

## Article

# Interdecadal Changes of the MERRA-2 Incoming Surface Solar Radiation (SSR) and Evaluation against GEBA & BSRN Stations

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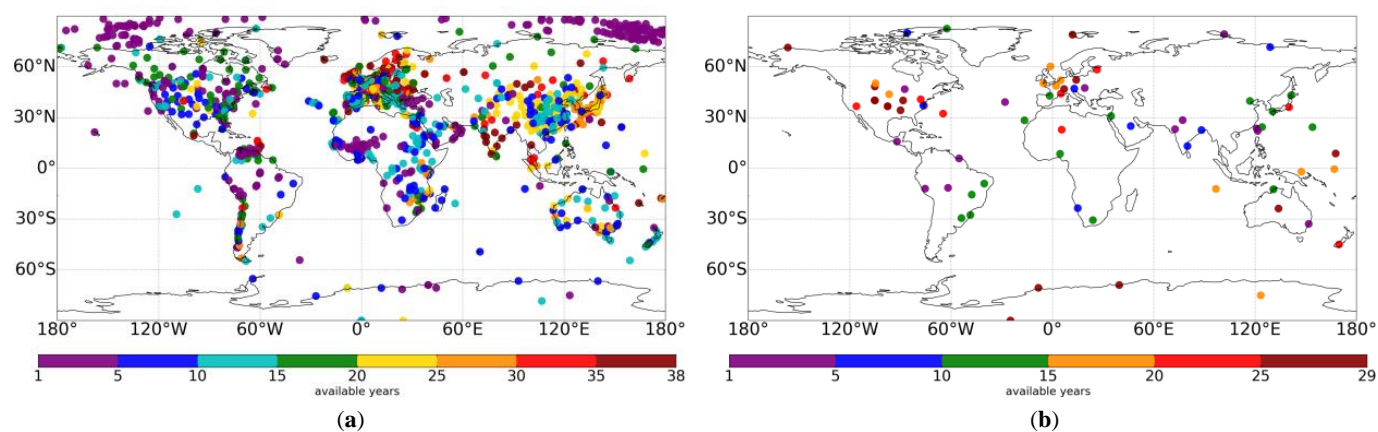
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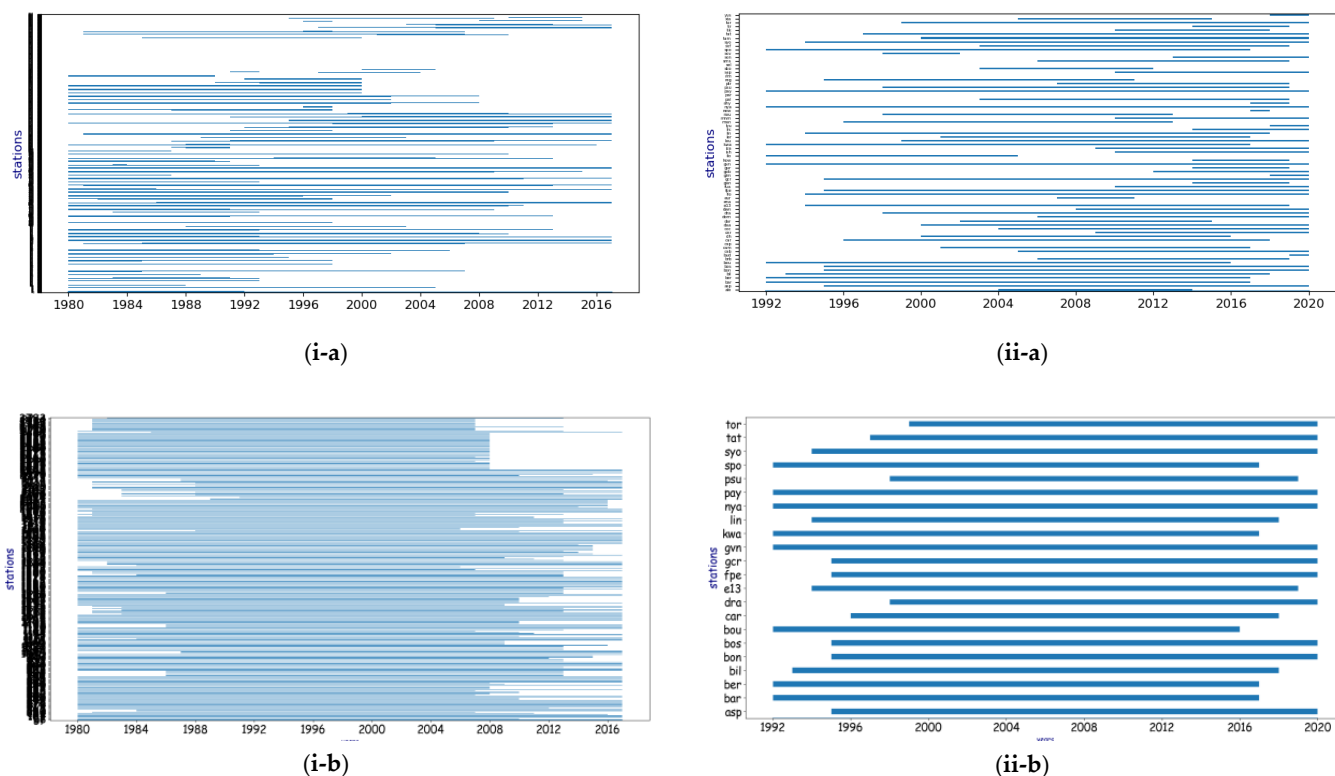
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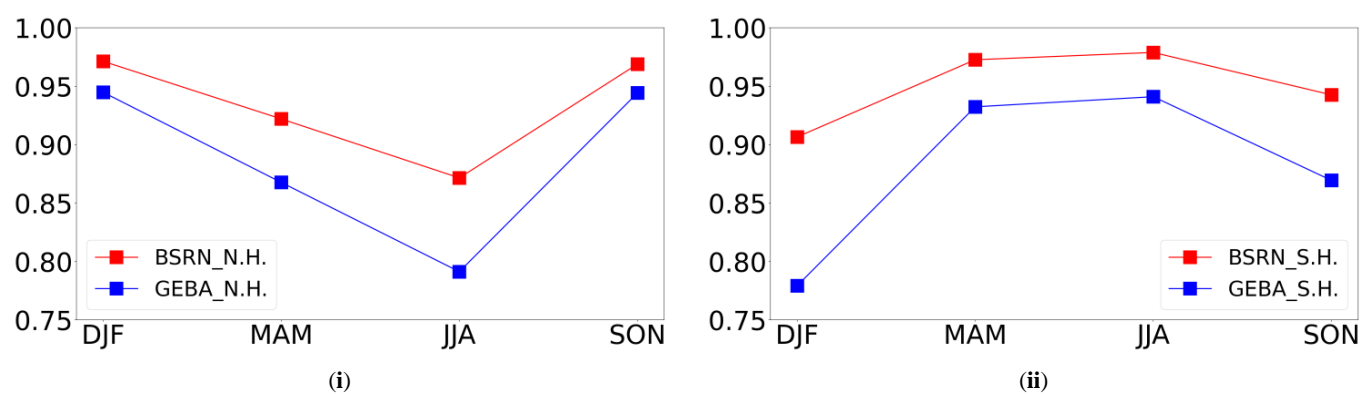
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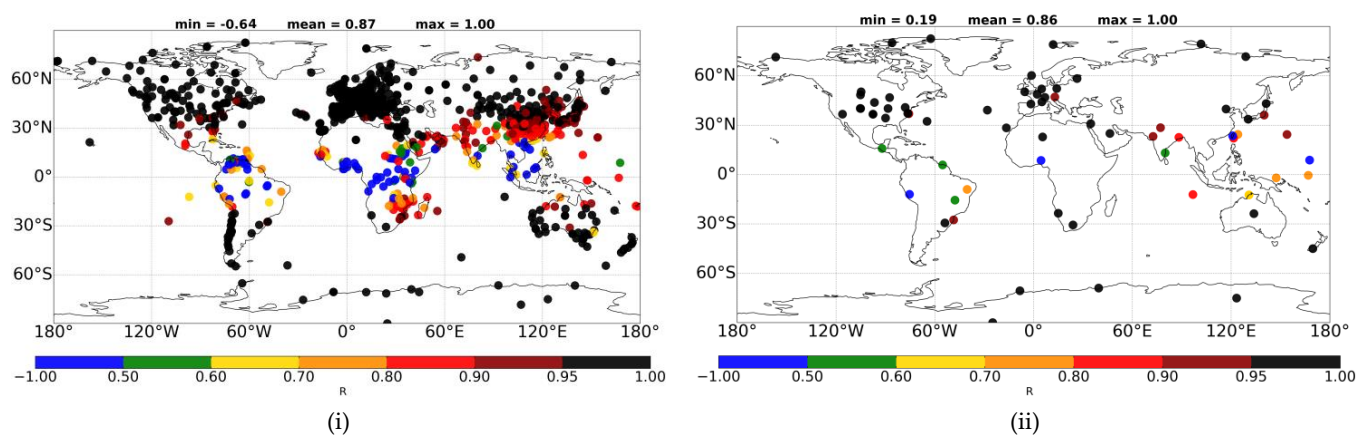
**Figure S1.** Global distribution of: (a) Global Energy Balance Archive (GEBA) 1397 stations and (b) Baseline Surface Radiation Network (BSRN) 73 stations, whose surface solar radiation (SSR) data (availability in years indicated in the colorbars) have been used in the study.



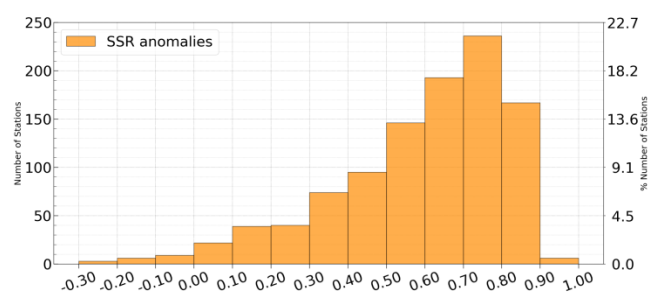
**Figure S2.** Time periods covered by measurements of each station for (i) GEBA and (ii) BSRN networks. (a) Total number of stations since 1980 and (b) Number of available stations after applying criteria to compute linear slopes, i.e. 232 GEBA and 22 BSRN stations.



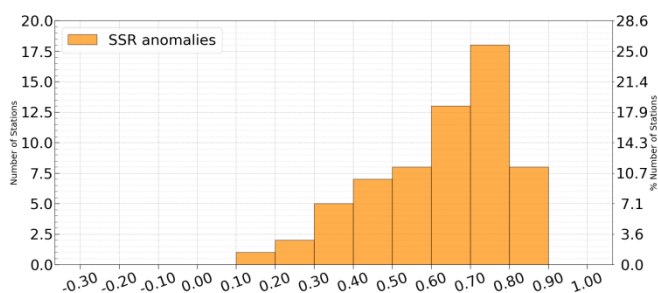
**Figure S3.** Seasonal variation of hemispherical mean correlation coefficient  $R$  between MERRA-2 and GEBA (blue color) and between MERRA-2 and BSRN (red color) stations, computed using SSR fluxes for the North Hemisphere (i) and the South Hemisphere (ii).



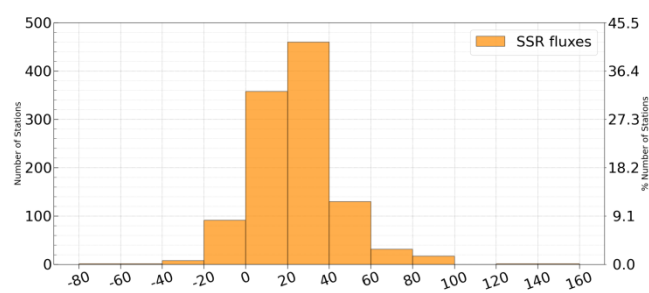
**Figure S4.** Global distribution of correlation coefficient between MERRA-2 and each GEBA (i, left column) and BSRN (ii, right column) station SSR fluxes.



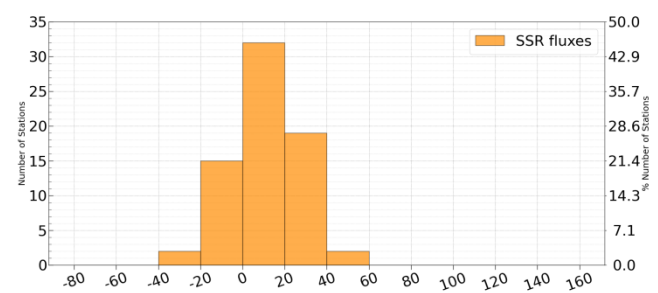
(i-a)



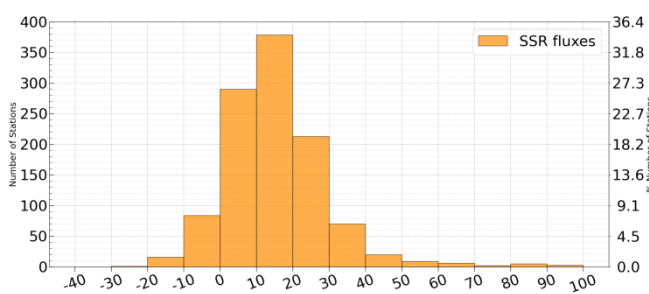
(ii-a)



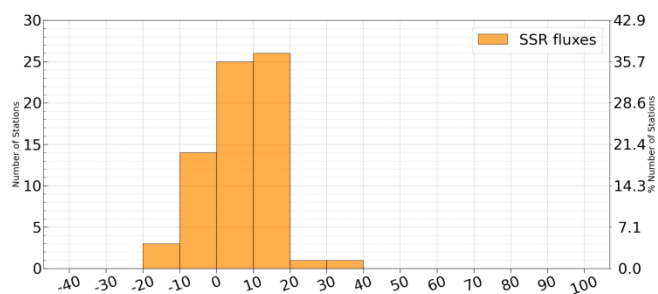
(i-b)



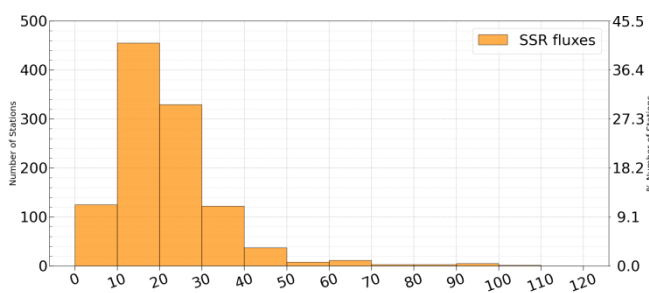
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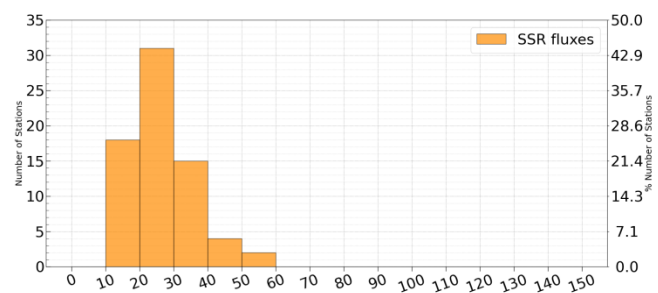
(i-c)



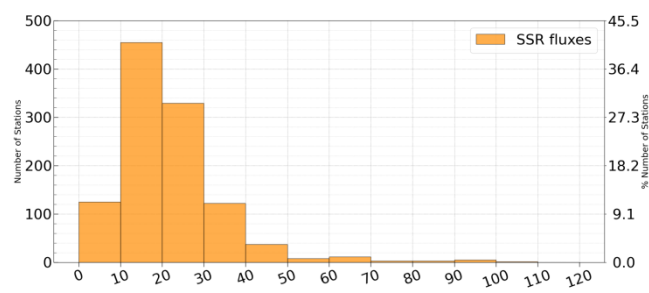
(ii-c)



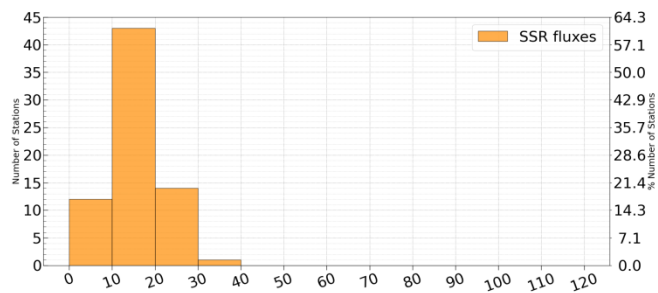
(i-d)



(ii-d)

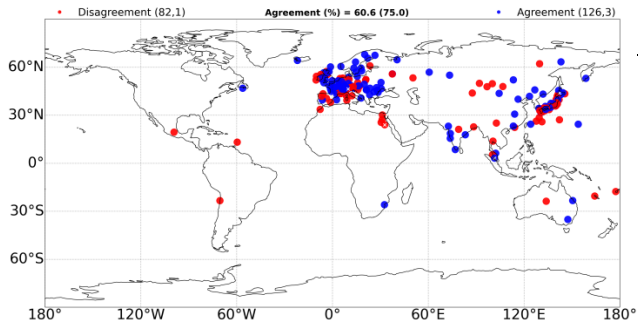


(i-e)

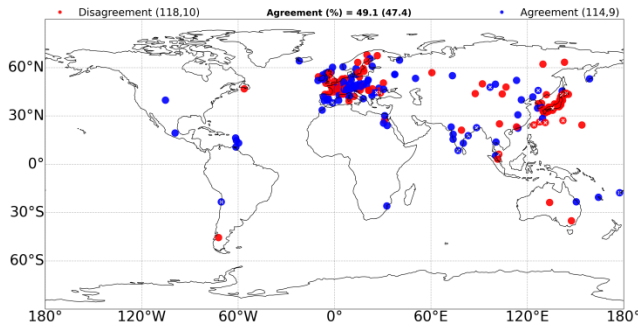


(ii-e)

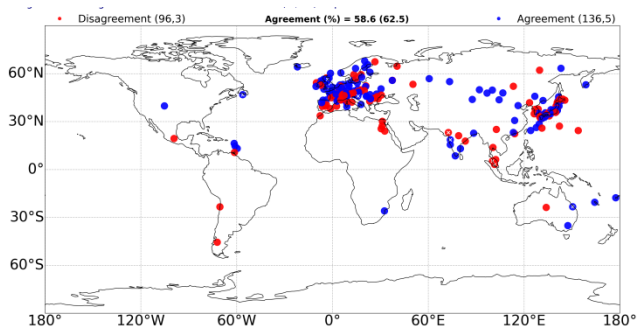
**Figure S5.** Histogram of frequency distribution of correlation coefficient R (a), bias (b), relative bias (c), root mean squared error (RMSE) (d), relative RMSE (e), between MERRA-2 and GEBA (i, left column) and BSRN (ii, right column) stations. Results are computed using MERRA-2, and GEBA and BSRN station SSR fluxes, except for R, which is computed using deseasonalized SSR anomalies. In the left y axis shown is given the number of stations, while in the right y axis the % number of stations.



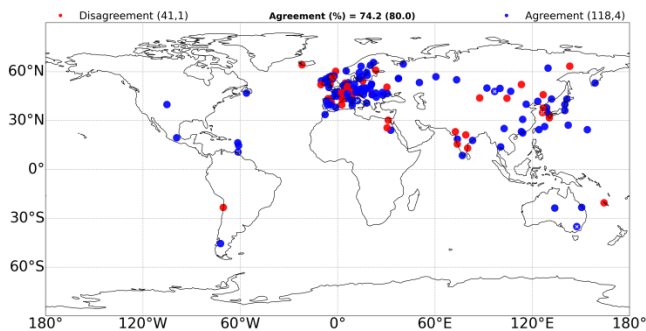
(i-a)



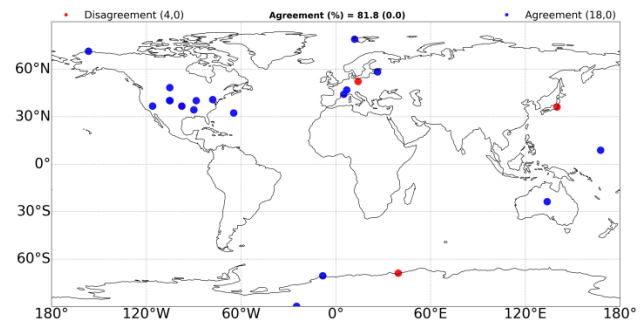
(i-b)



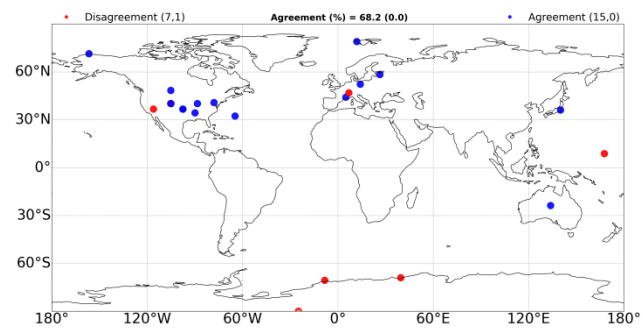
(i-c)



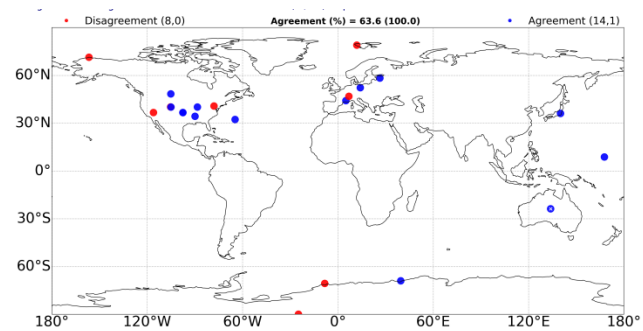
(i-d)



(ii-a)



(ii-b)

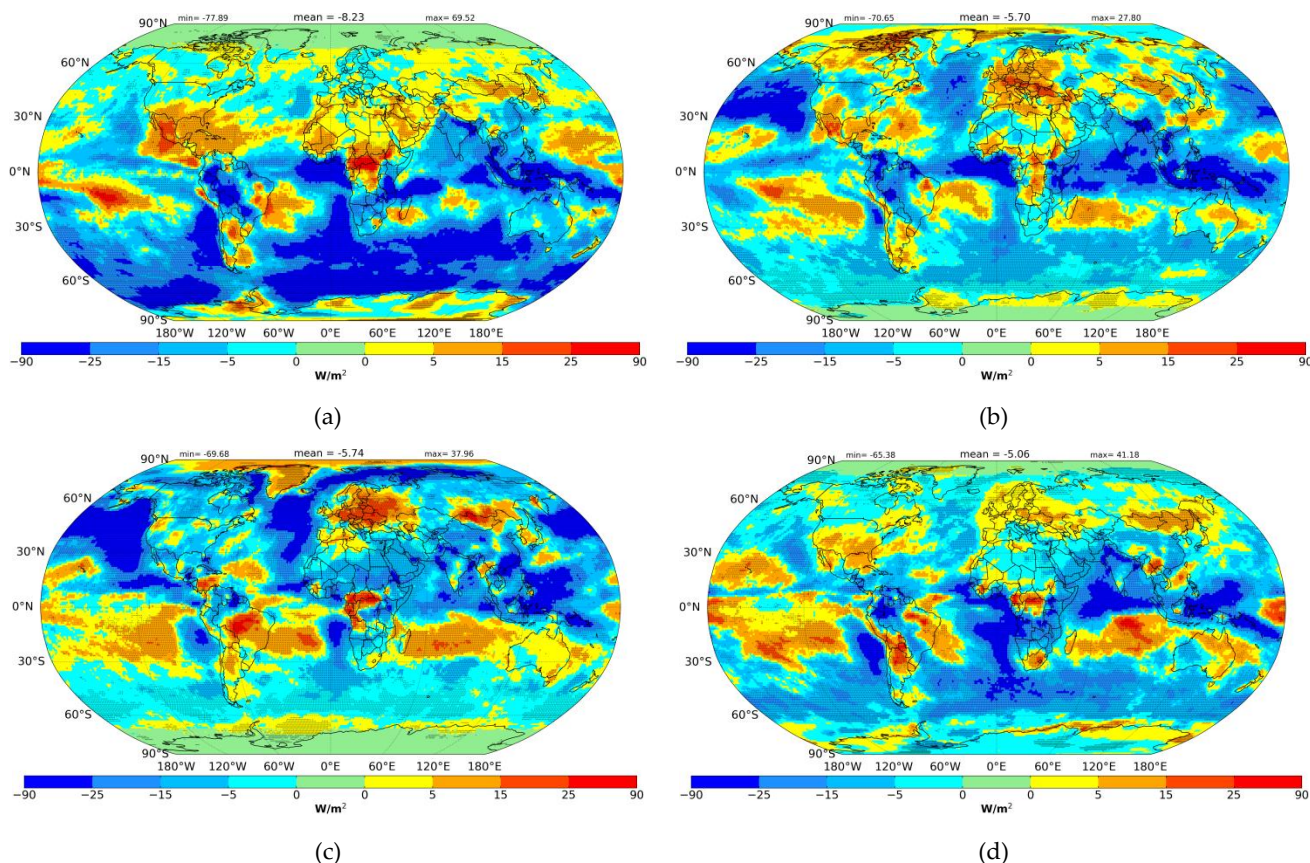


(ii-c)

**Figure S6.** Agreement (blue dots) and disagreement (red dots) between trends of MERRA-2 and station SSR fluxes. The comparison is done for the associated deseasonalized anomalies for GEBA (left column, i) and BSRN (right column, ii) stations per selected time periods that are characterized as Global Dimming & Brightening periods (GDB phases). The embedded white x symbols indicate the



statistically significant trends. The numbers in parentheses provide the total number of stations for which there is agreement/disagreement (first number) and the corresponding numbers for statistically significant trends (second number). The GDB phases are (a) 1980–1985, (b) 1986–2000, (c) 2001–2010, (d) 2011–2017 for GEBA and (a) 1992–2000, (b) 2001–2010, (c) 2011–2020 for BSRN. (Wild et al., WIREs Clim Change 2016, 7:91–107)



**Figure S7.** Global distribution of MERRA-2  $\Delta(SSR)$  anomalies over the 40-year period 01/1980 – 12/2019, for (a) DJF, (b) MAM, (c) JJA, (d) SON. Reddish colors are those with positive trends (brightening), and those with bluish colors have negative trends (dimming). Statistically significant trends are indicated by black dots.