ANTHROPOGENIC AEROSOLS AND CLIMATE CHANGE

AN ALTERNATIVE VIEW

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Table of contents

Summary

In order to mitigate climate change, policymakers need to carefully consider why these changes are taking place. While many believe that global warming is the result of rising levels of carbon dioxide (CO_2) emissions, I put forward the view that it is related to toxic by-products of the burning of petrol.

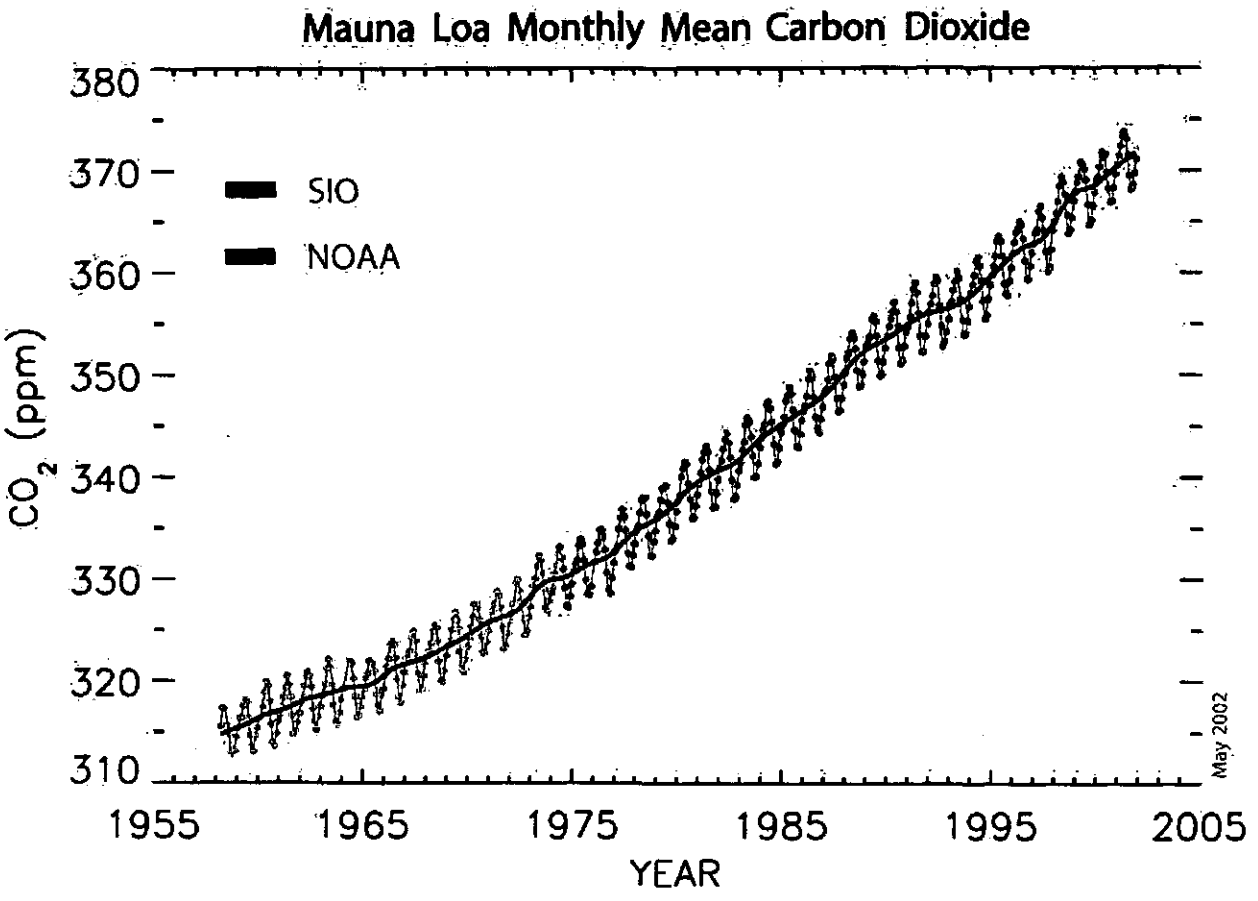
These by-products, called polycyclic aromatic hydrocarbons (PAH), act as anthropogenic aerosols. The PAH attach to natural water-attracting aerosols from the ocean and inhibit cloud production and rain.

I suggest that the effects on climate change of PAH could be mitigated by:

- phasing out the use of petrol as fuel for all automotive transport
- creating coastal forests
- adopting perennial forest management protocols.

Introduction

When the graph below was first published by the Mauna Loa Observatory, it created the belief that the rising levels of carbon dioxide (CO_2) were directly related to observed changes in the world climate. The gas CO_2 was seen to be responsible for global warming and was thus classified as a greenhouse gas.



The result has been to create a panoply of programs to capture the gas and to reduce the emissions from power stations, especially those burning coal.

But that is not the only way this graph can be interpreted.

There is a close affinity between CO_2 and water, and in the atmosphere they are rarely found apart. What this graph recorded is that, in samples of freeze dried air (not mentioned on the chart), the CO_2 component slowly increased with time, the inference being that there was less water vapour available for the gas to mate with. The differential has increased at the rate of 12.5 per cent per decade.

It may be just a coincidence that growth rate of the world population over that period was 12 per cent. *(Wikipedia)*

To find the causes of this decrease in atmospheric water it is necessary to look elsewhere.

Anthropogenic aerosols and climate change.

Carbon dioxide is 50 per cent heavier than air, so that when it forms a couplet with water vapour, the pair sinks slowly into the ocean. This natural drying process is normally balanced by evaporation from the oceans, cloud formation and precipitation; however, there appears to be a problem developing in the cloud formation stage.

Cloud formation from water vapour depends on the presence of suitable particles called aerosols that are hydroscopic (water-attracting). These come from the oceans and are typically sea salt or wind blown dust. Also present in the atmosphere are anthropogenic aerosols, which can inhibit cloud formation.

> The scattering of energy associated with aerosols is amplified by the fact that some aerosols act as nuclei for cloud droplets and can thereby increase the reflectance of clouds. They also may modify the lifetime of clouds by affecting precipitation. The extent of these mutual effects of aerosols on clouds and of clouds on aerosols is perhaps the single largest unknown in climate change prediction.
> *(US Earth Systems Research Laboratory/ Climate and Air Quality)*

> The comforting fire that graces your hearth or keeps your car or furnace humming is really a chemical reactor. Although most of the substances it produces (such as water and carbon dioxide) are more or less harmless, the burning of fuel can also produce a variety of chemicals that are harmful to the environment. One of the most prominent groups of chemicals in smoke, soot and exhaust are polycyclic aromatic hydrocarbons or PAH; natural products of the incomplete combustion of carbon compounds. When released directly into the atmosphere through burning, PAH may attach to small particles and be transported for considerable distances before returning to earth.
> *(Envirofacts)*

Being the leftover atoms from incomplete combustion, PAH form a group with over 100 variants and can collectively be described as sticky, insoluble, carcinogenic, toxic vapours.

At ground level temperatures these vapours stick to dust particles and rapidly disappear; unattached ones disperse in a few hours. At the lower temperatures of higher altitudes they may persist for days or weeks and ocean aerosols become a ready target. With an insoluble coating of PAH these ocean aerosols are no longer effective so cloud production and precipitation is reduced.

Water vapour in the atmosphere also serves another purpose. Compared with the other atmospheric gases, it has nearly twice the heat-absorbing capacity (specific heat value) and acts as a thermal sponge. As its stabilising effectiveness is reduced, weather patterns become more violent.

Anthropogenic aerosols and public health

> Common examples of the adverse health effects of aerosols among humans are the higher incidence of bronchial infections during periods of high aerosol loading, and short- and long-term adverse reactions to the toxicity of pollution particles.
> *(US Earth Systems Research Laboratory/ Climate and Air Quality)*

Traffic fumes are associated with respiratory problems:

> Pregnant women have been advised to reduce their exposure to traffic fumes after Australian researchers found strong evidence that air pollution may stunt the growth of unborn babies. The main pollutants, all mainly caused by car and truck exhausts, were strongly associated with reduced fetal growth at between 13 and 26 weeks of pregnancy among hundreds of Brisbane women.....
> *(The Australian Tuesday Jan 8. 2008)*

> Traffic fumes may be just annoying to most of us, but in children already at increased risk of asthma such pollution could be enough to bring on the disease. In a new study in the medical journal *Thorax*, scientists collected mouth-swab DNA samples from 3124 children aged 10 to 16. They looked for variations in genes that help clear the body of the harmful air pollutants known as polyaromatic hydrocarbons (PAH). Children whose genes resulted in active clearance of PAH were up to four times more likely to suffer from asthma as those with very low clearance activity. From maps, the distance between each child's house and the nearest major-road was calculated. Among children with active PAH clearance, those who lived less than 75m from a main road were up to nine times more likely to have asthma as those who lived further away.
> *(Thorax 2007;doi:10.1136/thx.2007.080127 (Satam MT, et al))*

> Studies show that individuals exposed by breathing or skin contact for long periods to mixtures that contain PAHs and other compounds can also develop cancer.
> *(The US Dept of Health Report)*

When driving along in traffic, all the occupants in a car are being constantly bathed with freshly minted PAH from the vehicle exhausts ahead.

This raises new questions for researchers:

- If PAH affects the unborn, what is the effect on children being taken to and from school?
- The drivers, mostly women, get twice the exposure: is there any connection to breast cancer rates?

Numbers of new cases of breast cancer by age

Age	0-34	35-44	45-54	55-64	65-74	75-84	85+	Total
Females	98	419	983	1,050	778	556	201	4,085

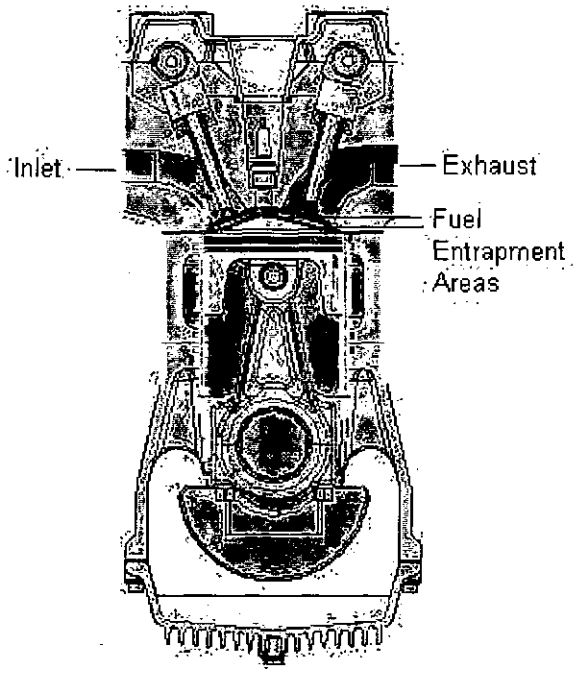
NSW Health Statistics 2007

So many questions...so few answers.

Polycyclic Aromatic Hydrocarbons

At the start of the 20th century a new source of PAH appeared on the scene in the form of the petrol burning Internal Combustion Engine, a device that now provides the motive power for almost all transport systems. The exhaust gas from these engines would appear to be one of the major causes of climate change.

The following description explains how the hydrocarbon fuel (petrol) of an internal combustion engine is converted into Polycyclic Aromatic Hydrocarbons.
A cross section view of the four-stroke engine is shown below.



On the first downward piston stroke the air/hydrocarbon mixture is sucked into the piston/cylinder cavity and then, on the upward stroke, is compressed into the small volume above the piston. About 2 per cent of the mix is forced into small cavities in the combustion zone such as the piston/cylinder clearance, the spark plug, round the valve seats and the narrow crack formed by the cylinder head gasket. Being shielded by relatively cold metal during the downward combustion stroke it remains unburned and emerges during the upward exhaust stroke. In the presence of the products of combustion and heat, up to 50 per cent of the hydrocarbon atomic structure is rearranged to form Polycyclic Aromatic Hydrocarbon, PAH.

This rearrangement does not occur with Autogas and in the Diesel Engine Cycle only air is compressed. A simple solution to the health problems mentioned above would be to replace petrol with autogas or diesel for all automotive transport.

It is time to revisit the External Combustion Engine Cycle. With the high temperature materials available it may now be a possibility. If a prize of $10 million was on offer for the first to demonstrate a practical example, we would soon find out. The advantages could be quieter operation, a wider range of fuels, and no PAH.

Forest management

The picture is of a typical forest maintenance activity. A chipper (yellow) is being used to reduce fallen timber to woodchips that are blown into the large bin ahead and removed for disposal elsewhere.

Although widely practised, the removal of woodchips is poor economics.
In the process of growing, trees extract essential minerals from the ground and these remain in the woodchips. Australian soils are old and the mineral content is quite low.
Not only should the woodchips remain in the forest, but additional mineralisation increases future growth.

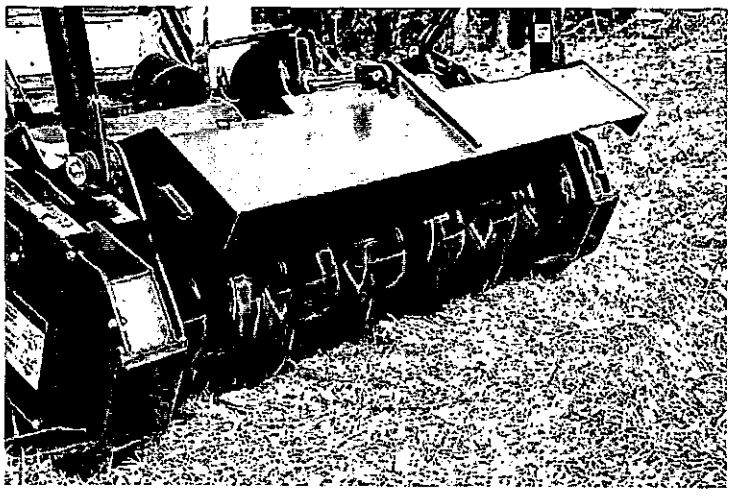
> Forests play a major role in the recycling of carbon, nitrogen and oxygen. Forests regulate worldwide rainfall and temperatures. They tend to support greater stocks of biomass, and produce new biomass faster than other ecological zones. Trees, particularly from old growth forests, retain water in our soils. Wet soils and dense tree cover attract rainfall by transpiring water back into the atmosphere.
> Deforestation not only reduces previous rainfall levels, but it increases desertification. In the tropics most of the ecosystems nutrients are held within the trees and so logging destroys the fertility of the ecosystem. When the trees are cut down, soils wash away, rainfall decreases and the habitat for animals, birds and insects are destroyed.
> Deforestation has devastating impacts on the climate. "When vegetation is removed, solar energy, instead of being absorbed by the trees, is reflected from the bare ground increasing temperatures, drying the soil, creating dust in the atmosphere and helping to stop rain clouds forming".
> Clive Ponting.
> ("Collapse " by Jared Diamond)

The use of fire to limit the extent of bushfires is also self-defeating as it only encourages regrowth, as well as releasing large quantities of PAH into the atmosphere.

A recent development, by the Bobcat Co of USA, is a Forestry Cutter that has the potential to eliminate the use of fire as a forestry tool. It should also find extensive use in suburban scrublands to control the build-up of undergrowth.

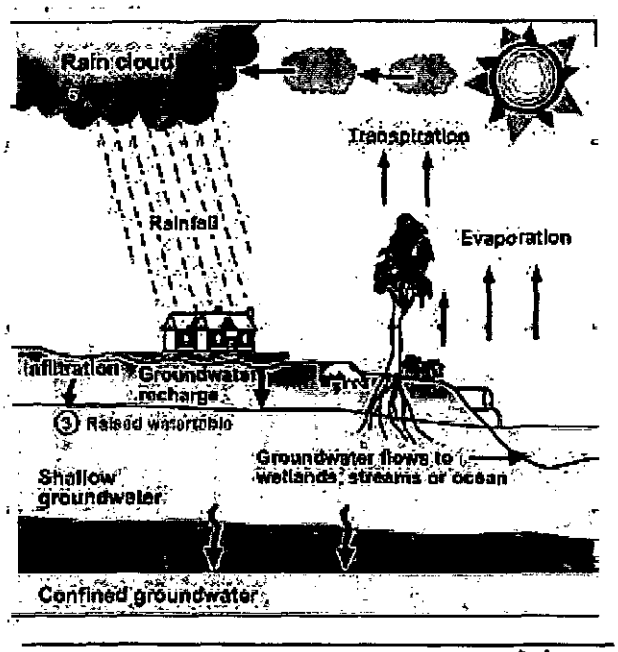
Page 6 contains photos of the Forestry Cutter at work.

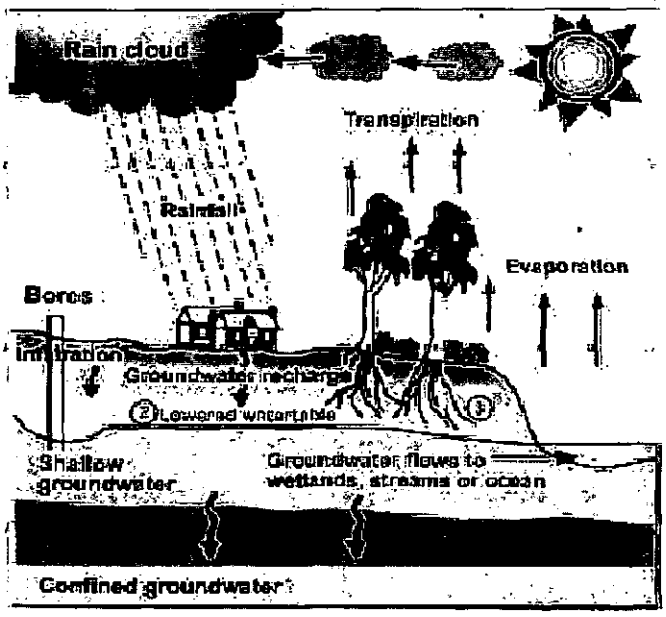
The Bobcat Forestry Cutter at work tree felling and clearing undergrowth.

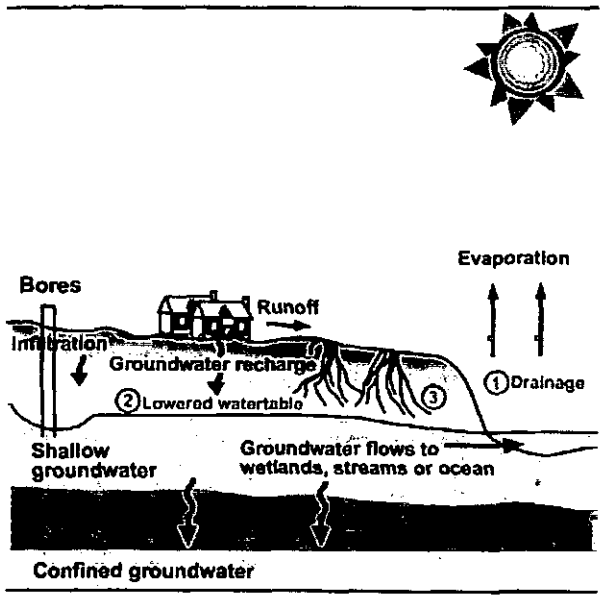


Create coastal forests

The primary source of atmospheric water vapour over the land areas of the earth comes from the oceans, mostly in the form of weather fronts. What happens to them after arrival depends on the scene at ground level.







Drawings adapted from The Water and Rivers Commission. The photo, from SA Life, of South Australian farm land.

A simple story. The property has a new owner. He finds the rainfall adequate so plants more trees. He then puts in a crop or plants vines that require irrigation, so installs bores. These eventually lower the water table so much that the trees die, and with them, the rain.

Perennial forests

The Government of France has evolved forest management protocols that effectively result in perennial forests. Started in coastal dunes 140 years ago, these forests now cover 14 million hectares and are managed under these protocols.
(The Forests of France)

A PERENNIAL FOREST

The Protocols are quite simple:

- There is minimal undergrowth.
- All forest thinnings are chipped, returned to the forest floor and become a source of natural seedlings; only millable timber goes to the sawmills.
- To maintain the required age balance throughout the forest and also to preserve the canopy, regular harvesting and regeneration by replanting is normal.
- There is no clear felling.

> According to research at Fraser USA, about one fourth of a sub-alpine forest managed for water yield should consist of stands in the seedling/sapling stage that are less than 30 years old, while not more than one fourth should consist of mature stands greater than 90 years old."
> *(Division of Water Resources. Colorado.USA)*

If the above protocols were adopted across Australia, and applied to the management of National Parks, they could open up employment possibilities for our Pacific Islands neighbours.

Recommendations

I ask that the Garnaut Climate Change Review considers the effect of anthropogenic aerosols on climate change.

I recommend that the following steps be taken by the Government of Australia to mitigate climate change in this country:

- phase out the use of petrol as a fuel for all automotive transport
- assess all woodchip export licences with the view to eventual termination
- create coastal forests
- adopt the Perennial Forest Management Protocols.