Development of Spatial Distribution Dataset of Buildings in Haibei Prefecture, Qinghai Province (2020)

Ma, M. F.[1] Liu, F. G.[1,2*] Zhou, Q.[1,2] Che, Q.[1,2] MA, X. Y.[3] Gao, Y.[1] Chen, Y. M.[1] Gao, H. X.[1] Ding, Y. H.[1]

1. School of Geographical Sciences, Qinghai Normal University, Xining 810008, China;
2. Academy of Plateau Science and Sustainability, Xining 810008, China;
3. Hualong Qunke New Area Middle School, Haidong 810900, China;

Abstract: Haibei Tibetan autonomous prefecture (hereinafter referred to as Haibei prefecture) is located in the northeastern part of Qinghai province, and is one of the regions where more earthquakes occur in Qinghai province, Among them, Menyuan has been the site of several major earthquakes, the most recent of which occurred on January 8, 2022 with a magnitude of 6.9 in Menyuan. In earthquakes, there is a lack of data on buildings as one of the most important substrates of disaster-bearing bodies.Based on AI Earth platform of Ali cloud and ESA's 10-m resolution land use data, the buildings within the counties of Haibei prefecture were extracted by using the 0.6 m high resolution image of July 2020 and combined with the construction land use data in the land use. Finally, the spatial distribution dataset of regional buildings in Haibei prefecture (2020) was obtained, including building data of Qilian county, Menyuan county, Guncha county and Haiyan county. The dataset is archived in .shp format with data size of 9.18 MB (compressed into 1 file, 3.55 MB in total).

Keywords: Haibei prefecture; Qinghai province; building; spatial distribution; 2020

DOI: https://doi.org/10.3974/geodp. 2022.04.15

CSTR: https://cstr.escience.org.cn/CSTR:20146.14.2022.04.15

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.2021.11.01.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2022.11.01.V1.

1 Introduction

Earthquake disasters are characterized by high suddenness, destructiveness and uncertainty. Directly affecting human life safety issues, about 60% of global land-based destructive

Received: 01-11-2022; **Accepted:** 18-12-2022; **Published:** 24-12-2022

Foundation: Ministry of Science and Technology of P. R. China (2019QZKK0906)

***Corresponding Author:** Liu, F. G., Qinghai Normal University, lfg_918@163.com

Data Citation: [1] Ma, M. F., Liu, F. G., Zhou, Q., *et al*. Development of spatial distribution dataset of buildings in Haibei prefecture, Qinghai province (2020) [J]. *Journal of Global Change Data & Discovery*, 2022, 6(4): 638–644. https://doi.org/10.3974/geodp.2022.04.15. https://cstr.escience.org.cn/CSTR:20146.14.2022.04.15.

[2] Ma, M. F., Liu, F. G., Zhou, Q., *et al*. Spatial distribution dataset of buildings in Haibei, Qinghai of China (2020) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2022. https://doi.org/10.3974/geodb.2022.11.01.V1. https://cstr.escience.org.cn/CSTR:20146.11.2022.11.01.V1.

seismic hazards occur in the Mediterranean-Himalayan seismic zone[1], Earthquakes occur frequently in the northeastern region of Qinghai province, and Haibei prefecture is one of the more frequent regions in Qinghai province, On January 21, 2016, a 6.4 magnitude earthquake occurred in Menyuan county, Haibei prefecture, Qinghai province, with a depth of 10 km, various economic losses were estimated to reach 76 million yuan, 600 houses were damaged, and 9 people were injured. At 1:00 on January 8, 2022, a 6.9 magnitude earthquake occurred in Menyuan county, Haibei prefecture, with a depth of 10 km, in which 5,831 people from 1,662 households were affected, 4,052 houses were damaged, 3 bridges were damaged, 17 culverts were damaged, and drainage, heating and roads were damaged to varying degrees. On August 15, 2022, a 4.7 magnitude earthquake occurred in Qilian county, Haibei prefecture, Qinghai, with a depth of 8 km, and some houses and ecological environment were damaged to different degrees, where about 95% of the casualties in earthquakes are caused by building damage and collapse[2].

The total area of Haibei prefecture is 34,068.44 km^2, with a population of 265,300 people, the highest altitude is 5,287 m, the lowest altitude is 2,180 m, and the altitude of more than 3,000 m accounts for 85% of the state.There are river valleys, basins, hills, etc. The ecological environment of the region is relatively fragile. In 2017, the state established the Qilian Mountain National Park in Haibei prefecture, as one of the ten pilot national parks in China, which is of great significance for the regional ecological security barrier and water connotation, and can better protect the biodiversity and natural ecological environment of the Qilian Mountain region.

This paper obtains the spatial distribution of building contours and building footprint in the study area by using AI Earth platform and remote sensing images with high accuracy resolution, which requires high quality of remote sensing images in data processing and has time limitation in platform computing. Buildings, as one of the most important substrates of disaster-bearing bodies, are also important basic data for urban refinement management[3]. An accurate understanding of the spatial distribution of buildings is important for later exploring the social development, earthquake emergency response, disaster prevention and mitigation, and disaster assessment of the region.

2 Metadata of the Dataset

The metadata of the Spatial distribution dataset of buildings in Haibei, Qinghai of China (2020)[4] is summarized in Table 1.

3 Methods

3.1 Study Area and Data Sources

The study area of this paper is the Tibetan autonomous prefecture of Haibei prefecture, Qinghai province, which includes four counties, i.e., Menyuan, Qilian, Haiyan and Gangcha counties. It is located in the northeastern part (36°44′00″N–39°05′18″N, 98°5′00″E–102°41′03″E) of the Qinghai-Tibet Plateau and the western edge of the Loess Plateau and belongs to the continental climate of the plateau. Among them, Mengyuan

Table 1 Metadata summary of the Spatial distribution dataset of buildings in Haibei, Qinghai of China (2020)

Items	Description
Dataset full name	Spatial distribution dataset of buildings in Haibei, Qinghai of China (2020)
Dataset short name	BuildingHaibeiQinghai
Authors	Ma, M. F., Qinghai Normal University, 841880419@qq.com Liu, F. G., Qinghai Normal University, lfg_918@163.com Zhou, Q., Qinghai Normal University, 598416603@qq.com Che, Q., Qinghai Normal University, 872636400@qq.com Gao, Y., Qinghai Normal University, 2480216410@qq.com MA, X. Y., Hualong Qunke New Area Middle School, 935558381@qq.com Chen,Y. M., Qinghai Normal University, 15643198582@qq.com Gao, H. X., Qinghai Normal University, 3506422405@qq.com Ding, Y. H., Qinghai Normal University, 905087165@qq.com
Geographical region	Haibei prefecture, Qinghai province
Year	2020
Data format	.shp
Spatial resolution	10 m
Data size	3.55 MB (After compression)
Data files	.shp
Foundation	Ministry of Science and Technology of P. R. China (2019QZKK0906)
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 per cent 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 datase[5]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

county has experienced more frequent large earthquakes in recent years.

For the data, the 10-m resolution land use data was obtained from ESA, and the 0.6-m high resolution remote sensing image in July 2020 was obtained from Shuijingjing software platform, based on the data obtained from AI Earth platform and ArcGIS 10.7 software of AliCloud.

3.2 Technical Route

The technical route of this study consists of four parts: downloading remote sensing image data, data processing, importing into the platform and spatialization of buildings (Figure 1). Firstly, downloading the 0.6-m high precision remote sensing impact data of 2020 (selected to minimize clouds and fog, etc.) and the 10-m land use data of ESA 2020. Secondly, the downloaded data are processed and the regional construction land use data are obtained through the land use data, and then the processed data are typed into the platform for extraction. Finally, the spatial distribution dataset of buildings in Haibei prefecture is obtained by processing with ArcGIS 10.7 software.

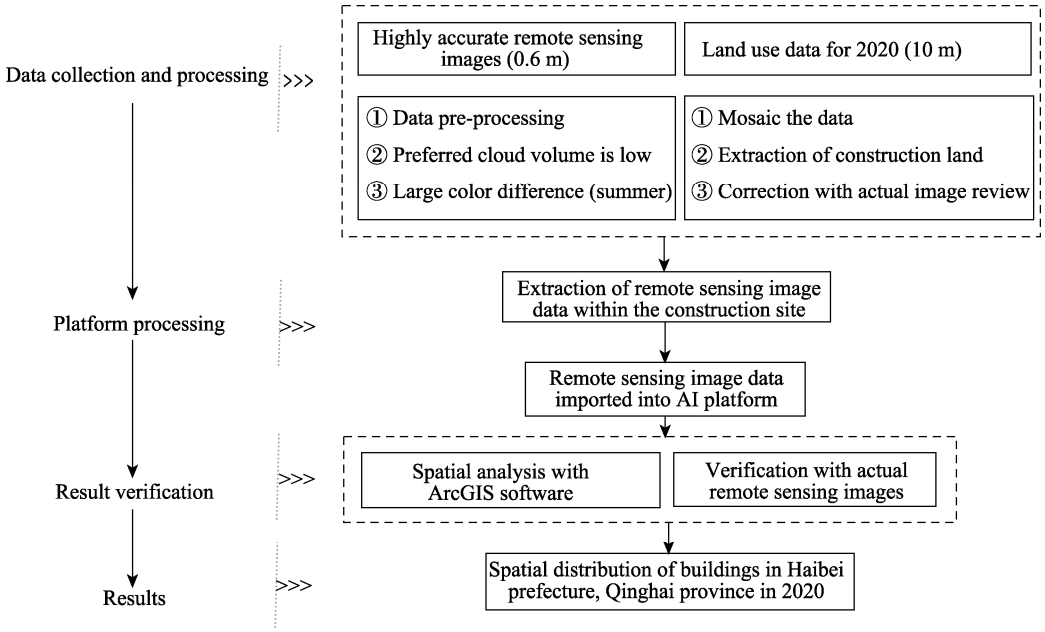

Figure 1 Technicalogy roadmap of the dataset development

4 Data Results and Validation

4.1 Data Results

The dataset of Haibei prefecture includes four counties of Haibei prefecture, including Menyuan county, Qilian county, Gangcha county and Haiyan county, etc. This data is dated July 2020, and the distribution area of the building distribution data is urban and rural in the study area, and the final result shipment file format (Figure 2).

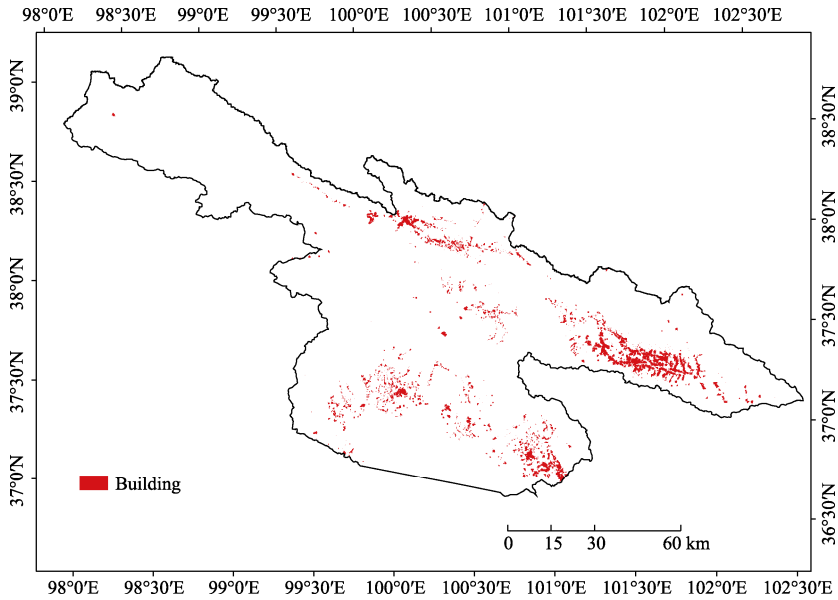

Figure 2 Spatial distribution map of buildings in Haibei prefecture, Qinghai province

The distribution of buildings in Haibei prefecture generally shows the spatial characteristics of dense east and sparse west, dense south and sparse north. Among the four counties in Haibei prefecture, Mengyuan county has the largest number of buildings, accounting for 55% of the total regional buildings, followed by Qilian county with 18.5%, Haiyan county with 15%, and Gangcha county with 11.5%. Population distribution Mengyuan county accounts for 52.3% of the state, followed by Qilian county with 18.3%, Haiyan county with 15.3% and Gangcha county with 14.1%, the number of buildings is basically the same compared to the data of the 7th census. The largest area is Qilian county, accounting for 40.6% of the state's land and only 18.3% of the population, due to Qilian county is mainly pastoralism, grass hills cover a large area and the establishment of the Qilian Mountains National Park, in order to ecological and biodiversity conservation, to limit human activities.

4.2 Data Validation

By comparing some areas arbitrarily selected with the original downloaded 0.6-m high precision remote sensing images, the accuracy of urban areas can reach more than 90%. Residential neighborhoods and office buildings in the city can be well identified, mainly because of the large building spacing and regular shape (Figure 3), while the identification is generally poor for irregular or obsolete houses in the city or in the suburbs (Figure 4). The accuracy of the rural area can reach 85%, for the agricultural area, mainly the rural areas in Haibei prefecture of Qinghai province are mainly inhabited by villages, which are relatively concentrated, which results in a small and irregular shape of household-to-household spacing and poor recognition (Figure 5). For pastoral areas, on the other hand, the house buildings are more scattered and each household is relatively independent, and the buildings are regular in shape and widely spaced, which are generally better identified but less numerous (Figure 6).

4.3 Exploration of Preliminary Classification of Building-Related Attributes

After completing the preparation of spatial distribution data of buildings in Haibei prefecture, attributes such as spatial location and area (one floor) of buildings were obtained, while for other attributes such as height, structure type, total building area and construction year could not be obtained. Therefore, through my participation in the Qinghai-Tibet second scientific research project, it was found that the difference between urban and rural buildings in northeastern Qinghai is obvious. In terms of height, rural areas are generally dominated by one story with a height of 3.5 m, while urban areas are generally dominated by two to five stories, with residential houses mainly dominated by five stories and stores mainly dominated by three stories with a height of 3 m. In terms of structure types, buildings before 2010 were mainly brick and mortar, while buildings after 2010 were mainly frame and rural houses were mainly brick and mortar. As far as the total building area is concerned, the area of the ground floor in rural areas is the total building area, while in urban areas the number of floors is obtained through the height of the storey, and the total building area can be obtained through the number of floors. The year of construction is obtained by means of field survey. The relevant attributes can be obtained by the above methods, but they are more time-consuming and laborious. In the next step, by means of remote sensing, combined with GDP, population and other data, we can try to get the height, structure type, area,

construction age and other attributes of buildings, which can provide strong support for regional rescue and disaster relief and disaster damage assessment.

Figure 3 Image comparison of urban building profiles

Figure 4 Image comparison of building profiles in the suburbs

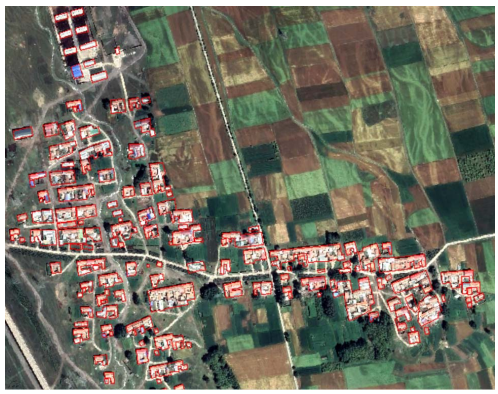

Figure 5 Image comparison of rural building contours

Figure 6 Image comparison of building outlines in pastoral areas

5 Discussion and Conclusion

5.1 Discussion

The spatial distribution of buildings in Haibei prefecture, Qinghai was obtained through AliCloud's AI Earth platform and land use data. However, in the process of data production, high-precision remote sensing images are required and the platform import requires data less than 5G, so the data production process takes a long time. Meanwhile, after this application of land use data, the effect is relatively good and can reduce the size of remote sensing images. However, after extracting the buildings within the counties of Haibei prefecture, it is found that the buildings are much dense in rural gathering areas or urban suburbs, and there are contiguous buildings, which makes it necessary to manually review and correct the data subsequently, so as to improve the accuracy of the data.

5.2 Conclusion

Through this method, the spatial data of buildings in each county of Qinghai Haibei prefecture in 2020 was obtained. When natural disasters such as earthquakes, floods and mudslides occur, the data accuracy is relatively good for buildings in the city, which can be used for reference, and the buildings in the suburbs are relatively poor, which can reflect the number of dwellings and other related information through the density as well. The accuracy of rural areas is relatively low, where the accuracy of pastoral areas is high, then it can be used, while agricultural areas can be used due to poor centralized identification, which can be reflected by density and other methods. This dataset provides basic data for the local government's timely emergency plan, and at the same time, the building, as one of the most important disaster-bearing base, can improve help for subsequent disaster damage assessment, prevention and mitigation in a timely and accurate manner.

Author Contributions

Liu, F. G., Zhou, Q. designed the algorithms of dataset. Ma, M. F. collected and processed the remote sensing image data; Ma, M. F., Chen, Y. M., Gao, H. X., and Ding, Y. H. collected and compared the methods; Chen, Q. and Gao, Y. did the data validation; Ma, M. F., and Ma, X. Y. wrote the data paper, etc.

Conflicts of Interest

The authors declare no conflicts of interest.

References

[1] Hu, S. K., Shi, P. J. Spatial and temporal characteristics of global land-based destructive earthquakes in terms of human casualties and their contribution rates from 1970–2019 [J]. *Disaster Science*, 2021, 36(4): 163–167, 174.

[2] Sun, B. T., Zhang, G. X. Study on the distribution of seismic hazard risk of buildings in mainland China [J]. *Journal of Civil Engineerin*g, 2017, 50(9): 1–7.

[3] Liu, Y. F., Lu, B. R., Peng, L., *et al*. Training samples dataset of building identification in urban village [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2020. https://doi.org/10.3974/geodb.2020.02.16.V1. https://cstr.escience.org.cn/CSTR:20146.11.2020.02.16.V1.

[4] Ma, M. F., Liu, F. G., Zhou, Q., *et al*. Spatial distribution dataset of buildings in Haibei prefecture, Qinghai province (2020) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2022. https://doi.org/10.3974/geodb.2022.22.01.V1. https://cstr.escience.org.cn/CSTR:20146.11.2022.11.01.V1.

[5] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. https://doi.org/10.3974/dp.policy.2014.05 (Updated 2017).