EGU26-20780, updated on 13 Jun 2026
https://doi.org/10.5194/egusphere-egu26-20780
EGU General Assembly 2026

Urban influences on cloud patterns over Europe from satellite observations

Herminia Torelló-Sentelles[1] and Angela Meyer[1,2]
[1]School of Engineering and Computer Science, Bern University of Applied Sciences, Biel, Switzerland (herminia.torelloisentelles@bfh.ch)
[2]Department of Geoscience and Remote Sensing, Delft University of Technology, Delft, The Netherlands

As urbanization accelerates worldwide, understanding how urban areas influence cloud patterns is increasingly important because clouds directly affect local climate and related impacts, including heat stress, precipitation patterns, solar energy resources, and air quality. While urban impacts on temperature, humidity, and rainfall have been widely studied, urban effects on clouds remain comparatively less explored. Existing evidence suggests that cities often act to enhance cloud cover; however, less is known about urban effects on other cloud properties or how these effects vary across different cloud types and background atmospheric conditions. Here, we investigate how urbanization modifies cloud patterns across Europe using high-resolution satellite observations from 2002 to 2025. We use Moderate Resolution Imaging Spectroradiometer (MODIS) Level-2 products at ~1 km spatial resolution (nadir) from the Terra and Aqua satellites, with approximately four daily overpasses (~10:30 a.m./p.m. and ~1:30 a.m./p.m.). Cloud cover fractions are compared between urban areas and their adjacent rural surroundings. Urban–rural differences in cloud cover are evaluated as a function of season, time of day, and cloud type. Cloud types are classified using MODIS-derived cloud-top properties, following the International Satellite Cloud Climatology Project (ISCCP) framework. Finally, we relate urban cloud modification effects to background atmospheric conditions, as well as to urban characteristics such as urban form, regional climate, topography, and proximity to the coast. Overall, our results indicate a general enhancement of cloud cover over urban areas relative to their rural surroundings, with the strongest differences occurring at night and during summer. The urban influence is most pronounced for low-level clouds. We discuss potential drivers of these patterns, including atmospheric stability, moisture availability and urban characteristics, and highlight potential implications for urban radiative forcing and urban heat islands. This research is part of the UrbanAIR project under the Horizon Europe research and innovation programme.