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

Krishna Prasad Vadrevu
NASA MSFC (ZP11)

Adjunct Associate Professor
Dept. of Geographical Sciences
University of Maryland College Park, USA
SEARRIN-SARI is strengthening its activities through facilitating international collaborations, capacity building and publications.
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
NARIT Establishment of a National Research Center for Atmospheric Science (Oct 2016) – mini-Micropulse LiDARs (aerosol profiles up to 10 km: Jan. 2017)

TNO (Thai National Observatory)
(Chalermprakiat Astronomical Observatory Commemorating King Bhumibol’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
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/skynet_index.html
Wanted: partners for obs in SE/S Asia!
Climatology of NO2 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)
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
non-spherical (dust) aerosols
weak-absorption fine (sulfate, etc.)
weak-absorption coarse (sea salt)
strong-absorption fine (black carbon)
AD-Net is a contributing network to WMO GAW program.
Standard near realtime AD-Net data products (updated every hour)

Up to this morning

Also provided in NetCDF format
### Regional Emissions Inventory on Asia (REAS version 2)

**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

**Emissions Inventory Items:**
- SO₂, NOₓ, CO, PM₁₀, PM₂.₅, BC, OC, NMV, NH₃, CH₄, N₂O, CO₂

### Emission Sources

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fossil Fuel</td>
<td></td>
</tr>
<tr>
<td>Biofuel</td>
<td>● ● ● ● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>Industrial</td>
<td>● ● ● ● ● ● ● ● ● ●</td>
</tr>
<tr>
<td>Process</td>
<td></td>
</tr>
<tr>
<td>Fertilizer use</td>
<td>●</td>
</tr>
<tr>
<td>Livestock</td>
<td>● ● ●</td>
</tr>
<tr>
<td>Others</td>
<td>● ● ● ●</td>
</tr>
</tbody>
</table>

*Kurokawa et al., ACP, 2013, 2014*
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
The 7-SEAS [http://7-seas.gsfc.nasa.gov/](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

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.
JAXA Earth Environment Observation Satellites

1. GCOM-C (2014)
   - Long-term observation of the horizontal distribution of aerosol, cloud, and ecosystem CO₂ absorption and discharge

2. GCOM-W 2012-
   - Long-term observation of water cycle such as the snow/ice coverage, water vapor, and SST

3. GOSAT Jan. 2009-
   - Observation of distribution and flux of the atmospheric greenhouse gases, CO₂ and CH₄

4. EarthCARE/ CPR: Observation of vertical structure of clouds and aerosols

5. GPM/ DPR: Observation of cloud and aerosols

   - Accurate and frequent observation of precipitation with active and passive sensors

ALOS-2 (2014)
   - Fine resolution mapping by SAR instruments

Other variables:
- Ozone
- Sea level
- Salinity
- Sea state
...
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.

- 1st satellite, **GOSAT**, was launched in 2009 and has been obtaining CO₂ and methane concentration data for more than seven years. 2nd satellite, **GOSAT-2**, will be launched in 2018. It will measure not only CO₂ and methane but also carbon monoxide and PM2.5. The feasibility of 3rd 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

<table>
<thead>
<tr>
<th></th>
<th>GOSAT Specifications</th>
<th>GOSAT-2 Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch year and life time</td>
<td>Jan. 2009, 5 years</td>
<td>2018, 5 years</td>
</tr>
<tr>
<td>Satellite (Dimension, mass, power)</td>
<td>3.7 x 1.8 x 2.0 m, 1750kg, 3.8KW (EOL)</td>
<td>5.3 x 2.0 x 2.8 m, &lt;2000kg, 5.0KW</td>
</tr>
<tr>
<td>Orbit (Type, altitude, repeat cycle, equator crossing time)</td>
<td>Sun synchronous, 666 km, 3 days, 13:00</td>
<td>Sun synchronous, 613 km, 6 days, 13:00±15 min</td>
</tr>
<tr>
<td>Target gases</td>
<td>CO₂, CH₄, O₂, O₃, H₂O</td>
<td>CO₂, CH₄, O₂, O₃, H₂O, CO</td>
</tr>
<tr>
<td>Fourier Transform Spectrometer</td>
<td>Band 1 : 0.76 – 0.78 µm</td>
<td>Band 1 : 0.75 – 0.77 µm</td>
</tr>
<tr>
<td></td>
<td>Band 2 : 1.56 – 1.72 µm</td>
<td>Band 2 : 1.56 – 1.69 µm</td>
</tr>
<tr>
<td></td>
<td>Band 3 : 1.92 – 2.08 µm</td>
<td>Band 3 : 1.92 – 2.33 µm</td>
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<tr>
<td></td>
<td>Band 4 : 5.6 – 14.3 µm</td>
<td>Band 4 : 5.5 – 8.4 µm</td>
</tr>
<tr>
<td></td>
<td>IFOV = 10.5 kmφ</td>
<td>IFOV = 9.7 kmφ</td>
</tr>
<tr>
<td></td>
<td>Pointing = ±20° (AT), ±35° (CT)</td>
<td>Pointing = ±40° (AT), ±35° (CT)</td>
</tr>
<tr>
<td></td>
<td>Polarimetry = Band 1, 2, 3</td>
<td>Polarimetry = Band 1, 2, 3</td>
</tr>
<tr>
<td>Cloud and Aerosol Imager</td>
<td>Nadir</td>
<td>B1-5: forward (+20°), B6-10: backward(-20°)</td>
</tr>
<tr>
<td></td>
<td>B1 = 380 nm</td>
<td>B1 = 343 nm</td>
</tr>
<tr>
<td></td>
<td>B2 = 674 nm</td>
<td>B6 = 380 nm</td>
</tr>
<tr>
<td></td>
<td>B3 = 870 nm</td>
<td>B2 = 443 nm</td>
</tr>
<tr>
<td></td>
<td>B4 = 1600 nm</td>
<td>B7 = 550 nm</td>
</tr>
<tr>
<td></td>
<td>B1-B3 = 500 m / 1000 km, B4 = 1500 m / 750 km</td>
<td>B3 = 674 nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B8 = 674 nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B4 = 869 nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B9 = 869 nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B5 = 1630 nm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>B10= 1630 nm</td>
</tr>
<tr>
<td>Other new features of GOSAT-2 FTS-2</td>
<td>Intelligent pointing using FTS-2 FOV camera, fully programmable (target mode) observation, and improved SNR.</td>
<td></td>
</tr>
</tbody>
</table>
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 oh 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:

- new partnerships with space agencies, universities and non-government organizations;
- novel and regionally-appropriate methodologies and algorithms for LCLUC products;
- data sharing mechanisms;
- leadership training;
- international workshops to identify regional priorities, discuss and share scientific findings;
- capacity building programs; and
- 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