Table S1 Summary of the total bias and its three independent components for five evaluated satellite-only global precipitation estimates in main areas of the global land areas.[a]

Products	Season	COUNS	Mexico	Brazil	Europe	India	China	Australia
IMERG suite	MAM	T: >100% in most areas of humid; MC: H	T: > 100% in most regions; MC: H and F	The mutual cancellations between M and F	T: >100% in most regions; MC: H	T: > 100% in most regions; MC: H and F	T: >100% in most areas of semi-humid; MC: F and M	The mutual cancellations between M and F
	JJA	T: >100% in areas other than humid areas; MC: H	T: >100% in northwest; MC: H	Similar to MAM season, except for the magnitude of T and H is higher than MAM season	MC: H; the mutual cancellations between M and F	The mutual cancellations between M and F	T: between ±20%; MC: F and M	The mutual cancellations between M and F
	SON	T: between ±60%; MC: H	The mutual cancellations between M and F	The mutual cancellations between M and F	The mutual cancellations between M and F	The mutual cancellations between M and F	T: between ±40%; MC: F and M	The mutual cancellations between M and F
	DJF	T: > 100% in humid areas and less than -60% in arid and semi-arid areas; MC: H,	T: >100% in south; MC: F and H	the mutual cancellations between M and F	T: >80% in most areas; MC: H	T: >100% in most areas; MC: H and F	MC: underestimation (overestimation): M (F)	The mutual cancellations between M and F

		F and M, respectively						
GSMaP suite	MAM	T: >100% in most areas of humid; MC: H	T: > 100% in most regions; MC: H and F	The mutual cancellations between M and F	T: >80% in most regions; MC: H	T: >100% in most regions; MC: H and F	T: > 100% in most areas of semi-humid; MC: F and M	The mutual cancellations between M and F
	JJA	T: >100% in most areas; MC: H and F	T: > 100% in northwest; MC: H	Similar to MAM season, except for the magnitude of T and H is higher than MAM season	MC: H; the mutual cancellations between M and F	The mutual cancellations between M and F	T: between ±20%; MC: F and M	The mutual cancellations between M and F
	SON	T: >60% in most areas; MC: H	The mutual cancellations between M and F	The mutual cancellations between M and F	T: >60% in most areas; MC: H	The mutual cancellations between M and F	T: between -40% and -60% in south, and >100% in most areas other than south; MC: M and F, respectively	The mutual cancellations between M and F
	DJF	T: > 80% in southeast; MC: H	T: > 100% in most areas; MC: H	The mutual cancellations between M and F	T: between -40% and -60% in most areas; MC: M	The mutual cancellations between M and F	T: > 80% in midlands; MC: F	The mutual cancellations between M and F
PERSIANN-CCS	MAM	T: >100% in most areas other than	T: >100%; MC: F	T: >80% in most regions; MC: H and F	T: <40% in most areas; the mutual	T: >100% in south; MC: H and F	T: >100% in areas other than humid (< -40%); MC: F and	The mutual cancellations between M

		humid; MC: F and H			cancellations between M and F		M (humid)	and F
	JJA	T: >100% in parts of midlands to west; MC: H and F	T: > 100% in northwest; MC: H and F	T: >60% in most inland areas; MC: F	The mutual cancellations between M and F	The mutual cancellations between M and F	The mutual cancellations between H and F	The mutual cancellations between M and F
	SON	T: >100% in most areas of northeast and between -40 and -60 in southeast; MC: F and H, respectively	The mutual cancellations between M and F	T: >80% in most inland areas; MC: F and H	The mutual cancellations between M and F	The mutual cancellations between M and F	T: < -60% in humid; MC: M	The mutual cancellations between M and F
	DJF	T: >100% in areas other than humid; MC: F and H	T: >100%; MC: F	T: >80% in inland and east; MC: F and H	T: >60% in most areas; MC: F	T: > 80% in most areas; MC: F	T: < -40% in most areas of humid and > 100% in other areas; MC: M and F	The mutual cancellations between M and F

[a] Noation: T, H, M, and F represents the total bias, hit bias, miss bias, and false bias, respectively; MC indicates the major component of total bias.
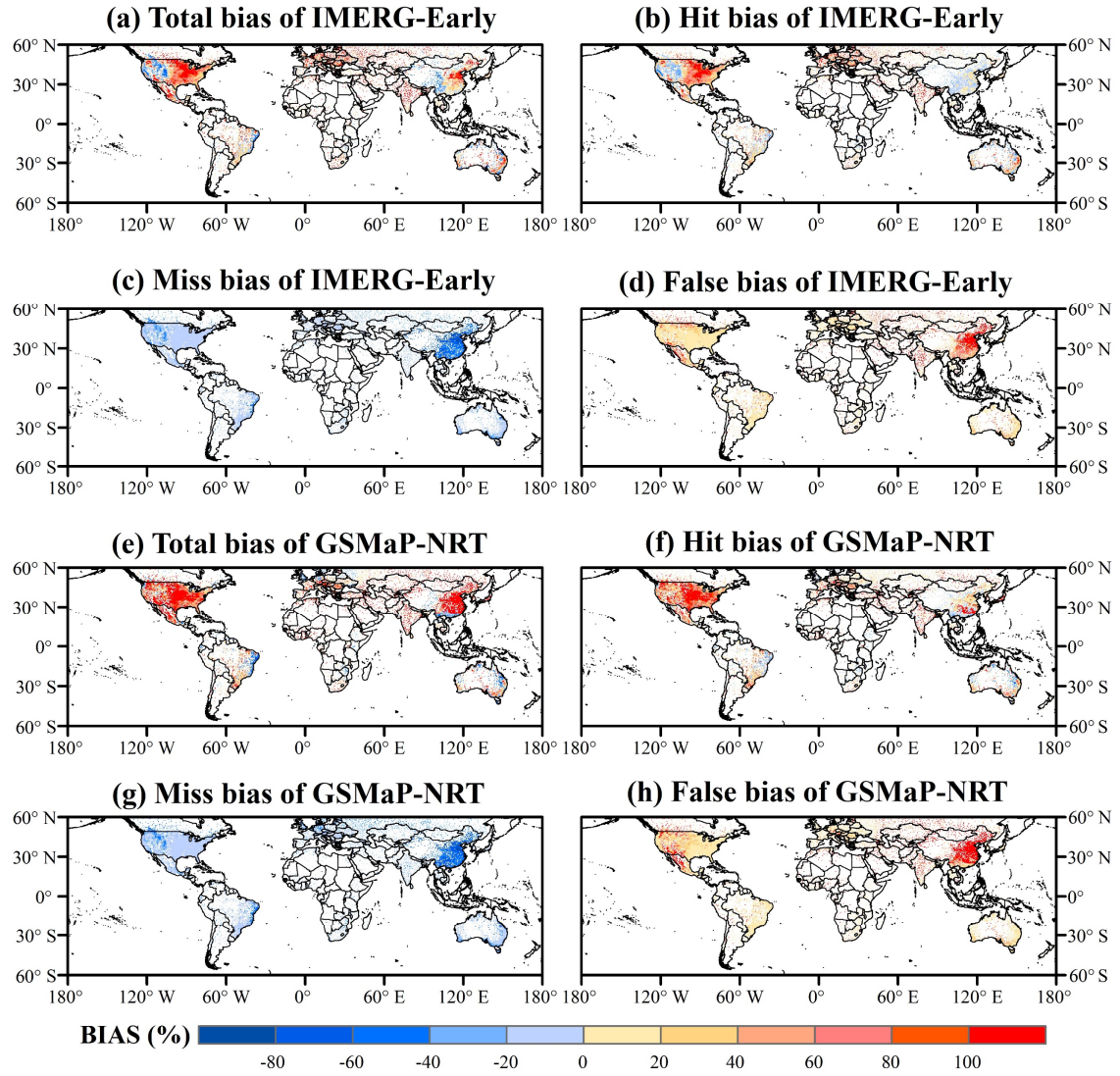
Fig. S1. Spatial distribution of the total bias and its three independent components for the two satellite-only global precipitation estimates (i.e., IMERG-Early, and GSMaP-NRT) at a 0.5° spatial and daily temporal resolution in the MAM season across global land for the period from 2015 to 2019 (5 years): (a-d) IMERG-Early, (e-h) GSMaP-NRT.
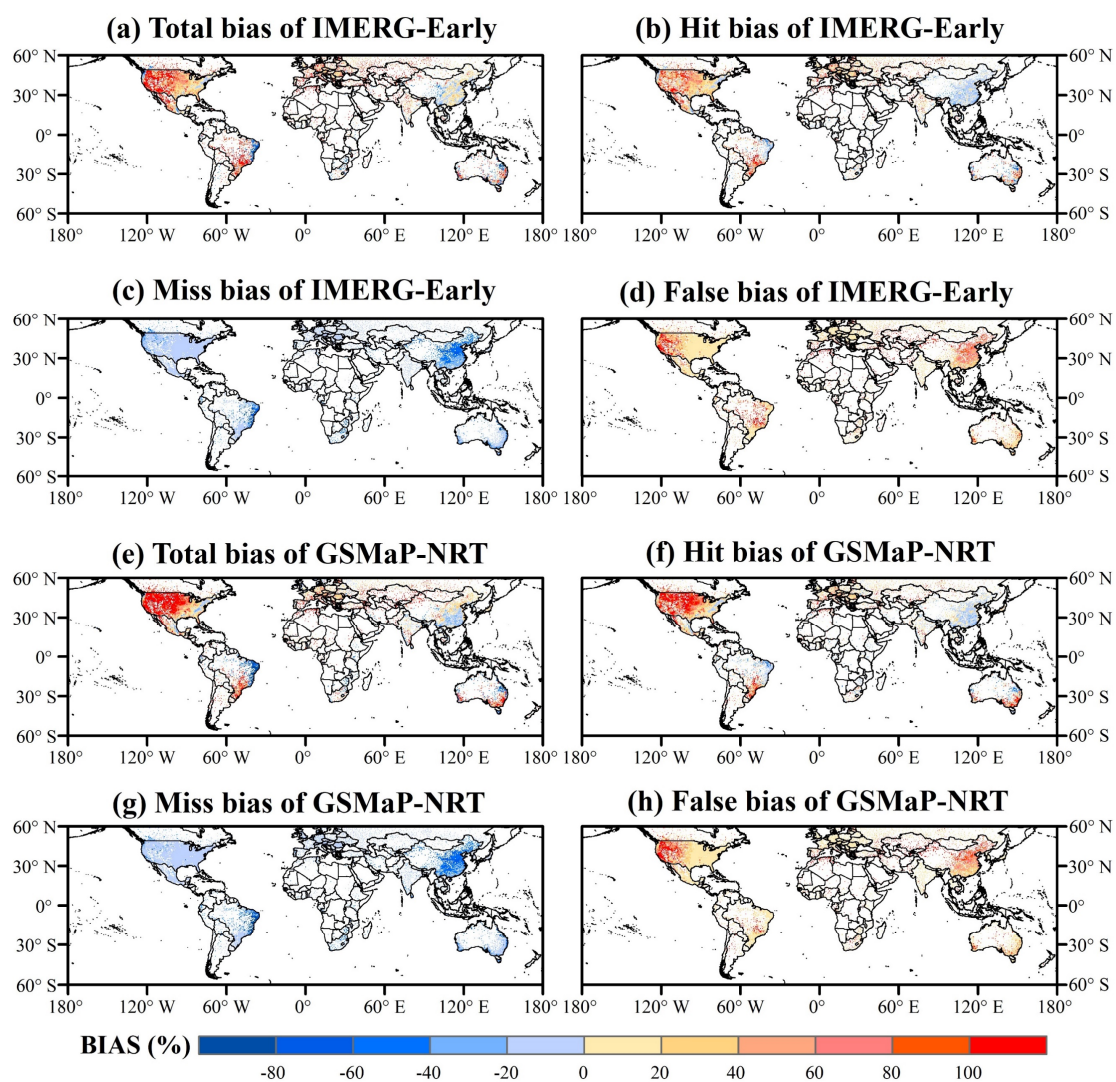
Fig. S2. As in Fig. S1 for JJA season.
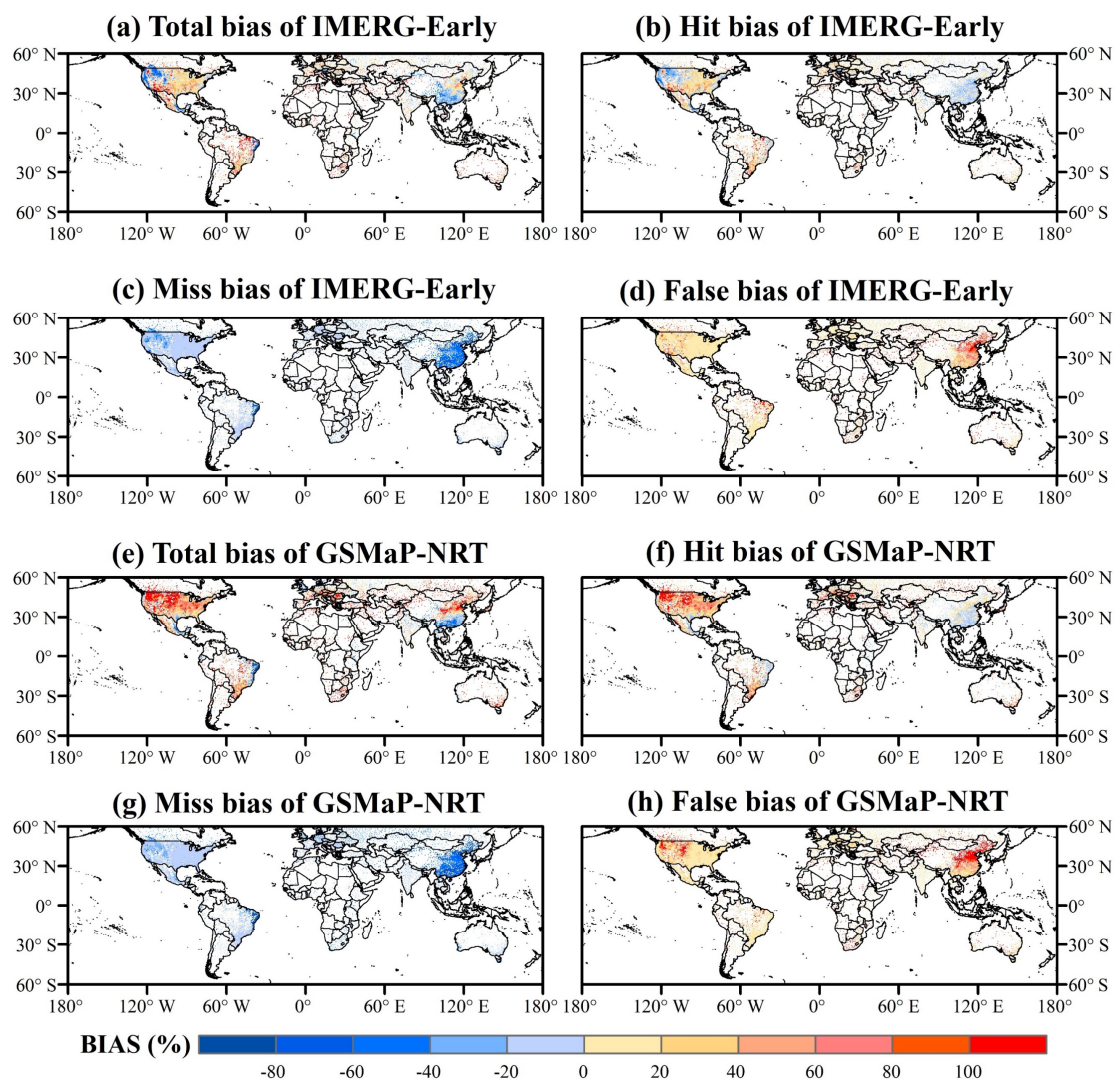
Fig. S3. As in Fig. S1 for SON season.
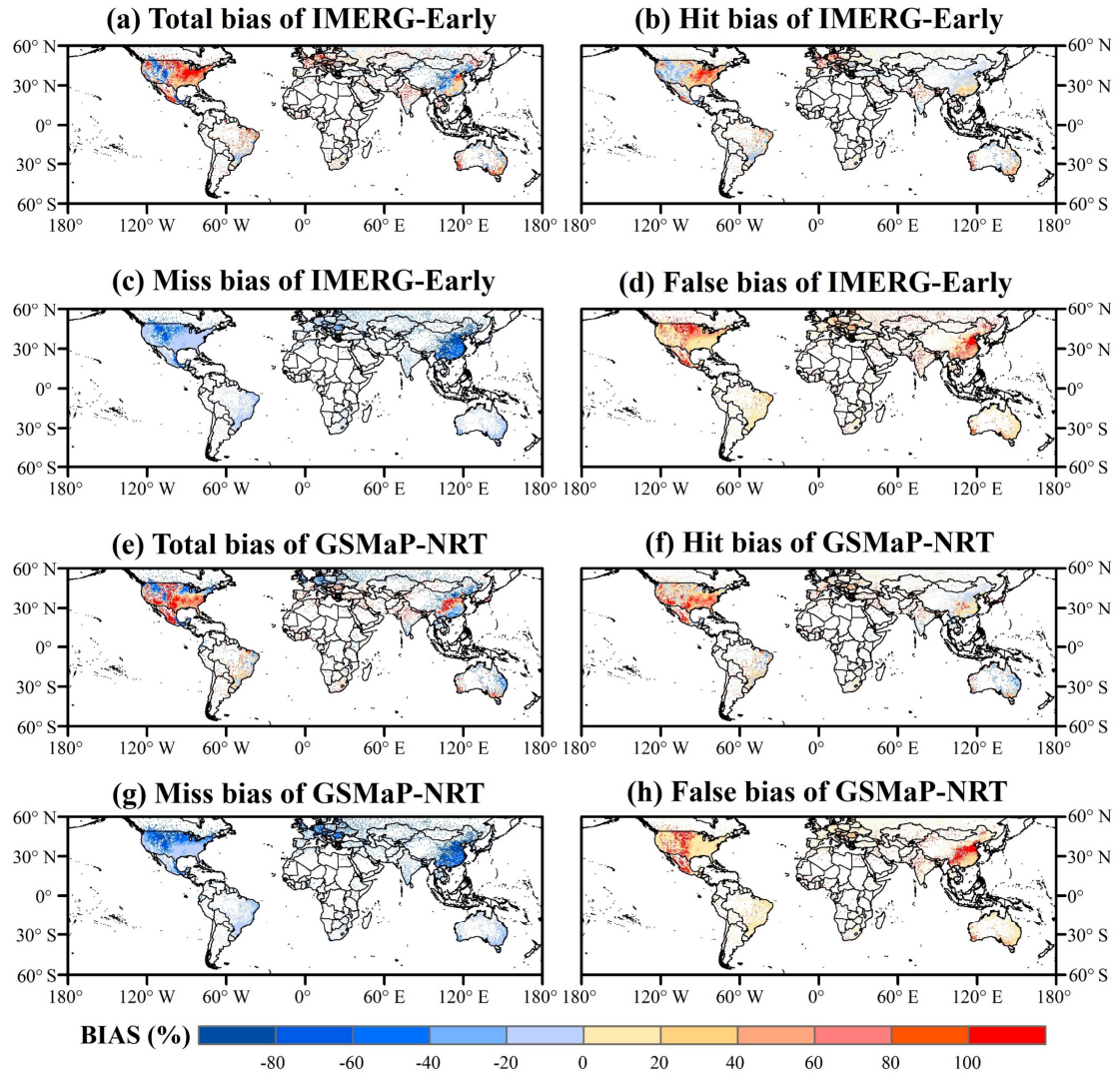
Fig. S4. As in Fig. S1 for DJF season.
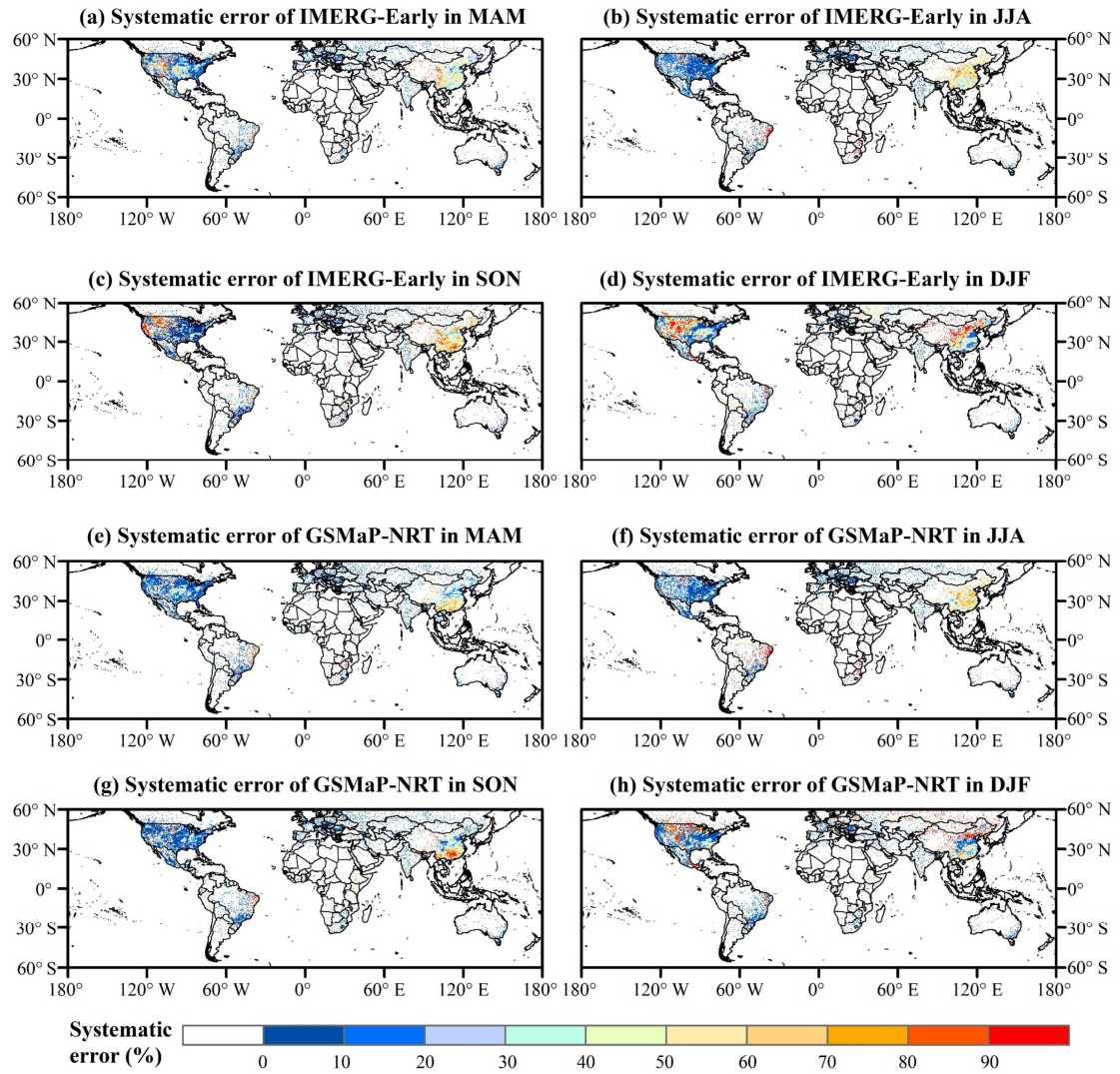
Fig. S5. Spatial distribution of systematic errors for the two satellite-only global precipitation estimates (i.e., IMERG-Early, and GSMaP-NRT) at a 0.5° spatial and daily temporal resolution in the four seasons (i.e., MAM, JJA, SON, and DJF) across global land for the period from 2015 to 2019 (5 years): (a-d) IMERG-Early, (e-h) GSMaP-NRT.