Assignment 5

1. Potential Renewable Energy Spots in China

1.1 Download the following data sets and load them in R:

- ***Solar radiation, 2.5 minutes***
- ***Precipitation, 2.5 minutes***
- ***Wind speed, 2.5 minutes***

Here, I read the data in November.

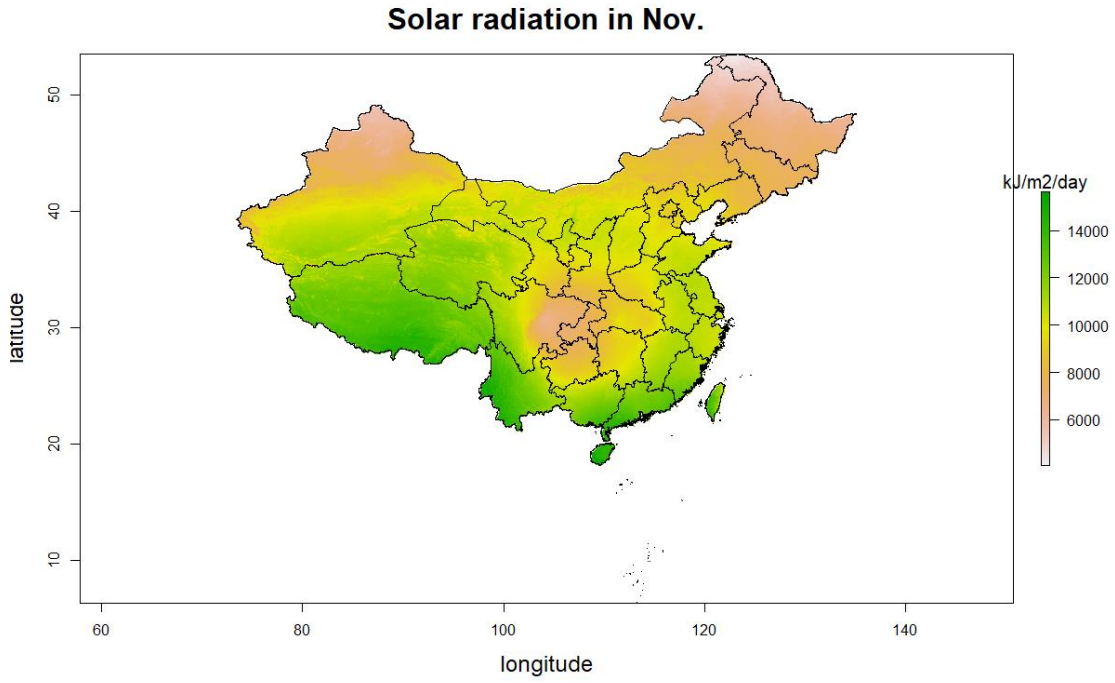
```
install.packages("sp")
install.packages("rgdal")
install.packages("sf")
install.packages("raster")
library("sp")
library("rgdal")
library("sf")
library("raster")
library(fields);
library(maps);
library(RNetCDF)
setwd("E:/课程/ESE5023_Assignments/HW5")
getwd()
#1.1 Download the following data sets and load them in R
# Read Solar radiation tiff file(NOV)
Srad_Nov <- raster("wc2.1_2.5m_srad_11.tif")
# Look at the raster attributes
Srad_Nov
# Read Precipitation tiff file(NOV)
Prec_Nov <- raster("wc2.1_2.5m_prec_11.tif")
# Look at the raster attributes
Prec_Nov
# Read Wind speed tiff file(NOV)
Wind_Nov <- raster("wc2.1_2.5m_wind_11.tif")
# Look at the raster attributes
Wind_Nov
```

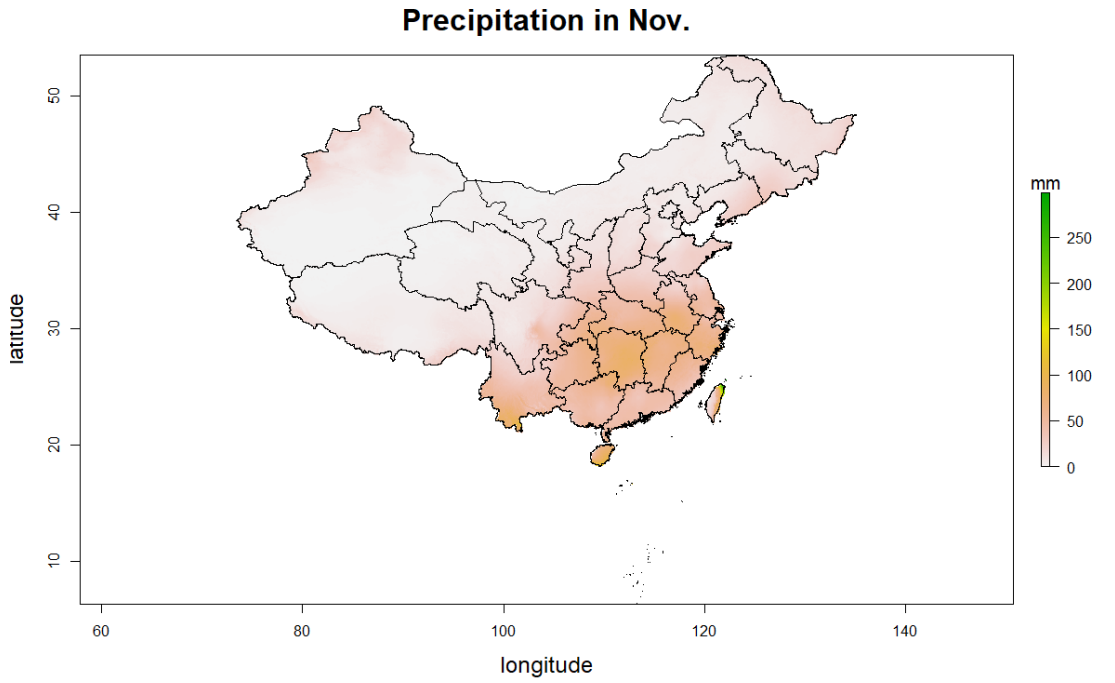
```
> #1.1 Download the following data sets and load them in R
> # Read Solar radiation tiff file(NOv)
> Srad_Nov <- raster("wc2.1_2.5m_srad_11.tif")
> # Look at the raster attributes
> Srad_Nov
class       : RasterLayer
dimensions  : 4320, 8640, 37324800  (nrow, ncol, ncell)
resolution  : 0.04166667, 0.04166667  (x, y)
extent      : -180, 180, -90, 90  (xmin, xmax, ymin, ymax)
crs         : +proj=longlat +datum=WGS84 +no_defs
source      : E:/课程/ESE5023_Assignments/HW5/wc2.1_2.5m_srad_11.tif
names       : wc2.1_2.5m_srad_11
values      : 0, 36361  (min, max)

> # Read Precipitation tiff file(NOv)
> Prec_Nov <- raster("wc2.1_2.5m_prec_11.tif")
> # Look at the raster attributes
> Prec_Nov
class       : RasterLayer
dimensions  : 4320, 8640, 37324800  (nrow, ncol, ncell)
resolution  : 0.04166667, 0.04166667  (x, y)
extent      : -180, 180, -90, 90  (xmin, xmax, ymin, ymax)
crs         : +proj=longlat +datum=WGS84 +no_defs
source      : E:/课程/ESE5023_Assignments/HW5/wc2.1_2.5m_prec_11.tif
names       : wc2.1_2.5m_prec_11
values      : 0, 755  (min, max)

> # Read Wind speed tiff file(NOv)
> Wind_Nov <- raster("wc2.1_2.5m_wind_11.tif")
> # Look at the raster attributes
> Wind_Nov
class       : RasterLayer
dimensions  : 4320, 8640, 37324800  (nrow, ncol, ncell)
resolution  : 0.04166667, 0.04166667  (x, y)
extent      : -180, 180, -90, 90  (xmin, xmax, ymin, ymax)
crs         : +proj=longlat +datum=WGS84 +no_defs
source      : E:/课程/ESE5023_Assignments/HW5/wc2.1_2.5m_wind_11.tif
names       : wc2.1_2.5m_wind_11
values      : 0.38, 22.312  (min, max)
```

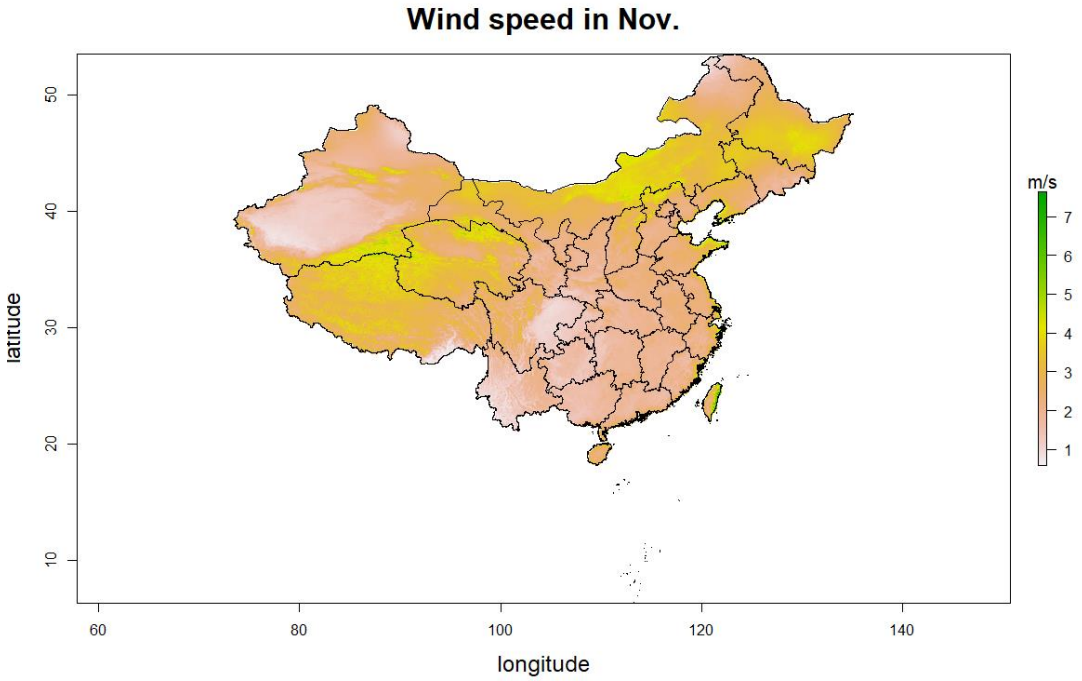
1.2 Plot the above data sets over China. You should make three plots, each should contain its own legend.

Here, I plot the above data sets in November over China.

```
#1.2 Plot the above data sets over China. You should make three plots, each should contain its own legend.
China_map <- readOGR("E://课程/ESE5023_Assignments/HW5/China_map", "bou2_4p")
plot(China_map)
#plot Solar radiation in Nov.
plot(Srad_Nov, main="Solar radiation in Nov.")
Srad_Nov_crop <- crop(Srad_Nov, China_map)
Srad_Nov_china <- Srad_Nov_crop %>%
  mask(China_map, na.rm=TRUE)
plot(Srad_Nov_china, main="Solar radiation in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="kJ/m2/day",cex=1.25))
plot(China_map, add=T)
#plot Precipitation in Nov.
plot(Prec_Nov, main="Precipitation in Nov.")
Prec_Nov_crop <- crop(Prec_Nov, China_map)
Prec_Nov_china <- Prec_Nov_crop %>%
  mask(China_map, na.rm=TRUE)
plot(Prec_Nov_china, main="Precipitation in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="mm",cex=1.25))
plot(China_map, add=T)
#plot Wind speed in Nov.
plot(Wind_Nov, main="Wind speed in Nov.")
Wind_Nov_crop <- crop(Wind_Nov, China_map)
Wind_Nov_china <- Wind_Nov_crop %>%
  mask(China_map, na.rm=TRUE)
plot(Wind_Nov_china, main="Wind speed in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="m/s",cex=1.25))
plot(China_map, add=T)
contour(Wind_Nov_china, add=T, col="red", nlevels=4)
```


Solar radiation in Nov.
kJ/m2/day
14000
12000
10000
8000
6000
latitude
longitude
10
20
30
40
50
60
80
100
120
140


Precipitation in Nov.
mm
250
200
150
100
50
0
latitude
longitude
10
20
30
40
50
60
80
100
120
140

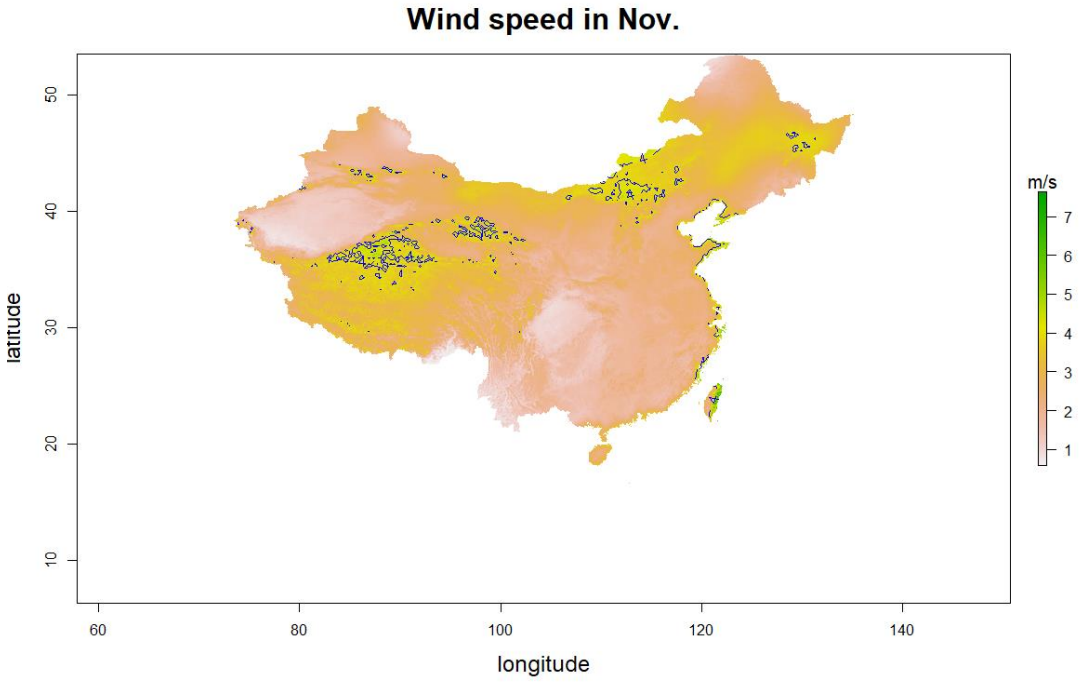


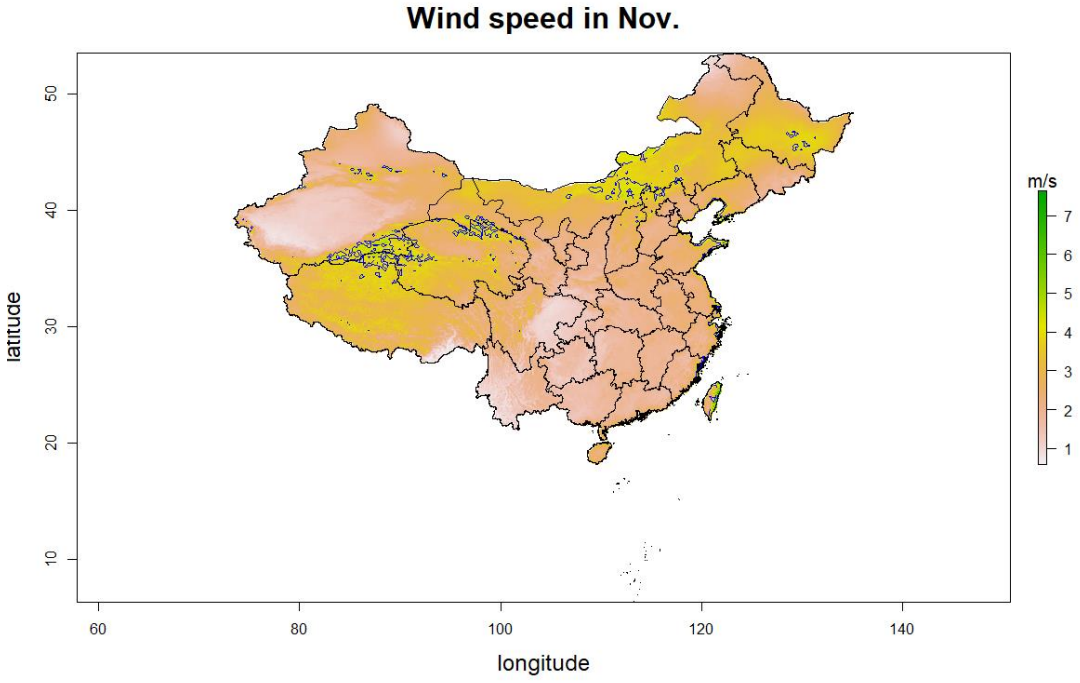
1.3 First, let's search for regions with relatively high wind speed to build wind farms. Define a reasonable wind speed as the threshold, and describe your favorite spots.

According to the results in 1.2, the range of the wind speed in November in China varies from 0.568 to 7.648 m/s. The medium wind speed (4 m/s) is determined to be the threshold. Here, I plot the contour to show the area where wind speed is over 4 m/s. I discussed the method here with Yue Hou.

```
> Wind_Nov_china
class       : RasterLayer
dimensions  : 1133, 1479, 1675707  (nrow, ncol, ncell)
resolution  : 0.04166667, 0.04166667  (x, y)
extent      : 73.45833, 135.0833, 6.333333, 53.54167  (xmin, xmax, ymin, ymax)
crs         : +proj=longlat +datum=WGS84 +no_defs
source      : memory
names       : wc2.1_2.5m_wind_11
values      : 0.568, 7.648  (min, max)
```

```
#1.3 First, let's search for regions with relatively high wind speed to build wind farms.
#Define a reasonable wind speed as the threshold, and describe your favorite spots.
#Discuss with Yue Hou
plot(Wind_Nov_china, main="Wind speed in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="m/s",cex=1.25))
contour(Wind_Nov_china, add=T, col="blue", levels = seq(0, 8, by=4), labcex=1)
plot(Wind_Nov_china, main="Wind speed in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="m/s",cex=1.25))
plot(China_map, add=T)
contour(Wind_Nov_china, add=T, col="blue", levels = seq(0, 8, by=4), labcex=1)
```



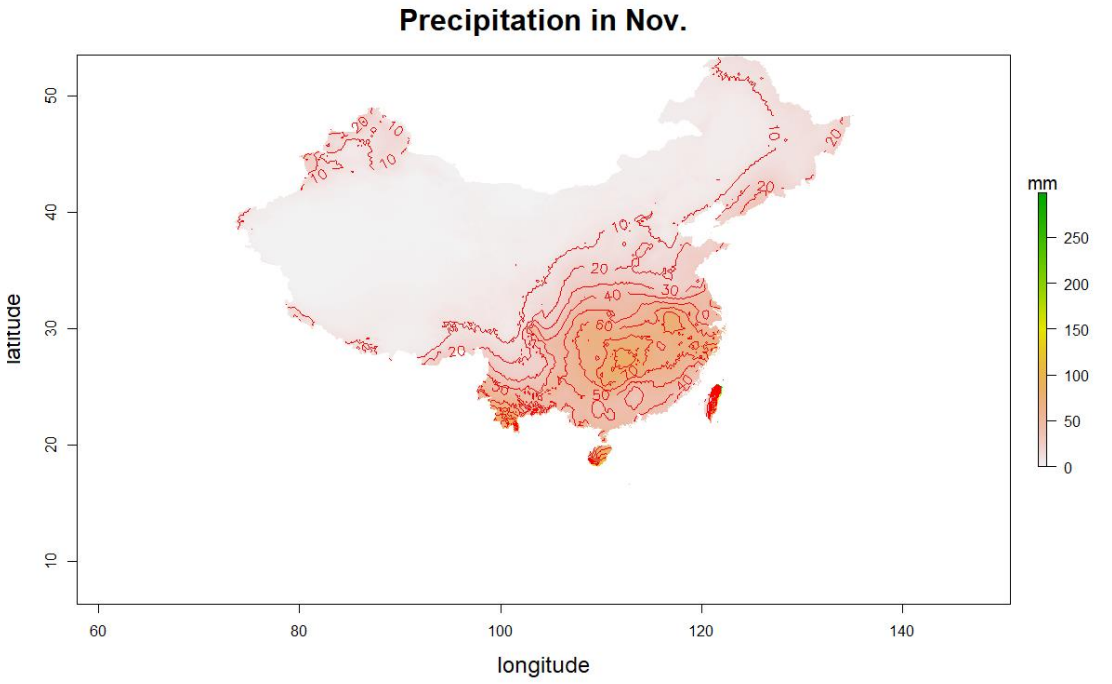


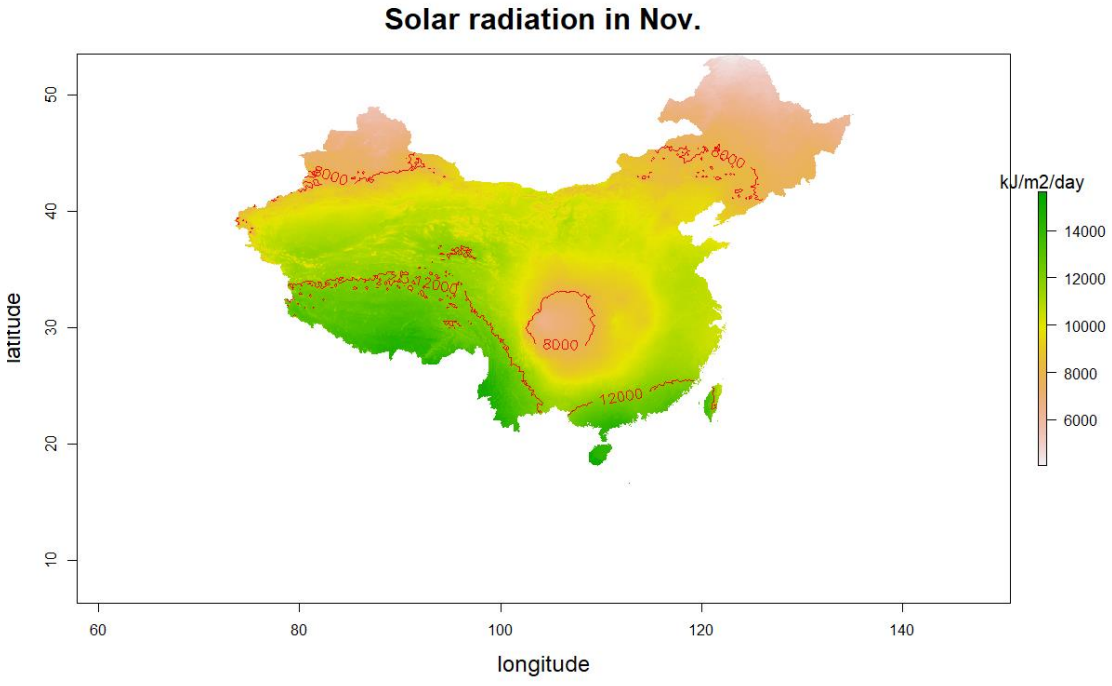
Discussion: My favorite spots may be located in the upper middle of the Xinjiang, in the west of Qinghai, at the junction of Qinghai and Gansu, in the middle of Inner Mongoria, in the east-south of Heilongjiang, in the eastern coastal area and in the east of Taiwan.

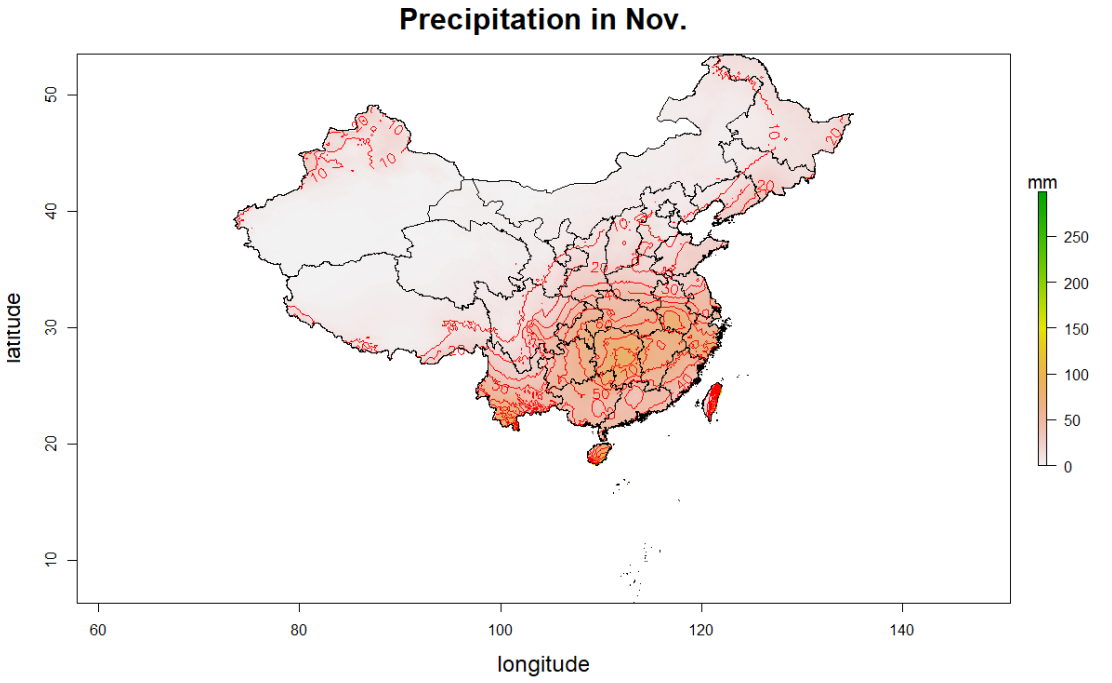
1.4 Second, let's search for regions with relatively high solar radiation and low precipitation as potential locations of photovoltaics (PV) farms. Describe your favorite spots of PV farms.

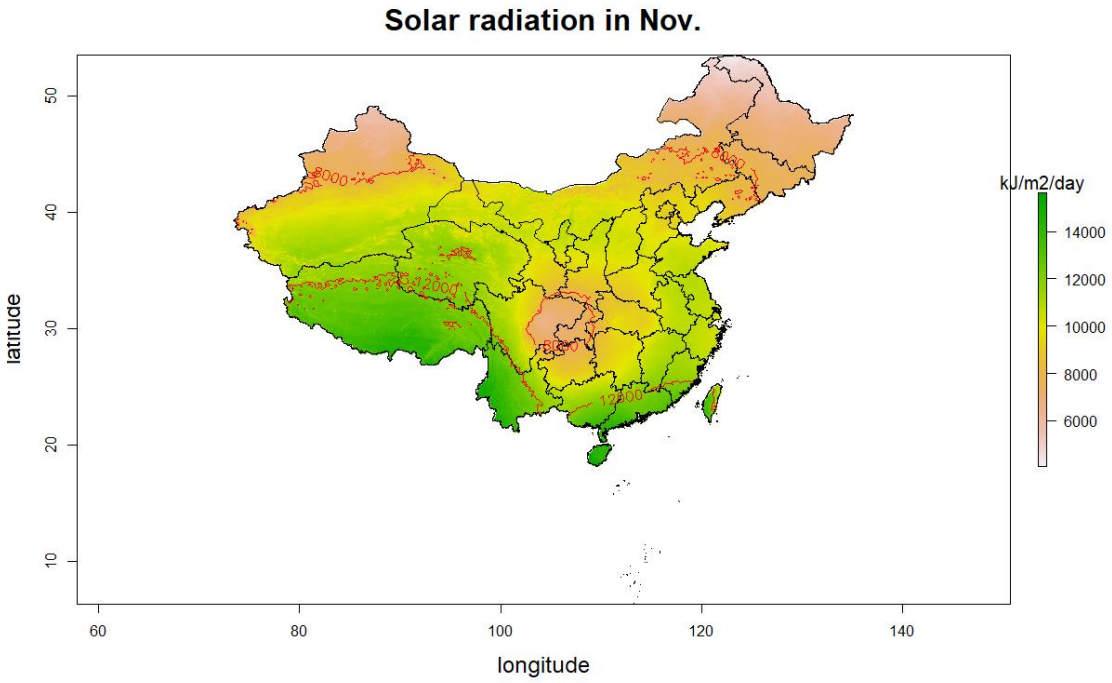
Here, I take the same methods from 1.3. I plot the contour to show the regions with relatively high solar radiation and low precipitation.

```
#1.4 Second, let's search for regions with relatively high solar radiation and low precipitation as potential locations of photovoltaics (PV) farms.
#Describe your favorite spots of PV farms.
#Discuss with Yue Hou
plot(Srad_Nov_china, main="Solar radiation in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="kJ/m2/day",cex=1.25))
contour(Srad_Nov_china, add=T, col="red", levels = seq(4000, 16000, by=4000), labcex=1)
plot(Srad_Nov_china, main="Solar radiation in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="kJ/m2/day",cex=1.25))
plot(China_map, add=T)
contour(Srad_Nov_china, add=T, col="red", levels = seq(4000, 16000, by=4000), labcex=1)
plot(Prec_Nov_china, main="Precipitation in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="mm",cex=1.25))
contour(Prec_Nov_china, add=T, col="red", levels = seq(0, 300, by=10), labcex=1)
plot(Prec_Nov_china, main="Precipitation in Nov.",xlab="longitude", ylab="latitude", cex.lab=1.5, cex.main=2, legend.args=list(text="mm",cex=1.25))
plot(China_map, add=T)
contour(Prec_Nov_china, add=T, col="red", levels = seq(0, 300, by=10), labcex=1)
```









Discussion: My favorite spots of PV farms may be distributed in the south of Tibet where solar radiation is over 12000 kJ/m^2/d and precipitation is less than 20 mm.

2. More Linux Commands

2.1 Make a link called data_demo_link to data_demo folder using ln

```
[ese-wangjq@login03 ~]$ ln -s data_demo data_demo_link
[ese-wangjq@login03 ~]$ ll
total 133
drwxr-xr-x 2 root       root      4096 Sep 26 15:20 billing_report
drwxr-xr-x 8 ese-wangjq ese-ouycc 4096 Dec  1 16:44 data_demo
lrwxrwxrwx 1 ese-wangjq ese-ouycc    9 Dec  1 16:47 data_demo_link -> data_demo
-rw-r--r-- 1 ese-wangjq ese-ouycc  253 Nov 26 20:49 err.log
drwxr-xr-x 2 ese-wangjq ese-ouycc 4096 Sep 12 11:01 exam
-rw-r--r-- 1 ese-wangjq ese-ouycc 8594 Nov 26 20:49 job.log
-rw-r--r-- 1 ese-wangjq ese-ouycc  312 Nov 26 20:27 job.sh
drwxr-xr-x 2 ese-wangjq ese-ouycc 4096 Nov 19 19:57 mytest
-rw-r--r-- 1 ese-wangjq ese-ouycc    0 Nov 26 20:24 result2.log
-rw-r--r-- 1 ese-wangjq ese-ouycc    0 Nov 26 20:49 result.log
-rw-r--r-- 1 ese-wangjq ese-ouycc  134 Nov 26 19:27 t1.R
-rw-r--r-- 1 ese-wangjq ese-ouycc  162 Nov 26 20:48 t2.R
drwxr-x--- 2 ese-wangjq ese-ouycc 4096 Nov 24 20:00 test
```

2.2 Go to data_demo/data/, make an empty file planets.txt_1st with touch.

```
[ese-wangjq@login03 ~]$ cd /work/ese-wangjq/data_demo/data/
[ese-wangjq@login03 data]$ touch planets.txt_lst
```

```
[ese-wangjq@login03 ~]$ cd /work/ese-wangjq/data_demo/data/
[ese-wangjq@login03 data]$ ll
total 260
-rw-r--r-- 1 ese-wangjq ese-ouycc   283 Nov 24 20:13 amino-acids.txt
drwxr-xr-x 2 ese-wangjq ese-ouycc  4096 Nov 19 20:26 animal-counts
-rw-r--r-- 1 ese-wangjq ese-ouycc   136 Nov 24 20:13 animals.txt
drwxr-xr-x 2 ese-wangjq ese-ouycc  4096 Nov 19 20:26 elements
-rw-r--r-- 1 ese-wangjq ese-ouycc   554 Nov 24 20:13 morse.txt
drwxr-xr-x 2 ese-wangjq ese-ouycc  4096 Nov 26 20:33 pdb
-rw-r--r-- 1 ese-wangjq ese-ouycc  8898 Nov 24 20:13 planets.txt
-rw-r--r-- 1 ese-wangjq ese-ouycc     0 Dec  1 16:50 planets.txt_lst
-rw-r--r-- 1 ese-wangjq ese-ouycc    45 Nov 24 20:13 salmon.txt
-rw-r--r-- 1 ese-wangjq ese-ouycc 73861 Nov 24 20:13 sunspot.txt
```

2.3 Print your home directory using echo.

```
[ese-wangjq@login03 data]$ echo $HOME
/work/ese-wangjq
```

2.4 Find how many files in data_demo/data/pdb/ using find.

```
[ese-wangjq@login03 data]$ find ./pdb/ -type f -print | wc -l
53
```

2.5 Count how many C character appears in data_demo/data/pdb/tnt.pdb with grep.

```
[ese-wangjq@login03 data]$ grep "C" ./pdb/tnt.pdb -c -i
9
```

2.6 Compare data_demo/data/pdb/ethane.pdb and data_demo/data/pdb/ethanol.pdb with diff

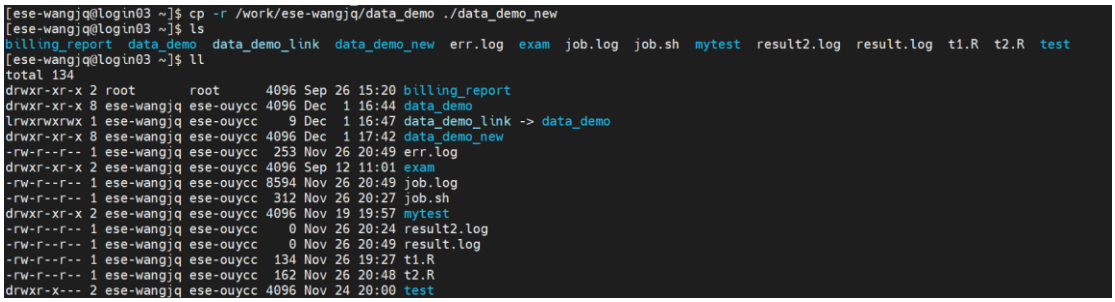
```
[ese-wangjq@login03 pdb]$ diff ethane.pdb ethanol.pdb -y -w
COMPND      ETHANE                                | COMPND      ETHANOL
AUTHOR      DAVE WOODCOCK  95 12 18               | AUTHOR      DAVE WOODCOCK  96 01 03
ATOM      1  C           1      -0.752   0.001  -0.141  1.00 | ATOM      1  C           1      -0.426  -0.115  -0.147  1.00
ATOM      2  C           1       0.752  -0.001   0.141  1.00 | ATOM      2  O           1      -0.599   1.244  -0.481  1.00
ATOM      3  H           1      -1.158   0.991   0.070  1.00 | ATOM      3  H           1      -0.750  -0.738  -0.981  1.00
ATOM      4  H           1      -1.240  -0.737   0.496  1.00 | ATOM      4  H           1      -1.022  -0.351   0.735  1.00
ATOM      5  H           1      -0.924  -0.249  -1.188  1.00 | ATOM      5  H           1      -1.642   1.434  -0.689  1.00
ATOM      6  H           1       1.158  -0.991  -0.070  1.00 | ATOM      6  C           1       1.047  -0.383   0.147  1.00
ATOM      7  H           1       0.924   0.249   1.188  1.00 | ATOM      7  H           1       1.370   0.240   0.981  1.00
ATOM      8  H           1       1.240   0.737  -0.496  1.00 | ATOM      8  H           1       1.642  -0.147  -0.735  1.00
TER       9              1                                    | ATOM      9  H           1       1.180  -1.434   0.405  1.00
                                                              > TER      10              1
END                                                             END
```

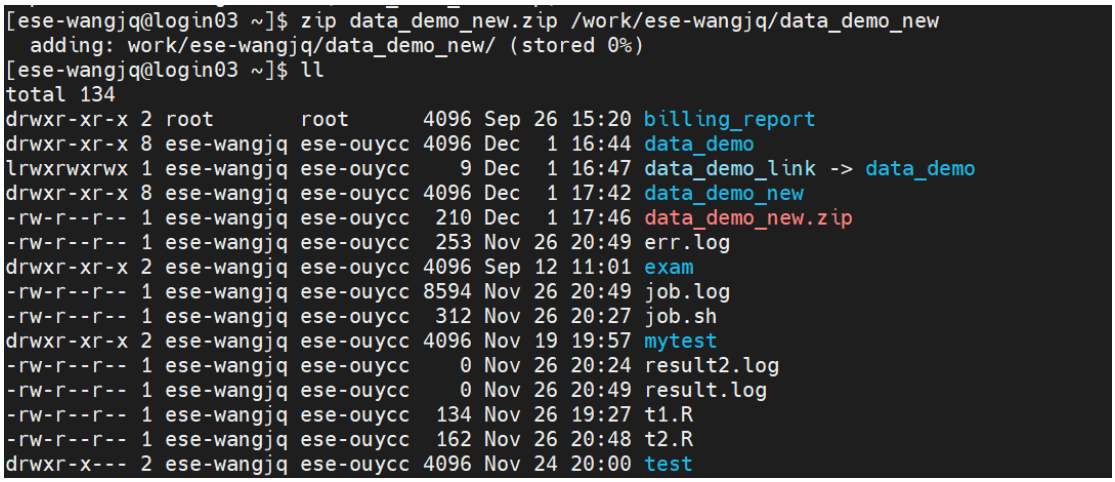
2.7 Check the total file size of the data_demo folder using du.

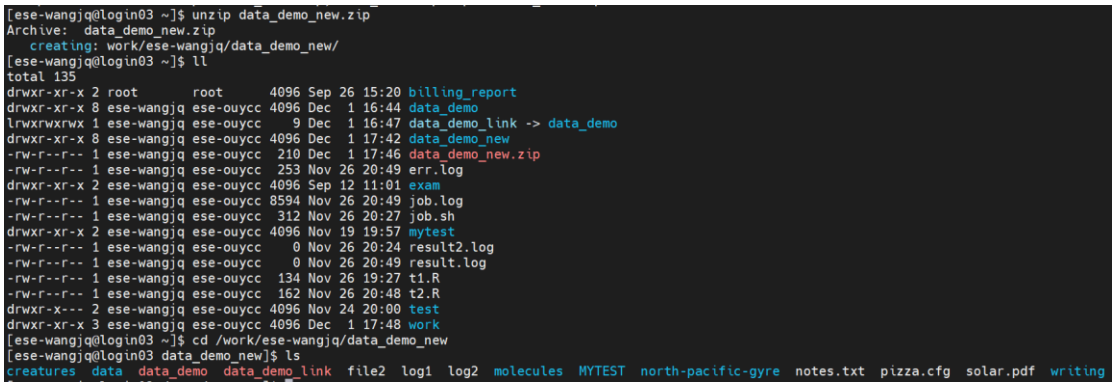
```
[ese-wangjq@login03 data_demo]$ du -h
3.5K    ./molecules
512     ./MYTEST/t1/t2
1.0K    ./MYTEST/t1
2.5K    ./MYTEST
512     ./writing/tools/old
2.0K    ./writing/tools
1.3M    ./writing/data
512     ./writing/thesis
1.3M    ./writing
2.1M    ./north-pacific-gyre/2012-07-03
2.1M    ./north-pacific-gyre
2.0K    ./creatures
410K    ./data/pdb
52K     ./data/elements
1.0K    ./data/animal-counts
721K    ./data
4.1M    .
[ese-wangjq@login03 data_demo]$ du -s
4196    .
[ese-wangjq@login03 data_demo]$ du -a
1       ./molecules/methane.pdb
1       ./molecules/pentane.pdb
1       ./molecules/cubane.pdb
1       ./molecules/ethane.pdb
1       ./molecules/propane.pdb
1       ./molecules/octane.pdb
4       ./molecules
1       ./MYTEST/file2
1       ./MYTEST/file1
1       ./MYTEST/t1/t2
1       ./MYTEST/t1
3       ./MYTEST
128     ./solar.pdf
1       ./data_demo
1       ./writing/haiku.txt
1       ./writing/tools/stats
0       ./writing/tools/old/oldtool
1       ./writing/tools/old
1       ./writing/tools/format
2       ./writing/tools
1       ./writing/data/one.txt
1152    ./writing/data/LittleWomen.txt
128     ./writing/data/two.txt
1281    ./writing/data
0       ./writing/thesis/empty-draft.md
```

注：du -a 的结果不完整，太长了，截屏没有截完整。

2.8 Copy the data_demo folder to data_demo_new, compress it using zip, and decompress the .zip file with unzip.







2.9 Change the file permissions flags on data_demo_new to drwxr-x--- using chmod.

```
[ese-wangjq@login03 ~]$ chmod 750 data_demo_new
[ese-wangjq@login03 ~]$ ll
total 135
drwxr-xr-x 2 root       root      4096 Sep 26 15:20 billing_report
drwxr-xr-x 8 ese-wangjq ese-ouycc 4096 Dec  1 16:44 data_demo
lrwxrwxrwx 1 ese-wangjq ese-ouycc    9 Dec  1 16:47 data_demo_link -> data_demo
drwxr-x--- 8 ese-wangjq ese-ouycc 4096 Dec  1 17:42 data_demo_new
-rw-r--r-- 1 ese-wangjq ese-ouycc  210 Dec  1 17:46 data_demo_new.zip
-rw-r--r-- 1 ese-wangjq ese-ouycc  253 Nov 26 20:49 err.log
drwxr-xr-x 2 ese-wangjq ese-ouycc 4096 Sep 12 11:01 exam
-rw-r--r-- 1 ese-wangjq ese-ouycc 8594 Nov 26 20:49 job.log
-rw-r--r-- 1 ese-wangjq ese-ouycc  312 Nov 26 20:27 job.sh
drwxr-xr-x 2 ese-wangjq ese-ouycc 4096 Nov 19 19:57 mytest
-rw-r--r-- 1 ese-wangjq ese-ouycc    0 Nov 26 20:24 result2.log
-rw-r--r-- 1 ese-wangjq ese-ouycc    0 Nov 26 20:49 result.log
-rw-r--r-- 1 ese-wangjq ese-ouycc  134 Nov 26 19:27 t1.R
-rw-r--r-- 1 ese-wangjq ese-ouycc  162 Nov 26 20:48 t2.R
drwxr-x--- 2 ese-wangjq ese-ouycc 4096 Nov 24 20:00 test
drwxr-xr-x 3 ese-wangjq ese-ouycc 4096 Dec  1 17:48 work
```

2.10 Print the last 10 commands you made using history.

```
[ese-wangjq@login03 ~]$ history 10
  539  unzip data_demo.zip
  540  unzip data_demo_new.zip
  541  ll
  542  cd /work/ese-wangjq/data_demo_new
  543  ls
  544  cd ..
  545  chmod 750 data_demo_new
  546  ll
  547  man history
  548  history 10
```