A dataset of integrated mountain characteristic elements in Liangshan plateau mountain

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Abstract: 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 100m. 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, 14.9MB). The research paper based on the dataset was published in the Journal of Geo-Information Science (Vol 22, Issue 3, 2020).

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 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,

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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.

The Liangshan plateau mountain is 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 9000 square kilometers. 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 Dataset

The metadata of the integrated mountain characteristic elements in the Liangshan plateau mountain dataset ^[12] 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, *et al.*

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 90m near the equator). This study uses the SRTM3 data provided by the Geospatial Data Cloud¹ 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 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):

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

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

where AS denotes the average slope, AE denotes the average elevation, and AD represents the average deviation. In addition, the fuzzy membership ^[15] is used for the main ridgeline identification to verify the mountain characteristic elements.

Items	Description
Dataset full name	A dataset of integrated mountain characteristic elements in Liangshan plateau mountain
Dataset short name	Ridgeline&MountainareaLiangshan
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0 1 1	qinzihan2021@126.com
Geographical region	Liangshan plateau mountain
Year	2000
Temporal resolution	-
Spatial resolution	90m
Data format	.shp, .tif, and .txt
Data size	29.6MB (14.9MB after compression)
	the boundary of Liangshan plateau mountain
D (C1	the mountain area data
Data files	the ridgeline data obtained by using the fuzzy membership
	the contours with 100m contour interval
Foundation(s)	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
	<i>Data</i> 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
Data sharing policy	use Data subject to citation; (3) Users, who are by definition also value-added service providers,
	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, DCI, CSCD, WDS/ISC, GEOSS, China GEOSS, Crossref

 Table 1
 Metadata Summary of the integrated mountain characteristic elements in Liangshan plateau mountain dataset ^[12]

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 Fig. 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.



Fig. 1 Flowchart of the data development

4 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.

 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	81.63KB
the main mountain area data	.shp	Vector	226.42KB
the mountain area data at all level	.shp	Vector	788.13KB
the main ridgeline data	.shp	Vector	197.07KB
the ridgeline data at all level	.shp	Vector	2.09MB
the ridgeline data obtained by using the fuzzy membership	.tif	Raster	753.05KB
the contours with an interval of 100 m	.shp	Vector	25.55MB

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 1849 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 Fig. 2.



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.

NumberMountain nameNaming materials1Mountain in Central LiangshanCounty Record of Ganluo [16,17]2Mountain in Central Liangshan, AmiteluoCounty Record of Ganluo and Meigu [16-19]3Dafengding, Huangmaogeng, Lianzhaguoe, Jigong ShanCounty Record of Meigu and Mabian [18-20]4Tekehonghong Shanmaterials of Ganluo [21]

materials of Meigu^[21] materials of Mabian^[21]

County Record of Mabian^[20]

County Record of Mabian^[20]

County Record of Mabian^[20]

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

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

4.3 Data Validation

Wahounenghe

Mamizhe

Yaozi Shan, Dahuageng

Maniegu, Chatiao Shan

Laisi Gang and Dayou Gang

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6

7

8

9

The main mountain area and ridgeline data at all levels after data post-processing are shown in Fig. 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 (Fig. 4).



Fig. 4 Overlay effect of the sample areas

It can be seen from Fig. 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.

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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