appeared on 15th Jul 2008

Shading the earth is not all good

Global DIMMING is proving as dangerous as global warming, says S.Ananthanaryanan

Side by side with raising temperatures by pumping greenhouse gases into the atmosphere, exhaust fumes and power station emissions are also leading to ***drop in temperatures***, with equally damaging results. This contrary effect, of lowering temperatures is called ***Global Dimming.***

Greenhouse gases

Gases whose molecules are able to absorb and store heat in the atmosphere are called greenhouse gases because they trap the heat we receive in sunlight and warm up the earth. The most common gas in the atmosphere is nitrogen, whose molecule is a simple dumbbell of towo atoms, each fourteen times as heavy as an atom of hydrogen. Against this, carbon dioxide, the most common greenhouse gas, is a three-headed mammoth, with a carbon atom, twelve times as heavy as hydrogen, in the middle and two oxygen atoms, each one sixteen times as heavy as hydrogen, on the sides. Apart from being a lot heavier, the three-headed form has a 'spinning momentum' about five times as great as nitrogen and also many forms of storing energy as 'vibrating modes' and 'twisting modes'. Methane, the other common greenhouse gas, is actually lighter, but with five atoms in the molecule, it has even more heat storing capacity!

So, as we burn fossil fuels and fill the air with carbon dioxide, the atmosphere stores more heat than it loses and the earth gradually warms up. Apart from unpredictable effects on the climate, this directly causes melting of arctic ice and snows and this would lead to rising of the sea level. This would jeopardize coastal settlements and also modify rainfall behaviour. At the same time, melting of glaciers that feed the world's most important rives would lead first to floods and then to drought as the river beds dry, with no glaciers left to feed the rivers.

Contrary effect

All the above is because of rising temperatures, caused by the use of fossil fuels. Fossil fuels also create pollutants like sulphur dioxide, soot, ash, which have their own affects, mostly harmful and one effect is on the formation of clouds. Pollution that consists of minute particles leads both to the formation of clouds and to formation of water droplets and ice crystals in clouds. Now, clouds act as a reflective roofing cover over parts of the earth and in these parts the energy received from the sun is reflected back to space! The result is then that there is less heating of the earth, or cooling, and the effect is called ***global dimming***.

At first glance it may appear that the by-products of greenhouse gas production are thus acting to mitigate the effect of global warming. At first glance, yes, this is true, there is some moderation of temperature rise. But it is not temperature rise, *per se*, that we are worried about, it is the effects of temperature rise, particularly the effect on ice formations at the poles and in glaciers, and the consequences for the climate and human populations.

In this respect, global dimming has been seen to be affecting the hydrological cycle – where the heat energy of the sun drives the evaporation of water from the sea and the water cycle through cloud formation, convection winds and then rainfall. With reduced delivery of heat down at the surface of the earth, there would be less evaporation and also less heating of land masses, to give rise to winds that blow from over the sea, laden with moisture.

Scripps' Study

Global dimming could thus affect fresh water supplies on which millions of people depend. In a study in the American Meteorological Society's *Journal of Climate*, Chul Eddy Chung and V. Ramanathan of Scripps Oceanography, San Diego, have described their conclusions from sea-surface temperatures and other data from the Indian Ocean region.. They find that cooler-than-normal temperatures in the northern part of the ocean have weakened the natural climate, circulation and monsoon conditions, resulting in reduced rainfall over India and increased rainfall over the Sahel area south of the Saharan Africa.

As the tropical Indian Ocean heats up due to greenhouse gases, the authors say, the northern Indian Ocean is not warming as quickly as the rest of the ocean, resulting in increased drought conditions that could affect a range of industries and resources, from agriculture to freshwater availability and.more than two billion people in South Asia.

"It appears that the whole tropical region in this area is being pulled in different directions," says Ramanathan, director of the Center for Clouds, Chemistry and Climate at Scripps. "The observed trend of reduced sunlight reaching the Earth's surface, with compensating solar heating aloft from the pollution, also called the 'brown haze,' appears to be masking the greenhouse warming in the northern Indian Ocean, while the greenhouse warming continues unabated in the southern Indian Ocean. We are starting to see that the air pollution affects sunlight and is potentially having a major disruption of the rain patterns, with some regions getting more and some less."

Global dimming is hence no antidote to warming but a creator of havoc in its own right, apart from maybe masking the real impact of fossil fuel based energy use.

The vapour trails created by jet aircraft have been suspected as being one more agent of dimming. The products of burning hydrocarbon fuels, like aviation fuel, are water vapour and carbon dioxide. At high altitudes, the vapour rapidly condensing into water and freezing to ice, producing the so called contrails behind jet aircraft.

However, as contrails are rapidly disturbed by movement of air, their role in global dimming could not be tested. An occasion arose in the three days after the 11th Septermber attack in New York, when all civil aircraft movement was curtailed. This created a three-day period of no contrail-induced vapour and ice crystals in clouds, and was a rare opportunity to see what would happen. It was seen that there was a rise in the day temperature by 1ºC – which suggests that contrails have a strong effect of keeping the day temperature down. During the three day contrail holiday, there was also fall in the night temperature, as there were no clouds to keep the heat in!