Monitoring – Why AI isn't the answer to every engineering question

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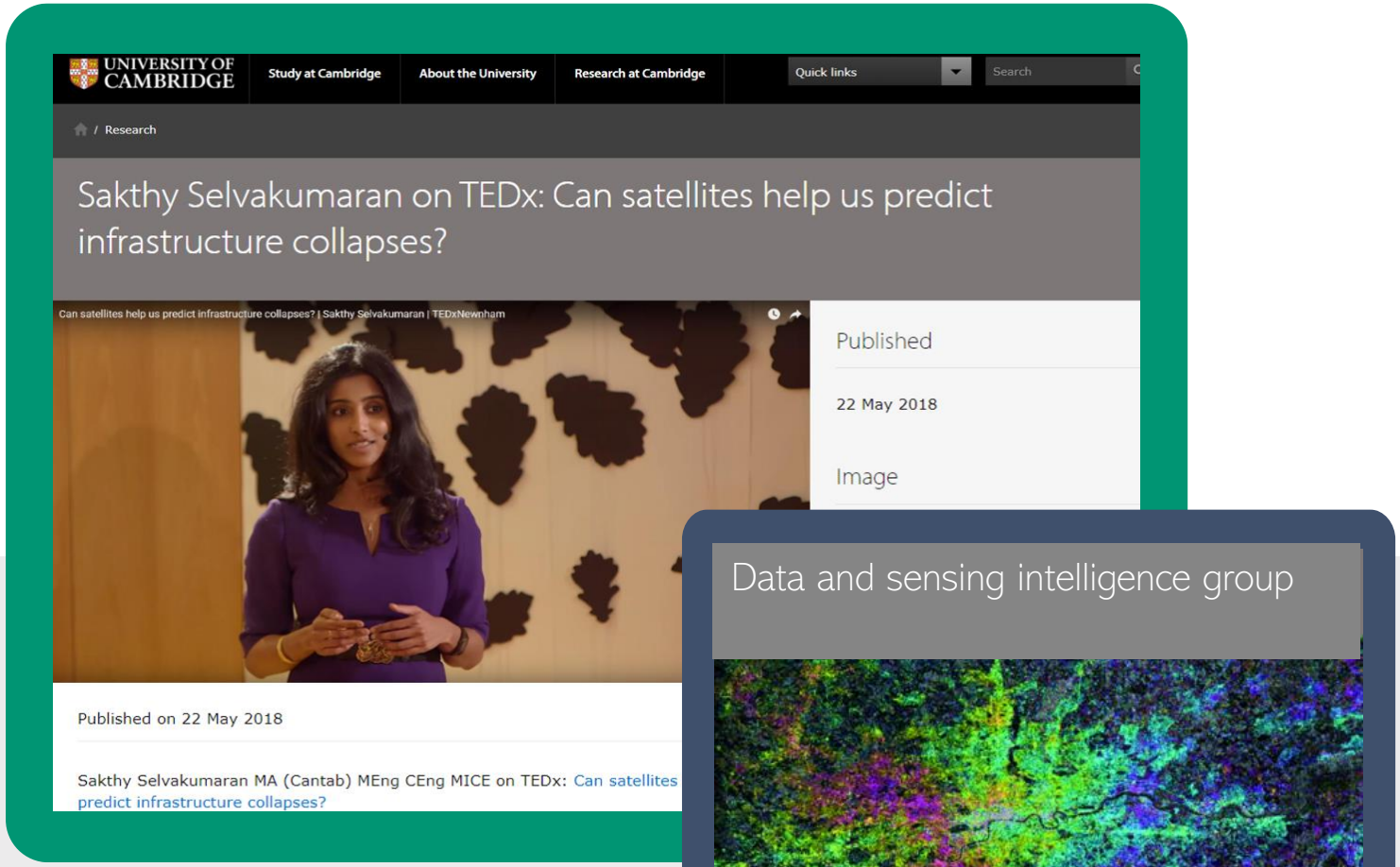
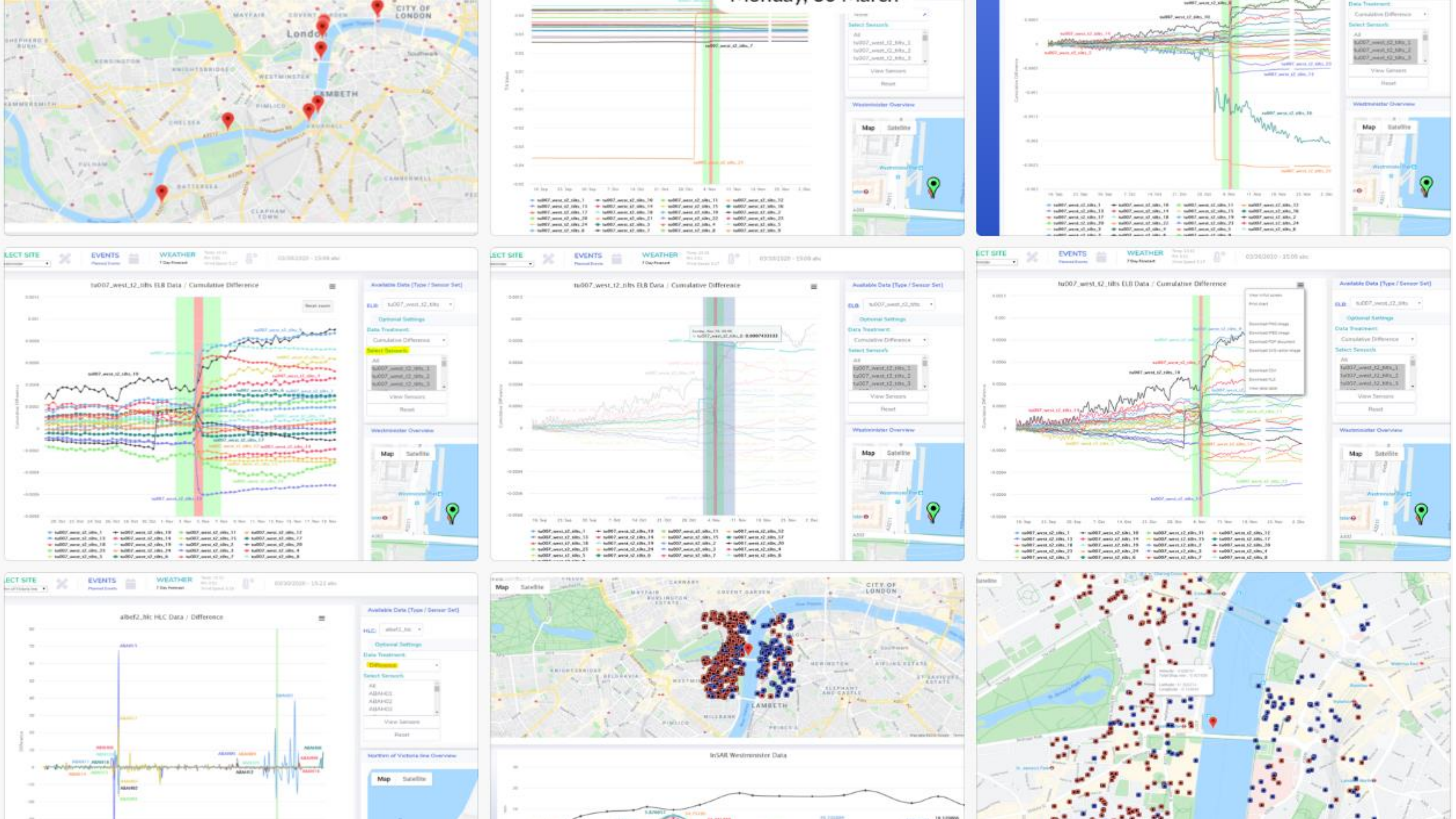


Managing increasing risks



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The History of Artificial Intelligence

1943

THE BIRTH OF NEURAL NETWO

The brain inspired tools behind most of todays cutting edge AI

Mathematical Theory by Warren McCulloch & Walter Pitts

Describes how networks of artifi neutrons can be made to perfor logical functions

1956

ARTIFICIAL INTELLIGENCE GETS ITS NAME

a 2 month, 10 man study of artificial intelligence

Considered the official birthdate of AI

1965

CONVERSING WITH COMPUTERS

Professor at MIT Ai Lab develops a computer psychotherapist called ELIZA

Can carry out seemingly intelligent conversations via text with users

1969

THE ARRIVAL OF 'BACKPROP'

'Backpropagation'

Allows for a network to be trained to perform better by correcting them when they make mistakes

1986

FIRST DRIVERLESS CARS

A Mercedes-Benz van kitted out with cameras and smart sensors by researchers at Germany's Bundeswehr University

Successfully drove up to 55 mph on empty streets

1997

MACHINE BEATS WORLD CHESS CHAMPION

IBM's Deep Blue becomes the first computer chess-playing program to beat a reigning world chess champion

2011

AI TRIUMPHS AT JEOPARDY!

Watson, a natural language question answering computer, competes on TV game show Jeopardy! and defeats two former champions

2016

AI BEATS THE GO WORLD CHAMP

Google DeepMind's AlphaGo defeats Go champion Lee Sedo in four games to one

2016

AI TRAINED TO IDENTIFY CATS

Google researchers trained a giant neural network by feeding it to 10 million unlabelled images. Despite being given no identifying information about them, the AI was able to detect pictures of felines.

AI definitions in 4 categories

Think like human	**Think rationally**
The exciting new effort to make computers **think**…machines **with minds**, in the full and literal sense. [Haugeland, 1895]	The study of the computations that make it possible to **perceive, reason,** and **act**. [Winston, 1992]
Act humanly	**Act rationally**
The study of how to make computers **do** things at which, at the moment, **people** are better [Rich & Knight, 1991]	The branch of computer science that is concerned with the automation of **intelligent behaviour**. [Luger & Stubblefield, 1993]

When AI is not so intelligent…

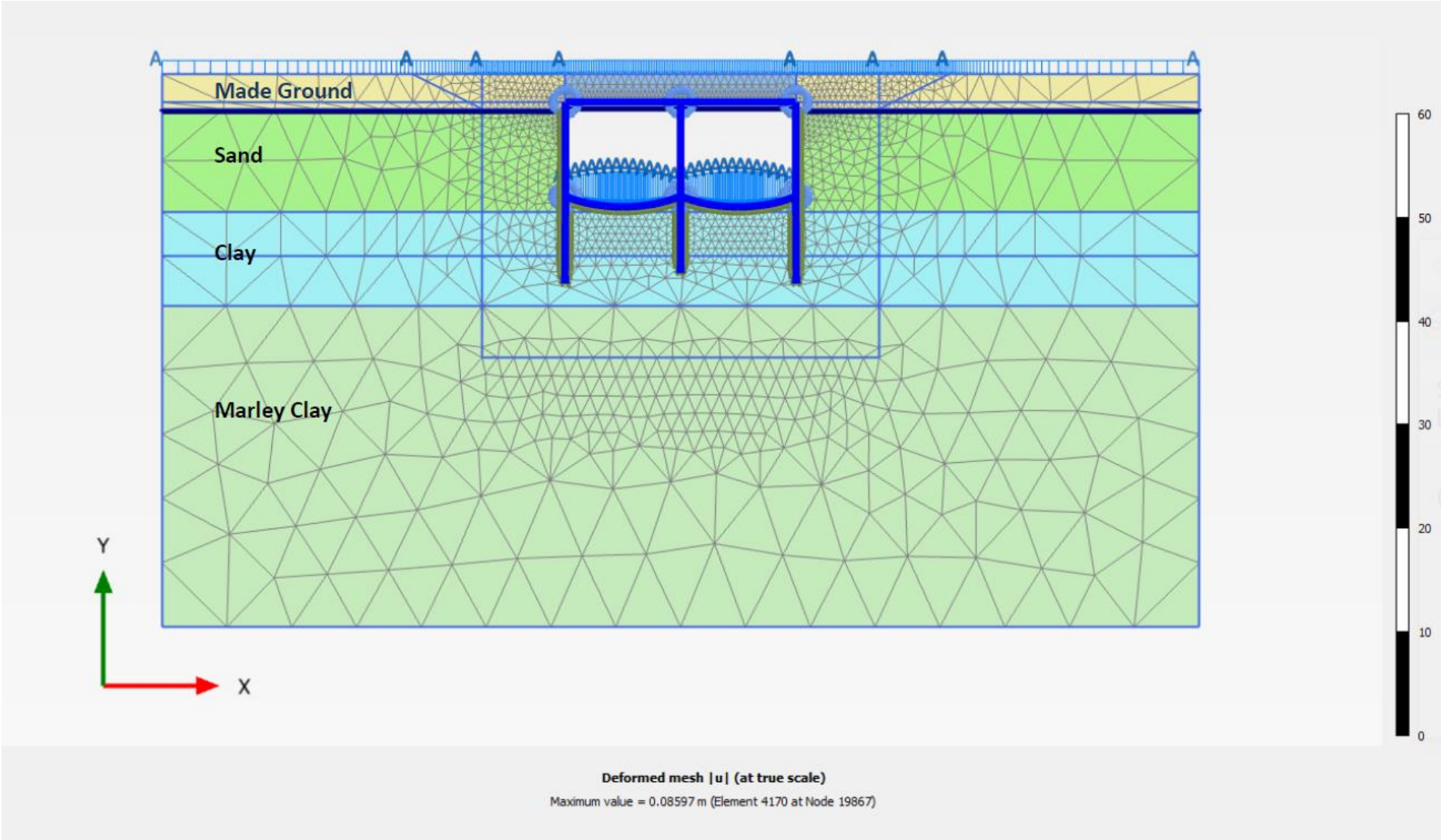
Similarity is hard to define, but…

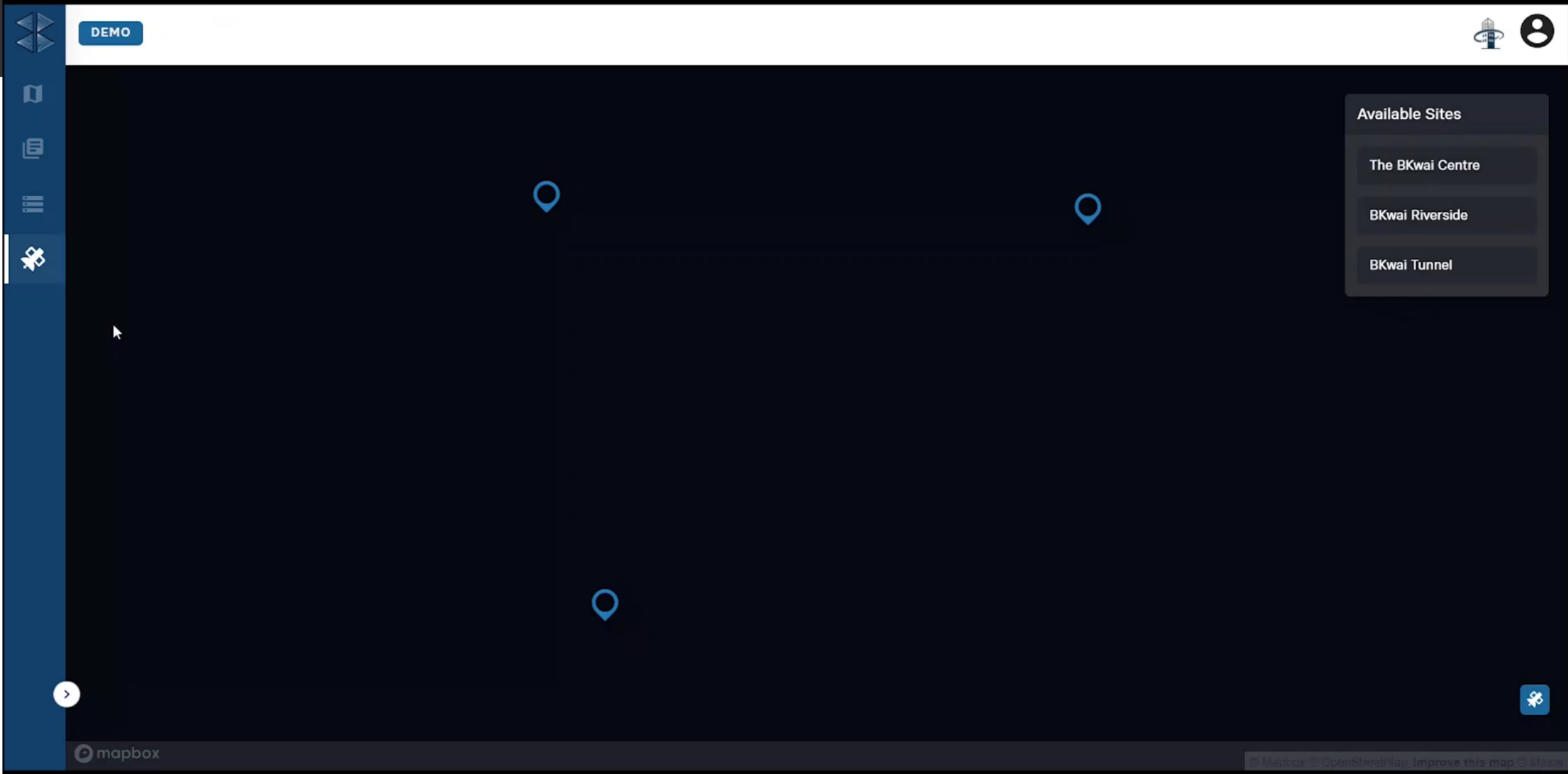
"*We know it when we see it*"

Slide from Eamonn Keogh

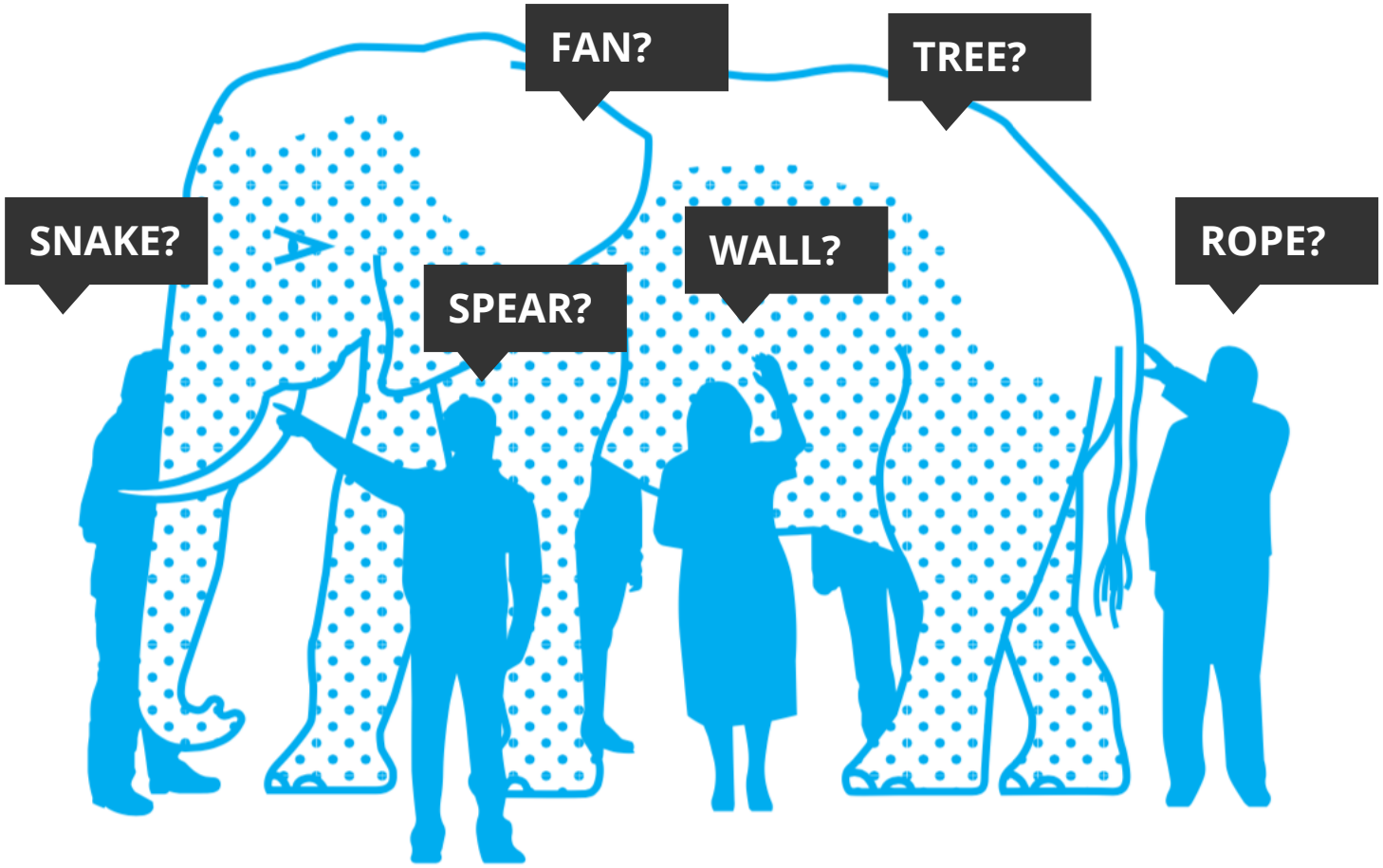
When AI is challenged

Would we do the same for geotechnical models?




DEMO
Available Sites
The BKwai Centre
BKwai Riverside
BKwai Tunnel
mapbox

Multimodal: understanding the full picture



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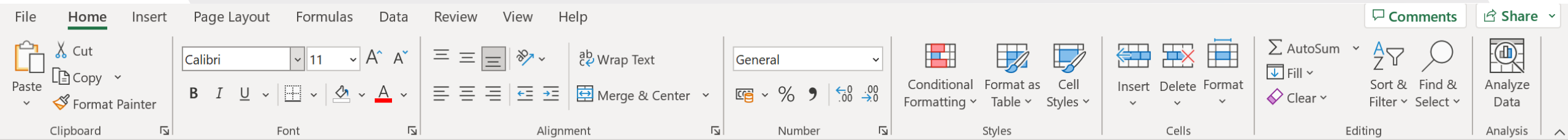
If we have a Gigabyte of data in a day…

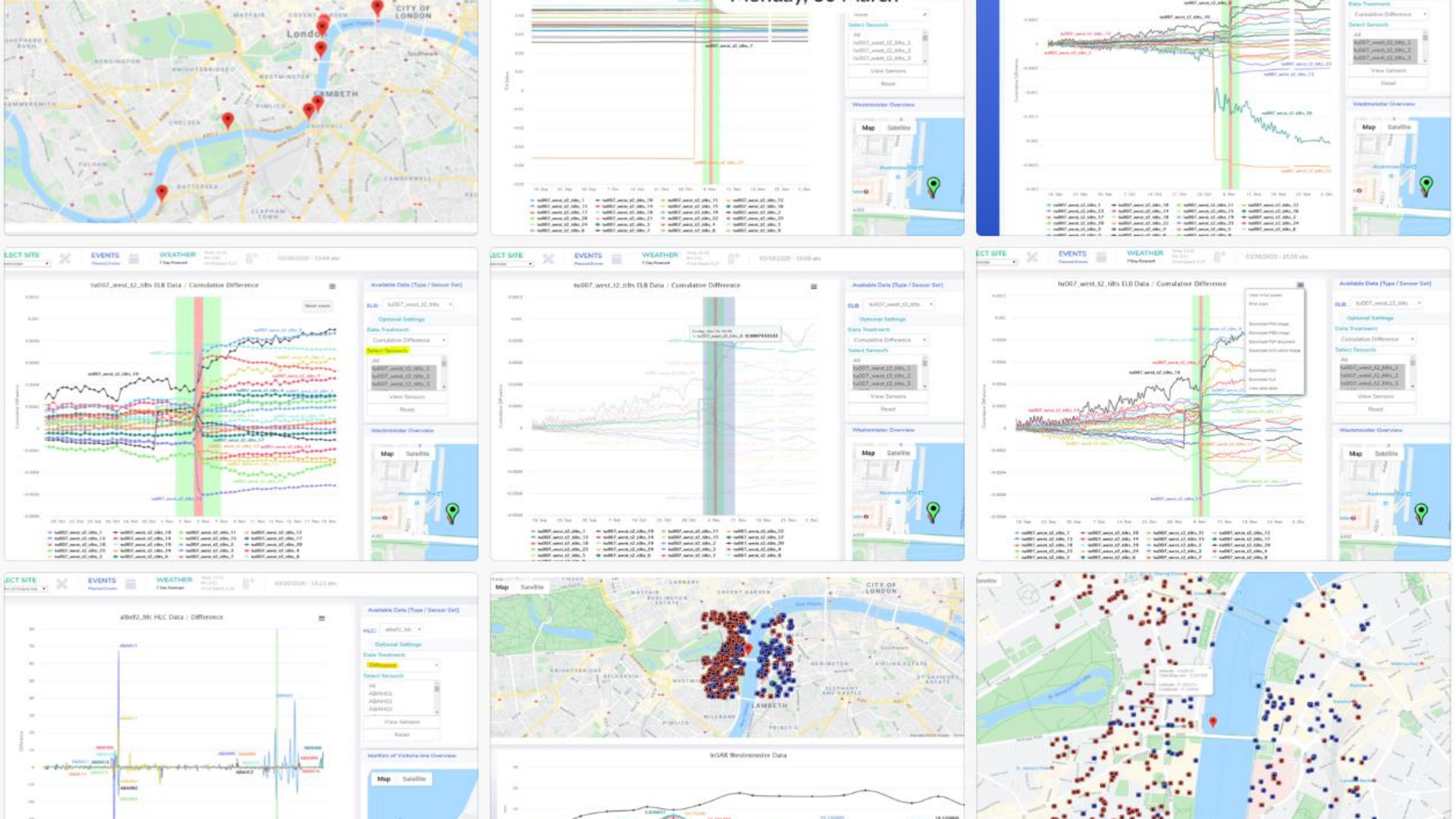


X1

East 1_X

Find the anomalous points?

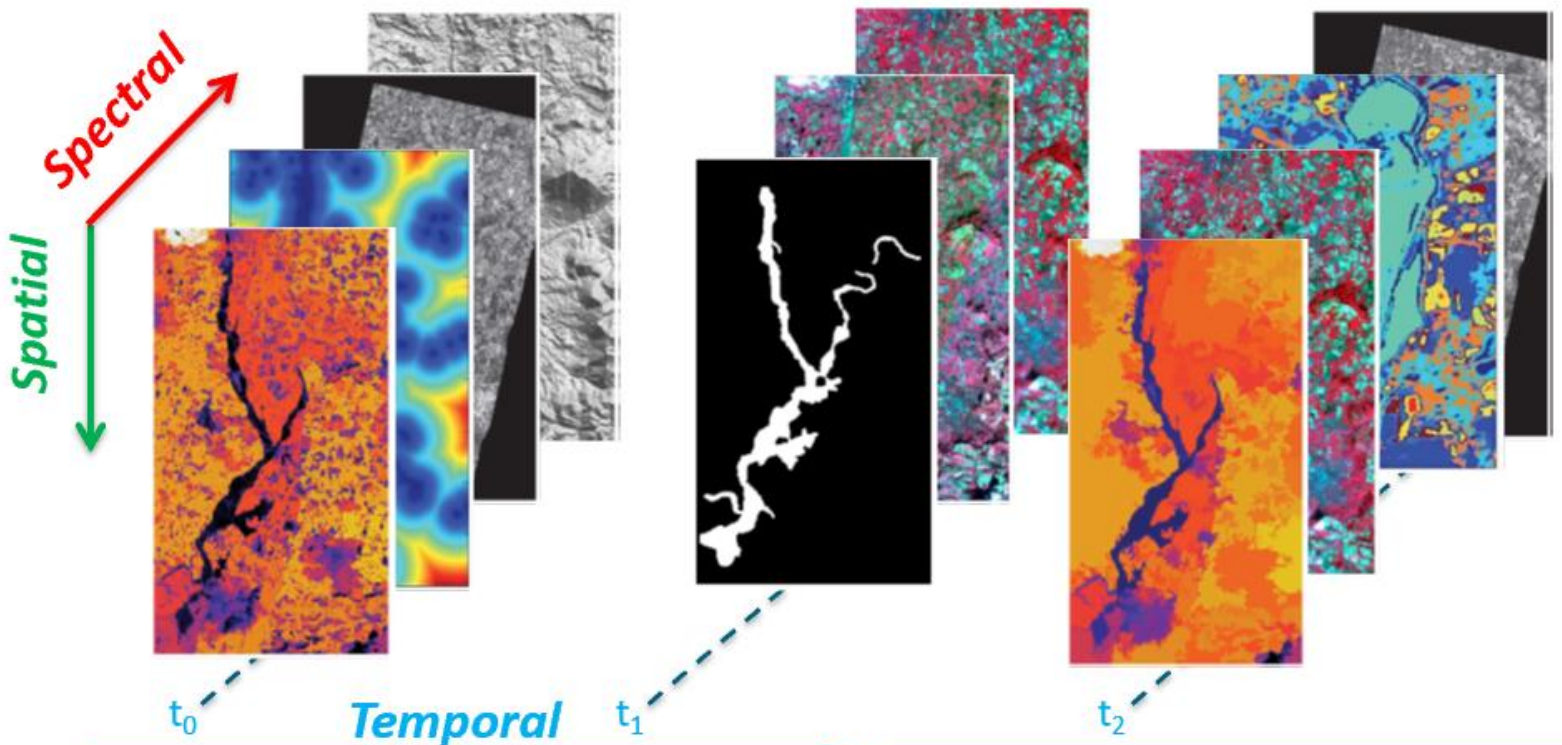
F2_	RNLI	RF2_	RNLI	RF2_	RNLI	RF2_	RNLI	RF3_	RNLI	RF3_	RNLI	RF3_	RNLI	RF4_	RNLI	RF4_	RNLI	RF4_	RNLI	RF4_	East 1_Ten	East 1_Pre	East 1_X	East 1_Y	East 1_Z	East 2_Ten	East 2_Pre	East 2_X	East 2_Y	East 1_Lon	East 1_Tra	East 2_Lon	East 2_Tra	East 3_Lon	East 3_Tra	East 4_Lon	East 4_Tra	East 5_Lon	East 5_Tra	East 6_Lon	East 6_Tra	RNLI	RF1_	RNLI	RF1_	RNLI	RF2_	RNLI	RF2_	RNLI	RF3_	RNLI	RF3_	RNL
.85	987.966	-249.337	152.592	-2.17198	2.64185	987.966	-239.756	168.242	-2.1257	2.64185	987.966	-230.746	184.172	-2.11219	2.64185	987.966	-198.954	175.494	1.13061	2.64185	987.966	-133.672	141.295	0	0	73.6978	-0.00909	97.85	-0.00425	125.056	-0.00995	152.752	0.00476	228.879	0	257.637	-108.479	-34.0074	-43.6622	-32.7802	-25.3537	-3
78	988.103	-249.337	152.592	-2.16593	2.62127	987.986	-239.755	168.243	-2.12463	2.62127	987.986	-230.745	184.173	-2.11143	2.64924	987.988	-198.954	175.494	1.13061	2.64924	987.988	-133.672	141.295	0	0	73.6978	-0.00909	97.85	-0.00425	125.056	-0.00995	152.752	0.00476	228.879	0	257.636	-108.479	-34.0077	-43.6629	-32.7802	-25.3523	-3
78	988.103	-249.336	152.594	-2.1661	2.60069	988.005	-239.754	168.244	-2.12356	2.60069	988.005	-230.745	184.174	-2.11067	2.65663	988.01	-198.954	175.494	1.13061	2.65663	988.01	-133.672	141.295	0	0	73.6978	-0.00909	97.85	-0.00425	125.056	-0.00995	152.752	0.00476	228.879	0	257.636	-108.479	-34.0077	-43.6599	-32.7802	-25.351	-3
78	988.103	-249.334	152.597	-2.16626	2.58011	988.025	-239.754	168.246	-2.12249	2.58011	988.025	-230.744	184.174	-2.1099	2.66403	988.032	-198.954	175.494	1.13061	2.66403	988.032	-133.672	141.295	0	0	73.6978	-0.00909	97.85	-0.00425	125.056	-0.00994	152.752	0.00476	228.879	-1.42E-14	257.636	-108.479	-34.0076	-43.6568	-32.7801	-25.3496	-3
78	988.103	-249.333	152.6	-2.16643	2.55954	988.045	-239.753	168.247	-2.12141	2.55954	988.045	-230.744	184.175	-2.10914	2.67142	988.055	-198.954	175.494	1.13061	2.67142	988.055	-133.672	141.295	0	0	73.6978	-0.00909	97.85	-0.00425	125.056	-0.00994	152.752	0.00476	228.879	-1.42E-14	257.635	-108.479	-34.0075	-43.6538	-32.7801	-25.3482	-3
78	988.103	-249.331	152.602	-2.16659	2.53896	988.064	-239.752	168.248	-2.12034	2.53896	988.064	-230.743	184.176	-2.10837	2.67882	988.077	-198.954	175.494	1.13061	2.67882	988.077	-133.672	141.295	0	0	73.6978	-0.00908	97.85	-0.00424	125.056	-0.00994	152.752	0.00476	228.879	1.42E-14	257.635	-108.479	-34.0074	-43.6507	-32.7801	-25.3468	-
78	988.103	-249.33	152.605	-2.16676	2.51838	988.084	-239.751	168.249	-2.11927	2.51838	988.084	-230.743	184.177	-2.10761	2.68621	988.099	-198.954	175.494	1.13061	2.68621	988.099	-133.672	141.295	0	0	73.6978	-0.00908	97.85	-0.00424	125.056	-0.00994	152.752	0.00476	228.879	0	257.635	-108.479	-34.0073	-43.6477	-32.78	-25.3454	-3
78	988.103	-249.335	152.597	-2.16474	2.4978	988.103	-239.751	168.25	-2.11819	2.4978	988.103	-230.742	184.178	-2.10685	2.69361	988.121	-198.954	175.494	1.13061	2.69361	988.121	-133.672	141.295	0	0	73.6978	-0.00908	97.85	-0.00424	125.056	-0.00993	152.752	0.00477	228.879	1.42E-14	257.634	-108.479	-34.0078	-43.6572	-32.78	-25.344	-3
89	988.288	-249.334	152.597	-2.16542	2.4978	988.103	-239.761	168.237	-2.11924	2.46789	988.288	-230.742	184.178	-2.10753	2.701	988.143	-198.954	175.494	1.13062	2.701	988.143	-133.672	141.295	0	0	73.6978	-0.00908	97.85	-0.00424	125.056	-0.00993	152.752	0.00477	228.879	0	257.634	-108.479	-34.0079	-43.6567	-32.7824	-25.3608	-3
98	988.473	-249.334	152.598	-2.1661	2.4978	988.103	-239.755	168.246	-2.11865	2.43798	988.473	-230.742	184.179	-2.10821	2.7084	988.165	-198.954	175.494	1.13062	2.7084	988.165	-133.672	141.295	0	0	73.6978	-0.00908	97.85	-0.00424	125.056	-0.00993	152.752	0.00477	228.879	0	257.634	-108.479	-34.008	-43.6562	-32.7811	-25.35	-3
07	988.657	-249.334	152.598	-2.16678	2.4978	988.103	-239.748	168.255	-2.11805	2.40807	988.657	-230.742	184.179	-2.1089	2.71579	988.187	-198.954	175.494	1.13062	2.71579	988.187	-133.672	141.295	0	0	73.6978	-0.00908	97.85	-0.00424	125.056	-0.00993	152.752	0.00477	228.879	0	257.634	-108.479	-34.0081	-43.6556	-32.7798	-25.3391	-
15	988.842	-249.334	152.599	-2.16746	2.45792	988.35	-239.748	168.255	-2.11897	2.37815	988.842	-230.742	184.179	-2.10958	2.72319	988.209	-198.954	175.494	1.13062	2.72319	988.209	-133.672	141.295	0	0	73.6978	-0.00907	97.85	-0.00423	125.056	-0.00992	152.752	0.00477	228.879	1.42E-14	257.634	-108.479	-34.0082	-43.6551	-32.7799	-25.3392	-3
24	989.027	-249.334	152.599	-2.16814	2.41804	988.596	-239.749	168.255	-2.11989	2.34824	989.027	-230.742	184.18	-2.11027	2.73058	988.231	-198.954	175.494	1.13062	2.73058	988.231	-133.672	141.295	0	0	73.6978	-0.00907	97.85	-0.00423	125.056	-0.00992	152.752	0.00477	228.879	0	257.633	-108.479	-34.0083	-43.6546	-32.78	-25.3393	-3
89	989.212	-249.334	152.6	-2.16882	2.37815	988.842	-239.749	168.255	-2.12081	2.31833	989.212	-230.742	184.18	-2.11095	2.73797	988.253	-198.954	175.494	1.13062	2.73797	988.253	-133.672	141.295	0	0	73.6978	-0.00907	97.85	-0.00423	125.056	-0.00992	152.752	0.00477	228.879	0	257.633	-108.479	-34.0084	-43.6541	-32.7801	-25.3393	-3
42	989.396	-249.334	152.6	-2.1695	2.33827	989.088	-239.749	168.255	-2.12172	2.28842	989.396	-230.741	184.18	-2.11163	2.74537	988.276	-198.954	175.494	1.13062	2.74537	988.276	-133.672	141.295	0	0	73.6978	-0.00907	97.85	-0.00423	125.056	-0.00991	152.752	0.00478	228.879	0	257.633	-108.479	-34.0085	-43.6536	-32.7802	-25.3394	-3
85	989.581	-249.333	152.601	-2.17018	2.29839	989.335	-239.749	168.255	-2.12264	2.2585	989.581	-230.741	184.18	-2.11232	2.75276	988.298	-198.954	175.494	1.13062	2.75276	988.298	-133.672	141.295	0	0	73.6978	-0.00907	97.85	-0.00423	125.056	-0.00991	152.752	0.00478	228.879	1.42E-14	257.633	-108.479	-34.0086	-43.6531	-32.7803	-25.3395	-3
59	989.766	-249.333	152.601	-2.17086	2.2585	989.581	-239.749	168.255	-2.12356	2.22859	989.766	-230.741	184.181	-2.113	2.76016	988.32	-198.954	175.494	1.13062	2.76016	988.32	-133.672	141.295	0	0	73.6978	-0.00907	97.85	-0.00422	125.056	-0.00991	152.752	0.00478	228.879	0	257.633	-108.479	-34.0087	-43.6526	-32.7804	-25.3395	-3
68	989.95	-249.333	152.602	-2.17153	2.21862	989.827	-239.749	168.255	-2.12448	2.19868	989.95	-230.741	184.181	-2.11368	2.76755	988.342	-198.954	175.494	1.13062	2.76755	988.342	-133.672	141.295	0	0	73.6978	-0.00906	97.85	-0.00422	125.056	-0.00991	152.752	0.00478	228.879	1.42E-14	257.634	-108.479	-34.0088	-43.6521	-32.7805	-25.3396	-3
77	990.135	-249.333	152.602	-2.17221	2.17874	990.073	-239.749	168.255	-2.1254	2.16877	990.135	-230.741	184.181	-2.11437	2.77495	988.364	-198.954	175.494	1.13063	2.77495	988.364	-133.672	141.295	0	0	73.6978	-0.00906	97.85	-0.00422	125.056	-0.0099	152.752	0.00478	228.879	0	257.633	-108.479	-34.0089	-43.6515	-32.7806	-25.3397	-3
85	990.32	-249.333	152.603	-2.17289	2.13885	990.32	-239.749	168.255	-2.12632	2.13885	990.32	-230.741	184.182	-2.11505	2.78234	988.386	-198.954	175.494	1.13063	2.78234	988.386	-133.672	141.295	0	0	73.6978	-0.00906	97.85	-0.00422	125.056	-0.0099	152.752	0.00478	228.879	0	257.633	-108.479	-34.0089	-43.651	-32.7807	-25.3397	-3
36	990.36	-249.333	152.603	-2.17226	2.12936	990.36	-239.75	168.254	-2.12562	2.12936	990.36	-230.741	184.181	-2.11452	2.78974	988.408	-198.954	175.494	1.13063	2.78974	988.408	-133.672	141.295	0	0	73.6978	-0.00906	97.85	-0.00422	125.056	-0.0099	152.752	0.00478	228.879	-1.42E-14	257.633	-108.479	-34.0091	-43.6513	-32.7809	-25.3401	-3
87	990.401	-249.333	152.603	-2.17163	2.11987	990.401	-239.75	168.254	-2.12491	2.11987	990.401	-230.742	184.181	-2.11399	2.79713	988.43	-198.954	175.494	1.13063	2.79713	988.43	-133.672	141.295	0	0	73.6978	-0.00906	97.85	-0.00421	125.056	-0.00989	152.752	0.00479	228.879	-1.42E-14	257.633	-108.479	-34.0092	-43.6516	-32.7811	-25.3405	
38	990.442	-249.333	152.602	-2.17099	2.11038	990.442	-239.75	168.254	-2.12421	2.11038	990.442	-230.742	184.181	-2.11346	2.80453	988.452	-198.954	175.494	1.13063	2.80453	988.452	-133.672	141.295	0	0	73.6978	-0.00906	97.85	-0.00421	125.056	-0.00989	152.752	0.00479	228.879	0	257.634	-108.479	-34.0093	-43.6518	-32.7813	-25.3409	-3
89	990.483	-249.334	152.602	-2.17036	2.10089	990.483	-239.751	168.254	-2.12351	2.10089	990.483	-230.742	184.181	-2.11293	2.81192	988.475	-198.954	175.494	1.13063	2.81192	988.475	-133.672	141.295	0	0	73.6978	-0.00905	97.85	-0.00421	125.056	-0.00989	152.752	0.00479	228.879	0	257.634	-108.479	-34.0094	-43.6521	-32.7815	-25.3413	-3
14	990.524	-249.334	152.602	-2.16973	2.0914	990.524	-239.751	168.253	-2.12281	2.0914	990.524	-230.743	184.18	-2.1124	2.81931	988.497	-198.954	175.494	1.13063	2.81931	988.497	-133.672	141.295	0	0	73.6978	-0.00905	97.85	-0.00421	125.056	-0.00989	152.752	0.00479	228.879	0	257.634	-108.479	-34.0095	-43.6524	-32.7817	-25.3417	-3
91	990.564	-249.334	152.602	-2.1691	2.08191	990.564	-239.751	168.253	-2.12211	2.08191	990.564	-230.743	184.18	-2.11187	2.82671	988.519	-198.954	175.494	1.13063	2.82671	988.519	-133.672	141.295	0	0	73.6978	-0.00905	97.85	-0.00421	125.056	-0.00988	152.752	0.00479	228.879	-1.42E-14	257.634	-108.479	-34.0097	-43.6526	-32.7818	-25.3421	-3
42	990.605	-249.334	152.602	-2.16846	2.07242	990.605	-239.752	168.253	-2.12141	2.07242	990.605	-230.743	184.18	-2.11134	2.8341	988.541	-198.954	175.494	1.13063	2.8341	988.541	-133.672	141.295	0	0	73.6978	-0.00905	97.85	-0.00421	125.056	-0.00988	152.752	0.00479	228.879	0	257.634	-108.479	-34.0098	-43.6529	-32.782	-25.3424	-3
93	990.646	-249.335	152.602	-2.16783	2.06293	990.646	-239.752	168.253	-2.12071	2.06293	990.646	-230.744	184.18	-2.11081	2.8415	988.563	-198.954	175.494	1.13063	2.8415	988.563	-133.672	141.295	0	0	73.6978	-0.00905	97.85	-0.0042	125.056	-0.00988	152.752	0.00479	228.879	0	257.634	-108.479	-34.0099	-43.6532	-32.7822	-25.3428	-
44	990.687	-249.335	152.601	-2.1672	2.05344	990.687	-239.752	168.252	-2.12001	2.05344	990.687	-230.744	184.18	-2.11028	2.84889	988.585	-198.954	175.494	1.13064	2.84889	988.585	-133.672	141.295	0	0	73.6979	-0.00905	97.85	-0.0042	125.056	-0.00987	152.752	0.0048	228.879	1.42E-14	257.634	-108.479	-34.01	-43.6534	-32.7824	-25.3432	-3
95	990.727	-249.335	152.601	-2.16656	2.04395	990.727	-239.753	168.252	-2.11931	2.04395	990.727	-230.744	184.179	-2.10975	2.85629	988.607	-198.954	175.494	1.13064	2.85629	988.607	-133.672	141.295	0	0	73.6979	-0.00904	97.85	-0.0042	125.056	-0.00987	152.752	0.0048	228.879	2.84E-14	257.634	-108.479	-34.0101	-43.6537	-32.7826	-25.3436	-3
33	991.23	-249.335	152.601	-2.16683	1.9833	991.23	-239.753	168.252	-2.11933	1.9833	991.23	-230.744	184.18	-2.10942	2.86368	988.629	-198.954	175.494	1.13064	2.86368	988.629	-133.672	141.295	0	0	73.6979	-0.00904	97.85	-0.0042	125.056	-0.00987	152.752	0.0048	228.879	0	257.634	-108.479	-34.0103	-43.6542	-32.7826	-25.3432	-3
65	991.733	-249.336	152.6	-2.1671	1.92265	991.733	-239.752	168.253	-2.11935	1.92265	991.733	-230.743	184.181	-2.10909	2.87108	988.651	-198.954	175.494	1.13064	2.87108	988.651	-133.672	141.295	0	0	73.6979	-0.00904	97.85	-0.0042	125.056	-0.00987	152.752	0.0048	228.879	1.42E-14	257.634	-108.479	-34.0104	-43.6548	-32.7826	-25.3427	-3
62	992.236	-249.336	152.6	-2.16736	1.862	992.236	-239.752	168.253	-2.11937	1.862	992.236	-230.742	184.182	-2.10876	2.87847	988.673	-198.954	175.494	1.13064	2.87847	988.673	-133.672	141.295	0	0	73.6979	-0.00904	97.8501	-0.00419	125.056	-0.00986	152.752	0.0048	228.879	0	257.634	-108.479	-34.0106	-43.6553	-32.7826	-25.3423	-3
62	992.236	-249.336	152.6	-2.16669	1.862	992.236	-239.753	168.253	-2.11917	1.862	992.236	-230.743	184.181	-2.10863	2.88586	988.696	-198.954	175.494	1.13064	2.88586	988.696	-133.672	141.295	0	0	73.6979	-0.00904	97.8501	-0.00419	125.056	-0.00986	152.752	0.0048	228.879	-1.42E-14	257.634	-108.479	-34.0107	-43.6549	-32.7828	-25.3427	-3
62	992.236	-249.336	152.601	-2.16601	1.862	992.236	-239.753	168.253	-2.11897	1.862	992.236	-230.743	184.181	-2.1085	2.89326	988.718	-198.954	175.494	1.13064	2.89326	988.718	-133.672	141.295	0	0	73.6979	-0.00904	97.8501	-0.00419	125.056	-0.00986	152.752	0.0048	228.879	0	257.634	-108.479	-34.0107	-43.6545	-32.783	-25.343	-3
62	992.236	-249.336	152.601	-2.16533	1.862	992.236	-239.753	168.253	-2.11878	1.862	992.236	-230.744	184.181	-2.10838	2.90065	988.74	-198.954	175.494	1.13064	2.90065	988.74	-133.672	141.295	0	0	73.6979	-0.00903	97.8501	-0.00419	125.056	-0.00986	152.752	0.0048	228.879	0	257.634	-108.479	-34.0108	-43.654	-32.7831	-25.3434	-3
62	992.236	-249.336	152.601	-2.16573	1.862	992.236	-239.753	168.252	-2.11879	1.862	992.236	-230.744	184.18	-2.10816	2.90805	988.762	-198.954	175.494	1.13064	2.90805	988.762	-133.672	141.295	0	0	73.6979	-0.00903	97.8501	-0.00419	125.056	-0.00985	152.752	0.00481	228.879	1.42E-14	257.634	-108.479	-34.0109	-43.6547	-32.7832	-25.3435	-
62	992.236	-249.337	152.6	-2.16612	1.862	992.236	-239.753	168.252	-2.1188	1.862	992.236	-230.745	184.18	-2.10794	2.91544	988.784	-198.954	175.494	1.13064	2.91544	988.784	-133.672	141.295	0	0	73.6979	-0.00903	97.8501	-0.00418	125.056	-0.00985	152.752	0.00481	228.879	1.42E-14	257.634	-108.479	-34.011	-43.6554	-32.7833	-25.3436	-3
62	992.236	-249.337	152.6	-2.16652	1.862	992.236	-239.753	168.252	-2.11881	1.862	992.236	-230.745	184.18	-2.10772	2.92284	988.806	-198.954	175.494	1.13065	2.92284	988.806	-133.672	141.295	0	0	73.6979	-0.00903	97.8501	-0.00418	125.056	-0.00985	152.752	0.00481	228.879	1.42E-14	257.634	-108.479	-34.0111	-43.6561	-32.7833	-25.3436	-3
84	992.723	-249.337	152.6	-2.16632	1.78184	992.723	-239.754	168.252	-2.11851	1.87035	992.255	-230.745	184.18	-2.10773	2.93023	988.828	-198.954	175.494	1.13065	2.93023	988.828	-133.672	141.295	0	0	73.6979	-0.00903	97.8501	-0.00418	125.056	-0.00984	152.752	0.00481	228.879	0	257.634	-108.479	-34.0112	-43.6557	-32.7835	-25.3438	-3
68	993.21	-249.337	152.6	-2.16611	1.70168	993.21	-239.754	168.252	-2.11821	1.87871	992.274	-230.745	184.18	-2.10773	2.93763	988.85	-198.954	175.494	1.13065	2.93763	988.85	-133.672	141.295	0	0	73.6979	-0.00903	97.8501	-0.00418	125.056	-0.00984	152.752	0.00481	228.879	-1.42E-14	257.634	-108.479	-34.0113	-43.6553	-32.7836	-25.3441	-3
52	993.697	-249.337	152.601	-2.16591	1.62152	993.697	-239.754	168.252	-2.11791	1.88706	992.293	-230.745	184.18	-2.10773	2.94502	988.872	-198.954	175.494	1.13065	2.94502	988.872	-133.672	141.295	0	0	73.6979	-0.00902	97.8501	-0.00418	125.056	-0.00984	152.752	0.00481	228.879	0	257.634	-108.479	-34.0114	-43.6549	-32.7838	-25.3443	-3
12	993.715	-249.337	152.601	-2.16592	1.63012	993.715	-239.754	168.252	-2.11792	1.89541	992.312	-230.745	184.18	-2.10773	2.95242	988.894	-198.954	175.494	1.13065	2.95242	988.894	-133.672	141.295	0	0	73.6979	-0.00902	97.8501	-0.00417	125.056	-0.00984	152.752	0.00481	228.879	0	257.634	-108.479	-34.0114	-43.655	-32.7838	-25.3443	-3
71	993.733	-249.337	152.601	-2.16592	1.63871	993.733	-239.754	168.252	-2.11792	1.90377	992.331	-230.745	184.18	-2.10774	2.95981	988.917	-198.954	175.494	1.13065	2.95981	988.917	-133.672	141.295	0	0	73.6979	-0.00902	97.8501	-0.00417	125.056	-0.00983	152.752	0.00482	228.879	-1.42E-14	257.634	-108.479	-34.0114	-43.655	-32.7838	-25.3443	-3
73	993.75	-249.337	152.601	-2.16593	1.6473	993.75	-239.754	168.252	-2.11793	1.91212	992.35	-230.745	184.18	-2.10774	2.9672	988.939	-198.954	175.494	1.13065	2.9672	988.939	-133.672	141.295	0	0	73.6979	-0.00902	97.8501	-0.00417	125.056	-0.00983	152.752	0.00482	228.879	0	257.634	-108.479	-34.0114	-43.655	-32.7838	-25.3443	-3



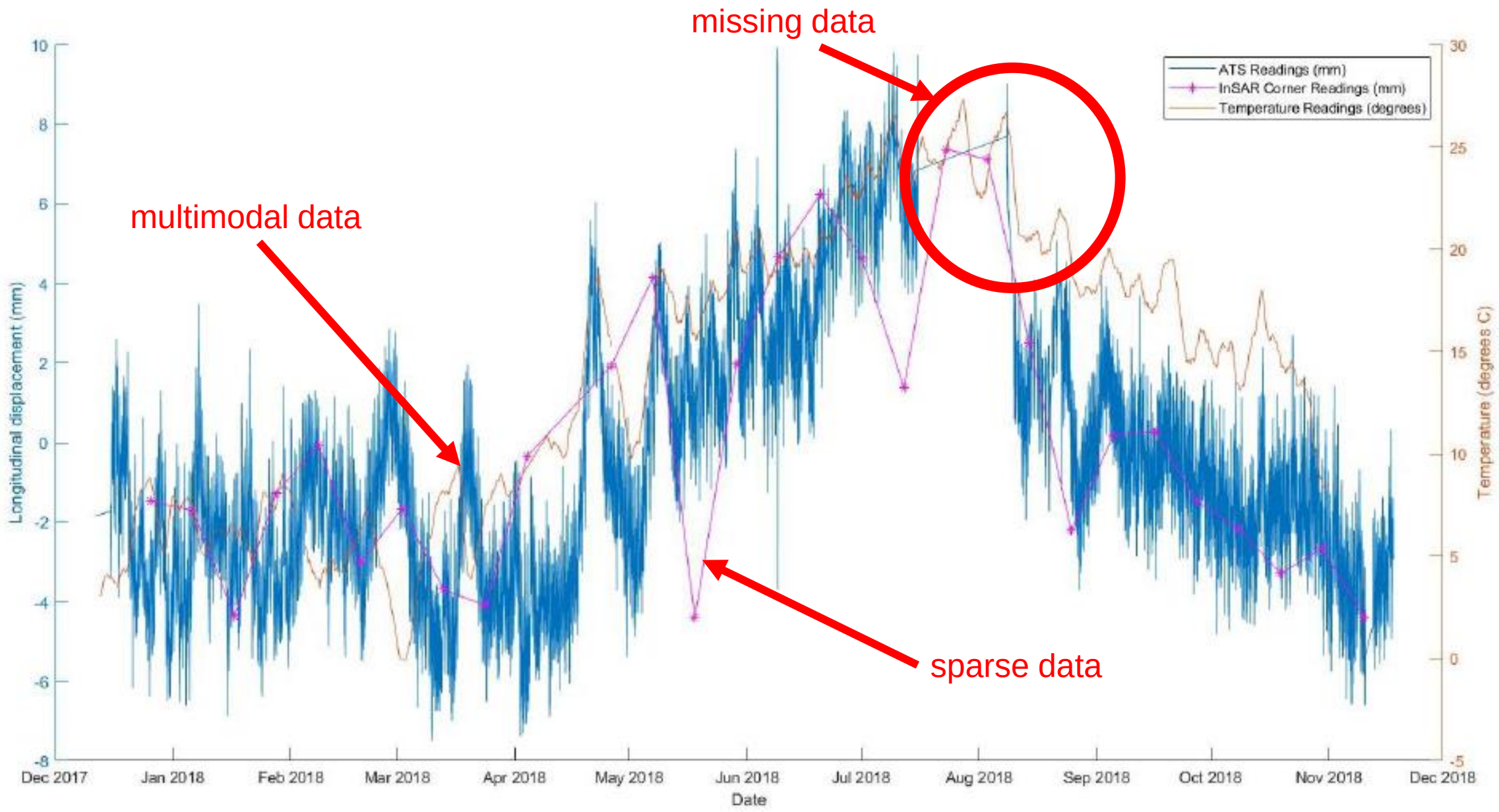
London
CITY OF LONDON
LAMBETH
EVENTS
WEATHER
tu007_west_t2_tilts ELB Data / Cumulative Difference
Available Data (Type / Sensor Set)
Optional Settings
Data Treatment
Cumulative Difference
Select Sensor/s
View Sensors
Reset
Westminster Overview
Map
Satellite
albef2_hlc HLC Data / Difference
Difference
Northern of Victoria line Overview
InSAR Westminster Data

Multimodal: understanding the full picture

Goal = extract the most accurate and reliable information on the region of interest (with the lowest computational load)



Data can be observations, in situ measurements, models, … →*multimodal*


missing data
multimodal data
sparse data
ATS Readings (mm)
InSAR Corner Readings (mm)
Temperature Readings (degrees)
Longitudinal displacement (mm)
Temperature (degrees C)
Date
Dec 2017
Jan 2018
Feb 2018
Mar 2018
Apr 2018
May 2018
Jun 2018
Jul 2018
Aug 2018
Sep 2018
Oct 2018
Nov 2018
Dec 2018
10
8
6
4
2
0
-2
-4
-6
-8
30
25
20
15
10
5
0
-5

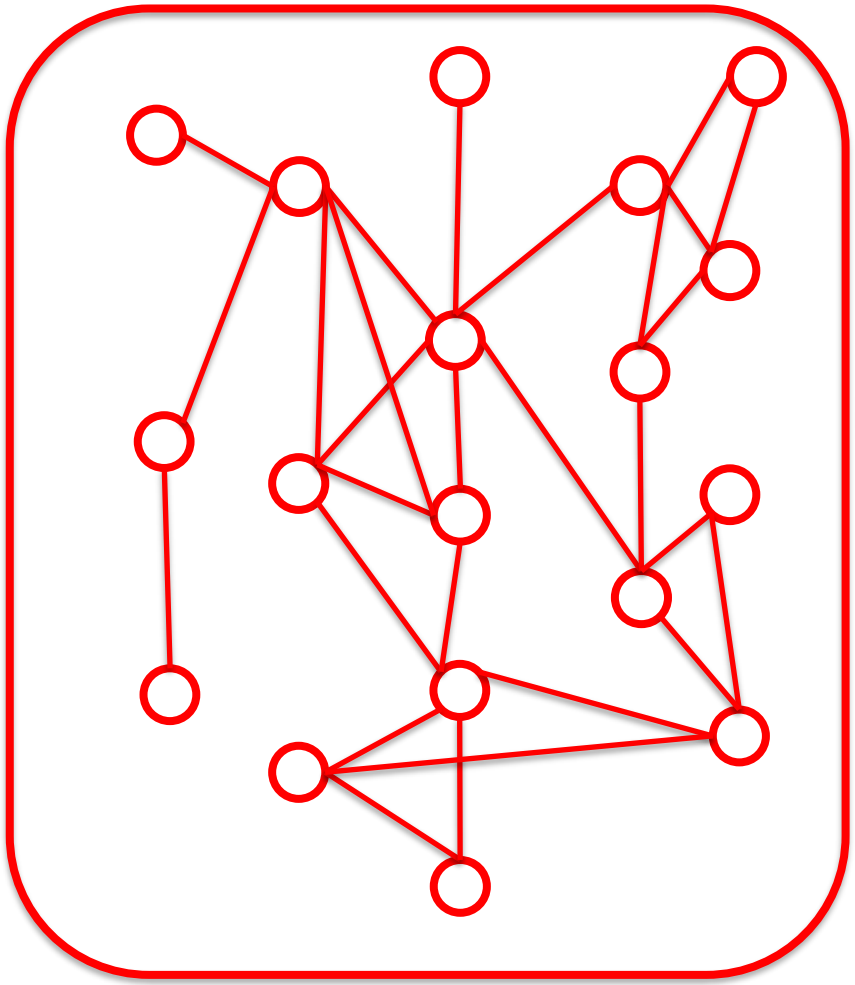
Technology

Multimodal data learning methods

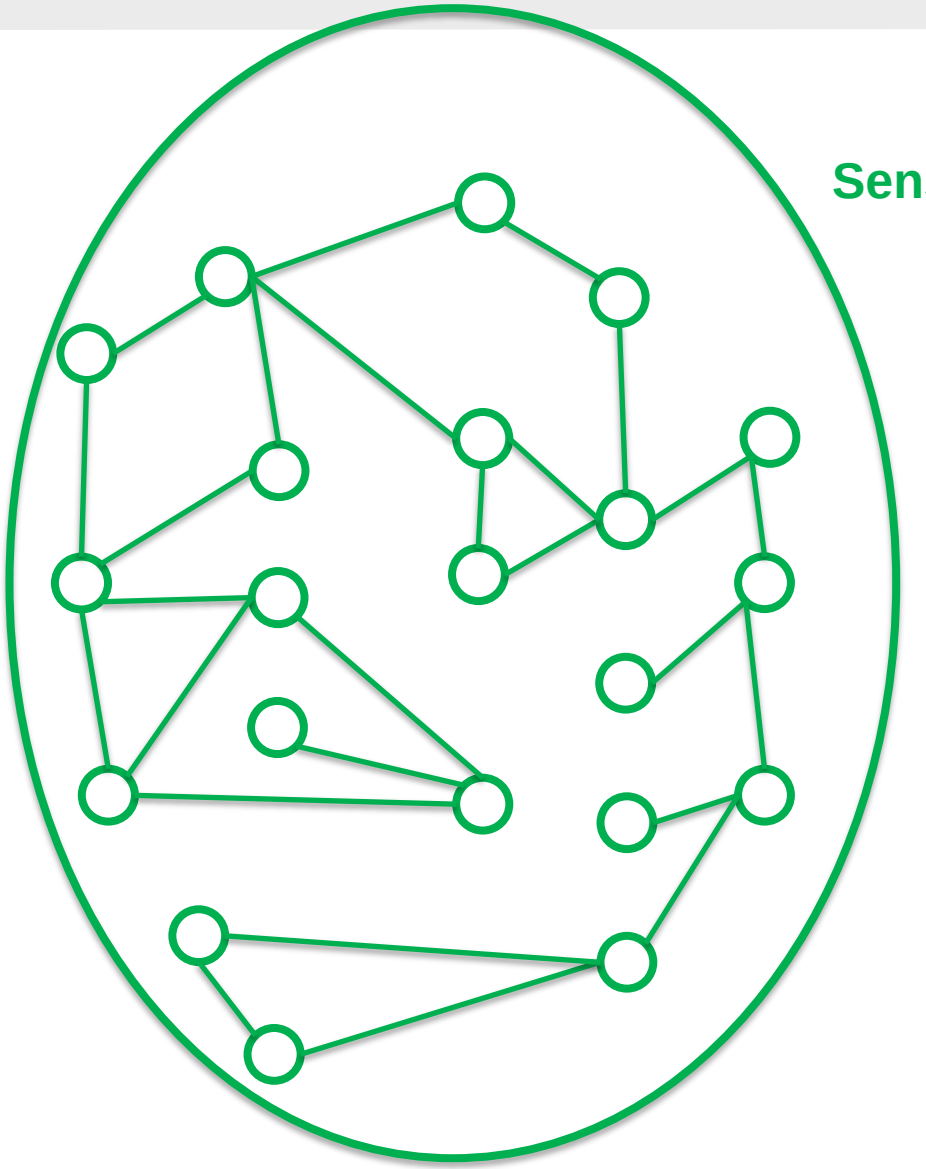
Understanding

Graph representation

Sensor 1

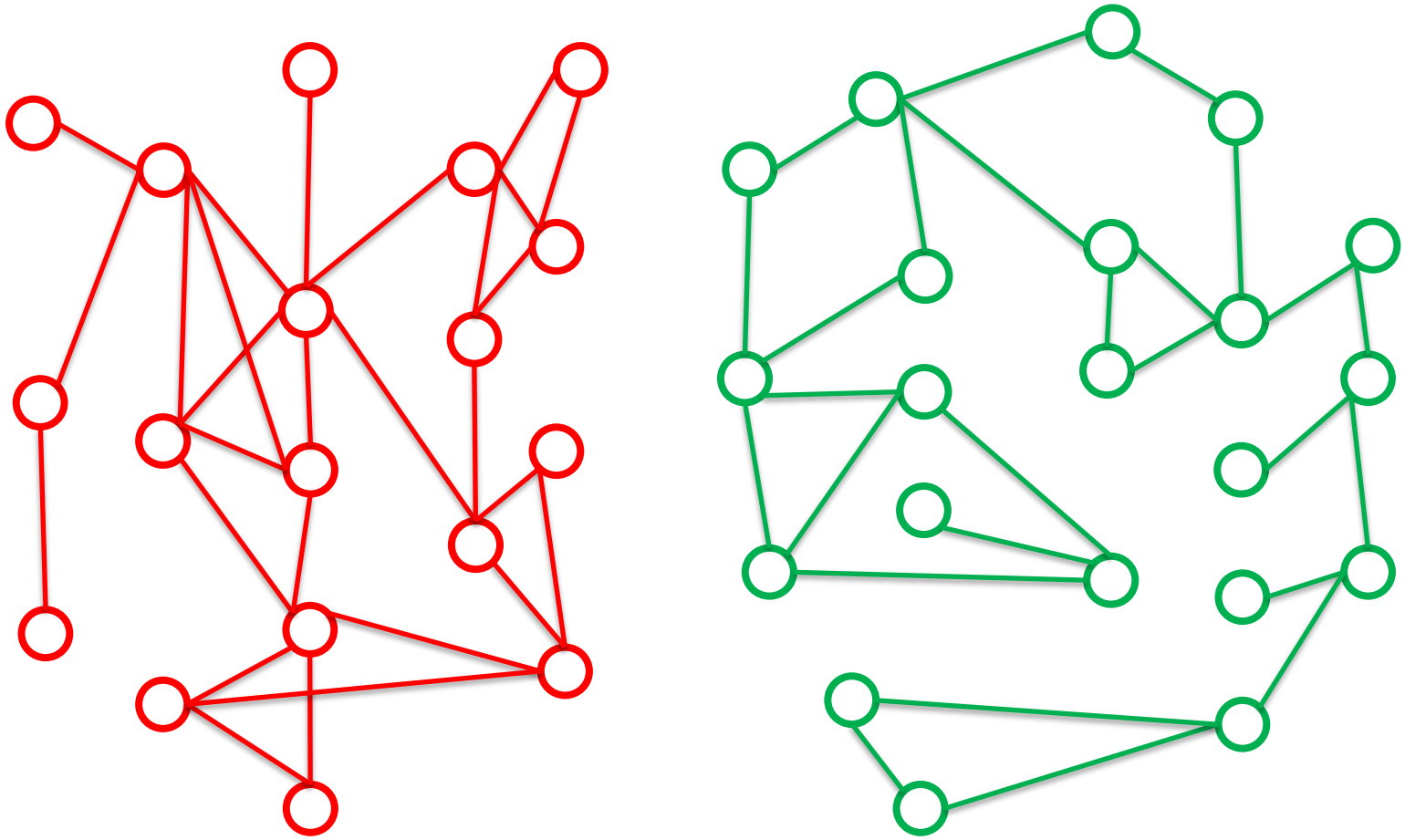


Sensor 2

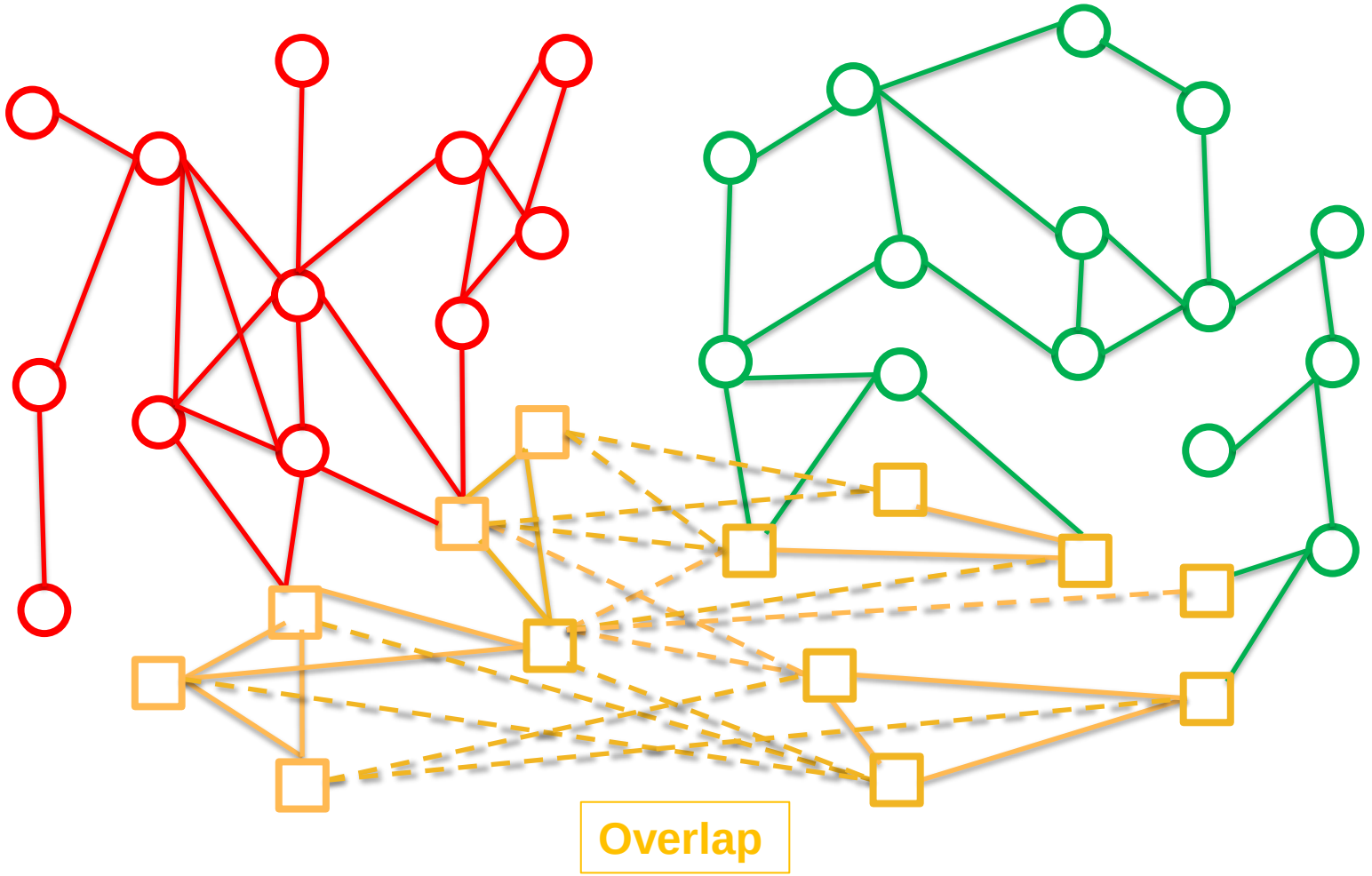


Graph representation

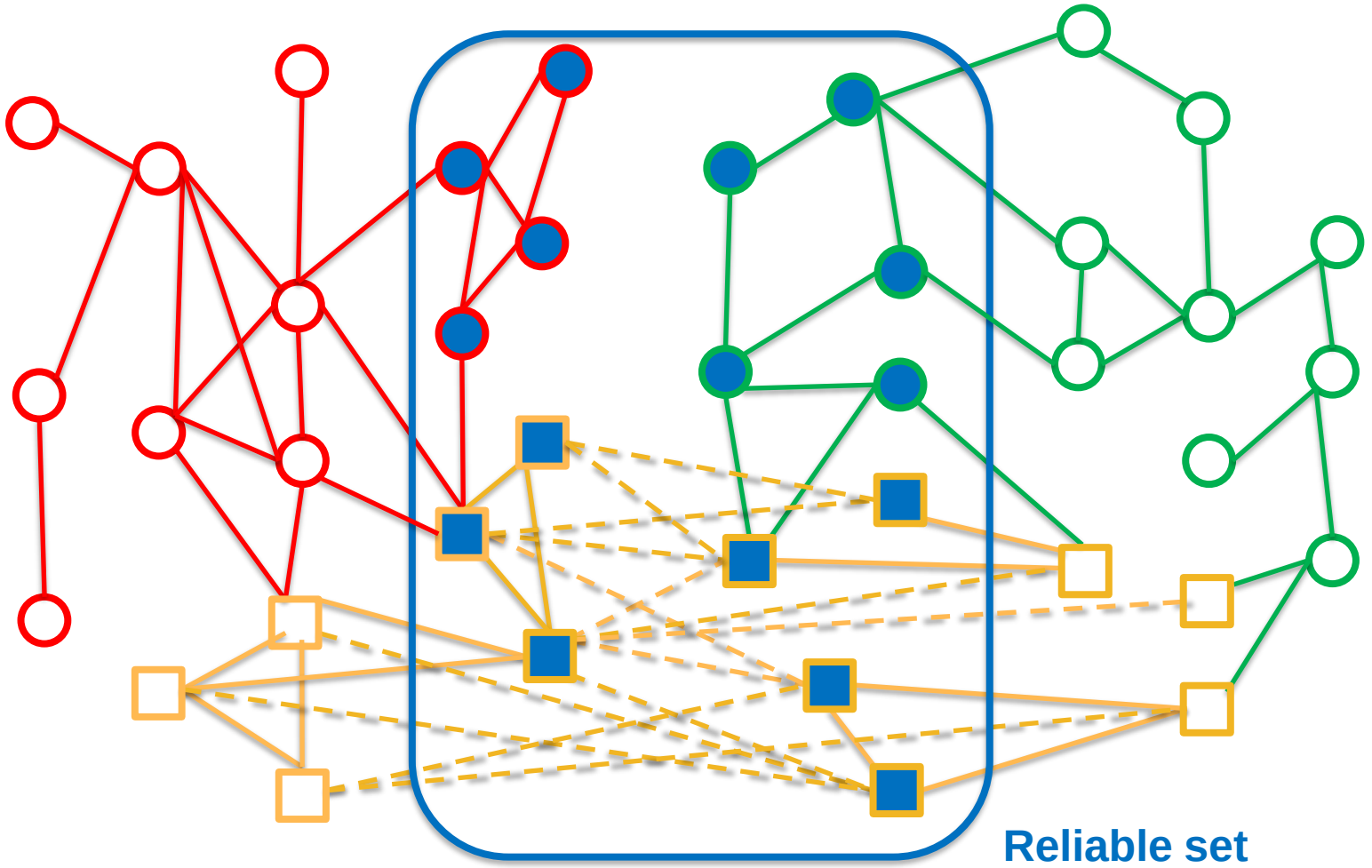
Edges might represent geometrical, statistical, and/or informative relationships



Graph representation

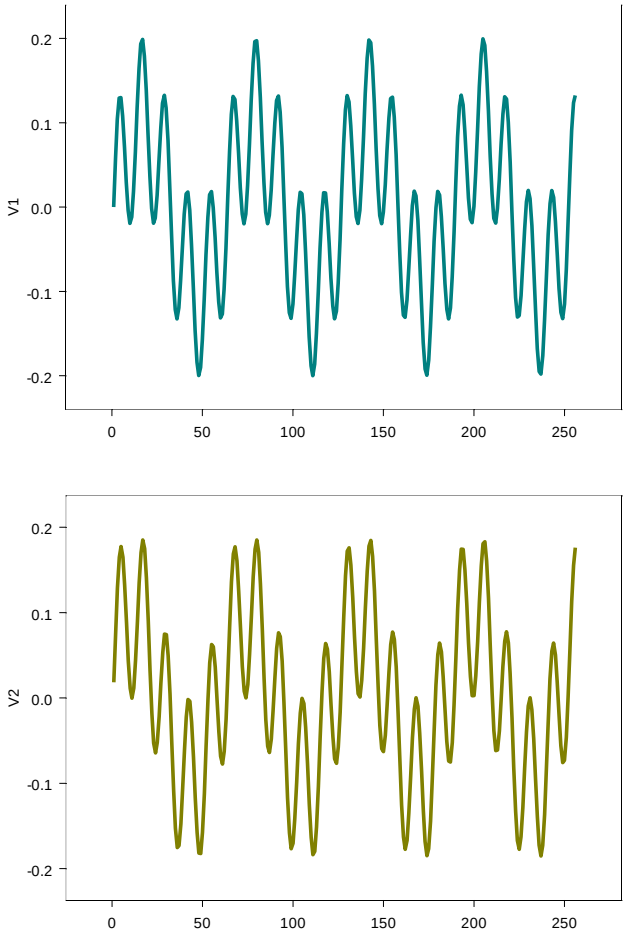


Graph representation



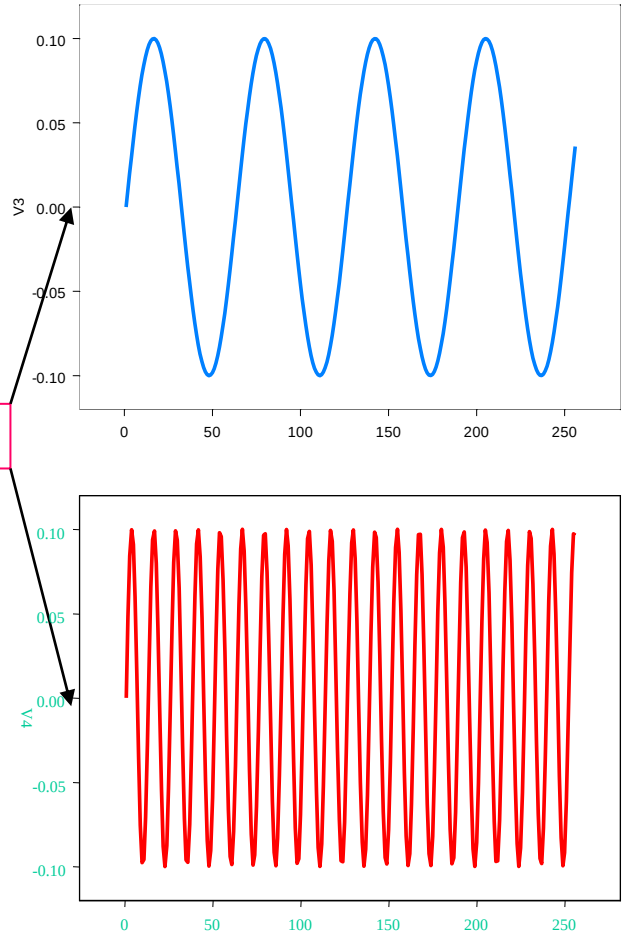
If we have a Gigabyte of data in a day…

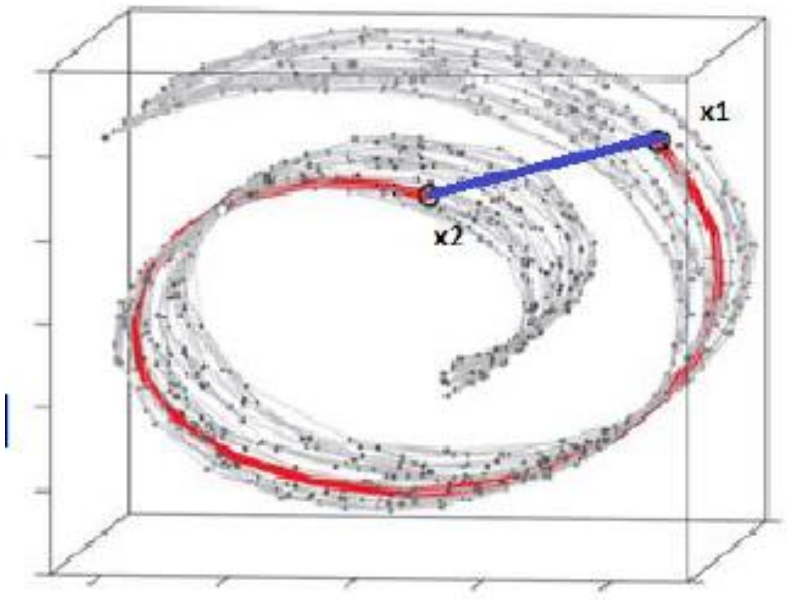
Observing signals



Analysis

Original source signal

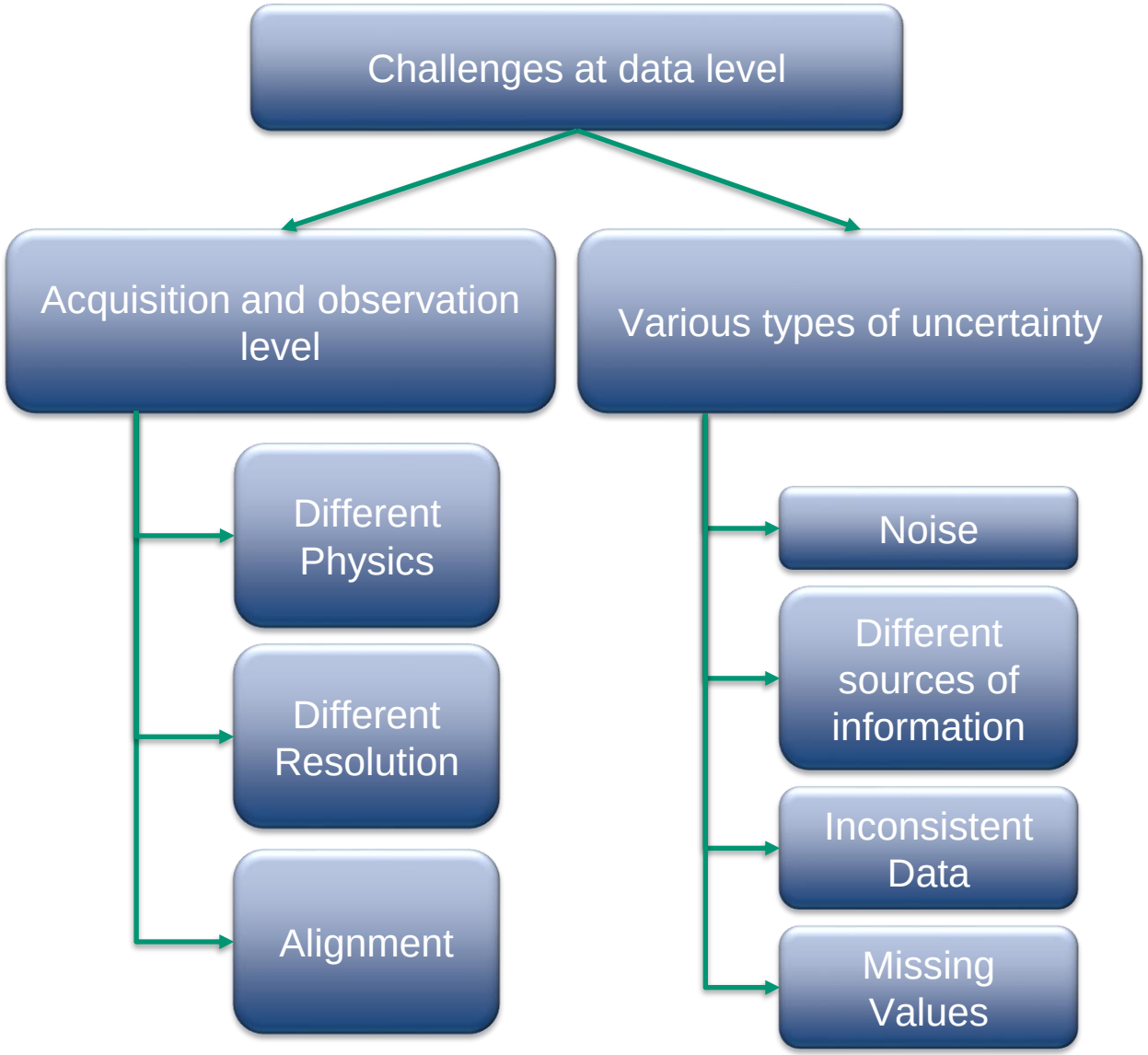


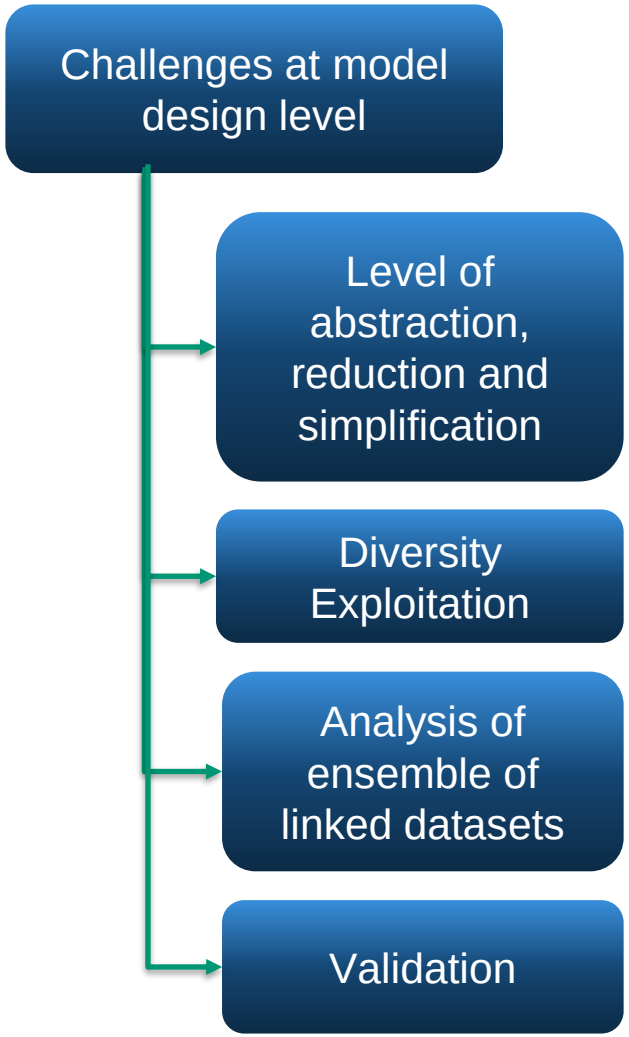


What are some of the main challenges?

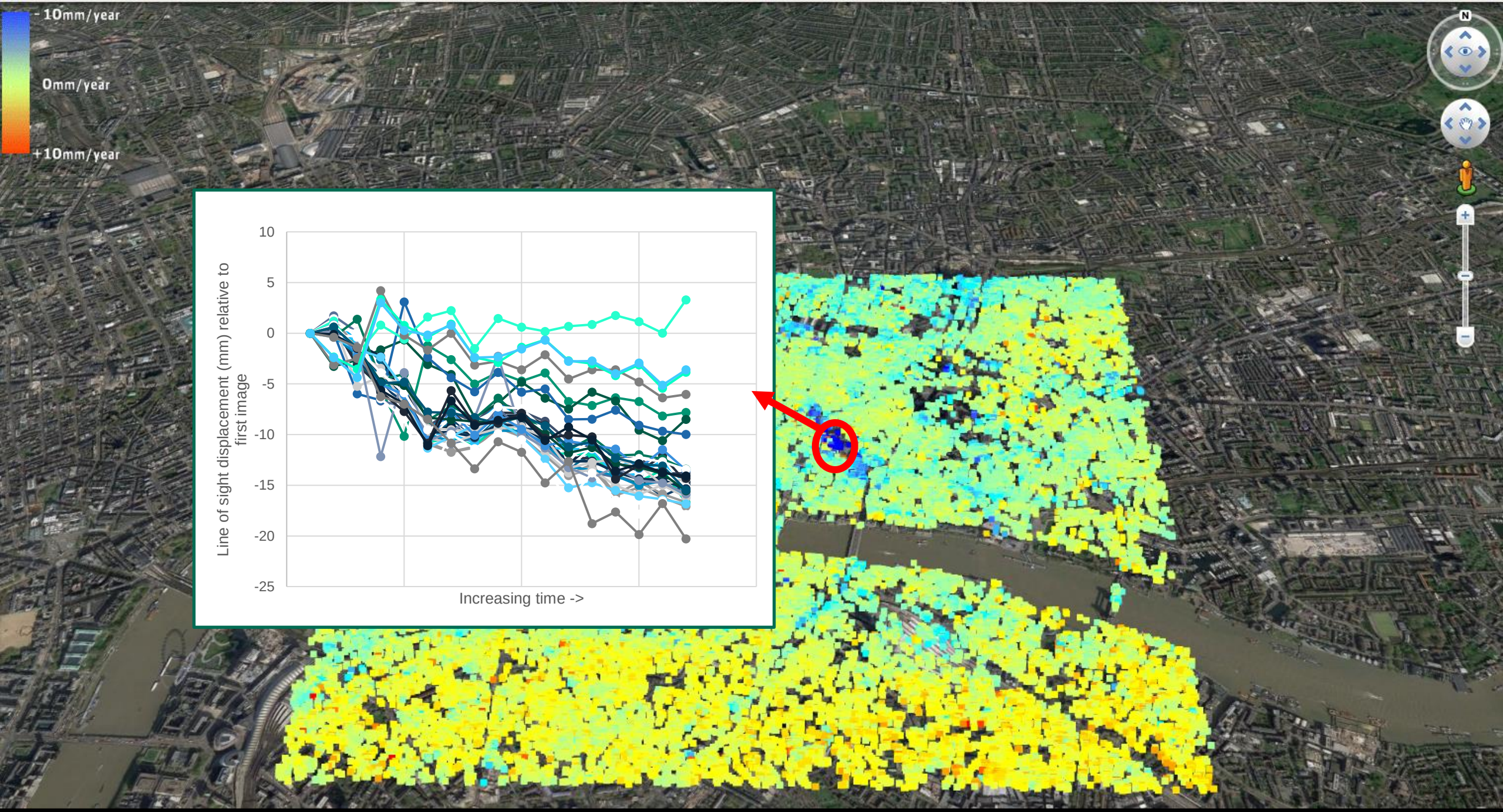
- Limited training data (limited annotations, label noise)
- Uncertainty (measurement, sensor reliability)
- Interpretable data and confidence

What are some of the main challenges?

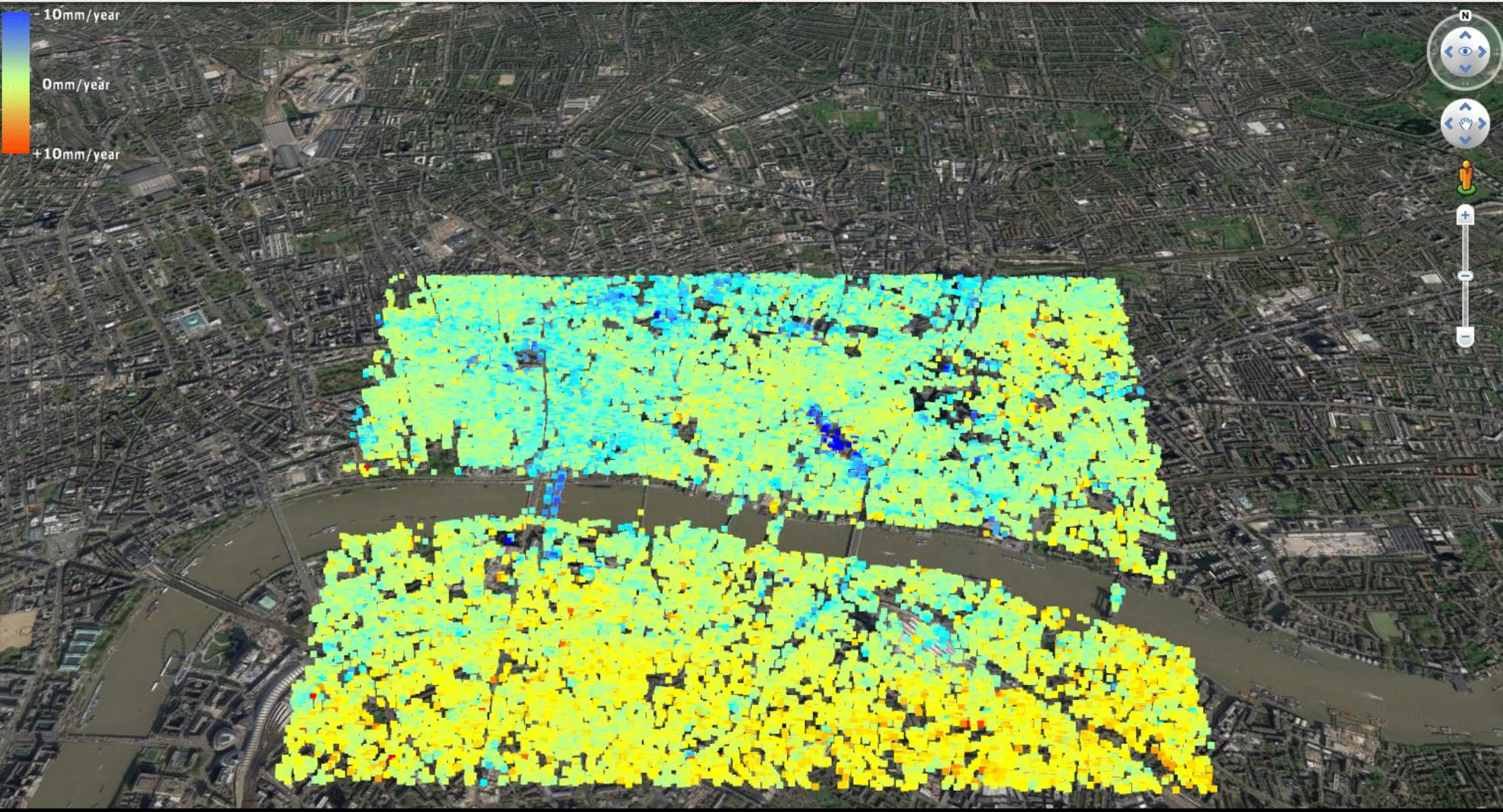




Data-driven forecasting

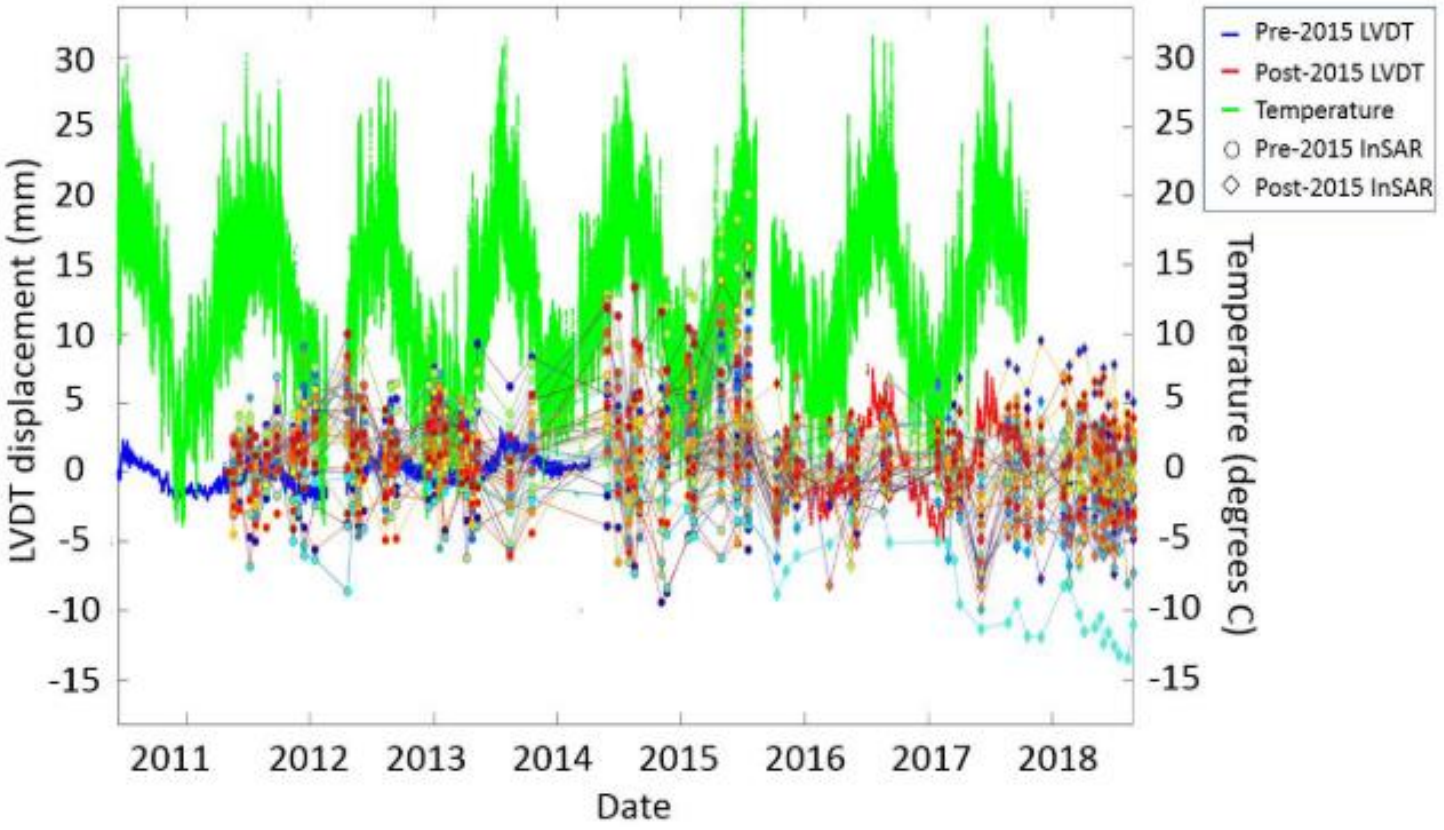


Map of ground movement in Bank region, London, using TerraSAR-X data



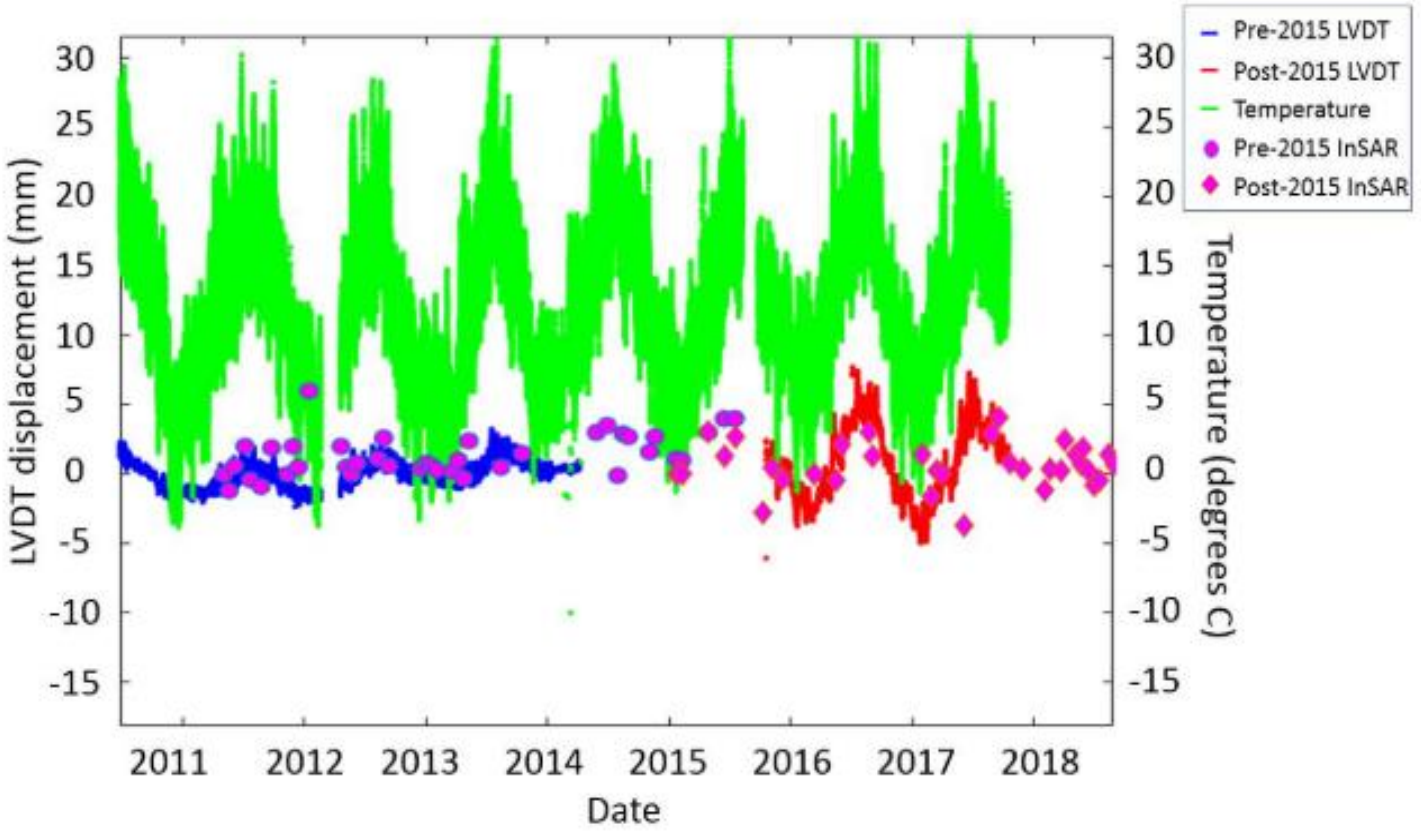
Map of ground movement in Bank region, London, using TerraSAR-X data

If we have a Gigabyte of data in a day…



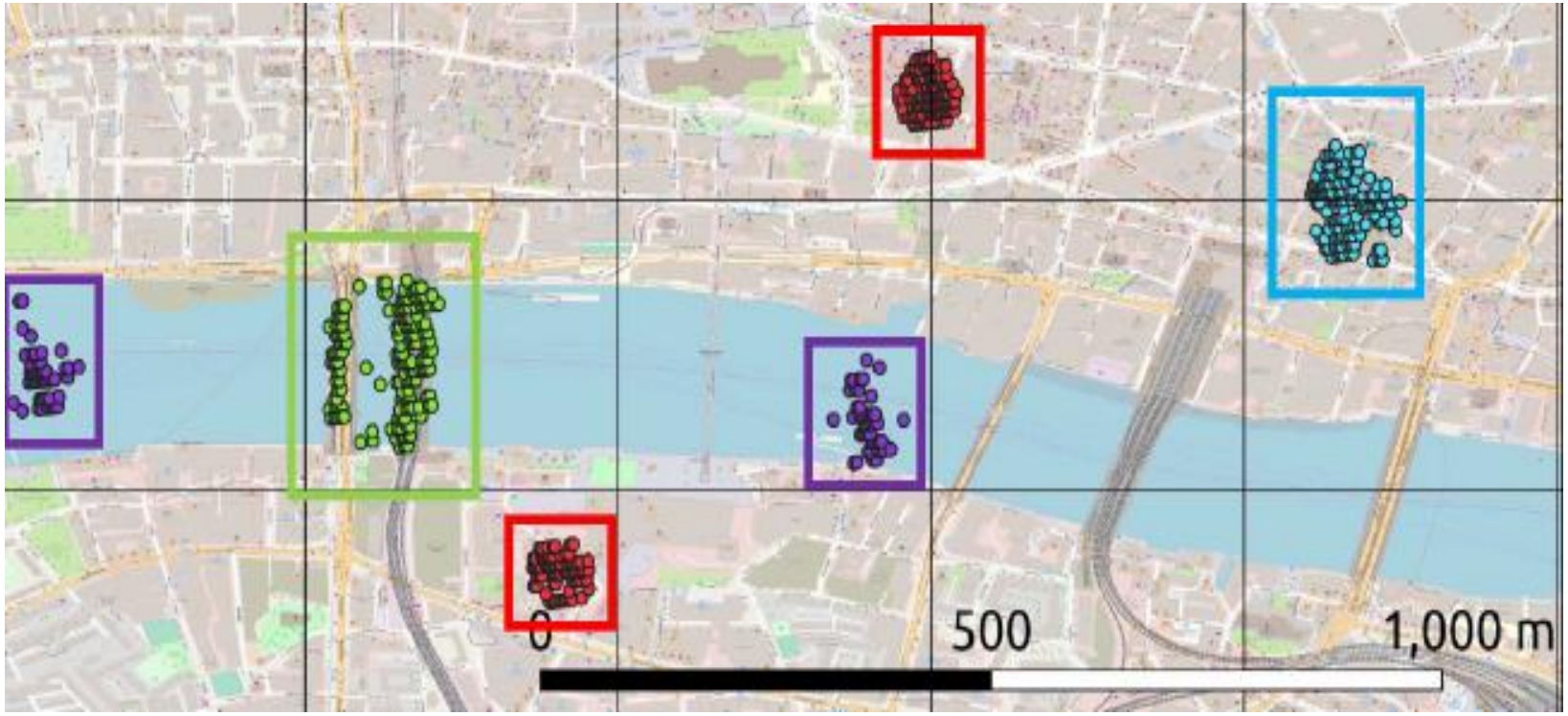
Find the relevant points?

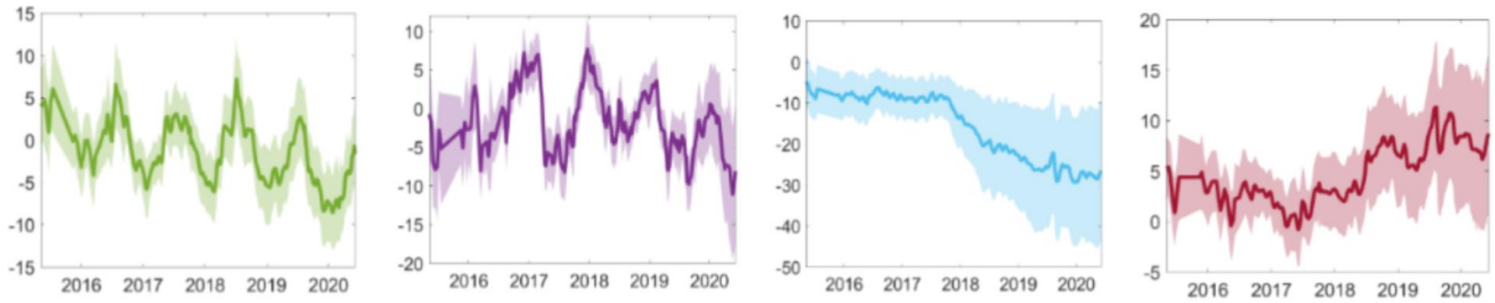
If we have a Gigabyte of data in a day…



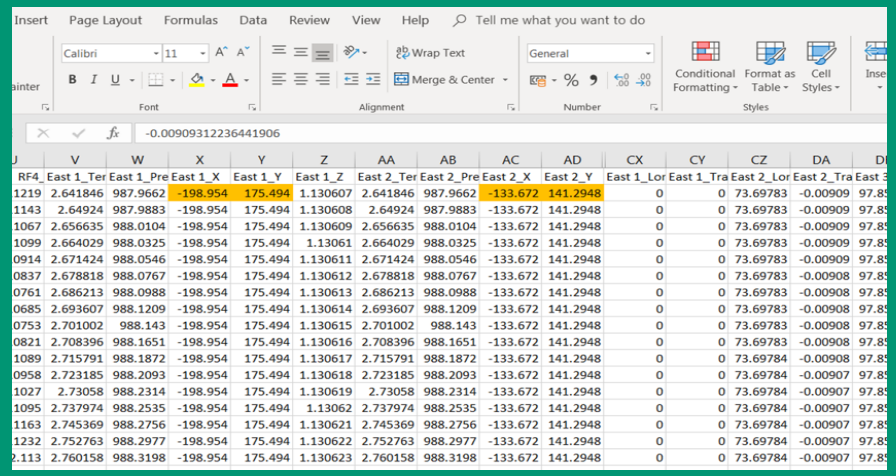
Find the relevant points?

How do we deal with large volumes of data?

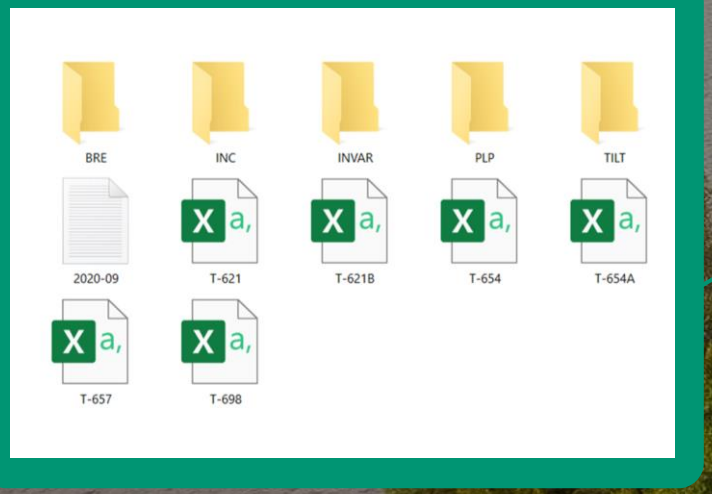


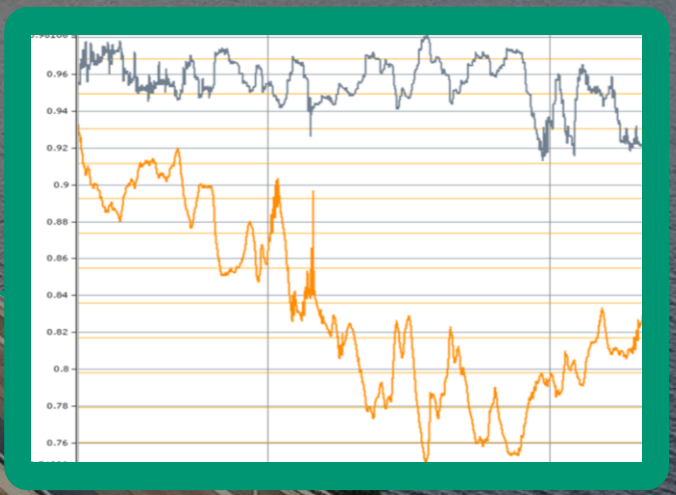


Dealing with data today



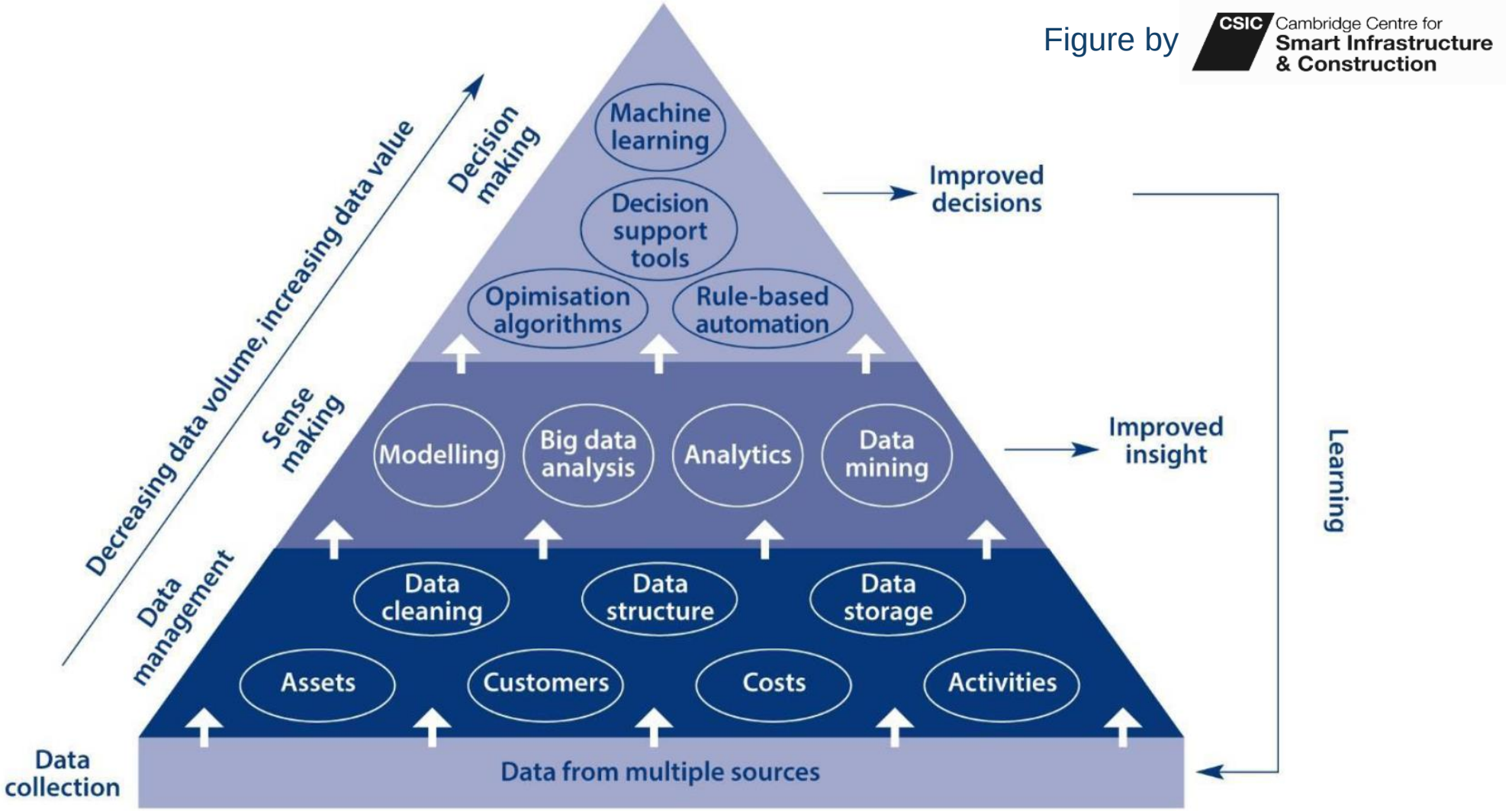
RF4_	East 1_Ter	East 1_Pre	East 1_X	East 1_Y	East 1_Z	East 2_Ter	East 2_Pre	East 2_X	East 2_Y	East 1_Lor	East 1_Tra	East 2_Lor	East 2_Tra
1219	2.641846	987.9662	-198.954	175.494	1.130607	2.641846	987.9662	-133.672	141.2948	0	0	73.69783	-0.00909
1143	2.64924	987.9883	-198.954	175.494	1.130608	2.64924	987.9883	-133.672	141.2948	0	0	73.69783	-0.00909
1067	2.656635	988.0104	-198.954	175.494	1.130609	2.656635	988.0104	-133.672	141.2948	0	0	73.69783	-0.00909
1099	2.664029	988.0325	-198.954	175.494	1.13061	2.664029	988.0325	-133.672	141.2948	0	0	73.69783	-0.00909
0914	2.671424	988.0546	-198.954	175.494	1.130611	2.671424	988.0546	-133.672	141.2948	0	0	73.69783	-0.00909
0837	2.678818	988.0767	-198.954	175.494	1.130612	2.678818	988.0767	-133.672	141.2948	0	0	73.69783	-0.00908
0761	2.686213	988.0988	-198.954	175.494	1.130613	2.686213	988.0988	-133.672	141.2948	0	0	73.69783	-0.00908
0685	2.693607	988.1209	-198.954	175.494	1.130614	2.693607	988.1209	-133.672	141.2948	0	0	73.69783	-0.00908
0753	2.701002	988.143	-198.954	175.494	1.130615	2.701002	988.143	-133.672	141.2948	0	0	73.69783	-0.00908
0821	2.708396	988.1651	-198.954	175.494	1.130616	2.708396	988.1651	-133.672	141.2948	0	0	73.69783	-0.00908
1089	2.715791	988.1872	-198.954	175.494	1.130617	2.715791	988.1872	-133.672	141.2948	0	0	73.69784	-0.00908
0958	2.723185	988.2093	-198.954	175.494	1.130618	2.723185	988.2093	-133.672	141.2948	0	0	73.69784	-0.00907
1027	2.73058	988.2314	-198.954	175.494	1.130619	2.73058	988.2314	-133.672	141.2948	0	0	73.69784	-0.00907
1095	2.737974	988.2535	-198.954	175.494	1.13062	2.737974	988.2535	-133.672	141.2948	0	0	73.69784	-0.00907
1163	2.745369	988.2756	-198.954	175.494	1.130621	2.745369	988.2756	-133.672	141.2948	0	0	73.69784	-0.00907
1232	2.752763	988.2977	-198.954	175.494	1.130622	2.752763	988.2977	-133.672	141.2948	0	0	73.69784	-0.00907
2.113	2.760158	988.3198	-198.954	175.494	1.130623	2.760158	988.3198	-133.672	141.2948	0	0	73.69784	-0.00907

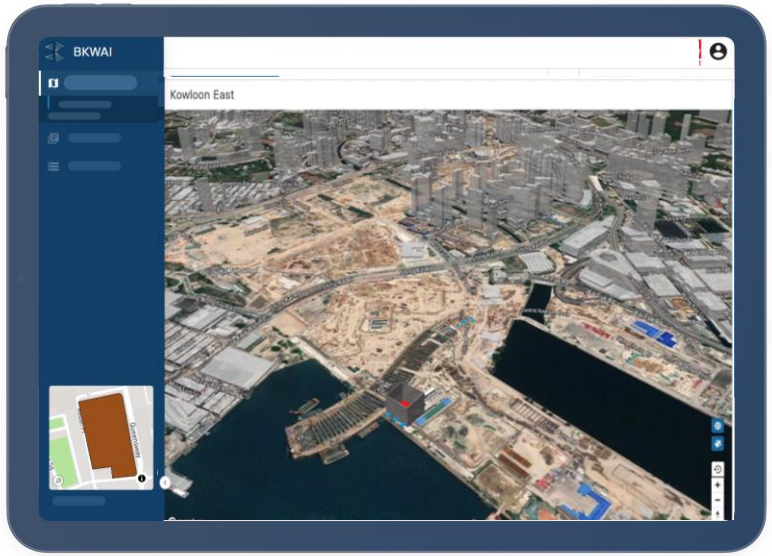


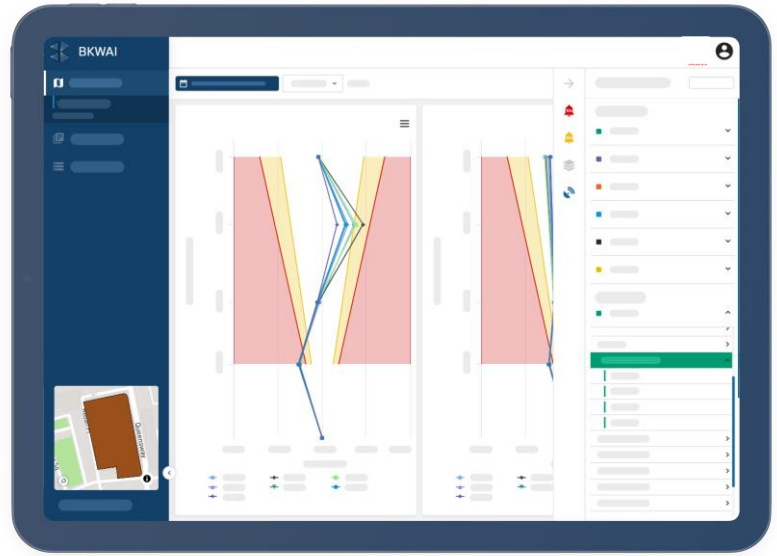


Using better data, and using data better

Figure by CSIC Cambridge Centre for Smart Infrastructure & Construction







And what? → **So what?** → **Now what?**

Thanks

Get in touch

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