A difference of the Depolarization Ratio Detected at Locally Generated Dust Layers and Transported Asian Dust Layers over Japan with AD-Net

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04.Synergistic use of multiple instruments and techniques, networks and campaigns

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04-P13

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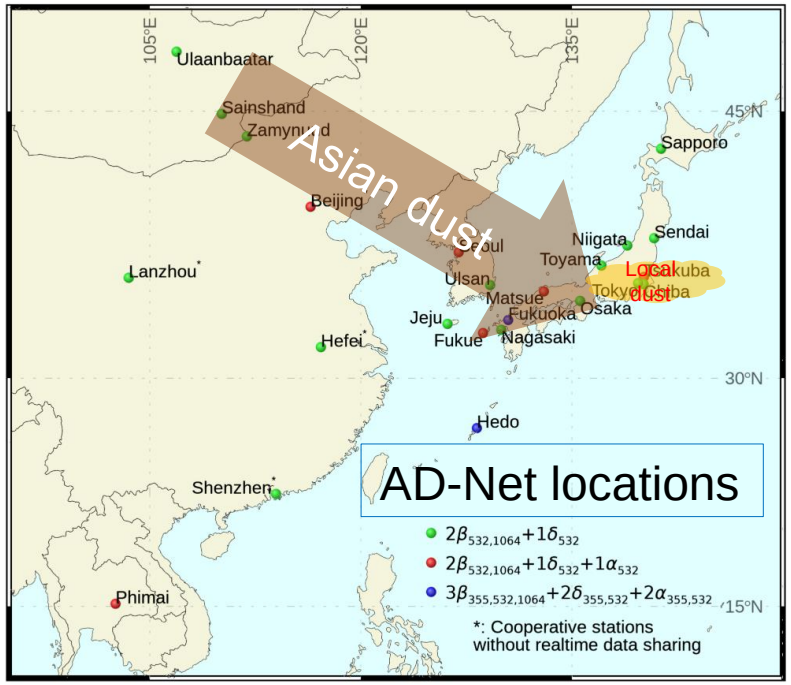
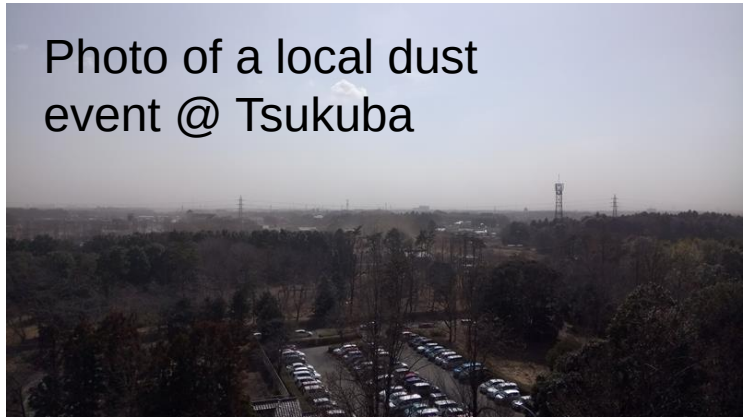
Motivation

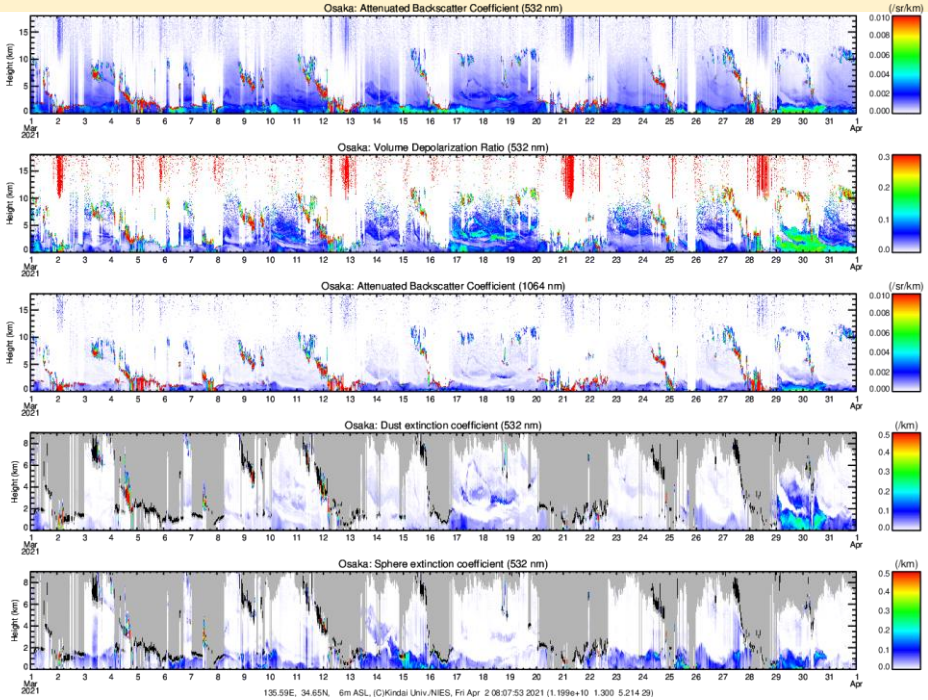




- AD-Net (Asian dust and aerosol observation lidar network) provides ‘dust extinction coefficient’ and ‘spherical particle extinction coefficient’ as standard products based on the depolarization ratio. Usually dust extinction is utilized as an index of Asian dust loading in the atmosphere in epidemiology etc. Asian dust is transported from source regions (mainly Gobi desert) to Japan for several thousand kilometers.
- In Kanto area (around Tokyo), strong local dust events occur in early spring with strong southerly. In this period, floating dust has larger size-distribution compared with long-range transported Asian dust. It implies different environmental impact by dust particles, and AD-Net is expected to supply information such difference based on lidar observations.
- In order to identify a threshold of optical parameter to distinguish these two dust layers, lidar observations in Tsukuba are analyzed.

Lidar observations in AD-Net

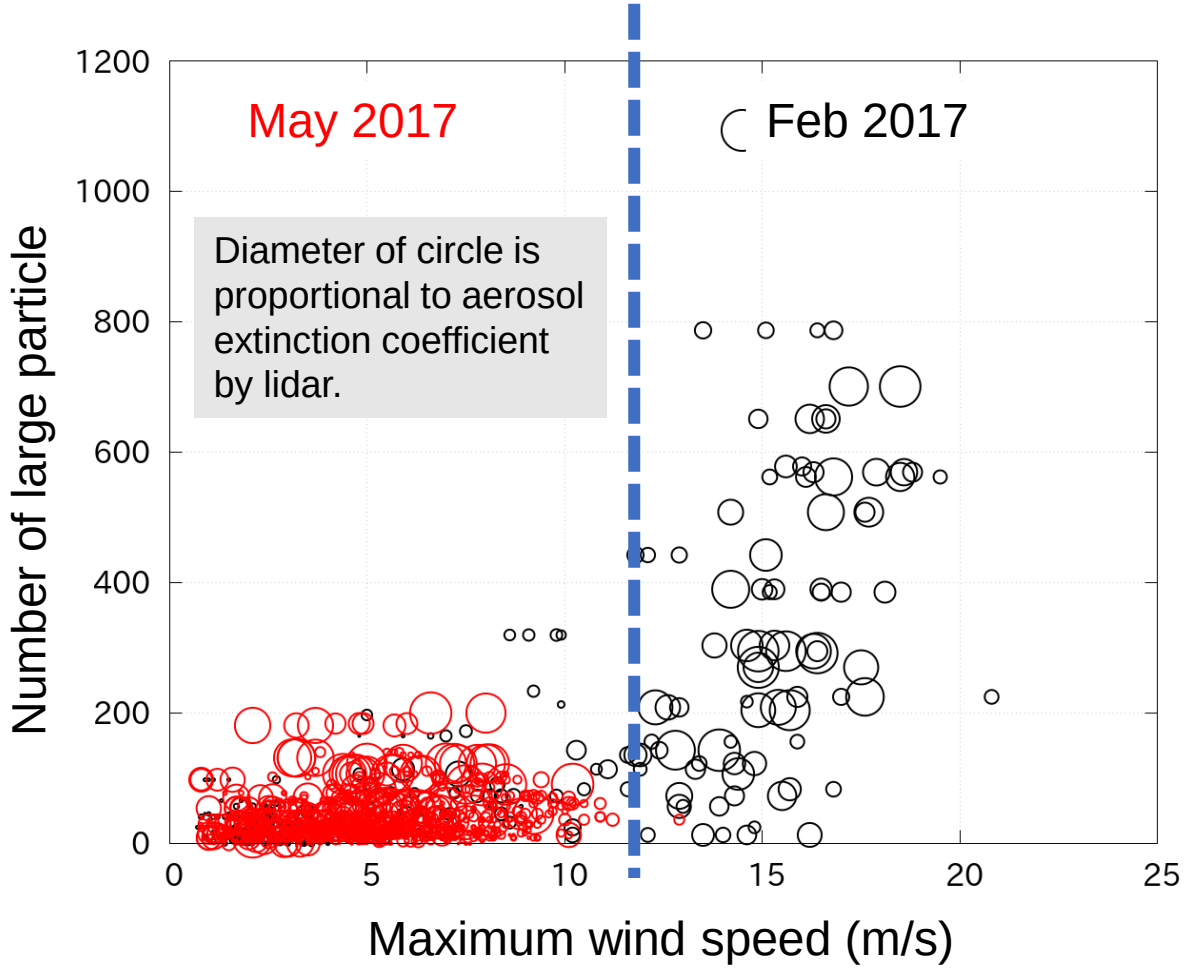
- (at least) 2β+1δ
- Flashlamp pumped Nd:YAG laser with 10Hz and 50 mJ/pulse
- Repeat 5minutes signal accumulation and 10 minutes rest = 4 profiles / hour, with vertical resolution of 6 m.
- Fernald inversion with fixed S1(50sr) at 532 nm for clear profiles
- Aerosol extinction coefficient is divided into two components based on the particle depolarization ratio
- Dust extinction and spherical particle extinction are visualized and uploaded into WWW every hour.



←Time-height sections in March 2022, Osaka, Japan
(from top to bottom)
532nm attenuated backscatter coefficient
532nm volume depolarization ratio
1064nm attenuated backscatter coefficient
532nm dust extinction coefficient
532nm spherical particle coefficient
(black and gray in extinction figures corresponds to cloud layers and unobservable region, respectively)

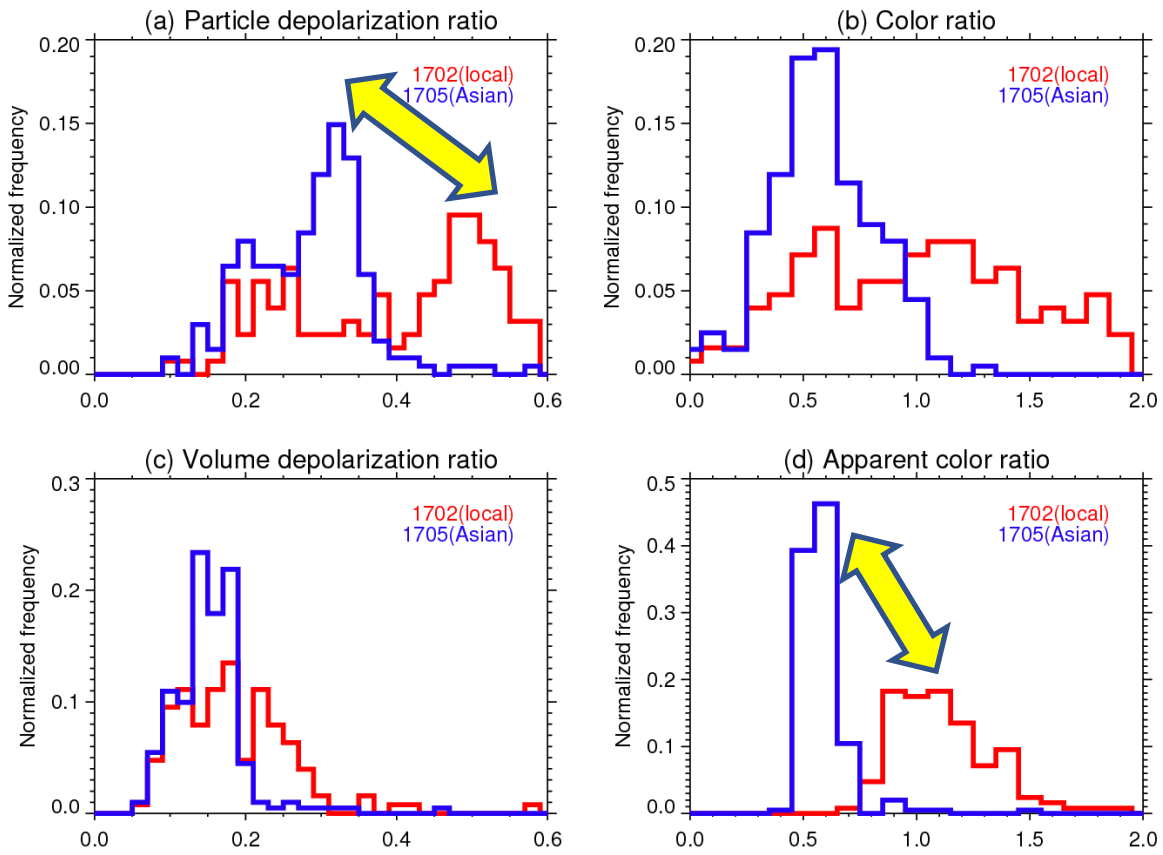
Determination of periods for Asian dust and local dust

- OPC for larger particles (originally designed to capture pollen particles, 28—35um) indicates high values when the surface wind speed exceeds 12 m/s in February 2017. Human eye observation by telescope did not find any pollen, thus the floating particle in this period is recognized as large dust particles.
- May 2017 was a typical Asia dust month in Japan. Meteorological observations in source and downwind region, chemical transport model, and lidar observations confirmed that Asian dust frequently occurred and was transported in this month.
- Lidar observation results in these two months were statistically compared.

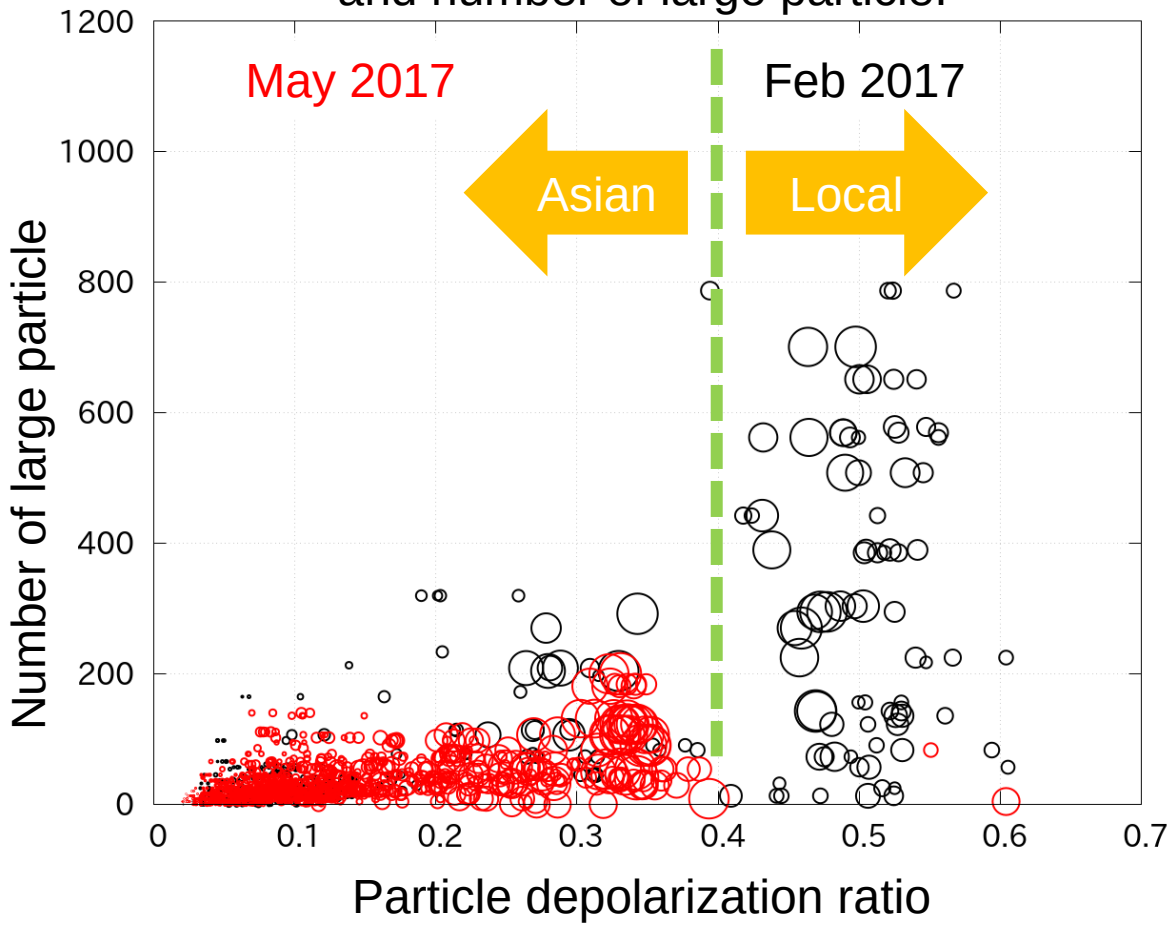


Differences of optical parameters

Frequency distribution of optical parameters for February and May

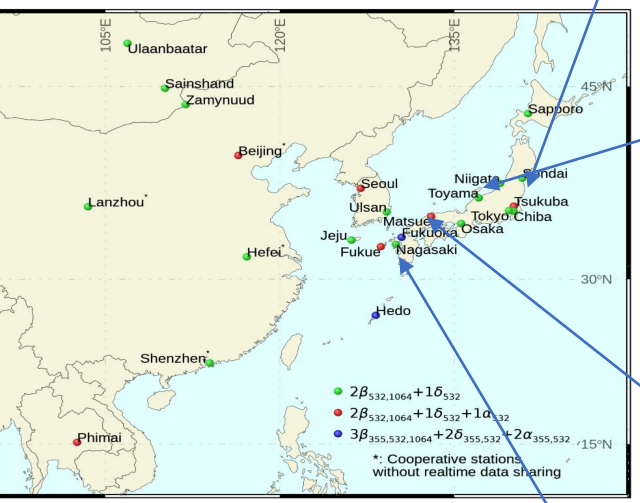


Relationship of particle depolarization ratio and number of large particle.



PDR is more suitable because the vertical structure of separated layers seems continuous.

Hours of large PDR (>30%) in spring months in Japan

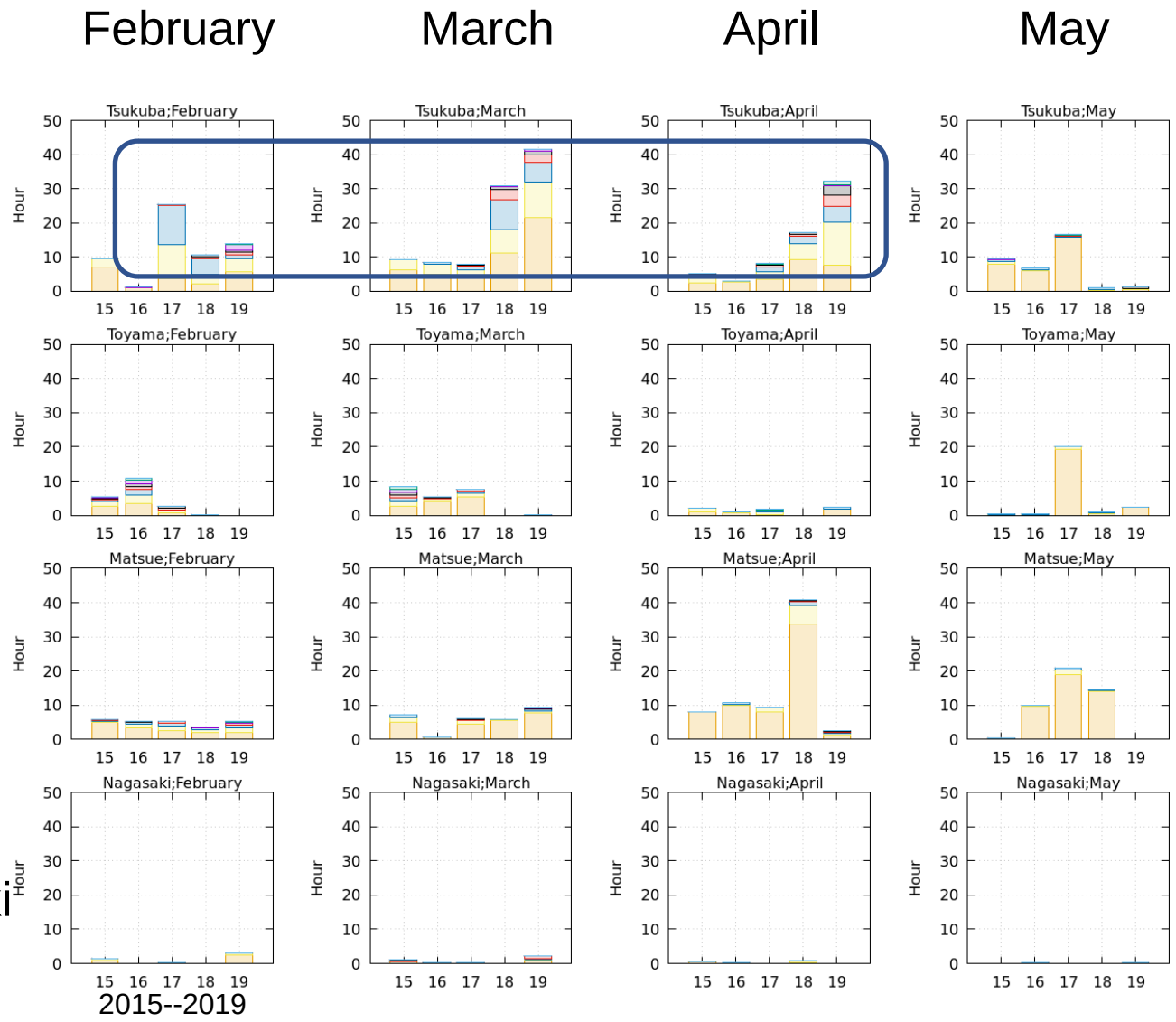


Tsukuba

Toyama

Matsue

Nagasaki



PDR>40% (blue) corresponds to hours of local dust in Kanto region.

0 hour in western Japan implies dust is always mixed with spherical particles.

Concluding remarks

- Based on surface observation (OPC, wind speed), a threshold of optical parameter to distinguish local and Asian dust layer is investigated.
- Particle depolarization ratio > 40% is proposed to indicate the signature of local dust.
- Hours of PDR > 40% in a month of spring were 10~20 in Tsukuba, and few in other stations (Toyama, Matsue, Nagasaki).
- This kind of information is expected to be included in the products of AD-Net.

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