Spatial Analysis and Visualization of Climate Data Using R

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ACIS

Applied Climate Information System

NOAA Regional Climate Centers

ACIS - A Climate-Data Management Solution

About ACIS

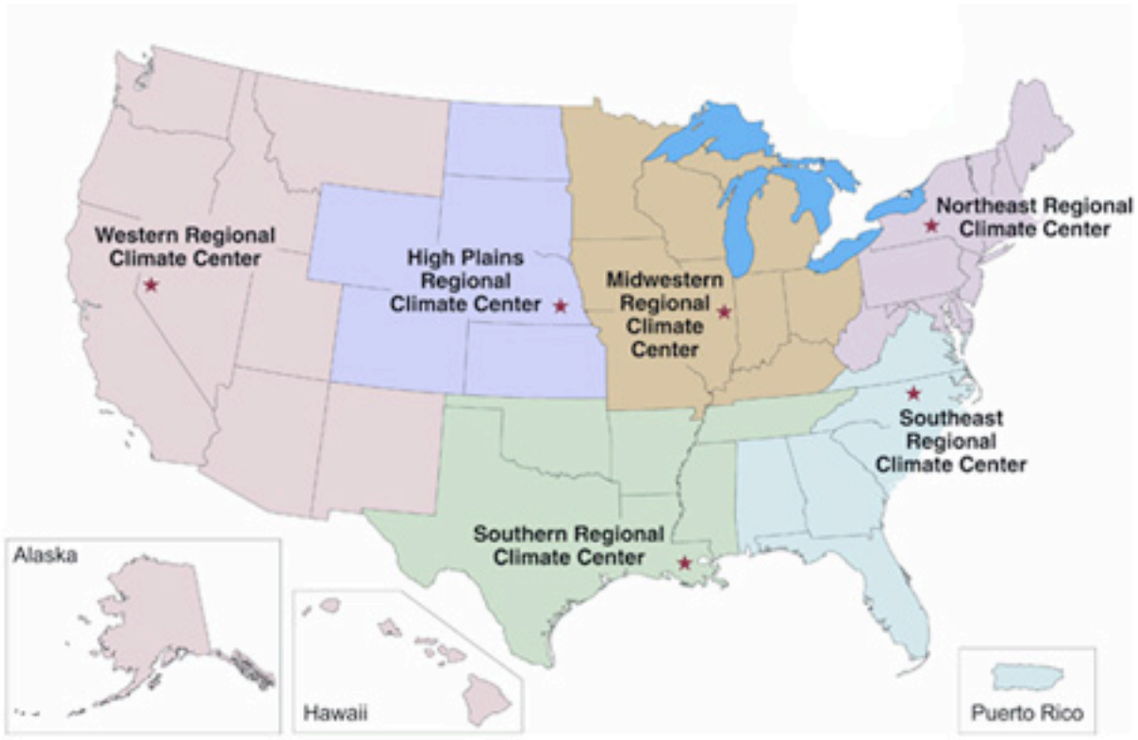
Why is ACIS Unique?
The ACIS Design Concept
Benefits of using ACIS

The ACIS System

MetaData
Climate Data
Data Ingest & Archive
Quality Control

Climate Products

User Interfaces
Visual Products



There are 6 Regional Climate Centers offering climate services in the U.S. Click on the map to go directly to the center serving your area.

State and Federal Agencies use ACIS to Enhance their operations

- NWS: NOWData, xmACIS
- NRCS: Custom interface and products
- USDA/JAWF: Data for mapping
- University of Washington: Uses ACIS data for near real-time soil moisture model
- State Climatologists: Web pages in the following states use ACIS data - LA, MS, OK, DE, PA, CA, NV, IL

ACIS Highlights

- Download the ACIS brochure
- BAMS Announcement
- ACIS Current Climate Summary Maps
- 2003 ACIS Power Point Presentation

CLIMOD Servers

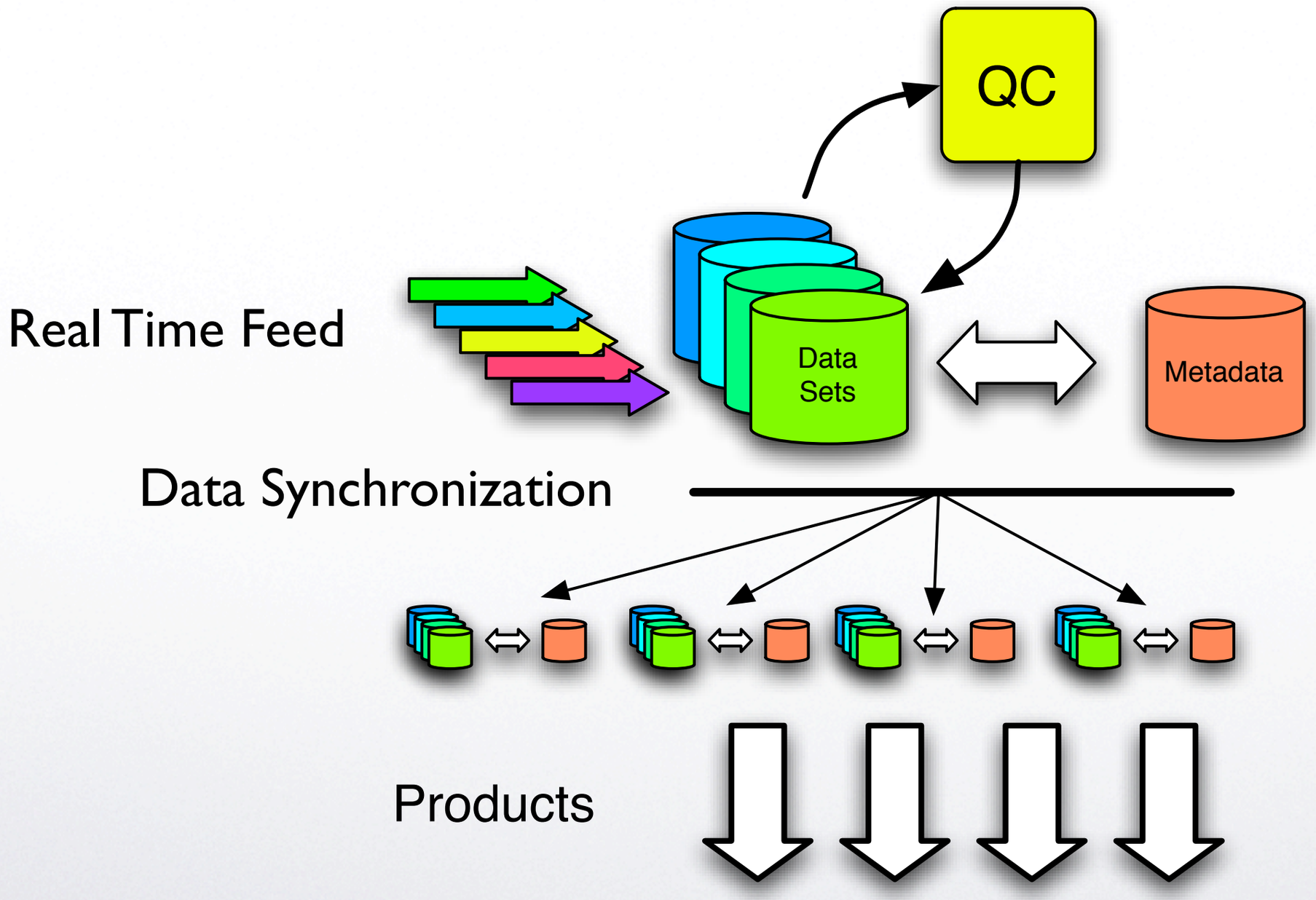
- Northeast
- Southern
- High Plains

ACIS VISION

ACIS is a fully functional system with a flexible design. ACIS will evolve to incorporate additional data sources, generate new and improved data products, take advantage of emerging technologies, and respond to the needs of its users.

ACIS

- ACIS - Applied Climate Information System (www.rcc-acis.org)
- Provides Storage, Access and Analysis of Climate Data
- 3 layer abstracted architecture - comprises of station meta data, climate data and derived product layers
- Data Source for generating maps


Real Time Feed
QC
Data
Sets
Metadata
Data Synchronization
Products

Why R?

- Simple data structures
- Robust matrix computations
- Spatial libraries
- Visualization tools

Map Generation Tools

- Color Selection - RColorBrewer
- Masking - sp
- Map Projection - mapproj
- Fitting and Modeling - fields, sp

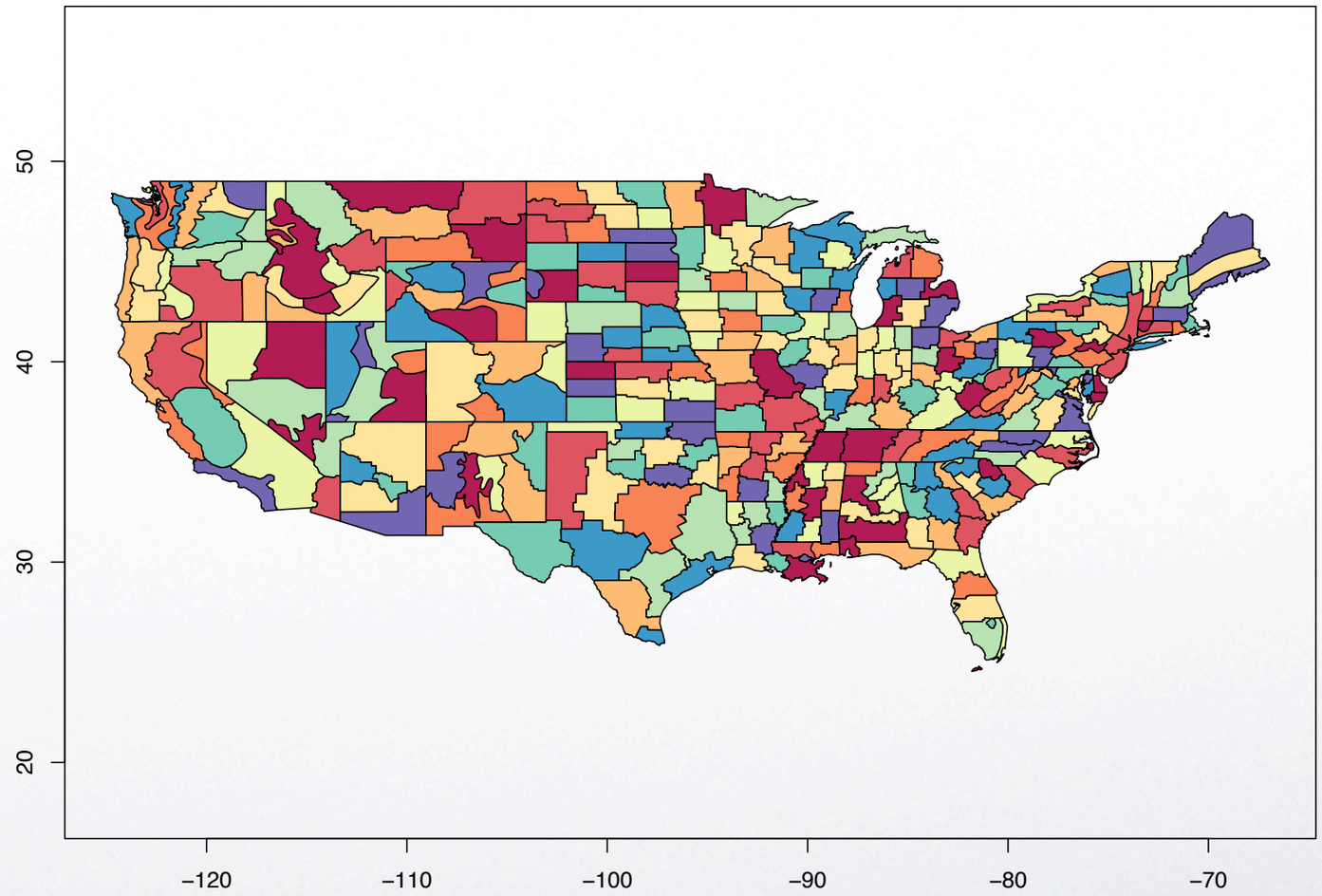
Mapping Climate Divisions

- <u>Climate divisions shape file</u>

  usdiv = readShapePoly("divisions.shp")

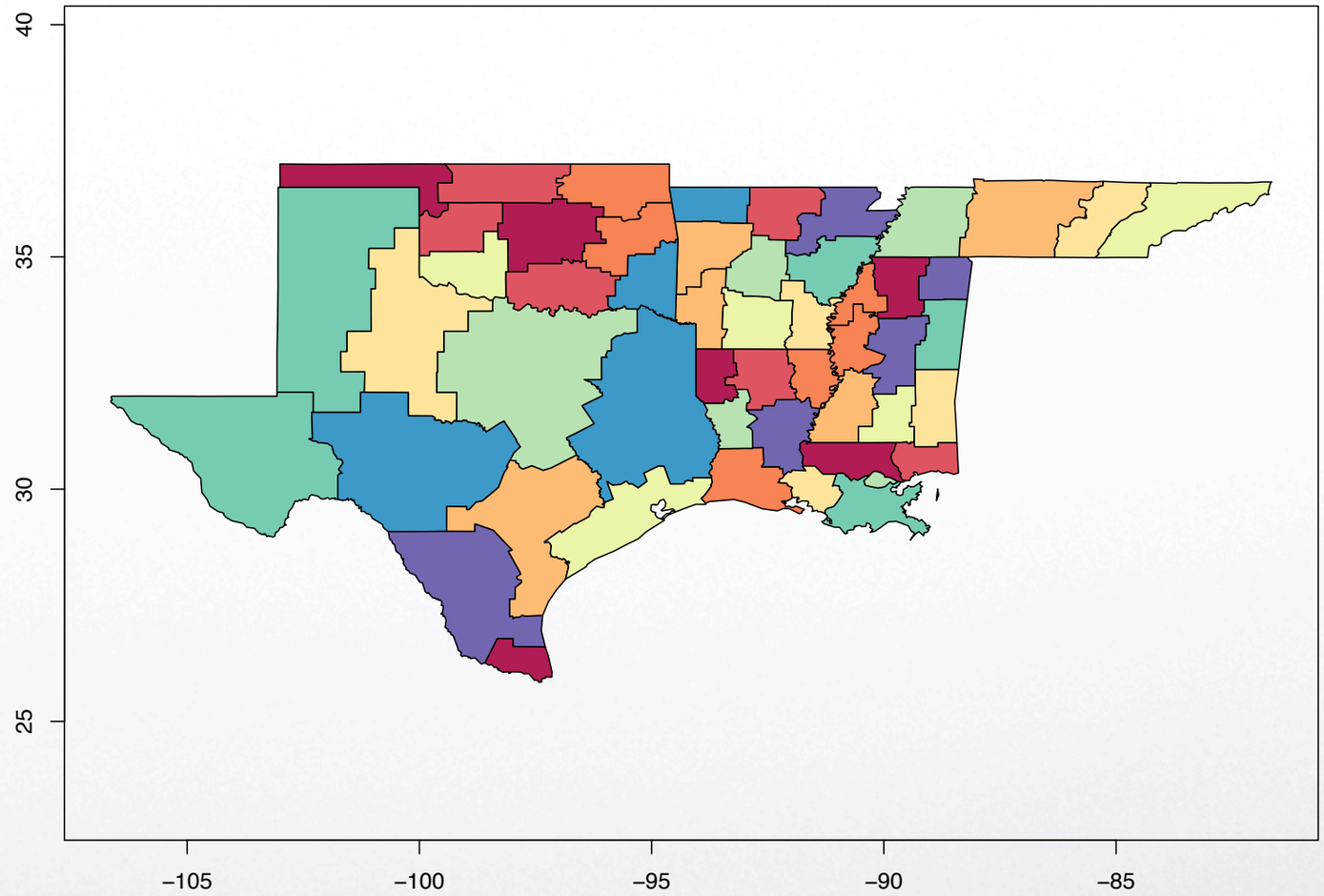
  plot(usdiv,col=brewer.pal(11, `Spectral')

- Get a subset of climate divisions
- Choose Color (based on climate data)
- Plot and Draw legend



Mapping Climate Divisions

- Get a subset of climate divisions
  - Using subset command in R
- Choose Color (based on climate data)
- Plot and Draw legend

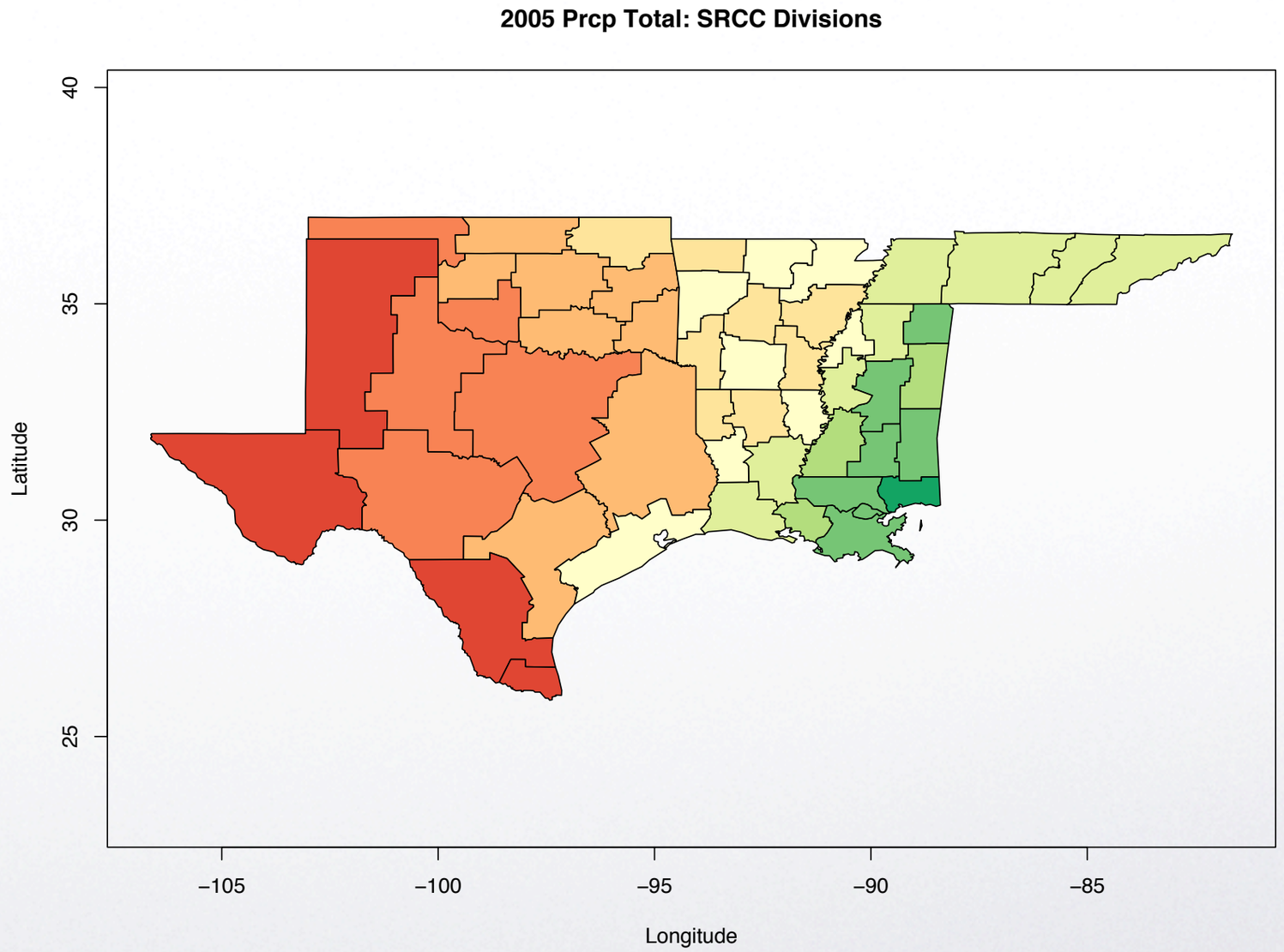


Mapping Climate Divisions

- Choose Color (based on climate data)

```
colours <-
brewer.pal(nclr,"RdYlGn")

ratio<-(max(prcp)-min(prcp))/nclr

brks<-
round(seq(min(prcp),max(prcp),
by=ratio),digits=0)

colorIndx <- findInterval(prcp,
brks, all.inside=T)
```

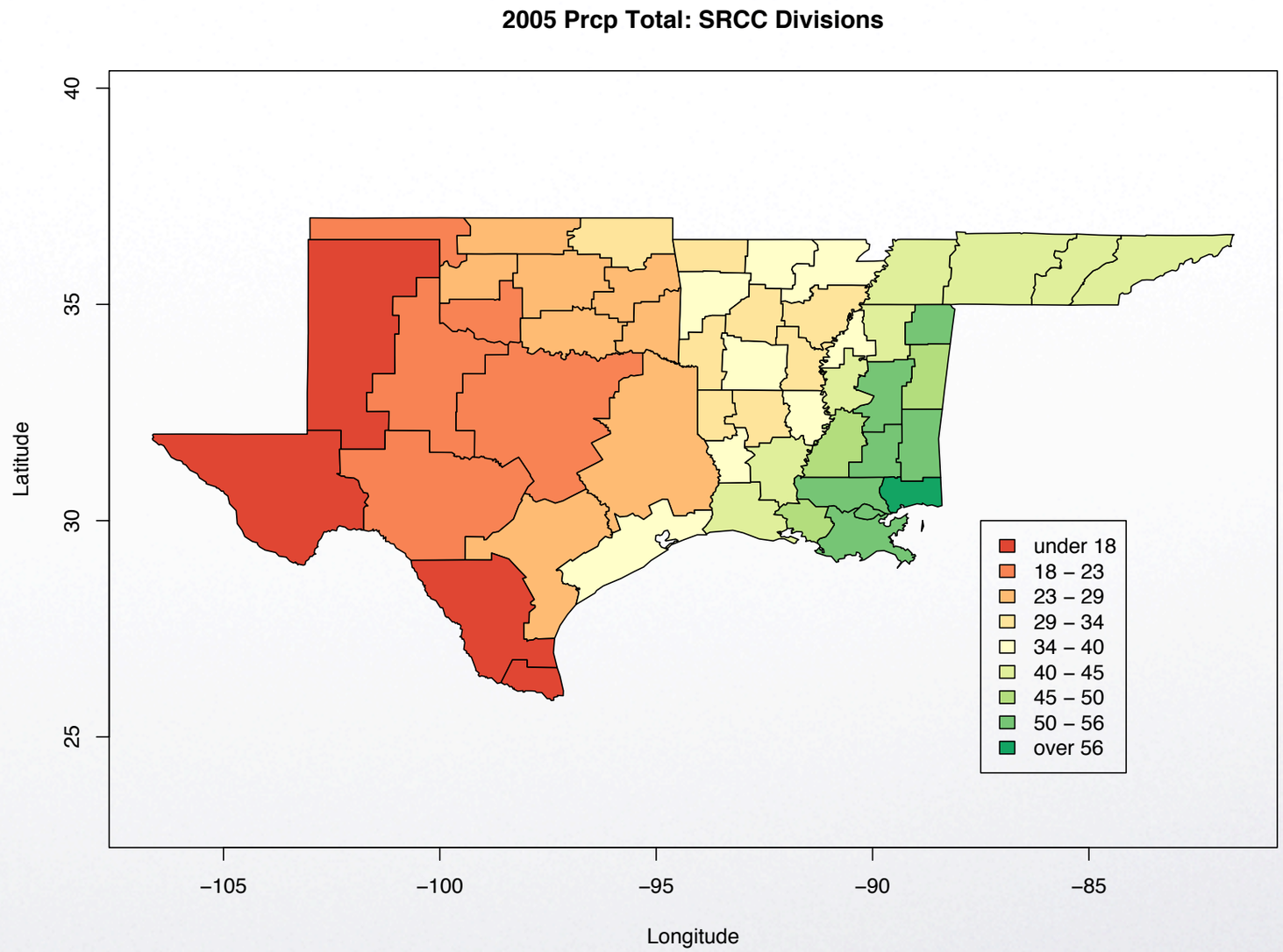
- Plot and Draw legend

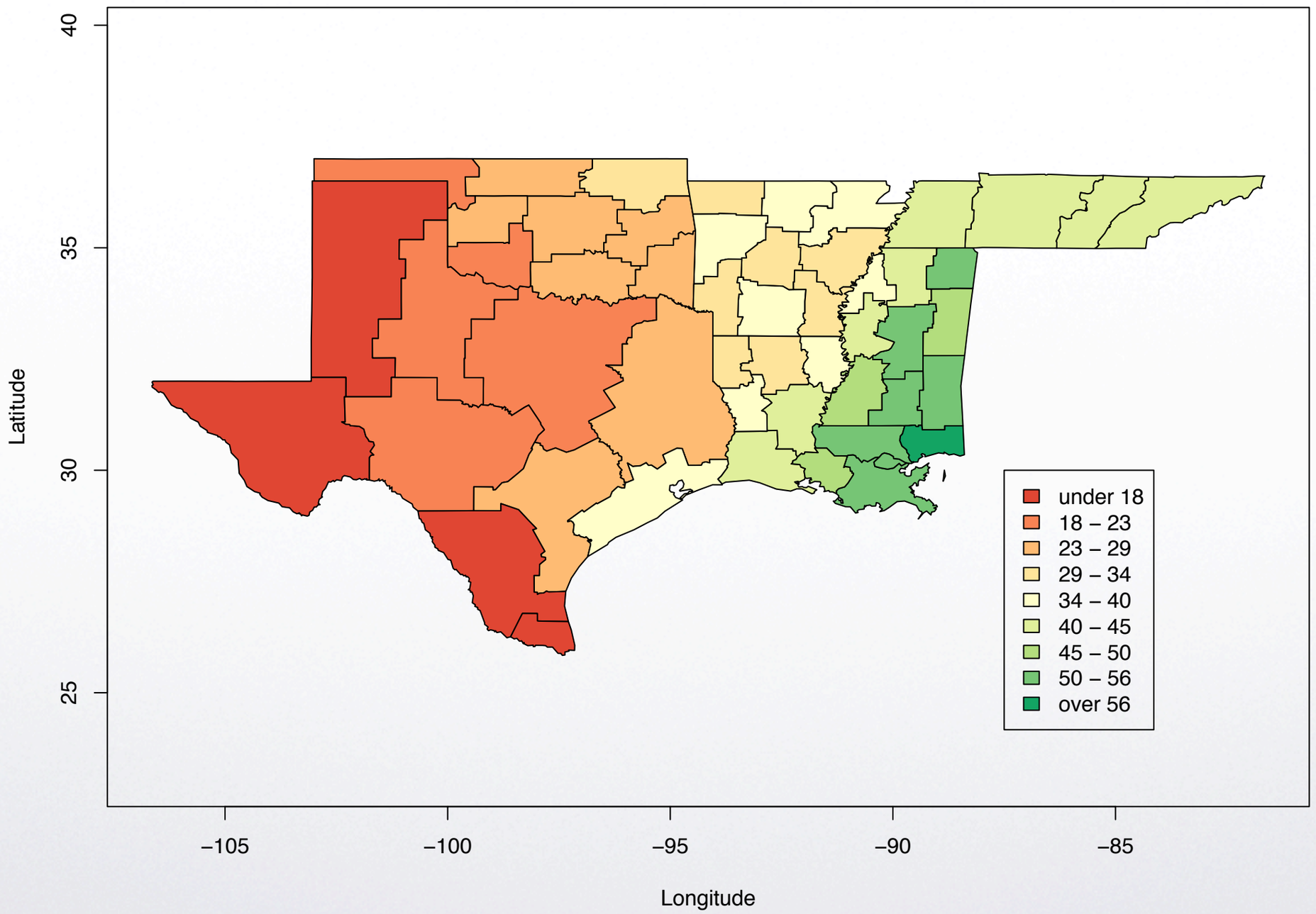


Mapping Climate Divisions

- Plot and Draw legend

```
- plot(srccdiv_shp,
  col=colours[colorIndx],
  xlab="Longitude",
  ylab="Latitude")

- title("2005 Prcp Total: SRCC
  Divisions")

- legend(-87.5, 30,
  legend=leglabs(brks),
  fill=colours, cex=1, bty="o")
```




2005 Prcp Total: SRCC Divisions
Latitude
40
35
30
25
−105
−100
−95
−90
−85
Longitude
under 18
18 – 23
23 – 29
29 – 34
34 – 40
40 – 45
45 – 50
50 – 56
over 56

Surface Fitting

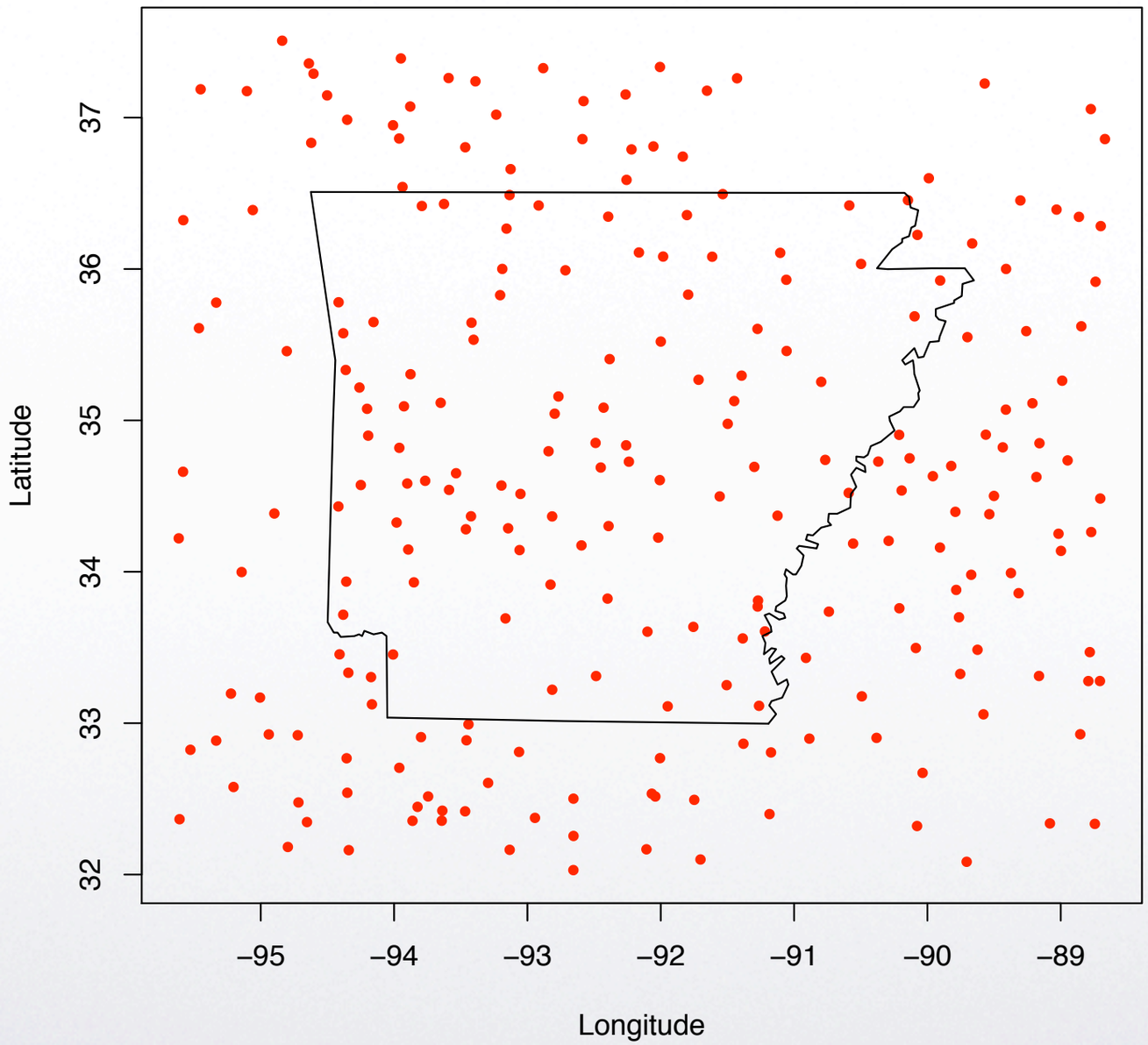
- Fields package in R
- krig.image (from fields)
- tim.colors (from fields)
- Masking Routine
- Map projection

Kriging using fields

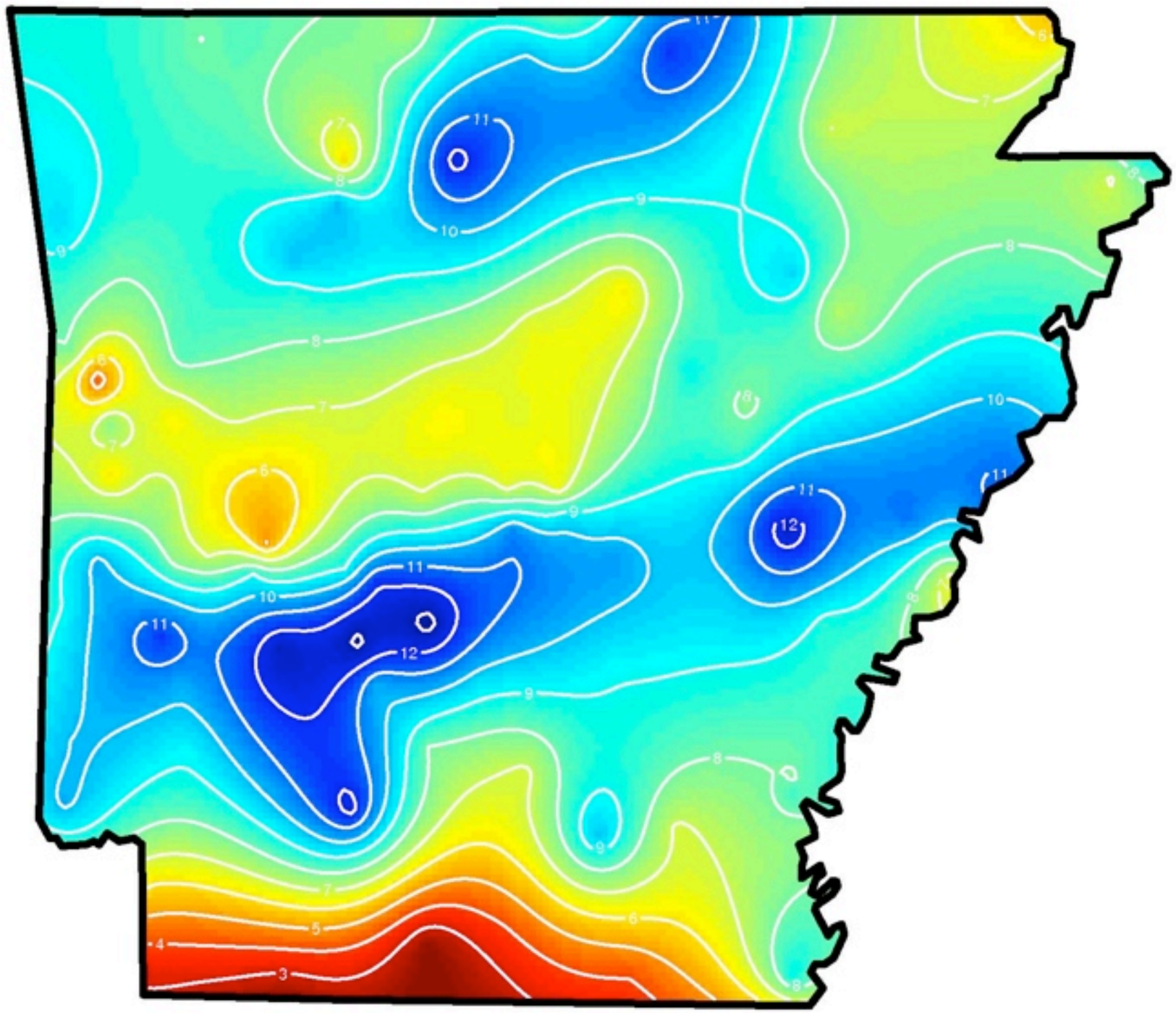
```
fit=krig.image(xy,z,cov.function=Exp.image.cov,m=mx,n=nx,lambda=0.01,
kmax=1000,expand=1.2)

res<- predict( fit, fit$xM) - fit$yM

img=list(fit$surface$x,fit$surface$y,fit$surface$z)

proj_pts = mapproject(list(x=img$x,y=img$y),projection="mercator")

proj_img = list(x=proj_pts$x,y=proj_pts$y,z=img$z)

proj_img = mask(proj_img)

image.plot(proj_img,col=rev(tim.colors(64)),xlab='Longitude',ylab='La
titude',add=1,projection="",horizontal=1)
```

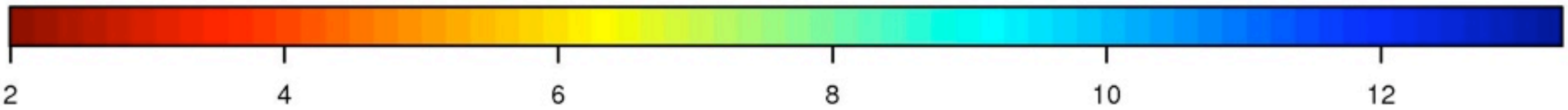
Masking

- Pass the array of fitted points to the masking routine
- Find which points lie ‘inside’ the polygon(I) and which lie ‘outside’ (O) - ‘inout’ method in the ‘sp’ package
- Nullify the ‘outside’ points, O
    - one possibility is assign their ‘z’ values to NA
- Return the array comprising of nullified outside points, O and ‘inside’ points, I

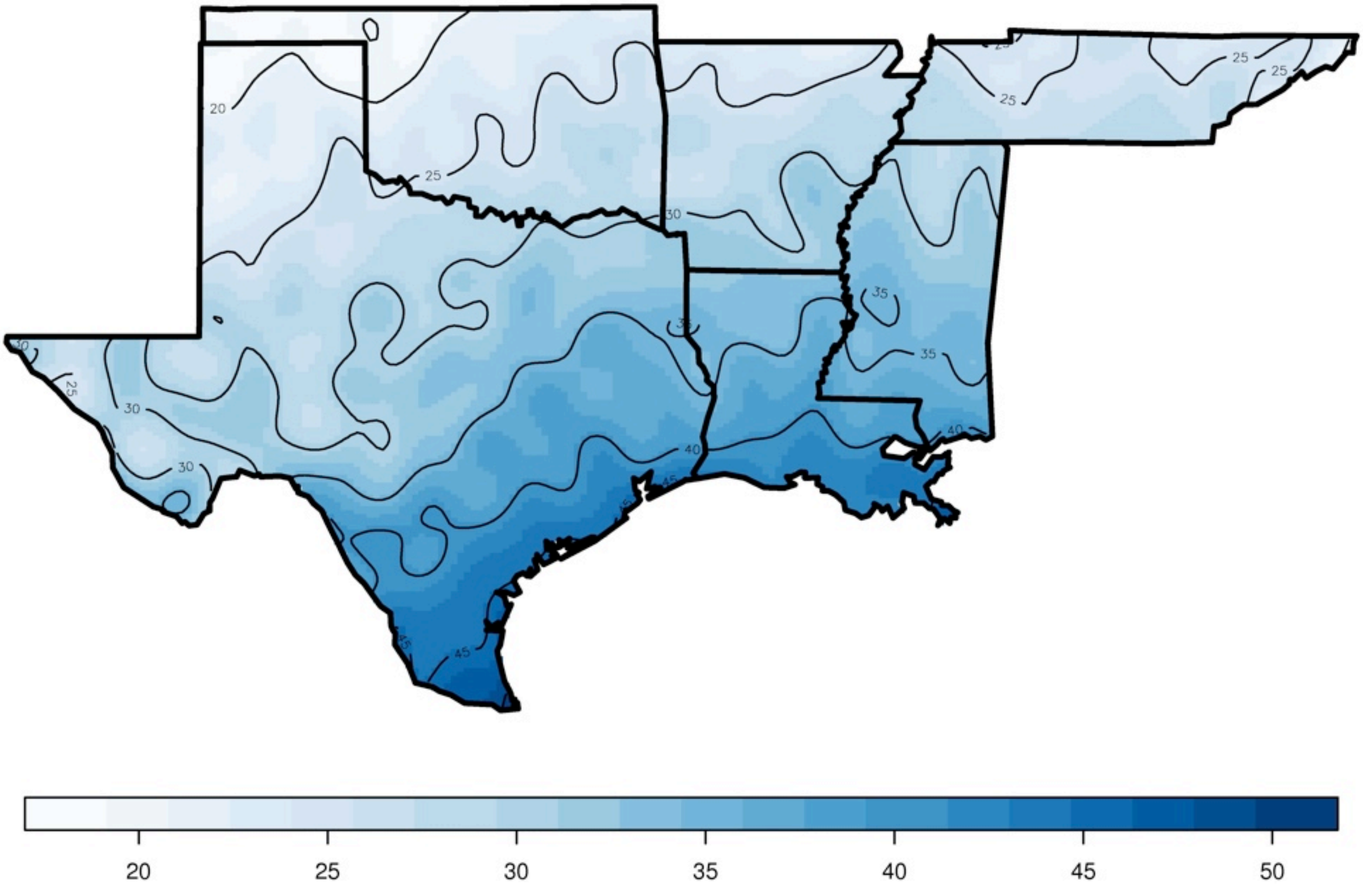

Latitude
37
36
35
34
33
32
−95
−94
−93
−92
−91
−90
−89
Longitude

Rainfall Totals – April 2008

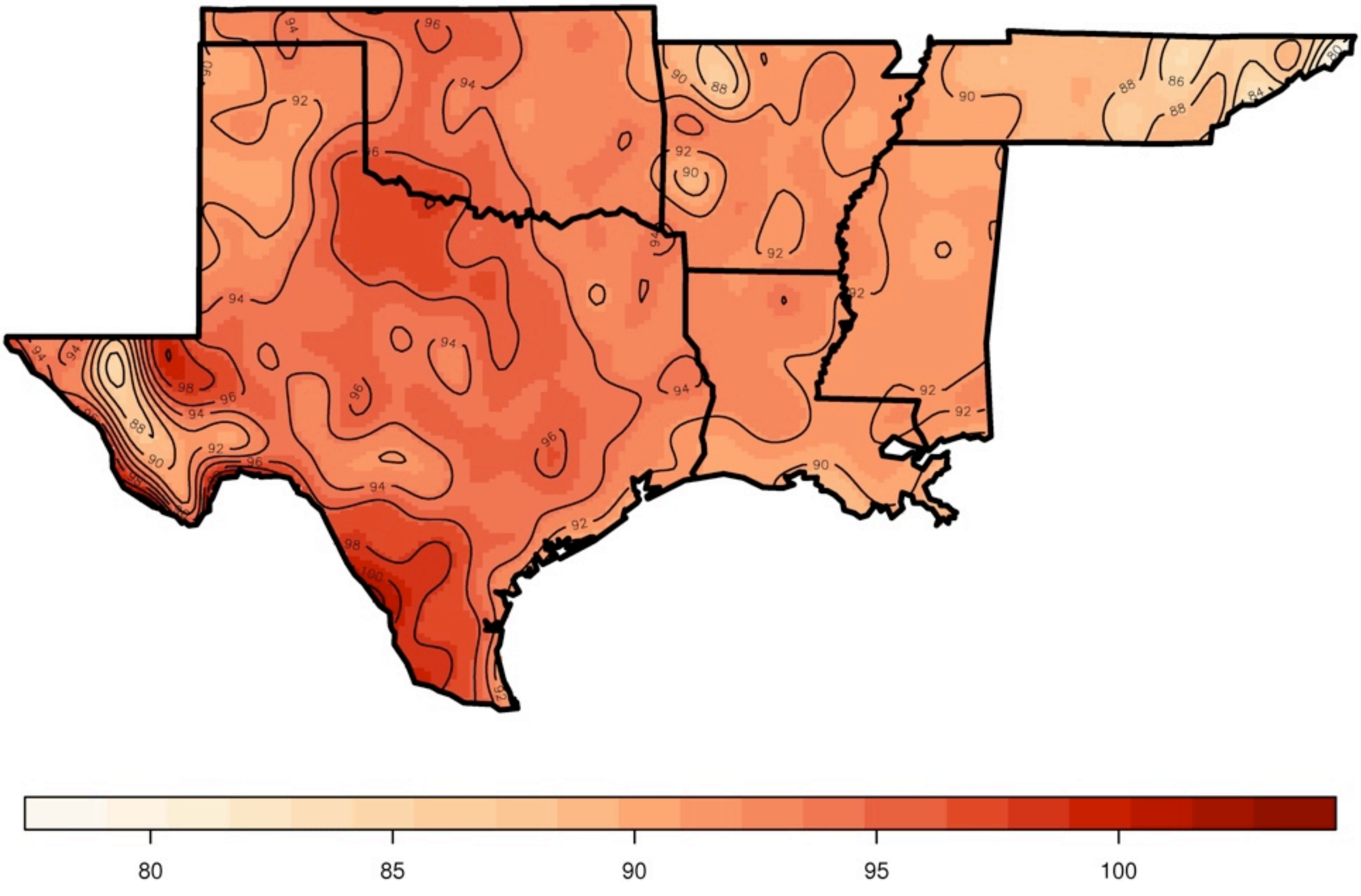




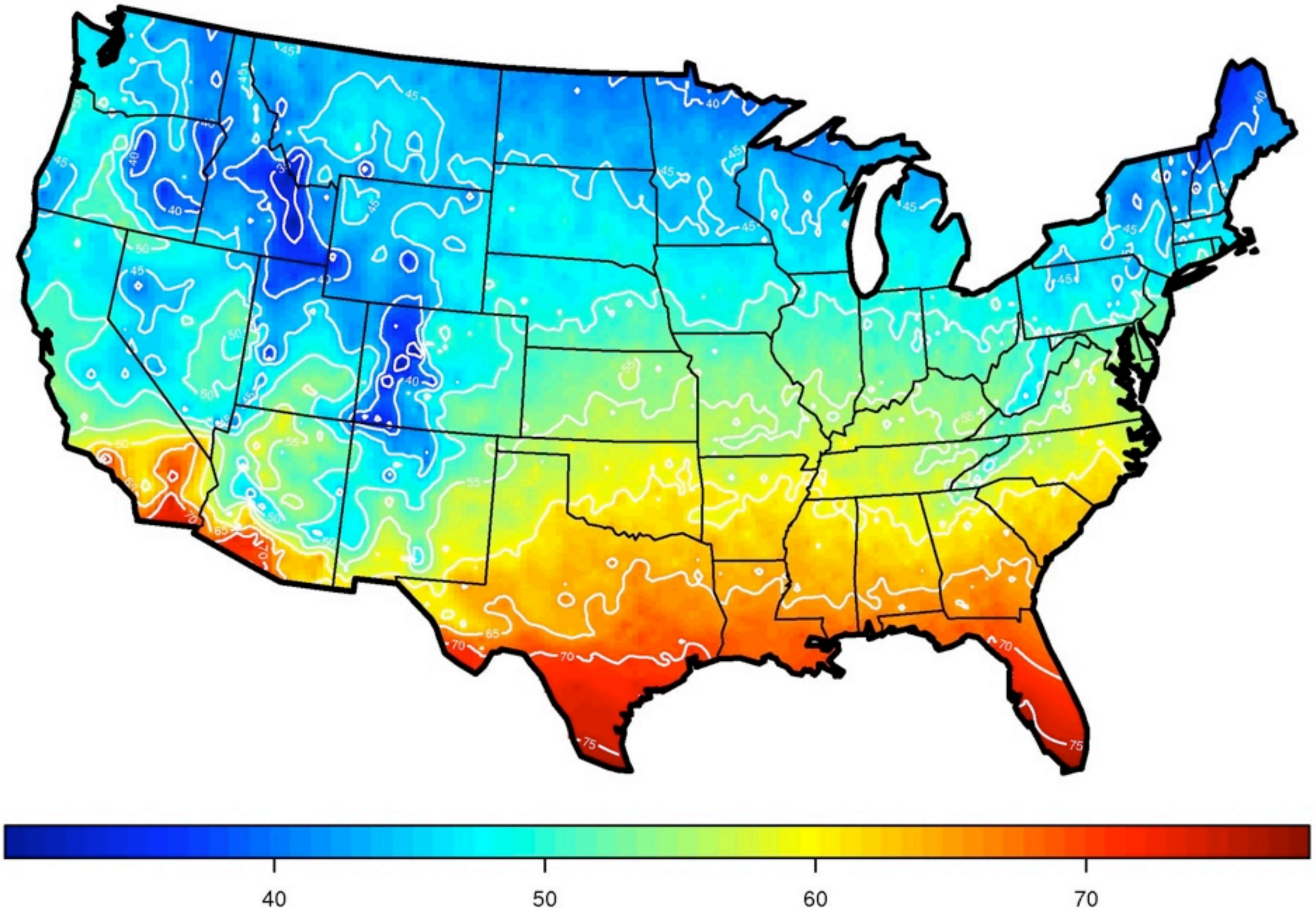
JAN – TMIN based on 1971–2000 normals



JULY – TMAX based on 1971–2000 normals



ANNUAL – TAVG based on 1971–2000 normals



Charts using R