Supplementary information. A daily/25km short-latency rainfall product for data scarce regions based on the integration of the GPM IMERG Early Run with multiple satellite soil moisture products

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Data availability. $\mathrm{P_{R+SM}}$ is available via https://zenodo.org/record/3345323.XThcfHvOOUk

Competing interests. The authors declare no conflicts of interest.

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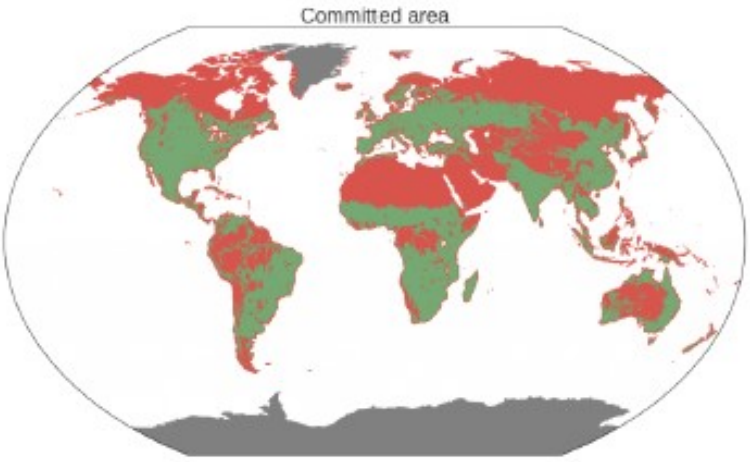
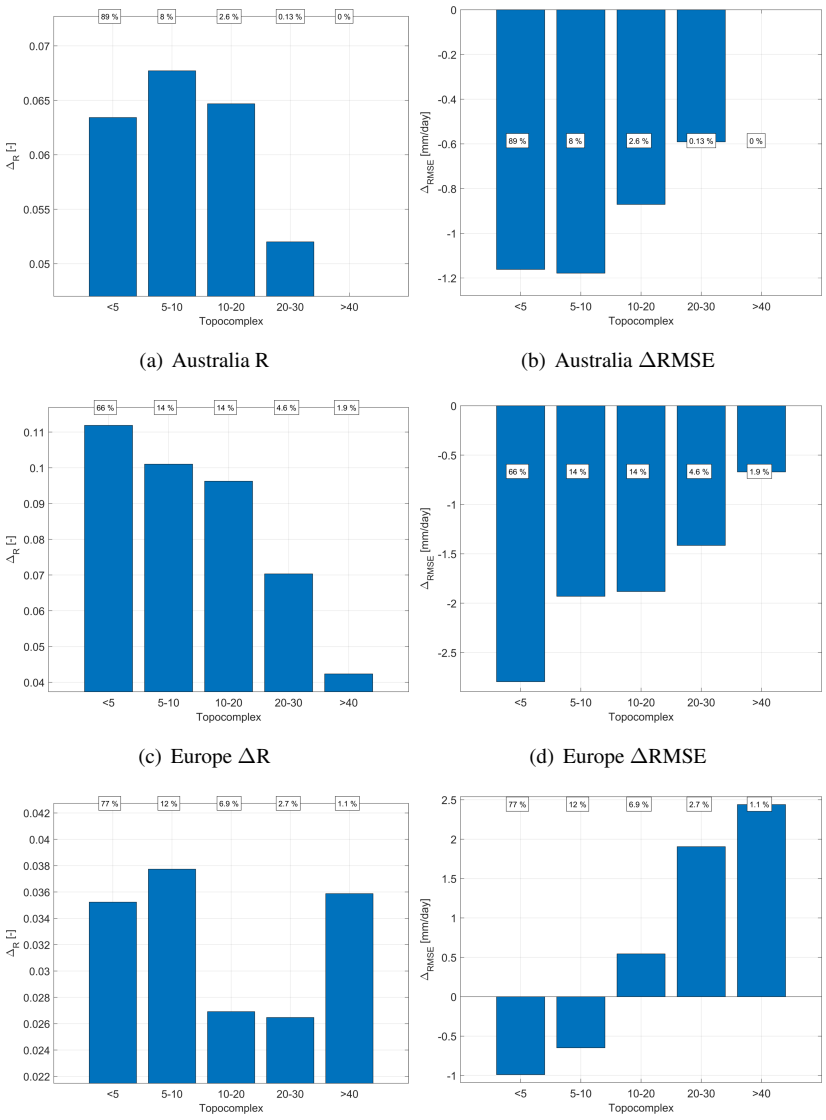


Figure A1. ASCAT committed area. In green validation points, in red areas excluded from validation but where the product is still available.



(a) Australia R

(b) Australia ΔRMSE

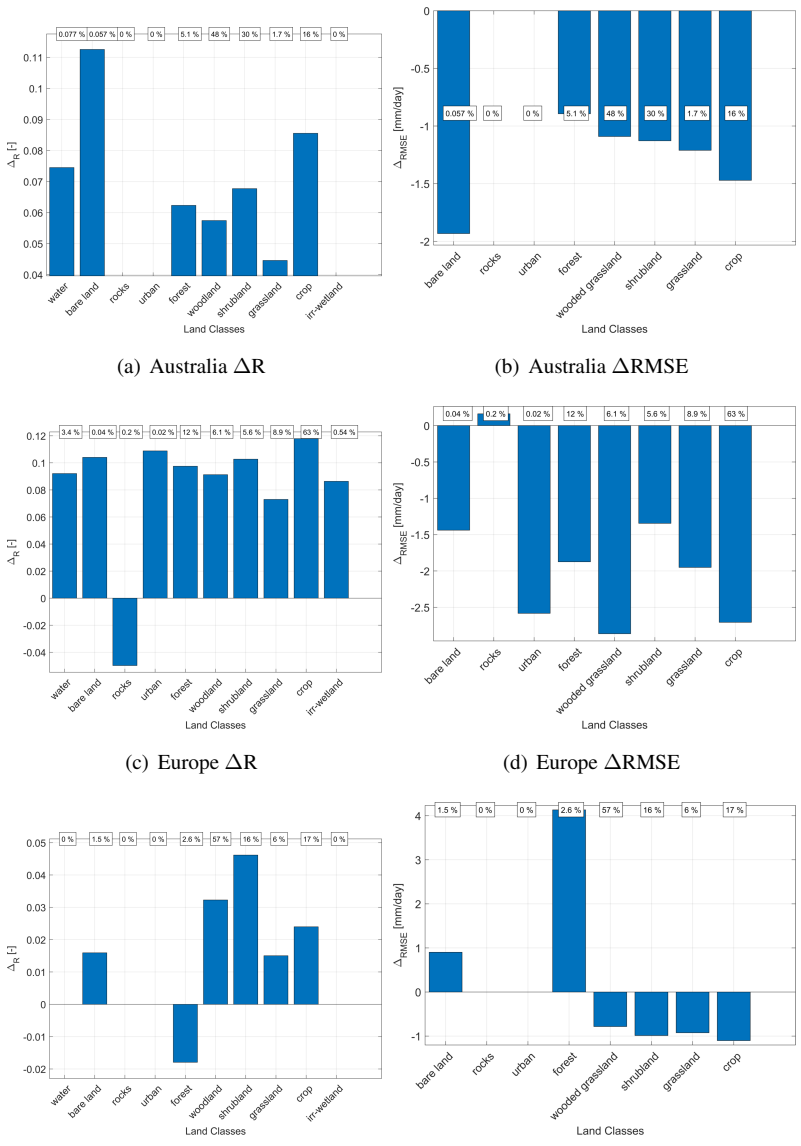
(c) Europe ΔR

(d) Europe ΔRMSE

(e) India ΔR

(f) India ΔRMSE

Figure A2. Difference in correlation (R, left) and error (RMSE, right) between the integrated product P_{R+SM} and the IMERG Early Run product (IMERG-ER) as a function of the topographic complexity. The results refer to 2015-2017 period.



(a) Australia ΔR

(b) Australia ΔRMSE

(c) Europe ΔR

(d) Europe ΔRMSE

(e) India ΔR

(f) India ΔRMSE

Figure A3. Difference in correlation (R, left) and error (RMSE, right) between the integrated product P_{R+SM} and the IMERG Early Run product (IMERG-ER) as a function of the land cover type. Period 2015-2017.

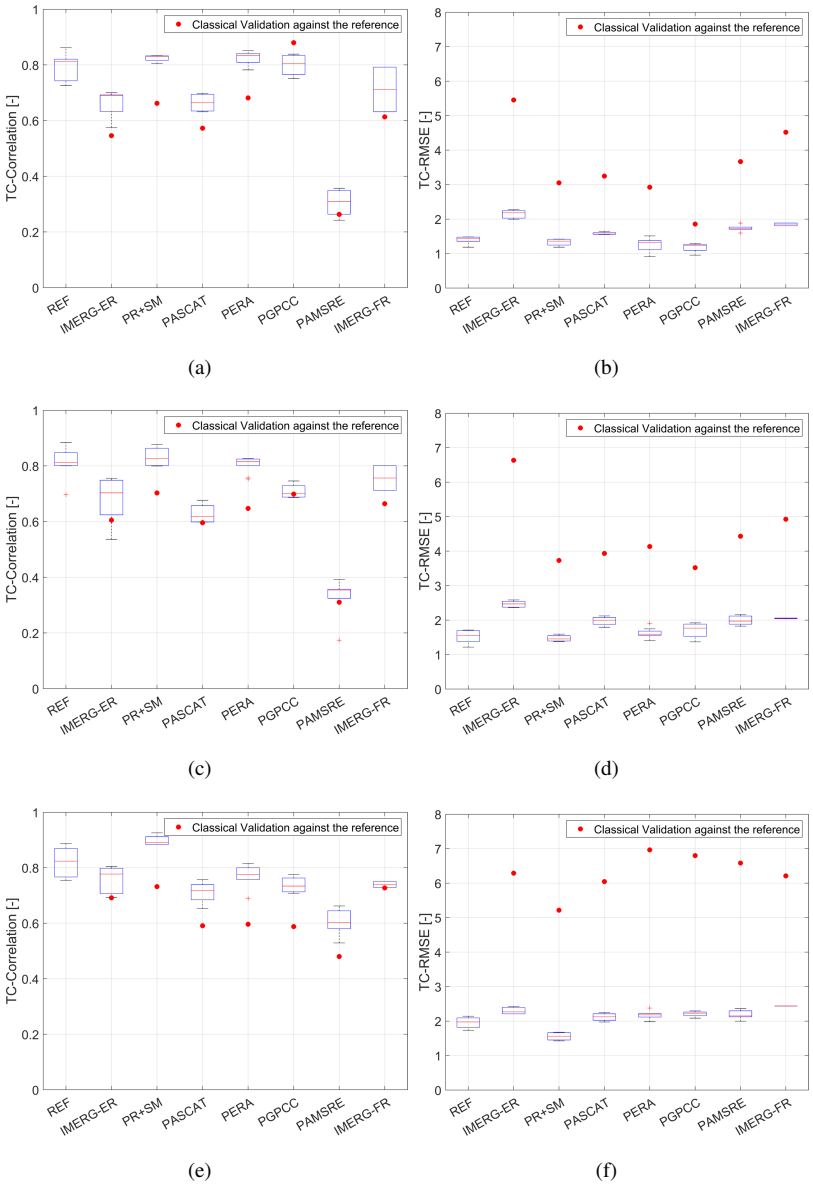
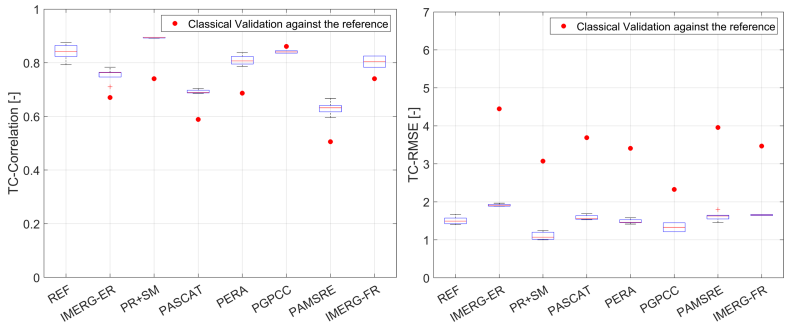
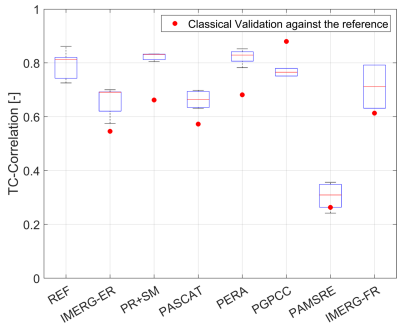


Figure A4. Box plots of TC correlation and error obtained by using the 15 triplets in Table A1, "first configuration") compared with the classical correlation and RMSE scores (red dots). (a) and (b) TC correlation and error for Europe, REF=E-OBS. (c) and (d) TC correlation and error for CONUS, REF=Stage IV rainfall dataset described in section **??**. (e) and (f) TC correlation and error for India REF=Indian Meteorological Institute rainfall.

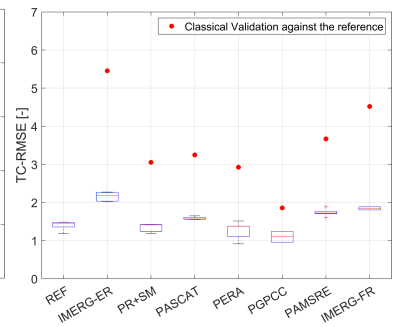


(a)

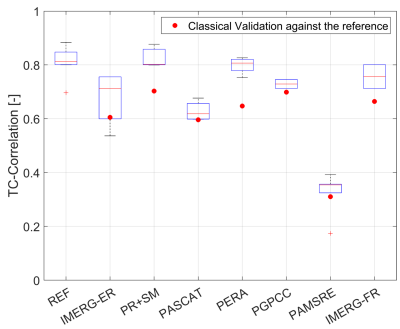
(b)



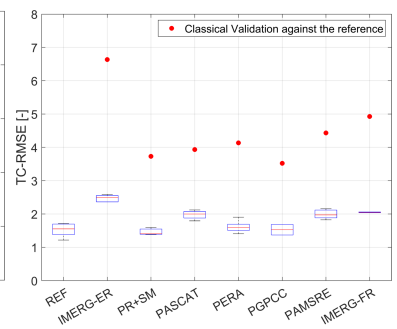
(c)



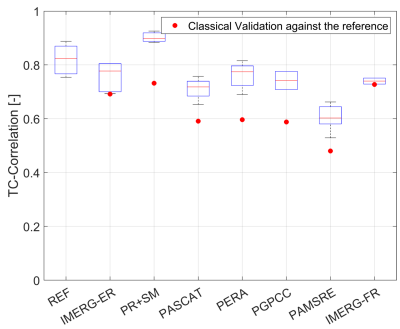
(d)



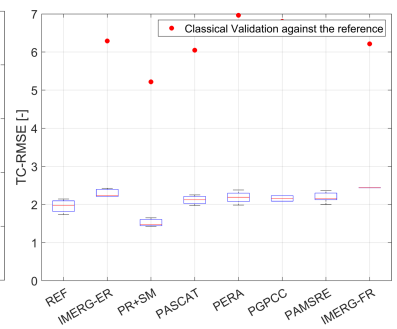
(e)



(f)



(g)



(h)

Figure A5. Box plots of TC correlation and error obtained by using the 13 triplets in Table A2, "second configuration") compared with the classical correlation and RMSE scores (red dots). (c) and (d) TC correlation and error for Europe, REF=E-OBS. (e) and (f) TC correlation and error for CONUS, REF=Stage IV rainfall dataset described in section **??**. (g) and (h) TC correlation and error for India REF=Indian Meteorological Institute rainfall.

Product A	**Product B**	**Product C**
REF	SM2RAIN-ASCAT*	ERA5
IMERG-FR	ERA5	SM2RAIN-AMSR2*
REF	ERA5	SM2RAIN-AMSR2*
IMERG-FR	ERA5	SM2RAIN-ASCAT*
GPCC	IMERG-ER	SM2RAIN-AMSR2*
GPCC	$\mathrm{P_{R+SM}}$	SM2RAIN-AMSR2*
REF	IMERG-ER	SM2RAIN-ASCAT*
REF	IMERG-ER	ERA5
ERA5	IMERG-ER	SM2RAIN-ASCAT*
REF	IMERG-ER	SM2RAIN-AMSR2*
REF	$\mathrm{P_{R+SM}}$	SM2RAIN-AMSR2*
REF	IMERG-ER	ERA5
REF	$\mathrm{P_{R+SM}}$	ERA5
GPCC	IMERG-ER	ERA5
GPCC	$\mathrm{P_{R+SM}}$	ERA5

Table A1. Triplets used in the first configuration according to section **??**. Here also triplets containing ERA along with $\mathrm{P_{R+SM}}$ are used. REF here refers to: 1) AWAP for Australia, 2) E-OBS for India, 3) Stage IV for CONUS and 4) IMD for India.

Product A	Product B	Product C
REF	SM2RAIN-ASCAT*	ERA5
IMERG-FR	ERA5	SM2RAIN-AMSR2*
REF	ERA5	SM2RAIN-AMSR2*
IMERG-FR	ERA5	SM2RAIN-ASCAT*
GPCC	IMERG-ER	SM2RAIN-AMSR2*
GPCC	P_{R+SM}	SM2RAIN-AMSR2*
REF	IMERG-ER	SM2RAIN-ASCAT*
REF	IMERG-ER	ERA5
ERA5	IMERG-ER	SM2RAIN-ASCAT*
REF	IMERG-ER	SM2RAIN-AMSR2*
REF	P_{R+SM}	SM2RAIN-AMSR2*
REF	IMERG-ER	ERA5
GPCC	IMERG-ER	ERA5

Table A2. Triplets used in the second configuration according to section **??**. REF here refers to: 1) AWAP for Australia, 2) E-OBS for India, 3) Stage IV for CONUS and 4) IMD for India.