Topographical Hill Shading Map Production Based TIANDITU (MAP WORLD)

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ABSTRACT:

TIANDITU (Map World) is the public version of National Platform for Common Geospatial Information Service, and the terrain service is an important channel for users on the platform. With the development of TIANDITU, topographical hill shading map production for providing and updating global terrain map on line becomes necessary for the characters of strong intuition, three-dimensional sense and aesthetic effect. As such, the terrain service of TIANDITU focuses on displaying the different scales of topographical data globally. And this paper mainly aims to research the method of topographical hill shading map production globally using DEM (Digital Elevation Model) data between the displaying scales about 1:140,000,000 to 1:4,000,000, corresponded the display level from 2 to 7 on TIANDITU website.

1. INTRODUCTION

Topographical hill shading map production for providing and updating global terrain map on TIANDITU (MAP WORLD) becomes necessary for enriching multi-resource data and multi-scale coverage. Compares with traditional topographical hill shading map, the map online for topographical hill shading map production requires the characters of stronger intuition, three-dimensional sense and aesthetic effect.

As a significant channel for users on TIANDITU, the terrain service of TIANDITU focuses on displaying the different scales of topographical data globally. And this paper mainly aims to research the method of topographical hill shading map production globally using DEM (Digital Elevation Model) data between the displaying scales about 1:140,000,000 to 1:4,000,000, corresponded the display level from 2 to 7 on TIANDITU website.

2. GENERAL DESIGN

2.1 Technology Design

The general design process involves DEM data preprocessing, hill shading map production, which includes adjust the azimuth, altitude (solar elevation angles) and Z factor, elevation classification, hypsometric tint, cache production, and data updating on line. From data processing to terrain service release on TIANDITU website, DEM hill shading map production and data displaying is the critical technologies to be solved. The whole design shows in Figure 1.

2.2 Data Source

The data SRTM (Shuttle Radar Topography Mission) 90m is selected as the DEM data source for global land part on TIANDITU which can better display the global land topographical relief and main mountain range in different scales (display level from 2 to 7 on the website),. And the coverage area shows in Figure 2. The coverage area can achieve 80% of the global land area, and the rest part will use other DEM data as a supplement. The other DEM data using on the website are also important for this research, because it involves data merging and whole display effect with SRTM 90m.

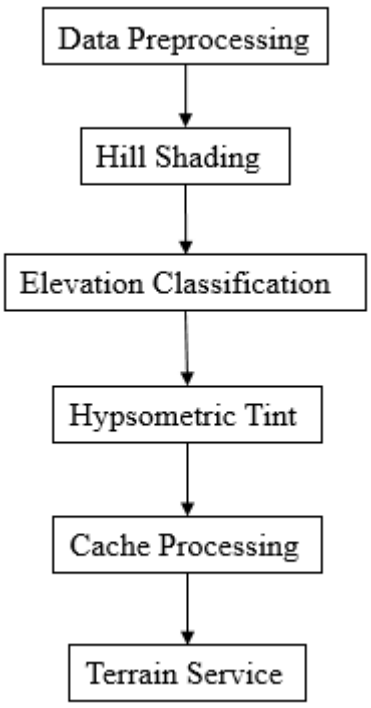

Figure 1. General design for topographical hill shading map

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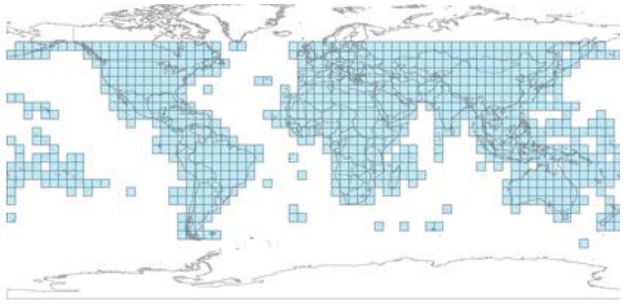


Figure 2. SRTM 90m coverage area used on TIANDITU

3. KEY TECHNOLOGY

The methods for hill shading and hypsometric tint are the key technology for the topographical hill shading map on TIANDITU.

3.1 Hill Shading

The hill shading is a grayscale 3D representation of the land surface, with the sun’s relative position taken into account for shading the image. The Figure 3 shows the satellite image and the original terrain data of the sample research area data.

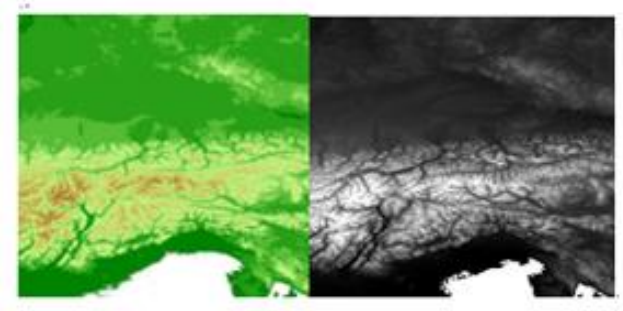
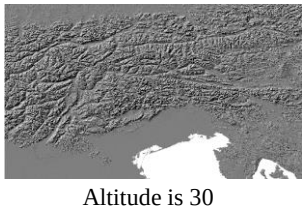


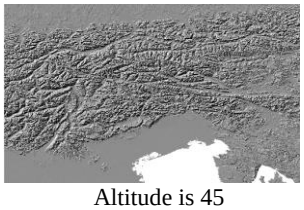
Figure 3 Satellite image and original terrian data

To realize the best display effect of the general map, appropriate azimuth, altitude, and the Z factor should be decided for optimization. Therefore the optimization for the three factors is significant for displaying effect. In this paper, mountain area is selected to be the research area to illustrate the importance of the three factors for hill shading, however, the ultimate optimization should consider the global effect which combines with global terrain changes and other DEM sources.

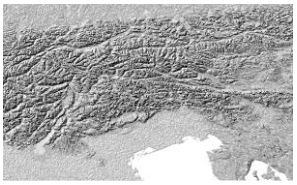
The different altitude can lead to different shading effect via controlling variable, for instance, the smaller altitude would lead to more lost for details and the bigger altitude would lead to the brighter image and slope contract would lead to decrease, if the other two factors is invariable. Generally, when the altitude is between 45 degree and 50 degree, the map will achieve better hill shading effect. So Figure 4 shows the different hill shading effect with different altitude when the azimuth and Z factor are constant.



Altitude is 30



Altitude is 45

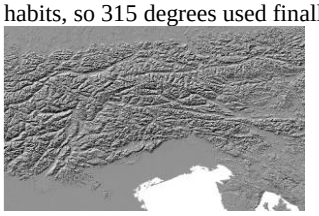


Altitude is 55

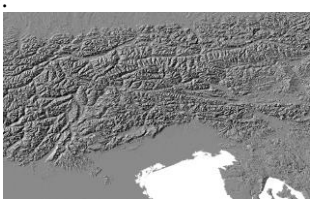
Altitude is 65

Figure 4. Hill shading effect with different altitude

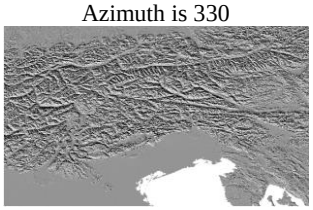
Also, the optimization for azimuth should consider and adjust the people’s visual habits. In general, the sunlight from northwest meets the people’s visual habits relatively, on the other hand, the sunlight from southwest will lead to anti-3dimension effects (high elevation shows lower, and low elevation shows higher). Hence, the hill shading map choose the sunlight from northwest, and the certain angle will take into account to the overall global mountain range and topographic features. When the azimuth are between 300 degrees to 330 degrees, the hill shading effect will meet the people’s visual habits, so 315 degrees used finally.



Azimuth is 330



Azimuth is 300



Azimuth is 200

Azimuth is 145

Figure 5.Hill shading effect with different azimuth

As well as, the Z factor, that is to convert the elevation units to horizontal coordinated units of the dataset and to add vertical exaggeration for visual effect, changes as the different scales in TIANDITU and the SRTM 90m data.

For the SRTM 90m and the display scale level 2 to 7 (about 1:140,000,000 to 1:4,000,000), the Z factor on the website select to be 0.00001.

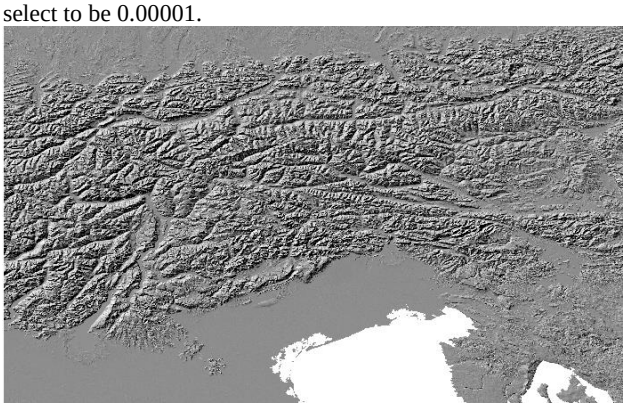


Figure 6. Sahding effect of certain Z factor

To determine the proper azimuth, altitude and the Z factor, the research also details some different shading effect simultaneously, such as the shading effect with different azimuth, the shading effect with different and the shading effect with different Z factor. Though some researches indicate the

three factors for creating hill shading map, the exact value used on TIANDITU are not included in research, and the research just provide range for the real technological plan. Because the merging effect with other data and the global should be considered. Figure 7 shows the effect with ultimate value of three factors on website.

Figure7. Effect with ultimate values of three factors on website

3.2 Elevation Classification

The elevation classification should be enough to revealing the terrain change all over the world, in that the classification should consider the various DEM data in each level on TIANDITU. So the elevation be classified into 46 levels on TIANDITU website

3.3 Hypsometric Tint

The layered colour used in this topographical map production to make the map presentation clearly and intuitively. For TIANDITU’s topographic map (web map), the elevation divides into 46 layers, and each layers attach different RGB level. Thus six different colour schemes indicate the certain land elevation level. Figure 8 shows the large area effect after hypsometric tint and Figure 9 shows effect of the some details after hypsometric tint.

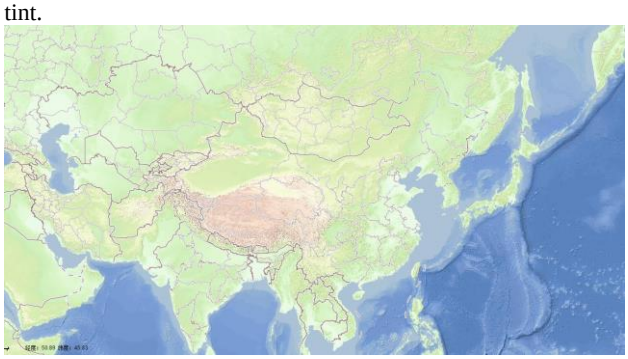


Figure 8. Effect of hypsometric tint for large area

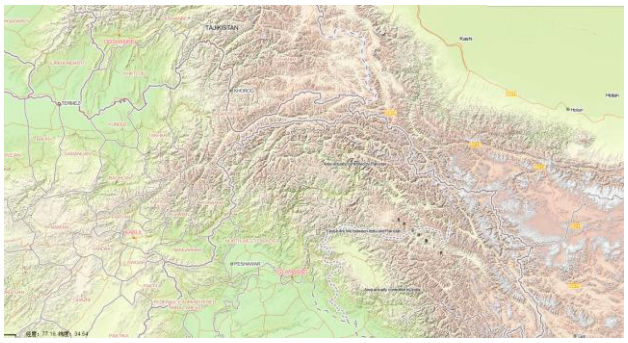


Figure9. Effect of hypsometric tint for details

3.4 Cache Processing

In order to call the terrain service and ensure the scan speed on website, the final effect DEM data should process into tile cache, and then launce via website. A cached map service is a collection of prerendered map tiles that can be used for display of a map service, which can support multiscale maps. It does this by creating a multiscale image map for the map at a specified series of map scales. So the data processes into tile cache, and launces via website. In conclusion, the method of hill shading production has applied in TIANDITU for different scales at display level from 1 to 14 (display scale between about 1:300,000,000 to 1:36,000) , not only used in SRTM 90m hill shading map, and rich the terrain cover area on TIANDITU dramatically. Figure 10 shows the effect of tile cache on website.

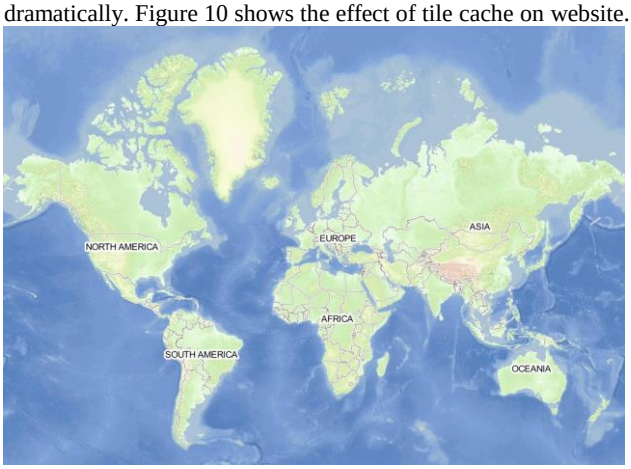


Figure 10. Effect of tile cache on website

4. CONCLUSION

The topographic hill shading map production is different from other hill shading production, especially the traditional topographic hill shading map, for the reason that the display effect should consider various factors. Different DEM data source and global display effect are the significant elements for the TIANDITU terrain service relatively. So the key methodology should adjust to the displaying scales about 1:140,000,000 to 1:4,000,000, corresponded the display level from 2 to 7 on TIANDITU website.

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