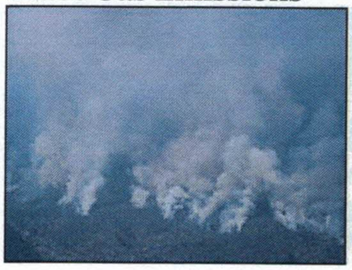
NASA Earth Observatory

Global Fire Monitoring

Trace Gas Emissions



Since the beginning of the industrial revolution, humans have transformed about 40 percent of Earth's land surface and have increased carbon dioxide levels by about 25 percent. Scientists estimate that from 1850 to 1980, between 90 and 120 billion metric tons (90-120 trillion kilograms) of carbon dioxide were released into the atmosphere from tropical forest fires. Comparatively, during that same time period, an estimated 165 billion metric tons of carbon dioxide were added to the atmosphere by industrial nations through the burning of coal, oil, and gas. Today, an estimated 5.6 gigatons of carbon are released into the atmosphere each year due to fossil fuel burning. Burning of tropical forests contributes another 2.4 gigatons of carbon per year; or, about 30 percent of the total.

Over the last decade, it seems that the regional distribution of biomass burning has increased worldwide, as well as the length of burning time. The result is a continuing increase in the release of emission products, and an increase in the severity of their impact on climate and on the environment. Scientists estimate that in just a few months the burning that took place in 1997 in Indonesia released as many greenhouse gases as all the cars and power plants in Europe emit in an entire year.

After carbon dioxide, the most significant greenhouse gas is methane, another emission product from biomass burning (about 10 percent globally). Although methane is about 200 times less abundant than carbon dioxide in the atmosphere, molecule for molecule methane is 20 times more effective at trapping heat. Since the beginning of the Industrial Revolution, methane has doubled in the troposphere. Additionally, its concentration has been increasing about 1 percent per year, so scientists are concerned that its relative significance as a greenhouse gas may dramatically increase in the future, although there are indications that this increase may have slowed down in the last decade.

Nitrous oxide (N_2O) concentrations have been increasing at about 0.3 percent per year for the last several decades. Yet, nitrous oxide has a lifetime of 150 years in the atmosphere, which contrasts sharply with the 10-year lifetime of methane. A single nitrous oxide molecule is the equivalent of 206 carbon dioxide molecules in terms of its greenhouse gas effect. Biomass burning accounts for about 2-3 percent of the total amount of tropospheric nitrous oxide.

Emissions of nitrous oxides and methane are further associated with the production of tropospheric ozone. Unlike "good" ozone in the stratosphere (upper atmosphere) that acts as a shield to screen out the sun's harmful ultraviolet rays, ozone in the troposphere is a pollutant that, when breathed, damages lung tissue and is also harmful to plants.

Greenhouse gases—such as carbon dioxide, methane, and nitrous oxide—are mostly "transparent" to incoming solar radiation; that is, they rarely interact with sunlight. However, these gases are very efficient at trapping heat radiated from the Earth's surface by absorbing and re-emitting it.

There is a wide margin of error in the estimates of biomass burning given above—significantly more error than in our estimates of industrial emissions. The accuracy of scientist's biomass burning emission estimates must be improved if they are to better understand, model and predict the impacts of the emissions on climate change.

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