

Climate Grid Points Retrieval by Integrating R with QGIS

S. Thiyaku

M. Tech I Year, Remote Sensing and GIS
National Institute of Technology Warangal
Warangal, India, thiyakus.civil@gmail.com

Dr. K. Venkata Reddy

Assistant Professor, Remote Sensing and GIS
National Institute of Technology Warangal
Warangal, India, kvreddy229@gmail.com

Sri Lakshmi Sesha Vani Jayanthi

M. Tech II Year, Remote Sensing and GIS
National Institute of Technology Warangal
Warangal, India, vani.j88@gmail.com

Modugu Sudhakar

M. Tech I Year, Remote Sensing and GIS
National Institute of Technology Warangal
Warangal, India, vinaysdhr2@gmail.com

Abstract— Climate data is the very essential in the climate change, trend pattern and water resources studies. Most of the studies related to climate data deal with small areas but the climate data available is mostly global level or regional level. So retrieval of climate data for the area of interest is the cumbersome process. In order to overcome the difficulty a tool is developed for retrieval of climate grid points using open source software R. A Graphical User Interface (GUI) is created using R, which takes the climate data in NetCDF format and returns the grid points for area of interest in the form of text file. This R code is later integrated with the QGIS. A model is also created in QGIS to project the obtained grid points on the DEM (Digital Elevation Model) and shape file of the area of interest in order to obtain elevation data at the retrieved grid points. This model tool has been verified for different climate model data.

Keywords-Climate model data; Grid points retrieval; R language; QGIS.

I. INTRODUCTION

Global climate consists of temperature, wind pressure, density, concentration of water vapor and various other parameter data for nearly 105 grid points covering the whole earth at each time step. For a period of 30 years in hourly time step the data to be saved is 4×105 megabytes. Such data is large and using for the climate data related studies is difficult and time consuming. Many statistical methods are used but no direct tool is available for the retrieval of climate grid points for the researcher's area of interest. In present study R statistical programming language is integrated with QGIS and a tool is developed for retrieval of climate grid points. R is well known as a powerful, extensible and relatively fast statistical programming language. What is less well known is R has cutting edge spatial packages that allow it to function like a fully featured GIS [2]. Users can improve the base code of R, and can also write extensions/packages. But R itself is

not good in creating dynamic interfaces, which can be overcome by integrating with GIS software. QGIS is one of the free and open source GIS software which supports integration of R and more importantly it runs on multiple platforms like Linux, Unix, Mac OSX, Windows and even Android.

Integration is technique that combines software components to save time and resources and it enables to use specialized tools [6]. R has many packages which can be integrated easily with GIS software to gain the advantages of both the software. "osmar" package integrates the OpenStreetMap into R environment. This package enables OpenStreetMap data in R and converts data into objects based on classes provided by existing R packages [5]. The FOSS tool for immediate flood disaster response planning was developed as a plugin for QGIS [3]. A geospatial tool was developed for extracting climate data grid points using R is developed and integrated with ArcGIS environment with the help of python script [1]. The "ncdf" package provides a high-level R interface to Unidata's netCDF files, which are portable across platforms and include metadata information in addition to the data sets. This package provides interface considerably more functionality than the old "netCDF" package for R. This special package of R works effectively in handling the climate data files which are usually in netCDF format. In the present study a basic code is written using this package for extraction of grid point data in R and further the code is integrated with QGIS environment to make it available for QGIS users as well.

II. METHODOLOGY

The methodology consists of two steps; first step is extraction of the grid points as text file using R code for the given bounding box coordinates. In second step the Graphical modeler in QGIS is used to remove the grid points which are

not in area of interest and add the elevation attribute to the extracted grid points with the help of DEM.

A. R integration with QGIS

First R code to read the NetCDF file and extract the grid points for the given bounding box is developed. The R code uses the ncdf package to read the NetCDF files, and chron package to handle dates and times. Later R code was added to the QGIS processing toolbox and interface was created. QGIS has an inbuilt facility that provides the integration of R with help of Python. The 'Climate grid point R' toolbox takes the NetCDF file, start and end latitude values, start and end longitude values, output folder to save the text file and name of the text file as shown in figure 1. It gives all the grid points

inside the bounding box as text file. The format of the output text file form this toolbox is shown in figure 2.

```
ID,LAT,LONG,y,x  
1,14,74,60,110  
2,14,74.5,60,111  
3,14,75,60,112  
4,14,75.5,60,113
```

Figure 1. Output from 'Climate grid points R' toolbox

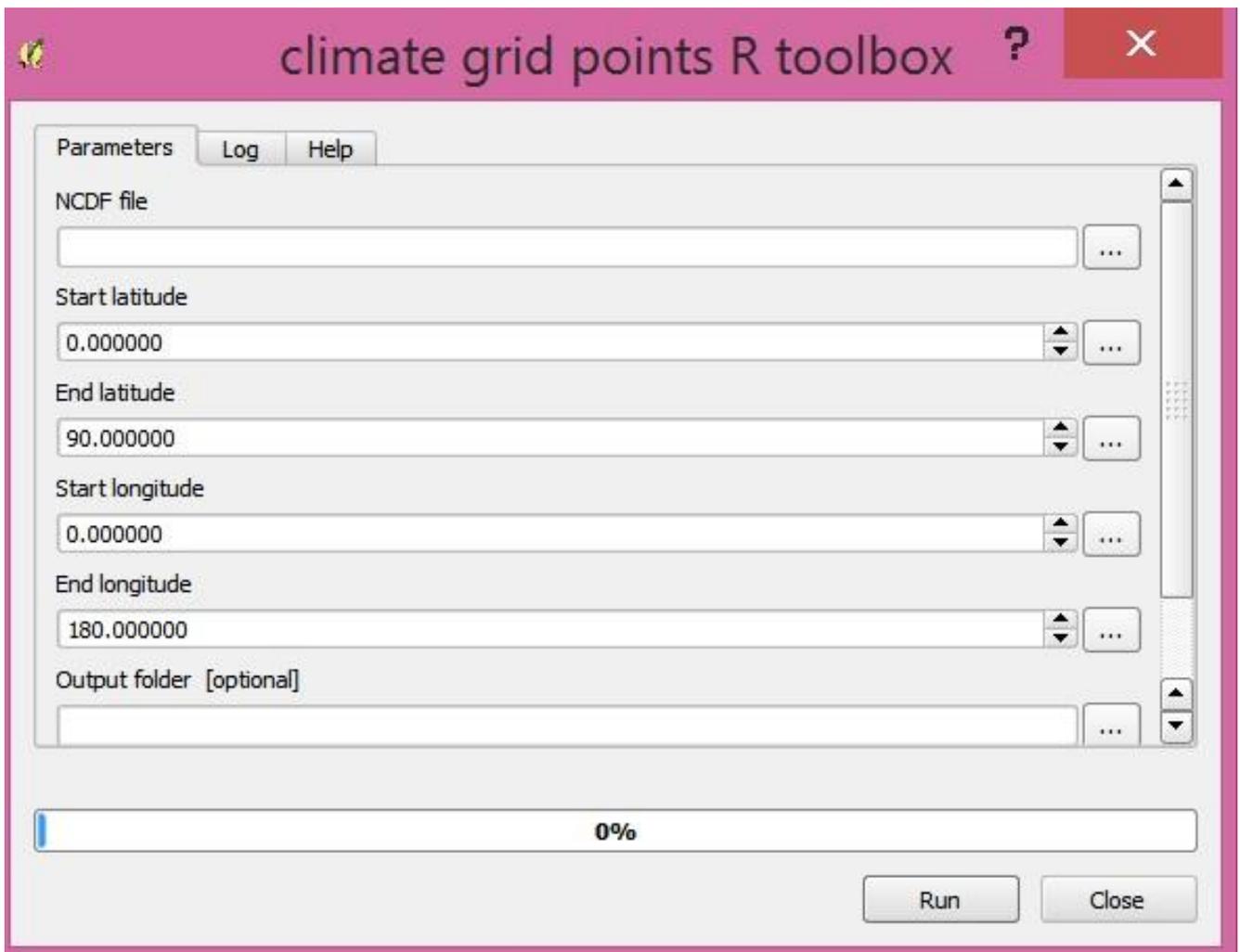


Figure 2. Climate grid points R toolbox

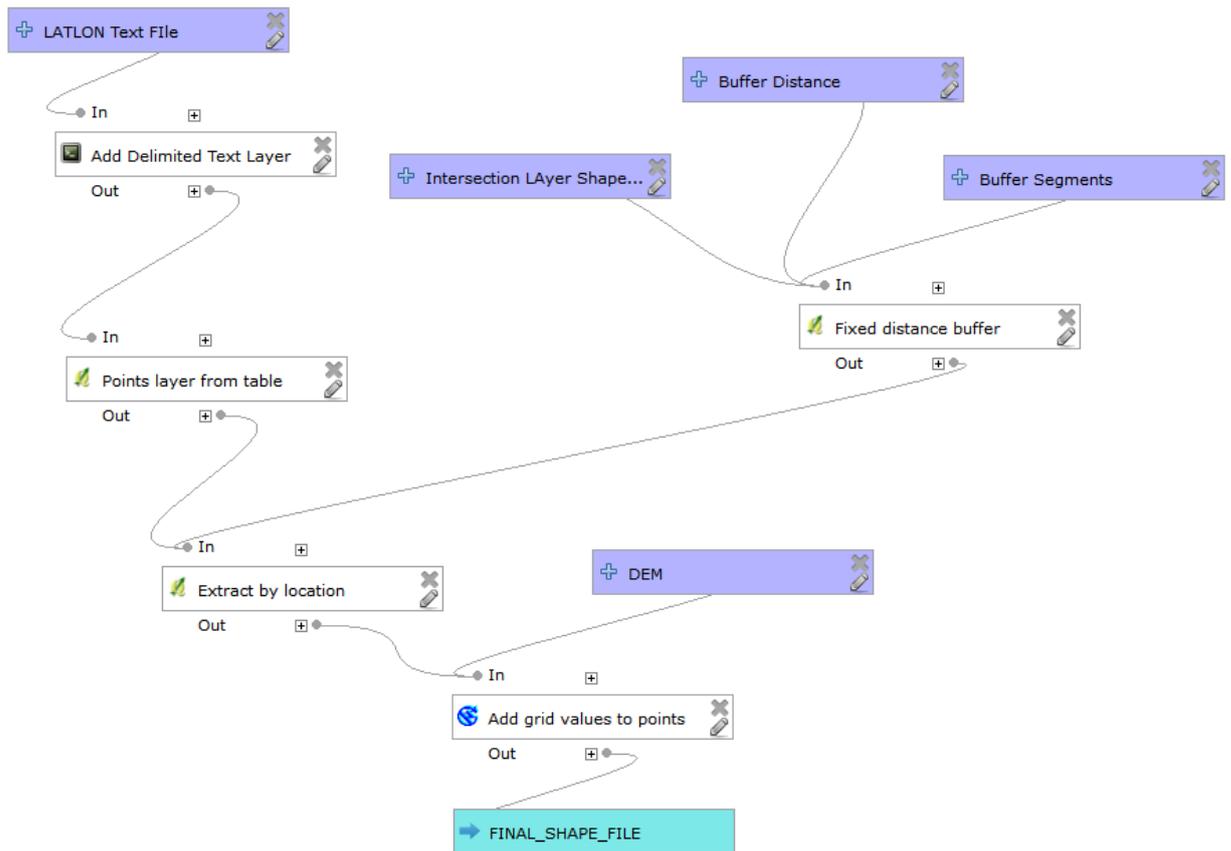


Figure 3. Graphical Modeler

The Climate grid point R toolbox takes the NetCDF file, start and end latitude values, start and end longitude values, output folder to save the text file and name of the text file. It gives all the grid points inside the bounding box in text file. The text file consists of Id, latitude, longitude, x and y value.

B. QGIS Graphical modeler

Graphical modeler is used to automate the workflow using the already available processing tools. QGIS processing tools provides tools from various other software like SAGA, GRASS, R, Python script tools, etc. Using Graphical modeler the toolbox is created to first convert the text file from the 'Climate grid point R' toolbox to shapefile, then this shapefile is intersected with the shapefile of watershed boundary or any other area of interest to obtain the grid point in area of interest and the elevation from the DEM is added to the attribute table of the grid point shapefile. This tool also allows adding the buffer to the boundary shapefile if area of influence is greater than area of interest.

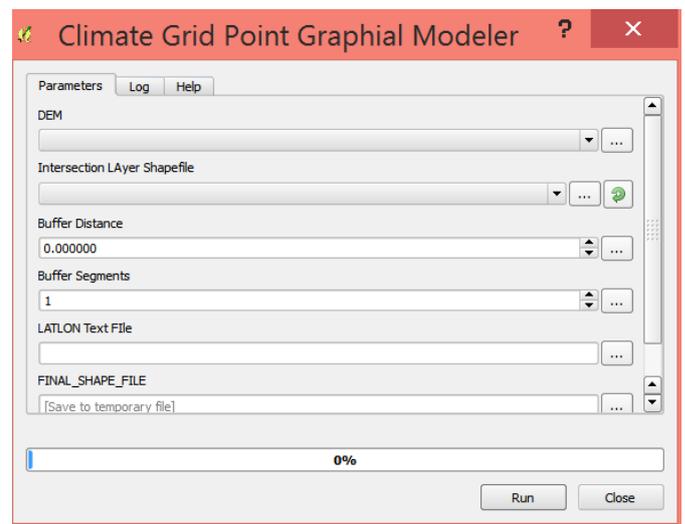


Fig 4. Climate Grid Point Graphical Modeler Toolbox

III. RESULTS

The modeling tool is used for the Wardha basin, Maharashtra, India and the grid points are initially obtained without any buffer (Fig 5). Then the grids points are obtained with the buffer distance of 0.5° (Fig 6). 17 grid points are obtained in the case of zero buffer and 41 in the case of 0.5 ° buffer.

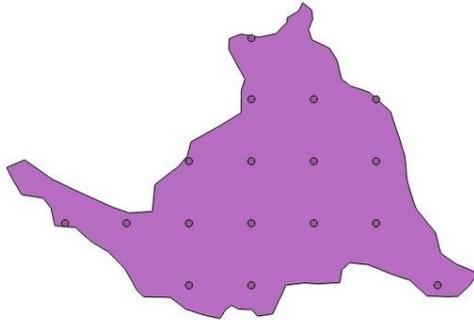


Fig 5 Wardha basin grid points with 0 buffer distance

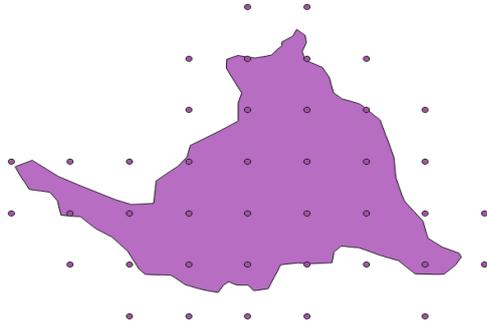


Fig 6. Wardha Basin grid points with 0.5° buffer distance

IV. CONCLUSION AND FURTHER DIRECTIONS

The modeling tool is used to obtain grid points from different types of CORDEX data models like CCSM4, GFDL, Access, etc. The grid points obtained from model is checked with manually obtained grid points. The model saves considerable amount of time in obtaining grid points compared to manual retrieval method. The retrieval of grid points for area of interest saves lot of disk space. The grid points obtained are useful in further studies like climate change detection, watershed analysis, and also can be used in SWAT (Soil and Water Assessment tool). Further it is planned to develop this tool into QGIS plug-in to make it available for all the climate researchers.

REFERENCES

- [1] Venkata K. R., Sri Lakshmi S. V. J., Kotrike T., Sowjanya P. N., "Geospatial model tool for climate data retrieval"
- [2] Lovelace R., "R, an integrated statistical programming environment and GIS", *GeoInformatics*, vol. 17, pp. 22 – 24, December 2014.
- [3] Kasun R., Dilma V., Nisansala H., Givanthika R., Samantha R. and Nimalika F., "GEO enabled FOSS tools support for immediate flood disaster response planning" *IEEE*, pp. 1 – 6, December 2014.
- [4] Pavel Mchhna and Milton Woods, "RNetCDF – A package for reading and writing NetCDF datasets", *The R Journal*, vol. 5/2, pp. 29 – 36, December 2013.
- [5] Manuel J. A. E., and Thomas S., "osmar: OpenStreetMap and R" *The R Journal*, vol. 5/1, pp. 53 - 63, June 2013.
- [6] Pedro R. de A. N., Paulo J. R. Jr. and Karla D. K., "Integration of statistics and Geographic Information Systems: the R/TerraLib case" *INPE*, pp. 139 -151, November 2005.