Global spatiotemporal solar resource availability

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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
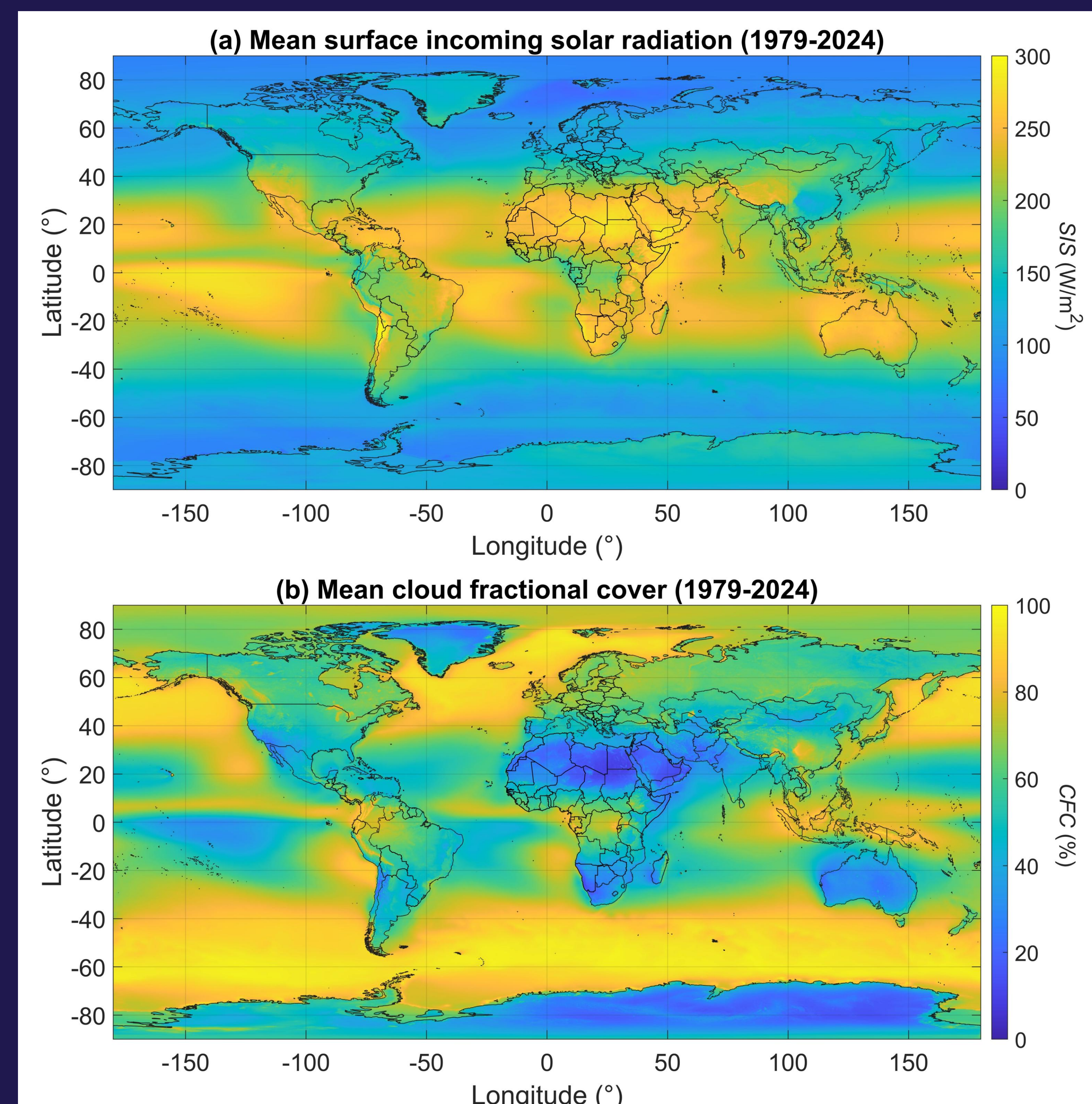
Methods

- 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
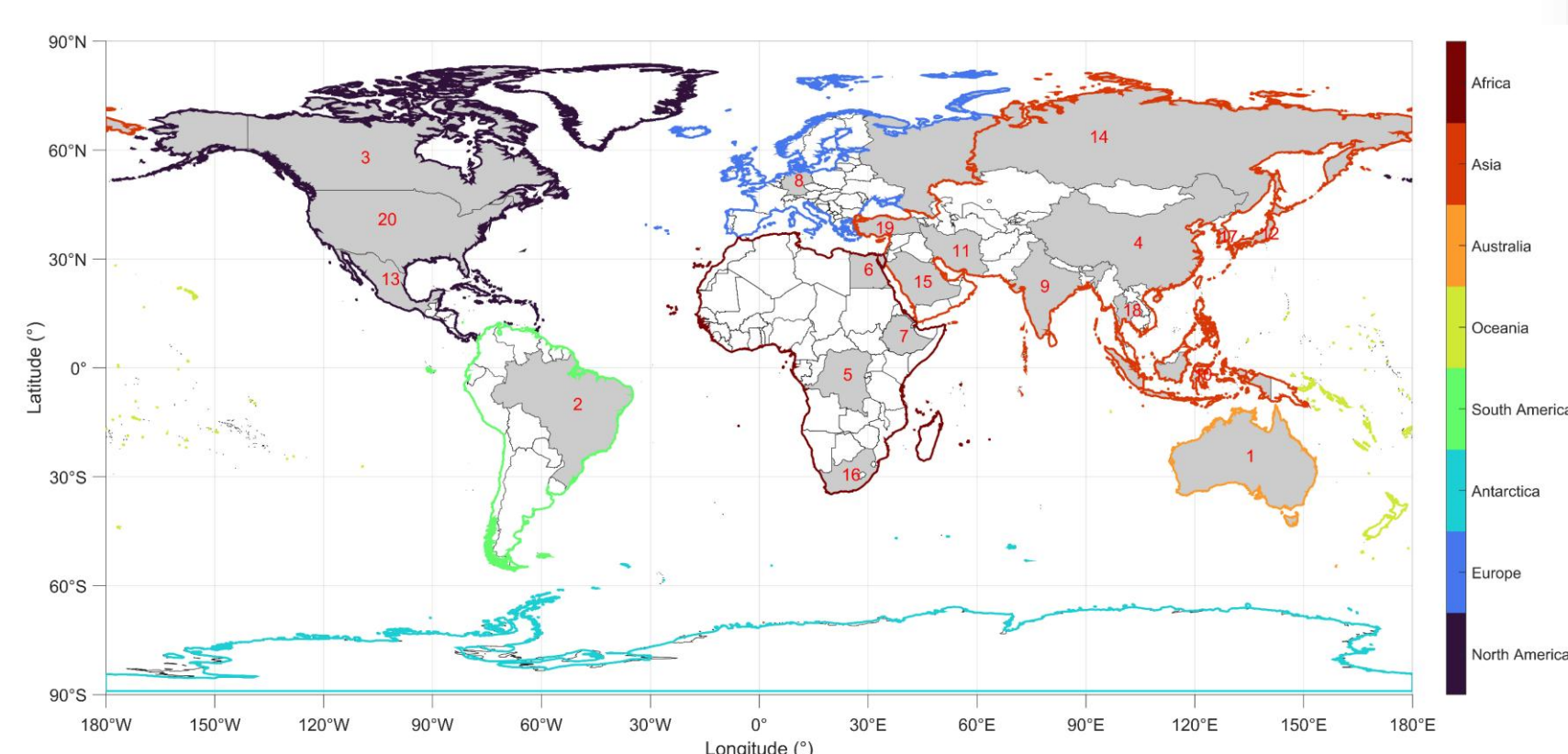
Study area.

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

(a) Mean surface incoming solar radiation (1979-2024)

(b) Mean cloud fractional cover (1979-2024)

Updates on ResearchGate

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Zentrum für Erneuerbare Energien
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Sander et al., 2025 (in preparation)

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Results and Discussion

- Spatially diverse patterns of the annual cycle, inter-annual 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
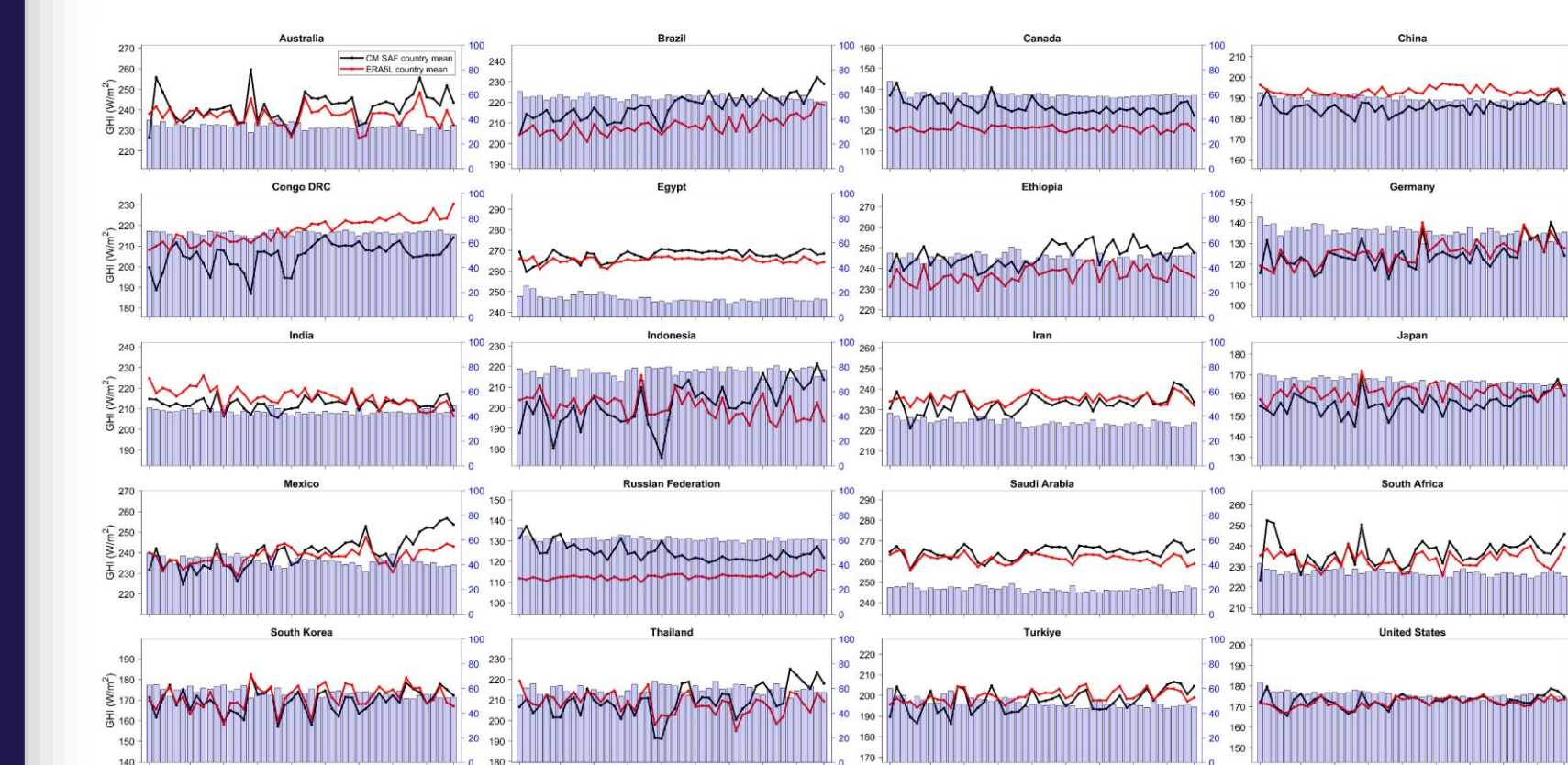
Inter-annual variability of solar radiation and cloud cover.
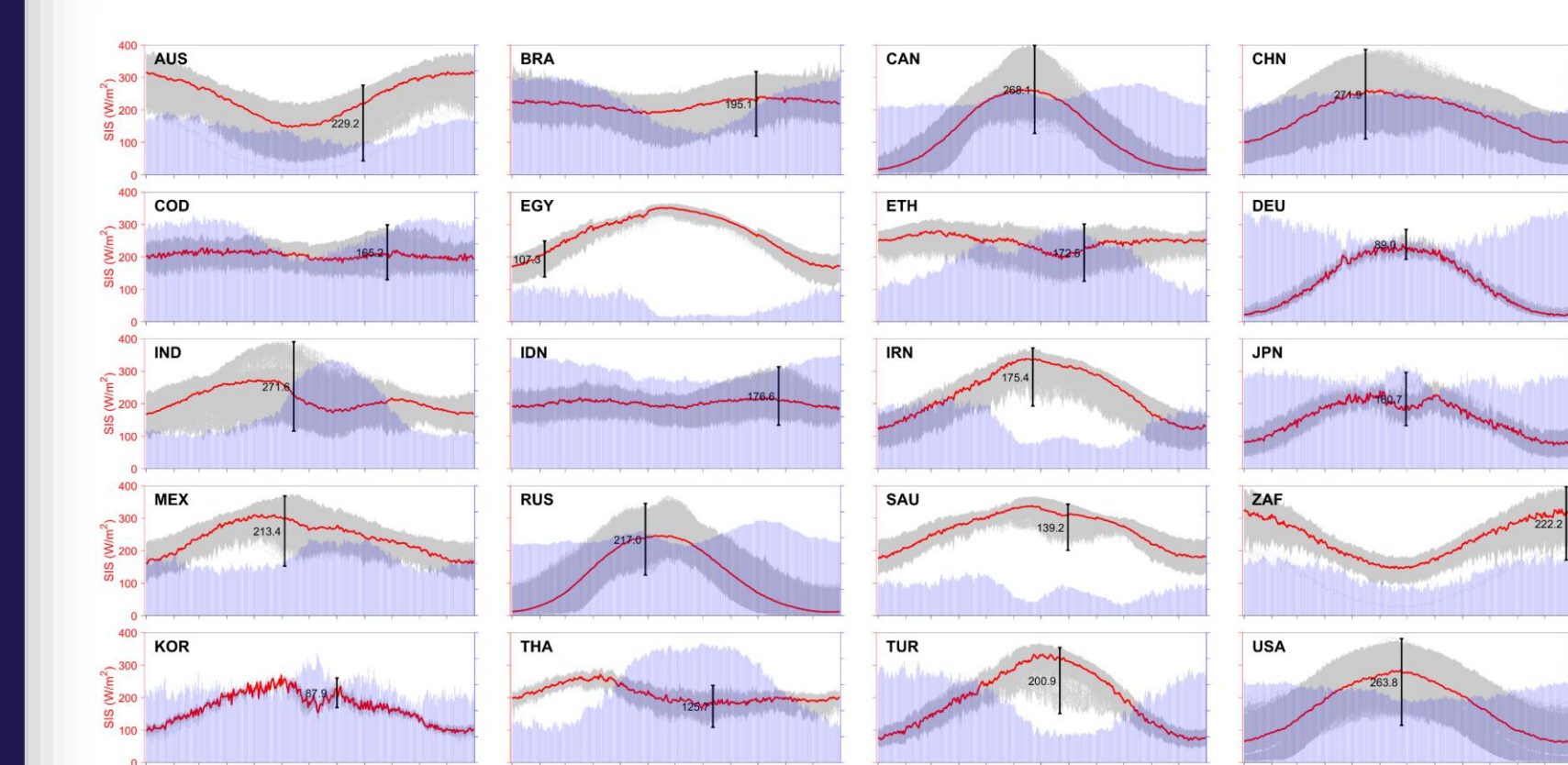
Mean annual cycles of solar radiation and cloud cover.