

Article

Supplementary Material

A mechanistic data-driven approach to synthesize human mobility considering the spatial, temporal, and social dimensions together

Giuliano Cornacchia ^{1,2,*} and Luca Pappalardo ²

¹ Department of Computer Science, University of Pisa, 56127, Pisa, Italy

² Institute of Information Science and Technologies (ISTI), National Research Council of Italy (CNR), 56124, Pisa, Italy; luca.pappalardo@isti.cnr.it

* Correspondence: giuliano.cornacchia@phd.unipi.it;

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Results H3 res 9

Table S1: Results of STS-EPR, DITRAS, and GeoSim for each city. The results refer to the hexagonal tessellation of H3 resolution 9. For each mobility measure, we show the average and standard deviation of the KL divergence of five generation experiments.

		Δr	r_g	L_i	Vl	Δ_t	$t(h)$	S^{unc}	mob_{sim}
New York City	STS-EPR	0.0262	0.2956	0.0176	0.0253	0.0847	0.0221	1.8018	0.1648
		± 0.0016	± 0.0695	± 0.0004	± 0.0057	± 0.0024	± 0.0005	± 0.0645	± 0.0114
	DITRAS	0.0324	0.0755	0.1344	0.102	0.0826	0.0227	3.2694	0.9346
Tokyo	DITRAS	± 0.0013	± 0.019	± 0.0025	± 0.0024	± 0.004	± 0.0008	± 0.2694	± 0.1049
		0.7963	5.4786	0.0021	4.0225	0.9974	0.1792	7.7701	0.4925
	GeoSim	± 0.0091	± 0.0407	± 0.0003	± 0.0037	± 0.0006	± 0.0003	± 0.0721	± 0.0087
Bangkok	STS-EPR	0.0712	0.1589	0.0078	0.0091	0.2381	0.0285	1.5052	0.0256
		± 0.0021	± 0.0547	± 0.0002	± 0.001	± 0.0004	± 0.0006	± 0.0244	± 0.0027
	DITRAS	0.0773	0.2719	0.0976	0.1481	0.2379	0.0284	1.9981	1.1522
Osaka	DITRAS	± 0.004	± 0.024	± 0.0009	± 0.0082	± 0.0019	± 0.0005	± 0.059	± 0.0591
		0.7621	4.9671	0.0007	2.6197	0.9806	0.2867	6.2246	0.0763
	GeoSim	± 0.0055	± 0.004	± 0.0001	± 0.0114	± 0.0474	± 0.0001	± 0.0381	± 0.001
Osaka	STS-EPR	0.1181	0.2096	0.0051	0.012	0.157	0.0149	1.4649	0.0049
		± 0.0016	± 0.0663	± 0.0003	± 0.0015	± 0.0037	± 0.0004	± 0.0827	± 0.0007
	DITRAS	0.0918	0.1344	0.0762	0.0821	0.1592	0.0151	1.9102	1.5515
Istanbul	DITRAS	± 0.0048	± 0.0103	± 0.0019	± 0.0063	± 0.0014	± 0.0004	± 0.1134	± 0.0802
		0.728	5.1905	0.0046	3.2883	0.9339	0.2938	4.5127	0.1503
	GeoSim	± 0.0029	± 0.0096	± 0.0003	± 0.0037	± 0.047	± 0.0006	± 0.1056	± 0.0049
Osaka	STS-EPR	0.0506	0.0871	0.0049	0.0118	0.3939	0.0349	1.8964	0.0413
		± 0.0041	± 0.0252	± 0.0003	± 0.002	± 0.1782	± 0.0013	± 0.0583	± 0.0112
	DITRAS	0.0651	0.1117	-	0.0641	0.2477	0.0353	2.3394	1.3277
Jakarta	DITRAS	± 0.005	± 0.0204	-	± 0.0044	± 0.0024	± 0.0007	± 0.2083	± 0.0478
		0.8045	5.0066	0.006	3.9076	1.0224	0.3052	6.648	0.2651
	GeoSim	± 0.0052	± 0.0095	± 0.0004	± 0.0034	± 0.0006	± 0.0006	± 0.1205	± 0.0084
Istanbul	STS-EPR	0.0146	0.1122	0.0136	0.0098	0.2926	0.0058	1.7694	0.0671
		± 0.0007	± 0.0092	± 0.0003	± 0.001	± 0.1857	± 0.0002	± 0.0361	± 0.0032
	DITRAS	0.0171	0.5511	0.1244	0.212	0.3686	0.0057	3.5729	1.203
Sao Paulo	DITRAS	± 0.002	± 0.0118	± 0.0008	± 0.0048	± 0.152	± 0.0001	± 0.2698	± 0.062
		0.5615	4.9706	0.0004	2.2908	0.9498	0.2224	5.6302	0.3216
	GeoSim	± 0.0025	± 0.0039	± 0.0	± 0.0017	± 0.0576	± 0.0002	± 0.0127	± 0.0056
Jakarta	STS-EPR	0.0411	0.0373	0.0078	0.0177	0.144	0.0154	1.2441	0.0238
		± 0.0012	± 0.0075	± 0.0003	± 0.0022	± 0.0011	± 0.0004	± 0.025	± 0.0057
	DITRAS	0.0224	0.2547	0.0673	0.1175	0.1461	0.0154	1.1071	1.8051
Kuala Lumpur	DITRAS	± 0.0019	± 0.0277	± 0.0024	± 0.0112	± 0.0019	± 0.0005	± 0.0473	± 0.2297
		0.7088	5.3841	0.0047	3.2406	0.9634	0.2199	5.1039	0.3361
	GeoSim	± 0.0031	± 0.0096	± 0.0007	± 0.0087	± 0.0003	± 0.0007	± 0.1239	± 0.0045
Sao Paulo	STS-EPR	0.0484	0.1075	0.0044	0.0064	0.2359	0.0168	2.0142	0.0493
		± 0.0021	± 0.0133	± 0.0002	± 0.0003	± 0.1609	± 0.0008	± 0.1312	± 0.0055
	DITRAS	0.0278	0.1481	-	0.0553	0.3194	0.0166	2.0506	0.8342
Kuala Lumpur	DITRAS	± 0.0029	± 0.0156	-	± 0.0063	± 0.1981	± 0.0008	± 0.1336	± 0.0883
		0.7021	5.8643	0.0093	3.5917	0.9887	0.1694	4.79	0.3266
	GeoSim	± 0.0049	± 0.0	± 0.0008	± 0.0039	± 0.0003	± 0.0003	± 0.1284	± 0.0086
Kuala Lumpur	STS-EPR	0.0675	0.152	0.008	0.0129	0.1443	0.0097	1.4778	0.02
		± 0.0019	± 0.0189	± 0.0002	± 0.003	± 0.0016	± 0.0003	± 0.0474	± 0.0015
	DITRAS	0.0542	0.6099	-	0.4499	0.1451	0.0097	1.7144	1.0094
Kuala Lumpur	DITRAS	± 0.0027	± 0.0381	-	± 0.0734	± 0.0033	± 0.0002	± 0.0646	± 0.0566
		0.6722	4.6182	0.0041	1.9364	0.9327	0.1927	6.54	0.2318
	GeoSim	± 0.0014	± 0.0161	± 0.0002	± 0.004	± 0.0569	± 0.0005	± 0.0974	± 0.0047

New York City sq. 300m

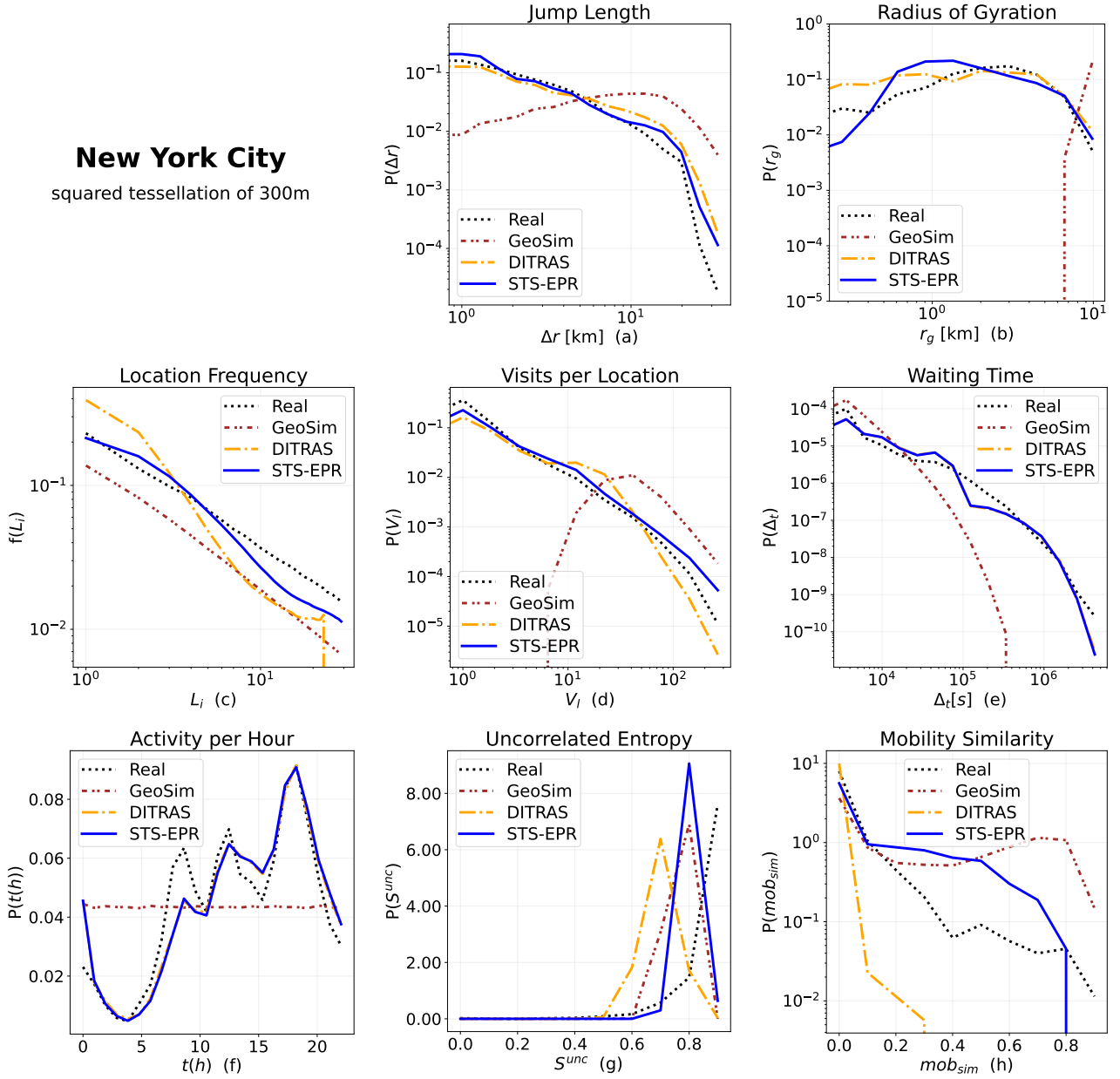


Figure S1. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for New York City and the squared tessellation with tiles of 300m.

Tokyo sq. 300m

Tokyo
squared tessellation of 300m

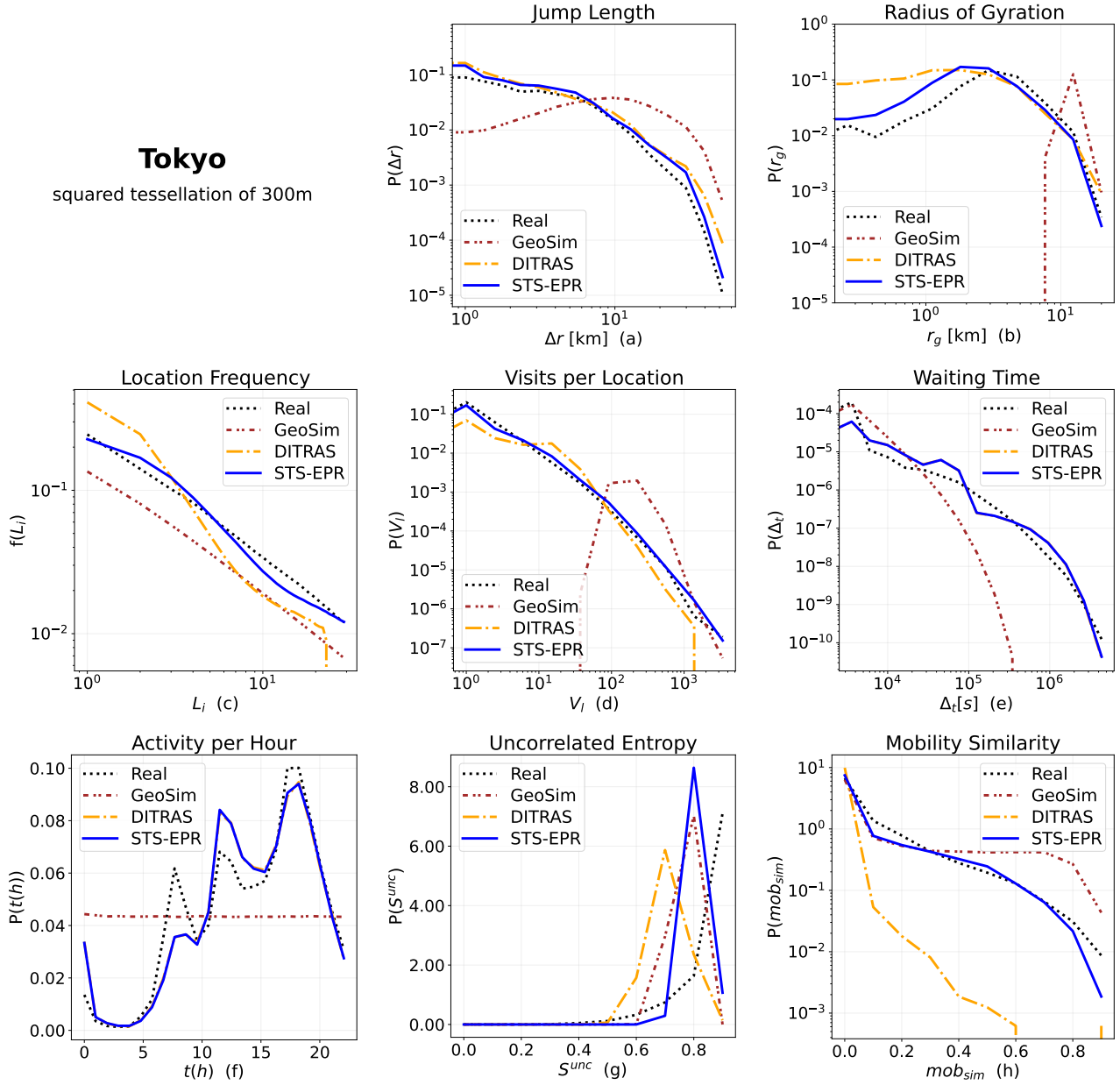


Figure S2. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Tokyo and the squared tessellation with tiles of 300m.

Bangkok sq. 300m

Bangkok
squared tessellation of 300m

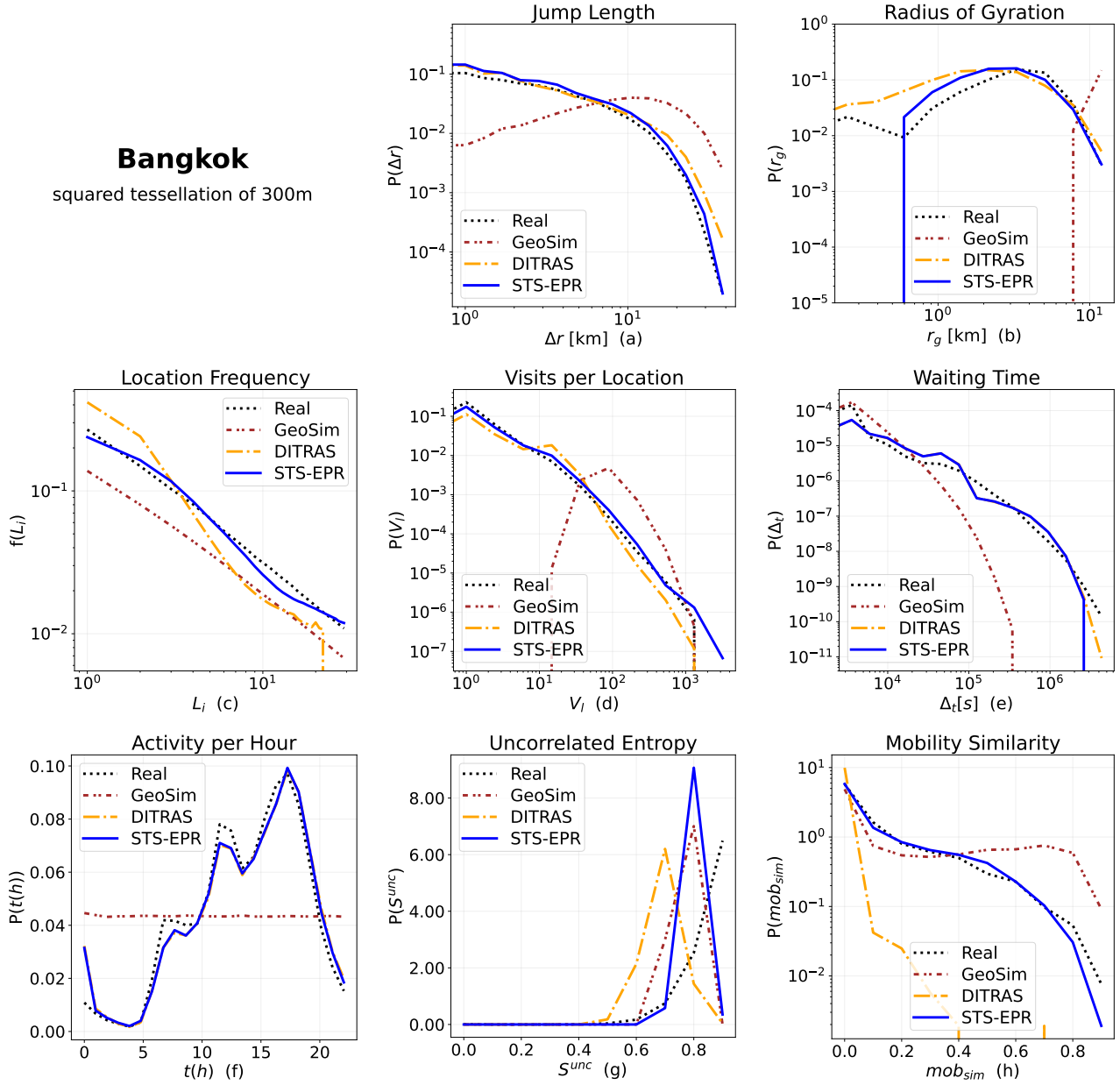


Figure S3. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Bangkok and the squared tessellation with tiles of 300m.

Osaka sq. 300m

Osaka
squared tessellation of 300m

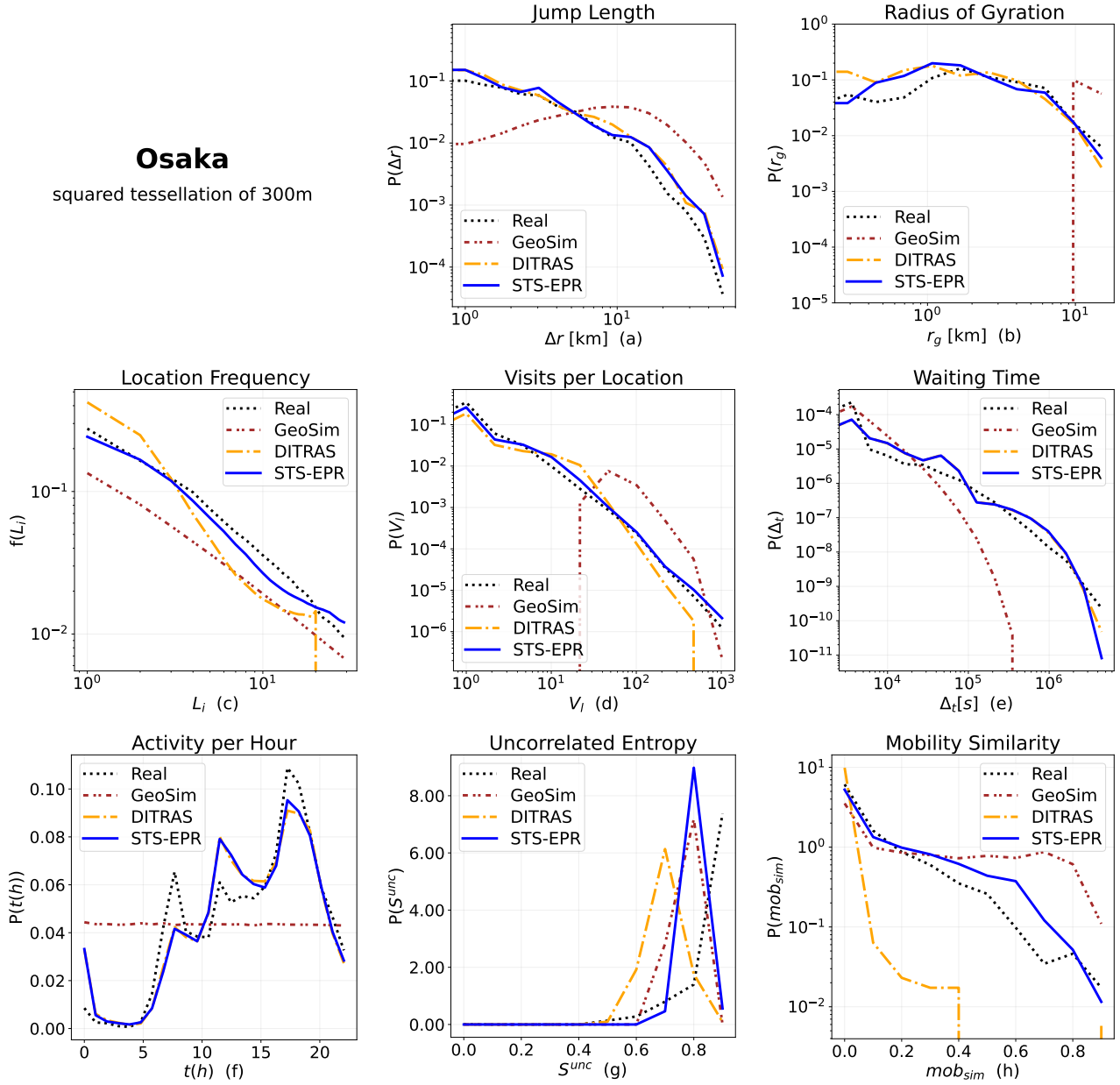


Figure S4. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Osaka and the squared tessellation with tiles of 300m.

Istanbul sq. 300m

Istanbul
squared tessellation of 300m

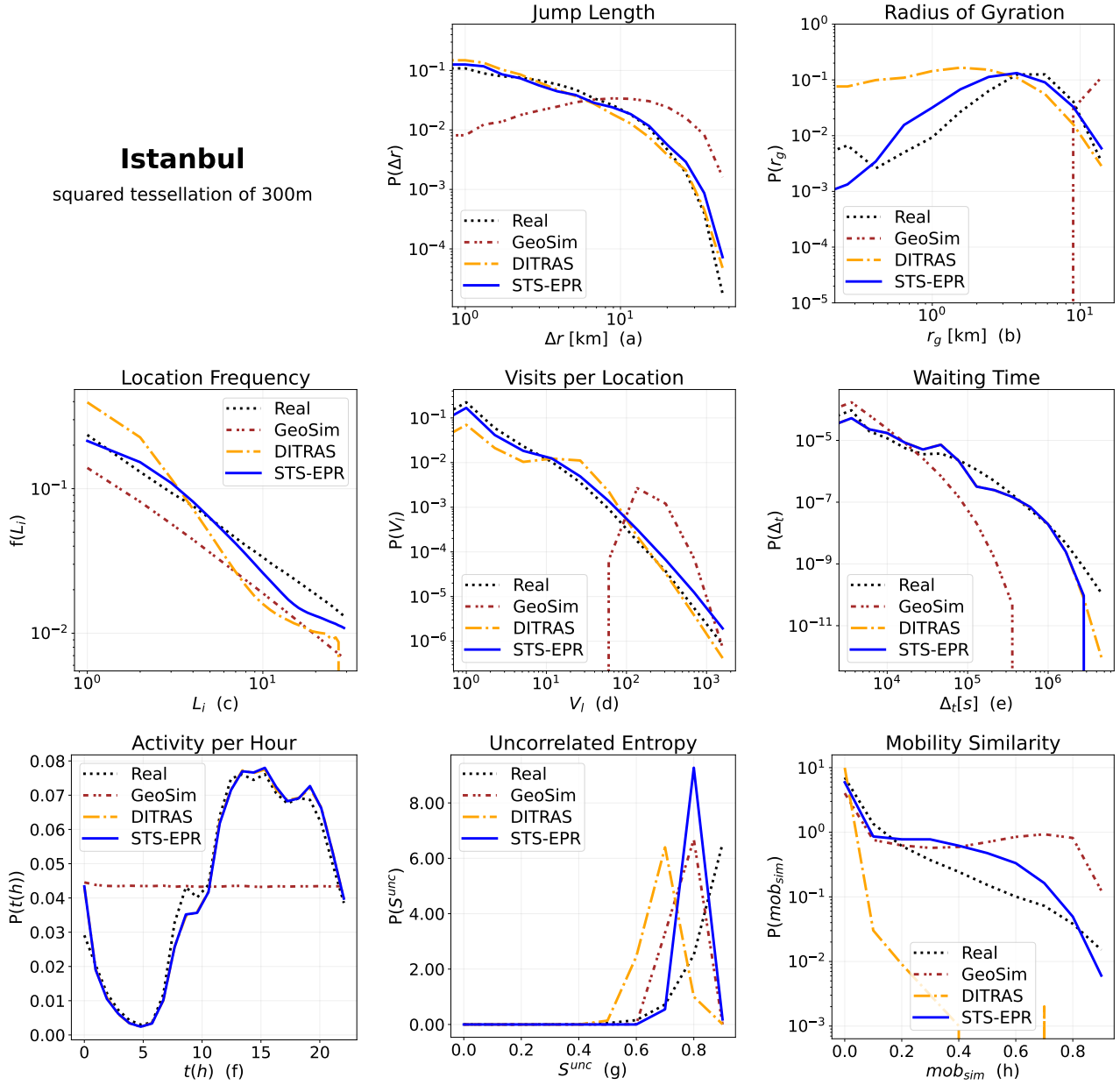


Figure S5. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Istanbul and the squared tessellation with tiles of 300m.

Jakarta sq. 300m

Jakarta
squared tessellation of 300m

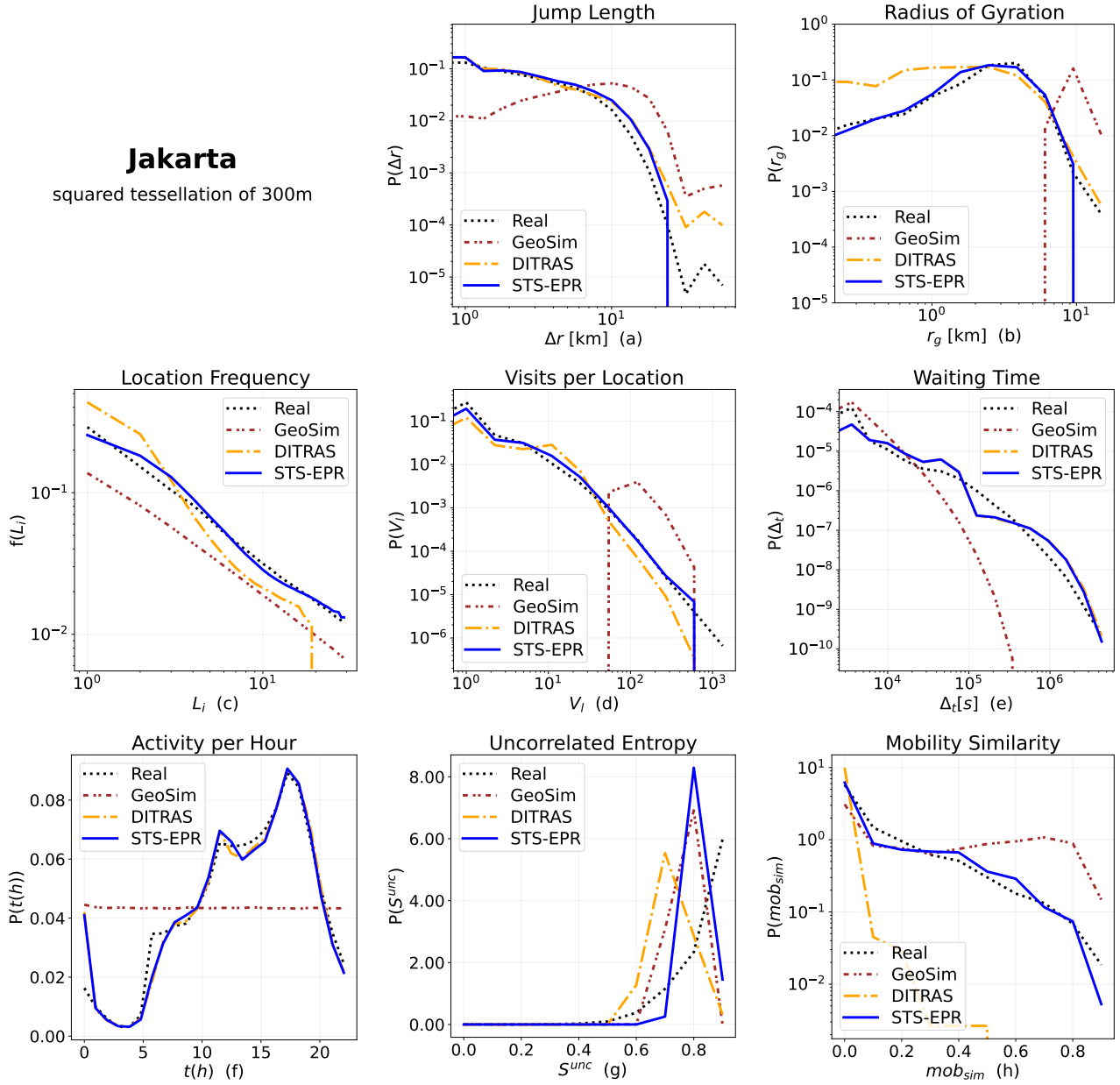


Figure S6. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Jakarta and the squared tessellation with tiles of 300m.

Sao Paulo sq. 300m

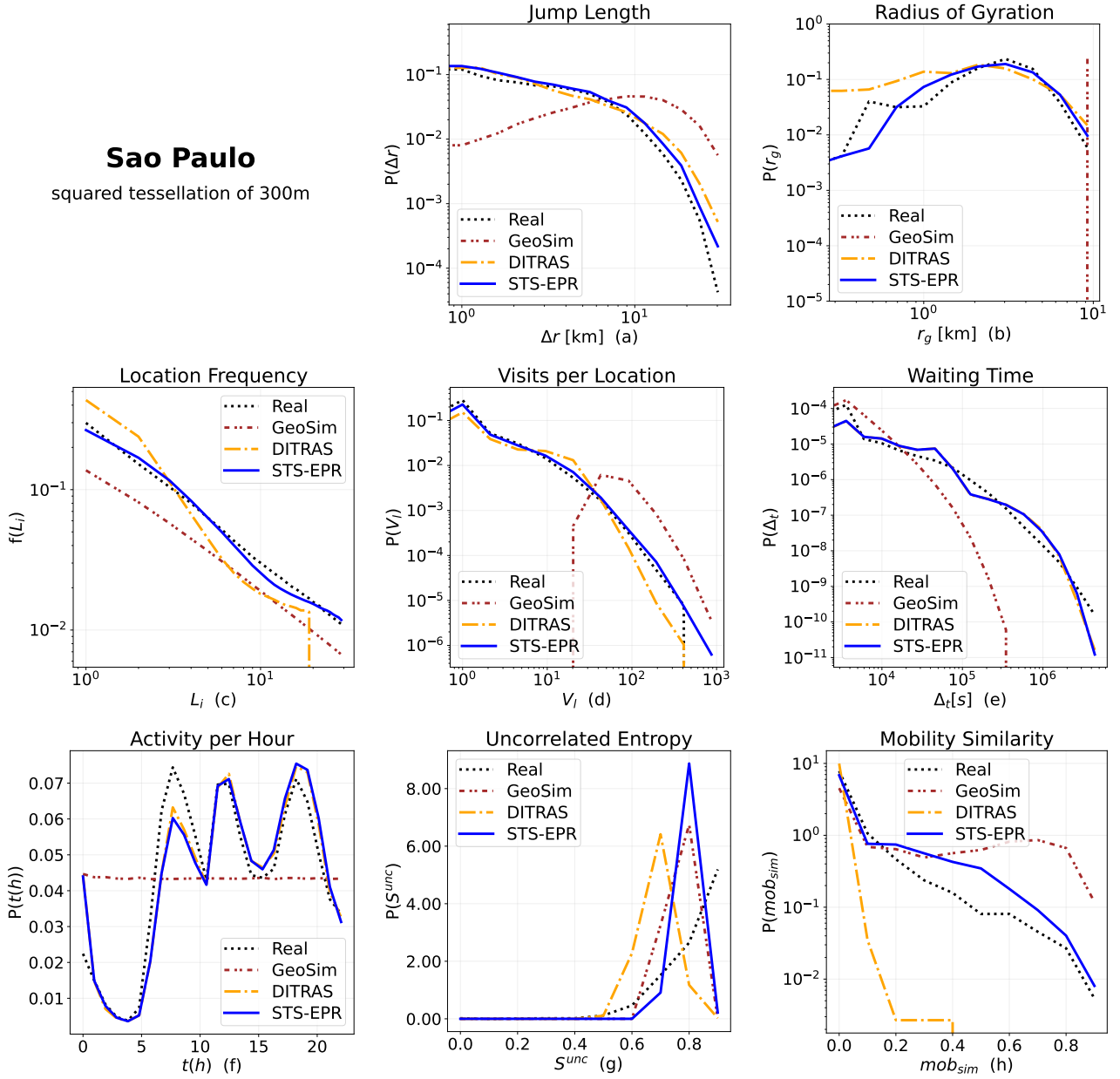


Figure S7. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Sao Paulo and the squared tessellation with tiles of 300m.

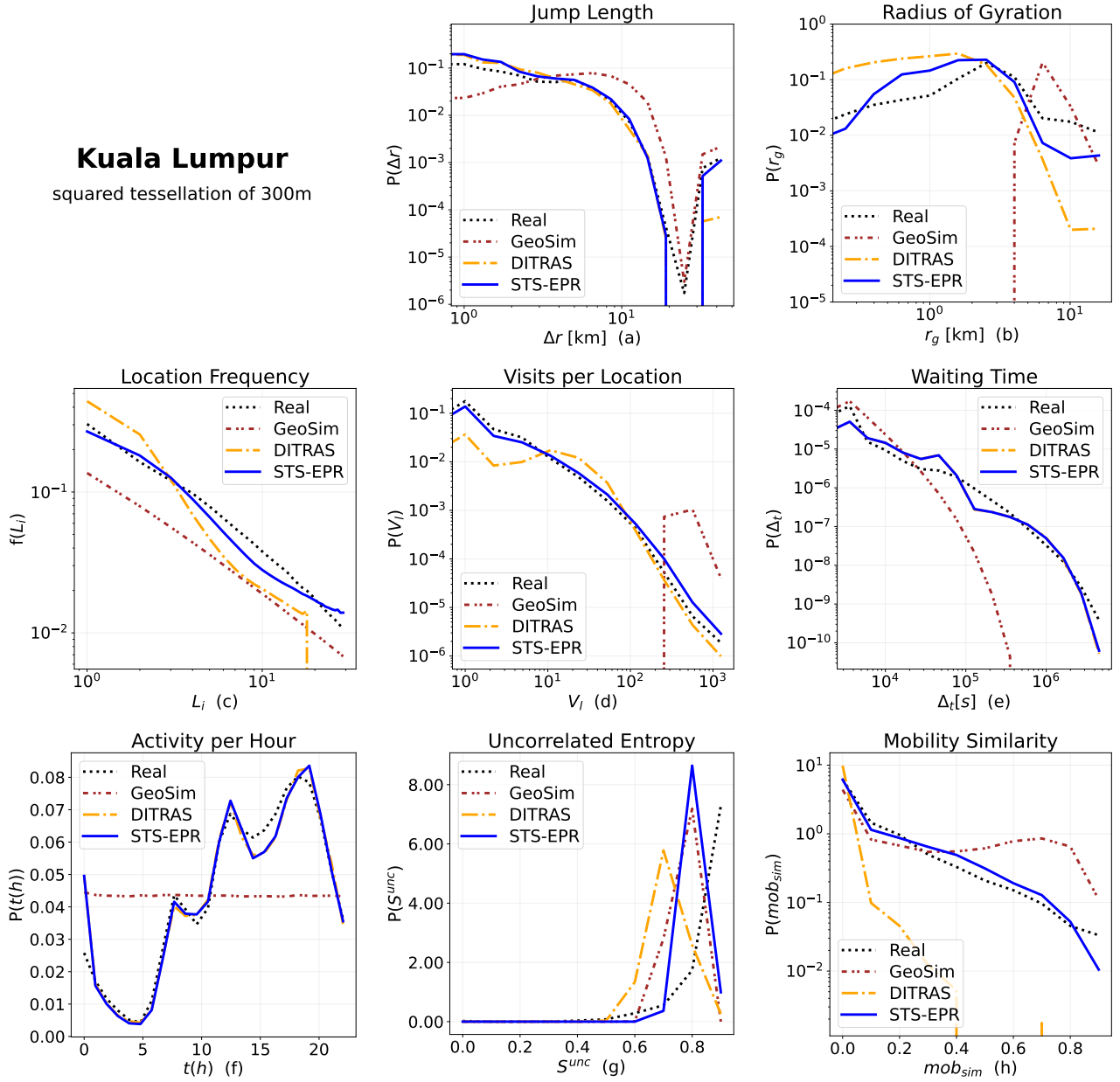
Kuala Lumpur sq. 300m**Kuala Lumpur**
squared tessellation of 300m

Figure S8. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Kuala Lumpur and the squared tessellation with tiles of 300m.

New York City hex H3 res. 9

New York City
H3 hexagonal tessellation res. 9

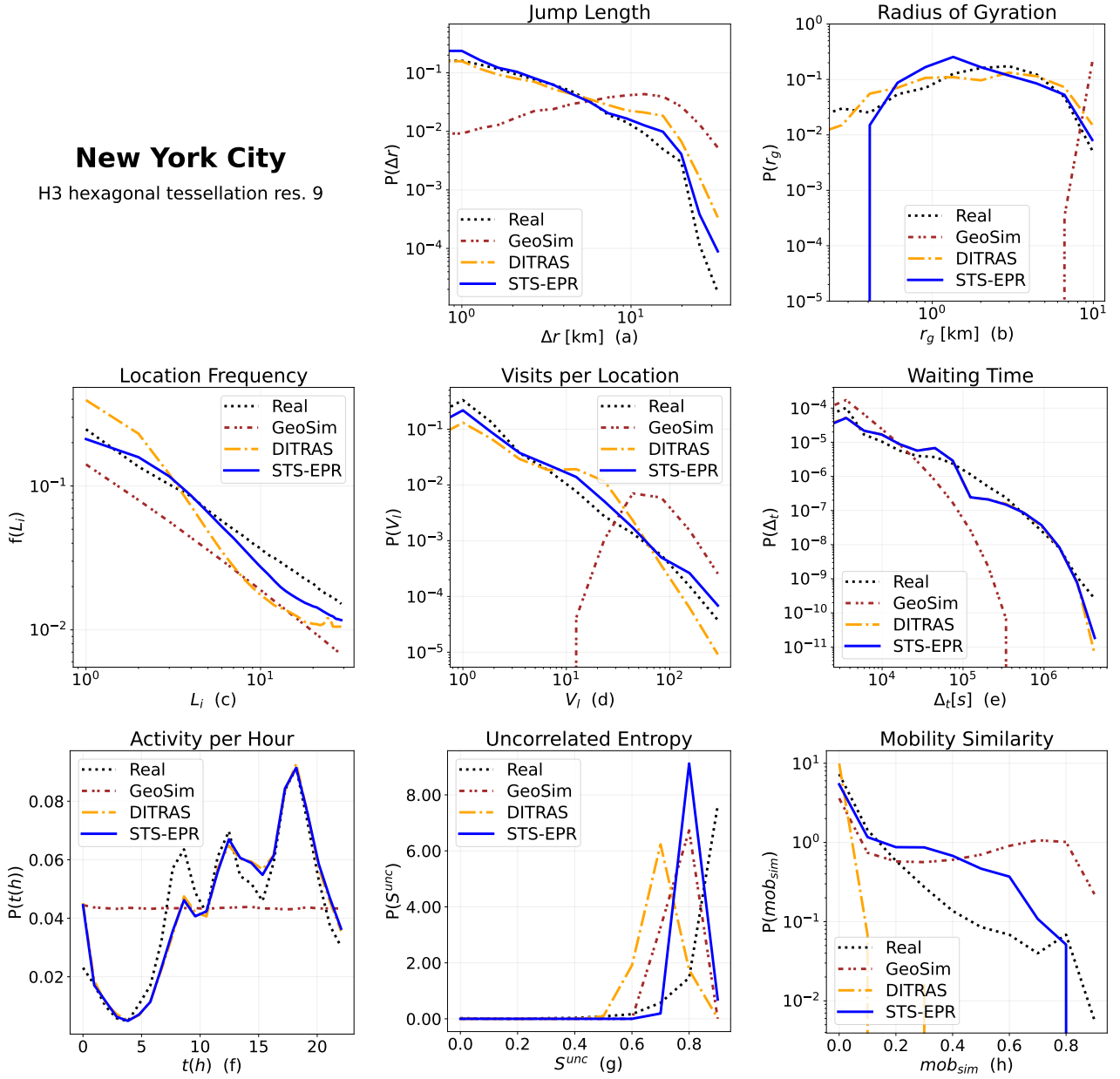


Figure S9. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for New York City and the hexagonal tessellation with H3 resolution of 9.

Tokyo hex H3 res. 9

Tokyo

H3 hexagonal tessellation res. 9

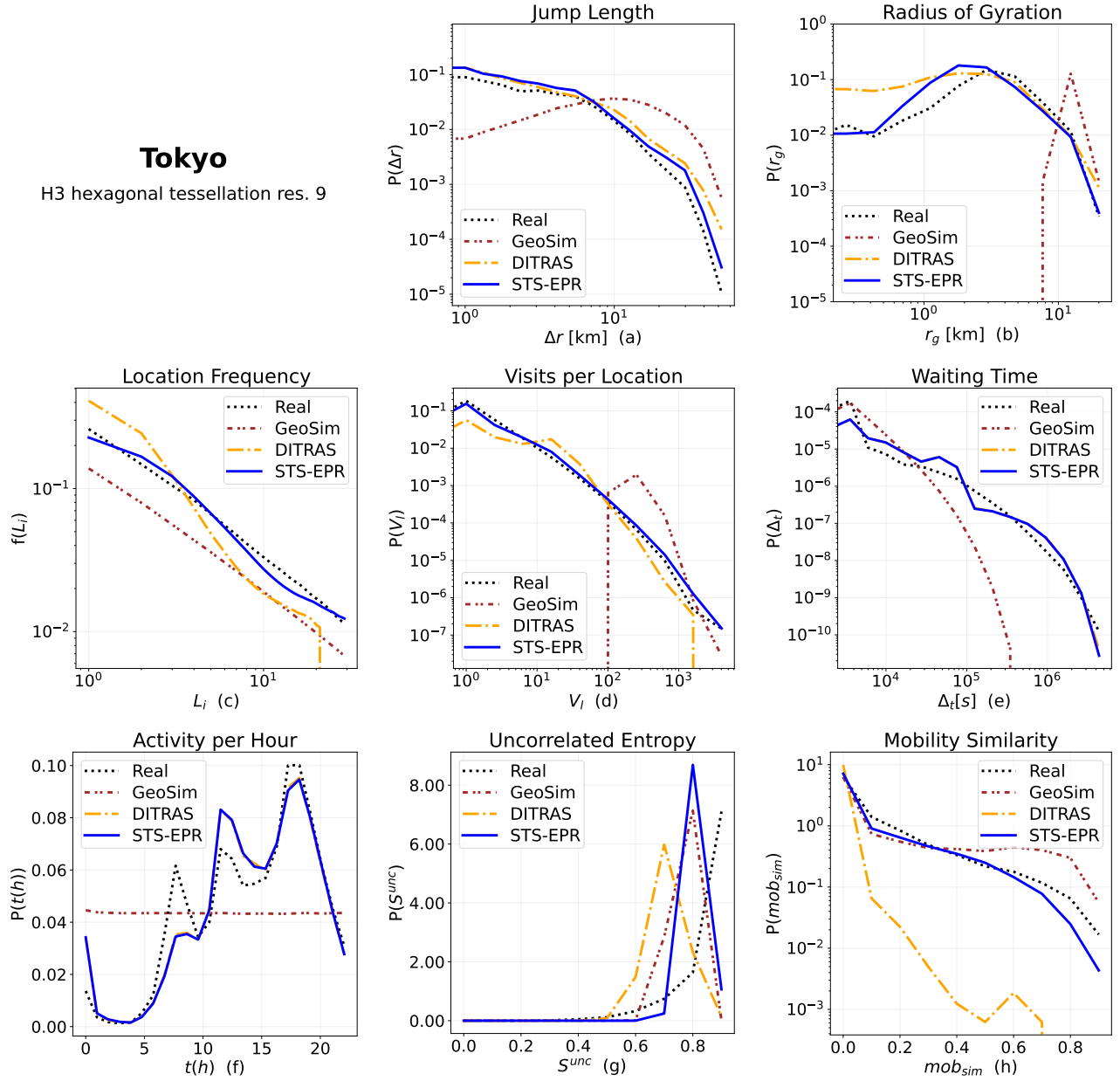


Figure S10. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Tokyo and the hexagonal tessellation with H3 resolution of 9.

Bangkok hex H3 res. 9

Bangkok

H3 hexagonal tessellation res. 9

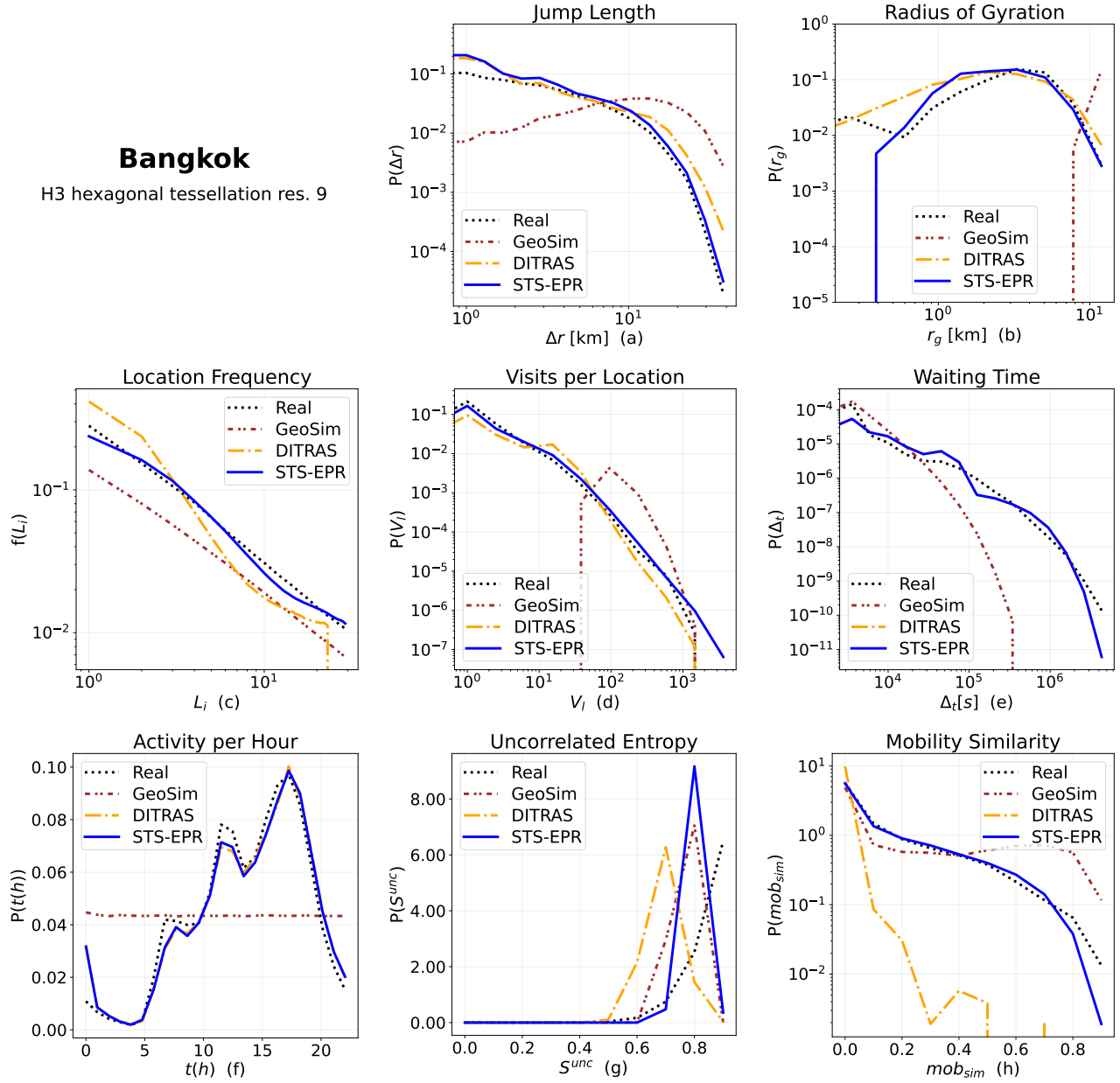


Figure S11. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Bangkok and the hexagonal tessellation with H3 resolution of 9.

Osaka hex H3 res. 9

Osaka

H3 hexagonal tessellation res. 9

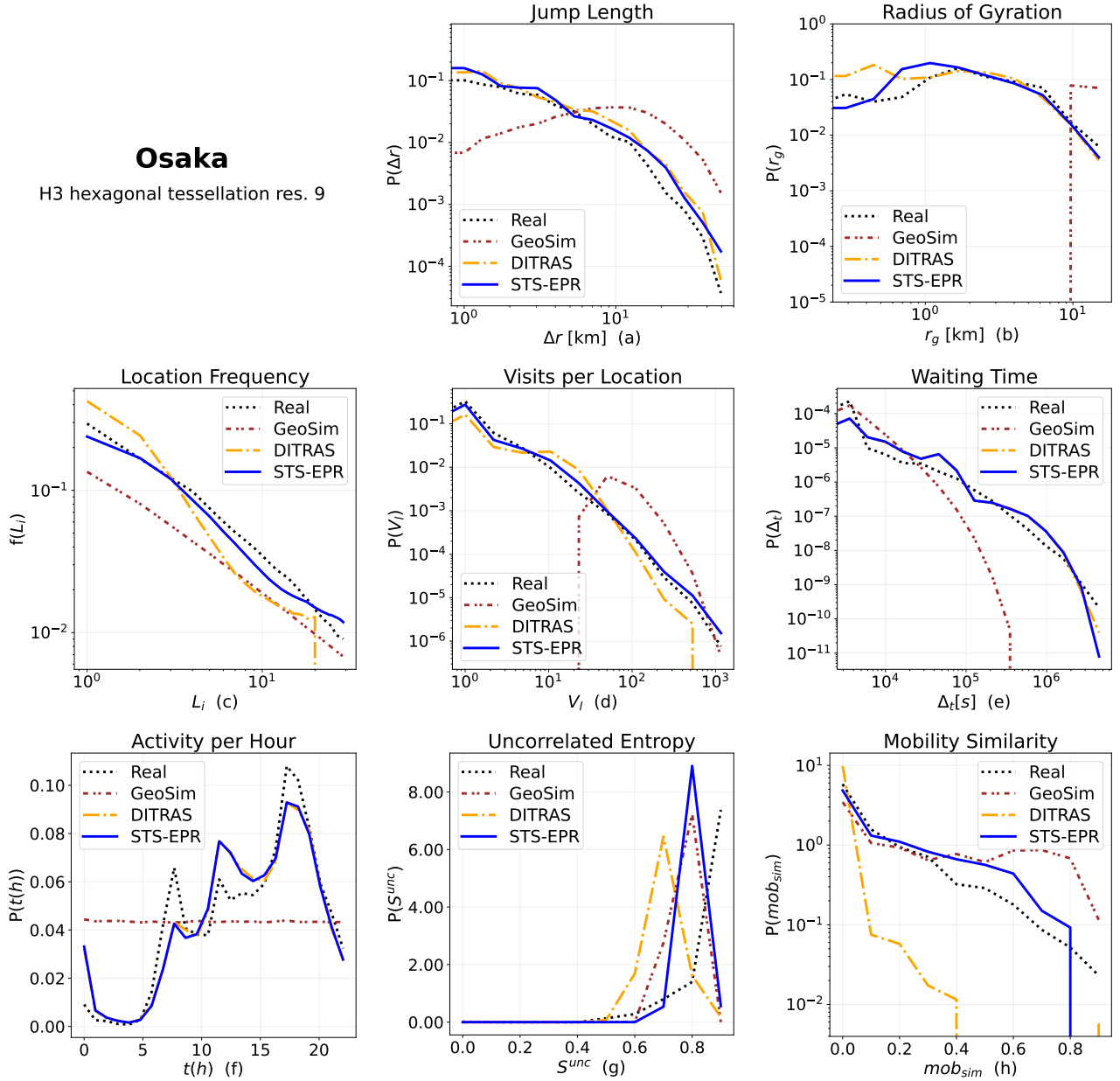


Figure S12. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Osaka and the hexagonal tessellation with H3 resolution of 9.

Istanbul hex H3 res. 9

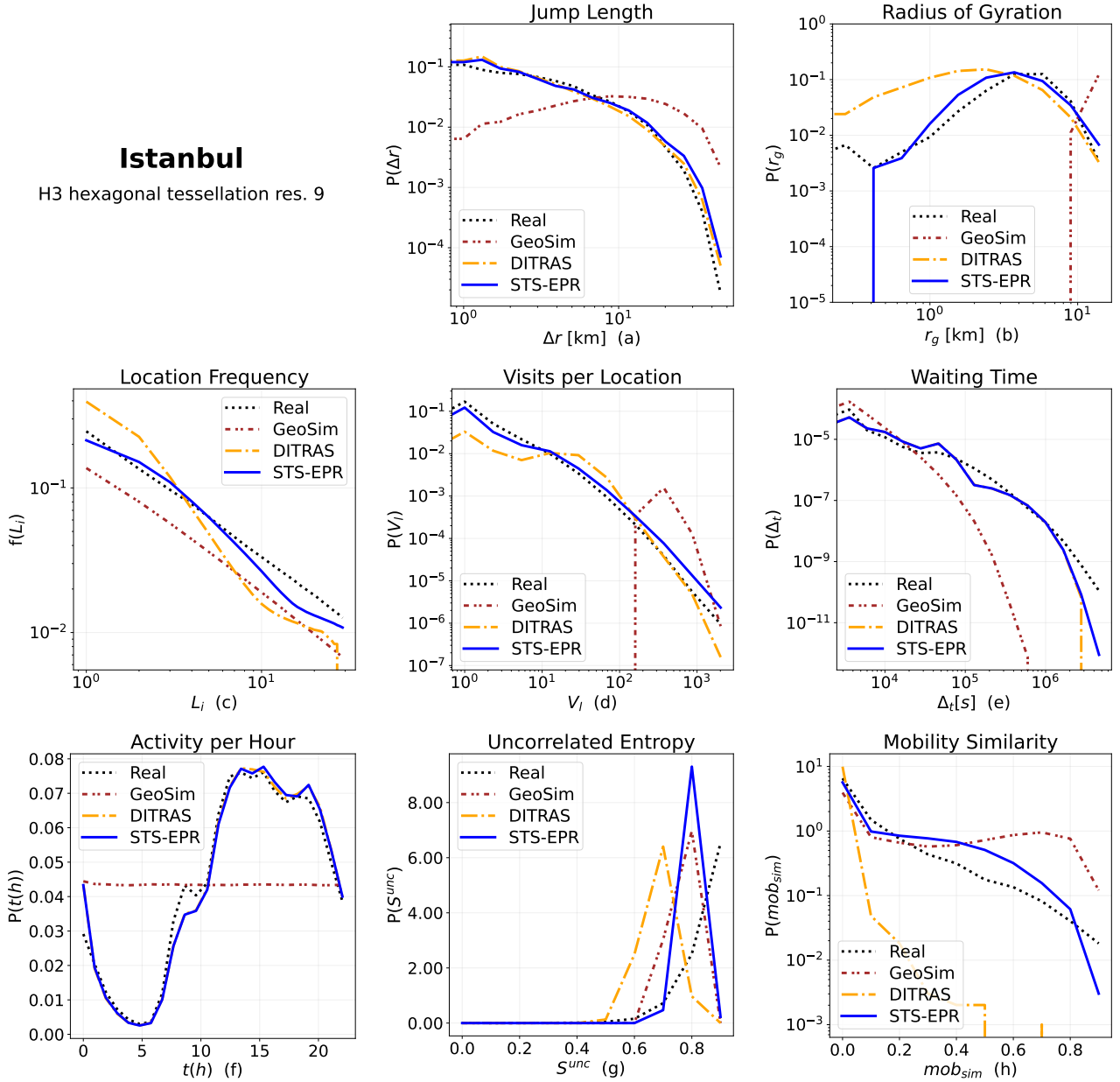


Figure S13. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Istanbul and the hexagonal tessellation with H3 resolution of 9.

Jakarta hex H3 res. 9

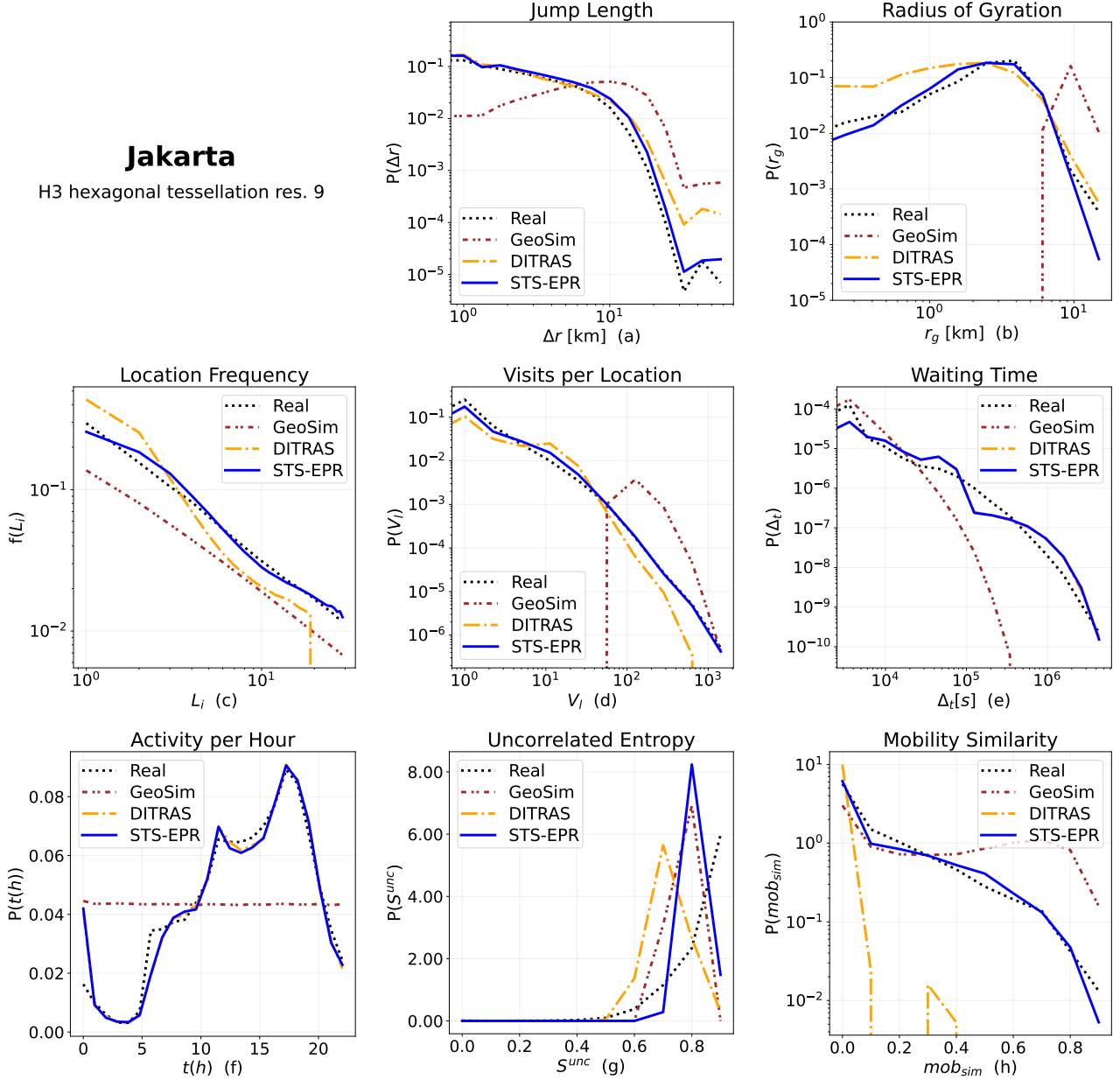


Figure S14. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Jakarta and the hexagonal tessellation with H3 resolution of 9.

Sao Paulo hex H3 res. 9

Sao Paulo

H3 hexagonal tessellation res. 9

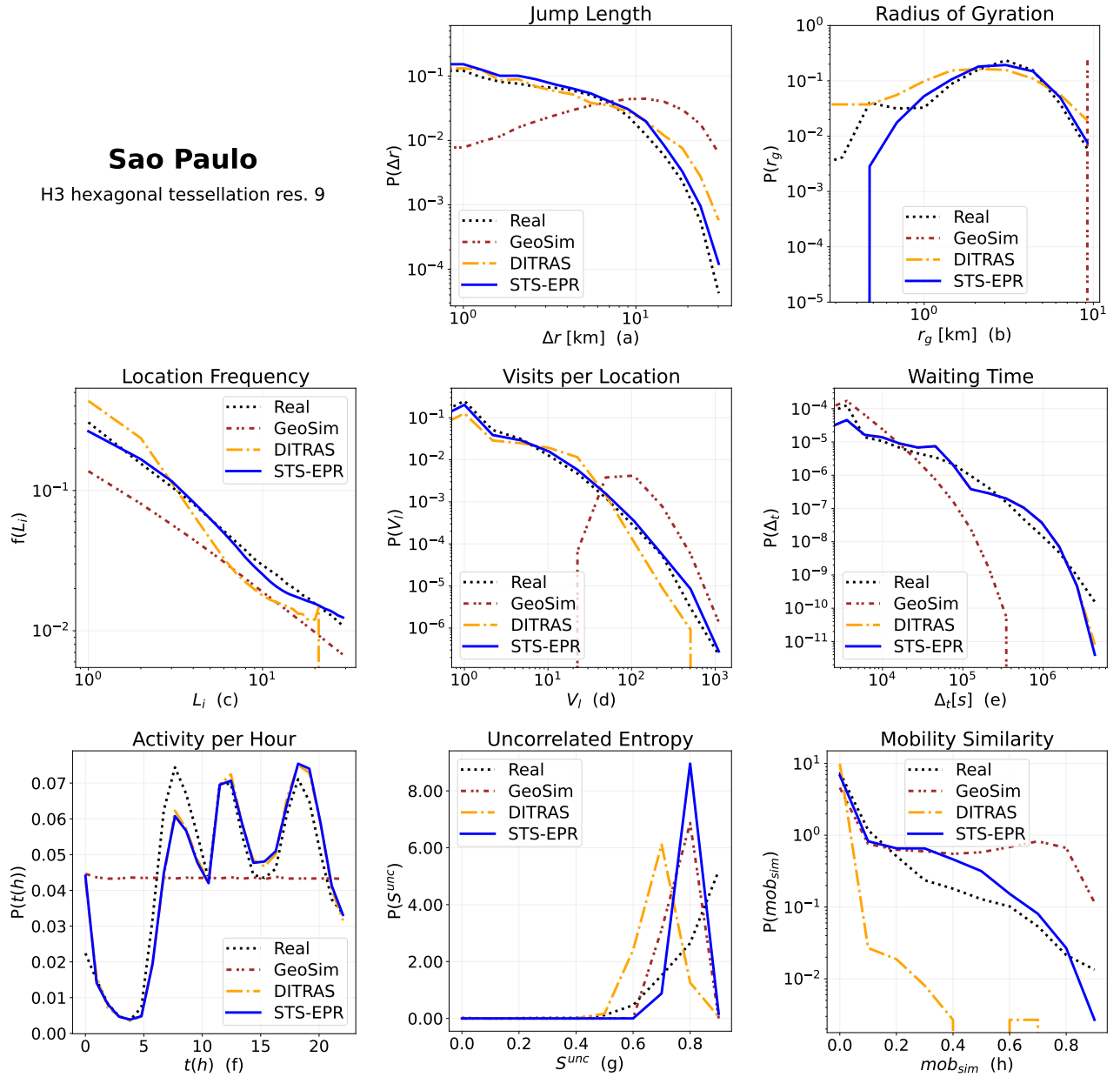


Figure S15. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Sao Paulo and the hexagonal tessellation with H3 resolution of 9.

Kuala Lumpur hex H3 res. 9

Kuala Lumpur
H3 hexagonal tessellation res. 9

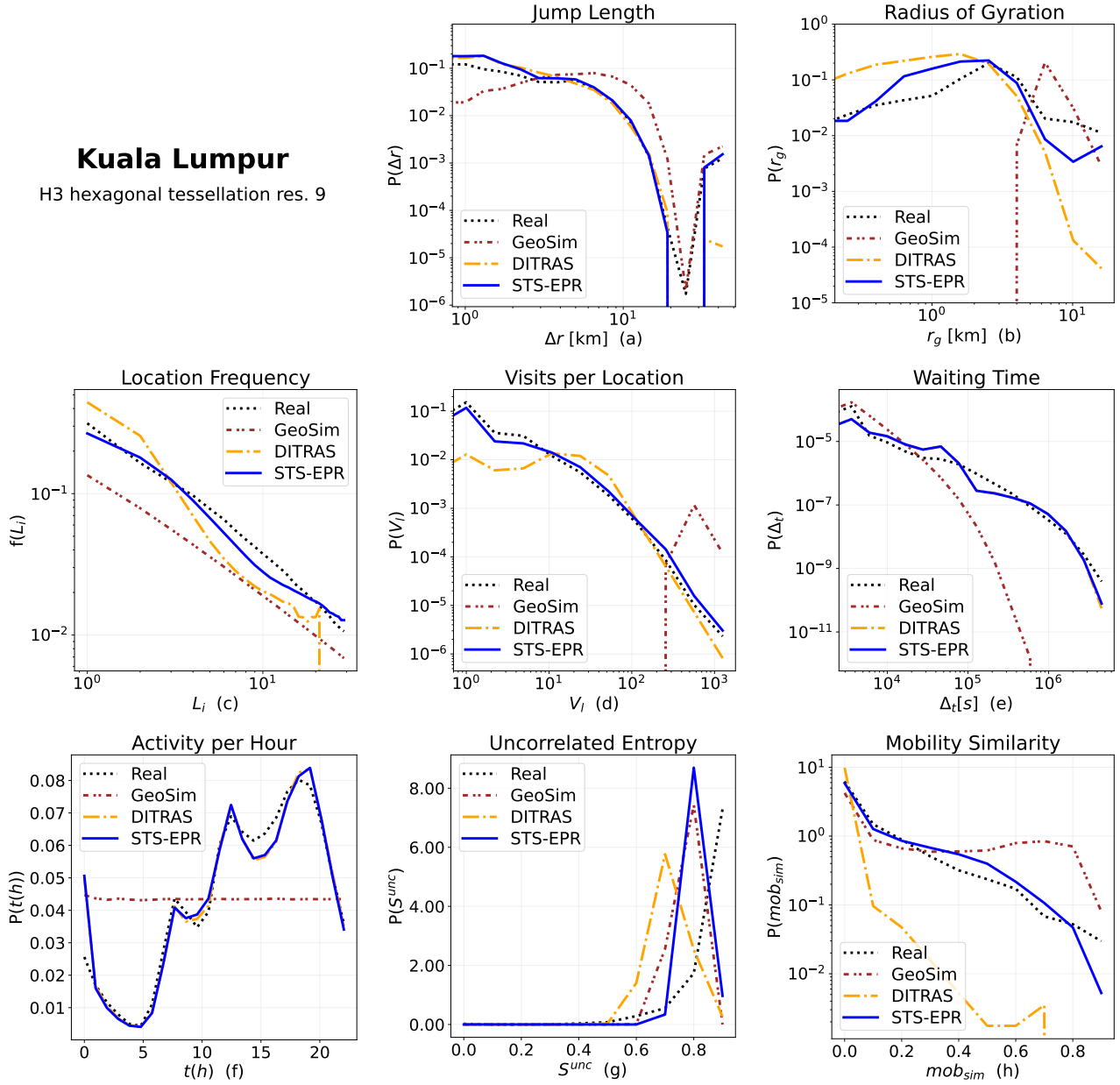


Figure S16. Comparison of the distribution of the mobility measures jump length (a), radius of gyration (b), location frequency (c), visits per location (d), waiting time (e), activity per hour (f), uncorrelated entropy (g), and mobility similarity (h) of real data (black dotted line) and data produced by GeoSim (red dash-dotted line), DITRAS (orange dash-dotted line), and STS-EPR (blue line), for Kuala Lumpur and the hexagonal tessellation with H3 resolution of 9.