The New Version 2.3 of the Global Precipitation Climatology Project (GPCP) Monthly Analysis Product

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R. Adler, M. Sapiano, G. Huffman, D. Bolvin, G. Gu, J. Wang, E. Nelkin, P. Xie, L. Chiu, R. Ferraro, U. Schneider, A. Becker

The GPCP has been in existence for over twenty years as part of the Global Energy and Water Cycle Exchanges (GEWEX) effort under the World Climate Research Program (WCRP). The GPCP Monthly product provides a consistent analysis of global precipitation from an integration of various satellite data sets over land and ocean and a gauge analysis over land (Huffman et al., 1997). Improvements to the original version have been made at irregular intervals over the past years (Adler et al., 2003; Huffman et al., 2009) with Version 2.2 being available since 2012.

During the last few years the GPCP group has been working with NOAA through the University of Maryland to streamline the multi-organization data streams, processing procedures and associated computer code to make the current GPCP Version 2 a part of NOAA's Climate Data Record (CDR) [now Reference Environmental Data Record (REDR)] program.

In addition, during the last several years small changes or shifts (decreases) in mean precipitation were noted for the post-2003 period over oceans that did not appear to be natural. After extensive analysis, these changes were determined to be related to subtle shifts in input satellite precipitation estimates due to transitioning from one satellite to the next using inadequate overlap and cross-calibration procedures.

New cross-calibration procedures were developed, tested and applied to correct the problems and have been incorporated into the new Version 2.3, which will be the version to become part of the NOAA program. Tables 1-6 indicate the quantitative changes between V2.2 and the new V2.3 for global and tropical (40N-40S) total precipitation (Total, Land, and Ocean). The corrections in V2.3 affect ocean precipitation in two ways. From January 2009 onward tropical ocean (40N-40S) precipitation increases in V2.3 by ~.03 mm/d (Table 6) due to an improved cross-calibration of estimates from SSMIS to those of the earlier SSMI estimates. From January 2003 onward ocean precipitation estimates poleward of 40N and 40S increase slightly in V2.3, varying with latitude, up to ~.04 mm/d in the region 40-60N due to a corrected cross-calibration of precipitation estimates from TOVS to AIRS. This produces a slight change over global ocean (~ .01 mm/d) from 2003-2008 (Table 2), but a larger global ocean change (~ .05 mm/d) starting in 2009 (Table 3).

In addition to changes in satellite inputs, new sets of gauge analyses became available from the Global Precipitation Climatology Center (GPCC) in Germany and these were also integrated into the analysis record, with the GPCC V7 Full analysis (Schneider et al., 2015a) being used from 1979-2013 and the GPCC Monitoring analysis V5 (Schneider et al., 2015b) being used for 2014 and beyond. There are also changes over land for the recent years due to the replacement of the GPCC Monitoring product with the GPCC Full analysis, which increases the land values by up to .04 mm/d (see Tables 3 and 6). The impact of the continuing use of the GPCC Monitoring product for the years after 2013 is under investigation.

Table 1 Global mean precipitation (P, mm day^{-1}) from GPCP V2.3 and V2.2 and their differences during 1979-2013

	Land + Ocean	Land	Ocean
V2.3	2.69	2.25	2.89
V2.2	2.68	2.23	2.88
V2.3-V2.2	0.01	0.02	0.01
Relative difference	+0.37%	+0.90%	+0.35%

Table 2 Global mean precipitation (P, mm day^{-1}) from GPCP V2.3 and V2.2 and their differences during 2003-2008

	Land + Ocean	Land	Ocean
V2.3	2.71	2.25	2.92
V2.2	2.69	2.24	2.90
V2.3-V2.2	0.02	0.01	0.02
Relative difference	+0.74%	+0.45%	+0.69%

Table 3 Global mean precipitation (P, mm day^{-1}) from GPCP V2.3 and V2.2 and their differences during 2009-2013

	Land + Ocean	Land	Ocean
V2.3	2.70	2.27	2.89
V2.2	2.65	2.23	2.84
V2.3-V2.2	0.05	0.04	0.05
Relative difference	+1.89%	+1.79%	+1.76%

Table 4 Mean precipitation (P, mm day^{-1}) between 40^{o}N-40^{o}S from GPCP V2.3 and V2.2 and their differences during 1979-2013

	Land + Ocean	Land	Ocean
V2.3	2.95	2.81	3.00
V2.2	2.93	2.80	2.99
V2.3-V2.2	0.02	0.01	0.01
Relative difference	+0.68%	+0.36%	+0.33%

Table 5 Mean precipitation (P, mm day^{-1}) between 40°N-40°S from GPCP V2.3 and V2.2 and their differences during 2003-2008

	Land + Ocean	Land	Ocean
V2.3	2.97	2.81	3.03
V2.2	2.96	2.80	3.02
V2.3-V2.2	0.01	0.01	0.01
Relative difference	+0.34%	+0.36%	+0.33%

Table 6 Mean precipitation (P, mm day^{-1}) between 40°N-40°S from GPCP V2.3 and V2.2 and their differences during 2009-2013

	Land + Ocean	Land	Ocean
V2.3	2.96	2.84	3.00
V2.2	2.92	2.81	2.97
V2.3-V2.2	0.04	0.03	0.03
Relative difference	+1.37%	+1.07%	+1.01%

These are all "small changes" (all less than 2%), but they are important when tracking trends at global and regional scales. Figs. 1 and 2 show the global and tropical totals as a function of time for the GPCP record and the effect of the corrections in V2.3 in the later years. All these changes are well within the bias error estimates for the GPCP climatology (Adler et al., 2012).

Figs. 3 and 4 focus on the zonal mean changes over the ocean. In Fig. 3 the changes are only noticeable in the higher latitudes. Fig. 4 shows the differences as a function of ocean latitude and here one can see the small, but noticeable increase in the tropics after 2009, and the latitudinal varying, both positive and negative, but overall positive, above 40° latitude. These variations are related to changes made in the weighting in the transition from SSMI/SSMIS-based estimates to AIRS-based estimates as a function of latitude above 40° latitude. Fig. 5 shows difference maps for the same periods to further illustrate the regional differences. Over land the effect of the change to the GPCC V7 Full analysis can be discerned.

A more detailed description of the changes for V2.3 and the impact on the mean fields will follow on this website and in Adler et al. (2016).

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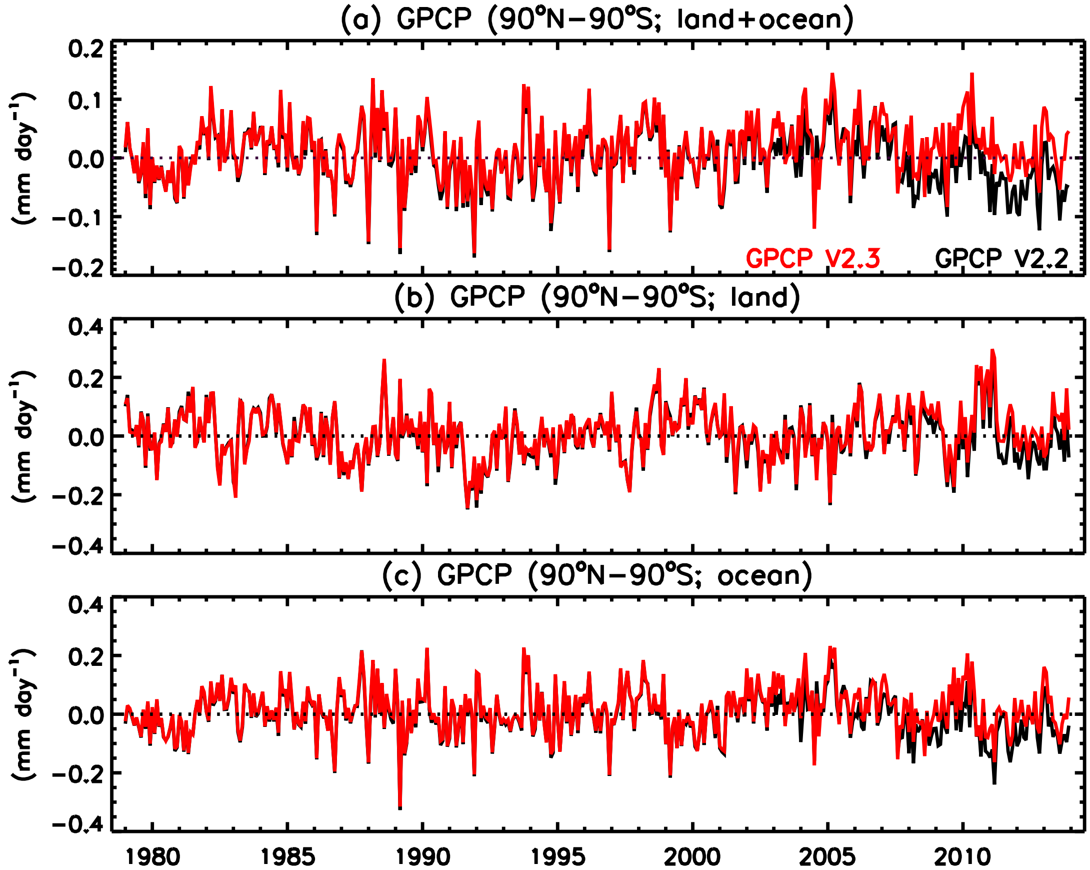

Fig. 1. Time series of global mean precipitation anomalies based on the GPCP V2.2 climatology during 1979-2012

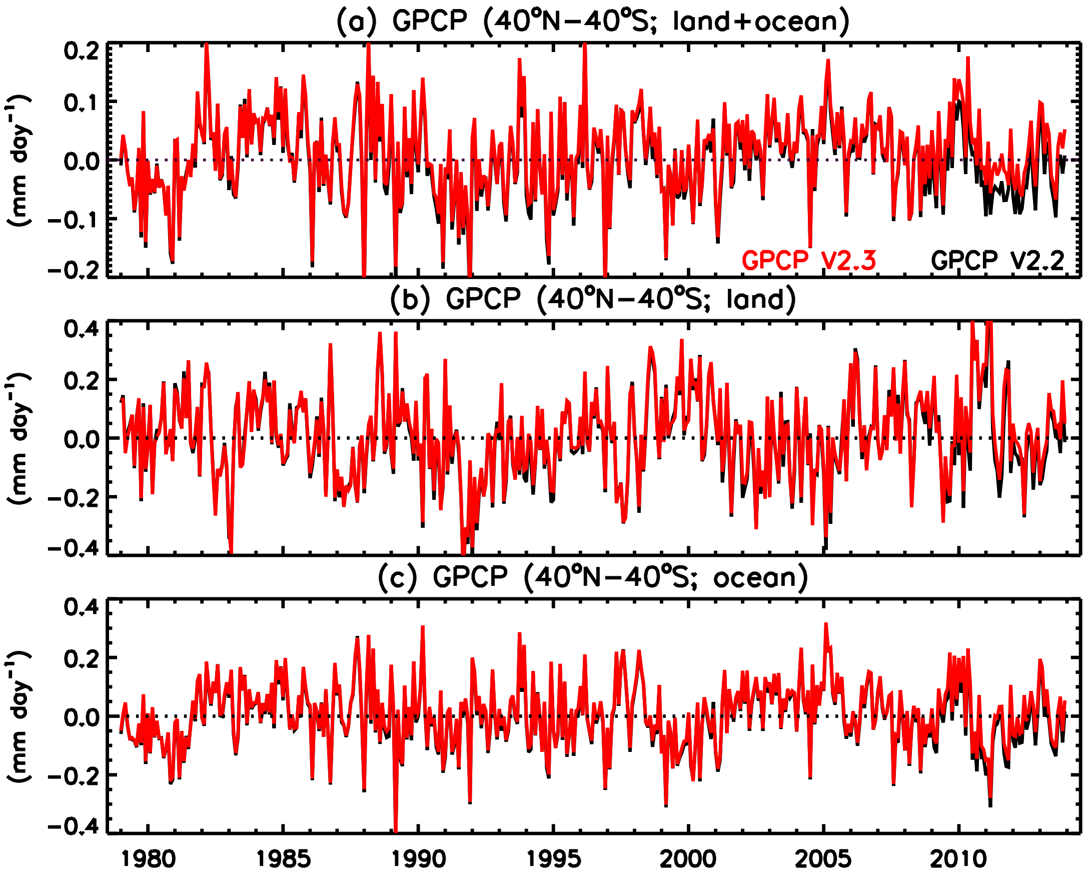

Fig. 2. Time series of mean precipitation anomalies (40°N-40°S) based on the GPCP V2.2 climatology during 1979-2012

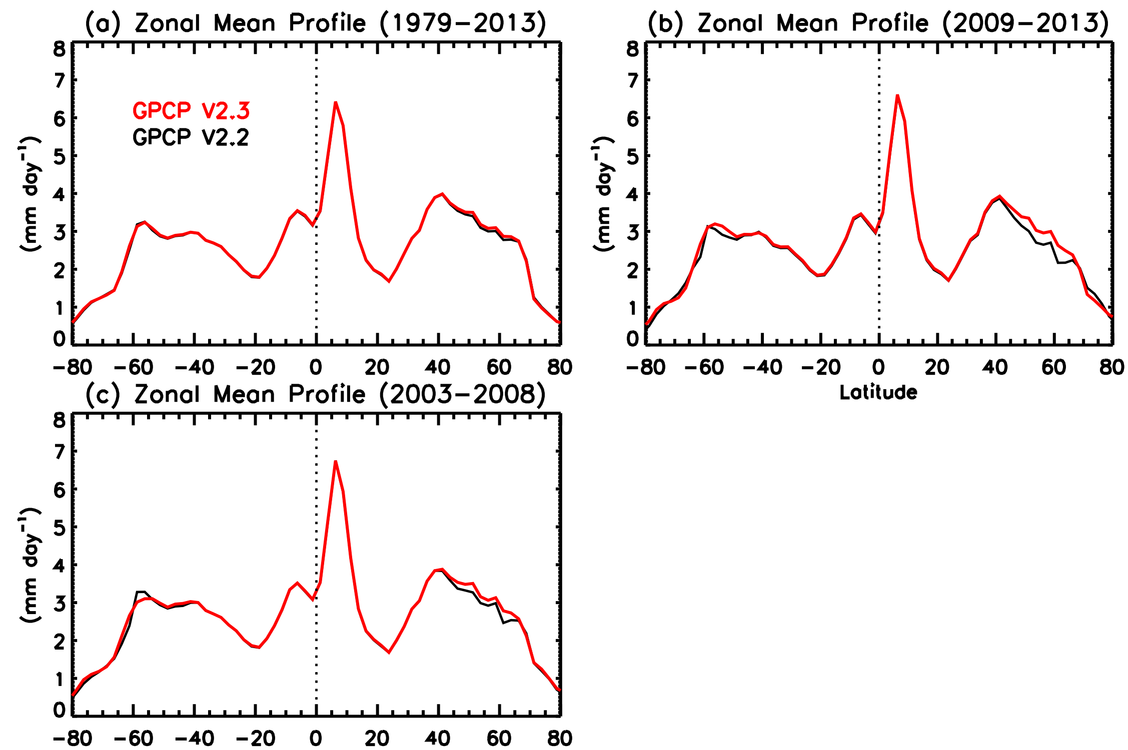

Fig. 3. Zonal mean profiles of GPCP oceanic precipitation during three time periods

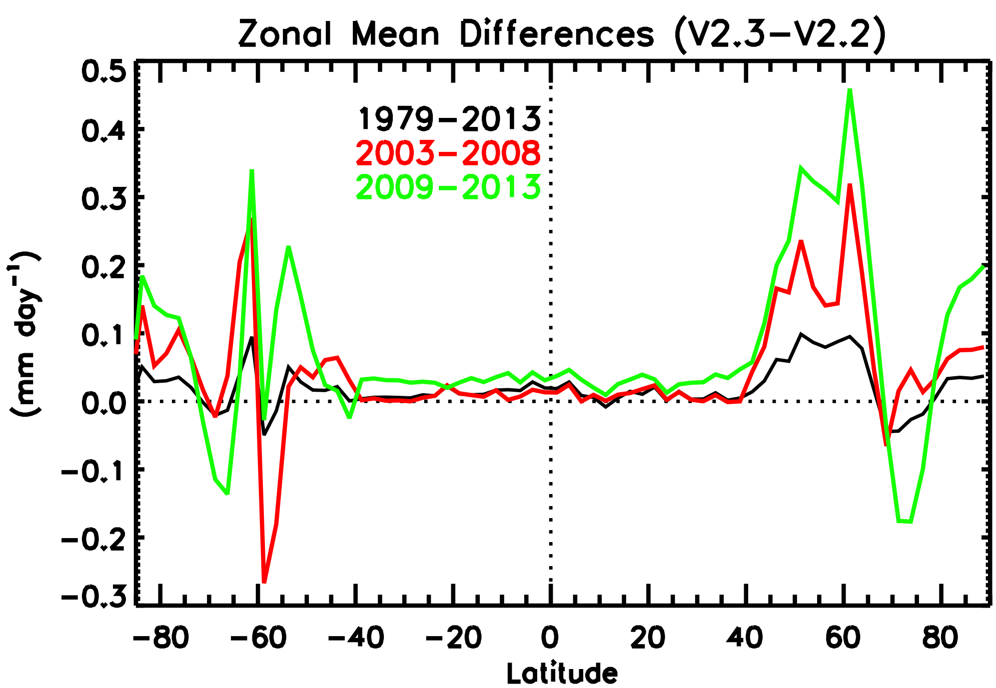

Fig. 4. Differences in zonal mean profiles of GPCP oceanic precipitation (V2.3-V2.2)

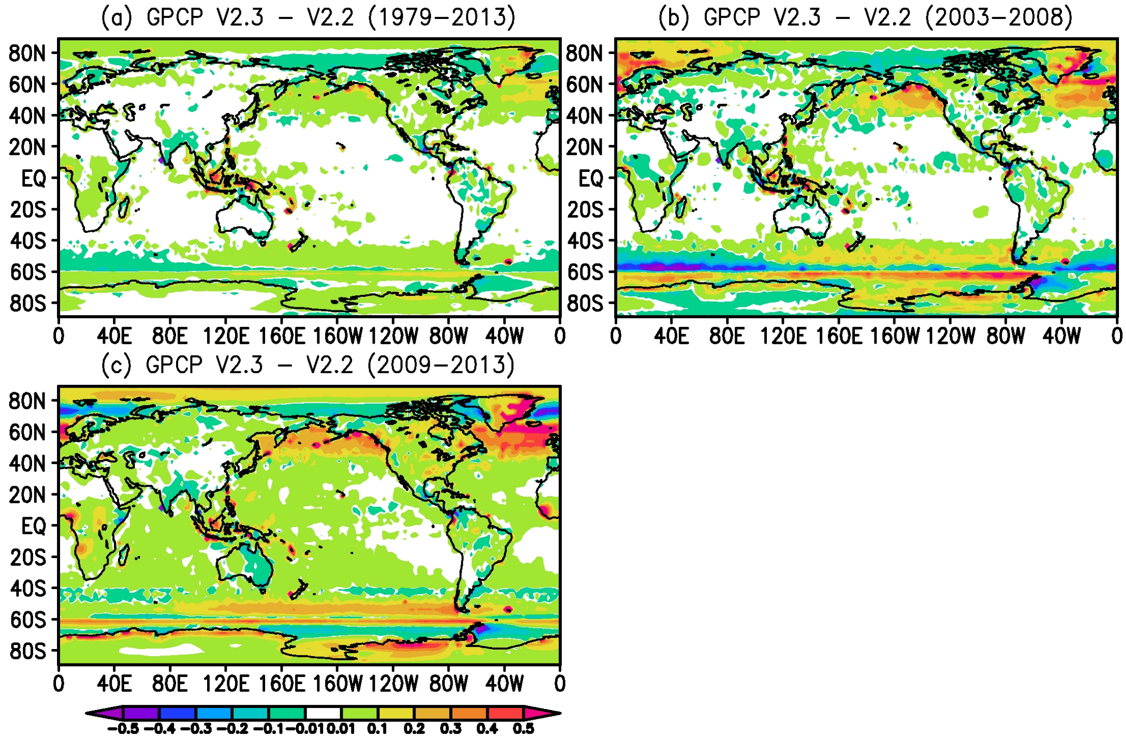

Fig. 5. Differences between GPCP V2.3 and V2.2 during 1979-2013, 2003-2008, and 2009-2013