General comments:

1. **Comment:** Station to grid comparison: The authors assert that station to grid comparisons are difficult and conduct 'linear interpolation' from station to grid and from product grid to a common 0.1x0.1 degree comparison. I find the overall description of this vague and am also not entirely convinced that this solves the problem given that a lot of the variability within each grid-cell is due to topography and localized patterns that don't change linearly. I am also concerned/ confused that the authors ony consider stations within the district for the regional/ district comparison. Given the irregular shape additional stations outside the region should also be considered.

Response: Previous studies have used interpolated ground station data to evaluate precipitation products (Liu et al., 2015, Duan et al. 2016, Shukla et al. 2019). The study considered stations distributed both inside and on the boundary of the study region, ensuring a comprehensive representation of precipitation within the region. While the irregular shape of the region could suggest including external stations, this was not feasible due to the poor distribution of meteorological stations in surrounding areas during the study period. The surrounding districts lacked research institutes and Agricultural Universities, which were essential for maintaining meteorological stations and providing reliable data. Since the real stations are arranged almost in a regular grid, we can expect low interpolation errors. This is also shown by the LOOCV analysis below.

Table: LOOCV performance of Linear interpolation of precipitation at monthly timescale

Study Region	Mean RMSE (mm)	Percent Mean Absolute Error (%)
Coimbatore	39.22	36
Madurai	52.50	30
Tiruchirappalli	39.93	29
Tuticorin	42.32	25

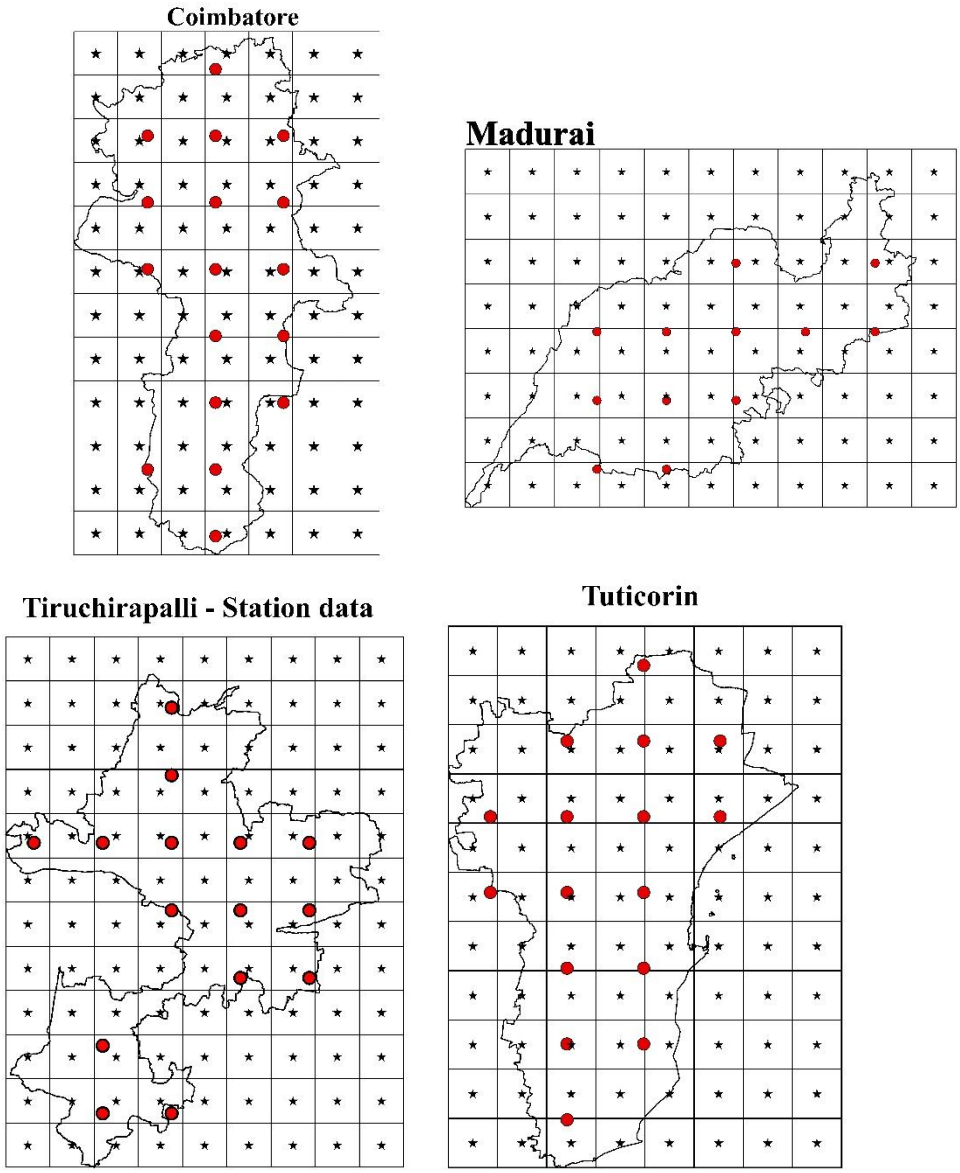


Figure: Linearly interpolated grids (0.1°) of the study regions along with the station data.

In the figure above, red points denote the distribution of station datasets. The grids and the stars represent the linear interpolation. Only grids that are surrounded by at least one rain gauge station were included in the analysis to avoid uncertainties in the analysis. A similar explanation has been addressed to Comment No: 8.

2. **Comment:** Choice of regions: I might have missed that, but why are only some regions compared and not India as a whole?

Response: This study investigates the use of climate data products for agricultural analyses, focusing on agriculturally significant semi-arid regions in Tamil Nadu: Coimbatore, Madurai, Tiruchirappalli, and Tuticorin. These regions were chosen because each has a State-owned Agricultural University, which ensures their agricultural representativeness and data availability. Although numerous studies have evaluated precipitation products in India, such evaluations are typically conducted at the state or district levels using weekly or monthly time scales. The accuracy of these assessments often depends on access to ground station data, which is not uniformly available across the country. To overcome this challenge, the present study utilizes high-resolution daily data tailored to the specific agro-hydrologic units under consideration. Including India as a whole would limit the spatial resolution of the evaluation, particularly at the grid level for individual districts. The findings of this study are designed to support field-level experimentation and provide a proof of concept for modelers developing climate data products, with the potential for extrapolation to other regions with similar agro-climatic conditions.

3. **Comment:** Reliance on Tables and many figures to compare: Apart from the Taylor diagrams, the authors have many tables and many figures with subplots that compare values between the products. It is very difficult to keep track of all of these comparisons. It would be good to think about a better way to integrate and present results.

Response: In the revised document, we have reduced the number of metrics, which allowed us to consolidate two tables into a single table for better integration. Additionally, the figures in the main document have been streamlined to focus on key timescales: daily (IDF plots), monthly (Percent MAE), and annual (Taylor diagrams, Spatial maps). To improve clarity, the IDF plots now exclude return periods for 2 and 10 years, focusing instead on only 5-year return period.

As a result, the revised manuscript now includes three tables and four figures (with subplots) corresponding to the three timescales, making the comparisons more concise and easier to follow. In this way, we integrated tables and reduced reductant figures for better clarity without loss of information. The sequence of Tables and Figures in the revised manuscript is given at the end of this document.

Specific comments:

4. **Comment:** Section 2.2. This section could probably be shortenened to focus on the most important information here.

Response: As per the reviewer's suggestion, the information has been reduced to highlight only the most important information.

5. **Comment:** L153: Climate Data Guide, 2024 is not an appropriate citation for the datasets since the CDG is not the primary source of the data but a guide for data users by UCAR.

Response: As per reviewer's suggestion, the Climate Data Guide referenced has now been revised to Huffman et al. (2023), as mentioned on the webpage.

6. **Comment:** Figure 1: The regular gridded station distribution seems to be an error in the figure?

Response: The appearance of a regular gridded station distribution in Figure 1 is not an error, but rather a result of how the data were selected for homogenous distribution within the districts. The datasets used in this study were collected from the Public Works Department (PWD) of Tamil Nadu, which collects and maintains meteorological data for the entire state. Additionally, each selected study region has a State-owned Agricultural University with many crop-specific research institutes, including the Wheat Research Station in Coimbatore, located at a higher altitude. These institutes provide both agro-meteorological and hydro-meteorological data, enabling coverage even in mountainous regions. According to Rajeev et al. (2005), the southern Peninsular region, where the study is located, has a higher density of meteorological stations. When these datasets are combined at the state level, the station data may appear to be distributed in a regular grid, even though the actual distribution is more varied.

7. **Comment:** L240: " For quality reasons, the years 2005 and 2010 were excluded from the present study" > Please explain

Response: There were large data gaps in those two years, which means more missing than available data. Instead of filling the gaps with uncertain results using imputation methods, we decided to skip the years.

8. **Comment:** L253: "The interpolated 0.1degree station dataset was used as ground truth to evaluate all the other precipitation products" > See my general comment. Also, it would be really good if the authors could come up with a way to provide any kind of quality measure for this. For example, the authors could have reserved some stations for verification of that methodolody. Or conduct a leave-one-out cross-validation to assess how well the interpolated data reflects actual precipitation in that location.

Response: As per the Reviewer's suggestion, Leave-One-Out Cross Validation was conducted to assess how well the interpolated data reflected the actual precipitation. LOOCV was performed on linear interpolation based on assuming that the value of a station was unknown. The unknown station was estimated from the value of the neighboring stations based on linear interpolation. The analysis was systematically carried out in Python. Since the real stations are arranged almost in a regular grid, we can expect low interpolation errors. This is also shown by the LOOCV analysis below.

Table: LOOCV performance of Linear interpolation of precipitation at monthly timescale

Study Region	Mean RMSE (mm)	Percent Mean Absolute Error (%)
Coimbatore	39.22	36
Madurai	52.50	30
Tiruchirappalli	39.93	29
Tuticorin	42.32	25

9. **Comment:** L320: It would be good to also provide MAE as a percentage value of mean precipitation.

Response: This will be added in the supplementary table of the revised manuscript.

10. **Comment:** Figure 2: I am a bit confused with this figure because alls of these lines seem to be perfectly straigt on a log-log plot and that is something that I would not have expected. It is also not possible to always see all lines.

Response: As the IDF graph was perfectly straight on the log-log plot, we now revised it to a scatter plot (without taking log on both the x and y axes). We opted for this plotting compared to the log-log plot because similar studies followed this technique (Ombadi et al. 2018, Ghebreyesus & Sharif, 2021). Also, the time scale is now of more significance concerning hydrometeorological events. Since some of the products had values close to each other, variations in terms of line style and color are made in the revised graph to increase the visibility of lines which is given at the end of the document (Figure 2). Also, to highlight the performance for a single return period and avoid redundancy, sub-plots of Return periods 2 and 10 have been removed.

11. **Comment:** Figures 3-6: I was initailly confused by these figures. I guess the key message here would be, how the errors compare between monosson and non-monsoon season, but for that, the reader has to do their own math.

Response: The stacked plots of monsoon and non-monsoon precipitation (Figures 3-6) in the original manuscript have now been revised to column plots for better interpretation. The revised plots now convey the variation of precipitation in both the monthly means along with its %MAE (Figure. 3, given at the end of the document).

12. **Comment:** Figure 8-11: These should contain the station locations to better understand the interpolation.

Response: The station data in Figures 8-11 have now been revised, and they contain station data, representing the intra-region precipitation variation and interpolation.

13. **Comment:** L490: "ERA5-Land produced the closest approximation to the station data (Fig. 8). " > It would be good to back this up with some quantittative quality measure rather than a qualitative comparison.

Response: As per the reviewer's suggestion, the following quantitative comparison will be added: Based on the correlation values and RMSE given in the Table. 5, along with the Figure 8, it is concluded that ERA5Land produces a close estimate of the station data. Similar explanations will also be added for the other comparisons also.

14. **Comment:** Section 5: This should start with a discussion of results including general patterns and limitations of the study. Then followed by

Response: The above-mentioned section is deleted from the revised manuscript, and the discussion section starts with a discussion of the study.

Revised Tables and Figures:

Table 3. Daily precipitation characteristics of Coimbatore, Madurai, Tiruchirappalli and Tuticorin

		Coimbatore			Madurai			Tiruchirappalli			Tuticorin		
Scale	**Product**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**
Grid	**CMORPH**	0.19	8.92	0.26	0.24	10.92	-0.25	0.20	9.46	-0.28	0.33	8.50	-0.45
	GPM-IMERG	0.21	9.00	0.44	0.29	9.20	-0.36	0.26	9.53	-0.16	0.38	7.94	-0.34
	MSWEP	0.33	6.07	0.16	0.41	7.87	-0.41	0.33	7.23	-0.33	0.46	6.62	-0.29
	PERSIANN CDR	0.20	7.72	0.16	0.35	8.00	-0.43	0.33	7.32	-0.33	0.43	6.53	-0.34
	TRMM	0.21	8.76	0.09	0.26	10.13	-0.28	0.23	9.65	-0.19	0.36	8.47	-0.41
	ERA5Land	0.37	6.32	0.15	0.45	7.51	-0.46	0.37	6.92	-0.34	0.39	7.23	-0.39
	MERRA2	0.24	41.36	8.04	0.31	35.74	2.43	0.21	33.08	2.70	0.30	33.27	2.83
	NCEP2	0.05	15.77	1.14	0.07	14.00	0.10	0.10	13.33	0.31	0.12	13.59	0.40
District	**CMORPH**	0.23	8.09	0.26	0.25	10.56	-0.25	0.21	9.16	-0.28	0.37	7.75	-0.45
	GPM-IMERG	0.25	8.03	0.44	0.31	8.81	-0.36	0.27	9.10	-0.16	0.43	7.24	-0.34
	MSWEP	0.38	5.37	0.16	0.43	7.59	-0.41	0.35	6.94	-0.33	0.46	6.53	-0.29
	PERSIANN CDR	0.23	7.15	-0.15	0.36	7.80	-0.43	0.35	7.08	-0.33	0.47	6.03	-0.34
	TRMM	0.23	1.87	0.63	0.27	9.78	-0.28	0.24	9.30	-0.19	0.40	7.73	-0.41
	ERA5Land	0.39	0.61	-0.45	0.48	7.24	-0.46	0.39	6.66	-0.34	0.46	6.37	-0.39
	MERRA2	0.29	39.9	8.04	0.32	35.41	2.43	0.22	32.84	2.70	0.33	32.24	2.83
	NCEP2	0.06	15.51	1.14	0.07	13.91	0.10	0.10	13.21	0.31	0.12	13.36	0.40

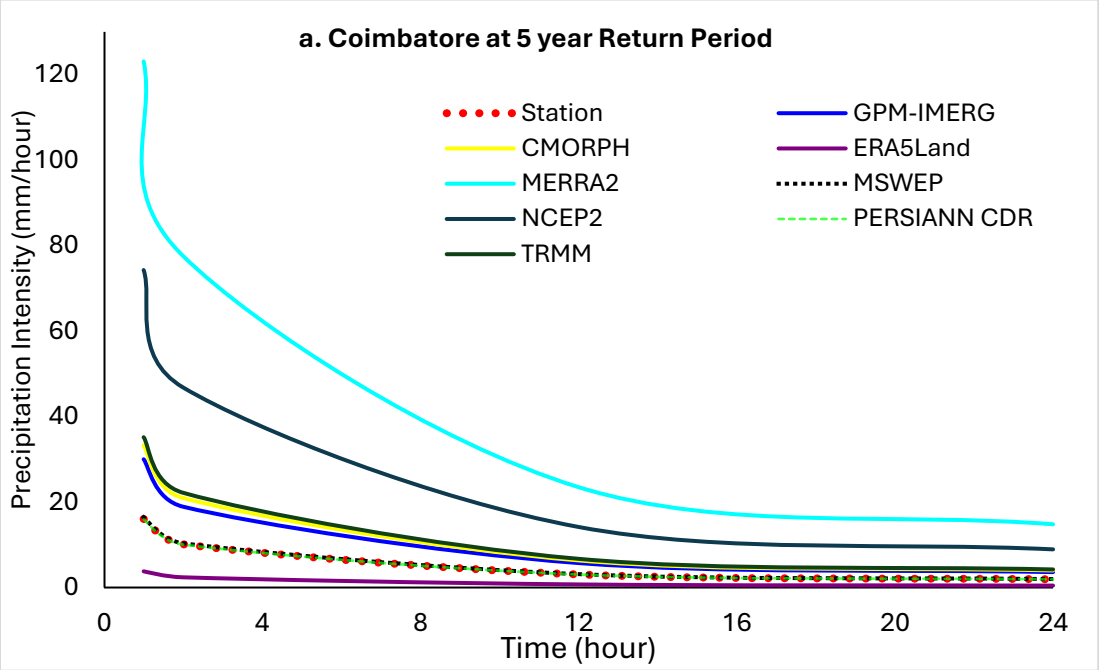
Table 4. Monthly precipitation characteristics of Coimbatore, Madurai, Tiruchirappalli and Tuticorin

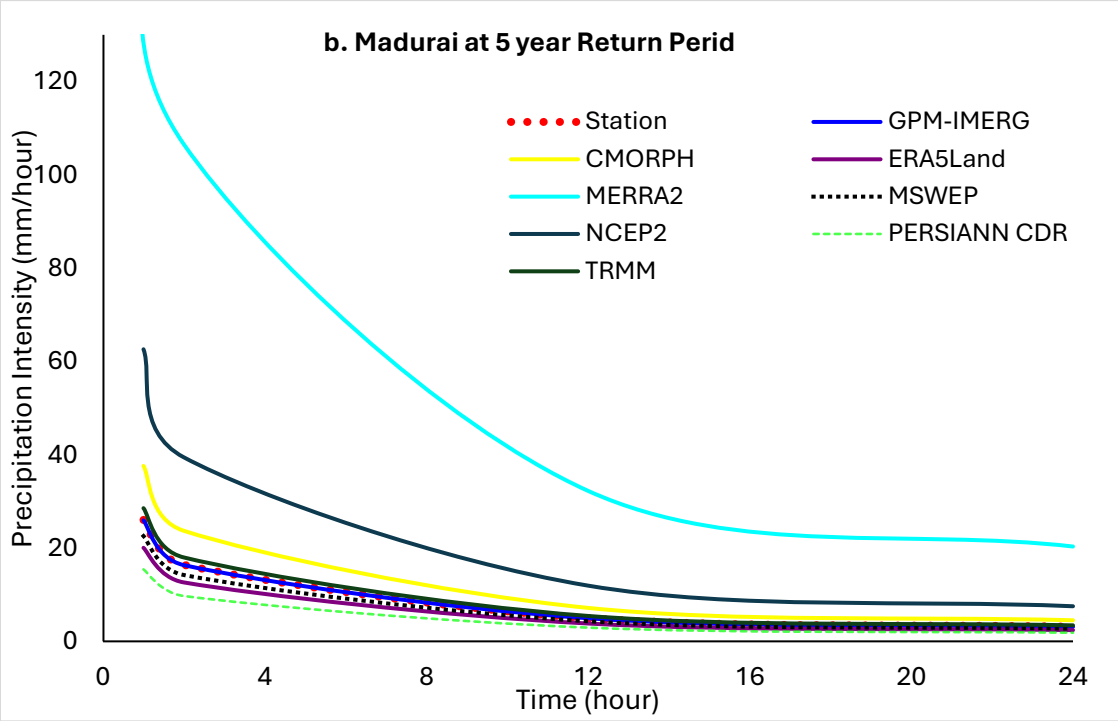
		Coimbatore			Madurai			Tiruchirappalli			Tuticorin		
Scale	**Product**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**
Grid	**CMORPH**	0.54	72.09	0.26	0.16	91.80	-0.25	0.64	79.11	-0.28	0.73	83.80	-0.45
	GPM-IMERG	0.48	83.12	0.44	0.78	87.07	-0.36	0.71	72.25	-0.16	0.77	75.04	-0.34
	MSWEP	0.59	63.01	0.12	0.80	91.04	-0.43	0.75	69.96	-0.35	0.80	66.35	-0.31
	PERSIANN CDR	0.34	113.09	0.79	0.69	87.18	-0.19	0.77	61.65	-0.07	0.73	69.23	-0.26
	TRMM	0.10	109.78	0.09	0.75	84.70	-0.28	0.69	74.32	-0.19	0.77	77.44	-0.41
	ERA5Land	0.62	62.80	0.08	0.81	93.25	-0.46	0.79	66.13	-0.34	0.65	89.45	-0.39
	MERRA2	-0.15	96.82	8.04	0.71	459.54	2.43	0.59	416.93	2.70	0.64	448.33	2.83
	NCEP2	-0.08	225.95	1.14	-0.02	190.56	0.10	0.17	160.10	0.31	0.11	169.54	0.40
District	**CMORPH**	0.63	60.63	0.26	0.69	89.22	-0.25	0.65	76.60	-0.28	0.80	75.62	-0.45
	GPM-IMERG	0.56	73.52	0.44	0.80	85.03	-0.36	0.73	69.47	-0.16	0.80	68.40	-0.34
	MSWEP	0.69	50.66	0.12	0.81	89.25	-0.43	0.77	67.24	-0.35	0.80	65.58	-0.31
	PERSIANN CDR	0.39	107.45	0.79	0.70	85.39	-0.19	0.79	58.07	-0.07	0.82	61.57	-0.26
	TRMM	-0.01	14.08	0.50	0.77	82.40	-0.28	0.71	71.46	-0.19	0.83	70.34	-0.41
	ERA5Land	0.72	50.35	0.08	0.83	91.38	-0.46	0.81	63.27	-0.34	0.76	75.15	-0.39
	MERRA2	0.56	705.76	8.04	0.72	457.92	2.43	0.60	415.75	2.70	0.68	443.23	2.83
	NCEP2	-0.09	223.0	1.14	-0.02	189.86	0.10	0.18	158.98	0.31	0.11	167.21	0.40

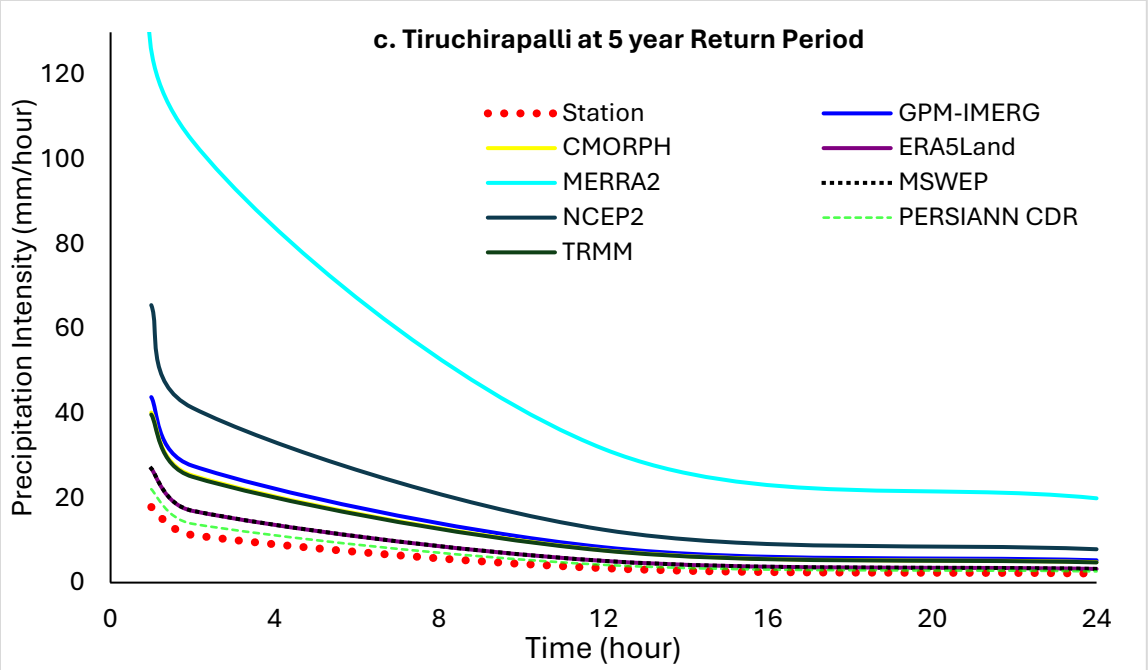
Table 5. Yearly precipitation characteristics of Coimbatore, Madurai, Tiruchirappalli and Tuticorin

		Coimbatore			Madurai			Tiruchirappalli			Tuticorin		
Scale	**Product**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**	**CC**	**RMSE**	**RB**
Grid	**CMORPH**	0.21	423.07	0.24	0.42	539.15	-0.26	0.32	468.57	-0.29	0.46	693.33	-0.46
	GPM-IMERG	0.12	536.78	0.44	0.64	644.06	-0.36	0.68	283.43	-0.16	0.71	517.85	-0.34
	MSWEP	0.05	397.89	0.12	0.45	767.09	-0.43	0.68	481.53	-0.35	0.77	425.33	-0.31
	PERSIANN CDR	0.39	731.66	0.79	0.61	416.82	-0.19	0.68	217.84	-0.07	0.48	463.14	-0.26
	TRMM	-0.61	939.29	0.09	0.48	560.14	-0.28	0.60	333.92	-0.19	0.60	617.91	-0.41
	ERA5Land	0.33	346.07	0.08	0.66	791.22	-1.00	0.82	461.09	-0.34	0.21	669.71	-0.39
	MERRA2	-0.01	6878.40	8.04	0.35	4148.24	2.43	0.31	3523.97	2.70	0.30	3923.29	2.83
	NCEP2	-0.23	1145.97	1.14	-0.75	609.66	0.10	-0.23	567.99	0.31	-0.54	746.16	0.40
District	**CMORPH**	0.42	56.92	0.24	0.44	200.58	-0.26	0.35	160.87	-0.29	0.73	187.02	-0.46
	GPM-IMERG	0.41	85.22	0.44	0.67	241.07	-0.36	0.74	92.69	-0.16	0.88	138.19	-0.34
	MSWEP	0.43	53.03	0.12	0.47	287.87	-0.43	0.74	165.86	-0.35	0.81	295.53	-0.31
	PERSIANN CDR	0.47	138.93	0.79	0.63	154.01	-0.19	0.79	62.87	-0.07	0.85	113.78	-0.26
	TRMM	0.37	39.02	0.09	0.49	208.98	-0.28	0.67	110.92	-0.19	0.90	164.62	-0.41
	ERA5Land	0.69	41.64	0.08	0.71	296.84	-0.46	0.92	157.49	-0.34	0.90	154.23	-0.39
	MERRA2	0.30	1394.66	8.04	0.36	1565.42	2.43	0.33	1245.12	2.70	0.44	1127.75	2.83
	NCEP2	-0.48	225.68	1.14	-0.77	228.17	0.10	-0.24	197.06	0.31	-0.71	207.55	0.40

Revised Figures







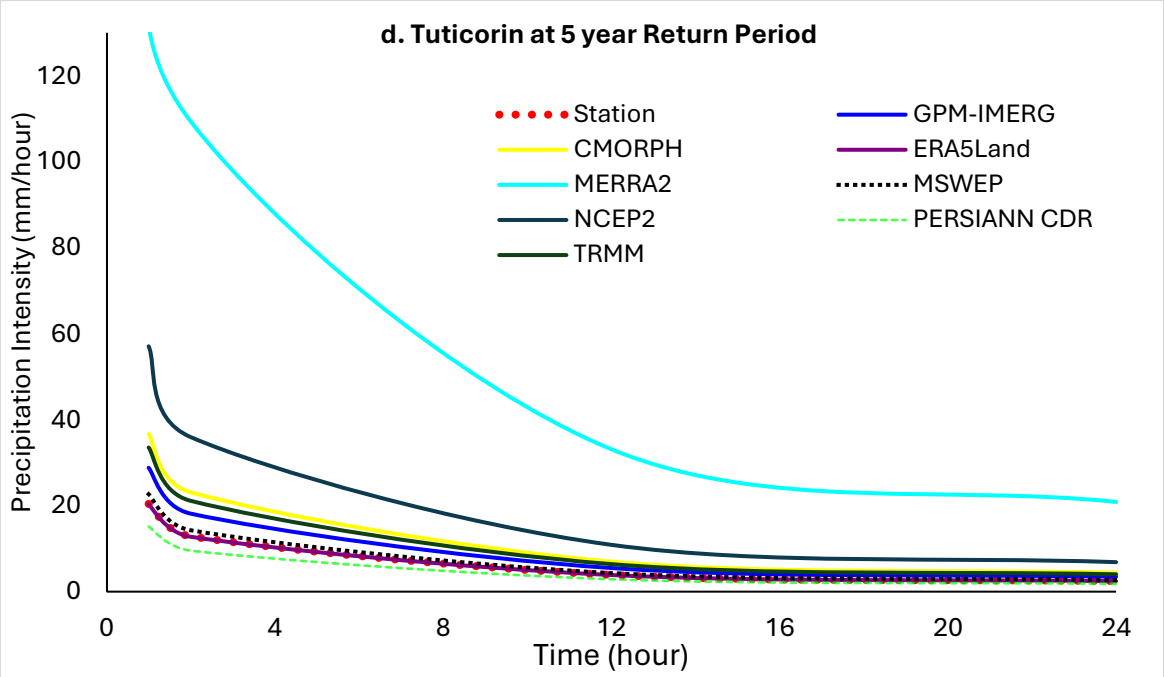
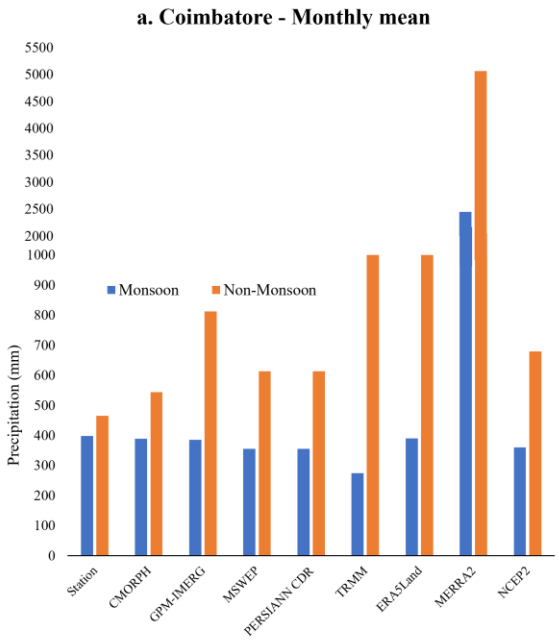
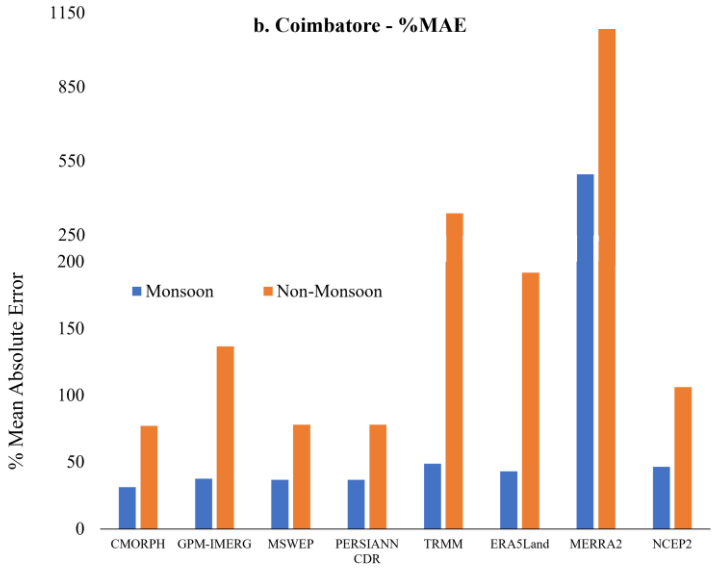
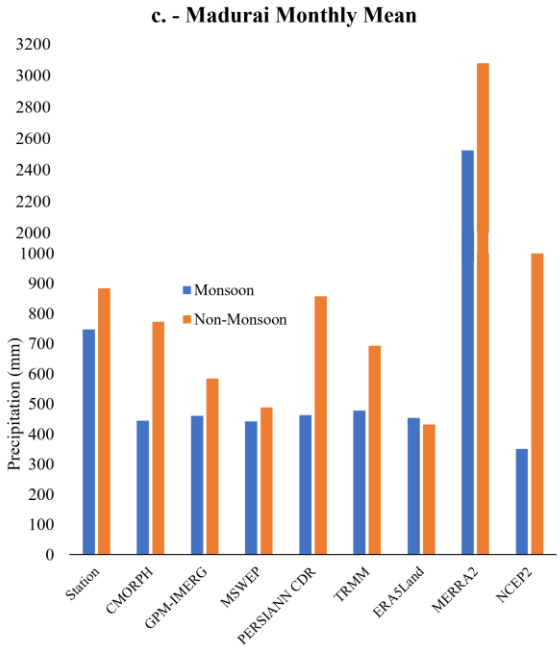
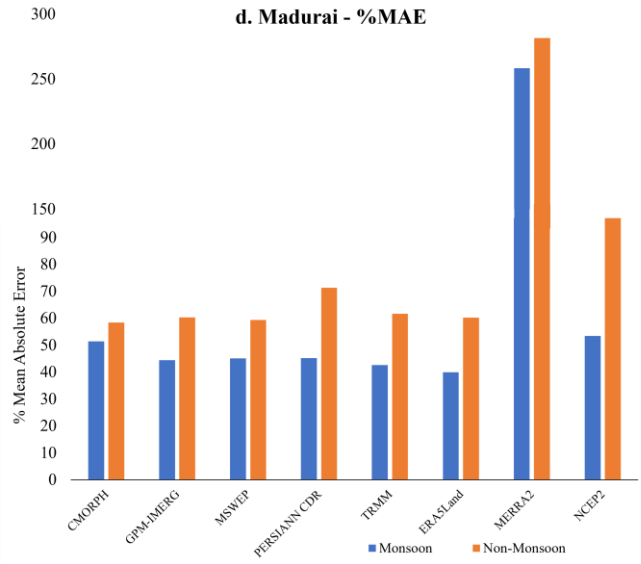


Figure 2. Intensity Duration Frequency (IDF) curves based on daily extreme (maximum) precipitation values for the study regions at 5 return period


a. Coimbatore - Monthly mean
Precipitation (mm)
Monsoon
Non-Monsoon
Station
CMORPH
GPM-IMERG
MSWEP
PERSIANN CDR
TRMM
ERA5Land
MERRA2
NCEP2


b. Coimbatore - %MAE
% Mean Absolute Error
Monsoon
Non-Monsoon
CMORPH
GPM-IMERG
MSWEP
PERSIANN CDR
TRMM
ERA5Land
MERRA2
NCEP2


c. - Madurai Monthly Mean
Precipitation (mm)
Monsoon
Non-Monsoon
Station
CMORPH
GPM-IMERG
MSWEP
PERSIANN CDR
TRMM
ERA5Land
MERRA2
NCEP2


d. Madurai - %MAE
% Mean Absolute Error
CMORPH
GPM-IMERG
MSWEP
PERSIANN CDR
TRMM
ERA5Land
MERRA2
NCEP2
Monsoon
Non-Monsoon

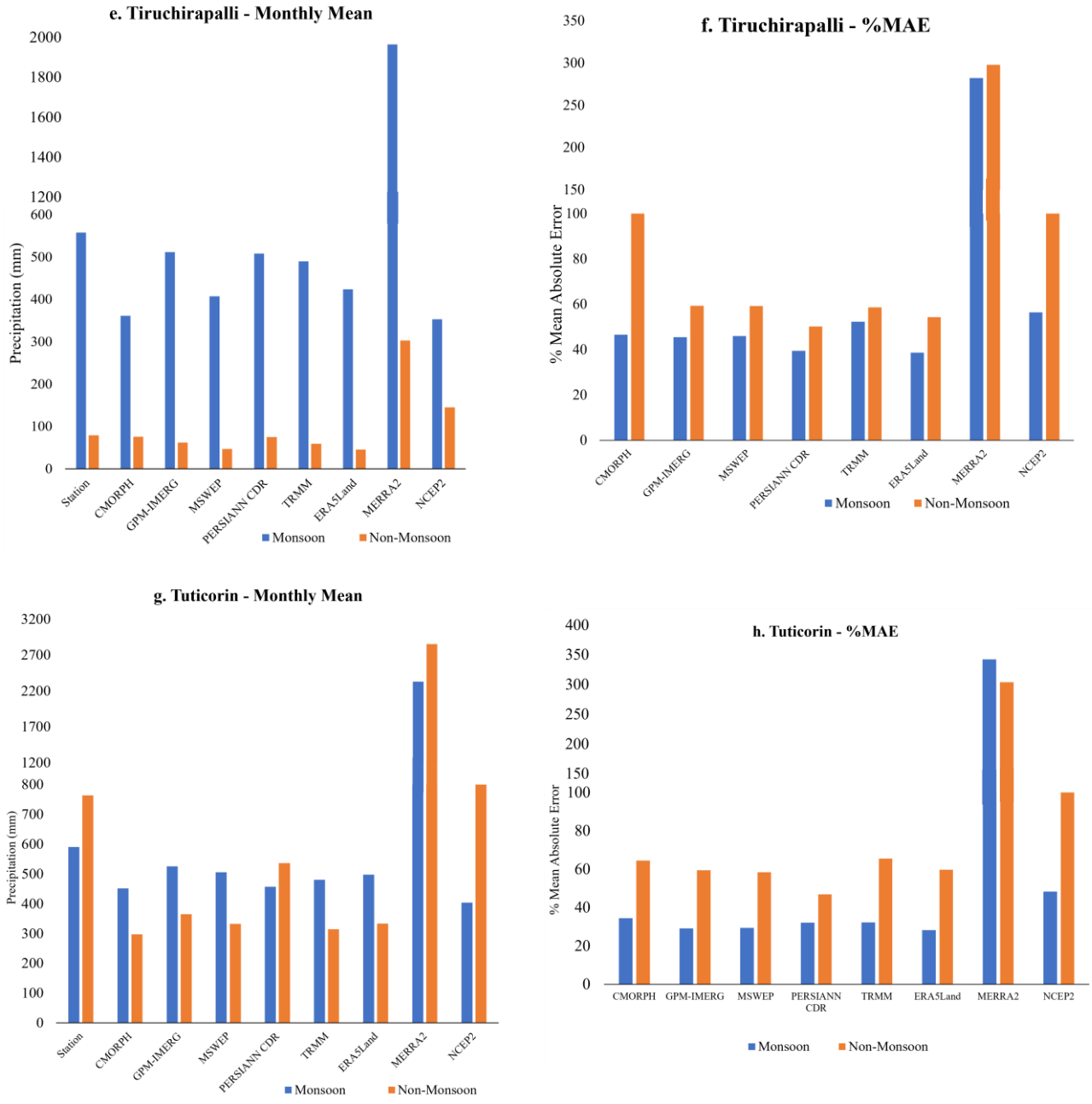


Figure 3. Monthly Mean and %MAE of different precipitation products with respect to Station data in Coimbatore (a,b), Madurai (c,d), Tiruchirapalli (e,f) and Tuticorin (g,h)

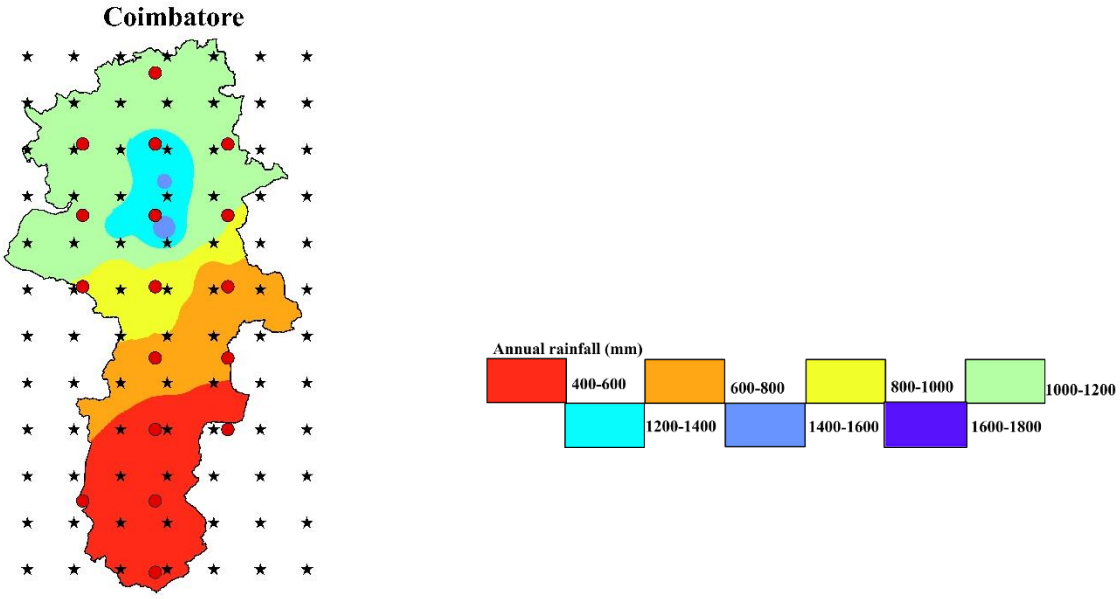


Figure 8. Mean annual precipitation for the Station data at Coimbatore. *Red dots represent the station data and stars denote the linearly interpolated grids*. *As the inclusion of station data is relevant information for station data spatial maps, it will be revised as given above and included with the other spatial maps in the revised manuscript*.

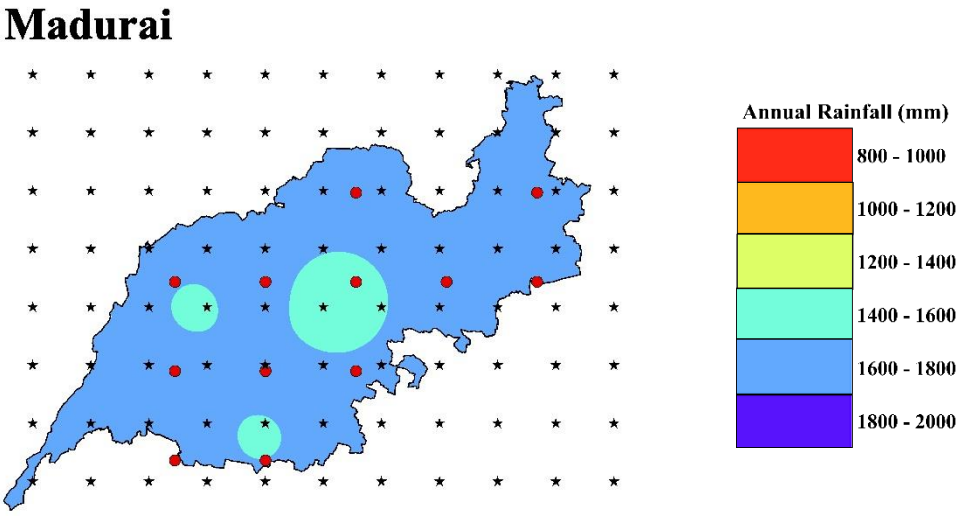


Figure 9. Mean annual precipitation for the Station data at Madurai. *Red dots represent the station data and stars denote the linearly interpolated grids*. *As the inclusion of station data is relevant information for station data spatial maps, it will be revised as given above and included with the other spatial maps in the revised manuscript*.

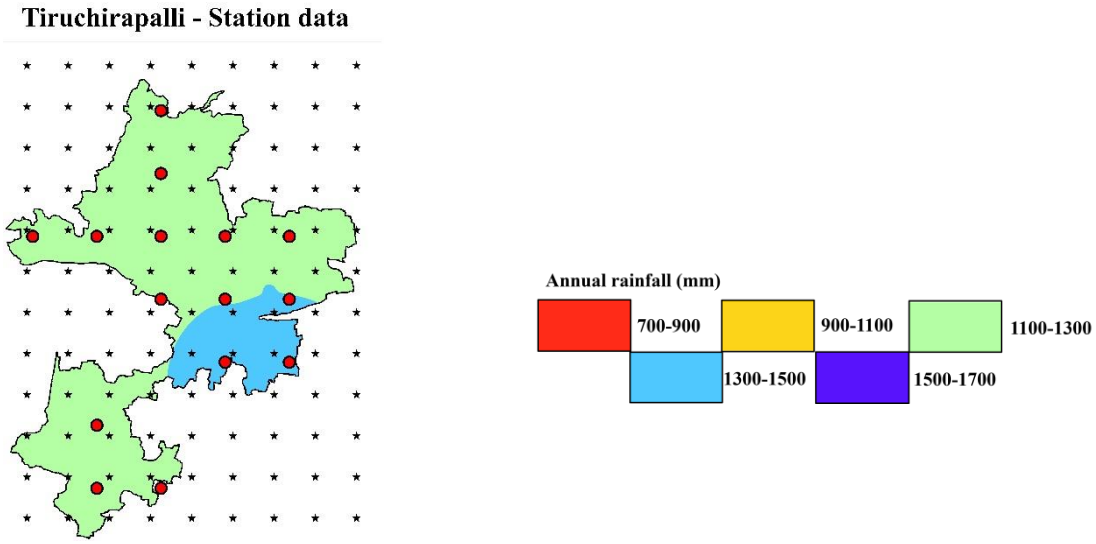


Figure 10. Mean annual precipitation for the Station data at Tiruchirapalli. *Red dots represent the station data and stars denote the linearly interpolated grids*. *As the inclusion of station data is relevant information for station data spatial maps, it will be revised as given above and included with the other spatial maps in the revised manuscript*.

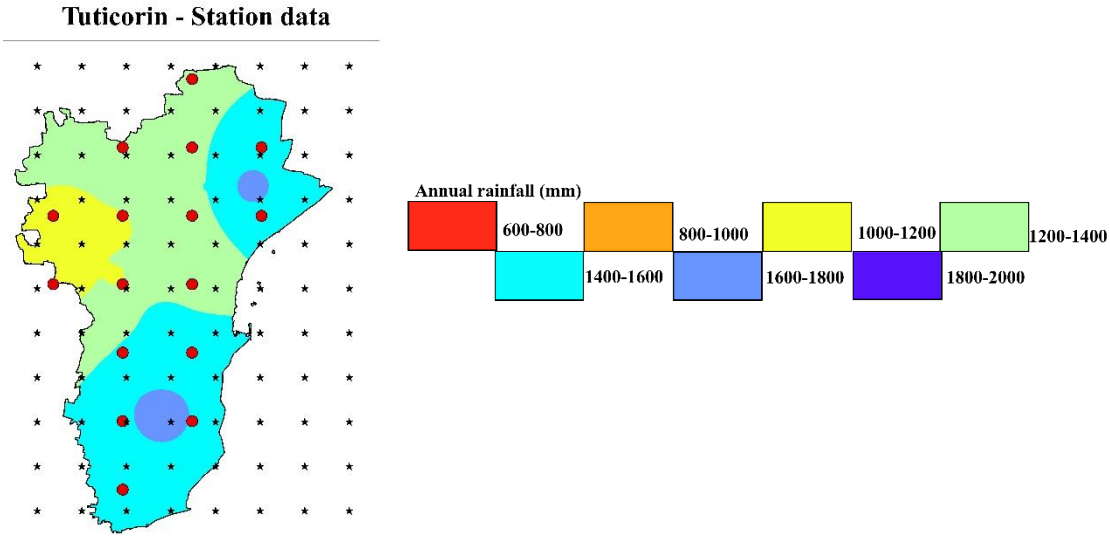


Figure 11. Mean annual precipitation for the Station data at Tuticorin. *Red dots represent the station data and stars denote the linearly interpolated grids*. *As the inclusion of station data is relevant information for station data spatial maps, it will be revised as given above and included with the other spatial maps in the revised manuscript*.

References

Duan, Z., Liu, J., Tuo, Y., Chiogna, G., and Disse, M.: Evaluation of eight high spatial resolution gridded precipitation products in Adige Basin (Italy) at multiple temporal and spatial scales, Science of the Total Environment, 573, 1536–1553, https://doi.org/10.1016/j.scitotenv.2016.08.213, 2016.

Ghebreyesus, D. T., & Sharif, H. O. (2021). Development and assessment of high-resolution radar-based precipitation intensity-duration-curve (IDF) curves for the state of Texas. *Remote Sensing*, *13*(15), 2890.

Huffman, George J. &, Pendergrass, Angeline & National Center for Atmospheric Research Staff (Eds). Last modified 2023-09-04 "The Climate Data Guide: TRMM: Tropical Rainfall Measuring Mission." Retrieved from https://climatedataguide.ucar.edu/climate-data/trmm-tropical-rainfall-measuring-mission on 2024-01-01.

Liu, J., Duan, Z., Jiang, J., Zhu, A.X., 2015. Evaluation of three satellite precipitation products TRMM 3B42, CMORPH, and PERSIANN over a subtropical watershed in China. Adv. Meteorol. 2015 https://doi.org/10.1155/2015/151239.

Ombadi, M., Nguyen, P., Sorooshian, S., & Hsu, K. L. (2018). Developing intensity-duration-frequency (IDF) curves from satellite-based precipitation: Methodology and evaluation. *Water Resources Research*, *54*(10), 7752-7766.

Rajeevan, M., Bhate, J., Kale, J. D., & Lal, B. (2005). Development of a high resolution daily gridded rainfall data for the Indian region. Met. Monograph Climatology, 22, 2005.

Shukla, A.K., Ojha, C.S.P., Singh, R.P., Pal, L., Fu, D., 2019. Evaluation of TRMM precipitation dataset over Himalayan Catchment: the upper Ganga Basin, India. Water (Switzerland) 11 (3). https://doi.org/10.3390/w11030613.