

Erfan Haghighi

Eawag - Swiss Federal Institute of
Aquatic Science and Technology,
Überlandstrasse 133
8600 Dübendorf
Switzerland

Phone: +41 78 733 9989
Email: erfan.haghighi@eawag.ch
URLs: orcid.org/0000-0002-8358-5619
[eawag.ch/en/aboutus/portrait/organisation/staff/
profile/erfan-haghighi/](https://eawag.ch/en/aboutus/portrait/organisation/staff/profile/erfan-haghighi/)

Research Interests

- Terrestrial water, energy and carbon cycles
- Land-atmosphere interactions and boundary layer processes
- Ecohydrological processes in water-limited ecosystems
- Hydrology-climate feedback mechanisms
- Climate change and extreme events
- Ecosystem functioning in a changing climate
- Land evaporation retrieval and drought monitoring using remote sensing
- Vadose zone hydrology and soil evaporation
- Heat and mass transfer processes in porous media

Education

- **PhD (Dr. sc.)** in Environmental Systems Science
ETH Zurich, Zurich, Switzerland, Aug. 2011-July 2015
✓ *Nominee for the ETH Medal*
- **MSc** in Mechanical Engineering – Energy Conversion
Sharif University of Technology, Tehran, Iran, Sep. 2007-Sep. 2009
✓ *With distinction, top 8%*
- **BSc** in Mechanical Engineering – Thermal Fluids
The University of Guilan, Rasht, Iran, Sep. 2003-July 2007
✓ *With distinction, 1st rank*

Employment

- **Eawag (ETH Domain)**, Dübendorf, Switzerland, Jan. 2018-present
Research Scientist
Dept. of Water Resources and Drinking Water
- **University of Zurich**, Zurich, Switzerland, Jan. 2018-present
Scientific Collaborator
Remote Sensing of Water Systems
- **Massachusetts Institute of Technology**, Cambridge, USA, Nov. 2016-April 2018
Postdoctoral Fellow, Water Cycle Research Group (Prof. Dara Entekhabi)
Dept. of Civil and Environmental Engineering
- **ETH Zurich**, Zurich, Switzerland, Nov. 2015-Oct. 2016
Postdoctoral Associate, Physics of Environmental Systems (Prof. James W. Kirchner)
Dept. of Environmental Systems Science
- **ETH Zurich**, Zurich, Switzerland, Aug. 2011-Sep. 2015
Graduate Research Assistant, Soil and Terrestrial Environmental Physics (Prof. Dani Or)
Dept. of Environmental Systems Science
- **Sharif Energy Research Institute**, Tehran, Iran, Sep. 2009-July 2011
Senior Research Assistant, Division of Energy Management and Optimization
 - Group Leader in a nationwide project entitled “development of a comprehensive plan for energy management in oil and gas upstream” (sponsor: National Iranian Oil Company)
 - Executive Director of a nationwide project entitled “development and implementation of energy

demand and supply models for strategic planning in energy sector” (sponsor: Institute for International Energy Studies)

- **Research Institute of Petroleum Industry**, Tehran, Iran, Feb. 2009-Feb. 2010
Reservoir Engineer, Faculty of Research and Development in Upstream Petroleum Industry
- **Sharif University of Technology**, Tehran, Iran, Sep. 2008-Sep. 2009
Graduate Research Assistant, Hydrocarbon Reservoir Simulation (Prof. Mehrdad T. Manzari)
Dept. of Mechanical Engineering
- **Sakura-Japan Corp.**, Tehran, Iran, July 2008-Jan. 2009
HVAC Design Engineer

Awards and Recognitions

- Nominee for the Silver Medal of ETH Zurich for outstanding doctoral theses, ETH Zurich, Switzerland, July 2015
- Graduated with distinction (top 8%), Department of Mechanical Engineering, Sharif University of Technology, Iran, Sep. 2009
- Introduced as a Scientific Elite by Iran’s National Elites Foundation (INEF), Iran, Feb. 2008
- Ranked 36th among 30,000+ participants in Iran’s nationwide entrance exam for graduate admissions in public universities, Iran, Sep. 2007
- Finalist in 12th National Scientific Olympiad for University Students (Mechanical Engineering program), Iran’s National Organization for Educational Testing, Iran, July 2007
- Exempted from MSc program entrance exam in recognition of excellent academic performance during BSc program, The University of Guilan, Iran, July 2007
- Ranked 1st among 70+ students in the BSc program (Mechanical Engineering), Faculty of Engineering, The University of Guilan, Iran, July 2007
- Faculty of Engineering Prize, Four times for 4 consecutive years, Faculty of Engineering, The University of Guilan, Iran, 2004-2007
- Honored to be a member of National Organization for Development of Exceptional Talents (NODET), Iran, 2004-2007

Awarded Research Grants

2. The hidden frontier: Pore-scale phenomena governing land surface feedbacks in a changing climate, Eawag Postdoctoral Fellowship [[link](#)], Swiss Federal Institute of Aquatic Science and Technology (Eawag), Jan. 2018
1. Towards a mechanistic understanding of land-atmosphere interactions affecting evaporative water losses from terrestrial surfaces, SNSF Early Postdoc.Mobility Fellowship [[link](#)], Swiss National Science Foundation (SNSF), Oct. 2016-present (USD 96,950) – Received

Teaching Experience

- Teaching assistant/Co-instructor:
 - Remote Sensing of Water Systems, University of Zurich, Spring 2018 and 2019
 - Environmental Fluid Transport Processes Laboratory, MIT, Fall 2017
 - Vadose Zone Hydrology, ETH Zurich, Fall 2013 and 2014
 - Advanced Engineering Mathematics, The University of Guilan, Fall 2006
 - Automatic Control, The University of Guilan, Fall 2006
 - Internal Combustion Engines, The University of Guilan, Fall 2006
 - Gas Dynamics, The University of Guilan, Fall 2006
- Additional training and certificates:
 - Kaufman Teaching Certificate [[link](#)], Teaching and Learning Laboratory, MIT, June 2017
 - MIT Festival of Learning [[link](#)], Teaching and Learning Laboratory, MIT, Feb. 2017

- Promoting Critical Thinking [\[link\]](#), Refresh Teaching series, ETH Zurich, May 2016
- Inter/Trans-disciplinary and Design-Thinking Teaching [\[link\]](#), TdLab, ETH Zurich, Feb. 2016
- Flipped Classroom [\[link\]](#), Refresh Teaching series, ETH Zurich, April 2015

Professional and Community Service

- Co-supervision of BSc, MSc and PhD students:
 - Kazi Rifat Ahmed, PhD student, University of Zurich, Switzerland, Jan. 2018-present
 - Mohammad Abdoli, MSc student, Sharif University of Technology, Iran, Feb. 2018-present
 - 4 BSc students, University of Zurich, Switzerland, March 2019
- Scientific conference organizations:
 - Judge for the Outstanding Student Paper Award (OSPA) program at AGU Fall Meeting, New Orleans, USA, Dec. 2017
 - Judge for the Outstanding Student Poster and PICO (OSPP) Awards contest at EGU General Assembly, Vienna, Austria, April 2017
 - Discussion leader of a symposium entitled “Porous media-free flow interfaces” at Gordon Research Seminar, Girona, Spain, July 2016
- Reviewer for international journals*:
 - Water Resources Research, Geophysical Research Letters, Journal of Geophysical Research: Atmospheres, Journal of Hydrology, Agricultural and Forest Meteorology, Climate Dynamics, Water, Vadose Zone Journal, Transport in Porous Media, International Journal of Heat and Mass Transfer, Journal of Food Engineering, Royal Society Open Science, Computers and Geosciences, Sustainable Cities and Society
*see my [\[publons\]](#) and [\[ORCID\]](#) profiles for review statistics
- Reviewer for government agencies:
 - Chilean National Science and Technology Commission, Chile
- Other services:
 - Technical supervisor of [\[Lake Urmia\]](#) restoration program, Remote Sensing Research Center, Sharif University of Technology, Tehran, Iran, Feb. 2018-present
 - Member of a student/postdoc advisory panel to recruit a tenure track assistant professor at Massachusetts Institute of Technology, Cambridge, USA, March 2017
- Professional membership:
 - American Society of Mechanical Engineering (since 2008), European Geosciences Union (since 2012), American Geophysical Union (since 2013)

Scientific Talks

10. [invited] When less is not more: Linking pore- and landscape-scale processes toward improved estimation of land-atmosphere exchanges, Remote Sensing Laboratories research colloquium, University of Zurich, Switzerland, April 2018
9. [invited] When less is not more: Linking pore- and landscape-scale processes toward improved estimation of land-atmosphere exchanges, Chair of Groundwater and Hydromechanics, ETH Zurich, Switzerland, March 2018
8. [invited] When less is not more: Linking pore- and landscape-scale processes toward improved estimation of land-atmosphere exchanges, W+T Seminar Series, Eawag, Switzerland, March 2018
7. What determine transitions between energy- and moisture-limited evaporative regimes?, American Geophysical Union-Fall Meeting, San Francisco, USA, Dec. 2017
6. Mutual soil and atmospheric controls on land-atmosphere coupling in the context of dominant evaporative regime, NASA’s SMAP meeting – SMAP loss function and its utilization, MIT,

USA, July 2017

5. Revisiting EF-soil moisture relationships, NASA's SMAP meeting – SMAP loss function and its utilization, MIT, USA, May 2017
4. Mechanistic understanding of evapotranspiration-soil moisture coupling, NASA's SMAP meeting – SMAP loss function and its utilization, MIT, USA, March 2017
3. A missing piece of the puzzle in climate change hotspots: Near-surface turbulent interactions controlling ET-soil moisture coupling in semiarid areas, EGU General Assembly, Vienna, Austria, April 2017
2. [invited] Evaporation from terrestrial surfaces – Linking pore-scale phenomena with landscape processes, Physics of Environmental Systems Seminar, ETH Zurich, Switzerland, Sep. 2015
1. [invited] Effects of surface roughness on evaporation from porous surfaces into turbulent airflows, Laboratory for Multiscale Studies in Building Physics, ETH Zurich, Switzerland, June 2015

Computer Skills

- Programming in MATLAB, C++, and Fortran
- Ample experience with off-the-shell packages such as COMSOL Multiphysics, HYDRUS1D and 2D, ANSYS-FLUENT, and AutoCAD
- Genetic algorithms
- Image processing techniques

Experimental Skills

- Soil measurement and monitoring techniques
- Ample experience with running soil drying experiments in a wind tunnel, including instrumentation for soil water content and temperature measurements
- Turbulence measurement with hot-wire and 3D sonic anemometers
- Infrared thermography and extraction of soil water evaporation rates from thermal images

Languages

- **English** (Full professional proficiency)
- **German** (Elementary proficiency)
- **Persian** (Native speaker)

Journal Publications (Peer-reviewed)

[\[Google Scholar\]](#)

[\[ResearchGate\]](#)

In Preparation:

2. **Haghighi, E.**, and D. Entekhabi, The trade-off between saving water and being cool drives stomatal responses to extreme temperatures, in preparation for *PNAS*
1. **Haghighi, E.**, W.P. Kustas, G.D. Salvucci, and D. Entekhabi, A generalized KB-1 concept improving estimates of evapotranspiration and its partitioning using remote sensing, in preparation for *Remote Sensing of Environment*

In Review/Revision:

2. Paul-Limoges, E., S. Wolf, **E. Haghighi**, F.D. Schneider, M. Longo, P. Moorcroft, M. Gharun, and A. Damm, Partitioning water vapor fluxes with concurrent eddy covariance measurements in a mixed forest, submitted to *Agricultural and Forest Meteorology*
1. Damm, A., **E. Haghighi**, E. Paul-Limoges, L. Fritsche, C. van der Tol, and J. Berry, Sun-induced chlorophyll fluorescence to advance estimates of ecosystem transpiration: Insights from observations and models, submitted to *Remote Sensing of Environment*

In Press/Published:

16. Li, Y., W.P. Kustas, C. Huang, H. Nieto, **E. Haghghi**, M.C. Anderson, F. Domingo, and M. Garcia (2019), Evaluating soil resistance formulations in thermal-based two-source energy balance (TSEB) model: Implications for heterogeneous semiarid and arid regions, *Water Resources Research*, 55, 1059-1078
✓ *Featured on the [front cover] of Water Resources Research*
15. **Haghghi, E.**, K. Madani, and A.Y. Hoekstra (2018), The water footprint of water conservation with shade balls in California, *Nature Sustainability*, 1, 358-360
✓ *Featured on the [front cover] of Nature Sustainability*
✓ *Featured by over 50 news outlets around the world including [Nature News], [BBC], [Seeker], [PBS NewsHour], [ScienceDaily], [myScience], [ScienceAlert], [EurekAlert], [Phys.Org], [IEEE GlobalSpec], [NowThisNews], [The Weather Channel], [Spiegel] etc.*
14. Li, Y., W.P. Kustas, C. Huang, D. Kool, and **E. Haghghi** (2018), Evaluation of soil resistance formulations for estimates of sensible heat flux in a desert vineyard, *Agricultural and Forest Meteorology*, 260-261, 255-261
13. Damm, A., P.L. Eugenie, **E. Haghghi**, C. van der Tol, M. Migliavacca, and U. Rascher (2018), Remote sensing of plant-water relations: An overview and future perspectives, *Journal of Plant Physiology*, 227, 3-19
12. Akbar, R., D.J. Short Gianotti, K. McColl, **E. Haghghi**, G.D. Salvucci and D. Entekhabi (2018), Estimation of ecosystem-scale soil water losses from satellite observations of soil moisture, *Journal of Hydrometeorology*, 19, 871-889
11. **Haghghi, E.**, R. Akbar, D.J. Short Gianotti, G.D. Salvucci, and D. Entekhabi (2018), Soil and atmospheric controls on the land surface energy balance: A generalized framework for distinguishing moisture- and energy-limited evaporation regimes, *Water Resources Research*, 54, 1831-1851
10. Akbar, R., D.J. Short Gianotti, K. McColl, **E. Haghghi**, G.D. Salvucci, and D. Entekhabi (2018), Hydrological storage length-scales represented by remote sensing estimates of soil moisture and precipitation, *Water Resources Research*, 54, 1476-1492
9. **Haghghi, E.**, and J.W. Kirchner (2017), Near-surface turbulence as a missing link in modeling evapotranspiration-soil moisture relationships, *Water Resources Research*, 53, 5320-5344
✓ *Featured in journal highlights as [Editor's Highlight]*
8. **Haghghi, E.**, and D. Or (2015), Interactions of bluff-body obstacles with turbulent airflows affecting evaporative fluxes from porous surfaces, *Journal of Hydrology*, 530, 103-116
7. **Haghghi, E.**, and D. Or (2015), Turbulence-induced thermal signatures over evaporating bare soil surfaces, *Geophysical Research Letters*, 42, 5325-5336
6. **Haghghi, E.**, and D. Or (2015), Evaporation from wavy porous surfaces into turbulent airflows, *Transport in Porous Media*, 110, 225-250
5. **Haghghi, E.**, and D. Or (2015), Thermal signatures of turbulent airflows interacting with evaporating thin porous surfaces, *International Journal of Heat and Mass Transfer*, 87, 429-46
4. **Haghghi, E.**, and D. Or (2015), Linking evaporative fluxes from bare soils across surface viscous sublayer with the Monin-Obukhov atmospheric flux-profile estimates, *Journal of Hydrology*, 525, 684-693
3. **Haghghi, E.**, and D. Or (2013), Evaporation from porous surfaces into turbulent airflows: Coupling eddy characteristics with pore scale vapor diffusion, *Water Resources Research*, 49, 8432-8442
2. **Haghghi, E.**, E. Shahraeeni, P. Lehmann, and D. Or (2013), Evaporation rates across a convective air boundary layer are dominated by diffusion, *Water Resources Research*, 49, 1602-1610
1. **Haghghi, E.**, M.T. Manzari, S.K. Hannani, and H. Naderan (2011), A high-resolution central scheme for compositional flow simulations in hydrocarbon reservoirs, *Sharif Journal*,

Books and Chapters

1. **Haghighi, E.** (2015), Evaporation from porous surfaces into turbulent airflows: From pores to eddies, *Doctoral Thesis*, ETH Zurich

Conference Proceedings, Abstracts and Presentations

31. **Haghighi, E.**, E. Paul-Limoges, and A. Damm (2019), Mechanistic modeling of leaf gas exchanges expands the utility of SIF into estimation of ecosystem transpiration, International Network on Remote Sensing of Terrestrial and Aquatic Fluorescence, Davos, Switzerland
30. Ahmed, K.R., E. Paul-Limoges, **E. Haghighi**, and A. Damm (2018), Towards advanced estimates of ecosystem transpiration using multi-mission Sentinel satellite data, 8th Advance Training Course on Land Remote Sensing, Leicester, UK
29. Akbar, R., D.J. Short Gianotti, K. McColl, **E. Haghighi**, G.D. Salvucci, and D. Entekhabi (2018), First-order water balance studies using SMAP soil moisture, IGARSS, Valencia, Spain
28. **Haghighi, E.** (2018), Mechanistic modeling of plant gas exchange resolves carbon-water relation dynamics under water-limited conditions, EGU General Assembly, Geophysical Research Abstracts, 20, EGU2018-16213
27. **Haghighi, E.**, D.J. Short Gianotti, R. Akbar, G.D. Salvucci, and D. Entekhabi (2017), What determine transitions between energy- and moisture-limited evaporative regimes?, American Geophysical Union-Fall Meeting, New Orleans, USA, Abstract H44C-07
26. Akbar, R., D.J. Short Gianotti, **E. Haghighi**, K. McColl, G.D. Salvucci, and D. Entekhabi (2017), What effective hydrological depth do remote sensing estimates of soil moisture and precipitation represent?, Science Utilization of SMAP (SUSMAP) Meeting, Cambridge, Massachusetts
25. Akbar, R., D.J. Short Gianotti, K. McColl, **E. Haghighi**, G.D. Salvucci, and D. Entekhabi (2017), Estimation of dominant hydrologic processes from SMAP data over the Contiguous United States, Science Utilization of SMAP (SUSMAP) Meeting, Cambridge, Massachusetts
24. **Haghighi, E.**, A.J. Rigden, W.P. Kustas, G.D. Salvucci, J.W. Kirchner, and D. Entekhabi (2017), From pores to eddies: The missing link in modelling evapotranspiration and its partitioning using remote sensing, SSSA International Annual Meeting: Managing Global Resources for a Secure Future, Tampa, Florida
23. **Haghighi, E.**, J.W. Kirchner, and D. Entekhabi (2017), The dilemma of saving water or being cool: What determines the stomatal response under a changing climate?, EGU General Assembly, Geophysical Research Abstracts, 19, EGU2017-5823
22. **Haghighi, E.**, D.J. Gianotti, A.J. Rigden, G.D. Salvucci, J.W. Kirchner, and D. Entekhabi (2017), A missing piece of the puzzle in climate change hotspots: Near-surface turbulent interactions controlling ET-soil moisture coupling in semiarid areas, EGU General Assembly, Geophysical Research Abstracts, 19, EGU2017-5808
21. **Haghighi, E.**, J.W. Kirchner, and D. Entekhabi (2016), Vegetation-induced turbulence influencing evapotranspiration-soil moisture coupling: Implications for semiarid regions, American Geophysical Union-Fall Meeting, San Francisco, USA, Abstract H21D-1442
20. **Haghighi, E.**, and J.W. Kirchner (2016), Dissecting evapotranspiration-soil moisture coupling in semiarid environments, ITES Research Day, ETH Zurich, Zurich, Switzerland
19. **Haghighi, E.**, J.W. Kirchner, and D. Or (2016), Thermal imprints of surface-free flow interactions affecting evaporative fluxes from bluff-rough porous surfaces, Gordon Research Conferences: Flow and Transport in Permeable Media, Girona, Spain
18. **Haghighi, E.**, and J.W. Kirchner (2016), A process-based evapotranspiration model incorporating coupled soil water-atmospheric controls, EGU General Assembly, Geophysical Research Abstracts, 18, EGU2016-4691
17. **Haghighi, E.**, J.W. Kirchner, and D. Or (2016), Interactions between surface roughness and airflow turbulence affecting drying dynamics of rough porous surfaces, EGU General

Assembly, Geophysical Research Abstracts, 18, EGU2016-4665

16. **Haghighi, E.**, and D. Or (2015), Thermal signatures and evaporative fluxes from regular wavy porous surfaces into turbulent airflows, 7th International Conference on Porous Media and Annual Meeting, International Society for Porous Media, Padua, Italy
15. **Haghighi, E.**, and D. Or (2015), Turbulent evaporative fluxes from wavy porous surfaces, IBP PhD Congress, ETH Zurich, Switzerland
14. **Haghighi, E.**, and D. Or (2015), Evaporative fluxes from wavy porous surfaces, MUSIS workshop on Interfaces and Interfacial Displacement in Unsaturated Porous Media, Potsdam, Germany
13. **Haghighi, E.**, S. Laguela, M. Aminzadeh, and D. Or (2014), The role of bluff-body roughness elements on turbulent evaporative fluxes from porous surfaces: Effects of momentum and energy partitioning, American Geophysical Union-Fall Meeting, San Francisco, USA, Abstract H33E-0864
12. **Haghighi, E.**, and D. Or (2014), Effects of surface roughness on evaporation from porous surfaces into turbulent airflows, EGU General Assembly, Geophysical Research Abstracts, 16, EGU2014-15915
11. Or, D., S. Assouline, M. Aminzadeh, **E. Haghighi**, S. Schymanski, and P. Lehmann (2014), Stomata size and spatial pattern effects on leaf gas exchange - a quantitative assessment of plant evolutionary choices, EGU General Assembly, Geophysical Research Abstracts, 16, EGU2014-14801
10. **Haghighi, E.**, and D. Or (2014), Modelling evaporative fluxes from wavy porous surfaces, ZHydro (Hydrology Seminar), Zurich, Switzerland
9. **Haghighi, E.**, and D. Or (2013), Rapid surface thermal signatures for estimation of evaporative fluxes into turbulent flows, American Geophysical Union-Fall Meeting, San Francisco, USA, Abstract H21C-1046
8. **Haghighi, E.**, and D. Or (2013), Surface thermal signatures of turbulent evaporative fluxes, ZHydro (Hydrology Seminar), Zurich, Switzerland
7. **Haghighi, E.**, and D. Or (2013), Estimating evaporation rates from terrestrial surfaces using thermal measurements: On the coupling of air turbulent field with evaporative thermal signatures, ITES Research Day, ETH Zurich, Zurich, Switzerland
6. **Haghighi, E.**, and D. Or (2013), Evaporation from porous surfaces into turbulent airflows: On the coupling of momentum and thermal signatures, EGU General Assembly, Geophysical Research Abstracts, 15, EGU2013-3148
5. **Haghighi, E.**, and D. Or (2012), Diffusion-dominant transport from partially wet surfaces: Applications to evaporation across an air boundary layer, ZHydro (Hydrology Seminar), Zurich, Switzerland
4. **Haghighi, E.**, and D. Or (2012), Evaporation from porous surfaces into turbulent airflows: Thermal signatures of local evaporation, ITES Research Day, ETH Zurich, Zurich, Switzerland
3. **Haghighi, E.**, and D. Or (2012), Thermal signatures of diffusive evaporative fluxes from porous surfaces into turbulent airflows: Coupling eddies with vapor diffusion, Gordon Research Conferences: Flow and Transport in Permeable Media, Les Diablerets, Switzerland
2. **Haghighi, E.**, and D. Or (2012), From pores to eddies: Linking diffusion-based evaporative fluxes from porous surfaces with a turbulent air boundary layer, EGU General Assembly, Geophysical Research Abstracts, 14, EGU2012-2439
1. **Haghighi, E.**, B. Borzou, A.R. Ghahremani, and M. Behshad Shafii (2009), Optimization of a regenerative gas turbine engine with isothermal heat addition with the genetic algorithm, Proceedings of ASME Turbo Expo: Power for Land, Sea and Air, Orlando, Florida

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