A REVIEW OF PAPER MAP CONVERSION

Jamaah Binti Hj. Sekon
Civil Engineering Department, Polytechnic Sultan Idris Shah (PSIS), Sungai Lang, Sungai Air Tawar, Sabak Bernam, Selangor.
Jamaah.sekon@psis.edu.my / adq8134@yahoo.com

Abstract

A review of paper map conversions study is being crucial role in geospatial data management specially to preserve the existing data. Using Geological Map of Northern and Southern part of Malaysian Peninsular and Soil Map of Peninsular converted, Isodose Map to finally output. Methods, processes and procedures that were conducted for the conversion of paper map including of geometric corrections to be able to assign a coordinate system that associate the data with a specific location on earth, creation simple topological map for cleaning up the gabs between two adjacent polygons will determine in this study. Many legends to represent and depict different geological time scales and soil types these included such as Quaternary, Tertiary, Cretaceous-Jurassic, Triassic, Permian, Carboniferous, Devonian, Cambrian, sand deposits, sedimentary rocks, extrusive and intrusive rocks, and also different types of soils alluvial and sedentary soils. Isodose map sources from all these lithological structures and soil types parameters is useful to predict Terrestrial Gamma Radiation Dose (TGRD) rates. Perhaps, a review of paper map conversion method in this study can be useful for how human resources and time can be managed especially for decision support making purposes.

Keyword: Geospatial data, Isodose Map, dose rates, topological, lithological structures.

1. Introduction:

Spatial GIS data entry either vector and raster data may provide various approach. Vector premier data which consist point, line and polygon easily derived from map digitization, digital map from Jabatan Ukur dan Pemetaan Negara (JUPEM), aerial photo (Photogrammetry), land survey field work, Global Positioning System (GPS) and so on (Mohamad Nor Said, 1999). Raster premier data mainly derived from digital imagery such as Remote Sensing, Terrestrial Light Detection and Ranging (LIDAR) and Unmanned Aerial Vehicle (UAV). Between vector and raster have their advantages and disadvantages. In term of price, vector data is cheaper than raster. In accuracy, raster data more accurate because of its pixel measurement but, in availability and easy to get or buy are spatial vector data. Due of main sources of spatial vector data acquisition, more cheap and easy to get, absolutely maps are the best choices.

Paper map conversion terms are crucial role in geospatial data management and preserve the existing data challenging. Reliable, correct and consistent, technology proof and secure are part of preserve the existing data challenging. In the other hand, conversion terms need to preserve quality, maintain the cost, well time consume and availability which are include entire of data entry parts, correction, verification and updating data most required for ensuring our data sources most useful and powerful (Mohd Faisal Abdul Khanan, 2015).

Manual digitizing in paper map conversion also known as a records map coordinates and map information in digital format. On screen digitizing requires a scanner to scan the document. A scanned image displayed on screen follow computer screen axes of coordinate. Different with past technology which is using digitizer data recorder (table). But, even technology proof that digitizing work become more flexibility and faster than before, in certain aspect need to clarify
particularly. Especially while do geodatabase establishing, coordinate capturing, coordinate transformation into MRSO coordinate system, digitizing, topology constructing, editing and attribute entry.

Some issues in map conversion regarding Stephanie Routhier Perry (2014), involving human error, data loss, fading memory, lack of effective education, and technological. Knowing what to preserve, and the best method to use, is a major concern for professionals, and one that requires specialized training. Other related issues on map conversion into digital such as age of maps, maps scale, conversion of projection, processing errors (require knowledge of the information and the systems used to process it), errors in topological analysis, classification and generalization problems, digitizing and geocoding errors (overlay and boundary intersections, and errors from rasterizing a vector map. Physiological errors of the operator by involuntary muscle contractions may result in spikes, switchbacks, polygonal knots, and loops. Errors associated with damaged source maps, operator error while digitizing, and bias can be checked by comparing original maps with digitized versions. (Kenneth E. Foote et al., 1996).

Changing formats and obsolescence of technology, untrained staff and human error, authenticity and reliability of material, standardization, copyright and cost issues and awareness some issues in preserving factor during map conversion process. Stephanie Routhier Perry (2014) also mention important to focus on the future, anticipating what challenges could arise, and devising solutions. This paper almost explains the issues and short list all the factors could arise while map conversion process. But in detail about how to measure the accurateness and the precision of digital map after hard copy map conversion done, supposedly to be clarify.

Further due to overcome all the above challengers of map conversion, researchers mention about changes conversion era. For example, as mention by article writer A.C Seijmonsbergen (2013), map hardcopy conversion birds-eye views, three-dimensional display and animations, virtual globe visualizations, geospatial portable document format maps or access to geomorphological maps via web-based services are possible through remote servers. The visualization and publication of digital geomorphological information layers have drastically changed the end-user interactively controls the information that is on-screen displayed, analyzed, and distributed.

Many papers and previous research related on paper map conversion but a little bit highlight all the preserving factor in details and comprehensive. If those preserving factor are not being identify and solve efficiency, somehow a new digital map are lacking in term of currentness, accuracy and precision. Perhaps, a review of paper map conversion method in this study can be useful for how human resources and time can be managed especially for decision support making purposes. For all the changes and development of previous research, find solution as mention by Stephanie Routhier Perry (2014) to focus on the future, anticipating what challenges could arise, and devising solutions. But in term of find a better accurate and precise while doing map paper conversion are not mention clearly. Hence, the following section will discuss about map conversion factor and its implication.

Several research questions for this study as follows:

(1) How to identify the characteristics of map conversion preserving factor?
(2) Why necessary to study all those characteristics of map conversion preserving factor is important?
(3) Are there any limitations in using map to convert into digital once compare with others input data approach?
This study is to review of paper map conversion including to identify the characteristics of map preserving factor and then publish a precision map within the specific map theme. Three maps were using which are Geological Map of Northern and Southern parts of Malaysian Peninsular and Soil Map of the Peninsular. Those these maps, Isodose map will publish.

2. Conversion approach and Geometric correction

Above previous research has been through digitalization of hard copy maps within value added factor such as DEMs and develop a database. But supposedly integrated with to preserving the accurateness and precision during digitize. Standard georeferencing methods, that use reference control points to compare historical cartography with the present one, in this specific case demonstrated to be not successful in describing the real location of disappeared landscape details with an adequate level of accuracy. (Gabriele Bitelli et al., 2014). Follow by Gabriele Bitelli et al., (2014), consists in three contemporaneous pre-geodetic maps (late 16th century) from the ancient Po river delta area (Italy), by means of which a geometrically correct representation of those parts of the landscape, not preserved today because of sea erosion, was tried. In fact, standard georeferencing methods, that use reference control points to compare historical cartography with the present one, in this specific case demonstrated to be not successful in describing the real location of disappeared landscape details with an adequate level of accuracy. For these reasons, in order to define which map among the others was the most faithful to the contemporaneous physical reality, a compound methodology, consisting of a three-step analytical process.

The correction of errors in remotely sensed data, such as those caused by satellites or aircraft not staying at a constant altitude or by sensors deviating from the primary focus plane. Images are often compared to ground control points on accurate base maps and resembled, so that exact locations and appropriate pixel values can be calculated (Maloney, 2000). The image data acquired by remote sensing includes the considerable distortion portion made by the earth’s curved surface. In order to overlap this distorted image with the existing topographical map, which exists on the plane, we should go through the process to transform the satellite’s image into the same size and projection value as the topographical map. We call this transformation process geometric correction, and only after going through this process, we can get the stable images as the form that we can generally see through maps (Gomarasca, 2009).

Corrected geometrically using Personal Geodatabase for three given maps separately. Then the group registered MRSO coordinate of the map and selected Projection Coordinate system, choose GDM2000 MRSO. Imported the raster dataset that are Soil Map, Geology North Map and Geology South Map into the Geodatabase. Ground Control Point (GCP) were added to point feature class by clicking add XY Coordinate from Add XY Coordinate such as below figure:
Figure 1: Ground Control Point (GCP) were added to point feature class by clicking add XY Coordinate from Add XY Coordinate.

The group managed to launch doing georeferencing on the Soil map and selected nearest location similarity. It can be rectified and verified the image by turning on the Georeferencing toolbar by either right clicking in empty gray space beside toolbars menus at the top of the ArcMap window, or by going to Customize then to Toolbars tab, and then placing a check mark in the box next to the Georeferencing toolbar option. Georeferencing can be started by clicking Add Control Point at Georeferencing Toolbar and the RMS error should less than 0.1 to increase the accuracy of selected control points.

Figure 2: Georeferencing can be started by clicking Add Control Point at Georeferencing Toolbar.
2.1 Digitizing: To start this project, created a Geodatabase, by clicking right on the working lab directory and going to new and then creating personal Geodatabase that was suitable for our small project. Within the personal Geodatabase, feature datasets were created and named to hold different feature classes. After giving a name to feature dataset, it was followed the procedures by clicking next.
After named the feature class, a window appeared to choose the coordinate system for the X and Y, where the group was supposed to select GDM 2000 MRSO. Then, followed the instructions by clicking next such display on Figure 5.

![Figure 5: Named the feature class](image)

Now, from the editor tool bar we clicked on create features to open the window so that we can add new features for digitizing.

![Figure 6: Create future](image)
From the create feature window, clicked a feature template to set up the editing environment with those properties, and then we clicked on the construction tool on the window to digitize features. From this stage, well prepared the data for digitizing and started digitizing manually by clicking the Zoom In/Zoom Out buttons to digitize the interested layers.

![Image](image_url)

**Figure 7:** Prepared the data for digitizing

After digitized all the polygons for a particular layer, went to the editor tool bar and clicked on save edits to save the edits polygons. After saving our edits, we clicked on stop editing. The group repeated the same procedures to all the layers.

3. **Topology:** In Geodatabase, the arrangement that constrains how point, line, and polygon features share geometry, for instance, street centerlines and census blocks share geometry, and adjacent soil polygons share geometry. Topology defines and enforces data integrity rules (for example, there should be no gaps between polygons). It supports topological relationship queries and navigation (for example, navigating feature adjacency or connectivity), supports sophisticated editing tools, and allows feature construction from unstructured geometry (for example, constructing polygons from lines).

Furthermore, topology is the modern version of geometry, the study of all different sorts of spaces. The thing that distinguishes different kinds of geometry from each other (including topology here as a kind of geometry) is in the kinds of transformations that are allowed before you really consider something changed.

When editing a digitized map, it is common to have features that share boundaries. Editing with topology reduced the chance of introducing inadvertent gaps or overlaps between features that share geometry. The group created a simple topology in ArcCatalog by clicking on feature datasets within the personal Geodatabase and pointing new with topology. The following print screens are primary data source and show the procedures that were following by the group.
Figure 8: Prepared the data for topology cleaning

Figure 9: All errors highlighted as figure above
4. Results: Isodose mapping

The term isodose relating to points or zones in a medium that receive equal doses of radiation or dose of radiation applied to a part that is equal to the dose applied to a different part. An isodose map was produced to represent exposure rate from natural sources of terrestrial gamma radiation (M.S.M. Sanusi et al., 2014). Isodose mapping also use for mapping the soil deposition density data using dose conversion coefficients from soil deposition density to the annual additional effective dose data. (Ryugo Hayano and Makoto Miyazaki, 2018). Regarding to Siak Kuan Lee et al., (2009), the evaluation data of the radiological hazard of the natural radioactivity, the radium equivalent activity data, the gamma-absorbed dose rate and the mean population weighted dose rate were calculated. Then, to visualize all the data, an Isodose map for the Kinta District was produced.
4.1 Location of 145 gamma survey point map. TGRD rates were measured at 145 measuring points using a NaI [TI] micro roentgen survey meter held at one meter (1 m) above the ground. Measurements were recorded when the reading on the survey meter were stable with at least four set of reading taken from each point in order to minimize error. Gamma radiation detection due to cosmic
sources was negligible due to the low detector’s response to high energy cosmic gamma radiation. The instrument uses (2.54 x 2.54 cm²) sodium iodide (NaI) crystal doped with thallium (Tl). The gamma detector was calibrated at higher dose rates at the Malaysian Nuclear Agency.

The instrument uses (2.54 x 2.54 cm²) sodium iodide (NaI) crystal doped with thallium (Tl). The gamma detector was calibrated at higher dose rates at the Malaysian Nuclear Agency.

![Figure 13: Location of 145 gamma survey point map](image)

<table>
<thead>
<tr>
<th>District</th>
<th>External gamma radiation dose rates (nGy h⁻¹)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
</tr>
<tr>
<td>Besut</td>
<td>129</td>
</tr>
<tr>
<td>Dungun</td>
<td>143</td>
</tr>
<tr>
<td>Hulu Terengganu</td>
<td>189</td>
</tr>
<tr>
<td>Kemaman</td>
<td>141</td>
</tr>
<tr>
<td>Kuala Terengganu</td>
<td>154</td>
</tr>
<tr>
<td>Marang</td>
<td>125</td>
</tr>
<tr>
<td>Setiu</td>
<td>142</td>
</tr>
<tr>
<td>Terengganu State</td>
<td>150</td>
</tr>
</tbody>
</table>

*Figure 14: Mean TGRD rates from each district of the study area*

The higher mean TGRD rates values observed in these districts could be attributed to acid intrusive geological formation overlain by steep land and Haplic Acrisol (which has granite as their parent material) soil types. Hulu Terengganu district recorded the highest TGRD rates mean value of 189 nGy h⁻¹, this could be associated with the acid intrusive geological formation which was overlain by steep land soil type. These areas are igneous acidic and extensively intruded by granitic rocks, which relatively rich in radioactive minerals. The lowest mean gamma dose rates of 125 nGy h⁻¹ was recorded in the Quaternary (3) geological formation where as consists of marine and continental deposits with unconsolidated clay, silt, sand and gravel undifferentiated which was formed from continental and marine deposits with unconsolidated humic clay, peat and silt which was overlain by steep land soil type.
4.2 Overlay geological, soil types and site survey location of TGRD measurement. Isodose lines mapping and isodose map production use Radiological mapping of the study area was plotted using ARCGIS 9.3 software. The coordinates of each sampling point was converted into the degree decimal unit. The World Geodetic System of 1984 was used for definition of the coordination system.

![Figure 15: The gamma Isodose mapping](image)

5. Conclusion

Repetitive attempts were made and practiced the utilization of ArcGIS techniques for coordinate transformation, Georeferencing, establishing Geodatabase which enabled to store, manipulate, manage sets of feature classes and making on screen digitizing isodose maps to finally output both digitized geological and soil maps. The scanned geological and soil maps had many legends with explanations to represent and depict different geological time scales and soil types such as: Quaternary, Tertiary, Cretaceous-Jurassic, Triassic, Permian, Carboniferous, Devonian, Cambrian, sand deposits, sedimentary rocks, extrusive and intrusive rocks, and also different types of soils alluvial and sedentary soils etc. These lithological structures and soil types can be used as parameters to predict environmental radiation dose rates.

The group practiced many technical skills that were necessary for the conversion of paper map these technical processes include geometric corrections to be able to assign a coordinate system that associate the data with a specific location on earth, creation simple topological map for cleaning up the gaps between two adjacent polygons. However, human resources and time were wisely managed by assigning a specific task for any two individuals and ample time was allocated for digitizing to achieve the prescribed goals.
References


M.S.M.Sanusi\textsuperscript{a}, A.T.Ramli\textsuperscript{a}, H.T.Gabdo\textsuperscript{ab}, N.N.Garba\textsuperscript{ab}, A.Heryanshah\textsuperscript{c}, H.Wagiran\textsuperscript{a}, M.N.Said\textsuperscript{d}. (2014). Isodose mapping of terrestrial gamma radiation dose rate of Selangor state, Kuala Lumpur and Putrajaya, Malaysia. Journal of Environmental Radioactivity. Volume 135, September 2014, Pages 67-74.


