Characterizing Wind Gusts in Complex Terrain.

Supplementary Information

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As described in the main text, (Section 3.1) best fit distribution types are chosen based on minimum negative-log-likelihood (NLL), though the minimum NLL is frequently similar to the next-best choice. In order to expand on the information given in Table 2 of the main text, Table S1 shows the best and second-best fit distribution types and their associated NLL values.

Figures S1 to S5 show joint distributions of pairs of gust parameters which have been transformed to be normally distributed as described in Section 3.1. These parameters joint probability distributions describe the correlation of gusts parameters between towers and between measurements heights at Tower 29.

Table S1 – Best and second-best fit distribution types for each gust properties (in each 10 minute period when $U_{mean} > 3ms^{-1}$) for a measurement height of 60 m a.g.l. at each tower. The distribution types are referred to as 1-4 where 1: Weibull, 2: log-logistic, 3: log-normal, 4: gamma. Negative-log-likelihood values for each distribution type (best and second-best) are also shown.
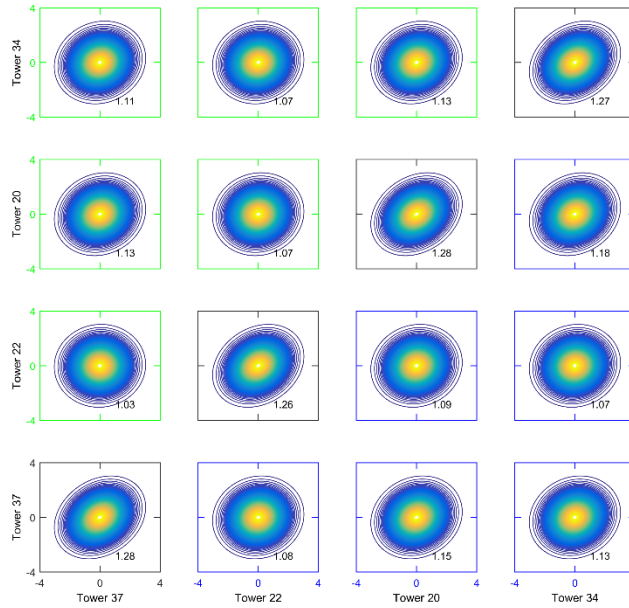
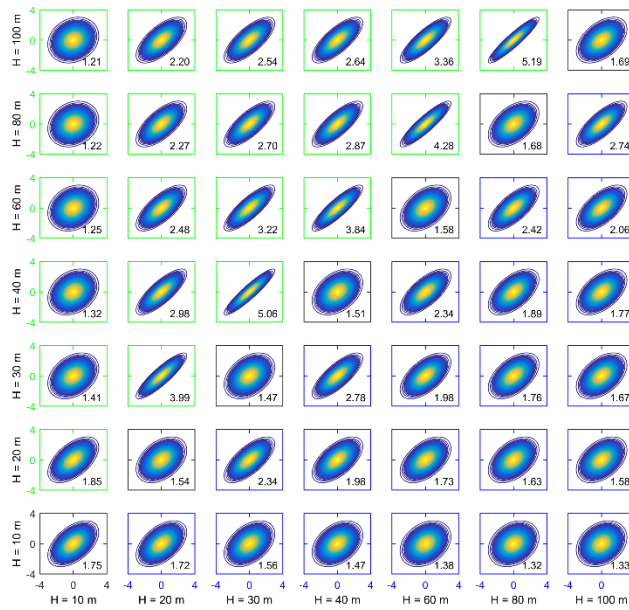|		Tower								
		7	10	20	22	25	27	29	34	37
Best fit distributions	U_{mean}	3	3	3	3	3	3	3	3	3
	U_{gust}	3	3	3	3	3	3	3	3	3
	GF	2	3	2	3	3	3	3	2	2
	a_{gust}	1	1	1	1	4	1	1	1	1
	k_{peak}	2	2	2	2	3	2	2	2	2
	t_{rise}	3	3	3	3	3	3	3	3	3
	t_{lapse}	3	3	3	3	3	3	3	3	3
	t_{gust}	3	3	3	3	3	3	3	3	4
	L_{gust}	3	3	4	3	3	3	4	4	4
Best fit NLL	U_{mean}	3447	10129	15010	5572	3527	4332	13835	14954	14879
	U_{gust}	4711	12790	16767	7188	4714	5962	15716	16858	16558
	GF	201	771	-1691	532	475	686	-1352	-1735	-1878
	a_{gust}	3792	9677	10027	5569	3695	4801	9733	10257	9756
	k_{peak}	4303	6889	-16140	4374	1097	4077	-10870	-16874	10026
	t_{rise}	7786	19802	23128	12302	7983	9904	22580	23292	22608
	t_{lapse}	9000	23589	28551	14216	9183	11552	28329	28945	28292
	t_{gust}	9001	23098	26872	14238	9174	11495	26347	27216	26318
	L_{gust}	13543	35204	42949	21266	13845	17136	42128	43278	42450
Second-best fit distributions	U_{mean}	4	4	4	2	4	4	2	4	4
	U_{gust}	4	4	4	2	4	4	4	4	4
	GF	3	2	3	2	4	2	2	3	3
	a_{gust}	2	4	4	4	2	4	4	4	4
	k_{peak}	3	3	3	3	4	3	3	3	3
	t_{rise}	2	2	2	2	2	2	2	2	2
	t_{lapse}	2	2	2	2	2	4	4	2	2
	t_{gust}	4	2	4	2	4	4	4	4	3
	L_{gust}	4	4	3	2	4	4	3	3	3
Second-best fit NLL	U_{mean}	3497	10246	15159	5588	3577	4403	14000	15084	15037
	U_{gust}	4737	12865	16860	7226	4727	5967	15836	16953	16654
	GF	227	862	-1599	538	501	712	-1325	-1686	-1817
	a_{gust}	3888	9730	10076	5656	3716	4913	9807	10303	9898
	k_{peak}	7103	14773	16307	9151	1109	7907	15713	17693	19044
	t_{rise}	7820	19900	23234	12364	8019	9948	22679	23402	22719
	t_{lapse}	9029	23682	28662	14277	9222	11597	28438	29051	28397
	t_{gust}	9009	23172	26907	14283	9189	11517	26364	27271	26320
	L_{gust}	13550	35251	42975	21312	13865	17139	42175	43307	42499
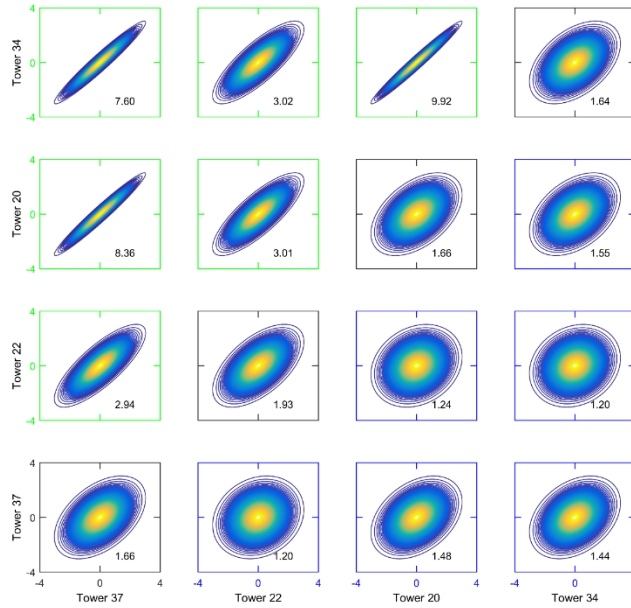
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Figure S1 – Joint distributions of gust magnitude (U_{gust}) at different towers and joint distribution of gust length scale (L_{gust}) at different towers. Wind data from Towers 20, 22, 34, and 37 at 60 m (See Figure 1 and Table 1 in the main text for locations). Upper-left off-diagonal panels (green boxes): U_{gust} vs. U_{gust} at each pair of towers; Diagonal panels (black boxes): U_{gust} vs. L_{gust} at the same tower; Bottom-right off-diagonal panels (blue boxes): L_{gust} vs. L_{gust} at each pair of towers. There are 99 ellipses corresponding to the confidence levels from 1% (the innermost ellipse with the warmest color) to 99% (the outermost with the coldest color).
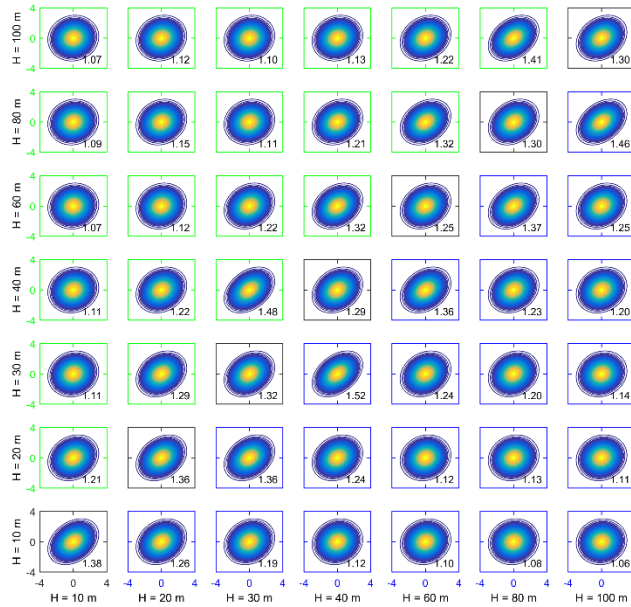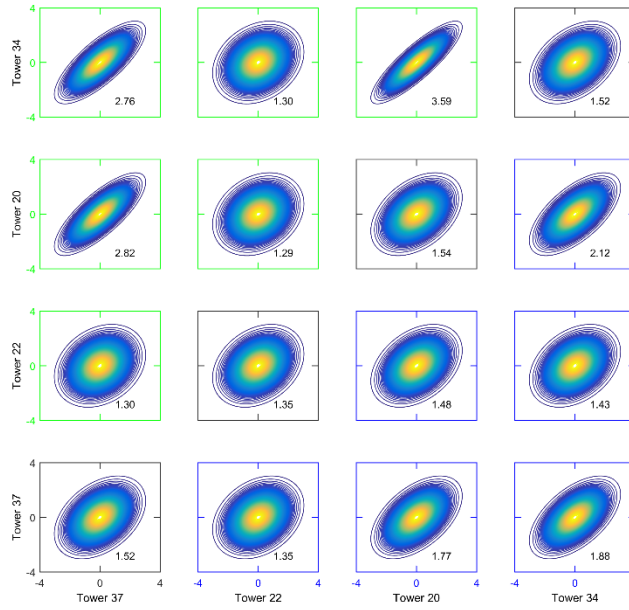

Figure S2 – Joint distributions of gust lapse time (t_{lapse}) and gust rise time (t_{rise}) at different heights from Tower 29. Upper-left off-diagonal panels with green boxes show the joint distributions of t_{lapse} at each pair of heights. Diagonal panels with black boxes show the joint distributions of t_{lapse} and t_{rise} at the same height. Bottom-right off-diagonal panels with blue boxes show the joint distributions of t_{rise} at each pair of heights. The number at the bottom-right corner of each panel is the average ratio between the major axis and minor axis of ellipses. There are 99 ellipses corresponding to the confidence levels from 1% (the most inner ellipse with the warmest color) to 99% (the most outer ellipse with the coldest color).

Figure S3 – Joint distributions of lapse time (t_{lapse}) at different towers and joint distribution of gust rise time (t_{rise}) at different towers. Wind data are from Towers 20, 22, 34, and 37 at 60 m (See Figure 1 and Table 1 in the main text for locations). Upper-left off-diagonal panels (green boxes): t_{lapse} vs. t_{lapse} at each pair of towers; Diagonal panels (black boxes): t_{lapse} vs. t_{rise} at the same tower; Bottom-right off-diagonal panels (blue boxes): t_{rise} vs. t_{rise} at each pair of towers. Wind data are from Towers 20, 22, 34, and 37 at 60 m (See Figure 1 and Table 1 in the main text for locations). There are 99 ellipses corresponding to the confidence levels from 1% (the innermost ellipse with the warmest color) to 99% (the outermost with the coldest color).

Figure S4 – Joint distributions of gust peak factor (k_{peak}) and gust factor (GF) at different heights from Tower 29. Upper-left off-diagonal panels with green boxes show the joint distributions of k_{peak} at each pair of heights. Diagonal panels with black boxes show the joint distributions of k_{peak} and GF at the same height. Bottom-right off-diagonal panels with blue boxes show the joint distributions of GF at each pair of heights. The number at the bottom-right corner of each panel is the average ratio between the major axis and minor axis of ellipses. There are 99 ellipses corresponding to the confidence levels from 1% (the most inner ellipse with the warmest color) to 99% (the most outer ellipse with the coldest color).

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Figure S5 – Joint distributions of gust peak factor (k_{peak}) at different towers and joint distribution of gust factor (GF) at different towers. Wind data from Towers 20, 22, 34, and 37 at 60 m (See Figure 1 and Table 1 in the main text for locations). Upper-left off-diagonal panels (green boxes): k_{peak} vs. k_{peak} at each pair of towers; Diagonal panels (black boxes): k_{peak} vs. GF at the same tower; Bottom-right off-diagonal panels (blue boxes): GF vs. GF at each pair of towers. There are 99 ellipses corresponding to the confidence levels from 1% (the innermost ellipse with the warmest color) to 99% (the outermost with the coldest color).

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