ATTACHMENTS

ATTACHMENT I: vms2viirs RAW CODE

```
#'vms 2 viirs
#'
#'@param viirsfile is a geospatial dataframe with viirs data obtained from https://eogdata.mines.edu/vbd/
#'@param vmsfile is a geospatial dataframe with VMS data over a certain period of time obtained via KKP (the Fisheries Ministrie of Indonesia)
#'@param is a geospatial dataframe with a Region of Interest which determines the scope of your research area.
#'@return a dataframe with positions of vessels that were included in the VMS dataset at the time of overpass of the VIIRS satellite.
#'@export
vms2viirs <- function(viirsfile, vmsfile, ROI) {
  vmstoviirs <- data.frame(matrix(ncol = 6, nrow = 0))
  x <- c("TRANSMITTE","NAMA_ALAT_","LATTITUDE","LONGITUDE","DAY","ROI")
  colnames(vmstoviirs) <- x
  viirsfile$Date_Mscan <- as.POSIXct(viirsfile$Date_Mscan)
  viirsfile$day <- as.Date(viirsfile$Date_Mscan)
  vmsfile$PING_TIME <- as.POSIXct(vmsfile$PING_TIME)
  vmsfile$day <- as.Date(vmsfile$PING_TIME)
  vmsfile$LAT <- as.numeric(vmsfile$LATITUDE)
  vmsfile$LONG <- as.numeric(vmsfile$LONGITUDE)
  daysviirs <- unique(viirsfile$day)
  daysvms <- unique(vmsfile$day)
  rois <- unique(ROI$id)
  for (i in daysviirs) {
    viirsdatum <- subset(viirsfile, day == i)
    vmsdatum <- subset(vmsfile, day == i)
    if (nrow(vmsdatum)<1) {
      next
    }
    dagen <- i
    for (i in rois) {
      roidid <- i
      ROII <- subset(ROI, id == i)
      raster::crs(ROII) <- raster::crs(viirsdatum)
      raster::crs(vmsdatum) <- raster::crs(viirsdatum)
      viirsinroi <- viirsdatum[ROII, ]
      if (nrow(viirsinroi)<1) {
        next
      }
      vmsinroi <- vmsdatum[ROII, ]
      if (nrow(vmsinroi)<2) {
        next
      }
      overpasstime <- mean(viirsinroi$Date_Mscan)
      upperborder <- overpasstime + 3600
```

```
lowerborder <- overpasstime - 3600
catchtech <- unique(vmsinroi$NAMA_ALAT_)
for (i in catchtech) {
 vmstechinroi <- subset(vmsinroi, NAMA_ALAT_ == i)
 if (nrow(vmstechinroi)<2) {
  next
 }
 alat <- i

 uniqueids <- unique(vmstechinroi$TRANSMITTE)
 for (i in uniqueids) {
  jahoor <- subset(vmstechinroi, TRANSMITTE == i)
  if (nrow(jahoor)<2) {
   next
  }
  clip1 <- subset(jahoor, PING_TIME < upperborder)
  clip2 <- subset(jahoor, PING_TIME > lowerborder)
  if (nrow(clip2)<2) {
   next
  }
  maxi <- max(clip2$PING_TIME)
  mini <- min(clip2$PING_TIME)
  dataset <- as.data.frame(clip2)
  dataset$LAT <- as.numeric(dataset$LATITUDE)
  dataset$LONG <- as.numeric(dataset$LONGITUDE)
  maxiset <- subset(dataset, PING_TIME == maxi)
  maxiset$LAT <- as.numeric(maxiset$LATITUDE)
  maxiset$LONG <- as.numeric(maxiset$LONGITUDE)
  miniset <- subset(dataset, PING_TIME == mini)
  miniset$LAT <- as.numeric(miniset$LATITUDE)
  miniset$LONG <- as.numeric(miniset$LONGITUDE)
  minimumlat <- mean(miniset$LATITUDE)
  minimumlat <- as.numeric(minimumlat)
  maximumlat <- mean(maxiset$LATITUDE)
  maximumlat <- as.numeric(maximumlat)
  minimumlon <- mean(miniset$LONGITUDE)
  minimumlon <- as.numeric(minimumlon)
  maximumlon <- mean(maxiset$LONGITUDE)
  maximumlon <- as.numeric(maximumlon)
  inbetweentime <- as.numeric(maxi - mini, units="hours")
  inbetweenlat <- maximumlat - minimumlat
  inbetweenlat <- as.numeric(inbetweenlat)
  inbetweenlon <- maximumlon - minimumlon
  inbetweenlon <- as.numeric(inbetweenlon)
  inbetweenminandmean <- as.numeric(meandate - mini, units="hours")
  addlat <- (inbetweenminandmean*inbetweenlat)/inbetweentime
  addlat <- as.numeric(addlat)
  addlon <- (inbetweenminandmean*inbetweenlon)/inbetweentime
  addlon <- as.numeric(addlon)
```

```
92.           newlat <- minimumlat + addlat
93.           newlat <- as.numeric(newlat)
94.           newlon <- minimumlon + addlon
95.           newlon <- as.numeric(newlon)
96.           vmstoviirs <-
      tibble::add_row(vmstoviirs,TRANSMITTE = i,NAMA_ALAT_ = alat,LATTITUDE = newlat, LONGITUDE
      = newlon, DAY = dagen, ROI = roidid)
97.           vmstoviirs$DAY <- as.numeric(as.Date(vmstoviirs$DAY, origin="1970-01-01"))
98.         }
99.       }
100.
101.
102.
103.   }
104. }
105. vmstoviirs$DAY <- as.POSIXct.Date(vmstoviirs$DAY)
106. vmstoviirs$DAY <- as.Date(vmstoviirs$DAY, format = "%Y/%M/%D")
107.
108. return(vmstoviirs)
109.}
```

ATTACHMENT II: vms2viirs2shp RAW CODE

```
#'vms 2 viirs 2 shp
#'
#'@param vms2viirs is the output of the earlier 'vms2viirs' function
#'@param ROIfile is a geospatial dataframe with a Region of Interest which determines the scope of your res
earch area.
#'@return the output of vms2viirs in s4 format (can be exported to shapefile now)
#'@export
vms2viirs2shp <- function(vms2viirs,ROIfile) {
  vms2viirs$LATTITUDE <- as.numeric(vms2viirs$LATTITUDE)
  vms2viirs$LONGITUDE <- as.numeric(vms2viirs$LONGITUDE)
  vms2viirs <- na.omit(object = vms2viirs)
  vms2viirs <- SpatialPointsDataFrame(vms2viirs[,4:3],
                                      vms2viirs,
                                      proj4string = CRS("+init=epsg:4326"))
  raster::crs(ROIfile) <- raster::crs(vms2viirs)
  vms2viirsfilt <- vms2viirs[ROIfile, ]
  return(vms2viirsfilt)
}
```

ATTACHMENT III: vms2viirsanalysis RAW CODE

```
#'vms 2 viirs
#'
#'@param vmstooviirshp is the output of the 'vms2viirs2shp' function.
#'@param viirsfile is a geospatial dataframe with viirs data obtained from https://eogdata.mines.edu/vbd/
#'@param vmsfile is a geospatial dataframe with VMS data over a certain period of time obtained via KKP (the Fisheries Ministrie of Indonesia)
#'@return a geopsatial dataframe with all detected vessels through VIIRS satellite that could be connected to VMS vessel data.
#'@export
vms2viirsanalysis <- function(vmstoviirshp,viirsfile,vmsfile) {
  dagen <- unique(vmstoviirshp$DAY)
  viirsfile$Date_Mscan <- as.POSIXct(viirsfile$Date_Mscan)
  viirsfile$day <- as.Date(viirsfile$Date_Mscan)
  vmsfile$PING_TIME <- as.POSIXct(vmsfile$PING_TIME)
  vmsfile$day <- as.Date(vmsfile$PING_TIME)
  outfile <- viirsfile[0,]
  outfile <- as.data.frame(outfile)
  for (i in dagen) {
    dayn <- i
    vmstoviirshperday <- subset(vmstoviirshp, DAY == dayn)
    viirsfileperday <- subset(viirsfile, day == dayn)
    vmsfileperday <- subset(vmsfile, day == dayn)
    transmitters <- unique(vmstoviirshperday$TRANSMITTE)
    for (i in transmitters) {
      transnr <- i
      vmstoviirshperdaytransmitte <- subset(vmstoviirshperday, TRANSMITTE == transnr)
      if (nrow(vmstoviirshperdaytransmitte)<1) {
        next
      }
      bufferdistance <- 500 #knot2kph/2
      buvver <- function(x,y) {
        requireNamespace("sp")
        buv1 <- x[,-(2:8)]
        buv2 <- sp::spTransform(buv1, sp::CRS('+init=epsg:3857'))
        requireNamespace("rgeos")
        buv3 <- rgeos::gBuffer(buv2, byid=TRUE, widt=y)
        buv4 <- sp::spTransform(buv3, sp::CRS('+init=epsg:4326'))
        return(buv4)
      }
      vmstoviirsbuffer <- buvver(vmstoviirshperdaytransmitte,bufferdistance)
      overlayer <- function(y,z) {
        x <- sp::over(y,z,returnlist = TRUE)
        x[x == "list(id = numeric(0))"] <- "NA"
        x[x == "list(id = integer(0))"] <- "NA"
      }
      raster::crs(viirsfileperday) <- raster::crs(vmstoviirsbuffer)
      planka <- viirsfileperday[vmstoviirsbuffer, ]
```

```
    if (nrow(planka)<1) {
      next
    }
    planka$TRANSMITTE <- rep(transnr,length(planka))
    planka <- as.data.frame(planka)
    outfile <- rbind2(outfile,planka)
  }

}
haron <- dplyr::select(outfile, dplyr::contains("id_Key"), dplyr::contains("TRANSMITTE"))
texigo <- sp::merge(viirsfile, haron, by = 'id_Key' , duplicateGeoms = TRUE)
texigo$TRANSMITTE[is.na(texigo$TRANSMITTE)] <- "unidentified"
return(texigo)
}
```

ATTACHMENT IV: vms2viirs4path RAW CODE

```
#'vms 2 viirs 4 path
#'
#'@param vmsanalysisfile is the output of the 'vms2viirsanalysis' function.
#'@param vmsfile is a geospatial dataframe with VMS data over a certain period of time obtained via KKP (the Fisheries Ministrie of Indonesia)
#'@return a daily path file for all detected vessels of the vms2viirsanalysis function.
#'@export
vms2viirs4path <- function(vmsanalysisfile,vmsfile) {
  # if clipfile
  outfile <- vmsfile
  outfile$sepparator <- NA
  outfile <- vmsfile[0,]
  vmsanalysisfile <- subset(vmsanalysisfile, TRANSMITTE != "unidentified")
  dagn <- unique(vmsanalysisfile$day)
  for (i in dagn) {
    dayn <- i
    vmsanalysisperday <- subset(vmsanalysisfile, day == dayn)
    vmsperday <- subset(vmsfile, day == dayn)
    transnummers <- unique(vmsanalysisperday$TRANSMITTE)
    for (i in transnummers) {
      numtrans <- i
      vmsperdaynr <- subset(vmsperday, TRANSMITTE == numtrans)
      vmsperdaynr$sepparator <- paste(vmsperdaynr$TRANSMITTE,vmsperdaynr$day,sep = "_")
      outfile <- rbind(outfile, vmsperdaynr)
    }
  }
  return(outfile)
}
```