Supplementary Submission to the

House of Representatives Industry, Science and Innovation Committee

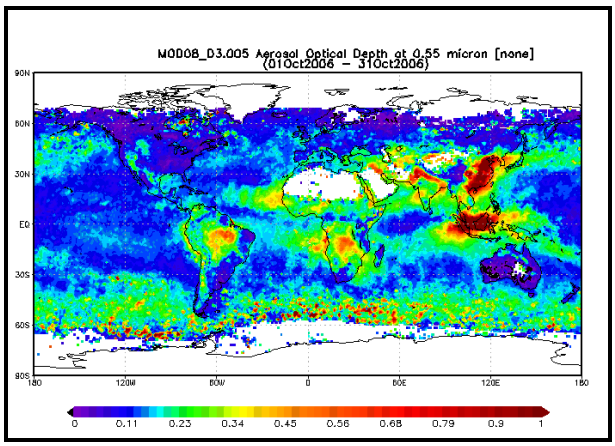
Inquiry into Long-term Meteorological Forecasting in Australia

by

Keith Potts

Particulate Modelling

(Particulates are: Solid and/or Liquid Particles Suspended in the Atmosphere)



Two Images showing Particulates in the Atmosphere

Left from the NASA Terra satellite shows the particulates plumes in the atmosphere
Note the two large plumes to the north of Australia in October 2006.
(Blue denotes low to zero particulates, yellow and red high particulate loadings)

Right from the USA Geological Survey shows the eruption of Mount Pinatubo which ejected an estimated 11 cubic kilometres of tephra into the atmosphere.
(Tephra is defined as the material explosively ejected into the atmosphere & includes particulates)

Supplementary Submission

Executive Summary

My original submission to this inquiry and the associated exhibit demonstrate the role of particulate plumes over south eastern Asia in creating droughts in Australia and submits that particulate analysis must form part of any long-term meteorological forecasting system.

This supplementary submission outlines the results of some initial modelling undertaken by the CSIRO on the effects of a particulate plume over Indonesia and Papua New Guinea (PNG) such as those experienced in 2002, 2004 and 2006. CSIRO has refused permission for me use these results in my research papers and I now provide those results to this Committee **under privilege** for the sole purpose of demonstrating that the effects of particulate plumes over south eastern Asia on the climate of Australia are significant and resources must be allocated to investigate them rigorously.

After developing my Regional Dimming Model in 2006 to explain the recent spate of droughts in south eastern Australia I approached CSIRO {on the advice of the Bureau of Meteorology} to discuss the effects of the anthropogenic particulate plumes over Indonesia and PNG on the climate of south eastern Australia. A "quick and dirty" experiment on the low resolution climate model was run over the Christmas period in 2006 as a preliminary investigation and some of the results of this experiment were supplied to me in early 2007.

My interpretation of the results of this experiment which compares the effects of the particulate plume with the pre-industrial climate {no anthropogenic carbon dioxide increase} is that without any increase in carbon dioxide a particulate plume over Indonesia and PNG as seen in Fig 1 has a significant effect on both the regional climate in and around Australia and the global climate. My detailed interpretation is shown on the following pages.

Finally I provide two further quotations from the USA Climate Change Science Program (CCSP) report Synthesis and Assessment Product (SAP) 3.1, *Climate Models: An Assessment of Strengths and Limitations* **{***Bader, D. C. et al*, 2008} which demonstrate that climate models are not yet reliable due to the lack of accurate modelling of particulates as the report states:

- Particulate modelling is one of the major stumbling blocks in climate modelling; and
- The models do not correctly model the occurrence of El Niño's, the major perturbation of the global climate system. {Note that my research demonstrates a clear causal connection between particulate plumes over south eastern Asia and El Niño events and without accurate particulate modelling of course El Niño events will not be modelled correctly as the two are inextricably linked}

I submit therefore that:

> **These modelling results are significant and clearly demonstrate that particulate plumes over Indonesia and PNG affect the regional climate in and around Australia and, taken in conjunction with the CCSP report, confirm that particulate modelling should be incorporated in any long-term meteorological forecasting system.**

Figure 1

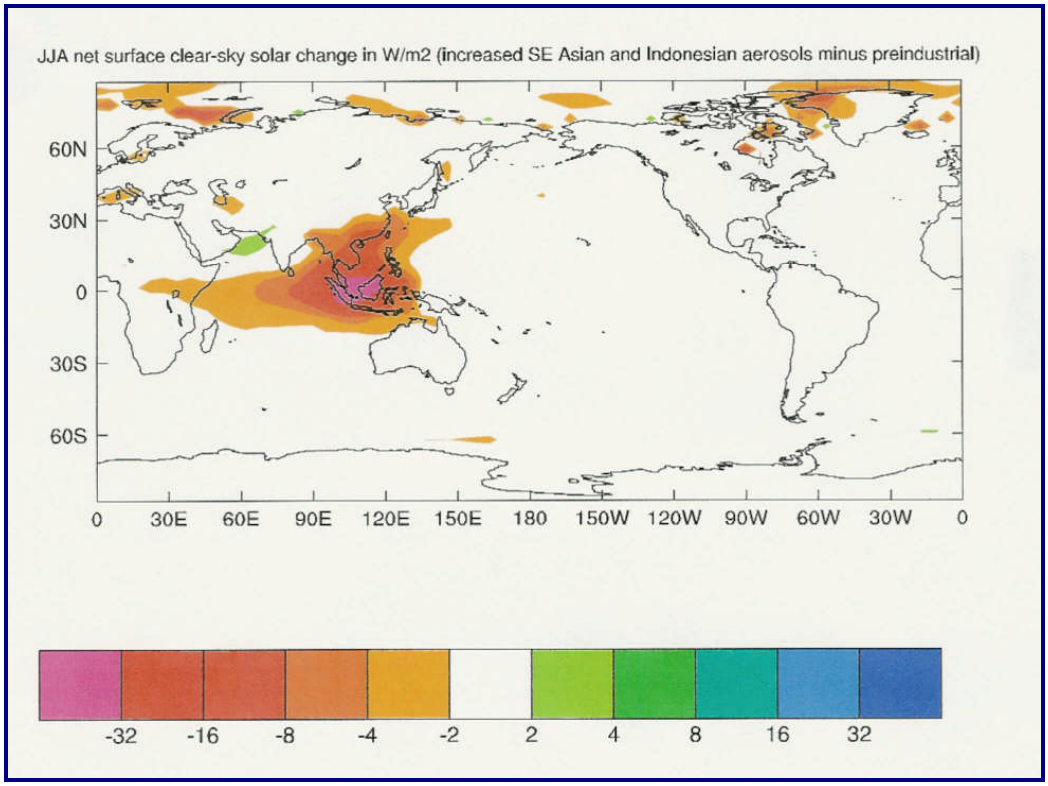


Figure 1: June, July and August average surface solar radiation change measured in W/m^2 due to the particulate plume compared with the preindustrial climate (1750?)

Interpretation – K.A.Potts

This plot shows the extent and surface radiative forcing of the particulate plume as it is carried across the Indian Ocean by the prevailing wind systems. At the centre of the plume the change in surface solar radiation is over 32 W/m^2 and over the greater Indian Ocean between 2 and 16W/m^2. These Indian Ocean figures agree well with figures of 8 to 10w/m^2 which are reported in the scientific literature and they are an order of magnitude (ten times) greater than the globally averaged effects of carbon dioxide and particulates reported by the IPCC.

Note: The months of the plot are JJA instead of Sept, Oct and Nov when the actual plume occurs.

The model has failed to capture the south easterly trending particulate plume over the south Pacific which can be clearly seen on the October 2006 image on the front of this and my original submission.

This experiment only investigated the effects of the South East Asian Plume and there may well be an increased effect when the East Asian plume is modelled at the same time.

Climate reanalysis data from NCEP/NCAR {*Kalnay, E. and Coauthors*, 1996} indicates that the reduction in surface solar radiation is greater than this figure by at least 25%.

Figure 2

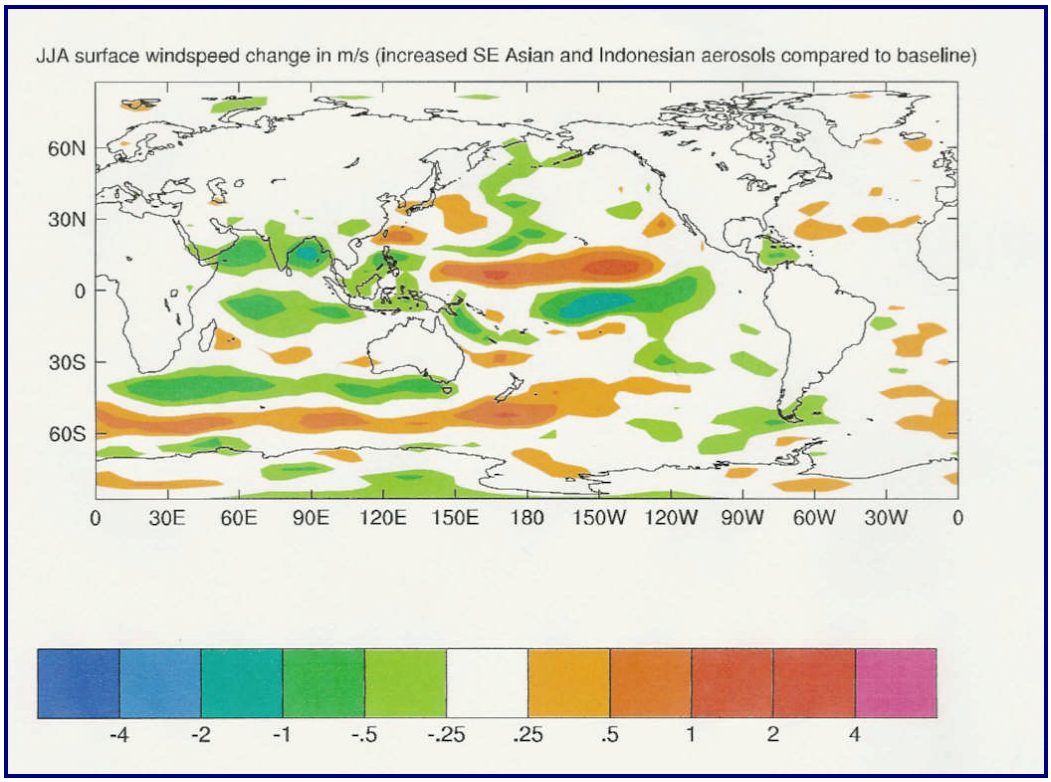


Figure 2: Wind Speed Change in m/sec – June, July and August
Increased SE Asian particulates compared to baseline preindustrial (1750?)

Interpretation – K.A.Potts

This plot shows:

1. A reduction in wind speed in the Indian Ocean under the plume which is more intense in the western half of the Indian Ocean.
2. A reduction in wind speed to the south of Australia, the Indian Ocean and South Africa at about 35° to 45°S latitude and an increase in wind speed in the same region at 50° to 60°S latitude. In effect the "roaring forties" have moved south to become the "roaring fifties". This region also demonstrates two of the shortcomings of the model as:
    a. It shows the effect from 0° to 150° / 180°longitude whereas the NCEP/NCAR climate reanalysis data plot on the following page does not show this.
    b. It also shows the wind speed reduction occurring too far south in the Australian region by about 5° of latitude when compared to the NCEP/NCAR data.
3. A reduction in wind speed in the central Pacific Ocean over the Niño 3.4 area which will result in an increase in sea surface temperature and is, of course, an El Niño. This region correlates reasonably with the NCEP/NCAR data.

and demonstrates the significant effect that a particulate plume over south eastern Asia has on the regional climate – moving the subtropical high and the Antarctic front south by ten degrees {which has been a major effect visible on Australian weather maps for much of the last decade}

Figure 3

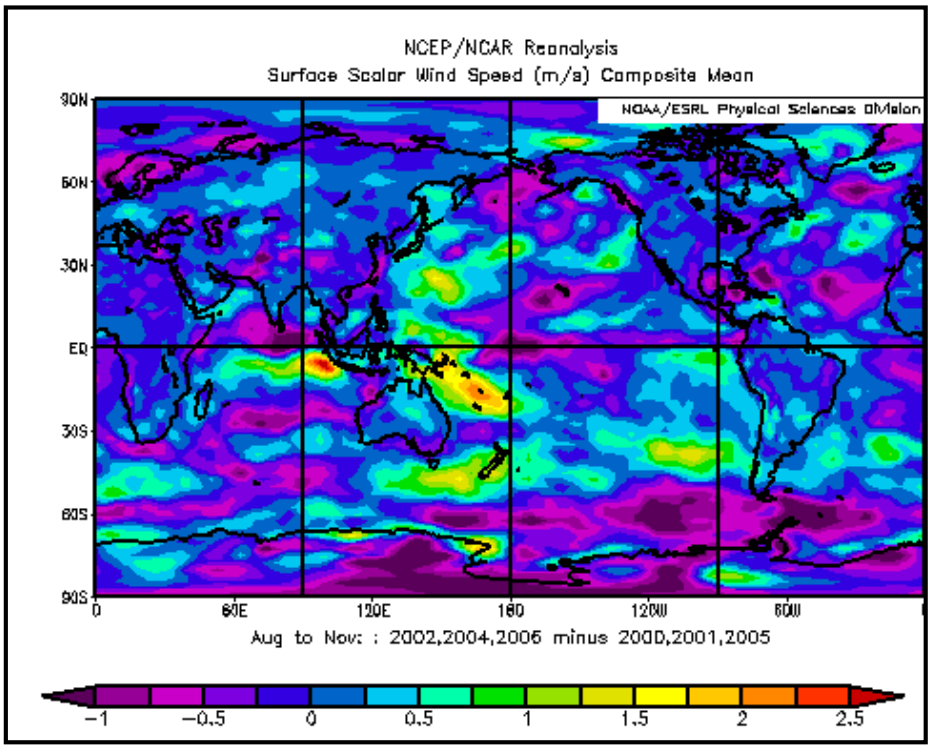


Figure 3: NCEP/NCAR image from

NOAA/ESRL Physical Sciences Division, Boulder Colorado

showing:

The average wind speed anomaly caused by the anthropogenic particulate plumes over south eastern Asia from August to November in 2002, 2004 and 2006 when the extreme rainforest burn off events occurred compared with the years when no significant plume was visible as no major burn off events occurred: 2000, 2001 and 2005.

Interpretation – K.A.Potts

This plot shows:

1. A decrease in wind speed over south eastern Australia;
2. An increase in wind speed to the south of Tasmania; and
3. A significant reduction in the wind speed in the Nino 3.4 area in the central Pacific Ocean.

Figure 4

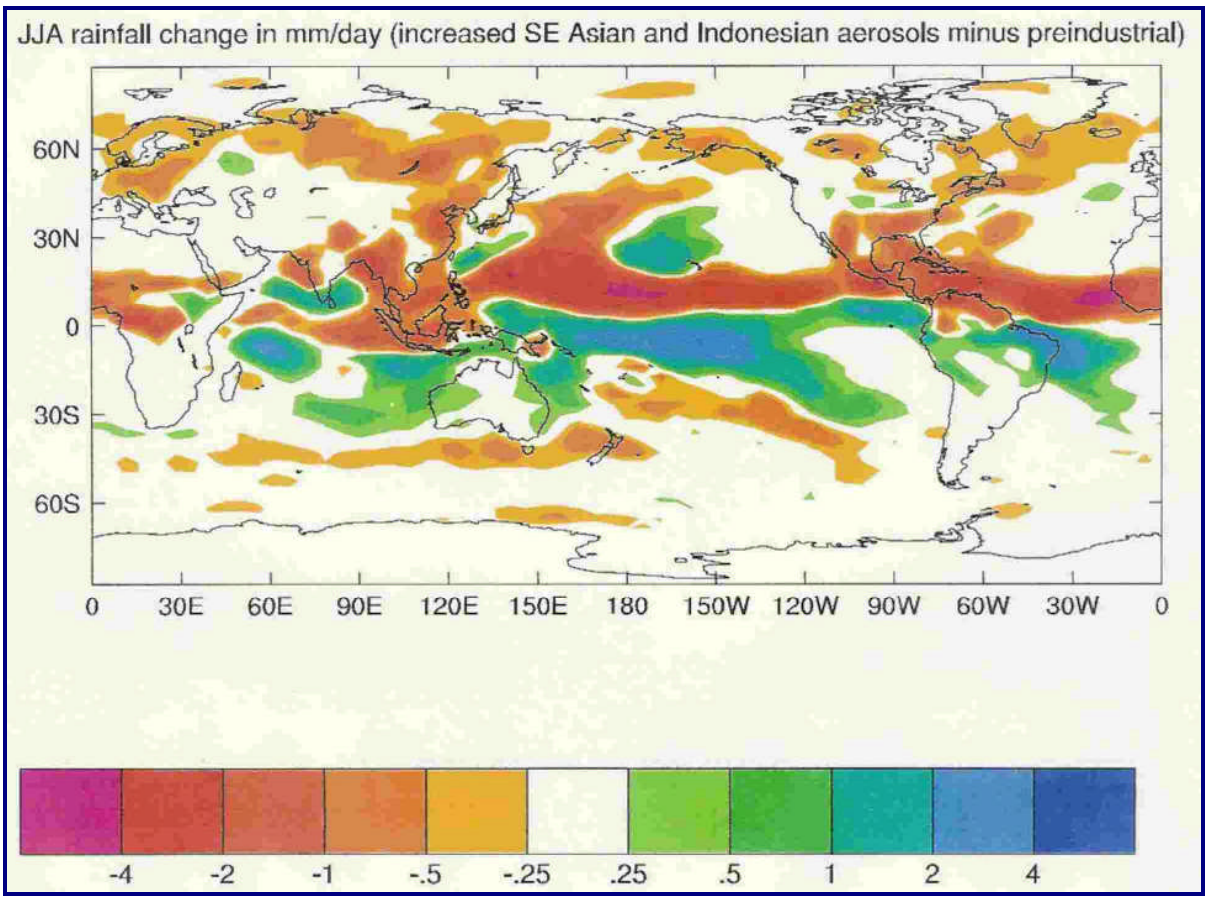


Figure 3: Rainfall change in mm/day compared with preindustrial (1750?)

Interpretation – K.A.Potts

1. This plot clearly shows a reduction of rainfall of 0.25 to 1mm per day to the south of Australia in the area where the wind speed is reduced. However as noted in the wind speed analysis of Fig 2 the effect is about 5° of latitude too far south when compared with real data.
2. Note also the reduction in rainfall in the USA which the USA Climate Change Science Program {*Levy II, H.*, 2008}, also reports may occur in the following quotations:

   "Changes in pollutant levels, primarily over Asia, may significantly increase surface temperature and reduce rainfall over the summertime continental United States."

   and

   "It is noteworthy that the simulated climate response to these pollutants is not confined to the geographical area where they are released."

USA Climate Change Science Program

Synthesis and Assessment Product (SAP) 3.1

Climate Models: An Assessment of Strengths and Limitations

The following quotations demonstrate that climate models do not yet provide an accurate assessment of the global and regional climates mainly because of the uncertainties in modelling the effects of aerosols. The first quotation emphasises this point:

> **"Uncertainties in the climatic effects of manmade aerosols (liquid and solid particles suspended in the atmosphere) constitute a major stumbling block in quantitative attribution studies" {p3}**

The second quotation:

> **"Realistic simulation of El Niño and its global influence remains a challenge for coupled models because of myriad contributing processes and their changing importance in the observational record." {p68}**

demonstrates that climate models find it difficult to simulate correctly El Niño events which are the most important perturbation of the global climate.

Note: My research in the exhibit submitted to this committee with my original submission demonstrates a clear causal connection between particulate plumes over south eastern Asia and El Niño events and without accurate particulate modelling of course El Niño events will not be modelled correctly as the two are inextricably linked.

References

Kalnay, E. and Coauthors, (1996), The NCEP/NCAR Reanalysis 40-year Project, *Bull. Amer. Meteor. Soc., 77*, 437-471.

Bader, David C., Curt Covey, William J. Gutowski Jr., Isaac M. Held, Kenneth E. Kunkel, Ronald L. Miller, Robin T. Tokmakian, Minghua H. Zhang, *Climate Models: An Assessment of Strengths and Limitations* USA Climate Change Science Program Synthesis and Assessment Product (SAP) 3.1

Levy II, H., D.T. Shindell, A. Gilliland, M.D. Schwarzkopf, L.W. Horowitz (2008), *Executive Summary in Climate Projections Based on Emissions Scenarios for Long-Lived and Short-Lived Radiatively Active Gases and Aerosols*. H. Levy II, D.T. Shindell, A. Gilliland, M.D. Schwarzkopf, L.W. Horowitz, (eds.). A Report by the U.S. Climate Change Science Program and the Subcommittee on Global Change Research, Washington, D.C.

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