Using Geoinformation Science to Reveal the Impact of the Eritrea-Ethiopia Boundary Commission's Decision on Irobland and People

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Part I

General Overview and Facts about the Irobland

Prior to proceeding to the border issue of the Irobland, the author of this self explanatory notes has tried to reveal the existing realities on the Irob ground to the national and international public using different geospatial satellite maps that can show location, elevation range, contours, landforms and its associated drainage system, etc.. These features, later on, will enable the readers to clearly see which drainage and terrain-chains the current EEBC's boundary line is following to delimit parts of Irobland to Eritrea without any base or justification. To serve this purpose, most of these maps are prepared and presented in three dimensional views so that the rivers, valleys, hills, mountains, ridges, etc. can clearly be visible and easily understandable for the readers--which further demonstrates which hills and valleys the 'newly imposed EEBC's border line' follows.

Location, Elevation difference and Areal coverage of the Irobland

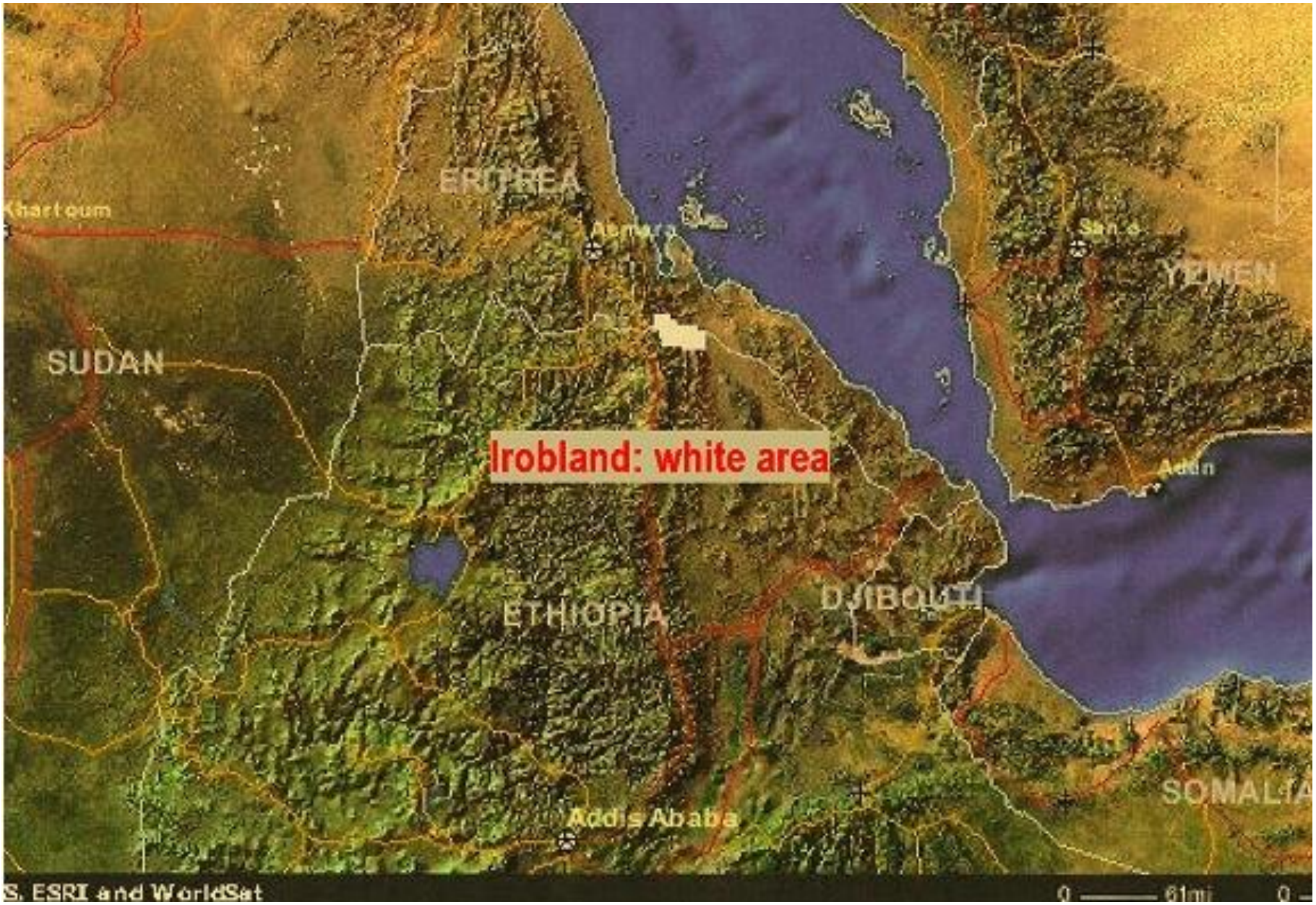
Irobland is located in northeastern Ethiopia at the border with Eritrea, lying at the western escarpment of Ethiopian (Afar) rift valley (see map 1). Because of its location, the landforms in Irobland are associated with the formation of Ethiopian rift valley and its related tectonic and volcanic activities. It is bounded by Endeli river from the North East, latitude 14^0 40' 53" (1623210

meter in UTM) from North, longitude $39^0$28’42” (552052 meter in UTM) from the west, and 39^0 59’ 35” (606092 meter in UTM) to east and by La-Asa (Gundagunde) river to the south.

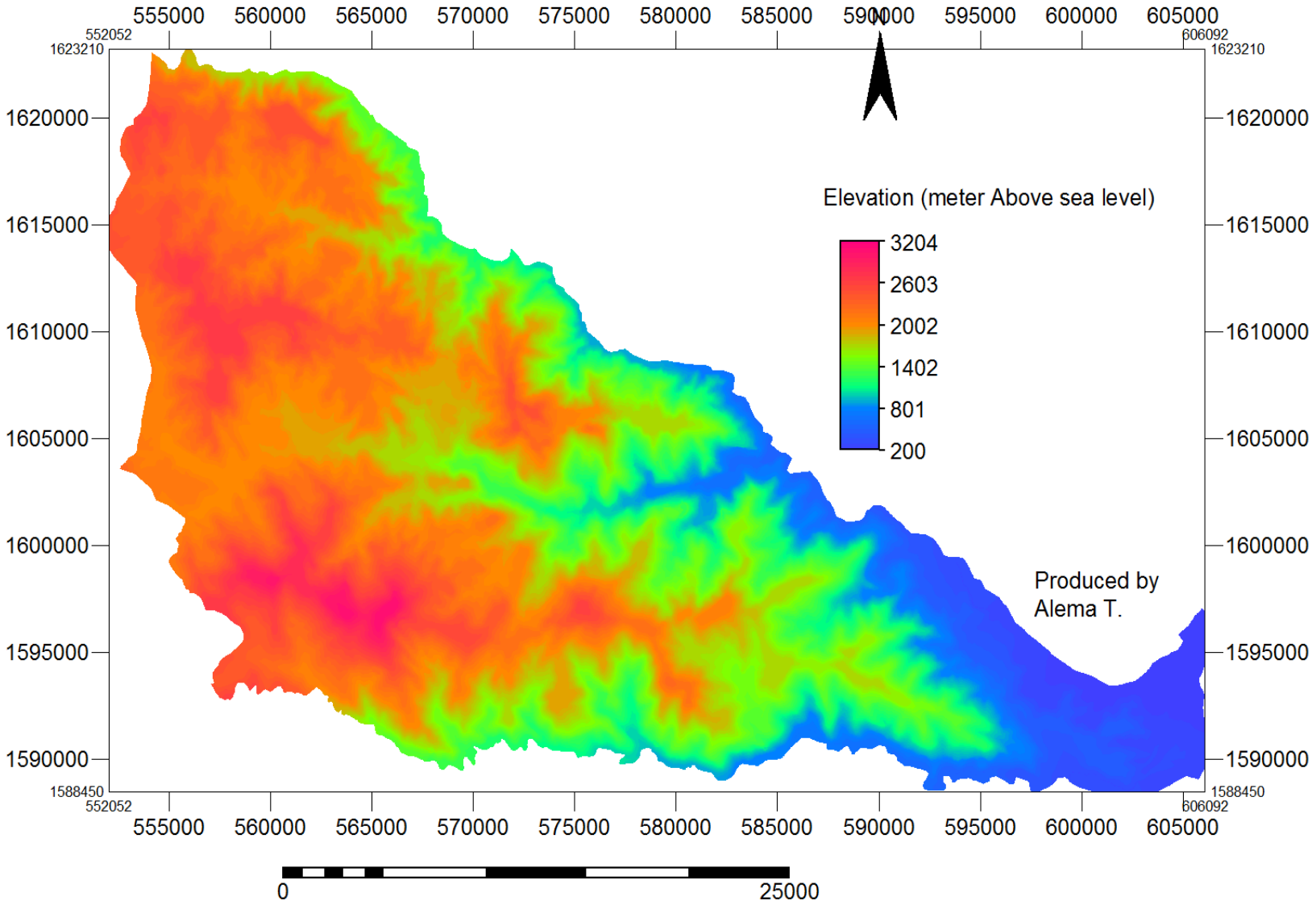
The perimeter and the total areal coverage plus individual internal administrative divisions of the Irobland are determined by using ILWIS software and the details are presented below (see table 1). As can be seen from the table below, when viewed from areal coverage point of view, Ara‘e administrative division takes the largest coverage while the smallest being contributed by Mosi-Gade. Adgadi-Are, one of the totally ceded parts of Irobland (to Eritrea), is the third largest internal administrative division of the Irobland (See Map 4 for details).

Wereda	Area (m)	Perimeter (m)	Tabia	Area (Sq. km)	Area (hectares)
Irob	128712000	54096.73	Adgadi-Are	128.71	12871.19
	201396000	88108.45	Waratle	201.4	20139.55
	75946100	55466.1	Daya-Alitena	75.95	7594.6
	51464000	35969.27	Agarale	51.46	5146.4
	452241000	137494.4	Arae	452.24	45224.12
	20355000	28119.27	Mosi-Gade	20.35	2035.49
Total	**930114100**	**399254.22**		**930.11**	**93011.35**

Table 1. The areal coverage of each internal administrative division and the total Irob territory

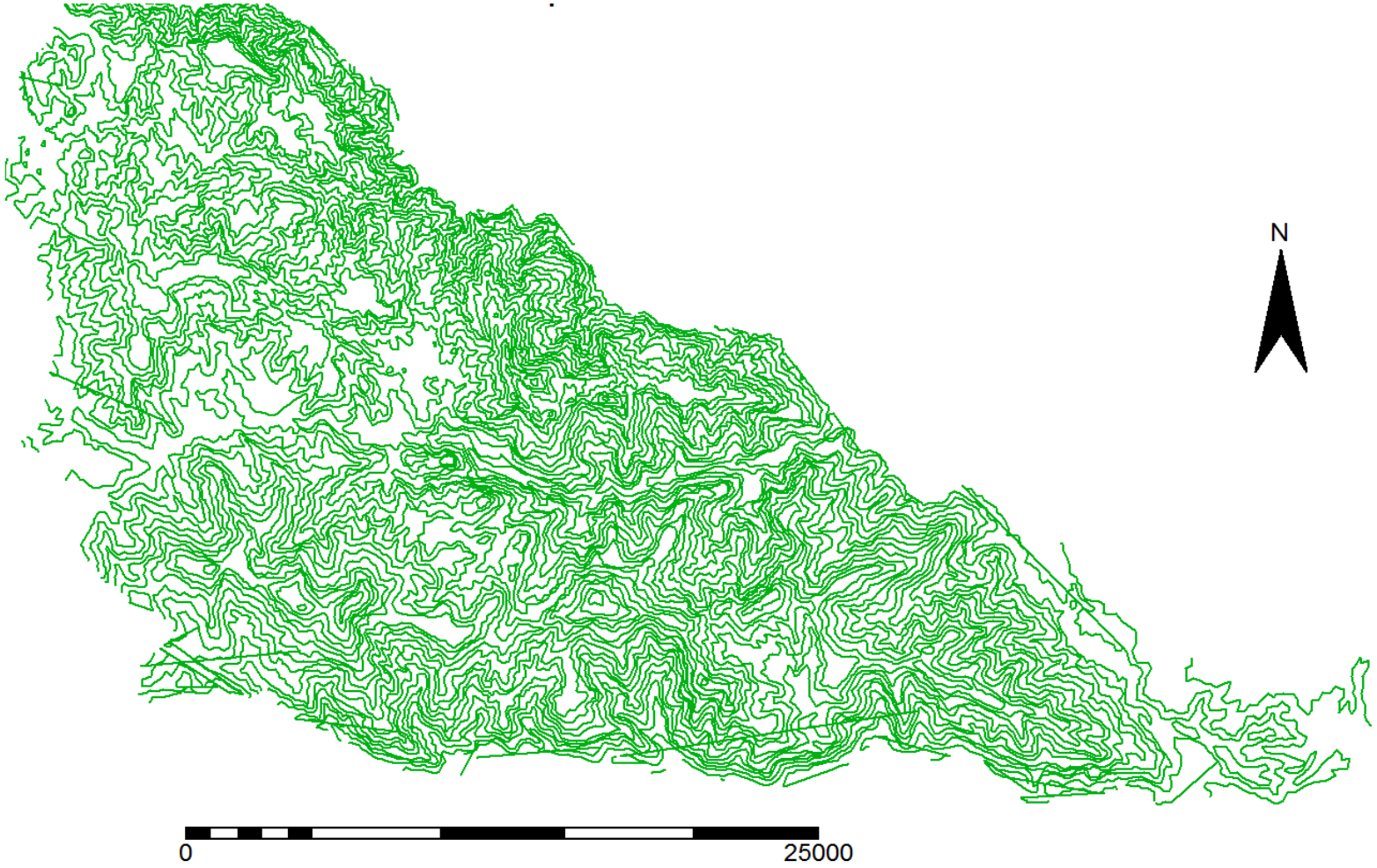


Map1. Location of the Irobland



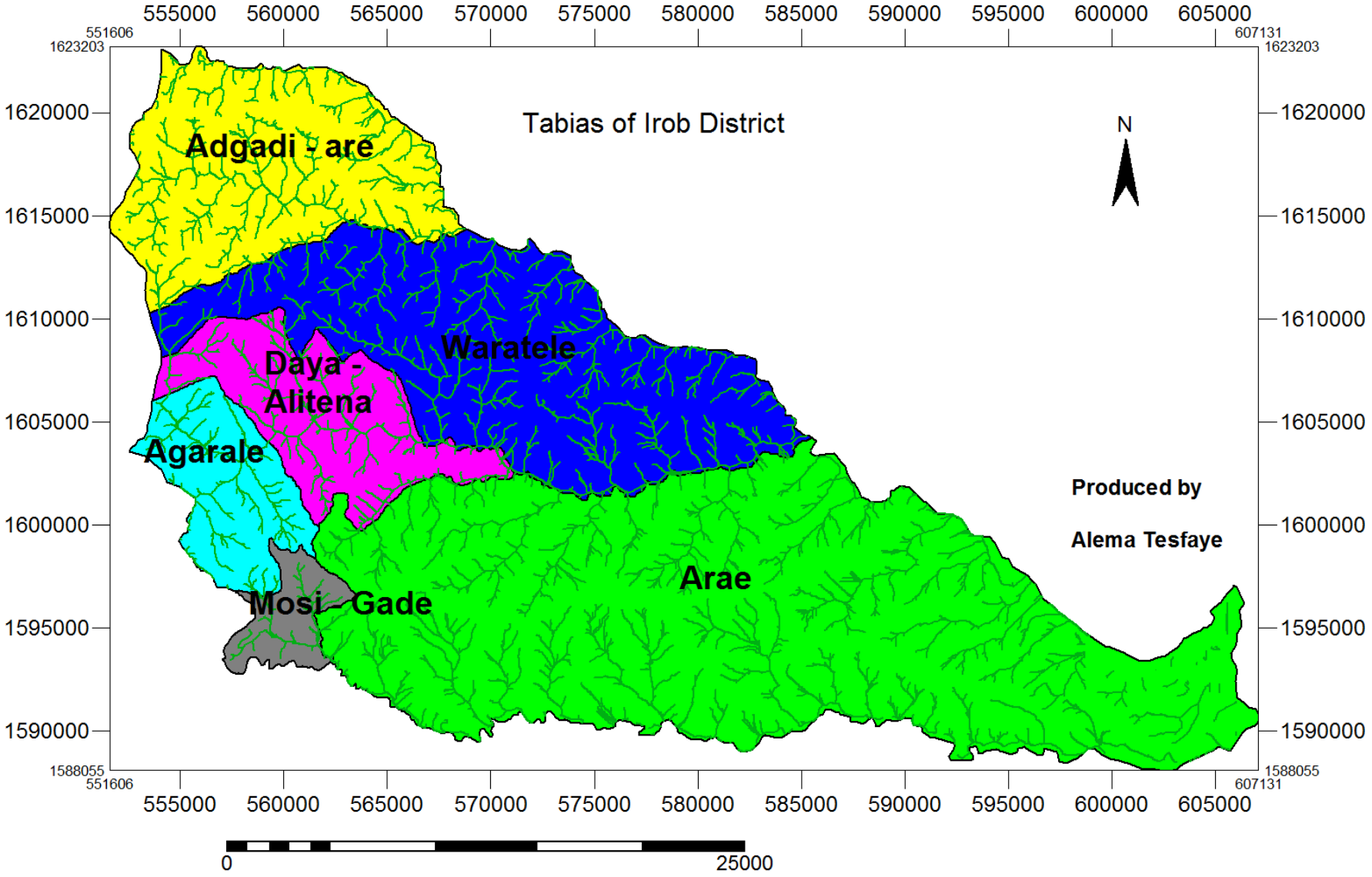
Map 2. Digital elevation model (Elevation map) of The Irobland

The highest elevation in Irobland is 3204 meters above see level (Mt. Assimba) and the lowest point is 200 meter above sea level (occurs at Endeli plain called Ragali, near Afar Depression). The elevation of all the remaining places in Irobland varies between these two extreme values or points. (See Map 2)



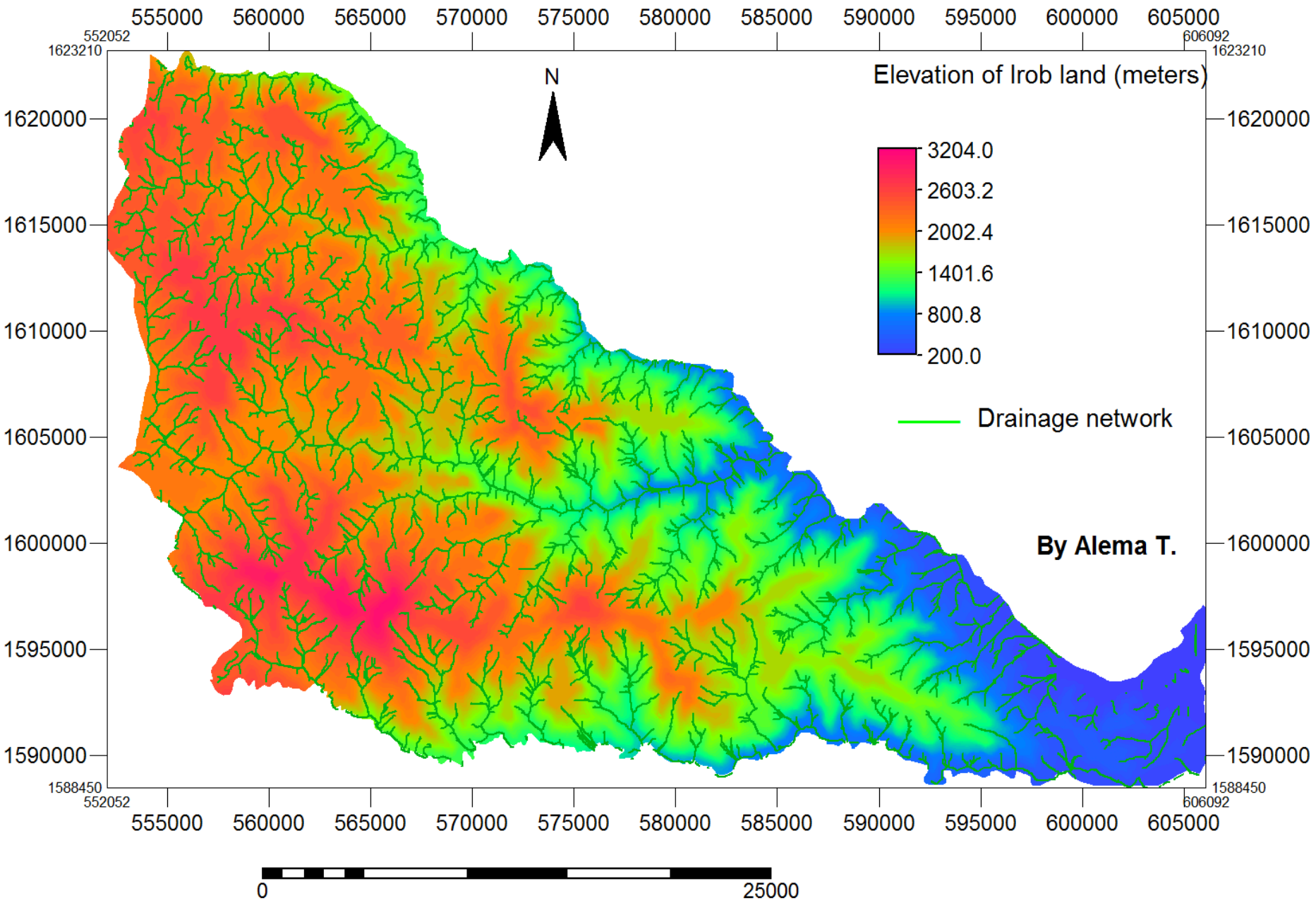
Map 3. Contour map of Irobland with the contour interval (spacing) of 50 meters

The closer the contours, the steeper the slopes (cliffs) and the wider the contour lines, the flatter the areas are. The more one goes to north and Northwestern part of the Irobland, the more flatter the topography and thus more suitable for agricultural development for enhancing crop production. Amazingly, the flatter areas with wider contour spacing at northern and north-western parts of Irobland are totally ceded to Eritrea by irresponsible Eritrean-Ethiopian boundary commission (EEBC).(See Map 3)



Map 4. Internal administrative divisions of Irobland with its associated drainage system

Most of the internal administrative division boundary in Irobland follows the drainage (river or stream) systems. Besides that, there are also fewer ones that follow water divides and goes arbitrarily on the land as in a case some parts of Mosi-Gade, Agarale and Aiga area of Daya-Alitena administrative units. (See Map 4)



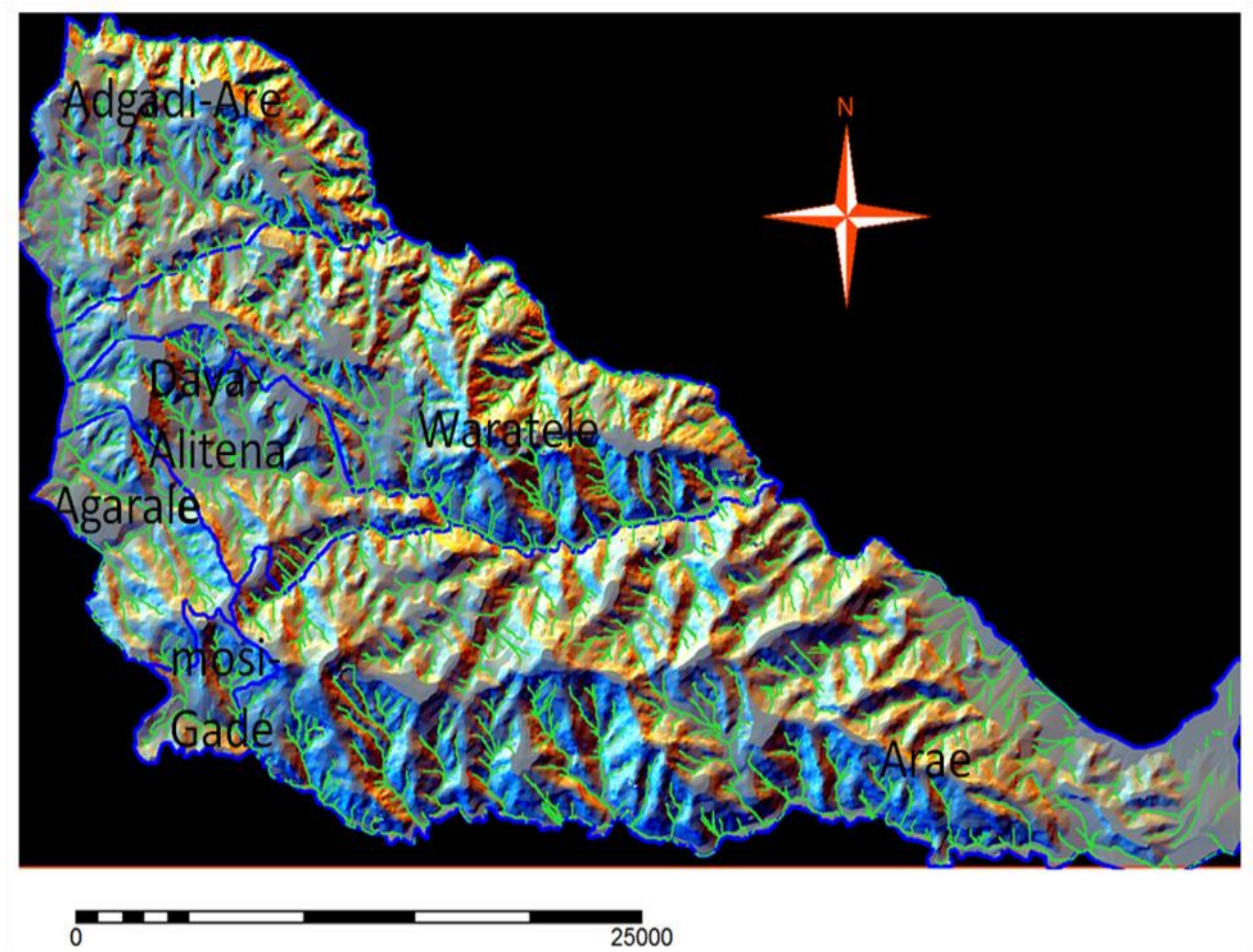
Map 5. Drainage systems superimposed on Digital Elevation Model (Elevation map) of the Irobland

Drainage system extraction from Digital Elevation Model (DEM) of Irobland

The Author of this note has tried to extract the drainage (river or stream) networks of the Irobland from its Digital Elevation Model because, later on, it will help the readers to clearly show where the EEBC's boundary line is lying and which stream and river systems of the Irob territories it is following, dissecting the historic Irobland in to two. See map 6 and 7 for the further clarification of river and stream (drainage) networks in Irobland. This phenomenon will be clearly presented later in the coming up parts of this article displaying varieties of maps with the newly imposed EEBC boundary line that divides the Irobland in to two hostile nations, Ethiopia and Eritrea.

Surface Micro-topography: Analysis of terrain of the Irobland

Digital elevation models (DEMs) are readily available digital data sets that represent the elevation of the earth's surface parameters such as valleys, ridges, mountains, etc. Terrain analysis is central to a range of important geographic information systems (GIS) applications related with topography, geomorphology and its associated features. Due to this the surface micro-topography of the Irobland is analyzed carefully and presented as shown in map 6 and 7 below. In order to show these features clearly to the readers, different levels of transparency and background colors were used after trial of options to improve visualization of Irob terrain. As can be seen in maps 6 and 7 below, the valleys, ridges, mountain chains, intersection of streams, and relatively flatter areas and steep cliffs, etc are clearly visible. When the author tries to address the newly imposed EEBC's boundary line between two countries (Ethiopia and Eritrea) focusing on Irob case, in part II and III this article, more clarification on land forms of the region with the help of different visualization mechanisms will be addressed in depth.



Map 6. Drainage system, valleys, ridges, plains, cliffs and other topographic features of Irobland (blue color)

Map 7. Drainage system, valleys, ridges, plains, cliffs and other topographic features of Irobland (orange color)

Notice: The purpose of this part of the article is to understand the over all land forms and its associated drainage networks that are so important to know before starting part II of the same article. Part II will try to explain the parts of the Irobland that are ceded to Eritrea by the Eritrean-Ethiopian Boundary Commission's decision.

Details and procedures of Irob Terrain mapping

Below, the Author will try to present the digital elevation model, mapping datum and software used to accomplish this mapping task. Geoinformation science is important for monitoring the responses to changes in the topographic phenomena and other human induced stresses such as the Ethio-Eritrean boundary demarcation that is currently pending in Irobland.

Geodetic Base Networks

The first step in producing different maps such as border delineation, drainage, elevation, etc. of the Irobland lies in choosing of correct geodetic network. As the border line has to be defined by border markers (boundary pillars on the fixed points), they should be precisely and accurately put on the map and shown to the public without any modification (the details will be seen in the coming parts of this article). To accurately represent the boundary line and the commission's points on the map, the same datum (WGS84) and proper geodetic reference frame should be selected. Therefore, as geodetic frame, ITRF (International Terrestrial Reference Frame) were selected and the overall accuracy of the network and the border points were in a range of a few millimeters. Absolute reference of the height values to the mean sea level of each points and terrain surfaces was done by connecting the base survey network to one of national bench marks (Assmiba Mountain).

NASA Shuttle Radar Topographic Mission's (SRTM) Digital Elevation Model (DEM)

Satellite remote sensing projects make large amounts of massive terrain data readily available. NASA's Shuttle Radar Topography Mission (SRTM) acquired 30-meter resolution data for 80% of the Earth's land area, or about 10 terabytes of data,

forming the most complete high-resolution database of the Earth. This data is currently distributed free of charge by United States Geological Survey (USGS) and is available for download from the National Map Seamless Data Distribution System, or the USGS ftp site. A SRTM, Digital Elevation Model (DEM), is a numerical representation of a topographic elevation map and is a fundamental model in geographic information systems because it assists in modeling, analyzing, and displaying the Earth's surface in suitable manner. The drainage and geomorphologic features of the region is produced through processing of this Digital Elevation Model (SRTM digital elevation data), produced by NASA originally, is a major breakthrough in digital mapping of the world, and provides a major advance in the accessibility of high quality elevation data for large portions of the tropics and other areas of the developing world. Therefore, SRTM 90m Digital Elevation Data (after resampling in to 30m resolution) is used to produce different maps and extract different geoinformational layers of the Irobland. DEMs are always in the form of raster maps, with a value domain. Each pixel in the raster map contains the altitude of the center of the pixel. Using a large pixel size will therefore result in more general DEMs (a smoother topography). When the pixel size is chosen too large, ridges and small streams may be suppressed and missed. For this purpose, the DEM was resampled in to 30 meter resolution as I mentioned.

Geographic Information System software used for Irob terrain mapping

ILWIS is a remote sensing and GIS software which integrates image, vector and thematic data in one unique and powerful package. Moreover, this software is renowned for its functionality, user-friendliness and low cost, and has established a wide user community over the years of its development. Lastly, the Author has used Universal Transverse Mercator (UTM) geographic coordinate system for the purpose of mapping of the Irobland and analyzing other related phenomena in the region.

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To be continued…….