Local and long-range transport of dust aerosols over the Japan

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Motivation

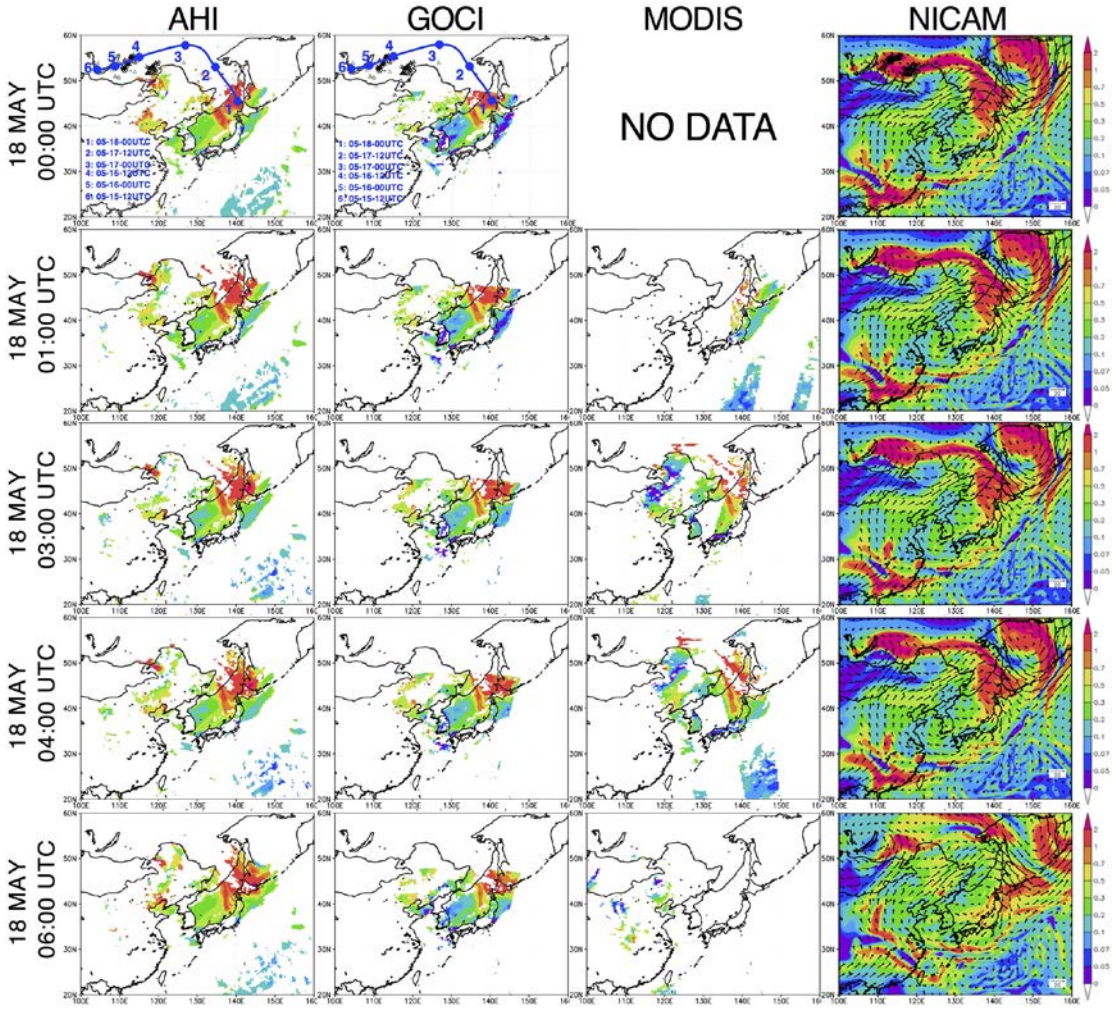
GCOM-C/ SGLI
（Shikisai）

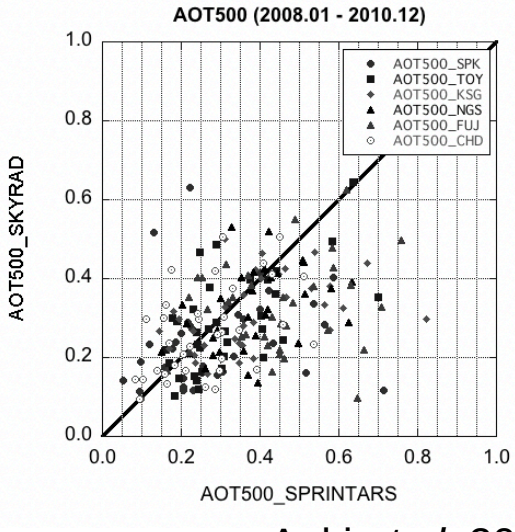
- Dust aerosols play an important role in the Earth Climate Change of the Atmosphere.
- We are often influenced by natural and/or anthropogenic aerosols over the Japan.
- Especially, it is observed long-range transport of natural and anthropogenic dust in Spring and Autumn in Japan.
- However, on May 20, 2019, the Himawari-8 and GCOM-C have an image of a different type of dust aerosols in East Hokkaido, Japan.

Objectives: Aerosol optical properties are studied using data from ground-based and ship-borne sky radiometer measurements. We are seeking in this data information on the aerosol optical properties with respect to their temporal and spatial variability and validation of Satellite (ex. GCOM-C, Himawari-8) and numerical models (ex. SPRINTARS).

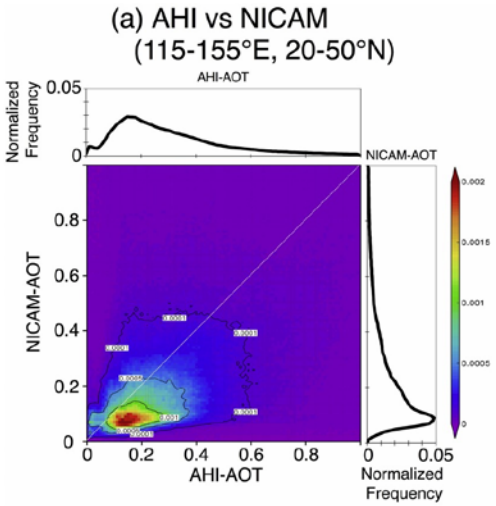
Why is observation important ?

Aerosol model evaluation using two geostationary satellites over East Asia in May 2016

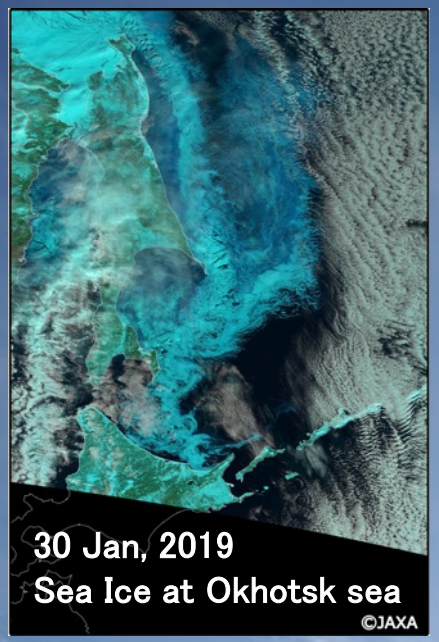




Aoki *et al*, 2013, AIP.

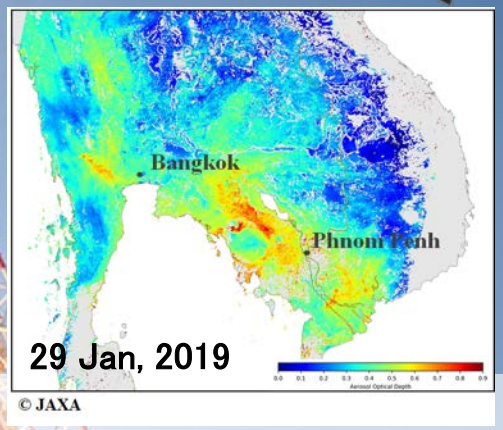


Goto *et al*, 2019, Atmos Res.



H2A/JAXA

GCOM-C/ SGLI（Shikisai）



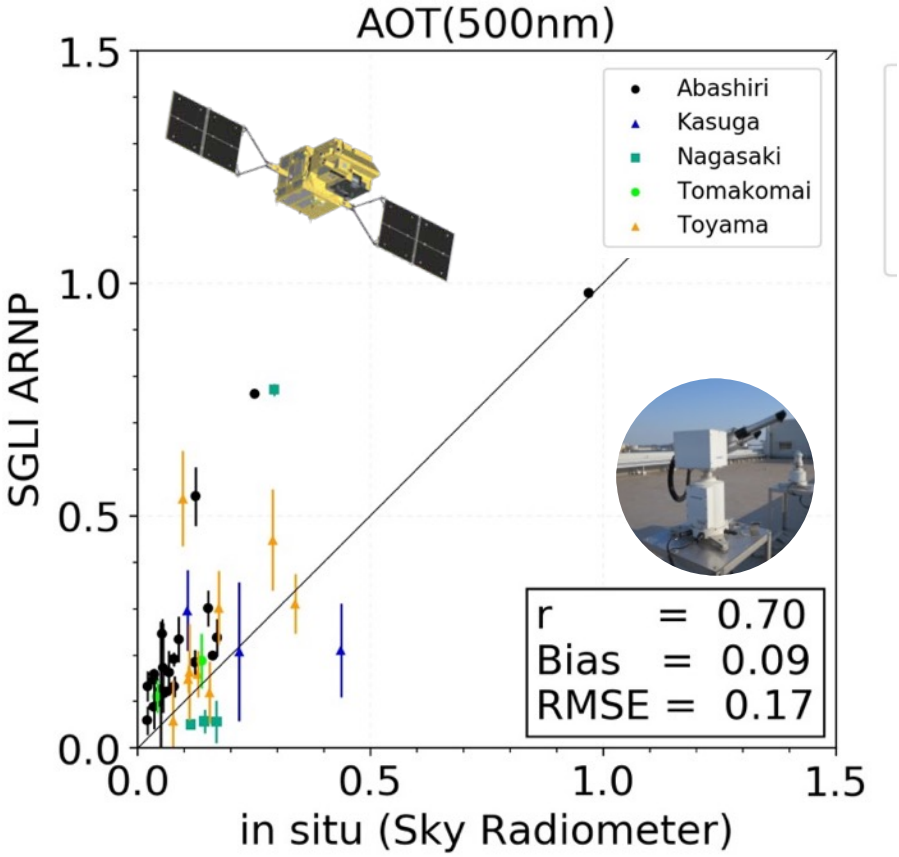
GCOM-C/SGL/JAXA

GCOM-C/JAXA, mission aims to establish and demonstrate a global, long-term satellite-observing system to measure essential geophysical parameters to facilitate understanding the global radiation budget and carbon cycle mechanism, and eventually contribute to improving future climate projection through a collaborative framework with climate model institutions. The SGLI (Second-Generation Global Imager) is an optical sensor aboard GCOM-C. SGLI is an optical sensor capable of multi-channel observation at wavelengths from near-UV to the thermal infrared wavelength (380nm~12μm).

The GCOM-C satellite launched in 23 Dec, 2017.

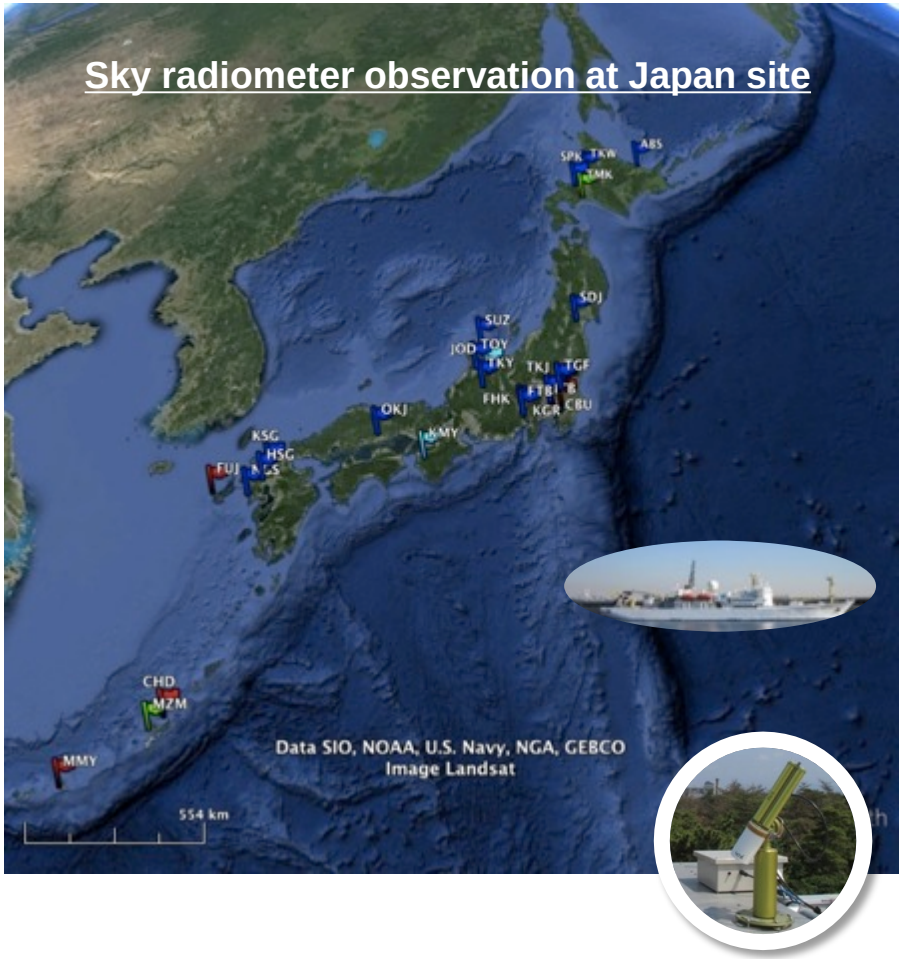
Comparison between SKYRAD and SGLI at five sites

2018.09.01 to 2019.01.15



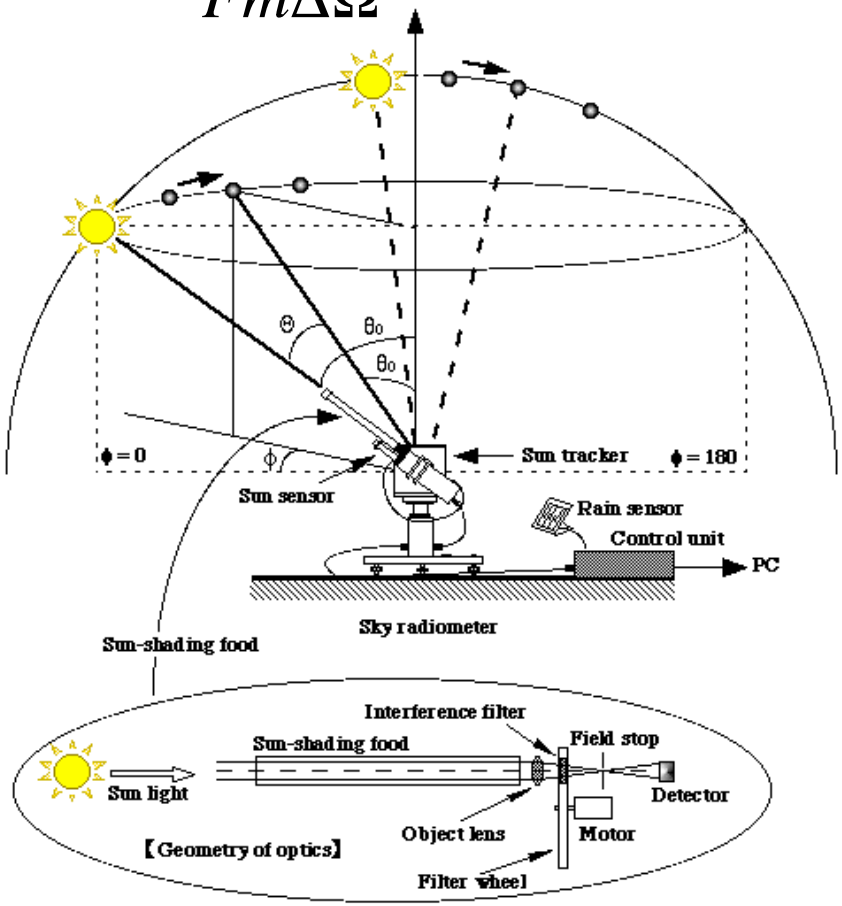
Preliminary results by Nagao and Aoki, 2019

AOT: Spatial average within 10 km from the site



How to measurements of solar aureole?

$$R(\Theta) \equiv \frac{E(\Theta)}{Fm\Delta\Omega} = \omega\tau P(\Theta) + q(\Theta)$$

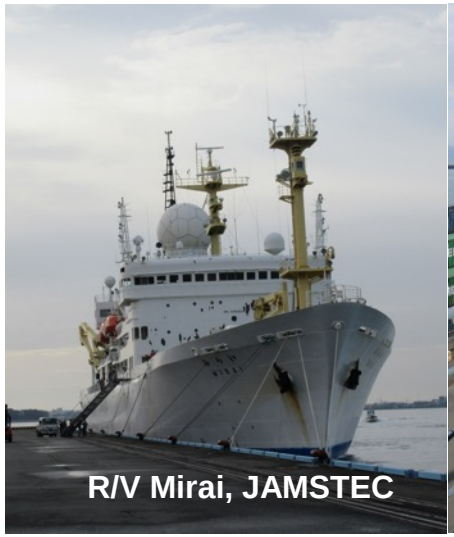


Aoki and Fujiyoshi, 2003, JMSJ

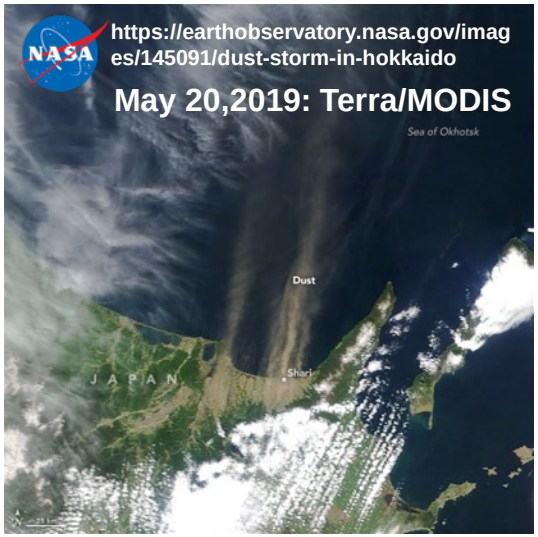
- We observed only in daytime under clear skies at each site.
- Every 10 min/once (aureole)
- Every 1 min/once (direct)
- Data have been analyzed by an inversion software called SKYRAD.pack (Nakajima *et al.* 1996). Available version are SKYRAD.pack 4.2. L0, L1A and L2A.
- POM-01: 0.315, 0.4, 0.5, 0.675, 0.87, 0.94, 1.02 μm
- POM-02: 0.315, 0.34, 0.38, 0.4, 0.5, 0.675, 0.87, 0.94, 1.02, 1.627, 2.2 μm
- Ref. ex. Aoki., 2013.

Contents of Lacal and long-range transport dust study

- **Long-range transport**: Natural & anthropogenic dust
  - Maritime by using R/V Mirai, JAMSTEC
  - Mountain and Ground-based
- **Local dust** in Abashiri, East Hokkaido, Japan

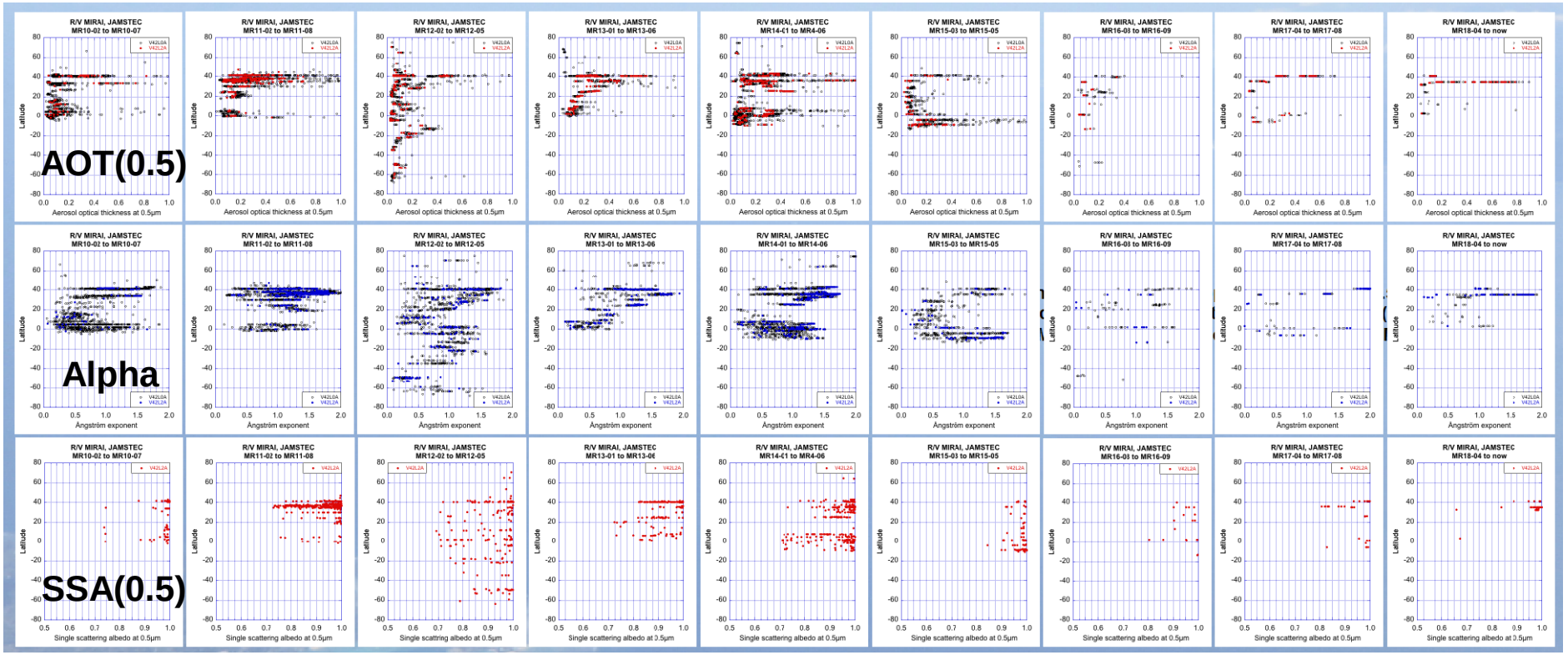

R/V Mirai, JAMSTEC


Murodo-daira, Mt. Tateyama
Alt. 2450m
Snow depth: 6 to 7m/year



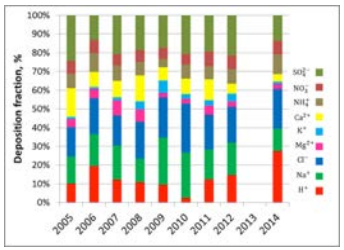
Asian dust case from Ocean study

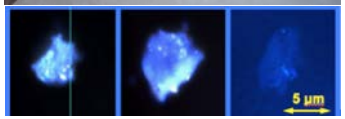
R/V Mirai, JAMSTEC Cruises MR10-02 to MR18-04

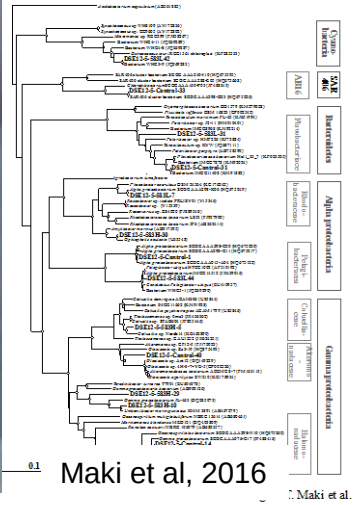


2010 2011 2012 2013 2014 2015 2016 2017 2018

Asian dust case from Snow study

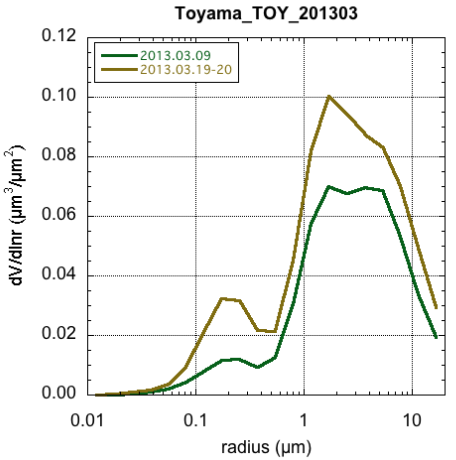






Maki et al, 2016

2013.03.09, 19, 20 at Toyama



Local and long-range transport dust in Hokkaido

Long-term record & Aeronet

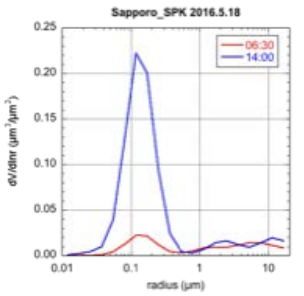
Sapporo_SPK
43.1N, 141.3E
since 1997

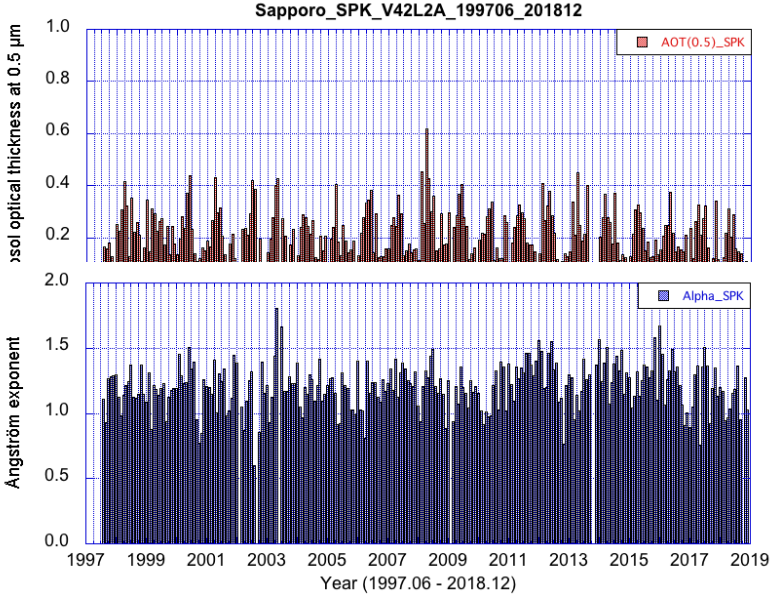
Abashiri_ABS
44.0N, 144.3E
since 2012

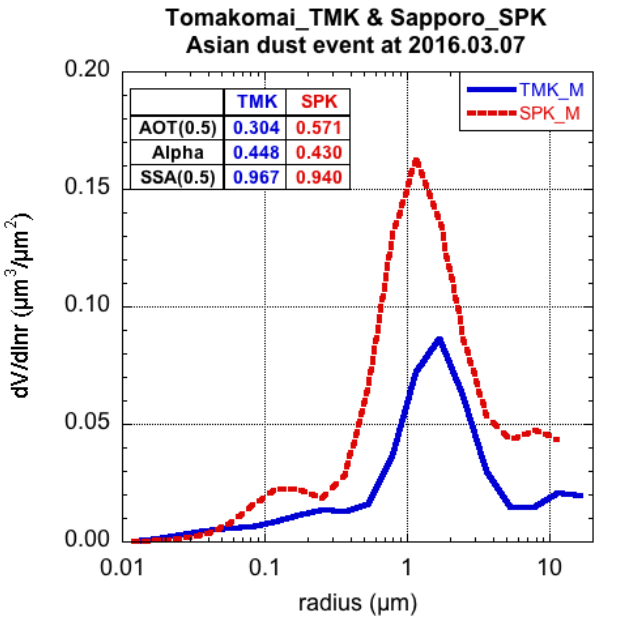
Atmosphere – Cryosphere

Atmosphere - Land

Tomakomai_TMK
42.7N, 141.6E
since 2015



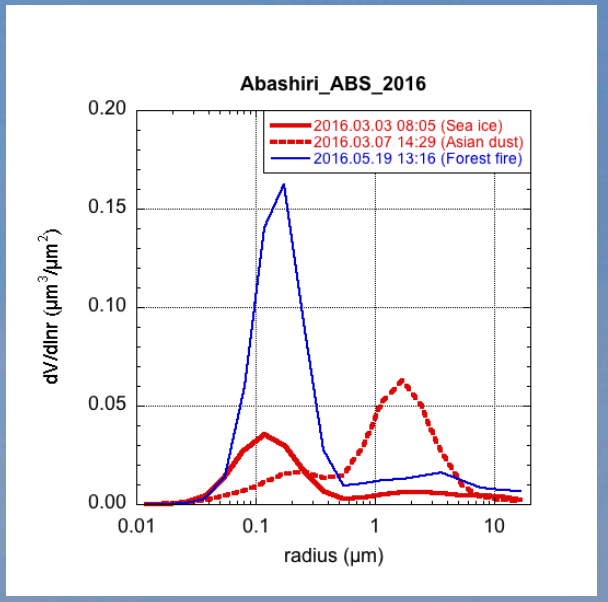




Abashiri, Hokkaido site

2016.03.03

AOT = 0.30
Alpha = 1.73

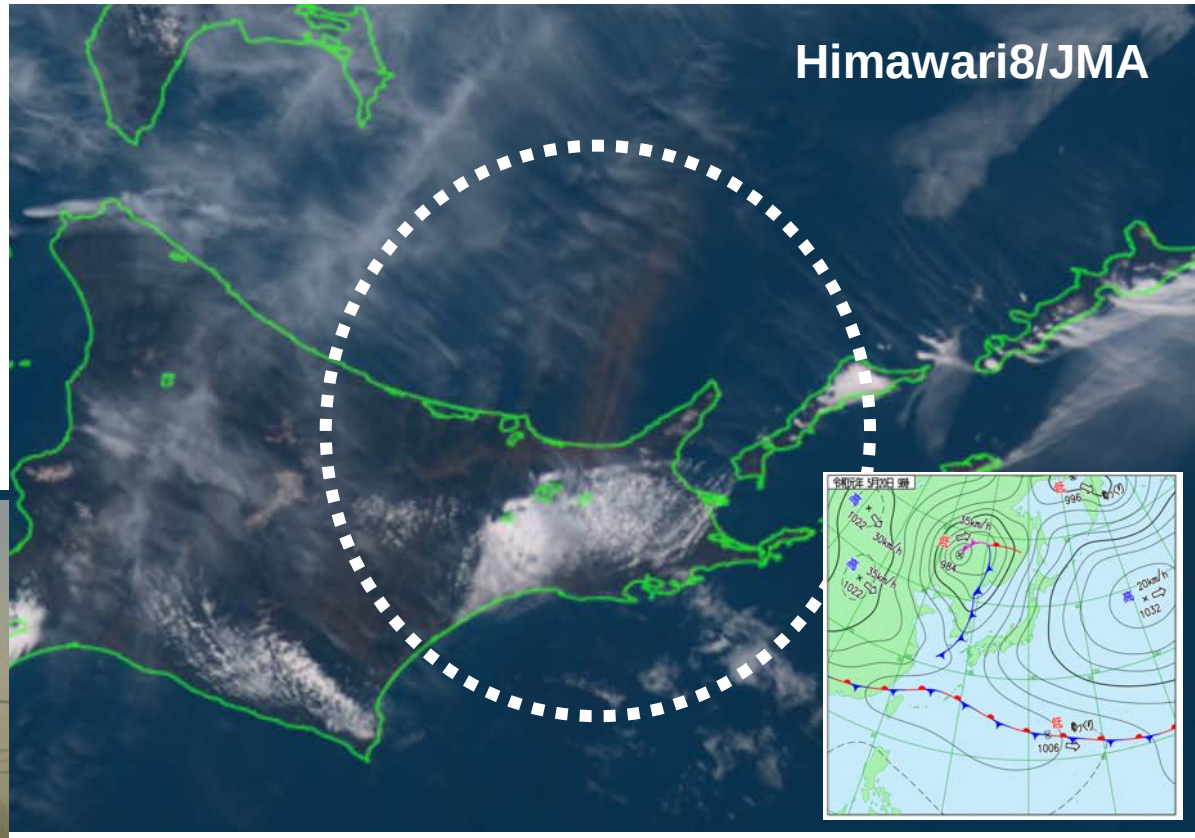


2016.03.07

AOT = 0.32
Alpha = 0.69

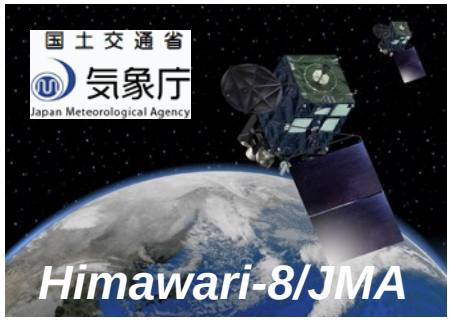
Sea ice event at Abashiri (Photo: 2016.03.03)

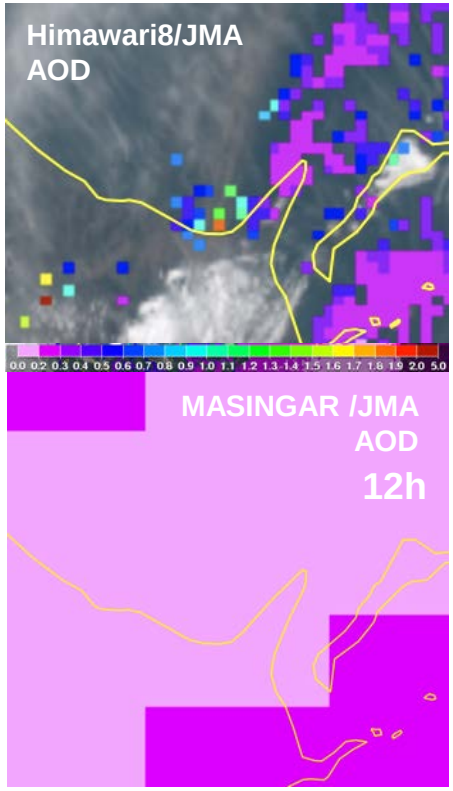
Local dust event in East Hokkaido 2019.05.20



- no rain: about one week in this area
- dry soil due to before planting
- High wind: maximum 25.7 m/s from South

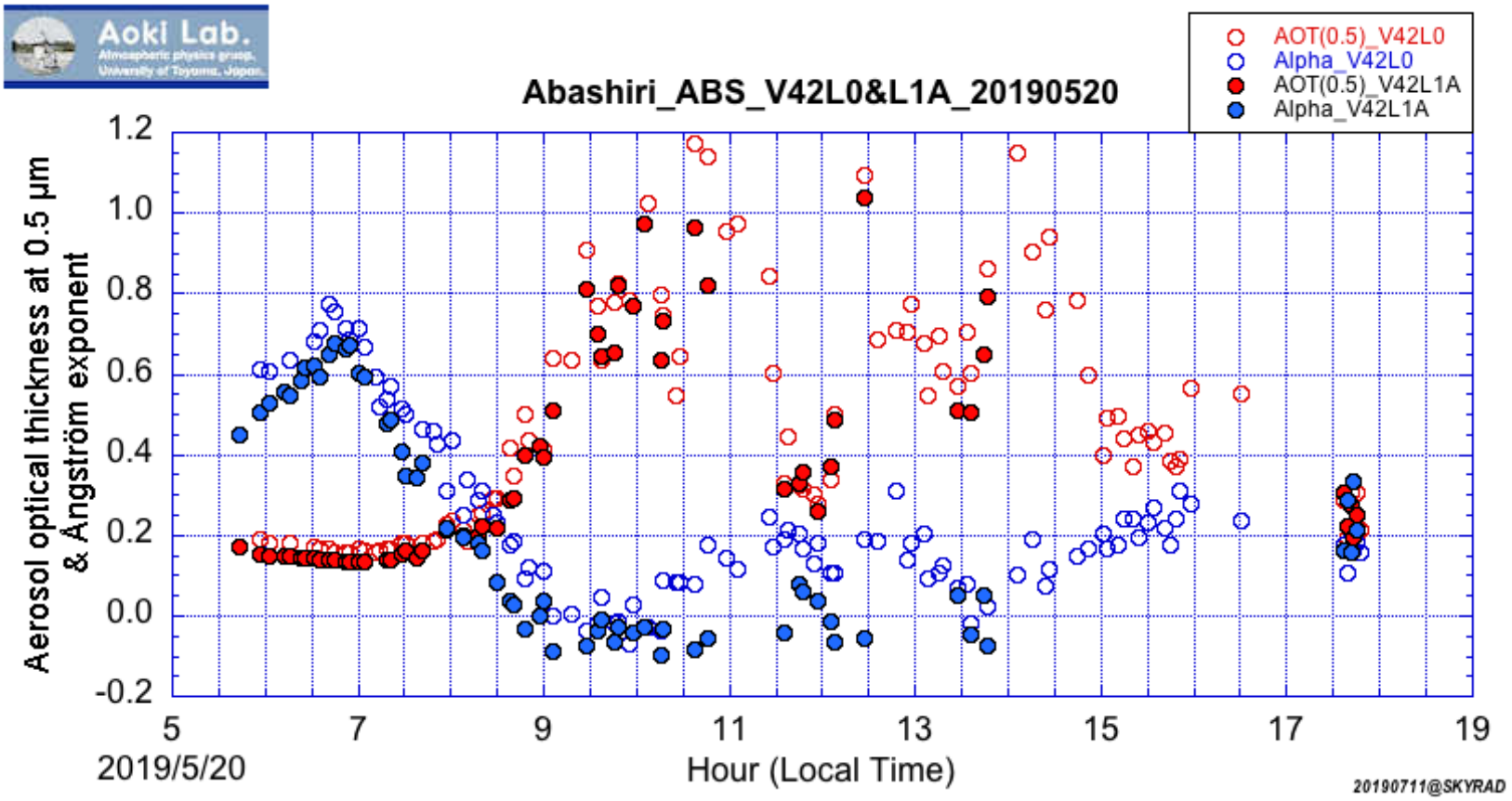
Local dust event in East Hokkaido 2019.05.20





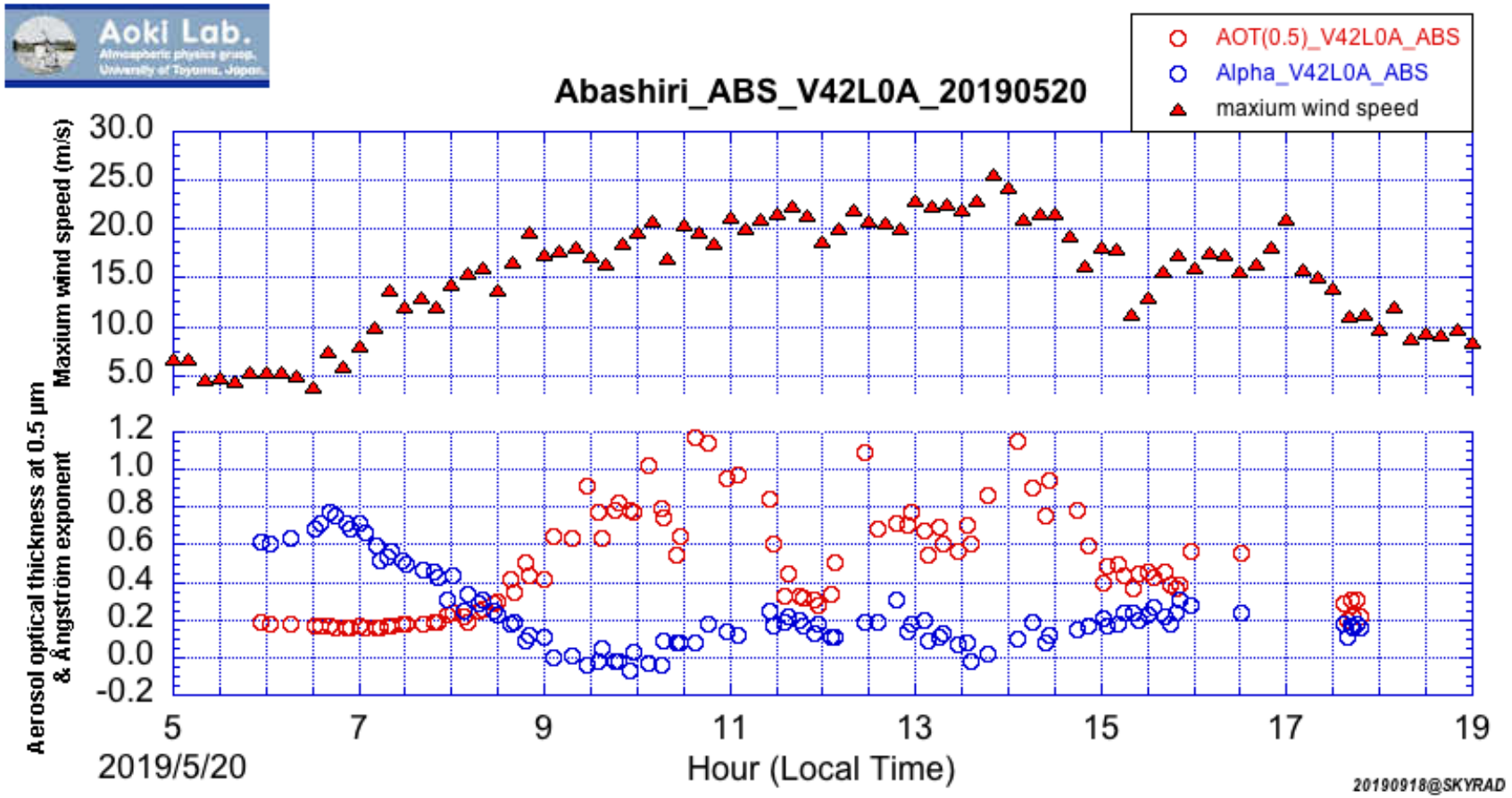
Local dust event in East Hokkaido

Aerosol optical properties



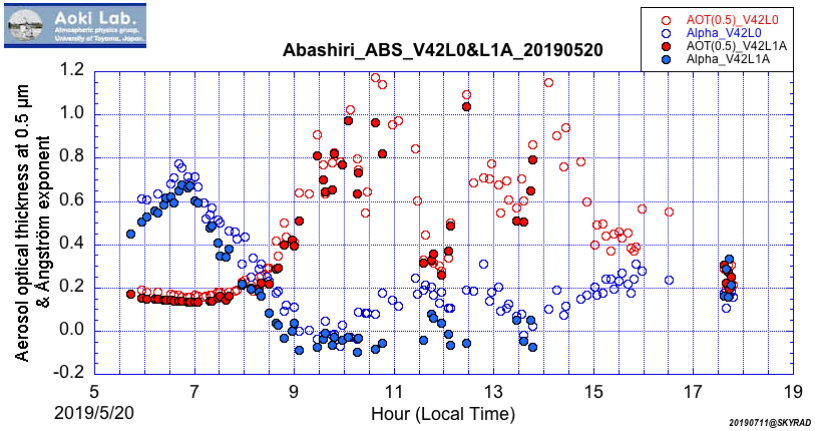
Local dust event in East Hokkaido

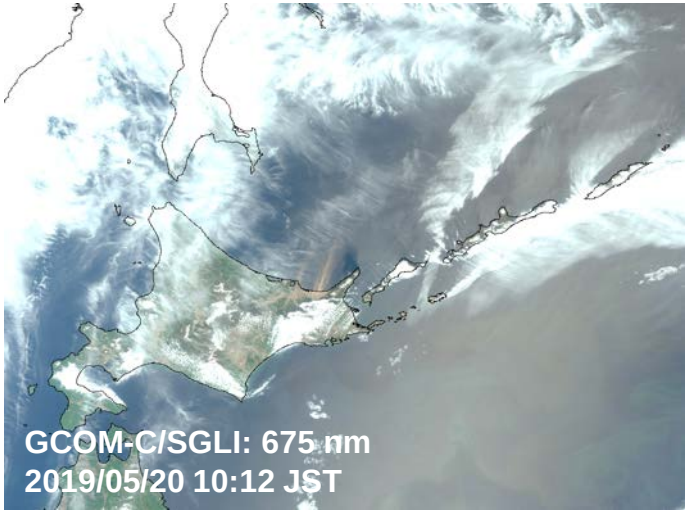
Aerosol optical properties & wind speed

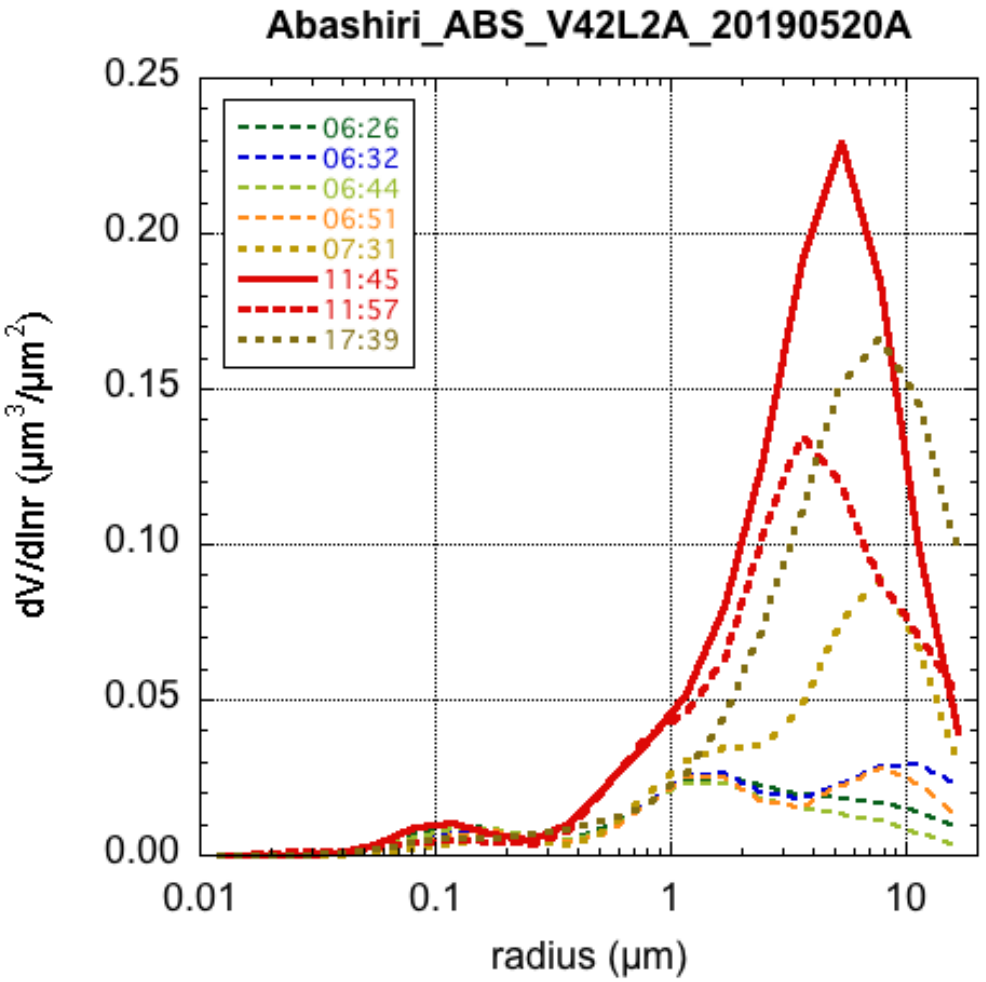


Local dust event in East Hokkaido

Size distribution of volume

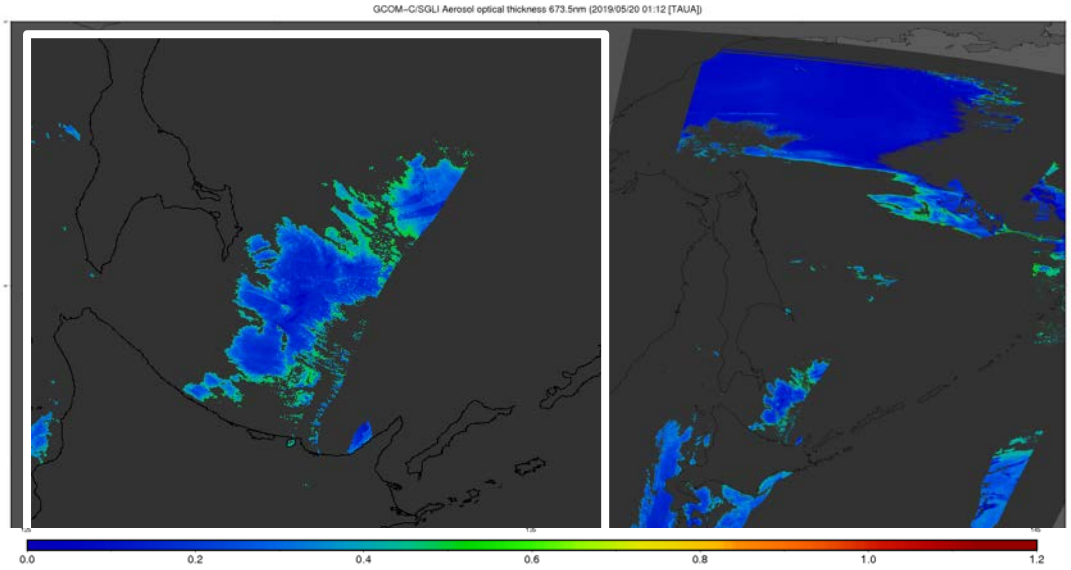


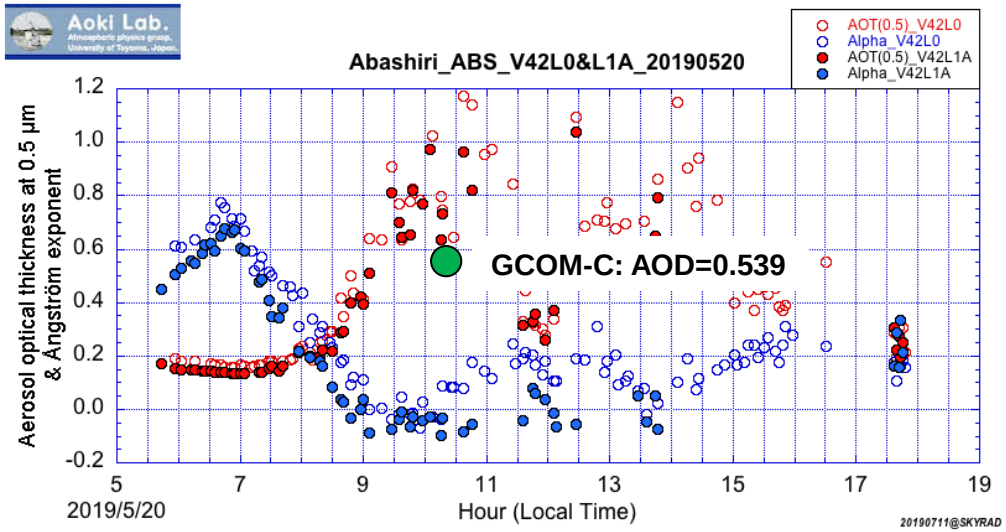


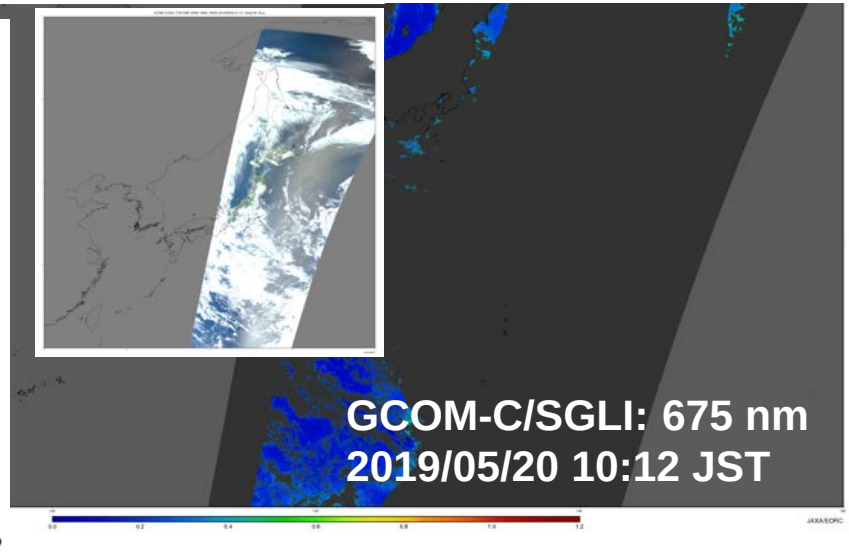


Local dust event in East Hokkaido

Comparison between groud-based (skyradio) and satellite (GCOM-C)







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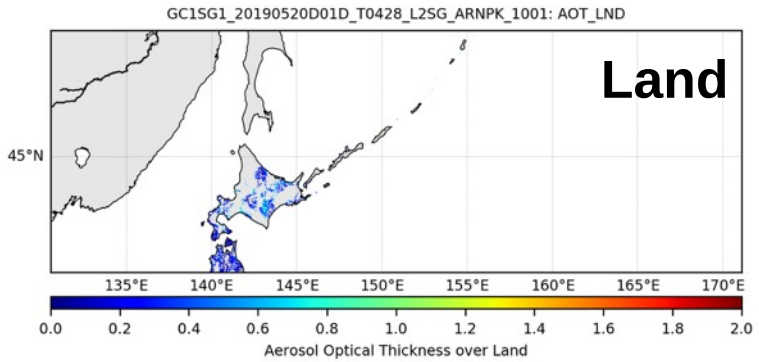
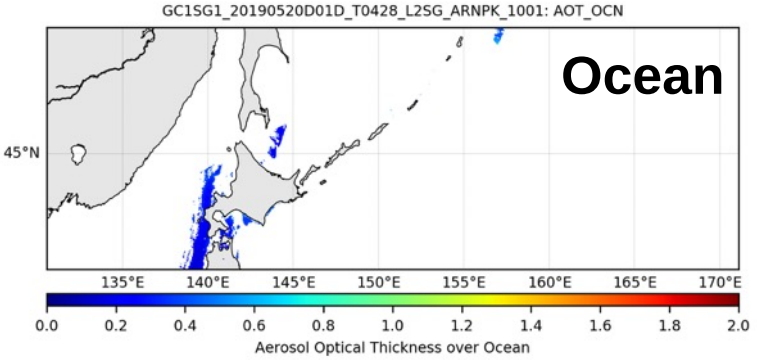
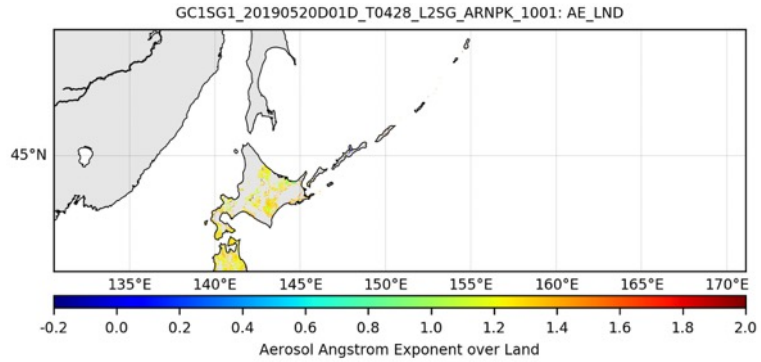
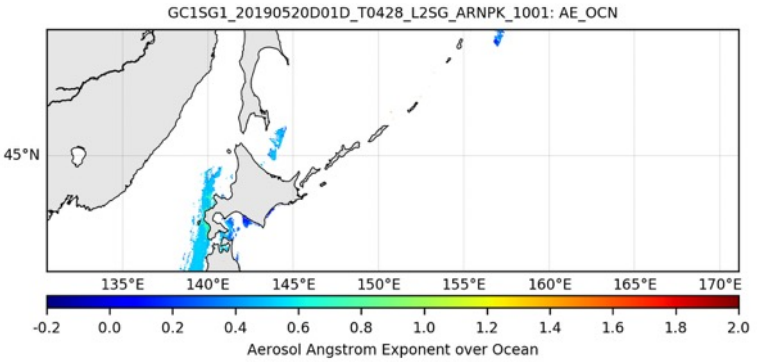
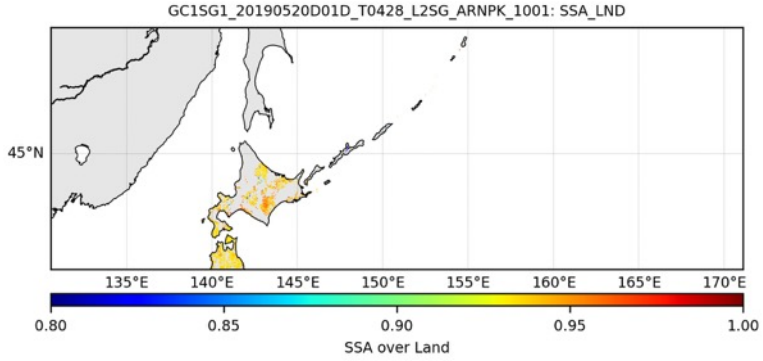










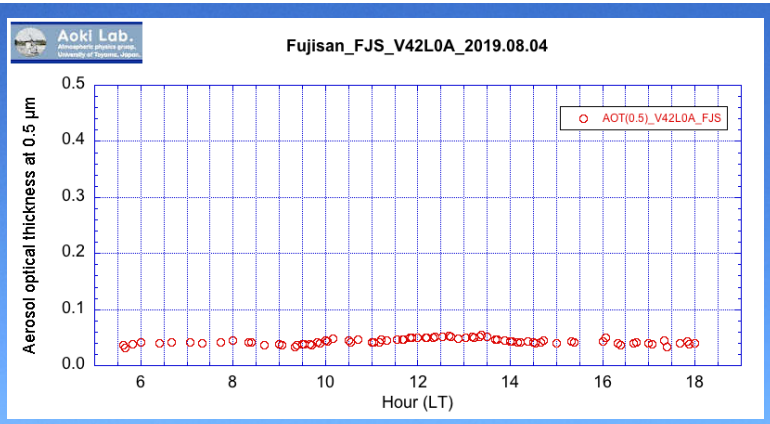
Preliminary results by Aoki and Okata, 2019

Summary

- Aerosols optical properties
  - More high AOT and low Alpha
- Size distribution of volume
  - Long-range (1 to 2 μm) < Local (5 to 8 μm)

Future plan

- Continuously of Aerosol climatology and quality control
- Improvement of AOT accuracy and observation method
- Comparison model, satellite and observation
  - Especially, AOD of clear sky and all sky



Thanks.

UNIVERSITY OF TOYAMA 富山大学

きっときっとな大学やちゃ～