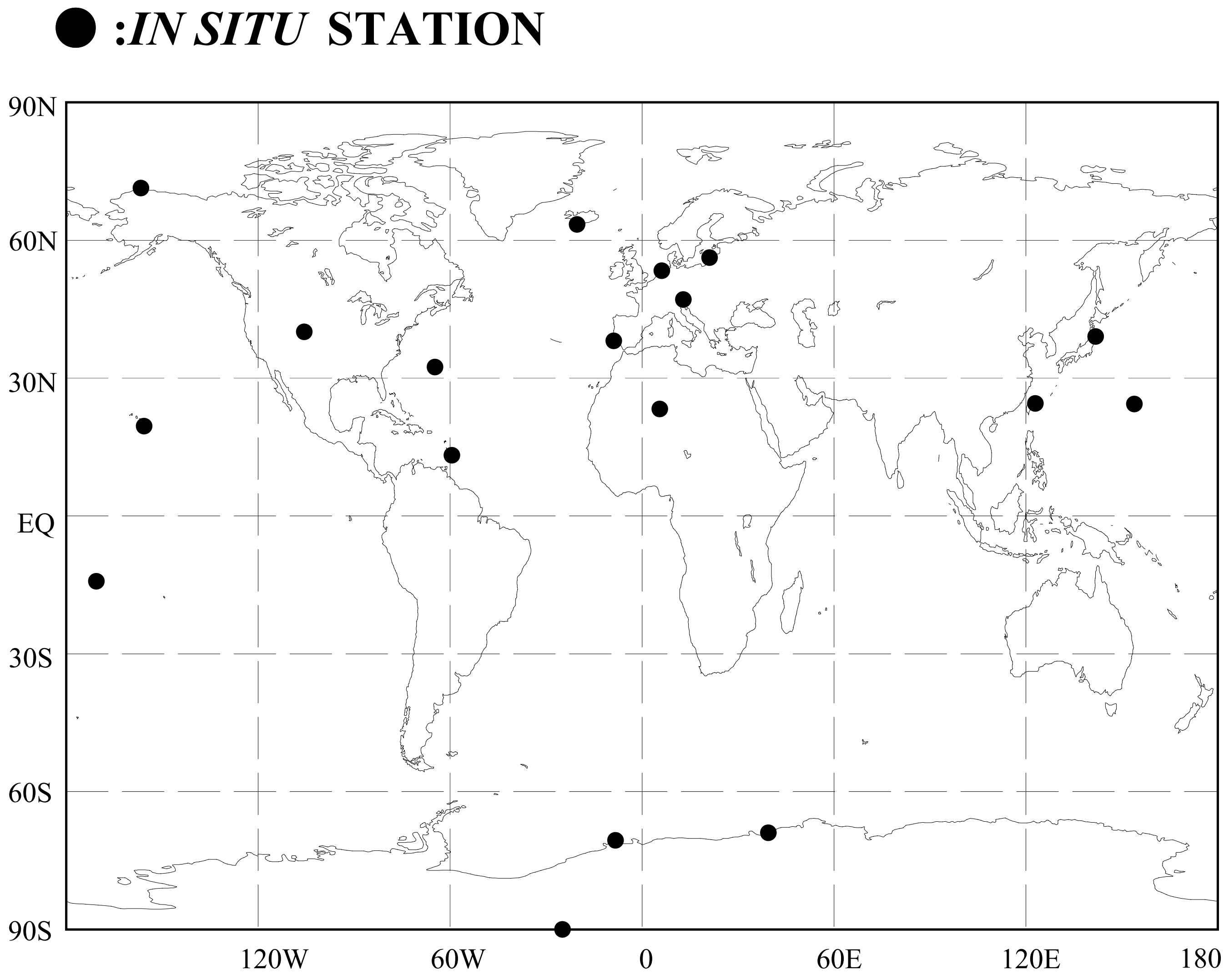
7.
Surface Ozone
(O_3)



7. Surface Ozone (O_3)

Ozone plays an important role in the atmospheric environment through radiative and chemical processes. Ozone absorbs UV radiation in the stratosphere making temperature profile and circulation there with its absorbed energy. As well, ozone absorbs IR radiation, and thus is one of the greenhouse gases in the troposphere. However, ozone is much different in characteristics from other greenhouse gases (such as CO_2, CH_4, N_2O, CFCs). Ozone is not directly emitted from Earth's surface but produced in the atmosphere, and its concentration is not uniform as it ranges from about 10 ppb near the surface to about 10 ppm in the stratosphere. In contrast to ozone, CO_2, CH_4, N_2O, and halocarbons (e.g., CFCs) are relatively uniform, so they are called well-mixed greenhouse gases.

A variation in ozone near the surface (so-called surface ozone) reflects various processes there. While a part of tropospheric ozone is transported from the stratosphere, the rest is chemically produced in the troposphere especially near the surface from which various ozone precursors are emitted. At the same time ozone is destroyed through chemical reactions and deposition at surface.

Ozone is produced in the troposphere through oxidation of CO or hydrocarbons in the presence of rich NO_x. As mentioned in following chapters, these constituents (so-called ozone precursors) are anthropogenic. As they are localized and their lifetimes are generally short, their distribution is not uniform. Thus the distribution of surface ozone is also localized and variable in time.

Surface ozone is estimated to be increased since the pre-industrial times (IPCC, 2001).

The World Data Centre for surface ozone was transferred from NILU to JMA in August 2002. Observation stations that have submitted data for surface O_3 to the WDCGG are shown in the map at the top page of this chapter.

Figure 7.1 shows the time series of monthly mean concentrations of surface O_3 for individual stations in colors that change with the concentration. Please note that data for surface O_3 is reported in two units, i.e., ppb, $\mu g/m^3$-25°C 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 [$\mu g/m^3$]

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 O_3, which is 47.9982,
P_0 is the standard pressure, which is 1013.25 [hPa].

The concentration of surface O_3 is variable from station to station. Relatively high concentration with spring maximum is observed at Sonnblick, Niwot Ridge, Assekrem, and Mauna Loa, all of which locate in high mountain area (higher than 2700 m). As the number of observation sites for surface O_3 is quite small and the seasonal and interannual variation is relatively large, it is difficult to identify a general long-term trend for surface O_3 concentrations.