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Globalization of Atmospheric Environmental Issues and Local Air Pollution

大気環境問題のグローバル化とローカルな取り組み課題

Hajime Akimoto
Frontier Research Center for Global Change
Japan Agency For Marine Earth Science and Technology
秋元　肇
独立行政法人　海洋研究開発機構　地球環境フロンティア研究センター

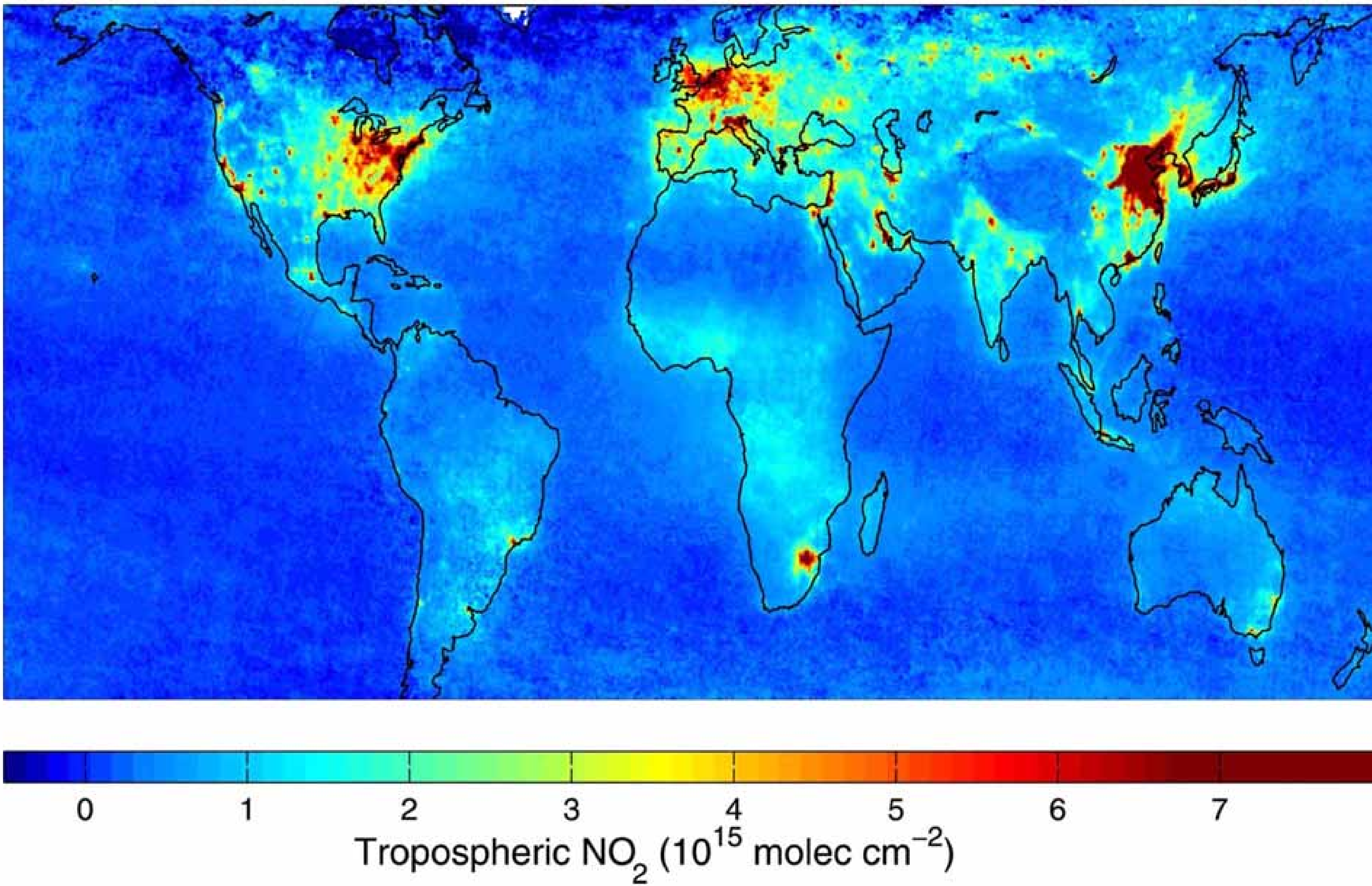
Globalization of Atmospheric Environment Issues

"Global Air Pollution"

- Global-scale Air Pollution Observed by Satellite Sensors
- Global Warming Impact of Air Pollution
- Hemispheric Transport of Air Pollution

Average Tropospheric NO_2 Column Observed by SCIAMACHY

(May, 2004—April, 2005) (Martin et al. JGR, 2006)

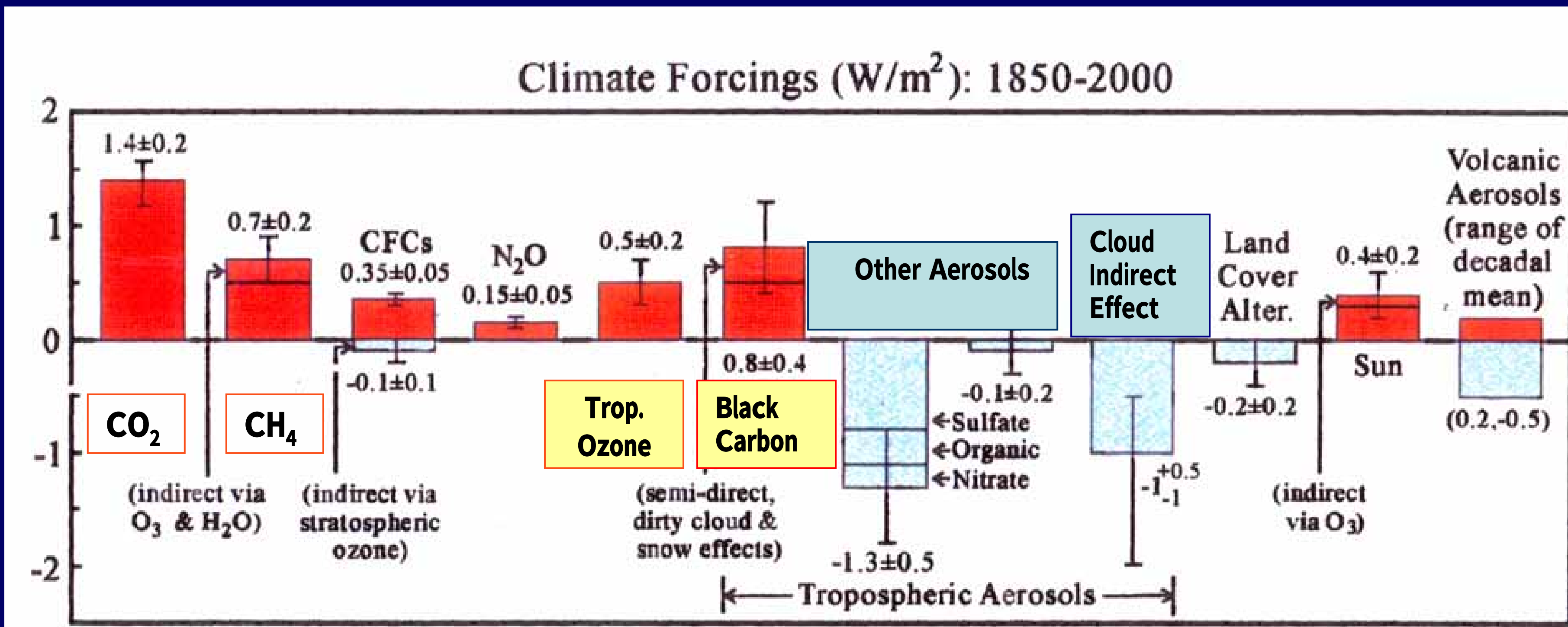


Global Warming Impact of Air pollution

Localization of Global Warming
and
Globalization of Air Pollution

What Causes Global Warming ?

Radiative Forcing due to Atmospheric Composition Change during 1850-2000



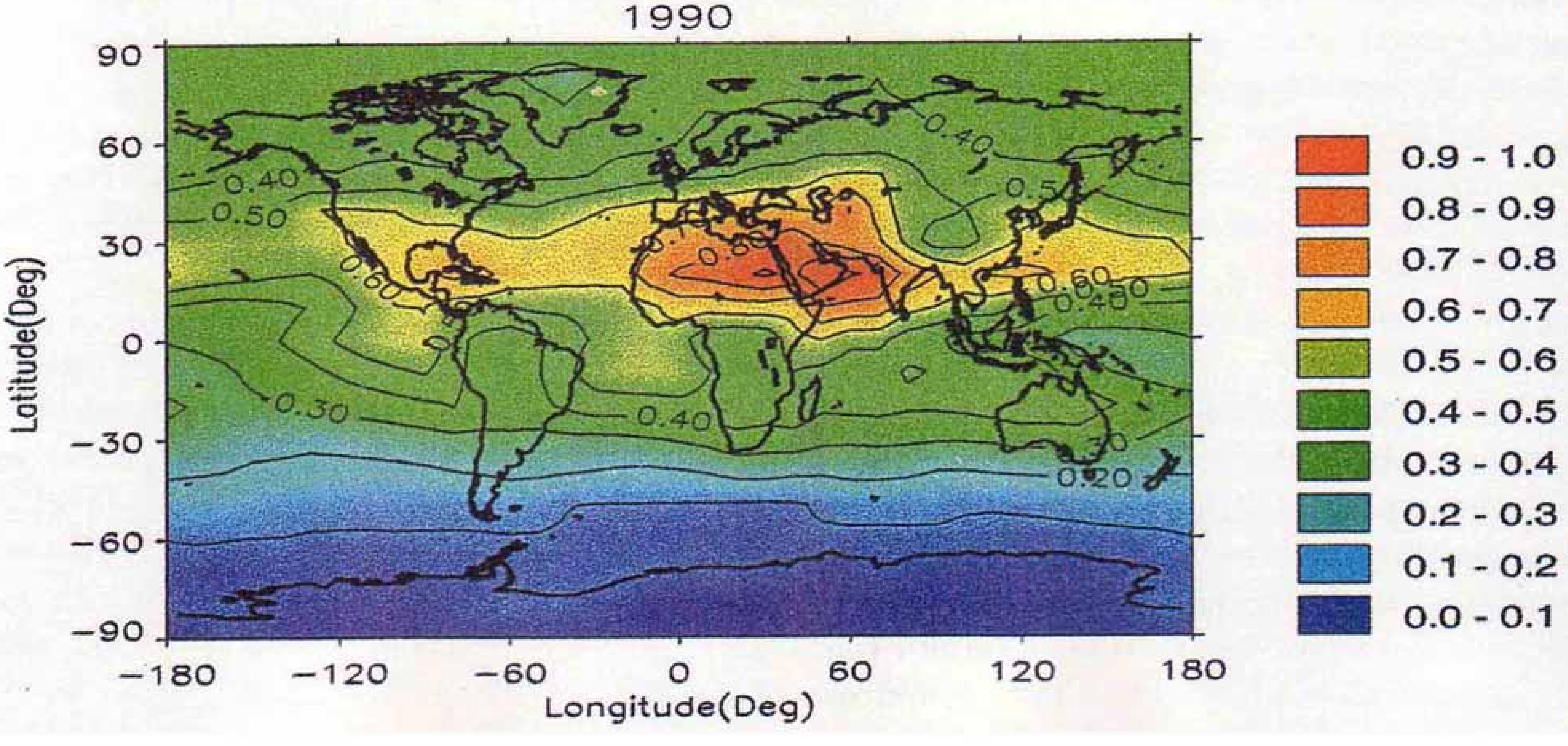
Long-lived Greenhouse Gases (GHG)

Short-lived Global Air Pollutants (GAP)

Natural Change

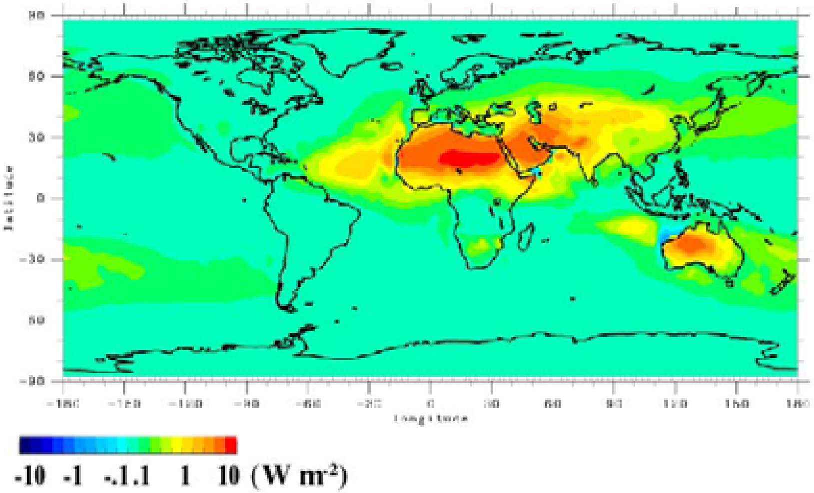
J. Hansen and M. Sato, Proc. Nat'l. Acad. Sci., 98, 14778-14783, 2001.

Regional Characteristics of Radiative Forcing of Tropospheric Ozone

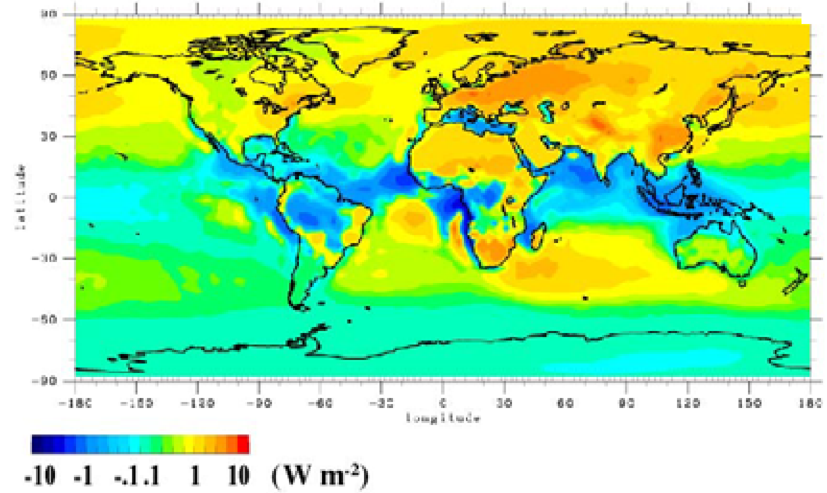


Regional Characteristics of Radiative Forcing by Aerosols

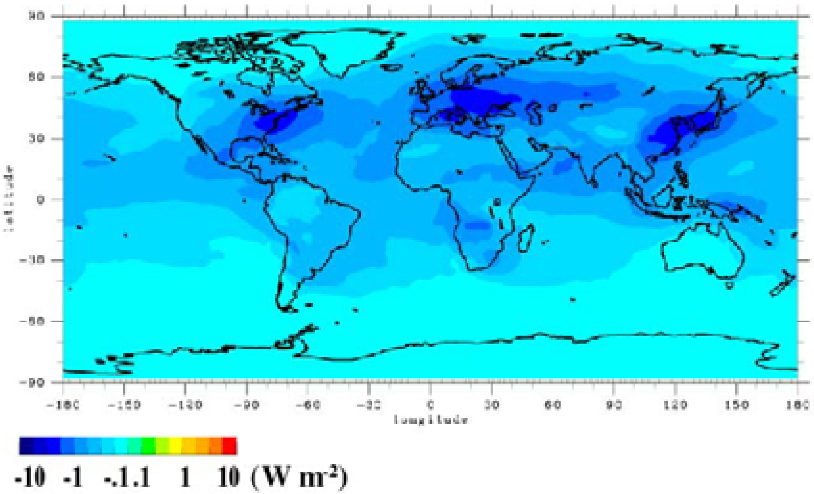
Soil dust (Avr. +0.413 W m^{-2}) **+0.36**



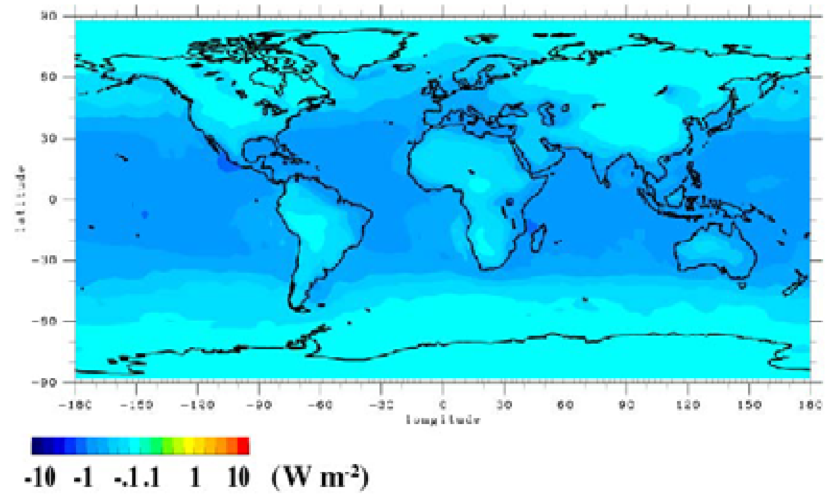
Carbonaceous (BC + OC) (Avr. +0.471 W m^{-2} **+0.12**



Sulfate (Avr. -0.362 W m^{-2}) **-0.32**

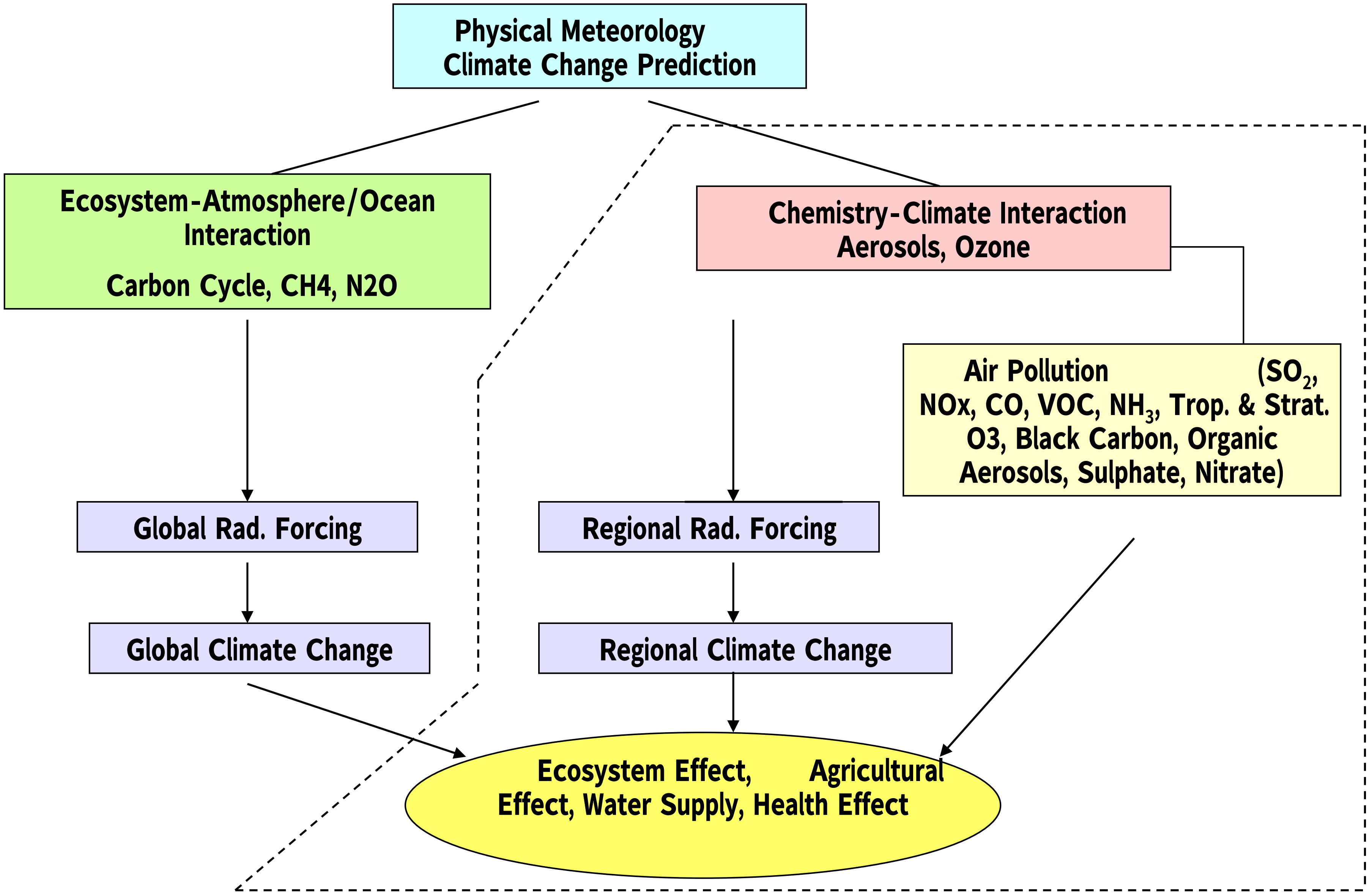


Sea-salt (Avr. -0.372 W m^{-2}) **-0.31**



Takemura et al. (JC2001, p333)

New Framework of Global Warming and Atmospheric Environment Research



Connection of Air Pollution Control and Global Warming Measures Particularly for Developing Countries

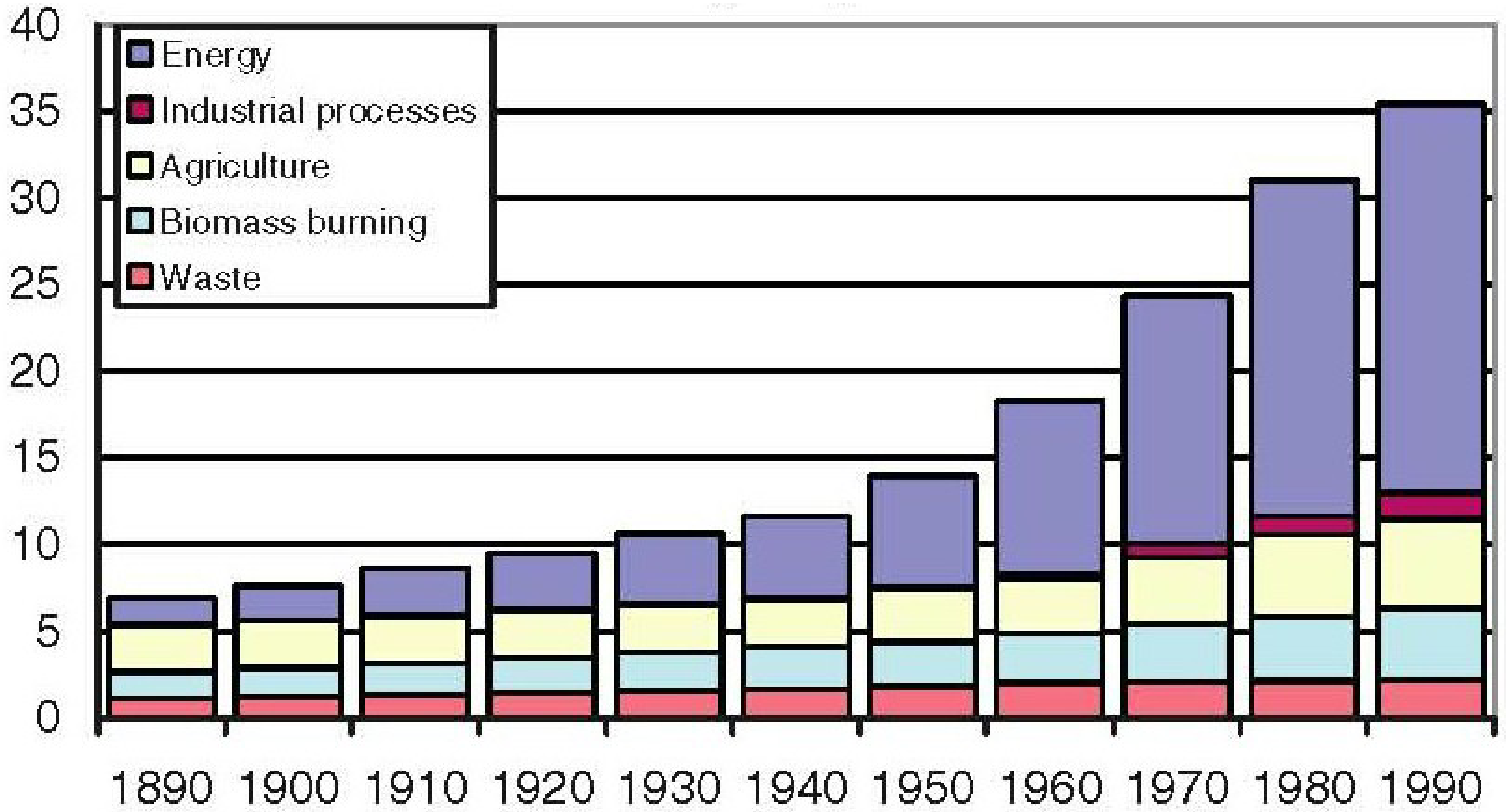
Co-Control, Co-Benefit Policy

Hemispherical Transport of Air Pollution

Coupling of Hemispherical, Regional and Local Air Pollution

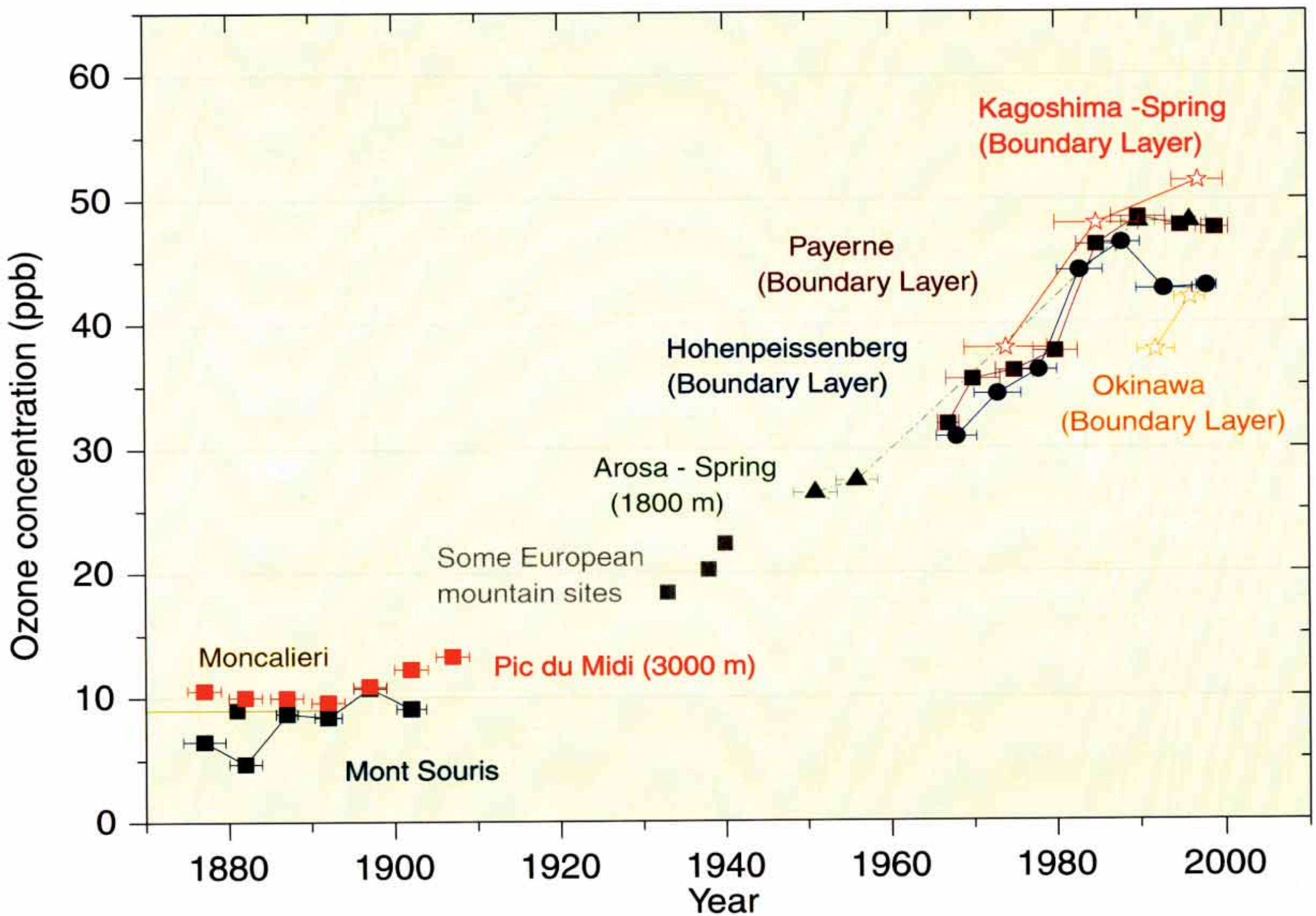
Task Force for Hemispherical Transport of Air Pollution / Convention of Long-Range Transport of Air Pollution

Global Historical Emission Trend of NOx (TgN/yr)



van Aadenne et al., Global Biogeochem. Cycles, 15, 909, 2001

Boundary layer Ozone Trend From the End of 19th Century

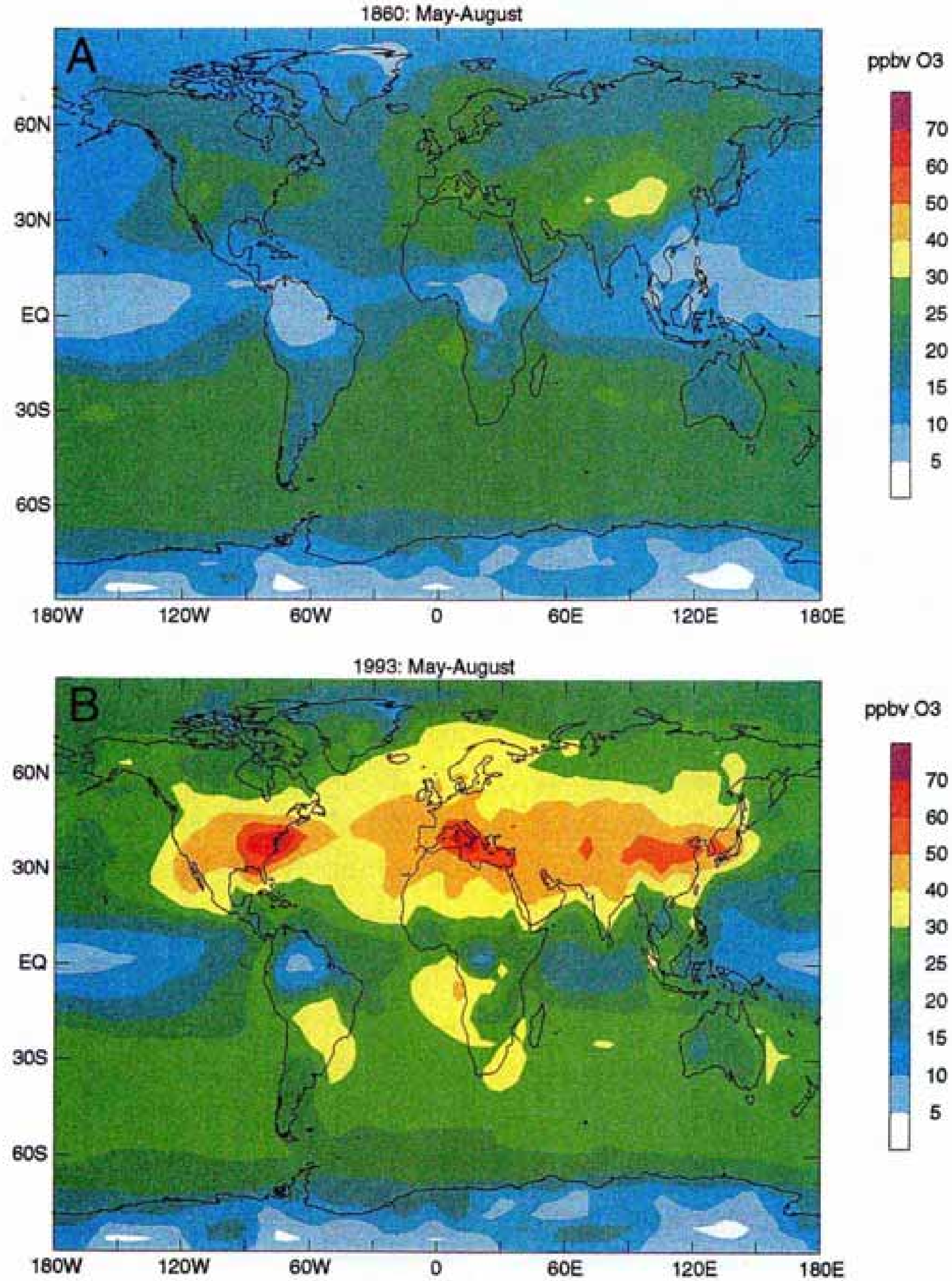


Near Surface Distriution of Ozone

- Model Simulation -

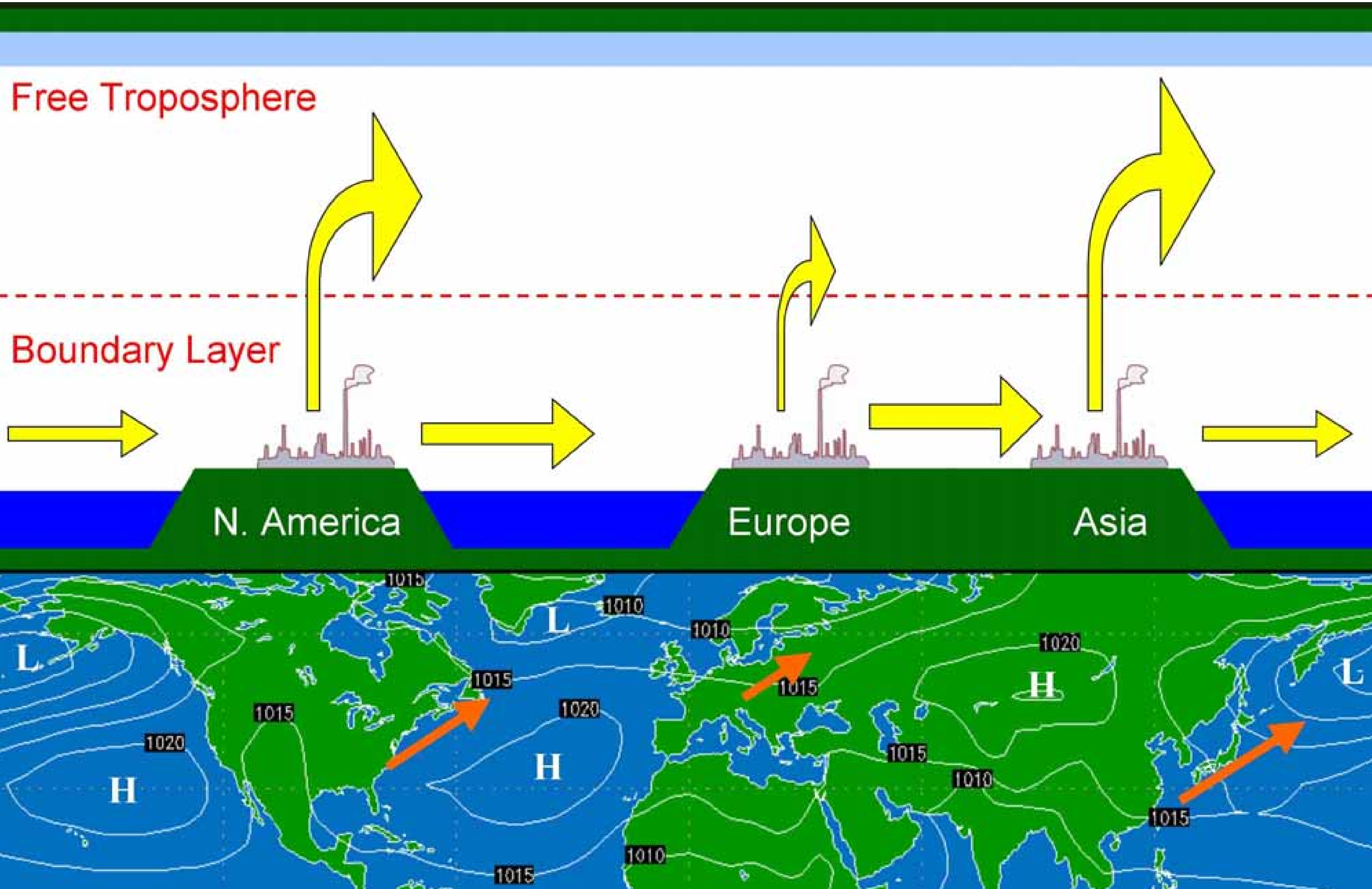
1850

1993



Lelieveld, JGR (2000)

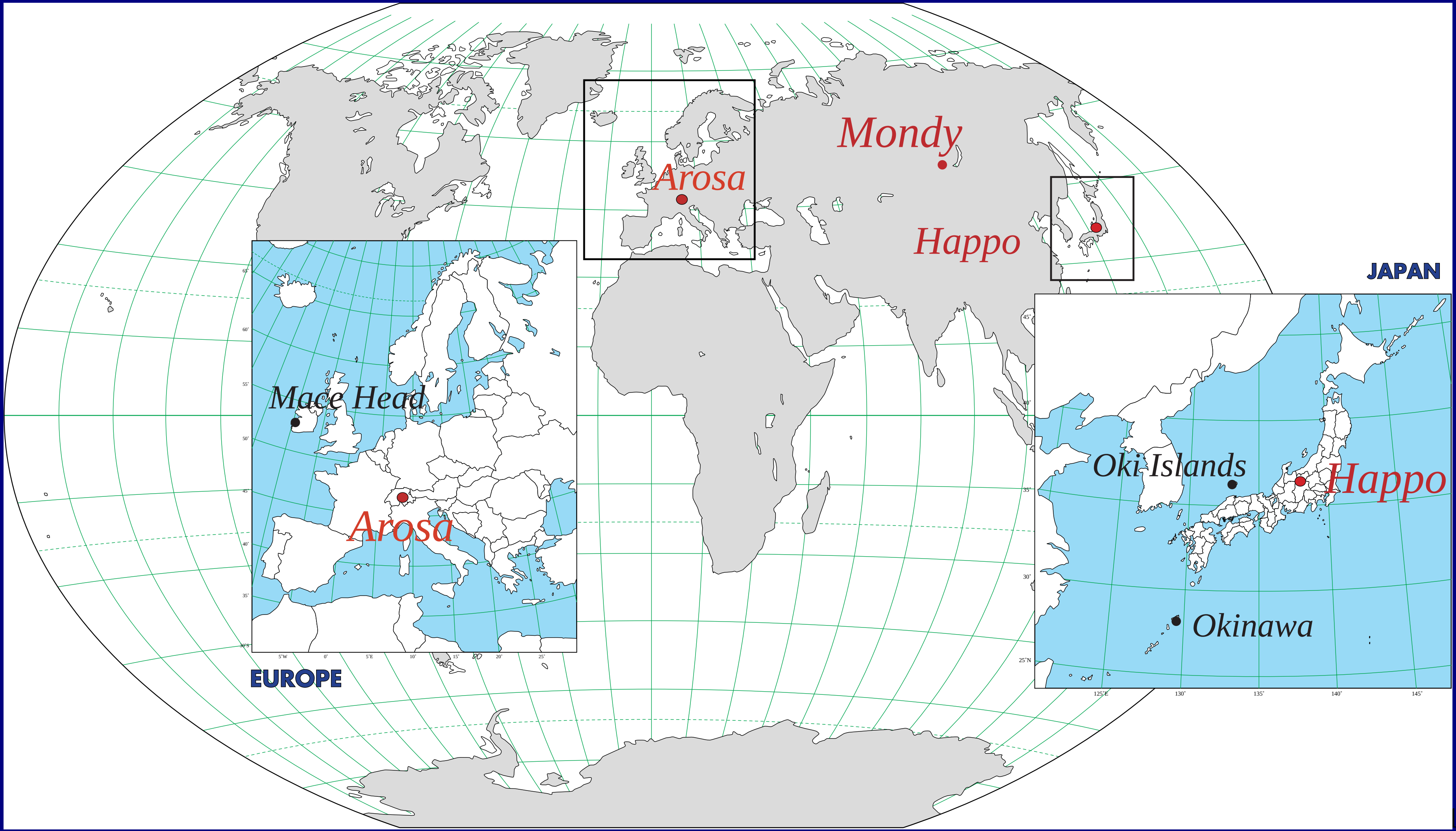
Schematic View of Hemispherical Transport in NH



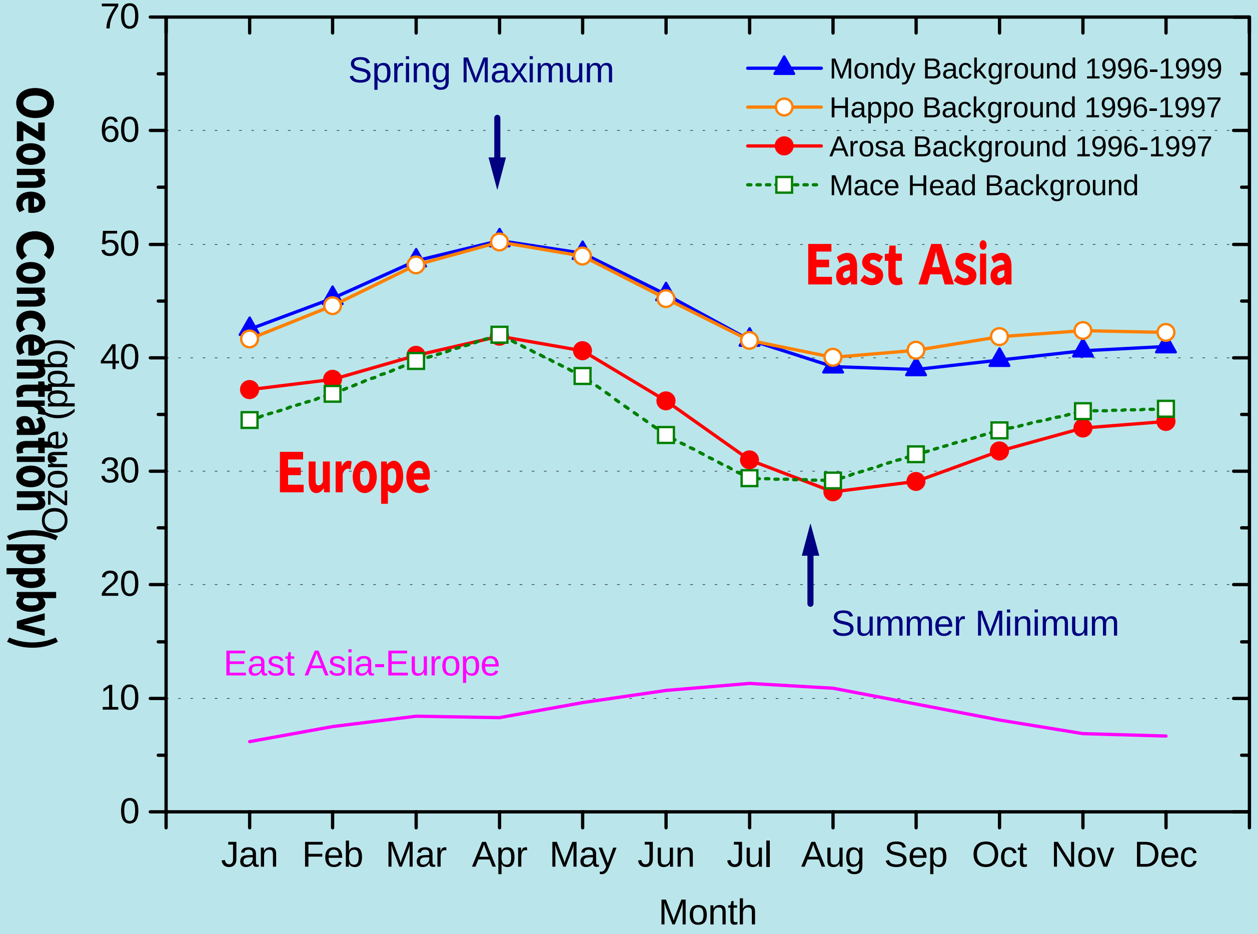
Atmospheric Lifetime of Air Pollutants

CO	1 - 2 month
Ozone	A few days - 1 month
Aerosols	A few days - 1 week
SO_2	2 - a few days
NOx	a few hours - 1 day

Detection of European Contribution of Ozone at remote sites in East Asia



Difference in Surface Ozone Concentration between East Asia and Europe -Observational Data-



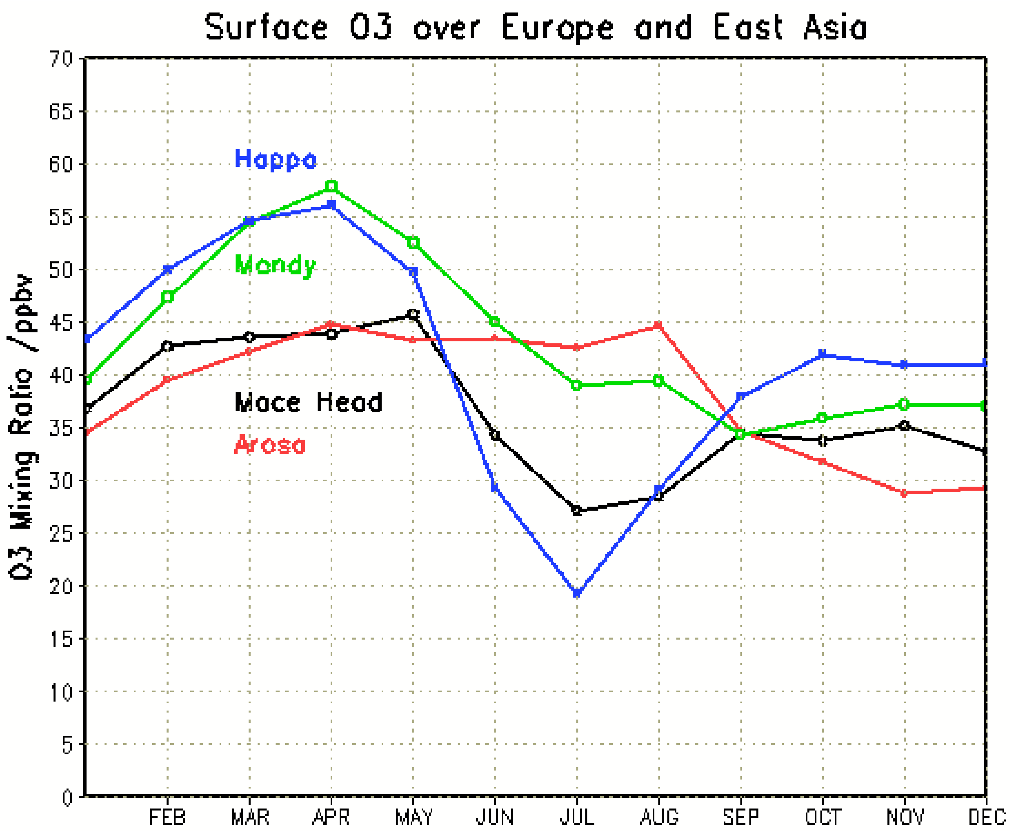
Difference in Surface Ozone Concentration between East Asia and Europe - Model Simulation -

Comparison at:
- **Mace Head (Ireland)**
- **Arosa (Switzerland)**
- **Mondy (Siberia)**
- **Happo (Japan)**

East Asian O3 is low in summer due to monsoon.

East Asian O3 is 5-10 ppb higher than in Europe except summer.

–Why?



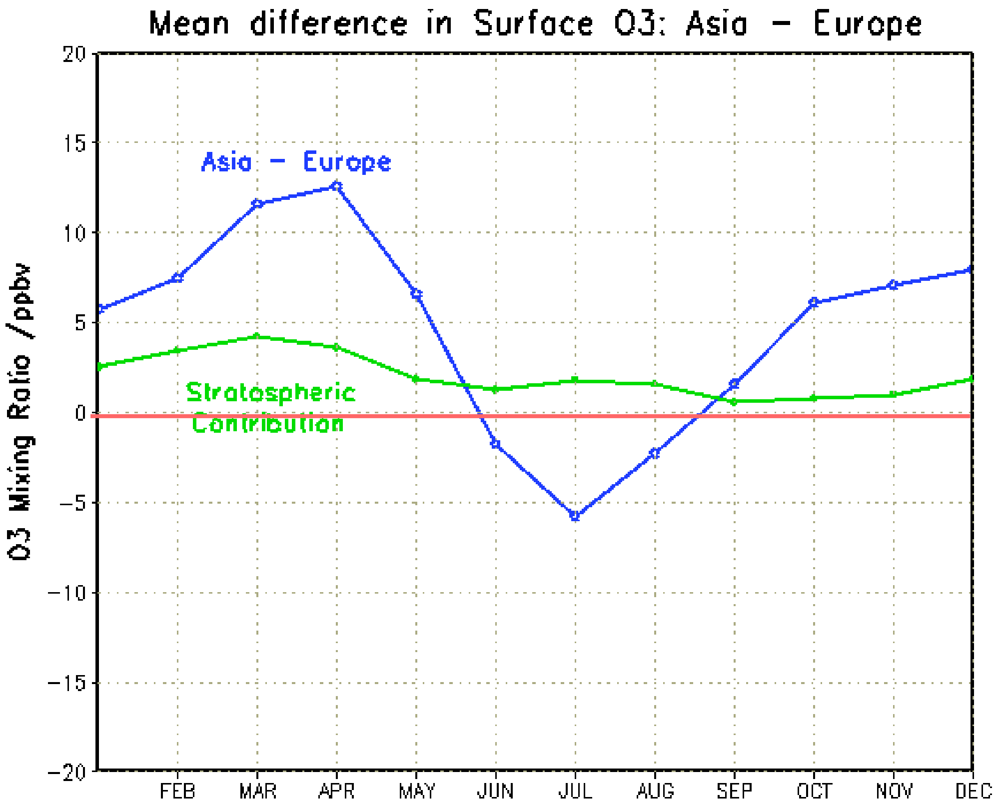
Wild, Pochanart and Akimoto

Cause of Difference in Ozone Concentration between East Asia and Europe

Stratospheric O_3 is ca. 3 ppb higher in East Asia。
- Subsidence of stratospheric O_3 in Central Asia.

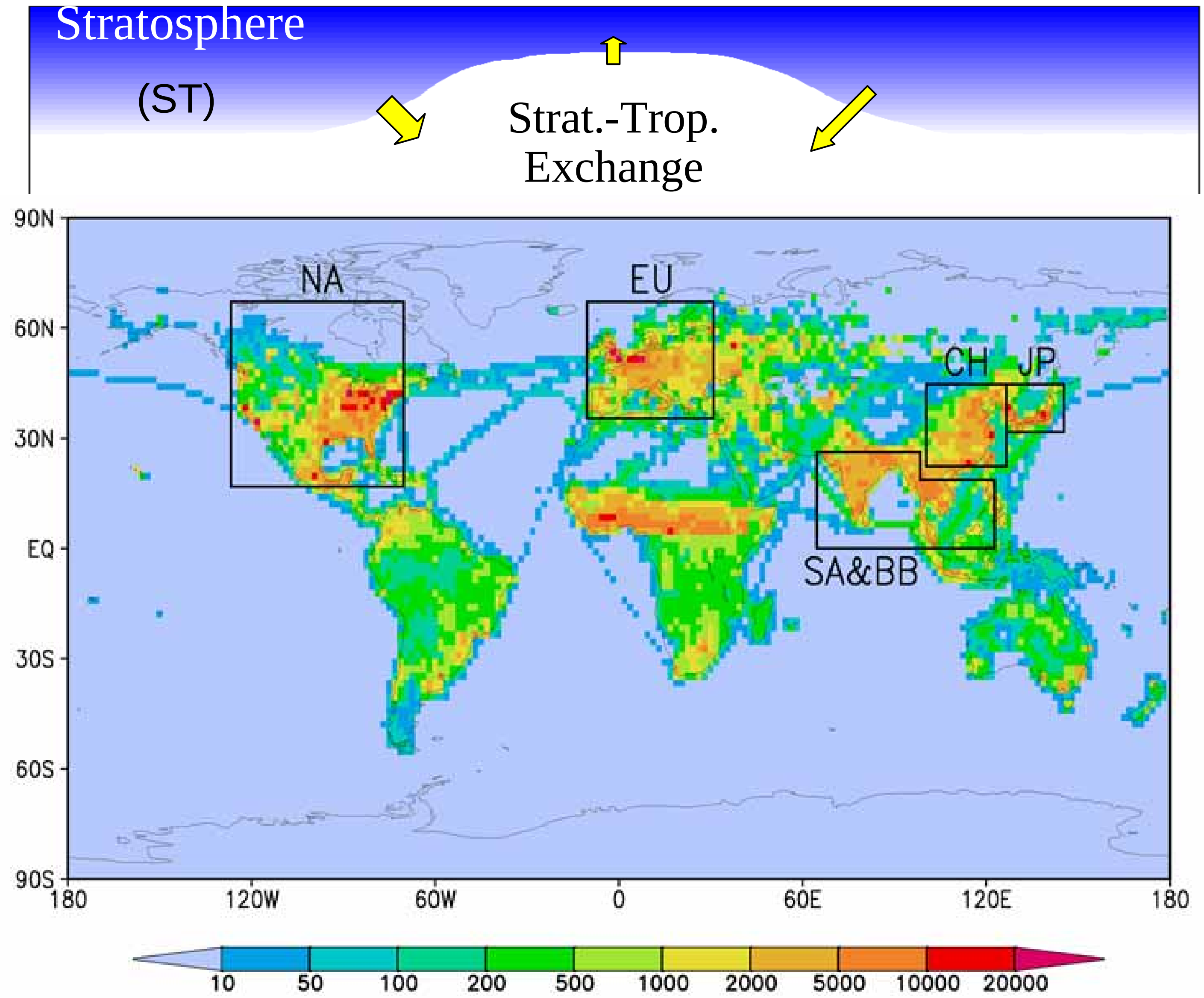
Residue:
- Emission in Europe
- Emission in Central Asia and other

High background O_3 has serious impact of air quality in East Asia.



Wild, Pochanart and Akimoto

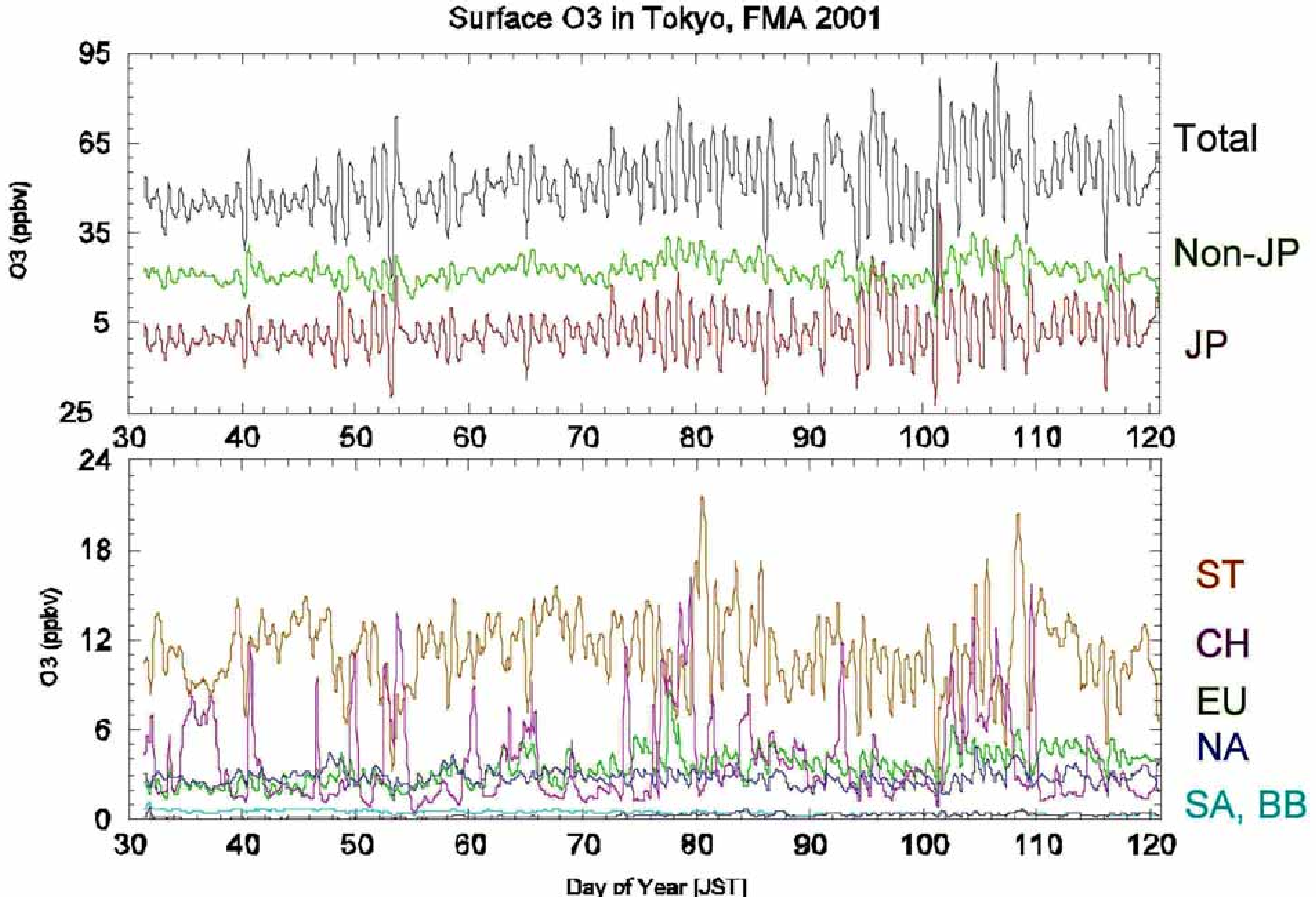
Where Ozone Come From ?   Global CTM (FRCGC/UCI), T63 (180 km)



Key Source Regions

Yoshitomi, Wild and Akimoto, 2006

Variations of Surface Ozone from Different Sources in Tsukuba/Tokyo Grid in Spring (February-April) (180 km mesh)



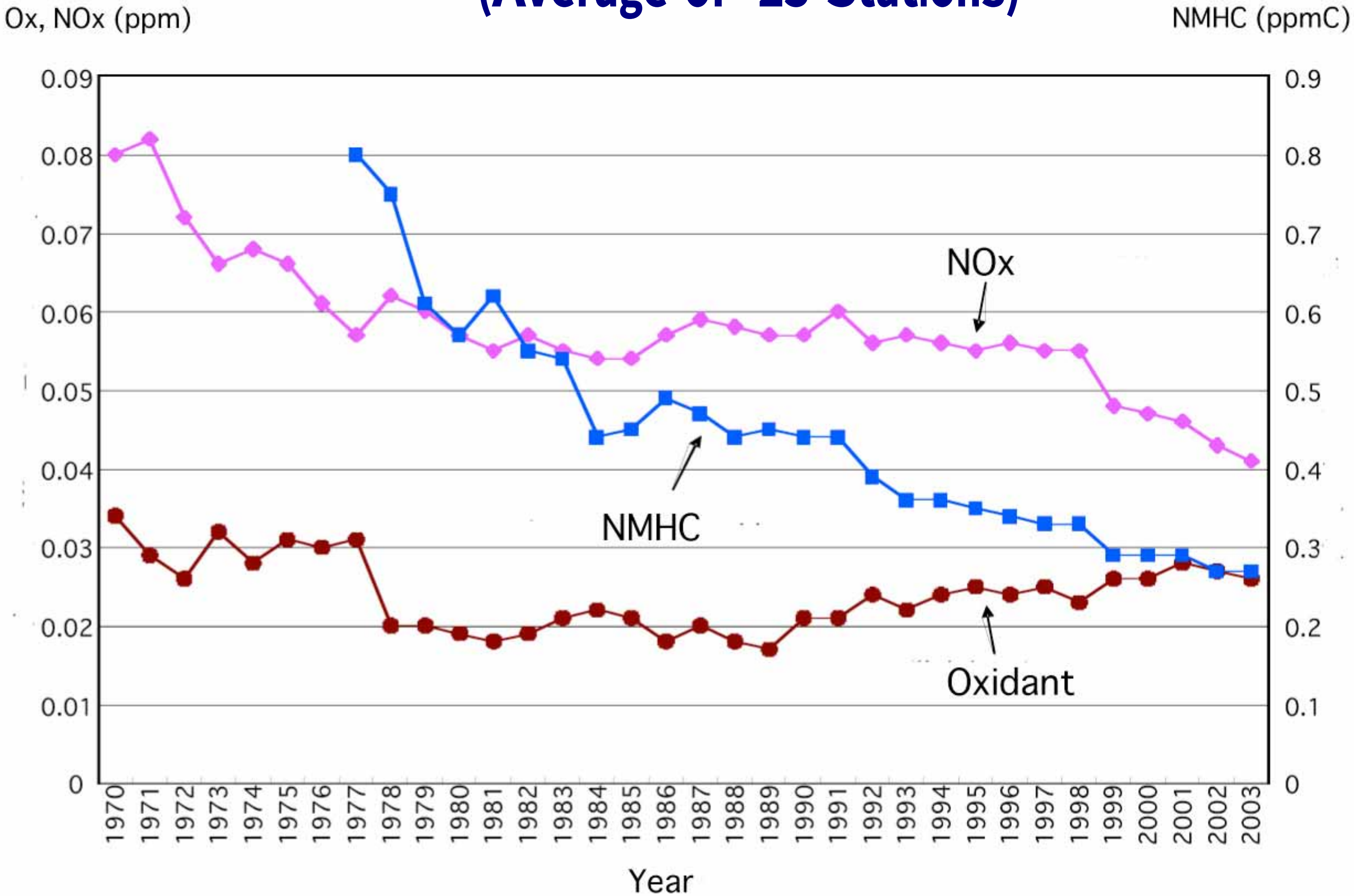
Contributions of Ozone by Sources to Tsukuba/Tokyo Grid in Spring

Source Region	February	March	April
Total	52.3 ppbv	61.2 ppbv	68.0 ppbv
JP	5.6 ppb	8.2 ppb	14.7 ppb
CH	4.2 ppb	4.6 ppb	4.5 ppb
EU	2.8 ppb	4.2 ppb	4.5 ppb
NA	3.1 ppb	3.1 ppb	3.0 ppb
SA	0.6 ppp	0.6 ppb	0.4 ppb
BB	0.2 ppb	0.3 ppb	0.4 ppb
ST	11.8 ppb	13.2 ppb	11.9 ppb

Yoshitomi, Wild and Akimoto, 2006

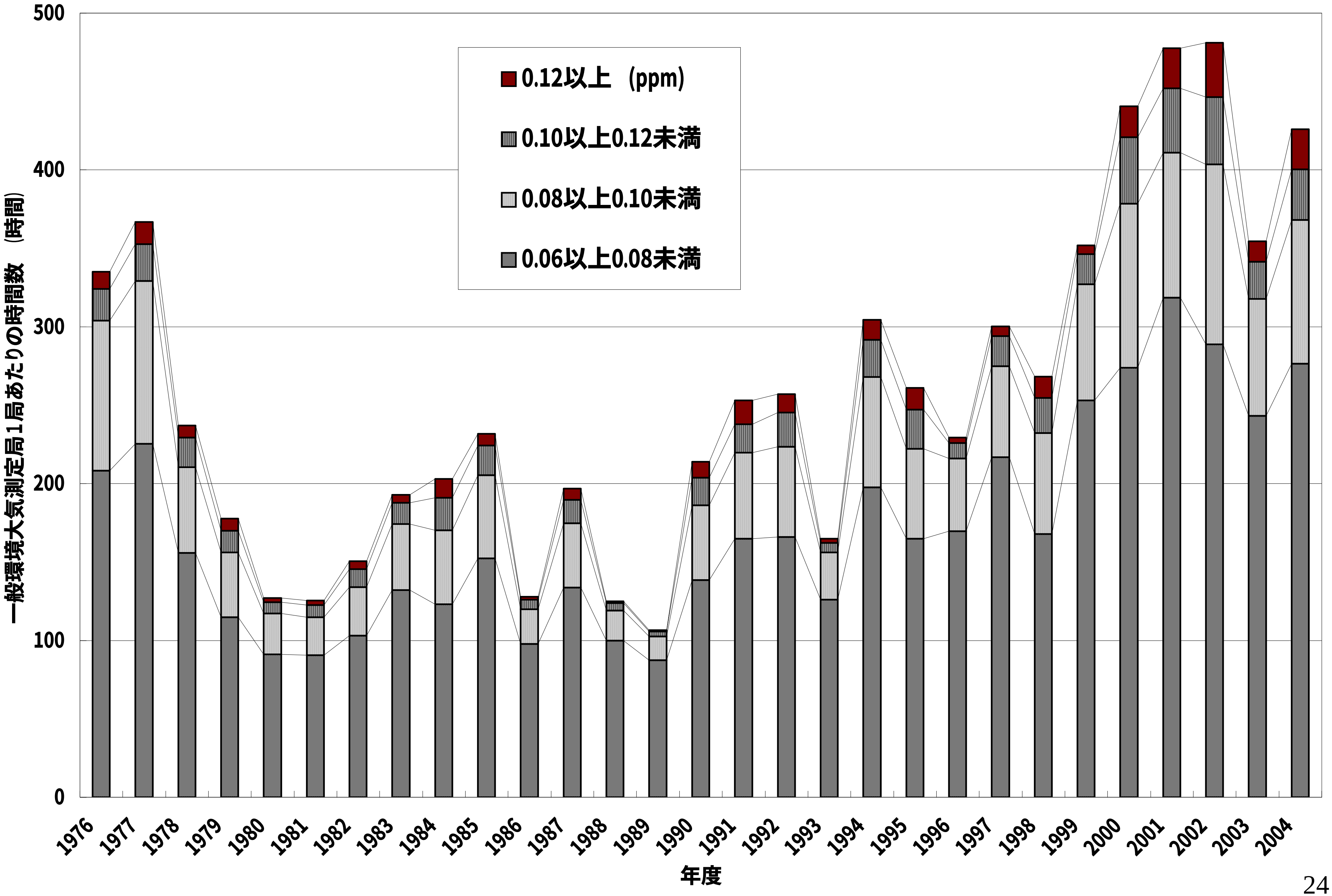
Trends of Ox, NOx, NMHC in Tokyo (1970-2003)

(Average of 23 Stations)



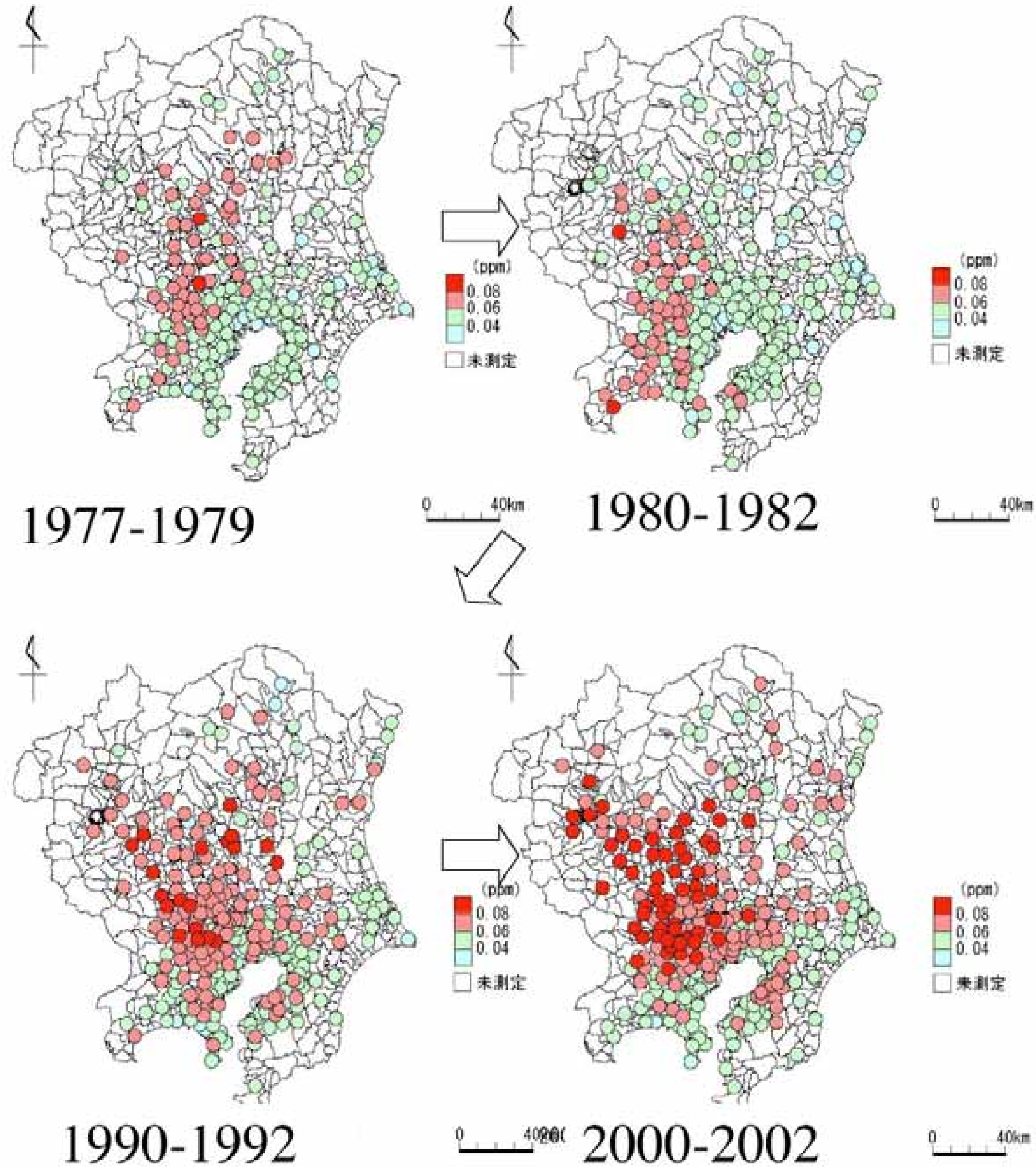
Committee for Photochemical Oxidant Control, Tokyo Metropolitan Government (2005)

Trend of Hours Ox Concentration Exceeds 0.06 ppm in Tokyo



Change of Ox Distribution in Tokyo Metropolitan Area (1 - 4 pm)

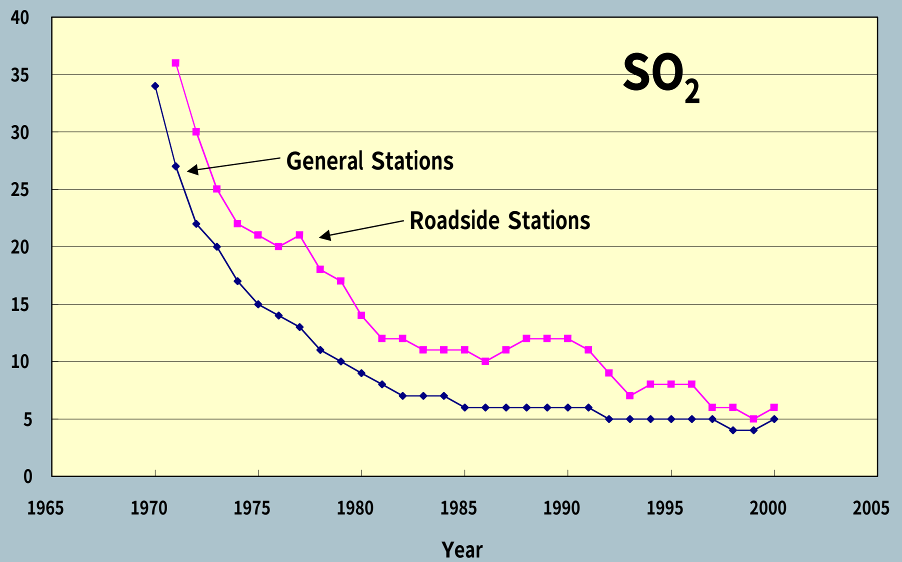
(1977-2002)

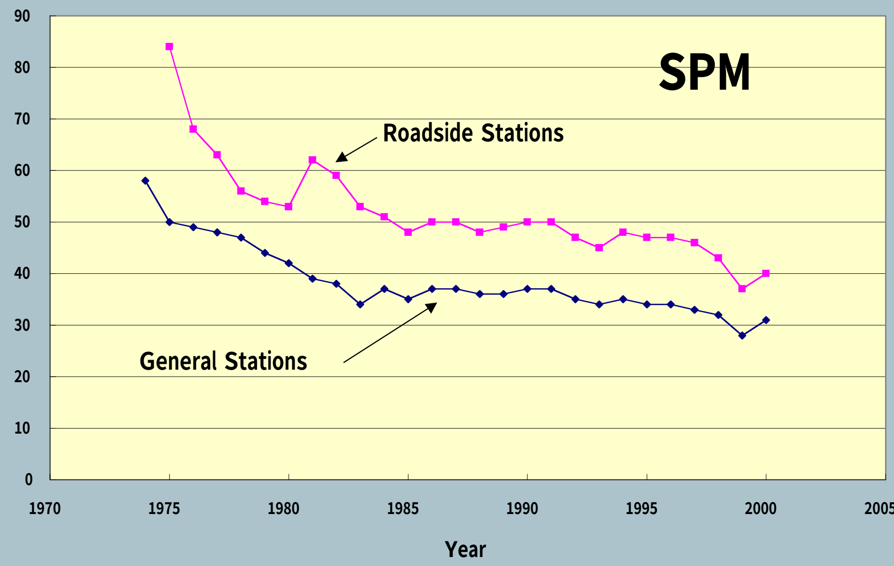


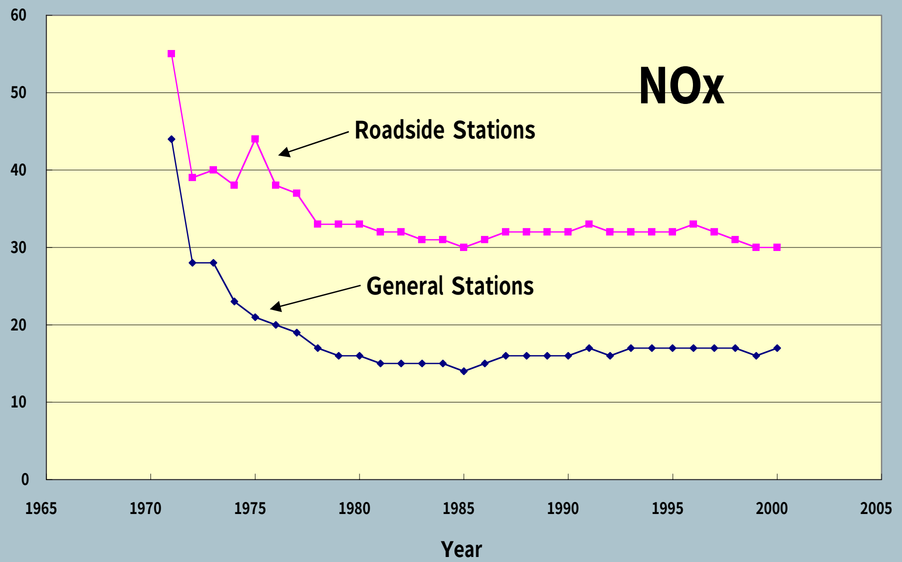
Why?

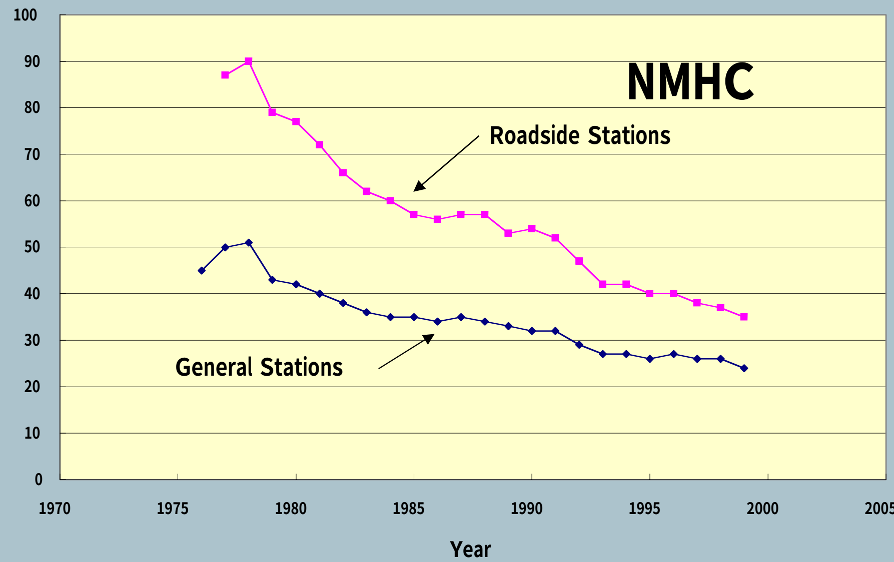
Committee for Photochemical Oxidant Control, Tokyo Metropolitan Government (2005)

Trends of Air Pollution in Japan

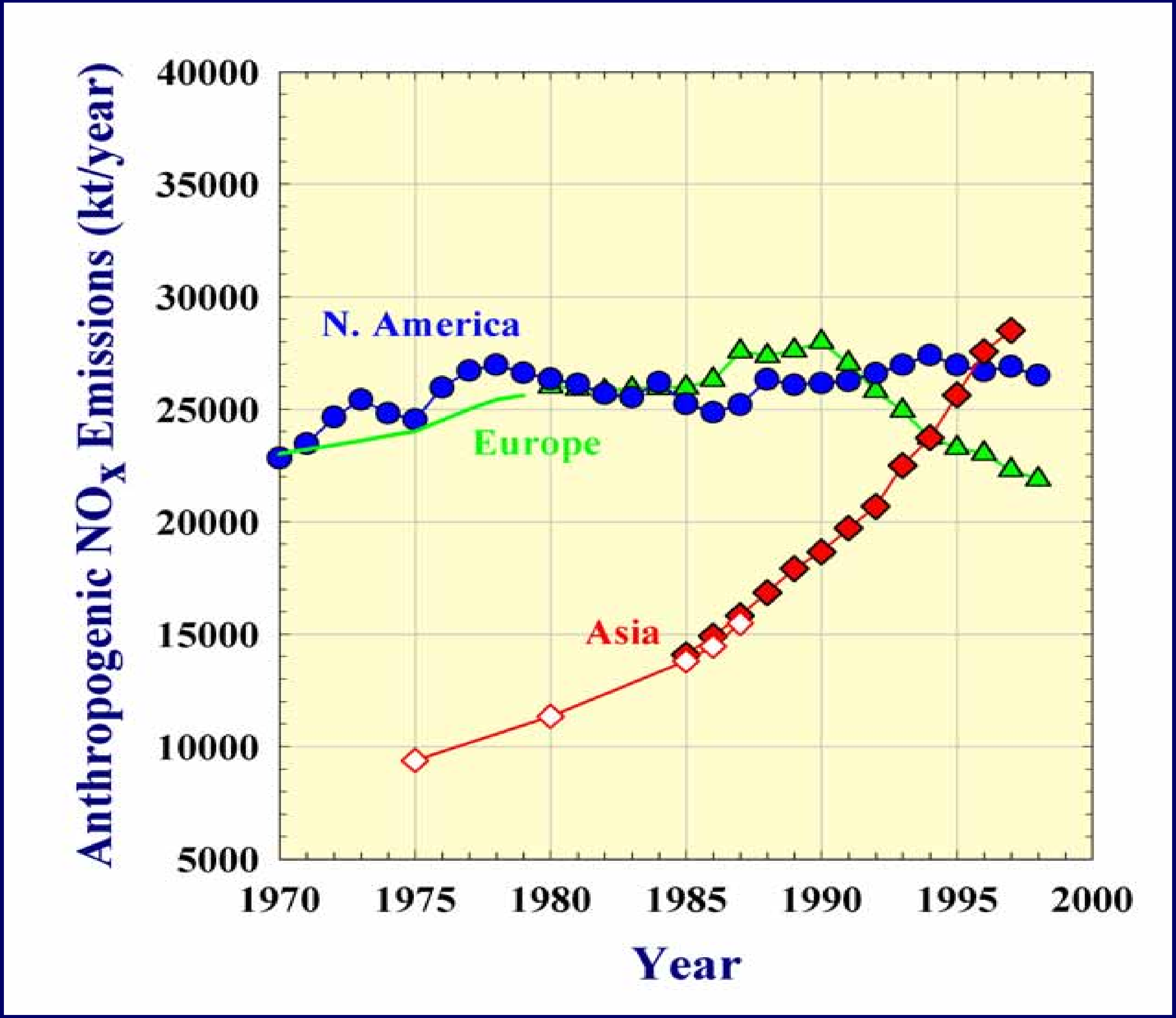








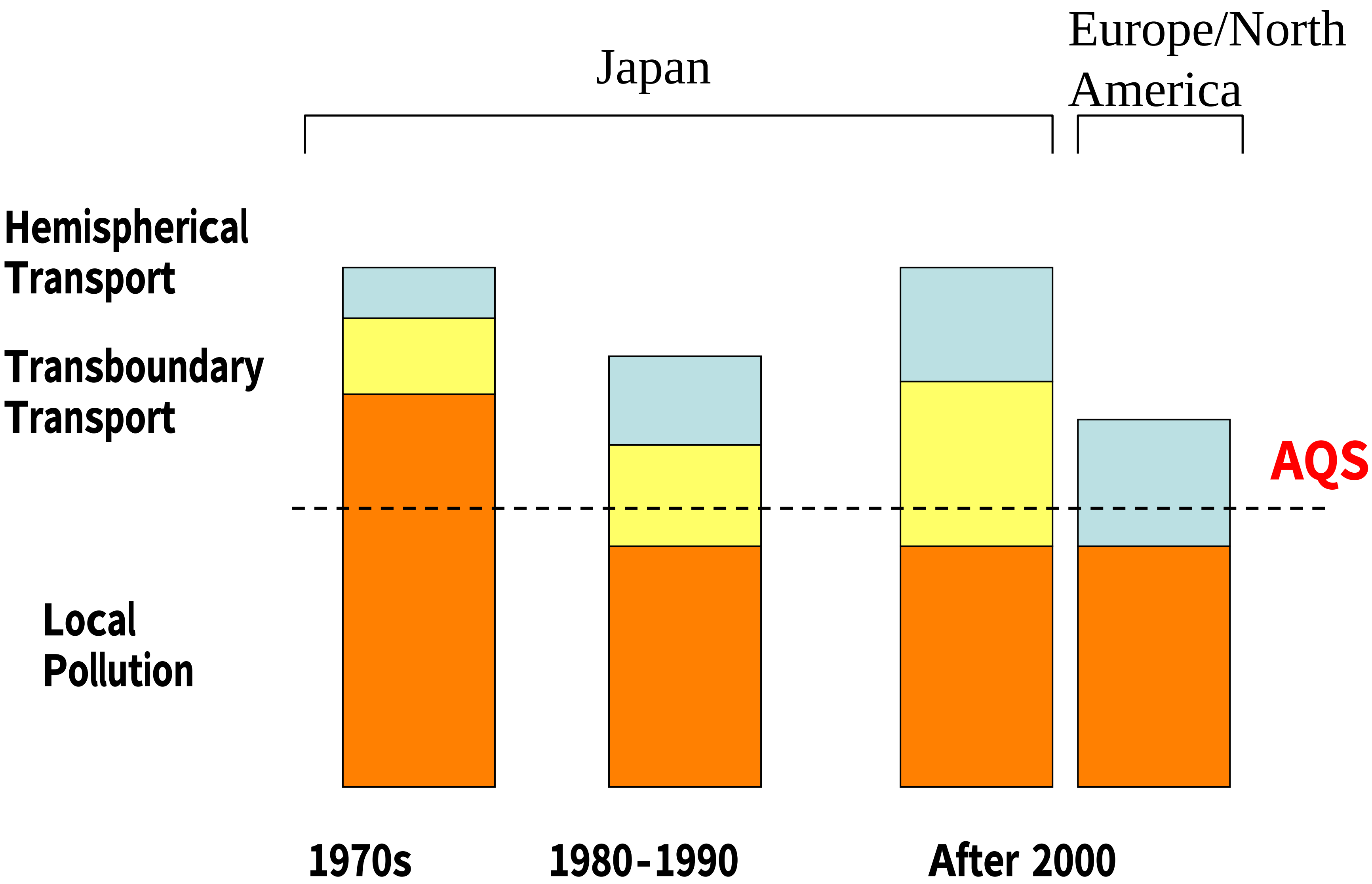
NOx Emission Trend in the Three Continent



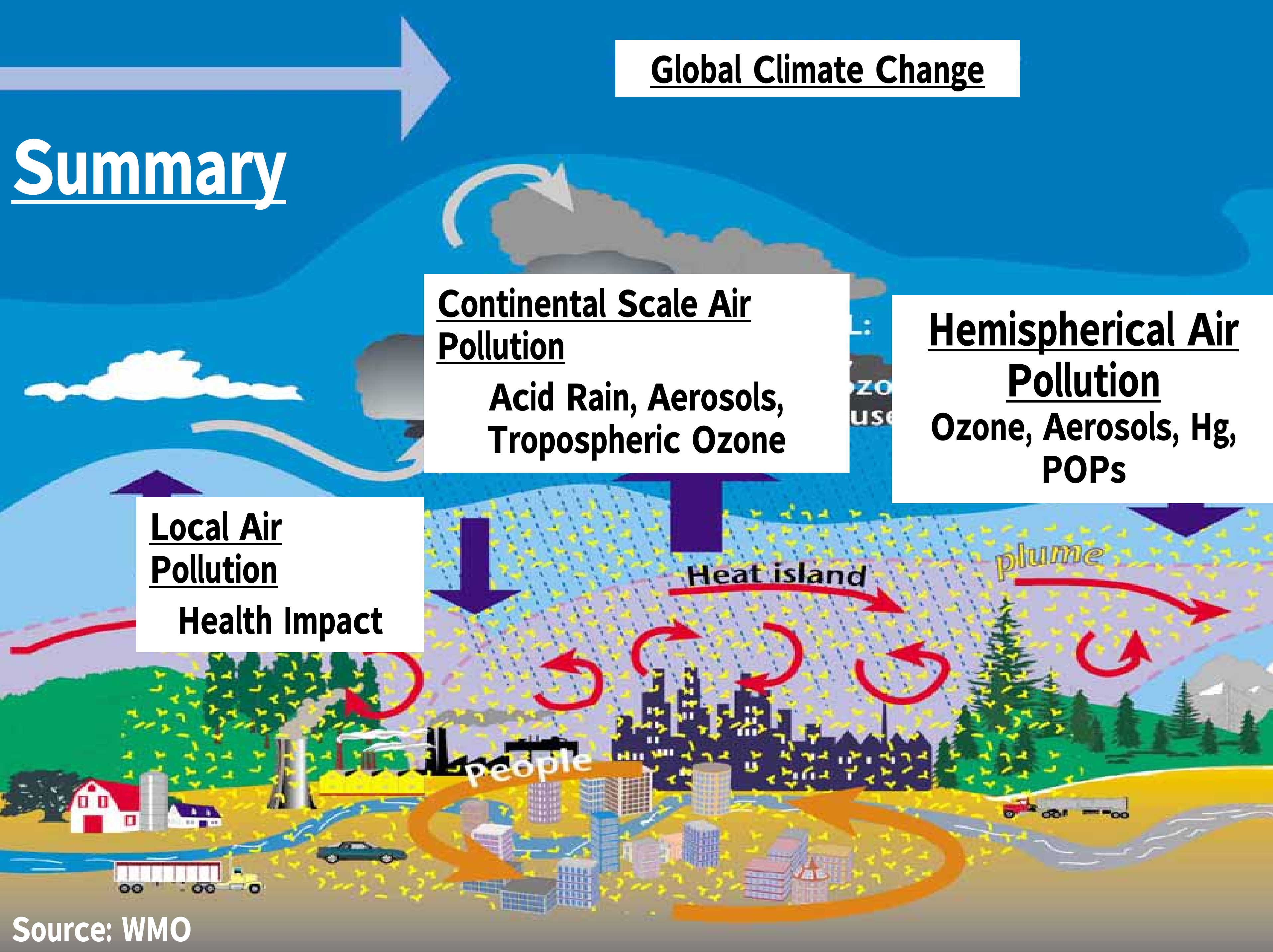
Akimoto, Science (2005)

N. America: USA + Canada, Europe: including FSU, Asia: South, SE and NE

Schematic View of Ozone Pollution by Sources



Summary



Global Climate Change

Continental Scale Air Pollution

Acid Rain, Aerosols, Tropospheric Ozone

Hemispherical Air Pollution

Ozone, Aerosols, Hg, POPs

Local Air Pollution

Health Impact

Source: WMO