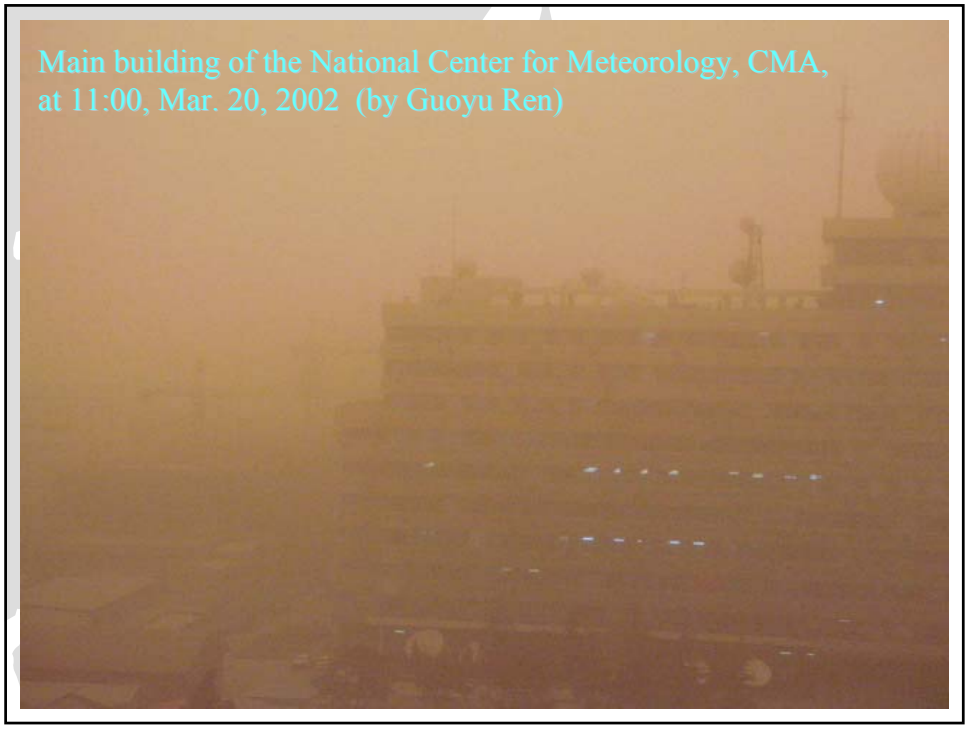
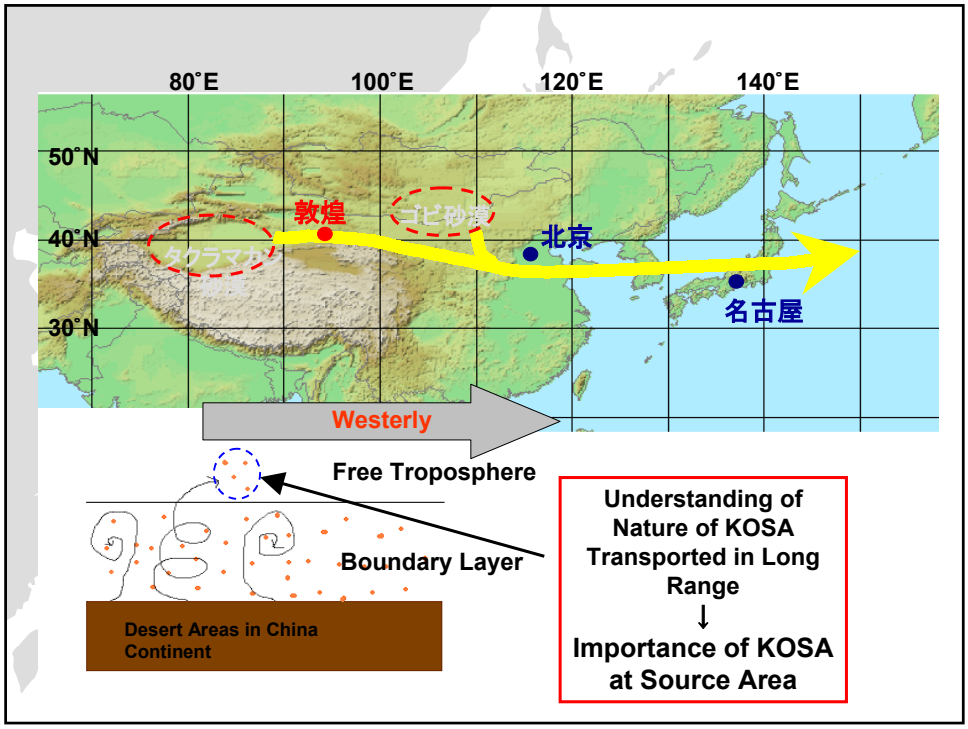
記念講演資料

Behavior of KOSA particles over the Taklamakan desert: Effect of KOSA on Environment in East Asia

Y. IWASAKA
NAGOYA University


Main building of the National Center for Meteorology, CMA,
at 11:00, Mar. 20, 2002 (by Guoyu Ren)


中新社图片



KOSA Research in Japan After The 2nd War

Electrics from Water Power

Expanding Human Activities and Increase in Power Supply

⇓

Demands and Ask to Meteorologists

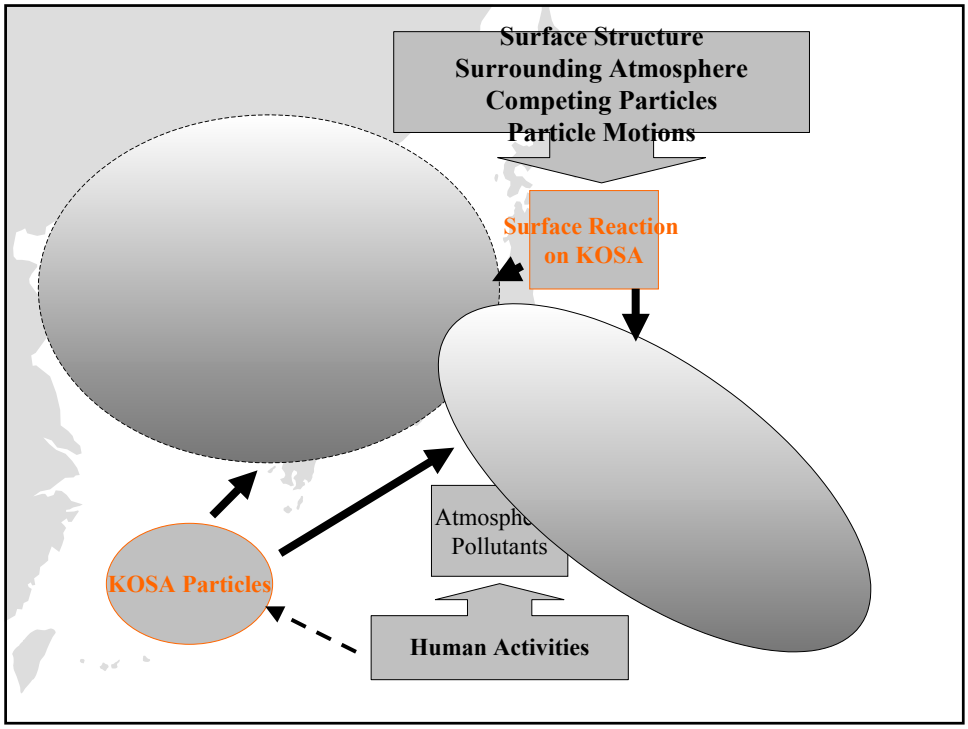
- **Possible to make artificial rain ?**
- **What is effective nuclei ?**
- **Clay works well as Ice nuclei !**

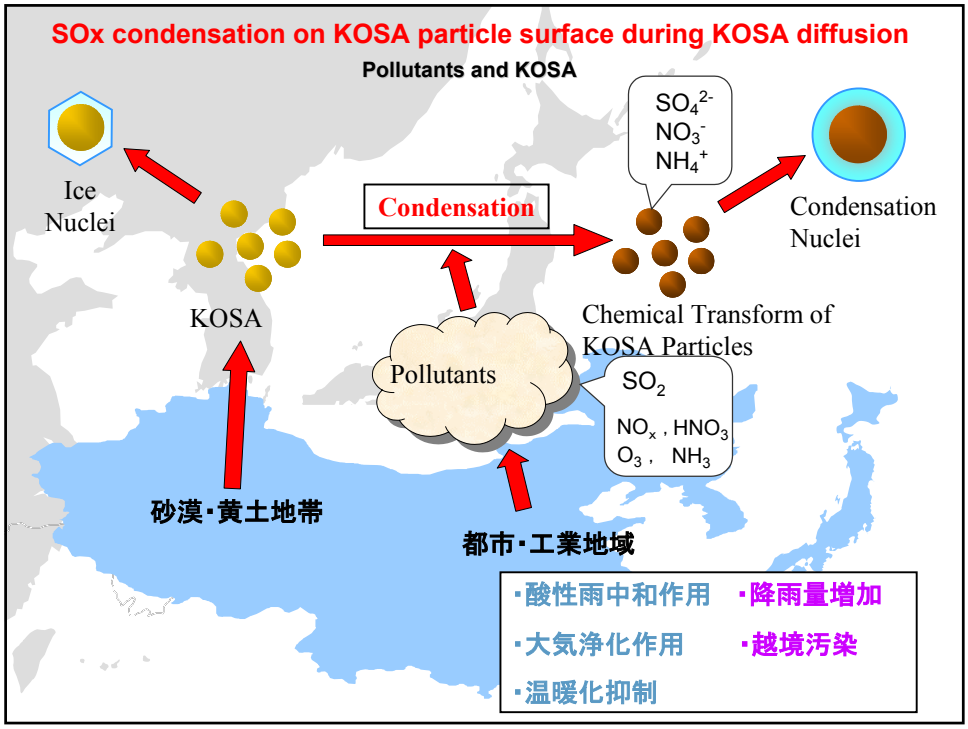
KOSA (Dust Particles) and Global Environment

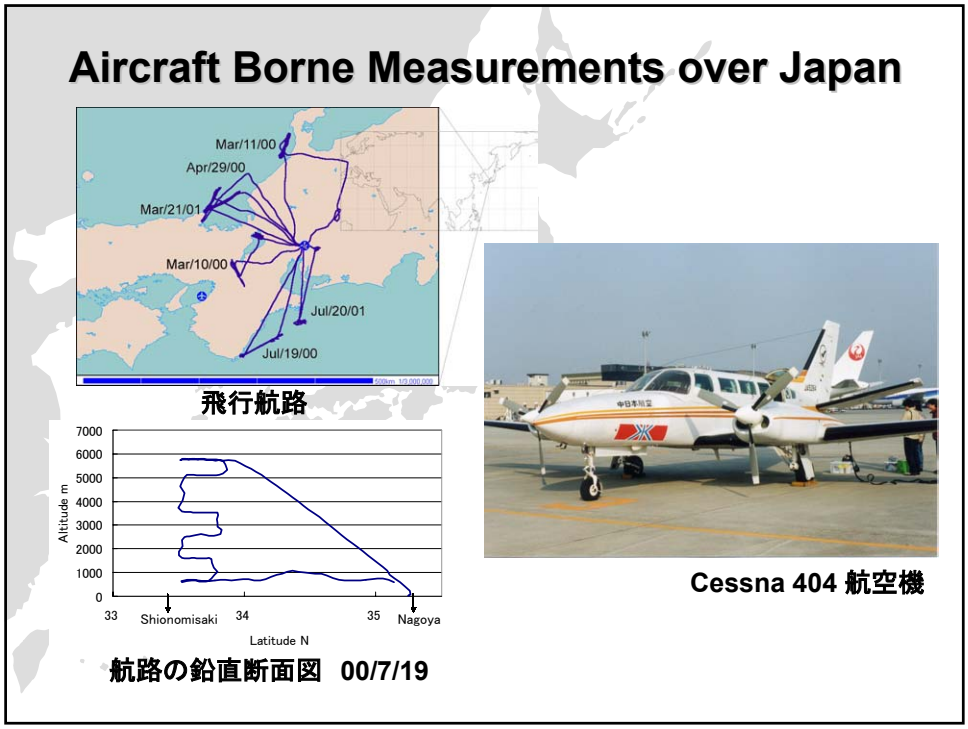
Changing Social and Life

- **Road, Transport, Communication**
  - Usage of Car, Expanding Network of Roads, • • • •
- **Power Supply Network**
  - Expanding of Power Cable Network
- **Transport**
  - Change from walking to usage of cars, aircrafts, trains, and others
- **Products of Fine Mechanical Instruments and Electronics Parts**
  - Increase in Industries and transporting materials

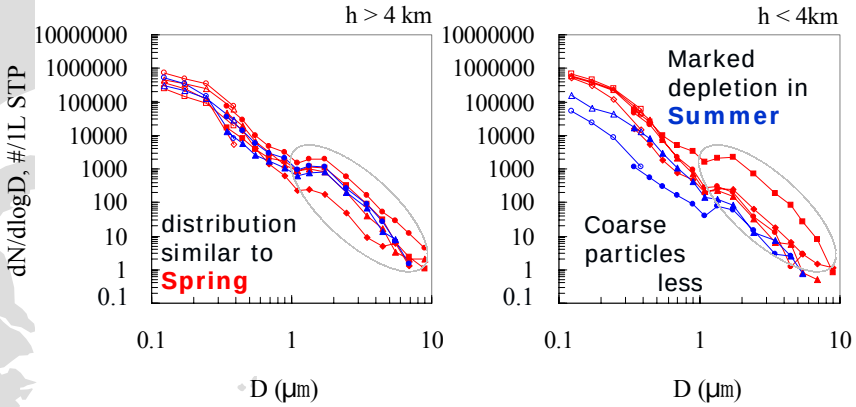
Now Global Warming




SOx condensation on KOSA particle surface during KOSA diffusion
Pollutants and KOSA
Ice Nuclei
KOSA
Condensation
SO_4^{2-} NO_3^- NH_4^+
Condensation Nuclei
Chemical Transform of KOSA Particles
Pollutants
SO_2
NO_x , HNO_3
O_3 , NH_3
砂漠・黄土地帯
都市・工業地域
・酸性雨中和作用 ・降雨量増加
・大気浄化作用 ・越境汚染
・温暖化抑制

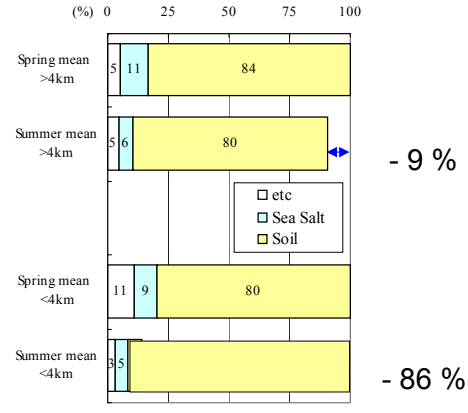

Aircraft Borne Measurements over Japan
Mar/11/00
Apr/29/00
Mar/21/01
Mar/10/00
Jul/20/01
Jul/19/00
飛行航路
Altitude m
7000
6000
5000
4000
3000
2000
1000
0
33
Shionomisaki
34
35
Nagoya
Latitude N
航路の鉛直断面図 00/7/19
Cessna 404 航空機

Particle number size distribution



Particle number-size distributions observed by Optical Particle Counters above and below the altitude of 4km over Japan. Distributions from cases of Spring and Summer of 2000-01 are compared. All values are corrected for the standard temperature and pressure (STP: 20℃, 1013hPa)

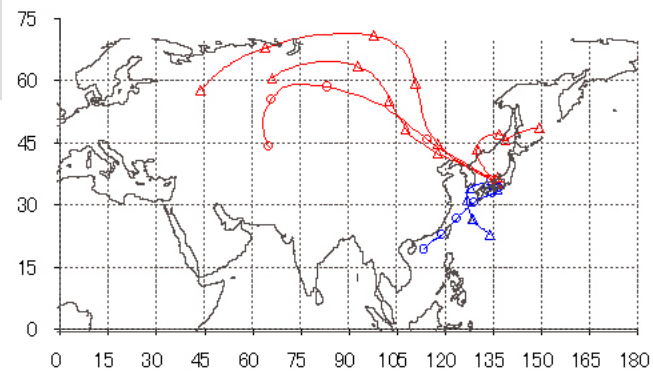
Temporal and Spatial changes



Observed seasonal change in the vertical structure of coarse (D>1μm) aerosols over Japan. Relative seasonal change in the total number of coarse particles is shown as 100% being the mean value for spring. Fractions by different particle types are superimposed.

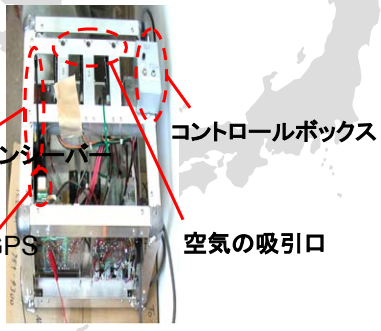
Origin of the air parcels

(a) h > 4 km (b) h < 4 km

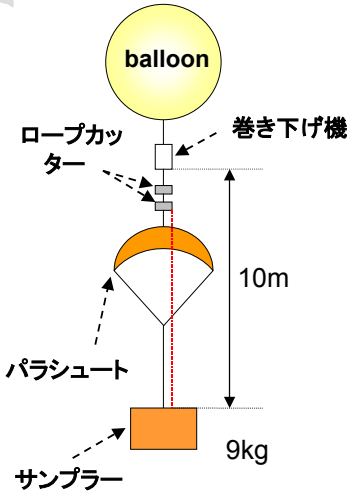


Trajectories of air parcels traced backwards from the points of aircraft-borne measurement. Isentropic assumption was used in the analysis. Trajectories starting above (a) and below (b) the altitude of 4km are compared. Markers on the trajectory denote position at every 24 hr.

Particle Collector Mounted on Balloon

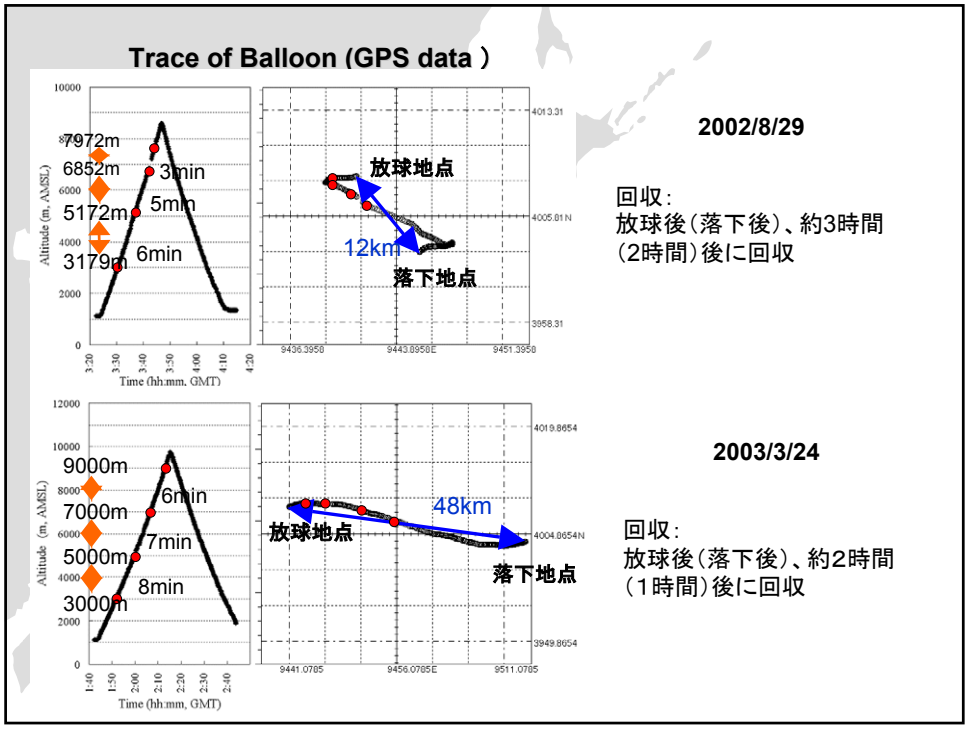


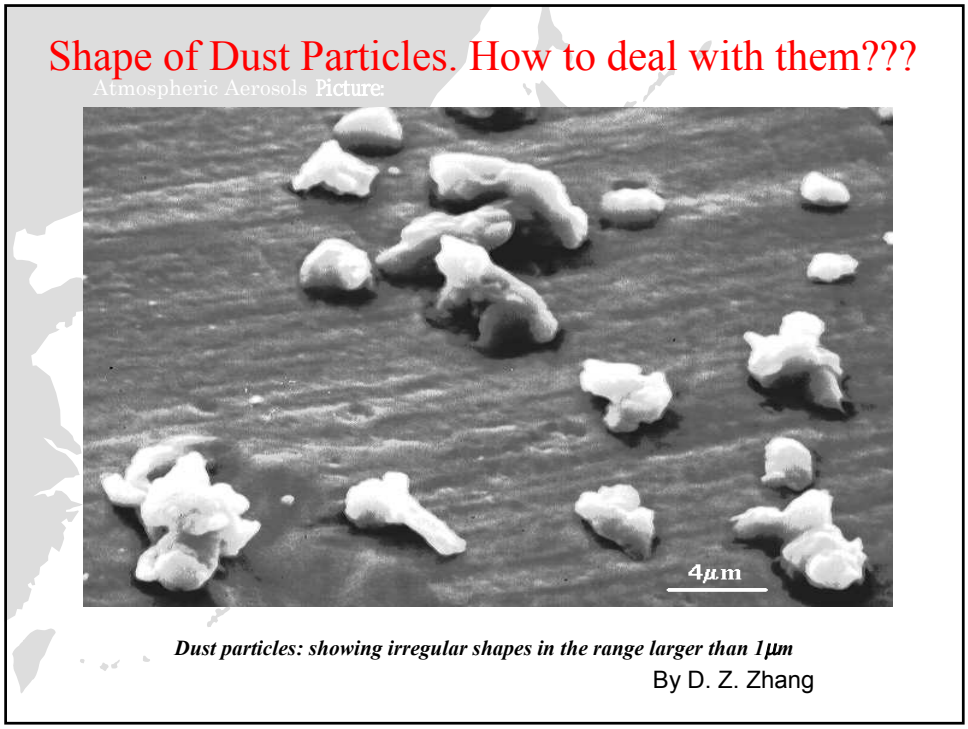
サイズ：30cm×30cm×15cm
（W×D×H）

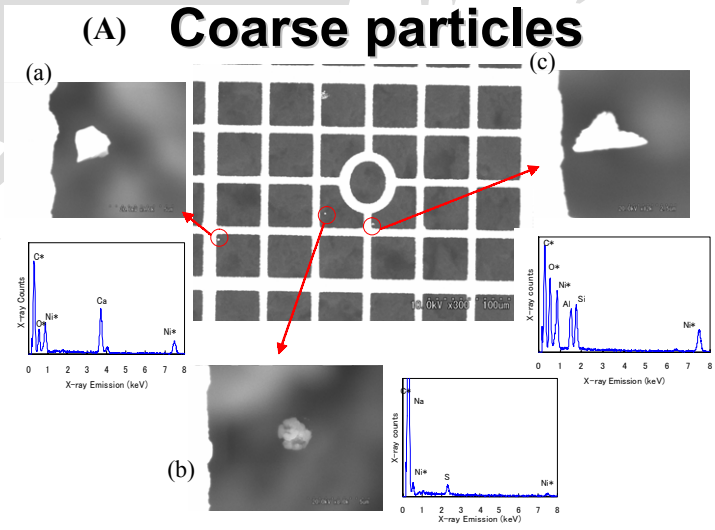


Sounding of Balloon-borne Particle Collector

Landing of Particle Collector and Recovering

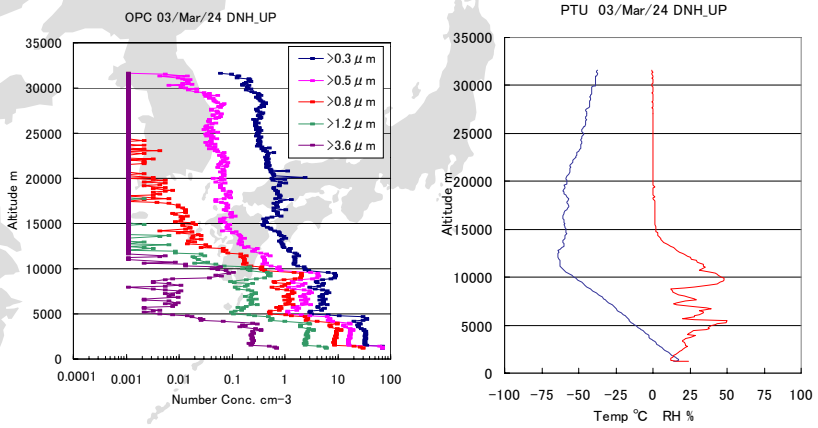

Trace of Balloon (GPS data)
7972m
6852m
5172m
3179m
3min
5min
6min
Altitude (m, AMSL)
Time (hh:mm, GMT)
放球地点
12km
落下地点
2002/8/29
回収:
放球後(落下後)、約3時間
(2時間)後に回収
9000m
7000m
5000m
3000m
6min
7min
8min
48km
放球地点
落下地点
2003/3/24
回収:
放球後(落下後)、約2時間
(1時間)後に回収


Shape of Dust Particles. How to deal with them???
Atmospheric Aerosols Picture:
4μm
Dust particles: showing irregular shapes in the range larger than 1μm
By D. Z. Zhang

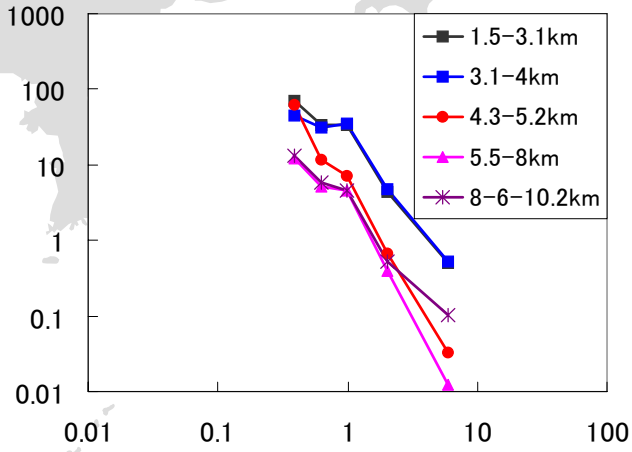


Electron micrograph of individual particles collected in the free troposphere between about 3km and 5km over Dunhuang, China. Coarse particles (a), (b) and (c) is calcite (CaCO3), thenardite (Na2SO4) and aluminosilicate, respectively.

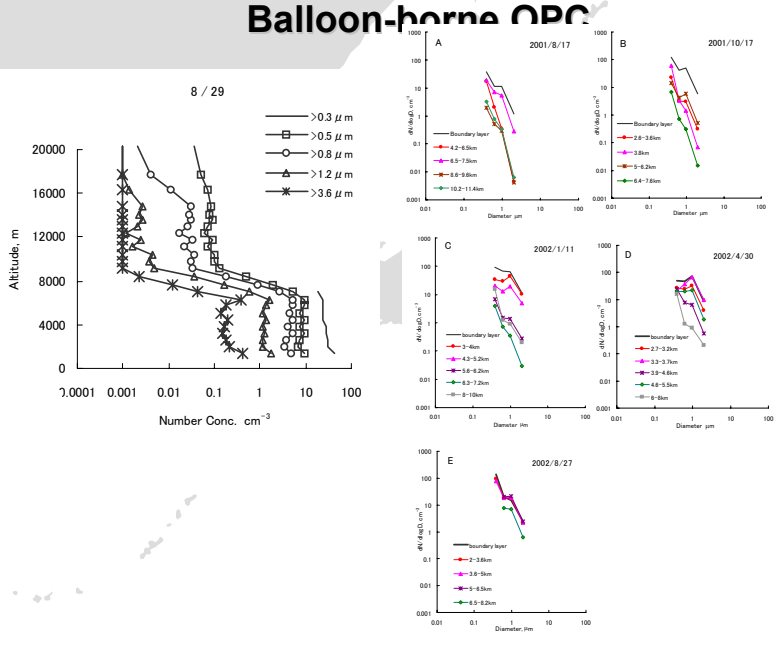
Typical Example of Balloon-borne OPC Measurements



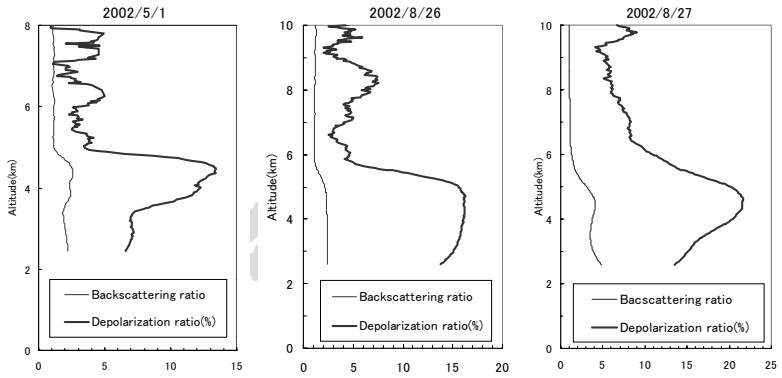
Size Distribution of Particles Estimated from OPC Measurements



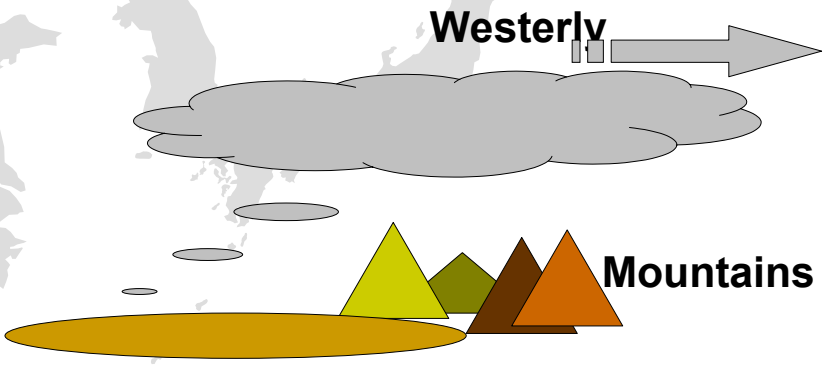
Measurements of Atmospheric Particles with Balloon-borne OPC



Lidar Returns in Dunhuang

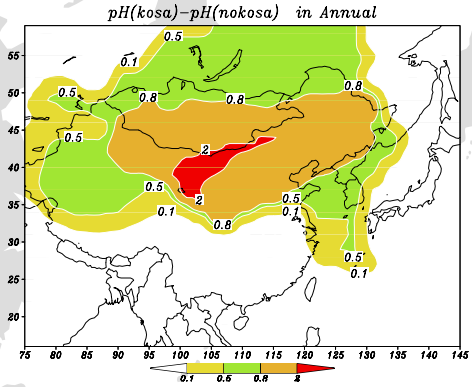


Hypothesis on Tarimu Basin as KOSA Particle Pool

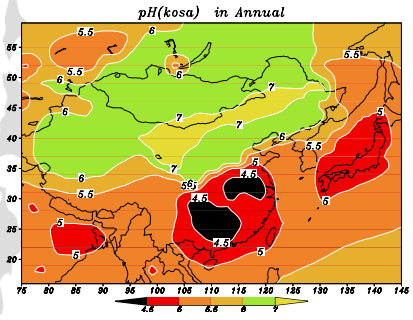


Effects of soil dust neutralization

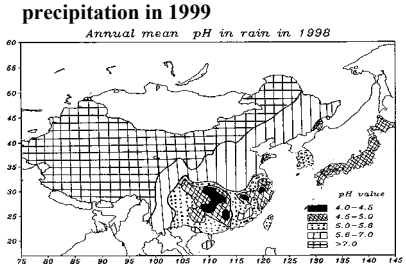
Numerical simulation was performed for another case with the neutralization effect of soil dust, i.e., neglecting the netralization reactions but with other conditions remaining the same.



Difference of anuual mean pH value in rainwater with and without neutralization reactions by soil aerosol



Predicted annual pH value of precipitation in 1999



Observed pH value of precipitation over China

KOSA Particle Effects on Radiative Balance (1)

- **Optical Properties of KOSA Pariticles**
  Size Chemical Composition Shape ····
- **Condition of Ground Surface during KOSA Diffusion in Atmosphere**
  Desert Sea Cloud Green Land ····
- **Solar Zenith Angle**
  Day time or Night Time Summer and Others
- **Life Time of KOSA in the Atmosphere**
  Atmospheric Motion

KOSA Particle Effects on Radiative Balance (2)

- **Effects on Water Cycle**
  - Condensation and Ice Nuclei→Albedo Change
- **Effects on Carbon Cycle**
  - Input of Mineral and Nutrients on Marine Microbes →CO2 Concentration change
- **Effects on Sulfur Cycle**
  - Condensation of Sulfur Components on KOSA Surface →Change in Sulfate Particle Concentration

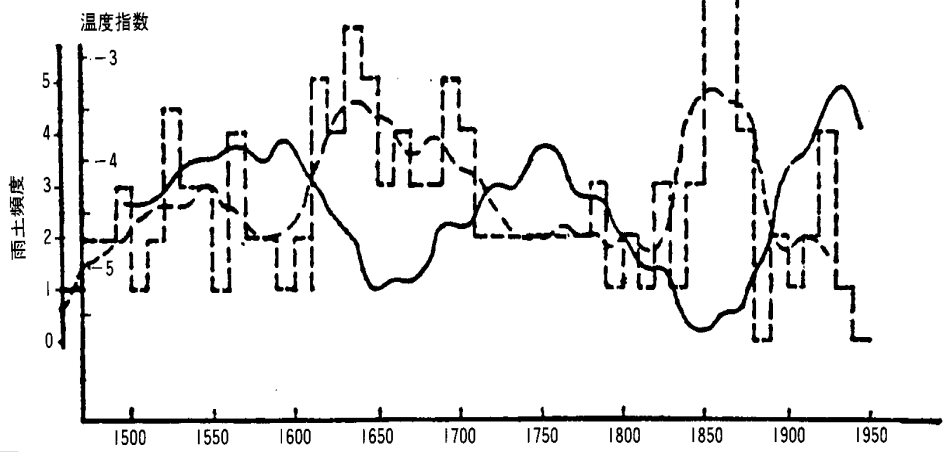
Number of Strong and very Strong Dust Storm over Northern China during past 50 years

Deca-des	1950s	1960s	1970s	1980s	1990s
No.(1)	48	68	89	47	36
No.(2)	5	8	13	14	23

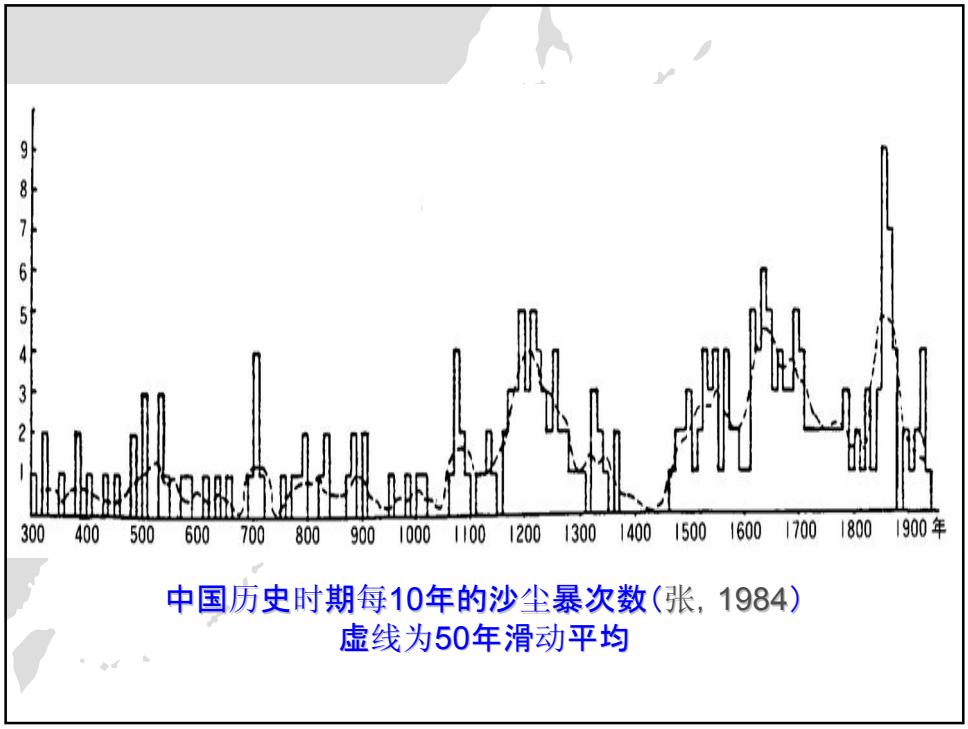
- Increased rapidly after 1998
- 2000: 10 Times
- (1) (Qian et al., 2002)
- (2) (Qian et al., 1997)

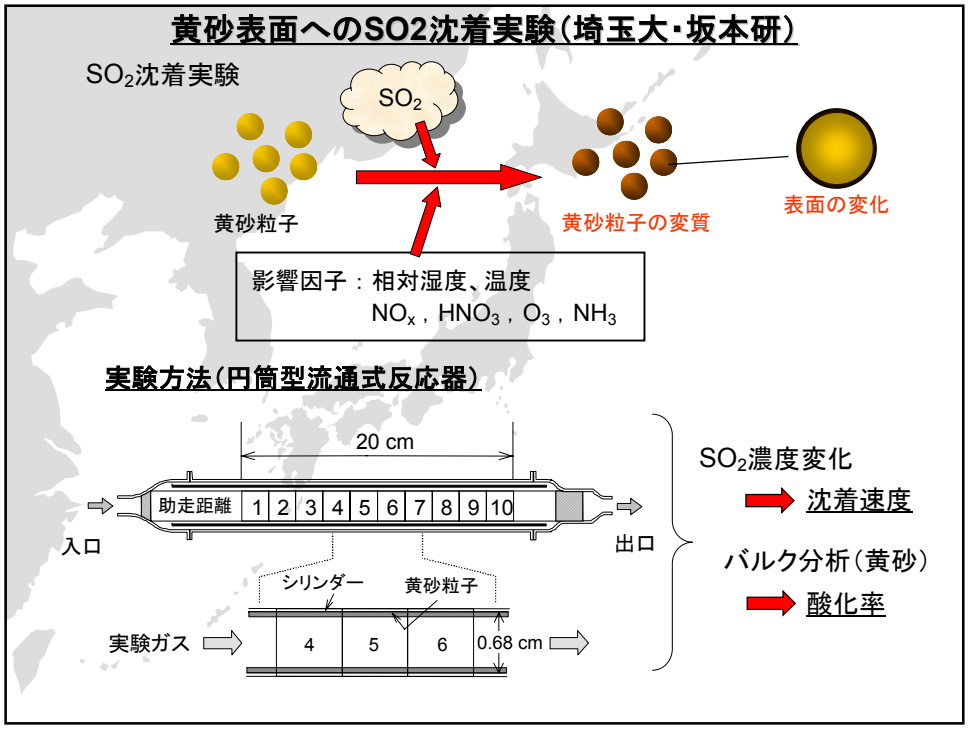
Summary

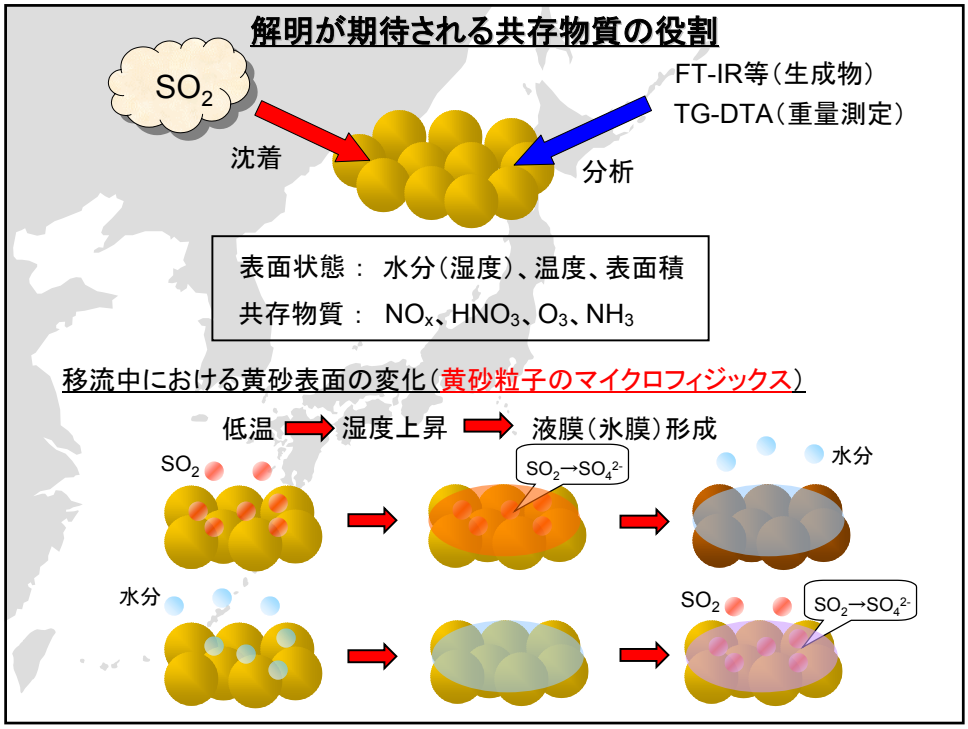
- Understanding of KOSA (Dust) is not high
- KOSA event is essentially relating with global environment
- International collaboration is essential for KOSA research
- Problems caused by KOSA events are sometimes due to expanding human activities



Correlation between dust storms (dashed line) and temperature index (solid line) over last 500 years in China (after Zhang, 1992)


9
8
7
6
5
4
3
2
1
300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 年
中国历史时期每10年的沙尘暴次数(张，1984)
虚线为50年滑动平均


黄砂表面へのSO2沈着実験(埼玉大・坂本研)
SO2沈着実験
SO2
黄砂粒子
黄砂粒子の変質
表面の変化
影響因子：相対湿度、温度
NOx，HNO3，O3，NH3
実験方法(円筒型流通式反応器)
20 cm
助走距離 1 2 3 4 5 6 7 8 9 10
入口
出口
シリンダー
黄砂粒子
実験ガス
4 5 6
0.68 cm
SO2濃度変化
沈着速度
バルク分析(黄砂)
酸化率


解明が期待される共存物質の役割
SO2
沈着
分析
FT-IR等（生成物）
TG-DTA（重量測定）
表面状態： 水分（湿度）、温度、表面積
共存物質： NOx、HNO3、O3、NH3
移流中における黄砂表面の変化（黄砂粒子のマイクロフィジックス）
低温
湿度上昇
液膜（氷膜）形成
SO2
SO2→SO4 2-
水分
水分
SO2
SO2→SO4 2-