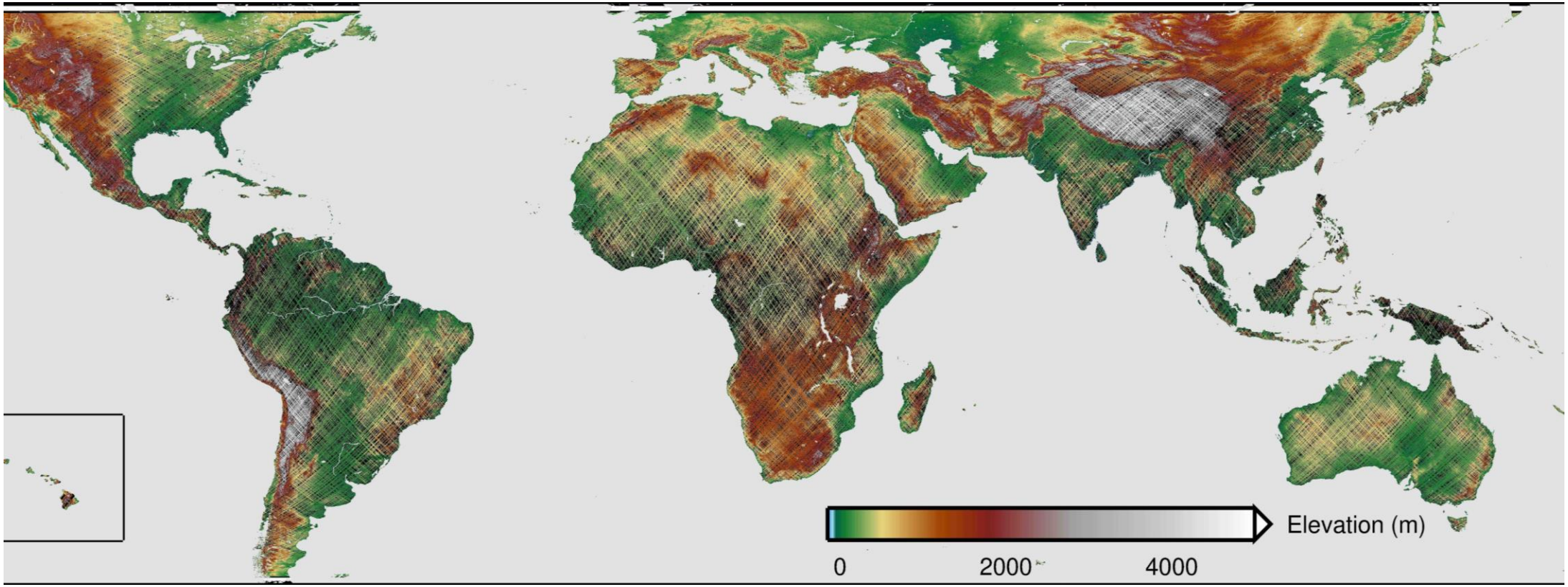



Dr. Adrián Pascual Dr. Juan Guerra-Hernández

Postdoctoral researchers

Aplicaciones con Lidar satelital

**Global Ecosystem Dynamics Investigation (GEDI)**

**Monitoring forests from the International Space Station (ISS)**



GEDI ECOSYSTEM LIDAR

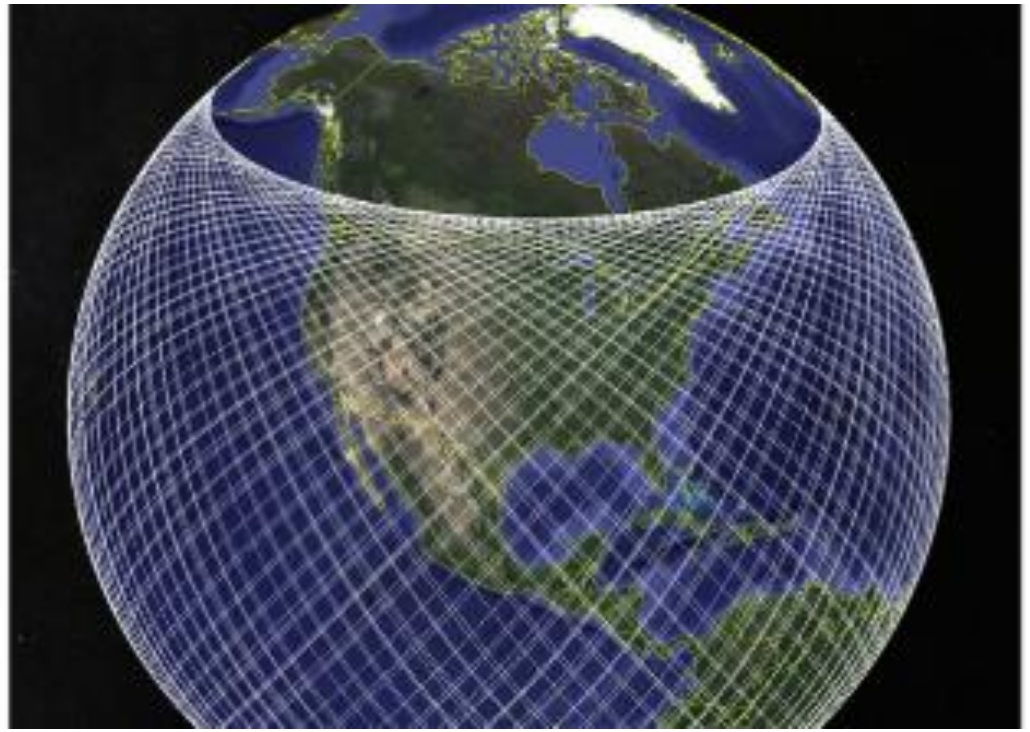
GEDI
ECOSYSTEM LIDAR

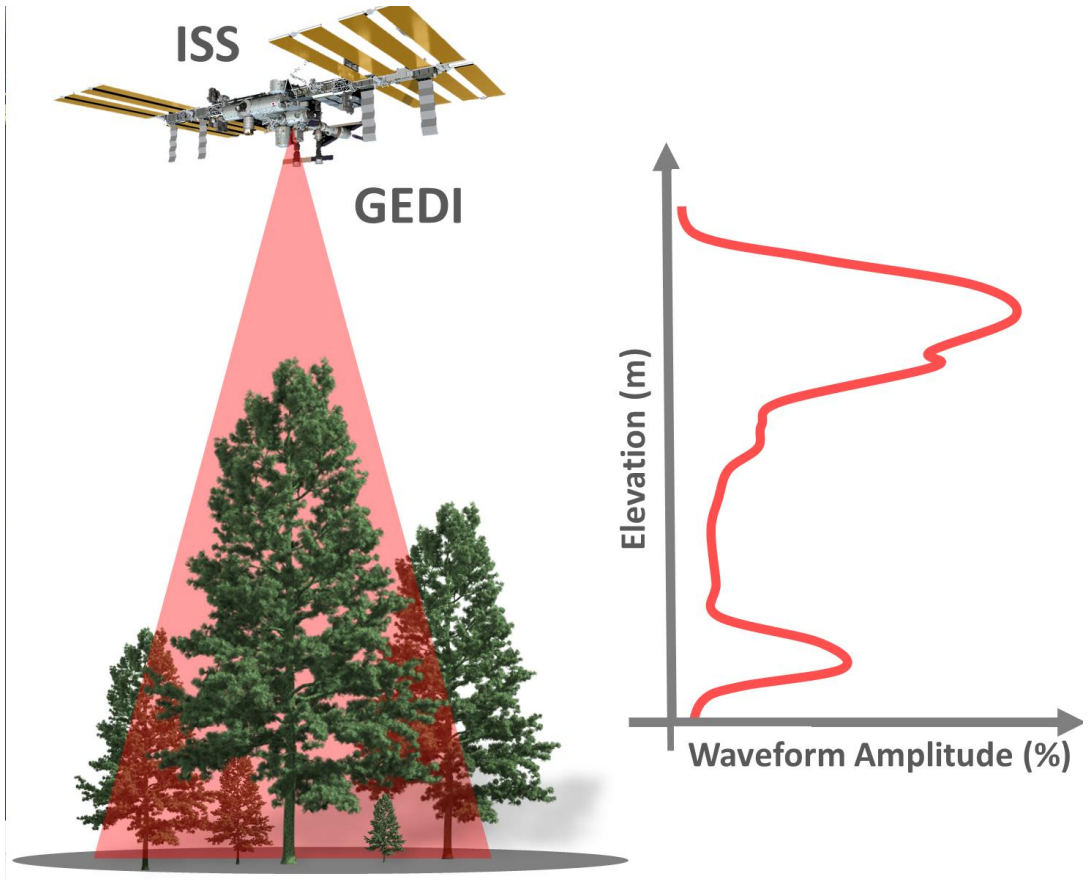
- ✓ Carbono, estructura y servicios ecosistémicos
- ✓ LiDAR is the technology
- ✓ El LiDAR satelital no está tan desarrollado como las misiones y proyectos terrestres Global Ecosystem Dynamics Investigation (GEDI). Lanzamiento Diciembre 2018
- ✓ Misión: 2 años, al menos.
- ✓ Info del 4% de la superficie Terrestre: 4% of land surface : 10000 millones de puntos láser.

Dubayah, R., Blair, J. B., Goetz, S., Fatoyinbo, L., Hansen, M., Healey, S., … Silva, C. (2020). The Global Ecosystem Dynamics Investigation: High-resolution laser ranging of the Earth's forests and topography. Science of Remote Sensing, 1: 100002. https://doi.org/10.1016/j.srs.2020.100002

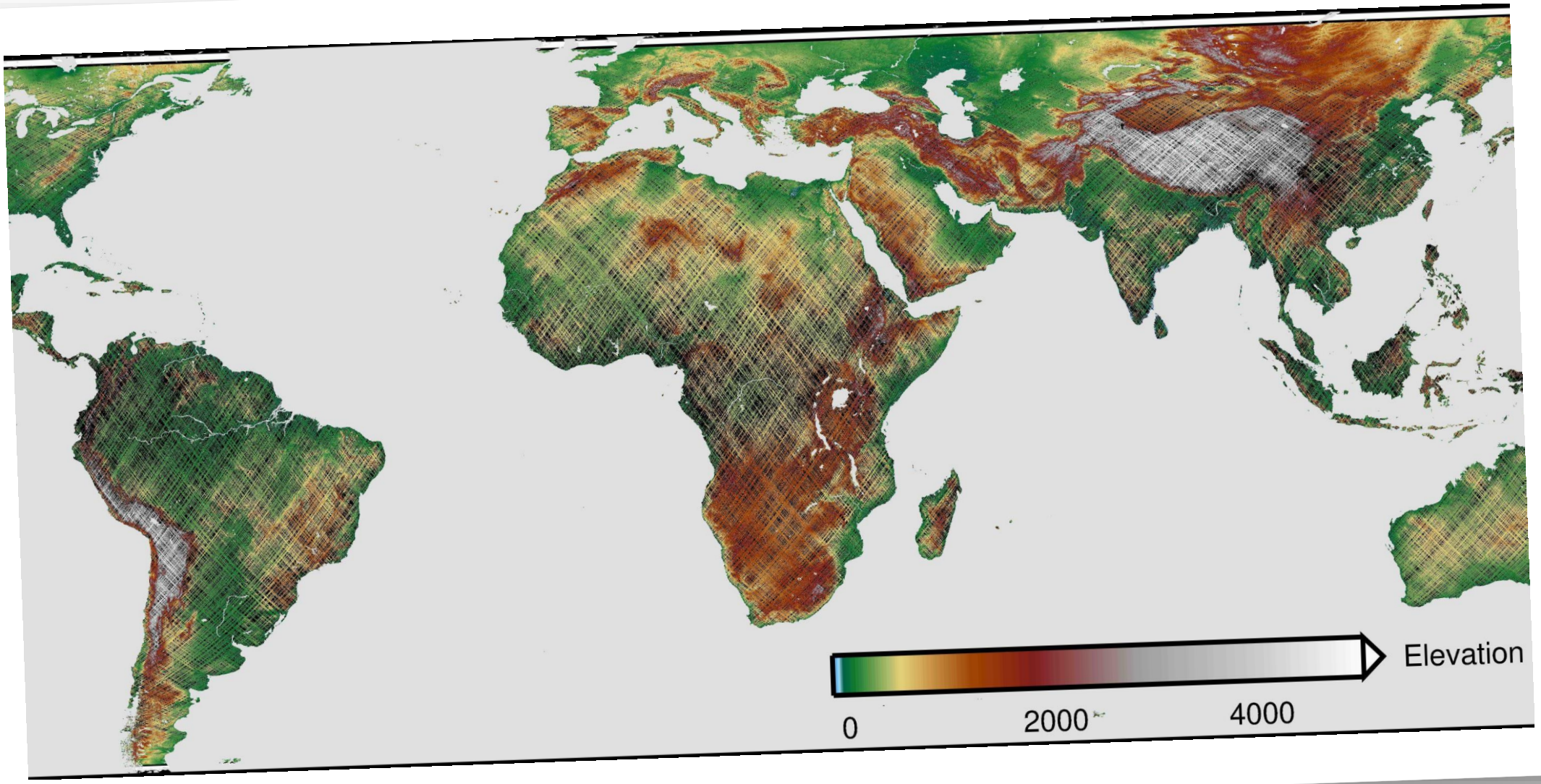
GEDI

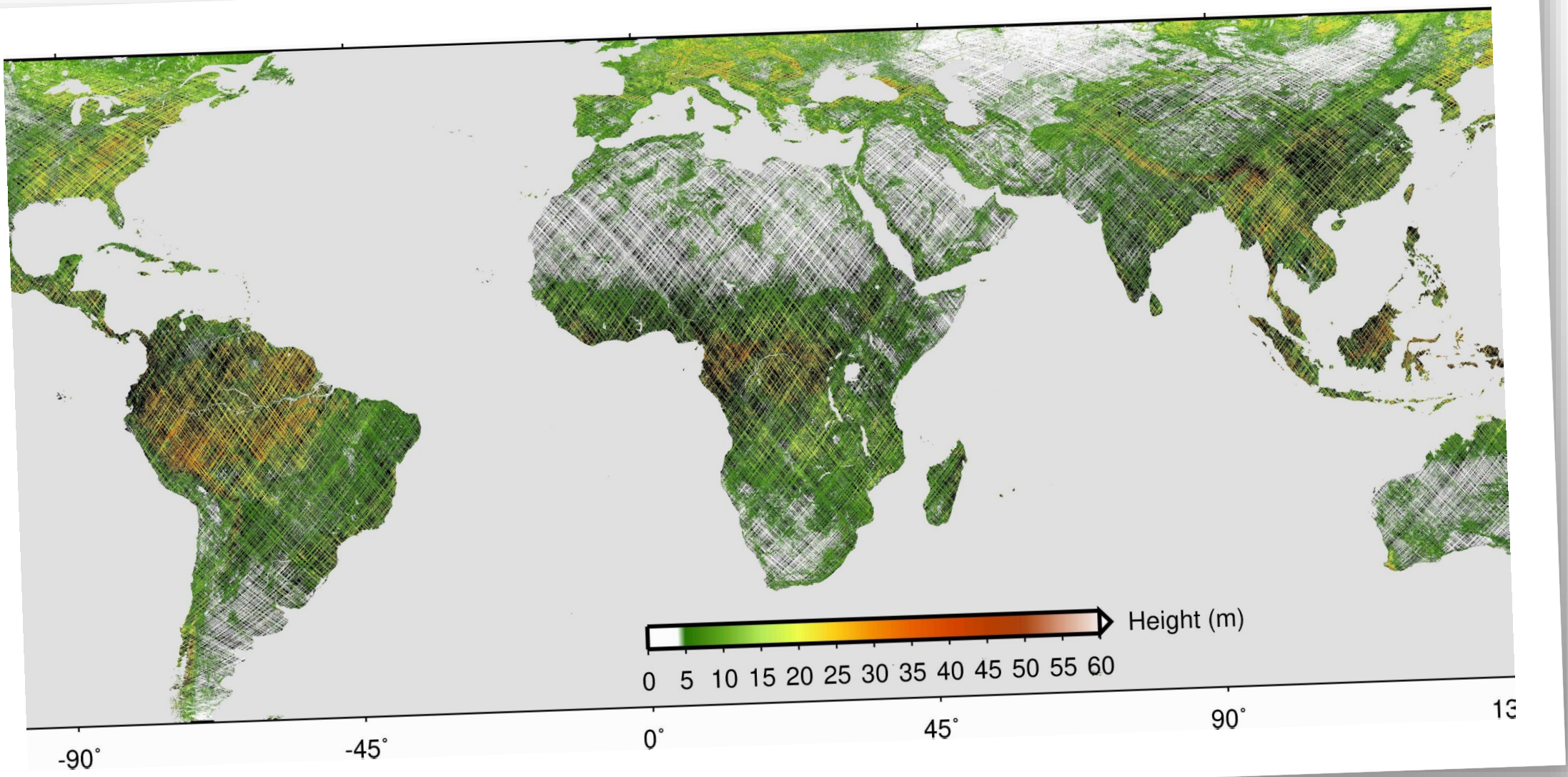
ECOSYSTEM LIDAR

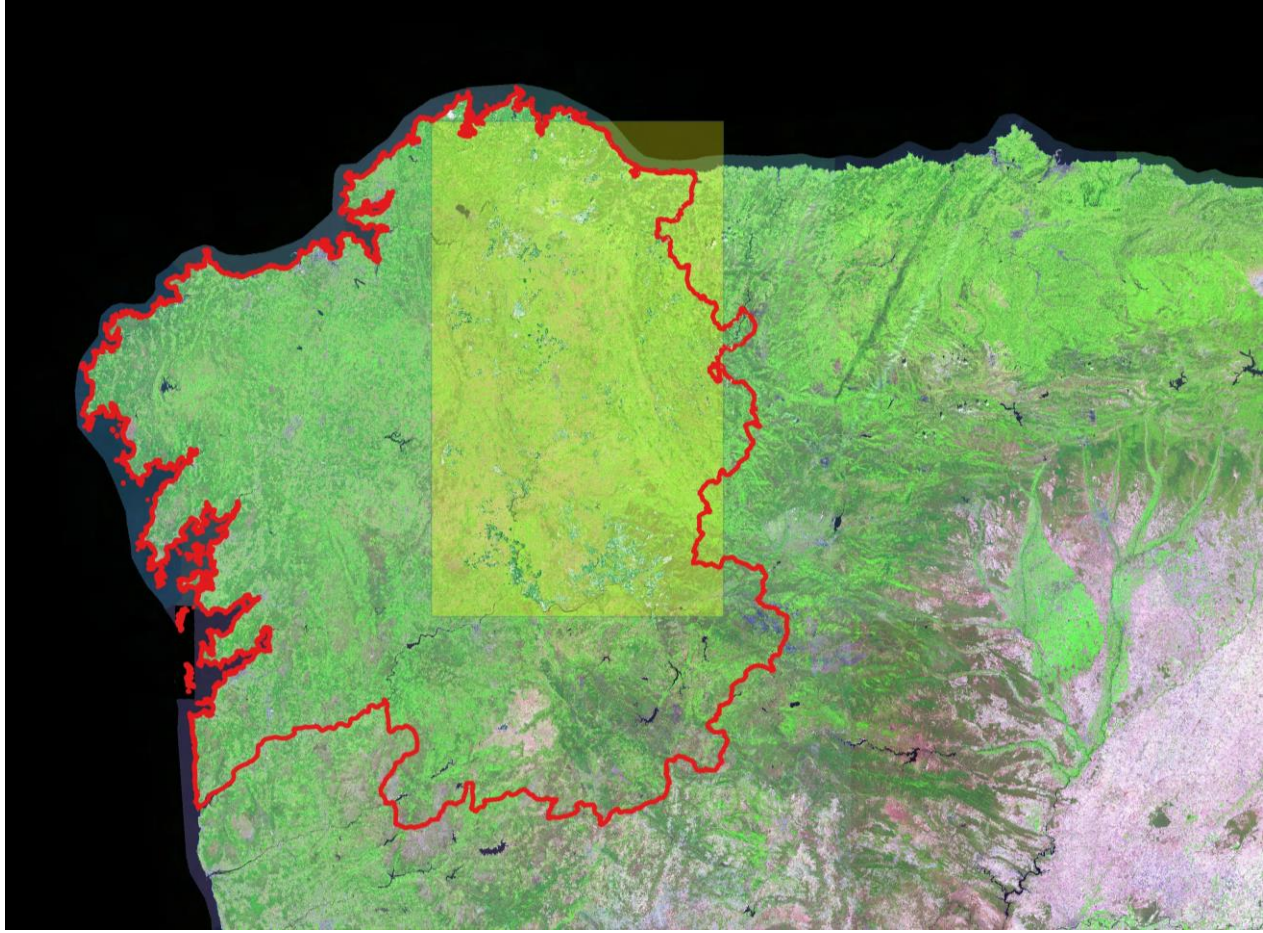





Silva,C.A; Hamamura,C.; Valbuena, R.; Hancock,S.; Cardil,A.; Broadbent, E. N.; Almeida,D.R.A.; Silva Junior, C.H.L; Klauberg, C. rGEDI: NASA's Global Ecosystem Dynamics Investigation (GEDI) Data Visualization and Processing. version 0.1.2, accessed on April. 1 2020, available at: https://CRAN.R-project.org/package=rGEDI

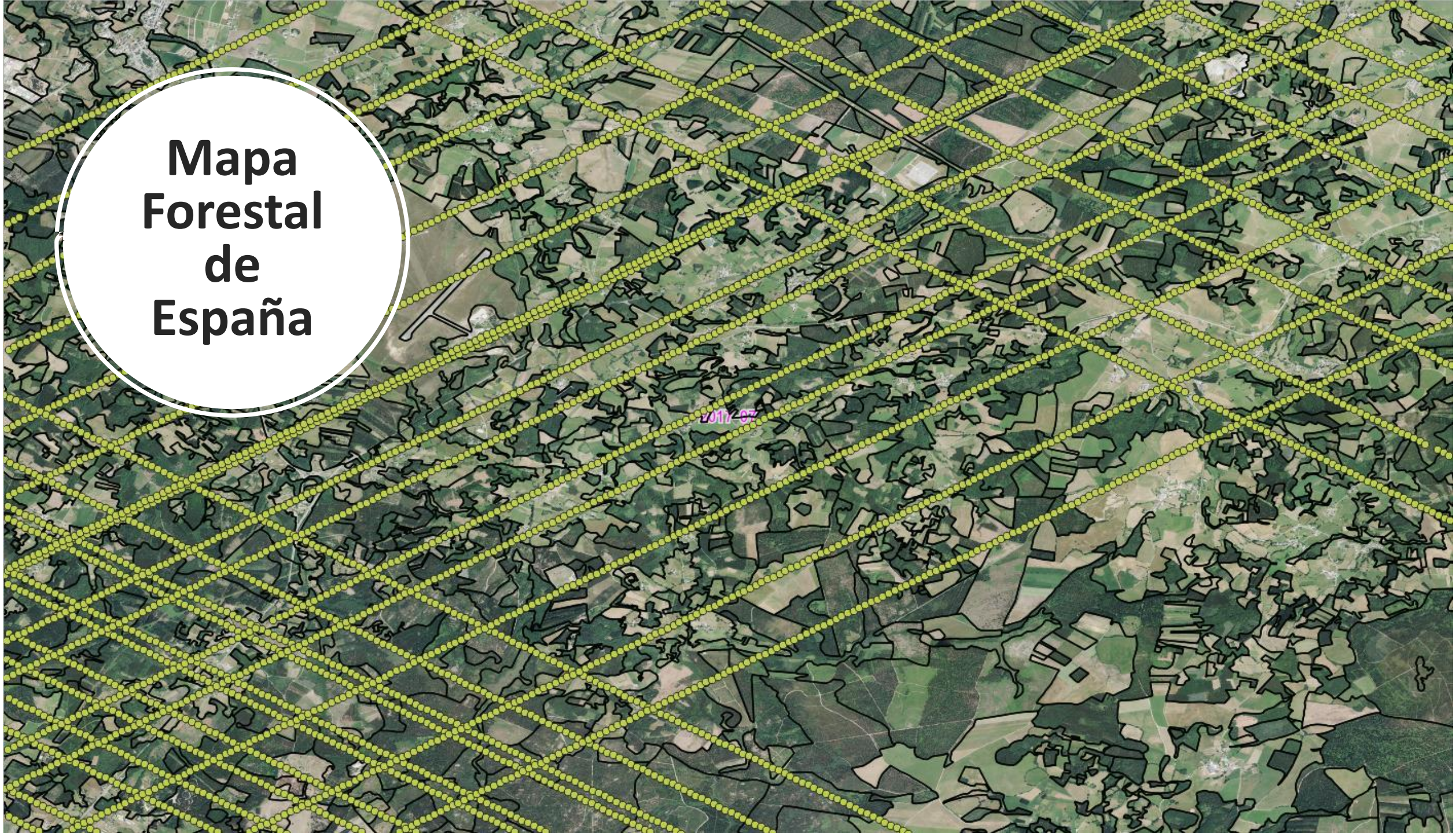

Elevation
0
2000
4000


Height (m)
0 5 10 15 20 25 30 35 40 45 50 55 60
-90˚
-45˚
0˚
45˚
90˚
13

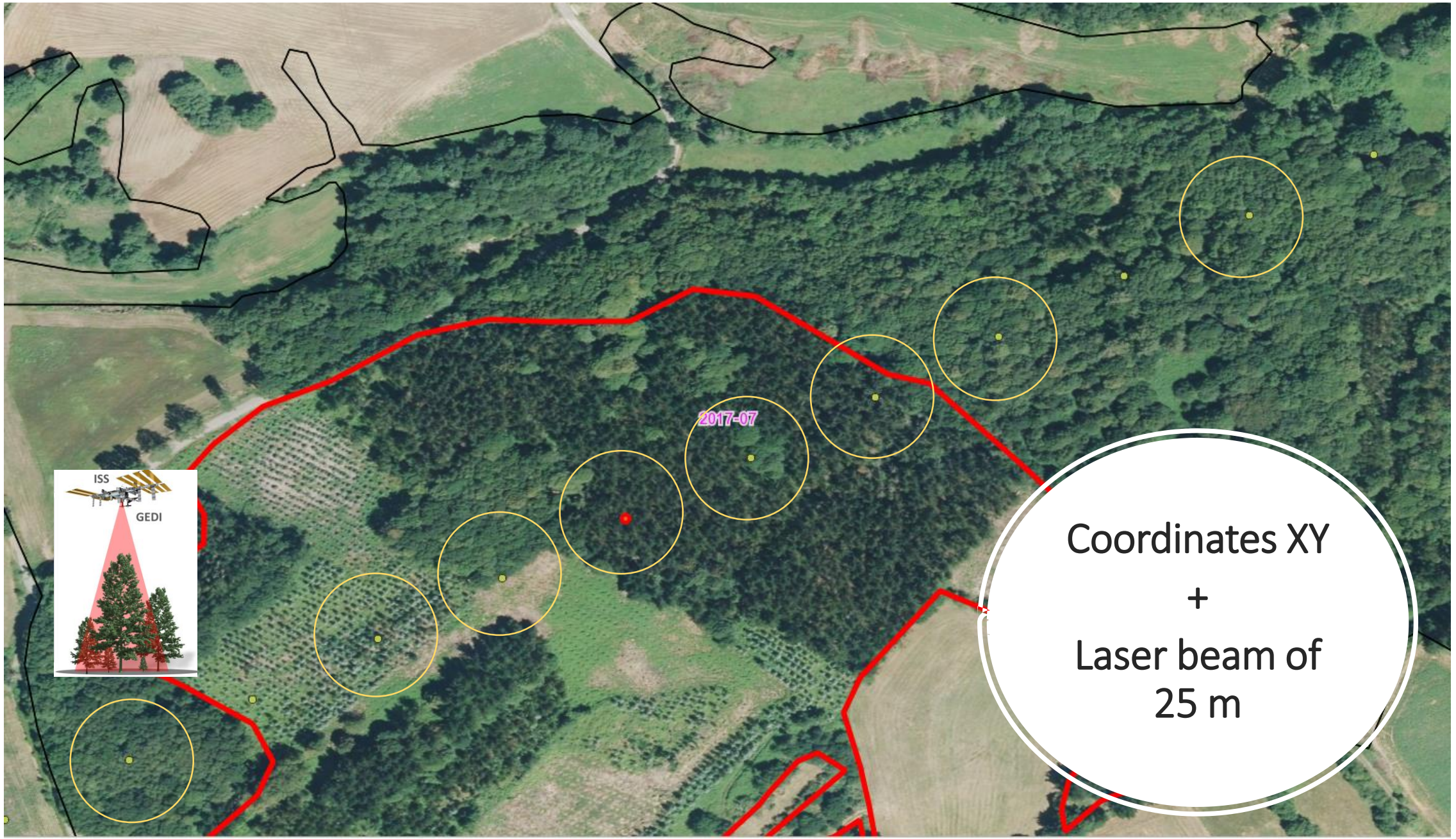



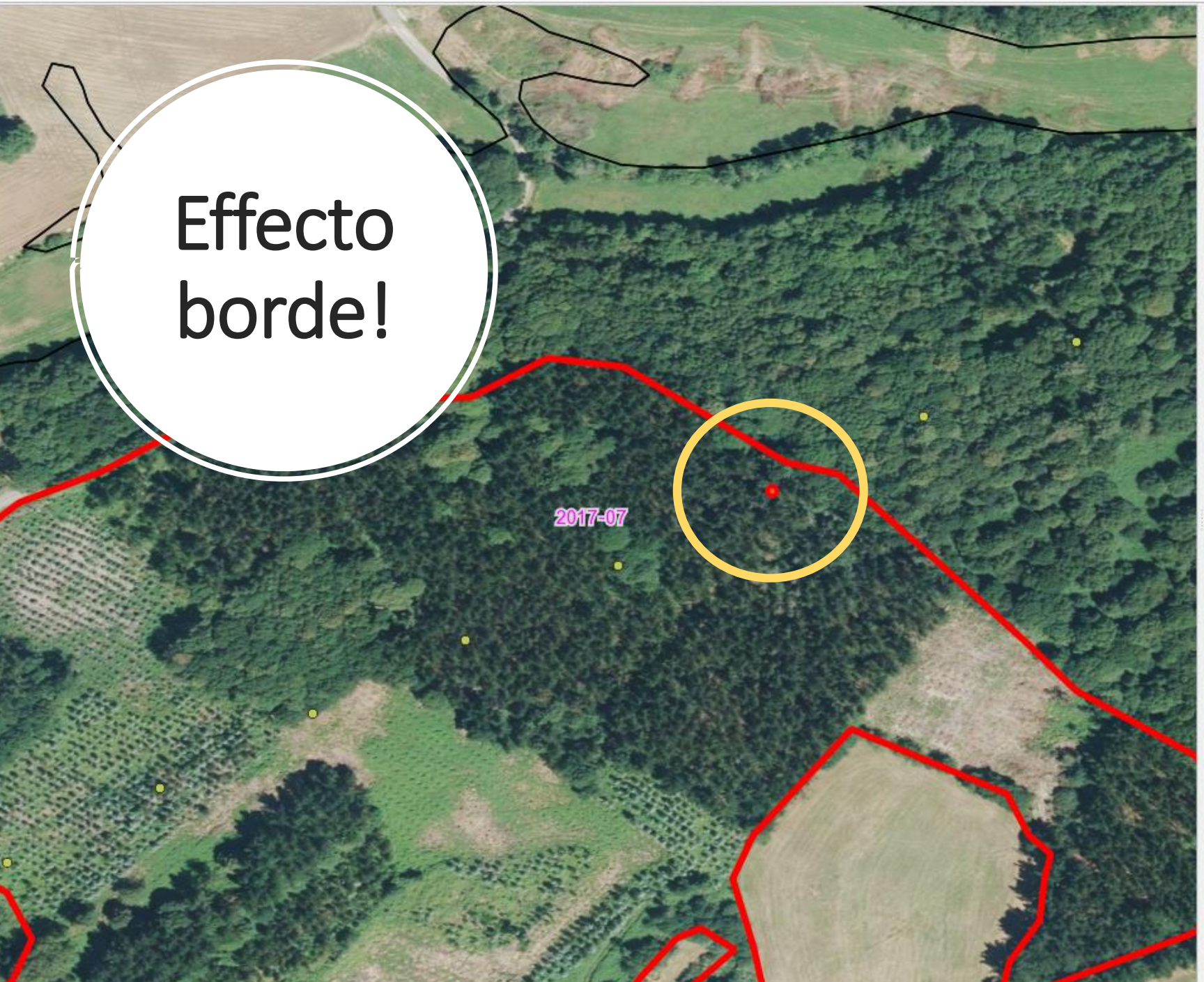
# GEDI en ESPAÑA para actualizar decisiones en base al LiDAR PNOA


Mapa
Forestal
de
España


Mapa
Forestal
de
España

# The GEDI Shooting contest

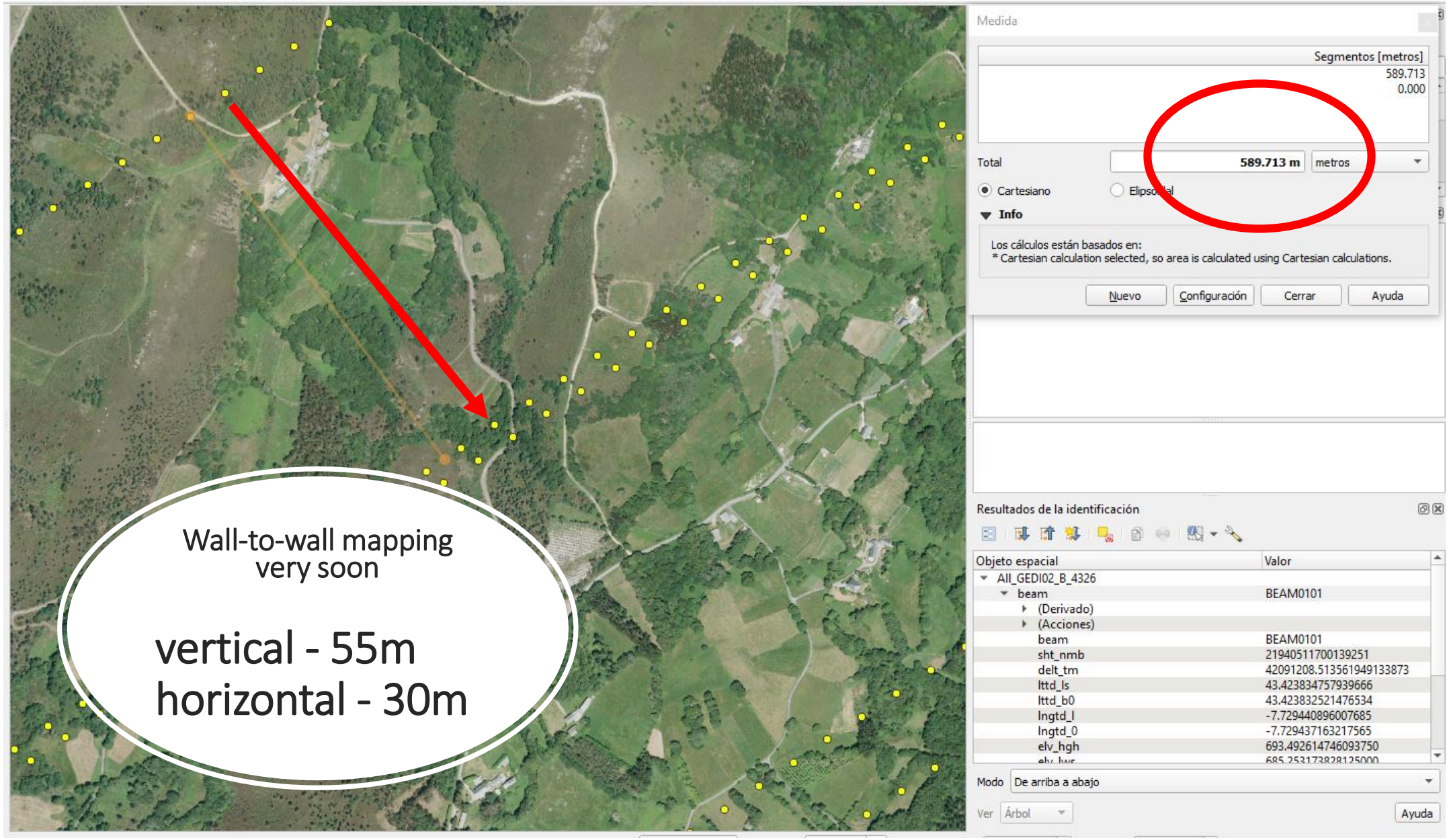

2017-07
ISS
GEDI
Coordinates XY
+
Laser beam of
25 m

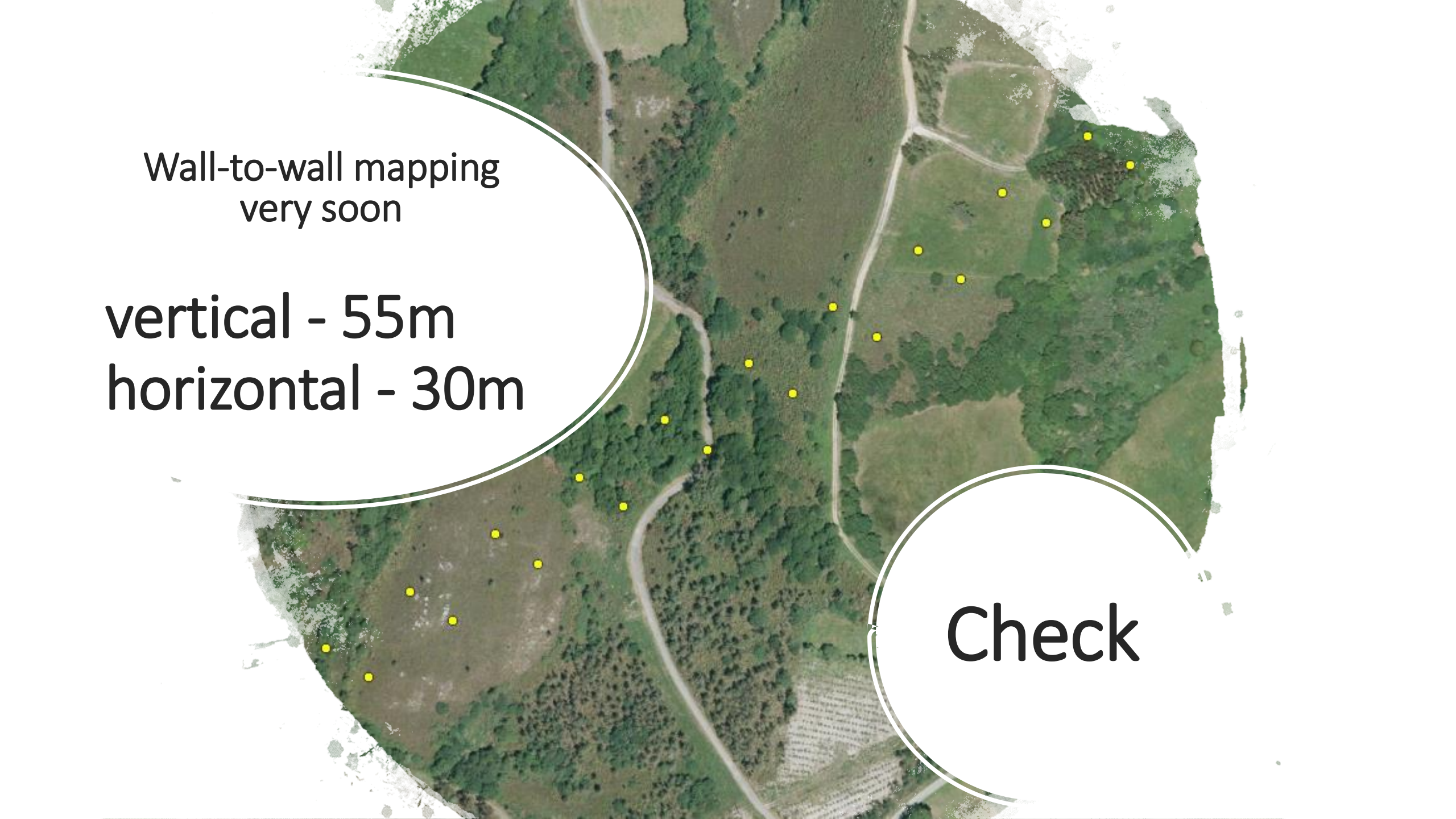



Resultados de la identificación

| Objeto espacial | Valor |
|---|---|
| ▾ All_GEDI02_B | |
| ▾ OBJECTID | 223491 |
| ▸ (Derivado) | |
| ▸ (Acciones) | |
| OBJECTID | 223491 |
| beam | BEAM0101 |
| sht_nmb | 33700506700140696 |
| delt_tm | 48635581.59600000083 |
| lttd_ls | 43.10734647880 |
| lttd_b0 | 43.10734445320 |
| lngtd_l | -7.43210773812 |
| lngtd_0 | -7.43210459639 |
| elv_hgh | 562.38879394500 |
| elv_lws | 556.84582519500 |
| pai | 0.068999446929 |
| fhd_nrm | 1.60493290424 |
| omega | 1.00000000000 |
| pgp_tht | 0.96607798338 |
| cover | 0.033911205828 |
| ▸ Galicia | |
| ▸ 2 | Ortoimagen/Mosaico |

Modo De arriba a abajo


Medida
Segmentos [metros]
589.713
0.000
Total
589.713 m
metros
Cartesiano
Elipsoidal
Info
Los cálculos están basados en:
* Cartesian calculation selected, so area is calculated using Cartesian calculations.
Nuevo
Configuración
Cerrar
Ayuda
Resultados de la identificación
Objeto espacial
Valor
All_GEDI02_B_4326
beam
BEAM0101
(Derivado)
(Acciones)
beam
BEAM0101
sht_nmb
21940511700139251
delt_tm
42091208.513561949133873
lttd_ls
43.423834757939666
lttd_b0
43.423832521476534
lngtd_l
-7.729440896007685
lngtd_0
-7.729437163217565
elv_hgh
693.492614746093750
Modo
De arriba a abajo
Ver
Árbol
Ayuda
Wall-to-wall mapping
very soon
vertical - 55m
horizontal - 30m


Wall-to-wall mapping
very soon
vertical - 55m
horizontal - 30m
Check

# Time to play

RStudio®

# Gracias

## Package 'rGEDI'

May 7, 2020

**Type** Package

**Title** NASA's Global Ecosystem Dynamics Investigation (GEDI) Data Visualization and Processing

**Version** 0.1.7

**Maintainer** Carlos Alberto Silva <carlos_engflorestal@outlook.com>

**Description** Set of tools for downloading, reading, visualizing and processing GEDI Level1B, Level2A and Level2B data.

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Depends** methods

**Imports** bit64, curl, data.table, fs, getPass, ggplot2, h
jsonlite, lazyeval, raster, RColorBrewer, sp, stat

**Suggests** devtools, knitr, leaflet, leafsync, lidR, plot3
rmarkdown, viridis, xtable

**SystemRequirements** GNU Scientific Library (>= 2.
libgeotiff (>= 1.4.0), szip (>= 2.1) zlib (>= 1.2)

**NeedsCompilation** yes

**RoxygenNote** 7.1.0

**VignetteBuilder** knitr

**BugReports** https://groups.yahoo.com/neo/gro

**URL** https://github.com/carlos-alberto-silv

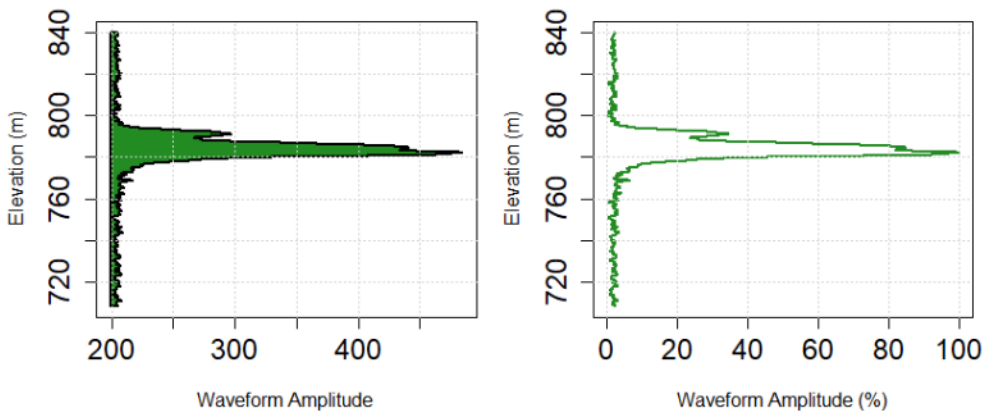
**Copyright** inst/COPYRIGHTS

**Author** Carlos Alberto Silva [aut, cre, cph],
Caio Hamamura [aut, cph],
Ruben Valbuena [aut, ctb],
Steven Hancock [aut, ctb],
Adrian Cardil [aut, ctb],

# We set the shot number to compute Level 2A statistics RH100

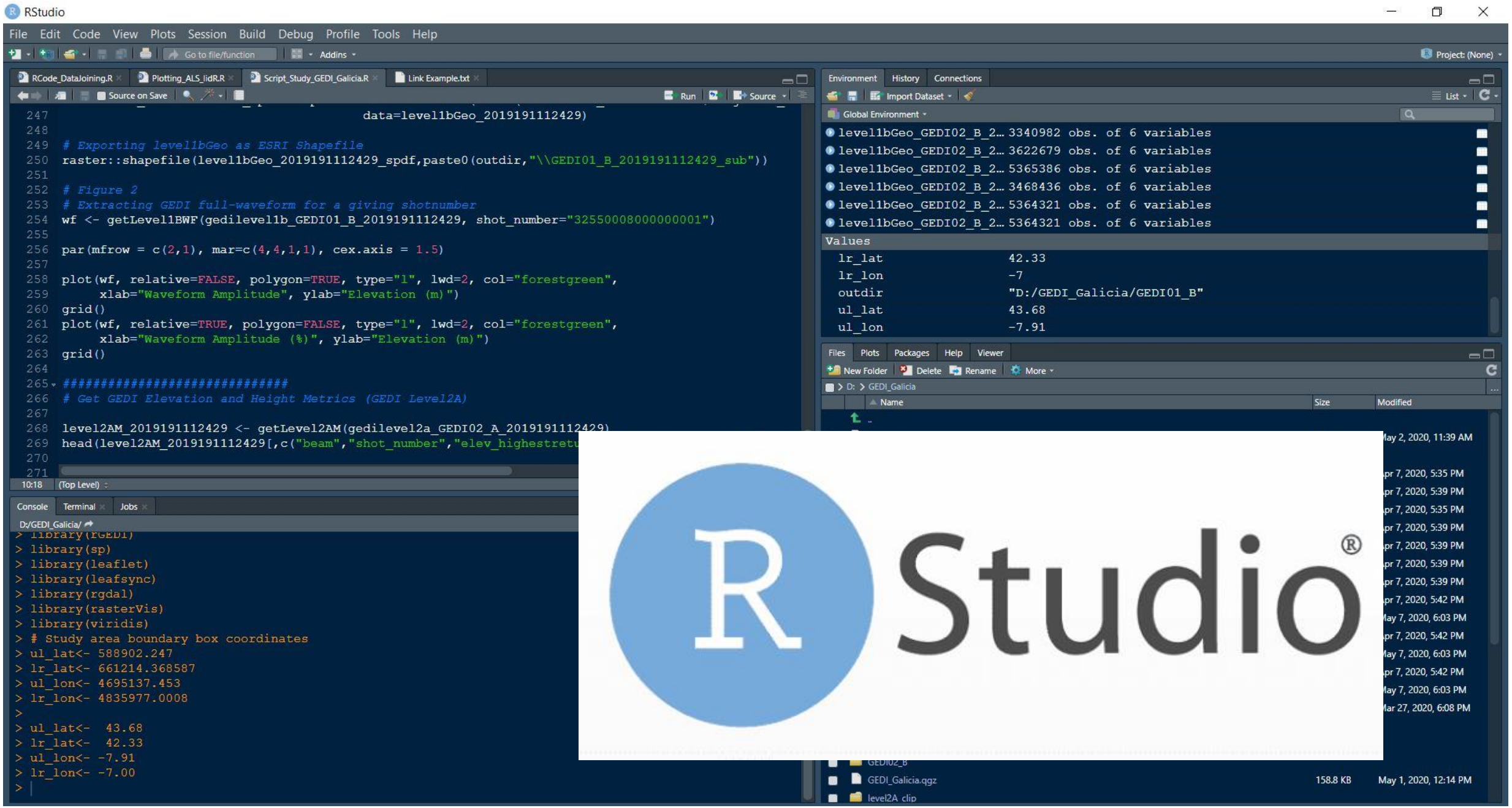
## Get GEDI Full-waveform (GEDI Level1B)

```
# Extracting GEDI full-waveform for a giving shotnumber
wf <- getLevel1BWF(gedilevel1b, shot_number="19640521100108408")

par(mfrow = c(2,1), mar=c(4,4,1,1), cex.axis = 1.5)

plot(wf, relative=FALSE, polygon=TRUE, type="l", lwd=2, col="forestgreen",
     xlab="Waveform Amplitude", ylab="Elevation (m)")
grid()
plot(wf, relative=TRUE, polygon=FALSE, type="l", lwd=2, col="forestgreen",
     xlab="Waveform Amplitude (%)", ylab="Elevation (m)")
grid()
```

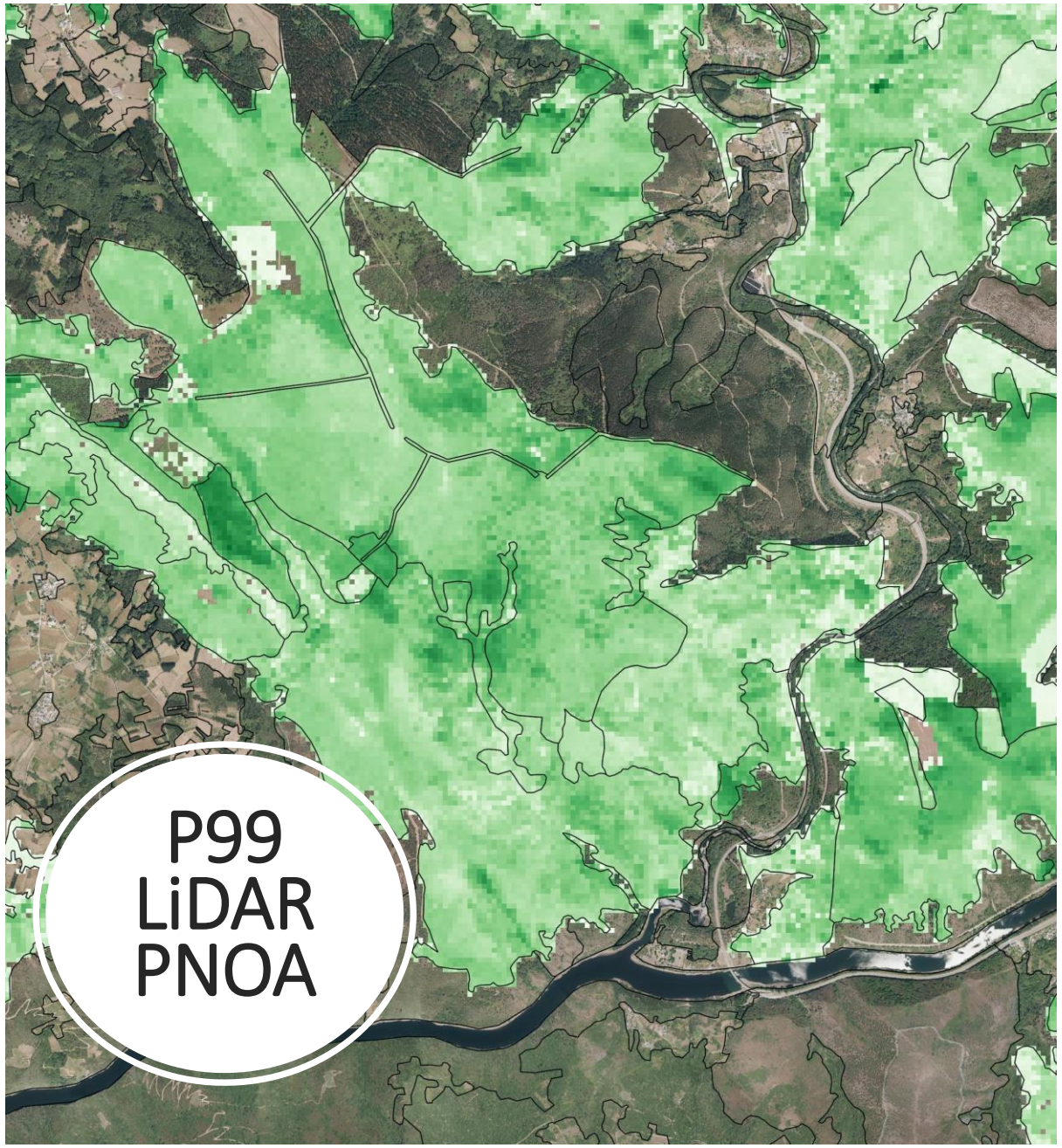


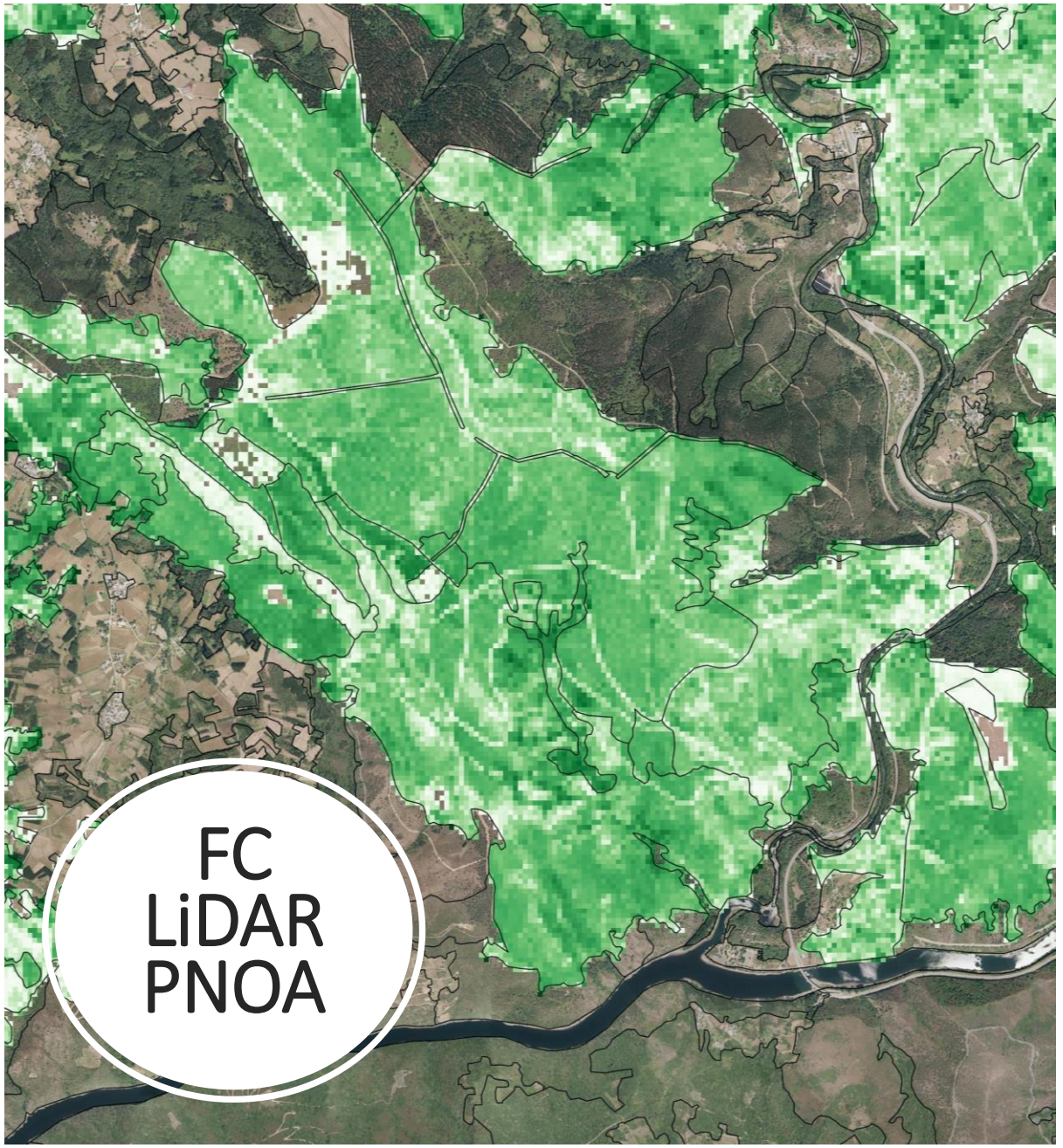

## Get GEDI Elevation and Height Metrics (GEDI Level2A)

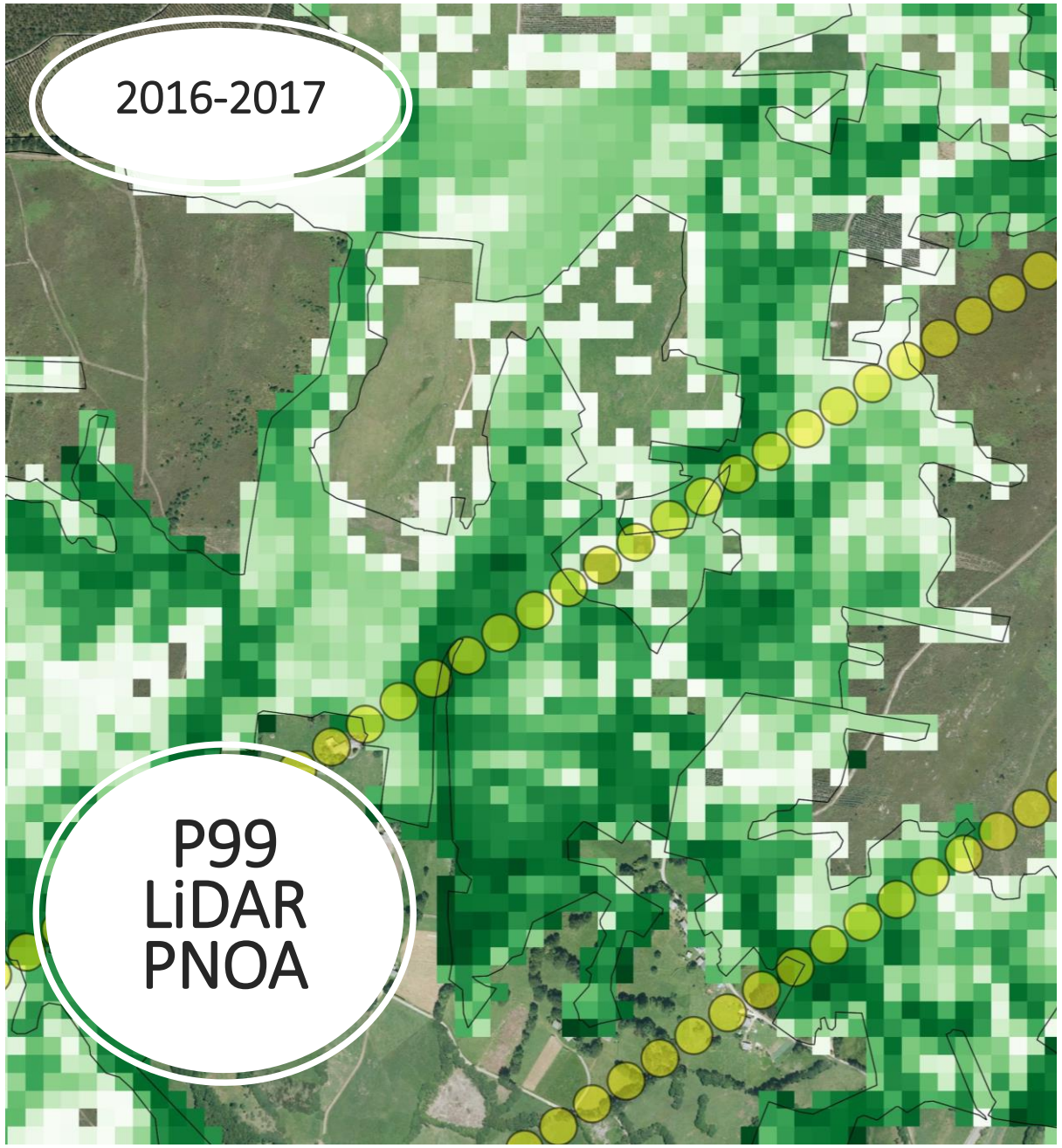
```
# Get GEDI Elevation and Height Metrics
level2AM<-getLevel2AM(gedilevel2a)
head(level2AM[,c("beam","shot_number","elev_highestreturn","elev_lowestmode","rh100")])

##          beam       shot_number elev_highestreturn elev_lowestmode rh100
##  1: BEAM0000 19640002800109382           740.7499        736.3301  4.41
##  2: BEAM0000 19640003000109383           756.0878        746.7614  9.32
##  3: BEAM0000 19640003200109384           770.3423        763.1509  7.19
##  4: BEAM0000 19640003400109385           775.9838        770.6652  5.31
##  5: BEAM0000 19640003600109386           777.8409        773.0841  4.75
##  6: BEAM0000 19640003800109387           778.7181        773.6990  5.01

# Converting shot_number as "integer64" to "character"
level2AM$shot_number<-paste0(level2AM$shot_number)

# Converting Elevation and Height Metrics as data.table to SpatialPointsDataFrame
level2AM_spdf<-SpatialPointsDataFrame(cbind(level2AM$lon_lowestmode,level2AM$lat_lowestmode),
                                      data=level2AM)

# Exporting Elevation and Height Metrics as ESRI Shapefile
raster::shapefile(level2AM_spdf,paste0(outdir,"\\GEDI02_A_2019108080338_O01964_T05337_02_001_01_sub"))
```

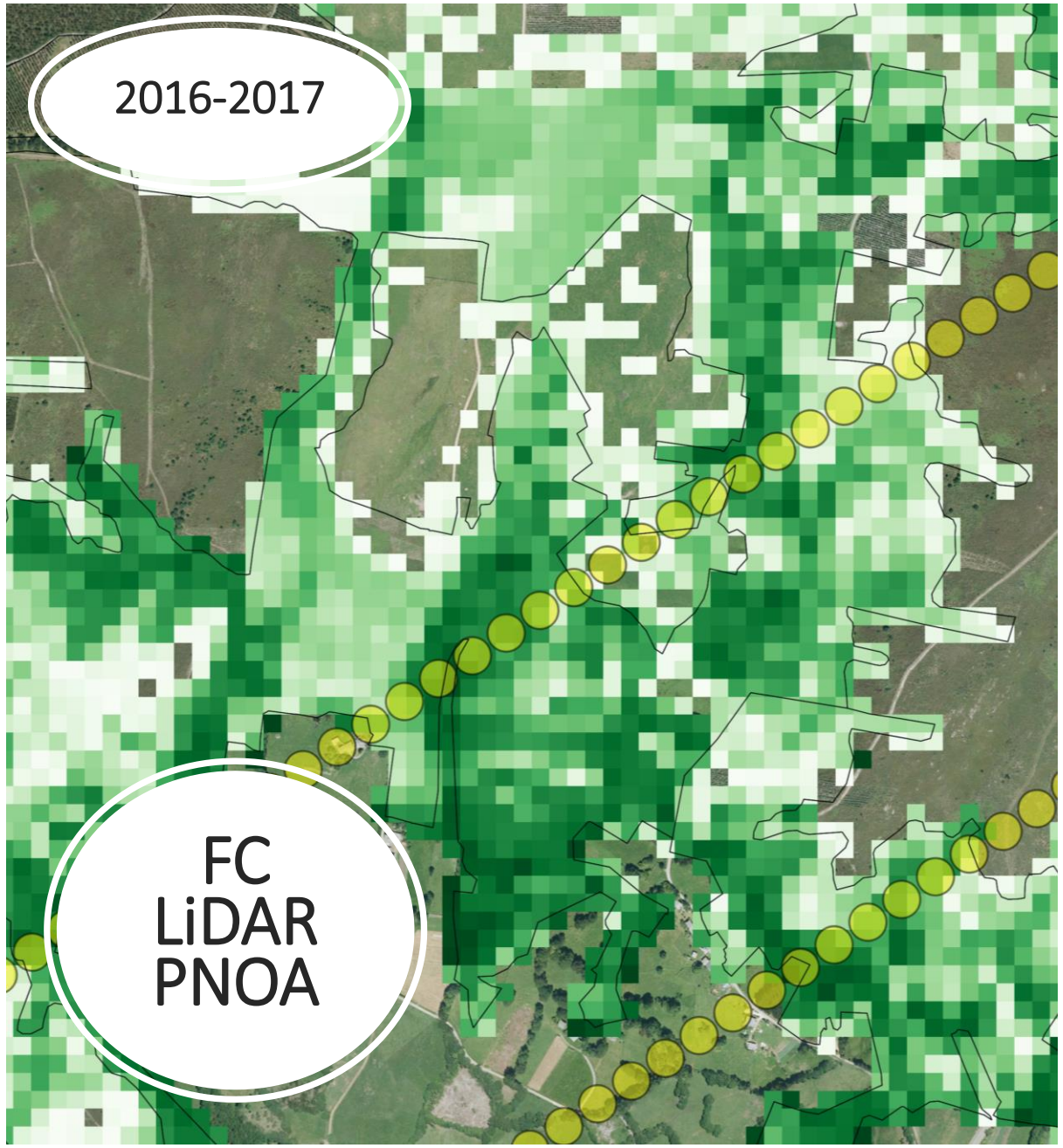

RStudio
File Edit Code View Plots Session Build Debug Profile Tools Help
RCode_DataJoining.R
Plotting_ALS_lidR.R
Script_Study_GEDI_Galicia.R
Link Example.txt
data=level1bGeo_2019191112429)
# Exporting level1bGeo as ESRI Shapefile
raster::shapefile(level1bGeo_2019191112429_spdf,paste0(outdir,"\\GEDI01_B_2019191112429_sub"))
# Figure 2
# Extracting GEDI full-waveform for a giving shotnumber
wf <- getLevel1BWF(gedilevel1b_GEDI01_B_2019191112429, shot_number="32550008000000001")
par(mfrow = c(2,1), mar=c(4,4,1,1), cex.axis = 1.5)
plot(wf, relative=FALSE, polygon=TRUE, type="l", lwd=2, col="forestgreen",
xlab="Waveform Amplitude", ylab="Elevation (m)")
grid()
plot(wf, relative=TRUE, polygon=FALSE, type="l", lwd=2, col="forestgreen",
xlab="Waveform Amplitude (%)", ylab="Elevation (m)")
grid()
############################
# Get GEDI Elevation and Height Metrics (GEDI Level2A)
level2AM_2019191112429 <- getLevel2AM(gedilevel2a_GEDI02_A_2019191112429)
head(level2AM_2019191112429[,c("beam","shot_number","elev_highestretu
Environment History Connections
Import Dataset
Global Environment
level1bGeo_GEDI02_B_2... 3340982 obs. of 6 variables
level1bGeo_GEDI02_B_2... 3622679 obs. of 6 variables
level1bGeo_GEDI02_B_2... 5365386 obs. of 6 variables
level1bGeo_GEDI02_B_2... 3468436 obs. of 6 variables
level1bGeo_GEDI02_B_2... 5364321 obs. of 6 variables
level1bGeo_GEDI02_B_2... 5364321 obs. of 6 variables
Values
lr_lat 42.33
lr_lon -7
outdir "D:/GEDI_Galicia/GEDI01_B"
ul_lat 43.68
ul_lon -7.91
Files Plots Packages Help Viewer
New Folder Delete Rename More
D: > GEDI_Galicia
Name Size Modified
Console Terminal Jobs
D:/GEDI_Galicia/
> library(rGEDI)
> library(sp)
> library(leaflet)
> library(leafsync)
> library(rgdal)
> library(rasterVis)
> library(viridis)
> # Study area boundary box coordinates
> ul_lat<- 588902.247
> lr_lat<- 661214.368587
> ul_lon<- 4695137.453
> lr_lon<- 4835977.0008
> ul_lat<- 43.68
> lr_lat<- 42.33
> ul_lon<- -7.91
> lr_lon<- -7.00
GEDI_Galicia.qgz 158.8 KB May 1, 2020, 12:14 PM
level2A_clip
R Studio®

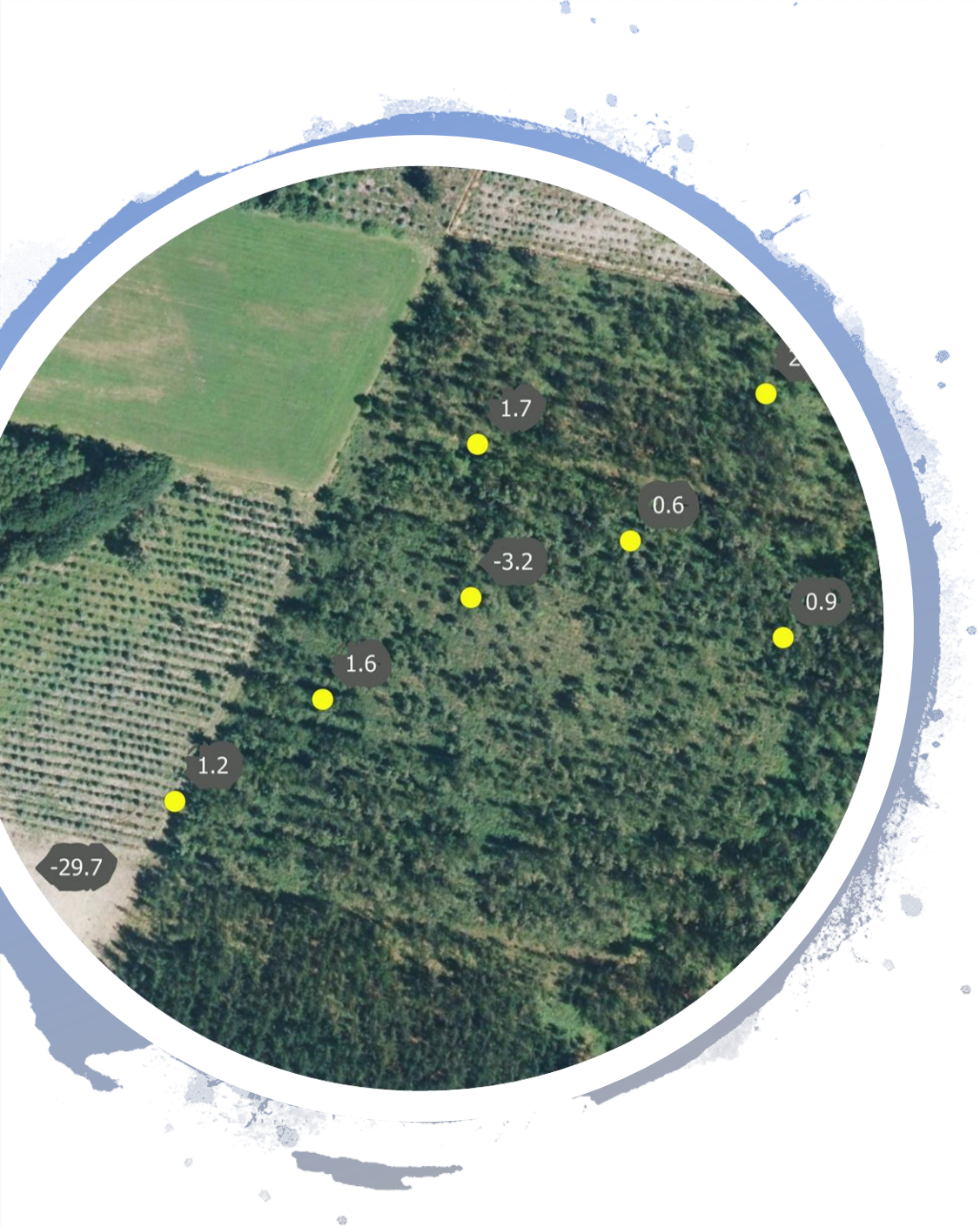

MFE
Sentinel


P99
LiDAR
PNOA


FC
LiDAR
PNOA


2016-2017
P99
LiDAR
PNOA


2016-2017
FC
LiDAR
PNOA




# Queremos….

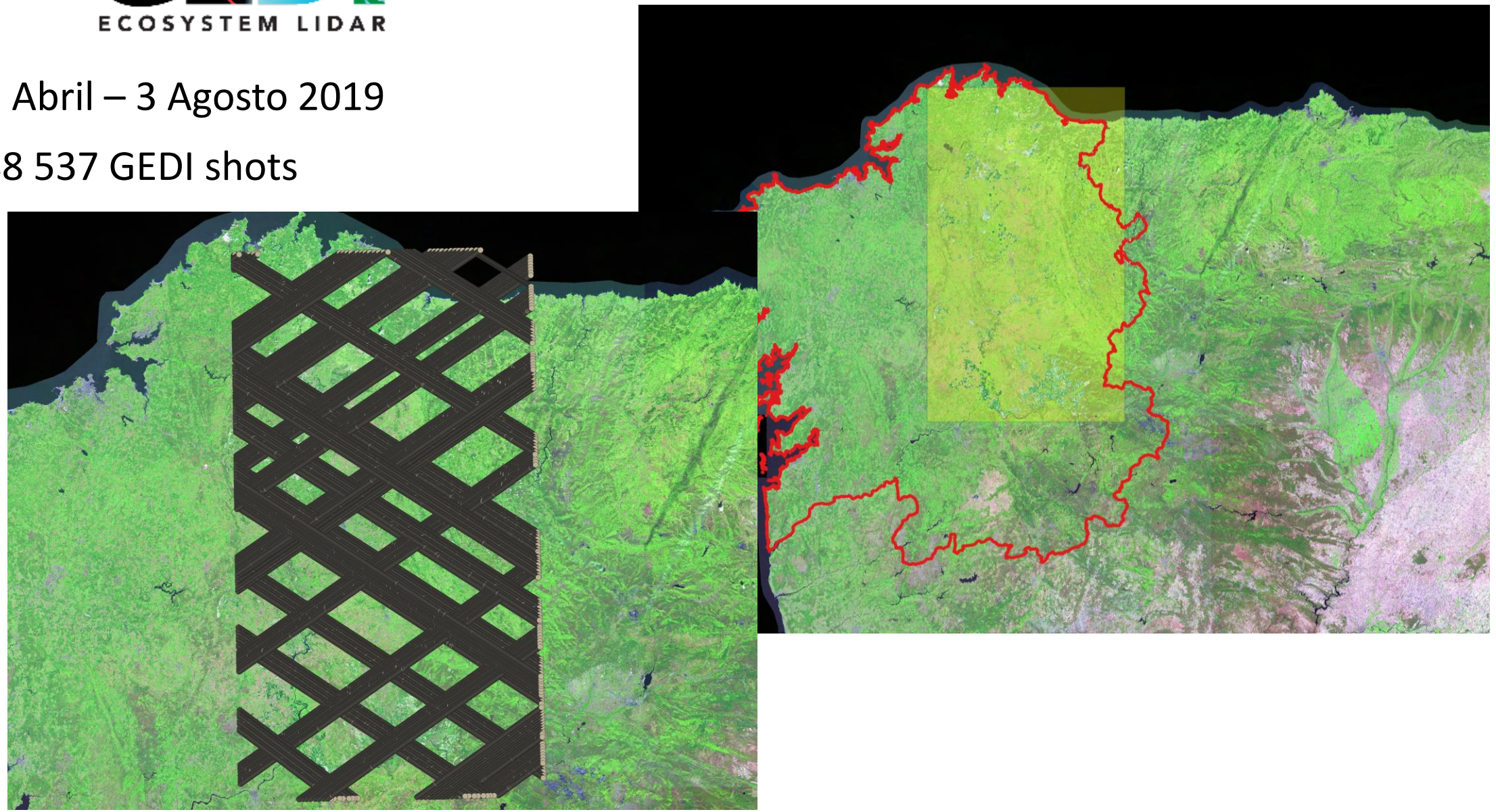
- ✓ **Detectar cambios desde ALS PNOA 2016-2017 a GEDI LiDAR 2019**

- ✓ Localizar cambios bruscos de altura
- ✓ Cortas y perturbaciones
- ✓ Dinámica forestal
- ✓ Dotar de mayor información a los polígonos del MFE

- ✓ Mostrar los problemas
- ✓ Efecto borde
- ✓ DTM
- ✓ Coregistro & Positioning

GEDI
ECOSYSTEM LIDAR

- ✓ 21 Abril – 3 Agosto 2019
- ✓ 288 537 GEDI shots

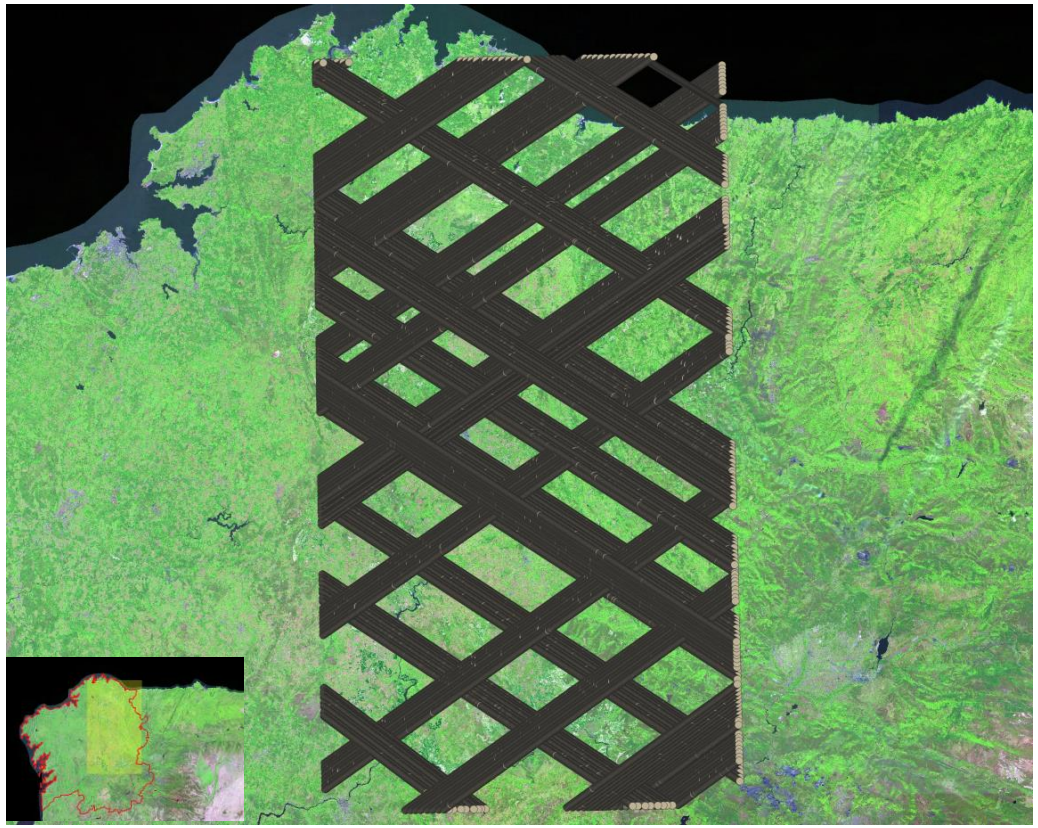


GEDI
ECOSYSTEM LIDAR

PNOA
Plan Nacional de Observación del Territorio
Plan Nacional de Ortofotografía Aérea

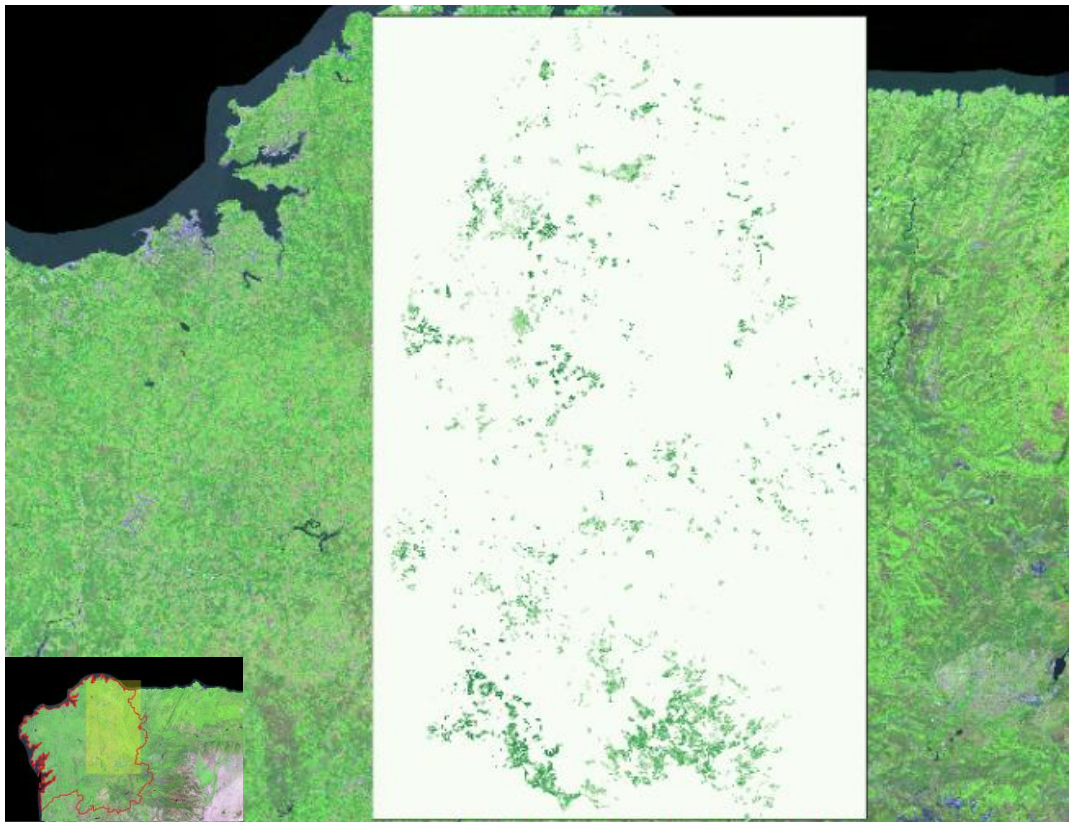
✓ 21 Abril – 3 Agosto 2019

✓ 288 537 GEDI shots



✓ LiDAR PNOA 2016-2017

✓ 4 especies



# Eucalyptus

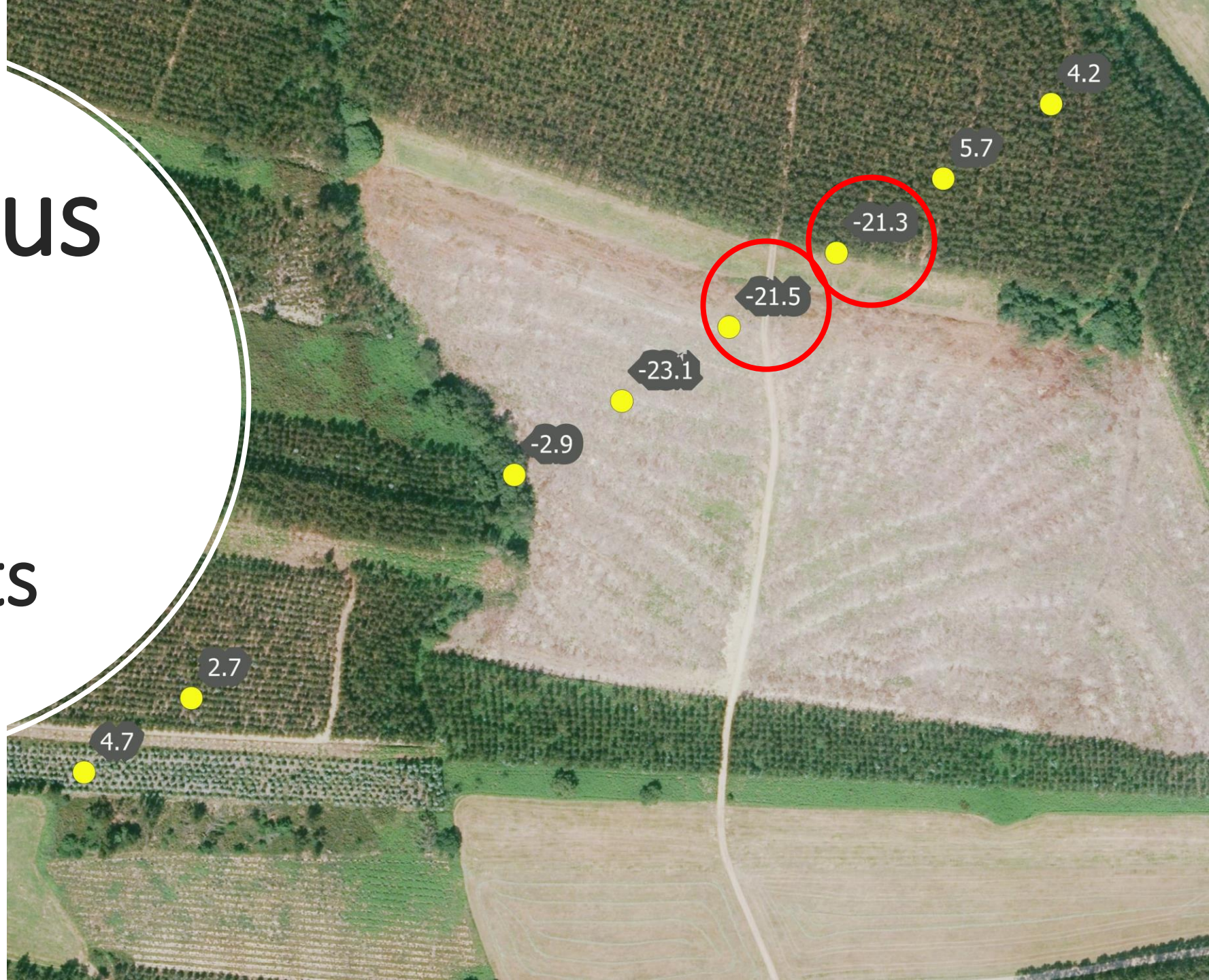
11 856

GEDI shots

# Eucalyptus

11 856

GEDI shots



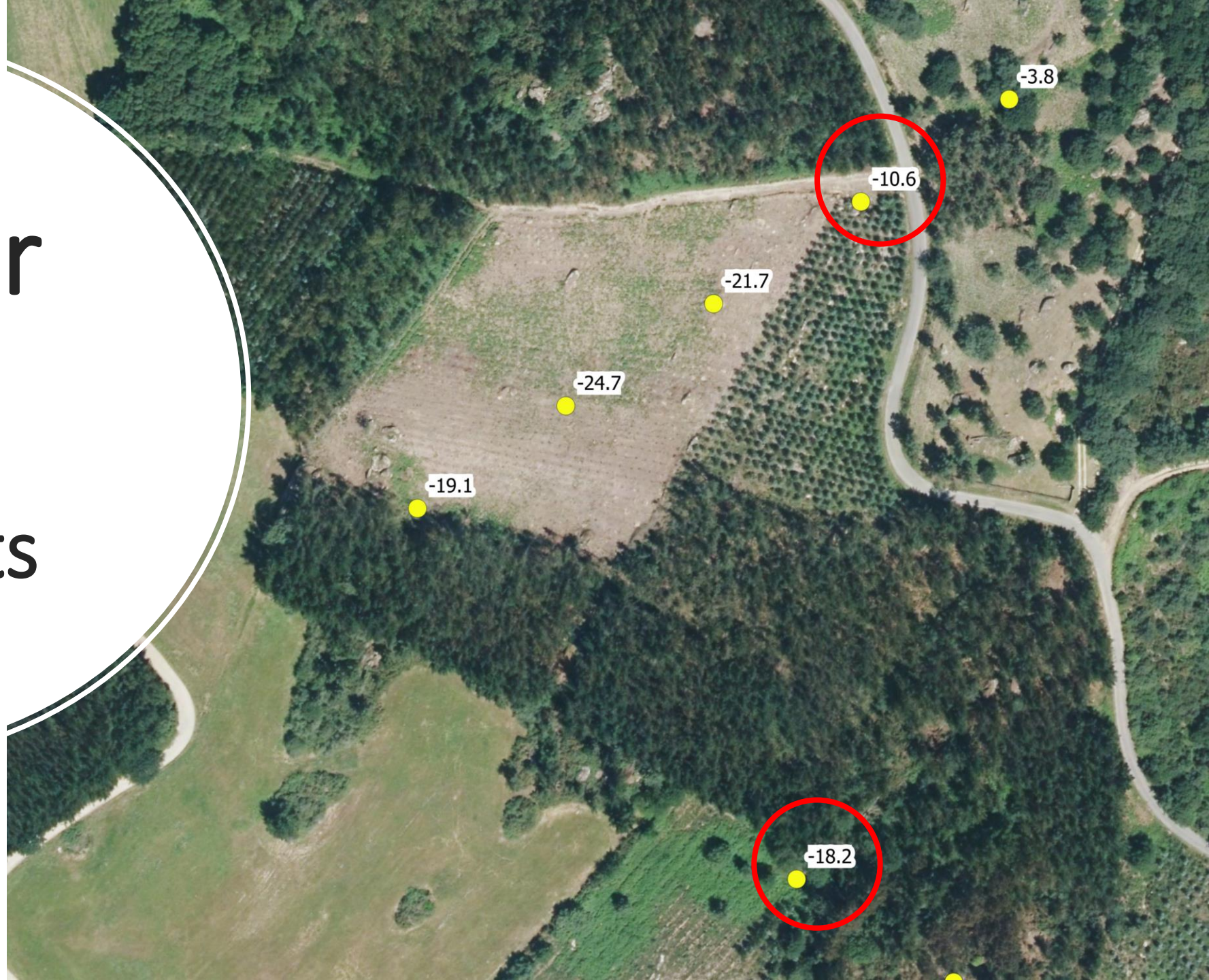
# Eucalyptus

11 856

GEDI shots

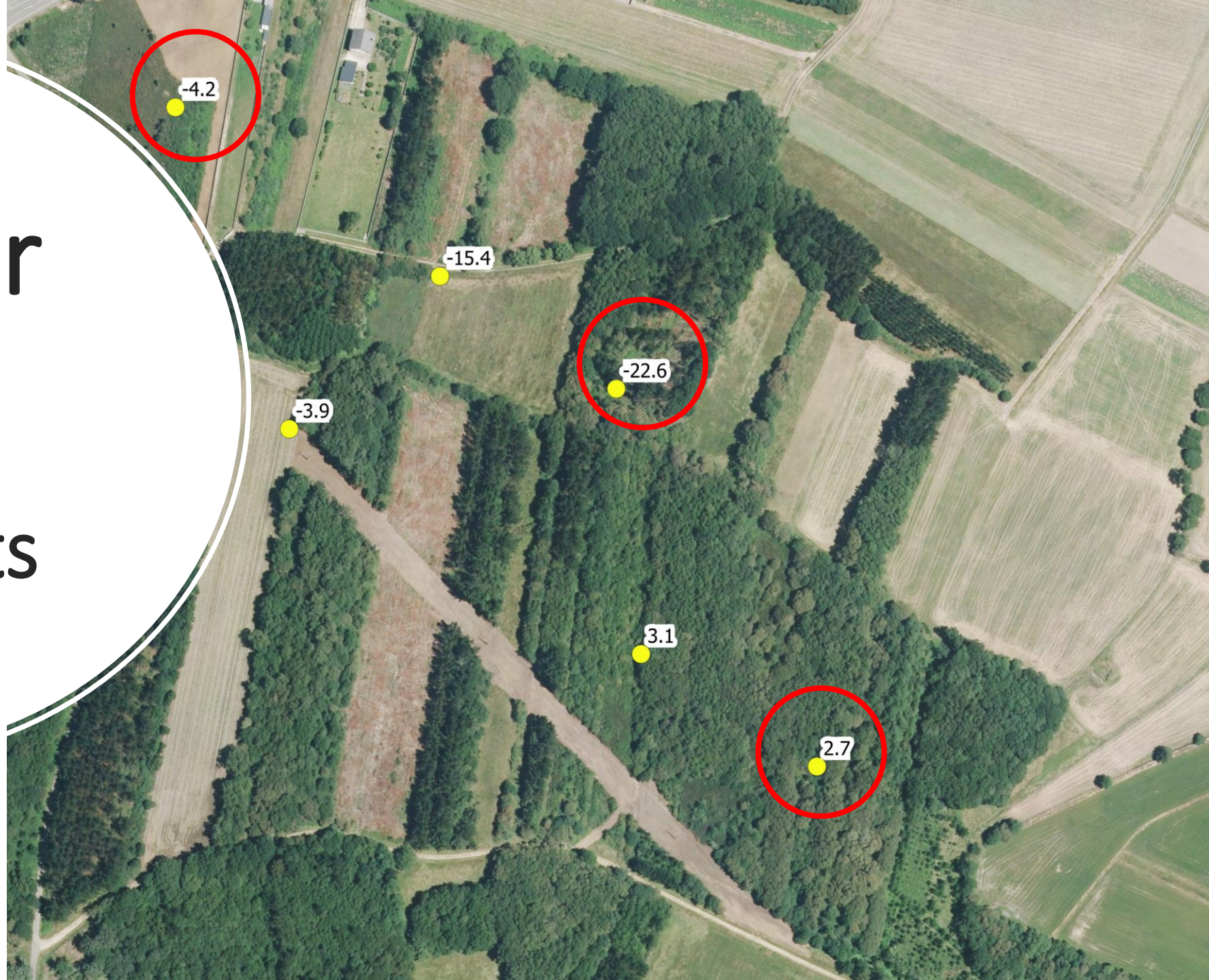
# Pinaster

7 245
GEDI shots



# Pinaster

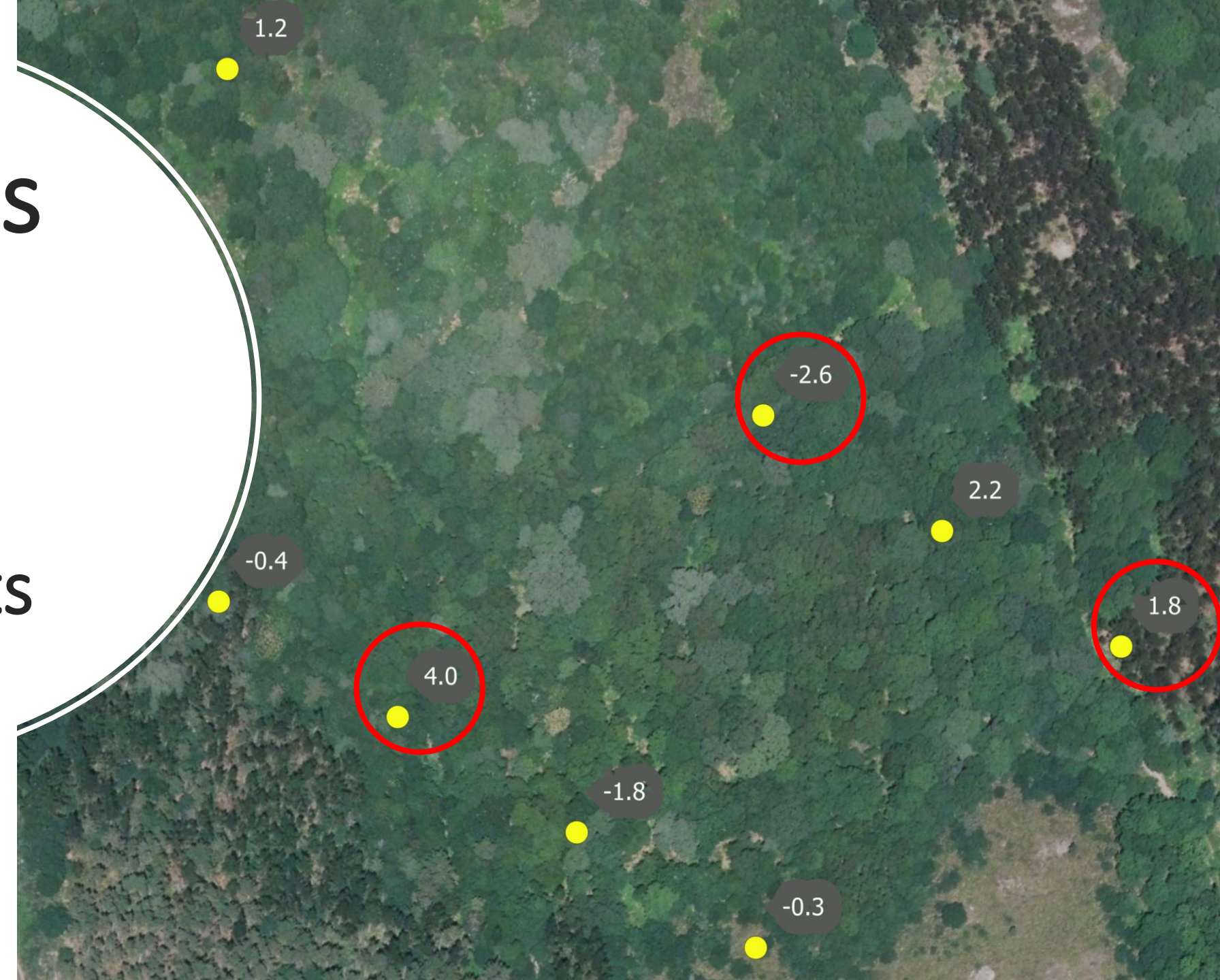
7 245
GEDI shots



# Quercus robur

12 827

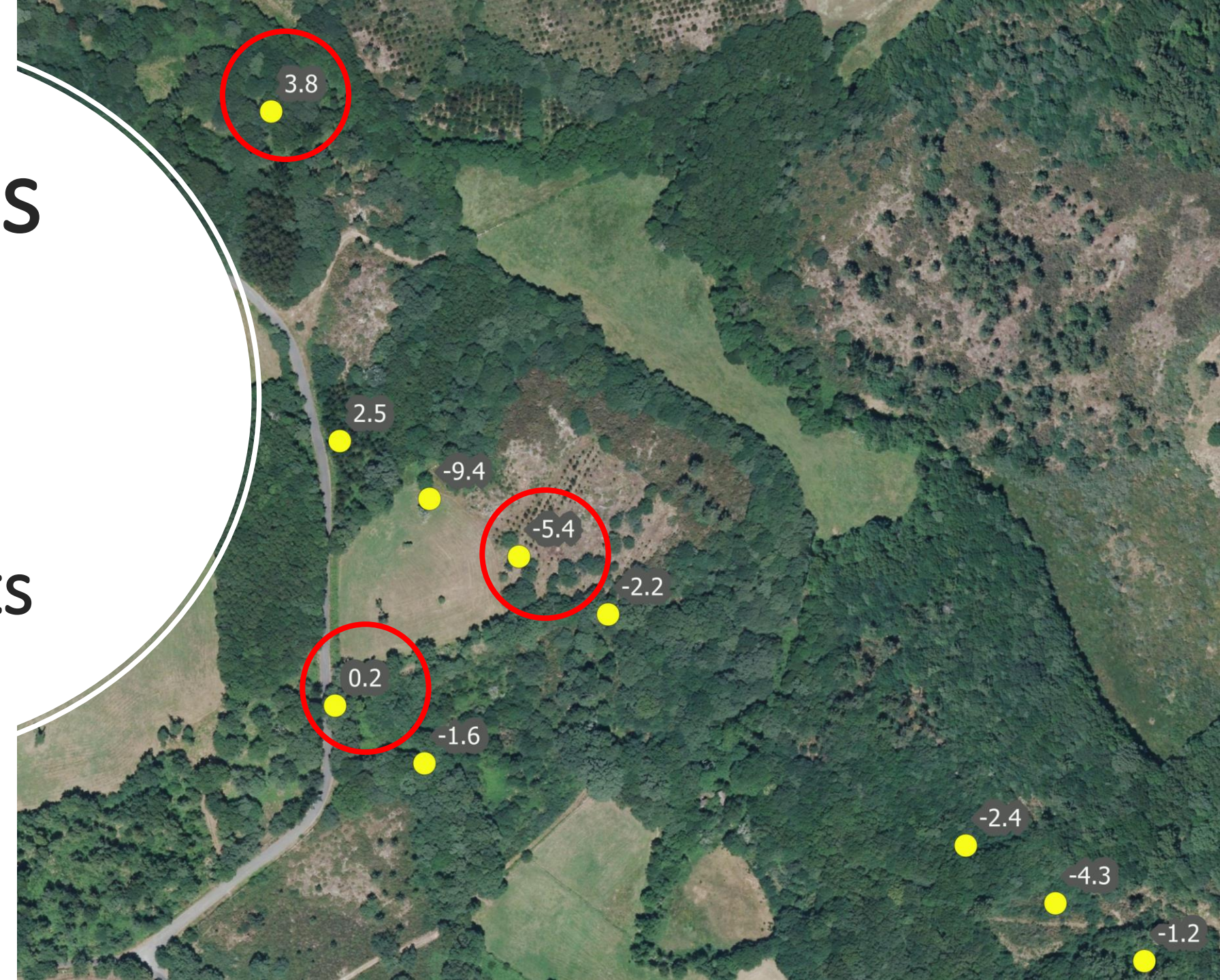
GEDI shots



# Quercus robur

12 827

GEDI shots



# Quercus robur

12 827

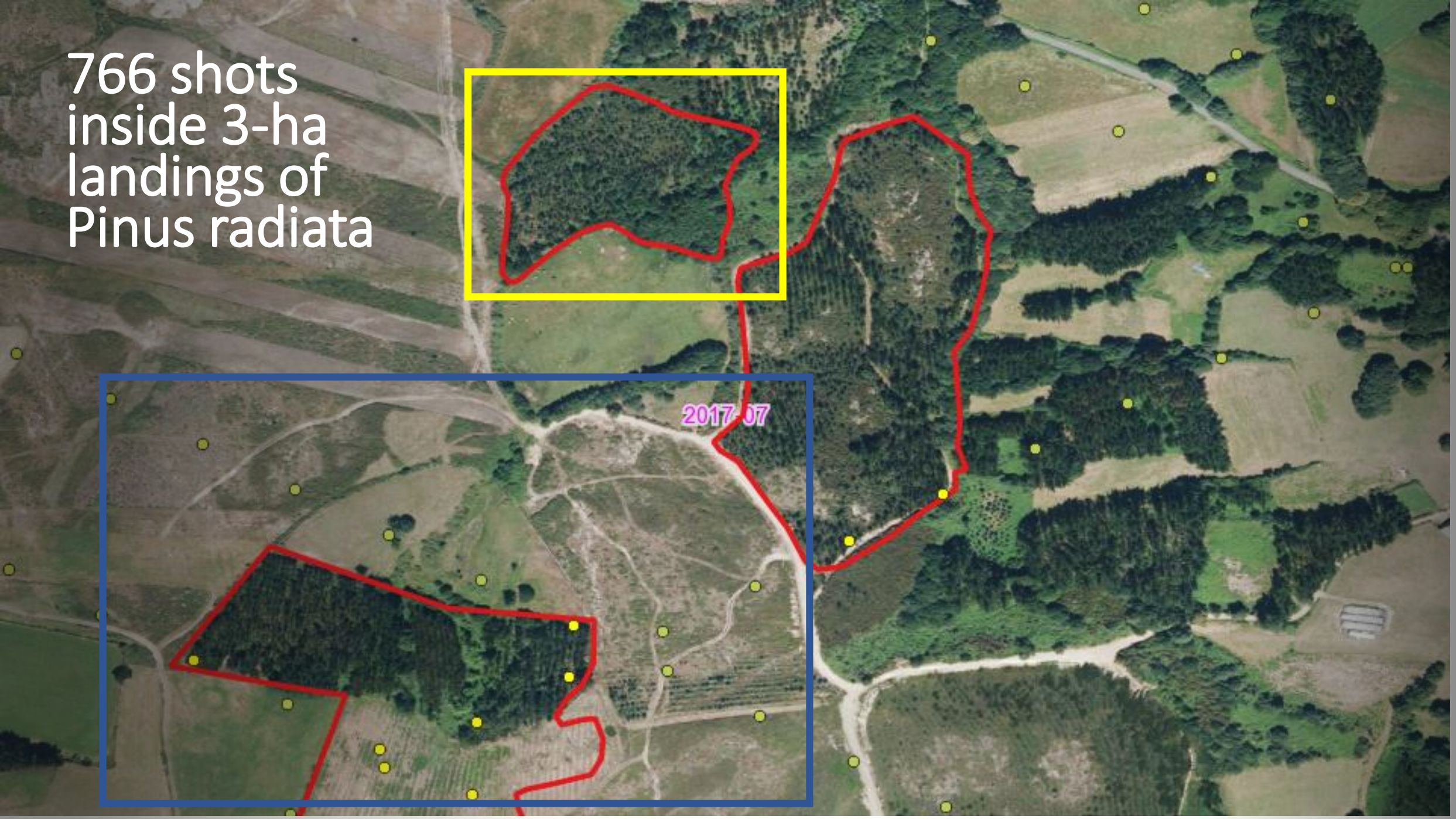
GEDI shots

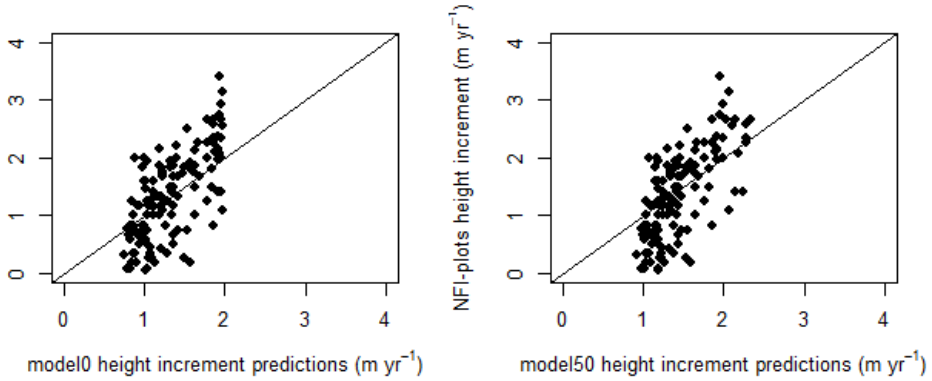
# Queremos….

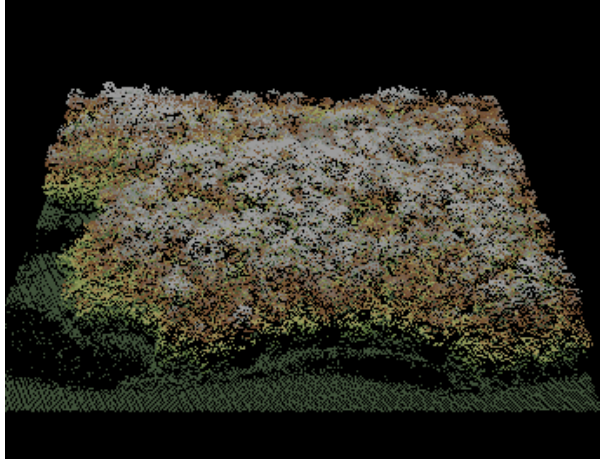

- ✓ **Validar**
- ✓ Incrementos con IFN3 – IFN4 – IFN5
- ✓ Coming:
  - ✓ IFN + GEDI + Bi-temporal ALS
- ✓ Detallar el depurado de los datos a fin de comparer valores de polígonos con valores extraídos de puntos GEDI

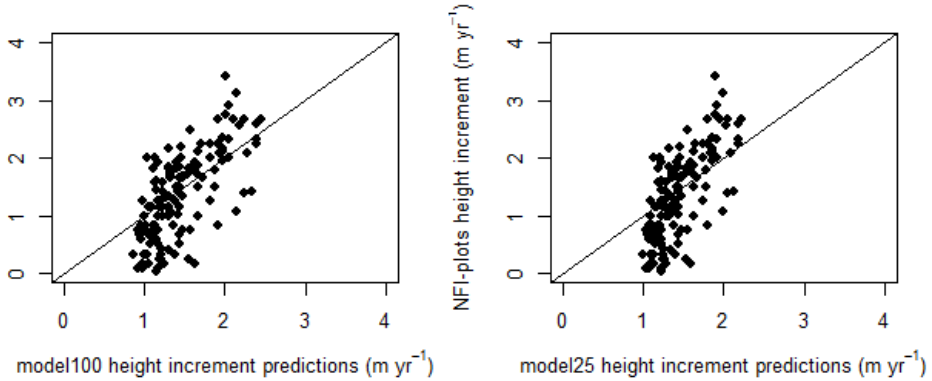
# Aplicaciones

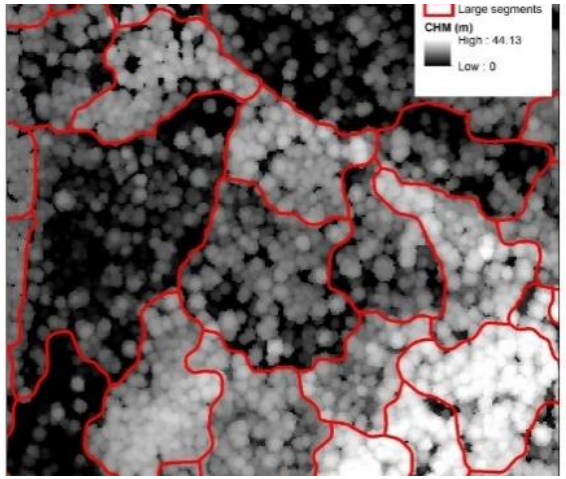
Polygons for Pinus radiata of less than 3 ha

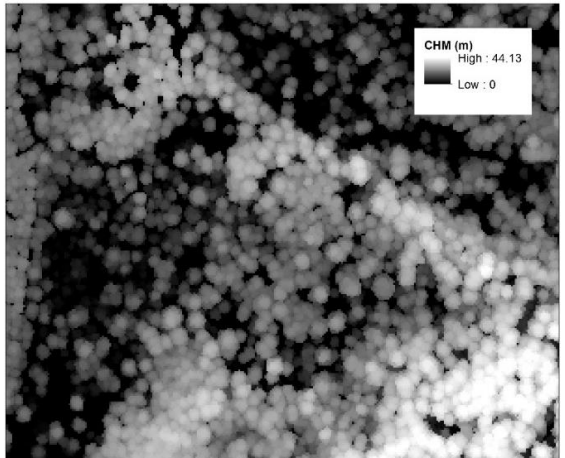

766 shots
inside 3-ha
landings of
Pinus radiata
2017_07

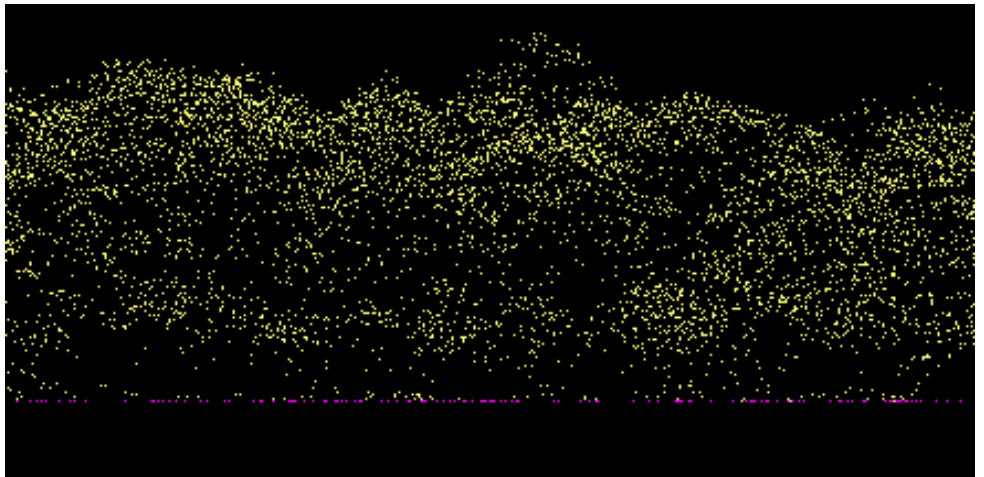




# Core of the seminar

- **Key 1: Identify problems**
- **Key 2: Test solutions**

- **Descriptive models**
- What's there? – patterns
- What's happening? – processes
- Spatial and temporal interactions
- Measurements, monitoring
- Statistical models

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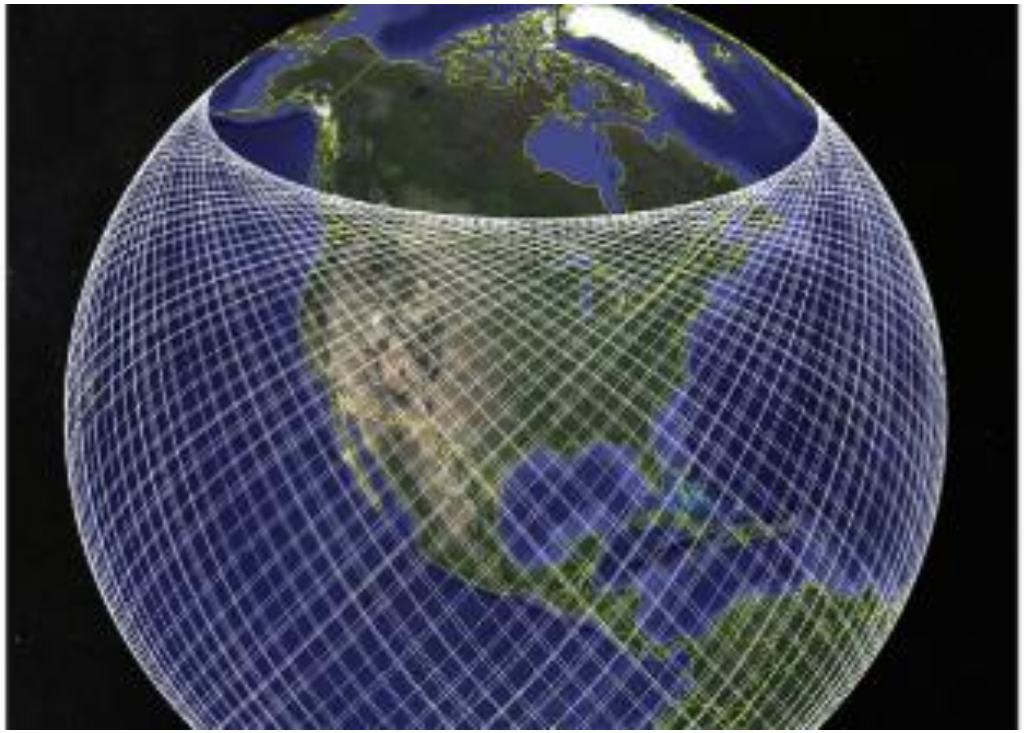

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# JORNADA EN INNOVACIÓN EN LA CARTOGRAFÍA E INVENTARIOS DE RECURSOS FORESTALES

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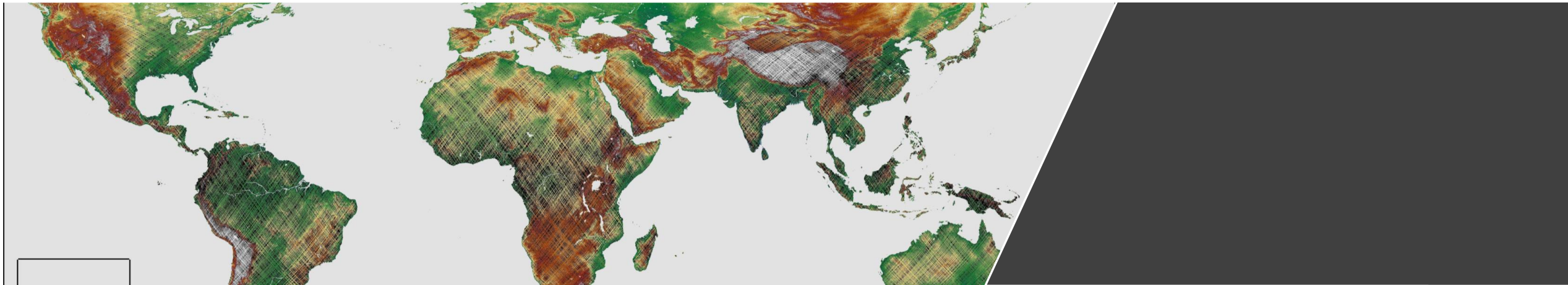



# Gracias por vuestro tiempo!

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