

# Land Atmospheric Interactions in Southeast Asia – Instrumentation, Emissions Data and Research Activities

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# SEARRIN Meetings

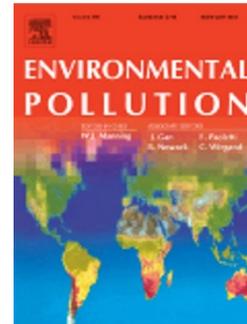
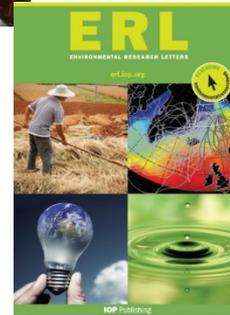


*SEARRIN-SARI is strengthening its activities through facilitating international collaborations, capacity building and publications.*



## SARI Publications

## SARI On-going collaborations



# Land Use and Emissions Meeting in Ho Chi Minh City, Vietnam (October 17-29, 2016)

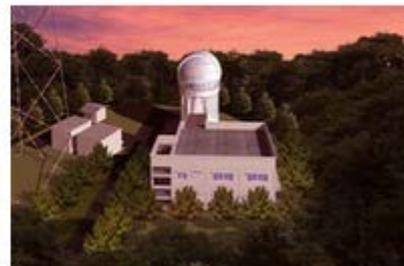


**150 attendees from different countries; Presentations to be uploaded soon to the SARI website**



TNO (Thai National Observatory)

(Chalermprakhat Astronomical Observatory Commemorating King Bhumibhol's 7th Birthday Anniversary)



Regional Observatories for the Public

In addition to the main National Observatory at Doi Inthanon, NARIT has been committed to establish 5 more regional observatories scattered through the five geographical zones of the country.



TST (Thai Southern Hemisphere Telescope)

In collaboration with the University of North Carolina at Chapel Hill



**NARIT Establishment of a National Research Center  
for Atmospheric Science (Oct 2016) – mini-Micropulse  
LiDARs (aerosol profiles up to 10 km: Jan. 2017)**

# Asian Brown Cloud – AERONET – SKYNET – Measuring Stations



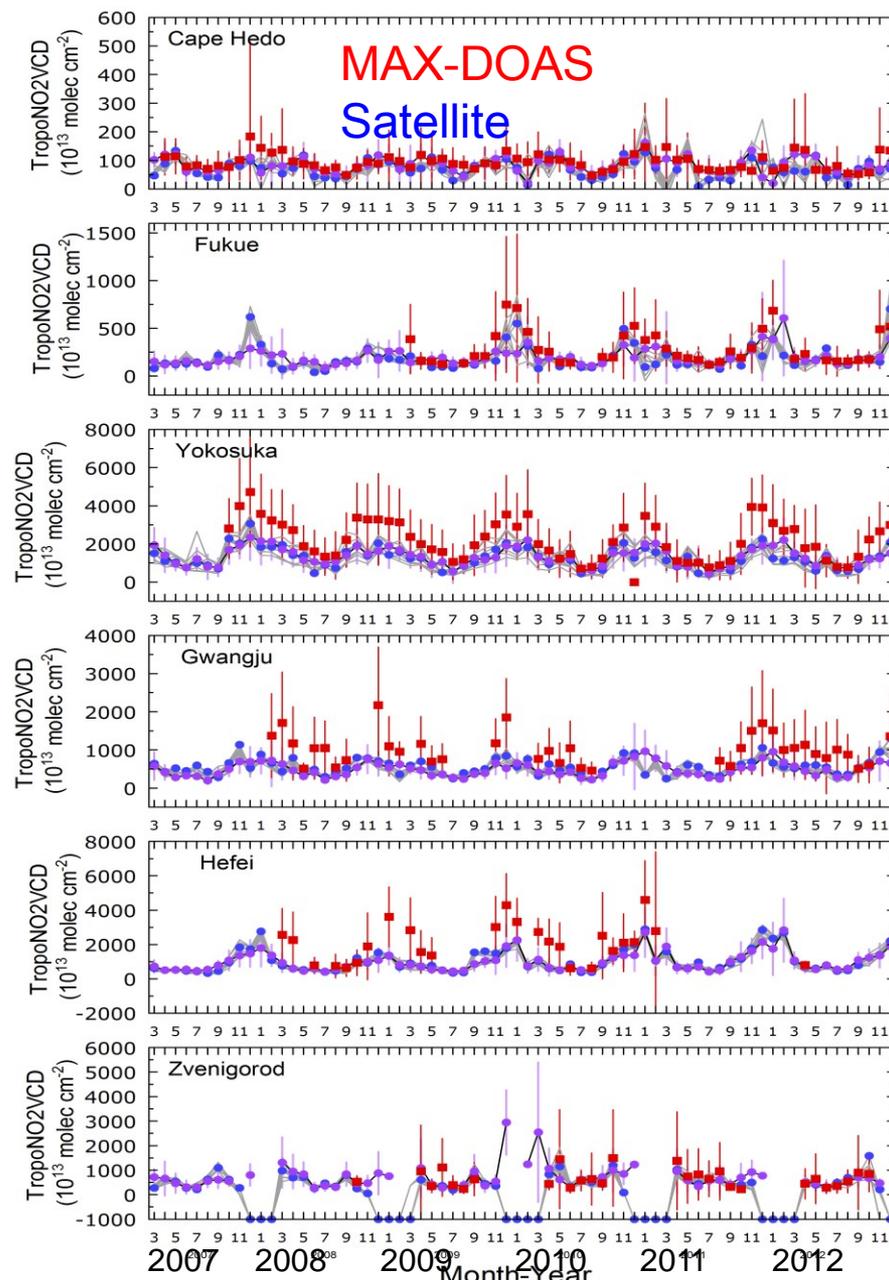
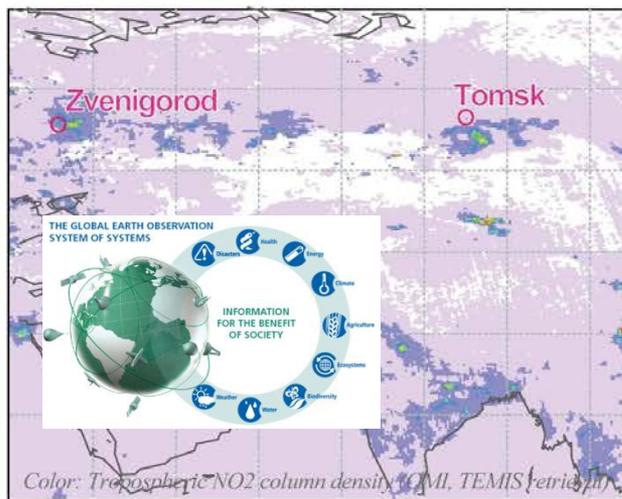
Monitoring stations for atmospheric aerosols by ABC, AERONET, and SKYNET in Asia.

**SKYNET** is an observation network to understand **aerosol -cloud-radiation interaction** in the atmosphere. The main instruments consist of a sky radiometer and radiation instruments such as a pyranometer and pyrgeometer as a basic site, and a super site has more instruments extended for analyzing atmospheric parameters of aerosol , cloud and radiation.



[http://atmos.cr.chiba-u.ac.jp/skyenet\\_index.html](http://atmos.cr.chiba-u.ac.jp/skyenet_index.html)

# MAX-DOAS network over Asia and Russia

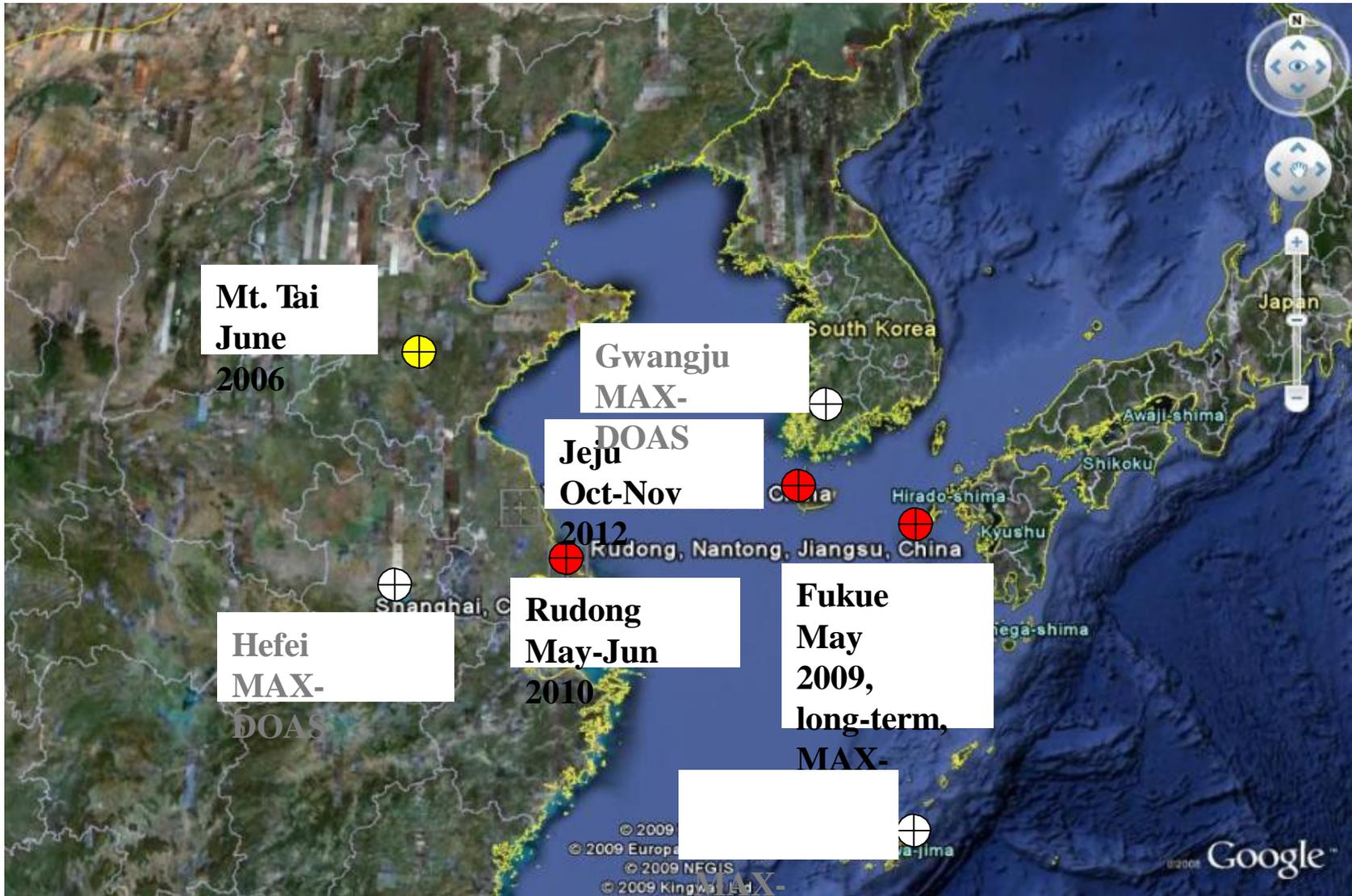


- Wanted: partners for obs in SE/S Asia!
- Climatology of NO<sub>2</sub> and aerosols
- Validation of satellite & model

<http://ebcrpa.jamstec.go.jp/maxdoashp/>

JAMSTEC - Representatives

# MAX-DOES Network over Asia – China, Korea, Japan (as of now)



MAX-DOAS

# Continuous observation of aerosols in East Asia using a ground-based lidar network (AD-NET)

Asian Dust (AD-Net) is an evolving advanced multi-  
parameter lidar network

Contact: Dr. Nobuo Sugimoto  
National Institute for Environmental Studies, Japan

## LIDAR Instrument useful for measuring:

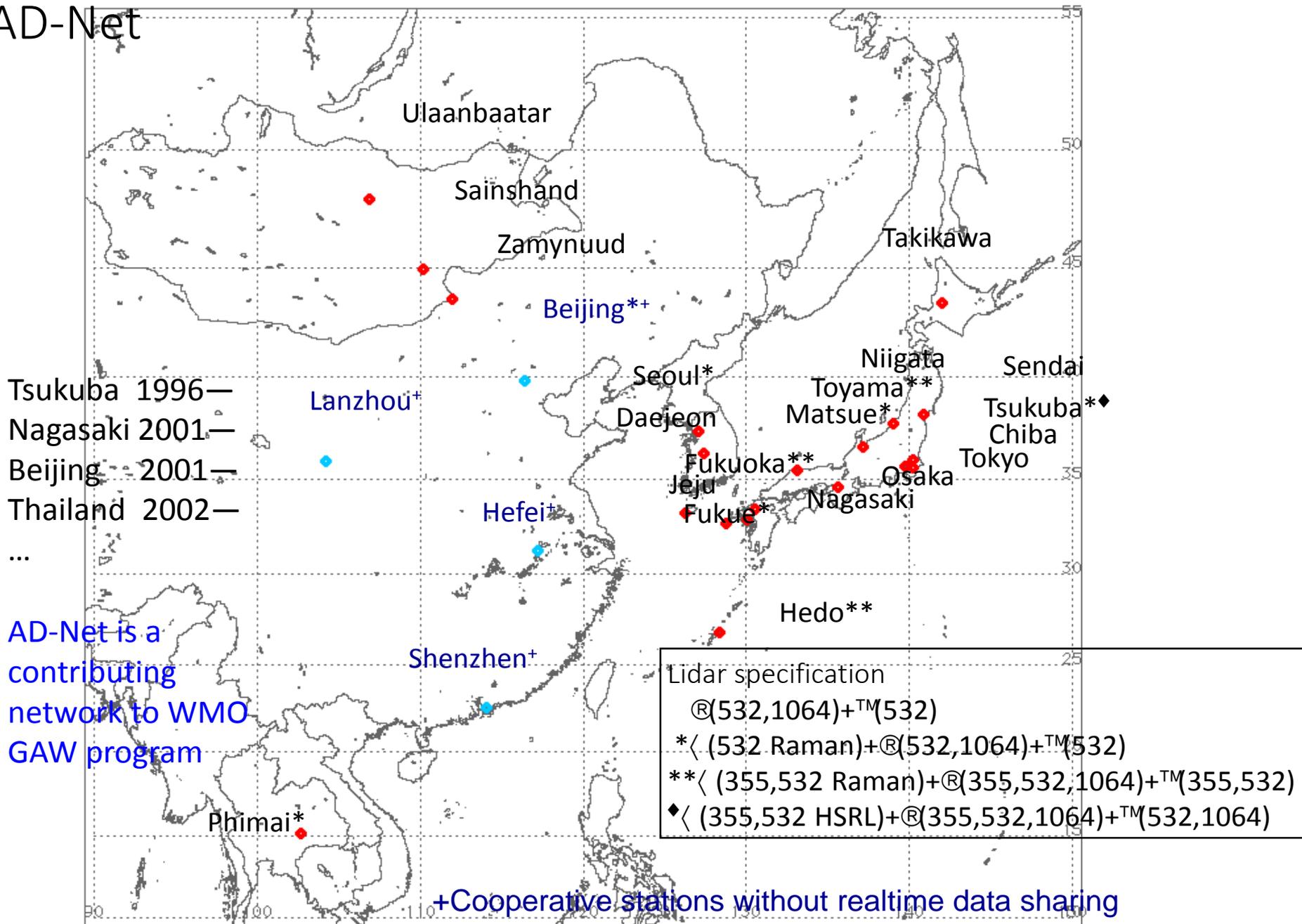
**non-spherical (dust) aerosols**  
**weak-absorption fine (sulfate, etc.)**  
**weak-absorption coarse (sea salt)**  
**strong-absorption fine (black carbon)**



**$\alpha$ : extinction,**  
 **$\beta$ : backscattering,**  
 **$\delta$ : depolarization**

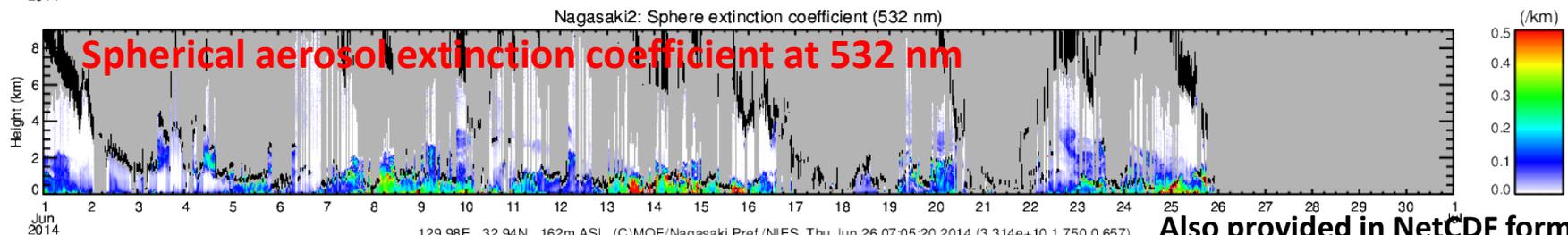
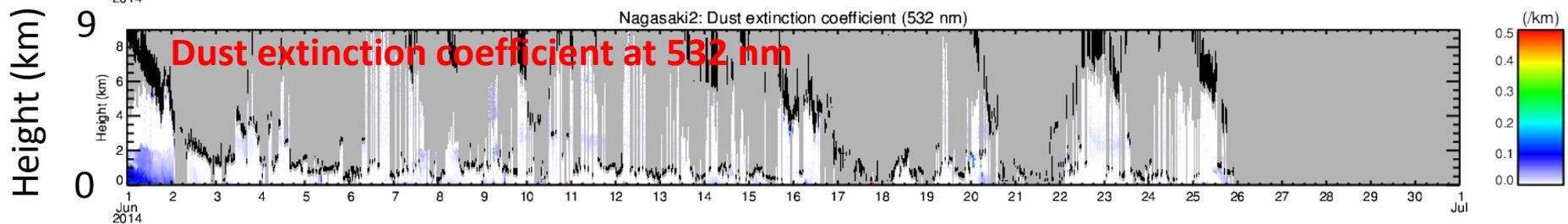
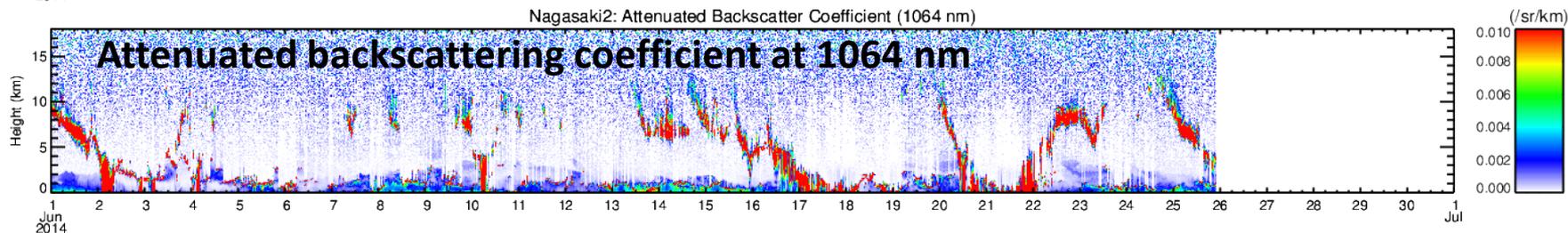
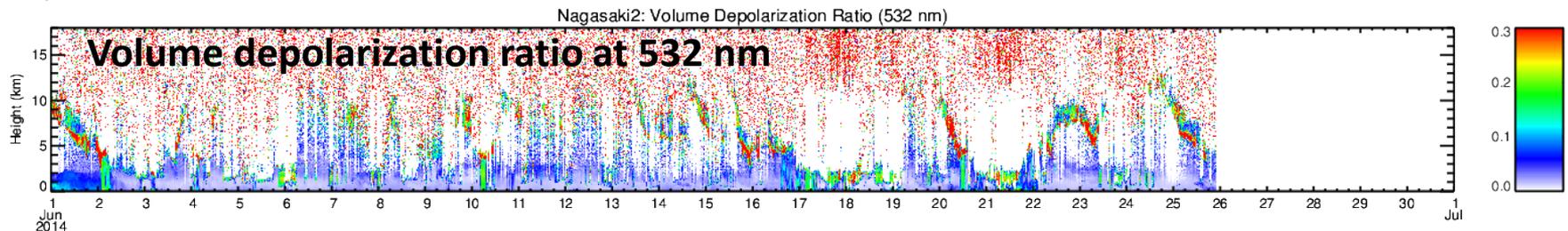
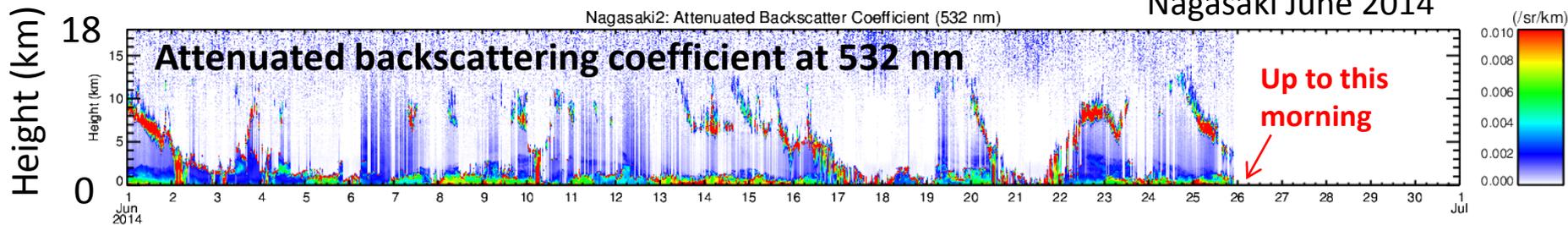
Source: Picture taken by Sugimoto, NIES, Japan

# AD-Net



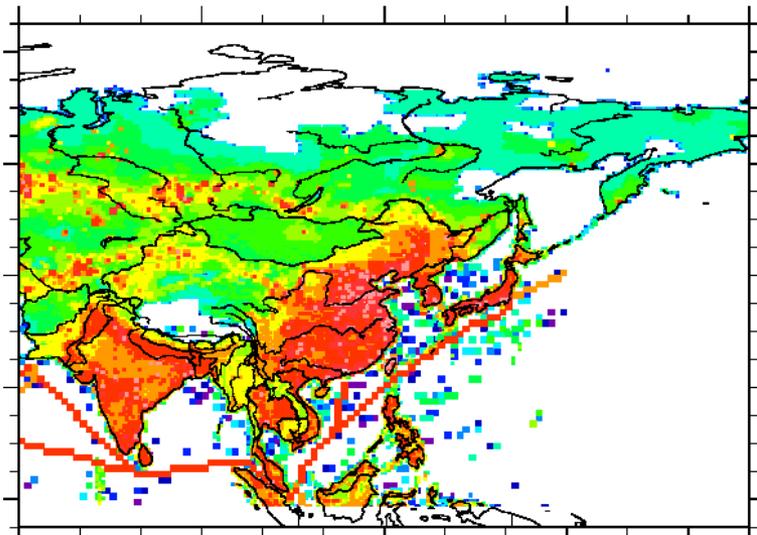
# Standard near realtime AD-Net data products (updated every hour)

Nagasaki June 2014



# Regional Emissions Inventory on Asia (REAS version 2)

NIES, Japan – Toshimasa Ohara (NIES)



Kurokawa et al., ACP, 2013, 2014

Item	Description
Target Areas	E, SE, S, and Central Asia Asian part of Russia
Target Years	2000-2008 ( - 2015)
Spatial Resolution	0.25 x 0.25 degree
Temporal Resolution	Monthly
Japan	JEI-DB/OPRF*
Korea and Taiwan	Officially estimated data

	SO <sub>2</sub>	NO <sub>x</sub>	CO	PM <sub>10</sub>	PM <sub>2.5</sub>	BC	OC	NM <sub>V</sub>	NH <sub>3</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub>
Fossil Fuel Biofuel	●	●	●	●	●	●	●	●	●	●	●	●
Industrial Process	●		●	●	●	●	●	●	●		●	●
Fertilizer use		●							●	●	●	
Livestock									●	●	●	
Others								●	●	●	●	

# Recent progress of REAS update

- ✓ Developing emission inventory system
- ✓ Historical emissions (1950 – 2011)
- ✓ Updating for recent years and collaboration with inverse modeling
  - ✓ Contact: Toshimasa Ohara (NIES) –  
[tohara@nies.go.jp](mailto:tohara@nies.go.jp)

# On-Going Campaigns

The 7-SEAS <http://7-seas.gsfc.nasa.gov/>

Investigates the impacts of aerosols on *weather and the total SE Asian environment*

- Aerosol lifecycle and air quality
- Tropical meteorology
- Radiation and heat balance
- Clouds and precipitation
- Land processes and fire
- Biomass burning



Contact George Lin ([nhlin@ncu.edu](mailto:nhlin@ncu.edu)) National Central University, Taiwan for more details; new campaign from 2017-2019

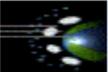
## 7-SEAS Phase III for N. Region

- **2016-2019**
- **Data analysis and modeling**
- **Regional network involvement for long-term studies**
- **Incorporation with 2018 NASA flight missions of SW monsoon studies in SE Asia**

# On-Going Campaigns

## KORUS-AQ -- An International Cooperative Air Quality Field Study in Korea

➔ Data Archive: KORUS-AQ 

➔ KORUS-AQ Data @ ASDC 

File Sharing:  
Telecons, Meetings, Presentations, etc.

Research Intentions:  
Collaboration, Analysis, Ideas, etc.

➔ Flight Summaries 

➔ KORUS-AQ Data Management 

➔ ICARTT Data Format Document

### Relevant Data / Links

- ➔ Forecast Products . . .
- ➔ Satellite Observations . . .
- ➔ Real-time Surface Observations . . .
- ➔ PANDORA Data

### Data Upload Tools

- ➔ Steps for submitting data to the Archive

### Recent Activities

- KORUS-AQ Science Team Meeting, 15-16 October 2015  
NASA Langley Research Center

KORUS-AQ offers the opportunity to further advance NASA goals and those of its international partners related to air quality through a targeted field study focused on the South Korean peninsula and surrounding waters. The study would integrate observations from aircraft, ground sites, and satellites with air quality models to understand the factors controlling air quality across urban, rural, and coastal interfaces.

KORUS-AQ serves as a model for international collaboration as Korean and U.S. scientists would cooperate on all aspects of air quality research. This would build relationships and strengthen future collaboration critical to the success of the constellation of geostationary air quality satellites to be launched by NASA, KARI, and ESA later this decade » [more](#)

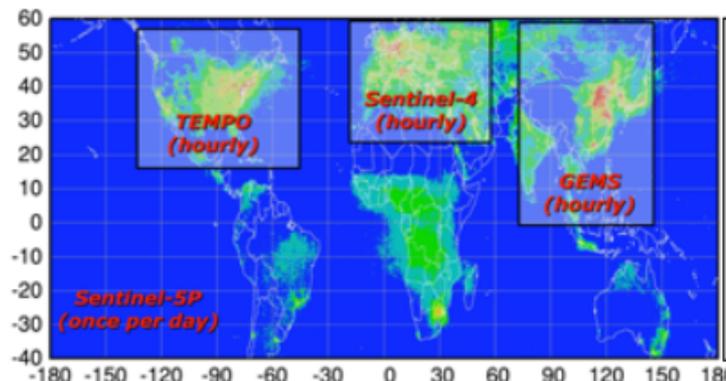
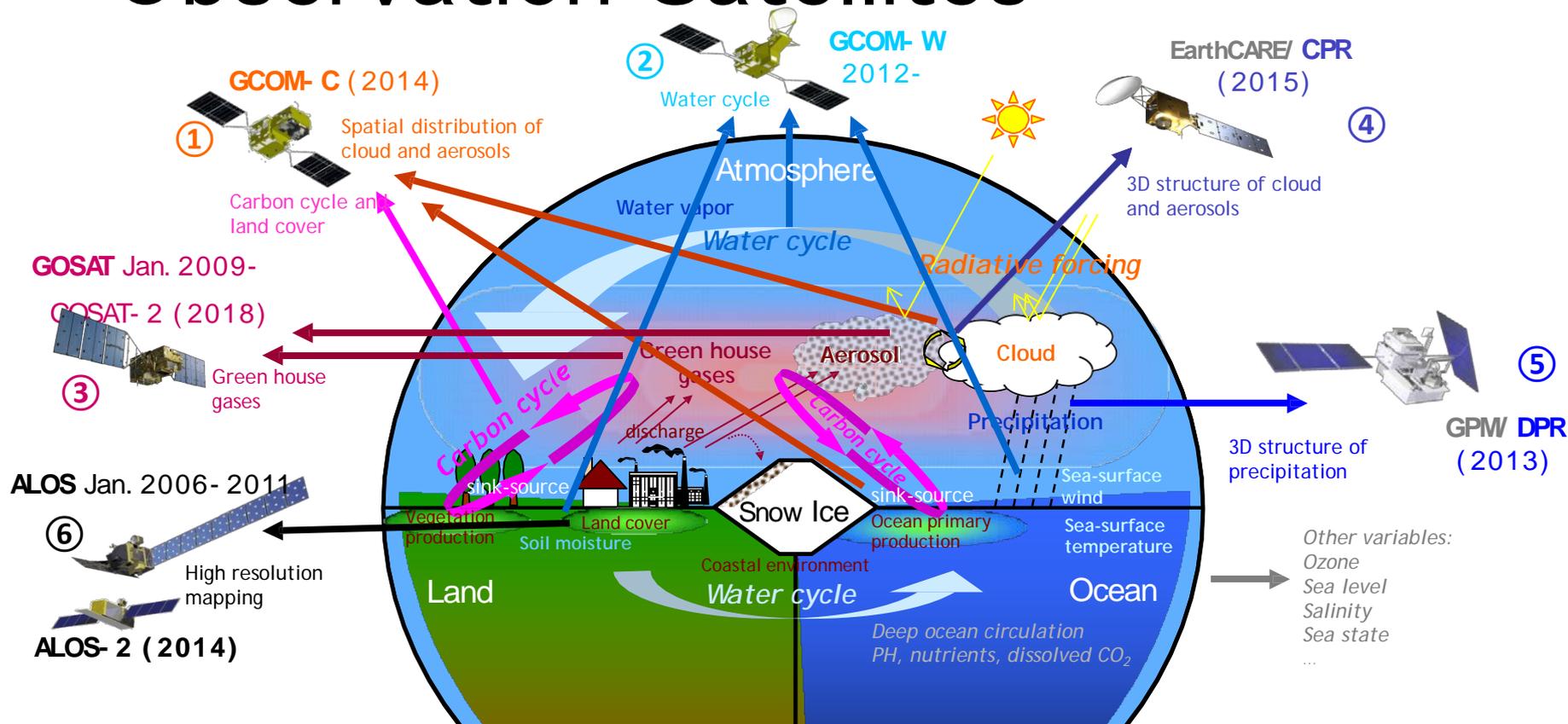


Figure 1. Global air quality satellite constellation showing expected fields of view for hourly geostationary observations from satellites positioned over North America (NASA-TEMPO), Europe (ESA-Sentinel-4), and Asia (KARI-GEMS). These observations will be supplemented by daily global views from TROPOMI onboard ESA's LEO satellite, Sentinel-5P. The background image is the global distribution of NO<sub>2</sub> as seen from space

# JAXA Earth Environment Observation Satellites



- ① **GCOM- C:** Long- term observation of the horizontal distribution of aerosol, cloud, and ecosystem CO<sub>2</sub> absorption and discharge
- ② **GCOM- W:** Long- term observation of water- cycle such as the snow/ ice coverage, water vapor, and SST
- ③ **GOSAT:** Observation of distribution and flux of the atmospheric greenhouse gases, CO<sub>2</sub> and CH<sub>4</sub>
- ④ **EarthCARE/ CPR:** Observation of vertical structure of clouds and aerosols
- ⑤ **GPM/ DPR:** Accurate and frequent observation of precipitation with active and passive sensors
- ⑥ **ALOS, - 2** Fine resolution mapping by SAR instruments

# GOSAT Satellite Series

## GOSAT, GOSAT-2, and GOSAT-3



- **GOSAT (Greenhouse gases Observing Satellite) Satellite Series** is a Japanese earth observation satellite program to monitor global atmospheric concentrations of greenhouse gases from space.
- 1<sup>st</sup> satellite, **GOSAT**, was launched in 2009 and has been obtaining **CO<sub>2</sub> and methane** concentration data for more than seven years. 2<sup>nd</sup> satellite, **GOSAT-2**, will be launched in 2018. It will measure not only CO<sub>2</sub> and methane but also **carbon monoxide and PM2.5**. The feasibility of 3<sup>rd</sup> satellite, **GOSAT-3**, will be investigated in FY2017.
- **More than 120 joint research contracts** have been concluded with **more than 20 countries** under GOSAT Research Announcement framework so far.

# Quick Overview of GOSAT and GOSAT-2

	GOSAT Specifications	GOSAT-2 Requirements
Launch year and life time	Jan. 2009, 5 years	2018, 5 years
Satellite (Dimension, mass, power)	3.7 x 1.8 x 2.0 m, 1750kg, 3.8KW (EOL)	5.3 x 2.0 x 2.8 m, <2000kg, 5.0KW
Orbit (Type, altitude, repeat cycle, equator crossing time)	Sun synchronous, 666 km, 3 days, 13:00	Sun synchronous, <b>613 km, 6 days</b> , 13:00±15 min
Target gases	CO <sub>2</sub> , CH <sub>4</sub> , O <sub>2</sub> , O <sub>3</sub> , H <sub>2</sub> O	CO <sub>2</sub> , CH <sub>4</sub> , O <sub>2</sub> , O <sub>3</sub> , H <sub>2</sub> O, <b>CO</b>
Fourier Transform Spectrometer (FTS and FTS-2)	Band 1 : 0.76 – 0.78 μm Band 2 : 1.56 – 1.72 μm Band 3 : 1.92 – 2.08 μm Band 4 : 5.6 – 14.3 μm  IFOV = 10.5 kmφ Pointing = ±20° (AT), ±35° (CT) Polarimetry = Band 1, 2, 3	Band 1 : 0.75 – 0.77 μm Band 2 : 1.56 – 1.69 μm Band 3 : 1.92 – <b>2.33</b> μm Band 4 : 5.5 – 8.4 μm Band 5 : 8.4 – 14.3 μm IFOV = 9.7 kmφ Pointing = <b>±40°</b> (AT), ±35° (CT) Polarimetry = Band 1, 2, 3
Cloud and Aerosol Imager (CAI and CAI-2)	Nadir  B1 = 380 nm B2 = 674 nm B3 = 870 nm B4 = 1600 nm  B1-B3 = 500 m / 1000 km, B4 = 1500 m / 750 km	<b>B1-5: forward (+20° ), B6-10:backward(-20° )</b>  B1 = <b>343</b> nm    B6 = 380 nm B2 = <b>443</b> nm    B7 = <b>550</b> nm B3 = 674 nm    B8 = 674 nm B4 = 869 nm    B9 = 869 nm B5 = 1630 nm    B10= 1630 nm B1-B4, B6-B9= 460 m / 920 km B5, B10 = <b>920 m / 920 km</b>
Other new features of GOSAT-2 FTS-2	<b>Intelligent pointing using FTS-2 FOV camera, fully programmable (target mode) observation, and improved SNR.</b>	

# A New TCCON Site in Philippines

(Total Carbon Column Observing Network)

## ● FY 2014

- Potential sites were identified and visited.
- Bruker 125 HR FTS with solar tracker were installed in the container at NIES.

## ● FY2015

- Decide the site considering scientific, logistical, and human resource aspects. => **Burgos**
- Negotiate with various stakeholders and conclude MOU.
- Adjust and evaluate the newly procured FTS at NIES

## ● FY2016

- Conclude all the contracts
- Move FTS from Tsukuba to the site and start its operation



a) Locations of three candidate sites in Philippines, b) Landscape at Burgos, c) Installation of a container for FTS at NIES, d) A high resolution FTS in the container.





## Welcome to SARI

The goal of SARI is to develop an innovative regional research, education, and capacity building program involving state-of-the-art remote sensing, natural sciences, engineering and social sciences to enrich Land Cover/Land Use Change (LCLUC) science in South Asia. Our objectives are twofold. First, we aim to advance LCLUC science in the region. Second, we endeavor to strengthen existing and build new collaborations between US and South Asia researchers in the areas of LCLUC research. To address LCLUC science, SARI will utilize a systems approach to problem-solving that examines both biophysical and socioeconomic aspects of land systems, including the interactions between land use and climate and the interrelationships among policy, governance, and land use. A central component of this initiative will be the use of geospatial data from both remotely sensed and in situ sources and models. To strengthen the theoretical underpinnings of LCLUC science in the South Asian region, SARI will facilitate:

- a) new partnerships with space agencies, universities and non-government organizations;
- b) novel and regionally-appropriate methodologies and algorithms for LCLUC products;
- c) data sharing mechanisms;
- d) leadership training;
- e) international workshops to identify regional priorities, discuss and share scientific findings;
- f) capacity building programs; and
- g) international student/researcher exchanges, including among LCLUC scientists in the region.

SARI will serve as a facilitator and catalyst for LCLUC research in South Asia. The outputs will be beneficial to the U.S., South Asia and international researchers and will serve as a model for interdisciplinary research that links LCLUC science with NASA assets.

# SARI website

# [www.sari.umd.edu](http://www.sari.umd.edu)