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Smoke from forest fires kills approximately 340,000 people each year

Inhaling smoke from forest, grass and peat fires causes about 340,000 premature deaths worldwide every year, according to new research. Reducing the number and extent of human-induced landscape fires could significantly improve air quality, mitigate climate change and reduce the rate of biodiversity loss, say scientists.

Globally, landscape fires release two billion (10^{12}) kg of carbon into the atmosphere each year. Some wildfires occur naturally in dry areas but one of the biggest contributors is deforestation in tropical regions. Smoke from landscape fires is known to affect global temperature, regional cloud formation and rainfall patterns but this new research is the first to attempt to quantify the impact on human health. The estimate of 340,000 deaths represents premature mortality of the order of a few (1-4) years (depending on the severity and duration of the pollution) in people already at higher risk, such as those with chronic medical conditions, especially heart and lung diseases and the elderly.

The scientists looked at a group of particles known as $PM_{2.5}$. These particles, which include organic carbon and black carbon, have a diameter of less than 2.5 millionths of a metre and are easily inhaled. It is thought that $PM_{2.5}$ from landscape fires produces health effects akin to those caused by similar sized particles in fossil fuel smoke, including respiratory and cardiovascular disease. In the study, the scientists used satellite-derived data to estimate global fire activity between 1997 and 2006, the size of the area burned and the type of vegetation burned. They then input these data into a three-dimensional computer model to simulate how $PM_{2.5}$ in the smoke from the landscape fires was distributed in the atmosphere.

The results showed that, on average, 340,000 premature deaths every year could be attributed to $PM_{2.5}$ from landscape fire smoke around the world, the average exposure ranging from 0 to 180 days. The regions most affected by smoke as a *chronic* exposure (i.e. pollution lasts for whole seasons) were sub-Saharan Africa and Southeast Asia, with 160,000 and 110,000 deaths per year, respectively. In western and central Europe, which experienced *sporadic* exposure (i.e. pollution for a few days per year), the approximate number of deaths was 5000 per year. These figures were calculated for each country using the number of deaths expected from the level of exposure above a hypothetical minimum background concentration of smoke-related $PM_{2.5}$. Since little research exists specifically for landscape fire smoke, coefficients for the relationship between smoke-related $PM_{2.5}$ and mortality were derived from previously published estimates for slightly larger particles and for $PM_{2.5}$ from fossil fuel combustion.

The number of deaths attributable to $PM_{2.5}$ in the current study (340,000) is lower than previous estimates for fossil fuel-derived air pollution in cities (800,000) and the use of solid household fuel (1,600,000). However, the scientists acknowledge that there is a large amount of uncertainty in their estimates. They tested a range of assumptions used in their analyses, including the magnitude of the association between smoke exposure and mortality, the hypothetical minimum for background exposure to smoke, and different methods used to derive the exposure estimates. Groups at higher risk of death in association with air pollution are the same for short term as for long term (chronic) exposure to smoke. Chronic exposure puts people at risk of developing respiratory and cardiovascular diseases, while acute exposure puts people at risk of disease exacerbations. Both are associated with mortality, but the association is larger for chronic exposure. The interquartile range of all these estimates was 260,000–600,000 deaths per year. The average number of deaths per year was also shown to be sensitive to climate variability. Estimated mortality was 530,000 in El Niño years compared to 260,000 in La Niña years. This is attributed to the increased likelihood of fires caused by hotter and drier conditions, particularly in Southeast Asia. The study's estimate of exposure took atmospheric transport, deposition (eg with rain) and likely time in the atmosphere into account. But the estimate of mortality linked to the estimated exposures did not specifically examine other climate-related issues. Weather also affects mortality– thus heatwaves coinciding with landscape fire smoke, would further increase mortality.

Reducing landscape fires due to human activities in tropical regions could go a long way towards improving human health worldwide. As more empirical data become available, exposure assessment will significantly improve for $PM_{2.5}$, say the researchers. Ongoing uncertainties, however, include the extent to which global fires will increase if climate change causes modification of the El Niño cycle. Climate change could be affecting this high mortality rate.

Source: Johnston, F. H., Henderson, S. B. *et al.* 2012. Estimated global mortality attributable to smoke from landscape fires. *Environmental Health Perspectives*. 120(5); 695-701. DOI: 10.1289/ehp.1104422

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