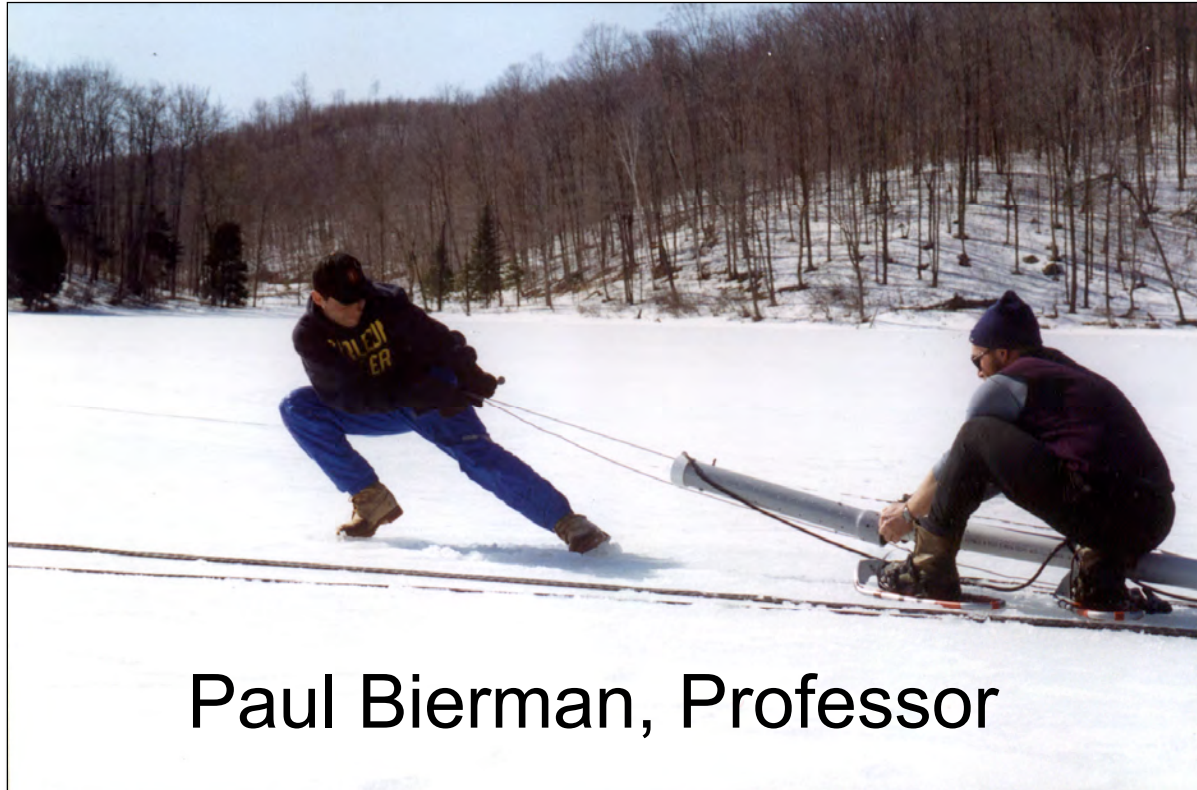


1997 - NSF CAREER proposal

Hydrologic Sciences -- L. Douglas James, PO



Paul Bierman, Professor

For more information see: <http://www.uvm.edu/cosmolab/?Page=projects/career/career.html>

What am I talking about?

The NSF CAREER Program

...The (CAREER) Program is a Foundation-wide activity that offers ... awards in support of junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research....

The Grant we got...

Holocene Geologic Records of Episodic Sedimentation -- Characterizing the Timing and Distribution of Hillslope Erosion and Extreme Hydrologic Events



A bit of history...

- Evolved out of work with my first graduate students.
- New approach, process orientation.
- Understanding erosion - time and place in New England

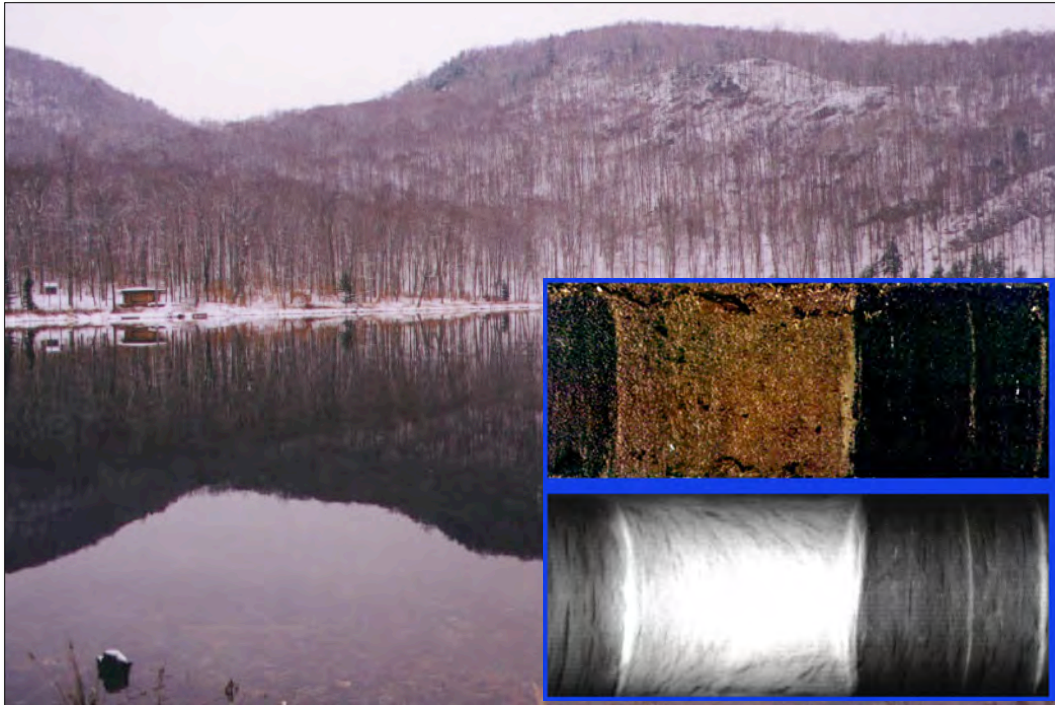


Alluvial Fans....



We are geologists...we
like to get dirty

Pond Muck...



Remember, we are geologists...we like to get dirty, really.



Third try was the charm..

Try 1 (1994) **FAILED**

*New England Debris and
Alluvial Fans: Recorders of
Holocene Hillslope Activity*
*too regional, too narrow, senior co-PI had
no NSF record.*

Gather more data....

Try 2 (1995) **FAILED**

*Landscape and biotic response
to deglaciation*
too broad, won't work in New England.

Gather more data....



Deeply integrated Research and Teaching Plan

- MS students
- Undergraduate classes
- Field and lab based - hands on



From the project summary: This Career proposal integrates my own field and laboratory research with the research and training of both my undergraduate and graduate students; it furthers my educational philosophy of active student involvement at all levels and is designed to provide discreet, achievable research projects for every student involved.



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A-Z | Directory | Webmail

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:: UVM Home

:: UVM Cosmogenic Nuclide Laboratory and Geomorphology Research Group

About the Lab

People

Laboratory Facilities

Lab Methods

Projects

Publications

Fun Photos & Videos

Geocosmo list serve

UVM Geology webpage

Operating Information

Sample Database (login required)

Lab Safety

Paul Bierman's webpage

Contact Us

Cosmogenic Nuclide Laboratory and Geomorphology Research Group

Paleostorminess, New England Ponds and Lakes



The ponds and lakes of New England preserve in their sediments a detailed history of post-glacial surface processes. After coring two dozen ponds we did pollen, radiocarbon, grain size, LOI, stable isotope, C/N and radiocarbon analyses to determine the history of sedimentation and thus infer the temporal and spatial distribution of major paleostorms - paleotempestology in action.

Project Support

NSF EAR-9702643 - CAREER award - Timing and Distribution of Extreme Hydrologic Events
Proposal Project Summary ([download pdf](#))

Millennial-scale storminess variability in the northeastern United States during the Holocene epoch

Authors: J. Mervin*, Paul R. Bierman*, Eric J. Shultz*, Andrea Lister*, & John Southon*

*Department of Geology, University of Vermont, Burlington, Vermont 05405, USA
†Quaternary Research Center and Department of Earth and Space Sciences, University of Washington, Seattle, Washington 98195, USA
‡Center for Accelerator Mass Spectrometry, Lawrence Livermore National Laboratory, Livermore, California 94550, USA

For the purpose of detecting the effects of human activities on climate change, it is important to document natural change in past climate¹. In this context, it has proved particularly difficult to study the variability in the occurrence of extreme climate events, such as storms with exceptional rainfall. Previous investigations have established storm chronologies using sediment cores from single lakes²⁻⁴, but such studies can be susceptible to local environmental bias. Here we demonstrate the frequency of storm events in the northeastern United States has varied in cores from 13 lakes, which show that the frequency of storm events in the past 15,000 years (15 kyr), with a regular cycle during the past 3 kyr. Our data show four peaks characteristic during the past 14 kyr, approximately 2.6, 5.8, 9.1 and 11.9 kyr ago. This pattern is consistent with long-term changes in the average sign of the Arctic Oscillation⁵, suggesting that modulation of this dominant atmospheric mode may account for a significant fraction of Holocene climate variability in North America and Europe.

Lakes in the hilly terrain of Vermont and eastern New York contain sedimentary archives that consist of organic lake mud (gyttja), punctuated by layers of terrestrially derived material. These terrigenous layers are commonly coarser, less organic, and contain more macrofossils of terrestrial plants than the surrounding gyttja; they are graded⁶ and have distinctive stable isotopic signatures⁷. Previous work has demonstrated that such terrigenous layers are deposited by exceptional runoff events during localized intensity and/or duration affects mountaintop lake drainage basins⁸. In New England, the heaviest rains occur during localized convective storms, "nor'easters" or other mid-latitude cyclones, and immediately after these events, material is moved in upland streams and on steep basin hill-slopes is eroded and transported to the lake basins, as indicated by our field observations during two major storms, during which we documented increased fluvial transport of woody forest debris, sand and gravel into lakes. Thus, stratigraphic analysis and dating of lake sediment cores allows the determination of paleostorm chronologies⁹.

Other mechanisms (earthquakes, fires, lake-level fluctuations and removal of vegetation by drought or disease) may also cause or facilitate the deposition of terrigenous material in lakes, but the effects of such other forcings have been shown to be minimal in New England¹⁰. The first European settlers in the area described most of the lake cores, but the significant effects of these and other human activities are limited to the past ~250 yr (ref. 3). Snowmelt floods do not transport enough sediment to cause the deposition of terrigenous layers¹¹. Analyses of cores from lakes with small, low-relief drainage basins show that periods of low aquatic primary productivity have not occurred in this region during the Holocene.

letters to nature

Analyses of nine shallow fans near our coring sites show periods of aggradation caused by increased storminess, runoff and lake-level increases¹², correlated in time with the lacustrine storm record we present here. Most relevant to the argument that terrigenous layers in lake sediment represent storms are findings in locations with long documentary records, which reveal a strong correlation between heavy rainfall and the occurrence and thickness of terrigenous layers in lacustrine sediment¹³.

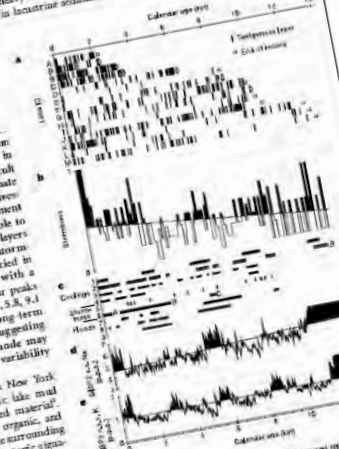


Figure 1. Individual terrigenous sedimentation event chronologies for records a, b, c and d. The storminess index is calculated as the ratio of the number of terrigenous layers to the number of gyttja layers. The storminess index is calculated as the ratio of the number of terrigenous layers to the number of gyttja layers. The storminess index is calculated as the ratio of the number of terrigenous layers to the number of gyttja layers. The storminess index is calculated as the ratio of the number of terrigenous layers to the number of gyttja layers.

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<http://www.uvm.edu/cosmolab/?Page=projects/paleostorms/paleostorms.html>



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A-Z | Directory | Webmail

ABOUT UVM ADMISSIONS ACADEMICS STUDENT LIFE RESEARCH ATHLETICS

UVM Home

UVM Cosmogenic Nuclide Laboratory and Geomorphology Research Group

About the Lab

People

Laboratory Facilities

Lab Methods

Projects

Publications

Fun Photos & Videos

Geocosmo list serve

UVM Geology webpage

Operating Information

Sample Database (login required)

Lab Safety

Paul Bierman's webpage

Contact Us

Cosmogenic Nuclide Laboratory and Geomorphology Research Group

Vermont Alluvial Fans



Humid-temperate Vermont has alluvial fans, not quite at the scale of western North America, but these humid-temperate alluvial fans have their own story to tell. Using numerous hand-dug trenches, detailed stratigraphic analysis, precision surveying, and numerous radiocarbon dates, we reconstructed intervals of increased fan sedimentation and thus human impact on the landscape. The human impact on the landscape is clearly shown by the uptick in sedimentation rates over the last several hundred years.

Project Support

NSF EAR-9702643 - CAREER award - Timing and Distribution of Extreme Hydrologic Events

Proposal Project Summary ([download pdf](#))



<http://www.uvm.edu/cosmolab/?Page=projects/vermontalluvialfans/vermontalluvialfans.html>



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ABOUT UVM

ADMISSIONS

ACADEMICS

STUDENT LIFE

RESEARCH

ATHLETICS

:: UVM Home

:: UVM Cosmogenic Nuclide Laboratory and Geomorphology Research Group

About the Lab

People

Laboratory Facilities

Lab Methods

Projects

Publications

Fun Photos & Videos

Geocosmo list serve

UVM Geology webpage

Operating Information

Sample Database (login required)

Lab Safety

Paul Bierman's webpage

Contact Us

Cosmogenic Nuclide Laboratory and Geomorphology Research Group

Urban Hydrology



Undergraduate and graduate students worked closely with City of Burlington Code Enforcement Office Staff as well as those from the Department of Public Works to map greenspace loss primarily from the conversion of lawns to parking lots at residential rental properties. We designed and deployed a sprinkling infiltrometer to measure infiltration rates on land subjected to different uses. Students created test plots on the UVM campus to determine the effectiveness of tilling and compost addition as remediation agents.

Project Support

NSF EAR-9702643 - CAREER award – Timing and Distribution of Extreme Hydrologic Events
Proposal Project Summary ([download pdf](#))

Quantifying Urban Land Use and Runoff Changes Through Service-Learning Hydrology Projects

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Lyman Persico

Andrew Bosley

Paul R. Mello

James Kurfis

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ABSTRACT

We have used land use change, driven by development of the University of Vermont campus and recent student occupancy of surrounding neighborhoods in Burlington, Vermont, as an opportunity for service learning and for teaching fundamental hydrologic and geologic skills in two undergraduate Geology courses. Two students from a Geomorphology class used historical maps and aerial photographs of the University campus to document the dramatic increase in impermeable surfaces on campus from 4% of the land area in 1869 to 42% in 1999. In Geology, student teams used aerial photographs, field mapping, and door-to-door surveys to document green-space losses of 40 to 50% over the past 20 years in neighborhoods inhabited predominantly by students. Despite zoning controls enacted in 1973 to demonstrate that this unregulated change in land use increased both the volume and peak flow of stormwater runoff. Senior research projects have also made field and demographic studies of individual neighborhoods and examined the percent of land use change. In each of these studies, students worked closely with City and University staff and presented results at local forums, professional national meetings, and on the World Wide Web. These service-learning projects have received positive feedback from the students, city officials, and community members.

INTRODUCTION

The University of Vermont (UVM) is located in Burlington, Vermont, a moderate-sized (population 39,000 in 2000) college town situated on and above the shores of Lake Champlain (Figure 1). Burlington is often considered a desirable place to live because of its "Green" reputation and its family friendly environment (e.g. Steere, 1999). However, in recent years, some neighborhoods close to the UVM campus have experienced a significant change in character and land use as students have moved off campus and several related service-learning projects in which students quantify the hydrologic impact of these land use changes, specifically the conversion of permeable green space to impermeable parking lots and buildings.

SERVICE-LEARNING PROJECTS

Undergraduate projects provide excellent opportunities for student and faculty involvement with public issues and for hands-on service learning that requires students to interact with community members while collecting data (National Service-Learning Clearinghouse, 2002; Ward, 1999). At UVM, we use service learning as part of the sophomore/junior level Geomorphology class (Persico et al., 2000), the junior/senior level Hydrology class (Cron et al., 1999; Clapp et al., 1996), and as part of senior research projects provide the greatest opportunity for independent research in the hydrological sciences. Senior research projects have included quantifying land use change in Burlington neighborhoods (e.g. Kurfis et al., 2002; Kurfis et al., 2001) and surveying groundwater wells (University of Vermont Geology Department, 2002a).

BURLINGTON SETTING AND LAND USE HISTORY

Burlington underlain primarily by glacial post-glacial sediment including till, lacustrine silt, and deltaic sand, began urban development in the late 1800s. Most urban neighborhoods were built out by 1930 and are served by stormwater codes (passed in 1973) mandate that imperviousness may not cover more than 35% of each lot. The code is designed to leave 65% of a lot's space where precipitation can infiltrate. Between 1963 and 1973, UVM enrollment, adding more than 3000 concomitant students to live off campus, forced many students to live in multi-unit transformation of single and multi-family houses into student apartments. On average, four more cars per parcel (six for two, two for one) increased the number of vehicles on the road. Most houses currently occupied by single-family homes or duplexes have insufficient driveway space for their landfills have reduced the number of available spaces between the number of available

Nichols et al. - Quantifying Urban Land Use



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landscape
images
on-line**

24/7 access
Free to anyone
Web-based archive
Collected by students
Community involvement
National Science and Lintilhac Foundation funding

<http://uvm.edu/landscape>



Take home messages....

1. Do something new and different
2. Have evidence project will work
3. Don't give up (resubmit and keep gathering data)
4. Truly synthesize research and teaching
5. Be passionate about the project and have fun



November stream crossing to
survey fan trench



Graduate Seminar - ice cream
cake erosion