Testing models of sediment yield to the Great Barrier Reef

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Key Points

- Modelled sediment and nutrient loads to the GBR compared well with field measured estimates
- There is a substantial lag between changes in land condition and changes in load to the reef

Keywords

Burdekin, grazing, sediment, erosion, Great Barrier Reef, models, Sednet

Introduction

This technical note describes the testing of numerical models of sediment and nutrient delivery to the Great Barrier Reef (SedNet) against measured loads. SedNet is a spatial model that produces catchment scale sediment budgets by predicting various erosion and deposition processes within a river link network (Prosser *et al.*, 2001b; Wilkinson *et al.*, 2004). The SedNet model is considered to be robust when applied at large scales (>10,000 km^2) and has been shown to perform well when evaluated against end of catchment load monitoring and tracing data in catchments with rivers that have regular flow (e.g. Bartley *et al.*, 2004). There has, however, been no similar comparison for ephemeral rivers such as those in the dry tropics. In this paper we: (1) compare measured and modelled sediment load data for six sub- catchments in the Burdekin River (14 - 36,000 km^2); and (2) evaluate a within catchment sediment budget derived from field monitoring and modelling for the Weany Creek catchment (14 km^2) in the Upper Burdekin. The Burdekin and Fitzroy River basin, are considered to be the largest contributors of sediment to the GBR lagoon (McKergow *et al.*, 2005).

Field sites and methods

Over the last 7 years, a range of organisations have funded the installation and maintenance of 10 sub-catchment water quality monitoring stations in the Burdekin River basin (Figure 1A). Variables measured were turbidity, total suspended solids (TSS), nitrogen, phosphorus and, at some sites, sediment size distribution. An overview of the processes, methods and timescales of data collection is given in Bartley et.al. (In Press).

Results and discussion

There is a good agreement between the measured and modelled sub-catchment sediment loads (Table 2 and Figure 2). SedNet is over-predicting sediment load in 5 out of 6 catchments, but, this is expected given the lower rainfall years available for calculating measured loads. This analysis suggests that SedNet is suitable for estimating average end of catchment sediment loads at a range of spatial scales.

There is a reasonable match between the modelled and measured sub- catchment load data in the Burdekin catchment. However, this does not mean you can assume the same level of accuracy when interpreting the erosion process data. It is also possible that the right predicted yield is obtained for the wrong reasons. Table 3 presents the sediment budget for Weany Creek as measured by the SedNet model (Kinsey-Henderson *et al.*,

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2005) and from field monitoring data (Bartley *et al.*, In Press). Both the modelled and field measured sediment budgets have very similar fine sediment loads of 830 and 784 t/yr, respectively. Both these load estimates are within 30% of the suspended sediment flux measured at the end of the catchment (Table 3).

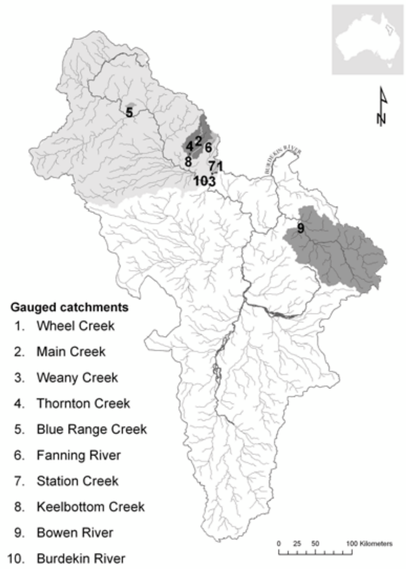

Figure 1. (A) map of the Burdekin sub-catchments currently monitored for sediment loads and (B) the Weany Creek catchment showing the location of the hillslope, gully and bank erosion measurement sites.

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Table 2. Monitoring and modelling results for 6 gauged sites in the Burdekin catchment ranked according to catchment size. It is estimated that there is ±50% error associated with the measured load estimates.

	Measured data					Modelled data
Site # in Fig. 1	**Site name**	**Catchment area (km^2)**	**Data collection period (year wet season started)**	**Years of data**	**Mean suspended sediment yield (Kt/yr)**	**Mean suspended sediment yield (Kt/yr)**
3	Weany Creek	14	1999-2005	7	0.54	0.83
4	Thornton Creek	85	2001-2005	5	2.9	3.2
7	Station Creek	148	2001-2005	4	7.98	9.8
8	Keelbottom Creek	1170	2002-2005	4	18.2	71.1
9	Bowen@ Myuna	7200	2003-2005	2	375.2	584.4
10	Burdekin@ Macrossan	36390	2001-2005	5	1987.4	1755.8

It is important to stress that the comparison between modelled and measured results presented in Table 3 is influenced by the different time periods of the two methods. The measured sediment budget was developed during an extremely low rainfall period and therefore this budget is representative of drought conditions (average runoff of 17.46 mm/yr for 2003-2005). The modelled results are based on a slightly wetter rainfall period (~ 49.36 mm/yr of runoff for 2000-2002).

The field monitoring in Weany Creek also highlighted that there is likely to be a temporal delay between the erosion event in the catchment, and the delivery of sediment from the catchment due to storage of material in channel and gully systems in dry years. Research using sediment tracing and dating techniques would be useful for quantifying the residence times of both fine and coarse sediment, which is crucial for understanding the link between land management change and the downstream impacts on receiving water bodies. Further work looking at the impact of different climate regimes (drought versus wet periods) would also provide an insight into how end of catchment loads, and thus water quality targets, may be expected to change with time.

Conclusion

His technical note has shown that there is good agreement between modelled and measured end of catchment sediment loads at a range of scales in the Burdekin catchment. However, more detailed field monitoring in a headwater catchment of the Burdekin has highlighted that that the models do not adequately represent the erosion processes contributing to the end of catchment loads, however, this is potentially due to low rainfall conditions during data collection. This research highlights how long term catchment scale monitoring projects are crucial for understanding the process of sediment transport within catchments. It also emphasises that models such as SedNet will continually evolve as new data and process understanding becomes available. Any load based predictions and associated water quality targets made using these models will change over time. Water quality targets should therefore be presented using a range of values rather than single load values.

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References

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