Atmospheric Chemistry Observation at the Summit of Mt. Fuji:

A Proposal for a Permanent Ground Base Platform of Free Troposphere

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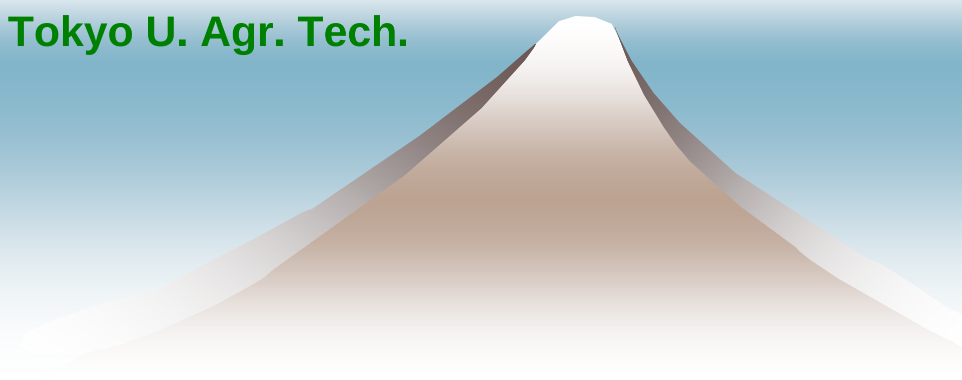
4:Shimane Pref., 5: Tokyo U. Agr. Tech.



Why Mt. Fuji？

(1) Free Troposphere

(2) Weather Station since 1932

(3) But･･･

(1) Free Troposphere

How it is shown:

- Diurnal change in O_3: *very little*
- Concentrations of chemical species in aerosol: *comparable to the reported values of those in free troposphere* *→background level*
- High wind speed *→long range transport*

(1) Free Troposphere

Reasons why it is so

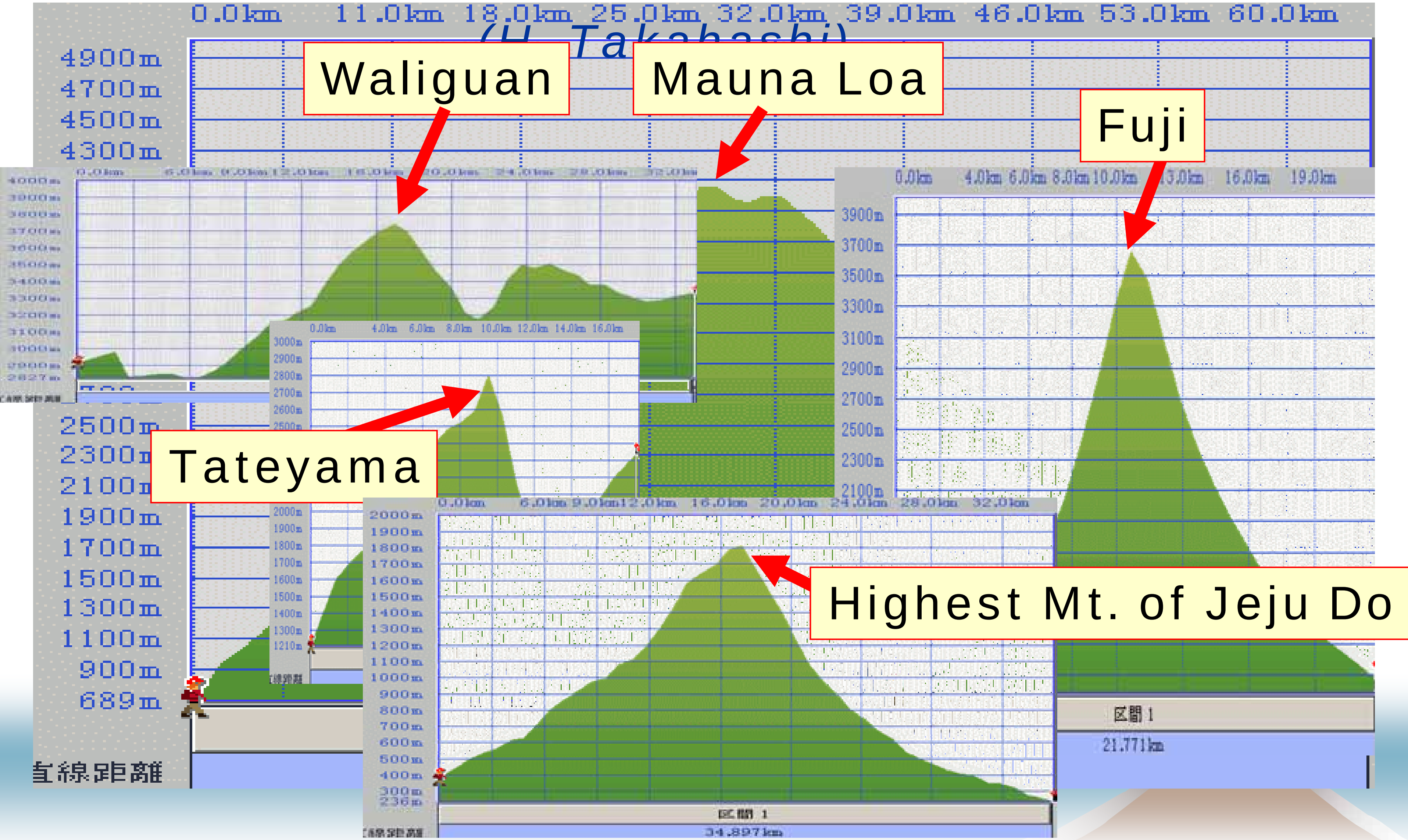
The shape of the mountain

(heat capacity)

Sole peak

Height

E-W Cross Section of Mountain



The summit is above boundary layer!
Levels of contamination from local area are very low!

(2) Weather Station since 1932

Short History

19th century: an important meteorological observation point.

pioneers : Itaru & Chiyoko Nonaka

(Oct.-Dec., 1895)

: Jun'ichi Satoh

(Jan.-Feb., 1926),

Since 1932 operated manually by Japan Meteorological Agency (JMA)

Itaru (29) and Chiyoko(24) Nonaka,
Pioneers of Mt. Fuji meteorological observation

(2) Weather Station since 1932

- 1964 RADAR Dome set up

  Typhoon forecast (800**km**)

- 1999 RADAR observation ceased

  staff members: 5 → 4

- 2001 RADAR Dome removed

(2) Weather Station since 1932

Air Chemistry:

What we have done since 1990

- **1990-1992 : occasional precipitation sampling**
  (E. Maruta and Meteorol. Coll.)
- **1992- : surface ozone started**
  (continuous) ***(Y. Tsutsumi)***
  aerosol by LV ***(Meteorol. Coll.)***
- **1993 : aerosol by LV, Andersen LV,**
  HCl, SO_2, NH_3 (a week in summer)
- **1994 : aerosol by LV& HV(^{7}Be), Andersen LV,**
  HCl, SO_2, NH_3 (five days in summer)
- **1997 : Summer Campaign** ***(Meteorol. Res. Inst. & Meteorol. Coll.)***
- **1998-2001 :** ***(Meteorol. Res. Inst., Meteorol. Coll. & Tokyo U. Agr.&Tech.)***
- **2002-2004 :** ***(MRI, Meteorol. Coll. , TUAT、Edogawa U., NIES, AIST, Shimane Pref. Inst. Publ. Health & Environ Sci.,Toyama Pref. U.)***

Major findings during 1997-2001

Fog and precipitation chemistry

Hayashi et al, (2001) Water, Soil and Air Pollut.

Aerosol chemical species

Dokiya et al., (2001) Anal. Sci.

CO and O_3

Tsutsumi and Matsueda (2000), Atmos. Environ.

O_3 and Be-7

Tsutsumi, Igarashi, et al.(1998) J. Geophys. Res.

H_2O_2 and MHP

Yonekura et al. in contribution

Mt. Fuji Weather Station *at Present*

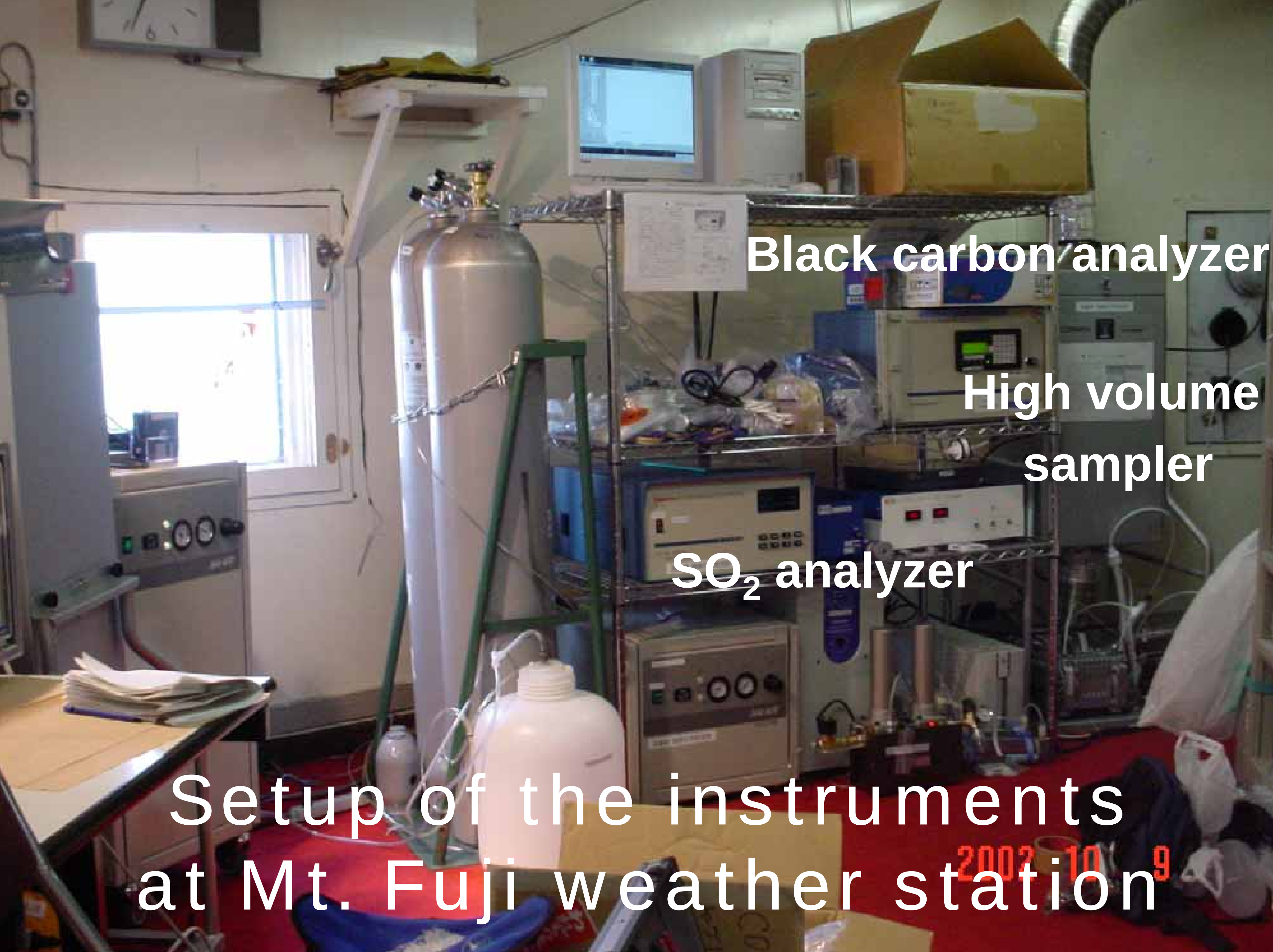
- 4 staff members conduct surface meteorological observation on site, rotating every 3 weeks
- Voluntarily taking care of instruments of atmospheric chemistry: *O_3, CO, CO_2, SO_2, ^{222}Rn, BC, ^{7}Be, Aerosols etc.*

Observation site

- The room used for the preparation of RADAR observation is now available for atmospheric chemistry observation.
- The effect of Mountain climber can be negligible even in summer.

Atmospheric trace species measured

Species	measurement method	Instrument	DL	Precision
^{7}Be	HV-sampler → g spectrometry	Sibata HVC1000F Ortec or Eurysis	～0.1 mBq/m3	～ 20%RSD
^{222}Rn	Electrostatic collection → a spectrometry	Semi-home made Ohyoh-Koken Co.	0.3 Bq/m3	～20%RSD at 1 Bq/m3
Species compared				
O_3	Ultraviolet absorption	Dylec 1007-AHJ Dylec 1150		2 ppbv
CO	Gas filter correlation	Thermo Electron 48C		15 ppbv
SO_2	Ultraviolet fluorescence	Thermo Electron 43C-TL	0.1 ppbv	0.1 ppbv
Other species measured				
CO_2	Infrared absorption	Licor 6252		0.1 ppmv
Black carbon	Aethalometer	Andersen Instruments		
Aerosol sulfate and ionic species	HV sampler → ion chromatography	Sibata HVC1000F HP-Yokogawa or Dionex		
Particle number	Laser particle counter	Kanomax		


Black carbon analyzer
High volume sampler
SO_2 analyzer
2002 10 9
Setup of the instruments at Mt. Fuji weather station


Rn monitor
CO2 monitor
Setup of the instruments
at Mt. Fuji Weather Station

Recent issues found at the summit of Mt. Fuji

(1) **Determination of the effects of a Siberian forest fire, as found in black carbon concentration**

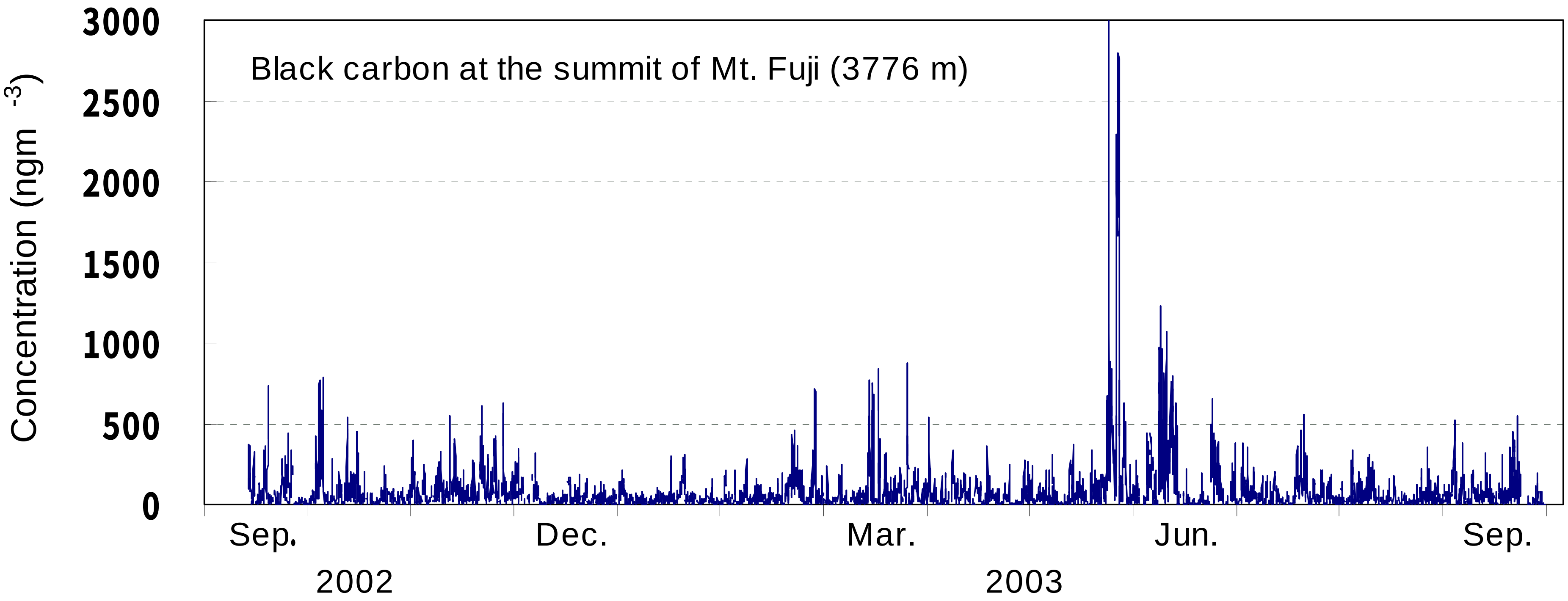
(2) **Continuous SO_2 observation prevails sporadic transport of polluted air masses from the continent controlled by synoptic scale meteorology**

(3) **Nitrate transportation with Kosa particles**

Smoke from a Siberian Forest Fire May 22, 2003, 15:00pm

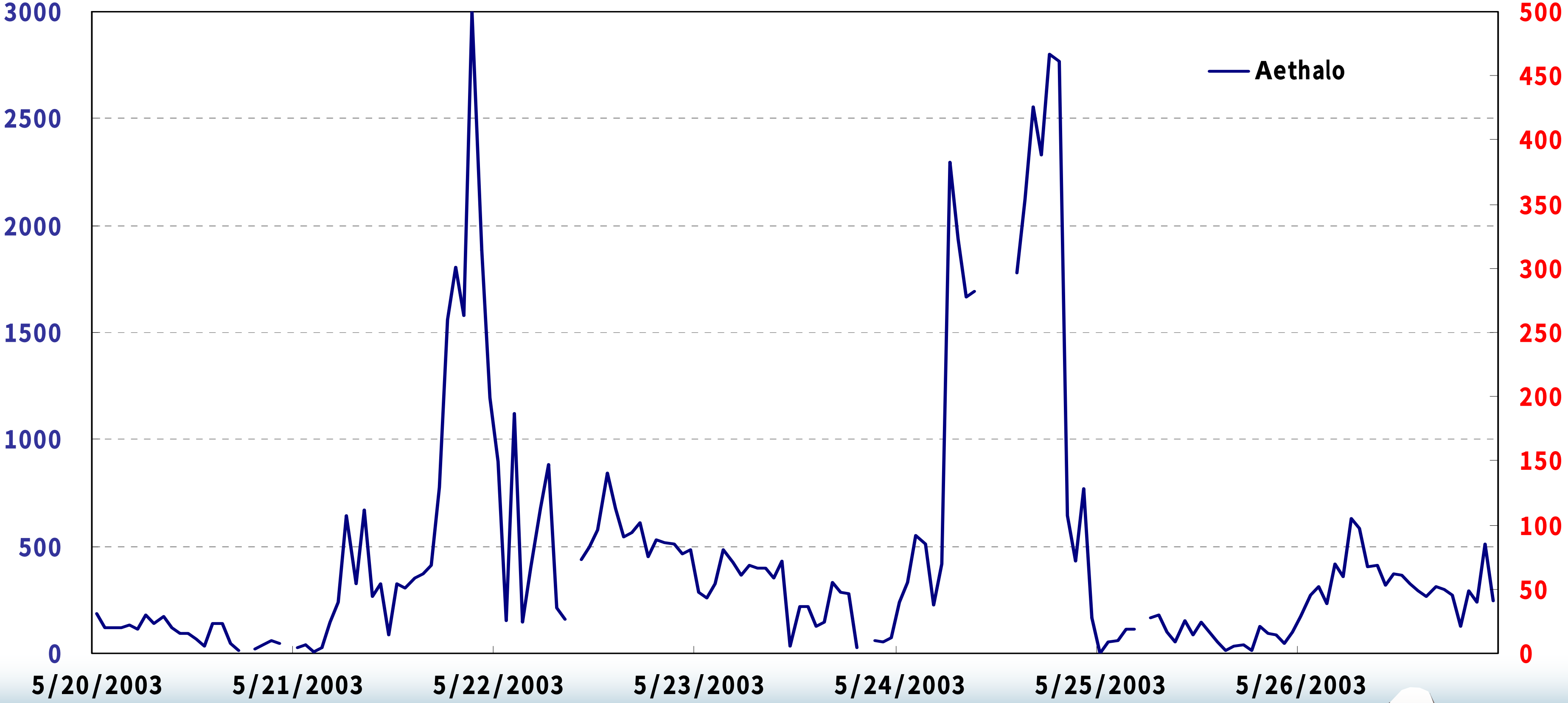
Mid-town Sapporo
Hazy from the reddish sun, even though no cloud was observed
(provided by Sapporo Meteorological Observatory)

Annual change of BC concentration at the summit of Mt. Fuji *(N. Kaneyasu)*

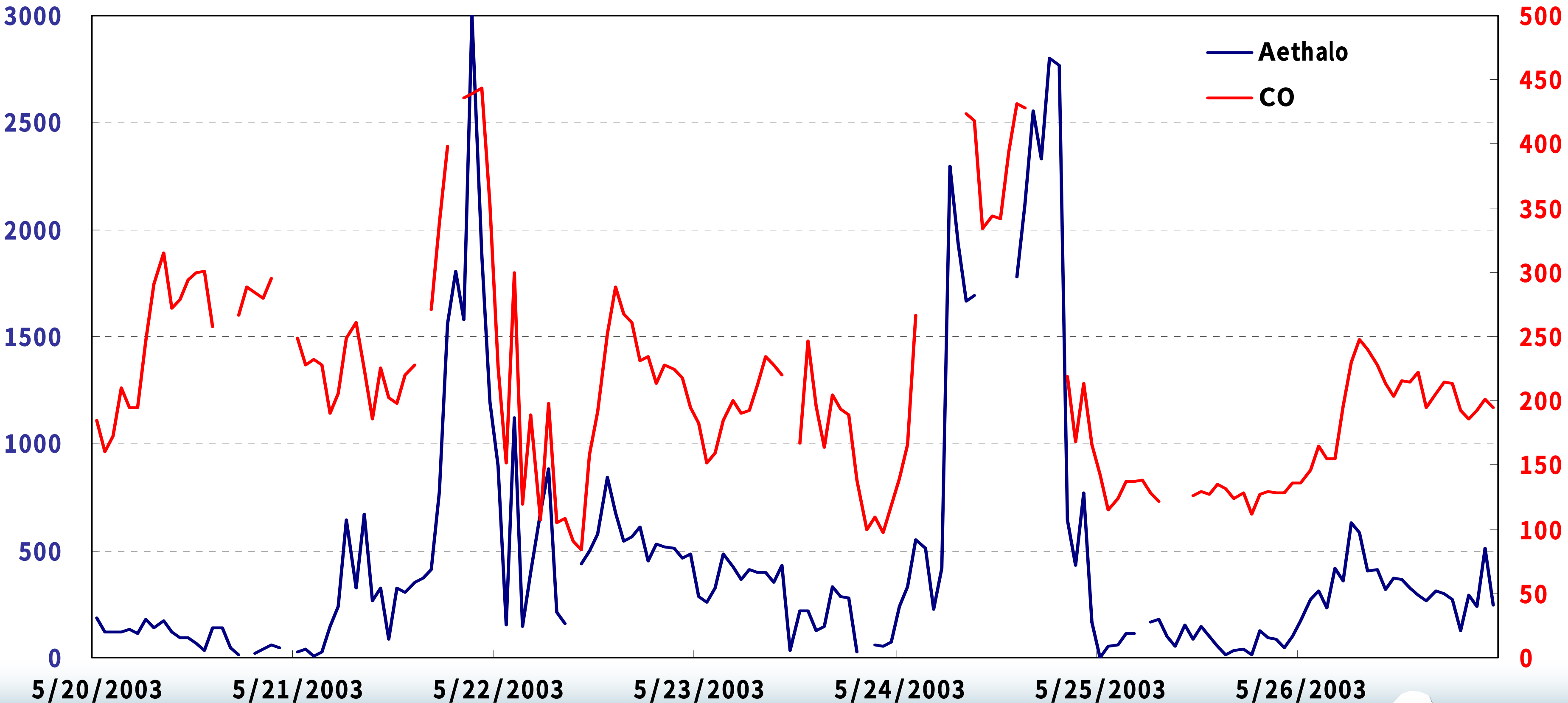


- **Typically, no high concentrations of BC are seen in winter**

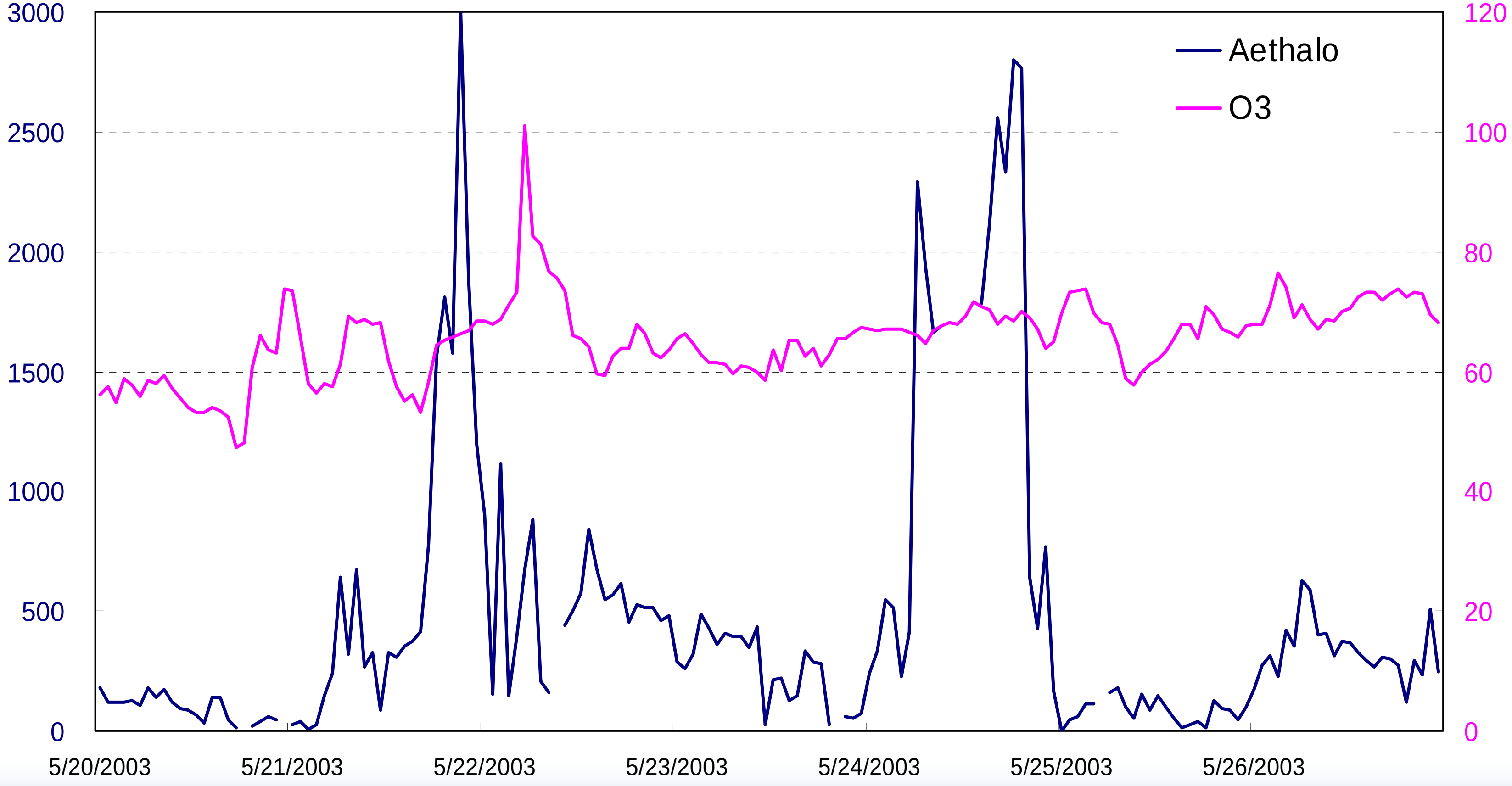
Concentration of BC in the "forest fire plume" on May 21 and May 24, 2003 *(N. Kaneyasu)*



Concentrations of BC and CO in the "forest fire plume" on May 21 and May 24, 2003 *(N. Kaneyasu)*

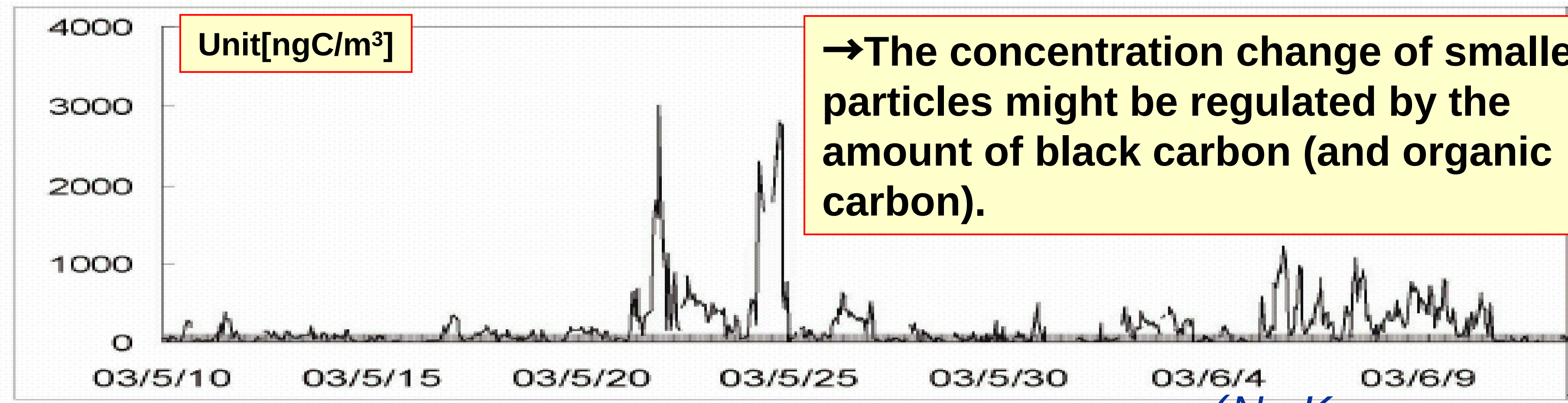


Concentrations of BC and O_3 in the "forest fire plume" on May 21 and May 24, 2003 *(N. Kaneyasu)*



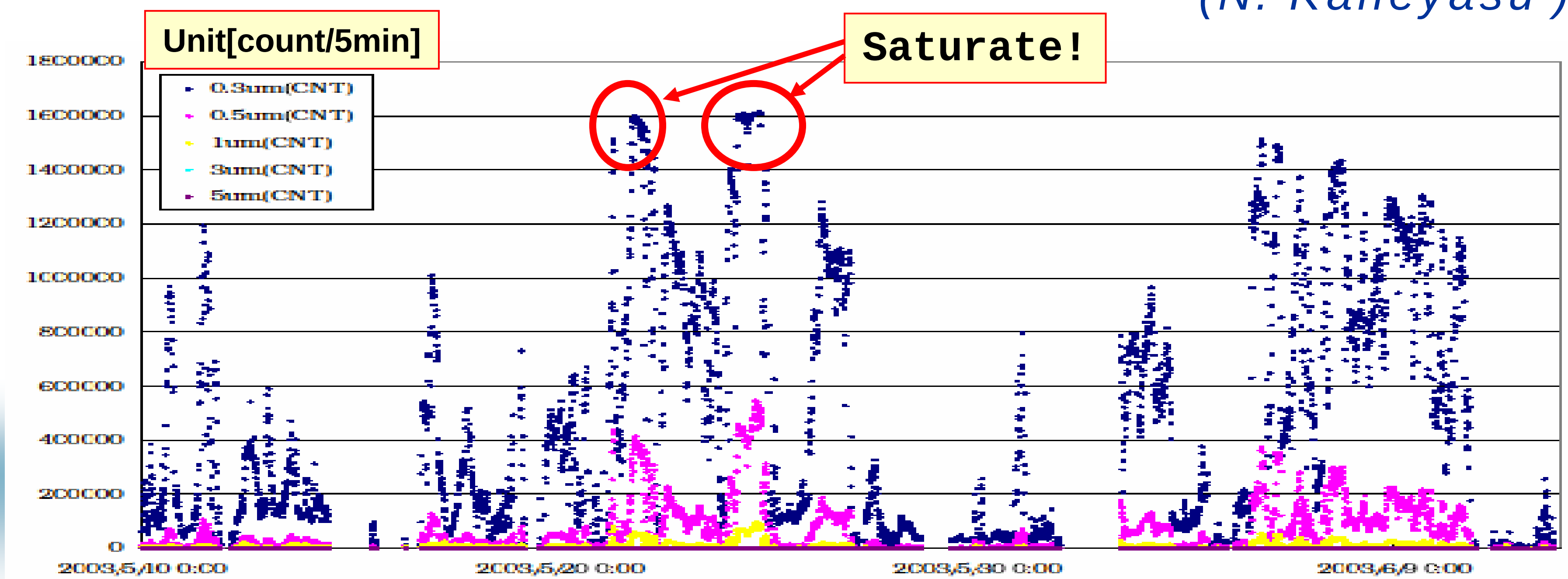
- **No typical photochemical production of ozone is found in the plume**
- **The reason of concentration increase about 2 hours after 0500JST on May 22?**

Particle counter compared with Aethalometer



→The concentration change of smaller particles might be regulated by the amount of black carbon (and organic carbon).

(N. Kaneyasu)



Summary for Siberian forest fire

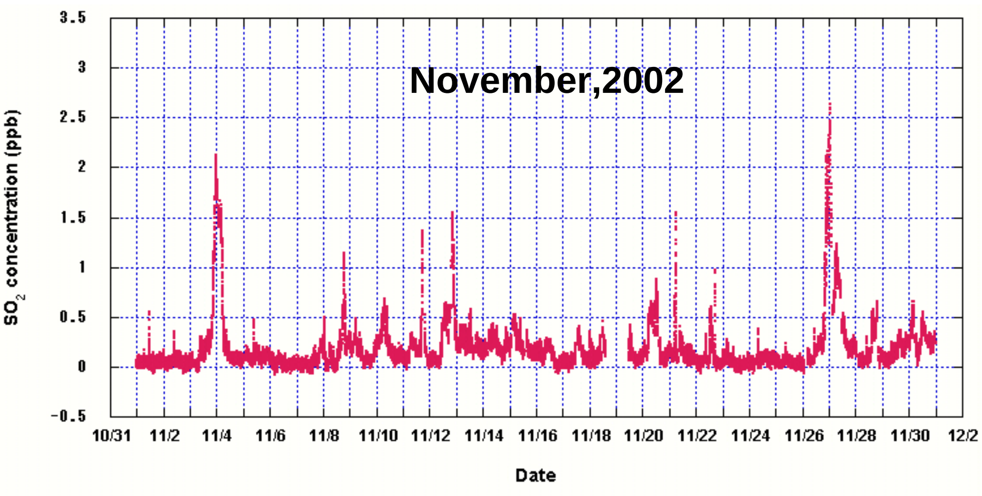
- **Aethalometer showed peaks (BC)**
- **Particle counter showed peaks in small particles**
- **CO showed good correlation with BC**
- **O3 showed no correlation with BC**
- **Model study**

Recent issues found at the summit of Mt. Fuji

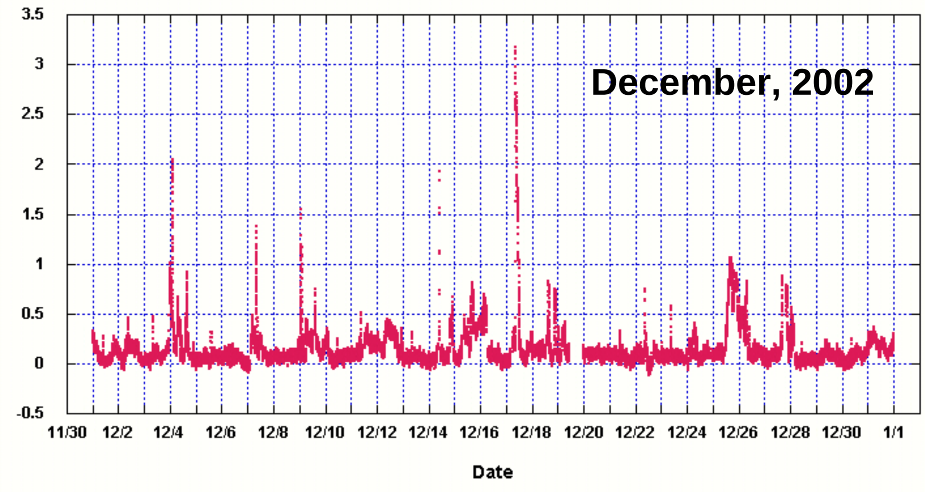
(2) Continuous SO_2 observation prevails sporadic transport of polluted air masses from the continent controlled by synoptic scale meteorology.

Continuous measurement of SO_2
(Y.Igarashi)

Max. 3.5 ppbv

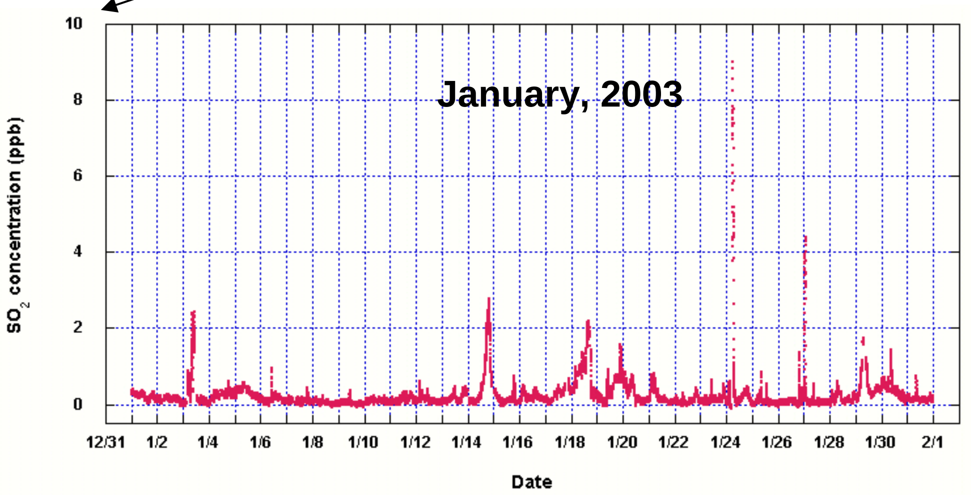


SO_2 concentrations observed at the summit of Mt. Fuji



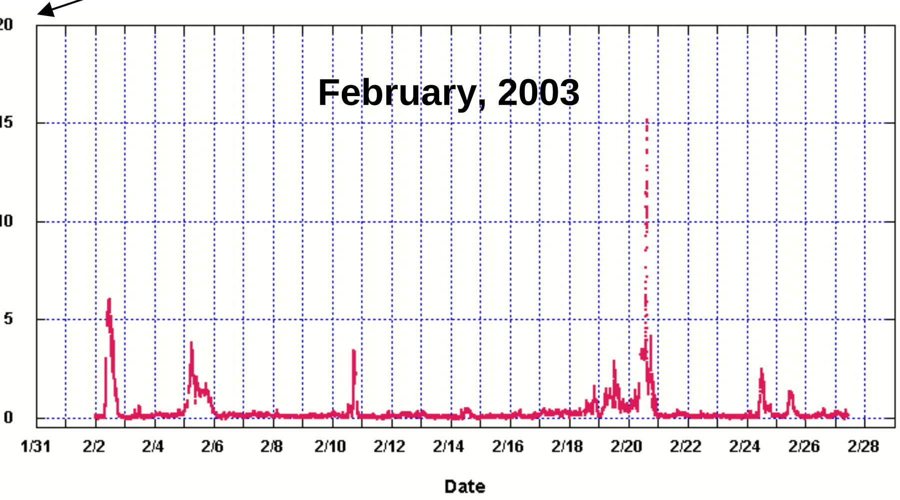
SO_2 concentrations observed at the summit of Mt. Fuji

Max. 10 ppbv



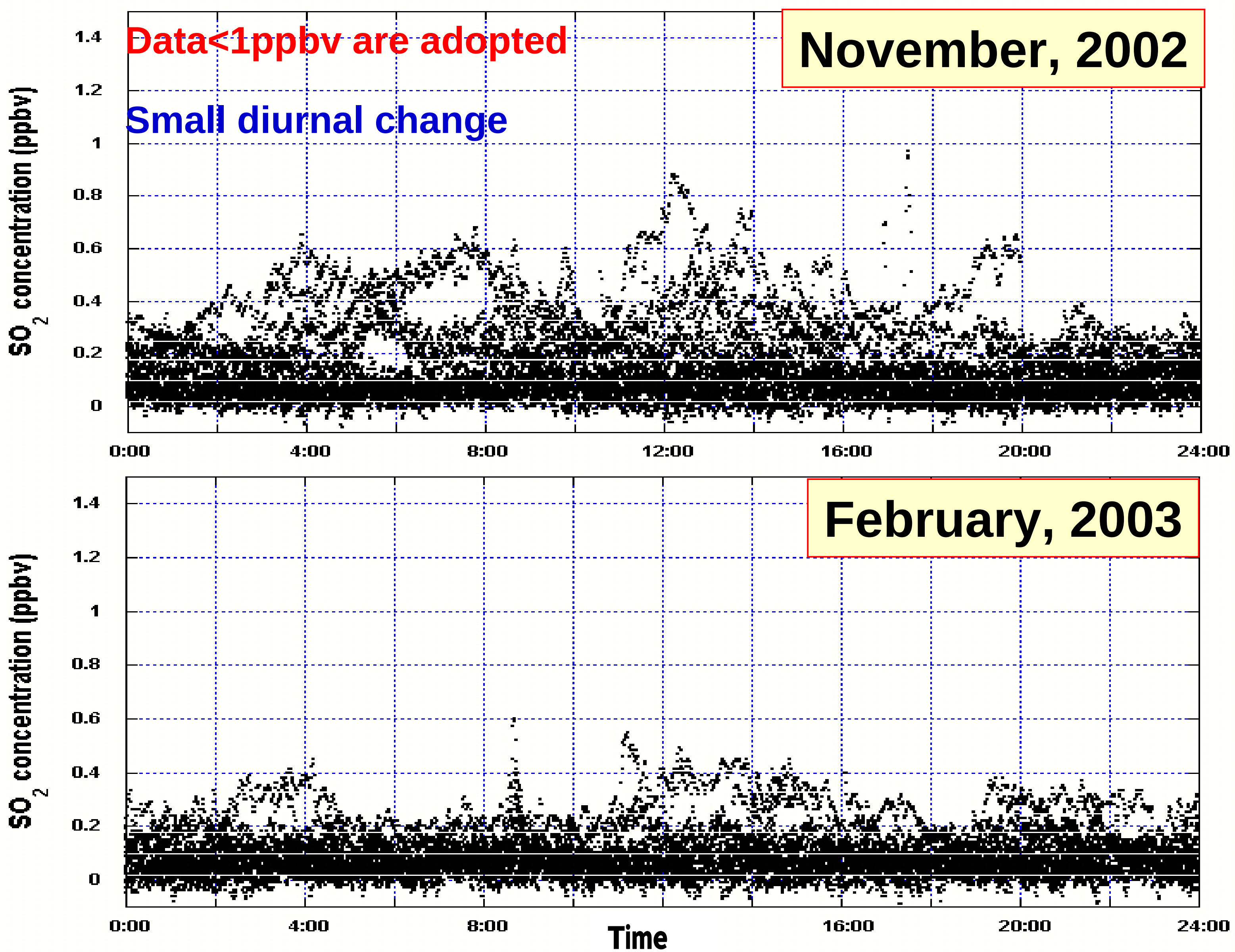
SO_2 concentrations observed at the summit of Mt. Fuji

Max. 20 ppbv

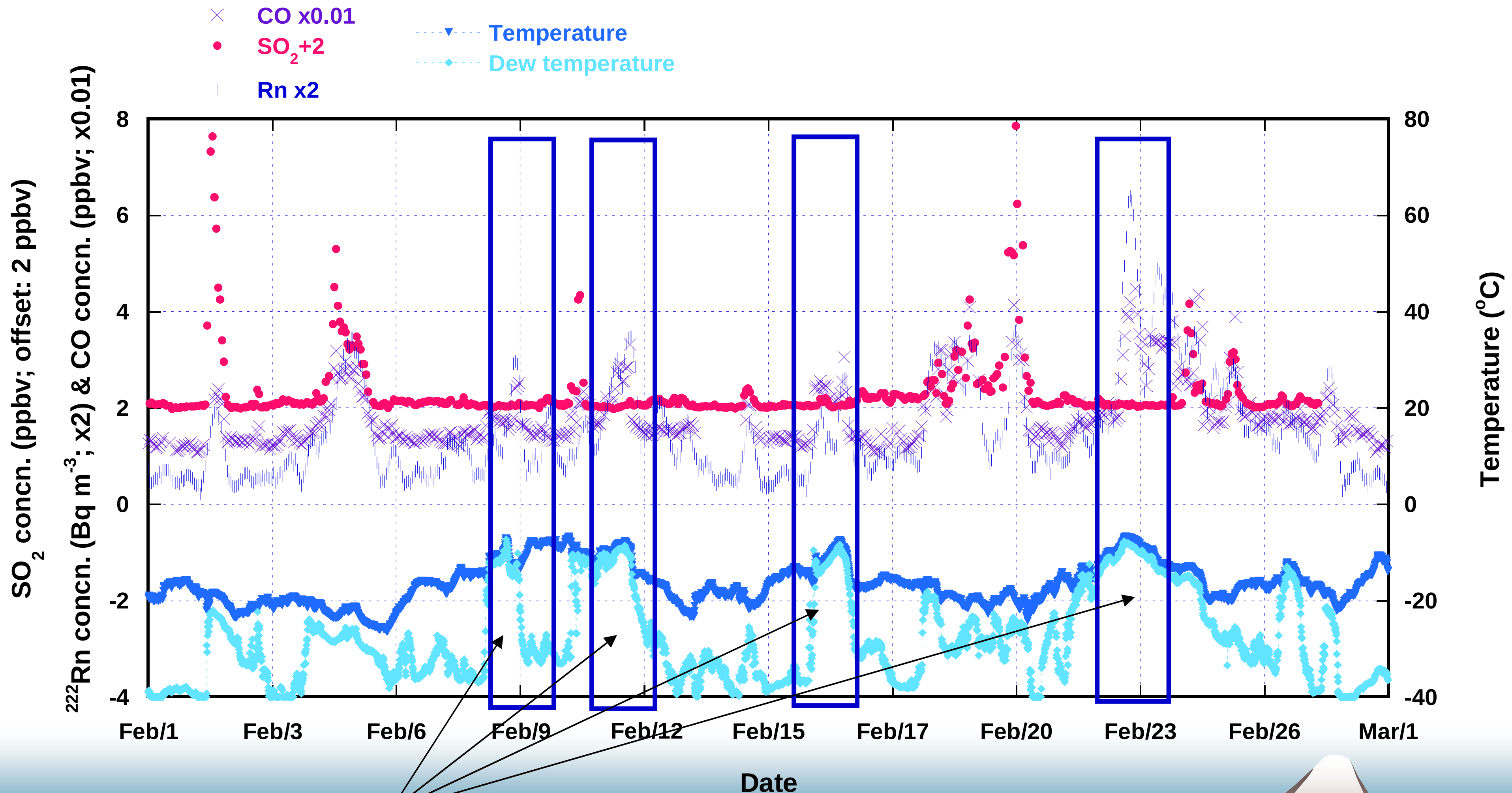


SO_2 concentrations observed at the summit of Mt. Fuji

Diurnal change of SO2 concentration



Concentration peaks of CO and Rn without SO_2 peaks (Y. Igarashi)



High Humidity

Scavenged in Liquid/Solid phase?

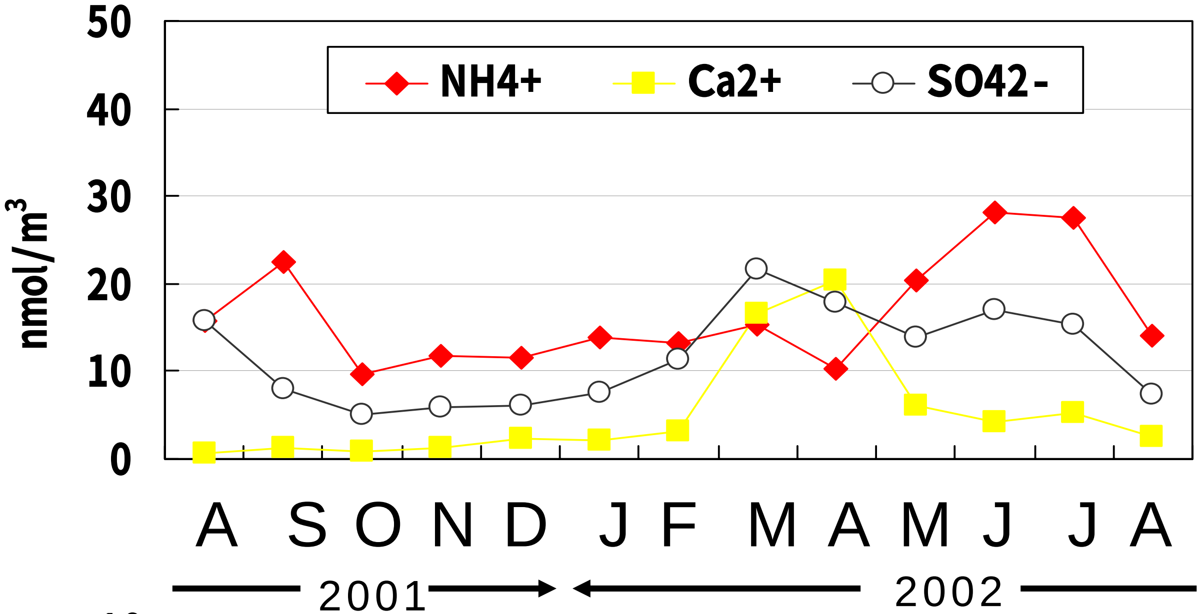
Summary for SO_2 (Y. Igarashi)

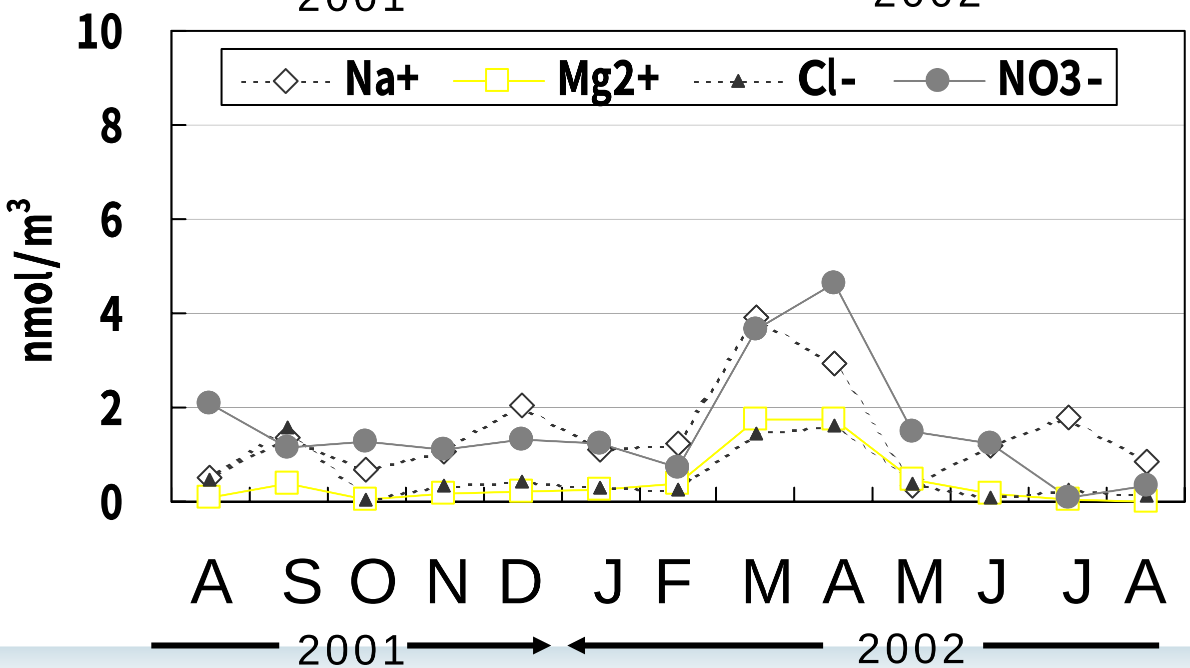
- SO_2 is very low at the summit of Mt. Fuji.
- Dirunal change is very small.
- Winter high concentration event is observed in the Continental air mass.
- The effect of volcano may be negligible.
- Most SO_2 peaks coincided with CO and Rn peaks.
- CO and Rn peaks without SO_2 peaks occurs when the humidity is high.

Recent issues found at the summit of Mt. Fuji

(3) Nitrate transportation with Kosa particles

Soluble Chemical Species in Aerosol *(I. Suzuki)*





High in Spring

$\boxed{Ca^{2+}}$, Na^{+}, Mg^{2+}, Cl^{-}, $\boxed{NO_3^{-}}$

High from Spring to Summer

$\boxed{SO_4^{2-}}$

High in Summer

$\boxed{NH_4^{+}}$

Tentative conclusions from recent research

* Mt. Fuji has potential importance as *a platform for chemical observation of free troposphere*.
* Mt. Fuji can offer *continuous observation* data, which cannot be obtained by airplane observations.
* *More fruitful outcomes can be expected from observation in the future,*

if continued

(3) But

Mt. Fuji Weather Station is now closing after this summer !

At best, automatic operation may be continued

Because chemists need SAMPLES, manual operations are *really* desirable.

In the world

High mountain observations have been performed

- Mauna Loa, USA,
- Jungfraujoch, Switzerland,
- Mt. Waliguan, China,
- Mt.Sonnblick, Austria, etc.

Japan is far behind in this field.

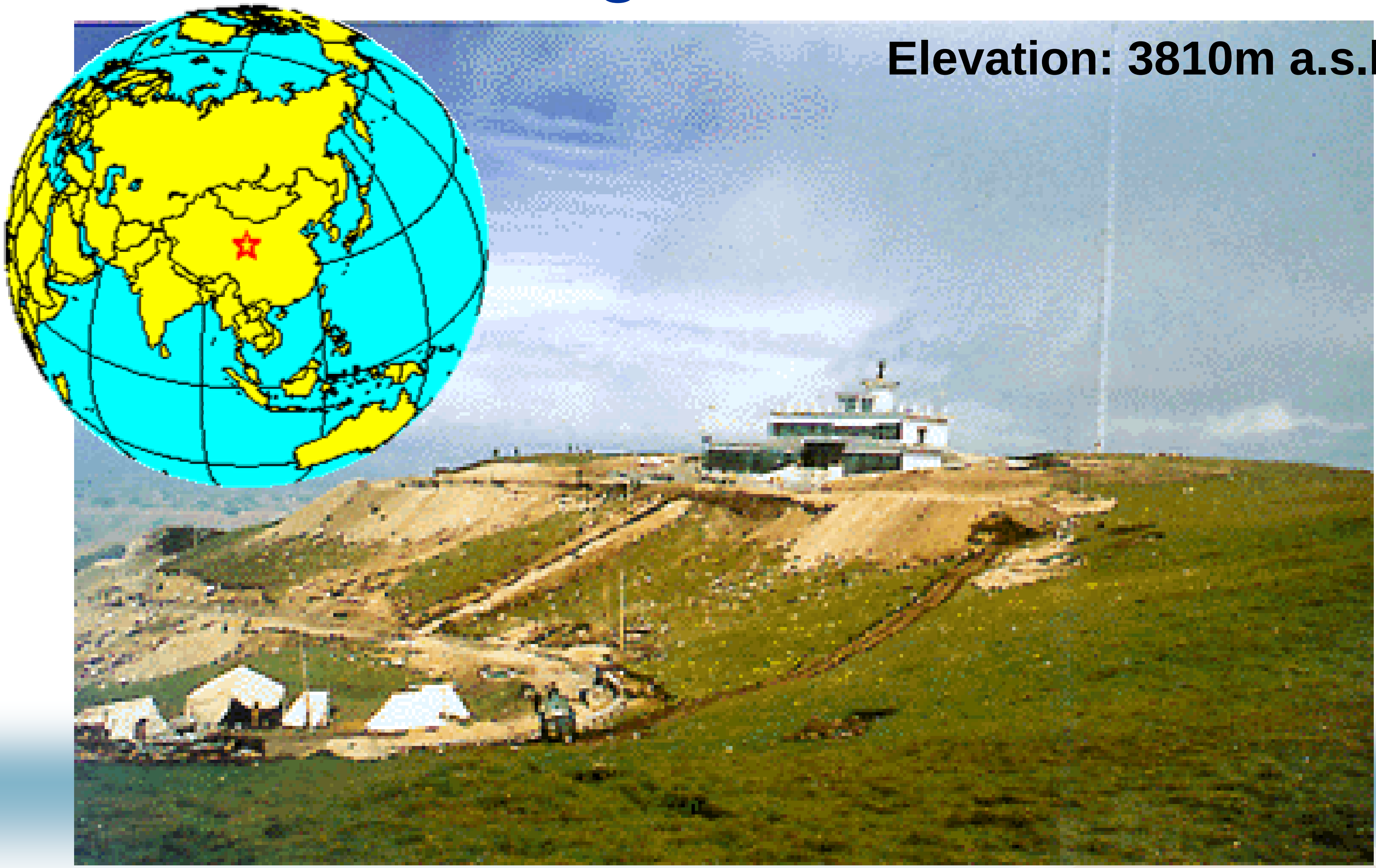
Mauna Loa, Hawaii

Elevation: 3397m a.s.l.

http://www.mlo.noaa.gov/


Gletscher-Restaurants
Jungfraujoch–Top of Europe
Elevation: 3578m a.s.l.
JUNGFRAUBAHNEN

Mt.Waliguan, China



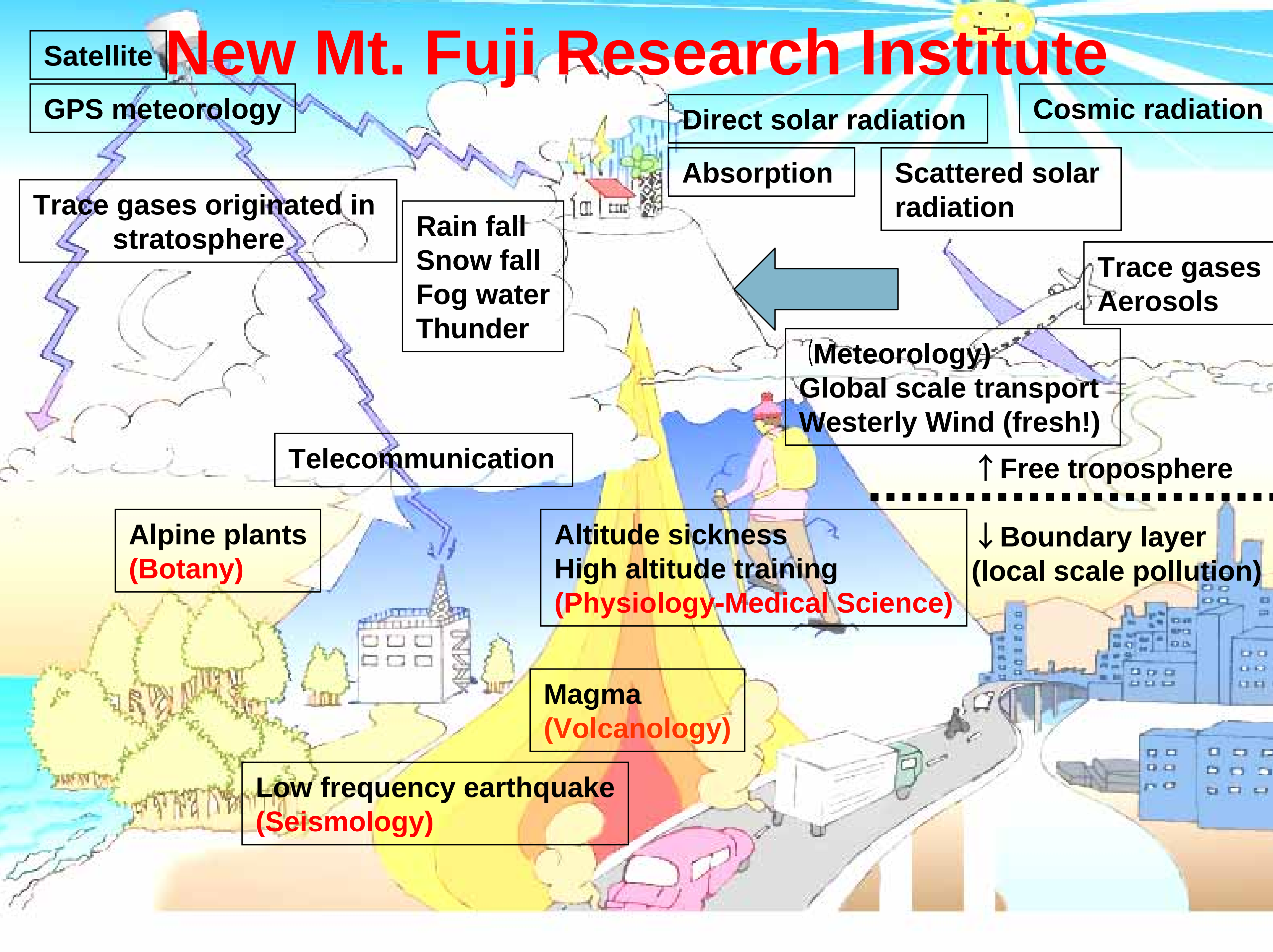
Therefore

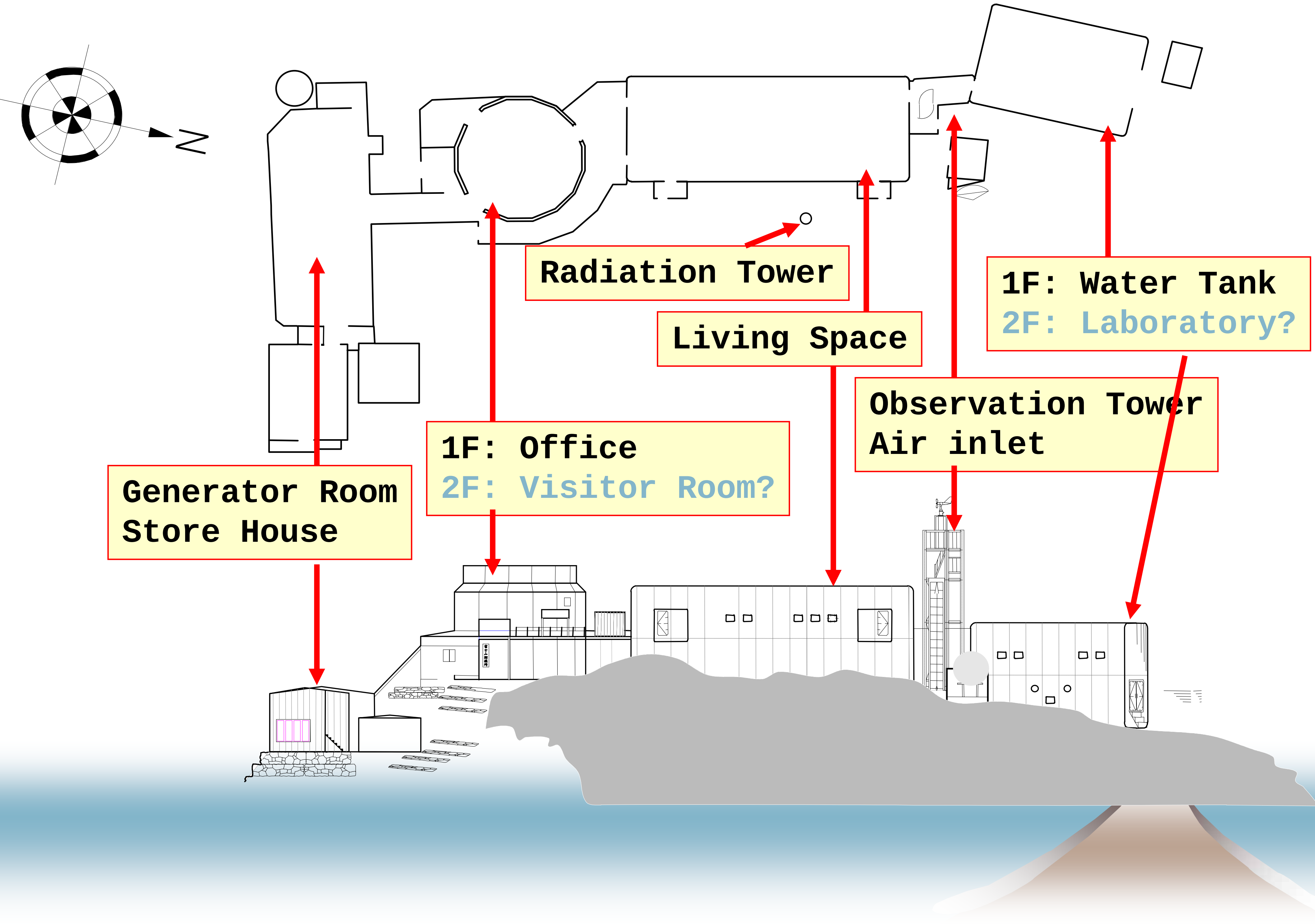
An Atmospheric Science Institute must be established

at the summit of Mt. Fuji

which is *open for all researchers*

which is *open internationally*


New Mt. Fuji Research Institute
Satellite
GPS meteorology
Direct solar radiation
Cosmic radiation
Absorption
Scattered solar radiation
Trace gases originated in stratosphere
Rain fall
Snow fall
Fog water
Thunder
Trace gases
Aerosols
(Meteorology)
Global scale transport
Westerly Wind (fresh!)
Telecommunication
↑Free troposphere
↓Boundary layer
(local scale pollution)
Alpine plants
(Botany)
Altitude sickness
High altitude training
(Physiology-Medical Science)
Magma
(Volcanology)
Low frequency earthquake
(Seismology)


N
Radiation Tower
Living Space
1F: Water Tank
2F: Laboratory?
Observation Tower
Air inlet
1F: Office
2F: Visitor Room?
Generator Room
Store House

Present cost for maintenance and operation

- Maintenance only:

  ～$ 400,000/year

- With personnel expenses:

  ～$1,500,000/year

Expensive? Reasonable?

However

- No concrete plan exists at present

neither public nor private

Thus

We ask for Support

Domestic

and also

International

Thank you!