Visualize uncertainty

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R Markdown

In this document, we explore the visualization of uncertainties for the global GIA.

Load the data and functions

```
load("Z:/WP1-BHM/Experiment1b/GIA_RGL/res1.RData")
library(ggplot2)
library(grid)
library(gridExtra)
library(mapproj)
```

```
## Loading required package: maps
```

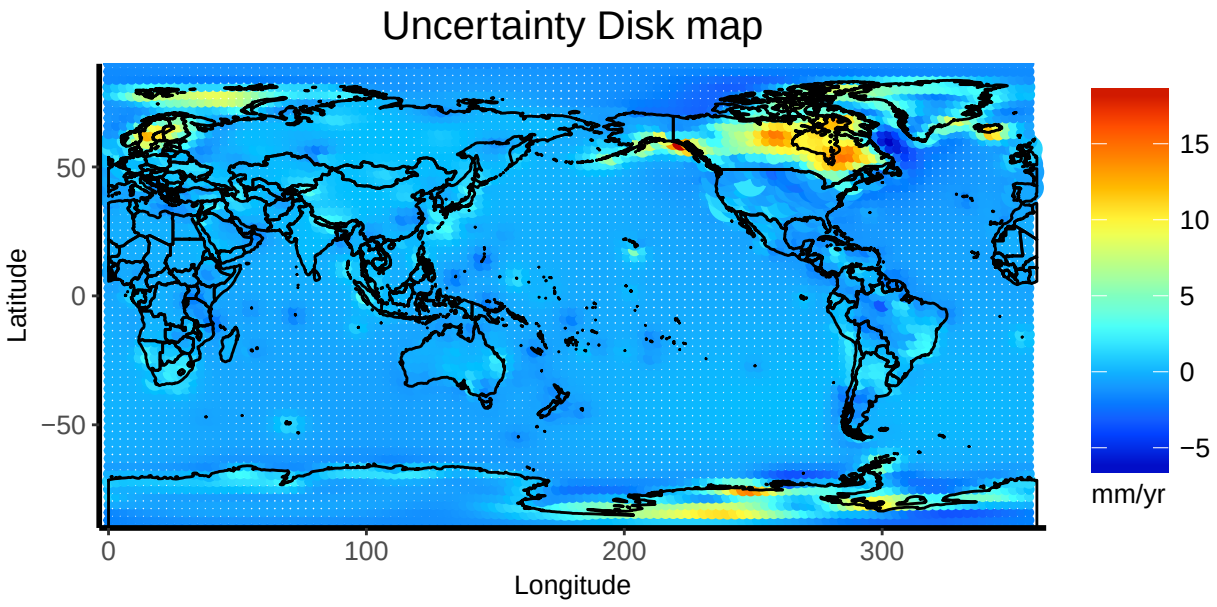
```
GPS_pred1 <- res1$GPS_pred
GIA_pred1 <- res1$GIA_pred
```

Method I: Uncertainty Disks

The uncertainties are represented by colored disks at grid points. The disk size is proprotional to $1/u$, where u is the uncerternty and the color is defined by the predicted mean.

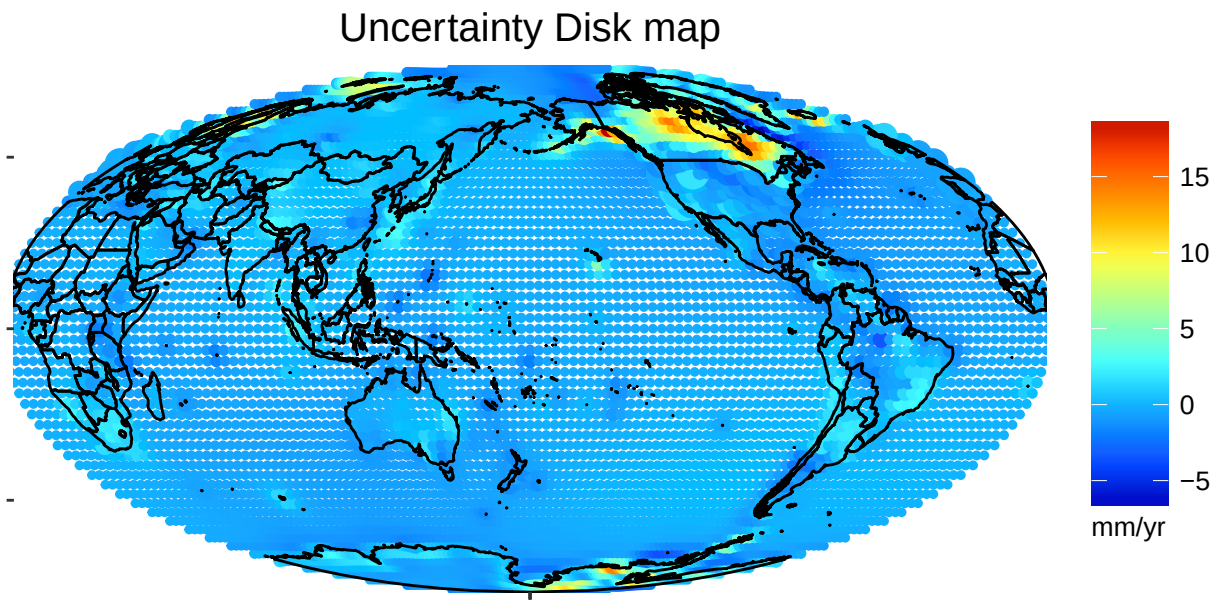
```
## Wrapper for plotting
plotU1 <- function(data, colpal, limits=NULL, title, resize = 0.001, zoomin = NULL){
  if(is.null(zoomin)){
    lon1 <- 0
    lon2 <- 360
    lat1 <- -90
    lat2 <- 90
    zoom_data <- data
    }else{
      lon1 <- zoomin$lon[1]
      lon2 <- zoomin$lon[2]
      lat1 <- zoomin$lat[1]
      lat2 <- zoomin$lat[2]
      zoom_data <- subset(data, lon > lon1 & lon < lon2 & lat > lat1 & lat < lat2)
    }

  beauty <-
    theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
          panel.background = element_rect(fill = "white", colour = 'white'),
          legend.text = element_text(size = 10),
          legend.title = element_text(size = 10),
          axis.text = element_text(size = 10),
          axis.title = element_text(size = 10),
```

```
          axis.line = element_line(size = 1),
          plot.title = element_text(hjust = 0.5, size = 15),
          plot.subtitle = element_text(hjust = 0.5, size = 10),
          panel.border = element_blank())
  world_map <- map_data("world2")
  baseworld <- geom_polygon(data = world_map, aes(x=long, y=lat, group=group), colour="black", fill = NA
  colbar <- guide_colorbar(barwidth = 2, barheight = 10, label.position = "right", title.position = "bo

  Map <- ggplot(zoom_data) + geom_point(aes(x = lon, y = lat, color = mean, size = 1/u * resize)) + coo
    xlab("Longitude") + ylab("Latitude") +
    scale_x_continuous(limits=c(lon1,lon2),  expand = c(0.01, 0.01)) +
    scale_y_continuous(limits=c(lat1,lat2),  expand = c(0, 0)) +
    scale_colour_gradientn(colors = colpal, name = "mm/yr", limits = limits,  guide = colbar) +
    scale_size_continuous(guide = FALSE)

  Map <- Map +  baseworld + ggtitle(title) + beauty
  return(Map)
}

GIA_pred1s <- subset(GIA_pred1, lon %in% seq(0,359, 3))
GIA_pred1s <- subset(GIA_pred1s, lat %in% seq(-90,90, 3))
mapU1 <- plotU1(data = GIA_pred1s, colpal = colorRamps::matlab.like(12), title = "Uncertainty Disk map"
mapU1
```



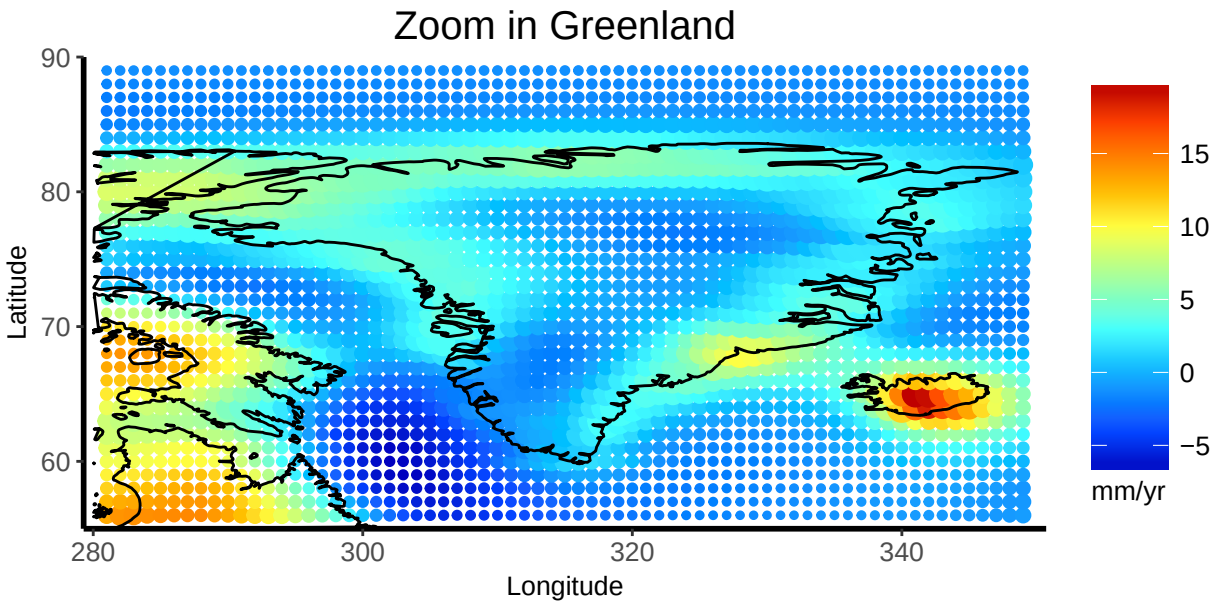

```
mapU1 + coord_map(projection = "mollweide") + theme(axis.text = element_blank(),
          axis.title = element_blank(),
```

```
          axis.line = element_blank())
```

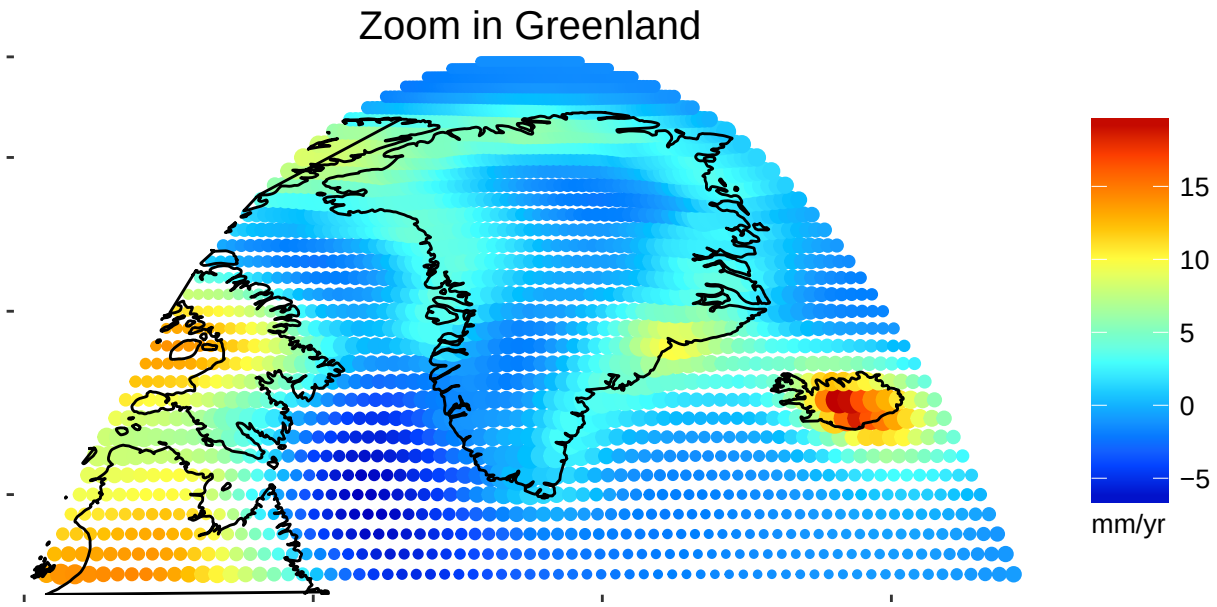


Zoom in near Greenland.

```
GIA_zoom <- plotU1(data = GIA_pred1, zoomin = list(lon = c(280, 350), lat = c(55, 90)),
                   colpal = colorRamps::matlab.like(12),  title = "Zoom in Greenland")
GIA_zoom
```




```
GIA_zoom + coord_map(projection = "mollweide") + theme(axis.text = element_blank(),
          axis.title = element_blank(),
          axis.line = element_blank())
```

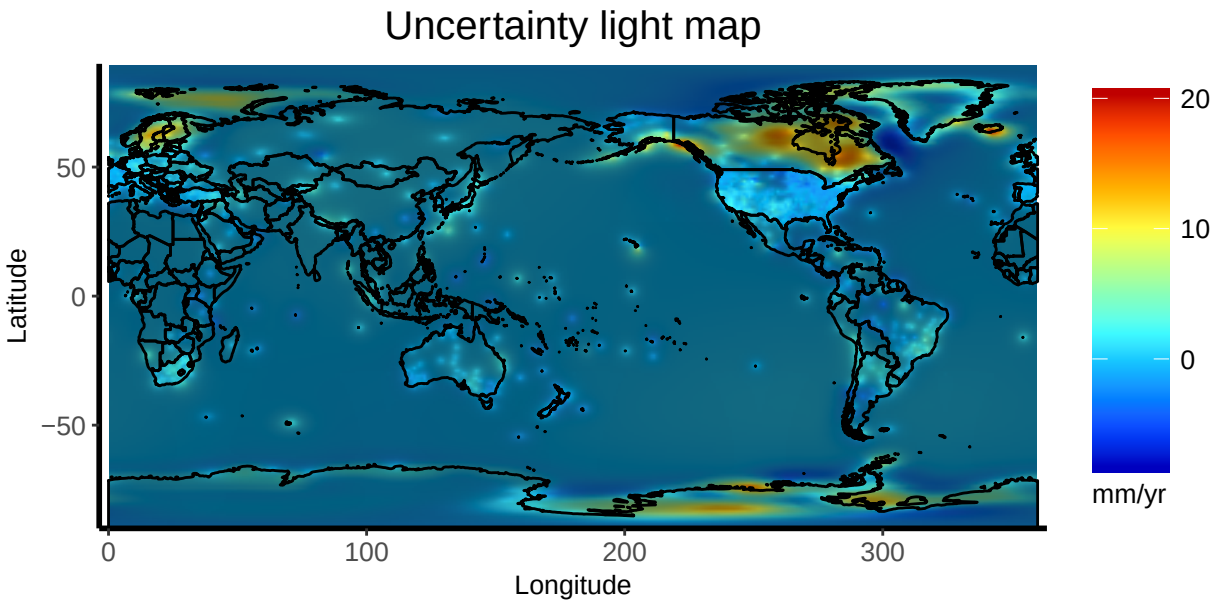


Method II: Adding uncertainty light

The uncertainties are represented by adding transparent noises. So darker regions have higher uncertainties.

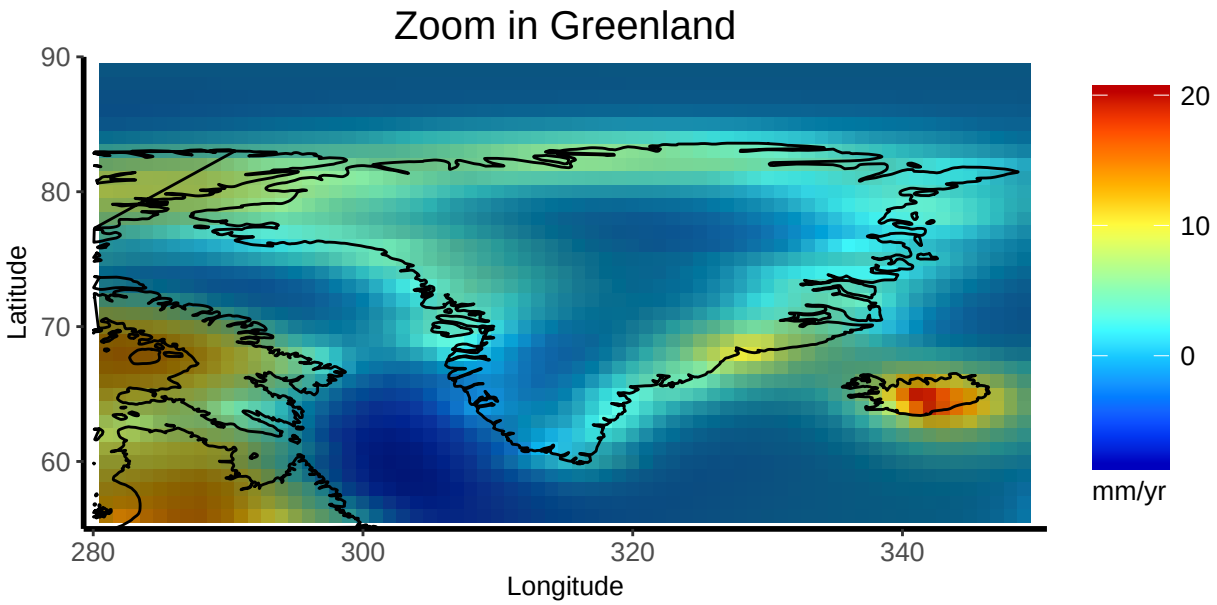
```
## Wrapper for plotting
plotU2 <- function(data, colpal, limits=NULL, title, zoomin = NULL){
  if(is.null(zoomin)){
    lon1 <- 0
    lon2 <- 360
    lat1 <- -90
    lat2 <- 90
    zoom_data <- data
    }else{
      lon1 <- zoomin$lon[1]
      lon2 <- zoomin$lon[2]
      lat1 <- zoomin$lat[1]
      lat2 <- zoomin$lat[2]
      zoom_data <- subset(data, lon > lon1 & lon < lon2 & lat > lat1 & lat < lat2)
    }

  beauty <-
    theme(panel.grid.major = element_blank(), panel.grid.minor = element_blank(),
          panel.background = element_rect(fill = "white", colour = 'white'),
          legend.text = element_text(size = 10),
          legend.title = element_text(size = 10),
```

```
          axis.text = element_text(size = 10),
          axis.title = element_text(size = 10),
          axis.line = element_line(size = 1),
          plot.title = element_text(hjust = 0.5, size = 15),
          plot.subtitle = element_text(hjust = 0.5, size = 10),
          panel.border = element_blank())
  world_map <- map_data("world2")
  baseworld <- geom_polygon(data = world_map, aes(x=long, y=lat, group=group), colour="black", fill = NA
  colbar <- guide_colorbar(barwidth = 2, barheight = 10, label.position = "right", title.position = "bo

  signs <- rbinom(nrow(zoom_data), size = 1, prob = 0.5)*2 -1
  zoom_data$mnoisy <- zoom_data$mean + signs*2*zoom_data$u

   Map <- ggplot(zoom_data) + geom_raster(aes(x = lon, y = lat, fill = mean)) + coord_fixed() +
    xlab("Longitude") + ylab("Latitude") +
    scale_x_continuous(limits=c(lon1,lon2),  expand = c(0.01, 0.01)) +
    scale_y_continuous(limits=c(lat1,lat2),  expand = c(0, 0)) +
    scale_fill_gradientn(colors = colpal, name = "mm/yr", limits = limits,  guide = colbar)
  Map <- Map + geom_raster(data = zoom_data, aes(x=lon, y=lat, alpha = u), fill = "black") +
    scale_alpha_continuous(range = c(0, 0.5), guide = FALSE)

  Map <- Map +  baseworld + ggtitle(title) + beauty
  return(Map)
}

mapU2 <- plotU2(data = GIA_pred1, colpal = colorRamps::matlab.like(12), limit = c(-8, 20), title = "Unc
mapU2
```



Zoom in near Greenland.

```
GIA_zoom <- plotU2(data = GIA_pred1, zoomin = list(lon = c(280, 350), lat = c(55, 90)),
                   colpal = colorRamps::matlab.like(12),  limit = c(-8, 20), title = "Zoom in Greenland
GIA_zoom
```


Zoom in Greenland
90
80
70
60
Latitude
280
300
320
340
Longitude
20
10
0
mm/yr