Title	**Numerical investigation on the impact of massive deployment of urban PV systems, on the local microclimate.**
Student level	M2 research
Starting date Duration	February 2023 5 to 6 months
City, Country	CEREMA Nantes or LOCIE in Le Bourget du Lac
Laboratories	LOCIE - Laboratoire prOCédés énergIe bâtimEnt *https://www.univ-smb.fr/locie/* DTerOuest/DTT/BPE Centre d'études et d'Expertise sur les Risques, l'Environnement, la Mobilité et l'Aménagement
Internship description	The use of solar energy in urban environment is considerably spreading. In this context, it is crucial to model the solar irradiance in cities, which are characterized by complex built environments and related complex urban phenomena such as overshading effects and solar mutual inter-buildings and ground reflections. Indeed, the knowledge of the solar irradiance is important for passive and active uses of solar energy. The uses of façades, in addition to the roofs, become an attractive solution to deploy more PV systems. The total capacity installed in urban areas is expected to skyrocket in coming years. This will change the radiation properties on façades and may induce change in the urban microclimate, but to which extent? This remains an open question (See refs). The goal of this internship will be to assess the impact of a massive urban installation of PV system, on the local microclimate. To that aim, a microclimate tool (SOLENE Microclimate) will be used. The Solene-Microclimat model has been developed to investigate the consequences of urban context on local microclimate and indoor thermal conditions. It is dedicated to modeling urban microclimate and building thermal behavior at the district scale. The district's geometry can be discretized with triangular meshes making it possible to get a simulation close the 3D realistic urban form. As a first step, the candidate will redact a short literature review on the impact of PV systems on the urban microclimate and on the numerical modelling of the energy balance of a PV system in urban microclimate tool. Then the second step will consist is implementing the PV system model in the SOLENE microclimate tool and to validate it. In the third step the candidate will run different simulations for different scenario (from low level of PV penetration to high level). Analysis of the results and conclusion on the obtained results will end this work. For this work 6 month are preferred.
Candidate	The candidate should have a taste for numerical modelling as well as thermal heat transfer, and energy balances approaches.
Traineeship grant	Legal internship gratification (~575 €/month)

Supervisors	Auline Rodler (CEREMA)	Martin Thebault (CNRS)

Deadline	Send CV + Cover Letter to martin.thebault@cnrs.fr or auline.rodler@cerema.fr before the 15th of November

References	Boccalatte, A., Fossa, M., & Ménézo, C. (2020). Best arrangement of BIPV surfaces for future NZEB districts while considering urban heat island effects and the reduction of reflected radiation from solar façades. Renewable Energy, 160, 686-697. Sailor, D. J., Anand, J., & King, R. R. (2021). Photovoltaics in the built environment: A critical review. Energy and Buildings, 253, 111479. Hu, A., Levis, S., Meehl, G. A., Han, W., Washington, W. M., Oleson, K. W., ... & Strand, W. G. (2016). Impact of solar panels on global climate. Nature climate change, 6(3), 290-294.