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SEDIMENT LOADS, SOURCE AREAS AND SOIL LOSS RATES DURING A LARGE DUST STORM IN THE QUEENSLAND CHANNEL COUNTRY, LAKE EYRE BASIN

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ABSTRACT

Large dust storms are capable of carrying enormous dust loads. The dust storm on 1st November 1994 transported at least 15 Mt of dust from the Queensland Channel Country northward over Mt Isa and out over Cape York and the Gulf of Carpentaria. Relative erodibilities based upon dust flux measurements on three major land types, dunefields, alluvial floodplains and downs country at Diamantina National Park, show that the channel alluvium was the most erodible, followed by the dunefields and downs country. Estimated soil loss rates are, however, very sensitive to estimates of the area of each land type.

INTRODUCTION

Dust storms remove enormous quantities of top soil as they traverse large tracts of inland Australia. Dust loads during these events can be estimated and trajectories mapped, however accurate estimates of soil loss rates (measured in t/ha) are difficult to make because land types traversed by the storm may erode at different rates. This paper initially describes the dust load and trajectory of a large dust storm which passed through the Channel Country area of the Lake Eyre Basin on the 1st November 1994. Data are then used from a study in progress to show how realistic estimates of soil loss rates require information on the relative erodibility of different land types.

METHODS

Dust load estimates are based upon visibility data from Diamantina National Park using the method of Raupach *et al.* (1994) to estimate a dust concentration, which is then multiplied by the dimensions of the plume to get total dust load. Dust trajectory information was collected from meteorological observers and other sources during the event. Relative erodibility data are based upon dust flux measurements collected by wind vane sediment samplers at Diamantina National Park during the event.

RESULTS AND DISCUSSION

Dust Storm Trajectory and Dust Load

On 31 October 1994 a trough, followed by a cold front, passed over central Australia producing a rolling dust storm which passed through Diamantina National Park at 5:25am on 1st November 1994. Winds associated with the front increased from approximately 7 km/hr to more than 70 km/hr, which exceeds the threshold velocity of 36 km/hr for dust entrainment in the Channel Country. The storm was tracked from the Innamincka area to the NNE over the Queensland Channel Country, as far east as Longreach, and north to Mt Isa, where the airport was closed due to low visibility, then north over the Gulf of Carpentaria and Cape York Peninsula. The dust load was conservatively estimated to be 15 Mt.

Soil Loss and Relative Erodibility

Soil loss, as measured by tonnes of soil removed from a particular land area, is the most useful measure of the land degradation resulting from soil erosion. The broadscale nature and unpredictable trajectories of dust storms, combined with the lack of data on the relative erodibility of the different land types, make such information rare in wind erosion studies. Using data collected at Diamantina National Park during the 1994 storm it is possible to demonstrate how estimated soil loss rates change depending upon the relative erodibility estimates of three major land types which the dust storm passed over (i.e. dunefields, alluvial channels and downs country).

The relative erodibilities of the three land types measured at Diamantina National Park during the week of the storm are expressed as percentages. The most erodible land type was the channel alluvium which yielded 72% of the dust flux from the area, whereas the dunefields yielded 24% and the downs country only 4%. The total land area over which soil erosion occurred can only be guessed because of limited observations at the time of the event. For example, while there were observations of the eastern extent of the storm, the western edge probably extended into the Simpson Desert, but there are no observations currently available to verify this. As a result, the western edge of the storm has been arbitrarily positioned along the Queensland/Northern Territory border.

Soil Loss Scenarios

Within the wind erosion area, the percentage area covered by the three land types is roughly estimated to be 79.5% downs country, 18.1% channel alluvium and 2.4% dunes. To highlight the effects of different land type erodibilities upon soil loss rates, three scenarios are presented (Table 1). Scenario 1 assumes that all land types have the same relative erodibility, which results in an overall soil loss rate of 0.38 t/ha. Scenario 2 uses the relative erodibilities measured at Diamantina National Park during the dust storm, which results in soil loss rates of 3.89 t/ha on the dunes, 1.5 t/ha on the channels and 0.02 t/ha on the downs. Scenario 3 uses the same relative erodibilities but increases the area of dunes by 5% (from 2.4% to 7.4%) and reduces the area of channel alluvium by the same amount, to test the sensitivity of soil loss rate estimates to land area estimates. This change significantly reduces the soil loss rate on the dunes by 68% to 1.24 t/ha and increases the channel alluvium soil loss by 37% to 2.08 t/ha, which demonstrates the high sensitivity of soil loss rate estimates to assumed land area.

Table 1. Soil loss scenarios.

Land Type	Scenario 1			Scenario 2			Scenario 3		
	t/km^2	t/ha	mm	t/km^2	t/ha	mm	t/km^2	t/ha	mm
Dunes				389.2	3.89	0.389	124.4	1.24	0.124
Alluvium	38.1	0.38	0.038	151.2	1.51	0.151	208.8	2.08	0.208
Downs				1.9	0.02	0.002	1.9	0.02	0.002

These soil loss rates are low compared with water erosion rates, but wind erosion in rangelands covers much larger land areas. Worst-case water erosion rates under bare fallow conditions in eastern Australia range from 2 to 380 t/ha (Rose 1993). The average depth of soil removed in this dust event is 0.389 mm on the dunes. According to a study of field evidence of wind eroded land in the USA (Kimberlain *et al.* 1977) there is no visible evidence of wind erosion at removal depths of less than 3 mm.

ACKNOWLEDGEMENTS

This research is supported by an ARC Large Grant, with field infrastructure support from Griffith University, NSW Department of Land and Water Conservation and the Qld Dept of the Environment. Thanks to Chris Mitchell (Ranger, Diamantina National Park) for assistance with field data collection.

REFERENCES

Kimberlain, L.W., Hidlebaugh, A.L. and Grunewald, A.R. (1977). The potential wind erosion problem in the United States. *Transactions of the American Society of Engineers* 20: 873-879.

Raupach, M.R., McTainsh, G.H. and Leys, J.F. (1994) Estimates of dust mass in a recent major Australian dust storm. *Aust. J. Soil Water Conserv.* 7(3): 20-24.

Rose, C.W. (1993) Soil erosion by water. *In* 'Land Degradation Processes in Australia.' (Eds G.H. McTainsh and W.C. Boughton). Longman Cheshire.