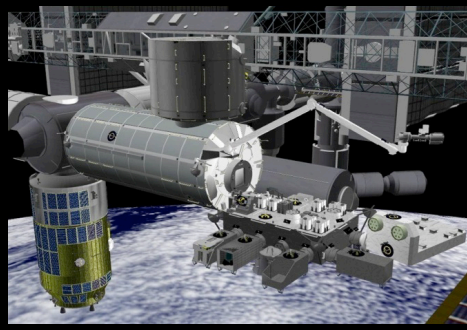
2011 GEMS **International Workshop**
August 30th – September 3rd, 2011, Korea

Objectives and Status of Japanese GEO Mission (GMAP-ASIA) and ISS Mission (APOLLO)

(GMAP: Geostationary Mission for

Meteorology and Air Pollution in Asia)

(APOLLO: Air Pollution Observation Mission)



Sachiko Hayashida (Nara Women's University)
Committee on Atmospheric Environment
Observation Satellite,
Japan Society of Atmospheric Chemistry (JSAC)
(Leader Kazuyuki KITA)

Heritage/History

1996: ADEOS-I (Advanced Earth Observing Satellite)
TOMS (Total Ozone Mapping Spectrometer: provided by NASA)
ILAS (Improved Limb Atmospheric Spectrometer)
IMG (Interferometric Monitor for Greenhouse gases)

2002: ADEOS-II
ILAS-2 (Improved Limb Atmospheric Spectrometer)

~ 2003: ATMOS C-1/ GCOM-A examined
- TOMS Follow-on was proposed by EORC/JAXA
  Ozone Dynamics UV Spectrometer (ODUS)
⇒Ozone and pollution Measuring Ultraviolet Spectrometer (OPUS)
- Sub-mm sounder was proposed by NICT (SMILES)

- ILAS-II Follow-on was proposed by NIES/MOE
  Solar Occultation FTS for Inclined orbit Satellite (SOFIS)

2010: Greenhouse gases Observing SATellite (GOSAT)

2011: Superconductive Sub-mm Limb Emission Sounder (SMILES) on ISS

Background of JAXA Geostationary Air Quality Mission

2006 Japan Society of Atmospheric Chemistry (JSAC) :
Committee on Atmospheric Environment
Observation Satellite took initiative on making plan of GEO

2007 Feasibility Study WG under the above Committee
Science Requirement Team (SRT)
Simulations and Sensitivity Study Team (S3T)

2008 JAXA : Committee for Discussion on Geostationary Atmospheric Observation Mission

Air quality Mission

JAXA : Communication with Japan Meteorological Agency, etc

Meteorology Mission

2009 JAXA : MDR (Mission Definition Review) on 24th December

2010 ~ JAXA: Study of key issues of an imaging FTS
JSAC: Aerosol sensitivity study under S3T

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2013? Phase C/D in our third mid-term plan (2013-2017)

2017? Launch (no earlier than 2017)

Objectives and Scientific Requirement
GMAP-Asia

To observe temporal and spatial distributions of ozone, aerosols and their precursors in Asia

To identify emission sources, transport and photochemical processes

To serve for atmospheric environment policy by clarifying atmospheric environment issues in each region and trans-boundary air pollution

To aim for accurate chemical weather forecasting by data assimilation

■ Primary Targets :

O_3 (tropospheric column), Aerosols, NO_2, CO, HCHO, HNO_3

■ Region :

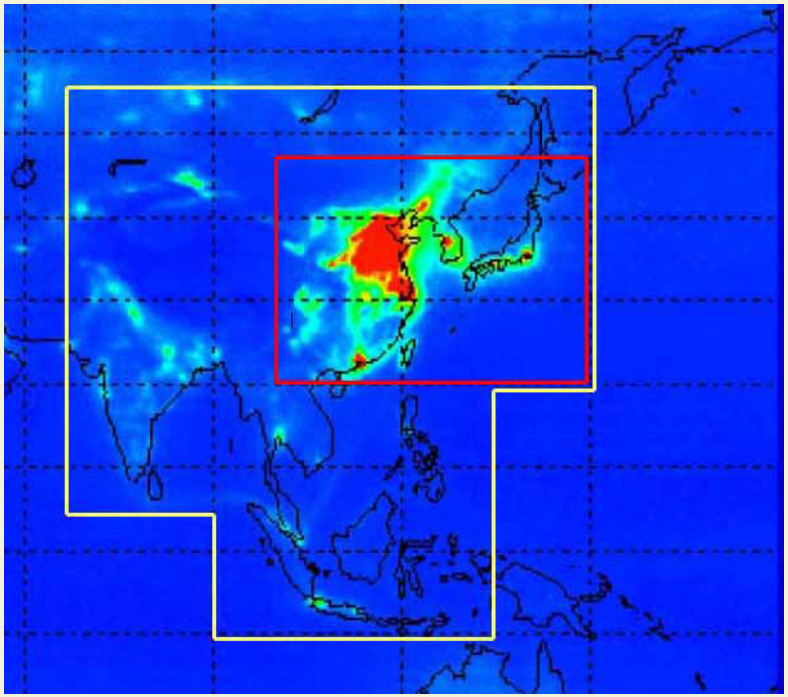
Over Asia/Over Northeast Asia

■ Sampling rate :

1-2 hours resolution for 24 hours

■ Instantaneous FOV :

about 10 km × 10 km



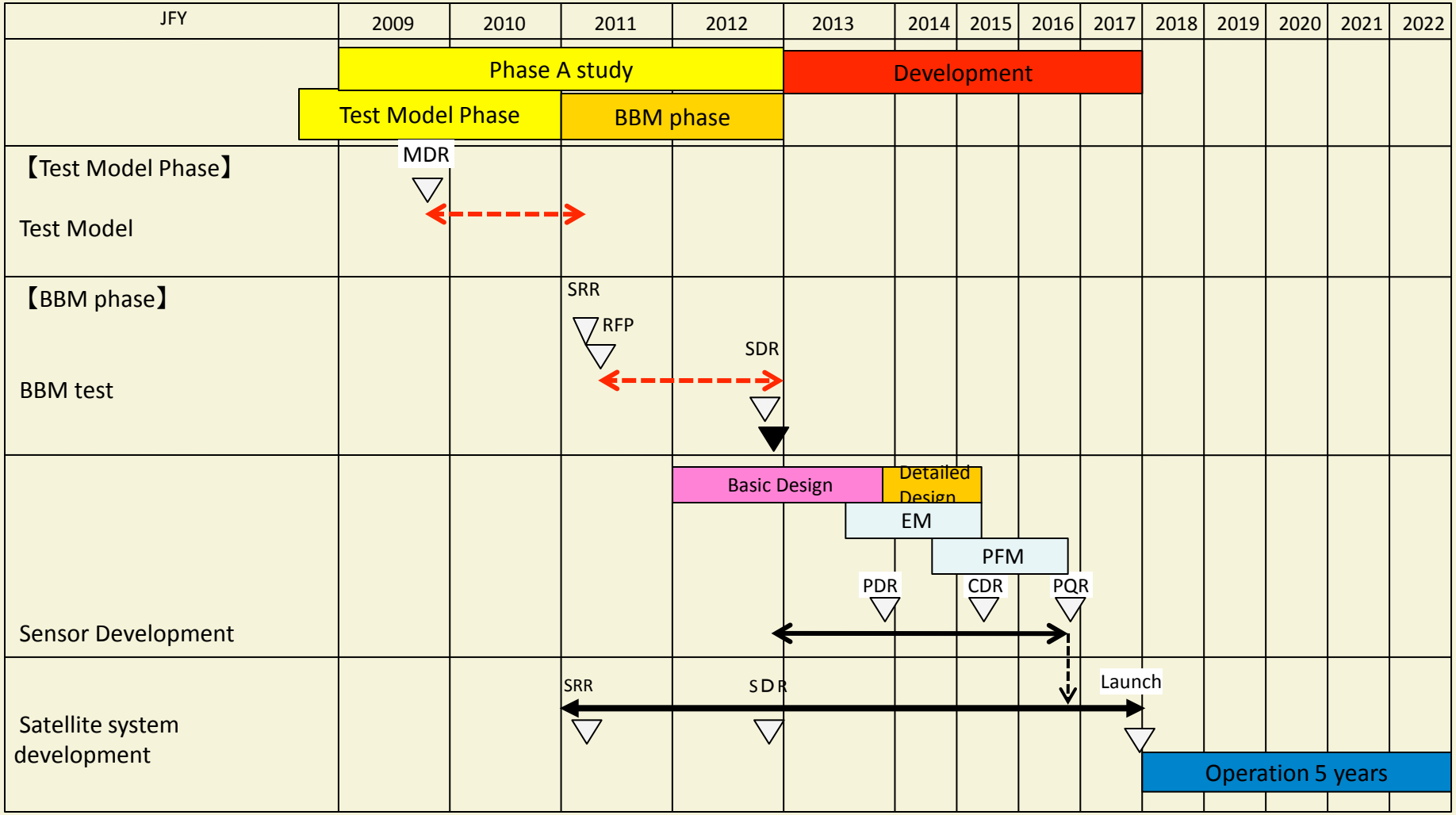
Defined Parameters of Sensors in the MDR

	UV/VIS	Thermal IR
L1 products	Radiance	BrightnessTemp.
L2 products (research products)	O_3, NO_2, (SO2, HCHO, Aerosol(AOT))	O_3 (upper/lower Trop.) , CO, (HNO_3), H_2O, Temp.
Diurnal Observation	Daytime only (hourly)	Day and Night (hourly)
Observation Area	Japan and East China (4000 km × 4000 km)	Full disk
Spectral Domain	280-600 nm [753-784 nm (O_2-A)]	700-1200 cm^{-1} 1600-2250 cm^{-1}
Spectral Resolution (sampling interval)	<0.6nm (0.1nm@310-600 nm) [<0.12 nm (O_2-A)]	0.6 cm^{-1}
IFOV	40 km (280-310 nm) 10 km (310-600 nm)	less than 10 km (4km)
S/N (requirement to instr.)	350@500 nm 500@330 nm	0.23K(SN290)@1030cm-1 0.85K(SN30)@2160cm-1

Comparison between Required SNR and Expected Instrumental SNR for UV/VIS Sensor

Species for UV/VIS Sensor	Required Precision Slant Column (cm^{-2})	Required SNR	Instrumental SNR	
			10 km, 1h	20 km, 1h
O_3 (UV)	2.5×10^{17}	> 1000 @330 nm	540-820	1090-1650
O_3 (VIS)	5.0×10^{17}	> 800 @500 nm	730-1030	1480-2080
NO_2 (VIS)	4.0×10^{15}	> 300 @450 nm	730-1030	1480-2080
HCHO (UV)	5.0×10^{15}	> 1500 @330 nm	540-820	1090-1650

Master Schedule

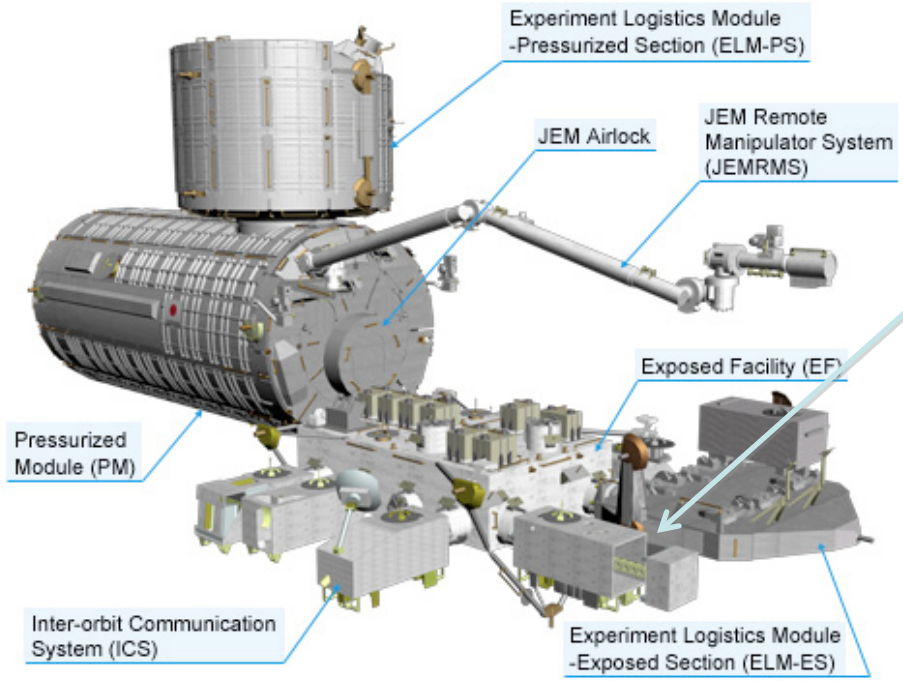


Examination of IR imaging spectrometer is currently in progress.

International Space Station

International Space Station (ISS)
(APOLLO: Air Pollution Observation Mission)

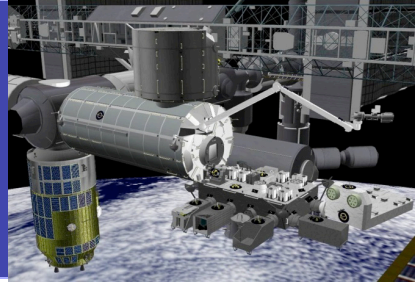
January 2011: APOLLO Mission was proposed to JAXA
May 2011: Started preparation to MDR
MDR is scheduled at the end of this year.



Experimental Logistic Module
Exposed Section (ELM-ES)

APOLLO Mission

Air Pollution Observation Mission

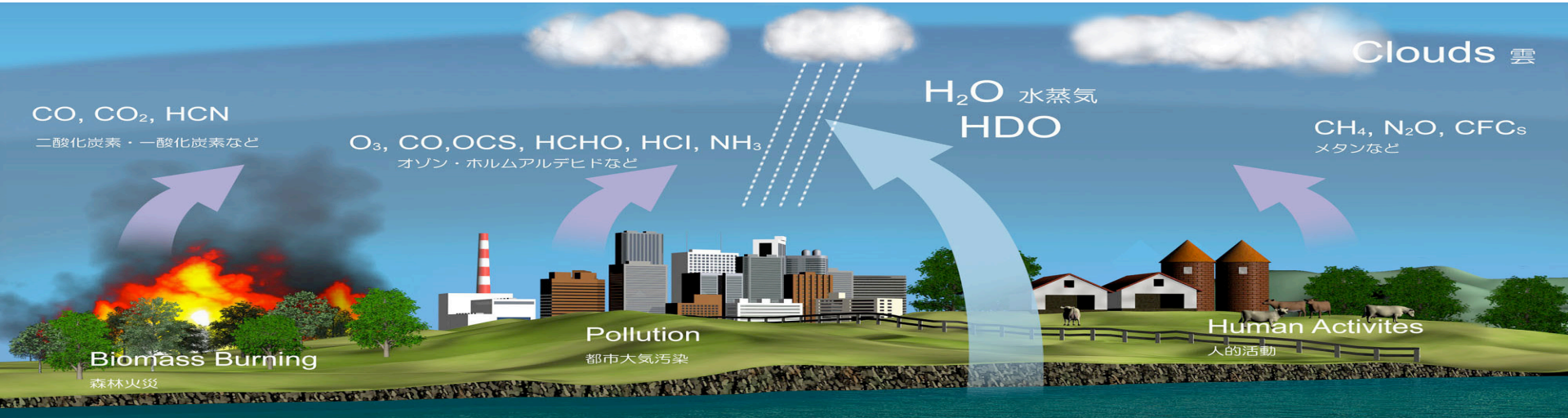


1. Air quality status and related processes:

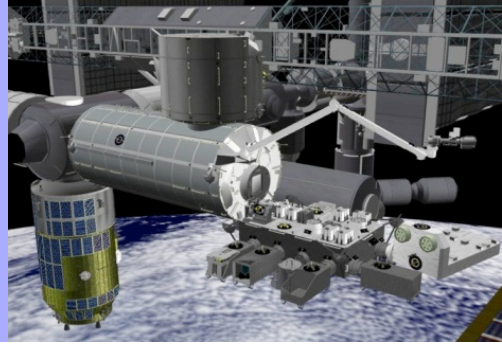
- Influence of Air pollution on human health.
- Observation of aerosol parameters and photochemical species such as ozone.
- Observation of temporal and spatial distributions of ozone, aerosols, and their precursors.
- Identification of emission sources, transport and photochemical processes.

2. Impact of air pollution on climate change

- Estimate of radiative effect of enhancement of tropospheric ozone
- Stratosphere-troposphere exchange (STE) processes



Scientific requirement



- Observation parameters :

- Atmospheric compositions: O_3, NO_2 , SO_2 , HCHO , CHOCHO , CO , CH_4 , H_2O , HNO_3 , NH_3 , IO, BrO, HONO, NO3, aromatic hydrocarbon, C_nH_m
- Aerosol, Rain, Cloud : Optical depth, Particle size, Aerosol type, Rain, Water cloud, Ice cloud

- Characteristics: Variety of local time information
- Observation geometry: Nadir and Limb
- FOV: less than 3km x 3km for Nadir, less than 2km for Limb (TBD)
- Global coverage: 1 full global cover/1 day

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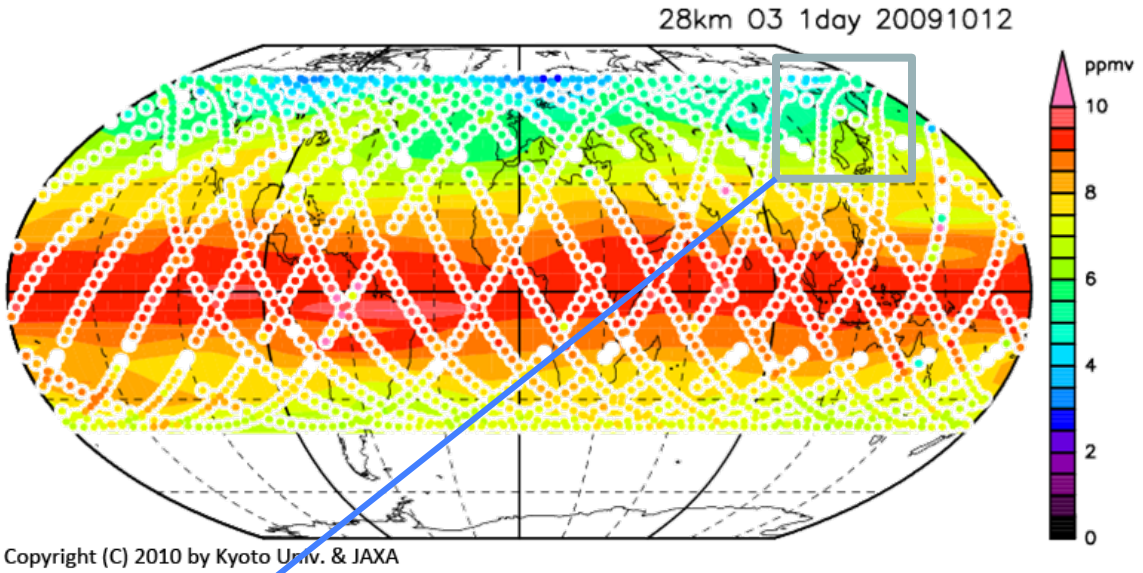
Instrument candidates and requirement

	UV/VIS/NIR imaging spectrometer	IR imaging spectrometer	IR imaging spectrometer	Sub-mm imaging spectrometer
Country	JAXA	USA/JPL	Germany/KIT	USA/JPL
Role	**Pollution**		**Pollution on Climate**	
Geometry	Nadir		Limb	
Obs. Species	O_3, NO_2 , SO_2 , HCHO , CHOCHO , CH_4, H_2O , IO, BrO, HONO, Aerosol , O2	CO , O_3, CH_4, H_2O, HNO_3, NH_3 , HONO, NO_3 , C_nH_m, Aromatic hydrocarbon, Aerosol	CO , O_3, CH_4, H_2O, HNO_3, NH_3 , HONO, NO_3 , C_nH_m, Aerosol	CO , O_3, H_2O, and its isotopes, ClO, HCl, BrO, HCN, CH3CN, Ice cloud
Target Altitude	Colum	3 layers in Trop.	MT/UT/LS # clear sky case	UT/LS # with cloud
Diurnal var.	Day time	24hours	24hours	24hours
Horizontal res.	< 3km x 3km	< 3km x 3km	Limb	Limb
Vertical res.	Column	6km	1 - 3km	1 - 3km
Freq. region	TBD	TBD	TBD	TBD
Freq. res.	TBD	TBD	TBD	TBD
S/N	TBD	TBD	TBD	TBD
Mass, Power, Data rate*	50kg, 100W	100kg, 1-200W	200kg, 300W	400kg, 200W
Region	Equator and mid-latitude (50S – 50N)			
Coverage	Full global cover/1day			

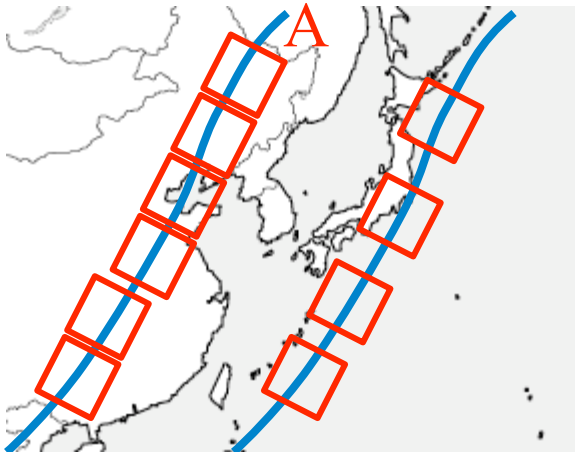
*JEM/ISS total: 500kg, 500W

Advantage of ISS



Fine spatial resolution

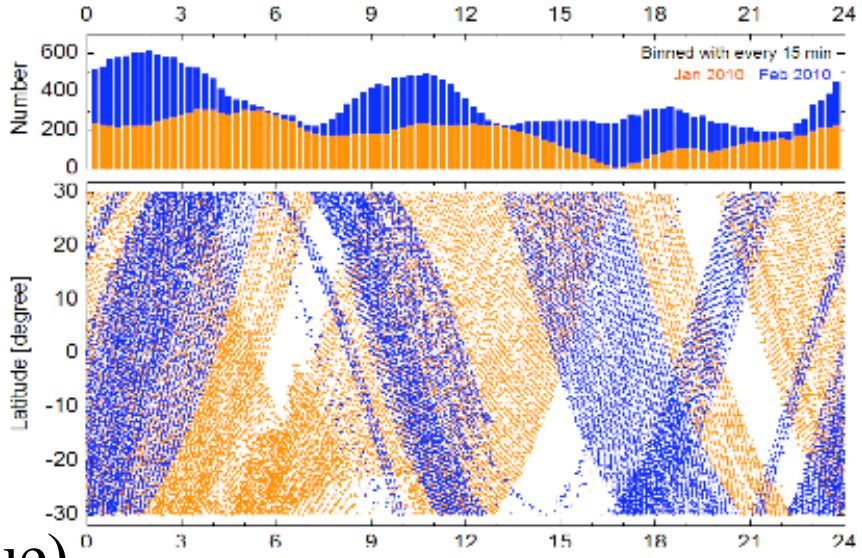
3x3 km^2 in red area



B

Jan.2010 (orange) & Feb.2010(blue)

Time coverage (example of SMILES)



Synergy of GEO and ISS

Sentinel-4

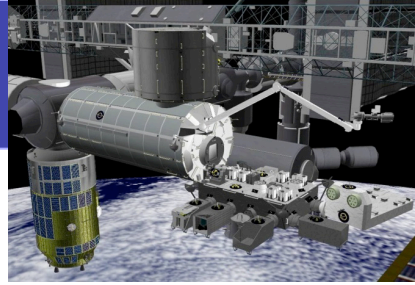
GEMS (Korea)
GMAP-ASIA (Japan)

GEO-CAPE

Asian Missions

Toward International Framework of Air Pollution Control Including Asia

Summary



- Japanese GEO Mission (GMAP-ASIA)
  - is planned to be launched after 2018.
- ISS Mission (APOLLO)
  - is now under examination towards MDR
  - is planned to be launched in ~ 2016 (or later)
- Synergy of Korean GEMS and APOLLO will be possible.

Sensor specifications and signal simulation/error analysis will be presented by Dr. Hitoshi Irie.