



Establishment of a Next-Generation Monitoring and Assessment System for Air Pollution in East Asia

Hiroyuki Sase

Head of Ecological Impact Research
Department

**Asia Center for Air Pollution
Research (ACAP)**

Next-Generation Monitoring and Assessment System for Air Pollution

Hiroyuki SASE and Toshimasa OHARA

Asia Center for Air Pollution Research

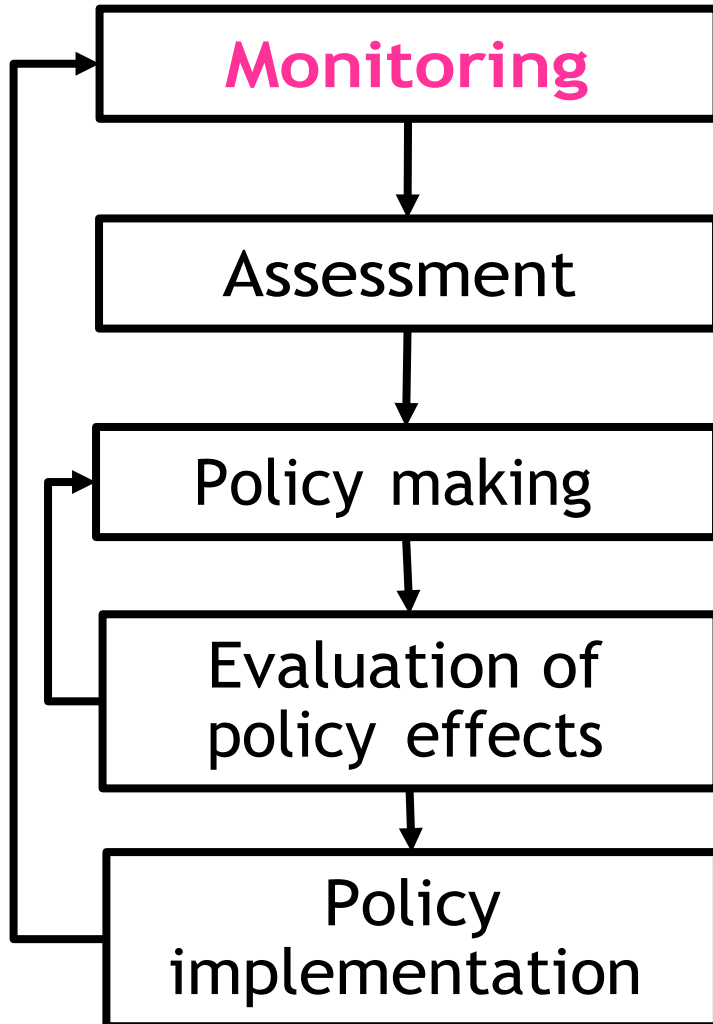


Introduction

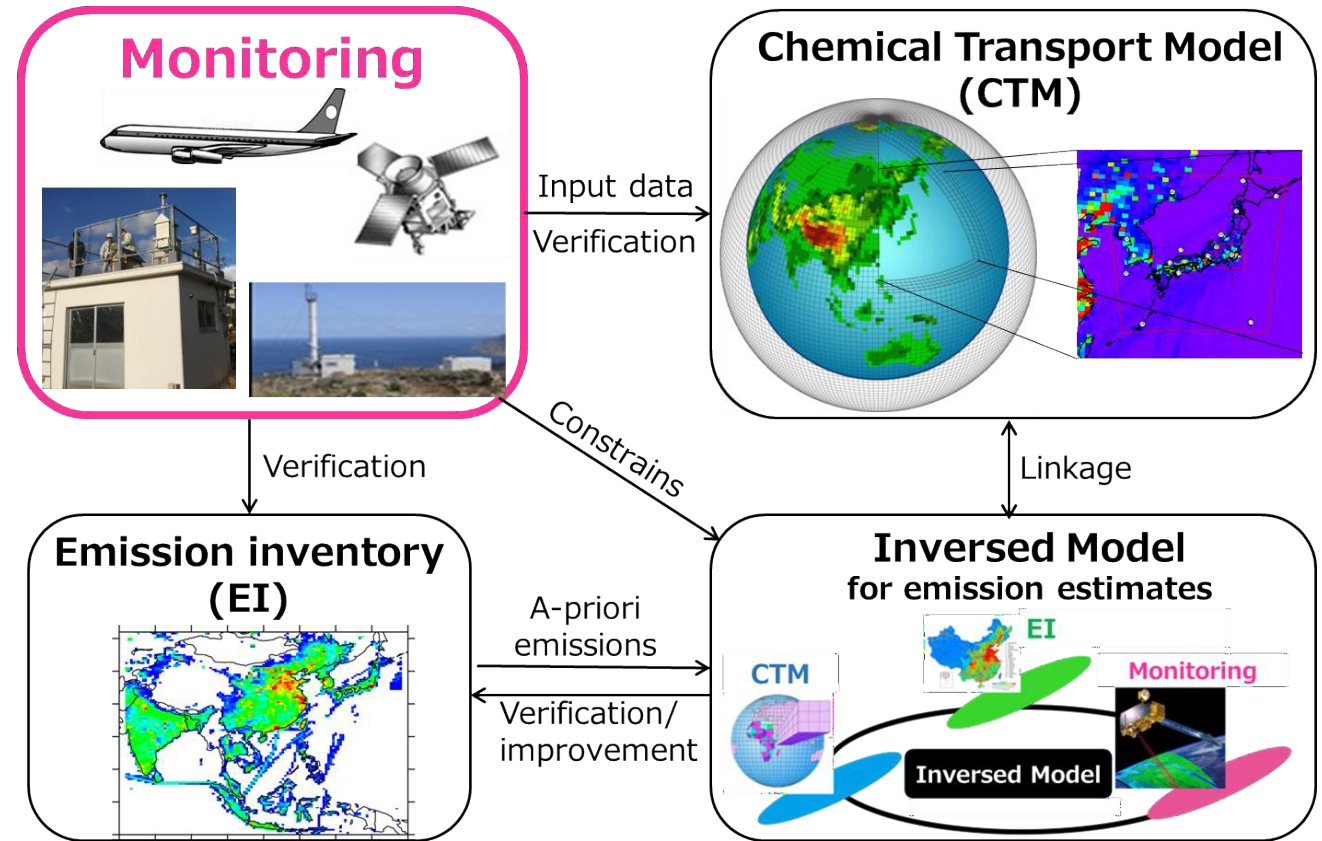
- Air pollution, including ozone and PM2.5, remains a significant threat to human health and ecosystems.
- These pollutants are directly or indirectly linked to global environmental challenges, particularly climate change.
- Therefore, well-structured monitoring and assessment systems are essential for comprehensively understanding the current situation and evaluating future risks.
- Currently, in addition to conventional monitoring instruments, emerging technologies, such as satellite observations and low-cost sensors (LCS), offer new opportunities to obtain spatiotemporally diverse data.
- This presentation introduces the concept of a next-generation monitoring and assessment system for air pollution.

Air pollution management system

Flowchart



System tools



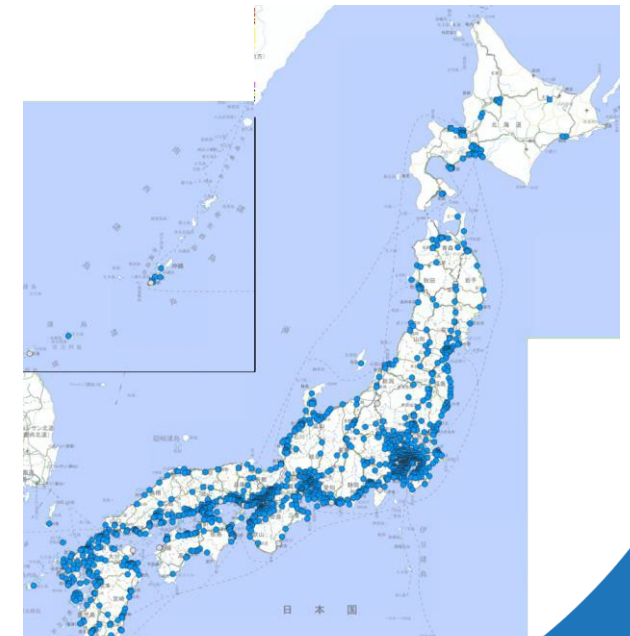
Elucidation of pollution structures, estimation of emissions, assessment, policy evaluation, future projections etc.

Limitation of ground monitoring stations

- Air pollution monitoring has been conducted for various media, including gases, particles, and rainwater.
- To obtain continuous, high-time-resolution (hourly) data for gaseous and particulate matter, conventional automatic monitors installed in an air-quality monitoring station are required.
- In addition to the initial costs of setting up such stations, these monitors also require regular maintenance, including calibration.
- Therefore, it is challenging to increase the number of monitoring stations and even to maintain the existing ones.



Kameda Station, Niigata City

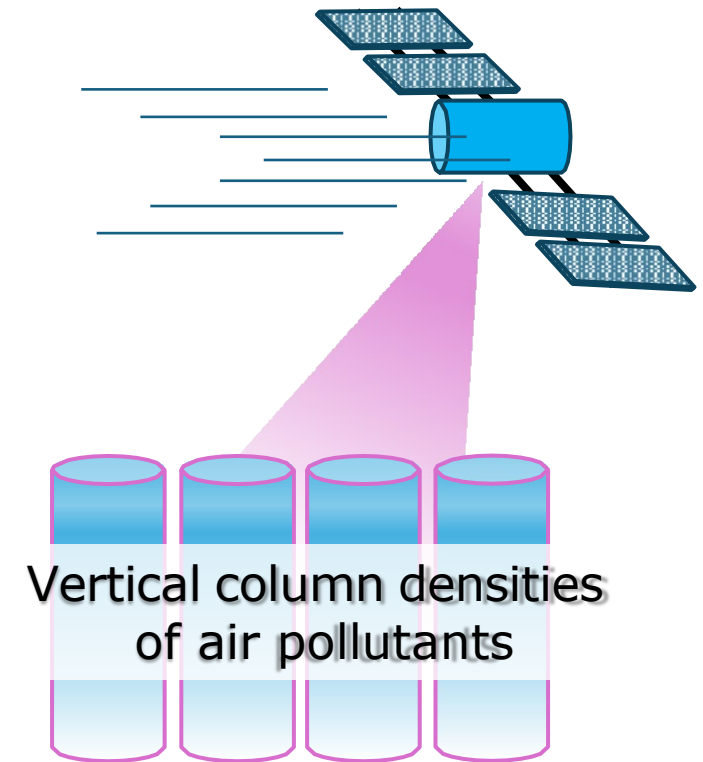


Distribution of Monitoring Stations across Japan (e.g., SPM)

New technologies for updating monitoring (1)

Satellite observation

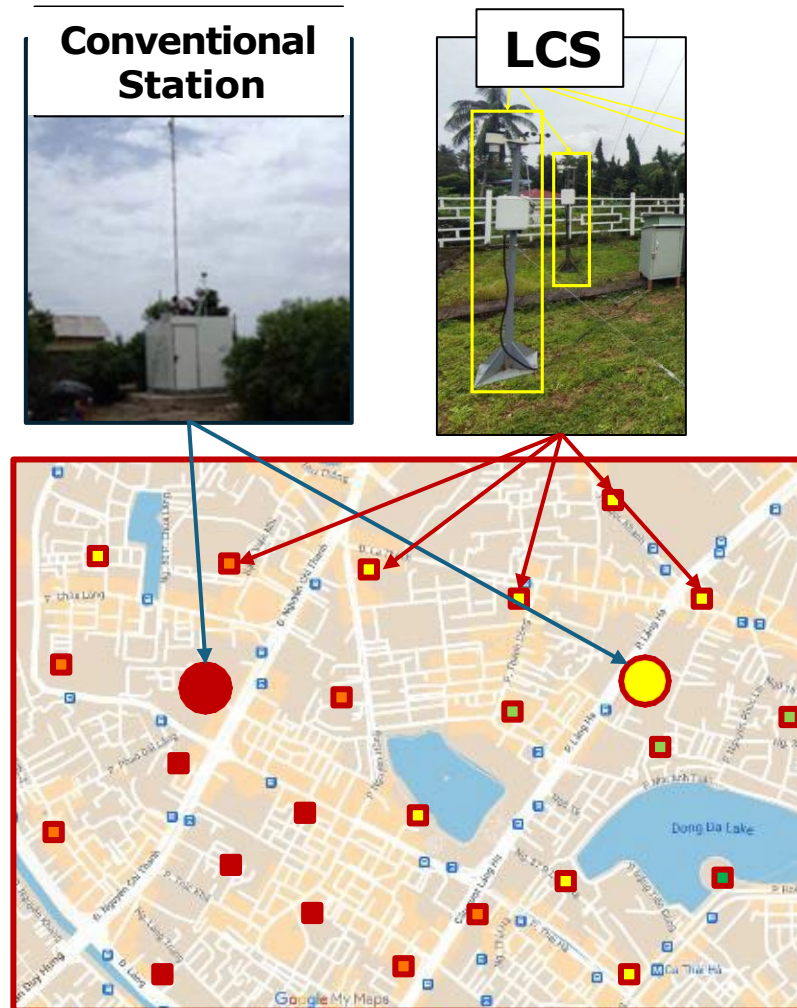
- ✓ Provides wide-area data (unlike point measurements from conventional monitoring stations)
- ✓ Enables global coverage in a few days (e.g., within three days for the satellite GOSAT-GW, Japan)
- ✓ Useful for understanding the current situation over broad regions, including rural and remote areas such as agricultural and forested regions



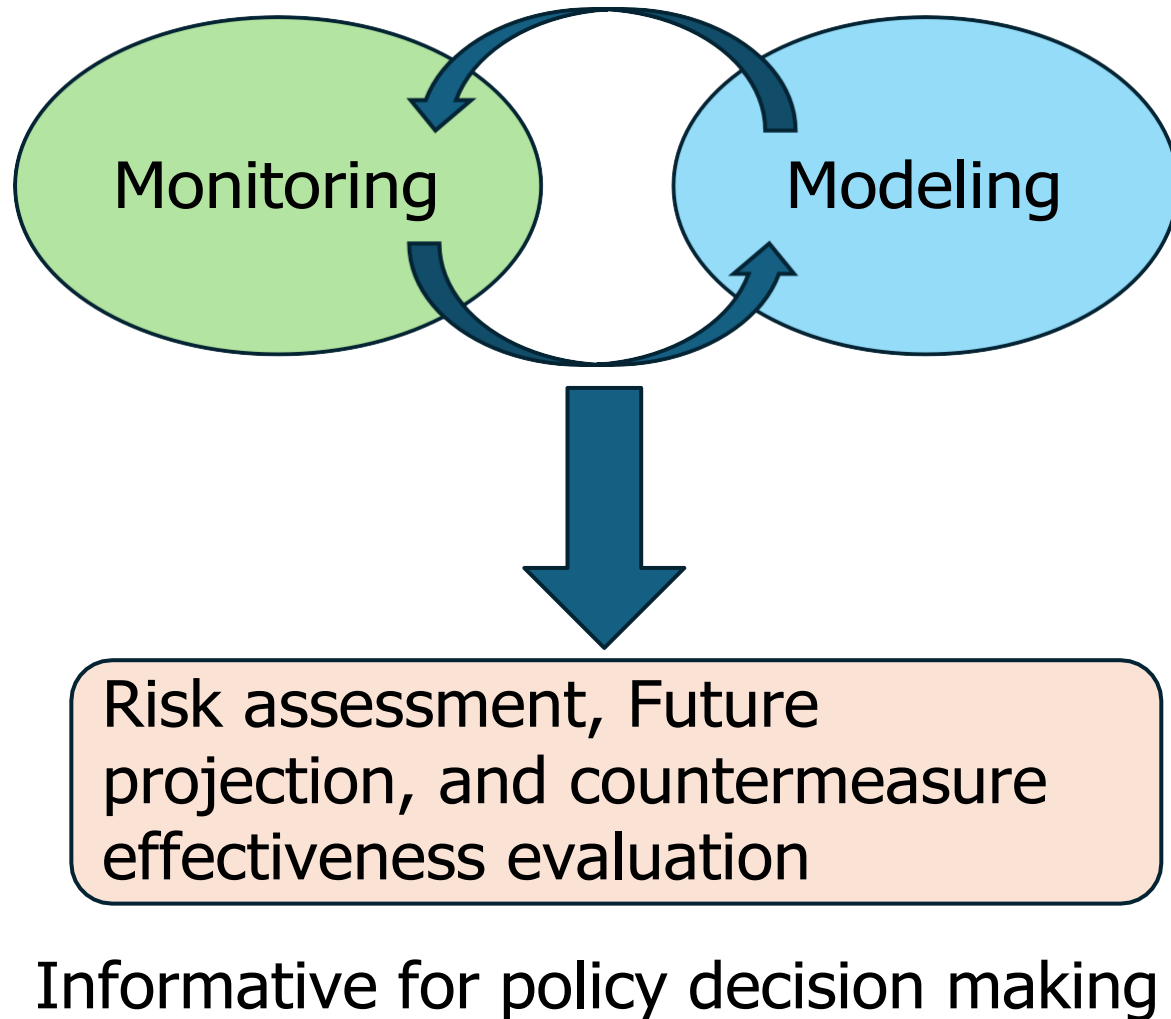
New technologies for updating monitoring (2) ¹¹

Low-cost sensors (LCS)

- ✓ Small devices, easy to install and add new monitoring points
- ✓ Relatively low cost and can operate for several years without regular maintenance
- ✓ Useful for detailed understanding of concentration distributions within urban areas, in combination with conventional monitoring stations
- ✓ Also useful for understanding areas that have not been monitored so far, such as agricultural and forested regions



Linkage between Monitoring and Modeling

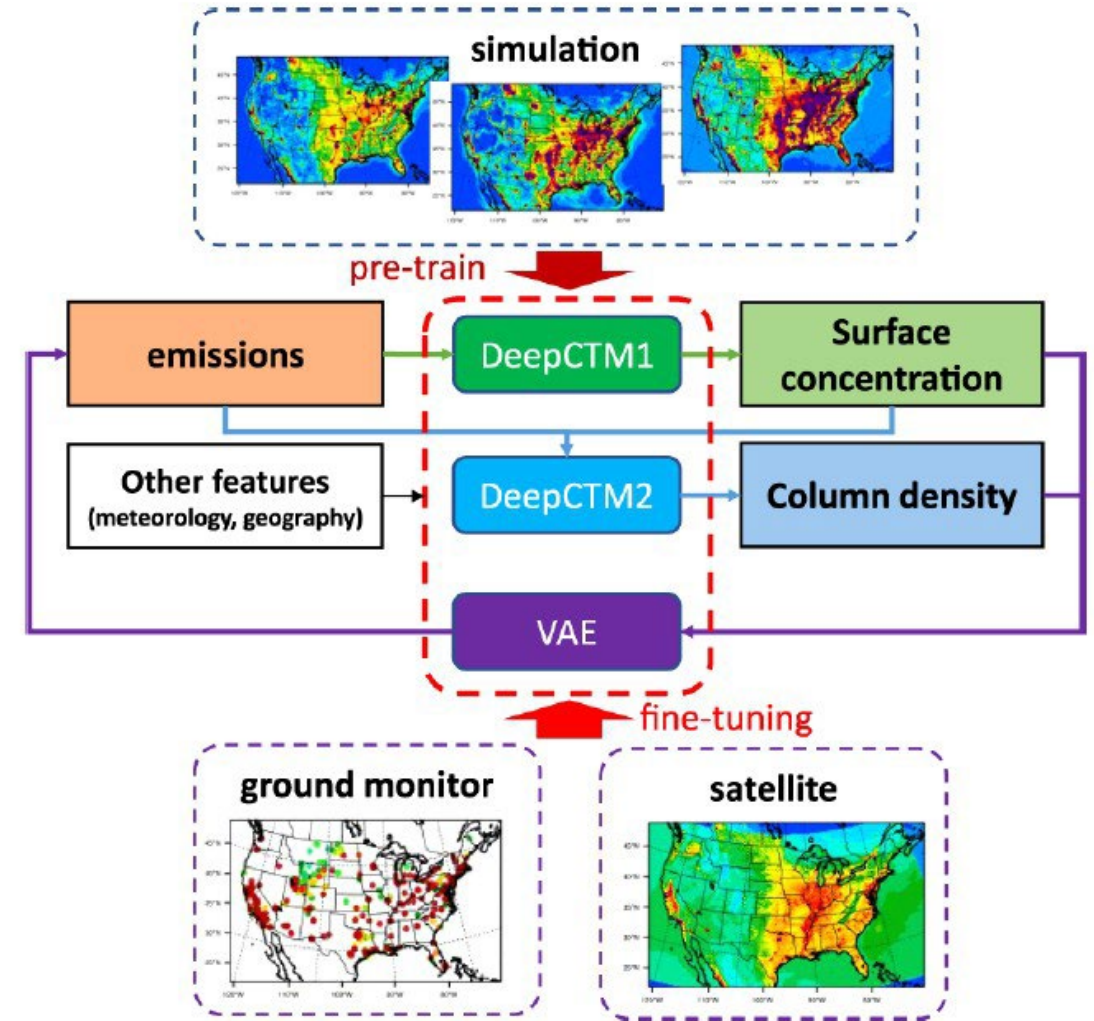


- Enables the integration of spatiotemporally diverse data produced by different monitoring approaches
(including different time resolutions, frequencies, and spatial scales from the city level to the regional level)
- Essential for providing useful information for policy decision-making

Measurement-Model Fusion (MMF)

Enables the integration of simulation modeling with monitoring data, including ground-based measurements, sensing data, and satellite observations

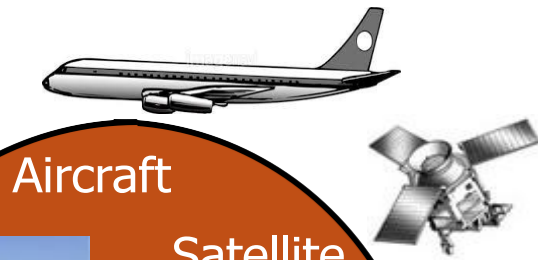
Has been developed in combination with deep learning techniques (e.g., Xing et al. 2024)



Deep-learning fusion method proposed by Xing et al. (2024, EST)

MMF-Based Mapping of Nitrogen Deposition at the East Asian Scale

Measurement



Aircraft

Satellite



Ground-based stations



Chemical transport model

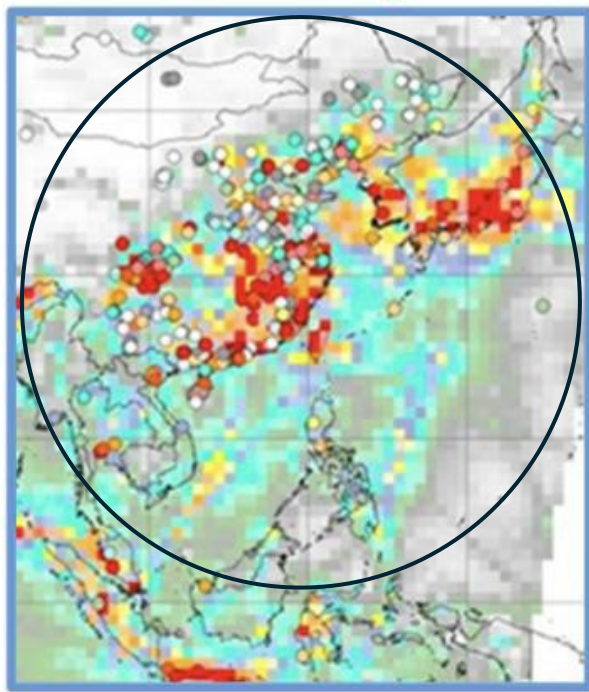
Emission inventory

Met. model

Model

Data fusion (with AI)

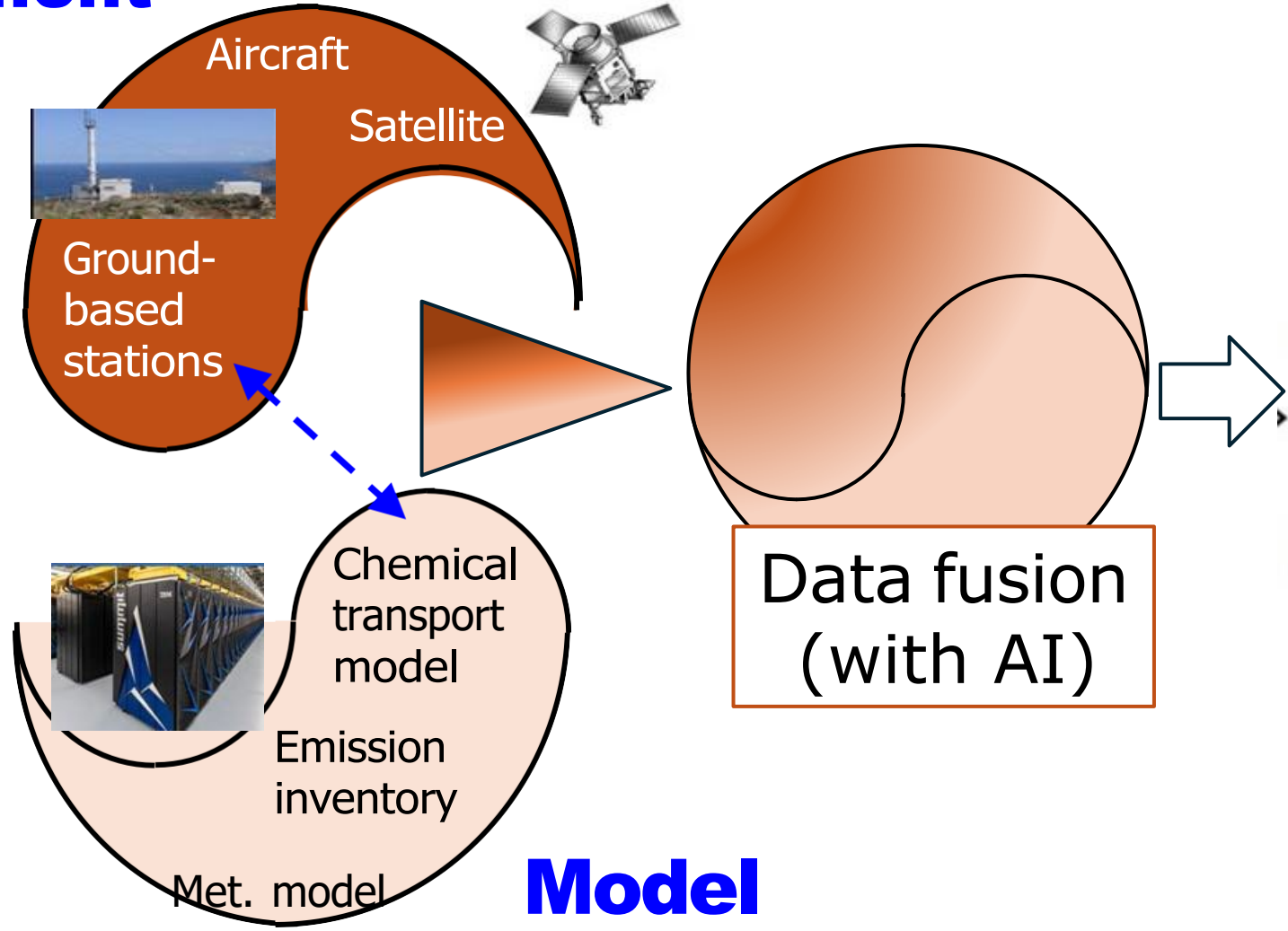
Deposition Map Covering East Asia



Fu et al. 2022

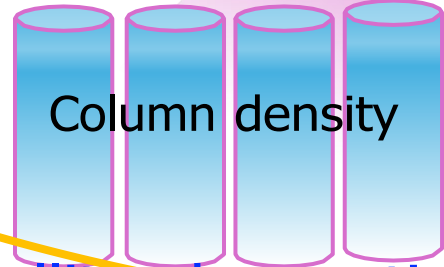
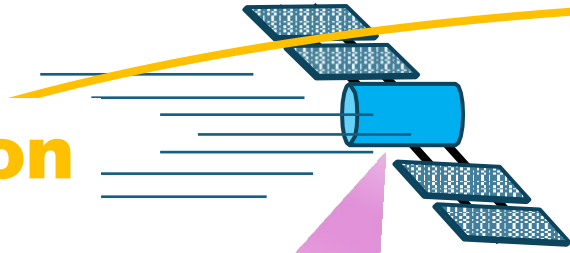


EANET sites

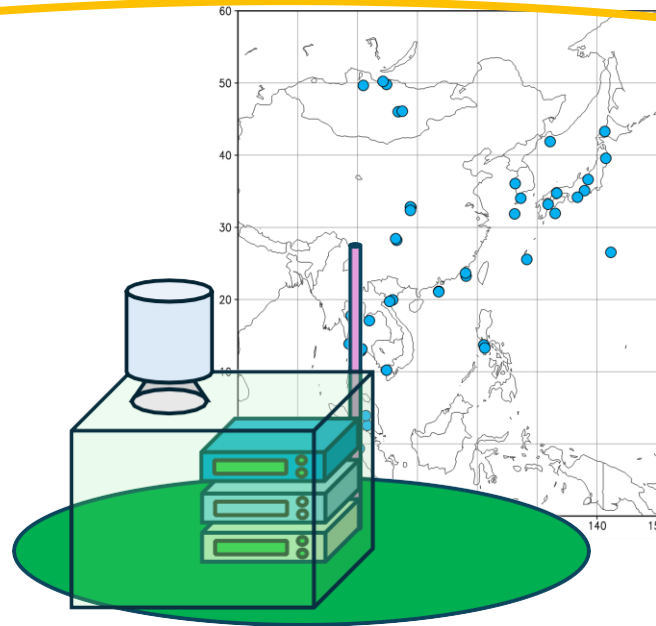


Next-Generation Monitoring and Assessment System for Air Pollution in East Asia

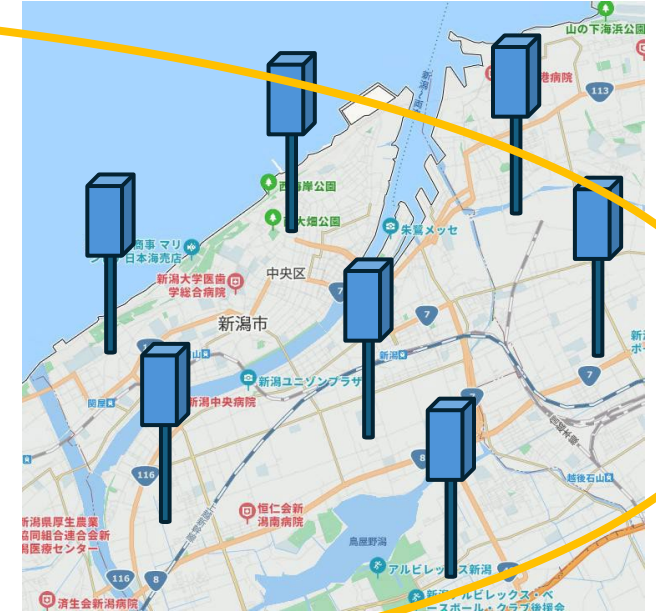
Integration



Satellite observation



Ground observation



Low-cost sensors

Data properties

Wide area

Long-term/Multiple substances simultaneously

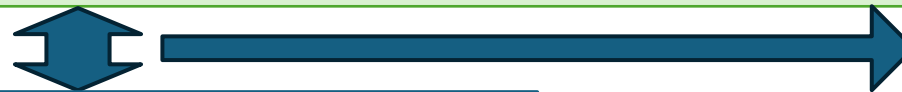
Multipoint

Usage

Understanding the current situation over broad regions

Trend analysis/Mechanism elucidation

Detailed understanding of concentration distributions



Emission inventory, Chemical transport model, Inversed model, Impact assessment model



AI

Risk assessment, future projection, and countermeasure effectiveness evaluation

Concluding remarks

- Air pollution remains a significant threat for human health and the global environment.
- Emerging technologies, such as satellite observations and LCS, offer new opportunities to obtain spatiotemporally diverse data (including different time resolutions, frequencies, and spatial scales from the city level to the regional level).
- Linkage between monitoring and modeling, such as the model-measurement fusion approach and inversed modeling, is essential for providing useful information for policy decision-making.
- Such a next-generation monitoring and assessment system for air pollution should be developed, especially in East Asia.



BAQ 2026

BETTER AIR QUALITY
CONFERENCE 11-13 MAR • BANGKOK



Thank you for listening!

