8.
Nitrogen Monoxide and Nitrogen Dioxide (NO and NO_2)

8. Nitrogen Monoxide (NO) and Nitrogen Dioxide (NO_2)

Nitrogen oxides (NO_x, i.e., NO and NO_2) are not greenhouse gases, but have an effect upon controlling the concentration of hydroxyl radicals (OH), and eventually of methane (CH_4), carbon monoxide (CO), and HCFCs. In the presence of NO_x, CO and hydrocarbons are oxidized to produce ozone (O_3) in the troposphere, affecting, as a greenhouse gas, the Earth's radiative balance and, by reproducing OH, the oxidization capacity of the atmosphere. NO_x thus play a great role in controlling greenhouse gas concentrations (CH_4, HCFCs, etc.).

Sources of NO_x include fossil fuel combustion, biomass burning, and soil (IPCC, 1990; IPCC, 1995). The oxides' dominant sink in the atmosphere is conversion into nitric acid (HNO_3) and peroxyacetylnitrate (PAN) that are finally removed as dry or wet deposition. In some cases, NO_x are removed from the atmosphere directly as dry deposition. Anthropogenic emission of NO_x is currently one of the major causes of acid rain and deposition. NO_x have a large variability in space and time because of their short lifetimes and complex source distribution (IPCC, 1990).

Observation stations that submitted data for NO_2 and NO to the WDCGG are shown in Figure 8.1 and listed in Table 8.1. All of the 30 contributing stations are located in Europe. Figures 8.2 and 8.3 illustrate annual mean concentrations of NO_2 and NO, respectively, for individual stations in colours that change with the concentration. Please note that data for NO_x is reported in various units, i.e., ppb, $\mu g/m^3$, mg/m^3, $\mu gN/m^3$, and mgN/m^3, and that it can be converted to the single unit of ppb, as follows:

$X_p\ [ppb] = (R * T / M / P_0) * 10^3 * X_g\ [\mu g/m^3]$

$X_p\ [ppb] = (R * T / M / P_0) * 10^6 * X_g\ [mg/m^3]$

$X_p\ [ppb] = (R * T / M_N / P_0) * 10^3 * X_g\ [\mu gN/m^3]$

$X_p\ [ppb] = (R * T / M_N / P_0) * 10^6 * X_g\ [mgN/m^3]$

where R is the molar gas constant ,which is 8.31451 [J/K/mol],

T is the temperature assuming 25 °C or 298.15 [K] for all of the reports,

M is the molecular weight of NO, which is 30.00614, and of NO_2, which is 46.00554,

M_N is the atomic weight of N, which is 14.00674, and

P_0 is the standard pressure, which is 1013.25 [hPa].

A decrease is seen in particular in Eastern Europe for the annual mean concentrations of NO_2. NO_2 concentrations are generally higher in southern regions than in northern regions. Few data have been reported from Northern Europe, but it is likely that NO_2 concentrations are low in Northern Europe.

The number of observation sites for NO is quite small, and it is difficult to identify a changing trend for NO concentrations. However, it is likely that NO concentrations are lower in the northern part of central Europe than in the southern part of this region.

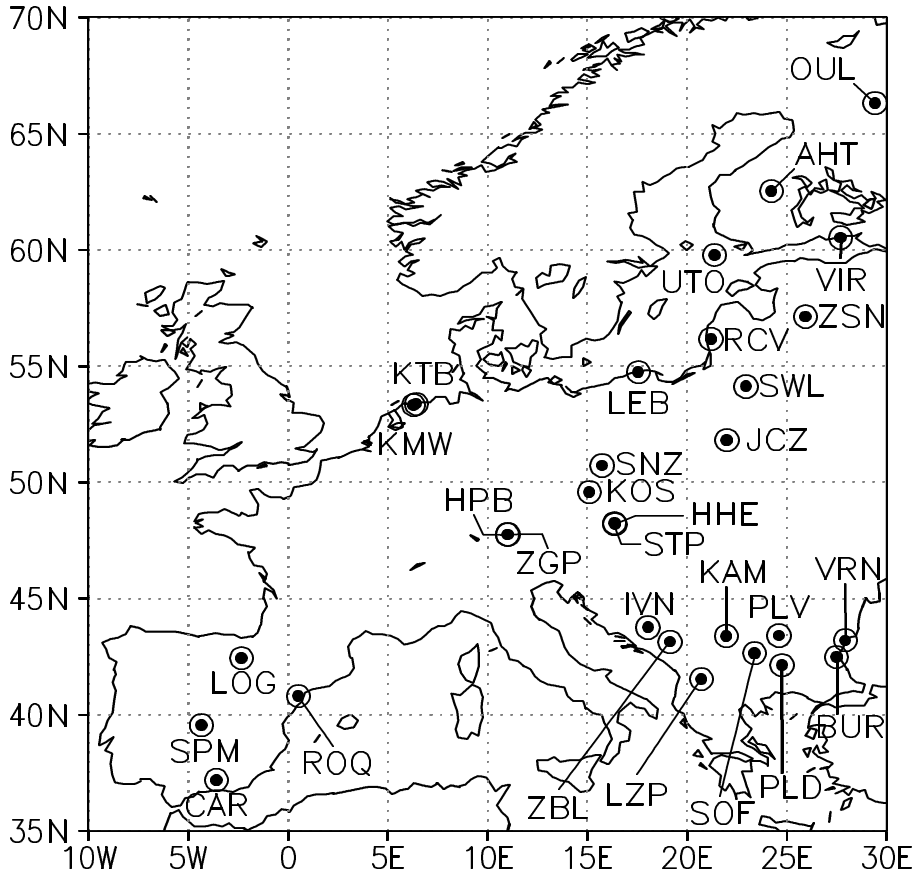

Fig. 8.1 Location of observation stations.

Table 8.1 List of observation stations for nitrogen oxides (NO_x) in alphabetical order.

Index	Station	Country/Territory	Organization
AHT	Ahtari, Myllymaki	FIN	Finnish Meteorological Institute
BUR	Burgas	BGR	National Institute of Meteorology and Hydrology
HHE	Hohe Warte/WIEN	AUT	Central Institute for Meteorology and Geodynamics
HPB	Hohenpeissenberg	DEU	Deutscher Wetterdienst (DWD)
IVN	Ivan Sedlo	BIH	Federal Hydrometeorological Institute
JCZ	Jarczew	POL	Institute of Meteorology and Water Management
KAM	Kamenicki Vis	YUG	Federal Hydrometeorological Institute
KTB	Kloosterburen	NLD	Air Research Laboratory
KMW	Kollumerwaard	NLD	Air Research Laboratory
KOS	Kosetice	CZE	Czech Hydrometeorological Institute
CAR	La Cartuja	ESP	Instituto Nacional de Meteorologia
LZP	Lazaropole	MCD	Hydrometeorological Institute
LEB	Leba	POL	Institute of Meteorology and Water Management
LOG	Logrono	ESP	Instituto Nacional de Meteorologia
OUL	Oulanka, Kuusamo	FIN	Finnish Meteorological Institute
PLV	Pleven	BGR	National Institute of Meteorology and Hydrology
PLD	Plovdiv	BGR	National Institute of Meteorology and Hydrology
ROQ	Roquetas	ESP	Instituto Nacional de Meteorologia
RCV	Rucava	LVA	Environmental Pollution Observation Centre
SPM	San Pablo de los Montes	ESP	Instituto Nacional de Meteorologia
SNZ	Sniezka	POL	Institute of Meteorology and Water Management
SOF	Sofia	BGR	National Institute of Meteorology and Hydrology
STP	Stephansplatz/WIEN	AUT	Central Institute for Meteorology and Geodynamics
SWL	Suwalki	POL	Institute of Meteorology and Water Management
UTO	Uto, Korppoo	FIN	Finnish Meteorological Institute
VRN	Varna	BGR	National Institute of Meteorology and Hydrology
VIR	Virolahti, Koivuniemi	FIN	Finnish Meteorological Institute
ZBL	Zabljak	YUG	Federal Hydrometeorological Institute
ZGP	Zugspitze	DEU	Umweltbundesamt, Federal Environmental Agency
ZSN	Zoseni	LVA	Environmental Pollution Observation Centre

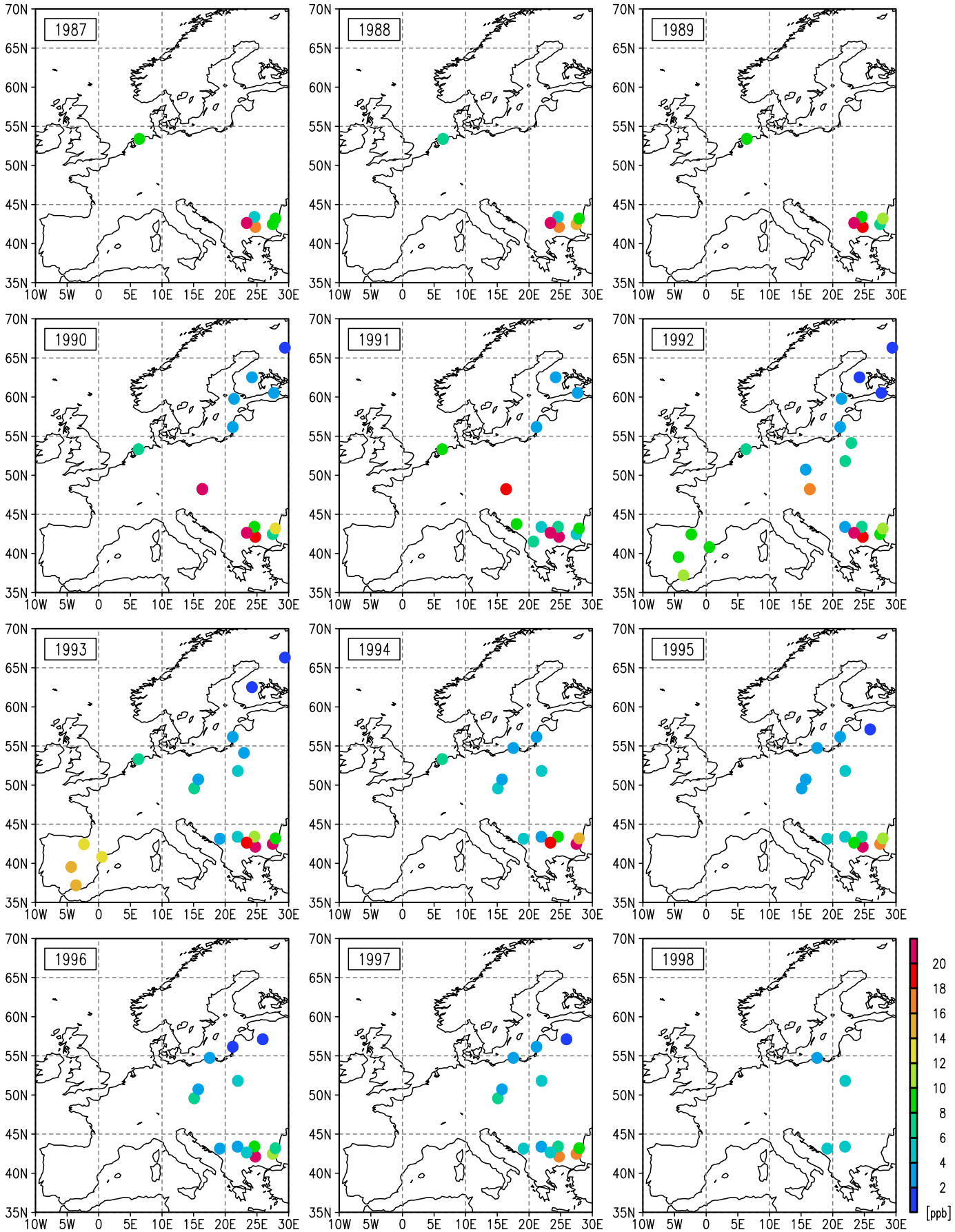

Fig. 8.2 Annual mean concentrarions of NO_2 for individual stations in colors that change with concentrations.

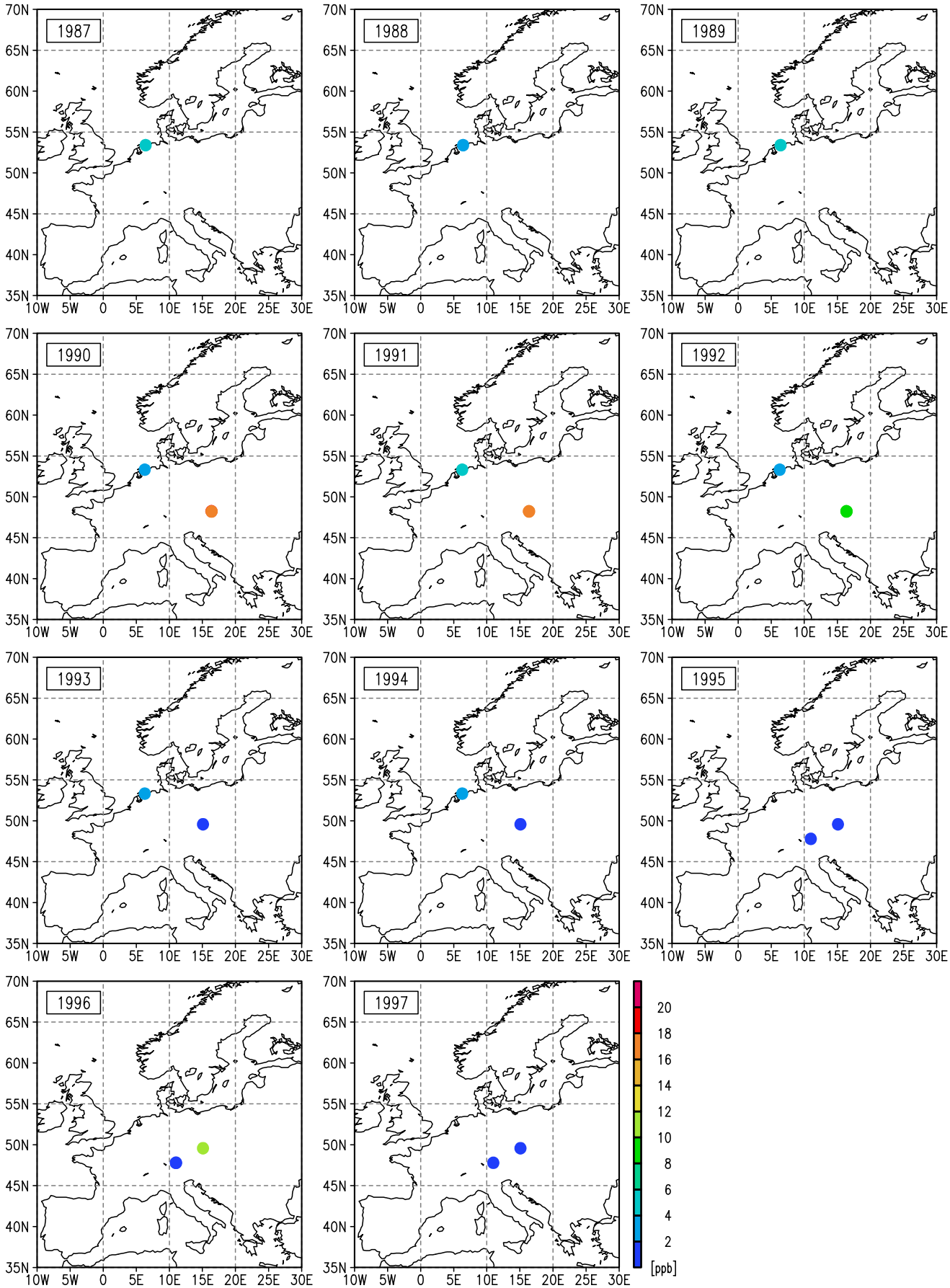

Fig. 8.3 Annual mean concentrarions of NO for individual stations in colors that change with concentrations.