# Response to Anonymous Referee # 2:

The authors would like to thank Referee # 2 on providing valuable feedback on the manuscript. We duly acknowledge the value of the comments of Referee # 2 and have incorporated changes in the manuscript and the supplementary section accordingly. The remaining portion of this document provides a specific account of the authors' responses to the comments provided by Referee # 2. Please note that comments of Referee # 2 are marked in red, and the corresponding responses are provided in black text.

**Comment**: The manuscript is logically structured, and written very well with adequate contextualization, clarity in objectives, description of methodology and discussion of results. Authors have put huge efforts to address the needs of such ready-to-use database and to develop a web-based platform to disseminate the dataset.

**Response**: The authors thank the anonymous reviewer for his/her positive comments.

**Comment**: However, they have simply used available APHRODITE and CFSR reanalysis products to calculate the statistics and named the product with data from two sources as the new dataset. Authors may consider clarifying whether it's good enough to consider this as new dataset.

**Response**: The authors firmly believe that the Asia Pacific Weather Statistics (APWS) dataset presented in the manuscript, is indeed a new statistics dataset designed for SWAT models, that is derived from APHRODITE and CFSR products. We agree with the reviewer that APWS statistics are derived from existing weather products. However, the choice of statistics derived from each product (specifically derivation of rainfall statistics from APHRODITE), plays an important role in ensuring that the synthetic weather generated from APWS is more accurate than the weather generated from the existing statistics dataset available for the Asia Pacific region. We illustrate this in the context of hydrologic modeling using SWAT and our findings are discussed in Section 4.5 of the revised manuscript.

Rainfall is the primary driver of hydrological cycle in majority of river basins in Asia Pacific region. Precise and gap-free rainfall data is thus needed for robust hydrological model setup. Soil and Water Assessment Tool (SWAT) is a widely established hydrological model, which uses an inherent weather generator (WXGN) to fill gaps in meteorological inputs. It is also possible to generate entirely new series of synthetic weather such as rainfall, maximum and minimum temperatures, relative humidity, wind speed and solar radiation, based on user-defined weather statistics in the WXGN. Currently, river basins in the contiguous US are benefitted for meteorological gap filling by the availability of the First Order US stations weather statistics database, which is in-built within SWAT model. For river basins outside USA, user needs to specify the statistics manually using long-term daily observed data (20 years or more), which is cumbersome and error-prone, and mostly unavailable in data-scarce regions. Alternatively, the user can define such statistics using existing CFSR database available at 0.38-degree spatial resolution. However, CFSR statistics are computed using reanalysis CFSR daily data, which has been reported to have inferior performance compared to APHRODITE in several river basins of Asia Pacific (please refer 137-141 and references cited therein). Thus, daily data series of APHRODITE from 1981-2007 (more than 20 years) are used to derive rainfall-related weather statistics for APWS, across the Asia Pacific region at 0.25-degree resolution.

Since APHRODITE only includes daily rainfall series, rainfall-related weather statistics for APWS are derived from it and remaining weather statistics are interpolated from the CFSR product. For the convenience of potential SWAT modelers, APWS is disseminated in SWAT-ready format via a web-platform for any region of interest within Asia Pacific. As such, no other weather statistics dataset (to be used for synthetic weather generation) employing observed rainfall is available at the presented resolution for Asia Pacific region.

Furthermore, the originality of APWS dataset has been highlighted in the revised manuscript at the end of Introduction section, along the lines 98-99.

**Comment**: Furthermore, evaluation by comparing performance between APHRODITE and CFSR may not be convincing enough unless validated with observe datasets at several ground stations.

**Response**: To further validate the APHRODITE and CFSR statistics at several ground stations, we chose 15 additional countries (36 meteorological stations) from the Asia-Pacific (see Figure S1) to evaluate the performance of observed (NOAA derived from https://www.ncdc.noaa.gov/cdo-web/datatools/findstation), APHRODITE and CFSR rainfall during 1981-2007. The list of stations selected, their basic information and their comparison statistics (summarized via Nash Sutcliffe Efficiency (NSE) and Percent-Bias (PBIAS)) with APHRODITE and CFSR are shown in the Table below (this Table is also included in revised Supplementary Document). Moreover, observed, APHORDITE-based and CFSR-based rainfall data are visually compared and presented in Figures A (cumulative mean monthly time-series) and B (cumulative monthly distribution) below (these Figures are also included in the revised Supplementary Document).

Table: List of rainfall stations used for comparison, along with their location information and statistics (NSE and PBIAS) against monthly NOAA observed rainfall during 1981-2007

| Stations | Country | Lat | Long | Elevation | NSE | | PBIAS | |
|---|---|---|---|---|---|---|---|---|
| | | | | | APHRODITE | CFSR | APHRODITE | CFSR |
| AGARTALA | India | 23.88 | 91.25 | 16.00 | 0.85 | -1.73 | -10.50 | 55.5 |
| AHMADABAD | India | 23.07 | 72.63 | 55.00 | 0.87 | 0.84 | -31.8 | -0.90 |
| ALYANGULA POLICE | Australia | -13.85 | 136.42 | 20.00 | 0.75 | 0.90 | -32.1 | 11.20 |
| AMBON PATTIMURA | Indonesia | -3.70 | 128.08 | 12.00 | 0.57 | 0.59 | -8.00 | -15.2 |
| AMRITSAR | India | 31.71 | 74.80 | 230.40 | 0.50 | 0.51 | -45.30 | -46.4 |
| ANQING | China | 30.53 | 117.05 | 20.00 | 0.96 | 0.90 | -6.2 | 0.70 |
| ANYANG | China | 36.05 | 114.40 | 64.00 | 0.96 | 0.91 | -9.10 | -11.8 |
| ARANYAPRATHET | Thailand | 13.70 | 102.58 | 49.00 | 0.88 | 0.76 | -19.9 | 11.30 |
| BAISE | China | 23.90 | 106.60 | 177.00 | 1.00 | 0.61 | 0.70 | 40.1 |
| BANG NA AGROMET | Thailand | 13.67 | 100.62 | 6.00 | -0.89 | -0.16 | -56.6 | -36.90 |
| BAR KHAN | Pakistan | 29.88 | 69.72 | 1098.00 | 0.45 | -0.52 | -16.80 | -49.7 |
| BATAM HANG NADIM | Indonesia | 1.12 | 104.12 | 24.00 | -2.11 | -1.35 | -64.6 | -50.30 |
| BAU BAU BETO AMBIRI | Indonesia | -5.47 | 122.62 | 2.00 | -28.00 | -276.93 | 83.40 | 309.9 |
| BINTULU | Malaysia | 3.20 | 113.03 | 5.00 | -1.28 | -6.16 | -27.20 | -47 |
| BRUNEI INTERNATIONAL | Brunei | 4.94 | 114.93 | 22.30 | 0.51 | -2.41 | -8.00 | -39.3 |
| CA MAU | Vietnam | 9.18 | 105.15 | 2.00 | 0.17 | -1.70 | 52.90 | 103.4 |
| DANANG INTERNATIONAL | Vietnam | 16.04 | 108.20 | 10.10 | 0.38 | -0.38 | 60.40 | 106.8 |
| DANIEL Z ROMUALDEZ | Philippines | 11.23 | 125.03 | 3.00 | 0.47 | -2.34 | 18.80 | 31 |
| DONGFANG | China | 19.10 | 108.62 | 8.00 | 0.95 | 0.69 | 11.30 | 38.6 |
| H AS HANANDJOEDDIN | Indonesia | -2.75 | 107.76 | 51.00 | 0.48 | 0.47 | -15.3 | 3.60 |
| HAMBANTOTA | Sri Lanka | 6.12 | 81.13 | 20.00 | 0.88 | 0.63 | -6.10 | -21.1 |
| K. PARAMATHY | India | 10.95 | 78.08 | 181.00 | 0.00 | 0.47 | -66.4 | -34.70 |
| KIUNGA W.O. | Papua New Guinea | -6.08 | 141.18 | 35.00 | -7.61 | -2.48 | -58.5 | -33.40 |
| KUANTAN | Malaysia | 3.62 | 103.22 | 16.00 | -0.11 | 0.57 | -44 | -9.50 |
| M.O. RANCHI | India | 23.32 | 85.32 | 652.00 | 0.90 | 0.74 | -24.7 | -4.80 |
| MADANG W.O. | Papua New Guinea | -5.22 | 145.80 | 4.00 | -2.76 | -1.28 | -53.3 | -35.40 |
| MALACCA | Malaysia | 2.26 | 102.25 | 10.70 | -0.40 | -1.70 | -21.5 | 15.30 |
| NABIRE | Indonesia | -3.37 | 135.50 | 6.10 | -78.54 | -136.19 | -70.40 | -93.2 |
| PADANG TABING | Indonesia | -0.88 | 100.35 | 3.00 | -0.27 | -1.93 | -20.90 | 38.1 |
| PENANG INTERNATIONAL | Malaysia | 5.30 | 100.28 | 3.40 | 0.01 | -7.83 | -31.10 | 96.4 |
| PHNOM PENH INTERNATIONAL | Cambodia | 11.55 | 104.84 | 12.20 | -9.85 | -42.30 | 127.80 | 324 |
| PHU QUOC | Vietnam | 10.22 | 103.97 | 4.00 | 0.60 | -0.49 | 31.30 | 63.2 |
| PORT MORESBY W.O. | Papua New Guinea | -9.38 | 147.22 | 48.00 | 0.84 | -0.07 | -20.40 | -56.1 |
| SAVANNAKHET | Laos | 16.55 | 104.77 | 155.10 | -6.87 | -137.00 | 66.40 | 416.2 |
| SINGAPORE CHANGI INTERNATIONAL | Singapore | 1.35 | 103.99 | 6.70 | 0.59 | -0.48 | -8.80 | 20.6 |
| SURIGAO | Philippines | 9.80 | 125.50 | 55.00 | 0.33 | 0.79 | 28.5 | 2.30 |

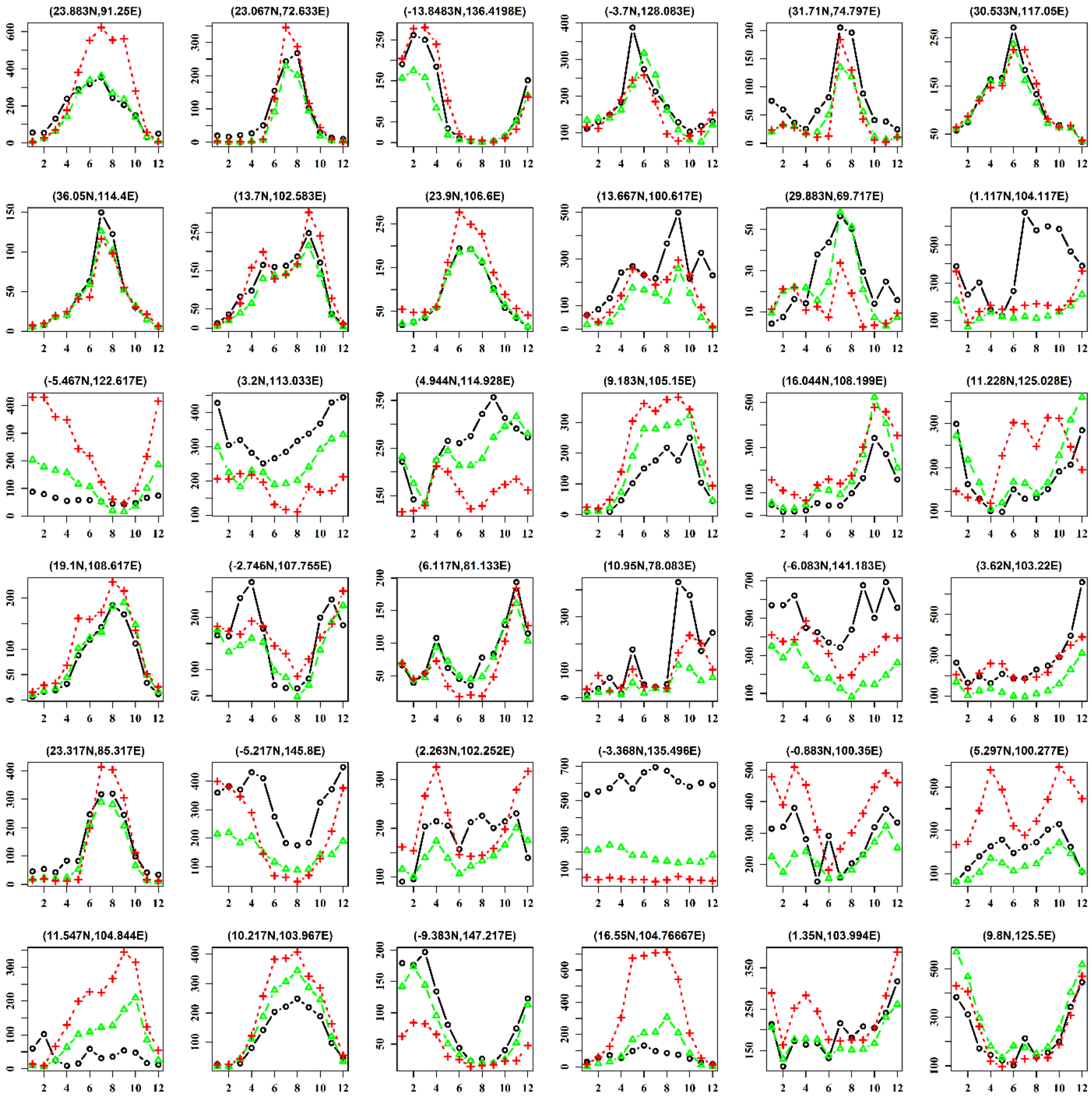

Figure A: Plots of cumulative monthly (averaged across years) OBS (black with circle), APHRODITE (green with triangle) and CFSR (red with cross) rainfall (mm) during 1981-2007

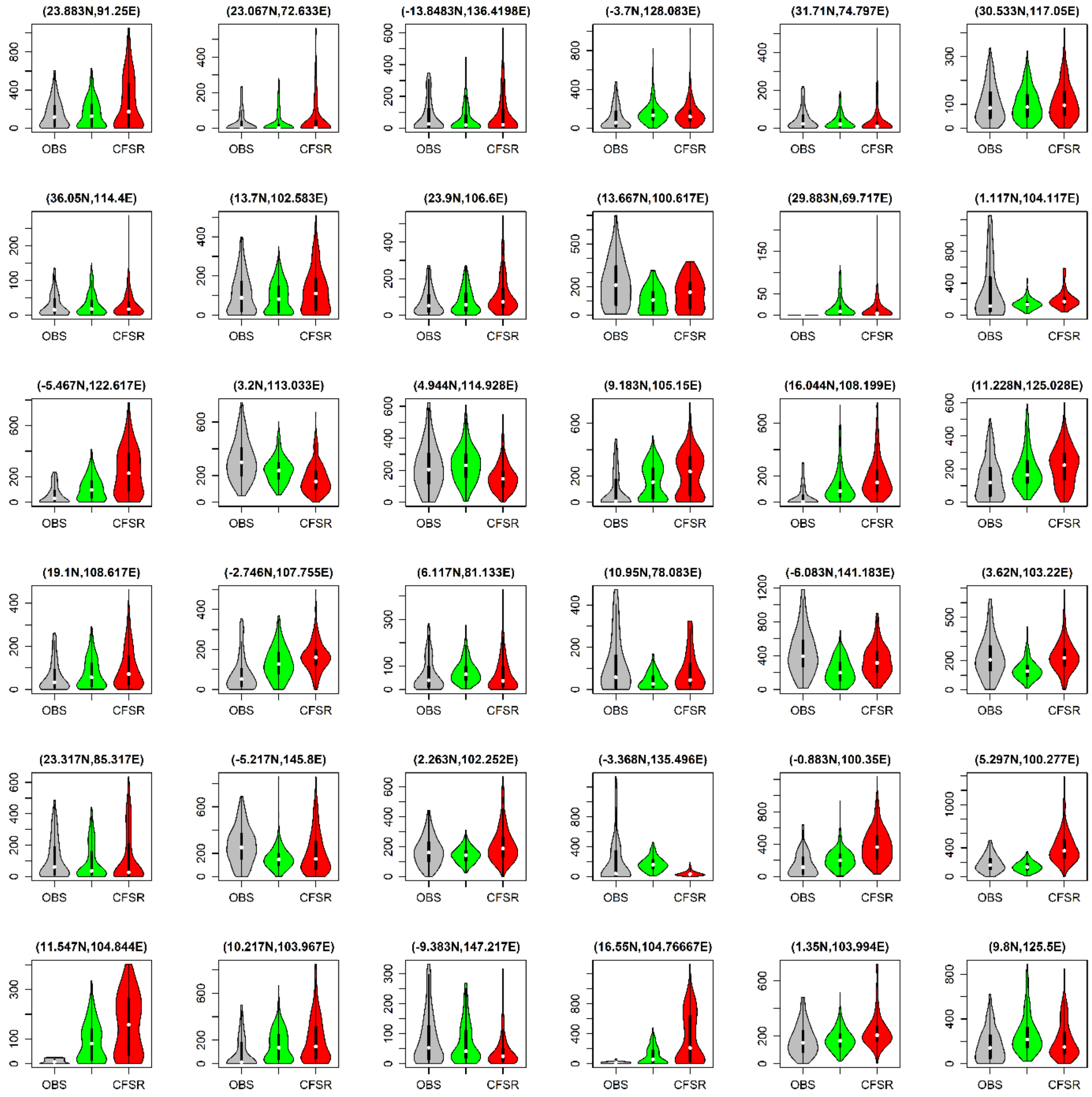

Figure B: Density distribution plots of cumulative monthly OBS (black), APHRODITE (green) and CFSR (red) rainfall during 1981-2007

The visual comparison of observed (OBS derived from the NOAA), APHRODITE and CFSR rainfall data, along with time series based statistics such as NSE and PBIAS clearly show that APHRODTE outperforms CFSR in multiple locations across the Asia-Pacific and thus validates the use of APHRODITE for deriving rainfall statistics for the APWS dataset. It is also worthwhile to note that countries like Indonesia, Papua New Guinea, Cambodia and Laos are exhibiting highest discrepancies (for both APHRODITE and CFSR) compared to the observed datasets. This is expected as these countries have scarce rain-gauge networks and thus are unable to adequately represent the climatology and a significant portion of observed data is missing. Rainfall products like APHRODITE make use of surface stations to interpolate a continuous grid of data. If the surface rainfall stations are scant or not included in the interpolation process of APHRODITE or CFSR, the generated data may also have huge discrepancies, compared with observed data. Thus, the user needs a careful scrutinization of data before its usage. The visual interface of APWS (https://hydrawater.shinyapps.io/APWS/) allows a user to visually analyze and validate the APWS data (via rainfall and temperature time-series plots) before potential use in synthetic weather generation and hydrologic modelling.

We have included the above detailed comparative analysis of observed rainfall data with APHRODITE and CFSR in the supplementary section of the revised manuscript and have also included a summary of our findings in lines 136-141 (Section 3.1) of the main manuscript.

**Comment**: Furthermore, it would be good to provide Author’s view/recommendation on the size of the basins that the data can be applied with reasonably good accuracy, and other considerations and/or limitations that the potential user should be aware of while using the dataset.

**Response**: A section has been added in the revised manuscript wherein general recommendations regarding the usage of data have been given. Please refer to lines 329-341 of the revised manuscript for the following revision:

**Revision**: A preliminary analysis of six hydrological stations (3 in each basin) in this study suggests that smaller river basins (within few thousand square kilometers) are likely to benefit more from the developed APWS dataset (for e.g. refer to locations of Haa and Jomsom stations in Wangchhu and in Narayani river basins in Fig. 4 and check their performances in Fig. 7 and Fig. 8). First order river basins exhibit higher variability among the flows simulated by different weather statistics than the second and tertiary order river basins (again refer to Fig. 4 and Fig. 7 and Fig. 8). Hence, synthetic rainfall generation from a more accurate statistics dataset like APWS is recommended for first over basins.

Our analysis also indicates that, for the two study basins, observed precipitation data gaps in the range of 0-30% are can be adequately filled with synthetic data using APWS. Performance of SWAT deteriorates significantly if more than 30% of observed precipitation data is missing. Hence, it is recommended that APWS be used in SWAT scenarios, where up to 30% observed rainfall data is missing (for larger basins, even 50% missing data scenarios may be acceptable). It should also be noted that this percentage threshold (i.e., 30%) may be an over-estimation for highly arid basins, where typically, the entire annual rainfall occurs within a day or two.