Tropospheric Ozone Assessment Report Phase II (TOAR II)
East Asia Focus Working Group (EAWG)
Kick-off meeting (virtual)

May 13, 2021

Agenda

1. Introduction of TOAR and EAWG (Lin Zhang, Peking University; Xiao Lu, Sun Yat-sen University)
2. Introduction of EAO3 database (Ke Li, Harvard; Ja-Ho Koo, Yonsei University)
3. Introduction of EAWG modeling activity (Xiao Lu; Tatsuya Nagashima, NIES)
4. Introduction of EAWG members (EAWG members)
5. Open discussion

1.Introduction of TOAR and EAWG

TOAR-I (2014-2019) Mission and deliverables

Mission:

To provide the research community with an up-to-date scientific assessment of tropospheric ozone's global distribution and trends from the surface to tropopause.

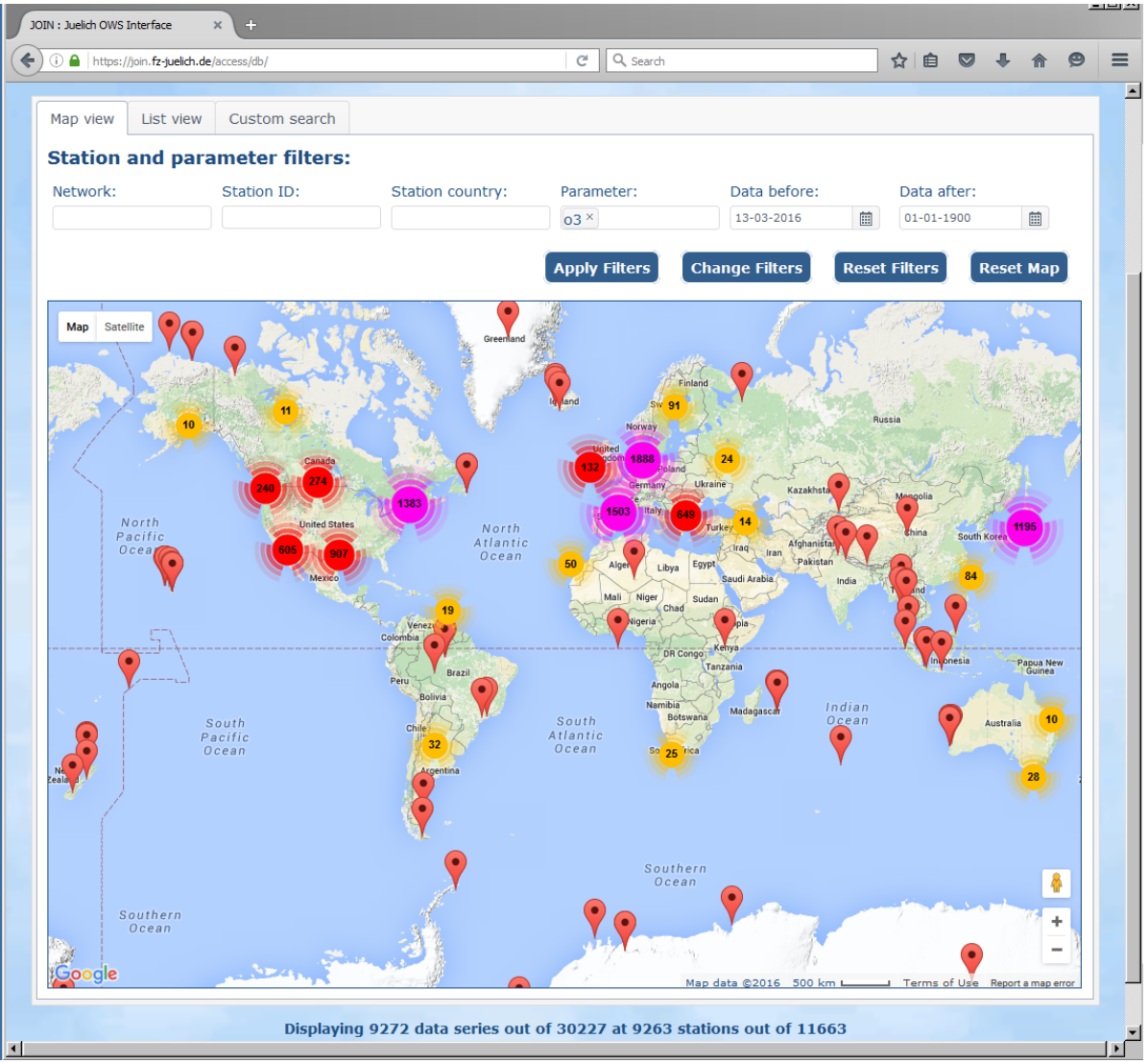
Deliverables:

1) The first tropospheric ozone assessment report based on all available surface observations, the peer-reviewed literature and new analyses.
2) A database containing ozone exposure metrics at thousands of measurement sites around the world, freely accessible for research on the global-scale impact of ozone on climate, human health and crop/ecosystem productivity.

https://igacproject.org/activities/TOAR/TOAR-I

TOAR-I (2014-2019) Achievements

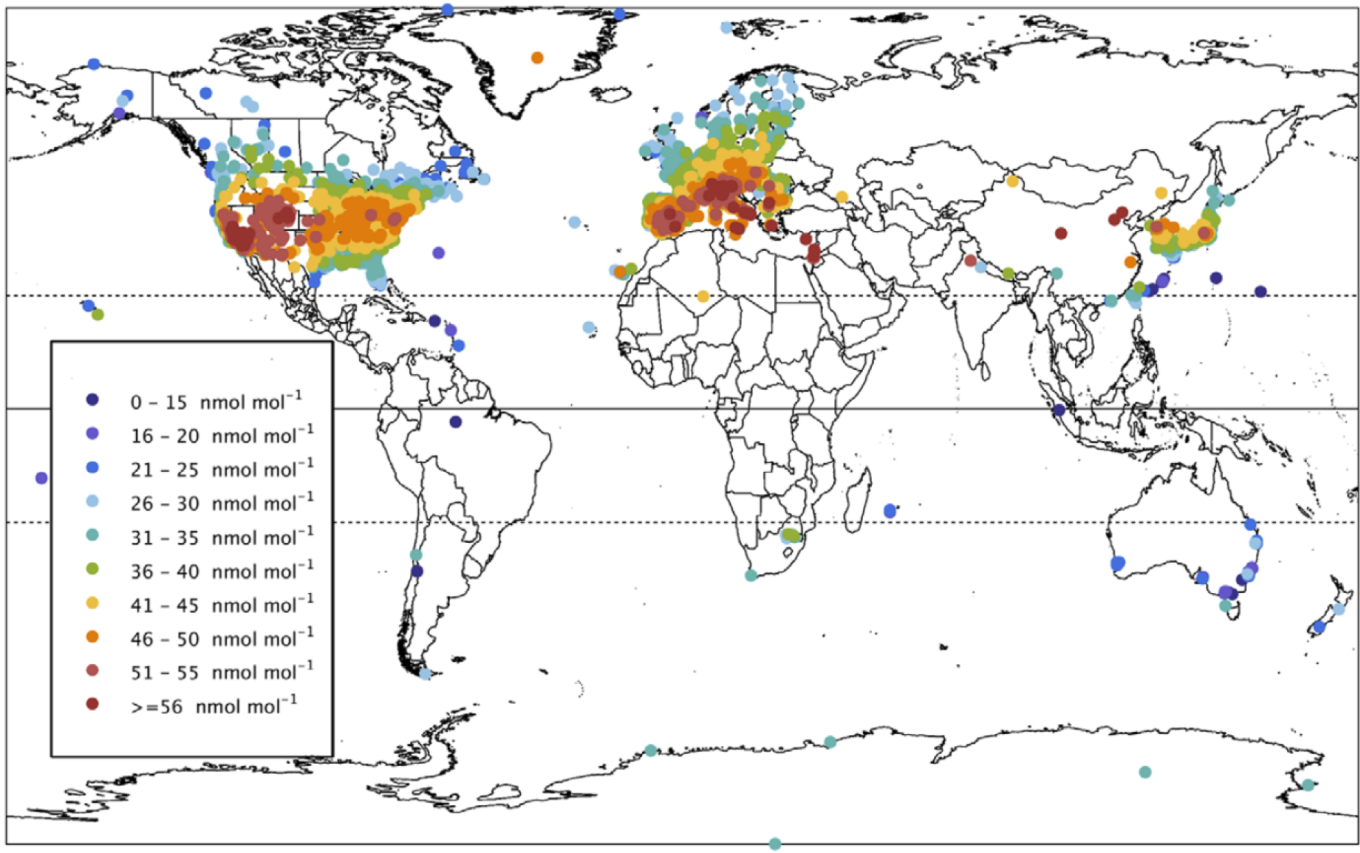
Open-access TOAR-I ozone database



https://join.fz-juelich.de/

First global-scale view of surface ozone (9 highly cited publications in Elementa)

JJA daytime average ozone, 2010-2014, TOAR I



[Gaudel et al., 2018, Elementa]

TOAR-II (2020-2024) Goals

1. **TOAR Ozone Data Portal:** Update the ozone observations in the TOAR surface ozone database to include all recent observations (since 2014), and include data from new sites and regions, as well as ozone precursor and meteorological data. Develop methods for including historical data (pre-1975) and create working links to repositories of free tropospheric observations.
2. **TOAR publications:** Exploit the new observational datasets collected by Goal 1 (with data through 2020) to provide an updated state of the science estimate of ozone's global distribution and trends relevant to climate, human health and vegetation. Extend the statistical toolbox and metrics of the TOAR trend analyses. These results will be published in the open-access, peer-reviewed literature.
3. **Involve scientists from the atmospheric sciences community**, as well as statisticians and scientists who focus on broader issues of global change and sustainability, to identify outstanding science questions in relation to tropospheric ozone. The range of topics can be expanded beyond the scope of the original TOAR effort to investigate the impacts of tropospheric ozone on climate, human health and vegetation, and to address urban-scale issues in addition to the regional and global scale.
4. **Maximize exploitation of the TOAR Surface Ozone Database** by, 1) helping scientists around the world, beyond the TOAR effort, to apply the database to new analyses, and 2) exploring new data science methods to improve the analysis of global ozone trends and their attribution.

TOAR-II (2020-2024) Chairs and Working Groups

Dr. Owen R. Cooper
CIRES University of Colorado/NOAA Chemical Sciences Laboratory, Boulder, CO, USA

Dr. Martin G. Schultz
Forschungszentrum Jülich, Germany

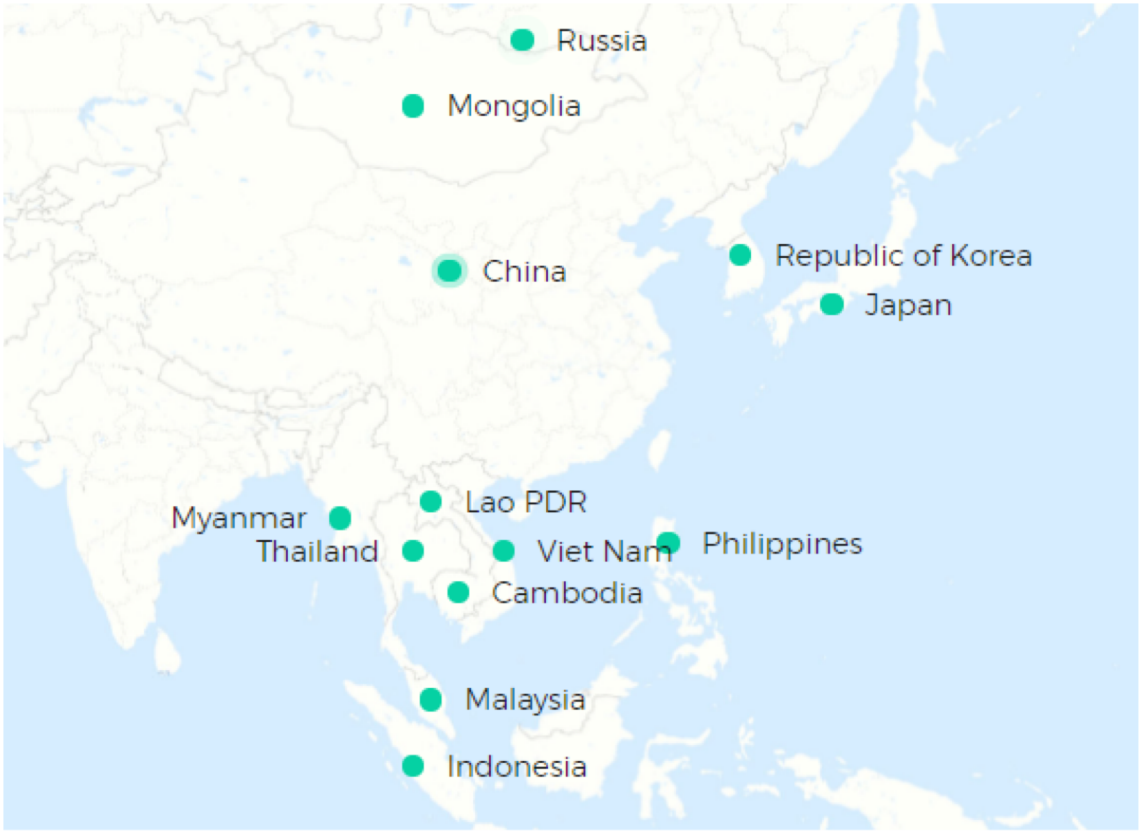
11 Steering Committee members

10 Working Groups

- Chemical Reanalysis Focus Working Group
- East Asia Focus Working Group
- HEGIFTOM Focus Working Group (Harmonization and Evaluation of Ground Based Instruments for Free Tropospheric Ozone Measurements)
- Ozone over the Oceans Focus Working Group
- Ozone and Precursors in the Tropics (OPT) Focus Working Group
- Radiative Forcing Focus Working Group
- Satellite Ozone Focus Working Group
- Statistics Focus Working Group
- Tropospheric Ozone Precursors (TOP) Focus Working Group
- Urban Ozone Focus Working Group

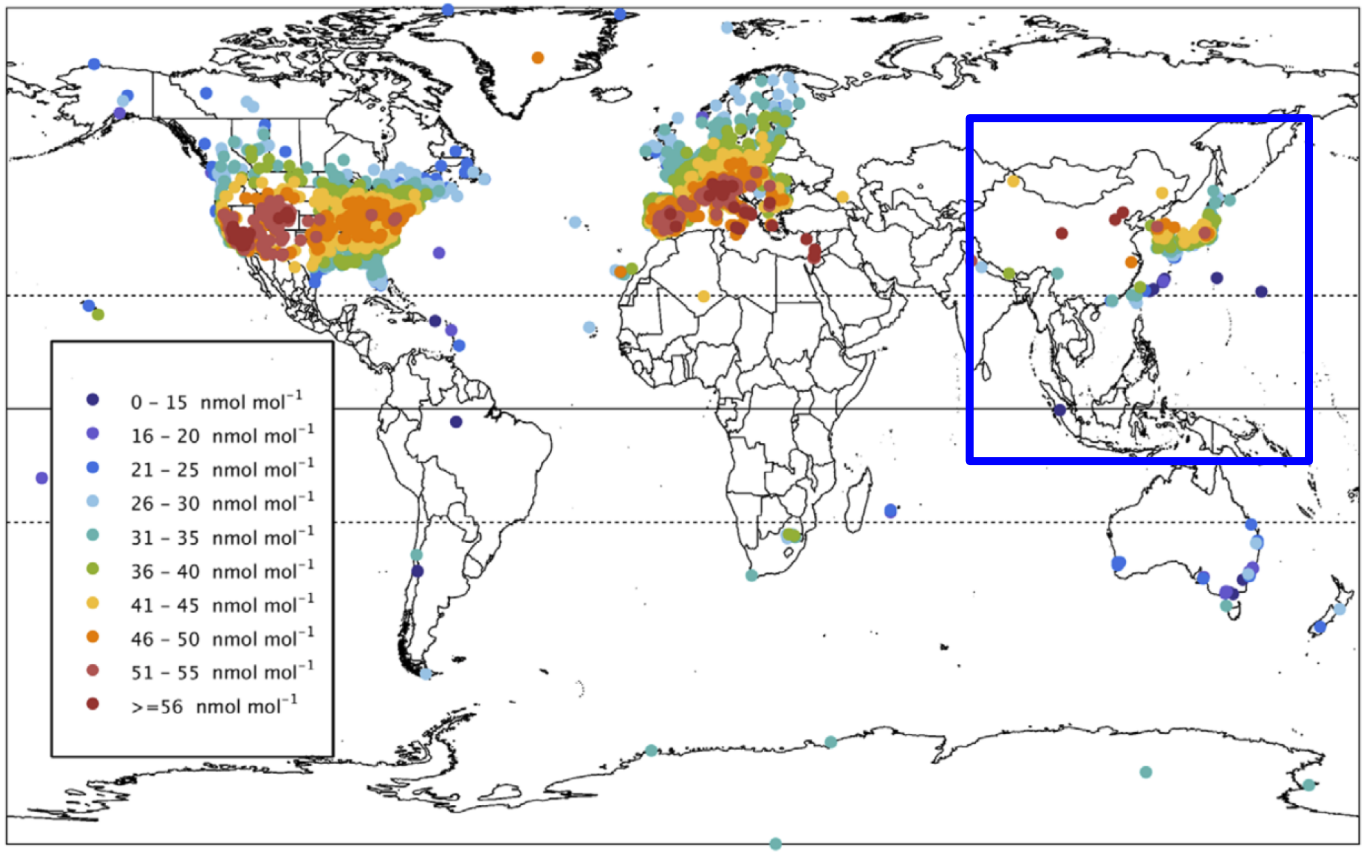
TOAR-II EAWG Motivation: ozone over EA was not well characterized in TOAR I

The East Asia region



https://www.eanet.asia/

JJA daytime average ozone, 2010-2014, TOAR I



[Gaudel et al., 2018, Elementa]

TOAR-II EAWG Challenges and priorities in ozone study over East Asia

Data collections

- Surface/free tropospheric ozone observations are sparse.
- Auxiliary/supporting data (precursor measurements, meteorological parameters/emission inventory, etc.) are poorly collected or shared.

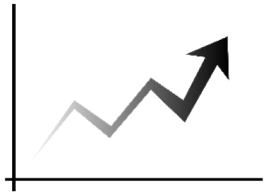
Ozone trend attributions and global impacts

- Ozone trends in East Asia are not well understood, models fail to capture the trends and disagree with each other on the trend attributions.
- Global impacts of ozone change in East Asia need to be re-evaluated.

TOAR-II EAWG Goals

Goal 1: Construction of the EAO3 database

- Ozone measurements from the surface to free troposphere.
- Auxiliary data, including in-situ meteorological data, ozone precursor and aerosol measurements, gridded anthropogenic and natural emissions, geographic data, etc.



Goal 2: Quantification of factors driving EA ozone trends

- Quantify climatic and chemical factors driving EA ozone trends over East Asia, reconciling the results from different methods (statistics/CTMs/ML) using the same (similar) data source in EAO3 database.

Goal 3: Quantification of global influences of EA ozone and precursors

- Quantify the influences of East Asia ozone and precursor outflow on intercontinental ozone transport, the global ozone budget, and radiative forcing.

TOAR-II EAWG Team: 4 co-chairs and 26 members from 9 countries/regions

Surface measurement; Ozonesonde; Satellite; Model

China: Jianlin Hu (Nanjing University of Information Science and Technology)
Xin Huang (Nanjing University)
Junli Jin (China Meteorological Administration)
Yiming Liu (Sun Yat-sen University)
Keding Lu (Peking University)
Lu Xiao (Sun Yat-sen University, co-lead)
Xiaobin Xu (China Meteorological Administration)
Wanyun Xu (China Meteorological Administration)
Likun Xue (Shandong University)

Hong Kong:
Meng Gao (Hong Kong Baptist University)
Hai Guo (The Hong Kong Polytechnic University)
Xiaopu Lyu (The Hong Kong Polytechnic University)
Tao Wang (The Hong Kong Polytechnic University)

Japan:
Junichi Kurokawa (Asian Center for Air Pollution Research)
Tatsuya Nagashima (National Institute for Environmental Studies, co-lead)
Keiichi Sato (Asian Center for Air Pollution Research)
Seiji Sugata (National Institute for Environmental Studies)

South Korea: Juseon Bak (Pusan National University)
Dongwon Lee (National Institute of Environmental Research)
Mee-Hye Lee (Korea University)
Joowan Kim (Kongju National University)
Ja-Ho Koo (Yonsei University, co-lead)

USA: Yuqiang Zhang (Duke University)
Lu Shen (Harvard)
Ke Li (Harvard, co-lead)

Malaysia: Mohd Talib Latif (Universiti Kebangsaan Malaysia)

Thailand: Kasemsan Manomaiphiboon (King Mongkut's University of Technology Thonburi)
Pornpan Uttamang (Maejo University)

Vietnam: Nguyen Tran Huong Giang (Da Lat University)

Germany: Bing Gong (Jülich Supercomputing Centre)

2. Introduction of EAO3 database to achieve Goal 1

TOAR-II EAWG Goal 1: Construction of the EAO3 database

To produce a full database for ozone research in East Asia and beyond:

Ozone dataset

- Ozone from the surface to tropopause (ozonesonde/lidar, aircraft, satellite), providing full pictures of ozone over EA.

Precursors dataset

- NO_x, CO, VOCs, PANs, $PM_{2.5}$ from site observations, field campaigns, and satellite observations, supporting study on ozone chemistry, model validation, etc.

Meteorology dataset

- In situ observations of meteorological parameters, supporting O_3-meteorology relationship studies and modeling activities.

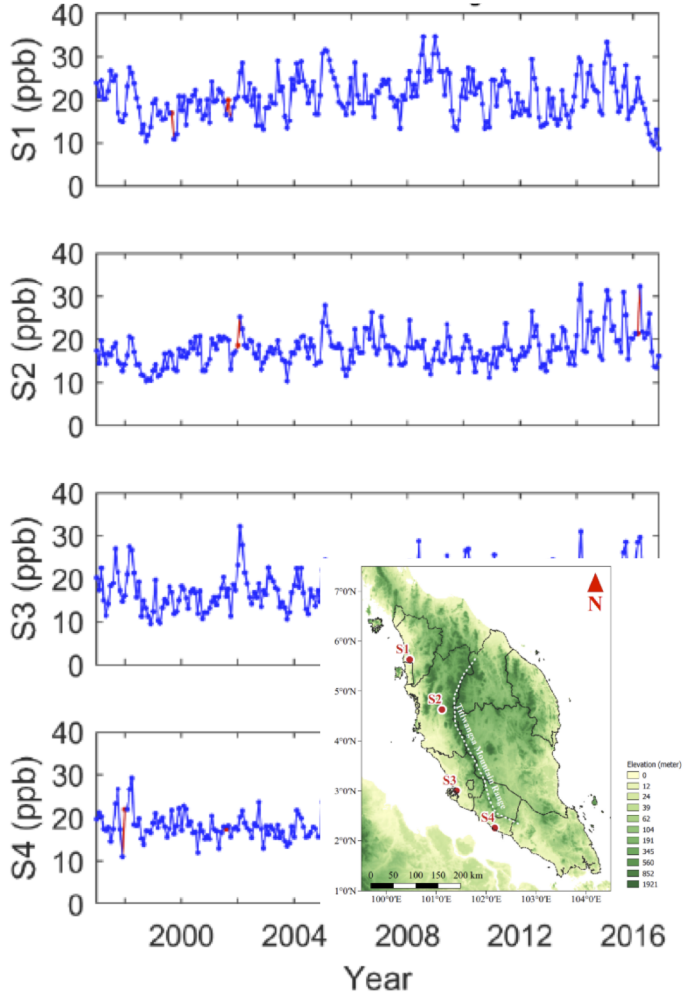
Emission dataset

- Include anthropogenic and natural emissions for supporting modeling (CTM/statistical/ML) activities.

TOAR-II EAWG Goal 1: Construction of the EAO3 database

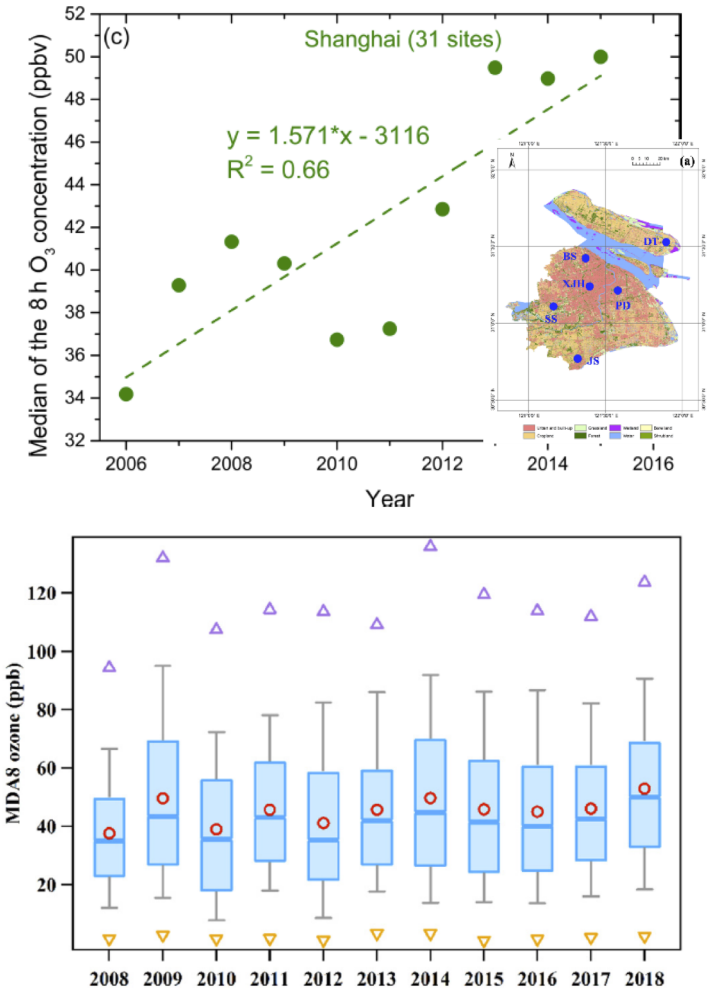
Examples of EA ozone measurements not included in the nationwide monitoring network (Table A1)

20-year surface ozone in Malaysia



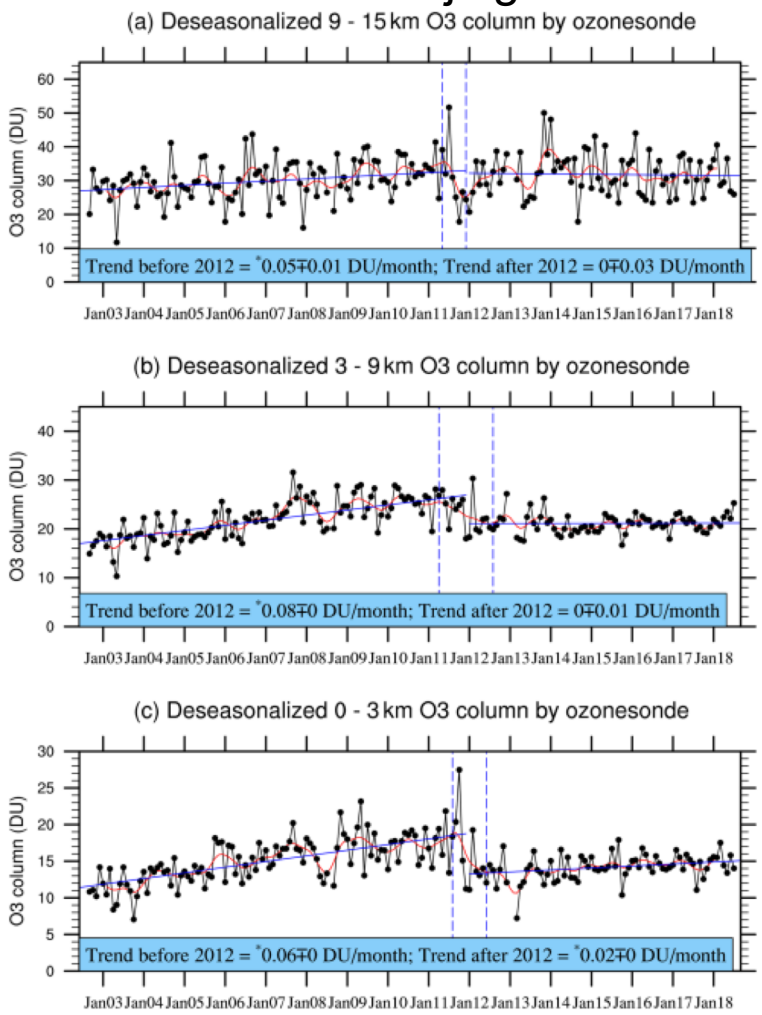
[Ahamad et al. 2020]

15-year surface ozone in Shanghai/Guangzhou



[Xu et al. 2019; Yin et al., 2019]

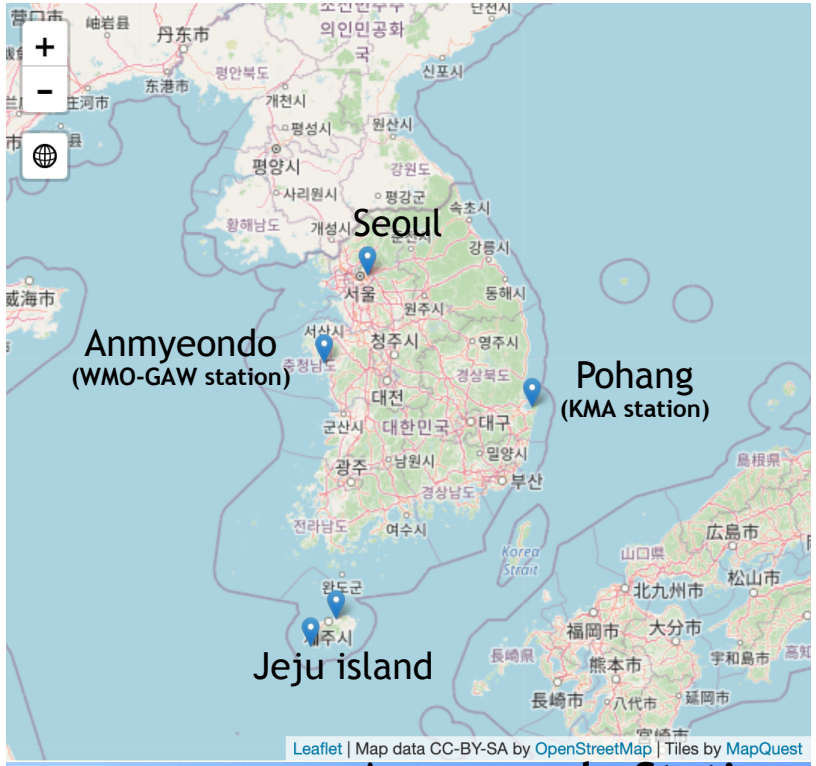
15-year tropospheric ozone in Beijing

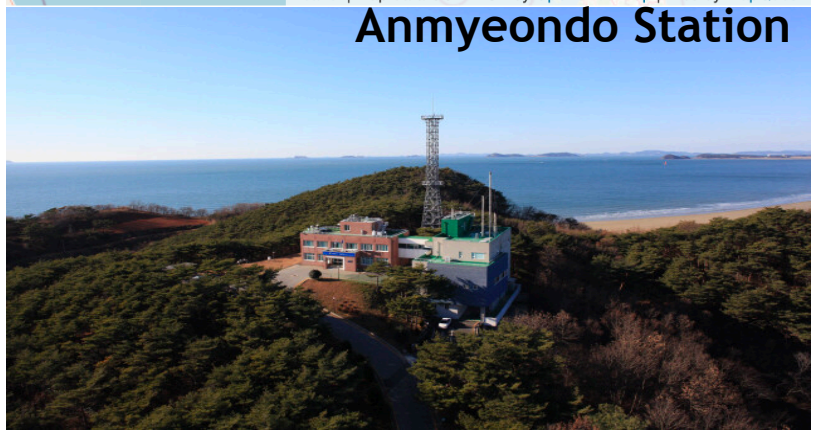


[Zhang et al., 2020]

TOAR-II EAWG Goal 1: Construction of the EAO3 database

Highlight: ozonesonde measurement plan in South Korea





Plan 2021 at Anmyeondo

- JUL-AUG: ~30 launches for the pre-ACCLIP and GEMS validation
  (ACCLIP: Asian Summer Monsoon Chemical and Climate Impact Project by NCAR and NASA)
- SEP-OCT: ~20 launches for the domestic monitoring with NIER
  (NIER: National Institute of Environmental Research, Korea)
- OCT: preliminary results will be presented in the Quadrennial Ozone Symposium (**QOS**). **3-9 October** (qos2021.yonsei.ac.kr)

Plan 2022 at Anmyeondo

- MAY-JUN: ~20 launches for the domestic monitoring with NIER
  (comparison to the findings during the Korea-US Air Quality campaign, KORUS-AQ, in 2016)
- JUL-AUG: ~30 launches for the main ACCLIP and GEMS validation

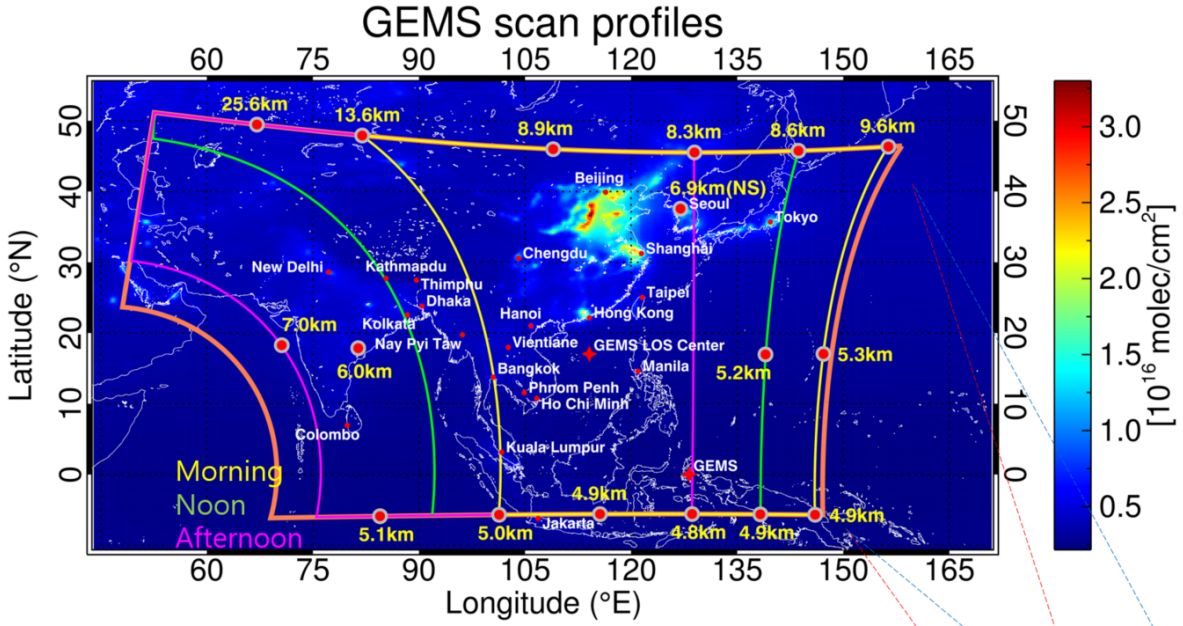
Plan at Pohang

- Launching about every week since 1995.

Joowan Kim, Kongju U. (member of EAWG)
Ja-Ho Koo, Yonsei U. (Co-chair of EAWG)

TOAR-II EAWG Goal 1: Construction of the EAO3 database

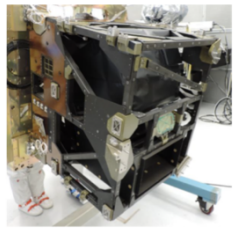
Highlight: Geostationary Environment Monitoring Spectrometer (GEMS)

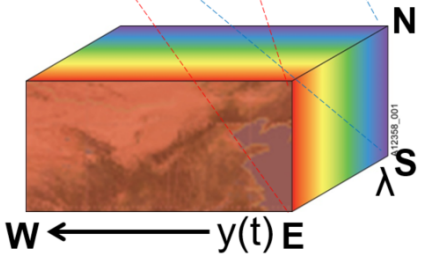


2048 N-S x 695 E-W
x 8 times/day
= 11,386,880 spectra/day

x 20 products

Kim et al. (BAMS, 2020)

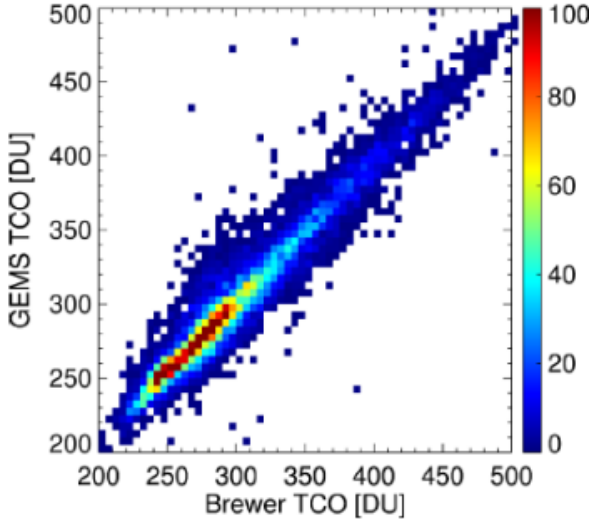




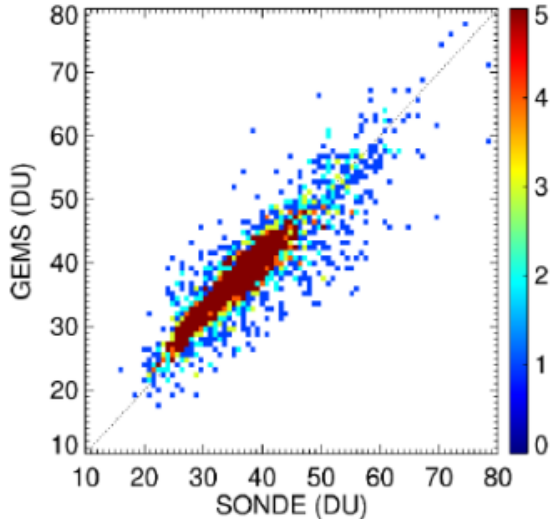
Inter-comparison

(Courtesy of Jae-Hwan Kim, Pusan national Univ.)

Total column ozone (TCO)
X: Brewer obs. Y: pre-GEMS
(2004-2008)



Ozone profile
X: ozonesonde obs. Y: pre-GEMS
(2005-2006)



Time table:

- Spring 2021: Total column ozone data will be released.
- Spring 2022: Tropospheric ozone and ozone profiles will be released.

Juseon Bak, Pusan National U. (member of EAWG and GEMS)
Dongwon Lee, NIER Korea (member of EAWG and GEMS)
Ja-Ho Koo, Yonsei U. (Co-chair of EAWG and member of GEMS)

Data Requirement and Credit Statement

To acknowledge the EAO3 data providers and make the dataset accessible to a wide range of users, the following guidelines are recommended:

Data requirement

- Ozone measurement:

(1) Raw data with quality control would be preferable
(2) Post-processed data with common metrics (e.g. MDA8 ozone) are also acceptable.
(3) Ozone precursor species and meteorological parameters along with surface ozone measurement should follow (1) or (2).

- Satellite products:

Processed gridded data (Level 3) would be preferable, and links of Level 2 data repositories should be provided.

- Field campaign data:

Descriptions of data and PIs contacts should be provided at least.

- Emissions/Meteorology/Others:

Links and descriptions of data repositories or PIs contacts should be provided at least.

Data Requirement and Credit Statement

Credit statement

Download of EAO3：

We are proposing three levels for data sharing, which is applicable to all the measurement data in the EAO3 database.

- ✓ ***Level 1***: Users can freely download the data without further notice to data provider;
- ✓ ***Level 2***: Users can freely download the data but need to notify the data provider and make acknowledgement in their publications;
- ✓ ***Level 3***: Users must contact the data provider for any use before they can download the data.

For the publication of any TOAR assessment report contributed by our WG:

We are happy to provide authorship on the TOAR II publications once the data are accepted in the EAO3 database.

For any other publications:

(1) In case of using data with Level 1 or Level 2, there is no requirement but it is suggested to offer co-authorship to data providers if EAO3 data contributes a lot to your work.

(2) In case of using data with Level 3, it is determined by the data providers if a co-authorship is needed.

(3) If the EAO3 data are a principal component of the publications, then co-authorship should be offered to the data providers.

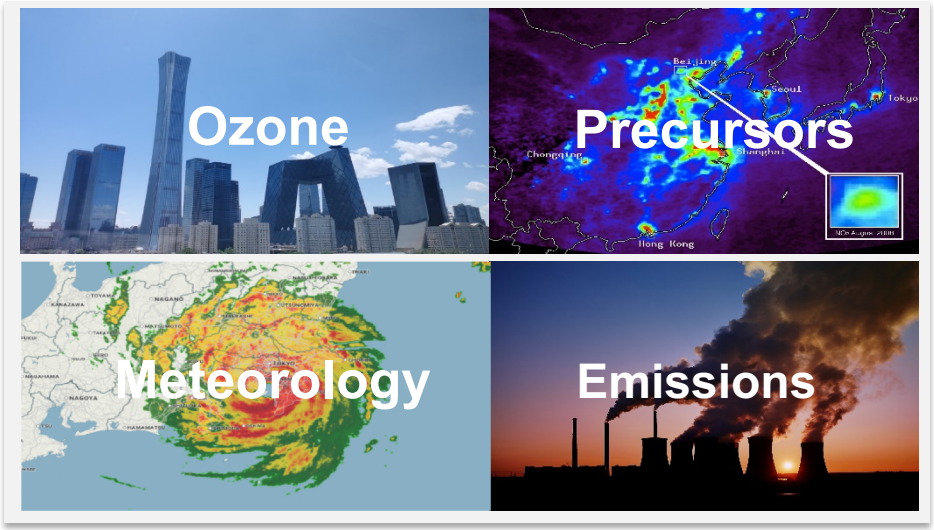
3. Introduction of modeling activities to achieve Goals 2 and 3

TOAR-II EAWG Goal 2: Quantification of factors driving EA ozone trends

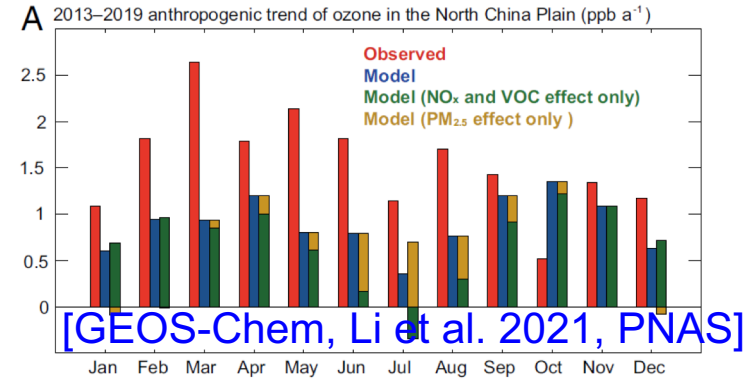
Key questions to be answered:

- What causes the model biases/discrepancies in capturing short-term/long-term ozone trends over EA?
- What are the relative contributions of chemical vs. climatic factors to ozone trends? Can we reconcile the results from different methods?

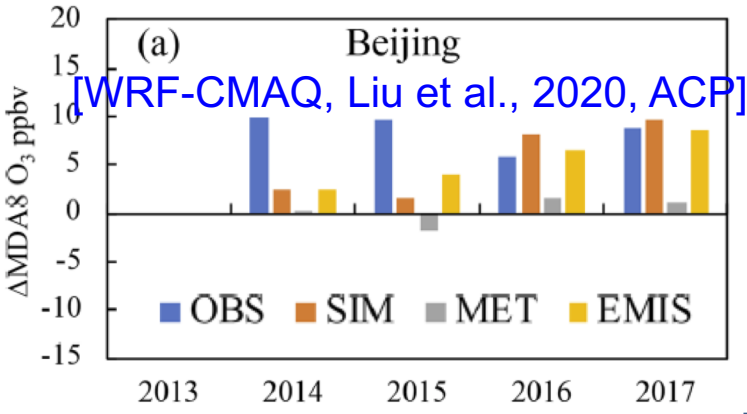
EAO3 database → **Different modeling tools** → **O_3 trend attributions**



- Statistical models
- Machine learning methods
- Chemical model simulations



[GEOS-Chem, Li et al. 2021, PNAS]



[WRF-CMAQ, Liu et al., 2020, ACP]

TOAR-II EAWG Goal 3: Quantification of global influences of EA O_3 and precursors

Key questions to be answered:

- What are the short-term and long-term contributions of EA emissions to air quality downwind, global ozone budgets, and radiative forcing?

EAO3 database → **Modeling tools** → **EA ozone influences on:**

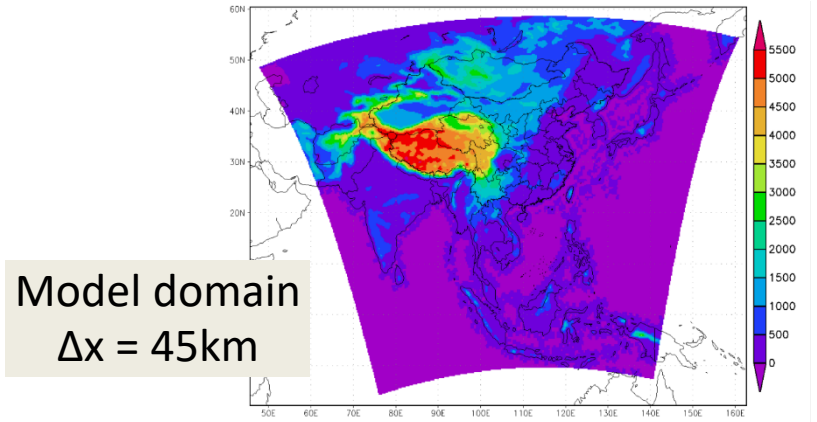
Chemical (global) model simulations

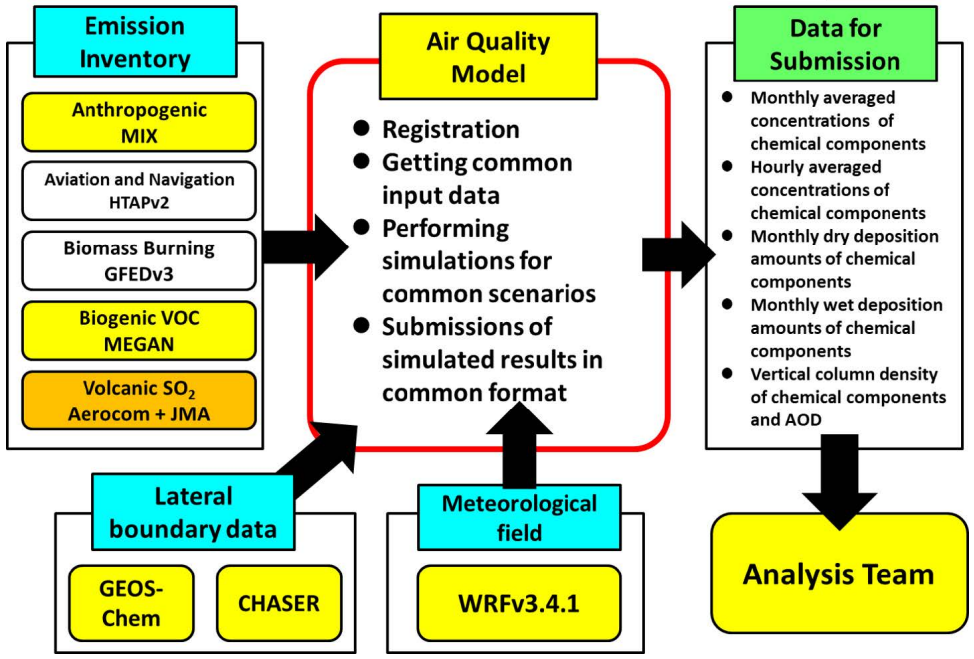
- Downwind air quality
- Global ozone budgets
- Ozone radiative forcing

TOAR-II EAWG Collaboration with MICS-Asia

Model Inter-Comparison Study for Asia (MICS-Asia) Phase IV

Basic setup for MICS-Asia Phase III





Experimental design of MICS- Asia Phase IV is now under consideration, but expected improvements from Phase III include

- Finer model horizontal resolution
- Updated Emission data
- Updated chemical mechanisms in the models, and
- **More Observations** to be compared

Linkage to TOAR-II EA-WG

- Surface monitoring data
- Vertical profiles
- Satellite data
- Chemical reanalysis data

Tatsuya Nagashima, NIES, Japan
Co-chair of EAWG and core member of MICS-Asia

TOAR-II EAWG Modeling activities for supporting Goals 2 and 3

Category	Methods	Groups/Person
Regional ozone chemistry/transport	Multi-model assessment using MICS-Asia models	Tatsuya Nagashima (NIES)
Trend attribution	Statistical methods	Ke Li (Harvard)
Trend attribution (with focus on ozone extremes)	Statistical methods Machine learning methods	Lu Shen (Harvard)
Regional ozone chemistry/transport **Trend attribution**	CMAQ (regional)	Jianlin Hu (NUIST)
Regional ozone chemistry/transport **Trend attribution**	CMAQ (regional)	Yiming Liu (SYSU)
Regional ozone chemistry/transport **Trend attribution** **/impacts on human health**	WRF-Chem (regional)	Meng Gao (HK Baptist)
Regional ozone chemistry/transport **Trend attribution**	WRF-Chem (regional)	Xin Huang (NJU)
Trend attribution **/impacts on global ozone**	GEOS-Chem model CMIP6 models	Xiao Lu (SYSU)
Trend attribution **/ impacts on global ozone**	CAM-Chem model	Yuqiang Zhang (Duke)
		You!

Model configuration (duration, emissions, resolution etc.) is under design.

TOAR-II EA WG Expected outcome

- **The EAO3 database for supporting ozone research over East Asia.**

- **A review/research article introducing the EAO3 database and overviewing ozone and precursor levels over East Asia.**
- **A review/research article quantifying factors driving ozone trends over East Asia from different approaches.**
- **A review/research article quantifying global influences of East Asian ozone and precursors.**
- **Independent research articles from Working Group members making use of the EAO3 database and modeling results.**

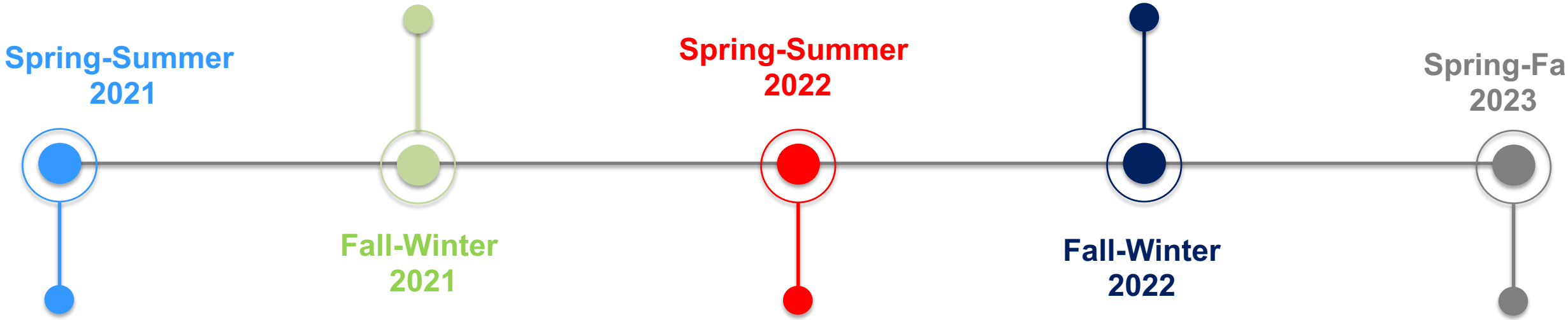
TOAR-II EA WG Opportunities for WG members

- **Participations in the WG will be acknowledged by the WG websites**
- **Co-authorships of the WG research articles**
- **Early use of EAO3 database and/or modeling results for your own research (need to comply with the WG data policy)**
- **Special issue of "TOAR – East Asia ozone research" on academic journals is in the plan, and WG members will be welcome to contribute**
- **Collaborations with WG members on other research topics**

TOAR-II EAWG Roadmap

- Collect and compile the EAO3 dataset.
- Discuss the Statistical/ML/CTMs setup.

- Complete CTM simulations for ozone trend attribution.
- Compare the results from different approaches for ozone trend drivers.
- Conduct CTM simulations to quantify the impacts of EA ozone.



- EAWG Kick-off meetings.
- Outline EAO3 dataset categories.
- Reach out and invite research groups who would be interested in providing ozone and auxiliary data or joining modeling activities.

- Complete and release the EAO3 database.
- Conduct and complete statistical analyses for ozone trend attributions.
- Conduct CTM simulations for ozone trend attribution.

- Wrap up results and prepare for publication.
- Summit for publication by 1 September, 2023

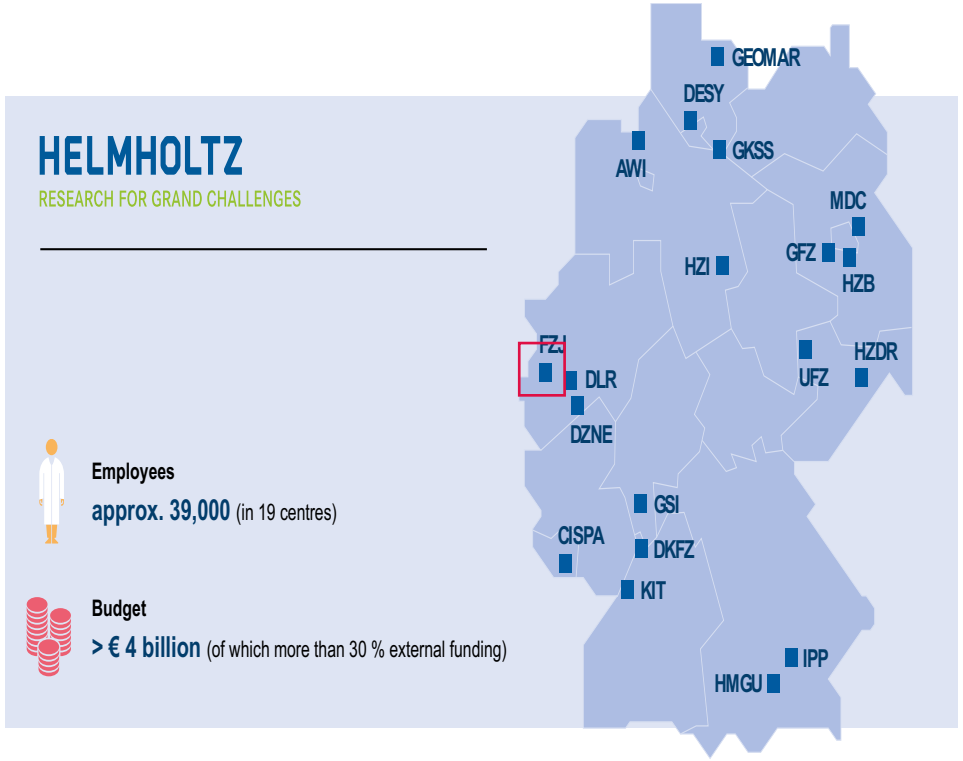
4. Introduction from WG members

INTRODUCTION TO BING GONG

2021-05-13 I TOAR-II EAST ASIA FOCUS WORKING GROUP KICK-OFF MEETING

JÜLICH SUPERCOMPUTING CENTRE (JSC)

19 Helmholtz Centres in Germany – We are One of Them



Objectives of JSC:

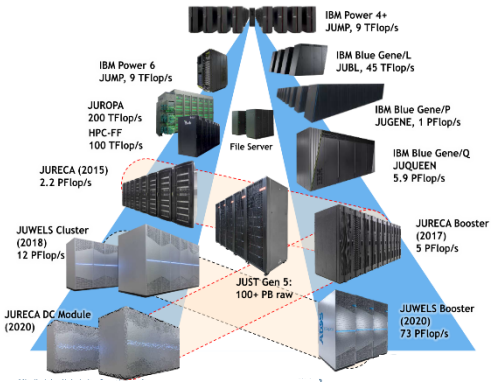
Develop the supercomputing facility towards Exascale (2023)

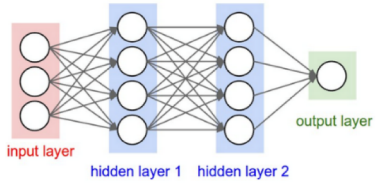
Complement the Exascale by a quantum computer facility JUNIQ

Develop federated data infrastructures and advanced data science

Provide most innovative support structures, tools, algorithms and methods

Educate a new generation of simulation and data science specialists





EARTH SYSTEM DATA EXPLORATION (ESDE)

Team members and research focus

ESDE :

- Led by Martin Schultz
- ~ 20 members
- ~ Key expertise of ESDE
  - Deep Learning methods for atmospheric data (weather & atmospheric chemistry)
  - HPC system applications for Earth Science
  - Data management
- ~ 3 subgroups
  - Data infrastructures
  - AI for Air quality
  - **AI for Weather and Climate**

Bing Gong

Research focus:

- AI in Air quality, and Weather
- Distributed deep learning on HPC
- Deep learning workflow tool development

Possible contributions:

- statistical methods
- machine learning methods

Bing Gong

Self Introduction

Name: Nguyen Tran Huong Giang

Nationality: Vietnamese

Current position: Vice Dean
Faculty of Chemistry and Environment, Da Lat University

Education: PhD in Environmental Engineering (Osaka University, Japan)

Expertise: air quality modeling, air pollution assessment, environmental quality management

Recent works: aerosol direct effects in East Asia, and Continental Southeast Asia; future climate change and emission change impacting on $PM_{2.5}$ and O_3 in Continental Southeast Asia

Possible contribution to the EAWG

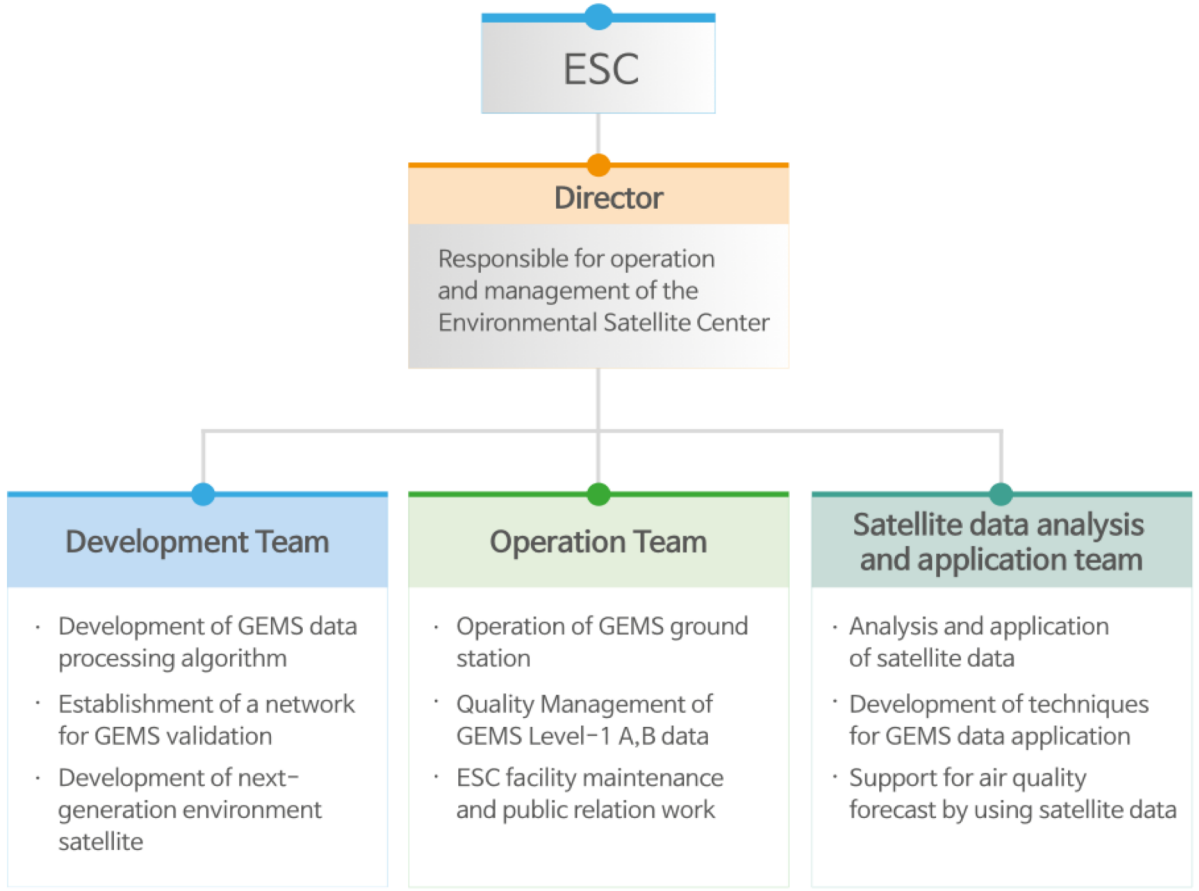
- ❖ Supporting in data collection in Vietnam
  (O_3 , O_3 precursor species, meteorological parameters)
- ❖ **Disscusion** on CTM model simulation design
  (O_3 trend attribution, CMAQ)
- ❖ **P**aticipating in CTM model output analysis and assessment
  (O_3 trend attribution, CMAQ)
- ❖ **Participating in writing report**

Something to discuss

- ❖ Official document certifying member collaboration ?
- ❖ Listing member names in the EAWG website ?
- ❖ Member benefits ?

Establishment of National Environmental Satellite Center(NESC)

➢ Organization

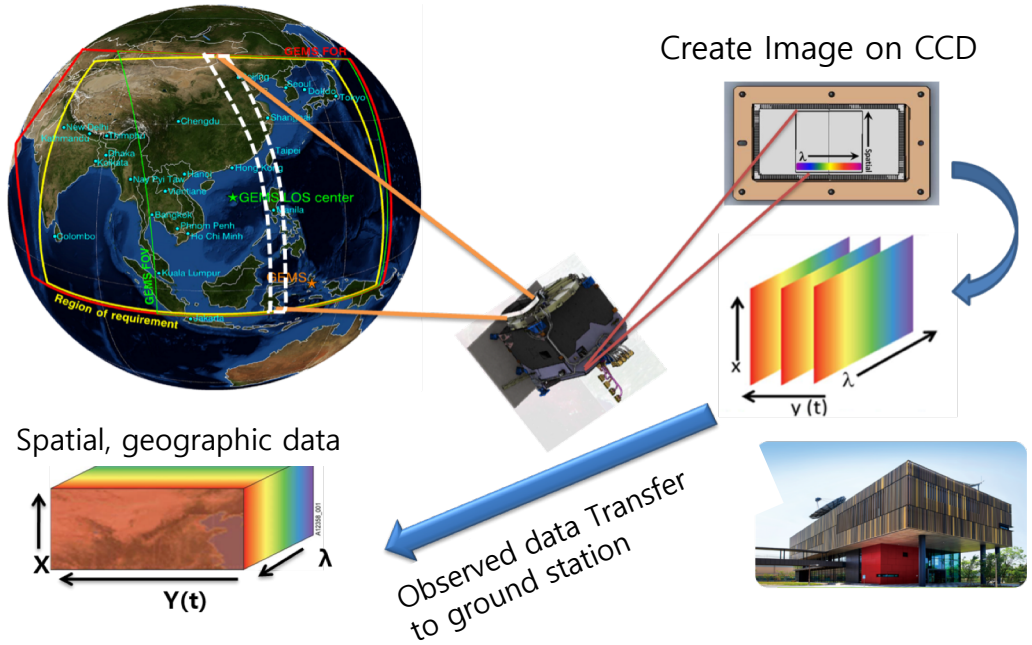


ESC is a new department for GEMS operation(Apr, 2018)

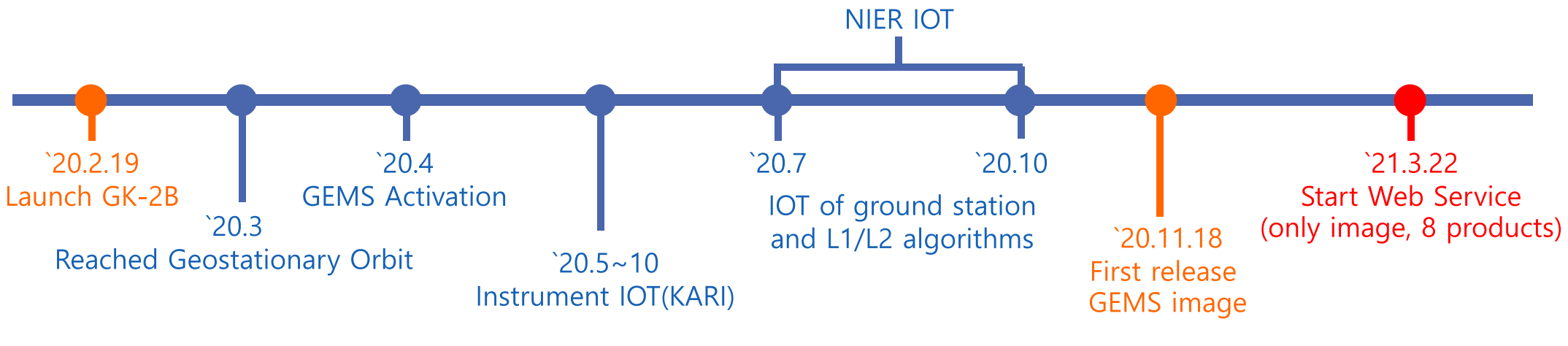
Located in National Institute of Environmental Research(NIER), Incheon, South Korea

02 Status of GEMS products

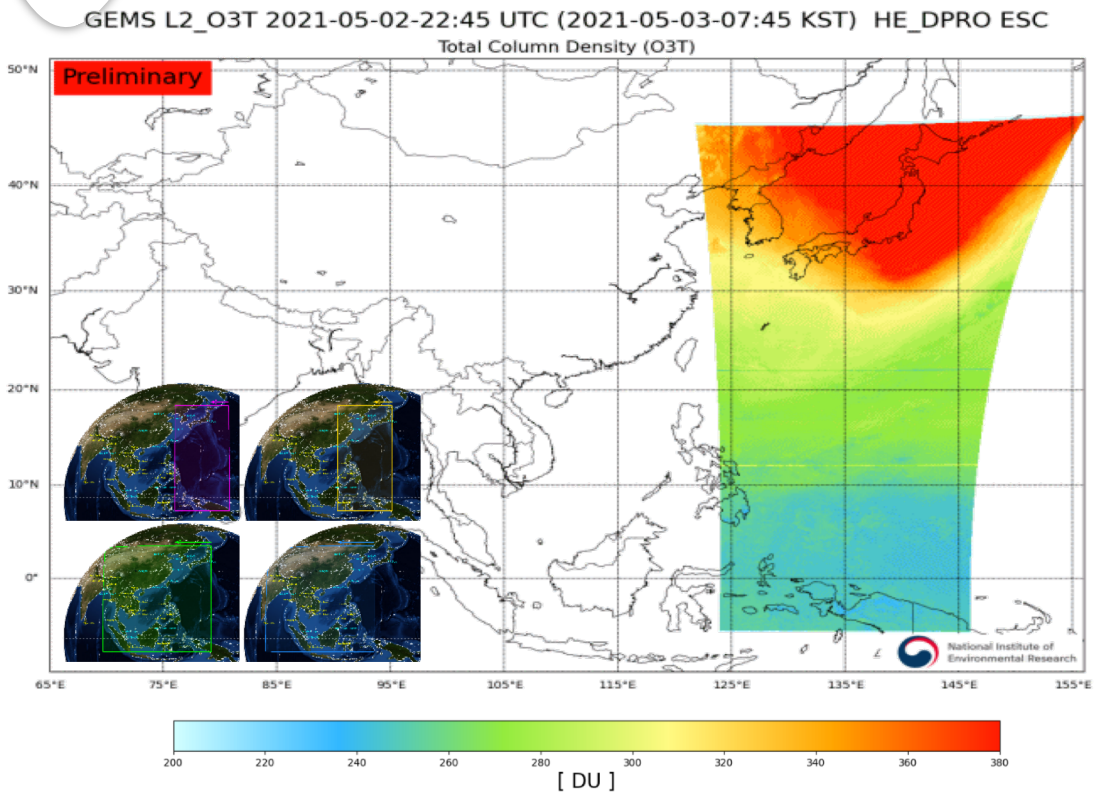
Targeted gases	**O_3, SO_2, NO_2, HCHO, CHOCHO, and aerosol, etc.**
Lifetime	10 Years
Spatial coverage	5,000 km × 5,000 km (5 °S – 45 °N, 75 °E – 145 °E)
Spatial resolution	7 km × 8 km @Seoul
Revisit time	8 times / day
Spectral range / FWHM	300 – 500 nm / 0.6 nm
Orbit / Altitude / Longitude	Geostationary earth orbit (GEO) / 35,786 km / 128 °E



Timeline of ESC activities



03 Status of GEMS products

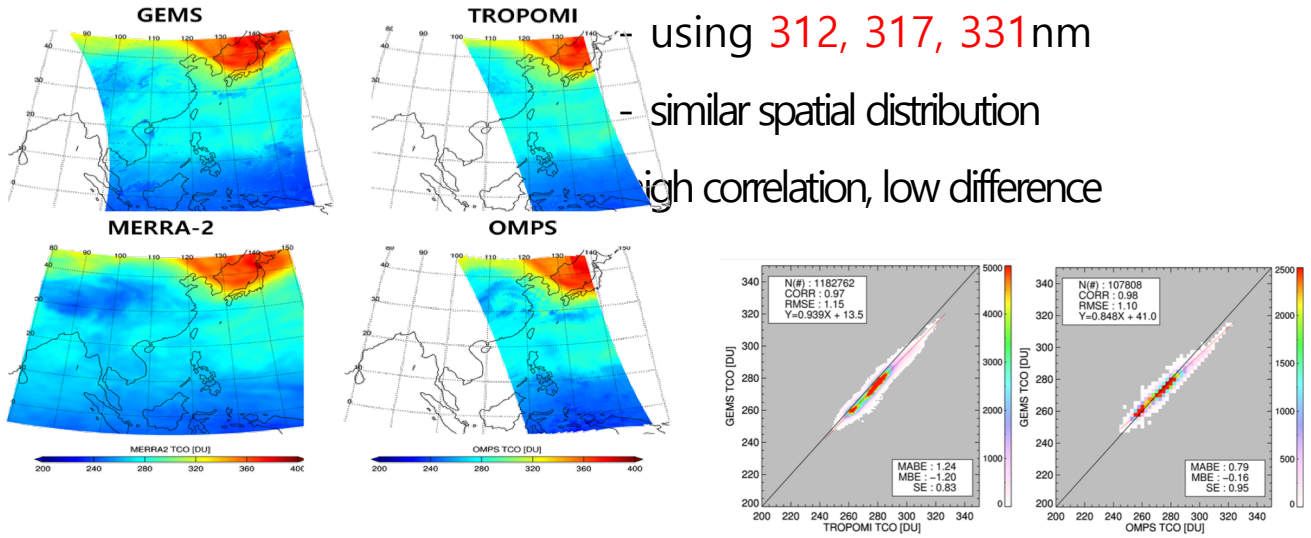


to efficient GEMS has **four observation coverages(FC, FW, HE, ND)**

Among 20 products, **8 types of observation image services including total O3 were started on 22th Mar.**

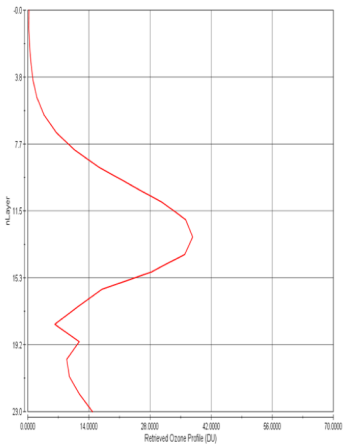
Tropospheric and stratospheric ozone are expected to be released as image in next year.

Total O3: developed base on TOMS v9.0

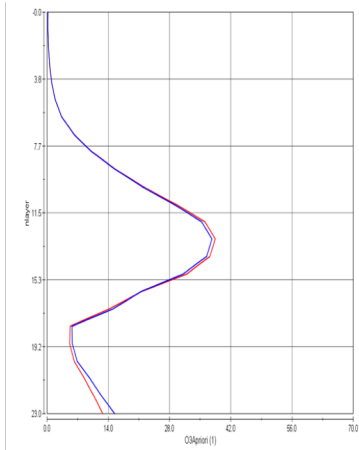


- using 312, 317, 331nm
- similar spatial distribution
- high correlation, low difference

O3 profile: based on OE, yield 24 vertical layers



OMI PROFOZ
lon **123.0**, lat **37.0**



GEMS O3P(red)/A priori(blue)
lon **122.9**, lat **37.0**

- using 310*(300)~340nm
  * Reduce stray light effect
- similar vertical shape
- On going study about improvement for tropopause

Release plan of GEMS image

No.	Products		Unit	Release date
1	Aerosol	AOD	-	Mar. `21
2		Single Scatter Albedo	-	Oct. `21
3		Aerosol Index	-	Oct. `21
4		Aerosol Effective Height	km	`22
5	O3	Total Ozone	DU	Mar. `21
6		Stratospheric Ozone	DU	`22
7		Tropospheric Ozone	DU	`22
8	Surface reflectance	Surface Reflectance	-	`22
9	Cloud	Cloud Centroid Pressure	hPa	Oct. `21
10		Effective Cloud Fraction	-	Mar. `21
11		Cloud Radiance Fraction	-	Oct. `21
12	VOCs	HCHO	molec/cm2	`22
13		CHOCHO	molec/cm2	`22
14	NO2	Tropospheric NO2	molec/cm2	`22
15		Total NO2	molec/cm2	Mar. `21
16	SO2	SO2	molec/cm2	Mar. `21
17	UV	UV index	-	Oct. `21
18		Plant response rate	-	Mar. `21
19		DNA damage rate	-	Mar. `21
20		Vitamin D production rate	-	Mar. `21

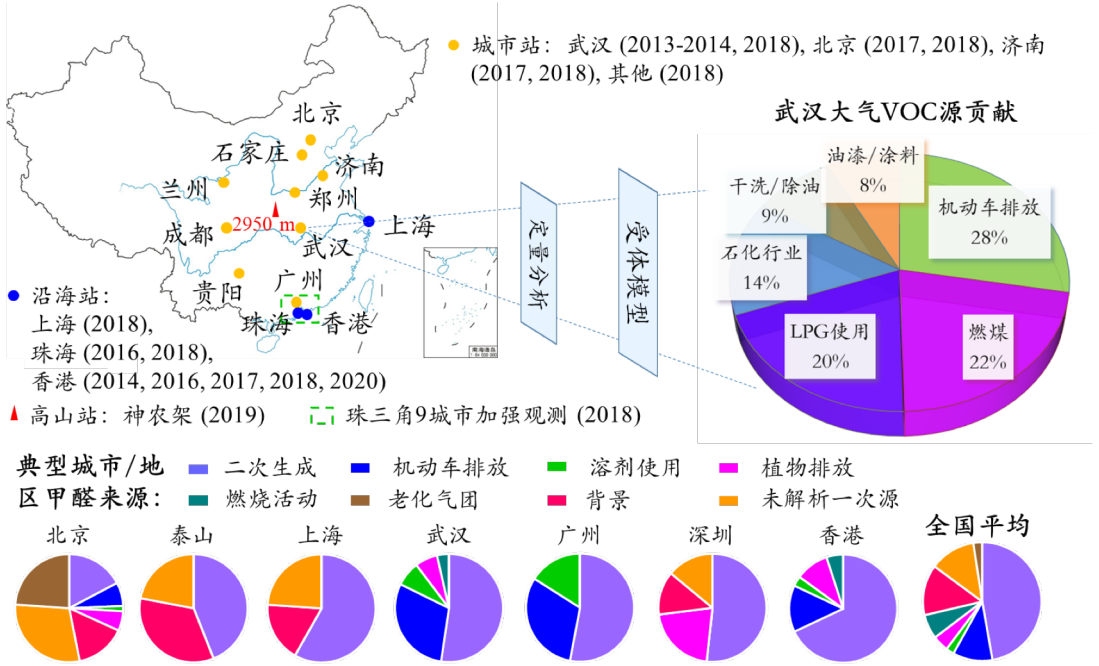
Self-Introduction

Xiaopu Lyu, PhD
Research Assistant Professor
The Hong Kong Polytechnic University

Observation and Modelling of Atmospheric Reactive Organic Carbon and Secondary Products

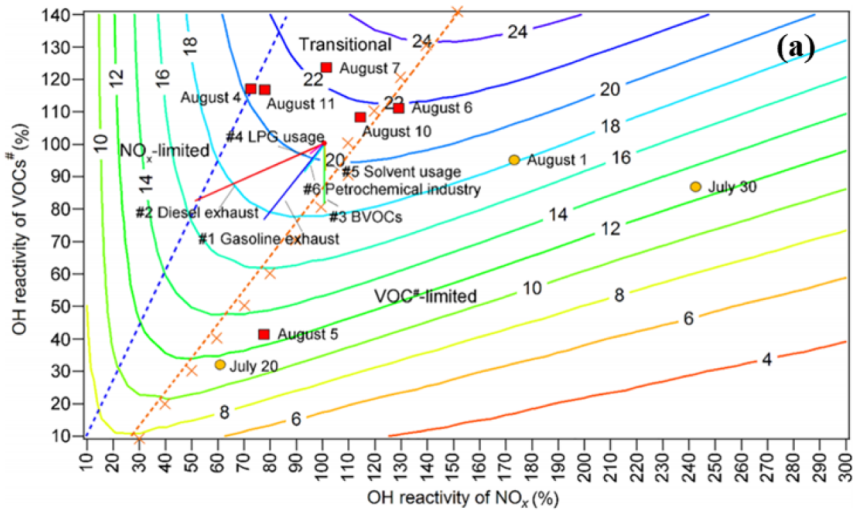
ORCID: https://orcid.org/0000-0002-3306-1008

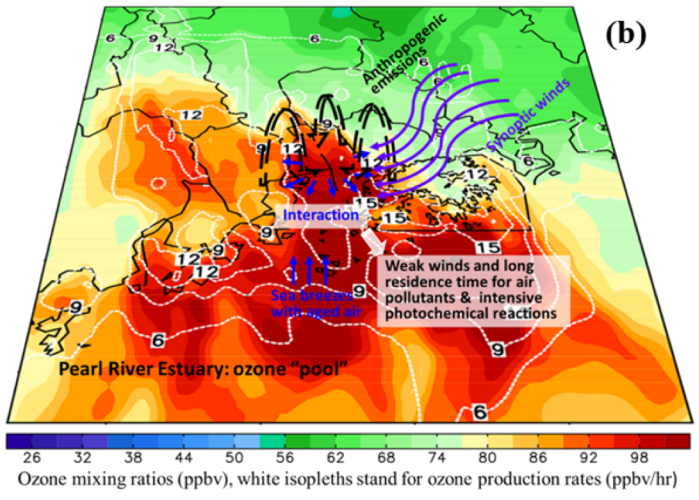
Total citation > 1,100 (h index: 18)



Possible contributions:

- VOC data at more than 20 Chinese cities;
- In-situ photochemical modelling with MCM;
- WRF-Chem modelling.





Prof. GUO's group

Professor
Hai GUO

Research
Assistant
Professor

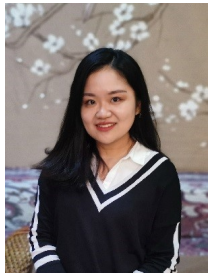
Reactive organic carbon & secondary products

HKPU
Postdoc
Fellow

Air pollution & health

HKPU
Postdoc
Fellow

Indoor physics



PhD
Student

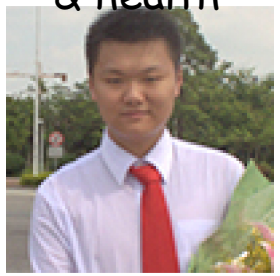
Ozone chemistry

PhD
Student

Ozone chemistry & dynamics

PhD
Student

Acidic ultrafine particle



PhD
Student

Organic aerosol

PhD
Student

Organic aerosol

PhD
Student

Ozone chemistry

PhD
Student

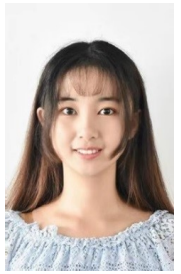
Ozone chemistry & dynamics

PhD
Student

Ozone chemistry & dynamics

Research
Assistant

Ozone chemistry



Research
Assistant

Indoor physics

Research
Assistant

Organic aerosol

Introduction to CMA/CAMS group

Xiaobin Xu
Chinese Academy of Meteorological Sciences
China Meteorological Administration

Group members

- Dr. Xiaobin Xu (xiaobin_xu@189.cn)

  Leader of Reactive Gases Group, CAMS

  Participated in TOAR-I (coauthor: Database, Metrics, Health, Vegetation, Climate)

- Dr. Junli Jin (jinjl@cma.gov.cn)

  Deputy director, Center for Atmosphere Watch and Services of CMA,CMA Meteorological Observation Center

  Participated in the analysis of long-term O_3 measurements from Mt. Waliguan and regional GAW sites in China

- Dr. Wanyun Xu (xuwy@cma.gov.cn)

  Member of Reactive Gases Group, CAMS

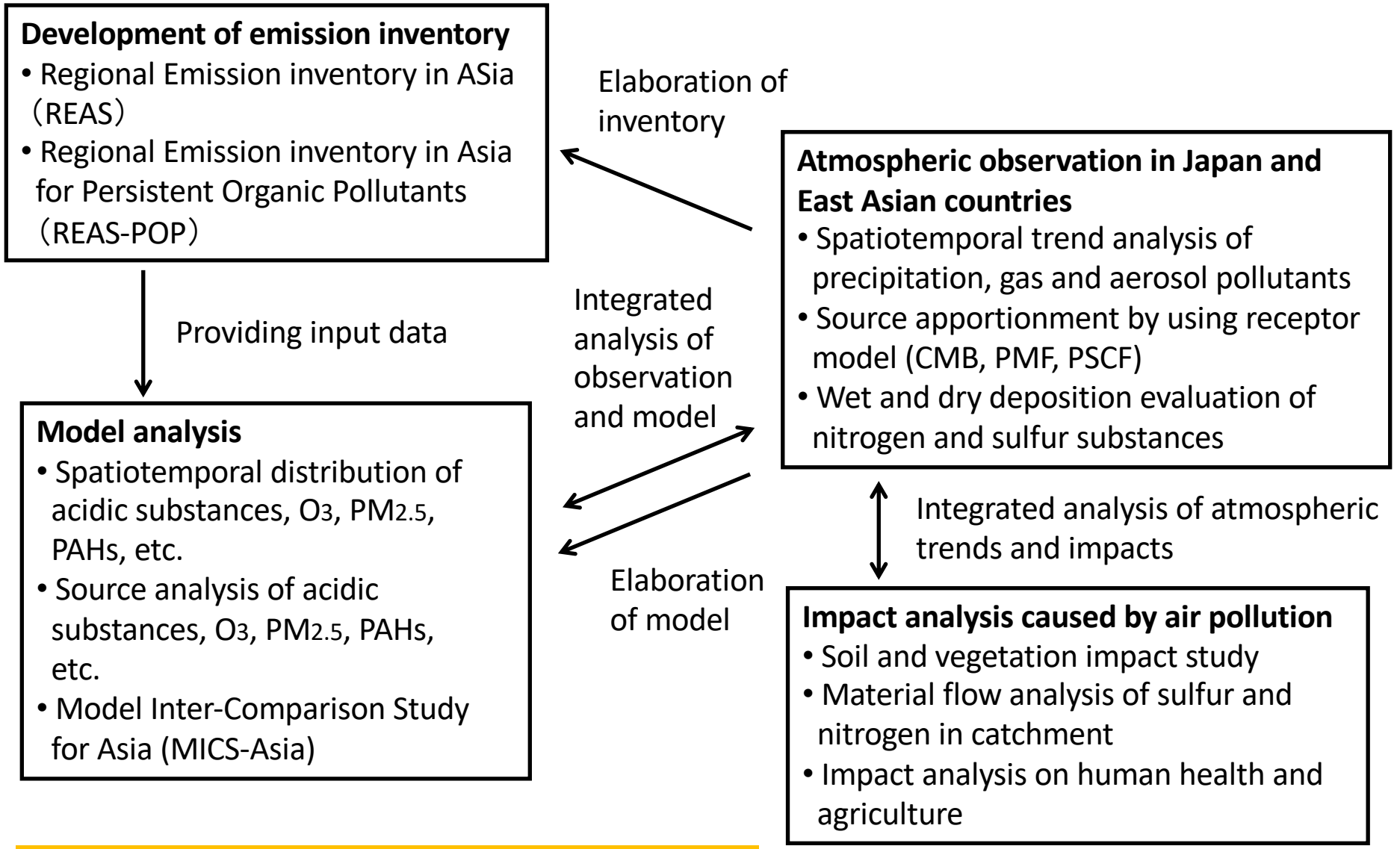
  Participated in the analysis of long-term O_3 measurements from Mt. Waliguan and regional GAW sites in China

Potential contributions to TOAR-II

- Process data from CMA/CAMS sites
- Analyze data from CMA/CAMS and other organizations/ EA countries
- Coauthor TOAR-II/EAWG publications

- Note: Long-term O_3 data from CMA sites should be submitted by a CMA-designated institution. Official communication with CMA is necessary.

Overview of research activities of ACAP



Research achievements of ACAP
https://www.acap.asia/en/research-achieve/

Major Topics of Model Inter-Comparison Study for Asia (MICS-Asia) Phase IV

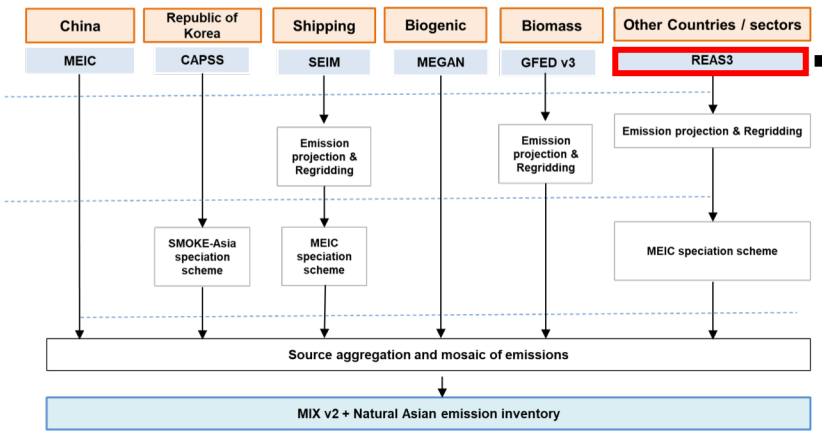
Inter-comparison studies for **air quality modeling**

Inter-comparison studies for **air quality and climate change modeling**

Development and analysis of **emission inventories** in Asia

Collection and analysis of **observation** data in Asia (and conducting own monitoring)

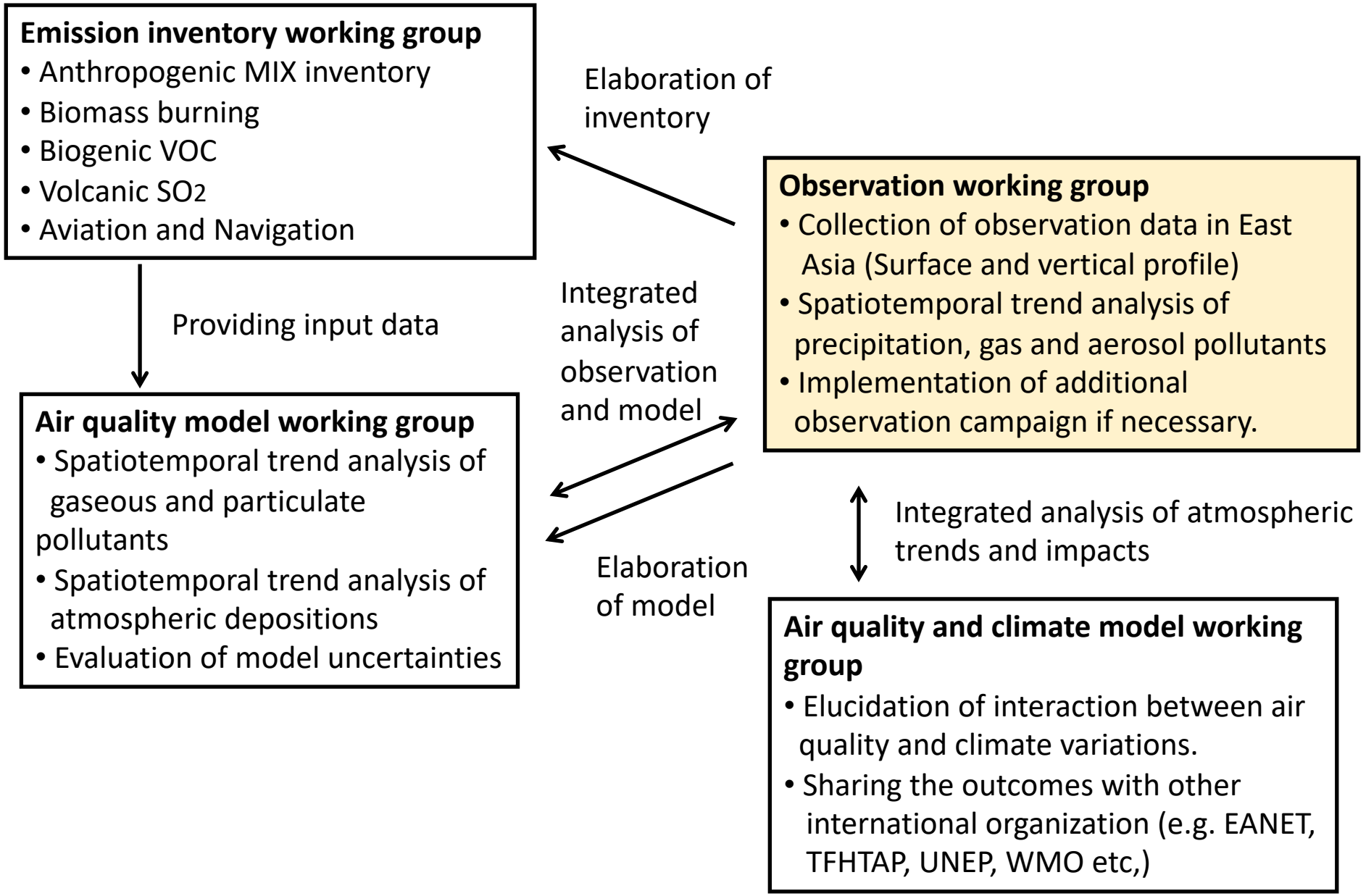
MIXv2 (Mosaic EI)



REAS (Regional Emission inventory in ASia) Version 3.2 will be updated.

Item	Description
Species	SO_2, NO_x, CO, NMVOCs, NH_3, CO_2, PM_{10}, $PM_{2.5}$, BC, and OC
Years	1950–2015
Areas	East, Southeast, and South Asia
Emission sources	Fuel combustion in the power plant, industry, transport, and domestic sectors; industrial processes; agricultural activities (fertilizer application and livestock); and others (fugitive emissions, solvent use, human, etc.)
Spatial resolution	0.25° by 0.25°
Temporal resolution	Monthly
Data distribution	https://www.nies.go.jp/REAS/index.html (last access: 31 October 2020)

Interaction between each working group in MICS IV



Activity of observation working group in 2021-2022

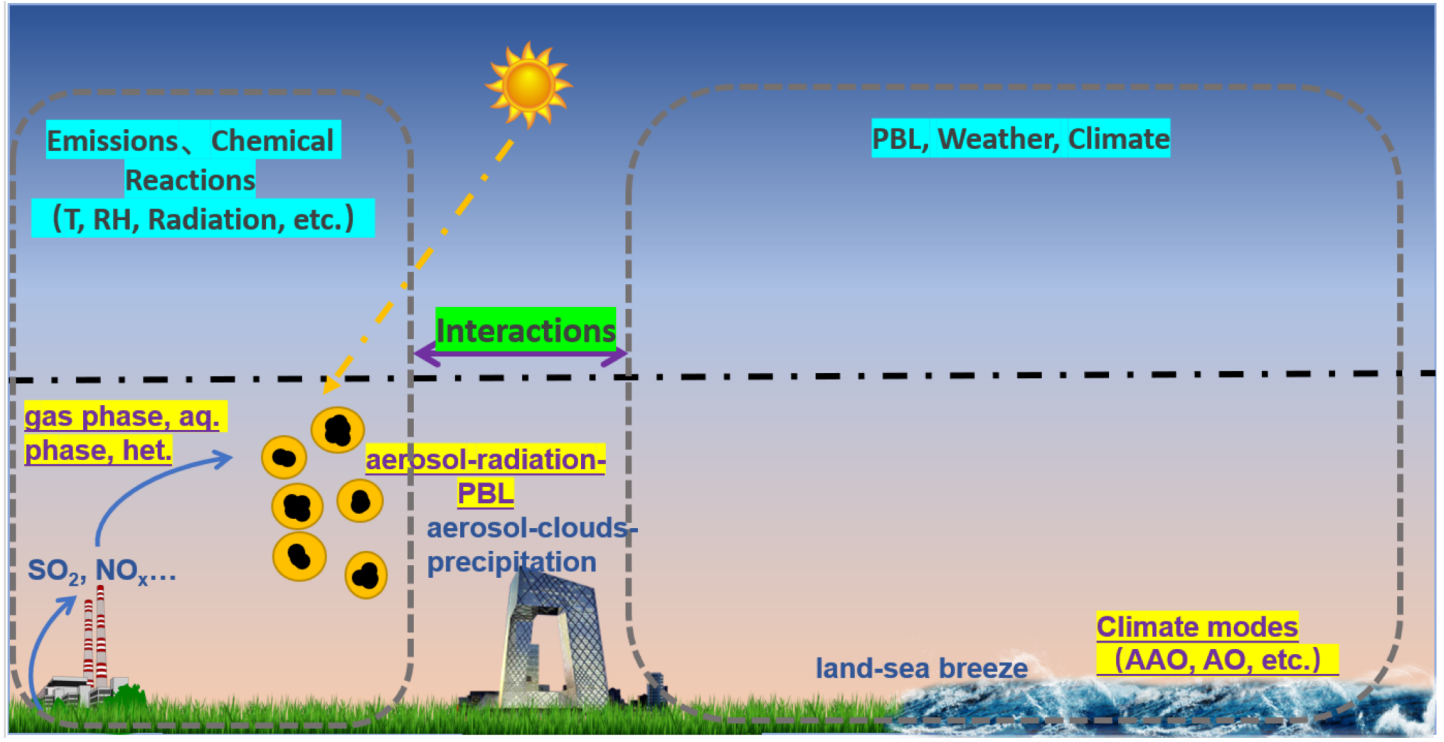
- Asking for key researchers of MICS-Asia for nomination of observation working group. Preparation of the detailed work plan of MICS-Asia Phase IV.
- Preparation of the observation data catalog in East Asia via opened databases. Update of 2020 EANET observation data and announcement of user registration.
- Discussing with the air quality model working group and the air quality and climate model working group how to implement measurement-model fusion in East Asia.
- Collaboration with TOARII East Asia Focus Working Group and arrangement of sharing the observation data in East Asia.

Gao Group for Air Quality, Health, and Climate (GGAHC)
at Hong Kong Baptist University

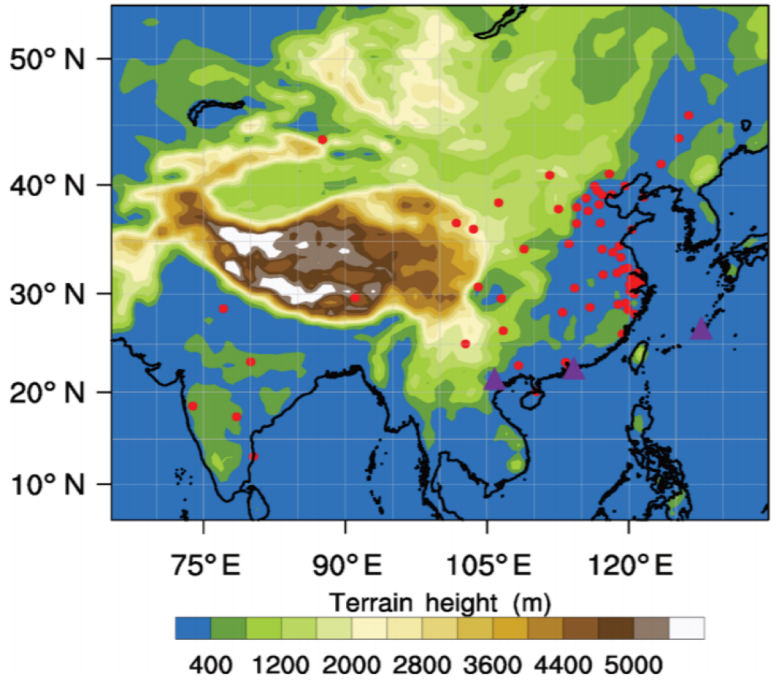
Meng GAO (高蒙)
Assistant Professor
Department of Geography
Hong Kong Baptist University
Email: mmgao2@hkbu.edu.hk

Professional Preparation

- Postdoctoral Fellow, Harvard University
- Ph.D. in Chemical Engineering, University of Iowa, USA
- B.S. in Atmospheric Physics, Nanjing University of Information Science & Technology, China

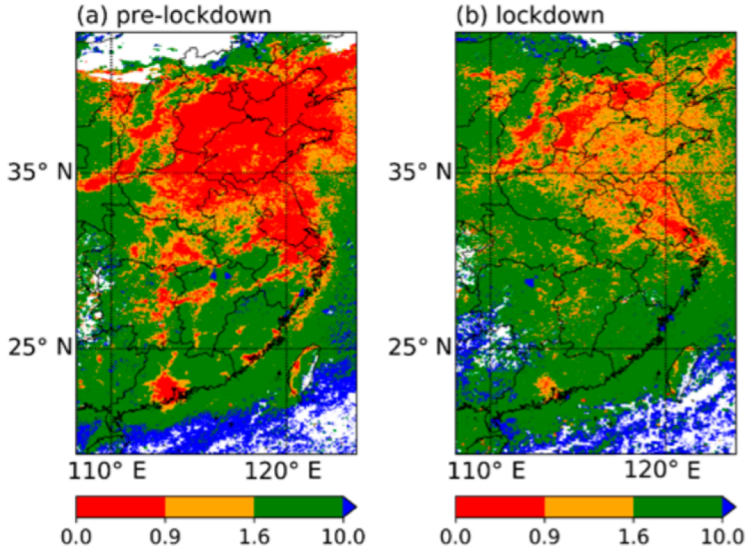


Potential contribution to TOAR-II



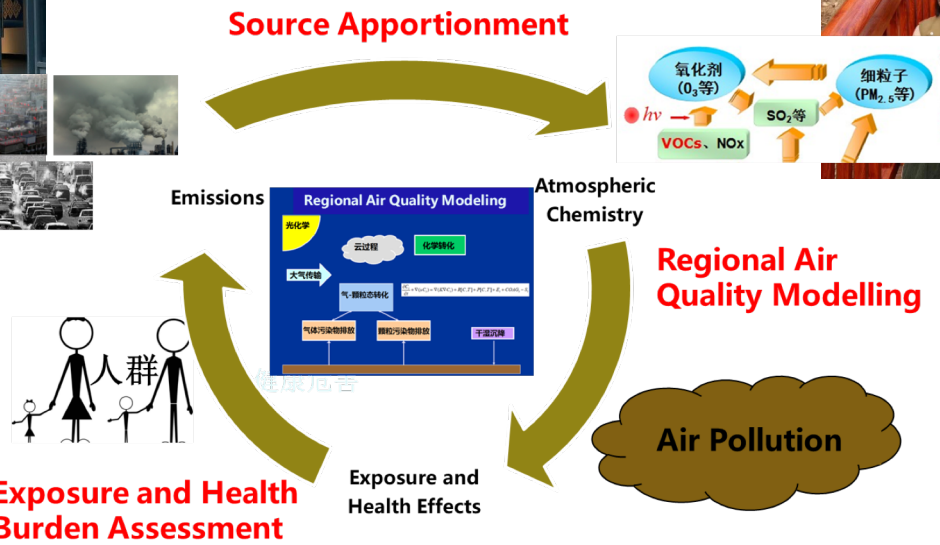
Gao et al., 2020

- WRF-Chem or WRF-GC model to understand the influences of precursors, transport, etc.
- Statistical methods (machine learning, chemical data assimilation) to fuse ozone data from multiple sources



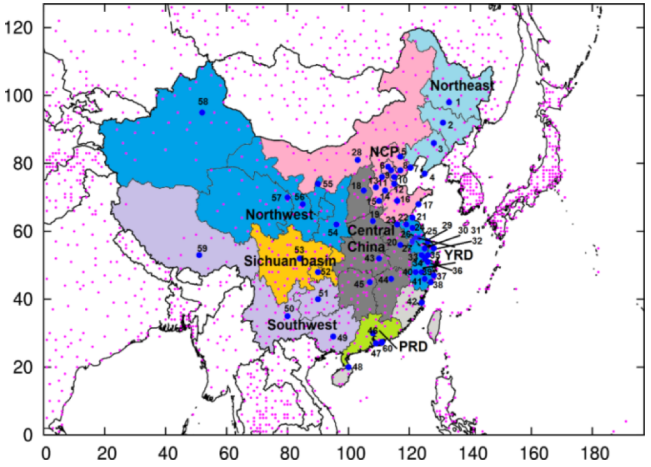
Liu et al., 2021

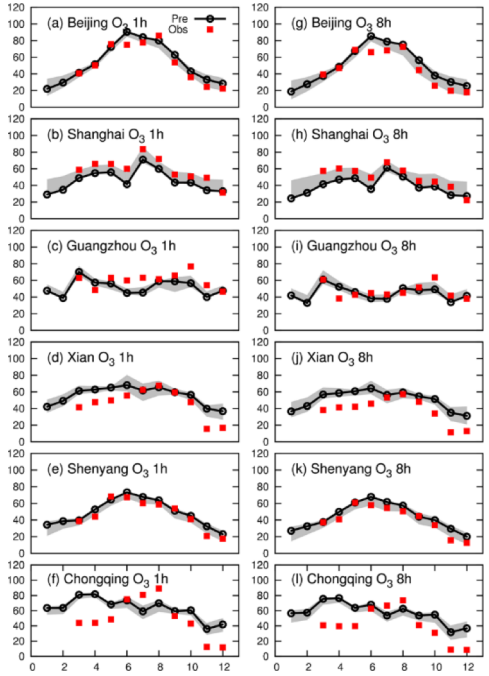
I am leading REACH group @NUIST
(Research for Energy, Air Quality, Climate, and Health)



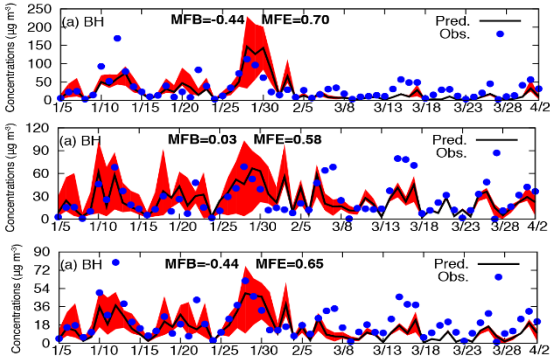
We have CMAQ prediction results in 2013-2018

- ✓ **Domain: China**
- ✓ **Grid Resolution: 36km**
- ✓ **WRFv4.0**
- ✓ **MEICv1.3+REAS2.1+MEGAN2.1+FINN**
- ✓ **CMAQ v5.2**
  - ☐ **SO_2 het. formation** Zhang et al., (2015), Hu et al. (2017)
  - ☐ **NO_2 het. formation** Zheng et al. (2015)
  - ☐ **GLY/MGLY → SOA** Fu et al., (2018), Ying et al. (2014)
  - ☐ **HO_2 uptake by $PM_{2.5}$ surface** Li et al. (2018), Xue et al. (2014)

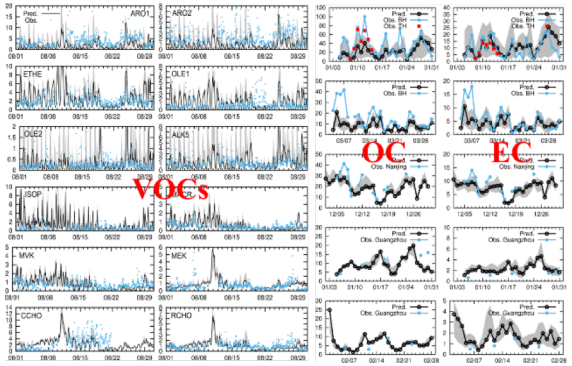




Hu, et al., 2016, ACP



Shi et al. SoTE, 2017



Hu, et al., 2017, ACP

Atmospheric Chemistry & Physics Modeling Group at Nanjing University

Xin Huang

Associate Professor

School of Atmospheric Sciences

Nanjing University

Email: xinhuang@nju.edu.cn

EDUCATION & EMPLOYMENT

Bachelor of Engineering

2005-2009 School of Environmental Science & Engineering, Shanghai Jiao Tong University

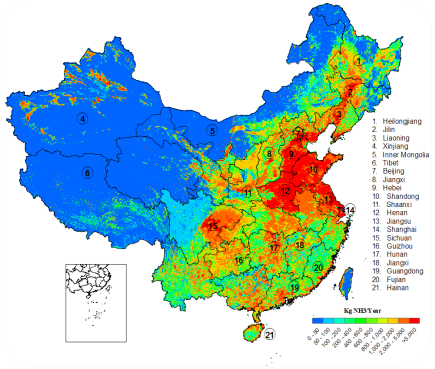
Doctor of Philosophy

2009-2014 College of Environmental Sciences & Engineering, Peking University

Research Assistant Professor

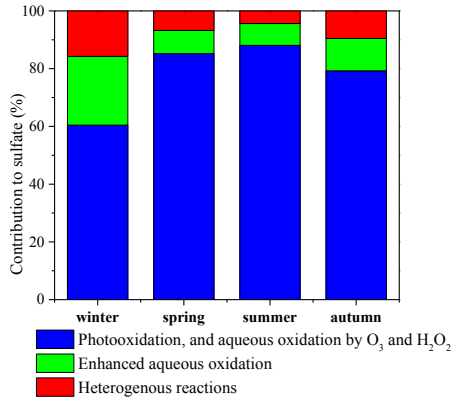
2014- School of Atmospheric Sciences, Nanjing University

- **Development of high-resolution emission inventories**

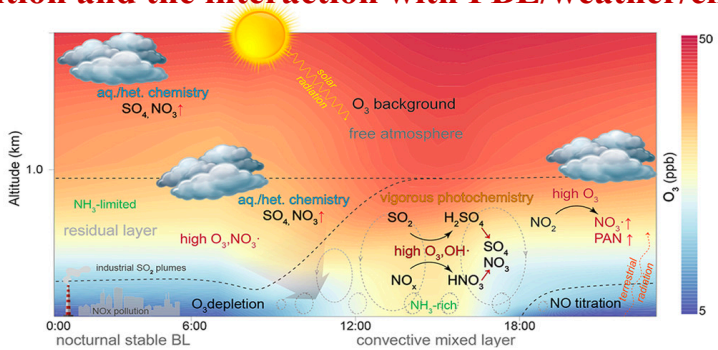


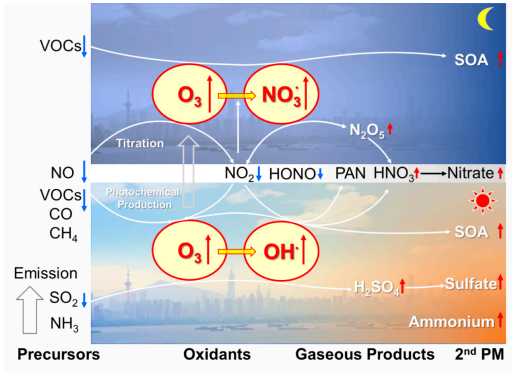
ammonia emission intensity (1km×1km)

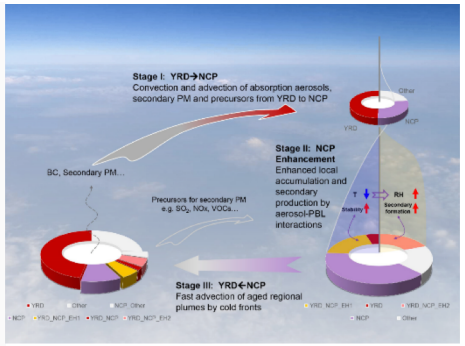
- **Improving chemical transport model in China**



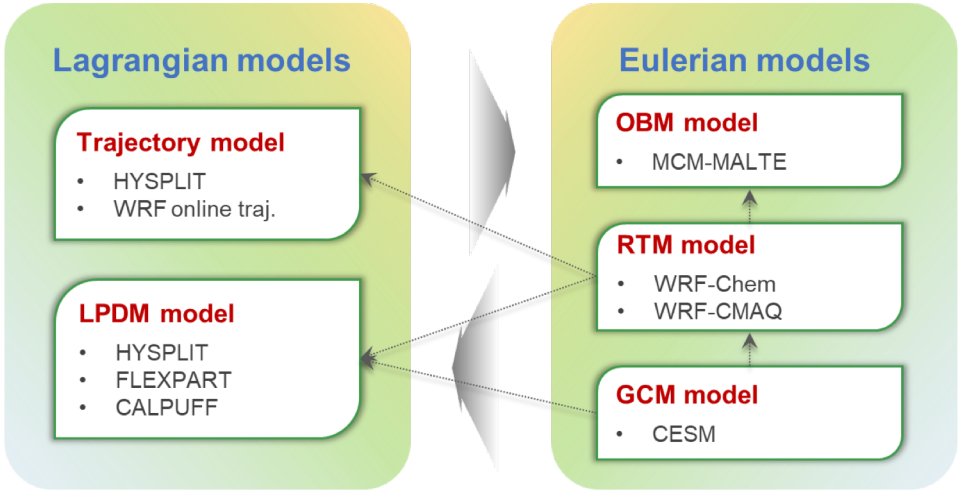
- **Air pollution and the interaction with PBL/weather/climate**



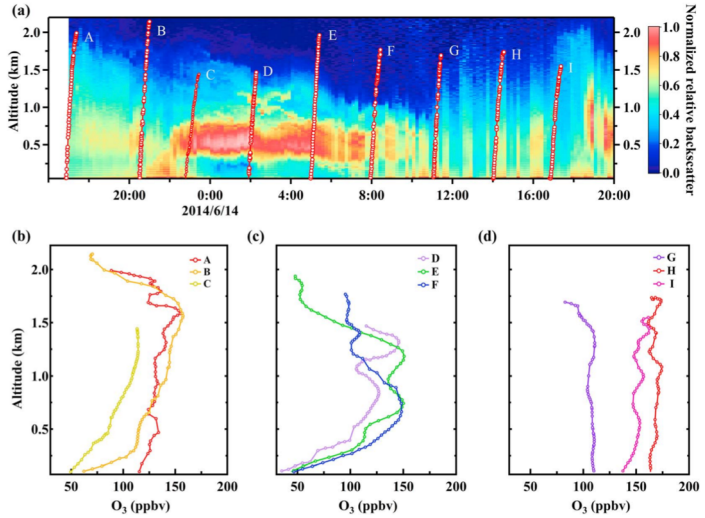




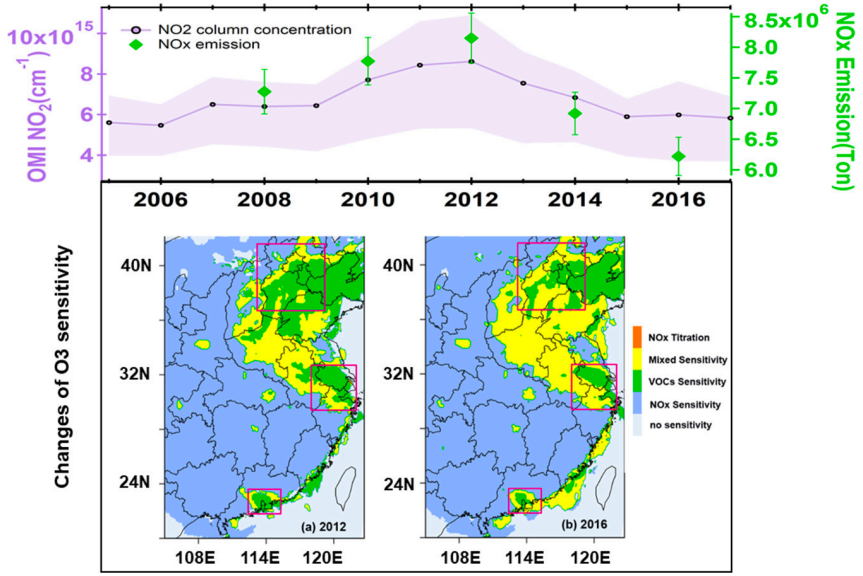
Models



Observations



Aggravating O_3 pollution in eastern China despite strict emission control



Using LPDM model and WRF-Chem model to identify the impacts from

- Emission/Urbanization
- Chemistry
- Meteorology
- Stratosphere-to-troposphere transport

Wang et al. 2019

Self-Introduction

Yiming Liu (刘一鸣)

Assistant Professor
School of Atmospheric Science
Sun Yat-sen University
Zhuhai, China

Education:

2018.6, Doctor's degree, Sun Yat-sen University

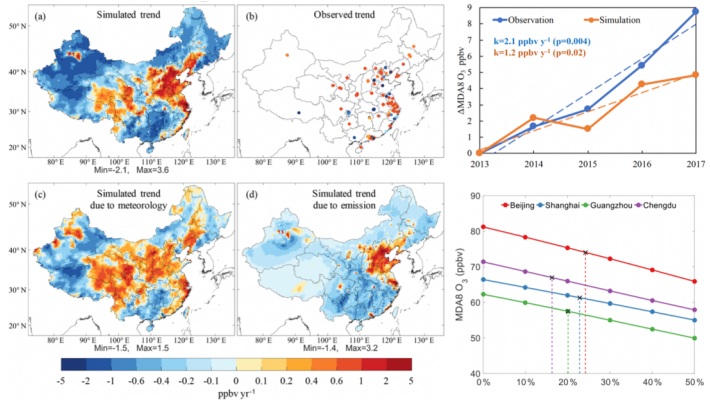
Work experience:

2018.8-2020.12 Postdoc, Hong Kong Polytechnic University (Advisor: Prof. Tao Wang)

2021.1-Now Assistant Professor, Sun Yat-sen University

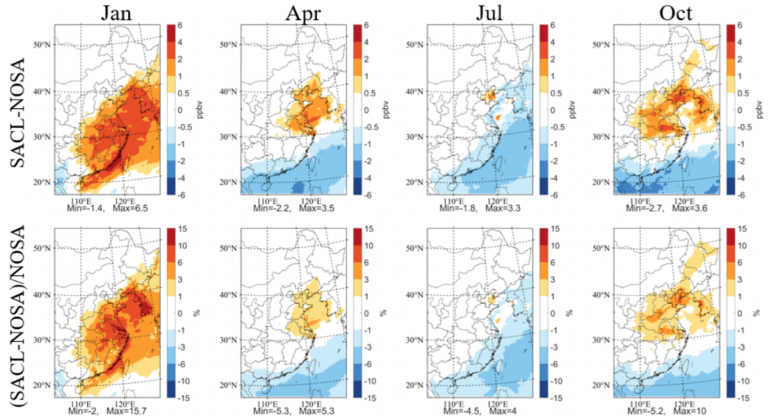
Research interest: Regional air quality modeling (CMAQ, WRF-Chem, CAMx)

Ozone trend in China and its meteorological and emission drivers



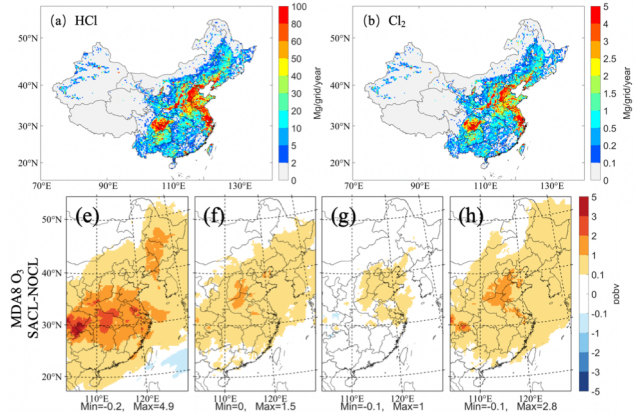
Liu & Wang, 2020 @ ACP

Sea salt emission and its impact



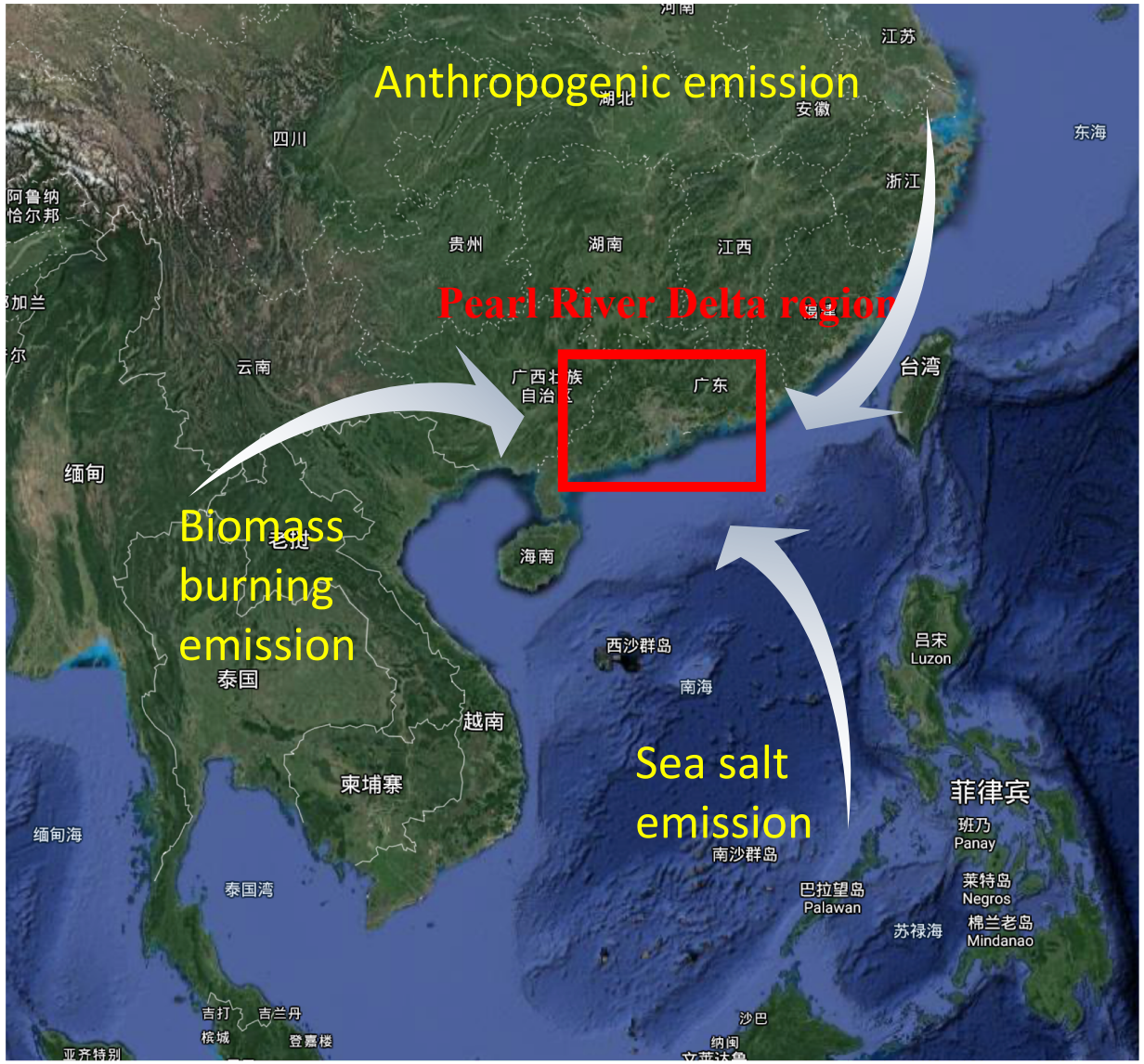
Liu et al., 2015 @ AAQR

Anthropogenic chlorine emission and its impact



Liu et al., 2018 @ ACP; Hong et al., 2020 @ STE

Possible Contribution



Modeling data contribution

- Model: WRF (3.9.1) – CMAQ (5.2.1)
- Domain: South China, Southeast Asia, and South China Sea (Pearl River Delta region as the center)
- Resolution: 27/9/3 km
- Time: 2013-Now (can be longer)
- Emissions: Anthropogenic emission, sea salt emission, Biomass burning emission, biogenic emission,
- Chemical boundary conditions: Geos-Chem (will collaborate with Dr. Xiao Lu)

Mohd Talib Latif

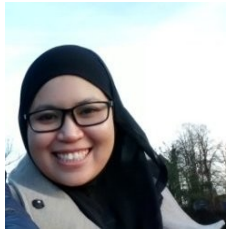
Atmospheric Chemistry and Air Pollution Research group
Universiti Kebangsaan Malaysia

MT Latif

L Ju Neng

MSM Nadzir

MCG Ooi



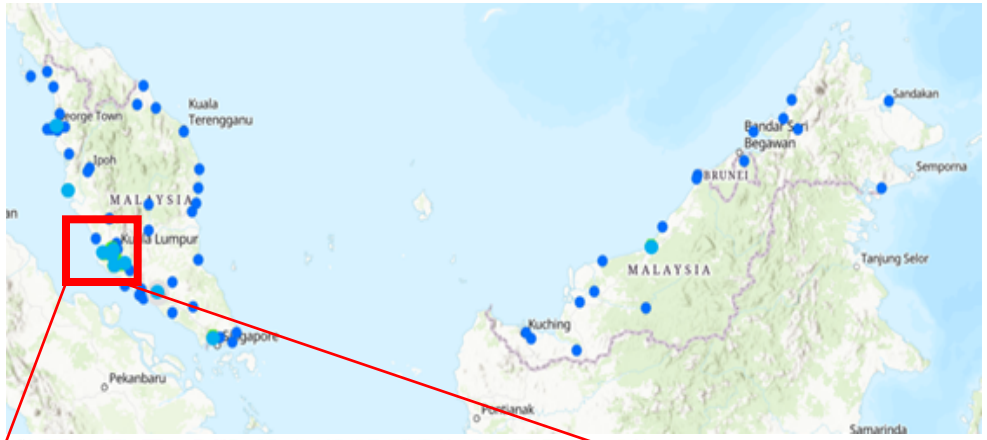
N Mohd Hanif

M Othman

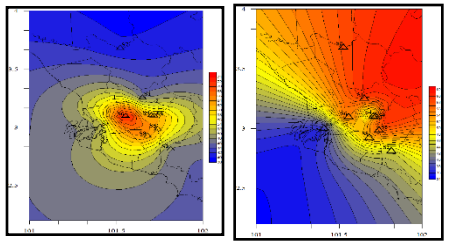
HHA Hamid

M Sahani

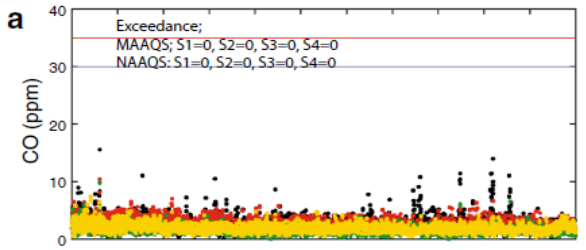
MIA Wahab

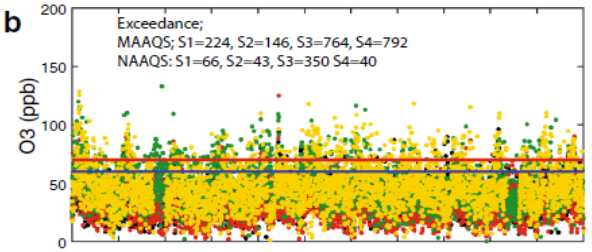


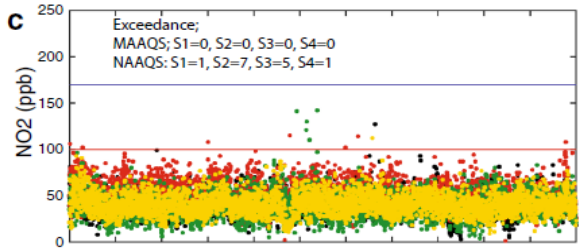
CAQMS in GKL

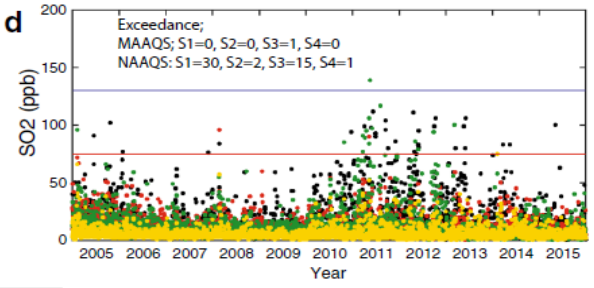


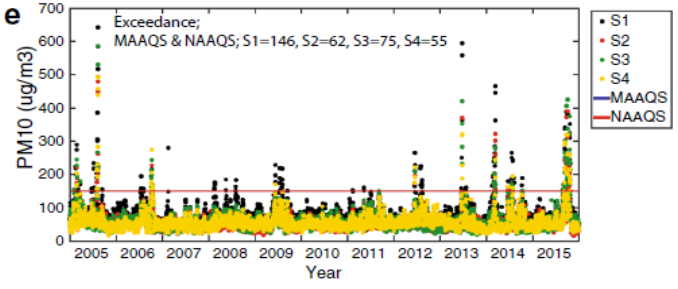
NE SW







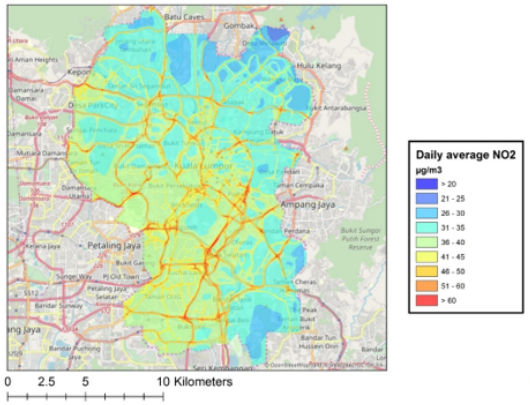




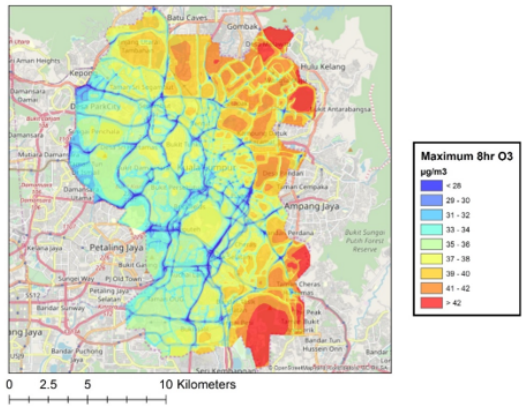
Continuous Air Quality Monitoring

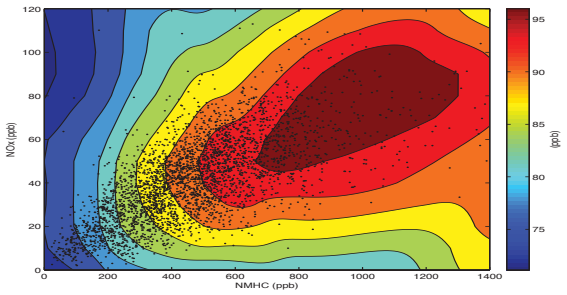
Low-cost sensor

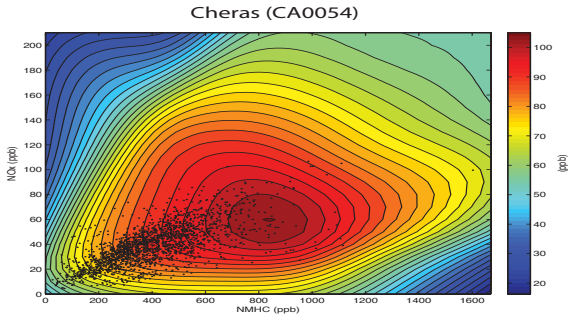
- Daily NO_2 concentrations



- Daily O_3 concentrations







Current Project

- Composition of VOCs as ozone precursors
- Assessing the impact of global temperatures on surface ozone climate change penalty in Malaysia

NSL Hawari

H Mahidin

THANK YOU

Universiti Kebangsaan Malaysia
The National University of Malaysia

https://www.ukm.my/talib/

5. Open discussion