

Calculate wind data

There are two data sources for calculating wind data inputs for the Random Walk Model. One source is high frequency (10-20 Hz) sonic data. The other source is the mean wind data at a local weather station.

The u^* values calculated from sonic data (covariance) and from mean wind speed data from a local weather station are similar. If choose appropriate Z_m (roughness length), the difference will be within 5%.

See the data file:

Modis on Remotesensing:\Jim\RandomWalk\Wind\SonicData2008-3-13-1 min data.xls

The columns P and Q show how to calculate U^* from mean wind speed data collected from a weather station.

Monin–Obukhov Length (L , m) can be estimated from time of day, wind speed, and the cloud cover.

If it is a clear sky around noon time and wind speed is around 2 m/s, the atmosphere will be unstable, you can give $L = -10$ m.

If it is in the early morning or late afternoon times, you can give neutral condition, i.e., $L = -99999$ m.

Between early morning to noon or between noon to late afternoon, you can give $L = -100$ m (slightly unstable).

If it is in the evening, it will be stable. You can give $L = 10$ m.

How to calculate average wind data from high-frequency sonic data

Rand Walk model needs the average wind data inputs:

u^* : m/s; Obukhove Length, m; Wind Direction, degree .

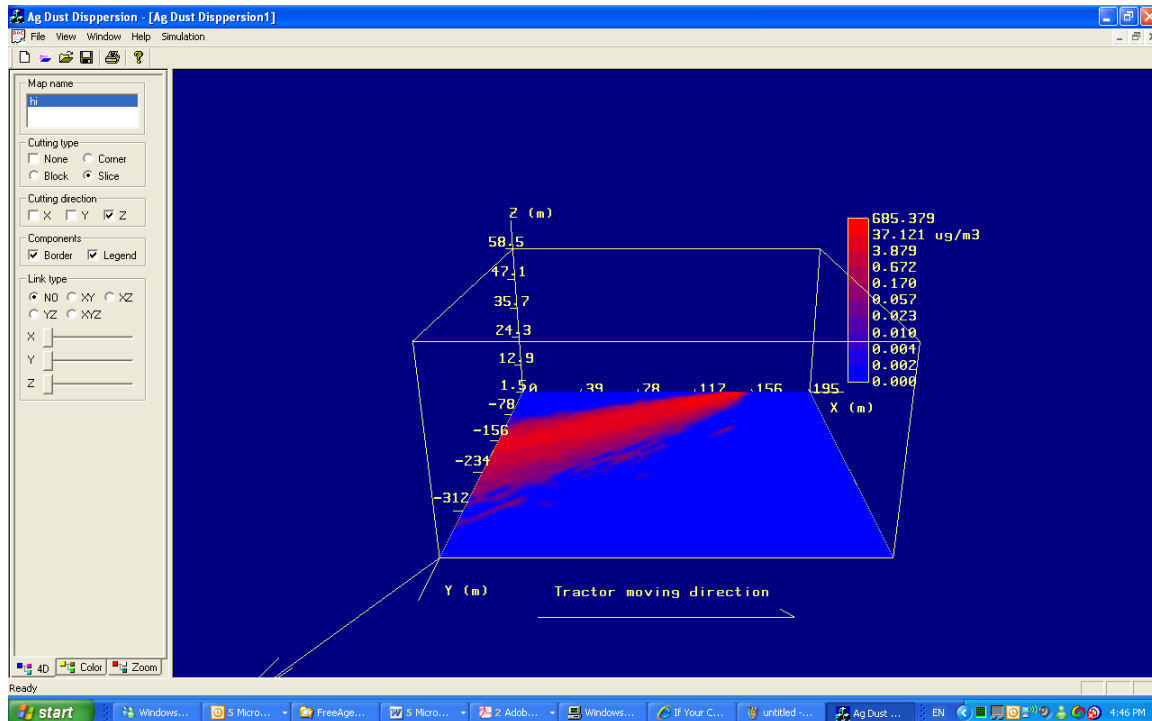
These wind inputs can be calculated based on the equations in Stull 1998:

Stull, R. B. An Introduction to Boundary Layer Meteorology. Kluwer, Boston. 1988.

ustar: Equations 2.10b (p67)

Obukhove Length : Equations 5.7c (p181)

wind direction: wind direction is the wind blowing from direction relative the y-axis positive direction. For example, the following graph shows that a simulation from a wind direction of 40 degree. The tractor travel direction is from (0,0,0) to (0, 195,0)



Sample calculating for 1-s average wind data:

Modis on Remotesensing1:\Jim\RandomWalk\Wind\Samplewind.xls

This spreadsheet shows the sample calculations (you can use a Macro or other programs to automatically calculate the average data once you know the equations).

The left columns are the raw sonic data (20 Hz) imported to Excel spreadsheet (you can copy your own data in also)

Columns A: time, B: U wind (m/s) (sonic sensor points to the y axis positive direction, i.e., positive U points the negative direction of y axis), C: V wind speed(m/s) (positive V points to right in the above picture), D: W wind speed(m/s) (positive W points to Z positive direction), E: air temperature (°C)

	A	B	C	D	E
1					
2	3/31/2005 13:50	1.894	3.33575	0.2595	14.9448
3	50:21.0	1.9225	3.20075	0.09	14.8466
4	50:21.1	1.71175	3.58675	-0.06975	13.8722
5	50:21.1	1.994	3.3805	-0.11325	14.2695
6	50:21.2	1.93225	3.239	0.0735	13.8079
7	50:21.2	2.00025	3.444	0.20025	15.348
8	50:21.3	2.12925	3.44775	0.09925	14.3625
9	50:21.3	2.05925	3.457	0.0065	13.546
10	50:21.4	2.04925	3.38925	0.10025	13.5697
11	50:21.4	1.9745	3.56975	-0.03775	13.5291

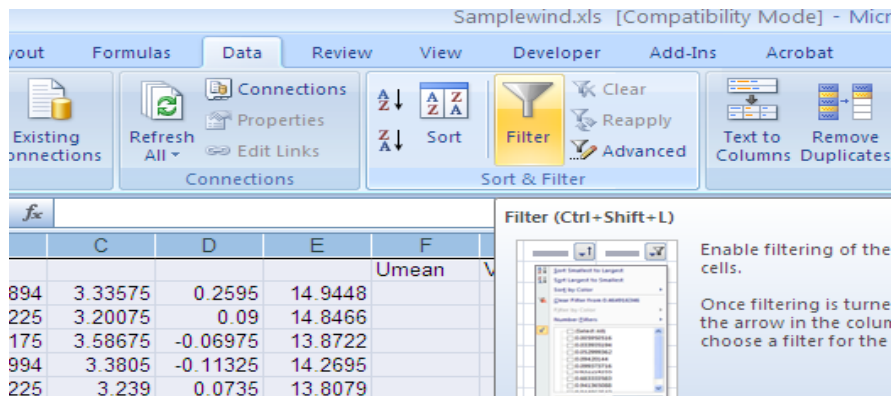
The columns of F to O calculate the 1-s average wind data (average of each 20 rows data)

C	D	E	F	G	H	I	J	K	L	M	N	O
			Umean	Vmean	Wmean	Tmean	UWcovaria	VWcovariance	TWcovaria	Ustar	L	wind direc
3.33575	0.2595	14.9448										
3.20075	0.09	14.8466										
3.58675	-0.06975	13.8722										
3.3805	-0.11325	14.2695										
3.239	0.0735	13.8079										
3.444	0.20025	15.348										
3.44775	0.09925	14.3625										
3.457	0.0065	13.546										
3.38925	0.10025	13.5697										
3.56975	-0.03775	13.5291										
3.439	-0.07225	13.3602										
3.2675	-0.1955	13.2927										
3.22	-0.1465	13.6677										
3.14425	-0.3265	13.9398										
2.83725	-0.39525	14.4285										
3.116	0.06625	13.5173										
3.12525	0.125	13.34										
3.29925	-0.0615	13.955										
3.657	0.01275	14.5723	2.127487	3.324	-0.02026	14.00894	-0.01882	0.012190424	0.028724	0.14975	-8.560020648	302.5917
3.88625	0.01025	14.8229										
3.84175	-0.00975	14.4455										

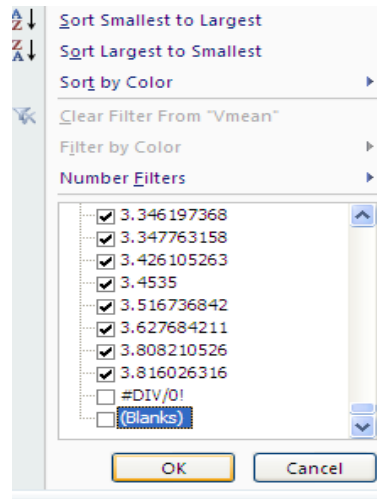
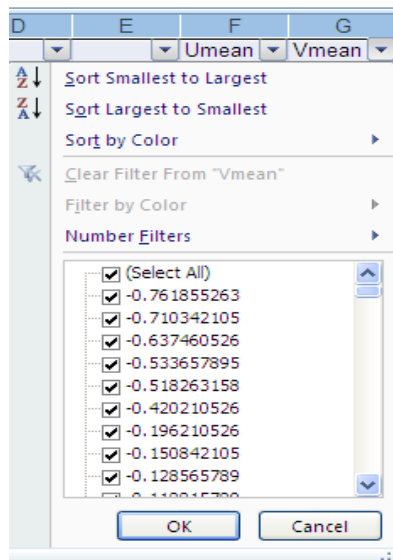
Then you can press Ctrl-A keys and select all the data

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
						Umean	Vmean	Wmean	Tmean	UWcovaria	VWcovariance	TWcovaria	Ustar	L	wind direction
1															
2	3/31/2005 13:50	1.894	3.33575	0.2595	14.9448										
3	50:21.0	1.9225	3.20075	0.09	14.8466										
4	50:21.1	1.71175	3.58675	-0.06975	13.8722										
5	50:21.1	1.994	3.3805	-0.11325	14.2695										
6	50:21.2	1.93225	3.239	0.0735	13.8079										
7	50:21.2	2.00025	3.444	0.20025	15.348										
8	50:21.3	2.12925	3.44775	0.09925	14.3625										
9	50:21.3	2.05925	3.457	0.0065	13.546										
10	50:21.4	2.04925	3.38925	0.10025	13.5697										
11	50:21.4	1.9745	3.56975	-0.03775	13.5291										
12	50:21.5	2.12825	3.439	-0.07225	13.3602										
13	50:21.5	2.40175	3.2675	-0.1955	13.2927										
14	50:21.6	2.542	3.22	-0.1465	13.6677										
15	50:21.6	2.45	3.14425	-0.3265	13.9398										
16	50:21.7	2.36575	2.83725	-0.39525	14.4285										
17	50:21.7	2.29975	3.116	0.06625	13.5173										
18	50:21.8	2.38975	3.12525	0.125	13.34										
19	50:21.8	2.2605	3.29925	-0.0615	13.955										
20	50:21.9	1.9175	3.657	0.01275	14.5723	2.127487	3.324	-0.02026	14.00894	-0.01882	0.012190424	0.028724	0.14975	-8.560020648	302.5917
21	50:21.9	2.074	3.88625	0.01025	14.8229										
22	3/31/2005 13:50	1.79825	3.84175	-0.00975	14.4455										
23	50:22.0	1.5305	3.77975	0.00325	14.3727										
24	50:22.1	1.57675	3.74725	0.205	14.2611										

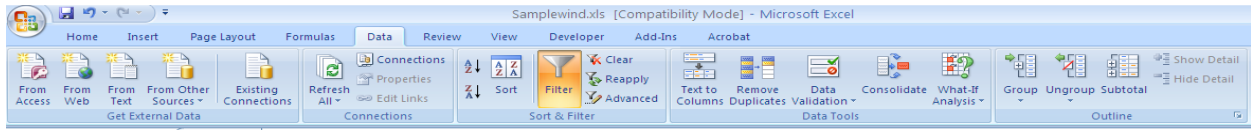
Click on Filter



Click G column and Deselect the non-number rows



The filter then just shows the 1-s data and then you can copy them to a new spreadsheet and prepare for the Random Walk model format.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1						Umean	Vmean	Wmean	Tmean	UVcov	VWcovarianc	TWCov	Ustar	L	wind dir
20	50.21.9	1.9175	3.657	0.01275	14.5723	2.127487	3.324	-0.02026	14.00894	-0.01882	0.012190424	0.028724	0.14975	-8.560020648	302.5917
40	50.22.9	1.206	2.9025	0.38975	14.7704	1.201763	3.346197	0.068171	14.22348	-0.00728	-0.064558096	0.15207	0.254886	-7.978645406	289.7198
60	50.23.9	1.434	2.80375	0.1045	15.614	1.679645	2.90025	0.123382	14.47594	0.025371	-0.021139678	-0.04387	0.181724	10.03183652	300.0464
80	50.24.9	1.448	3.18875	0.03625	13.7657	1.649066	2.843053	-0.04762	14.03795	-0.00709	-0.011364494	0.029532	0.115737	-3.843934218	300.0848
100	50.25.9	1.9535	2.587	0.3745	15.7514	1.575684	2.857566	0.084474	14.63569	0.012729	-0.026482219	0.074597	0.171413	-4.954171244	298.8417
120	50.26.9	1.56125	2.61575	0.11575	15.5411	1.642237	2.704421	0.112697	15.28471	-0.00109	-0.001739146	0.046654	0.045755	-0.150996074	301.2381
140	50.27.9	1.7395	2.62575	-0.0475	17.0382	1.623865	2.470316	0.346868	16.74901	-0.00091	-0.00866818	0.042468	0.093361	-1.416353568	303.2901
160	50.28.9	2.47375	2.6125	-0.03475	13.7877	2.052224	2.548276	0.123737	17.13704	-0.01616	-0.000500006	0.095908	0.127149	-1.586335726	308.8199
180	50.29.9	1.7215	3.01625	-0.09125	13.906	2.142092	2.875842	0.072368	14.09524	0.00772	0.0001532	-0.00675	0.087873	7.368587504	306.6538
200	50.30.9	1.691	2.9215	-0.28025	13.9837	1.801711	2.96775	-0.04021	14.14191	-0.00103	-0.000414352	0.020735	0.033298	-0.130426909	301.232
220	50.31.9	1.1395	2.91175	0.138	14.0091	1.692539	2.965079	-0.23253	13.85708	-0.0133	0.008750805	0.021519	0.12617	-6.830168224	299.6882
240	50.32.9	1.93325	3.31225	-0.01075	14.4387	1.403289	3.347763	0.047211	14.31071	-0.06318	0.020779953	0.04827	0.257893	-26.04402087	292.708
260	50.33.9	2.11025	2.8765	-0.01225	14.8567	1.927	2.947092	-0.09939	14.65857	-0.03268	-0.00714352	0.03626	0.182886	-12.37953007	303.1504
280	50.34.9	2.05725	2.475	0.16425	13.5917	2.048421	2.553513	0.092618	13.80337	0.004571	-0.022028784	0.019667	0.149994	-12.5536398	308.7105
300	50.35.9	1.42125	1.8645	0.31075	15.8243	1.517645	2.228908	0.312461	15.11032	-0.00491	-0.002057395	0.003661	0.072977	-7.803256686	304.2223
320	50.36.9	1.5865	2.64175	-0.419	14.591	1.414224	2.631092	-0.28171	14.16388	-0.00555	-0.006414329	0.021918	0.092112	-2.612135559	298.2269
340	50.37.9	0.89225	2.26425	0.48675	14.6316	1.227316	2.295303	0.004316	15.06308	-0.02847	-0.015414372	0.013127	0.179934	-32.612957	298.1024
360	50.38.9	2.5715	2.176	-0.08575	13.6187	2.077408	2.513816	0.221974	15.21459	-0.00074	0.022842255	0.106731	0.151176	-2.380053772	309.5446
380	50.39.9	1.67025	2.496	0.21225	16.1976	1.980461	2.141553	0.184618	14.88118	-0.02687	0.006967714	0.020861	0.166605	-16.28027438	312.738
400	50.40.9	1.929	2.80025	-0.14925	14.1342	1.517947	2.295816	0.256395	15.79931	-0.04279	-0.005294049	0.154496	0.207634	-4.268605179	303.4432
420	50.41.9	2.068	2.7835	-0.1455	14.0547	1.934447	2.745013	-0.02659	14.06297	-0.00299	-0.007424206	0.074705	0.08946	-0.701836188	305.1451
440	50.42.9	1.86725	2.398	-0.0535	15.1769	2.097895	2.455197	-0.13496	14.66563	-0.02279	0.00833787	-0.05393	0.155774	5.143816282	310.4878
460	50.43.9	2.4965	2.1895	-0.155	16.0075	2.261592	2.191513	-0.19384	15.97545	0.000894	-0.010290555	0.049249	0.101533	-1.671389241	315.8792
480	50.44.9	1.5935	2.03725	0.31	15.3971	1.906447	2.137487	0.073329	14.92678	-0.01666	-0.012658173	0.035281	0.144657	-6.301928416	311.7056
500	50.45.9	1.11525	2.58925	0.63275	16.7613	1.480868	2.027737	0.201355	15.4188	-0.02107	0.024164561	0.146567	0.179058	-2.881920493	306.1136

Sort Smallest to Largest
 Sort Largest to Smallest
 Sort by Color
 Clear Filter From "Vmean"
 Filter by Color
 Number Filters

3.346197368
 3.347763158
 3.426105263
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