High-resolution Monthly Satellite Precipitation Product over the Conterminous United States

Hashemi, Hossein; Fayne, Jessica; Knight, Rosemary ; Lakshmi, Venkat

2017

Document Version:
Publisher's PDF, also known as Version of record

Citation for published version (APA):
Hashemi, H., Fayne, J., Knight, R., & Lakshmi, V. (2017). *High-resolution Monthly Satellite Precipitation Product over the Conterminous United States*. Poster session presented at AGU (American Geophysical Union) Fall Meeting, 2017, New Orleans, Louisiana, United States.

Total number of authors:
4

High-resolution Monthly Satellite Precipitation Product over the Conterminous United States

Hossein Hashemi[1,2], Jessica Fayne[3], Rosemary Knight[2], and Venkat Lakshmi[4]

[1]Lund University, [2]Stanford University, [3]University of California-Los Angeles, [4]University of South Carolina

Introduction and Objective

Problem: Despite the unique spatial and temporal coverage (3-hourly global coverage between latitude 50° North and 50° South) and advanced retrieval algorithm, numerous studies have shown that TRMM-TMPA estimates of precipitation differ from ground-based estimates.

The inaccuracy in the satellite data is related to high spatial variability of precipitation as well as low spatial resolution of retrievals from the TRMM Multisatellite sensors over the mountainous terrain.

Objective: Quantify the relationship between bias in the satellite precipitation and elevation.

- Develop a correction model to improve the accuracy of the satellite product, particularly, at high elevations.
- Produce a very high-resolution (~1 km) bias corrected satellite-based monthly precipitation data set.

Methodology

We resampled the TRMM-TMPA precipitation product into the DEM grid size (~1 km) using nearest neighbor.

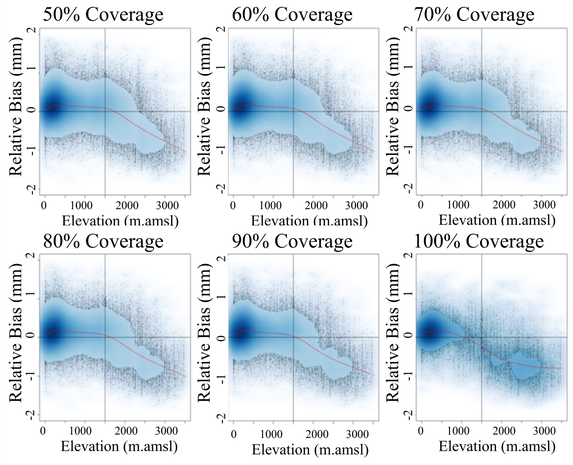
We investigated the differences between satellite-based and rain gauge precipitation measurements as function of elevation and based on the temporal overlap between the two data sets (high-resolution TRMM and Gauges).

Bias Calculation

We calculated the relative bias (δB_i) between the high-resolution TRMM-TMPA (1 km) and about 9,200 rain gauges across the country between 1998 and 2015.

$$\delta B_i = 2\frac{S_i - G_i}{\epsilon + (S_i + G_i)}$$

G_i: ground-based estimate
S_i: satellite-based estimate



Correction Model and Validation

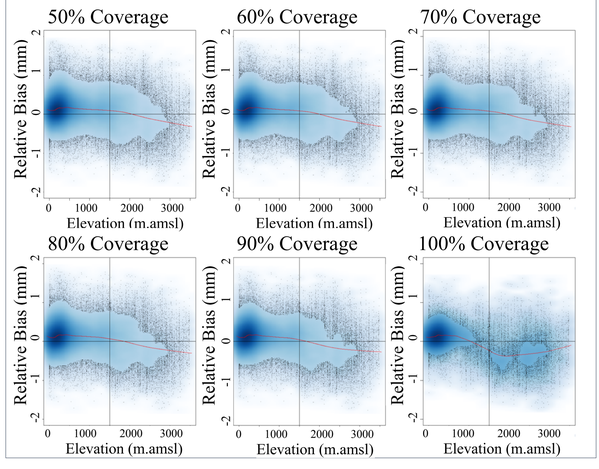
We corrected high-resolution TRMM with respect to elevation using the correction model as follows (Hashemi et al. 2017):

$$\delta B_i = \frac{G_i}{(S_i+1)} - 1 = \alpha E_i + \beta$$

$$S_{ic} \rightarrow S_i(\alpha E_i + \beta + 1)$$

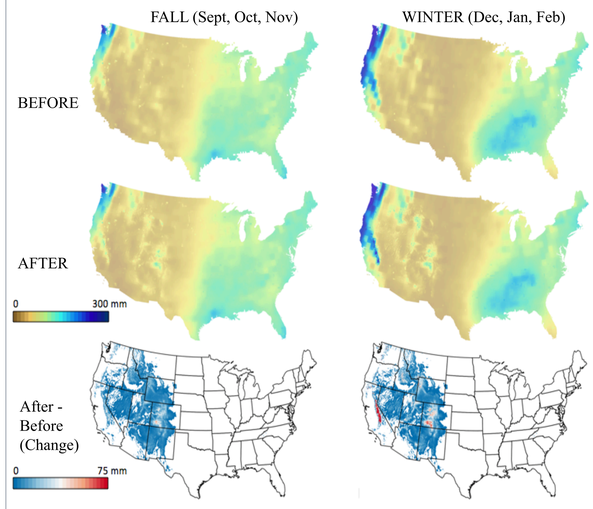
α and β: unknown coefficients

E_i: elevation
S_{ic}: corrected satellite-based precipitation



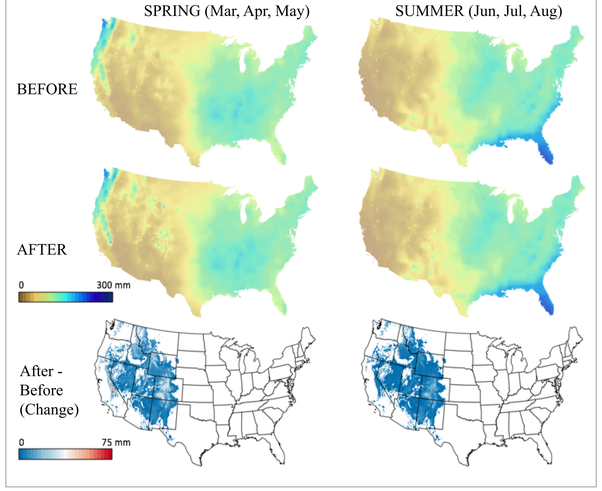
High-resolution Bias Corrected TRMM

The top two figures show the uncorrected original TRMM-TMPA 3B43. The middle figures show the corrected high-resolution TRMM-TMPA 3B43. The two bottom figures show the amount of correction applied to average TRMM-TMPA 3B43 precipitation for fall and winter seasons.



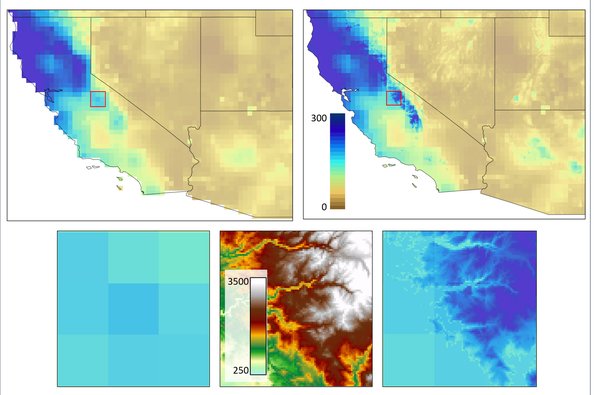
High-resolution Bias Corrected TRMM

The top two figures show the uncorrected original TRMM-TMPA 3B43. The middle figures show the corrected high-resolution TRMM-TMPA 3B43. The two bottom figures show the amount of correction applied to average TRMM-TMPA 3B43 precipitation for spring and summer seasons.



High-resolution Bias Corrected TRMM

Very high-resolution satellite-based monthly precipitation in the mountainous region of Sierra Nevada, California.



Conclusion

- There is significant correlation between satellite bias and elevation.
- We developed a model to correct the TRMM product under the assumption that the bias is related to the TRMM data and is dependent on elevation.
- The TRMM correction is only applied to the high elevation regions, leaving the lower elevations unchanged.
- The new product captured more detail in the changes in precipitation over the mountainous region than the original TRMM 3B43.
- Comparisons between the high-resolution corrected satellite-based data and gauges showed an excellent agreement.

Reference

Hashemi, H., M. Nordin, V. Lakshmi, G.J. Huffman, and R. Knight (2017). Bias correction of long-term satellite monthly precipitation product (TRMM 3B43) over the conterminous United States. *Journal of Hydrometeorology,* 18:9, 2491-2509.

Contact Information

Hossein Hashemi (hossein.hashemi@cme.lu.se)
Jessica Fayne (jfayne@g.ucla.edu)
Rosemary Knight (rknight@stanford.edu)
Venkat Lakshmi (vlakshmi@geol.sc.edu)

H21E-1500