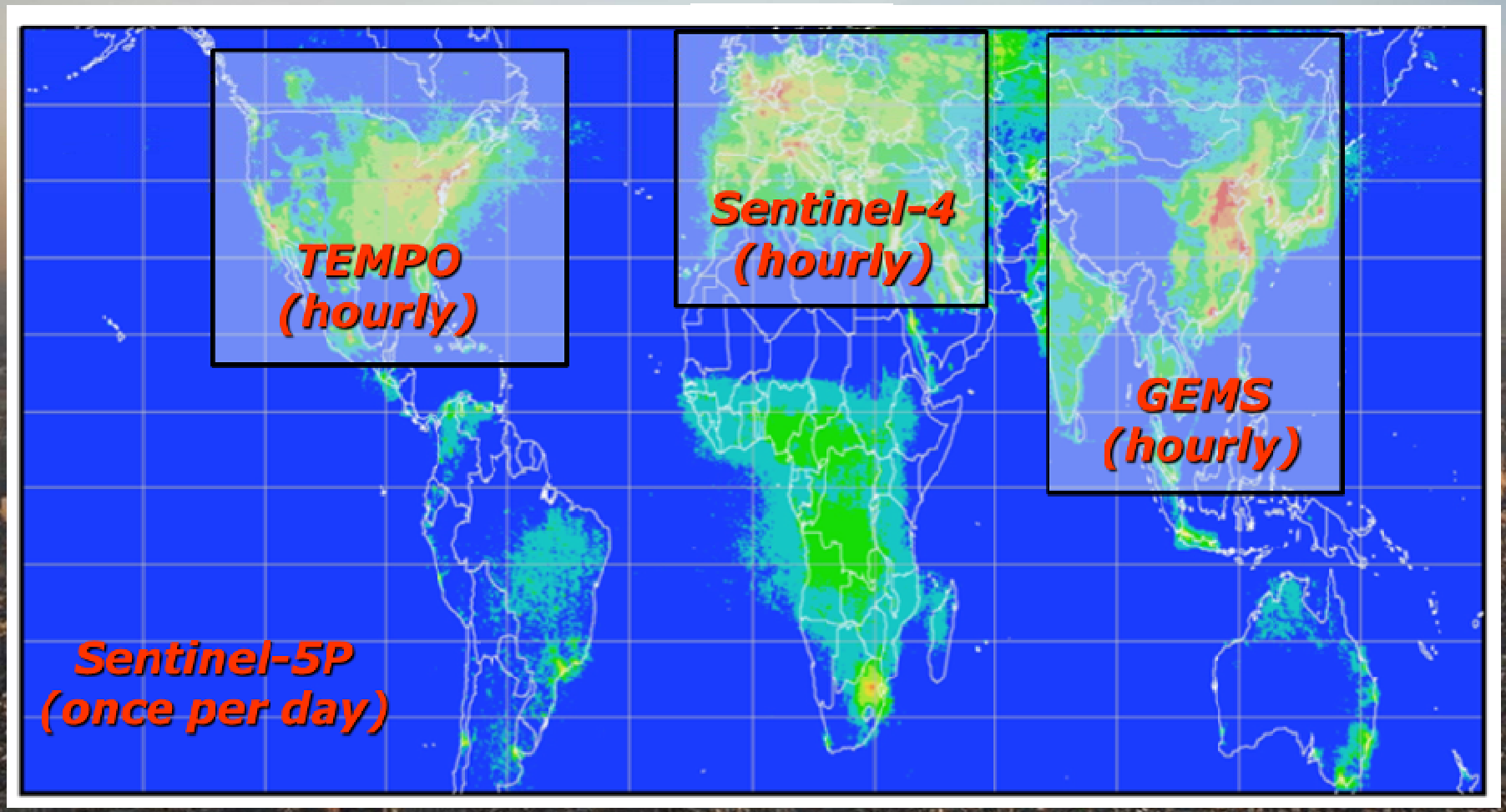
The Korea-U.S. Air Quality Study (KORUS-AQ)

NIER
(National Institute of Environmental Research)

NASA
(National Aeronautics and Space Administration)

Importance of GEMS

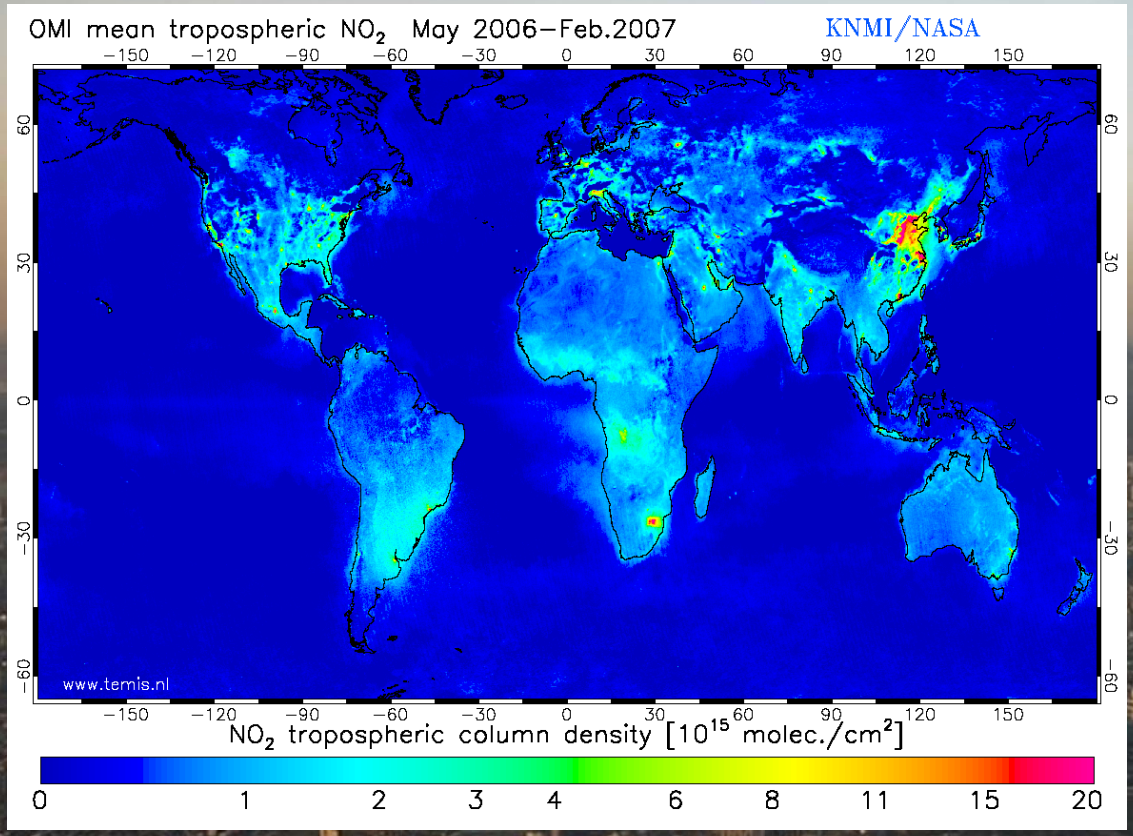
Global Air Quality Satellite Constellation Picture from [KORUS-AQ white paper]



1. GEMS covers the Asian part of the world
   and supports the global coverage of geostationary satellite monitoring

Importance of GEMS

Picture from [http://www.temis.nl/products/no2.html]



2. High concentrations of pollutants

- High signal to observe
- May provide a chance to verify our contemporary understanding in air quality
  (could be reproductive phenomena of 70's and 80's pollution issues in western country)

Helpful for establishing effective control strategies for future by taking advantage of the accumulative experiences of western countries and well established mechanical understanding in air quality controlling processes.

Importance of GEMS

Topography of NE Asia

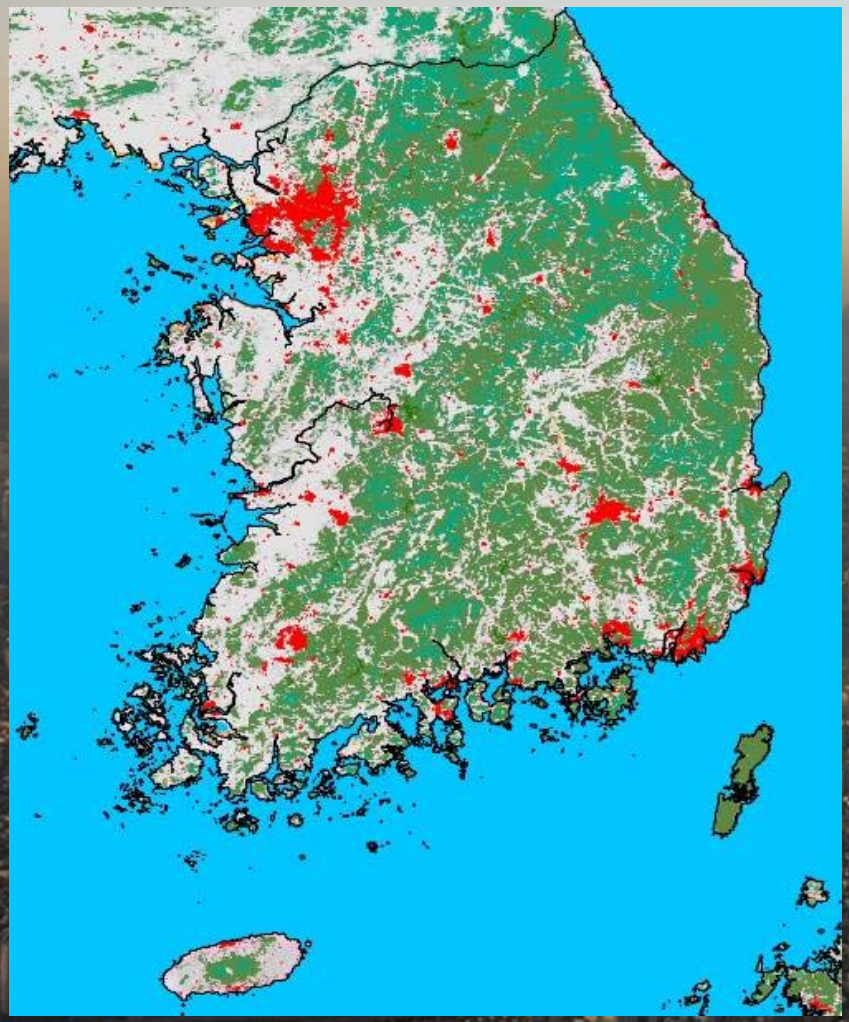
Picture from [http://www.ngii.go.kr/en/contents/contentsView.do?rbsIdx=58]

3. Complex terrain may challenges the satellite retrievals

- Good subject domain for testing the satellite retrieval algorithms

Importance of GEMS

Land use map of Korea
Picture from [KORUS-AQ white paper]



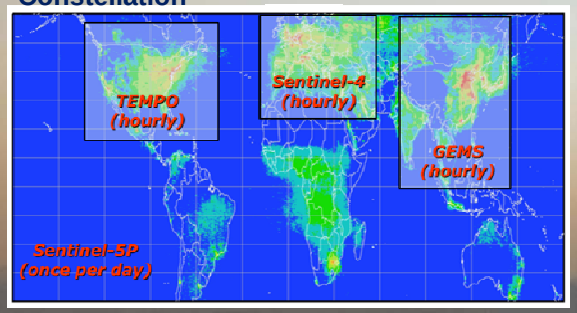
Red: urban
Green: forests
Gray: croplands

4. Suitable location for scientific studies on anthropogenic and biogenic interaction

- The land use patterns on Korean peninsular are complicated.
- Important location for testing the satellite retrieval algorithms and developing our knowledge in human-atmosphere-biosphere interactions

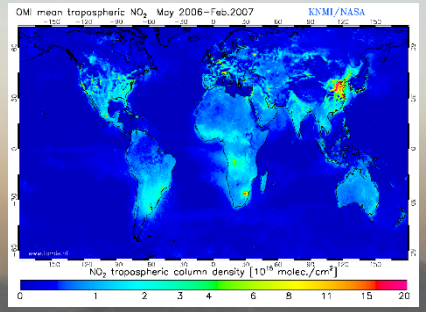
Importance of GEMS & KORUS-AQ

Global Air Quality Satellite Constellation



Support global coverage

NO_2 map



High conc. of pollutants

Topography of NE Asia

Complex terrain

Land use map of Korea

New scientific interests

KORUS-AQ

To provide most up-to-date in situ and remote monitored air quality data from multi-platform (ground-, ship- and air- borne) observations.

KORUS-AQ

KORUS-AQ is an collaborative field mission btw. NIER & NASA

NIER

NASA

There are opportunities for other prospective collaborations!

If you are interested in this mission, contact us!

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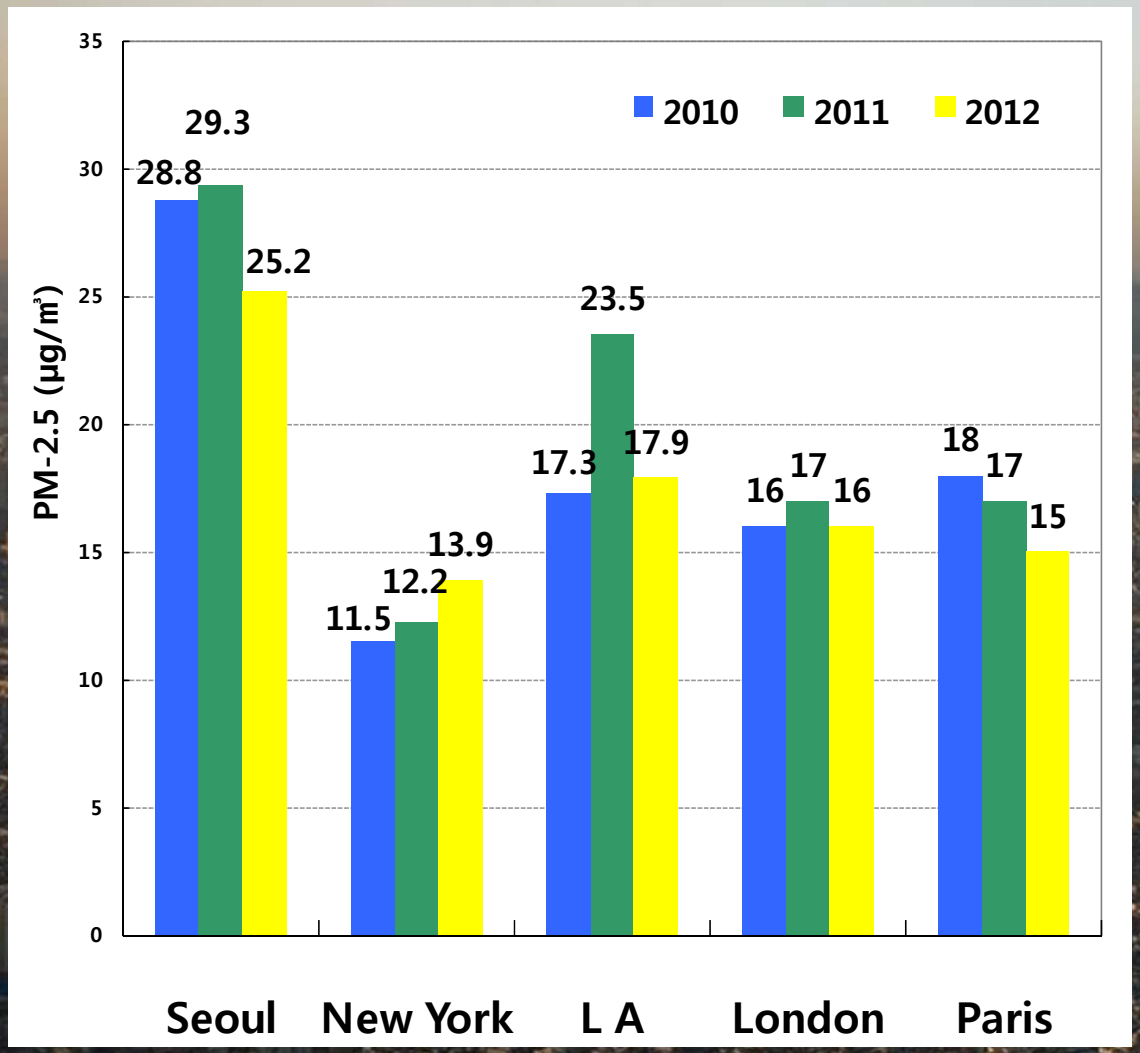
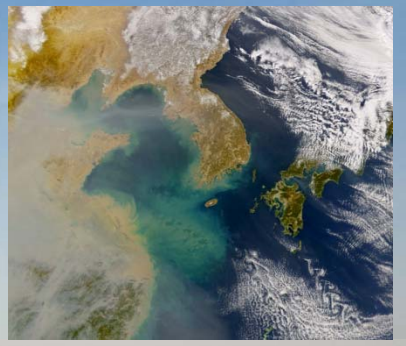
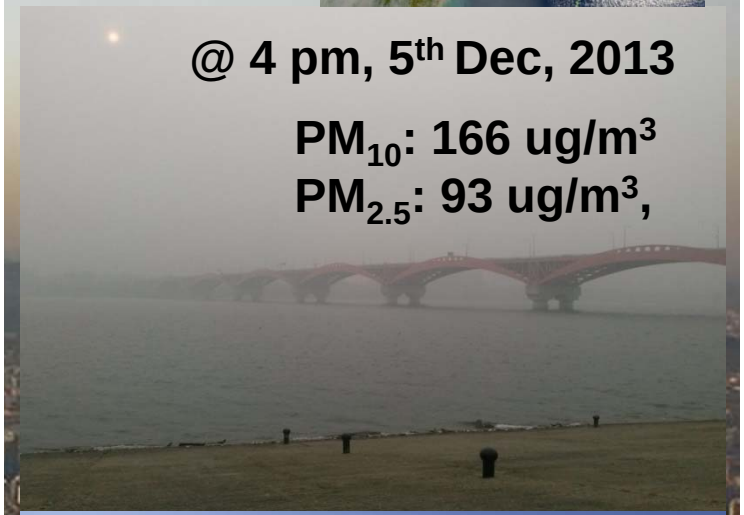
KORUS-AQ

Serious Air Pollution in Korea







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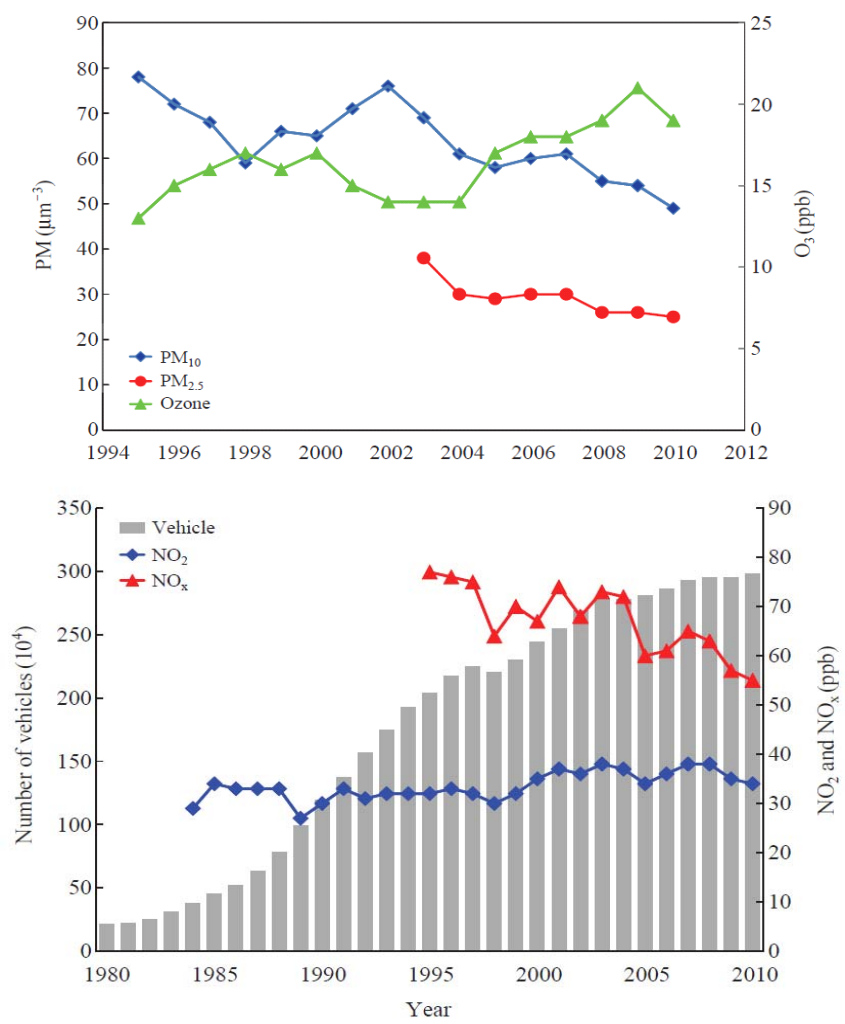
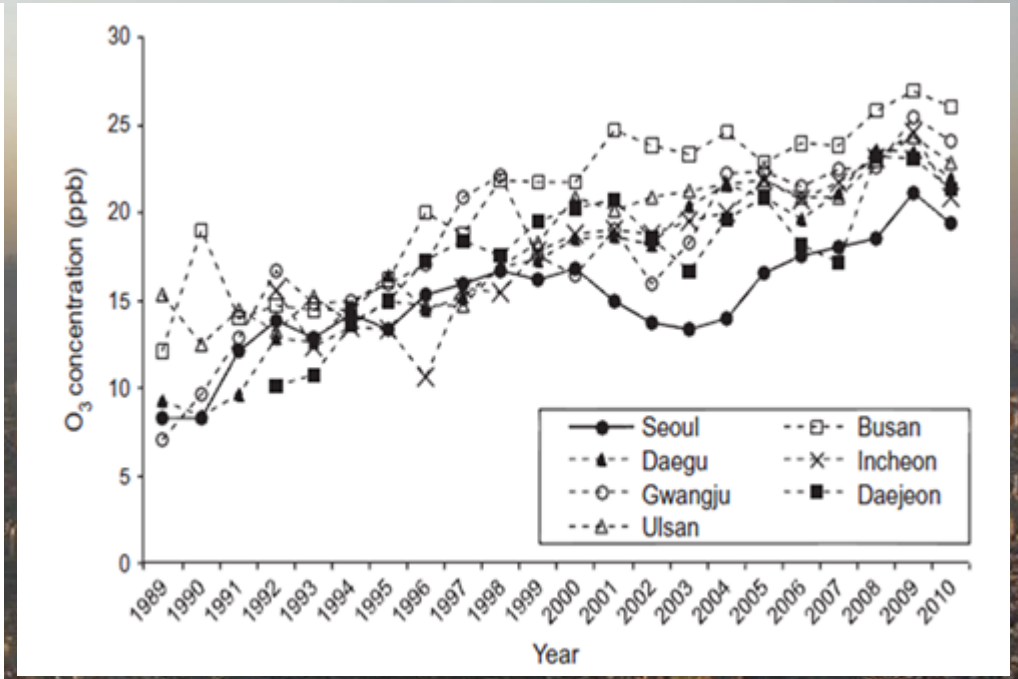
Serious Air Pollution in Korea



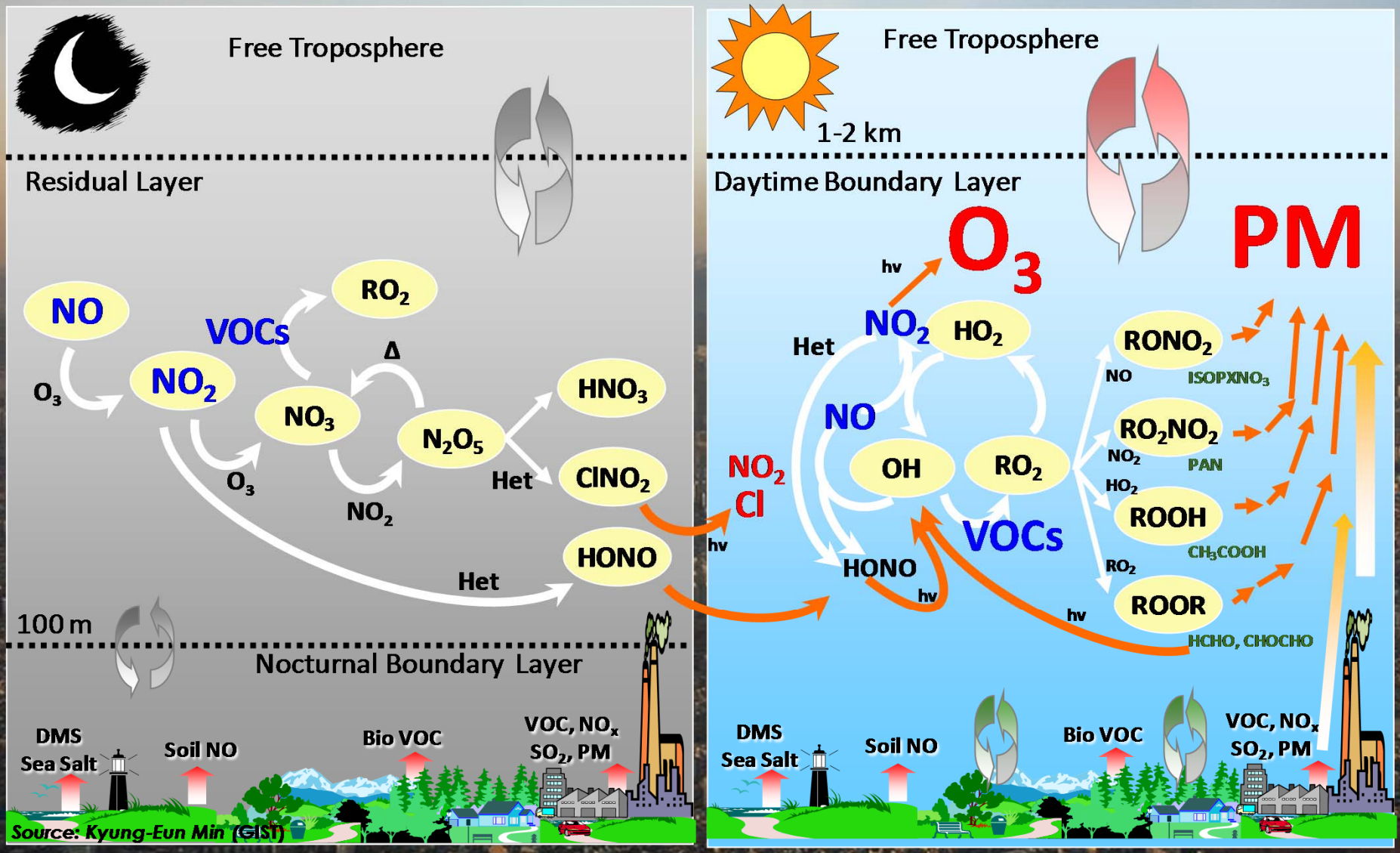


Precursors are decreasing (or leveling off) but O_3 is increasing.

$PM_{2.5}$ and PM_{10} are decreasing but visibility degrades drastically.
(14 km → 11 km from 1994 to 2010)

Underlying chemistry

Complexity of atmospheric chemistry



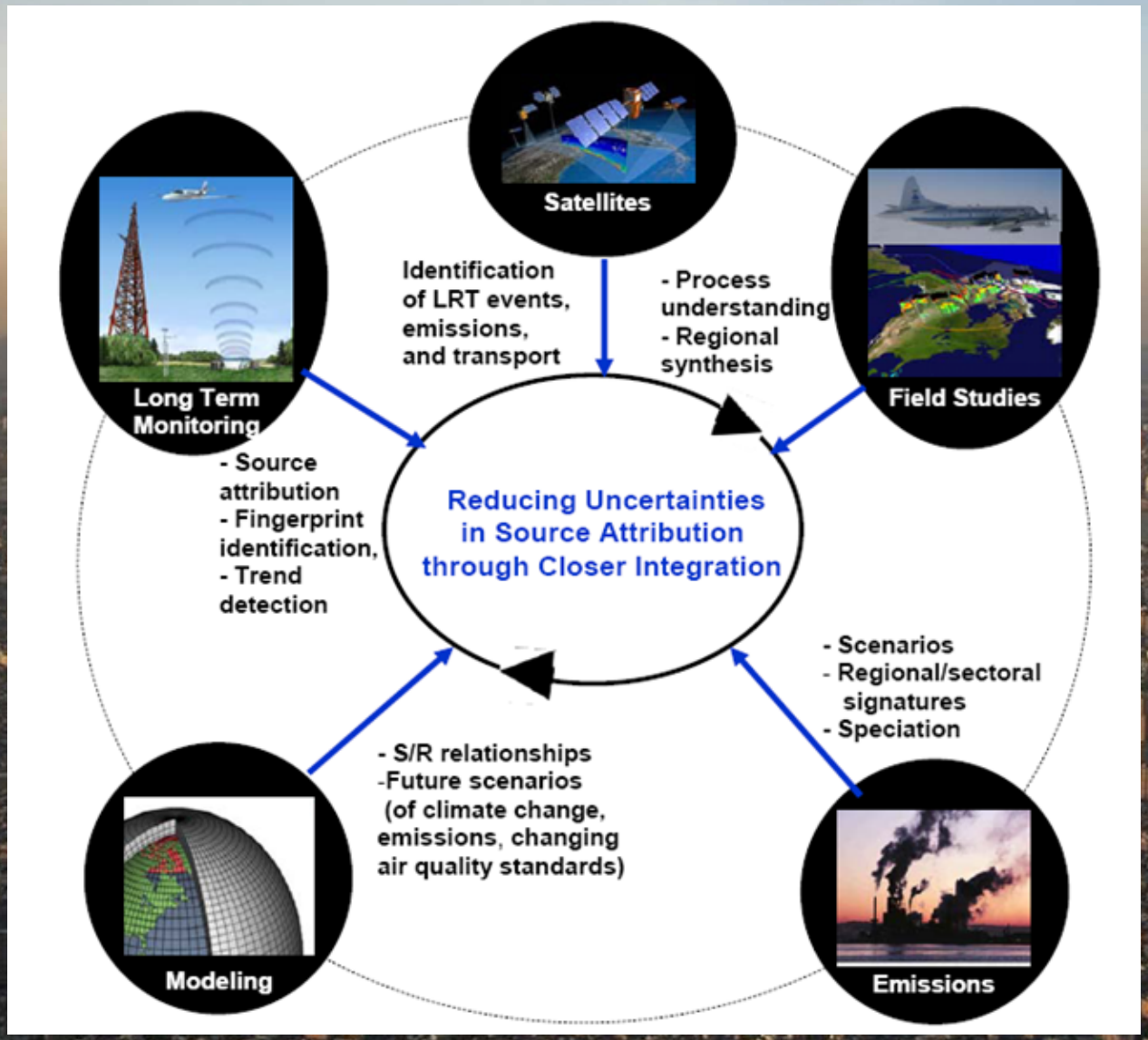
Scientific Questions for KORUS-AQ

To strengthen our understanding in Korean air quality, as well as provide important data sets for GEMS retrievals…

1. What are the **background concentrations** of air pollutants in SMA?
2. What are the **production and loss rates of oxidants** (O_x, H_2O_2, RO_2, HO_x) along VOC/ NO_X ratios at different parts of the SMA?
3. What are the **production rates of secondary aerosols** during the photochemically active periods or the transported events? In addition, what precursor species are the main drivers for high aerosol loadings?
4. What are the **contributions of long-range transport *vs.* local sources** to the SMA's air quality?
5. How much do **the nighttime** NO_3 and Cl radicals contribute to the production of aerosol and photochemical species in consecutive daytime periods?
6. What is the extent of the ground **ozone and aerosol interaction or exchange** with those in elevated levels?
7. What are the effects of **heterogeneous chemistries** on aerosol and oxidant productions in the SMA?
8. What is **the relationship between aerosol properties and their radiative forcing**?

KORUS-AQ

KORUS-AQ mission integrates the efforts from multi-platforms



Current Setup for KORUS-AQ

Field observation

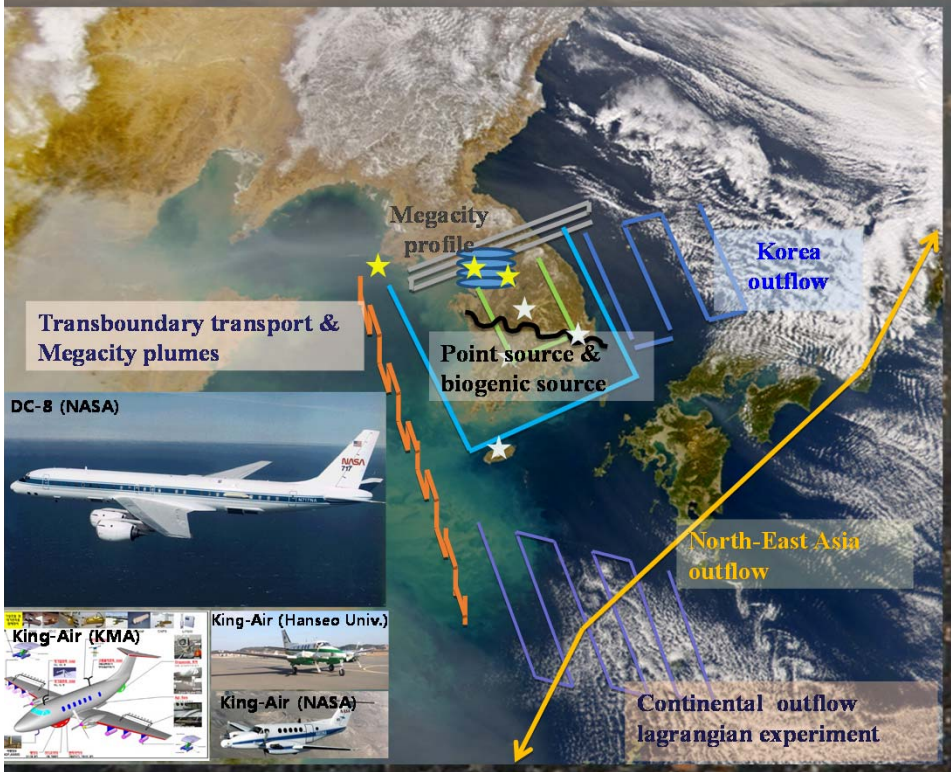
- 4 research aircrafts
  (NASA DC-8, 3 King-Airs)
- 2 research vessels
  (KMA-Kisang 1, KOPRI Araon)
- 8 ground sites
- 1 mobile laboratory

Models

- UM/Geos–Chem
- WRF–CMAQ
- WRF–Chem
- WRF–CAMx
- SMOKE
- MEGAN/BEIS

Satellite & Remote Sensing

- 6 Pandora & AERONET stations
- 10 LIDAR stations
- Geo-TASO (King-Air)
- Available Satellites
  (e.g. GOCI, TROPOMI, OCO-2, OMI, TES, MODIS, etc.)



KORUS-AQ

Measurements species

	Measurement Target	Up Stream	Seoul	Down Stream	NIER Airplane	KMA Airplane	KMA Gisang 1	DC-8 Airplane	Necessity (!!!=important) Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Total necessity (10point: Essential part)
Oxidant or Precursor	NO, NO_2, NO_X	◎	◎	◎	◎		◎	NASA	!!!	!!!	!!!	!!	!!!	!!	!!	!!!	10
	OH radical	◎	●	●				NASA	!!!	!!!	!!!		!!!		!!	!!	9
	NO_3, N_2O_5		●	●				●	!!!	!!	!!!	!	!!!	!	!!	!!!	8
	Cl and $ClNO_2$		●	●				NASA	!!	!!	!!!	!	!!!	!	!!!	!!	8
	VOCs speciation	◎	◎	◎				◎	!!!	!!!	!!!	!!!	!!!	!!	!!	!!!	10
	BVOCs (or OH reactivity)			●			●	NASA	!	!!!	!!!	!!!	!!!	!!	!!!	!!	9
Oxidized compounds	HCHO and aldehydes	◎	◎	●				●	!!!	!!!	!!	!!!	!!!	!!	!!	!!!	10
	Oxidized hydrocarbons		●	●				●	!!!	!!!	!!!	!!	!!!	!	!	!!!	9
	PAN	◎	●	●				◎	!!	!!!	!!!	!!	!!!	!!	!!	!!!	9
	H_2O_2 , Peroxides	◎	●	●				NASA	!!	!!!	!!!	!!	!!!	!!	!!	!!!	9
	Organic Aerosol speciation	◎	◎	●				NASA	!!!		!!!	!!!		!	!!!	!!!	7
Product or Pollutant	O_3	◎	◎	◎	◎		◎	NASA	!!!	!!!		!!	!!!	!!!	!!	!!!	9
	CO, SO_2	◎	◎	◎	◎		◎	NASA	!!!		!!!			!!	!!	!!	5
	HNO_3, NH_3	◎	●	●				NASA	!!		!!!	!!		!!	!!!	!!	6
	EC/OC	◎	◎	◎				NASA	!!!		!!!	!!	!!!	!!!	!!!	!	8
	HR aerosol speciation	◎	◎	◎	◎			◎	!!		!!!	!!!	!!!	!	!!!	!!	8
	WSOC		●	●				NASA			!!!	!!	!!	!	!!!	!	5
	Aerosol profile	◎	●	◎				NASA						!!!	!	!!!	5
	Aerosol number and size	◎	◎	◎	◎	◎	◎	NASA	!!!		!!!	!!	!!!	!!!	!!!	!!!	9
	scattering & Absorption	◎	◎	◎		◎	◎	NASA	!!!		!!!			!!	!!	!!!	6
	Aerosol trace metals	◎	◎	◎					!			!!!			!!	!!	4
	$PM_{2.5}$ mass & compositions	◎	◎	◎			◎	NASA	!!!		!!!	!!	!!!	!!!	!!!	!!!	9
	refractory Black Carbon (rBC)	◎	◎	◎	◎			◎	!!!					!!	!		3
	Black carbon	◎	◎	◎				NASA	!!!					!!	!	!!!	4

There are opportunities for other prospective collaborations!
If you are interested in this mission, contact us!

Thank you!!!

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