

CURRICULUM VITAE - LEONARDO MICHELI

PERSONAL INFORMATION

Name and surname / Title

Contact

SCIENTIFIC PROFILE

Highest degree

Main research topics

Experience in

Indexed publications (H-index)

RESEARCH EXPERIENCE

March 2022 to Present

January 2022 to February 2022

December 2020 to December 2021

December 2018 to December 2020

November 2017 to November 2018

October 2016 to November 2017

December 2015 to October 2016

June 2015 to November 2015

November 2011 to June 2015

RESEARCH PROJECTS

March 2022 to February 2025

December 2015 to November 2018

April 2016 to January 2020

November 2011 to November 2015

RESEARCH FUNDING

INDIVIDUAL

Leonardo Micheli, PhD

leonardo.micheli@uniroma1.it

PhD in Renewable Energy, awarded in 2015 by the University of Exeter (UK).

Photovoltaic (PV) Soiling, PV Reliability & Performance, Concentrator PV (CPV), Heat Transfer.

PV and CPV performance analysis, PV soiling, data analysis, experimental characterization of energy systems and materials, multiphysics modelling, development of CPV components.

59 (18). First publication in 2013. Source: Scopus (Author ID: 55573166700).

"Rita Levi Montalcini" Assistant Professor (RTDB) at Sapienza University of Rome, Italy.

"Ramón y Cajal" Research Fellow at the Univ. of Jaén (UJA), Spain.

Postdoctoral Researcher at UJA, Spain.

Marie Skłodowska-Curie Actions Individual Fellowships (MSCA IF) Researcher at UJA, Spain.

Scientist at the National Renewable Energy Laboratory, USA.

Salaried visiting scholar at the Colorado School of Mines, USA, based at the National Renewable Energy Laboratory, USA, under a Memorandum of Understanding.

Working at the National Renewable Energy Laboratory, USA, under a collaborative appointment.

Associate Research Fellow at the Environment and Sustainability Institute, Univ. of Exeter, UK.

PhD student in Renewable Energy. Supervisor: Prof. Tapas K. Mallick.

- *December 2013 to April 2014*: Visiting PhD at the Indian Institute of Technology Madras, India. Host: Prof. K.S. Reddy.
- *March 2013 to June 2015*: PhD position moved with the same research group and supervisor to the Environment and Sustainability Institute, University of Exeter, UK.
- *November 2011 to February 2013*: PhD student at Heriot-Watt University, UK.

"Soiling Live Estimation for Photovoltaics (Sole4PV)" [€263k], funded by the Italian Ministry of University and Research under the 2019 «Rita Levi Montalcini» Program for Young Researchers (*Principal Investigator*).

- Skills: PV performance & data analysis, soiling extraction and estimation, mapping, concept development and project management.

"Novel Soiling Identification Logics for Photovoltaics (NoSoilPV)" [€158k], funded by the European Commission (*Leader and Research fellow*).

- Skills: PV performance & data analysis, soiling extraction, statistical & stochastic methods, concept development and project management, PhD supervision.

"Addressing Soiling: from Interface chemistry to practicality" [\$6M], funded by Dept. of Energy, USA (*researcher*, and, from November 2017, *leader of the modelling effort*).

- Skills: data analysis, soiling extraction, statistical computation, characterization of materials properties and abrasion, mapping, achievement of quarterly milestones.

"Global investigation on the spectral effects of soiling losses" [£19k], funded by the EPSRC SUPERGEN SuperSolar Hub, UK (*Co-PI and leading researcher*).

- Skills: optical characterization & modeling, identification of experimental procedures, concept development, project manag., leadership, building & coordination of international partnerships

"BioCPV" (<http://biocpv.ex.ac.uk/>) [£1.5M], funded by EPSRC, UK (*PhD student*).

- Skills: multi-physics modelling and material characterization, prototype and product development, communication, liaising with industrial and university partners.

2019 "Rita Levi Montalcini" fellowship (Sole4PV project, October 2021). [€263k, PI]

2020 "Ramón y Cajal" fellowship (CleanerPV project, RYC2020-030094-I, Aug 2021). [€220k, PI]

MSCA-IF-2017 - Individual Fellowship (NoSoilPV project, ID 793120, January 2018). [€158k, PI]

NREL's 2018 Accelerating Inventions to Market Award (July 2018). [\$10k, PI]

International visiting scholarship awarded in 2014 by Sapienza University of Rome for 10-month research activity at the National Renewable Energy Laboratory (NREL) in Golden, Colorado, USA. [€12k, PI]

RESEARCH IMPACT

PUBLICATIONS

CONFERENCE ATTENDANCE

SOLAR-ERA.NET Cofund 2, 2020. [€450k]

DOE's Technology Commercialization Fund, 2019. [\$50k]

Fondo Fomento a la Investigación UP 2018, Campus Aguascalientes, Mexico (2017). [Mex\$24k]

Programa Estatal de I+D+i Orientada a los Retos de la Sociedad, Spain (2016). [€132k]

SuperSolar International and Industrial Engagement Fund 3rd Call (2016). [€19k, co-PI]

The list of publication is attached below.

Orals:

PearlPV Final Conference, Online, 2022; PearlPV Workshop, Online, 2021; 48th IEEE-PVSC, Online, 2021; 47th IEEE-PVSC, Online, 2020; 2019 International Soiling Workshop, Marrakech, Morocco, 2019; 46th IEEE-PVSC, Chicago, IL, USA, 2019; 2018 PVRW, Denver, USA, 2018; CPV-13, Ottawa, Canada, 2017; 70^o Congresso Nazionale ATI, Rome, Italy, 2015; PGR Cornwall Conference: Exploring Research in Cornwall, 2015; ICSET-14, Coimbatore, India, 2014; PVSAT, Leeds, UK, 2015; ICAER 2013, IIT-Bombay, India, 2013.

Orals and Posters:

36th EU PVSEC, Marseille, FR, 2019; 2018 International Soiling Workshop, Golden, CO, USA, 2018; 35th EU PVSEC, Bruxelles, BE, 2018; *Oral and Poster: 7th WCPEC-7*, Waikoloa, HI, USA, 2018; 44th IEEE-PVSC, Washington, USA, 2017.

Posters:

2017 PVRW, Denver, USA, 2017; 43rd IEEE-PVSC, Portland, USA, 2016; 42nd IEEE-PVSC, New Orleans, USA, 2015; CPV-11, Aix-les-Bains, France, 2014; 40th IEEE-PVSC, Denver, USA, 2014; CPV-10, Albuquerque, USA, 2014; 28th EU PVSEC, Paris, France, 2013; 27th EU PVSEC, Germany, 2012.

INVITED TALKS

March 2022

January 2021

September 2020

June 2019

May 2019

November 2018

March 2018

September 2017

August 2016

March 2015

December 2014

April 2013

Conference: *2nd Annual Solar and Wind Power Conference*, Online.

Workshop: *Online WG2 Workshop on Reliability and Durability of PV*, Online.

Meeting: *24th IEA PVPS Task 13 Meeting*, Online.

MSCA Monitoring Meeting: *Artificial intelligence a way forward for Europe*, Bruxelles, Belgium.

Workshop: *INDUST COST Action: The Effect of Soiling on Solar Energy*, Munich, Germany.

Workshop: *TwinPV Workshop on Photovoltaic and grid integration for PV Cypriot Industry*, CY.

Panel: *2018 Solar Asset Management North America*, USA, 2018.

Webinar: *PVQAT TG12 Webinar Series: Particulate Matter (PM) monitoring networks*, USA.

Workshop: *Integrated Renewables for Autonomous Power Supply and Fuel Generation*, UK.

Workshop: *Advances in Concentrator Photovoltaics*, Imperial College, London, UK.

Workshop: *Advances in Renewable Energy Technologies*, IIT Madras, Chennai, India.

Workshop: *Environment and Sustainability Institute Business Network*, University of Exeter, UK.

INVOLVEMENT IN PV COMMUNITY

Member of:

- IEA Photovoltaic Power Systems Programme (PVPS) Task 13 (since 2020),
- International PV Quality Assurance Task Force (PVQAT) – Task Group 12 (since 2016),
- IEEE and of IEEE Electron Devices Society (since 2015).

Reviewer for *Progress in Photovoltaics: Research and Applications*, *Solar Energy Materials and Solar Cells*, *Solar Energy*, and *IEEE Journal of Photovoltaics* journals.

Member of the Planning Committee of the 2022 NREL PV Reliability Workshop (PVRW).

Chairman of one sub-area at 49th IEEE-PVSC (2022).

Member of the Steering Committee of the 2019 International Soiling Workshop (Marrakech, Morocco), and chairman of one session.

Chairman of one oral session at 46th IEEE-PVSC (2019) and 48th IEEE-PVSC (2021).

Chairman of two sessions at 2018 International Soiling Workshop (Golden, CO, USA).

Chairman of the "Soiling session" at 2017 & 2018 PVRW (Lakewood, CO, USA).

Poster judge for 2016, 2017, 2018 PVRW (Lakewood, CO, USA).

Part of the publication team for 40th IEEE-PVSC (2014) and 42nd IEEE-PVSC (2015).

PUBLIC ENGAGEMENT

2022

Member of Pint of Science Spain National Team (Webmaster).

2020

Coordinator of first Pint of Science edition in Jaén, Spain (Cancelled because of COVID-19).

October 2019

10-minute radio interview with SER Radio Jaén on MSCA IF project, Jaén, Spain.

September 2019

Stand on PV soiling at the *European Researchers' Night*, Jaén, Spain.

November 2015

Participant of *3 minute wonder*, University of Exeter, Exeter, UK.

May 2015

Speaker at *Pint of Science*, Exeter, UK.

AWARDS

April 2015

Delegate Registration Bursary Award (PVSAT-11, University of Leeds, UK).

December 2013

University of Exeter Impact Awards 2013 (as part of the BioCPV project team).

TEACHING EXPERIENCE

A.Y. 2021/2022

Professor of "Solar Resource" (4CFU) within the "Engineering of PV Systems" Master Degree at the University of Jaén, Spain.

A.Y. 2020/2021

Delivered a soiling lecture to the Renewable Energy MSc students as part of the "Advanced Photovoltaics" course, University of Jaén, Spain.

A.Y. 2019/2020

Delivered a soiling lecture to the Renewable Energy MSc students as part of the "Advanced Photovoltaics" course, University of Jaén, Spain.

A.Y. 2018/2019

Delivered a soiling lecture to the Renewable Energy MSc students as part of the "Advanced Photovoltaics" course, University of Jaén, Spain.

2014-2015

Assistant for lab activity of the 3rd year classes in Renewable Energy, University of Exeter, UK.

Since September 2013

Associate Fellow of the Higher Education Academy, UK.

April 2013 to October 2013

Tutor in the "Realising Opportunities" Program, UK.

September 2013 to December 2012

Teaching assistant in the "Renewable energy technology" course at Heriot-Watt University, UK.
Duties: tutoring & marking.

February to May 2012

Teaching assistant in the "Energy Studies" course at Heriot-Watt University, UK.
Duties: tutoring & marking.

STUDENT SUPERVISION

Since March 2019

Co-Supervisor: Álvaro Fernández Solas (PhD student at the University of Jaén).

Since December 2018

Co-Supervisor: Joao Gabriel Bessa Dos Reis De Freitas (PhD student at the University of Jaén).

June to October 2018

Supervisor: Antonino Di Maggio (Intern at NREL - Science Undergraduate Laboratory Internship program).

January to May 2017

Assistant: Daniel Ruth (Intern at NREL - Science Undergraduate Laboratory Internship program).

January to May 2016

Assistant: Sanjay Roberts (Intern at NREL - Science Undergraduate Laboratory Internship program).

October 2014 to April 2015

Assistant: Fausto Calabria (Renewable Energy Student - 3rd year dissertation at the University of Exeter). Thesis: Design of a 3G Enabled Data Acquisition System for BioCPV Off-grid Application.

September 2013 to June 2014

Assistant: Fahad Al Harbi (Renewable Energy Student - 3rd year dissertation at the University of Exeter). Thesis: Applicability and effectiveness of PMMA as coverglass for CPV applications.

EDUCATION

October 2015

Awarded the PhD in Renewable Energy at the University of Exeter (UK), with a thesis titled: "Enhancing Electrical and Heat Transfer Performance of High-Concentrating Photovoltaic Receivers". Supervisor: Prof. Tapas K. Mallick. Passed Viva in June 2015.

September 2011

Licensed as an Industrial Engineer at Sapienza - University of Rome, Rome (Italy).

May 2011

Completed the Master's degree in "Renewable Energies Engineering" at Sapienza University of Rome, Rome (Italy), with a mark 110/110 cum laude and a thesis, in English, titled: "Model and analysis of compound parabolic collectors and organic Rankine cycles applied to concentrating solar power plants". Supervisor: Prof. Franco Rispoli.

December 2009

Completed the Bachelor's degree in "Energy Engineering" at Sapienza University of Rome, Rome (Italy), with a mark of 110/110 and a thesis, in Italian, titled: "Model And Experimental Validation of a Photovoltaic Tracker and Comparison Between Performances of Tracked and Fixed Photovoltaic Systems". Supervisor: Prof. Vincenzo Naso.

SKILLS & COMPETENCES

MOTHER TONGUE: ITALIAN

OTHER LANGUAGES: ENGLISH

SPANISH

TECHNICAL COMPETENCES

SOFTWARE AND PROGRAMMING SKILLS

PRESENTATION SKILLS

ORGANIZATIONAL EXPERIENCE

Experience: living in English speaking countries (UK, India and USA) from 2011 to 2018.

Understanding, writing, speaking: C1.

Experience: living in Spain from Dec 2018 to Feb 2022. Completed B1.1 and B2.1 courses.

Reading, Listening and Writing: B2. Speaking: B1

PV performance, soiling station and particulate matter data analysis, modelling and processing.

Statistical analysis, artificial neural network, weather analysis and generation.

PV characterization (including I-V curves and EQE) using solar simulators, I-V tracers, IPCE.

Material and surface characterization using spectrophotometers, optical profilers, IR spectroscopy, microscopes and image processing software tools.

Proficient: Python 2x and 3x, Igor, Visual Basic, COMSOL, ImageJ, Microsoft Office.

Familiar: C, SQL, Fortran, MatLab, LiveCode.

Number of presentations delivered to a variety of audiences and through a number of methods, including Prezi, PechaKucha 20x20 and elevator speech formats.

Member of the Planning Committee of the 2022 NREL PV Reliability Workshop (PVRW).

Chairman of one sub-area at 49th IEEE-PVSC (2022).

Webmaster of Pint of Science Spain 2022.

Coordinator of first Pint of Science edition in Jaén, Spain (Cancelled because of COVID-19).

Member of the Steering Committee of the 2019 International Soiling Workshop, held in Marrakech, Morocco, in October 2020.

In 2018, leader of the modelling effort of the U.S. DOE funded-project on PV soiling, with the duties of coordinating the team and presenting the results to the DOE officers.

Co-PI and coordinator of the EPSRC SUPERGEN SuperSolar Hub funded project "Global investigation on the spectral effects of soiling losses", involving 18 researchers from 14 institutions.

Co-founder of RIMUN (Rome International Model United Nations, rimun.com), the largest Model United Nations for secondary school students in Italy, awarded by the President of the Republic of Italy. Served as conference manager and head of press.

Rome, Italy
March 2022

List of publications

JOURNAL PAPERS (*corresponding author)

1. M Muller*, K Perry, **L Micheli***, F Almonacid, EF Fernandez, "Automated detection of photovoltaic cleaning events: A performance comparison of techniques as applied to a broad set of labeled photovoltaic data sets", Prog. Photovoltaics Res. Appl. (2022).
2. JG Bessa*, **L Micheli**, J Montes-Romero, F Almonacid, EF Fernandez, "Estimation of photovoltaic soiling using environmental parameters: A comparative analysis of existing models", Advanced Sustainable Systems 2100335 (2022).
3. AF Solas*, J Montes, **L Micheli**, F Almonacid, EF Fernandez, "Estimation of soiling losses in photovoltaic modules of different technologies through analytical methods", Energy 123173 (2022).
4. **L Micheli***, GP Smestad, JG Bessa, M Muller, EF Fernandez, F Almonacid, "Tracking Soiling Losses: Assessment, Uncertainty, and Challenges in Mapping", IEEE Journal of Photovoltaics 12 (2022).
5. **L Micheli***, EF Fernandez, AF Solas, JG Bessa, F Almonacid, "Analysis and Mitigation of Non-Uniform Soiling Distribution on Utility-Scale PV Systems", Prog. Photovoltaics Res. Appl. 30 (2022).
6. **L Micheli***, "Energy and economic assessment of floating photovoltaics in Spanish reservoirs: cost competitiveness and the role of temperature", Solar Energy 227 (2021).
7. **L Micheli***, EF Fernandez, F Almonacid, "Photovoltaic Cleaning Optimization through the Analysis of Historical Time Series of Environmental Parameters", Solar Energy 227 (2021).
8. M Theristis*, A Livera, **L Micheli**, J Ascencio-Vásquez, G Makrides, GE Georghiou, JS Stein, "Comparative Analysis of Change-Point Techniques for Nonlinear Photovoltaic Performance Degradation Rate Estimations", IEEE J. Photovoltaics, 11 (2021).
9. **L Micheli***, AF Solas, A Soria-Moya, F Almonacid, EF Fernandez, "Short-term impact of the COVID-19 lockdown on the energy and economic performance of photovoltaics in the Spanish electricity sector", Journal of Cleaner Production 308 (2021).
10. AF Solas*, **L Micheli**, F Almonacid, EF Fernandez*, "Optical degradation impact on the spectral performance of photovoltaic technology", Renew. & Sust. Energy Rev. 141 (2021).
11. M Muller*, **L Micheli**, AF Solas, M Gostein, J Robinson, K Morely, M Dooraghi, YA Alghamdi, ZA Almutairi, F Almonacid, EF Fernandez, "An in-depth field validation of DUSST: A novel low-maintenance soiling measurement device". Prog. Photovoltaics Res. Appl. (2021).
12. JG Bessa, **L Micheli***, F Almonacid, EF Fernandez, "Monitoring Photovoltaic Soiling: Assessment, Challenges and Perspectives of Current and Potential Strategies", iScience, 102165 (2021).
13. **L Micheli***, M Theristis, A Livera, JS Stein, GE Georghiou, M Muller, F Almonacid, EF Fernandez "Improved PV Soiling Extraction through the Detection of Cleanings and Change Points", IEEE J. Photovoltaics, 11 (2021).
14. **L Micheli***, M Theristis, D Talavera, F Almonacid, JS Stein, EF Fernandez, "Photovoltaic Cleaning Frequency Optimization Under Different Degradation Rate Patterns", Renewable Energy, 166 (2020).
15. **L Micheli***, EF Fernandez, JT Aguilera, F Almonacid, "Economics of seasonal photovoltaic soiling and cleaning optimization scenarios", Energy, 215, Part A, 119018 (2021).
16. AF Solas*, **L Micheli**, M Muller, F Almonacid, EF Fernandez, "Design, Characterization and Indoor Validation of the Optical Soiling Detector "DUSST"", Solar Energy, 211 (2020).
17. P Rodrigo*, S Gutierrez, **L Micheli**, EF Fernandez, F Almonacid, "Optimum cleaning schedule of photovoltaic systems based on levelised cost of energy and case study in central Mexico", Solar Energy, 209 (2020).
18. **L Micheli***, EF Fernandez, M Muller, GP Smestad, F Almonacid, "Selection of Optimal Wavelengths for Optical Soiling Modelling and Detection in Photovoltaic Modules", Sol. Energy Mater. Sol. Cells, 212 (2020).
19. GP Smestad*, TA Germer, H Alrashidi, EF Fernández, S Dey, H Brahma, N Sarmah, A Ghosh, N Sellami, IAI Hassan, M Desouky, A Kasry, B Pesala, S Sundaram, F Almonacid, KS Reddy, TK Mallick, **L Micheli***, "Modelling photovoltaic soiling losses through optical characterization," Scientific Reports, 10 (2020).
20. **L Micheli***, EF Fernandez, M Muller, F Almonacid, "Extracting and Generating PV Soiling Profiles for Analysis, Forecasting, and Cleaning Optimization," IEEE J. Photovoltaics, 10 (2020).
21. K Ilse*, **L Micheli** et al., "Techno-Economic Assessment of Soiling Losses and Mitigation Strategies for Solar Power Generation," Joule, 3 (2019).
22. EF Fernández*, D Chemisana, **L Micheli**, F Almonacid, "Spectral nature of soiling and its impact on multi-junction based concentrator systems," Sol. Energy Mater. Sol. Cells, 201 (2019).
23. **L Micheli***, EF Fernandez, JA Caballero, GP Smestad, G Nofuentes, TK Mallick, et al., "Waveband investigation on the impact of soiling on various photovoltaic technologies", Energy, 180 (2019).
24. A Einhorn, **L Micheli**, DC Miller, LJ Simpson, H Moutinho, B To, et al., "Evaluation of Soiling and Potential Mitigation Approaches on Photovoltaic Glass", IEEE J. Photovoltaics, 9 (2019).
25. **L Micheli***, MG Deceglie, M Muller, "Mapping Photovoltaic Soiling Using Spatial Interpolation Techniques", IEEE J. Photovoltaics, 27 (2019).
26. **L Micheli***, MG Deceglie, M Muller, "Predicting photovoltaic soiling losses using environmental parameters: An update," Prog. Photovoltaics Res. Appl., 27 (2019).
27. S Toth*, M Muller, DC Miller, H Moutinho, B To, **L Micheli**, et al., "Soiling and cleaning: Initial observations from 5-year photovoltaic glass coating durability study," Sol. Energy Mater. Sol. Cells., 185 (2018).
28. MG Deceglie*, **L Micheli**, M Muller, "Quantifying Soiling Loss Directly From PV Yield", IEEE Journal of Photovoltaics 8 (2018)

29. S Sharma*, L Micheli*, W Chang, AA Tahir, KS Reddy, TK Mallick*, "Nano-enhanced Phase Change Material for thermal management of BICPV", *Applied Energy*, 208 (2017)
30. L Micheli* and M Muller, "An Investigation of the Key Parameters for Predicting PV Soiling Losses", *Progress in Photovoltaics: Research and Applications* 25 (2017).
31. L Micheli*, EF Fernández, F Almonacid, TK Mallick, GS Smestad, "Performance, limits and economic perspectives for passive cooling of High Concentrator Photovoltaics", *Solar Energy Materials and Solar Cells*, 153 (2016).
32. L Micheli*, KS Reddy, TK Mallick, "Experimental comparison of micro-scaled plate-fins and pin-fins under natural convection", *Int. Comm. in Heat and Mass Transfer* 75 (2016).
33. L Micheli*, EF Fernández, N Sarmah, S Senthilarasu, KS Reddy, TK Mallick, "Small-Volume Fabrication of a 144-Cell Assembly for High-Concentrating Photovoltaic Receivers", *Journal of Solar Energy Engineering*, 138 (2016).
34. L Micheli*, KS Reddy, TK Mallick, "Plate Micro-Fins in Natural Convection: Experimental Study on Thermal Effectiveness and Mass Usage", *Applied Thermal Engineering*, 97 (2016).
35. L Micheli*, KS Reddy, TK Mallick, "General correlations among geometry, orientation and thermal performance of natural convective micro-finned heat sinks", *International Journal of Heat and Mass Transfer*, 91 (2015).
36. L Micheli*, S. Senthilarasu, KS Reddy, T K Mallick, "Applicability of silicon micro-finned heat sinks for 500x Concentrating Photovoltaics Systems", *J. of Materials Science*, 50 (2015).
37. L Micheli, N Sarmah, KS Reddy, X Luo, TK Mallick*, "Design, Development, and Analysis of a Densely Packed 500x Concentrating Photovoltaic Cell Assembly on Insulated Metal Substrate", *Int. Journal of Photoenergy* (2015).
38. L Micheli, N Sarmah, X Luo, KS Reddy, TK Mallick*, "Opportunities and challenges in micro- and nano- technologies for concentrating photovoltaic cooling: A review", *Renew. & Sust. Energy Rev.* 20 (2013).

BOOK SECTIONS

39. P Rodrigo, L Micheli, F Almonacid, "The High Concentrator Photovoltaic Module", In: *High Concentrator Photovoltaics: Fundamentals, Engineering and Power Plants*, Springer, 2015.

PATENTS

40. EF Fernández, M Muller, L Micheli, FM Almonacid, Methods and systems for determining soiling on various photovoltaic devices, Publication Number: WO/2019/195718

REPORTS

41. Among the primary authors of the "IEA PVPS Task 13, Subtask 2.4 Report" on soiling losses, *In preparation*.
42. L Micheli, D Ruth, M Deceglie, M Muller, "Time Series Analysis Of Photovoltaic Soiling Station Data: Version 1.0, August 2017", NREL Report (NREL/TP-5J00-69131), August 2017.
43. M Muller, M Deceglie, L Micheli, "Review of PV Soiling Models", Report produced for the US Department of Energy, April 2016.

RESOURCES

44. National Renewable Energy Laboratory, Photovoltaic modules soiling map, (2018). <https://www.nrel.gov/pv/soiling.html>.
45. National Renewable Energy Laboratory, PV_soiling: code for extracting soiling loss from PV plant data, (2018). https://github.com/NREL/pv_soiling

CONFERENCE COMMUNICATIONS

46. L Micheli, GP Smestad, JG Bessa, M Muller, EF Fernandez, F Almonacid, "Tracking Soiling Losses: Assessment, Uncertainty, and Challenges in Mapping" 2021 IEEE 48th Photovoltaic Specialists Conference (PVSC), Virtual Conference, 2021.
47. AF Solas, M Muller, J Morse, EF Fernandez, F Almonacid, L Micheli, "Calibration and Validation of DUSST sensor soiling measurement," 37th European Photovoltaic Solar Energy Conference And Exhibition (EU PVSEC), Virtual Conference, 2020.
48. L Micheli, M Muller, F Almonacid, EF Fernandez "Change Point Detection: An Opportunity to Improve PV Soiling Extraction," 2020 IEEE 47th Photovoltaic Specialists Conference (PVSC), Virtual Conference, 2020.
49. M Theristis, A Livera, L Micheli, B Jones, G Makrides, G Georghiou, J Stein, "Modeling nonlinear photovoltaic degradation rates," 2020 IEEE 47th Photovoltaic Specialists Conference (PVSC), Virtual Conference, 2020.
50. M Muller, J Morse, F Almonacid, EF Fernandez, L Micheli, "Indoor and Outdoor Test Results for "DUSST", a Low-Cost, Low-Maintenance PV Soiling Sensor," 2019 IEEE 46th Photovoltaic Specialists Conference (PVSC), Chicago, IL, USA, 2019.
51. J Montes-Romero, L Micheli et al., "Impact of soiling on the outdoor performance of CPV modules in Spain," 15th International Conference on Concentrator Photovoltaics (CPV-15), Fes, Morocco, 2019.
52. L Micheli, MG Deceglie "Predicting Future Soiling Losses Using Environmental Data", 35th Eur. Photovolt. Sol. Energy Conf. Exhib., Bruxelles, Belgium, 2018.
53. M Muller, J Morse, F Almonacid, E Fernandez, L Micheli, "Design and Indoor Validation of "DUSST": A Novel Low-Maintenance Soiling Station", 35th Eur. Photovolt. Sol. Energy Conf. Exhib., Bruxelles, Belgium, 2018.

54. M Gostein, K Passow, MG Deceglie, **L Micheli**, B Stueve, "*Local Variability in PV Soiling Rate*", 35th Eur. Photovolt. Sol. Energy Conf. Exhib., Bruxelles, Belgium, 2018.
55. **L Micheli**, MG Deceglie, M Muller, "*Map and regional analysis of photovoltaic soiling across the United States*", 7th World Conference on Photovoltaic Energy Conversion, WCPEC-7 (2018).
56. M Gostein, K Passow, MG Deceglie, **L Micheli**, B Stueve, "*Local Variability in PV Soiling Rate*", 7th World Conference on Photovoltaic Energy Conversion, WCPEC-7 (2018).
57. A Einhorn, **L Micheli**, D Miller, LJ Simpson, M Muller, S Toth, JJ John, A Kottantharayl, C Engtrakul, "*Optical microscopy study of soiling on PV glass: Evaluation of possible mitigation strategies*", 7th World Conference on Photovoltaic Energy Conversion, WCPEC-7 (2018).
58. **L Micheli**, EF Fernández, GP Smestad, H Alrashidi, N Sarmah, N Sellami, IAI Hassan, A Kasry, G Nofuentes, N Sood, B Pesala, S Senthilarasu, F Almonacid, KS Reddy, M Muller, TK Mallick, "*A unified global investigation on the spectral effects of soiling losses of PV glass substrates: preliminary results*", 2017 IEEE 44th Photovoltaic Specialist Conference, PVSC (2017).
59. **L Micheli**, D Ruth, M Muller, "*Seasonal trends of soiling on photovoltaic systems*", 2017 IEEE 44th Photovoltaic Specialist Conference, PVSC (2017).
60. M Muller, **L Micheli**, AA Martinez-Morales, "*A Method to Extract Soiling Loss Data From Soiling Stations with Imperfect Cleaning Schedules*", 2017 IEEE 44th Photovoltaic Specialist Conference, PVSC (2017).
61. M Deceglie, **L Micheli**, M Muller "*Quantifying Year-to-Year Variations in Solar Panel Soiling from PV Energy-Production Data*", 2017 IEEE 44th Photovoltaic Specialist Conference, PVSC (2017).
62. L Simpson, M Muller, M Deceglie, H Moutinho, C Jensen, CS Jiang, D Miller, **L Micheli**, M Al-Jassim, S Toth, "*NREL Efforts to Address Soiling on PV Modules*", 2017 IEEE 44th Photovoltaic Specialist Conference, PVSC (2017).
63. **L Micheli**, G Femia, M Liani, R Poli, Y Banin, G Lanzara, S Kurtz, "*Thermal Performance of Solergy's Cogen CPV System as Part of Smart Grid Application at Rome-Fiumicino International Airport*", CPV-13 (2017).
64. **Micheli**, M Muller, S Kurtz, "*Determining the effects of environment and atmospheric parameters on PV field performance*", 2016 IEEE 43rd Photovoltaic Specialist Conference, PVSC (2016).
65. **L Micheli***, KS Reddy, TK Mallick, "*Plate Micro-fins in Natural Convection: An Opportunity for Passive Concentrating Photovoltaic Cooling*", Energy Procedia, 82 (2015).
66. **L Micheli**, EF Fernández, F Almonacid, KS Reddy, TK Mallick, "*Optimization of the least-material approach for passive Ultra-High CPV cooling*", 2015 IEEE 42nd Photovoltaic Specialist Conference, PVSC (2015).
67. **L Micheli**, EF Fernández, F Almonacid, KS Reddy, TK Mallick, "*Enhancing ultra-high CPV passive cooling using least-material finned heat sinks*", AIP Conference Proceedings 1679, 130003 (2015).
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