

# Synoptic - Satellite Analysis of Super Heavy Rainfall Wave in Chaharmahal-O Bakhtiari Province

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## 1. Introduction

The interaction between mesoscale convective cells and the synoptic conditions results in heavy precipitation which causes flooding in certain regions. Deep and dump convection, which are product of interaction of processes in various time-zone scales are different. When the moist troposphere which is conditional unstable and unstable air masses which are able to climb a medium scale systems, in that place at the moment, we can expect formation of a deep moist convection which results in heavy rainfall. Heavy rainfalls can be one of the most dangerous risks in most parts of the world as we have seen floods that killed many people around the world. In Iran and also in this region, heavy rainfalls occur in different parts of the country. But according to the country's arid and semi-arid climates and nature destruction and manipulation by humankind, such phenomena face with severe reaction, leading to severe flooding and destruction is in the range of Iran.

## 2. The Study Area

Chaharmahal-O Bakhtiari province with 533/16 square kilometers occupies 1% area of the country, and is a high area which has located in spread of Central Iranian Plateau and along the Zagros Mountains. In terms of geographical location it has located, between 31 degrees and 9 minutes to 32 degrees 48 minutes north latitude and 49 degrees 30 minutes to 51 degrees 26 minutes east longitude. Nearly 80 percent of this province is occupied with mountains and hills. This mountains has 16 peaks with more than 3,500 meters high. The highest one is the Zardkouh with 4548 high in north west of the country and 4548 meters in the north west and the lowest region of the country with 800 meters high, is located in exiting part of the Karoun river in joint of the Khorasan river to the Karoun. Precipitation in this area is as much as supplying 10 percent of the country's water which can feed central parts of Iran and Khuzestan plain as 4.7 billion cubic meters of water, in a year, exits from this province and is stored in Shahid Abbaspour, Des and Zayandehroud dams.

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### 3. Material and Methods

In this study, three sets of data, data from ground stations, data from upper atmosphere, and TRMM satellite data have been used to analyze heavy rainfall wave of Chaharmahal-O Bakhtiari. This was an 8-day study from April 25, 2009 to May 2, 2009. Data used from the upper atmosphere re-analyzed data elements of geopotential height, Omega orbital wind, meridional wind, especial humidity, relative humidity, sea level pressure that have been obtained from website of the National Center for Environmental Prediction (NCEP ). Also, we used 3B42 data of TRMM satellite for satellite analyzing. TRMM 3B42 data of seventh version of this satellite were available for anyone to use from May 22, 2012. This version has spatial resolution of 0/25 degrees latitude and 0/25 degrees longitude and temporal resolution of 1 day and 3 hours. For this purpose, at first according to data obtained from upper levels, atmospheric maps were designed and analyzed. For detecting occurred rainfall and estimating amount of it, after getting TRMM satellite's data, we prepared a data base in Excel. For zoning TRMM satellite rainfall data, some small amounts of data were transferred to GIS software and then Geostatistics model and Kriging method for precipitation zone were used, which had less error zone compared with other methods for estimating TRMM rainfall data.

### 4. Results and Discussion

Drawing and analyzing atmospheric maps showed that the pressure gradient between anticyclone located on Central Europe, the North Caspian and West China, with cyclone located on the North West of Saudi Arabia, the Persian Gulf, the West Indies and North West Africa and on the other hand, domination of cyclonic conditions in last days of study in earth with blocking event on upper levels and stretching deep descending's of them, on studied region in 500, 600, 700 and 850 HP, and ascendance of airflow in atmosphere (negative omega) which is indicator of air ascending and reinforcement of convection flows in mentioned levels that causes extreme divergence and instability. Atmospheric eddies with negative balance of 850, 925, 1000, HP has provided favorable conditions for the occurrence of heavy rainfall. In addition, supplying and feeding of humidity by the Red Sea at levels of 500, 600, 700 HP and the Persian Gulf at levels of 850, 925, 1000 HP, and at the end, existence of all mentioned conditions with domination of strong jet stream in most parts of Iran in period of study has caused rising atmospheric divergence and instability in studied region and resulted in 551 mm heavy rainfall. Considering precipitation estimated by TRMM satellite and comparing it with recorded values by observation stations, it is obvious that TRMM satellite does not have adequate accuracy for estimating rainfall in this region. And in most stations, the estimation was more than which has been observed. The correlation and coefficient determination between them is 22/0 and 05/0 percent.

**Conclusion**  
According to atmospheric maps analysis, we can say that pressure differences between anticyclone in the northern area and low pressure located in south of it, along with occurrence of blocking in the upper atmosphere and also locating the region in the East, along with this, domination of negative conditions of eddy and omega in atmosphere of

studied area, with adequate moisture and with association atmospheric jet streams the proper condition for precipitation of heavy cloud has been prepared . TRMM satellite rainfall estimation results of the evaluation of this heavy precipitation cloud wave indicate not so good accuracy of this satellite in this area. TRMM satellite in most stations have had surplus estimation in comparison to other recorded data. Therefore, we can say that in complex topographical areas like Bakhtiari region due to being located in the Zagros mountainous region that has complex topography, we cannot trust estimated values of this satellite.

**Key words:** Synoptic, Satellite TRMM, Climate risk, heavy precipitation, Chaharmahal-O Bakhtiari

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