

# The variation and distribution of snow cover in China

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**Abstract:** This paper presents the results of research and analysis with the satellite-derived snow data. It provides the main climatic characteristics of snow cover in China and shows the variation and distribution of snow in regions of Xinjiang, Inner Mongolia and Tibet plateau. The study reveals the vicissitude periods of winter snow cover in Tibetan Plateau by using wavelet analysis with the data from 1980 to 2001. It has about 10 years large period and 3-5 years small period. The analysis shows that the extension of snow increased in recent years in Xinjiang. The results of analysis prove the relationship between winter snow cover in Tibetan Plateau and next summer precipitation in the middle and lower reaches of the Yangtze River. They have good correlation.

**Keywords:** satellite, snow cover, variation, distribution

## 1. Introduction

Snow cover is an important resource of the Earth. It is a potential factor related to climate and global changes. On account of its high reflectance and low heat conductivity, the existence of snow cover can affect surface and air temperature, radiation balance, soil moisture and so on. It may have influence on the earth-atmosphere system. In order to understand the impact of snow cover on climate and hydrologic budgets, it is necessary to have variation and distribution of snow cover over China and surrounding areas.

The purpose of this study is to get the main climatic characteristics of snow cover in China with the satellite-derived snow data from both USA and China. Another purpose is to know the relationship

<sup>1</sup>between winter snow cover in Tibetan Plateau and next summer rainfall in the middle and lower reaches of the Yangtze River.

## 2. The data and its validation

Two kinds of satellite snow data have been used in this study, one is the weekly snow data from NESDIS/NOAA and another is 10 days snow cover data from NSMC/CMA. The snow data from NESDIS is a lower resolution data. The spatial resolution varies along with latitude is  $60 \text{ km}^2$  at the equator and  $120 \text{ km}^2$  on the North Pole. It is in polar stereographic projection. This data is produced by men-computer interactive to identify snow from satellite data. The data with different number represents snow, ice, land and ocean. Every data point has the exact area value with it. This is the only snow data set in such a long period from 1973-2002. The snow data from China was produced with multi-spectral thresholds test method from NOAA and FY-1C/1D satellite data. The resolution is 0.05 by 0.05 which is better than the data from NESDIS, but the time period is too short. It is only cover 6 years period from 1997-2003. Fig.1 is an example of the data. Snow is in white, it overlies on the normalize vegetation index(in green, light green or dark yellow color).

In order to calculate the distribution and variation

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of snow, we convert the weekly data to every 10 days, and to validate snow data against land surface observations from weather stations in China. Snow cover areas have been calculated for regions of Xinjiang, Inter Mongolia and Tibet plateau and to compare each other. Tendency of variation of snow data is quite similar. The correlation coefficient is about 0.78 between snow from NSMC and the ground observation reports. It is 0.68 for the snow data from NESDIS.

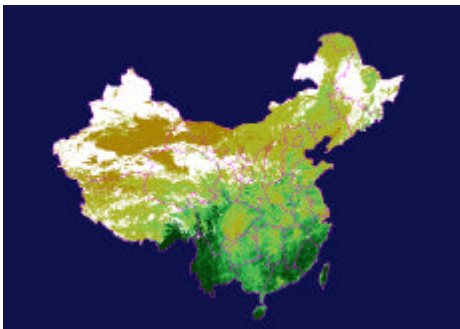


Fig.1 An example of snow cover data produced in

### 3. Main climatic characteristics of snow cover in China

#### 1) The Distribution of Snow cover in China

China is located in a seasonal snow cover region. Snow coverage increase from north to south during early winter, and reduce from south to north in spring. The distribution of snow cover is related to the weather system and climate changes year by year. Based on the statistic with 23-year snow cover and the conventional data in China, we classified the snow cover by the number of weeks covered with snow during the whole year. We found that there are four categories of snow cover in China, the permanent, the stable seasonal, the annual unstable seasonal, and non-annual unstable seasonal snow cover. Xinjiang, Inter Mongolia and Tibet plateau are three major snow cover regions in China during the winter season. The distribution of snow cover is quite different in this three regions. According to the statistics, it is mainly stable seasonal snow cover in

Xinjiang during the winter, and also permanent snow along the mountain of Tianshan. The snow cover type in Inter Mongolia is stable seasonal and annual unstable seasonal snow cover. The extent of snow is various each year. It is very complicated in the Tibet plateau. Four kinds of snow cover intertwine each other. The permanent snow cover distribute along the Ximalaya and other mountains. The distribution of snow coverage is different every year with other three kinds of snow cover.

#### 2) The Variation of Snow cover in China

The annual variation of snow cover is mainly caused by snowfall and temperature along with weather system. In this study, the snow coverage area was calculated. According to the statistic of 23 years snow cover, we found that annual variation of snow cover in Xinjiang, Inner Mongolian and Tibet plateau are quick different. Fig.2 is the monthly variation of snow cover from 1980 to 2003 in Xinjiang. The annual snow cover decreases from 1982 –1988 and increases from 1989-2003. Fig.3 is the Monthly anomaly of snow cover in Inter Mongolia. It has about 3 or 5 years variation period. It is very special in Tibet plateau: The most of Variation curves have two peaks(Fig. 4). Using wavelet analysis, the period of snow cover from 1980 to February 2003 was determined. Fig.5 shows the wavelet transform contour. The vicissitude periods of winter snow cover in Tibetan Plateau has about 10 years large period and 3-5 years small period.

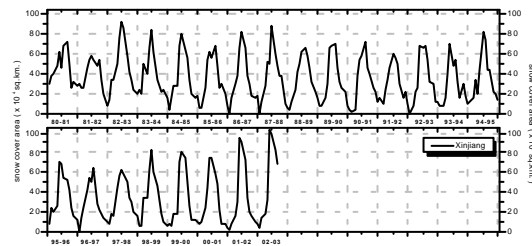


Fig.2 Monthly variation of snow cover in Xinjiang

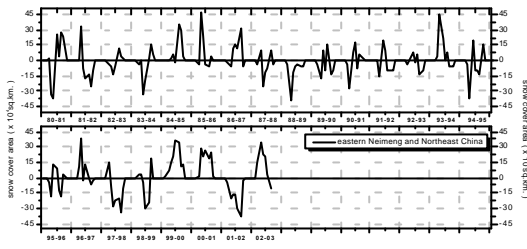


Fig.3 Monthly anomaly of snow cover in Inter Mongolia

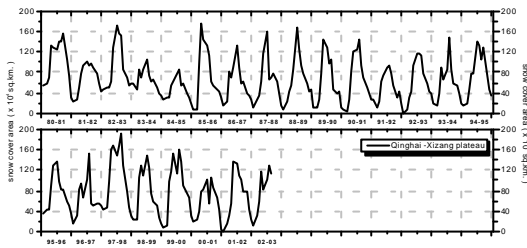


Fig.4 Monthly variation of snow cover in Tibetan plateau

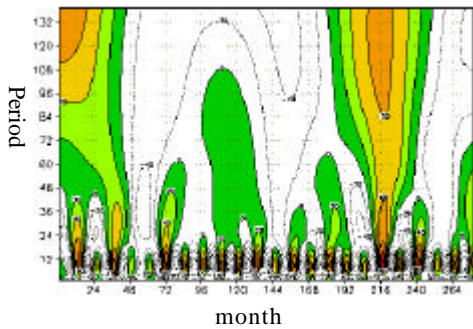


Fig.5 The wavelet analysis transform of winter snow in Tibetan Plateau

#### 4. The Impact of Snow cover in Tibetan Plateau

We calculated the correlation between winter snow in Tibetan Plateau and the next summer precipitation data from 160 main ground stations from 1980 to 2001 in China. Fig.6 shows the better correlation between winter snow cover in Tibetan plateau and next summer precipitation along the Yangtze River. The maximum correlation coefficient is 0.62.

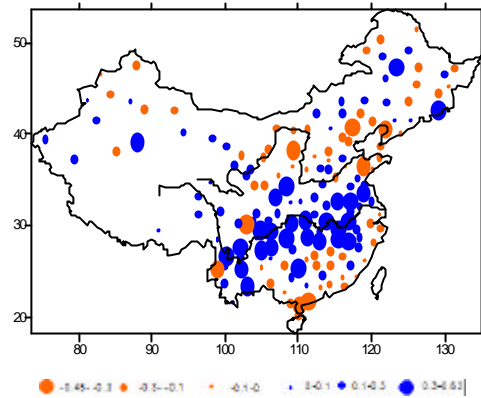


Fig 6.The correlation between winter snow cover in Tibetan plateau

#### 5. Conclusions

The results show us that satellite snow data is very useful in climate research. It provides the main climatic characteristics of snow cover in variation and distribution in China. It reveals the vicissitude periods of winter snow cover in Tibetan Plateau and shows the extension of snow increased in recent years in Xinjiang. The results prove the good correlation between winter snow cover in Tibetan and next summer rainfall in the middle and lower reaches of the Yangtze River.

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