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# Identifying land cover suitability factors for photovoltaic installations with focus on cropland and urban areas

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Solar photovoltaic (PV) systems will foreseeably be an integral part of future energy systems. Land cover area analysis has a large influence on estimatiin of long-term solar photovoltaic potential of the world in high spatial detail. In this regard, it is often seen in contemporary works, that the suitability of various land cover categories for PV installation is considered in a yes/no binary response. While some areas like natural parks, sanctuaries, forests are usually completely exempted from PV potential calculations, other land over categories like urban settlements, bare, sparsely vegetated areas, and even cropland can principally support PV installations to varying degrees. This depends on the specific land use competition, social, economic and climatic conditions, etc. In this study, we attempt to evaluate these 'factors of suitability' of different land cover types for PV installations.

As a basis, the openly available global land cover datasets from the Copernicus Land Monitoring Service were used to identify major land cover types like cropland, shrubland, bare, wetlands, urban settlements, forests, moss and snow etc. For open area PV installations, with a focus on cropland, we incorporated the promising technology of 'Agri-voltaics' in our investigation. Different crops have shown to respond positively or negatively, so far, to growing under PV panels according to various experimental and commercial sources. Hence, we considered 18 major crops of the world (covering 85% of world cropland) individually and consequently, evaluated a weighted overall suitability factor of cropland cover for PV, for three acceptance scenarios of future.

For rooftop PV installations in urban areas, various socio-economic and geographical influences come in play. The rooftop area available and further usable for PV depends on housing patterns (roof type, housing density) which vary with climate, population density and socio-economic lifestyle. We classified global urban areas into several clusters based on combinations of these factors. For each cluster, rooftop area suitability is evaluated at a representative location using the land cover maps, the Open Street Map and specific characteristics of the cluster.

Overall, we present an interdisciplinary approach to integrate technological, social and economic aspects in land cover analysis to estimate PV potentials. While the intricacies may still be insufficient for planning small localized energy systems, this can reasonably benefit energy system modelling from a regional to international scale.