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Sensitivity of precipitation in the highlands and lowlands of Peru to physics parameterization options in WRFV3.8.1

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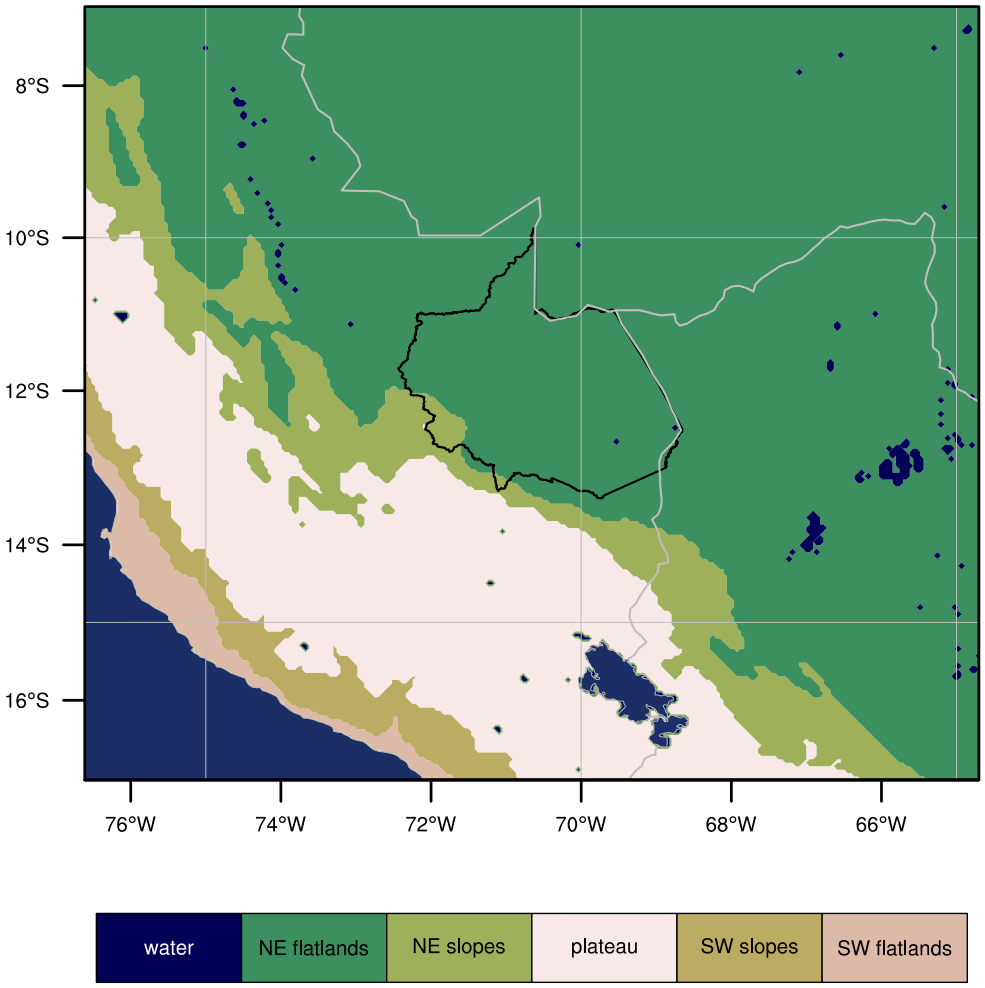

Figure S1. Map of the second domain highlighting the five regions included in the analysis with different shading.

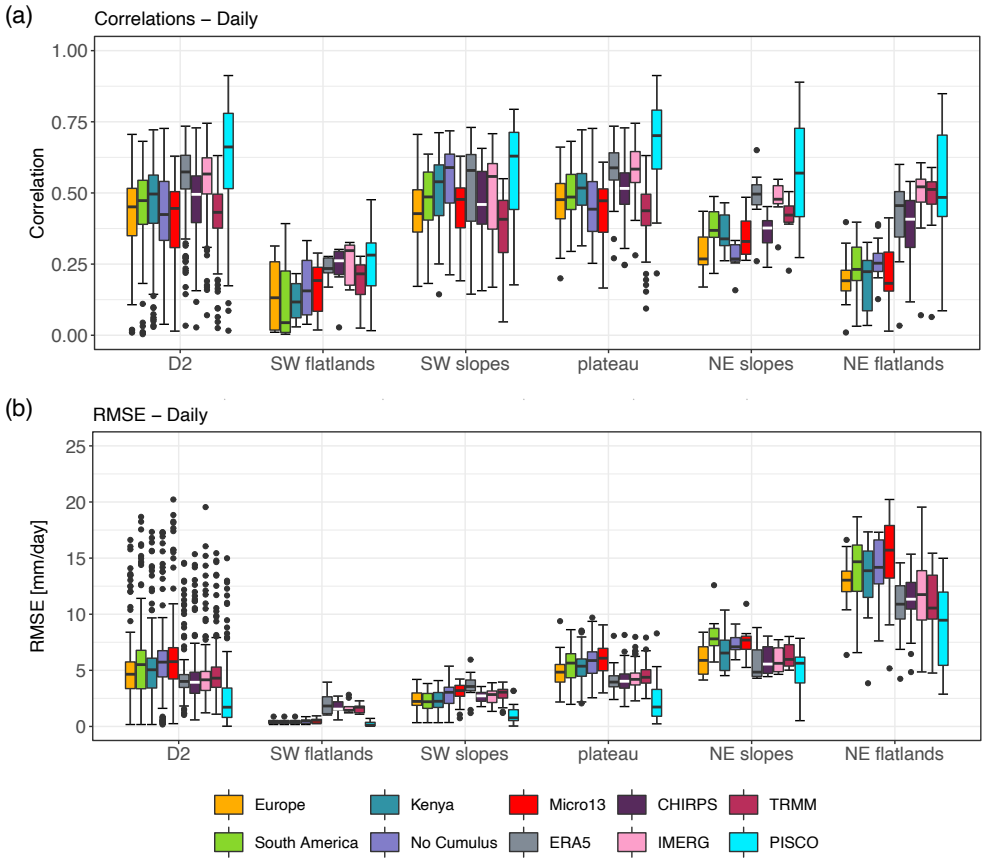

Figure S2. (a) The temporal correlation and (b) root-mean-square error (RMSE) between the annual cycle for the year 2008 of measured and simulated daily precipitation sums at the nearest grid point to the station's location shown for the different parameterization options and gridded observational datasets. The whiskers extend to the value that is no more than 1.5 times the inter-quartile range away from the box. The values outside this range are defined as outliers and are plotted with dots.

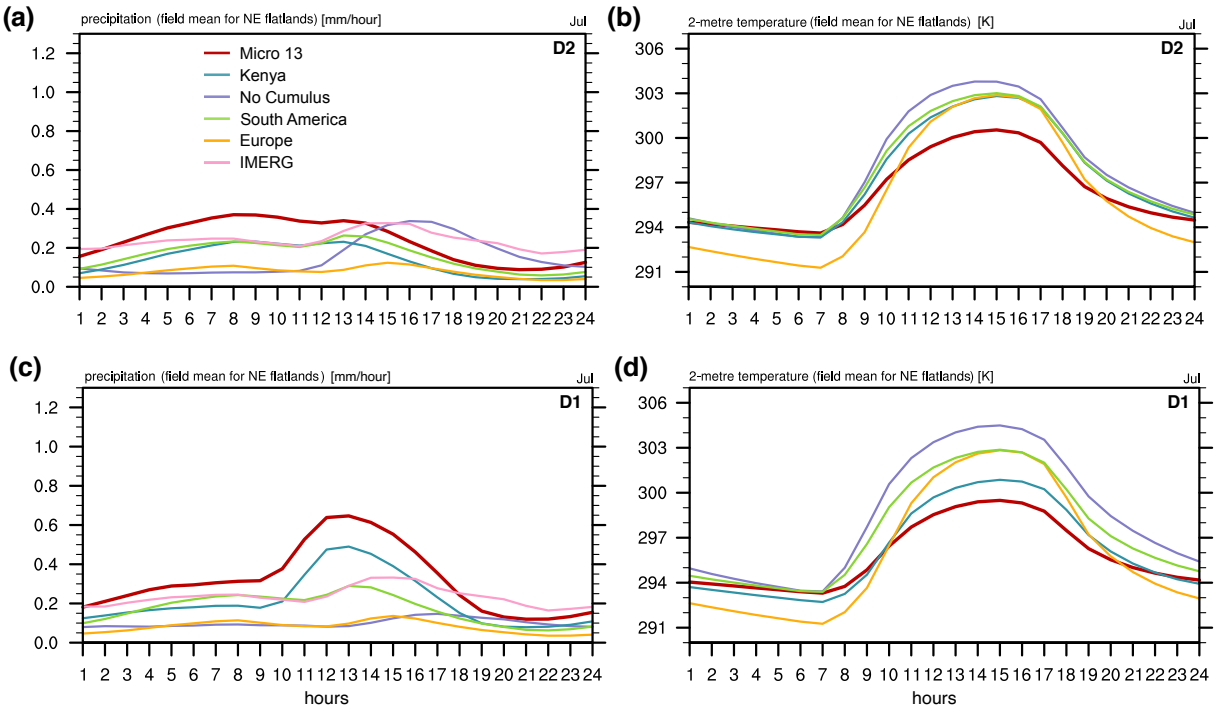

Figure S3. Daily cycle for July of a field mean over the northeastern flatlands of D2 for (a) precipitation (mm), and (b) 2-metre temperature (K). (c) and (d) show the same variables respectively, but over the same area (D2) in the first domain (D1). The daily cycles of precipitation (a and c) also include IMERG, depicted with a pink line. The x-axis shows the hours of the day, shifted by 5 hours from UTC to show local Peru time.

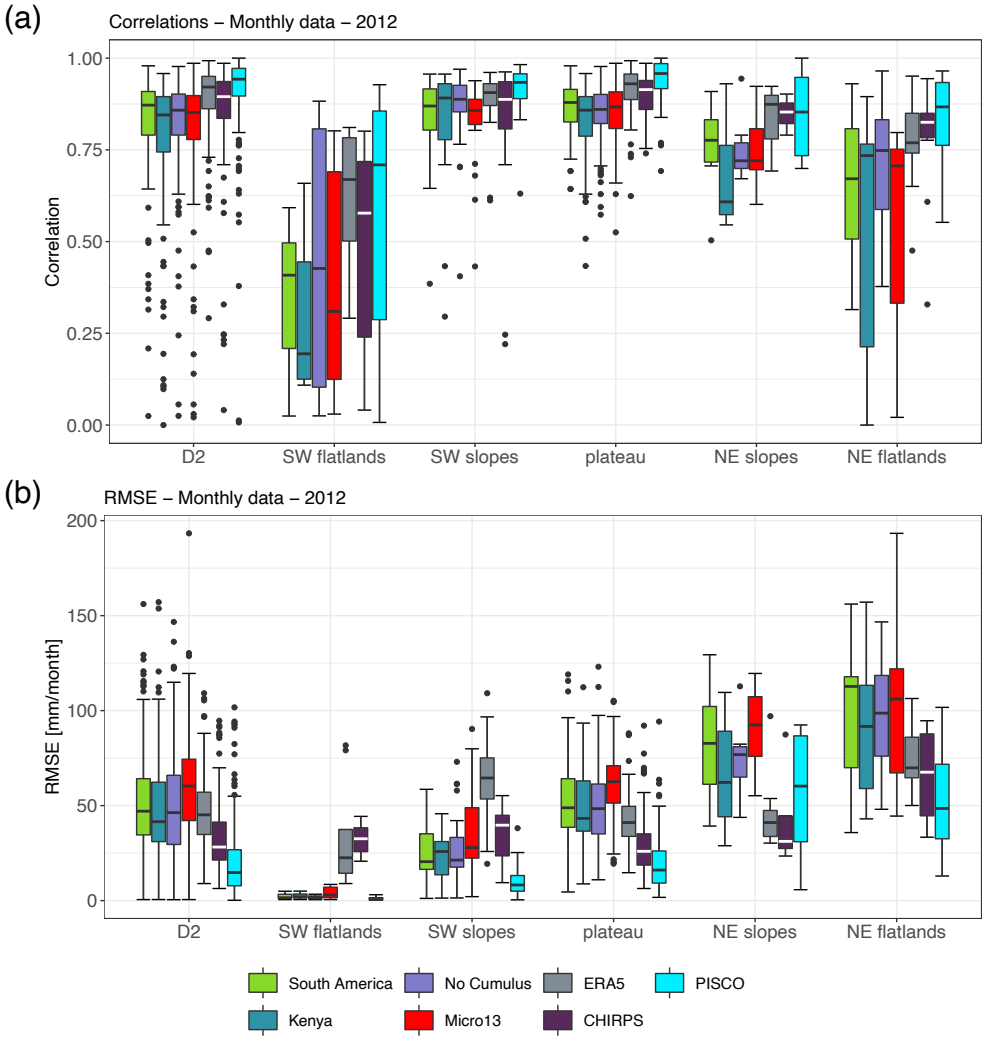

Figure S4. Box and whisker plots showing the (a) temporal Spearman correlation and (b) RMSE (in millimetres per month) for precipitation in 2012 against weather station data. The box and whiskers are divided into six groups according to the elevation of each station and location related to the Andean mountain range: the entire domain, the SW flatlands, the SW slopes, the plateau, the NE slopes, and the NE flatlands.

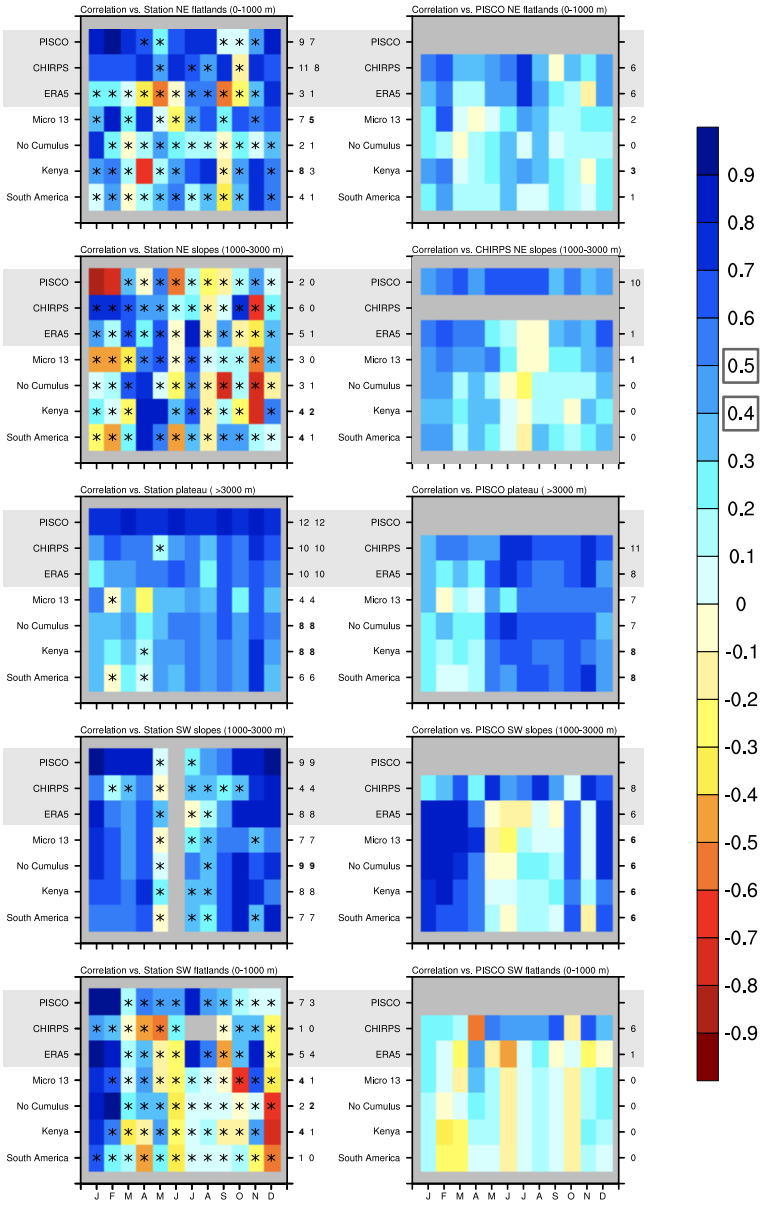

Figure S5. Spearman pattern correlation for year 2012 compared to weather station data (left column) and compared to PISCO (right column) and CHIRPS (only second row, right column). The five rows represent stations and data points in the northeastern flatlands (< 1000 metres a.s.l.), along the northeastern slopes of the Andes (1000–3000 metres a.s.l.), on the plateau (> 3000 metres a.s.l.), along the southwestern slopes of the Andes (1000–3000 metres a.s.l.), and in the southwestern flatlands (< 1000 metres a.s.l.), respectively. The light grey shading denotes satellite based or reanalysis data, and facilitates the separation from the WRF simulations. Asterisks inside the pixels indicate non significance at $\alpha = 5\ \%$. The numbers in the first column of the right y-axis indicates the number of months that result in a correlation larger than 0.5 compared to weather station data (left panels) and 0.4 in comparison to PISCO and CHIRPS data (right panels). The second column of the right y-axis considers only months that are statistically significant (left panels only). The bold numbers indicate the best option for each region.

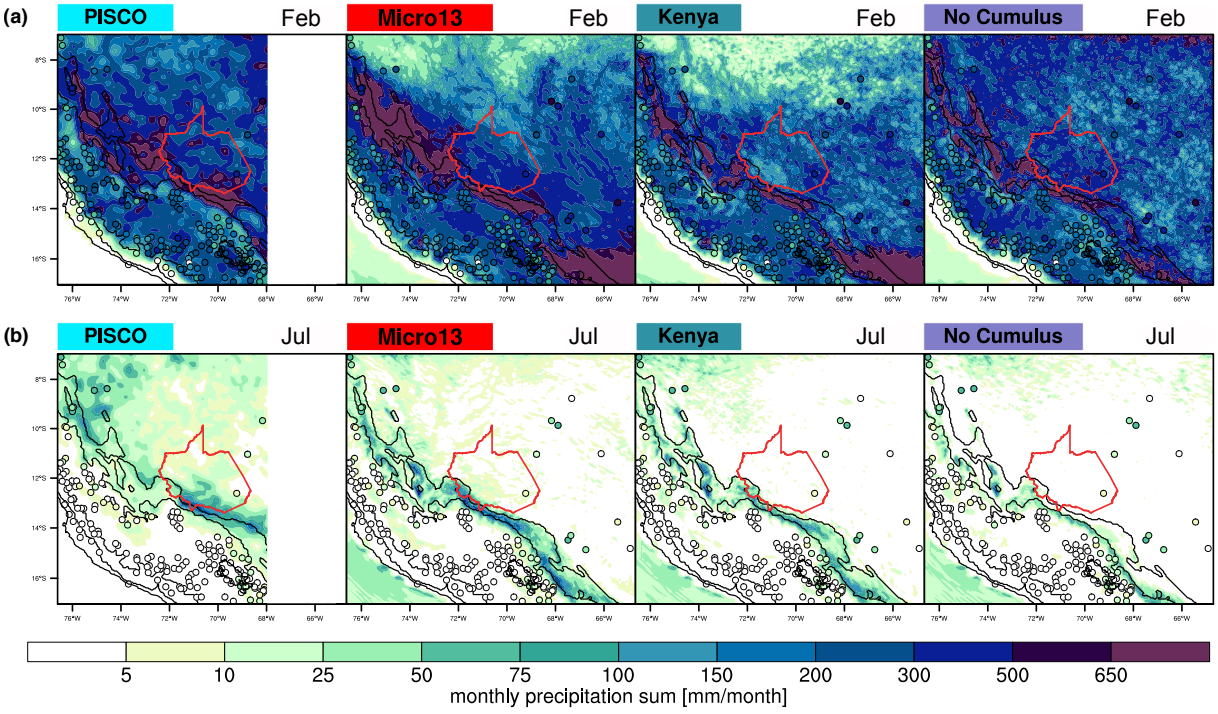

Figure S6. Monthly precipitation sums in millimetres per month for (a) February 2012 – a month in the rainy season and (b) July 2012 – a month in the dry season are shown for the gridded observational data set PISCO and the parameterization options Micro13, Kenya, and No Cumulus. The circles on the map indicate the monthly precipitation sums recorded at the respective weather station.

Table S1. Mean accumulated precipitation (in millimetres) for February 2008 of each run over the different regions of the second domain: NE flatlands and slopes, the plateau, and the SW flatlands and slopes.

Experiment	NE flatlands	NE slopes	Plateau	SW slopes	SW flatlands
Europe	101.20	276.03	116.22	4.59	1.18
South America	241.22	477.15	170.67	6.59	0.63
Kenya	167.76	482.18	168.61	6.87	2.24
No Cumulus	205.66	395.34	219.56	10.74	2.28
Micro13	269.71	595.73	270.82	50.00	2.08
CHIRPS	265.44	244.33	119.05	48.05	26.94
PISCO	259.18	353.58	126.95	16.28	2.13

Table S2. Same as Table S1, but for July 2008.

Experiment	NE flatlands	NE slopes	Plateau	SW slopes	SW flatlands
Europe	1.37	5.47	1.59	0.00	2.45
South America	1.32	21.37	4.32	0.00	3.67
Kenya	4.23	34.65	5.32	0.00	4.87
No Cumulus	4.40	26.15	8.01	0.00	4.65
Micro13	10.87	93.62	14.67	0.01	5.86
CHIRPS	35.70	23.78	6.60	1.85	0.47
PISCO	21.15	25.12	1.18	0.09	0.09