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MINERAL PARTICULATES AND VEGETATION

Mineral particulates and vegetation: Modelled effects of dust on photosynthesis in plant canopies

D. Doley and L. Rossato

ABSTRACT
Deposition of mining, quarry and road dust on vegetation canopies has been observed to inhibit plant growth when dust burdens exceed 7 g m⁻². But there is little quantitative information on the effects of dust deposition at typical rates for industrial or agricultural environments. Using published data for the functioning of cotton leaves and canopies, variations in several components of cotton canopy photosynthesis were analysed. Daily totals of plant dry matter increase are linearly related to net dust deposition rate up to 1 g m⁻² d⁻¹. For cotton plants that mature during sunny weather, it is estimated that a net rate of coarse coal over burden dust deposition of 0.5 g m⁻² d⁻¹ may reduce canopy photosynthesis by about 11% and cotton fibre yield by about 3%. Modelling also indicates that the impact of dust deposition on vegetation at the bottom of a plant canopy is greater than on vegetation that is fully exposed to sunlight. These differences mean that acceptable dust burdens may vary between species and their positions in the plant community. By incorporating several generalised physiological characteristics of plants it is possible to estimate the likely effects of dust deposition on vegetation and thereby the environmental risks associated with proposed dust-generating activities.

Keywords: Light interception, vegetation canopy growth, mining, quarry, dust.

INTRODUCTION
Most studies of the effects of mineral dusts on vegetation have focussed on dusts that have chemical effects (e.g., cement dust) or where the dust loads exceed 7 g m⁻² (Farmer 1993; Grantz et al. 2003). Relatively inert mineral dusts, such as those generated in quarrying (Vardaka et al. 1995) or iron ore mining and processing (Borka 1984; Kuki et al. 2008), by very heavy traffic on unsealed roads (Walker and Everett 1987) or by military activities in deserts (Shariff et al. 1996; Wijayaratne et al. 2008), have been investigated to a lesser extent but they principally influence light and temperature relations of leaves (Grantz et al. 2003; Doley 2006). However, estimates of the effects of dust on plant growth and commercial yield of crops are commonly required for major mining or earth moving operations and the management of dust effects may be important for the protection of endangered species (Wijayaratne et al. 2009). Australian air quality standards for dust are based on human health objectives (e.g., National Environment Protection Council 2003) and there is no guidance concerning the ecological effects of dusts.

Application of fine (<2 μm diameter) white kaolin dust to foliage at up to 10 g m⁻² may reduce leaf temperature and transpiration and enhance water use efficiency in several fruit species (Glenn and Puterka 2005). Attention will be focussed here on coarser or darker dusts more likely to be encountered in agricultural, mining, quarrying and road environments. In Australia, cultivation of a cotton field may give rise to atmospheric dust concentrations at 1.2 m from the ground of 0.05 g m⁻² while a single vehicle on an unsealed road may generate a local dust concentration of 0.12 g m⁻² (Leys et al. 1998). Most particles in this example exceeded 10 μm in diameter so it is difficult to associate these dust generating activities with the Australian ambient air quality guideline of 50 μg m⁻³ for particles less than 10 μm diameter (National Environment Protection Council 2003). Hirano et al. (1995) found reduced photosynthesis and growth in bean plants subjected to loam dust loads of 1.2 g m⁻² of leaf surface. Other crop species might be affected in similar ways, so it is appropriate to establish whether dust loads or deposition rates that can be associated with conventional industrial or land use activities are likely to have detrimental effects on plant and ecosystem functions. The effects of dusts on plant function depend not only on the dust load or deposition rate but also on their physical characteristics, especially colour and volume-weighted mean particle diameters (Hirano et al. 1995; Glenn and Puterka 2005; Chaston and Doley 2006).

It is very difficult to examine physiological responses of plants to dust loads under conditions that are truly representative of field conditions because the requirements for measurement of plant function often conflict with those for the maintenance of steady dust loads or rates of dust deposition on leaf surfaces (Aucilair 1976; Hirano et al. 1995). However, simulations of environmental conditions and plant functions can indicate possible thresholds for the effects of dust accumulation on the leaf surfaces of crop plants.

Cotton (Gossypium hirsutum) is a valuable crop species in some areas where mining occurs or is being considered. In Australia, cotton is normally grown under irrigation, with intensive management of nutrition, pests and diseases in order to maximise the yield and quality of cotton fibre (Williams and Williams 2000). Consequently, there is a need to analyse any factor that may diminish the value of the crop. This contribution assembles information that may assist in the modelling of the effects of dust deposition on cotton crops and indicate where these assumptions may be applied to vegetation in general.

MODELLING CROP CANOPY FUNCTIONS
Models describing the effects of dust on crop growth should estimate: (i) light interception and photosynthesis within a plant canopy, (ii) effects of varying physiological conditions within a plant canopy on the photosynthetic model, (iii) the pattern of dust distribution within the canopy, and (iv) the effect of this dust on plant function. Simple models are preferred because the quality of available data or the assumptions concerning many parameters do not justify the application of more sophisticated models.

Light penetration through a plant canopy
If the leaves in a crop canopy are distributed uniformly over the ground surface, the penetration of sunlight through the canopy will be a function of the cumulative leaf area index (LAI) (leaf area per unit ground area), L, between the upper surface of the crop and any point of interest, and the orientation of the leaves with respect to the direction of the solar beam. The orientation of the foliage determines the light extinction coefficient, k, which is the proportion of incident light that is not transmitted through unit leaf area index, averaged for a day. These parameters are related by

\[ I = I_o e^{-kL} \]  

where \( I \) is the amount of light penetrating to a point in the plant canopy and \( I_o \) is the amount of light incident on the upper surface of the plant canopy (Warren Wilson 1965).
The value of $k$ varies from 0.2 for pendant or vertically oriented foliage to 0.9 for nearly horizontal foliage. For cotton, $k$ can be assumed to be 0.7 (Benedict 1984; Harley et al. 1992). This value reflects the tendency for leaves to be displayed almost horizontally near the upper part of the plant when the supplies of water and nitrogen are adequate (Turner et al. 1986).

**Estimation of photosynthesis in a plant canopy**

Carbon dioxide uptake by photosynthesis is very sensitive to light at low levels of irradiance, and for leaves of most species from temperate or humid environments it becomes light-saturated before full sunlight is reached. As a result, the rates of photosynthesis in different parts of a plant canopy vary in their sensitivities to particular changes in solar irradiance, such as those caused by dust deposition.

Net photosynthesis ($A_{n}$) is described very conveniently and with acceptable precision as a non-rectangular hyperbolic function of the photosynthetically active photon flux density (PPFD) incident on a leaf surface beneath the dust load ($t$), the efficiency of light conversion of CO$_2$ (a), the maximum (light-saturated) rate of gross photosynthesis at the top of the canopy ($A_{\infty}$), a convexity factor of the non-rectangular hyperbola ($\phi$), and the rate of dark respiration (R) (Cannell and Thornley 1998)

$$A = (aA_{\infty} - (1 + a)A_{\infty}^2 + 4\phi A_{\infty}^3/2\phi - R)$$

(2)

**Variation in photosynthesis parameters within a plant canopy**

Physiological characteristics of photosynthesis in cotton leaves are summarised in Table 1. Differences in the light environment within which leaves develop or are maintained may affect each leaf parameter so they should be considered in dust effects models. In the absence of direct information, the values in Table 1 can be used to estimate the effects of dust on other plant species.

Quantum efficiency of assimilation, $a$: This attribute is often considered to be constant and about 0.05 (mol CO$_2$) (mol quanta)$^{-1}$ (Cannell and Thornley 1998). However, $a$ may be up to 50% higher in shade-grown leaves (Peach and Franceschi 1986; Brugnoli and Bjorkman 1992) due to an increase in the number of chloroplasts (Chow et al. 1988), or changes in their orientation (Mada 2003) and internal organisation (Peach and Franceschi 1986).

It is reasonable to allow for an increase in $a$ from 0.05 to 0.075 mol CO$_2$ (mol quanta)$^{-1}$ between the top and the bottom of a relatively dense plant canopy but it may be constant in a canopy with a low light extinction coefficient. The quantum efficiency at a designated LAI from the top of the canopy ($A_{\infty}$) is described as a linear function of the quantum efficiency at the top of the canopy ($A_{\infty}$) and LAI in Equation 3.

$$A_{\infty} = a_{\infty} + 0.005 L$$

(3)

Curvature of light response function, $\phi$: Accompanying the increase in quantum efficiency in shaded environments is an increase in $\phi$ from about 0.7 for leaves in high light to 0.85 for heavily shaded leaves (Bjorkman et al. 1988; Evans et al. 1993). For the present model, $\phi$ for a given LAI layer, $L$, ($\phi_{L}$) was assumed to vary linearly from 0.7 in the uppermost leaves ($\phi_{L}$) to 0.8 in the lowermost leaves:

$$\phi_{L} = \phi_{L} + 0.2 L$$

(4)

**Variation in $A_{\infty}$ with leaf age.** The highest $A_{\infty}$ commonly occurs at the completion of expansion and in cotton it declines linearly with increasing leaf age (Benedict 1984; Sasser and Cole et al. 1996). Consequently, the maximum rate of net photosynthesis, $A_{\infty}$, for each successive LAI layer, L, from the top of the crop canopy can be described by

$$A_{\infty} = A_{\infty}(1 - L/L_{w})$$

(5)

where $L_{w}$ is the total LAI of the crop and $A_{\infty}$ is the maximum rate of gross photosynthesis in the uppermost unit LAI.

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**Table 1. Physiological characteristics of leaves and the canopy of a cotton crop, used in the estimation of the effect of dust on crop functioning and typical values that may be applied to models for other species.**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
<th>Typical Values</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_{\infty}$</td>
<td>Maximum rate of gross photosynthesis</td>
<td>$\mu$mol CO$_2$ m$^{-2}$ s$^{-1}$</td>
<td>5 - 30</td>
</tr>
<tr>
<td>$A_{\infty}$</td>
<td>Net rate of photosynthesis</td>
<td>$\mu$mol CO$_2$ m$^{-2}$ s$^{-1}$</td>
<td>derived</td>
</tr>
<tr>
<td>$a$</td>
<td>Light use efficiency</td>
<td>mol CO$_2$ (mol quanta)$^{-1}$</td>
<td>0.05 - 0.8</td>
</tr>
<tr>
<td>$\phi$</td>
<td>Convexity factor for photosynthetic light response curve</td>
<td>dimensionless</td>
<td>0.7 - 0.8</td>
</tr>
<tr>
<td>$I_{c}$</td>
<td>Photosynthetically active radiant flux density at top of canopy</td>
<td>$\mu$mol quanta m$^{-2}$ s$^{-1}$</td>
<td>2000</td>
</tr>
<tr>
<td>$J$</td>
<td>Photosynthetically active radiant flux density at any leaf layer</td>
<td>$\mu$mol quanta m$^{-2}$ s$^{-1}$</td>
<td>derived</td>
</tr>
<tr>
<td>$k$</td>
<td>Light extinction coefficient of the plant canopy</td>
<td>(leaf area index)$^{-1}$</td>
<td>0.2 - 0.8</td>
</tr>
<tr>
<td>$R$</td>
<td>Dark respiration rate</td>
<td>$\mu$mol m$^{-2}$ s$^{-1}$</td>
<td>1 - 4</td>
</tr>
<tr>
<td>$L$</td>
<td>Leaf area index</td>
<td>m$^2$ m$^{-2}$</td>
<td>1 - 10</td>
</tr>
<tr>
<td>$f$</td>
<td>Time between addition of unit leaf area index layer</td>
<td>days</td>
<td>5 - 100</td>
</tr>
<tr>
<td>$d$</td>
<td>Dust load</td>
<td>g m$^{-2}$</td>
<td>inserted</td>
</tr>
<tr>
<td>$d$</td>
<td>Dust particle diameter, volume-weighted</td>
<td>$\mu$m</td>
<td>0.1 - 300</td>
</tr>
<tr>
<td>$k$</td>
<td>Light extinction coefficient of dust</td>
<td>m$^2$ g$^{-1}$</td>
<td>0.005 - 0.2</td>
</tr>
</tbody>
</table>
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Variation in dark respiration \( R \) with leaf position: Charles-Edwards (1981) described dark respiration in any leaf area index layer \( x \) as a function of dark respiration in the uppermost leaf area index layer, \( R_0 \), the maximum rates of gross photosynthesis in the uppermost layer \( A_{\text{meat}} \) and in the layer in question, \( A_{\text{act}} \):

\[
R = R_0 A_{\text{act}} / A_{\text{meat}}
\]

(6)

The absolute effects of incorporating the variations in leaf functioning defined in Table 1 into a canopy photosynthetic model are modest where the LAI is 3 or less. However, they are large enough to justify inclusion if the LAI reaches 5 or 6. Adjustment of the rates of \( \alpha, A_{\text{meat}} \) and \( \delta \) for increasing leaf age may be warranted but the incorporation of adjustments in \( \phi \) made relative little difference to \( A_{\text{meat}} \) and can be ignored except where leaf structure varies substantially within a plant canopy or where light availability in the lower canopy may be extremely low.

While these variations in canopy characteristics may not be great in a cotton crop, a mixed species canopy will have a greater range of physiological attributes that justifies consideration of their variation. In addition, estimates of the effects of dust on leaf functioning may need to incorporate all of the variables discussed above.

MODELLING DUST INTERACTIONS WITH CROP CANOPIES

The amount of dust deposited on a leaf is a function of ambient dust concentration, particle size and consequently the rate of sedimentation, the size, orientation and surface characteristics of the leaf and the period for which it has been exposed to dust deposition (Raupach et al. 2001; Grantz et al. 2003). Smooth and pendant leaves accumulate less dust than rough, hairy or horizontal leaves, and old leaves may retain more dust than young leaves (Neinhuiz and Barthlott 1998). Shaking of the leaves in the wind and leaching by rain (possibly \( > 10 \) mm) may completely remove a dust load. There are few data relating to physical deposition rates with dust retention, so it is necessary to assume a net dust deposition rate in a model calculation.

One important factor affecting the dust load on vegetation is the length of time for which leaves are exposed to dust deposition, and this depends on the growth characteristics of the species. In many plants, leaves develop progressively during a growing season, or sometimes over several years. Therefore, it is necessary to consider variation in leaf age and dust load within the vegetation canopy, and consequently the development and lifecycles of the leaves.

At the optimum growth temperature for cotton plants of \( 30^\circ \)C, leaves are added to the extremities of the main stem at intervals of 6 days, and to the branches at the base of the plant at intervals of 2 days (Benedit 1984). Fageria et al. (1991) indicated that cotton has a growing period of up to 200 days, but leaves do not persist for the life of the plant. Leaf life span is likely to be 60 days when environmental conditions are ideal, but a shorter leaf span is associated with non-optimal conditions. For simplicity, a 60-day leaf life span has been selected. Leaves are added at the top of the plant and the extremities of the branches, so the new, fully functional and fully illuminated leaves have the least dust loads. By the time the dust load increases substantially, the leaves are already extensively shaded by younger, more efficient leaves (Sassenrath-Cole et al. 1996) that carry lesser dust loads.

In an established cotton crop, LAI may vary from 3 under water deficits (Fageria et al. 1991) to 5 or 6 under optimum conditions, while a LAI of 4 is common (Bondada et al. 1996; Reta-Sanchez and Fower 2002). If the cotton crop has a LAI of 5, and if each leaf survives for 60 days, then each successive unit leaf area layer is added at an interval of 12 days. That is, the uppermost layer of leaves will have an average dust load of 6 days' deposition, the second layer 18 days' deposition, and so on. Total dust deposition on a cotton crop may be up to 1.0 g m\(^{-2}\) d\(^{-1}\) at 1 m from an unsealed road and about 0.2 g m\(^{-2}\) d\(^{-1}\) at 100 m from the road (Larney et al. 1999). If the net rate of dust deposition on the crop is 0.2 g m\(^{-2}\) d\(^{-1}\), the maximum total dust load on a leaf at the time of shedding from the plant at age 60 days could be 12 g m\(^{-2}\). This dust load would be diminished if allowance is made for the dissolution of dust by wind or rain. The following calculations are based on net dust deposition and it is assumed that deposition is uniform throughout the canopy.

Light interception by dust

The effects on light attenuation by leaves and dust are identical in principle, and they can be combined for modelling the consequences of dust deposition on photosynthesis in a crop canopy. Chaston and Doyle (2006) found that, for dusts ranging from flyash, loam, overburden to coal dust and carbon black, there was a close correlation between light extinction coefficient for dust, \( \kappa \), and the volume-weighted mean particle diameter, \( d_{\text{w}} \):

\[
K = 0.304 - 0.0535 \ln d
\]

(7)

Equation 1 can be modified to allow for the effects of dust deposition on light penetration through a plant canopy:

\[
I = I_0 e^{-\kappa d_{\text{w}}}
\]

(8)

where \( \kappa \) is the light extinction coefficient of the dust and \( D \) is the net dust load (g m\(^{-2}\)) accumulated on the leaves for the development of unit leaf area index. Equation 8 has the effect of increasing the light extinction coefficient of each layer of leaves, so that for progressively greater dust loads lower in the canopy, the extent of light attenuation will be increased. A further modification may be made to allow the use of dust deposition rate rather than dust load as the determinant of light extinction. It is assumed that dust deposition occurs uniformly on all leaves within the canopy, and that a unit leaf area index layer is added to the top of the canopy at a constant rate

\[
I = I_0 e^{-\kappa d_{\text{w}}}
\]

(9)

where \( \kappa \) is the rate of net dust deposition (g m\(^{-2}\) d\(^{-1}\)) and \( f \) is the number of days between the additions of successive unit leaf area layers to the top of the canopy. Attenuation of dust lower in the canopy could also be calculated as a function of \( k \) but there is no evidence to inform the choice of rate of attenuation.

The effect of dust on light penetration through a cotton canopy is indicated in Figure 1. Light reduction at the top of the canopy must be included as an additional layer of dust on the upper canopy surface, as subsequent calculations are based on light available within each layer of leaves. The reduction in light penetration to the uppermost leaf layer due to dust accumulation at the net rate of 1.0 g m\(^{-2}\) (unit leaf area index) d\(^{-1}\) (63%) is greater than that due to an additional layer of foliage (50%).

Dust and canopy photosynthesis

Crop growth is a function of the integral of photosynthesis throughout the canopy over a given period of time. Figure 2 shows the effect of increasing net dust deposition rates on the light response of instantaneous canopy photosynthesis for a cotton crop on 1 m\(^2\) of land surface. The relative reduction in photosynthesis is similar throughout the range of photon flux rates. As a result, the daily integral of dry weight (carbohydrate) gain by individual leaf area index layers in the plant canopy declines linearly with increasing dust load (Figure 3), but with increasing sensitivity as the relative light integral decreases in successively lower layers in the canopy. The dry weight gain (\( G_2 \)) of a cotton crop for the conditions defined in Table 1 can be described in terms of the dry weight gain (\( G_1 \)) by individual LAI layers in the canopy (\( G_1 \) from \( T \) to \( x \)) and net dust deposition rate (\( D \)) by

\[
G_C = \Sigma G_{\text{meat}} = (24.15 - 5.1xL) - (2.86 + 17.66xL) D\]

(10)

Equation 10 may be extended to other canopies and conditions by incorporation of the canopy light extinction coefficient and a function describing the daily integral of radiation. These calculations apply only during rainless periods with steady dust deposition and rain will effectively reset the dust accumulation process.

If the cotton canopy is considered as a whole, the relative reduction in daily dry matter accumulation is approximately 10% with a LAI of 1.0 and dust deposition of 0.5 g m\(^{-2}\) d\(^{-1}\), but increases to 25% if LAI
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Figure 1. Light Incident on successive leaf layers with different rates of overburden dust deposition per day throughout the canopy. Canopy architecture and growth characteristics for cotton derived from Table 1.

Figure 2. Total canopy instantaneous net photosynthesis for a cotton crop in relation to photon flux density with the physiological parameters described in Table 1 and net dust deposition rates ranging from 0 to 0.5 g m⁻² d⁻¹.

Figure 3. Net daily gain of dry matter (C₆H₁₀O₅) in relation to net rate of dust deposition for four successive leaf area index layers (LAI 1 to 4) from the top of a cotton canopy with the characteristics described in Table 1.

Figure 4. Relationship between cotton lint yield (per cent of maximum) and mean integral of canopy photosynthesis in a cotton crop during 40 days around canopy maturity (per cent of maximum) for plants supplied with four levels of nitrogen (data from Bondada et al. 1996).

increases to 2.0. As LAI increases further, the lower layers become so shaded by dust that they do not contribute to dry matter gain and die.

In more complex plant associations, understory plants are likely to be affected much more by dust accumulation than are the uppermost vegetation strata. Understory shading can be especially important where dust may be generated at a low level in a shaded environment, such as on an unsealed forest road.

**Canopy photosynthesis and growth in cotton**

In the absence of direct data on the effects of dust on cotton crop yield, the effects of shading on cotton photosynthesis and dry weight accumulation or the yield of lint (cotton fibre) can be used as a guide.

In a field experiment, Pettigrew (2001) reduced incident light by 30% and recorded similar reductions in starch and sugar contents of developing cotton fibres, but fibre strength was reduced by only 3%. Zhao and Oosterhuis (1998) reduced incident light by 63% for 8 days at different times during crop development and observed decreases in the rate of photosynthesis of 43 to 55%, in leaf starch and sugars of 47 to 71%, and in floral bud numbers of 5 to 20%. The accompanying decreases in plant dry weight ranged from 23% in the earlier stages to 8% in the final stage of boll development (Zhao and Oosterhuis 2000). Although these changes were statistically significant, the reductions in availability of carbohydrates for cotton fibre growth were substantially less than the decreases in incident light.

Bondada et al. (1996) examined the effects of nitrogen fertiliser treatments in the field on the rates of canopy photosynthesis in cotton plants for approximately 40 days spanning the time of maximum photosynthesis and progressing towards fruit maturity. For the modelled cotton crop, mean photosynthetic rates over this period and the relative yield of cotton lint (fibre) varied substantially between treatments but the variation was not linear. Figure 4 suggests that lint yield is directly related to canopy photosynthesis at relative rates lower than about 50% of the maximum, but between 70 and 100% of the maximum integral of photosynthetic rate, there is little response of lint yield to the availability of sugars from photosynthesis.

In other crops such as tobacco (Nicotiana tabacum, Cestero and Castelli 2002) and canola (Brassica napus; L. Rosato unpublished data), a deficiency of nitrogen leads to a reduction in leaf size but relatively constant leaf nitrogen concentration. Consequently, photosynthetic production per
unit leaf area is maintained but radiation use efficiency declines through reduced leaf area and reduced light interception by the plant.

Table 2 calculates the effects of coarse overburden dust with a median diameter of 200 μm (Chaston and Doley 2006) on photosynthesis in cotton and, using the relationship in Figure 4, on lint production. In addition to demonstrating the effect of particle diameter on the effectiveness of dust load, Table 2 shows the importance of weather conditions on crop production. Overcast weather is assumed to have continuous cloud cover, with noon sunlight intensity equal to approximately half that of a sunny day. These conditions would be extreme for a commercial cotton growing area, where a large majority of days could be expected to be sunny.

**CONCLUSIONS**

In considering the effects of dust on the functioning of plant canopies, it is appropriate to take account of the variations in physiological attributes of leaves at different positions in the canopy. Changes in photosynthetic light use efficiency, the maximum (light saturated) rate of photosynthesis and the rate of respiration should be incorporated in estimates of total canopy photosynthesis. Many plant species have similar ranges of values for several of the photosynthetic parameters and it is possible to use common estimates for the purpose of dust effects modelling.

For the conditions described in a simple model for photosynthesis in cotton canopies, the effect of overburden on photosynthesis is proportional to the net rate of deposition. A net dust deposition rate of 0.5 g m⁻² d⁻¹ is likely to reduce canopy dry matter production by 11 to 15%. In turn, this may cause a reduction in cotton fibre yield of 3 and 5% in association with a dust deposition rate of 0.5 g m⁻² d⁻¹ in sunny and overcast weather, respectively.

In more complex plant associations, species that grow in a heavily shaded understory are likely to be much more susceptible to dust deposition than are the taller plants that are exposed to direct sunlight. Forest understory environments close to unsealed roads carrying heavy traffic may be especially at risk to the effects of dust. The effects on plant growth of dust deposition on vegetation can be estimated with sufficient precision and reliability that models of these effects can supplement dust dispersion and deposition models for the better estimation of the environmental impacts of dust-generating activities and the attendant risks to sensitive receptors.

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New Transport SIG

A new Special Interest Group, "Transport Emissions and Fuel Consumption Modelling" or Transport SIG, was formed on 23 April, 2010. Given that environmental impacts of transport are of growing importance, it is envisaged that this will be an active group. The focus will be on quantification/modelling of emissions (air quality) and greenhouse gas impacts from transport, which includes road traffic, shipping, aircraft, rail and also non-road equipment (e.g. cargo handling equipment in port areas, ground support equipment at airports). The SIG is intended to be a platform for information sharing, discussion of emerging issues and it will provide a certain level of coordination. The first activity will be the upcoming Transport SIG Workshop called "Modelling Emission Impacts of Road Transport Projects" (Brisbane, 21 May, 2010). Refer to www.caseanz.org.au (for the program and registration form). Any questions may be directed to Dr Robin Smit (Chair Transport SIG, transport-sig@caseanz.org.au).