Warming world in range of dangerous consequences

September 17 2008

Scripps Atmospheric and Climate Sciences Professor V. Ramanathan. Credit: Scripps Institution of Oceanography, UC San Diego

The earth will warm about 2.4° C (4.3° F) above pre-industrial levels even under extremely conservative greenhouse-gas emission scenarios and under the assumption that efforts to clean up particulate pollution continue to be successful, according to a new analysis by a pair of researchers at Scripps Institution of Oceanography at UC San Diego.

That amount of warming falls within what the world's leading climate change authority recently set as the threshold range of temperature increase that would lead to widespread loss of biodiversity, deglaciation and other adverse consequences in nature. The researchers, writing in the online edition of the *Proceedings of the National Academy of Sciences,* argue that coping with these circumstances will require "transformational research for guiding the path of future energy consumption."

"This paper demonstrates the major challenges society will have to face in dealing with a problem that now seems unavoidable," said the paper's lead author, Scripps Atmospheric and Climate Sciences Professor V. Ramanathan. "We hope that governments will not be forced to consider trade-offs between air pollution abatement and mitigation of greenhouse gas emissions."

In their analysis, Ramanathan and co-author Yan Feng, a Scripps postdoctoral research fellow, assumed a highly optimistic scenario that greenhouse gas concentrations would remain constant at 2005 levels for the next century. For the concentrations to remain at 2005 levels, the emissions of greenhouse gases such as carbon dioxide must decrease drastically within the next decade. Economic expansion, however, is expected to see emissions increase. The researchers then analyzed expected future warming by assuming that the cooling effect of man-made aerosol pollution will be eliminated during the 21st Century. Currently, particulate air pollution caused by fossil fuel combustion, forest fires and smoke from cooking and agricultural waste burning serves to mask global warming caused by greenhouse gases. The smog does so chiefly by creating a dimming effect at Earth's surface.

But mitigation of this type of pollution has been increasingly successful by countries around the world. Because soot and similar particles remain airborne only for a matter of weeks, it is expected that clean-up efforts produce relatively immediate results. Therefore, the authors based their projections of temperature increase assuming the absence of these pollutants in the atmosphere.

By contrast, greenhouse gases can remain in the atmosphere for decades or, in the case of carbon dioxide, more than a century.

Ramanathan and Feng estimated that the increase in greenhouse gases from pre-industrial era levels has already committed Earth to a warming

range of 1.4° C to 4.3° C (2.5° F to 7.7° F). About 90 percent of that warming will most likely be experienced in the 21st Century. In 2007, the Intergovernmental Panel on Climate Change identified a temperature increase range between 1° C and 3°C (1.8° F and 5.4°F) as the threshold at which society commits the planet to biodiversity loss and deglaciation in areas such as Greenland and the Himalayas.

The pace at which the world approaches the threshold depends in part on national and international air pollution reduction policies. Despite the masking effects of atmospheric aerosols, the authors note that their removal is still an important objective because of the deleterious human health, agricultural and water supply effects of smog. The authors point out that the real problem is not the reduction of air pollution, but it is the lack of comparable reductions in emissions of CO2 and other greenhouse gases to offset the reductions in the surface cooling effect of fog. The paper also offers potential solutions.

"Given that a potentially large warming is already in our rear-view mirror, scientists and engineers must mount a massive effort and develop solutions for adapting to climate change and for mitigating it," Ramanathan said. "Drastic reduction of short-lived warming agents is one way to buy the planet time for developing cost-effective ways for reducing CO2 concentrations."

Source: University of California - San Diego