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Regional Haze Evolved from Peat Fires—an Overview

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This work provides an overview of haze episodes, their cause, emissions and health effects found in the scientific literature. Peatlands, the terrestrial ecosystems resulting from the accumulation of partially decayed vegetation, become susceptible to smouldering fires because of natural droughts or anthropogenic-induced drainages. Once ignited, smouldering peat fires persistently consume large amounts of soil carbon in a flameless form. It is estimated that the average annual carbon gas emissions (mainly CO_2 and CO) from peat fires are equivalent to 15% of manmade emissions, representing influential perturbation of global carbon circle. In addition to carbon emissions, smouldering peat fires emit substantial quantities of heterogeneous smoke, which is responsible for haze phenomena, has not yet been fully studied.

Peat-fire-derived smoke is characterized by high concentration of particulate matter (PM), ranging from nano-scale ultrafine fraction (PM1, particle diameter < 1 μm) to micro-scale fine (PM2.5, particle diameter < 2.5 μm) and coarse fraction (PM10, particle diameter < 10 μm). The dispersal of the smoke could be blocked due to the stagnant weather condition, and then low buoyant smoke plume could accumulate and migrate long distances, leading to regional haze. Apart from air quality deterioration, haze leads to severe reduction in visibility, which strongly affects local transportation, construction, tourism and agriculture-based industries. For example, an unprecedented peatland mega-fire burst on the Indonesian islands Kalimantan and Sumatra during the 1997 El-Niño event, resulting in transboundary smoke-haze disaster. Severe haze events continue to appear in Southeast Asia every few years due to periodical peat fires in this region. In addition, smouldering peat fires have been frequently reported in tropical, temperate and boreal regions (Botswana in 2000, North America in 2004, Scotland in 2006 and Central Russia in 2010 et al.), peat-fire-induced haze has become a regional seasonal phenomenon.

Exposure to smoky haze results in deleterious physiologic responses, predominantly to the respiratory and cardiovascular systems. In 1997, an estimation of 100 million people in 5 countries in Southeast Asia were affected by Indonesia haze episode while 20 million people suffered from respiratory problems in Indonesia alone. Fine PM fraction generated from peat fires could penetrate into lower respiratory tracks and exacerbate respiratory diseases including chronic bronchitis, emphysema and asthma. Epidemiological studies show that direct exposure to haze pollution is associated with decreased pulmonary function and increased morbidity and mortality among individuals with pre-existent cardiovascular diseases. Reported cases of acute respiratory infection increased 3.8 times during the 1997 Indonesia haze episode (1,446,120 cases in total with 527 haze-related deaths). Collectively, peat fire and the resultant haze considerably affect the local society in many aspects, and more thorough research need to be carried out for further haze mitigation and governance.

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