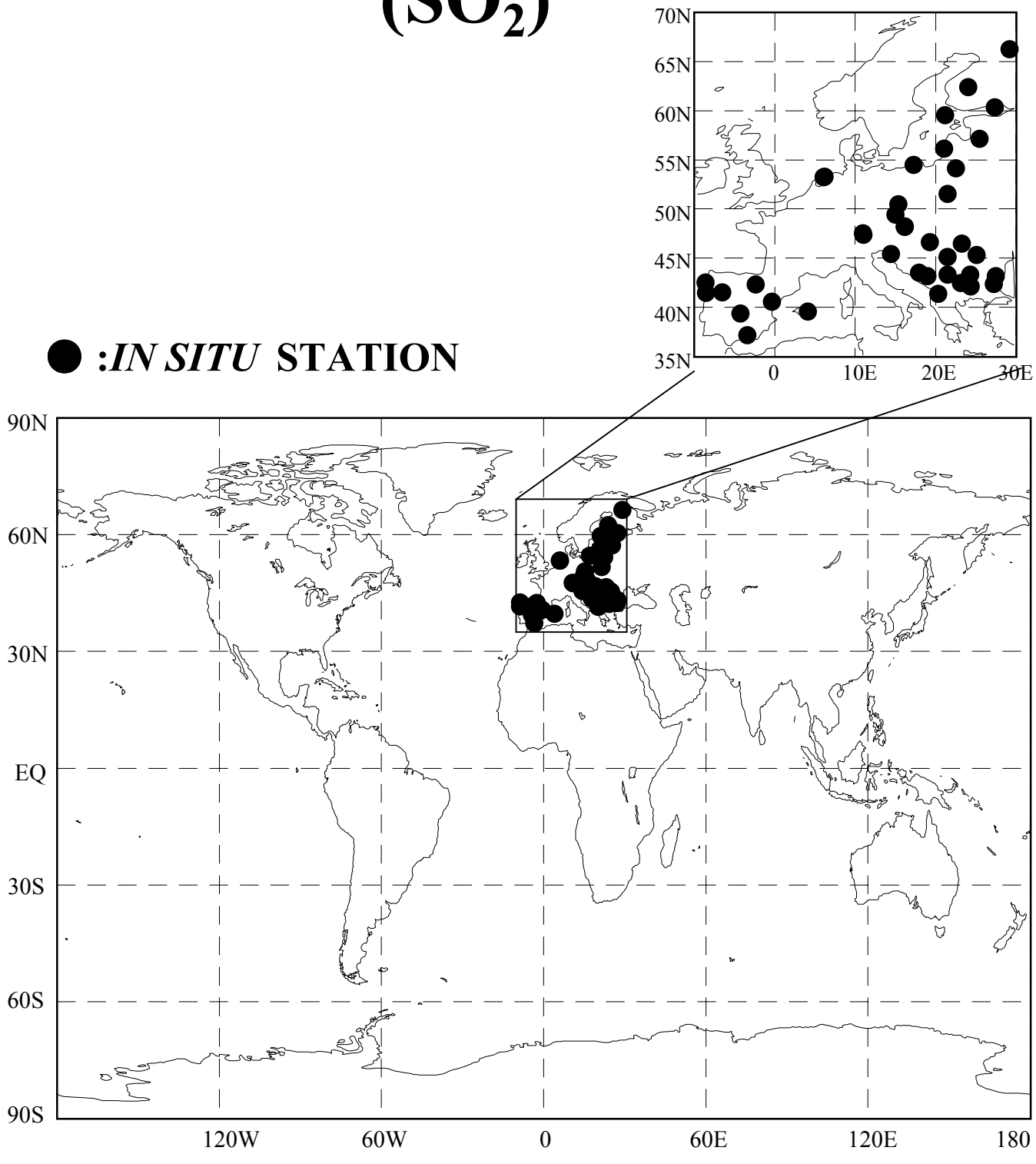
9.
Sulfur Dioxide
(SO_2)



9. Sulfur Dioxide (SO_2)

Sulfur dioxide (SO_2) is not a greenhouse gas but is a precursor of atmospheric sulfuric acid (H_2SO_4) as an aerosol. SO_2 is oxidized by hydroxyl radicals (OH) to form sulfuric acid, although this reaction is much slower than the corresponding one between NO_2 and nitric acid. Nevertheless, SO_2 dissolves easily in suspended droplets in the atmosphere, unlike NO_x. Sulfuric acid aerosol is produced by SO_2 oxidation through photochemical gas-to-particle conversion.

Sources of SO_2 include fossil fuel combustion by industries, biomass burning, volcanoes and the oxidation of dimethylsulfide (DMS) from oceans (IPCC, 2001). Major SO_2 sinks are the formation of sulfuric acid and deposition onto wet surfaces. For SO_2, removal by dry deposition is more important than for NO_2 because of its high degree of solubility. Anthropogenic SO_2 has caused acid rain and deposition throughout industrial times. SO_2 has a large variability in space and time because of its short life time and localized anthropogenic sources.

Observation stations that submitted data for SO_2 to the WDCGG are shown in the map at the beginning of this chapter. All of the contributing stations are located in Europe. Figure 9.1 illustrates the time series of monthly mean concentrations of SO_2 for individual stations in colors that change with the concentration. Please note that data for SO_2 is reported in various units, i.e., ppb, μg/m^3, mg/m^3 and μgS/m^3, and that it can be converted to a single unit of ppb as follows:

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

X_p [ppb] = (R * T / M / P_0) * 10^4 * X_g [mg/m^3]

X_p [ppb] = (R * T / M_S / P_0) * 10 * X_g [μ gS/m^3]

where R is the molar gas constant, which is 8.31451 [J/K/mol],
T is the absolute temperature reported from an individual station,
M is the molecular weight of SO_2, which is 64.0648,
M_S is the atomic weight of S, which is 32.066 and
P_0 is the standard pressure, which is 1013.25 [hPa].

Generally, SO_2 concentrations are higher in southern regions than in northern regions in Europe. But, it is difficult to identify an increasing or decreasing trend for SO_2 concentrations.