

DEVELOPMENT OF A WIND RESOURCE MAP FOR MAURITIUS



MAURITIUS RESEARCH COUNCIL
ASHWIN KATHAPERMALL

October 30, 2012

OVERVIEW

- Rationale
- Wind energy
- Methodology for wind resource assessment
- Weibull Analysis
- Way forward

RATIONALE

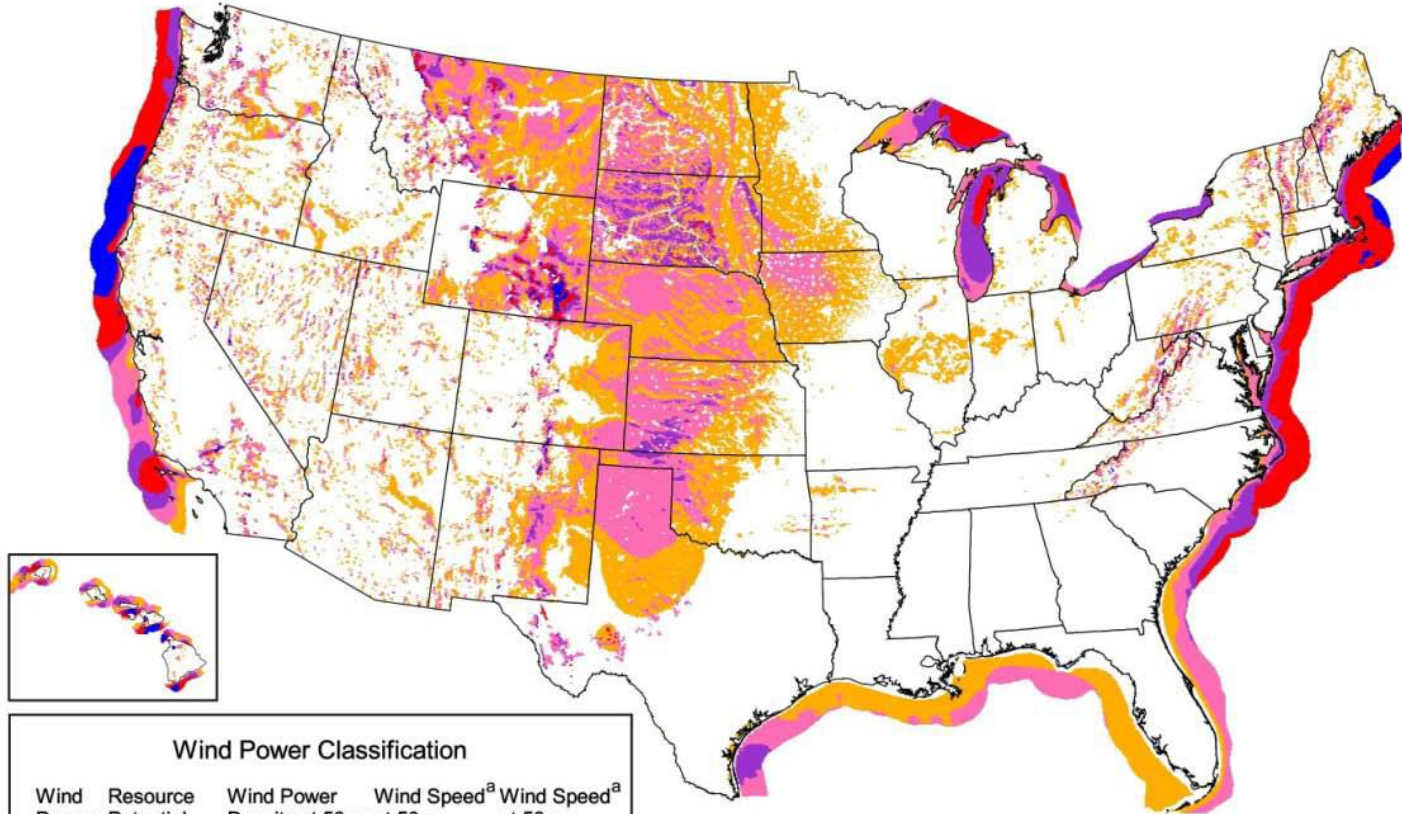
- Increasing energy demand ($\approx 5\%$ annually)
- Heavy reliance on fossil fuels
- Impact on environment, sustainability and climate change
- Urgent need for development of local renewable energy sources – *WIND ENERGY*

WIND ENERGY

- Clean and free source of energy
- Better wind capture with well-matured technologies
- Occupy relatively less space than the average power station
- Allows the production of energy in remote locations

**WIND RESOURCE ASSESSMENT IS REQUIRED TO QUANTIFY
AMOUNT OF POWER AVAILABLE LOCALLY**

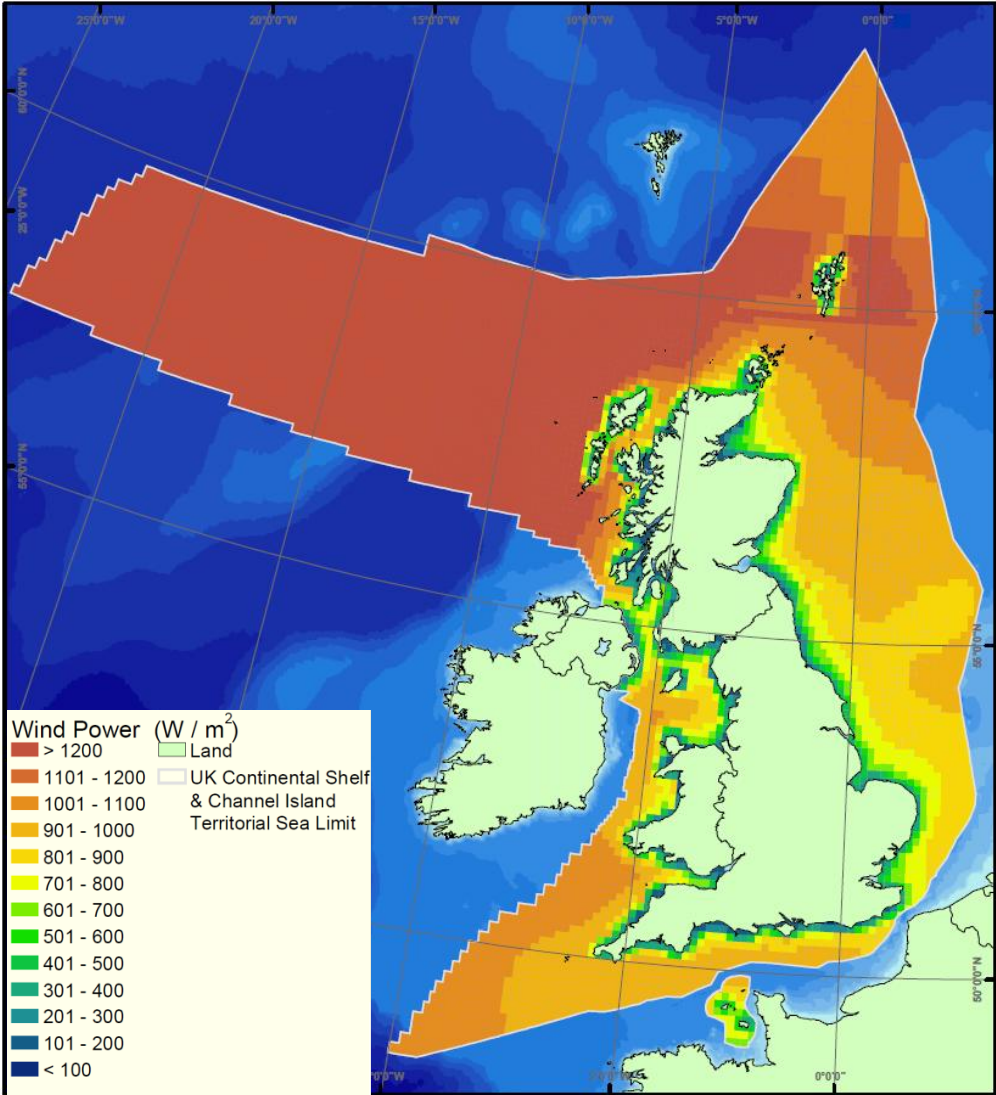
WIND RESOURCE MAP - AMERICA



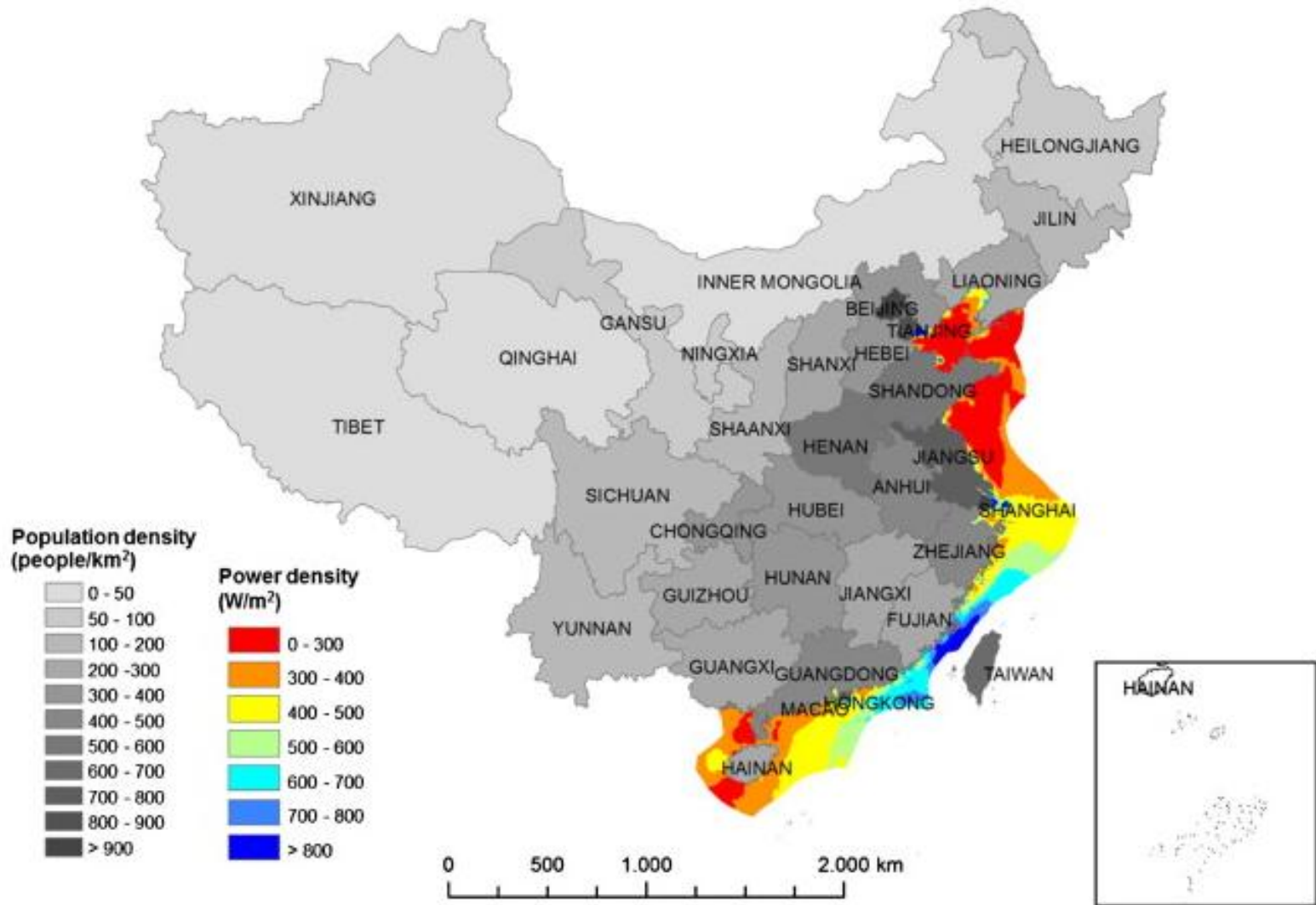
Wind Power Classification				
Wind Power Class	Resource Potential	Wind Power Density at 50 m W/m ²	Wind Speed ^a at 50 m m/s	Wind Speed ^a at 50 m mph
3	Fair	300 - 400	6.4 - 7.0	14.3 - 15.7
4	Good	400 - 500	7.0 - 7.5	15.7 - 16.8
5	Excellent	500 - 600	7.5 - 8.0	16.8 - 17.9
6	Outstanding	600 - 800	8.0 - 8.8	17.9 - 19.7
7	Superb	800 - 1600	8.8 - 11.1	19.7 - 24.8

^aWind speeds are based on a Weibull k value of 2.0

OFFSHORE WIND RESOURCE MAP - UK



OFFSHORE WIND RESOURCE MAP - CHINA



Lixuan Hong et al. (2012)



METHODOLOGY FOR WIND RESOURCE ASSESSMENT - Onshore

- Wind speed data available through MMS as well as anemometers installed by MRC at different locations
- Mathematical model developed based on wind speed data collected at Bigara from January-December 2008
- Allows the conversion of wind speed collected at 10m height to wind power density at any hub height

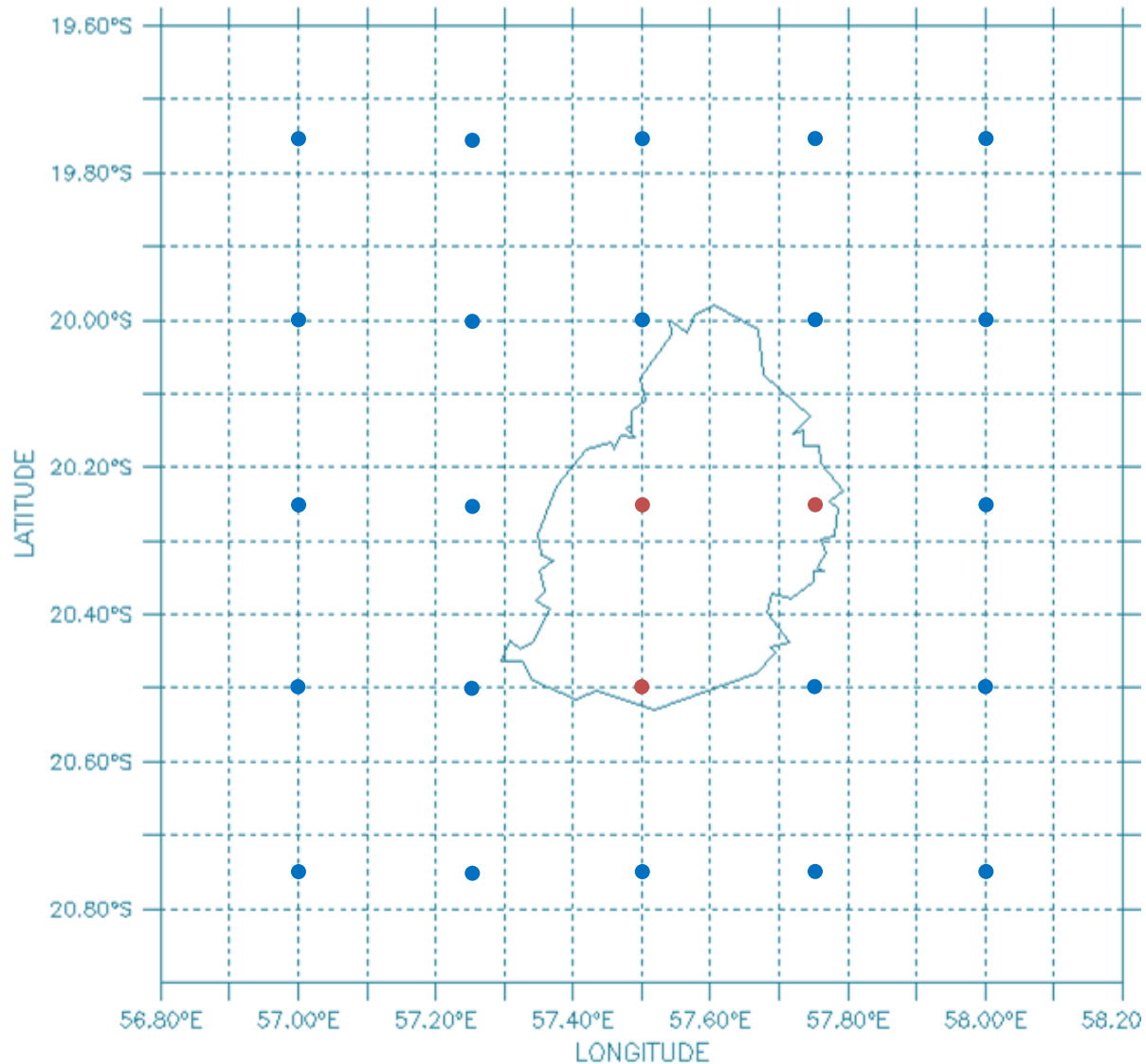
METHODOLOGY FOR WIND RESOURCE ASSESSMENT - Offshore

- Offshore wind data downloaded from 2 satellite sources
- Ocean wind data for November 2004 – October 2009
- 0.25° interval along:

Longitudes: 57.00 E to 58.00 E

Latitudes: 19.75 S to 20.75 S

SATELLITE WIND SPEED DATA POINTS



SATELLITE SOURCE 1 SEAWIND DATA

MONTH	YEAR	A1	B1	C1	D1	E1	A2	B2	C2	D2	E2	A3	B3	C3	D3	E3	A4	B4	C4	D4	E4	A5	B5	C5	D5	E5	
January	2005	6.027	6.019	6.036	6.213	6.336	6.226	6.235	6.208	6.43	6.32	6.575	6.621	6.623	6.747	6.756	6.904	7.023	7.141	7.133	7.042	7.123	7.198	7.238	7.183	7.111	
January	2006	6.101	6.237	6.363	6.389	6.406	6.791	6.155	6.32	6.486	6.461	6.545	6.119	6.304	6.545	6.506	6.166	6.416	6.712	6.72	6.583	6.281	6.504	6.896	6.975	6.808	
January	2007	9.33	8.47	9.39	9.73	9.71	9.41	9.48	9.85	10.05	9.97	9.48	9.48	9.54	10.44	10.13	9.42	9.5	9.86	10.22	10.35	9.52	9.83	9.8	9.97	10.02	
January	2008	7.964	8.03	8.135	8.284	8.299	8.032	8.096	8.12	8.433	8.509	8.107	8.16	8.158	8.614	8.623	8.173	8.34	8.518	8.66	8.616	8.299	8.429	8.517	8.636	8.617	
January	2009	8.258	8.284	8.327	8.323	8.286	8.348	8.401	8.477	8.495	8.438	8.492	8.556	8.78	8.719	8.55	8.598	8.648	8.718	8.732	8.62	8.593	8.575	8.561	8.591	8.557	
February	2005	7.275	7.318	7.401	7.554	7.754	7.463	7.518	7.599	7.838	8.01	7.684	7.814	8.027	8.216	8.264	7.859	8.089	8.296	8.403	8.359	7.929	8.148	8.296	8.316	8.281	
February	2006	6.716	6.731	6.711	6.761	6.805	6.622	6.673	6.698	6.89	8.96	8.67	8.714	8.686	8.009	8.035	8.699	8.83	8.856	8.984	8.951	8.74	8.878	8.759	8.785	8.79	
February	2007	6.841	6.848	7.108	7.429	7.583	6.556	6.803	7.117	7.713	7.778	6.834	6.837	7.138	8.072	7.884	6.768	7.038	7.409	7.723	7.733	6.889	7.114	7.321	7.44	7.513	
February	2008	8.427	8.61	8.678	8.78	8.856	8.597	8.571	8.732	8.915	8.981	8.46	8.645	8.801	8.983	9.057	8.64	8.821	8.969	9.079	9.121	8.688	8.803	8.849	8.878	8.908	
February	2009	7.064	7.144	7.232	7.305	7.33	6.984	7.1	7.232	7.411	7.443	6.933	7.069	7.226	7.4	7.536	7.105	7.311	7.615	7.689	7.666	7.271	7.5	7.705	7.729	7.719	
March	2005	6.829	6.934	7.034	7.186	7.292	6.833	6.943	7.031	7.346	7.437	7.001	7.069	7.091	7.538	7.534	7.153	7.298	7.479	7.374	7.5	7.215	7.384	7.456	7.468	7.428	
March	2006	7.155	7.313	7.437	7.5	7.634	6.97	7.179	7.383	7.472	7.493	6.832	7.017	7.26	7.311	7.345	6.793	6.975	7.069	7.111	7.141	6.749	6.876	6.928	6.952	6.974	
March	2007	8.445	8.662	8.886	9.039	9.017	8.364	8.575	8.911	9.321	9.204	8.417	8.586	8.92	8.548	8.287	8.577	8.832	9.189	9.374	9.256	8.642	8.856	8.943	8.143	8.191	
March	2008	6.397	6.563	6.71	6.823	6.83	6.259	6.492	6.691	6.863	6.812	6.444	6.277	6.471	6.755	6.687	5.974	6.077	6.212	6.399	6.434	5.788	5.94	6.043	6.123	6.18	
March	2009	8.013	8.141	8.284	8.228	8.257	8.05	8.149	8.258	8.239	8.29	8.126	8.226	8.266	8.257	8.358	8.314	8.451	8.501	8.448	8.471	8.389	8.483	8.501	8.57	8.507	
April	2005	6.233	6.367	6.53	6.661	6.832	6.182	6.257	6.435	6.682	6.662	6.247	6.282	6.307	6.591	6.582	6.428	6.516	6.573	6.557	6.51	6.488	6.538	6.524	6.481	6.41	
April	2006	6.505	6.623	6.697	6.719	6.717	6.522	6.709	6.803	6.823	6.738	6.599	6.75	6.785	6.814	6.773	6.598	6.777	6.826	6.793	6.971	6.952	6.85	6.673	6.611	6.55	
April	2007	7.652	7.715	7.823	7.988	8.028	7.612	7.634	7.781	8.011	8.049	7.593	7.627	7.712	7.848	7.888	7.585	7.647	7.69	7.822	7.85	7.537	7.6	7.636	7.701	7.742	
April	2008	7.668	7.643	7.635	7.741	7.774	7.763	7.745	7.696	7.843	7.85	7.888	7.882	7.75	7.904	7.87	7.863	7.889	7.816	7.868	7.805	7.844	7.853	7.904	7.823	7.742	
April	2009	7.023	7.149	7.263	7.368	7.462	7.026	7.169	7.286	7.442	7.501	7.093	7.215	7.335	7.448	7.508	7.173	7.353	7.48	7.503	7.479	7.186	7.367	7.476	7.485	7.466	
May	2005	6.797	6.864	6.935	6.947	6.964	6.804	6.774	6.955	6.935	6.261	6.519	6.61	6.769	6.929	6.926	6.813	6.782	6.985	7.127	7.121	6.663	6.811	6.927	7.01	6.928	
May	2006	6.121	6.271	6.451	6.605	6.834	6.938	6.984	6.947	6.911	6.908	6.82	6.99	6.996	6.413	6.455	6.85	6.901	6.927	6.929	6.984	6.914	6.115	6.144	6.114	6.114	
May	2007	6.557	6.689	6.8	6.927	6.957	6.589	6.675	6.803	6.892	6.94	6.707	6.804	6.92	6.99	6.954	6.818	6.937	6.964	6.995	6.901	6.826	6.912	6.943	6.927	6.899	
May	2008	9.9	9.99	10.07	10.09	10.08	9.9	10.01	10.1	10.12	10.09	9.94	10.06	10.15	10.02	10.05	9.91	10.09	10.04	9.99	10.001	9.74	9.82	9.85	9.85	9.89	
May	2009	7.857	7.994	8.103	8.215	8.289	7.846	7.948	8.073	8.221	8.407	7.943	8.017	8.092	8.381	8.419	8.092	8.186	8.23	8.338	8.321	8.164	8.229	8.252	8.262	8.21	
June	2005	6.19	6.302	6.491	6.686	6.872	6.807	6.134	6.365	6.653	6.683	6.012	6.045	6.102	6.332	6.376	6.899	6.978	6.989	6.829	6.821	6.809	6.809	6.827	6.809	6.827	
June	2006	10	10.14	10.32	10.44	10.47	9.93	10.05	10.26	10.47	10.53	10	10.1	10.24	10.32	10.6	10.21	10.38	10.61	10.62	10.63	10.27	10.41	10.34	10.56	10.57	
June	2007	6.893	6.865	6.821	6.892	6.968	6.547	6.803	6.767	6.948	9.11	6.551	6.266	6.59	6.992	6.952	6.994	6.886	6.855	6.999	6.901	6.822	6.755	6.84	6.908	6.927	
June	2008	9.5	9.6	9.77	9.89	10.05	9.33	9.42	9.62	9.97	10.06	9.33	9.34	9.57	9.85	9.95	9.38	9.49	9.48	9.69	9.77	9.3	9.36	9.41	9.56	9.67	
June	2009	9.6	9.71	9.87	10.09	10.15	9.51	9.59	9.73	10.03	10.06	9.48	9.49	9.5	9.8	9.85	9.45	9.47	9.48	9.55	9.61	9.3	9.33	9.31	9.33	9.36	
July	2005	6.35	6.73	6.95	10.12	10.17	6.39	6.57	6.86	10.12	10.18	6.33	6.47	6.68	10.01	10.12	9.46	9.67	9.9	10.02	10.06	6.55	6.73	6.86	6.94	6.98	
July	2006	6.924	6.985	6.948	6.976	6.902	6.805	6.847	6.915	6.911	6.935	6.762	6.846	6.938	6.124	6.195	6.75	6.834	6.887	9	9.024	6.683	6.739	6.782	6.823	6.834	
July	2007	6.207	6.303	6.42	6.535	6.542	6.127	6.228	6.362	6.598	6.619	6.105	6.183	6.238	6.585	6.618	6.122	6.215	6.292	6.501	6.51	6.047	6.118	6.202	6.312	6.351	
July	2008	7.972	8.123	8.451	8.631	8.648	7.803	8.028	8.325	8.665	8.619	7.792	7.948	8.063	8.389	8.44	7.822	7.922	7.985	8.048	8.136	7.708	7.798	7.827	7.849	7.858	
July	2009	6.179	6.341	6.415	6.48	6.525	6.021	6.121	6.255	6.485	6.515	6.832	6.959	6.937	6.936	6.938	6.733	6.911	6.976	6.146	6.194	6.706	6.87	6.898	6.98	6.916	
August	2005	6.35	6.47	6.64	6.79	6.91	6.22	6.33	6.57	6.8	10.05	6.22	6.29	6.47	6.68	6.68	6.43	6.6	6.86	10.04	10.04	9.6	9.74	9.83	9.8	9.88	
August	2006	6.182	6.418	6.709	6.904	6.917	6.088	6.224	6.556	6.901	6.892	6.048	6.104	6.139	6.741	6.713	6.013	6.088	6.149	6.373	6.441	6.862	7.914	7.943	8.07	8.151	
August	2007	6.628	6.787	6.958	6.956	6.944	6.963	6.769	6.996	6.984	6.904	6.436	6.689	6.853	6.873	6.811	6.48	6.571	6.569	6.833	6.558	6.321	6.375	6.365	6.339	6.364	
August	2008	7.834	8.093	8.351	8.621	8.601	7.784	8.01	8.289	8.738	8.971	7.847	8.039	8.281	8.914	9.046	7.996	8.18	8.391	8.604	8.928	8.093	8.211	8.481	8.647	8.741	
August	2009	6.359	6.504	6.674	6.893	6.945	6.192	6.351	6.603	6.921	6.915	6.11	6.205	6.409	6.975	6.926	6.143	6.302	6.465	6.664	6.668	6.162	6.298	6.36	6.39	6.387	
September	2005	7.752	7.88	8.037	8.203	8.216	7.695	7.837	8.029	8.274	8.248	7.71	7.813	7.879	6.878	6.186	7.784	7.916	7.995	8.067	8.068	7.793	7.895	7.939	7.947	7.939	
September	2006	6.409	6.526	6.668	6.779	6.808	6.377	6.505	6.712	6.908	6.936	6.423	6.562	6.823	6.964	6.845	6.477	6.626	6.705	6.897	6.893	6.383	6.44	6.402	6.388	6.425	
September	2007	6.291	6.433	6.629	6.821	6.869	6.169	6.286	6.513	6.683	6.926	6.123	6.171	6.282	6.882	6.901	6.12	6.201	6.315	6.619	6.691	6.084	6.207	6.299	6.408	6.48	
September	2008	6.071	6.345	6.603	6.732	6.704	6.767	6.048	6.457	6.909	6.766	6.616	6.781	6.075	6.766	6.705	6.657	6.814	6.845	6.424	6.486	6.68	6.705	6.722	6.083	6.208	
September	2009	6.928	7.071	7.217	7.336	7.369	6.665	7.039	7.245	7.437	7.508	6.887	7.082	7.167	7.306	7.374	6.543	6.991	7.261	7.483	7.57	7.56	7.031	7.262	7.424	7.473	7.441
October	2005	7.117	7.276	7.453	7.475	7.406	7.051	7.195	7.39	7.491	7.407	7.054	7.17	7.351	7.453	7.391											

SATELLITE SOURCE 2 SEAWIND DATA

Fortran Code

```
Plato - [C:\Users\user\Desktop\QuikSCAT Data Extraction Routine\Use_Scat_Averaged_Mauritius.f95]
File Edit View Project Build Tools Window Help
CheckMate Win32 c
Use_Scat_Averaged_Mauritius.f95
PROGRAM Use_Scat_Averaged_Example

character(120) filemonth

real windspd(1440,720)
real winddir(1440,720)
real radrain(1440,720)
integer scatflag(1440,720)

integer ierr,ilat,ilon

write(*,*) '*****month*****'
filemonth='C:\Users\user\Desktop\QuikSCAT Data Extraction Routine\qscat_200810v4' !change to match your system or use loop structure above
!filemonth='qscat_200411v4' !for qscat verification

call GET_SCAT_AVERAGED_V4(filemonth,windspd,winddir,scatflag,radrain,IERR)

IF (IERR.ne.0) THEN
  WRITE(*,*) 'no scat data: ', filemonth
  STOP
ENDIF

OPEN (unit=9, file='C:\Users\user\Desktop\QuikSCAT Data Extraction Routine\QSCATOutput_200810.

      write(*,*) ' ilon ilat  windspd  winddir  scatflag  radrain'
      write(9,*) ' ilon ilat  windspd  winddir  scatflag  radrain'

!! write out verification file data for comparison
DO ilat=277,281 !1,720
DO ilon=229,233 !1,1440

! XLAT=0.25*ILAT-90.125
! XLON=0.25*ILON-0.125

write(*, '(2i6,2f10.2,i9,f12.2)') ilon,ilat,windspd(ilon,ilat),winddir(ilon,ilat),s
write(9, '(2i6,2f10.2,i9,f12.2)') ilon,ilat,windspd(ilon,ilat),winddir(ilon,ilat),s

Output
Ready
```

```
Plato IDE
*****month*****
ilon  ilat  windspd  winddir  scatflag  radrain
229  277  7.80  285.00  0
230  277  7.80  286.50  0
231  277  7.80  286.50  0
232  277  8.00  286.50  0
233  277  8.00  288.00  0
229  278  8.00  291.00  0
230  278  7.80  286.50  0
231  278  7.80  286.50  0
232  278  8.20  288.00  0
233  278  8.20  289.50  0
229  279  7.40  297.00  0
230  279  -999.00  -999.00  -999
231  279  -999.00  -999.00  -999
232  279  8.20  289.50  0
233  279  8.20  291.00  0
229  280  7.20  292.50  0
230  280  7.80  286.50  0
231  280  -999.00  -999.00  -999
232  280  8.40  292.50  0
233  280  8.40  295.50  0
229  281  8.00  286.50  0
230  281  8.00  288.00  0
231  281  8.40  292.50  0
232  281  8.40  295.50  0
233  281  8.40  295.50  0

Press RETURN to close window . . .
```

Output



WEIBULL ANALYSIS

$$p\left(\frac{u}{U}\right) = k\Gamma\left(1 + \frac{1}{k}\right) \left\{\frac{u}{U}\Gamma\left(1 + \frac{1}{k}\right)\right\}^{k-1} e^{-\left[\frac{u}{U}\Gamma\left(1 + \frac{1}{k}\right)\right]^k}$$

u is the unsteady wind speed component and U is the mean value

$p\left(\frac{u}{U}\right)$ is the non-dimensional probability density distribution

k is a factor that determines the shape of the curve.

$\Gamma\left(1 + \frac{1}{k}\right)$ is the value of the Gamma function for $\left(1 + \frac{1}{k}\right)$.

$$\frac{\sigma}{U} = \sqrt{\frac{\Gamma\left(1 + \frac{2}{k}\right)}{\left[\Gamma\left(1 + \frac{1}{k}\right)\right]^2} - 1}$$

$$k = \left(\frac{0.9874}{\frac{\sigma}{U}}\right)^{1.0983}$$

MATHEMATICAL MODEL

WIND POWER DENSITY ANALYSIS SHEET

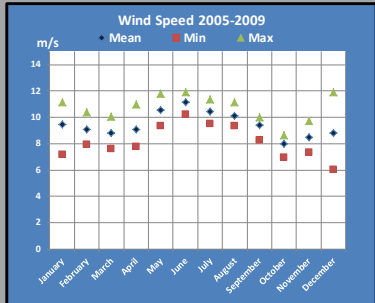
Coordinate (User Input)	A1	
Height, href	10	m
Height, h (User Input)	80	m
Surface roughness, z0	0.0002	m

After inserting required coordinate and height, update worksheet by pressing "Ctrl+E"

WIND POWER DENSITY @ height, h = 80m	
WPD (Vmeandata)	516.59164 W/m ²
WPD (Vmeanweibull)	442.49823 W/m ²
WPD(weibullparams)	718.70027 W/m ²

	Month	Year	Wind speed at height href (m/s)	Wind speed at height h (m/s)
1	January	2005	6.027	7.185
2	January	2006	8.101	9.658
3	January	2007	9.350	11.147
4	January	2008	7.964	9.495
5	January	2009	8.258	9.845
6	February	2005	7.275	8.673
7	February	2006	8.716	10.391
8	February	2007	6.641	7.917
9	February	2008	8.427	10.047
10	February	2009	7.064	8.422
11	March	2005	6.859	8.177
12	March	2006	7.155	8.530
13	March	2007	8.445	10.068
14	March	2008	6.397	7.626
15	March	2009	8.013	9.553
16	April	2005	9.233	11.007
17	April	2006	6.505	7.755
18	April	2007	7.652	9.123
19	April	2008	7.668	9.142
20	April	2009	7.023	8.373
21	May	2005	8.797	10.488
22	May	2006	9.121	10.874
23	May	2007	8.557	10.202
24	May	2008	9.900	11.803
25	May	2009	7.857	9.367
26	June	2005	9.190	10.956
27	June	2006	10.000	11.922
28	June	2007	8.595	10.247
29	June	2008	9.500	11.326
30	June	2009	9.600	11.445
31	July	2005	9.550	11.385
32	July	2006	8.924	10.639
33	July	2007	8.207	9.784
34	July	2008	7.972	9.504
35	July	2009	9.179	10.943
36	August	2005	9.350	11.147
37	August	2006	8.192	9.766
38	August	2007	8.628	10.286
39	August	2008	7.834	9.340
40	August	2009	8.359	9.966
41	September	2005	7.752	9.242
42	September	2006	8.409	10.025
43	September	2007	8.291	9.884
44	September	2008	8.071	9.622
45	September	2009	6.928	8.259
46	October	2005	7.117	8.485
47	October	2006	6.690	7.976
48	October	2007	6.653	7.932
49	October	2008	5.849	6.973
50	October	2009	7.264	8.660
51	November	2004	7.405	8.828
52	November	2005	6.212	7.406
53	November	2006	8.155	9.722
54	November	2007	7.574	9.030
55	November	2008	6.145	7.325
56	November	2009	7.070	8.429
57	December	2005	8.000	9.538
58	December	2006	6.760	8.059
59	December	2007	10.010	11.934
60	December	2008	5.063	6.036

	Mean	Min	Max
January	9.465980053	7.185322642	11.14696644
February	9.089963667	7.917326641	10.39118866
March	8.790962685	7.626432544	10.06803546
April	9.07994928	7.755188948	11.00748033
May	10.54658009	9.367028372	11.80267034
June	11.17915554	10.2468638	11.92188924
July	10.45120498	9.50413099	11.38540422
August	10.10093987	9.339608027	11.14696644
September	9.40669045	8.259484862	10.02511666
October	8.005071746	6.973113014	8.660060341
November	8.462395417	7.326000935	9.722300672
December	8.799069569	6.03605252	11.93381112
YEARLY MEAN	9.448156829		



V(meandata)	9.44816 m/s
STDEV	1.35175
N	60.00000

ALPHA [k]	8.26556
C	-18.61955
BETA [c]	9.51306

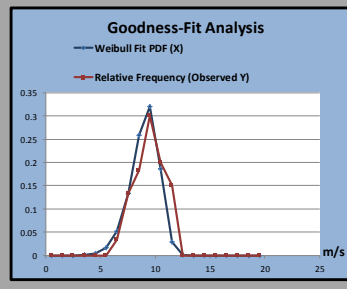
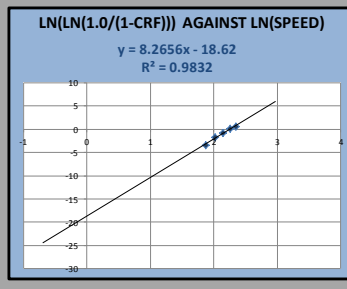
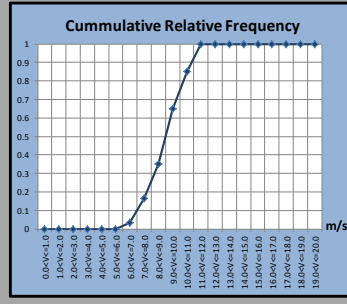
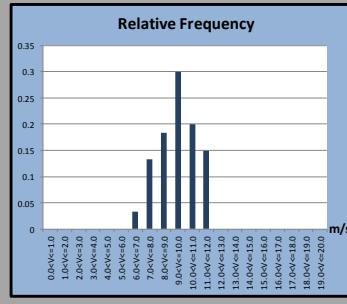
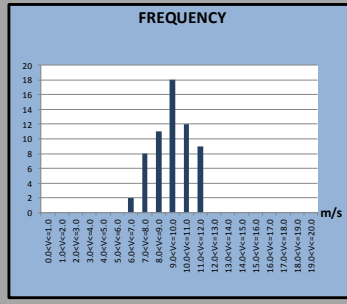
GAMMA FUNCTION	
A	0.50000
gamma(A) Excel	1.77245
Gamma (A) Stirling Careful	1.55238

Weibull mean speed	8.97295 m/s
VMEAN	8.97295 m/s

Weibull Standard Deviation	1.29126
sigma(weibull)	1.29126

V(most probable)	9.36580 m/s
V(Emax)	9.76576 m/s

FREQUENCIES EVALUATION												
Speed range (m/s)	Mean speed Band	Frequency	Relative Frequency	C.R.Frequency	1-CRF	LN(speed)	LN(LN(1.0/(1-CRF)))	weibull fit (pdf) X	(Y-Z)^2	(X-Y)^2	vf	vX
0.0<V<=1.0	0.5	0	0	0	1	-0.693147181		4.40303E-10	89.26766746	1.93866E-19	0	2.20151E-10
1.0<V<=2.0	1.5	0	0	0	1	0.405465108		1.28916E-06	89.26766746	1.66192E-12	0	1.93373E-06
2.0<V<=3.0	2.5	0	0	0	1	0.916290732		5.27418E-05	89.26766746	2.78169E-09	0	0.000131854
3.0<V<=4.0	3.5	0	0	0	1	1.252762968		0.000607788	89.26766746	3.69407E-07	0	0.002127259
4.0<V<=5.0	4.5	0	0	0	1	1.504077397		0.003766757	89.26766746	1.41885E-05	0	0.016950408
5.0<V<=6.0	5.5	0	0	0	1	1.704748092		0.01646038	89.26766746	0.000257475	0	0.088253207
6.0<V<=7.0	6.5	2	0.033333333	0.033333333	0.966666667	1.871802177	-3.384294493	0.0523034	88.6380045	0.000359863	13	0.339972099
7.0<V<=8.0	7.5	8	0.133333333	0.166666667	0.833333333	2.014903021	-1.701983355	0.134233872	86.76593675	8.10966E-07	60	1.006754037
8.0<V<=9.0	8.5	11	0.183333333	0.35	0.65	2.140066163	-0.842150991	0.258477501	85.8369544	0.005646646	93.5	2.197058755
9.0<V<=10.0	9.5	18	0.3	0.65	0.35	2.251291799	0.048620745	0.32005634	83.68877336	0.000402257	171	3.040535235
10.0<V<=11.0	10.5	12	0.2	0.85	0.15	2.351375257	0.640336939	0.185523914	85.52840473	0.000209557	126	1.948001102
11.0<V<=12.0	11.5	9	0.15	1	0	2.442347035		0.028478326	86.45572041	0.014767517	103.5	0.327500752
12.0<V<=13.0	12.5	0	0	1	0	2.525728644		0.000447805	89.26766746	2.00529E-07	0	0.005975566
13.0<V<=14.0	13.5	0	0	1	0	2.602689685		1.60112E-07	89.26766746	2.56357E-14	0	2.16151E-06
14.0<V<=15.0	14.5	0	0	1	0	2.674148649		1.31302E-13	89.26766746	1.72402E-26	0	1.90388E-12
15.0<V<=16.0	15.5	0	0	1	0	2.740840024		8.36074E-24	89.26766746	6.9902E-47	0	1.29592E-22
16.0<V<=17.0	16.5	0	0	1	0	2.803360381		3.19358E-04	89.26766746	1.01989E-79	0	5.2694E-39
17.0<V<=18.0	17.5	0	0	1	0	2.862200881		7.95929E-66	89.26766746	6.335E-131	0	1.39288E-64
18.0<V<=19.0	18.5	0	0	1	0	2.917770732		1.0923E-104	89.26766746	1.193E-208	0	2.0207E-103
19.0<V<=20.0	19.5	0	0	1	0	2.970414466		2.6148E-162	89.26766746	0	0	5.0988E-161
SUM		60	1						1766.66204	0.02165889	567	8.97288636



ERROR ANALYSIS	
R ² =	0.99999
RMSE =	0.03291

WIND POWER DENSITY NUMERICAL MAP

Height h = 10m						Height h = 30m							
Longitude	57.00 E	57.25 E	57.50 E	57.75 E	58.00 E	Longitude	57.00 E	57.25 E	57.50 E	57.75 E	58.00 E		
Latitude	A	B	C	D	E	Latitude	A	B	C	D	E		
19.75 S	1	259.657	270.545	282.681	293.128	308.590	19.75 S	1	354.565	371.693	381.905	404.858	413.509

Height h = 80m						
Longitude	57.00 E	57.25 E	57.50 E	57.75 E	58.00 E	
Latitude	A	B	C	D	E	
19.75 S	1	442.498	473.371	495.551	515.574	522.690
20.00 S	2	458.301	467.417	500.606	524.400	539.237
20.25 S	3	462.001	475.254	510.847	570.753	569.039
20.50 S	4	475.254	485.738	521.429	570.129	558.399
20.75 S	5	475.815	506.190	534.517	542.900	536.577

20.00 S	2	466.844	491.380	508.944	536.090	556.144	20.00 S	2	485.730	497.699	515.833	559.234	569.999
20.25 S	3	470.126	484.433	510.847	618.645	589.855	20.25 S	3	478.779	489.427	529.520	623.808	597.400
20.50 S	4	478.154	491.874	533.204	586.145	582.106	20.50 S	4	485.793	519.498	543.259	576.654	618.520
20.75 S	5	482.943	512.890	546.450	553.739	555.111	20.75 S	5	502.359	515.322	561.404	576.893	564.362



WIND POWER DENSITY EXTENDED NUMERICAL MAP

WIND POWER DENSITY MAP [W/m²]

Height h = 80m

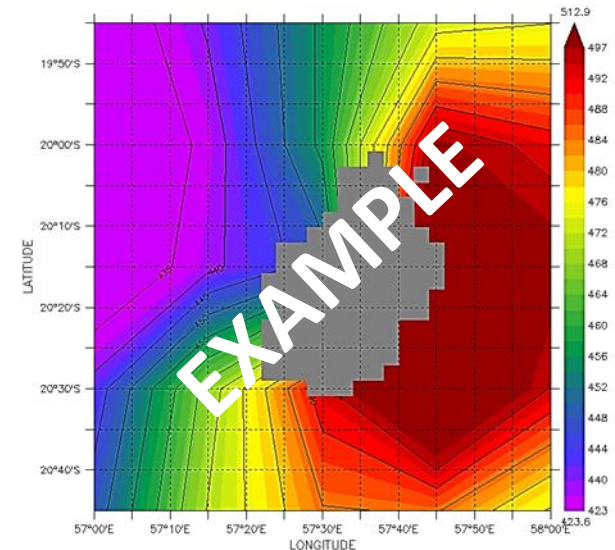
Longitude		56.00 E	56.25 E	56.50 E	56.75 E	57.00 E	57.25 E	57.50 E	57.75 E	58.00 E	58.25 E	58.50 E
Latitude		A	B	C	D	E	F	G	H	I	J	K
18.00 S	17	416.961	422.397	426.105	438.961	444.662	448.334	458.568	458.049	463.296	473.520	482.346
18.25 S	16	408.907	417.059	429.324	440.445	438.961	455.855	458.305	457.430	456.241	487.710	499.681
18.50 S	15	407.725	410.672	412.589	424.559	435.396	447.803	458.305	459.639	464.868	476.924	485.715
18.75 S	14	405.031	411.807	417.437	419.118	431.081	441.053	446.145	457.180	466.071	485.854	476.869
19.00 S	13	409.222	406.874	411.913	419.972	429.341	440.800	432.645	434.519	440.863	459.639	460.523
19.25 S	12	389.804	401.939	400.241	416.201	421.543	423.445	440.899	442.561	450.060	453.070	461.902
19.50 S	11	386.285	387.221	390.439	404.252	417.908	420.493	415.700	444.527	444.830	457.598	453.731
19.75 S	10	398.343	389.833	387.013	384.336	408.661	408.585	414.182	438.079	446.395	442.564	436.031
20.00 S	9	400.338	385.189	376.212	361.540	358.109	355.967	388.048	No data	433.382	430.362	437.207
20.25 S	8	393.664	386.419	387.802	384.243	387.256	384.585	No data	No data	410.156	424.138	428.020
20.50 S	7	379.082	364.321	378.082	390.446	401.269	405.453	424.405	419.984	408.236	411.996	422.113
20.75 S	6	360.966	346.925	357.478	378.271	394.862	406.325	417.524	413.704	422.471	416.885	422.918
21.00 S	5	No data	344.024	341.298	378.891	381.968	387.370	406.317	417.456	421.566	405.321	424.269
21.25 S	4	402.707	352.039	352.263	366.555	377.828	392.728	395.817	397.204	413.028	414.781	420.768
21.50 S	3	416.370	383.368	371.006	380.827	383.539	388.867	400.452	414.790	417.212	415.680	416.171
21.75 S	2	412.917	405.668	387.620	376.855	379.974	385.915	400.465	404.717	401.496	403.032	409.649
22.00 S	1	401.684	393.762	383.368	369.395	381.475	381.483	388.442	403.544	402.527	405.599	412.581

WAY FORWARD

- Model validation
- Data mapping - GIS

By December 2012

WIND POWER DENSITY MAP [W/m ²]											
Height h = 80m											
Longitude	56.00 E	56.25 E	56.50 E	56.75 E	57.00 E	57.25 E	57.50 E	57.75 E	58.00 E	58.25 E	58.50 E
Latitude	A	B	C	D	E	F	G	H	I	J	K
18.00 S	434.961	422.397	426.105	438.961	444.002	448.334	458.588	458.089	463.296	473.530	482.346
18.25 S	408.807	417.059	429.324	440.448	438.961	455.855	458.305	457.430	456.241	467.710	499.681
18.50 S	407.725	435.672	412.588	424.558	435.396	447.800	458.305	459.639	464.888	476.031	485.715
18.75 S	405.031	411.807	417.427	419.139	421.081	441.053	446.145	457.180	466.071	485.054	476.889
19.00 S	409.222	406.874	411.913	419.972	429.341	440.800	432.645	434.519	440.803	459.639	460.523
19.25 S	389.404	401.939	400.241	416.201	421.543	423.845	440.899	442.561	450.000	453.070	461.902
19.50 S	386.285	387.221	390.439	404.252	417.908	420.489	415.700	444.527	444.830	457.598	453.711
19.75 S	398.341	389.833	387.011	384.336	408.661	408.585	414.192	438.079	446.395	442.564	436.011
20.00 S	400.338	385.189	376.212	361.540	358.109	355.967	388.048	388.048	433.302	430.302	437.207
20.25 S	393.664	386.413	387.802	384.243	387.256	384.585	388.048	388.048	410.156	424.138	428.020
20.50 S	379.002	364.321	378.002	390.448	401.209	405.453	424.405	419.884	408.258	411.996	422.113
20.75 S	360.966	346.925	357.478	378.271	394.802	406.325	417.528	413.704	422.471	416.885	422.818
21.00 S	380.000	344.024	341.298	378.891	381.968	387.370	406.317	417.456	421.586	405.321	424.298
21.25 S	403.707	352.839	352.263	366.555	377.828	392.728	395.817	397.204	413.028	414.701	420.789
21.50 S	416.370	383.368	371.006	380.827	383.539	388.987	400.452	414.790	417.212	415.680	416.171
21.75 S	412.917	405.668	387.620	376.855	378.974	385.915	400.465	404.717	401.496	403.012	406.649
22.00 S	401.681	393.702	383.368	369.395	381.475	381.483	388.442	403.544	402.527	405.599	412.581



THANK YOU



Mauritius Research Council
Level 6, Ebène Heights, 34 Cybercity, Ebène, Mauritius
Tel: (230) 465 1235
Fax: (230) 465 1239
Email: mrc@intnet.mu
Website: <http://www.mrc.org.mu>