

Patterns of first winter snowfall in Thimphu, Bhutan

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Car driving over Thrumshingla Pass, Bhutan, on a snowy day

Abstract

The first winter snowfall in Thimphu is of importance and interest to the Thimphu population for various reasons including anticipation of the national snow holiday, which occurs on the first snowfall day of each year. Only the first snowfall of the season is reported in the newspaper (Kuensel)—there are no other records of snowfall incidents in the country. The records reported in Kuensel and other sources from 1991 to 2014 were compiled to understand the trend in first snowfall date for Thimphu. For the years studied, the median

annual start date of snowfall in Thimphu was January 20th, with a range from December to March.

Keywords: First snowfall, Thimphu, Bhutan

Introduction

Every year, many people are excited about when Thimphu will receive its first snowfall. Whether it is a small child longing to play in the snow or a farmer wishing to have his field snowed on or a government employee expecting the “first

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snowfall holiday” it boils down to when and how much snow there is.

Snow is a mixture of ice, water and air and forms from crystallization of ice particles in the atmosphere during precipitation. Snow originates in clouds when temperatures are below freezing point (Armstrong & Brun 2008). Globally the total volume of snow is small at only 2000–3000 km³, but its aerial coverage is very large with 47,000,000 km² of area receiving seasonal snow in about 95 countries (Valisuo 2014). Snow occurs at high latitudes and altitudes.

Besides being just a pure clean white substance to look at, there are many other reasons why studying and understanding snow is important. Snow is a very good reflector and has an important role to play in albedo feedback. When there is more snow cover, more sunlight is reflected back and the area is kept cool. If the snow cover area decreases, more dark ground areas are exposed to sunlight, leading to greater absorption of sunlight and consequent heating of the surroundings. Thus, decreasing snow cover leads to higher temperatures and global warming.

Good snowfall and hydrological flows are directly proportional to the water availability downstream for many purposes such as drinking water, agriculture and industry (Watson 2012). As an important source of national income hydropower energy generation in Bhutan is also helped by good and timely snowfall (Kuensel 2013).

Snow cover acts as a thermal blanket on the ground and helps maintain the ground temperature due to its low thermal conductivity, which then protects crops from subfreezing winters (Armstrong & Brun 2008). Snowmelt also replenishes the soil moisture in the dry winter months, impacting vegetation growth including crops. Snowmelt water increases root growth of winter crops such as wheat. Ground that is covered by snow cover or snowmelt is heavier and protected from being blown away by wind erosion, thus leading to better crop productivity (Watson 2012). When there is

snowmelt and sublimation, surroundings are cooled by the absorption of heat.

While Bhutanese simply play with snowballs, build snowmen and do snow sledding, winter sports such as skiing, snowmobiling and snow boarding are major global sports creating hundreds of thousands of jobs. In the United Kingdom alone, the snow sports industry has over 1.4 million people taking part in some form and over 12,000 people working within the industry, with an estimated turnover of about £1 billion per year (The Snowsports Experts 2014).

On the other hand, snow is also a cause of disasters and inconvenience to people. Hundreds of people are stranded on highways in Bhutan every year due to snow blocks on the high pass (Kuensel 2014). Snow avalanches and other snow induced disasters can also be life threatening. Heavy snowfall during inappropriate times can cause damage to livestock and agriculture across the globe (Xinhua 2013).

Hitherto, there has been no formal process of recording the snowfall days in Bhutan and in particular the annual start of snow. An initiative has thus been implemented by the Snow and Glacier Division of the Department of Hydro-Met Services, Bhutan, to compile information about snowfall. Past records from newspapers, television and the Internet were used to collate information on historical first snowfall days. The objective of this short communication is to provide information on the first snowfall days in Thimphu, for better understanding by the Bhutanese society.

Methods

Information on snowfall events in Thimphu and its vicinity, as reported in newspapers, television and the Internet, were used to determine the start of snowfall each year in Thimphu. When there were no recorded incidents of snow for a year, we assumed in this research that snowfall occurred, but it might have occurred during the night and was not

recorded, or that we were not able to trace the record.

The first snowfall day information recorded for the last 24 years (1991–2014) was used for the analysis. July 1st was considered as the first day of the year for the analysis so that December and January are consecutive months for better understanding.

Results

Based on the data available from various sources, over the last 24 years (1991–2014) Thimphu typically received its first snowfall in the month of January (62.5% of years, i.e. 15/24 observations; Fig. 1). The median start date of snowfall in Thimphu was January 20th. No particular dates were repeated consistently for first snowfall. However, there were also years when the snow first fell very early in December (1992 and 2009), late in February (2000 and 2007), or even very late in March (1998). For the years surveyed, the first snowfall always occurred between December and March (Figs. 1 and 2). The snow thicknesses were about 1–2 cm for the first snowfall (Figs. 3 and 4). There were no

recorded incidents of snow in Thimphu for four years of this study: 1999, 2001, 2006 and 2010.

The snowfall data were compared with the Climate Reanalyzer data from the University of Maine (<http://cci-reanalyzer.org>). The most sensible result was from MERRA ERA-Interim data for Bhutan’s area for Annual Accumulated Snow (Land Areas). It has been found that there was a very low annual accumulation of snow for 1998, 1999, 2001, 2006 and 2010. For four of these five years we had not been able to obtain record of a first snowfall (Fig. 5).

Conclusion

Snow is an important part of the hydrologic cycle. It is also vital for agriculture, water supply, hydropower energy generation and disaster risk reduction. In many countries of Europe and America much of the precipitation is in the form of snow during the winter and is very critical for maintaining water supplies. Similar to our neighboring Himalayan countries, most precipitation in Bhutan is in the form of the summer monsoons, whereas the winter months are usually dry. Comparatively we do not receive a lot of snow, but we do

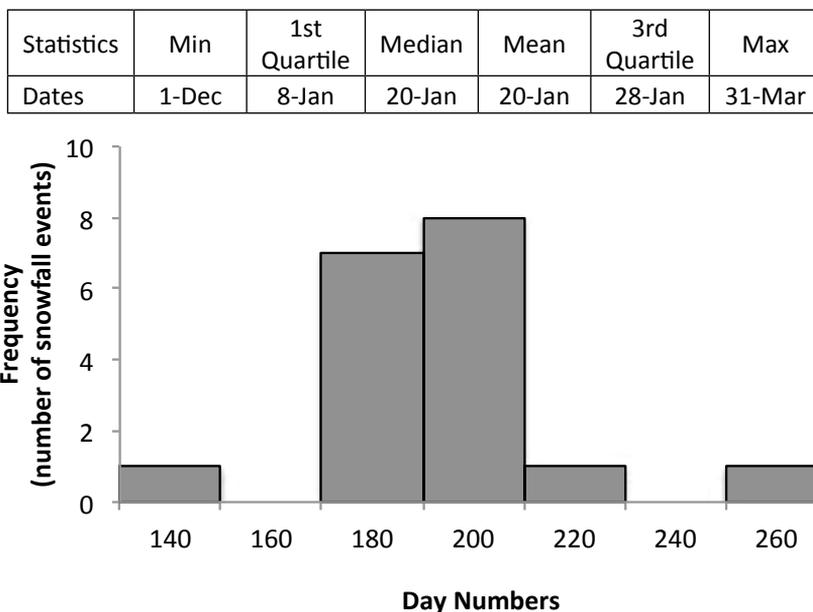


FIGURE 1 Summary statistics and histogram of start dates of snowfall in Thimphu.

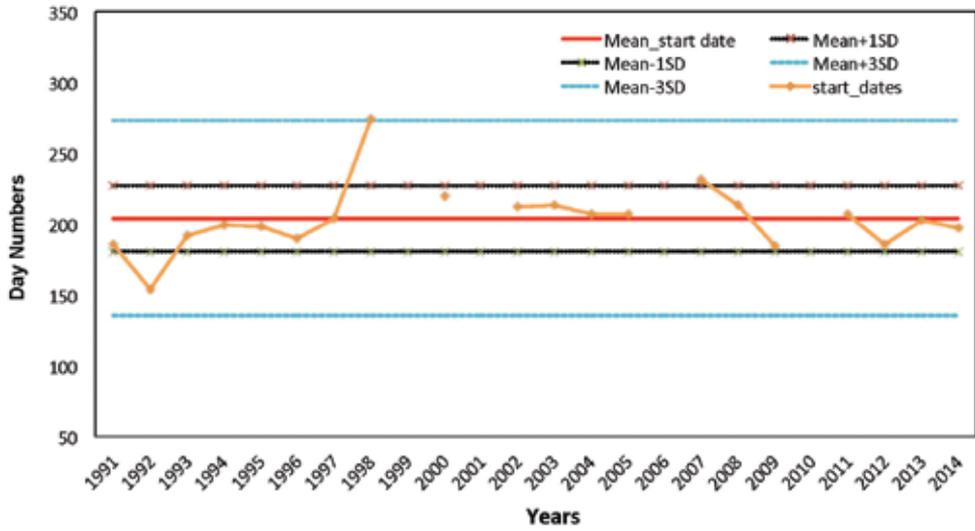


FIGURE 2 Start of snowfall in Thimphu within different standard deviations from the mean start day of snowfall.



FIGURE 3 The first snowfall of 2013 in Thimphu on Jan 19, 2013. Behind Hotel River View. (Photo Credit: Sherab Phuntsho)



FIGURE 4 The first snowfall of 2014 in Thimphu on January 13, 2014. Thimphu Tashichhodzong from Zilukha. (Photo Credit: Chhimi Dorji)

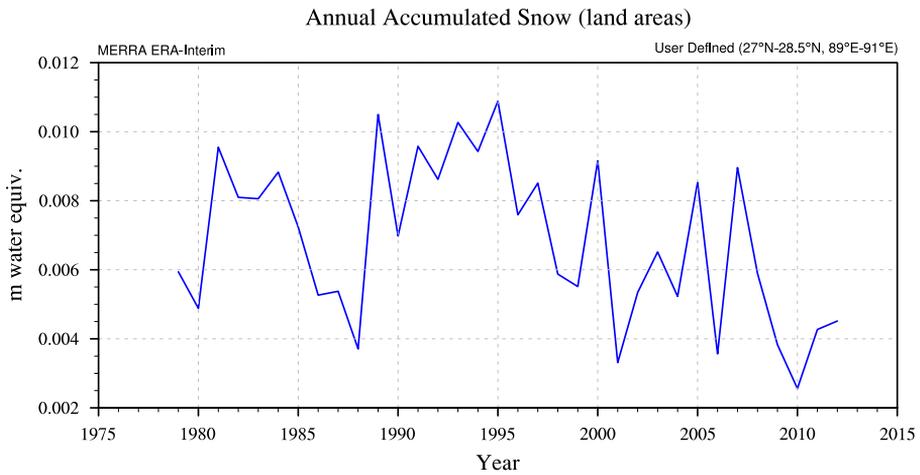


FIGURE 5 Annual accumulated snow for Bhutan (land areas).

receive snowmelt in the summer on the high Himalayas when the snow is melting off (Tashi & Tenzin 2013).

Analysis and in-depth reviews into the causes of the snowfall patterns were not conducted in this study. Review of historical winter temperatures and related climate parameters, more literature review and review of previous studies done would be very helpful in determining why some years are different from others.

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Literature cited

Armstrong, R. L. and E. Brun. 2008. *Snow and Climate*. Cambridge University Press, Cambridge, UK.

Kuensel. 2014, Jan 13. Kuensel Online. First snowfall leaves hundreds stranded. Available from <http://www.kuenselonline.com/first-snowfall-leaves-hundreds-stranded>. (Accessed April 16, 2014).

Kuensel. 2013, Feb 21. Kuensel Online. Snow Worth 15M. Available from <http://www.kuenselonline.com>. (Accessed April 18, 2014).

Null, J. 2014. El Niño and La Niña Years and Intensities. Available from <http://ggweather.com/enso/oni.htm>. (accessed Nov 1, 2014)

The Snowsports Experts. 2014. The Snowsports Industry. Available from <http://www.thesnowsportsexperts.co.uk/the-snowsports-industry>. (accessed April 16, 2014)

Tashi, T. and T. Kanjur. 2014. Thana glacier report. Snow and Glacier Division, Department of Hydro-Met Services, Thimphu, Bhutan.

Valisuo, I. 2014. Basics of snow. Finnish Meteorological Institute, University of Helsinki, Finland.

Watson, S. 2012. Snow can provide benefits to wheat crop. Available from http://www.agriculture.com/crops/wheat/production/snow-c-provide-benefits-to-wheat-crop_145-ar28437, 12/21/2012. K-State Research and Extension. (Accessed April 16, 2014)

Xinhua. 2013. Heavy snowfall hits Vietnam's agriculture. Available from <http://www.globaltimes.cn/content/832610.shtml#.U1nvaeaSwqY>. Published: 2013-12-17. (Accessed April 17, 2014)

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