Modeling Solar Albedo in Desert Environments and Implications for the Surface Energy Balance

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Abstract:

The German Space Agency (ASA) has demonstrated, through satellite imagery, that Algeria possesses the highest solar energy flux potential in the entire Mediterranean basin, with 169,000 TWh/year for thermal solar power and 13.9 TWh/year for photovoltaic solar power. Southern Algeria ranks among the sunniest regions in the world, with an energy intensity exceeding 6,000 kWh/m²/day and an annual sunshine duration of approximately 3,500 hours. Indeed, the optimal exploitation of this solar resource would likely be sufficient to meet the entire global energy demand.

In this work, we experimentally highlight the significance of reflected solar flux (albedo) in these natural environments throughout the year, particularly on terrains covered with white, high-density materials. Additionally, we have modeled the albedo using a mathematical framework capable of predicting the energy flux as a function of incident solar flux, the reflectivity of the reflecting material, and the height of the measurement point. Consequently, it is strongly recommended to install photovoltaic plants in these natural settings, on grounds covered with dense, light-colored materials.