

AISUS+ Initiative

AI-Empowered Climate & AQ System for Urban Sustainability and Climate Resilience

PEEX Online Seminar | International Collaboration Update
9 April 2026 | Xu Tang, Fudan University

- scientific framing and progress
- city laboratories and science-to-services
- international collaboration and next steps



Why AISUS+ now?

Urban sustainability challenges increasingly require linked climate–air quality–risk intelligence and international cooperation.

- Cities are where climate change, air pollution, energy stress, ecosystem pressure and public-health exposure interact most directly.
- PEEEX is an ideal forum because it connects climate change, air quality, environmental research and research infrastructures across the Pan-Eurasian region.
- AISUS+ responds by building an AI-empowered urban research-to-services pathway, with strong emphasis on implementation and collaboration.

WMO-relevant urban logic

Advances WMO GAW Science to Services through Urban Test Base by integrating air quality, climate and AI for actionable city decision support..

PEEX seminar context

The seminar aims include sharing research results, discussing future collaboration on climate change and air quality, and improving the PEEEX COST Action proposal.

UNEP-relevant urban logic

UNEP highlights integrated urban solutions, clean air action and digitalization for sustainability. AISUS+ can become a practical bridge across these agendas.

IPCC-SR-Climate Change and Cities relevant urban logic

Aligns with the emerging IPCC Cities agenda by demonstrating practical urban climate-risk and resilience solutions before 2027.

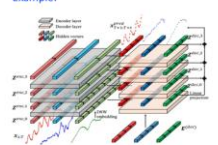
AISUS+ framework

An implementation-oriented framework, not only a concept.

2. Enable Model Interoperability

- Use a **shared latent representation or embedding space** to align data types (like LMMs do for text + image)
- Leverage **transformer architectures or graph neural networks (GNNs)** for learning cross-domain relationships.
- Use **standardized data formats**
- Develop **modular, plug-and-play architectures**
- Implement **resampling or aggregation techniques** to align model resolutions.

Example:




Architecture of the Hierarchical Encoder-Decoder in Crossformer with 3 encoder beams. (Crossformer: transformer utilizing cross-dimension dependency for multivariate time series forecasting. In The Eleventh International Conference on Learning Representations (ICLR), 2023).

1. Integration of AI Foundation Models: LMMs

B). Training new Large Multi-Modal Model with all data stream

- Integration = Multi-modal + Multi-scale modeling**
- Integrated diverse data streams (text, image, video, audio)**
- Large Multi-Modal Models (LMMs) as a path forward**



Multi-modal

Multi-source multi-modal data:

Meteorological & Climate data:

- ECMWF ERA5, CMR2, ECMWF WRES etc.
- Medusa:** a multi-purpose dataset for data-driven wildfire modeling in the Mediterranean. In *Advances in Neural Information Processing Systems* (2024).
- WeatherBench 2:** a benchmark for the next generation of data-driven global weather models. *J. Adv. Modeling Earth Syst.* **16**, e2023MS004019 (2024).
- Caspan:** a global community dataset for large-sample hydrology. *Sci. Data* **10**, 61 (2023).

Citizen & Geospatial data:

- EO, IoT
- Publicly funded data from earth observation, satellites and radar: Landat, VIIRS, Sentinel-1/2/5, MODIS, DMI
- Geo-bench:** toward foundation models for earth monitoring. In *Advances in Neural Information Processing Systems* (2024).

Socioeconomic data:

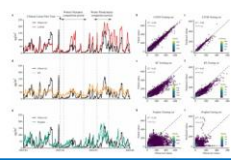
- WorldPop (PMU) (Demographic and Health Surveys) (World Bank Open Data).
- High resolution global gridded data for use in population studies. *Sci. Data* **4**, 1–17 (2017).

The feasibility of AI models depends on the availability and harmonization of key datasets

4. Build feedback loops for decision-making

- Use **reinforcement learning or counterfactual simulation** to evaluate decisions (e.g., "what if no emergency control measures were enacted to mitigate haze?")
- Incorporate **community data** (e.g., surveys, social media, policymaker's comments and feedback) into models
- Enable **adaptive learning over time**

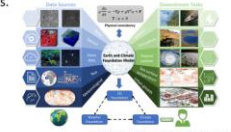
Counterfactual scenario data



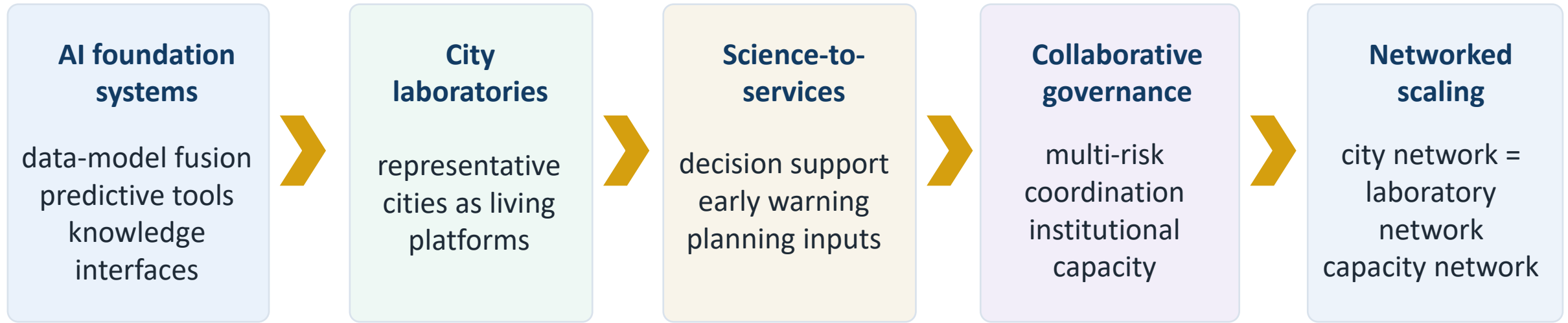
An illustrative case is a city-level intervention, Beijing 2022 Winter Olympics—Counterfactual PM_{2.5} concentrations, were first predicted using a Random Forest Long Short-Term Memory (RF-LSTM) hybrid model.

5. Ensure System-Level Integration

- Align with **Sustainable Development Goals (SDGs)** or **urban planning frameworks** (e.g., sponge cities)
- Promote open standards and model APIs for **modular architecture**
- Support **governance frameworks** that involve public institutions and local communities.



Zhu et al., On the Foundations of Earth and Climate Foundation Models, preprint, 2024, arXiv:2409.20033v1 [cs.LG]



Two strategic transitions

- from city laboratories as research platforms to actual capacities for collaborative urban governance
- from science outputs to service-oriented applications and practical urban solutions

Main research and implementation tasks

What AISUS+ is actually trying to do.

Scientific and technical tasks

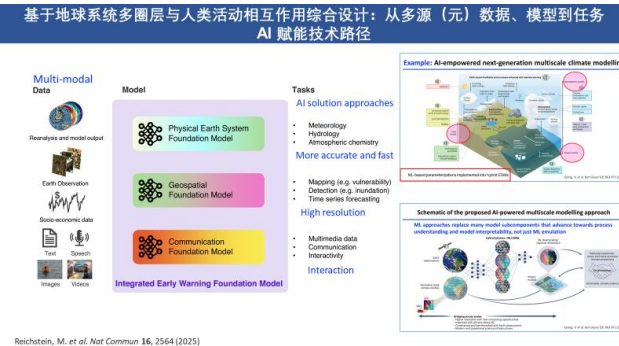
- **Develop AI-enabled foundation systems** for urban climate, air quality and environment applications.
- **Identify low-hanging fruits** that can produce early, visible and policy-relevant outcomes.
- **Use representative cities** as living laboratories for integrated experiments and validation.

Implementation and collaboration tasks

- **Build a city network** as a laboratory network for comparative learning and transferability.
- **Translate science outputs into services:** diagnostics, decision support, early warning and planning support.
- **Strengthen practical capacities** for multi-risk interconnectivity governance and collaborative action.

Progress so far

Early achievements already show a workable design.



- **A coherent AISUS+ architecture** has been formed, linking AI, urban sustainability, climate resilience, air quality and governance-oriented applications.
- **A series of AI foundation-system and prototype-oriented efforts** has been initiated.
- **A low-hanging-fruits strategy** has been used to generate early demonstrators and practical value.
- **An emerging network of pilot and partner cities** is being built, shifting AISUS+ from concept to operational platform.

International collaboration logic

Why AISUS+ fits well in PEEEX and other transnational networks.



Empower the Public
with Personalised
Air Quality Information



- **PEEX already provides a strong trans-Eurasian platform** for climate change, air quality, environmental research and research infrastructures.
- **AISUS+ can contribute a city-facing collaboration model:** linked observations, AI-enabled analysis, pilot laboratories and research-to-services pathways.
- **This creates room** for joint science, shared methodologies, comparative city studies, capacity building and future project development.

Potential collaboration nodes

- **AI-enabled urban** climate and air-quality **modelling**
- sensor and observation integration
- **city comparison** across regions
- **research infrastructures and digital platforms**
- **joint pilots** and student / expert exchange

Message to partners and next steps

Toward a practical international platform for AI-enabled urban sustainability.

What AISUS+ can offer now

- **a structured framework** for AI-enabled climate & AQ research-to-services
- **city laboratories** for testing integrated approaches
- **an emerging international collaboration platform**
- **a practical bridge** from science to services and governance capacity

Possible next steps with partners

- **co-design** pilot city activities
- **link** modelling and observation communities
- develop **shared methods and demonstrators**
- build toward **coordinated projects and networks**

Xu Tang | Fudan University | tangxu@fudan.edu.cn



MAX-PLANCK-INSTITUT FÜR METEOROLOGIE



谢谢支持!
Thanks for your support

tangxu@fudan.edu.cn



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



復旦大學 IRDR 國際卓越中心
IRDR ICoE-RIG-WECEIPHE
FUDAN UNIVERSITY



Pan-Eurasian Experiment

PEEX