

ALEJANDRO N. FLORES

Department of Geosciences
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EDUCATION

- Ph. D. Massachusetts Institute of Technology, Cambridge, MA**
Civil and Environmental Engineering (Hydrology), November 2008
Thesis Title: *Hillslope-scale Soil Moisture Estimation with a Physically-based Ecohydrology Model and L-band Microwave Remote Sensing Observations from Space*
Advisors: Rafael L. Bras (primary), Dara Entekhabi
- M.S. Colorado State University, Fort Collins, CO**
Civil Engineering (River Hydraulics), December 2003
Thesis Title: *Multi-scale Models for Predicting Stream Substrate Size and Channel Morphology in Watersheds of the Western U.S.*
Advisor: Brian P. Bledsoe
- B.S. Colorado State University, Fort Collins, CO**
Civil Engineering, May 2001

PROFESSIONAL EXPERIENCE

Assistant Professor, Department of Geosciences, Boise State University

Boise, ID July 2009 to present

- Preparation of research proposals submitted to various extramural funding agencies, including Army Research Office, NASA, and NOAA
- Numerical experiments for performing soil moisture data assimilation under challenges of high dimensionality and high computational burden
- Preparation of original manuscripts to summarize scientific findings in peer-reviewed journals

Assistant Research Professor, Department of Geosciences, Boise State University

Boise, ID January 2009 to July 2009

- Preparation of research proposals submitted to various funding agencies, including Army Research Office, NASA, and NOAA
- Constructing a forward radiative transfer model to produce predicted observations of microwave brightness temperatures given surface soil moisture and vegetation states
- Numerical experiments for performing soil moisture data assimilation under challenges of high dimensionality and high computational burden
- Preparation of original manuscripts to summarize scientific findings in peer-reviewed journals

Postdoctoral Research Associate, Department of Civil and Environmental Engineering, MIT

Cambridge, MA November 2008 to January 2009

- Numerical experiments for performing soil moisture data assimilation under challenges of high dimensionality and high computational burden
- Preparation of original manuscripts to summarize scientific findings in peer-reviewed journals
- Assisting in preparation of research proposals submitted to various funding agencies

Graduate Research Assistant, Department of Civil and Environmental Engineering, MIT

Cambridge, MA September 2003 to November 2008

- Adapting a fully distributed rainfall-runoff watershed model for ensemble-based assimilation of remotely sensed observations of soil moisture-related measurements. Develop and test innovative methods for performing soil moisture data assimilation under challenges of high dimensionality and high computational burden
- Constructing a forward radiative transfer model to produce predicted observations of microwave brightness temperatures given surface soil moisture and vegetation states
- Assisting in preparation of research proposals submitted to various funding agencies

- Managing, guiding and providing research direction to four undergraduate research assistants
- Procuring, overseeing initial testing, calibration, and deployment of a portable weather station and energy balance-resolving eddy covariance device
- Collaborating with colleagues to maintain and update of a high performance computing Apple cluster

Graduate Research Assistant, Civil Engineering Department, Colorado State University

Fort Collins, CO

May 2001 to August 2003

- Enhanced knowledge of fluvial and geomorphic systems learned and became familiar with aquatic ecosystem form and process
- Gained understanding of mathematical concepts underlying research such as power-law scaling and uncertainty
- Acquired skills with geographic information systems necessary to model fluvial and geomorphic processes
- Applied knowledge to development of landscape variables to quantify anthropogenic disturbance and watershed health, detect of local ecological attributes from geospatial data, and investigate spatial variability in slope
- Performed field inspection of small streams in Oregon, Washington and Colorado

CURRENT AND PENDING SUPPORT

Evaluating the Effect of Improved Snow and Soil Representation in Physically Based, Distributed Hydrologic Models

Jim McNamara (PI), Alejandro Flores (Co-I), *current*

Source of Funding: National Oceanic and Atmospheric Administration

Performance Period: September 1, 2009 – August 31, 2012

Total Budget: \$360,146

Commitment: 2 summer mos.

Measuring and Modeling Hydrologic Fluxes and States from Aquifer to Atmosphere at Multiple Scales

Warren Barrash (PI), Alejandro Flores (Co-PI), *current*

Source of Funding: U.S. Army Research Office (EPSCoR)

Performance Period: August 3, 2009 – August 2, 2012

Total Budget: \$665,880

Commitment: 3 summer mos.

Enhancing rooting-zone soil moisture estimation by assimilating NASA and in-situ ecological data to improve understanding of vegetation water content and demand

Alejandro Flores (PI), Danny Marks (Co-I), *pending*

Source of Funding: NASA Terrestrial Ecology Program

Performance Period: January 1, 2010 – December 31, 2012

Total Budget: \$576,007

Commitment: 3 summer mos.

A Multiscale Data Assimilation Approach to the Prediction of Soil Moisture and Energy States from Sub-meter to Kilometer Scales

Alejandro Flores (PI), *pending*

Source of Funding: U.S. Army Research Office (Young Investigator Program)

Performance Period: August 3, 2009 – August 2, 2012

Total Budget: \$150,000

Commitment: 3 summer mos.

PUBLICATIONS IN REFEREED JOURNALS

1. Flores, A. N., D. Entekhabi, and R. L. Bras, Evaluation of anticipated SMAP products for estimation of soil moisture at hillslope scales, manuscript in preparation.
2. Flores, A. N., D. Entekhabi, and R. L. Bras, Hillslope-scale soil moisture estimation with the ensemble kalman filter during the North American Monsoon Experiment, manuscript in preparation.
3. Flores, A. N., D. Entekhabi, and R. L. Bras, Reproducibility of soil moisture ensembles when representing soil parameter uncertainty and correlation using a Latin Hypercube-based approach, *Water Resour. Res.*, accepted – in revision.
4. Flores, A. N., D. Entekhabi, and R. L. Bras, Assimilation of SMAP measurements for soil moisture-based military trafficability assessment at tactical scales, *IEEE J. Sel. Topic Appl. Remote Sens.*, accepted – in revision.
5. Flores, A. N., V. Y. Ivanov, D. Entekhabi, and R. L. Bras, Impacts of hillslope-scale organization in topography, soil moisture, soil temperature, and vegetation on modeling surface microwave radiation emission, *IEEE Trans. Geosci. Remote Sens.*, **47**(8), 2557-2571.
6. Flores, A. N., B. P. Bledsoe, C. O. Cuhaciyan, and E. E. Wohl (2006), Channel-reach morphology dependence on energy, scale, and hydroclimatic processes with implications for prediction using geospatial data, *Water Resour. Res.*, **42**, W06412, doi:10.1029/2005WR004226.

PRESENTATIONS

1. Flores, A.N., D. Entekhabi, and R. L. Bras, Synthetic experiments to estimate hillslope-scale soil moisture through assimilation of anticipated remotely sensed microwave products, *23rd Conference on Hydrology, 89th Annual Meeting of the American Meteorological Society*, Phoenix, AZ, 11-15 January 2009.
2. Flores, A.N., D. Entekhabi, and R. L. Bras, Hillslope-scale soil moisture estimation with the ensemble Kalman Filter and a process ecohydrology model: Evaluation of anticipated microwave observations, *AGU Fall Meeting*, San Francisco, CA, 15-19 December 2008
3. Flores, A.N., D. Entekhabi, and R. L. Bras, Soil moisture active-passive (SMAP) mission data for hillslope-scale soil moisture estimation with a spatially distributed ecohydrology model and data assimilation, *International Workshop on Microwave Remote Sensing for Land Hydrology*, Oxnard, CA, 20-22 October 2008.
4. Flores, A. N., V. Y. Ivanov, D. Entekhabi, and R. L. Bras, Hillslope-scale controls on remote sensing of soil moisture with microwave radiometry, *IEEE Geoscience and Remote Sensing Symposium (IGARSS) '08*, Boston, MA, 6-11 July 2008.
5. Flores, A. N., V. Y. Ivanov, D. Entekhabi, and R. L. Bras, Assessing the role of hillslope-scale heterogeneity in soil moisture remote sensing and data assimilation using microwave radiometry, *22nd Conference on Hydrology, 88th Annual Meeting of the American Meteorological Society*, New Orleans, LA, 20-24 January 2008.
6. Flores, A. N., D. Entekhabi, and R. L. Bras, Modeling uncertainty and correlation in soil properties using restricted pairing and implications for ensemble-based hillslope-scale soil moisture and temperature estimation, *AGU Fall Meeting*, San Francisco, CA, 10-14 December 2007. **Recipient Outstanding Student Paper Award.**
7. Flores, A. N. and R. L. Bras, The role of topography, vegetation and soils in predictability of high-resolution soil moisture and implications for data assimilation, *ARO Terrestrial Sciences Soil Moisture/Arid Lands Research Review Meeting*, Fort Carson, CO, 5-6 March 2007.

8. Flores, A. N., R. L. Bras, and D. Entekhabi, Predicting soil moisture with models and observations through an ensemble quasi steady-state filter, *GSA Annual Meeting and Exposition*, Philadelphia, PA, October 22-25, 2006.
9. Flores, A. N., R. L. Bras, and D. Entekhabi, Downscaling remotely sensed soil moisture observations to hillslope scales with physically based distributed models through data assimilation, *AGU Hydrology Days*, Fort Collins, CO, March 20-22, 2006.
10. Istanbuluoglu, E., R. L. Bras, and A. N. Flores, On the dynamics of soil moisture, vegetation, and erosion: Implications of stochastic climate forcing, *AGU Fall Meeting*, San Francisco, CA, December 13-17, 2004.
11. Flores, A. N., E. Istanbuluoglu, R. L. Bras, and D. Entekhabi, A Framework for the Prediction of Soil Moisture, *Proceedings of the 24th Army Science Conference*, Orlando, FL, November 29-December 2, 2004.
12. Bledsoe, B. P., A. N. Flores, S. C. Sanborn, and C. O. Cuhaciyen, Multi-scale factors influencing stream substrate size within and among watersheds, *AGU Fall Meeting*, San Francisco, CA, December 8-12, 2003.
13. Bledsoe, B. P., A. N. Flores, N. L. Poff and C. O. Cuhaciyen. Prediction of local stream habitat attributes with spatial analysis of watershed-scale data, *North American Benthocological Society (NABS) Annual Meeting*, Athens, GA, May 27-June 1, 2003.
14. Poff, N. L., B. P. Bledsoe, J. D. Olden and A. N. Flores, Functional organization of benthic invertebrate communities along multiscale environmental gradients, *NABS Annual Meeting*, Athens, GA, May 27-June 1, 2003.
15. Flores, A. N. and B. P. Bledsoe. Factors affecting predictions of stream reach morphology using remotely sensed data: implications for restoration and habitat evaluation, *AGU Hydrology Days*, Fort Collins, CO, March 31-April 2, 2003.
16. Flores, A. N. and B. P. Bledsoe. Depicting channel reaches at sub-link scales using digital elevation models, *AGU Hydrology Days*, Fort Collins, CO, March 31-April 2, 2003.
17. Bledsoe, B. P., E. E. Wohl, D. V. Pizzi, K. Sable, A. N. Flores, C. O. Cuhaciyen, S. C. Sanborn, Hydrogeomorphic classification of western streams for ecological assessment, *AGU Fall Meeting*, San Francisco, CA, December 6-10 2002.
18. Flores, A. N. and B. P. Bledsoe. Investigating spatial variability in slope and flow energy within and between watersheds, *AGU Fall Meeting*, San Francisco, CA, December 10-14, 2002.
19. Flores, A. N. and B. P. Bledsoe. Watershed-scale implications of Hack's slope-drainage area relationship and application to the prediction of in-channel features of ecological interest. *GSA Annual Meeting and Exposition*, Denver, CO, October 27-30, 2002.
20. Flores, A. N. and B. P. Bledsoe. Application of Hack's law to predict in channel features of ecological interest with coarse scale watershed variables. *AGU Hydrology Days*, Fort Collins, CO, April 1-4, 2002.
21. Bledsoe, B. P., R. J. Anderson, B. McCaig, A. N. Flores, and C. C. Watson. Modeling Package for Assessing the Potential Effects of Land Use Change on Stream Form and Integrity, *ASCE Wetlands Engineering and River Restoration Conference*, Reno, NV, August 27-31, 2001.

INVITED PRESENTATIONS AND SEMINARS

1. Assimilation of remotely sensed soil moisture data: challenges and opportunities, Boise State University, March 31, 2008.
2. Assimilation of remotely sensed soil moisture data: challenges and opportunities, University of Wyoming, March 11, 2008.

3. A Framework to Combine Models and Observations to Predict Soil Moisture at Fine Spatial Scales, Ralph Parsons Laboratory, Massachusetts Institute of Technology, April 26, 2005.
4. The dependence of channel morphology on scale, energy and hydroclimatology and some implications for prediction of reach-scale channel morphology with geospatial data, Ralph Parsons Laboratory, Massachusetts Institute of Technology, December 4, 2003.

TECHNICAL REPORTS

1. Bras, R.L., D. Entekhabi, A.N. Flores. 2008. A framework for the prediction of soil moisture fusing multiple scale data sources and modeling. Final report. Submitted to U.S. Army Research Office, Research Triangle Park, North Carolina.
2. Bras, R.L., D. Entekhabi, A.N. Flores. 2007. A framework for the prediction of soil moisture fusing multiple scale data sources and modeling. Interim progress report. Submitted to U.S. Army Research Office, Research Triangle Park, North Carolina.
3. Bras, R.L., D. Entekhabi, A.N. Flores. 2006. A framework for the prediction of soil moisture fusing multiple scale data sources and modeling. Interim progress report. Submitted to U.S. Army Research Office, Research Triangle Park, North Carolina.
4. Bras, R.L., D. Entekhabi, A.N. Flores. 2005. A framework for the prediction of soil moisture fusing multiple scale data sources and modeling. Interim progress report. Submitted to U.S. Army Research Office, Research Triangle Park, North Carolina.
5. Bledsoe, B.P., D.A. Raff, A.N. Flores. 2004. GeoTool User's Manual. Final Report Submitted to U.S. Army Corps of Engineers, Engineering Research and Development Center Vicksburg, Mississippi, 88 pp. + app.

PROFESSIONAL MEMBERSHIPS AND REGISTRATIONS

Engineering Intern (Colorado)
American Geophysical Union
American Meteorological Society
American Society of Civil Engineers
Environmental Water Resources Institute (EWRI)
American Association for the Advancement of Science
IEEE Geoscience and Remote Sensing Society
Sigma Xi
Tau Beta Pi
Chi Epsilon

PROFESSIONAL SERVICE

Member, NASA Soil Moisture Active Passive (SMAP) Satellite Algorithms Working Group
Member, NASA SMAP Calibration/Validation Working Group
Member, NASA SMAP Applications Working Group
Member, EWRI Uncertainty Analysis Approaches of Hydrologic Models Task Committee
Reviewer, ASCE Journal of Hydrologic Engineering
Reviewer, EGU Hydrologic and Environmental System Science (HESS)

TEACHING AND EDUCATIONAL GUIDANCE EXPERIENCE

Hydrology Expert, starHydro Hydrology and Geomorphology Education Software, MIT
Cambridge, MA 2006-present

- Communicated important concepts in watershed hydrology and fluvial geomorphology and provided end user-oriented feedback to software developers programming a Java-based application for undergraduate and graduate students in hydrology and geomorphology.

Alejandro N. Flores

- Application encourages students to: (1) develop intuitive understanding of fundamental concepts in hydrology and geomorphology class work through interaction with digital elevation models (DEMs), and (2) become familiar with concepts underlying distributed modeling.
- Alpha version available at: <http://web.mit.edu/star/hydro/>

Graduate Resident Tutor (in residence), McCormick Hall, MIT
Cambridge, MA

2006-2007 Academic Year

- Fostered a supportive, safe, and positive living environment for, and contribute to building a community among undergraduate students in MIT's only all-women's undergraduate dormitory.
- Encouraged personal growth, effective stress management, and positive interpersonal relationships.
- Organized informal study breaks for students, assisted in dorm-wide event planning and implementation.
- Maintained working knowledge of MIT's student resources.
- Coordinated with academic advisors and housemasters to promote academic growth and accountability.

Graduate Teaching Assistant, Traveling Research Environmental Xperiences (TREX), Department of Civil and Environmental Engineering, MIT

Islands of O'ahu and Hawai'i, HI and Cambridge, MA

January 2006

- Provided logistical and academic support for a two-week traveling field course.
- Encouraged students to develop experience in field data collection techniques, strategies and problem solving.
- Gave feedback and constructive criticism for student ideas and questions.
- Fostered an environment in which students felt comfortable providing input in field experiment protocols.
- Prompted students to think critically about field experiment protocols and sample locations.

SKILLS

Programming/scripting languages: C/C++, Perl, Unix/Linux shell scripting, Arc Macro Language (AML), Visual Basic, HTML.

Specialized data formats: NetCDF, XML, HDF-EOS

Math and science software: MATLAB, ArcInfo, ArcView, SAS.

Productivity software: Microsoft Excel, Microsoft Word, Microsoft PowerPoint, Adobe Acrobat, Adobe Illustrator, Adobe PhotoShop.

Operating systems: Mac OS X, Microsoft Windows XP, UNIX, LINUX.

Surveying equipment: Topcon survey grade GPS RTK system, Total Station laser theodolite, autolevel, transit.

Field equipment: WeatherPak 2000 portable weather station, Eppley Lab solar and infrared pyrometers, Campbell Scientific energy balance-resolving eddy covariance device (including LiCor 7500 open path CO₂/H₂O gas analyzer, 3D sonic anemometer, IR surface temperature probe, Huskeflux soil heat flux plates, CS616 soil water content reflectometers), LiCor LI6400Q portable photosynthesis device, LiCor LAI2000 leaf area meter, Campbell Scientific data loggers (CS5000, CS1000) and LoggerNet programming software.

AWARDS AND HONORS

Outstanding Student Paper Award, AGU Fall Meeting, 2007

Martin Family Society of Fellows for Sustainability, MIT, 2007

Trond Kaalstad Award, MIT, 2006

Norman B. Leventhal Presidential Fellowship, MIT, 2003

Jeng Song Wang Memorial Scholarship, Colorado State University, 2002

AGEP Program Diversity Fellowship, Colorado State University, 2001

Boettcher Foundation Scholarship, 1997-2001

Distinguished Scholar Award, Colorado State University, 1997-2001

Diversity Appreciation Award, Colorado State University, 1997-2001

Harold H. Short Award, Colorado State University, 1999, 2000

Alejandro N. Flores

President's Award, Colorado State University, 1998, 1999

HYDROLOGY-RELATED COMMUNITY OUTREACH

MIT Parsons Lab Hydrology Seminar

Student Organizer

2005 to 2007 Academic Years

- Solicited requests for Hydrology Seminar speakers within Department and invited speakers with a diverse spectrum of interests to present timely and relevant research
- Secured commitments of funding for speaker transportation, lodging
- Maintained seminar website
- Coordinated seminar logistics

MIT Civil and Environmental Engineering Dept. Newsletter

Contributing Editor

April 2006 to May 2007

- Authored articles and brief summaries of events within the CEE Department and non-CEE sponsored local events of potential interest to CEE Alumni

MIT IDEAS Competition

Judge (Only student judge)

2006, 2007 Competitions

- Evaluated proposals for small grants from groups comprised of MIT students and outside members for projects that attempt to make a positive impact on a target community
- Assessed the innovation, feasibility and potential impact on the target community of proposed solutions
- Provided suggestions in written response to the proponents of a subset of proposals
- Presented a summary of a subset of proposals to the judging panel
- see <http://web.mit.edu/ideas/www/index.htm>

FloodSafe Honduras Flood Warning System

Hydrology Consultant

June 2005 to January 2007

- Provided hydrologic and geomorphic expertise for siting of low-cost pressure transducers to measure river flow depth in the Rio Aguan Basin, Honduras
- Gave input regarding the use of the HEC-RAS model and GeoRAS interface in attempting to map variation in flood stage associated with uncertainty in channel and floodplain roughness
- see <http://web.mit.edu/lem/honduras/sat.html>

John F. Kennedy School, Somerville, MA

Guest instructor on Climate Change

April 2007

- Introduced 8th grade students to the role of CO₂ in climate change and the role of vegetation in global carbon cycle, and concepts of land-atmosphere exchange of water and carbon

COLLABORATORS

Rafael L. Bras, University of California, Irvine

Dara Entekhabi, Massachusetts Institute of Technology

Jim McNamara, Boise State University

Shawn Benner, Boise State University

Jen Pierce, Boise State University

Warren Barrash, Boise State University

Danny Marks, USDA-ARS Northwest Watershed Research Center

Valeriy Ivanov, University of Michigan

Mahta Moghaddam, University of Michigan

Chandra Pathak, South Florida Water Management District

Sharika Senarath, South Florida Water Management District

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