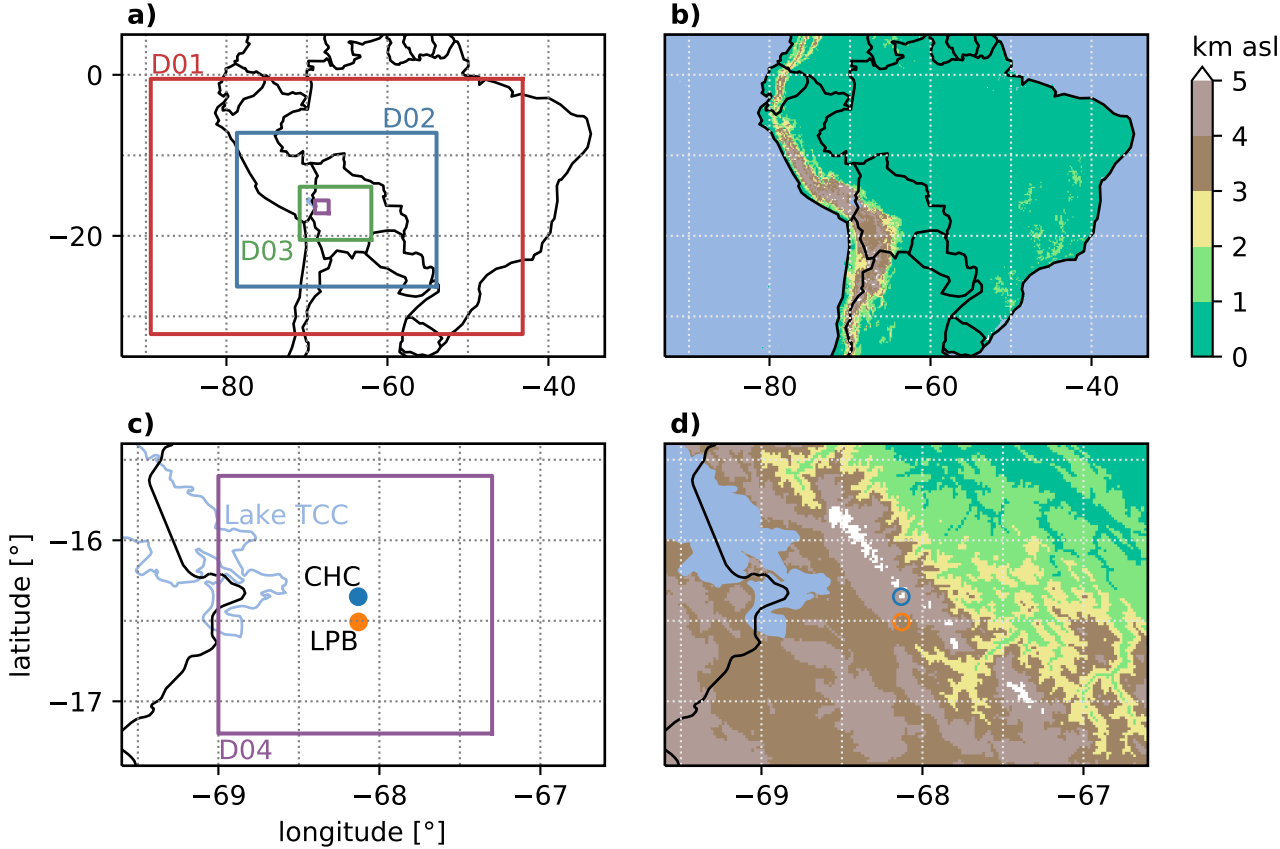
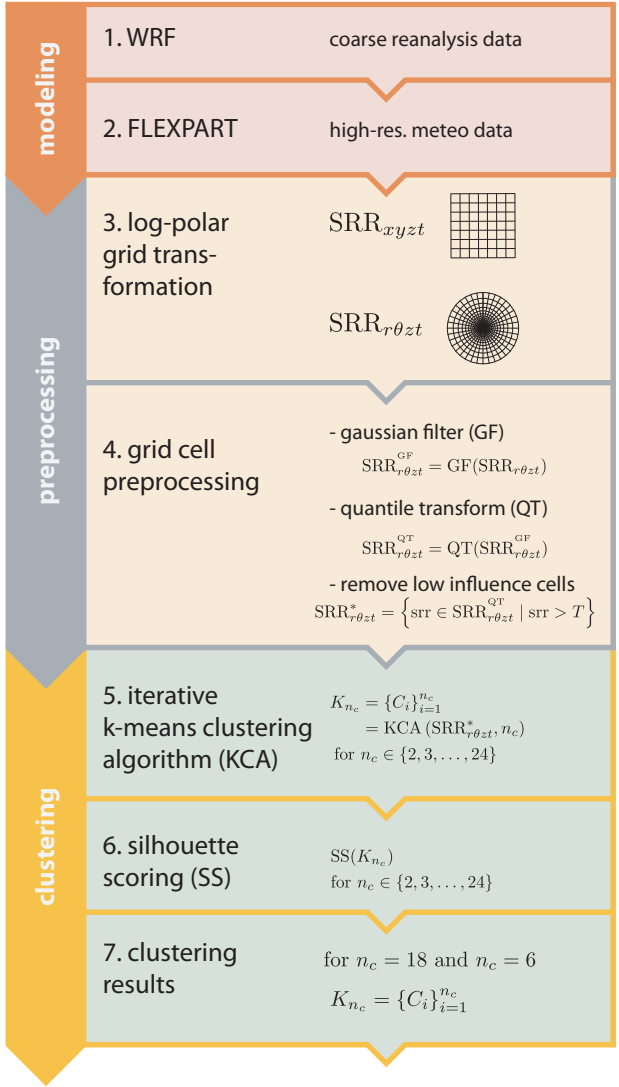


gure 1. Description of the studied region. Panels a) and c) display the 4 nested domains used for the weather research and forecasting (WRF) simulation. Panel c) so includes the location of the Chacaltaya station (CHC, 5.2 km a.s.l.), La Paz City (LPB, 3.6 km a.s.l.) and Lake Titicaca (TCC, 3.9 km a.s.l.). Panels b) and d)

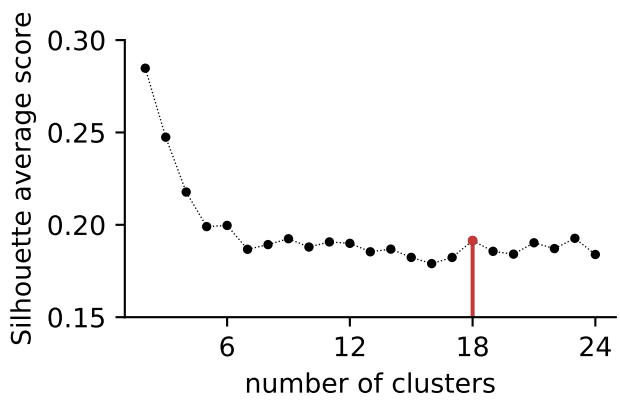


gure 2. Flowchart describing the method's steps. The steps are divided in three groups: modeling, preprocessing and and clustering. SRR refers to the source

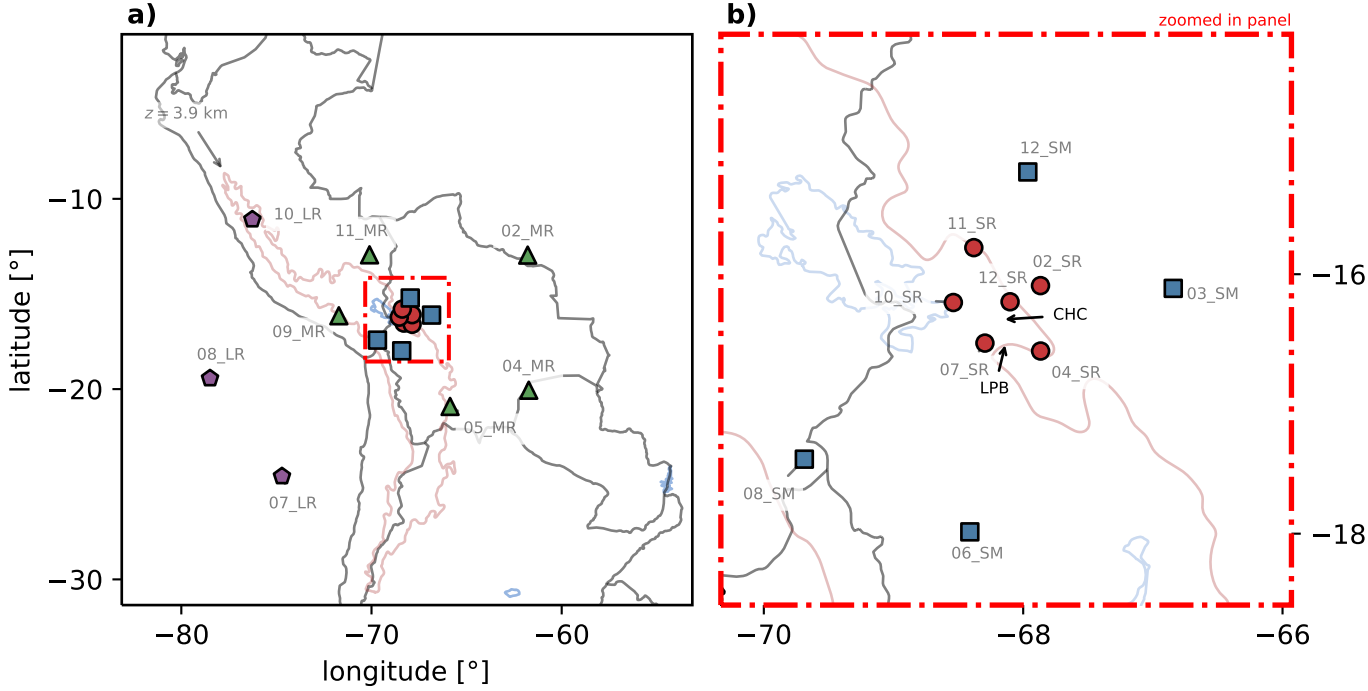
	lower left [°]		upper right [°]			number of cells		parent start	
domain	**lat.**	**lon.**	**lat.**	**lon.**	**p.g.r***	**w.e.†**	**s.n.‡**	**i**	**j**
D01	-0.5	-89.4	-32.2	-43.2	1	118	86	1	1
D02	-26.3	-78.7	-7.2	-53.9	4	253	205	28	18
D03	-20.5	-70.9	-13.9	-62.0	3	274	214	80	65
D04	-17.2	-69.0	-15.6	-67.3	3	154	151	61	110

*parent grid ratio, †west east, ‡south north

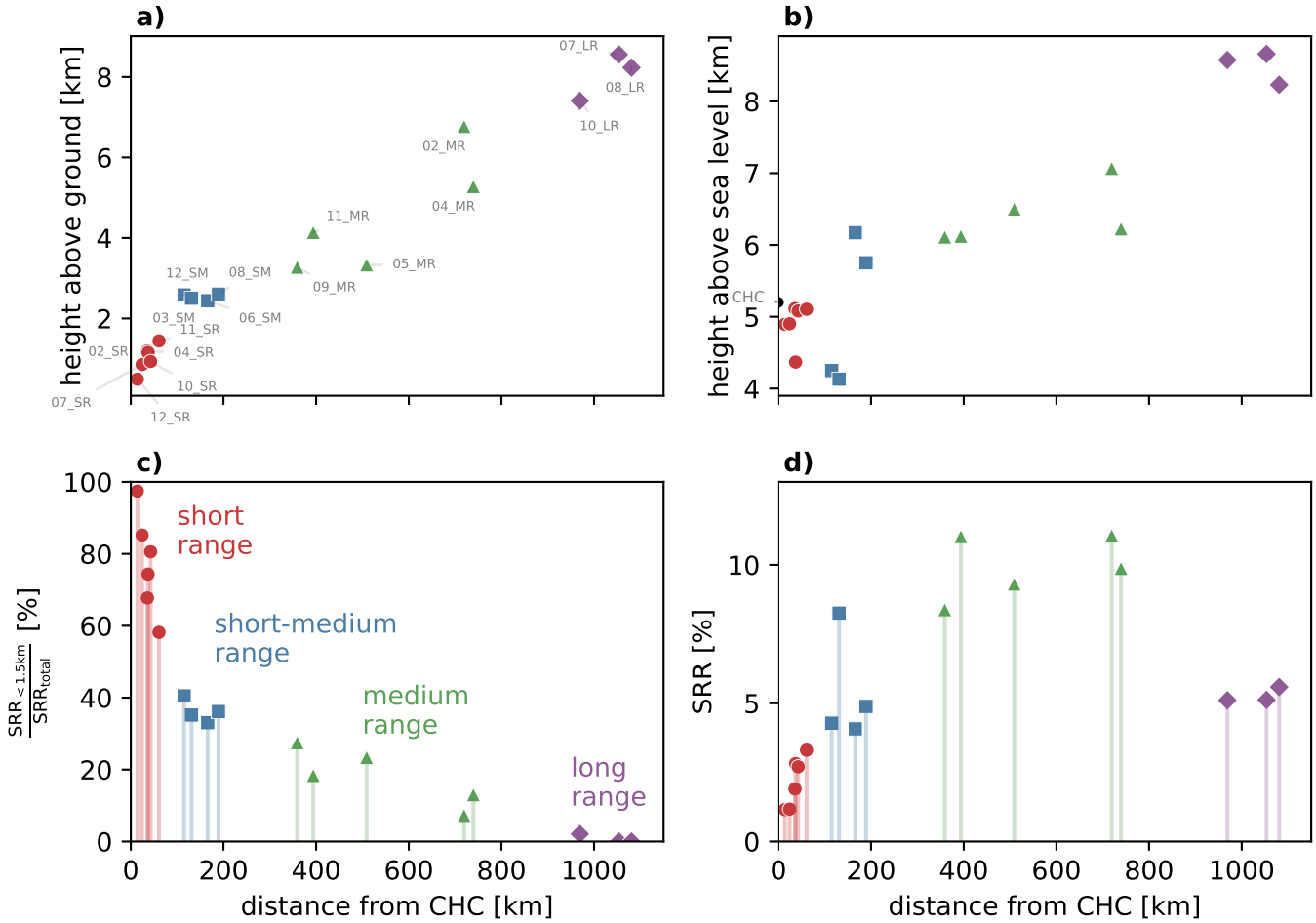
Table 1. Description of the domains used for the WRF simulation.



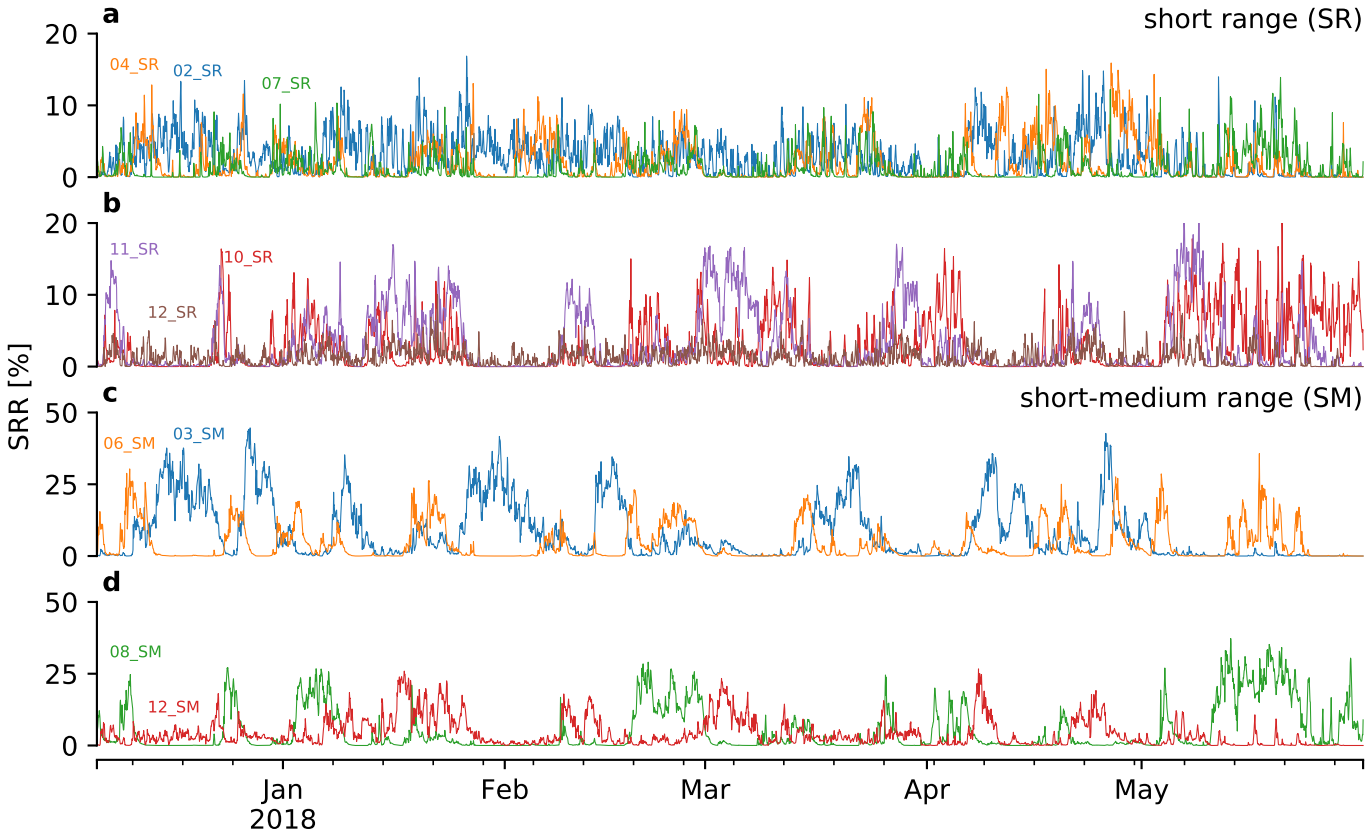
gure 3. Silhouette average score for the iterative 'k means' clustering algorithm from 2 to 24 number of clusters. We decide to use 18 clusters since it has a local



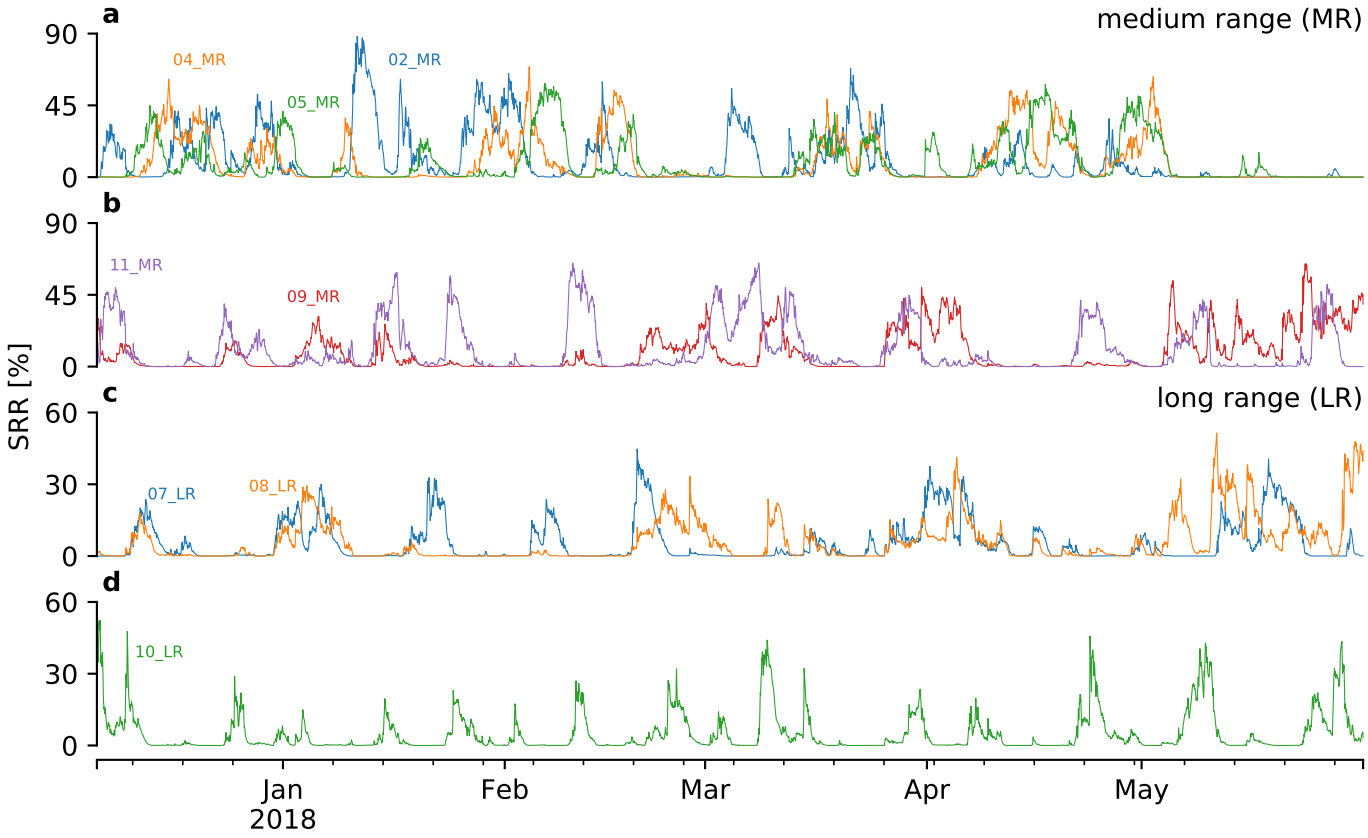
gure 4. Horizontal center of mass of the 18 clusters. Each cluster centroid is marked with a disk (short range), square (short medium range), triangle (medium nge), or pentagon (long range) locator. The brown line corresponds to a height of 3.9 km a.s.l. and encircles the Altiplano plateau. Panel b) corresponds to the gion inside the red rectangle in panel a). The city of La Paz (panel b)) is located in the intersection of clusters 07_SR and 04_SR. The first cluster contains the part



gure 5. Cluster mean properties for each cluster. The horizontal axis for all panels represents the radial distance from CHC. Panel a) shows the median height above ound level of each cluster while panel b) portrays the height above sea level. Panel c) show the ratio between the SRR values that are below 1.5 km above ground



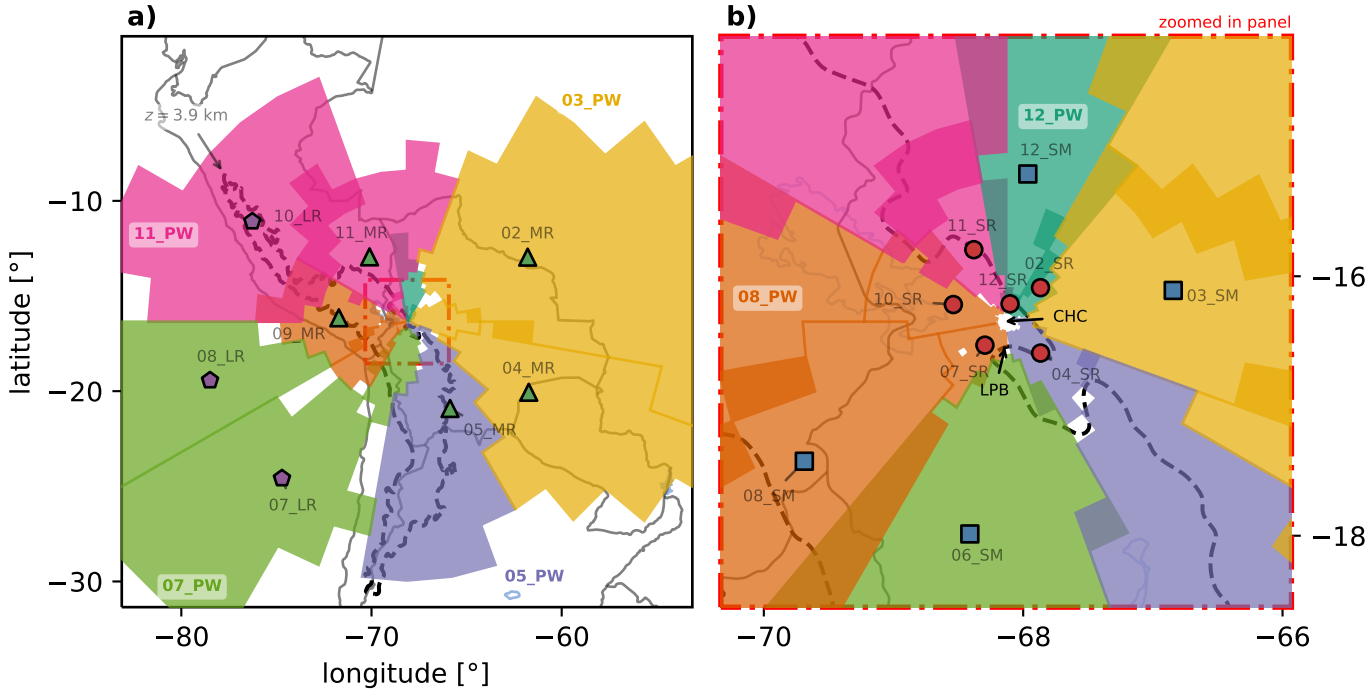
gure 6. Time series of the SRR [%] cluster influence. Panels a and b show the short range (SR) clusters. Panels c and d display the short-medium range (SM)



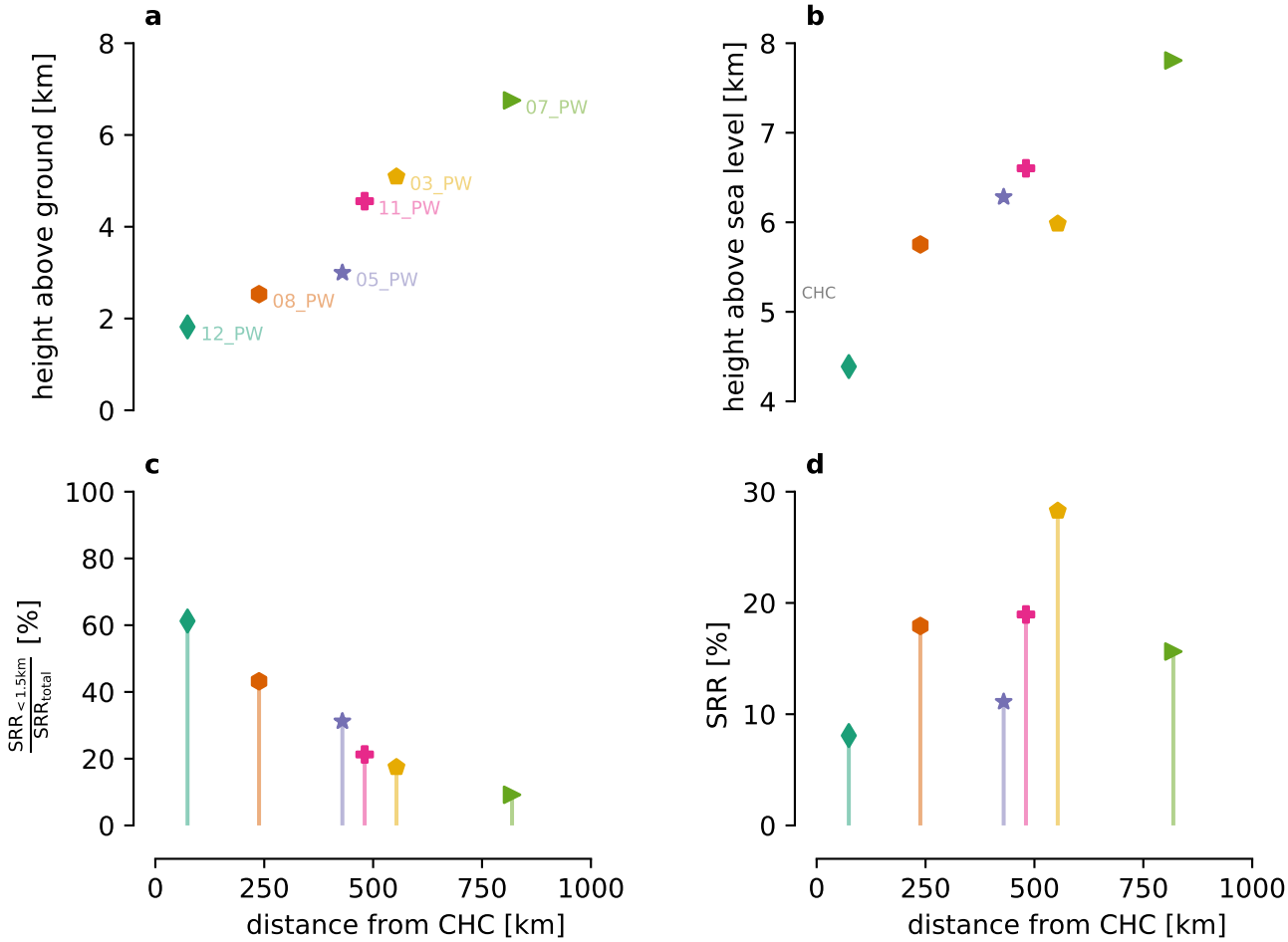
gure 7. Time series of the SRR [%] cluster influence (similar to fig. 6). Panels a and b show the medium range (MR) clusters. Panels c and d display the long range

short name	SRR [%] $n_c = 18$	distance from CHC [km]	height above ground [km]	height above sea level [km]	$\frac{\text{SRR}_{<1.5\text{km}}}{\text{SRR}_{\text{total}}}$ [%]	main pathway	SRR [%] $n_c = 6$
03_SM	8.0	131	2.52	4.14	36	03_PW	28.3
02_MR	10.7	713	6.83	7.13	7		
04_MR	9.6	728	5.28	6.23	14		
04_SR	1.9	36	1.24	5.14	68	05_PW	11.1
05_MR	9.2	509	3.35	6.51	24		
06_SM	4.1	165	2.38	6.13	34	07_PW	15.6
07_LR	5.5	1045	8.55	8.66	0		
08_LR	6.1	1080	8.23	8.23	0		
07_SR	1.2	24	0.83	4.87	85	08_PW	17.9
10_SR	2.8	43	0.91	5.04	81		
08_SM	5.2	189	2.55	5.73	38		
09_MR	8.8	359	3.27	6.11	29		
11_SR	3.2	61	1.45	5.10	59	11_PW	19.0
11_MR	10.7	392	4.15	6.12	19		
10_LR	5.0	950	7.48	8.66	2		
12_SR	1.2	14	0.53	4.90	98	12_PW	8.1
02_SR	2.8	37	1.18	4.38	75		
12_SM	4.1	116	2.61	4.25	42		

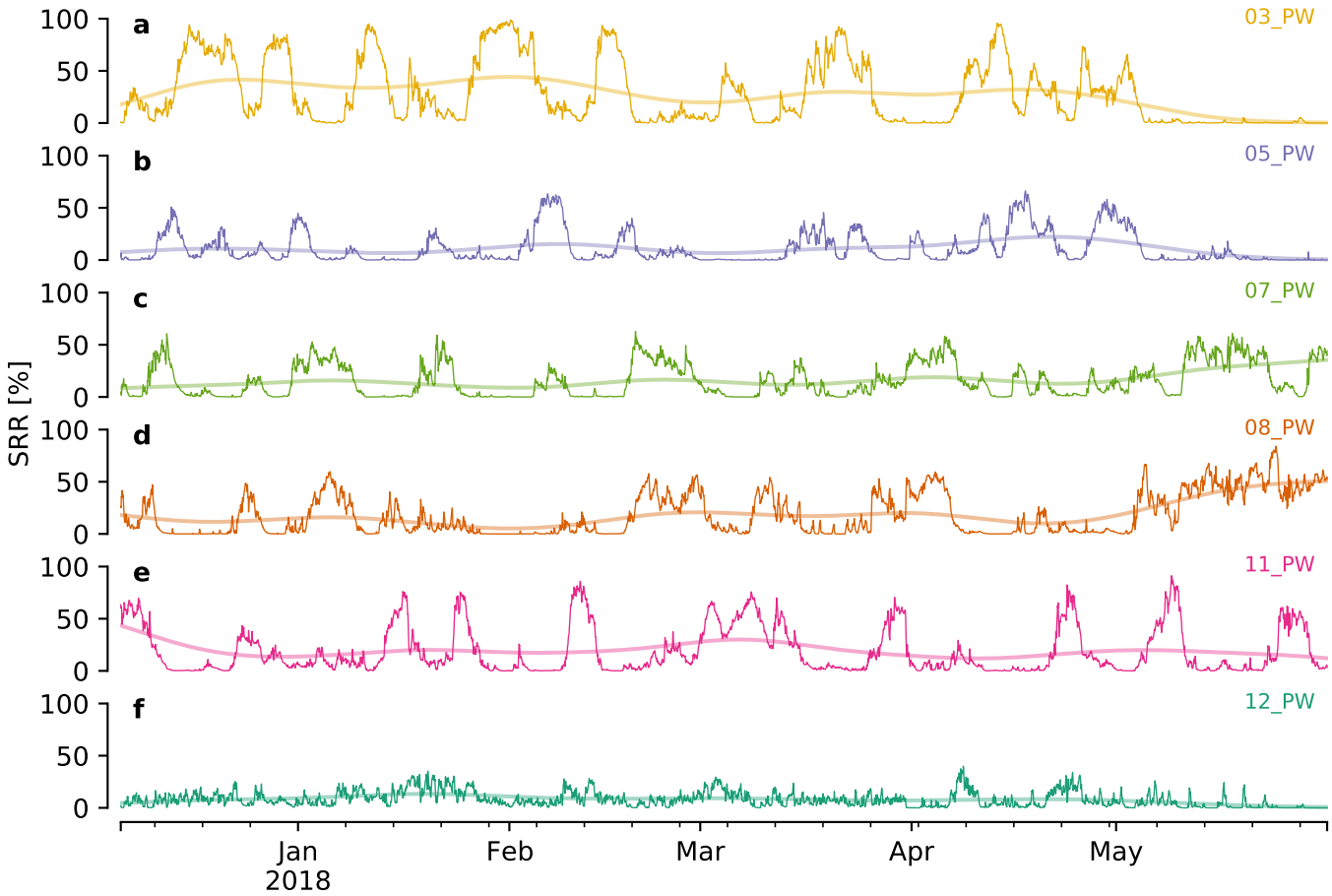
able 2. Describes the properties of the eighteen clusters ($n_c = 18$). The short-name's digits refer to the clockwise direction of the center of mass of each cluster. he letters refer to the range: SR = short range, SM = short medium range, MR = medium range, and LR = long range. The SRR [%] column describe the average ontribution of each cluster. We also show the distance from CHC, height above ground and height above sea level of each cluster's center of mass. Furthermore, $\frac{\text{SRR}_{<1.5\text{km}}}{\text{SRR}_{\text{total}}}$ [%] shows the ratio between the SRR below 1.5 km and the SRR summed over the full vertical column ($\text{SRR}_{\text{total}}$). The last two columns describe the results clustering the 18 clusters into 6 clusters (main pathways, $n_c = 6$). The digits also refer to the clockwise direction. Finally the last columns adds up the SRR [%] of e cluster belonging to each main pathway.



gure 8. Similar to fig. 4 including the horizontal location of the 18 clusters but also adding the main 6 pathways (PW). Each cluster centroid is marked with a disk hort range), square (short medium range), triangle (medium range), or pentagon (long range) locator. For each cluster we select cells that contain 80% of its SRR lues during the modeling period. The color of each cluster is related to the main pathway they belong to: 03_PW (yellow), 05_PW (purple), 07_PW (green), 08_PW range), 11_PW (pink), and 12_PW (teal). Cluster boundaries are delimited by a darker 'border' line. The dashed black line corresponds to a height of 3.9 km a.s.l. d encircles the Altiplano plateau. Panel b) corresponds to the region inside the red rectangle in panel a). The city of La Paz (panel b)) is located in the intersection



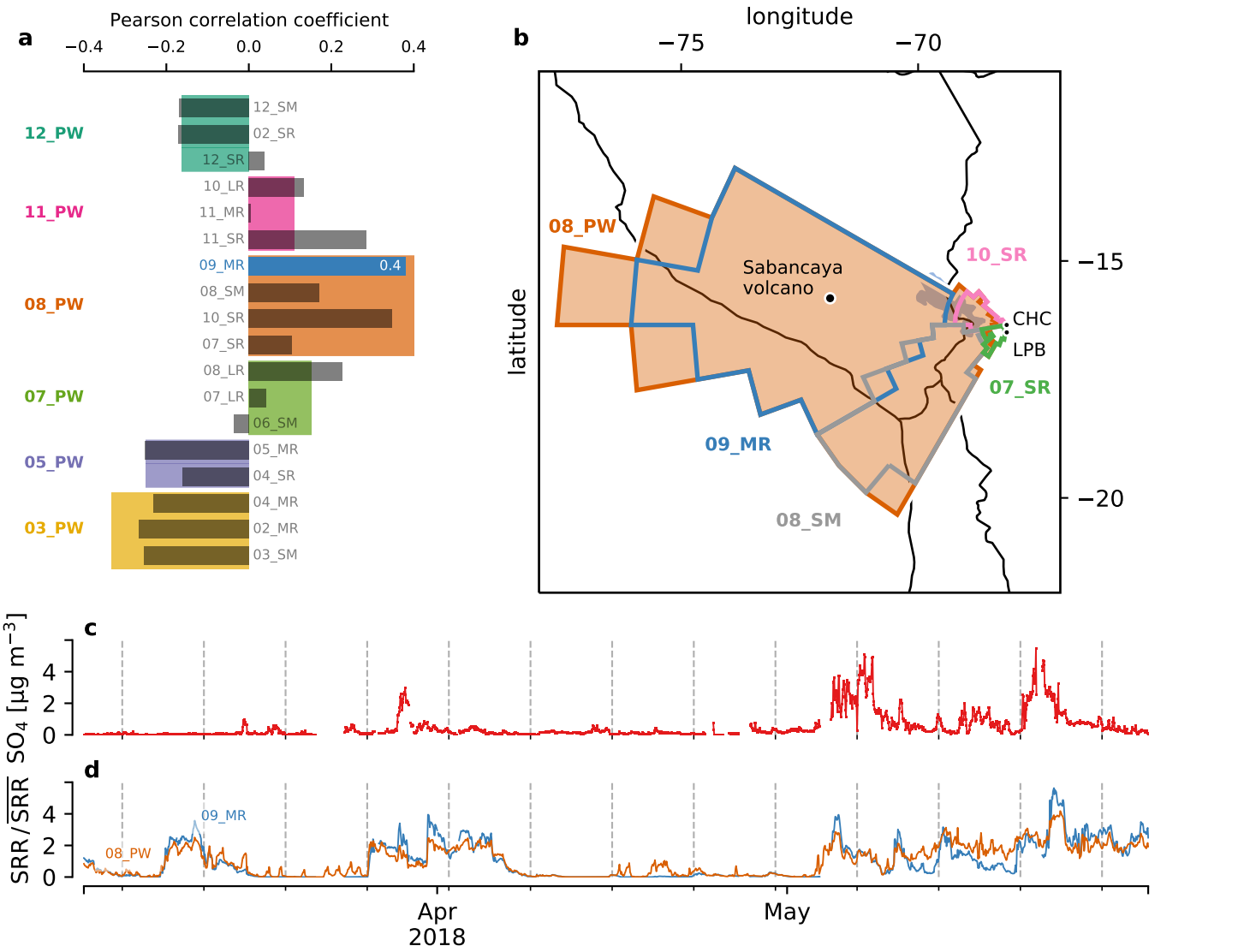
gure 9. Centroid properties for each of the main pathways (PW). This figure is similar to fig. 5. Panel a shows the median height above ground level of each cluster hile panel b portrays the height above sea level. Panel c shows the ratio between the SRR values that are below 1.5 km above ground level and the total SRR value



gure 10. Time series of the SRR [%] influence for each main pathway (PW). The figure is similar to figs. 6 and 7. The smooth line on each panel is obtained by plying a gaussian filter on the original dataset with std=10 days. It can be seen that 03_PW, 05_PW and to a lesser extent 12_PW reduce their influnce in May hich is the transition month between the wet and the dry season suggesting that these pathways are more influential during the wet season. 07_PW and 08_PW

main pathway	SRR [%] $n_c = 6$	distance from CHC [km]	height above ground [km]	height above sea level [km	$\frac{\mathrm{SRR}_{<1.5\mathrm{km}}}{\mathrm{SRR}_{\mathrm{total}}}$[%]
03_PW	28.3	554	5.09	5.98	17
05_PW	11.1	429	3.00	6.28	31
07_PW	15.6	819	6.75	7.81	9
08_PW	17.9	238	2.53	5.75	43
11_PW	19.0	481	4.56	6.60	21
12_PW	8.1	74	1.82	4.39	61

able 3. Describes the properties of the main 6 pathways (similar to table 2). The main-pathway's digits refer to the clockwise direction of the center of mass of the r masses. The colors are unique for each PW and the same scheme is used on table 2 and fig. 8. The SRR [%] columns describe the average contribution of each uster. We also show the distance from CHC, height above ground and height above sea level of each cluster's center of mass. Furthermore, $\frac{\mathrm{SRR}_{<1.5\mathrm{km}}}{\mathrm{SRR}_{\mathrm{total}}}$[%] shows the tio between the SRR below 1.5 km and the SRR summed over the full vertical column ($\mathrm{SRR}_{\mathrm{total}}$).



gure 11. In panel a, we show the pearson correlation between SO_4 concentrations sampled at CHC and, both, the 18 clusters and the 6 pathways (PW). In panel the regions covered by the pathway 08_PW and the clusters 09_MR, 08_SM, 10_SR and 07_SR are shown. All of the aforementioned clusters are contained by