Surrogate measures of suspended sediment transport in rivers: the use of ADCP

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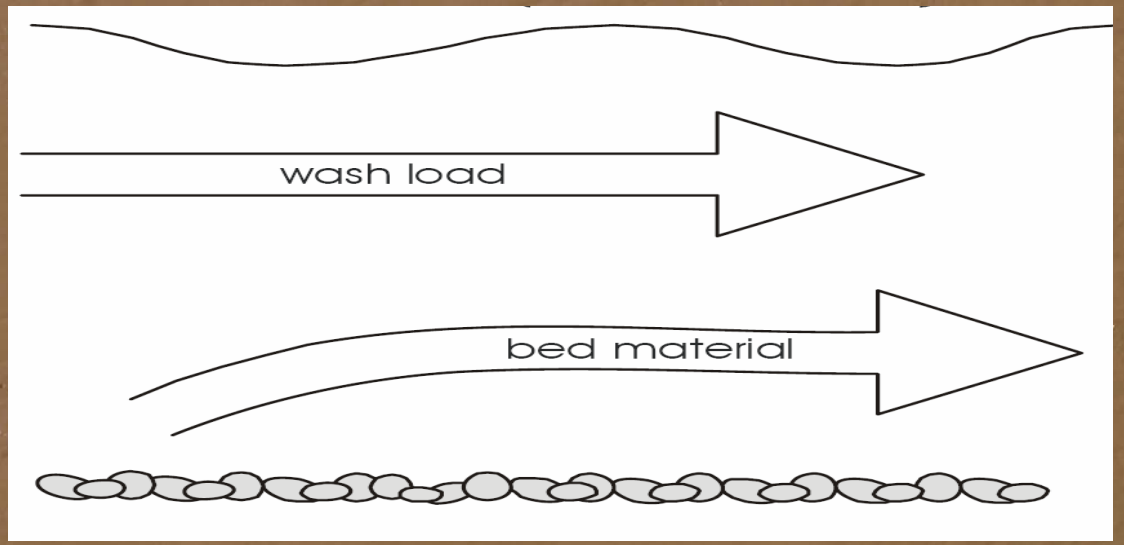
Introduction

- ADCPs are routinely used to measure velocity and discharge in large rivers
- Recent work has shown that ADCPs can also be used to estimate bed load and suspended load
- This presentation outlines the application of ADCPs to estimate suspended sediment concentration and transport

Introduction

- Suspended sediment in most large rivers consists of:
  - **Wash load**: fine sediment (usually silt-clay) in continuous suspension
  - **Suspended bed-material load**: coarser sediment (usually sand) in intermittent suspension



Equipment Requirements: ADCP

- ADCP must measure backscatter, the strength of the reflected signal from particles in suspension

RDI 600 kHz

Sontek 1500 kHz

Equipment Requirements: ADCP

- Magnitude of backscatter depends on ADCP frequency and suspended sediment concentration and size

Values of sound absorption for fresh water (α) and sensitivity to particle size for SonTek aDcps (based on data from SonTek, 1997)

ADcp frequency (kHz)	α (dB/m)	Particle radius for peak sensitivity (μm)	Minimum detectable particle radius (μm)
3000	2.4	80	4
1500	0.6	160	8
750	0.15	320	15
500	0.067	480	25
250	0.017	960	50

Equipment Requirements: Suspended Sediment

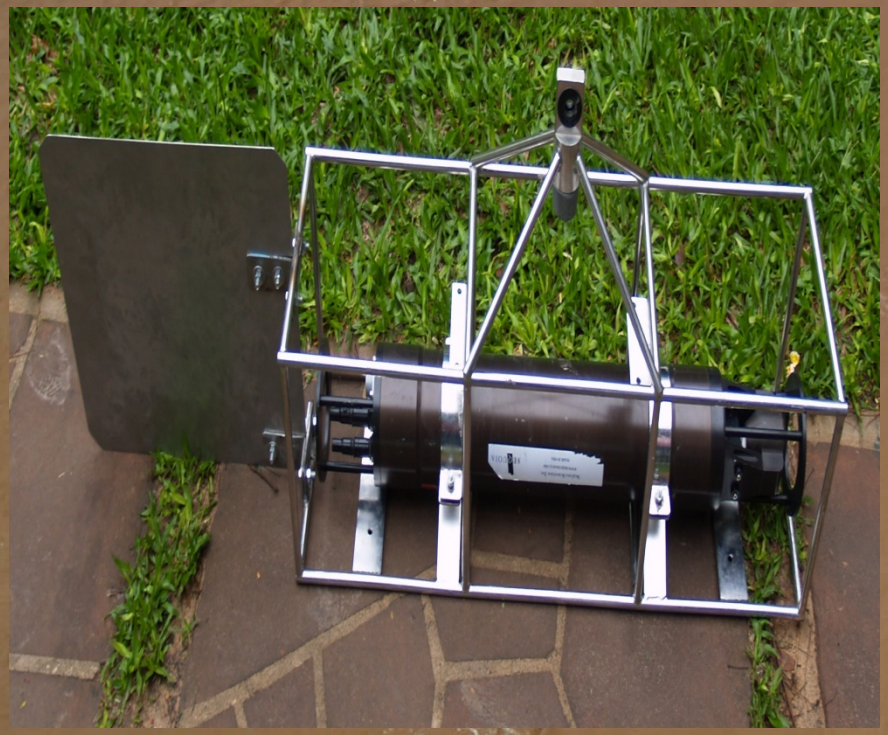
- Point measurements of suspended sediment concentration and particle-size to calibrate ADCP backscatter
- Water samples can be analyzed in the laboratory for concentration and size

P-61 sampler

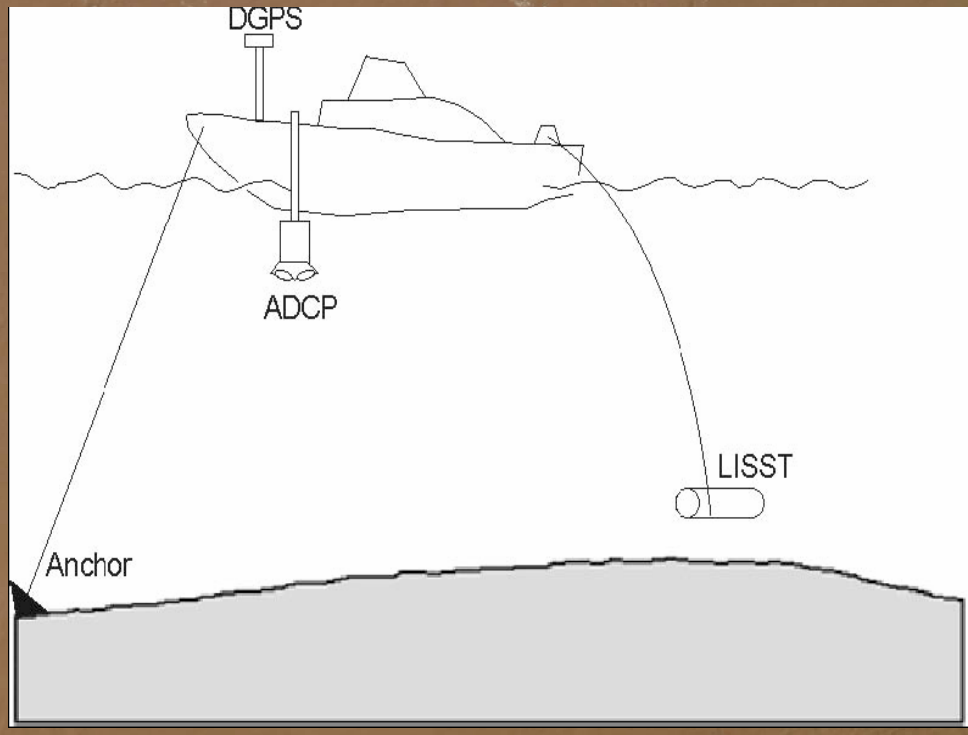
Sequoia LISST Portable

Equipment Requirements: Suspended Sediment

- In situ measurements best, using a submersible particle-size analyzer



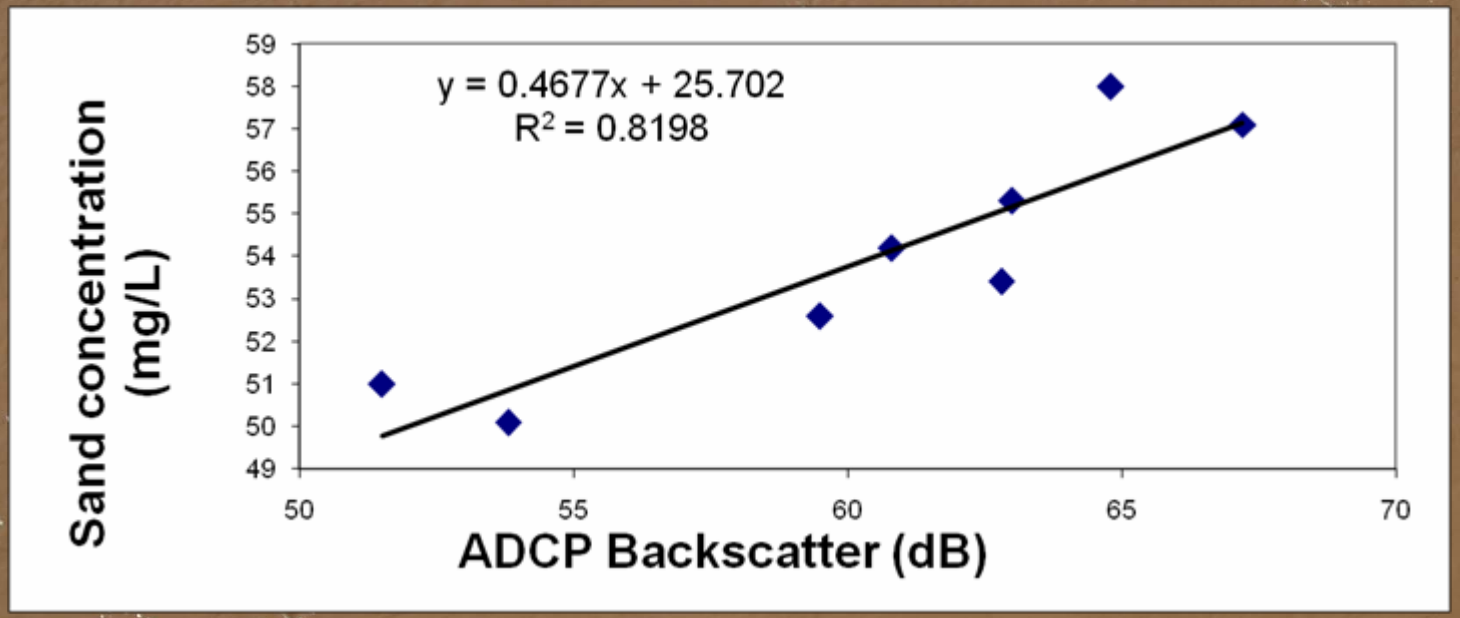
Sequoia LISST 100C deployment



ADCP-LISST

ADCP Calibration

- ADCP backscatter is calibrated with simultaneous measurements of suspended sediment concentration using (usually linear) regression



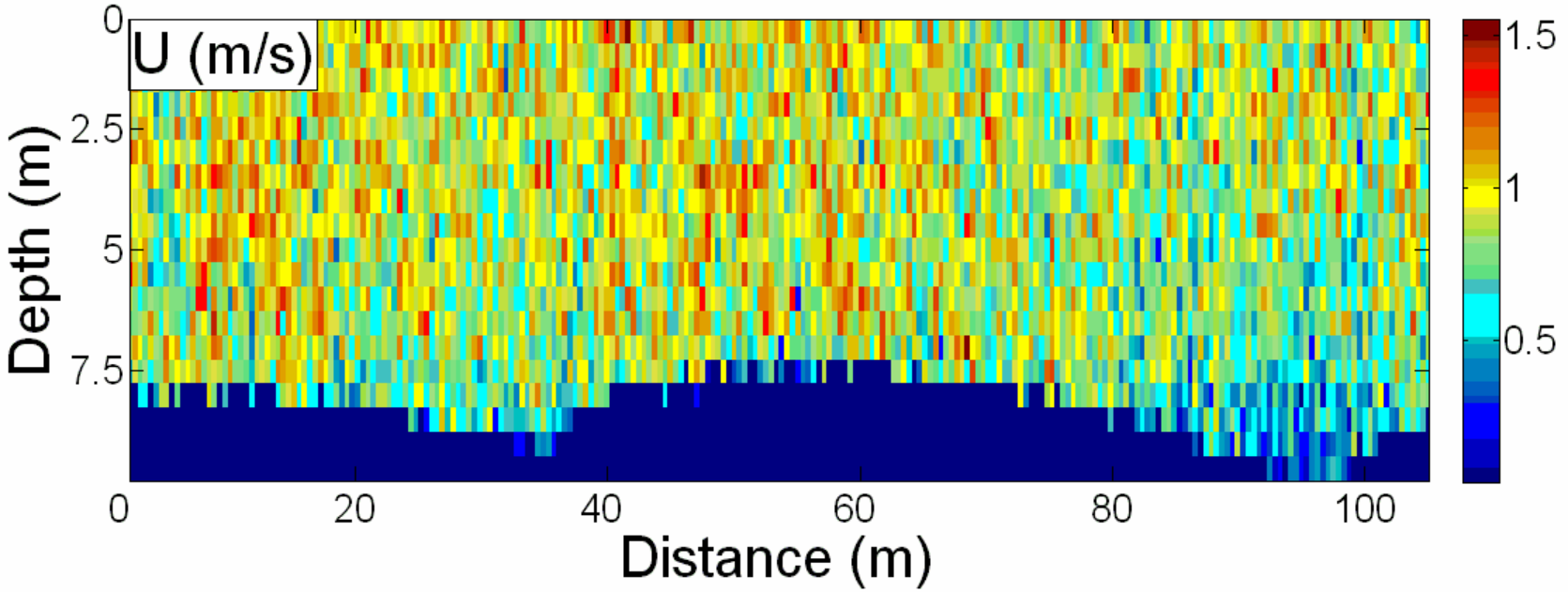
Example of RDI 600 kHz ADCP-LISST 100C calibration: Parana River, Argentina

Example: Parana River, Argentina

- RDI 600 kHz ADCP and LISST measurements made over a dune in the Parana River
- Calibration curve on previous slide

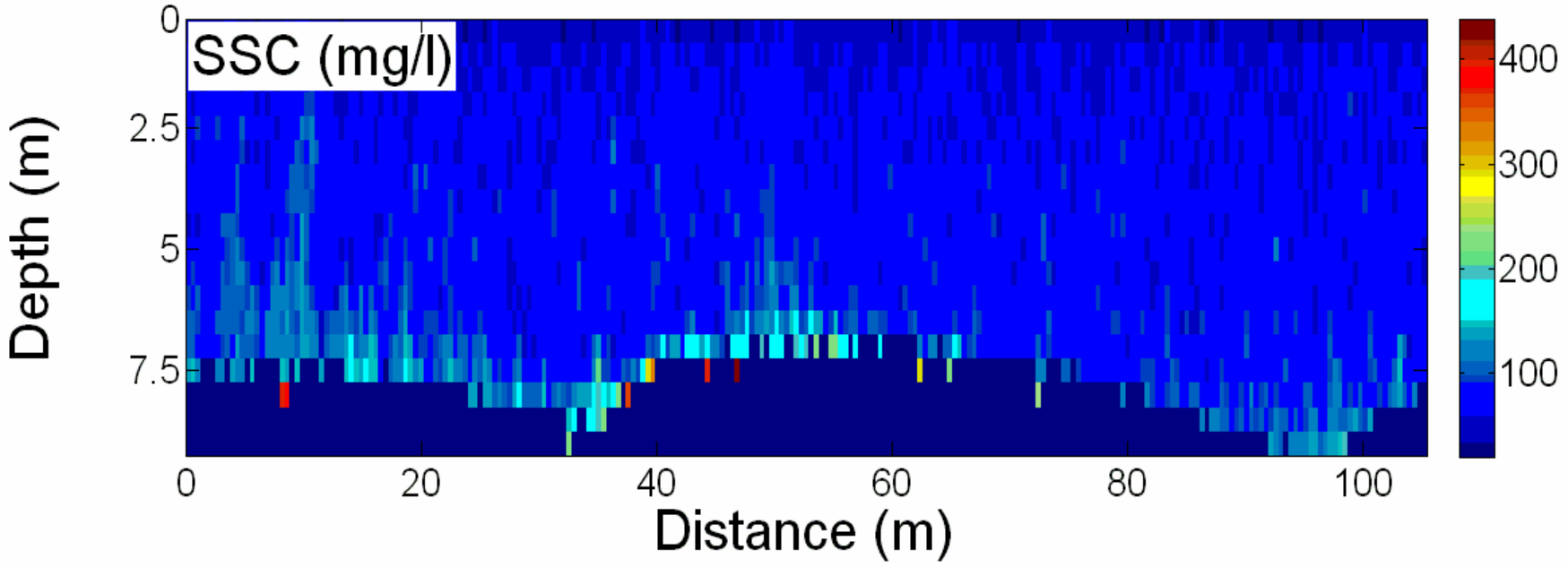
Example: Parana River, Argentina

- Streamwise velocity (U) from a launch traveling upstream over study dune



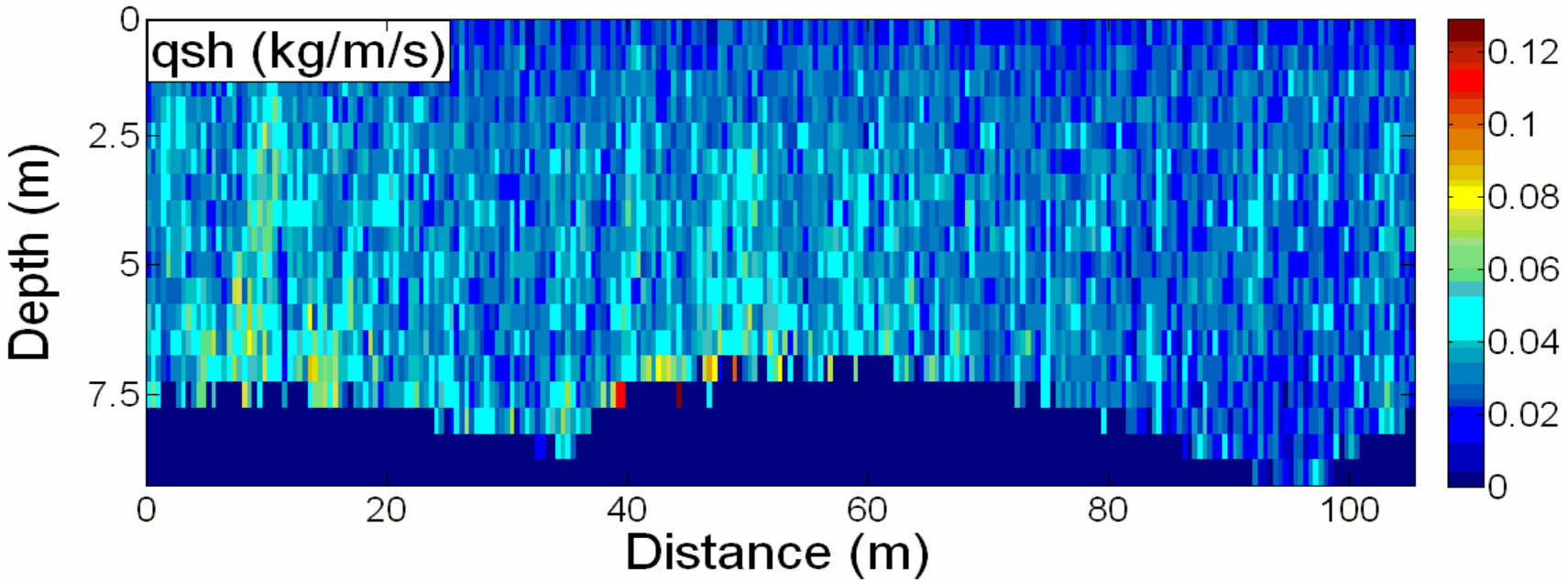
Example: Parana River, Argentina

- Suspended sand concentration (SSC) over study dune based on calibration with LISST



Example: Parana River, Argentina

- Streamwise suspended sand flux (qsh) over study dune based on streamwise velocity (U) and sand concentration (SSC)



Summary

- ADCPs can be used to measure velocity and discharge and to estimate suspended sediment concentration and transport from a moving launch
- Approach has several important limitations however:
  - Estimate of concentration from backscatter depends on the quality of the calibration curve
  - ‘Mixed load’ rivers require separation of wash and suspended bed–material concentrations and separate calibrations

Summary

- Calibrations are often better for sand than for silt-clay
- ADCP does not provide measurements of velocity and backscatter close to the bed, where concentrations are usually highest, and therefore is likely to underestimate actual transport rates