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Scientists Assess Impact of Indonesia Fires

The fires burning in Indonesia over the past several months are setting aflame the biomass and wildlife habitat of the tropical forests, spreading a dangerously unhealthy haze across the populous country and nearby nations in southeast Asia, causing transportation hazards, and sending plumes of smoke up into the troposphere.

Most of the fires have been set—by big landowners, commercial loggers, and small farmers—in attempts to clear and cultivate the land, as people have done in the past. But this year a drought induced by El Niño limited the rainfall that could help extinguish the flames and wash away the smoke and haze. In addition, some scientists say that smoke could even delay the monsoon, which usually arrives in early November.

Johann Goldammer, head of the Fire Ecology Research Group at the Max Planck Institute for Chemistry at Freiburg University, in Germany, says he has seen similar situations before—in 1987, 1991, and 1994—and that another major episode also had occurred in 1982–83. They were all El Niño years when controlled and uncontrolled fires raged throughout Indonesia. Goldammer, who began working on fire issues in Indonesia in 1985, says that the current event is among the worst, with smoke concentrations heavier than before. He adds that with the world media jumping on the issue this year, both international awareness and political pressure to deal with the situation have increased.

Goldammer and other scientists say the regional impacts of the fires are severe, but that the long-term, global atmospheric consequences will be limited. They say the smoke plumes will not loft high enough into the atmosphere to disperse globally and cause direct forcing before rain scavenges the aerosol particles. Scientists express more concern, however, about global climate effects from the burning of peat materials and from indirect forcing.

Direct radiative forcing scatters solar light back into space and has a cooling effect on the atmosphere. However, direct forcing due to smoke from biomass burning worldwide recently has been determined to be far too small to counteract the greenhouse effect, according to Peter Hobbs, professor of atmospheric sciences at the University of Washington and Ronald Ferek, a scientist at the U.S. Office of Naval Research, and others, who published a paper in the March 21, 1997, issue of *Science*.

Indirect forcing produces smaller water droplets, which enhances the reflectivity of the sunlight and also has a cooling effect. Aerosol particles act as cloud condensation nuclei around which water droplets form. The reduced droplet size also potentially reduces the amount of rain falling from a cloud. Hobbs and other scientists say, however, that not enough is known about the potential global impact from indirect forcing.

A conference to discuss the current fires and haze takes place in Jakarta, Indonesia, from November 10–12. The "International Conference on Science and Technology for the Assessment of Global Environmental Change and Impacts on the Indonesian Maritime Continent" will discuss science and technology issues as well as an action plan to deal with the problem, according to Goldammer, a conference organizer.

In addition, the World Meteorological Organization last week announced the formation of a special task force—similar to one that investigated the 1991 Kuwaiti oil field fires—and a meeting, to be held next April, probably in Indonesia, to review the biosphere burning, climatic patterns that may have intensified the fires, and lessons that can be drawn from the event.

A number of other scientists also are conducting research on the smoke and visiting southeast Asia. Darold Ward, project leader for the fire chemistry research work unit of the U.S. Forest Service in Missoula, Montana, arrived in Indonesia earlier this week for a quick reconnaissance mission to learn more about the smoke. By taking air and ground samples, he hopes to determine some characteristics about the fire, including the type of vegetative fuel—leafy or woody—that is burning; whether the vegetation is being consumed by flames or smoldering; the amount of biomass the fire is consuming; and the effects of massive peat swamp fires in Borneo and Sumatra, which could consume large amounts of carbon and potentially smolder for years.

Ward, who has researched smoke in different ecosystems around the world, says the fires in Indonesia probably are similar to those in the Brazilian Amazon and the African savannah, where smoke accumulates and hangs over a community for weeks at a time.

A team of scientists from the National Oceanic and Atmospheric Administration (NOAA) and the U.S. Environmental Protection Agency also plans to visit Indonesia soon. NOAA's Air Resources Laboratory (ARL)—in its role as the U.S. Regional Specialized Meteorological Center—is providing forecasts of smoke concentrations of eight super plumes in the region that comprise thousands of smaller fires. In addition, several NOAA Environmental Research Laboratory groups, which operate sensing systems in the area, plan to assess possible radiative consequences of the smoke pall.

Jeff McQueen, research meteorologist with ARL, says that a computer model indicates that 500,000 hectares of biomass material are burning in Indonesia, with 27,000 kilograms of particulates burning per hour. According to McQueen, 300 million hectares of biomass burn worldwide annually. Combustion from other sources, including cars and factories, adds even more to total burning. The Indonesian fires, bad as they are, represent a small amount of the total biomass and other fuels aflame.

On a regional scale, direct radiative forcing due to smoke can be significant, affecting the local climate. Hobbs says, "You know that when you can't see the Sun, [direct forcing] is having a big effect locally and regionally."

Other potential regional concerns include biological impacts from the loss of forests; effects of haze on health and on the hydrological cycle; perturbation of the atmospheric water cycle due to lack of vegetation; enhanced erosion; increased mudslides when the rains come; and the potential effects of particulates settling in rivers and estuaries. However, many regional problems related to the haze will disappear once the monsoon arrives and saturates the land.

Yoram Kaufman, senior scientist at NASA's Goddard Space Flight Center, has studied fire and smoke events around the world. He says that although the global impact from one year's burning in Indonesia may not be significant globally, should similar-sized fires occur over the next 10–20 years there would be a significant problem. Kaufman, who is project scientist for NASA's Earth Observing System satellite, which launches in June, adds, though, that the fires in Indonesia are troubling for another reason. "It shows that Brazil is not alone, that Africa is not alone, and that there is new competition to pollute the planet."

For more information, view NOAA's web site: www.arl.noaa.gov/ss/transport/indofire; and the Online Haze Report web site: www.vensara.com/haze/.—*Randy Showstack*