clusters_ssc.R

mtst

Mon Apr 16 11:28:42 2018

```
# Data analysis using varclust initialized with SSC clusterings.
## Load libraries, functions, SSC clusterings and datasets ----
library(varclust)
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(tidyr)
library(readr)
library(stringr)
library(ggplot2)
library(ggmap)
library(readr)
source("functions.R")
source("ssc_clusters_vecs.R")
load("./data/march_less.rda")
load("./data/march_daily.rda")
load("./data/stations.rda")
sensor_locations <- read_csv("./data/sensor_locations.csv")
```

```
## Parsed with column specification:
## cols(
##   id = col_integer(),
##   latitude = col_double(),
##   longitude = col_double()
## )
```

```
## Run varclust on each of the SSC clusterings ----
every_cl <- list(rep(1, 263), c(1, cl2[2:263]), cl3, cl4, cl5, cl6, cl7, cl8, cl9,
                 cl10, cl11, cl12, cl13, cl14, cl15, cl16, cl17, cl18, cl19, cl20)
every_vcl <- lapply(1:20, function(x)
               mlcc.reps(march_less, numb.clusters = x, numb.runs = 30, max.iter = 50,
                         initial.segmentations = list(every_cl[[x]][1:263])))
```

```
## Warning in mlcc.reps(march_less, numb.clusters = x, numb.runs = 30,
## max.iter = 50, : X is not a matrix. Casting to matrix.
```

```
## Warning in mlcc.reps(march_less, numb.clusters = x, numb.runs = 30,
## max.iter = 50, : Missing values are imputed by the mean of the variable
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## max.iter = 50, : Missing values are imputed by the mean of the variable
```

```r
lapply(every_vcl, function(x) x$BIC)
```

```
## [[1]]
## [1] -68580.87
##
## [[2]]
## [1] -22036.34
##
## [[3]]
## [1] -13641.49
##
## [[4]]
## [1] -11748.06
##
```

```
## [[5]]
## [1] 5055.665
##
## [[6]]
## [1] 5508.149
##
## [[7]]
## [1] 11875.32
##
## [[8]]
## [1] 14652
##
## [[9]]
## [1] 13942.13
##
## [[10]]
## [1] 17218.34
##
## [[11]]
## [1] 17907.84
##
## [[12]]
## [1] 18939.17
##
## [[13]]
## [1] 18758.9
##
## [[14]]
## [1] 18838.02
##
## [[15]]
## [1] 19426.28
##
## [[16]]
## [1] 18712.95
##
## [[17]]
## [1] 18771.47
##
## [[18]]
## [1] 17901.94
##
## [[19]]
## [1] 39554.07
##
## [[20]]
## [1] 29662.71
```

```
### The largest BIC: 19 clusters
clusters_ssc19 <- print.clusters.vec(march_less, cl19)
clusters_vcl9 <- print.clusters(march_less, every_vcl[[19]])
### What about other partitions?
lapply(1:20, function(x) {
  cl_ssc <- print.clusters.vec(march_less, (every_cl[[x]])[1:263])
```

```
  cl_vcl <- print.clusters(march_less, every_vcl[[x]])
  if(all(dim(cl_ssc) == dim(cl_vcl))) {
    sum(cl_ssc == cl_vcl)/(nrow(cl_ssc)*ncol(cl_ssc))
  } else {
    "Diff dim"
  }
})
```

```
## [[1]]
## [1] 1
##
## [[2]]
## [1] "Diff dim"
##
## [[3]]
## [1] "Diff dim"
##
## [[4]]
## [1] 1
##
## [[5]]
## [1] 1
##
## [[6]]
## [1] 1
##
## [[7]]
## [1] 1
##
## [[8]]
## [1] 1
##
## [[9]]
## [1] 1
##
## [[10]]
## [1] 1
##
## [[11]]
## [1] 1
##
## [[12]]
## [1] 1
##
## [[13]]
## [1] 1
##
## [[14]]
## [1] 1
##
## [[15]]
## [1] 0.9224806
##
## [[16]]
```

```
## [1] 0.9273256
##
## [[17]]
## [1] 0.9316005
##
## [[18]]
## [1] 0.9354005
##
## [[19]]
## [1] 0.8580171
##
## [[20]]
## [1] 0.8616279
```

```
## Draw maps showing the clusterings ----
print.clusters(march_less, every_vcl[[19]])
```

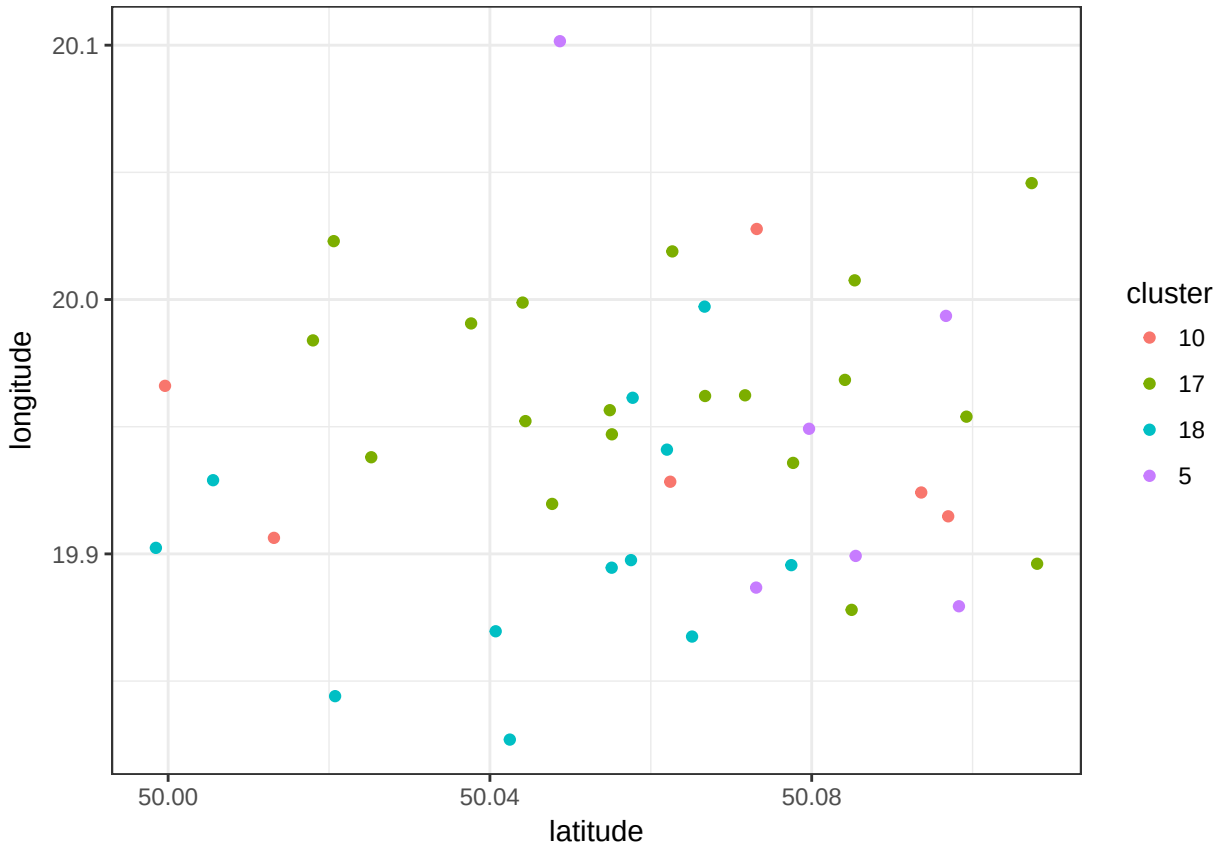
```
##    cluster_1 cluster_2 cluster_3        cluster_4     cluster_5 cluster_6
## 1   X170_pm1  X171_pm1  X173_pm1 X140_temperature X169_pressure  X172_pm1
## 2  X170_pm25 X171_pm25 X173_pm25 X170_temperature X172_pressure X172_pm25
## 3  X170_pm10 X171_pm10 X173_pm10 X171_temperature X183_pressure X172_pm10
## 4   X185_pm1  X208_pm1  X189_pm1 X172_temperature X185_pressure  X183_pm1
## 5  X185_pm25 X208_pm25 X189_pm25 X173_temperature X215_pressure X183_pm25
## 6  X185_pm10 X208_pm10 X189_pm10 X176_temperature X220_pressure X183_pm10
## 7   X209_pm1  X215_pm1  X192_pm1 X177_temperature             -  X225_pm1
## 8  X209_pm25 X215_pm25 X192_pm25 X179_temperature             - X225_pm25
## 9  X209_pm10 X215_pm10 X192_pm10 X180_temperature             - X225_pm10
## 10  X895_pm1  X221_pm1  X212_pm1 X181_temperature             -  X263_pm1
## 11 X895_pm25 X221_pm25 X212_pm25 X182_temperature             - X263_pm25
## 12 X895_pm10 X221_pm10 X212_pm10 X183_temperature             - X263_pm10
## 13         -         -         - X184_temperature             -         -
## 14         -         -         - X185_temperature             -         -
## 15         -         -         - X189_temperature             -         -
## 16         -         -         - X192_temperature             -         -
## 17         -         -         - X194_temperature             -         -
## 18         -         -         - X195_temperature             -         -
## 19         -         -         - X196_temperature             -         -
## 20         -         -         - X201_temperature             -         -
## 21         -         -         - X202_temperature             -         -
## 22         -         -         - X203_temperature             -         -
## 23         -         -         - X204_temperature             -         -
## 24         -         -         - X208_temperature             -         -
## 25         -         -         - X209_temperature             -         -
## 26         -         -         - X210_temperature             -         -
## 27         -         -         - X212_temperature             -         -
## 28         -         -         - X214_temperature             -         -
## 29         -         -         - X215_temperature             -         -
## 30         -         -         - X218_temperature             -         -
## 31         -         -         - X219_temperature             -         -
## 32         -         -         - X220_temperature             -         -
## 33         -         -         - X221_temperature             -         -
## 34         -         -         - X222_temperature             -         -
## 35         -         -         - X223_temperature             -         -
## 36         -         -         - X225_temperature             -         -
## 37         -         -         - X226_temperature             -         -
```

```
## 38         -         -         - X228_temperature             -         -
## 39         -         -         - X263_temperature             -         -
## 40         -         -         - X622_temperature             -         -
## 41         -         -         - X808_temperature             -         -
## 42         -         -         - X857_temperature             -         -
## 43         -         -         - X895_temperature             -         -
##    cluster_7 cluster_8     cluster_9    cluster_10       cluster_11
## 1  X140_pm25  X176_pm1 X171_humidity X177_pressure    X140_humidity
## 2  X140_pm10 X176_pm25 X172_humidity X189_pressure X169_temperature
## 3  X181_pm25 X176_pm10 X173_humidity X194_pressure    X169_humidity
## 4  X181_pm10  X194_pm1 X183_humidity X228_pressure         X169_pm1
## 5  X201_pm25 X194_pm25 X192_humidity X263_pressure        X169_pm25
## 6  X201_pm10 X194_pm10 X195_humidity X808_pressure        X169_pm10
## 7          -  X195_pm1 X196_humidity             -    X170_humidity
## 8          - X195_pm25 X202_humidity             -    X176_humidity
## 9          - X195_pm10 X203_humidity             -    X177_humidity
## 10         -  X210_pm1 X208_humidity             -    X179_humidity
## 11         - X210_pm25 X209_humidity             -    X180_humidity
## 12         - X210_pm10 X210_humidity             -    X181_humidity
## 13         -  X857_pm1 X212_humidity             -    X182_humidity
## 14         - X857_pm25 X214_humidity             -    X184_humidity
## 15         - X857_pm10 X215_humidity             -    X185_humidity
## 16         -         - X219_humidity             -    X189_humidity
## 17         -         - X220_humidity             -    X194_humidity
## 18         -         - X221_humidity             -    X201_humidity
## 19         -         - X222_humidity             -    X204_humidity
## 20         -         - X223_humidity             -    X218_humidity
## 21         -         - X225_humidity             -    X263_humidity
## 22         -         - X226_humidity             -    X895_humidity
## 23         -         - X228_humidity             -                -
## 24         -         - X622_humidity             -                -
## 25         -         - X808_humidity             -                -
## 26         -         - X857_humidity             -                -
## 27         -         -             -             -                -
## 28         -         -             -             -                -
## 29         -         -             -             -                -
## 30         -         -             -             -                -
## 31         -         -             -             -                -
## 32         -         -             -             -                -
## 33         -         -             -             -                -
## 34         -         -             -             -                -
## 35         -         -             -             -                -
## 36         -         -             -             -                -
## 37         -         -             -             -                -
## 38         -         -             -             -                -
## 39         -         -             -             -                -
## 40         -         -             -             -                -
## 41         -         -             -             -                -
## 42         -         -             -             -                -
## 43         -         -             -             -                -
##    cluster_12 cluster_13 cluster_14 cluster_15 cluster_16    cluster_17
## 1    X140_pm1   X177_pm1   X180_pm1   X179_pm1   X218_pm1 X171_pressure
## 2    X181_pm1  X177_pm25  X180_pm25  X179_pm25  X218_pm25 X176_pressure
## 3    X184_pm1  X177_pm10  X180_pm10  X179_pm10  X218_pm10 X179_pressure
```

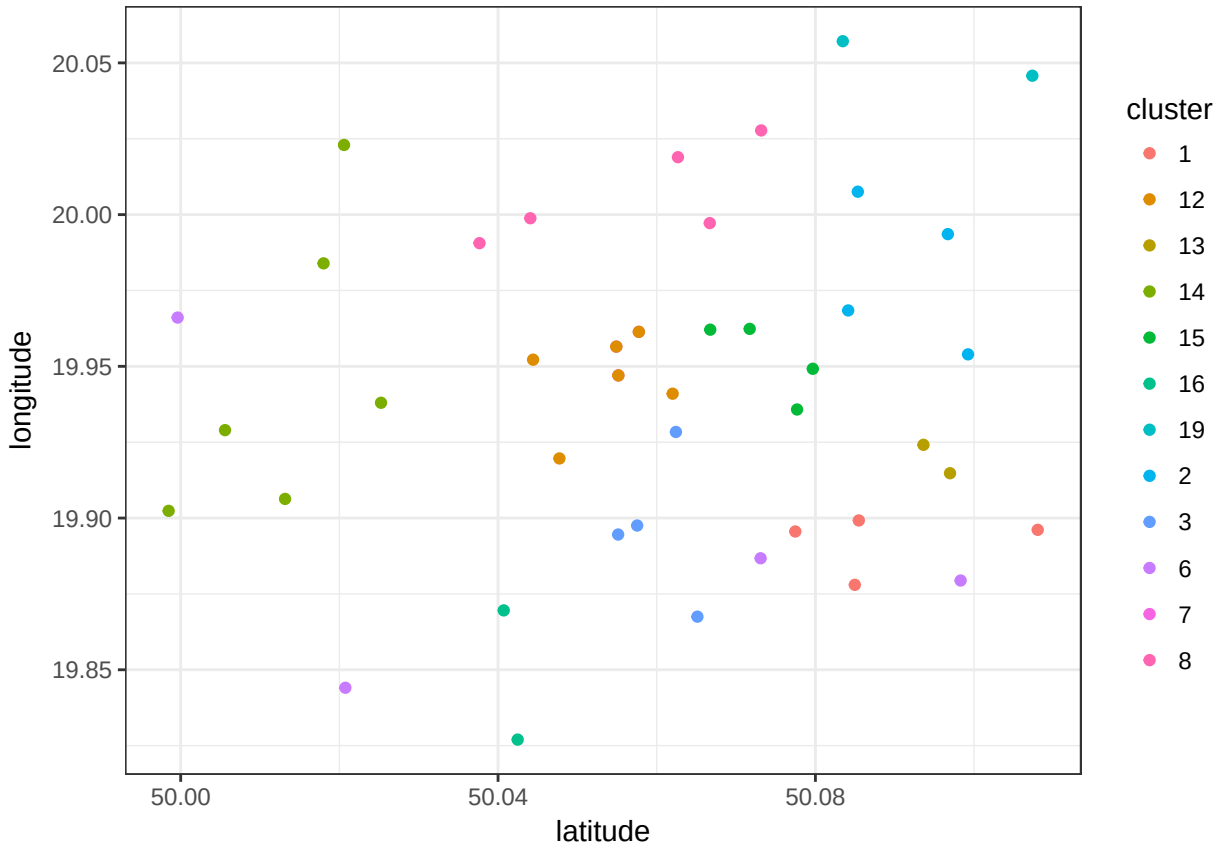
```
## 4   X184_pm25   X808_pm1   X182_pm1   X196_pm1   X222_pm1 X180_pressure
## 5   X184_pm10  X808_pm25  X182_pm25  X196_pm25  X222_pm25 X181_pressure
## 6    X201_pm1  X808_pm10  X182_pm10  X196_pm10  X222_pm10 X182_pressure
## 7    X204_pm1          -   X202_pm1   X214_pm1          - X184_pressure
## 8   X204_pm25          -  X202_pm25  X214_pm25          - X196_pressure
## 9   X204_pm10          -  X202_pm10  X214_pm10          - X201_pressure
## 10   X622_pm1          -   X223_pm1   X220_pm1          - X208_pressure
## 11  X622_pm25          -  X223_pm25  X220_pm25          - X209_pressure
## 12  X622_pm10          -  X223_pm10  X220_pm10          - X210_pressure
## 13          -          -   X226_pm1          -          - X214_pressure
## 14          -          -  X226_pm25          -          - X219_pressure
## 15          -          -  X226_pm10          -          - X221_pressure
## 16          -          -   X228_pm1          -          - X223_pressure
## 17          -          -  X228_pm25          -          - X622_pressure
## 18          -          -  X228_pm10          -          - X857_pressure
## 19          -          -          -          -          - X895_pressure
## 20          -          -          -          -          -              -
## 21          -          -          -          -          -              -
## 22          -          -          -          -          -              -
## 23          -          -          -          -          -              -
## 24          -          -          -          -          -              -
## 25          -          -          -          -          -              -
## 26          -          -          -          -          -              -
## 27          -          -          -          -          -              -
## 28          -          -          -          -          -              -
## 29          -          -          -          -          -              -
## 30          -          -          -          -          -              -
## 31          -          -          -          -          -              -
## 32          -          -          -          -          -              -
## 33          -          -          -          -          -              -
## 34          -          -          -          -          -              -
## 35          -          -          -          -          -              -
## 36          -          -          -          -          -              -
## 37          -          -          -          -          -              -
## 38          -          -          -          -          -              -
## 39          -          -          -          -          -              -
## 40          -          -          -          -          -              -
## 41          -          -          -          -          -              -
## 42          -          -          -          -          -              -
## 43          -          -          -          -          -              -
##       cluster_18 cluster_19
## 1  X140_pressure   X203_pm1
## 2  X170_pressure  X203_pm25
## 3  X173_pressure  X203_pm10
## 4  X192_pressure   X219_pm1
## 5  X195_pressure  X219_pm25
## 6  X202_pressure  X219_pm10
## 7  X204_pressure          -
## 8  X212_pressure          -
## 9  X218_pressure          -
## 10 X222_pressure          -
## 11 X225_pressure          -
## 12 X226_pressure          -
## 13             -          -
```

```
## 14              -           -
## 15              -           -
## 16              -           -
## 17              -           -
## 18              -           -
## 19              -           -
## 20              -           -
## 21              -           -
## 22              -           -
## 23              -           -
## 24              -           -
## 25              -           -
## 26              -           -
## 27              -           -
## 28              -           -
## 29              -           -
## 30              -           -
## 31              -           -
## 32              -           -
## 33              -           -
## 34              -           -
## 35              -           -
## 36              -           -
## 37              -           -
## 38              -           -
## 39              -           -
## 40              -           -
## 41              -           -
## 42              -           -
## 43              -           -
```

```r
### First for pressure
draw.map(every_vcl[[19]]$segmentation, clusters = c(5, 10, 17, 18))
```




```
### Then for particular matter
draw.map(every_vcl[[19]]$segmentation, clusters = c(1:3, 6:8, 12:16, 19))
```




```
### Compare to SSC initial clustering
print.clusters.vec(march_less, cl19)
```

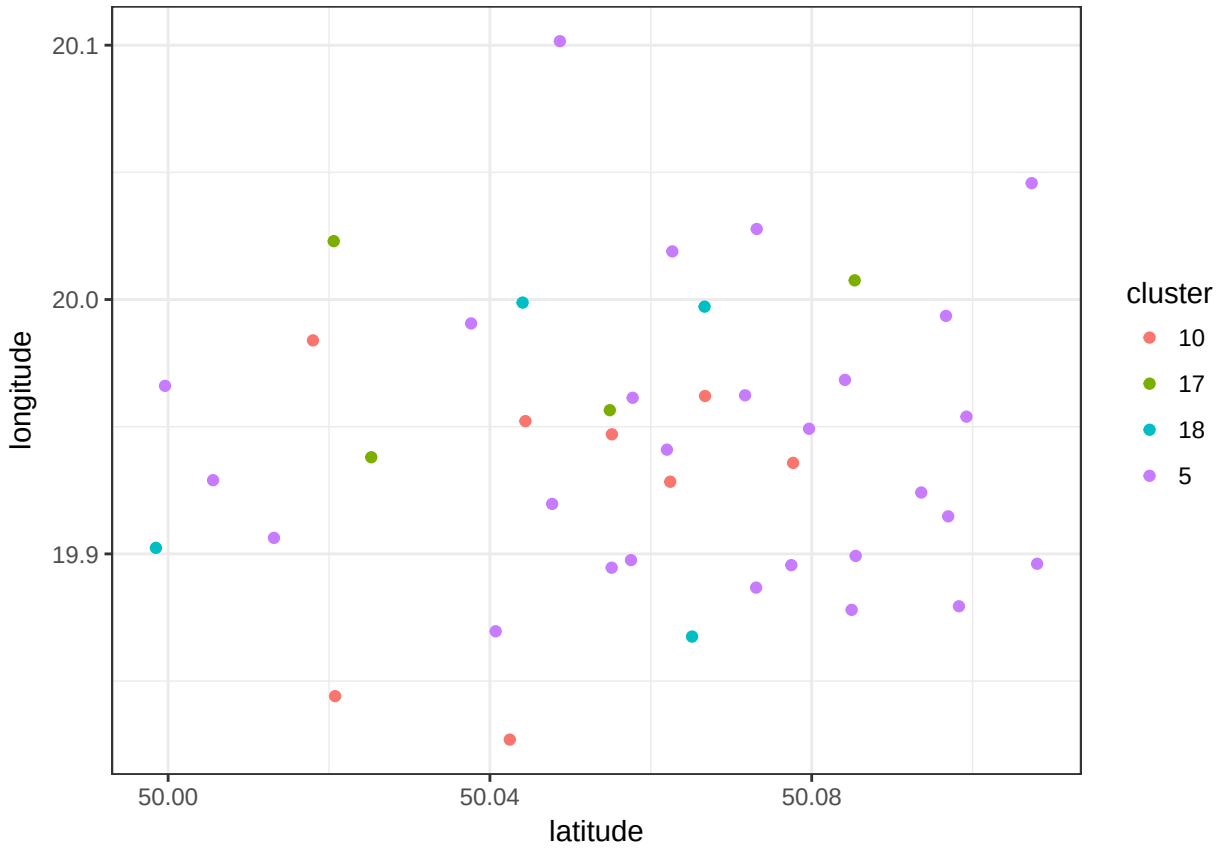
```
##    cluster_1 cluster_2 cluster_3        cluster_4     cluster_5 cluster_6
## 1   X170_pm1  X171_pm1  X173_pm1 X140_temperature X140_pressure  X172_pm1
## 2  X170_pm25 X171_pm25 X173_pm25 X170_temperature X169_pressure X172_pm25
## 3  X170_pm10 X171_pm10 X173_pm10 X171_temperature X170_pressure X172_pm10
## 4   X185_pm1  X208_pm1  X189_pm1 X172_temperature X171_pressure  X183_pm1
## 5  X185_pm25 X208_pm25 X189_pm25 X173_temperature X172_pressure X183_pm25
## 6  X185_pm10 X208_pm10 X189_pm10 X176_temperature X173_pressure X183_pm10
## 7   X209_pm1  X215_pm1  X192_pm1 X177_temperature X177_pressure  X225_pm1
## 8  X209_pm25 X215_pm25 X192_pm25 X179_temperature X183_pressure X225_pm25
## 9  X209_pm10 X215_pm10 X192_pm10 X180_temperature X184_pressure X225_pm10
## 10  X895_pm1  X221_pm1  X212_pm1 X181_temperature X185_pressure  X263_pm1
## 11 X895_pm25 X221_pm25 X212_pm25 X182_temperature X194_pressure X263_pm25
## 12 X895_pm10 X221_pm10 X212_pm10 X183_temperature X202_pressure X263_pm10
## 13         -         -         - X184_temperature X204_pressure         -
## 14         -         -         - X185_temperature X208_pressure         -
## 15         -         -         - X189_temperature X209_pressure         -
## 16         -         -         - X192_temperature X210_pressure         -
## 17         -         -         - X194_temperature X212_pressure         -
## 18         -         -         - X195_temperature X214_pressure         -
## 19         -         -         - X196_temperature X215_pressure         -
## 20         -         -         - X201_temperature X219_pressure         -
## 21         -         -         - X202_temperature X220_pressure         -
## 22         -         -         - X203_temperature X222_pressure         -
## 23         -         -         - X204_temperature X228_pressure         -
```

```
## 24         -         -         - X208_temperature X263_pressure         -
## 25         -         -         - X209_temperature X808_pressure         -
## 26         -         -         - X210_temperature X857_pressure         -
## 27         -         -         - X212_temperature X895_pressure         -
## 28         -         -         - X214_temperature             -         -
## 29         -         -         - X215_temperature             -         -
## 30         -         -         - X218_temperature             -         -
## 31         -         -         - X219_temperature             -         -
## 32         -         -         - X220_temperature             -         -
## 33         -         -         - X221_temperature             -         -
## 34         -         -         - X222_temperature             -         -
## 35         -         -         - X223_temperature             -         -
## 36         -         -         - X225_temperature             -         -
## 37         -         -         - X226_temperature             -         -
## 38         -         -         - X228_temperature             -         -
## 39         -         -         - X263_temperature             -         -
## 40         -         -         - X622_temperature             -         -
## 41         -         -         - X808_temperature             -         -
## 42         -         -         - X857_temperature             -         -
## 43         -         -         - X895_temperature             -         -
##    cluster_7 cluster_8     cluster_9    cluster_10       cluster_11
## 1  X140_pm25  X176_pm1 X172_humidity X179_pressure    X140_humidity
## 2  X140_pm10 X176_pm25 X195_humidity X180_pressure X169_temperature
## 3  X181_pm25 X176_pm10 X201_humidity X181_pressure    X169_humidity
## 4  X181_pm10  X194_pm1 X202_humidity X189_pressure         X169_pm1
## 5  X201_pm25 X194_pm25 X204_humidity X196_pressure        X169_pm25
## 6  X201_pm10 X194_pm10 X208_humidity X218_pressure        X169_pm10
## 7          -  X195_pm1 X210_humidity X225_pressure    X170_humidity
## 8          - X195_pm25 X212_humidity X622_pressure    X171_humidity
## 9          - X195_pm10 X214_humidity             -    X173_humidity
## 10         -  X210_pm1 X215_humidity             -    X176_humidity
## 11         - X210_pm25 X220_humidity             -    X177_humidity
## 12         - X210_pm10 X221_humidity             -    X179_humidity
## 13         -  X857_pm1 X222_humidity             -    X180_humidity
## 14         - X857_pm25 X223_humidity             -    X181_humidity
## 15         - X857_pm10 X225_humidity             -    X182_humidity
## 16         -         - X226_humidity             -    X183_humidity
## 17         -         - X857_humidity             -    X184_humidity
## 18         -         -             -             -    X185_humidity
## 19         -         -             -             -    X189_humidity
## 20         -         -             -             -    X192_humidity
## 21         -         -             -             -    X194_humidity
## 22         -         -             -             -    X196_humidity
## 23         -         -             -             -    X203_humidity
## 24         -         -             -             -    X209_humidity
## 25         -         -             -             -    X218_humidity
## 26         -         -             -             -    X219_humidity
## 27         -         -             -             -    X228_humidity
## 28         -         -             -             -    X263_humidity
## 29         -         -             -             -    X622_humidity
## 30         -         -             -             -    X808_humidity
## 31         -         -             -             -    X895_humidity
## 32         -         -             -             -                -
## 33         -         -             -             -                -
```

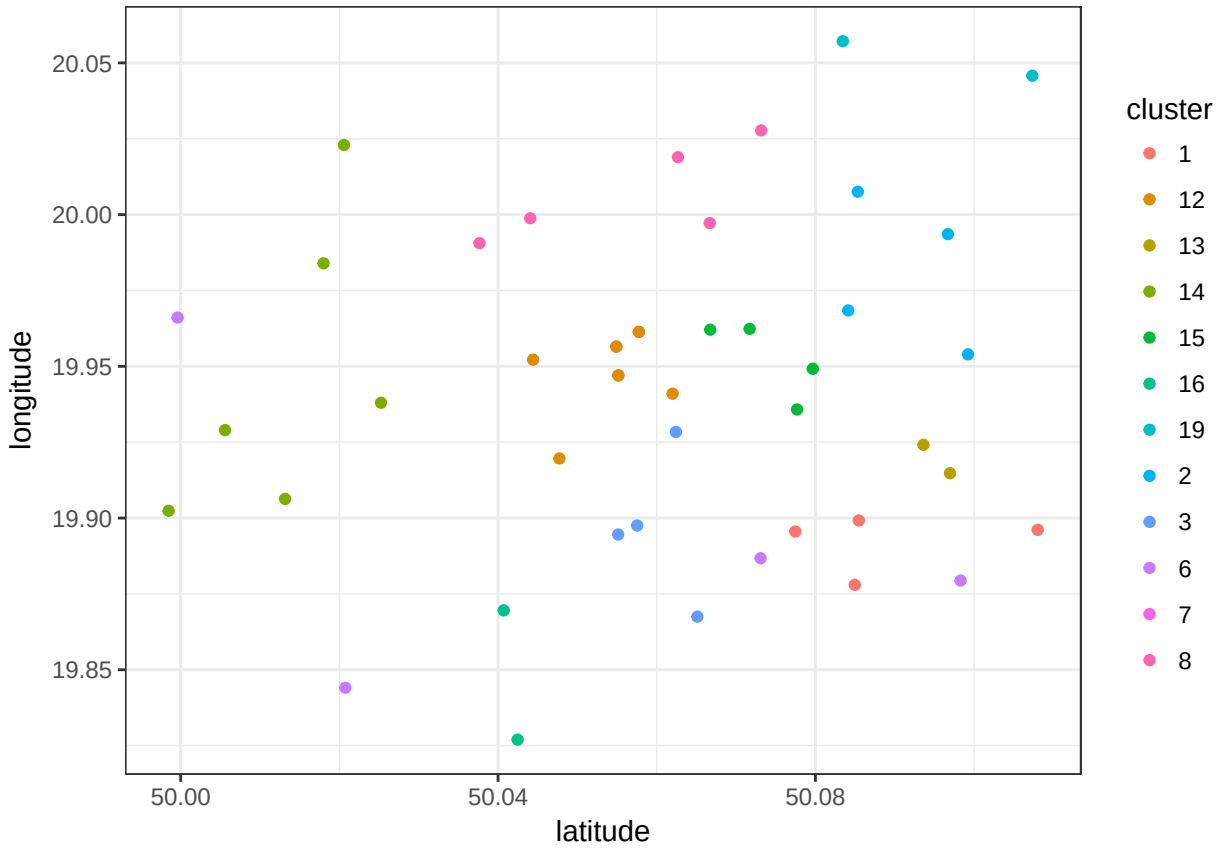
```
## 34         -         -            -            -              -
## 35         -         -            -            -              -
## 36         -         -            -            -              -
## 37         -         -            -            -              -
## 38         -         -            -            -              -
## 39         -         -            -            -              -
## 40         -         -            -            -              -
## 41         -         -            -            -              -
## 42         -         -            -            -              -
## 43         -         -            -            -              -
##    cluster_12 cluster_13 cluster_14 cluster_15 cluster_16    cluster_17
## 1    X140_pm1   X177_pm1   X180_pm1   X179_pm1   X218_pm1 X182_pressure
## 2    X181_pm1  X177_pm25  X180_pm25  X179_pm25  X218_pm25 X201_pressure
## 3    X184_pm1  X177_pm10  X180_pm10  X179_pm10  X218_pm10 X221_pressure
## 4   X184_pm25   X808_pm1   X182_pm1   X196_pm1   X222_pm1 X223_pressure
## 5   X184_pm10  X808_pm25  X182_pm25  X196_pm25  X222_pm25             -
## 6    X201_pm1  X808_pm10  X182_pm10  X196_pm10  X222_pm10             -
## 7    X204_pm1          -   X202_pm1   X214_pm1          -             -
## 8   X204_pm25          -  X202_pm25  X214_pm25          -             -
## 9   X204_pm10          -  X202_pm10  X214_pm10          -             -
## 10   X622_pm1          -   X223_pm1   X220_pm1          -             -
## 11  X622_pm25          -  X223_pm25  X220_pm25          -             -
## 12  X622_pm10          -  X223_pm10  X220_pm10          -             -
## 13         -          -   X226_pm1          -          -             -
## 14         -          -  X226_pm25          -          -             -
## 15         -          -  X226_pm10          -          -             -
## 16         -          -   X228_pm1          -          -             -
## 17         -          -  X228_pm25          -          -             -
## 18         -          -  X228_pm10          -          -             -
## 19         -          -          -          -          -             -
## 20         -          -          -          -          -             -
## 21         -          -          -          -          -             -
## 22         -          -          -          -          -             -
## 23         -          -          -          -          -             -
## 24         -          -          -          -          -             -
## 25         -          -          -          -          -             -
## 26         -          -          -          -          -             -
## 27         -          -          -          -          -             -
## 28         -          -          -          -          -             -
## 29         -          -          -          -          -             -
## 30         -          -          -          -          -             -
## 31         -          -          -          -          -             -
## 32         -          -          -          -          -             -
## 33         -          -          -          -          -             -
## 34         -          -          -          -          -             -
## 35         -          -          -          -          -             -
## 36         -          -          -          -          -             -
## 37         -          -          -          -          -             -
## 38         -          -          -          -          -             -
## 39         -          -          -          -          -             -
## 40         -          -          -          -          -             -
## 41         -          -          -          -          -             -
## 42         -          -          -          -          -             -
## 43         -          -          -          -          -             -
```

```
##       cluster_18 cluster_19
## 1  X176_pressure   X203_pm1
## 2  X192_pressure  X203_pm25
## 3  X195_pressure  X203_pm10
## 4  X226_pressure   X219_pm1
## 5              -  X219_pm25
## 6              -  X219_pm10
## 7              -          -
## 8              -          -
## 9              -          -
## 10             -          -
## 11             -          -
## 12             -          -
## 13             -          -
## 14             -          -
## 15             -          -
## 16             -          -
## 17             -          -
## 18             -          -
## 19             -          -
## 20             -          -
## 21             -          -
## 22             -          -
## 23             -          -
## 24             -          -
## 25             -          -
## 26             -          -
## 27             -          -
## 28             -          -
## 29             -          -
## 30             -          -
## 31             -          -
## 32             -          -
## 33             -          -
## 34             -          -
## 35             -          -
## 36             -          -
## 37             -          -
## 38             -          -
## 39             -          -
## 40             -          -
## 41             -          -
## 42             -          -
## 43             -          -
```

```
draw.map(cl19, clusters = c(5, 10, 17, 18))
```




```
draw.map(cl19, clusters = c(1:3, 6:8, 12:16, 19))
```


20.05
20.00
19.95
19.90
19.85
longitude
50.00
50.04
50.08
latitude
cluster
1
12
13
14
15
16
19
2
3
6
7
8