

Body size trends in Neogene tortoises

30.05.2017

TO DO:

- figure out if Checklist data is of any use (means? medians? sample size?) or see if authors can provide necessary data
- do paleoTS analyses with FFB data set
- read Hunt papers (see citations in Catalina's paper 2006, 2008, 2008, 2010; also 2015)
- figure out how to implement phylogeny... well, figure out how to do paleoTS analyses with more than one taxon without pooling everything together (as in Test2)

06.06.2017

```
tidyCL<-read.csv("tortoises_tidy.csv", sep=";", header=TRUE)

colnames(tidyCL)[6] <- "MAmin"
colnames(tidyCL)[7] <- "Mamax"
colnames(tidyCL)[17] <- "CL"
colnames(tidyCL)[18] <- "PL"

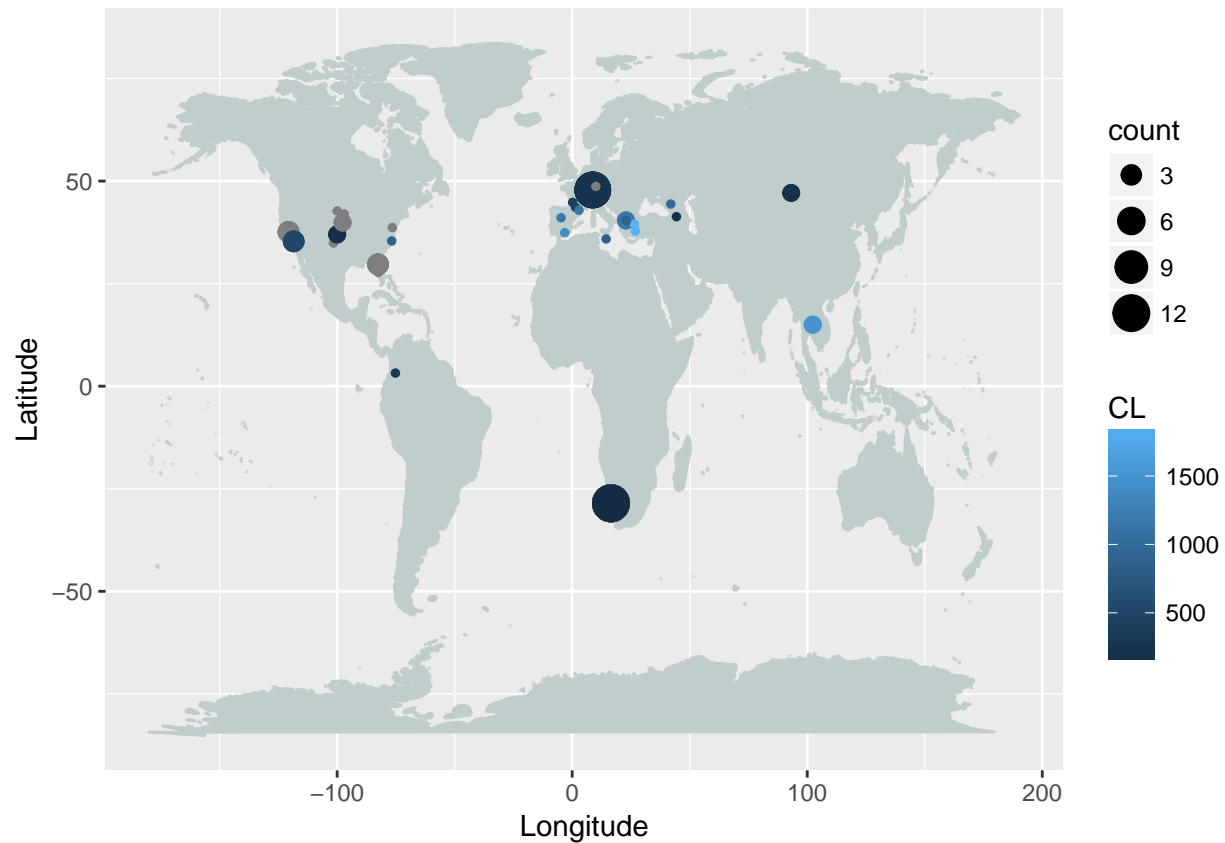
statsCL <- tidyCL %>%
  dplyr::filter(!is.na(CL)) %>%
  summarise(min = min(CL), max = max(CL), var= var(CL), mean= mean(CL), median= median(CL))#, skew(CL), kurt

Map <- tidyCL %>%
  dplyr::select(Genus, Taxon, Latitude, Longitude, Country, CL, PL) %>%
  group_by(Latitude) %>%
  mutate(count= n())

mapWorld <- borders("world", colour="azure3", fill="azure3") # create a layer of borders

mp <- Map %>%
  ggplot(aes(Longitude, Latitude)) + mapWorld +
  # geom_point(fill="red", colour="red", size=0.5) +
  geom_point(aes(Longitude, Latitude,colour=CL, size=count))

mp
```



```
library(plotly)
```

```
##
## Attaching package: 'plotly'

## The following object is masked from 'package:ggplot2':
##
##   last_plot
## The following object is masked from 'package:stats':
##
##   filter
## The following object is masked from 'package:graphics':
##
##   layout
```

```
ggplotly(mp)
```

```
## We recommend that you use the dev version of ggplot2 with `ggplotly()`
## Install it with: `devtools::install_github('hadley/ggplot2')`
```

TO DO:

- map localities with differing colors for: CL available, CL extrapolated (from PL or figures), CL missing
- complete data set!
- get missing references/make list of missing references

08.06.17

Map all localities with sample size and age indicated (regardless of whether CL information is available):

```
test<-read.csv("tortoises13-04.csv", sep=";", header=TRUE)

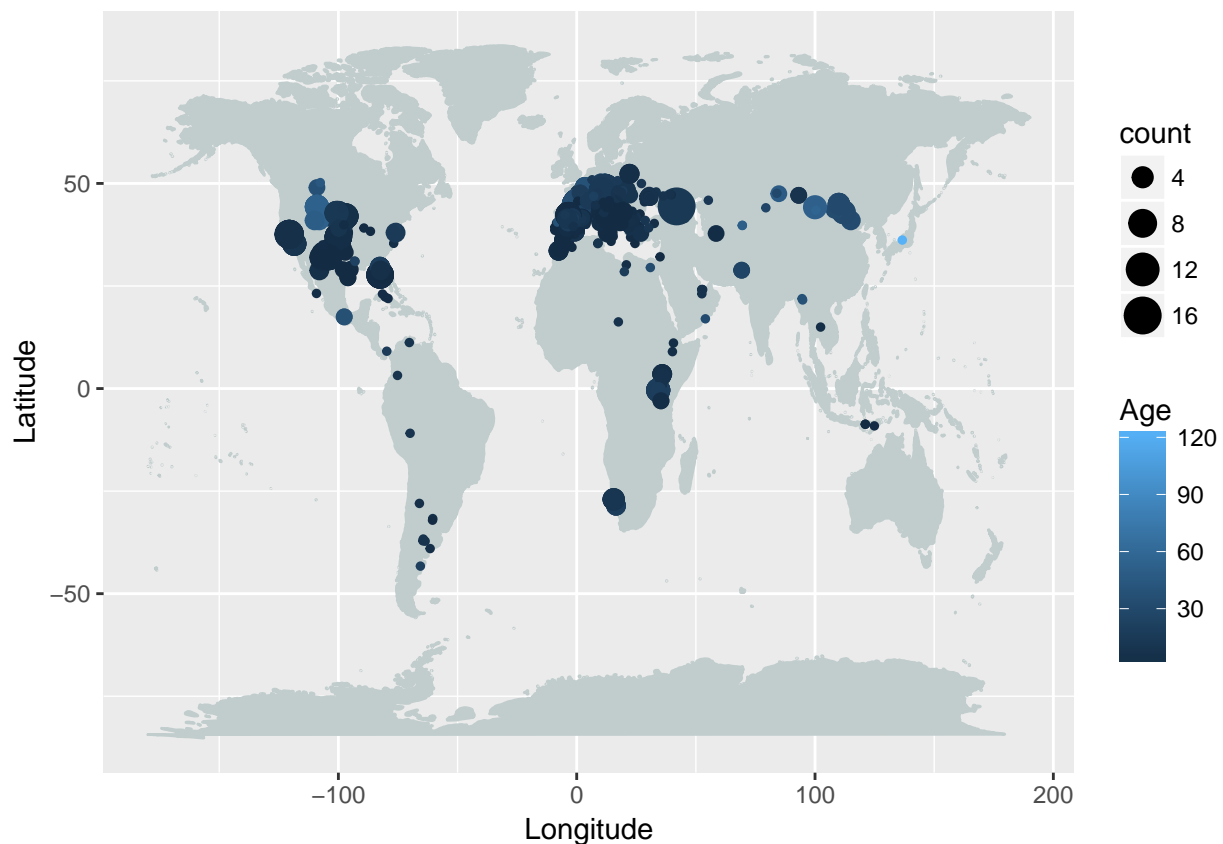
colnames(test)[6] <- "Mamin"
colnames(test)[7] <- "Mamax"

Test <- test %>%
  dplyr::select(Locality, Country, Latitude, Longitude, Mamin, Mamax, Epoch, Genus, Species, Taxon, CL)
  mutate(Age= (Mamin+Mamax)/2) %>% # create mean age
  group_by(Latitude) %>%
  mutate(count= n())

#mapWorld <- borders("world", colour="azure3", fill="azure3") # create a layer of borders

map <- Test %>%
  ggplot(aes(Longitude, Latitude)) + mapWorld +
  #geom_point(fill="red", colour="red", size=0.5) +
  geom_point(aes(Longitude, Latitude, colour=Age, size=count))

map
```



```
ggplotly(map)
```

We recommend that you use the dev version of ggplot2 with `ggplotly()`

```
## Install it with: `devtools::install_github('hadley/ggplot2')`
```

TO DO:

- get general statistical overview over data (stru, normal distribution?, mean/mode/median/min/max, hist plot etc. -> see Catalina's paper)

Try paleoTS with some first real data. Here is the underlying data:

```
tidyCL
```

```
##                                     Locality
## 1      UCMP V71137, Turlock Lake 10, Stanislaus County, California
## 2      UCMP V-3952, Ingram Creek site 8, Stanislaus County, California
## 3      UCMP V81248, Turlock Lake 11, Stanislaus County, California
## 4      Randle Cliff, Calvert County, Maryland
## 5      Cragin Quarry Local Fauna, Meade County, Kansas
## 6      Santee, Knox County, Nebraska
## 7      North Cita Canyon (Middle Stratum), Randall County, Texas
## 8      Leisey Shell Pit 1A, Hillsborough County, Florida
## 9      Sand Draw local fauna, Brown County, Nebraska
## 10     McGehee Farm near Newberry, Alachua County, Florida
## 11     Arredondo IIA, Alachua County, Florida
## 12     Epanomi (EPN I), western Chalkidiki Peninsula, Thessaloniki area
## 13     Epanomi (EPN II), western Chalkidiki Peninsula, Thessaloniki area
## 14     Hohenhöwen, Engen, Hegau, southwestern Germany
## 15     Hohenhöwen, Engen, Hegau, southwestern Germany
## 16     Hohenhöwen, Engen, Hegau, southwestern Germany
## 17     Hohenhöwen, Engen, Hegau, southwestern Germany
## 18     Hohenhöwen, Engen, Hegau, southwestern Germany
## 19     Hohenhöwen, Engen, Hegau, southwestern Germany
## 20     Hohenhöwen, Engen, Hegau, southwestern Germany
## 21     Hohenhöwen, Engen, Hegau, southwestern Germany
## 22     Hohenhöwen, Engen, Hegau, southwestern Germany
## 23     Altan-Teli main fossiliferous bed (Dzereg valley)
## 24     Altan-Teli main fossiliferous bed (Dzereg valley)
## 25     Sawrock Canyon local fauna, Seward County, Kansas
## 26     Sawrock Canyon local fauna, Seward County, Kansas
## 27     Baby 2, Saint-André-et-Appelles, Gironde
## 28     Toulouse Puits Borderouge niveau inférieur, Haute-Garonne
## 29     Dmanisi
## 30     Lee Creek Mine, Yorktown Sample, Beaufort County, North Carolina
## 31     Iron Canyon Fauna, Mojave Desert, Kern County, California
## 32     Ricardo Fauna, Mojave Desert, Kern County, California
## 33     Ricardo Fauna, Mojave Desert, Kern County, California
## 34     Thomas Farm Local Fauna, Gilchrist County, Florida
## 35     Thomas Farm Local Fauna, Gilchrist County, Florida
## 36     San Nicolas, UCMP locality V4536
## 37     Lesbos Island, F-Site
## 38     Kirchdorf an der Iller
## 39     Belomechetskaya
## 40     Elisabethfeld (= Elisabeth Bay) area, northern Sperrgebiet
## 41     Elisabethfeld (= Elisabeth Bay) area, northern Sperrgebiet
## 42     Auchas
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## 43		Auchas
## 44		Auchas
## 45		Auchas
## 46		Arrisdrift
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## 53		Arrisdrift
## 54		Samos 1
## 55	Serrat-d'en-Vacquer near Perpignan, Pyrénées-Orientales	
## 56	Zebbug and Gahr Dalam Cave deposits	
## 57	El Lugarejo (Arévalo), Ávila, Castilla	
## 58	Fonelas P-1, Guadix Basin	
## 59	White Rock local fauna, Republic County, Kansas	
## 60	White Rock local fauna, Republic County, Kansas	
## 61	Tha Chang area, Chaloem Pra Kiat district, Nakhon Ratchasima Province	
## 62	Tha Chang area, Chaloem Pra Kiat district, Nakhon Ratchasima Province	
## 63	Nea Kallikratia, western Chalkidiki Peninsula, Thessaloniki area	
## 64	Nea Michaniona, western Chalkidiki Peninsula, Thessaloniki area	
## 65		Sandelzhausen
## 66		Sandelzhausen unterer Geröllmergel (B)
## 67		Gammelsdorf
## 68		Gammelsdorf
## 69		Altenstadt, 7 km S Illertissen
## 70	Hohenhöwen, Engen, Hegau, southwestern Germany	
## 71	Hohenhöwen, Engen, Hegau, southwestern Germany	
## 72		Steinheim a. Albuch
##	Country Latitude Longitude	
## 1	USA 37.6000 -120.6000	
## 2	USA 37.6000 -120.8000	
## 3	USA 37.6000 -120.6000	
## 4	USA 38.6665 -76.5298	
## 5	USA 37.2242 -100.4176	
## 6	USA 42.0000 -97.0000	
## 7	USA 34.9000 -101.6000	
## 8	USA 27.7000 -82.5000	
## 9	USA 42.7000 -100.0000	
## 10	USA 29.7000 -82.6000	
## 11	USA 29.6000 -82.4000	
## 12	Greece 40.4046 22.8980	
## 13	Greece 40.4046 22.8980	
## 14	Germany 47.8356 8.7490	
## 15	Germany 47.8356 8.7490	
## 16	Germany 47.8356 8.7490	
## 17	Germany 47.8356 8.7490	
## 18	Germany 47.8356 8.7490	
## 19	Germany 47.8356 8.7490	
## 20	Germany 47.8356 8.7490	
## 21	Germany 47.8356 8.7490	
## 22	Germany 47.8356 8.7490	
## 23	Mongolia 47.1000 93.1667	

## 24	Mongolia	47.1000	93.1667
## 25	USA	37.0000	-100.0000
## 26	USA	37.0000	-100.0000
## 27	France	44.8120	0.2133
## 28	France	43.6000	1.4333
## 29	Georgia	41.3200	44.3500
## 30	USA	35.4000	-76.8000
## 31	USA	35.3000	-118.5000
## 32	USA	35.3000	-118.5000
## 33	USA	35.3000	-118.5000
## 34	USA	29.7000	-82.6000
## 35	USA	29.7000	-82.6000
## 36	Colombia	3.2000	-75.2000
## 37	Greece	39.5000	26.5000
## 38	Germany	48.0728	10.1424
## 39	Russia	44.4000	41.9333
## 40	Namibia	-26.9161	15.1838
## 41	Namibia	-26.9161	15.1838
## 42	Namibia	-28.5500	16.5000
## 43	Namibia	-28.5500	16.5000
## 44	Namibia	-28.5500	16.5000
## 45	Namibia	-28.5500	16.5000
## 46	Namibia	-28.5500	16.5000
## 47	Namibia	-28.5500	16.5000
## 48	Namibia	-28.5500	16.5000
## 49	Namibia	-28.5500	16.5000
## 50	Namibia	-28.5500	16.5000
## 51	Namibia	-28.5500	16.5000
## 52	Namibia	-28.5500	16.5000
## 53	Namibia	-28.5500	16.5000
## 54	Greece	37.8000	26.9000
## 55	France	42.8800	2.8800
## 56	Malta	35.8897	14.4425
## 57	Spain	41.0560	-4.7169
## 58	Spain	37.4170	-3.1670
## 59	USA	39.9000	-97.7000
## 60	USA	39.9000	-97.7000
## 61	Thailand	14.9874	102.3352
## 62	Thailand	14.9874	102.3352
## 63	Greece	40.3146	23.0462
## 64	Greece	40.4731	22.8385
## 65	Germany	48.6283	11.7960
## 66	Germany	48.6283	11.7960
## 67	Germany	48.5495	11.9382
## 68	Germany	48.5495	11.9382
## 69	Germany	48.1542	10.1178
## 70	Germany	47.8356	8.7490
## 71	Germany	47.8356	8.7490
## 72	Germany	48.6939	10.0678
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35 a sinkhole lake that then collapsed into a larger underground chamber earliest Hemmingfordian Nor

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##      MAmin  Mamax      Epoch      upper.stage
## 1      5.000  6.000      Pliocene/Miocene      Zanclean
## 2      9.000 10.000      Miocene      Tortonian
## 3      5.000  6.000      Pliocene/Miocene      Zanclean
## 4     15.000 15.800      Miocene      Langhian
## 5      0.300  0.300      Pleistocene Middle Pleistocene
## 6      4.800  5.200      Pliocene      Zanclean
## 7      1.800  3.600 Pleistocene/Pliocene      Gelasian
## 8      1.000  1.500      Pleistocene Lower Pleistocene
## 9      3.000  3.000      Pliocene      Piacencian
## 10     10.900 11.000      Miocene      Tortonian
## 11      0.012  0.126      Pleistocene Upper Pleistocene
## 12      2.600  5.300      Pliocene      Piacencian
## 13      2.600  5.300      Pliocene      Piacencian
## 14     13.000 13.000      Miocene      Serravallian
## 15     13.000 13.000      Miocene      Serravallian
## 16     13.000 13.000      Miocene      Serravallian
## 17     13.000 13.000      Miocene      Serravallian
## 18     13.000 13.000      Miocene      Serravallian
## 19     13.000 13.000      Miocene      Serravallian
## 20     13.000 13.000      Miocene      Serravallian
## 21     13.000 13.000      Miocene      Serravallian
## 22     13.000 13.000      Miocene      Serravallian
## 23      2.600  5.300      Pliocene      Piacencian
## 24      2.600  5.300      Pliocene      Piacencian
## 25      3.000  3.000      Pliocene      Piacencian
## 26      3.000  3.000      Pliocene      Piacencian
## 27     33.900 34.000      Eocene      Priabonian
## 28     23.030 23.200      Oligocene      Chattian
## 29      1.770  1.770      Pleistocene Lower Pleistocene
## 30      4.000  5.000      Pliocene      Zanclean
## 31     11.200 12.500      Miocene      Tortonian
## 32      9.000 11.200      Miocene      Tortonian
## 33      9.000 11.200      Miocene      Tortonian
## 34     18.000 19.000      Miocene      Burdigalian
## 35     18.000 19.000      Miocene      Burdigalian
## 36      6.000 11.000      Miocene      Messinian
## 37      2.000  2.000      Pleistocene      Gelasian
## 38     16.500 16.800      Miocene      Burdigalian
## 39     13.500 14.500      Miocene      Serravallian

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## 40	19.000	20.000	Miocene	Burdigalian
## 41	19.000	20.000	Miocene	Burdigalian
## 42	18.000	18.000	Miocene	Burdigalian
## 43	18.000	18.000	Miocene	Burdigalian
## 44	18.000	18.000	Miocene	Burdigalian
## 45	18.000	18.000	Miocene	Burdigalian
## 46	17.000	17.500	Miocene	Burdigalian
## 47	17.000	17.500	Miocene	Burdigalian
## 48	17.000	17.500	Miocene	Burdigalian
## 49	17.000	17.500	Miocene	Burdigalian
## 50	17.000	17.500	Miocene	Burdigalian
## 51	17.000	17.500	Miocene	Burdigalian
## 52	17.000	17.500	Miocene	Burdigalian
## 53	17.000	17.500	Miocene	Burdigalian
## 54	5.300	7.200	Miocene	Messinian
## 55	3.600	4.200	Pliocene	Zanclean
## 56	0.005	0.127	Holocene/Pleistocene	Holocene
## 57	9.500	11.000	Miocene	Tortonian
## 58	1.800	1.900	Pleistocene	Lower Pleistocene
## 59	1.800	2.200	Pleistocene	Gelasian
## 60	1.800	2.200	Pleistocene	Gelasian
## 61	1.000	5.000	Pleistocene/Pliocene	Lower Pleistocene
## 62	1.000	5.000	Pleistocene/Pliocene	Lower Pleistocene
## 63	2.600	5.300	Pliocene	Piacencian
## 64	2.600	5.300	Pliocene	Piacencian
## 65	16.270	16.470	Miocene	Burdigalian
## 66	16.270	16.470	Miocene	Burdigalian
## 67	11.600	12.700	Miocene	Serravallian
## 68	11.600	12.700	Miocene	Serravallian
## 69	11.600	12.700	Miocene	Serravallian
## 70	13.000	13.000	Miocene	Serravallian
## 71	13.000	13.000	Miocene	Serravallian
## 72	12.500	13.500	Miocene	Serravallian
##	lower.stage		Genus	Species
## 1	Messinian	Hesperotestudo	orthopygia	
## 2	Tortonian	Hesperotestudo	sp.	
## 3	Messinian	Hesperotestudo	orthopygia	
## 4	Langhian	Floridemys	hurdi	
## 5	Middle Pleistocene	Hesperotestudo	equicomes	
## 6	Zanclean	Geochelone	sp.	
## 7	Piacencian	Gopherus	canyonensis	
## 8	Lower Pleistocene	Hesperotestudo	crassiscutata	
## 9	Piacencian	Hesperotestudo	oelrichi	
## 10	Tortonian	Hesperotestudo	alleni	
## 11	Upper Pleistocene	Hesperotestudo	incisa	
## 12	Zanclean	Titanochelon	bacharidisi	
## 13	Zanclean	Titanochelon	bacharidisi	
## 14	Serravallian	Paleotestudo	antiqua	
## 15	Serravallian	Paleotestudo	antiqua	
## 16	Serravallian	Paleotestudo	antiqua	
## 17	Serravallian	Paleotestudo	antiqua	
## 18	Serravallian	Paleotestudo	antiqua	
## 19	Serravallian	Paleotestudo	antiqua	
## 20	Serravallian	Paleotestudo	antiqua	

## 21	Serravallian	Paleotestudo	antiqua	
## 22	Serravallian	Paleotestudo	antiqua	
## 23	Zanclean	Ergilemys	oskarkuhni	
## 24	Zanclean	Ergilemys	oskarkuhni	
## 25	Piacencian	Hesperotestudo	riggsi	
## 26	Piacencian	Hesperotestudo	riggsi	
## 27	Priabonian	Cheirogaster	maurini	
## 28	Chattian	Ergilemys	bruneti	
## 29	Lower Pleistocene	Testudo	graeca	
## 30	Zanclean	Geochelone	sp.	
## 31	Serravallian	Gopherus	? sp.	
## 32	Tortonian	Geochelone	sp.	
## 33	Tortonian	Gopherus	? sp.	
## 34	Burdigalian	Geochelone	tedwhitei	
## 35	Burdigalian	Geochelone	tedwhitei	
## 36	Tortonian	Geochelone	hesterna	
## 37	Gelasian	Titanochelon	aff. schafferi	
## 38	Burdigalian	Geochelone	sp.	
## 39	Langhian	Ergilemys	sp.	
## 40	Burdigalian	Namibchersus	namaquensis	
## 41	Burdigalian	Namibchersus	namaquensis	
## 42	Burdigalian	Namibchersus	namaquensis	
## 43	Burdigalian	Namibchersus	namaquensis	
## 44	Burdigalian	Namibchersus	namaquensis	
## 45	Burdigalian	Namibchersus	namaquensis	
## 46	Burdigalian	Mesocherus	orangeus	
## 47	Burdigalian	Mesocherus	orangeus	
## 48	Burdigalian	Mesocherus	orangeus	
## 49	Burdigalian	Mesocherus	orangeus	
## 50	Burdigalian	Mesocherus	orangeus	
## 51	Burdigalian	Namibchersus	aff. namaquensis	
## 52	Burdigalian	Namibchersus	aff. namaquensis	
## 53	Burdigalian	Namibchersus	aff. namaquensis	
## 54	Messinian	Titanochelon	schafferi	
## 55	Zanclean	Titanochelon	perpiniana	
## 56	Upper Pleistocene	Testudo	graeca	
## 57	Tortonian	Cheirogaster	sp.	
## 58	Lower Pleistocene	Titanochelon	sp.	
## 59	Gelasian	Geochelone	sp.	
## 60	Gelasian	Geochelone	sp.	
## 61	Zanclean	Aldabrachelys	? sp.	
## 62	Zanclean	Aldabrachelys	? sp.	
## 63	Zanclean	Titanochelon	bacharidisi	
## 64	Zanclean	Titanochelon	bacharidisi	
## 65	Burdigalian	Testudo	rectogularis	
## 66	Burdigalian	Titanochelon	cf. perpiniana	
## 67	Serravallian	Paleotestudo	antiqua	
## 68	Serravallian	Paleotestudo	antiqua	
## 69	Serravallian	Testudo	steinheimensis	
## 70	Serravallian	Paleotestudo	antiqua	
## 71	Serravallian	Paleotestudo	antiqua	
## 72	Serravallian	Testudo	steinheimensis	
##		Taxon		Author
## 1	Hesperotestudo	orthopygia		(Cope, 1878)

## 2	Hesperotestudo sp.	Williams, 1950
## 3	Hesperotestudo orthopygia	(Cope, 1878)
## 4	Floridemys hurdi	Weems & George, 2013
## 5	Hesperotestudo equicomis	(Hay, 1917)
## 6	Geochelone sp.	Fitzinger, 1835
## 7	Gopherus canyonensis	(Johnston, 1937)
## 8	Hesperotestudo crassiscutata	(Leidy, 1889)
## 9	Hesperotestudo oelrichi	Holman, 1972
## 10	Hesperotestudo alleni	(Auffenberg, 1996)
## 11	Hesperotestudo incisa	(Hay, 1916)
## 12	Titanochelon bacharidisi	(Vlachos, Tsoukala & Corsini, 2014)
## 13	Titanochelon bacharidisi	(Vlachos, Tsoukala & Corsini, 2014)
## 14	Paleotestudo antiqua	(Bronn, 1831)
## 15	Paleotestudo antiqua	(Bronn, 1831)
## 16	Paleotestudo antiqua	(Bronn, 1831)
## 17	Paleotestudo antiqua	(Bronn, 1831)
## 18	Paleotestudo antiqua	(Bronn, 1831)
## 19	Paleotestudo antiqua	(Bronn, 1831)
## 20	Paleotestudo antiqua	(Bronn, 1831)
## 21	Paleotestudo antiqua	(Bronn, 1831)
## 22	Paleotestudo antiqua	(Bronn, 1831)
## 23	Ergilemys oskarkuhni	M?ynarski(, 1968)
## 24	Ergilemys oskarkuhni	M?ynarski(, 1968)
## 25	Hesperotestudo riggsi	(Hibbard, 1944)
## 26	Hesperotestudo riggsi	(Hibbard, 1944)
## 27	Cheirogaster maurini	Bergounioux, 1935
## 28	Ergilemys bruneti	Broin, 1977
## 29	Testudo graeca	Linnaeus, 1758
## 30	Geochelone sp.	Fitzinger, 1835
## 31	Gopherus ? sp.	Rafinesque, 1832
## 32	Geochelone sp.	Fitzinger, 1835
## 33	Gopherus ? sp.	Rafinesque, 1832
## 34	Geochelone tedwhitei	(Williams, 1953)
## 35	Geochelone tedwhitei	(Williams, 1953)
## 36	Geochelone hesternata	Auffenberg, 1971
## 37	Titanochelon aff. schafferi	(Szalai, 1931)
## 38	Geochelone sp.	Fitzinger, 1835
## 39	Ergilemys sp.	Ckhikvadze, 1972
## 40	Namibchersus namaquensis	(Stromer, 1926)
## 41	Namibchersus namaquensis	(Stromer, 1926)
## 42	Namibchersus namaquensis	(Stromer, 1926)
## 43	Namibchersus namaquensis	(Stromer, 1926)
## 44	Namibchersus namaquensis	(Stromer, 1926)
## 45	Namibchersus namaquensis	(Stromer, 1926)
## 46	Mesocherus orangeus	Lapparent de Broin, 2003
## 47	Mesocherus orangeus	Lapparent de Broin, 2003
## 48	Mesocherus orangeus	Lapparent de Broin, 2003
## 49	Mesocherus orangeus	Lapparent de Broin, 2003
## 50	Mesocherus orangeus	Lapparent de Broin, 2003
## 51	Namibchersus aff. namaquensis	(Stromer, 1926)
## 52	Namibchersus aff. namaquensis	(Stromer, 1926)
## 53	Namibchersus aff. namaquensis	(Stromer, 1926)
## 54	Titanochelon schafferi	(Szalai, 1931)
## 55	Titanochelon perpiniana	(Depéret, 1885)

## 56	<i>Testudo graeca</i>	Linnaeus, 1758
## 57	<i>Cheirogaster</i> sp.	Bergounioux, 1935
## 58	<i>Titanochelon</i> sp.	Pérez-García and Vlachos, 2014
## 59	<i>Geochelone</i> sp.	Fitzinger, 1835
## 60	<i>Geochelone</i> sp.	Fitzinger, 1835
## 61	<i>Aldabrachelys</i> ? sp.	Loveridge & Williams, 1975
## 62	<i>Aldabrachelys</i> ? sp.	Loveridge & Williams, 1975
## 63	<i>Titanochelon bacharidisi</i>	(Vlachos, Tsoukala & Corsini, 2014)
## 64	<i>Titanochelon bacharidisi</i>	(Vlachos, Tsoukala & Corsini, 2014)
## 65	<i>Testudo rectogularis</i>	Schleich, 1981
## 66	<i>Titanochelon</i> cf. <i>perpiniana</i>	(Depéret, 1885)
## 67	<i>Paleotestudo antiqua</i>	(Bronn, 1831)
## 68	<i>Paleotestudo antiqua</i>	(Bronn, 1831)
## 69	<i>Testudo steinheimensis</i>	(Staesche, 1931)
## 70	<i>Paleotestudo antiqua</i>	(Bronn, 1831)
## 71	<i>Paleotestudo antiqua</i>	(Bronn, 1831)
## 72	<i>Testudo steinheimensis</i>	Staesche, 1931
##		
## 1		
## 2		
## 3		
## 4		
## 5	Holotypus: NMNH 10944 (cast UMMP V31427) right epiplastron, left hyoplastral fr	
## 6		
## 7		
## 8		UF 64395, 65005, 80593, 84300, 0
## 9	Holotypus: UMMP V56298 almost complete specimen, Paratypes: UMMP V59919 one fragmentary nuchal, 5	
## 10		
## 11		
## 12		
## 13		
## 14		Neotypus: MT PAL 2012.0.10 r
## 15		Neotypus: MT PAL 2012.0.10 r
## 16		Neotypus: MT PAL 2012.0.10 r
## 17		Neotypus: MT PAL 2012.0.10 r
## 18		Neotypus: MT PAL 2012.0.10 r
## 19		Neotypus: MT PAL 2012.0.10 r
## 20		Neotypus: MT PAL 2012.0.10 r
## 21		Neotypus: MT PAL 2012.0.10 r
## 22		Neotypus: MT PAL 2012.0.10 r
## 23		Holotypus: ZI
## 24		Holotypus: ZI
## 25		Holotypus: KUMVP 6789 nearly
## 26		
## 27		
## 28		
## 29		DM-H-14 nearly complete shell, asso
## 30		
## 31		
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 ## 71
 ## 72
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 ## 1
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MSGN
 MSGN
 MSGN
 MSGN
 MSGN old collections: PQ AD 73, PQ AD 1293, PQ AD 2789
 MSGN old collections: PQ AD 73, PQ AD 1293, PQ AD 2789
 MSGN old collections: PQ AD 73, PQ AD 1293, PQ AD 2789
 UMMMP V60631 distal phalange (UM-I
 UMMMP V60631 distal phalange (UM-I
 CollNo CL
 UCMP 95918 1200
 UCMP 36080 1200
 UCMP 131794 NA
 CMM-V-4666 NA
 NMNH 10944 NA
 Santee Type B NA
 TPPHM 1534 NA
 80593 NA
 UMMMP V56298 NA
 UF 9370 NA
 7 specimens: 192.0-264.0 mm (mean=211.6 mm) NA
 LGPUT EPN I 100-199 1196
 LGPUT EPN II 200-287 1164
 MT PAL 2012.0.10 185
 FFSM3446.1 229
 FFSM 3446.2 220
 FFSM 3446.3 195

## 18	FFSM 3446.4	206
## 19	SMNS 4450 (incomplete)	195
## 20	SMNS 51467	NA
## 21	SMNS 51469	180
## 22	UFGC 9	145
## 23	MgCH/15	NA
## 24	MgCH/17	220
## 25	KUMVP 6789	176
## 26	KUMVP 6790	185
## 27	-	400
## 28	MP 29	400
## 29	DM-H-14	195
## 30	CL: 88 cm, PL: 70 cm	880
## 31	several specimens, no exact number given	500
## 32	several specimens, no exact number given	500
## 33	several specimens, no exact number given	500
## 34	MCZ 2020	370
## 35	MCZ 2021	NA
## 36	UCMP 40200	278
## 37	-	1860
## 38	-	1000
## 39	-	1000
## 40	Holotype (Stromer, 1926) --> was destroyed during World War II	NA
## 41	ca. 30 cm (wsl CL)	300
## 42	AM 1'99	254
## 43	AM 9'93	470
## 44	OMS x1	470
## 45	Am xf	815
## 46	Holotypus	180
## 47	Holotypus	160
## 48	Holotypus	180
## 49	Holotypus	200
## 50	Holotypus	180
## 51	-	NA
## 52	-	NA
## 53	-	110
## 54	NHMW 2009z0103/0001	1850
## 55	type locality	1140
## 56	-	850
## 57	-	1170
## 58	-	1420
## 59	-	NA
## 60	-	NA
## 61	-	1500
## 62	-	1500
## 63	LGPUT KLK 501-528	900
## 64	LGPUT MIC 300-303	900
## 65	Holotypus: BSP 1959 II 1172	213
## 66	1959 II 2033	NA
## 67	BSP 1954 I 539a	203
## 68	BSP 1954 I 539b	NA
## 69	BSP 1932 I 50	111
## 70	-	152
## 71	-	240

```

## 72
##      PL      size
## 1      NA      <NA>
## 2      NA      <NA>
## 3  620.0      <NA>
## 4      NA      <NA>
## 5      NA medium to large
## 6  160.0      <NA>
## 7  805.0      <NA>
## 8  510.0      small
## 9  258.0      large
## 10 219.0      <NA>
## 11 211.6      <NA>
## 12 1150.0      <NA>
## 13 1120.0      <NA>
## 14      NA      <NA>
## 15      NA      <NA>
## 16      NA      <NA>
## 17      NA      <NA>
## 18      NA      <NA>
## 19  186.0      <NA>
## 20  145.0      <NA>
## 21      NA      <NA>
## 22      NA      <NA>
## 23  180.0      <NA>
## 24      NA      <NA>
## 25  189.0      <NA>
## 26      NA      <NA>
## 27      NA      <NA>
## 28      NA      <NA>
## 29      NA      <NA>
## 30  700.0      large
## 31      NA      <NA>
## 32      NA      <NA>
## 33      NA      <NA>
## 34      NA      <NA>
## 35  400.0      <NA>
## 36      NA      <NA>
## 37      NA      <NA>
## 38      NA      <NA>
## 39      NA      <NA>
## 40  240.0      <NA>
## 41  244.0      <NA>
## 42  225.0      <NA>
## 43  406.0      <NA>
## 44      NA      <NA>
## 45      NA      <NA>
## 46  155.0      medium
## 47      NA      medium
## 48      NA      medium
## 49      NA      medium
## 50      NA      medium
## 51  400.0      large
## 52  500.0      large

```

Tüb. 1 NA

## 53	NA	large
## 54	NA	giant
## 55	NA	giant
## 56	NA	large
## 57	NA	giant
## 58	NA	giant
## 59	NA	larrge
## 60	NA	small
## 61	NA	<NA>
## 62	NA	<NA>
## 63	NA	<NA>
## 64	NA	<NA>
## 65	180.0	<NA>
## 66	910.0	<NA>
## 67	178.0	<NA>
## 68	167.0	<NA>
## 69	110.0	<NA>
## 70	134.0	<NA>
## 71	NA	<NA>
## 72	207.0	<NA>
##		
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## 10		
## 11		
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Holotype KUMVP C

Tortoises (Geochelone sp. and
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Tortoises (Geochelone sp. and


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## 64
## 65 der leider nur fragmentär überlieferte Panzer des Typusexemplares misst eine rekonstruierbare Länge
## 66
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## 72
##      estimated...from.verbal.description..ev..from.plastron..ep..or.measured..m..measured.from.figure
## 1
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8 Meylan P.A., 1995: Pleistocene amphibians and reptiles from the Leisey Shell Pit, Hillsborough Co
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## 62
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## 65
## 66
## 67
## 68
## 69
## 70
## 71
## 72
##      in.fossil.checklist.
## 1      NA
## 2      NA
## 3      NA
## 4      NA
## 5      NA
## 6      NA
## 7      NA
## 8      NA
## 9      NA
## 10     NA
## 11     NA
## 12     NA
## 13     NA
## 14     NA
## 15     NA
## 16     NA
## 17     NA
## 18     NA
## 19     NA
## 20     NA
## 21     NA
## 22     NA
## 23     NA
## 24     NA
## 25     NA
## 26     NA
## 27     NA
## 28     NA
## 29     NA
## 30     NA

```

```
## 31          NA
## 32          NA
## 33          NA
## 34          NA
## 35          NA
## 36          NA
## 37          NA
## 38          NA
## 39          NA
## 40          NA
## 41          NA
## 42          NA
## 43          NA
## 44          NA
## 45          NA
## 46          NA
## 47          NA
## 48          NA
## 49          NA
## 50          NA
## 51          NA
## 52          NA
## 53          NA
## 54          NA
## 55          NA
## 56          NA
## 57          NA
## 58          NA
## 59          NA
## 60          NA
## 61          NA
## 62          NA
## 63          NA
## 64          NA
## 65          NA
## 66          NA
## 67          NA
## 68          NA
## 69          NA
## 70          NA
## 71          NA
## 72          NA
```

Prepare data for conversion to paleoTS-object:

```
SampleSize <- tidyCL %>%
  dplyr::select(MAmin, Mamax, CL) %>%
  filter(CL != "NA")

length(SampleSize$CL)
```

```
## [1] 52
```

```
TidyCL <- tidyCL %>%
  dplyr::select(MAmin, Mamax, CL) %>%
  dplyr::filter(CL != "NA") %>%
```

```
mutate(tt= (MAmin+Mamax)/2) %>% # create mean age
group_by(tt) %>% #create time bins
summarise(mm=mean(CL), vv=var(CL), nn=n()) #create means etc. for each time bin
```

```
TidyCL[is.na(TidyCL)]<-0 #subset NAs with 0 for
```

```
TidyCL
```

```
## # A tibble: 26 × 4
##      tt      mm      vv      nn
##    <dbl> <dbl> <dbl> <int>
## 1  0.066  850.00    0.0     1
## 2  1.770  195.00    0.0     1
## 3  1.850 1420.00    0.0     1
## 4  2.000 1860.00    0.0     1
## 5  3.000  840.25 580373.6     4
## 6  3.900 1140.00    0.0     1
## 7  3.950  876.00 154208.0     5
## 8  4.500  880.00    0.0     1
## 9  5.500 1200.00    0.0     1
## 10 6.250 1850.00    0.0     1
## # ... with 16 more rows
```

```
bins <- tidyCL %>%
# select(MAmin, Mamax, CL) %>%
filter(CL != "NA") %>%
mutate(tt= (MAmin+Mamax)/2) %>% # create mean age
group_by(tt)
```

```
bins
```

```
## Source: local data frame [52 x 24]
```

```
## Groups: tt [26]
```

```
##
```

```
##                                     Locality
##                                     <fctr>
```

```
## 1          UCMP V71137, Turlock Lake 10, Stanislaus County, California
```

```
## 2          UCMP V-3952, Ingram Creek site 8, Stanislaus County, California
```

```
## 3          Epanomi (EPN I), western Chalkidiki Peninsula, Thessaloniki area
```

```
## 4          Epanomi (EPN II), western Chalkidiki Peninsula, Thessaloniki area
```

```
## 5                Hohenhöwen, Engen, Hegau, southwestern Germany
```

```
## 6                Hohenhöwen, Engen, Hegau, southwestern Germany
```

```
## 7                Hohenhöwen, Engen, Hegau, southwestern Germany
```

```
## 8                Hohenhöwen, Engen, Hegau, southwestern Germany
```

```
## 9                Hohenhöwen, Engen, Hegau, southwestern Germany
```

```
## 10               Hohenhöwen, Engen, Hegau, southwestern Germany
```

```
## # ... with 42 more rows, and 23 more variables: Country <fctr>,
```

```
## #   Latitude <dbl>, Longitude <dbl>, Formation.Location.comment <fctr>,
```

```
## #   MAmin <dbl>, Mamax <dbl>, Epoch <fctr>, upper.stage <fctr>,
```

```
## #   lower.stage <fctr>, Genus <fctr>, Species <fctr>, Taxon <fctr>,
```

```
## #   Author <fctr>, comment <fctr>, CollNo <fctr>, CL <int>, PL <dbl>,
```

```
## #   size <fctr>, verbal.description <fctr>,
```

```
## #   estimated...from.verbal.description...ev...from.plastron...ep...or.measured...m...measured.from.figure
```

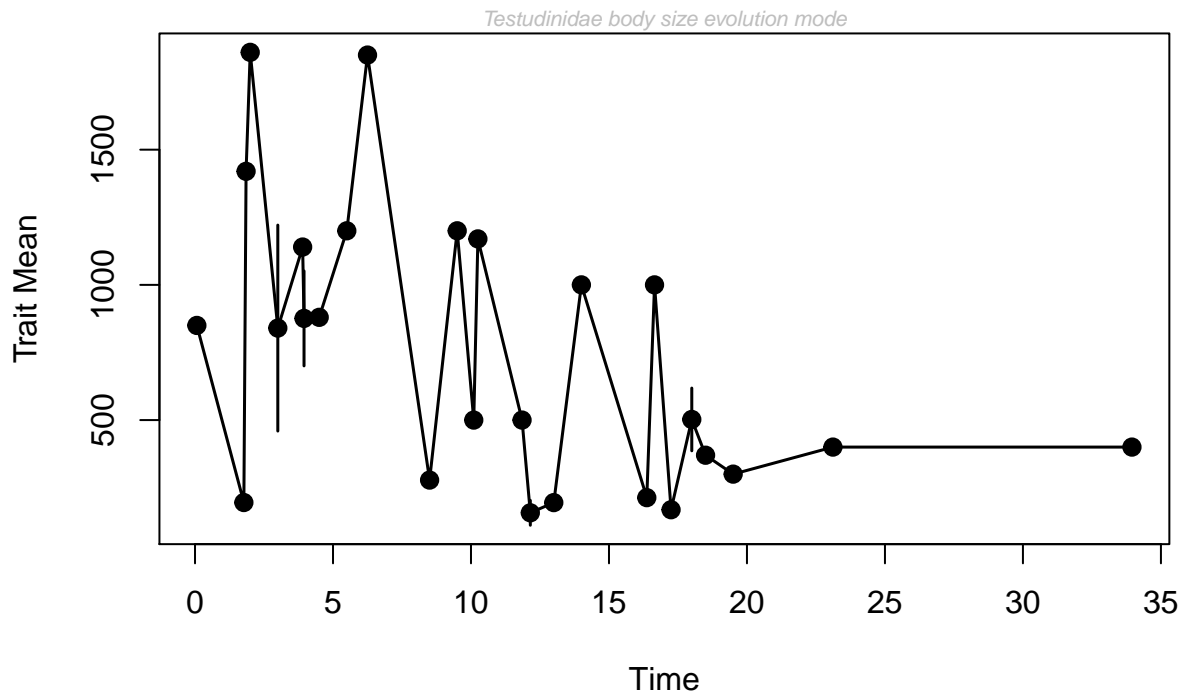
```
## #   Reference <fctr>, in.fossil.checklist. <lgl>, tt <dbl>
```

```

library(paleoTS)
paleoTidyCL <-as.paleoTS(TidyCL$mm, TidyCL$vv, TidyCL$nn, TidyCL$tt, MM = NULL, genpars = NULL, label =
paleoTidyCL

## $mm
## [1] 850.0000 195.0000 1420.0000 1860.0000 840.2500 1140.0000 876.0000
## [8] 880.0000 1200.0000 1850.0000 278.0000 1200.0000 500.0000 1170.0000
## [15] 500.0000 157.0000 194.7000 1000.0000 213.0000 1000.0000 168.3333
## [22] 502.2500 370.0000 300.0000 400.0000 400.0000
##
## $vv
## [1] 0.0000 0.0000 0.0000 0.0000 580373.5833
## [6] 0.0000 154208.0000 0.0000 0.0000 0.0000
## [11] 0.0000 0.0000 0.0000 0.0000 0.0000
## [16] 4232.0000 955.5667 0.0000 0.0000 0.0000
## [21] 976.6667 53840.2500 0.0000 0.0000 0.0000
## [26] 0.0000
##
## $nn
## [1] 1 1 1 1 4 1 5 1 1 1 1 1 2 1 1 2 10 1 1 1 6 4 1
## [24] 1 1 1
##
## $tt
## [1] 0.000 1.704 1.784 1.934 2.934 3.834 3.884 4.434 5.434 6.184
## [11] 8.434 9.434 10.034 10.184 11.784 12.084 12.934 13.934 16.304 16.584
## [21] 17.184 17.934 18.434 19.434 23.049 33.884
##
## $MM
## NULL
##
## $genpars
## NULL
##
## $label
## [1] "Testudinidae body size evolution mode"
##
## $start.age
## [1] 0.066
##
## $timeDir
## [1] "increasing"
##
## attr(,"class")
## [1] "paleoTS"
plot(paleoTidyCL)

```



```
fit3models(paleoTidyCL, silent=FALSE, method="AD", pool=FALSE) #not working with Test1, because no va
```

```
##
## Comparing 3 models [n = 25, method = AD]
##
##           logL K      AICc Akaike.wt
## GRW      -207.9854 2 420.5163         0
## URW      -257.5946 1 517.3631         0
## Stasis   -192.7485 2 390.0425         1
```

This is an R Markdown Notebook. When you execute code within the notebook, the results appear beneath the code.

Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Ctrl+Shift+Enter*.

Add a new chunk by clicking the *Insert Chunk* button on the toolbar or by pressing *Ctrl+Alt+I*.

When you save the notebook, an HTML file containing the code and output will be saved alongside it (click the *Preview* button or press *Ctrl+Shift+K* to preview the HTML file).