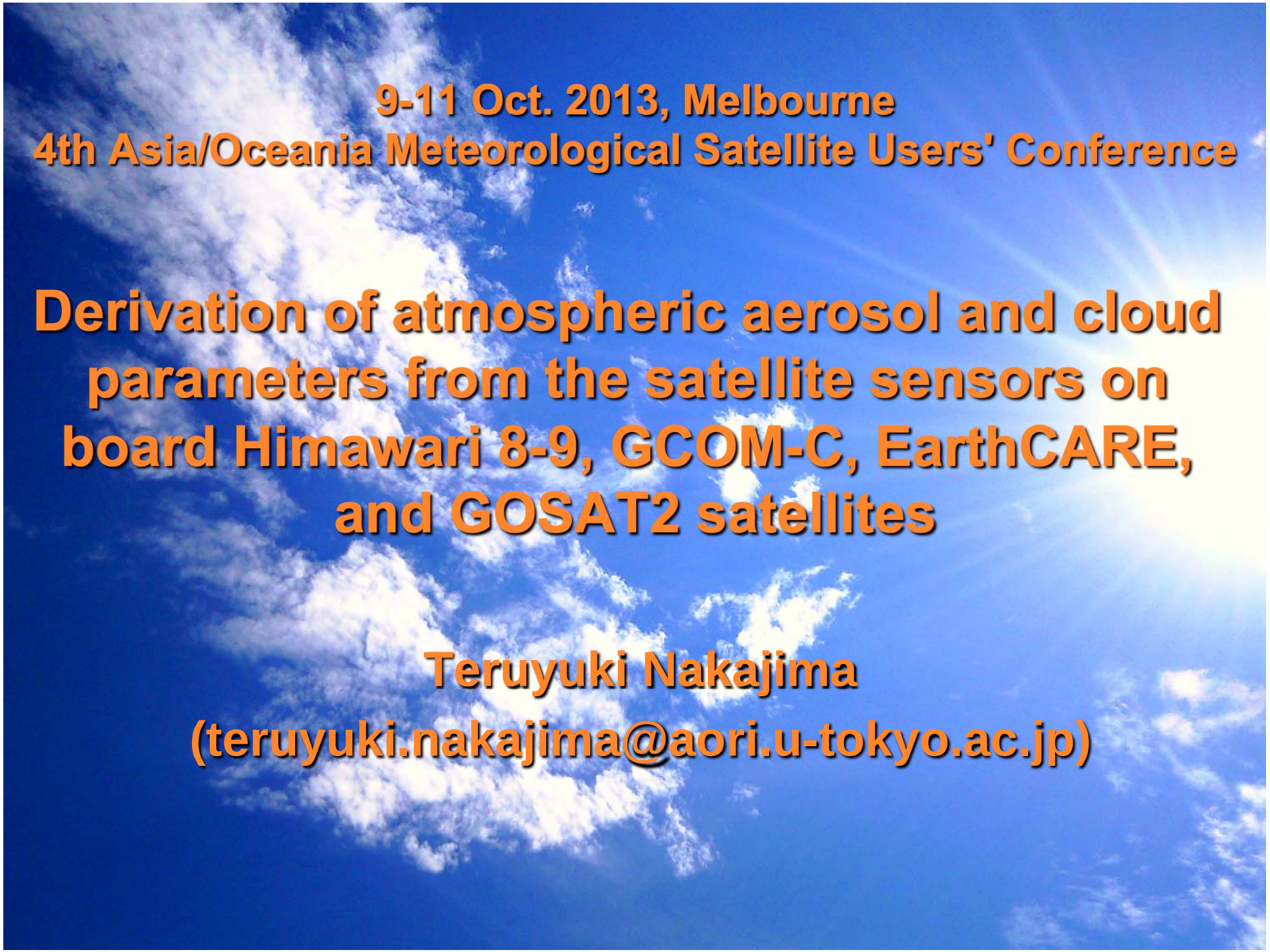
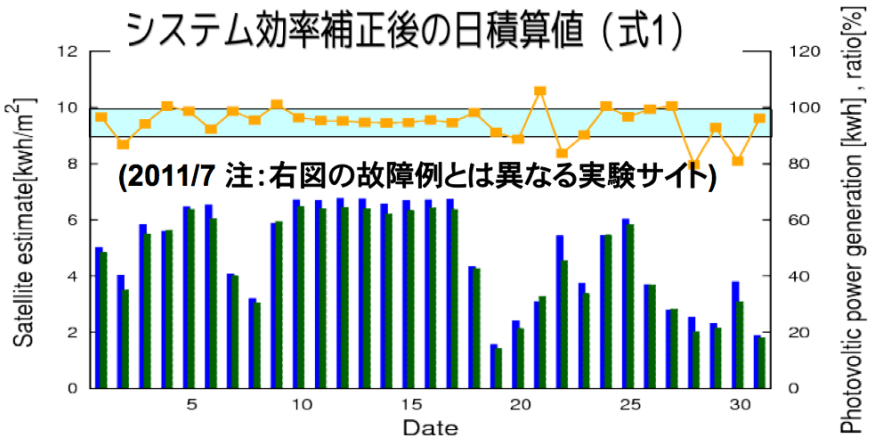

9-11 Oct. 2013, Melbourne
4th Asia/Oceania Meteorological Satellite Users' Conference
Derivation of atmospheric aerosol and cloud parameters from the satellite sensors on board Himawari 8-9, GCOM-C, EarthCARE, and GOSAT2 satellites
Teruyuki Nakajima
(teruyuki.nakajima@aori.u-tokyo.ac.jp)

Surface solar radiation retrieval

(1) PV system malfunction detection

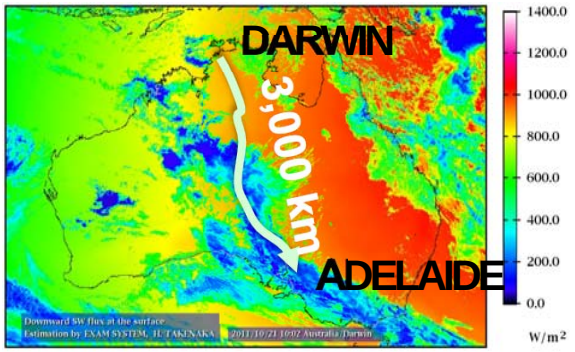


EXAM system: Takenaka et al. (JGR 11)

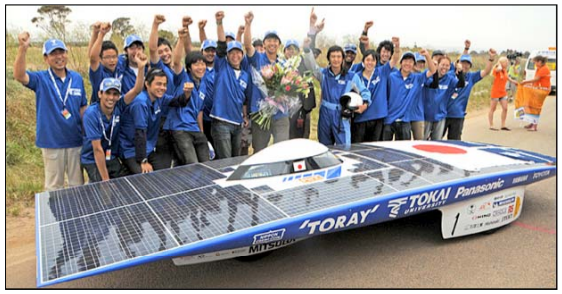
2013 result

POS	TEAM	ARRIVAL
1	3. Nuon Solar Team Nuna7	10:03
2	1. Tokai University Tokai Challenger	13:22
3	21. Solar Team Twente The RED Engine	14:38
4	16. Stanford Solar Car Project Luminos	16:31
5	8. Punch Powertrain Solar Team Indupol One	12:09
6	15. Solar Energy Racers SER-2	12:43
7	30. Team Arrow Arrow1	10:38

(2) Solar car race support

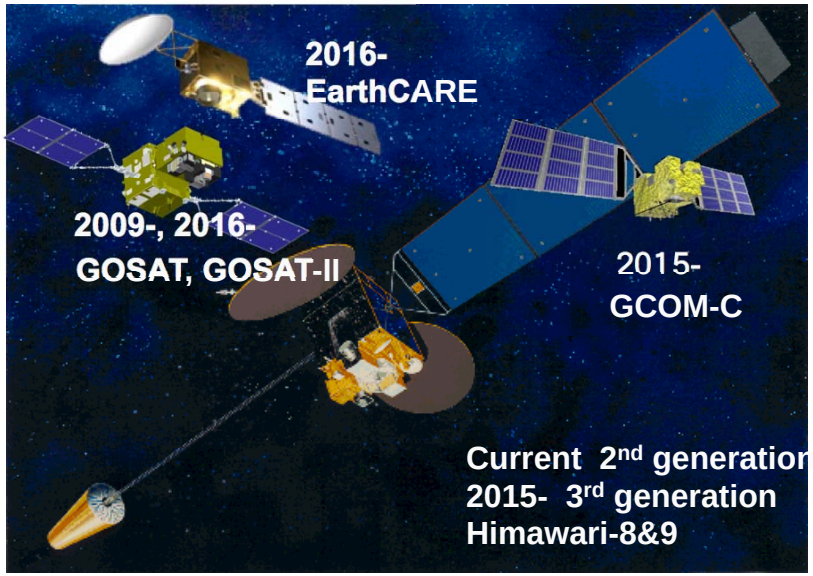


World Solar Challenge



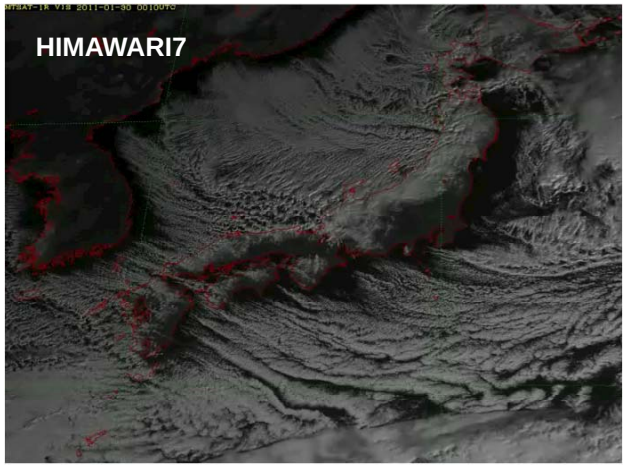
Tokai U. team
Winner 2011-2012
2nd in 2013

Next generation satellites



AHI specs, JMA/ HIMAWARI-8/9

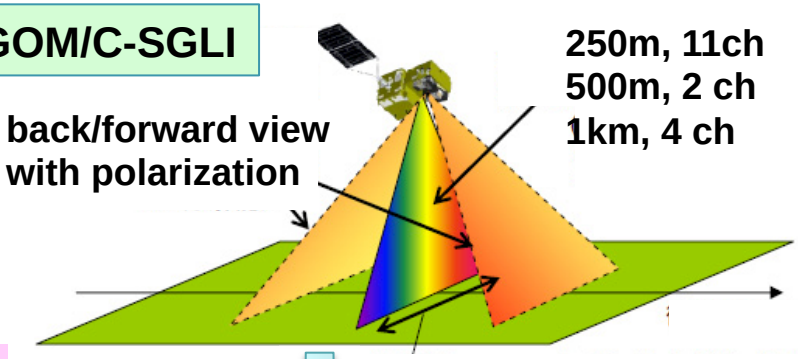
16 bands (1km, 2km)
Full disk scan every 10min
Rapid scan every 2.5 min



Aerosol and cloud monitoring

CGOM/C-SGLI

imager



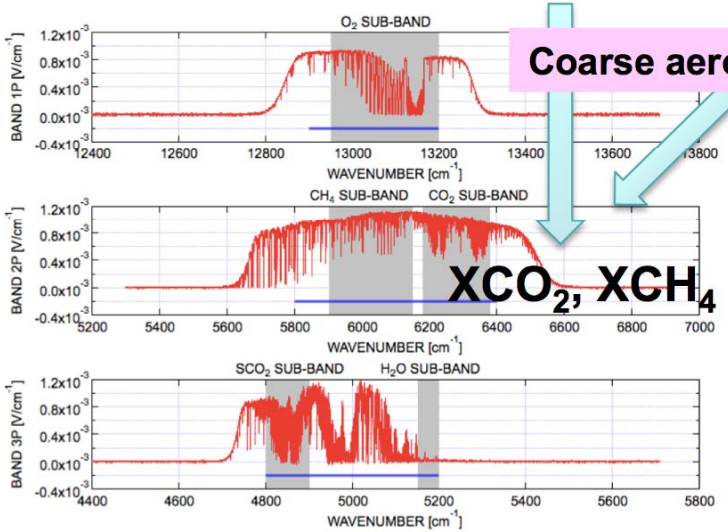
back/forward view with polarization

250m, 11ch
500m, 2 ch
1km, 4 ch

GOSAT2/FTS-SWIR

FTS-TIR

CAI2



Coarse aerosol correction

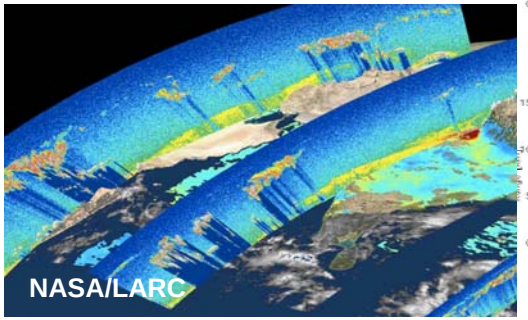
XCO$_2$, XCH$_4$

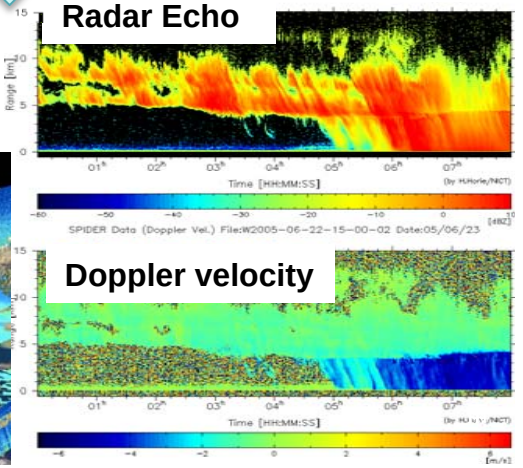
Imaging

Dynamics with aerosol

ESA-JAXA/EarthCARE

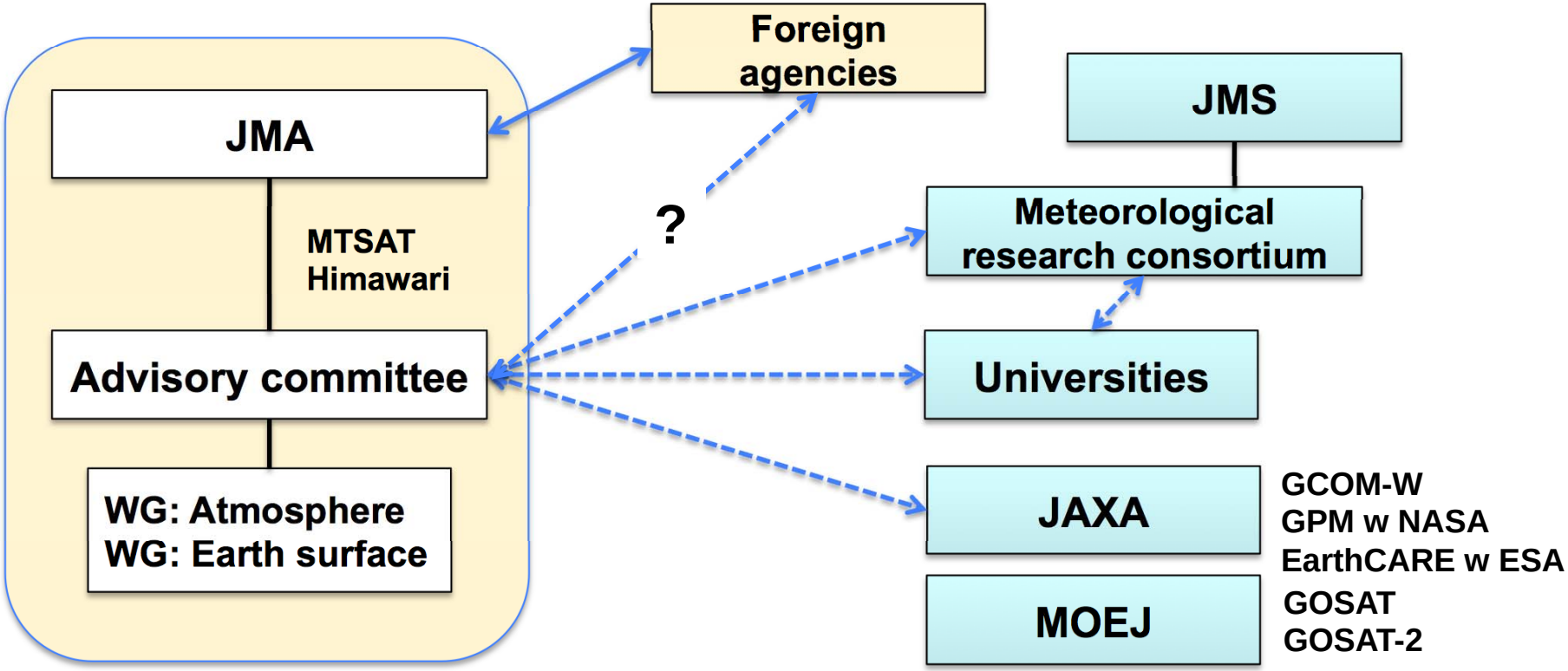
Aerosol forcing





JMA Advisory Committee for Geostationary Satellite Data Use

- Members: T. Nakajima (Chair), R. Oki (JAXA), T. Koike, H. Shimoda, T. Takamura, Y. Takayabu, E. Nakakita, T.Y. Nakajima, K. Nakamura, Y. Honda
- WGs: T.Y. Nakajima (Atmosphere), Y. Honda (Earth surface)
- Data use exploitation and community supports
- Data distributions to research community (430GB/day nc)
- Algorithm developments and requests from foreign agencies and groups?
- Simulation data (Himawari simulator@JMA, Joint Simulator@JAXA)



Joint Simulator@JAXA EarthCARE mission

- NICAM (Non-hydrostatic Icosahedron Atmospheric Model)
- Module: MIROC, NICAM, NHM, WRF

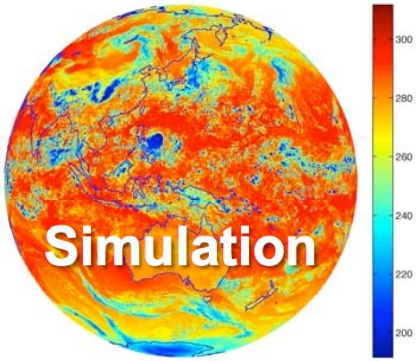
Tropical Cyclone Fengshen simulation 3.5km, 2008/06/21 00Z

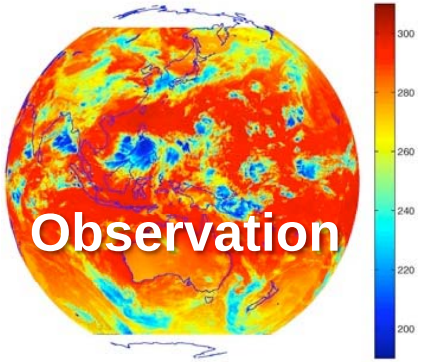
VIS 0.62 μm

IR 10.8 μm TB [K]

MTSAT (MRI, Japan; Chiba University, CEReS)+ globally-merged IR (CPC, NOAA)

Background: Blue Marble: Next Generation, NASA

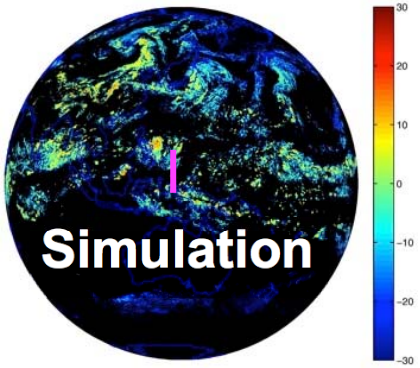


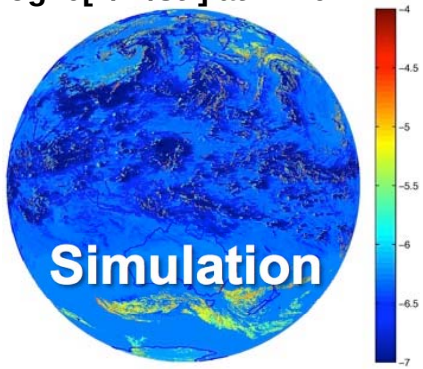


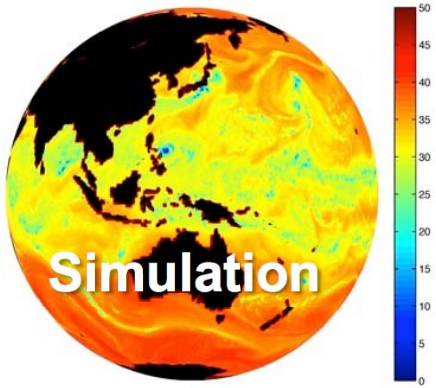
94 GHz CPR [dBZ] at h=10 km

532 nm backscattering coef. Log10[1/m/str] at h=10 km

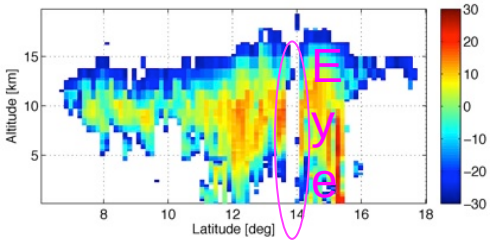
Microwave（19.35GHz）

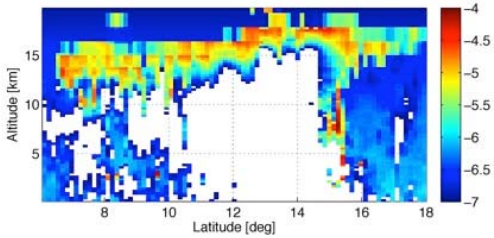






Z-Lat plot





Cross section through the TC at longitude = 127°E

,

T. Hashino et al. (JGR 13)

JMA products for Himawari 8&9

study implement test

Category	New	Product	FY2011	FY2012	FY2013	FY2014	FY2015	FY2016
Wind		Wind vector						
	N	New wind vector						
Cloud	N	Standard cloud						
	N	High resolution cloud analysis						
	N	Improved cloud amount						
		Cloud amount						
		Cloud amount for typhoon analysis						
		Cloud amount in NW Pacific						
		Cloud amount for weather analysis						
		Objective cloud analysis						
		Active cumulus area, cumulonimbus area (MetAir)						
		Wide area cloud analysis						
TBB		Clear sky TBB						
Land surface		Snow ice area	Developed with standard cloud					
Sea surface		High resolution SST						
		Sea ice vector						
Environment	N	Aerosol (VNIR: yellow sand)						
	N	Aerosol (TIR: yellow sand)						
Volcanic	N	Aerosol (TIR: volcanic ash						
Others		Low level wind for typhoon analysis						
		Simulation imageries						
	N	Instability index						
		Data format			Notification			

Wavelength allocations

- High resolution NUV (EarthCARE, GCOM-C, GOSAT2)
- Rich NIR to TIR (Himawari 8&9) vs GOSAT1&2 FTS: time&space sampling
- Active sensing with lidar and CPR (EarthCARE)

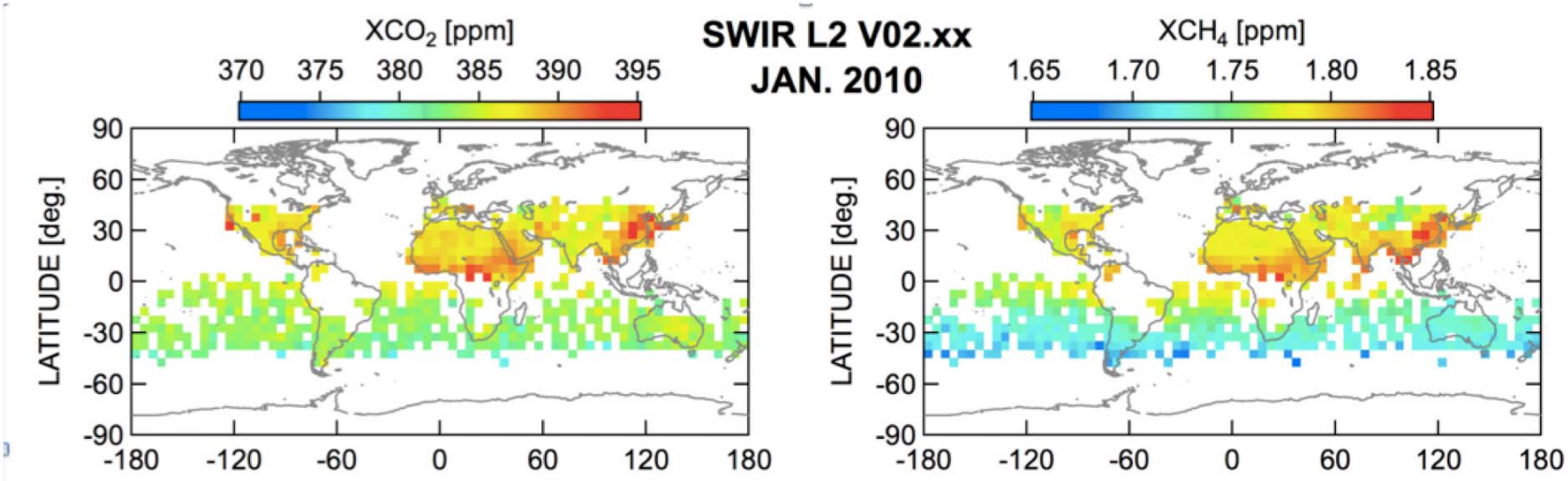
Solar P: Polarization F&B: Forward&backward S: Spectrometer

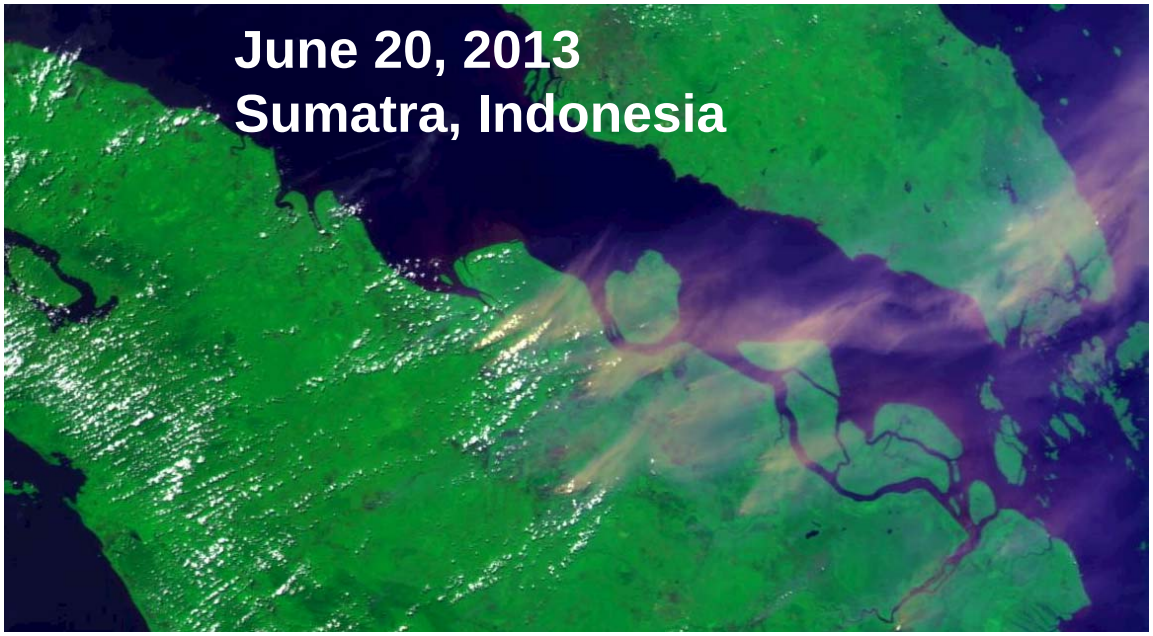
Himawari	AHI	Geo				460	510	650		860			1.61		2.26	3.85
EarthCARE	MSI	13:45						670		865			1.65		2.21	
	Lidar		355P													
GCOM-C	SGLI	10:30		380	412	443	530	674	763	869	1.05	1.38	1.63		2.21	
								PF		PF						
								PB		PB						
GOSAT2	CAI2F	13:00	340F			430				870F			1.6			
	CAI2B			380B			550B			B						
	FTS2								760S				1.6S	2.0S	2.3S	

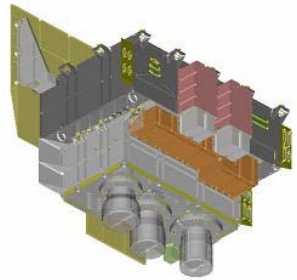
Thermal, Microwave

Himawari	AHI	6.25	7.00	7.35	8.6	9.63	10.5	11.2	12.4	13.3	
EarthCARE	MSI				8.8		10.8		12.0		
	CPR										3mm
GCOM-C	SGLI						10.8		12.0		
GOSAT2	CAI2										
	FTS2	5.5-	-	-	-	-	-	-	-	-14.3	

GOSAT XCO2, XCH4, aerosols





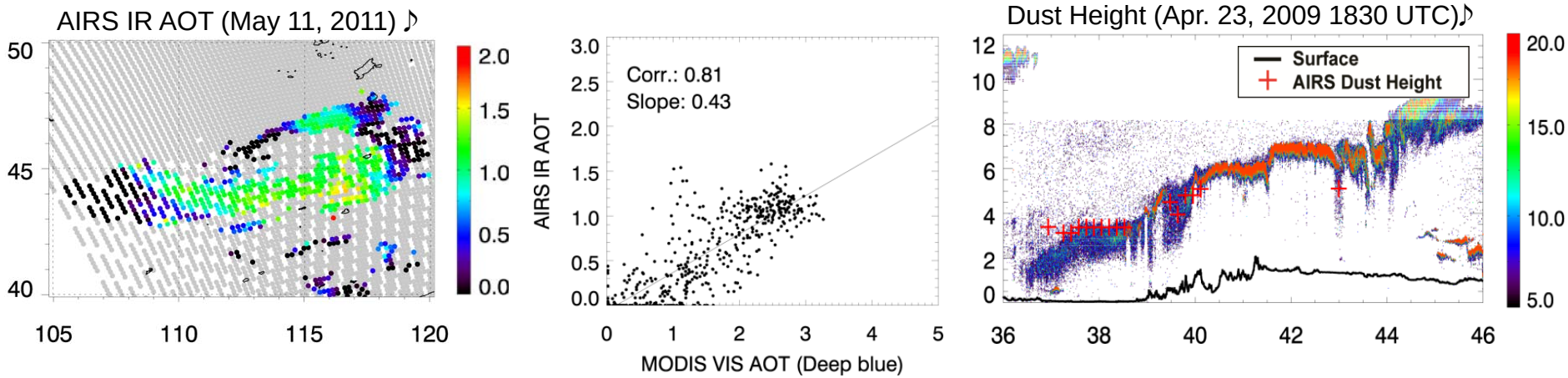


Cloud and Aerosol Imager (CAI)
380, 670, 860, 1600nm
FOV 500m 750m
Push-broom imager, Cheap!

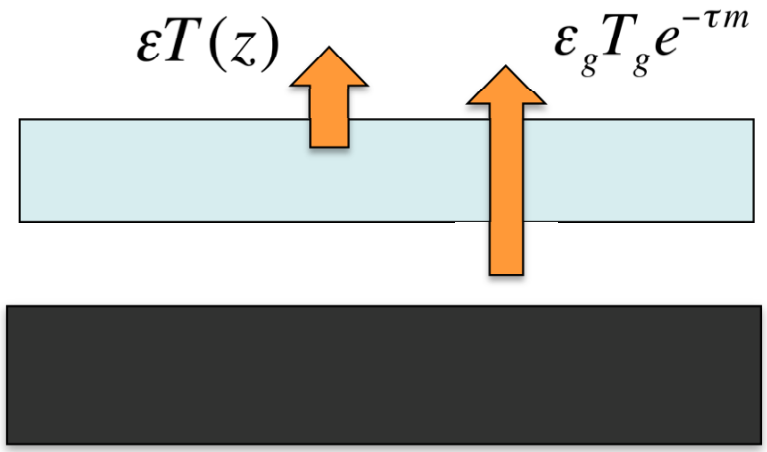
Four channel aerosol species:
Higurashi and Nakajima (GRL 02)

Use of TIR spectrum for coarse particles

- **Dust events**
- **Coarse aerosol correction for CO2 retrieval from GOSAT 1&2 (planned)**



Courtesy: Hyojin Han & B.J. Sohn (2013)



$\mathbf{AOT_{coarse}}$
$\mathbf{Height_{coarse}}$

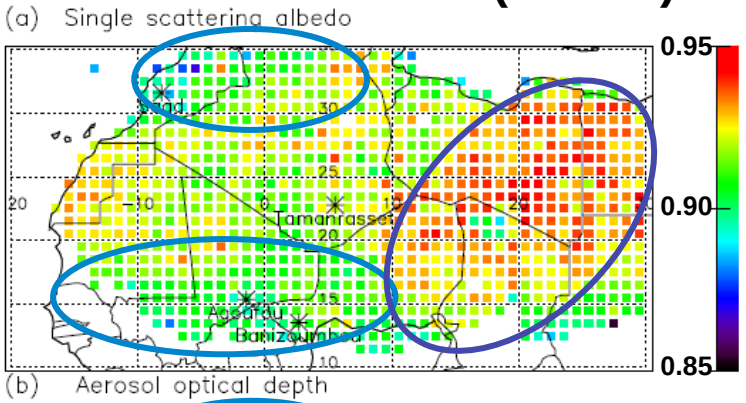
$\mathbf{AOT_{fine} << 1}$ **in TIR**

Dust optical properties (multi-time/pixel method)

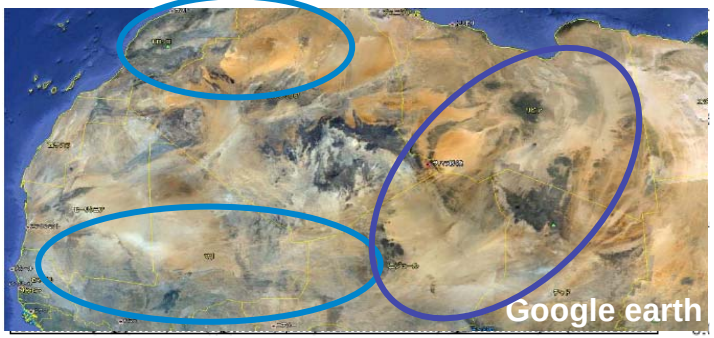
- **Neutral reflectance method (*Kaufman, JGR 87*)**
- **Extended for any AOT (*Yoshida et al., ACP 13*)**

Africa MODIS band 9 (443nm)

SSA

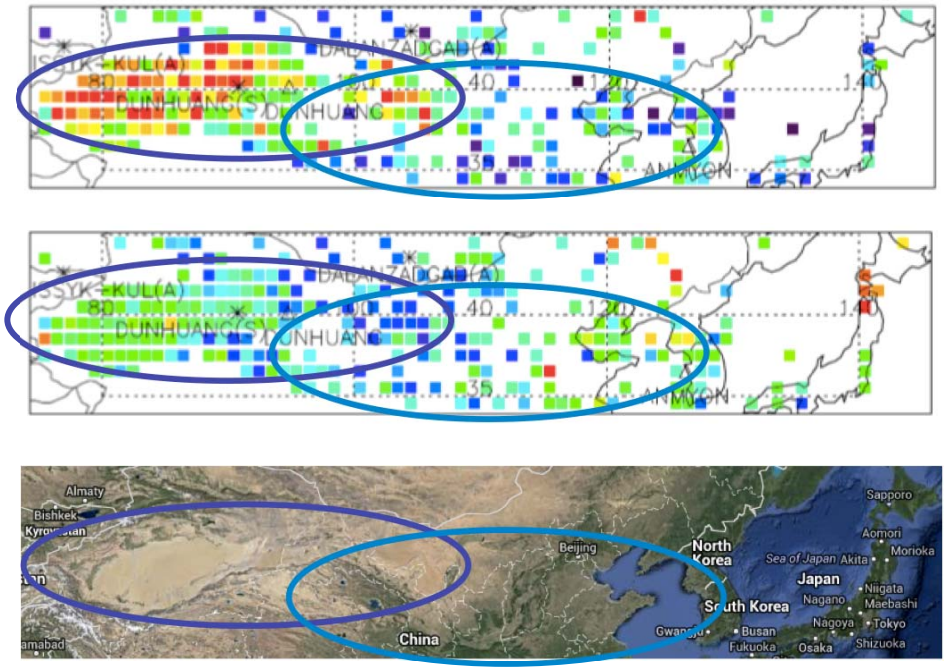


AOT

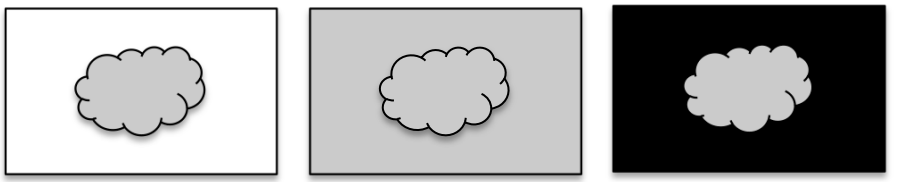


- **9 year mean (2003-2011), OMI prescreen**
- **Lower SSA in Asia: Dust and soot mixed**
- **SSA related with land albedo**

Asia

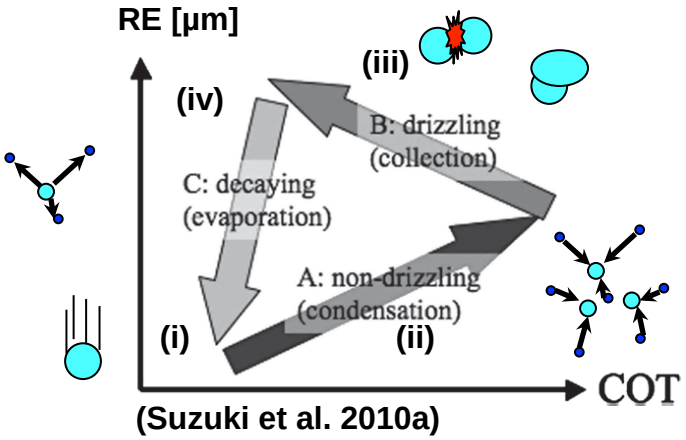


RE>0 **RE=0** **RE<0**

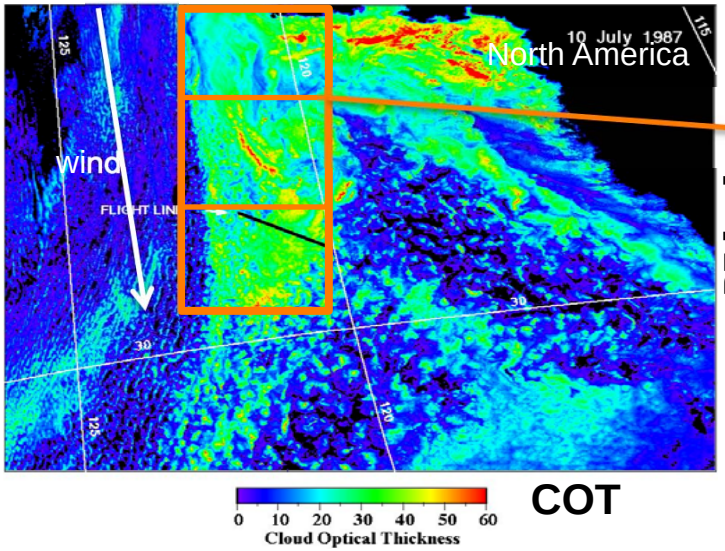


Cloud observables

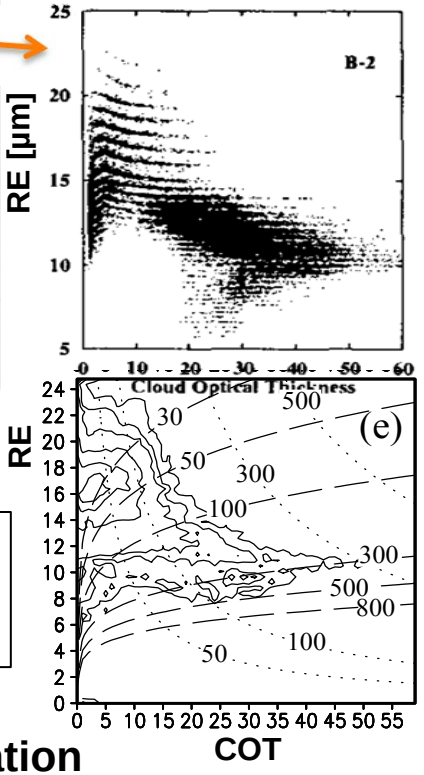
- COT-RE diagram: Nakajima and King (JAS 90), TY. Nakajima & Nakajima (JAS95)
- CFODD: TY. Nakajima et al. (JAS10)



(Suzuki et al. 2010a)

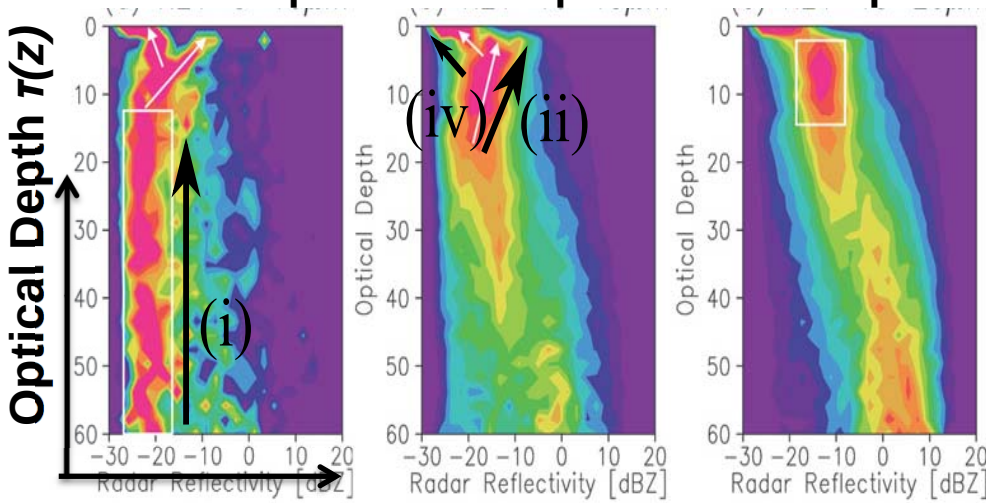


FIRE campaign (July 7, 1987） Off California



JMA/NHM+UT/ACBM (2D-bin model): *K. Suzuki. (JAS10); Y. Sato (JAS11, 12)*

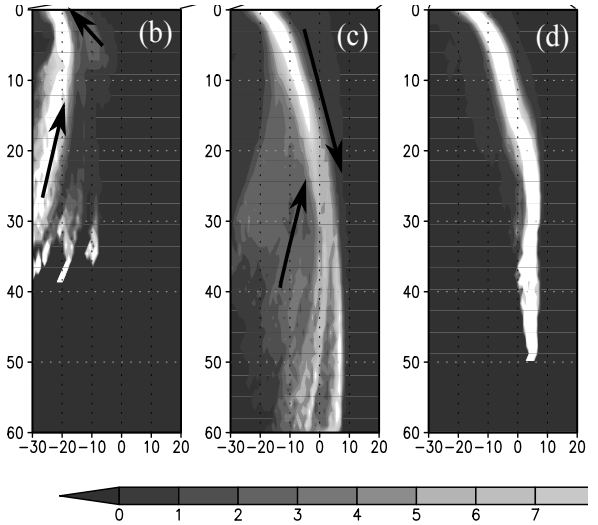
RE=5-10μm 10-15μm 15-20μm



CPR Radar Reflectivity [dBZ]

Cloudsat

Bin-model simulation



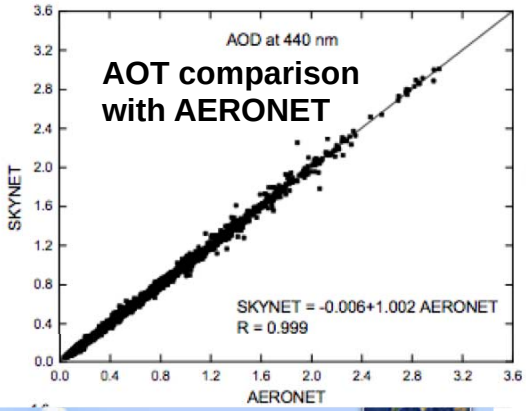
Aerosol & Cloud detection capability

- Geos for good aerosol and cloud variation and motion
- Geos for bridging EarthCARE, GCOM-C, GOSAT2 observation
- EarthCARE profiling for Geos analysis
- GOSAT column trace gases (CO2, CO, CH4) and aerosols

	Himawari	EarthCARE	GCOM-C	GOSAT2
Time variation, motion	OK	-	-	-
AOT&AE dark target	OK	OK	OK	OK
Aerosol species dark target	medium	-	OK	OK
AOT over bright land	medium	-	OK	OK
Coarse particle AOT	OK	-	OK	OK
SSA neutral reflectance	medium	-	OK	OK
Aerosol profiling (nadir)	-	Lidar	-	O2A
Screen by cloud shadow	-	-	UV	UV
COT	OK	OK	OK	OK
RE	1.6, 2.2, 3.7	1.6, 2.2	1.6, 2.2	1.6, 2.2(FTS)
Clouds over snow	OK	OK	OK	OK
Thin cirrus	OK	medium	OK	FTS
Cloud profiling (nadir)	-	CPR	-	-

PREDE skyradiometer sites (SKYNET)

- **Unique on-site calibration system**
- **AOT, SSA, SZF, COT, RE, O3, WV**
- **Approval process for GAW contributing network**
- **Co-location with ADNET lidar**



99 sites

Conclusions

- **JMA preparation for Himawari 8&9 processing started with healthy collaboration with the research community.**
- **2017 era: Himawari 8&9, EarthCARE, GCOM-C, and GOSAT-2**
- **High resolution NUV data sets for aerosol detection**
- **COT-RE, CFODD for cloud process analysis with active sensing combined with imagers**
- **SKYNET skyradiometer network expanding**
- **CEOS and WMO should enhance the international satellite program coordination**
  - **Japan Basic plan for space policy (Cabinet Office, Government of Japan) endangers JAXA earth observation**

Himawari 8&9 data distribution to research community (Planned)