# Remote Sensing Change Detection

The remote sensing analysis was actually done quite simply (one I figured out how to) using QGIS. I will go through each of the steps of the analysis and the accompanying files in the folder.

1. First I used the SA-TIED data (your data) to detect known mining areas. I did this in Google Earth Enginge.

   (a) Load in the datapoints from the datafile.

   (b) add a raster layer (the newest with respect to the given time-series you are looking at), in order to actually see the mines on a satellite image.

   (c) From here I actually just zoomed in on the mines and manually draw polygons around them, giving each of the a name and lastly saving them all in one shapefile.
   Earth Engine script: hhttps://code.earthengine.google.com/?scriptPath=users%2Fannabeckthelin%2Ftest%3ACreate%20mine-polygons
   Output folder: "01 Mine Polygons - Bojanala Platinum District"

   (d) Lastly, to visually see if the mine changed whithin the polygons over time, I created a new script with a raster-layer for each year I was considering and added the polygons on top. This was just a visual "test" and not something I used for the analysis.
   Earth Engine script: https://code.earthengine.google.com/?scriptPath=users%2Fannabeckthelin%2Ftest%3ALandsat8%20Mine%20Bands

2. Next I created the albedo calculated satellite images.

   (a) I downloaded the relevant top of atmosphere (TOA) reflectance corrected satellite images via United States Geological Surveys (USGS) EarthExplorer (descriptions in thesis).

   (b) The output from USGS is a folder containing each of the bands from the given image.

(c) I uploaded the relevant rasters (band 2,3 and 4) into QGIS and simply used the raster calculater to calculate the difuse visible albedo layers (equation in thesis). The output tiff-files are really large, and I am not able to upload them here on GitHub. However, an example of an albedo-calulated image is depicted in my thesis.

3. As a last step in data process, I used R to extract the pixelvalues within the mine-polygons. I actually did the evaluation in Python instead of R. There is not other reason for this than me being much better at Python than R, why it would make sence to make the whole thing run in R.
   R script: "02 R_extract_pixel_values.R"
   Python script: "03 Python change detection Mines.ipynb"

4. Knowing know in which polygons change had been detected I merged their ID's to their shapes and added them to QGIS in order to visualize the changes.

## Regression Analysis

For the regression analysis I needed to expand the SA-TIED data to also include a valid proxy for the minerals being extracted at each of the locations. This was no easy task and I ended up finding an 2001 map compiled by SAMINDABA (South Africa Mineral Deposits Database) (see map: "rsadeposits.gif").

1. I uploaded the SAMINDABA mineral map and a South African shapefile to QGIS. Using the "Georeferencer" (https://www.qgistutorials.com/en/docs/georeferencing_basics.html) I was able to convert the map into a gis file. From here I created a new layer and added points to it by manually clicking on each of the mines on the map and giving the point a number according to the mineral extracted at them.
   Output file: "04 rsadeposits_points.csv"

2. Uploading the mineral points and the SA-TIED mine points I used the nearest neightbor function in QGIS to proxy each of the 1532 mines in the SA-TIED with the nearest mineral point.
   Output file: "05 mines_w_mineral_proxy.csv"

3. Lastly I needed to create a grid on South Africa. I also did this in QGIS by uploading a SA shapefile, adding a grid on top and giving each of the grids a ID.

   (a) I then plotted the mine and conflicts points on top of the gridded SA map and used the "vector geometry $\rightarrow$ interaction" to detect grids which contain a mine(s) (time-invariant) and/or conflict(s) (timevariant).

   (b) Having done this I lastly created the final dataset in Python by creating a row for each month in my timeseries per grid ($96$ months $* \, 4,668$ grids $= 448,128$ rows). I then added the mine-data, conflict-data, administrativ boundaries data and mineral-price-data.
   Output folder: "06 Final Datasets"

4. I did the regression analysis in STATA. I will provide these files if requested.