

Wind speed and global radiation from the regional reanalysis COSMO-REA6

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The regional reanalysis COSMO-REA6 provides data from 1995 onwards, covering the European CORDEX domain. Because of the high spatial and temporal resolution (about 6km and an hourly time step) the data set exhibits a great potential in the field of renewable energy applications. One aspect of the German joint research project “Network of Experts” within the Ministry of Transport and Digital Infrastructure is the investigation of energy production by solar and wind with a focus on the transportation infrastructure. Here we show how to use regional reanalysis data for this question. We will present estimations of data quality, concerning wind speed and global radiation. In order to highlight advantages and disadvantages of the COSMO-REA6 product we compare the reanalysis data with different data sources, including station observations from the German station network and satellite based data.

Data

Observations:

- Station observations for wind gusts and global radiation are taken from the German station network, <ftp://ftp-cdc.dwd.de/pub/CDC>

Reanalysis:

- COSMO-REA6 is available via <ftp://ftp-cdc.dwd.de/pub/REA>. More details at Bollmeyer et al., 2014.
- COSMO-REA6 provides 1-hourly variables for the CORDEX-EUR11 domain with 0.055° spatial resolution.
- Assimilated observations include conventional data like synop stations, ships, radiosondes, aircraft, but no remote sensing.

Satellite:

- Surface incoming shortwave radiation is taken from SARA-2 records, provided by EUMETSAT CMSAF. The product may be ordered via www.cmsaf.eu.
- Spatial resolution is about 0.05° and temporal resolution is 30 min.

Results – Wind gust

- The model bias of wind gusts is higher than for mean wind speed.
- The correlation shows no significant drop.
- For single test periods COSMO-REA6 shows good results in reproducing wind gusts for stormy time periods.
- At coastal stations the underestimation of frequency for high wind speeds is less pronounced, than for inland stations (Fig. 1).
- The seasonal variability shows significant reduced/increased values of correlation/MAE for the summer season (Fig. 2). Here the wind fields are often controlled by low scale convective situations, which can not be reproduced correctly by COSMO-REA6.

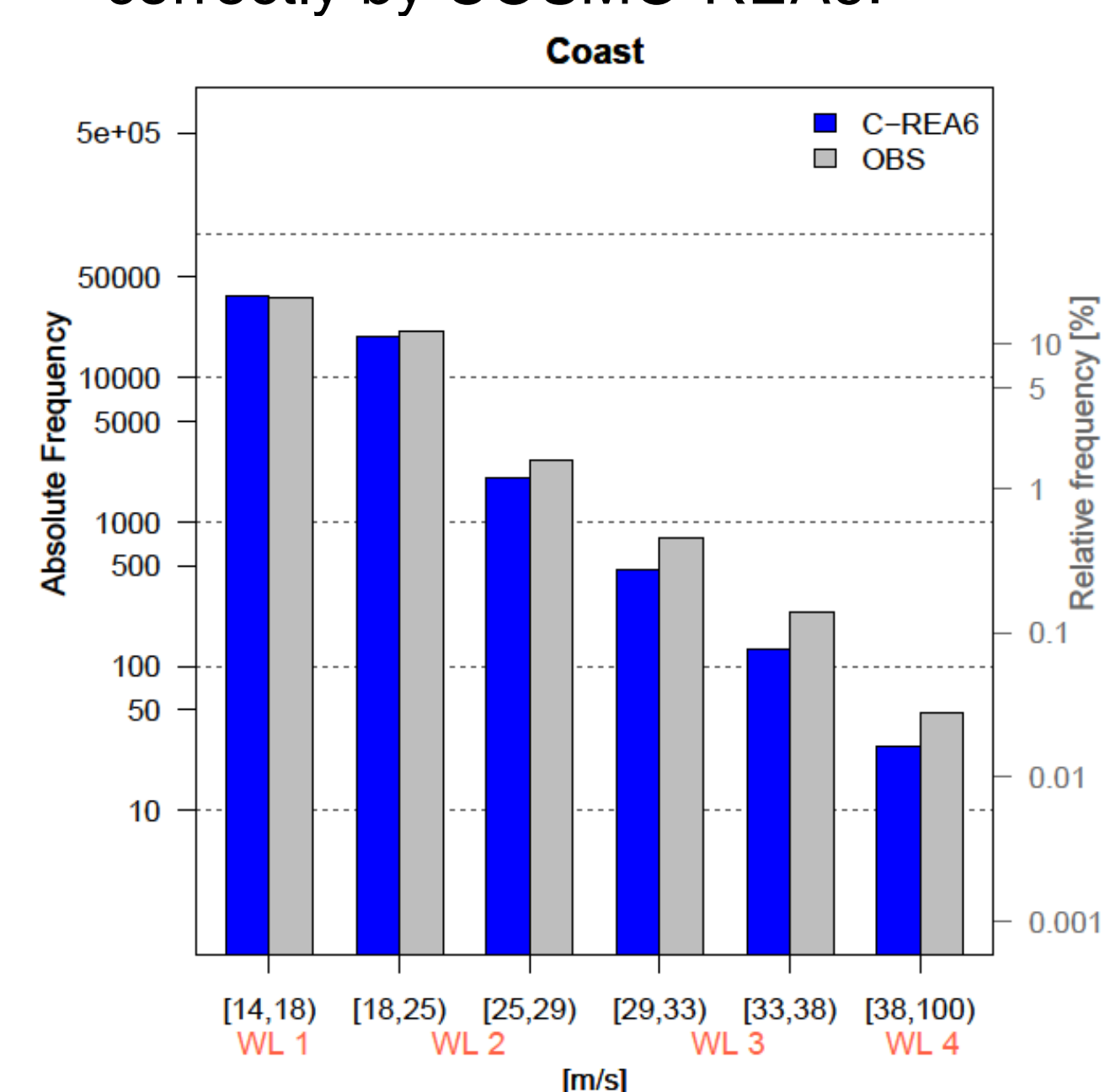


Fig. 1: Frequency of wind gusts for COSMO-REA6 and observations at stations near the coast for time period 1995-2015. The frequencies are computed for warning level (WL) 1-5.

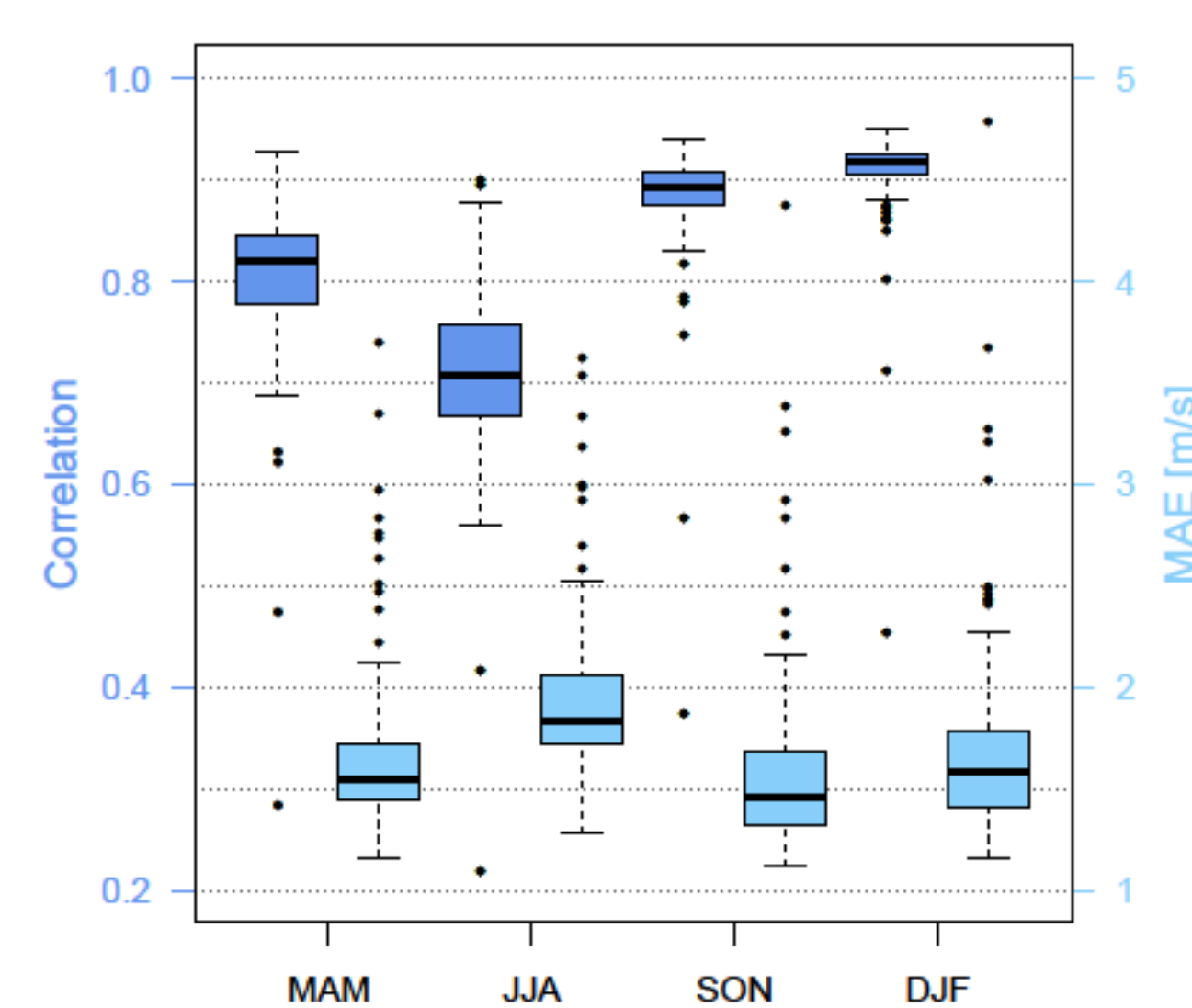


Fig. 2: Seasonal dependency of correlation and MAE for all station locations beneath 500m based on daily maximum values of wind gusts for COSMO-REA6 and station observation for time period 1995-2015.

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References

- (1) Bollmeyer et al. (2014): Towards a high-resolution regional reanalysis for the European CORDEX domain, Q.J.R. Meteorol. Soc., 2014, doi:10.1002/qj.2486
- (2) Frank et al. (2018): Bias correction of a novel European reanalysis data set for solar energy, Solar Energy, 2018, doi:10.1016/j.solener.2018.02.012

Results – Global radiation

- The accordance of COSMO-REA6 and SARA-2 for global radiation is shown at three selected stations: Lindenberg, Seehausen and Konstanz.
- For the evaluation period 2006-2010 SARA-2 shows slight advantage, concerning correlation, bias and mean absolute error (MAE).

Station	Corr. COSMO-REA6	Corr. SARA-2	Bias COSMO-REA6	Bias SARA-2	MAE COSMO-REA6	MAE SARA-2
Lindenberg	0.934	0.975	-8.593	1.29	34.733	26.393
Seehausen	0.93	0.97	-8.165	3.075	34.396	24.705
Konstanz	0.932	0.969	-2.799	4.719	37.353	28.573

- The mean daily cycle of COSMO-REA6 reveals an underestimation in the summer season (Fig. 3), caused by too high optical thickness of aerosols (Frank et al., 2018).

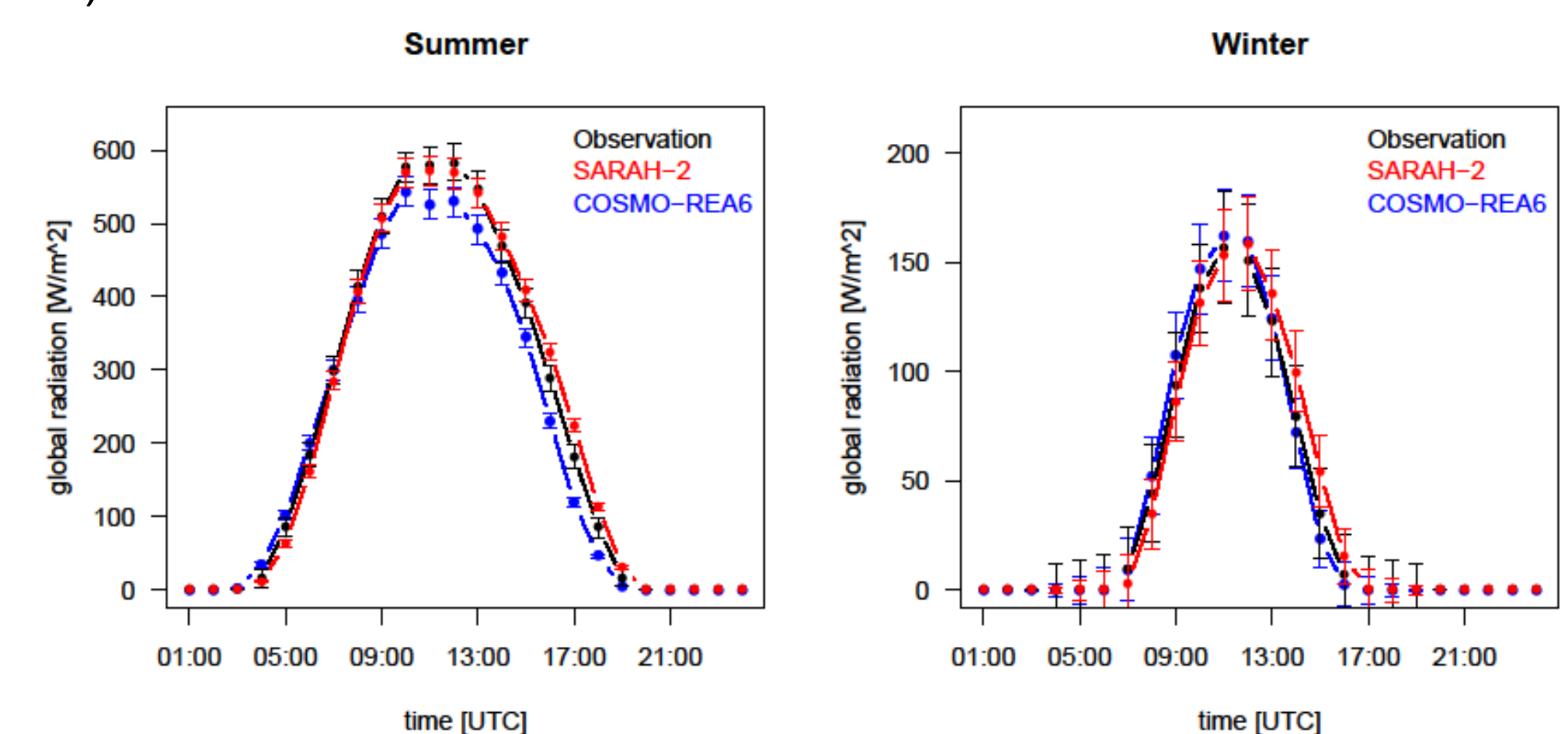


Fig. 3: Mean daily cycle of global radiation for COSMO-REA6, SARA-2 and observations at station Lindenberg near Berlin, averaged over summer (left) and winter (right) season from 2006-2010. Error bars mark the 95% confidence interval.

- The Jensen-Shannon divergence is used to measure the similarities between probability distributions of COSMO-REA6, SARA-2 and the observations.
- Higher discrepancies are reached for the summer month (Fig. 4).
- Variability of JS-divergence between months is higher than between the three data sets within one month.
- Increased JS-divergence during summer exist for station Konstanz and Seehausen as well.

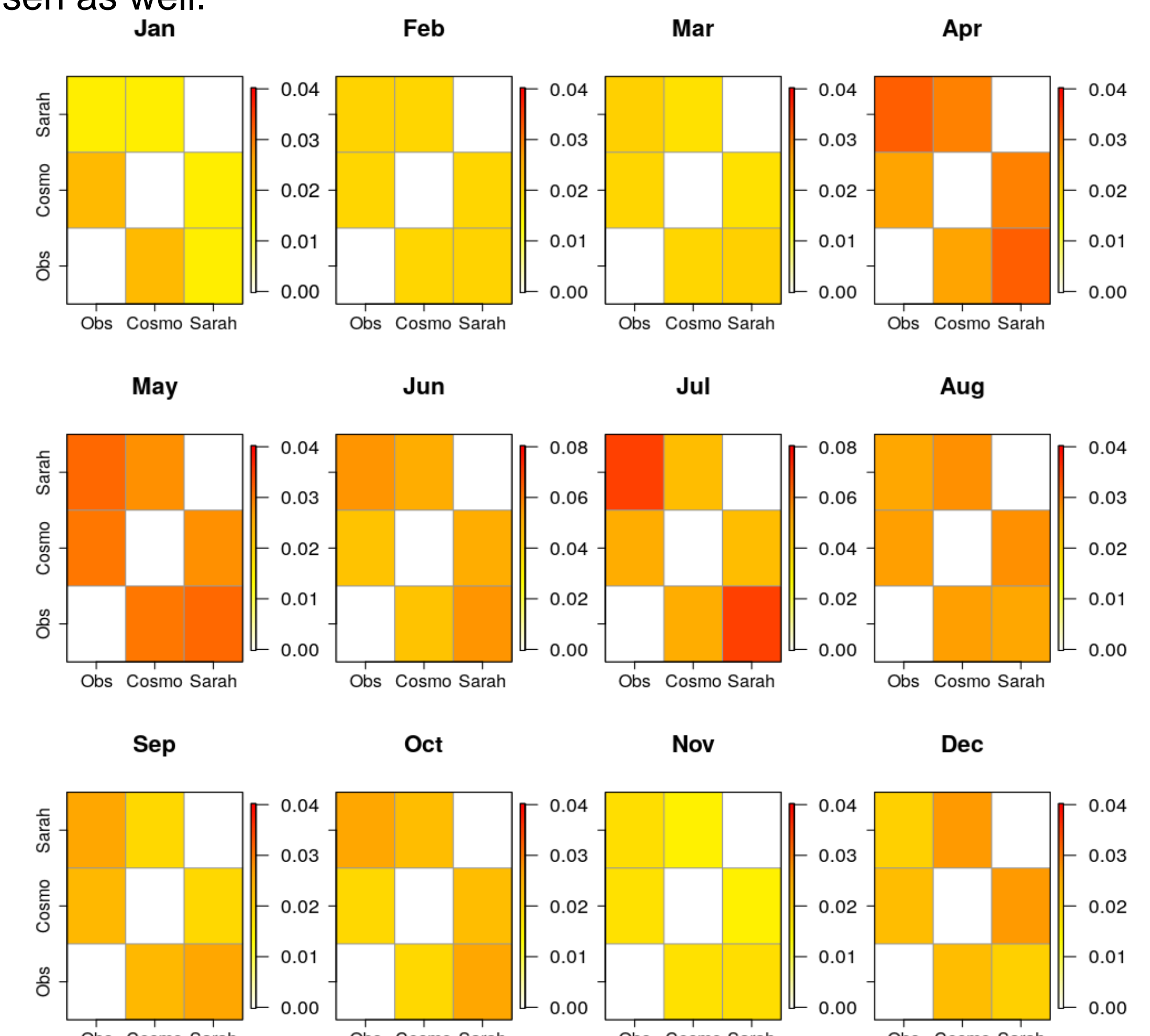


Fig. 4: Jensen Shannon divergence of station Lindenberg for every month, based on hourly global radiation from 2006-2010.

