Community Energy Malawi GIS Workshop

22-24. January 2016
Lilongwe
Madis Org (madis.org@gmail.com)

1 GET STARTED

- Open up QGIS and familiarize yourself with the view, icons, etc.
    - BROWSER window allows you to scan through files to add to the project
    - LAYERS window displays the layers present in the current project. You can change layer visibility here, also you can display properties of individual layers by right-clicking on them
- Let us go ahead and import the first layer into the project. Navigate in the BROWSER window to the GIS WORKSHOP folder and drag and drop Ethiopian Outline layer (ETH_outline.shp) into the main window in QGIS.
- Now go ahead and save the project:
    - Project -> Save As -> navigate to the GIS WORKSHOP folder, pick a name and press save

2 IMPORT ALL RELEVANT LAYERS

- Now go ahead and import all the rest of the layers in the GIS WORKSHOP folder:
    - Eth_pop (population data saved as a raster file)
    - Roads (polylines representing road network of Ethiopia)
    - ETH_alt (the digital elevation model or the height data for Ethiopia)
    - Administrative borders level 1 (this represents the regions of Ethiopia)
    - Wind data[1] (DTU Risoe data) in raster format
    - Diesel data[2]
    - Solar data[3]
    - Settlements information
    - Hillshade data
- Get familiar with the layers one by one...by turning visibility of all layers off, except the one you are investigating. Perform the following:
    - Investigate the attribute table of the ROADS layer (right click->Attributes table)
    - Investigate the histogram of the population layer, wind speed layer, solar and diesel layers (right click -> Properties -> Histogram -> Compute histogram)
- To make sense of various information at the same time, we need to make sure the layers are stylized neatly and are in the relevant order:
    - Settlements (rightClick -> properties -> Style -> change „single symbol“ to „Categorized“ -> Pick Column = „STATUS“ -> click Classify -> untick all but National

[1] The file contain the generalize annual mean wind speed [m/s] at 50 m a.g.l. over the flat terrain and uniform roughness of 0.03 m.
[2] Estimated cost of electricity (EUR/kWh) delivered by a diesel generator
[3] Yearly sum of global irradiation on a horizontal surface (kWh/m2) period 1998-2011

and Regional capitals -> pick relevant sympols for both -> go to Labels and label this layer with „Settlement“ column -> Buffer text with 1mm -> Placement distance = 3mm -> click APPLY

- Roads (rightClick -> properties -> Style -> change „single symbol“ to „Categorized“ -> Pick Column = „type“ -> click Classify -> deselect all entries in the list other than primary, secondary and motorways (and links) -> holding down CTRL, pick the following from the list: „motorway_link“; „primary“; „primary_link“; „yes“ -> right click on any of the lines and change width = 0,5 and color into black -> next select „secondary_link“ and „secondary“ and change their line color also to black and line width = 0,3 -> click APPLY
- Eth_borders_level1
  - ➔ Firstly lets identify the areas that we are interested in this excercise: Afar, Oromia and Somali (open Attributes table for the layer -> toggle editing mode -> New Column -> name = „RP“ -> change the newly created RP values for the 3 regions from NULL into 1 -> end editing and save the attribute table
  - ➔ Next, using already familiar classification, lets display regional borders that are of interest to us. Make sure the line is distinguishable from roads.
- Wind data (Right click -> properties -> Style -> Render type = Singleband pseudocolor -> Generate new color ramp „spectral“ -> tick the „invert box“ -> click „classify“ -> go to transparency and pick 50% -> APPLY
- Solar data (same as wind data but use different colors)
- Diesel data (same as wind data but use different colors)

3 CREATE MASK LAYER OF REGIONS UNDER CONSIDERATION

As we are only interested in certain regions, we should perform analysis only on these regions to save computing power and be more efficient.

- Select the administrative borders LEVEL1 layer (MAKE SURE IT IS SELECTED AND NOT ONLY VISIBLE BY CLICKING ON THE LAYER IN THE LAYERS WINDOW). On this layer, select the relevant regions (Afar, Somali and Oromia) by clicking on them while holding CTRL key.
- Right click on the Administrative borders LEVEL1 layer -> Save As -> (Browse the GIS WORKSHOP folder and name the layer ADMIN_LEVEL1_MASK) -> make sure the box „Save only selected features“ is selected -> OK

ALT1-1 IDENTIFY HIGH WIND REGIONS

- Raster Calculator to identify areas with mean wind speed > 5 m/s
  - Raster -> Raster calculator -> insert the following formula into the expression box (make sure the layer name is the sme as you have in your project):
    ("DTU_Wind@1">5)*" DTU_Wind@1"
    -> Click current layer extent -> in the output file again navigate to the workshop folder and type file name WIND_HIGH_SPEED)-> OK

ALT1-2 IDENTIFY HIGH SOLAR REGIONS

- Perform similar analysis, except in this case use the solar layer and use a treshhold value of 2200

ALT1-3 IDENTIFY CHEAP DIESEL AREAS

- Perform similar analysis, except in this case use the diesel layer and use a treshhold value SMALLER THAN 0,25

ALT1-4 OVERLAY DIESEL, WIND and SOLAR layers

- Change the display settings of the three layers so they can be overlayed:
    - Turn all other layers visibility off, other than the 3 resource layers
    - Change display options under style such that all layers are displayed on single-band black-white. Change black-white into white-black so that black corresponds to the more attractive areas (e.g. high wind, high irradiation, low diesel price) and change the color to be different for all of the 3 layers. Make sure that the display range minimum is set to slightly above 0 (e.g. 0,1) so that zeros dont get displayed as white, and also change the display option into „clip to minmax".
    - Change transpparency of all of the three layers into 50%

ALT2 CREATE A NICE-LOOKING MAP OF WINDY AREAS

Reorganize and change display options of the layers to make a nice-looking wind map of Ethiopia:

- To give a nice feel to the map, lets use hillshaade as a background layer. To do this, add the Digital Elevation Model raster layer into the project.
- Next, perform hillshade analysis on this layer: Raster -> DEM -> Hillshade; change vertical exageration into 3; define new output file name and folder -> OK
- Add the newly generated hillshade to the project, make sure mountains and valleys are displayed logically
- On top of the hillshade layer place the wind layer. Make sure it has the pseudocolor display. Now change transparency of this layer into about 50%.
- On top of that display the major roads
- On top of that display the administrative borders Level 1
- On top of that display the major settlements

ALT3 CALCULATE POPULATION WITHIN HIGH WIND AREAS AND WITHIN 1km OF ROADS

- Clip Road layer using the mask layer
    - Vector->Geoprocessing tools -> Clip -> input layer = roads; clip layer = ADMIN_LEVEL1_MASK; output file ROADS_CLIPPED
- Find out areas that are within 0,01 degrees from existing road network:
    - As running this algorithm takes a very long time, it is done for you already and the layer can be found under the ROADS folder called BUFFER. For your reference, to make the buffer use the following:

    - Vector -> Geoprocessing tools -> Buffer -> input layer = ROADS; number of segments = 5; Buffer distance = 0.01; tick the „Dissolve buffer results“ -> OK
- Display the population map on the canvas (drag and drop the layer from browser)
- Create new population layer where POP=POP if in high wind areas, otherwise 0
    - Raster -> Raster Calculator -> enter the following formula (make sure the layer name is the sme as you have in your project):
      ("WIND_SPEED@1">5)*"eth_msk_pop@1"
- Next, extract the areas on the high wind population map that are close to the roads:
    - Using Raster->Clipper clip the newly created population layer using the Roads_Buffer vector layer
- Use Zonal analysis using administrative borders and newly clipped population layer to count population in high wind areas within the administrative areas.