The Science of Global Climate Change

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Thank you for the opportunity to speak before you today. I am Dean of the Nicholas School of the Environment and Earth Sciences at Duke University—the nation's first school wholly focused on professional graduate education in environmental science and policy. We have 50 faculty and more than 400 students who, every day, study critical problems of the environment, including climate change.

It is, of course, the issue of climate change that brings me before you today. Despite a few nay-sayers, I have never before seen a scientific consensus that is stronger than that which accompanies predictions of future climate change. Last year, the American Geophysical Union (AGU), the nation's premier society of more than 10,000 earth scientists, issued a new statement on climate change, which says, "Human activities are increasingly altering the Earth's climate. These effects add to natural influences that have been present over Earth's history. Scientific evidence strongly indicates that natural influences cannot explain the rapid increase in global near-surface temperatures observed during the second half of the 20th century."

After 10,000 years of relatively stable concentrations, the carbon dioxide content of Earth's atmosphere began to rise rapidly at the start of the Industrial Revolution, with concentrations increasing from around 270 ppm in 1850 to today's value of about 380 ppm. Along with other gases, carbon dioxide imparts a "greenhouse" warming to Earth's atmosphere. The natural greenhouse effect is enough to keep Earth's temperature above the freezing point of water—something we can all be thankful for. Rising concentrations can be expected to raise the temperature of the planet, especially at night and in polar regions. The temperature on Venus is 890 F, versus a predicted equilibrium temperature of 130 F, which would be found if Venus had no CO_2 in its atmosphere.

During the past 500,000 years, through several ice ages, the Earth has shown a strong correlation between its temperature and carbon dioxide concentrations, as measured in Antarctic ice cores. The cause-and-effect relationship is still under scientific scrutiny, but there seems to be no doubt that when CO_2 has risen, so has the Earth's temperature. The rise in Earth's carbon dioxide during the past 150 years is well correlated to a rise in its temperature, as seen in the records of tree rings, weather stations, measurements taken from satellites, and trends in Arctic ice.

Future increases in Earth's temperature—global warming—around 4 to 10 F for our state are destined to cause changes in the distribution of vegetation, drought, frequency and occurrence of

tropical diseases, the intensity of hurricanes, and sea level rise. The latter is due to the thermal expansion of the ocean and a loss of "grounded" ice, from mountain and polar glaciers. We can expect an 18" rise in mean sea level by the end of this century, leading to inundation of much of our coastal areas, a reconfiguration of many beaches and barrier islands, and perhaps even the disappearance of the Outer Banks. If not under water under calm conditions, these areas will be subject to catastrophic overwash during hurricanes, which themselves are predicted to be more frequent and severe with global warming.

We can expect large changes in what grows in North Carolina—the crops that feed us and the forests that form such an important part of our economy. More than one model shows increases in the productivity of hardwood forests, at the expense of conifers. North Carolina will not be treeless, but if I were a corporate executive in the forest products industry, I would seriously question whether I was planting the right trees today for harvest tomorrow. The rising levels of carbon dioxide in our atmosphere that cause global warming are known to increase the growth of trees, but also the growth of poison ivy and the production of pollen—a problem for all of you that may suffer from summertime respiratory problems. In the high CO_2 experiment in Duke Forest, the growth of poison ivy increased more than three-fold and the active content of the skin allergen was higher in its leaf tissue.

We can expect other impacts on the health of North Carolina citizens. Looking globally, there is a strong correlation between climate and the occurrence of disease. A warmer North Carolina will certainly be more likely to harbor some diseases now confined to and associated with the tropics. The health community in this state can expect a greater epidemiology of diseases, along with a greater occurrence of direct heat-related deaths such as by stroke.