ERA5 aggregation bug in the ISIMIP4a GSWP3-ERA5 data

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16-10-2026

1 Introduction

In ISIMIP4a we adjusted the ERA5 data pipeline to aggregate the hourly data to daily values shifting the time axis by one hour, a bugfix with respect to the ISIMIP3a pipeline. That shift is needed for the accumulated variables, but it was inadvertently applied to all of them, creating a new bug: those variables were then aggregated over the wrong hours of the day. The GSWP3 data are harmonised to ERA5 from 1901 to 1939 and were therefore affected, in a smaller magnitude. The affected `gswp3-era5_obsclim_*` files have been recalculated.

This document compares the two versions of the **GSWP3-ERA5** input data: all 11 variables, 1901-2025, the 0.5° ISIMIP grid. The differences between the corrected and the flawed version of the same day at the same pixel are shown, in the unit of the variables (see Table 1). The fluxes, `pr`, `prsn`, `rlds`, `rsds` are unchanged, the rest were affected.

2 Magnitude of the difference

The mean absolute deviation (MAD) between the two versions, over every pixel and every day, split into the bias-adjusted part of GSWP3 (1901-1939) and the plain ERA5 part (1940-2025).

Table 1: **corrected mean** is the mean of the corrected data itself, over every pixel and day; all columns between it and the last are of |corrected - flawed|, in the units of the variables: its mean (MAD) over the whole period, the MAD over 1901-1939 and over 1940-2025; the 99th percentile, and its largest value over the whole period. The last column is the share of pixel-days whose value differs at all.

variable	unit	corrected mean	MAD	1901-1939	1940-2025	p99	max	% changed
hurs	%	74.11	0.21	0.064	0.28	1.21	45.74	99.997
huss	kg kg-1	9.75e-03	2.64e-05	7.74e-06	3.49e-05	1.57e-04	1.10e-03	99.998
pr	kg m-2 s-1	3.34e-05	0	0	0	0	0	0
prsn	kg m-2 s-1	2.67e-06	0	0	0	0	0	0
ps	Pa	98566.16	9.65	0.53	13.78	85.45	373.47	99.774
rlds	W m-2	336.13	0	0	0	0	0	0
rsds	W m-2	189.34	0	0	0	0	0	0
sfcwind	m s-1	6.02	0.056	2.76e-03	0.080	0.38	3.94	99.990
tas	K	287.03	0.037	3.62e-03	0.052	0.37	2.23	99.841
tasmax	K	289.04	0.030	0.018	0.036	0.59	15.55	57.346
tasmin	K	285.10	0.040	0.024	0.048	0.66	13.07	58.765

3 Variable maps and time series

Four global maps on top, drawn over 1940-2025, the plain ERA5 part where the flaw was: the time mean of the corrected data, the mean absolute deviation, the mean of the difference, and the largest daily deviation, the last two on a log colour scale. Below them, for three pixels, the daily difference between the two versions: the whole record on the left, 1901-2025, and the last five years of it on the right. These are daily values, not averages. Pixel 1 (star) is contains the largest difference of the whole record, corresponding to the `max` column of Table 1 reports. The maps cover 1940-2025, so for the four variables whose largest day falls before 1940 the star is not the max value of the diff map. Pixels 2 and 3 are random, to depict non-extreme locations.

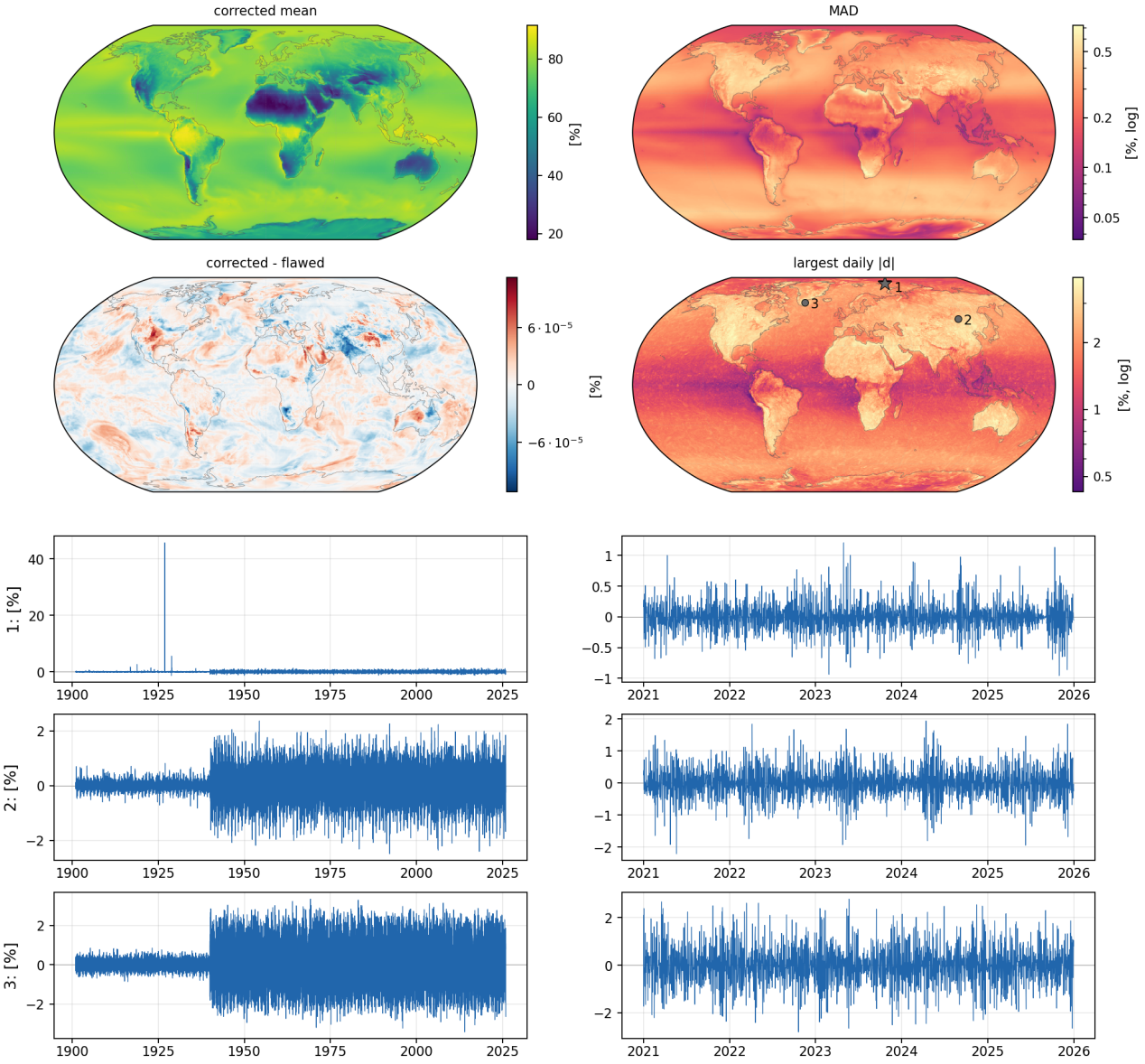


Figure 1: `hurs`: the four maps of 1940-2025, and below them the daily deviation of three pixels over the whole record and over 2021-2025; pixel 1 (star) holds the largest day of the record.

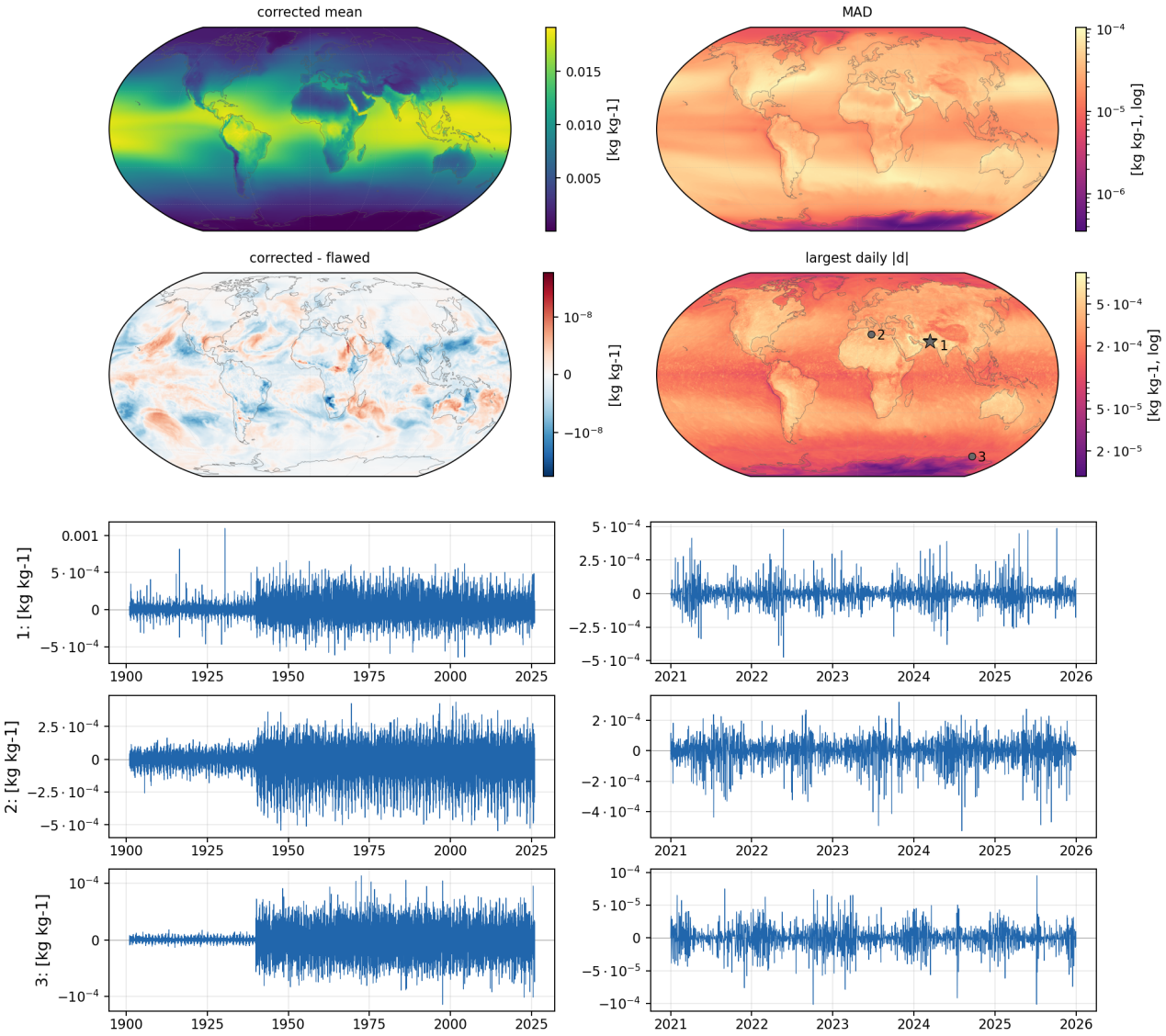


Figure 2: Same as Figure 1 but for huss.

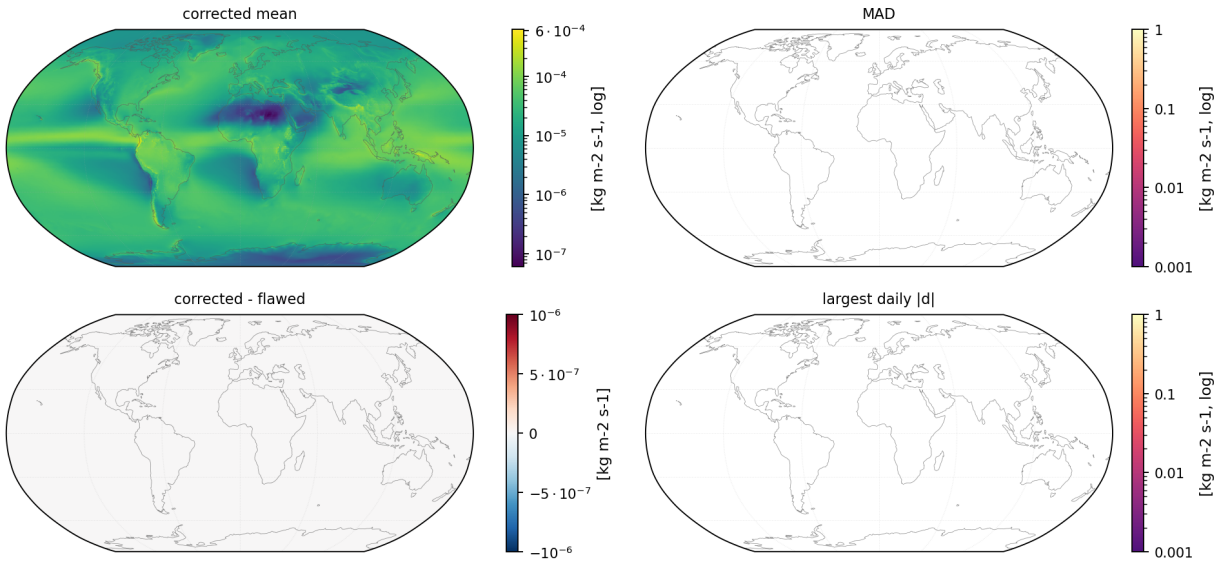


Figure 3: Same as Figure 1 but for pr, which is identical in both versions; its raw maps are on a log colour scale and the timeseries skipped.

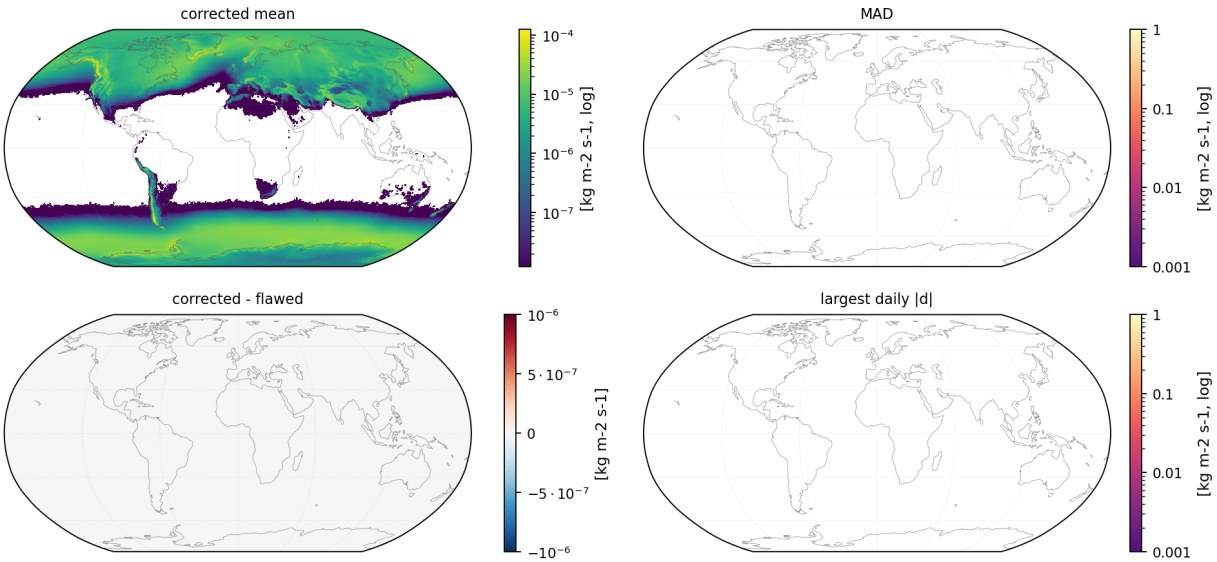


Figure 4: Same as Figure 1 but for `prsn`, which is identical in both versions; its raw maps are on a log colour scale and the timeseries skipped.

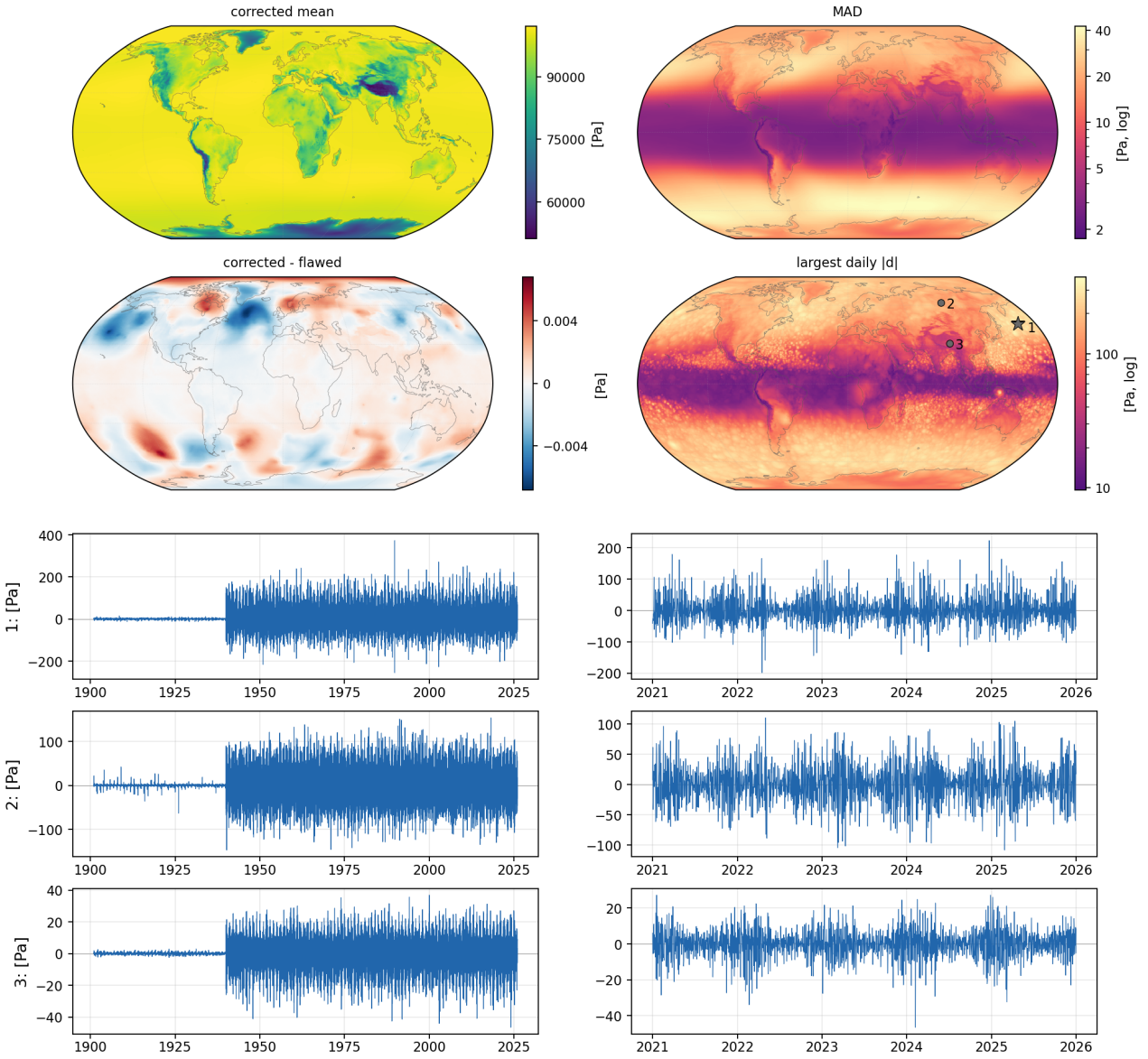


Figure 5: Same as Figure 1 but for `ps`.

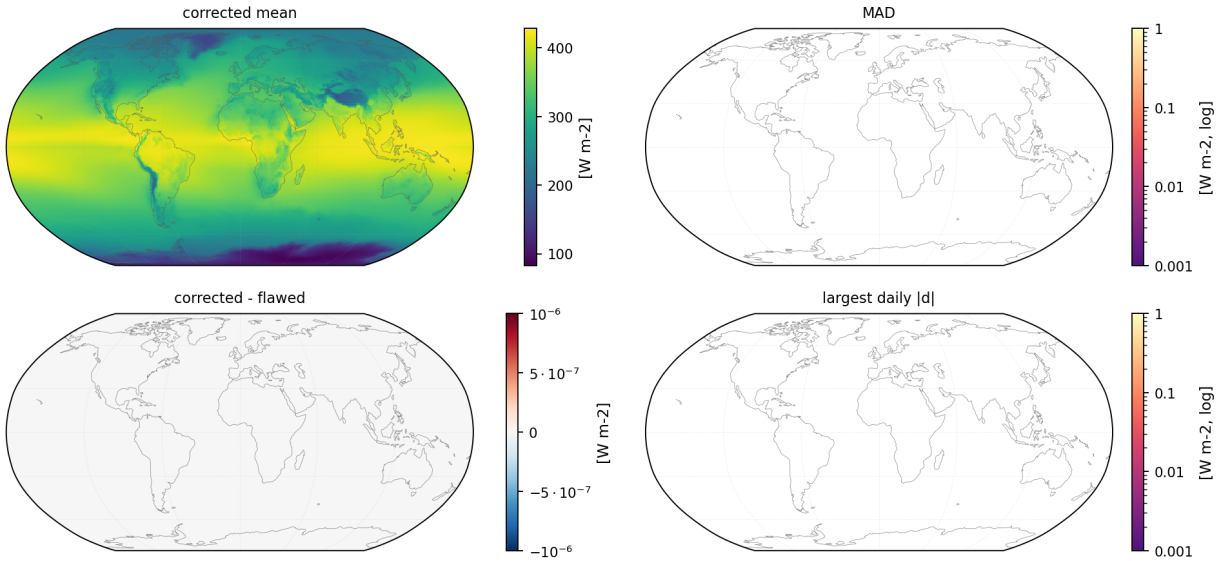


Figure 6: Same as Figure 1 but for `rlds`, which is identical in both versions. The timeseries are skipped.

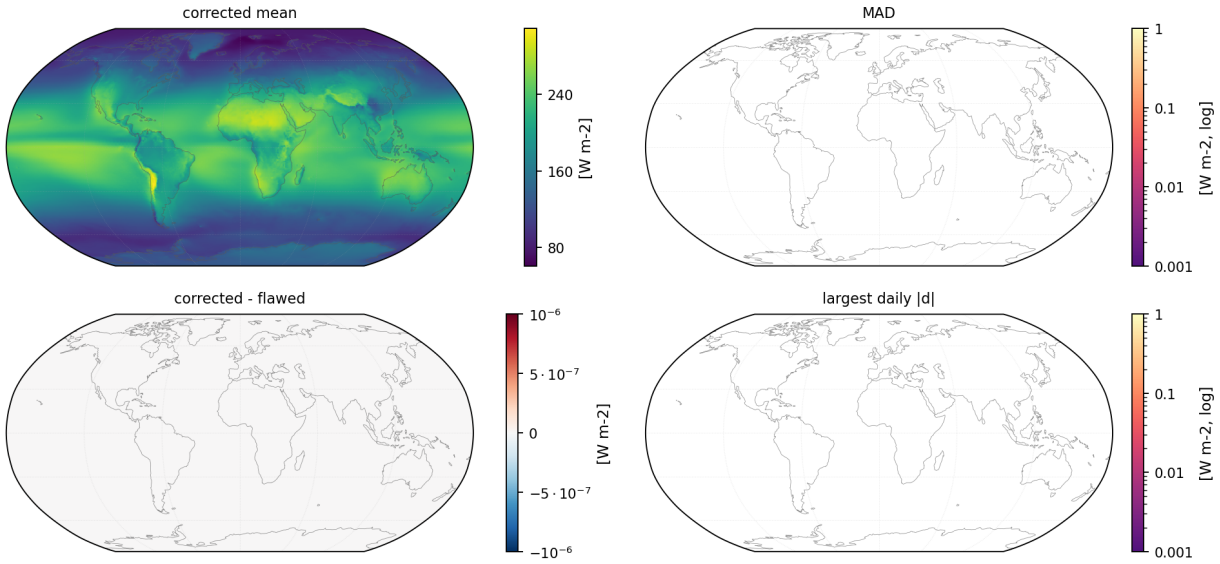


Figure 7: Same as Figure 1 but for `rsds`, which is identical in both versions. The timeseries are skipped.

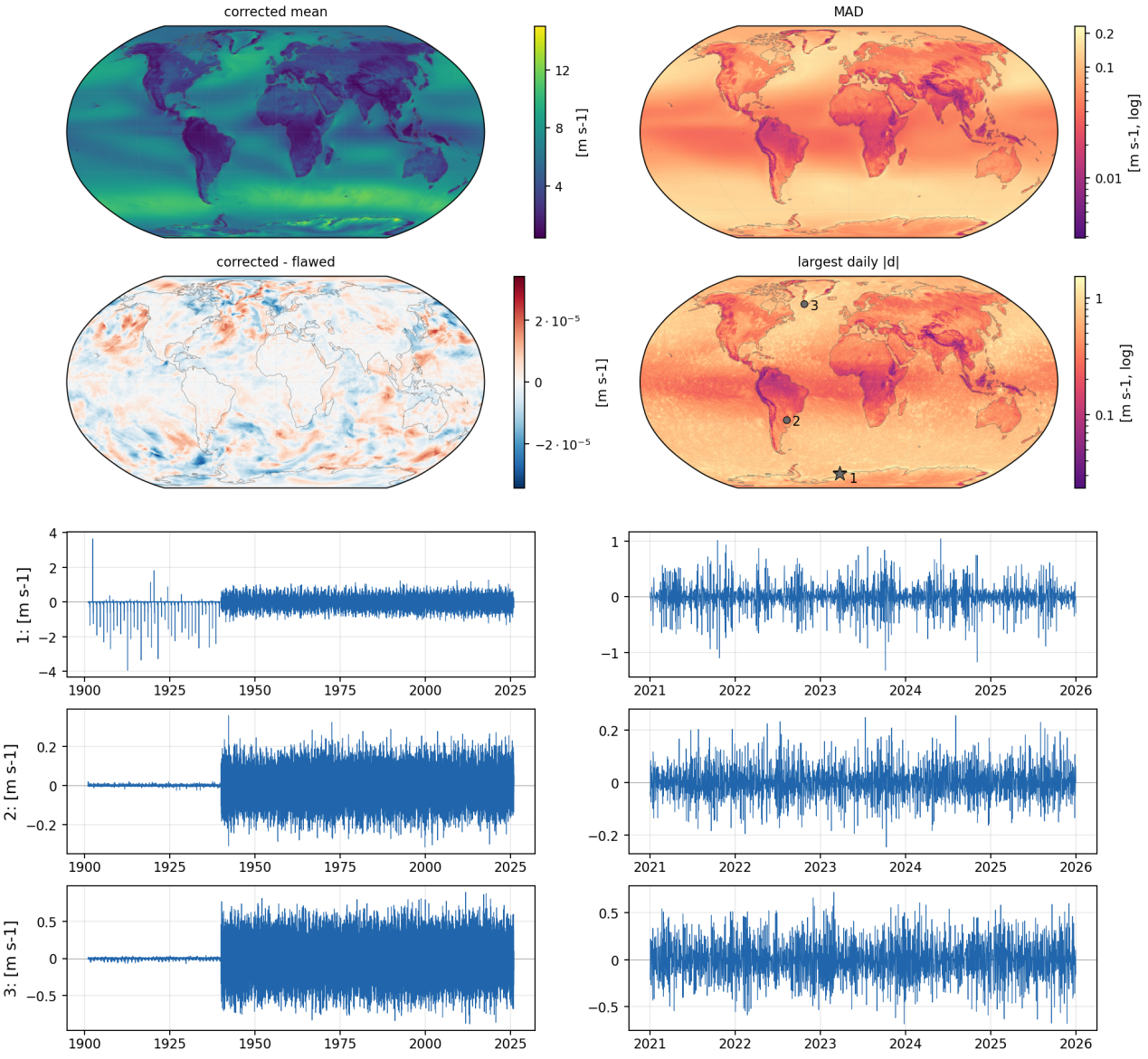


Figure 8: Same as Figure 1 but for `sfcwind`.

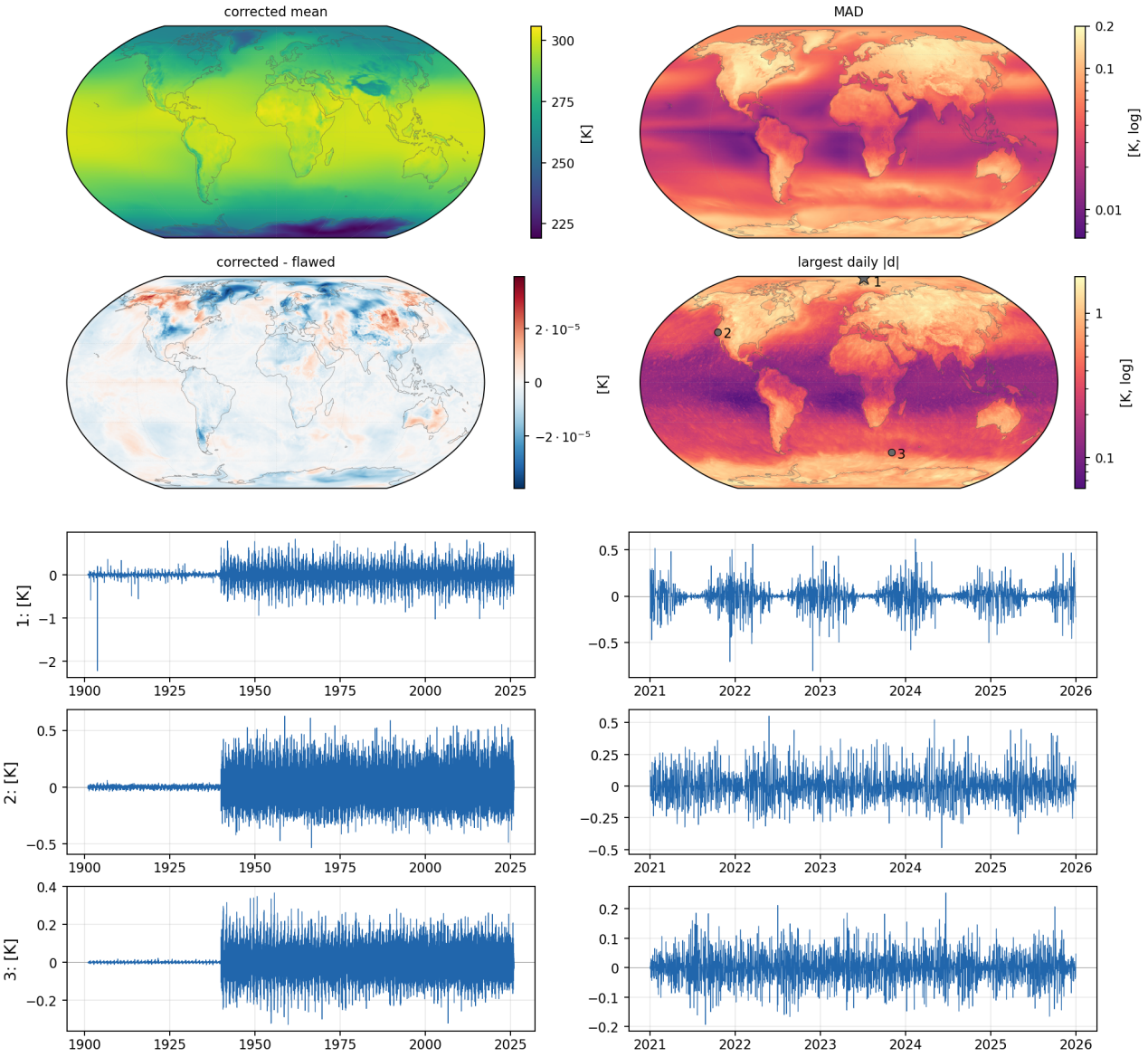


Figure 9: Same as Figure 1 but for `tas`.

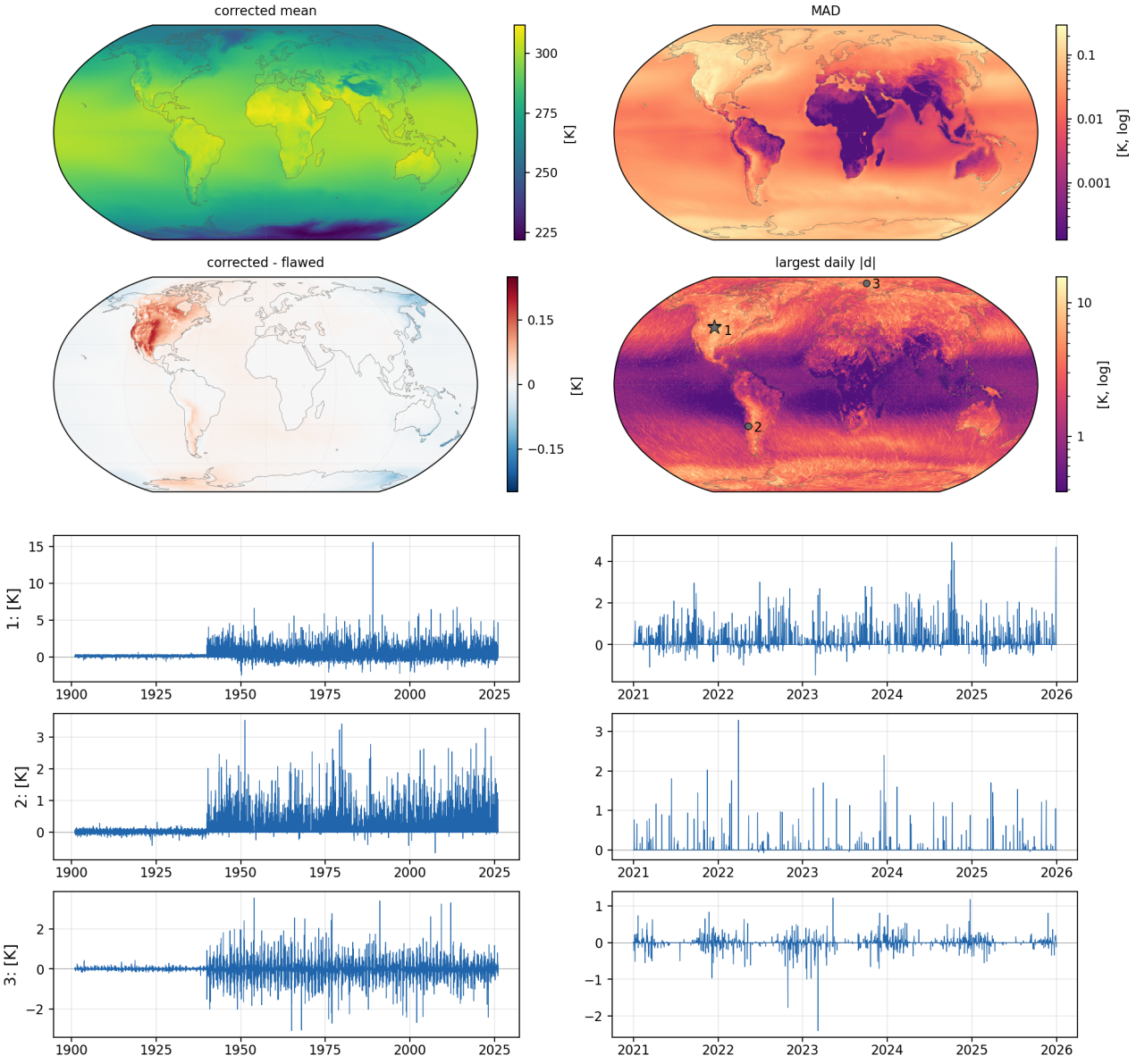


Figure 10: Same as Figure 1 but for `tasmax`.

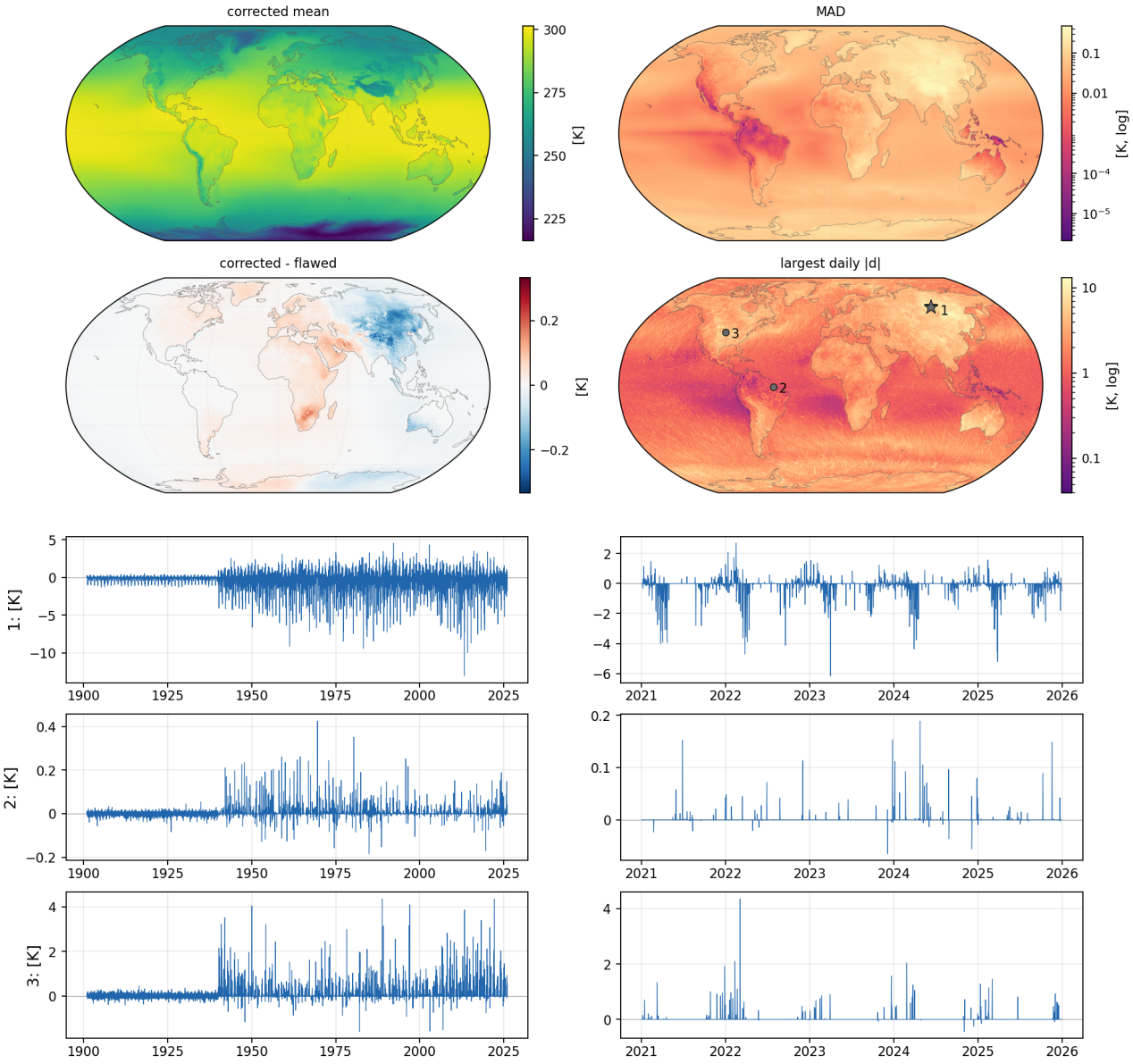


Figure 11: Same as Figure 1 but for `tasmin`.

4 Final remarks

- The deviation is generally small as a global daily mean but not negligible at single days and pixels, and largest for `tasmin` and `tasmax`.
- Downstream applications should be aware of this correction, and the new files should be used for any future work.
- ISIMIP4a data will be updated in the ISIMIP data portal as soon as possible.
- ISIMIP4b will use the corrected files as reference for bias-adjustment and downscaling.