TPM11 - Session 4

PRA4. Dust and Sand Storm
- Asian Dust Observation

Asian Dust Observation

- PRA of Dust and Sand Storm -

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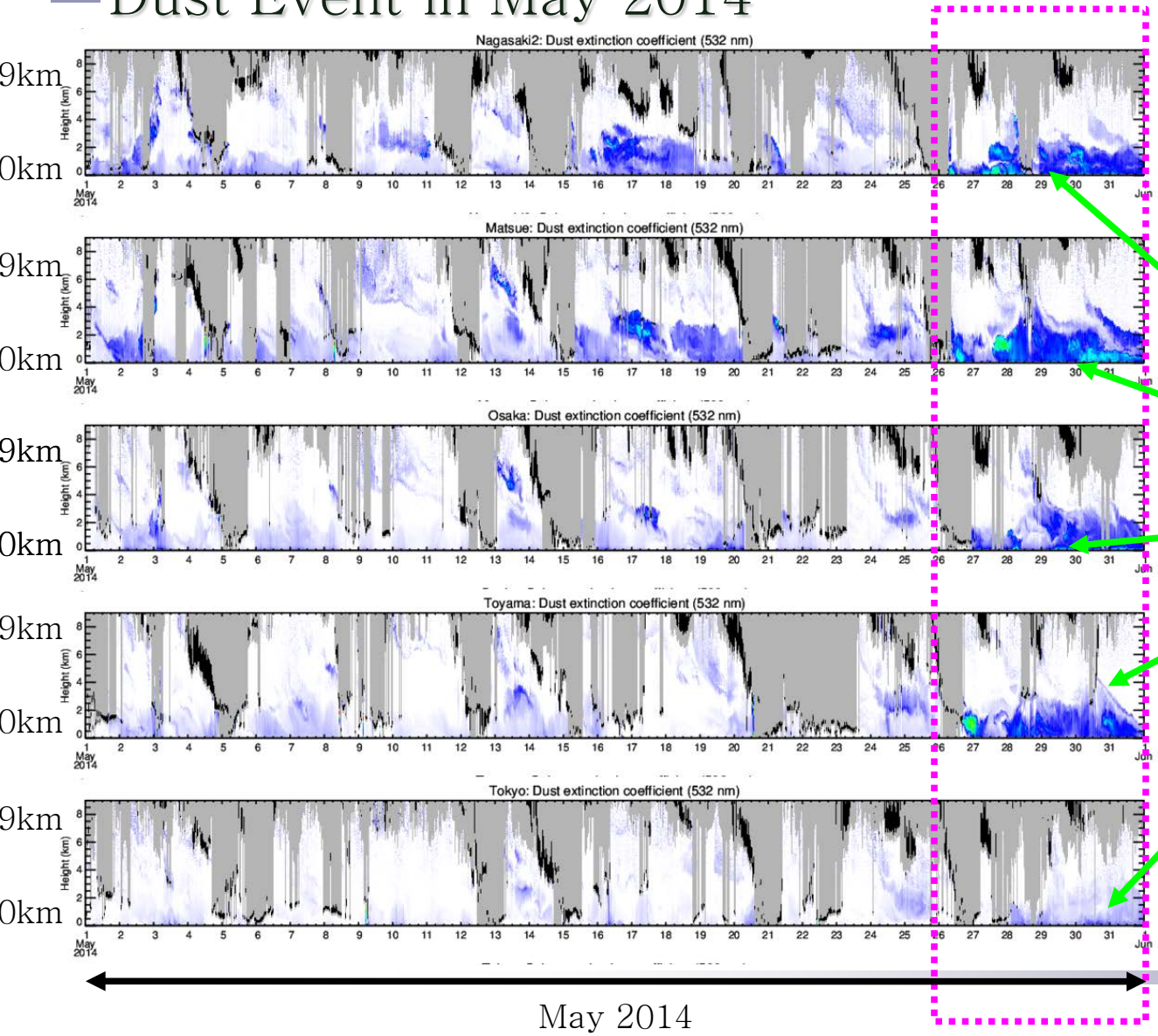
Content

Asian Dust Observation by NIES

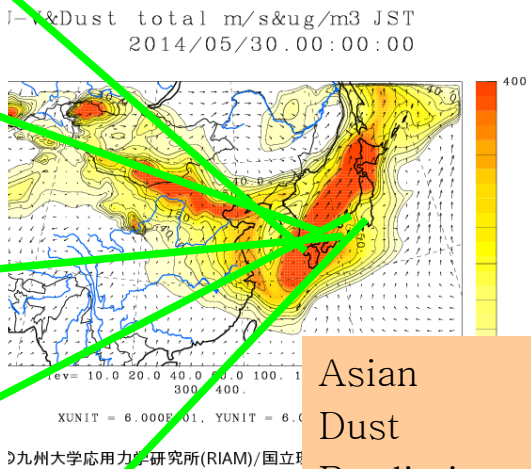
- 16 polarization LIDARs in Japan, Korea, and Mongolia were continuously operated during spring season of 2014.
- The most significant dust event in Japan occurred at the end of May when a dense dust layer covered for more than 5 days in wide area.
- Polarization OPC (optical particle counter) was operated in Seoul and in Beijing, but the data is not yet fully analyzed.

Asian Dust Observation by NIES

Dust Event in May 2014



Dust Extinction Coefficient by lidars

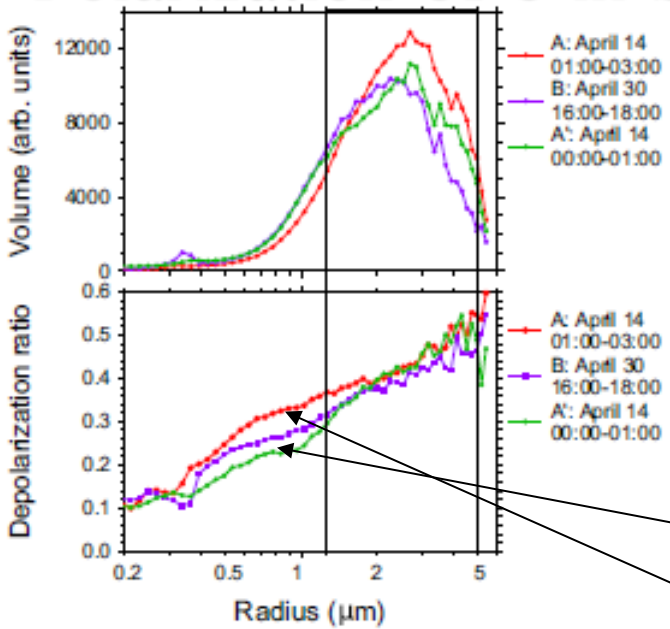


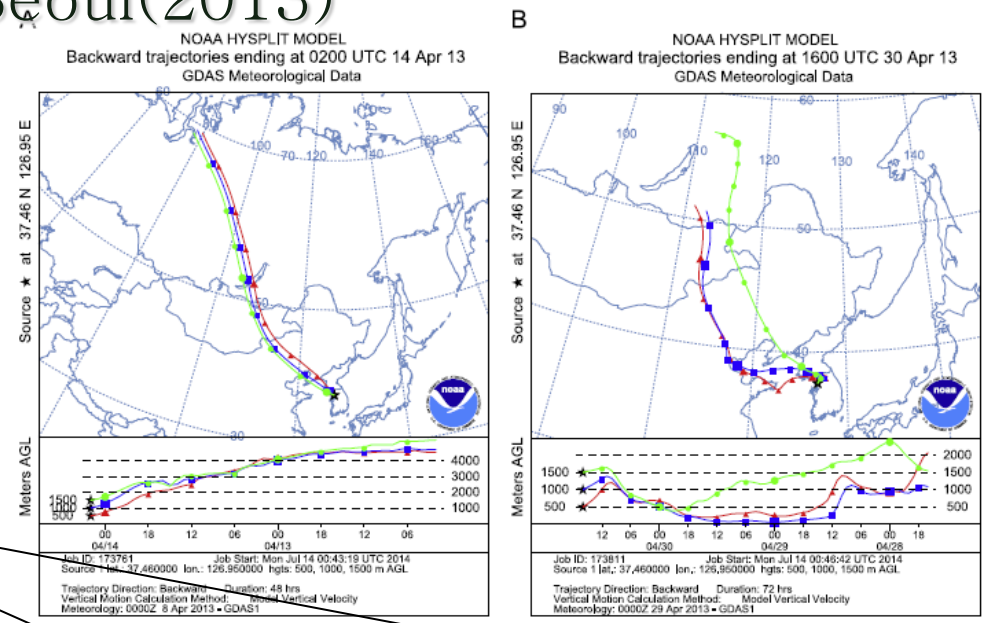
Asian Dust Prediction by CFORS (chemical transport model)

May 2014

Asian Dust Observation by NIES

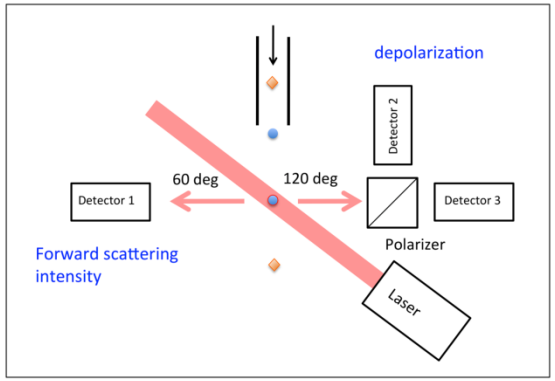
Polarization OPC in Seoul(2013)





'Pure dust'

'Polluted dust'



Polarization Optical Particle Counter (concept)

Lower depolarization ratio (which means particles are more spherical) was detected during 'Polluted dust'. Thus, <u>the shape of dust particle was modified during mixing with anthropogenic pollutants.</u>

Sugimoto et al., J. Quantum Spectoroscopy & Radiative Tansfer, 150(2015) 107-113

Asian Dust Observation by NIER

Measurement Instruments in Backryung island

Routine Monitoring

PM_{10}	Mass	(MetOne, BAM1020)
$PM_{2.5}$	Mass	(MetOne, BAM1020)
	Mass	(Thermo, TEOM1400a)
	Ion	(URG, AIM9000D)
	OC/EC	(Sunset, OCEC analyzer)
	BC	(Magee, Aethalometer)
	Element	(Cooper, Xact620)
Size	0.01~0.5um	(TSI, SMPS 3080)
	0.5~20um	(TSI, APS 3321)
Optic	B_{sca}	(TSI, Nephelometer 3563)
	B_{abs}	(Magee, Aethalometer)

In-depth Monitoring

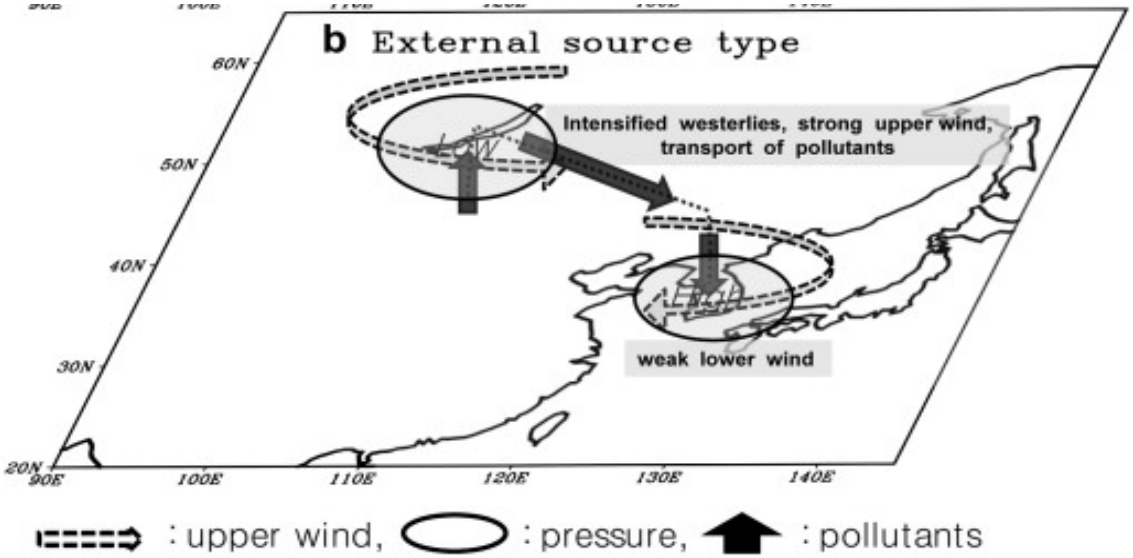
Single partile	Size, Ion, Organics etc.	(Aerodyne, ToF-AMS)
	Soot	(Droplet, SP2)

Reference (QA)

Sampler	$PM_{2.5}$	(APM, PMS-103)
	PM_{10}	(APM, PMS-103)
	TSP	(Tisch, TE-5000)
	Nano-MOUDI	(MSP, 125B)
	Metal	(Ondov, SEAS)
Met	WD/WS, Temp/Humid.	
	Precip., Pressure, UV	(LSI, LASTEM)
Gas Phas	SO_2, CO, O_3, NOx, NOy, NH_3	

Asian Dust Observation by NIER

Long-range transport pattern of Asian dust



8 times Asian Dust

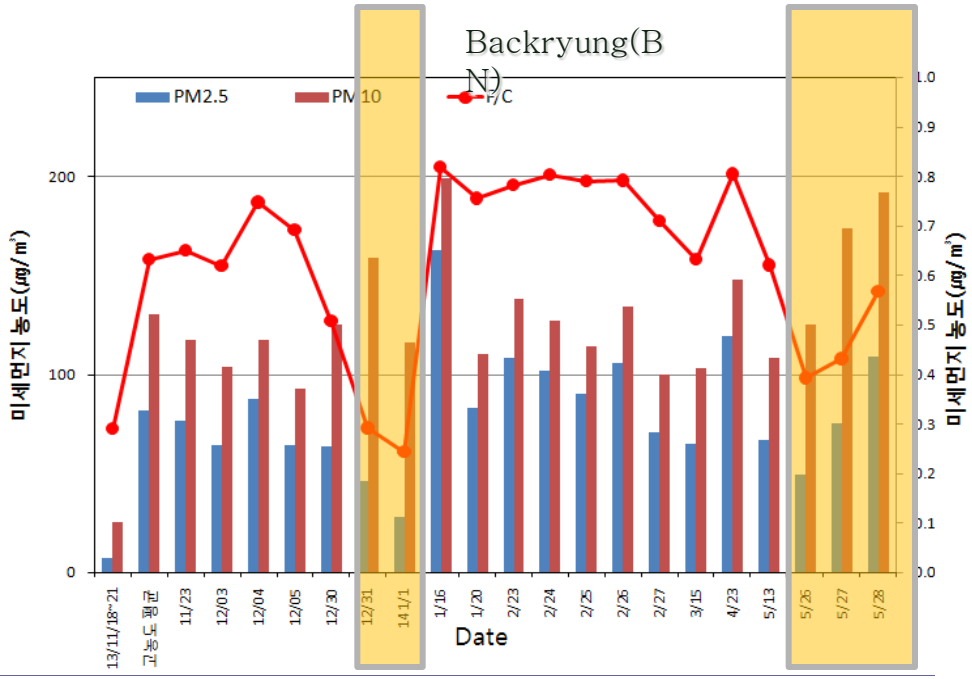
1.1(121), 3.16(100), 3.18(119) 3.19(114), 5.27(154), 5.28(166), 5.29(127), 5.31(111)

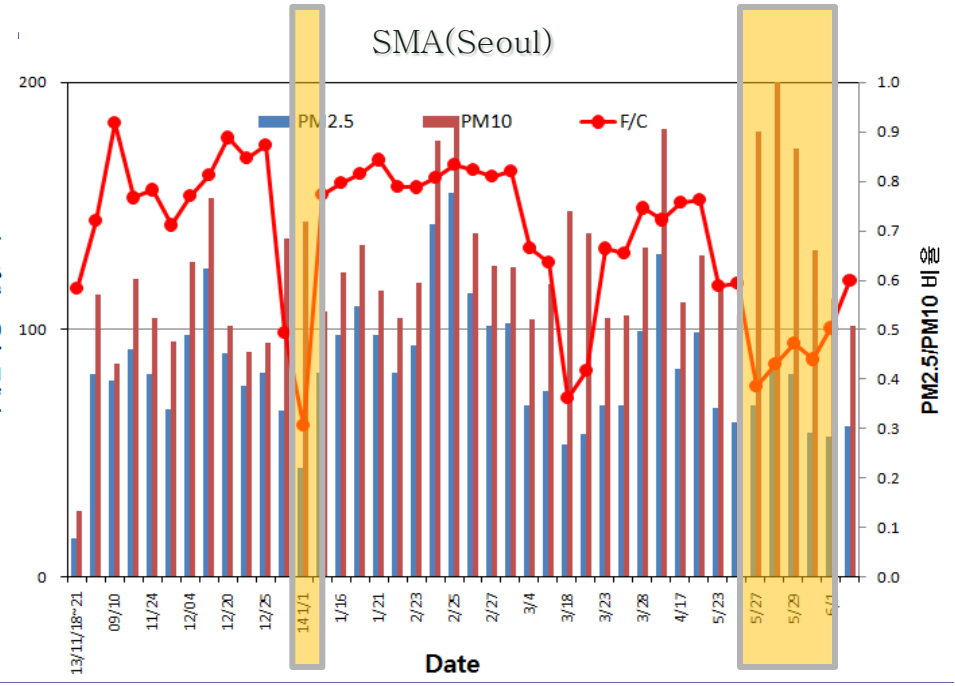
( ) Daily PM10 average concentrations

5.29~5.31 : Upper – Asian Dust, Lower – Anthropogenic pollution

Asian Dust Observation by NIER

Summary of Dust Event including LTP event



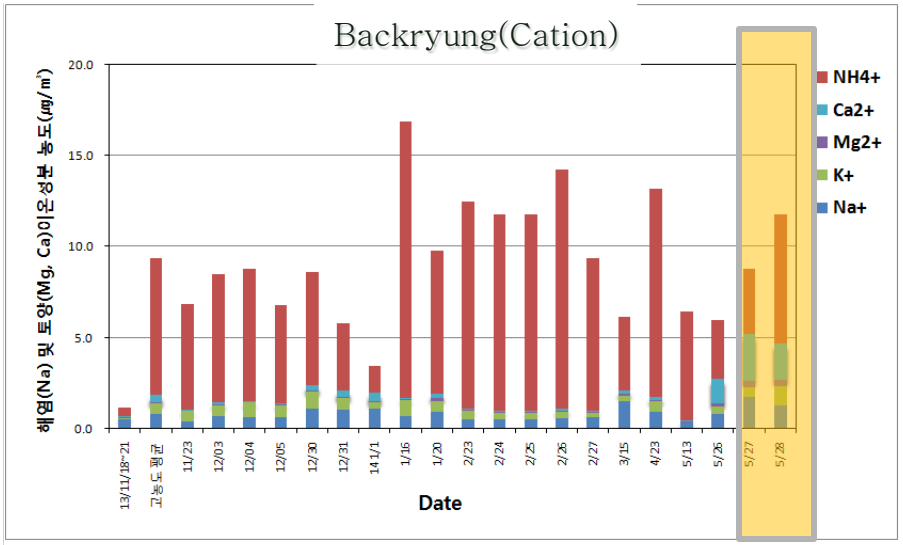


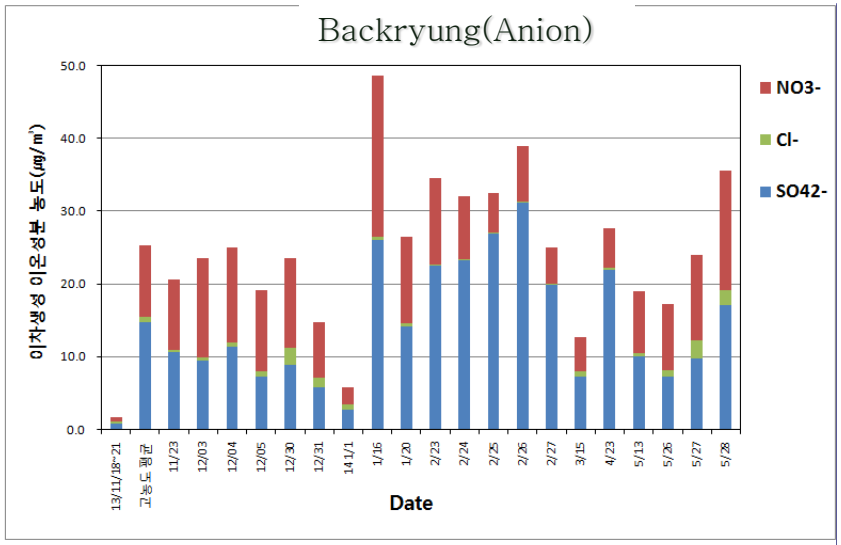
BN	PM2.5	PM10	F/C	SO42-	NO3-	Cl-	Na+	NH4+	K+	Mg2+	Ca2+	EC	OM	Si	Ca	K	Fe	Ti	As	Se	Ni	Pb
Clean	7	25	0.29	0.8	0.6	0.3	0.5	0.5	0.1	0.0	0.0	0.4	2.6	1196	72	540	62	4	2.1	0.2	0.3	10
High	82	130	0.6	14.7	9.9	0.7	0.8	7.5	0.6	0.1	0.4	2.5	12.5	3697	1651	3471	1083	76	14	7.2	6.9	114

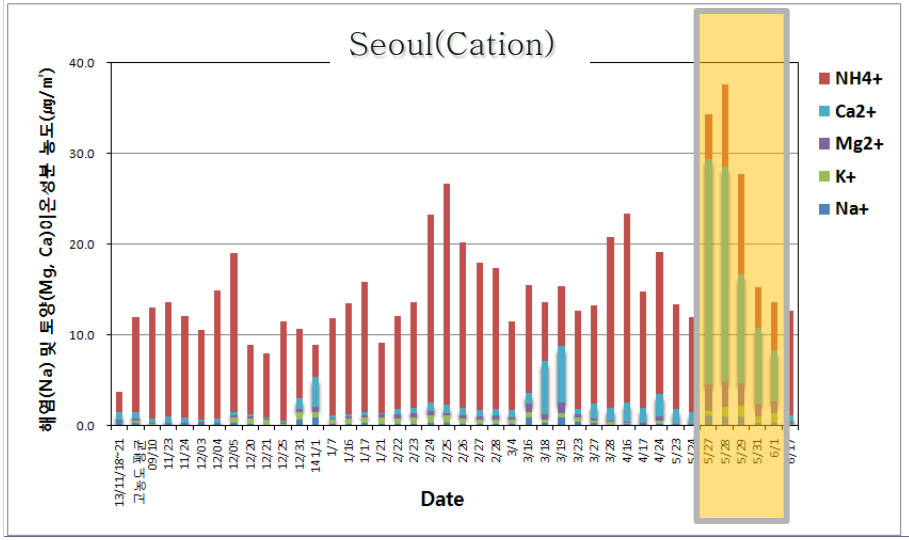
Seoul	PM2.5	PM10	F/C	SO42-	NO3-	Cl-	Na+	NH4+	K+	Mg2+	Ca2+	EC	OM	Si	Ca	K	Fe	Ti	As	Se	Ni	Pb
Clean	15	26	0.58	3.7	5.5	2.2	0.6	2.2	0.0	0.1	0.8	0.9	3.3	253	37	175	111	9	4.9	0.3	0.2	18
High	82	114	0.72	13.8	21.2	1.5	0.3	10.4	0.3	0.2	0.7	3.6	13.6		481	2203	559	32	14.2	5.6	3.4	106

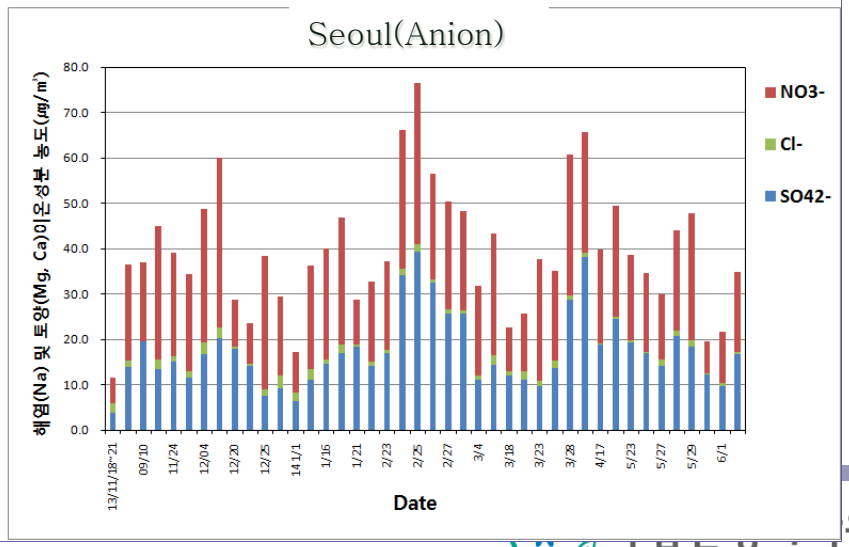
Asian Dust Observation by NIER

Chemical composition (Anion & Cation) in PM10









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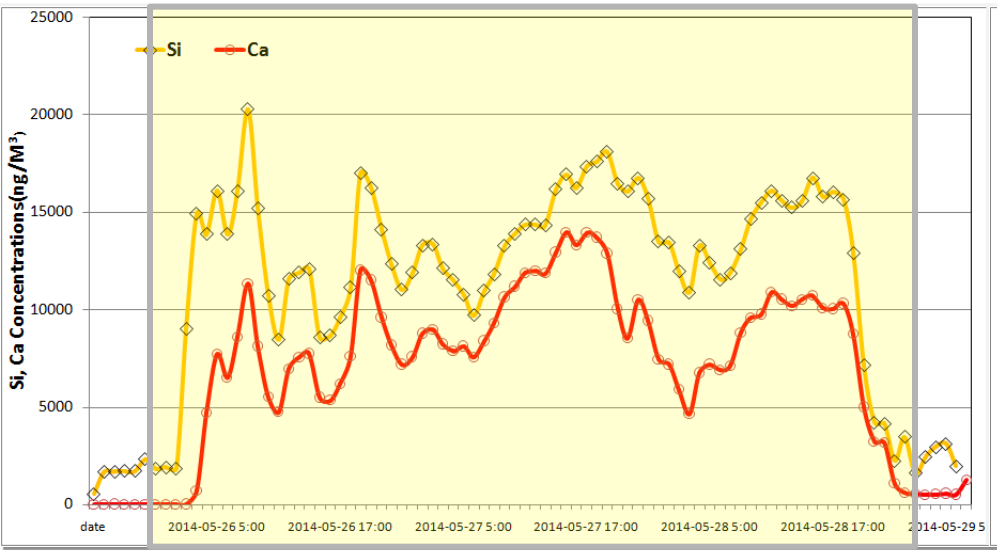
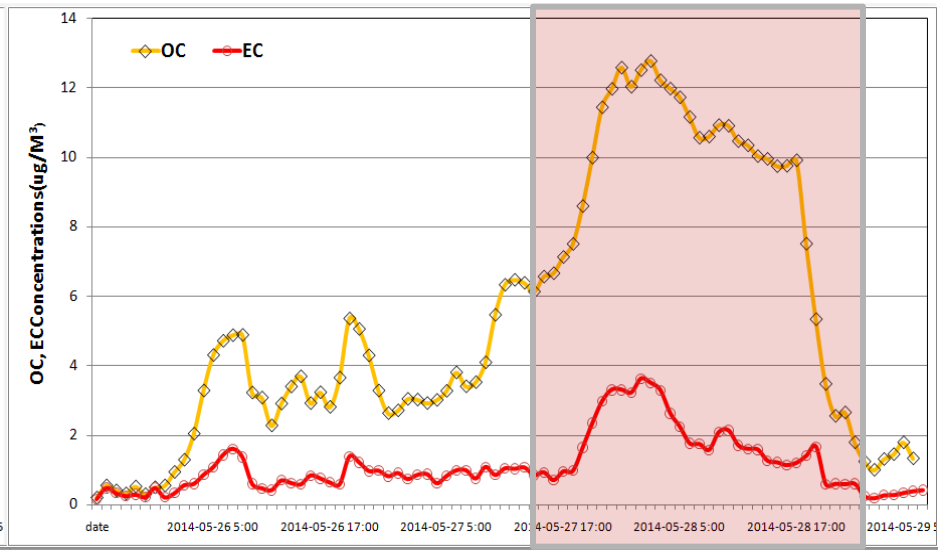
Chemical characteristics of Asian dust vs Anthropogenic pollution (May 2014, Backryung Island)



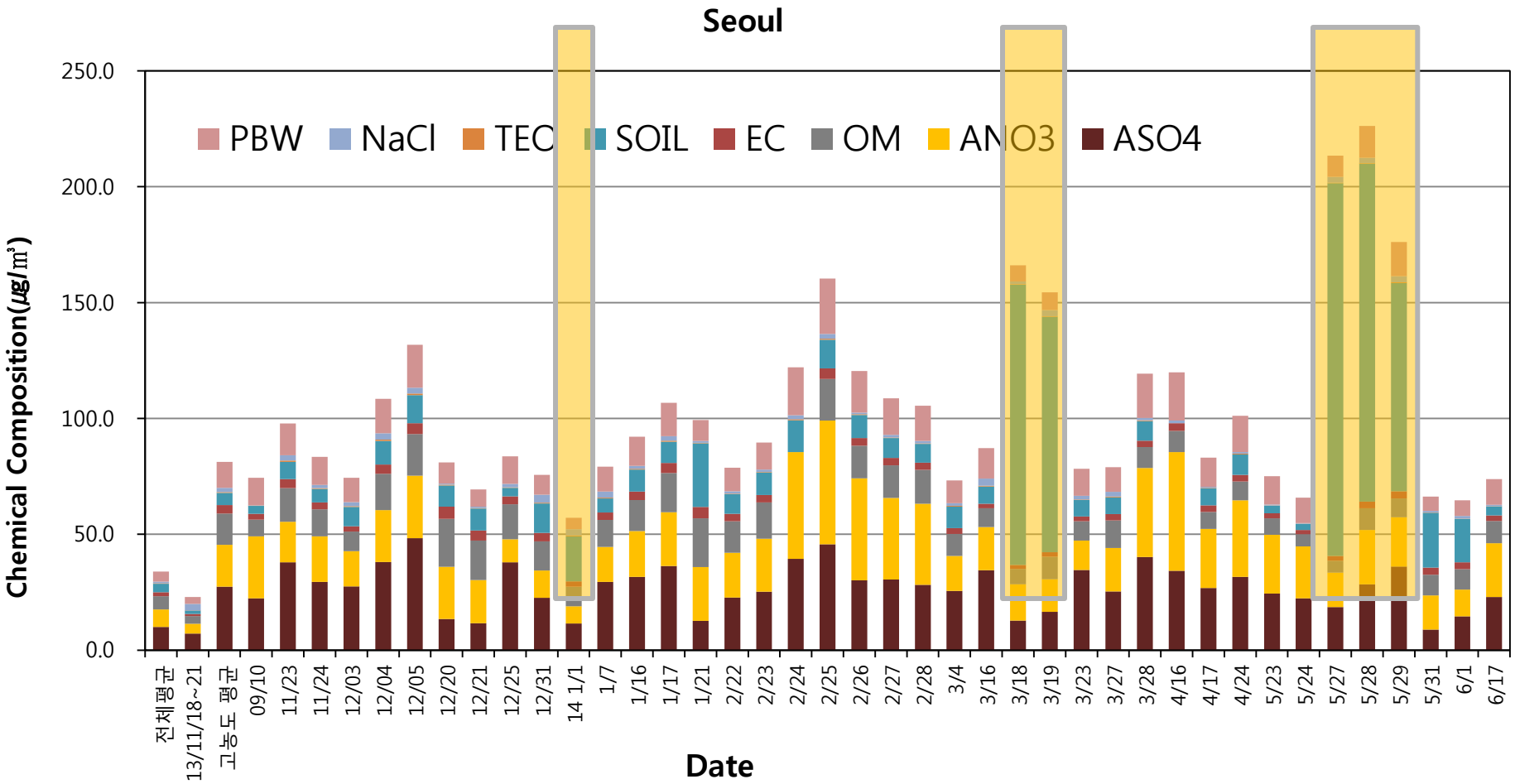


Caused by Sand Storm Transport

Caused by PM2.5 Transport

Asian Dust Observation by NIER

Time series of mass reconstruction of $PM_{2.5}$ (May, 2014, Seoul)



Bioaerosol Research of Asian dust

Source

Biology
Human, animal & plant

Nature
Soil, water, forest & atmosphere

Industry
Treatment (water & waste), processing (food, bio & wood)

Human activity
Construction, farming, ventilation & urbanization

Natural activity
Yellow dust, Hurricane, & convection

Origin

Airborne
- Indoor
- Outdoor

Matrix

Bioaerosol

Variety
- Virus
- Bacteria
- Fungi
- Protozoa
- Toxins
- Allergens
- Biological dusts

Impact

Negative
- Health impact (Respiratory or skin disease)
- Activity decrease

*Harmful bioaerosol

Positive
- Atopy protection
- Microbial diversity

*Sound bioaerosol

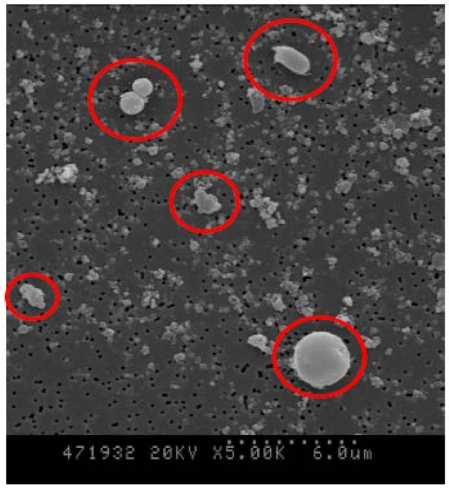
▶ **Bio+aerosol → 'Biological Particle'**

▶ **Biological agents dispersed in the air environment**

Bioaerosol Research of Asian dust

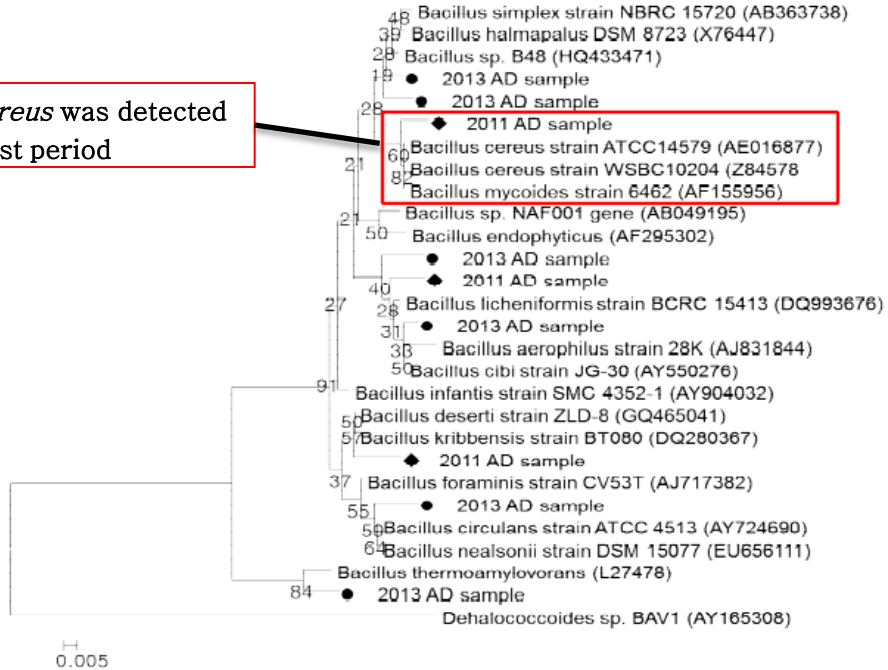
Comparison of fine dust (A, April 16) and clear day (B, April 30) in Seoul, Korea(2014)

Mini volume sampler | Anderson sampler | High volume sampler



Microorganisms attached to membrane filter from Asian Dust season

Bacillus cereus was detected in Asian dust period



Microbial community during Asian Dust season(2013)

Thank you for your attention.