

Supplementary Information - Variation in Sleep Duration Across Latitudes and Countries: A Bayesian Hierarchical Analysis of Wearable Data

Faraaz Akhtar^{1*}, Alistair Brownlee^{2†} and Cameron Crawford^{3†}

^{1,2,3}Terra API, Beaconsfield Street, London, N1C 4EW, United Kingdom.

*Corresponding author(s). E-mail(s): faraaz@tryterra.co;
Contributing authors: alistair@tryterra.co; cameron@tryterra.co;
[†]These authors contributed equally to this work.

1 Supplementary Tables

Table S1: Posterior summaries for the baseline photoperiod model estimated using a 20-night minimum observation cutoff. Means, standard deviations, and 95% highest density intervals (HDI) are reported. Global offset (α_0), weekend effects (γ_0), and seasonal label effects ($\gamma_1, \gamma_2, \gamma_3, \gamma_4$) on sleep duration are reported in minutes. The photoperiod coefficient (β_p) is reported in minutes of sleep per additional minute of daylight.

Parameter	Mean	SD	HDI 2.5%	HDI 97.5%
Duration Offset (α_0)	434.268	19.622	396.532	472.718
Photoperiod (β_P)	-0.071	0.010	-0.090	-0.051
Weekend (γ_0)	13.006	0.325	12.354	13.631
Spring (γ_1)	1.159	14.811	-27.342	30.474
Summer (γ_2)	-0.890	14.808	-29.186	28.722
Fall (γ_3)	-2.153	14.808	-30.654	27.214
Winter (γ_4)	-1.187	14.812	-29.057	28.910

Table S2: Posterior summary for the interaction between photoperiod and latitude (β_{PL}) estimated under a 20-night minimum observation cutoff. Sleep duration is measured in minutes. The interaction coefficient represents the change in sleep duration (minutes) per additional hour of daylight per degree of latitude.

Parameter	Mean	SD	HDI 2.5%	HDI 97.5%
Photoperiod $\times$ Latitude (β_{PL})	0.001	0.000	0.001	0.001

Table S3: Posterior summaries for selected country-specific photoperiod sensitivity coefficients (b) and variance components (v) estimated using a 20-night minimum observation cutoff.

Parameter	Mean	SD	HDI 2.5%	HDI 97.5%
b [Australia]	0.037	0.015	0.007	0.067
b [Cyprus]	0.041	0.021	0.002	0.082
b [Denmark]	0.023	0.010	0.003	0.044
b [Italy]	-0.029	0.009	-0.047	-0.012
b [Portugal]	0.030	0.012	0.006	0.054
b [Romania]	-0.033	0.016	-0.065	-0.001
b [Saudi Arabia]	-0.064	0.024	-0.111	-0.018
b [Switzerland]	0.028	0.009	0.011	0.046
b [Turkey]	0.029	0.014	0.001	0.057
v [Australia]	43.051	15.322	12.740	72.834
v [Brazil]	45.115	23.926	2.528	93.637
v [South Africa]	38.335	17.431	2.176	70.604

Table S4: Mean absolute difference between activity-designated latitude and inferred country latitude. Biggest values are expected for countries that are big and have a small population of people.

Country	Latitude difference (degrees)
Argentina	1.571
Australia	6.991
Austria	0.651
Belgium	0.296
Brazil	11.438
Canada	9.520
Chile	4.010
Croatia	0.410
Cyprus	0.191
Czechia	0.744
Denmark	0.117
Dominican Republic	0.401
El Salvador	0.044
France	7.082
Germany	1.574
Greece	1.652
Hungary	0.482
India	7.785
Indonesia	4.151
Ireland	0.579
Italy	2.989
Japan	1.753
Latvia	0.270
Luxembourg	0.236
Malaysia	0.665
Mexico	3.547
Netherlands	0.658
Norway	4.674
Oman	4.237
Philippines	3.405
Poland	1.238
Portugal	1.217
Puerto Rico	0.223
Romania	0.938
Russia	2.760
Saudi Arabia	0.705
Slovenia	0.073
South Africa	2.767
South Korea	0.627
Spain	1.818
Sweden	3.249
Switzerland	0.459
Taiwan	0.545
Thailand	2.819
The Bahamas	0.489
Turkey	0.822
United Arab Emirates	0.777
United Kingdom	1.546
United States of America	5.411
Vietnam	5.721

2 Supplementary Figures

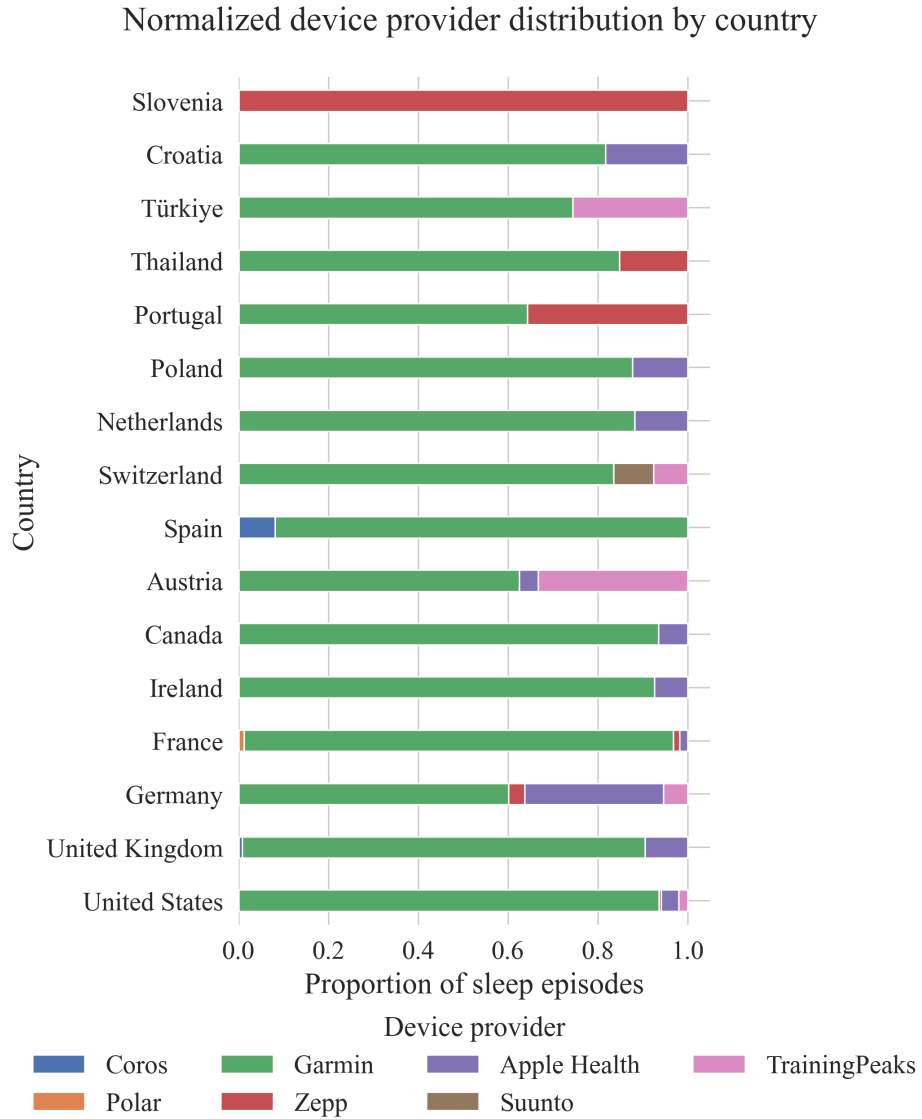


Fig. S1: Device provider distribution for all countries where Garmin provided less than 99% of devices.

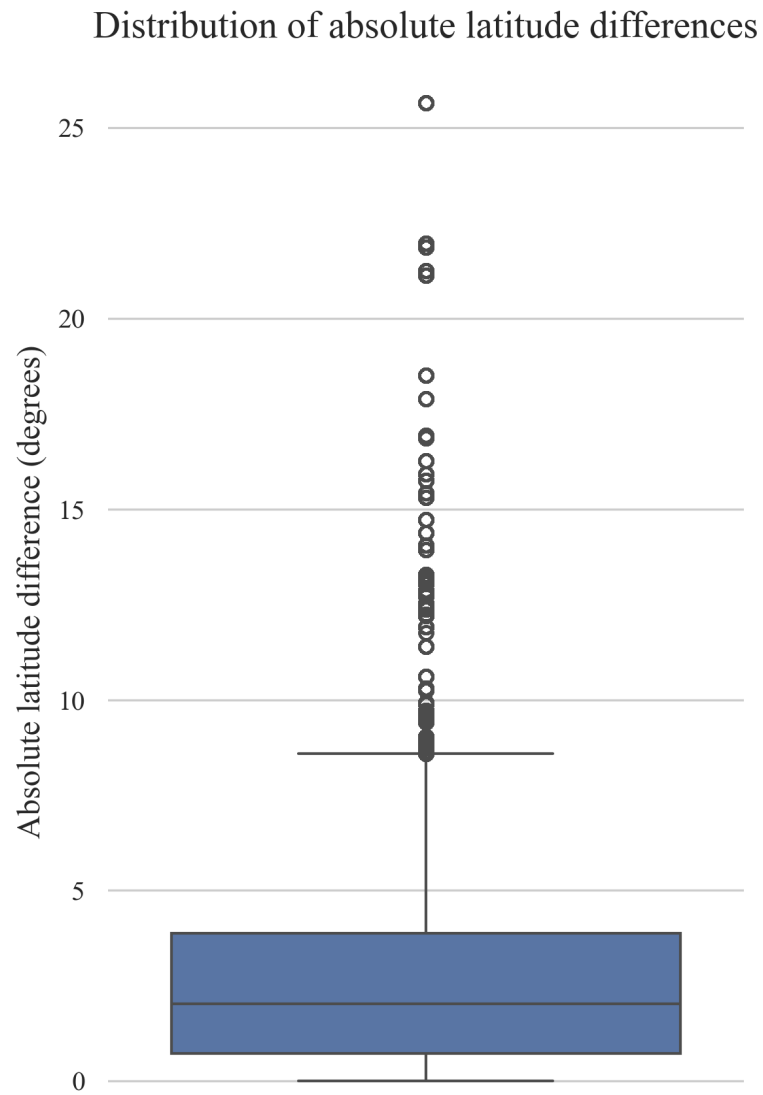


Fig. S2: Boxplot depicting distribution of absolute differences in sampled activity latitude and assigned centroid latitude for all participants. It can be seen that most values show <5 degree deviation.