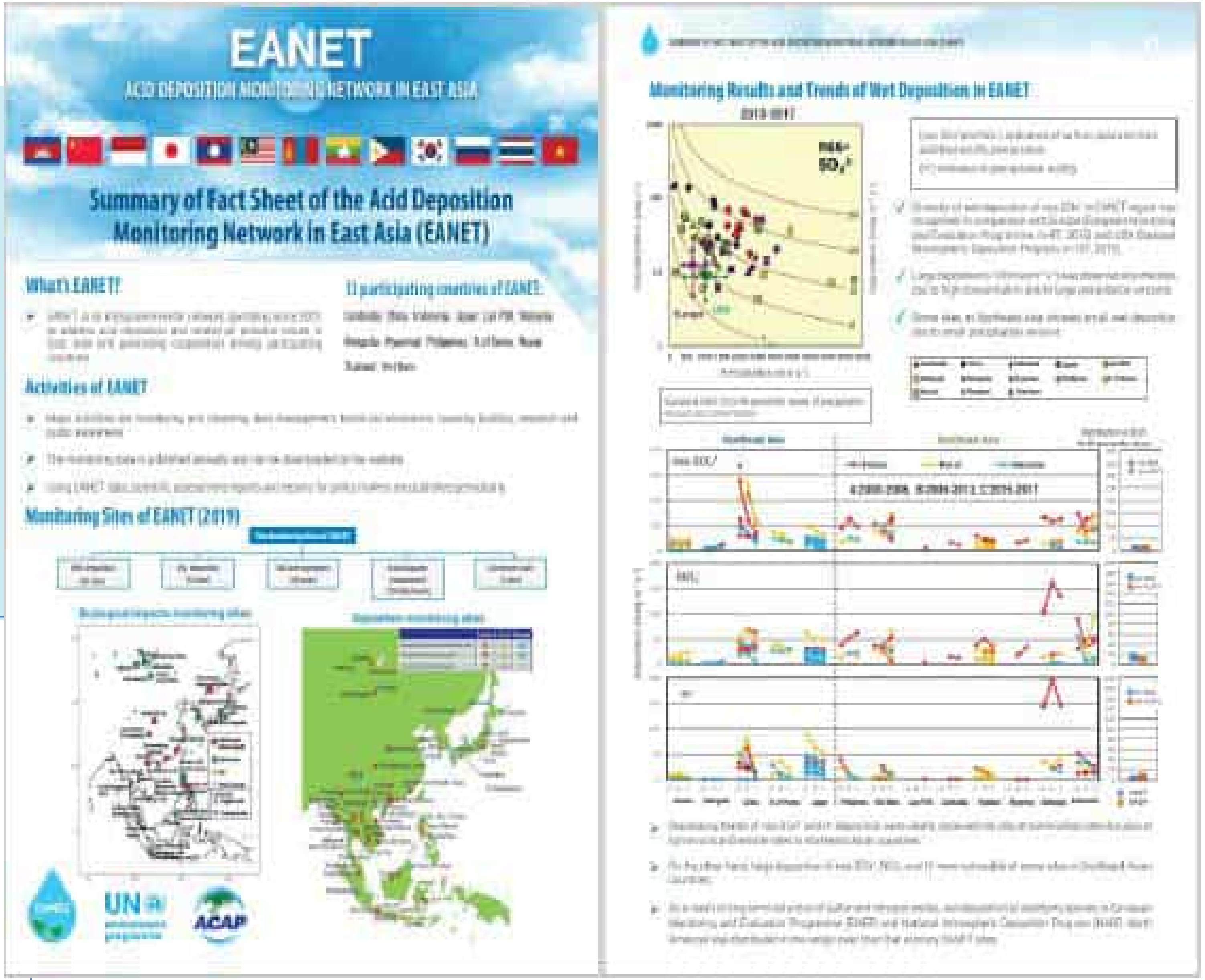
Part II: International Conference on Chemical Weather and Chemical Climate (CWCC) and Regional Capacity Building

MAP-AQ Collaboration with EANET in East Asia

MAP-AQ 亚洲区域办公室
ASIAN OFFICE SHANGHAI
Monitoring, Analysis, and Prediction of Air Quality

ACID DEPOSITION MONITORING NETWORK IN EAST ASIA (EANET)

- Inter-governmental regional network
- 13 countries participated
- The biggest network in Asia for monitoring air pollution and acid deposition
- The EANET Secretariat is in the Regional Office of UNEP in Bangkok, Thailand
- Collaboration between MAP-AQ and EANET is developing.



FUDAN UNIVERSITY 1905 復旦大學 FUDAN UNIVERSITY

WORLD METEOROLOGICAL ORGANIZATION

MAP-AQ

IRDR Integrated Research on Disaster Risk

EANET

UNEP

CLEAN AIR ASIA

Side event: Shaping Future Leaders: The Fellowship for Building Leadership in Atmospheric Environment and Air Quality Management in East Asia – Jointly organized by EANET, FDU, CAA and MAP-AQ Asian Office, 27 July – 10 August, 2024

復旦大學大气与海洋科学系 DEPARTMENT OF ATMOSPHERIC AND OCEANIC SCIENCES FUDAN UNIVERSITY

復旦大學大气科学研究院 INSTITUTE OF ATMOSPHERIC SCIENCES FUDAN UNIVERSITY

MAP-AQ 亚洲区域办公室 ASIAN OFFICE SHANGHAI Monitoring, Analysis and Prediction of Air Quality

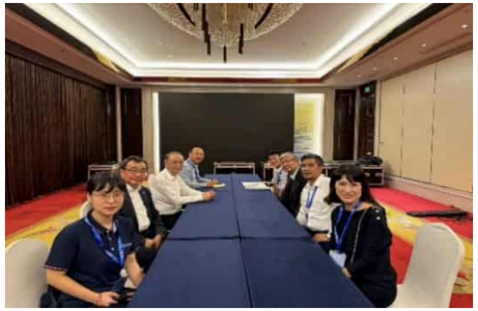
极端天气气候与健康风险互联和治理国际卓越中心

IRDR ICoE Integrated Research on Disaster Risk International Centre of Excellence

Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health (RIG-WECEIPHE)

Trainings and Technical Transformations with GMIT

EANET Training for Next Generation Leadership



- Since the establishment of the Asia-Pacific Joint Laboratory in December 2022, the ICoE has actively organized academic exchanges and personnel training for the Joint Laboratory.
- In 2023, the ICoE, MAP-AQ Asian Office, and Mongolian Environmental Research Institute (GMIT) organized three online and offline academic exchanges, and carried out a two-week international technical training, and jointly formulated a work plan for joint research in 2024 with GMIT.
- The ICoE and AOS/IAS are responsible for organizing the EANET Training for Asian Next Generation Leadership in FDU in August, 2024.

The 1st CWCC Organized in Shanghai, Oct. 2023

GLOBAL ATMOSPHERE WATCH

MAP-AQ

IRDR

Integrated Research on Disaster Risk

第一届化学天气与化学气候国际会议：
多尺度环境扰动的科学认知、健康影响与风险治理

The First International Conference on Chemical Weather and Chemical Climate (CWCC): Science, Risks, Impacts, Health and Governance Associated with Multi-scale Environmental Perturbations

极端天气气候与健康风险互联和治理国际卓越中心

IRDR ICoE Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health (RIG-WECEIPHE)

16-20, Oct. 2023, Shanghai China

MAP-AQ

Session Structure and Provisional agenda

The three plenary sessions are
(i) Opening and 4 invited key notes;
(ii) Session outcomes sharing and crosscutting issues discussion;
(iii) Young Scientist Award, chair's report and closing.

(i) *Emissions* and physical-chemical transformations of atmospheric components
(ii) *Simulation* and forecasting of chemical weather/climate and its impacts
(iii) *Environmental and health impact* of air quality, climate change, and weather/climate extremes
(iv) Strategies for reducing *inequities*
(v) Towards *mitigation and adaptation* to environmental changes
(vi) Towards the development *of climate-smart and sustainable cities*
(vii) Coordinative pathways for *climate-environment-health governance* (roundtable);
(viii) Coordinative pathways for *climate-environment-carbon neutrality governance* (roundtable);
(ix) *Global partnership* on the crosscutting and collaboration with stakeholders (roundtable);
(x) Poster session.

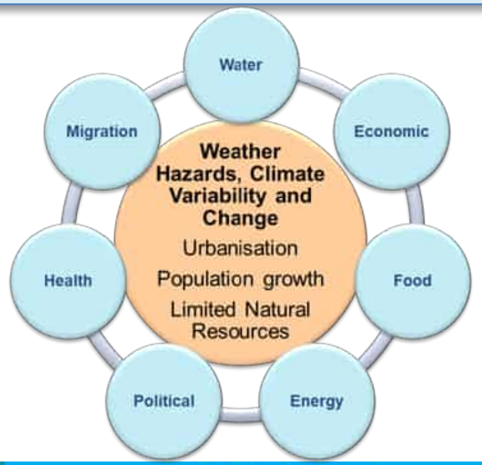
Conference Chairs:
Prof. Guy Brasseur, Chiar of MAP-AQ Project, Max-Plank Institute-Meteorology
Prof. Jürg Luterbacher, Chief Scientist, Director, Science and Innovation Department, WMO
Prof. Renhe Zhang, Academician of CAS, Vice President of Fudan University

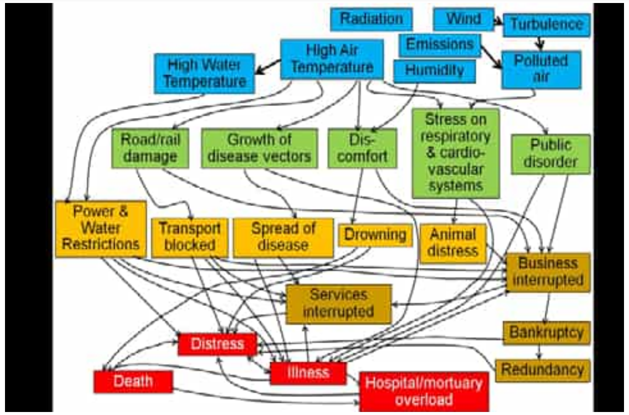
Opening Remarks was presented by Dr. Handoko, Chairman of Ministry of Research and Innovation (BRIN), Indonesia

Opening Remarks were presented by Prof. Motoko Kotani on behalf of ISC and IRDR

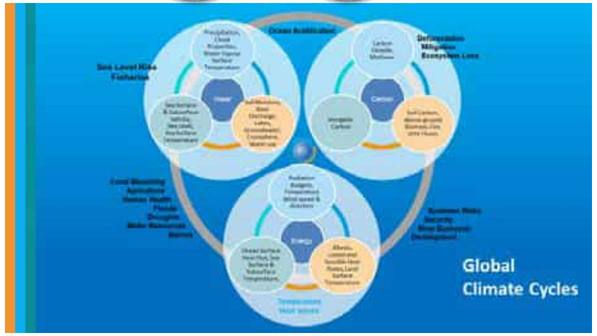
- Executive Vice President for Research, Tohoku University, Japan
- ISC Vice-President for Science and Society (2022–2024)
- Chair, ISC Standing Committee for Science Planning (2022–2025)
- ISC Fellow

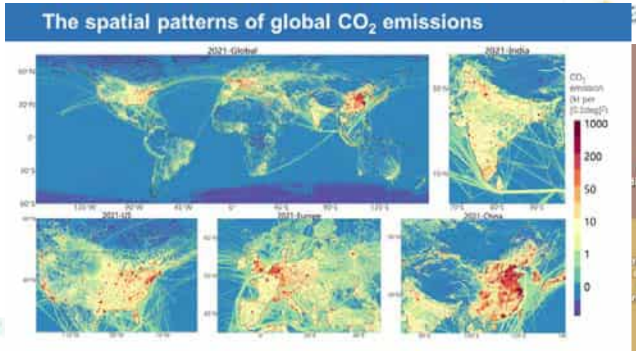
The conference outcomes have been documented in the Chair's Report, which calls for a united, innovative, and systematic approach to address the interconnectivity of risks in complex systems.

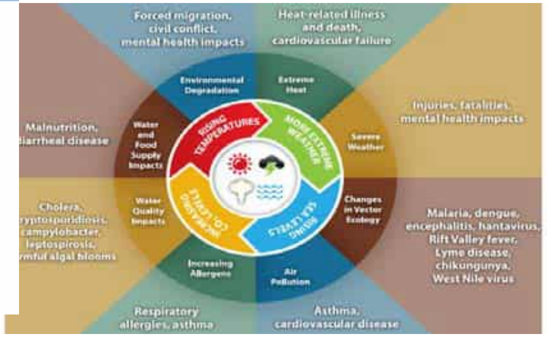




More than 400 offline participation from 15 countries and over 1200 online participation







FDU

WMO

MAP-AQ

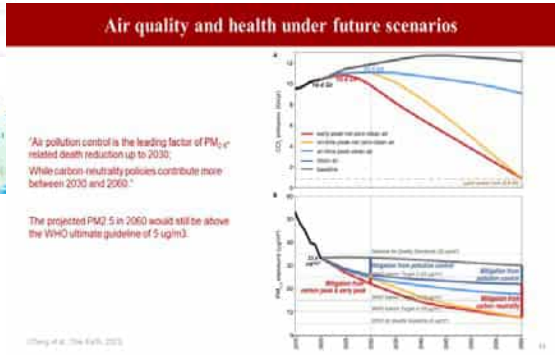
UNEP

ISC

上海市科委

BRIN, Indonesia

21世纪中心



FUDAN UNIVERSITY 1905 | WMO | GAW | MAP-AQ | IRDR Integrated Research on Disaster Risk | IGAC | ANGA African Group on Atmospheric Sciences

The 2nd International Conference on Chemical Weather and Chemical Climate (CWCC) - Science, Impacts, Risks, Resilience, and Governance Associated with Sustainable Developments in Different Regions of the World.
UM6P Benguerir, Morocco, 14-16 Oct. 2025,

Conference Topics: **Conference web site: https://cwcc-conference.online/**

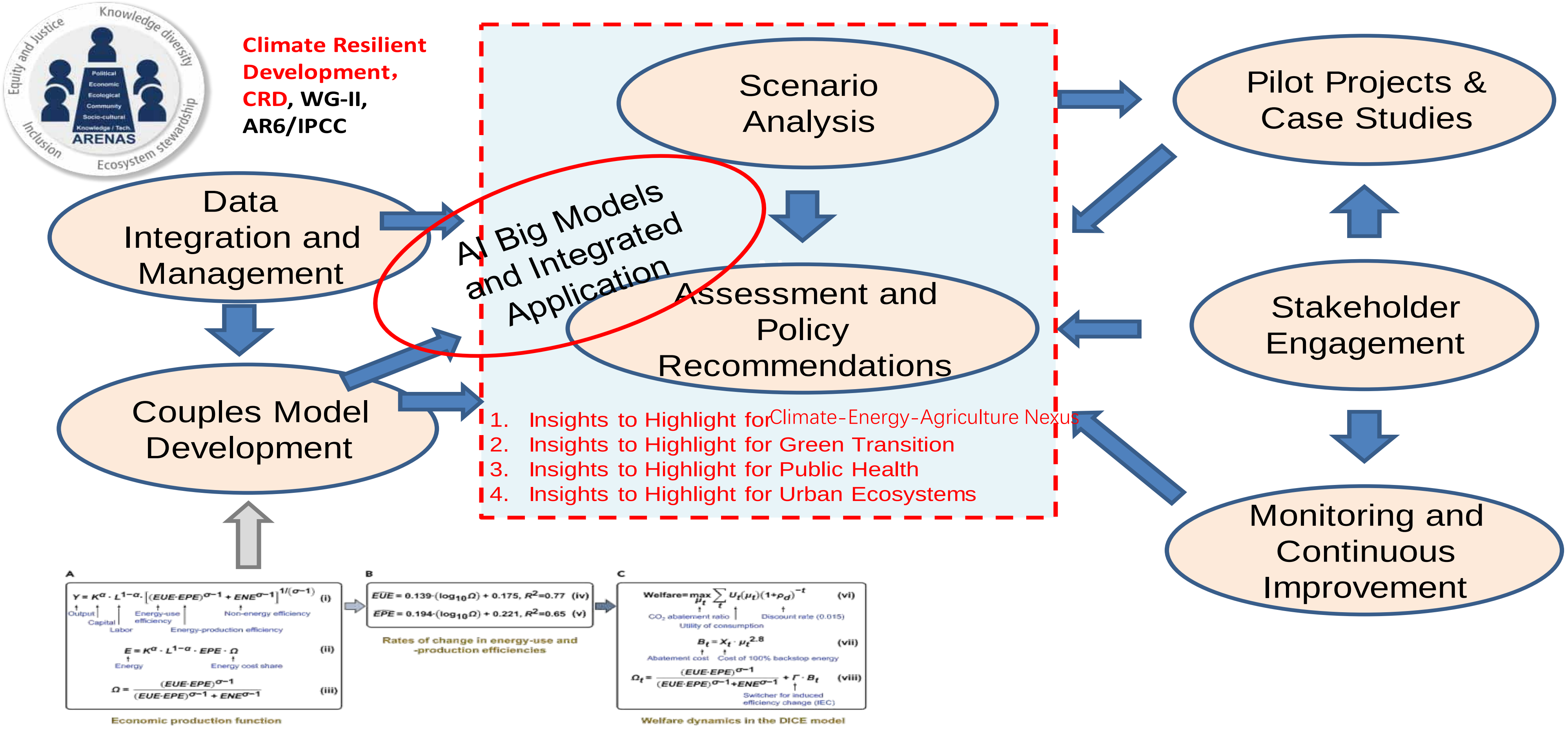
The following topics will be covered at the conference:

- Emissions and physical-chemical transformations of atmospheric components
- Simulation and forecasting of chemical weather/climate and its impacts
- Climate change, extreme weather, air pollution, and their combined effects
- Technical innovations, including AI, for reducing impacts of chemical climate and weather strategies for mitigating inequities faced by those exposed to high climate and environmental risks
- Mitigation and adaptation in climate and air quality and the concept of co-benefit
- Towards the development of climate-smart and sustainable cities
- Coordinative pathways for climate-environment-health governance including the climate-water-food/agriculture-air quality nexus.
- Coordinative pathways for climate-environment-carbon neutrality governance and transition to green economy.
- Global partnerships for crosscutting approaches and collaboration with stakeholders.
- Use of research achievements to inform evidence-based environmental policies and governance.

UM6P University Mohammed VI Polytechnic | MAP-AQ 亚洲区域办公室 ASIAN OFFICE SHANGHAI Monitoring, Analysis and Prediction of Air Quality | 极端天气气候与健康风险互联和治理国际卓越中心 IRDR ICoE Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health (RIG-WECEIPHE)

Part III: Earth System Coupling for Building Science-based Climate Governance

Integrated Climate Adaptation Assessment Initiative developed



Vision: ICAAI is to develop *a robust, integrated assessment initiative* that informs climate adaptation strategies by *coupling climate and atmospheric environment system models with socio-economic models*, providing *comprehensive insights* into *the impacts of climate change and the effectiveness of adaptation measures.*

Fig.4. Technical Framework for Integrated CAA

Tools for Assessing the Risk Interconnectivity

Address Interaction between the earth system and the social economy

Use observational data to improve Earth system models

Along with feedback of climate change on energy systems and socio-economic systems

Interrelated Earth system models of varying complexity that support and calibrate each other

Combination of Earth system models

- Earth system model of high resolution LMDZORINCA
- Earth system model of medium complexity at regional scale OSCAR
- National Scale Conceptual Earth System Model FUDCCM (Self-developed)

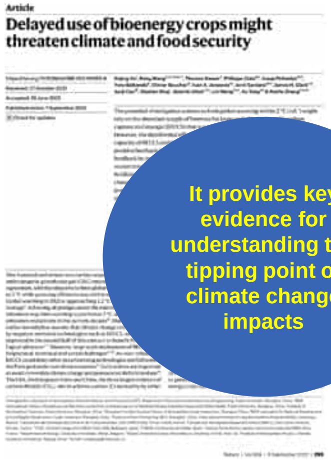
Insights on various themes at different levels

Global digital intelligence information system

- Meteorological data and socio-economic basic data
- Atmospheric chemical composition, aerosol optical thickness, surface and atmospheric carbon fluxes
- Greenhouse gas and material emissions

- health assessment model

Case 1: Simulating the impact process of CO_2 emission reduction on bioenergy crop production from the perspective of the Earth system


Article
Delayed use of bioenergy crops might threaten climate and food security

It provides key evidence for understanding the tipping point of climate change impacts

Selected as a recommended paper for the cover of Nature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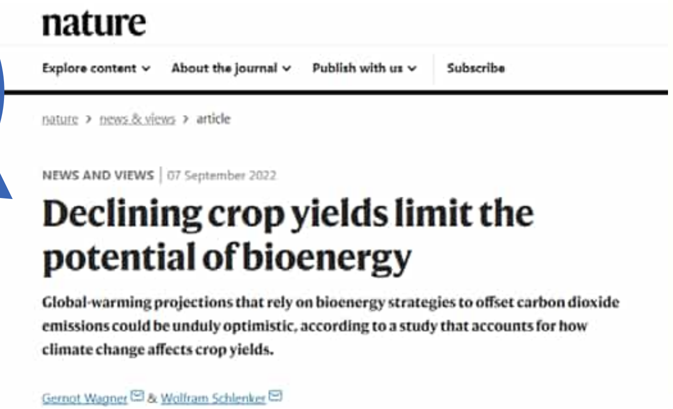
Delayed use of bioenergy crops might threaten climate and food security

In the same issue, the journal distributes supporting views of other scholars.


nature
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nature > news & views > article
NEWS AND VIEWS | 07 September 2022

Declining crop yields limit the potential of bioenergy

Global-warming projections that rely on bioenergy strategies to offset carbon dioxide emissions could be unduly optimistic, according to a study that accounts for how climate change affects crop yields.

Gernot Wagner & Wolfram Schlenker

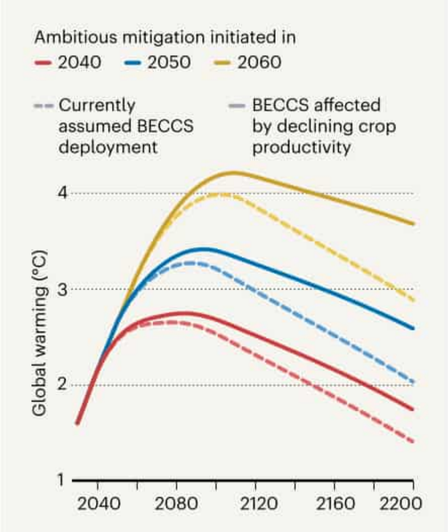
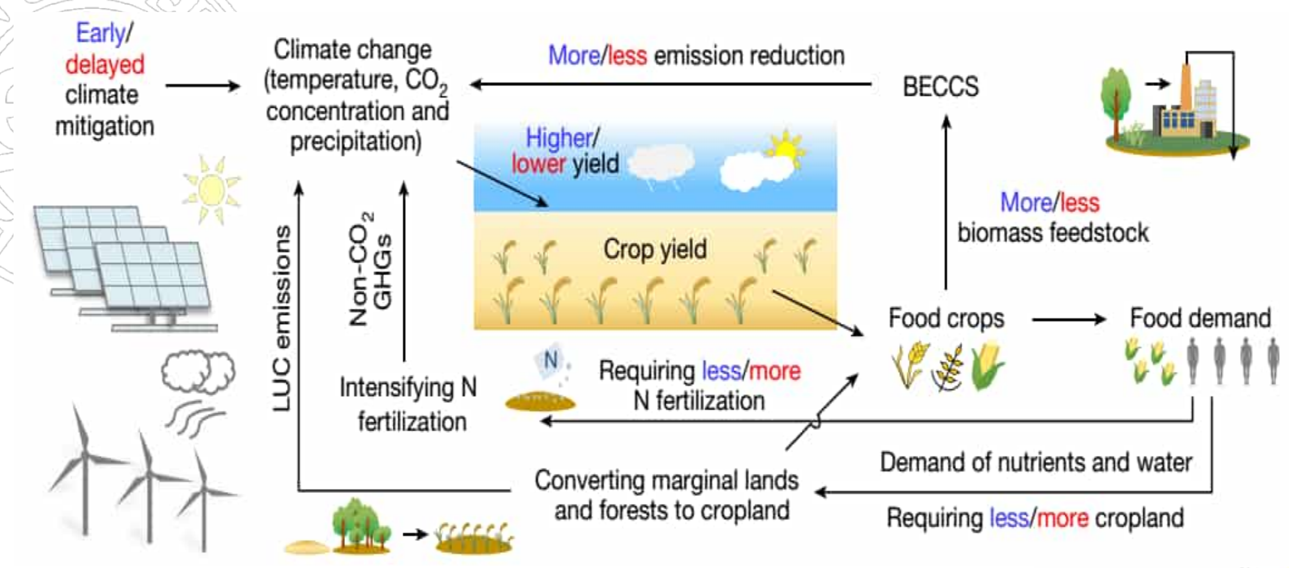


Figure 1 | Crop yields could affect global-warming mitigation. Climate–economy models assume that strategies for curbing global warming must involve increased deployment of technology known as bioenergy with carbon capture and storage (BECCS). However, Xu *et al.*[5] found that the effectiveness of BECCS is likely to be influenced by the temperature sensitivity of crop productivity rates, which is typically highly non-linear. The authors' analysis suggests that the timing of widespread implementation of BECCS will be key to its climate impact. (Adapted from Fig. S8 of ref. 5.)

Taking biomass carbon-negative emission reduction technology as the starting point, the two-way coupling of the earth system and the socio-economic system is realized, and the concept of global "climate governance tipping point" is proposed.

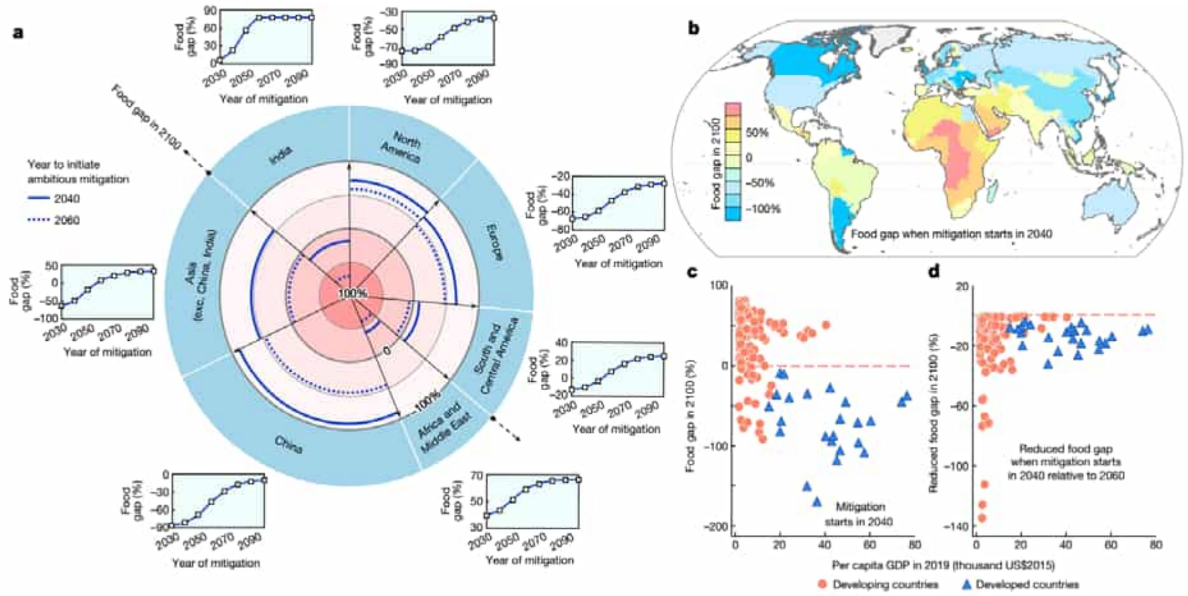
Climate Change Mitigation: Delayed Use of Bioenergy Crops might threaten global warming control and food Security



Interactive coupling of earth system and economic models with ML approach: Climate–yield feedbacks owing to reduced biomass feedstocks of crop residues for BECCS and the potential impacts on food supply and LUC.

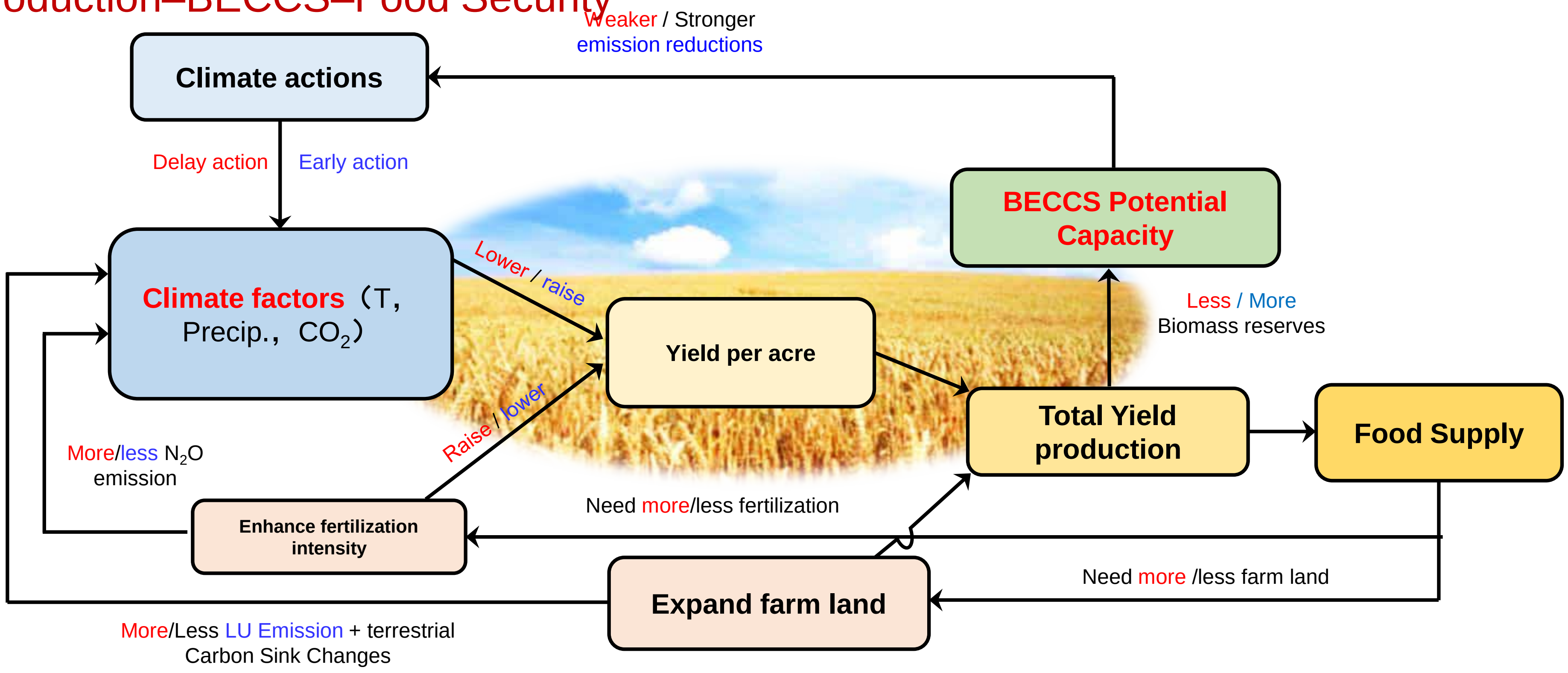
Xu S., et al., *Nature* , 609, 299 (2022)

Contribution of climate mitigation to reduce the regional food gap



Earth system model coupled with socioeconomic systems set up

Research Pathway: addressing Interconnections of Climate Change-Biomass Production–BECCS–Food Security



The feedback mechanisms on climate change and BECCS mitigation potential revealed

- Postpone/advance greenhouse gases emission reductions
- Weaken/enhance BECCS emission reduction potential
- Exacerbate/mitigate food crises and climate change

Case 2: A quantitative evaluation of strategies to accelerate the development of China's wind power and photovoltaic resources

nature

Article

Accelerating the energy transition towards photovoltaic and wind in China

https://doi.org/10.1038/s41586-023-06180-8

Received: 13 February 2022

Accepted: 9 May 2023

Open access

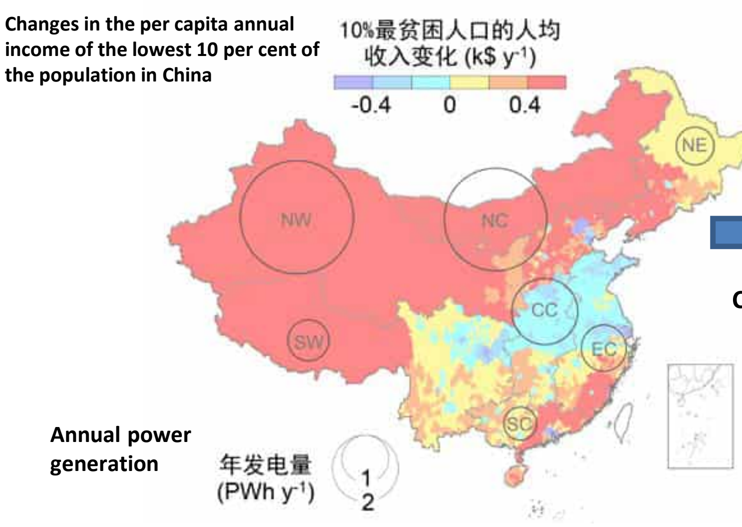
China's goal to achieve carbon (C) neutrality by 2060 requires scaling up photovoltaic (PV) and wind power from 1 to 10–15 PWh year⁻¹ (refs. 1–5). Following the historical rates of renewable installation[1], a recent high-resolution energy-system model[6] and forecasts based on China's 14th Five-year Energy Development (CFED)[7], however, only indicate that the capacity will reach 5–9.5 PWh year⁻¹ by 2060. Here we show that, by individually optimizing the deployment of 3,844 new utility-scale PV and wind power plants coordinated with ultra-high-voltage (UHV) transmission and energy storage and accounting for power-load flexibility and learning dynamics, the capacity of PV and wind power can be increased from 9 PWh year⁻¹ (corresponding to the CFED path) to 15 PWh year⁻¹, accompanied by a reduction in the average abatement cost from $97 to $6 per tonne of carbon dioxide (tCO_2). To achieve this, annualized investment in PV and wind power should ramp up from $77 billion in 2020 (current level) to $127 billion in the 2020s and further to $426 billion year⁻¹ in the 2050s. The large-scale deployment of PV and wind power increases income for residents in the poorest regions as co-benefits. Our results highlight the importance of upgrading power systems by building energy storage, expanding transmission capacity and adjusting power load at the demand side to reduce the economic cost of deploying PV and wind power to achieve carbon neutrality in China.

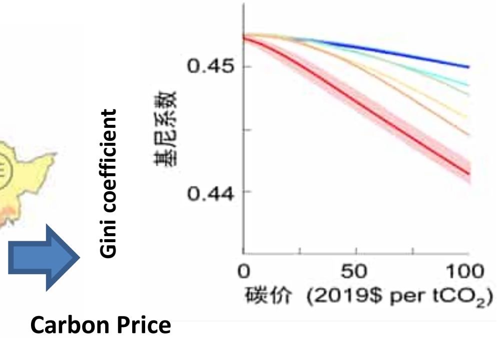
中国科学报

CHINA SCIENCE DAILY

总第8316期 2023年8月2日 星期三 今日4版

寻找发展太阳能和风能的最优路径



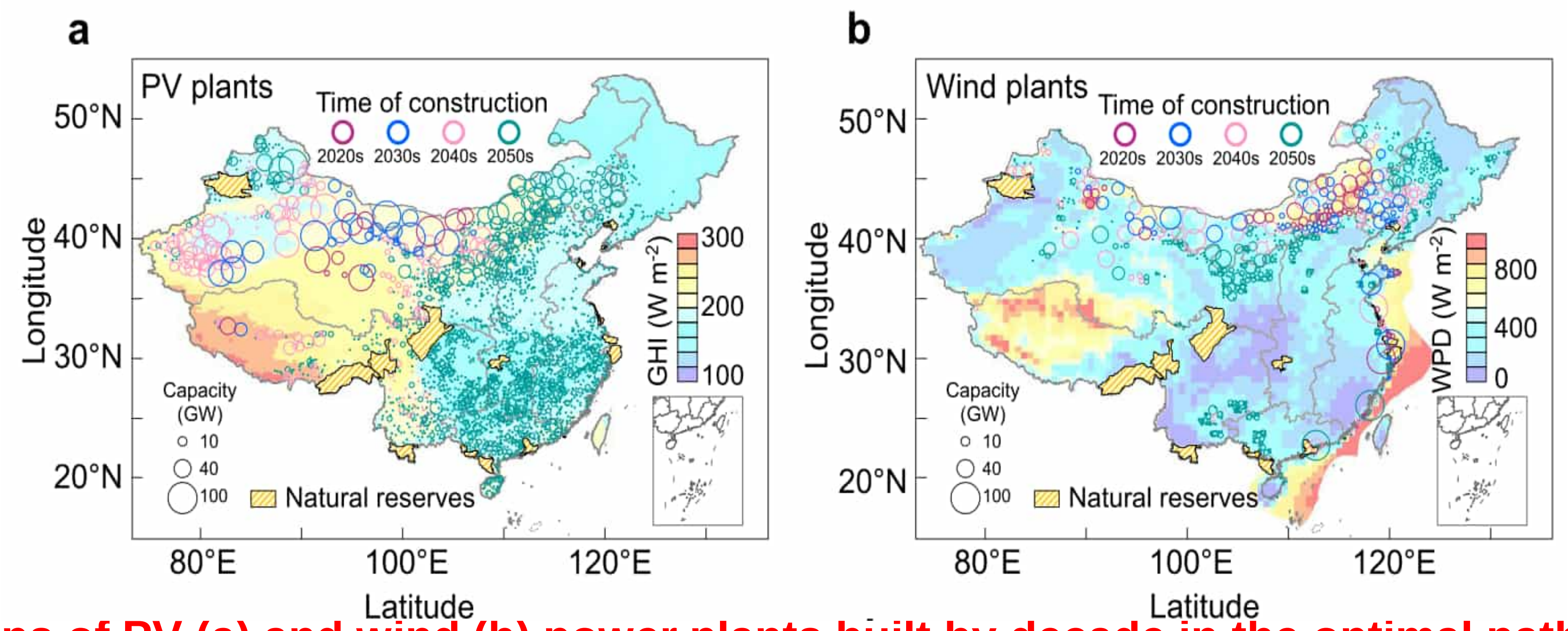


- From the perspective of overall planning and integration of energy system, the optimal path for China to accelerate the development of photovoltaic and wind power and achieve the goal of "3060 carbon peak and carbon neutrality" is proposed, and the potential and cost of China's solar and wind energy resources are quantitatively revealed.

Wang, et al. *Nature*, 2023

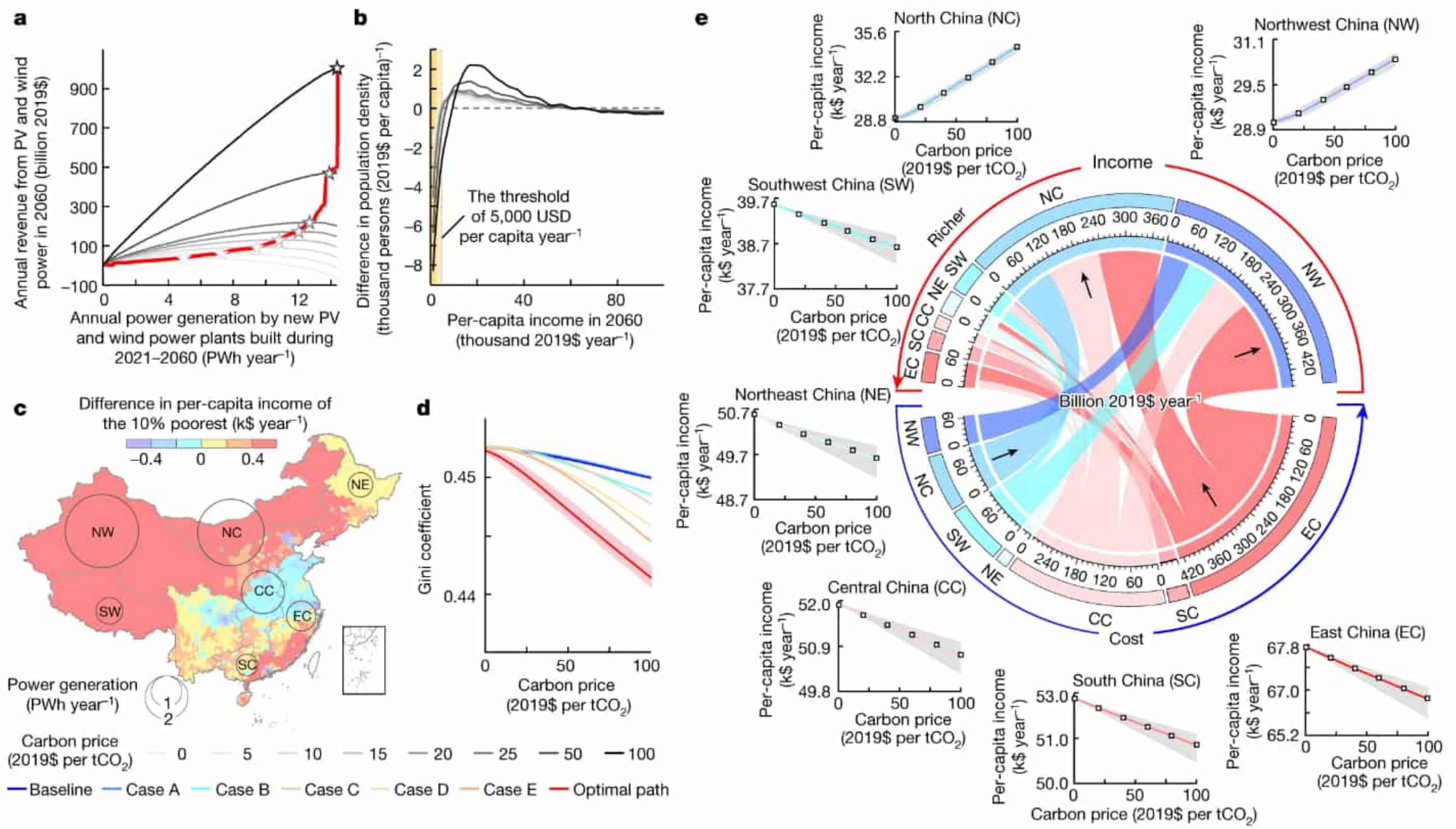
Optimization of spatiotemporal deployment for PV and wind power plants

- In the study, we optimized the location, capacity and construction time of 2,767, 1,066 and 11 power plants of PV, onshore-wind and offshore-wind at the utility scale in China during 2021–2060 by minimizing the levelized cost of electricity.
- A medium- and long-term construction plan for solar and wind power to replace fossil fuel power plants at the scale of power plants in China was established



Maps of PV (a) and wind (b) power plants built by decade in the optimal path

Effect of PV and Wind Power on Poverty Alleviation identified



- After optimizing the spatial and temporal distribution of solar photovoltaic and wind power generation and upgrading the national power system, the development of solar and wind power will increase the income of the western region, reduce the poverty population.

Case 2+ extended study: Global optimization of photovoltaic and wind power at high spatial and temporal resolutions

✓ **Our recent research on the global scale has made progress:**

- Regional-scale scenarios for high-capacity photovoltaic and wind power were determined;

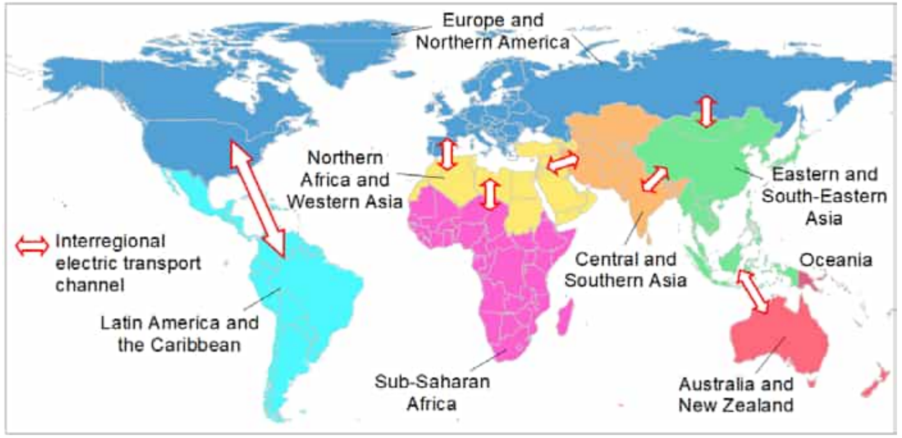
- The feasibility of incorporating a high proportion of solar and wind energy into the grid was investigated;

- The impact of building transmission and energy storage infrastructure was quantified;

- The demand for minerals in renewable energy deployments was assessed, and

- The financial gap for the deployment of renewable energy was estimated.

The country groupings are based on the geographic regions defined in the Standard Country or Area Codes for Statistical Use (known as M49) of the United Nations Statistics Division.



Global cross-regional power transport corridor

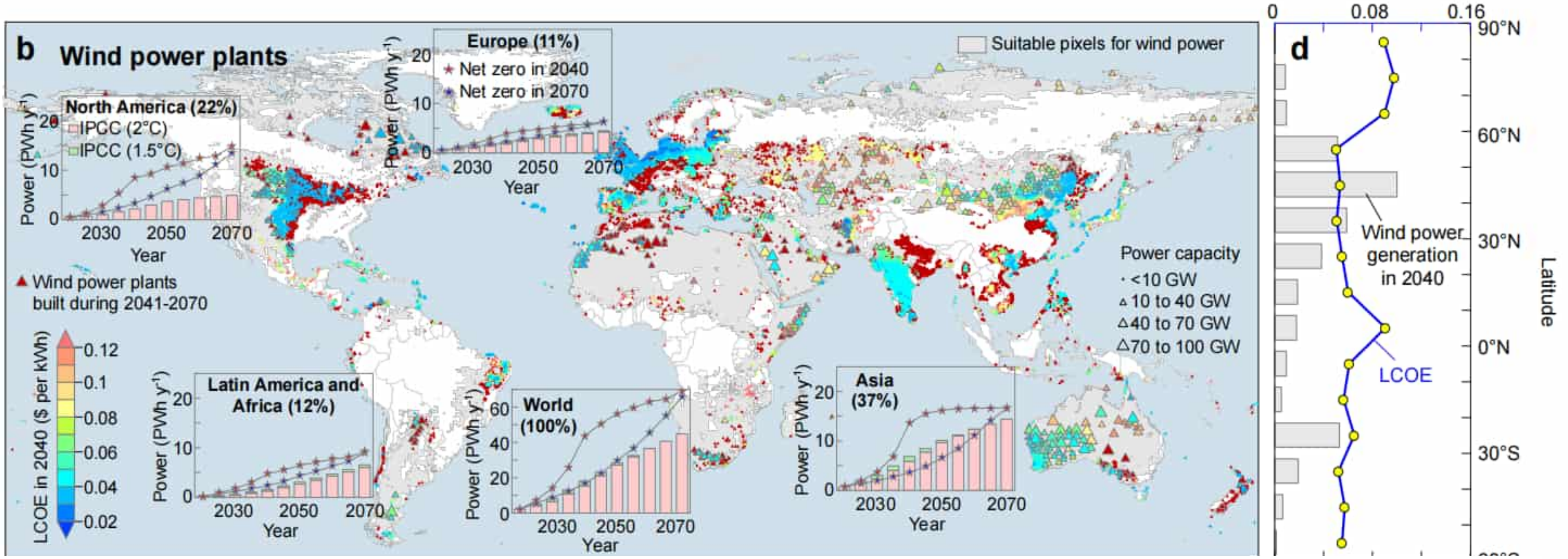
Global optimization of photovoltaic and wind power at high spatial and temporal resolutions to achieve the 1.5°C target

Yijing Wang[1], Rong Wang[1,2,3*], Katsumasa Tanaka[4,5], Philippe Ciais[4,6], Josep Penuelas[7,8], Yves Balkanski[4], Jordi Sardans[7,8], Didier Hauglustaine[4], Junji Cao[9], Libo Wu[10,11,12], Jianmin Chen[1,2,3], Lin Wang[1,2,3], Xu Tang[2,3], Xiaoye Zhang[13], Renhe Zhang[2,3]

Wang, et al. Nature Communication 2025

Case 2+: Global optimization of photovoltaic and wind power at high spatial and temporal resolutions

LCOE (Levelized Cost of Electricity,平准发电成本,$ kWh)



The study also indicates that

Electricity generation in 2040 (PWh y-1)

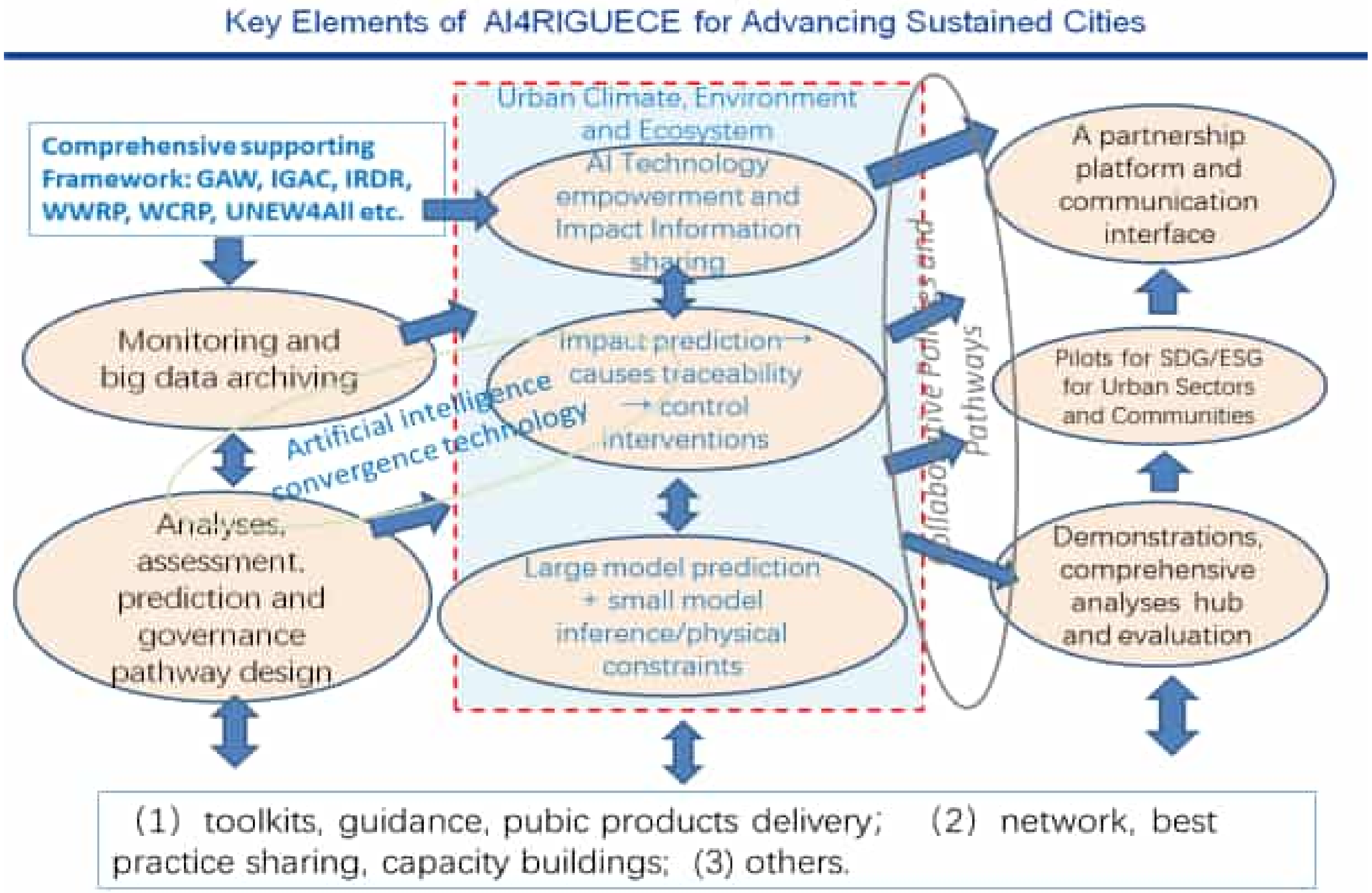
- Global wind power generation in 2040 and 2070 will be 37.2 and 58.3 picowatt hours, respectively, much higher than the average of the IAMs scenario (15.6 and 38.6 picowatt hours).
- Wind power is growing faster in Asia and North America, accounting for 22.1% and 36.7% of the global total, respectively, in 2040.

Conclusion of Case 2+

- ✓ Our research highlights the importance of ensuring inter-regional deployment, electricity flows, mineral trade, and international finance.
- ✓ Our findings support that it is not too late for a global energy system transition to achieve net-zero CO_2 emissions by 2040.
- ✓ Our findings imply that long-term planning for deep decarbonization requires governance structural reforms.
- ✓ Our research indicates the importance of financing a stable post-COP28 transition for low-carbon energy, with a concerted global effort.
- ✓ We found evidence of the potential impact of trade protectionism on green technology materials and mineral supply chains and a further investigation will be extended.
- ✓ Energy security and regional conflicts can create additional double obstacles that threaten the security of energy infrastructure.

Part IV: Initiative on AI for Integration

Fig.9. The Integrated Framework and its key elements for Building Climate Resilience and Sustainability



A Workshop: AI for Urban Integration on AQ, Climate and Ecosystem

Group Photo:

The Workshop on AI for Air Quality Modelling and Prediction, hosted by the Shanghai Innovation Institute,

13 March 2025.

The AI4UIAQCE initiative

The Artificial Intelligence for Urban Integration on Air Quality, Climate, and Ecosystem is a strategic proposal developed. It seeks to address the multifaceted challenges faced by urban environments at the intersection of climate change, air quality, ecosystem sustainability, and public health for sustainable cities.

Through the integration of AI, this initiative proposes a co-designed, interdisciplinary platform that links observations, modeling, and real-world urban metrics, offering a transformative approach for data-informed and equity-centered urban policies.

Urban areas are increasingly vulnerable to complex, interconnected risks related to:

- Emissions and air pollution
- Climate and weather extremes
- Health disparities
- Ecosystem degradation

AI's Transformative Potential in Urban Development

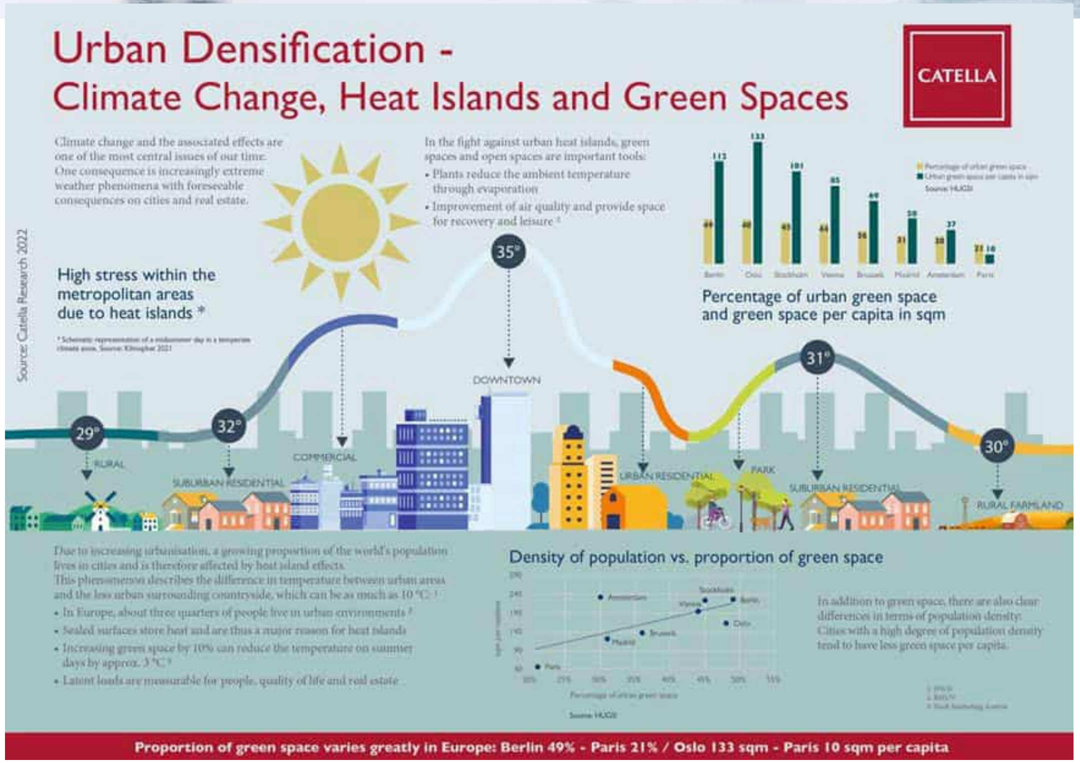


Fig.1 Urban Densification – Climate Change, Heat Island, and Green Spaces, Catella,2022

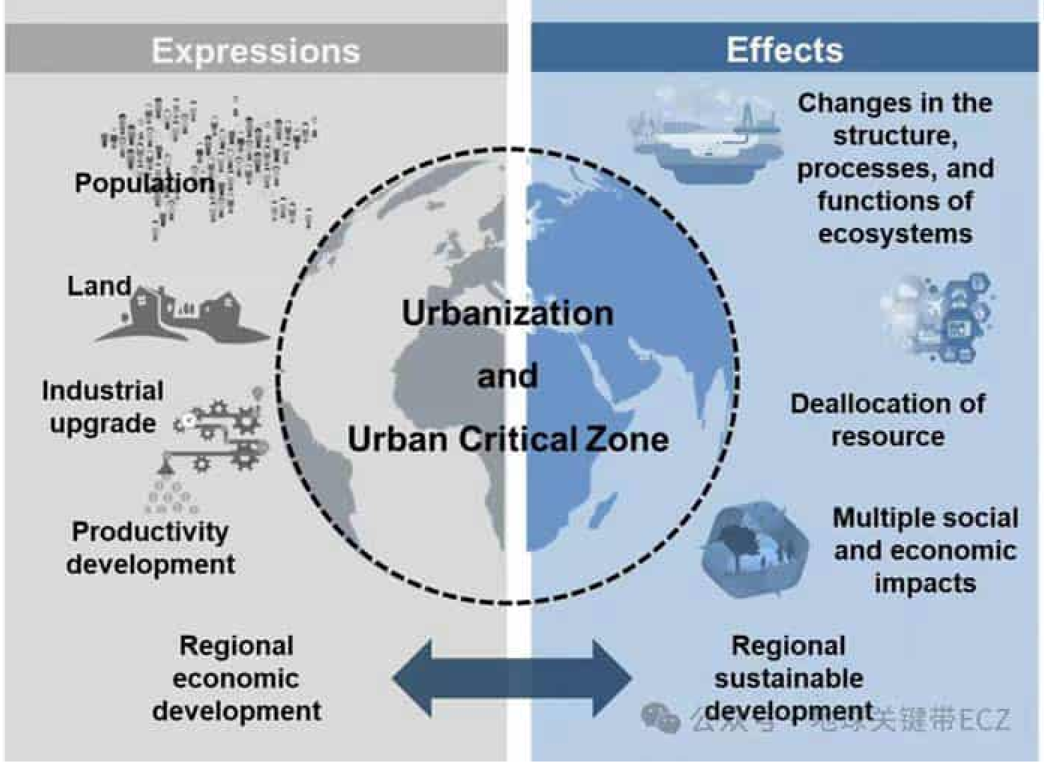


Fig 2. Conceptual diagram to show comprehensive effects and expressions of urban critical zone.

Specific Objectives of AI4UIAQCE

Addressing Equity & Justice Issues

Integrate public health and ecosystem considerations into urban planning to address environmental justice.
Protect vulnerable communities from disproportionate environmental risks.
MAUI promotes equitable urban environments with clean air, safe water, and healthy ecosystems for all.

Green Transition Promotion

Promote low-carbon pathways and circular economy models in urban settings, using AI-driven insights to identify and implement sustainable practices.
The initiative encourages the adoption of renewable energy sources, waste reduction strategies, and other environmentally friendly measures to transition cities towards a greener future.

Urban ESG Framework Development

Develop a comprehensive framework that links urban climate, environment, and ecosystem dynamics with emissions and resilience strategies, creating a holistic approach to urban sustainability.
This framework will serve as a guide for cities to integrate various aspects of urban development with ESG principles, ensuring a balanced and sustainable growth trajectory.

AI-Driven Urban Systems Integration

Integrate existing models, tools, and databases, leveraging AI for real- time monitoring, predictive analytics, and optimization of urban ESG metrics within urban systems.
By enhancing the capabilities of current urban systems with AI, cities can better track and manage their progress towards sustainability goals.

Climate & Health Resilience Enhancement

Enhance urban adaptation to climate risks through AI-enhanced risk modeling tools and pre-assessment strategies for decision-making, improving the overall resilience of cities.
This includes developing strategies to address the impacts of climate change on public health, such as heat-related illnesses and respiratory issues caused by poor air quality.

Methodology and Implementation

The initiative will be implemented through:

- City-scale demonstration projects across different regions (e.g., Vienna, Singapore, Shanghai, Hong Kong, Sao Paolo, Konstanz (at the German-Swiss border), Jakarta, Nairobi, Addis Ababa, etc.)
- Co-development with municipal, academic, and regional actors
- Integration of existing WMO and IGAC tools, including GAW stations, IG3IS methodologies, and MAP-AQ capabilities
- AI-enhanced platforms for dynamic urban SDG/ESG performance tracking

Main Research Items

Comprehensive AI Integration Framework

- Create a framework integrating AI with model outputs, measurements, emissions, ecosystems, health, and urban behaviors.
- Provide a blueprint for AI-driven urban sustainability efforts.
- Ensure seamless collaboration across components.

AI for Seamless Air Quality Prediction

- Build AI models to predict air quality across short-term forecasts and long-term trends.
- Provide insights for planning and implementing air quality improvements.
- Help cities anticipate and address potential issues.

Specific Impact Assessments

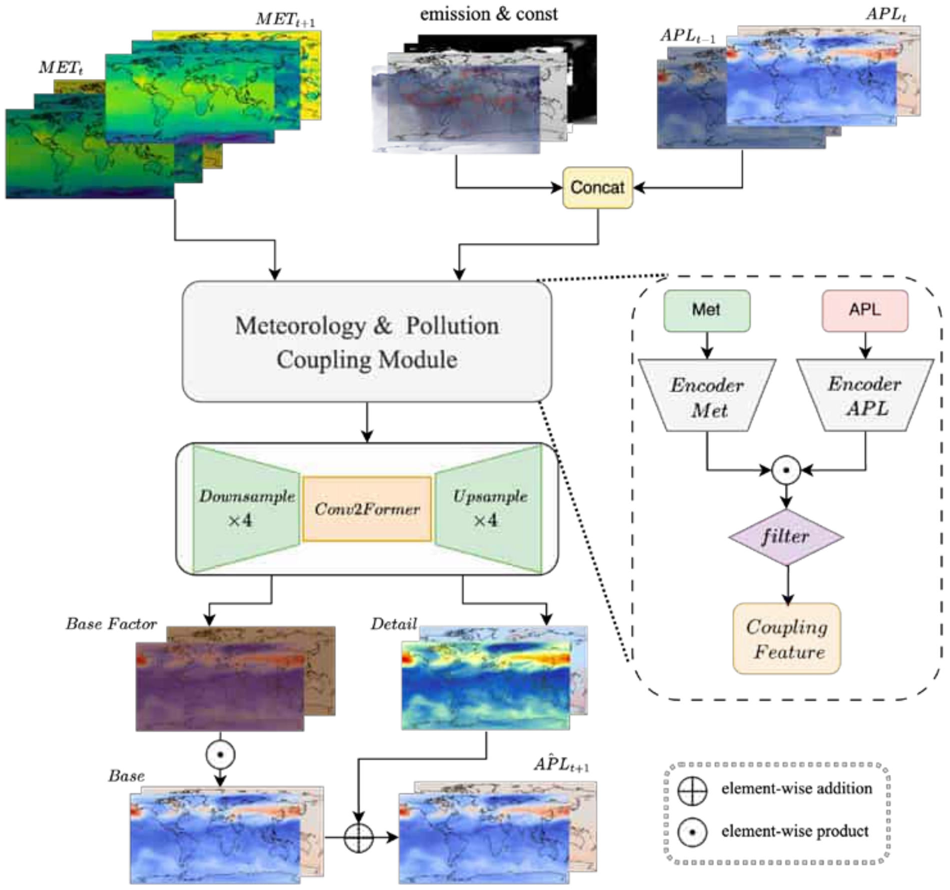
- Conduct impact assessments: urban ecosystem inequality index and health burden from environmental factors.
- Identify inequality areas and prioritize interventions.
- Promote environmental justice and public health.

Science-Based Urban ESG/SDG Indicators System

- Create a science-based urban ESG/SDG indicators system to measure sustainability progress.
- Develop application and evaluation methods for standardized assessment.
- Enable comparison of ESG performance across cities.

FuXi-Global AP： Coupling the meteorological environment with global pollutant forecasting

复旦大学人工智能创新与产业研究院
Artificial Intelligence Innovation and Incubation (AI3) Institute



FuXi-GlobalAP模型架构

Traditional Solution:

1. Traditional global chemical transport models are computationally expensive and inefficient

2. The AI-based online coupling forecasting scheme has high training cost and difficult adaptation.

Innovation with AI

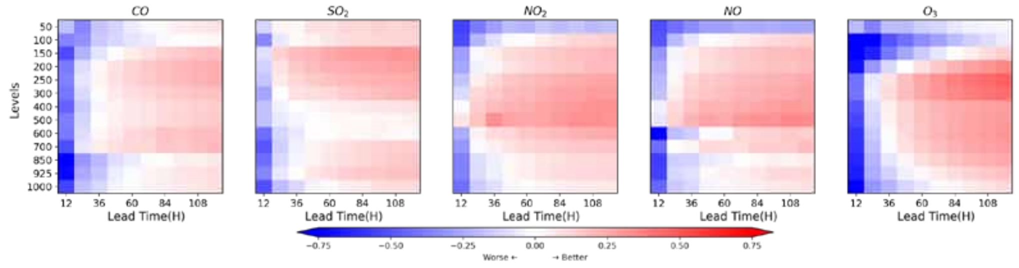
1. A global pollutant forecasting model coupled with AI weather forecasting was constructed

2. Through bilinear pooling technology, it can be flexibly adapted to different types of global weather forecasting results

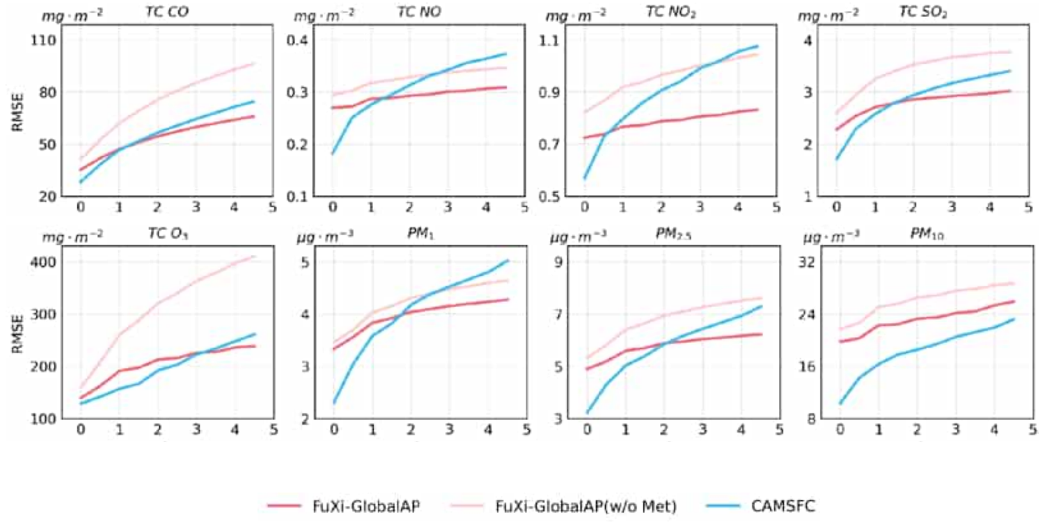
FuXi-GlobalAP： Coupling the meteorological environment with global pollutant forecasting

- FuXi- GlobalAP:It outperformed the CAMS/ECMWF forecast on 66% of the variables.
- FuXi-GlobalAP has outstanding advantages in the late forecast, and 88% of the forecast results over 48 hours exceed the CAMS forecast results.

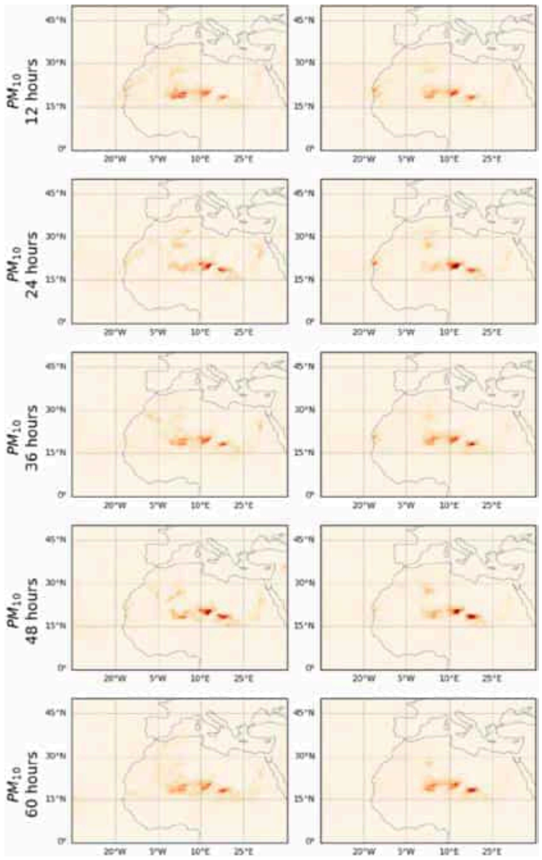
高空逐层大气污染物相对误差 (参照 CAMSFC)



整层及近地面大气污染物 RMSE 对比

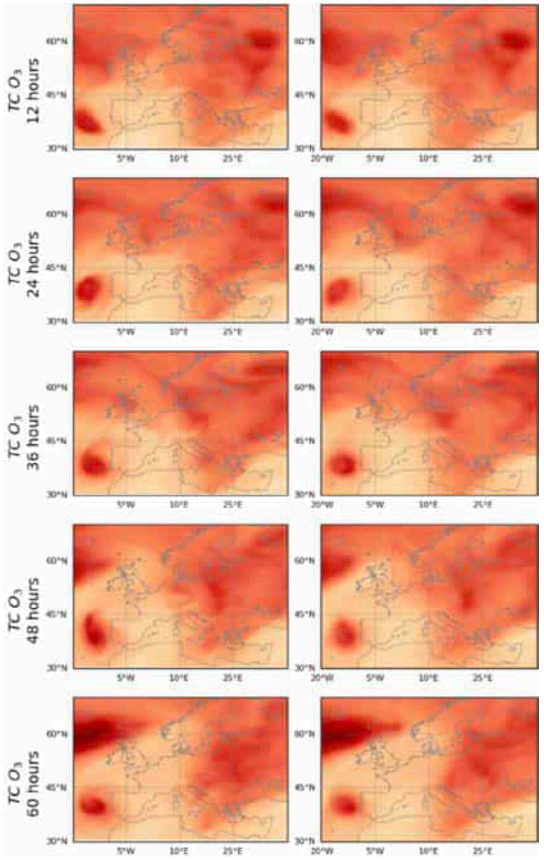


Target FuXi-GlobalAP



Forecasting from 2022.10.06 00:00
撒哈拉沙漠沙尘天气过程PM10预报结果对比

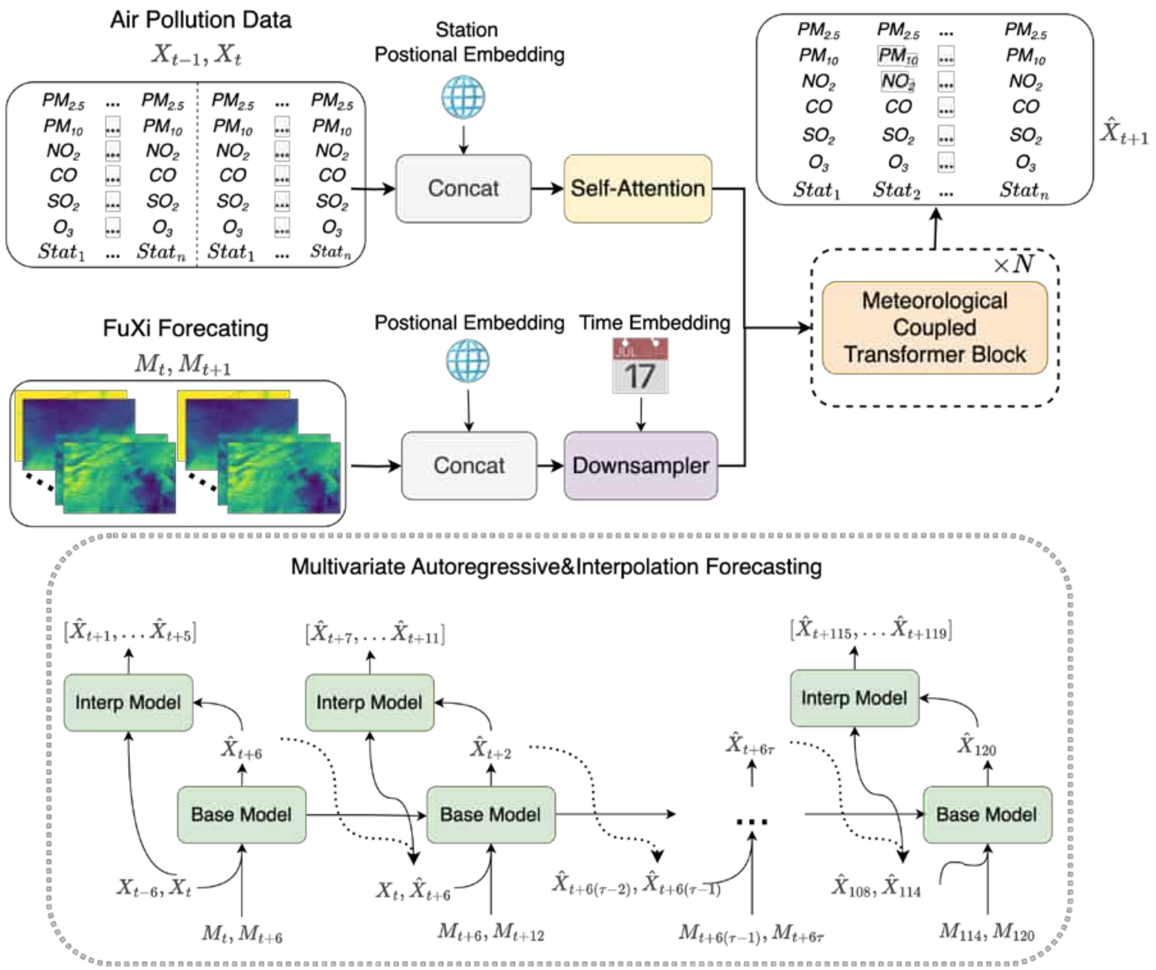
Target FuXi-GlobalAP



Forecasting from 2022.06.15 00:00
欧洲热浪天气过程 TC O3预报结果对比

FuXi-Regional AP: Meteorological environment coupled with regional pollutant forecasting

复旦大学人工智能创新与产业研究院
Artificial Intelligence Innovation and Incubation (AI3) Institute



FuXi-RegionalAP模型架构

Traditional scenario:

1. The physical model is expensive and takes a long time to run

In the operational operation of the AI model, there are observations

2. The contradictory relationship between data dependence and lack of observational data

传统方案：物理模型运行成本高、时间长；AI模型业务化运行中，存在观测数据依赖和观测数据缺测的矛盾关系

Innovation with AI:

1. This paper proposes a coupling forecasting scheme between AI meteorological forecasting field and regional air pollutants, which greatly improves the accuracy of forecasting and achieves the effect of AI model SOTA in the field

2. Considering the daily cycle characteristics of air pollutants, a combined model scheme of 6-hour autoregressive forecast + 1-hour interpolation forecast is designed to reduce the dependence of the model forecast on the measured data.

创新点：1. 提出AI气象预报场与区域大气污染物耦合预报方案，大幅度提升预报准确性，效果达到领域内AI模型SOTA；2. 考虑大气污染物日循环特征，设计6小时自回归预报+1小时插帧预报的组合模型方案，减少模型预报对于实测数据依赖。

FuXi-RegionalAP：Meteorological environment coupled with regional pollutant forecasting

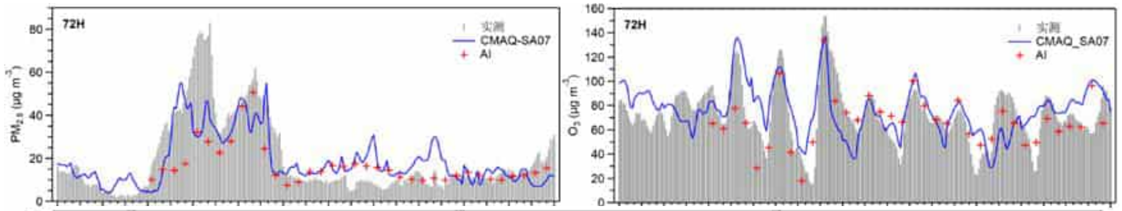
A single forecast only needs 2 hours of pollutant station data to achieve 6 conventional pollution concentration forecasts with a resolution of 120 hours and 1 hour

FuXi-RegionAP(ReAP)与站点污染物 AI 预报模型对比（华北，6小时分辨率）

Model	MS (MB)	TDS	SO_2				NO_2				$PM_{2.5}$			
			1-24h	25-48h	49-72h	97-120h	1-24h	25-48h	49-72h	97-120h	1-24h	25-48h	49-72h	97-120h
STGCN [Yu *et al.*, 2018]	3.44	5120	13.23	13.04	12.94	12.97	22.2	22.25	22.29	22.28	33.78	34.64	34.65	34.97
AGCRN [Bai *et al.*, 2020]	2.95	5120	17.53	16.76	17.42	16.25	25.84	25.68	25.52	25.39	42.9	42.5	43.9	41.9
STNorm [Deng *et al.*, 2021]	3.10	5120	13.4	13.6	13.69	13.59	21.93	22.28	22.37	22.46	34.58	35.66	35.92	36.3
STID [Shao *et al.*, 2022]	3.14	5120	13.01	13.12	13.1	13.08	22.36	22.38	22.4	22.49	34.93	35.31	35.44	35.82
Airformer [Liang *et al.*, 2023]	3.31	5120	13.4	13.35	13.25	13.18	20.55	20.38	20.33	20.27	36.43	36.32	36.17	36.13
GAGNN [Chen *et al.*, 2023b]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ReAP (ours)	2.53	6464	12.34	12.3	12.35	12.3	17.13	18.4	18.68	18.78	29.66	33.88	34.3	34.1
$ReAP_{fuxi}$ (ours)	5.93	6464	**12.14**	**12.09**	**12.16**	12.22	**16.07**	**16.79**	**16.92**	17.15	**28.09**	**30.66**	**30.97**	31.36
$ReAP_{era5}$ (ours)	5.93	6464	**12.14**	12.11	12.18	**12.21**	16.07	16.81	16.92	**16.97**	28.11	30.69	31.0	**31.29**

Model	MS (MB)	TDS	PM_{10}				CO				O_3			
			1-24h	25-48h	49-72h	97-120h	1-24h	25-48h	49-72h	97-120h	1-24h	25-48h	49-72h	97-120h
STGCN [Yu *et al.*, 2018]	3.44	5120	91.97	93.08	93.54	94.54	0.45	0.46	0.45	0.45	55.24	55.51	55.7	55.77
AGCRN [Bai *et al.*, 2020]	2.95	5120	104.22	103.11	102.63	103.34	0.6	0.58	0.61	0.58	52.42	52.85	52.56	52.65
STNorm [Deng *et al.*, 2021]	3.10	5120	91.69	93.07	93.48	94.02	0.46	0.47	0.48	0.47	52.95	52.72	52.6	52.68
STID [Shao *et al.*, 2022]	3.14	5120	93.24	93.82	94.13	94.61	0.46	0.46	0.46	0.46	56.07	55.93	55.85	55.72
Airformer [Liang *et al.*, 2023]	3.31	5120	93.98	93.76	93.75	93.8	0.47	0.46	0.46	0.46	38.09	37.81	37.93	37.83
GAGNN [Chen *et al.*, 2023b]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
ReAP (ours)	2.53	6464	86.19	92.29	93.29	93.38	0.4	0.42	0.43	0.43	28.76	32.39	34.03	34.95
$ReAP_{fuxi}$ (ours)	5.93	6464	84.6	89.42	90.28	**90.15**	**0.39**	**0.4**	**0.41**	**0.41**	25.98	27.97	28.28	28.86
$ReAP_{era5}$ (ours)	5.93	6464	**84.55**	**89.28**	**90.17**	90.47	**0.39**	0.41	**0.41**	0.42	**25.93**	**27.81**	**28.07**	**28.06**

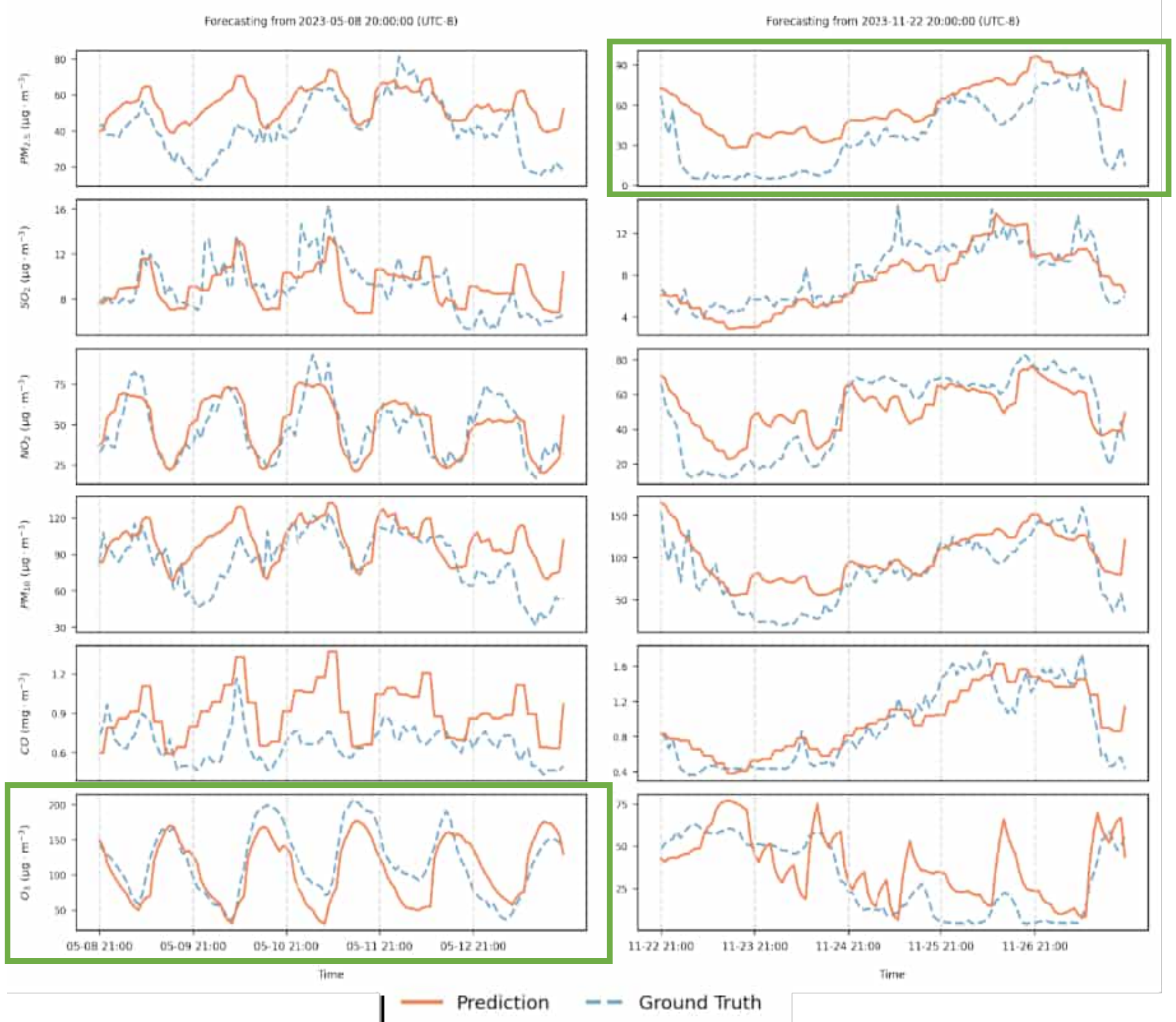
2024年进博会期间 FuXi-RegionAP试运行与上海市环境监测中心最优集合预报结果对比



Time	24H				48H				72H			
Model	RegionalAP		SHA-CMAQ-ENS		RegionalAP		SHA-CMAQ-ENS		RegionalAP		SHA-CMAQ-ENS	
Metric	R	RMSE	R	RMSE	R	RMSE	R	RMSE	R	RMSE	R	RMSE
PM2.5	0.82	13.5	0.85	11.0	0.74	15.4	0.79	12.5	0.73	15.0	0.76	12.7
PM10	0.76	14.9	0.88	10.7	0.58	17.0	0.78	13.4	0.53	15.8	0.67	15.2
NO2	**0.84**	**7.6**	0.76	10.9	0.72	**9.7**	0.75	12.8	0.64	**10.3**	0.64	13.7
O3	**0.81**	**16.1**	0.73	19.6	**0.77**	**18.6**	0.64	22.5	**0.74**	**19.5**	0.67	22.3
SO2	**0.60**	**0.8**	0.56	2.6	0.65	**1.1**	0.68	2.2	0.2	**1.1**	0.2	0.36
CO	**0.73**	**0.1**	0.77	0.2	**0.76**	**0.1**	0.72	0.1	**0.71**	**0.1**	0.52	0.68

RegionalAP在受本地源排放影响大的物种上具有明显优势

O_3污染过程和$PM_{2.5}$污染过程120小时预报结果（华北，1小时分辨率）



Integrated design from data, model to tasks

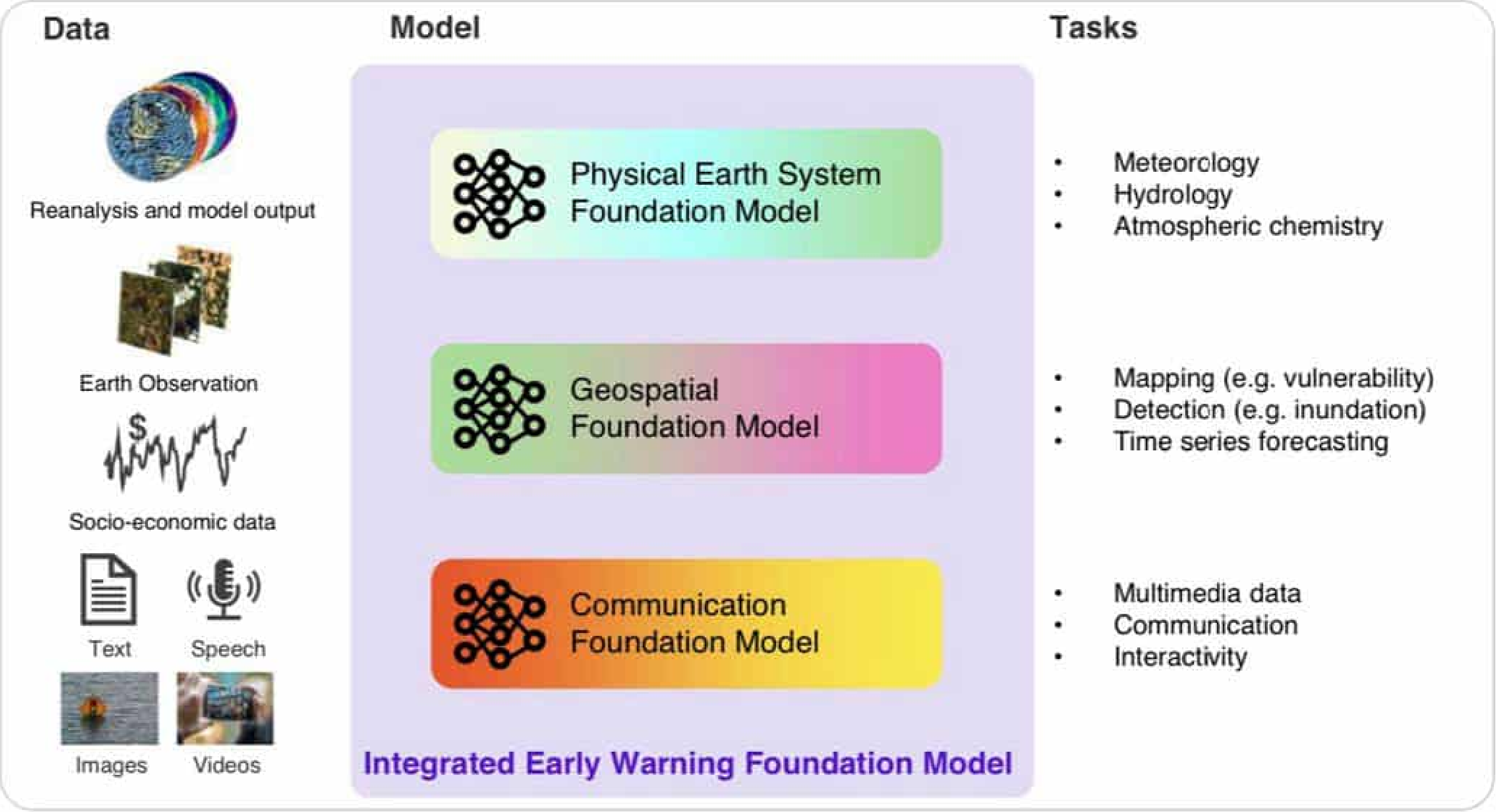


Fig. 7. Example: A smart simulator on chemical transport modelling

A smart simulator for chemical transport simulation

The input and output variables are selected according to the gas continuity equation:

$$\frac{\partial \bar{c}}{\partial t} = -\frac{\partial(\overline{uc})}{\partial x} - \frac{\partial(\overline{vc})}{\partial y} - \frac{\partial(\overline{wc})}{\partial z} + \frac{\partial}{\partial x}\left(K_x \frac{\partial \bar{c}}{\partial x}\right) + \frac{\partial}{\partial y}\left(K_y \frac{\partial \bar{c}}{\partial y}\right) + \frac{\partial}{\partial z}\left(K_z \frac{\partial \bar{c}}{\partial z}\right) + \bar{P} - \bar{L}$$

Running AQ Model

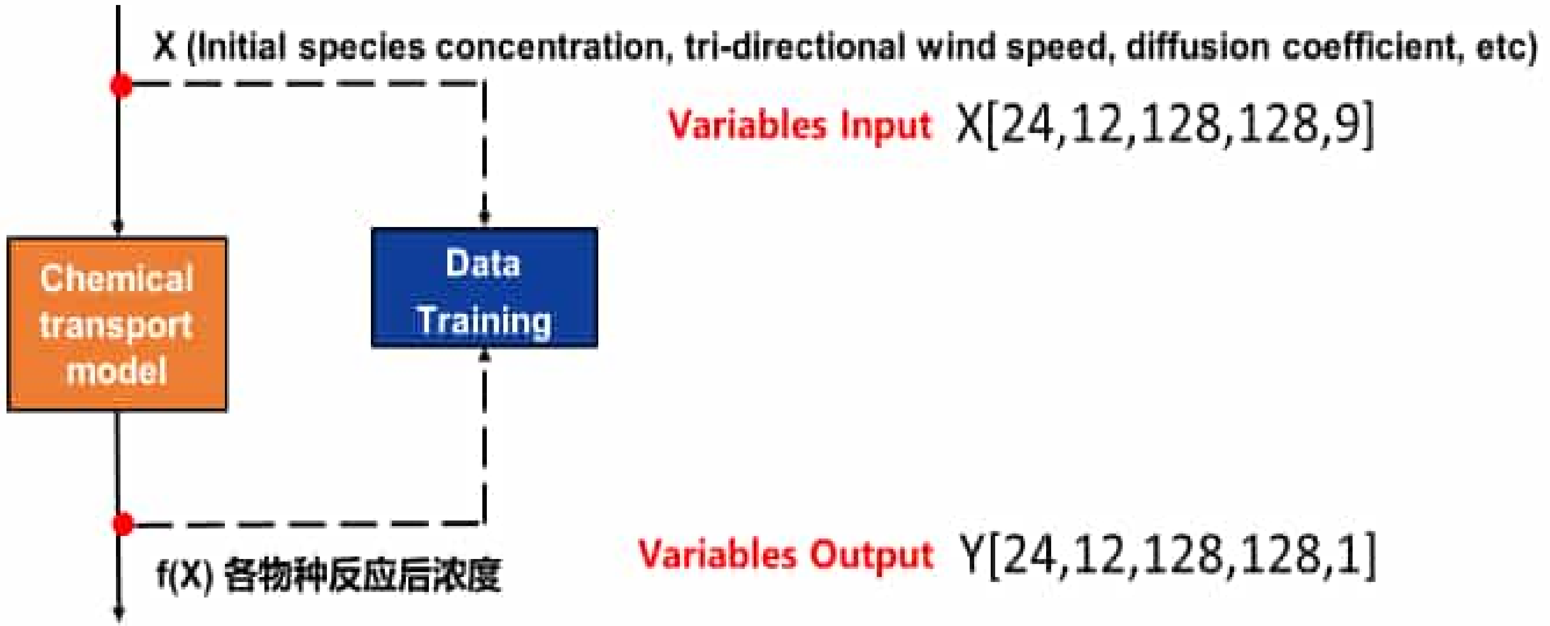
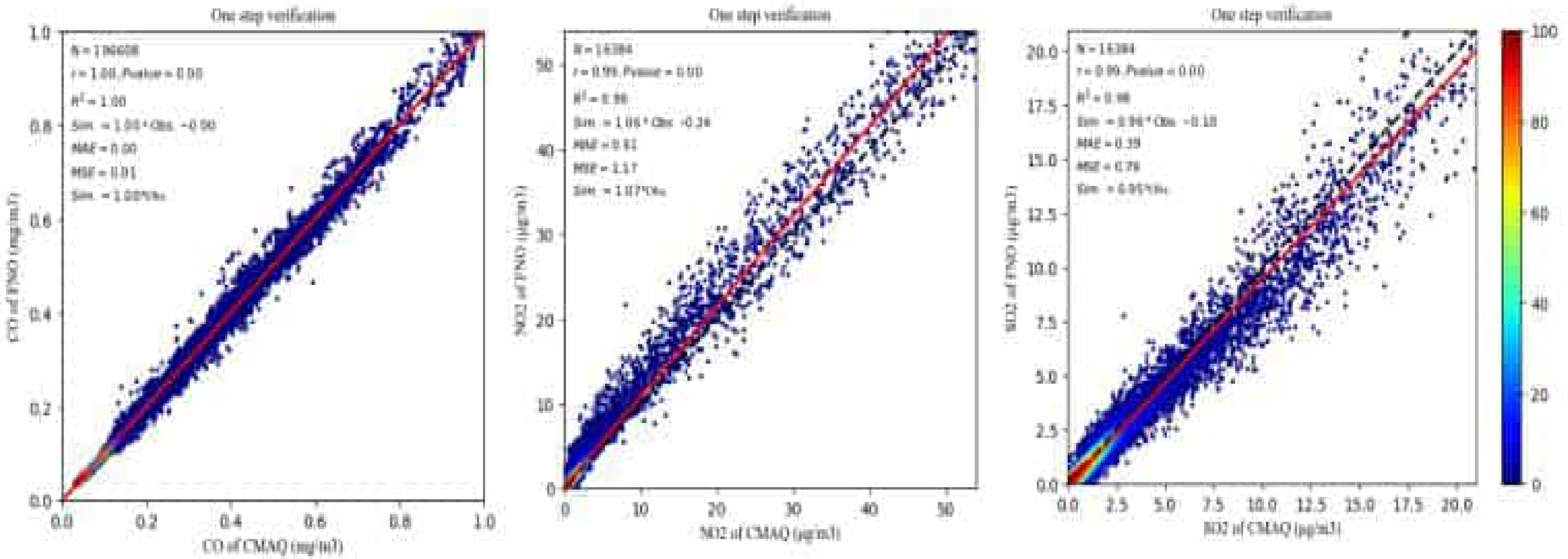


Fig. 7. Example: A smart simulator on chemical transport modelling

Fig. 7. Example: A smart simulator on chemical transport modelling

成果一 化学传输模拟的智能仿真器



CO　　NO2　　SO2

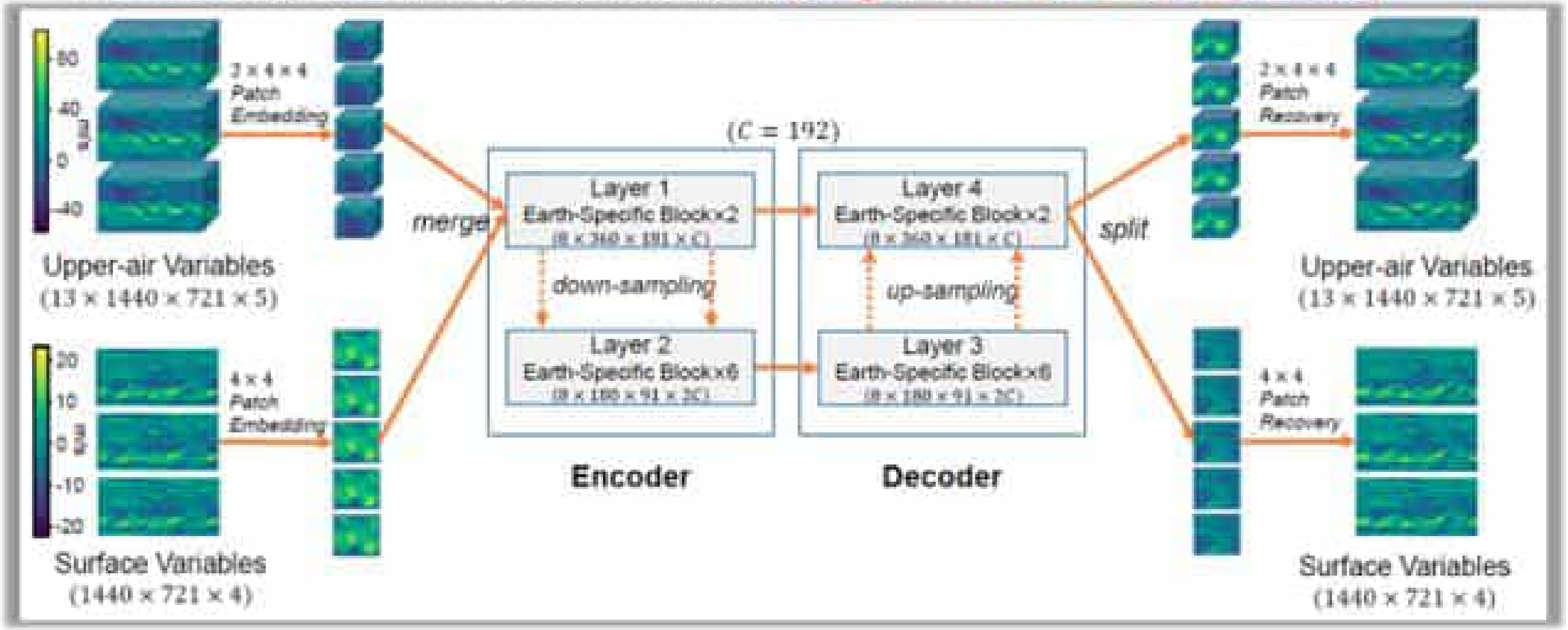
单时间步长预测，各物种能够学习到较好的一致性

With multiple time steps, the consistency of each species will decrease rapidly over time and then remain at a certain stable value

Fig 8. Example: AI 4 AQI - Training → Prediction → Attribution

Architecture: 3D Earth-Specific Transformer

- **A 3D vision transformer to process volumetric data**
  - Swin transformer[A] to accelerate computation (standard window attentions)
  - Reduced network depth and width **(larger models can be better!)**

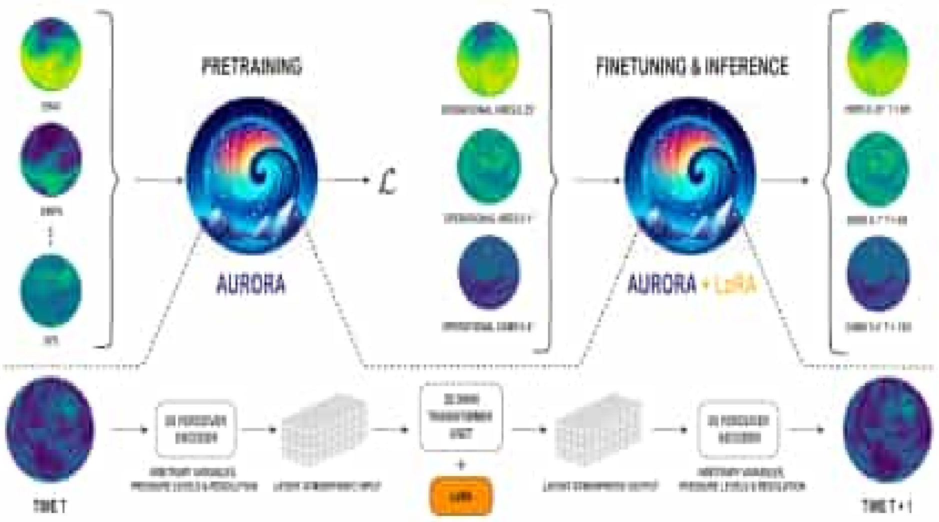


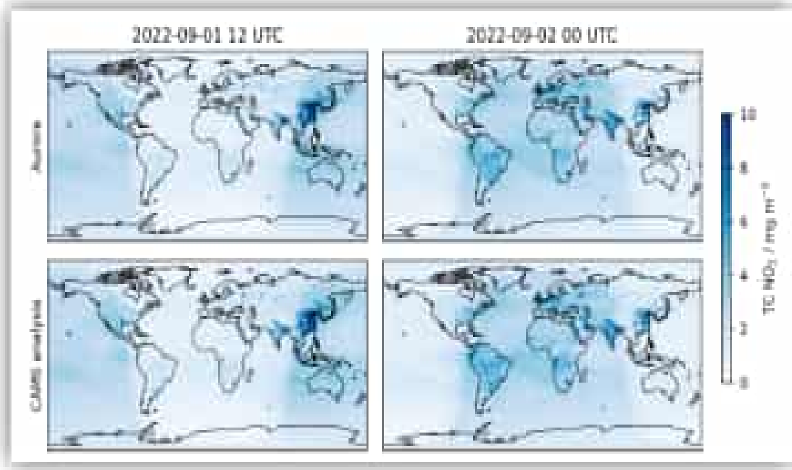
[A] Z. Liu et al., Swin Transformer: Hierarchical Vision Transformer using Shifted Windows, in ICCV, 2021.

Fig 8. Example: AI 4 AQI - Training → Prediction → Attribution

Microsoft Aurora - AQ prediction

Aurora: A Foundation Model of the Atmosphere





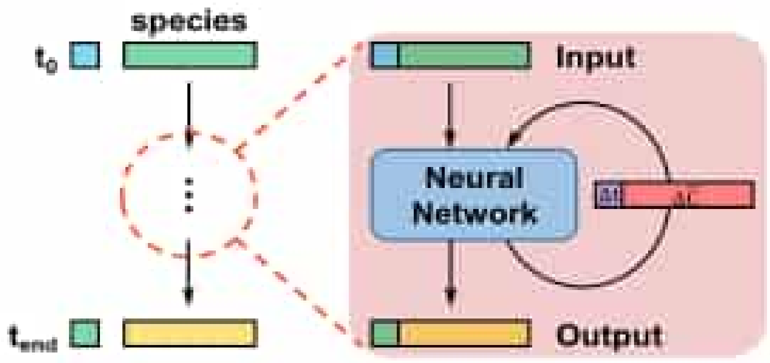
A flexible 3D Swin Transformer with 3D Perceiver-based encoders and decoders

Fig 8. Example: AI 4 AQI - Training → Prediction → Attribution

Bodnar et al., **Aurora: A Foundation Model of the Atmosphere**, preprint, https://arxiv.org/abs/2405.13063

Take-Home Message

Stiff Ordinary Differential Equations

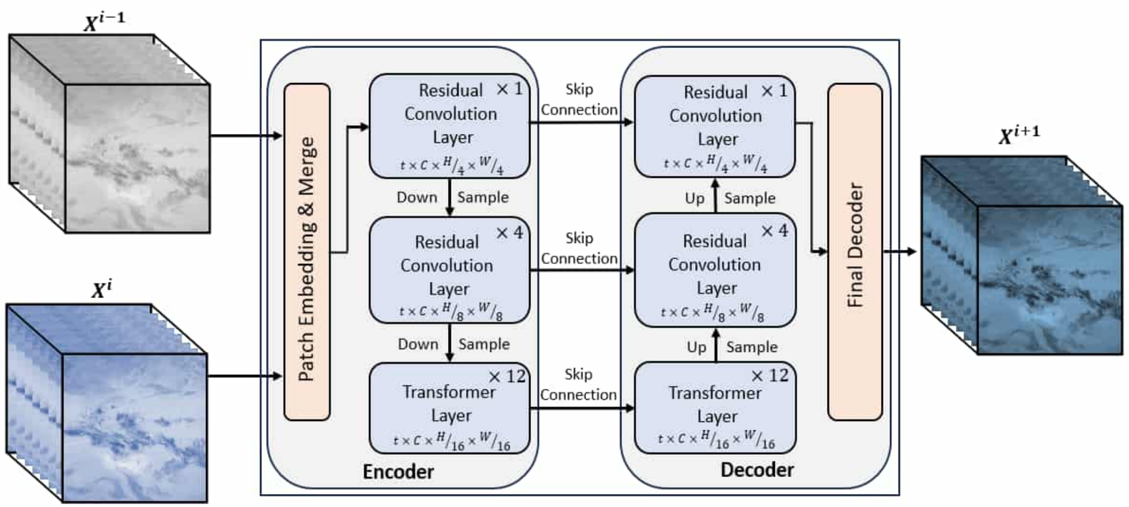


- Neural Network-Assistant Euler Integrator
  - Avoid calculating inversion of Jacobian matrix
    - 90%-time reduction from the ROS3 method
  - Mechanism-specific
    - Must re-train the neural networks when new species or reactions are considered
- Application to CTM (Prof. Zhen Cheng at SJTU)
  - How to include time-dependent rate constant
  - What is the most efficient way to execute this method

Huang and Seinfeld, ES&T, 2022

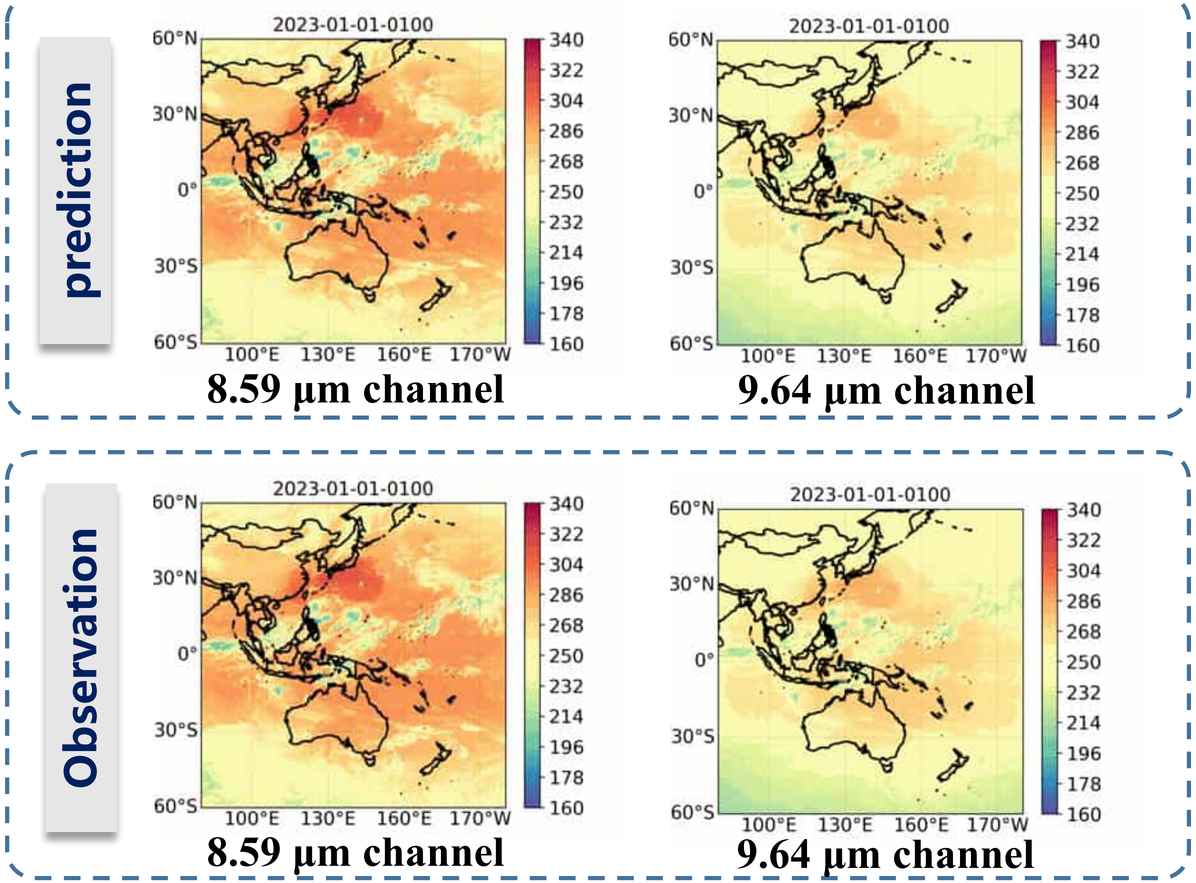
“大禹”短临预报大模型“- ”DaYu” Brightness Temperature Large AI Model

Network Structure - “DaYu” Large AI Model



HR IBT Satellite Image → Feature extract → Restore details → Image Forecasting

2 Billion parameters, Temporal Resolution: 30 min; Spatial Resolution: 5 km; Forecasting Lead Time up to 12 h.



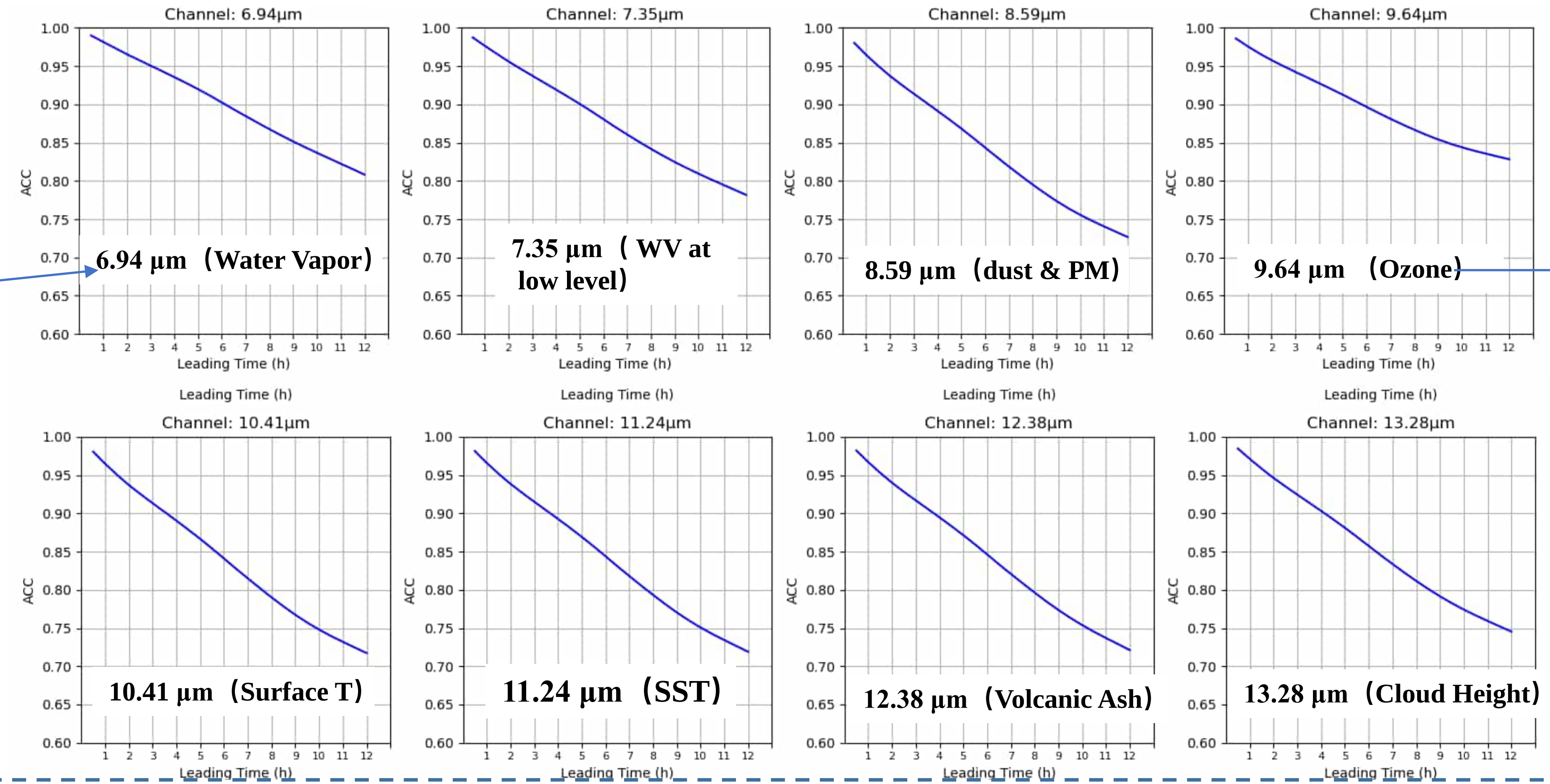
The first large AI model driven by infrared brightness temperature with 12h prediction lead time.

The model encoder extracts the key evolutionary features of the image. The decoder restores the image details at the next time through key evolutionary features. The large-parameter transformer architecture in the model can learn the evolution law of high-resolution cloud images through a large amount of data, so as to achieve accurate forecasting.

Research Foundation- "DaYu" Brightness Temperature Large AI Model

'DaYu' Model Correlation Coefficient Verification

The central wavelength of the bright-temperature radiation channel

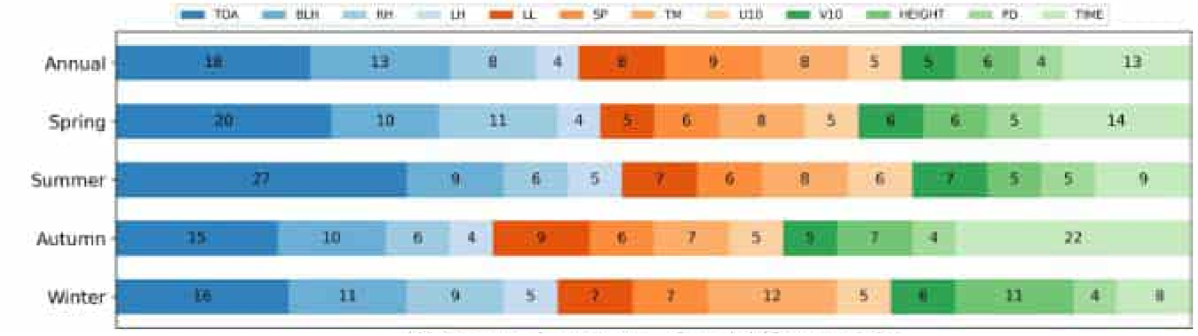


Corresponds to the composition of the substance reflected in this channel

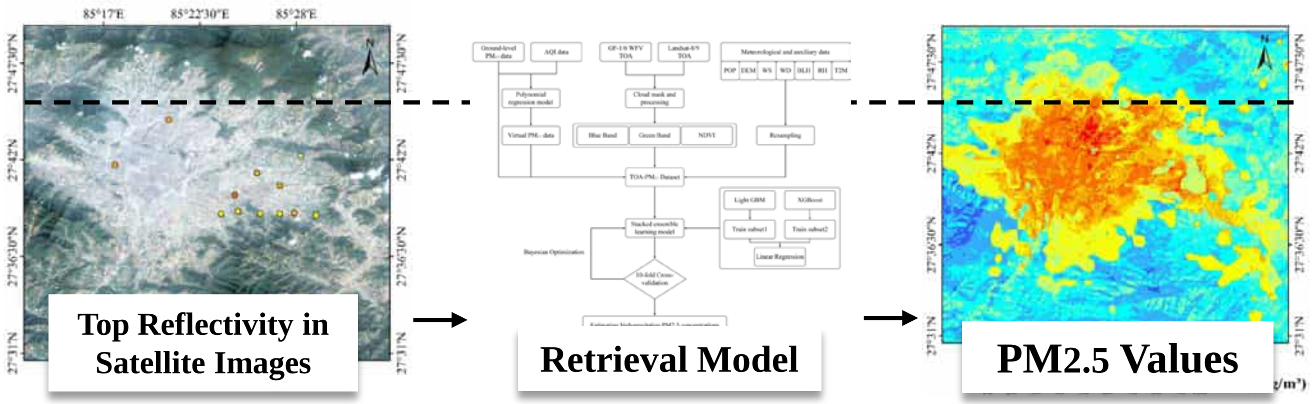
'*DaYu' achieves a correlation coefficient of 0.85 or higher within 6h, enabling high-precision Nowcasting. The correlation coefficient within the 12-hour forecast time limit can reach more than 0.7*. We generally agree that **greater than 0.6** proves a good correlation between the two.

Next Step - Large AI Model driven by Visible Light Products and AQ Forecasting

■ **PM2.5 forecasting for high-value areas of global air pollution based on Visible Satellite Remote Sensing.**



Strong correlation between top reflectivity and PM2.5 distribution



Top Reflectivity - PM2.5 Retrieval Algorithm

Visible Light Product-PM2.5 Forecasting System

Visible Light Satellite Products

↓

Large AI Model for Visible Light Products

↓

PM2.5 Retrieval Model

↓

PM2.5 Forecasting Products

The retrieval algorithm has been identified for PM2.5, that is, to build a retrieval model between the top reflectance image of visible light observed by satellite and the PM2.5 pollution value of ground observations.

FOR THE FIRST TIME IN THE WORLD, A BENCHMARK SET FOR THE APPLICATION EVALUATION OF LARGE MODELS IN THE FIELD OF ECOLOGICAL ENVIRONMENT HAS BEEN ESTABLISHED

Through the Ecological Environment Artificial Intelligence Special Committee, standard question and answer pairs in the environmental field are widely solicited.

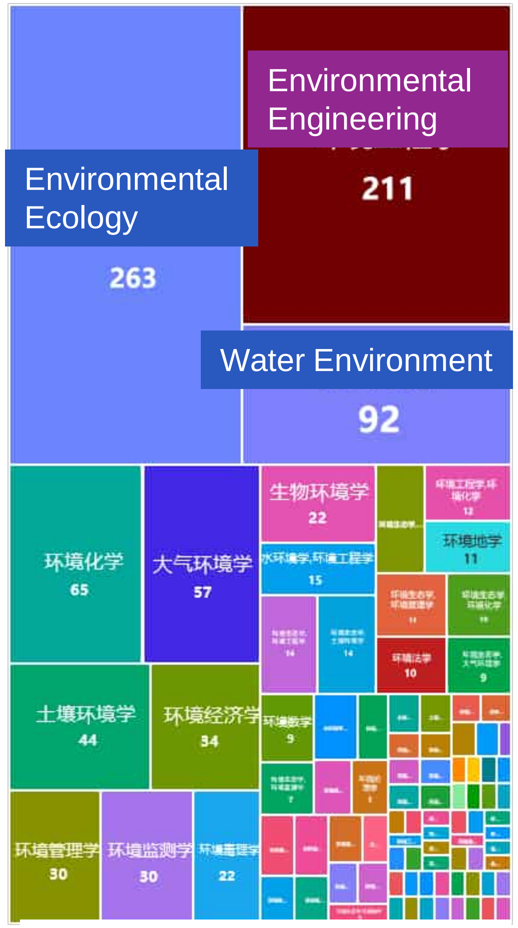
- Version 1.0 has a total of 1,130 question and answer pairs

Ecological environment large model test set

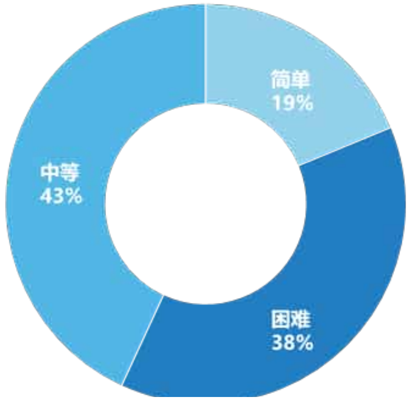
The base test set is released to the whole society on the basis of the voluntary signature of all contributing experts

Release website：https://elle.ceeai.net/

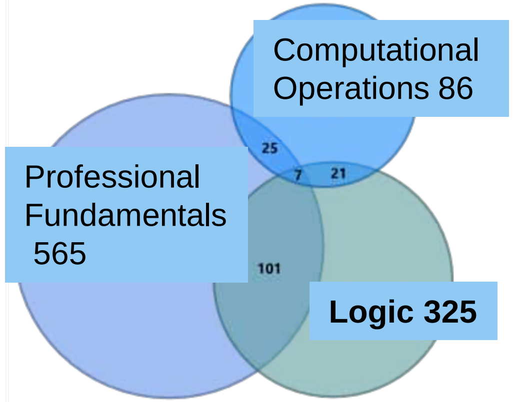
The project is open source through：https://github.com/CEEAI/elle



Discipline distribution



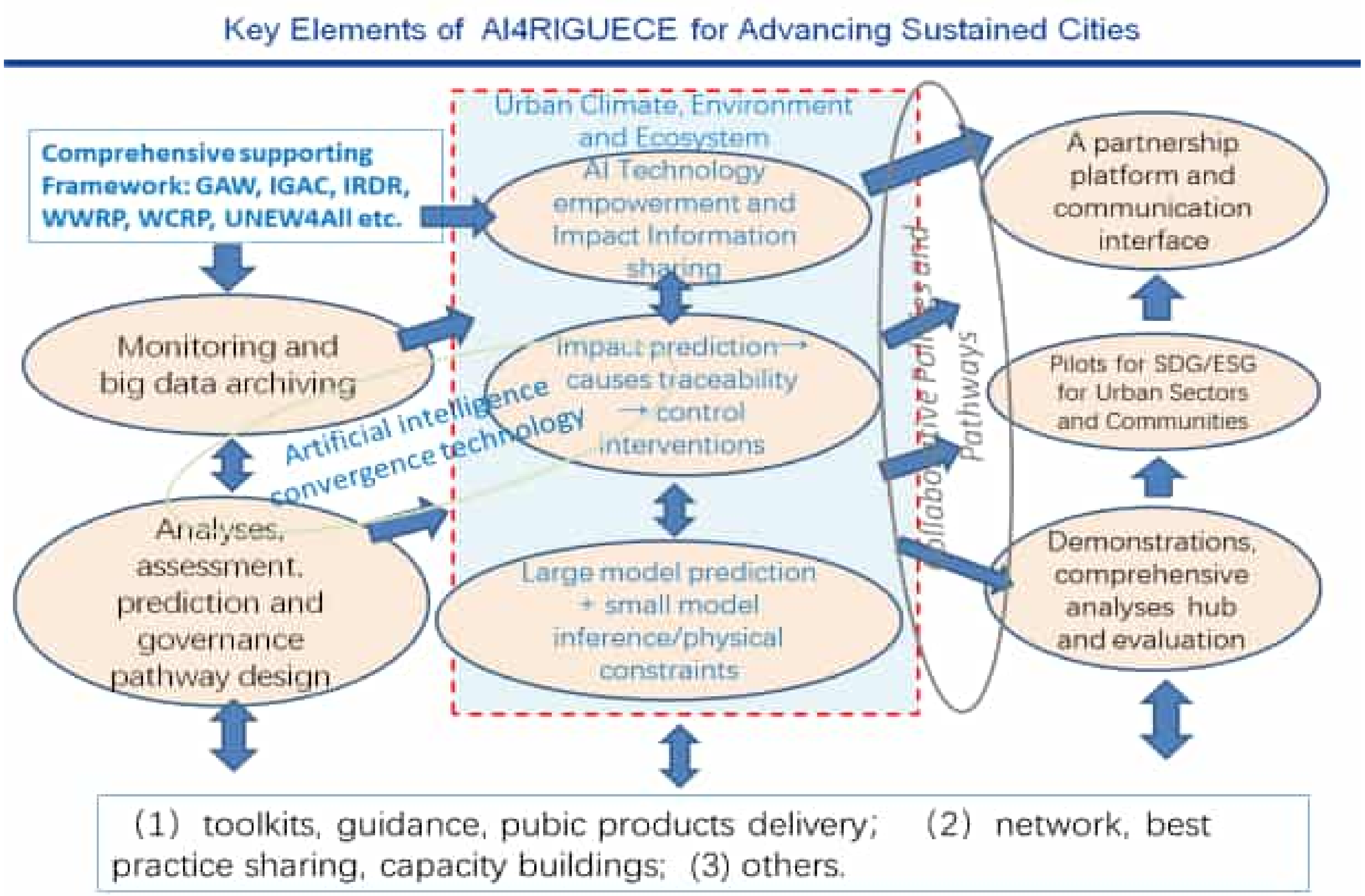
Level difficulty distribution



Type distribution

Part V: Adaptation for Building Climate Resilient and Sustained Cities

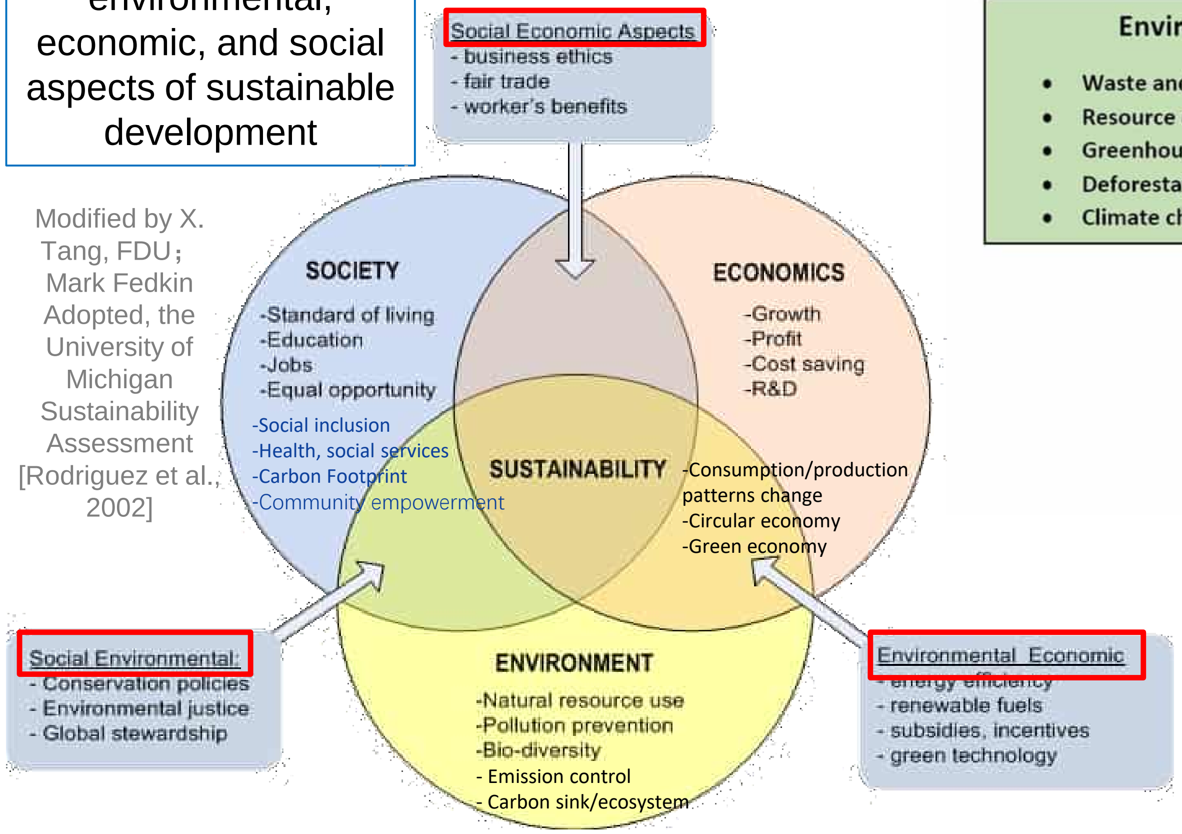
Fig.9. Diagram on key elements of the GAW ARCH/MAP-AQ Initiative: AI4UIAQCE for Advancing Urban SDG/ESG and Sustained Cities



Interplay of environmental, economic, and social factors

Interplay of the environmental, economic, and social aspects of sustainable development

Modified by X. Tang, FDU; Mark Fedkin Adopted, the University of Michigan Sustainability Assessment [Rodriguez et al., 2002]

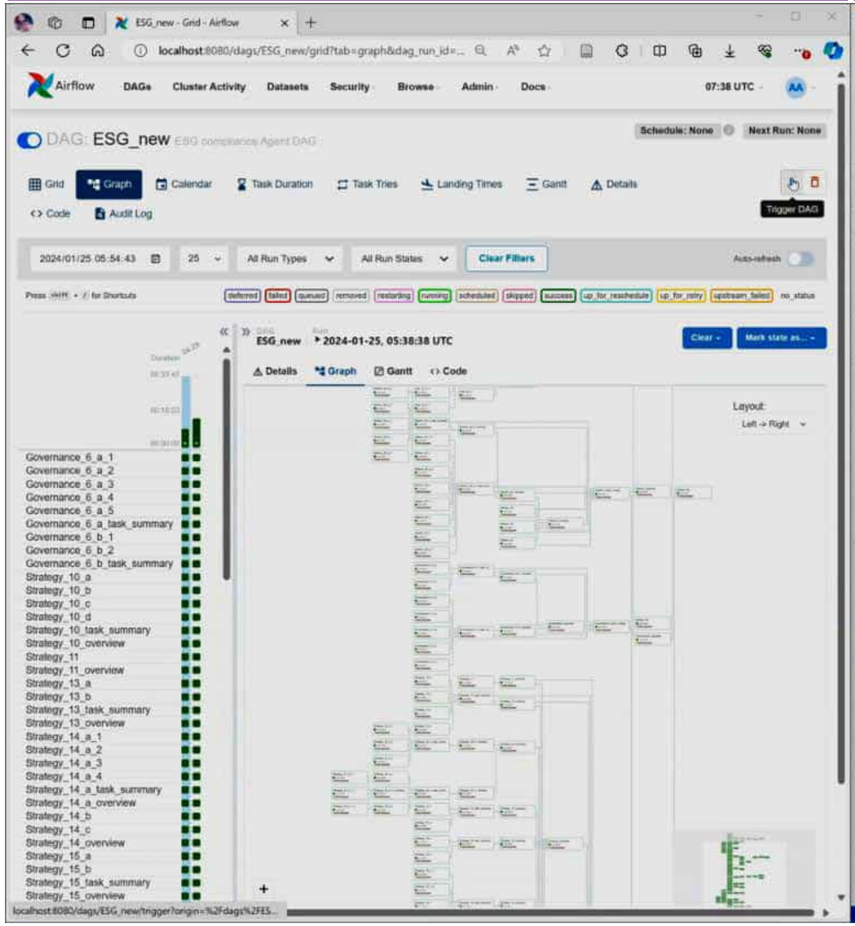


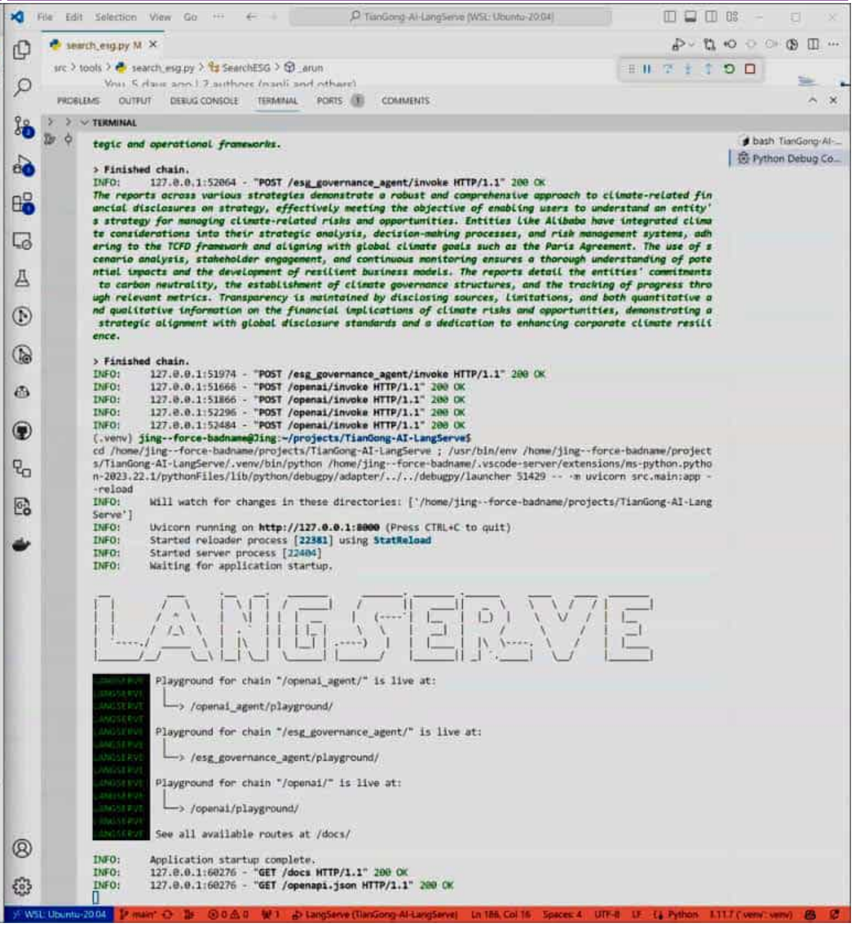
Environmental Social and Governance are the three main factors that socially responsible investors measure when deciding whether to invest in a company. It is a generic term used in capital markets.

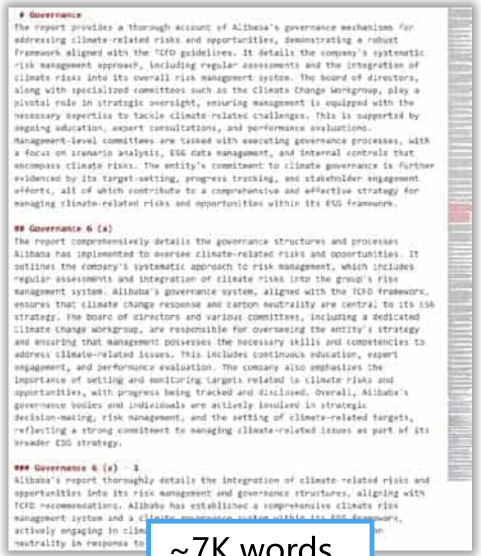
- Science indicates significant links between CC and SD, highlighting the interactions of environmental, social, economic risks and its emergence aspects. Consequently, the core ESG principles serve as a guide for promoting greener and more sustainable investment practices, as well as transforming economic growth, social behavior, and production sectors.
- The big stories of 2023 included the silencing effect of "anti-ESG" movement on many companies; the explosion of clean tech; new reporting laws that are pressuring companies to measure and do more. (Andrew Winston, 2024)

ESG REPORT INFORMATION DISCLOSURE COMPLIANCE EVALUATION

智能体编排	智能体服务运行日志







~7K words

10K+ 字

例：阿里集团2023ESG报告（**219页**）合规性分析，**10~15分钟**生成完整中英文分析报告

Adapting to the Impacts of Climate Change:
A Comparative Study of Climate Governance Processes in Australia, China, and the United States

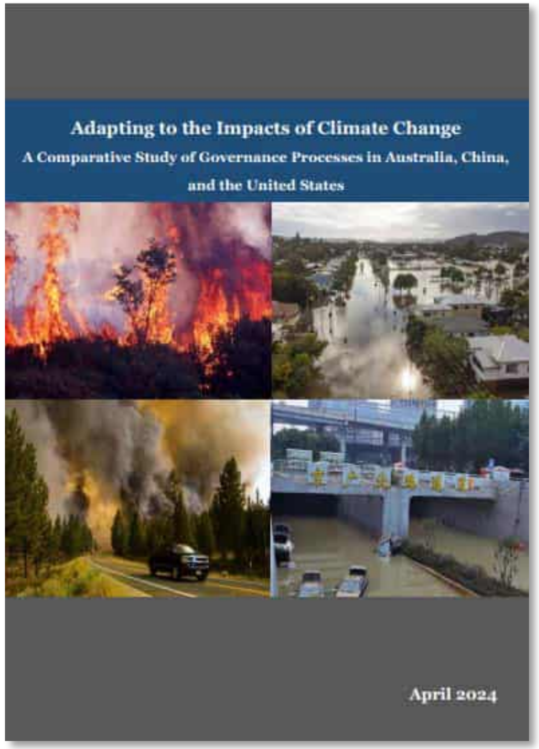
Addressing governance invalidation and challenges of adaptation to climate change; and further identifying clues for improvement in legislation and policy through cases studies.

Devastating Flooding, Zhengzhou, 20 July 2021

Europe's deadly floods, July 2021

The remnants of Hurricane Ida inundated New York City, exposing the city's weaknesses in defending itself against the more intense storms caused by climate change. Sept. 4 2021

Australian Bushfires/Heat/dry Waves, 12/2019-01/2020



Adapting to the Impacts of Climate Change

A Comparative Study of Governance Processes in

Australia, China, and the United States

Authors

Climate adaptation calls for transformation of core governance structures, tools and resources. Adaptation requires governance to response impacts of climate change. Adaptation is locally focused, requiring levels of data and analysis not now available and consideration of complex interactions among many human and natural systems, and local capacity to use data and analyses. This report seeks to set a framework for use by practitioners and scholars for learning from country efforts to reduce adaptation governance deficits.

https://napawash.org/standing-panel-blog/adapting-to-the-impacts-of-climate-change-a-comparative-study-of-governance-processes-in-australia-china-and-the-united-states

Methodology and Approach for the Comparative Study of Governance Processes in Australia, China, and US

- Learning from Comparison: Points of Entry as a Framework to Begin With

In relation to environmental challenges, for example, the U.S. and Australia are "law centric." China today has many environmental laws, but policies, such as Five-Year Plans and sectoral plans, and crisis management are dominant governance processes. In this context, we have proceeded by identifying Points of Entry for Comparison of efforts of governance systems to address the challenges of climate adaptation.

- Point of Entry 1 deals with core common governance tools - risk analysis and planning based on the analyses. While there are substantial differences among the three systems in these terms, we find serious limitations in efforts to make use of risk analysis and planning procedures in all three countries.

- Point of Entry 2 focuses on organizational arrangements. They are all limited by common perspectives and practices associated with emergency management or disaster relief. We conclude that in all three systems there is a need for fundamental innovation to achieve success in adapting to the impacts of climate change.

Methodology and Approach for the Comparative Study of Governance Processes in Australia, China, and US

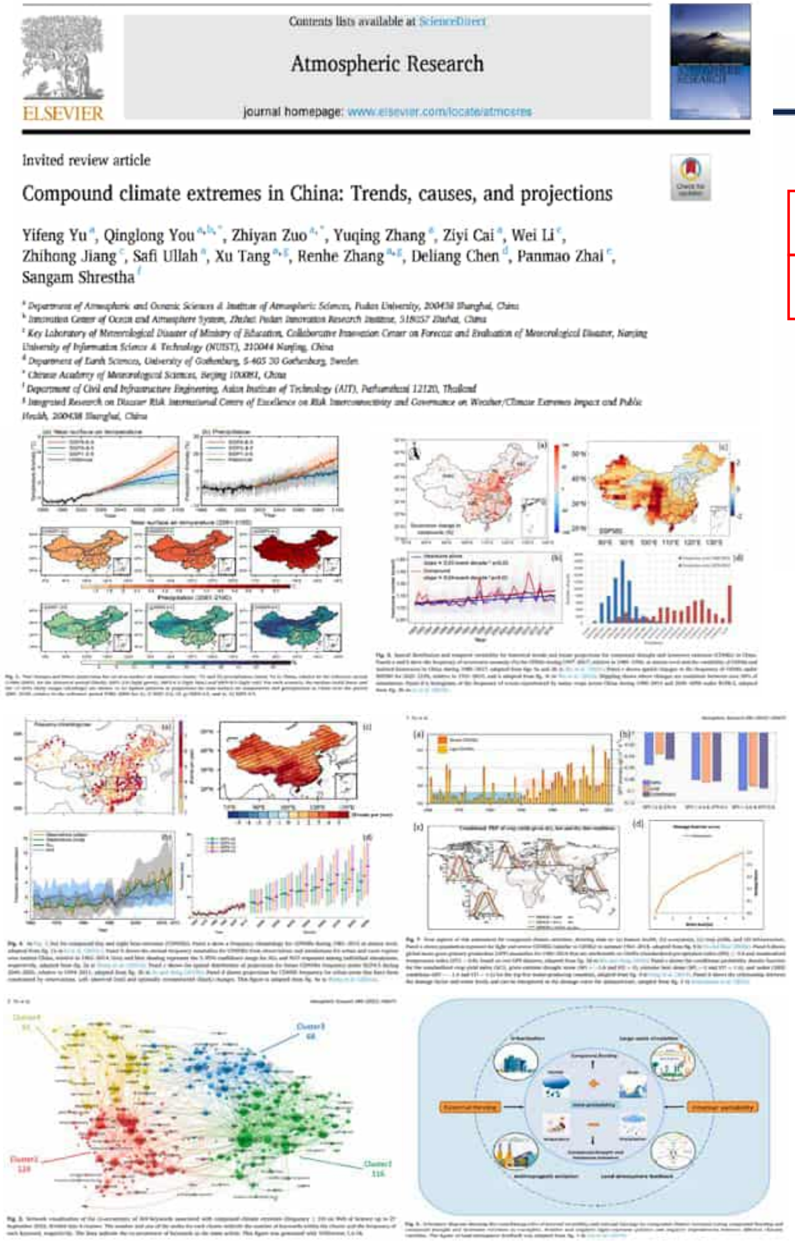
- Point of Entry 3 explores strategies that governance systems can adopt to improve the effectiveness of their efforts to address the impacts of climate change. In considering options for Australia, China, and the U.S., we consider four types of response strategies:

(1) adjusting center/local relations to address climate impacts,
(2) transforming cross-jurisdictional arrangements to address climate impacts,
(3) guiding or cushioning major demographic and economic shifts, and
(4) enhancing capacity to prepare for and respond to disaster.

3 sets of priorities for the next phase of our work:

(1) in-depth case studies of response strategies (e.g., efforts to address jurisdictional impediments limiting efforts to deal with flooding or the allocation of water),
(2) crosscutting analyses of tools, resources, and processes (e.g., initiatives to overcome the limitations of risk analysis in addressing climate adaptation), and
(3) deepening the framework by engaging more countries and colleagues (e.g., extensions to include efforts to address climate adaptation in developing regions).

Trends, mechanisms and projections of extreme climate compounds in China, *Atmospheric Research, 2023*


Contents lists available at ScienceDirect

Atmospheric Research

journal homepage: www.elsevier.com/locate/atmosres

Invited review article

Compound climate extremes in China: Trends, causes, and projections

Yifeng Yu, Qinglong You, Zhiyan Zuo, Yuqing Zhang, Ziyi Cai, Wei Li, Zhihong Jiang, Safi Ullah, Xu Tang, Renhe Zhang, Deliang Chen, Panmao Zhai, Sangam Shrestha

In the face of the new normal of extreme weather, it is urgent to coordinate global climate change adaptation and disaster reduction

Springer Link

Short Article | Open Access | Published: 09 February 2023

Resilience Building and Collaborative Governance for Climate Change Adaptation in Response to a New State of More Frequent and Intense Extreme Weather Events

Huiling Ouyang, Xu Tang, Renhe Zhang, Alexander Baklanov, Guy Brasseur, Rajesh Kumar, Qunli Han & Yong Luo

International Journal of Disaster Risk Science (2023) | Cite this article

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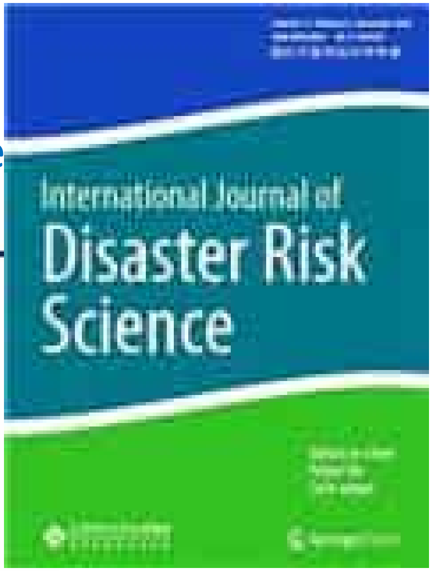
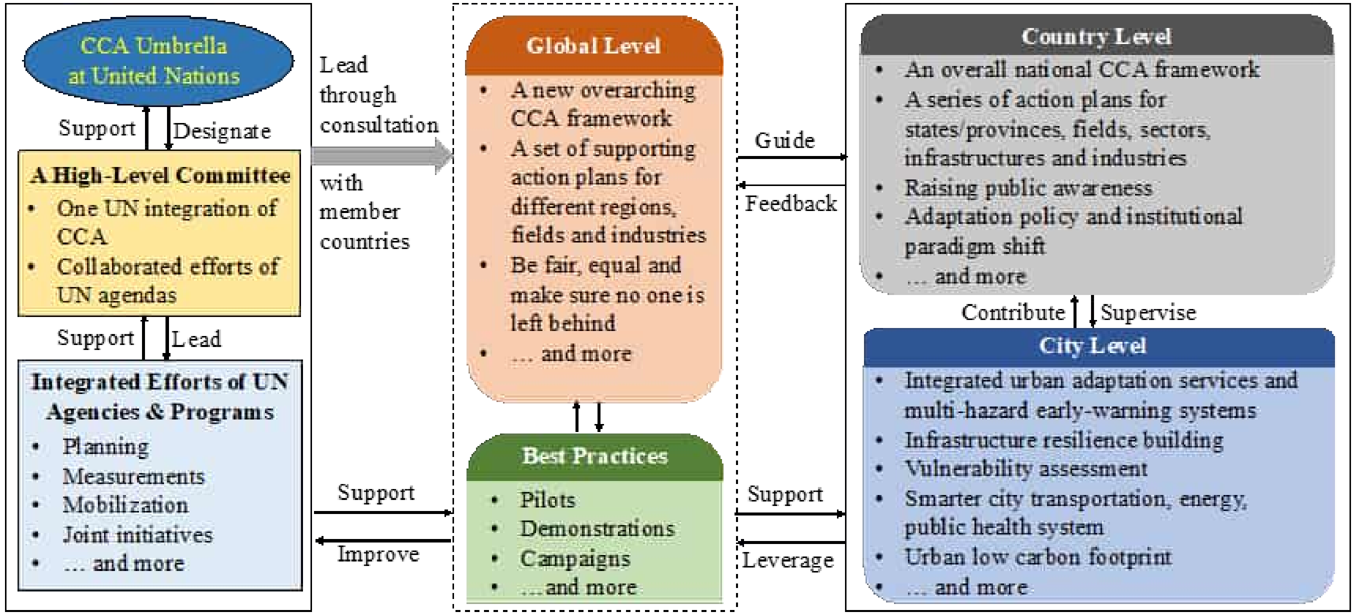


IJDRS, 2023



Part VI: Building a reciprocity structured consortium for sustained Research Infrastructure

Major Achievements， Challenges & Oppertunity

Engaging international stakeholders

- Strengthening global collaboration and engagement
- High user interest from other world regions
- Jointly operated international facilities but not cost recovery by local stakeholders
- Need for structured international access frameworks to create mutual opportunities
- Outside Europe, appropriate programmes on RI level are lacking
- **Increased efforts made: initiatives engaged with Chinese partners, example of CARGO-ACT with US partners**
- Need for a reciprocity-based structured access scheme

极端天气气候与健康风险互联和治理国际卓越中心
IRDR ICoE Risk Interconnectivity and Governance on Weather/Climate Extremes Impact and Public Health (RIG-WECEIPHE)

IRDR UNDRR International Science Council

Looking forward to strengthening our collaborations

Thank You

空气质量监测分析预测(MAP-AQ)
国际计划亚洲区域办公室

International Initiative on Monitoring, Analysis and Prediction of Air Quality (MAP-AQ) Asian Office Shanghai

MAP-AQ is endorsed by WMO GAW + IGAC

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GLOBAL ATMOSPHERE WATCH

MAP-AQ 亚洲区域办公室
ASIAN OFFICE SHANGHAI
Monitoring, Analysis, and Prediction of Air Quality