APHRODITE-2 Daily grid precipitation analysis algorithm V1801R1 & its difference from that of V1101

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1. Introduction

In order to represent extreme precipitation and use our product for improving precipitation forecasts, APHRODITE-2 project began in June 2016. As the first batch of this project, here we release "no mixed EOD (End of the day)" version as described below. Next, we will release EOD adjusted product. We fixed some bugs that was found with V1801 which was released on 27 September 2018, so we named current product as V1801R1.

2. Main improvement

In order to represent extreme precipitation (heavy rainfall, continuous 0 mm rainfall) in our gridded product, we are taking the three improvement below.

1. Check end of the day (EOD) and do not mix different EOD data at the same domain
2. Station value is conserved (SVC) at 0.05 degree grid box, if there is one or more station there.
3. Refined quality control (QC) to make out real extreme and error.

2.1 EOD

In some countries, precipitation is observed hourly or 10 minutes, and in other countries, precipitation is measured in the morning or at regulated time manually. For example, in India, "daily precipitation" is observed in the morning (8:30 local time, LT), and stamped on that day. 8:30LT corresponds to 03 UTC (universal time). Hence, if station data shows 10 mm/day on August 31st, then, 10 mm rainfall is observed from 03 UTC of August 30th to 03 UTC of August 31st. We call this record as "EOD = 03 UTC". In the previous and current APHRODITE products, daily grid precipitation data over India ends at 03 UTC of recorded time, and start time is -21 which is 24 hours before the EOD. The hydrometeorological service of most South Asian countries (Bhutan, India, Nepal and Pakistan), EOD = 03 UTC, and the data they send to global telecommunication system (GTS), which is available via global summary of day of NOAA, is also EOD = 03 UTC.

In Japan, we have AMeDAS network based on 10 minutes automatic measurements, and we can accumulate hourly and/or daily values at any interval from 10 minutes observation. In APHRO_JP, we made grid precipitation according Japan standard time (JST), which is from 15 UTC of previous day to 15 UTC of the stamped date. In this case,

EOD=15. Further, Japan Meteorological Agency (JMA) sends either 6-hrly, 12-hrly or 24-hrly precipitation to GTS network according to the WMO's regulation. (e.g. Synoptic stations (relatively big station) must send previous 24-hr rainfall at 00 UTC). This leads different EOD data are archived at GSOD database, although it contains flags of their processing. In previous version (V1101), we use only AMeDAS for APHRO_JP, but we used both AMeDAS and GTS based data for APHRO_MA_V1101.

So, in V1801, we check EOD of each data file and we carefully select data to use. Especially, we decide not to use different EOD data in a domain (mostly in a country).

2.2 SVC

When we interpolate station values (or ratio of the station value to climatology), we take several to several decadal number of station data around the target grid (box) into consideration. Hence, if extremely heavy and localized precipitation occurs at or very near to the grid (box), using surrounding many station data may cause underestimate of the target grid. In V1801, after interpolation of ratio to climatology and after getting grid precipitation values by multiplying ratio to climatology, we put the original station value to the 0.05 degree grid box, if the grid box has a station. That means, station value is conserved (SVC) at each 0.05 grid box. If there are two or more stations in a grid box, we average them and put the averaged value into the grid box.

Same way, if the grid has no rainfall, but if surrounding stations have rainfall, V1101 showed some precipitation. But V1801 conserves the station value at 0.05 degree (intermediate) file, we can get statistics of "0 mm" at the grid.

For the publicly released data, we regrid 0.05 grid to 0.25/0.5 degree, and station value is no more conserved (see Figures 1 and 2).

2.3 QC

We are using automatic quality control program (Hamada et al., 2011) and put flags for the suspicious value. If a large value exceeds "country record" of the country, the data was automatically neglected. However, we have sometimes record-breaking heavy rainfall, and sometimes "country record" information of historical maximum is not available. In order to distinguish the real extremes with errors, we compared the large amount values with satellite estimates. Then we put specific errors to "black list" and real extremes to "white list".

3. Difference from V1101

1) In V1101, we try to collect and use data as many as possible. However, in V1801 we

do not use GSOD if we have enough offline data, and we do not use data of different EOD in a country. So, number of data to use is smaller in V1801 than V1101.

2) We applied SVC for V1801. So, we get extreme precipitation value (incl. "0") at the 0.05 degree box, and

3) More detailed QC using satellites. However, QC'ed information are used for V1101_EX (2007-2015).

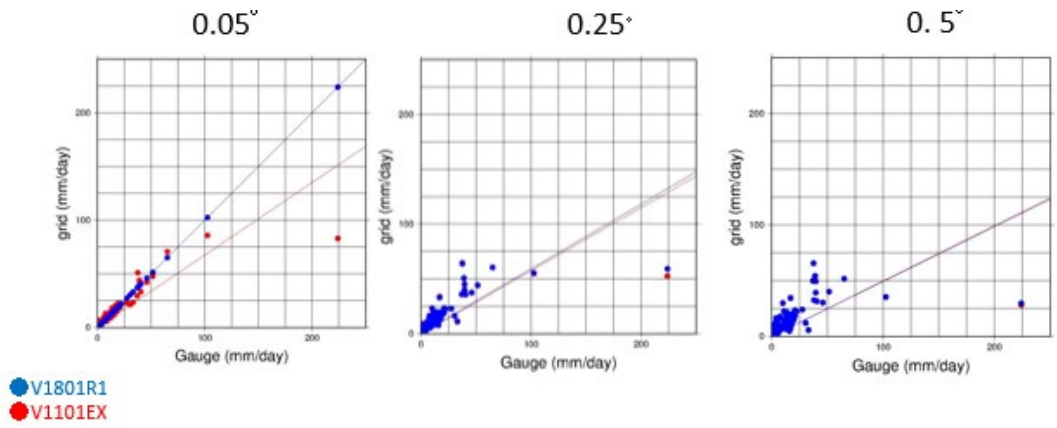

Figure 1 Scatter plots between rain-gauge value and gridded values.
At a station in Hiroshima prefecture (132.53E, 34.54N) in the year 2014. Left: 0.05 degree, Middle: 0.25 degree, Right: 0.5 degree. Red shows V1101EX and blue shows V1801R1 (current).

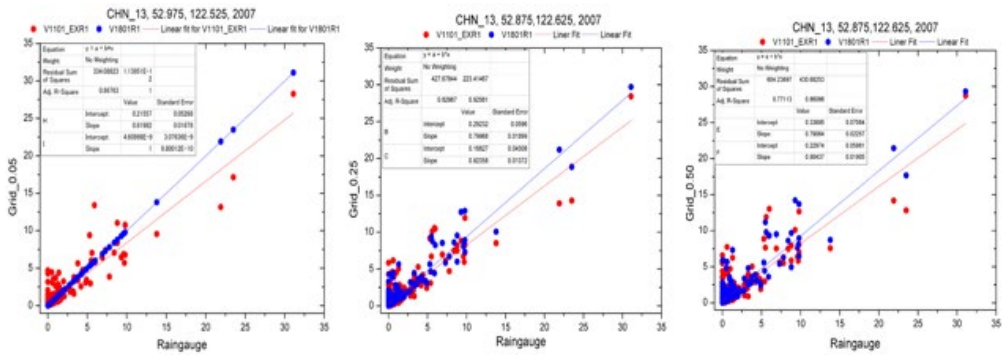

Figure 2 The same with Fig.1 but for a station in North China (122.6E, 52.9N) for the year 2007.

The difference is clear in 0.05 degree data (it is not publically open). At an example station in Japan (which had Hiroshima heavy rainfall event in 2014), difference between V1801R1 and V1101EX is only seen with 0.05 degree product. However, at a station in North China (Fig.2), 0.25/0.5 degree products show closer value to original station, and hence, it shows more extreme precipitation characteristics.

4. Period

V1801 is given for 1998-2015, and temporal resolution is "daily."

5. Region

We use the same domain with that of V1101.

For monsoon Asia, MA: 60.0E - 150.0E, 15.0S - 55.0N

However, due to un-mixed EOD strategy, number of used data is fewer compared to that of V1101 of the same year. If we do not have data at some area (e.g. around Kazakhstan Papua New Guinea and Indonesia), we masked them. If you do need to use some data over there, please use V1101EX.

6. File Format

Name: APHRO_MA_V1801.yyyy (yyyy: year)

Parameters: precipitation (mm/day)

RSTN (ratio of 0.05 grid box containing stations (%)

NetCDF data is also available.

7. Reference paper (tentative)

Yatagai, A., N. Yasutomi, M. Maeda, M. Masuda S. Khadgarai, (2018): Impact of no-mixed end-of-the-day and station value conservation to represent extremes precipitation over East Asia, (manuscript under preparation.)

(for Japanese users, you may see an abstract B303 of Japan Meteorological Society's fall meeting 2018.)

8. Contact

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