Biogeosciences

Discussions

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Supplement of

Reconstructions of biomass burning from sediment charcoal records to improve data-model comparisons

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```r
rm(list=ls())
library(devtools)
library(paleofire)
library(GCD)


#install_github("paleofire","paleofire", ref="daily")
#load_all("~/Work/research/GPWG/paleofire/")

# ------------------------- Options and parameters
# Working directory
  setwd('~/methods/charcoal/GCD v3.0 Paper figures/')

  plotdata.file = "./Data/All_GCDv1.1_rawplots_BB21k_2015-09-18.rds"

# File for transformed data
  TR.file = './Data/All_GCDv1.1_Transformed_BB21k.rds'
  #TR.file = './Data/All_GCDv1.1_Transformed_BB1k.rds'
  TR.mode = 0 #1 # 0==Run transformation, save result for later,
1==use saved data

# Figure file name base.
  # - Can include a path (otherwise goes in working directory); all
directories must exist.
  # - Year designation and file suffix will be added automatically
  # - Set to NULL to only print to screen

   fig.base.name = './1perPg/GCDv3-SI-21k_'
  # fig.base.name = './1perPg/GCDv3-SI-1k_'
  # fig.base.name = NULL # Use for paper figures

# Base map ('coasts' or 'countries')
  base.map = 'coasts'

# Grid resolution and extent (in degrees)
  grd.res = 5
  grd.ext = c(-180,180,-90,90)  # c(lonmin, lonmax, latmin, latmax)

# Composite params
  tarAge = seq(0,21000,1000) #increments = 1000 (Figs. 6 & 7 gridded
maps)
  #tarAge =  seq(-50,1050,100) #increments = 100
  hw     =  250 #10 # (v3 Figs. 6 & 7 paper setting)
  binhw  =  500 #50 #20 # (v3 Figs. 6 & 7 paper setting) ### THIS
CHANGES THE MAP INTERVALS & FILE NAMES
  n.boot = 1000 #1000 #(v3 Fig. 6 paper setting)

# Dot size parameters
  cx.mult = 1.5
```

```
    cx.minsize = 0.4

# Projection for maps
  # Unprojected
proj4 = "+proj=longlat"

  # Robinson
#   proj4 = "+proj=robin +lon_0=0 +x_0=0 +y_0=0 +ellps=WGS84
+datum=WGS84 +units=m +no_defs"

  # Gall-Peters equal-area projection
  # proj4 = "+proj=cea +lon_0=0 +lat_ts=45 +x_0=0 +y_0=0 +ellps=WGS84
+units=m +no_defs"

  # Lambert equal-area
  # proj4 = '+proj=laea +lat_0=30 +lon_0=0 +x_0=0 +y_0=0'

  # Mercator
  # proj4 = "+proj=merc +lon_0=0 +k_0=1 +x_0=0 +y_0=0"




# ------------------------- End Options
  # ----- Make dir
  if(!is.null(fig.base.name))
    dir.create(dirname(fig.base.name), recursive=T, showWarnings=F)

  # ----- Transform records (slow, which is why TR.mode=1 is added)
  if(TR.mode==0) {
    # New transform
    id = pfSiteSel()  # Select all sites
    TR = pfTransform(id, method=c("MinMax","Box-Cox","Z-Score"),
BasePeriod=c(200,21000),QuantType="INFL") #Fig. 6
    #TR = pfTransform(id, method=c("MinMax","Box-Cox","Z-Score"),
BasePeriod=c(200,1000),QuantType="INFL") #Fig. BB1k
      saveRDS(TR, file=TR.file)
  } else {
    # load existing
    TR = readRDS(TR.file)
  }

  # ----- Run pfDotMap
  dotmap = pfDotMap ( TR=TR, tarAge=tarAge, binhw=binhw, hw=hw,
n.boot=n.boot,
                      fig.base.name=fig.base.name, base.map=base.map,
                      grd.res=grd.res, grd.ext=c(-180,180,-90,90),
proj4=proj4,
                      cx.minsize=cx.minsize, cx.mult=cx.mult
                    )
```

```
saveRDS(dotmap, plotdata.file)
```

```r
rm(list=ls())
library(rgdal)
library(rworldmap)

# ------------------
  setwd('~/methods/charcoal/GCD v3.0 Paper figures/')
  dotmap = readRDS('./Data/All_GCDv1.1_rawplots_BB1k_2015-08-18.rds')
  outdir = './PaperFigs_pfCompositeLF/'

  y.lim = c(-70,80)
  x.lim = c(-180,180)

####### extract 1000-year slices desired
grd  = list(dotmap$sp.grd[[1]], dotmap$sp.grd[[6]], dotmap
$sp.grd[[11]])
site = list(dotmap$sp.sites[[1]], dotmap$sp.sites[[6]], dotmap
$sp.sites[[11]])
  n.bin = length(grd)
# picked 1,6,11 for paper figure #5




# ----- Load base map
  proj4 = proj4string(grd[[1]])
  data(countriesCoarse)  # A dataset in rworldmap used in the plots
below
  data(coastsCoarse)     # An alternative base map. Needs one fix:
    countriesCoarse = spTransform(countriesCoarse, CRS(proj4))
    coastsCoarse = spTransform(coastsCoarse, CRS(proj4))


# --------------------------------- MEAN PLOT
---------------------------------
dir.create(outdir, recursive=T, showWarnings=F)
file.plot   = paste0(outdir, 'Mean.pdf')
file.legend = paste0(outdir, 'Mean_v3_legend.pdf')

# cols = c("#0571B0","#92C5DE",grey(0.9),"#F4A582","#CA0020") #
modified from colorbrewer
# cols = rev( c( rgb(1.000,0.250,0.000), rgb(1.000,0.501,0.144),
rgb(1.000,0.740,0.376), rgb(1.000,0.924,0.694),
rgb(0.887,1.000,1.000), rgb(0.607,0.918,1.000),
rgb(0.376,0.792,1.000), rgb(0.194,0.630,1.000) ))
cols = c( rgb(0,0,1), rgb(0.194,0.630,1), rgb(0.376,0.792,1),
grey(0.95),
          rgb(1,0.74,0.376), rgb(1,0.501,0.144), rgb(1,0,0) )

cuts = c(-1.75,-1.25,-0.75,-0.25,0.25,0.75,1.25,1.75)
# cuts = c(-1.5,-0.9,-0.3,0.3,0.9,1.5) # Defines range and resolution
of color scale
```

```r
# cuts = c(-3,-1.8,-0.6,0.6,1.8,3) # Defines range and resolution of
color scale
cx.sizes = c(0.75,1)

panel.labels = rep("",3) # c("Present", "6 ka", "21 ka")
grid.grey = grey(0.8)


mp = list()
for(i in 1:n.bin) {
  sp.grd = grd[[i]]

  # Assign symbol size based on whether CI contain 0
  cx = ifelse(sp.grd$CI.lower>0 | sp.grd$CI.upper<0, max(cx.sizes),
min(cx.sizes))

  # The previous line will produce NA for cells with n=1 since CI are
undefined. Give these "non-significant" symbol size by default.
  cx[which(sp.grd$sitesPerCell==1)] = min(cx.sizes)

  # Create plot object (actually plotted later)
  mp[[i]] =
  spplot(sp.grd, 'mean.CHAR', xlim=x.lim, ylim=y.lim,
    cuts=cuts, colorkey=T, col.regions=cols, cex=cx,
edge.col=grey(0.7), lwd=0.1,
    sp.layout=list(
      list("sp.lines",coastsCoarse,col=grid.grey,lwd=0.3),
      list("sp.polygons",countriesCoarse,col=grid.grey,lwd=0.3),
      list("sp.lines",gridlines(sp.grd),col=grid.grey, lwd=0.3),
      list("sp.text",c(-150,-50), panel.labels[i], fontface=2)),
    par.settings=list(
        layout.widths=list(left.padding=3, right.padding=3),
        layout.heights=list(top.padding=-3, bottom.padding=-3)),
    scales=list(alternating=0,tck=-0.5)
  ) # End spplot
  if(i==1) mp.legend = mp[[i]]
  mp[[i]]$legend = NULL
}
names(mp.legend$legend) = "bottom"
  mp.legend$legend$bottom$args$key$space="bottom"

save.plot = T
if(save.plot) pdf(file.plot, width=17.5/2.54, height=11)
print(mp[[1]], position=c(0,0.635,1,0.905),
panel.width=list(17.2,"cm"), panel.height=list(17.5*0.42,"cm"),
more=T)
print(mp[[2]], position=c(0,0.365,1,0.635),
panel.width=list(17.2,"cm"), panel.height=list(17.5*0.42,"cm"),
more=T)
print(mp[[3]], position=c(0,0.095,1,0.365),
```

```r
        panel.width=list(17.2,"cm"), panel.height=list(17.5*0.42,"cm"),
        more=F)
if(save.plot) dev.off()

if(save.plot) {
  pdf(file.legend, width=20, height=5)
    print(mp.legend, position = c(0,0,1,1),
panel.width=list(17.2,"cm"), panel.height=list(17.5*0.42,"cm"))
  dev.off()
}




# --------------------------------- NSITES PLOT
------------------------------------
file.plot   = paste0(outdir, 'Nsites.pdf')
file.legend = paste0(outdir, 'Nsites_legend.pdf')

cols       = grey(0.2)   # Can be replaced by a vector if different
colors are desired

cuts       = c(0.9,1.9,9.9,1000) # Where to divide symbol sizes
cx.legend = c("1", "2-9", "10+") # legend text
cx.key = c(0.3,0.4,0.5)
  n.cx = length(cuts)-1   # number of bins represented

mp = list()
for(i in 1:n.bin) {
  sp.grd = grd[[i]]

  cx = cx.key[ cut(sp.grd$sitesPerCell, cuts, labels=F) ]

  # Create plot object (actually plotted later)
  mp[[i]] =
  spplot(sp.grd, 'sitesPerCell', xlim=x.lim, ylim=y.lim,
    cex=cx, cex.key=cx.key, legendEntries=cx.legend, cuts=cuts,
    col.regions=cols, edge.col="transparent",
    sp.layout=list(
      list("sp.lines",coastsCoarse,col=grid.grey,lwd=0.3),
      list("sp.polygons",countriesCoarse,col=grid.grey,lwd=0.3),
      list("sp.lines",gridlines(sp.grd),col=grid.grey, lwd=0.3),
      list("sp.text",c(-150,-50), panel.labels[i], fontface=2,
cex=0.7)),
    par.settings=list(
        layout.widths=list(left.padding=-3, right.padding=-3),
        layout.heights=list(top.padding=-3, bottom.padding=-3)),
    scales=list(alternating=0,tck=-0.5)

  )
```

```r
  if(i==1) mp.legend = mp[[i]]
  mp[[i]]$legend = NULL
}

save.plot = T
if(save.plot) pdf(file.plot, width=8.5/2.54, height=5.3)

print(mp[[1]], position=c(0,0.635,1,0.905),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"),
more=T)
print(mp[[2]], position=c(0,0.365,1,0.635),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"),
more=T)
print(mp[[3]], position=c(0,0.095,1,0.365),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"),
more=F)
if(save.plot)  dev.off()

if(save.plot) {
  pdf(file.legend, width=8.5/2.54, height=5)
    print(mp.legend, position = c(0,0,1,1),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"))
  dev.off()
}




# --------------------------------- NSITES PLOT
-----------------------------------
file.plot   = paste0(outdir, 'Ncells.pdf')
file.legend = paste0(outdir, 'Ncells_legend.pdf')

cols      = grey(0.2)   # Can be replaced by a vector if different
colors are desired

cuts       = c(0.9,1.9,3.9,100) # Where to divide symbol sizes
cx.legend = c("1", "2-3", "4+") # legend text
cx.key = c(0.3,0.4,0.5)
  n.cx = length(cuts)-1   # number of bins represented

#   ind.non0 = which(cx>0) # Don't want to change size 0 (== not
plotted)
#   cx[ind.non0] = cx[ind.non0] + cx.minsize - min(cx[ind.non0])

mp = list()
for(i in 1:n.bin) {
  sp.site = site[[i]]

  cx = cx.key[ cut(sp.site$cellsPerSite, cuts, labels=F) ]
```

```
  # Create plot object (actually plotted later)
  mp[[i]] =
  spplot(sp.site, 'cellsPerSite', xlim=x.lim, ylim=y.lim,
    cex=cx, cex.key=cx.key, legendEntries=cx.legend, cuts=cuts,
    col.regions=cols, edge.col="transparent",
    sp.layout=list(
      list("sp.lines",coastsCoarse,col=grid.grey,lwd=0.3),
      list("sp.polygons",countriesCoarse,col=grid.grey,lwd=0.3),
      list("sp.lines",gridlines(sp.grd),col=grid.grey, lwd=0.3),
      list("sp.text",c(-150,-50), panel.labels[i], fontface=2,
cex=0.7)),
    par.settings=list(
        layout.widths=list(left.padding=-3, right.padding=-3),
        layout.heights=list(top.padding=-3, bottom.padding=-3)),
    scales=list(alternating=0,tck=-0.5)

  )
  if(i==1) mp.legend = mp[[i]]
  mp[[i]]$legend = NULL
}

save.plot = T
if(save.plot) pdf(file.plot, width=8.5/2.54, height=5.3)

print(mp[[1]], position=c(0,0.635,1,0.905),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"),
more=T)
print(mp[[2]], position=c(0,0.365,1,0.635),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"),
more=T)
print(mp[[3]], position=c(0,0.095,1,0.365),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"),
more=F)
if(save.plot)  dev.off()

if(save.plot) {
  pdf(file.legend, width=8.5/2.54, height=5)
    print(mp.legend, position = c(0,0,1,1),
panel.width=list(8.25,"cm"), panel.height=list(8.25*0.42,"cm"))
  dev.off()
}
```

Charcoal Influx z−Scores: −100−0 BP
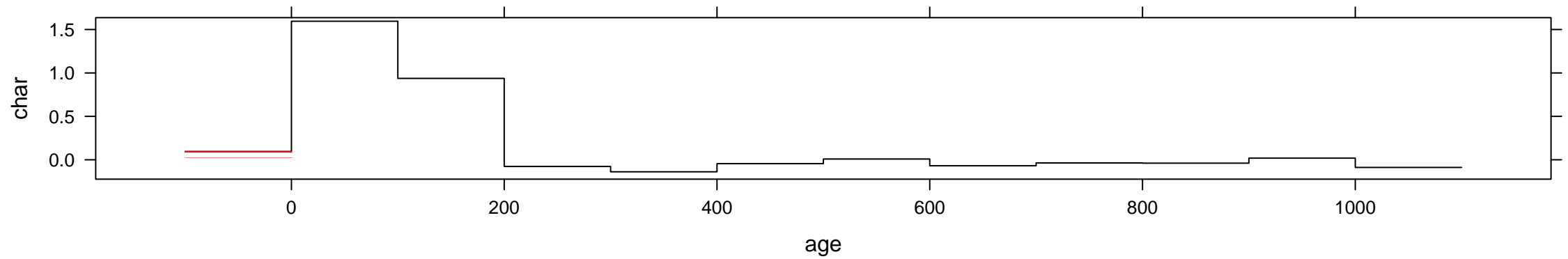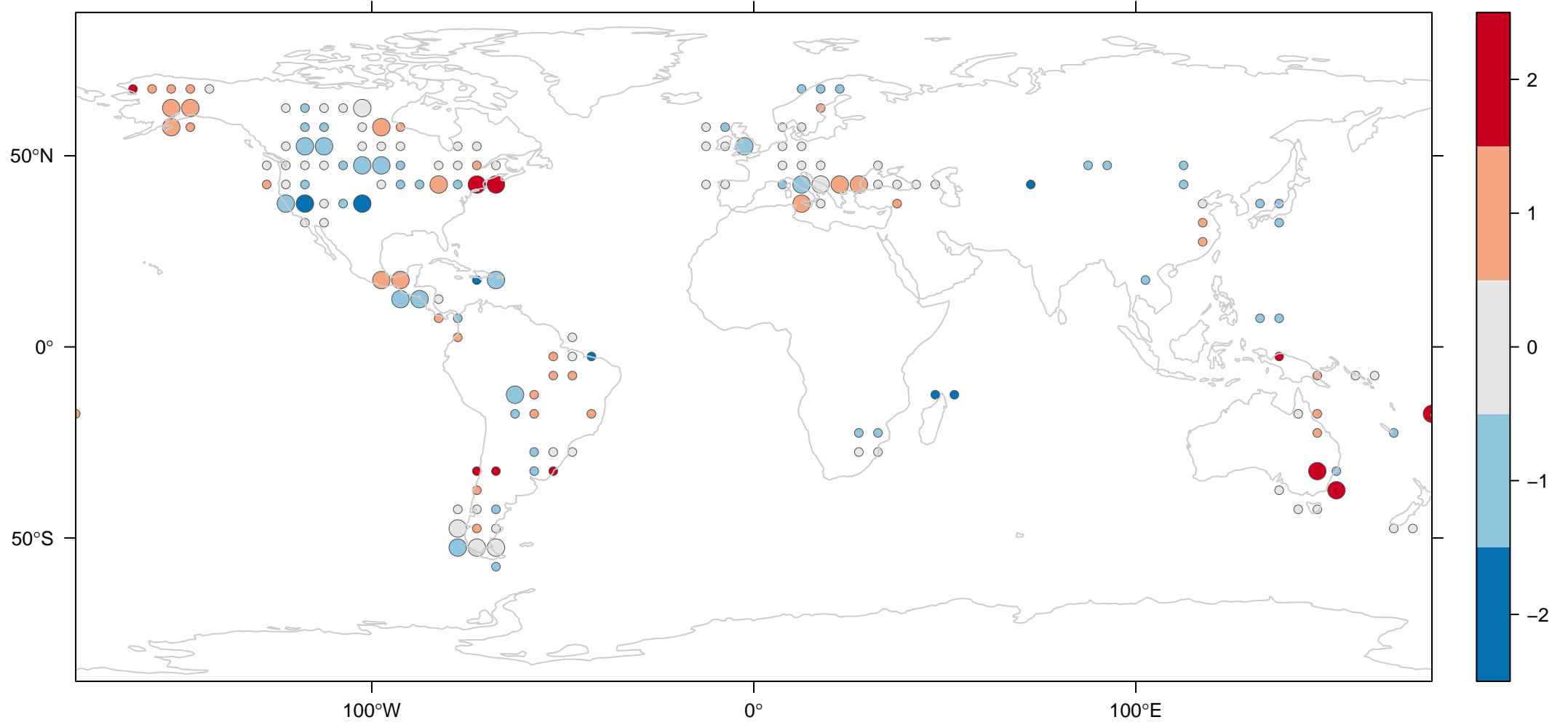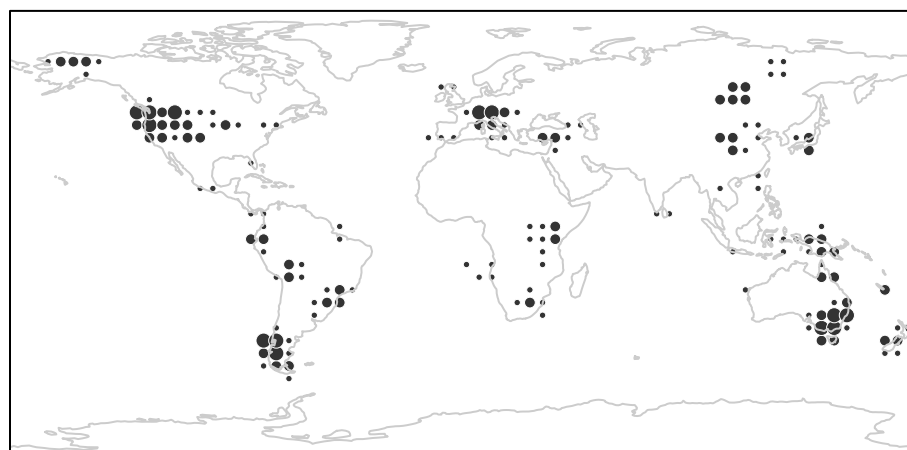
Number of sites per grid cell
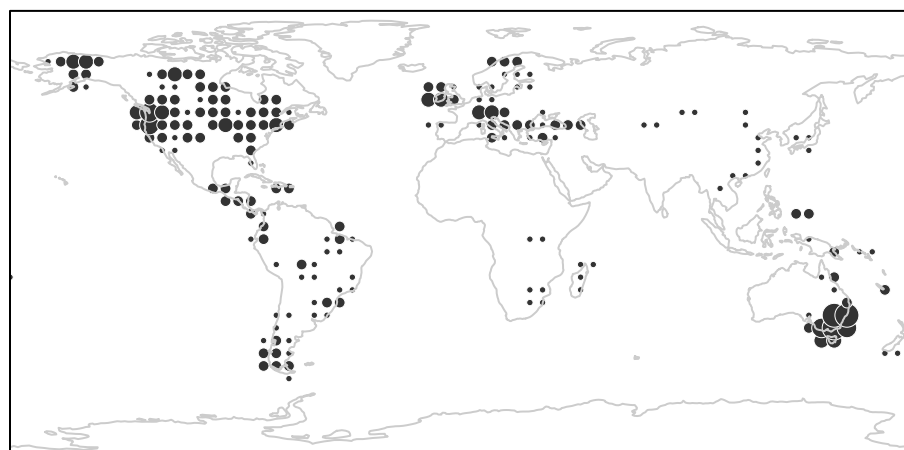
Number of grid cells influenced by each site
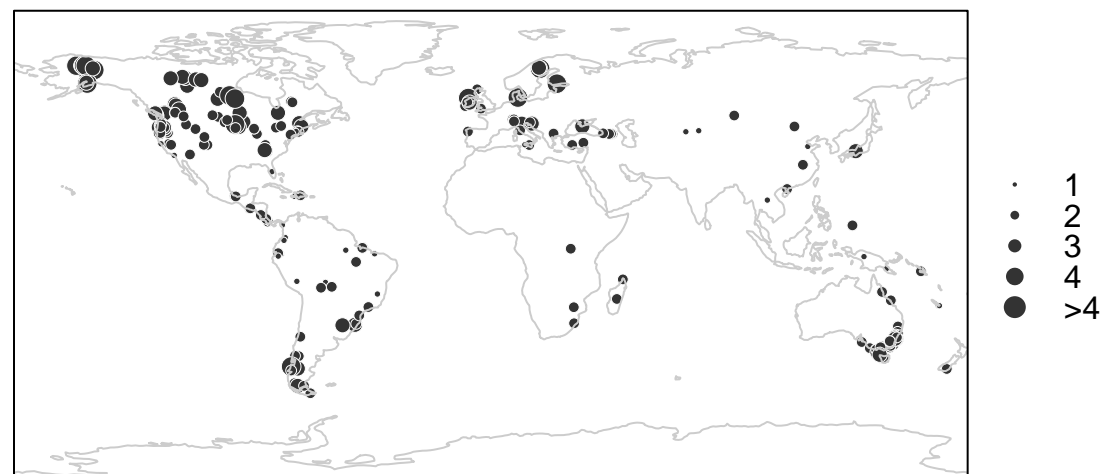
Charcoal Influx z−Scores: 0−100 BP
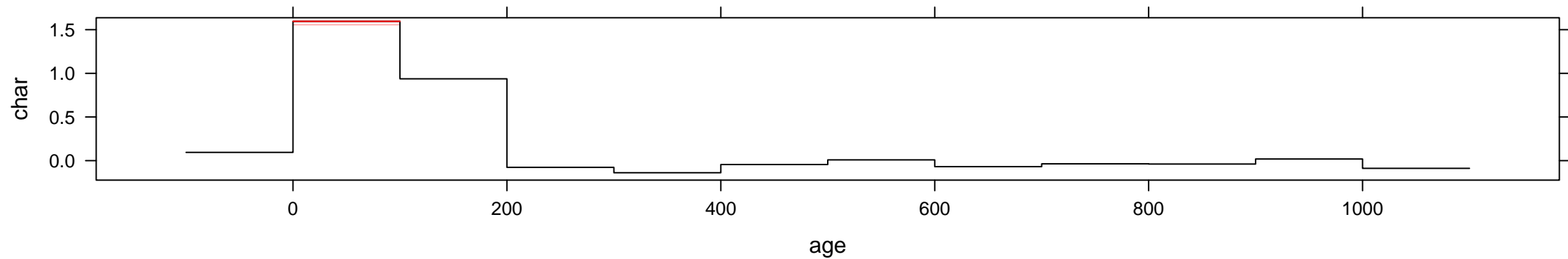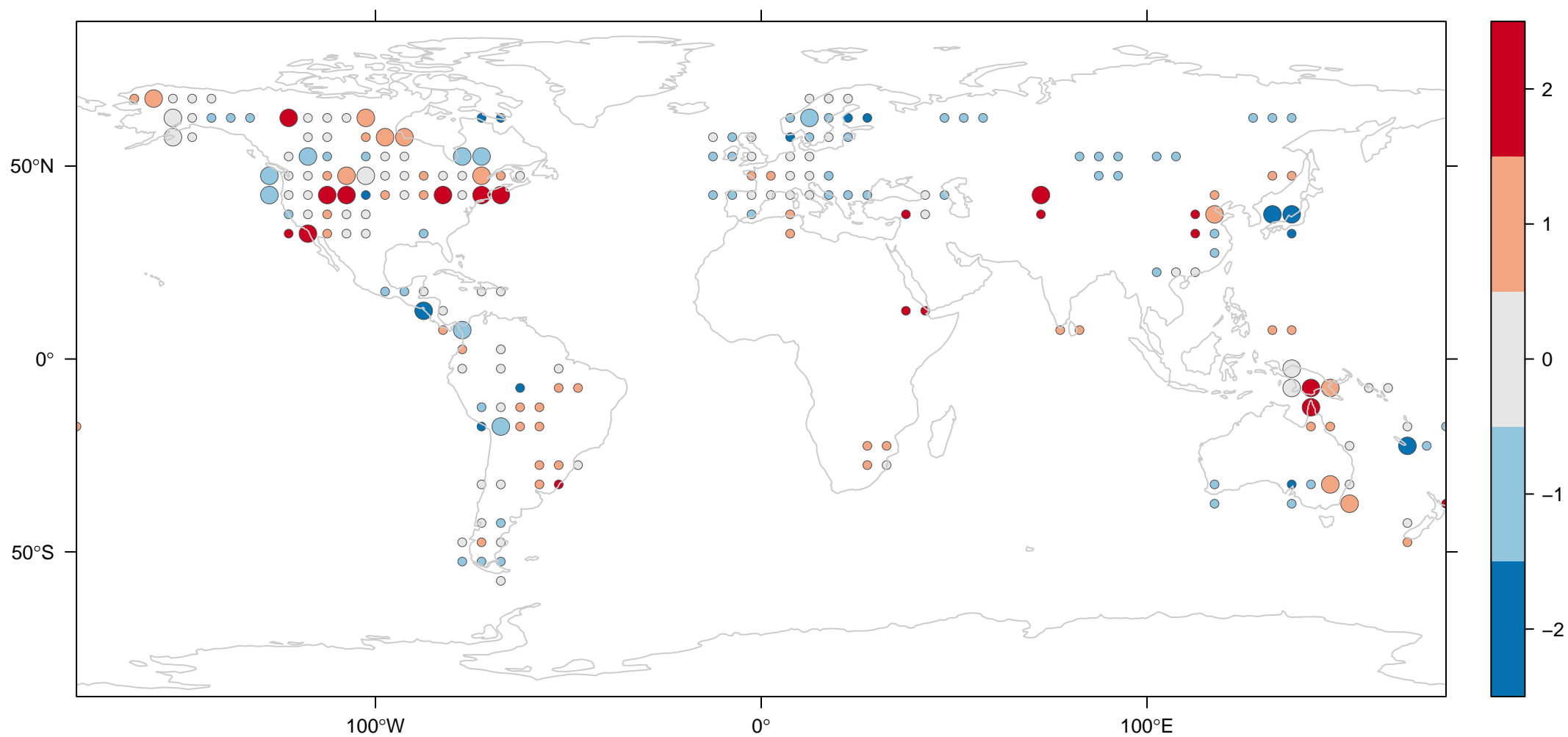
Number of sites per grid cell

1
2–5
6–10
11–20
>20

Number of grid cells influenced by each site

1
2
3
4
>4
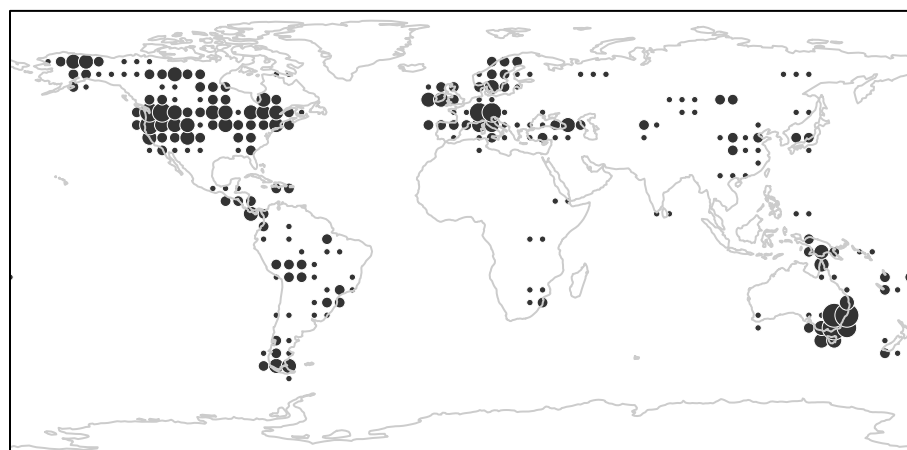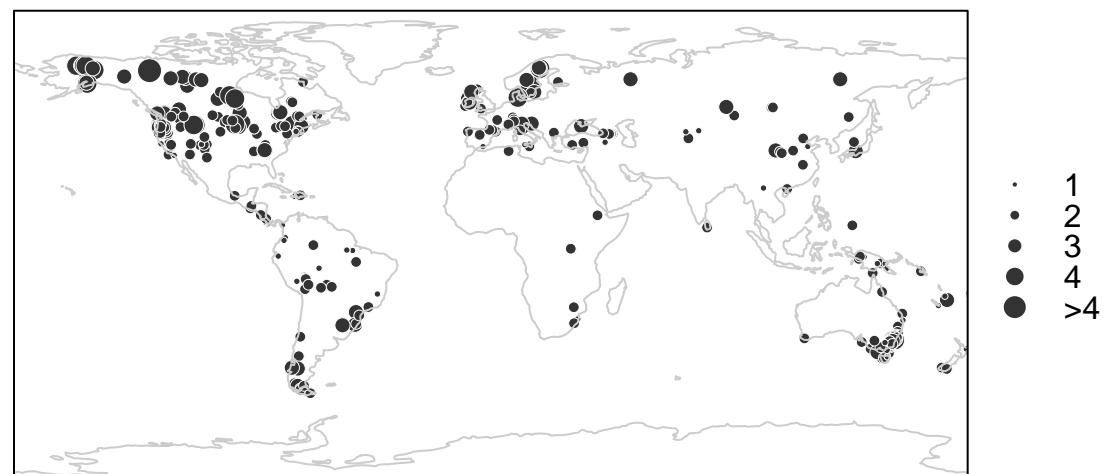
Charcoal Influx z−Scores: 100−200 BP
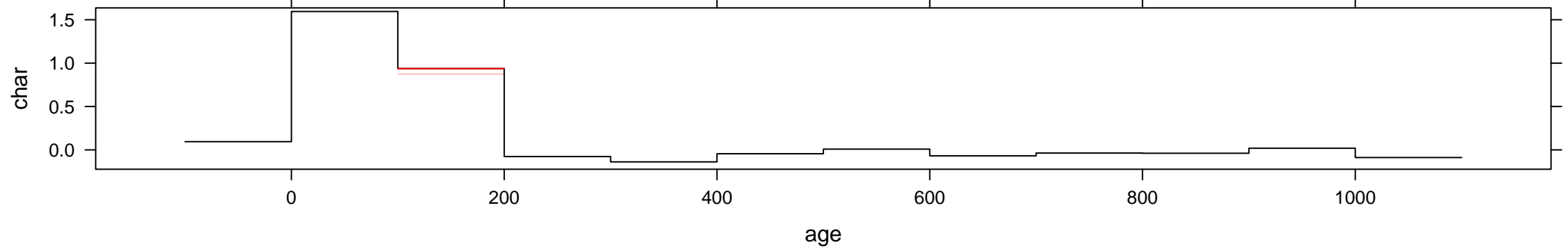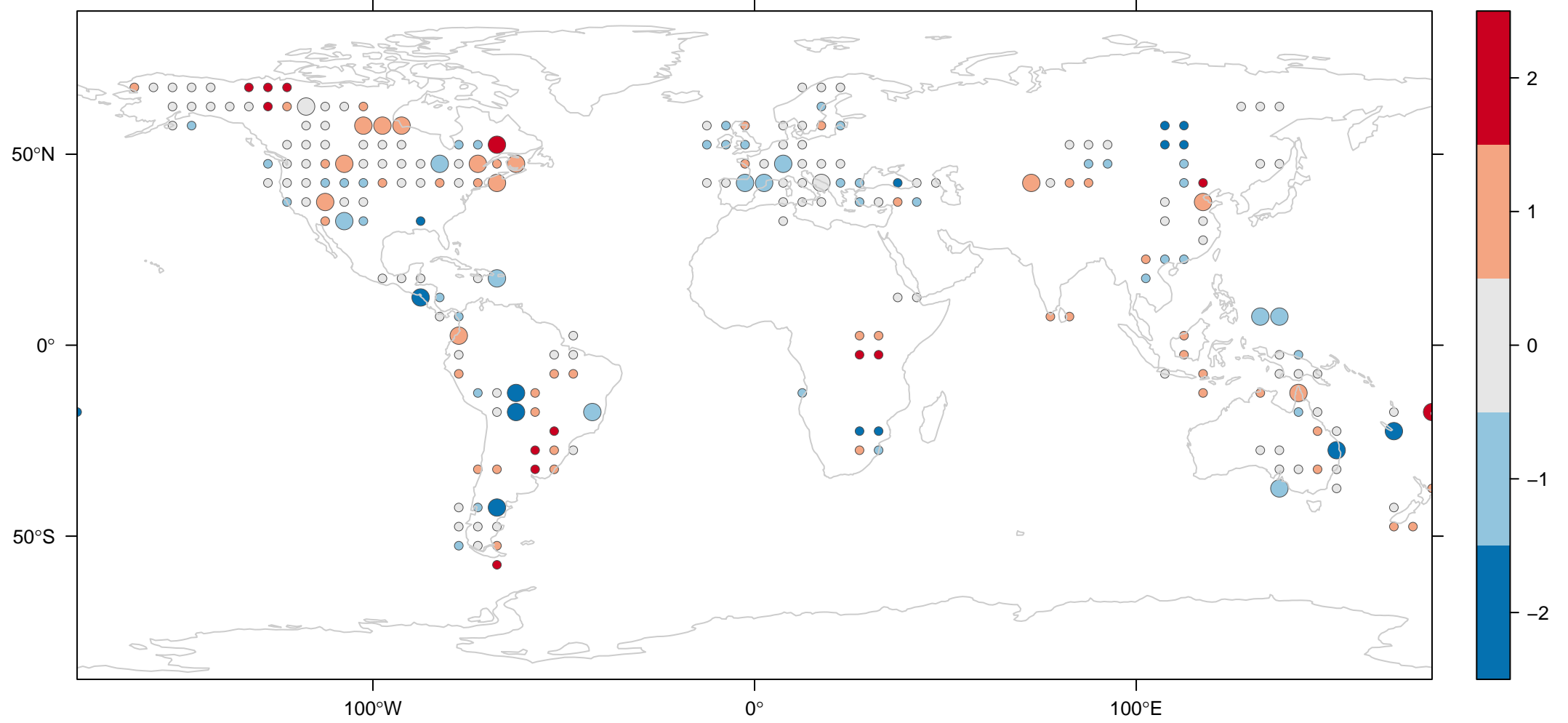
Number of sites per grid cell
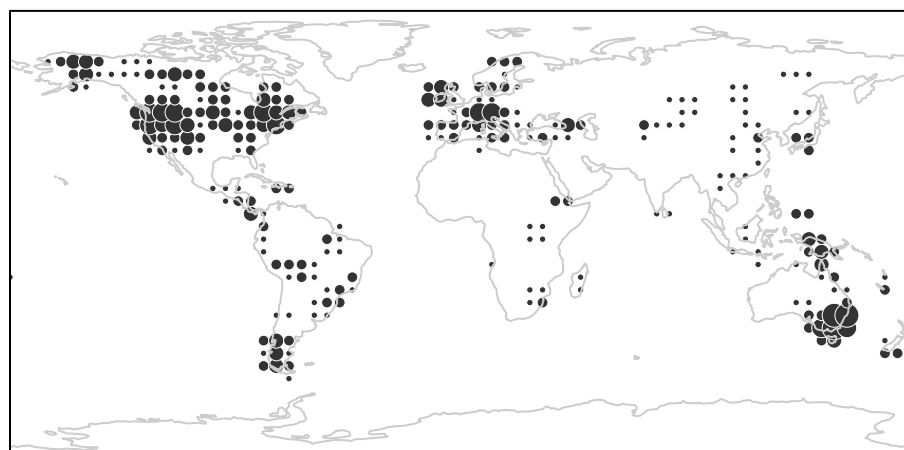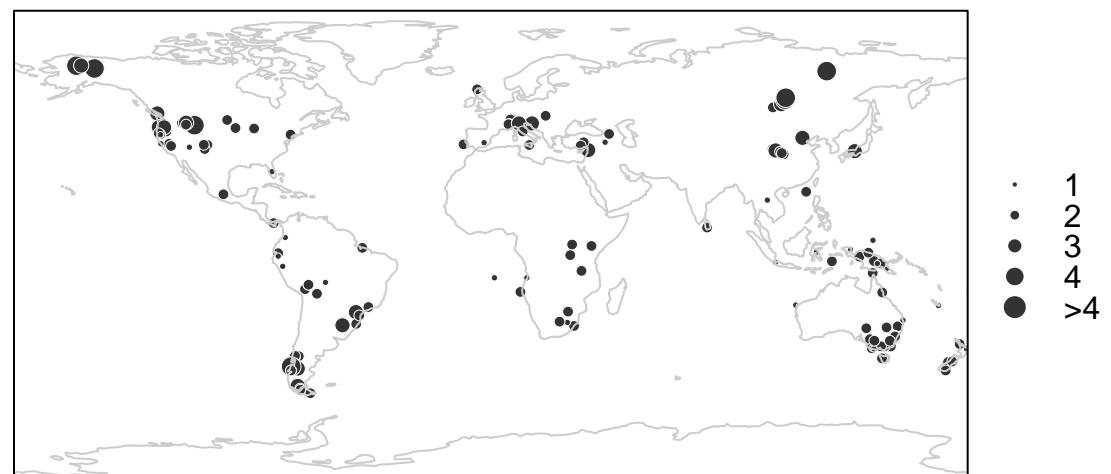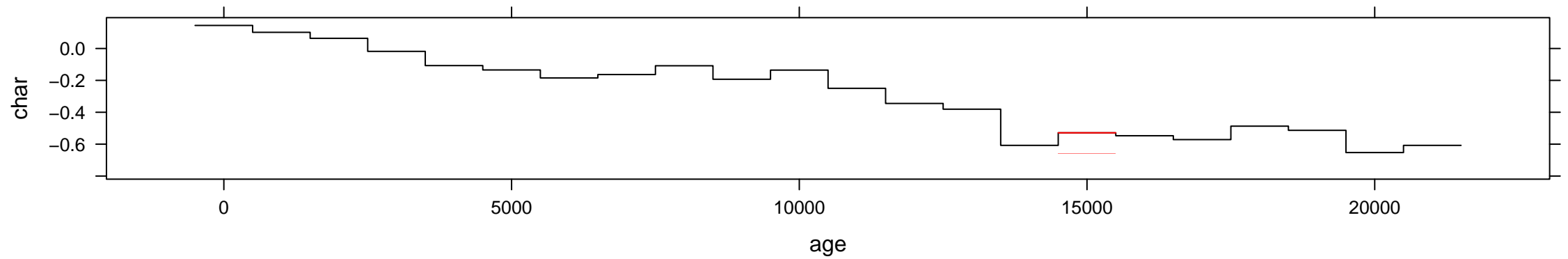
Number of grid cells influenced by each site
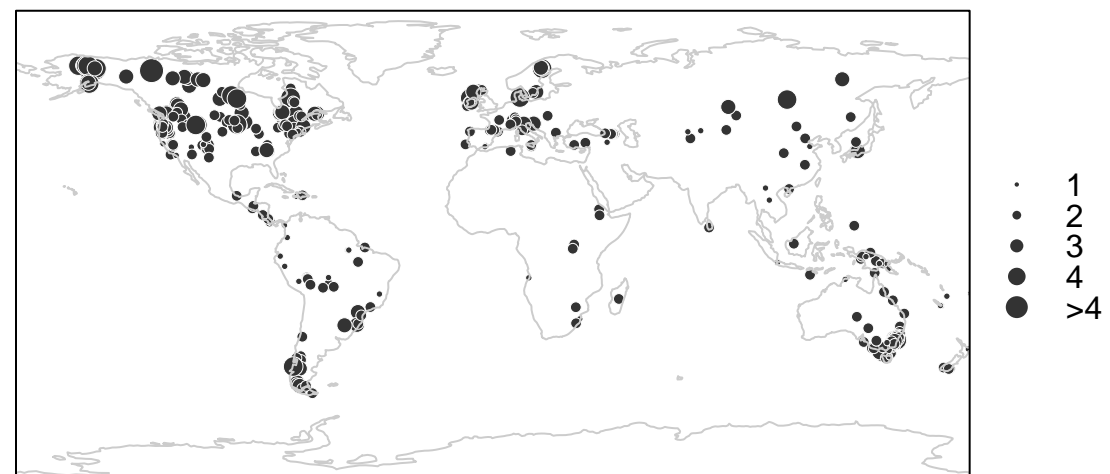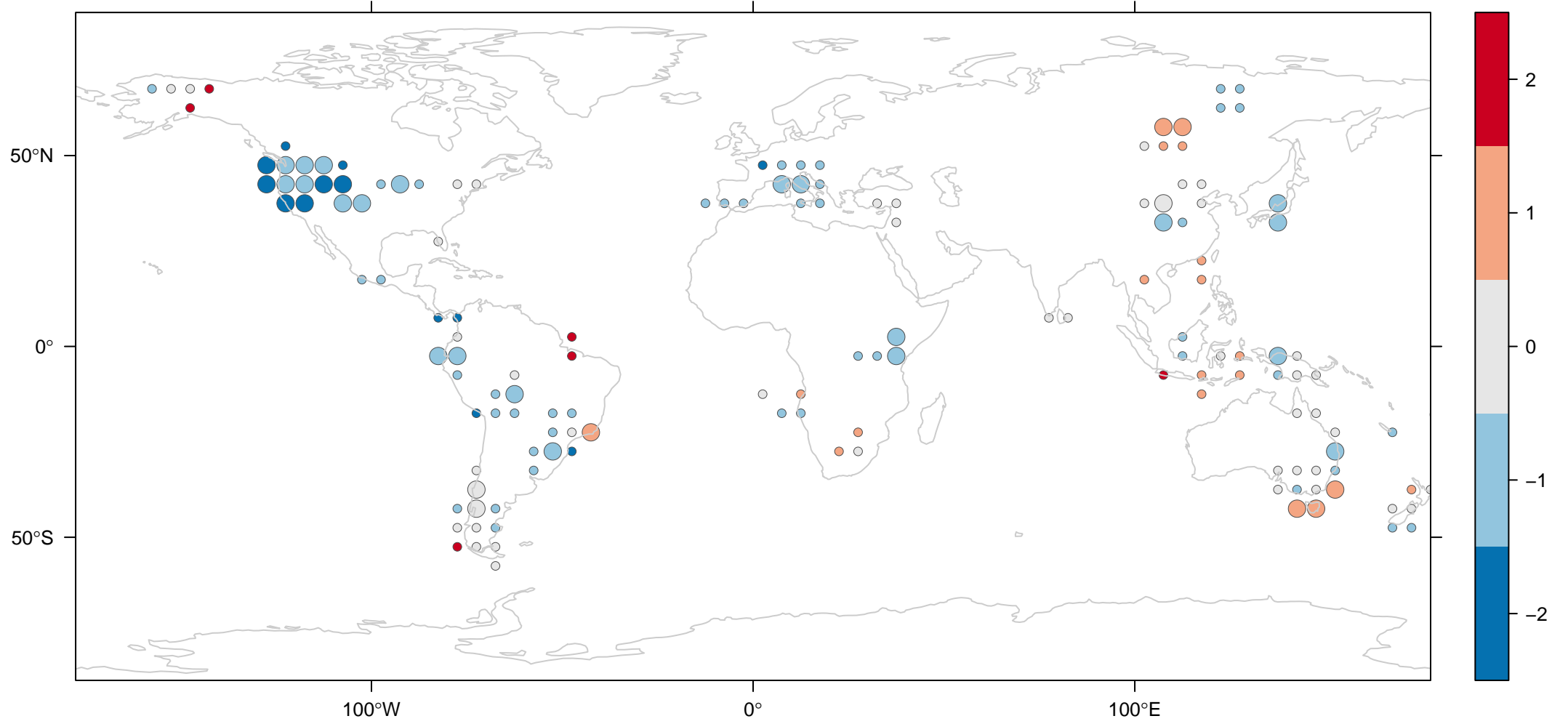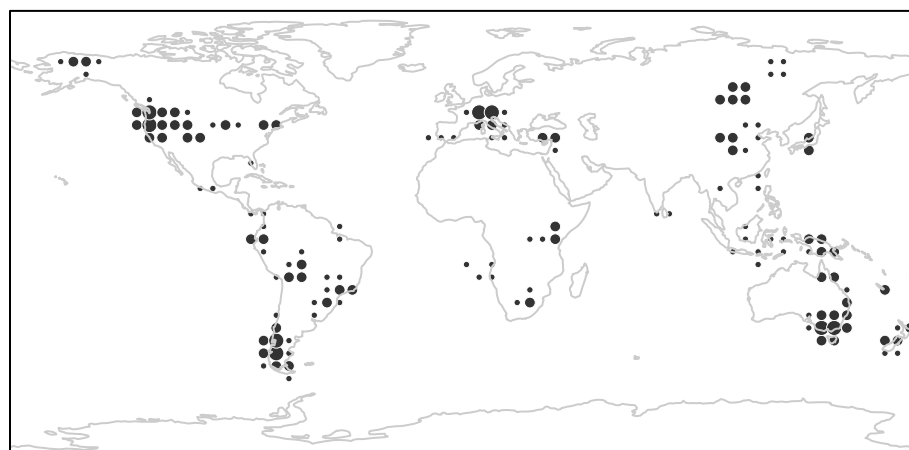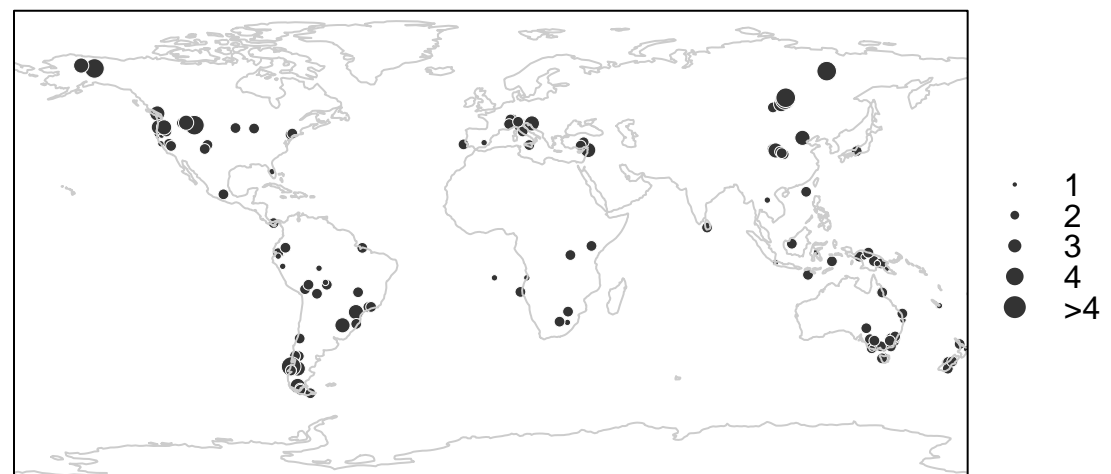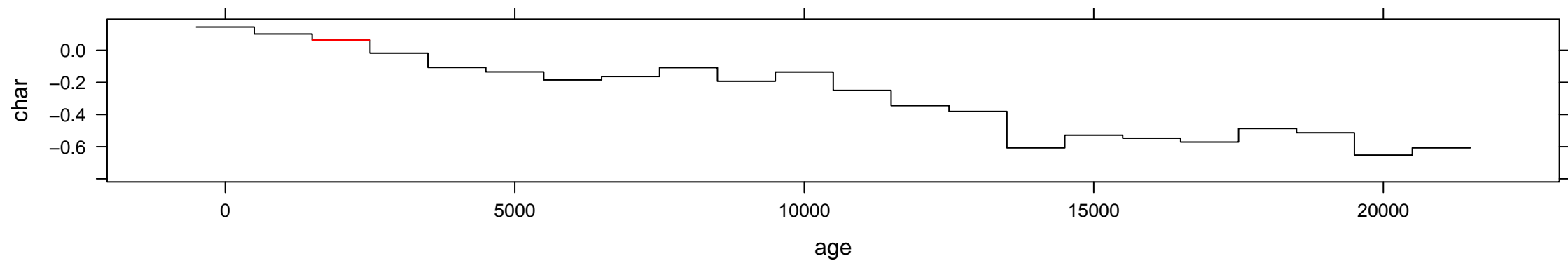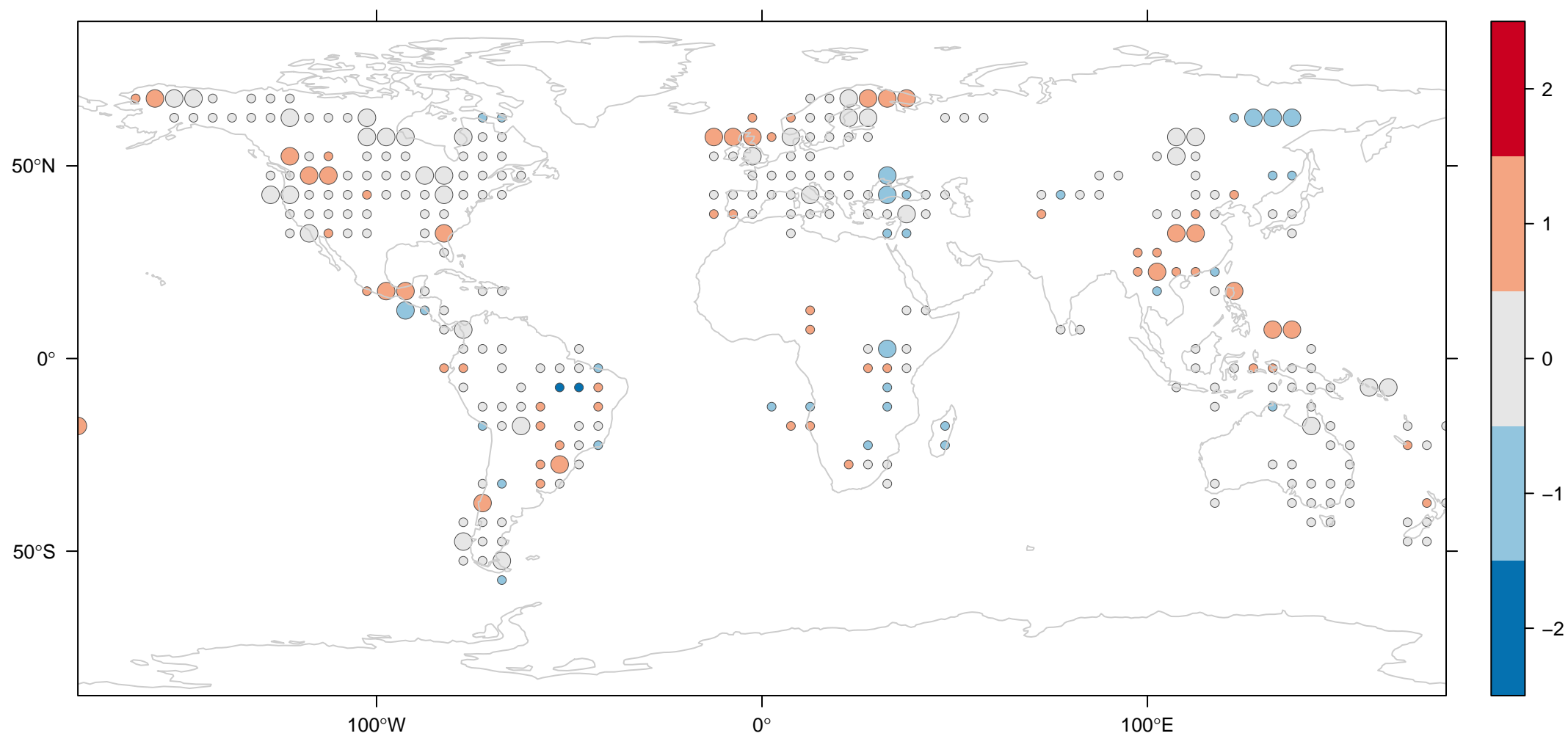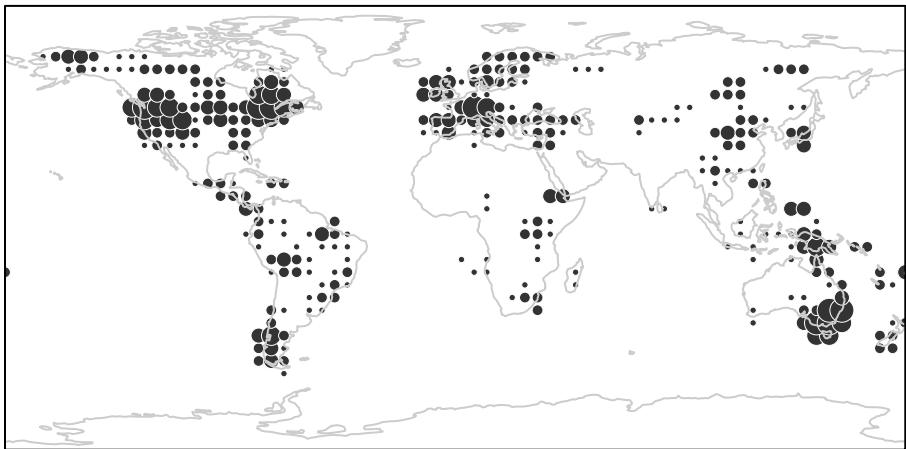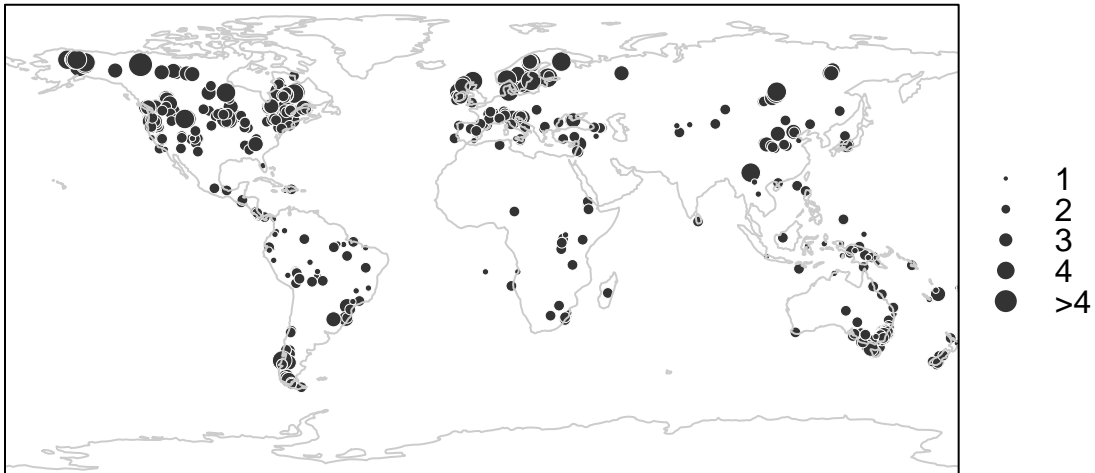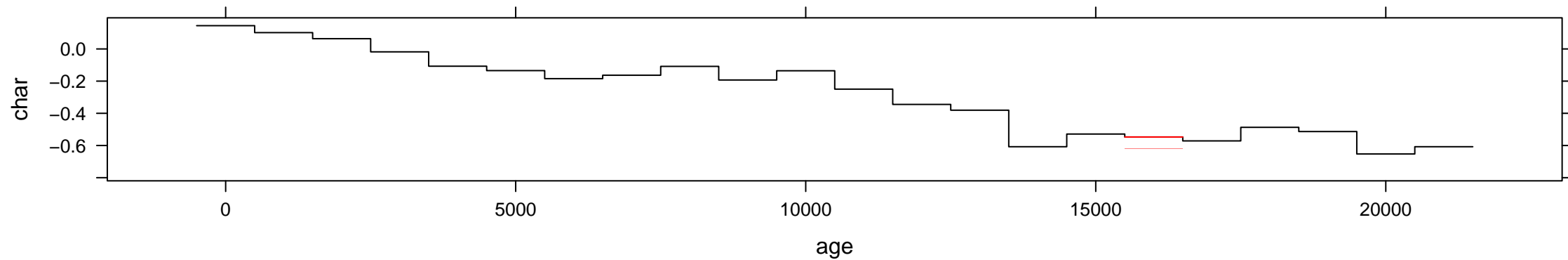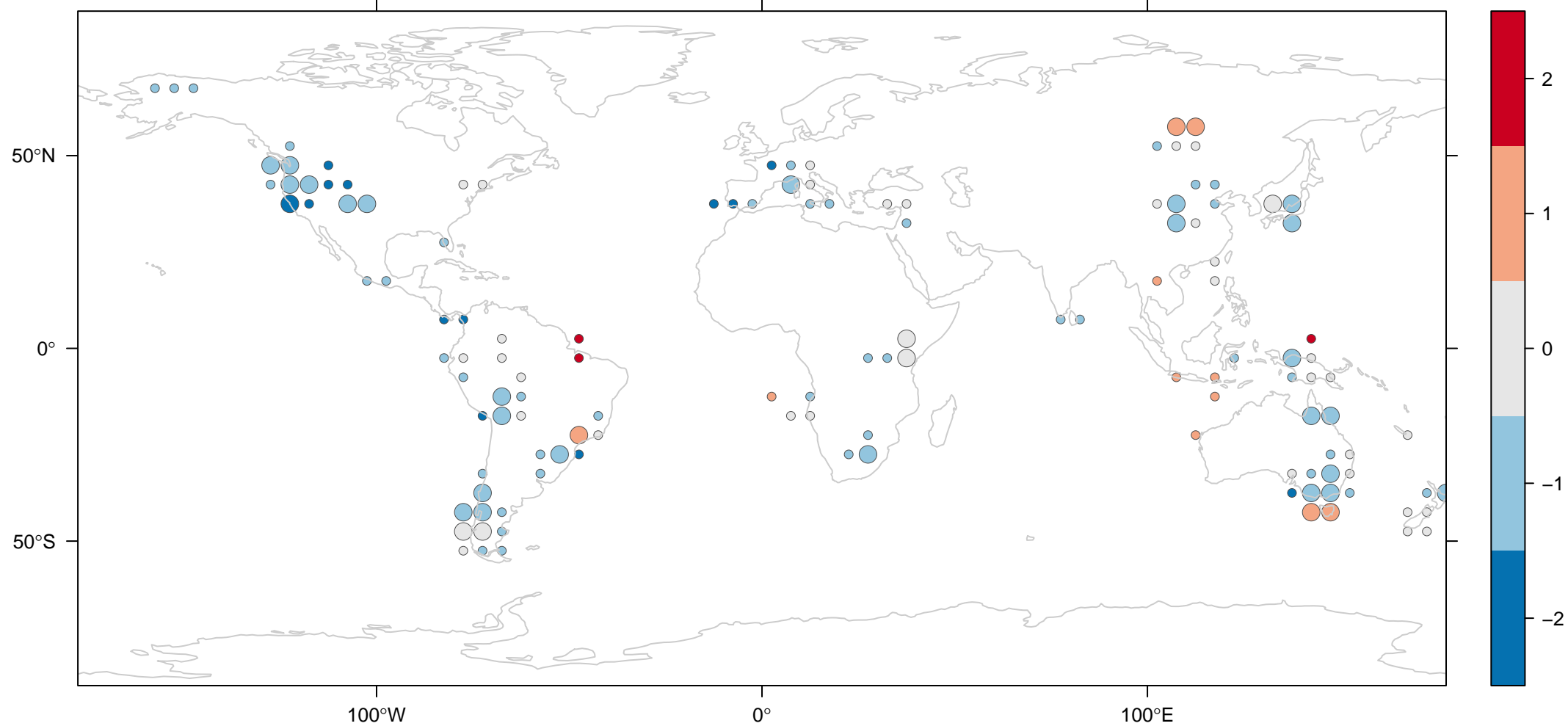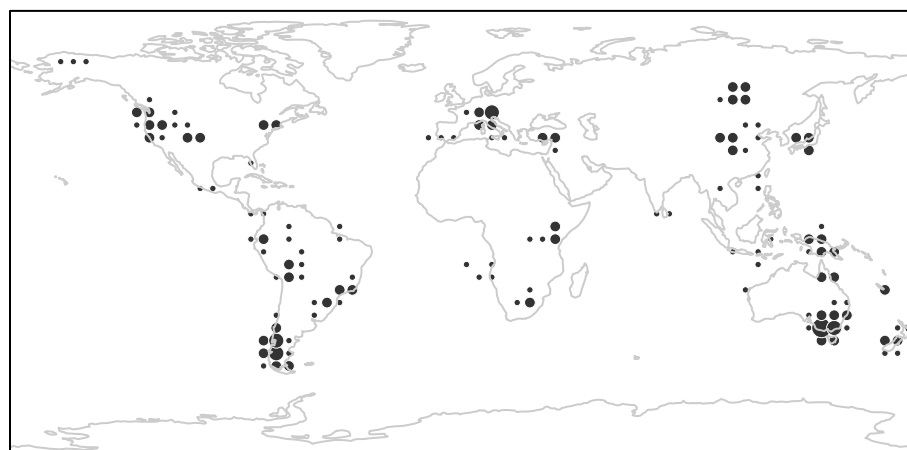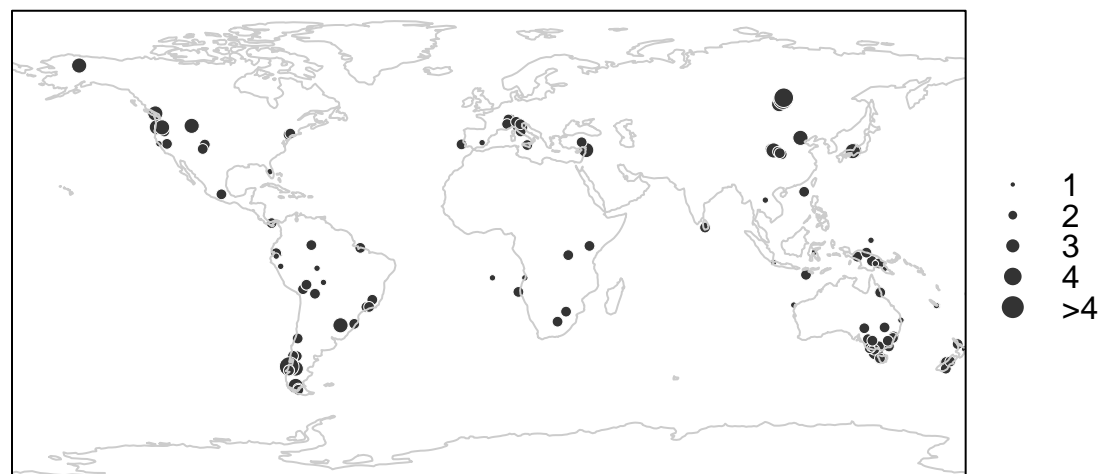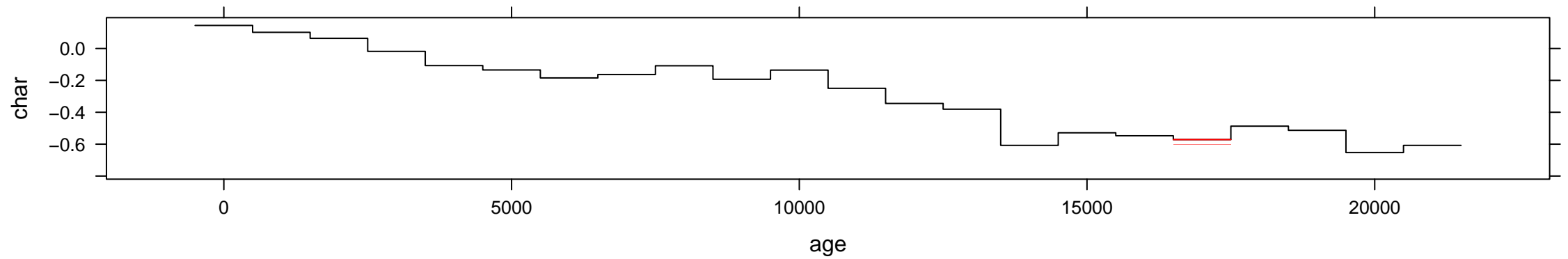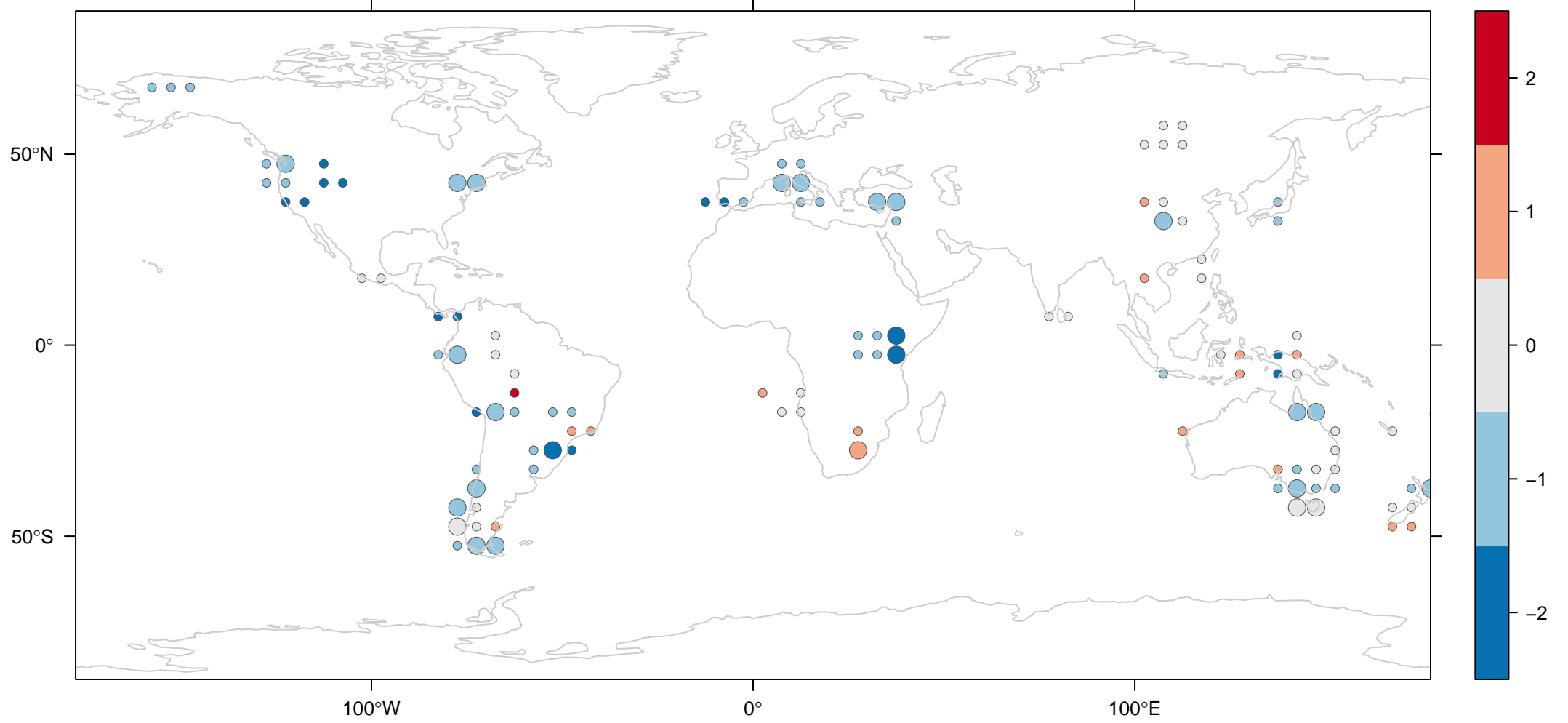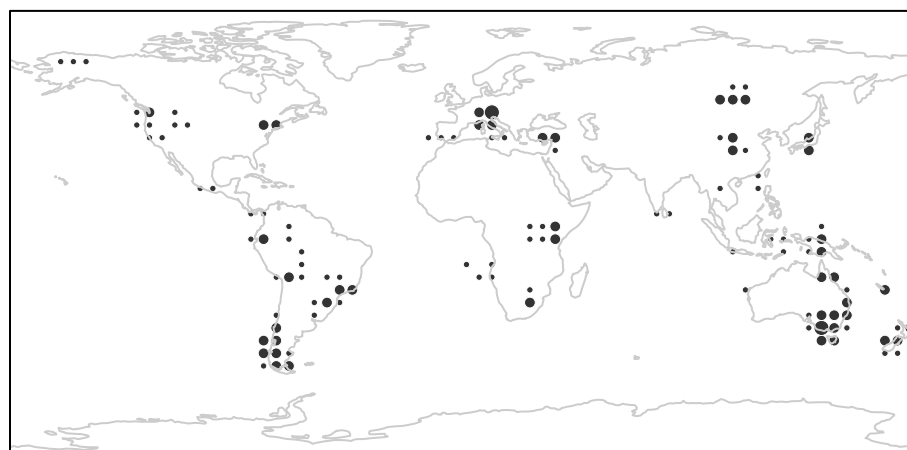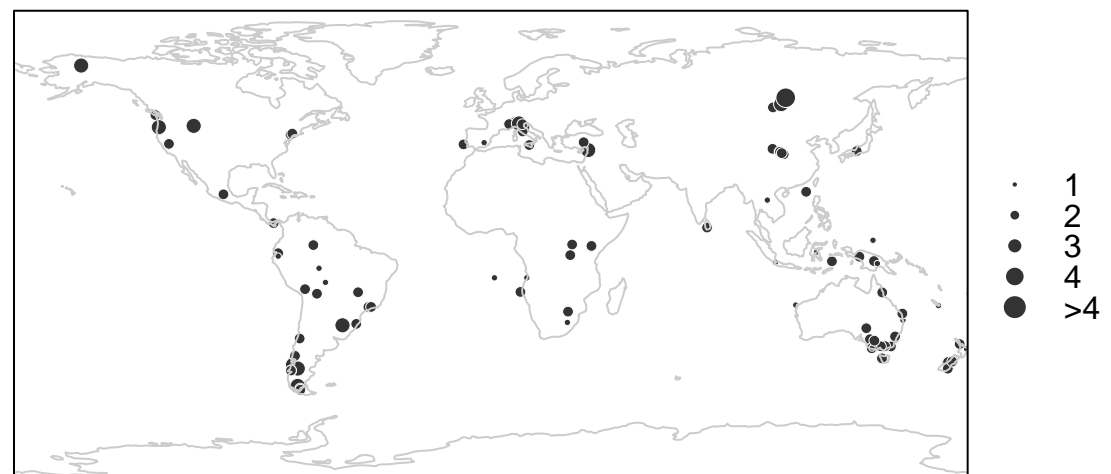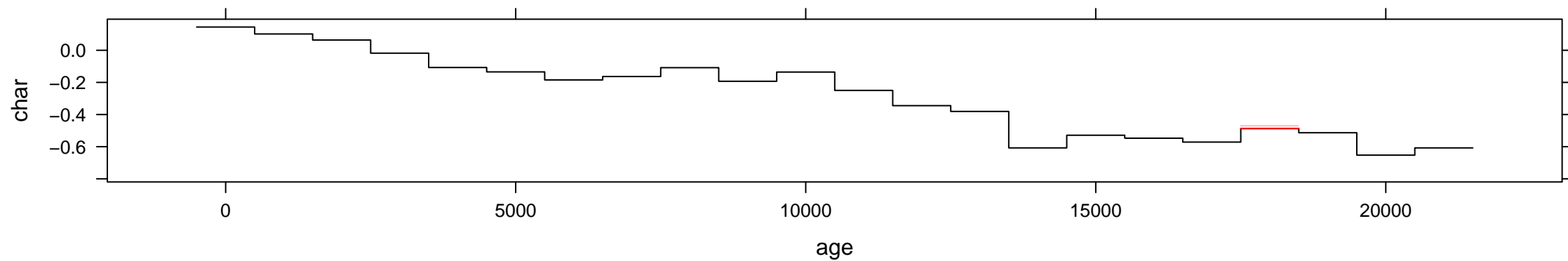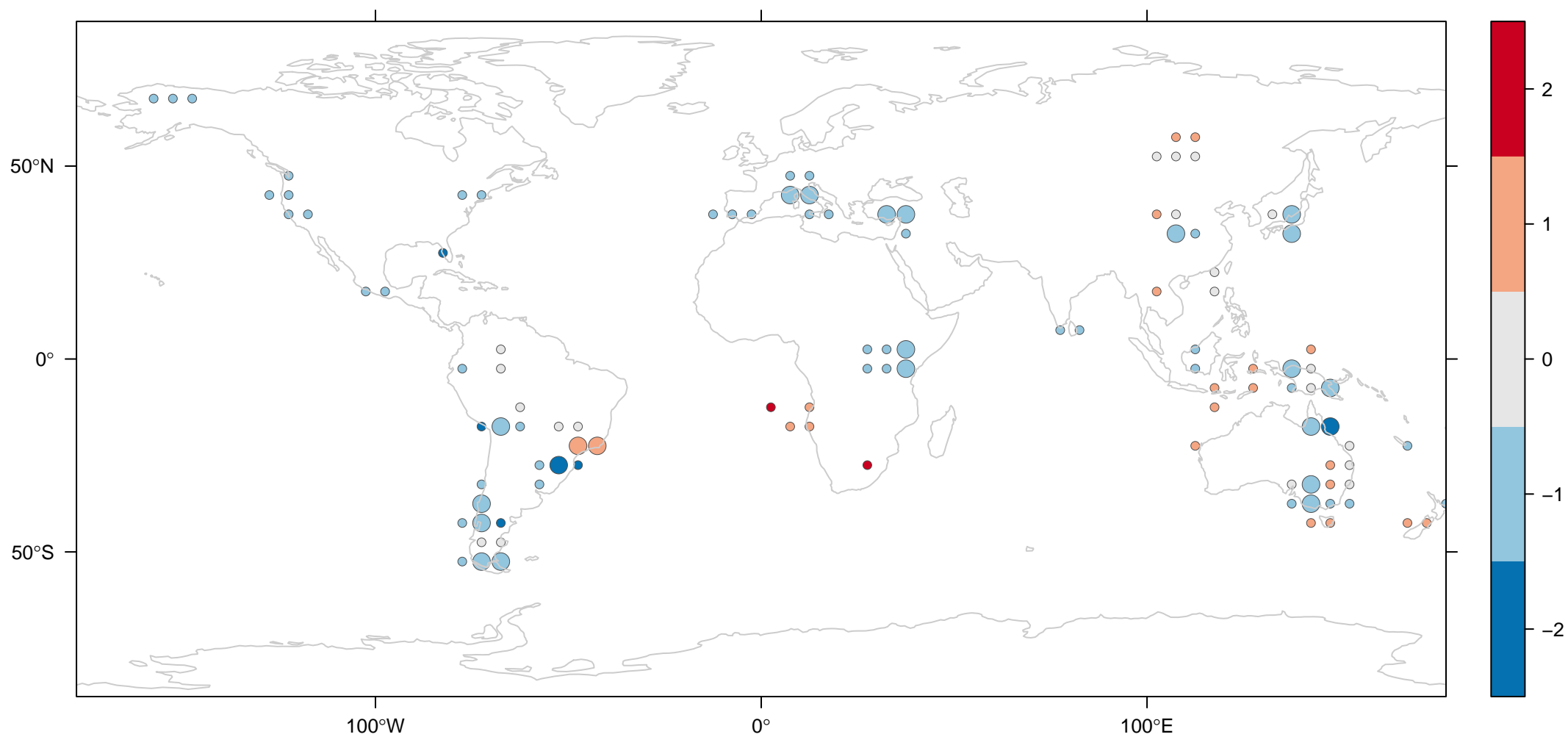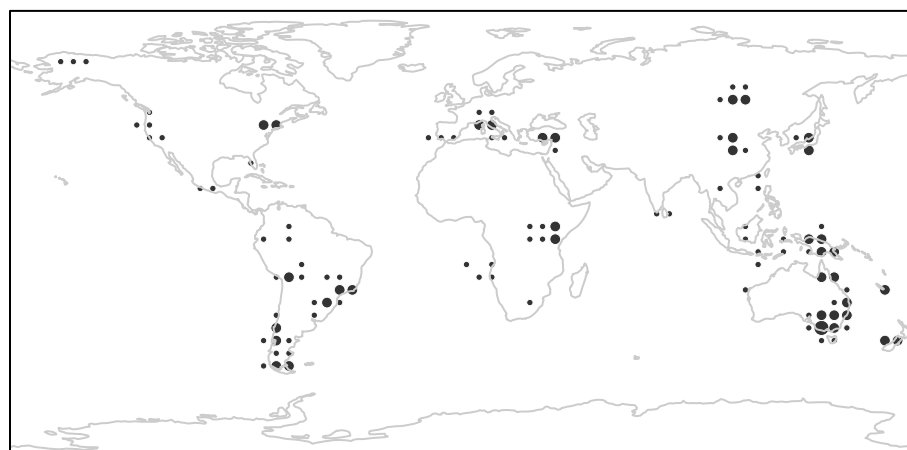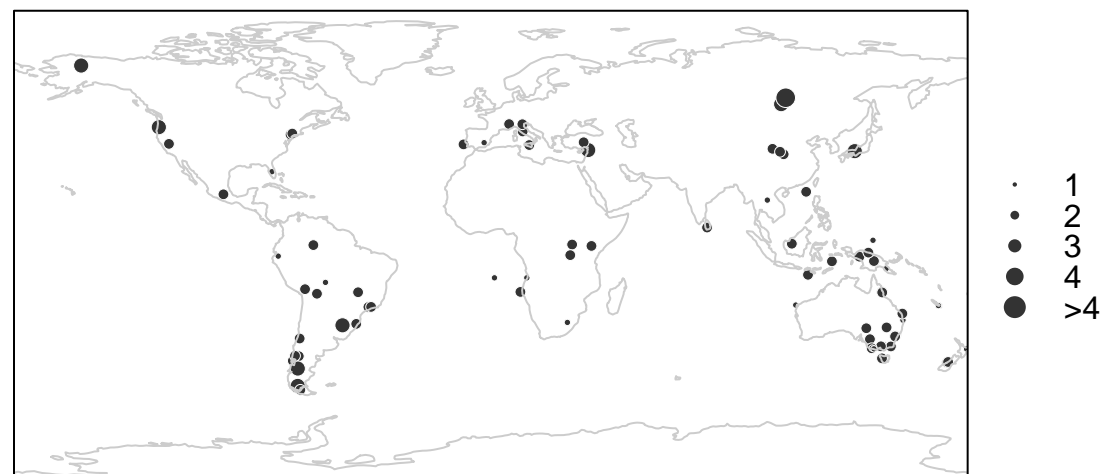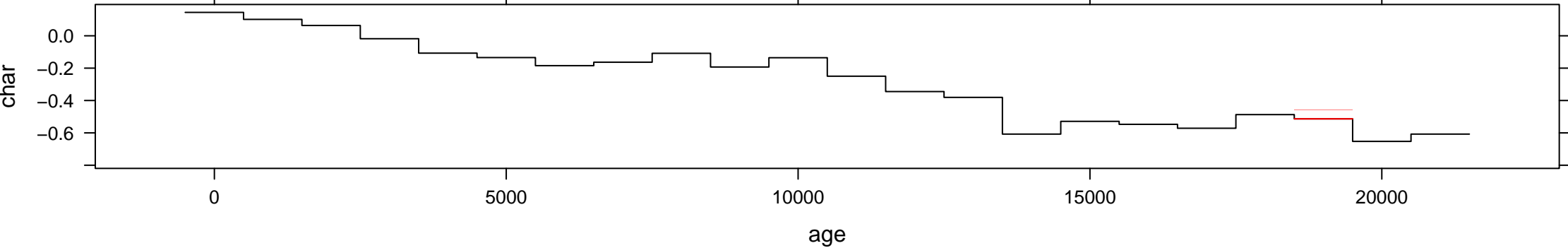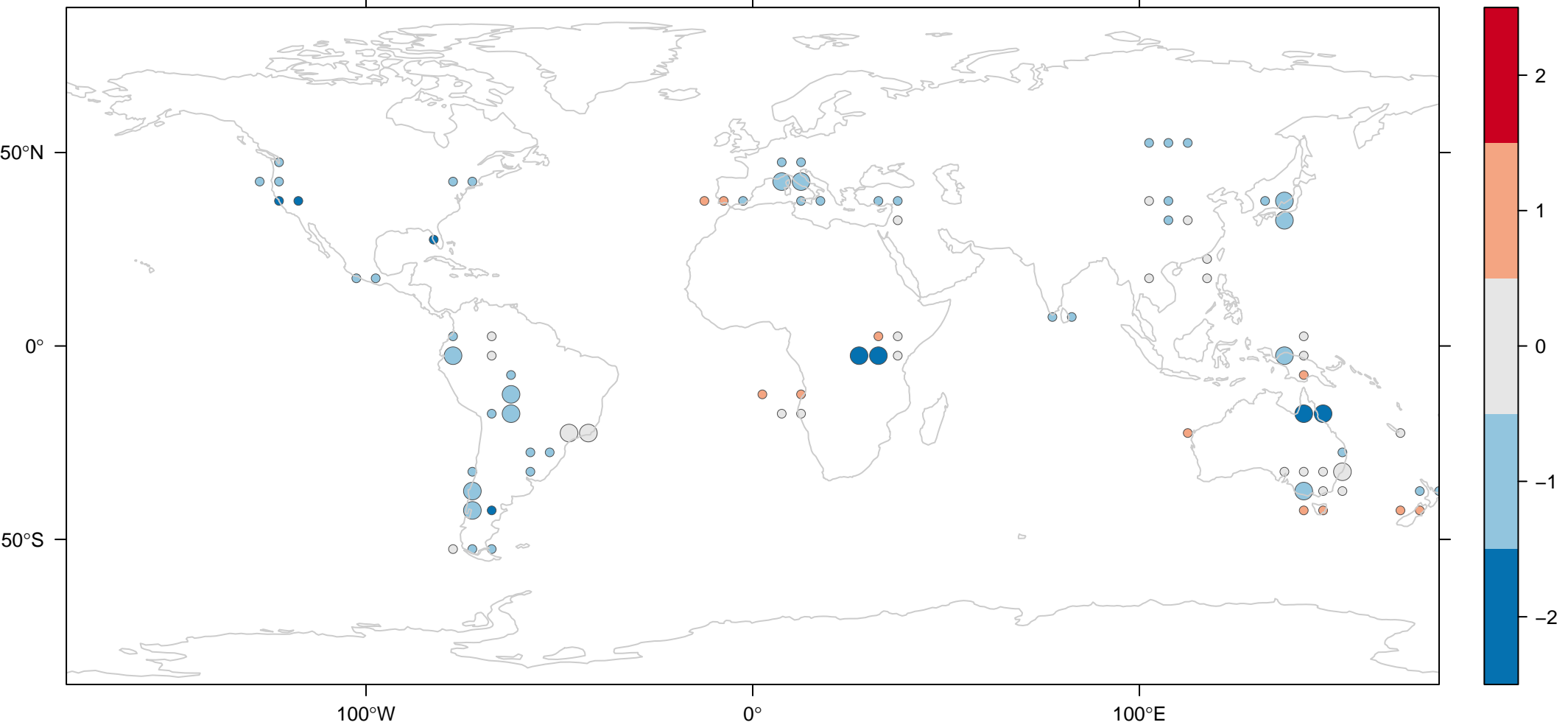
Charcoal Influx z−Scores: 1000−1100 BP
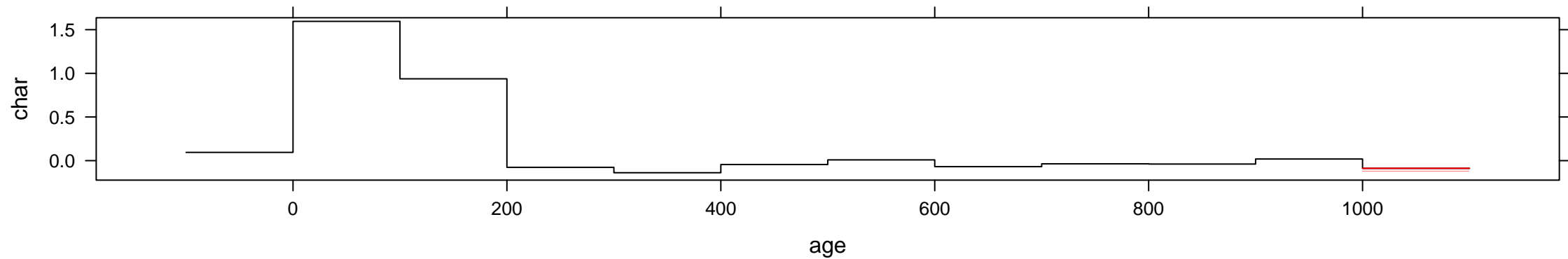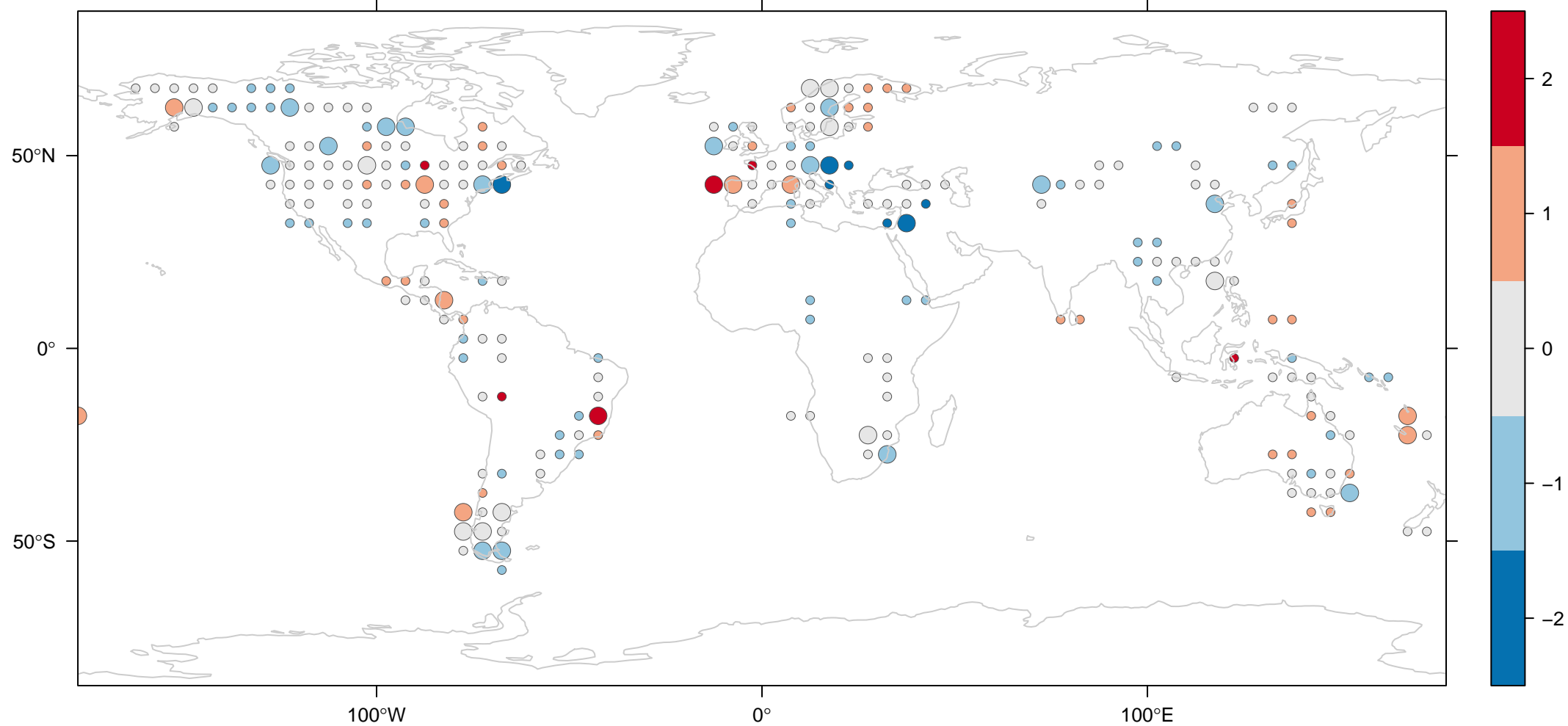
Number of sites per grid cell

1
2–5
6–10
11–20
>20

Number of grid cells influenced by each site

1
2
3
4
>4
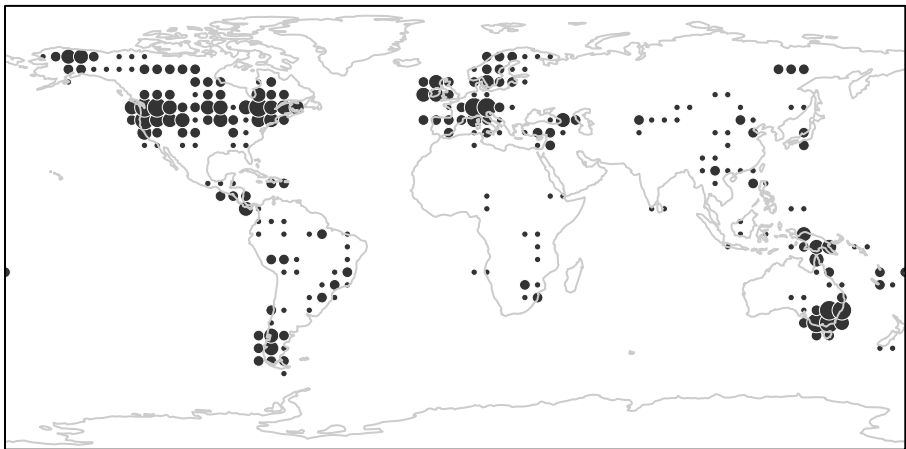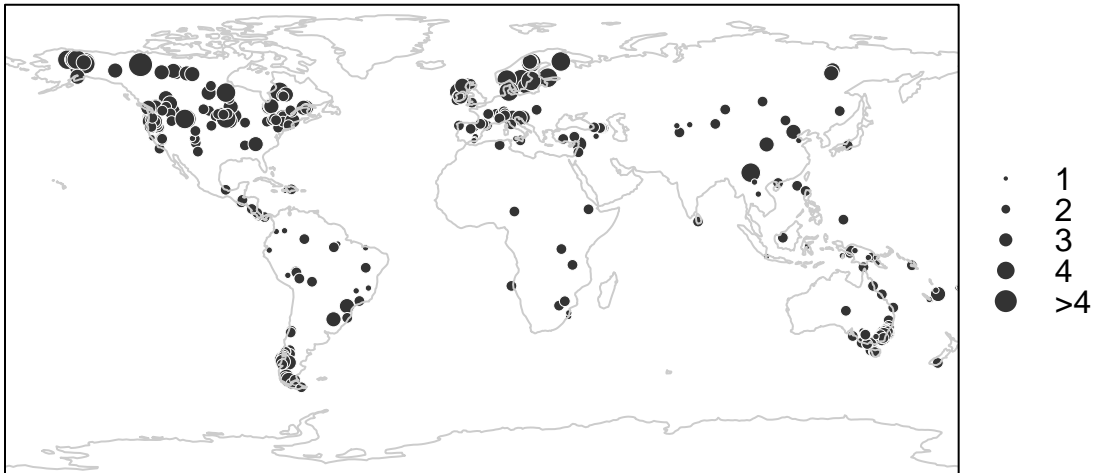
Charcoal Influx z−Scores: 200−300 BP
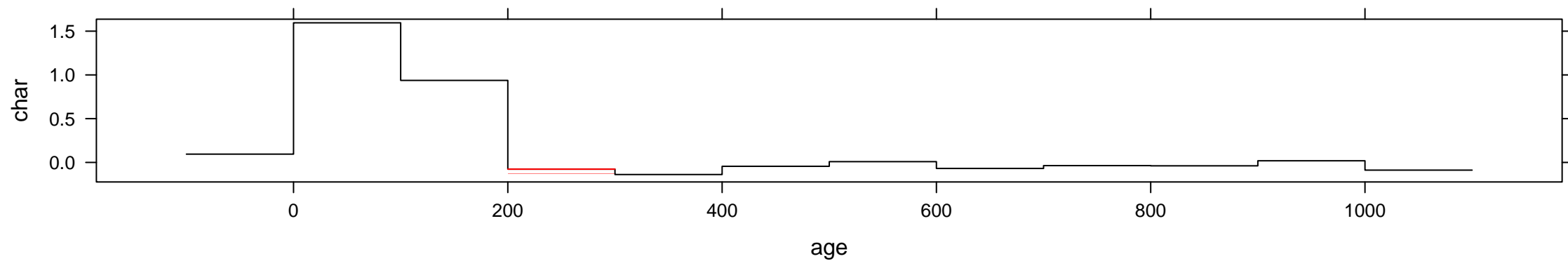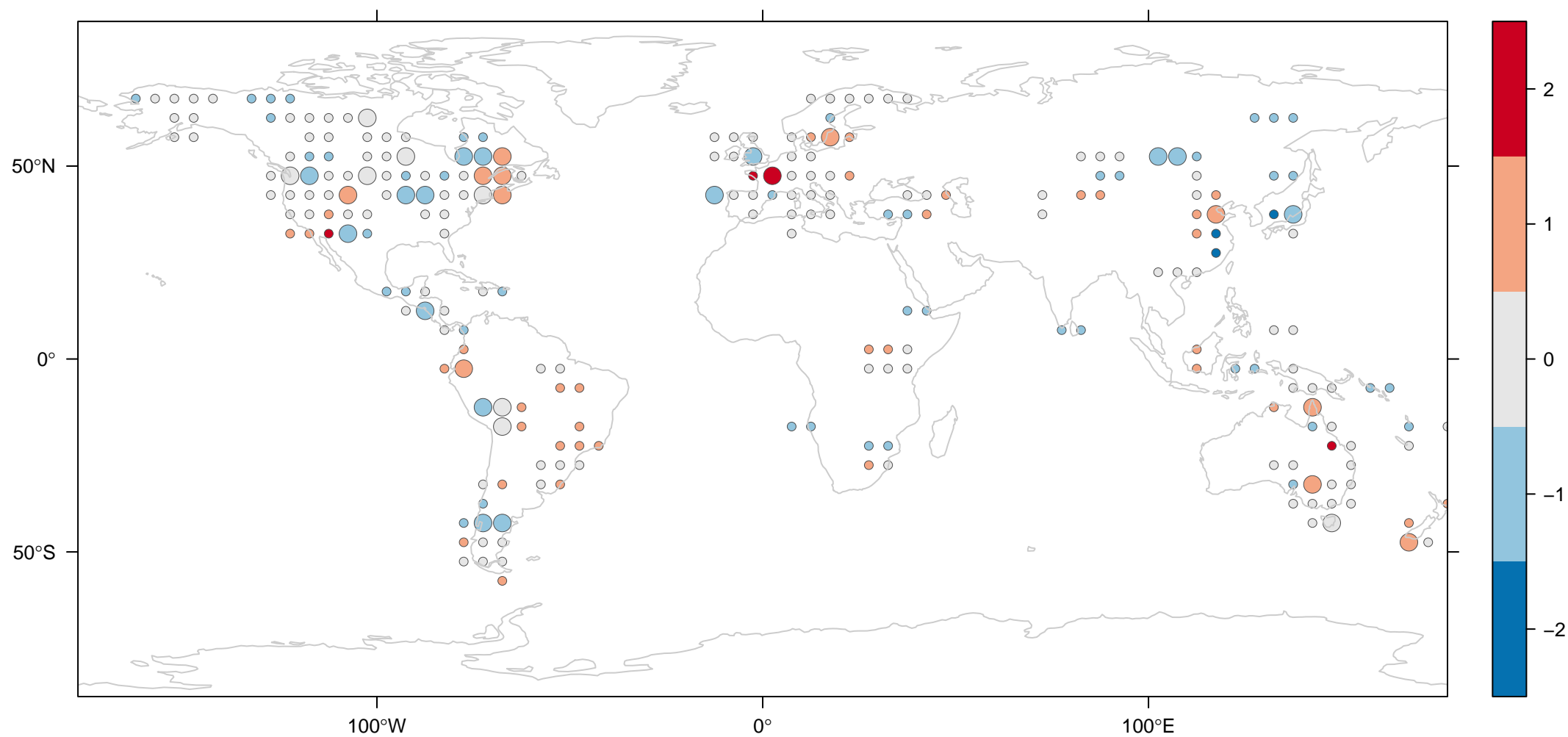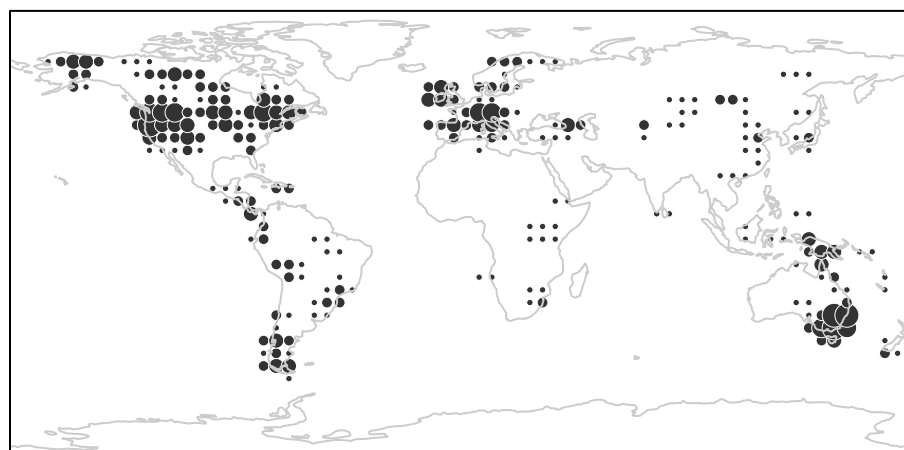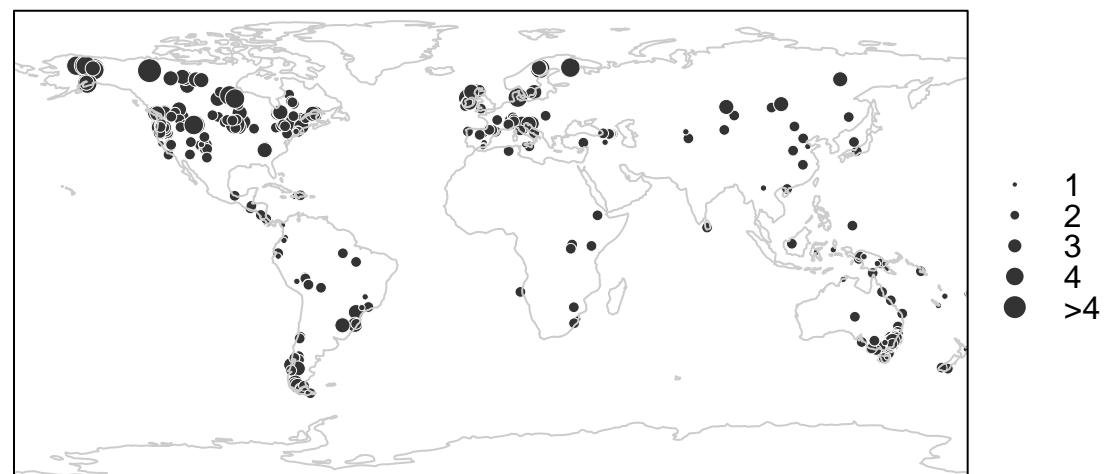
Charcoal Influx z−Scores: 300−400 BP
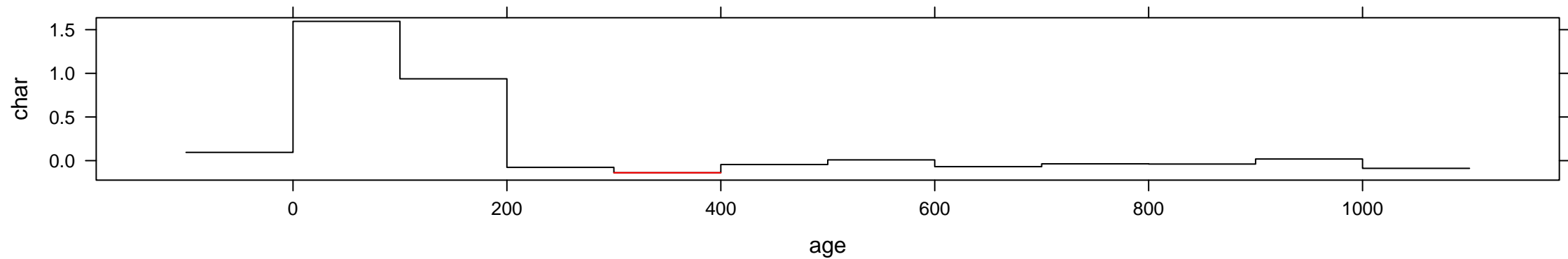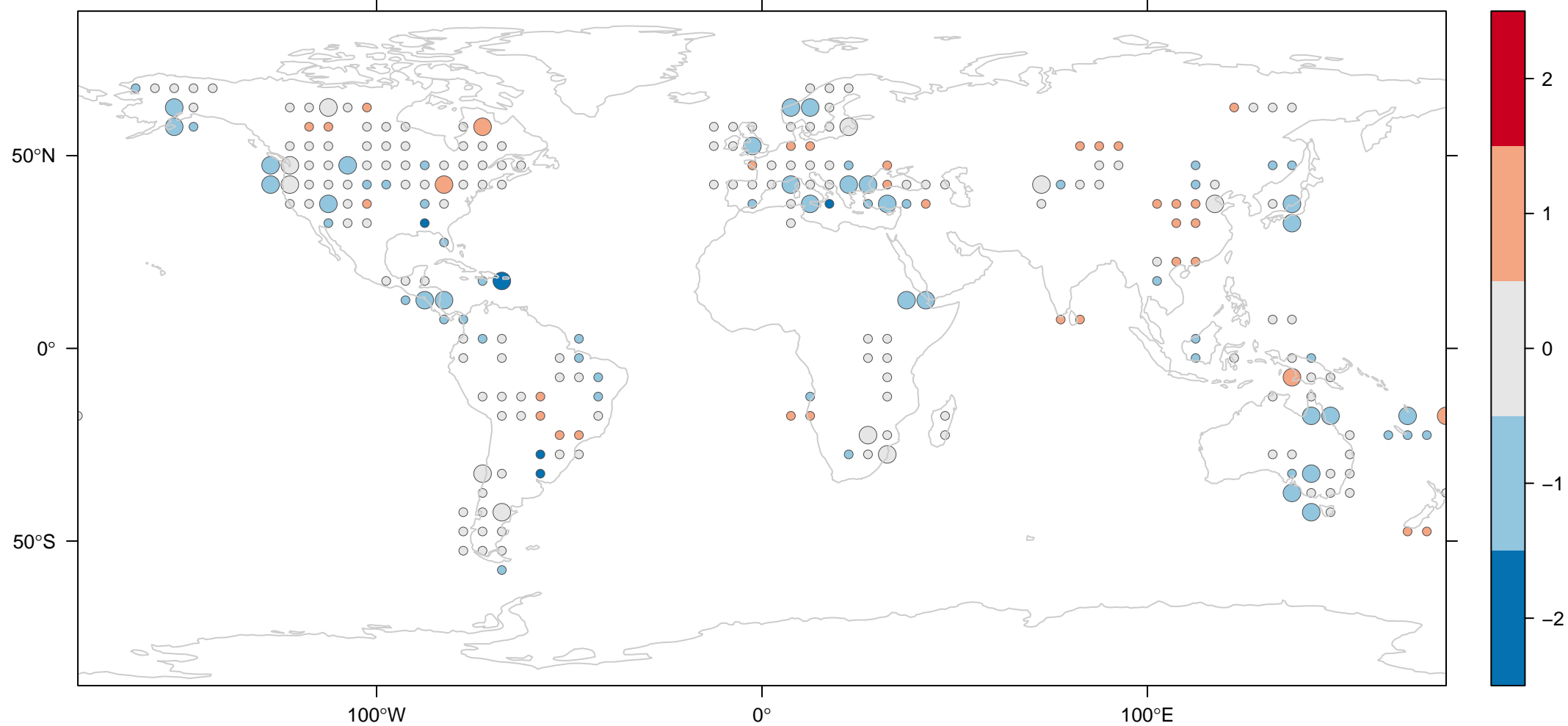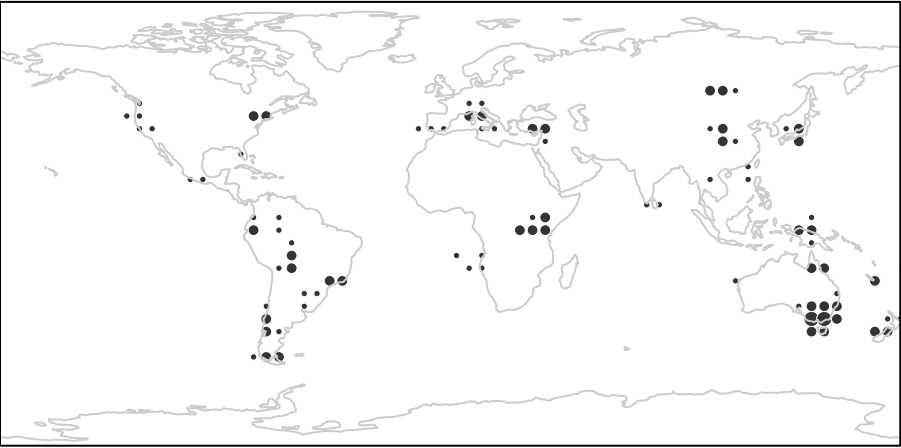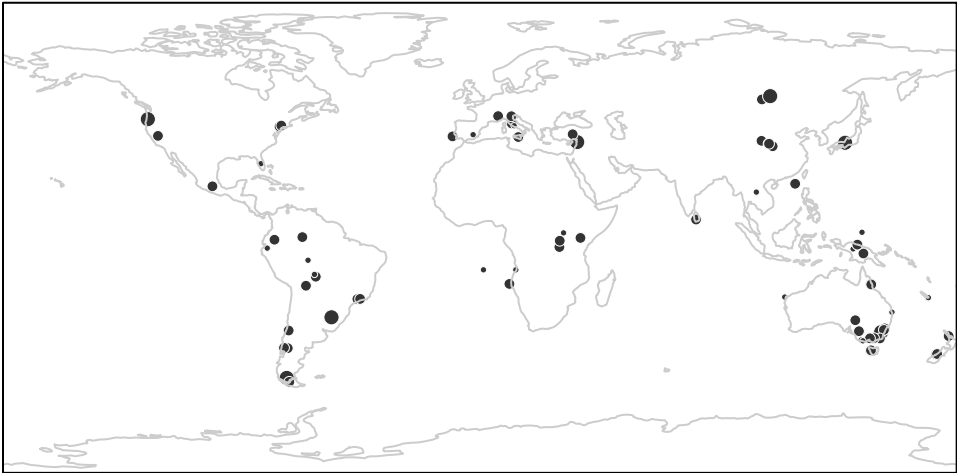
Number of sites per grid cell
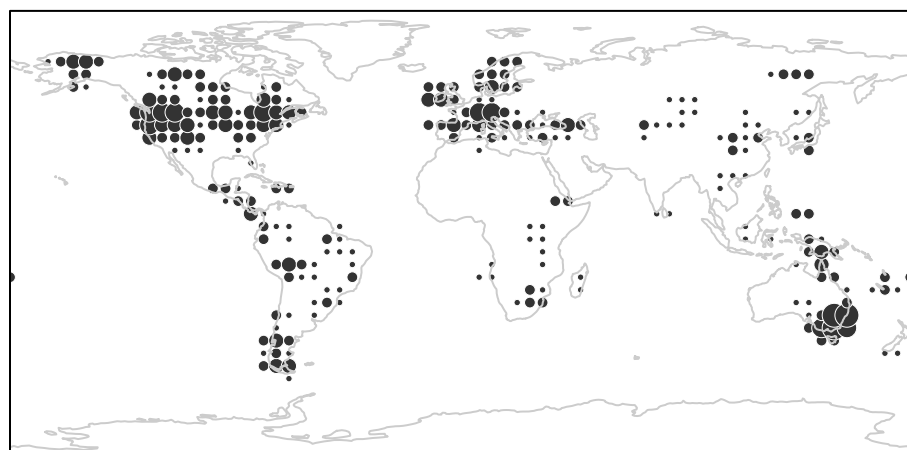
Number of grid cells influenced by each site
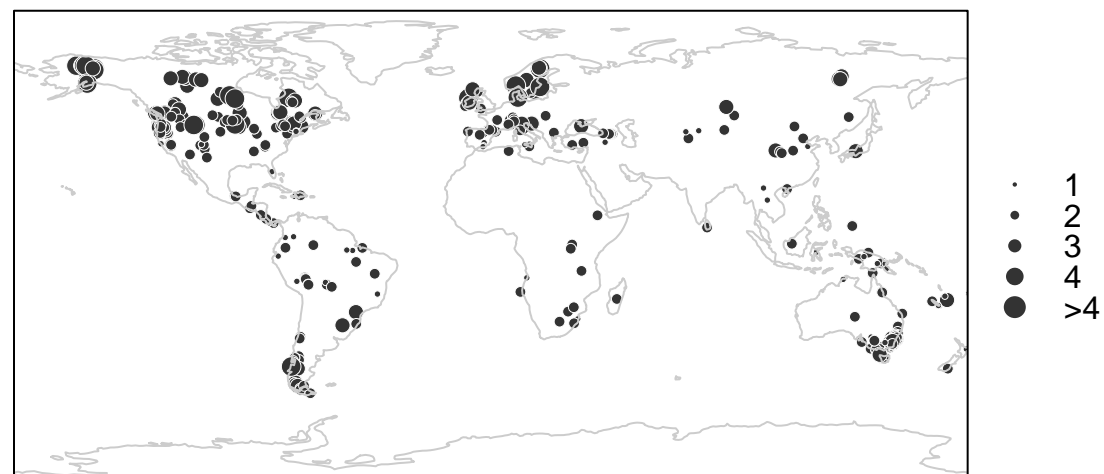
Charcoal Influx z−Scores: 400−500 BP
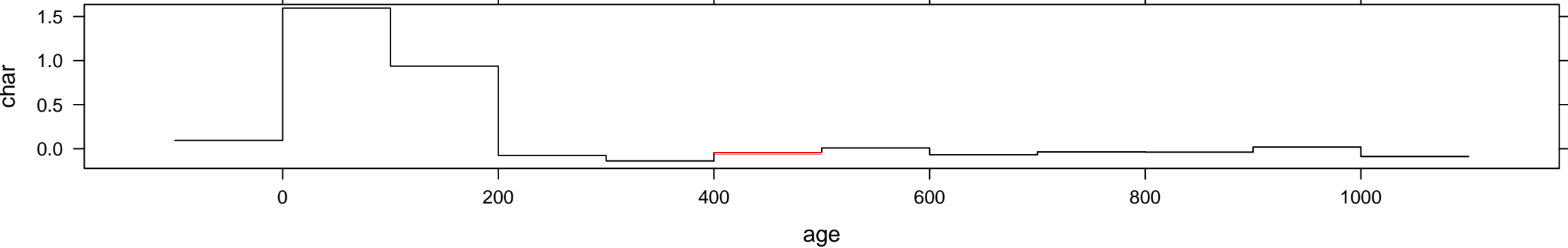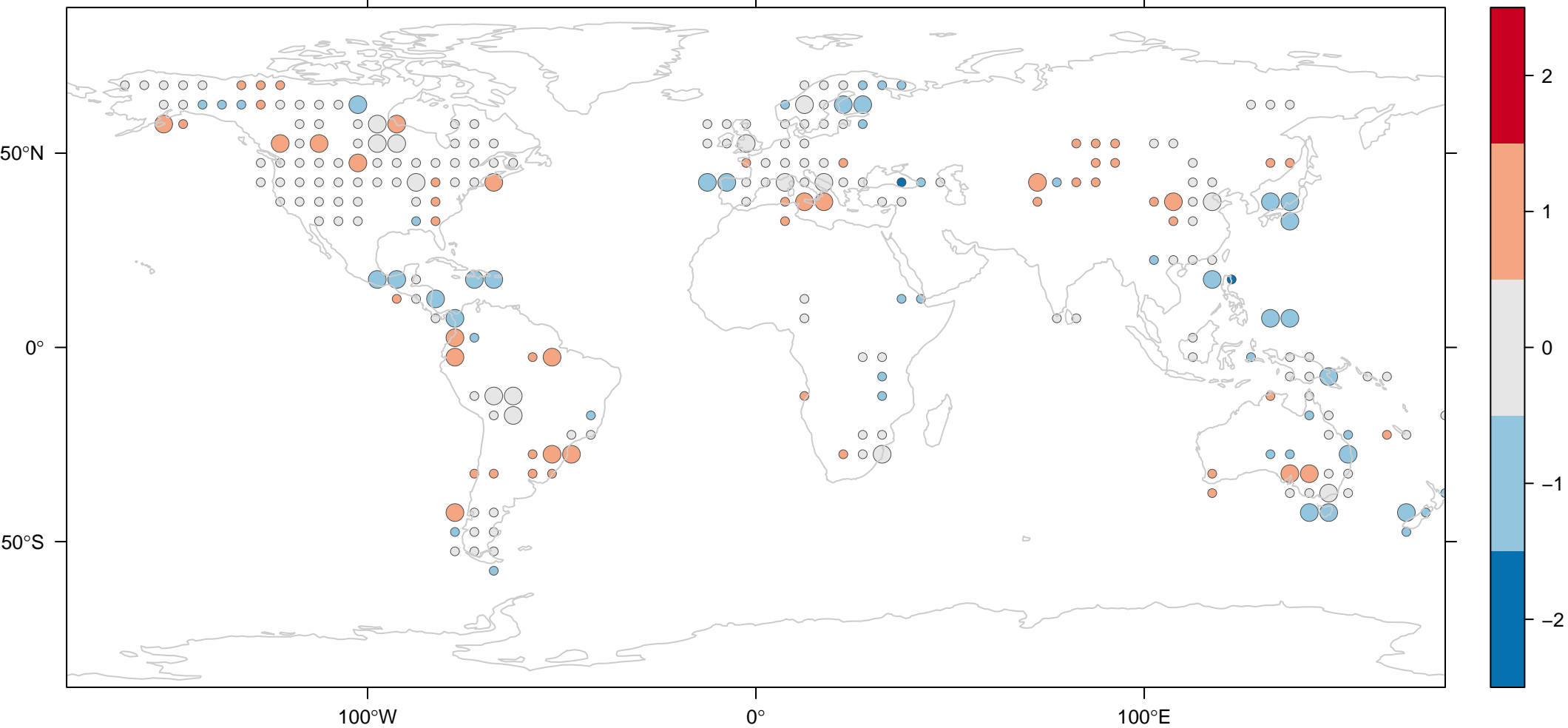
Number of sites per grid cell
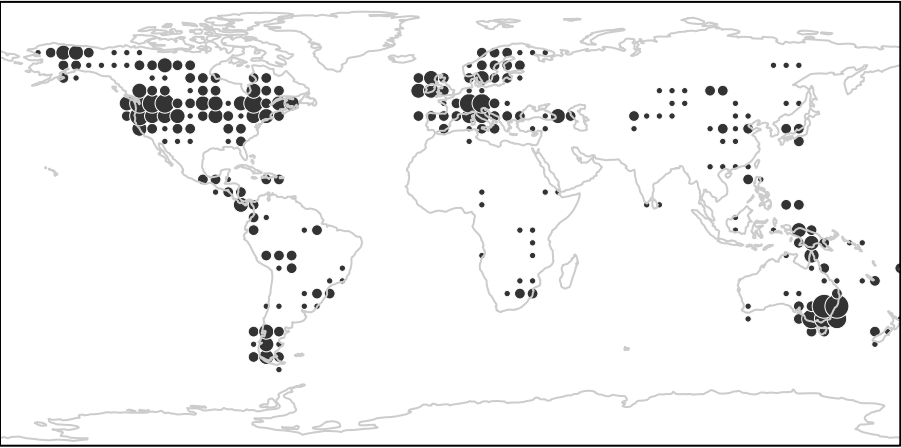
Number of grid cells influenced by each site
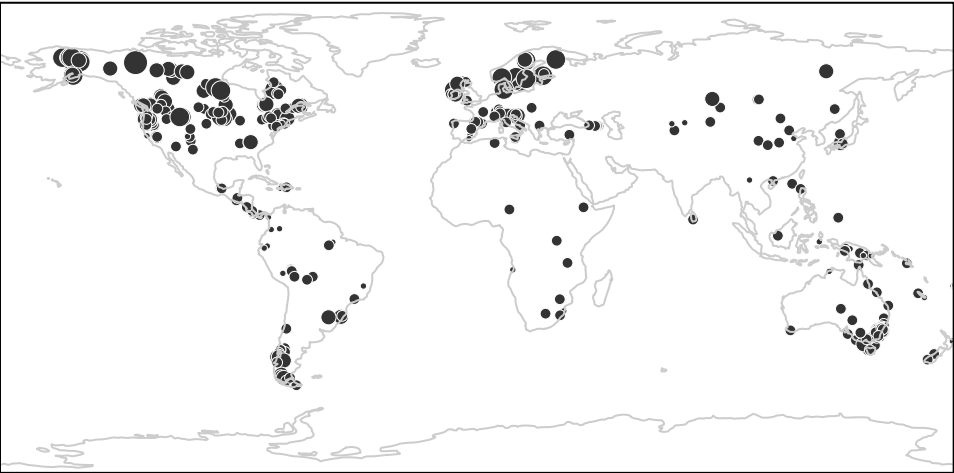
Charcoal Influx z−Scores: 500−600 BP
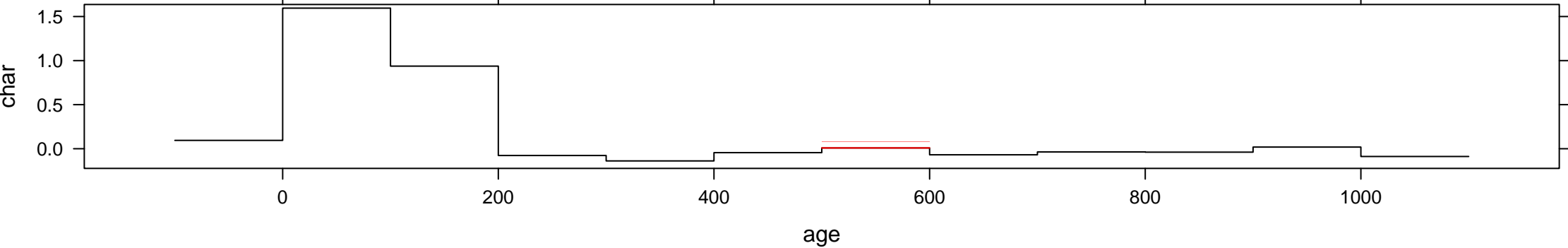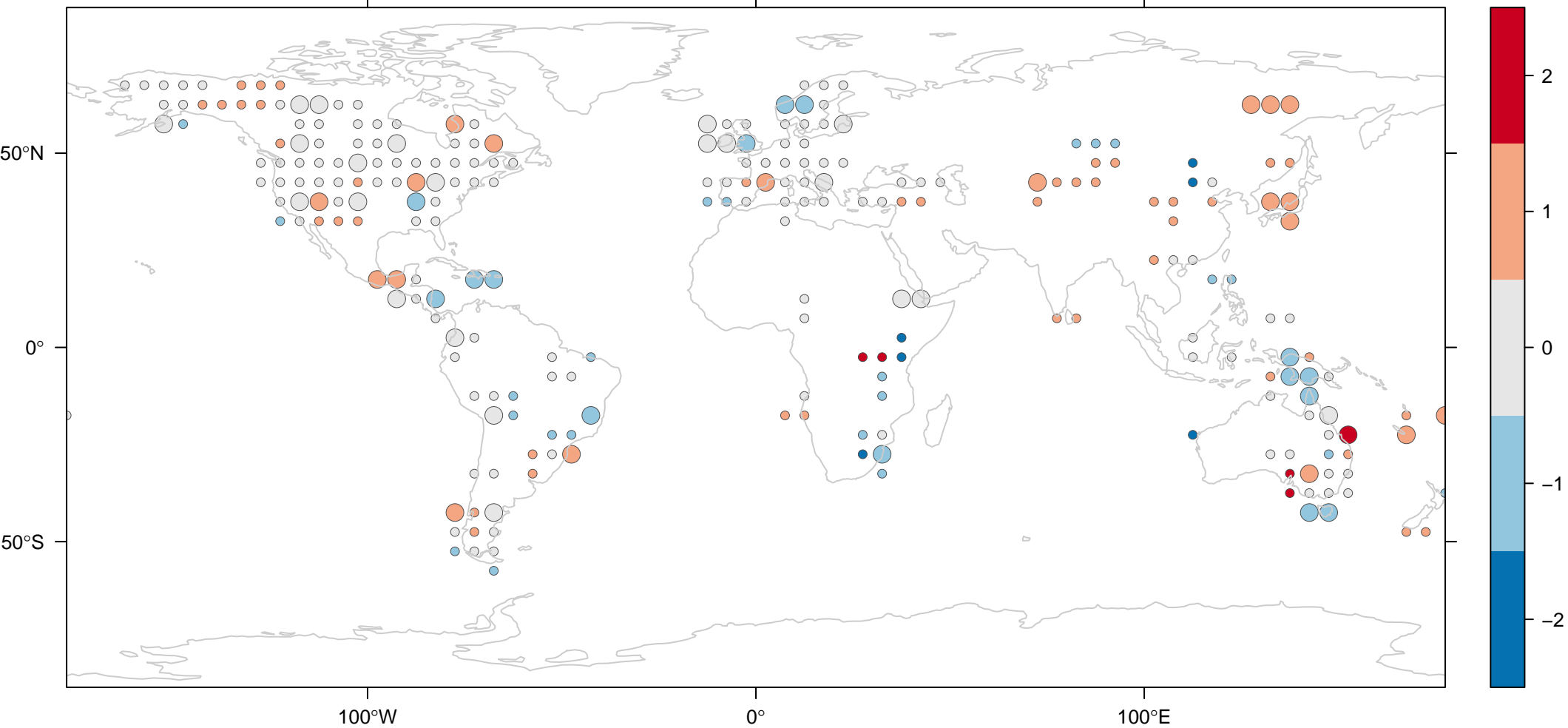
Number of sites per grid cell
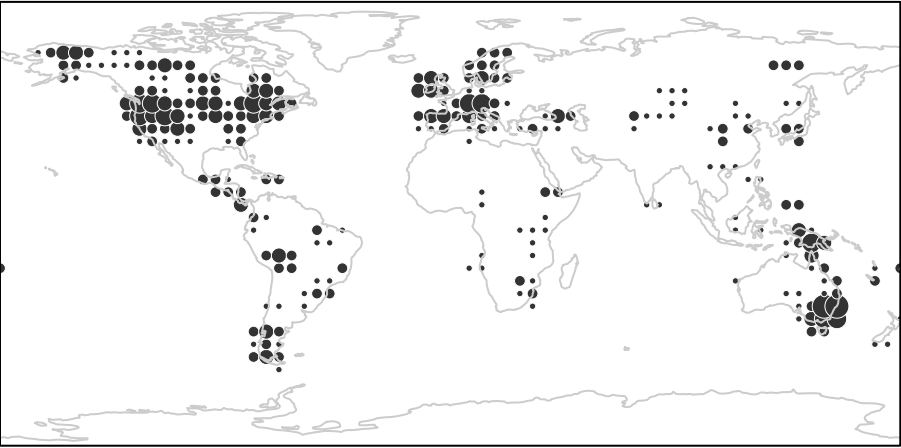
Number of grid cells influenced by each site
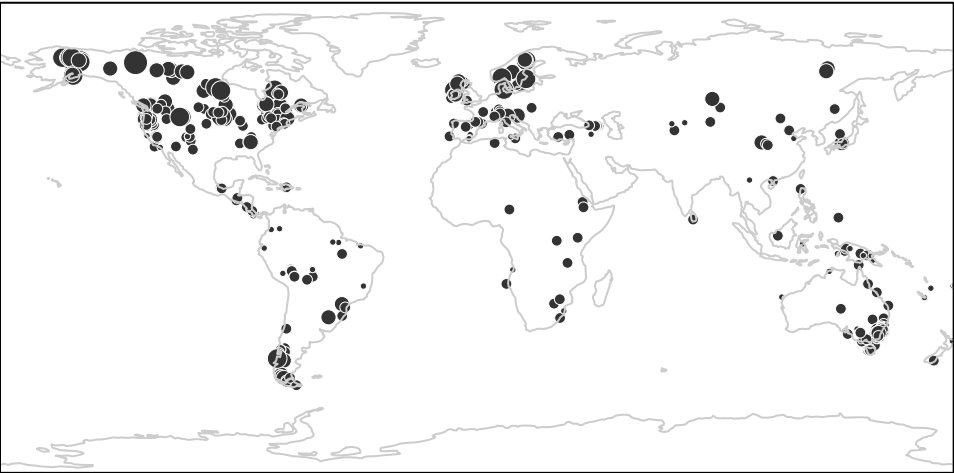
Charcoal Influx z–Scores: 600–700 BP
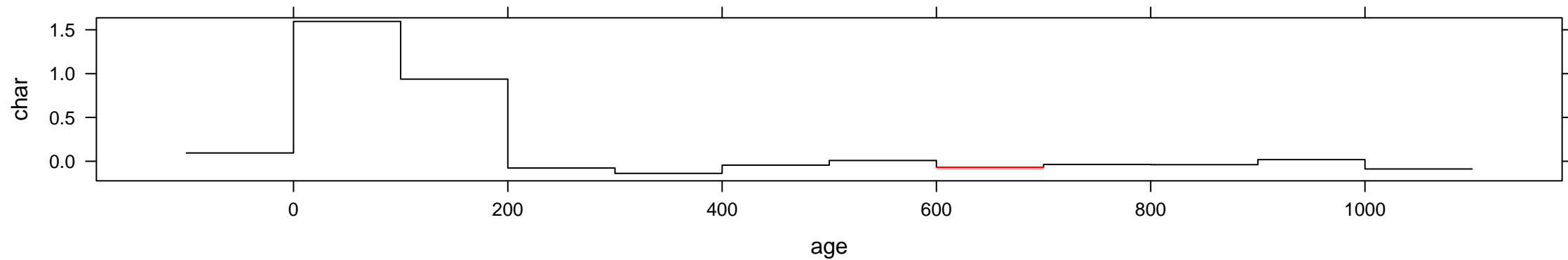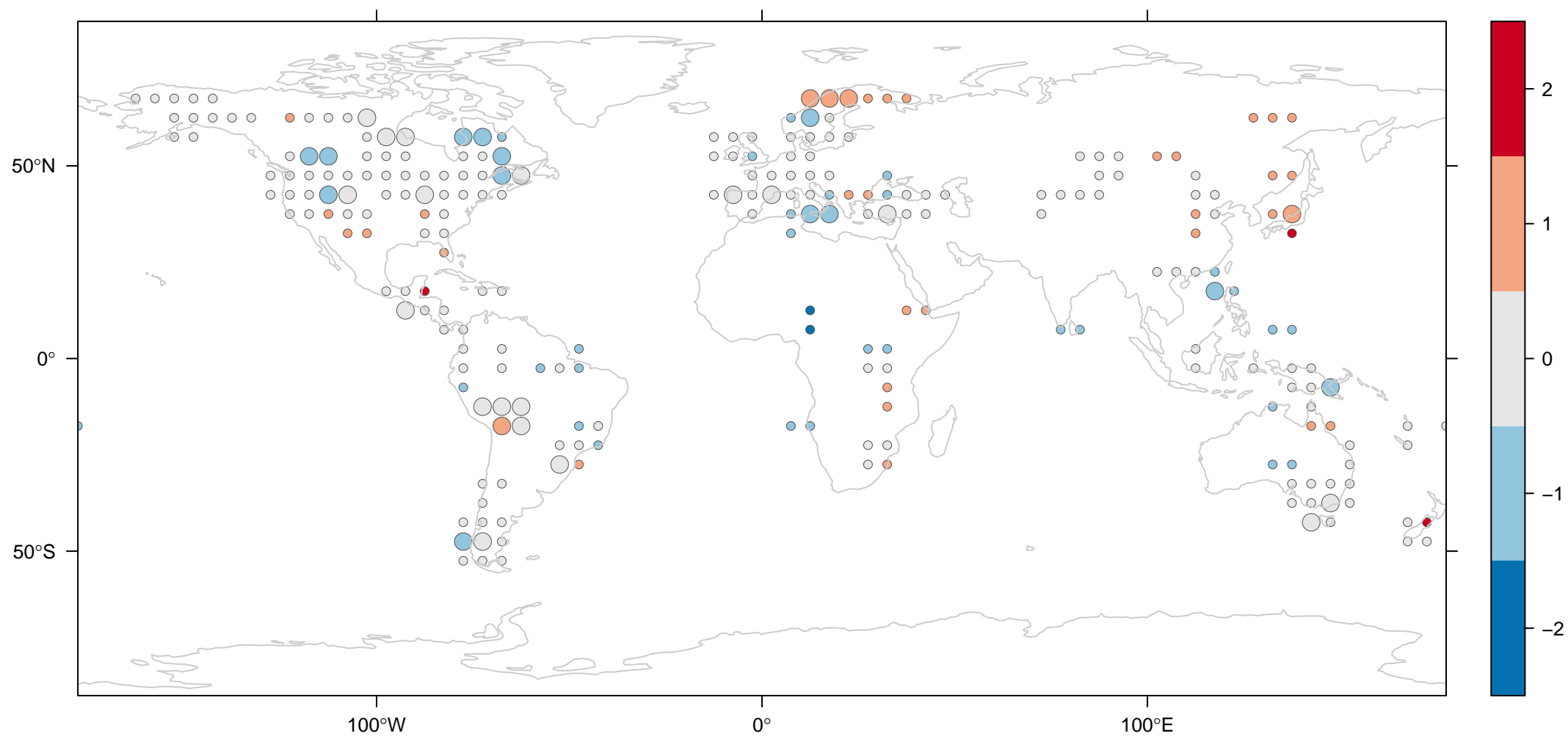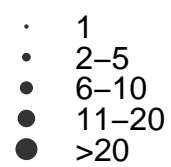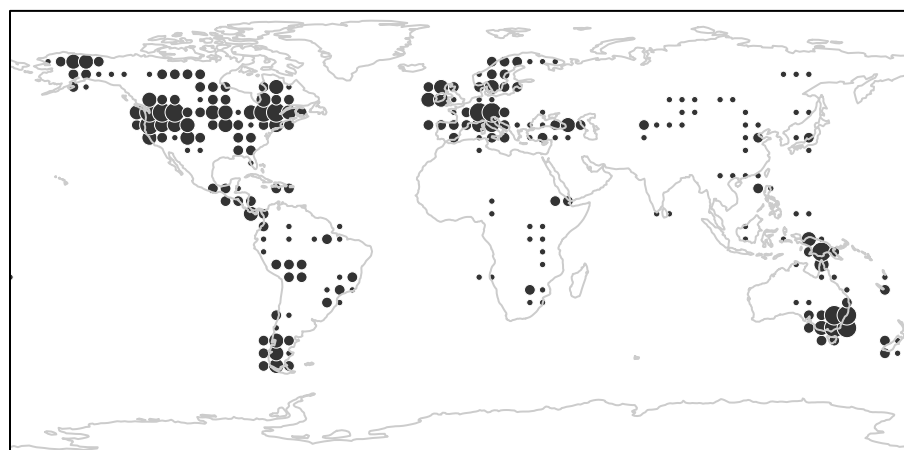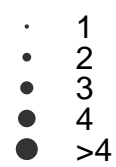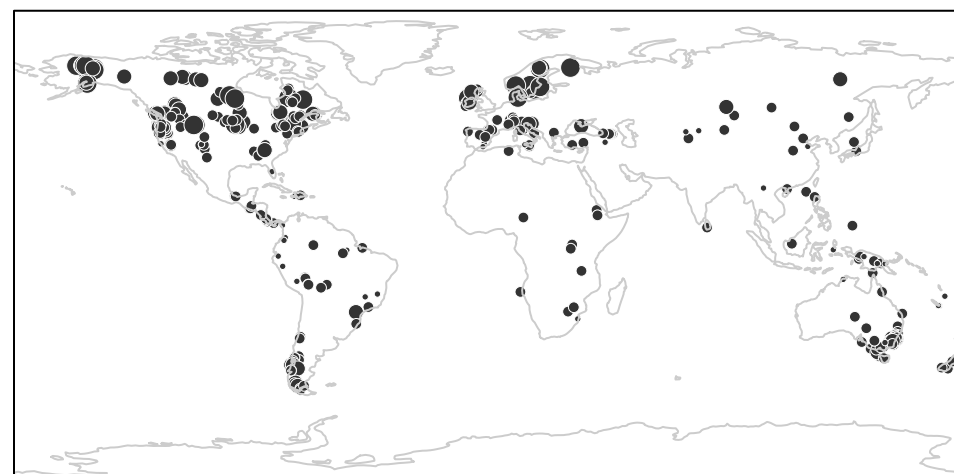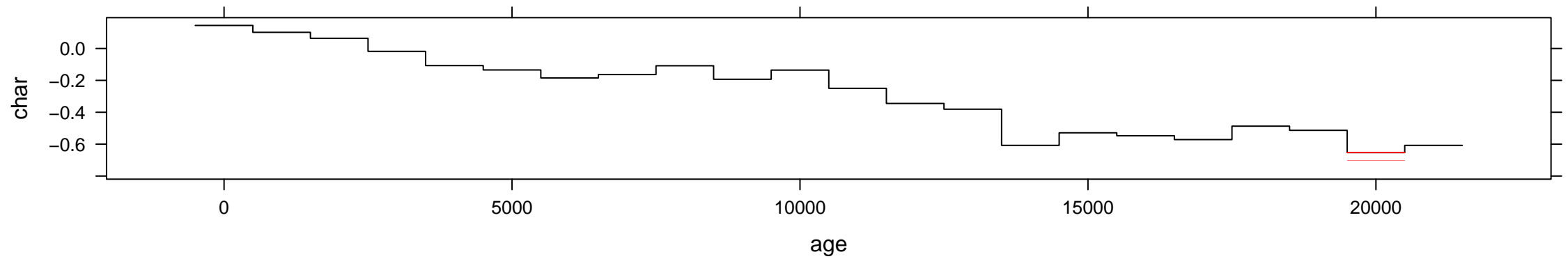
Charcoal Influx z−Scores: 700−800 BP
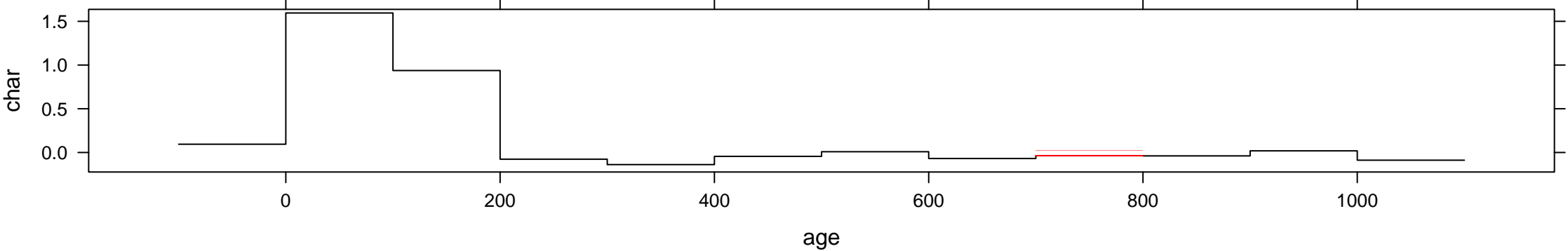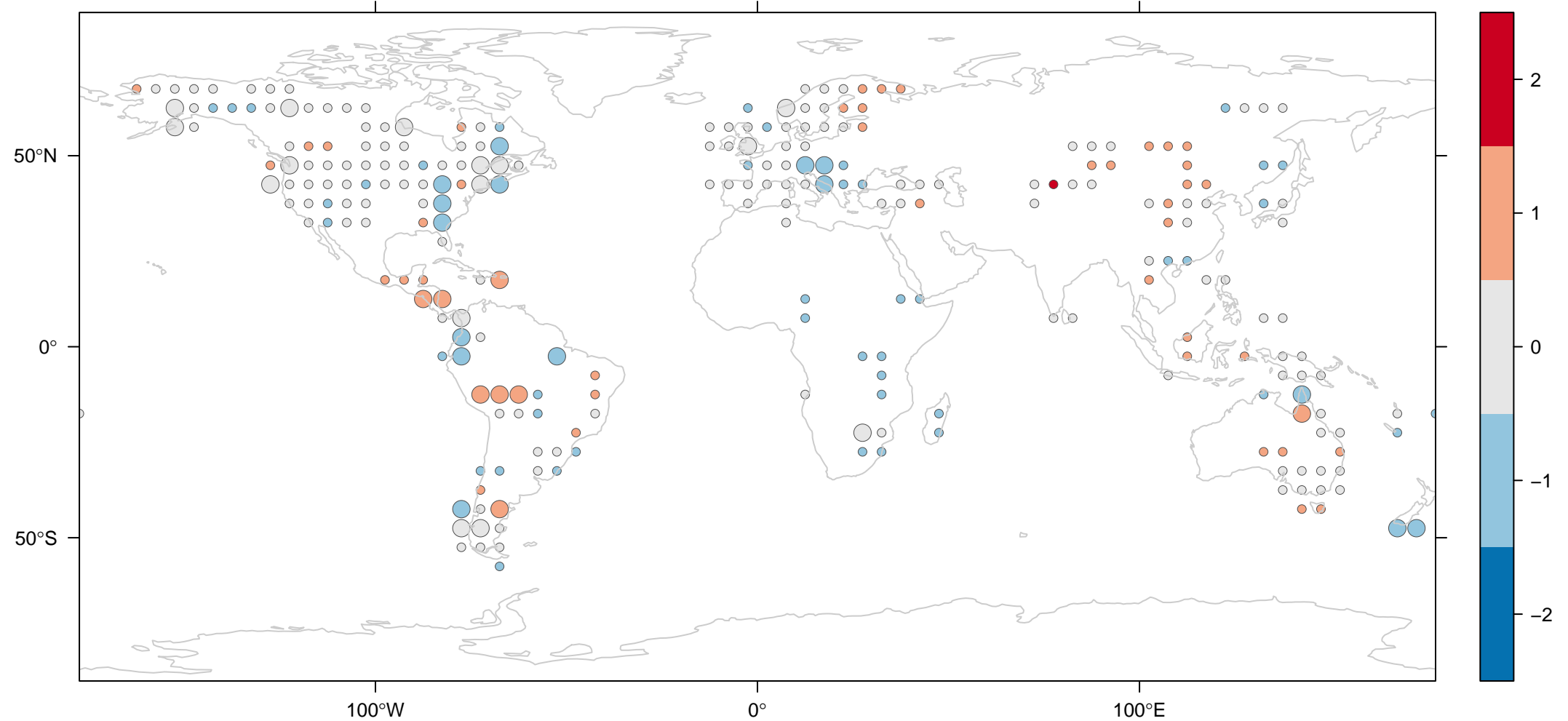
Number of sites per grid cell
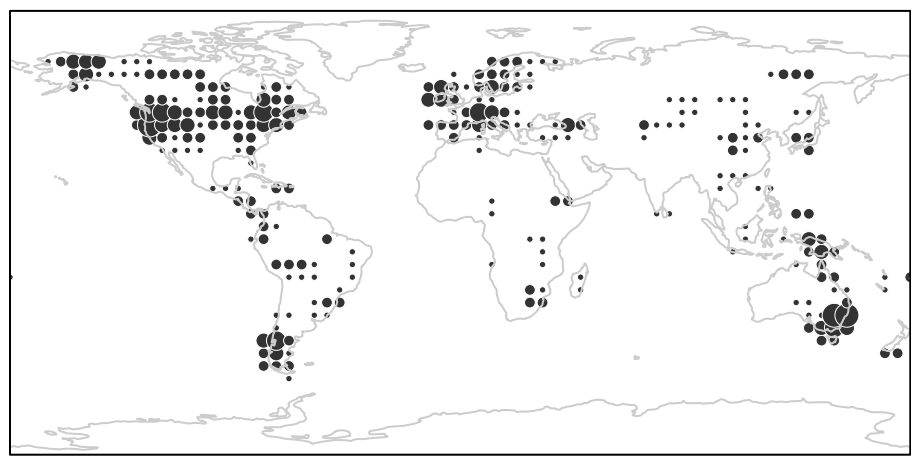
Number of grid cells influenced by each site
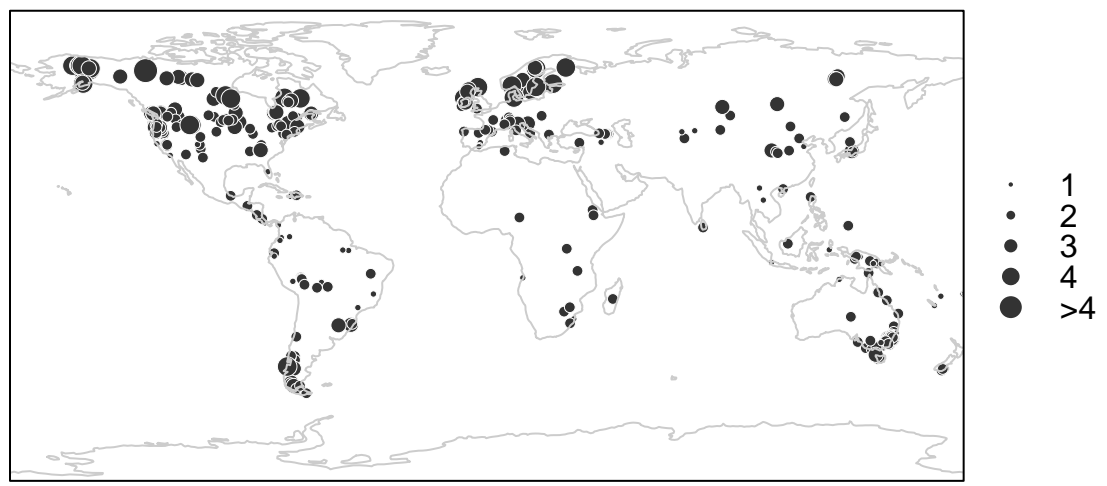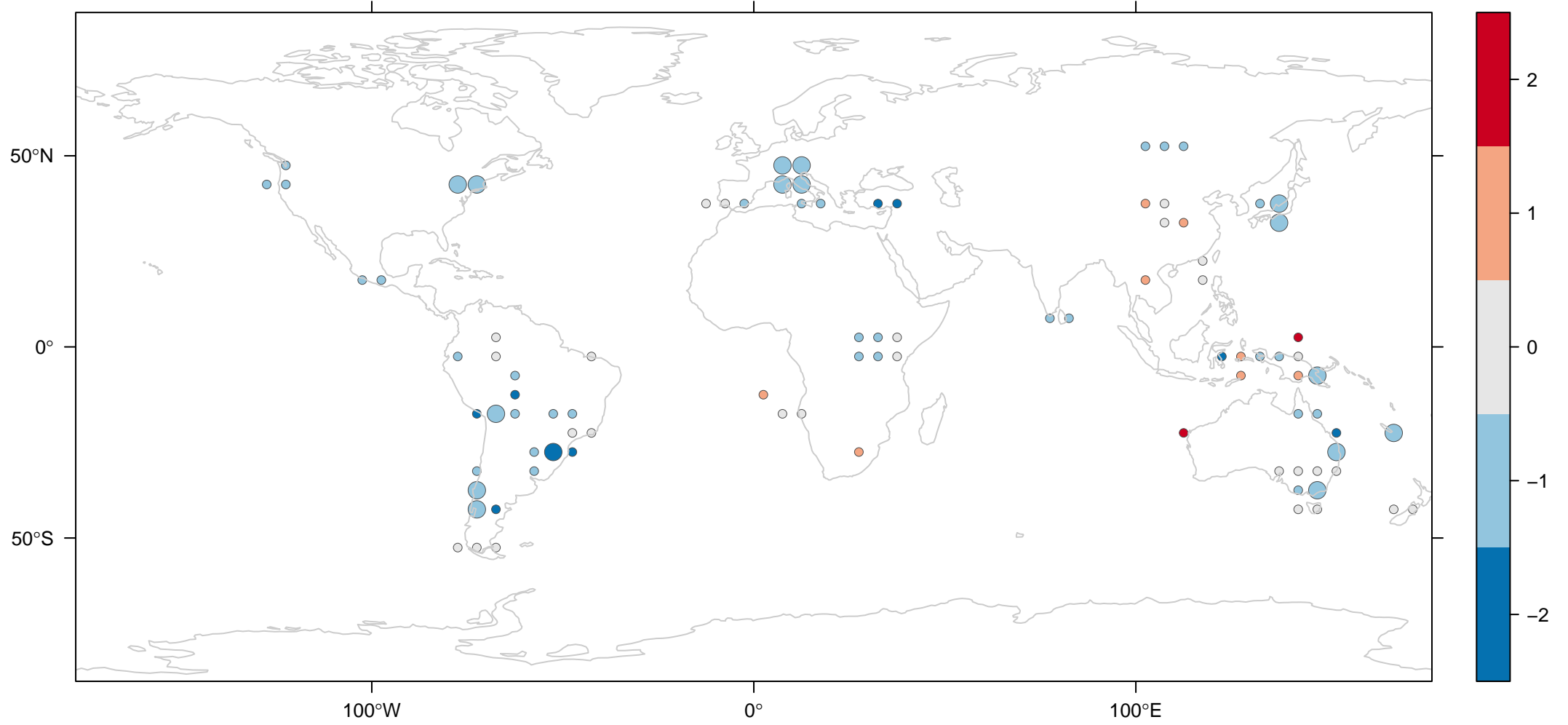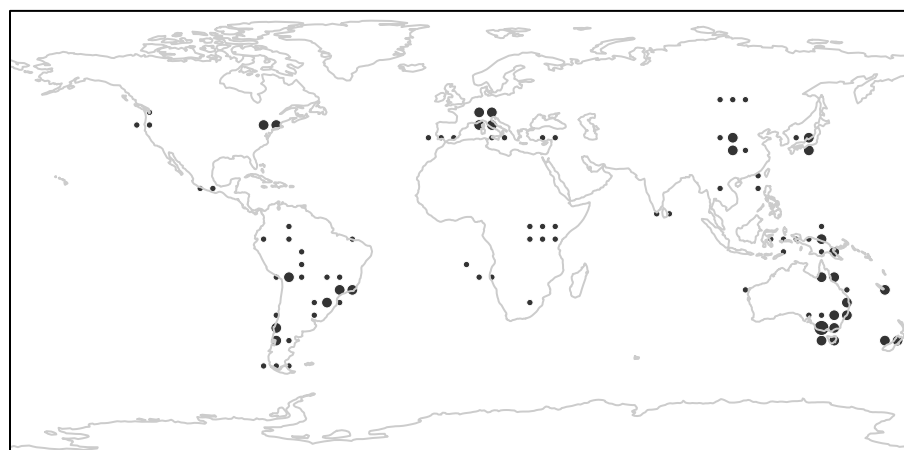
Charcoal Influx z−Scores: 800−900 BP
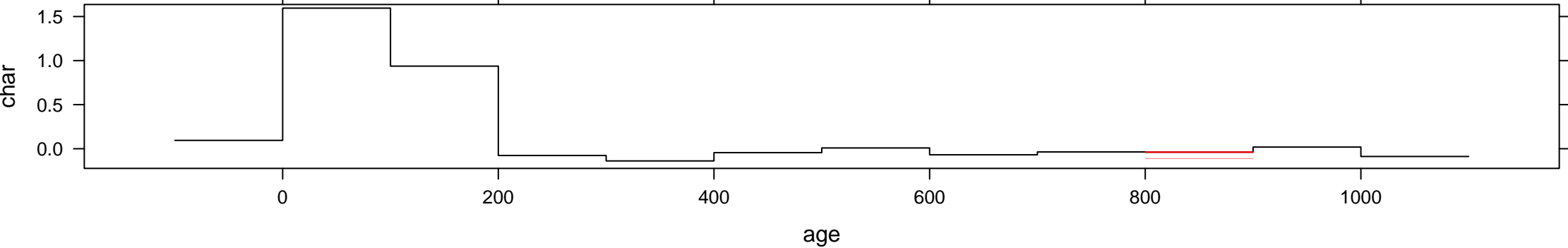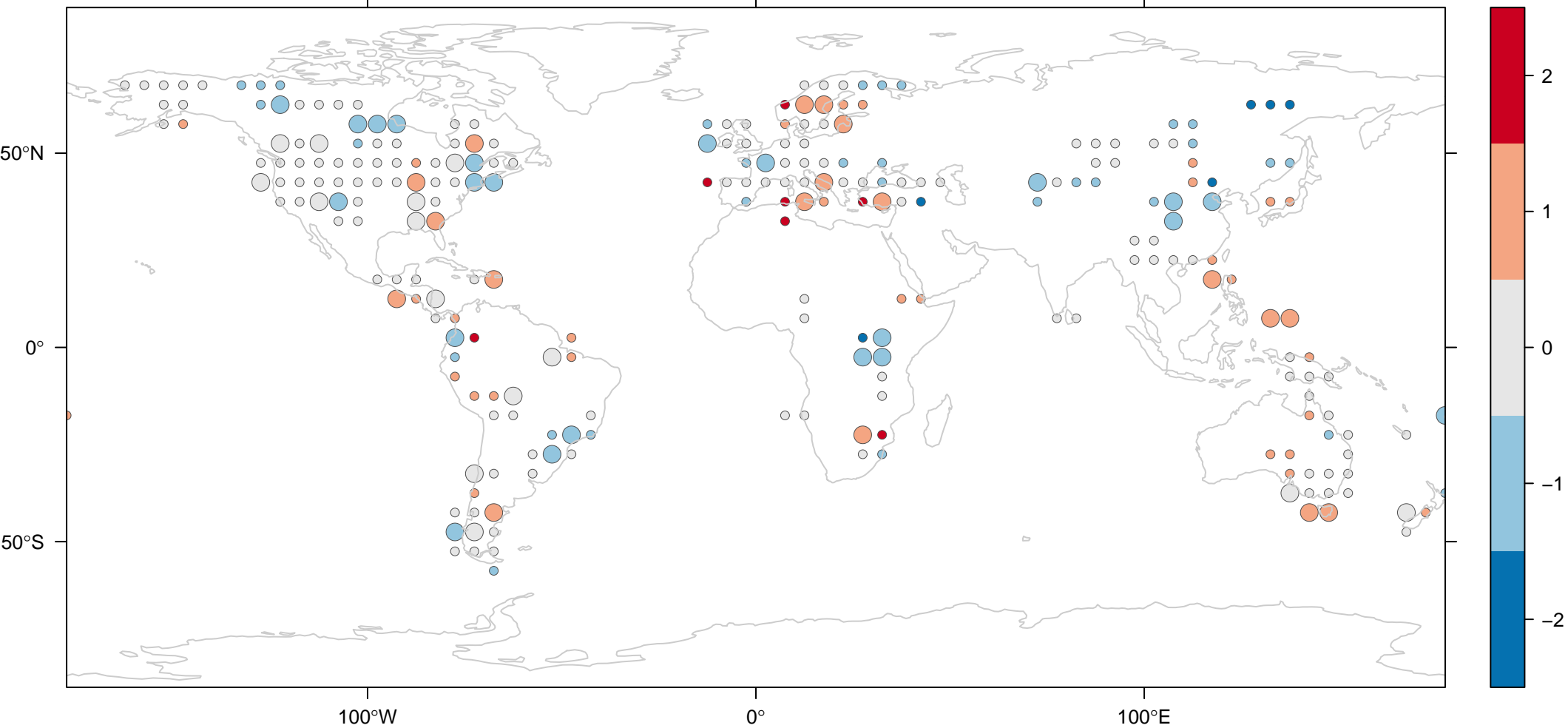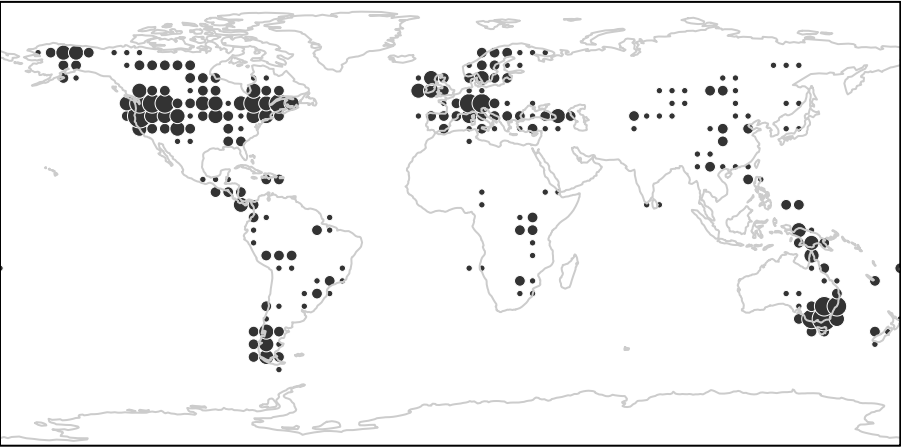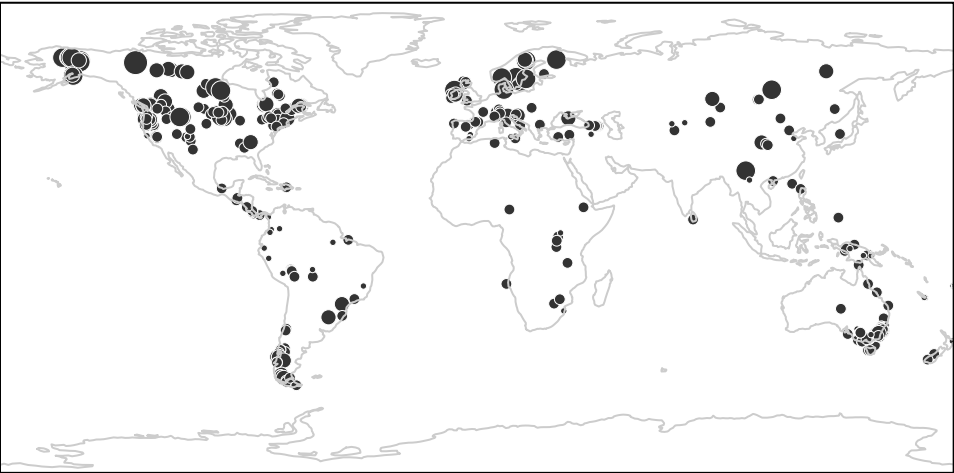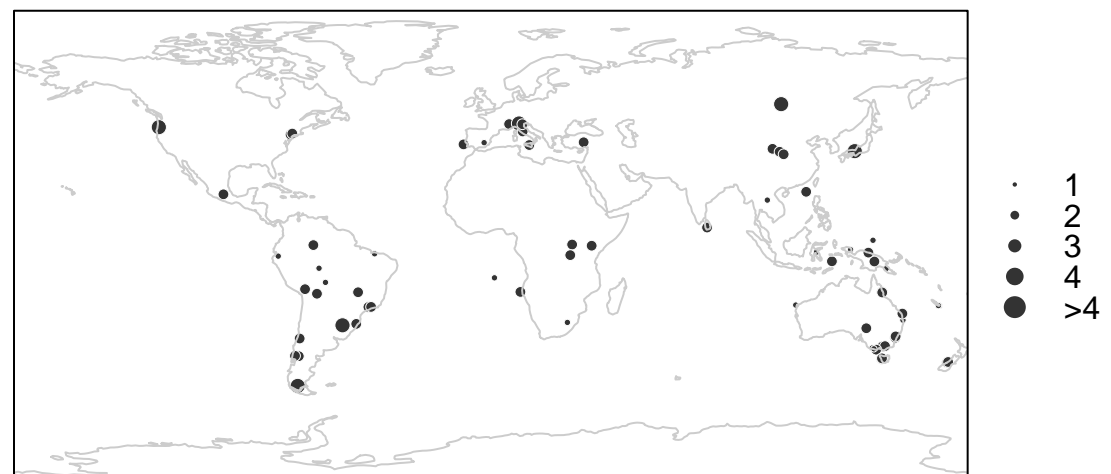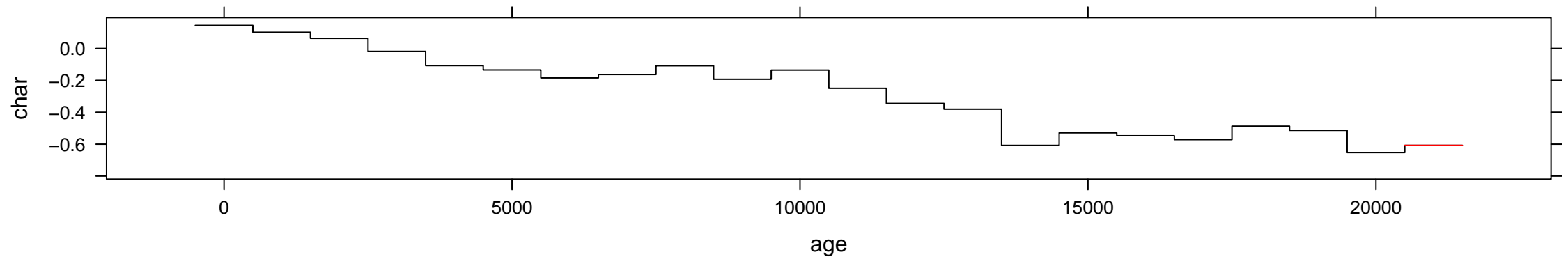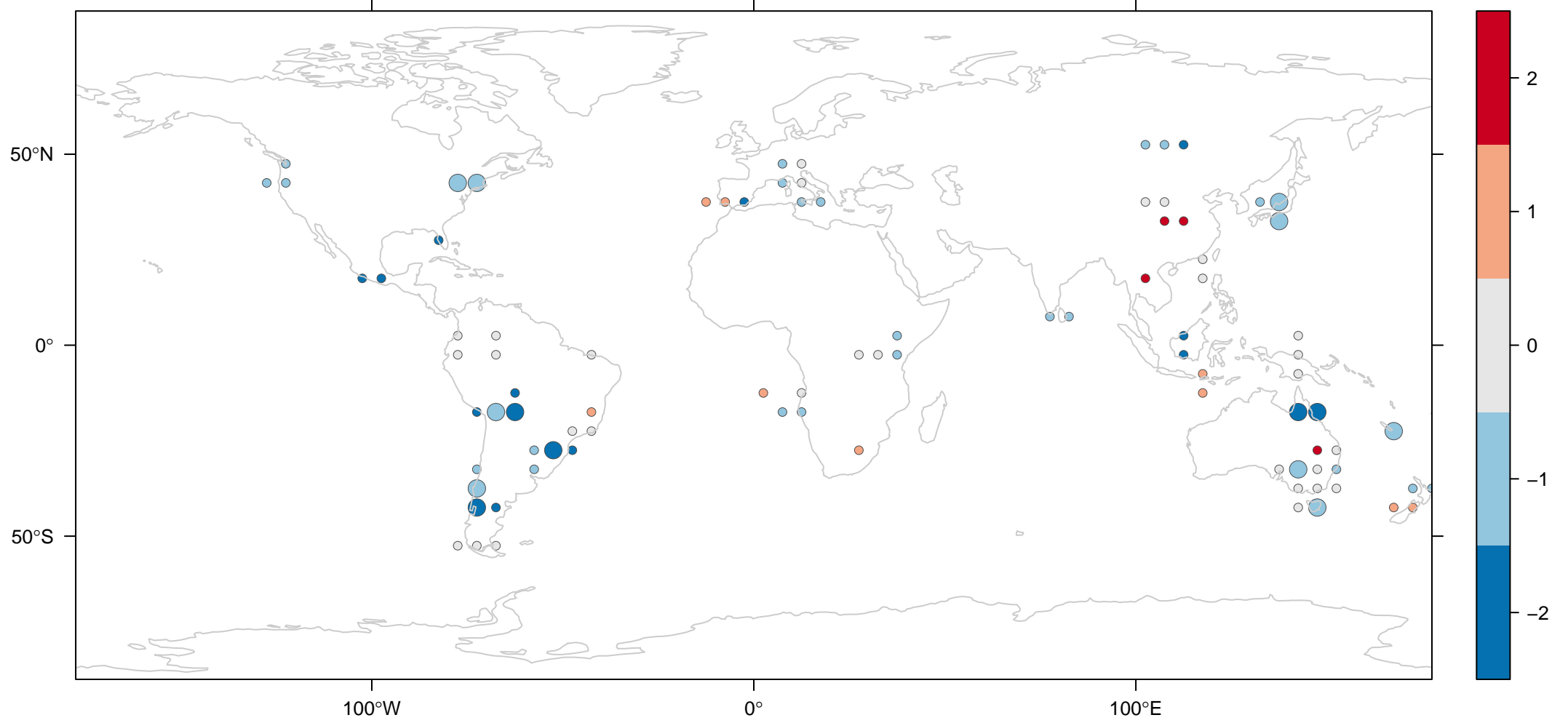
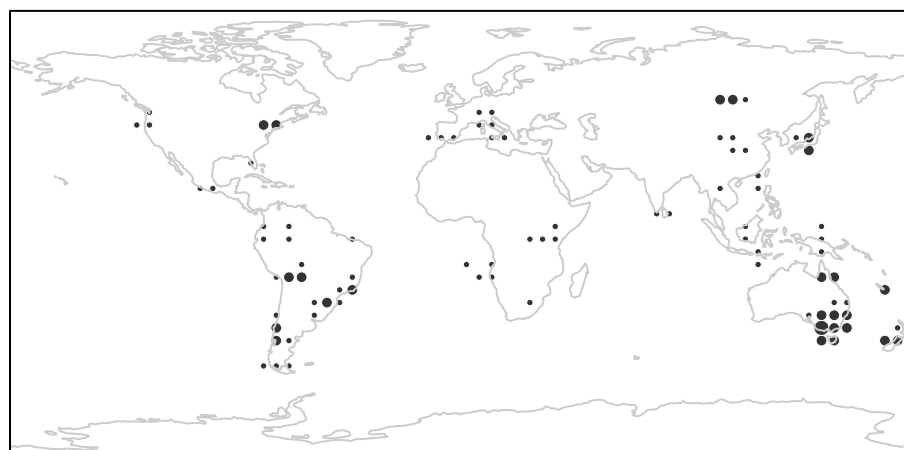Charcoal Influx z−Scores: 900−1000 BP
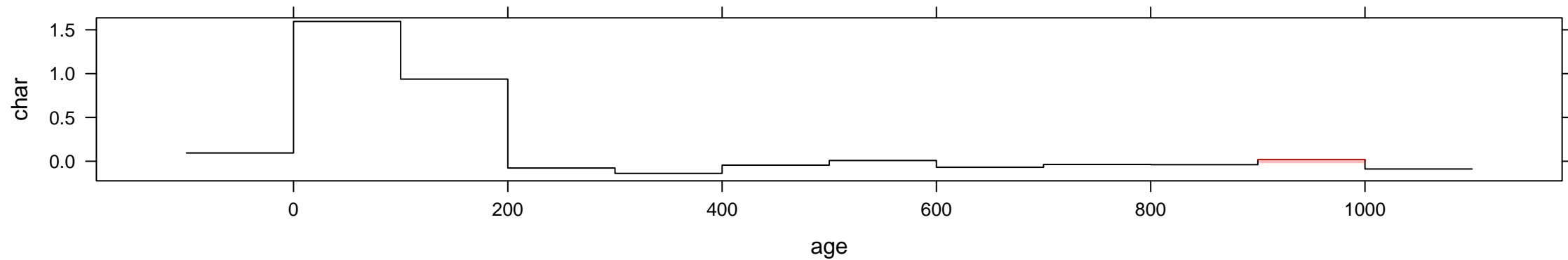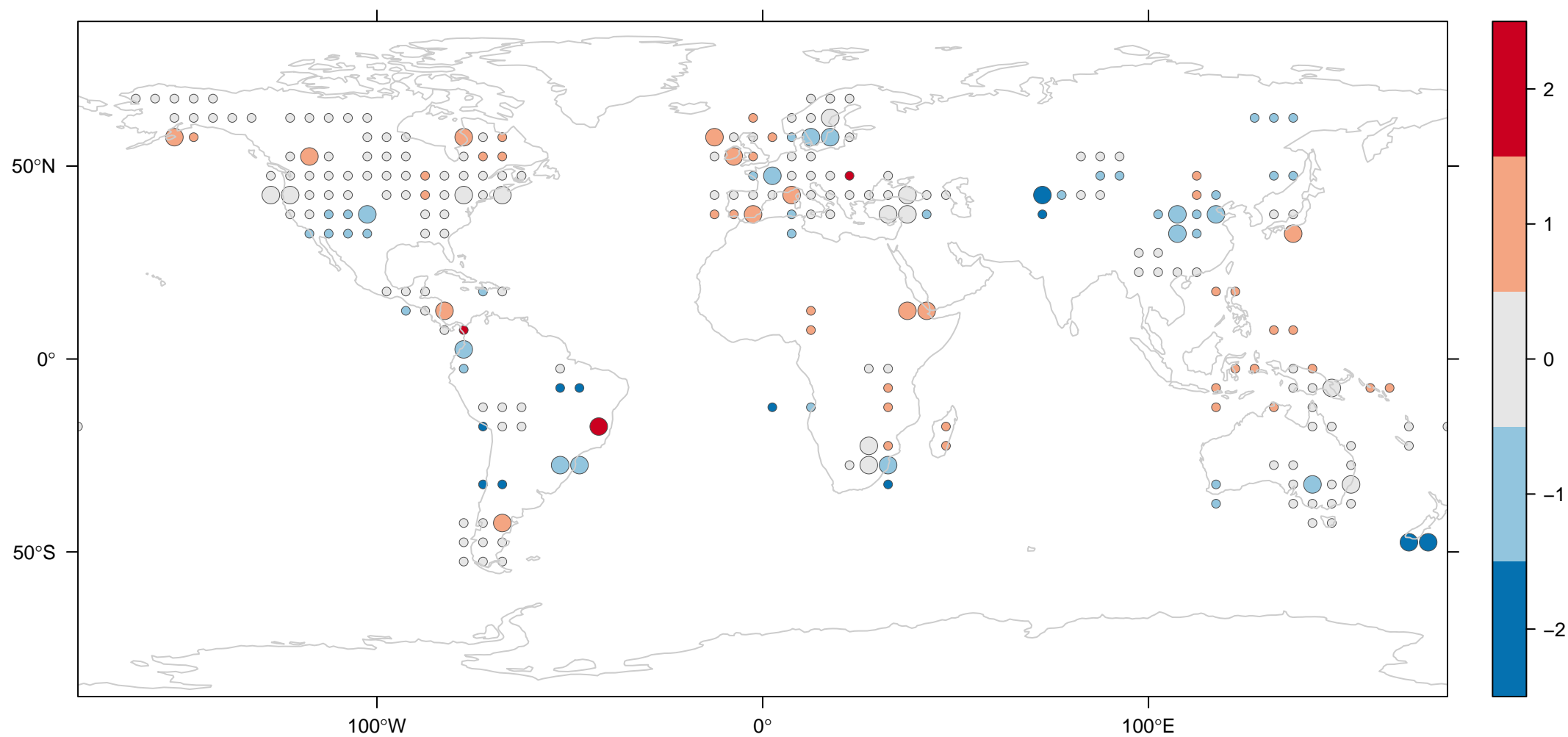
Number of sites per grid cell
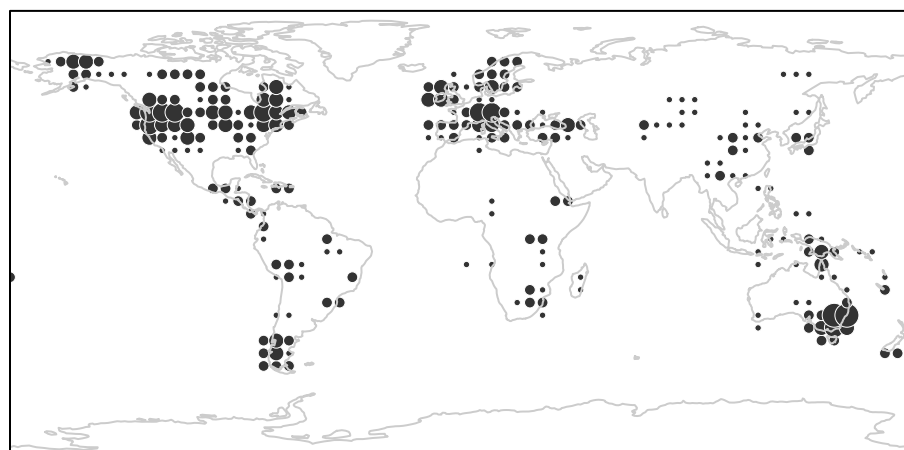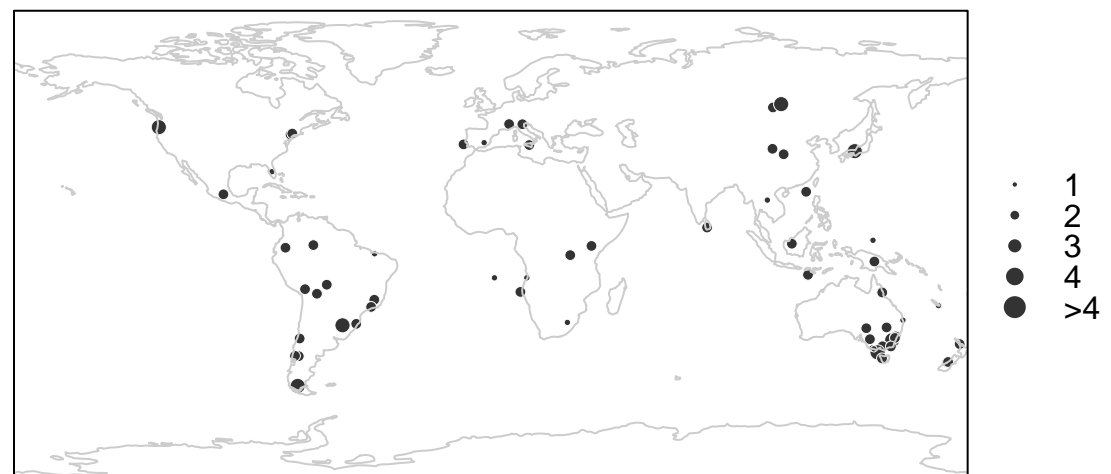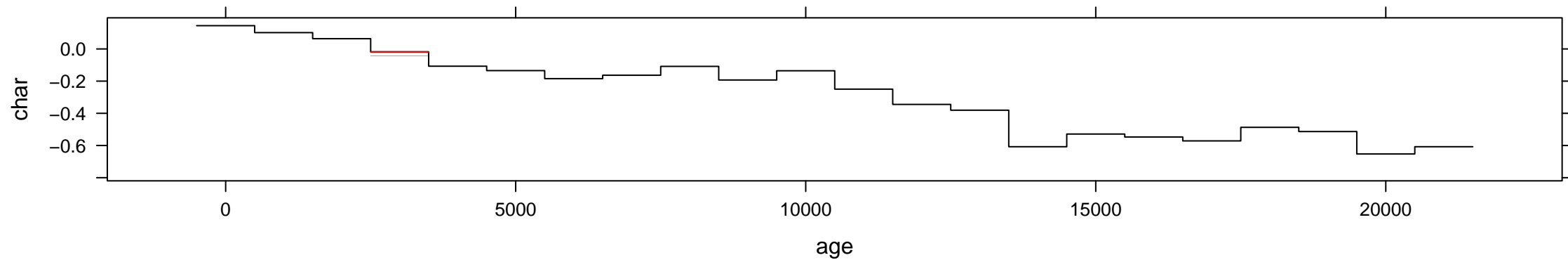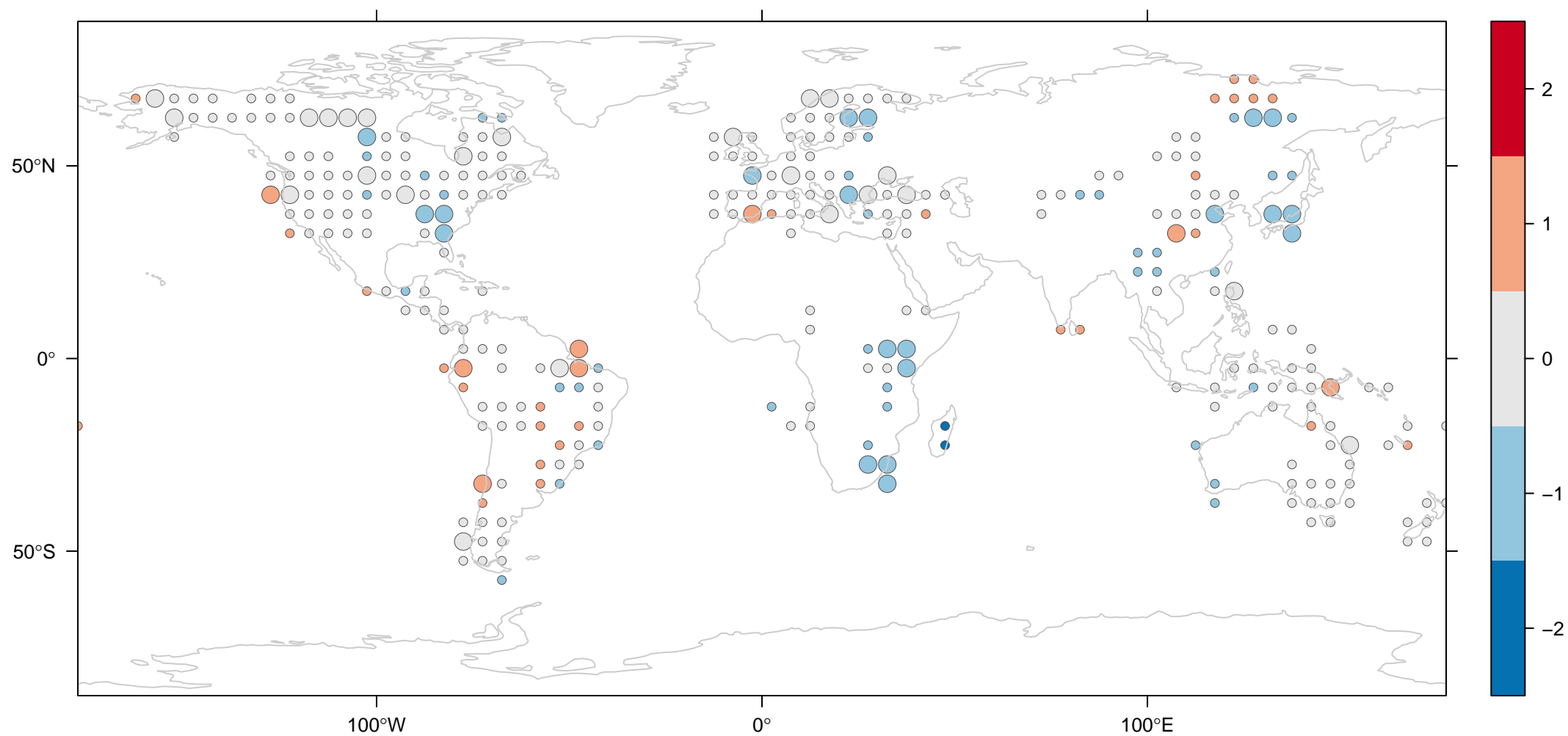
Number of grid cells influenced by each site
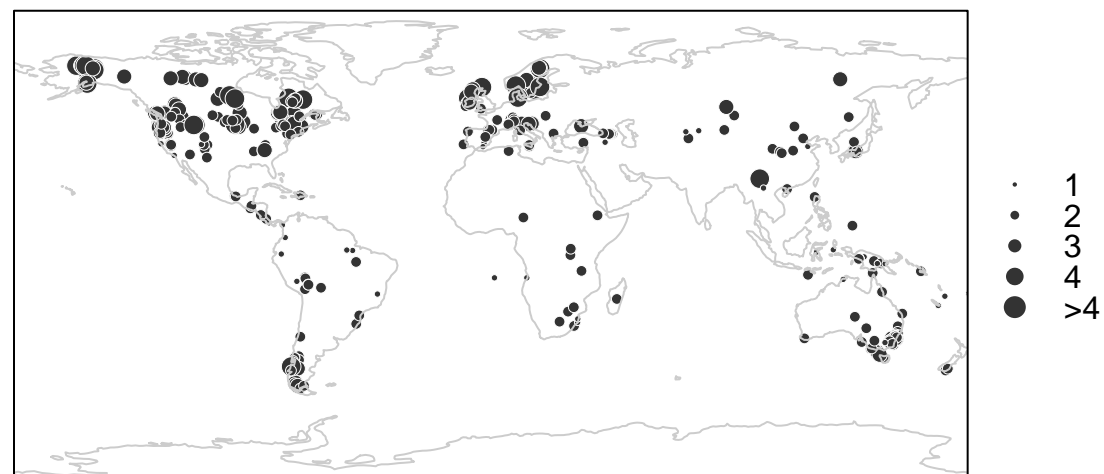
Charcoal Influx z−Scores: −500–500 BP
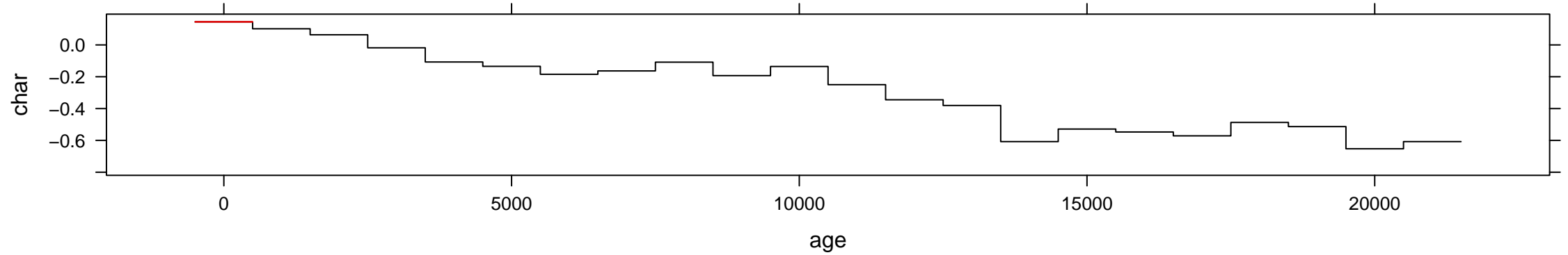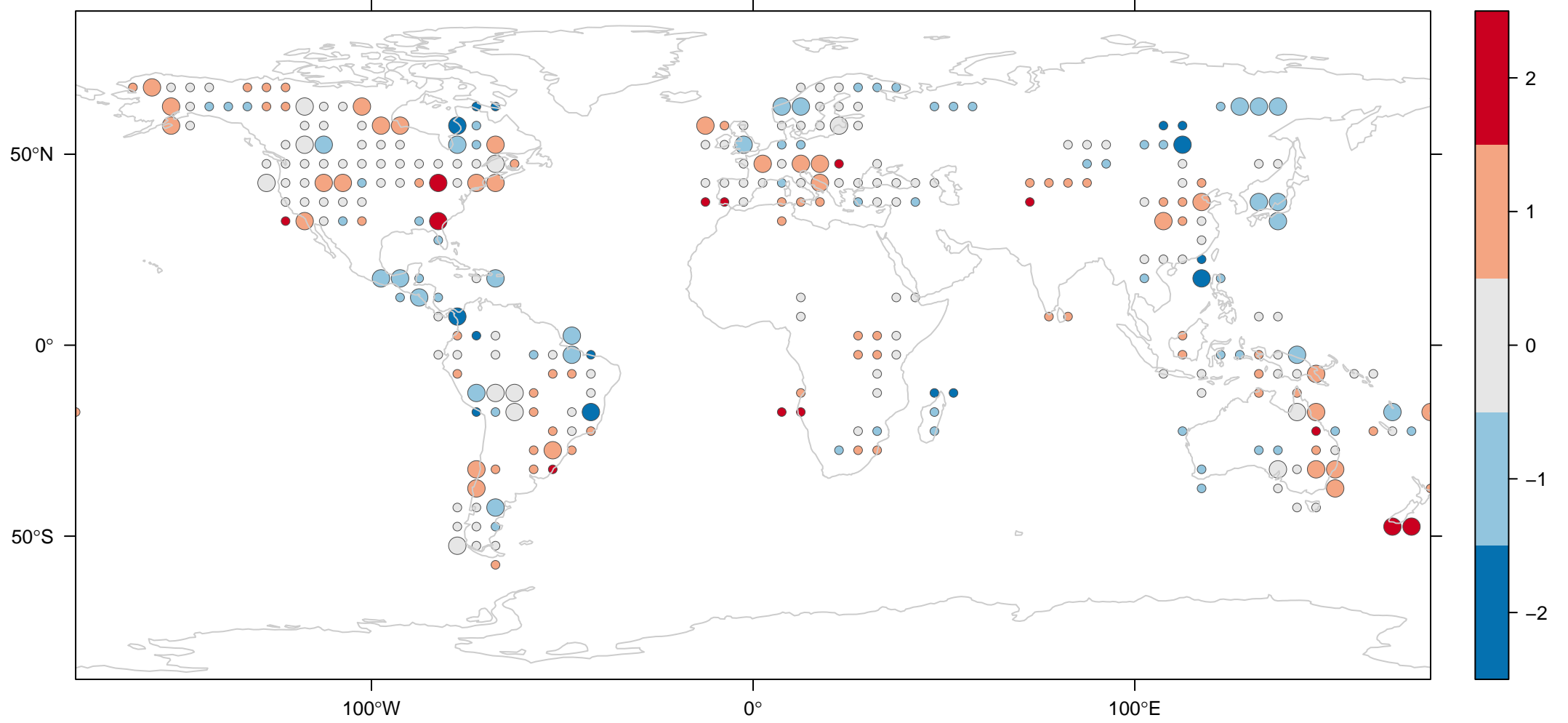
Number of sites per grid cell

1
2−5
6−10
11−20
>20

Number of grid cells influenced by each site

1
2
3
4
>4
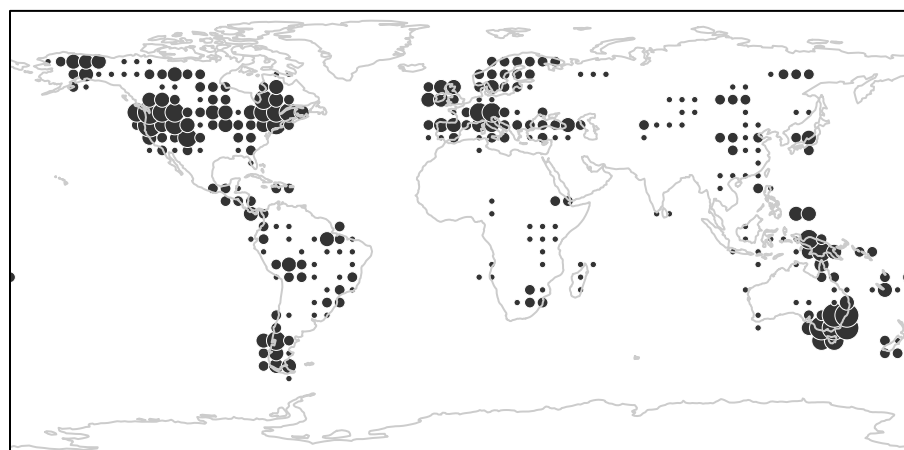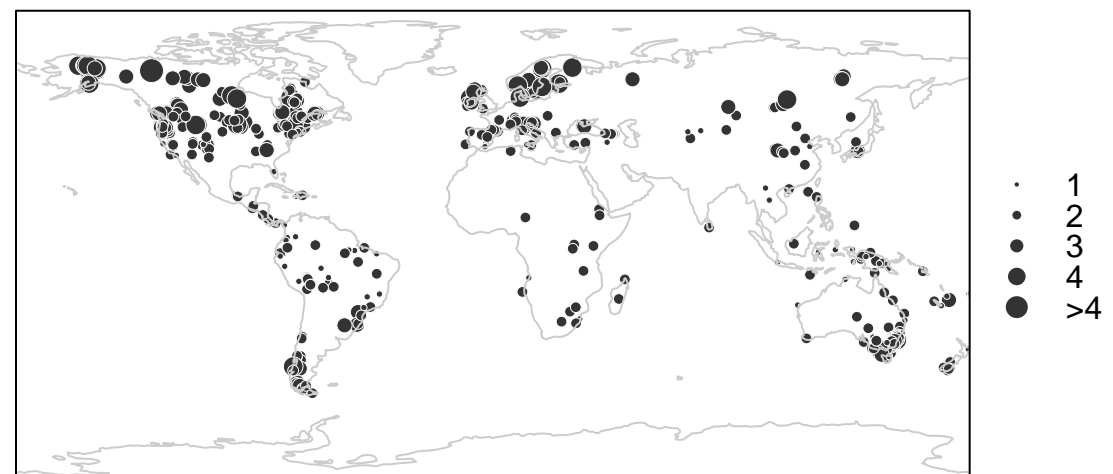
Charcoal Influx z−Scores: 10500−11500 BP
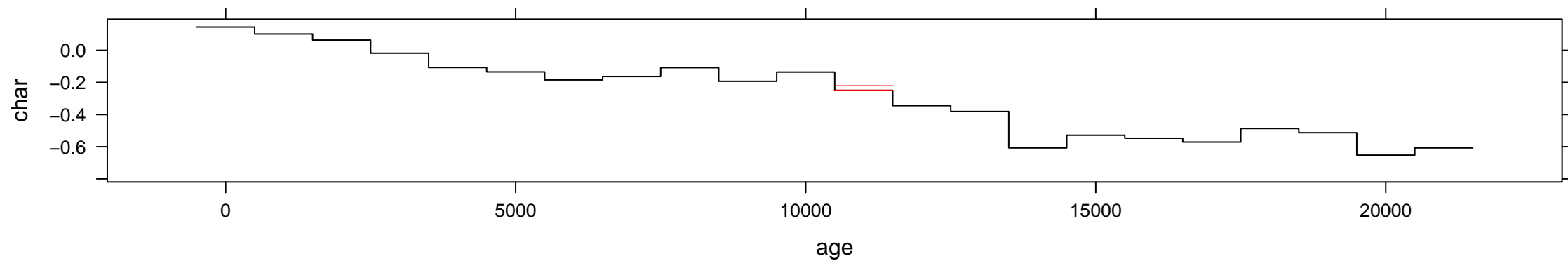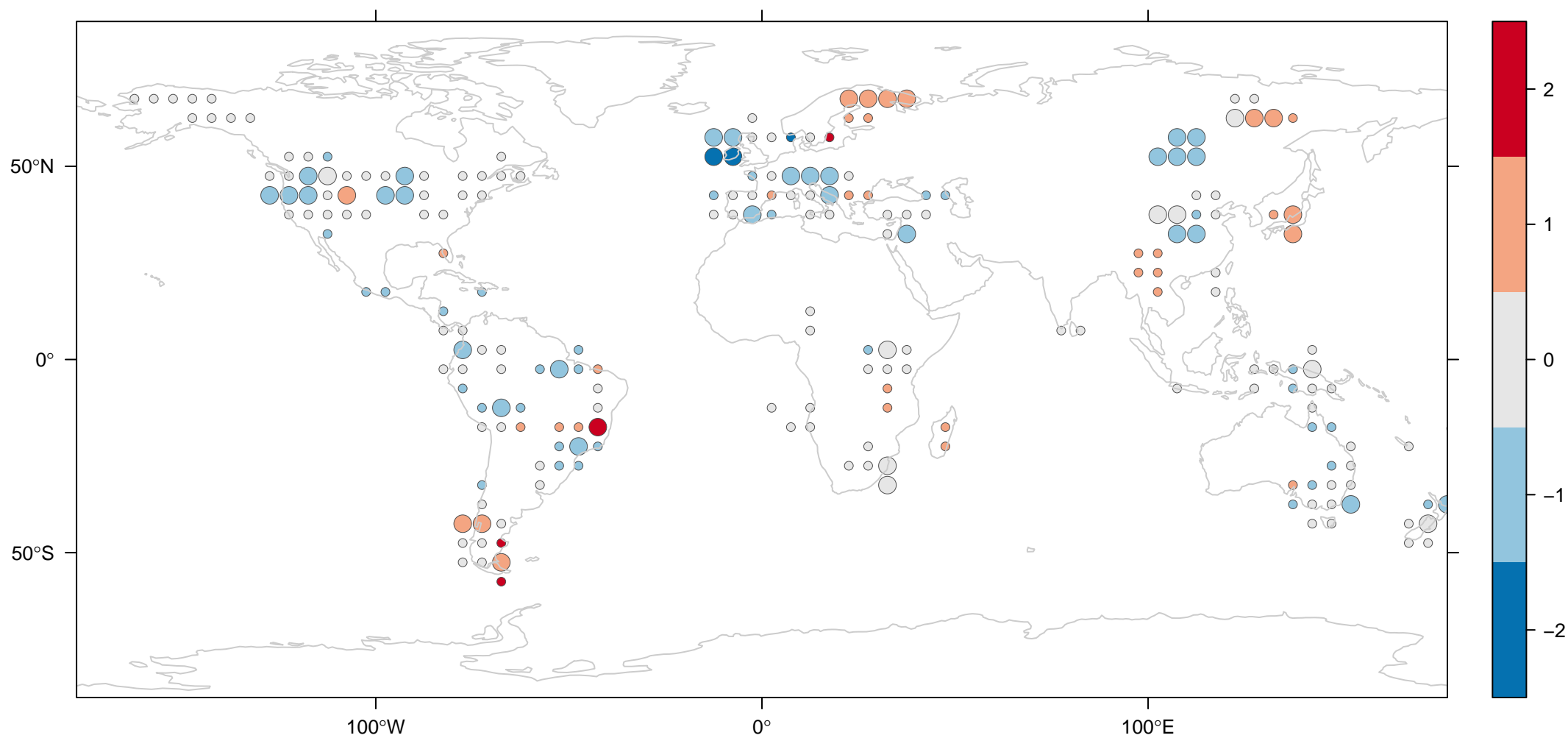
Number of sites per grid cell

1
2–5
6–10
11–20
>20

Number of grid cells influenced by each site

1
2
3
4
>4
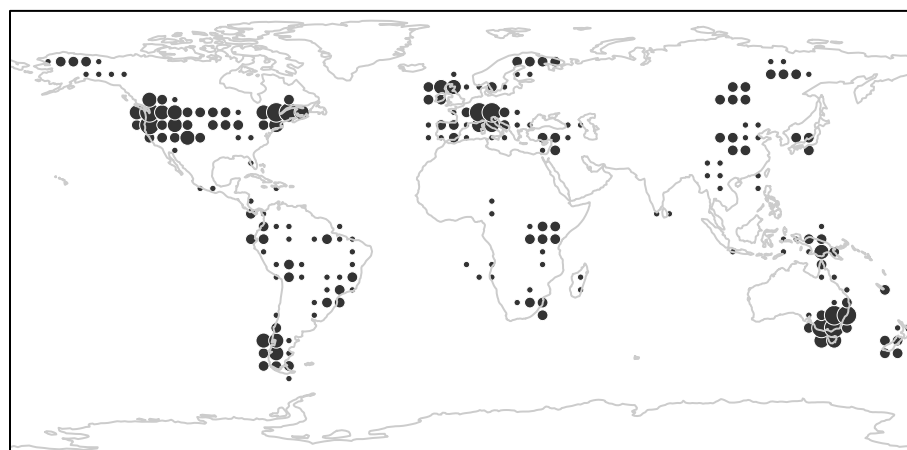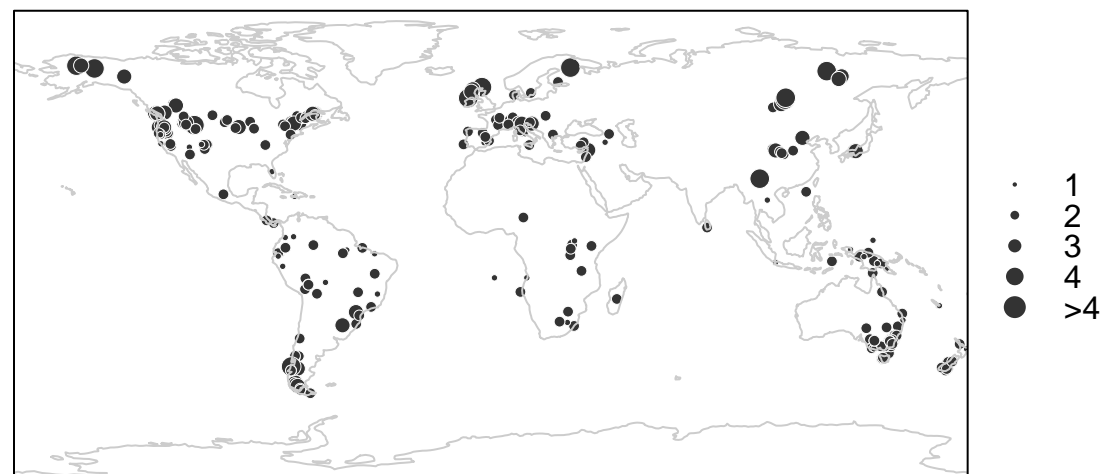
Charcoal Influx z−Scores: 11500−12500 BP
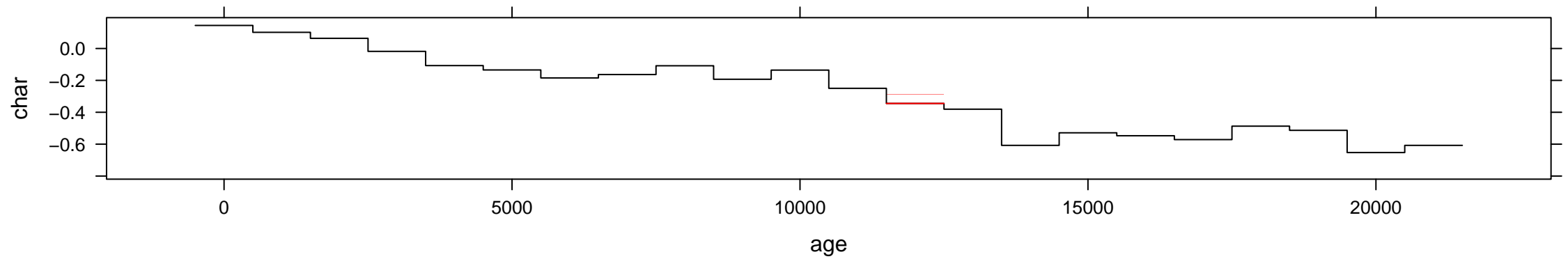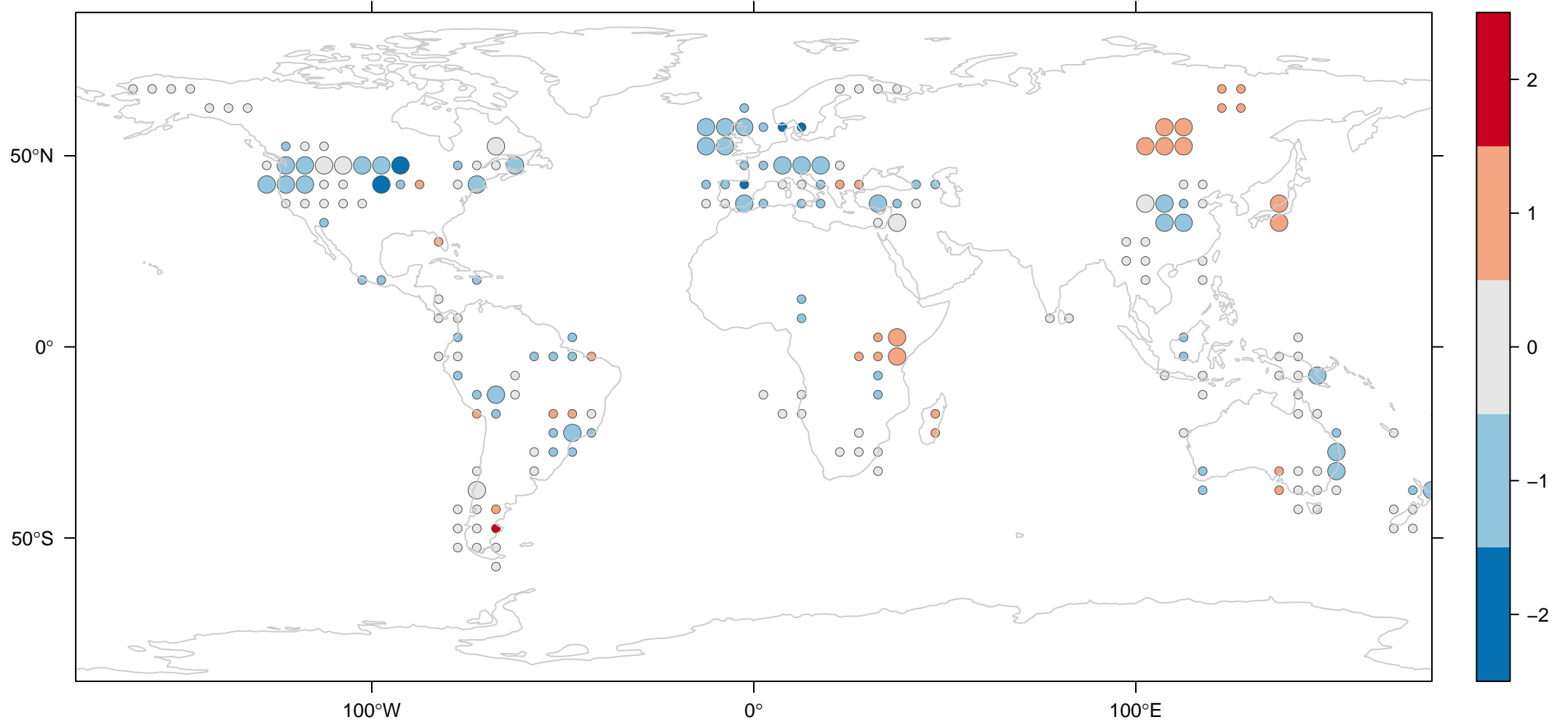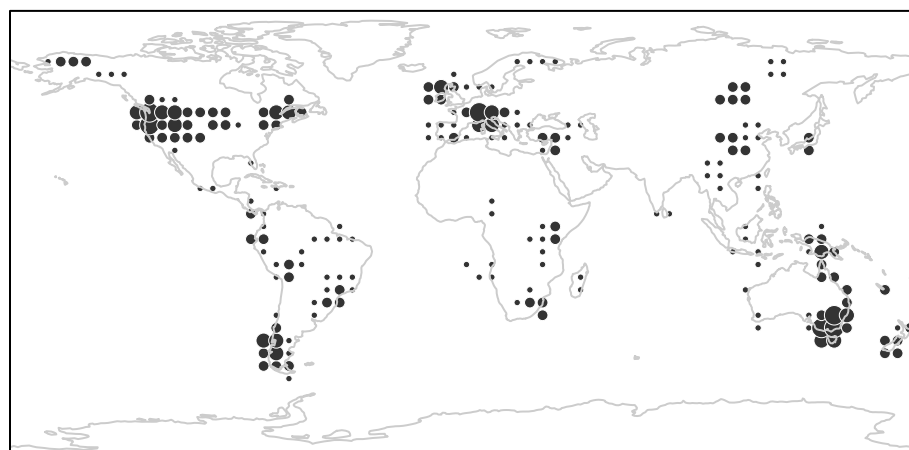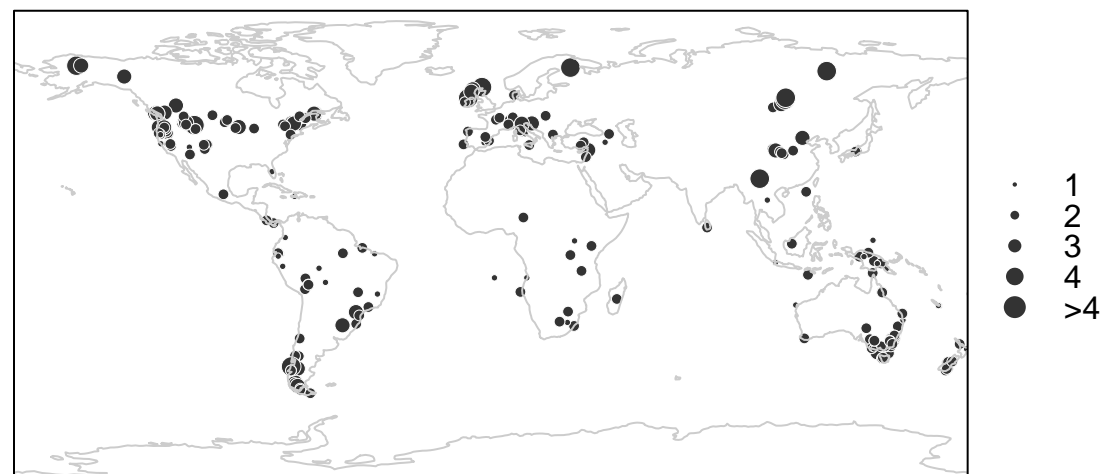
Charcoal Influx z−Scores: 12500−13500 BP
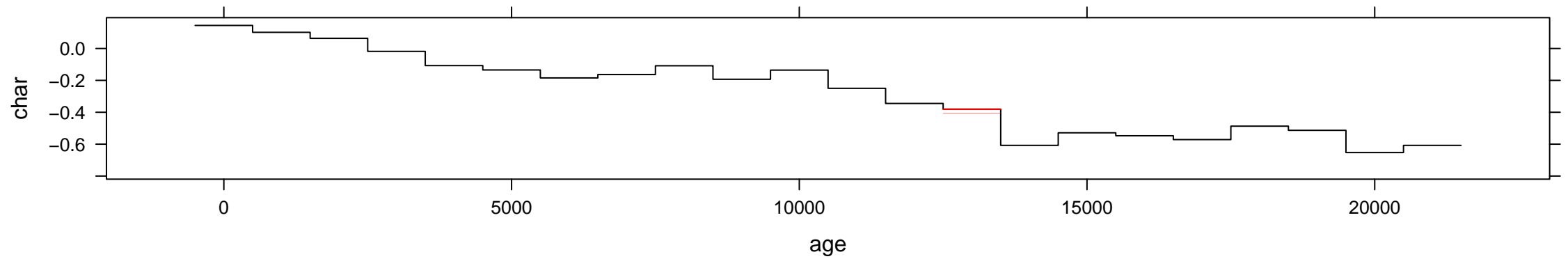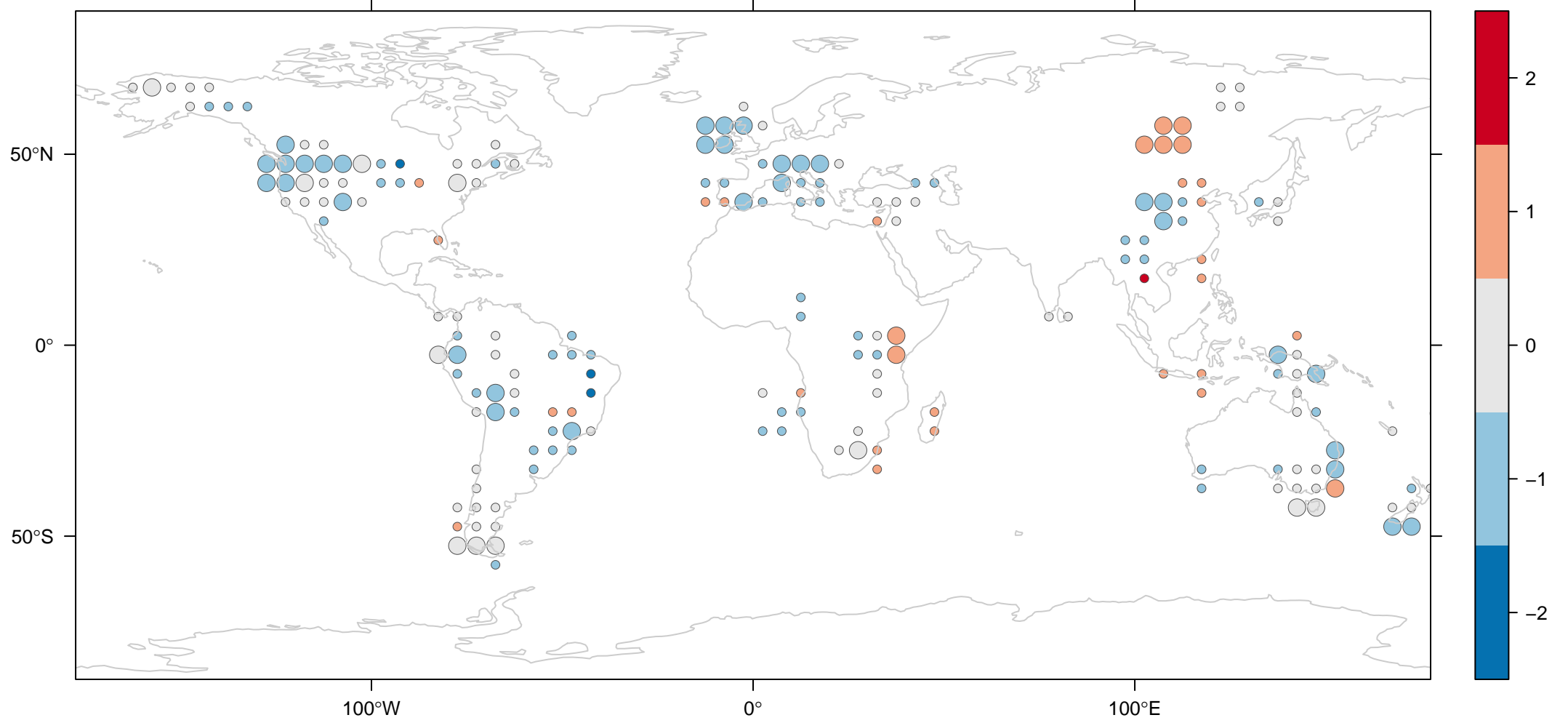
Number of sites per grid cell
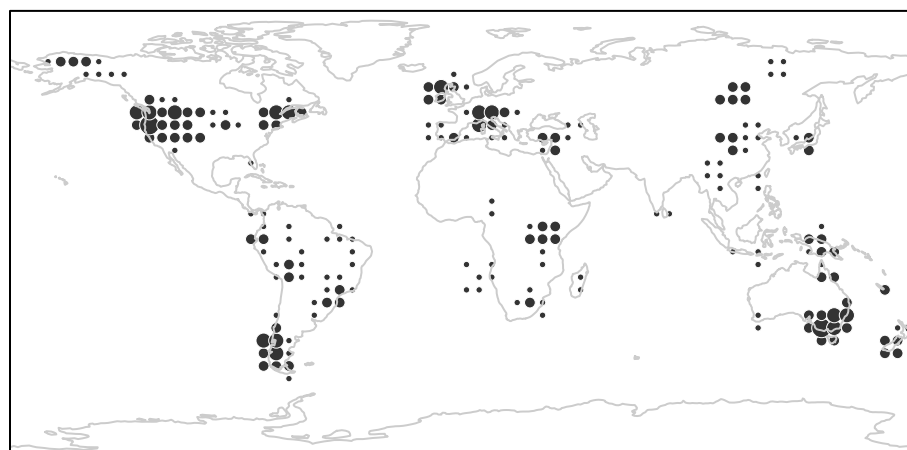
Number of grid cells influenced by each site
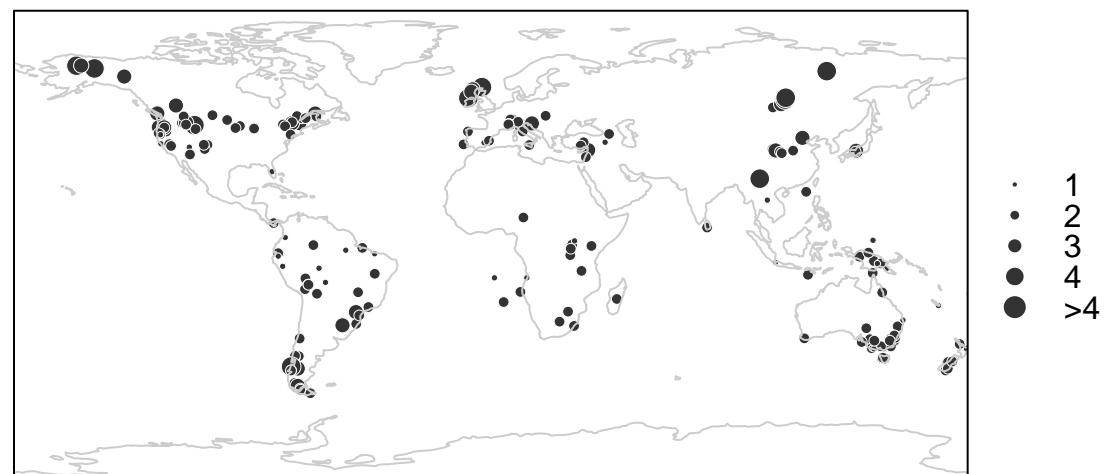
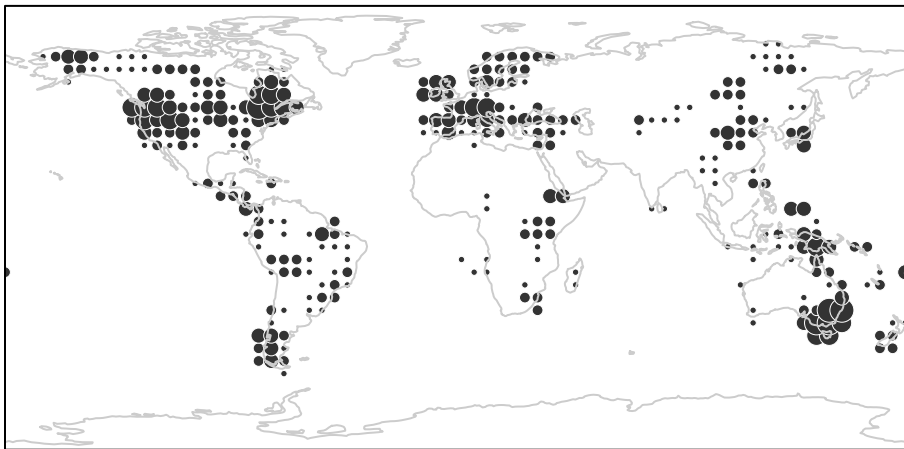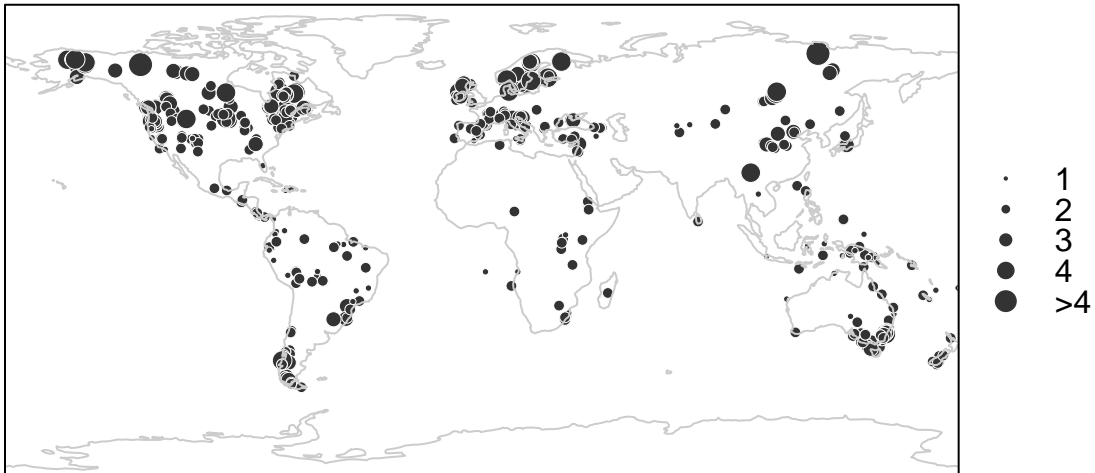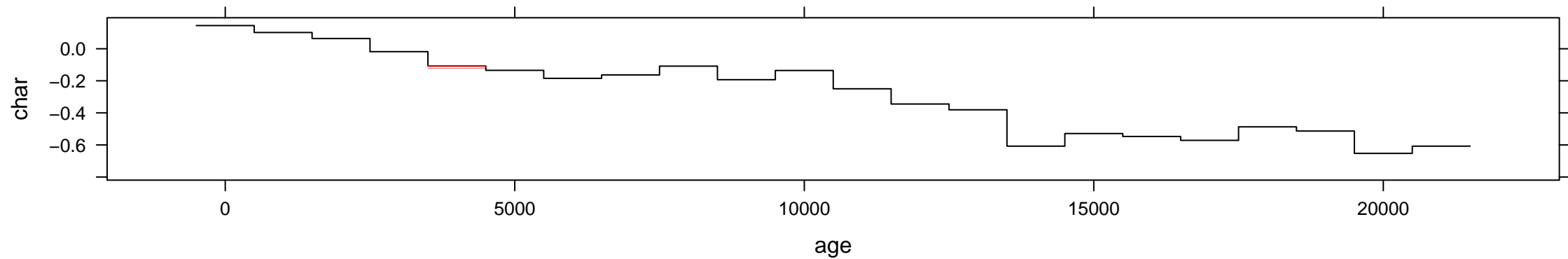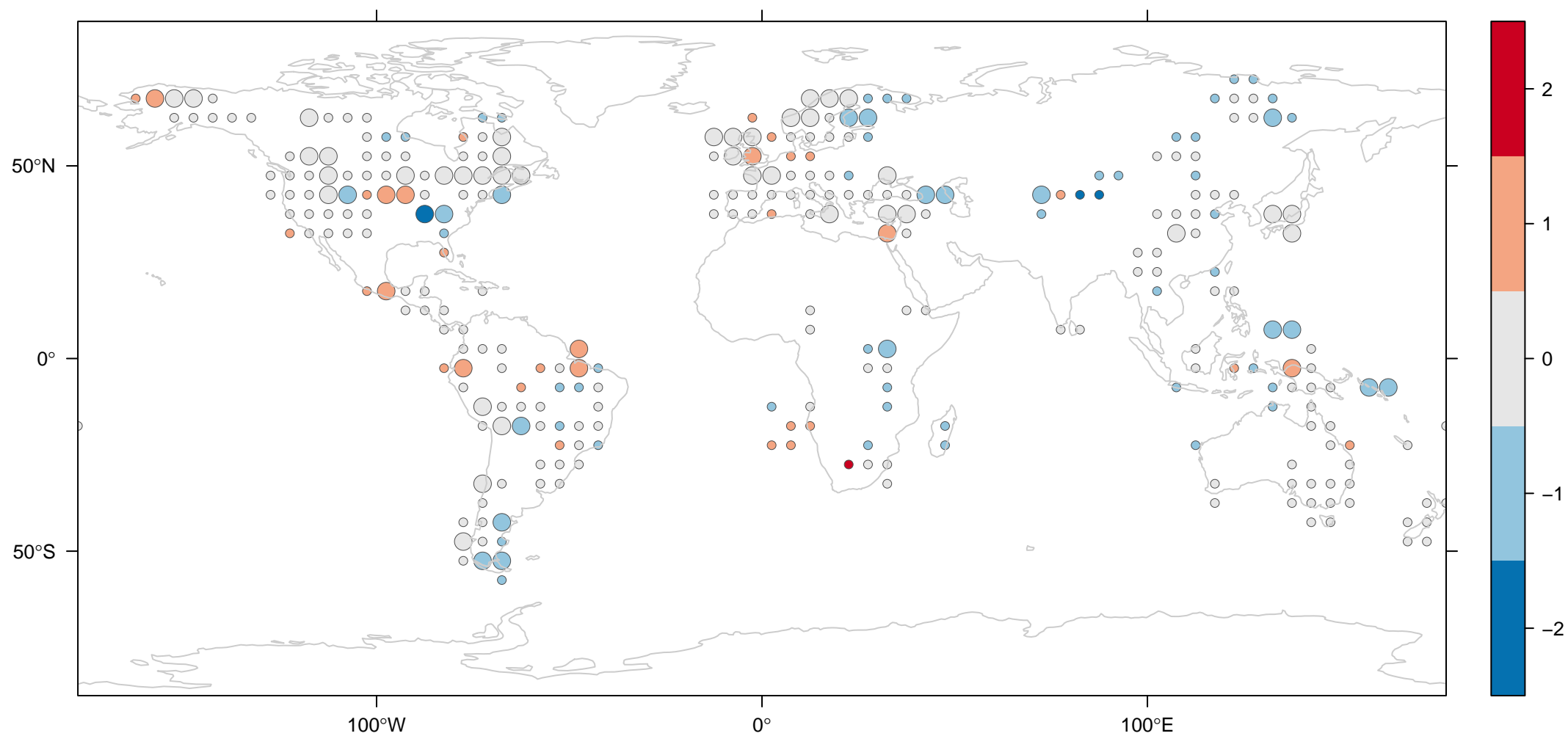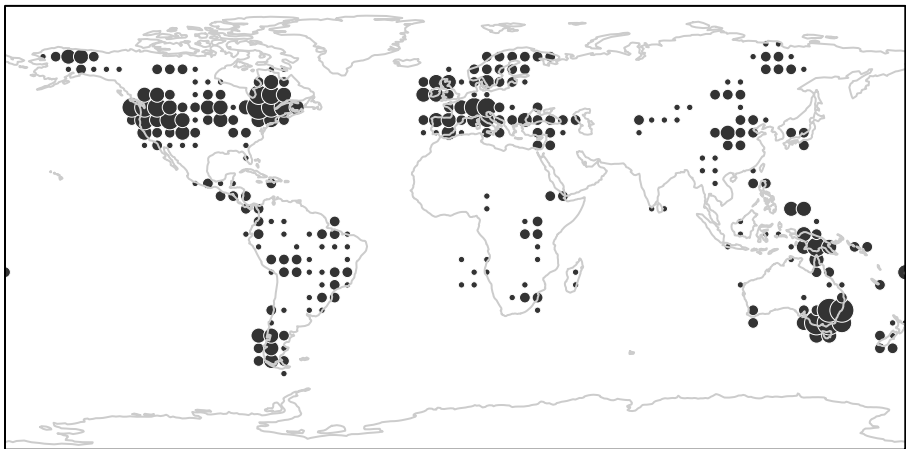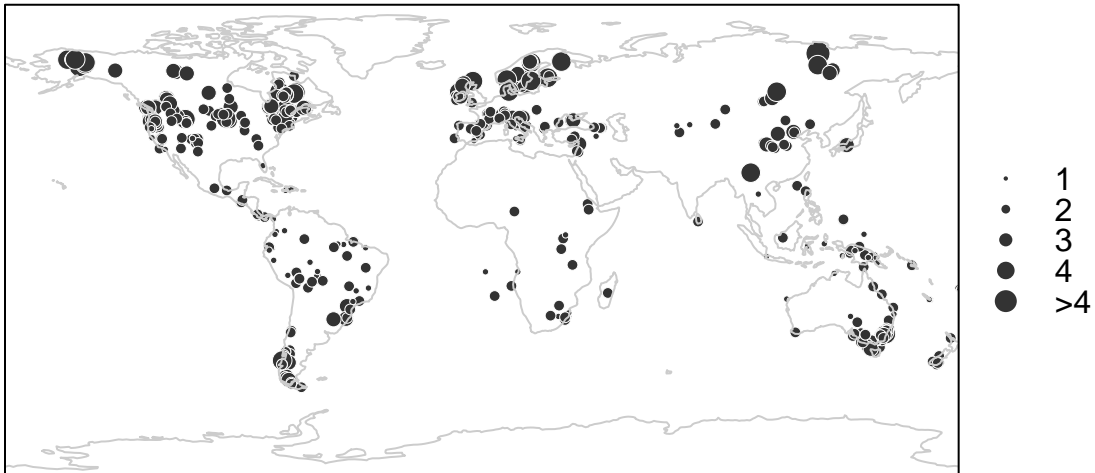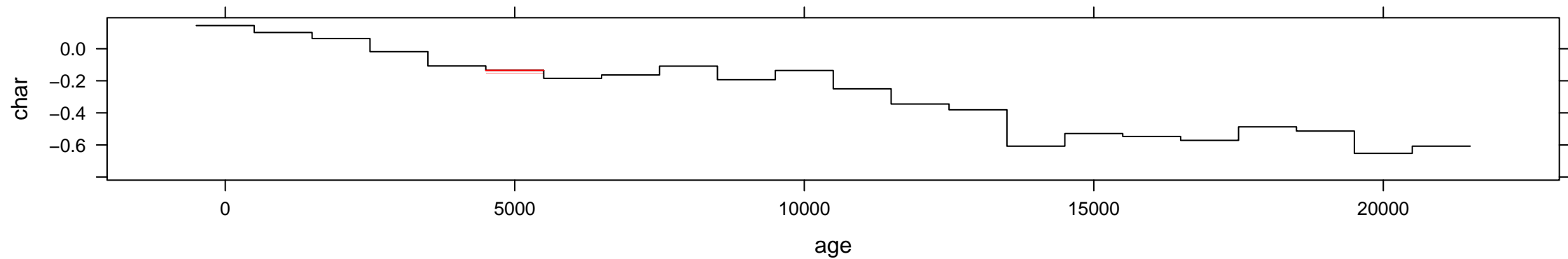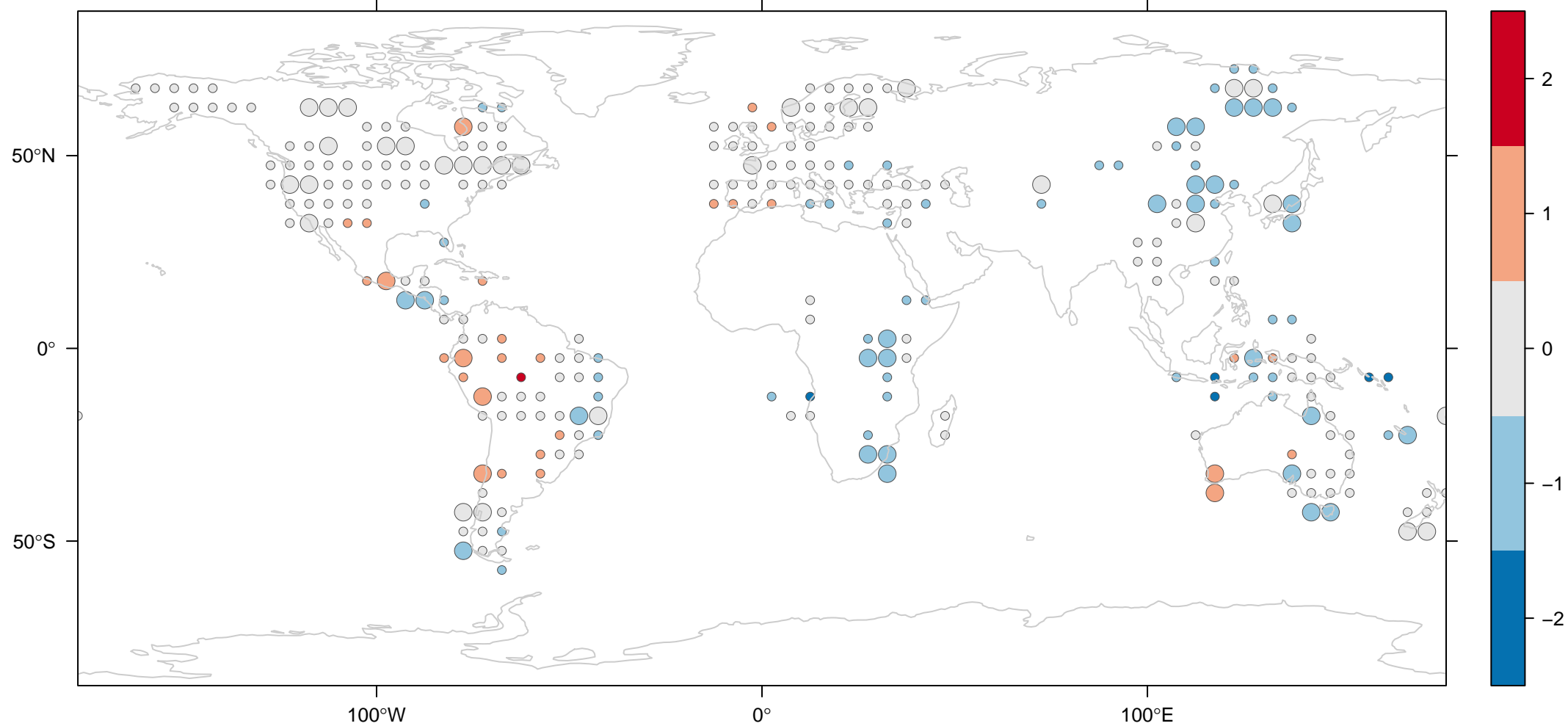**Charcoal Influx z−Scores: 13500−14500 BP**
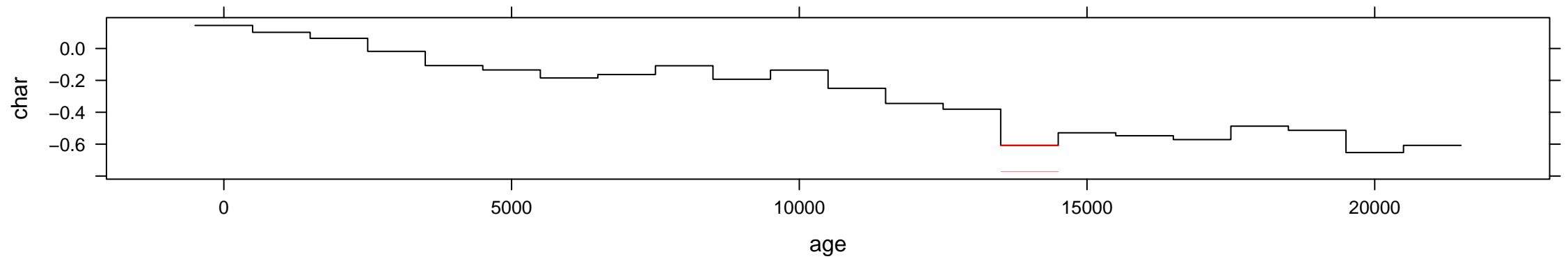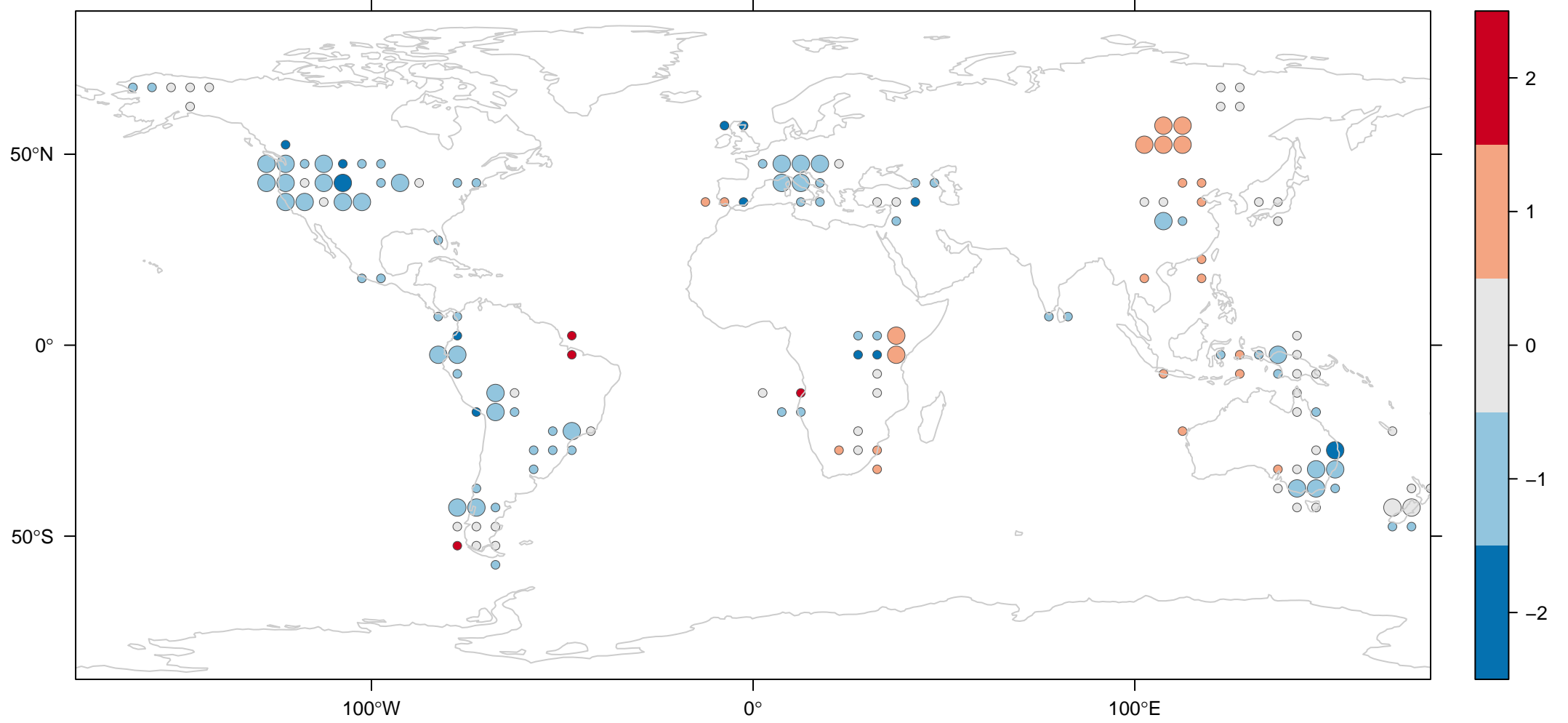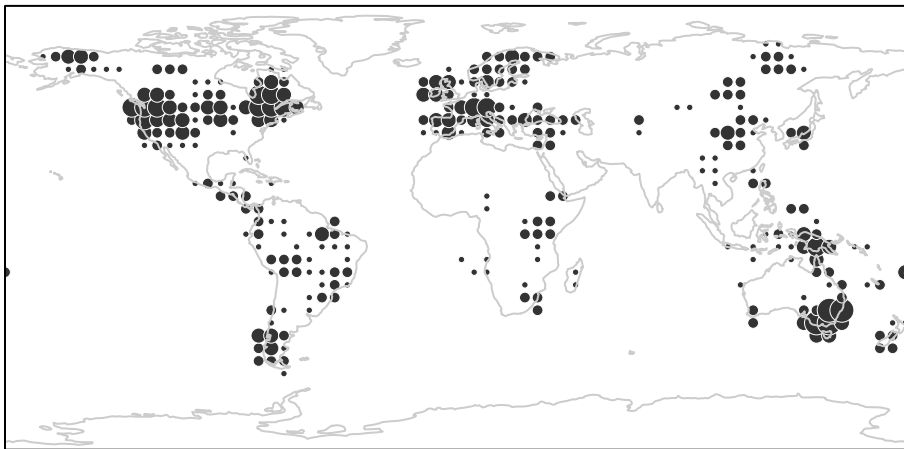
Number of sites per grid cell

Number of grid cells influenced by each site

Charcoal Influx z−Scores: 14500−15500 BP

Charcoal Influx z−Scores: 1500−2500 BP

Number of sites per grid cell

1
2−5
6−10
11−20
>20

Number of grid cells influenced by each site

1
2
3
4
>4

Charcoal Influx z−Scores: 15500−16500 BP

Number of sites per grid cell

Number of grid cells influenced by each site
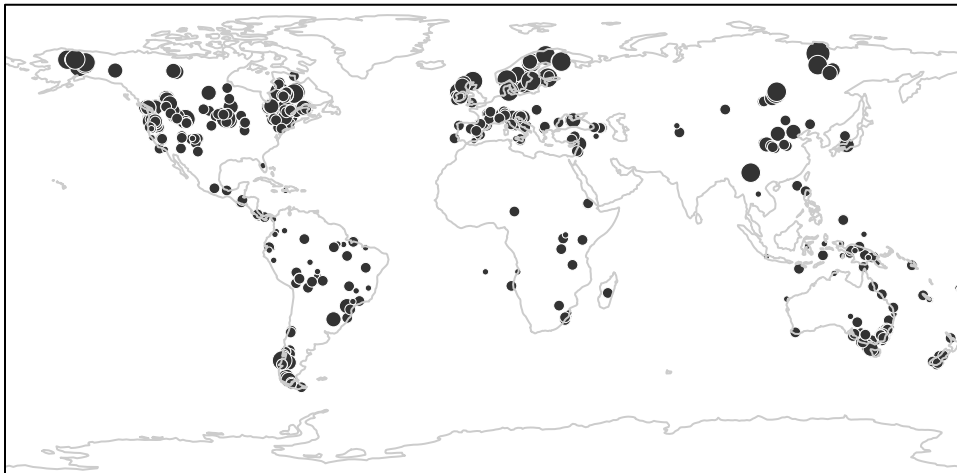
Charcoal Influx z-Scores: 16500-17500 BP

Number of sites per grid cell

1
2-5
6-10
11-20
>20

Number of grid cells influenced by each site

1
2
3
4
>4

Charcoal Influx z-Scores: 17500–18500 BP

Number of sites per grid cell

Number of grid cells influenced by each site

Charcoal Influx z−Scores: 18500−19500 BP
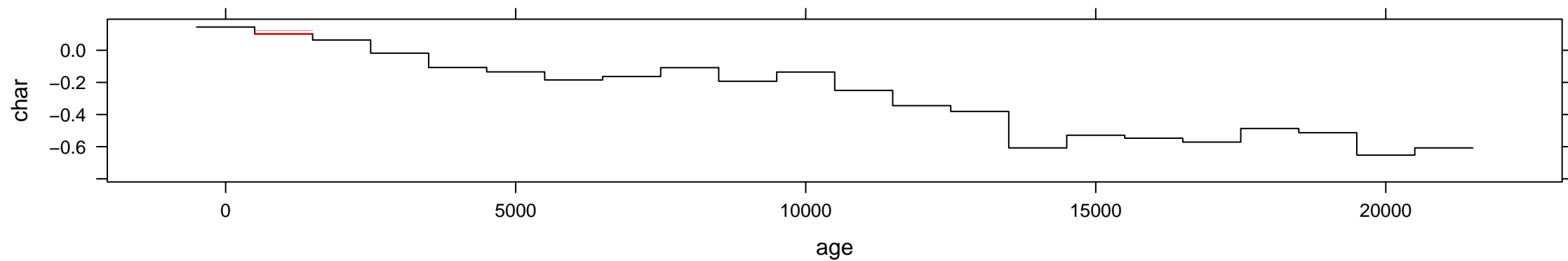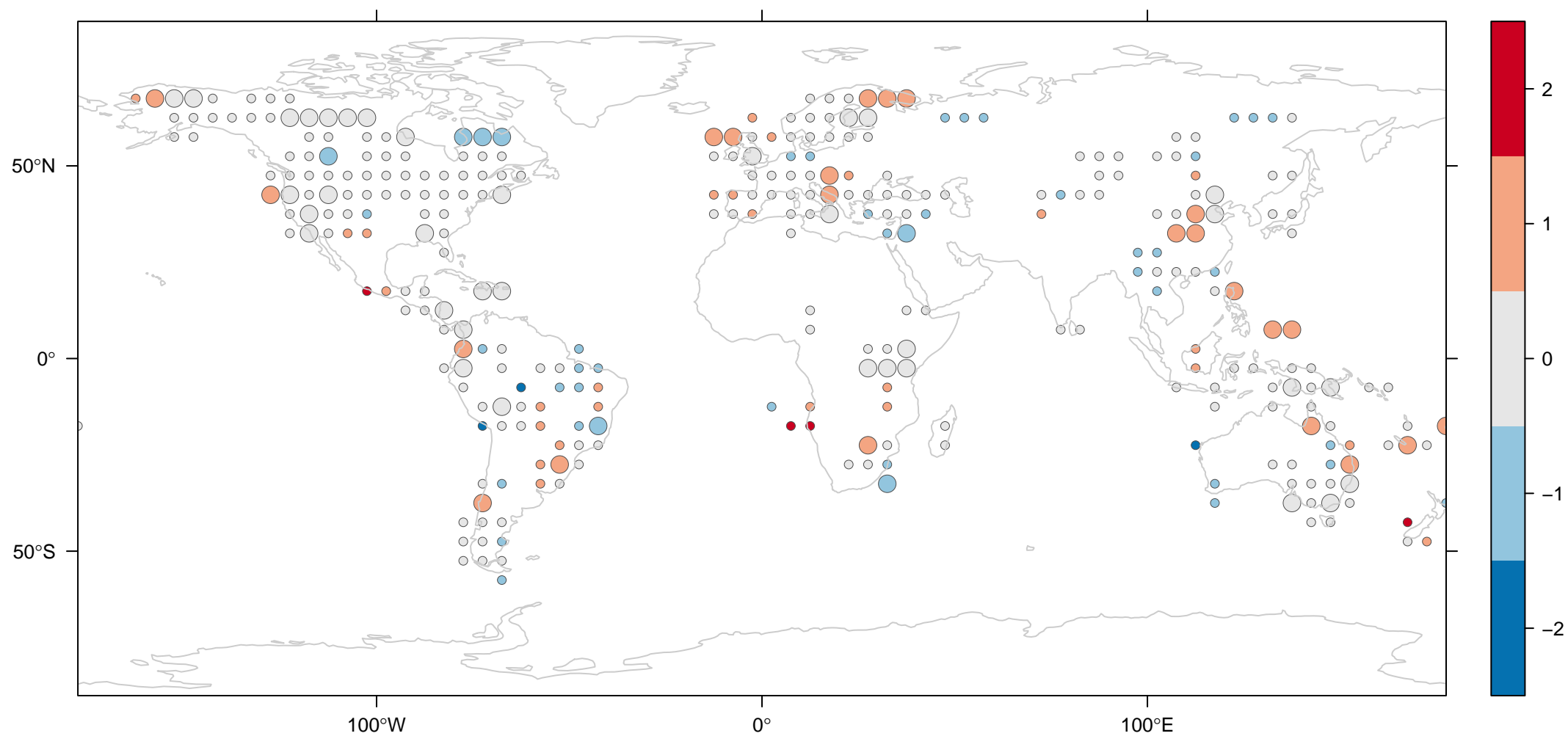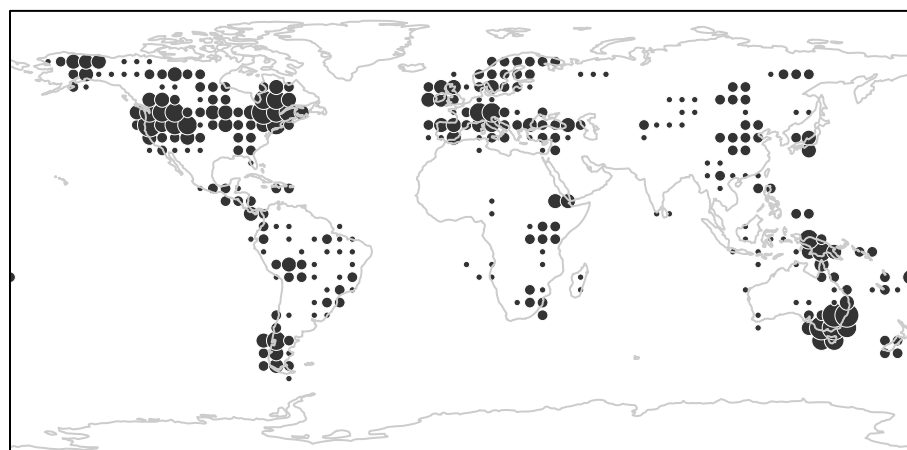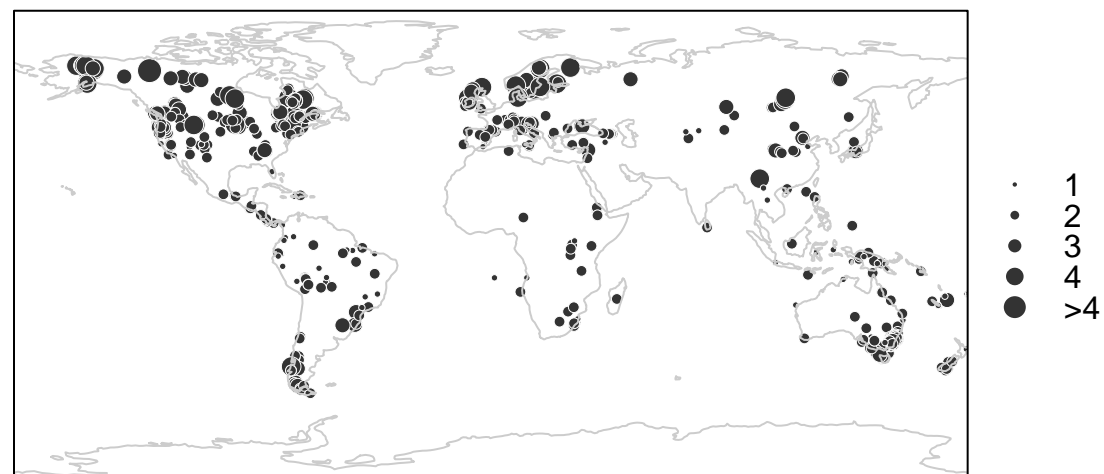
Number of sites per grid cell

Number of grid cells influenced by each site

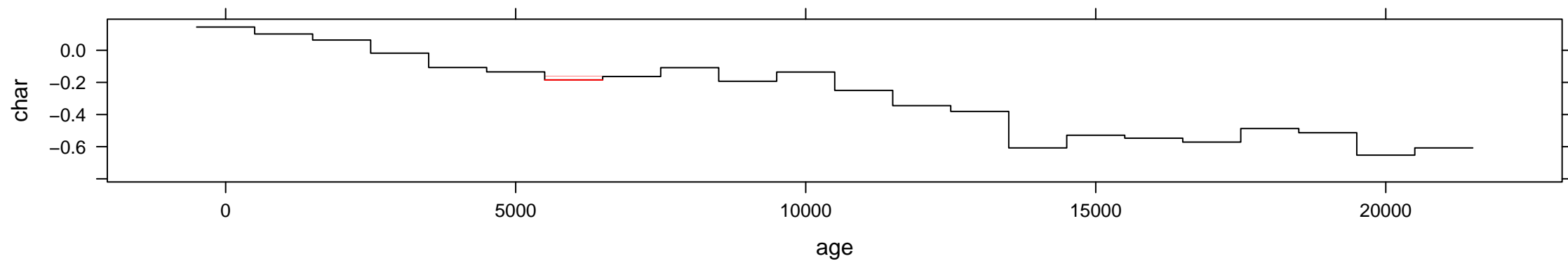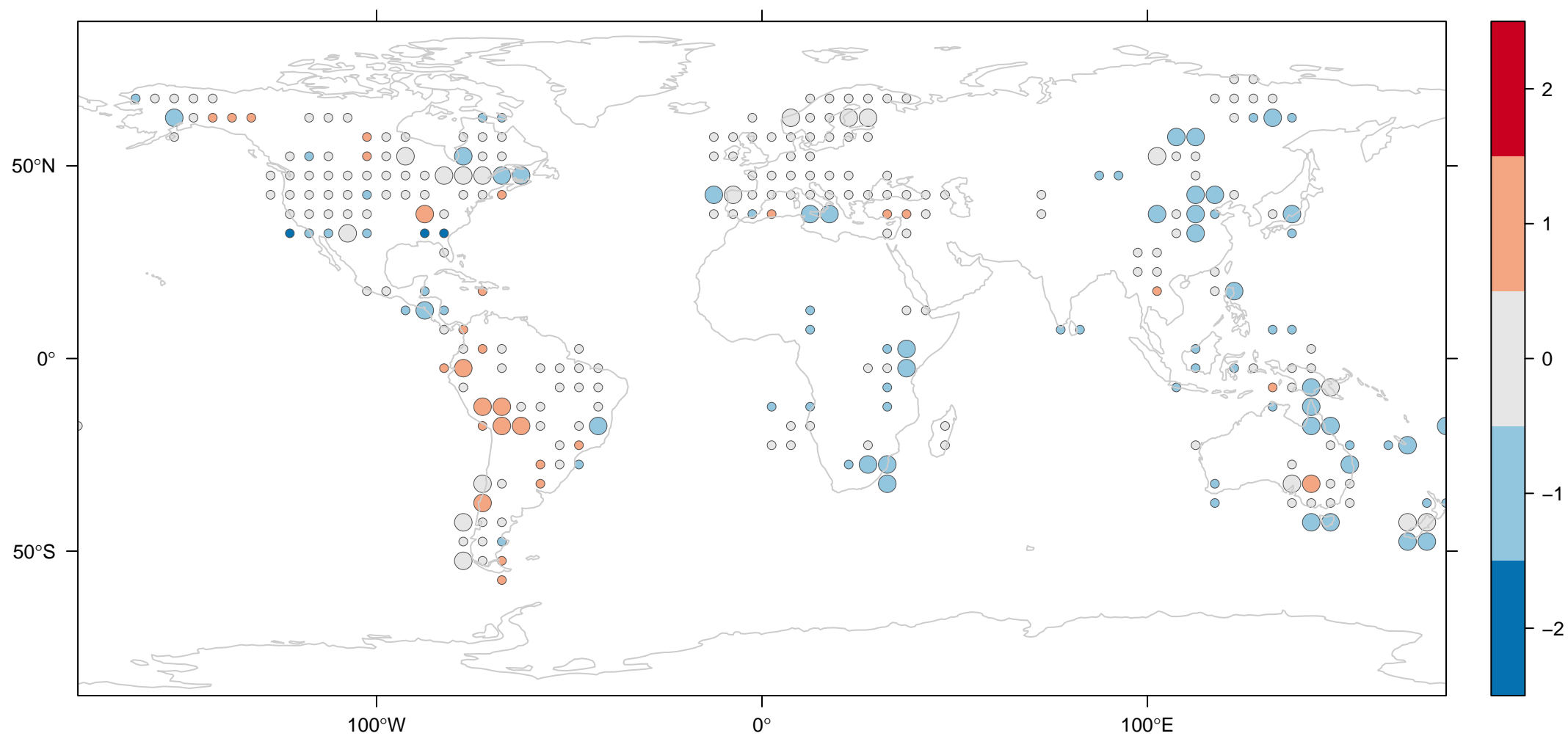**Charcoal Influx z−Scores: 19500−20500 BP**

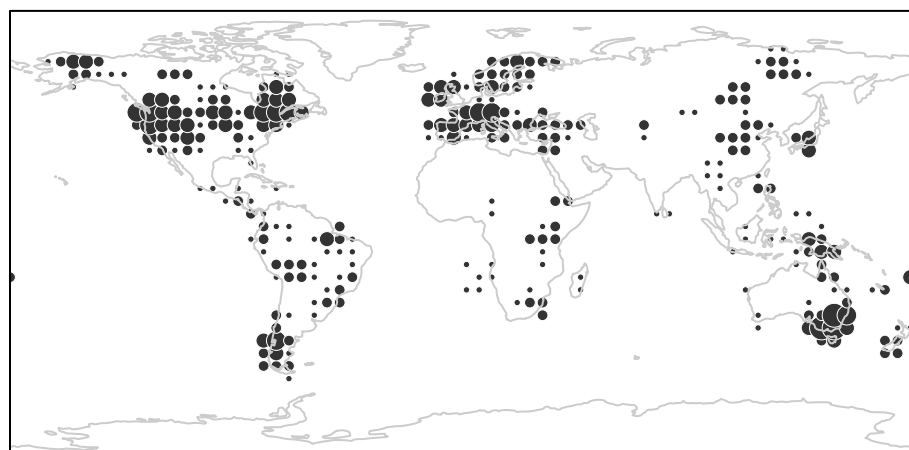**Number of sites per grid cell**

Number of grid cells influenced by each site

Charcoal Influx z-Scores: 20500–21500 BP

Number of sites per grid cell

Number of grid cells influenced by each site

Charcoal Influx z−Scores: 2500−3500 BP

Number of sites per grid cell

1
2−5
6−10
11−20
>20

Number of grid cells influenced by each site

1
2
3
4
>4

Charcoal Influx z−Scores: 3500−4500 BP

Number of sites per grid cell
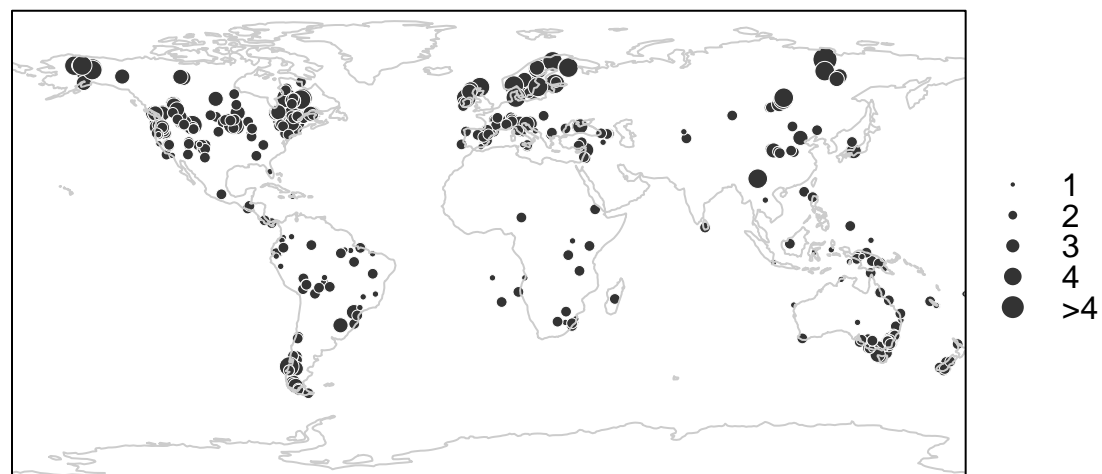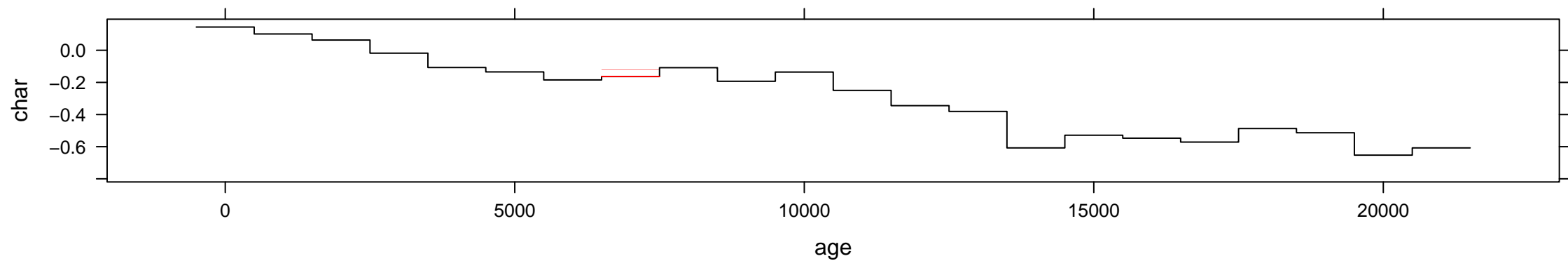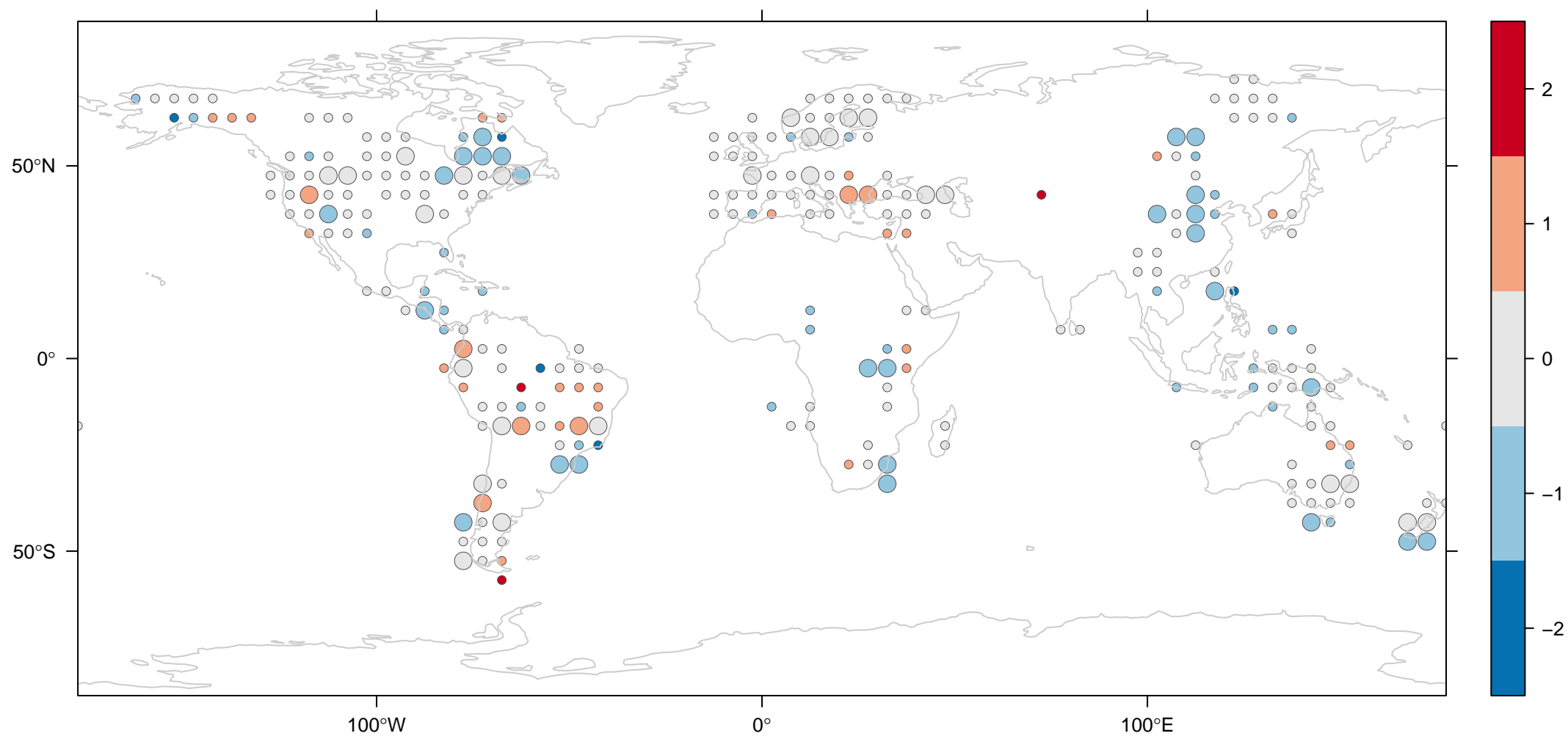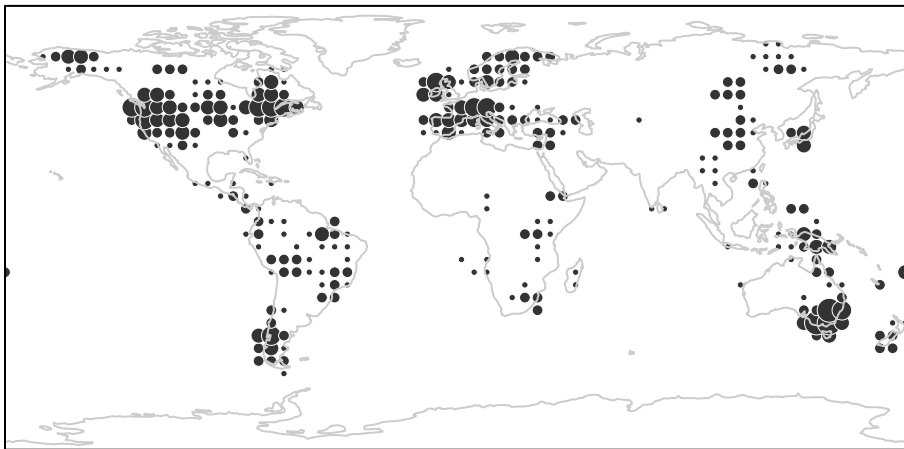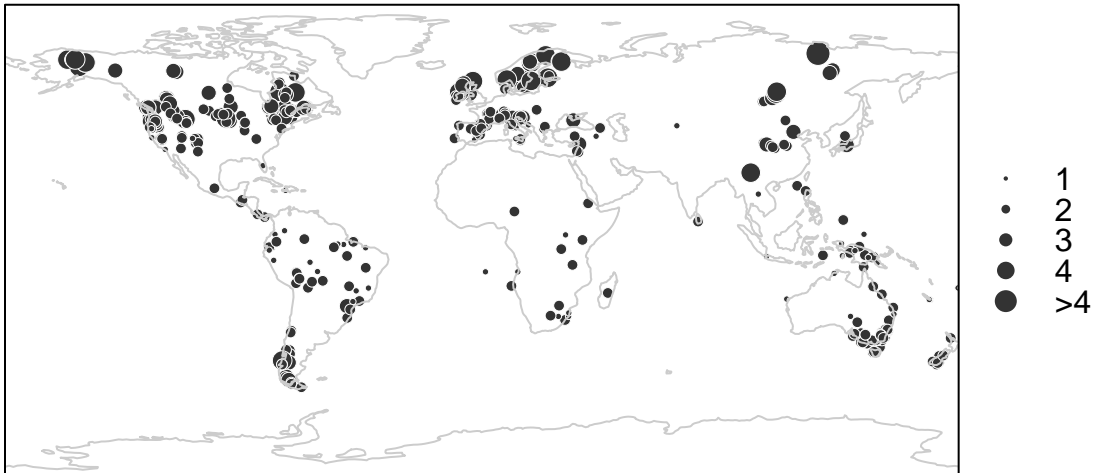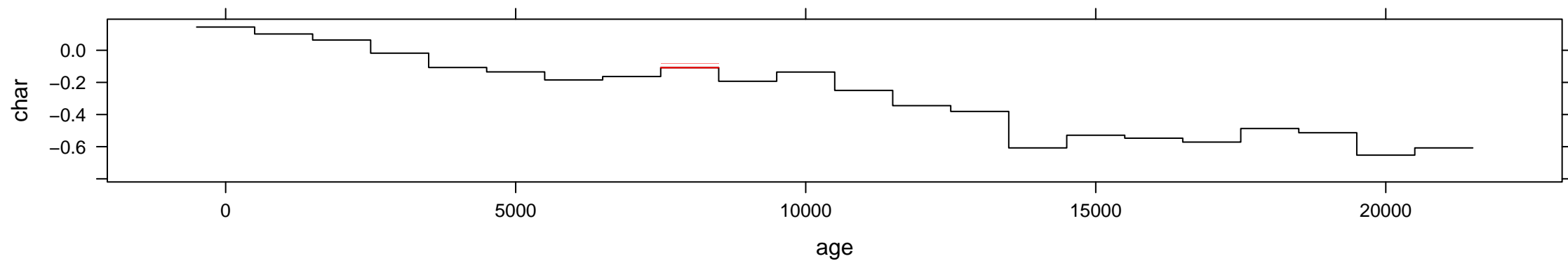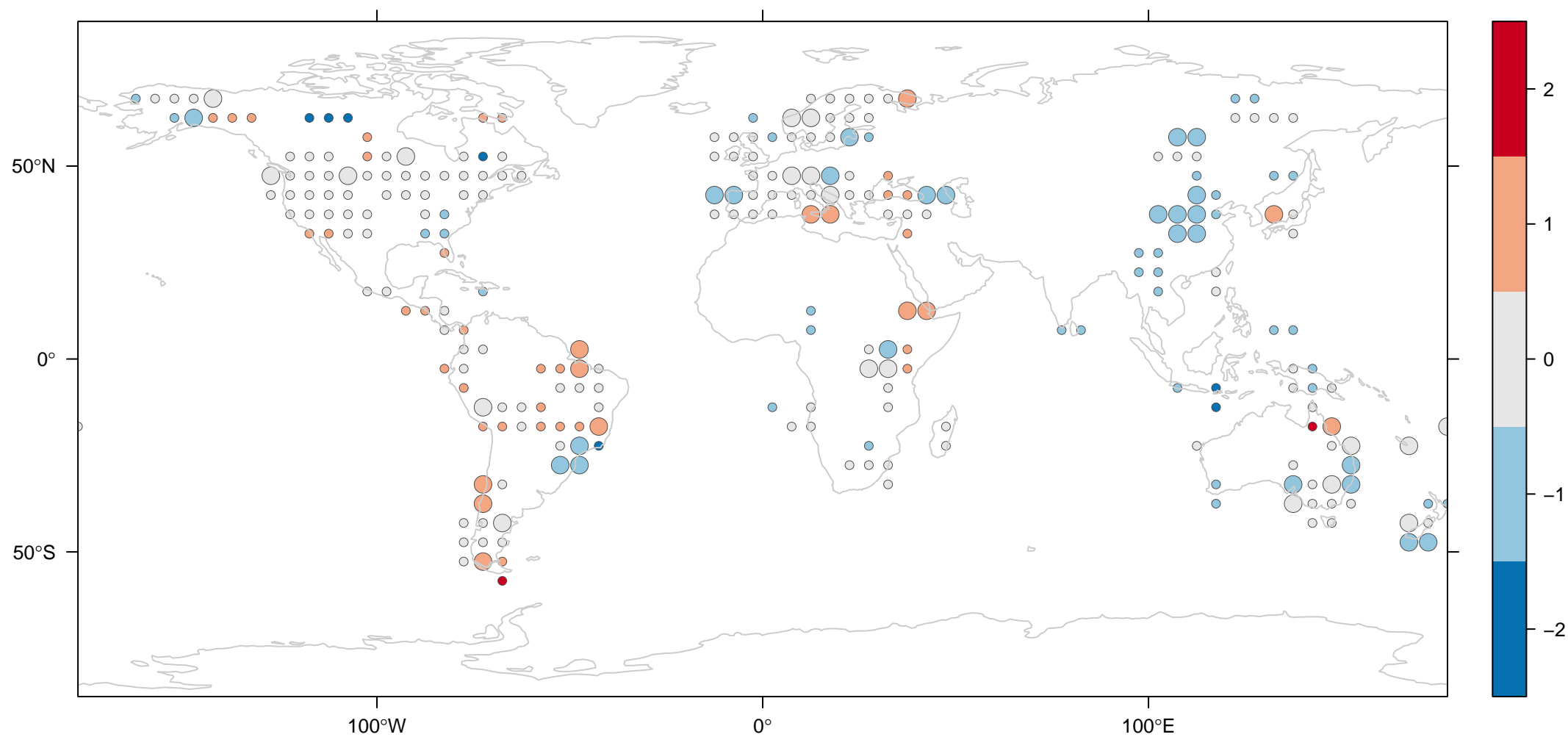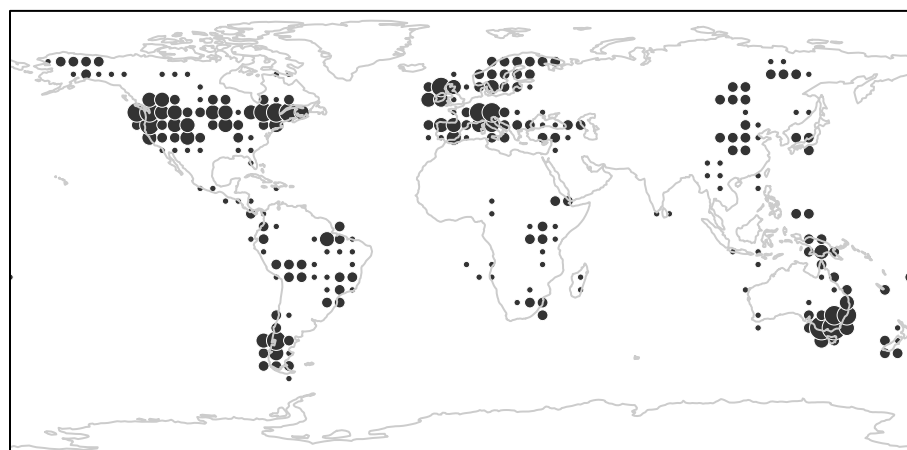
Number of grid cells influenced by each site

Charcoal Influx z−Scores: 4500−5500 BP

Number of sites per grid cell

Number of grid cells influenced by each site

Charcoal Influx z−Scores: 500−1500 BP

Number of sites per grid cell

1	
2−5	
6−10	
11−20	
>20	

Number of grid cells influenced by each site

1	
2	
3	
4	
>4	

Charcoal Influx z−Scores: 5500−6500 BP

Charcoal Influx z−Scores: 6500−7500 BP

Number of sites per grid cell

1
2−5
6−10
11−20
>20

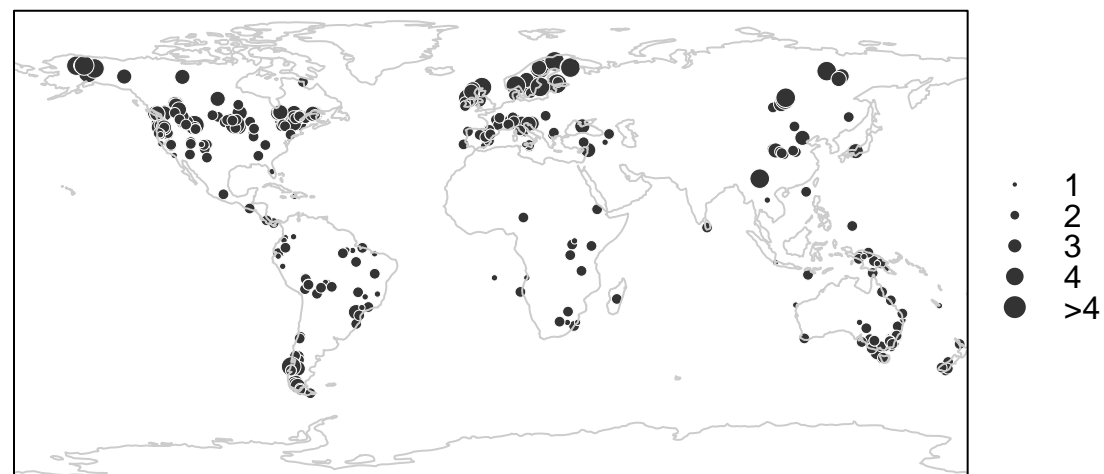**Number of grid cells influenced by each site**
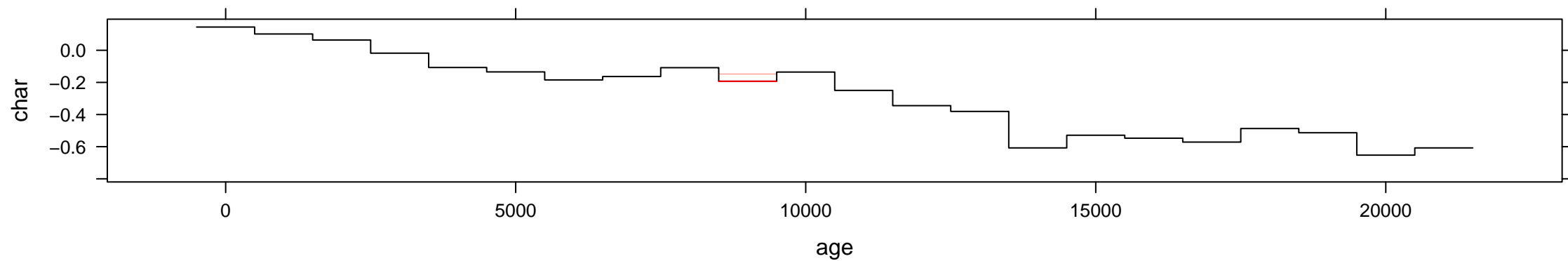
1
2
3
4
>4

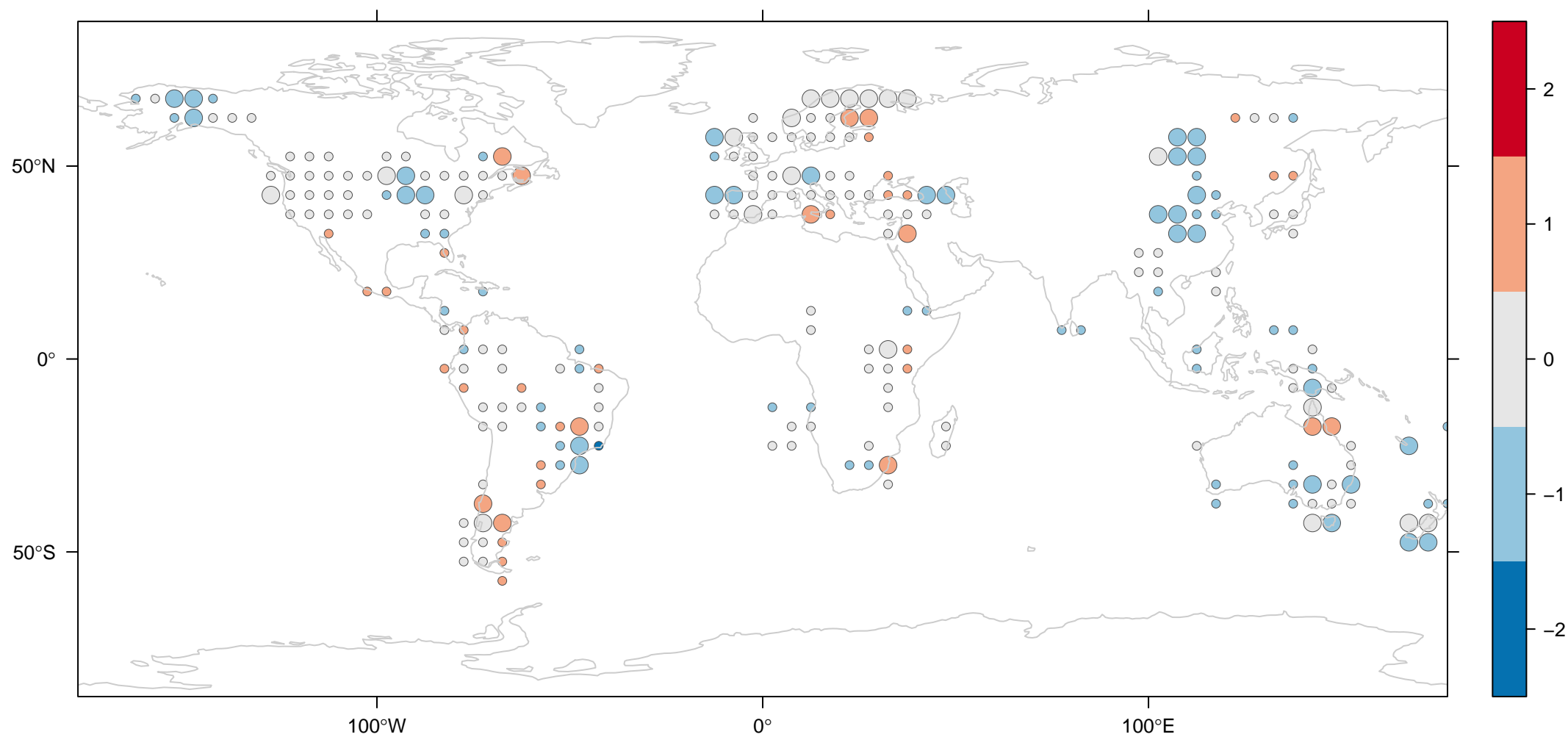Charcoal Influx z−Scores: 7500−8500 BP
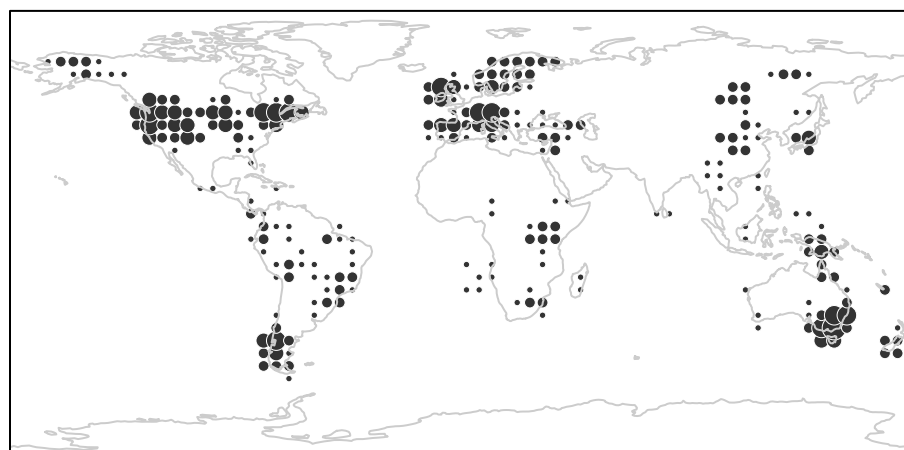
Number of sites per grid cell
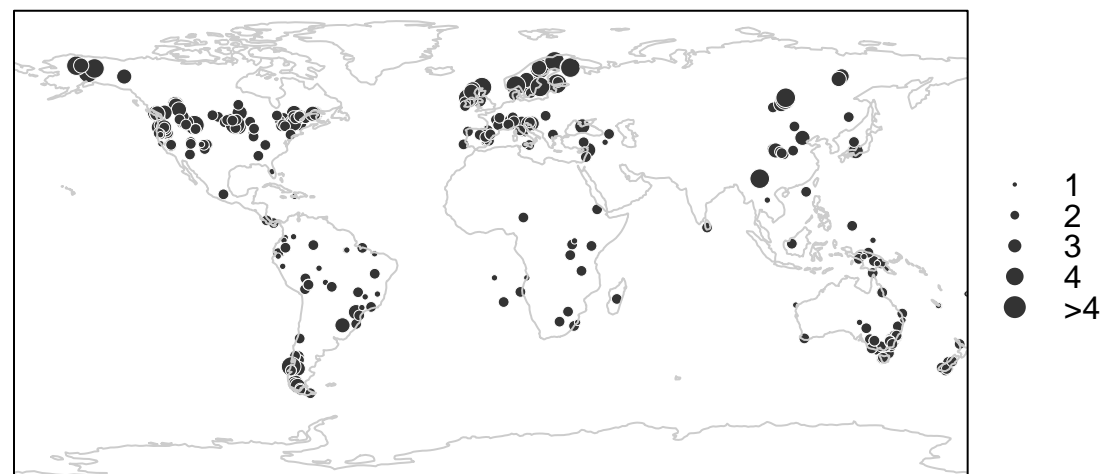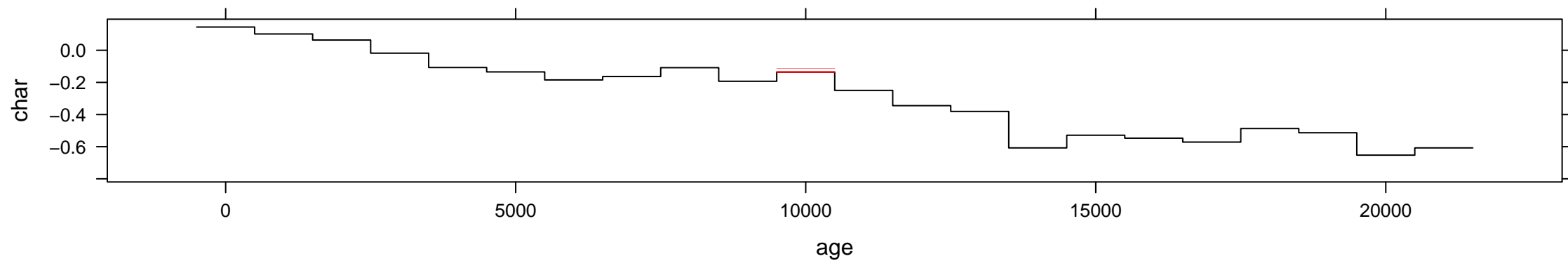
Number of grid cells influenced by each site
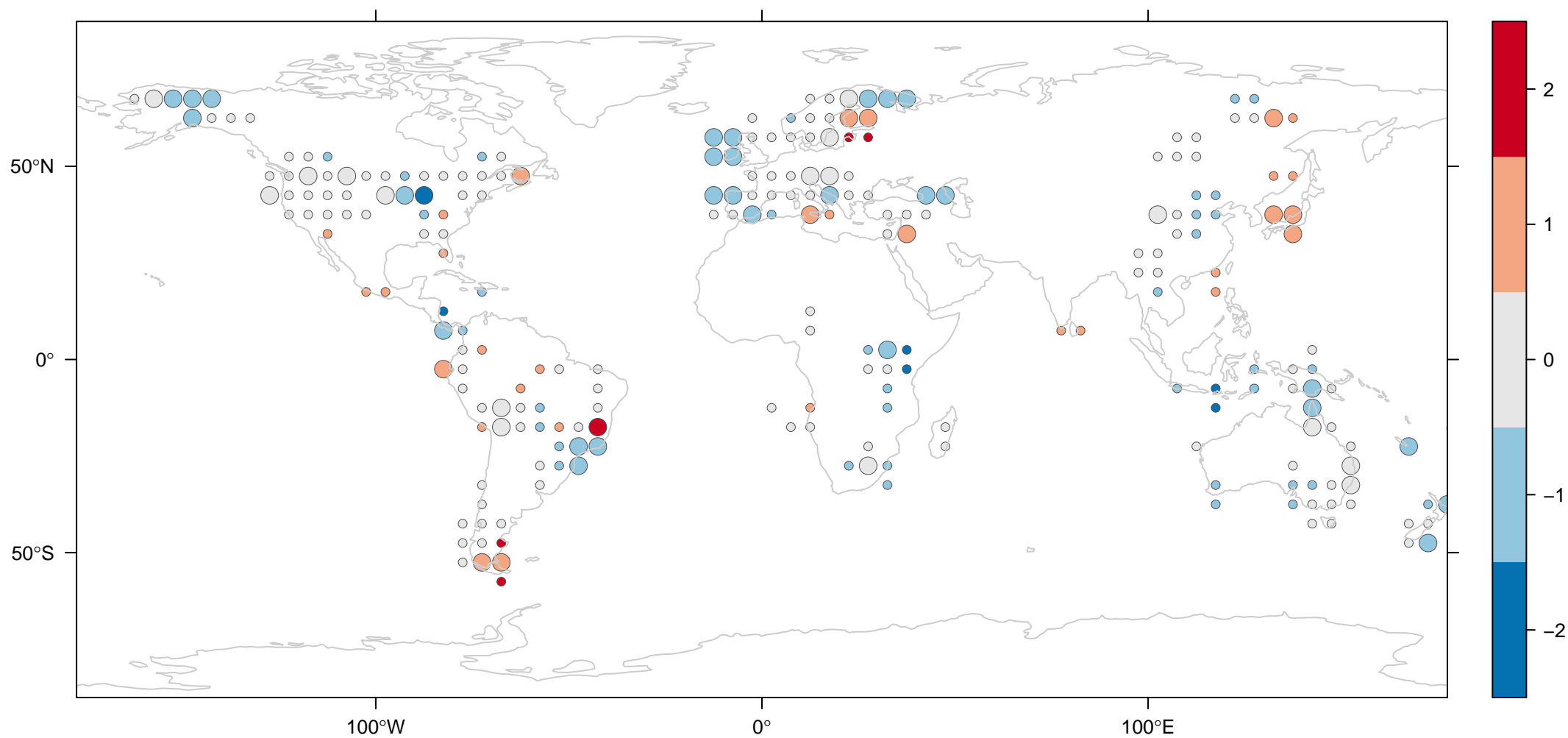
Charcoal Influx z−Scores: 8500−9500 BP
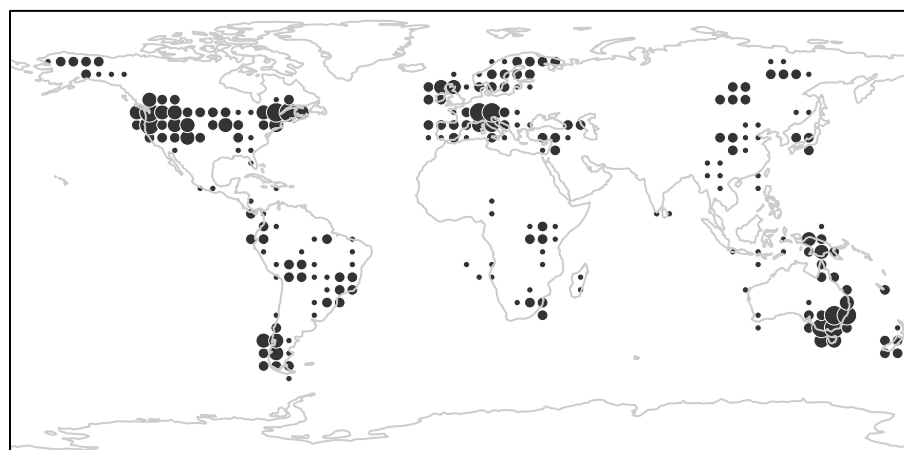
Number of sites per grid cell

1
2−5
6−10
11−20
>20

Number of grid cells influenced by each site

1
2
3
4
>4

Charcoal Influx z−Scores: 9500−10500 BP

Number of sites per grid cell

Number of grid cells influenced by each site