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A Dataset of Integrated Mountain Characteristic Elements in Liangshan Plateau Mountain

Hu, J. L.[1] Luo, M. L.[2, 3*] Tang, M. G.[4] Wei, L.[5] Yan, Z. H.[2] Qin, Z. H.[2]

1. School of Civil Engineering and Geomatics, Southwest Petroleum University, Chengdu 610500, China;
2. School of Land and Resources, China West Normal University, Nanchong 637002, China;
3. Sichuan Provincial Engineering Laboratory of Monitoring and Control for Soil Erosion on Dry Valleys, China West Normal University , Nanchong 637009, China
4. Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing 100101, China;
5. Yingjing Natural Resources and Planning Bureau, Ya'an 625200, China

Abstract: Plateau mountain is a large plateau with a large average height, vast area, complex structure. The Liangshan plateau mountain is one of the typical plateau mountain areas in China, located at the southwest edge of the Sichuan basin. This study produced a dataset of integrated mountain characteristic elements in Liangshan plateau mountain based on the SRTM3 DEM data with a resolution of 90 m. Firstly, the integration extraction method is used to identify the ridgelines and their grades and the corresponding mountain areas. Then, the results are validated and corrected using the fuzzy membership and Google Earth image data. This dataset consists of 5 parts: (1) the boundary of Liangshan plateau; (2) the mountain area data; (3) the ridgeline data; (4) the ridgeline data obtained by using the fuzzy membership; (5) the contour data with a contour interval of 100 m. The dataset is archived in .shp, .tif, and .txt formats and is composed of 55 data files, with a data size of 29.6 MB (compressed into one file, 14.9 MB).

Keywords: mountain characteristic element; ridgeline; Liangshan plateau mountain

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2021.10.09.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2021.10.09.V1.

1 Introduction

Mountains are one of the essential topographies that influence climate and the geographical distribution of flora and fauna[1,2]. Mountain characteristic elements characterize mountain topography and undulations, which are the important indicators to describe regional

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***Corresponding Author:** Luo, M. L., School of Land and Resources, China West Normal University, lolean586@163.com

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geomorphological features[3,4]. In recent years, the extraction and analysis of characteristic elements have become one of the research hotspots in Digital Terrain Analysis. However, current researches focus on the extraction and analysis of single characteristic elements, such as mountain peaks[5–7] or feature lines[8–10], while there is a lack of relation between these characteristic elements. Hu *et al*. proposed an integration extraction method of mountain characteristic elements[11], which extracting the mountain areas and the mountain characteristic elements based on the DEM data simultaneously. The obtained mountain areas are complete, and the mountain characteristic elements are well coupled, which is consistent with geomorphological cognition.

Plateau mountain is a large plateau with a large average height, vast area, complex structure. It includes mountains, plateaus and intermountain basins, etc., forming a complicated complex[12]. The Liangshan plateau mountain is one of the typical plateau mountain areas in China, located in the southwest edge of the Sichuan basin. It extends from the Dadu river in the north to the Puxiong river, the Niger river, the Mandan river, and the Niuri river in the west and is bounded by the Jinsha river valley in the southeast, covering an area of nearly 9,000 km^2. It is a typical mountainous area because of its fragmented surface cut, undulating topography, and steep slopes. This dataset is based on the integration extraction method proposed by Hu *et al*.[11] to obtain the mountain characteristic elements of the Liangshan plateau mountain. On this basis, we got nine main ridgelines after post-processing and manual correction. The dataset results can reflect the overall geomorphological structure of the region, and the division of mountains conforms to the geomorphology recognition. Meanwhile, the characteristic elements' structure is consistent with the affiliation structure, and the coupling relationship between them is great. The dataset can assist in the geomorphological classification and zoning of the Liangshan plateau mountain, and helpful attempts have been made to the mountain characteristic element extraction and geomorphological zoning.

2 Metadata of the Dataset

The metadata of the Dataset of mountain characteristic elements in Liangshan mountain[13] is summarized in Table 1. It includes the dataset full name, short name, authors, year of the dataset, temporal resolution, spatial resolution, data format, data size, data files, data publisher, and data sharing policy, etc.

3 Data Development Method

This dataset is produced based on the SRTM3 DEM surveyed by the U.S. Space Shuttle radar. The DEM data was collected in February 2000, and the processed spatial resolution was three arc seconds (approximately 90 m near the equator). This study uses the SRTM3 data provided by the Geospatial Data Cloud[1] with the original data in the WGS84 coordinate system. In this study, the data is projected into the WGS_1984_ Lambert_ Conformal_Conic coordinate system, and the resolution is resampled to 90 m.

3.1 Method Principle

This dataset is based on the integration extraction method proposed by Hu *et al*.[11] to obtain the mountain characteristic elements of the Liangshan plateau mountain. The main process includes that: (1) extraction of peaks and the corresponding control areas by natural terrain

[1] Geospatial Data Cloud [OL]. http://www.gscloud.cn/.

segmentation; (2) ridgeline extraction by watershed boundary filtering; (3) the membership degree W calculation for each ridgeline; (4) ridgeline level coding at all levels; (5) coupling of peaks, ridgelines, and peak control areas. Among them, the membership degree W is determined by Equation (1):

$$W = (AE - AD)^{(1-AS/90)} \quad (1)$$

where *AS* denotes the average slope, *AE* denotes the average elevation, and *AD* represents the average deviation. In addition, the fuzzy membership[16] is used for the main ridgeline identification to verify the mountain characteristic elements.

Table 1 Metadata summary of the Dataset of mountain characteristic elements in Liangshan mountain[13]

Items	Description
Dataset full name	Dataset of mountain characteristic elements in Liangshan mountain
Dataset short name	Ridgeline&MountainareaLiangshan
Authors	Hu, J. L. 0000-0002-8123-7282, School of Civil Engineering and Geomatics, Southwest Petroleum University, ltpai91@hotmail.com Luo, M. L., School of Land and Resources, China West Normal University, lolean586@163.com Tang, M. G., Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, baymintang@hotmail.com Wei, L., Yingjing Natural Resources and Planning Bureau, 1324265289@qq.com Yan, Z. H., School of Land and Resources, China West Normal University, 2327626923@qq.com Qin, Z. H., School of Land and Resources, China West Normal University, qinzihan2021@126.com
Geographical region	Liangshan plateau mountain
Year	2000
Spatial resolution	90 m
Data format	.shp, .tif, .txt
Data size	29.6 MB (14.9 MB after compression)
Data files	the boundary of Liangshan plateau mountain the mountain area data the ridgeline data the ridgeline data obtained by using the fuzzy membership the contours with 100m contour interval
Foundation	National Natural Science Foundation of China (41871324)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the *Digital Journal of Global Change Data Repository*), and publications (in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten percent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset[7]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

3.2 Implementation

The process of generating this dataset includes data preprocessing, mountain characteristic extraction, and data post-processing, and the main process is shown in Figure 1. Firstly, the data preprocessing consists of calibrating the original range of the Liangshan plateau, DEM data cropping, and raster reprojection. Then, the mountain characteristic extraction consists of mountain characteristic element extraction by the integration extraction method and the

main ridgeline identification by the fuzzy membership. Finally, the data post-processing contains a manual correction of characteristic elements, name calibration of the main ridgeline, and data integration. Among them, the manual correction is based on Google Earth Map, Google Earth Topographic Map, and experts' experience, its' main processes include that: (1) ridgeline alignment correction; (2) mountain boundary correction; (3) adjacent mountain without obvious division merging; (4) boundary correction of the Liangshan plateau mountain.

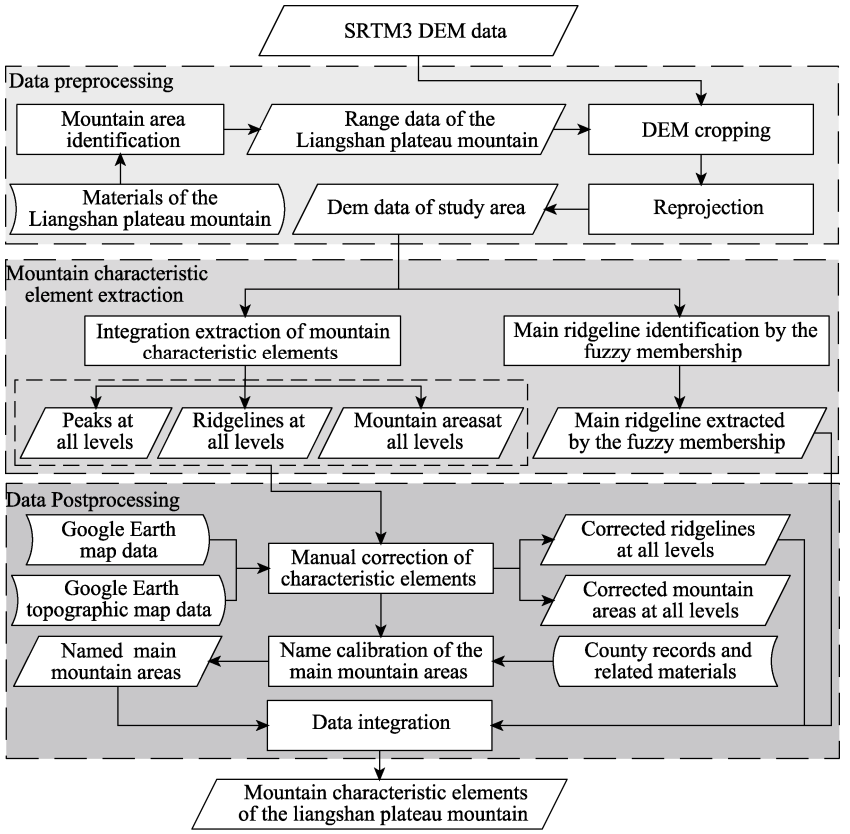

Figure 1 Flowchart of the dataset development

4 Data Results and Validation

4.1 Data Composition

The dataset consists of the Liangshan plateau mountain range data, the mountain area data, the ridgeline data, the ridgeline data obtained by the fuzzy membership, and the contour data with a contour interval of 100 m. The details are shown in Table 2.

4.2 Data Results

After manual correction, this dataset contains a total of 9 main mountain areas and 232 mountain areas at all levels; 9 main ridgelines and 1,849 ridgelines at all levels. The peaks at all levels are all eliminated because there is no known data for verification. The corrected mountain characteristic element data are shown in Figure 2.

Table 2 The composition files of the dataset of integrated mountain characteristic elements in Liangshan plateau mountain

Data name	Data format	Data type	Data size
The boundary of Liangshan plateau mountain	.shp	Vector	81.63 KB
The main mountain area data	.shp	Vector	226.42 KB
The mountain area data at all level	.shp	Vector	788.13 KB
The main ridgeline data	.shp	Vector	197.07 KB
The ridgeline data at all level	.shp	Vector	2.09 MB
The ridgeline data obtained by using the fuzzy membership	.tif	Raster	753.05 KB
The contours with an interval of 100 m	.shp	Vector	25.55 MB

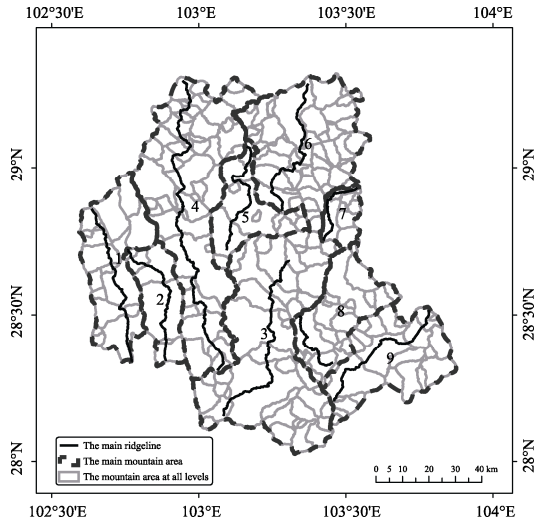

Figure 2 Corrected mountain characteristic elements

To further improve the data quality and facilitate the subsequent use of the data, the names of each main ridgeline were determined by the county records of Ganluo county, Meigu county, and Mabian county and related materials, and the results are shown in Table 3.

Table 3 The names of the main ridgeline of Liangshan plateau mountain

Number	Mountain name	Naming materials
1	Mountain in central Liangshan	County Record of Ganluo[17,18]
2	Mountain in central Liangshan, Amiteluo	County Record of Ganluo and Meigu[17–20]
3	Dafengding, Huangmaogeng, Lianzhaguoe, Jigongshan	County Record of Meigu and Mabian[19–21]
4	Tekehonghongshan	Materials of Ganluo[22]
5	Wahounenghe	Materials of Meigu[22]
6	Yaozishan, Dahuageng	Materials of Mabian[22]
7	Laisigang, Dayougang	County Record of Mabian[21]
8	Maniegu, Chatiaoshan	County Record of Mabian[21]
9	Mamizhe	County Record of Mabian[21]

Note: Local county records, such as the county record of Ganlao, are obtained by consulting local county records.

4.3 Data Validation

The main mountain area and ridgeline data at all levels after data post-processing are shown in Figure 3. To verify the correctness of the mountain area boundary and ridgeline orientation, three sample areas were selected and overlaid with Google Earth Map and Google Earth Topographic Map data (Figure 4).

It can be seen from Figure 4 that: (1) the ridgeline data of the dataset match well with the

ridgeline data extracted by the fuzzy membership while the main ridgelines of the two basically overlap, and good results are achieved in the areas where the ridgeline is not extracted by the fuzzy membership; (2) the ridgelines and mountain area boundaries are consistent with geomorphological while they are mostly located on the ridges or in the valleys indicated by the contours, and they mostly intersect vertically with the contours; (3) the ridgeline and mountain area boundaries are well superimposed with the optical images and terrain relief maps while they are mostly located on the top of the slope or in the roads and rivers shown in the images. To sum up, this data is consistent with geomorphological perception and highly accurate, which can meet the application and research needs.

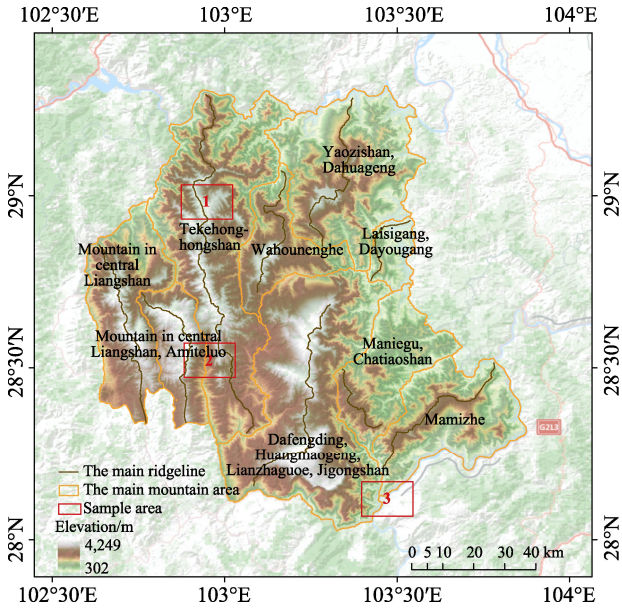

Figure 3 The named main ridgelines of the Liangshan plateau mountain

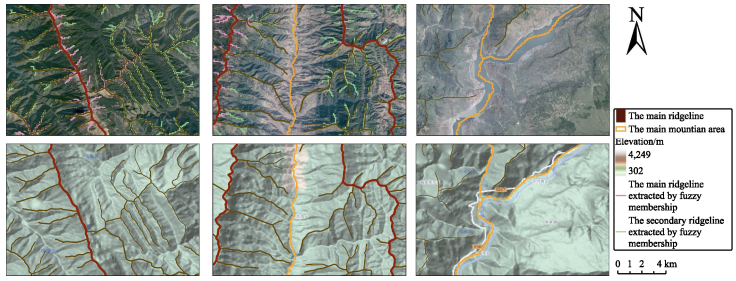

Figure 4 Overlay effect of the sample areas

5 Discussion and Conclusion

In this paper, the integration extraction method proposed by Hu *et al.*[11] is used to obtain the mountain characteristic elements of the Liangshan plateau mountain. Next, the mountain characteristic elements were validated with the ridgelines by the fuzzy membership and the contours. Finally, this data was manually corrected and named based on Google Earth Map, Google Earth Topographic Map data, county records, and other related materials. In the results of this dataset, the corrected ridgelines greatly match with the ridgelines extracted by the fuzzy membership, and they are mostly on the ridges. Meanwhile, the boundaries of the mountain are mostly within the rivers and valleys. The mountain characteristic elements are consistent

with the geomorphological cognition while their spatial location is correct, and the coupling is great. To sum up, this dataset reflects the overall topographic and terrain characteristics of the Liangshan plateau mountain. It can provide a reference for regional geomorphology classification, geographic planning, and other related applications and research.

Author Contributions

Luo, M. L. designed the algorithms of the dataset. Hu, J. L. implemented the algorithm and extracted the mountain characteristic elements. Tang, M. G., Wei, L., Yan, Z. H., and Qin, Z. H. did the data validation. Hu, J. L., and Luo, M. L. wrote the data paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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