Improvement of aerosol retrieval algorithms for GCOM-C/SGLI

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Research issues & publications in FY2021

1. Characterization of aerosols from wildfires
   * Improved algorithms for remote sensing-based aerosol retrieval during extreme biomass burning, *Atmosphere*, 12, 403, 2021, doi:10.3390/atmos12030403.
   * Analysis of aerosols in cloudy scene with satellite GCOM-C, Proc. SPIE 11859, Remote Sensing of Clouds and the Atmosphere XXVI, 118590S, 2021, doi:10.1117/12.2597988.
   * Characterization of aerosols by wildfires in western North America from multi-use of satellite/ground observations and meteorological models, (under review).
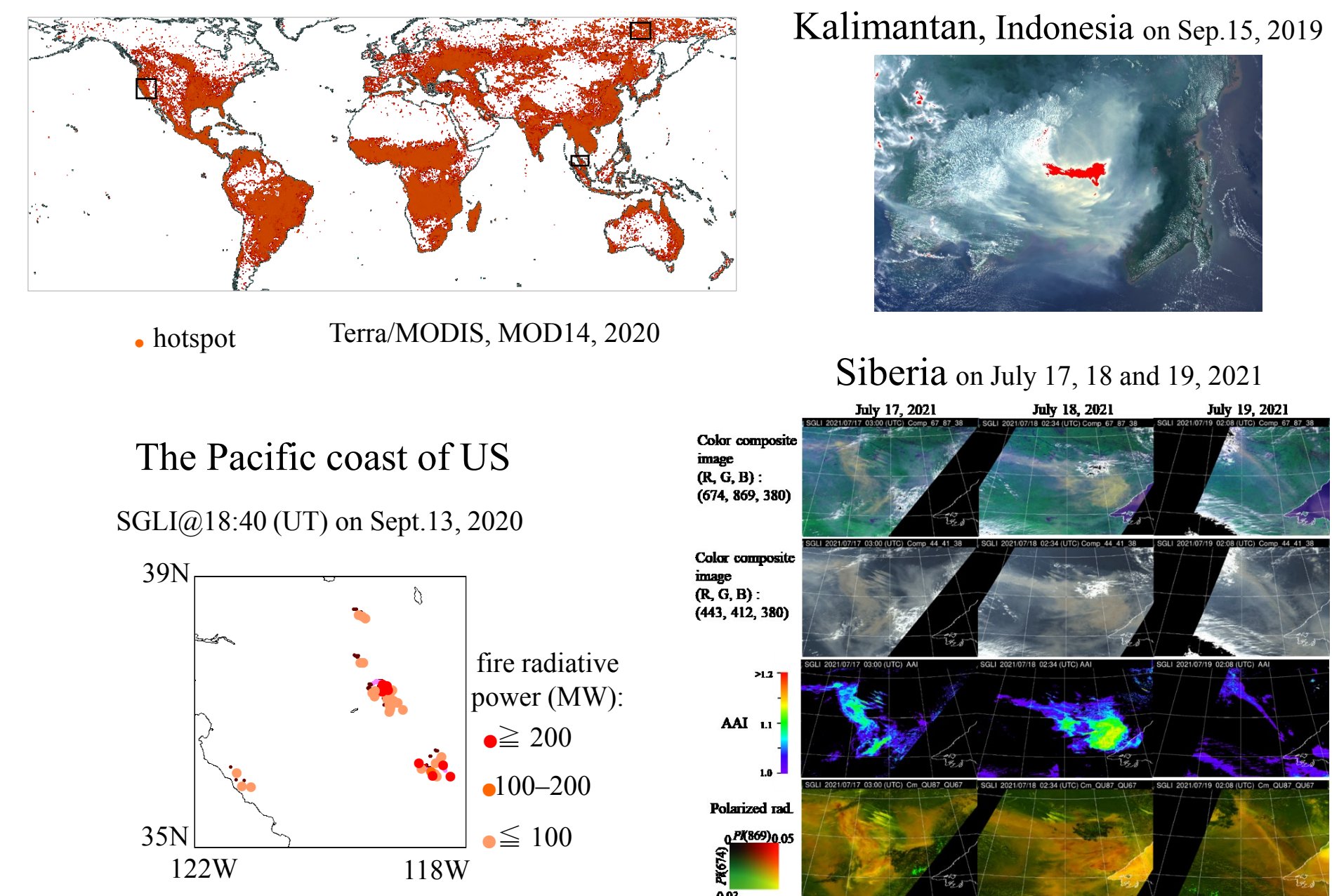
2. AERONET/DRAGON/J-ALPS
   March to May in 2020 ⟶ Covid-19 ⟶ Extended until the end of October 2021
   * Characteristics of aerosol distribution in mountainous regions obtained from AERONET/DRAGON/JALPS, Proc. SPIE 11859, Remote Sensing of Clouds and the Atmosphere XXVI, 118590R, doi: 10.1117/12.2597987.
   * エアロゾル集中観測AERONET/J-ALPSを終えて、 エアロゾル研究 （査読中） .
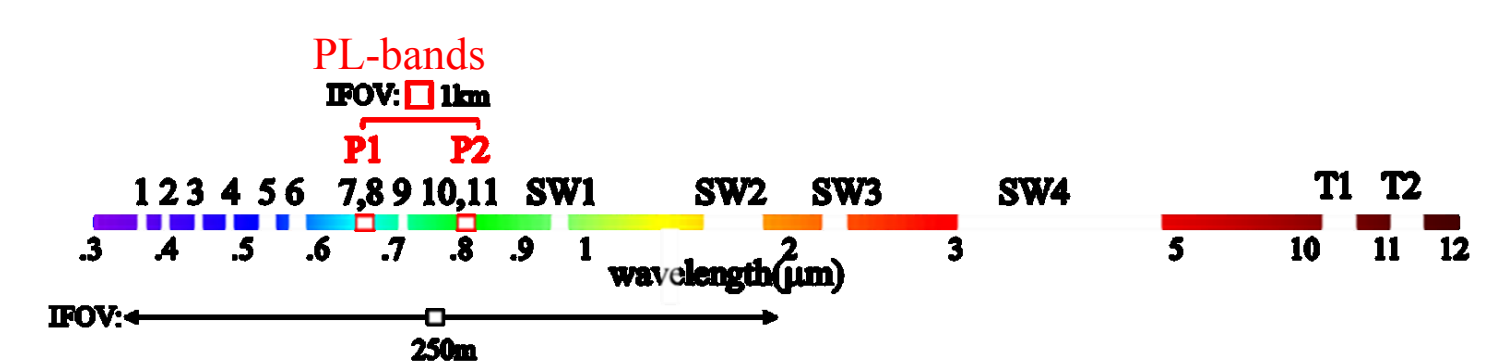
3. Development of regional model "SCALE-Chem"
   * Effects of mountains on aerosols determined by AERONET / DRAGON / J-ALPS measurements and regional model simulations, *AGU Advancing Earth and Space Science*, 2021, doi:10.1029/2021EA001972.

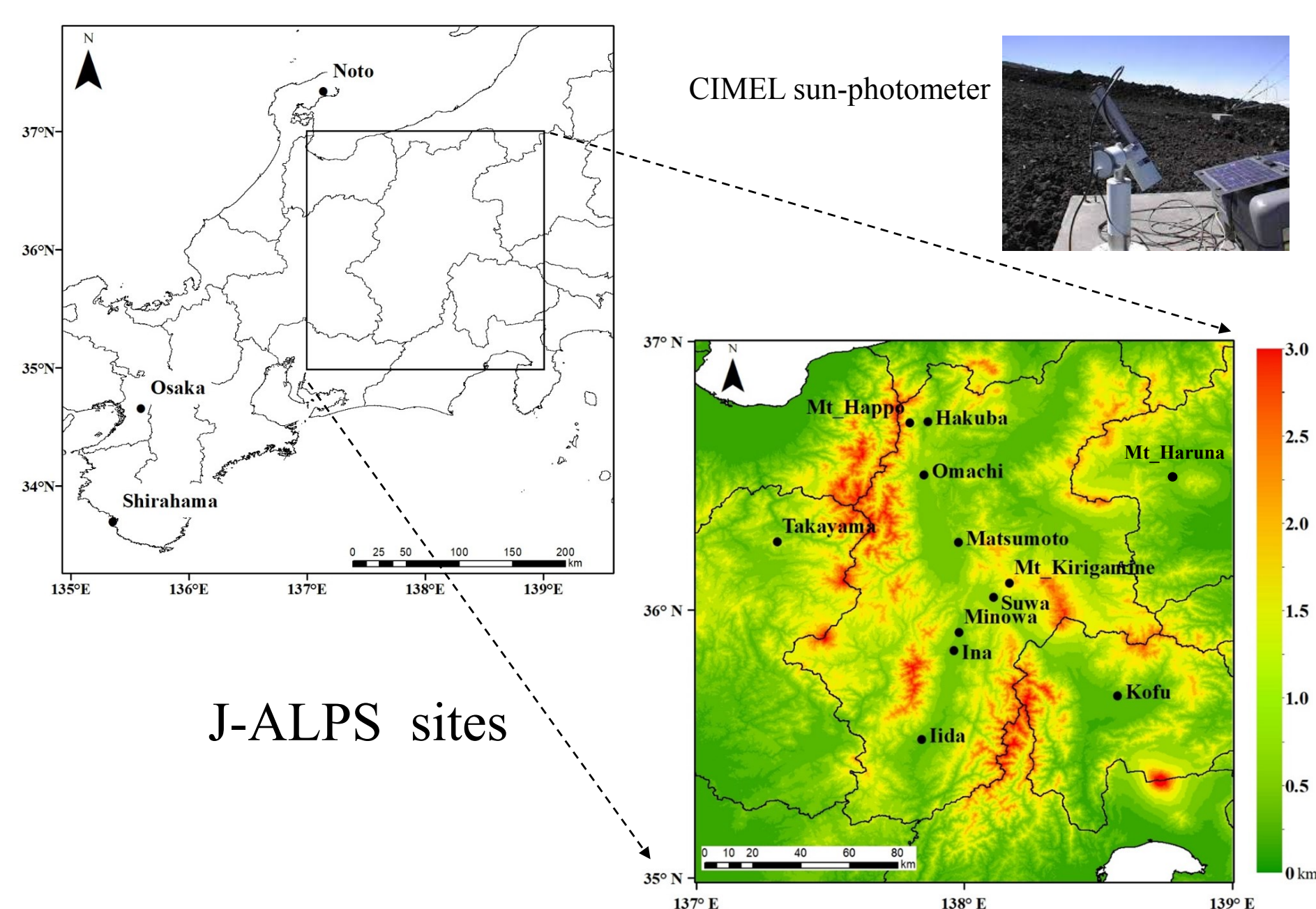## 1. Characterization of aerosols due to wildfires using SGLI

Kalimantan, Indonesia on Sep.15, 2019

• hotspot   Terra/MODIS, MOD14, 2020

The Pacific coast of US

SGLI@18:40 (UT) on Sept.13, 2020

fire radiative power (MW):
● ≧ 200
● 100–200
● ≦ 100

Siberia on July 17, 18 and 19, 2021

Aerosol retrieval flow for severe wildfires using GCOM-C/SGLI

SGLI channels :[NUV – NIR] □ : IFOV		wavelength (nm)		
available channels	380, 412	443, 530	PL1(674), PL2(869)	
aerosol model	AOT	≈ ∞	required solution : AOD(443) & AOD(530)	required solution : AOD(674) & AOD(869)
	aerosol size (f)	:f	f	f
	aerosol component: refractive index (g)	required solution : g₁	required solution : g₂	required solution : g₃
RT simulation	Earth surface model	unnecessary	BPDF	BPDF
	Radiative Transfer method	MSOS	Adding doubling (scalar)	Adding doubling (vectors)
	available SGLI data	reflectance	reflectance	polarized reflectance

PL-bands
P1 P2
1 2 3 4 5 6 7,8 9 10,11   SW1   SW2   SW3   SW4   T1 T2

2. Field campaign AERONET/DRAGON/J-ALPS

CIMEL sun-photometer

J-ALPS sites

Hida Observatory

Takayama

Mountain sites>1300m

Happo

Mt. Happo ● Hakuba
● Omachi
Takayam ● ● Matsumoto
Mt. Kirigamine ● Suwa
Ina ● ● Minowa
Jida

Mt. Happo

• Mt. Haruna

Mt. Kirigamine

Ina Basin cooperative observation in March , 2020

Collaborative observation in the Ina Basin on March 19, 2020

Before dawm

(Ceilometer: Backscatter Coefficient at 910nmVaisala CL31)

Drone obs. base Nagoya U.
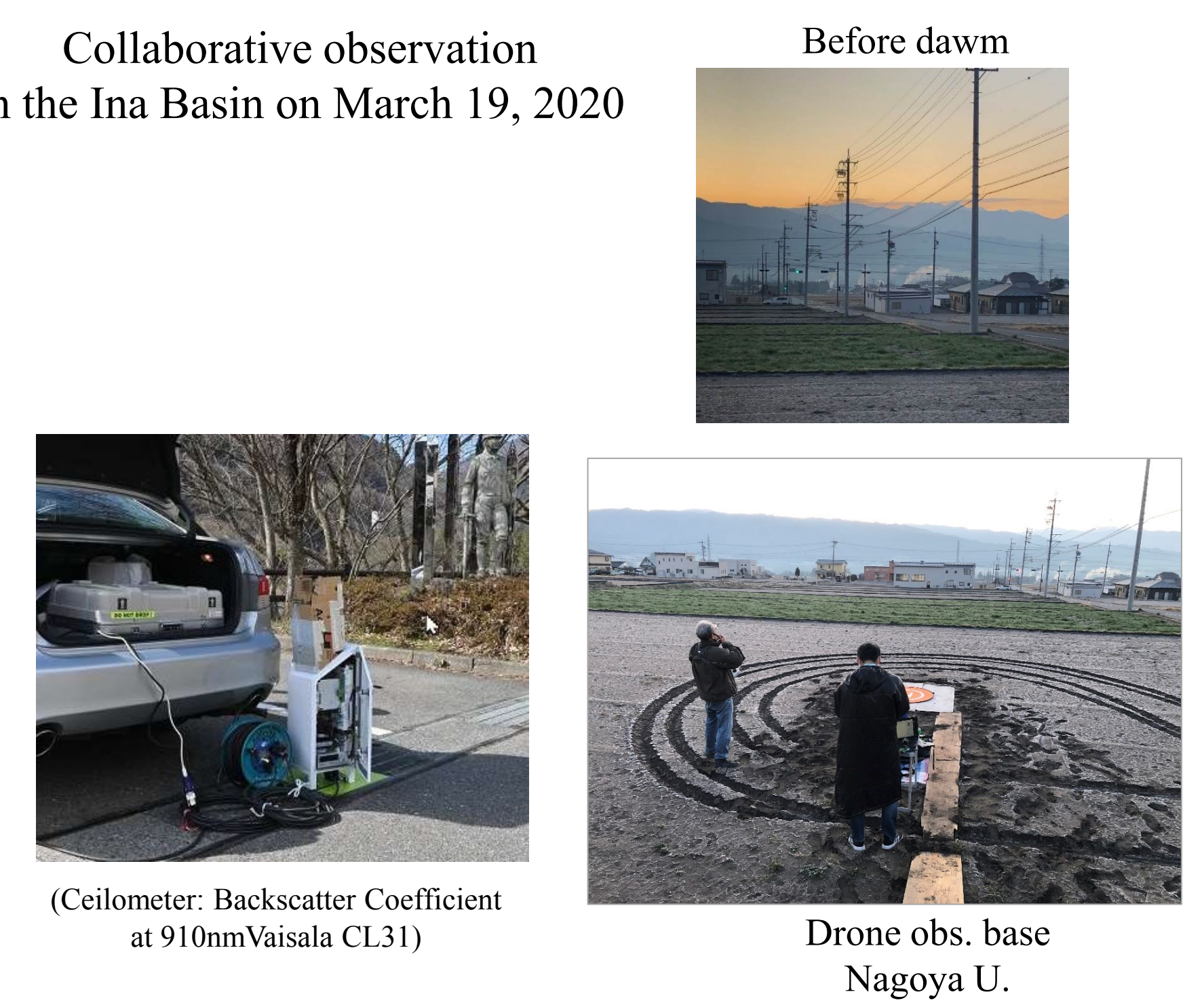
Validation of GCOM-C/SGLI

It is worth noting that fine resolution images from SGLI are available to validate the ground-based measurements, and vice versa.

Dust events in spring, 2021

Mar.28, 2021

Mar.29, 2021

Mar.30, 2021

Mar.29, 2021

J-ALPS

a) Color comp. image   b) AOT(500 nm) & COT(500 nm) from SGLI/L2 products   c) Enlarged view of J-ALPS
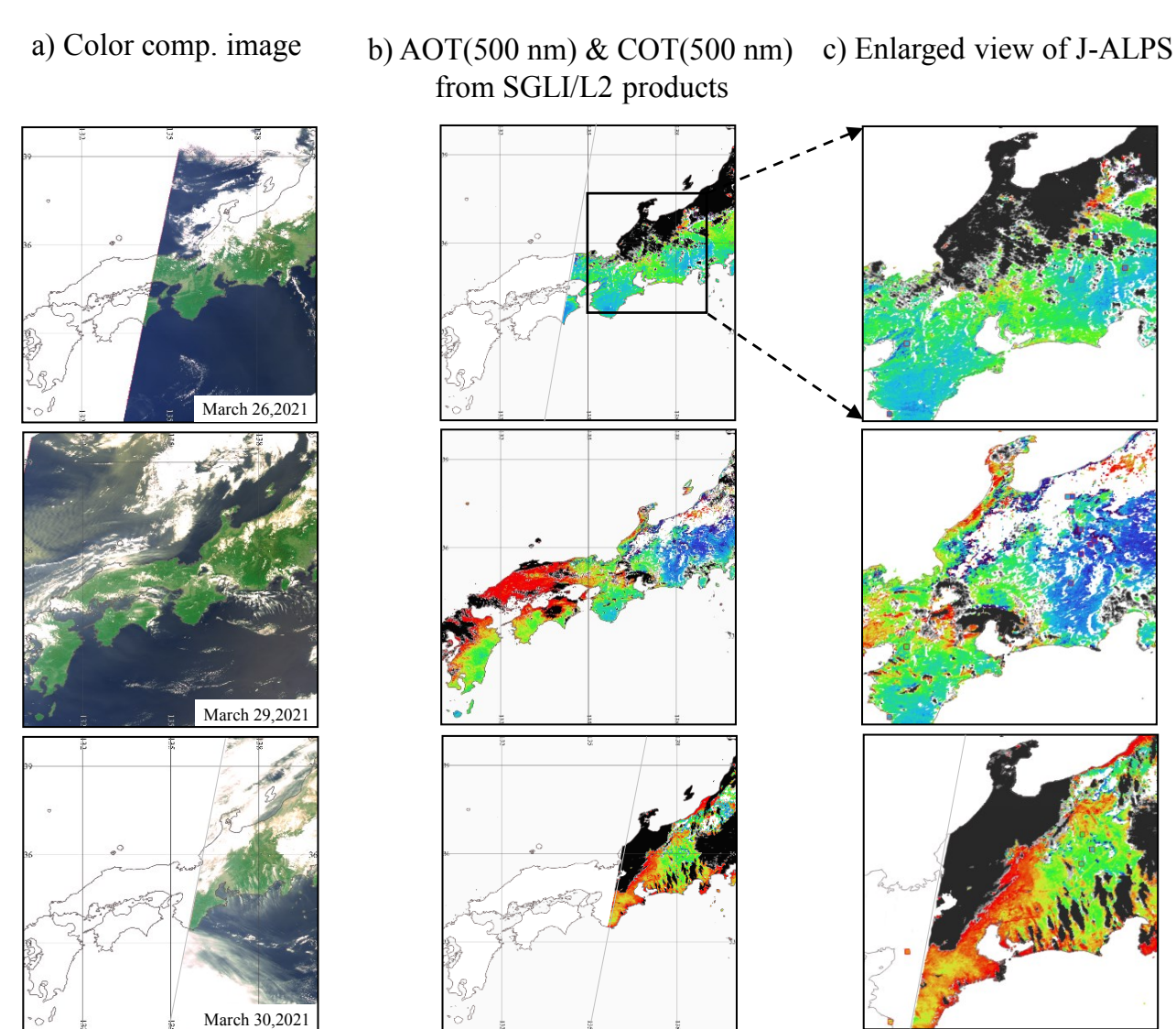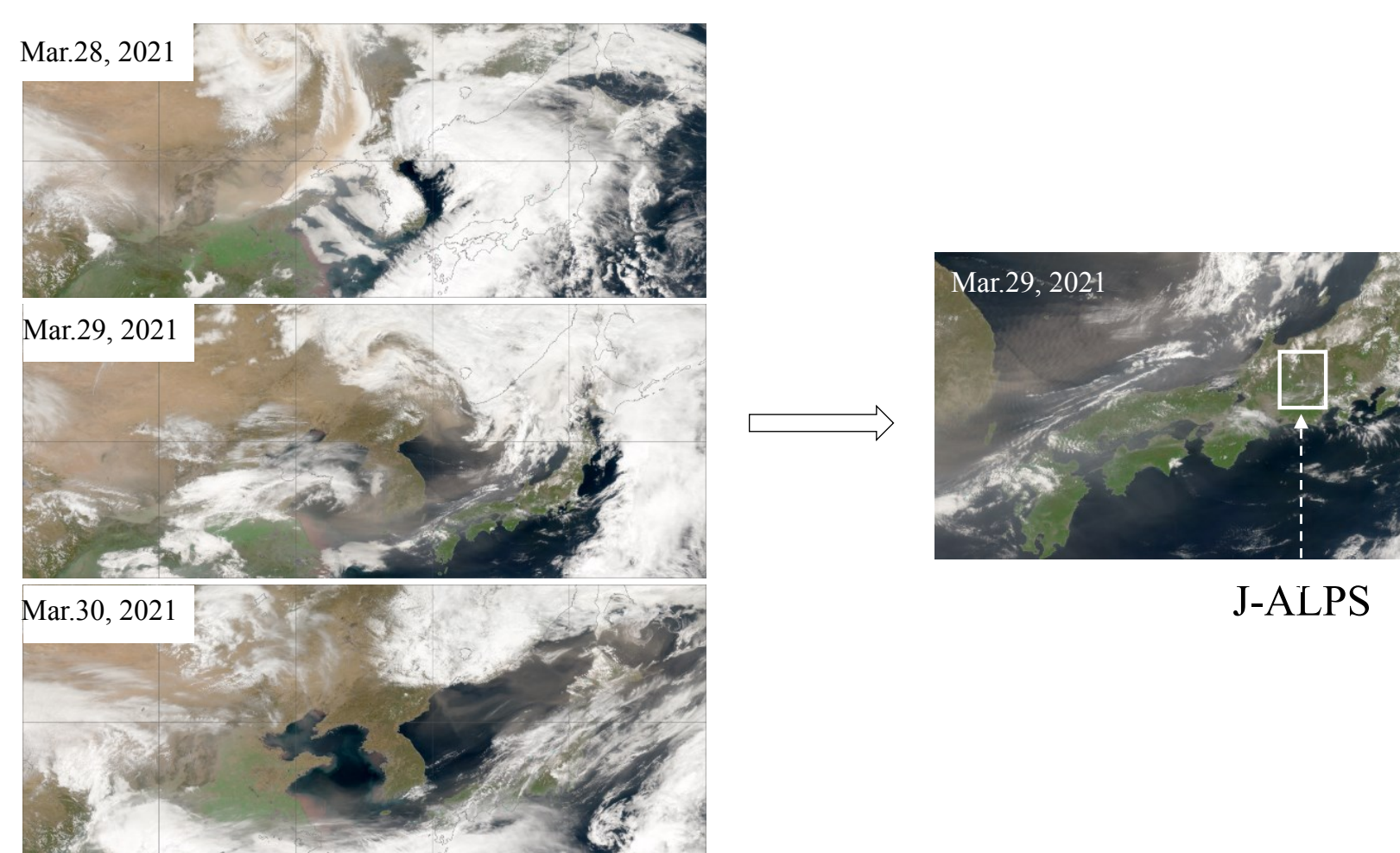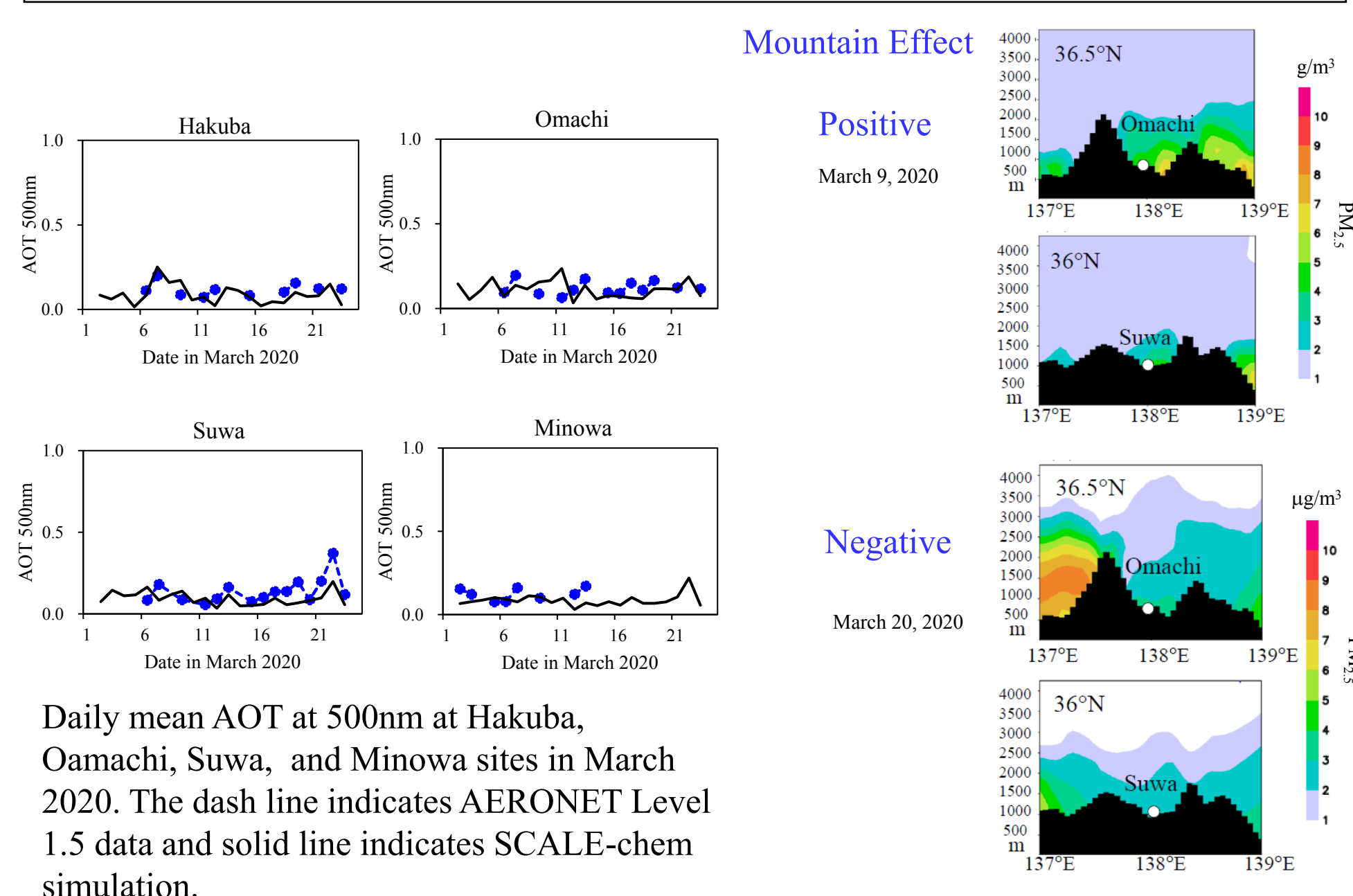
(a) Color composite image, (b) AOT at 500nm and COT at 500nm derived from SGLI/L2 products and (c) Enlarged view of J-ALPS derived by SGLI, where the small squares denote J-ALPS/AERONET/AOT(500nm).

Inter-comparison of AOT(500nm) values observed with SGLI(●) and J-ALPS/AERONET sites (×)

Osaka   Shirahama   Matsumoto   Suwa

Ina   Mt_Kirigamine   Iida   Kofu
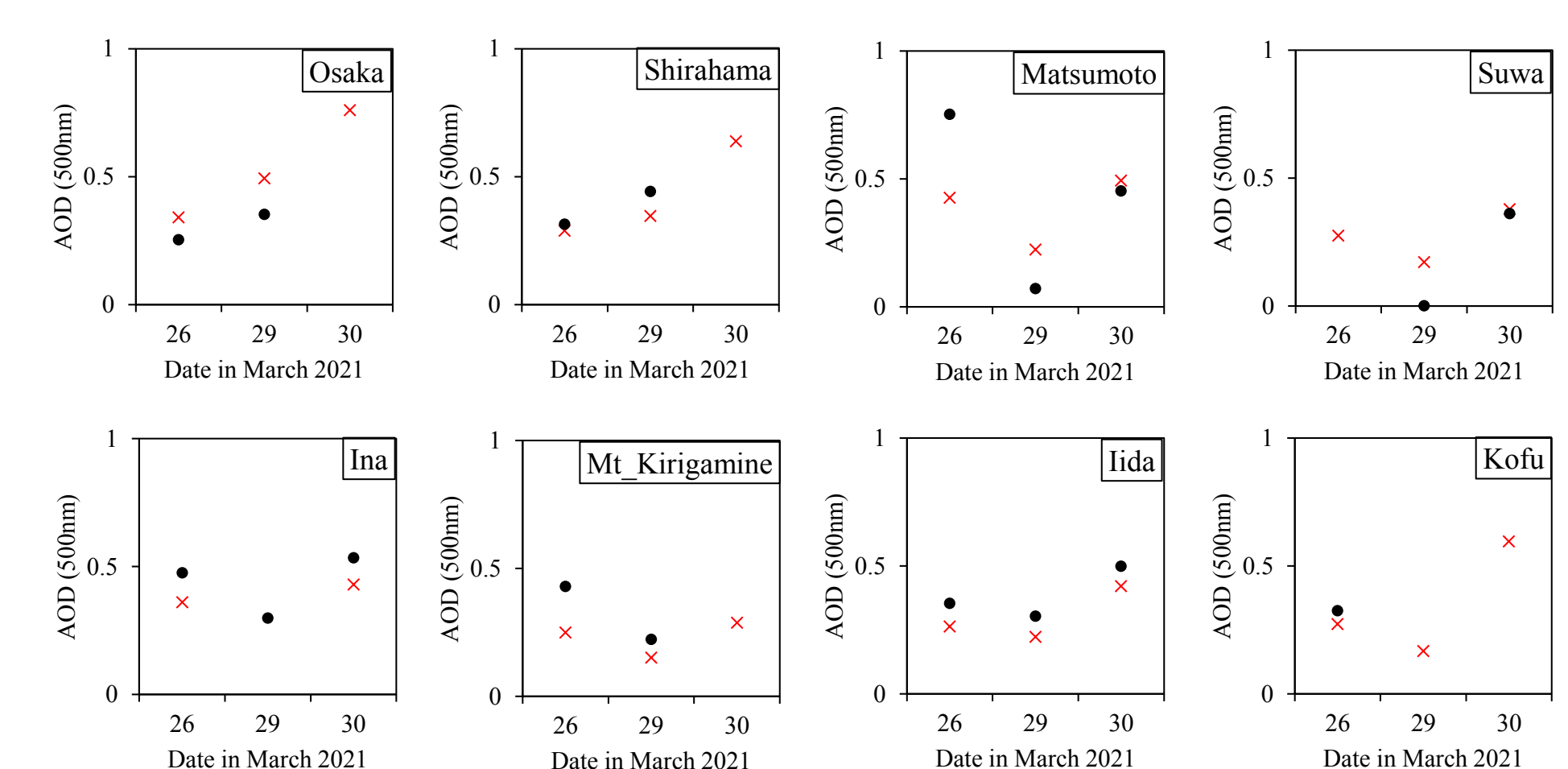
Inter-comparison of AOT(500nm) values observed with SGLI(●) and J-ALPS /AERONET sites (×) . Note that AERONET/AOT is the average of the 30 minutes before and after the satellite pass.

3. Regional model "SCALE-Chem"

Hakuba   Omachi

Suwa   Minowa

Daily mean AOT at 500nm at Hakuba, Oamachi, Suwa, and Minowa sites in March 2020. The dash line indicates AERONET Level 1.5 data and solid line indicates SCALE-chem simulation.

Mountain Effect

Positive
March 9, 2020

Omachi

Suwa

Negative
March 20, 2020

Omachi

Suwa

Future Outlook

1. Operation of the current SGLI in step-and-stare mode in limited airspace during DSS, large forest fires, and severe PM, if possible.

2. Development and operation of an SGLI-like future instrument equipped with multi-directional observation, polarized multi-channel (particularly in UV and SWIR), and including the "step-and-stare" mode.

Polarization Advertisement

The key advantage of the polarimetry in the remote sensing of aerosols over land surfaces is the ability to systematically correct for the ground contribution. Stokes parameters (I, Q, U, V) provide such several kinds of information at a wavelength λ as radiance , polarized radiance and degree of polarization.

$I(\lambda)$ $Pol(\lambda) = \sqrt{Q^2 + U^2}$ $\dfrac{Pol.\ Deg.(\lambda):}{Pol(\lambda)\ /\ I(\lambda)}$

Single scattering simulation for an aerosol model.

refer to GCOM-C/SGLI

Note that especially directional " multi-viewing " and spectral " multi-channel " polarization measurements are effective for retrieval of
● aerosols,
● clouds,
● aerosols above clouds.

Polarization; 45°forward or 45°backward view (switched near the equator)

Radiance; straight down view

The SGLI can perform "step-and-stare" mode in the orbit!

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