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Aerosol optical properties at Yonsei university based on the skyradiometer measurement in 2016-2018

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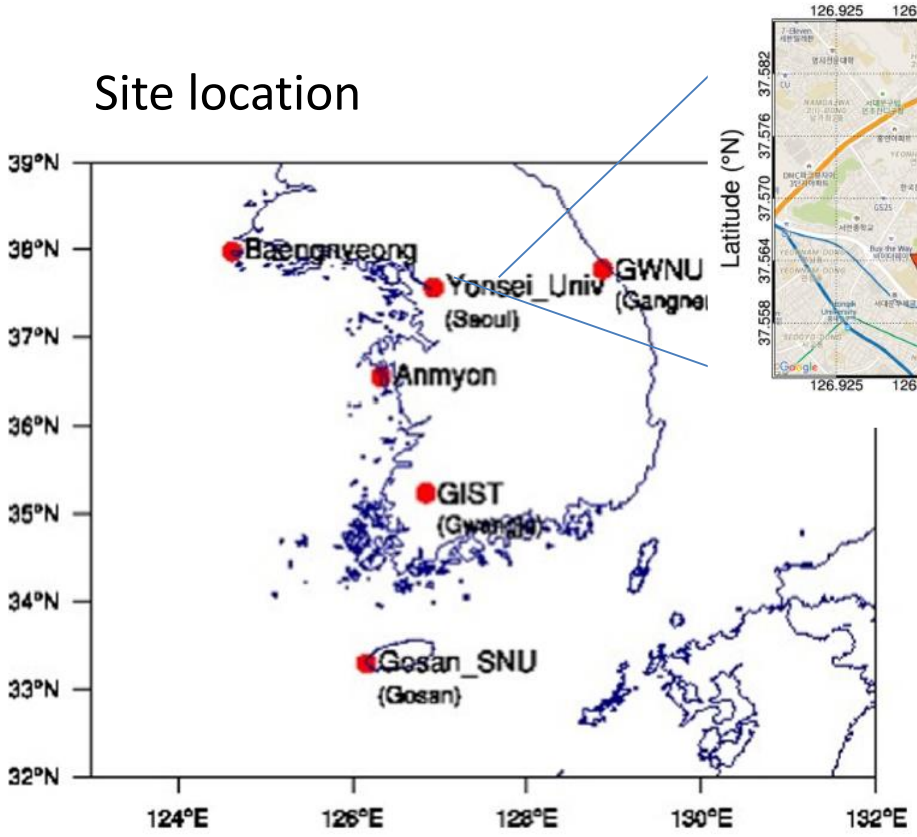
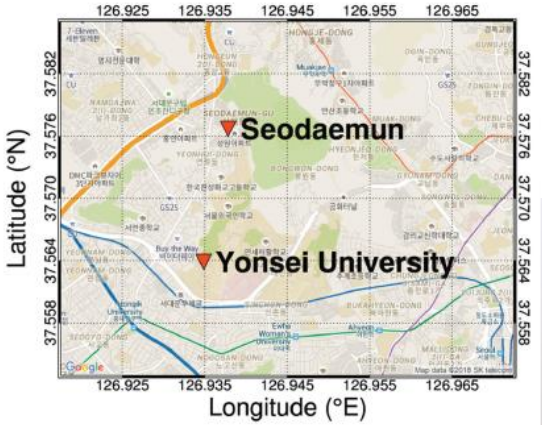
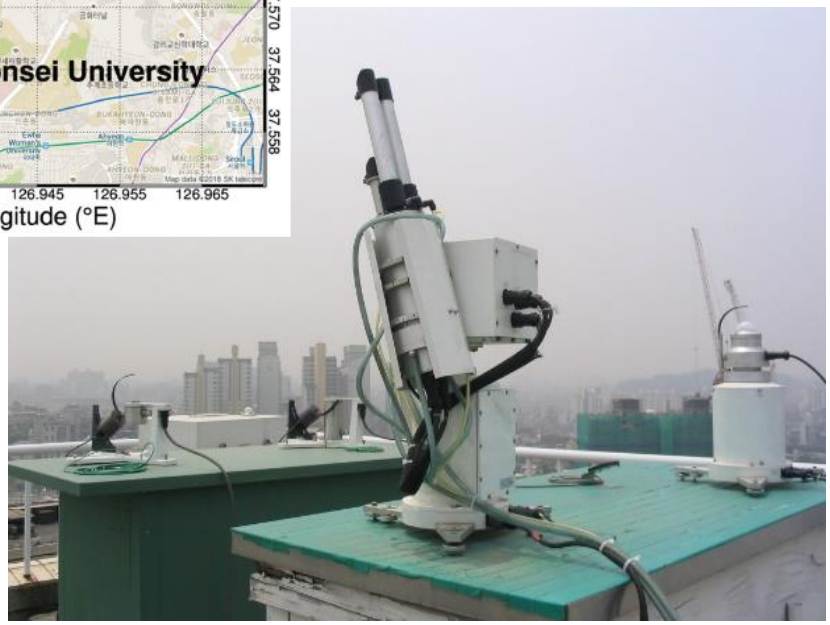
Information of SKYNET site at Yonsei University, Seoul

Site location





POM-02
skyradiometer



- SKYNET in Yonsei University started in December 2005.
- Continuous monitoring has been operated for a long time, but frequently ceased due to the instrumental malfunctions.
- Data in 2006, 2007, and 2016 were significantly investigated, resulted in the publication (Koo et al., 2007; Koo 2008; Koo et al., 2016; Mok et al., 2018)

Research motivation

http://atmos3.cr.chiba-u.jp/skynet/data.html

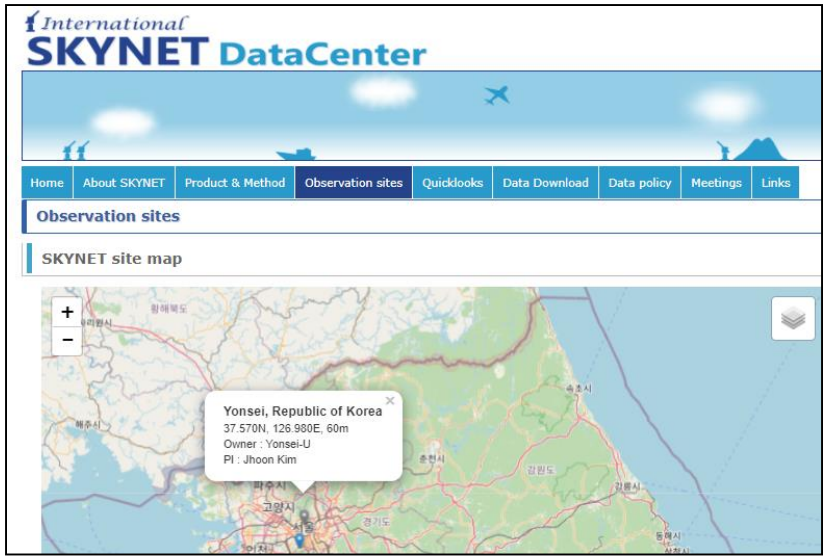
Home | Data and Site info | Publications

Data and Site infomation

Republic of Korea

- Seoul

(Seoul National University)



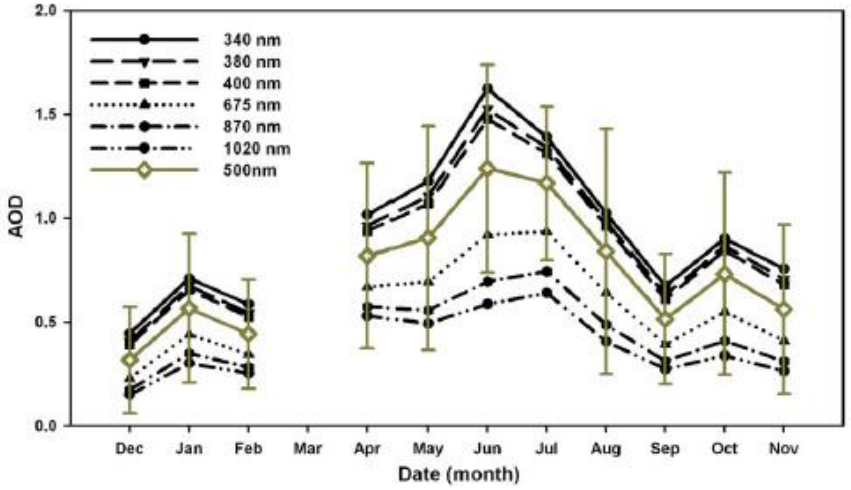
- SKYNET site in Yonsei University was registered as the site name of SYU until the early 2010s.
- SYU site was not operated well recently due to the instrument malfunction. Now our instrument is still under the repair (will be returned to Yonsei soon).

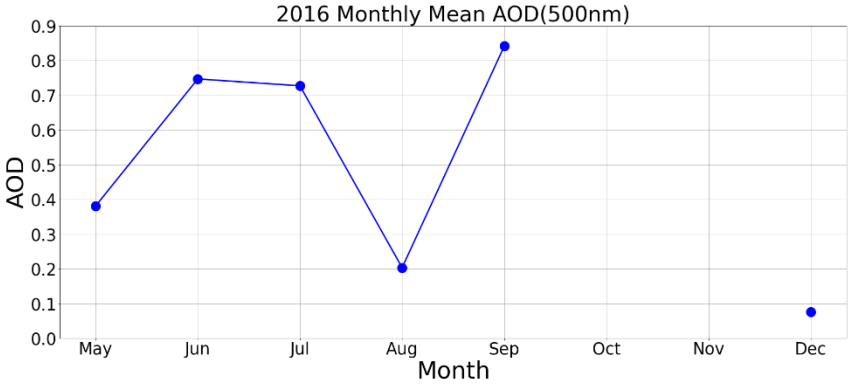
- Connecting to the KORUS-AQ campaign, our SKYNET produced data from MAY 2016 to AUG 2018. We would check the data quality for that period.

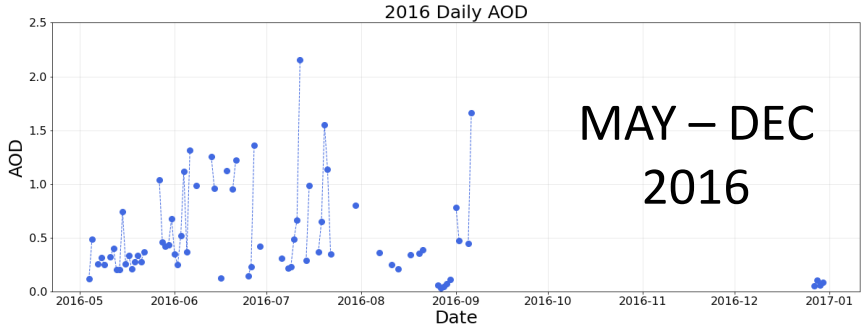
Results – 1. Aerosol Optical Depth (AOD)

10-year difference

DEC 2005 – NOV 2006







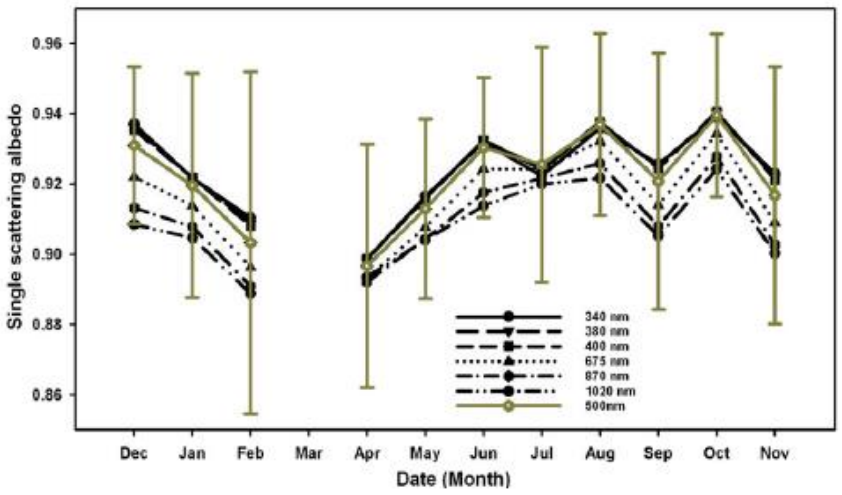
- **Data in spring and summer 2016 (The period of KORUS-AQ) were used in Mok et al. (AMT, 2018)**

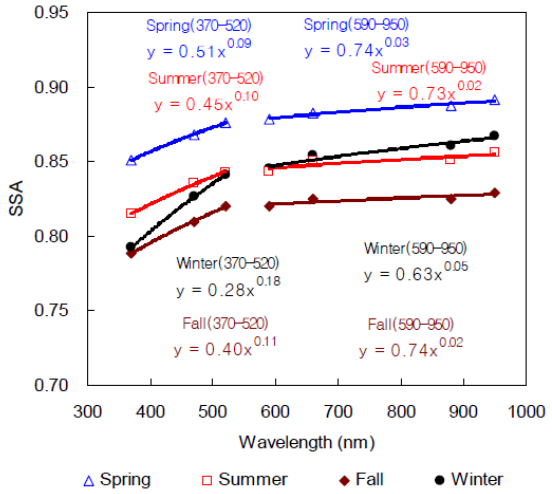
=> doi:10.5194/amt-11-2295-2018

- AOD peak in June is very famous in the Korean peninsula (Kim, S.-W. et al., 2007), because of the humid and stagnant air condition.
- In 2016, June also has high-AOD days more frequent than other months.

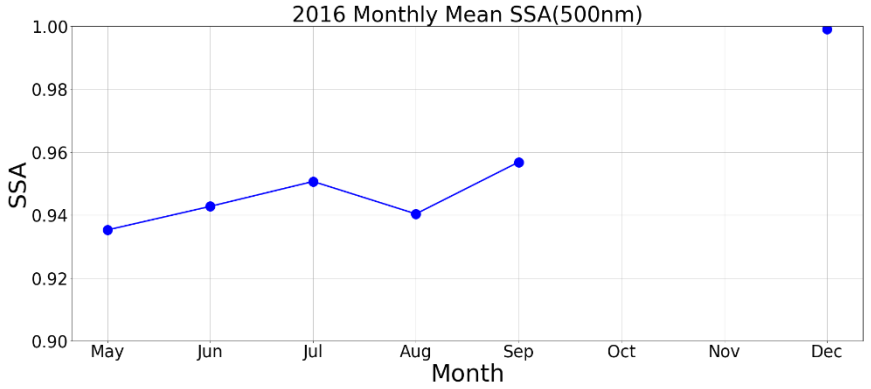
Results – 2. Single scattering albedo (SSA)

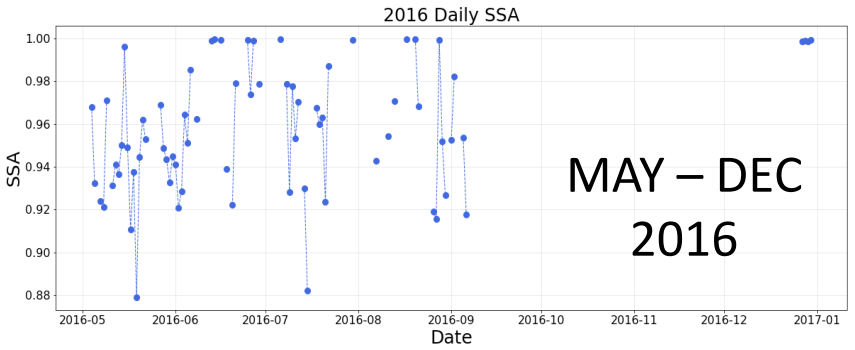
DEC 2005 – NOV 2006





(Jung et al., 2010)





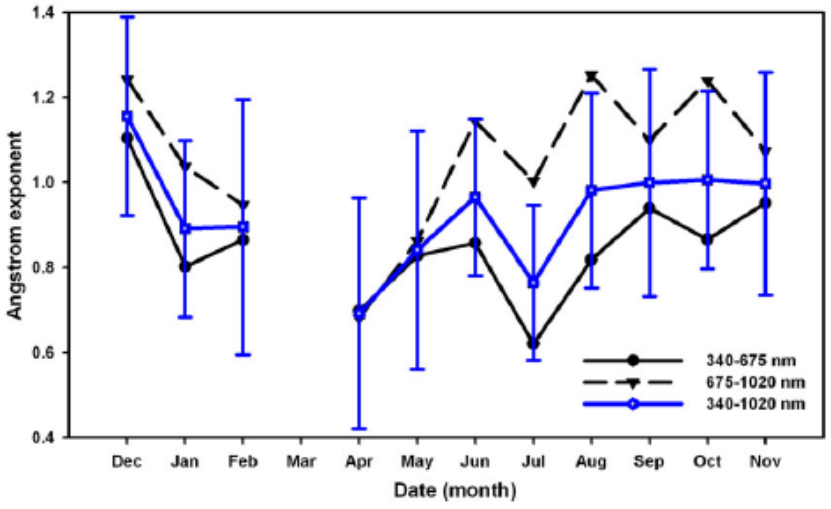
MAY – DEC 2016

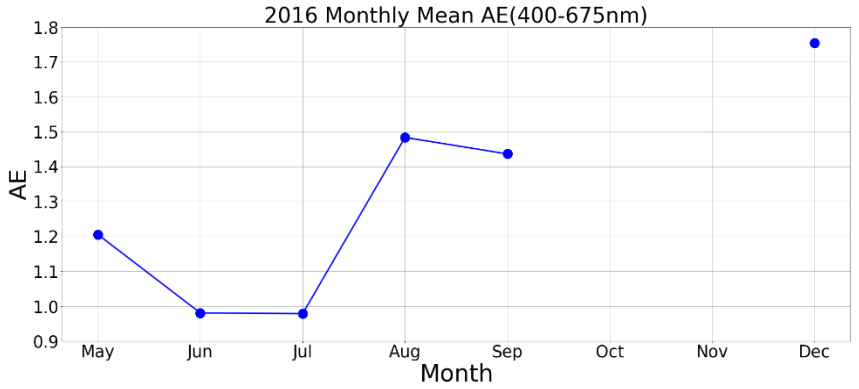
- SSA from SKYNET (i.e., columnar SSA) is generally lower in spring due to the Asian dust. SSA from the ground in-situ measurement (i.e., Aethalometer + Nephelometer) is a little different.

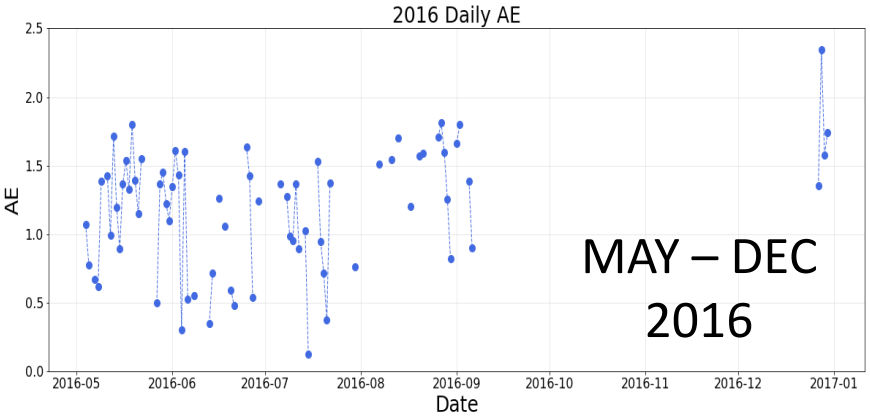
- The SSA pattern in 2016 looks similar to the result in 2006 (sometimes too high, close to 1, which looks a little weird.

Results – 3. Angstrom exponent (AE)

DEC 2005 – NOV 2006



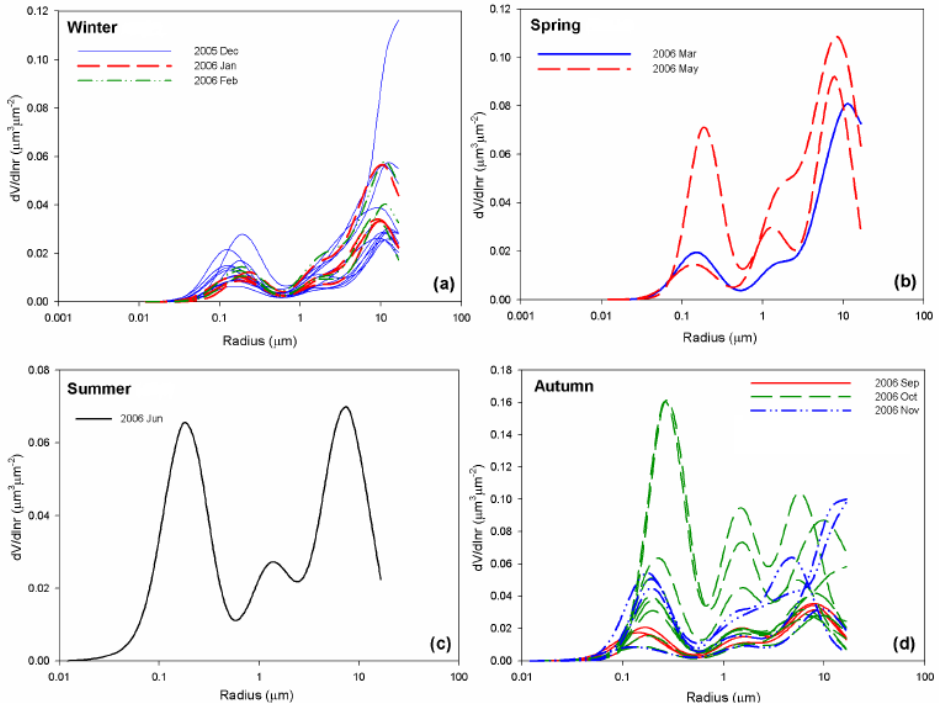




MAY – DEC 2016

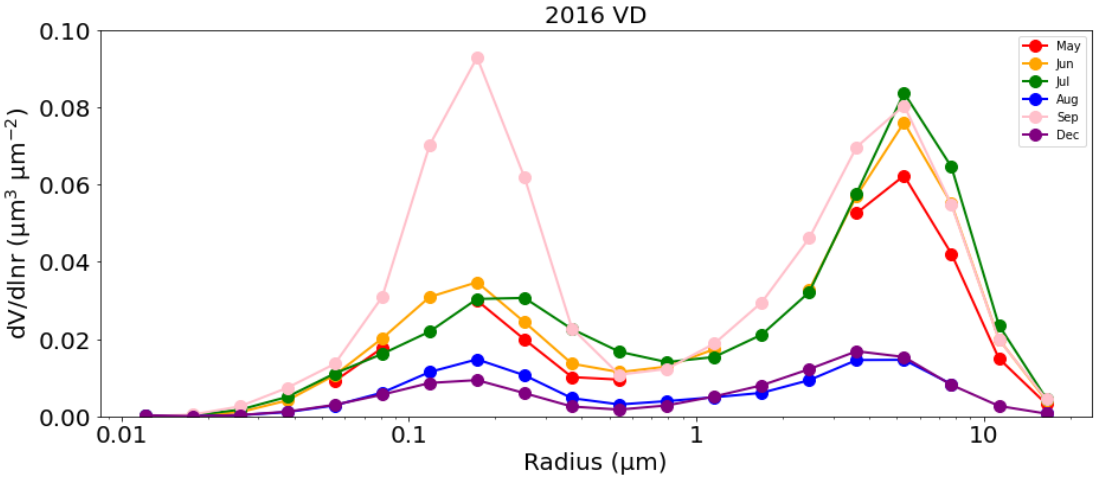
- AE is small in spring, due to the dominance of coarse-mode particles (i.e., Asian dust)
- The AE pattern in 2016 looks similar to the result in 2006.

Results – 4. Volume size distribution



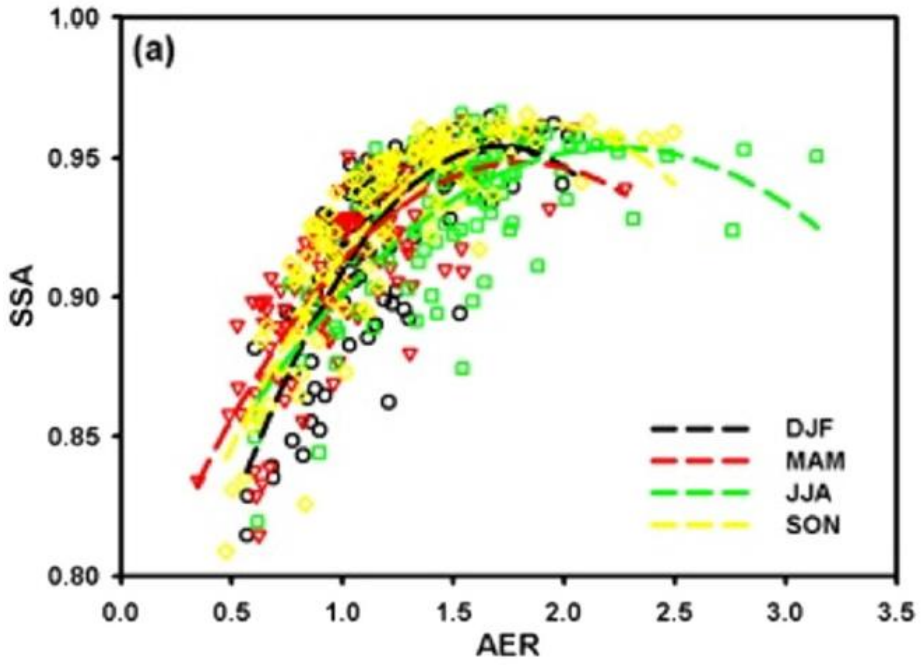
DEC 2005 – NOV 2006

- In general, it is known that the bimodal distribution is obvious in Korean peninsula except the springtime, when the coarse-mode dominance is clearer.
- In 2016, the coarse-mode dominant pattern happen in May, Jun, and July, but the bimodal distribution is clearer in August, September, and October.



MAY – DEC 2016

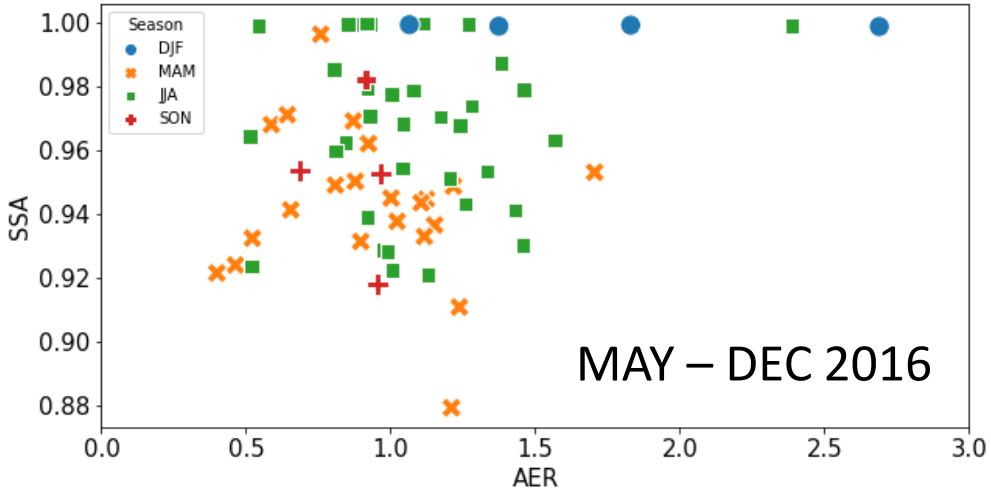
Results – 5. AER vs. SSA



DEC 2005 – NOV 2007

$$AER = \frac{LW-AE}{SW-AE} = \frac{AE(675-1020\ nm)}{AE(340-675\ nm)}$$

- AER is the ratio of AE between the short and long wavelength pairs. This is related to the curvature shape for the wavelength dependence of AOD (Eck et al., 1999; Koo et al, 2016).



- Summertime tends to showsthe larger AER relatively. The feature is a little found in 2016, too, but not very clear.

Wavelength dependence of AE

Eck et al. (JGR,1999)

Slope : AE

$\Rightarrow$ Curvature shape in a log-scale wavelength (x-axis) and AOD (y-axis)

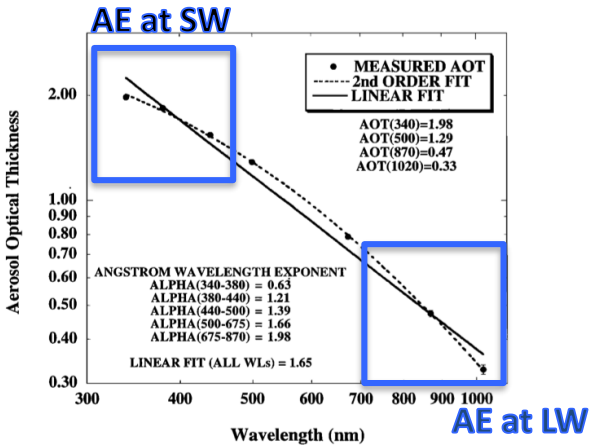


Figure 3. Same as Figure 1a except for biomass burning aerosols in Mongu, Zambia on September 1, 1997 at 0858 UT with $\tau_{a500} = 1.29$.

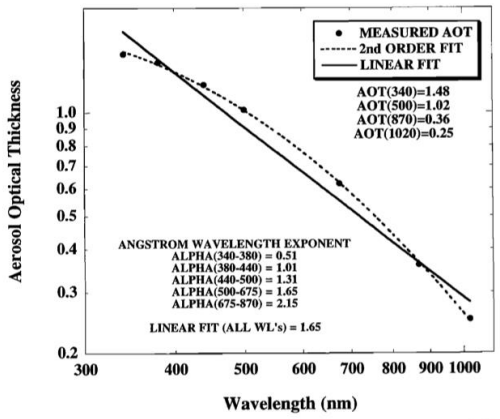


Figure 8. Same as Figure 1a, except for urban aerosols at Goddard Space Flight Center (GSFC) on July 15, 1997 at 1458 UT, when $\tau_{a500} = 1.02$.

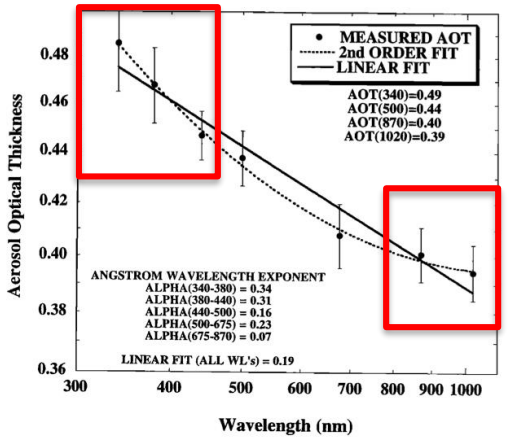


Figure 10. Same as Figure 1a, except for desert dust aerosols at Dalanzadgad, Mongolia on April 18, 1998, at 1008 UT, when $\tau_{a500} = 0.44$.

Biomass burning

Fine mode dominance
SW_AE < LW_AE

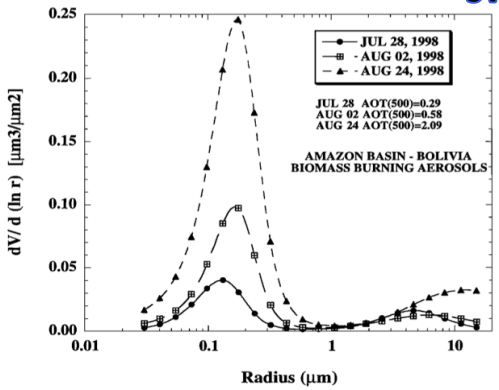


Figure 4. Aerosol volume size distributions for biomass burning aerosols in Concepcion, Bolivia, for 3 days in July-August 1998 with different aerosol optical depths. Aerosol size distribution retrievals were derived from simultaneous analysis of sky radiances in the almucantar and spectral τ_a at 440, 675, 870, and 1020 nm. The retrievals were derived from observations made at 1816 UT on July 28, at 1716 UT on August 02, and at 1713 UT on August 24, 1998.

Urban

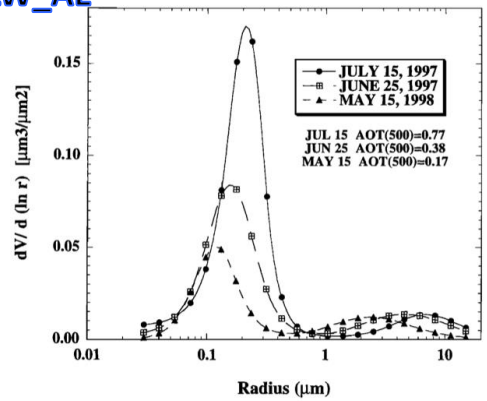


Figure 9. Aerosol volume size distributions for urban aerosols at GSFC for three days in 1997-1998 with different aerosol optical depths. The retrievals were derived from simultaneous analyses of sky radiances in the almucantar and spectral τ_a at 440, 675, 870, and 1020 nm with observations made at 1147 UT on July 15, 1997, at 1233 UT on June 25, and at 1241 UT on May 15, 1998.

Coarse mode dominance
SW_AE > LW_AE

Desert dust

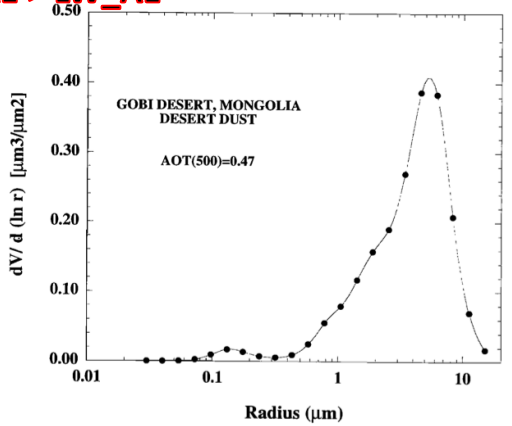
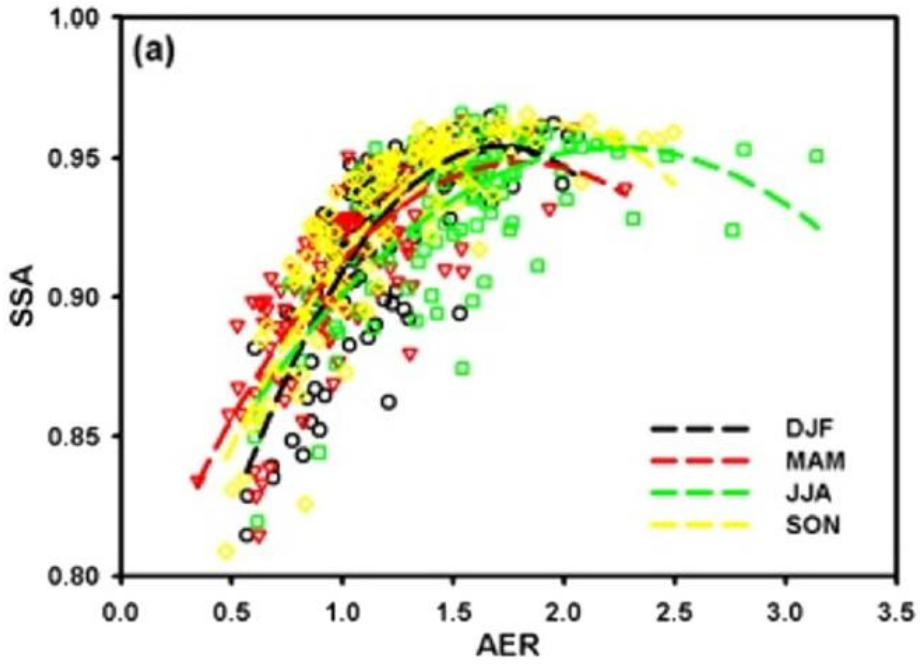


Figure 11. Aerosol volume size distribution for desert dust aerosols at Dalanzadgad, Mongolia for the same day as the data shown in Figure 10 but for 0955 UT.

Biomass / urban aerosol : Convex-up curvature

Dust : Convex-down curvature

Results – 5. AER vs. SSA



DEC 2005 – NOV 2007

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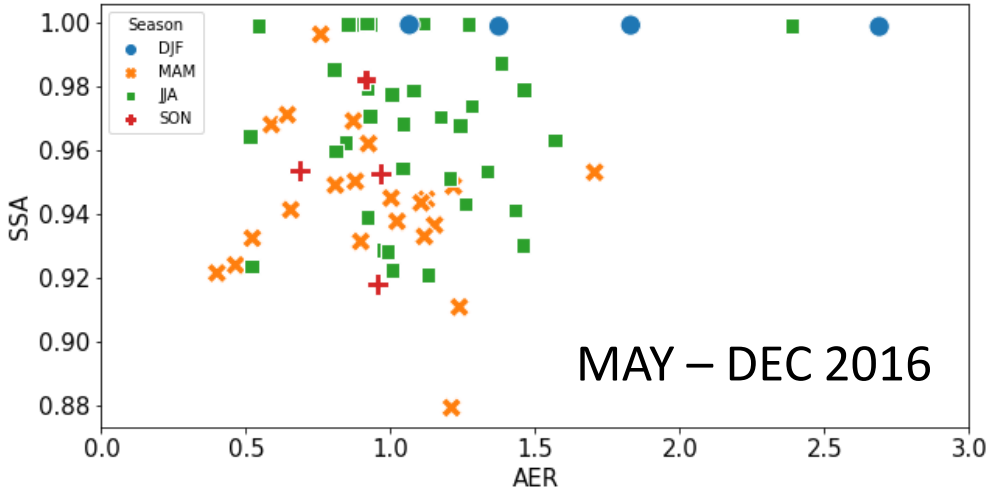
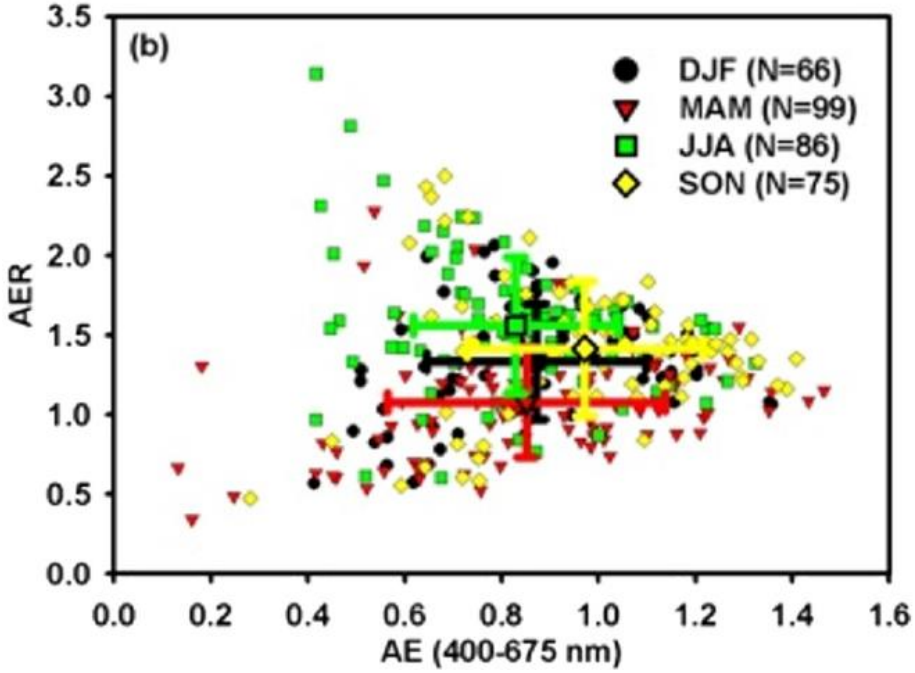


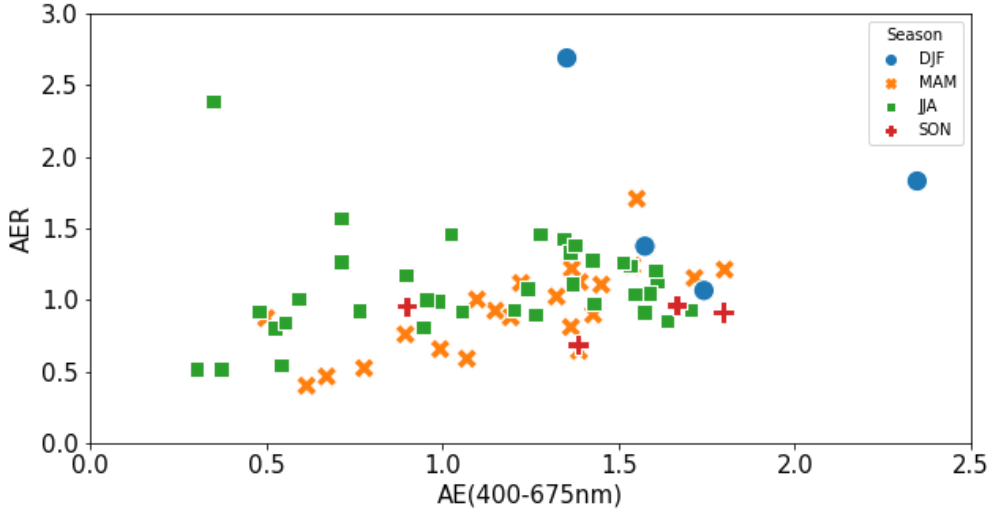
- Summertime tends to showsthe larger AER relatively. The feature is a little found in 2016, too, but not very clear.

Results – 6. AER vs. AE



DEC 2005 – NOV 2007

- There is a positive relationship between AER and AE in spring, but negative in summer (Koo et al, 2016).
- This implies that the small AE is not determined by a single aerosol property.
- Data in 2016 shows a little similar seasonal pattern as shown in Koo et al. (2016) using data in 2006 and 2007.



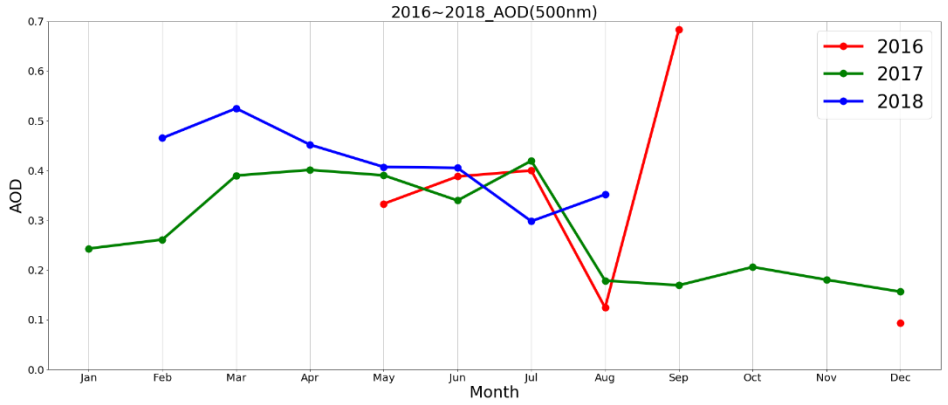
MAY – DEC 2016

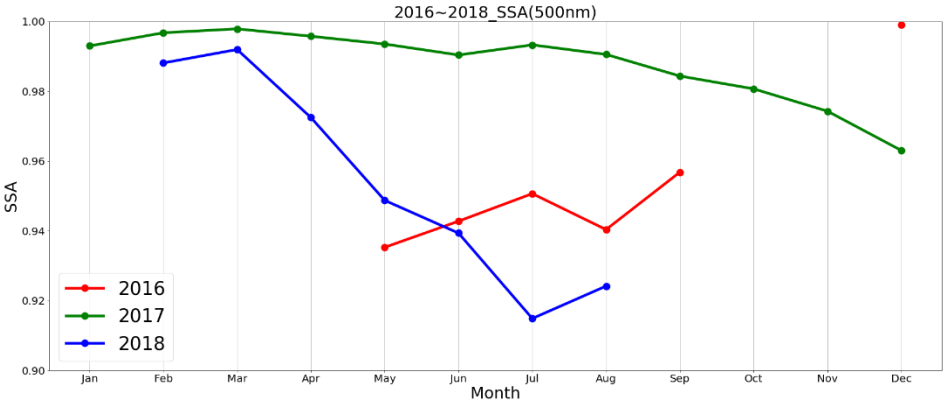
Results
– 2007 and 2008?

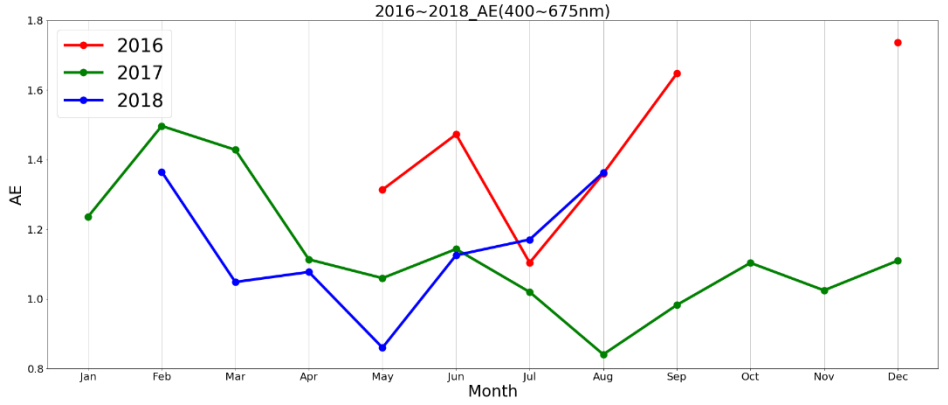
- For the KORUS-AQ campaign (MAY-JUN 2016), we repaired our POM-02 and performed the monitoring. But the malfunction occurred after SEP 2016.

- The measurement restarted from DEC 2016 and the measurement was continued until AUG 2018 (1.5 years).

- But the data in 2017 and 2018 looks strange to us, so it is not easy to analyzed now.







Summary

- Yonsei University started the SKYNET since DEC 2005. We have obtained some useful data and used them for the analysis of local aerosol optical properties.
- But the instrumental malfunctions occurred frequently, so unfortunately, the continuous measured dataset is not much guaranteed.
- Although we repaired our POM-02 instrument frequently, the quality of measurement data often looks suspicious. This study confirmed the data in 2016 was not so bad, but data in 2017 and 2018 does not look possible to use.
- Recently we repaired our POM-02 once more, and this fixed one will be installed in Yonsei University again soon. We hope that we will collect better data in this time.

More details:

Koo, J.-H., and co-authors (2007), Analysis of aerosol optical properties in Seoul using skyradiometer observation, **Atmosphere (KMS)**, 17, 407-420. *(written in Korean)*

Koo, J.-H., and co-authors (2016), Wavelength dependence of Ångström exponent and single scattering albedo observed by skyradiometer in Seoul, Korea, **Atmos. Res.**, 181, 12-19.

Mok, J., and co-authors (2018), Comparisons of spectral aerosol absorption in Seoul, South Korea, **Atmos. Meas. Tech.**, 11, 2295-2311.

Thanks for your attention