R Notebook

```
# required libraries

library("RStoolbox")
library("raster")
```

```
## Loading required package: sp
```

```
library("rgdal")
```

```
## rgdal: version: 1.2-16, (SVN revision 701)
##  Geospatial Data Abstraction Library extensions to R successfully loaded
##  Loaded GDAL runtime: GDAL 2.2.0, released 2017/04/28
##  Path to GDAL shared files: C:/Users/asterisko/Documents/R/win-library/3.4/rgdal/gdal
##  GDAL binary built with GEOS: TRUE
##  Loaded PROJ.4 runtime: Rel. 4.9.3, 15 August 2016, [PJ_VERSION: 493]
##  Path to PROJ.4 shared files: C:/Users/asterisko/Documents/R/win-library/3.4/rgdal/proj
##  Linking to sp version: 1.2-7
```

```
library("ggplot2")
library("SDMTools")
```

```
##
## Attaching package: 'SDMTools'
```

```
## The following object is masked from 'package:raster':
##
##     distance
```

```
library("png")
```

En este caso se eligieron 2 imágenes cada una con 2 parcelas distintas

```
# load tif using stack function instead raster

TTC08226_modified.stack <- stack("../6_qgis/output/TTC08226_modified.tif")
class(TTC08226_modified.stack)
```

```
## [1] "RasterStack"
## attr(,"package")
## [1] "raster"
```

```
TTC08350_modified.stack <- stack("../6_qgis/output/TTC08350_modified.tif")
class(TTC08350_modified.stack)
```

```
## [1] "RasterStack"
## attr(,"package")
## [1] "raster"
```

```
# load parcela 4

parcelas <- readOGR("../6_qgis/input/alamala.kml", "alamala")[0]
```

```
## OGR data source with driver: KML
## Source: "../6_qgis/input/alamala.kml", layer: "alamala"
## with 12 features
## It has 2 fields
```

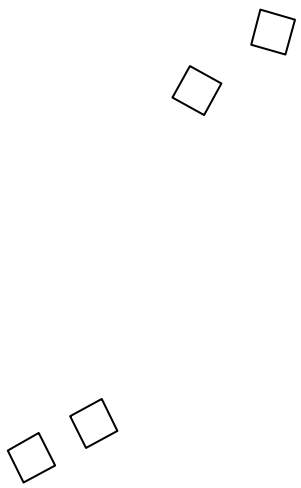
```
nrowdim <- dim(parcelas@data)
parcelas@data$id <- c(rep(1:nrowdim))
```

```
## Warning in 1:nrowdim: numerical expression has 2 elements: only the first
## used
```

```
# 7 8 N
# 5, 6 S
parcela4 <- subset(parcelas, parcelas@data$id %in% c(5,6, 7, 8))
class(parcela4)
```

```
## [1] "SpatialPolygonsDataFrame"
## attr(,"package")
## [1] "sp"
```

```
plot(parcela4)
```



```
# ojo cambio de id entre parcela4 y parcela4.df
parcela4.df <- fortify(parcela4) # to plot with ggplot
```

```
## Regions defined for each Polygons
```

```
head(parcela4.df)
```

```
##        long       lat order  hole piece id group
## 1 -79.44136 -3.997619     1 FALSE     1  4   4.1
## 2 -79.44144 -3.997662     2 FALSE     1  4   4.1
## 3 -79.44148 -3.997581     3 FALSE     1  4   4.1
## 4 -79.44140 -3.997537     4 FALSE     1  4   4.1
```

```
## 5 -79.44136 -3.997619     5 FALSE     1  4   4.1
## 6 -79.44152 -3.997706     1 FALSE     1  5   5.1
```

```
parcela4_1 <- subset(parcelas, parcelas@data$id %in% c(7,8))
parcela4_1.df <- fortify(parcela4_1) # to plot with ggplot
```

```
## Regions defined for each Polygons
```

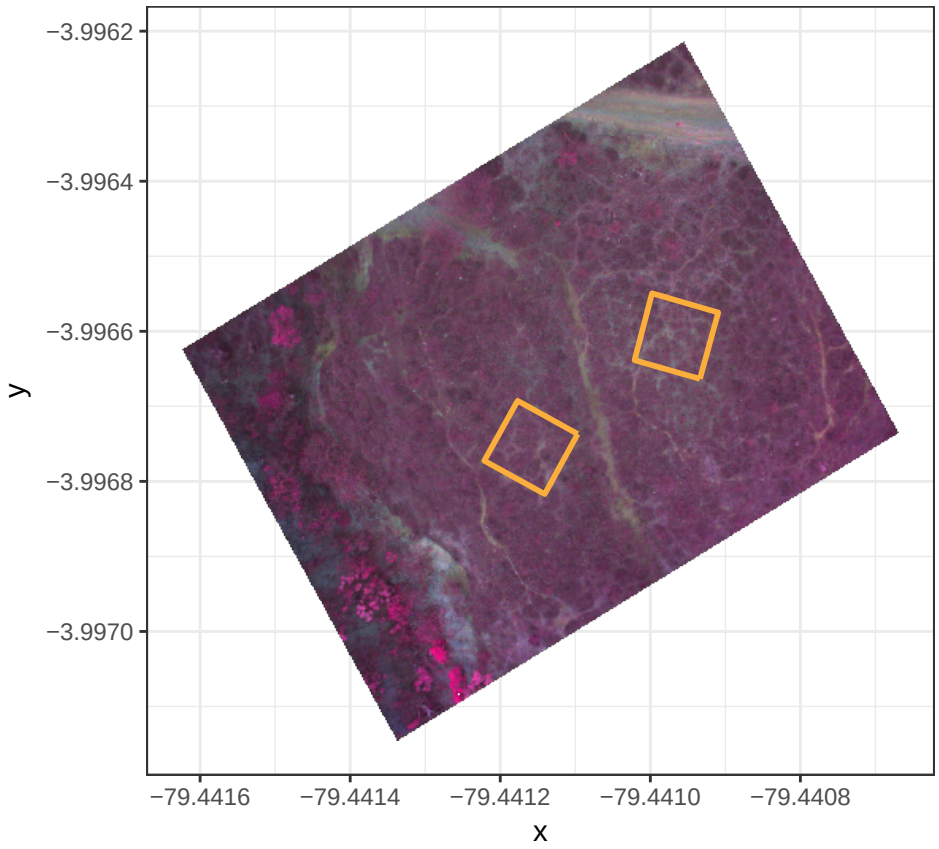
```
parcela4_2 <- subset(parcelas, parcelas@data$id %in% c(5,6))
parcela4_2.df <- fortify(parcela4_1) # to plot with ggplot
```

```
## Regions defined for each Polygons
```

```
# Set all pixels to NA, where bands are 0 (remove black background)
# Check if results are affected
# instead use crop and mask together (ver más adelante)

TTC08226_modified.stack[TTC08226_modified.stack[,] == 0] <- NA


# plot scene using ggRGB (from ggplot and RStoolbox)
ggRGB(TTC08226_modified.stack, r = 1, g = 2, b = 3, maxpixels = 2e+05, stretch="none", geom_raster = TRU
    geom_path(data = parcela4_1, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    coord_equal() +
    theme_bw()
```

```
## Regions defined for each Polygons
```

```
## Warning: Removed 94823 rows containing missing values (geom_raster).
```

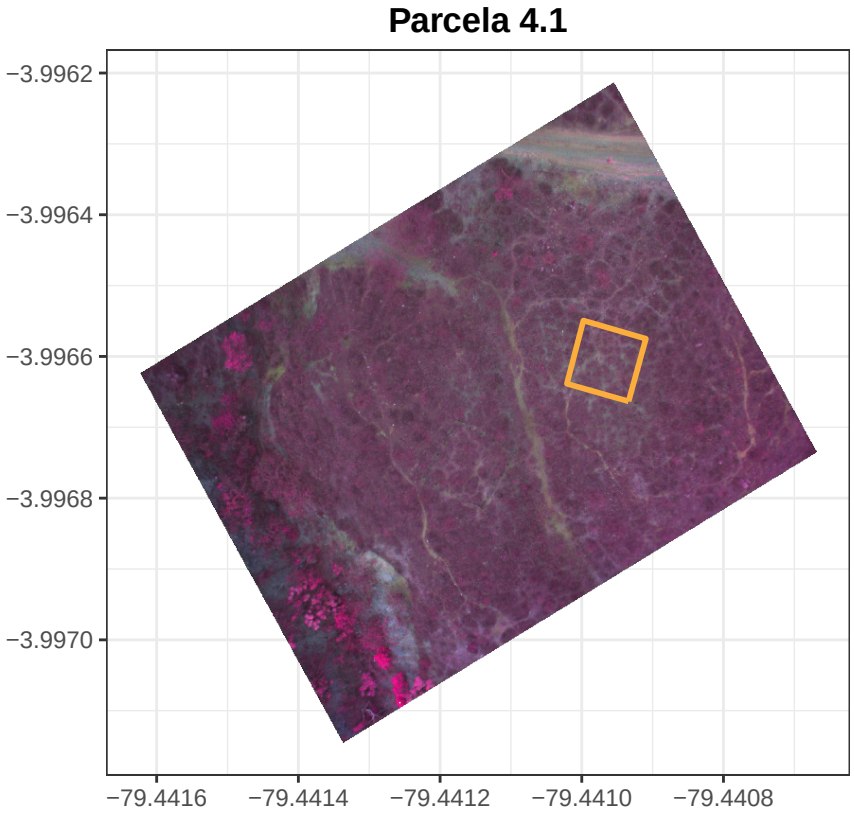


```
ggsave("figures/parcela4N.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 94823 rows containing missing values (geom_raster).
```

Plot parcel 4.1 (de norte a sur)

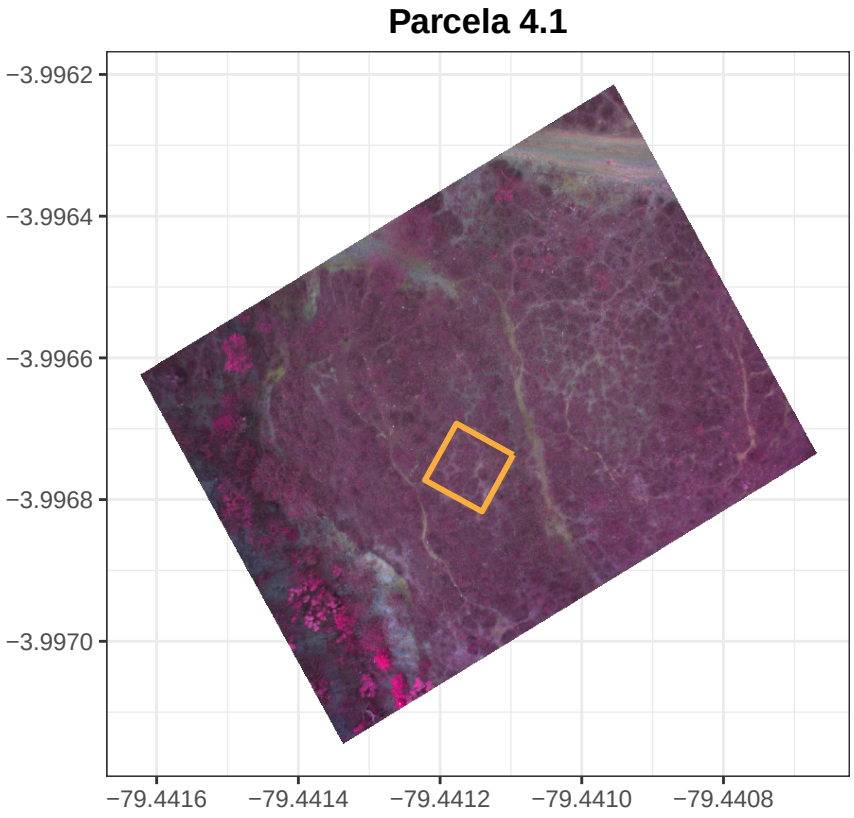
```
p41 <- subset(parcela4.df, id == 6)

ggRGB(TTC08226_modified.stack, r = 1, g = 2, b = 3) +
    geom_path(data = p41, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.1") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```



Plot parcel 4.2

```
p42 <- subset(parcela4.df, id == 7)

ggRGB(TTC08226_modified.stack, r = 1, g = 2, b = 3) +
    geom_path(data = p42, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.1") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
```

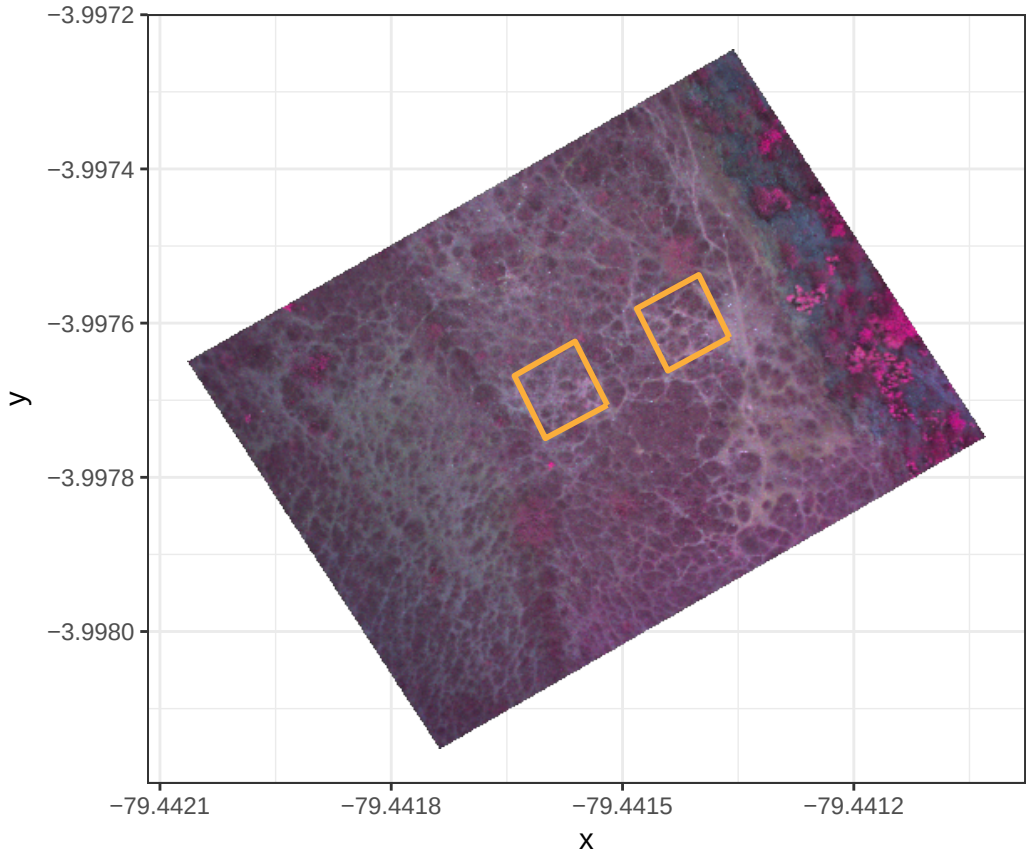
```
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```




```
# Set all pixels to NA, where bands are 0 (remove black background)
# Check if results are affected
# instead use crop and mask together (ver más adelante)

TTC08350_modified.stack[TTC08350_modified.stack[,] == 0] <- NA


# plot scene using ggRGB (from ggplot and RStoolbox)
ggRGB(TTC08350_modified.stack, r = 1, g = 2, b = 3, maxpixels = 2e+05, stretch="none", geom_raster = TRU
    geom_path(data = parcela4_2, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    coord_equal() +
    theme_bw()
```

```
## Regions defined for each Polygons
```

```
## Warning: Removed 95622 rows containing missing values (geom_raster).
```



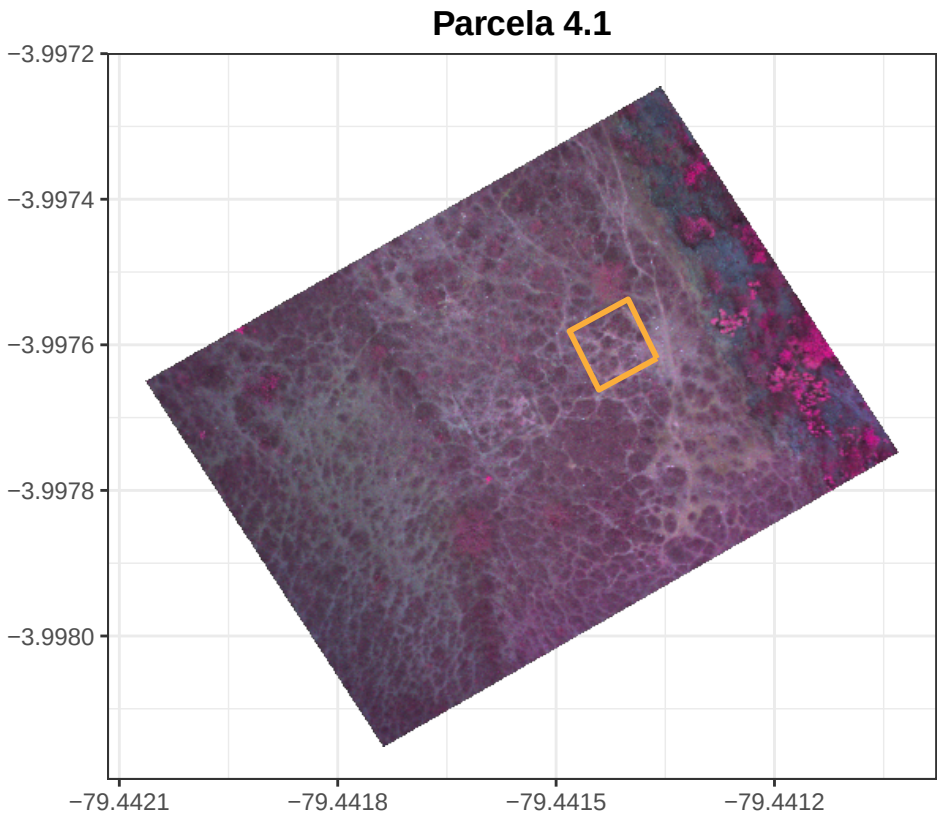

```
ggsave("figures/parcela4S.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 95622 rows containing missing values (geom_raster).
```

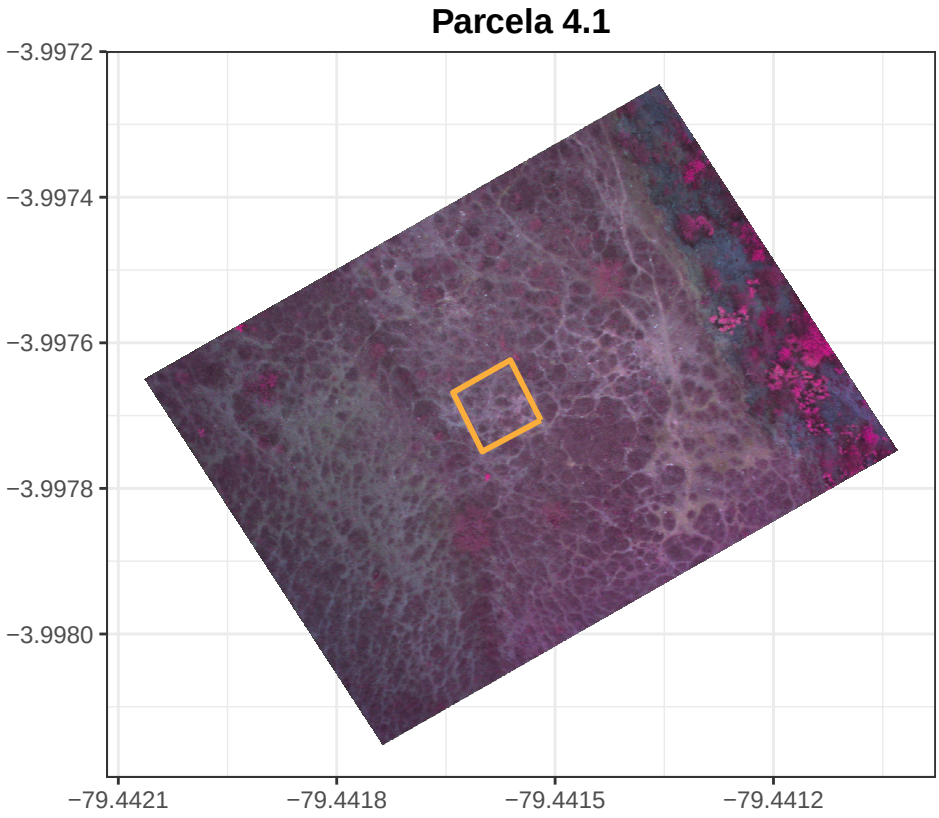
Plot parcel 4.3

```
p43 <- subset(parcela4.df, id == 4)

TTC08350_modified.stack[TTC08350_modified.stack[,] == 0] <- NA


ggRGB(TTC08350_modified.stack, r = 1, g = 2, b = 3, maxpixels = 2e+05, stretch="none", geom_raster = TRU
    geom_path(data = p43, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.1") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```

```
## Warning: Removed 95622 rows containing missing values (geom_raster).
```




```
p44 <- subset(parcela4.df, id == 5)

ggRGB(TTC08350_modified.stack, r = 1, g = 2, b = 3) +
    geom_path(data = p44, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.1") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```



Extraemos las parcelas

parcela 4N

```
# crop and mask whole area
TTC08226_modified.stack_p4N <- crop(mask(TTC08226_modified.stack, parcela4_1),parcela4_1)
```

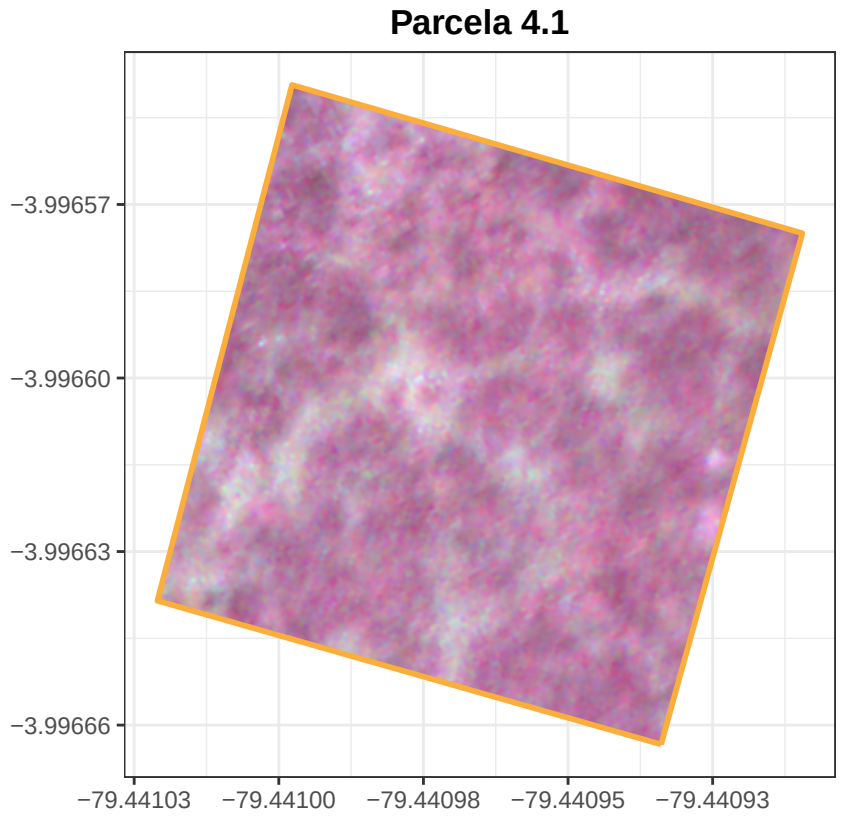
Crop parcela 4N

```
# requires spatialpolygondataframe

# crop parcela 4N 1
parcela41 <- subset(parcelas, parcelas@data$id %in% c(7))

TTC08226_modified.stack_p41 <- crop(mask(TTC08226_modified.stack_p4N, parcela41), parcela41)


# crop parcela 4N 2

parcela42 <- subset(parcelas, parcelas@data$id %in% c(8))
TTC08226_modified.stack_p42 <- crop(mask(TTC08226_modified.stack_p4N, parcela42), parcela42)
```

Plot parcel 4N 1

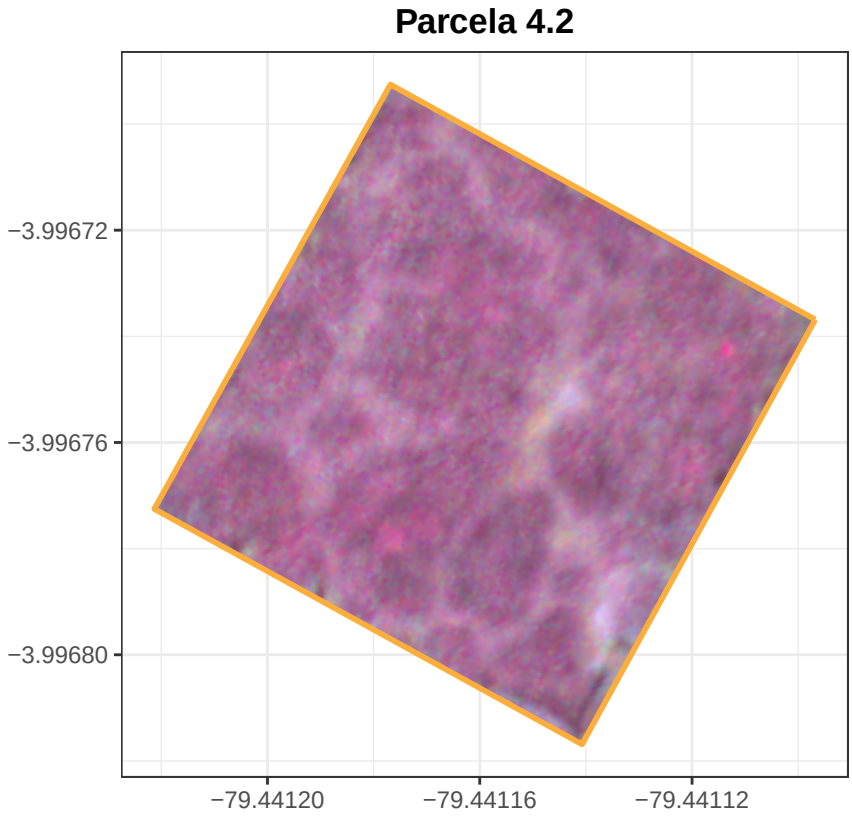
```
# cambio de id !! 7 es igual a 6
p41 <- subset(parcela4.df, id == 6)

ggRGB(TTC08226_modified.stack_p41, r = 1, g = 2, b = 3) +
    geom_path(data = p41, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
```

```
    labs(x="", y="", title="Parcela 4.1") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```



Plot parcel 4N 2

```
# cambio de id !! 8 es igual a 7
p42 <- subset(parcela4.df, id == 7)

ggRGB(TTC08226_modified.stack_p42, r = 1, g = 2, b = 3) +
    geom_path(data = p42, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.2") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```



parcela 4S

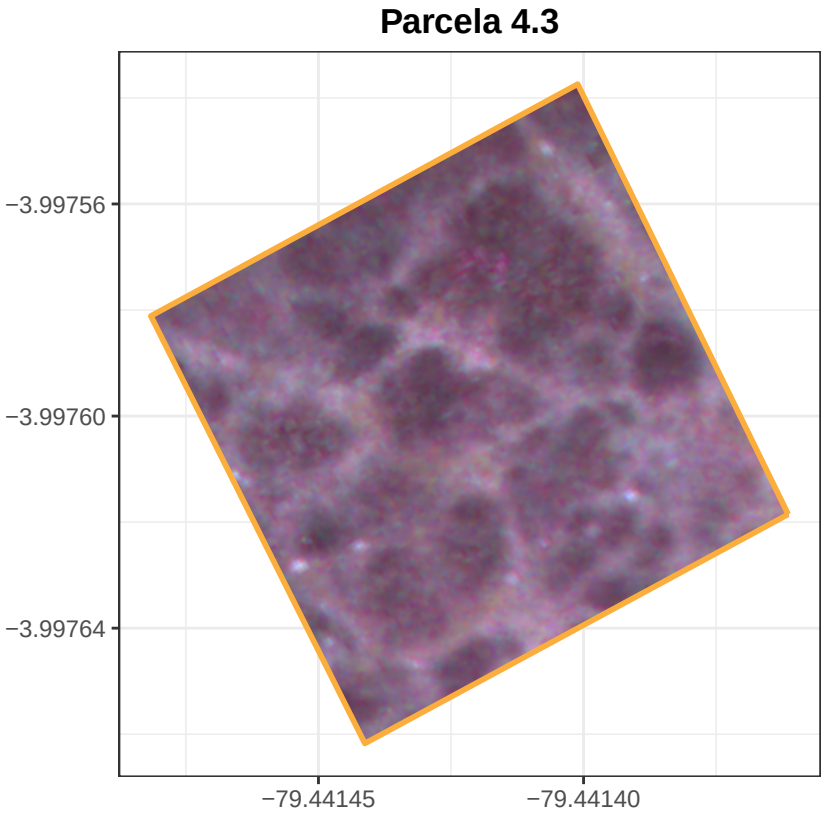
```
# crop and mask whole area
TTC08350_modified.stack_p4S <- crop(mask(TTC08350_modified.stack, parcela4_2),parcela4_2)
```

crop parcela 4 S

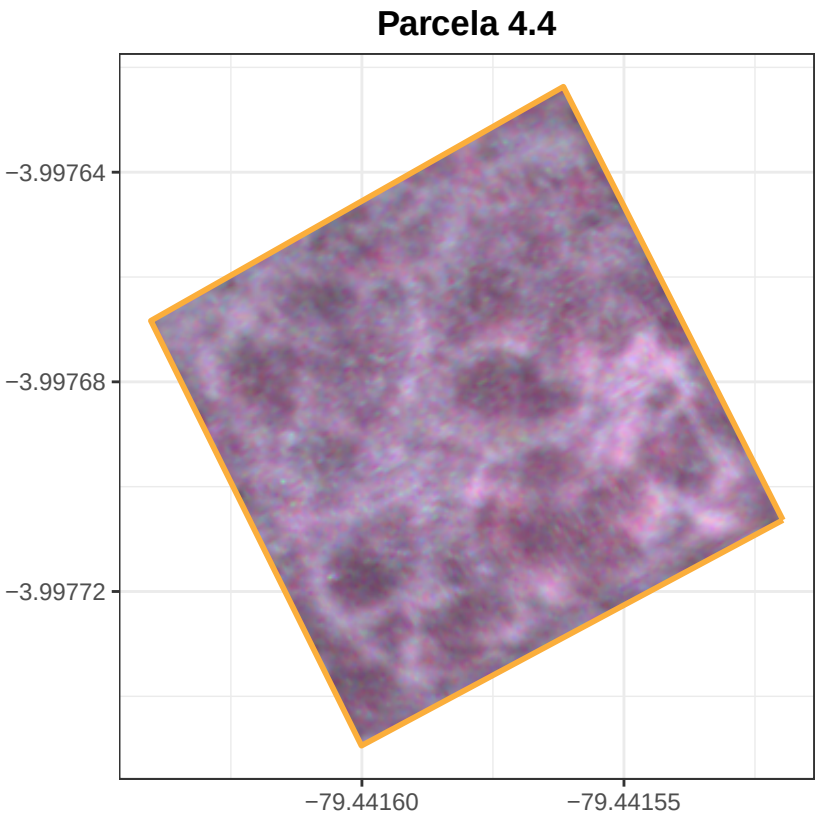
```
# requires spatialpolygondataframe

# crop parcela 4N 1
parcela43 <- subset(parcelas, parcelas@data$id %in% c(5))

TTC08335_modified.stack_p43 <- crop(mask(TTC08350_modified.stack_p4S, parcela43), parcela43)


# crop parcela 4N 2

parcela44 <- subset(parcelas, parcelas@data$id %in% c(6))
TTC08335_modified.stack_p44 <- crop(mask(TTC08350_modified.stack_p4S, parcela44), parcela44)
```

```
# cambio de id !! 8 es igual a 7
p43 <- subset(parcela4.df, id == 4)

ggRGB(TTC08335_modified.stack_p43, r = 1, g = 2, b = 3) +
    geom_path(data = p43, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.3") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
```

```
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```

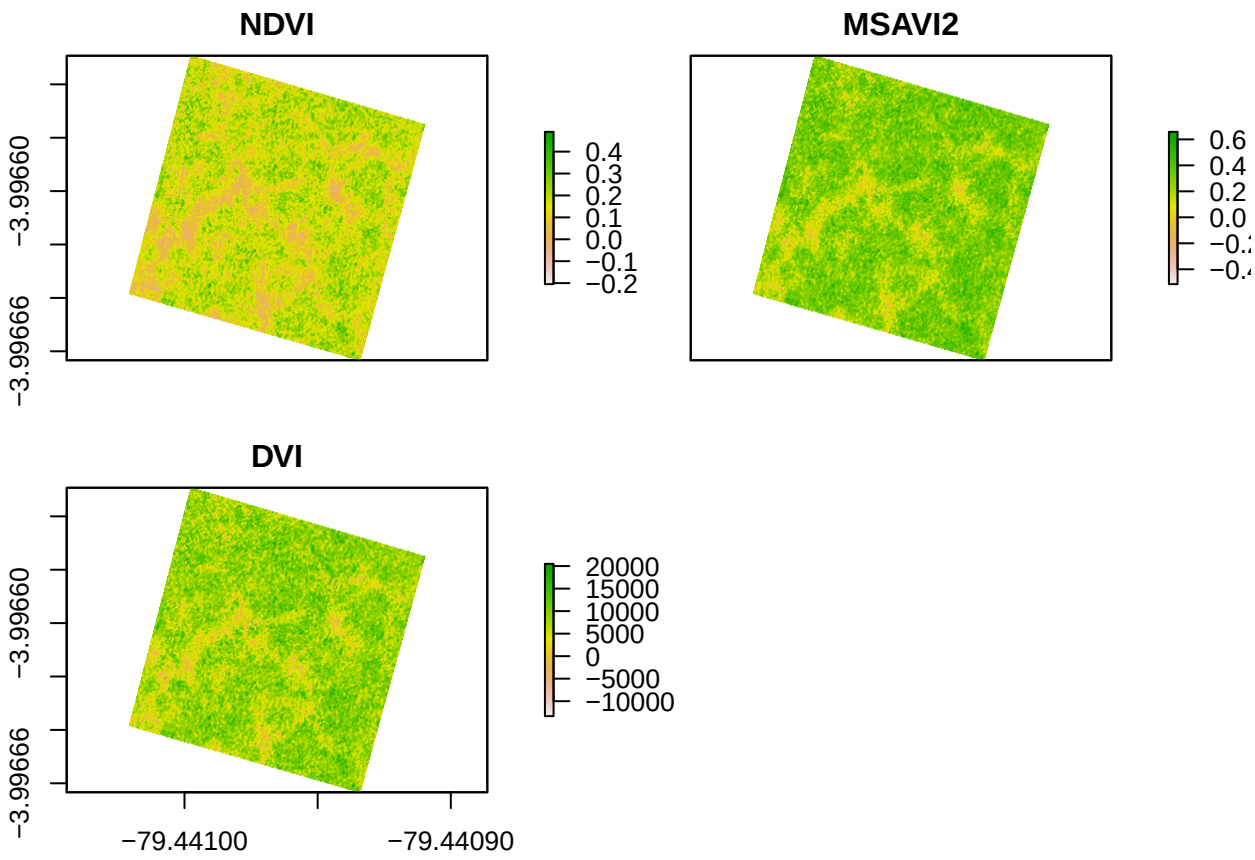



```
# cambio de id !! 8 es igual a 7
p44 <- subset(parcela4.df, id == 5)

ggRGB(TTC08335_modified.stack_p44, r = 1, g = 2, b = 3) +
    geom_path(data = p44, aes(x = long, y = lat, group = group), size = 1, col="#fbae3b") +
    labs(x="", y="", title="Parcela 4.4") +
   # coord_equal(ylim = c(min(p11$lat), max(p11$lat)), xlim= c(min(p11$long), max(p11$long))) +
    theme_bw() +
    theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bo
```

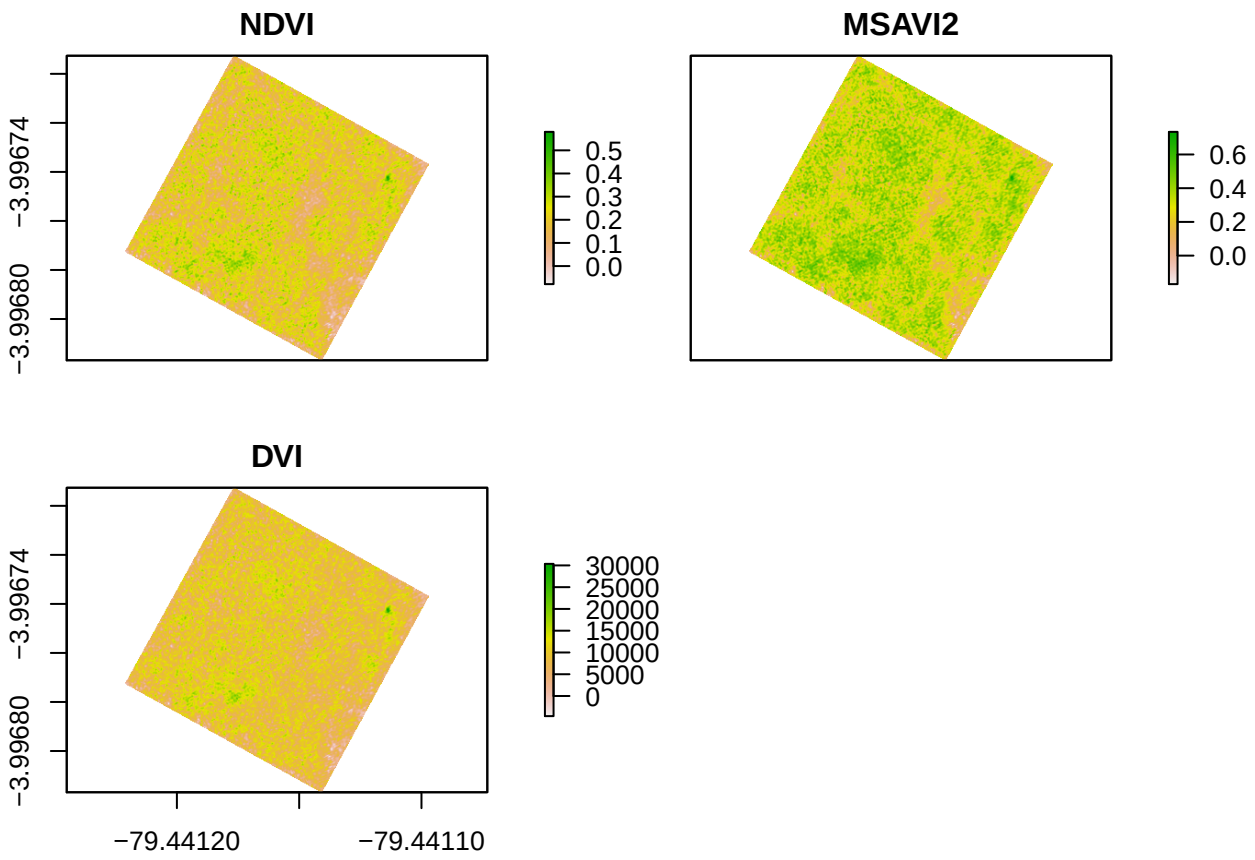


Calculate VIs

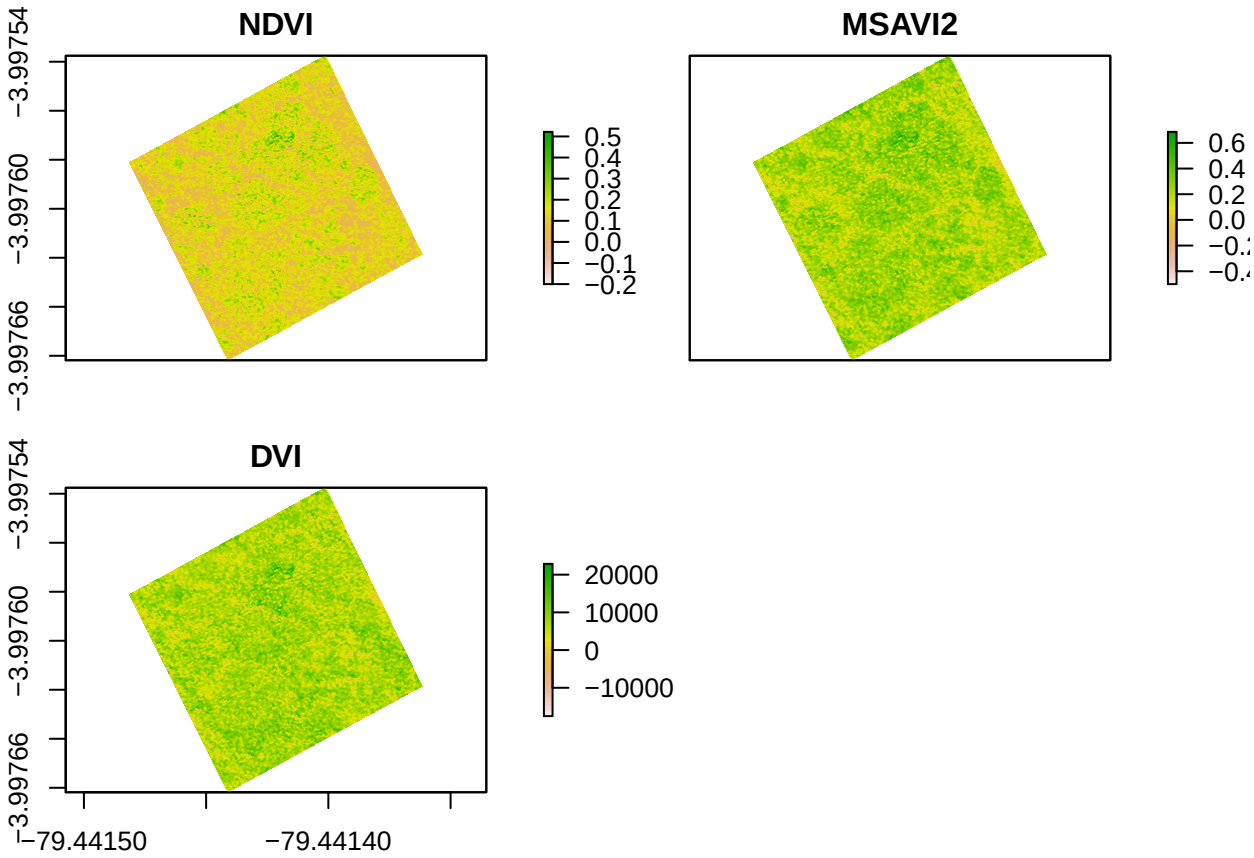
```
p41.VIs <- spectralIndices(TTC08226_modified.stack_p41, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p41.VIs)
```



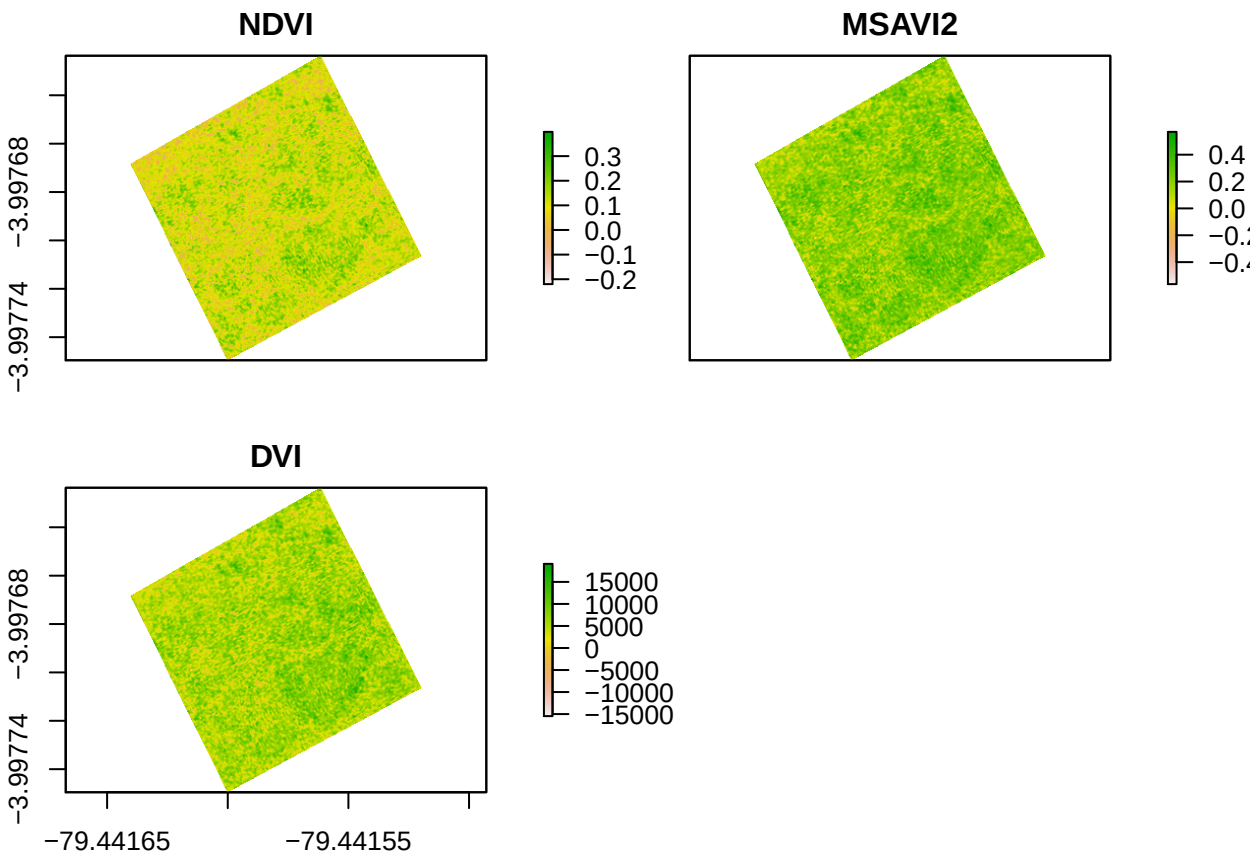

```
p42.VIs <- spectralIndices(TTC08226_modified.stack_p42, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p42.VIs)
```




```
p43.VIs <- spectralIndices(TTC08335_modified.stack_p43, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p43.VIs)
```




```
p44.VIs <- spectralIndices(TTC08335_modified.stack_p44, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p44.VIs)
```

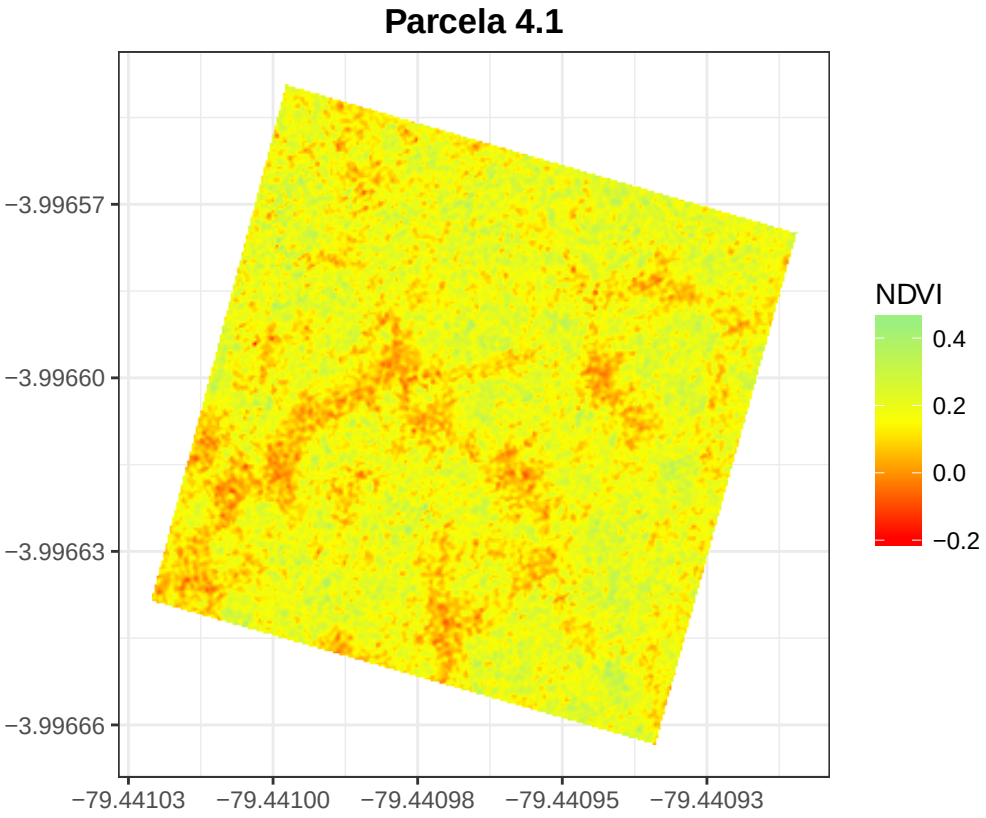


Plot VI one by one

NDVI Parcela 4.1

```
cols <- colorRampPalette(c("red", "yellow", "lightgreen"))(length(breaks)-1)
ggR(p41.VIs$NDVI, geom_raster = TRUE) +
  labs(x="", y="", title= "Parcela 4.1") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))
```

```
## Warning: Removed 31053 rows containing missing values (geom_raster).
```



And save

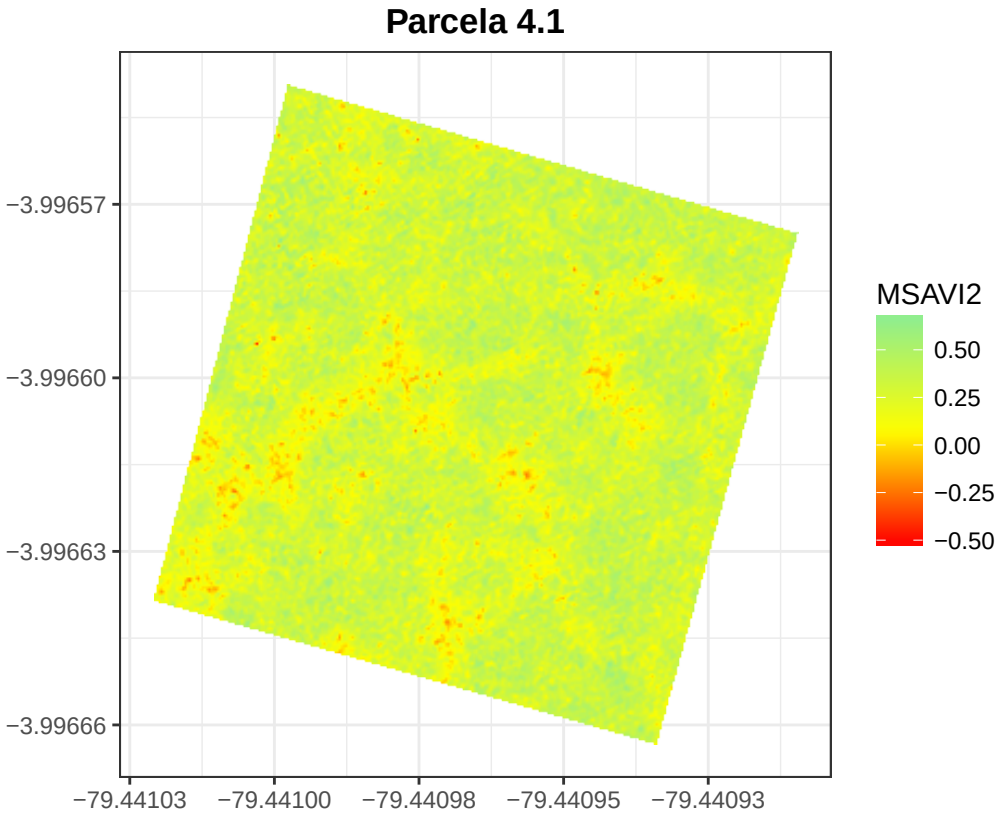
```
ggsave("figures/parcela4_1_NDVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 31053 rows containing missing values (geom_raster).
```

MSAVI2 Parcela 4.1

```
cols <- colorRampPalette(c("red", "yellow", "lightgreen"))(length(breaks)-1)
ggR(p41.VIs$MSAVI2, geom_raster = TRUE) +
  labs(x="", y="", title= "Parcela 4.1") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))
```

```
## Warning: Removed 31053 rows containing missing values (geom_raster).
```



And save

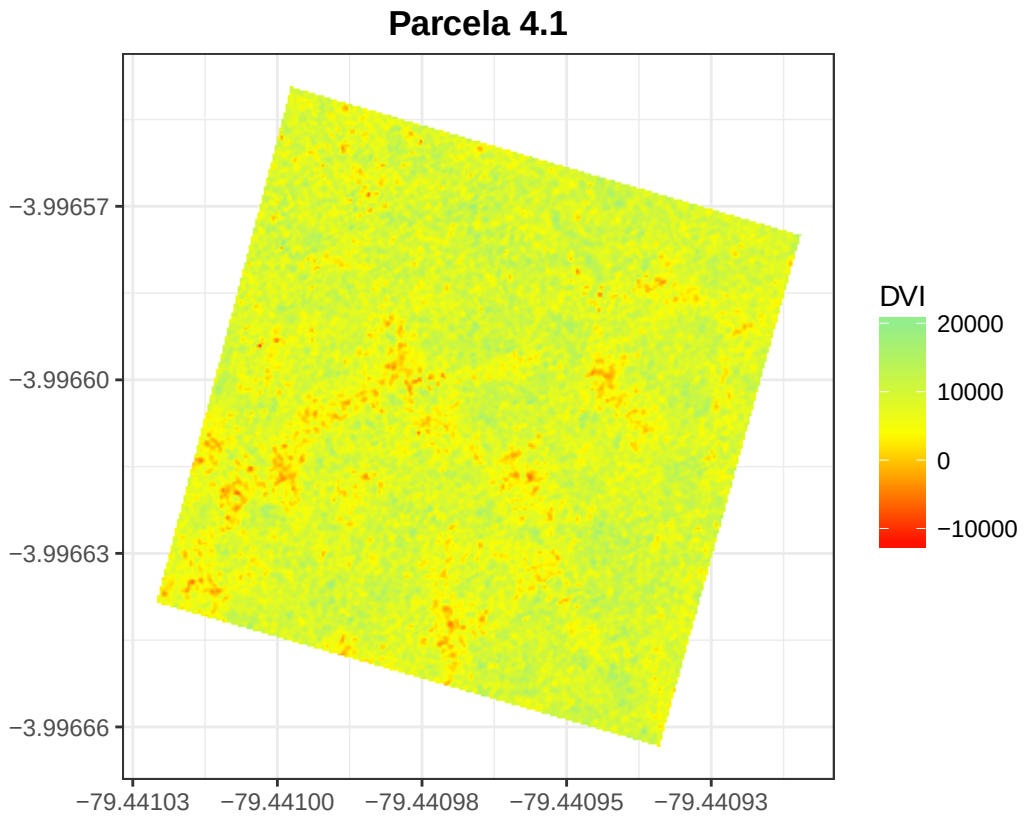
```
ggsave("figures/parcela4_1_MSAVI2.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 31053 rows containing missing values (geom_raster).
```

DVI Parcela 4.1

```
cols <- colorRampPalette(c("red", "yellow", "lightgreen"))(length(breaks)-1)
ggR(p41.VIs$DVI, geom_raster = TRUE) +
  labs(x="", y="", title= "Parcela 4.1") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))
```

```
## Warning: Removed 31053 rows containing missing values (geom_raster).
```



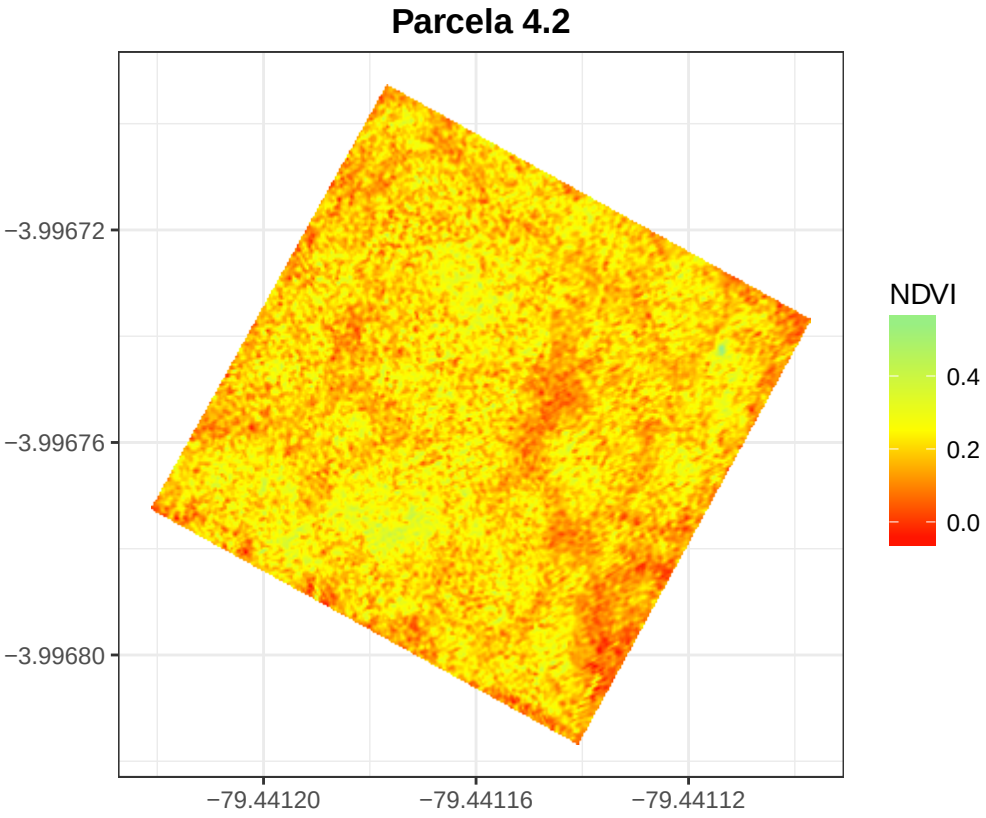

```
ggsave("figures/parcela4_1_DVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 31053 rows containing missing values (geom_raster).
```

NDVI Parcela 4.2

```
cols <- colorRampPalette(c("red", "yellow", "lightgreen"))(length(breaks)-1)
ggR(p42.VIs$NDVI, geom_raster = TRUE) +
  labs(x="", y="", title= "Parcela 4.2") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))
```

```
## Warning: Removed 49996 rows containing missing values (geom_raster).
```



And save

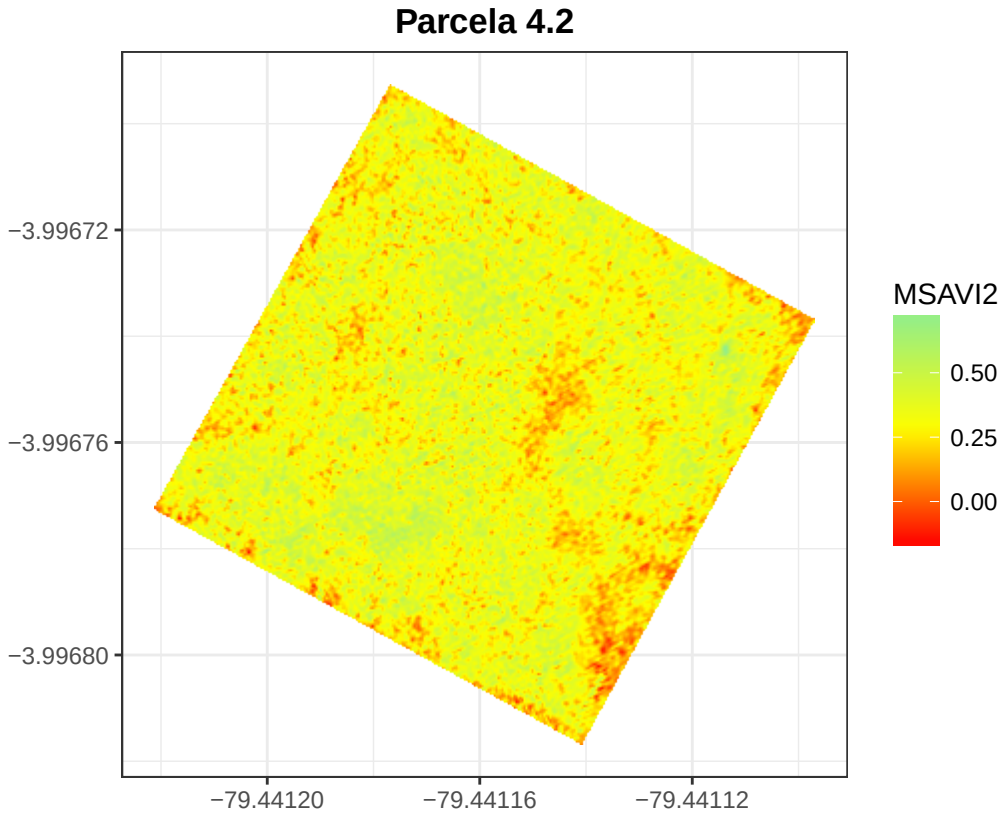
```
ggsave("figures/parcela4_2_NDVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 49996 rows containing missing values (geom_raster).
```

MSAVI2 Parcela 4.2

```
cols <- colorRampPalette(c("red", "yellow", "lightgreen"))(length(breaks)-1)
ggR(p42.VIs$MSAVI2, geom_raster = TRUE) +
  labs(x="", y="", title= "Parcela 4.2") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))
```

```
## Warning: Removed 49996 rows containing missing values (geom_raster).
```



And save

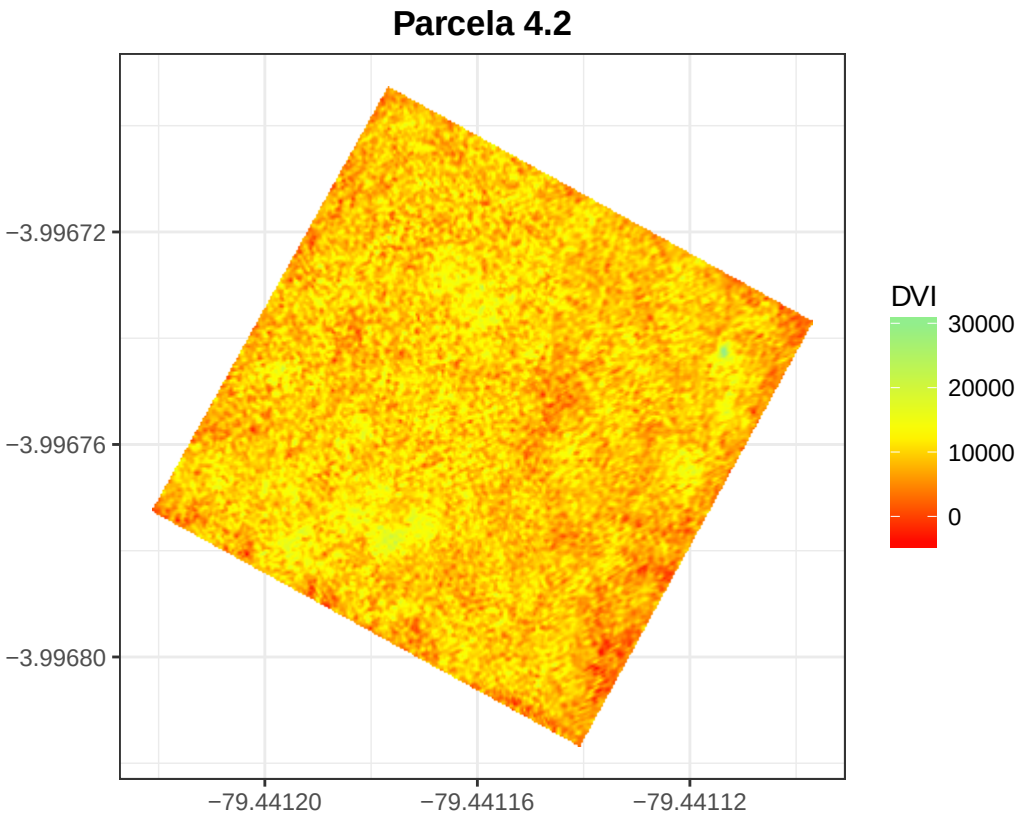
```
ggsave("figures/parcela4_2_MSAVI2.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 49996 rows containing missing values (geom_raster).
```

DVI Parcela 4.2

```
cols <- colorRampPalette(c("red", "yellow", "lightgreen"))(length(breaks)-1)
ggR(p42.VIs$DVI, geom_raster = TRUE) +
  labs(x="", y="", title= "Parcela 4.2") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))
```

```
## Warning: Removed 49996 rows containing missing values (geom_raster).
```

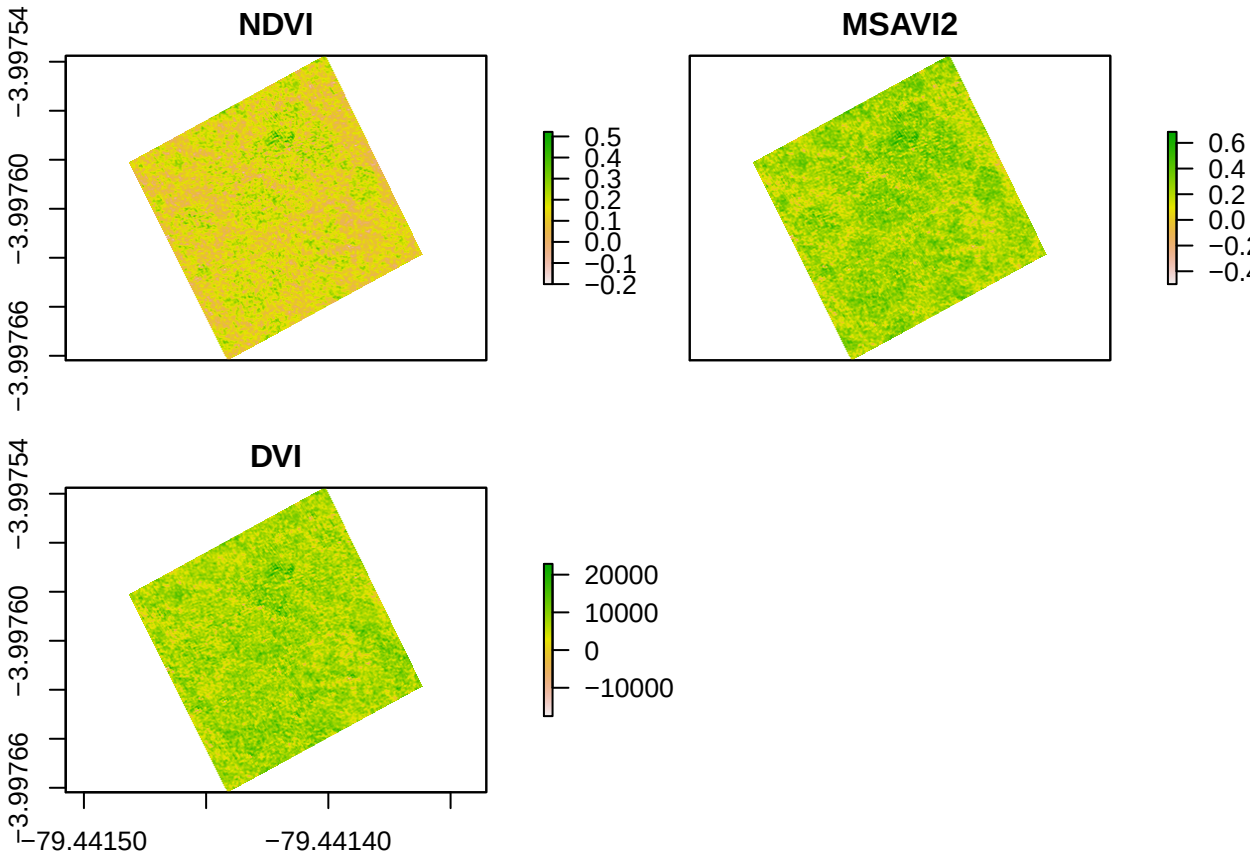



```
ggsave("figures/parcela4_1_DVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 49996 rows containing missing values (geom_raster).
```

Again with p4.3

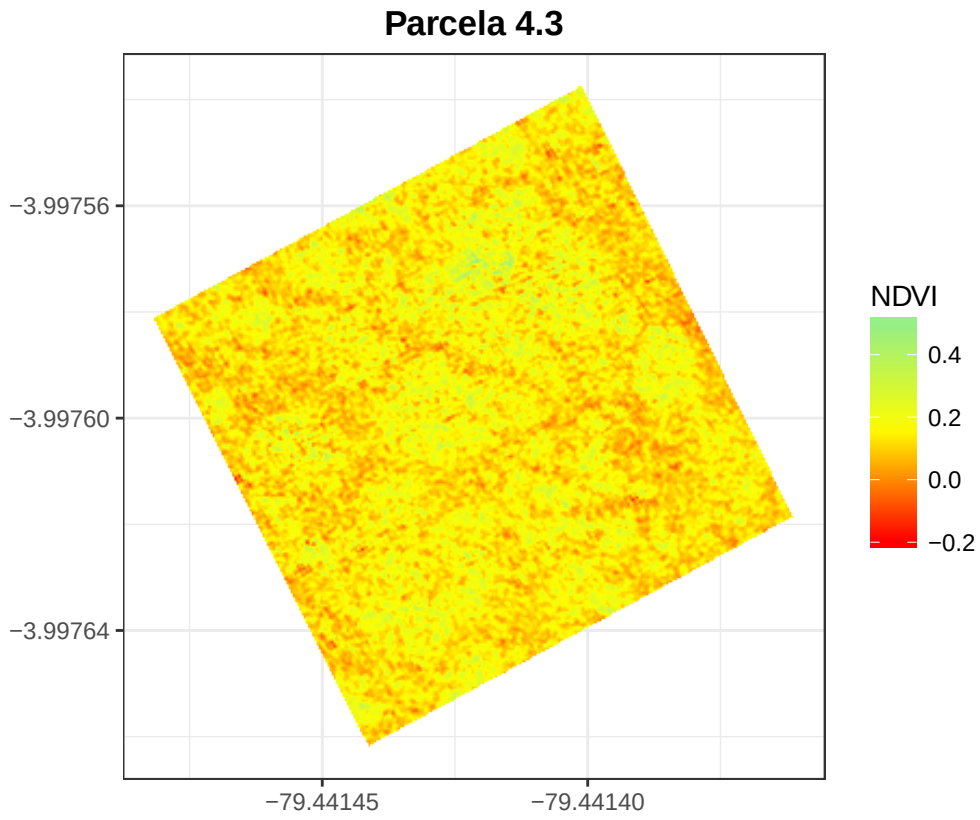
```
p43.VIs <- spectralIndices(TTC08335_modified.stack_p43, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p43.VIs)
```



NDVI Parcela 4.3

```
ggR(p43.VIs$NDVI, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.3") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```



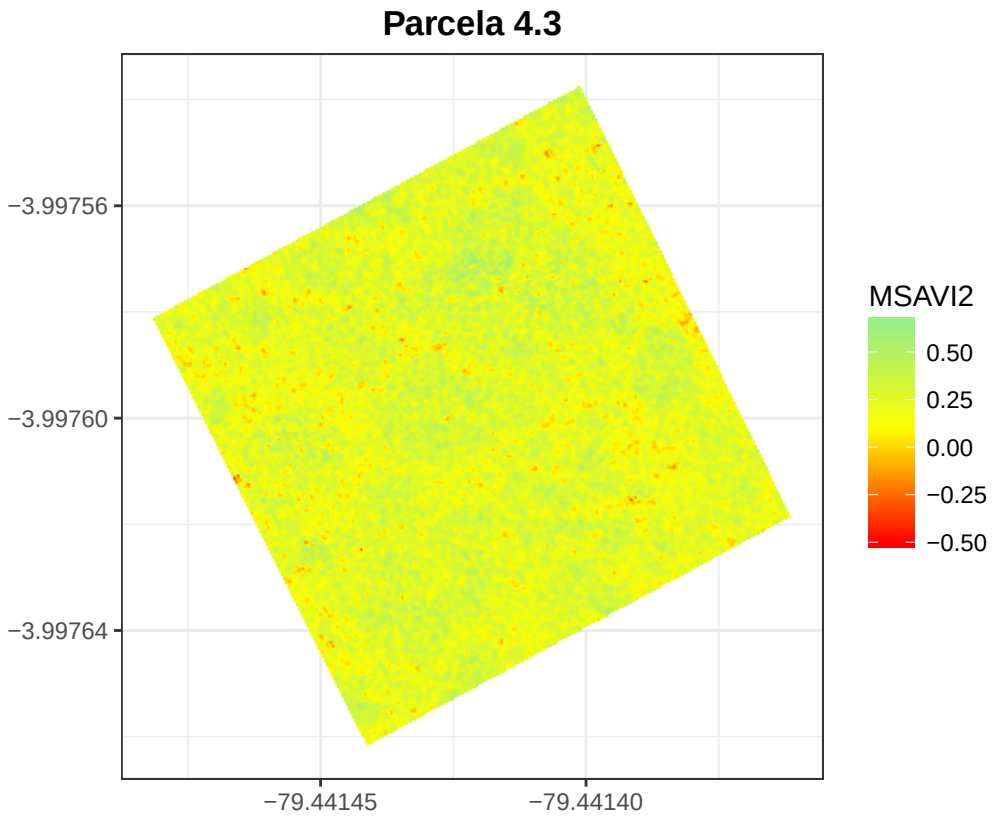

```
ggsave("figures/parcela4_3_NDVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```

MSAVI2 Parcela 4.3

```
ggR(p43.VIs$MSAVI2, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.3") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```



Save

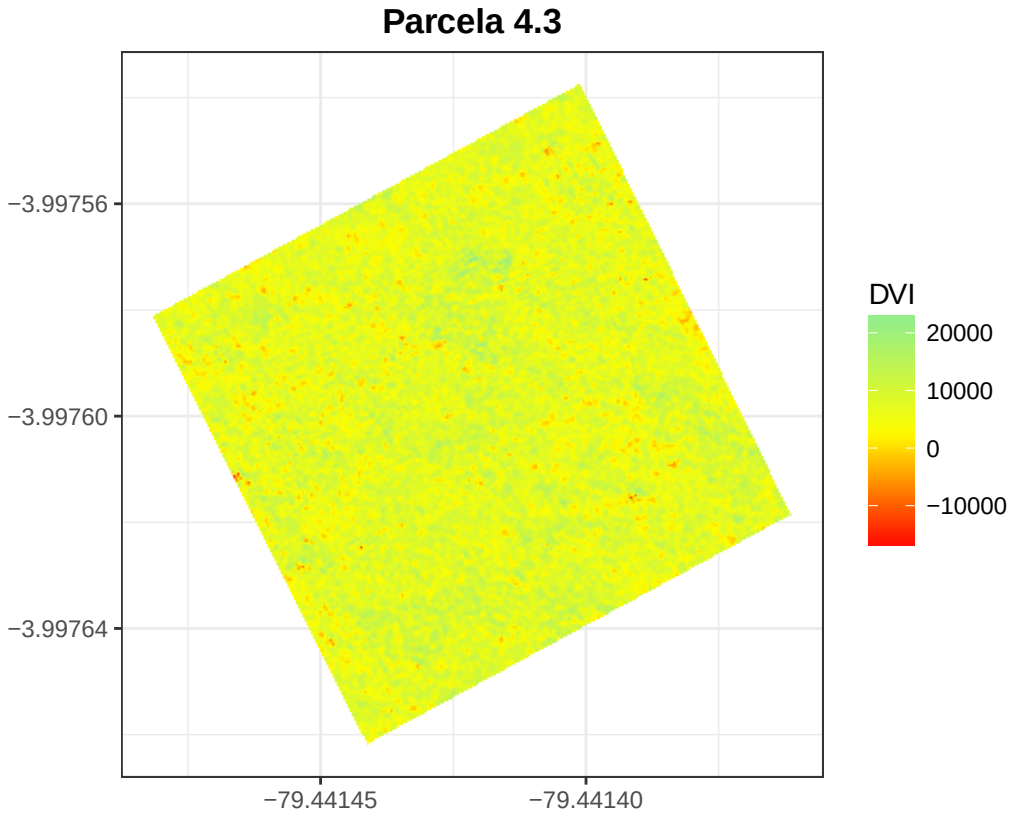
```
ggsave("figures/parcela4_3_MSAVI2.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```

DVI Parcela 4.3

```
ggR(p43.VIs$DVI, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.3") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```



Save

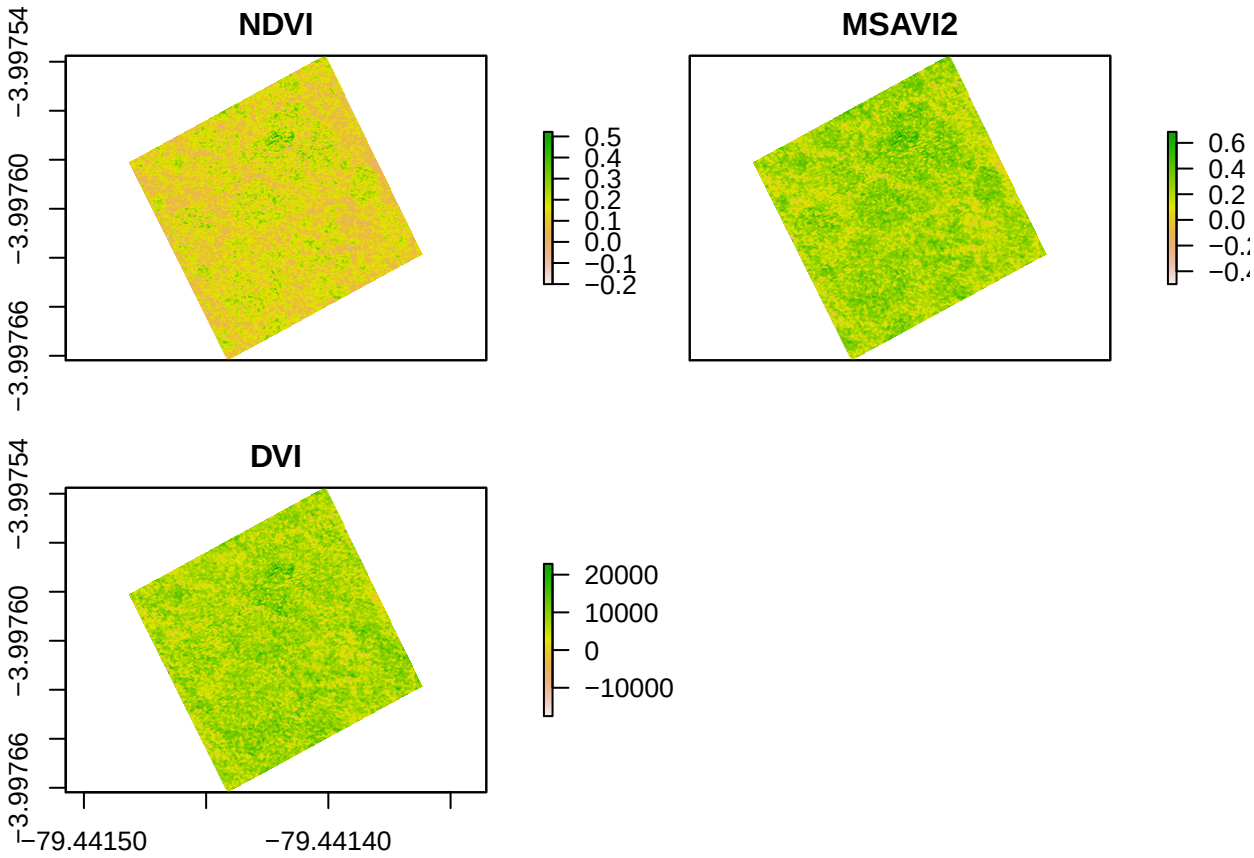
```
ggsave("figures/parcela4_3_DVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```

foo

Again with p4.3

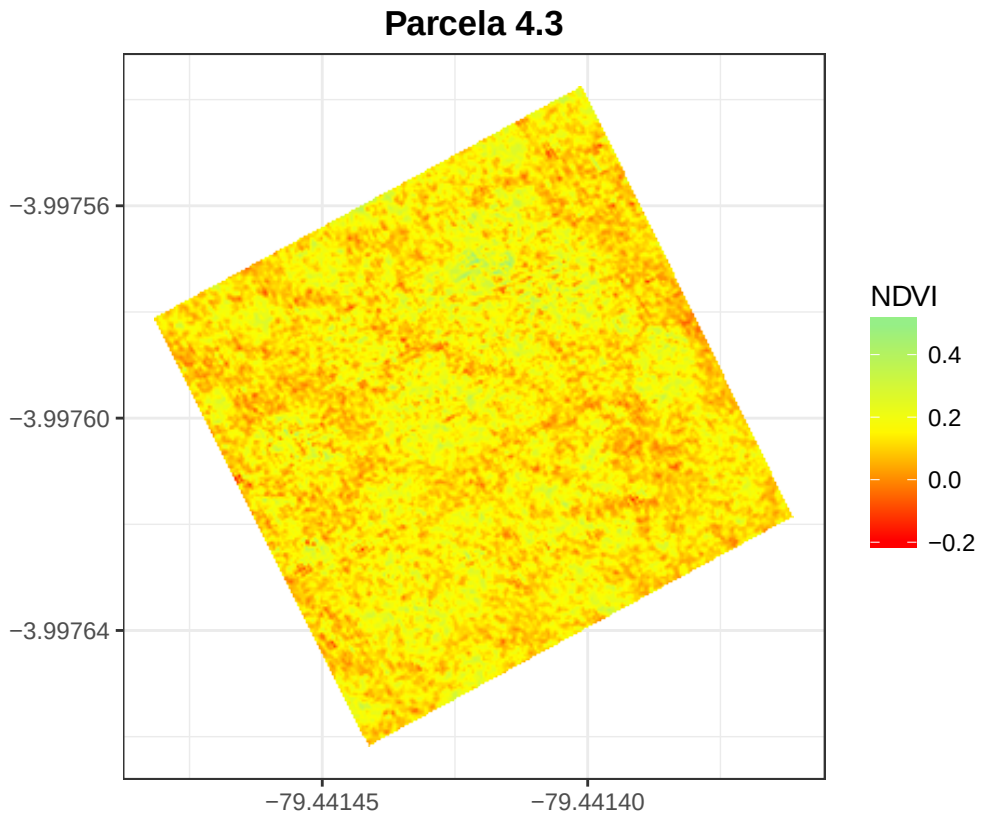
```
p43.VIs <- spectralIndices(TTC08335_modified.stack_p43, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p43.VIs)
```



NDVI Parcela 4.3

```
ggR(p43.VIs$NDVI, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.3") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```



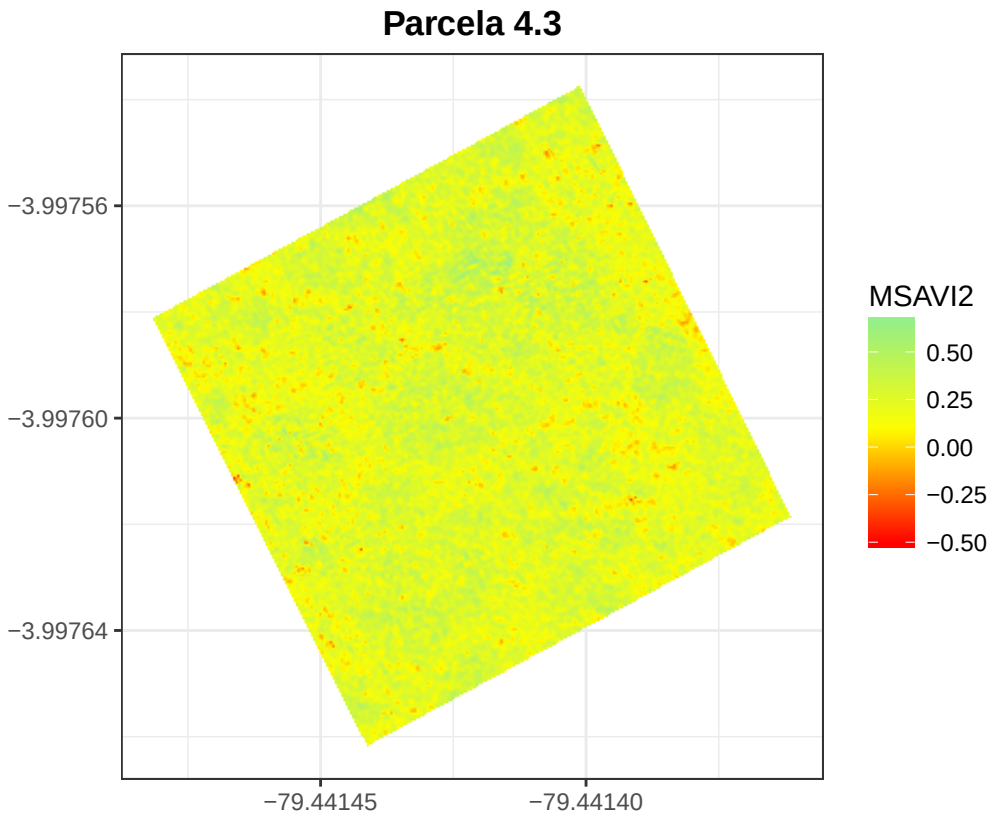

```
ggsave("figures/parcela4_3_NDVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```

MSAVI2 Parcela 4.3

```
ggR(p43.VIs$MSAVI2, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.3") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```



Save

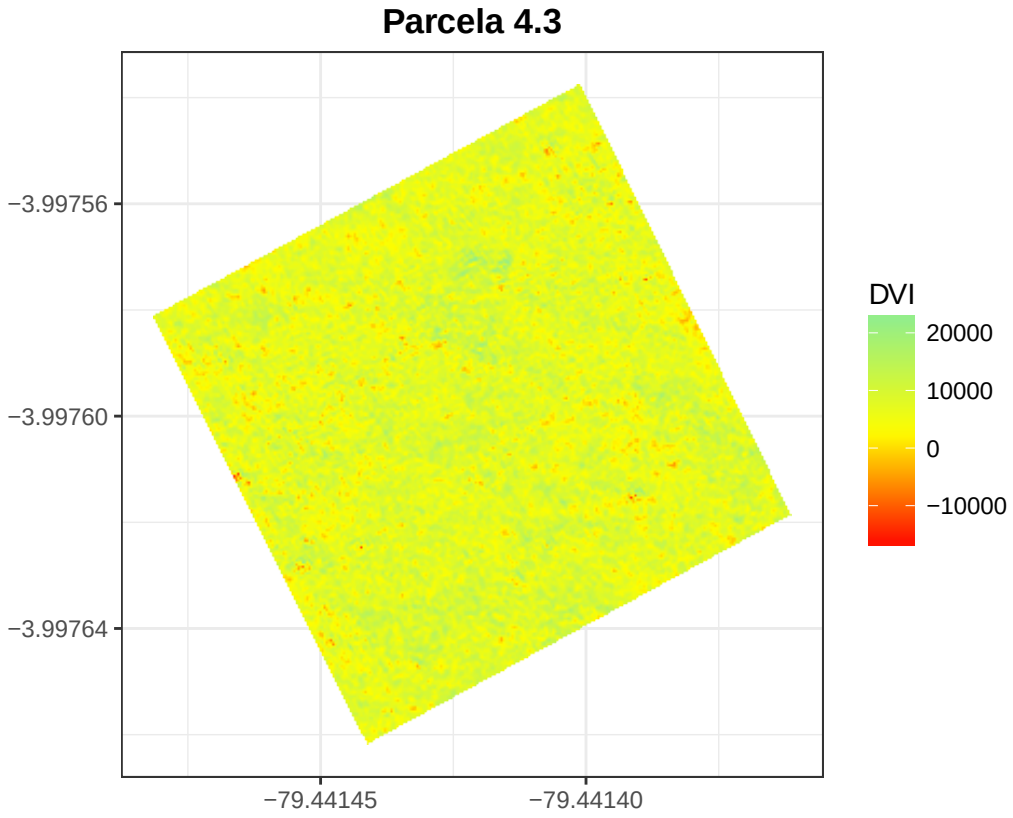
```
ggsave("figures/parcela4_3_MSAVI2.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```

DVI Parcela 4.3

```
ggR(p43.VIs$DVI, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.3") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```



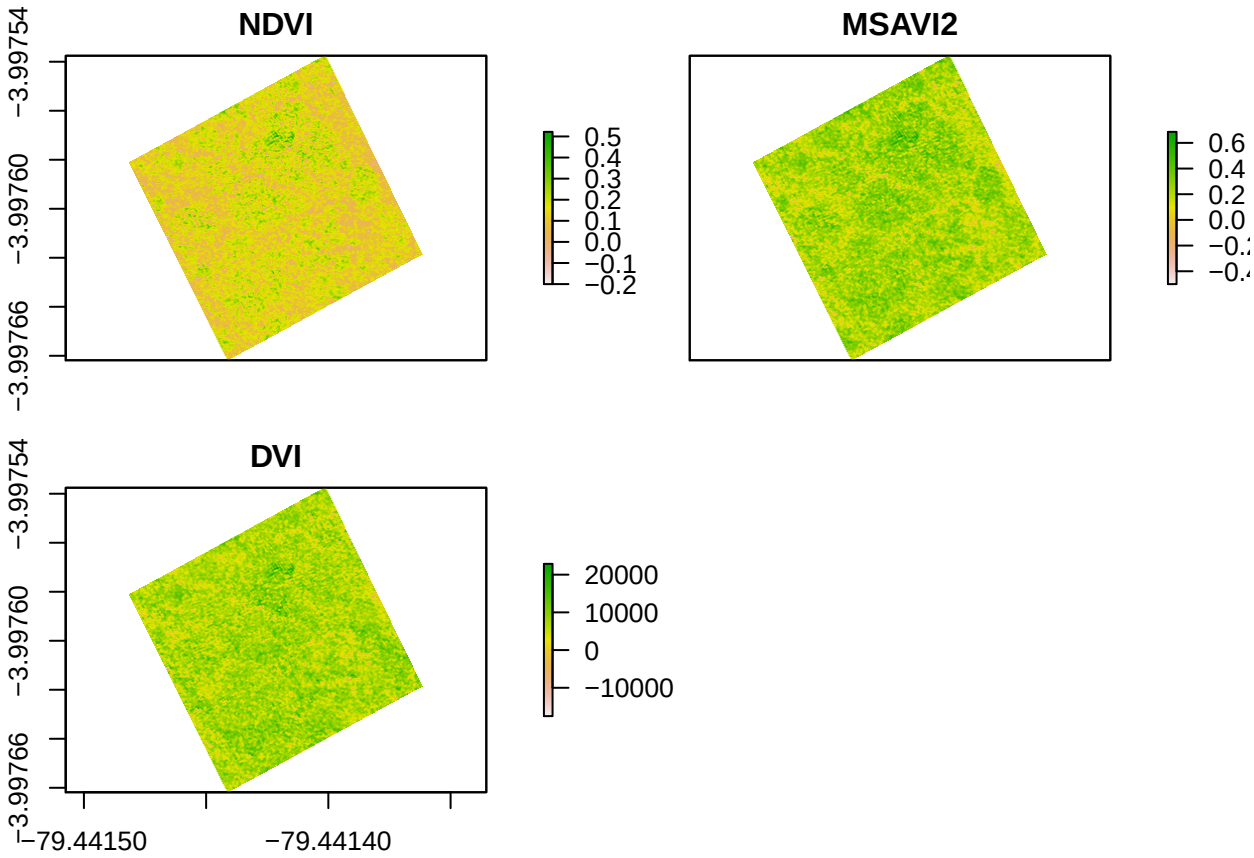
Save

```
ggsave("figures/parcela4_3_DVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 40677 rows containing missing values (geom_raster).
```

Again with p4.3

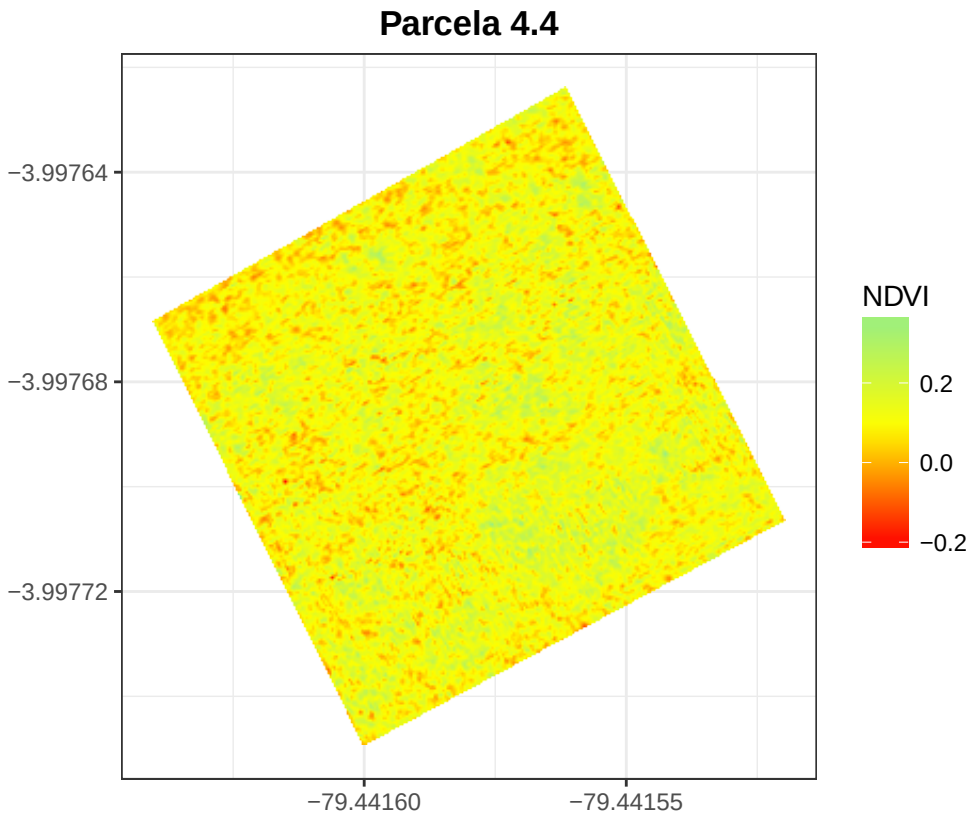
```
p44.VIs <- spectralIndices(TTC08335_modified.stack_p44, red=2, nir =1, indices=c("NDVI", "MSAVI2", "DVI
breaks <- seq(0, 1, by=0.01)

plot(p43.VIs)
```



NDVI Parcela 4.4

```
ggR(p44.VIs$NDVI, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.4") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 41667 rows containing missing values (geom_raster).
```



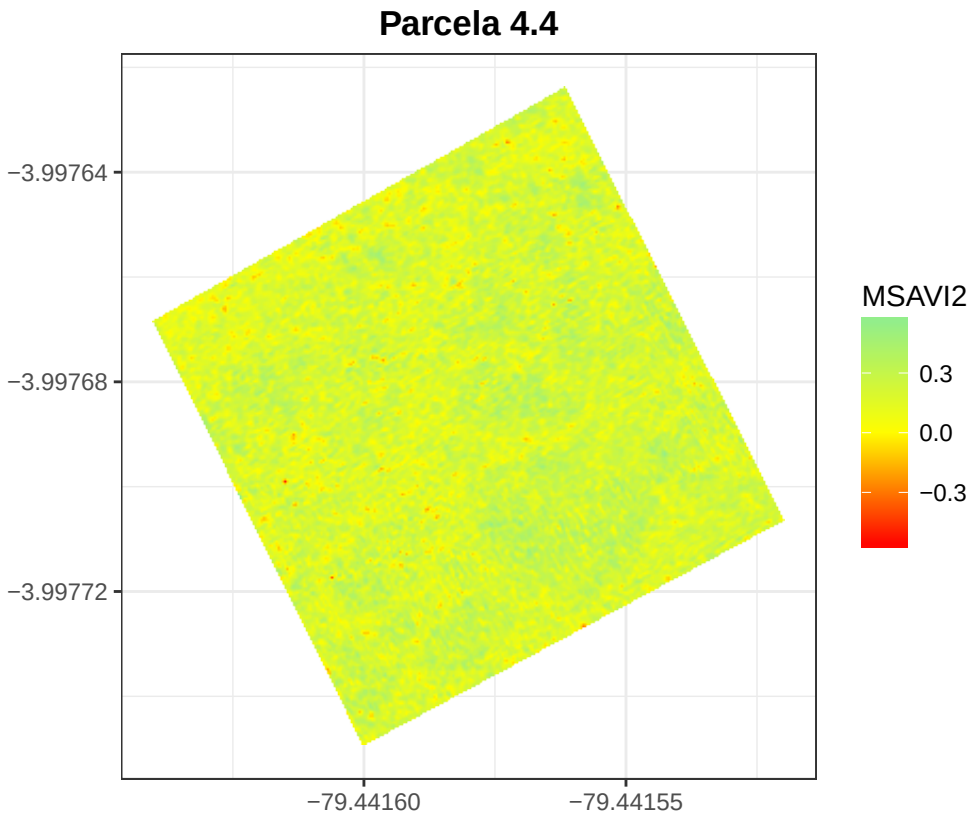

```
ggsave("figures/parcela4_4_NDVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 41667 rows containing missing values (geom_raster).
```

MSAVI2 Parcela 4.3

```
ggR(p44.VIs$MSAVI2, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.4") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 41667 rows containing missing values (geom_raster).
```



Save

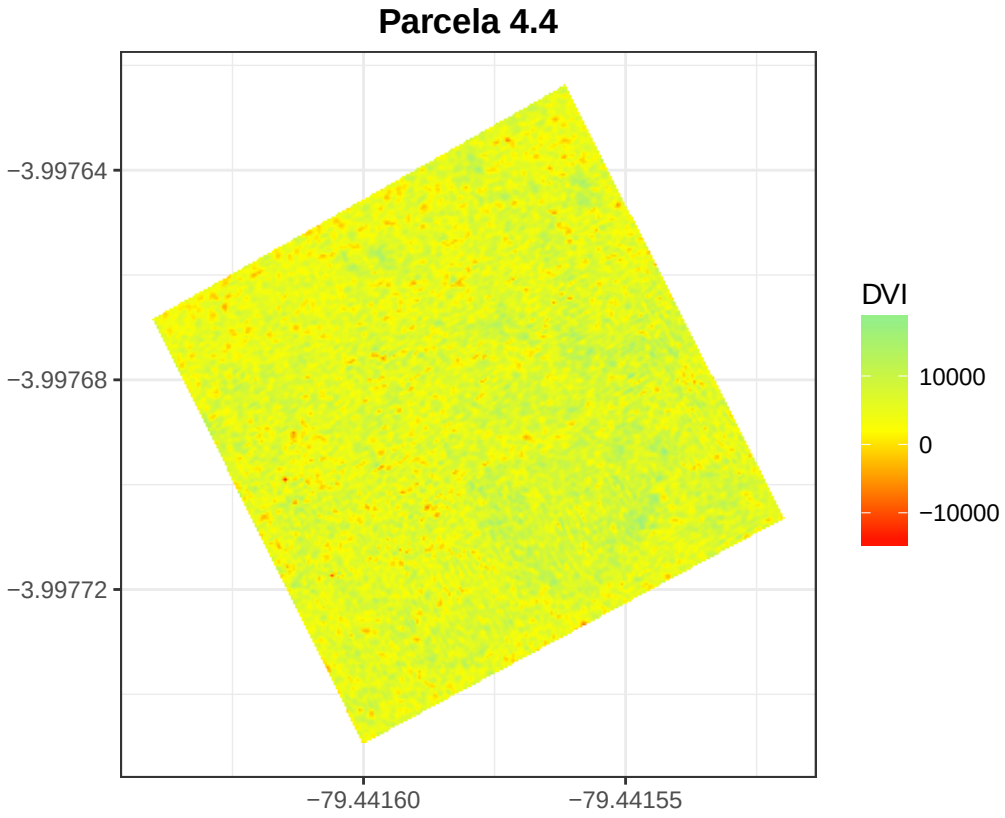
```
ggsave("figures/parcela4_4_MSAVI2.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 41667 rows containing missing values (geom_raster).
```

DVI Parcela 4.3

```
ggR(p44.VIs$DVI, geom_raster = TRUE) +
  labs(x="", y="", title="Parcela 4.4") +
  scale_fill_gradientn(colours=cols,  na.value=NA) +
  theme_bw() +
  theme(plot.title = element_text(lineheight=.8, face="bold", vjust=1, hjust = 0.5))  # make title bold
```

```
## Warning: Removed 41667 rows containing missing values (geom_raster).
```



Save

```
ggsave("figures/parcela4_4_DVI.png",
 plot = last_plot(), # or give ggplot object name as in myPlot,
 width = 5, height = 5,
 units = "in", # other options c("in", "cm", "mm"),
 dpi = 300)
```

```
## Warning: Removed 41667 rows containing missing values (geom_raster).
```