SO_2 observation at the summit of Mt. Fuji

Yasuhito Igarashi[1], Yosuke Sawa[1], Katsuhiro Yoshioka[2], Hiroshi Takahashi[3], Hidekazu Matsueda[1], Yukiko Dokiya[4]

[1]Geochemical Research Department, Meteorological Research Institute, Ibaraki, Japan
[2]Shimane Prefectural Institute of Public Health and Environment Science, Shimane, Japan
[3]Atmospheric Environment and Applied Meteorology Research Department, Meteorological Research Institute, Ibaraki, Japan
[4]Edogawa University, Chiba, Japan

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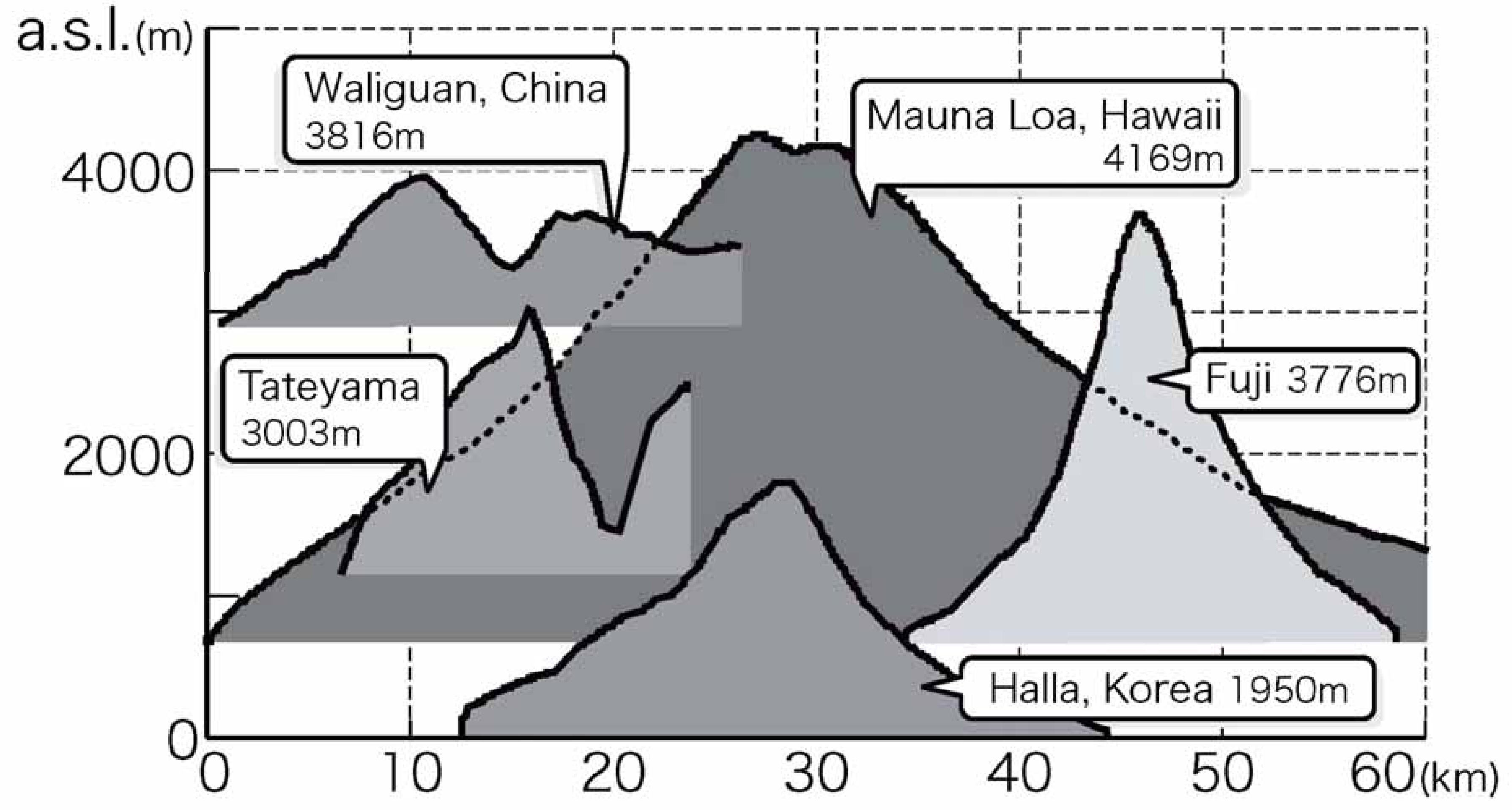
Igarashi et al., Atmos. Environ., 40 (2006) 7018–7033

Photo from
www2.ocn.ne.jp/~ynika57

Advantage of Mt. Fuji

Comparison with other mountain platform for atmospheric chemistry (EW cross section)

(Original drawing was depicted by Kashmir, a PC software)



Introduction

- **SO_2 is a precursor of sulfate which has impacts on the acidification and climate change.**
- **Concerned is the Asian outflow of the pollution over the Pacific region. e.g. aircraft observation such as ACE-Asia, PEM-West, TRACE-P, etc.**
- **Little SO_2 observation at mountain sites situated in the free tropospheric condition especially in the far East**
- **SO_2 observation using a UV fluorescence monitor was carried out during Sep. 2002 to Jul. 2004 at the summit of Mt. Fuji.**
- **Today's talk highlights high SO_2 episodes and its seasonal change.**

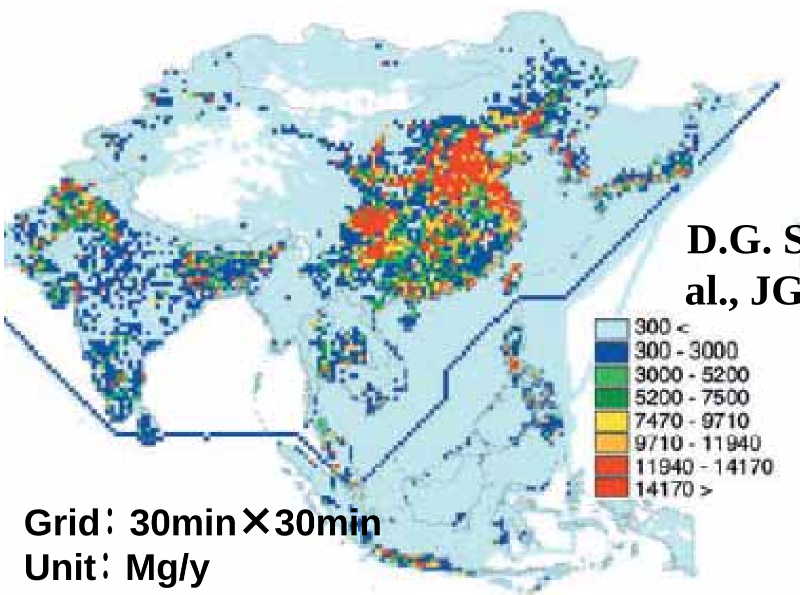
- **Global emission inventory of gaseous S**

  (average of 11 models referred in IPCC 2001)

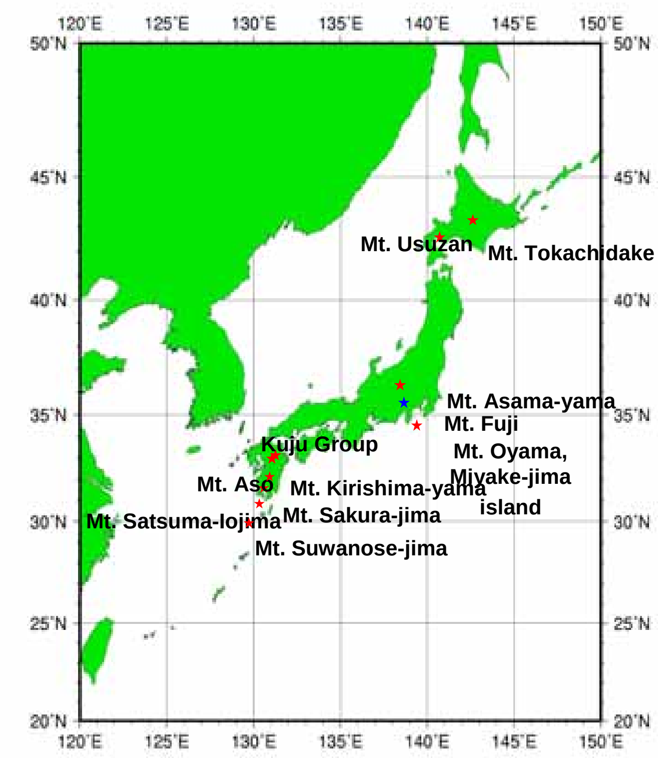
98.2±14.7 TgS/y

- **SO_2 emission inventory from Asia (2000)**

17.2 TgS/y

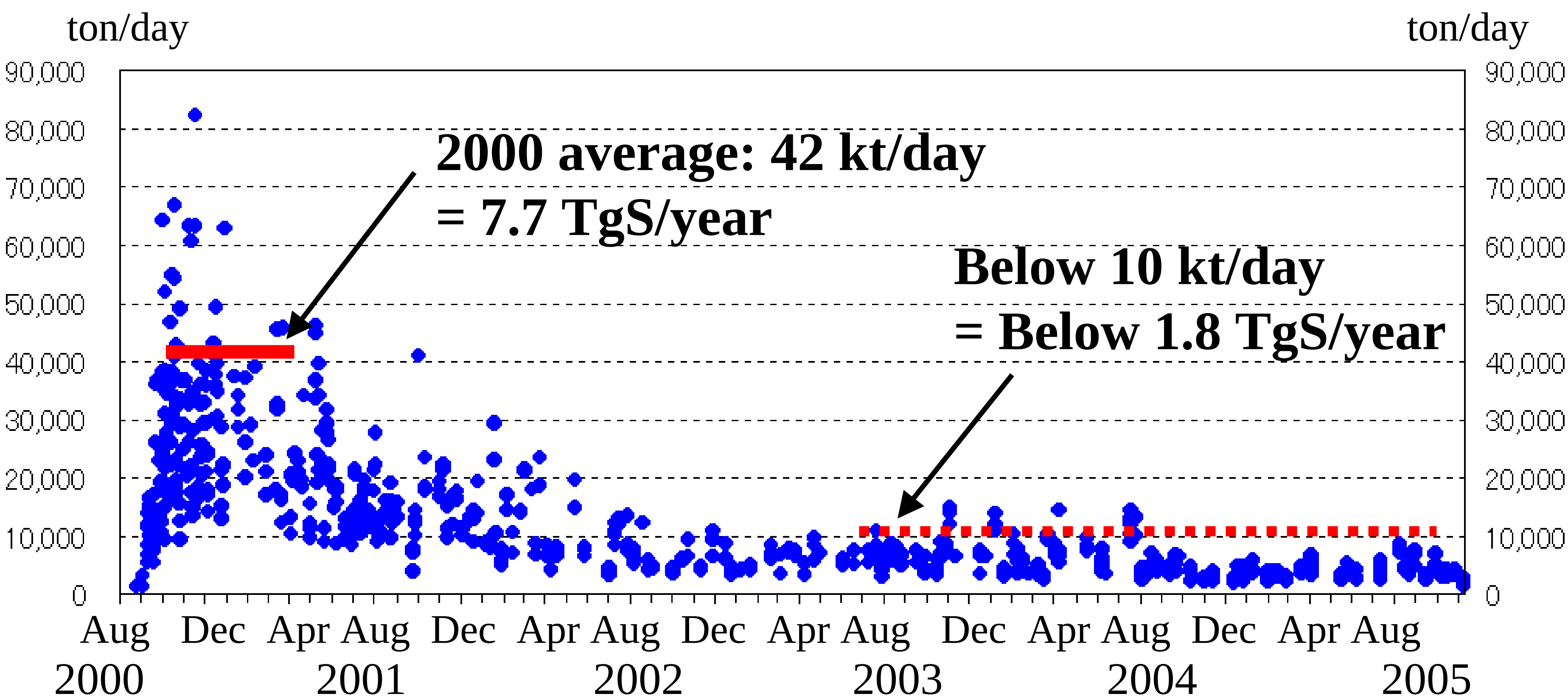


D.G. Streets et al., JGR, 2003.



- **SO_2 emission from active volcano (quiescent condition) in Japan : 0.55 TgS/y (Fujita et al., 1992)**
- **Anthropogenic emission in Japan : 0.4 TgS/y**

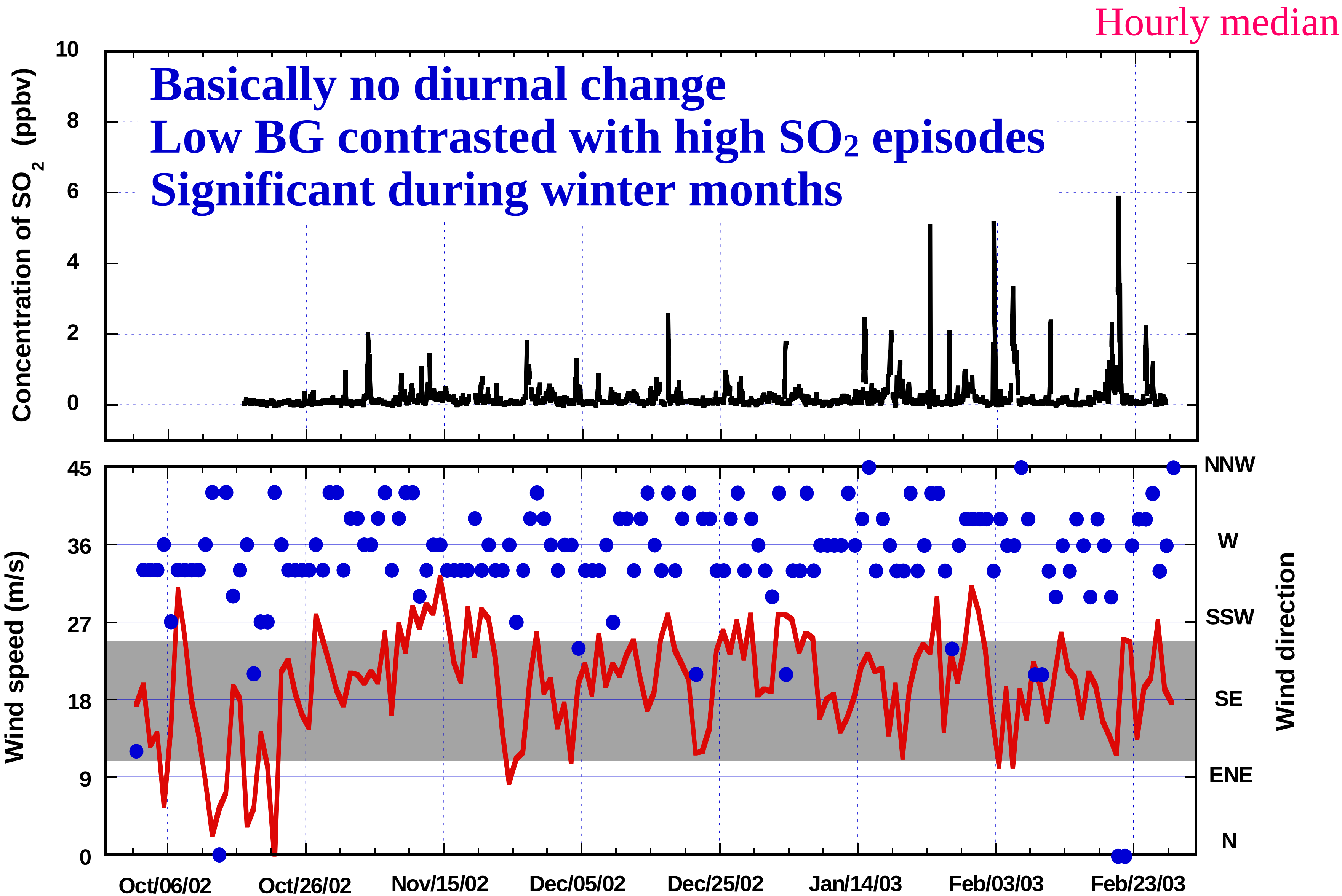
SO_2 emission from the Miyake-jima island



From JMA Reports on Volcanic Activity in Japan

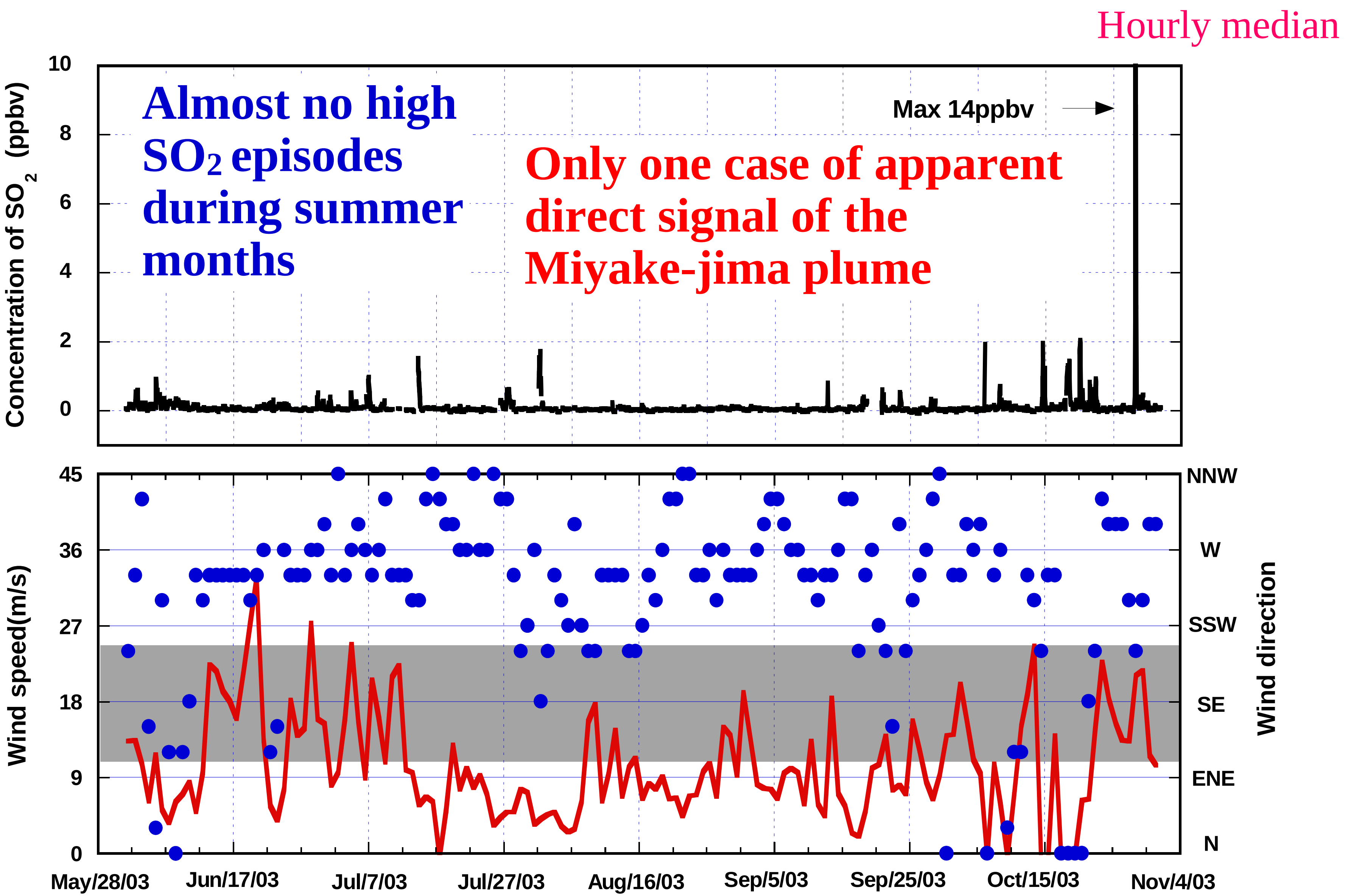
Temporal variation of SO_2 concentration during winter months (Oct. 2002 - Feb. 2003)

Y. Igarashi et al., J. Geophys. Res., 109, D17304,doi:10.1029/2003JD004428.



Temporal variation of SO_2 concentration during summer months (Jun. 2003 - Oct. 2003)

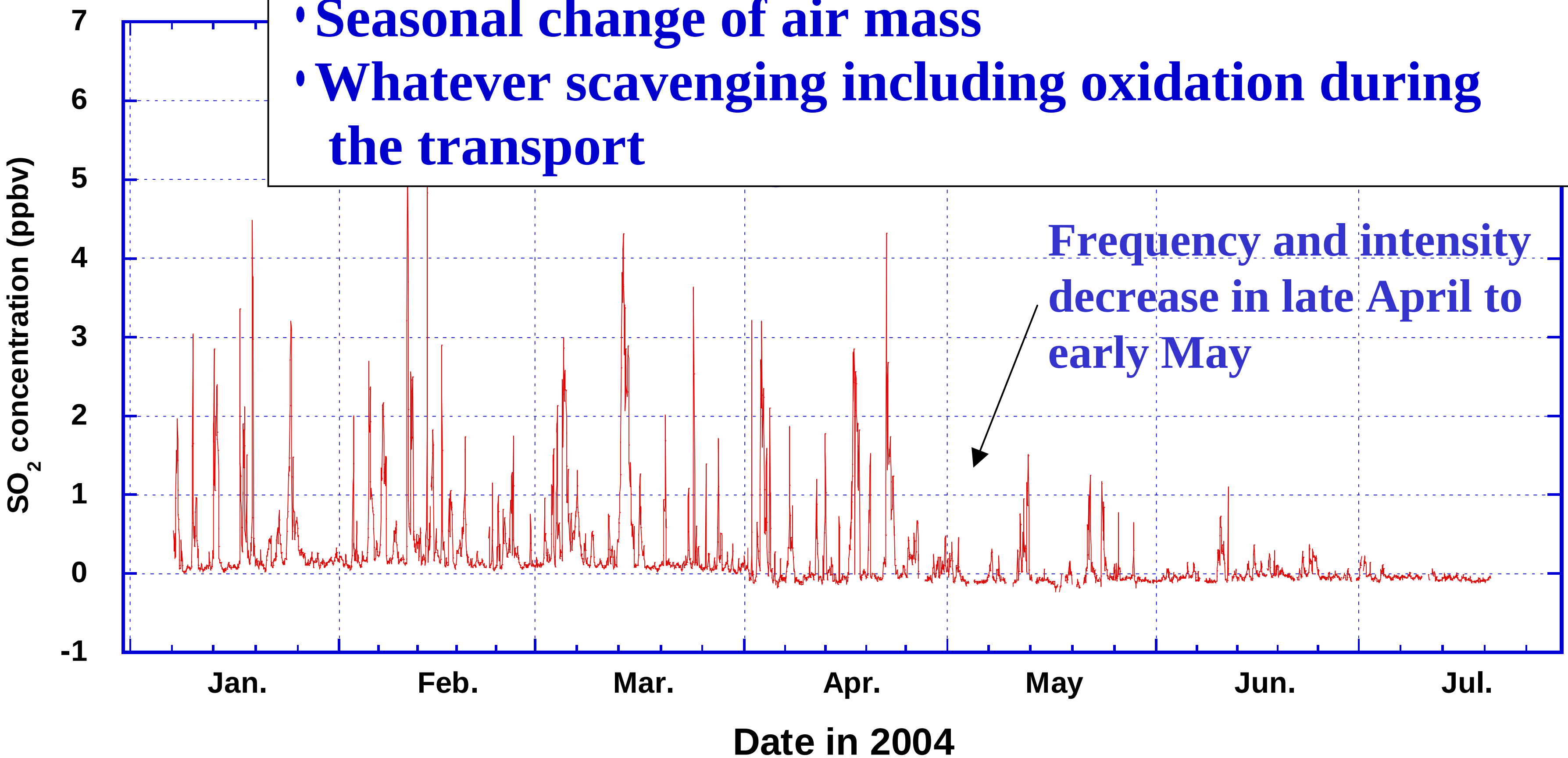
Y. Igarashi et al., J. Geophys. Res., 109, D17304,doi:10.1029/2003JD004428.



Temporal variation of SO_2 concentration during winter to summer: shift seasonal

What is the cause of the change?

- Seasonal change in source
- Seasonal change of air mass
- Whatever scavenging including oxidation during the transport

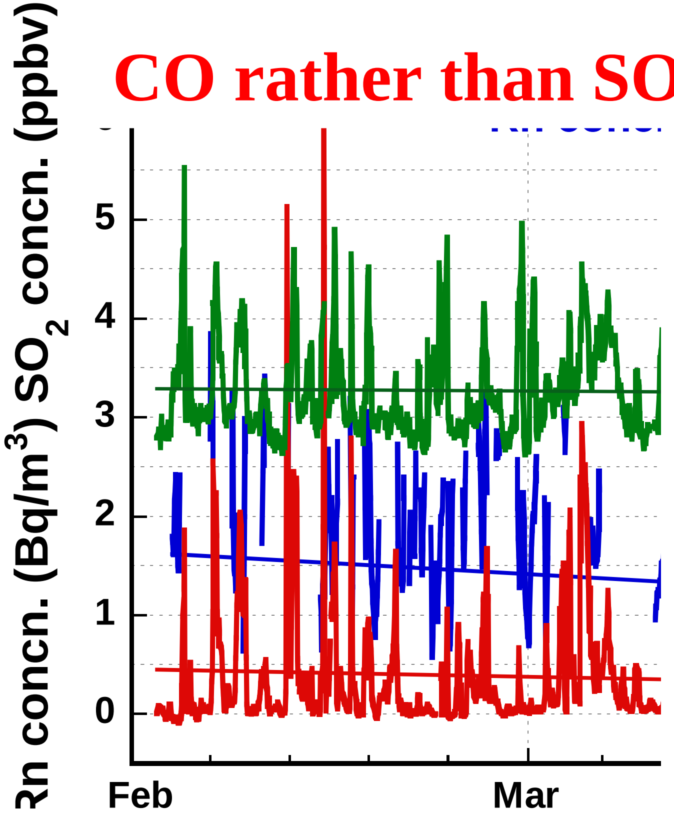


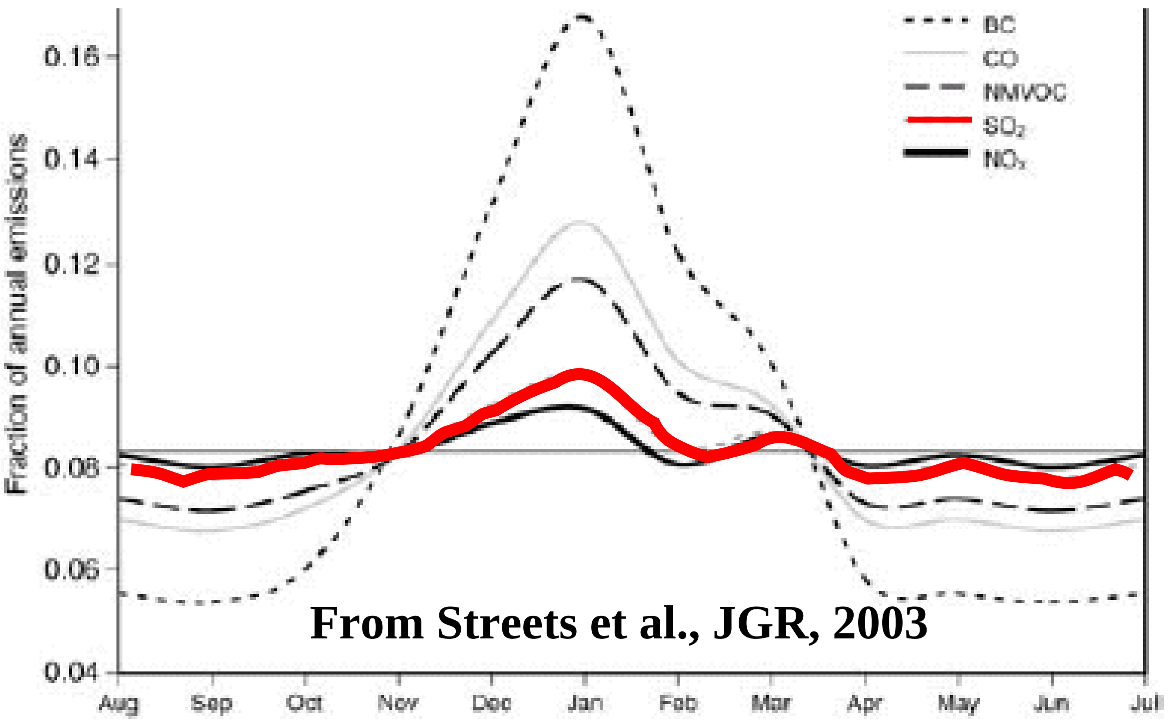
Comparison of temporal change in SO_2 concentration with those of ^{222}Rn and CO (Feb. 2004 – May 2004)

- Good correlations in general among these gases
- Concentration decrease in SO_2 and radon after spring
- Basically little change in CO
- Transport episode exists even in May

~~Seasonal change in SO_2 emission?~~

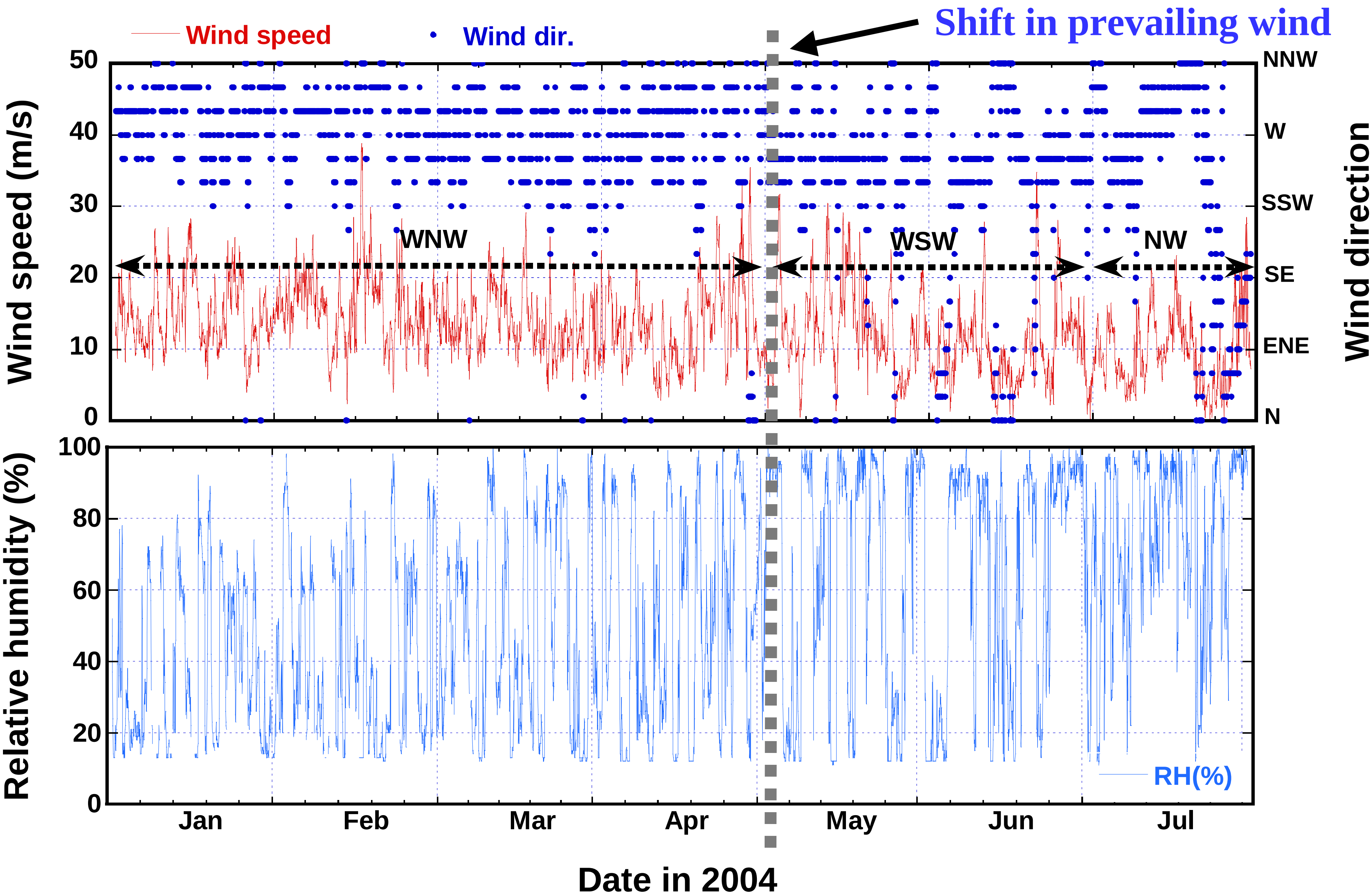
CO rather than SO_2 should have shown seasonal change.





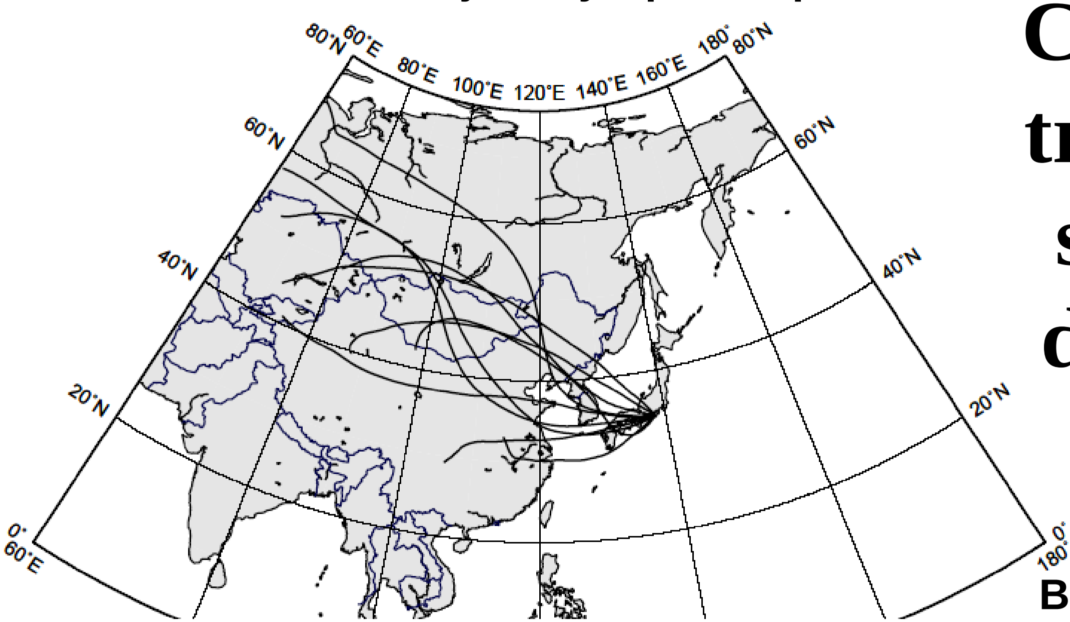
From Streets et al., JGR, 2003

Temporal variation in wind and RH on site (Jan. 2004 - Jul. 2004)



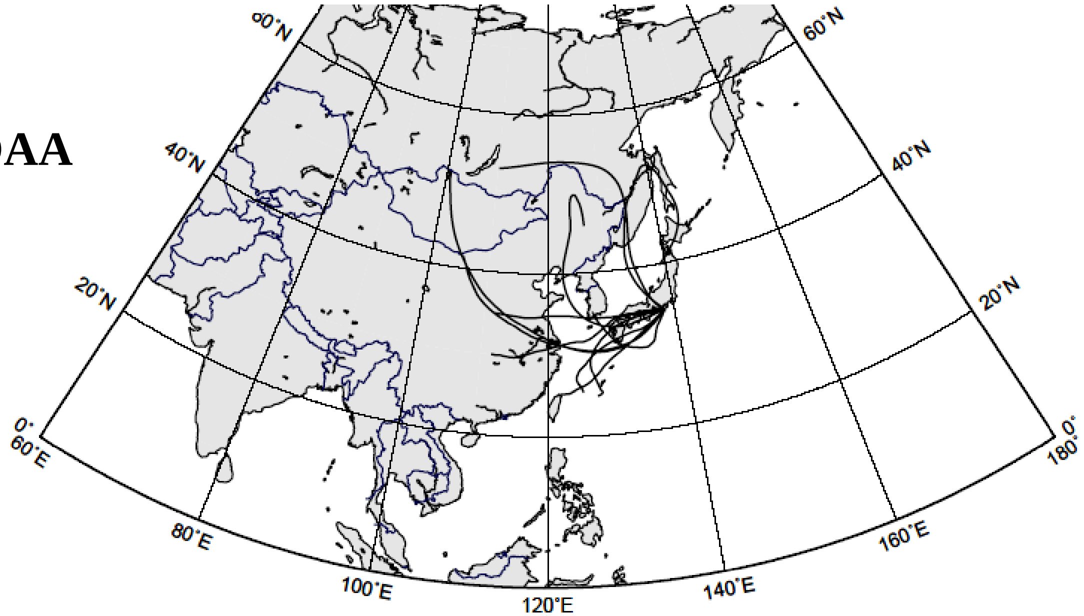
Change in backward trajectories from the summit of Mt. Fuji during Apr. 2004 to May 2004

Backward trajectory Apr/01-Apr/10



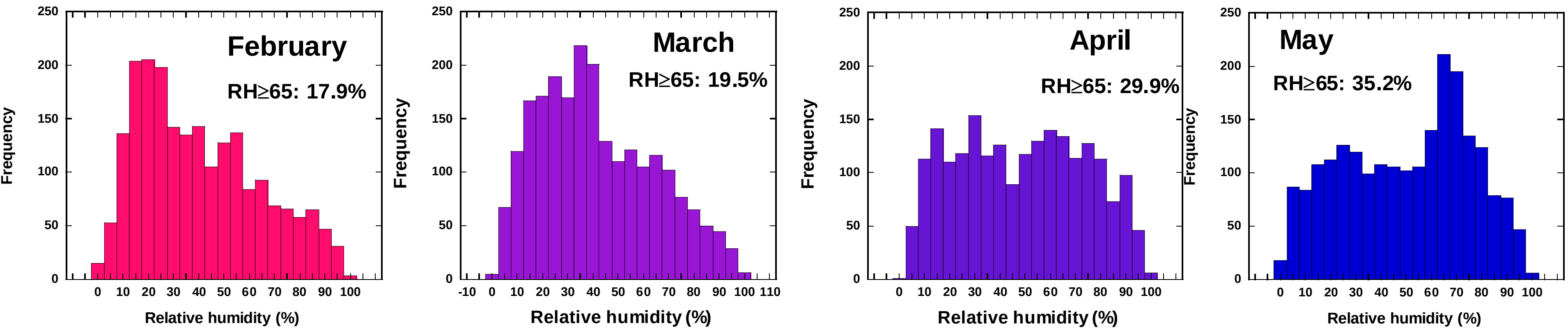
Backward trajectory May/21-May/31

Backward trajectories from the SW sector increased in May

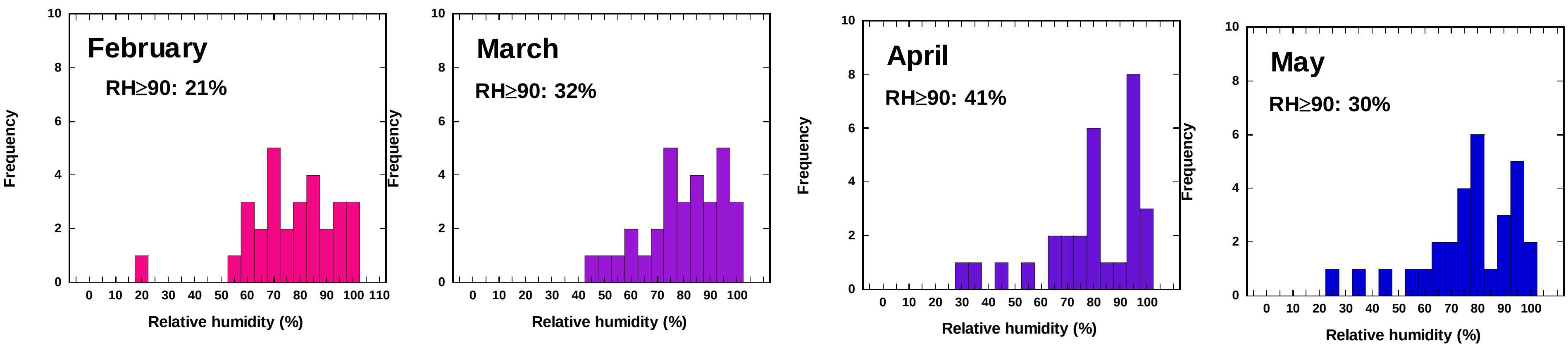


Calculated by HYSPLIT model, NOAA

Seasonal change of RH in the air mass reaching to the summit of Mt. Fuji

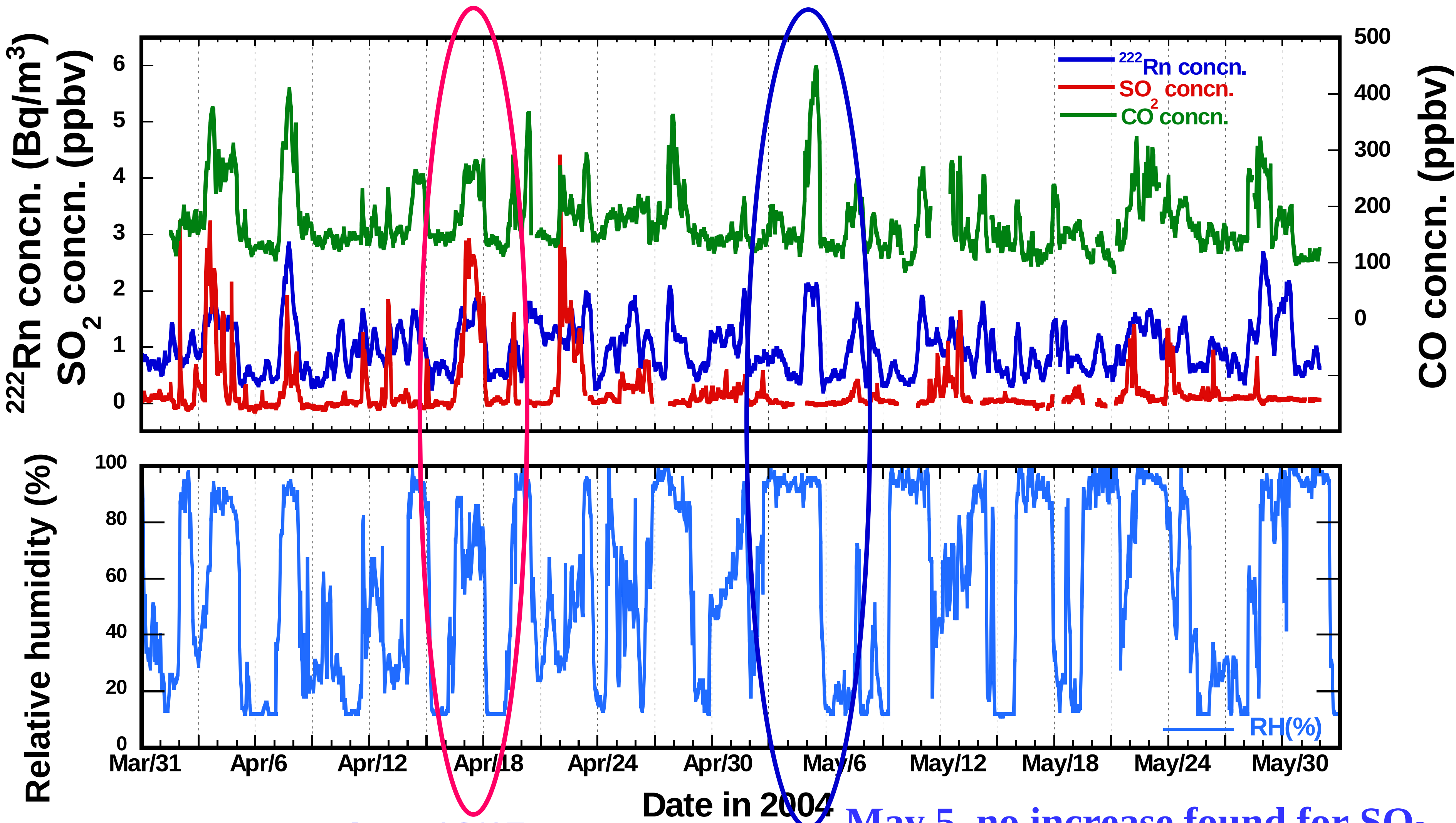


Seasonal change of maximal RH in the air mass reaching to the summit of Mt. Fuji



(2004)

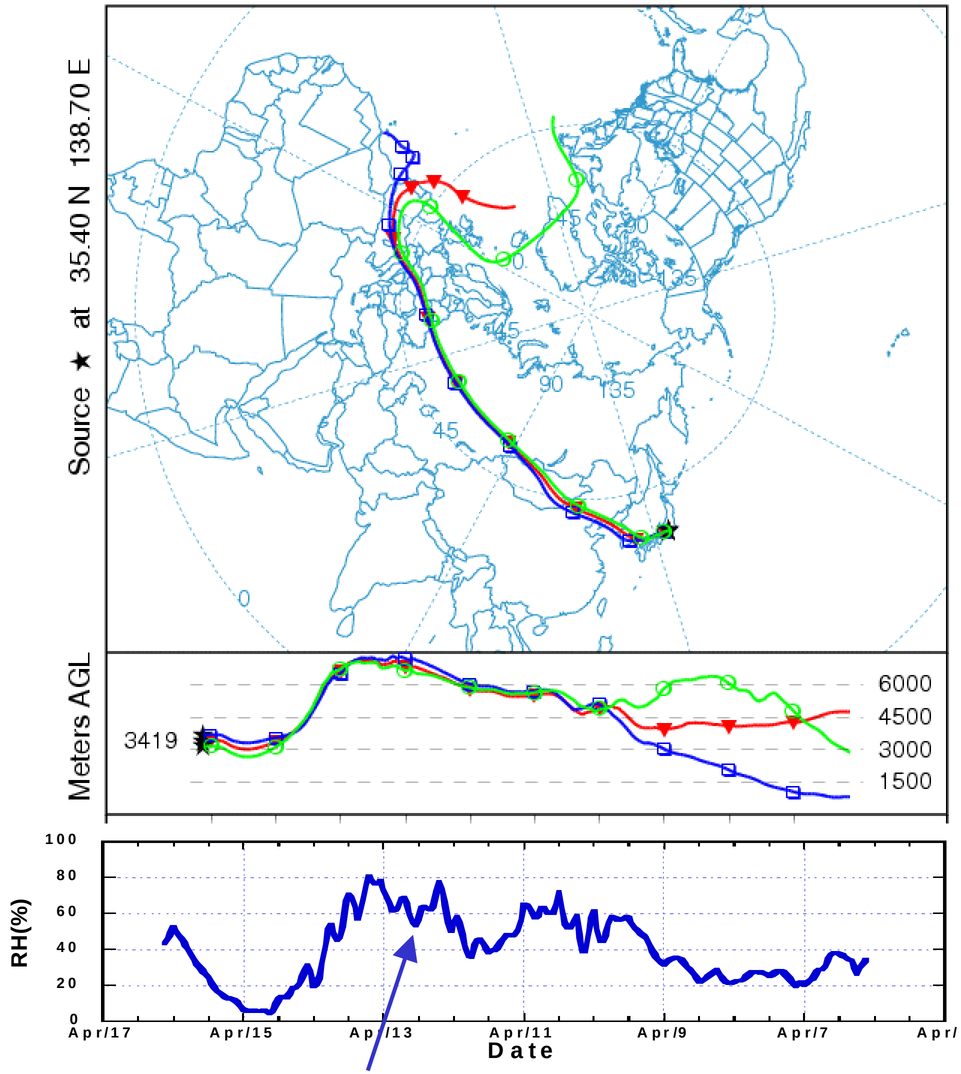
Case studies of transport episodes appeared in SO_2, CO and ^{222}Rn time series during Apr. 2004 to May 2004

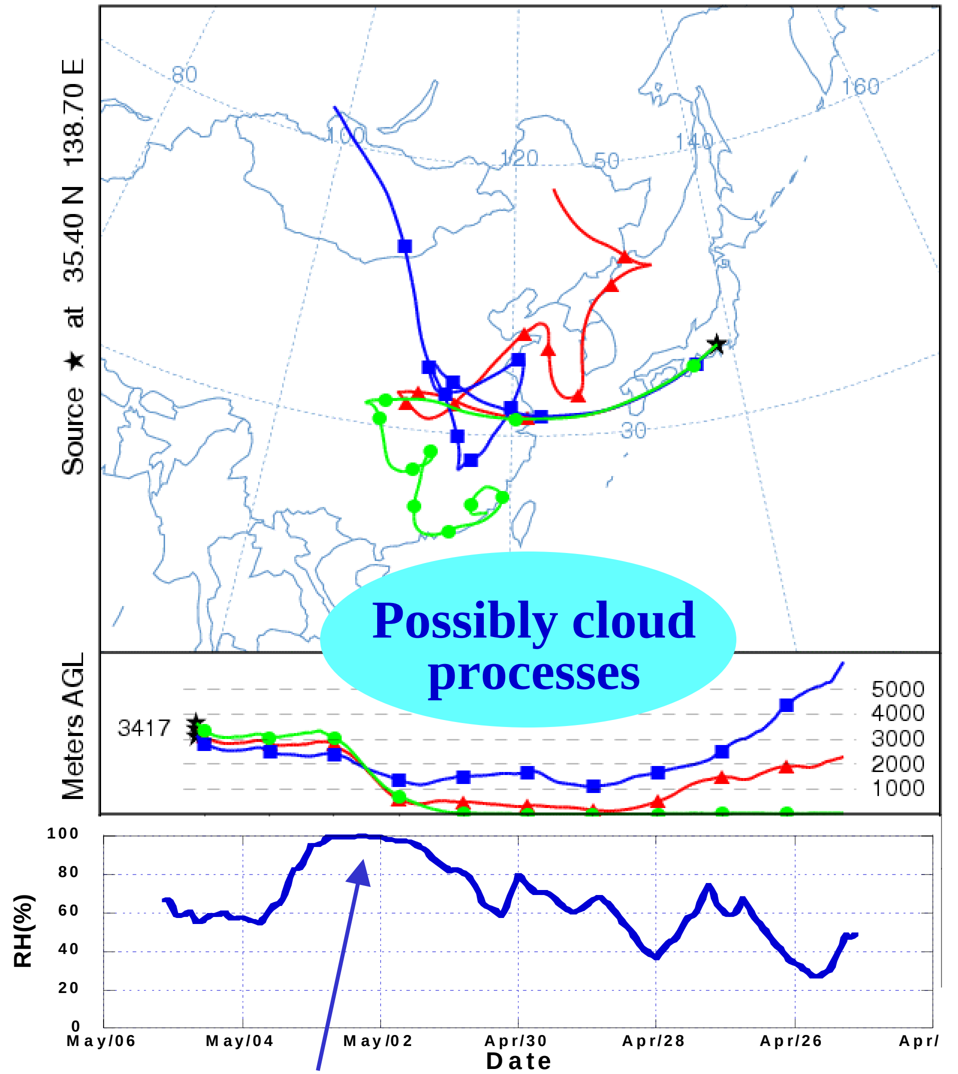


Apr. 16/17
SO_2 CO and ^{222}Rn increased together

May 5, no increase found for SO_2 while ^{222}Rn and CO increased

Comparison of two episodes by the backward trajectory analysis





RH was at the moderate level.

RH was high.

Summary and Future tasks

- SO_2 climatology was revealed at first time.
- The high SO_2 concentration episode in winter was noteworthy and quite sporadic.
- $SO_2$was transported coincidently with CO and ^{222}Rn, confirming Asian continental pollution transport.
- Backward trajectory analysis also indicated the continental origin of such episodes.
- The SO_2 episode reduced its frequency and intensity around April to early May. Most likely causes are air mass change and related change of RH (encounter possibility with clouds)
- Impacts of the Miyake-jima SO_2 were in general small as the plume height was not so elevated as entering into the free troposphere since late of 2002.
- SO_2 undergoes into sulfate. What is the fate of sulfate during the transport? Is there seasonal change? Simultaneous measurements of SO_2 and sulfate with similar time resolution should be done in the future.