

## Assaad Mrad

mradassaad2@gmail.com | 919.519.0011 | [www.mradassaad.com](http://www.mradassaad.com) | [ORCID](#)

### Education

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**Nicholas School of the Environment**, Duke University – Durham, NC

2016- Ph.D. candidate, Environmental Science

Advisor: Dr. Gabriel G. Katul

Committee: Gabriel G. Katul, Amilcare Porporato (Princeton University, USA),  
Ram Oren, Jean-Christophe Domec (Bordeaux Sciences Agro, France).

**Faculty of Engineering and Architecture**, American University of Beirut – Beirut, Lebanon

2012-2016 Bachelor of Engineering, Mechanical Engineering

### Research Experience

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- Collaborating with an international team of wood anatomists and plant physiologists to produce a publication and a working paper on the influence of xylem vessel network on plant resistance to embolism spread.
- Formalized a dynamic optimality approach to produce a publication on the response of photosynthesis to drought.
- Developed an object-oriented program on Matlab to simulate water flow in vegetation and its resistance to embolism spread (available on Github).
- Performed a dynamical systems analysis to project groundwater withdrawal and crop production on the United States High Plains.
- Orchestrated a synthesis of the literature on size-density relationships in mono-specific stands shaped by competition.

### First-Authored Peer-Reviewed Publications

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1. **Mrad, A.**, S. Manzoni, R. Oren, G. Vico, M. Lindh, & G. Katul (2020). Recovering the metabolic, self-thinning and constant final yield rules in mono-specific stands. *Frontiers in Forests and Global Change*, 3, 62. IF: N/A
2. **Mrad, A.**, S. Sevanto, Y. Liu, J.-C. Domec, M. Nakad & G. Katul (2019). A dynamic optimality principle for water use strategies explains isohydric to anisohydric plant responses. *Frontiers in Forests and Global Change* 2, 49. IF: N/A
3. **Mrad, A.**, J.-C. Domec, C.-W. Huang, F. Lens & G. Katul (2018). A network model links wood anatomy to xylem tissue hydraulic behavior and vulnerability to cavitation. *Plant, Cell & Environment* 41 (12), 2718-2730. IF: 6.2

### Co-Authored Peer-Reviewed Publications

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1. Katul, G., **A. Mrad**, S. Bonetti, G. Manoli, and A. Parolari (2020). Global convergence of COVID-19 basic reproduction number and estimation from early-time SIR dynamics. *medRxiv*. Major revisions: PLOS ONE. IF: 2.8

2. Cardoso, A., L.-M. Billon, A. Fanton Borges, L. Fernández-de-Uña, J. Gersony, A. Güney, K. Johnson, C. Lemaire, **A. Mrad**, Y. Wagner, G. Petit (2020). New developments in understanding plant water transport under drought stress. *New Phytol*, 227, 1025-1027. IF: 7.3

### **Papers in Progress**

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1. **Mrad, A.**, J.-C. Domec, D. Johnson, D. Love, J. Rojas, G. Katul (2020). Vessel grouping confers embolism resistance and blurs safety-efficiency trade-offs. In Preparation.
2. **Mrad, A.**, G. Katul, D. Levia, A. Guswa, E. Boyer, M. Bruen, D. Carlyle-Moses, R. Coyte, I. Creed, N. van de Giesen, D. Grasso, D. Hannah, J. Hudson, V. Humphrey, S. Iida, R. Jackson, T. Kumagai, P. Llorens, B. Michalzik, K. Nanko, C. Peters, J. Selker, D. Tetzlaff, M. Zalewski, B. Scanlon (2020). Peak grain forecasts for the U.S. High Plains amid withering waters. Minor revisions: Proceedings of the National Academy of Sciences. IF: 9.6

### **Honors, Scholarships, and Grants**

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| 2019      | Nicholas School of the Environment - Dean's award for outstanding student manuscript \$1000.                                                                                                                                                                                                                                                                                                                          |
| 2019      | Financial support to attend the "Sensing Forest Water Dynamics from Space: Towards Predicting the Earth System Responses to Droughts" workshop sponsored by the Keck Institute for Space Studies as an ECR \$1000.                                                                                                                                                                                                    |
| 2019      | Financial support offered by the Federation of European Societies of Plant Biology (FESPB) to attend the 4 <sup>th</sup> Xylem International Meeting in Padova, Italy €500.                                                                                                                                                                                                                                           |
| 2018      | NSF proposal "The dynamics of embolism formation and repair in xylem conduits: from bubble scale to loss in plant hydraulic transport capacity" \$598,000.<br>Principal Investigators: J.-C. Domec, G. Katul, D. Johnson.<br>Collaborators: <b>A. Mrad</b> , A. Ponomarenko - My Contribution: Edited sections, provided preliminary data, created figures pertinent to the functional significance of plant anatomy. |
| 2016      | Scholarship awarded through Mr. Jihad Hassan, philanthropist – covered 1 semester's tuition.                                                                                                                                                                                                                                                                                                                          |
| 2015      | Alexis and Anne-Marie Habib Foundation Scholarship – covered 1 semester's tuition.                                                                                                                                                                                                                                                                                                                                    |
| 2012-2016 | Faculty of Engineering and Architecture Dean's Honor List every semester.                                                                                                                                                                                                                                                                                                                                             |

### **Teaching and Mentoring Experience**

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| 2020      | <ul style="list-style-type: none"><li>• Mentoring three engineering student interns at the American University of Beirut: Nahia Kanj, Layane Sakr, and Yasmina Ghantous.</li><li>• Guiding the interns in developing a dynamical system for the groundwater-salinity-vegetation system under stochastic rainfall.</li></ul>                    |
| 2016-2018 | <ul style="list-style-type: none"><li>• Instructed Masters and Ph.D. students on modeling using Matlab and Mathematica and analytically solving Ordinary Differential Equations.</li><li>• Mentored students through their homework and course projects centered around Dynamical Systems analysis of environmental complex systems.</li></ul> |

- Managed office hours for Masters and Ph.D. students in two classes: Watershed Hydrology and Mathematics of Dynamical Systems Describing Complex Environmental Phenomena.

2015-2019 Instructed high school students in mathematics and physics during private tutoring sessions and classroom sessions for more than 30 attendees.

2015 Led a hands-on robotics workshop at my high school and participated in a country-wide competition where my students won the robot design award.

## **Presentations**

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1. Poster: **Mrad, A.**, J-C. Domec, F. Lens, G. Katul. Sept 2019. "Upscaling plant anatomical traits to organ-scale vulnerability to embolism." 4<sup>th</sup> Xylem International Meeting.
2. Oral: **Mrad, A.**, Y. Liu, M. Liu, S. Sevanto, G. Katul. Dec 2018. "A dynamic optimality principle for water use strategies explains isohydric to anisohydric plant responses." American Geophysical Union Fall Meeting 2018.
3. Poster: **Mrad, A.**, J.-C. Domec, C.-W. Huang, G. Katul. Dec 2017. "A Revised Similarity Law in Botanic Describes the Genesis of the Vulnerability Curve Shape in Vascular Plants." American Geophysical Union Fall Meeting 2017.

## **Service & Involvement**

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2019-2020 Reviewer for various publications including Nature Communications, New Phytologist, Oecologia, and Plant, Cell, & Environment.

Publons: <https://publons.com/researcher/2949477/assaad-mrad/>

2018-2019 Fellow, *Building Outdoor Leaders at Duke*

- Led a team of nine members to the peak of one of the tallest mountains of South America, Cayambe.
- Planned and executed workouts to increase stamina in low-oxygen environments.
- Managed team expectations and assessed mental and physical readiness.

2015-2016 Committee member, *American University of Beirut Astronomy Club*

- Executed trips to low-light environments and mountains for over 50 participants.
- Led telescope observations and information sessions on celestial objects.

2012-2014 Team leader, *Lebanese Red Cross Emergency Medical Services*

- Led a team of nine emergency medical technicians to respond to various medical emergencies overnight for 4 mountainous cities and villages in Lebanon.

2012-2014 Organization leader, *Lebanese Red Cross Blood Donation Services*

- Managed and improved a database of blood donors for Lebanon.
- Supported patients in need of blood transfusions with donor matching services.

## **Relevant Graduate Coursework**

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- Physics and Mathematics: Statistical Mechanics, Turbulence, Non-Linear Dynamics, Mathematical Modeling, Random Signals and Noise.
- Environmental Sciences: Functional Ecology of Trees, Ecohydrology, Dendrology.

## **Languages**

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English: Professional written and oral proficiency

French: Professional written and oral proficiency

Arabic/Lebanese: Professional written and oral proficiency

## **Programming Skills**

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Expert use of Matlab, Python, and Mathematica

Extensive experience with C++ and Java

## **References**

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Gabriel Katul, Ph.D. (Duke University): [gaby@duke.edu](mailto:gaby@duke.edu)

Jean-Christophe Domec, Ph.D. (Bordeaux Sciences Agro): [jc.domec@agro-bordeaux.fr](mailto:jc.domec@agro-bordeaux.fr)

Sanna Annika Sevanto, Ph.D. (Los Alamos National Laboratory): [sanna@lanl.gov](mailto:sanna@lanl.gov)

Delphis Levia, Ph.D. (University of Delaware): [dlevia@udel.edu](mailto:dlevia@udel.edu)

Ram Oren, Ph.D. (Duke University): [ramoren@duke.edu](mailto:ramoren@duke.edu)

Amilcare Porporato, Ph.D. (Princeton University): [aporpora@princeton.edu](mailto:aporpora@princeton.edu)