SUPPLEMENTARY MATERIAL

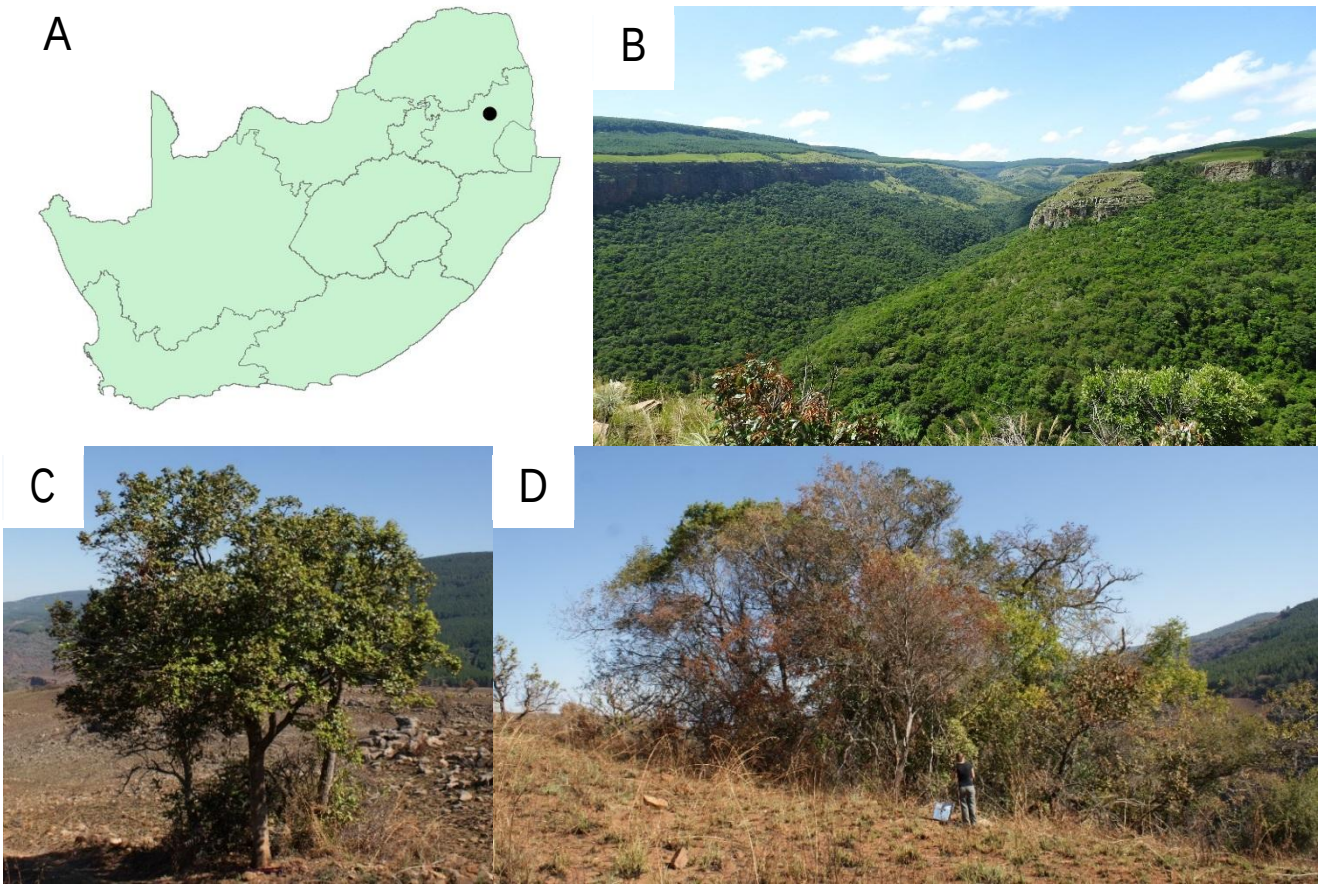


FIGURE S1. Images of a) a map illustrating where Buffelskloof Private Nature Reserve (green dot) is located in South Africa, b) the study site (including a section of the indigenous forested valley surrounded by grassy vegetation types), c) a small bush clump (approximately 61.827 m^2), and d) a large bush clump (approximately 1342.999 m^2) found at Buffelskloof Private Nature Reserve. Bush clumps surveyed in this study ranged in size from 10.053 m^2 to 1342.999 m^2.

Table S1 Table indicating which environmental variables were collected for each bush clump. A tick indicates that the respective environmental variables were measured for that clump, whereas a cross indicates that data (e.g. an ibutton) was recorded as faulty or lost on collection.

Bush clump	Temperature	Relative humidity	Soil moisture	Light intensity
BC01	✓		✓	✓
BC02	✓		✓	✓
BC03	X		✓	✓
BC04	✓		✓	✓
BC05	X		✓	✓
BC06	✓	✓	✓	✓
BC07	X		✓	✓
BC08	✓	✓	✓	✓
BC09	✓		✓	✓
BC10	✓		✓	✓
BC11	✓		✓	✓
BC12	✓	✓	✓	✓
BC13	✓		✓	✓
BC14	✓		✓	✓
BC15	✓	✓	✓	✓
BC16	✓	✓	✓	✓
BC17	✓		✓	✓

BC18	✓	✓	✓	✓
BC19	✓	✓	✓	✓
BC20	✓		✓	✓
BC21	✓	✓	✓	✓
BC22	X		✓	✓
BC23	✓	✓	✓	✓
BC24	✓		✓	✓
BC25	✓		✓	✓
BC26	✓	✓	✓	✓
BC27	✓		✓	✓
BC28	✓	✓	✓	✓
BC29	✓	✓	✓	✓
BC30	✓	✓	✓	✓
BC31	✓		✓	✓
BC32	✓		✓	✓
BC33	✓	✓	✓	✓
BC34	✓	✓	✓	✓
BC35	✓		✓	✓
BC36	✓		✓	✓
BC37	✓	✓	✓	✓

BC38	✓		✓	✓
BC39	✓		✓	✓
BC40	✓	✓	✓	✓

TABLE S2 List of tree species and their habitat preferences in the Buffelskloof Private Nature Reserve, South Africa. Depicted in the table are forest specialization values and habitat breadths calculated for each of the species (compare Table S3). Founder species were identified as those species that initiated a bush clump. Forest species were classified according to field guides as those species that only occurred in forest-type habitats.* indicates whether the species was identified as a savanna species (i.e. not found in either the bush clumps or forested valley of the reserve but rather within the surrounding grassy matrix between bush clumps) and/or found within the 40 bush clumps (BCs) sampled in this study. Median Boral values indicate the results from the Boral analysis that was implemented using the sapling data. As such only species that were found as saplings and present in more than 10 clumps) have values presented. More negative numbers indicate a preference for younger bush clumps, whereas more positive values indicate a preference for more mature bush clumps. Species are ranked based on where they are most likely be found along the successional gradient; thus species most likely to be found in larger bush clumps (which have larger associated basal areas) are expected to be more 'forest' type species, whereas species most likely to be found in the smaller bush clumps (with smaller associated basal areas) are expected to be more savanna type species.

Species	Forest specialization	Habitat breadth	Savanna species	BC species	Founder species	Forest species	Median Boral values
Acalypha glabrata	4.67	5	*	*			
Allophylus africanus	5	5		*			
Aloe arborescens	2.67	5	*				
Aloe marlothii	3	5	*				
Annona senegalensis	3.5	6	*				
Apodytes dimidiata	4	4		*			0.128
Berchemia zeyheri	3	5	*	*			
Brachylaena rotundata	3	5	*				
Brachylaena transvaalensis	4.5	4		*			
Canthium inerme	4	4		*			0.030

Canthium mundianum	5	5		*			0.108
Carissa bispinosa	5	3		*			0.200
Cassinopsis ilicifolia	6.5	6		*		*	
Cassipourea gerrardii	6.5	6		*		*	
Celtis Africana	3.86	1		*			0.063
Cephalanthus natalensis	5	5	*	*	*		
Chaetachme aristate	4.4	3		*			
Chionanthus foveolatus subsp. *Foveolatus*	6.5	6		*		*	
Choristylis rhamnoides	6.5	6		*		*	
Clausena anisata	5.67	5		*			
Clerodendrum glabrum	4	3		*			
Combretum erythrophyllum	3.5	6	*				
Combretum kraussii	5.67	5		*	*		0.148
Combretum molle	3	5	*	*	*		0.056
Combretum zeyheri	3	5	*	*	*		
Coptosperma supra-axillare	3.75	4	*				
Crotolaria capensis	5.5	6	*				
Crypolepis oblongifolia	3.33	5		*			
Cryptolepis cryptolepioides	1.67	5		*			
Cussonia natalensis	3	5	*	*			
Cussonia paniculata var. *sinuata*	3	5	*				
Cussonia spicata	3.75	4	*	*	*		
Cyathea dregei	3	6	*				
Dalbergia armata	6.5	6		*		*	0.190
Dichrostachys cinerea subsp. *africana*	3.5	6	*				
Diospyros lycioides subsp. *guerkei*	3.5	0	*	*			
Diospyros lycioides subsp. *sericea*	3.5	4	*				
Diospyros whyteana	3.33	5		*			0.153
Dombeya pulchra	4.33	5		*			

Dombeya rotundifolia	3.5	6	*	*			
Dovyalis lucida	7	7		*		*	
Dovyalis zeyheri	3.75	4		*			
Ehretia rigida	2.67	5	*	*			
Ekebergia pterophylla	5	5	*	*	*		0.037
Empogona lanceolata	4	2		*			
Englerophytum magalismontanum	5	5	*	*	*		0.078
Erythrina lysistemon	3.5	4	*				
Erythroxylum delagoense	2.83	2		*			
Erythroxylum emarginatum	6	5		*		*	
Euclea crispa subsp. *crispa*	3	3		*	*		0.090
Euclea natalensis subsp. *natalensis*	4	1		*			0.234
Eugenia natalitia	7	7		*	*		
Euphorbia cooperi	3	5	*				
Euphorbia ingens	3	5	*				
Faurea rochetiana subsp. *speciosa*	2.33	5	*				
Faurea saligna	3	5	*	*	*		
Ficus burkei	3	5		*			
Ficus glumosa	3	5	*				
Ficus ingens	2.25	4	*				
Ficus salicifolia	3	5	*				
Ficus sur	4.5	4		*	*		
Grewia occidentalis	5	3		*			0.101
Gymnosporia buxifolia	3	1	*	*			
Gymnosporia harveyana	5.5	4		*		*	
Halleria lucida	4.2	3		*			
Harpephyllum caffrum	7	7		*		*	
Heteromorpha arborescens var. *abyssinica*	3.75	4		*			
Heteropyxis natalensis	4.25	4	*	*	*		

Hippobromus pauciflorus	6	5		*			0.171
Hyperacanthus amoenus	4.67	5	*				
Ilex mitis	7	7		*		*	
Indigofera swaziensis	2.67	5	*				
Keetia gueinzii	6.5	6		*		*	
Lannea discolor	3	5	*				
Lopholaena coriifola	1.67	5	*				
Maerua cafra	5	5	*	*			
Maesa lanceolata	3.6	3		*	*		
Maytenus peduncularis	6	6		*		*	0.118
Maytenus undata	4.4	3		*			
Mimusops obovata	5.33	5		*			
Morella microbracteata	3	6	*				
Morella pilulifera	2.67	5	*	*			
Morella serrata	3	6	*				
Mundulea sericea	3	5	*				
Myrsine Africana	4	3		*			0.105
Nuxia congesta	3.2	3	*				
Obetia tenax	3	5	*				
Ochna holstii	5	5		*		*	0.248
Ochna natalitia	2.75	4		*			0.069
Olea europaea subsp. *africana*	3	5	*				
Osyris lanceolata	4	3	*	*			
Pappea capensis	3.33	5	*	*			
Pavetta cooperi	4.5	6	*	*			0.238
Pavetta edentula	3	5	*				
Pavetta eylesii	3	5	*				
Pavetta gardeniifolia var. *subtomentosa*	3	5		*			0.165
Pavetta gracilifolia	3	3		*			
Peddiea africana	6.5	5		*		*	

Peltophorum africanum	3.5	6	*				
Phylica paniculata	3.75	4	*				
Pittosporum viridiflorum	4.5	2		*			0.076
Pleurostylia capensis	6	5		*			0.231
Protea caffra subsp. *caffra*	2.5	6	*				
Protea gaguedi	2.25	4	*				
Protea roupelliae subsp. *roupelliae*	1.67	5	*	*			
Psychotria capensis	5	4		*			0.129
Psydrax obovata subsp. *Elliptica*	6	6		*			
Ptaeroxylon obliquum	4.67	5	*				
Pterocarpus angolensis	3	5	*				
Pterocelastrus echinatus	5	5	*	*	*		0.092
Pterocelastrus rostratus	4.5	6		*		*	
Rhamnus prinoides	6.5	6		*		*	
Rhoicissus rhomboidea	6.5	6		*		*	
Rhoicissus tomentosa	6.5	6		*		*	
Rhoicissus tridentata subsp. *cuneifolia*	3.75	4	*	*			
Rhus (Searsia) chirindensis	4.5	2		*	*		0.104
Rhus (Searsia) dentata	4.4	3	*	*			0.042
Rhus(Searsia) lucida	6.5	6		*	*		0.098
Rhus (Searsia) pentheri	2.5	4	*	*	*		0.109
Rhus (Searsia) pyroides var. *gracilis*	3.6	3		*	*		
Rhus (Searsia) rehmanniana subsp. *rehmanniana*	3	4	*	*			
Rhus (Searsia) tumulicola var. *meeuseana*	1	6	*				
Rhus (Searsia) tumulicola var. *tumulicola*	2.67	5	*				
Robsonodendron eucleiforme	6.5	6		*	*		
Rotheca myricoides	3.33	5	*	*			
Rothmannia capensis	5	5		*		*	

Schefflera umbellifera	6.5	6		*		*	
Schrebera alata	5	4	*	*			
Scolopia mundii	4.33	5		*			0.093
Scolopia zeyheri	4.4	3		*			0.146
Scutia myrtina	6.5	6		*		*	
Secamone alpinii	6	5		*			
Senegalia ataxacantha	4	3		*	*		0.096
Senegalia caffra	2.8	3	*				
Solanum giganteum	3.33	2		*			
Strychnos henningsii	4	4	*	*			
Strychnos madagascariensis	4.67	5	*				
Strychnos spinosa	4.5	4	*				
Syzygium cordatum	4.2	3	*	*	*		0.169
Tarchonanthus trilobus	3.8	3	*	*	*		
Tricalysia capensis var. *transvaalensis*	7	7		*		*	
Trimeria grandifolia	6.5	6		*			
Vachellia karroo	2.33	5	*				
Vachellia nilotica subsp. *kraussiana*	3.5	6	*				
Vachellia sieberiana subsp. *woodiana*	2.33	5	*				
Vangueria infausta	3.5	4	*	*	*		
Vepris reflexa	3	5	*				
Ximenia caffra	3	5	*	*			
Zanthoxylum capense	3.75	4		*			0.117
Ziziphus mucronata	4	3	*	*	*		

TABLE S3 An eight-class habitat gradient classification ranging from closed habitats (values close to 1) to open habitats (values close to 8). Characteristic terms used in field guide descriptions are provided for each habitat class (Coates Palgrave, 2002, Schmidt, Lotter & McCleland, 2002, Van Wyk & Van Wyk, 2013). Each tree species (compare Table S2) was scored on the habitat class/es they were reported in the literature. For species occurring in a number of different habitat classes, an average forest specialization score was calculated as the mean class for which the species was described (Table S2).

Habitat	**Ordered gradient**	**Field guide descriptions**
Forest	8	Mist-belt forest, evergreen forest, afromontane forest, coastal forest, riverine forest, montane forest
Wooded crevices	7	Forest margins, wooded gullies/ kloofs/ ravines
Thicket	6	Riverine fringe thicket, coastal thicket/ dune bush, sand dunes/ coastal scrub, valley bushveld, Albany thicket, coastal bush
Closed woodland (mesic)	5	Thornveld, moist bushveld, bushveld, Jesse bush, low altitude woodlands
Open woodland (arid)	4	Grassy woodlands, wooded grassland, open woodland/bushveld, dry woodlands, wooded grasslands, high altitude woodlands
Rocky areas in otherwise shurbland, woodland or grassland	3	Rocky ridges, including termite mounds, mountain slopes and hillsides *Please note: rocky ridges can have quite dense woody vegetation, even in grassland areas

Open shrubland	2	Low scrub (taller forms to be placed under thicket), karroid scrub
Grasslands	1	Montane grasslands, high-altitude grasslands, grassy hillsides/mountain slopes, Highveld grassland, plateau, coastal grasslands

TABLE S4 Results of univariate generalized linear models testing the relationship between bush clump area and a) species richness (log-transformed), b) basal area, and c) the number of large trees within each bush clump. *** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$, NS = not significant.

	Estimate	**Std Error**	**t-value**	**R^2 value**	**p-value**
Species richness ~ Area	0.045	0.005	8.930	0.68	***
Basal area ~ Area	0.012	0.001	13.053	0.88	***
Total trees ~ Area	0.003	0.001	58.32	0.76	***

TABLE S5 Results from generalized linear models testing if environmental variables influenced the change in species composition over succession. Similarity was calculated as follows: the Morisita-Horn index of similarity in species composition between each of the 10 smallest bush clumps was calculated and averaged. This average was then compared to the similarity between each of the remaining 30 bush clumps. Similarity was used as a response variable and environmental variable measures (mean and minimum temperature, the range of relative humidity, minimum soil moisture and light intensity inside and outside of clumps) were used as predictor variables. NS = not significant; * = $p < 0.05$; ** = $p < 0.01$; and *** = $p < 0.001$.

		Estimate	**Std Error**	**t-value**	**R^2**	**p-value**
Temperature	Mean	1.061	0.637	1.665	0.10	*
	Minimum	-1.004	0.361	-2.778	0.25	*
Humidity	Range	0.198	0.150	1.320	0.13	*
Soil moisture	Minimum	-0.291	0.143	-2.037	0.12	*
Light intensity	Range	-0.004	0.001	-2.632	0.20	**

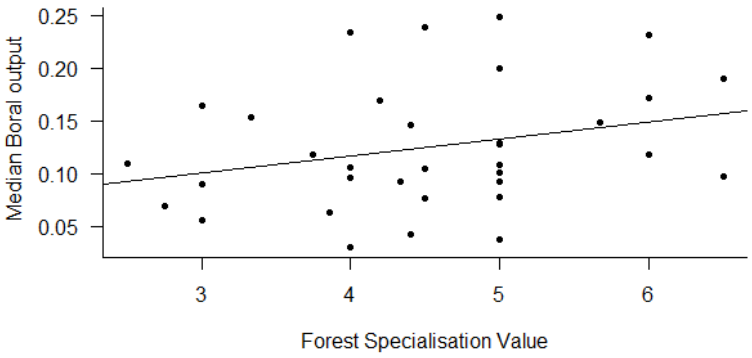
TABLE S6 Results of beta regression models (fitted with a Gaussian distribution and log link) testing the relationships between a) the proportion of founder species across different sized bush clumps, and b) the proportion of forest species across different sized bush clumps. NS = not significant; * = $p < 0.05$; ** = $p < 0.01$; and *** = $p < 0.001$.

	Estimate	**Std Error**	**t-value**	**R^2 value**	**p-value**
Proportion founder species ~ Area	-0.002	0.001	-5.624	0.61	***
Proportion forest species ~ Area	0.002	0.001	4.072	0.15	***

Table S7 Results of a generalized linear model testing the relationships between a) the community-weighted mean of species forest specialization of trees with bush clump area, b) the community-weighted mean of species specialization of saplings with bush clump area, c) the community-weighted mean of habitat breadth of trees with bush clump area and d) the community-weighted mean of habitat breadth of saplings with bush clump area. NS = not significant; * = $p < 0.05$; ** = $p < 0.01$; and *** = $p < 0.001$.

	Estimate	**Std Error**	**t-value**	**R^2 value**	**p-value**
Tree specialisation ~ Area	-0.0005	0.0001	-3.299	0.22	**
Sapling specialisation ~ Area	-0.0004	0.0002	-2.060	0.10	*
Tree habitat breadth ~ Area	-0.0002	0.0002	-1.030	0.03	NS
Sapling habitat breadth ~ Area	-0.0003	0.0002	-1.124	0.03	NS

FIGURE S2 Results of a generalized linear model illustrating the relationship between the median basal area output (generated from a Boral analysis) and the forest specialization values of saplings that were found to be present in more than 10 bush clumps (R^2 = 0.08, F(32,33) = 2.785, P = 1.05e-01).



Appendix A

We tested if the average similarity index calculated between each large bush clump and the ten smallest bush clumps (see Methods) was associated with the environmental conditions (temperature, relative humidity, soil moisture and light intensity) of the respective large bush clump. We hypothesized that both measures of central tendency, extremes and variation in environmental conditions could affect successional gradients (O'Connor & Chamane, 2012). Therefore, the mean, range, maximum, minimum and coefficient of variation of temperature, relative humidity and soil moisture were calculated. Because only one mean measure of light intensity was calculated, no measures of central tendency, extremes and variation were considered for this variable. Environmental measures had different sample sizes due to limited availability of hygrobuttons (humidity) and damaged or lost ibuttons (temperature: $n = 27$, relative humidity: $n = 13$, soil moisture: $n = 30$, light intensity: $n = 30$). A correlation matrix of the mean, median, range, coefficient of variation, minimum and maximum for temperature, relative humidity and soil moisture and light intensity was generated to test for collinearity amongst these variables (Table A1). After excluding highly correlated variables ($r > 0.7$), the variables that remained and thus used in further analyses were: mean and minimum temperature, the range of relative humidity, minimum soil moisture and light intensity.

TABLE A1 Pearson's correlation coefficients between environmental variables used to test if the average similarity index of each bush clumps was associated with environmental conditions of the bush clumps. For temperature, relative humidity and soil moisture, the mean, range, maximum, minimum and coefficient of variation were calculated. Light intensity was calculated as the difference in light intensity between inside and outside of a bush clump. Maximum relative humidity was excluded from analyses as all ibuttons reached a maximum humidity of 100%. Shaded cells indicate variables that were retained for analyses.

		Soil moisture					Light intensity	Temperature					Relative humidity			
		Range	Mean	Maximum	Minimum	Coefficient of variation	Difference	Range	Mean	Maximum	Minimum	Coefficient of variation	Range	Mean	Minimum	Coefficient of variation
Soil moisture	Range	1	0.41	0.64	0.09	0.55	-0.01	-0.14	0.15	-0.03	0.67	-0.10	0.07	0.06	-0.07	0.05
	Mean	0.41	1	0.94	0.92	-0.4	0.31	-0.11	0.27	-0.04	0.41	0.12	-0.28	0.05	0.28	-0.24
	Maximum	0.64	0.94	1	0.82	-0.14	0.18	-0.15	0.22	-0.06	0.52	0.05	-0.14	0.02	0.14	-0.16
	Minimum	0.09	0.92	0.82	1	-0.59	0.33	-0.07	0.19	-0.08	0.01	0.23	-0.35	-0.04	0.35	-0.35
	Coefficient of variation	0.55	-0.4	-0.14	-0.59	1	0.51	0.15	-0.01	0.17	0.10	-0.04	-0.08	-0.18	0.08	0.10
Light intensity	Difference	-0.01	0.31	0.18	0.33	0.51	1.00	-0.03	0.16	0.04	0.45	-0.26	-0.11	0.06	0.11	-0.18
Temperature	Range	-0.14	-0.11	-0.15	-0.07	0.15	-0.03	1	0.43	0.98	-0.51	0.78	0.20	-0.45	-0.20	0.19
	Mean	0.15	0.27	0.22	0.19	-0.01	0.16	0.43	1	0.51	0.19	0.44	-0.06	-0.15	0.06	-0.10
	Maximum	-0.03	-0.04	-0.06	-0.08	0.17	0.04	0.98	0.51	1	-0.35	0.72	0.21	-0.42	-0.21	0.18
	Minimum	0.67	0.41	0.52	0.01	0.10	0.45	-0.51	0.19	-0.35	1	-0.6	0.04	0.27	-0.04	-0.11
	Coefficient of variation	-0.10	0.12	0.05	0.23	-0.04	-0.26	0.78	0.44	0.72	-0.6	1	-0.14	-0.37	0.14	-0.02
Relative humidity	Range	0.07	-0.28	-0.14	-0.35	-0.08	-0.11	0.20	-0.06	0.21	0.04	-0.14	1	-0.66	-1	0.89
	Mean	0.06	0.05	0.02	-0.04	-0.18	0.06	-0.45	-0.15	-0.42	0.27	-0.37	-0.66	1	0.76	-0.77
	Minimum	-0.07	0.28	0.14	0.35	0.08	0.11	-0.20	0.06	-0.21	-0.04	0.14	-1	0.76	1	-0.89
	Coefficient of variation	0.05	-0.24	-0.16	-0.35	0.10	-0.18	0.19	-0.10	0.18	-0.11	-0.02	0.89	-0.77	-0.89	1