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Podcast Script

Societal Implications of Industrial Emissions Preserved in Global Ice Archives

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Hello, my name is Ashley Suitter and this is a podcast I prepared for a senior project. This podcast will provide some basic information about using ice cores to study past climates and atmospheric conditions, what the results of these studies suggest, why this is relevant to your life, and what you can do about it.

Over the years technological advancements have led to new methods for collecting data from our environment. These methods allow us to study both current and past environmental conditions. This information will help us to predict what changes may happen in the future and allow us to determine how to deal with the problems observed. One method used for studying past climate and atmospheric changes is the analysis of ice cores. The information I'll be discussing during this podcast was learned using ice cores.

Ice cores have been collected for several decades by teams of researchers throughout the world. The development of this method has been valuable in scientists' efforts to learn about past climates and how our current climate compares with previous ones because no other method allows direct measurement of past atmospheric composition. The ice in glaciers and ice sheets is a treasure trove of atmospheric data. Every year new layers of snow are deposited on ice sheets and glaciers. As this piles up and is compacted it traps gases and particles present in the atmosphere at that time. By drilling and analyzing ice cores, we can study the physical and chemical properties of the ice which was deposited and learn about past environmental conditions. The dust, ash, and gases collected can be used to reconstruct past climates and the timing of events which would have caused increased concentrations of certain elements in the atmosphere, like volcanic eruptions.[1]

Advanced technologies and collaborations between different institutions have led to large archives of data which can illuminate the trends and variations occuring in Earth's climate during the last 800,000 years.[2] This data shows trends of glacial periods followed by interglacial periods in 100,000 year intervals. An interglacial period is a time interval when the average global temperature warms for thousands of years between glacial periods, when it gets colder and glaciers spread.[1]

Atmospheric levels of carbon dioxide correspond well with global temperature so by graphing recorded carbon dioxide levels found in ice cores we can see how the temperature has changed during the last several hundred thousand years. From 800,000 years ago to present day the carbon dioxide levels have regularly varied between about 175 parts per million to 300 parts per million. The peak at 300 parts per million happens during an interglacial period. Since we are currently in an interglacial it is expected that the carbon dioxide levels would be near this 300 parts per million mark, however data consistently shows the levels have increased to about 390 parts per million. It is normal for the levels to fluctuate over 50-100 thousand year periods, but the increase we have experienced in the last few hundred years is significantly higher and more rapid than any previously recorded.[1]

It is not only carbon dioxide levels which have risen in the last few hundred years. The concentrations of various heavy metals in the atmosphere have increased since the second half of the twentieth century, even compared with levels as recent as the seventeenth and eighteenth centuries.[3,4,5] These include cadmium and lead which are common air pollutants and are emitted as byproducts of industrial activities. Once in the atmosphere they can be inhaled or rain down, contaminating crops.[4] This has negative

effects on not only the environment and wildlife but also on the health of humans. Many of these metals have long lifetimes and can contaminate areas far from their source. An 8,000 year-long ice core record from the Mt. Logan summit plateau gives evidence for trans-Pacific spread of lead emissions and a greater than 10-fold increase in lead concentrations beyond the recorded natural levels. Mandatory emissions reductions and the phase out of leaded gasoline in most areas in the 1970s caused levels to decrease, but these measures are not as stringent in areas such as Asia.[5,6] Cadmium concentrations found in ice cores in the Swiss-Italian alps show that the average concentration after 1970 was over 36 times greater than the average concentration before the 1700s.[3] Historical data gathered from lake sediments in Scandinavia show a two- to five-fold increase in mercury concentrations compared to the pre-industrial era.[4] High levels of these sorts of pollutants is very concerning because of the potentially serious health effects of exposure to them. Cadmium exposure is associated with kidney and bone damage and may cause lung cancer. Lead can cause developmental problems in children and raise blood pressure in adults. Approximately 80-90% of human lead exposure is through food, most of which is due to contamination by lead in the atmosphere.[7] Exposure to mercury can lead to nervous system and cognitive problems in children and kidney and respiratory issues in adults.[4]It is very likely that the increases in these pollutants are due to human activity through industries developed in the last few hundred years since they are substances emitted through these industrial activities and their concentrations began to increase so rapidly during the same time span that these processes were being developed.[4,6,7]

Although the impacts of this type of pollution are already apparent, it is possible to turn things around. There have been other cases in history and even in recent years when people realized the dangers of a chemical or practice and worked to lessen pollution levels and decrease contamination of our air, soil, and water. So-called “acid rain” in Europe is an example of a success story. Industrial emissions were making the rainwater acidic enough to damage trees and contaminate soil but through improvements in regulations and practices they have lessened this problem and made those areas safer for their citizens.[8]

Within the last century countries have begun to set limits on emissions of these and other pollutants due to mounting evidence that they are health concerns. Improvements in technology have also helped decrease the amounts of some pollutants being emitted in recent years. This is a very important step but because the metals still exist in the atmosphere and accumulate in soil they continue to be a problem. Their ability to be spread over long distances makes this a global concern. Given recent increases in U.S. Healthcare costs it becomes not just a public health risk but also an economic concern.

Direct energy use by households accounts for 38 percent of the overall U.S. CO_2 emissions, or 626 million metric tons of carbon, a larger amount than any country except China. This amount can be reduced by changes as easy as using more efficient household appliances, line-drying laundry, and other adjustments which would reduce emissions while keeping the same quality of life. If 90 percent of people weatherized their homes it could save 21.2 million metric tons of carbon and if only 50 percent of U.S. Citizens used fuel-efficient cars it could keep 31.4 million metric tons of carbon out of the atmosphere. It was estimated that the national reasonably achievable emissions reduction is 20% within 10 years by making changes such as these, and higher if a larger percentage of

citizens enacted these changes.[9]

It can be hard to see the changes in our atmosphere as an immediate concern that people worldwide should share but given the extensive evidence showing the steadily increasing levels of dangerous materials in our air and soil it is clear we need to, as a society, take this seriously and take action to lessen or prevent future harm. Therefore it is important that when considering electing government officials or voting on a proposal we take into account the positive or negative effects it would have on our world and the health of the people in it. As a global issue it is something that should be addressed on a large scale. This could be done through government policies regulating the emissions and energy consumption of the people and companies in their country as well as through cooperation among countries. On an individual basis we can make reasonably small changes in our lives which can lead to beneficial decreases in emission rates. Because we breathe air and eat food grown in soil that is impacted by our level of emissions reducing pollution should be at the forefront of everyone's minds. We can lessen the amount of pollution we're causing, but it will require changes and it is very important that these changes be made as soon as possible for everyone's wellbeing.

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