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# Issues in the calibration of an acoustic bedload sensor in mountain rivers, Japan

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## INTRODUCTION

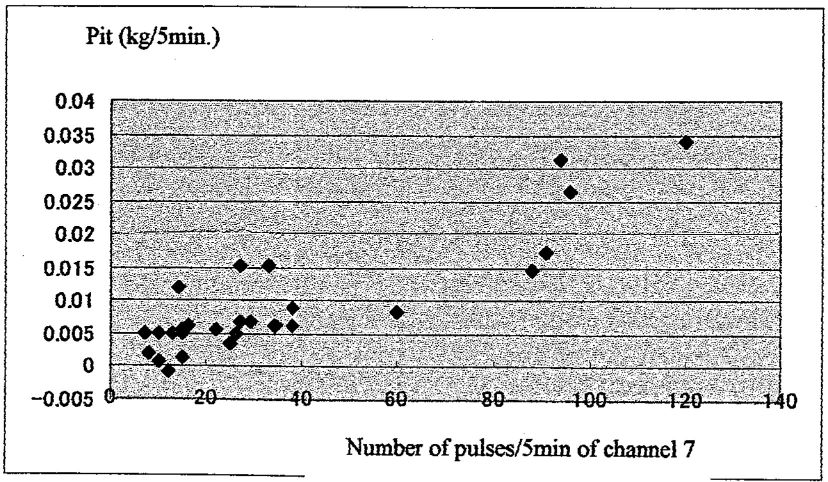
The continuous transport of coarse bedload has previously been indirectly monitored in rivers and flumes, but has not yet been calibrated by comparison with continuously operating samplers. We have examined an acoustic system that has been deployed immediately above a recording Reid (Birkbeck type) pit bedload sampler in several mountain rivers in Japan. The acoustic system consists of a hydrophone within a pipe set across a sill along the entire width of a concrete flume; the pipe is closed at both ends, one with a preamplifier connected to an amplifier, band-width filter and logger. We report on system calibration in two mountain torrents.

## BEDLOAD MEASUREMENT SITES

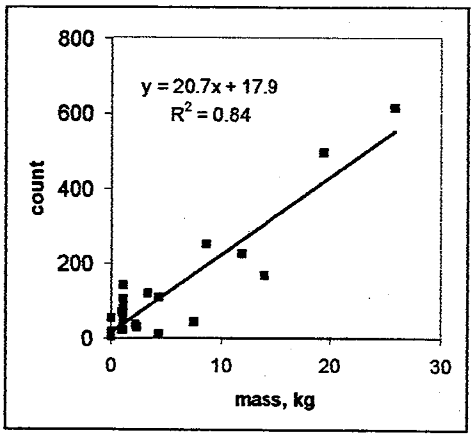
Bedload measurement has been carried out in the gravelly Nishi-takiga-tani Brook in the Rokko Mountains near Kobe and the Ashi-arai-tani Brook in the higher Hodaka Mountains. These respectively drain 1.5 km$^2$ of steep granitic terrain typified by low bedload fluxes and infrequent flow events and 6.5 of km$^2$ of steep erodible volcanics with elevated bedload yields which have been monitored since the 1980's.

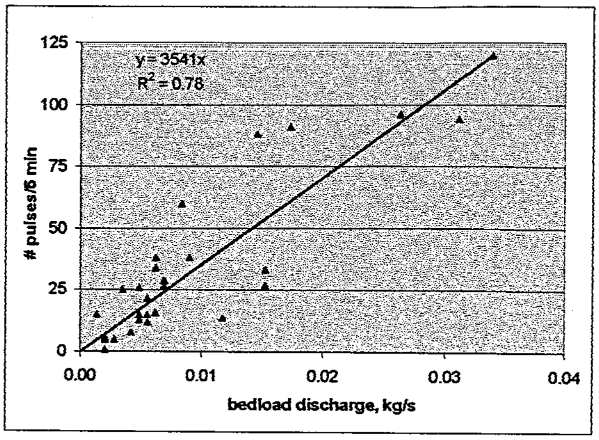
## CALIBRATION OF HYDROPHONE

Sensor and sampler sensitivities are similar. At very low fluxes the correlation between acoustic signal and bedload flux is poor to nonexistent for short (5-minute) durations. Neveretheless, the correlations improves considerably (for linear regressions typically $r^2 \approx 0.85$) when summed over longer (0.5-1 hour) intervals, allowing determination of threshold conditions.




Example of correlation between hydrophone and pit sampler data at the Ashi-arai-tani in July 2004

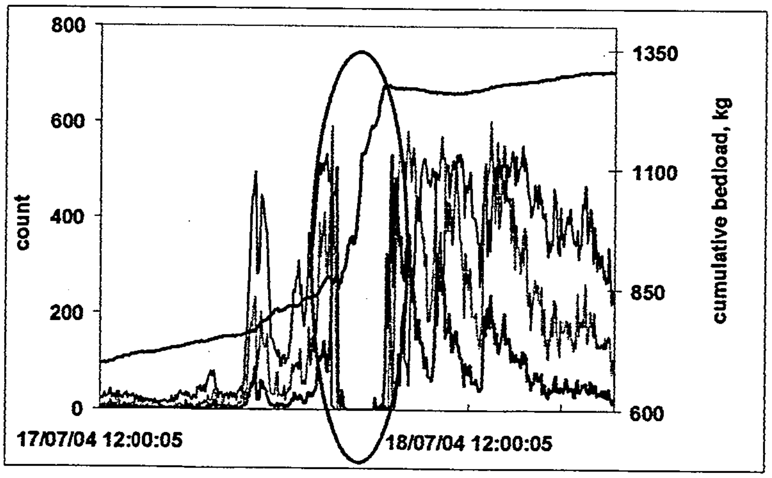



Correlation between acoustic response (counts) *vs* cumulative bedload mass for the Nishi-takiga-tani (left) at low flow and *vs* bedload discharge (0.5-1 hr count duration) for the Ashi-arai-tani at higher bedload flux (5-minute data). Both express confidence in the representation of bedload discharge by acoustic response.

## CONCLUTION AND REMAINED PROBLEM

At higher flux correlation is as good for short intervals (5-minute), acoustic response typically explaining 80% of the variance in flux. Such relatively high explanation for short durations of a field-calibrated acoustic bedload device has not been previously reported.
At very elevated fluxes the acoustic system ceases to respond either due to saturation or due to being covered by gravel sheets. An advantage of the acoustic system is that it continues to monitor bedload flux after the sampler fills, allowing continuous monitoring of bedload during long (several days) duration, also in mountainous rivers with higher bedload yields.




Example of the data of the hydrophone at high flow in theAshi-arai-tani.

## REFERENCES

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