DataSUN: DATA SCIENCES FOR SOLAR ENERGY



When: 14th to 18th of November

Where:

Chambéry (45° 34' 12" N, 5° 54' 42" E)

Le Grand Bornand – French Alps – (45° 56' 33" N, 6° 25' 33" E)

Description:

The DataSUN scientific school addresses **Data sciences and their applications to solar energy.** A massive deployment of the use of solar energy is inevitable in order to decarbonate the energy sector. This implies to multiply by 5 to 10 the actual capacity in coming years. This can only be achieved through a holistic planning of the deployment of the solar energy.

Solar energy is inherently very complex in terms of spatial and temporal scales and data, its generation, diffusion and analysis plays a crucial role.

Organized by



Contacts

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PROGRAM:

Date	Monday 14 Nov.	Tuesday 15	Wednesday 16	Thursday 17	Friday 18
Place	Le Bourget du Lac and Departure for Le Grand Bornand	Le Grand Bornand	Le Grand Bornand	Le Grand Bornand	Le Grand Bornand, Travel back to Chambery and Le Bourget du Lac
9h to 10h30	<u>Mathieu David</u> (PIMENT - UR) Solar energy forecasts and their value for the stakeholders of the energy sector	<u>Alexandre Benoit</u> (LISTIC - USMB) Explainable AI for Earth Observation	Roberto Castello (EPFL) Data-driven methods for a large-scale integration of photovoltaic technology in the built environment	<u>Robert Blaga</u> (West University of Timisoara) Modelling chains for solar resource assessment in the presence of aerosols	<u>Marion Perrin</u> (Oscaro-Power) Solar Digitization, a necessity for massification before and after installation. How data collection help optimize sizing, operating and sharing ?
10h30-11h	Break	Break	Break	Break	Break
11h-12h30	Leon Gaillard (Heliocity) Remote diagnostic analysis of solar photovoltaic installations Presentation Solar Academy/USMB/INES/CEA	<u>Evelina Trutnevyte</u> (UNIGE) Solar PV futures: from national to global levels	<u>Gilles Desthieux</u> (HES-SO hepia) Solar modelling tools for energy urban planning. Application to the solar cadaster of the Greater Geneva	Demba Diallo (Geeps - Univ. Paris Saclay) Contribution to Fault Diagnosis of PV modules: Analysis of I-V curves	<u>François Maréchal</u> (EPFL) The importance of systemic approach for the energy transition
12h30 to 14h	Lunch				
14h to 16h	Visit of INES and INCAS Platform	Poster session	Workshop 2	Activities	Ford and travel back to
16h to 16h30		Break	Break	End and trav Chambery's tr	Chambery's train station
16h30 to 18h30	Travel to Le Grand Bornand	Workshop 1	Workshop 3	Poster session	
18h to 19h	End of the day	End of the day	End of the day	Gala dinner	
Theme	Solar forcasting	Applied IA method	City and Territory Scale	Market prospective	Global scale

INVITED SPEAKERS



ALEXANDRE BENOIT Professor, Polytech Annecy-Chambéry – LISTIC Laboratory

Presentation:

Explainable AI for Earth Observation.

Abstract: Earth Observation (EO), as for other domains, is subject to impressive advances thanks to the availability of abundant data, modern AI methods and more specifically deep neural networks. However, most of the available EO data is generally unlabelled, generally illustrates very local context with specific orientation, climate and so on such that the generalization behaviours of machine learning models can be limited. In addition, the implication of model inference applied to EO may lead to costly decisions such as infrastructure design or modification or crop yield. Then automatic decisions should be justified or explained. However, in the era of deep learning-based models, opening those black boxes is a challenge in itself. In this talk, we will present a variety of activities related to EO and explainable AI at LISTIC Lab. A focus on contributions related to explainable Al relying on 3 complementary directions: black box explanation, explanation by model design and redescription mining. These contributions highlight the interest of explanation methods combinations in order to present more concise and focused explanation to the human experts.

Bio:

Alexandre Benoit received PhD degree in electronics and computer science from the University of Grenoble, INP in 2007 (France). Starting 2008, he has been an associate professor at Université Savoie Mont Blanc at LISTIC lab. In 2021, he reached a full professor position at LISTIC lab. His main research interest is related to image and time series understanding. He develops standard and deep learning approaches for a variety of application domains: remote sensing, multimedia and astrophysics. He develops specific approaches adapted to the sensor and data as well as visual perception models.



ROBERT BLAGA West University of Timisoara

Presentation:

Modelling chains for solar resource assessment in the presence of aerosols

Abstract:

The design and management of PV projects requires accurate knowledge of the available solar resource on both long time scales and in real-time. Assessment of the solar irradiance incident on oriented surfaces often implies the application of a chain of models, including parametric, decomposition and transposition models. The optimal combination of such models is generally site-specific. Control of error propagation through the modelling chain is a paramount aspect. Application and evaluation of such a modelling chain will be explored in this presentation.

Bio:

I have a PhD in the field of theoretical physics, on the topic of quantum fields on curved spacetimes, completed in 2016. After the PhD, I have slowly transitioned into the solar energy field. Between 2019 and 2022 I have been a Research Assistant, and now hold the position of Scientific Researcher, at the Faculty of Physics at the West University of Timisoara. I am active in the Solar Energy Research Group coordinated by prof. Marius Paulescu. Our work revolves around subjects of solar energy and photovoltaic power forecasting and estimation. In the first years working in the field I have focused on so-called empirical decomposition models for separating the

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Data Scientist, Swiss Data Science Center

Presentation:

Data-driven methods for a large scale integration of photovoltaic technology in the built environment

Abstract:

Solar photovoltaic (PV) generation is seeing tremendous growth and it is becoming a significant component of the energy mix in many countries. As per their nature, solar PV modules are typically installed on rooftops of homes and businesses, to allow a prompt consumption of the energy they generate. Not all these solar PV installations are accurately registered or logged in any form of central database. Also, the potential of this technology in generating electricity is often hard to quantify at the national scale. This lack of insight poses significant problems for many participants in the energy sector, from market and network operators to policy makers, manufacturers and installers. Aerial and satellite images and national building databases coupled with the state-of-the-art Machine Learning techniques can provide an accurate and scalable geolocation of solar PV installation as well as quantify their realistic potential in covering the national energy demand. This talk will review the most promising approaches and discuss the future opportunities to address the remaining gaps towards a more widespread uptake of solar PV and other renewable energy resources.

Bio:

Dr Roberto Castello holds an M.Sc. and a Ph.D. in Particle Physics from the University of Torino, Italy. He worked as Research Fellow for the Belgian National Fund for Scientific Research (FNRS) and later at the CERN Experimental Physics division as a Senior Research Fellow and Data Scientist. In 2018 he joined the Swiss Federal Institute of Technology in Lausanne (EPFL) as a Senior Scientist and group leader at the Solar Energy and Building Physics Laboratory to work on data mining and Machine Learning for the built environment and renewable energy. He has started and led multiple collaborations with academic and industrial partners in the energy domain. His main research interests focus on spatial-temporal modelling of renewable energy potential, energy consumption forecasting, anomaly detection, and computer vision techniques for an automated classification of the built environment. In 2021 Dr Castello joined the EPFL Swiss Data Science Center (SDSC) as a Principal Data Scientist with the mission of accompanying industries, NGOs and international organizations through their data science journey.



Presentation:

Solar energy forecasts and their value for the stakeholders of the energy sector

The recent large-scale increase in solar renewable energy has a direct impact on the management of the energy grids. Indeed, due to the variability and intermittency of the solar resource, anticipating the fluctuations of the power

generation of photovoltaics and thermal power plants is of major importance.

Therefore knowing the resource availability for the next few hours and days

becomes essential. In this presentation, the main techniques used to forecast

Abstract:

MATHIEU DAVID Associate Professor at Université de La Réunion

DataSUN Thematic School, 14-18 of November, Chambéry and Le Grand Bornand

the solar irradiance and hence the output of solar systems will first be presented. Then, a focus will be done on the evaluation of the quality of deterministic and probabilistic forecasts. Finally, added value for users of solar forecast will be analysed for several case studies.
Bio: Mathieu DAVID (44 years old) is associate professor since 2010. He is currently the head of the laboratory PIMENT of the University of La Reunion and senior lecturer at the Energy and Building dept. of the engineering school ESIROI. His main field of interest is energy meteorology. He is more specifically involved in research projects about low consumption buildings in tropical areas and about the integration of solar renewables in energy grids.

Presentation:



GILLES DESTHIEUX Associate Professor HES-SO/hepia Solar modelling tools for energy urban planning. Application to the solar cadaster of the Greater Geneva

Abstract:

The lecture will introduce GIS-based modelling tools to process solar irradiance in urban environment at large scale, on both building roofs and facades. The approach will be presented through several examples, from the regional level with the solar cadaster developed for the Greater Geneva and its Web interface, to the local level with the use of the solar cadaster as support for feasibility analysis of solar installations. The presentation will rise the issues about the access to reliable data and their update among others.

Bio:

Gilles Desthieux is an associate professor at the Geneva Institute of Landscape, Engineering and Architecture (HES-hepia) and a consultant in urban energy planning in the company Amstein+Walthert Genève. He holds an MA in environmental engineering and sciences and a PhD from the Swiss Federal Institute of Technology Lausanne (EPFL). His recent and current research & consultancy activities deal with integrated urban and energy planning at district and municipal levels, development of GIS tools for energy mapping and planning, 3D urban modeling for environmental assessment – solar energy (application to the solar cadaster in Geneva) and flood risks, platforms for eco-neighbourhood development support, collaborative urban planning support based on geographical indicator systems.



DEMBA DIALLO Professor at Université Paris Saclay – GEEPS laboratory

Presentation:

Contribution to Fault Diagnosis of PV modules: Analysis of I-V curves

Abstract:

With the rapid development of the PV industry and the increase in installed capacity, efficient operation and maintenance strategies are increasingly necessary. Environmental conditions, manufacturing, transportation, installation or poor operating conditions can cause cell, module or string failures. These faults are responsible for the degradation of production and profitability of PV plants. Their performance must be monitored to ensure photovoltaic installations' reliability, availability and safety. This presentation will focus on PV module fault detection and diagnosis methodologies based on the use of partial or full I-V curves.

Bio:

Demba Diallo (M'99–SM'05) received the M.Sc. and Ph.D. degrees in Electrical and Computer Engineering, from the National Polytechnic Institute of Grenoble, France, in 1990 and 1993, respectively. He is currently Full

Professor of Electrical Engineering at Universite Paris-Saclay. He is member of the Group of Electrical Engineering of Paris, France. He is director of the French National Research Network on Electrical Engineering (GDR SEEDS). His current area of research includes fault diagnosis, fault-tolerant control and energy management. The applications are related to more electrified transportation systems (EV and HEV) and microgrids with renewable
Professor Diallo was a laureate of the 1000 Talent Program of Shanghai Province, Shanghai Maritime University, from 2018 to 2021. Prof. Diallo has served as Editor for the IEEE Transactions on Vehicular Technology from 2007 to 2019. Demba.Diallo@universite-paris-saclay.fr



LEON GAILLARD CTO cofounder at HELIOCITY

Presentation:

Remote diagnostic analysis of solar photovoltaic installations

Abstract:

The widespread and accelerating adopion of solar photovoltaic technologies in the built environment in many regions of the world forms an integral part of the transition towards decentralised, cleaner forms of energy generation. In order to attain their potential, all solar installations must be adequately serviced and maintained, with a timely identification and replacement of faulty components throughout their operational lifetime. This requirement proves to be quite a challenge, especially for smaller installations in the built environment where performance losses are hard to detect, and onsite inspections may be prohibitively expensive. Consequently, the development of remote diagnostics has been identified as a means to overcome this compound problem. The aim of this presentation is to provide the audience with some core insights as to the nature of the problem of how to assess the performance of a solar photovoltaic installation using only remotely available data. Analysis tools developed by Heliocity will be used to demonstrate the effectiveness of the approach and to illustrate the valuable information that can be inferred and reported to owners and operators of photovoltaic systems.

Bio:

Leon is CTO and co-founder of Heliocity, a solar analytics company based in Grenoble, France. He has over 10 years experience of academic and industrial research in the field of solar energy and building physics, specialising in performance evaluation methods for photovoltaic installations in the built environment. He has worked as a research engineer on experimental and numerical topics at INES (French National Solar Energy Institute) and regional laboratories. Leon holds a PhD in Physics from Birmingham University, UK.



Presentation:

The importance of systemic approach for the energy transition

Bio:

Ph D. in engineering Chemical process engineer Researcher and lecturer in the field of computer aided process and energy systems engineering. Lecturer in the mechanical engineering, electrical engineering and environmental sciences engineering in EPFL. I'm responsible for the Minor in Energy of EPFL and I'm involved in 3 projects of the Competence Center in Energy and Mobility (2nd generation biofuel, Wood SOFC, and gas turbine

FRANÇOIS MARECHAL	development with CO2 mitigation) in which i'm contributing to the energy conversion
MARECHAL Professor at EPFL	conversion My present R&D work concerns the application of multi-objective optimisation strategies in the design of processes and integrated energy conversion systems. Since 2001, I'm working in the Industrial Energy Systems Laboratory (LENI) of Ecole Polytechnique fédérale de Lausanne (EPFL) where I'm leading the R&D activities in the field of Computer Aided Analysis and Design of Industrial Energy Systems with a major focus on sustainable energy conversion system development using thermo-economic optimisation methodologies. A part from the application and the development of process integration techniques, that remains my major field of expertise, the applications concern : Rational use of water and energy in Industrial processes and industrial production sites: projects with NESTLE, EDF, VEOLIA and Borregaard (pulp and paper). Energy conversion and process design : biofuels from waste biomass (with GASNAT, EGO and PSI), water dessalination and waste water treatment plant (VEOLIA), power plant design (ALSTOM), Energy conversion from geothermal sources (BFE). Integrated energy systems in urban areas : together with SCANE and SIG (GE) and IEA annexe 42 for micro-cogeneration systems.
	I as well contributed to the definition of the 2000 Watt society and to studies concerning the emergence of green technologies on the market in the frame
	of the Alliance for Global Sustainability.

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	Presentation: Solar Digitization, a necessity for massification before and after installation. How data collection help optimise sizing, operating and sharing.
MARION PERRIN Scientific Director of OSCARO-POWER	Bio: Marion carried out her study in physics and chemistry of matter at the University Nancy, followed by a PhD in electrochemistry made in Germany at ZSW. The PhD dealt with the improvement of lead acid batteries. She then worked for 16 years with CEA from 2002 to 2018, including the participation to the creation of INES, the french national research institute for solar technologies in 2005 where she first lead a storage research lab and later a 80 people reasearch group on Intelligent Electrical Systems in order to maximise penetration of renewables in small and large electrical systems.
	In 2018, she joined Pierre-Noel LUIGGI, a French serial entrepreneur, for creating of Oscaro-Power, an empowerment company. Oscaro-Power aims at becoming the european leader of housing with self-installed solar photovoltaics as main energy source. She acts now as a scientific director of Oscaro-Power.



Professor at the University of Geneva, Head of the Renewable Energy Systems group	Evelina Trutnevyte is an associate professor and head of the Renewable Energy Systems group at the University of Geneva. Evelina is an energy systems analyst and modeler, specializing in renewable energy, long-range energy projections, socio-technical analysis, and decision making under deep uncertainty and at science-society interface. She is an engineer by training and has completed her PhD studies at ETH Zurich, Chair of Natural and Social Science Interface. She brings experiences from three different departments of ETH Zurich as well as University College London Energy Institute, Carnegie Mellon University, Aalborg University, and Vilnius Gediminas Technical University.
	In addition to an extensive list of peer-reviewed journal publications, she has received two of the most prestigious and competitive Swiss National Science Foundation grants: Eccellenza for tenure-track professors (2021 – 2025) and Ambizione Energy (2015 – 2018). As principal investigator, she has led projects for over 6.4 million Swiss francs (6.4 million euros) from a diverse range of sources, including Swiss National Science Foundation, Swiss Federal Office of Energy, European Horizon grants, and industrial funding. In 2021-2027, she co-leads the national SWEET-EDGE consortium "Enabling decentralized renewable generation in the Swiss cities, midlands, and the Alps" with 16 research groups, 60 practice partners, and the overall budget of 22.3 mln CHF.
	Evelina is a member of the extended energy commission of the Swiss Academies of Arts and Sciences. She is an associate editor of <i>Renewable and</i> <i>Sustainable Energy Transition</i> , an assistant deputy editor of <i>Climatic</i> <i>Change</i> (IF=3.5), and a member of the editorial board of <i>Environmental</i> <i>Modelling & Software</i> (IF=4.5). She acts as a reviewer for many journals, including <i>Proceedings of the National Academy of Sciences of the United</i> <i>States</i> (PNAS), <i>Nature Climate Change, Nature Energy, Nature</i> <i>Sustainability, Joule</i> , or <i>Applied Energy</i> , as well as for several funding mechanisms, like European Research Council Starting Grant, Swiss National Science Foundation, Netherlands Organization for Scientific Research, and others.