R.J.B Flat-earth paper (2017- 11th November 2018). Supplementary file 1 of terrain data plus SOM
Below is raw data file from Nunn & Puga (2010/2012) - https://diegopuga.org/data/rugged/. Below

isocode	isonum	country	rugged [Ter	rugged_popw	rugged_slope [%
ABW	533	Aruba	0.462	0.38	1.226
AFG	4	Afghanistan	2.518	1.469	7.414
AGO	24	Angola	0.858	0.714	2.274
AIA	660	Anguilla	0.013	0.01	0.026
ALB	8	Albania	3.427	1.597	10.451
AND	20	Andorra	5.717	6.722	17.774
ANT	530	Netherlands Ar	0.255	0.039	0.68
ARE	784	United Arab Em	0.769	0.316	2.112
ARG	32	Argentina	0.775	0.22	2.268
ARM	51	Armenia	2.688	0.934	8.178
ASM	16	American Samc	2.647	1.63	7.032
ATG	28	Antigua and Ba	0.006	0.003	0.012
AUS	36	Australia	0.143	0.183	0.405
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LTU	440	Lithuania	0.175	0.229	0.578
LUX	442	Luxembourg	0.881	0.581	2.844
LVA	428	Latvia	0.154	0.136	0.522
MAC	446	Macao Special	0.732	0.527	1.921
MAR	504	Morocco	2.413	1.291	6.853
MCO	492	Monaco	6.612	6.043	20.834
MDA	498	Republic of Mo	0.799	0.573	2.527
MDG	450	Madagascar	1.169	0.738	3.185
MDV	462	Maldives	0.012	0.012	0.024
MEX	484	Mexico	1.732	0.825	4.795
MHL	584	Marshall Island	0.014	0.016	0.033
MKD	807	The former Yug	2.665	0.885	8.19
MLI	466	Mali	0.147	0.305	0.393
MLT	470	Malta	1.527	1.171	4.292
MMR	104	Myanmar	1.988	0.332	5.517
MNG	496	Mongolia	1.057	0.765	3.352
MNP	580	Northern Maria	1.7	1.484	4.572
MOZ	508	Mozambique	0.612	0.438	1.653
MRT	478	Mauritania	0.115	0.147	0.308
MSR	500	Montserrat	3.395	2.824	9.256
MTQ	474	Martinique	1.206	0.659	3.311
MUS	480	Mauritius	0.949	0.788	2.436
MWI	454	Malawi	1.027	0.821	2.759
MYS	458	Malaysia	1.009	0.374	2.684
MYT	175	Mayotte	2.673	2.483	5.809

NAM	516	Namibia	0.913	0.423	2.489
NCL	540	New Caledonia	1.586	0.621	4.338
NER	562	Niger	0.178	0.222	0.481
NFK	574	Norfolk Island	1.154	0.812	3.266
NGA	566	Nigeria	0.312	0.229	0.833
NIC	558	Nicaragua	0.992	0.768	2.671
NIU	570	Niue	0.177	0.205	0.472
NLD	528	Netherlands	0.037	0.042	0.108
NOR	578	Norway	2.409	1.245	8.516
NPL	524	Nepal	5.043	1.26	14.458
NRU	520	Nauru	0.311	0.527	0.781
NZL	554	New Zealand	2.038	0.451	6.233
OMN	512	Oman	1.109	0.896	3.012
PAK	586	Pakistan	1.949	0.341	5.665
PAN	591	Panama	1.54	0.546	4.128
PCN	612	Pitcairn	0.404	0.79	1.067
PER	604	Peru	1.347	0.991	3.653
PHL	608	Philippines	2.028	0.574	5.428
PLW	585	Palau	0.475	0.38	1.293
PNG	598	Papua New Gui	1.589	0.98	4.217
POL	616	Poland	0.297	0.259	0.951
PRI	630	Puerto Rico	1.447	0.699	3.928
PRK	408	Democratic Pe	2.521	0.884	7.681
PRT	620	Portugal	1.304	0.967	3.937
PRY	600	Paraguay	0.245	0.479	0.681
PSE	275	Occupied Pales	2.775	1.754	7.927
PYF	258	French Polynes	2.072	1.389	5.637
QAT	634	Qatar	0.181	0.156	0.493
REU	638	Réunion	3.873	0.962	10.657
ROU	642	Romania	1.267	0.555	4.005
RUS	643	Russian Federa	0.94	0.355	3.278
RWA	646	Rwanda	3.309	3.178	8.748
SAU	682	Saudi Arabia	0.914	0.688	2.514
SCG	891	Serbia and Mor	1.673	0.711	5.144
SDN	736	Sudan	0.442	0.292	1.186
SEN	686	Senegal	0.244	0.246	0.647
SGP	702	Singapore	0.016	0.004	0.036
SHN	654	Saint Helena	3.863	2.368	11.182
SJM	744	Svalbard and Ja	1.623	1.278	6.575
SLB	90	Solomon Island	1.54	1.109	4.111
SLE	694	Sierra Leone	0.498	0.574	1.317
SLV	222	El Salvador	1.75	1	4.746
SMR	674	San Marino	1.802	1.925	5.497
SOM	706	Somalia	0.65	0.45	1.711
SPM	666	Saint Pierre and	0.833	1.054	2.467
STP	678	Sao Tome and I	2.347	0.876	5.991
SUR	740	Suriname	0.307	0.034	0.815
SVK	703	Slovakia	1.56	0.672	5.043
SVN	705	Slovenia	2.496	0.746	7.713
SWE	752	Sweden	0.715	0.343	2.53

SWZ	748	Swaziland	3.063	2.301	8.574
SYC	690	Seychelles	4.885	1.802	11.129
SYR	760	Syrian Arab Rep	0.756	0.741	2.174
TCA	796	Turks and Caicc	0.007	0.01	0.013
TCD	148	Chad	0.419	0.197	1.135
TGO	768	Togo	0.28	0.247	0.745
THA	764	Thailand	1.051	0.189	2.826
TJK	762	Tajikistan	5.301	1.033	15.976
TKL	772	Tokelau	0	0	0
TKM	795	Turkmenistan	0.284	0.248	0.834
TLS	626	Timor-Leste	1.85	1.286	5.001
TON	776	Tonga	0.773	0.07	1.992
TTO	780	Trinidad and Tc	0.603	0.521	1.611
TUN	788	Tunisia	0.726	0.585	2.079
TUR	792	Turkey	2.62	1.192	7.773
TUV	798	Tuvalu	0.025	0.02	0.055
TWN	158	Taiwan	3.49	0.429	9.785
TZA	834	United Republi	0.677	0.541	1.814
UGA	800	Uganda	0.913	0.779	2.424
UKR	804	Ukraine	0.416	0.359	1.317
UMI	581	United States M	0.005	0.035	0.011
URY	858	Uruguay	0.435	0.391	1.283
USA	840	United States o	1.073	0.333	3.384
UZB	860	Uzbekistan	0.526	0.243	1.589
VAT	336	Holy See	0.438	0.428	1.162
VCT	670	Saint Vincent a	3.071	1.878	8.401
VEN	862	Venezuela (Boli	0.634	0.594	1.716
VGB	92	British Virgin Is	1.257	1.873	3.131
VIR	850	United States V	1.404	1.268	3.652
VNM	704	Viet Nam	2.054	0.439	5.603
VUT	548	Vanuatu	1.729	1.041	4.709
WLF	876	Wallis and Futu	1.306	0.977	3.505
WSM	882	Samoa	1.677	0.968	4.644
YEM	887	Yemen	2.323	2.197	6.155
ZAF	710	South Africa	1.761	1.318	4.942
ZMB	894	Zambia	0.533	0.506	1.422
ZWE	716	Zimbabwe	1.194	1.106	3.232
isocode	isonum	country	rugged	rugged_popw	rugged_slope
	MEAN OR TOT		1.38		3.94
	SCALE OR TOT				%

This is the Terrain Rugged

This is average slo

% slope is 100 x r

a 4 % slope is 0.0

Note a slope of 4

So, all this would

But scale is only 3

Japan slope is abo

This slope is just

isocode	isonum	country	rugged	rugged_popw	OK rob, multiply a rugged_slope
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LVA	428	Latvia	0.154	0.136	0.522
MAC	446	Macao Special	0.732	0.527	1.921
MAR	504	Morocco	2.413	1.291	6.853
MCO	492	Monaco	6.612	6.043	20.834
MDA	498	Republic of Mo	0.799	0.573	2.527
MDG	450	Madagascar	1.169	0.738	3.185
MDV	462	Maldives	0.012	0.012	0.024
MEX	484	Mexico	1.732	0.825	4.795
MHL	584	Marshall Island	0.014	0.016	0.033
MKD	807	The former Yug	2.665	0.885	8.19
MLI	466	Mali	0.147	0.305	0.393
MLT	470	Malta	1.527	1.171	4.292
MMR	104	Myanmar	1.988	0.332	5.517
MNG	496	Mongolia	1.057	0.765	3.352
MNP	580	Northern Maria	1.7	1.484	4.572
MOZ	508	Mozambique	0.612	0.438	1.653
MRT	478	Mauritania	0.115	0.147	0.308
MSR	500	Montserrat	3.395	2.824	9.256
MTQ	474	Martinique	1.206	0.659	3.311
MUS	480	Mauritius	0.949	0.788	2.436
MWI	454	Malawi	1.027	0.821	2.759
MYS	458	Malaysia	1.009	0.374	2.684
MYT	175	Mayotte	2.673	2.483	5.809
NAM	516	Namibia	0.913	0.423	2.489

NCL	540	New Caledonia	1.586	0.621	4.338
NER	562	Niger	0.178	0.222	0.481
NFK	574	Norfolk Island	1.154	0.812	3.266
NGA	566	Nigeria	0.312	0.229	0.833
NIC	558	Nicaragua	0.992	0.768	2.671
NIU	570	Niue	0.177	0.205	0.472
NLD	528	Netherlands	0.037	0.042	0.108
NOR	578	Norway	2.409	1.245	8.516
NPL	524	Nepal	5.043	1.26	14.458
NRU	520	Nauru	0.311	0.527	0.781
NZL	554	New Zealand	2.038	0.451	6.233
OMN	512	Oman	1.109	0.896	3.012
PAK	586	Pakistan	1.949	0.341	5.665
PAN	591	Panama	1.54	0.546	4.128
PCN	612	Pitcairn	0.404	0.79	1.067
PER	604	Peru	1.347	0.991	3.653
PHL	608	Philippines	2.028	0.574	5.428
PLW	585	Palau	0.475	0.38	1.293
PNG	598	Papua New Gui	1.589	0.98	4.217
POL	616	Poland	0.297	0.259	0.951
PRI	630	Puerto Rico	1.447	0.699	3.928
PRK	408	Democratic Pe	2.521	0.884	7.681
PRT	620	Portugal	1.304	0.967	3.937
PRY	600	Paraguay	0.245	0.479	0.681
PSE	275	Occupied Pales	2.775	1.754	7.927
PYF	258	French Polynes	2.072	1.389	5.637
QAT	634	Qatar	0.181	0.156	0.493
REU	638	Réunion	3.873	0.962	10.657
ROU	642	Romania	1.267	0.555	4.005
RUS	643	Russian Federa	0.94	0.355	3.278
RWA	646	Rwanda	3.309	3.178	8.748
SAU	682	Saudi Arabia	0.914	0.688	2.514
SCG	891	Serbia and Mor	1.673	0.711	5.144
SDN	736	Sudan	0.442	0.292	1.186
SEN	686	Senegal	0.244	0.246	0.647
SGP	702	Singapore	0.016	0.004	0.036
SHN	654	Saint Helena	3.863	2.368	11.182
SJM	744	Svalbard and Ja	1.623	1.278	6.575
SLB	90	Solomon Island	1.54	1.109	4.111
SLE	694	Sierra Leone	0.498	0.574	1.317
SLV	222	El Salvador	1.75	1	4.746
SMR	674	San Marino	1.802	1.925	5.497
SOM	706	Somalia	0.65	0.45	1.711
SPM	666	Saint Pierre an	0.833	1.054	2.467
STP	678	Sao Tome and I	2.347	0.876	5.991
SUR	740	Suriname	0.307	0.034	0.815
SVK	703	Slovakia	1.56	0.672	5.043
SVN	705	Slovenia	2.496	0.746	7.713
SWE	752	Sweden	0.715	0.343	2.53
SWZ	748	Swaziland	3.063	2.301	8.574

SYC	690	Seychelles	4.885	1.802	11.129
SYR	760	Syrian Arab Rep	0.756	0.741	2.174
TCA	796	Turks and Caicc	0.007	0.01	0.013
TCD	148	Chad	0.419	0.197	1.135
TGO	768	Togo	0.28	0.247	0.745
THA	764	Thailand	1.051	0.189	2.826
TJK	762	Tajikistan	5.301	1.033	15.976
TKL	772	Tokelau	0	0	0
TKM	795	Turkmenistan	0.284	0.248	0.834
TLS	626	Timor-Leste	1.85	1.286	5.001
TON	776	Tonga	0.773	0.07	1.992
TTO	780	Trinidad and Tc	0.603	0.521	1.611
TUN	788	Tunisia	0.726	0.585	2.079
TUR	792	Turkey	2.62	1.192	7.773
TUV	798	Tuvalu	0.025	0.02	0.055
TWN	158	Taiwan	3.49	0.429	9.785
TZA	834	United Republi	0.677	0.541	1.814
UGA	800	Uganda	0.913	0.779	2.424
UKR	804	Ukraine	0.416	0.359	1.317
UMI	581	United States M	0.005	0.035	0.011
URY	858	Uruguay	0.435	0.391	1.283
USA	840	United States o	1.073	0.333	3.384
UZB	860	Uzbekistan	0.526	0.243	1.589
VAT	336	Holy See	0.438	0.428	1.162
VCT	670	Saint Vincent a	3.071	1.878	8.401
VEN	862	Venezuela (Boli	0.634	0.594	1.716
VGB	92	British Virgin Is	1.257	1.873	3.131
VIR	850	United States V	1.404	1.268	3.652
VNM	704	Viet Nam	2.054	0.439	5.603
VUT	548	Vanuatu	1.729	1.041	4.709
WLF	876	Wallis and Futu	1.306	0.977	3.505
WSM	882	Samoa	1.677	0.968	4.644
YEM	887	Yemen	2.323	2.197	6.155
ZAF	710	South Africa	1.761	1.318	4.942
ZMB	894	Zambia	0.533	0.506	1.422
ZWE	716	Zimbabwe	1.194	1.106	3.232
isocode	isonum	country	rugged	rugged_popw	rugged_slope
	MEAN OR TOT		1.38		3.94
	SCALE OR TOT				2.26 degree
					With slope of 3.9
					ADD ANTARCTICA
					What is slope % i
Slope degree	Extra area				3.94% = 2.26 deg
				2.26 x 3 =	6.78
	10	1.52			
	20	6.38			
	30				

CHINA Ying 2014 - h deg		%	Area	%Diff	%Diff check
1.00	12	21	**0.9574**	2.23	2.23
10.00	11.65	20.62	**0.9562**		2.10
30.00	10.92	19.29	**0.9538**		1.85
100.00	9	15.84	**0.9482**		1.25
Nunn & Pega 926	3.14	5.49	**0.9378**		0.14
1000.00	3.53	6.19	**0.9383**	0.19	0.19
10000.00	0	0	0.9365		0.00
diff 1 vs 1000 times	3.40	3.39	1.0204		
% Diff 1 vs 1,000	239.9	239.3	2.0	1,074	% inc in accuracy
% Diff 10 vs 1,000	230.0	233.1	1.9		

Ying et al. formula 1 is just for calculating hypotenuse length, not area

Area projected = bas	**slope deg**	**pi/180**	**sum**	**sec (= Ratio TS**	**Area true = hypo**
400	8.8	**0.01745**	**0.15356**	**1.011907302**	**404.7629**
94 x 94					
8836					10000
94					163833.022

Square when sloped projects a rectangle if square on, or an irregular diamond shape if angled. Rel

Area projected = bas	slope deg	sqrt = base	pi/180	sum	sec
12	10	3.464	0.01745	0.1745	1.015420717

Circle when sloped casts an ellipse - this is more constant thus is perhaps better for large area calc

Area projected = bas	slope deg	diameter	pi/180 (In E	sum	sec
400	8.8	22.56759287	0.01745	0.15356	1.011907302

Circle only is wrong!!!!!!!!!!!!!!!

Area projected = bas	slope deg	diameter	pi/180	sum	sec
400	8.8	22.56759287	0.01745	0.15356	1.011907302

If circular the above area diameter is

22.57					New area is

			Corrugated sheet analogy		Diff %
			1.50%	203.04	
			10.50%	224.315	
Yang et al China stud	area 1,000 ha	Gha	70%	381.34	90.67
China	932,748				
Taiwan	3,615				
HK	110				
Macao	3				
Total	936,476	936			

Actual hypothenuse	Projected base	
As	Ap	
296,513	*222,236*	
-25.050	-25.050	% Diff

Nunn & Puga, 2010 give examples of Terrain ruggedness index and these I compare to their slope in

Country	TRI	Slope %	Ratio			
Netherland	0.037	0.12	3.24			
Mauritania	0.115	0.308	2.68			
Romania	1.267	4.005	3.16			
Zimbabwe	1.194	3.232	2.71			
Italy	2.458	7.506	3.05			
Djibouti	2.432	6.416	2.64		radians	
Nepal	5.043	14.458	2.87			
Lesotho	6.202	17.595	2.84	1		0.79
		MEAN	2.90			

CALCULATE GLOBAL AREA INCREASES			1,000 Ha	%	radians	
isocode	isonum	country	land_area	rugged_slope		
ABW	533	Aruba	18	1.226		0.01
AFG	4	Afghanistan	65209	7.414		0.07
AGO	24	Angola	124670	2.274		0.02
AIA	660	Anguilla	9	0.026		0.00
ALB	8	Albania	2740	10.451		0.10
AND	20	Andorra	47	17.774		0.18
ANT	530	Netherlands Ar	80	0.68		0.01
ARE	784	United Arab Em	8360	2.112		0.02
ARG	32	Argentina	273669	2.268		0.02
ARM	51	Armenia	2820	8.178		0.08
ASM	16	American Samc	20	7.032		0.07
ATG	28	Antigua and Ba	44	0.012		0.00
AUS	36	Australia	768230	0.405		0.00
AUT	40	Austria	8245	11.095		0.11
AZE	31	Azerbaijan	8260.5	5.08		0.05
BDI	108	Burundi	2568	4.721		0.05
BEL	56	Belgium	3023	1.239		0.01
BEN	204	Benin	11062	0.377		0.00
BFA	854	Burkina Faso	27360	0.638		0.01
BGD	50	Bangladesh	13017	0.502		0.01
BGR	100	Bulgaria	11063	4.498		0.04
BHR	48	Bahrain	71	0.627		0.01
BHS	44	Bahamas	1001	0.144		0.00
BIH	70	Bosnia and Her	5120	7.075		0.07
BLR	112	Belarus	20748	0.54		0.01
BLZ	84	Belize	2281	1.616		0.02
BMU	60	Bermuda	5	0.03		0.00
BOL	68	Bolivia	108438	2.343		0.02
BRA	76	Brazil	845942	0.654		0.01
BRB	52	Barbados	43	2.581		0.03
BRN	96	Brunei Darussa	527	1.366		0.01
BTN	64	Bhutan	4700	19.325		0.19
BWA	72	Botswana	56673	0.488		0.00
CAF	140	Central African	62300	0.528		0.01
CAN	124	Canada	909351	2.695		0.03
CCK	166	Cocos (Keeling)	1	0.031		0.00
CHE	756	Switzerland	4000	14.999		0.15

CHL	152	Chile	74880	7.365	0.07
CHN	156	China	932748	5.493	0.05
CIV	384	Côte d'Ivoire	31800	0.594	0.01
CMR	120	Cameroon	46540	1.374	0.01
COD	180	Democratic Rep	226705	1.177	0.01
COG	178	Congo	34150	0.406	0.00
COK	184	Cook Islands	24	2.641	0.03
COL	170	Colombia	110950	2.376	0.02
COM	174	Comoros	186.1	9.049	0.09
CPV	132	Cape Verde	403	6.502	0.06
CRI	188	Costa Rica	5106	5.708	0.06
CUB	192	Cuba	10982	1.448	0.01
CXR	162	Christmas Islan	13.5	3.477	0.03
CYM	136	Cayman Islands	26	0.237	0.00
CYP	196	Cyprus	924	7.867	0.08
CZE	203	Czech Republic	7727	2.845	0.03
DEU	276	Germany	34877	1.906	0.02
DJI	262	Djibouti	2318	6.416	0.06
DMA	212	Dominica	75	0.005	0.00
DNK	208	Denmark	4243	0.611	0.01
DOM	214	Dominican Rep	4838	4.495	0.04
DZA	12	Algeria	238174	1.445	0.01
ECU	218	Ecuador	27684	3.446	0.03
EGY	818	Egypt	99545	2.001	0.02
ERI	232	Eritrea	10100	6.663	0.07
ESH	732	Western Sahara	26600	0.565	0.01
ESP	724	Spain	49900	5.062	0.05
EST	233	Estonia	4239	0.414	0.00
ETH	231	Ethiopia	100000	4.193	0.04
FIN	246	Finland	30459	1.202	0.01
FJI	242	Fiji	1827	3.723	0.04
FLK	238	Falkland Islands	1217	0.859	0.01
FRA	250	France	55010	3.406	0.03
FRO	234	Faeroe Islands	140	8.215	0.08
FSM	583	Micronesia, Fed	70	3.61	0.04
GAB	266	Gabon	25767	0.583	0.01
GBR	826	United Kingdom	24269	1.878	0.02
GEO	268	Georgia	6949	11.258	0.11
GHA	288	Ghana	22754	0.601	0.01
GIB	292	Gibraltar	1	21.453	0.21
GIN	324	Guinea	24572	1.969	0.02
GLP	312	Guadeloupe	169	3.23	0.03
GMB	270	Gambia	1000	0.915	0.01
GNB	624	Guinea-Bissau	2812	1.302	0.01
GNQ	226	Equatorial Guin	2805	1.449	0.01
GRC	300	Greece	12890	9.166	0.09
GRD	308	Grenada	34	5.655	0.06
GRL	304	Greenland	217500	1.548	0.02
GTM	320	Guatemala	10843	4.893	0.05
GUF	254	French Guiana	8815	0.546	0.01

GUM	316	Guam	54	1.825	0.02
GUY	328	Guyana	19685	0.744	0.01
HKG	344	Hong Kong Spe	110	6.692	0.07
HND	340	Honduras	11189	5.824	0.06
HRV	191	Croatia	5592	3.842	0.04
HTI	332	Haiti	2756	6.448	0.06
HUN	348	Hungary	8962	1.09	0.01
IDN	360	Indonesia	181157	2.587	0.03
IND	356	India	297319	2.842	0.03
IOT	86	British Indian O	8	0.037	0.00
IRL	372	Ireland	6889	1.676	0.02
IRN	364	Iran, Islamic Re	162855	6.962	0.07
IRQ	368	Iraq	43737	1.919	0.02
ISL	352	Iceland	10025	5.318	0.05
ISR	376	Israel	2164	4.808	0.05
ITA	380	Italy	29411	7.506	0.07
JAM	388	Jamaica	1083	4.837	0.05
JOR	400	Jordan	8824	3.115	0.03
JPN	392	Japan	36450	6.275	0.06
KAZ	398	Kazakhstan	269970	1.172	0.01
KEN	404	Kenya	56914	1.781	0.02
KGZ	417	Kyrgyzstan	19180	13.105	0.13
KHM	116	Cambodia	17652	1.421	0.01
KIR	296	Kiribati	81	0.021	0.00
KNA	659	Saint Kitts and	26	0.012	0.00
KOR	410	Republic of Kor	9873	5.807	0.06
KWT	414	Kuwait	1782	0.691	0.01
LAO	418	Lao People's De	23080	6.976	0.07
LBN	422	Lebanon	1023	12.042	0.12
LBR	430	Liberia	9632	0.695	0.01
LBY	434	Libyan Arab Jar	175954	1.124	0.01
LCA	662	Saint Lucia	61	5.841	0.06
LIE	438	Liechtenstein	16	17.18	0.17
LKA	144	Sri Lanka	6463	1.712	0.02
LSO	426	Lesotho	3035	17.595	0.17
LTU	440	Lithuania	6268	0.578	0.01
LUX	442	Luxembourg	259	2.844	0.03
LVA	428	Latvia	6205	0.522	0.01
MAC	446	Macao Special	3	1.921	0.02
MAR	504	Morocco	44630	6.853	0.07
MCO	492	Monaco	0	20.834	0.21
MDA	498	Republic of Mo	3288	2.527	0.03
MDG	450	Madagascar	58154	3.185	0.03
MDV	462	Maldives	30	0.024	0.00
MEX	484	Mexico	194395	4.795	0.05
MHL	584	Marshall Island	18	0.033	0.00
MKD	807	The former Yug	2543	8.19	0.08
MLI	466	Mali	122019	0.393	0.00
MLT	470	Malta	32	4.292	0.04
MMR	104	Myanmar	65755	5.517	0.06

MNG	496	Mongolia	156650	3.352	0.03
MNP	580	Northern Maria	46	4.572	0.05
MOZ	508	Mozambique	78638	1.653	0.02
MRT	478	Mauritania	103070	0.308	0.00
MSR	500	Montserrat	10	9.256	0.09
MTQ	474	Martinique	106	3.311	0.03
MUS	480	Mauritius	203	2.436	0.02
MWI	454	Malawi	9408	2.759	0.03
MYS	458	Malaysia	32855	2.684	0.03
MYT	175	Mayotte	37.4	5.809	0.06
NAM	516	Namibia	82329	2.489	0.02
NCL	540	New Caledonia	1828	4.338	0.04
NER	562	Niger	126670	0.481	0.00
NFK	574	Norfolk Island	4	3.266	0.03
NGA	566	Nigeria	91077	0.833	0.01
NIC	558	Nicaragua	12140	2.671	0.03
NIU	570	Niue	26	0.472	0.00
NLD	528	Netherlands	3388	0.108	0.00
NOR	578	Norway	30428	8.516	0.08
NPL	524	Nepal	14300	14.458	0.14
NRU	520	Nauru	2	0.781	0.01
NZL	554	New Zealand	26771	6.233	0.06
OMN	512	Oman	30950	3.012	0.03
PAK	586	Pakistan	77088	5.665	0.06
PAN	591	Panama	7443	4.128	0.04
PCN	612	Pitcairn	4.7	1.067	0.01
PER	604	Peru	128000	3.653	0.04
PHL	608	Philippines	29817	5.428	0.05
PLW	585	Palau	46	1.293	0.01
PNG	598	Papua New Gui	45286	4.217	0.04
POL	616	Poland	30436	0.951	0.01
PRI	630	Puerto Rico	887	3.928	0.04
PRK	408	Democratic Pe	12041	7.681	0.08
PRT	620	Portugal	9150	3.937	0.04
PRY	600	Paraguay	39730	0.681	0.01
PSE	275	Occupied Pales	602	7.927	0.08
PYF	258	French Polynes	366	5.637	0.06
QAT	634	Qatar	1100	0.493	0.00
REU	638	Réunion	250	10.657	0.11
ROU	642	Romania	22971	4.005	0.04
RUS	643	Russian Federa	1638134	3.278	0.03
RWA	646	Rwanda	2467	8.748	0.09
SAU	682	Saudi Arabia	214969	2.514	0.03
SCG	891	Serbia and Mor	10200	5.144	0.05
SDN	736	Sudan	237600	1.186	0.01
SEN	686	Senegal	19253	0.647	0.01
SGP	702	Singapore	67	0.036	0.00
SHN	654	Saint Helena	39	11.182	0.11
SJM	744	Svalbard and Ja	0	6.575	0.07
SLB	90	Solomon Island	2799	4.111	0.04

SLE	694	Sierra Leone	7162	1.317	0.01
SLV	222	El Salvador	2072	4.746	0.05
SMR	674	San Marino	6	5.497	0.05
SOM	706	Somalia	62734	1.711	0.02
SPM	666	Saint Pierre anc	23	2.467	0.02
STP	678	Sao Tome and I	96	5.991	0.06
SUR	740	Suriname	15600	0.815	0.01
SVK	703	Slovakia	4810	5.043	0.05
SVN	705	Slovenia	2014	7.713	0.08
SWE	752	Sweden	41033	2.53	0.03
SWZ	748	Swaziland	1720	8.574	0.09
SYC	690	Seychelles	46	11.129	0.11
SYR	760	Syrian Arab Rep	18378	2.174	0.02
TCA	796	Turks and Caicc	43	0.013	0.00
TCD	148	Chad	125920	1.135	0.01
TGO	768	Togo	5439	0.745	0.01
THA	764	Thailand	51089	2.826	0.03
TJK	762	Tajikistan	13996	15.976	0.16
TKL	772	Tokelau	1	0	0.00
TKM	795	Turkmenistan	46993	0.834	0.01
TLS	626	Timor-Leste	1487	5.001	0.05
TON	776	Tonga	72	1.992	0.02
TTO	780	Trinidad and Tc	513	1.611	0.02
TUN	788	Tunisia	15536	2.079	0.02
TUR	792	Turkey	76963	7.773	0.08
TUV	798	Tuvalu	3	0.055	0.00
TWN	158	Taiwan	3615	9.785	0.10
TZA	834	United Republi	88580	1.814	0.02
UGA	800	Uganda	19710	2.424	0.02
UKR	804	Ukraine	57935	1.317	0.01
UMI	581	United States M	0	0.011	0.00
URY	858	Uruguay	17502	1.283	0.01
USA	840	United States o	916192	3.384	0.03
UZB	860	Uzbekistan	42540	1.589	0.02
VAT	336	Holy See	0	1.162	0.01
VCT	670	Saint Vincent a	39	8.401	0.08
VEN	862	Venezuela (Boli	88205	1.716	0.02
VGB	92	British Virgin Is	15	3.131	0.03
VIR	850	United States V	35	3.652	0.04
VNM	704	Viet Nam	31106	5.603	0.06
VUT	548	Vanuatu	1219	4.709	0.05
WLF	876	Wallis and Futu	14	3.505	0.04
WSM	882	Samoa	283	4.644	0.05
YEM	887	Yemen	52797	6.155	0.06
ZAF	710	South Africa	121447	4.942	0.05
ZMB	894	Zambia	74339	1.422	0.01
ZWE	716	Zimbabwe	38685	3.232	0.03
isocode	isonum	country	13193676	rugged_popw	TOTs or MEANs
	MEAN OR TOT		24897.11		
	SCALE OR TOT				ADD ANTARCTICA

Duursman & Poisson O2 and CO2 tab. To convert mols to g for O2 x 32; for C x 12 .

	Air	Sea	Land	Tot	% Air	
mol O2	3.75	0.031		3.78	99.2	
mol CO2-C	0.053	2.9		2.953	1.8	
O2 g (mol x 16 x 2)	120	0.992	na	120.99	99.2	
C g (mol x 12)	0.636	34.8		35.44	1.8	
D & P data for C	0.64	0.35		35.64		This may be their
C in CO2 is x 0.273	44	12.012	QED			

Carbon Gt	Gt	%			stored C
air	640	0.00		tot	16,000,000
land	81000000	99.96			65,000,000
sea	35000	0.04			40,000
Tot	81035640	100			1,350
				tot	81,041,350

	Area Gha	mean mol Org-C /m^2/yr	Total Org C/yr (%)	mol O_2 /m^2/yr	Total O_2/yr (%)
Land	15	12	1.84 x 10^{15} (46%)	12	1.84 x 10^{15} (44%)
Sea	36	6	2.16 x 10^{15} (54%)	6.45	2.32 x 10^{15} (56%)
Total	51		4.00 x 10^{15} (100%)		4.16 x 10^{15} (100%)

			x 10	15	
	180		180.00		180.00
			216.00		232.20
		Tot	396.00		412.20

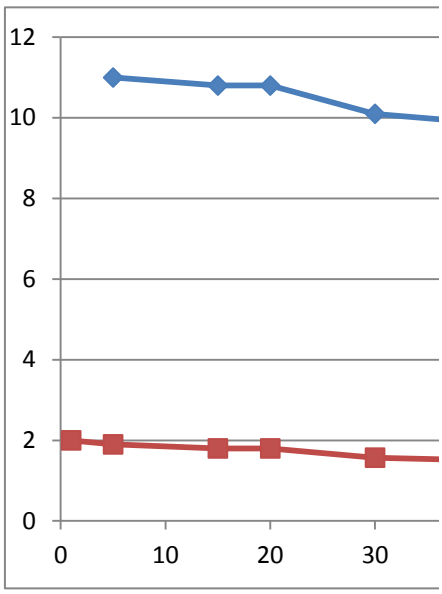
Oxygen imbalance

	mol x 10 15	Gt	%	
humus + biomass	180	5,760	0.48	1.904258133
fossil fuel	1,520	48,640	4.02	
atm	37,810	1,209,920	100	
tot				

Gha	C NPP	Tot	Inc	% inc
15	1.44	21.6	22.725	5.2
13.2	1.44	19.008	20.133	5.9
				5.6

Flat areas Gha	CIA	FAO	%
Land	14.98	13.01	87.0
Antarctica Gha		1.40	9.4
Greenland glaciers		0.18	1.2
Rivers/lakes		0.37	2.5
TOTAL	14.98	14.96	100
Total less water		14.59	

Milevski & Milevska	2015	
res	slope degree	% inc base area
1		2
5	11	1.9
15	10.8	1.8
20	10.8	1.8
30	10.1	1.57
90	8.8	1.2
	0	0



MAIN GRAPH ON COARSE TOPOGRAPHY AND REFINED ROUGHNESS

	Level of analysis	scale	Surface +%	Hilly	Author(s)
1	km Astronomy	>1	0.0	n	NASA/NOAA
2	km	>1	0.0	n	Ying et al.
1	m	1	4.5	n	Ying et al. (projec
2	m	1	2.0	?	Milevski & Milevs
3	m	1	0.6	n	Nunn & Puga (rec
4	m	5	1.9	?	Milevski & Milevs
5	m	30	4.6	n	Ying et al.
6	m	24-71	56.1	y	Anon.
7	m	90	25.0	y	Rashid
8	m	90	12.0	y	Sutton & Lopez
9	m	90	7.7	y	Zhang et al.
10	m	90	1.2	?	Milevski & Milevs
11	m	100	180.0	y	Nogués-Bravo &
12	m	100	3.8	n	Ying et al.
13	m	500	30.0	y	Nogués-Bravo &
14	m	926	0.2	n	Nunn & Puga
15	m	1,000	10.0	y	Nogués-Bravo &
16	m	1,000	0.5	n	Ying et al.
0	dm	-	-	-	-

1	cm	1	26.0	-	Martin et al. (rec
2	cm	1	33.0	-	Bramorski et al.
3	cm	1	57.0	-	Bramorski et al. (
4	cm	1	260.0	-	Bramorski et al. (
1	mm	1	163.0	-	Grims
2	mm	1	60.0	-	Koiter
3	mm	3	23.0	-	Helming et al.
4	mm	4	35.0	-	Kamphorst et al.
5	mm	90	100.0	-	Mirazai et al.
1	µm-nm Microbiol	1	millions %	-	various

84.11111111

			or	
BUT MANY CONTRIE	1 m scale mean (not mountain)	**2.57**	% or	**2.38**
HAVE MOUNTS	1 cm scale	**94.00**	%	
	<1 mm >1µm scale	**108.2**		
	If have all reports m	**21.25**		18.2
	cm	**94.00**		18.77
	mm	**108.2**	NEW LAND =	42.08
			NEW WORLD =	**78.08**

NPP productivity Mean land = **39.0** Mean world =

If the land does go up then the productivity of 1.44 C /yr gives new total of ..

Gha land or ocean	Productivity C/	C Gt	%	
39.0	1.44	56.2	68	2
36	0.72	25.9	32	1
75.0	Total	82.1	100.0	

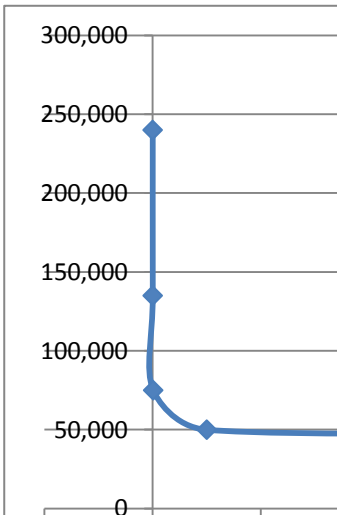
If the land does go up to 64 then the productivity of 1.44 C /yr gives new total

Gha land or ocean	Productivity C/	C Gt	%
64.0	1.44	92.2	78
36	0.72	25.9	22
100.0	Total	118.1	

So... productivity on land is increased from 21.6 G to 82.6 Gt or fourfold.
Productivity overall goes from about 48 Gt to about 108 Gt or doubled.

Missing sink and NPP method

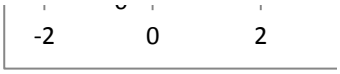
If terrain 5.1%	15.8 Gha	
Then times 94%	30.6 Gha	
Then 76.2%	53.9 Gha	
Multiplication factor		3.42
If 3.5 x	55.2	



Coastline of Britain

Length of Ruler m	Length of Coast km
10	48,000
1	50,000
0.01	75,000

0.001	135,000
0.0001	240,000
-1	



MODELLING MEANS

Land Gha	Model mean dm	New dm	Model mean cm		Model mean mm
15	1.8	27	1.8	48.6	1.8
				sea	
				Tot	
				Ratio soil : sea	
				% soil : sea	

Biome productivity from Campbell's Biology (2008) - https://slideplayer.com/slide/6548420/23/ima

Biome	%	Global area Gh	NPP (g/m2/	% NPP	Gt/yr
Open ocean	65	33.15	125	24.4	41.4
Cont. shelf	5.2	2.65	360	5.6	9.5
Mangrove/Estuary	0.3	0.15	1,500	1.2	2.3
Algal bed/Coral reef	0.1	0.05	2,500	0.9	1.3
Upwelling zone	0.1	0.05	500	0.1	0.3
Desert, rock, sand, ic	4.7	2.40	3	0.04	0.1
Semi-desert	3.5	1.79	90	0.9	1.6
Tropical rainforest	3.3	1.68	2,200	22	37.0
Savannah	2.9	1.48	900	7.9	13.3
Cultivated land	2.7	1.38	**650**	**9.1**	9.0
Boreal forest (taiga)	2.4	1.22	800	**9.6**	9.8
Temp. grassland	1.8	0.92	600	**5.4**	5.5
Wood and Shrub	1.7	0.87	700	3.5	6.1
Tundra/Alpine	1.6	0.82	140	0.6	1.1
Tropical decid forest	1.5	0.77	1,600	7.1	12.2
Temperate decid for	1.3	0.66	1,200	4.9	8.0
Tempeate evergreer	1	0.51	1,300	3.8	6.6
Swamp & marsh	0.4	0.20	2,000	2.3	4.1
Lake & stream	0.4	0.20	250	0.3	0.5
TOTAL	99.9	50.95	17,418	110	**170**
				OUT BY +10!	
Total Ocean	**70.7**	**36.1**	**138.5**	**32.2**	**54.8**
Total Land	**28.4**	**14.5**	**678.9**	**74.8**	**110.3**
Total water	**0.8**	**0.4**	**900.0**	**2.6**	**4.6**
TOTAL					**169.7**

The data in the table above is from R.H. Whittaker, quoted by Stiling (1996) "Ecology: Theories and

FINAL NPP TABLE

NPP Totals	C g/m2/yr	C g/m2/yr	C Gt/yr	C Gt/yr	**TOTAL NPP Gt C**
For 15 Gha land	Rate land	Rate sea	Tot land	Tot sea	
Duursma & Boisson :	144	72	21.6	25.9	**48**
Whitman et al. 1989	-	-	48	51	**99**
Stiling (1996)	773	152	115	55	**170**
UNEP (2002)	-	-	56.4	48.5	**105**
Campbell (2008) rec	678.9	138.5	110.3	54.8	**165**
NASA (2011)	-	-	93	-	**-**
For 30 Gha land	725.95	145.25	**218**	**52**	**270**

For 60 Gha land	725.95	145.25	**436**	**52**	**488**
Mean of all rates	532.0	120.8	74.1	47.0	121
Check rate by area	C g/m2/yr	C g/m2/yr	C Gt/yr	C Gt/yr	These data are ap
D & B	144	72	21.6	25.9	
Stiling	773	152	116.0	54.7	
Campbell	678.9	138.5	101.8	49.9	OK this is a bit dif
For 30 Gha land		mean x 2 -->	217.785	52.29	<--just mean

Biome	**Above C Gt**	**Below C GT**	Sharlemann et al.14 - https://www.tandfonli
Tropical wet	140	128	
Tropical moist	152	150	
Tropical dry	42	137	
Tropical montane	40	55	
Warm temp moist	28	63	
Warm temp dry	23	78	
Cool temp moist	25	210	
Cool temp dry	9	100	
Boreal moist	23	366	
Boreal dry	5	68	
Polar moist	2	50	
Polar dry	0	10	
Total	**489**	**1415**	

Bar-On et al. 2018 global biomass estimates (corrected by RJB in red)

Biomass in Gt C	Land	Ocean
Trees	450	
Bacteria		
Terr deep microbes	60	
Mar deep microbes		7
Soil	7	
Marine		1.3
Fungi ???	12	
Archaea		
Terr deep microbes	4	
Mar deep microbes		3
Soil	0.5	
Marine		0.3
Protists??	2	2
Animals		
Fish		0.5
Livestock	0.1	
Humans	0.06	
Wild mammals	0.007	
Wild birds	0.002	
Arthopods	0.2	1
Annelids	0.82	
Molluscs		0.2
Cnidarinas		0.1
Nematodes	0.02	
Viruses ??	0.1	0.1

Totals	536.8	15.5	552.3
%	97.2	2.8	
Tot all animals	1.309	1.4	

Life on Earth calculation in Gt carbon

	Land	Sea		
				900
				10000
Plants above ground	492			800
Roots	241			2000
Bacteria	241	6.3		15
VAM hyphae	15		TOTAL	13715
Earthworms	4			
Fish*		0.5		
Other organisms**	7.0	8.0		
Total	1,000	14.8		
Total x 2 for terrain	2,000	14.8		
Proportion %	99.3	0.7		

* From Bar-On (2018)

NPP from UNEP - https://archive.org/stream/worldatlasofbiod02groo#page/10/mode/2up

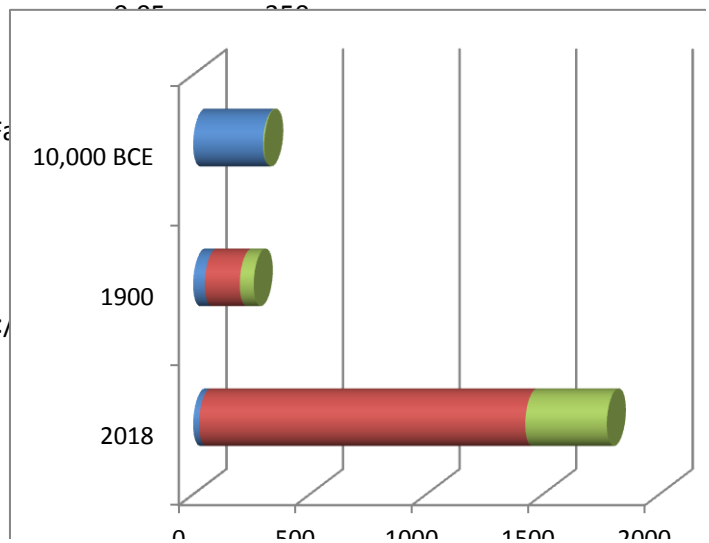
	Terrestrial	Ocean	Total
	56.4	48.5	104.9
	83	90	173
trf	17.8		
	1.5		
	3.1		
	3.1		
	1.4		
	16.8		
	2.4		
	1		
	0.8		
	0.5		
	8		
Total	56.4		

	Giga	Wt tonnes	Tot Gt
Humans	7000		
Farn stock and pets			
Wild mammals			

	Wild Mammals	Fa
10,000 BCE	300	
1900	50	
2018	25	

Biomass (Mt) and extinctions (from http:/

	2018
Wild mammals	25
Farm stock & pets	1400
Humans	350



Lal 2008 fig. 1 - https://www.researchgate.net/publication/200736458_Sequestration_of_atmosph
Carbon cycles in detail.

Cf FAO for Grasslands... http://www.fao.org/docrep/008/y8344e/y8344e05.htm

	%	Gha	%	FAO %	Diff
Desert, rock, sand, ic	4.7	2.40	16.5		
Semi-desert	3.5	1.79	12.3		
Tropical rainforest	3.3	1.68	11.6		
Savannah	2.9	1.48	10.2	13.8	26.1
Cultivated land	2.7	1.38	9.5		
Boreal forest (taiga)	2.4	1.22	8.4		
Temp. grassland	1.8	0.92	6.3		
Wood and Shrub	1.7	0.87	6.0		
Tundra/Alpine	1.6	0.82	5.6	5.7	
Tropical decid forest	1.5	0.77	5.3		
Temperate decid for	1.3	0.66	4.6		
Tempeate evergreer	1	0.51	3.5		
Tot	28.4	14.484	99.9		

R.J.B. Supplementary file 2 of soil carbon budgets from October, 2018, R.J.B - Soil carbon budgets (0

	A	B	A x B =		
Biome	**Area Gha**	**SOC kg/m2**	**Area x SOC**	**Total SOC Gt**	**% area**
Boreal forest	1.2	12.5	15.00	150	9.9
Crops	1.4	17.7	24.78	248	11.6
Deserts	1.8	11.5	20.70	208	14.9
Dry shrubs	0.85	14.6	12.41	124	7.0
Temp decid forest	0.7	22.8	15.96	160	5.8
Temp everg forest	0.5	20.4	10.20	102	4.1
Temp grass	0.9	19.1	17.19	172	7.4
Trop decid forest	0.75	29.1	21.83	218	6.2
Trop everg forest	1.7	27.9	47.43	474	14.0
Trop savannah	1.5	23	34.50	345	12.4
Tundra	0.8	18	14.40	144	6.6
Total	**12.1**	**216.6**	**234.40**	**2,345**	**100**
MEAN TOTAL		19.7	238.26	2,383	SO THIS DOES W(

Sorted by area

Biome	Area Gha	SOC 0-3m kg/m	tot	SOC 0-3 m Gt
Deserts	1.8	11.5	20.70	208
Trop everg forest	1.7	27.9	47.43	474
Trop savannah	1.5	23	34.50	345
Crops	1.4	17.7	24.78	248
Boreal forest	1.2	12.5	15.00	150
Temp grass	0.9	19.1	17.19	172

Dry shrubs	0.85	14.6	12.41	124
Tundra	0.8	18	14.40	144
Trop decid forest	0.75	29.1	21.83	218
Temp decid forest	0.7	22.8	15.96	160
Temp everg forest	0.5	20.4	10.20	102
Total	12.1	216.6	234.40	2345

Combined and SORTED BY AREA!!

Biome	**Area Gha**	**SOC kg/m2**	**Index (Area**	**Total SOC Gt**	**% area**
Tropical forest	2.45	57.0	1.00	692	20.2
Deserts	1.8	11.5	0.15	208	14.9
Trop savannah	1.5	23.0	0.25	345	12.4
Crops	1.4	17.7	0.18	248	11.6
Temperate forest	1.2	43.2	0.37	262	9.9
Boreal forest	1.2	12.5	0.11	150	9.9
Temp grass	0.9	19.1	0.12	172	7.4
Dry shrubs	0.85	14.6	0.09	124	7.0
Tundra	0.8	18.0	0.10	144	6.6
Total	**12.1**			**2345**	**100**

From IPCC (2000: tab. 1) https://www.ipcc.ch/pdf/special-reports/spm/srl-en.pdf also called Watso
Table of Global Carbon (Gt C) stocks in veggies and top 1 m soils (often doubled at 1-3 m)

Biome	**Area Gha**	**Plants**	**Soils**	**Total C**	**Area %**
Desert and arid	4.55	8	191	199	30.1
Tropical savannah	2.25	66	264	330	14.9
Tropical forest	1.76	212	216	428	11.6
Crops	1.60	3	128	131	10.6
Boreal forest	1.37	88	471	559	9.1
Temperate grasslanc	1.25	9	295	304	8.3
Temperate forest	1.04	59	100	159	6.9
Tundra	0.95	6	121	127	6.3
Wetlands	0.35	15	225	240	2.3
Total	**15.12**	**466.00**	**2011.00**	**2477.00**	**100.0**

From Watson et al. (2000). Land Use, Land Use Change and Forestry. 375pp. Cambridge University Press, Cambridge, UK on website https://www.cbd.int/doc/external/cop-09/fao-factsheet-en.pdf .

https://www.ipcc.ch/pdf/special-reports/spm/srl-en.pdf

Economic value from land and sea from Costanza et al 2014 - http://wedocs.unep.org/bitstream/ha

		2,011
		1,368
		660
		8,944
		28,916
		352,249
		2,222
Total Ocean		396,370
		4,901
		3,800
		5,382
		3,137
		4,166
		140,174
		193,843
		25,681
		12,512
		5,567
		6,661
Total Land		405,824
Diff		1.0
land		15,323
Lakes/rivers		200
%	-	98.7

1.3

Table of SOC deficits as revealed by BD shortfalls

SOC (1.3%)	Depth m (Auth.)	Soil Gt	Volume Gm	Density gm-3	For 1.35 gm-3
1,500	1 (IPCC, 4p1000)	115,385	120,000	0.96	1.4
1,000	1 (Kochy et al.)	76,923	120,000	0.64	2.1
2,300	3 (NASA)	176,923	360,000	0.49	2.7
3,000	>3 (Kochy et al.)	230,769	360,000	0.64	2.1
				MEAN of 4	2.1
				MEAN 1st 3	2.1

Table of Terrain scenarios.

BD gm-3	Area Gm2	Terrain Factor ›	Soil Gt	Depth m	SOC @ 1.3%
1.35	120,000 x 1	1	162,000	1	2,106
1.35	240,000 x 2	2	324,000	1	4,212
1.35	480,000 x 4	4	648,000	1	8,424

1.35	720,000 x 6	2	972,000	3	12,636
1.35	720,000 x 6	4	1,944,000	3	25,272

If soil weighs between 1.2- 1.7 tonnes per cubic m (https://www.reference.com/science/much-cubi

tonnes per m3	area Gm3	tot mass Gt	bd	SOC @ 1.3%	For 1,500 Gt
1.20	120,000	144,000	1.2	1,872	1.2
1.70	120,000	204,000	1.7	2,652	1.8

Or bcs bd is same as mass, then if BD is the required 1.35 get...

1.35	**120,000**	**162,000**	**1.35**	**2,106**	**1.4**

Q.E.D.

What happens if I put tm-3 as gcm-3 and then use 1 m depth i.e., 1 m vs. 100 cm?

This is OK as 1 million g = 1 t and 1 million cm3 = 1 m3; but only 10,000 m2 = 1 ha and I measure in (

Julieta Bramowski file data and calculations of tortuosity using straight or curved hypotensuses. R.J

	1		Cateto (1cn	Cateto diferen	Soma catetos
1	26	Diff			
2	29	3.00	1	9.00	10.00
3	29	0.00	1	0.00	1.00
4	28	1.00	1	1.00	2.00
5	28	0.00	1	0.00	1.00
6	28	0.00	1	0.00	1.00
7	28	0.00	1	0.00	1.00
8	27	1.00	1	1.00	2.00
9	27	0.00	1	0.00	1.00
10	28	1.00	1	1.00	2.00
11	28	0.00	1	0.00	1.00
12	26	2.00	1	4.00	5.00
13	26	0.00	1	0.00	1.00
14	27	1.00	1	1.00	2.00
15	27	0.00	1	0.00	1.00
16	24	3.00	1	9.00	10.00
17	24	0.00	1	0.00	1.00
18	23	1.00	1	1.00	2.00
19	23	0.00	1	0.00	1.00
20	23	0.00	1	0.00	1.00
21	23	0.00	1	0.00	1.00
22	23	0.00	1	0.00	1.00
23	23	0.00	1	0.00	1.00
24	25	2.00	1	4.00	5.00
25	25	0.00	1	0.00	1.00
26	27	2.00	1	4.00	5.00
27	27	0.00	1	0.00	1.00
28	26	1.00	1	1.00	2.00

29	26	0.00	1	0.00	1.00
30	25	1.00	1	1.00	2.00
31	25	0.00	1	0.00	1.00
32	24	1.00	1	1.00	2.00
33	24	0.00	1	0.00	1.00
34	23	1.00	1	1.00	2.00
35	23	0.00	1	0.00	1.00
36	25	2.00	1	4.00	5.00
37	25	0.00	1	0.00	1.00
38	24	1.00	1	1.00	2.00
39	24	0.00	1	0.00	1.00
40	23	1.00	1	1.00	2.00
41	23	0.00	1	0.00	1.00
42	25	2.00	1	4.00	5.00
43	25	0.00	1	0.00	1.00
44	29	4.00	1	16.00	17.00
45	29	0.00	1	0.00	1.00
46	33	4.00	1	16.00	17.00
47	33	0.00	1	0.00	1.00
48	33	0.00	1	0.00	1.00
49	33	0.00	1	0.00	1.00
50	34	1.00	1	1.00	2.00
51	34	0.00	1	0.00	1.00
52	35	1.00	1	1.00	2.00
53	35	0.00	1	0.00	1.00
54	35	0.00	1	0.00	1.00
55	35	0.00	1	0.00	1.00
56	33	2.00	1	4.00	5.00
57	33	0.00	1	0.00	1.00
58	32	1.00	1	1.00	2.00
59	32	0.00	1	0.00	1.00
60	32	0.00	1	0.00	1.00
61	32	0.00	1	0.00	1.00
62	32	0.00	1	0.00	1.00
63	32	0.00	1	0.00	1.00
64	32	0.00	1	0.00	1.00
65	32	0.00	1	0.00	1.00
66	28	4.00	1	16.00	17.00
67	28	0.00	1	0.00	1.00
68	28	0.00	1	0.00	1.00
69	28	0.00	1	0.00	1.00
70	26	2.00	1	4.00	5.00
71	26	0.00	1	0.00	1.00
72	28	2.00	1	4.00	5.00
73	28	0.00	1	0.00	1.00
74	30	2.00	1	4.00	5.00
75	30	0.00	1	0.00	1.00
76	30	0.00	1	0.00	1.00
77	30	0.00	1	0.00	1.00
78	29	1.00	1	1.00	2.00

79	29	0.00	1	0.00	1.00
80	25	4.00	1	16.00	17.00
81	25	0.00	1	0.00	1.00
82	24	1.00	1	1.00	2.00
83	24	0.00	1	0.00	1.00
84	24	0.00	1	0.00	1.00
85	24	0.00	1	0.00	1.00
86	24	0.00	1	0.00	1.00
87	24	0.00	1	0.00	1.00
88	22	2.00	1	4.00	5.00
89	22	0.00	1	0.00	1.00
90	20	2.00	1	4.00	5.00

T **1.416193**

*OK, 28th July, 2017 I recalculated all Julieta's data and got these TIs for straight hypoteneuses and

Reps	Straight	Curved	Ratio
1	4.146757548	6.513711517	**1.570796**
2	1.503317816	2.361406101	**1.570796**
3	5.95607406	9.355779245	**1.570796**
4	5.0978035	8.007611004	**1.570796**
5	2.724261132	4.279259375	**1.570796**
6	4.893820386	7.687195078	**1.570796**
7	8.478098704	13.31736629	**1.570796**
8	7.794378391	12.24338093	**1.570796**
9	3.498022711	5.49468122	**1.570796**
10	1.706685434	2.680855208	**1.570796**
11	4.350964155	6.834478504	**1.570796**
Tot	50.15018384	78.77572447	
Mean	**4.559107622**	**7.161429497**	**1.570796**
Mean mean		3.58	

Reps	Julieta's means 18th July
1	1.27
2	1.28
3	1.37
4	1.15
5	1.35
6	1.36
7	1.29
8	1.6
Tot	10.67
Mean	**1.33375**

calculations and Julieta data file appended at the bottom.
, that are my calculations and additions. RJB September, 2018. Zama, Japan.

rugged_lsd	rugged_pc [%	land_area [1000	lat	lon	soil [% Fertile soil]
0.144	0	18	12.508	-69.97	21.324
0.72	39.004	65209	33.833	66.026	27.849
0.228	4.906	124670	-12.299	17.551	26.676
0.006	0	9	18.231	-63.064	100
1.006	62.133	2740	41.143	20.07	68.088
1.616	99.064	47	42.551	1.576	0
0.08	0	80	12.725	-68.157	24.595
0.191	6.142	8360	23.913	54.331	0
0.226	9.407	273669	-35.396	-65.17	35.678
0.799	50.556	2820	40.294	44.938	30.148
0.792	44.303	20	-14.2	-170.388	100
0.003	0	44	17.271	-61.8	100
0.045	0.685	768230	-25.733	134.487	14.248
1.008	54.307	8245	47.589	14.14	55.098
0.49	27.713	8260.5	40.288	47.528	60.957
0.5	27.519	2568	-3.365	29.887	24.049
0.109	0.178	3023	50.642	4.661	48.967
0.045	0.014	11062	9.65	2.339	74.973
0.066	0.051	27360	12.274	-1.747	56.909
0.053	1.817	13017	23.848	90.27	41.883
0.427	20.196	11063	42.765	25.239	82.101
0.063	0	71	26.025	50.565	0
0.017	0	1001	24.255	-76.61	13.924
0.665	40.253	5120	44.175	17.784	76.888
0.046	0	20748	53.542	28.054	50.611
0.174	6.568	2281	17.205	-88.687	35.49
0.006	0	5	32.31	-64.772	20
0.258	13.57	108438	-16.71	-64.662	31.807
0.076	0.558	845942	-10.775	-53.085	18.783
0.289	3.823	43	13.167	-59.555	30.588
0.162	5.089	527	4.521	114.748	62.29
1.962	96.475	4700	27.417	90.435	66.365
0.048	0.301	56673	-22.189	23.814	15.249
0.06	0.033	62300	6.574	20.487	10.967
0.23	9.122	909351	61.495	-98.334	16.794
0.005	0	1	-12.122	96.867	0
1.388	66.06	4000	46.806	8.226	39.341
0.731	38.199	74880	-37.937	-71.384	22.158
0.537	28.648	932748	36.564	103.836	22.836
0.069	0.493	31800	7.623	-5.554	26.151
0.157	4.031	46540	5.697	12.743	27.829
0.126	2.763	226705	-2.879	23.658	16.001
0.049	0.243	34150	-0.831	15.246	4.063
0.3	14.999	24	-19.213	-158.978	25
0.277	14.366	110950	3.838	-72.866	30.444
1.063	64.479	186.1	-11.888	43.671	56.043
0.759	40.048	403	15.942	-23.981	11.663

0.623	36.61	5106	9.969	-84.199	52.082
0.153	6.129	10982	21.626	-79.018	45.947
0.403	14.025	13.5	-10.488	105.643	0
0.028	0	26	19.414	-80.926	100
0.706	44.072	924	35.049	33.235	26.866
0.252	4.154	7727	49.739	15.334	88.653
0.168	3.001	34877	51.11	10.392	61.338
0.627	39.024	2318	11.735	42.58	0
0.001	0	75	15.427	-61.356	36.405
0.054	0	4243	55.987	10.027	56.165
0.484	26.179	4838	18.895	-70.493	39.479
0.14	4.885	238174	28.168	2.647	9.59
0.405	20.09	27684	-1.434	-78.77	44.308
0.186	5.764	99545	26.562	29.782	0.007
0.658	37.141	10100	15.365	38.848	20.146
0.057	0.202	26600	24.674	-13.138	0
0.472	23.372	49900	40.231	-3.644	64.134
0.035	0	4239	58.673	25.549	62.517
0.443	20.128	100000	8.622	39.636	46.128
0.092	0.137	30459	64.481	26.24	2.097
0.421	14.011	1827	-17.447	161.988	98.293
0.083	0.786	1217	-51.745	-59.382	0
0.313	12.07	55010	46.56	2.551	59.939
0.665	39.927	140	62.073	-6.885	0
0.423	17.095	70	6.674	157.754	32.857
0.07	0.434	25767	-0.623	11.784	11.978
0.175	3.643	24269	54.15	-2.901	48.239
1.067	59.17	6949	42.179	43.513	34.021
0.071	0.371	22754	7.963	-1.208	65.738
1.728	100	1	36.139	-5.348	0
0.213	3.952	24572	10.435	-10.939	17.761
0.359	21.296	169	16.28	-61.601	76.5
0.091	0	1000	13.447	-15.388	81.699
0.123	0.098	2812	12.013	-14.987	43.253
0.177	5.54	2805	1.703	10.335	6.829
0.867	52.841	12890	39.043	22.989	48.588
0.606	39.913	34	12.157	-61.654	67.646
0.131	4.252	217500	74.728	-41.345	0
0.538	30.85	10843	15.697	-90.356	58.058
0.065	0.109	8815	3.93	-53.233	18.394
0.215	1.498	54	13.44	144.776	22.222
0.089	0.36	19685	4.794	-58.976	19.594
0.698	51.197	110	22.381	114.134	96.076
0.631	39.971	11189	14.822	-86.6	55.945
0.366	17.588	5592	45.026	16.419	48.395
0.697	42.462	2756	18.936	-72.686	42.05
0.098	0.921	8962	47.166	19.418	65.095
0.304	13.405	181157	-2.226	117.277	43.306
0.295	12.824	297319	22.876	79.627	51.042
0.006	0	8	-6.845	72.187	0

0.158	2.864	6889	53.181	-8.153	59.095
0.651	33.616	162855	32.56	54.305	21.824
0.175	5.572	43737	33.051	43.765	7.912
0.435	20.729	10025	64.99	-18.594	3.403
0.439	23.277	2164	31.353	34.967	27.477
0.711	38.884	29411	42.789	12.075	51.78
0.528	24.278	1083	18.156	-77.311	66.97
0.282	12.165	8824	31.25	36.788	15.479
0.604	37.173	36450	37.54	137.963	42.879
0.108	2.913	269970	48.18	67.313	9.877
0.195	5.427	56914	0.534	37.861	33.657
1.246	69.767	19180	41.464	74.556	12.534
0.154	6.094	17652	12.707	104.921	22.213
0.003	0	81	0.699	-46.958	45.679
0.003	0	26	17.274	-62.704	100
0.546	33.976	9873	36.356	127.806	43.556
0.063	0	1782	29.354	47.613	0
0.723	49.807	23080	18.495	103.774	12.068
1.103	71.642	1023	33.922	35.897	72.415
0.083	0.459	9632	6.448	-9.307	15.82
0.105	1.535	175954	27.041	18.029	2.756
0.59	35.476	61	13.894	-60.965	32.527
1.554	76.379	16	47.145	9.554	0
0.197	7.786	6463	7.63	80.701	51.595
1.559	90.249	3035	-29.58	28.254	54.695
0.049	0	6268	55.336	23.905	62.064
0.242	1.654	259	49.778	6.095	25.662
0.044	0	6205	56.854	24.931	77.568
0.185	4.168	3	22.169	113.555	0
0.629	36.083	44630	31.882	-6.302	43.968
2.106	100	0	43.753	7.422	0
0.222	0.403	3288	47.205	28.468	62.015
0.328	12.672	58154	-19.379	46.7	50.804
0.004	0	30	3.566	73.215	30
0.491	27.341	194395	23.941	-102.536	31.934
0.004	0	18	8.027	169.168	50
0.783	49.405	2543	41.6	21.701	52.895
0.042	0.228	122019	17.355	-3.524	18.562
0.381	14.699	32	35.925	14.407	100
0.577	34.731	65755	21.123	96.514	25.529
0.309	12.623	156650	46.836	103.07	44.883
0.504	25.44	46	15.8	145.63	4.13
0.17	4.54	78638	-17.264	35.549	55.384
0.034	0.278	103070	20.264	-10.336	2.042
1.027	69.921	10	16.736	-62.193	0
0.378	11.619	106	14.649	-61.021	61.658
0.283	9.101	203	-20.131	57.879	52.217
0.3	10.542	9408	-13.216	34.301	32.281
0.316	12.87	32855	3.791	109.709	49.196
0.72	42.602	37.4	-12.82	45.143	50.771

0.235	9.723	82329	-22.14	17.219	25.173
0.492	24.913	1828	-21.299	165.663	54.444
0.051	0.245	126670	17.424	9.401	8.236
0.351	12.248	4	-29.027	167.956	0
0.093	1.563	91077	9.585	8.092	56.263
0.286	11.923	12140	12.841	-85.033	33.249
0.055	0	26	-19.05	-169.86	26.923
0.012	0	3388	52.25	5.621	41.165
0.692	37.013	30428	64.467	14.082	0.073
1.493	75.265	14300	28.264	83.931	41.622
0.089	0	2	-0.641	167.801	0
0.606	31.49	26771	-41.806	171.478	44.643
0.283	12.216	30950	20.595	56.104	0
0.559	25.078	77088	29.97	69.395	6.988
0.457	22.956	7443	8.513	-80.109	42.843
0.104	7.424	4.7	-24.431	-128.445	0
0.427	20.01	128000	-9.173	-74.361	21.743
0.583	34.183	29817	11.739	122.868	80.137
0.148	0	46	7.801	135.16	13.043
0.491	25.222	45286	-6.476	145.252	46.833
0.084	1.2	30436	52.124	19.401	48.41
0.416	19.25	887	18.225	-66.464	59.186
0.71	52.428	12041	40.143	127.174	24.281
0.369	15.522	9150	39.593	-8.531	34.264
0.067	0.224	39730	-23.245	-58.393	28.751
0.706	54.906	602	31.914	35.207	62.369
0.645	40.29	366	-15.346	-145.232	6.284
0.047	0	1100	25.293	51.199	0
1.208	67.425	250	-21.121	55.54	16.4
0.357	16.71	22971	45.843	24.986	69.642
0.267	11.412	1638134	61.99	96.711	17.718
0.855	64.627	2467	-2.003	29.923	42.97
0.231	8.891	214969	24.097	44.562	0
0.48	27.128	10200	43.866	20.599	67.976
0.116	2.891	237600	13.887	30.09	19.8
0.065	0.168	19253	14.361	-14.474	60.496
0.005	0	67	1.361	103.82	3.488
1.205	72.252	39	-25.656	-10.466	10.256
0.464	24.247	0	78.845	18.31	0
0.476	21.213	2799	-8.895	159.601	80.002
0.144	1.943	7162	8.561	-11.791	7.546
0.518	26.108	2072	13.724	-88.869	65.938
0.522	14.144	6	43.944	12.459	0
0.17	6.914	62734	6.061	45.867	7.535
0.247	2.892	23	46.936	-56.323	0
0.71	42.127	96	0.446	6.727	88.013
0.096	0.743	15600	4.133	-55.911	22.425
0.442	23.419	4810	48.707	19.487	60.924
0.711	39.108	2014	46.112	14.823	67.604
0.207	3.868	41033	62.777	16.759	15.853

0.775	54.481	1720	-26.565	31.501	54.413
1.278	54.101	46	-6.723	51.924	13.043
0.198	6.63	18378	35.014	38.498	52.909
0.003	0	43	21.75	-71.856	0
0.112	3.605	125920	15.365	18.667	19.262
0.088	0.981	5439	8.528	0.977	56.646
0.302	16.408	51089	15.107	101.018	20.144
1.54	75.473	13996	38.527	71.038	17.449
0	0	1	-9.088	-171.83	0
0.082	1.426	46993	39.194	59.178	3.97
0.584	28.298	1487	-8.827	125.858	64.979
0.224	9.737	72	-19.859	-174.847	100
0.184	5.099	513	10.469	-61.257	50.384
0.198	7.434	15536	34.12	9.579	31.727
0.732	40.909	76963	39.061	35.174	65.295
0.008	0	3	-7.414	178.052	66.667
1.032	56.543	3615	23.752	120.953	9.843
0.201	5.346	88580	-6.266	34.826	39.711
0.251	8.765	19710	1.282	32.388	13.095
0.117	1.988	57935	49.009	31.411	69.003
0.001	0	0	7.141	-153.655	0
0.114	0.136	17502	-32.802	-56.013	68.979
0.304	14.317	916192	45.718	-112.982	41.6
0.154	5.782	42540	41.633	63.341	11.72
0.126	0	0	41.904	12.451	100
0.892	61.286	39	13.185	-61.205	38.818
0.202	5.994	88205	7.132	-66.153	21.567
0.34	19.147	15	18.511	-64.518	100
0.395	17.088	35	17.985	-64.805	100
0.583	36.775	31106	16.643	106.306	12.15
0.545	24.993	1219	-16.196	167.703	79.892
0.4	24.238	14	-13.829	-177.194	42.857
0.549	22.244	283	-13.738	-172.168	100
0.591	33.06	52797	15.863	47.58	0
0.45	23.957	121447	-29.004	25.094	27.647
0.145	2.455	74339	-13.458	27.794	23.114
0.306	13.837	38685	-19	29.869	54.877
rugged_lsd	rugged_pc	land_area	lat	lon	soil
%		13,193,676			36.70
		1,000 ha		Tot area	4,842,079

ope (%). As another alternative ruggedness measure, using the same GTOPO30 elevation data, we c
ise (height)/run (base) **% Fertile soil**. On t
4m per meter or rise of 4 cm giving extra hypoteneuse (area) by about 0.08%
% has 4 cm rise per metre and the hypoteneuse is just extra 0.08 cm, or the extra 0.08%.
add to the land area is 0.08%!!!
30 arc-seconds = ca. 1 km so is probably underestimation of undulations in each km.

out 6.3%
6.3 cm per metre with hypotenuse just an extra 0.2 cm or 0.2%.

all countries area by their % slope as it is expressed in the actual increase in hypoteneuse %....

rugged_lsd	rugged_pc	land_area	area x (slope/10C	Tot area	% Diff
0.144	0	18	0.22068	18.22068	1.211151285
0.72	39.004	65209	4834.59526	70043.59526	6.902265999
0.228	4.906	124670	2834.9958	127504.9958	2.223438997
0.006	0	9	0.00234	9.00234	0.025993242
1.006	62.133	2740	286.3574	3026.3574	9.462114422
1.616	99.064	47	8.35378	55.35378	15.09161615
0.08	0	80	0.544	80.544	0.675407231
0.191	6.142	8360	176.5632	8536.5632	2.068317142
0.226	9.407	273669	6206.81292	279875.8129	2.217702507
0.799	50.556	2820	230.6196	3050.6196	7.559762613
0.792	44.303	20	1.4064	21.4064	6.569997758
0.003	0	44	0.00528	44.00528	0.01199856
0.045	0.685	768230	3111.3315	771341.3315	0.403366366
1.008	54.307	8245	914.78275	9159.78275	9.986948107
0.49	27.713	8260.5	419.6334	8680.1334	4.834411877
0.5	27.519	2568	121.23528	2689.23528	4.508169326
0.109	0.178	3023	37.45497	3060.45497	1.223836664
0.045	0.014	11062	41.70374	11103.70374	0.375584048
0.066	0.051	27360	174.5568	27534.5568	0.633955365
0.053	1.817	13017	65.34534	13082.34534	0.499492547
0.427	20.196	11063	497.61374	11560.61374	4.304388601
0.063	0	71	0.44517	71.44517	0.623093206
0.017	0	1001	1.44144	1002.44144	0.143792938
0.665	40.253	5120	362.24	5482.24	6.607518095
0.046	0	20748	112.0392	20860.0392	0.537099662
0.174	6.568	2281	36.86096	2317.86096	1.59030074
0.006	0	5	0.0015	5.0015	0.029991003
0.258	13.57	108438	2540.70234	110978.7023	2.289360288
0.076	0.558	845942	5532.46068	851474.4607	0.649750631
0.289	3.823	43	1.10983	44.10983	2.516060479
0.162	5.089	527	7.19882	534.19882	1.347591895
1.962	96.475	4700	908.275	5608.275	16.19526503
0.048	0.301	56673	276.56424	56949.56424	0.485630125
0.06	0.033	62300	328.944	62628.944	0.525226802
0.23	9.122	909351	24507.00945	933858.0095	2.624275768
0.005	0	1	0.00031	1.00031	0.030990393
1.388	66.06	4000	599.96	4599.96	13.04272211
0.731	38.199	74880	5514.912	80394.912	6.859777395
0.537	28.648	932748	51235.84764	983983.8476	5.206980558
0.069	0.493	31800	188.892	31988.892	0.590492475
0.157	4.031	46540	639.4596	47179.4596	1.355377118
0.126	2.763	226705	2668.31785	229373.3179	1.163307866
0.049	0.243	34150	138.649	34288.649	0.404358305
0.3	14.999	24	0.63384	24.63384	2.573045859
0.277	14.366	110950	2636.172	113586.172	2.320856451
1.063	64.479	186.1	16.840189	202.940189	8.298104522
0.759	40.048	403	26.20306	429.20306	6.10504967
0.623	36.61	5106	291.45048	5397.45048	5.399780527

0.153	6.129	10982	159.01936	11141.01936	1.427332229
0.403	14.025	13.5	0.469395	13.969395	3.360166994
0.028	0	26	0.06162	26.06162	0.236439638
0.706	44.072	924	72.69108	996.69108	7.29324075
0.252	4.154	7727	219.83315	7946.83315	2.766298799
0.168	3.001	34877	664.75562	35541.75562	1.870351108
0.627	39.024	2318	148.72288	2466.72288	6.029168546
0.001	0	75	0.00375	75.00375	0.00499975
0.054	0	4243	25.92473	4268.92473	0.607289461
0.484	26.179	4838	217.4681	5055.4681	4.301641227
0.14	4.885	238174	3441.6143	241615.6143	1.424417172
0.405	20.09	27684	953.99064	28637.99064	3.33120662
0.186	5.764	99545	1991.89545	101536.8955	1.961745473
0.658	37.141	10100	672.963	10772.963	6.246777233
0.057	0.202	26600	150.29	26750.29	0.561825685
0.472	23.372	49900	2525.938	52425.938	4.818107403
0.035	0	4239	17.54946	4256.54946	0.412293107
0.443	20.128	100000	4193	104193	4.024262666
0.092	0.137	30459	366.11718	30825.11718	1.187723563
0.421	14.011	1827	68.01921	1895.01921	3.589367835
0.083	0.786	1217	10.45403	1227.45403	0.851684034
0.313	12.07	55010	1873.6406	56883.6406	3.293812738
0.665	39.927	140	11.501	151.501	7.591369034
0.423	17.095	70	2.527	72.527	3.48421967
0.07	0.434	25767	150.22161	25917.22161	0.579620811
0.175	3.643	24269	455.77182	24724.77182	1.843381299
1.067	59.17	6949	782.31842	7731.31842	10.11882292
0.071	0.371	22754	136.75154	22890.75154	0.597409568
1.728	100	1	0.21453	1.21453	17.66362297
0.213	3.952	24572	483.82268	25055.82268	1.930979023
0.359	21.296	169	5.4587	174.4587	3.128935387
0.091	0	1000	9.15	1009.15	0.906703661
0.123	0.098	2812	36.61224	2848.61224	1.285265839
0.177	5.54	2805	40.64445	2845.64445	1.428303877
0.867	52.841	12890	1181.4974	14071.4974	8.396387154
0.606	39.913	34	1.9227	35.9227	5.352325967
0.131	4.252	217500	3366.9	220866.9	1.524402253
0.538	30.85	10843	530.54799	11373.54799	4.664753606
0.065	0.109	8815	48.1299	8863.1299	0.543035029
0.215	1.498	54	0.9855	54.9855	1.792290695
0.089	0.36	19685	146.4564	19831.4564	0.738505519
0.698	51.197	110	7.3612	117.3612	6.272260338
0.631	39.971	11189	651.64736	11840.64736	5.503477472
0.366	17.588	5592	214.84464	5806.84464	3.699851698
0.697	42.462	2756	177.70688	2933.70688	6.057417706
0.098	0.921	8962	97.6858	9059.6858	1.078247107
0.304	13.405	181157	4686.53159	185843.5316	2.521762017
0.295	12.824	297319	8449.80598	305768.806	2.763462399
0.006	0	8	0.00296	8.00296	0.036986315
0.158	2.864	6889	115.45964	7004.45964	1.648373264

0.651	33.616	162855	11337.9651	174192.9651	6.508853612
0.175	5.572	43737	839.31303	44576.31303	1.882867768
0.435	20.729	10025	533.1295	10558.1295	5.049469227
0.439	23.277	2164	104.04512	2268.04512	4.587436074
0.711	38.884	29411	2207.58966	31618.58966	6.981935892
0.528	24.278	1083	52.38471	1135.38471	4.613829087
0.282	12.165	8824	274.8676	9098.8676	3.020898996
0.604	37.173	36450	2287.2375	38737.2375	5.90449306
0.108	2.913	269970	3164.0484	273134.0484	1.158423279
0.195	5.427	56914	1013.63834	57927.63834	1.749835431
1.246	69.767	19180	2513.539	21693.539	11.58657884
0.154	6.094	17652	250.83492	17902.83492	1.401090504
0.003	0	81	0.01701	81.01701	0.020995591
0.003	0	26	0.00312	26.00312	0.01199856
0.546	33.976	9873	573.32511	10446.32511	5.488294725
0.063	0	1782	12.31362	1794.31362	0.686257958
0.723	49.807	23080	1610.0608	24690.0608	6.521088842
1.103	71.642	1023	123.18966	1146.18966	10.74775531
0.083	0.459	9632	66.9424	9698.9424	0.690203089
0.105	1.535	175954	1977.72296	177931.723	1.111506665
0.59	35.476	61	3.56301	64.56301	5.518655342
1.554	76.379	16	2.7488	18.7488	14.66120498
0.197	7.786	6463	110.64656	6573.64656	1.683183892
1.559	90.249	3035	534.00825	3569.00825	14.96237085
0.049	0	6268	36.22904	6304.22904	0.574678359
0.242	1.654	259	7.36596	266.36596	2.765353351
0.044	0	6205	32.3901	6237.3901	0.51928931
0.185	4.168	3	0.05763	3.05763	1.884793124
0.629	36.083	44630	3058.4939	47688.4939	6.413483945
2.106	100	0	0	0	0
0.222	0.403	3288	83.08776	3371.08776	2.464716611
0.328	12.672	58154	1852.2049	60006.2049	3.086688957
0.004	0	30	0.0072	30.0072	0.023994241
0.491	27.341	194395	9321.24025	203716.2403	4.575599981
0.004	0	18	0.00594	18.00594	0.032989114
0.783	49.405	2543	208.2717	2751.2717	7.570015713
0.042	0.228	122019	479.53467	122498.5347	0.391461556
0.381	14.699	32	1.37344	33.37344	4.115368389
0.577	34.731	65755	3627.70335	69382.70335	5.228541372
0.309	12.623	156650	5250.908	161900.908	3.243285084
0.504	25.44	46	2.10312	48.10312	4.372107256
0.17	4.54	78638	1299.88614	79937.88614	1.626120233
0.034	0.278	103070	317.4556	103387.4556	0.307054273
1.027	69.921	10	0.9256	10.9256	8.47184594
0.378	11.619	106	3.50966	109.50966	3.204886217
0.283	9.101	203	4.94508	207.94508	2.37807021
0.3	10.542	9408	259.56672	9667.56672	2.684922975
0.316	12.87	32855	881.8282	33736.8282	2.613844416
0.72	42.602	37.4	2.172566	39.572566	5.490081184
0.235	9.723	82329	2049.16881	84378.16881	2.428553308

0.492	24.913	1828	79.29864	1907.29864	4.157641511
0.051	0.245	126670	609.2827	127279.2827	0.478697465
0.351	12.248	4	0.13064	4.13064	3.162706021
0.093	1.563	91077	758.67141	91835.67141	0.826118433
0.286	11.923	12140	324.2594	12464.2594	2.601513572
0.055	0	26	0.12272	26.12272	0.469782626
0.012	0	3388	3.65904	3391.65904	0.107883486
0.692	37.013	30428	2591.24848	33019.24848	7.847690663
1.493	75.265	14300	2067.494	16367.494	12.6317077
0.089	0	2	0.01562	2.01562	0.774947659
0.606	31.49	26771	1668.63643	28439.63643	5.867291708
0.283	12.216	30950	932.214	31882.214	2.923931192
0.559	25.078	77088	4367.0352	81455.0352	5.361283301
0.457	22.956	7443	307.24704	7750.24704	3.964351567
0.104	7.424	4.7	0.050149	4.750149	1.055735304
0.427	20.01	128000	4675.84	132675.84	3.524258825
0.583	34.183	29817	1618.46676	31435.46676	5.14853739
0.148	0	46	0.59478	46.59478	1.276494921
0.491	25.222	45286	1909.71062	47195.71062	4.046364797
0.084	1.2	30436	289.44636	30725.44636	0.942041188
0.416	19.25	887	34.84136	921.84136	3.779539681
0.71	52.428	12041	924.86921	12965.86921	7.133106119
0.369	15.522	9150	360.2355	9510.2355	3.787871499
0.067	0.224	39730	270.5613	40000.5613	0.676393759
0.706	54.906	602	47.72054	649.72054	7.344779342
0.645	40.29	366	20.63142	386.63142	5.336198491
0.047	0	1100	5.423	1105.423	0.490581434
1.208	67.425	250	26.6425	276.6425	9.63066051
0.357	16.71	22971	919.98855	23890.98855	3.850776405
0.267	11.412	1638134	53698.03252	1691832.033	3.173957668
0.855	64.627	2467	215.81316	2682.81316	8.044285872
0.231	8.891	214969	5404.32066	220373.3207	2.452347972
0.48	27.128	10200	524.688	10724.688	4.892338127
0.116	2.891	237600	2817.936	240417.936	1.172098907
0.065	0.168	19253	124.56691	19377.56691	0.64284082
0.005	0	67	0.02412	67.02412	0.035987045
1.205	72.252	39	4.36098	43.36098	10.05738339
0.464	24.247	0	0	0	0
0.476	21.213	2799	115.06689	2914.06689	3.948670169
0.144	1.943	7162	94.32354	7256.32354	1.299880573
0.518	26.108	2072	98.33712	2170.33712	4.530960609
0.522	14.144	6	0.32982	6.32982	5.210574708
0.17	6.914	62734	1073.37874	63807.37874	1.682217263
0.247	2.892	23	0.56741	23.56741	2.407604399
0.71	42.127	96	5.75136	101.75136	5.65236671
0.096	0.743	15600	127.14	15727.14	0.808411447
0.442	23.419	4810	242.5683	5052.5683	4.800891064
0.711	39.108	2014	155.33982	2169.33982	7.160695552
0.207	3.868	41033	1038.1349	42071.1349	2.467570467
0.775	54.481	1720	147.4728	1867.4728	7.896918231

1.278	54.101	46	5.11934	51.11934	10.01448767
0.198	6.63	18378	399.53772	18777.53772	2.12774287
0.003	0	43	0.00559	43.00559	0.01299831
0.112	3.605	125920	1429.192	127349.192	1.122262323
0.088	0.981	5439	40.52055	5479.52055	0.739490794
0.302	16.408	51089	1443.77514	52532.77514	2.748332134
1.54	75.473	13996	2236.00096	16232.00096	13.77526385
0	0	1	0	1	0
0.082	1.426	46993	391.92162	47384.92162	0.82710197
0.584	28.298	1487	74.36487	1561.36487	4.762811783
0.224	9.737	72	1.43424	73.43424	1.95309436
0.184	5.099	513	8.26443	521.26443	1.585458267
0.198	7.434	15536	322.99344	15858.99344	2.036657883
0.732	40.909	76963	5982.33399	82945.33399	7.21238158
0.008	0	3	0.00165	3.00165	0.054969767
1.032	56.543	3615	353.72775	3968.72775	8.912875165
0.201	5.346	88580	1606.8412	90186.8412	1.781680319
0.251	8.765	19710	477.7704	20187.7704	2.36663282
0.117	1.988	57935	763.00395	58698.00395	1.299880573
0.001	0	0	0	0	0
0.114	0.136	17502	224.55066	17726.55066	1.266747628
0.304	14.317	916192	31003.93728	947195.9373	3.273233769
0.154	5.782	42540	675.9606	43215.9606	1.564145724
0.126	0	0	0	0	0
0.892	61.286	39	3.27639	42.27639	7.749928506
0.202	5.994	88205	1513.5978	89718.5978	1.687050218
0.34	19.147	15	0.46965	15.46965	3.035944575
0.395	17.088	35	1.2782	36.2782	3.523328059
0.583	36.775	31106	1742.86918	32848.86918	5.305720481
0.545	24.993	1219	57.40271	1276.40271	4.497225644
0.4	24.238	14	0.4907	14.4907	3.38630984
0.549	22.244	283	13.14252	296.14252	4.43790375
0.591	33.06	52797	3249.65535	56046.65535	5.798125383
0.45	23.957	121447	6001.91074	127448.9107	4.709267977
0.145	2.455	74339	1057.10058	75396.10058	1.402062669
0.306	13.837	38685	1250.2992	39935.2992	3.130812151

rugged_lsd	rugged_pc	land_area		Tot area	Mean
%		13,193,676	369,512	13,563,189	3.55
		1,000 ha		**2.72**	Diff %

4 and total land a circle, what is extra land?

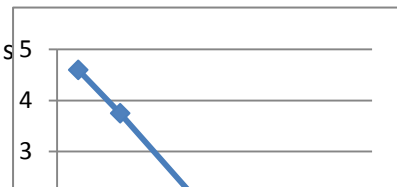
ı? 1,400,000,000 ha

ı degree?

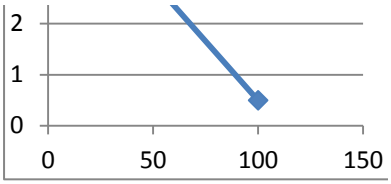
rees

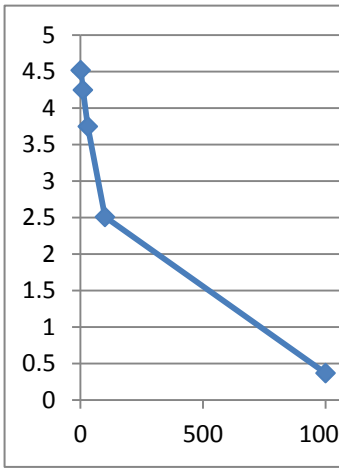
Africa	30 million km2 or 3,000,000,000			
Total land	148,940,000 km2		or	14,894,000,000

Res	Ying s
1	
10	4.6
30	3.75



			100	0.5
Ying say %	Resolution m	% inc land surfa	1100	0
	1	4.52	Diff check	
	10	4.25		
4.6	30	3.75		2.49
3.75	100	2.51		3.00
	1000	0.37		0.00
0.5	10000	0		2.60
0				





diff %	diff check
1.19	
1.0119073	1.19073018

levant for quadrats.

Hypotenuse	True area	diff %	
3.518	12.1850	1.54	**At O840 i calculate that country land area totals give 0**
	12.1850		

culations

Hypotenuse	True area	diff %
22.8363	404.763262	1.19

Hypotenuse	True area	diff %	
22.8363	409.5829	2.40	
	409.570821	2.39	Ditto (-ish due to pi points..)

		Diff %
340	70%	
375.7	10.50%	
381.41	1.50%	90.71

dex in original table above

degree (180/pi)			sqrt = base	pi/180
57.29578	15	2.23	3.872983346	0.01745
45				

Area Gha	degree (180/	sqrt = base	pi/180	sum	sec
0.000018	0.70241107	0.004242641	0.01745	0.012257073	1.000075123
0.065209	4.24015148	0.255360529	0.01745	0.073990643	1.002743566
0.12467	1.30268153	0.353086392	0.01745	0.022731793	1.000258423
0.000009	0.0148969	0.003	0.01745	0.000259951	1.000000034
0.00274	5.96632281	0.052345009	0.01745	0.104112333	1.005444275
0.000047	10.0784999	0.006855655	0.01745	0.175869823	1.015666944
0.00008	0.3896053	0.008944272	0.01745	0.006798612	1.000023111
0.00836	1.209907	0.091433036	0.01745	0.021112877	1.000222918
0.273669	1.29924555	0.523133826	0.01745	0.022671835	1.000257061
0.00282	4.67524478	0.053103672	0.01745	0.081583021	1.003337149
0.00002	4.02241782	0.004472136	0.01745	0.070191191	1.002468469
0.000044	0.00687549	0.00663325	0.01745	0.000119977	1.000000007
0.76823	0.23204664	0.876487307	0.01745	0.004049214	1.000008198
0.008245	6.33107322	0.090801982	0.01745	0.110477228	1.006133799
0.0082605	2.90812573	0.090887293	0.01745	0.050746794	1.001289002
0.002568	2.70292689	0.050675438	0.01745	0.047166074	1.001113351
0.003023	0.70985839	0.054981815	0.01745	0.012387029	1.000076724
0.011062	0.21600407	0.105176043	0.01745	0.003769271	1.000007104
0.02736	0.36554212	0.165408585	0.01745	0.00637871	1.000020344
0.013017	0.2876224	0.114092068	0.01745	0.005019011	1.000012595
0.011063	2.57542825	0.105180797	0.01745	0.044941223	1.001010707
0.000071	0.35923983	0.00842615	0.01745	0.006268735	1.000019649
0.001001	0.08250587	0.031638584	0.01745	0.001439727	1.000001036
0.00512	4.04693303	0.071554175	0.01745	0.070618981	1.002498712
0.020748	0.3093942	0.144041661	0.01745	0.005398929	1.000014574
0.002281	0.92581922	0.047759816	0.01745	0.016155545	1.000130515
0.000005	0.01718873	0.002236068	0.01745	0.000299943	1.000000045
0.108438	1.34219456	0.329299256	0.01745	0.023421295	1.000274341
0.845942	0.37470906	0.919751053	0.01745	0.006538673	1.000021378
0.000043	1.47847584	0.006557439	0.01745	0.025799403	1.000332897
0.000527	0.78261168	0.022956481	0.01745	0.013656574	1.000093258
0.0047	10.9375828	0.068556546	0.01745	0.19086082	1.018494539
0.056673	0.27960119	0.238060917	0.01745	0.004879041	1.000011903
0.0623	0.30251891	0.249599679	0.01745	0.005278955	1.000013934
0.909351	1.5437476	0.953598972	0.01745	0.026938396	1.000362948
0.000001	0.01776169	0.001	0.01745	0.000309942	1.000000048
0.004	8.53020533	0.063245553	0.01745	0.148852083	1.011181678

0.07488	4.21222902	0.273642102	0.01745	0.073503396	1.002707469
0.932748	3.1440975	0.965788797	0.01745	0.054864501	1.001506947
0.0318	0.34033293	0.178325545	0.01745	0.00593881	1.000017635
0.04654	0.78719448	0.215731314	0.01745	0.013736544	1.000094354
0.226705	0.67434019	0.476135485	0.01745	0.011767236	1.000069238
0.03415	0.23261959	0.184797186	0.01745	0.004059212	1.000008239
0.000024	1.51282989	0.004898979	0.01745	0.026398882	1.000348552
0.11095	1.36109164	0.333091579	0.01745	0.023751049	1.000282122
0.0001861	5.17061273	0.013641847	0.01745	0.090227192	1.004084326
0.000403	3.7201351	0.02007486	0.01745	0.064916357	1.002110773
0.005106	3.26689821	0.07145628	0.01745	0.057007374	1.001627124
0.010982	0.82958492	0.104795038	0.01745	0.014476257	1.00010479
0.0000135	1.99137204	0.003674235	0.01745	0.034749442	1.000604066
0.000026	0.13579074	0.00509902	0.01745	0.002369548	1.000002807
0.000924	4.49819455	0.030397368	0.01745	0.078493495	1.003088543
0.007727	1.62962536	0.087903356	0.01745	0.028436963	1.000404467
0.034877	1.09192535	0.186753849	0.01745	0.019054097	1.000181557
0.002318	3.67106544	0.048145612	0.01745	0.064060092	1.002055362
0.000075	0.00286479	0.008660254	0.01745	4.99906E-05	1.000000001
0.004243	0.35007286	0.065138314	0.01745	0.006108771	1.000018659
0.004838	2.57371285	0.069555733	0.01745	0.044911289	1.00100936
0.238174	0.8278664	0.488030737	0.01745	0.014446269	1.000104356
0.027684	1.9736316	0.166385095	0.01745	0.034439871	1.000593346
0.099545	1.14633558	0.315507528	0.01745	0.020003556	1.000200104
0.0101	3.81198331	0.100498756	0.01745	0.066519109	1.002216482
0.0266	0.32371771	0.163095064	0.01745	0.005648874	1.000015955
0.0499	2.89783895	0.223383079	0.01745	0.05056729	1.001279889
0.004239	0.23720317	0.065107603	0.01745	0.004139195	1.000008567
0.1	2.40100563	0.316227766	0.01745	0.041897548	1.000878345
0.030459	0.68866211	0.17452507	0.01745	0.012017154	1.00007221
0.001827	2.13213715	0.042743421	0.01745	0.037205793	1.000692535
0.001217	0.49215865	0.034885527	0.01745	0.008588168	1.000036879
0.05501	1.95074016	0.234542107	0.01745	0.034040416	1.000579655
0.00014	4.69630275	0.01183216	0.01745	0.081950483	1.003367363
0.00007	2.06747985	0.0083666	0.01745	0.036077523	1.000651147
0.025767	0.33403061	0.160521027	0.01745	0.005828834	1.000016988
0.024269	1.07588828	0.155785108	0.01745	0.01877425	1.000176262
0.006949	6.42331312	0.083360662	0.01745	0.112086814	1.006314779
0.022754	0.34434349	0.150844291	0.01745	0.006008794	1.000018053
0.000001	12.1081386	0.001	0.01745	0.211287018	1.022743972
0.024572	1.12800815	0.156754585	0.01745	0.019683742	1.000193756
0.000169	1.85001051	0.013	0.01745	0.032282683	1.000521312
0.001	0.52424176	0.031622777	0.01745	0.009148019	1.000041845
0.002812	0.74594891	0.053028294	0.01745	0.013016808	1.000084725
0.002805	0.83015776	0.052962251	0.01745	0.014486253	1.000104935
0.01289	5.23709732	0.113534136	0.01745	0.091387348	1.004190404
0.000034	3.23662915	0.005830952	0.01745	0.056479179	1.001597071
0.2175	0.88686784	0.466368953	0.01745	0.015475844	1.000119763
0.010843	2.80124841	0.104129727	0.01745	0.048881785	1.001195905
0.008815	0.31283185	0.093888231	0.01745	0.005458916	1.0000149

0.000054	1.04553192	0.007348469	0.01745	0.018244532	1.000166455
0.019685	0.42627274	0.140303243	0.01745	0.007438459	1.000027666
0.00011	3.82852533	0.010488088	0.01745	0.066807767	1.002235797
0.011189	3.33314107	0.10577807	0.01745	0.058163312	1.001693873
0.005592	2.20022171	0.074779676	0.01745	0.038393869	1.000737498
0.002756	3.68932455	0.052497619	0.01745	0.064378713	1.002075894
0.008962	0.62449927	0.09466784	0.01745	0.010897512	1.000059381
0.181157	1.48191129	0.425625422	0.01745	0.025859352	1.000334446
0.297319	1.62790788	0.545269658	0.01745	0.028406992	1.000403614
0.000008	0.02119944	0.002828427	0.01745	0.00036993	1.000000068
0.006889	0.96018737	0.083	0.01745	0.01675527	1.000140386
0.162855	3.98250617	0.403552971	0.01745	0.069494733	1.002419628
0.043737	1.09937108	0.209133928	0.01745	0.019184025	1.000184042
0.010025	3.04412204	0.100124922	0.01745	0.05311993	1.001412524
0.002164	2.75266131	0.046518813	0.01745	0.04803394	1.00115474
0.029411	4.29257187	0.171496356	0.01745	0.074905379	1.002811982
0.001083	2.76923854	0.032908965	0.01745	0.048323212	1.001168704
0.008824	1.78418662	0.093936149	0.01745	0.031134056	1.000484861
0.03645	3.59060239	0.190918831	0.01745	0.062656012	1.001966104
0.26997	0.6714758	0.519586374	0.01745	0.011717253	1.000068651
0.056914	1.02032997	0.238566553	0.01745	0.017804758	1.000158526
0.01918	7.46606498	0.138491877	0.01745	0.130282834	1.008547247
0.017652	0.81411824	0.132860829	0.01745	0.014206363	1.000100919
0.000081	0.01203211	0.009	0.01745	0.00020996	1.000000022
0.000026	0.00687549	0.00509902	0.01745	0.000119977	1.000000007
0.009873	3.32343362	0.099362971	0.01745	0.057993917	1.001684007
0.001782	0.39590754	0.042213742	0.01745	0.006908587	1.000023865
0.02308	3.99048881	0.151921032	0.01745	0.06963403	1.002429357
0.001023	6.86649491	0.031984371	0.01745	0.119820336	1.007221651
0.009632	0.39819926	0.098142753	0.01745	0.006948577	1.000024142
0.175954	0.64397745	0.419468712	0.01745	0.011237406	1.000063143
0.000061	3.34284833	0.00781025	0.01745	0.058332703	1.001703768
0.000016	9.74825109	0.004	0.01745	0.170106982	1.01464471
0.006463	0.98080794	0.080392786	0.01745	0.017115099	1.000146481
0.003035	9.97905063	0.055090834	0.01745	0.174134434	1.015355349
0.006268	0.33116592	0.079170702	0.01745	0.005778845	1.000016698
0.000259	1.62905287	0.016093477	0.01745	0.028426973	1.000404182
0.006205	0.29908126	0.078771822	0.01745	0.005218968	1.000013619
0.000003	1.10051657	0.001732051	0.01745	0.019204014	1.000184425
0.04463	3.92035034	0.211258136	0.01745	0.068410113	1.002344543
0	11.7686551	0	0.01745	0.205363032	1.021464004
0.003288	1.44755629	0.057341085	0.01745	0.025259857	1.000319115
0.058154	1.82425391	0.241151405	0.01745	0.031833231	1.000506891
0.00003	0.01375099	0.005477226	0.01745	0.000239955	1.000000029
0.194395	2.74522999	0.440902484	0.01745	0.047904263	1.001148507
0.000018	0.01890761	0.004242641	0.01745	0.000329938	1.000000054
0.002543	4.68207453	0.050428167	0.01745	0.081702201	1.003346933
0.122019	0.22517126	0.349312181	0.01745	0.003929238	1.00000772
0.000032	2.45762653	0.005656854	0.01745	0.042885583	1.000920292
0.065755	3.15780694	0.256427378	0.01745	0.055103731	1.001520134

0.15665	1.91983572	0.395790349	0.01745	0.033501133	1.000561426
0.000046	2.61774011	0.00678233	0.01745	0.045679565	1.001044219
0.078638	0.947013	0.280424678	0.01745	0.016525377	1.00013656
0.10307	0.17647044	0.321045168	0.01745	0.003079409	1.000004741
0.00001	5.2882297	0.003162278	0.01745	0.092279608	1.004272923
0.000106	1.8963705	0.01029563	0.01745	0.033091665	1.000547779
0.000203	1.39544922	0.014247807	0.01745	0.024350589	1.000296549
0.009408	1.58038965	0.096994845	0.01745	0.027577799	1.000380388
0.032855	1.53744962	0.181259483	0.01745	0.026828496	1.000359992
0.0000374	3.32457568	0.006115554	0.01745	0.058013846	1.001685166
0.082329	1.42579758	0.286930305	0.01745	0.024880168	1.000309591
0.001828	2.48393361	0.042755117	0.01745	0.043344641	1.000940115
0.12667	0.27559058	0.355907291	0.01745	0.004809056	1.000011564
0.000004	1.87061525	0.002	0.01745	0.032642236	1.000532994
0.091077	0.47726281	0.301789662	0.01745	0.008328236	1.000034681
0.01214	1.53000651	0.110181668	0.01745	0.026698614	1.000356514
0.000026	0.27043407	0.00509902	0.01745	0.004719075	1.000011135
0.003388	0.06187942	0.058206529	0.01745	0.001079796	1.000000583
0.030428	4.8675644	0.174436235	0.01745	0.084938999	1.003618193
0.0143	8.2268172	0.119582607	0.01745	0.14355796	1.010393676
0.000002	0.44747094	0.001414214	0.01745	0.007808368	1.000030486
0.026771	3.56663192	0.163618459	0.01745	0.062237727	1.001939898
0.03095	1.7252273	0.175926121	0.01745	0.030105216	1.000453333
0.077088	3.24234044	0.277647258	0.01745	0.056578841	1.00160272
0.007443	2.36382772	0.086272823	0.01745	0.041248794	1.000851335
0.0000047	0.61132277	0.002167948	0.01745	0.010667582	1.000056901
0.128	2.09208459	0.357770876	0.01745	0.036506876	1.000666746
0.029817	3.10696596	0.172675997	0.01745	0.054216556	1.00147152
0.000046	0.74079315	0.00678233	0.01745	0.012926841	1.000083557
0.045286	2.41473234	0.212805075	0.01745	0.042137079	1.000888424
0.030436	0.54486644	0.174459164	0.01745	0.009507919	1.000045202
0.000887	2.24942182	0.029782545	0.01745	0.039252411	1.000770871
0.012041	4.39226462	0.10973149	0.01745	0.076645018	1.002944436
0.00915	2.25457048	0.095655632	0.01745	0.039342255	1.000774406
0.03973	0.39017823	0.199323857	0.01745	0.00680861	1.000023179
0.000602	4.53235896	0.024535688	0.01745	0.079089664	1.00313576
0.000366	3.22634869	0.019131126	0.01745	0.056299785	1.001586929
0.0011	0.28246591	0.033166248	0.01745	0.00492903	1.000012148
0.00025	6.08305187	0.015811388	0.01745	0.106149255	1.005660404
0.022971	2.29347027	0.151561869	0.01745	0.040021056	1.000801377
1.638134	1.87748339	1.27989609	0.01745	0.032762085	1.000536917
0.002467	4.99950743	0.049668904	0.01745	0.087241405	1.003817637
0.214969	1.44011257	0.463647495	0.01745	0.025129964	1.000315841
0.0102	2.94469946	0.100995049	0.01745	0.051385006	1.001321663
0.2376	0.67949609	0.487442304	0.01745	0.011857207	1.000070301
0.019253	0.37069852	0.13875518	0.01745	0.006468689	1.000020922
0.000067	0.02062648	0.008185353	0.01745	0.000359932	1.000000065
0.000039	6.38030969	0.006244998	0.01745	0.111336404	1.006230071
0	3.76178296	0	0.01745	0.065643113	1.002158384
0.002799	2.35410394	0.052905576	0.01745	0.041079114	1.00084434

0.007162	0.7545418	0.0846286	0.01745	0.013166754	1.000086688
0.002072	2.71721881	0.045519227	0.01745	0.047415468	1.001125167
0.000006	3.14638243	0.00244949	0.01745	0.054904373	1.001509141
0.062734	0.98023515	0.250467563	0.01745	0.017105103	1.00014631
0.000023	1.41320024	0.004795832	0.01745	0.024660344	1.000304143
0.000096	3.42849224	0.009797959	0.01745	0.05982719	1.001792319
0.0156	0.46695027	0.12489996	0.01745	0.008148282	1.000033198
0.00481	2.88698047	0.069354164	0.01745	0.050377809	1.001270305
0.002014	4.41049128	0.044877611	0.01745	0.076963073	1.002968984
0.041033	1.44927406	0.202566039	0.01745	0.025289832	1.000319873
0.00172	4.90055507	0.041472883	0.01745	0.085514686	1.003667555
0.000046	6.35031618	0.00678233	0.01745	0.110813017	1.006171334
0.018378	1.24541408	0.135565482	0.01745	0.021732476	1.000236197
0.000043	0.00744845	0.006557439	0.01745	0.000129975	1.000000008
0.12592	0.65027918	0.354852082	0.01745	0.011347372	1.000064385
0.005439	0.42684566	0.073749576	0.01745	0.007448457	1.00002774
0.051089	1.61874791	0.226028759	0.01745	0.028247151	1.000399083
0.013996	9.07686875	0.118304691	0.01745	0.15839136	1.012676388
0.000001	0	0.001	0.01745	0	1
0.046993	0.47783573	0.216778689	0.01745	0.008338233	1.000034764
0.001487	2.86297678	0.038561639	0.01745	0.049958945	1.001249247
0.000072	1.14118101	0.008485281	0.01745	0.019913609	1.000198309
0.000513	0.92295518	0.022649503	0.01745	0.016105568	1.000129709
0.015536	1.19100769	0.124643492	0.01745	0.020783084	1.000216007
0.076963	4.44466387	0.277422061	0.01745	0.077559385	1.003015286
0.000003	0.03151268	0.001732051	0.01745	0.000549896	1.000000151
0.003615	5.58860114	0.06012487	0.01745	0.09752109	1.004774098
0.08858	1.03923147	0.297623924	0.01745	0.018134589	1.000164454
0.01971	1.38857778	0.140392307	0.01745	0.024230682	1.000293635
0.057935	0.7545418	0.240696905	0.01745	0.013166754	1.000086688
0	0.00630254	0	0.01745	0.000109979	1.000000006
0.017502	0.73506453	0.132295125	0.01745	0.012826876	1.00008227
0.916192	1.9381496	0.957179189	0.01745	0.033820711	1.000572193
0.04254	0.91035333	0.206252273	0.01745	0.015885666	1.00012619
0	0.665747	0	0.01745	0.011617285	1.000067484
0.000039	4.80214233	0.006244998	0.01745	0.083797384	1.003521303
0.088205	0.9830991	0.296993266	0.01745	0.017155079	1.000147166
0.000015	1.79334501	0.003872983	0.01745	0.03129387	1.000489853
0.000035	2.09151239	0.00591608	0.01745	0.036496891	1.000666381
0.031106	3.20692946	0.176368932	0.01745	0.055960919	1.001567858
0.001219	2.69606664	0.034914181	0.01745	0.047046363	1.001107702
0.000014	2.00739533	0.003741657	0.01745	0.035029048	1.000613831
0.000283	2.65890566	0.016822604	0.01745	0.046397904	1.001077349
0.052797	3.52211202	0.229775978	0.01745	0.061460855	1.001891696
0.121447	2.82925561	0.348492468	0.01745	0.04937051	1.001219963
0.074339	0.81469108	0.272651793	0.01745	0.014216359	1.000101061
0.038685	1.85115523	0.196685027	0.01745	0.032302659	1.000521958
13.194	**2.25**				
Area Gha	degree (180/pi)				
\?		1,400,000,000 ha		Plus Antarctica	1.61564082

Land of 15 Gha x mean exta 0.15%

THIS IS VERY SMALL ADDITIONAL LAN
AT 1m or even cm scale would expect

If it was for CO2 the value would be x 44; for c in CO2 is x 0.273!

% water

0.8
98.2
0.8
98.2

mistake or accuracy error, eitherway the are not talking about CO2

reactive C

900
1,500
800
791
14.3
4,005.3

	Area Gha	mean Org-C /m^2/yr g	Org-C /ha/yr t	Total Org-C/yr Gt
Land	15	144	1.44	21.6
Sea	36	72	0.72	25.92
Total	51	0	0	47.52

	%
Land	45
Sea	55
Tot	100

NPP sea Whitman et al. 1989: tab. 6

g/m2/yr	Tot
	48.0

NPP sea from Duursma & Poisson

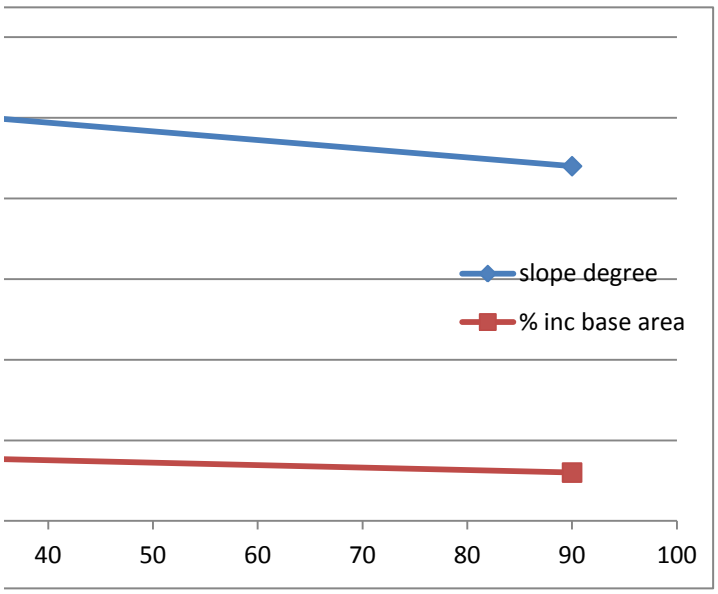
g/m2/yr	Tot
72	25.9

NPP land Whitman et al. 1989: tab. 6

g/m2/yr	Tot
	51.0

NPP land from Duursma & Poisson

g/m2/yr	Tot
144	21.6



Applications
Astronomy

Terrain, biomes, soil
ska (projected)
calc.)
ska

ska
Araújo

Araújo

Araújo

As terrain includes Antarctica, 15 Gha
Area increase for ter

Productivity

recalc.)
recalc.)
Soil moisture, respiration

SOM and colloid gas exchange

	(A) mean m (n=3)	
(a) % increase		2.4
(b) Land 15 Gha		15.4
(c) Soil 12 Gha (8		12.3
(d) Difference		3.1
(e) Soil 12.3 Gha (c) x (C) then (D)		
(f) Soil 14.6 Gha (c) x (C) then (D)		
Total (e) + Difference (d) (A)		
Total (f) + Difference (d) (B)		

Total land is between 52-62 Gha + 36
Allowing for microscopic porosity this
OR TRY THE TOTAL AND JUST REDUCE

2.475	Median value %	
%	15.36	terrain/slope
	15.85	tortuosity/rugosity
NEW LAND =	36.00	micro-relief
NEW WORLD	**72.00**	new global area including 36 Gha

Ratio = 2.0

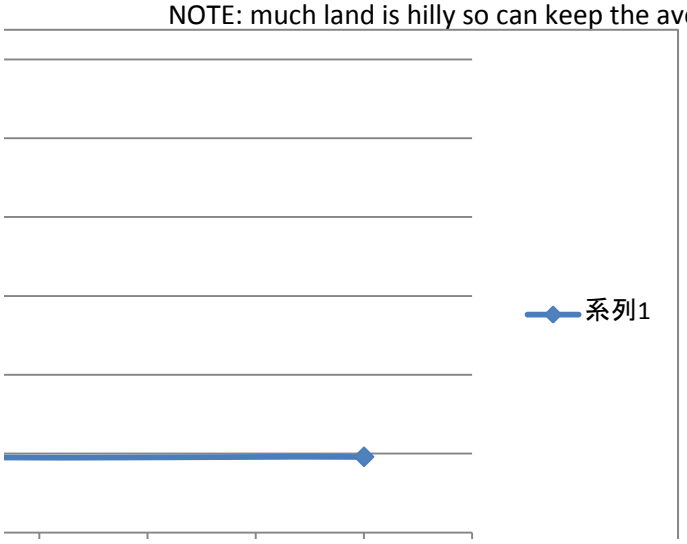
terrain/slope
tortuosity/rugosity 36x2 = 72
micro-relief
new global area including 36 Gha seas Ratio = 2.2 to 1

75.0 1.5 times increase 47.1 % increase

BIOMASS and PRODUCTIVITY ADJUSTMENTS (dependent upon original land area basis

	Scale of repo	Land area basis	% increase	New land Gha	Multiplication factor
	m2 (up to ha)	15	2.5	15.4	1.03
	m2 (up to ha)	15	21.25	18.2	1.71
of ..	cm2*	15.4	94.0	23.9	1.59
	cm2*	18.2	94.0	28.2	2.65
	mm2	23.9	108.2	49.7	3.31
	mm2	28.2	108.2	58.8	3.92

*80% of total flat land area is habitable with soil (15 x 0.8 = 12 Gha); but need to add
**Most megafauna and trees are ha-1; mesofauna/flora m-2; microbes g-1 = cm-2; hc
Antarctic is included as it too has a fauna composed mainly of seabirds, penguins and
Biomass on land is increased by at least 3 times (tripled) and possibly up to 3.9 times f
For energetics, the scale of measurment is the Joule (kg m2 s−2), calorie (1 g water 1
NOTE: much land is hilly so can keep the average terrrain hi 21.25%.



4 6 8 10 12

Or if arbitrary...

87.48	Gha		64	Gha	
36	Gha		36	Gha	
123.48	Gha		100	Gha	
2.43	: 1		1.8	:1	
71		29%	64		36%

ıges/18/Different+ecosystems+vary+considerably+in+their+net+primary+production.jpg

%		
24.5	OK	
5.6	OK	
1.4	OK	
0.8	OK	
0.2	OK	
0.0	OK	
1.0	OK	
21.9	OK	
7.9	OK	
5.3	**NOK needs correction**	
5.8	**NOK needs correction**	
3.3	**NOK needs correction**	
3.6	OK	
0.7	OK	
7.2	OK	
4.7	OK	
3.9	OK	
2.4	OK	
0.3	OK	
100		
OK		
32.4		
65.3		
2.7		

Gt C per year!!

Applications" (Prentice Hall) - this from https://en.wikipedia.org/wiki/Primary_production

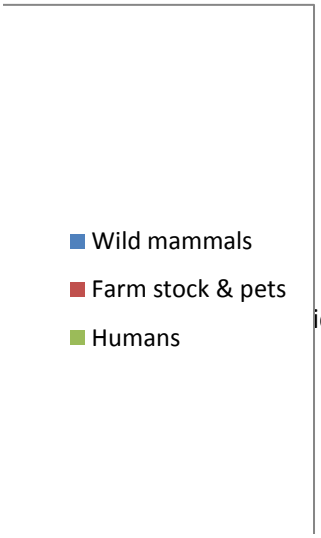
%land	%sea	check
45	55	100.0
48	52	100.0
68	32	100.0
54	46	100.0
67	33	100.0
-	-	
81	**19**	100.0

89	**11**	100.0
61	39	100.0

›parently almost equivalent.

ferent because they also have freshwater...

ine.com/doi/full/10.4155/cmt.13.77?scroll=top&needAccess=true



icle-to-commemorate-charles-darwins-birthday-on-12th-feb/.

eric_CO2_in_global_carbon_pools .

FAO	Gha	%
Total grasslar	5.25	40.5
composed of...		
woody savannah/savannah		13.8
open/closed shrub		12.7
non-woody grassland		8.3
tundra		5.7
	TOT	40.5

-3 m soil depth) from Jobaggy & Jackson (2000) upon which most NASA/NOAA data is based (http:/

%SOC	% sorted area		%sorted SOC	
6.4	Boreal forest	1239.669421	Boreal forest	6.396588486
10.6	Crops	2049.586777	Crops	10.57569296
8.9	Deserts	1719.008264	Deserts	8.869936034
5.3	Dry shrubs	1024.793388	Dry shrubs	5.287846482
6.8	Temp decid fore	1322.31405	Temp decid fores	6.823027719
4.3	Temp everg fore	842.9752066	Temp everg fores	4.349680171
7.3	Temp grass	1421.487603	Temp grass	7.334754797
9.3	Trop decid fores	1801.652893	Trop decid forest	9.296375267
20.2	Trop everg fores	3917.355372	Trop everg forest	20.21321962
14.7	Trop savannah	2851.239669	Trop savannah	14.71215352
6.1	Tundra	1190.082645	Tundra	6.140724947
100	Total		Total	

ORK AS AN APPROX!!! IF DOUBLE LAND AREA TO 24.2 get

Sorted by SOC

Biome	Area Gha	SOC 0-3m kg/m2		SOC 0-3 m Gt
Trop everg fo	1.7	27.9	47.43	474
Trop savanna	1.5	23	34.5	345
Crops	1.4	17.7	24.78	248
Trop decid fo	0.75	29.1	21.825	218
Deserts	1.8	11.5	20.7	208
Temp grass	0.9	19.1	17.19	172

Temp decid	0.7	22.8	15.96	160
Boreal forest	1.2	12.5	15	150
Tundra	0.8	18	14.4	144
Dry shrubs	0.85	14.6	12.41	124
Temp everg	0.5	20.4	10.2	102
Total	12.1	216.6	234.395	2345

%SOC			
29.5			
8.9			
14.7			
10.6			
11.2			
6.4			
7.3	0.7	22.8	15.96
5.3	0.5	20.4	10.20
6.1	1.2	43.2	51.84
100			

n et al (2000)

C %
8.0
13.3
17.3
5.3
22.6
12.3
6.4
5.1
9.7
100.0

ndle/20.500.11822/19113/Costanza_et_al_GEC_2014_%2b_SI.pdf?sequence=1&isAllowed=y

	For 1.4 gm-3	For 1.5 gm-3
x	1.5	1.6
x	2.2	2.3
x	2.8	3.1
x	2.2	2.3
	2.2	2.3
	2.2	2.3

Cf. 1,500 Gt

1.4	x
2.8	x
5.6	x

4.2 <--cf. 3,000
8.4 <--cf. 3,000
c-meter-soil-weigh-e48660fa83d913ab), then 120,000 m3 will weigh

x
x

x
My calculations seem reasoned and reasonable based upon these presumptions.

Gha, i.e., out by a factor of 100. Q.E.D. again.

.B. 2017- 11th November, 2018.

Hipotenusa (raiz da soma)	Diff	Diff x diff	Diff + 1	Sqrt
3.1622777	-3	9	10	3.16227766
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1.4142136	-1	1	2	1.414213562
1	0	0	1	1
2.236068	2	4	5	2.236067977
1	0	0	1	1
1.4142136	-1	1	2	1.414213562
1	0	0	1	1
3.1622777	3	9	10	3.16227766
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
2.236068	-2	4	5	2.236067977
1	0	0	1	1
2.236068	-2	4	5	2.236067977
1	0	0	1	1
1.4142136	1	1	2	1.414213562

1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
2.236068	-2	4	5	2.236067977
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
2.236068	-2	4	5	2.236067977
1	0	0	1	1
4.1231056	-4	16	17	4.123105626
1	0	0	1	1
4.1231056	-4	16	17	4.123105626
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1.4142136	-1	1	2	1.414213562
1	0	0	1	1
1.4142136	-1	1	2	1.414213562
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
2.236068	2	4	5	2.236067977
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
4.1231056	4	16	17	4.123105626
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
2.236068	2	4	5	2.236067977
1	0	0	1	1
2.236068	-2	4	5	2.236067977
1	0	0	1	1
2.236068	-2	4	5	2.236067977
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1.4142136	1	1	2	1.414213562

1	0	0	1	1
4.1231056	4	16	17	4.123105626
1	0	0	1	1
1.4142136	1	1	2	1.414213562
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
1	0	0	1	1
2.236068	2	4	5	2.236067977
1	0	0	1	1
2.236068	2	4	5	2.236067977
126.04114				
		Total		126.0411426
		expect		89
		T = L1/Lo		1.416192613

for curved hypoteneuses

desert [% [	tropical	dist_coast	near_coast	gemstones	rgdppc_20	rgdppc_19	rgdppc_19	rgdppc_20
0	100	0.001	100	0				
4.356	0	0.922	0	0		644.756	720.633	565.231
0.425	44.346	0.428	13.1587	47756	1794.729	1051.822	1073.036	765.215
0	100	0	100	0				
0	0	0.048	94.6919	0	3703.113	1001.339	2289.472	2741.42
0	0	0.134	0	0				
0	74.555	0.001	100	0				
77.28	0	0.065	75.7464	0	20604.46	15797.56	25465	17567.88
0	0	0.352	13.0167	0	12173.68	4986.725	8122.497	8543.558
0	0	0.348	0	0	2421.985			4565.035
0	100	0	100	0				
0	100	0.001	100	0	10022.03			
10.889	14.68	0.336	20.9399	264154	25417.44	7411.577	13169.83	21605.33
0	0	0.242	2.25634	0	28987.84	3706.075	11646.41	20691.42
0	0	0.584	0	0	2570.944			2538.14
0	75.354	0.906	0	0	621.652	360.142	534.858	495.977
0	0	0.113	45.9637	0	27302.99	5462.205	12440.79	20656.46
0	97.489	0.367	10.2806	0	959.222	1083.628	969.318	1282.898
0	49.82	0.735	0	0	998.416	474.313	669.515	921.09
0	75.038	0.071	71.3844	0	1479.086	539.544	528.607	861.7
0	0	0.149	31.4395	0	5979.171	1651.031	5830.809	5349.921
0	0	0.002	100	0	15928.09	2104.454	3922.257	5058.844
0	100	0.003	100	0	16977.2			
0	0	0.117	42.7623	0	5294.975			5572.282
0	0	0.598	0	0	4802.11			6264.544
0	100	0.026	100	0	5869.233			
0	0	0	100	0				
0	64.878	0.655	0	0	2398.855	1919.359	2515.915	2574.755
0	88.567	0.642	9.68309	12159	7300.865	1671.723	4189.509	5556.415
0	100	0.002	100	0	15290.58			
0	100	0.023	100	0				
0	0	0.389	0	0				
1.455	0	0.764	0	208687	7702.508	348.507	1223.49	4268.641
0	97.382	1.081	0	10802	1148.051	771.577	781.799	575.543
0	0	1.43	4.4433	5166	27289.26	7291.48	14316.26	22360.12
0	100	0	100	0				
0	0	0.278	0	0	30161.29	9063.698	17224.02	22474.86
15.489	0	0.074	68.3825	0	9115.475	3669.742	4273.292	10310.83
5.77	0.301	0.987	5.76513	4410	3928.315	448.022	871.181	3420.866
0	100	0.284	16.359	3239	1575.628	1040.878	1800.013	1352.019
0	94.12	0.389	10.9018	0	1882.687	670.951	1051.615	1082.339
0	94.866	1.016	0.686405	87149	668.663	569.742	760.789	216.95
0	100	0.457	4.83001	0	957.403	1198.207	2191.133	2005.219
0	100	0	100	0				
0	89.763	0.379	16.7275	0	6243.656	2152.841	3622.226	5095.796
0	100	0.003	100	0	1770.218	560.305	804.062	580.913
0	0	0.004	100	0	4859.108	449.648	524.742	1776.535

0	94.017	0.031	100	0	8621.291	1963.132	4396.007	6173.734
0	100	0.02	100	0		2046.226	2404.287	2415.604
0	100	0	100	0				
0	100	0.001	100	0				
0	0	0.012	100	0	20318			
0	0	0.426	0	0	15373.23			9155.582
0	0	0.246	19.7358	0	25481.43	3880.887	12040.61	18943.52
0	0	0.038	100	0	1881.967	1499.582	2065.445	1102.543
0	100	0.003	100	0	5931.715			
0	0	0.019	100	0	28750.61	6943.104	13621.13	22975.16
0	87.817	0.029	100	0	6410.803	1026.788	2111.321	3649.014
23.277	0	0.752	4.17952	0	5417.91	1364.74	2521.953	2864.551
0	73.165	0.157	37.3544	0	3373.415	1862.933	3459.407	3203.386
16.498	0	0.325	22.7899	0	3598.329	909.903	1420.783	2936.674
1.764	0	0.104	56.1576	0	911.884			
9.019	0	0.148	33.6288	0				
0	0	0.131	42.9055	0	21764.83	2188.97	8346.302	15621.72
0	0	0.135	37.0373	0	9762.76			11710.01
1.008	29.455	0.466	2.26331	0	635.794			
0	0	0.324	8.79128	0	25553.88	4253.287	11441.3	19770.36
0	100	0.009	100	0	4949.898			
0	0	0.005	100	0				
0	0	0.172	34.6184	0	25698.01	5271.312	13251.08	21025.38
0	0	0.001	100	0				
0	100	0	100	0				
0	100	0.195	28.1246	5200	6118.662	3108.377	9405.868	3847.075
0	0	0.034	96.3607	0	26332.05	6939.374	11847.09	20352.87
0	0	0.181	33.1835	0	1880.45			3243.627
0	100	0.283	19.3048	13275	1892.808	1121.794	1246.881	1269.883
0	0	0	100	0				
0	100	0.263	14.9423	4864	1975.794	303.321	512.136	571.719
0	100	0.003	100	0				
0	89.355	0.053	77.3706	0	1728.198	607.365	1049.606	894.813
0	100	0.045	87.3195	0	782.477	289.153	925.067	680.606
0	100	0.069	69.3531	0	15189.54	539.763	1294.001	7973.103
0	0	0.029	96.2131	0	17391.74	1915.007	7721.514	12110.87
0	100	0.001	100	0	7536.395			
0	0	0.867	3.50187	0				
0	78.376	0.099	48.2159	0	3974.407	2084.894	3683.875	4096.941
0	100	0.125	43.0358	0				
0	100	0	100	0				
0	100	0.215	28.642	1023	4072.166			
0	0	0.002	100	0	25795.83	2218.149	6990.537	23328.39
0	94.636	0.077	66.5159	0	2506.231	1313.356	1731.909	1911.571
0	0	0.113	51.0571	0	9545.475			6438.607
0	100	0.019	100	0	1798.406	1050.62	1034.517	796.162
0	0	0.467	0	0	13223.63	2479.958	5804.766	7132.268
0	99.835	0.062	77.0687	287	3028.274	839.518	1507.126	3258.498
4.495	39.447	0.407	18.0434	489	2415.093	619.003	897.336	1885.008
0	100	0	100	0				

0	0	0.035	95.8615	0	30532.31	3452.898	7316.275	21551.34
0.543	0	0.461	11.4317	0	5826.672	1719.611	5862.488	4662.057
0.01	0	0.456	2.58288	0		1363.606	4315.305	1221.224
9.086	0	0.04	93.2095	0	28929.43			
0.709	0	0.052	90.3822	0	23857.94	2817.303	10147.87	16925.59
0	0	0.058	80.9226	0	24994.66	3501.9	10741.87	18773.57
0	100	0.012	100	0	3650.39	1326.785	3844.877	3598.21
15.332	0	0.189	16.2407	0	3846.694	1663.149	2582.962	4088.574
0	0.006	0.032	97.7372	0	26219.79	1920.721	11343.78	20742.39
9.747	0	2.206	0	0	4594.435			5648.025
11.629	51.028	0.409	9.38789	0	1018.731	650.601	941.848	1030.687
0	0	1.918	0	0	1560			2167.491
0	100	0.17	25.378	0	1859.063	481.977	579.707	1141
0	100	0	100	0				
0	100	0.001	100	0	11224.7			
0	0	0.042	95.0484	0	16172.41	853.89	3161.702	14219.08
0	0	0.04	98.6018	0	15958.92	28878.14	18161.66	10082.73
0	54.794	0.267	6.8206	0	1569.901	612.943	783.584	1203.223
0	0	0.027	100	0	4216.305	2428.74	3461.337	3405.22
0	100	0.096	54.5897	9901		1054.759	1247.827	990.059
48.242	0	0.501	9.92269	0		857.168	5515.242	2312.993
0	100	0.002	100	0	5620.647			
0	0	0.305	0	0				
0	100	0.035	100	0	3625.534	1252.871	1540.745	3633.984
0	0	0.246	0	308	2122.544	355.366	714.936	1490.346
0	0	0.256	13.8029	0	8767.231			6346.336
0	0	0.259	0	0	57792.09			
0	0	0.265	15.7566	0	7903.728			7693.585
0	0	0	100	0	18581.94			
0.614	0	0.164	35.4198	0	3513.834	1455.361	1830.967	2657.562
0	0	0	100	0				
0	0	0.197	11.0077	0	1331.461			2127.236
0	65.224	0.087	61.0618	0	825.244	951.01	1126.29	705.899
0	100	0	100	0				
1.704	27.928	0.183	38.4165	0	9046.27	2365.019	5158.34	7274.678
0	100	0	100	0				
0	0	0.135	14.0538	0	6059.698			3340.784
26.132	11.688	1.014	0	0	779.597	456.875	612.963	891.656
0	0	0.002	100	0	18255.73			
0	50.245	0.287	30.3948	0		395.686	662.868	1376.179
1.49	0	1.694	0	0	1620.436	435.422	912.424	1084.652
0	100	0	100	0				
0	87.365	0.21	30.756	0	876.868	1133.42	1403.62	1364.891
74.857	0	0.511	5.9946	0	1729.208	463.918	961.991	1016.92
0	100	0	100	0				
0	100	0.003	100	0				
0	100	0.006	100	0	9622.512	2489.759	3969.069	10652.32
0	39.224	0.496	0	0	586.252	324.056	591.72	656.235
0	100	0.057	83.2625	0	8926.452	1559.265	2648.422	8165.59
0	100	0.002	100	0				

13.861	0	0.305	17.6842	55728	6057.856	2159.705	3333.925	3637.062
0	94.292	0.008	100	0	22140			
39.21	0.032	1.186	0	0	703.141	617.031	658.875	486.397
0	0	0	100	0				
0	73.44	0.491	9.17532	0	882.59	752.681	1416.623	1251.178
0	100	0.077	65.2217	0	3277.64	1615.788	3128.881	1520.552
0	100	0	100	0				
0	0	0.042	91.6192	0	28610.12	5996.128	13373.63	22161.45
0	0	0.053	79.6415	0	34207.82	5429.51	12271.32	25101.95
0	0	0.697	0	0	1322.873	496.334	641.508	999.145
0	100	0	100	0				
0	0	0.039	95.685	0	19614.94	8455.649	12488.61	16170.12
19.027	0	0.113	47.7134	0	12729.71	623.095	4267.115	7115.765
11.184	0	0.589	11.0758	0	1925.391	643.02	977.667	1815.145
0	100	0.018	100	0	6164.348	1915.962	4198.462	5675.752
0	100	0	100	0				
0.54	55.788	0.325	16.7165	0	4722.525	2307.632	4325.977	3832.72
0	98.973	0.02	100	0	4027.548	1070.263	2033.298	2421.199
0	100	0	100	0				
0	100	0.071	71.2843	0	2325.738			
0	0	0.283	14.8703	0	10401.36	2446.893	5807.87	7308.837
0	100	0.012	100	0	22242.23	2143.823	6946.214	14105.68
0	0	0.064	80.0171	0		853.857	2840.967	1169.178
0	0	0.072	70.0621	0	18255.28	2086.406	6517.205	13813.43
0	57.034	0.847	0	0	4553.069	1584.366	2220.024	3013.877
0	0	0.046	100	0		949.299	2329.271	5124.096
0	96.819	0.001	100	0	24538.31			
1.782	0	0.015	100	0		30387.13	35198.26	8290.317
0	58.336	0.008	100	0		1989.306	3821.115	4588.492
0	0	0.367	6.7651	0	5889.324	1181.952	3761.37	3005.54
0.056	0	1.841	2.76605	205550	7095.689			5276.657
0	68.88	0.946	0	0	1039.172	546.902	805.649	818.696
37.258	0	0.304	13.6641	0	12374.11	2230.766	11787.04	7647.705
0	0	0.236	11.654	0				2313.608
2.16	20.679	0.917	2.92113	0	1682.674	820.837	910.048	991.254
0	34.999	0.165	32.4713	0	1435.082	1258.898	1396.079	1358.175
0	100	0.003	100	0	23611.61	2218.961	6430.213	22518.17
0	0	0.001	100	0				
0	0	0.276	13.7615	0				
0	100	0.003	100	0	1862.47			
0	100	0.1	51.5546	16819	466.647	656.268	1125.709	409.872
0	100	0.039	99.6575	0	4594.274	1488.813	2503.697	2715.551
0	0	0.025	100	0				
3.358	0	0.126	44.7664	0		1056.633	1201.617	863.075
0	0	0.001	100	0				
0	100	0.004	100	0		820.358	1421.447	1225.896
0	100	0.191	25.757	0				
0	0	0.554	0	0	11303.75			8219.698
0	0	0.091	61.6056	0	16873.33			12876.63
0	0	0.223	21.2438	0	25899.88	6739.231	14183.35	20709.99

0	2.876	0.113	36.2172	426	4681.445	721.089	2461.908	2630.322
0	100	0	100	0	17957.47	1912.258	3250.874	6353.528
3.445	0	0.244	16.7091	0	3242.195	2408.502	5570.152	7368.301
0	100	0.001	100	0				
21.72	13.413	1.254	0	0	821.15	475.502	550.5	428.787
0	100	0.263	16.778	0	1436.855	573.994	1055.553	614.222
0	99.546	0.193	29.3876	0	6279.51	817.049	1958.72	6397.871
0.025	0	1.505	0	0	785.469			883.162
0	100	0	100	0				
55.087	0	1.286	0	0	3667.555			2324.556
0	100	0.013	100	0				
0	100	0	100	0	6568.724			
0	100	0.008	100	0	8969.766	3674.051	9117.805	13681.76
20.664	0	0.114	48.8258	0	6251.551	1114.596	2446.059	4552.262
0	0	0.152	38.9877	0	6510.354	1622.933	3894.789	6609.014
0	100	0	100	0				
0	8.846	0.023	100	0		924.393	3958.396	16858.58
0	88.294	0.42	10.2759	9035	521.827	423.714	600.268	535.125
0.02	97.783	0.909	0	0	1243.514	686.854	784.287	796.523
0	0	0.365	13.6144	0	4108.69			2745.334
0	100	0	100	0				
0	0	0.142	37.4727	0	8781.518	4659.398	5421.178	7883.267
0.278	0.358	0.677	13.1656	0	33970.17	9561.348	16283.63	28448.85
32.152	0	1.645	0	0	1515.708			3478.961
0	0	0.02	100	0				
0	100	0.001	100	0	5334.509			
0	96.752	0.306	25.2528	5124	5685.12	7461.959	10471.65	8414.729
0	100	0	100	0				
0	100	0.001	100	0				
0	56.535	0.112	57.8169	0	2011.743	658.076	709.929	1808.773
0	100	0.002	100	0	3172.14			
0	100	0	100	0				
0	100	0.003	100	0	4860.269			
10.75	0	0.148	38.1163	0	787.749	911.231	1783.548	2619.284
4.386	0.179	0.306	18.9404	144785	9419.122	2534.946	4270.851	3978.219
0	17.132	0.9	0	0	774.01	660.91	1040.744	645.375
0	8.401	0.499	0	898	2499.215	700.979	1401.811	1327.85
desert	tropical	dist_coast	near_coast	gemstones	rgdppc_20	rgdppc_19	rgdppc_19	rgdppc_20

2.77

1,000 ha

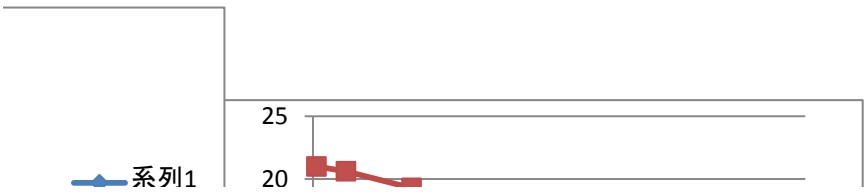
alculate the average uphi

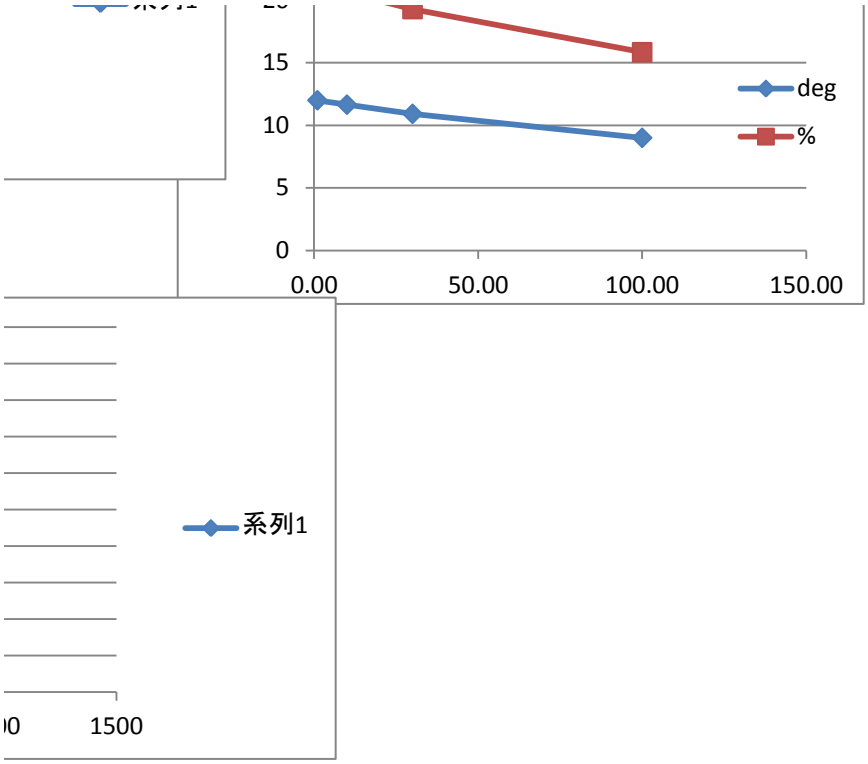
he basis of the FAO/UNESCO Digital Soil Map of the World and linked soil association composition tal

36,885

% doesnt really work as need better calc

ha





.154% extra surface.

sum	sec	Hypotenus	True area	diff %
0.038914	1.000758	3.88	15.0114	0.08

Hypotenus	True area	diff %
0.00	0.0000	0.01
0.26	0.0654	0.27
0.35	0.1247	0.03
0.00	0.0000	0.00
0.05	0.0028	0.54
0.01	0.0000	1.57
0.01	0.0001	0.00
0.09	0.0084	0.02
0.52	0.2737	0.03
0.05	0.0028	0.33
0.00	0.0000	0.25
0.01	0.0000	0.00
0.88	0.7682	0.00
0.09	0.0083	0.61
0.09	0.0083	0.13
0.05	0.0026	0.11
0.05	0.0030	0.01
0.11	0.0111	0.00
0.17	0.0274	0.00
0.11	0.0130	0.00
0.11	0.0111	0.10
0.01	0.0001	0.00
0.03	0.0010	0.00
0.07	0.0051	0.25
0.14	0.0207	0.00
0.05	0.0023	0.01
0.00	0.0000	0.00
0.33	0.1085	0.03
0.92	0.8460	0.00
0.01	0.0000	0.03
0.02	0.0005	0.01
0.07	0.0048	1.85
0.24	0.0567	0.00
0.25	0.0623	0.00
0.95	0.9097	0.04
0.00	0.0000	0.00
0.06	0.0040	1.12

0.27	0.0751	0.27
0.97	0.9342	0.15
0.18	0.0318	0.00
0.22	0.0465	0.01
0.48	0.2267	0.01
0.18	0.0342	0.00
0.00	0.0000	0.03
0.33	0.1110	0.03
0.01	0.0002	0.41
0.02	0.0004	0.21
0.07	0.0051	0.16
0.10	0.0110	0.01
0.00	0.0000	0.06
0.01	0.0000	0.00
0.03	0.0009	0.31
0.09	0.0077	0.04
0.19	0.0349	0.02
0.05	0.0023	0.21
0.01	0.0001	0.00
0.07	0.0042	0.00
0.07	0.0048	0.10
0.49	0.2382	0.01
0.17	0.0277	0.06
0.32	0.0996	0.02
0.10	0.0101	0.22
0.16	0.0266	0.00
0.22	0.0500	0.13
0.07	0.0042	0.00
0.32	0.1001	0.09
0.17	0.0305	0.01
0.04	0.0018	0.07
0.03	0.0012	0.00
0.23	0.0550	0.06
0.01	0.0001	0.34
0.01	0.0001	0.07
0.16	0.0258	0.00
0.16	0.0243	0.02
0.08	0.0070	0.63
0.15	0.0228	0.00
0.00	0.0000	2.27
0.16	0.0246	0.02
0.01	0.0002	0.05
0.03	0.0010	0.00
0.05	0.0028	0.01
0.05	0.0028	0.01
0.11	0.0129	0.42
0.01	0.0000	0.16
0.47	0.2175	0.01
0.10	0.0109	0.12
0.09	0.0088	0.00

0.01	0.0001	0.02
0.14	0.0197	0.00
0.01	0.0001	0.22
0.11	0.0112	0.17
0.07	0.0056	0.07
0.05	0.0028	0.21
0.09	0.0090	0.01
0.43	0.1812	0.03
0.55	0.2974	0.04
0.00	0.0000	0.00
0.08	0.0069	0.01
0.40	0.1632	0.24
0.21	0.0437	0.02
0.10	0.0100	0.14
0.05	0.0022	0.12
0.17	0.0295	0.28
0.03	0.0011	0.12
0.09	0.0088	0.05
0.19	0.0365	0.20
0.52	0.2700	0.01
0.24	0.0569	0.02
0.14	0.0193	0.85
0.13	0.0177	0.01
0.01	0.0001	0.00
0.01	0.0000	0.00
0.10	0.0099	0.17
0.04	0.0018	0.00
0.15	0.0231	0.24
0.03	0.0010	0.72
0.10	0.0096	0.00
0.42	0.1760	0.01
0.01	0.0001	0.17
0.00	0.0000	1.46
0.08	0.0065	0.01
0.06	0.0031	1.54
0.08	0.0063	0.00
0.02	0.0003	0.04
0.08	0.0062	0.00
0.00	0.0000	0.02
0.21	0.0447	0.23
0.00	0.0000	0.00
0.06	0.0033	0.03
0.24	0.0582	0.05
0.01	0.0000	0.00
0.44	0.1946	0.11
0.00	0.0000	0.00
0.05	0.0026	0.33
0.35	0.1220	0.00
0.01	0.0000	0.09
0.26	0.0659	0.15

0.40	0.1567	0.06
0.01	0.0000	0.10
0.28	0.0786	0.01
0.32	0.1031	0.00
0.00	0.0000	0.43
0.01	0.0001	0.05
0.01	0.0002	0.03
0.10	0.0094	0.04
0.18	0.0329	0.04
0.01	0.0000	0.17
0.29	0.0824	0.03
0.04	0.0018	0.09
0.36	0.1267	0.00
0.00	0.0000	0.05
0.30	0.0911	0.00
0.11	0.0121	0.04
0.01	0.0000	0.00
0.06	0.0034	0.00
0.18	0.0305	0.36
0.12	0.0144	1.04
0.00	0.0000	0.00
0.16	0.0268	0.19
0.18	0.0310	0.05
0.28	0.0772	0.16
0.09	0.0074	0.09
0.00	0.0000	0.01
0.36	0.1281	0.07
0.17	0.0299	0.15
0.01	0.0000	0.01
0.21	0.0453	0.09
0.17	0.0304	0.00
0.03	0.0009	0.08
0.11	0.0121	0.29
0.10	0.0092	0.08
0.20	0.0397	0.00
0.02	0.0006	0.31
0.02	0.0004	0.16
0.03	0.0011	0.00
0.02	0.0003	0.57
0.15	0.0230	0.08
1.28	1.6390	0.05
0.05	0.0025	0.38
0.46	0.2150	0.03
0.10	0.0102	0.13
0.49	0.2376	0.01
0.14	0.0193	0.00
0.01	0.0001	0.00
0.01	0.0000	0.62
0.00	0.0000	0.00
0.05	0.0028	0.08

0.08	0.0072	0.01
0.05	0.0021	0.11
0.00	0.0000	0.15
0.25	0.0627	0.01
0.00	0.0000	0.03
0.01	0.0001	0.18
0.12	0.0156	0.00
0.07	0.0048	0.13
0.05	0.0020	0.30
0.20	0.0410	0.03
0.04	0.0017	0.37
0.01	0.0000	0.62
0.14	0.0184	0.02
0.01	0.0000	0.00
0.35	0.1259	0.01
0.07	0.0054	0.00
0.23	0.0511	0.04
0.12	0.0142	1.27
0.00	0.0000	0.00
0.22	0.0470	0.00
0.04	0.0015	0.12
0.01	0.0001	0.02
0.02	0.0005	0.01
0.12	0.0155	0.02
0.28	0.0772	0.30
0.00	0.0000	0.00
0.06	0.0036	0.48
0.30	0.0886	0.02
0.14	0.0197	0.03
0.24	0.0579	0.01
0.00	0.0000	0.00
0.13	0.0175	0.01
0.96	0.9167	0.06
0.21	0.0425	0.01
0.00	0.0000	0.00
0.01	0.0000	0.35
0.30	0.0882	0.01
0.00	0.0000	0.05
0.01	0.0000	0.07
0.18	0.0312	0.16
0.03	0.0012	0.11
0.00	0.0000	0.06
0.02	0.0003	0.11
0.23	0.0529	0.19
0.35	0.1216	0.12
0.27	0.0743	0.01
0.20	0.0387	0.05
	13.202	**0.154** %

Hypotenus	True area	diff %
	14.81718	

15.000	15.000	
	0.023	
15.000	15.023	**0.154** %

D, BUT THE SCALE IS ONLY 1KM!!!
exponention inceases.

But... 0.154 may be 4 times under so = **0.616** %

O_2 /m^2/yr	Total O_2/yr Gt
3.84	57.6
2.064	74.304
	131.904

	%
	44
	56
	100

is reasonable; the tortuosity data are for soil only which is about 12 Gha or 80%.

·rain, tortuosity and relief Gha % differen(x inc

(B) mean r	(C) mean c	(D) mean mm (n=5) %							
21.3	94.0	108.2							
18.2									
14.6									
3.6									
	23.9	49.7							
	28.3	59.0							
	27.0	52.8	252	3.5					
	31.9	62.6	317	4.2					
						soil	sea	tot	
Gha ocean =		**88.8**	**98.6**	Gha	Mean	57.7	36	93.7	

could be increased to 100 Gha.

BY 80% for soil 61.824 67.888 Doesnt work!

to 1

so 72:36 = 2:1

;)

·**

3 Gha to total for land area.

owever, aquatic productivity and biomass based on phytoplankton is often measured inµg/cm2 and p

seals, all semi-terrestrial plus some plants and invertebrates.

for microbes.

Gha

'/onlinelibrary.wiley.com/doi/10.1890/1051-0761(2000)010%5b0423:TVDOSO%5d2.0.CO;2/full)

Land	ocean	Total	% Land	% diff land
15	36	51	29.4	0.0
30	36	66	45.5	50.0
60	36	96	62.5	75.0
64	36	100	64.0	76.6

Land	ocean	Total	% Land	% diff land	Roughly
15	36	51	29.4	0.0	Flat
16.5	36	52.5	31.4	9.1	Macro 10%
33	36	69	47.8	54.5	Meso 100%
64	36	100	64.0	76.6	Micro 90%

4,690
4,765 Gt SOC or about double!!!

Expect

	0	plus 1	cos	3.142857
1	-2.96998	-1.96998	-1.22152	
1	0	1	1.698093	
1	-0.5403	0.459698	2.816587	
1	0	1	1.698093	
1	0	1	1.698093	
1	0	1	1.698093	
1	0.414214	1.414214	0.490109	
1	0	1	1.698093	
1	0.414214	1.414214	0.490109	
1	0	1	1.698093	
1	1.236068	2.236068	-1.94	
1	0	1	1.698093	
1	0.414214	1.414214	0.490109	
1	0	1	1.698093	
1	2.162278	3.162278	-3.14218	
1	0	1	1.698093	
1	0.414214	1.414214	0.490109	
1	0	1	1.698093	
1	0	1	1.698093	
1	0	1	1.698093	
1	0	1	1.698093	
1	0	1	1.698093	
1	1.236068	2.236068	-1.94	
1	0	1	1.698093	
1	1.236068	2.236068	-1.94	
1	0	1	1.698093	
1	0.414214	1.414214	0.490109	

1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	3.123106	4.123106	-1.74669
1	0	1	1.698093
1	3.123106	4.123106	-1.74669
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	3.123106	4.123106	-1.74669
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0.414214	1.414214	0.490109

1	0	1	1.698093
1	3.123106	4.123106	-1.74669
1	0	1	1.698093
1	0.414214	1.414214	0.490109
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	0	1	1.698093
1	1.236068	2.236068	-1.94
1	0	1	1.698093
1	1.236068	2.236068	-1.94

Total length = hypoteneuse

30.95437 126.0411

Total base = base

89

Since a2 + b2 = c2, then b2 = c2 - a2

c2 - a 2

c2	15886.37
a2	7921
c2-a2	7965.37
sq rt = b	89.24892
a + b =	178.2489
T index=	2.002797

rgdppc_19	q_rule_law	cont_africa	cont_asia	cont_europ	cont_ocea	cont_north	cont_south	legor_gbr
		0	0	0	0	1	0	0
679.791	-1.687	0	1	0	0	0	0	0
1106.763	-1.567	1	0	0	0	0	0	0
		0	0	0	0	1	0	
1931.784	-0.82	0	0	1	0	0	0	0
	1.515	0	0	1	0	0	0	0
		0	0	0	0	1	0	0
20119.99	0.913	0	1	0	0	0	0	1
6926.81	0.033	0	0	0	0	0	1	0
	-0.453	0	1	0	0	0	0	0
		0	0	0	1	0	0	1
	0.99	0	0	0	0	1	0	1
13184.23	1.773	0	0	0	1	0	0	1
11601.7	1.853	0	0	1	0	0	0	0
	-1.007	0	1	0	0	0	0	0
530.763	-1.25	1	0	0	0	0	0	0
12223.31	1.413	0	0	1	0	0	0	0
1082.474	-0.23	1	0	0	0	0	0	0
719.511	-0.52	1	0	0	0	0	0	0
599.122	-0.807	0	1	0	0	0	0	1
4567.501	-0.16	0	0	1	0	0	0	0
3776.897	0.457	0	1	0	0	0	0	1
	1.063	0	0	0	0	1	0	1
	-0.44	0	0	1	0	0	0	0
	-0.9	0	0	1	0	0	0	0
	0.257	0	0	0	0	1	0	1
	1.255	0	0	0	0	1	0	1
2153.277	-0.327	0	0	0	0	0	1	0
3761.573	-0.257	0	0	0	0	0	1	0
	0.76	0	0	0	0	1	0	1
	0.59	0	1	0	0	0	0	1
	-0.277	0	1	0	0	0	0	1
1631.317	0.58	1	0	0	0	0	0	1
757.838	-1.07	1	0	0	0	0	0	0
14002.5	1.757	0	0	0	0	1	0	1
		0	0	0	1	0	0	
16696.84	2.023	0	0	1	0	0	0	0
5636.808	1.183	0	0	0	0	0	1	0
1268.328	-0.357	0	1	0	0	0	0	0
1536.27	-0.86	1	0	0	0	0	0	0
1036.539	-1.287	1	0	0	0	0	0	0
611.093	-2.05	1	0	0	0	0	0	0
1914.573	-1.413	1	0	0	0	0	0	0
	0.86	0	0	0	1	0	0	1
3661.919	-0.767	0	0	0	0	0	1	0
730.933	-1.28	1	0	0	0	0	0	0
809.993	0.71	1	0	0	0	0	0	0

3955.164	0.637	0	0	0	0	1	0	0
2334.104	-0.877	0	0	0	0	1	0	0
		0	1	0	0	0	0	
	1.515	0	0	0	0	1	0	1
	0.817	0	1	0	0	0	0	1
	0.793	0	0	1	0	0	0	0
11932.71	1.71	0	0	1	0	0	0	0
1647.355	-0.577	1	0	0	0	0	0	0
	0.495	0	0	0	0	1	0	1
13991.6	1.837	0	0	1	0	0	0	0
1989.486	-0.52	0	0	0	0	1	0	0
2389.185	-1.153	1	0	0	0	0	0	0
3209.836	-0.587	0	0	0	0	0	1	0
1711.68	-0.03	1	0	0	0	0	0	0
	-0.307	1	0	0	0	0	0	0
		1	0	0	0	0	0	
7811.794	1.333	0	0	1	0	0	0	0
	0.527	0	0	1	0	0	0	0
	-0.823	1	0	0	0	0	0	0
11059.54	1.897	0	0	1	0	0	0	0
	-0.093	0	0	0	1	0	0	1
		0	0	0	0	0	1	
12907.1	1.397	0	0	1	0	0	0	0
		0	0	1	0	0	0	0
	-0.365	0	0	0	1	0	0	1
5359.929	-0.553	1	0	0	0	0	0	0
12332.87	1.783	0	0	1	0	0	0	1
	-1.033	0	1	0	0	0	0	0
1217.556	-0.297	1	0	0	0	0	0	1
		0	0	1	0	0	0	
469.724	-1.32	1	0	0	0	0	0	0
		0	0	0	0	1	0	0
866.362	0.1	1	0	0	0	0	0	1
707.146	-1.65	1	0	0	0	0	0	0
1623.25	-1.263	1	0	0	0	0	0	0
6959.675	0.81	0	0	1	0	0	0	0
	0.27	0	0	0	0	1	0	1
		0	0	0	0	1	0	0
3228.048	-0.897	0	0	0	0	1	0	0
	0.99	0	0	0	0	0	1	
		0	0	0	1	0	0	1
	-0.23	0	0	0	0	0	1	1
9882.841	1.037	0	1	0	0	0	0	1
1690.379	-0.837	0	0	0	0	1	0	0
	-0.203	0	0	1	0	0	0	0
1007.399	-1.463	0	0	0	0	1	0	0
5178.71	0.8	0	0	1	0	0	0	0
1752.64	-0.653	0	1	0	0	0	0	0
1006.152	0.213	0	1	0	0	0	0	1
		0	1	0	0	0	0	

8281.263	1.643	0	0	1	0	0	0	1
3593.365	-0.6	0	1	0	0	0	0	0
2984.537	-1.507	0	1	0	0	0	0	0
	1.753	0	0	1	0	0	0	0
9250.91	1.07	0	1	0	0	0	0	1
11048.93	0.893	0	0	1	0	0	0	0
3139.55	-0.377	0	0	0	0	1	0	1
3248.945	0.39	0	1	0	0	0	0	0
11248.29	1.477	0	1	0	0	0	0	0
	-0.877	0	1	0	0	0	0	0
912.759	-1.05	1	0	0	0	0	0	1
	-0.74	0	1	0	0	0	0	0
766.583	-1.013	0	1	0	0	0	0	0
	-0.145	0	0	0	1	0	0	1
	0.06	0	0	0	0	1	0	1
4725.635	0.717	0	1	0	0	0	0	0
19359.77	0.77	0	1	0	0	0	0	0
826.834	-1.15	0	1	0	0	0	0	0
2881.809	-0.177	0	1	0	0	0	0	0
1195.255	-2.113	1	0	0	0	0	0	1
3978.577	-1.01	1	0	0	0	0	0	0
	0.06	0	0	0	0	1	0	1
	1.515	0	0	1	0	0	0	0
1891.942	-0.067	0	1	0	0	0	0	1
824.398	-0.083	1	0	0	0	0	0	1
	0.33	0	0	1	0	0	0	0
	1.767	0	0	1	0	0	0	0
	0.177	0	0	1	0	0	0	0
	0.195	0	1	0	0	0	0	0
1952.039	0.133	1	0	0	0	0	0	0
		0	0	1	0	0	0	0
	-0.317	0	0	1	0	0	0	0
966.595	-0.653	1	0	0	0	0	0	0
	0.35	0	1	0	0	0	0	1
4824.431	-0.473	0	0	0	0	1	0	0
	-0.405	0	0	0	1	0	0	1
	-0.433	0	0	1	0	0	0	0
638.532	-0.527	1	0	0	0	0	0	0
	1.003	0	0	1	0	0	0	0
725.201	-1.3	0	1	0	0	0	0	0
891.187	0	0	1	0	0	0	0	0
		0	0	0	1	0	0	
1278.82	-0.85	1	0	0	0	0	0	0
856.331	-0.523	1	0	0	0	0	0	0
		0	0	0	0	1	0	
	1.255	0	0	0	0	1	0	0
4876.056	0.793	1	0	0	0	0	0	0
507.871	-0.53	1	0	0	0	0	0	1
3467.013	0.517	0	1	0	0	0	0	1
		1	0	0	0	0	0	0

3181.151	0.293	1	0	0	0	0	0	1
	-0.86	0	0	0	1	0	0	0
683.153	-0.837	1	0	0	0	0	0	0
		0	0	0	1	0	0	
1109.575	-1.29	1	0	0	0	0	0	1
2131.895	-0.657	0	0	0	0	1	0	0
		0	0	0	1	0	0	1
12961.17	1.79	0	0	1	0	0	0	0
13253.49	1.95	0	0	1	0	0	0	0
691.527	-0.177	0	1	0	0	0	0	1
		0	0	0	1	0	0	1
11982.21	1.87	0	0	0	1	0	0	1
3880.417	0.843	0	1	0	0	0	0	0
1110.924	-0.727	0	1	0	0	0	0	1
3954.735	-0.143	0	0	0	0	1	0	0
		0	0	0	1	0	0	
3502.972	-0.633	0	0	0	0	0	1	0
1893.012	-0.237	0	1	0	0	0	0	0
		0	0	0	1	0	0	
	-0.68	0	0	0	1	0	0	1
4706.412	0.643	0	0	1	0	0	0	0
7177.506	0.917	0	0	0	0	1	0	0
1933.106	-0.977	0	1	0	0	0	0	0
6861.499	1.167	0	0	1	0	0	0	0
2405.144	-0.817	0	0	0	0	0	1	0
2596.531	-0.075	0	1	0	0	0	0	
		0	0	0	1	0	0	0
23511.4	0.433	0	1	0	0	0	0	0
3412.181		1	0	0	0	0	0	0
2935.706	-0.15	0	0	1	0	0	0	0
	-0.873	0	0	1	0	0	0	0
739.706	-1.4	1	0	0	0	0	0	0
7612.613	0.343	0	1	0	0	0	0	1
	-1.16	0	0	1	0	0	0	0
903.639	-1.547	1	0	0	0	0	0	1
1348.293	-0.207	1	0	0	0	0	0	0
8339.448	1.577	0	1	0	0	0	0	1
		1	0	0	0	0	0	
		0	0	1	0	0	0	
	-1.195	0	0	0	1	0	0	1
904.314	-1.29	1	0	0	0	0	0	1
2147.779	-0.743	0	0	0	0	1	0	0
		0	0	1	0	0	0	0
1117.015	-2.203	1	0	0	0	0	0	1
		0	0	0	0	1	0	
1255.841	-0.205	1	0	0	0	0	0	0
	-0.323	0	0	0	0	0	1	0
	0.263	0	0	1	0	0	0	0
	0.973	0	0	1	0	0	0	0
13259.33	1.813	0	0	1	0	0	0	0

1902.181	-0.16	1	0	0	0	0	0	1
3625.007	0.58	1	0	0	0	0	0	0
4961.027	-0.367	0	1	0	0	0	0	0
		0	0	0	0	1	0	
472.883	-0.92	1	0	0	0	0	0	0
833.23	-0.893	1	0	0	0	0	0	0
2729.121	0.477	0	1	0	0	0	0	1
	-1.61	0	1	0	0	0	0	0
		0	0	0	1	0	0	1
	-1.18	0	1	0	0	0	0	0
		0	1	0	0	0	0	
	-0.38	0	0	0	1	0	0	1
8591.538	0.42	0	0	0	0	1	0	1
2441.64	-0.083	1	0	0	0	0	0	0
3821.776	-0.04	0	1	0	0	0	0	0
	1.69	0	0	0	1	0	0	1
5906.895	0.867	0	1	0	0	0	0	0
527.04	-0.43	1	0	0	0	0	0	1
699.696	-0.7	1	0	0	0	0	0	1
	-0.823	0	0	1	0	0	0	0
		0	1	0	0	0	0	
5841.658	0.55	0	0	0	0	0	1	0
17349.76	1.697	0	0	0	0	1	0	1
	-1.023	0	1	0	0	0	0	0
		0	0	1	0	0	0	
	0.06	0	0	0	0	1	0	1
9366.497	-0.73	0	0	0	0	0	1	0
		0	0	0	0	1	0	
		0	0	0	0	1	0	1
932.382	-0.553	0	1	0	0	0	0	0
	-0.455	0	0	0	1	0	0	1
		0	0	0	1	0	0	
	0.36	0	0	0	1	0	0	1
1703.219	-1.127	0	1	0	0	0	0	0
3667.399	0.207	1	0	0	0	0	0	1
863.642	-0.587	1	0	0	0	0	0	1
1163.542	-0.813	1	0	0	0	0	0	1
rgdppc_19	q_rule_law	cont_africa	cont_asia	cont_europ	cont_ocea	cont_north	cont_south	legor_gbr

ole and climatic data compiled by the Climate Research Unit of the University of East Anglia, Fischer, va

ɔicometre scales.

legor_fra	legor_soc	legor_deu	legor_sca	colony_esp	colony_gbr	colony_fra	colony_prt	colony_oe
1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	0
				0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
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0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	1	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
				0	0	0	0	0
0	0	1	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	1
1	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	1	0

1	0	0	0	1	0	0	0	0
0	1	0	0	1	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
0	0	0	1	0	0	0	0	0
1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	1	0	0	0	0
1	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	0	0
				0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0
0	0	0	0	0	1	0	0	0
				0	0	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
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0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
				0	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
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1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
0	1	0	0	0	0	0	0	0
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0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
0	0	0	0	0	1	0	0	0
				0	0	0	0	0

0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0
0	0	0	1	0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	0	0
0	0	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	1	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0
0	1	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
0	0	0	0	0	1	0	0	0
0	0	1	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	1	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0
0	1	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
				0	0	0	0	0
1	0	0	0	0	0	0	1	0
1	0	0	0	0	0	1	0	0
				0	0	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0

0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0
				0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
				0	0	0	0	0
1	0	0	0	1	0	0	0	0
1	0	0	0	1	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	0
				0	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	1	0	0	0
1	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	1
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
				0	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	1
				0	0	0	0	0
1	0	0	0	0	0	0	1	0
1	0	0	0	0	0	0	0	1
0	1	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0

0	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0
				0	0	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	1	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	0	1	0	0
1	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	1	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
				0	0	0	0	0
1	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0
0	1	0	0	0	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	1	0	0	0	0
				0	0	0	0	0
0	0	0	0	0	0	0	0	0
0	1	0	0	0	0	1	0	0
0	0	0	0	0	1	0	0	0
				0	0	0	0	0
0	0	0	0	0	1	0	0	0
1	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
0	0	0	0	0	1	0	0	0
legor_fra	legor_soc	legor_deu	legor_sca	colony_esp	colony_gbr	colony_fra	colony_prt	colony_oe

ın Velthuizen, Shah, and Nachtergaele (2002) identify whether each cell on a 5-minute grid covering alı

africa_regi	africa_regi	africa_regi	africa_regi	africa_regi	slave_expc	dist_slaver	dist_slaver	dist_slaver
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	1	3.61E+06	5.669	6.981	4.926
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	86.997	10.626	2.57	3.719
0	0	0	0	0	0			
0	0	1	0	0	4.57E+05	5.121	9.234	2.835
0	0	1	0	0	1.67E+05	4.775	9.299	2.764
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	1	0	0	0	0	5.686	5.765	5.857
0	0	0	0	1	2009.941	5.642	8.772	2.84
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	1	0	0	52645.95	4.186	9.457	3.353
0	0	0	0	1	66718.81	5.642	8.772	3.003
0	0	0	0	1	7.67E+05	5.712	7.643	3.748
0	0	0	0	1	94662.92	5.527	7.924	3.697
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	0	10.131	1.754	4.846
0	0	1	0	0	0	3.647	11.6	3.482

0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	4.176	14.408	2.682	2.351
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
1	0	0	0	0	61834.15	6.559	14.912	0.985
0	0	0	0	0	0			
1	0	0	0	0	1491.701	16.393	4.667	0.43
0	0	0	1	0	1.33E+05	12.967	3.146	1.814
1	0	0	0	0	0	4.932	12.435	2.049
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	1.31E+06	12.589	2.706	2.543
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	1	27402.17	5.531	8.367	3.703
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	1	0	0	1.61E+06	4.773	9.3	3.174
0	0	0	0	0	0			
0	0	1	0	0	3.50E+05	3.72	10.269	3.245
0	0	0	0	0	0			
0	0	1	0	0	21730.9	3.889	10.793	3.172
0	0	1	0	0	1.81E+05	3.796	10.631	3.285
0	0	0	0	1	10.5	5.577	8.556	3.462
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			

0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	86447.91	11.083	2.705	3.359
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	1	0	0	6789.634	3.776	9.777	3.595
1	0	0	0	0	8847.93	8.422	16.775	0.61
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	1	0	0	0	0	7.202	3.035	6.637
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
1	0	0	0	0	0	5.794	13.676	1.023
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	1.25E+05	9.686	0.904	5.732
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	1	0	0	8.42E+05	3.897	10.79	2.263
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	1	0	0	0	6.26E+05	9.264	2.185	5.268
0	0	1	0	0	1.64E+05	4.424	11.914	2.255
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	0	10.31	0.032	6.274
0	1	0	0	0	1.25E+05	9.267	2.183	4.821
0	0	0	0	0	0			
0	0	0	1	0	0	10.108	1.551	4.995

0	1	0	0	0	190.351	5.683	5.792	5.981
0	0	0	0	0	0			
0	0	1	0	0	19911.73	5.159	9.223	1.768
0	0	0	0	0	0			
0	0	1	0	0	2.02E+06	5.224	9.151	2.642
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	0	10.09	0.208	6.256
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	0	10.754	2.623	3.568
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	8.64E+05	15.253	3.528	1.827
0	0	1	0	0	3.77E+05	3.898	10.791	3.035
0	0	0	0	0	0			
0	0	0	0	1	0	3.541	7.512	5.804
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	1	0	0	69606.72	3.705	10.188	3.474
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	32276.75	12.058	2.358	3.09
0	0	0	0	0	0			
0	0	0	0	1	0	5.197	8.474	3.67
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			

0	1	0	0	0	0	8.291	2.622	6.295
0	0	0	1	0	0	11.457	1.742	4.635
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	1	5.29E+05	5.581	8.876	1.879
0	0	1	0	0	2.90E+05	4.926	9.258	3.009
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
1	0	0	0	0	0	7.48	15.833	0.31
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	1	0	5.35E+05	10.595	2.558	4.056
0	0	0	1	0	4553.603	10.996	2.699	3.204
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	0	0	0	0	0			
0	1	0	0	0	2030.663	6.766	3.457	6.584
0	1	0	0	0	27957.1	9.027	2.389	4.849
0	1	0	0	0	1088.177	9.027	2.389	5.454
africa_regi	africa_regi	africa_regi	africa_regi	africa_regi	slave_expc	dist_slaver	dist_slaver	dist_slaver

nost the entire land area of the Earth is subject to various constraints for growing rainfed crops. Based

dist_slaver	pop_1400	european_descent
	614	
	1870829	0
3.872	1223208	2
	200000	100
	1802	
	19200	0
	276632	89.889
	105743	0.5
	747	
	200000	89.954
	1250000	98.4
	226250	4
2.215	239693	0
	773466	98
3.902	348867	0
4.239	692976	0
	9103705	0
	894427	98.85
	31897	0
	1276	
	366341	100
	487364	100
	5326	39.91
	601	
	829897	26.732
	931150	74.43
	3403	
	2328	
	36082	0
4.3	80312	1.5
2.293	387580	0.6
	174110	85.33
	600000	98.5
	553265	59.19
	80943756	0
4.794	435857	0
3.051	1317285	0
2.687	3593277	0.46
3.227	238219	0
	902880	45.6
2.61	0	0
6.465	0	41.4

	74647	60.39
	95479	63
	150000	1
	1801067	100
	6500000	97.6
0.064	34822	
	824	
	600000	99.2
	39145	52
3.654	1588836	0
	553265	31.976
1.113	4182558	0
0.07	101512	1.9
5.215	2439	
	5500000	99.24
	69282	100
0.51	1639589	0
	100000	100
	139322	2.2
	11000000	93.4
	10000	
	15427	
3.529	138320	1
	3306643	94.6
	275547	3
4.332	912300	0
5.259	455699	0
	3387	
5.638	51104	0.5
5.633	87833	3
3.515	66516	5.75
	1118034	100
	1237	
	10000	
	243109	21.965
		1.3
	42611	0
	114924	46
	530014	99.55
	51954	2.5
	1000000	99.3
	6987225	0
	77226807	0

	193357	99.885
	3741657	0
	1000000	0
	60000	
	229955	30.698
	7000000	99.8
	22626	8
	86370	1
	12500000	0
	1253389	41.9
1.361	1322790	0
	325361	15
	1383162	0
	10513	
	743	
	2308243	0
	42006	0
	348220	0
	313584	0.5
5.227	143361	0
2.151	500000	0
	1335	
	956352	0
4.846	26096	0
	161557	100
	26534	99.2
	122643	100
	13636	
4.571	1586397	8
	147311	99.1
3.454	544859	0.6
	4514402	30
	6267	
	169275	96.31
4.311	1063541	0
	10000	99.5
	3482202	0
	578516	1
3.298	786003	0
4.973	221211	0
	218	
	3580	
3.884	0	16
2.922	348220	0
	296322	0
2.722	0	

4.685	93798	10.85
	31251	
2.954	705385	0
3.314	5909180	0
	100069	51
	600000	95.95
	400000	100
	1852093	0
	15000	80.6
	200000	0
	7669487	0
	66462	45.2
	1888175	28.043
	362390	0
	866855	0
	2750000	100
	35772	66.3
	1191757	0
	900000	98.27
	174110	52.85
	183675	
	24449	
	6897	0.9
3.879	0	
	1250000	99.43
	6481410	99.5
2.102	211005	0
	2000000	0
	981591	98.68
0.983	3776350	0
5.518	442565	1.3
	49570	0.5
6.07	0	
	43289	
5.41	338261	0
	150732	50
0.695	661618	0
3.932	0	
	698933	99.61
	202779	100
	800000	99.3

dist_slaver	pop_1400	european_descent
4.423	9707	2.8
2.253	0	
	1306601	0
2.026	776187	0
4.085	231251	0
	1741101	0
	286375	3.9
	226444	5.5
	36325	0
	19021	
	10258	7.1
3.205	836512	0
	6438306	10
	174110	0
2.187	1496403	0
1.65	1322790	0
	2347003	100
		91.89
	783496	76.02
	1180650	7.5
	1081	
	377635	54.5
	120	
	432	
	1665106	0
	22994	
	33072	
	2250000	0
4.895	486527	18
3.253	348220	1
3.696	174110	1

on plates 20 (soil moisture storage capacity constraints), 21 (soil depth constraints), 22 (soil fertility co

ıstraints), 23 (soil drainage constraints), 24 (soil texture constraints), and 25 (soil chemical constraints

) in Fischer *et al.* (2002) and the country boundaries described above, we calculate the percentage of tl

he land surface area of each country that has fertile soil (defined as soil that is not subject to severe cons

straints for growing rainfed crops in terms of either soil fertility, depth, chemical and drainage propertie

es, or moisture storage capacity). Cape Verde, French Polynesia, Mauritius and Seychelles are not cover

ed by the Fischer *et al.* (2002) data, so for these countries we use instead the percentage of their land su

ırface area that is classified by the Food and Agriculture Organization (2008) as arable land or perman

ent crop land.