Daniel Buscombe

Assistant Research Professor

Northern Arizona University

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- I am Assistant Research Professor at NAU, teaching and researching in sedimentology, sediment transport, geomorphology, hydroacoustics, and scalable geocomputation. I often use machine learning tools in my research.
- Previously, I worked at the Grand Canyon Monitoring and Research Center, an interdisciplinary program within the U.S. Geological Survey carrying out basic and applied research into sediment issues related to the management of regulated rivers in the Western United States.
- Previously I was an a post-doctoral fellow, working in the Marine Science departments at the University of Plymouth, and before that at the University of California Santa Cruz. During those fellowships, I worked on sediment transport and hydrodynamics in nearshore and coastal shelf environments.
- My PhD research at the University of Plymouth (2004 - 2008) focused on the morphodynamics and sediment dynamics of macrotidal gravel beaches.
- I am interested in encouraging reproducible and open research practices in geosciences. To this end I spend significant time developing a variety of open-source scientific computing tools.

Education

PhD 2004-2008
School of Geography, University of Plymouth, Plymouth, UK
advised by Prof. Gerd Masselink and Dr Mark Davidson (School of Marine Science and Engineering)
Thesis: Morphodynamics, Sediment Dynamics and Sedimentation of a Gravel Beach

BSc 2000-2003
Bowland College, Lancaster University, Lancaster, UK
Major: Physical Geography; Minors: Environmental Science & Biological Science
First class, with honours.

Experience

Employment

NAU Nov. 2016–Present
Assistant Research Professor.
School of Earth Sciences & Environmental Sustainability, Northern Arizona University.

U.S. Geological Survey 2012– Nov. 2016
Research Geologist.
Grand Canyon Monitoring & Research Center, U.S. Geological Survey.
Supervised by Dr Paul Grams.

UoP Marine Science 2009–2012
NERC post-doctoral fellowship.
Department of Marine Science & Engineering, University of Plymouth, UK.
Supervised by Dr Daniel Conley & Dr Alex Nimmo-Smith.

UCSC Marine Science 2008–2009
Postdoctoral Researcher, U.S. Geological Survey
& Department of Earth & Planetary Sciences, University of California Santa Cruz.
Supervised by Dr David Rubin & Dr Jessica Lacy.

UoP Marine Ecology 2008–2011
Computer Programming Contractor.
Marine Biology & Ecology Research Centre, University of Plymouth, UK.
Supervised by Dr Kerry Howell.

UoP BARDEX 2008
Research Assistant, School of Geography, University of Plymouth, UK.
BARDEX (Barrier Dynamics Experiment), an EU Hydralab III-funded laboratory wave flume project. Supervised by Prof. Jon Williams & Prof. Gerhard Masselink.

UoP WHISSP 2007–2008
Research Assistant, School of Marine Science & Engineering, University of Plymouth, UK.
WHISSP (Wave Hub Impacts on Seabed and Shoreline Processes), an EU-funded field-based project studying the effects of marine renewable energy devices on the shoreline. Supervised by Prof. Jon Williams & Prof. Gerhard Masselink.

UoP Geography 2004–2008
Associate Lecturer and Demonstrator (part-time).
School of Geography, University of Plymouth, UK.

FSC 2003–2004
Assistant tutor.
Field Studies Council, Castle Head, Grange-over-Sands, UK.

Teaching

EES 680 Earth & Environmental Data Analysis
Spring 2017, 2018 *Course leader – University of Northern Arizona*

EES 529 Applied Remote Sensing
Fall 2014–Present *Guest lecturer – University of Northern Arizona*

EES 698-1 Topics in Fluvial Geomorphology
Fall 2015 *Guest lecturer – University of Northern Arizona*

OS204 Waves, Tides and Coastal Dynamics
2010 – 2012 *Guest lecturer – University of Plymouth*

OS311 Modelling Ocean Processes
2010 – 2012 *Guest lecturer – University of Plymouth*

Geography Introductory statistics, Glacial Geomorphology, Coastal Geomorphology
2004–2008 *Teaching assistant – University of Plymouth*

FSC Field- and classroom-based ecology, geology, environmental sciences
2003–2004 *Teaching assistant – Field Studies Council Castle Head*

Service

Journal Reviewer Arctic; Continental Shelf Research; Earth Surface Processes & Landforms; Geo-Marine Letters; Geophysical Research Letters; Hydrobiologia; IEEE Journal of Oceanic Engineering; Journal of Hydraulic Engineering; Journal of Marine Science & Engineering; Journal of Mountain Science; Journal of Sedimentary Research; Marine Geology; Remote Sensing; Sedimentology; Sedimentary Geology; Water Resources Research.
2007–

NEON Aquatic Technical Working Group Member of the NSF-funded National Ecological Observatory Network Aquatic Technical Working Group, advising on bathymetry, substrate characterisation, and hydroacoustic instrumentation and analyses.
2017–

GSA Co-convener for session T3: Advances in River Science in the Intermountain West. Geological Society of America Joint Rocky Mountain - Cordilleran section meeting, Flagstaff, AZ.
2018

Software Carpentry Lead organizer for this 3 day-long, 30-person workshop at U.S. Geological Survey.
2016

MBES in Rivers Lead organizer for 2nd Multibeam in Rivers Workshop, a 3 day-long, 30-person workshop at U.S. Geological Survey.
2015

AGU Co-convener of the session, EP010. Fluvial sediment budgets: Can we do better? American Geophysical Union Fall Meeting, December 2013
2013

AGU Co-convener of the session, H60: Linking sediment supply, bed-sediment particle size, sediment transport, and bed morphology in fluvial, marine, and aeolian settings. American Geophysical Union Fall Meeting, December 2007
2007

YCSEC On the organising committee for the Young Coastal Scientist and Engineers Conference, 2007 (YCSEC 2007) hosted by the School of Geography at the University of Plymouth 19-21 April 2007.
2007

QRA On the organising committee for the Quaternary Research Association's 4th International Postgraduate Symposium, hosted by the School of Geography at the University of Plymouth 31st August - 2nd September 2005.
2005

Mentoring

Andrew Platt *Estimates of total in-channel sand storage in Grand Canyon.* MS, Northern Arizona University School of Earth Sciences & Environmental Sustainability.
2016-Present Co-supervised with Dr Ryan Porter.

Ryan Lima *Remote sensing of sandbar dynamics.* PhD, Northern Arizona University School of Earth Sciences & Environmental Sustainability.
2016-Present Co-supervised with Dr Temuulen Sankey.

Thomas Ashley *Sediment transport and the evolution of dune topography at the grain scale.* PhD, School of Geology and Geophysics, University of Wyoming.
2014-Present Co-supervised with Dr Brandon McElroy.

Rebecca Rossi 2014-2017
Structure-from-Motion surveying of sandbars in Grand Canyon. MS, Utah State University Department of Watershed Sciences.
Co-supervised with Dr Joseph Wheaton.

Daniel Hamill 2015-2017
Transforming a Low-Cost Leisure Gadget into a High Resolution Riverbed Remote Sensing Tool. MS, Utah State University Department of Watershed Sciences.
Co-supervised with Dr Joseph Wheaton.

Martin Meoli 2011–2012
Gravel transport under waves. MSc Applied Marine Science, School of Marine Science & Engineering, University of Plymouth
Co-supervised with Dr Alex Nimmo-Smith.

James Sawyer 2011–2012
Holographic imaging of near-bed sand suspensions. MSc Applied Marine Science, School of Marine Science & Engineering, University of Plymouth
Co-supervised with Dr Daniel Conley.

AWARDS & HONORS

Institute of Electrical and Electronics Engineers 2017
"Excellence in Peer Review" Award for the journal, *IEEE Journal of Oceanic Engineering*

ASCE-EWRI Best Technical Note Award 2017 February 2017
For Buscombe et al. (2016) *Automated riverbed sediment classification using low-cost sidescan sonar*, Journal of Hydraulic Engineering. Awarded by the Environmental & Water Resources Institute, American Society of Civil Engineers.

USGS "What's the Big Idea?" March 2016
Research featured in the video What's the Big Idea? —Using Sound to Remotely Sense the Riverbed on the YouTube channel of the U.S. Geological Survey

American Geophysical Union Research Spotlight July 2015
Research featured in the article Using Sound Waves to Study Grand Canyon Sediment in EOS Earth and Space Science News

Elsevier "Excellence in Peer Review" Award 2013
for the Elsevier journal, *Sedimentary Geology*

JGR-Oceans Editor's Highlight September 2012
Research featured in the article Novel observations of currents and drag generated by a tsunami published in the Journal of Geophysical Research - Oceans.

COMPUTING

I am an active developer and maintainer of several scientific computing packages. See my github profile (http://github.com/dbuscombe-usgs) for details.

Skills

- Experienced open source developer, with a specialization in scientific computing, including visualization, geospatial statistics, signal processing, image processing and machine learning.
- Expert in the Python Language and extensions such as Cython; expert in the MATLAB language, experience writing R, C, C++, and Fortran code.
- Experience with a variety of tools and languages, including bash, csh, LaTeX, HTML, Git, Linux, virtual machines, virtual environments, auto-deployment of software packages (PyPI, SWIG, Distutils, conda), distributed, parallel, out-of-core and cloud computing.
- Experience with Hydrodynamic modelling software, including the General Ocean Turbulence Model; Simulating Waves Nearshore (SWAN); Simulating Waves 'til Shore (SWASH).
- Experience with Hydrographic surveying and mapping software, including Generic Mapping Tools, MB-System and HYPACK, GIS, and geospatial libaries such as GDAL, Mapbox and Proj-4.

Major Software Projects

PriSM 2018–Present — Software for probabilistic seafloor habitat mapping using multibeam backscatter. Source code currently available in Python.

DGS 2010–Present — Software for automated analyses of grain size from images of sediment. Source code currently available in Matlab and Python.

PyHum 2014–Present — Software for reading, processing and analysis of Humminbird sidescan data. Source code available in Python/Cython.

pysesa 2015–Present — Python program for spatially explicit spectral analysis. Software for spatially explicit analyis of point clouds and spatially distributed data. Source code available in Python.

Sand Simulation Toolbox 2011–2012 — Software for generating 3D discrete particle models consisting of realistic particles (with a size- and shape-distribution) with user-defined properties. Source code available in Matlab.

MATSCAT 20012 — Software for analysis of multiple-frequency acoustic backscatter for suspended sediment concentration and particle size. Source code available in Matlab.

Benthic Analysis Tool 2008–2011 — Software for the semi-automation of species identification and measurement in deep-sea ROV/drop frame images. Source code available in Matlab.

Selected Talks

***= invited talk*

**February 2018 — *PyHum: open-source software for acoustic remote sensing with low-cost sidescan sonar.*
Fish & Wildlife Service Remote Sensing Group

**October 2017 — *Comprehensive Sediment Transport Monitoring in Fine Grained Rivers with High Suspended Loads.*
USGS Minnesota Water Science Center, Mounds View, MN.

September 2017 — *The sand dunes of the Colorado River, Grand Canyon, USA.*
River, Coastal & Estuarine Morphodynamics Conference, Italy.

**August 2017 — *Automated substrate characterization using low-cost sidescan sonar.*
Annual American Fisheries Society Meeting, Tampa, FL.

**March 2017 — *Particle Size 'by Proxy': Decoding the Textural Information in Scattered Sound & Light*
Utah Water Research Laboratory, Utah State University, Logan, UT.

**December 2016 — *Large-scale SfM: Grand Canyon Style*
Pacific Coastal & Marine Science Center, USGS, Santa Cruz, CA.

**October 2016 — *Particle Size 'by Proxy': Decoding the Textural Information in Remotely Sensed Landforms*
School of Earth Sciences & Environmental Sustainability, Northern Arizona University, Flagstaff, AZ.

July 2016 — *Stochasticity of riverbed backscattering, with implications for acoustical classification of non-cohesive sediment using multibeam sonar*
8th International Conference on Fluvial Hydraulics, St. Louis, MO

**January 2016 — *The Digital Grain Size Web Computing Application*
USGS Center for Data Integration, Denver, CO

**January 2016 — *Observations of sand dune migration on the Colorado River in Grand Canyon*
Glen Canyon Dam Adaptive Management Program Adaptive Management Work Group Meeting, Phoenix, AZ

April 2015 — *Considerations for unsupervised riverbed sediment characterization using low-cost sidescan sonar: Examples from the Colorado River, AZ and the Penobscot River, ME.*
Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, NV

April 2015 — *Using oblique digital photography for alluvial sandbar monitoring and low-cost change detection.*
Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, NV

April 2015 — *Hydroacoustic signatures of Colorado riverbed sediments in Marble and Grand Canyons using multibeam sonar*
Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, NV

March 2015 *Acoustic and topographic sediment classification in Lower Marble Canyon*
2nd MBES in Rivers Workshop, USGS Flagstaff, AZ

March 2015 *Characterizing sand dune migration on the Colorado River in Western Grand Canyon using repeat multibeam mapping*
2nd MBES in Rivers Workshop, USGS Flagstaff, AZ

March 2015 *Towards automated substrate mapping with low-cost sidescan sonar*
2nd MBES in Rivers Workshop, USGS Flagstaff, AZ

**February 2015 *The Digital Grain Size Project: Past, Present and Future*
USGS Coastal and Marine Geology, Woods Hole, MA

December 2014 *Topographic and acoustic estimates of grain-scale roughness from high-resolution multibeam echo-sounder: examples from the Colorado River in Marble and Grand Canyons*
American Geophysical Union Fall Meeting, San Francisco, CA

**August 2014 *Measuring bed sediments for improved sediment budgets and physical habitat assessment*
Glen Canyon Dam Adaptive Management Program Adaptive Management Work Group Meeting, Flagstaff, AZ

**February 2014 *Bed Sediment Classification Using High-Frequency Acoustic Backscatter*
Multibeam in Rivers Summit, Utah State University, Logan, UT

December 2013 *Acoustic Scattering by an Heterogeneous River Bed: Relationship to Bathymetry and Implications for Sediment Classification using Multibeam Echosounder Data*
American Geophysical Union Fall Meeting, San Francisco, CA

July 2012 *Schmidt number of sand suspensions under oscillating-grid turbulence*
33rd International Conference on Coastal Engineering, Santander, Spain

**July 2012 *Digital Grain Size*
British Geological Survey, Marine Geosciences Division, Edinburgh, UK

**February 2012 *Nearshore Sediment Transport Through the Looking Glass*
Grand Canyon Monitoring and Research Center, Flagstaff, AZ

February 2012 *Co-variation of intertidal morphology, bedforms and grain size on a macrotidal sand beach: Praa Sands, UK*
Ocean Sciences 2012, Salt Lake City, UT

December 2011 *How do you tell how big something is without direct measurement? Estimating grain size using an image's spectrum*
American Geophysical Union Fall Meeting, San Francisco, CA

November 2010 *Hourly Measurements of Grain-Size from the Inner Continental Shelf Seabed Using a Fully-Automated, Hydraulically-Controlled Underwater Video Microscope*
Particles in Europe 2010, Villefranche-Sur-Mer, France

June 2010 *An automated and 'universal' method for measuring mean grain size from a digital image of sediment*
9th Federal Interagency Sedimentation Conference, Las Vegas, NV

February 2010 *Modeling sand resuspension and stratification in turbulent nearshore flows: sensitivity to grain size distribution*
Ocean Sciences 2010, Portland, OR

**February 2010 *Turbulence, Sediment Stratification and Altered Resuspension under Waves*
Centre for Coastal Science and Engineering, University of Plymouth, UK

**January 2009 *Morphodynamics and sediment dynamics of a macrotidal gravel beach*
Coastal and Marine Geology, United States Geological Survey, Santa Cruz, CA

**October 2008 *Optical sensing of gravel sediment transport and characteristics: recent advances and future challenges.*
Lancaster University Environmental Imaging Network, Lancaster University, UK

September 2008 *Granular Properties from Digital Images of Sediment: Implications for Coastal Sediment Transport Modelling*
31st International Conference on Coastal Engineering (ICCE), Hamburg, Germany

December 2007 *The relationship between sediment properties and sedimentation patterns on a macrotidal gravel beach over a semi lunar tidal cycle*
American Geophysical Union Fall Meeting, San Francisco, CA

**November 2007 *A year in the life of Slapton Sands - but was it a typical year?*
Slapton Research Seminar, Field Studies Council, Slapton Ley, UK

May 2007 *Field observations of step dynamics on a macrotidal gravel beach*
Coastal Sediments 2007, New Orleans, LA

**December 2006 *Field observations of morphological change and sediment dynamics from the nearshore of a gravel beach*
Centre for Coastal Dynamics and Engineering (C-CoDE), University of Plymouth

**November 2006 *A view from the beach*
Slapton Research Seminar, Field Studies Council, Slapton Ley, UK

**December 2004 *A tale of two storms*
Slapton Research Seminar, Field Studies Council, Slapton Ley, UK

Major Grants

U.S. Bureau of Reclamation $30,000 (pending)
Co-Principal Investigator (multiple PIs – J. Mueller and others), (2018 - 2020). Reservoir Operation Alternatives to Minimize the Economic Effects of Sedimentation.

USGS Center for Data Integration $30,000 (pending)
Co-Investigator (J. Warrick and others), (2018). Mapping land-use, hazard vulnerability and habitat suitability using deep neural networks

Minnesota Aquatic Invasive Species Research Center $30,000 (pending)
Co-Principal Investigator (multiple PIs – J. Kozarek and others), (2018 - 2020). Early detection of Zebra mussels using multibeam sonar.

National Science Foundation $52,209 (pending)
Co-Principal Investigator (multiple PIs – M. Guala and others), (2018 - 2020). NSF-GLD: Predictive bedload modeling of bedform sediment flux unders steady and transient flows informed by high resolution bathymetry at laboratory and field scales

Glen Canyon Dam Adaptive Management Work Group $XXXXX (pending)
Co-Investigator (multiple PIs – S. Vanderkooi and others), (2017 - 2019). Sandbars and sediment storage dynamics: long-term monitoring and research at the site, research and ecosystem scales. Grand Canyon Monitoring and Research Center Triennial Work Plan

U.S. National Park Service $49,710
Principal-Investigator, (2017 - 2018) Sediment Resources of the Colorado and Green River in Canyonlands National Park.

USGS Coastal and Marine Geology Program $23,298
Principal-Investigator, (2017 - 2018) Remote Sensing of Coastal Change with advanced structure-from-motion techniques.

USGS $144,290
Principal-Investigator, (2016 - 2017) Remote Sensing of alluvial sandbar dynamics in grand canyon.

USGS Mendenhall post-doctoral fellowship $200,000
Co-investigator: T. Sankey (PI), P. Grams, A. East, D. Buscombe., T. Sankey, (2015 – 2017). The fluvial-aeolian- hillslope continuum: measurement and modeling of topography and vegetation to inform landscape-scale connectivity for sediment in river valley ecosystems

USGS Center for Data Integration $46,417
Principal-Investigator (2015 - 2016). The digital grain size web and mobile computing application

USGS Innovation Fund $48,994
Principal-Investigator (2015 - 2016). LOBOS (Limnological and Oceanographic Benthic Observation System): The next generation dual-scale submersible benthic imaging system. Jointly funded by the USGS Innovation Fund ($16,497), the Innovation Center for Earth Science Director's Fund ($17,497) and the USGS Southwest Biological Science Center ($15,000)

Glen Canyon Dam Adaptive Management Work Group
$4,253,400

Co-Investigator (multiple PIs – J. Schmidt and others), (2015 - 2017). Sandbars and sediment storage dynamics: long-term monitoring and research at the site, research and ecosystem scales. Grand Canyon Monitoring and Research Center Triennial Work Plan

National Park Service
$232,016

Co-Investigator (multiple PIs – P.E. Grams and others), (2014 - 2017). Geomorphic Processes and Relations Among Flow Regime, Sediment Flux and Resource Conditions on the Green River in Canyonlands National Park

Glen Canyon Dam Adaptive Management Work Group
$2,911,400

Co-Investigator (multiple PIs – J. Schmidt and others), (2013 - 2014). Sandbars and sediment storage dynamics: long-term monitoring and research at the site, research and ecosystem scales. Grand Canyon Monitoring and Research Center Biennial Work Plan

Engineering and Physical Sciences Research Council, UK
£240,000

Co-Investigator; G. Masselink (PI), D.C. Conley, D. Buscombe., (2012 - 2014). Proto-type Experiment and Numerical Modelling of Energetic Sediment Transport under Waves (PESTS). EPSRC EP/K000306/1.

International Association for Mathematical Geology
$2000

Principal-Investigator (2008). Grant to develop and trial algorithms for quantification of granular properties and coarse-grain sediment transport from images of the sea bed

PEER-REVIEWED PUBLICATIONS

2006–2007

[1] D. Buscombe *et al. Field observations of step dynamics on a macrotidal gravel beach.* In Kraus, N., and Rosati, J., (Eds), Proceedings of Coastal Sediments 2007 (Volume 1), 2007.

[2] D. Buscombe & G. Masselink. *Concepts in Gravel Beach Dynamics.* EARTH SCIENCE REVIEWS 79:33-52, 2006.

2008

[3] G. Masselink *et al. Sediment Trend Models Fail to Reproduce Small Scale Sediment Transport Patterns on an Intertidal Beach.* SEDIMENTOLOGY 55:667-687, 2008.

[4] M. Austin & D. Buscombe. *Morphological Change and Sediment Dynamics of the Beach Step on a Macrotidal Gravel Beach.* MARINE GEOLOGY 249:167-183, 2008.

[5] D. Buscombe. *Estimation of Grain Size Distributions and Associated Parameters from Digital Images of Sediment.* SEDIMENTARY GEOLOGY 210:1-10, 2008.

[6] G. Masselink & D. Buscombe. *Shifting gravel: A case study of Slapton Sands.* GEOGRAPHY REVIEW 22:27-31, 2008.

[7] D. Buscombe *et al. Granular Properties from Digital Images of Sediment: Implications for Coastal Sediment Transport Modelling.* Proceedings of the 31st International Conference on Coastal Engineering (ICCE), Hamburg, 2008.

[8] A. Ruiz de Alegria *et al. Storm Impacts on a Gravel Beach Using the ARGUS video system.* Proceedings of the 31st International Conference on Coastal Engineering (ICCE), Hamburg, 2008.

[9] M. Austin *et al. Groundwater seepage between a gravel barrier beach and a freshwater lagoon.* Proceedings of the 31st International Conference on Coastal Engineering (ICCE), Hamburg, 2008.

2009

[10] D. Buscombe & G. Masselink. *Grain Size Information from the Statistical Properties of Digital Images of Sediment.* SEDIMENTOLOGY 56:421-438, 2009.

[11] J.A. Warrick *et al. Cobble Cam: Grain-size measurements of sand to boulder from digital photographs and autocorrelation analyses.* EARTH SURFACE PROCESSES & LANDFORMS 34:1811-1821, 2009.

[12] J. Williams *et al. BARDEX (Barrier Dynamics Experiment): taking the beach into the laboratory.* JOURNAL OF COASTAL RESEARCH SI 56:158-162, 2009.

2010

[13] D. Buscombe *et al. Universal Approximation of Grain Size from Images of Non-Cohesive Sediment*. JOURNAL OF GEOPHYSICAL RESEARCH - EARTH SURFACE 115:F02015, 2010.

[14] D. Buscombe *et al. An automated and 'universal' method for measuring mean grain size from a digital image of sediment*. Proceedings of the 9th Federal Interagency Sedimentation Conference, Las Vegas, June 2010.

2012

[15] J. Williams *et al. Barrier Dynamics Experiment (BARDEX): Aims, Design and Procedures*. COASTAL ENGINEERING 63:3-12, 2012.

[16] D. Buscombe & D. Conley *Effective Shear Stress of Graded Sediment*. WATER RESOURCES RESEARCH, 48:W05506, 2012.

[17] D. Buscombe & D.M. Rubin. *Advances in the Simulation and Automated Measurement of Granular Material, Part 1: Simulations*. JOURNAL OF GEOPHYSICAL RESEARCH - EARTH SURFACE 117:F02001, 2012.

[18] D. Buscombe & D.M. Rubin. *Advances in the Simulation and Automated Measurement of Granular Material, Part 2: Direct Measures of Particle Properties*. JOURNAL OF GEOPHYSICAL RESEARCH - EARTH SURFACE 117:F02002, 2012.

[19] J.R. Lacy *et al. Currents and sediment transport induced by a tsunami far from its source*. JOURNAL OF GEOPHYSICAL RESEARCH - OCEANS 117:C09028, 2012.

[20] J. A. Puleo *et al. Comprehensive study of swash-zone hydrodynamics and sediment transport*. Proceedings of the 33rd International Conference on Coastal Engineering, Santander, July 2012.

[21] D. Buscombe & D. Conley *Schmidt number of sand suspensions under oscillating-grid turbulence*. Proceedings of the 33rd International Conference on Coastal Engineering, Santander, July 2012.

[22] D. Conley *et al. Use of digital holographic cameras to examine the measurement and understanding of sediment suspension in the nearshore*. Proceedings of the 33rd International Conference on Coastal Engineering, Santander, July 2012.

2013

[23] D. Buscombe. *Transferable Wavelet Method for Grain Size-Distribution from Images of Sediment Surfaces and Thin Sections, and Other Natural Granular Patterns*. SEDIMENTOLOGY 60:1709–1732, 2013.

2014

[24] J.A. Puleo *et al. A Comprehensive Field Study of Swash-Zone Processes, Part 1: Experimental Design with Examples of Hydrodynamic and Sediment Transport Measurements*. JOURNAL OF WATERWAY, PORT, COASTAL, & OCEAN ENGINEERING 140:29–42, 2014.

[25] D. Buscombe *et al. Autonomous bed-sediment imaging-systems for revealing temporal variability of grain size*. LIMNOLOGY & OCEANOGRAPHY: METHODS 12:390 - 406, 2014.

[26] D. Buscombe *et al. Characterizing riverbed sediment using high-frequency acoustics 1: Spectral properties of scattering*. JOURNAL OF GEOPHYSICAL RESEARCH - EARTH SURFACE 119:F003189, 2014.

[27] D. Buscombe *et al. Characterizing riverbed sediment using high-frequency acoustics 2: Scattering signatures of Colorado River bed sediment in Marble and Grand Canyons*. JOURNAL OF GEOPHYSICAL RESEARCH - EARTH SURFACE 119:F003191, 2014.

2015

[28] E.J. Davies *et al. A Evaluating Unsupervised Methods to Size and Classify Suspended Particles using Digital in-line Holography*. JOURNAL OF ATMOSPHERIC & OCEANOGRAPHIC TECHNOLOGY 32:1241–1256, 2015.

[29] P.E. Grams *et al. Use of Flux and Morphologic Sediment Budgets for Sandbar Monitoring on the Colorado River in Marble Canyon, Arizona*. Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, April, 2015.

[30] D. Buscombe *et al. Hydroacoustic signatures of Colorado riverbed sediments in Marble and Grand Canyons using multibeam sonar*. Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, April, 2015.

[31] D. Buscombe *et al. Considerations for unsupervised riverbed sediment characterization using low-cost sidescan sonar: Examples from the Colorado River, AZ and the Penobscot River, ME*. Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, April, 2015.

[32] D. Buscombe *et al. Using oblique digital photography for alluvial sandbar monitoring and low-cost change detection*. Proceedings of the 10th Federal Interagency Sedimentation Conference, Reno, April, 2015.

2016

[33] M. Cuttler *et al. Estimating the settling velocity of bioclastic sediment from common grain-size analysis techniques*. SEDIMENTOLOGY, 10.1111/sed.12338.

[34] D. Hamill *et al. Towards bed texture change detection in large rivers from repeat imaging using recreational grade sidescan sonar*. Proceedings of the 8th International Conference on Fluvial Hydraulics, St. Louis, Missouri, July 2016.

[35] D. Buscombe & P.E. Grams. *Stochasticity of riverbed backscattering, with implications for acoustical classification of non-cohesive sediment using multibeam sonar*. Proceedings of the 8th International Conference on Fluvial Hydraulics, St. Louis, Missouri, July 2016.

[36] D. Buscombe. *Spatially explicit spectral analysis of point clouds and geospatial data*. COMPUTERS & GEOSCIENCES 86:92–108, 2016.

[37] D. Buscombe *et al. Automated riverbed sediment classification using low-cost sidescan sonar*. JOURNAL OF HYDRAULIC ENGINEERING, 10.1061/(ASCE)HY.1943-7900.0001079, 06015019, 2016.

2017

[38] D. Buscombe *et al. Compositional signatures in acoustic backscatter over vegetated and unvegetated mixed sand-gravel riverbeds*. JOURNAL OF GEOPHYSICAL RESEARCH - EARTH SURFACE, 122, https://doi.org/10.1002/2017JF004302

[39] D. Conley *et al. Grain size selection in seagrass beds*. Proceedings of Coastal Dynamics 2017, Denmark, July 2017 (paper no. 200).

[40] M. Kaplinski *et al. Channel mapping river miles 29–62 of the Colorado River in Grand Canyon National Park, Arizona, May 2009*. U.S. Geological Survey Open-File Report 2017–1030, 35 p., https://doi.org/10.3133/ofr20171030.

[41] D. Buscombe. *Shallow water benthic imaging and substrate characterization using recreational-grade sidescan-sonar*. ENVIRONMENTAL MODELLING & SOFTWARE, 89:1-18, 2017.

2018

[42] P.E. Grams *et al. Automated Remote Cameras for Monitoring Alluvial Sandbars on the Colorado River in Grand Canyon, Arizona*. U.S. Geological Survey Open-File Report 2018–1019, 50 p., https://doi.org/10.3133/ofr20181019.

[43] D. Hamill *et al. Substrate mapping by automated texture segmentation of recreational-grade side scan sonar imagery*. PLOS ONE, 13(3): e0194373. https://doi.org/10.1371/journal.pone.0194373, 2018.

In Review

[44] A. Kasprak *et al. The individual and additive effects of hydrologic alteration and vegetation encroachment on sediment connectivity in Grand Canyon.* PROGRESS IN PHYSICAL GEOGRAPHY, submitted Sept 2017

[45] P.E. Grams *et al. How many measurements are required to construct an accurate sand budget in a large river? Insights from analyses of signal and noise.* EARTH SURFACE PROCESSES & LANDFORMS, submitted Dec 2017.

[46] K. Leary *et al. Practical guidelines for estimating sand bed load in rivers by tracking dunes.* JOURNAL OF HYDRAULIC ENGINEERING, submitted Feb 2018

[47] D. Buscombe & P.E. Grams. *Probabilistic Benthic Substrate Classification with Multispectral Acoustic Backscatter.* IEEE GEOSCIENCE & REMOTE SENSING LETTERS, submitted Mar 2018

Forthcoming

[48] D. Buscombe *et al. Application of Deep Convolutional Neural Networks for Semantic Segmentation of Landscapes.* GEOSCIENCES, in preparation Mar 2018

[49] S. Werner *et al. Turbidity currents triggered in Delgada canyon headwall by canyon-focusing of wave energy.* MARINE GEOLOGY, in preparation Mar 2018

[50] D. Buscombe *et al. Effect of bubbles on acoustic measurements of suspended sand in the surf zone.* COASTAL ENGINEERING, in preparation Mar 2018

[51] R. Tusso *et al. Bed Grain Size Measurements the Colorado River in Grand Canyon, Arizona, 2009 - 2017.* U.S. Geological Survey Open-File Report, in preparation Mar 2018

[52] M. Kaplinski *et al. Channel mapping river miles 61–87 of the Colorado River in Grand Canyon National Park, Arizona, May 2011.* U.S. Geological Survey Open-File Report, in preparation Mar 2018