Environmental Effects of Acid Rain

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ABSTRACT: In marine, or water, habitats, such as streams, lakes, and marshes, the ecological effects of acid rain are most clearly seen. After landing on trees, fields, homes, and highways, acid rain flows into streams, lakes, and marshes. Acid rain often falls directly on marine ecosystems. Each and every part of the environment is impacted by acid rain. Acid rain also destroys man-made products and structures Acid rain is one of the most severe environmental issues caused by air pollution Sulphur dioxide (SO2) and to some degree the main sources of acid rain are oxides of nitrogen and ozone. These pollutants originate from human activities such as combustion of burnable waste, fossil fuels in thermal power plants and automobiles.

KEYWORDS: Acid, Deposition, Ecosystem, Environment, Rain.

INTRODUCTION

The word 'acid rain' refers to the atmospheric accumulation of acidic components such as rain, snow, particulates, gases, and vapor that influence the earth. Ducros first identified acid rain and then described it by the English chemist Robert Angus Smith, whose groundbreaking research related sources to industrial pollution and included early findings of deleterious effects on the atmosphere. The work of Smith was largely forgotten until the mid-20th century, when observations began to relate air pollution to the deposition of atmospheric sulphate (SO4 2) and other chemical components, first in Sudbury, Ontario, Canada, North America, and Australia, near the metal smelter[1]. Our current understanding of acid rain as an environmental issue primarily caused by regional emissions of sulphur dioxide (SO2) and nitrogen oxides (NOx) derives from observations by Svante Oden in Sweden in the 1960s and early 1970s (Oden, 1976), and Gene Likens and colleagues in North America (Likens and Bormann, 1974). These scientists, and many others who followed, demonstrated the connection between the pollution from coal-fired power plants and other industrial sources and reported the environmental effects of acid rain on vegetation, fish and other biota, such as surface water acidification and toxic effects. It was the work of these pioneers that first brought to the attention of governments, policy makers, the media and the general public the need to tackle this issue, which gave impetus to strict regulations on air pollution in North America and Europe, leading first to reductions in SO2 emissions and subsequently to decreases in NOx emissions across these regions[2]. In Asia, acid rain was defined and described later than in North America and Europe. Similarly, decreases in emissions of SO2 and NOx started later in Asia than in North America and Europe, and emissions continue to increase in some Asian countries, such as India.In other dispersed regions of the globe, studies have shown that elevated levels of deposition of sulphur (S) and nitrogen (N) occur locally or regionally near industrial or coal combustion facilities. Downwind in marine environments, including (Galloway et al., 1989). Ammonia (NH3) and ammonium (NH4 Я) emissions have also been generally accepted as contributing to ecosystem acidification (ApSimon et al., 1987). Furthermore, atmospheric N deposition has been identified as an important source of nutrients for marine habitats and a contributor to eutrophication of estuaries[3].

Scientists continue to observe and research deposition levels and the status of ecosystem recovery in many countries, although acid rain is no longer prominently present in the North American and European media. Indeed, in recent years, many scientific advances have been made, such as: improving our understanding of the role of soils in mediating the recovery of ecosystems, unraveling the myriad factors influencing the response of biota to lower deposition levels, and recording the pace at which ecosystems are recovering. An unforeseen hemispheric-scale ecosystem disturbance experiment that warrants ongoing research is acid rain. New findings inform scientists about the potential of habitats to recover from this significant disruption in magnitude[4]. In addition, awareness of the interaction of air contaminants such as mercury (Hg), ozone (O3) and others with those of SO2 and NOx, the key drivers of acid rain, is rising. In this special issue of Atmospheric Environment, the 31 papers published reflect the latest information on the state of acid rain worldwide, the degree to which the habitats affected are recovering or are likely to recover from the impacts of acid rain, and the interactions of acid rain with other contaminants, climate change, and the carbon cycle. These articles represent a selection of those presented at Acid Rain 2015, the 9th International Acid Rain Conference held in Rochester, New York, USA in October 2015. The articles are divided about equally between those that discuss atmospheric deposition and chemistry and those that discuss the ecosystem effects of acid rain. These articles highlight common scientific themes that transcend geographic regions as well as emphasizing key regional differences in deposition patterns, ecosystem effects, and air pollution policies[5].

Temporal and spatial patterns in acid deposition

Precipitation SO4 2 concentrations and loads have decreased in North America and Europe since the 1970s or 1980s, as shown by Driscoll et al. (this issue) in the Adirondack Mountains of the northeastern USA, Watmough et al. (this issue) in Ontario, Canada, Pascaud et al. in France, and Rogora et al. (this issue) in Switzerland and Italy's alpine region. In these studies, temporal trends in NO3 deposition have shown a different trend than those of SO4 2 only since the beginning or early part of the 21st century, with declining concentrations and loads apparent. Despite decreases in NOx emissions, decreases in precipitation NO3 concentrations are not evident in some cases, indicating that changes in atmospheric chemistry can influence long-term trends[6]. These four studies suggest that precipitation pH has risen by a few tenths to nearly one full unit across eastern North America and southern Europe, despite less pronounced downward trends in atmospheric NO3 deposition[7].

The highest rates of S and N atmospheric deposition on earth are currently occurring in parts of Asia and study in this field is of great interest to the scientific community. With major variations, temporal patterns of acid deposition in Asia show similarities to those recorded in North America and Europe. In Asia, emissions of SO2 and NOx did not begin to decrease until more recently than in Europe and North America, in line with the observed trends in SO4 2 and NO3 atmospheric deposition[8]. Since the 1990s, decreases in SO2 emissions and in precipitation SO4 2 concentrations have occurred in Japan and South Korea, while decreases in China did not begin until after 2005. Emissions of NOx did not peak in China until 2012, and thus far, decreases in NO3 deposition are not evident. Because China is a large source of N emissions that affect deposition patterns in downwind areas, decreases in atmospheric NO3 deposition are not yet evident at remote sites in Japan. SO2 and NOx emissions continue to increase in Southeast Asia and India, but a lack of records of long-term atmospheric deposition does not permit trend generalizations. In areas of Asia, other aspects of atmospheric deposition also vary from those of deposition in eastern North America and Europe. In northern China, for example, deposition is affected by large arid regions to the east that contain air masses with high concentrations of particulate matter. Most of the S and N deposition falls as dry particulates as these air masses travel westward through regions with high S and N emissions. Additionally, precipitation pH is higher for given levels of S and N deposition in northern China and in parts of India due to neutralization by high concentrations of base captions such as calcium (Ca2þ) and magnesium (Mg2þ)[9].

All effects would, of course, be exacerbated if acidic deposition were to increase. Experimental data and calibrated models enable us to estimate the degree of enhancement where the effects have been quantified, such as with lakes, at ambient levels of acid deposition. Acid rain will not be permitted to increase as the public and the political leadership is committed to reducing air pollution. In fact, a significant reduction in SO2 emissions will be expected by the proposed legislation. The pace and magnitude of the reduction are the only problems being discussed. Therefore, studying the impact of increased pollution is not useful. In the near term, a worst-case scenario for the next few decades might suggest that current pollution and acid deposition levels would remain unchanged. If so, the above-described human health situation, the rate of damage to building materials, the decrease in high elevation red spruce trees, crops, visibility, and the percentage of the lake area made inhospitable for fishing will not improve[10]. In the very long term, the leaching of vulnerable soils could be caused by prolonged acid rain at present levels to the point that tree nutrition could be impaired and some new lakes and streams would become too acidic to maintain healthy fish populations. The results will remain unchanged on other receptors. If, as suggested by some legislation, the emissions of SO2 were abruptly cut in half, acid deposition will be reduced by only around 30 percent, because the relationship is not linear. Such a decrease will theoretically favor all receptors, but no change can be quantified in cases where no clear negative effects have been seen on crops, trees, building materials and human health. Visibility would increase over the long term, but as sulphate aerosols are responsible for just a fraction of the interference, the gain would be proportionately smaller than the 30 percent reduction in acid formation. In the glaciated and other areas where the lake and stream chemistry is essentially in equilibrium with the acidity of the rain, a new equilibrium would be reached in less than a decade[7].

CONCLUSION & DISCUSSION

These emissions come from human activities, such as the burning of combustible waste, thermal power plant fossil fuels, and vehicles. These components interact with atmospheric reactants and result in acid deposition Due to the interaction of these acids with other atmospheric components, protons are released causing soil acidity to increase, soil pH mobilizes to decrease and leeches away nutrient captions and increases the supply of toxic heavy metals as acid rain flows through soils in a watershed. So, as the pH decreases in a lake or stream, aluminum levels increase. Low pH as well as elevated levels of aluminum is also specifically harmful to fish. In addition, chronic stress is caused by low pH and elevated aluminum levels that may not kill individual fish, but contributes to lower body weight and reduced size, making fish less capable of competing for food and habitat. Acid rain creates a cascade of effects that damage or destroy individual fish, decreases the number of fish stocks, removes fish species from the water body entirely and reduces biodiversity. These mobilized contaminants are dissolved in soil and water make their way to groundwater that is drunk by humans and contaminate the food (Fish, meat, and vegetables) eaten by humans .These heavy metals get accumulated in the body and resulted into various health problems like dry coughs, asthma, headache, eye, nose and throat irritations.

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