Project ID 1a12b4 with the title “Testing the possibilities of mapping *Posidonia ocenica* in Adriatic from EO and acoustic data”

Dr. Andreja Radović

Idea

Croatian organizations are preparing to start mapping marine habitats for the first time using EO and acoustic data. I would like to play (test) the usage of multiple EO data together with acoustic multibeam data, side scan sonar data and in preparing optimal spatial sampling and later detecting several marine and habitats, especially spatial distribution of Posidonia oceanica. Hopefully, well mapped Posidonia will be used for better planning of future marine Natura 2000 sites in Croatian part of Adriatic as well research paper will be result of this exercise. Some other habitats of interest can be mapped using EO data due to spatial distribution in water that do not exceed 10 meters together with the coastal habitats.

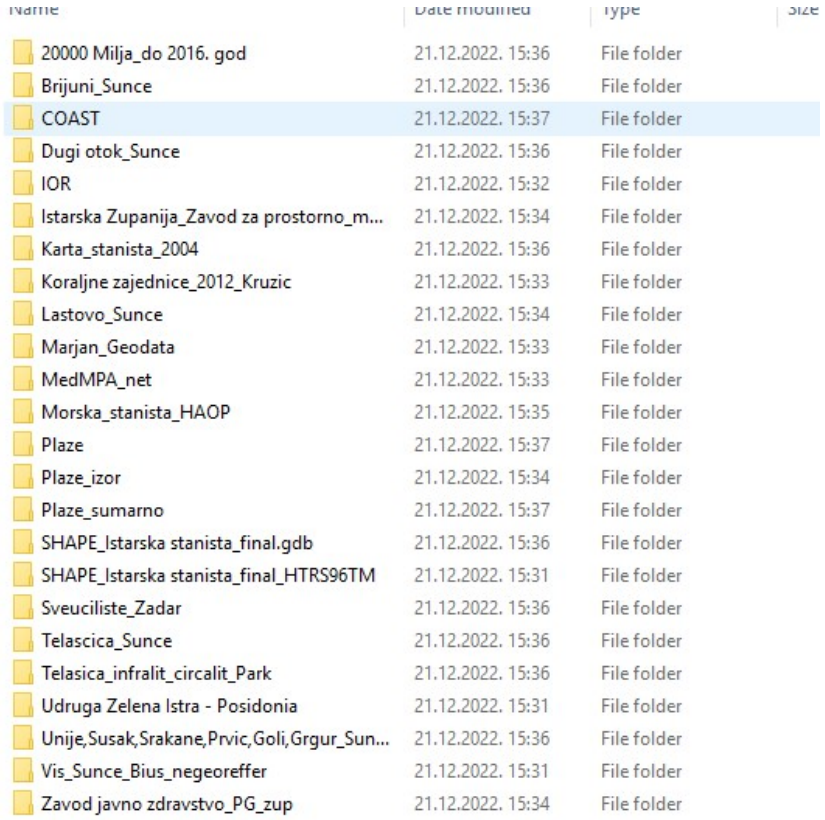
Methodology: Firsts, grid across the area of interest (Adriatic) will be prepared and already available data for Adriatic will be gridded to the same grid system (bathimetry and it's , geology/sediments, currents etc.). Sentinel S2 data will be used for supervised classification and detection of starting line of Posidonia oceanica in shallow waters. Data prepared in this way will be used to plan optimal sampling for acoustic transects in order to be able to detect lower edge of the habitat. I would like to be in a position to create a model that correctly predicts the presence of the species in the Adriatic and be able to explain the detected spatial distribution of the species. Model will be validated on site. I would like to use Copernicus data mostly but it would be great if some other, higher resolution data is available in the case of failure to detect clear margins for Posidonia. For example Planet/Dove or similar at least for the area in the middle part of Adriatic where is norther limit of the species.

Unfortunately: due to some disagreements in proposed methodology for the realisation of the project only part that is not underlayed is finalised during my stay in Oikon Ltd.

Hystorical data preparation

Data:

- mostly in ESRI Shapefiles
- habitat types, species
- Bathymetry, geology, sediments
- ...



Name	Date modified	Type	Size
20000 Milja_do 2016. god	21.12.2022. 15:36	File folder	
Brijuni_Sunce	21.12.2022. 15:36	File folder	
COAST	21.12.2022. 15:37	File folder	
Dugi otok_Sunce	21.12.2022. 15:36	File folder	
IOR	21.12.2022. 15:32	File folder	
Istarska Zupanija_Zavod za prostorno_m...	21.12.2022. 15:34	File folder	
Karta_stanista_2004	21.12.2022. 15:36	File folder	
Koraljne zajednice_2012_Kruzic	21.12.2022. 15:33	File folder	
Lastovo_Sunce	21.12.2022. 15:34	File folder	
Marjan_Geodata	21.12.2022. 15:33	File folder	
MedMPA_net	21.12.2022. 15:33	File folder	
Morska_stanista_HAOP	21.12.2022. 15:35	File folder	
Plaze	21.12.2022. 15:37	File folder	
Plaze_izor	21.12.2022. 15:34	File folder	
Plaze_sumarno	21.12.2022. 15:37	File folder	
SHAPE_Istarska stanista_final.gdb	21.12.2022. 15:36	File folder	
SHAPE_Istarska stanista_final_HTRS96TM	21.12.2022. 15:31	File folder	
Sveuciliste_Zadar	21.12.2022. 15:36	File folder	
Telascica_Sunce	21.12.2022. 15:36	File folder	
Telasica_infralit_circalit_Park	21.12.2022. 15:36	File folder	
Udruga Zelena Istra - Posidonia	21.12.2022. 15:31	File folder	
Unije,Susak,Srakane,Prvic,Goli,Grgur_Sun...	21.12.2022. 15:36	File folder	
Vis_Sunce_Bius_negeoreffer	21.12.2022. 15:31	File folder	
Zavod javno zdravstvo_PG_zup	21.12.2022. 15:34	File folder	

Preparation of ...

- Cleaning, reprojecting data from diverse mapping projects
- Preparation of refferent grids at different scale (100m, 50m, 10m) EPSG:3035
- Gridding hystorical data on referent grids
- Gridding of species data
- Gridding of habitat data at level 2 (national classification)
- Organising in spatial database (PostGres/PostGIS)
- Everything prepared by R scripts
- Planned:
  - preparation of spectral signatures for each habitat class (yearly cicle)
  - Preparation of spectral signatures across polygons with Posedonia ceanica
  - Preparation of zonal statistics for the species for spectral signatures in different parts of Adriatic / season
  - Preparation of script for download EO data (Sentinel S1 and S2) images for years that matches (preferably ot to download but to send metadata on images and make pixel based supervised classification
  - ...

Preparation of ...

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  - ...

1120_petricioli_sites_with_Posidonia_20.dbf	20.12.2022. 14:32	DBF File
1120_petricioli_sites_with_Posidonia_20.prj	20.12.2022. 14:32	PRJ File
1120_petricioli_sites_with_Posidonia_20.shp	20.12.2022. 14:32	SHP File
1120_petricioli_sites_with_Posidonia_20.shx	20.12.2022. 14:32	SHX File
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2019-STON_Marculeti_ronilacki_transekti_vrste_HTRS_46.shp	20.12.2022. 14:32	SHP File
2019-STON_Marculeti_ronilacki_transekti_vrste_HTRS_46.shx	20.12.2022. 14:32	SHX File
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BIUS_Scedro_island_Posidonia_4.prj	20.12.2022. 14:32	PRJ File
BIUS_Scedro_island_Posidonia_4.shp	20.12.2022. 14:32	SHP File
BIUS_Scedro_island_Posidonia_4.shx	20.12.2022. 14:32	SHX File
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COAST_Vis_Rukavac_Posidonia_5.prj	20.12.2022. 14:32	PRJ File
COAST_Vis_Rukavac_Posidonia_5.shp	20.12.2022. 14:32	SHP File
COAST_Vis_Rukavac_Posidonia_5.shx	20.12.2022. 14:32	SHX File
G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_41.dbf	20.12.2022. 14:32	DBF File
G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_41.prj	20.12.2022. 14:32	PRJ File
G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_41.shp	20.12.2022. 14:32	SHP File
G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_41.shx	20.12.2022. 14:32	SHX File
G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_44.dbf	20.12.2022. 14:32	DBF File
G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_44.prj	20.12.2022. 14:32	PRJ File
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G.3.5.1. Biocenoza naselja vrste Posidonia oceanica_44.shx	20.12.2022. 14:32	SHX File
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G.3.5.1.Biocenoza naselja vrste Posidonia oceanica_42.shx	20.12.2022. 14:32	SHX File
G.3.5.1.Biocenoza naselja vrste Posidonia oceanica_43.dbf	20.12.2022. 14:32	DBF File
G.3.5.1.Biocenoza naselja vrste Posidonia oceanica_43.prj	20.12.2022. 14:32	PRJ File
G.3.5.1.Biocenoza naselja vrste Posidonia oceanica_43.shp	20.12.2022. 14:32	SHP File
G.3.5.1.Biocenoza naselja vrste Posidonia oceanica_43.shx	20.12.2022. 14:32	SHX File
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IPA_Marine_Natura2000_project_II_Posidonia_probable_sites_17.prj	20.12.2022. 14:32	PRJ File
IPA_Marine_Natura2000_project_II_Posidonia_probable_sites_17.shp	20.12.2022. 14:32	SHP File
IPA_Marine_Natura2000_project_II_Posidonia_probable_sites_17.shx	20.12.2022. 14:32	SHX File
IPA_Marine_Natura2000_project_III_Posidonia_probable_sites_18.dbf	20.12.2022. 14:32	DBF File
IPA_Marine_Natura2000_project_III_Posidonia_probable_sites_18.prj	20.12.2022. 14:32	PRJ File
IPA_Marine_Natura2000_project_III_Posidonia_probable_sites_18.shp	20.12.2022. 14:32	SHP File
IPA_Marine_Natura2000_project_III_Posidonia_probable_sites_18.shx	20.12.2022. 14:32	SHX File
IPA_Marine_Natura2000_project_Posidonia_probable_sites_19.dbf	20.12.2022. 14:32	DBF File
IPA_Marine_Natura2000_project_Posidonia_probable_sites_19.prj	20.12.2022. 14:32	PRJ File
IPA_Marine_Natura2000_project_Posidonia_probable_sites_19.shp	20.12.2022. 14:32	SHP File

Hystorical data preparation

- Approximately 1000 shapefiles in different EPSG projections
- A lot of data with erroneous info on projection
- Projection parameters ususly defined as user defined
- Data not organised in database

	svi_crs	crs_Transverse_Merca	stari_crs_oznaka	EPSG	name_shp	xmin	xmax	ymin
1	#N/A	FALSE	#N/A	3907	batimetrija/lito_grad.shp	5382324,5	5791383,5	469
2	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	HGI_batimetrija/Kategorije_dubina/kategorije_dut	225182	667936,8	46098
3	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	HGI_batimetrija/Slojnice_5m/contour_linije_5.shp	225182	667965,3	46098
4	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	IOR_granulometrija_postaje/bogner_lokacije_uzor	226696,5	666909,4	45590
5	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	IOR_stanista_sediment_podaci/stanista_sediment_	226696,5	666909,4	45590
6	WGS 84	FALSE	WGS 84	4326	IOR_transekti_2/transekti.shp	13,3	17,9	
7	#N/A	FALSE	#N/A	3907	LITO_more/lito_mora.shp	5281447,5	5883772	443
8	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	Podloge_DON/more_adm_bez_otoka.shp	225169,3	667950,8	46098
9	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/20000 Milja_do 2016.	314876,4	556609,6	473
10	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/20000 Milja_do 2016.	315568,6	553587,7	47344
11	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/20000 Milja_do 2016.	315905,5	556324,9	47345
12	MGI / Balkans zone 5	FALSE	MGI / Balkans zone 5	3907	podloge_MINGO/0_kartiranje/Brijuni_Sunce/Brijur	5398555,2	5405866	49716
13	MGI / Balkans zone 5	FALSE	MGI / Balkans zone 5	3907	podloge_MINGO/0_kartiranje/Brijuni_Sunce/Brijur	5398943	5405649	49722
14	MGI / Balkans zone 5	FALSE	MGI / Balkans zone 5	3907	podloge_MINGO/0_kartiranje/Brijuni_Sunce/Brijur	5398456,6	5405683,8	49721
15	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/Brijuni_Sunce/HTRS9	279812,1	287033,7	49750
16	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/Brijuni_Sunce/HTRS9	280136,8	286816,8	49756
17	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/Brijuni_Sunce/HTRS9	279713,4	286846,7	49755
18	HTRS96 / Croatia TM	FALSE	HTRS96 / Croatia TM	3765	podloge_MINGO/0_kartiranje/CIM_N2K crvsta dna/	264787,7	282315,5	48915
19	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,2	
20	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,2	
21	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
22	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,2	
23	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
24	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
25	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
26	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,2	
27	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
28	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
29	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,2	
30	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
31	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
32	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	
33	HR_GK_5	FALSE	HR_GK_5	4326	podloge_MINGO/0_kartiranje/COAST/stanista_ruka	16,2	16,3	

Read all shapefiles in one object

```
for ( i in 1:length(sve_dat_shp_l)){
 names(sve_dat_shp_l[[i]]) <- sve_dat_shp_l[[i]]
}
#read 950 shp files in one loop
for ( i in 1:length(sve_dat_shp_l)){
sve_dat_shp_l[[i]] <- st_read(paste(getwd(),paste(sve_dat_shp[i], sep=""),sep="/" ))
}
save(sve_dat_shp_l, file="sve_dat_shp_l.RData")
```

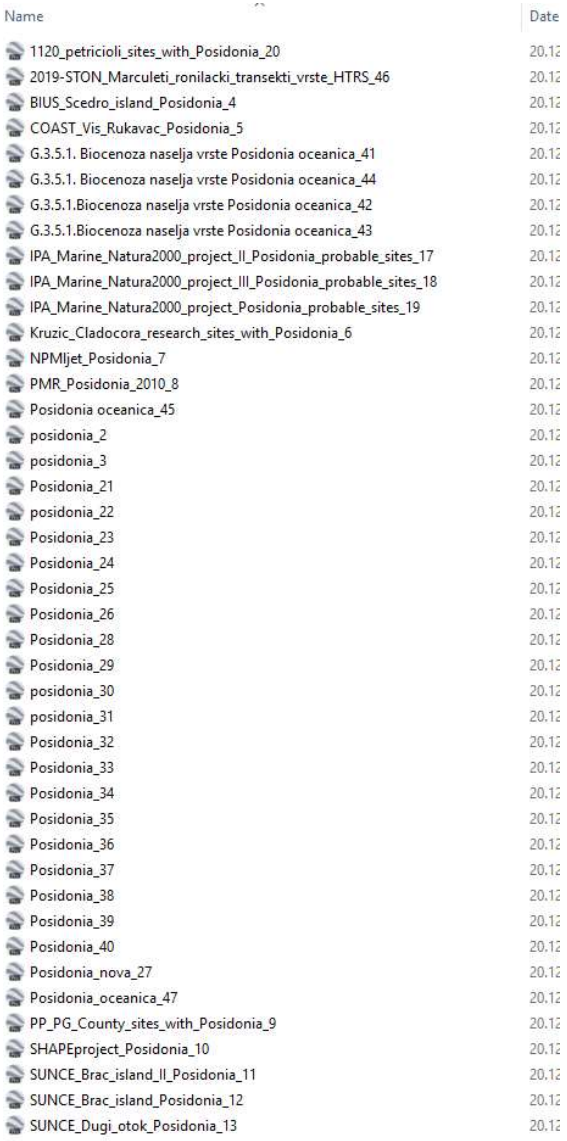
```
setwd("C:\\Users\\aradovic\\Nextcloud\\Gis_data\\")

svi_folderi <- list.files("C:/Users/aradovic/Nextcloud/Gis_data", include.dirs = T, recursive=F)

svi_folderi_paths <- list.files("C:/Users/aradovic/Nextcloud/Gis_data", include.dirs = T, recursive=F, full.names=T)
sve_datoteke_paths <- list.files("C:/Users/aradovic/Nextcloud/Gis_data", include.dirs = T, recursive=T, full.names = T)

sve_datoteke <- data.frame(list.files("C:/Users/aradovic/Nextcloud/Gis_data", include.dirs = T, recursive=T))# encoding='utf-8',

names(sve_datoteke) <- c("ime")

sve_datoteke$time <- Sys.time()
sve_datoteke$path <- sve_datoteke_paths



sve_datoteke$FD <- ifelse(sve_datoteke$ime %in% svi_folderi, "F", "D")

sve_dat_shp <- list.files("C:/Users/aradovic/Nextcloud/Gis_data", include.dirs = T, recursive=T, full.names = F, pattern=".shp")

##remove dat of type ".shp.xml"

sve_dat_shp <- sve_dat_shp[!grepl('.shp.xml', sve_dat_shp)]
sve_dat_shp <- sve_dat_shp[!grepl('.rar', sve_dat_shp)]
sve_dat_shp <- sve_dat_shp[!grepl('.shp.', sve_dat_shp)]
sve_dat_shp_df <- data.frame(sve_dat_shp)
```

Set correct EPSG code / reproject

```
sve_dat_shp_l_3035 <- as.list(sve_dat_shp)##or list?
names(sve_dat_shp_l_3035) <- sve_dat_shp
#reproject 950 shp files in one loop epsg 3035
for ( i in 1:length(sve_dat_shp_l)){
sve_dat_shp_l_3035[i] <- ifelse(is.na(st_crs(sve_dat_shp_l[i])), sve_dat_shp_l[i], st_transform(sve_dat_shp_l[i],
3035))
}
save(sve_dat_shp_l_3035, file= "sve_dat_shp_l_3035.RData")
```

Save in kml format for expert validation

```
for ( i in 1:nlevels(KMS_hhi_dxf$Layer)){
 layer_analiziram <- KMS_hhi_dxf[KMS_hhi_dxf$Layer==levels(KMS_hhi_dxf$Layer)[i],][1]
 ime <- levels(KMS_hhi_dxf$Layer)[i]
 st_crs(layer_analiziram) <- 3767
 layer_analiziram_ll <- st_transform(layer_analiziram, 4326)
 st_write(layer_analiziram_ll, paste(ime, ".kml", sep=""))
 }
```



Preparation of ...

- Cleaning, reprojecting data from diverse mapping projects
- **Preparation of refferent grids at different scale (1000m, 250m, 50m, 10m) EPSG:3035**
- Gridding hystorical data on referent grids

```
#create grid systems  in R

st_make_grid(x,
  cellsize = c(diff(st_bbox(x)[c(1, 3)]), diff(st_bbox(x)[c(2, 4)]))/n,
  offset = st_bbox(x)[c("xmin", "ymin")],
 #n = c(10, 10),
  crs = if (missing(x)) NA_crs_ else st_crs(x),
  what = "polygons",
  square = TRUE,
  flat_topped = FALSE
)


##create ref system and grid
rsaga.get.modules("grid_tools", env=rsaga.env())
rsaga.get.usage("grid_tools", 23)


#st_bbox(bat_1_3035)
#1000
rsaga.geoprocessor("grid_tools", 23, param = list(GRID=paste("/application/earthuser/KMS_projekt/KMS_results/", "Grid_system_1000_3035.sdat", sep=""),
CELLSIZE=cellsize1, M_EXTENT= 1,  ADJUST=0, XMIN=st_bbox(bat_1_3035)$xmin, XMAX=st_bbox(bat_1_3035)$xmax, YMIN=st_bbox(bat_1_3035)$ymin, YMAX=st_bbox
(bat_1_3035)$ymax))

#cellsize2-250m

rsaga.geoprocessor("grid_tools", 23, param = list(GRID=paste("/application/earthuser/KMS_projekt/KMS_results/", "Grid_system_250_3035.sdat", sep=""), CELLSIZ
=cellsize2, M_EXTENT= 1,  ADJUST=0, XMIN=st_bbox(bat_1_3035)$xmin, XMAX=st_bbox(bat_1_3035)$xmax, YMIN=st_bbox(bat_1_3035)$ymin, YMAX=st_bbox(bat_1_3035)$yma
))
```

Preparation of ...

- Cleaning, reprojecting data from diverse mapping projects
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  - Preparation of zonal statistics for the species for spectral
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  - ...

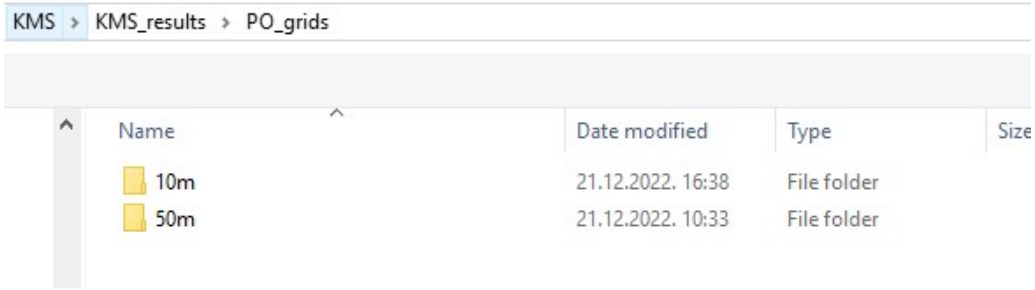
```r
for ( i in 1:length(E_NKS_sve_dat_shp_l_3035)){
  layer_analiziram <- E_NKS_sve_dat_shp_l_3035[[i]]
  ime <- gsub(".shp", "",  E_NKS_names[i])
  ime_2 <- strsplit(ime, "/")
  ime_3 <- paste(ime_2[[1]][length(ime_2[[1]])], i, sep="_")
  layer_analiziram_ll <- st_transform(layer_analiziram, 4326)
  st_write(layer_analiziram_ll, paste(ime_3, ".kml", sep=""))
}

##write shp(s)

setwd("/application/earthuser/KMS/KMS_results/NKS/F./F.1./F.1.2./shp_3035/")
for ( i in 1:length(E_NKS_sve_dat_shp_l_3035)){
  layer_analiziram <- E_NKS_sve_dat_shp_l_3035[[i]]
  layer_analiziram <- st_zm(layer_analiziram , drop=T, what='ZM')
  ime <- gsub(".shp", "",  E_NKS_names[i])
  ime_2 <- strsplit(ime, "/")
  ime_3 <- paste(ime_2[[1]][length(ime_2[[1]])], i, sep="_")
  st_write(layer_analiziram, paste(ime_3, ".shp", sep=""))
}


#gridding on ref grids
library(RSAGA)

#shapes for gridding

NKS_shps <- list.files( "/application/earthuser/KMS/KMS_results/NKS/F./F.1./F.1.2./shp_3035/", pattern="shp")



rsaga.get.modules("grid_gridding", env=rsaga.env())
rsaga.get.usage("grid_gridding", 0)

for ( i in 1:length(NKS_shps)){ ##should be removed
  shp_analiziram <-  paste("/application/earthuser/KMS/KMS_results/NKS/F./F.1./F.1.2./shp_3035/", NKS_shps[i], sep="")

  ime <- gsub(".shp", "", NKS_shps[i])

  ime_sdat <- paste(paste("/application/earthuser/KMS/KMS_results/NKS/F./F.1./F.1.2./grids/50m/", ime, sep=""), "_50m.sdat", sep="")

  rsaga.geoprocessor("grid_gridding", 0 ,param = list(INPUT=shp_analiziram ,  OUTPUT=0, TARGET_DEFINITION=1, TARGET_TEMPLATE="/application/earthuser/KMS
/KMS_results/Grid_system_50_3035.sdat",  GRID= ime_sdat ))
}
```

Preparation of ...

- Cleaning, reprojecting data from diverse mapping projects
- **Preparation of refferent grids at different scale (1000m, 250m, 50m, 10m) EPSG:3035**
- Gridding hystorical data on referent grids
- Gridding of species data
- Gridding of habitat data at level 2 (national classification)
- Organising in spatial database (PostGres/PostGIS)
- Everything prepared by R scripts
- Planned:
  - preparation of spectral signatures for each habitat class (yearly cicle)
  - Preparation of spectral signatures across polygons with Posedonia ceanica
  - Preparation of zonal statistics for the species for spectral signatures in different parts of Adriatic / season
  - Preparation of script for download EO data (Sentinel S1 and S2) images for years that matches (preferably ot to download l ation
  - ...

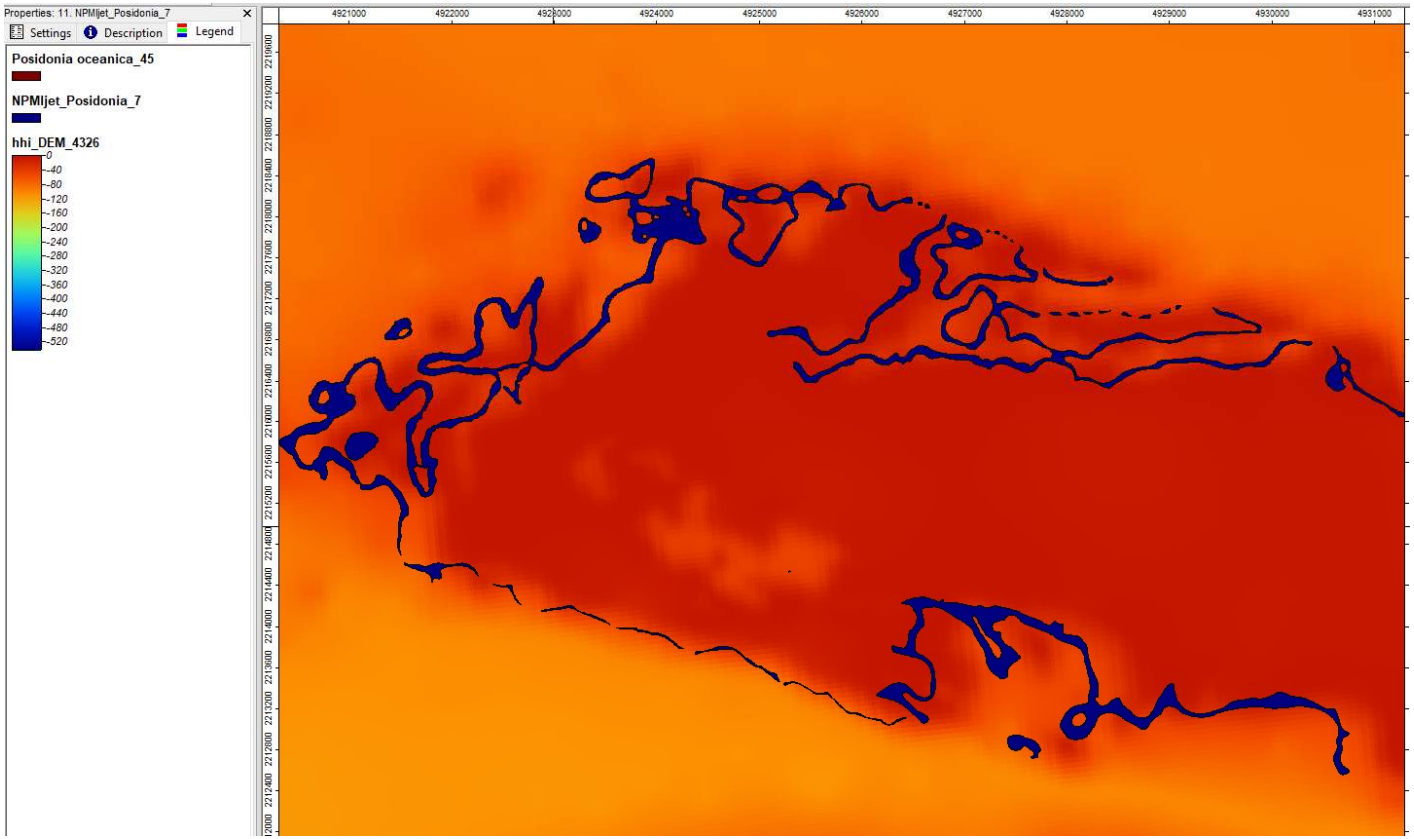
Main acheivements – prepared data for supervised classification

- Gridded data on habitat types at 2nd level of national classification
- Gridded data on species (*Posedonia oceanica*) PO_grids
- Gridded data on bathimetry, sedimentology, geology....
- Everything prepared for pixel based classification on referent grid (10 and 50 m)



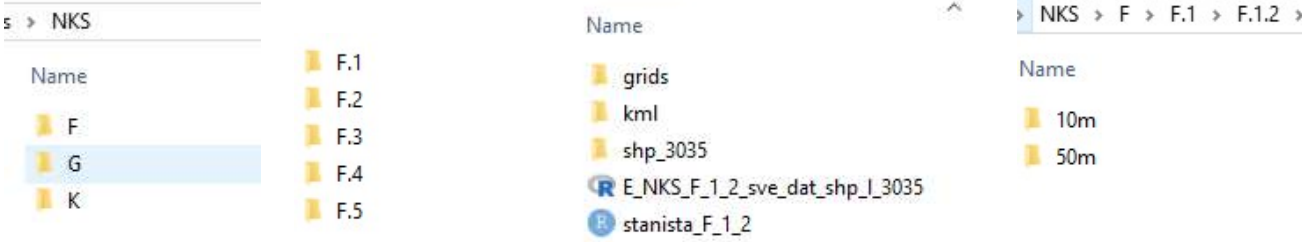
Main acheivements – prepared data for supervised classification

- Gridded data on species (Posedonia oceanica) PO_grids (with info on DEM (bathimetry)



Main acheivements – prepared data for supervised classification

- Gridded data on habitat types at 2nd level of national classification – example on habitat type F.1.2.
- Gridded data on species (Posedonia oceanica) PO_grids
- Gridded data on bathimetry, sedimentology, geology....
- Everything prepared for pixel based classification on referent grid (10 and 50 m)



Main acheivements – prepared data for supervised classification

- Gridded data on habitat types at 2nd level of national classification – example on habitat type F.1.2.
- Script for every habitat types based on Posedonia oceanica script (PO)