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Human displacements from Tropical Cyclone Idai attributable to climate change

Benedikt Mester et al.

Correspondence to: Benedikt Mester (benedikt.mester@pik-potsdam.de)

Supplement

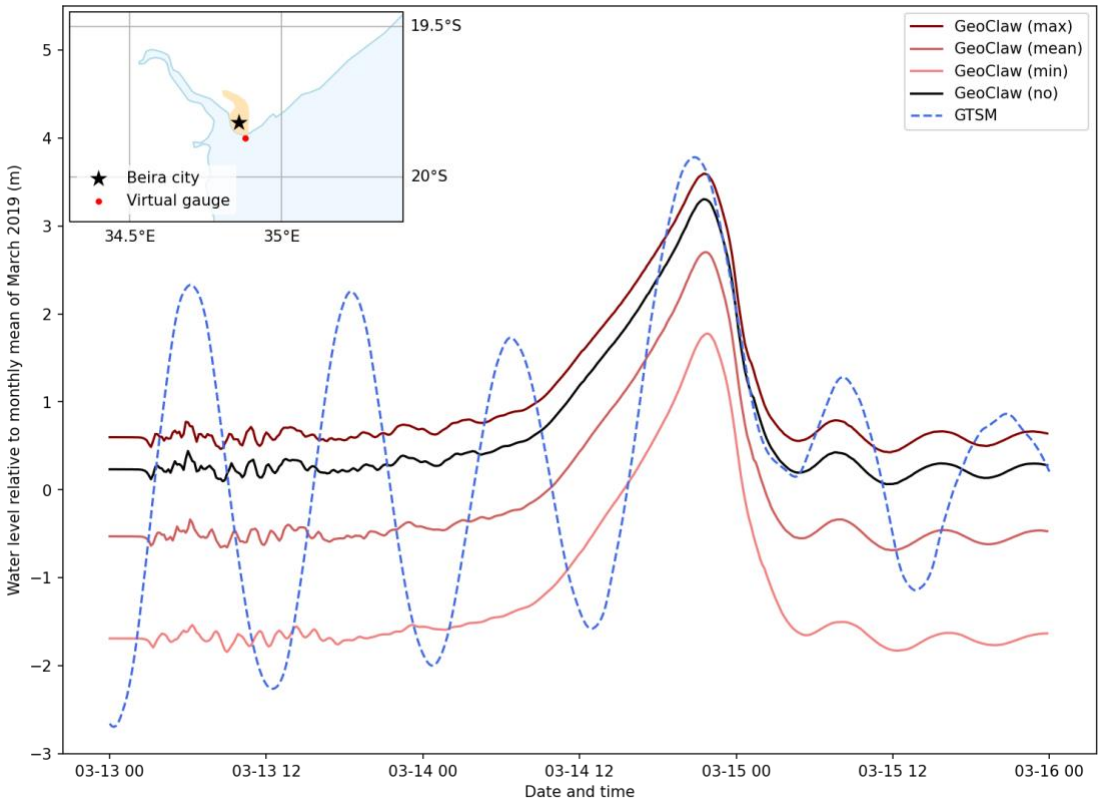

Figure S1: Water levels at a virtual tide gauge station off the coast of Beira, Mozambique, according to simulations. Several runs of GeoClaw are compared to GTSM: The GeoClaw runs are initialized with different base sea levels corresponding to assumptions of low (min), average (mean), and high (max) astronomical tides at landfall. Another run of GeoClaw is initialized with the monthly mean sea level from satellite altimetry (no). GTSM is driven by astronomical tidal forcing, and ERA5 meteorological forcing overlayed by a parametric TC wind field. While GeoClaw does not incorporate tidal dynamics, the maximum surge heights agree well with GTSM.

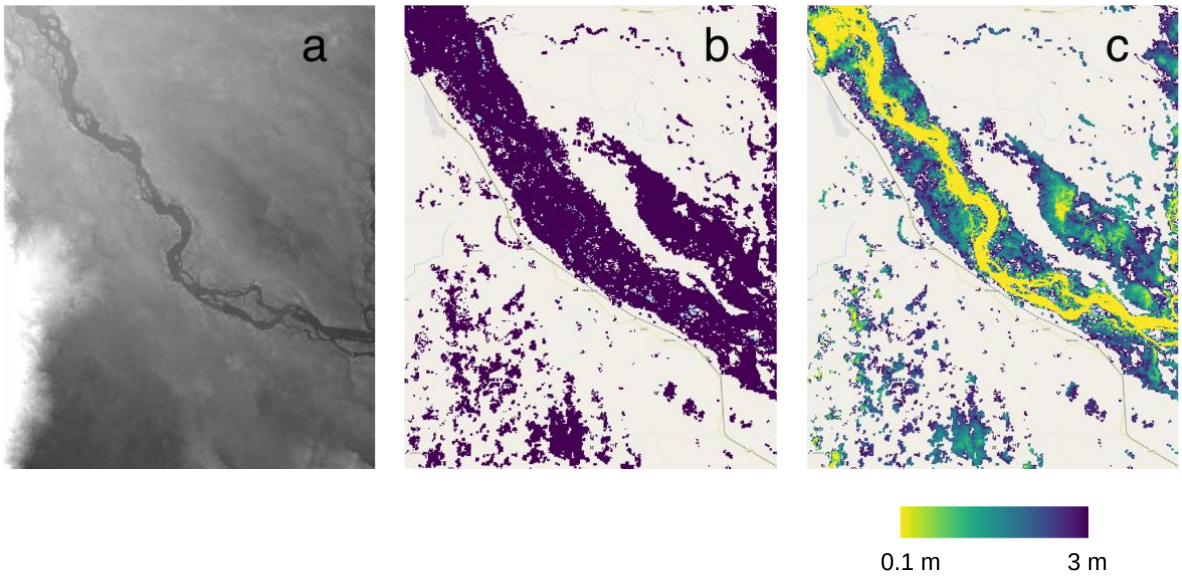

Figure S2: Extract of a) MERIT DEM (Yamazaki et al., 2019), b) flood extents obtained from FloodScan (Atmospheric and Environmental Research & African Risk Capacity 2022), and c) corresponding gridded-depths computed with the RICorDE algorithm. AFED-detected non-persistent water (2019/03/01 - 2019/03/31). Includes copyrighted material of Atmospheric and Environmental Research, Inc. with its permission.

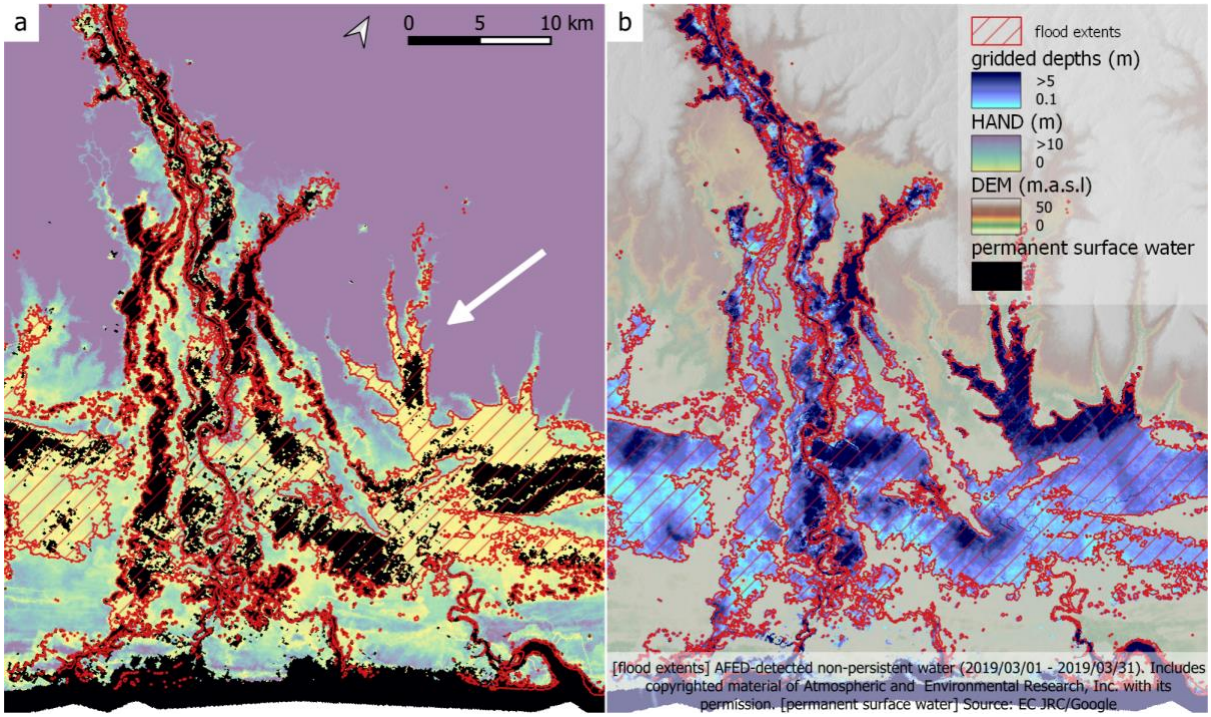

Figure S3: Example of RICorDE performance against flood extents obtained from FloodScan (Atmospheric and Environmental Research & African Risk Capacity 2022) showing a) permanent surface water (Pekel et al., 2016) and resulting HAND values; and b) MERIT DEM (Yamazaki et al., 2019) and resulting depths values.

Table S1: Critical flood depths for which the simulated affected people approximately equals the 478,000 reported displacements. The closest upper and lower 10 cm flood depth steps are shown for each tide.

Tide	Critical Flood Depth [cm]	Affected People
no	401-410	480,838
no	411-420	474,140
max	391-400	495,714
max	401-410	471,209
min	391-400	495,674
min	401-410	471,148
mean	391-400	502,572
mean	401-410	478,067

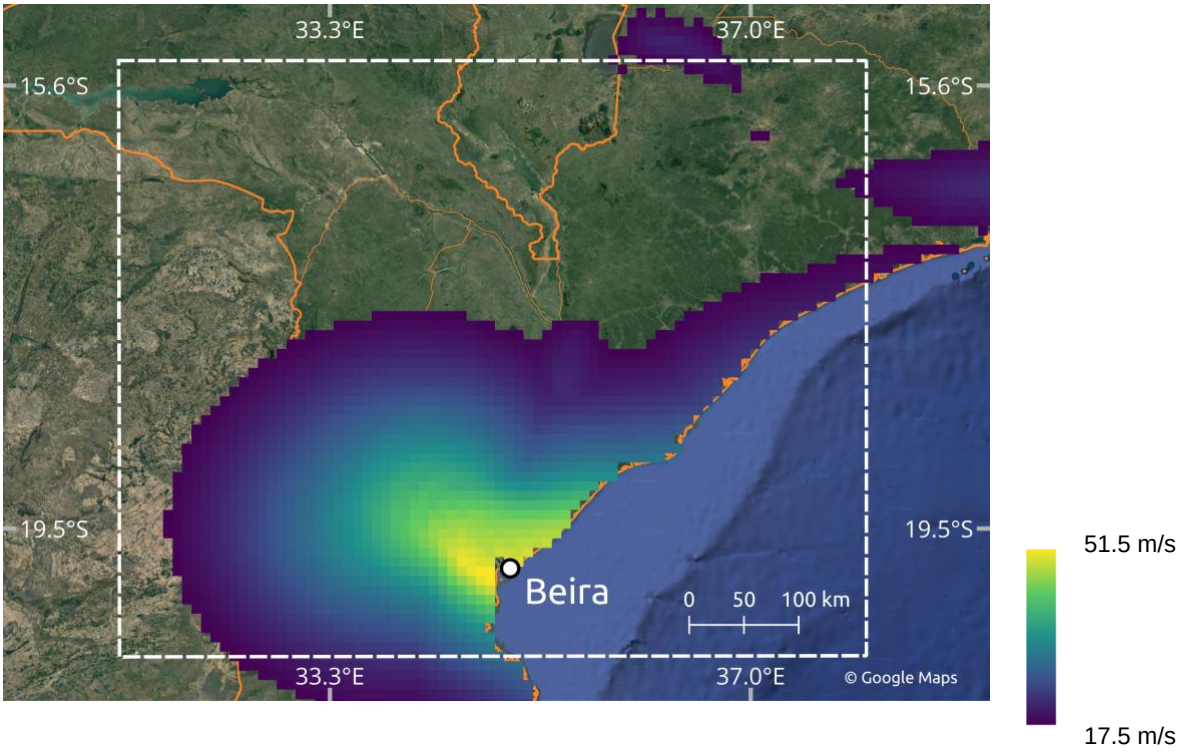

Figure S4: Maximum wind speeds of TC Idai, which made landfall in Mozambique in 2019. White dashed box shows the area of interest in which high wind speed exposure is computed; satellite image background by © Google Maps (Google Maps (b), 2022).

Table S2: Overview main results for modeled affected people. Min./Median/Max. are related to the SLR scenarios. Bold font of the first results row indicates the primary parameter estimate. Cells with a "*" indicate the altered parameter in comparison with the primary estimate.

Counterfactual	Flood-Depth Threshold [cm]	Intensification [%]	Tide	Affected Dif.. Min.	Affected Dif.. Median	Affected Dif. Max	Affected Dif. Min. [%]	Affected Dif. Median [%]	Affected Dif. Max [%]
SLR + wind	**100**	**10**	**max**	**35229**	**36887**	**39311**	**2.9**	**3.0**	**3.2**
SLR + wind	100	10	no*	32886	33200	38121	2.7	2.7	3.2
SLR + wind	100	10	min*	22557	22557	23481	1.9	1.9	2.0
SLR + wind	100	10	mean*	26222	27012	29087	2.2	2.3	2.4
SLR + wind	50*	10	max	161895	171054	181243	10.8	11.5	12.3
SLR + wind	10*	10	max	123102	138884	148528	6.4	7.2	7.8
SLR*	100	10	max	6360	14757	15805	0.5	1.2	1.3
wind*	100	10	max	-	24934	-	-	2.6	-
SLR + wind	100	8.5*	max	27443	35291	37847	2.2	2.9	3.1
SLR + wind	100	12*	max	37784	44583	48181	3.1	3.7	4.0

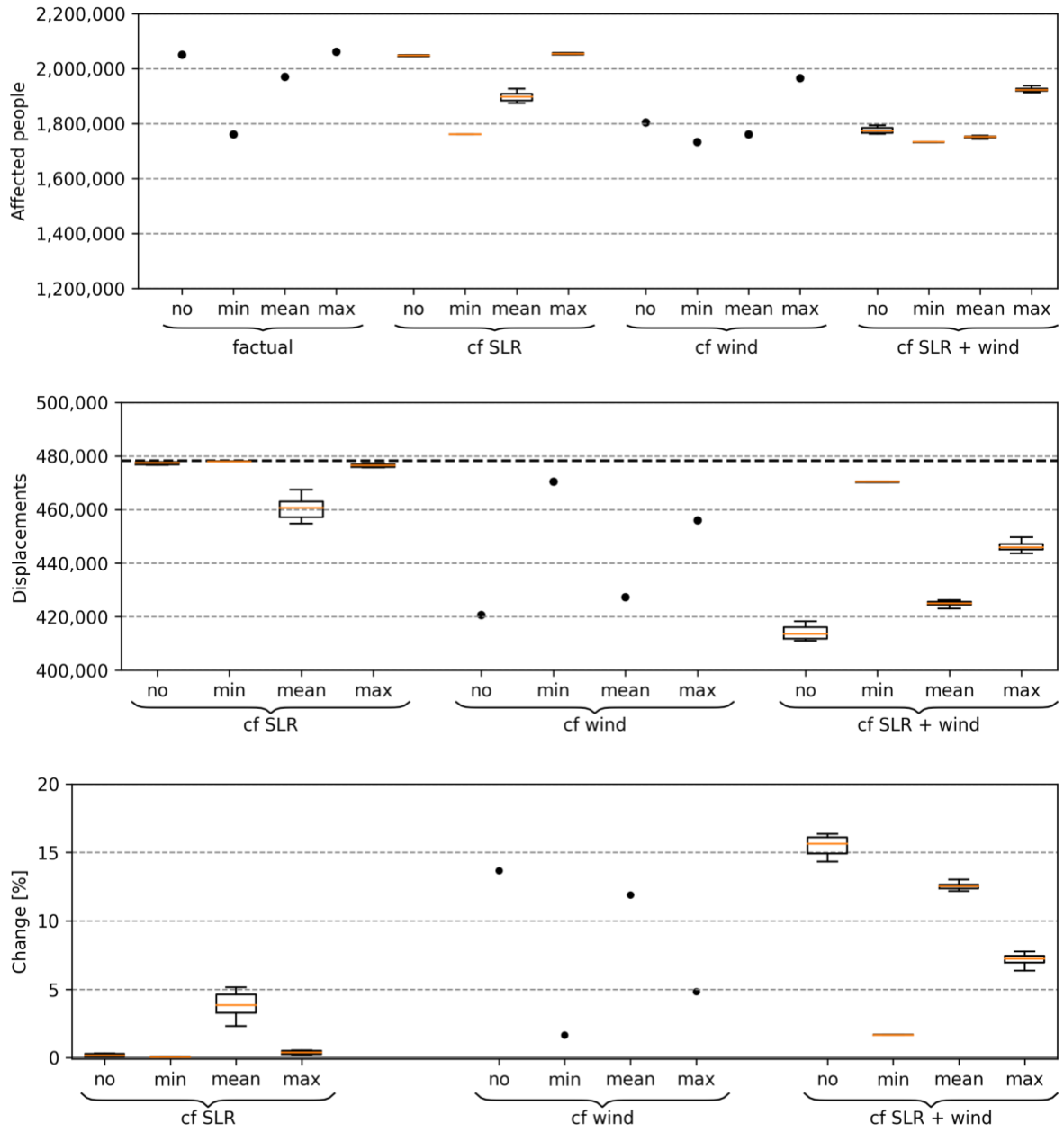

Figure S5: Simulated affected people, displacements and percentage change by flooding (10 cm impact threshold). The percentage change compares factual and counterfactual displacements, and represents the absolute relative change based on the counterfactual results. Three counterfactual scenarios are shown: lower sea level ("cf SLR")), intensification ("cf wind"), and a combination of both ("cf SLR + wind"). Additionally, a variety of counterfactual sea levels as well as a set of astronomical tides is presented, covering minimum ("min"), mean ("mean"), and maximum ("max") as well as monthly mean sea level from satellite altimetry ("no"). Bold dashed line in the middle panel shows the number of observed displacements. Percentile changes in affected people and displacements are the same. The second quartile Q2 (median) of the box plot is shown in orange, "whiskers" are placed at ±1.5 * interquartile range (Q3-Q1).

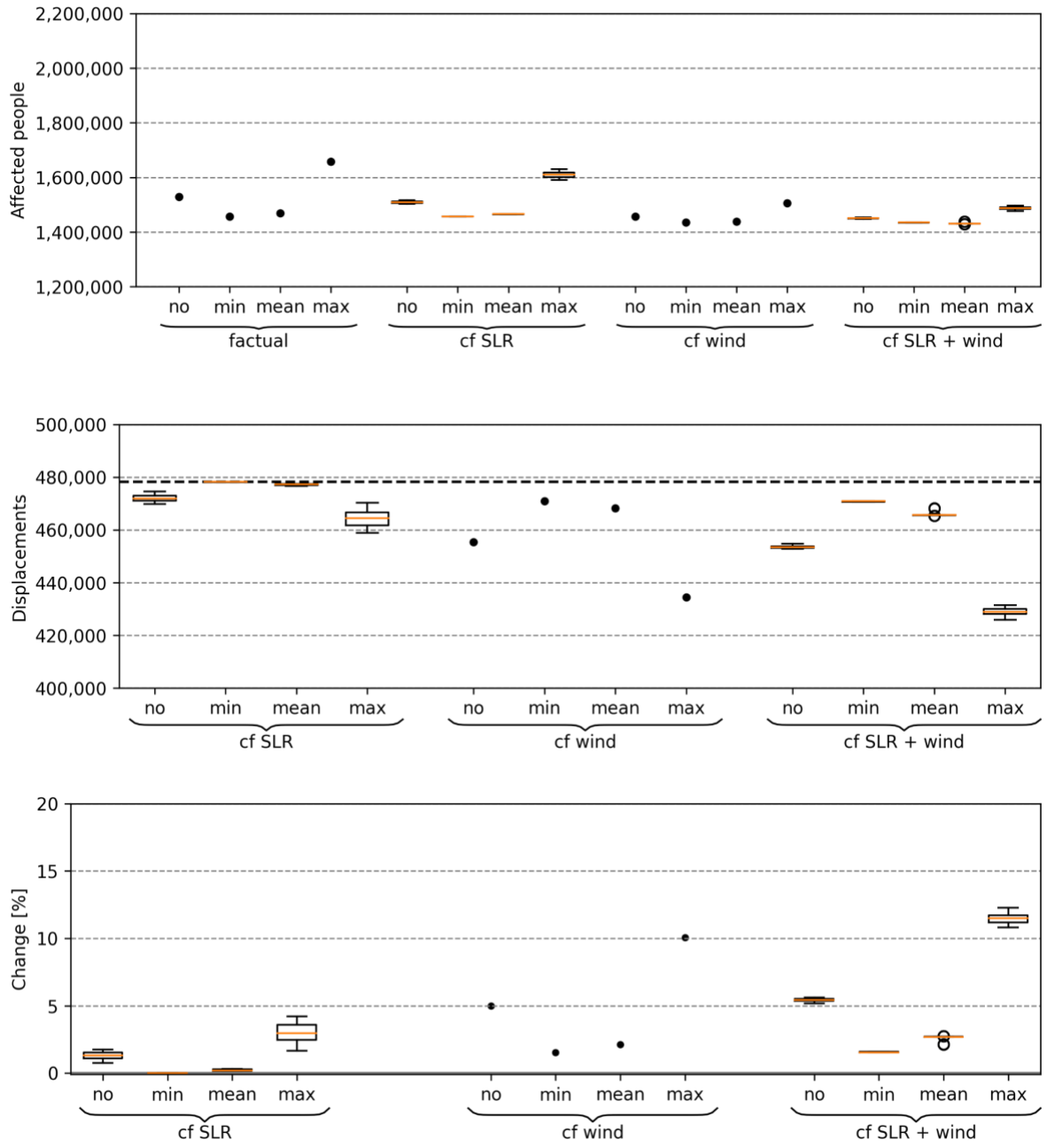

Figure S6: Simulated affected people, displacements and percentage change by flooding (50 cm impact threshold). The percentage change compares factual and counterfactual displacements, and represents the absolute relative change based on the counterfactual results. Three counterfactual scenarios are shown: lower sea level ("cf SLR")), intensification ("cf wind"), and a combination of both ("cf SLR + wind"). Additionally, a variety of counterfactual sea levels as well as a set of astronomical tides is presented, covering minimum ("min"), mean ("mean"), and maximum ("max") as well as monthly mean sea level from satellite altimetry ("no"). Bold dashed line in the middle panel shows the number of observed displacements. Percentile changes in affected people and displacements are the same. The second quartile Q2 (median) of the box plot is shown in orange, "whiskers" are placed at ±1.5 * interquartile range (Q3-Q1).