A PROPOSAL FROM THE UNIVERSITY OF MISSISSIPPI

SUBMITTED TO:	USGS
PROPOSAL TITLE:	Acoustic backscatter/attenuation discrimination of particle size with in-situ particle-size measurement
PRINCIPAL INVESTIGATOR:	Wayne O'Brian Carpenter
DEPARTMENT:	NCPA
PROJECT PERIOD:	1/1/2011-12/31/2011
AMOUNT REQUESTED:	$ 19,161.00

CONTACTS:

For Administrative Matters:

Robin C. Buchannon, Assistant Vice Chancellor
for Research and Sponsored Programs
P.O. Box 907
University MS 38677-0907
662-915-7482 voice
662-915-7577 fax

For Fiscal Matters:

Nina J. Jones
Director of Accounting
P.O. Box 1848
University MS 38677-1848
voice 662-915-6645
fax 662-915-7001

SIGNATURES:

[signature]	662-915-7839	10/27/10
Principal Investigator(s)	Telephone Number(s)	Date

Authorizing University Official:

Alice M. Clark /mm	11/5/10
Alice M. Clark, Ph.D. Vice Chancellor for Research and Sponsored Programs	Date

Acoustic backscatter/attenuation discrimination of particle size with in-situ particle-size measurement

Wayne O. Carpenter, R&D Engineer II, University of Mississippi, National Center for Physical Acoustics
James P. Chambers, PhD, Senior Research Scientist, University of Mississippi, National Center for Physical Acoustics

Daniel G. Wren, PhD, Hydraulic Engineer, USDA-ARS-National Sedimentation Laboratory
Roger A. Kuhnle, PhD, Hydraulic Engineer, USDA-ARS-National Sedimentation Laboratory

Background:

Acoustic technology has great potential for improving the current state of suspended-sediment measurement technology; it can be relatively inexpensive, lends itself well to remote deployment, and is non-intrusive.[1] Most acoustic systems have targeted sand sized particles (62-2000 μm) due to their heterogeneous distribution with depth.[2] However, a large portion of the sediment load in a stream may be <62 μm, a size range that is well-distributed throughout the cross-section.[3,4,5] These fine sediment particle concentrations have been observed to be as high as 56% by weight.[6,7] This research is aimed at the development of a device and measurement technique that will use measurements of acoustic signal attenuation during propagation through water containing clay and silt particles to determine the particle concentration.

The past year's acoustic data collection was performed with the goal of using a combination of backscatter and attenuation to differentiate between particle sizes in two rough size ranges: $\geq\approx$10 μm and $\leq\approx$10 μm. These ranges were chosen because they roughly represent the transition between the silt and clay size ranges. Typical acoustic instruments are 1 MHz or lower in frequency and so will produce very little backscatter from such small particles. Optical backscatter instruments (OBS) can be used successfully to measure these particle sizes, but there is a strong dependence of particle size which results in a need for regular physical samples to supplement the readings of an OBS probe. A high frequency (≈20 MHz) acoustic device that can discriminate between clay and silt-sized particles has the potential to be useful by providing a continuous record of particle concentration at a low cost and with little user intervention. Therefore, multiple data sets of backscatter and attenuation from various combinations of kaolinte, illite, bentonite, and silt were collected in the last year.

Results obtained to date suggest that using a combination of attenuation and backscatter from a single-frequency instrument to make a rough differentiation in particle sizes is possible. However, during the course of data collection, the issue of effective particle size became more important than anticipated as evidenced in Figures 1-3. The decrease in signal level for increasing particle size (indicating increased attenuation) from bentonite to kaolinte to silt can clearly be seen in the data. These results have been shown in previous FISP reports and archival literature.[8,9] Conversely, the *backscatter* amplitude for silt ($D_{50}\approx$50 μm) should be much larger than for bentonite clay (<1 μm) as more sound is reflected back toward the source for larger particles.

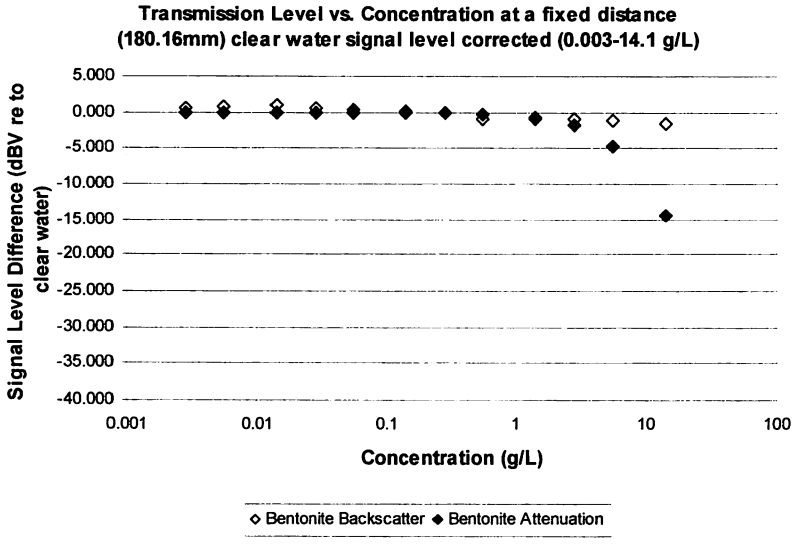

Figure 1: Attenuation and Backscatter for bentonite

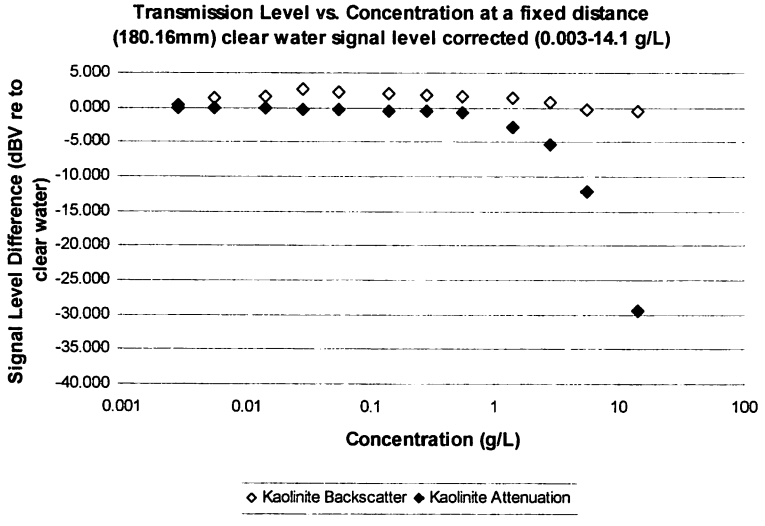

Figure 2: Attenuation and Backscatter for kaolinte

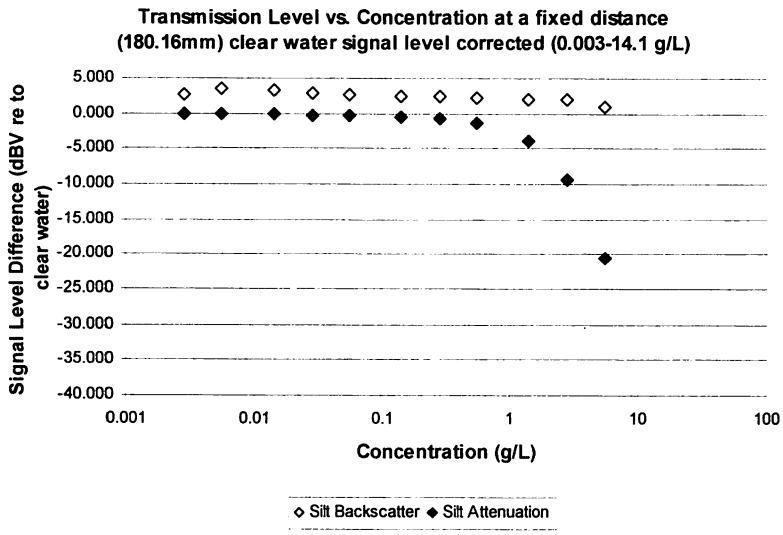

Figure 3: Attenuation and Backscatter for Silt

Indeed, there is more backscatter in the silt data than the bentonite data. However, the silt data does not strongly distinguish itself from the kaolinte data. The backscatter measurements suggest that the deflocculation procedures used in the work may not have been sufficient, resulting in unknown aggregate particle sizes. At the time of the experiments, we did not have any way to measure the in-situ particle size during our experiments. The collection of a physical sample would have broken up any aggregates, making it virtually impossible to know what size particles we were measuring. Since then, we have obtained a LISST-100X from Sequoia Scientific which will be used in a series of experiments to measure the in-situ effective particle size. Our plan is to repeat the experiments that resulted in the data shown in Figures 1-3 and, for each run, collect particle-size data with the LISST-100X. This step should add important information on what is happening with the acoustic backscatter from fine suspended particles.

Goals:

1. Assess the resulting signal levels from particle sizes within clays, silts, and clay/silt mixtures using backscatter and attenuation.
2. Collect and evaluate particle-size data using the LISST-100X to the deflocculation procedures to limitations of backscattered/reflected acoustic signals.
3. Quantify the accuracy of the fixed distance pitch-catch configuration in the laboratory.

Timeline:

Receive funding	0
Plan early experiments	Month 1
Perform experiments	Months 2-6
Analyze data, perform additional experiments if needed	Months 7-10
Complete reporting, publish, and/or present results	Months 10-12

Sources:

[1] D. G. Wren, B. D. Barkdoll, R. A. Kuhnle, and R. W. Derrow, "Field techniques for suspended-sediment measurement," J. Hydr. Eng. 126 (2), 97-104 (2000).

[2] P. D. Thorne, G. P. Holdaway, and P. J. Hardcastle, "Constraining acoustic backscatter estimates of suspended sediment concentration profiles using the bed echo," J. Acoust. Soc. Am. 98(4), 2285-2286 (1995).

[3] V. A. Vanoni, Sed. Eng. (ASCE, New York, 1975).

[4] R. A. Kuhnle, S. J. Bennett, C. V. Alonso, R. L. Bingner, and E. Langendoen, "Sediment Transport Processes in Agricultural Watersheds," Int. J. Sed. Res. 15(2), 182-197 (2000).

[5] R. A. Kuhnle, D. G. Wren, and J. P. Chambers, "Prediction of the Grain Size of Suspended Sediment: Implications for Calculating Suspended Sediment Concentrations using Single Frequency Acoustic Backscatter," Int. J. Sed. Res. 22(1), 1-15 (2007).

[6] E. W. Lane, "Notes on Limit of Sediment Concentration." J. Sed. Petro. 10(2), 95-96 (1940).

[7] C. T. Yang, F. J. M. Simoes, "Wash Load and Bed-Material Load Transport in the Yellow River," J. Hydr. Eng. May 2005.

[8] Carpenter, W. O. Jr., Chambers, J. P., Wren, D. G., Kuhnle, R. A., and Diers, J. A., "Acoustic Measurements of Suspended Fine Particle Concentrations by Attenuation", USDA ARS Research Report No. 67 12/2009

[9] Carpenter, W. O. Jr., Chambers, J. P., Wren, D. G., Kuhnle, R. A., and Diers, J. A., "Acoustic Measurements of Clay-Size Particles", J. Acoust. Soc. Am. Express Letters 126(6) (2009)

USGS

Acoustic backscatter/attenuation discrimination of particle size with in-situ particle-size measurement
1/1/2011-12/31/2011

			Jan - June 2011	July - Dec 2011 5% FY Increase	YEAR 1 Total
Salaries:					
Carpenter	6%	$ 62,458.00	$ 1,874.00	$ 1,967.00	$ 3,841.00
Total Salaries					$ 3,841.00
Salary Fringe	28.90%				$ 1,110.00
Students:					
Undergrad:					
Tom Kendricks	8 wks @ 20hrs/wk @$8.00 per hour				$ 1,280.00
Total Students					$ 1,280.00
Student Fringe	3%				$ 38.40
Total Fringe + Salary:					$ 6,269.00
Travel:					
Domestic (field sites)					$ -
Total Travel:					$ -
Contractual:					
Allowable costs for contractual services under OMB Circular A-21 such as federal express, postage, moving costs, machine shop charges, consulting costs, etc. That are specific to this project.					
Machine Shop	2 hours @$65.00/hour				$ 130.00
Electronics Shop					$ -
USDA Subcontract					$ 6,000.00
Total Contractual					$ 6,130.00
Commodities:					
Allowable Charge under OMB A-21 such as research materials.					$ 1,000.00
Total Commodities					$ 1,000.00
Tuition Remission:					
Total Tuition Remission					$ -
Equipment:					
Total Equipment					$ -
Total Direct Cost					$ 13,399.00
MTDC					$ 13,399.00
Indirect Cost	43%				$ 5,762.00
Total Cost Proposal					$ 19,161.00

Salaries include 5% increase for July 1, 2011 to December 31, 2011

lst
11-3-10

Budget Justification

Direct Labor:
Direct Labor will be charged as shown in the attached spreadsheet. Salaries for the individuals working on this project are based on current salaries. A factor of five percent (5%) per year is used, based on historical averages, to estimate cost of living and merit raises in salary. These raises are effective on 1 July of each year. University of Mississippi documentation of salaries is available upon request. The University of Mississippi charges for personnel based on a percentage of full-time effort. Student salaries are based on the National Center for Physical Acoustics policy.

Fringe Benefits:
Fringe benefits are charged as direct charges to the grant. The percentages used in the above budget are for estimation purposes only. The following table provides the components of the estimated fringe benefit rate for employees. Current University of Mississippi rates can be viewed at http://www.research.olemiss.edu/cms/toolbox/current_rates.
Fringe rate for students is 3%.

The University of Mississippi
Oxford • Jackson • Tupelo • Southaven

Accounting Office
318 Martindale
Post Office Box 1848
University, MS 38677-1848
(662) 915-6538
Fax: (662) 915-7001

October 21, 2010

Effective Immediately:

The University of Mississippi budgets fringe benefits at 28.90% of salaries and wages, excluding students.

This estimate is based on the University's overall composite rate and is broken down as follows:

State Retirement	12.00%
FICA-Medicare	1.45%
FICA-Social Security	5.90%
Worker's Compensation	0.70%
Health Insurance	7.65%
Life Insurance	0.13%
Unemployment	0.07%
Terminal Pay	1.00%
TOTAL	28.90%

This rate does not include an additional 1.10% budgeted for remission of fees. The rate is an estimate only. Actual amounts may vary from this estimate according to the benefits package selected by each individual employee.

If any questions should come up regarding this policy, please feel free to contact me at (662) 915-7078.

Sincerely,

Nina Jones
Director of Accounting

Travel:
There is no travel requested for this project.

Permanent Equipment:
There is no equipment requested for this project.

Expendable Equipment:
There is no expendable equipment requested for this project

Materials, Supplies, and Consumables:
Supplies include, but are not limited to, such items allowed by OMB Circular A-21: research materials, various commodities, goods, merchandise, shop supplies, miscellaneous hardware and electrical supplies, and expendable equipment (not to exceed $5,000.00).

Contractual Services:
Allowable costs for contractual services under OMB Circular A-21 may include, but are not limited to, the purchase of a service such as a maintenance contract, fabrication, machining, electronics design and fabrication, long distance telephone services, postage and shipping, moving costs, professional fees and services, consultant fees, and computer software acquisition that are specific to this project.
Machine Shop Charges will be for building the hardware.
Subcontract to USDA, please see attached information.

Indirect Costs:
Indirect rates are charged at a rate of 43% of the Modified Total Direct Cost (MTDC). Modified Total Direct Costs (MTDC) consist of all salaries and wages, fringe benefits, materials and supplies, travel, and subgrants or subcontracts up to $25,000 of each subgrant/subcontract (regardless of the period covered by the subgrant or subcontract). Modified total direct costs shall exclude equipment items above $5,000 per unit, capital expenditures, charges for patient care and tuition remission, rental costs of off-site facilities, scholarships, and fellowships, as well as the portion of each subgrant/subcontract in excess of $25,000.

The rate agreement was approved by the Department of Health and Human Services on 9 August 2007. The cognizant officer is Jay Mervis, who can be reached at 202-401-2808.

DEPARTMENT OF HEALTH & HUMAN SERVICES

Program Support Center
Financial Management Service
Division of Cost Allocation

Cohen Building-Room 1067
330 Independence Avenue, S.W.
Washington, DC 20201
PHONE: (202)-401-2808
FAX: (202)-619-3379

Aug 9, 2007

Mr. Larry D. Sparks
Vice Chancellor for Administration and Finance
University of Mississippi
Office of the Vice Chancellor for Administration & Finance
P.O. Box 1848
University, MS 38677-1848

Dear Mr. Sparks:

An original and one copy of the facilities and administrative (F&A) cost Rate Agreement are enclosed. This agreement reflects an understanding reached between your organization and the Division of Cost Allocation concerning the rate(s) that may be used to support your claim for F&A costs on grants and contracts with the Federal Government.

Please have the original signed by an authorized representative of your organization and return it to me, retaining the copy for your files. We will reproduce and distribute the Agreement to the appropriate awarding organizations of the Federal Government for their use.

The Office of Management and Budget (OMB) has requested that we reach an agreement with each institution on the components of the published F & A rates. The attached form is provided for that purpose. Please sign the form and fax it with the original Rate Agreement.

A facilities and administrative cost rate proposal, together with the supporting information, are required to substantiate your claim for indirect costs under grants and contracts awarded by the Federal Government. Thus, your next proposal based on actual costs for the fiscal year ending 06/30/10, will be due in our office by 12/31/10.

Sincerely,

Darryl W. Mayes
National Director,
Division of Cost Allocation

INSTITUTION:
University of Mississippi

AGREEMENT DATE: August 9, 2007

SECTION II: SPECIAL REMARKS

TREATMENT OF FRINGE BENEFITS:
Fringe benefits are specifically identified to each employee and are charged individually as direct costs. The directly claimed fringe benefits are listed below.

TREATMENT OF PAID ABSENCES:
Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are claimed on grants, contracts and other agreements as part of the normal cost for salaries and wages. Separate claims are not made for the costs of these paid absences.

OFF-CAMPUS DEFINITION: For all activities performed in facilities not owned by the institution and to which rent is directly allocated to the project(s), the off-campus rate will apply. Grants or contracts will not be subject to more than one F&A cost rate. If more than 50% of a project is performed off-campus, the off-campus rate will apply to the entire project.

Fringe Benefits include: FICA, Retirement, Tuition Remission, Workers' Compensation, Unemployment Insurance, Health Insurance, Terminal Leave and Life Insurance.

Equipment means an article of nonexpendable tangible personal property having a useful life of more than one year, and an acquisition cost of $5,000 or more per unit.

INSTITUTION:
University of Mississippi

AGREEMENT DATE: August 9, 2007

SECTION III: GENERAL

A. LIMITATIONS:
The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its facilities and administrative cost pools as finally accepted: such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as facilities and administrative costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate by the Federal Government. In such situations the rate(s) would be subject to renegotiation at the discretion of the Federal Government.

B. ACCOUNTING CHANGES:
This Agreement is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from facilities and administrative to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES:
If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES:
The rates in this Agreement were approved in accordance with the authority in Office of Management and Budget Circular A-21 Circular, and should be applied to grants, contracts and other agreements covered by this Circular, subject to any limitations in A above. The organization may provide copies of the Agreement to other Federal Agencies to give them early notification of the Agreement.

E. OTHER:
If any Federal contract, grant or other agreement is reimbursing facilities and administrative costs by a means other than the approved rate(s) in this Agreement, the organization should (1) credit such costs to the affected programs, and (2) apply the approved rate(s) to the appropriate base to identify the proper amount of facilities and administrative costs allocable to these programs.

BY THE INSTITUTION:
University of Mississippi

(INSTITUTION)

(SIGNATURE)

Larry D. Sparks

(NAME)

Vice Chancellor for Administration and Finance

(TITLE)

August 27, 2007

(DATE)

ON BEHALF OF THE FEDERAL GOVERNMENT:

Department of Health and Human Services

(AGENCY)

(SIGNATURE)

Darryl Mayes

(NAME)

Director
Division of Cost Allocation

(TITLE)

August 9, 2007

(DATE) 0306

HHS REPRESENTATIVE: Jay Mervis
Telephone: (202) 401-2808

ORIGINAL

COLLEGES AND UNIVERSITIES RATE AGREEMENT

EIN #: 16-46001159

DATE: August 9, 2007

INSTITUTION:
University of Mississippi
Office of the Vice Chancellor
Post Office Box 1848
University MS 38677-1848

FILING REF.: The preceding Agreement was dated June 30, 2004

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions in section III.

SECTION I: FACILITIES AND ADMINISTRATIVE COST RATES*

RATE TYPES: FIXED FINAL PROV.(PROVISIONAL) PRED.(PREDETERMINED)

TYPE	EFFECTIVE PERIOD FROM	TO	RATE(%)	LOCATIONS	APPLICABLE TO
PRED.	07/01/07	06/30/09	44.0	On-Campus	Organized Research
PRED.	07/01/09	06/30/11	43.0	On-Campus	Organized Research
PRED.	07/01/07	06/30/11	26.0	Off-Campus	Organized Research
PRED.	07/01/07	06/30/11	50.0	On-Campus	Instruction
PRED.	07/01/07	06/30/11	26.0	Off-Campus	Instruction
PRED.	07/01/07	06/30/11	28.2	On-Campus	Other Spons Act
PRED.	07/01/07	06/30/11	16.6	Off-Campus	Other Spons Act
PROV.	07/01/11	UNTIL AMENDED	Use same rates and conditions as those cited for fiscal year ending June 30, 2011.		

*BASE:
Modified total direct costs, consisting of all salaries and wages, fringe benefits, materials, supplies, services, travel and subgrants and subcontracts up to the first $25,000 of each subgrant or subcontract (regardless of the period covered by the subgrant or subcontract). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships, and fellowships as well as the portion of each subgrant and subcontract in excess of $25,000.

Statement of work:

The USDA-ARS-National Sedimentation Laboratory will be responsible for aiding in sample collection and for processing physical samples generated by experiments at NCPA concerning acoustic backscatter and attenuation from fine suspended sediment particles. This includes cleaning, prepping and weighing glassware and transport to and from NCPA. The supplies budget will be used to buy additional sampling flasks and to replace broken glassware when needed.

FISP fines measurement-lab measurement proposal:

Cat 1 & 4 salaries:	$0
Cat 1 & 4 salaries:	
Hourly rate for GS-1 step 1 student temporary employee (incl tax/social security):	$11
Hours Per Pay Period	40
Total Per Pay Period	$440
Number of Pay Periods	10
Total Salaries	$4,404
Supplies:	$564
Travel:	$0
Equipment:	$0
RSA:	$0
Overhead	
MS Area	$600
Lab Director	$432
Total Overhead	$1,032
Total:	$6,000