Identification of snow reservoirs in Iran

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Received: 23/07/2016 Accepted: 09/03/2017

Extended abstract

Introduction

At the high elevations of river basins, precipitations are mainly in the form of snow and its accumulation provides water of the rivers in warm seasons. Having accurate and on time information of the phenomena is of great importance for flood controlling and also estimation of snow water equivalent. The extent of snow cover and its variations are important in hydrologic and climatic systems. Suitable and accurate evaluation of snow cover on both small and large scales is very crucial. Lack of information on the high elevations is an issue which causes increasing concerns due to climate change as many large rivers are originated from these highlands. In the last few decades many researches have carried out the studies of snow cover using remote sensing data. For instance, Maskey et al (2011) used MODIS Terra data to examine seasonal snow cover in Nepal for the period from 2000 to 2008. His findings revealed that snow cover is more in the elevation zone of 3000 to 4000 meters compared with the elevation zone of 4000 to 5000 and 5000 to 6000. Khadka et al (2014) evaluated snow cover in different seasons in Tamakoshi in the highlands of Himalaya using MODIS data for the time coverage from 2000 to 2009. The results indicated that snow cover below the elevation of 4500 meters above sea level is not much significant. In winter and spring at the elevation above 4500 meters the snow cover areas are very noticeable. However, in summer the elevation zones above 5500 meters have significant extent of snow cover.

Materials and methods

In the present research, MODIS Terra and MODIS Aqua data were used to detect snow reservoirs of the country. The selected study period covers the years from 2003 to 2014. As MODIS Aqua data are missing before the year 2003, we had to limit the study period only to the aforementioned years. Before the analysis of the data, we have applied two different algorithms to minimize cloud contamination that is a big obstacle against snow cover monitoring. One of the applied algorithms is based on three days filtering and the second is made on the combination of the two products. By merging the two products we managed to develop a regional snow cover data set over Iran. We have also used a Digital Elevation Model that was exactly like the snow cover data both on the special resolution and projection system.

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Results and discussion

The findings of the present study revealed that there are three major snow reservoirs that are very suitable for the accumulation of snow cover. The snow reservoir is an area snow-covered in long period of time in a year. The three main snow reservoirs of the country are Alborz, North-west and Zagrous and the most number of snow covered days on the heart of these snow reservoir is 153, 132 and 127 days, respectively. The analysis has revealed that the heart of Alborz snow reservoir is a point in Alamkooh which has a north facing slopes that is suitable for snow accumulation. The findings have also revealed that in the snow reservoir of Zagrous the relation between snow covered days and elevation is not very matched in west to east direction. This is due to a decrease in precipitation from west to east in this area.

Conclusion

In this study, the daily time series of MODIS Terra and MODIS Aqua data have been applied to detect snow reservoirs of Iran. Before using the daily data, some cloud removal technics have been applied on the raw daily data to minimize cloud cover effects. The findings have also revealed that in Iran there are three main snow reservoirs which are Alborz, North-west and Zagrous. The most number of snow covered days was detected to be on Alborz snow reservoirs. It has been detected in this study that in eastern Zagrous the changes of snow cover with elevation is not a positive direct relation and it tends to be reduced as elevation increases. It can also be concluded that the most number of snow covered days are not necessarily seen on the highest mountains in Iran but in lower elevations. It was discovered that the role of topographic conditions is of great importance for the accumulation of the snow cover. The eastern and northern aspects are suitable for the persistence of snow cover days and the highest number of snow covered days was detected in these aspects in the country.

Keywords: Snow reservoirs, MODIS Terra, MODIS Aqua, Iran