

Bio3018F Practical 2022

Biodiversity and Ecosystem Function in the Cape Floristic Region

Jasper Slingsby

Introduction

Our understanding of and approach to studying the relationship between biodiversity and ecosystem function (B-EF) has evolved over the past few decades (Figure 1; van der Plas 2019). The historical view was one of biodiversity as the response variable, being determined by environmental and anthropogenic factors, with little feedback to ecosystem function. In the early 1990s, this shifted (and perhaps overcompensated) to focus on the causal effects of variation in biodiversity on ecosystem functioning, with little emphasis on the role of environmental variation. More recently, there is recognition that biodiversity both responds to the environment and partly drives ecosystem function in concert with environmental variation. The current focus of most B-EF research is on the relative importance of abiotic drivers (natural and anthropogenic) versus biotic variation in determining various ecosystem functions.

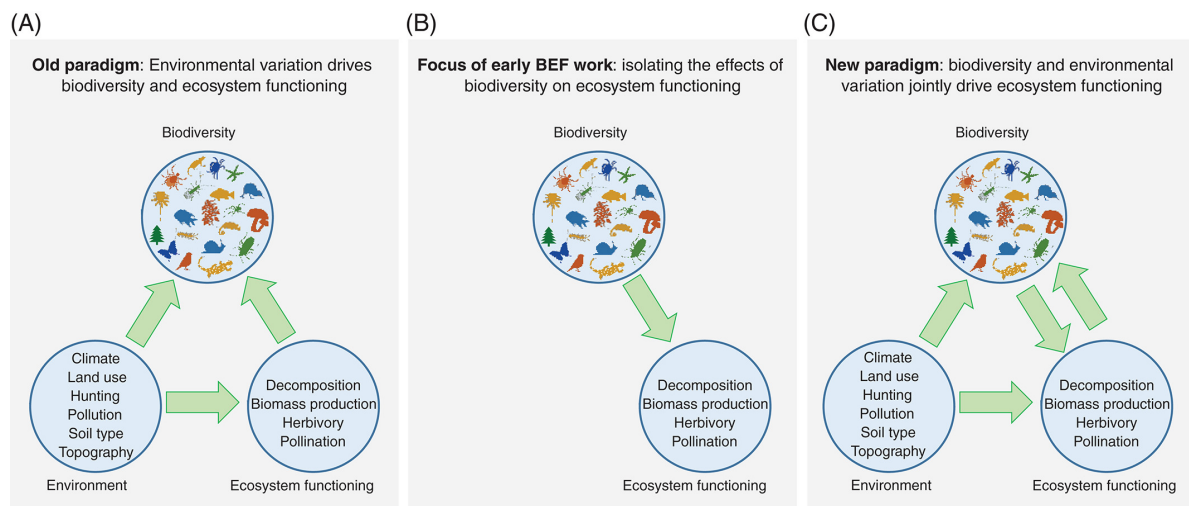


Figure 1: (from van der Plas 2019)

The Cape Floristic Region (CFR) of South Africa is one of the most botanically diverse areas on the planet. The indigenous flora of the CFR has several components with different evolutionary and biogeographic origins (Figure 2; Bergh et al. 2014), and distinct differences in a range of ecosystem functions. The CFR also has a long history of global change impacts, from direct anthropogenic disturbance (e.g. land use / land cover) to the introduction of invasive alien species. This provides a range of highly varied ecosystem types within close proximity, that often share or contrast in their biotic composition (species, functional and phylogenetic diversity) and abiotic conditions - climate, soils and disturbance regimes (fire, herbivory).

[Describe the measures of ecosystem function here... i.e. average and amplitude of seasonality of the Normalized Difference Vegetation Index (NDVI) recorded by the MODIS Terra satellite...]

In this practical, we will explore how variation in a set of measures of biodiversity (species, functional and

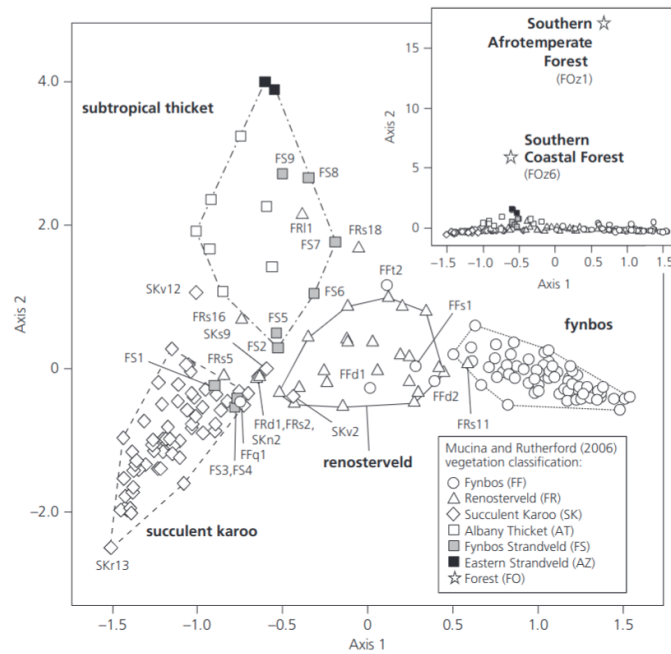


Figure 2: Ordination of genus-level floristic similarities of GCFR vegetation units sensu Mucina and Rutherford (2006), as inferred on the basis of the 'important species' lists provided in The vegetation of South Africa, Lesotho and Swaziland (Mucina and Rutherford 2006). Figure from Bergh et al. 2014.

phylogenetic α and β diversity) and environmental conditions relate to a set of metrics of ecosystem function derived from satellite timeseries.

The questions are:

- Does the variation in environmental conditions potentially explain the observed variation in biodiversity (species, functional and phylogenetic α and β diversity)?
- To what degree does the variation in functional and phylogenetic diversity potentially explain the observed variation in our measures of ecosystem function?
- What is the relative role of the environment versus biodiversity in determining the observed variation in ecosystem function?

Finally, consider this practical a descriptive study. In your discussion, describe a follow-up study that you would perform to discern cause from correlation and partition the relative influence of environmental conditions versus biodiversity on our measures of ecosystem function.

Methods:

The sites are selected to represent contrasting vegetation, but to all be the same (or similar) post-fire age (time since last fire). We will split into 4 teams of 2 or 3. Each pair will survey a point location (towards the corners) within the 250 by 250m MODIS pixel that makes up each site.

Each team will need:

- One or more smartphones
- 2 x 10m measuring tape (or longer)
- 1 x clipboard, paper and pen or pencil

- 1 x densiometer
- 1 x metre rule
- 1 x Vernier calipers
- 8 x large plastic bags for carrying soil and plant samples for each point location
- 8 x soil sample bags
- 2 x masking tape
- 2 x marker pen

At each site, navigate to your team's point location, lay out the two tapes at 90 degrees, crossing at 3.2m and ending at 6.4m. Consider this your guide for a 3.2m radius (~20m²) circle. Within the circle we will measure:

1. *Environmental conditions:*

- Estimate % projected cover (think the area you would see from above) bare soil
- Take a densiometer reading at ground level. To do this, hold the densiometer level on the soil surface. Pick a spot close to the centre, but try not to pick an obviously open (or closed) patch, it should be representative of the location. To take a reading, split each square into quarters and score them for the amount of light visible - a value from 0 (complete canopy cover) to 4 (no vegetation visible) - counting up these values for all 24 squares (to a maximum of 96), and write this down. We will convert this to canopy cover later, applying the formula $100 - 1.04 * X$, where X is your reading.
- Take a **soil sample** (as per Mike's prac, but it can be smaller as we are going to pool the 4 samples per site). These we will process for soil colour and pH as per Mike's prac.
- Do a **dung count**, scoring dung for the point location by the number of quarters where you find dung (i.e. a single score from 0-4 for the point location). Try to avoid scoring obvious single scat ("dung creation") events in more than one quadrat, unless it's an impressive pile.
- Take a few notes (and photos) on any other features that you think may be important or interesting (slope, rockiness, whatever).

2. *Diversity sampling:*

- First, make sure your smartphone is fully charged and set to record GPS location with your photographs!
- With your team, decide on which are the top 5 species by % projected cover. If your site is dominated by fewer than 5 species, count up as many species as make up 80% of the vegetation.
 - Take diagnostic photos for the 5 species (habit (whole plant), leaf, base, flowers and/or fruits).
 - For each of three individuals of your 5 target species, measure the height and collect a shoots for measuring leaf length and leaf width (mark with masking tape and put in sample bag for the site).
- Finally, set a timer and take as many photos of new species (other than your 5 target species) within or near your plot as you can before the alarm goes off. Make sure to take a photo of your site label on your sample bag between sites so you know which photos were collected at which sites. When we get back to base you will upload the photos to folders in the intranet labeled by site.

Analyses

Species Diversity

For this I have just taken the count of species encountered at each point, and the aggregated set of unique species for each site. i.e. no rarefaction etc. Do you think this is an issue for the method we used?

Site	Species Number
grass	13
invasion	13

Site	Species Number
sandstone	24

Functional Diversity

Here I've estimated Functional Diversity (FD) according to the method of Petchey and Gaston (2002) for each of the points, sites and functional turnover between points and between sites using the method of Bryant et al. 2008.

Sites:

	FD	SR
invasion	12.181	11
limestone	5.815	11
sandstone	6.964	9
grass	7.369	9
renosterveld	7.483	11
sand	6.876	9

By point sample:

	FD	SR
grass_SE	3.200	2
renosterveld_SE	4.181	5
invasion_SE	7.422	4
sand_SE	4.650	5
sandstone_SE	5.231	5
limestone_SE	4.599	5
grass_NE	3.729	3
renosterveld_NE	4.756	4
invasion_NE	5.856	5
sand_NE	4.136	4
sandstone_NE	4.344	3
limestone_NE	4.193	5
grass_SW	4.778	5
renosterveld_SW	5.410	5
invasion_SW	7.150	4
sand_SW	4.873	4
limestone_SW	4.599	5
sandstone_SW	4.344	3
grass_NW	4.680	3
renosterveld_NW	4.018	5
invasion_NW	6.413	3
sand_NW	2.713	1
sandstone_NW	5.840	5
limestone_NW	4.193	5

And functional turnover between sites:

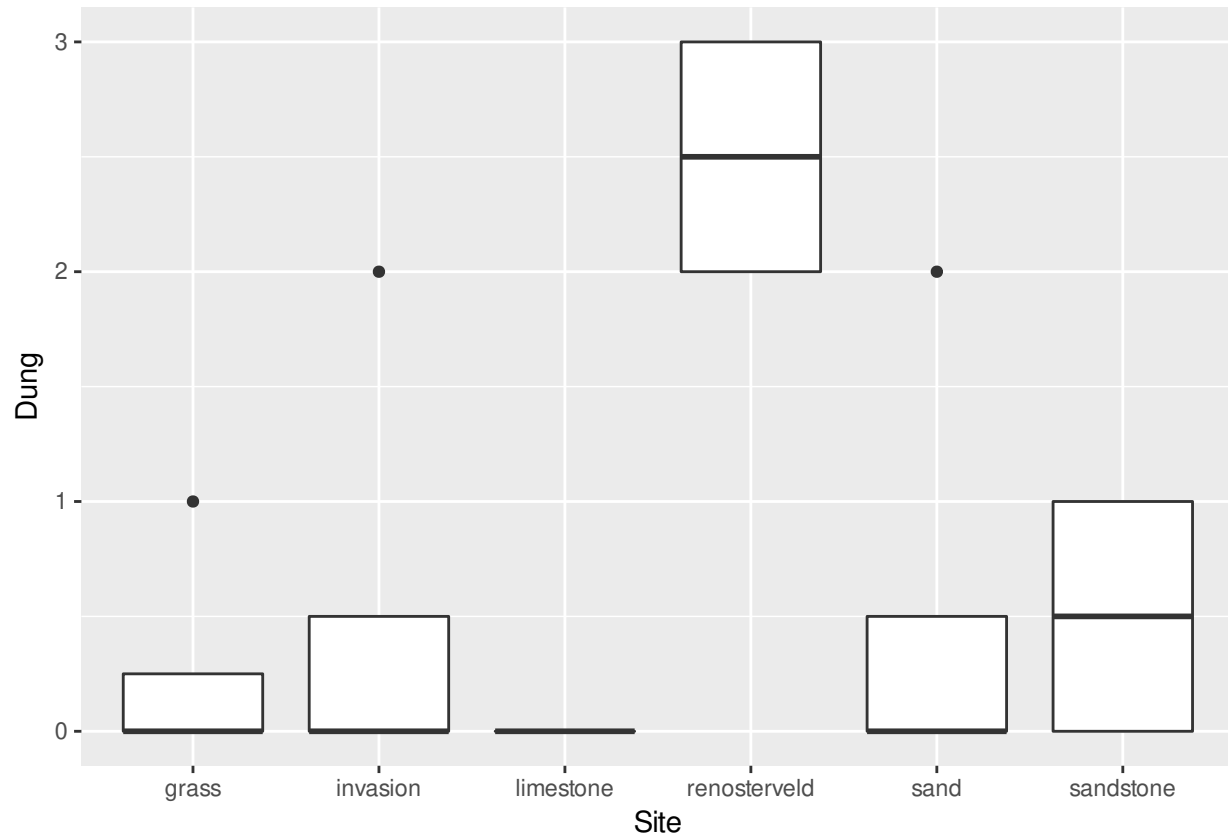
	invasion	limestone	sandstone	grass	renosterveld	sand
invasion						
limestone	0.401					
sandstone	0.431	0.487				
grass	0.487	0.481	0.643			
renosterveld	0.378	0.412	0.560	0.603		
sand	0.460	0.504	0.800	0.647	0.564	

See help file `?picante::phylosor` in R for details to help know how to interpret. Note that while the function was written for phylogenetic turnover, we've used it for functional turnover.

Environmental Similarity among sites

Here I provide a table and an ordination of the site-level environmental measurements we took relating to various aspects of soil conditions, canopy coverage and herbivory.

```
## [1] "Site"          "Point"          "PercentBareSoil" "SoilPH"
## [5] "SoilColour"     "Dung"           "Densiometer"
```



```
##
## Kruskal-Wallis rank sum test
##
## data:  Dung by Site
## Kruskal-Wallis chi-squared = 12.73, df = 5, p-value = 0.02604
## Warning: Site was coerced to a factor.
```

##	Comparison	Z	P.unadj	P.adj
## 1	grass - invasion	-0.2020726	0.839859973	0.89984997
## 2	grass - limestone	0.5196152	0.603331772	0.90499766
## 3	invasion - limestone	0.7216878	0.470486422	0.88216204
## 4	grass - renosterveld	-2.7135463	0.006656727	0.04992545
## 5	invasion - renosterveld	-2.5114737	0.012022825	0.04508560
## 6	limestone - renosterveld	-3.2331615	0.001224283	0.01836425
## 7	grass - sand	-0.2020726	0.839859973	0.96906920
## 8	invasion - sand	0.0000000	1.000000000	1.00000000
## 9	limestone - sand	-0.7216878	0.470486422	1.00000000
## 10	renosterveld - sand	2.5114737	0.012022825	0.06011413
## 11	grass - sandstone	-0.5196152	0.603331772	1.00000000
## 12	invasion - sandstone	-0.3175426	0.750831884	0.93853986
## 13	limestone - sandstone	-1.0392305	0.298697556	0.74674389
## 14	renosterveld - sandstone	2.1939310	0.028240369	0.08472111
## 15	sand - sandstone	-0.3175426	0.750831884	1.00000000

Ordination...

Species...

```
## Wisconsin double standardization
## Run 0 stress 0
## Run 1 stress 0
## ... Procrustes: rmse 0.1941456  max resid 0.3020618
## Run 2 stress 0
## ... Procrustes: rmse 0.2634795  max resid 0.4254076
## Run 3 stress 0
## ... Procrustes: rmse 0.248004  max resid 0.4999868
## Run 4 stress 0
## ... Procrustes: rmse 0.1835827  max resid 0.2515103
## Run 5 stress 9.621984e-05
## ... Procrustes: rmse 0.2447503  max resid 0.315346
## Run 6 stress 0
## ... Procrustes: rmse 0.2546058  max resid 0.3880521
## Run 7 stress 9.390315e-05
## ... Procrustes: rmse 0.2446446  max resid 0.3153557
## Run 8 stress 0.07554294
## Run 9 stress 0
## ... Procrustes: rmse 0.2541325  max resid 0.4201762
## Run 10 stress 0
## ... Procrustes: rmse 0.2297  max resid 0.4037676
## Run 11 stress 0
## ... Procrustes: rmse 0.2743042  max resid 0.4678663
## Run 12 stress 0.07554407
## Run 13 stress 0
## ... Procrustes: rmse 0.234981  max resid 0.343873
## Run 14 stress 0
## ... Procrustes: rmse 0.3006568  max resid 0.461236
## Run 15 stress 0.0755428
## Run 16 stress 0
## ... Procrustes: rmse 0.2306435  max resid 0.3130419
## Run 17 stress 0
## ... Procrustes: rmse 0.220787  max resid 0.258094
## Run 18 stress 0
```

```

## ... Procrustes: rmse 0.2792245  max resid 0.4164073
## Run 19 stress 7.714497e-05
## ... Procrustes: rmse 0.240895  max resid 0.4772407
## Run 20 stress 0
## ... Procrustes: rmse 0.2138839  max resid 0.2763718
## Run 21 stress 9.817108e-05
## ... Procrustes: rmse 0.2447687  max resid 0.3152426
## Run 22 stress 0
## ... Procrustes: rmse 0.1851204  max resid 0.2958558
## Run 23 stress 0
## ... Procrustes: rmse 0.2601809  max resid 0.4345994
## Run 24 stress 0
## ... Procrustes: rmse 0.2243857  max resid 0.3923987
## Run 25 stress 0
## ... Procrustes: rmse 0.2873341  max resid 0.4198273
## Run 26 stress 0
## ... Procrustes: rmse 0.2051153  max resid 0.2804596
## Run 27 stress 0
## ... Procrustes: rmse 0.2376658  max resid 0.346001
## Run 28 stress 0
## ... Procrustes: rmse 0.24786  max resid 0.4288902
## Run 29 stress 0
## ... Procrustes: rmse 0.248767  max resid 0.3783654
## Run 30 stress 0
## ... Procrustes: rmse 0.2395855  max resid 0.4002375
## Run 31 stress 6.03301e-05
## ... Procrustes: rmse 0.2008626  max resid 0.3629637
## Run 32 stress 0
## ... Procrustes: rmse 0.1385704  max resid 0.2458756
## Run 33 stress 0.07554357
## Run 34 stress 0
## ... Procrustes: rmse 0.190722  max resid 0.2652334
## Run 35 stress 0.07554303
## Run 36 stress 9.834261e-05
## ... Procrustes: rmse 0.2447309  max resid 0.3155207
## Run 37 stress 1.656061e-05
## ... Procrustes: rmse 0.261418  max resid 0.3832675
## Run 38 stress 9.057105e-05
## ... Procrustes: rmse 0.2446475  max resid 0.3153616
## Run 39 stress 0
## ... Procrustes: rmse 0.2232039  max resid 0.4113179
## Run 40 stress 9.55254e-05
## ... Procrustes: rmse 0.2616185  max resid 0.4346229
## Run 41 stress 0
## ... Procrustes: rmse 0.2342596  max resid 0.3230868
## Run 42 stress 0
## ... Procrustes: rmse 0.1737762  max resid 0.2739453
## Run 43 stress 2.993599e-05
## ... Procrustes: rmse 0.3040228  max resid 0.4664932
## Run 44 stress 7.405105e-05
## ... Procrustes: rmse 0.2595945  max resid 0.3857005
## Run 45 stress 0
## ... Procrustes: rmse 0.1985735  max resid 0.3087393
## Run 46 stress 0

```

```

## ... Procrustes: rmse 0.2409833 max resid 0.3900548
## Run 47 stress 0
## ... Procrustes: rmse 0.1539228 max resid 0.2575307
## Run 48 stress 0.0755431
## Run 49 stress 0
## ... Procrustes: rmse 0.2149904 max resid 0.3733981
## Run 50 stress 0
## ... Procrustes: rmse 0.2039205 max resid 0.3117415
## Run 51 stress 0
## ... Procrustes: rmse 0.2605085 max resid 0.4454501
## Run 52 stress 0
## ... Procrustes: rmse 0.22337 max resid 0.3911435
## Run 53 stress 0
## ... Procrustes: rmse 0.2448917 max resid 0.3734153
## Run 54 stress 0
## ... Procrustes: rmse 0.2025551 max resid 0.2871476
## Run 55 stress 0
## ... Procrustes: rmse 0.223718 max resid 0.3217976
## Run 56 stress 0
## ... Procrustes: rmse 0.2251098 max resid 0.3962341
## Run 57 stress 0
## ... Procrustes: rmse 0.2442244 max resid 0.4098058
## Run 58 stress 0
## ... Procrustes: rmse 0.2113223 max resid 0.3012029
## Run 59 stress 0
## ... Procrustes: rmse 0.2440639 max resid 0.3809131
## Run 60 stress 0.126243
## Run 61 stress 0
## ... Procrustes: rmse 0.1531734 max resid 0.2739461
## Run 62 stress 0
## ... Procrustes: rmse 0.2427576 max resid 0.4322134
## Run 63 stress 7.207211e-05
## ... Procrustes: rmse 0.2562691 max resid 0.4094413
## Run 64 stress 0
## ... Procrustes: rmse 0.1841445 max resid 0.327843
## Run 65 stress 0
## ... Procrustes: rmse 0.2119471 max resid 0.2877686
## Run 66 stress 0
## ... Procrustes: rmse 0.2165039 max resid 0.3840908
## Run 67 stress 0
## ... Procrustes: rmse 0.2939706 max resid 0.4428037
## Run 68 stress 9.836772e-05
## ... Procrustes: rmse 0.2446711 max resid 0.3153922
## Run 69 stress 9.188996e-05
## ... Procrustes: rmse 0.2403066 max resid 0.3169855
## Run 70 stress 0
## ... Procrustes: rmse 0.2373064 max resid 0.3896707
## Run 71 stress 0
## ... Procrustes: rmse 0.2139856 max resid 0.3879605
## Run 72 stress 0
## ... Procrustes: rmse 0.2390357 max resid 0.3468461
## Run 73 stress 0.07554381
## Run 74 stress 0
## ... Procrustes: rmse 0.2399689 max resid 0.3919265

```



```

## Run 75 stress 0
## ... Procrustes: rmse 0.2988747  max resid 0.4410314
## Run 76 stress 0
## ... Procrustes: rmse 0.260278  max resid 0.4215429
## Run 77 stress 0
## ... Procrustes: rmse 0.263991  max resid 0.3980484
## Run 78 stress 0
## ... Procrustes: rmse 0.2638317  max resid 0.419382
## Run 79 stress 0.0755428
## Run 80 stress 9.401107e-05
## ... Procrustes: rmse 0.2447596  max resid 0.315316
## Run 81 stress 0
## ... Procrustes: rmse 0.2290905  max resid 0.3306987
## Run 82 stress 0
## ... Procrustes: rmse 0.2692947  max resid 0.4660524
## Run 83 stress 7.922465e-05
## ... Procrustes: rmse 0.1396688  max resid 0.1915962
## Run 84 stress 0
## ... Procrustes: rmse 0.2487558  max resid 0.3906395
## Run 85 stress 1.302619e-05
## ... Procrustes: rmse 0.240176  max resid 0.3654305
## Run 86 stress 8.486938e-05
## ... Procrustes: rmse 0.2595085  max resid 0.5415384
## Run 87 stress 8.627427e-05
## ... Procrustes: rmse 0.219335  max resid 0.4038047
## Run 88 stress 0
## ... Procrustes: rmse 0.2843649  max resid 0.4042637
## Run 89 stress 0
## ... Procrustes: rmse 0.2621601  max resid 0.4539783
## Run 90 stress 0
## ... Procrustes: rmse 0.2181817  max resid 0.3324706
## Run 91 stress 0
## ... Procrustes: rmse 0.2942045  max resid 0.5271866
## Run 92 stress 0
## ... Procrustes: rmse 0.1951194  max resid 0.35005
## Run 93 stress 0
## ... Procrustes: rmse 0.3083938  max resid 0.4481045
## Run 94 stress 0.07554289
## Run 95 stress 0
## ... Procrustes: rmse 0.166265  max resid 0.2586955
## Run 96 stress 0.126243
## Run 97 stress 0
## ... Procrustes: rmse 0.2948387  max resid 0.3845264
## Run 98 stress 0.126243
## Run 99 stress 0
## ... Procrustes: rmse 0.2238125  max resid 0.3324432
## Run 100 stress 0.07554437
## Run 101 stress 5.063167e-05
## ... Procrustes: rmse 0.286358  max resid 0.5400302
## Run 102 stress 9.022858e-05
## ... Procrustes: rmse 0.244779  max resid 0.315318
## Run 103 stress 8.28633e-05
## ... Procrustes: rmse 0.1378844  max resid 0.2105593
## Run 104 stress 9.871485e-05

```

```

## ... Procrustes: rmse 0.244727 max resid 0.3154993
## Run 105 stress 9.966238e-05
## ... Procrustes: rmse 0.2447526 max resid 0.3153505
## Run 106 stress 0
## ... Procrustes: rmse 0.2757011 max resid 0.3930938
## Run 107 stress 7.914493e-05
## ... Procrustes: rmse 0.2210866 max resid 0.2727192
## Run 108 stress 0
## ... Procrustes: rmse 0.2278292 max resid 0.3659097
## Run 109 stress 8.69191e-05
## ... Procrustes: rmse 0.2447524 max resid 0.3154238
## Run 110 stress 9.418472e-05
## ... Procrustes: rmse 0.1438626 max resid 0.2469532
## Run 111 stress 0
## ... Procrustes: rmse 0.2631461 max resid 0.4157758
## Run 112 stress 5.549657e-05
## ... Procrustes: rmse 0.1412562 max resid 0.1815692
## Run 113 stress 0
## ... Procrustes: rmse 0.2496113 max resid 0.3819535
## Run 114 stress 0
## ... Procrustes: rmse 0.2534194 max resid 0.5222728
## Run 115 stress 0.126243
## Run 116 stress 0
## ... Procrustes: rmse 0.2441218 max resid 0.4263333
## Run 117 stress 0
## ... Procrustes: rmse 0.2199591 max resid 0.295466
## Run 118 stress 0
## ... Procrustes: rmse 0.2484498 max resid 0.3479379
## Run 119 stress 0
## ... Procrustes: rmse 0.264279 max resid 0.4075517
## Run 120 stress 0
## ... Procrustes: rmse 0.1252639 max resid 0.2349393
## Run 121 stress 5.993819e-05
## ... Procrustes: rmse 0.2499968 max resid 0.3947877
## Run 122 stress 0.07554446
## Run 123 stress 0
## ... Procrustes: rmse 0.257056 max resid 0.4051482
## Run 124 stress 0
## ... Procrustes: rmse 0.2107813 max resid 0.372321
## Run 125 stress 0
## ... Procrustes: rmse 0.2445511 max resid 0.4165092
## Run 126 stress 0.07554385
## Run 127 stress 0
## ... Procrustes: rmse 0.2448384 max resid 0.4293355
## Run 128 stress 9.114542e-05
## ... Procrustes: rmse 0.2447973 max resid 0.3154709
## Run 129 stress 0
## ... Procrustes: rmse 0.2168897 max resid 0.2989647
## Run 130 stress 0
## ... Procrustes: rmse 0.167822 max resid 0.2959878
## Run 131 stress 0
## ... Procrustes: rmse 0.1437493 max resid 0.2198038
## Run 132 stress 0
## ... Procrustes: rmse 0.2648239 max resid 0.3635054

```

```

## Run 133 stress 0
## ... Procrustes: rmse 0.2228419 max resid 0.3668272
## Run 134 stress 0.07554332
## Run 135 stress 0
## ... Procrustes: rmse 0.2019332 max resid 0.3190876
## Run 136 stress 0
## ... Procrustes: rmse 0.2266371 max resid 0.2977816
## Run 137 stress 0
## ... Procrustes: rmse 0.2224025 max resid 0.2970446
## Run 138 stress 9.64512e-05
## ... Procrustes: rmse 0.2447254 max resid 0.3153542
## Run 139 stress 0
## ... Procrustes: rmse 0.2415537 max resid 0.3803575
## Run 140 stress 0
## ... Procrustes: rmse 0.2215055 max resid 0.3919793
## Run 141 stress 0
## ... Procrustes: rmse 0.2151685 max resid 0.3679233
## Run 142 stress 0
## ... Procrustes: rmse 0.1897379 max resid 0.3258416
## Run 143 stress 0
## ... Procrustes: rmse 0.2718671 max resid 0.4861978
## Run 144 stress 9.738872e-05
## ... Procrustes: rmse 0.2446575 max resid 0.3153013
## Run 145 stress 0
## ... Procrustes: rmse 0.3157719 max resid 0.52675
## Run 146 stress 0
## ... Procrustes: rmse 0.2510774 max resid 0.3788781
## Run 147 stress 9.24354e-05
## ... Procrustes: rmse 0.24475 max resid 0.3153225
## Run 148 stress 0
## ... Procrustes: rmse 0.2016866 max resid 0.3301125
## Run 149 stress 0
## ... Procrustes: rmse 0.2461263 max resid 0.3695245
## Run 150 stress 0
## ... Procrustes: rmse 0.2706526 max resid 0.3434112
## Run 151 stress 0
## ... Procrustes: rmse 0.2544921 max resid 0.4505395
## Run 152 stress 0
## ... Procrustes: rmse 0.2124062 max resid 0.3997327
## Run 153 stress 0
## ... Procrustes: rmse 0.2052389 max resid 0.3410981
## Run 154 stress 0
## ... Procrustes: rmse 0.1698932 max resid 0.2763914
## Run 155 stress 0
## ... Procrustes: rmse 0.2227894 max resid 0.4445621
## Run 156 stress 0
## ... Procrustes: rmse 0.2453117 max resid 0.3883476
## Run 157 stress 0
## ... Procrustes: rmse 0.1787851 max resid 0.2722574
## Run 158 stress 0
## ... Procrustes: rmse 0.3072026 max resid 0.508865
## Run 159 stress 2.068767e-05
## ... Procrustes: rmse 0.249458 max resid 0.474373
## Run 160 stress 0

```

```

## ... Procrustes: rmse 0.2651954 max resid 0.4614357
## Run 161 stress 6.861476e-05
## ... Procrustes: rmse 0.1898216 max resid 0.2706023
## Run 162 stress 0
## ... Procrustes: rmse 0.2272299 max resid 0.4154768
## Run 163 stress 0
## ... Procrustes: rmse 0.2910832 max resid 0.5057274
## Run 164 stress 0
## ... Procrustes: rmse 0.2475288 max resid 0.3751254
## Run 165 stress 0
## ... Procrustes: rmse 0.2572975 max resid 0.4435754
## Run 166 stress 0
## ... Procrustes: rmse 0.2256707 max resid 0.4326396
## Run 167 stress 0
## ... Procrustes: rmse 0.2235935 max resid 0.3205188
## Run 168 stress 0
## ... Procrustes: rmse 0.2677501 max resid 0.4219588
## Run 169 stress 0.07554327
## Run 170 stress 0
## ... Procrustes: rmse 0.2262011 max resid 0.4028841
## Run 171 stress 0
## ... Procrustes: rmse 0.2732622 max resid 0.4908718
## Run 172 stress 9.773651e-05
## ... Procrustes: rmse 0.2446649 max resid 0.3152906
## Run 173 stress 0
## ... Procrustes: rmse 0.268853 max resid 0.4477557
## Run 174 stress 0
## ... Procrustes: rmse 0.2565218 max resid 0.4536221
## Run 175 stress 0
## ... Procrustes: rmse 0.2681227 max resid 0.433309
## Run 176 stress 9.060834e-05
## ... Procrustes: rmse 0.2076313 max resid 0.3150358
## Run 177 stress 9.817104e-05
## ... Procrustes: rmse 0.2447447 max resid 0.3153083
## Run 178 stress 0
## ... Procrustes: rmse 0.2860562 max resid 0.4673238
## Run 179 stress 0
## ... Procrustes: rmse 0.2689675 max resid 0.4210138
## Run 180 stress 0
## ... Procrustes: rmse 0.286279 max resid 0.3962711
## Run 181 stress 0
## ... Procrustes: rmse 0.3054511 max resid 0.499072
## Run 182 stress 0
## ... Procrustes: rmse 0.2627421 max resid 0.4041129
## Run 183 stress 0
## ... Procrustes: rmse 0.234736 max resid 0.3578983
## Run 184 stress 0
## ... Procrustes: rmse 0.2433329 max resid 0.4173787
## Run 185 stress 9.676399e-05
## ... Procrustes: rmse 0.2447151 max resid 0.3152608
## Run 186 stress 0.07554279
## Run 187 stress 0
## ... Procrustes: rmse 0.2972135 max resid 0.5063548
## Run 188 stress 8.924863e-05

```

```

## ... Procrustes: rmse 0.2401575  max resid 0.444384
## Run 189 stress 0
## ... Procrustes: rmse 0.2142134  max resid 0.4061505
## Run 190 stress 0
## ... Procrustes: rmse 0.2754274  max resid 0.3598718
## Run 191 stress 0
## ... Procrustes: rmse 0.2198081  max resid 0.3156415
## Run 192 stress 0
## ... Procrustes: rmse 0.2033484  max resid 0.329794
## Run 193 stress 0
## ... Procrustes: rmse 0.2295656  max resid 0.3587202
## Run 194 stress 0
## ... Procrustes: rmse 0.2614374  max resid 0.3737007
## Run 195 stress 9.663619e-05
## ... Procrustes: rmse 0.2447249  max resid 0.3152464
## Run 196 stress 7.235868e-05
## ... Procrustes: rmse 0.2351503  max resid 0.3725688
## Run 197 stress 0
## ... Procrustes: rmse 0.2442815  max resid 0.388346
## Run 198 stress 0
## ... Procrustes: rmse 0.2414974  max resid 0.367406
## Run 199 stress 0
## ... Procrustes: rmse 0.2538242  max resid 0.397537
## Run 200 stress 0
## ... Procrustes: rmse 0.1661095  max resid 0.2534194
## Run 201 stress 6.184131e-05
## ... Procrustes: rmse 0.2410502  max resid 0.4205954
## Run 202 stress 0
## ... Procrustes: rmse 0.2364196  max resid 0.4637963
## Run 203 stress 0
## ... Procrustes: rmse 0.2522758  max resid 0.3435137
## Run 204 stress 0
## ... Procrustes: rmse 0.226182  max resid 0.4261371
## Run 205 stress 0
## ... Procrustes: rmse 0.2121288  max resid 0.3058427
## Run 206 stress 0
## ... Procrustes: rmse 0.226109  max resid 0.4188964
## Run 207 stress 0
## ... Procrustes: rmse 0.3181905  max resid 0.5293156
## Run 208 stress 0
## ... Procrustes: rmse 0.2337621  max resid 0.2715954
## Run 209 stress 0
## ... Procrustes: rmse 0.2260563  max resid 0.342414
## Run 210 stress 0
## ... Procrustes: rmse 0.2346675  max resid 0.4290754
## Run 211 stress 8.563453e-05
## ... Procrustes: rmse 0.1363575  max resid 0.1797842
## Run 212 stress 9.669701e-05
## ... Procrustes: rmse 0.0990274  max resid 0.1748603
## Run 213 stress 5.238476e-05
## ... Procrustes: rmse 0.1817455  max resid 0.2757516
## Run 214 stress 8.655424e-05
## ... Procrustes: rmse 0.2447043  max resid 0.3153576
## Run 215 stress 0.1990853

```

```

## Run 216 stress 1.750375e-05
## ... Procrustes: rmse 0.1414305 max resid 0.2285512
## Run 217 stress 0
## ... Procrustes: rmse 0.2219042 max resid 0.2844032
## Run 218 stress 0.07554292
## Run 219 stress 9.617964e-05
## ... Procrustes: rmse 0.2446755 max resid 0.3152164
## Run 220 stress 0.07554412
## Run 221 stress 7.1718e-05
## ... Procrustes: rmse 0.2446939 max resid 0.3152986
## Run 222 stress 0
## ... Procrustes: rmse 0.2012246 max resid 0.2574144
## Run 223 stress 0
## ... Procrustes: rmse 0.2120624 max resid 0.3327002
## Run 224 stress 0
## ... Procrustes: rmse 0.2460354 max resid 0.4712174
## Run 225 stress 0
## ... Procrustes: rmse 0.2857182 max resid 0.5324698
## Run 226 stress 0.07554377
## Run 227 stress 0
## ... Procrustes: rmse 0.0922631 max resid 0.1789587
## Run 228 stress 0
## ... Procrustes: rmse 0.2598072 max resid 0.383837
## Run 229 stress 9.123086e-05
## ... Procrustes: rmse 0.1980595 max resid 0.3058759
## Run 230 stress 6.194413e-05
## ... Procrustes: rmse 0.1851714 max resid 0.2740749
## Run 231 stress 0
## ... Procrustes: rmse 0.2775278 max resid 0.3959787
## Run 232 stress 0
## ... Procrustes: rmse 0.2517708 max resid 0.3479033
## Run 233 stress 0
## ... Procrustes: rmse 0.1658093 max resid 0.2602376
## Run 234 stress 0.126243
## Run 235 stress 6.871021e-05
## ... Procrustes: rmse 0.2615023 max resid 0.3689718
## Run 236 stress 0
## ... Procrustes: rmse 0.2583701 max resid 0.3257561
## Run 237 stress 0.07554401
## Run 238 stress 9.290201e-05
## ... Procrustes: rmse 0.2447397 max resid 0.3154973
## Run 239 stress 0
## ... Procrustes: rmse 0.1411808 max resid 0.2199181
## Run 240 stress 9.311858e-05
## ... Procrustes: rmse 0.2447923 max resid 0.3152894
## Run 241 stress 0
## ... Procrustes: rmse 0.2465376 max resid 0.3787673
## Run 242 stress 0
## ... Procrustes: rmse 0.2700069 max resid 0.4600829
## Run 243 stress 0
## ... Procrustes: rmse 0.1942651 max resid 0.3148497
## Run 244 stress 0
## ... Procrustes: rmse 0.2185007 max resid 0.3631482
## Run 245 stress 0

```

```

## ... Procrustes: rmse 0.1936223  max resid 0.3337878
## Run 246 stress 0
## ... Procrustes: rmse 0.2775349  max resid 0.37459
## Run 247 stress 0
## ... Procrustes: rmse 0.2473819  max resid 0.4371664
## Run 248 stress 0
## ... Procrustes: rmse 0.2681199  max resid 0.3666146
## Run 249 stress 0
## ... Procrustes: rmse 0.2666245  max resid 0.3913387
## Run 250 stress 0
## ... Procrustes: rmse 0.1998733  max resid 0.3482925
## Run 251 stress 0
## ... Procrustes: rmse 0.2807799  max resid 0.3409649
## Run 252 stress 0
## ... Procrustes: rmse 0.1710441  max resid 0.2943551
## Run 253 stress 0
## ... Procrustes: rmse 0.2259547  max resid 0.3863895
## Run 254 stress 9.761294e-05
## ... Procrustes: rmse 0.2447202  max resid 0.3153182
## Run 255 stress 9.015208e-05
## ... Procrustes: rmse 0.2447671  max resid 0.3153833
## Run 256 stress 0
## ... Procrustes: rmse 0.1926125  max resid 0.3293218
## Run 257 stress 7.615169e-05
## ... Procrustes: rmse 0.2054084  max resid 0.3195684
## Run 258 stress 0.07554387
## Run 259 stress 0
## ... Procrustes: rmse 0.2388068  max resid 0.4810189
## Run 260 stress 9.528274e-05
## ... Procrustes: rmse 0.244786  max resid 0.3154348
## Run 261 stress 0.07554313
## Run 262 stress 0
## ... Procrustes: rmse 0.26253  max resid 0.3771331
## Run 263 stress 0
## ... Procrustes: rmse 0.2680156  max resid 0.4151315
## Run 264 stress 0
## ... Procrustes: rmse 0.2566718  max resid 0.4486669
## Run 265 stress 0
## ... Procrustes: rmse 0.2256735  max resid 0.3536911
## Run 266 stress 6.524229e-05
## ... Procrustes: rmse 0.1205813  max resid 0.1881889
## Run 267 stress 9.470394e-05
## ... Procrustes: rmse 0.24477  max resid 0.3152381
## Run 268 stress 0.07554372
## Run 269 stress 0
## ... Procrustes: rmse 0.2078434  max resid 0.331223
## Run 270 stress 0
## ... Procrustes: rmse 0.2381772  max resid 0.3559526
## Run 271 stress 0
## ... Procrustes: rmse 0.1874937  max resid 0.3316376
## Run 272 stress 0
## ... Procrustes: rmse 0.14028  max resid 0.2125149
## Run 273 stress 0
## ... Procrustes: rmse 0.2097008  max resid 0.3584317

```

```

## Run 274 stress 8.706879e-05
## ... Procrustes: rmse 0.2587159 max resid 0.5402698
## Run 275 stress 0
## ... Procrustes: rmse 0.1893409 max resid 0.3257293
## Run 276 stress 0
## ... Procrustes: rmse 0.3068173 max resid 0.4456848
## Run 277 stress 5.217332e-05
## ... Procrustes: rmse 0.3155019 max resid 0.5350582
## Run 278 stress 0
## ... Procrustes: rmse 0.2502284 max resid 0.3752832
## Run 279 stress 9.091638e-05
## ... Procrustes: rmse 0.2584011 max resid 0.4392848
## Run 280 stress 0
## ... Procrustes: rmse 0.2448514 max resid 0.3578771
## Run 281 stress 0
## ... Procrustes: rmse 0.2401795 max resid 0.4147394
## Run 282 stress 4.072023e-05
## ... Procrustes: rmse 0.2250054 max resid 0.3917007
## Run 283 stress 4.918702e-05
## ... Procrustes: rmse 0.2237176 max resid 0.3964462
## Run 284 stress 0
## ... Procrustes: rmse 0.2567296 max resid 0.4245028
## Run 285 stress 0.07554338
## Run 286 stress 0
## ... Procrustes: rmse 0.2906592 max resid 0.4543872
## Run 287 stress 0
## ... Procrustes: rmse 0.2581858 max resid 0.4171282
## Run 288 stress 9.093217e-05
## ... Procrustes: rmse 0.2447967 max resid 0.3153402
## Run 289 stress 0
## ... Procrustes: rmse 0.2785885 max resid 0.3798594
## Run 290 stress 0
## ... Procrustes: rmse 0.2682755 max resid 0.3301918
## Run 291 stress 0
## ... Procrustes: rmse 0.2408776 max resid 0.474969
## Run 292 stress 8.694704e-05
## ... Procrustes: rmse 0.2447646 max resid 0.3154458
## Run 293 stress 9.804559e-05
## ... Procrustes: rmse 0.2446262 max resid 0.3153717
## Run 294 stress 0
## ... Procrustes: rmse 0.2585173 max resid 0.406398
## Run 295 stress 7.4052e-05
## ... Procrustes: rmse 0.1128522 max resid 0.1510835
## Run 296 stress 0
## ... Procrustes: rmse 0.3043253 max resid 0.5010685
## Run 297 stress 3.241307e-05
## ... Procrustes: rmse 0.259851 max resid 0.3970133
## Run 298 stress 0
## ... Procrustes: rmse 0.2380152 max resid 0.3750384
## Run 299 stress 0
## ... Procrustes: rmse 0.2652956 max resid 0.4839231
## Run 300 stress 9.475488e-05
## ... Procrustes: rmse 0.244732 max resid 0.3152908
## Run 301 stress 0

```



```

## ... Procrustes: rmse 0.2676173 max resid 0.4207983
## Run 302 stress 9.742826e-05
## ... Procrustes: rmse 0.2447059 max resid 0.3154039
## Run 303 stress 9.934069e-05
## ... Procrustes: rmse 0.252058 max resid 0.4144835
## Run 304 stress 0.1990856
## Run 305 stress 5.581962e-05
## ... Procrustes: rmse 0.2264041 max resid 0.3238077
## Run 306 stress 0
## ... Procrustes: rmse 0.2554757 max resid 0.4100119
## Run 307 stress 2.075469e-06
## ... Procrustes: rmse 0.2381737 max resid 0.3942756
## Run 308 stress 0
## ... Procrustes: rmse 0.259201 max resid 0.4217298
## Run 309 stress 8.045306e-05
## ... Procrustes: rmse 0.2608019 max resid 0.4843325
## Run 310 stress 0
## ... Procrustes: rmse 0.2452655 max resid 0.4172883
## Run 311 stress 9.731118e-05
## ... Procrustes: rmse 0.2474838 max resid 0.5139343
## Run 312 stress 0
## ... Procrustes: rmse 0.2446927 max resid 0.3390146
## Run 313 stress 0
## ... Procrustes: rmse 0.1791374 max resid 0.2695999
## Run 314 stress 0
## ... Procrustes: rmse 0.2763518 max resid 0.4087521
## Run 315 stress 0
## ... Procrustes: rmse 0.2068705 max resid 0.3028973
## Run 316 stress 0.07554288
## Run 317 stress 0
## ... Procrustes: rmse 0.1782209 max resid 0.2918427
## Run 318 stress 0
## ... Procrustes: rmse 0.2150656 max resid 0.3358994
## Run 319 stress 0.07554442
## Run 320 stress 0
## ... Procrustes: rmse 0.2347365 max resid 0.3730739
## Run 321 stress 9.898559e-05
## ... Procrustes: rmse 0.2491042 max resid 0.3942415
## Run 322 stress 0.07554378
## Run 323 stress 9.900837e-05
## ... Procrustes: rmse 0.2447534 max resid 0.315321
## Run 324 stress 0
## ... Procrustes: rmse 0.2940641 max resid 0.4771272
## Run 325 stress 2.865574e-05
## ... Procrustes: rmse 0.3109414 max resid 0.5133341
## Run 326 stress 0
## ... Procrustes: rmse 0.2428136 max resid 0.3840837
## Run 327 stress 0
## ... Procrustes: rmse 0.2385884 max resid 0.373159
## Run 328 stress 0
## ... Procrustes: rmse 0.1972481 max resid 0.3003845
## Run 329 stress 0
## ... Procrustes: rmse 0.301038 max resid 0.4257037
## Run 330 stress 6.984542e-05

```

```

## ... Procrustes: rmse 0.2446917  max resid 0.3154043
## Run 331 stress 0
## ... Procrustes: rmse 0.2852694  max resid 0.4412474
## Run 332 stress 8.012664e-05
## ... Procrustes: rmse 0.253802  max resid 0.4414022
## Run 333 stress 0
## ... Procrustes: rmse 0.2734666  max resid 0.38356
## Run 334 stress 0
## ... Procrustes: rmse 0.2318144  max resid 0.3329107
## Run 335 stress 9.490399e-05
## ... Procrustes: rmse 0.2720986  max resid 0.5113832
## Run 336 stress 0
## ... Procrustes: rmse 0.3035727  max resid 0.5378458
## Run 337 stress 0
## ... Procrustes: rmse 0.2382594  max resid 0.3269238
## Run 338 stress 9.114465e-05
## ... Procrustes: rmse 0.244645  max resid 0.3154343
## Run 339 stress 0
## ... Procrustes: rmse 0.2592803  max resid 0.4574965
## Run 340 stress 0
## ... Procrustes: rmse 0.2307728  max resid 0.3476774
## Run 341 stress 0
## ... Procrustes: rmse 0.3189184  max resid 0.5332948
## Run 342 stress 9.221349e-05
## ... Procrustes: rmse 0.2447191  max resid 0.3152945
## Run 343 stress 0
## ... Procrustes: rmse 0.3008166  max resid 0.4968329
## Run 344 stress 0
## ... Procrustes: rmse 0.1995908  max resid 0.2830566
## Run 345 stress 0
## ... Procrustes: rmse 0.2127643  max resid 0.3032126
## Run 346 stress 0
## ... Procrustes: rmse 0.2682774  max resid 0.3572795
## Run 347 stress 0
## ... Procrustes: rmse 0.2302195  max resid 0.3518164
## Run 348 stress 0
## ... Procrustes: rmse 0.2064367  max resid 0.3239811
## Run 349 stress 0.07554297
## Run 350 stress 0.07554349
## Run 351 stress 0
## ... Procrustes: rmse 0.2449254  max resid 0.3560533
## Run 352 stress 0
## ... Procrustes: rmse 0.2542438  max resid 0.4238168
## Run 353 stress 0
## ... Procrustes: rmse 0.1832101  max resid 0.3017571
## Run 354 stress 9.3054e-05
## ... Procrustes: rmse 0.2854174  max resid 0.5360697
## Run 355 stress 0
## ... Procrustes: rmse 0.2963878  max resid 0.4740628
## Run 356 stress 0.0001750417
## ... Procrustes: rmse 0.2908253  max resid 0.4531762
## Run 357 stress 0.07554279
## Run 358 stress 9.34941e-05
## ... Procrustes: rmse 0.2447039  max resid 0.3152955

```

```

## Run 359 stress 0
## ... Procrustes: rmse 0.3094022 max resid 0.5106063
## Run 360 stress 0
## ... Procrustes: rmse 0.202902 max resid 0.3296609
## Run 361 stress 0
## ... Procrustes: rmse 0.2143407 max resid 0.3436069
## Run 362 stress 0
## ... Procrustes: rmse 0.2460695 max resid 0.4228905
## Run 363 stress 0
## ... Procrustes: rmse 0.1531054 max resid 0.2868526
## Run 364 stress 0
## ... Procrustes: rmse 0.2087271 max resid 0.276131
## Run 365 stress 0
## ... Procrustes: rmse 0.2205549 max resid 0.3350523
## Run 366 stress 0
## ... Procrustes: rmse 0.2869939 max resid 0.4688182
## Run 367 stress 9.844462e-05
## ... Procrustes: rmse 0.244743 max resid 0.3153422
## Run 368 stress 9.899399e-05
## ... Procrustes: rmse 0.2171067 max resid 0.3662934
## Run 369 stress 0
## ... Procrustes: rmse 0.1163371 max resid 0.1776812
## Run 370 stress 0.0001376004
## ... Procrustes: rmse 0.2268892 max resid 0.366606
## Run 371 stress 0
## ... Procrustes: rmse 0.1962429 max resid 0.3321447
## Run 372 stress 9.249621e-05
## ... Procrustes: rmse 0.1672455 max resid 0.3063662
## Run 373 stress 9.327726e-05
## ... Procrustes: rmse 0.2076006 max resid 0.3336184
## Run 374 stress 0
## ... Procrustes: rmse 0.2002633 max resid 0.2644834
## Run 375 stress 0
## ... Procrustes: rmse 0.2410301 max resid 0.3698976
## Run 376 stress 0
## ... Procrustes: rmse 0.2069734 max resid 0.3054031
## Run 377 stress 6.742613e-05
## ... Procrustes: rmse 0.2447354 max resid 0.3154592
## Run 378 stress 0
## ... Procrustes: rmse 0.2326071 max resid 0.3321897
## Run 379 stress 5.693032e-05
## ... Procrustes: rmse 0.2077586 max resid 0.3913045
## Run 380 stress 8.994678e-05
## ... Procrustes: rmse 0.2051906 max resid 0.3120354
## Run 381 stress 9.40631e-05
## ... Procrustes: rmse 0.2447663 max resid 0.3154807
## Run 382 stress 8.985514e-05
## ... Procrustes: rmse 0.1698489 max resid 0.3233887
## Run 383 stress 0
## ... Procrustes: rmse 0.1694989 max resid 0.2893366
## Run 384 stress 0.07554285
## Run 385 stress 0
## ... Procrustes: rmse 0.2109392 max resid 0.3517401
## Run 386 stress 0

```

```

## ... Procrustes: rmse 0.1781575  max resid 0.3087741
## Run 387 stress 0
## ... Procrustes: rmse 0.2355709  max resid 0.3138686
## Run 388 stress 4.546786e-05
## ... Procrustes: rmse 0.2165872  max resid 0.4117169
## Run 389 stress 0
## ... Procrustes: rmse 0.1956906  max resid 0.3347022
## Run 390 stress 9.749139e-05
## ... Procrustes: rmse 0.2447309  max resid 0.3154448
## Run 391 stress 0.07554296
## Run 392 stress 0
## ... Procrustes: rmse 0.2167256  max resid 0.2898531
## Run 393 stress 8.358664e-05
## ... Procrustes: rmse 0.2420884  max resid 0.303027
## Run 394 stress 0
## ... Procrustes: rmse 0.2709462  max resid 0.3971958
## Run 395 stress 0
## ... Procrustes: rmse 0.2167046  max resid 0.38566
## Run 396 stress 9.685327e-05
## ... Procrustes: rmse 0.2447749  max resid 0.3153176
## Run 397 stress 0
## ... Procrustes: rmse 0.2737798  max resid 0.4343818
## Run 398 stress 0
## ... Procrustes: rmse 0.2195503  max resid 0.3013049
## Run 399 stress 8.272925e-05
## ... Procrustes: rmse 0.2077411  max resid 0.3702488
## Run 400 stress 9.410266e-05
## ... Procrustes: rmse 0.2448085  max resid 0.3153337
## Run 401 stress 7.031178e-05
## ... Procrustes: rmse 0.1573335  max resid 0.2068605
## Run 402 stress 9.7648e-05
## ... Procrustes: rmse 0.2446465  max resid 0.3153454
## Run 403 stress 5.087285e-05
## ... Procrustes: rmse 0.2957858  max resid 0.480043
## Run 404 stress 0
## ... Procrustes: rmse 0.1900086  max resid 0.3352893
## Run 405 stress 0
## ... Procrustes: rmse 0.2375757  max resid 0.3433827
## Run 406 stress 0
## ... Procrustes: rmse 0.2484357  max resid 0.4048792
## Run 407 stress 9.625829e-05
## ... Procrustes: rmse 0.244734  max resid 0.3154356
## Run 408 stress 0
## ... Procrustes: rmse 0.2485511  max resid 0.3991037
## Run 409 stress 0
## ... Procrustes: rmse 0.2439438  max resid 0.3390708
## Run 410 stress 9.879798e-05
## ... Procrustes: rmse 0.2291263  max resid 0.3822484
## Run 411 stress 0
## ... Procrustes: rmse 0.152206  max resid 0.2418452
## Run 412 stress 0.07554362
## Run 413 stress 0
## ... Procrustes: rmse 0.3018148  max resid 0.4080934
## Run 414 stress 8.619169e-05

```

```

## ... Procrustes: rmse 0.2447451  max resid 0.3154242
## Run 415 stress 0.07554362
## Run 416 stress 0
## ... Procrustes: rmse 0.3000598  max resid 0.4996234
## Run 417 stress 0
## ... Procrustes: rmse 0.1796317  max resid 0.3235492
## Run 418 stress 0
## ... Procrustes: rmse 0.261866  max resid 0.3514331
## Run 419 stress 0
## ... Procrustes: rmse 0.2313091  max resid 0.4296502
## Run 420 stress 6.069589e-05
## ... Procrustes: rmse 0.1987727  max resid 0.3385658
## Run 421 stress 6.130389e-05
## ... Procrustes: rmse 0.2063565  max resid 0.3704171
## Run 422 stress 0
## ... Procrustes: rmse 0.1644957  max resid 0.2355706
## Run 423 stress 0
## ... Procrustes: rmse 0.2240509  max resid 0.4524559
## Run 424 stress 0
## ... Procrustes: rmse 0.2545304  max resid 0.3738343
## Run 425 stress 0
## ... Procrustes: rmse 0.2252973  max resid 0.3737216
## Run 426 stress 0
## ... Procrustes: rmse 0.2877787  max resid 0.3964271
## Run 427 stress 0
## ... Procrustes: rmse 0.2657342  max resid 0.396688
## Run 428 stress 0
## ... Procrustes: rmse 0.2703854  max resid 0.357152
## Run 429 stress 0
## ... Procrustes: rmse 0.2500308  max resid 0.4226756
## Run 430 stress 0
## ... Procrustes: rmse 0.2367838  max resid 0.3241441
## Run 431 stress 9.71489e-05
## ... Procrustes: rmse 0.2448083  max resid 0.3153009
## Run 432 stress 0
## ... Procrustes: rmse 0.234673  max resid 0.3418837
## Run 433 stress 0.07554279
## Run 434 stress 0
## ... Procrustes: rmse 0.2476123  max resid 0.381422
## Run 435 stress 0.07554346
## Run 436 stress 0
## ... Procrustes: rmse 0.2192922  max resid 0.3217904
## Run 437 stress 0
## ... Procrustes: rmse 0.2744364  max resid 0.5153952
## Run 438 stress 0
## ... Procrustes: rmse 0.2081272  max resid 0.2929699
## Run 439 stress 0
## ... Procrustes: rmse 0.2831469  max resid 0.4545856
## Run 440 stress 0
## ... Procrustes: rmse 0.2801349  max resid 0.5062692
## Run 441 stress 0
## ... Procrustes: rmse 0.09720216  max resid 0.1326102
## Run 442 stress 0
## ... Procrustes: rmse 0.243972  max resid 0.3606055

```

```

## Run 443 stress 0
## ... Procrustes: rmse 0.2080677 max resid 0.3336216
## Run 444 stress 4.485748e-05
## ... Procrustes: rmse 0.1850403 max resid 0.2796975
## Run 445 stress 0
## ... Procrustes: rmse 0.2673299 max resid 0.3985736
## Run 446 stress 0.07554432
## Run 447 stress 9.950104e-05
## ... Procrustes: rmse 0.2305457 max resid 0.3898208
## Run 448 stress 0
## ... Procrustes: rmse 0.2159825 max resid 0.3329515
## Run 449 stress 0
## ... Procrustes: rmse 0.2212977 max resid 0.3471138
## Run 450 stress 0
## ... Procrustes: rmse 0.2794376 max resid 0.485517
## Run 451 stress 0
## ... Procrustes: rmse 0.3059671 max resid 0.4549872
## Run 452 stress 0
## ... Procrustes: rmse 0.2375738 max resid 0.4246253
## Run 453 stress 8.894851e-05
## ... Procrustes: rmse 0.2447716 max resid 0.3153588
## Run 454 stress 7.509371e-05
## ... Procrustes: rmse 0.1867157 max resid 0.2749067
## Run 455 stress 0
## ... Procrustes: rmse 0.1836111 max resid 0.2393866
## Run 456 stress 0
## ... Procrustes: rmse 0.1981257 max resid 0.2940668
## Run 457 stress 9.320784e-05
## ... Procrustes: rmse 0.2447663 max resid 0.3153642
## Run 458 stress 1.916951e-05
## ... Procrustes: rmse 0.2656723 max resid 0.4646704
## Run 459 stress 0
## ... Procrustes: rmse 0.243868 max resid 0.4192954
## Run 460 stress 0
## ... Procrustes: rmse 0.2243212 max resid 0.3224281
## Run 461 stress 0
## ... Procrustes: rmse 0.1979533 max resid 0.3435508
## Run 462 stress 0
## ... Procrustes: rmse 0.2011165 max resid 0.3329936
## Run 463 stress 0
## ... Procrustes: rmse 0.1169997 max resid 0.176122
## Run 464 stress 0
## ... Procrustes: rmse 0.2250967 max resid 0.3149407
## Run 465 stress 0.0755431
## Run 466 stress 0
## ... Procrustes: rmse 0.2919384 max resid 0.414987
## Run 467 stress 7.257942e-05
## ... Procrustes: rmse 0.2444321 max resid 0.3142114
## Run 468 stress 7.877879e-05
## ... Procrustes: rmse 0.1484521 max resid 0.181004
## Run 469 stress 8.369657e-05
## ... Procrustes: rmse 0.2447276 max resid 0.3153199
## Run 470 stress 0
## ... Procrustes: rmse 0.2765829 max resid 0.4465819

```

```

## Run 471 stress 0
## ... Procrustes: rmse 0.2470087 max resid 0.3218702
## Run 472 stress 0.07554416
## Run 473 stress 0
## ... Procrustes: rmse 0.2384493 max resid 0.4300126
## Run 474 stress 0
## ... Procrustes: rmse 0.1657922 max resid 0.2676448
## Run 475 stress 9.64857e-05
## ... Procrustes: rmse 0.2447321 max resid 0.315245
## Run 476 stress 0
## ... Procrustes: rmse 0.2274523 max resid 0.3016228
## Run 477 stress 0
## ... Procrustes: rmse 0.2743318 max resid 0.4900093
## Run 478 stress 0
## ... Procrustes: rmse 0.3010067 max resid 0.530275
## Run 479 stress 0
## ... Procrustes: rmse 0.2255383 max resid 0.3565099
## Run 480 stress 0
## ... Procrustes: rmse 0.2495827 max resid 0.3206298
## Run 481 stress 0
## ... Procrustes: rmse 0.2031873 max resid 0.2668315
## Run 482 stress 0
## ... Procrustes: rmse 0.2680653 max resid 0.4463753
## Run 483 stress 9.293182e-05
## ... Procrustes: rmse 0.244716 max resid 0.3153787
## Run 484 stress 0.07554435
## Run 485 stress 0
## ... Procrustes: rmse 0.2081404 max resid 0.325109
## Run 486 stress 0.07554368
## Run 487 stress 0
## ... Procrustes: rmse 0.2415455 max resid 0.4479087
## Run 488 stress 0
## ... Procrustes: rmse 0.1854718 max resid 0.3209874
## Run 489 stress 0
## ... Procrustes: rmse 0.1780744 max resid 0.2216239
## Run 490 stress 9.39758e-05
## ... Procrustes: rmse 0.2446291 max resid 0.3153046
## Run 491 stress 0
## ... Procrustes: rmse 0.2368901 max resid 0.3739245
## Run 492 stress 0
## ... Procrustes: rmse 0.2428129 max resid 0.4191403
## Run 493 stress 9.265441e-05
## ... Procrustes: rmse 0.2808479 max resid 0.4640838
## Run 494 stress 9.71729e-05
## ... Procrustes: rmse 0.2447278 max resid 0.3153914
## Run 495 stress 0.07554394
## Run 496 stress 8.488401e-05
## ... Procrustes: rmse 0.2665278 max resid 0.43173
## Run 497 stress 0
## ... Procrustes: rmse 0.2532628 max resid 0.3742651
## Run 498 stress 0.07554301
## Run 499 stress 0
## ... Procrustes: rmse 0.1618008 max resid 0.2701188
## Run 500 stress 6.186157e-05

```

```

## ... Procrustes: rmse 0.1589248  max resid 0.2465861
## Run 501 stress 0
## ... Procrustes: rmse 0.2908355  max resid 0.5216796
## Run 502 stress 0
## ... Procrustes: rmse 0.2276031  max resid 0.3610704
## Run 503 stress 9.154994e-05
## ... Procrustes: rmse 0.2448006  max resid 0.3152733
## Run 504 stress 0
## ... Procrustes: rmse 0.2312947  max resid 0.3686997
## Run 505 stress 0.126243
## Run 506 stress 5.419354e-05
## ... Procrustes: rmse 0.2280116  max resid 0.4009636
## Run 507 stress 0
## ... Procrustes: rmse 0.2081554  max resid 0.3404272
## Run 508 stress 8.987016e-05
## ... Procrustes: rmse 0.2446958  max resid 0.3153015
## Run 509 stress 4.736085e-05
## ... Procrustes: rmse 0.2538936  max resid 0.5241882
## Run 510 stress 0.07554362
## Run 511 stress 0
## ... Procrustes: rmse 0.2223043  max resid 0.3010118
## Run 512 stress 0
## ... Procrustes: rmse 0.2588365  max resid 0.3687234
## Run 513 stress 0
## ... Procrustes: rmse 0.2115702  max resid 0.3741094
## Run 514 stress 8.990348e-05
## ... Procrustes: rmse 0.2581703  max resid 0.4926116
## Run 515 stress 0
## ... Procrustes: rmse 0.1912747  max resid 0.3059946
## Run 516 stress 0
## ... Procrustes: rmse 0.2364197  max resid 0.3391897
## Run 517 stress 0
## ... Procrustes: rmse 0.2134973  max resid 0.3368347
## Run 518 stress 0.1990861
## Run 519 stress 8.583879e-05
## ... Procrustes: rmse 0.2447479  max resid 0.3155292
## Run 520 stress 0
## ... Procrustes: rmse 0.2459604  max resid 0.431366
## Run 521 stress 0.07554384
## Run 522 stress 0
## ... Procrustes: rmse 0.1501425  max resid 0.2459135
## Run 523 stress 9.297353e-05
## ... Procrustes: rmse 0.2447301  max resid 0.3153468
## Run 524 stress 0
## ... Procrustes: rmse 0.2259821  max resid 0.29343
## Run 525 stress 0.07554381
## Run 526 stress 0
## ... Procrustes: rmse 0.2781773  max resid 0.4522147
## Run 527 stress 0
## ... Procrustes: rmse 0.2777938  max resid 0.327355
## Run 528 stress 0
## ... Procrustes: rmse 0.2423364  max resid 0.4659587
## Run 529 stress 8.516325e-05
## ... Procrustes: rmse 0.2827347  max resid 0.4990298

```



```

## Run 530 stress 0
## ... Procrustes: rmse 0.2766823 max resid 0.3259476
## Run 531 stress 0
## ... Procrustes: rmse 0.278665 max resid 0.4451517
## Run 532 stress 0
## ... Procrustes: rmse 0.1973353 max resid 0.3390174
## Run 533 stress 0
## ... Procrustes: rmse 0.2264091 max resid 0.3793294
## Run 534 stress 0
## ... Procrustes: rmse 0.3160465 max resid 0.4855683
## Run 535 stress 0.07554359
## Run 536 stress 0
## ... Procrustes: rmse 0.1885767 max resid 0.3043292
## Run 537 stress 0
## ... Procrustes: rmse 0.2054443 max resid 0.3446529
## Run 538 stress 7.701179e-05
## ... Procrustes: rmse 0.1838929 max resid 0.3071255
## Run 539 stress 0
## ... Procrustes: rmse 0.2756129 max resid 0.440523
## Run 540 stress 0.07554296
## Run 541 stress 9.016765e-05
## ... Procrustes: rmse 0.2447126 max resid 0.3153732
## Run 542 stress 0
## ... Procrustes: rmse 0.2423398 max resid 0.3655026
## Run 543 stress 0
## ... Procrustes: rmse 0.3114339 max resid 0.5209272
## Run 544 stress 9.289972e-05
## ... Procrustes: rmse 0.2447367 max resid 0.3153645
## Run 545 stress 0
## ... Procrustes: rmse 0.223661 max resid 0.3658213
## Run 546 stress 8.021119e-05
## ... Procrustes: rmse 0.2446525 max resid 0.3153755
## Run 547 stress 0
## ... Procrustes: rmse 0.22863 max resid 0.3717519
## Run 548 stress 9.894278e-05
## ... Procrustes: rmse 0.2447651 max resid 0.315288
## Run 549 stress 0
## ... Procrustes: rmse 0.2445134 max resid 0.4037487
## Run 550 stress 8.807485e-05
## ... Procrustes: rmse 0.2447215 max resid 0.3155629
## Run 551 stress 0
## ... Procrustes: rmse 0.246109 max resid 0.4592594
## Run 552 stress 0
## ... Procrustes: rmse 0.195048 max resid 0.3354949
## Run 553 stress 9.703692e-05
## ... Procrustes: rmse 0.2456245 max resid 0.4469413
## Run 554 stress 9.69262e-05
## ... Procrustes: rmse 0.2448134 max resid 0.3153105
## Run 555 stress 0
## ... Procrustes: rmse 0.1840662 max resid 0.3060592
## Run 556 stress 0
## ... Procrustes: rmse 0.2566241 max resid 0.3589755
## Run 557 stress 0
## ... Procrustes: rmse 0.2369868 max resid 0.349609

```

```

## Run 558 stress 0
## ... Procrustes: rmse 0.2448945 max resid 0.3883413
## Run 559 stress 0
## ... Procrustes: rmse 0.2140536 max resid 0.3538376
## Run 560 stress 0
## ... Procrustes: rmse 0.2458262 max resid 0.4066535
## Run 561 stress 0
## ... Procrustes: rmse 0.139112 max resid 0.2045952
## Run 562 stress 0
## ... Procrustes: rmse 0.235642 max resid 0.3627407
## Run 563 stress 0
## ... Procrustes: rmse 0.2796608 max resid 0.4136564
## Run 564 stress 9.201724e-05
## ... Procrustes: rmse 0.1635801 max resid 0.2237948
## Run 565 stress 0
## ... Procrustes: rmse 0.2634417 max resid 0.3423387
## Run 566 stress 0
## ... Procrustes: rmse 0.2328733 max resid 0.4267974
## Run 567 stress 0
## ... Procrustes: rmse 0.1959795 max resid 0.3580706
## Run 568 stress 9.948805e-05
## ... Procrustes: rmse 0.2133467 max resid 0.278965
## Run 569 stress 0
## ... Procrustes: rmse 0.2416013 max resid 0.4255491
## Run 570 stress 0
## ... Procrustes: rmse 0.2466542 max resid 0.3619344
## Run 571 stress 0
## ... Procrustes: rmse 0.1936315 max resid 0.2984731
## Run 572 stress 0
## ... Procrustes: rmse 0.2758947 max resid 0.439238
## Run 573 stress 0
## ... Procrustes: rmse 0.1584664 max resid 0.2515994
## Run 574 stress 0
## ... Procrustes: rmse 0.2509079 max resid 0.3485239
## Run 575 stress 0
## ... Procrustes: rmse 0.2081811 max resid 0.3350848
## Run 576 stress 0
## ... Procrustes: rmse 0.3039068 max resid 0.5142344
## Run 577 stress 0
## ... Procrustes: rmse 0.2579278 max resid 0.4306077
## Run 578 stress 0.07554285
## Run 579 stress 0.0755437
## Run 580 stress 8.615819e-05
## ... Procrustes: rmse 0.2447204 max resid 0.3152773
## Run 581 stress 0
## ... Procrustes: rmse 0.2225925 max resid 0.3505116
## Run 582 stress 0
## ... Procrustes: rmse 0.2146522 max resid 0.3333182
## Run 583 stress 0
## ... Procrustes: rmse 0.1895735 max resid 0.327758
## Run 584 stress 0
## ... Procrustes: rmse 0.216876 max resid 0.3628825
## Run 585 stress 0
## ... Procrustes: rmse 0.236161 max resid 0.3645943

```

```

## Run 586 stress 1.521791e-05
## ... Procrustes: rmse 0.2455162 max resid 0.4422018
## Run 587 stress 7.269278e-05
## ... Procrustes: rmse 0.2387359 max resid 0.4892562
## Run 588 stress 0
## ... Procrustes: rmse 0.3068591 max resid 0.515762
## Run 589 stress 9.747589e-05
## ... Procrustes: rmse 0.2194544 max resid 0.3659084
## Run 590 stress 0
## ... Procrustes: rmse 0.2134617 max resid 0.3738085
## Run 591 stress 0
## ... Procrustes: rmse 0.2837007 max resid 0.4463228
## Run 592 stress 0
## ... Procrustes: rmse 0.1929196 max resid 0.324771
## Run 593 stress 0
## ... Procrustes: rmse 0.2669617 max resid 0.46606
## Run 594 stress 0
## ... Procrustes: rmse 0.2583867 max resid 0.4148431
## Run 595 stress 0
## ... Procrustes: rmse 0.2058297 max resid 0.3298895
## Run 596 stress 0.1990858
## Run 597 stress 0
## ... Procrustes: rmse 0.2141327 max resid 0.3276217
## Run 598 stress 0.07554329
## Run 599 stress 0
## ... Procrustes: rmse 0.3026397 max resid 0.3837412
## Run 600 stress 9.914811e-05
## ... Procrustes: rmse 0.2446884 max resid 0.3152352
## Run 601 stress 0.07554357
## Run 602 stress 9.925922e-05
## ... Procrustes: rmse 0.2447543 max resid 0.3155046
## Run 603 stress 0
## ... Procrustes: rmse 0.2369872 max resid 0.4866473
## Run 604 stress 0
## ... Procrustes: rmse 0.1757566 max resid 0.2833384
## Run 605 stress 0
## ... Procrustes: rmse 0.2553297 max resid 0.3547
## Run 606 stress 9.547092e-05
## ... Procrustes: rmse 0.2446659 max resid 0.3152352
## Run 607 stress 0
## ... Procrustes: rmse 0.2146356 max resid 0.3017004
## Run 608 stress 0.07554325
## Run 609 stress 0
## ... Procrustes: rmse 0.2305227 max resid 0.3209289
## Run 610 stress 7.702985e-05
## ... Procrustes: rmse 0.1349962 max resid 0.2259236
## Run 611 stress 0
## ... Procrustes: rmse 0.1813184 max resid 0.2739712
## Run 612 stress 9.133541e-05
## ... Procrustes: rmse 0.244743 max resid 0.3154745
## Run 613 stress 0
## ... Procrustes: rmse 0.2558432 max resid 0.4224198
## Run 614 stress 0
## ... Procrustes: rmse 0.2268819 max resid 0.3659566

```

```

## Run 615 stress 0
## ... Procrustes: rmse 0.2213557 max resid 0.3904482
## Run 616 stress 0
## ... Procrustes: rmse 0.2876729 max resid 0.4644796
## Run 617 stress 0.07554389
## Run 618 stress 0
## ... Procrustes: rmse 0.2310559 max resid 0.376414
## Run 619 stress 0
## ... Procrustes: rmse 0.248298 max resid 0.3927929
## Run 620 stress 9.714963e-05
## ... Procrustes: rmse 0.244756 max resid 0.3152467
## Run 621 stress 9.518364e-05
## ... Procrustes: rmse 0.1014104 max resid 0.1326804
## Run 622 stress 0
## ... Procrustes: rmse 0.2231699 max resid 0.3674653
## Run 623 stress 0
## ... Procrustes: rmse 0.1748349 max resid 0.2695133
## Run 624 stress 0
## ... Procrustes: rmse 0.2670279 max resid 0.4288106
## Run 625 stress 1.694459e-05
## ... Procrustes: rmse 0.2877278 max resid 0.446606
## Run 626 stress 8.879488e-05
## ... Procrustes: rmse 0.1639376 max resid 0.2117993
## Run 627 stress 0
## ... Procrustes: rmse 0.2834072 max resid 0.4171214
## Run 628 stress 0.07554289
## Run 629 stress 0
## ... Procrustes: rmse 0.2540072 max resid 0.451446
## Run 630 stress 0
## ... Procrustes: rmse 0.1640387 max resid 0.2598584
## Run 631 stress 0
## ... Procrustes: rmse 0.2534925 max resid 0.3910097
## Run 632 stress 0
## ... Procrustes: rmse 0.225298 max resid 0.3120131
## Run 633 stress 0
## ... Procrustes: rmse 0.2406197 max resid 0.4318255
## Run 634 stress 0
## ... Procrustes: rmse 0.301972 max resid 0.5009863
## Run 635 stress 0
## ... Procrustes: rmse 0.2677466 max resid 0.3870102
## Run 636 stress 0
## ... Procrustes: rmse 0.207162 max resid 0.2903866
## Run 637 stress 0
## ... Procrustes: rmse 0.2975837 max resid 0.5474918
## Run 638 stress 9.578666e-05
## ... Procrustes: rmse 0.2447239 max resid 0.3152981
## Run 639 stress 0
## ... Procrustes: rmse 0.1933007 max resid 0.2963287
## Run 640 stress 0
## ... Procrustes: rmse 0.1878377 max resid 0.2725273
## Run 641 stress 0
## ... Procrustes: rmse 0.2536246 max resid 0.3872923
## Run 642 stress 0
## ... Procrustes: rmse 0.2998973 max resid 0.5047616

```

```

## Run 643 stress 0
## ... Procrustes: rmse 0.2189978 max resid 0.31346
## Run 644 stress 0
## ... Procrustes: rmse 0.2077866 max resid 0.379701
## Run 645 stress 0
## ... Procrustes: rmse 0.2543529 max resid 0.3104556
## Run 646 stress 0
## ... Procrustes: rmse 0.2559144 max resid 0.4058626
## Run 647 stress 0
## ... Procrustes: rmse 0.2375259 max resid 0.3580276
## Run 648 stress 0
## ... Procrustes: rmse 0.2601137 max resid 0.3306057
## Run 649 stress 8.079467e-05
## ... Procrustes: rmse 0.2447129 max resid 0.3154123
## Run 650 stress 0
## ... Procrustes: rmse 0.2680519 max resid 0.3654966
## Run 651 stress 0
## ... Procrustes: rmse 0.2818729 max resid 0.4141965
## Run 652 stress 8.187542e-05
## ... Procrustes: rmse 0.2447262 max resid 0.3152939
## Run 653 stress 9.973359e-05
## ... Procrustes: rmse 0.2019893 max resid 0.3211984
## Run 654 stress 0.07554381
## Run 655 stress 0
## ... Procrustes: rmse 0.1804377 max resid 0.2914805
## Run 656 stress 9.492719e-05
## ... Procrustes: rmse 0.1502414 max resid 0.1795264
## Run 657 stress 0.07554279
## Run 658 stress 0.07554362
## Run 659 stress 0
## ... Procrustes: rmse 0.2482748 max resid 0.3748637
## Run 660 stress 0
## ... Procrustes: rmse 0.2549971 max resid 0.3811399
## Run 661 stress 8.525727e-05
## ... Procrustes: rmse 0.26316 max resid 0.5448102
## Run 662 stress 0.07554395
## Run 663 stress 0
## ... Procrustes: rmse 0.237958 max resid 0.4115202
## Run 664 stress 0
## ... Procrustes: rmse 0.2181013 max resid 0.3899443
## Run 665 stress 0
## ... Procrustes: rmse 0.3180437 max resid 0.5319237
## Run 666 stress 0
## ... Procrustes: rmse 0.2890886 max resid 0.476782
## Run 667 stress 0
## ... Procrustes: rmse 0.2362574 max resid 0.3873585
## Run 668 stress 0
## ... Procrustes: rmse 0.2835012 max resid 0.3743711
## Run 669 stress 0.07554404
## Run 670 stress 0
## ... Procrustes: rmse 0.2540607 max resid 0.3585698
## Run 671 stress 0
## ... Procrustes: rmse 0.2061164 max resid 0.338939
## Run 672 stress 0

```

```

## ... Procrustes: rmse 0.1931102  max resid 0.2655684
## Run 673 stress 0.07554412
## Run 674 stress 6.800168e-05
## ... Procrustes: rmse 0.2312286  max resid 0.341399
## Run 675 stress 5.829458e-05
## ... Procrustes: rmse 0.2416087  max resid 0.3844494
## Run 676 stress 0.07554304
## Run 677 stress 0
## ... Procrustes: rmse 0.2614032  max resid 0.4467276
## Run 678 stress 0.07554279
## Run 679 stress 0
## ... Procrustes: rmse 0.1840666  max resid 0.3077535
## Run 680 stress 0
## ... Procrustes: rmse 0.2533319  max resid 0.4083893
## Run 681 stress 9.954578e-05
## ... Procrustes: rmse 0.1869967  max resid 0.2688487
## Run 682 stress 0
## ... Procrustes: rmse 0.2690483  max resid 0.4402512
## Run 683 stress 8.559731e-05
## ... Procrustes: rmse 0.2481316  max resid 0.5194168
## Run 684 stress 0
## ... Procrustes: rmse 0.1433578  max resid 0.2347972
## Run 685 stress 0
## ... Procrustes: rmse 0.1998845  max resid 0.3331493
## Run 686 stress 0
## ... Procrustes: rmse 0.2255202  max resid 0.3217487
## Run 687 stress 0
## ... Procrustes: rmse 0.22663  max resid 0.3381771
## Run 688 stress 0
## ... Procrustes: rmse 0.2910927  max resid 0.4177209
## Run 689 stress 9.624695e-05
## ... Procrustes: rmse 0.2447754  max resid 0.3153224
## Run 690 stress 0
## ... Procrustes: rmse 0.1979418  max resid 0.3206337
## Run 691 stress 8.836836e-05
## ... Procrustes: rmse 0.2446995  max resid 0.3154307
## Run 692 stress 4.771505e-05
## ... Procrustes: rmse 0.1893047  max resid 0.2402731
## Run 693 stress 0
## ... Procrustes: rmse 0.2857081  max resid 0.4316069
## Run 694 stress 0
## ... Procrustes: rmse 0.2603613  max resid 0.4478306
## Run 695 stress 0
## ... Procrustes: rmse 0.15617  max resid 0.2485722
## Run 696 stress 6.802813e-05
## ... Procrustes: rmse 0.2251464  max resid 0.3356685
## Run 697 stress 8.332231e-05
## ... Procrustes: rmse 0.2976763  max resid 0.5593975
## Run 698 stress 9.726488e-05
## ... Procrustes: rmse 0.2447506  max resid 0.3152898
## Run 699 stress 7.735799e-05
## ... Procrustes: rmse 0.2815653  max resid 0.5272547
## Run 700 stress 0.07554442
## Run 701 stress 0

```

```

## ... Procrustes: rmse 0.2346407 max resid 0.3299723
## Run 702 stress 0.07554378
## Run 703 stress 9.550574e-05
## ... Procrustes: rmse 0.2447619 max resid 0.3153246
## Run 704 stress 0
## ... Procrustes: rmse 0.2927947 max resid 0.4391693
## Run 705 stress 0
## ... Procrustes: rmse 0.2064959 max resid 0.3246192
## Run 706 stress 0
## ... Procrustes: rmse 0.2669815 max resid 0.4733869
## Run 707 stress 9.908863e-05
## ... Procrustes: rmse 0.2446885 max resid 0.3152219
## Run 708 stress 0
## ... Procrustes: rmse 0.2440678 max resid 0.4668408
## Run 709 stress 0
## ... Procrustes: rmse 0.1863917 max resid 0.2654375
## Run 710 stress 0
## ... Procrustes: rmse 0.2378838 max resid 0.4130751
## Run 711 stress 0.0002317253
## ... Procrustes: rmse 0.226416 max resid 0.3746157
## Run 712 stress 9.393288e-05
## ... Procrustes: rmse 0.2446674 max resid 0.315351
## Run 713 stress 8.356166e-05
## ... Procrustes: rmse 0.2419476 max resid 0.4015894
## Run 714 stress 0
## ... Procrustes: rmse 0.2181931 max resid 0.4028137
## Run 715 stress 0
## ... Procrustes: rmse 0.1514582 max resid 0.2328767
## Run 716 stress 8.052704e-05
## ... Procrustes: rmse 0.2206855 max resid 0.3892306
## Run 717 stress 0
## ... Procrustes: rmse 0.2754987 max resid 0.369404
## Run 718 stress 0
## ... Procrustes: rmse 0.1639798 max resid 0.2404571
## Run 719 stress 2.63337e-05
## ... Procrustes: rmse 0.2883137 max resid 0.4722248
## Run 720 stress 9.715307e-05
## ... Procrustes: rmse 0.2447599 max resid 0.3154126
## Run 721 stress 0
## ... Procrustes: rmse 0.2407861 max resid 0.39294
## Run 722 stress 0
## ... Procrustes: rmse 0.1947374 max resid 0.2925243
## Run 723 stress 0
## ... Procrustes: rmse 0.188076 max resid 0.3399984
## Run 724 stress 0
## ... Procrustes: rmse 0.1507656 max resid 0.2335789
## Run 725 stress 0
## ... Procrustes: rmse 0.1912346 max resid 0.3214705
## Run 726 stress 9.288408e-05
## ... Procrustes: rmse 0.2447341 max resid 0.3152406
## Run 727 stress 9.707614e-05
## ... Procrustes: rmse 0.2447924 max resid 0.3153223
## Run 728 stress 5.01177e-05
## ... Procrustes: rmse 0.2412134 max resid 0.4713982

```

```

## Run 729 stress 0
## ... Procrustes: rmse 0.2774078 max resid 0.3698472
## Run 730 stress 9.960519e-05
## ... Procrustes: rmse 0.2447513 max resid 0.3152934
## Run 731 stress 9.768612e-05
## ... Procrustes: rmse 0.2446304 max resid 0.3152255
## Run 732 stress 0
## ... Procrustes: rmse 0.2092636 max resid 0.3517469
## Run 733 stress 0
## ... Procrustes: rmse 0.2703362 max resid 0.4273928
## Run 734 stress 0
## ... Procrustes: rmse 0.2546886 max resid 0.3051878
## Run 735 stress 0
## ... Procrustes: rmse 0.226554 max resid 0.3635076
## Run 736 stress 0
## ... Procrustes: rmse 0.2924089 max resid 0.4132674
## Run 737 stress 7.909146e-05
## ... Procrustes: rmse 0.2447539 max resid 0.3153375
## Run 738 stress 4.216365e-05
## ... Procrustes: rmse 0.2588663 max resid 0.3289068
## Run 739 stress 0
## ... Procrustes: rmse 0.2263958 max resid 0.323567
## Run 740 stress 8.35913e-05
## ... Procrustes: rmse 0.2769344 max resid 0.5110719
## Run 741 stress 0
## ... Procrustes: rmse 0.3058552 max resid 0.4213707
## Run 742 stress 0
## ... Procrustes: rmse 0.1869421 max resid 0.348639
## Run 743 stress 9.382448e-05
## ... Procrustes: rmse 0.2447509 max resid 0.3153485
## Run 744 stress 0
## ... Procrustes: rmse 0.2468949 max resid 0.4034097
## Run 745 stress 0
## ... Procrustes: rmse 0.1228869 max resid 0.1652663
## Run 746 stress 0
## ... Procrustes: rmse 0.2073332 max resid 0.2865594
## Run 747 stress 6.581644e-05
## ... Procrustes: rmse 0.2482612 max resid 0.3851096
## Run 748 stress 9.769465e-05
## ... Procrustes: rmse 0.2257601 max resid 0.3756458
## Run 749 stress 0
## ... Procrustes: rmse 0.2425308 max resid 0.4372041
## Run 750 stress 0
## ... Procrustes: rmse 0.2790887 max resid 0.4235136
## Run 751 stress 0.126243
## Run 752 stress 0
## ... Procrustes: rmse 0.2111431 max resid 0.2840444
## Run 753 stress 9.291666e-05
## ... Procrustes: rmse 0.2215827 max resid 0.3619753
## Run 754 stress 0
## ... Procrustes: rmse 0.1986354 max resid 0.3101753
## Run 755 stress 0.0755437
## Run 756 stress 0
## ... Procrustes: rmse 0.2532829 max resid 0.3895672

```



```

## Run 757 stress 0
## ... Procrustes: rmse 0.1893474 max resid 0.3226497
## Run 758 stress 0
## ... Procrustes: rmse 0.2099669 max resid 0.408552
## Run 759 stress 0
## ... Procrustes: rmse 0.2276177 max resid 0.3469861
## Run 760 stress 0
## ... Procrustes: rmse 0.2308707 max resid 0.3169981
## Run 761 stress 0
## ... Procrustes: rmse 0.2085405 max resid 0.3198269
## Run 762 stress 0.07554315
## Run 763 stress 1.667248e-05
## ... Procrustes: rmse 0.2360291 max resid 0.4276833
## Run 764 stress 0
## ... Procrustes: rmse 0.2314437 max resid 0.3585629
## Run 765 stress 0
## ... Procrustes: rmse 0.2262869 max resid 0.2836172
## Run 766 stress 0
## ... Procrustes: rmse 0.2641644 max resid 0.3983025
## Run 767 stress 9.71845e-05
## ... Procrustes: rmse 0.2612874 max resid 0.3770047
## Run 768 stress 0
## ... Procrustes: rmse 0.2361782 max resid 0.390362
## Run 769 stress 0
## ... Procrustes: rmse 0.2303351 max resid 0.3027274
## Run 770 stress 0
## ... Procrustes: rmse 0.1984942 max resid 0.3552622
## Run 771 stress 0
## ... Procrustes: rmse 0.243855 max resid 0.3133254
## Run 772 stress 0
## ... Procrustes: rmse 0.2834288 max resid 0.4515828
## Run 773 stress 0
## ... Procrustes: rmse 0.2222409 max resid 0.3187893
## Run 774 stress 0
## ... Procrustes: rmse 0.2072395 max resid 0.2947745
## Run 775 stress 0.07554281
## Run 776 stress 0
## ... Procrustes: rmse 0.2156303 max resid 0.3172365
## Run 777 stress 9.937903e-05
## ... Procrustes: rmse 0.2446448 max resid 0.3153671
## Run 778 stress 0
## ... Procrustes: rmse 0.1629155 max resid 0.226566
## Run 779 stress 0
## ... Procrustes: rmse 0.2339872 max resid 0.3608121
## Run 780 stress 9.919064e-05
## ... Procrustes: rmse 0.2446345 max resid 0.3153293
## Run 781 stress 0.07554342
## Run 782 stress 0
## ... Procrustes: rmse 0.2545461 max resid 0.4047835
## Run 783 stress 0
## ... Procrustes: rmse 0.3062553 max resid 0.5252085
## Run 784 stress 0
## ... Procrustes: rmse 0.2035795 max resid 0.3237551
## Run 785 stress 0

```

```

## ... Procrustes: rmse 0.1173187  max resid 0.1713266
## Run 786 stress 0
## ... Procrustes: rmse 0.1841783  max resid 0.3210815
## Run 787 stress 0
## ... Procrustes: rmse 0.238173  max resid 0.4521179
## Run 788 stress 0.07554429
## Run 789 stress 0
## ... Procrustes: rmse 0.2583215  max resid 0.348147
## Run 790 stress 7.70465e-05
## ... Procrustes: rmse 0.2940393  max resid 0.5550396
## Run 791 stress 0
## ... Procrustes: rmse 0.2188979  max resid 0.3743916
## Run 792 stress 0
## ... Procrustes: rmse 0.1929733  max resid 0.3478376
## Run 793 stress 0
## ... Procrustes: rmse 0.2161477  max resid 0.3750417
## Run 794 stress 9.445647e-05
## ... Procrustes: rmse 0.2447363  max resid 0.3154572
## Run 795 stress 0.07554292
## Run 796 stress 0
## ... Procrustes: rmse 0.2437525  max resid 0.4117607
## Run 797 stress 0
## ... Procrustes: rmse 0.1726978  max resid 0.2973581
## Run 798 stress 0
## ... Procrustes: rmse 0.1256851  max resid 0.1700223
## Run 799 stress 0
## ... Procrustes: rmse 0.19473  max resid 0.3185778
## Run 800 stress 0.07554391
## Run 801 stress 9.433535e-05
## ... Procrustes: rmse 0.2447037  max resid 0.3152538
## Run 802 stress 0
## ... Procrustes: rmse 0.2141347  max resid 0.4166092
## Run 803 stress 9.408145e-05
## ... Procrustes: rmse 0.2447177  max resid 0.3155427
## Run 804 stress 9.729587e-05
## ... Procrustes: rmse 0.1931277  max resid 0.3192992
## Run 805 stress 0.07554337
## Run 806 stress 9.863501e-05
## ... Procrustes: rmse 0.2447171  max resid 0.3155695
## Run 807 stress 0
## ... Procrustes: rmse 0.2107725  max resid 0.2996816
## Run 808 stress 0
## ... Procrustes: rmse 0.09919165  max resid 0.1301487
## Run 809 stress 0.1756089
## Run 810 stress 4.519098e-05
## ... Procrustes: rmse 0.1369174  max resid 0.1863419
## Run 811 stress 8.940287e-05
## ... Procrustes: rmse 0.2355444  max resid 0.3228167
## Run 812 stress 7.201128e-05
## ... Procrustes: rmse 0.2862585  max resid 0.5307025
## Run 813 stress 0
## ... Procrustes: rmse 0.2253196  max resid 0.3827456
## Run 814 stress 0
## ... Procrustes: rmse 0.2109437  max resid 0.339494

```

```

## Run 815 stress 0
## ... Procrustes: rmse 0.2133755 max resid 0.3375495
## Run 816 stress 0
## ... Procrustes: rmse 0.2295076 max resid 0.3925673
## Run 817 stress 8.100393e-05
## ... Procrustes: rmse 0.2408567 max resid 0.3433928
## Run 818 stress 7.715343e-05
## ... Procrustes: rmse 0.2447075 max resid 0.3154484
## Run 819 stress 0
## ... Procrustes: rmse 0.2125619 max resid 0.3346439
## Run 820 stress 0
## ... Procrustes: rmse 0.2715368 max resid 0.3727089
## Run 821 stress 0
## ... Procrustes: rmse 0.2637344 max resid 0.4758965
## Run 822 stress 0
## ... Procrustes: rmse 0.08794118 max resid 0.1330387
## Run 823 stress 0.07554389
## Run 824 stress 0
## ... Procrustes: rmse 0.2281819 max resid 0.4231397
## Run 825 stress 7.60184e-05
## ... Procrustes: rmse 0.1827811 max resid 0.3343855
## Run 826 stress 0
## ... Procrustes: rmse 0.2446418 max resid 0.3435907
## Run 827 stress 0.07554361
## Run 828 stress 0
## ... Procrustes: rmse 0.2732691 max resid 0.3699733
## Run 829 stress 9.750798e-05
## ... Procrustes: rmse 0.2447193 max resid 0.3153587
## Run 830 stress 0
## ... Procrustes: rmse 0.2360084 max resid 0.3811371
## Run 831 stress 8.420178e-05
## ... Procrustes: rmse 0.2500373 max resid 0.5185458
## Run 832 stress 0
## ... Procrustes: rmse 0.2409069 max resid 0.4557895
## Run 833 stress 0
## ... Procrustes: rmse 0.2603838 max resid 0.4251056
## Run 834 stress 0
## ... Procrustes: rmse 0.2263866 max resid 0.3284026
## Run 835 stress 0
## ... Procrustes: rmse 0.1851235 max resid 0.2596752
## Run 836 stress 0
## ... Procrustes: rmse 0.2672066 max resid 0.4284126
## Run 837 stress 0
## ... Procrustes: rmse 0.2979064 max resid 0.4880451
## Run 838 stress 9.384436e-05
## ... Procrustes: rmse 0.2446855 max resid 0.3153424
## Run 839 stress 0
## ... Procrustes: rmse 0.2266546 max resid 0.2909855
## Run 840 stress 0
## ... Procrustes: rmse 0.1930441 max resid 0.3273586
## Run 841 stress 0
## ... Procrustes: rmse 0.2705197 max resid 0.4425419
## Run 842 stress 0
## ... Procrustes: rmse 0.3072116 max resid 0.504973

```

```

## Run 843 stress 9.874878e-05
## ... Procrustes: rmse 0.2446891 max resid 0.3153425
## Run 844 stress 7.053757e-05
## ... Procrustes: rmse 0.1038418 max resid 0.1316209
## Run 845 stress 7.283154e-05
## ... Procrustes: rmse 0.2172492 max resid 0.3202267
## Run 846 stress 5.391592e-05
## ... Procrustes: rmse 0.09020222 max resid 0.1206293
## Run 847 stress 0
## ... Procrustes: rmse 0.258347 max resid 0.3241533
## Run 848 stress 0
## ... Procrustes: rmse 0.2487432 max resid 0.3615833
## Run 849 stress 0.07554377
## Run 850 stress 0
## ... Procrustes: rmse 0.1834985 max resid 0.2813088
## Run 851 stress 0
## ... Procrustes: rmse 0.2900375 max resid 0.4706638
## Run 852 stress 0
## ... Procrustes: rmse 0.2813153 max resid 0.4226831
## Run 853 stress 0
## ... Procrustes: rmse 0.2921785 max resid 0.4470804
## Run 854 stress 0
## ... Procrustes: rmse 0.2699909 max resid 0.349024
## Run 855 stress 0
## ... Procrustes: rmse 0.237184 max resid 0.3608981
## Run 856 stress 0
## ... Procrustes: rmse 0.2466744 max resid 0.4139905
## Run 857 stress 0.07554387
## Run 858 stress 9.905664e-05
## ... Procrustes: rmse 0.2447557 max resid 0.3154336
## Run 859 stress 9.512493e-05
## ... Procrustes: rmse 0.2447062 max resid 0.3152955
## Run 860 stress 9.259162e-05
## ... Procrustes: rmse 0.2446898 max resid 0.3153567
## Run 861 stress 9.570164e-05
## ... Procrustes: rmse 0.2446875 max resid 0.3154471
## Run 862 stress 0.07554344
## Run 863 stress 0
## ... Procrustes: rmse 0.2987284 max resid 0.4339529
## Run 864 stress 8.689976e-05
## ... Procrustes: rmse 0.2447478 max resid 0.3154176
## Run 865 stress 9.077741e-05
## ... Procrustes: rmse 0.2447521 max resid 0.315419
## Run 866 stress 0
## ... Procrustes: rmse 0.2401986 max resid 0.3860175
## Run 867 stress 0.07554433
## Run 868 stress 0
## ... Procrustes: rmse 0.2497235 max resid 0.3504445
## Run 869 stress 0
## ... Procrustes: rmse 0.2296603 max resid 0.3995267
## Run 870 stress 0
## ... Procrustes: rmse 0.2320253 max resid 0.3743988
## Run 871 stress 0
## ... Procrustes: rmse 0.2304855 max resid 0.4295438

```

```

## Run 872 stress 0
## ... Procrustes: rmse 0.2840415 max resid 0.4459285
## Run 873 stress 9.293336e-05
## ... Procrustes: rmse 0.2447381 max resid 0.3154324
## Run 874 stress 9.371616e-05
## ... Procrustes: rmse 0.2975005 max resid 0.5592956
## Run 875 stress 9.823137e-05
## ... Procrustes: rmse 0.244737 max resid 0.3153104
## Run 876 stress 9.379302e-05
## ... Procrustes: rmse 0.2446967 max resid 0.3153401
## Run 877 stress 0
## ... Procrustes: rmse 0.2152153 max resid 0.3393717
## Run 878 stress 0
## ... Procrustes: rmse 0.1511248 max resid 0.2353511
## Run 879 stress 7.357099e-05
## ... Procrustes: rmse 0.177594 max resid 0.2930192
## Run 880 stress 0
## ... Procrustes: rmse 0.2233717 max resid 0.3968609
## Run 881 stress 0
## ... Procrustes: rmse 0.1243466 max resid 0.2094747
## Run 882 stress 0
## ... Procrustes: rmse 0.3086139 max resid 0.5060115
## Run 883 stress 0
## ... Procrustes: rmse 0.2552165 max resid 0.399511
## Run 884 stress 9.963951e-05
## ... Procrustes: rmse 0.2448066 max resid 0.3152251
## Run 885 stress 0
## ... Procrustes: rmse 0.2469563 max resid 0.3746392
## Run 886 stress 0
## ... Procrustes: rmse 0.2389638 max resid 0.3472194
## Run 887 stress 0
## ... Procrustes: rmse 0.2768957 max resid 0.4764891
## Run 888 stress 9.615497e-05
## ... Procrustes: rmse 0.2447116 max resid 0.3152818
## Run 889 stress 0
## ... Procrustes: rmse 0.08159468 max resid 0.1157008
## Run 890 stress 8.30885e-05
## ... Procrustes: rmse 0.2938141 max resid 0.5545021
## Run 891 stress 0
## ... Procrustes: rmse 0.2342253 max resid 0.3363514
## Run 892 stress 0
## ... Procrustes: rmse 0.3213609 max resid 0.5160653
## Run 893 stress 9.427931e-05
## ... Procrustes: rmse 0.2447523 max resid 0.315297
## Run 894 stress 0
## ... Procrustes: rmse 0.2074525 max resid 0.3327007
## Run 895 stress 0
## ... Procrustes: rmse 0.2225278 max resid 0.3040627
## Run 896 stress 9.854848e-05
## ... Procrustes: rmse 0.2447368 max resid 0.3152597
## Run 897 stress 0.0755428
## Run 898 stress 0
## ... Procrustes: rmse 0.2058658 max resid 0.3252069
## Run 899 stress 0.07554383

```

```

## Run 900 stress 0
## ... Procrustes: rmse 0.2270336 max resid 0.3510194
## Run 901 stress 0
## ... Procrustes: rmse 0.2369933 max resid 0.3720552
## Run 902 stress 0.07554384
## Run 903 stress 4.814309e-05
## ... Procrustes: rmse 0.2991612 max resid 0.4388757
## Run 904 stress 6.092495e-05
## ... Procrustes: rmse 0.2464625 max resid 0.5044792
## Run 905 stress 0
## ... Procrustes: rmse 0.2424956 max resid 0.2981276
## Run 906 stress 0.07554362
## Run 907 stress 0
## ... Procrustes: rmse 0.2764449 max resid 0.4380211
## Run 908 stress 0
## ... Procrustes: rmse 0.2149698 max resid 0.3271112
## Run 909 stress 0
## ... Procrustes: rmse 0.2132362 max resid 0.3068963
## Run 910 stress 0
## ... Procrustes: rmse 0.2508024 max resid 0.3931593
## Run 911 stress 0.07554309
## Run 912 stress 0
## ... Procrustes: rmse 0.2925298 max resid 0.479208
## Run 913 stress 0
## ... Procrustes: rmse 0.1984269 max resid 0.3414967
## Run 914 stress 0.07554362
## Run 915 stress 8.622199e-05
## ... Procrustes: rmse 0.259186 max resid 0.5253831
## Run 916 stress 9.825939e-05
## ... Procrustes: rmse 0.244681 max resid 0.3153946
## Run 917 stress 9.62231e-05
## ... Procrustes: rmse 0.2447652 max resid 0.315383
## Run 918 stress 9.442559e-05
## ... Procrustes: rmse 0.2446813 max resid 0.3153274
## Run 919 stress 7.155127e-05
## ... Procrustes: rmse 0.2447234 max resid 0.3153234
## Run 920 stress 0
## ... Procrustes: rmse 0.2405513 max resid 0.3611624
## Run 921 stress 0
## ... Procrustes: rmse 0.235164 max resid 0.3458089
## Run 922 stress 9.55781e-05
## ... Procrustes: rmse 0.2447308 max resid 0.3155016
## Run 923 stress 0
## ... Procrustes: rmse 0.2590005 max resid 0.4278661
## Run 924 stress 0
## ... Procrustes: rmse 0.1825742 max resid 0.2376147
## Run 925 stress 9.567906e-05
## ... Procrustes: rmse 0.2446934 max resid 0.3153458
## Run 926 stress 0
## ... Procrustes: rmse 0.2003872 max resid 0.3294537
## Run 927 stress 0
## ... Procrustes: rmse 0.2639913 max resid 0.4193376
## Run 928 stress 0
## ... Procrustes: rmse 0.2280028 max resid 0.3315384

```

```

## Run 929 stress 0
## ... Procrustes: rmse 0.1897616 max resid 0.2967024
## Run 930 stress 0
## ... Procrustes: rmse 0.3023192 max resid 0.4927201
## Run 931 stress 7.797421e-05
## ... Procrustes: rmse 0.2191061 max resid 0.3982249
## Run 932 stress 0
## ... Procrustes: rmse 0.2400451 max resid 0.4038609
## Run 933 stress 3.661658e-05
## ... Procrustes: rmse 0.3056502 max resid 0.4858379
## Run 934 stress 8.419498e-05
## ... Procrustes: rmse 0.3197758 max resid 0.4914951
## Run 935 stress 0
## ... Procrustes: rmse 0.31905 max resid 0.528012
## Run 936 stress 0
## ... Procrustes: rmse 0.2372713 max resid 0.4258934
## Run 937 stress 8.882425e-05
## ... Procrustes: rmse 0.2054311 max resid 0.320835
## Run 938 stress 0
## ... Procrustes: rmse 0.1244228 max resid 0.2017221
## Run 939 stress 0.07554335
## Run 940 stress 0
## ... Procrustes: rmse 0.31577 max resid 0.5090344
## Run 941 stress 6.540371e-05
## ... Procrustes: rmse 0.2614976 max resid 0.4174182
## Run 942 stress 9.494867e-05
## ... Procrustes: rmse 0.1755885 max resid 0.2349111
## Run 943 stress 0
## ... Procrustes: rmse 0.2295614 max resid 0.3529165
## Run 944 stress 0.07554281
## Run 945 stress 0
## ... Procrustes: rmse 0.2134364 max resid 0.3334161
## Run 946 stress 0
## ... Procrustes: rmse 0.2177624 max resid 0.312744
## Run 947 stress 0
## ... Procrustes: rmse 0.2163526 max resid 0.3530123
## Run 948 stress 0
## ... Procrustes: rmse 0.1742748 max resid 0.2767032
## Run 949 stress 0
## ... Procrustes: rmse 0.2929006 max resid 0.4471932
## Run 950 stress 0
## ... Procrustes: rmse 0.2603208 max resid 0.3833124
## Run 951 stress 0
## ... Procrustes: rmse 0.1978527 max resid 0.3150665
## Run 952 stress 8.085493e-05
## ... Procrustes: rmse 0.2447658 max resid 0.3153842
## Run 953 stress 0.07554325
## Run 954 stress 9.689067e-05
## ... Procrustes: rmse 0.2446686 max resid 0.3152194
## Run 955 stress 0
## ... Procrustes: rmse 0.2149827 max resid 0.3227061
## Run 956 stress 2.859818e-05
## ... Procrustes: rmse 0.2751476 max resid 0.4208297
## Run 957 stress 9.077077e-05

```

```

## ... Procrustes: rmse 0.2446887 max resid 0.3153039
## Run 958 stress 0
## ... Procrustes: rmse 0.2206288 max resid 0.4466723
## Run 959 stress 0
## ... Procrustes: rmse 0.2541588 max resid 0.4845915
## Run 960 stress 0
## ... Procrustes: rmse 0.2582839 max resid 0.3913114
## Run 961 stress 8.331175e-05
## ... Procrustes: rmse 0.2447007 max resid 0.3153651
## Run 962 stress 0
## ... Procrustes: rmse 0.1793782 max resid 0.2834081
## Run 963 stress 0
## ... Procrustes: rmse 0.2875442 max resid 0.4998209
## Run 964 stress 0
## ... Procrustes: rmse 0.2499969 max resid 0.3279716
## Run 965 stress 9.8109e-05
## ... Procrustes: rmse 0.2447676 max resid 0.3152936
## Run 966 stress 0.07554348
## Run 967 stress 0
## ... Procrustes: rmse 0.2479858 max resid 0.4645183
## Run 968 stress 0
## ... Procrustes: rmse 0.2690751 max resid 0.4325071
## Run 969 stress 8.409588e-05
## ... Procrustes: rmse 0.2446981 max resid 0.3154258
## Run 970 stress 0
## ... Procrustes: rmse 0.1653133 max resid 0.2392024
## Run 971 stress 0
## ... Procrustes: rmse 0.1947193 max resid 0.2598265
## Run 972 stress 0
## ... Procrustes: rmse 0.2428281 max resid 0.380312
## Run 973 stress 0
## ... Procrustes: rmse 0.2340087 max resid 0.343585
## Run 974 stress 5.212224e-05
## ... Procrustes: rmse 0.3123691 max resid 0.4462866
## Run 975 stress 0
## ... Procrustes: rmse 0.3038331 max resid 0.5047737
## Run 976 stress 0.126243
## Run 977 stress 0.075544
## Run 978 stress 5.856995e-05
## ... Procrustes: rmse 0.1799299 max resid 0.3165985
## Run 979 stress 0.07554351
## Run 980 stress 0
## ... Procrustes: rmse 0.260362 max resid 0.4170711
## Run 981 stress 8.585628e-05
## ... Procrustes: rmse 0.2606154 max resid 0.5429138
## Run 982 stress 6.050834e-05
## ... Procrustes: rmse 0.2172559 max resid 0.3250334
## Run 983 stress 0
## ... Procrustes: rmse 0.3092045 max resid 0.4622176
## Run 984 stress 0
## ... Procrustes: rmse 0.2351915 max resid 0.4188974
## Run 985 stress 0
## ... Procrustes: rmse 0.213777 max resid 0.4130001
## Run 986 stress 0.07554368

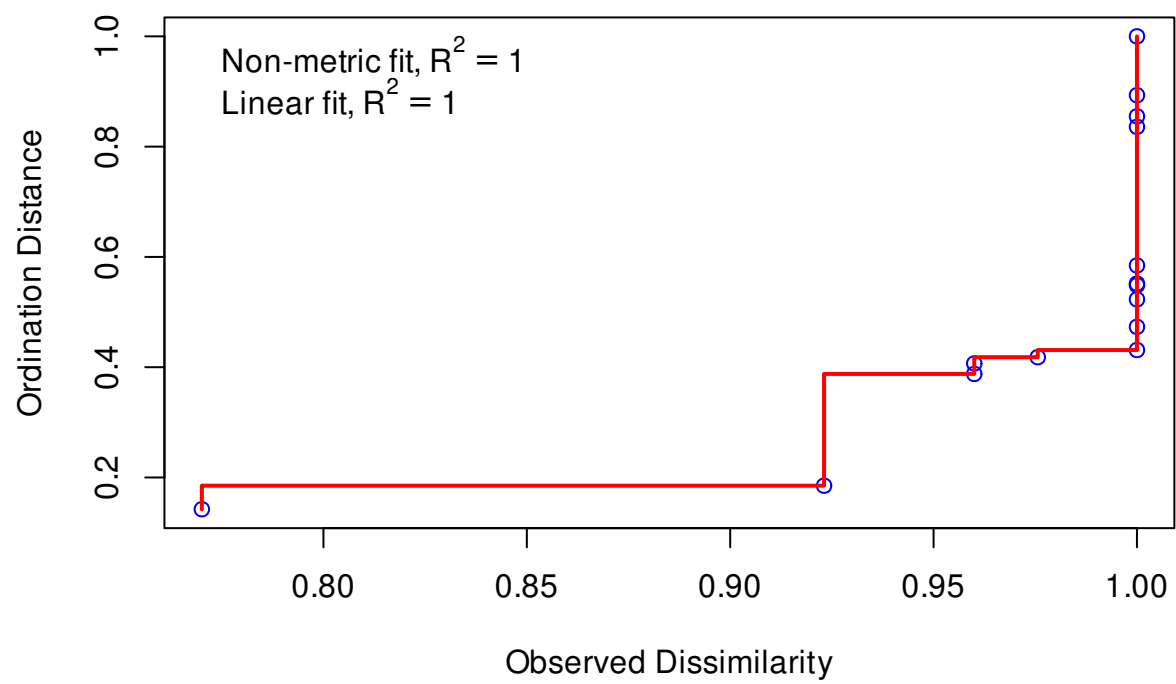
```

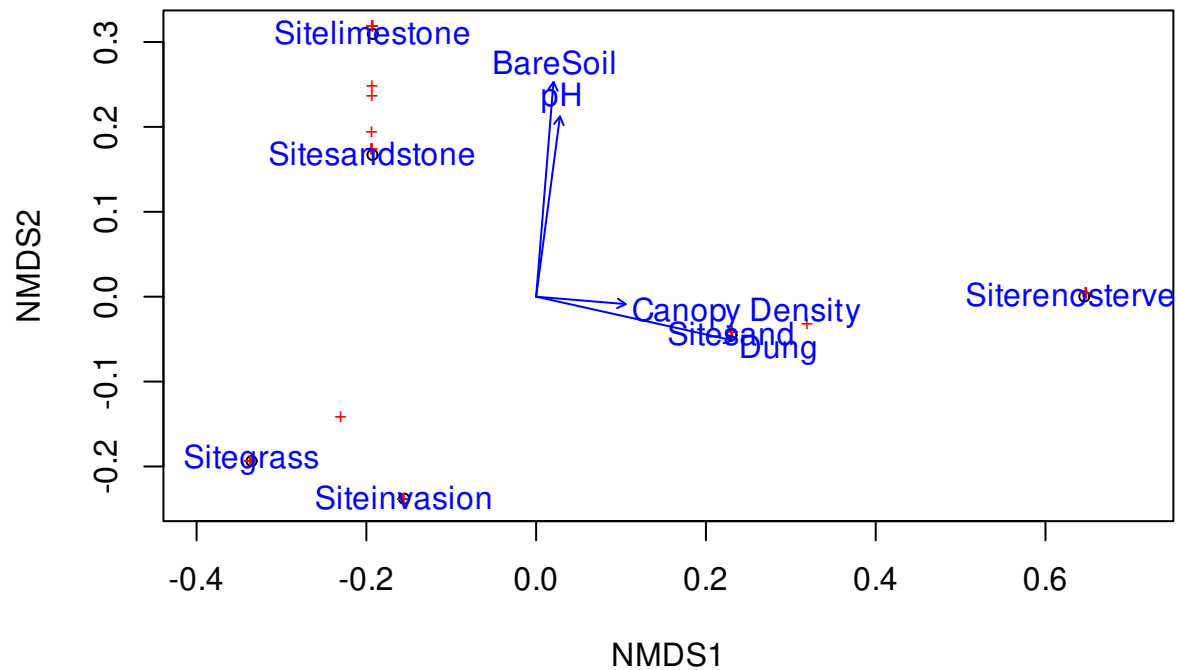


```

## Run 987 stress 9.834521e-05
## ... Procrustes: rmse 0.2061482 max resid 0.3392203
## Run 988 stress 0
## ... Procrustes: rmse 0.3106369 max resid 0.5200018
## Run 989 stress 0
## ... Procrustes: rmse 0.1344342 max resid 0.2109441
## Run 990 stress 6.505235e-06
## ... Procrustes: rmse 0.2667663 max resid 0.3537253
## Run 991 stress 0
## ... Procrustes: rmse 0.2083094 max resid 0.3324251
## Run 992 stress 6.720256e-05
## ... Procrustes: rmse 0.2051871 max resid 0.3558438
## Run 993 stress 0
## ... Procrustes: rmse 0.2204728 max resid 0.4336524
## Run 994 stress 0
## ... Procrustes: rmse 0.2009819 max resid 0.2732006
## Run 995 stress 0
## ... Procrustes: rmse 0.1516836 max resid 0.2090386
## Run 996 stress 9.40339e-05
## ... Procrustes: rmse 0.2776746 max resid 0.5089389
## Run 997 stress 0
## ... Procrustes: rmse 0.2510639 max resid 0.3897639
## Run 998 stress 0
## ... Procrustes: rmse 0.2459066 max resid 0.5122755
## Run 999 stress 3.74203e-05
## ... Procrustes: rmse 0.2843579 max resid 0.4685368
## *** No convergence -- monoMDS stopping criteria:
##     3: no. of iterations >= maxit
##    892: stress < smin
##   104: stress ratio > sratmax

```





FD

```
fnmnds <- metaMDS(msampBFD, trymax = 999)
```

```
## Run 0 stress 9.939348e-05
## Run 1 stress 9.284391e-05
## ... New best solution
## ... Procrustes: rmse 0.09959082 max resid 0.1767704
## Run 2 stress 9.882703e-05
## ... Procrustes: rmse 0.1887378 max resid 0.3262373
## Run 3 stress 9.500478e-05
## ... Procrustes: rmse 0.06162925 max resid 0.0936767
## Run 4 stress 8.723286e-05
## ... New best solution
## ... Procrustes: rmse 0.1537403 max resid 0.2652818
## Run 5 stress 6.379366e-05
## ... New best solution
## ... Procrustes: rmse 0.1572831 max resid 0.224073
## Run 6 stress 9.216081e-05
## ... Procrustes: rmse 0.1168586 max resid 0.1780707
## Run 7 stress 5.647045e-05
## ... New best solution
## ... Procrustes: rmse 0.1569852 max resid 0.2331445
## Run 8 stress 8.804099e-05
## ... Procrustes: rmse 0.1264031 max resid 0.2062333
## Run 9 stress 9.527071e-05
## ... Procrustes: rmse 0.2105029 max resid 0.2970828
```

```

## Run 10 stress 8.04623e-05
## ... Procrustes: rmse 0.0009307369 max resid 0.001582246
## ... Similar to previous best
## Run 11 stress 0.1211358
## Run 12 stress 9.212867e-05
## ... Procrustes: rmse 0.2645485 max resid 0.3747671
## Run 13 stress 8.617242e-05
## ... Procrustes: rmse 0.1381568 max resid 0.2264968
## Run 14 stress 9.123247e-05
## ... Procrustes: rmse 0.1508453 max resid 0.2485098
## Run 15 stress 9.146475e-05
## ... Procrustes: rmse 0.1548229 max resid 0.2554613
## Run 16 stress 0.1211361
## Run 17 stress 9.486146e-05
## ... Procrustes: rmse 0.2587119 max resid 0.3676782
## Run 18 stress 9.901118e-05
## ... Procrustes: rmse 0.01156929 max resid 0.01829058
## Run 19 stress 9.991586e-05
## ... Procrustes: rmse 0.1200671 max resid 0.2025225
## Run 20 stress 9.817788e-05
## ... Procrustes: rmse 0.154887 max resid 0.2555841
## *** Solution reached

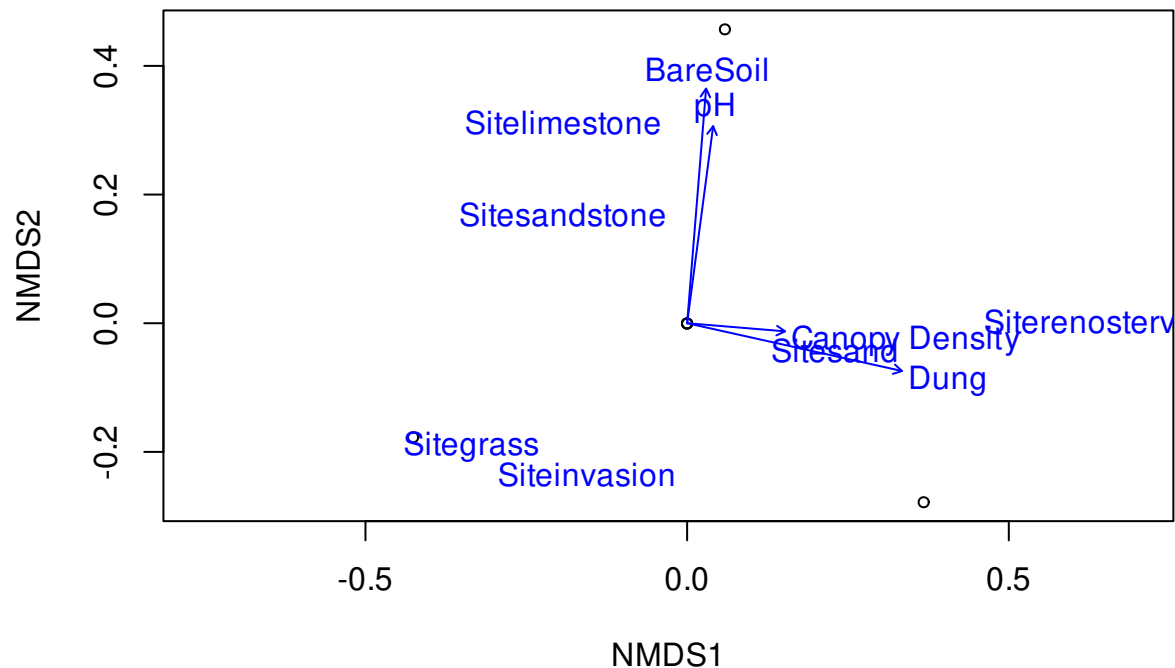
## Warning in metaMDS(msampBFD, trymax = 999): stress is (nearly) zero: you may
## have insufficient data

plot(fnmads)

## species scores not available

plot(en)

```



Try adding the rest yourself...

Mike has shown you how to explore soil colour. Feel free to explore and add it in...

Ecosystem function

To explore ecosystem function we looked at the 20-year time series of the Normalized Difference Vegetation Index (NDVI) recorded by the MODIS satellite mission. From these we used the post-fire recovery trajectory modelling framework developed by Wilson et al (2015) to derive estimates of the mean maximum NDVI ($\alpha + \gamma$), and the amplitude and timing of seasonality (big α and ϕ) as our measures of ecosystem function. Here I've provided a table of these parameters by site and plots of the model fits. Are the models good fits? Do they miss anything? Is it relevant to the questions we're asking?

Explore relationship between EF and measures of diversity

- Mantel tests? ?mantel

Test relationships using a null model?

References

Bergh et al
Mucina and Rutherford
Slingsby et al. 2020
van der Plas

