Global spatiotemporal solar resource availability

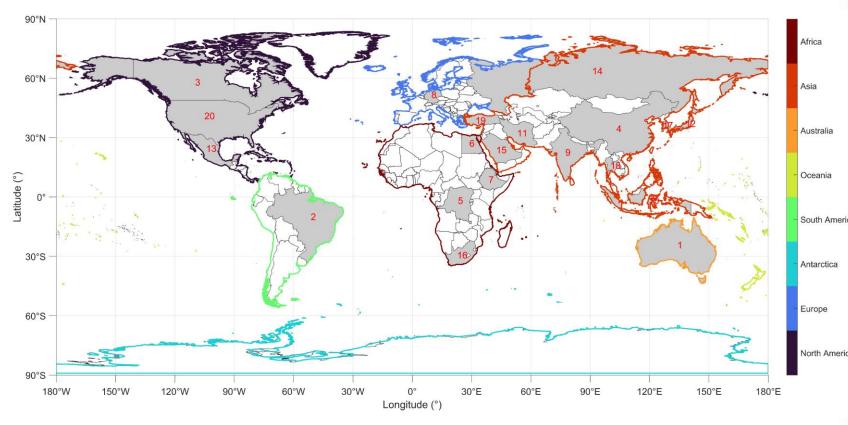
Sander L^{*}, Jung C, Schindler D Chair of Environmental Meteorology *leon.sander@meteo.uni-freiburg.de

Introduction

- Spatiotemporal solar resource availability forms the basis for an efficient use of solar energy
- Discrepancies between solar potential and solar energy expansion in many regions worldwide
- Satellite and reanalysis data provide gridded, long-term information with large spatial coverage

Methods

- Global analysis with focus on 20 selected countries
- Study period: 1979-2024
- Solar radiation and cloud cover (only satellite data)
- Reanalysis data: ERA5-Land
- Satellite data: CLARA-A3
- Daily values



Updates on ResearchGate

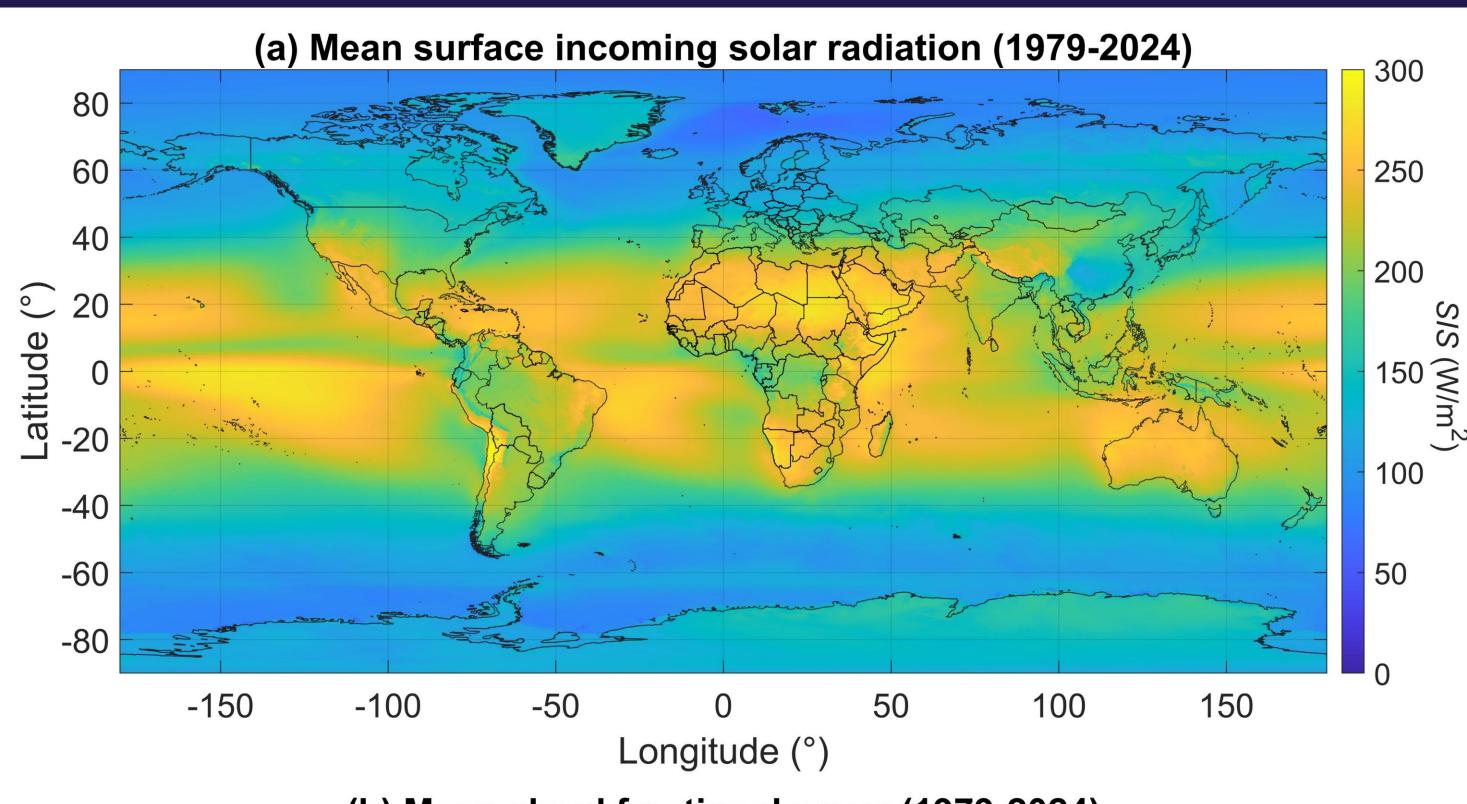


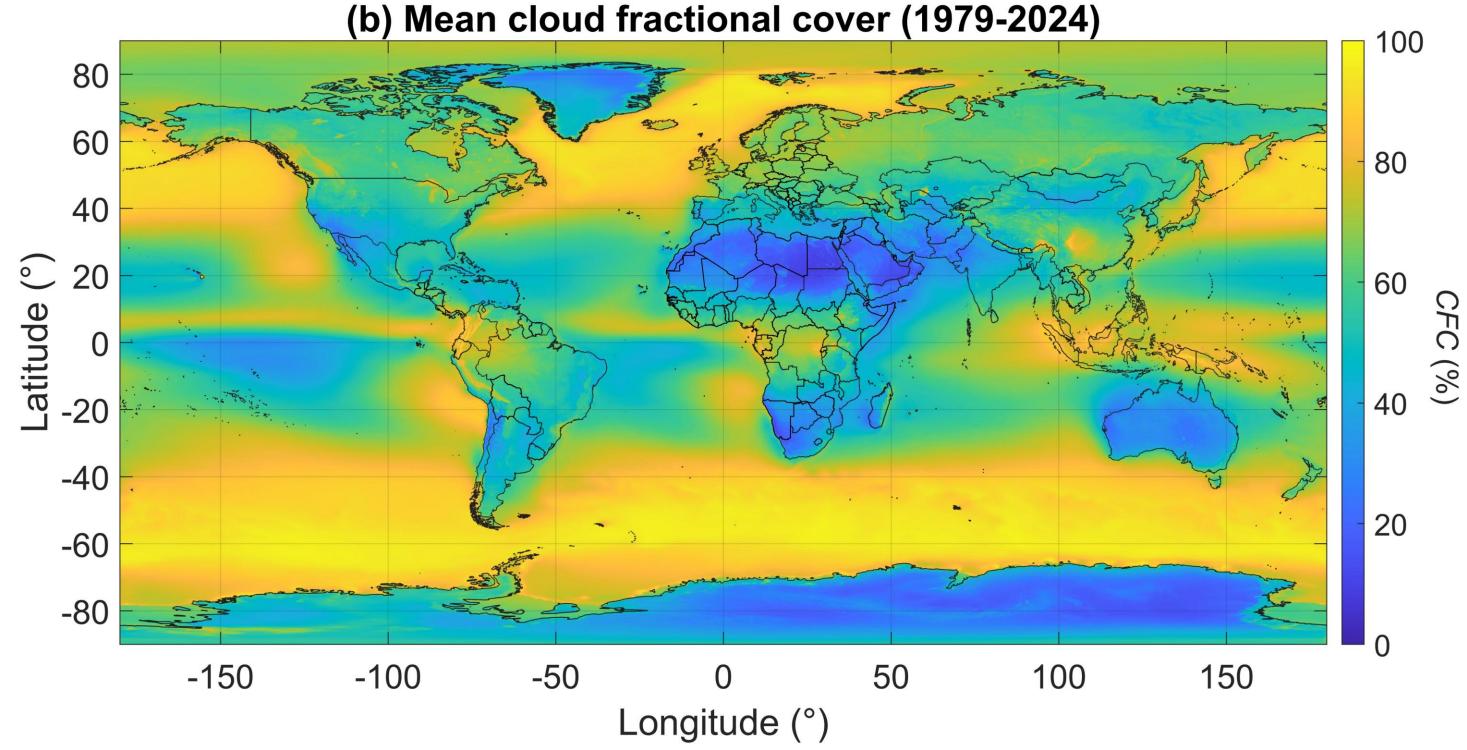


zee Zentrum für Erneuerbare Energien Centre for Renewable Energy

Study area.

High-potential areas for solar energy use should combine available land, high, consistent and predictable solar resource availability, and sufficient infrastructure.





Sander et al., 2025 (in preparation)



Download the poster



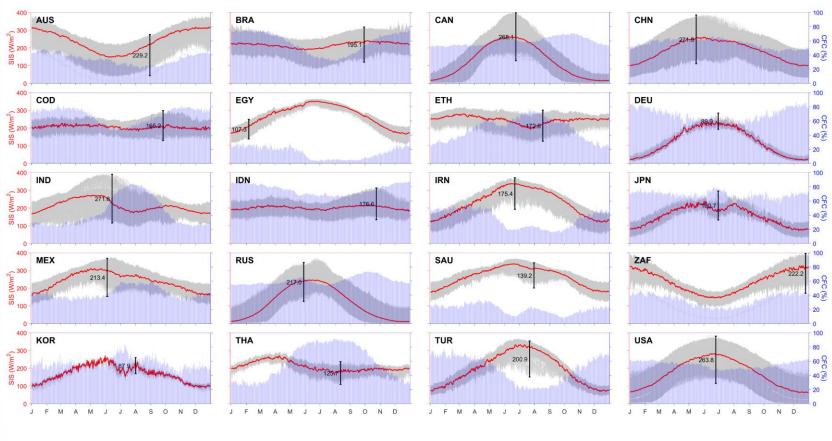
universitätfreiburg

Results and Discussion

- Spatially diverse patterns of the annual cycle, interannual variability and trends of surface solar radiation Spatial differences within a country vary over the course of a year Partly striking differences
- between satellite and reanalysis data
- Intra- and interannual variations of cloud cover at the country scale explain only in part the observed patterns of surface solar radiation
- Egypt and Saudi Arabia offer a high meteorological potential due to high solar resource availability, low cloud cover, weak intra- and inter-annual variations, and low regional disparities

Australia 270 Australia 280 CM SAF country mean ERASL country mean 230 CM SAF country mean		100 160 80 150 60 140 40 130 20 110	Canada	100 210 60 200 - 40 180 - 20 - 40 180 - 20 - 40 180 - 20 - 20 - 40 - 20 - 20 - 40 - 20 - 20 - 40 - 20 - 20 - 40 - 40 - 40 - 40 - 40 - 40 - 40 - 4	China 100
Congo DRC 220 220 220 5 200 190 100 100 200 2		100 270 80 260 60 250 40 240 20 230 0 220	Ethiopia	100 150 80 140 -60 130 -40 120 0 100	Germany 60 % 100 80 60 % 40 % 20 Japan 100 80 100 80 100 80 100 80 100 80 100 80 100 80 100 10
240 2 220 2 220 3 200 190 4 0 2 20 190 4 0 2 20 190 4 0 2 20 190 190 190 190 190 190 190 19	MANA	100 260 80 250 60 240 40 230 20 210 0	ran	100 180 170 - 60 170 - 40 150 - 20 140 - 30 - 130 - 40 - 100 - 20 - 140 - 30 - 130 	Japan 100 80 60 P 40 2 20 South Africa to
270 280 5 230 5 230 200 5 230 200 5 230 200 5 230 200 5 230 200 5 230 5 2 5 2 5 2 5 2 5 2 5 2 5 2 5 2 5 2 5 2	Marine	100 290 80 280 60 270 40 260 20 250 0		100 260 - 60 250 - 60 240 - 40 230 - 20 220 - 20 210 - 10 - 20 210 - 10 - 20 - 20 - 20 - 20 - 40 - 20 - 40 - 20 - 40 - 20 - 40 - 20 - 40 - 40 	Junited States
190 190 190 100 100 100 100 100	man have	100 80 220 60 200 40 190 20 180 0 170 1979 1985	MAAAA	100 200 80 190 -60 180 -40 170 -20 150 0 2024 1979 1985	100 100 100 100 100 100 100 100

Inter-annual variability of solar radiation and cloud cover.



Mean annual cycles of solar radiation and cloud cover.