CLIMATE CHANGE AND AIR QUALITY

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Climate and air pollution are closely coupled. Ground-level ozone absorbs solar radiation, and thus contributes to increases in global temperature. Particle pollution scatters or absorbs solar radiation and changes cloud formation processes and the amount of cloud cover. The net effect of particle pollution is cooling as scattering generally dominates.

Changes in climate affect air quality. Warming of the atmosphere increases the formation of ground-level ozone, while the overall directional impact of climate change on particle pollution in the U.S. remains uncertain.

Because of these links between climate and air quality, the National Academy of Sciences recommends that air pollution and climate change policies be developed through an integrated approach. A number of strategies being discussed for climate—energy efficiency, renewable energy, and reducing the number of vehicles on the highway will provide reductions in emissions that contribute to multiple air quality concerns such as ozone and particle pollution, toxic air pollutants, atmospheric deposition, and visibility.

TRENDS IN GREENHOUSE GAS EMISSIONS AND CLIMATE

EPA, in collaboration with other government agencies, tracks both changes in climate and changes in greenhouse gas emissions. Figure 31 shows the trends in domestic greenhouse gas emissions over time in the U.S. The dominant gas emitted is carbon dioxide (mostly from fossil fuel combustion). Total U.S. greenhouse gas emissions increased 15 percent between 1990 and 2006.

A number of EPA scientists participate on the Intergovernmental Panel on Climate Change (IPCC), an international scientific body that provides information about the causes of climate change and its potential effects on the environment. In a series of comprehensive reports completed in 2007, the IPCC concludes that "warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average global temperatures have been rising and the IPCC reports an increasing rate of warming over the last 25 years.

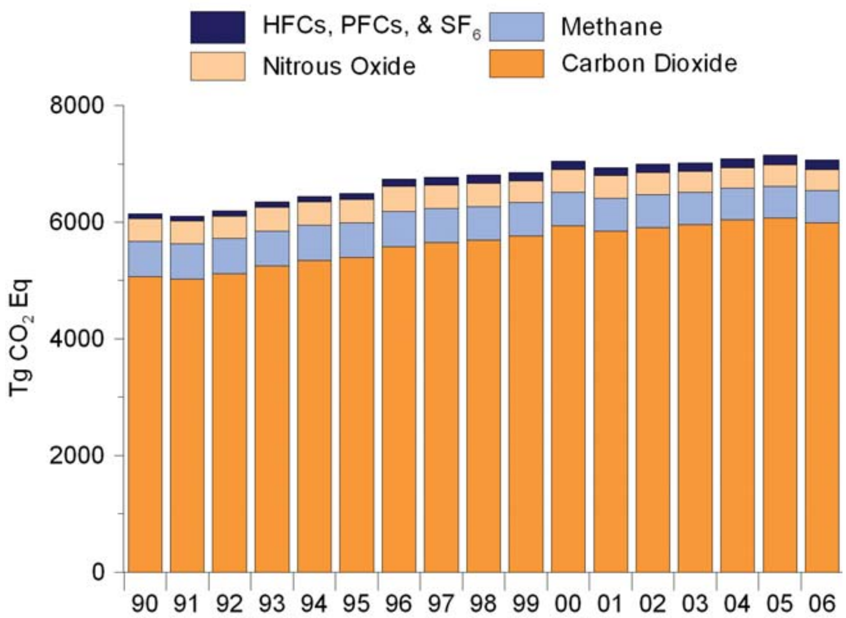

Figure 31. Domestic greenhouse gas emissions in teragrams of carbon dioxide equivalents (Tg CO_2 eq), 1990-2006. (Source: http://epa.gov/climatechange/emissions/usinventoryreport.html)

Notes: A teragram is equal to 1 million metric tons. Emissions in the figure include fluorocarbons (HFCs, PFCs) and sulfur hexafluoride (SF_6).

CHANGES IN CLIMATE AFFECT AIR QUALITY

Due to the warming, the IPCC projects with virtual certainty "declining air quality in cities." In summarizing the impact of climate change on ozone and particle pollution, the IPCC concludes that "future climate change may cause significant air quality degradation by changing the dispersion rate of pollutants, the chemical environment for ozone and particle pollution generation, and the strength of emissions from the biosphere, fires, and dust." Large uncertainties remain, limiting our ability to provide a quantitative description of the interactions between air quality and climate change. However, as noted in the following two examples, research is under way that will provide an improved understanding of these connections.

Using estimates from a computer model that assumes continued growth in global GHG emissions, a study cited in the 2007 IPCC report shows how ground-level ozone in the New York metropolitan area may increase from current levels given future climate change. Figure 32 shows this study projects daily 1-hour ozone increases of 0.0003 to 0.0043 ppm across the region due to climate change alone in the 2050s compared to the 1990s.

Pollutants from forest fires can affect air quality for thousands of miles. The IPCC reported that in North America wildfires are increasing and in a warmer future are likely to intensify with drier soils and longer growing seasons. Figure 33 shows increases in the annual frequency of large (>100,000 hectares) western U.S. forest wildfires (bars) associated with the mean March through August temperature. In the last three decades, the wildfire season in the western U.S. has increased by 78 days in response to a spring-summer warming of 0.87°C.

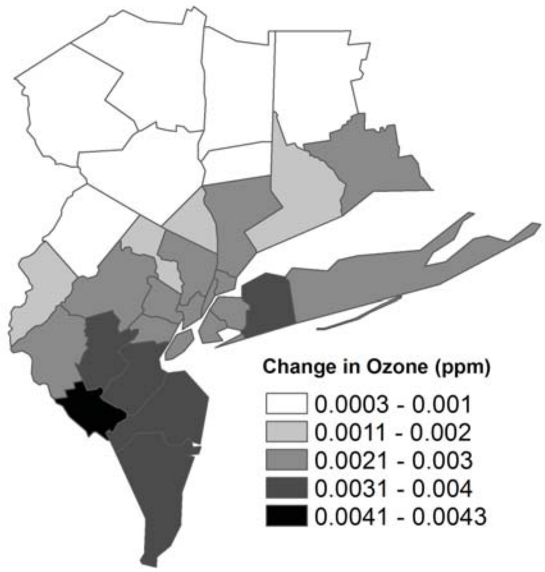

Figure 32. Estimated changes in 1-hour daily maximum ozone concentrations (ppm) in the 2050s compared with those in the 1990s for the New York metropolitan area, under scenario M1 in which climate change alone drives changes in air quality.

(Source: Knowlton K., et al. [2004] Assessing ozone-related health impacts under a changing climate. **Environ. Health. Perspect.**, *112: 1557-1563)*

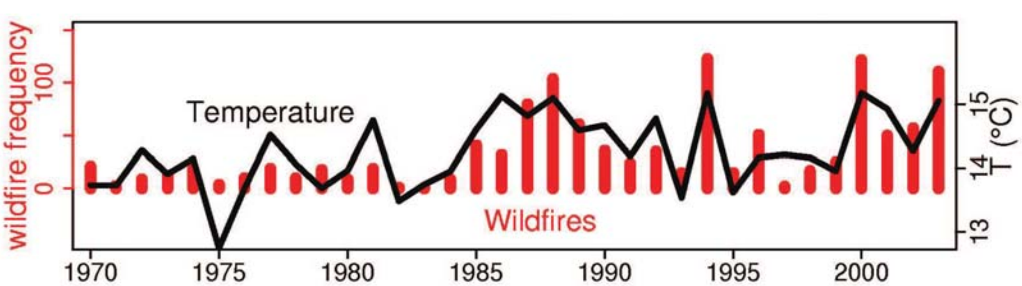

Figure 33. Frequency of Western U.S. forest wildfires compared to spring-summer temperature.
(Source: Westerling A.L., et al. [2006] Warming and earlier spring increase western U.S. forest wildfire activity. **Science**, *313: 940-943)*