Supplement of

"Risks of seasonal extreme rainfall events in Bangladesh under 1.5 and 2.0 degrees' warmer worlds – How anthropogenic aerosols change the story"

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Table S1: Basic information about the two observation datasets

Product Name	Product version	Spatial Resolution	Time Scale	Source/reference
APHRODITE	Monsoon Asia (MA) V1003R1	0.5°X 0.5°	1951-2007	Yatagai et al., 2012. Available at: http://journals.ametsoc.org/doi/pdf/10.1175/BAMS-D-11-00122.1
CPC	CPC daily rainfall	0.5°X 0.5°	1979- 2016	Chen, M. and Xie, P. 2008. Available at: ftp://ftp.cpc.ncep.noaa.gov/precip/CPC_UNI_PRCP/GAUGE_CONUS/DOCU/Chen_et_al_2008_Daily_Gauge_Anal.pdf

Table S2: The wettest and driest years of the four sub-regions during 2006-2015 (figured from the ACT model ensemble)

	pre-monsoon season (MAM)		monsoon season (JJAS)	
Sub-regions	Wettest years	Driest years	Wettest years	Driest years
Sub-region 1 (north-west region)	2008-2011	2009-2014	2008-2009	2013-2014
Sub-region 2 (north-east region)	2008-2015	2009-2014	2008-2012	2006-2013
Sub-region 3 (south-west region)	2008-2012	2009-2014	2008-2014	2011-2013
Sub-region 4 (south-east region)	2008-2015	2009-2013	2008-2014	2011-2013

Table S3: The risk ratios (RR) with associated uncertainty ranges (in brackets) for four rainfall events.

Return periods	Sub-region 1 (north-west region) – pre-monsoon season				Sub-region 2 (north-east region) – pre-monsoon season			
	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT
10 years	1.1 (0.9-1.2)	1.5 (1.2-1.6)	1.8 (1.5-2.0)	1.4 (1.2-1.6)	1.6 (1.3-1.9)	1.9 (1.5-2.3)	2.5 (2.0-2.9)	1.1 (1.0-1.2)
20 years	1.2 (0.9-1.5)	2.1 (1.6-2.8)	2.5 (1.9-3.4)	1.9 (1.6-2.2)	1.5 (1.2-2.0)	2.1 (1.6-2.8)	3 (2.2-3.9)	1.4 (1.0-1.9)
50 years	1.1 (0.7-1.5)	2.5 (1.8-3.8)	3.1 (2.0-4.5)	2.5 (1.9-3.8)	1.7 (1.1-2.2)	2.4 (1.7-3.4)	2.8 (1.9-4.0)	1.2 (0.9-1.9)
100 years	1.1 (0.6-2.1)	**4 (2.0-7.0)**	**3.9 (2.1-6.8)**	**3.3 (1.9-5.9)**	1.9 (1.1-3.1)	**3.2 (2.0-5.3)**	2.9 (1.9-4.5)	1.9 (1.0-3.2)
Return periods	Sub-region 3 (south-west region) – pre-monsoon season				Sub-region 4 (south-east region) – pre-monsoon season			
	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT
10 years	1 (0.9-1.1)	1.1 (1.0-1.3)	1.4 (1.2-1.6)	1.1 (1.0-1.3)	1.1 (1.0-1.3)	1.4 (1.2-1.5)	1.5 (1.3-1.6)	1.3 (1.0-1.5)
20 years	1.1 (0.9-1.2)	1.3 (1.1-1.8)	1.6 (1.3-2.1)	1.2 (0.9-1.4)	1.3 (1.0-1.6)	1.9 (1.3-2.3)	1.7 (1.2-2.1)	1.4 (1.0-1.6)
50 years	1.2 (0.9-1.8)	1.5 (1.2-2.1)	2.5 (1.9-3.8)	1.5 (1.0-2.0)	2.1 (1.4-3.0)	2.2 (1.5-3.2)	2.2 (1.6-3.2)	1.6 (1.0-2.2)
100 years	1.5 (0.9-2.8)	2 (1.0-3.0)	**3.1 (1.9-5.2)**	1.5 (0.9-2.4)	1.7 (0.9-2.9)	2.5 (1.6-4.0)	2.1 (1.2-3.3)	1.7 (0.9-2.3)
Return periods	Sub-region 1 (north-west region) – monsoon season				Sub-region 2 (north-east region) – monsoon season			
	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT
10 years	1.7 (1.5-2.0)	2.5 (2.1-2.9)	2.3 (2.0-2.6)	1.3 (1.0-1.5)	1.8 (1.5-2.1)	2.5 (2.1-3.1)	3.1 (2.6-4.0)	1.1 (1.0-1.2)
20 years	2.3 (1.9-2.9)	3.7 (2.9-4.5)	3.2 (2.5-4.0)	1.5 (1.1-1.9)	1.5 (1.1-1.9)	2.2 (1.8-2.9)	2.9 (2.2-3.8)	1.1 (0.9-1.2)
50 years	2.1 (1.5-2.9)	3.8 (2.8-4.9)	3.3 (2.6-4.6)	1.5 (1.1-2.1)	1.3 (0.9-1.9)	2.1 (1.5-3.0)	3.2 (2.2-4.8)	1.5 (1.0-1.9)
100 years	1.6 (1.0-2.5)	**4** (2.5-6.3)	**3.8** (2.3-6.0)	2 (1.2-3.7)	1.8 (1.0-3.0)	**3 (1.0-4.0)**	**4.6 (2.9-7.2)**	1.8 (1.0-2.9)
Return periods	Sub-region 3 (south-west region) – monsoon season				Sub-region 4 (south-east region) – monsoon season			
	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT	ACT/NAT	HAPPI1.5/NAT	HAPPI2.0/NAT	GHG/ACT
10 years	1.6 (1.4-1.9)	1.5 (1.3-1.7)	2 (1.7-2.2)	1 (0.8-1.2)	1.9 (1.6-2.1)	2.1 (1.9-2.5)	2.3 (2.0-2.8)	1 (0.9-1.2)
20 years	2 (1.8-2.2)	1.9 (1.4-2.3)	2.5 (2.0-3.0)	1.1 (0.8-1.8)	2 (1.5-2.5)	2.3 (1.8-2.8)	2.9 (2.2-3.8)	1.1 (0.9-1.5)
50 years	2.1 (1.7-2.5)	1.9 (1.2-2.6)	2.1 (1.5-2.8)	1.2 (0.7-1.9)	2.5 (1.9-3.5)	2.6 (1.9-3.7)	3.9 (2.9-5.5)	0.9 (0.5-1.2)
100 years	2.2 (1.6-3.1)	2.3 (1.3-3.6)	2.2 (1.3-3.8)	1.3 (0.5-2.2)	**3.9 (2.6-5.8)**	**4.1 (2.2-5.3)**	**5.5 (3.5-7.8)**	0.9 (0.3-1.8)

*** RR>2.9 is highlighted with bold font for the 1 in 100 year event.

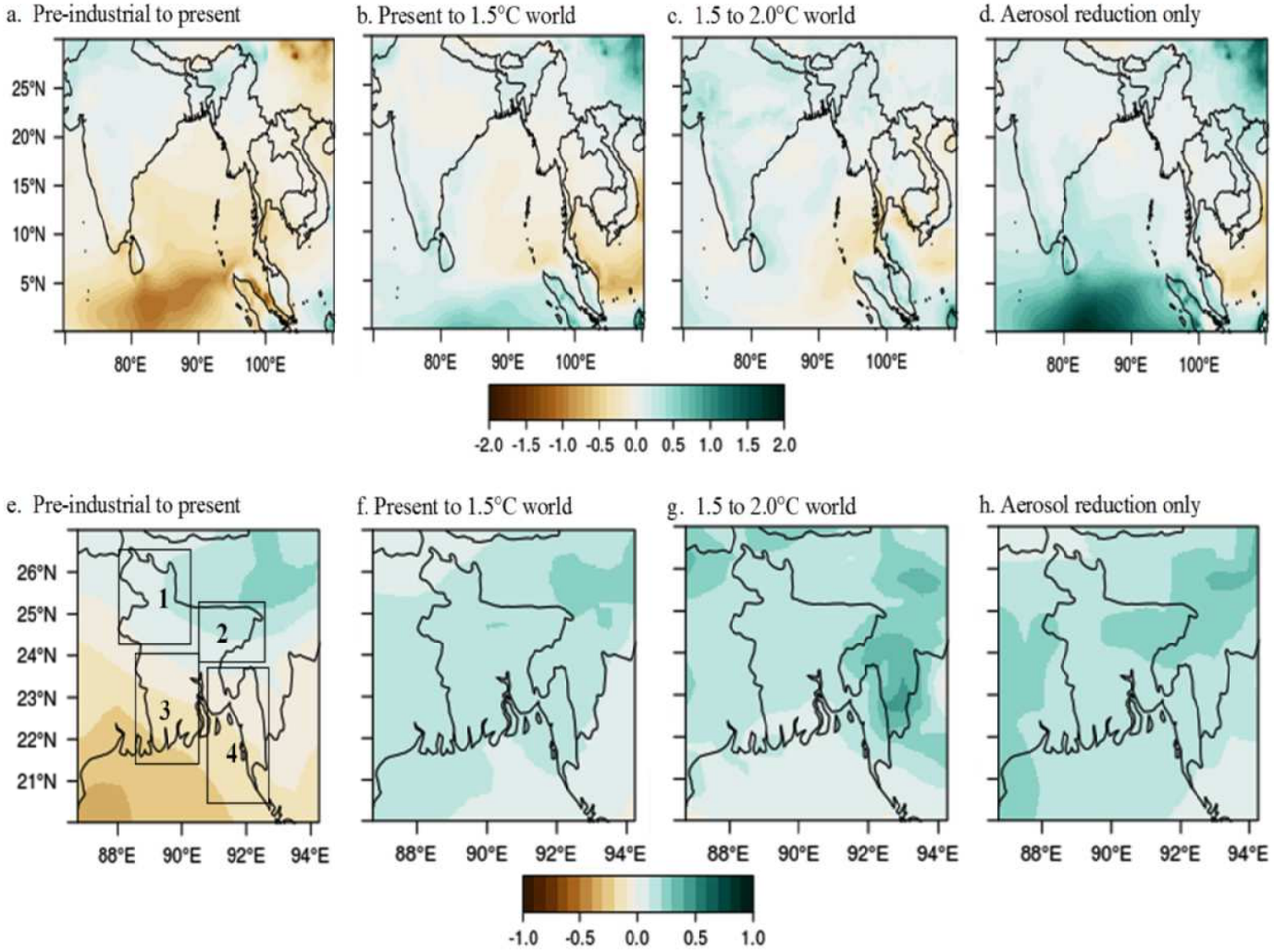

Figure S1. Relative changes in the SPI of pre-monsoon (MAM) seasonal mean rainfall between different forcing scenarios. The top row (panels a-d) shows the regional SPI over central parts of the South Asia (SA) while, bottom row (panels e-h) shows the SPI over Bangladesh. The four boxes (1-4) on top of the panel e approximately represent the four sub-regions of Bangladesh. These four sub-regions (1-4) are used later for the relative quantification of risks of extreme monsoon rainfall events. a. present day rainfall PC relative to natural pre-industrial climate over SA b. present day rainfall PC relative to 1.5°C world over SA c. 1.5°C world rainfall PC relative to 2.0°C world over SA d. present day rainfall PC relative to GHG only climate over SA.

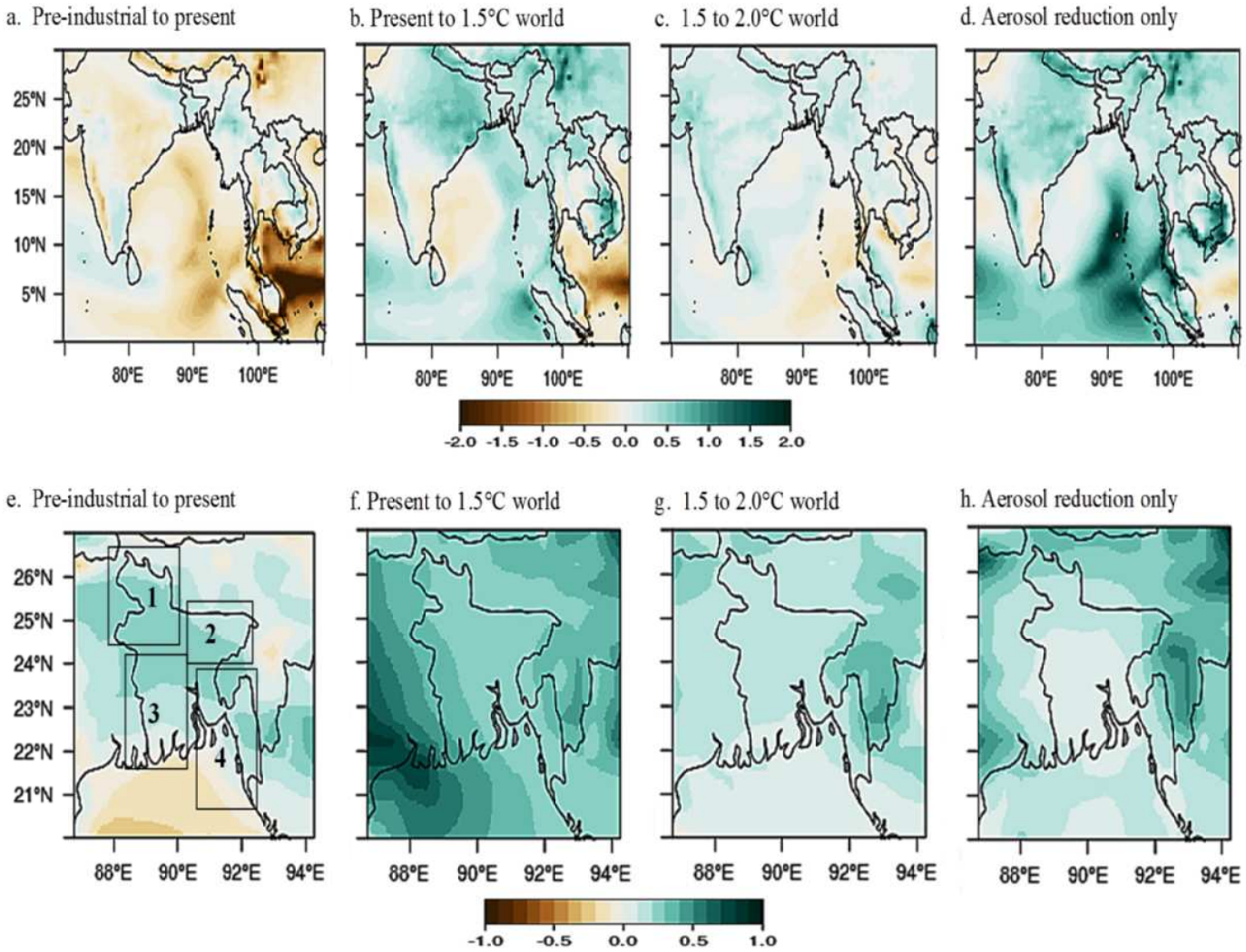

Figure S2. Relative changes in the SPI of monsoon (JJAS) seasonal mean rainfall between different forcing scenarios. The top row (panels a-d) shows the regional SPI over central parts of the South Asia (SA) while, bottom row (panels e-h) shows the SPI over Bangladesh. The four boxes (1-4) on top of the panel e approximately represent the four sub-regions of Bangladesh. These four sub-regions (1-4) are used later for the relative quantification of risks of extreme monsoon rainfall events. a. present day rainfall PC relative to natural pre-industrial climate over SA b. present day rainfall PC relative to 1.5°C world over SA c. 1.5°C world rainfall PC relative to 2.0°C world over SA d. present day rainfall PC relative to GHG only climate over SA. The figure shows that the apparently non-linear response between panels of a, b, and c (or, e, f, g) can be explained by the response for aerosols in the panel d (or, h).

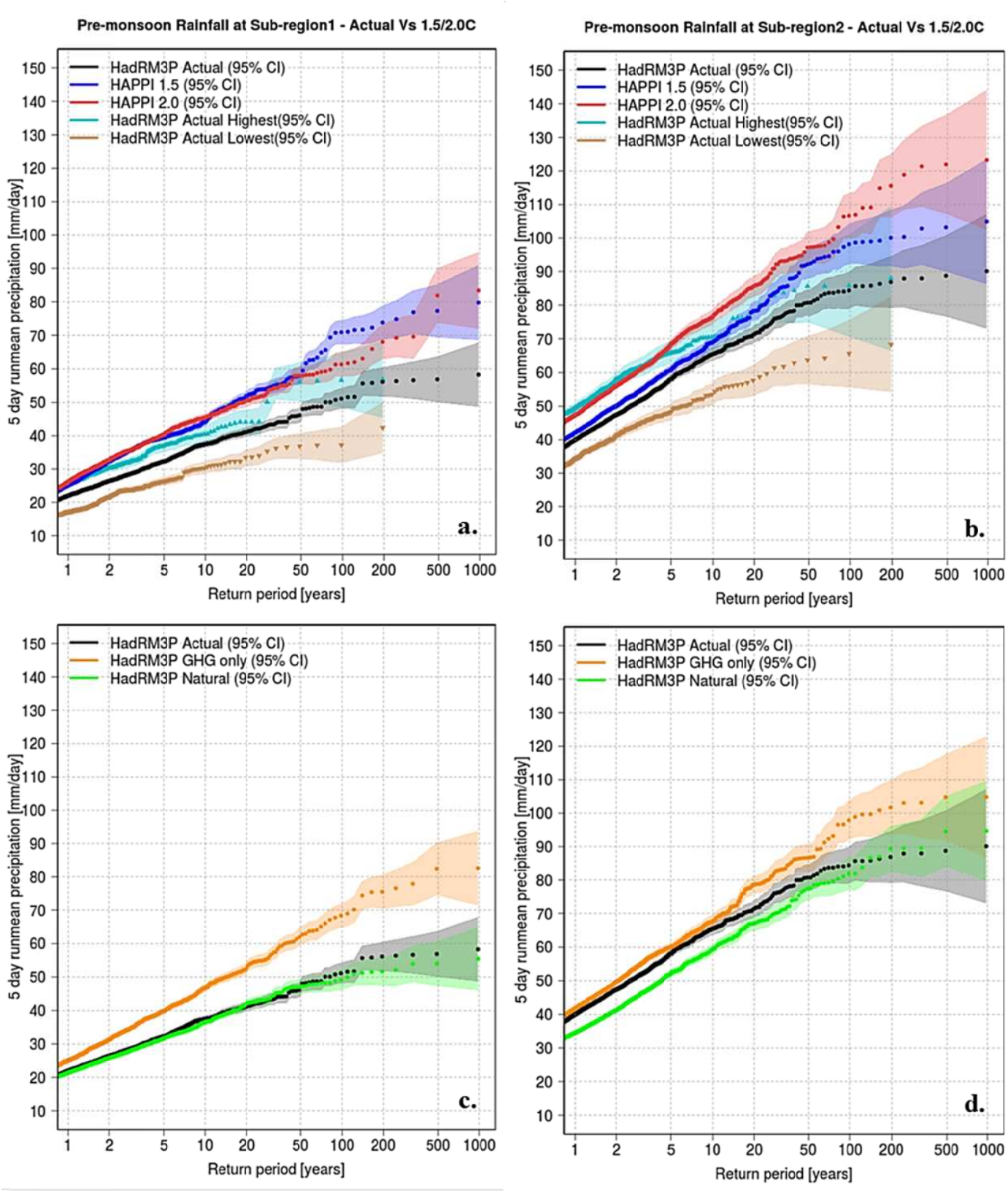

Figure S3. Return time plots for five day mean rainfall during pre-monsoon (MAM) season in different forcing scenarios over the sub-regions of 1 and 2 of Bangladesh. The HadRM3P ACT (black), ACT highest (upper grey with upward triangles), ACT lowest (lower grey with downward triangles), NAT (green) and GHG (orange) ensembles are compared with the HAPPI 1.5 (blue) and 2.0 (red) ensembles.

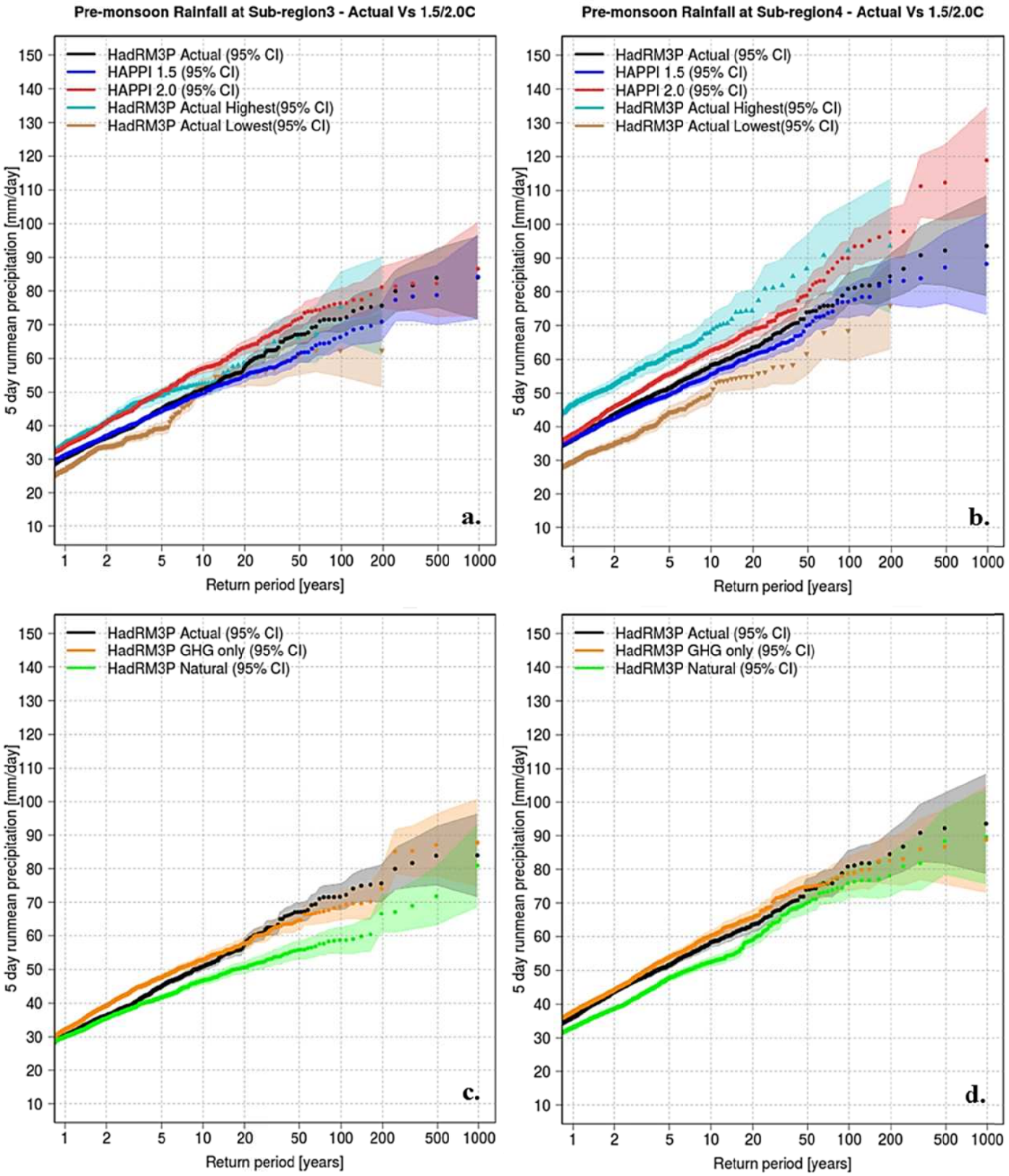

Figure S4. Same as Fig S3 but showing return time plots for five day mean rainfall during pre-monsoon (MAM) season in different forcing scenarios over the sub-regions of 3 and 4 of Bangladesh.

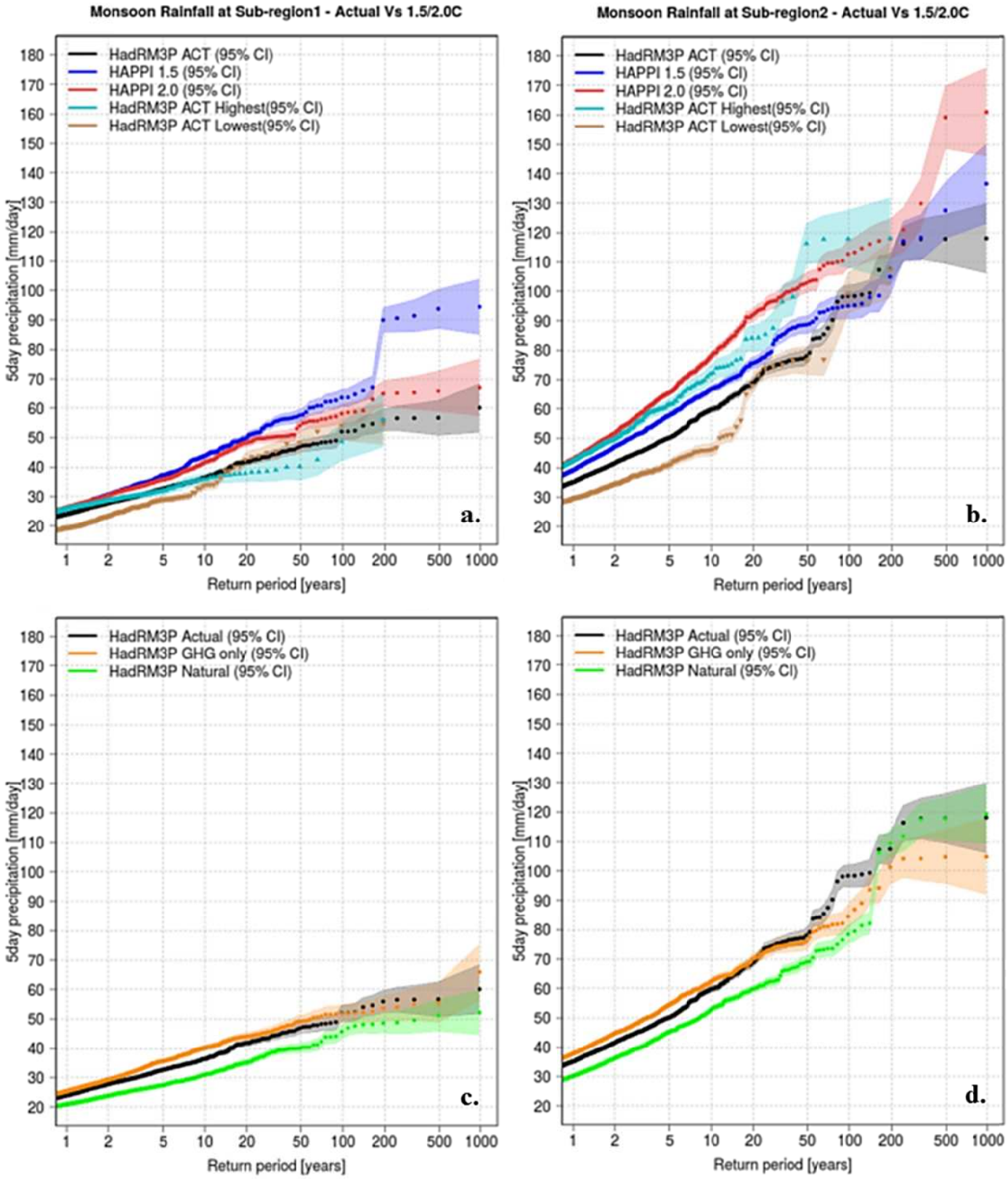

Figure S5. Return time plots for five day mean rainfall during monsoon (JJAS) season in different forcing scenarios over the four sub-regions of Bangladesh. The HadRM3P ACT (black), ACT highest (upper grey with upward triangles), ACT lowest (lower grey with downward triangles), NAT (green) and GHG (orange) ensembles are compared with the HAPPI 1.5 (blue)) and 2.0 (red) ensembles. The risks of extreme rainfall events are evidently increasing between different forcing scenarios over sub-region 2.

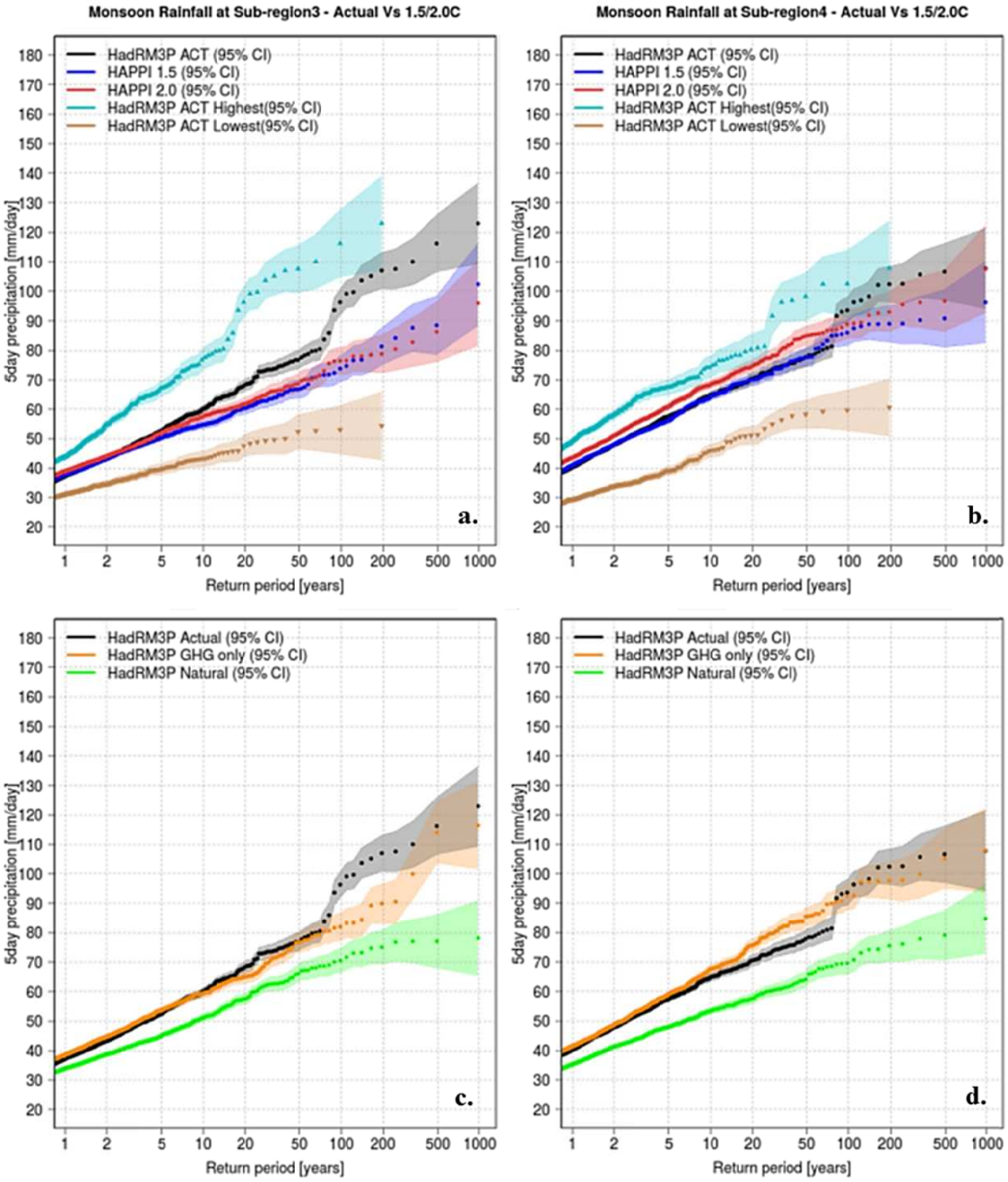

Figure S6. Same as Fig S5 but showing return time plots for five day mean rainfall during monsoon (JJAS) season in different forcing scenarios over the sub-regions of 3 and 4 of Bangladesh.