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Education

PhD. Geophysics, Univ. of Colo. (CU), Boulder, May 1995.
M.S. Mathematics, Oregon State Univ. (OSU), June 1989.
B.S. Physics, OSU, June 1987.
B.S. Engineering Physics, OSU, June 1987.

Honors

NASA Global Change Graduate
Student Fellow, 1990-1993.
National Research Council Research
Associate, 1995-1998.

Professional Societies

American Geophysical Union
International Association for Mathematical Geosciences
International Society for Geomorphometry

Employment

Research Scientist III and Fellow at INSTAAR and **Chief Software Architect** for CSDMS, Univ. of Colorado at Boulder. CSDMS (Community Surface Dynamics Modeling System) is a large, NSF-funded project that began in 2007 and serves the earth surface modeling community. Research interests include: cyberinfrastructure for modeling, hydrologic modeling, fluvial landscape evolution, seafloor and stratigraphic evolution, nonlinear PDEs, differential geometry, scaling theory, sediment plumes, coastal dynamics, efficient computer algorithms, source-to-sink sediment transport. Co-taught course in Oceanography, Spring 2003 to 2006. 1998-Present. Fellow since August 2006.

Research Associate, National Research Council (NRC). Research on the flow dynamics, sediment transport, and geometry of large river basins, with J. Dungan Smith at the Water Resources Division of the USGS, in Boulder. Developed a steady-state fluvial landscape model and a new mathematical method for solving this and similar types of nonlinear partial differential equations. 1995-1998.

Graduate Research Assistant, Center for the Study of Earth from Space (CSES), CU. Research to explain scaling laws for river networks. Developed expertise in remote sensing, image processing, mathematical methods of nonlinear dynamics, complexity theory, fractals/multifractals, cascades, chaos theory and dynamical systems. 1989-1995.

Graduate Research / Teaching Assistant, Mathematics Department, OSU. Developed models for the analysis and description of random networks with Ed Waymire. Extensive coursework in probability theory and stochastic processes. Taught courses in college algebra with good reviews. 1987-1989.

Teaching

Guest instructor in graduate-level course, RGSC 618, "Interdisciplinary modeling: Water-related issues and changing climate", New Mexico State University, sponsored by NSF/EPSCoR, June 7, 2012. Lead instructor: Laurel Saito.

Co-taught graduate-level course, GEOL/GEOG 5700, "Surface Process Modeling: Applying the CSDMS Modeling Tool", University of Colorado at Boulder, Fall 2010. Instructors: J. Syvitski, I. Overeem and S.D. Peckham. 2 credits.

Guest instructor in graduate-level course, NRES 730, "Interdisciplinary modeling: Water-related issues and changing climate", University of Nevada at Reno, sponsored by NSF/EPSCoR, July 28, 2010. Lead instructor: Laurel Saito.

Co-taught course GEOL 4060/5060, Oceanography, University of Colorado at Boulder, Spring 2003, Spring 2004, Spring 2005, Spring 2006. Instructors: J. Syvitski, and S.D. Peckham. 4 credits.

Peer-reviewed Publications

- Peckham, S.D. and E.C. Waymire (2013) A critical threshold for eventual extinction in a randomly disturbed population growth model, (in preparation), *American Naturalist*.
- Peckham, S.D. (2013) Manning's equation and power-law approximations to the logarithmic law of the wall, (submitted), *Water Resources Research*.
- Peckham, S.D., E.W.H. Hutton and B. Norris (2013) A component-based approach to integrated modeling in the geosciences: The Design of CSDMS, *Computers & Geosciences*, special issue: Modeling for Environmental Change, 53, 3-12, <http://dx.doi.org/10.1016/j.cageo.2012.04.002>.
- Peckham, S.D. and J.L. Goodall (2013) Driving plug-and-play models with data from web-services: A demonstration of interoperability between CSDMS and CUAHSI-HIS, *Computers & Geosciences*, special issue: Modeling for Environmental Change, 53, 154-161, <http://dx.doi.org/10.1016/j.cageo.2012.04.019>.
- Laniak, G.F., G. Olchin, J. Goodall, A. Voinov, M. Hill, P. Glynn, G. Whelan, G. Geller, N. Quinn, M. Blind, S. Peckham, S. Reaney, N. Gaber, R. Kennedy and A. Hughes (2013) Integrated environmental modeling: A vision and roadmap for the future, 39, 3-23, *Environmental Modeling & Software*.
- North, E.W., E.E. Adams, Z. Schlag, R. He, S. Socolofsky and S. Peckham (2013) Simulating the dispersal of degrading oil from the Deepwater Horizon spill: A model sensitivity study, *Geophysical Research Letters* (submitted).
- Cobourn, K.M., H. Lintz, S. Peckham and L. Saito (2013) A framework to understand and guide research and management in rangelands with ecological thresholds, *Rangeland Ecology and Management* (submitted)
- Syvitski, J.P.M., S.D. Peckham, O. David, J.L. Goodall, C. Deluca, G. Theurich (2012) Chapter 28: Cyberinfrastructure and community environmental modeling, 399-410, In: *Handbook of Environmental Fluid Dynamics, Volume 2: Systems, Pollution, Modeling and Measurements*, Editor: H.J.S. Fernando, CRC Press.
- Peckham, S.D. (2011) Profile, plan and streamline curvature: A simple derivation and applications, *Proceedings of Geomorphometry 2011*, Redlands, CA, pp. 27-30.
- Peckham, S.D. (2011) Monkey, starfish and octopus saddles, *Proceedings of Geomorphometry 2011*, Redlands, CA, pp. 31-34.
- Syvitski, J.P.M., E.W.H. Hutton, S.D. Peckham and R. Slingerland (2011) CSDMS -- A modeling system to aid sedimentary research, *The Sedimentary Record*, 9(1), 4-9, March, SEPM Society for Sedimentary Geology, doi: 10.2110/sedred.2011.1.
- Voinov, A.A., C. Deluca, R.R. Hood, S.D. Peckham, C.R. Sherwood, J.P.M. Syvitski (2010) A community approach to earth systems modeling, *EOS, Transactions American Geophysical Union*, 91(13), 117, doi:10.1029/2010EO1130001.
- Peckham, S.D. (2009) Geomorphometry and spatial hydrologic modeling, In: Hengl, T. and Reuter, H.I. (Eds), *Geomorphometry: Concepts, Software and Applications*, Chapter 25, Developments in Soil Science, vol. 33, Elsevier, 579-602.

- Gruber, S. and S.D. Peckham (2009) Land-surface parameters and objects specific to hydrology, In: Hengl, T. and Reuter, H.I. (Eds), *Geomorphometry: Concepts, Software and Applications*, Chapter 7, Developments in Soil Science, vol. 33, Elsevier, 171-194.
- Peckham, S.D. (2009) Geomorphometry in RiverTools, In: Hengl, T. and Reuter, H.I. (Eds), *Geomorphometry: Concepts, Software and Applications*, Chapter 18, Developments in Soil Science, vol. 33, Elsevier, 411-430.
- Peckham, S.D. (2008) A new method for estimating suspended sediment concentrations and deposition rates from satellite imagery based on the physics of plumes, *Computers & Geosciences*, 34, 1198-1222. (includes computer code, special issue)
- Peckham, S.D. (2008) On the form and stability of seafloor stratigraphy and shelf profiles: A mathematical model and solution method, *Computers & Geosciences*, 34, 1358-1369. (includes computer code, special issue)
- Peckham, S.D. (2008) Evaluation of model coupling frameworks for use by the Community Surface Dynamics Modeling System (CSDMS), In: *Proceedings of MODFLOW and MORE 2008: Ground Water and Public Policy Conference*, May 18-21, 2008, Golden, CO, 535p, Eds. E.P Poeter, M.C. Hill and C. Zheng.
- Goodall, J., D.G. Tarboton, S.D. Peckham, R. Hooper (2008) New software architecture for integrated water modeling, *EOS, Transactions*, 89(43), p. 420, American Geophysical Union.
- Syvitski, J.P.M., Kettner, A., Peckham, S.D. and Kao, S. (2005) Predicting the flux of sediment to the coastal zone: Application to the Lanyang watershed, northern Taiwan, *Journal of Coastal Research*, 21(3), 580-587.
- Peckham, S.D. (2003) Fluvial landscape models and catchment-scale sediment transport, *Global and Planetary Change* (special issue), 39(1), 31-51.
- Peckham, S.D. (2003) Mathematical modeling of landforms: Optimality and steady-state solutions, In: *Concepts and Modelling in Geomorphology: International Perspectives*, Eds. Evans, I.S., Dikau, R., Tokunaga, E., Ohmori, H. and Hirano, M., 167-182.
- Morehead, M.D., Syvitski, J.P.M., Hutton, E.W.H. and Peckham, S.D. (2003) Modeling temporal variability in the flux of sediment from ungauged river basins, *Global and Planetary Change* (special issue), 39(1), 95-110.
- Syvitski, J.P.M., Peckham, S.D. and Hilberman, R.D. and Mulder, T. (2003) Predicting the terrestrial flux of sediment to the global ocean: A planetary perspective, *Sedimentary Geology*, 162, 5-24.
- Syvitski, J.P.M., Hilberman, R. and Peckham, S.D. (2002) Sediment flux to the coastal zone: Predictions for the Navy, *Terra Nostra, IAMG*, Berlin, v. 2, 437-442.
- Peckham, S.D. and V.K. Gupta (1999) A reformulation of Horton's laws for large river networks in terms of statistical self-similarity, *Water Resources Research*, 35(9), 2763-2777.
- Peckham, S.D. (1999) Solutions to nonlinear partial differential equations - A geometric approach, In: *Proceedings of the Conference on Geometry in Present-Day Science*, edited by O.E. Barndorff-Nielsen and E.B. Vedel Jensen, World Scientific, New Jersey, 165-186.
- Peckham, S.D. (1998) Efficient extraction of river networks and hydrologic measurements from digital elevation data, In: *Stochastic Methods in Hydrology: Rain, Landforms and Floods*, edited by O.E. Barndorff-Nielsen, World Scientific, New Jersey, 173-203.
- Bahr, D.B. and S.D. Peckham (1996) Observations and analysis of self-similar branching topology in glacier networks, *J. Geophys. Res.*, 101(B11).
- Bahr, D.B., M. Meier, and S.D. Peckham (1997) The physical basis of glacier volume-area scaling, *J. Geophys. Res.*, 102(B9), p. 20355.
- Peckham, S.D. (1995) Self-similarity in the geometry and dynamics of large river basins, Ph.D. dissertation, University of Colorado, Boulder.
- Peckham, S.D. (1995) New results for self-similar trees with applications to river networks, *Water Resources Research*, 31(4), 1023-1029.
- Peckham, S.D. and E. Waymire (1992) On a symmetry of turbulence, *Commun. Math. Phys.*, 147, 365-370.

Key, J. and S.D. Peckham (1991) Probable errors in width distributions of sea ice leads measured along a transect, *J. Geophys. Res.*, 96, 18417-18423.

Technical Reports

Gochis, D., S. Peckham, J. Arrigo, J. Famiglietti and R. Hooper (2013) *NSF EarthCube: Earth System Model Coupling Roadmap*, (<http://earthcube.ning.com/page/earthcube-documents>)

Moore, R., L. Di, J. Fredericks, D. Arctur, S. Peckham, J. Horsburgh, Y. Liu, S. Ahalt, L. Band, I. Altintas and C. MacDermaid (2013) *NSF EarthCube: Layered Architecture Roadmap*, (<http://earthcube.ning.com/page/earthcube-documents>)

Peckham, S.D. and D. McKnight (2004) Expert Report: An analysis of the relative impact of conditions at Hanging Valley Ranch on the Town of Carbondale's municipal water supply as compared to conditions near the Roaring Fork Wells, prepared for the Town of Carbondale, Colorado.

Peckham, S.D. (1999) Using remotely-sensed images with a plume model to estimate suspended and deposited sediment near river mouths, Technical Report, 15 pp. Raytheon Systems.

Online Publications

Peckham, S.D. (2013) *CSDMS Basic Model Interface (BMI)*, http://csdms.colorado.edu/wiki/BMI_Description, (6,692 hits as of 2/26/13)

Peckham, S.D. (2013) *CSDMS Standard Names*, http://csdms.colorado.edu/wiki/CSDMS_Standard_Names, (2,984 hits as of 2/26/13)

Peckham, S.D. (2010) *CSDMS Discussion Page for the BP Oil Spill in the Gulf of Mexico*, http://csdms.colorado.edu/wiki/Talk:Marine_Discussion (18,203 hits as of 2/26/13)

Peckham, S.D. (2008) *CSDMS Handbook of Concepts and Protocols: A Guide for Code Contributors*, http://csdms.colorado.edu/wiki/index.php/Tools_CSDMS_Handbook (28,189 hits as of 2/26/13)

Extended Abstracts

Hutton, E.W.H., J.P.M. Syvitski and S.D. Peckham (2010) Producing CSDMS-compliant Morphodynamic Code to Share with the RCEM Community. In: Vionnet et al. (eds) *River, Coastal and Estuarine Morphodynamics RCEM 2009*, Taylor & Francis Group, London, ISBN 978-0-415-55426-CRC Press, p. 959-962.

Peckham, S.D. (2009) A new algorithm for creating DEMs with smooth elevation profiles, extended abstract, *Proceedings of Geomorphometry 2009*, Zurich, Switzerland, p. 34-37, R. Purves, S. Gruber, T. Hengl, R. Straumann (Eds).

Syvitski, J.P.M., W.F. Manley, S.D. Peckham, M. Dyurgerov, L. Lestak, A. Lynch, J. Maslanik (2003) Arctic coast erosion: A regional to local perspective, Tromso Meeting.

Peckham, S.D., Manley, W., Dyurgerov, M., and Syvitski, J.P.M. (2002) Modeling coastal erosion near Barrow, Alaska. Rachold, V., Brown, J. and Solomon, S. (Eds.) *Arctic Coastal Dynamics: Report of an International Workshop*, Reports on Polar Research, 413, 46-47.

Peckham, S.D. (2001) Mathematical modeling of landforms, Fifth International Conference on Geomorphology, Tokyo, Japan.

Published Abstracts

Peckham, S.D. (2012) Modeling frameworks, workflows and community modeling: Where are we now and where do we go from here? (Invited), *Eos Trans. AGU*, Fall Meet. Suppl., Abstract IN54B-05.

Peckham, S.D. (2012) Plug-and-play hydrologic modeling: Is that really possible? (Invited), *Eos Trans. AGU*, Fall Meet. Suppl., Abstract IN11B-1462.

Gochis, D.J., S.D. Peckham, J.S. Arrigo, J.S. Famiglietti, J.T. Reager, J. Edman (2012) Progress and

- opportunities in Earth System model coupling with emphasis on hydrological model components (Invited), *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H31N-01.
- Hinzman, L.D., W.R. Bolton, J.M. Cable, B. Nijssen, D. Lettenmaier, S.D. Peckham and D. Morton (2012) Quantifying interdependence among processes and characterizing dynamic controls across spatial scales by linking climate, hydrology and ecosystem models, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract B53E-0710 (or B41C-0311 ?)
- Overeem, I., E. Hutton, A. Kettner, S.D. Peckham and J.P. Syvitski (2012) The Community Surface Dynamics Modeling System: Experiences on building a collaborative modeling platform (Invited), *Eos Trans. AGU*, Fall Meet. Suppl., Abstract IN54A-06.
- Syvitski, J.P., E. Hutton, S.D. Peckham, I. Overeem and A. Kettner (2012) CSDMS 2.0: Computational infrastructure for community surface dynamics modeling, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract IN51D-1707.
- Peckham, S.D. (2011) A population growth model forced by random, episodic disturbances, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract B33E-0506.
- Cobourn, K.M. and S.D. Peckham (2011) When does ecological sustainability ensure economic sustainability? An integrated analysis of thresholds in semi-arid western rangelands, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract B31K-05.
- Peckham, S.D. (2010) Component-based hydrologic and landscape evolution models: Interoperability, standards and new algorithms, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H53H-07.
- North, E.W., Z. Schlag, E.E. Adams, R. He, K.H. Hyun, C.R. Sherwood, R.P. Signell and S.D. Peckham (2010) Simulating the three-dimensional dispersal of aging oil with a Lagrangian approach, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract OS42A-07.
- Peckham, S.D. and Hutton, E.H. (2009) Componentizing, standardizing and visualizing: How CSDMS is building a new system for integrated modeling from open-source tools and standards, *Eos Trans. AGU*, 90(52), Fall Meet. Suppl., Abstract IN11A-1045.
- Peckham, S.D. Hutton, E.W.H. and Syvitski, J.P.M. (2009) The CSDMS project and submission standards for model source code. Abstracts of the IAMG 2009 Meeting, August 23-29, 2009 Stanford, CA
- Peckham, S.D. (2008) Towards a system for high-performance, multi-language, component-based modeling, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract IN33A-1158.
- Bachman, S. and Peckham, S.D. (2008) Comparison of numerical approaches to a steady-state landscape equation, *Eos Trans. AGU*, 89(53), Fall Meet. Suppl., Abstract H51D-0862.
- Peckham, S.D. and Syvitski, J.P.M.(2007) Evaluation of model coupling frameworks for use by the Community Surface Dynamics Modeling System (CSDMS), *Eos Trans. AGU*, 88(52), Fall Meet. Suppl., Abstract H53C-1407.
- Peckham, S.D. (2006) Modeling longshore transport and coastal erosion due to storms at Barrow, Alaska, *Eos Trans. AGU*, 87(52), Fall Meet. Suppl., Abstract H311-01.
- Peckham, S.D. (2005) A new method for computing flow paths and contributing areas over both convergent and divergent topography, *Eos Trans. AGU*, 86(52), Fall Meet. Suppl., Abstract H43D-0526.
- Morehead, M.D., S.D. Peckham and J. Muskatirovic (2005) Lessons learned from predicting the poorly gauged Sweetwater Creek basin, in Central Idaho, *Eos Trans. AGU*, 86(52), Fall Meet. Suppl., Abstract H51B-0355.
- Peckham, S.D., E. Hutton and J.P.M. Syvitski (2004) New results on the form and stability of continental shelf profiles, 32nd Intl. Geological Congress, Abs. Vol., pt 2, abs. 307-12, p. 1377. (Florence, Italy)
- Peckham, S.D. (2004) The TopoFlow hydrologic model: A new community project, *Eos Trans. AGU*, 85(17), p. 255, Jt. Assem. Suppl., Abstract H52B-05. (Invited talk, AGU Joint Assembly Meeting, Montreal, Canada)
- Peckham, S.D. (2003) Estimating geomorphically effective rainrates from elevation data, *Eos Trans. AGU*, 84(46), p. 263, Fall Meet. Suppl., Abstract H41A-07.

- Bolton, W.R., L.D. Hinzman, S.D. Peckham, D.L. Kane and K. Yoshikawa (2003) Characterizing the influence of permafrost on hydrological processes through a spatially distributed model, *Eos Trans. AGU*, 84(46), p. 181, Fall Meet. Suppl., Abstract H22B-0929.
- Peckham, S.D., M. Nolan and L. Hinzman (2002) A new distributed hydrologic model based on ARHYTHM and RiverTools, *Eos Trans. AGU*, 83(47), Fall Meet. Suppl., Abstract H71E-08.
- Peckham, S.D. and M.F. Hutchinson (2001) Fluvial landscape reconstruction and process-based gridding algorithms, *Eos Trans. AGU*, 82(47), p. 429, Fall Meet. Suppl., Abstract H32A-0292.
- Morehead, M.D., M.S. Seyfried, S.D. Peckham and J.P.M. Syvitski (2001) Comparison of suspended sediment and discharge regimes among North American watersheds, *Eos Trans. AGU*, 82(47), p. 447, Fall Meet. Suppl., Abstract H41A-0262, Invited.
- Peckham, S.D. (2001) Mathematical modeling of landforms, Transactions, Japanese Geomorphological Union, v. 22(4), p. C-186. (Fifth International Conference on Geomorphology, Tokyo, Japan)
- Peckham, S.D. and J.P.M. Syvitski (2001) A 3D numerical model for fluvial landforms: Bifurcating channels and realistic longitudinal profiles from first principles, 7th International Conference on Fluvial Sedimentology, Univ. of Nebraska, Lincoln, NE.
- Peckham, S.D., E. Hutton and J.P.M. Syvitski (2000) Building seafloor stratigraphy via sediment deposition from plumes and other sources: A comparison of numerical and new analytic results, *Eos Trans. AGU*, 81(48), p. 632, Fall Meet. Suppl., Abstract OS61A-16.
- Peckham, S.D. (1999) Quantitative predictions from conservation equations, *Eos Trans. AGU*, Abstract H52F-03. (AGU Fall Meeting, San Francisco, CA)
- Peckham, S.D. (1998) Analytic solutions to nonlinear PDEs in geophysics, *Eos Trans. AGU*, v. 79(45), p. F2, Abstract U71B-04 (AGU Fall Meeting, San Francisco, CA)
- Peckham, S.D. and J.D. Smith (1997) Hydraulic geometry, a broken symmetry, and Hack's law, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H41B-09.
- Peckham, S.D. (1996) The topographic coordinate transformation: A new analytic solution method for nonlinear landform PDEs, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H32A-06.
- Peckham, S.D., V.K. Gupta and J.D. Smith (1996) A dynamic self-similarity hypothesis and predictions of downstream hydraulic geometry and longitudinal river profiles, *Eos Trans. AGU*, p. 77, Spring Meet. Suppl., Abstract H32C-05. (AGU Spring Meeting, Baltimore, MD)
- Bahr, D.B., M.F. Meier and S.D. Peckham (1995) The physical basis for glacier volume-area scaling and implications for mass balance profiles, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H21E-01, Invited.
- Veitzer, S.A., V.K. Gupta and S.D. Peckham (1995) Isomorphism between self-similar tree topologies and multinomial cascades via their width functions, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H41A-02.
- Peckham, S.D. (1995) Self-similarity in Shreve's random model, *Eos Trans. AGU*, Fall Meet. Suppl., Abstract H52E-08.

Additional Presentations and Unpublished Abstracts

- February 2013. An overview of the Community Surface Dynamics Modeling System (CSDMS), (Invited), Second Workshop on Coupling Technologies for Earth System Models (CW2013), National Center for Atmospheric Research, Boulder, CO (Feb. 20)
- December 2012. What's in a name? How the CSDMS Standard Names support sharing variables between models (Invited), Frontiers in Computational Physics: Modeling the Earth System, Boulder, CO (Dec. 20)
- September 2012. An introduction to CSDMS, the Community Surface Dynamics Modeling System, Meeting to evaluate model frameworks for IWRSS (Integrated Water Resources Science and Services), NOAA-NWS-OHD (Office of Hydrologic Development), Silver Spring, MD. (Sept. 13)

August 2012. A population growth model forced by random, episodic disturbances and a critical threshold, Workshop on Mathematical Problems in the Environmental Sciences (MPES), Oregon State University, Corvallis, Oregon (Aug. 1)

June 2012. A brief introduction to CSDMS, the Community Surface Dynamics Modeling System, guest lecture, Interdisciplinary Modeling: Water-Related Issues and Changing Climate (RGSC 618), New Mexico State University, Las Cruces, NM (June 9).

November 2011. Advances in component-based modeling: Insights from the CSDMS project, Model Fusion Conference 2011, The Geological Society, London (Nov. 29).

November 2011. The Community Surface Dynamics Modeling System (CSDMS -- Plug-and-play model interoperability for the earth sciences, Hydrologic Sciences and Water Resources Engineering Seminar Series, University of Colorado, Boulder (Nov. 9)

November 2011. Participated in NSF EarthCube Charrette, Washington, D.C.

October 2011. TopoFlow Hydrologic Model Hand-on Training, CSDMS Annual Meeting: Impact of time and process scales, Boulder, CO (Oct. 28).

October 2011. Introducing BMI: Basic Model Interface, CSDMS Annual Meeting: Impact of time and process scales, Boulder, CO (Oct. 30).

July 2011. Component-based ocean modeling with the Community Surface Dynamics Modeling System (CSDMS), Chesapeake Bay Program (CBP) Modeling Quarterly Review Meeting, Annapolis, MD (July 12)

June 2011, Component-based ocean modeling with the Community Surface Dynamics Modeling System (CSDMS), Chesapeake Community Modeling Program (CCMP) Hydrodynamic Modeling Workshop, Smithsonian Environmental Research Center (SERC), Edgewater, MD (June 10)

March 2011, Wishlist for a modeling framework and the design of CSDMS, Community Hydrologic Modeling Platform (CHyMP) 3rd Workshop, Irvine, CA.

October 2010, New tools and information for code contributors, Developer Clinic, CSDMS Conference: Modeling for Environmental Change, San Antonio, TX (Oct. 15)

October 2010, Poster: North, E.W., Z. Schlag, E.E. Adams, R. He, K.H. Hyun, C.R. Sherwood, R.P. Signell and S.D. Peckham (2010) Simulating the three-dimensional dispersal of aging oil with a Lagrangian approach, CSDMS Conference: Modeling for Environmental Change, San Antonio, TX (Oct. 15)

October 2010, Poster: Peckham, S.D. and J.L. Goodall (2010) Driving plug-and-play models with data from web services - A demonstration of interoperability between CSDMS and CUAHSI-HIS, CSDMS Conference: Modeling for Environmental Change, San Antonio, TX (Oct. 15)

September 2010, Towards landscape evolution models that run much faster, Landscapes into Rock, William Smith Meeting, Geological Society of London, London, UK. (Sept. 21-23)

September 2010, The Community Surface Dynamics Modeling System (CSDMS), 3rd Annual National CZO Meeting, Boulder, CO (Sept. 13)

July 2010, A cartoon overview of component-based modeling concepts and CSDMS, University of Nevada, Reno, In course: Interdisciplinary modeling: Water-related issues and changing climate, NRES 730, sponsored by NSF/EPSCoR (July 28)

July 2010, A brief introduction to CSDMS, the Community Surface Dynamics Modeling System, University of Nevada, Reno, Guest lecture in course: Interdisciplinary modeling: Water-related issues and changing climate, NRES 730, sponsored by NSF/EPSCoR (July 28)

July 2010, A brief introduction to CSDMS, the Community Surface Dynamics Modeling System, CUAHSI HIS Workshop, CUAHSI Biennial Meeting, Boulder, CO (July 19-22)

May 2010, A brief introduction to CSDMS, the Community Surface Dynamics Modeling System, EPSCoR Innovative Working Group meeting: "Identifying the most relevant spatial and temporal scales of climate change with respect to surface hydrologic processes, Valles Caldera National Preserve, New Mexico (May 25)

March 2010, Remote sensing-based flood mapping and flood hazard assessment in Haiti, Rebuilding for Resilience: How Science and Engineering Can Inform Haiti's Reconstruction (March 22-23), University of Miami, FL. (with G.R. Brakenridge)

November 2009, Review of progress on the CSDMS project, CSDMS Chesapeake Focus Research Group Annual Meeting, Virginia Institute of Marine Science (VIMS), Gloucester Point, VA.

September 2009, A relationship between plan and profile curvature in a fluvial landscape model, presentation, Morphometry, Glaciers and Landscapes: A Workshop in Honour of Dr. Ian S. Evans, Durham University, UK.

July 2009, Analytic, steady-state solutions for fluvial landscape evolution models, presentation, Geomorphology 2009, 7th International Conference on Geomorphology (ANZIAG): Ancient Landscapes - Modern Perspectives, Melbourne, Australia.

July 2009, A brief overview of CSDMS, the Community Surface Dynamics Modeling System, presentation, University of Newcastle, Newcastle, Australia.

June 2009 (Syvitski, J.P.M., E.W.H. Hutton, I. Overeem, A. Kettner, and S. Peckham), An Overview of Source to Sink Numerical Modeling Approaches & Applications, AAPG Denver.

April 2009, Technical overview of the Community Surface Dynamics Modeling System, Chesapeake Focus Research Group Meeting, Annapolis, MD.

April 2009, A brief overview of CSDMS, the Community Surface Dynamics Modeling System, presentation, NCED Cyberseminar Series, Minneapolis, MN.

March 2009, A brief overview of CSDMS, the Community Surface Dynamics Modeling System, presentation, Tropical Hydrology Symposium, Smithsonian Tropical Research Institute (SRTI), Panama City, Panama.

March 2009, A very brief discussion of the "Mass Flux Method", presentation, Tropical Hydrology Symposium, Smithsonian Tropical Research Institute (SRTI), Panama City, Panama.

December 2008, Sediment transport in a changing Arctic: River plumes, longshore transport and coastal erosion, Arctic Change 2008 Meeting, Quebec City, Canada. (Invited talk)

October 2008, The technology behind the Community Surface Dynamics Modeling System (CSDMS), CSDMS Education and Knowledge Transfer (EKT) Working Group Meeting, Boulder, CO.

September 2008, The TopoFlow hydrologic model: A community project, Third IAG/AIG SEDIBUD Workshop: Sediment Budgets in Cold Environments, Mountain Research Station, University of Colorado, Boulder.

July 2008, An introduction to CSDMS technical concepts and protocols, CSDMS Executive Committee Meeting, University of Colorado, Boulder, CO.

July 2008, (Goodall, J. and S.D. Peckham) Component-based architectures for building community models, CUAHSI Biennial Colloquium on Hydrologic Science and Engineering, Boulder, CO. (poster and session chair)

July 2008, Evaluation of model coupling frameworks for use by the Community Surface Dynamics Modeling System (CSDMS), Computational Methods in Water Resources, XVII International Conference, San Francisco, CA.

May 2008, Evaluation of model coupling frameworks for use by the Community Surface Dynamics Modeling System (CSDMS), International Ground Water Modeling Center, Golden, CO (poster).

April 2008, Community Surface Dynamics Modeling System overview and working group charge, NSF/EU Workshop on CUAHSI and OpenMI, Wallingford, UK.

March 2008, Community hydrologic modeling: Advantages of using the Common Component Architecture (CCA), Scoping Workshop on a Community Hydrologic Modeling Platform (CHyMP), National Academy of Sciences, Washington, DC.

March 2008, A brief overview of model coupling frameworks, CSDMS Marine and Coastal Working Group Meeting, Orlando, FL.

February 2008, Advantages of using the Common Component Architecture (CCA) for the CSDMS project, CSDMS Cyberinformatics and Numerics Working Group Meeting, University of Colorado, Boulder, CO.

January 2008, Update on CSDMS Adoption of CCA, CCA Winter Meeting, Boulder, CO.

December 2007, A brief overview of model coupling frameworks, CSDMS Terrestrial Working Group Meeting, UC Berkeley, CA.

October 2007, A brief introduction to the CSDMS initiative, CUAHSI Fall Regional Meeting, Boise, ID.

July 2007, Introduction to the Community Surface Dynamics Modeling System, CCA Summer Meeting, Silver Spring, MD.

May 2006, Geomorphometry with RiverTools, Geomorphometry: The Textbook Workshop, Universidad de Extremadura, Placencia, Spain. Sponsored by European Commission, Joint Research Centre.

July 2006, New Features in TopoFlow 1.5, TopoFlow Users Workshop, Saskatoon, Saskatchewan, Canada. Sponsored by National Water Research Institute at NHRC.

March 2004, The TopoFlow hydrologic model: A new community project, AGU Hydrology Days, Fort Collins, CO.

March 2004, Modeling longshore transport and coastal erosion due to storms at Barrow, Alaska, 34th Annual International Arctic Workshop, Univ. of Colorado, Boulder, CO.

October 2003, Using a spatially distributed model to characterize the influence of permafrost on hydrological processes, SEARCH Open Science Meeting (SEARCH = Study of Environmental Arctic Change), October 27, 2003, Seattle, WA. Student Poster (Bolton, W.R., L.D. Hinzman, S.D. Peckham, D.L. Kane and K. Yoshikawa)

August 2003, A numerical model for longshore sediment transport: Preliminary results, Exxon-Mobile Meeting, Univ. of Colorado, Boulder.

May 2003, Developing a Community Surface Dynamics Modeling System (CSDMS), NSF Tsunami Workshop, Honolulu, HI. (with J.P.M. Syvitski, C. Paola, D. Furbish, P. Wiberg and G. Tucker).

February 2003, Geoclutter project progress report, Geoclutter Project Meeting, Univ. of Colorado, Boulder.

January 2003, TopoFlow: A new distributed hydrologic model based on ARHYTHM and RiverTools, TopoFlow Model Workshop, Univ. of Alaska, Fairbanks.

August 2002, Simulating sediment transport near Barrow, Alaska, ANSCIA Project Meeting, Barrow, Alaska. (poster with E. Cassano and H. Cooper)

February 2002, RiverTools: From concept to commercial success, Community Sediment Model Workshop, Boulder, CO.

February 2002, Climate impacts at Barrow, Alaska: Quantifying coastal erosion and flooding, ARCSS All Hands Meeting, Seattle, WA. (poster with W.F. Manley, J.P.M. Syvitski, and M. Dyrgerov)

January 2002, Sediment flux to the coastal zone: Deposition from surficial plumes, Mine Burial Workshop, Scripps Oceanographic Inst., La Jolla, CA. (poster with J.P.M. Syvitski)

January 2002, Sediment flux to the coastal zone: Predictions for the Navy, Mine Burial Workshop, Scripps Oceanographic Institute. (poster with J.P.M. Syvitski and R.D. Hilberman)

January 2002, Progress report on conversion of the ARHYTHM hydrologic model to IDL and development of a graphical user interface, TopoFlow Project Workshop, Univ. of Alaska, Fairbanks.

November 2001, A source to sink sediment transport model for Molokai, USGS Coral Reef Project Workshop, Molokai, HI. (with H. Cooper)

November 2001, Modeling coastal erosion near Barrow, Alaska, Arctic Coastal Dynamics 2nd Workshop, Potsdam, Germany. (with W. Manley, M. Dyrgerov, and J.P.M. Syvitski)

September 2001, Fluvial landscape modeling, INSTAAR Noon Seminar, Univ. of Colorado, Boulder, CO.

August 2001, Fluvial landscape modeling and reconstruction, Geoclutter Project Meeting, Univ. of Colorado, Boulder, CO.

August 2001, A 3D numerical model for fluvial landforms: Bifurcating channels and realistic longitudinal profiles from first principles, 7th International Conference on Fluvial Sedimentology, Univ. of Nebraska, Lincoln. (with J.P.M. Syvitski)

February 2001, Using RiverTools for DEM and Watershed Analysis, UCSB, Santa Barbara, CA. (Invited talk.)

January 2000, Surface hydrology of the Snake River Watershed, Snake River Watershed Task Force Meeting, Keystone, Colorado.

December 1999, Quantitative predictions from conservation equations, AGU Fall Meeting, San Francisco, CA.

November 1999, Mathematical modeling of landforms, UCSB, Santa Barbara, CA (by invitation from Prof. Terry Smith)

April 1998, Flow routing in large river basins, Annual meeting of the European Geophysical Society, Nice, France.

March 1998, Self-similarity and the fluid dynamics of large river networks, Univ. of Illinois, Urbana, IL. (by invitation from Prof. Praveen Kumar)

July 1997, Dynamics of river networks: Towards flow routing at the basin scale, USGS, Menlo Park, CA.

June 1997, Self-similar trees and the fluid dynamics of river networks, Workshop on Networks and Random Structures on Trees, Sandbjerg, Denmark.

February 1997, Topographic coordinates: An analytic solution method for nonlinear landform PDEs, Oregon State Univ., Corvallis, OR.

February 1997, Geometry and surface flow dynamics in large river basins, USGS, Lakewood, CO.

January 1997, Two invited talks: Analytic solutions of nonlinear second-order PDEs by geometry, and Demonstration of the RiverTools program, Meeting on Geometry in Present Day Science, Aarhus, Denmark.

December 1996, The topographic coordinate transformation: A new analytic solution method for nonlinear landform PDEs, Annual Gilbert Club Meeting, Berkeley, CA.

July 1996, New results for self-similar trees, 1996 Annual Meeting of the Society for Industrial and Applied Mathematics, Kansas City, MO.

June 1996, Dynamic self-similarity and predictions of downstream hydraulic geometry, Fourth Annual Workshop on Scale Problems in Hydrology, Krumbach, Austria.

March 1996, Invited participant at Workshop on Stochastic and Statistical Methods in Hydrology, Guanajuato, Mexico.

December 1995, River networks and self-similar trees, Annual Meeting of the Gilbert Club, Berkeley, CA.

Additional Meetings and Workshops

April 2013. NSF EarthCube Modeling Workshop for the Geosciences, University of Colorado, Boulder, CO. Co-organizer. (Apr. 22-23).

February 2013. NSF EarthCube Summary Workshop on Earth System Model Coupling, University of California, Irvine, CA. Co-organizer. (Feb. 11-12)

January 2013. NSF EarthCube Digital Crust Workshop (GEO Domain Workshop: Envisioning a digital crust for simulating continental scale subsurface fluid flow in earth system models), USGS Powell Center, Fort Collins, CO (Jan 29-30).

January 2013. NSF EarthCube Workshop: Engaging the Critical Zone community to bridge long tail science with big data, University of Delaware, Newark, DE. (Jan. 21-23)

October 2012. NSF EarthCube PI Workshop #2, CIRES, University of Colorado, Boulder, CO (Oct. 4-5).

September 2012-Present. National Unified Operational Prediction Capability (NUOPC) - Monthly Telecon, (<http://earthsystemcog.org/projects/nuopc/>)
July 2012. NSF EarthCube PI Workshop #1, NSIDC, University of Colorado, Boulder, CO (July 10).
May 2012. NSF EarthCube: ESM Concept Award Workshop, Developing coupling strategies for Earth System Models: Challenges, opportunities and increasing community participation, National Center for Atmospheric Research (NCAR), Boulder, CO. Co-organizer, (May 22)
April 2012. IWRSS (Integrated Water Resources Science and Services) First Scoping Workshop for the "National Water Model", Chapel Hill, NC. Invited participant. (Apr. 9-11)
April 2012-2013. NSF EarthCube Layered Architecture Concept Award - Weekly Telcon.
June 2012. NSF EarthCube Charrette #2, Washington, D.C. (Jun. 12-14)
November 2011. NSF EarthCube Charrette #1, Washington, D.C. (Nov. 1-4)
February 2011. NSF EPSCoR Innovative Working Group Meeting: Identifying complementary indicators of ecological thresholds in a changing climate, McCall Outdoor Science School (MOSS), Ponderosa State Park, McCall, ID. Co-organizer. (Feb. 5-7)

Computer Models

A Light-weight Python-based Modeling Framework (Python): A light-weight modeling framework for coupling model components that have the CSDMS Basic Model Interface (BMI).

TopoFlow (Python): TopoFlow is a spatially-distributed hydrologic model that contains numerous, stand-alone submodels including: Channels_Diffusive_Wave, Channels_Dynamic_Wave, Channels_Kinematic_Wave, Data_HIS, Diversions_Fraction_Method, Evaporation_Energy_Balance, Evaporation_Priestley_Taylor, Evaporation_Read_File, Infiltration_Green_Ampt, Infiltration_Richards_1D, Infiltration_Smith_Parlange, Meteorology, Saturated_Zone_Darcy_Layers, Snowmelt_Degree_Day, Snowmelt_Energy_Balance, TopoFlow_Driver

D8_Global: A toolkit written as a class in Python/NumPy for D8-based hydrologic processing of digital elevation models (DEMs). It can (1) fill depressions in DEMs, (2) compute D8 flow direction code grids, (3) compute D8 contributing area grids in addition to other D8-related products.

DEM_Smoother: An innovative tool written in Python/NumPy that can create a DEM (digital elevation model) with smoothly decreasing elevation profiles from a DEM with poor vertical and horizontal resolution. This is an important pre-processing step that is required for accurate spatial hydrologic modeling.

Erode_D8_Global: A fluvial landscape evolution model written in Python/Numpy and developed in support of an NSF-CMG grant on which Peckham was PI. It uses a traditional "global" timestepping algorithm, a new stability condition and dynamics-based depression filling. It also has a CSDMS model component interface which allows it to be used as a plug-and-play modeling component within the CSDMS modeling framework. It was featured in a graduate-level modeling course co-taught by Peckham, GEOL 5700. Compare to Erode_D8_Local.

Erode_D8_Local: A fluvial landscape evolution model written in Python/Numpy and developed in support of an NSF-CMG grant on which Peckham was PI. It uses an innovative "local" timestepping algorithm that is much more efficient (i.e. faster) than the one used by Erode_D8_Global. It also employs a new stability condition and dynamics-based depression filling. It also has a CSDMS model component interface which allows it to be used as a plug-and-play modeling component within the CSDMS modeling framework.

Additional Models: *Pythor*: ALAS, I2PY, Py_Utils. *IDL*: Longshore, Plumes, Shoreline, Strata, TopModel-IDL, TopoFlow-IDL. *C*: TopModel-C

Synergistic Activities

Founder of a small software development company called Rivix, LLC in 1998 and developer of its flagship product, RiverTools (www.rivertools.com). RiverTools is a software toolkit for the analysis of digital terrain and river networks. It was specifically designed to extract, display, and analyze many different kinds of hydrologic data from very large elevation grids. Its speed, accuracy, platform-independence, extendibility and intuitive, point-and-click interface are unmatched by similar applications, and it contributes to hydrology education and research at many institutions around the world.

Author of numerous open-source models including: (1) a spatial hydrologic model called TopoFlow, (2) a fluvial landscape evolution model called Erode, (3) a coastline evolution model called Shoreline, (4) a sediment plume model called Plume and several others. Most of these can now be downloaded from the CSDMS wiki at: <http://csdms.colorado.edu/wiki>.

Frequent interactions with members of the modeling community as Chief Software Architect for CSDMS, including the developers of other integrated modeling and data service projects such as CCA (Common Component Architecture), OpenMI (Open Modeling Interface), ESMF (Earth System Modeling Framework), OMS (Object Modeling System), CUAHSI-HIS (Hydrologic Information System).

Recent Collaborators

Thomas Manteuffel (CU), Steve McCormick (CU), Greg Tucker (CIRES/CU), James Syvitski (INSTAAR), Eric Hutton (INSTAAR), Larry Hinzman (UAF), Bob Bolton (UAF), J. Dungan Smith (USGS, WRD), Boyana Norris (Argonne), Balazs Fekete (CUNY), David Kinner (INSTAAR)

Graduate Advisors and Postdoctoral Sponsors

J. Dungan Smith (NRC postdoctoral advisor), Vijay K. Gupta (doctoral thesis advisor), and Edward C. Waymire (masters thesis advisor)

Service on Graduate Student Committees

1999. Member of PhD Dissertation Committee for Mark Morehead (Geophysics)
2000. Member of MS Thesis Committee for Alejandro Machado (Geology)
2003. Member of PhD Qualifying Exam Committee for Eric Hutton (Geophysics)
2007. Member of MS Thesis Committee for Scott Bachman (Mathematics)

Service as Thesis Advisor

Scott Bachman (Univ. of Colorado, Boulder)

Service on Advisory Committees

Served as a member of the Snake River Watershed Task Force, which is a stakeholder organization that is examining strategies for mitigating the detrimental effects of acid mine drainage in the Snake River watershed of Summit County, Colorado. 1999-2003.

Served on the University of Colorado's Conflict of Interest Advisory Committee from 2005 to 2007 which led to new policies including the hire of a Compliance Director.

Served on the NSF CUAHSI (Consortium of Universities for the Advancement of Hydrologic Science, Inc.) HIS (Hydrologic Information System) Standing Committee for Informatics (2009 to Present).

Served on the Geomorphometry.org Society Scientific Committee. (2010 to Present)

Supervision

Harold Cooper, undergraduate student employee
Chad Stoffel, System and Network Administrator for INSTAAR
Eric Hutton, Professional Research Associate
Scott Bachman, Graduate Research Assistant
Jisamma Kallumadikal, Software Engineer

Grants Received as PI

Modeling the hydrology-driven evolution of Arctic landscapes, subaward from University of Alaska at Fairbanks (UAF), \$40,000, 01/01/13 to 06/30/13, 2.2 months/year.

EAGER: Collaborative Research: Developing a community computational infrastructure for Earth System Model research and applications, National Science Foundation, \$60,000, 04/01/12 to 03/31/13, 3 months/year. (Part of a collaborative \$200K award with lead PI David Gochis, NCAR.)

EAGER: Collaborative Research: Interoperability Testbed - Assessing a layered architecture for integration of existing capabilities, National Science Foundation, \$18,000, 04/01/12 to 03/31/13, 1 month/year. (Part of a collaborative \$200K award with lead PI Reagan Moore.)

A light-weight framework for model coupling adapted for hydrological and landscape evolution models, subaward from University of Alaska at Fairbanks (UAF), \$17,000, 04/01/12 to 09/30/12, 0.9 month/year. (Subaward from DOE-funded NGEE project awarded to UAF.)

A Super-regional testbed to improve models of environmental processes on the U.S. Atlantic and Gulf of Mexico coasts, SURA (Southeastern Universities Research Association, Inc.)/NOAA, subaward from Virginia Inst. of Marine Science (VIMS) to University of Colorado at Boulder, \$96,414, 06/01/10 to 05/31/11, 1 month/year.

Collaborative Research: Deepwater Horizon: Simulating the three-dimensional dispersal of aging oil with a Lagrangian approach, NSF RAPID, subaward to University of Colorado at Boulder from proposal with PI Elizabeth North, \$4,099, 07/15/10 to 06/30/11.

CMG Research - Modeling river basin dynamics: Parallel computing and advanced numerical methods, NSF/CMG, EAR 0621199, \$900,000, 9/15/06 – 8/31/10, 3 months/year for 4 years. (co-PIs: Tom Manteuffel, Steve McCormick and Greg Tucker)

Toward improved process-based pan-arctic prediction of land surface moisture and energy fluxes, Univ. of Alaska at Fairbanks, subcontract, \$15,000, 7/1/04 – 2/28/05, 1.5 months.

Modeling sediment transport to Molokai's coral reef, USGS subcontract, \$46,830, 8/28/03 – 6/30/04, 4 months.

Detection and attribution of changes in the hydrologic regimes of the Mackenzie, the Kuparuk and the Lena river basins, NSF/CHAMP subcontract from UAF, \$30,000, 11/1/02 – 12/31/04, 1.2 months/year for 2 years.

WERC hydrologic model: conversion and testing, GW Scientific (Univ. of Alaska at Fairbanks), subcontract, \$12,000, 8/1/02 – 7/31/03, 1.1 months.

Conversion of ARHYTHM hydrologic model from Fortran to IDL, Univ. of Alaska at Fairbanks, subcontract, \$15,000, 6/1/02 – 5/31/03, 1.2 months.

A source to sink sediment transport model for the Hawaiian island of Molokai, USGS subcontract, \$15,000, 1/1/02 – 12/31/03, 1.2 months.

Conversion of ARHYTHM hydrologic model from Fortran to IDL, Univ. of Alaska at Fairbanks, subcontract, \$30,000, 1/1/01-12/31/04, 1.2 months/year for 2 years.

Conversion of ARHYTHM hydrologic model from Fortran to IDL, Univ. of Alaska at Fairbanks, subcontract, \$20,000, 7/1/01-10/31/02, 1.6 months.

National Research Council Research Associate, \$150,000 + overhead, 1995-1998, 3 years.

NASA Global Change Student Fellow, \$50,000 + overhead, 1990-1993, 3 years.

Grants Received as Co-PI

Predicting the distribution and properties of buried submarine topography on continental shelves, ONR, \$264,000, 1/1/02 – 9/30/04, 3 months/year for 2 years, with J.P.M. Syvitski

Predicting the distribution and properties of buried submarine topography on continental shelves, ONR, \$409,586, 6/15/00 – 12/31/02, 3 months/year for 3 years, with J.P.M. Syvitski

Other Funding Received

NSF Cooperative Agreement, Facility Support: Computational infrastructure for the Community Surface Dynamics Modeling System (CSDMS), NSF/EAR 1226297, \$4.5M, 10/15/12 to 09/30/17, PI: James Syvitski, 6 months/year for 5 years as Chief Software Architect.

NSF Cooperative Agreement, Facility Support: Organizational infrastructure for the Community Surface Dynamics Modeling System (CSDMS), NSF EAR/OCE 0621695, \$4.5M (total), 4/15/07 – 4/14/12, PI: James Syvitski, 9 months/year for 5 years as Chief Software Architect.

An Integrated Assessment of the Impacts of Climate Variability on the Alaskan North Slope Coastal Region, INSTAAR subaward to model coastal sediment transport and erosion, NSF Office of Polar Programs, Arctic System Science Program, \$405,712 (subcontract) \$2,583,362 (total), 5/1/01 – 4/30/06, 2 months/year for 5 years.

Using remotely-sensed images to estimate suspended sediment concentrations in the littoral zone, subcontract from Raytheon Systems Company, \$100,000, 8/1/98 – 7/31/99, 12 months.