

Engi 9601, In Class Assignment, 25 Sept. 2012
Shindell et al., 2012, Simultaneously Mitigating Near-Term Climate Change and Improving Human Health and Food Security, Science, 335:183-189

Answer the questions below in your own words as much as possible. Point form is OK. (18 marks total).

- 1) List all the main sources that were considered to be both contributing to climate change and degrading air quality. (3 marks)

Coal mining, oil and gas production, long distance gas transmission, municipal waste and landfills, wastewater, livestock manure, rice paddies, diesel vehicles, clean-burning biomass stoves, brick kilns, coke ovens, agricultural waste burning, high emitting vehicles, primitive cooking and heating, tropospheric ozone, black carbon, methane

- 2) The trends in Figure 1 that take account of CO₂ measures are convex (or curving down) whereas the trends that do not include CO₂ measures are concave (or curving up). Explain the reasons for the different curve shapes. (2 marks)

CO₂ has a long atmospheric lifetime and so the effects of reductions will not be felt for a long time whereas tropospheric ozone, CH₄, and BC have short atmospheric lifetimes and so their emission reduction will have a much sooner effect

- 3) What is albedo and why is it important in the arctic? (2 mark)

Albedo is the proportion of incoming solar radiation that is reflected back into space. Ice and snow in the arctic have highly reflective surfaces and so reflect a much higher proportion of sunlight than the other surfaces and so there is more of a cooling effect

- 4) What is black carbon and what is black carbon forcing? Why is BC forcing especially important in the arctic? (3 marks)

Black carbon includes the carbon particulates of incomplete combustion such as soot and charcoal. These particles in the air absorb sunlight and warm the atmosphere. Over the arctic they will absorb sunlight that would have otherwise been reflected and so the effect is stronger. They can also be deposited on the ground and reduce the reflectiveness of the ice and snow and so increase warming

5) Why do BC measures have a greater impact on health than CH₄ measures? (1 mark)

BC includes pm_{2.5} which is dangerous when inhaled into the lungs and can cause heart attacks and lung disease

6) The paper gives the most abundant sources of CH₄ emissions by geographic location. List these sources (and locations) in order of most significant to least significant based on the data from the Intergovernmental Panel on Climate Change. (3 marks)

coal mining in China, oil and gas production in Central Africa, the Middle East, and Russia, coal mining in south Asia, gas transmission in high-pressure mains in Russia, and municipal waste in the United States and China

7) Which group of measures is predicted to have the greatest effect on agriculture by 2030? Explain how this occurs. (3 marks)

CH₄ measures show the greatest effect on agriculture in Table 2. CH₄ measures have the greatest effect on warming and crops can only adjust so much to temperature change. Climate change will also bring about change in rainfall patterns which will affect crops.

8) What is the advantage of combining a study on climate change, human health and food security? (1 mark)

The authors suggest that when the people are aware that addressing the problems of human health and food security will also address the problems of climate change that they may be more motivated to take action