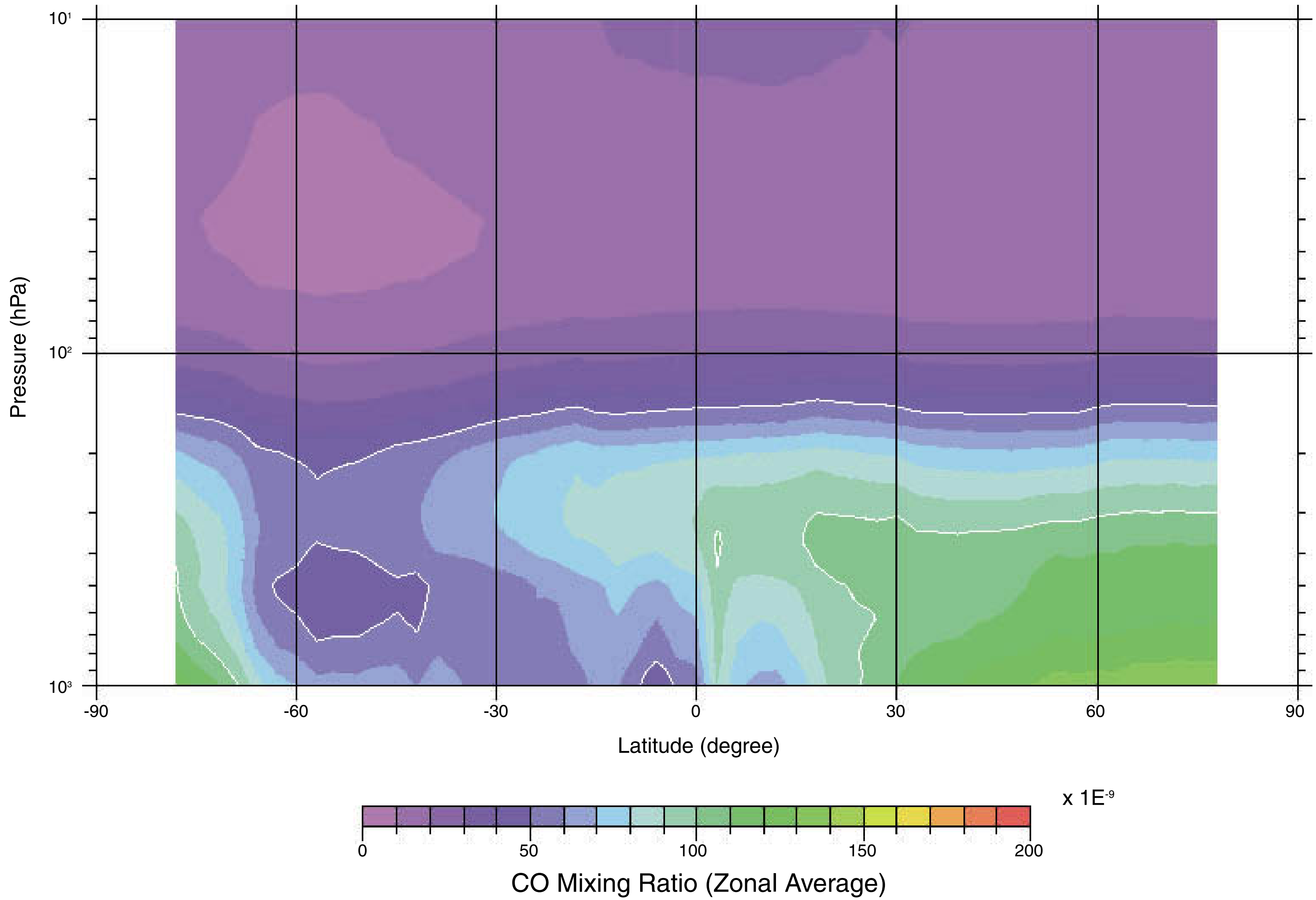
Greenhouse Gases



Provided by NASDA/MITI/CRIEPI

Greenhouse Gases

The third Conference of Parties on International Framework Convention on Climate Change (COP Ⅲ (*1)) held in Kyoto in December 1997 agreed to reduce the emissions of greenhouse gases of six species including carbon dioxide, methane, and nitrous oxide. These spiecies all clearly exhibit a long-term increasing trend in their tropospheric concentrations. It is almost certain that the increases of greenhouse gas concentrations lead to global warming because they trap the Earth's thermal radiation. Chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) that have strong greenhouse effects are already regulated internationally because they are ozone-depleting substances. Tropospheric ozone is now considered a greenhouse gas. Its concentration has increased during this century and that it may have impacted the global warming. Nitrogen oxides, carbon monoxide and hydrocarbons are known to be ozone precursor gases, and the increase of these atmospheric concentrations is also a concern.

To understand the mechanism of the global warming phenomena, it is necessary to precisely measure the long-term trends of greenhouse gas concentrations in the atmosphere. Moreover, to treat this global warming issue in a scientific way, the distributions of greenhouse gas sources and sinks should be described quantitatively with respect to countries and/or regions. The data from the IMG instrument aboard ADEOS enabled us to retrieve the vertical profiles of methane, carbon moxide and ozone mainly in the troposphere; the ILAS instrument enabled us to retrieve the stratospheric profiles of several greenhouse gases in high latitudes.

The greenhouse gas sources and sinks are located mostly on the Earth's surface, with their strengths varying from place to place. The data from IMG can discriminate atmospheric methane and carbon monoxide concentrations in the planetary boundary layer near the surface from that aloft in the free troposphere (*2). On-going studies infer the geographical distributions of sources and sinks of atmospheric methane and carbon monoxide from the geographical distributions of their concentrations by solving the inverse problem. Those source and sink distributions will be useful for monitoring and controling the various emission sources. Moreover, IMG provided global data on tropospheric ozone that is considered an index for the oxidative capacity of the atmosphere and a concern in relation to acidification of rains.

The figure shows a global distribution of carbon monoxide concentration in the troposphere near the surface. This is constructed using 9,500 observations obtained with IMG from late December 1996 to mid June 1997. A part of carbon monoxide is produced by oxidation of methane in the atmosphere while another part is emitted into the atmosphere through human activities. Since the anthropogenic emission sources are more intense in the northern hemisphere (NH) than in the southern hemisphere (SH), carbon monoxide concentration is generally higher in NH than in SH. This figure shows carbon moxide concentration to be about 1.3×10^{-7} (130 n mol/mol) in NH and about 0.6×10^{-7} (60 n mol/mol) in SH. It should be noted that the relatively high concentration seen over the Antarctic continent is artefact because this retrieval procedure did not consider the strong reflection of solar radiation by snow or ice surfaces.

*1 COP Ⅲ: United Nations Framework Convention on Climate Change, Conference of the Parties, Third session, Kyoto, 1-10, Dec., 1997.

*2 Free troposphere: Troposphere except planetary boundary layer and tropopause.