AGU PUBLICATIONS

JGR

Journal of Geophysical Research: Atmospheres

RESEARCH ARTICLE

10.1002/2015JD023779

Key Points:

- TRMM 3B42V7 is validated with rain gauge data over the Himalayan region
- Satellite data give poor overall accuracy in correctly identifying rainfall events
- 3B42V7 may not be suitable for the study of very heavy rainfall events in the region

Correspondence to:
C. Singh,
charu@iirs.gov.in;
singhcharu105@gmail.com

Citation:
Bharti, V., and C. Singh (2015), Evaluation of error in TRMM 3B42V7 precipitation estimates over the Himalayan region, *J. Geophys. Res. Atmos.*, *120*, doi:10.1002/2015JD023779.

Received 11 JUN 2015
Accepted 25 NOV 2015
Accepted article online 28 NOV 2015

Evaluation of error in TRMM 3B42V7 precipitation estimates over the Himalayan region

Vidhi Bharti[1] and Charu Singh[1,2]

[1]Indian Institute of Remote Sensing, Indian Space Research Organization, Dehradun, India, [2]Marine and Atmospheric Science Department, Indian Institute of Remote Sensing, Indian Space Research Organization, Department of Space, Government of India, Dehradun, India

Abstract Accurate precipitation measurement is crucial for weather forecasting and hydrological modeling. Tropical Rainfall Measuring Mission (TRMM) 3B42V7 satellite precipitation product offers an opportunity to monitor precipitation at high spatiotemporal resolution. However, it has several inherent errors related to observation, instrument, and rainfall retrieval algorithms. It is, therefore, essential to validate it with ground-based measurements. We divide the region into different elevation ranges and compare 3B42V7 with India Meteorological Department gauge-based measurements, so as to observe the behavior of satellite at different altitudes. This paper evaluates error characteristics of 3B42V7 using continuous and categorical validation schemes. The analysis reveals 3100 m altitude as the breakpoint for the satellite overestimating and underestimating rainfall amount for elevation ranges below and above it, respectively. It gives a poor positive correlation of ~0.23 between individual rainfall events, though the correlation improves (~0.67) for areal-averaged precipitation values. 3B42V7 also underestimates the frequency of actual rainfall events and is not very good at identifying correct rain and no-rain events with the overall accuracy of ~66%. Conclusively, the satellite exhibits comparatively better performance for 1000–2000 m elevations but exacerbates over higher-altitude regions. Further, we assess its capability for very heavy rainfall events using three percentile thresholds. The low-magnitude bias for 98th and 99th percentiles and high-magnitude bias for 99.99th percentile imply that 3B42V7 may not be suitable for the study of very heavy rainfall events. On the basis of these findings, it is recommended to improve satellite precipitation retrieval algorithms by incorporating topographical and local climatic factors into consideration.

1. Introduction

Precipitation is one of the most critical elements of the hydrological cycle as it affects the environment both directly and indirectly. Accurate precipitation measurement is crucial to better comprehend climate changes, particularly in the northwestern Himalayan region which is highly prone to extreme rainfall events. Precipitation accuracy has significant implications in hydrological modeling, agriculture and drought monitoring, and climate change studies. For extreme hazards studies, it is important to capture both the frequency and intensity of the precipitation correctly.

As precipitation varies highly in space and time dimensions, its irregular patterns pose myriad challenges for its precise measurement. Rain gauges are considered as the most effective way of direct measurement of rainfall, but establishing an evenly distributed in situ precipitation measurement network is infeasible considering the geographical heterogeneity of the planet. There have been continuous efforts from the India Meteorological Department (hereafter referred to as IMD) to expand the rain gauge network in the Himalayas, but their maintenance has proved a costly affair over this complex mountainous terrain. Over the years, weather radars have also been proved highly efficient in providing precipitation estimates with high spatiotemporal sampling density. Yet certain limitations like ground clutter and beam blockage asso-