Satellite-based monitoring air pollution:
Geostationary Environment Monitoring Spectrometer (GEMS)

gems1.yonsei.ac.kr

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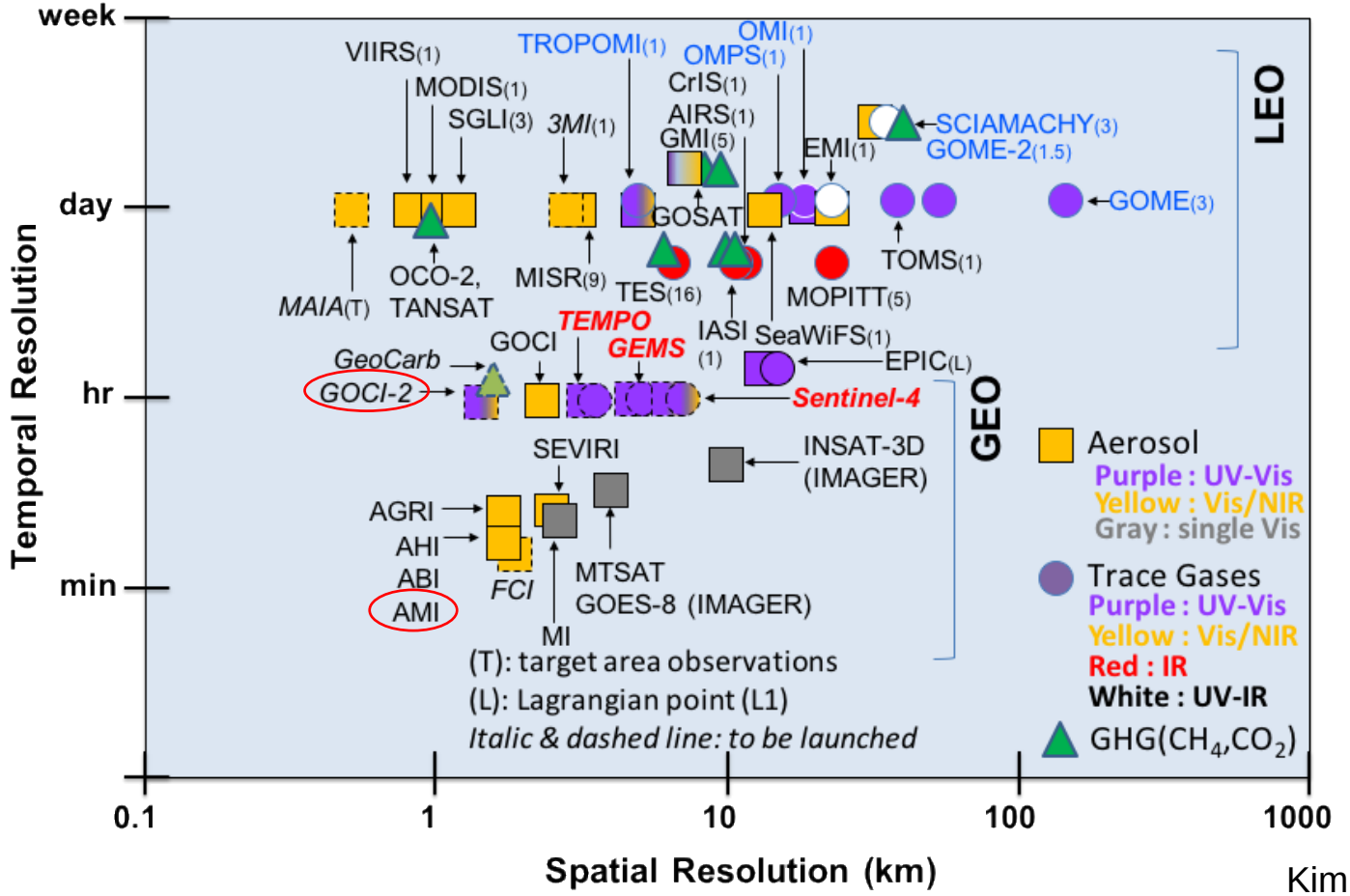
NEASPEC
NEACAP

GEMS

Outline

- Introduction
- GEMS Instrument & Operation
- GEMS Science Algorithm and Data Products
- Data Application
- Summary

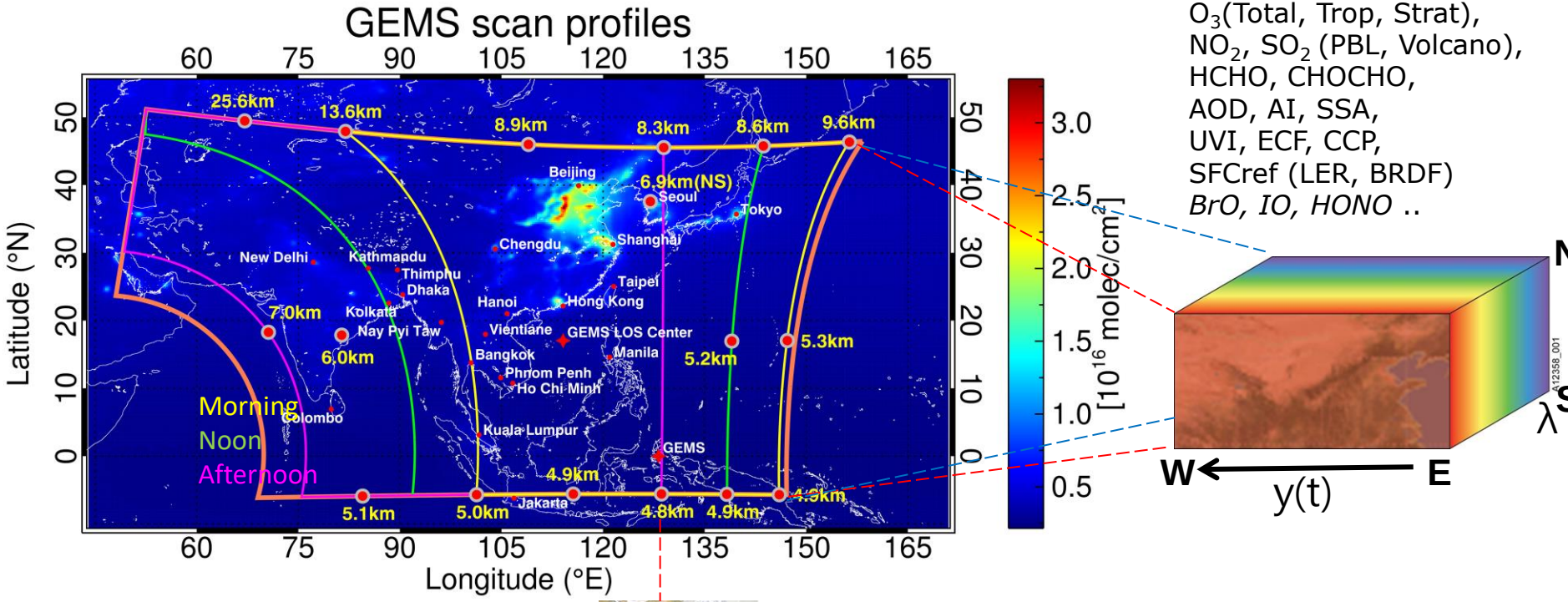
Development of Satellite Remote Sensing for Air Quality



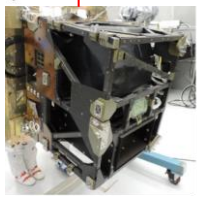
(*) : Revisit time in days

Kim et al. (BAMS 2020)

GEMS E-W SCAN SCENARIO



O_3(Total, Trop, Strat),
NO_2, SO_2 (PBL, Volcano),
HCHO, CHOCHO,
AOD, AI, SSA,
UVI, ECF, CCP,
SFCref (LER, BRDF)
BrO, IO, HONO ..



2000 N-S x 697 E-W
x 8 times/day x 20 products
=223,040,000 data/day

Kim et al. (BAMS 2020)

In Orbit Test (IOT)

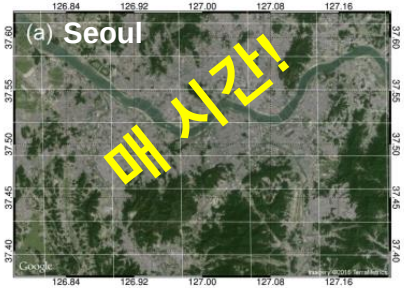
Instrument Activation and Commissioning Timeline

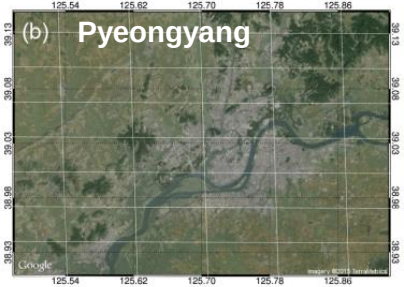
Activity	Duration (months)	L0	L0+1m	L0+2m	L0+3m	L0+4m	L0+5m	L0+6m	L0+7m	L0+8m	- L0+12m
LEOP (GTO to GEO)	1										
BUS IOT (start from drift orbit)	0.5										
GOCI-II Activation	0.5										
GEMS Activation	1										
GOCI-II/GEMS INR Test	4										
GEMS INR	2										
GEMS Science Test	4										

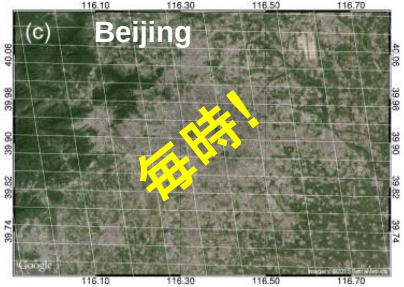
2/19 3/6 3/23

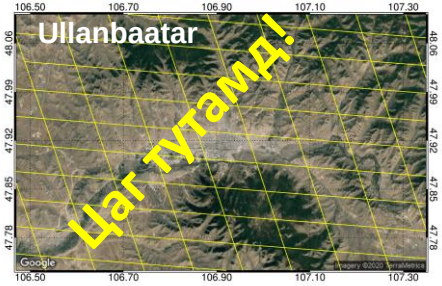
* BUS: GK-2B spacecraft (GEMS and GOCI-II)
* INR: Image Navigation and Registration

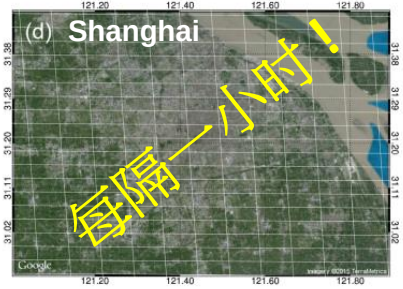
City Coverage of GEMS in Asia

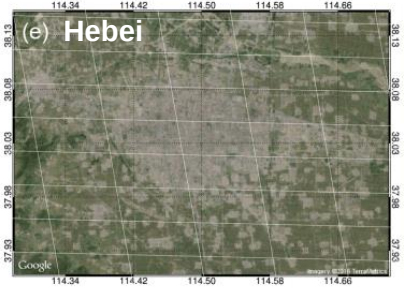


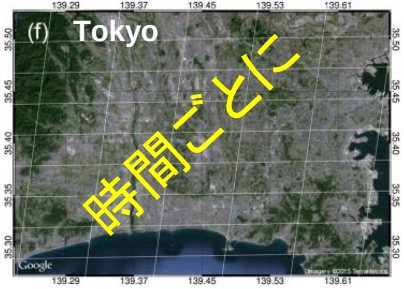


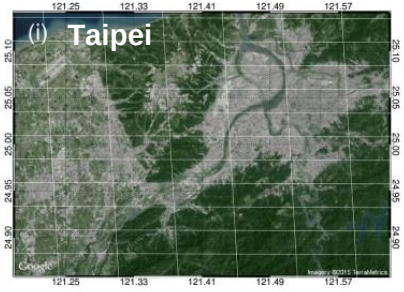


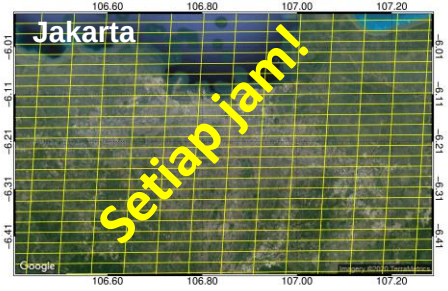




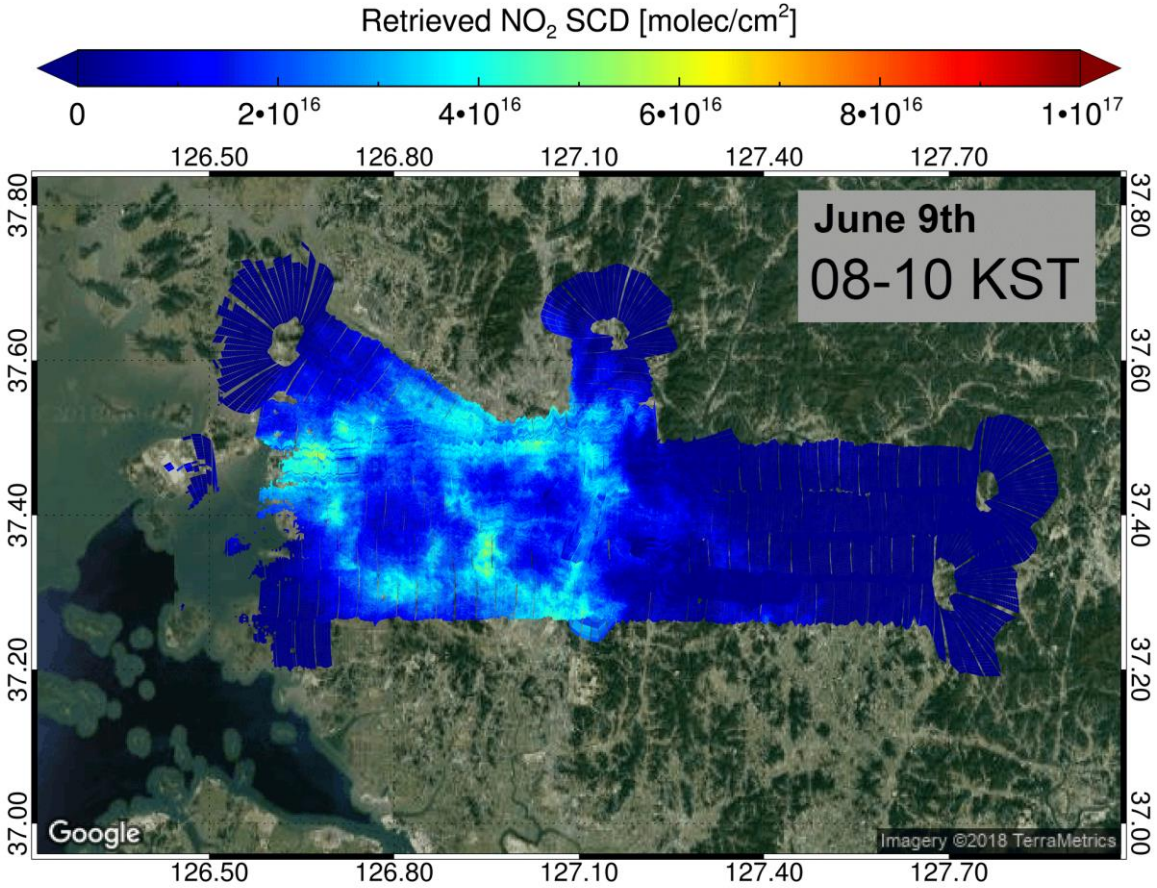








NO_2 in Seoul Metropolitan Area



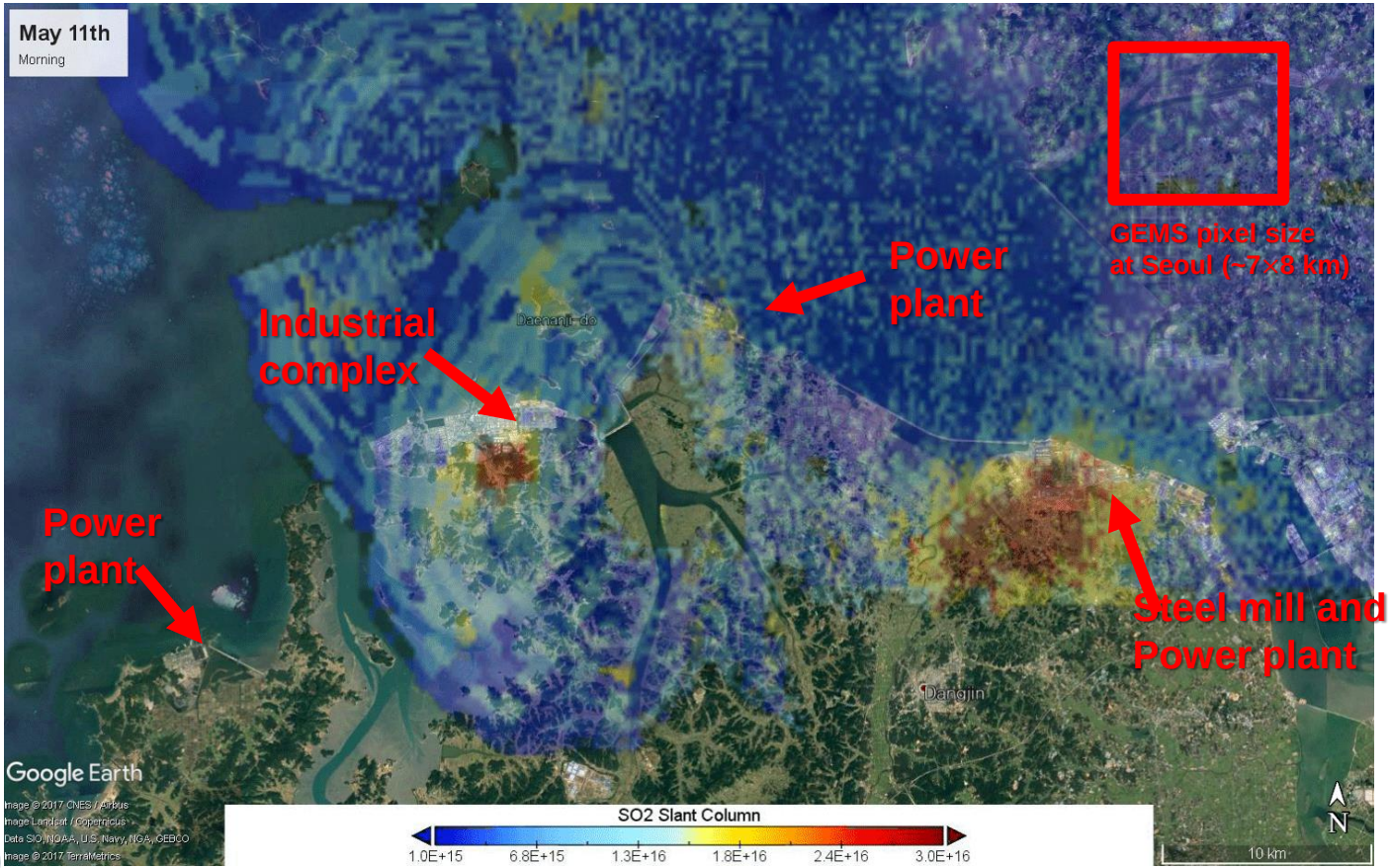
GeoTASO Airborne Measurements

KORUS-AQ

GEOTASO
Jay Al-Saadi,
Scott Janz
Matt Kowalewski

Version of L1B data: V2y

SO_2 – Point Sources Capture



GeoTASO Airborne Measurements

KORUS-AQ

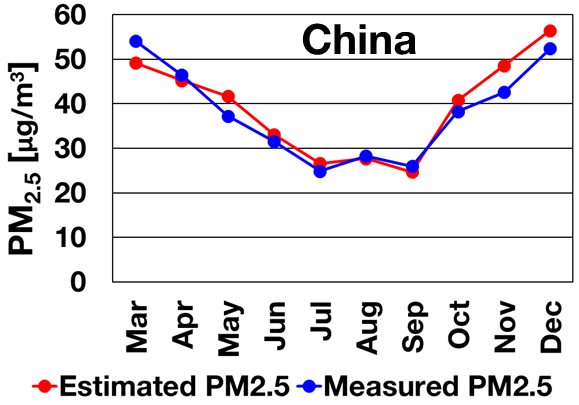
GEOTASO
Jay Al-Saadi,
Scott Janz
Matt Kowalewski

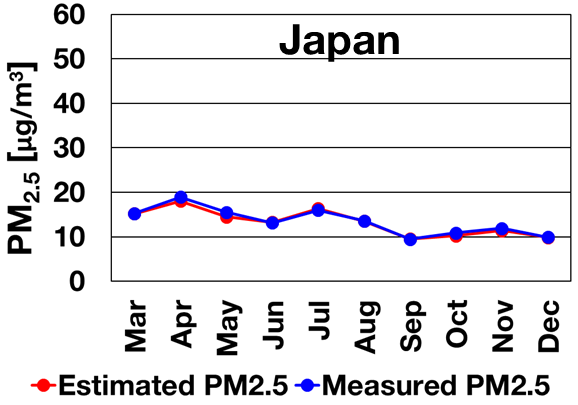
Chong et al. (revised, RSE)

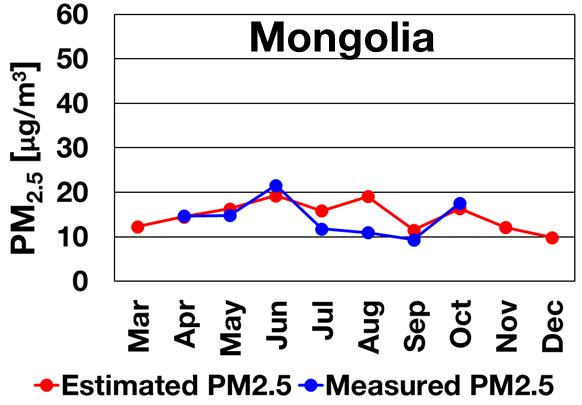
Version of L1B data: V2c

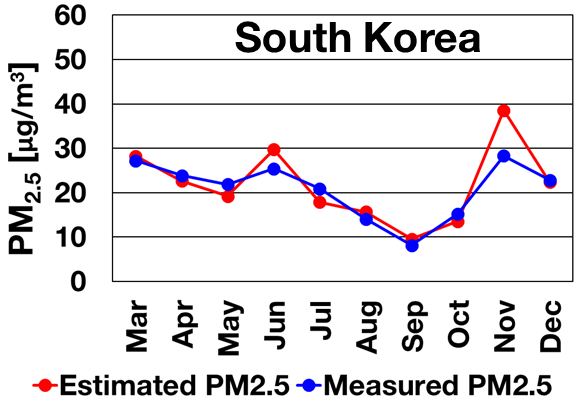
Columnar AOPs to surface $PM_{2.5}$ using Machine Learning

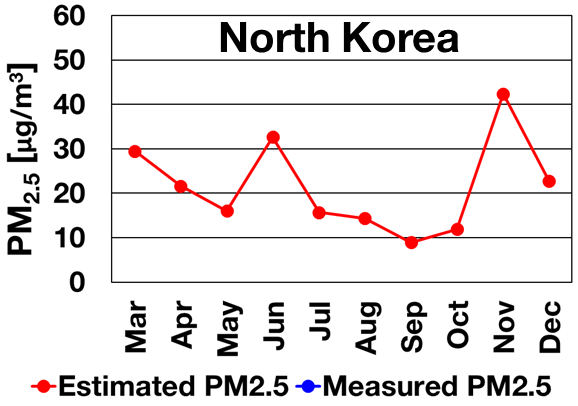
Satellite AOD + MET. data + GIS information

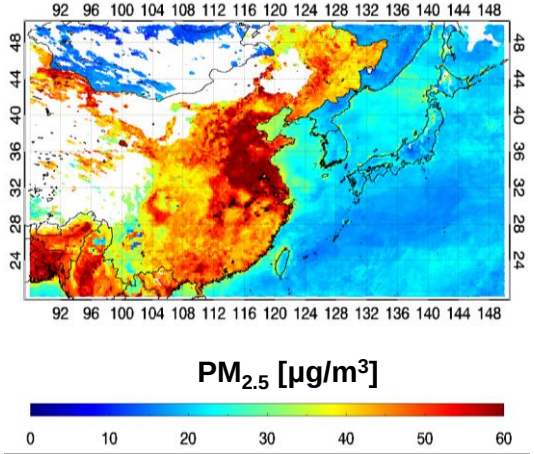




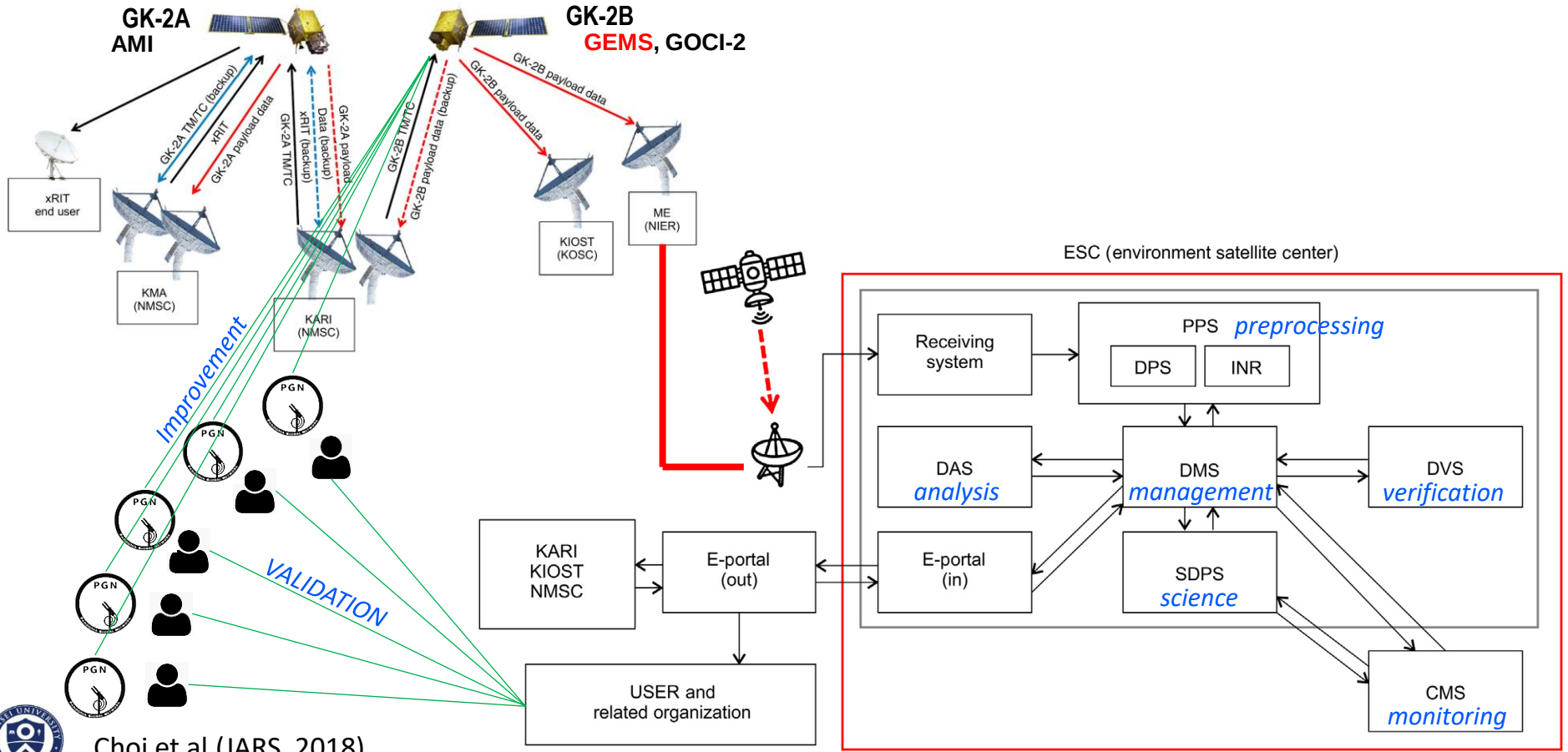






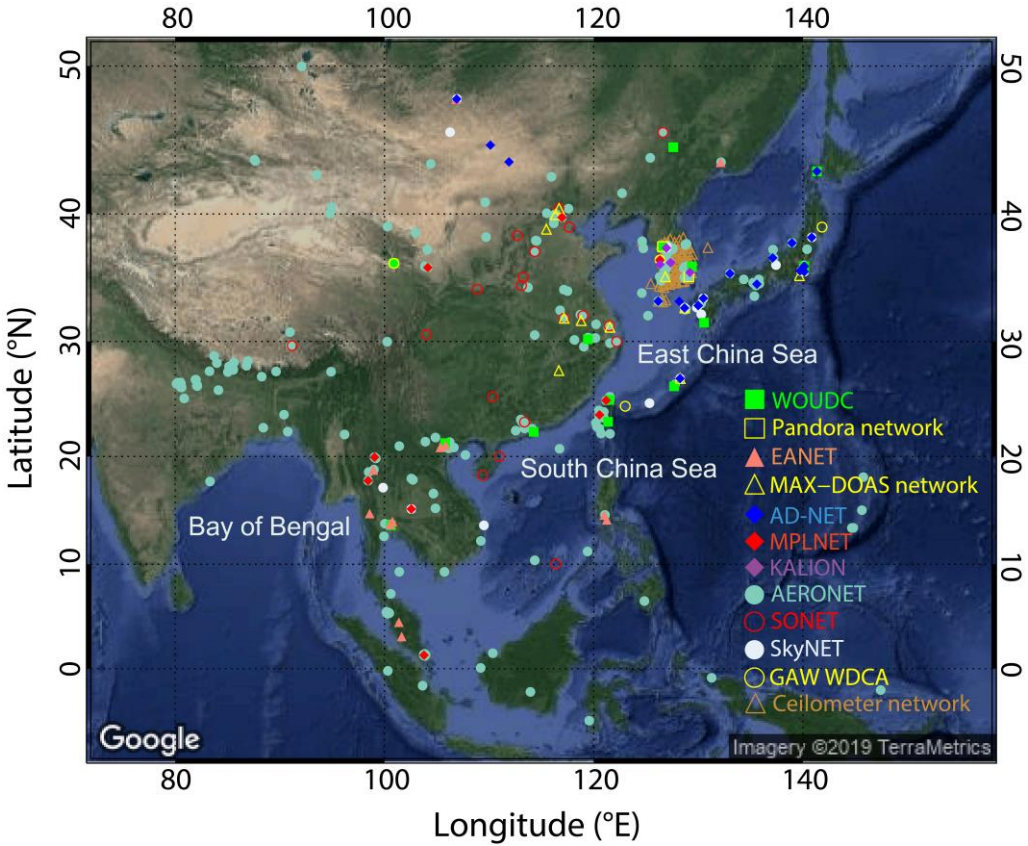


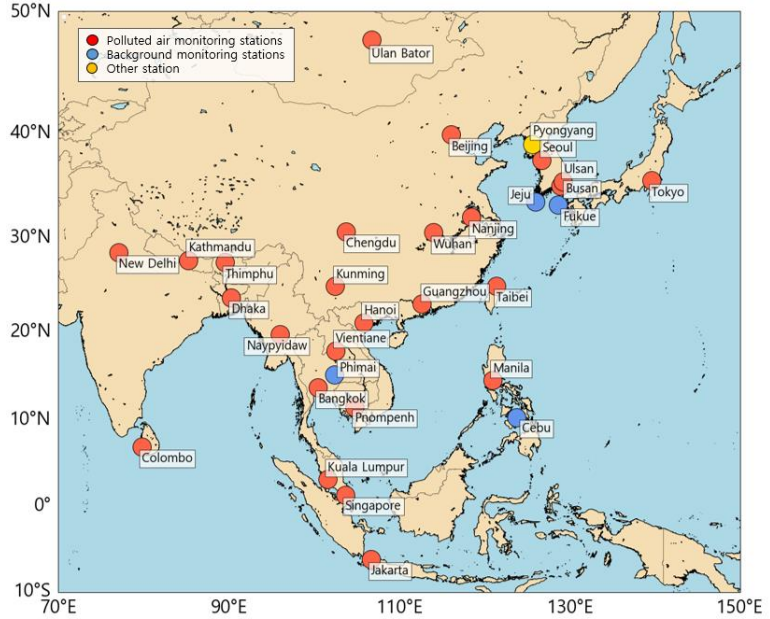
Data Processing and Distribution



Choi et al.(JARS, 2018)

GEMS Validation and Pandora Asia Network (PAN)



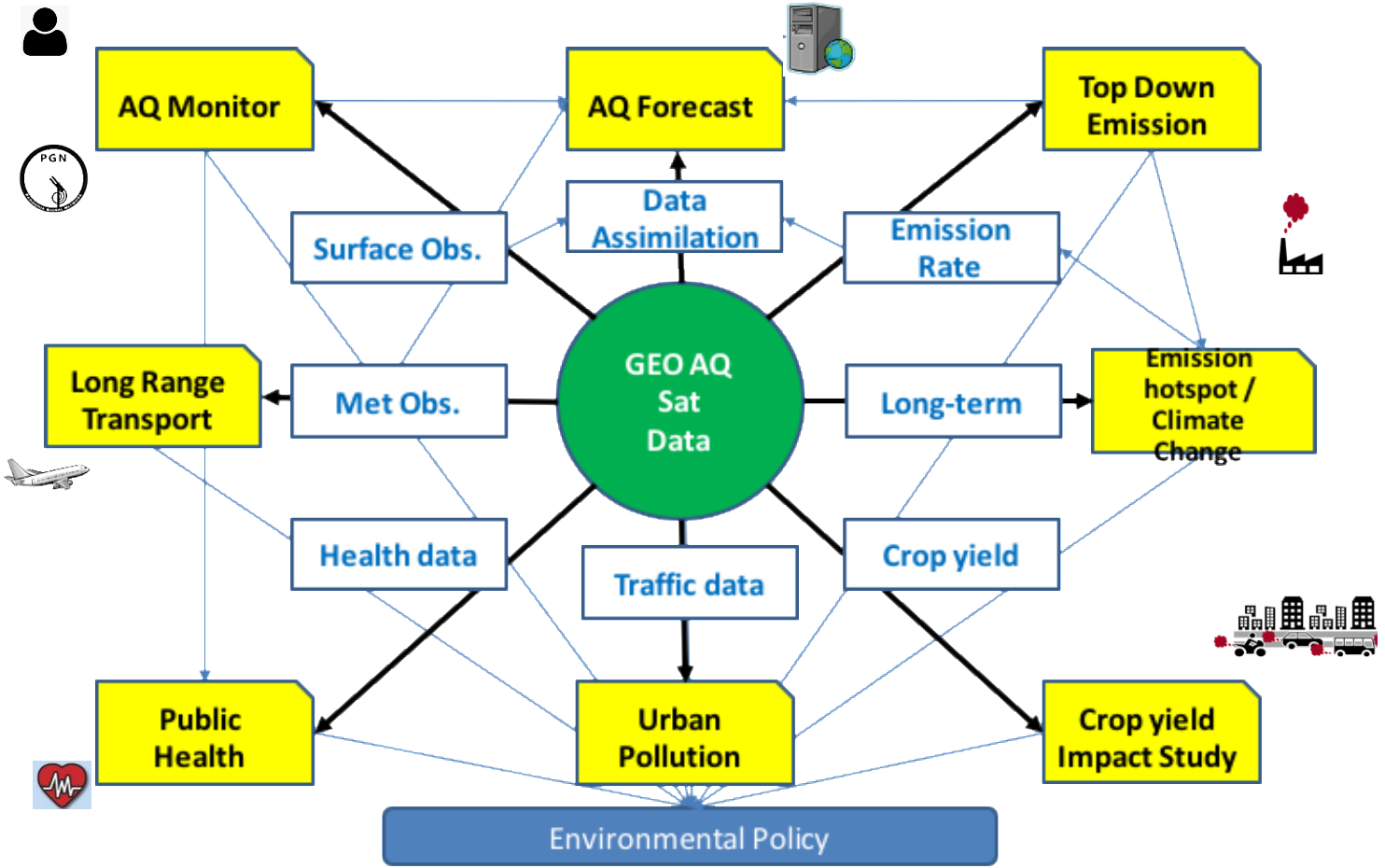


PAN site map (project + China, Japan, Korea, Singapore)

(Courtesy, L. Chang, NIER)

Kim et al. (BAMS, 2020)

GEO AQ Sat Data Application & Service



SUMMARY

- GEMS was launched on Feb. 19th, 2020, to form an Asian part for the GEO AQ Constellation with TEMPO and Sentinel-4 by early 2020s.
- Application of GEMS data include air quality monitoring, forecast, top-down emission inventory, long-range transport, air pollution studies, public health and much more.
- Validation is a very important part of GEMS to evaluate data quality during the IOT and the lifetime of GEMS. Active participation by participating countries are required for the success of the mission.
- NEACAP can utilize the GEMS dataset for short- and long-term assessment of air quality within the region. GEMS dataset can also be used for top-down emission estimates which can be processed in shorter time scale than bottom-up. These all will contribute to improve the accuracy of air quality forecasting.
- NEACAP can play an essential role in data distribution, joint analysis, and capacity building in above mentioned activities.

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Ministry of Environment

Ministry of Science and ICT

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KEITI

GEMS

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