COMPARISON OF TRMM PRECIPITATION RADAR with GROUND RAIN GAUGE NETWORK in TURKEY

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ABSTRACT

Precipitation Radar (PR) is an important sensor of the Tropical Rainfall Measuring Mission (TRMM) that was built by the Japan Aerospace Agency (JAXA) as part of its contribution to the joint US/Japan. It is the first spaceborn instrument which has ability to see the precipitation field with high resolution in both the horizontal and vertical. The Precipitation Radar is able to capture fairly light rain rates down to about .027 inches (0.7 milimeters) per hour with a range resolution of 250 m, a horizontal resolution of about 4 km. The radar reflectivity observed by the PR should be compared to ground measurements. The purpose of this study is to compare radar based precipitation data from TRMM/PR with ground rain gauge measurements. In this study, we selected 2015 year as study period. Daily accumulated observed precipitation was obtained from PR, while ground precipitation measurements was obtained from records of Turkish State Meteorological Service. Firstly, we analysed observed PR and measured data together in seasonal. Bias maps were also mapped. Secondly, daily accumulated PR data were extracted for several station's coordinate in order to compare with ground measurements. Then, scatter plot diagrams and correlations were analysed in detail.

DATA and METHODOLOGY

1. Tropical Rainfall Measuring Mission (TRMM)

In this study, we firstly used the TRMM 3B42 V7 data product, which is daily accumulated precipitation product. The resolution of the dataset is 0.25 degree x 0.25 degree (see Fig.1).

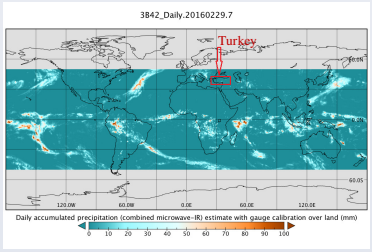

Figure 1. An illustration of TRMM product and study area.
(Image is from http://disc.gsfc.nasa.gov/)

This daily accumulated precipitation product is generated from the research quality 3-hourly TMPA (3B42). It is produced at the NASA GES DISC, as a value added product. Simple summation of valid retrievals in a grid cell is applied for the data day. The result is given in (mm). The beginning and ending time for every daily granule are listed in the file global attributes, and are taken correspondingly from the first and the last 3-hourly granules participating in the aggregation. Thus the time period covered by one daily granule amounts to 24 hours, which can be inspected in the file global attributes (http://disc.gsfc.nasa.gov/).

2. Ground Rain Gauge Network

Secondly, we used precipitation dataset from ground rain gauge network (1450 Automated Weather Observing System - AWOS) operated by Turkish State Meteorological Service in Turkey. We elected values smaller than 0.2 mm. The distribution of the used AWOS's can be seen at Figure 2.

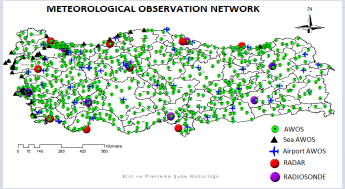

Figure 2. Meteorological Observation Network

3. Methodology

Three main statistical methods were used to compare TRMM and ground measurement including **Coefficient of Determination** (R2) and **Root Mean Squared Error** (RMSE).

The coefficient of determination (R2) is used to evaluate the goodness of fit of the relation. R2 addresses the question of how well the satellite rainfall estimates correspond to the ground rainfall observations: it is the degree of linear association between the two terms; see Eq. (1).

$$R^2 = \left(\frac{n\sum(G_i S_i) - (\sum G_i)(\sum S_i)}{\sqrt{\left(n\left(\sum G_i^2\right) - (\sum G_i)^2\right)\left(n\left(\sum S_i^2\right) - (\sum S_i)^2\right)}} \right)^2, \qquad (1)$$

where R2 is the coefficient of determination, Gi the ground rainfall measurements, Si the radar rainfall estimates, and n the number of data pairs. RMSE measures the difference between the distributions of the ground-observed rainfall and the distribution of satellite rainfall estimation, and calculates a weighted average error, weighted according to the square of the error. RMSE is useful when large errors are undesirable. The lower the RMSE score, the closer the radar rainfall estimation represents the observed ground rainfall measurement; see Eq. (2). (A. W. Worqlul et al., 2014).

$$\mathrm{RMSE} = \sqrt{\frac{\sum (G_i - S_i)^2}{n}}, \qquad (2)$$

RESULTS

1. SEASONAL AREAL COMPARISON

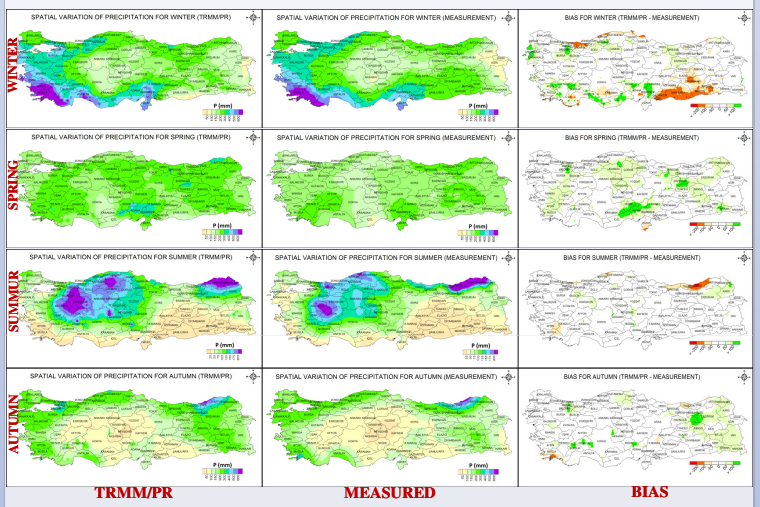

Figure 3. Seasonal Variation of Accumulated Precipitation for TRMM/PR and Measured

-Precipitation in **winter is accumulated over southwestern Turkey** for both TRMM/PR and measured. Most regions in Turkey show good similarity except Gaziantep and Şanlıurfa.

- Precipitation in **spring shows bias at the range of -50 and +100mm** for most regions.

- Precipitation in **summer is accumulated over some middle and northeastern parts** of Turkey and the **bias shows low values** except Trabzon and Rize provinces.

- For autumn, differences between TRMM and measurement are low for most regions (see Fig.3)

2. POINT-BASED COMPARISON

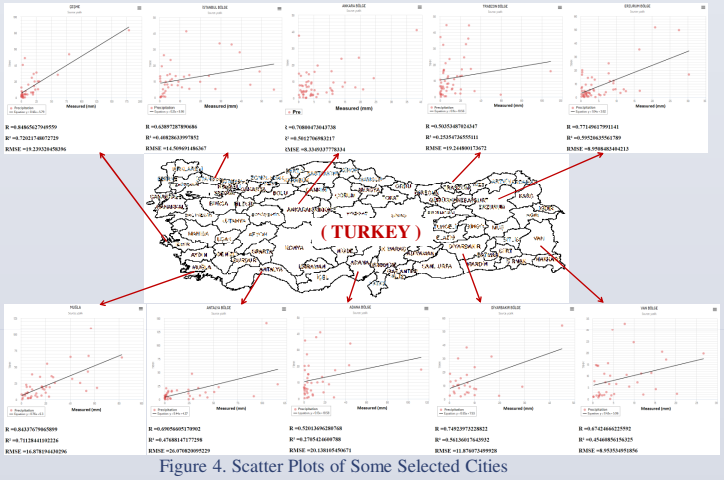

Figure 4. Scatter Plots of Some Selected Cities

- R, R2 and RMSE values for some selected cities are Fig.4. Most cities show strong or close to strong Coefficient of Determination (R2) values.

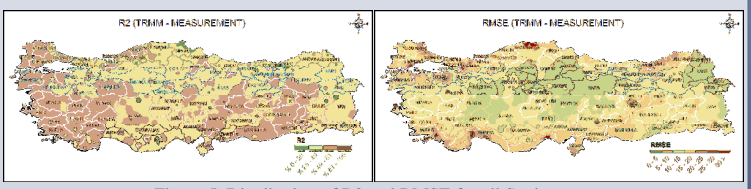

Figure 5. Distribution of R2 and RMSE for all Stations

- Very high percent of stations show moderate (%25 - 49) and strong (%49 - 81) correlation (R2).

- RMSE is close to 0 over central Anatolia, while bigger than 15 at coastal regions (Fig. 5).

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