

Yearly Winter Cold Index Dataset in Southern China during the Last 300 Years (1710–2009)

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Abstract: Based on the features of records in historical documents (Yu-Xue-Fen-Cun Archives—the Rain and Snow Measurement Archives of the Qing Dynasty, collections from local gazettes, and other historical data) and characteristics of winter climate analysis by meteorological observations in Southern China (including Guangdong, Guangxi, Fujian, Hainan, etc.), methods for standardizing the winter cold index were established to build the yearly winter cold index dataset in Southern China during the last 300 years (1710–2009), with an index 1 for cool, 2 for cold, 3 for very cold, and 4 for especially cold, according to the locations for events of frost, snow and freezing. Results showed that the winters in the majority of years (145 years out of 300) were cold, accounting for 48.33% of the total, 98 years of winters (32.67%) were very cold, 50 years of winters (16.67%) were cool, and seven years of winters (2.33%) were especially cold. This dataset is archived in .xlsx format with a volume of 13.7 KB.

Keywords: Southern China; winter cold index; 1710–2009

1 Introduction

Climate-change research tracing back to before the current century not only has considerable importance for predicting future climate change but also plays a positive role in analysis of the characteristics of current climate change at longer time scales^[1]. The yearly winter cold index dataset in Southern China during the last 300 years (1710–2009) is a quantitative result of collecting data of winter cold and warm climate changes during historical periods in Southern China, more specifically the southernmost part of China, including Guangdong, Guangxi, Fujian, Hainan, Hong Kong, and Macao. Southern China is located at a prominent position affected by the East Asia monsoon, and has the features of an unbalanced spa-

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tion-temporal distribution of hydrothermal resources of spatial and temporal and multiple meteorological disasters, such as typhoons, rainstorms, droughts, cold waves, cold air, hailstorms, and gales. Such events affect agricultural production and economic and social development, since Southern China contains many ports where foreign exchange and international trade are conducted in light of the rapidly re-developing Chinese economy. In addition, it is the main agricultural zone for tropical and sub-tropical plants^[2–5]. Establishment of a long-term dataset of winter cold index in Southern China during the last 300 years (1710–2009) is not only beneficial to the study on the change of winter warm and cold patterns and to recognizing current temperature situations but also can provide empirical evidence and bases for predicting climate change, meteorological disasters, and the prognosis of agricultural and economic development.

2 Metadata of Dataset

The metadata of the yearly winter cold index dataset in South China during the last 300 years (1710–2009)^[6] is summarized in Table 1, including the dataset full name, short name, authors, years, data format, data size, data files, data publisher, and data sharing policy.

Table 1 Metadata summary of yearly winter cold index in south China during the last 300 years (1710–2009)

Items	Description
Dataset full name	Yearly winter cold index dataset in south China during the last 300 years (1710–2009)
Dataset short name	WinterColdIndexSouthChina_1710-2009
Authors	Ding, L. L. L-3300-2018, College of Resource Environment and Tourism, Hubei University of Arts and Science, lingling_ding@163.com Zheng, J. Y. M-5789-2015, Key Laboratory of Land Surface Pattern and Simulation, Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, zhengjy@igsnr.ac.cn
Geographical region	Guangdong, Guangxi, Fujian and Hainan, Hong Kong, and Macao
Years	1710–2009
Data format	.xlsx
	Data size 13.7 KB
Data files	Series of Annual Winter Cold Index from 1710 to 2009
Foundation(s)	National Natural Science Foundation of China (41601046, 41430528, 41630529)
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 (data products), and publications (in this case, in the <i>Journal of Global Change Data & Discovery</i>). 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]

3 Methods

3.1 Data Source

Two data sources were used to compile the index: historical documents and modern meteorological observations. Historical documents include the Yu-Xue-Fen-Cun Archives (i.e., the Rain and Snow Measurement Archives of the Qing Dynasty), collections from local gazettes,

and other historical data. Main data sources are listed in Table 2.

Table 2 Data sources for developing the yearly winter cold index dataset in Southern China during the last 300 years (1710–2009)

Items	Date from Yu-Xue-Fen-Cun achieves	Data from local gazettes and other historical data	Modern meteorological observations
Years	1735–1911	1710–2000	1951–2010
Temporal resolution	Daily	Yearly	Daily
Spatial resolution	Prefecture, state, and county	Province, city, and county	Meteorological stations
Record information	Snow	Frost, snow, and freezing	Temperature, frost, snow and freezing
Amount	1,499 records	1,237 records	61 stations
Reliability	High	High	With Quality control
Detailed information	Qing dynasty archives of memos sent to the Emperor, recording the rainfall infiltration depth in the ground and the depth of snowfall, measured in units of fen (length unit, ≈ 0.32 cm) and cun (≈ 3.20 cm); qualitative descriptions of weather conditions and other relevant information ^[8]	Collection of the Climate Records in China during the Three Thousand Years ^[9] China Meteorological Disaster Canon ^[10] New local gazettes of administrative districts in Southern China	Daily dataset of meteorological sites in China ^[11] Report of Monthly Surface Meteorological Records in China (1971–1996) ^[12–14] Book of Monthly Surface Meteorological Records in China (1997–2008) ^[15–16]

3.2 Data Collection and Processing

According to the features of the study data, methods for reconstructing a winter cold index were built by referring to the classification standard of winter temperatures in Southern China established previously^[2,4].

3.2.1 Cold and Warm Zones

Based on the winter isotherm, boundaries of climatic zones, terrain and records of conditions of frost, snow and freezing culled from the historical documents covering Southern China, ancient sites and modern meteorological stations were divided into three zones: the northern (zone I), middle (zone II), and southern parts (zone III) of Southern China, as shown in Figure 1^[17]. There are 244 stations in the three aforementioned zones, with 124 stations in the middle part of Southern China, accounting for 50.8% of the total, 107 stations (43.9%) in the northern part of Southern China, and 13 (5.3%) in the southern part of Southern China^[17].

3.2.2 Classification Standards for Winter Cold Index

The winter cold indexes were established as follows:

Index 1 (Cool): Light snow (less than 1 cun) or freezing occurred at a site in Zone I or frost occurred at a site in Zone II.

Index 2 (Cold): Heavy snow (more than 1 cun and less than 10 fen) or freezing of more than 1 cun occurred at a site in Zone I; light snow (less than 1 cun) or freezing occurred at a site in Zone II; frost occurred at a site in Zone III.

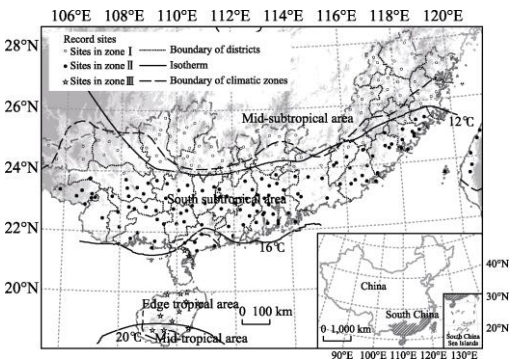


Figure 1 Geographical locations and features for cold and warm zones in South China

Index 3 (Very cold): Snow of more than 10 fens and less than 1 m occurred at a site in Zone I; heavy snow or freezing of more than 1 cun occurred at a site in Zone II; light snow (less than 1 cun) or freezing occurred at a site in Zone III.

Index 4 (Especially cold): Snow of more than 1 m occurred at a site in Zone I; snow of more than 10 fens and less than 1 m occurred at a site in Zone II; heavy snow or freezing of more than 1 cun occurred at a site in Zone III.

For years in which no records were available between 1710 and 1948, the winter cold index was defined as the average of established winter cold indexes during the five years before and after the year without records, since such an approach can minimize the impact of years having no records on an inter-decade analysis; the possibility of missing records in historical remote periods is higher compared with modern periods. However, for years with no records between 1949 and 2009, the winter cold index was defined as the minimum of established winter cold indexes during the five years before and after the year without a record, because records in this period were almost complete and fewer snowfall events were missed.

4 Results and Validation

4.1 Data Products

Annual winter cold index for Southern China from 1710 to 2009 was calculated, and the results are shown in Table 3, in which the year of 1710 is the winter of 1710. A total of 300 years of data were compiled, with the average value of 2.21 (approximately the level of “cold”).

Results showed that winters in a majority of years were cold, accounting for 48.33% of the total, while only a small part of winters were especially cold, accounting for 2.33% of the total. Counts and numbers for each level are listed in Table 4.

4.2 Data Validation

The data was validated by the winter cold index in Southern China and the Pearson correlation coefficient between the station instruments in the area. It is -0.23 of Pearson correlation coefficient between the winter cold index in Southern China from 1884 to 1990 and the monthly average temperature in Hong Kong.

Table 3 Annual winter cold index for Southern China (1710–2009)

Year	Winter cold index
1710	3
1711	2
1712	2
.....
1716	3
1717	3
.....
2008	1
2009	1

Table 4 Distribution of winter cold index levels in Southern China, 1710–2009

Winter cold index	Years	Percent (%)
Index 1	50	16.67
Index 2	145	48.33
Index 3	98	32.67
Index 4	7	2.33

5 Discussion and Conclusion

Compared with Northern China and other places, winter is much warm in Southern China, where historical records were relatively rough. However, with the southward invasion of the strong cold air, the winter temperature were also drop sharply, which had an important impact on the tropical and subtropical crops, and frost, as well as snowfall and freezing were recorded. The reconstruction of time series of winter cold index was established considering the characteristics of temperature distribution in Southern China, which was based on the

time series of temperature records in a larger area. The data reliability analysis shows that the winter cold index in Southern China can reflect cold and warm change in Southern China to a certain extent, but it is more of a reflection of extreme cold events.

Author Contributions

Zheng, J. Y. designed the algorithms of dataset. Ding, L. L. contributed to the data collection, data processing and analysis, and wrote the data paper.

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