

Supplementary Materials: Urban-induced changes on local circulation in complex terrain: Central Mexico Basin






Lourdes P. Aquino-Martínez ¹, Arturo I. Quintanar ²^{*}, Carlos A. Ochoa-Moya ², Erika Danaé López Espinoza ², David K. Adams ² and Aron Jazcilevich-Diamant ²

Table S1: Station locations.

ID	Lat (°N)	Lat (°W)	Elev (m)	Station
ACO	19.64	98.91	2198	ACOLMAN
AJU	19.15	99.16	2942	AJUSCO
AJM	19.27	99.21	2548	AJUSCO MEDIO
CHO	19.27	98.89	2253	CHALCO
CUA	19.37	99.29	2704	CUAJIMALPA
CUT	19.72	99.20	2263	CUAUTITLAN
FAC	19.48	99.24	2299	FES ACATLAN
GAM	19.48	99.09	2227	GUSTAVO A. MADERO
HGM	19.41	99.15	2234	HOSPITAL GENERAL
LAA	19.48	99.15	2255	LAB. DE ANALISIS AMBIENTAL
MER	19.42	99.12	2245	MERCED
MGH	19.40	99.20	2327	MIGUEL HIDALGO
MPA	19.18	98.99	2594	MILPA ALTA
NEZ	19.39	99.03	2235	NEXAHUALCOYOTL
PED	19.33	99.20	2326	PEDREGAL
SFE	19.36	99.26	2599	SANTA FE
TAH	19.25	99.01	2297	TLAHUAC
UAX	19.30	99.10	2246	UAM XOCHIMILCO
UIZ	19.36	99.07	2221	UAM IZTAPALAPA
VIF	19.66	99.10	2242	VILLA DE LAS FLORES
XAL	19.53	99.08	2160	XALOSTOC
059	19.50	99.15	2240	ENCB II
061	19.39	99.10	2358	TEZONTLE
095	19.12	98.66	4007	ALTZOMONI
097	19.54	99.52	3754	CERRO CATEDRAL
099	19.10	98.64	3682	PARQUE IXTA-POPOCATEPETL
100	19.52	99.27	2364	PRESA MADIN
RAS	19.40	99.20	2313	RADIOSONDE
RAWP	19.48	99.14	2255	RADAR WIND PROFILER

Table S2: Taylor metrics(denoted by the first letter) correlation coefficient (R), root mean square error (S) and bias relative to observations (B), the second letter indicates the meteorological variable: T for temperature at 2m ($^{\circ}\text{C}$), U for u-horizontal wind (ms^{-1}) and V for v-horizontal wind (ms^{-1}), for CTRL experiment.

ID	RT	ST	BT	RU	SU	BU	RV	SV	BV
ACO	0.969	0.982	-2.241	0.335	0.883	0.048	-0.234	1.379	0.768
AJU	0.926	0.543	2.949	0.707	2.333	-0.108	0.720	1.020	-1.209
AJM	0.981	1.004	0.538	0.861	0.745	-0.919	0.229	0.667	-0.247
CHO	0.990	0.753	0.410	0.717	1.335	-0.090	0.855	2.125	-0.027
CUA	0.955	0.940	0.918	0.536	0.933	-0.304	0.457	0.660	-0.397
CUT	0.952	0.790	-0.104	0.380	1.223	-0.160	0.724	1.417	-1.120
FAC	0.893	0.615	-0.368	0.668	0.799	-0.525	-0.340	1.060	-1.275
GAM	0.974	0.907	-0.557	0.141	0.582	-0.375	0.522	1.017	-0.141
HGM	0.974	0.938	-0.957	0.180	1.147	-0.775	-0.400	1.730	-0.354
LAA	0.984	0.944	1.053	0.433	1.005	-0.427	0.100	1.123	0.105
MER	0.985	0.946	-0.482	0.509	0.963	-0.015	0.247	2.091	0.283
MGH	0.969	0.973	-0.702	0.698	0.730	0.114	0.315	0.981	-0.682
MPA	0.947	0.759	-0.933	0.650	0.701	0.339	0.803	0.848	0.023
NEZ	0.986	0.880	-0.239	0.591	0.784	0.449	0.739	1.015	0.241
PED	0.963	0.901	-0.199	0.791	0.743	-0.786	0.025	1.009	-1.039
SFE	0.952	0.894	0.614	0.739	0.804	-0.681	0.107	0.580	-0.904
TAH	0.952	0.698	0.839	0.526	0.961	0.418	0.347	1.153	0.313
UAX	0.969	0.777	1.108	0.422	1.093	-0.112	0.079	1.291	-0.612
UIZ	0.982	0.903	-0.795	0.385	1.003	-0.006	0.425	1.309	-0.048
VIF	0.954	1.061	-3.290	0.268	1.149	-0.005	0.729	2.817	-0.241
XAL	0.980	0.969	-0.645	0.037	0.554	-0.255	0.705	0.968	-0.151
059	0.949	0.755	-1.888	0.555	0.214	-0.586	0.490	0.441	1.821
061	0.955	0.920	-1.020	-0.653	0.906	0.074	0.481	1.098	-0.612
095	0.921	0.620	-3.316	0.407	0.125	8.269	-0.274	0.413	-3.575
097	0.915	1.279	-2.689	-0.243	0.503	3.919	0.297	0.180	5.241
099	0.950	1.016	-4.778	0.356	0.188	4.107	-0.377	0.408	-3.083
100	0.904	0.702	1.348	0.868	0.174	-2.126	-0.055	0.598	1.399
CCA	0.950	0.813	0.780	0.714	0.961	-0.161	-0.086	2.052	-0.556

Table S3: Hourly Taylor metrics(denoted by the first letter) correlation coefficient (R), root mean square error (S) and bias relative to observations (B), the second letter indicates the meteorological variable: T for temperature at 2m (°C), U for u-horizontal wind (ms^{-1}) and V for v-horizontal wind (ms^{-1}), for CTRL experiment.

HR	RT	ST	BT	RU	SU	BU	RV	SV	BV
00	0.860	1.153	0.073	0.197	0.124	1.208	-0.220	0.416	-1.736
01	0.845	1.185	0.174	0.334	0.201	1.367	-0.095	0.402	-0.922
02	0.823	1.212	0.500	0.393	0.215	1.123	0.060	0.551	-0.726
03	0.785	1.169	0.764	0.370	0.186	1.093	0.110	0.415	-1.055
04	0.772	1.203	0.992	0.352	0.206	0.781	0.119	0.345	-1.179
05	0.711	1.210	1.111	0.370	0.237	0.738	0.003	0.314	-1.111
06	0.651	1.239	1.280	0.235	0.226	0.285	0.235	0.383	-0.838
07	0.554	1.343	0.822	0.351	0.249	0.654	0.077	0.292	-0.758
08	0.390	0.944	-0.509	0.415	0.207	0.962	0.148	0.433	-0.302
09	0.377	1.030	-1.946	0.552	0.179	1.277	-0.055	0.292	-0.607
10	0.403	0.983	-2.279	0.610	0.231	1.355	0.554	0.274	-0.380
11	0.648	1.082	-2.578	0.642	0.261	0.740	0.370	0.320	-0.244
12	0.804	1.134	-2.703	0.710	0.271	1.057	0.511	0.393	-0.104
13	0.854	1.208	-2.735	0.631	0.273	1.379	0.548	0.461	0.101
14	0.885	1.247	-2.324	0.553	0.349	1.209	0.720	0.481	0.463
15	0.910	1.219	-1.737	0.594	0.351	0.797	0.554	0.805	1.066
16	0.945	1.111	-1.015	0.029	0.349	-0.983	0.421	0.743	1.738
17	0.957	1.054	-0.448	0.439	0.631	-1.137	0.601	0.701	2.022
18	0.965	0.983	0.230	0.483	0.750	-1.619	0.684	0.806	1.751
19	0.909	1.124	-0.045	0.458	0.472	-0.673	0.561	1.079	0.219
20	0.850	1.128	-0.374	0.381	0.502	-0.818	0.530	0.978	-0.647
21	0.853	1.067	-0.332	0.388	0.466	-1.748	0.073	0.707	-0.906
22	0.866	1.025	0.026	0.059	0.252	-0.886	0.013	0.343	-0.502
23	0.840	1.012	0.498	-0.058	0.182	-0.171	0.127	0.293	-0.554

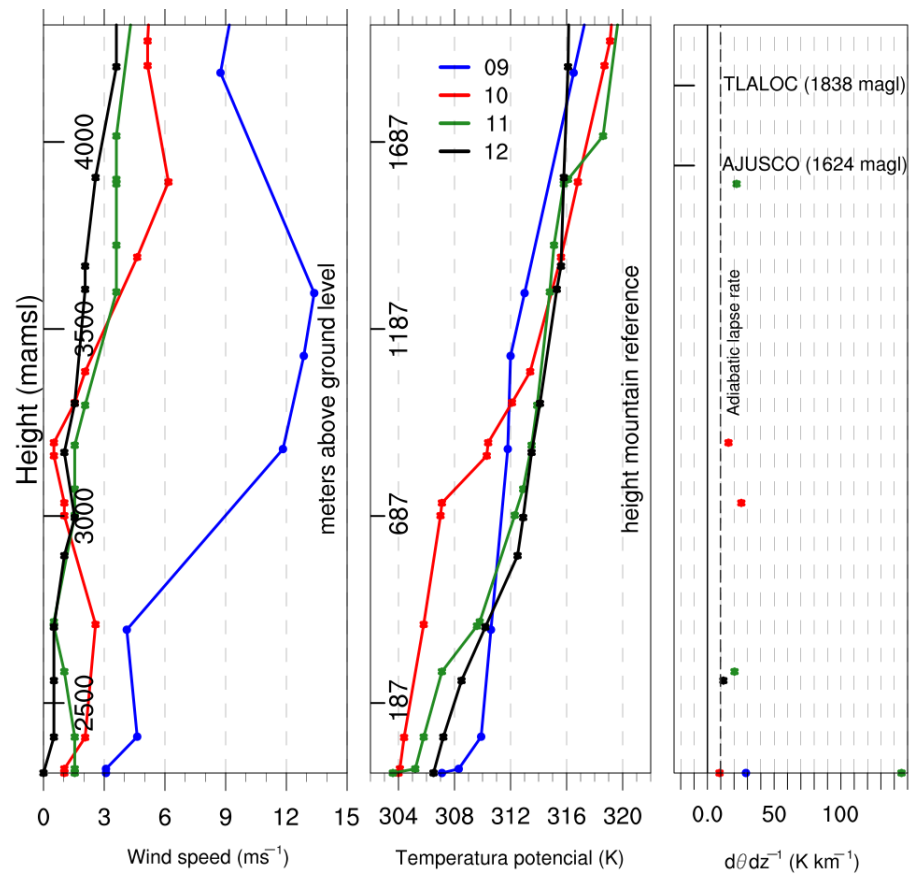


Figure S1. Wind speed ($m s^{-1}$), θ (K) and $d\theta/dz$ ($K km^{-1}$) profiles from radiosonde at 1200 UTC (0600 LST) in 09 to 12 February, 2017.

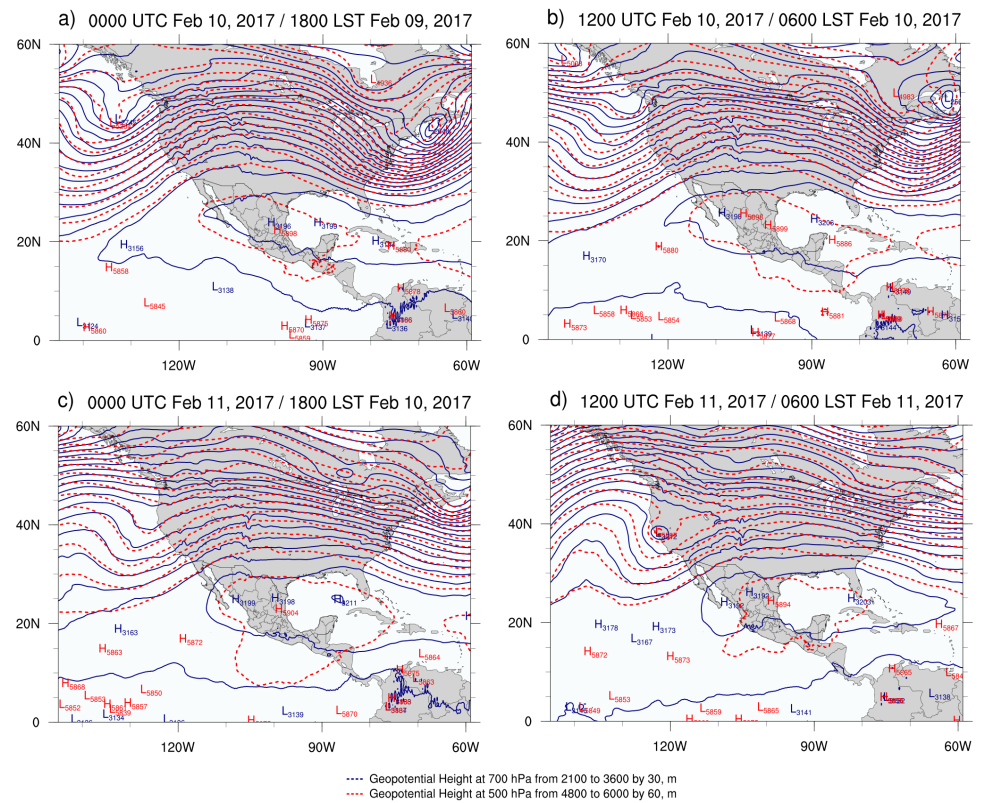


Figure S2. Synoptic weather conditions from ERA5 reanalysis showing geopotential height at 700 hPa (blue lines) and 500 hPa (red lines), at (a) 0000 UTC 10 Feb (18 LST 09 Feb), (b) 1200 UTC 10 Feb (0600 LST 09 Feb), (c) 0000 UTC 11 Feb (1800 LST 10 Feb) and (d) 1200 UTC 11 Feb (0600 LST 11 Feb).

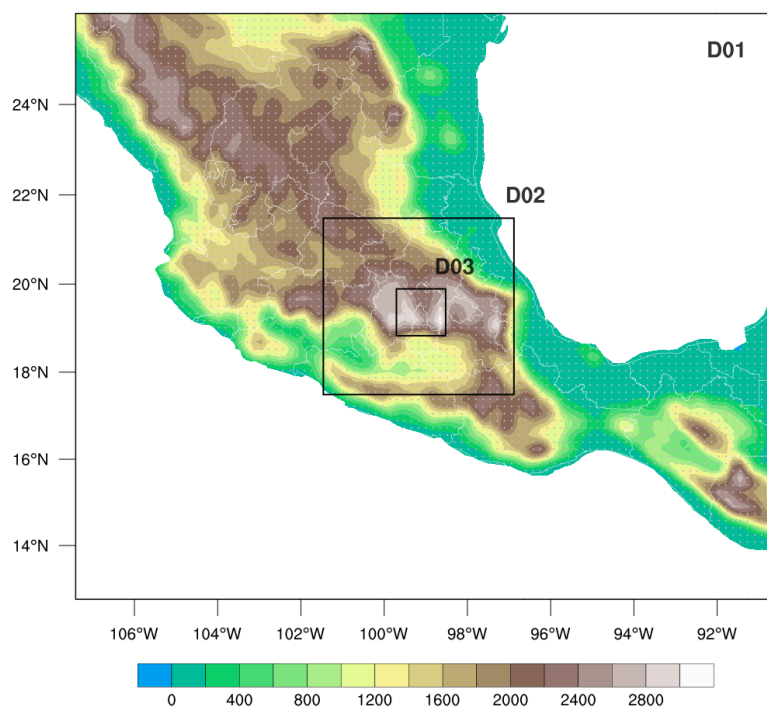


Figure S3. Computational domain distribution covering the Mexico and the Mexico Basin (domain D03) for the WRF model. Domains D01, D02 and D03 have a horizontal resolution of 18, 6 and 2 km respectively.

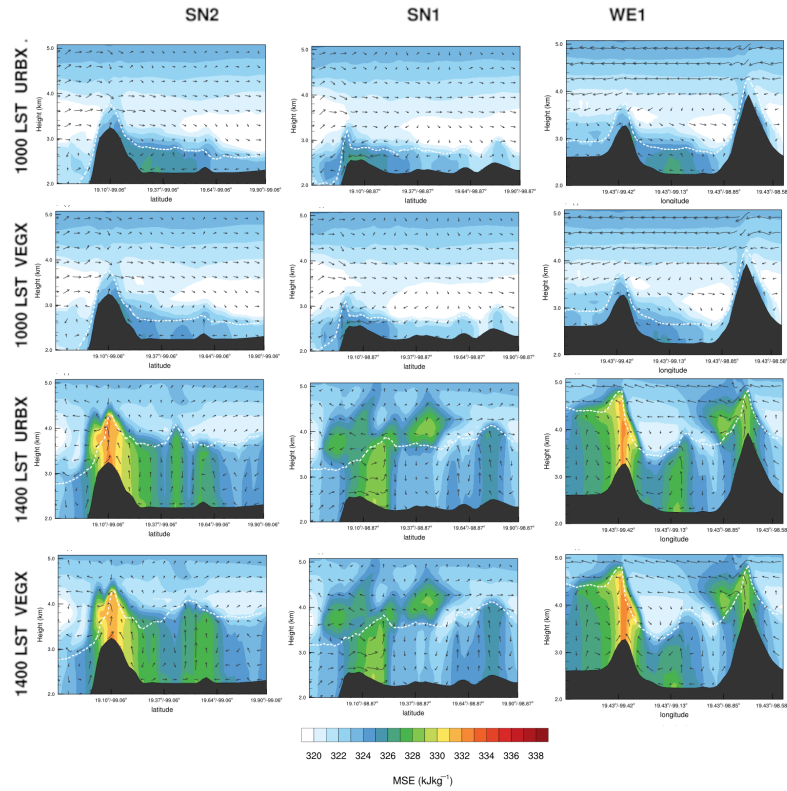


Figure S4. Vertical cross-sections of moist static energy in the URBX, and VEGX simulations for 10 February, 2017 at 1000 and 1400 LST. Each panel column represents a transect as defined in Figure 1 of the manuscript. The wind field pattern is represented by the vertical and meridional components of the wind for the south-north transects (SN1, and SN2) and zonal wind component for the west-east transect (WE1). In order to facilitate inspection of the fields, the vertical wind component is multiplied by a factor of 10 and the vertical scale is exaggerated compared to the horizontal scale. The white line represents the height in m amsl of the PBL, from the model simulation.

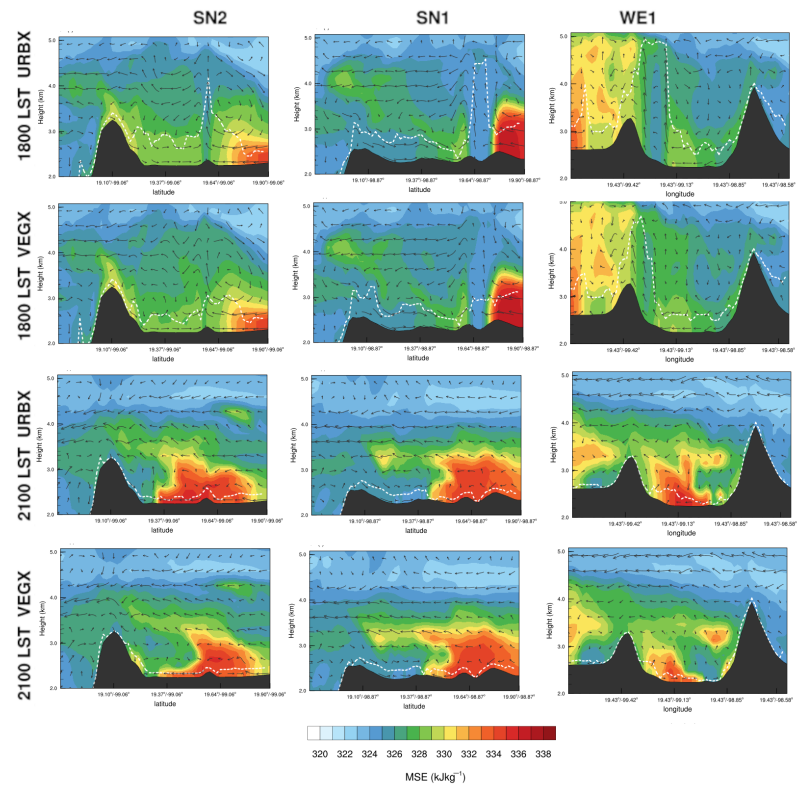


Figure S5. Same as Figure S5, except for 1800 and 2100 LST.

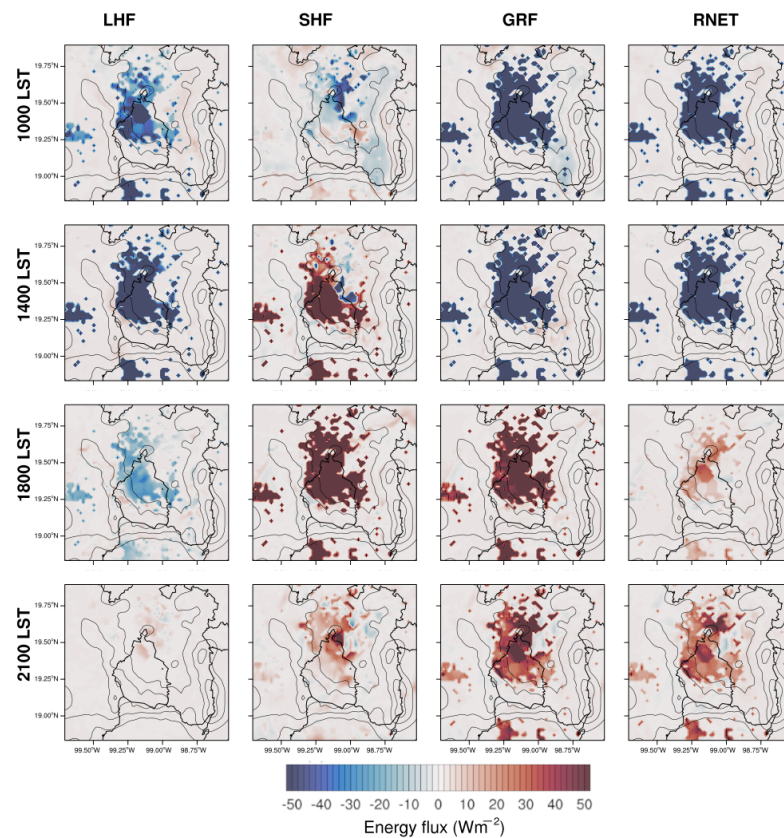


Figure S6. Urban effect as the difference in energy fluxes W m^{-2} at the surface between the URBX simulation and the VEGX experiment for 10 February at 1000, 1400, 1800, and 2100 LST. Columns 1, 2, 3 and 4 are for latent heat fluxes (LHF), sensible heat fluxes (SHF), ground flux (GRF), and net radiation, respectively. Positive direction for fluxes implies atmosphere receives energy from the surface below.