Climate Change Analysis for Sri Lanka

Additional analysis focusing on monthly moisture index and potential evapotranspiration changes

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This report represents a summarized representation of projected trends in climate change for Sri Lanka. The report expands earlier analyses conducted on bioclimatic and monthly precipitation changes. All data and software used are open access.

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1. Project area

The project area consists of an upland area in the south and a downstream area in the north (figures 1.1 – 1.3).

Figure 1.1. Focal areas of the project. Map prepared in QGIS 3.6.0 with Google terrain as baseline map, obtained with the QuickMapServices plugin.

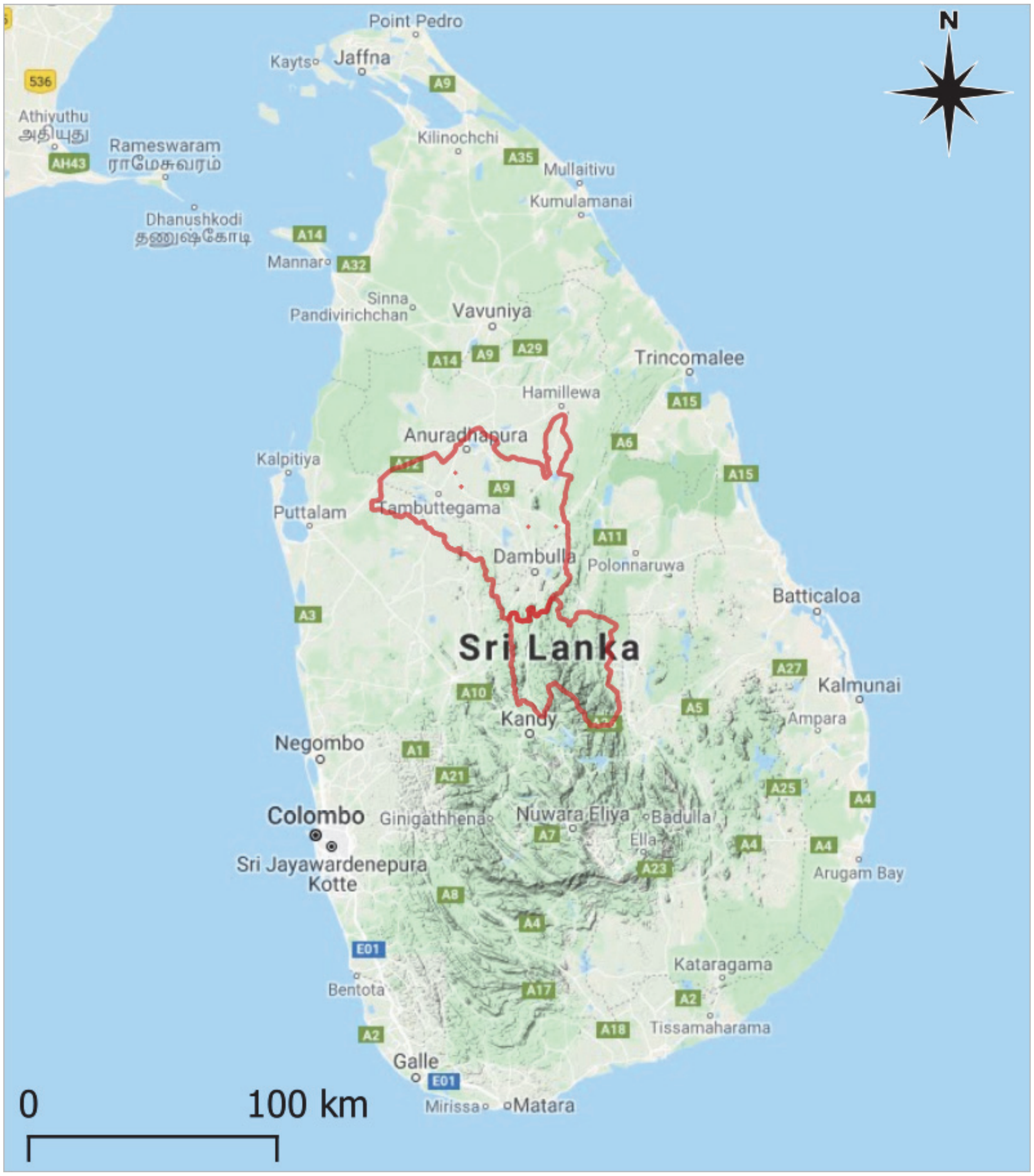


Figure 1.2. Focal areas of the project. Map prepared in QGIS 3.6.0 with Google terrain as baseline map, obtained with the QuickMapServices plugin.

Figure 1.3. Focal areas of the project. Map prepared in QGIS 3.6.0 with Bing as baseline map, obtained with the QuickMapServices plugin.

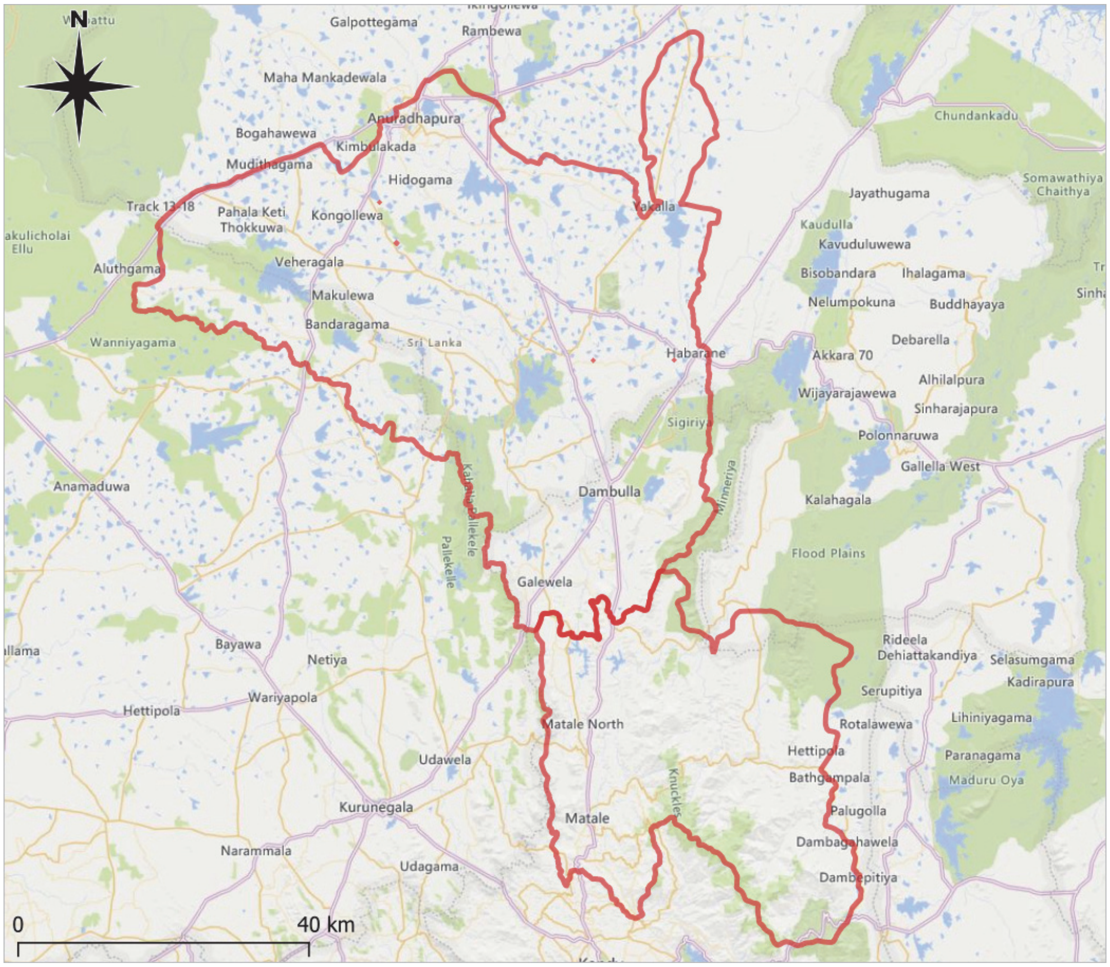
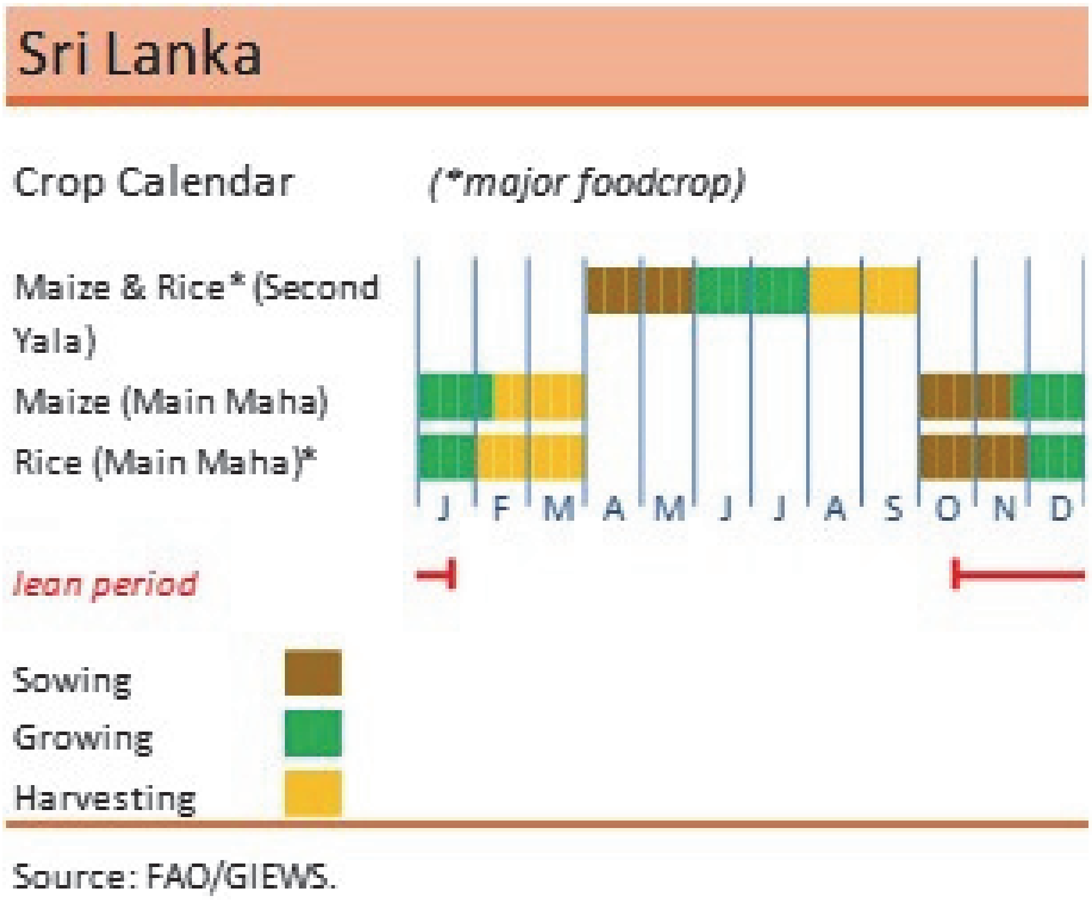


Figure 1.4. Focal areas of the project. Map prepared in QGIS 3.6.0 with Esri National Geographic as baseline map, obtained with the QuickMapServices plugin.

Figure 1.5. Crop calendar for Sri Lanka. Sourced from:
http://www.fao.org/giews/countrybrief/country.jsp?lang=en&code=LKA



Special attention is given in this report to months where the major foodcrops of rice and maize are sown and grown according to the FAO's Global Information and Early Warning System (Figure 1.5): April – May (sowing period during Yala season), June – July (growing period during Yala season), October – November (sowing period during Maha season) and December – January (growing period during Maha season). The Yala season corresponds to the South-west monsoon of May to September, whereas the Maha season correspons to the North-east monsoon of December to February.

2. Changes in moisture index

To deal with uncertainties in projecting future climatic changes, analyses focused on consensus among General Circulation Models (it is generally recommended to treat the different GCM projections as equally likely and to adopt ensemble [consensus] approaches). In checking for consensus among models, the likelihood scale recommended for the fifth assessment report of the IPCC (Mastrandea *et al.* 2011) was adopted. As such, results were reported as **likely** in case that at least 66% of models showed the same trend and as **unlikely** in case that at most 33% of models showed the same trend.

Data on baseline and future (2050, the average of 2041-2060) monthly precipitation were downloaded from WorldClim 1.4 at resolution of 2.5 arc-minutes (no downscaled results for future climates are available yet from WorldClim 2). Future data sets correspond to CMIP5 data for the Representative Concentration Pathway 4.5, a medium emissions scenario and the scenario for which most (i.e., 19) future General Circulation Model data sets were available from WorldClim.

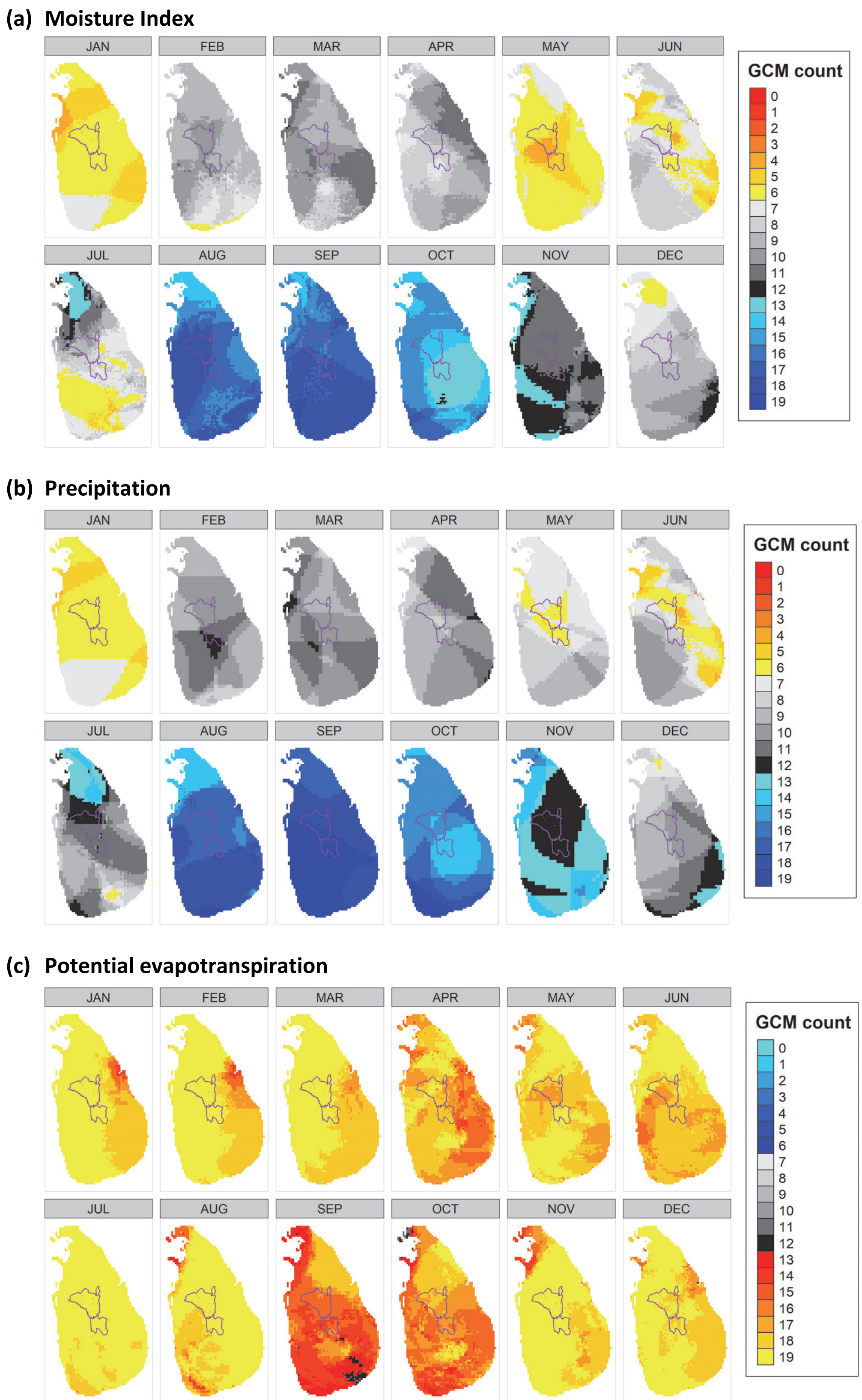
Monthly moisture index (the product of P PET^{-1} where P is precipitation and PET potential evapotranspiration; this index is also known as the aridity index) were obtained after calculating monthly PET with the *envirem* package through its *monthlyPET* function. Input data layers of minimum, maximum and mean monthly temperatures were obtained from WorldClim 1.4, whereas monthly extra-terrestrial solar radiation was obtained from the CGIAR CSI.

Processing and mapping of geospatial data sets were done with *R 3.5.1*.

Comparison of the future and baseline monthly moisture indices shows that there is a likely decrease of the moisture index for the project area in January and May and for a part of the area in June (figures 2.1 – 2.2). These trends follow trends in precipitation, but as a result from the general increases in PET, larger sections of the project area are expected to experience decreases in the moisture index in May and June.

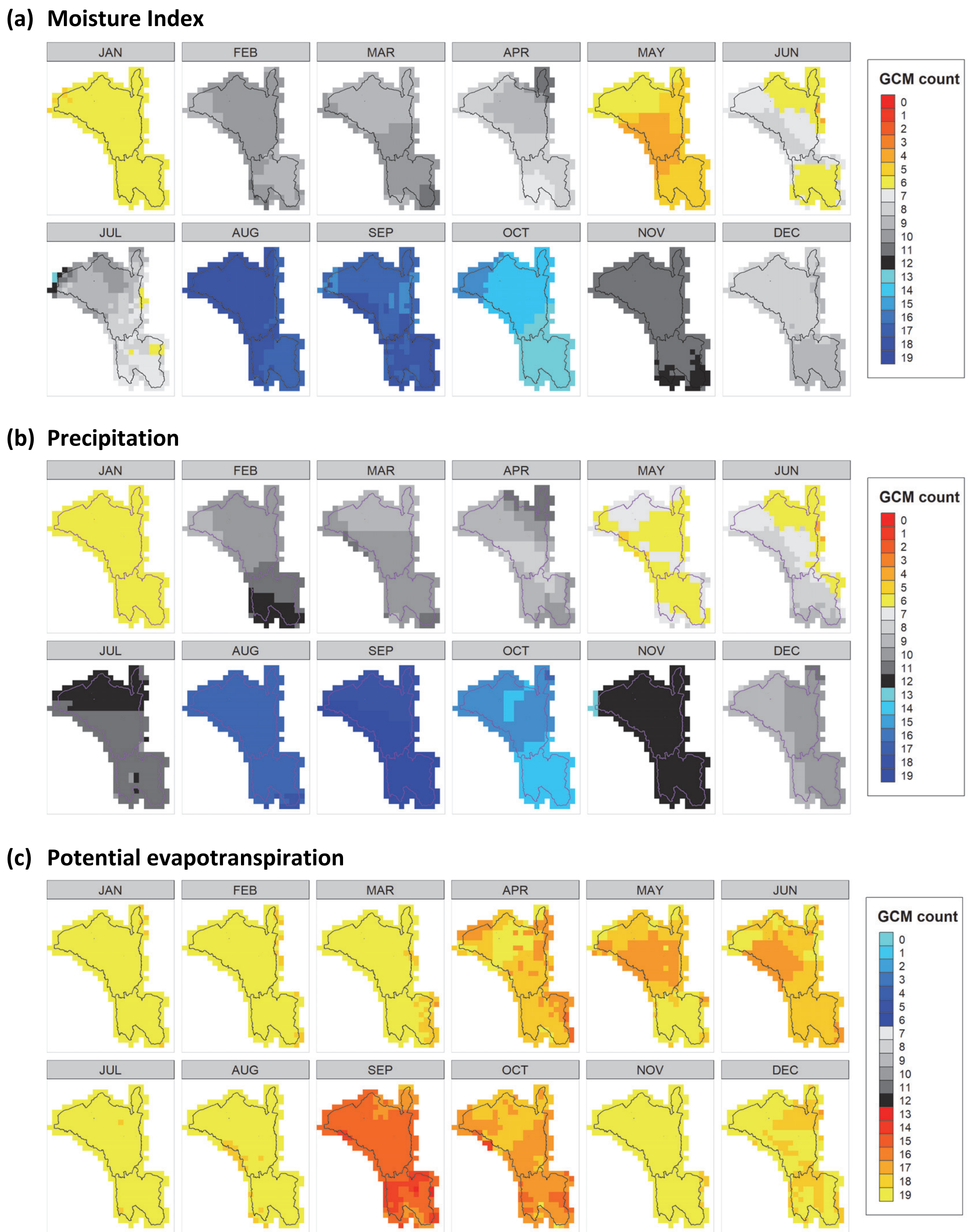
From August to October, the project area is likely to experience increases in the moisture index and precipitation (figures 2.1 – 2.2).

Figure 2.1 (next page). Counts of General Circulation Models that project monthly increases for Sri Lanka in moisture index, precipitation and potential evapotranspiration by the 2050s for RCP4.5 compared to the baseline centred on 1975. The major changes in the colour schemes correspond to the likelihood scale recommended for the fifth Assessment Report of the IPCC.



(a) Moisture Index
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
GCM count
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
(b) Precipitation
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
GCM count
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
(c) Potential evapotranspiration
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC
GCM count
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19

Figure 2.2. Counts of General Circulation Models that project monthly increases for the project area in moisture index, precipitation and potential evapotranspiration by the 2050s for RCP4.5 compared to the baseline centred on 1975. The major changes in the colour schemes correspond to the [likelihood scale recommended for the fifth Assessment Report of the IPCC].



The next series of maps focuses on the months with likely changes in the moisture index.

Figure 2.3. Projected mid-21st century changes (RCP4.5) for the project area in January in moisture index (top), precipitation (middle) and PET (bottom)

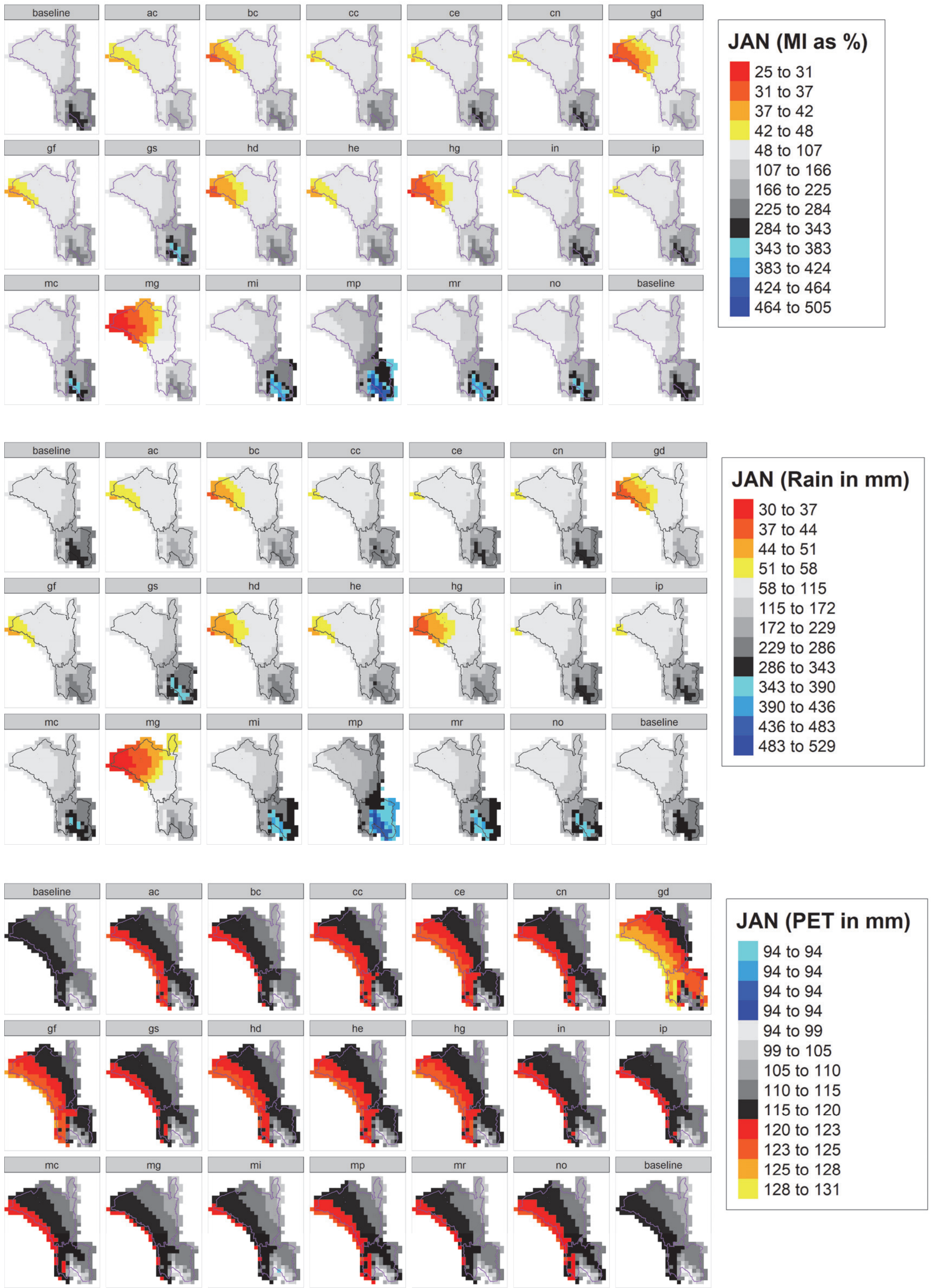


Figure 2.3 shows that the January moisture index will decrease beyond baseline conditions (baseline conditions were coloured in greyscale) in the north-western part of the project area, within the downstream area. Although there was consensus among the GCMs on a general decline in moisture index, some models (gs, mc, mi, mp, mr and no; see Table 4.1 for full names of models) depicted an opposite trend of increasing values and values beyond the baseline range in the upland areas.

Figure 2.4. Projected mid-21st century changes (RCP4.5) for the project area in May in moisture index (top), precipitation (middle) and PET (bottom)

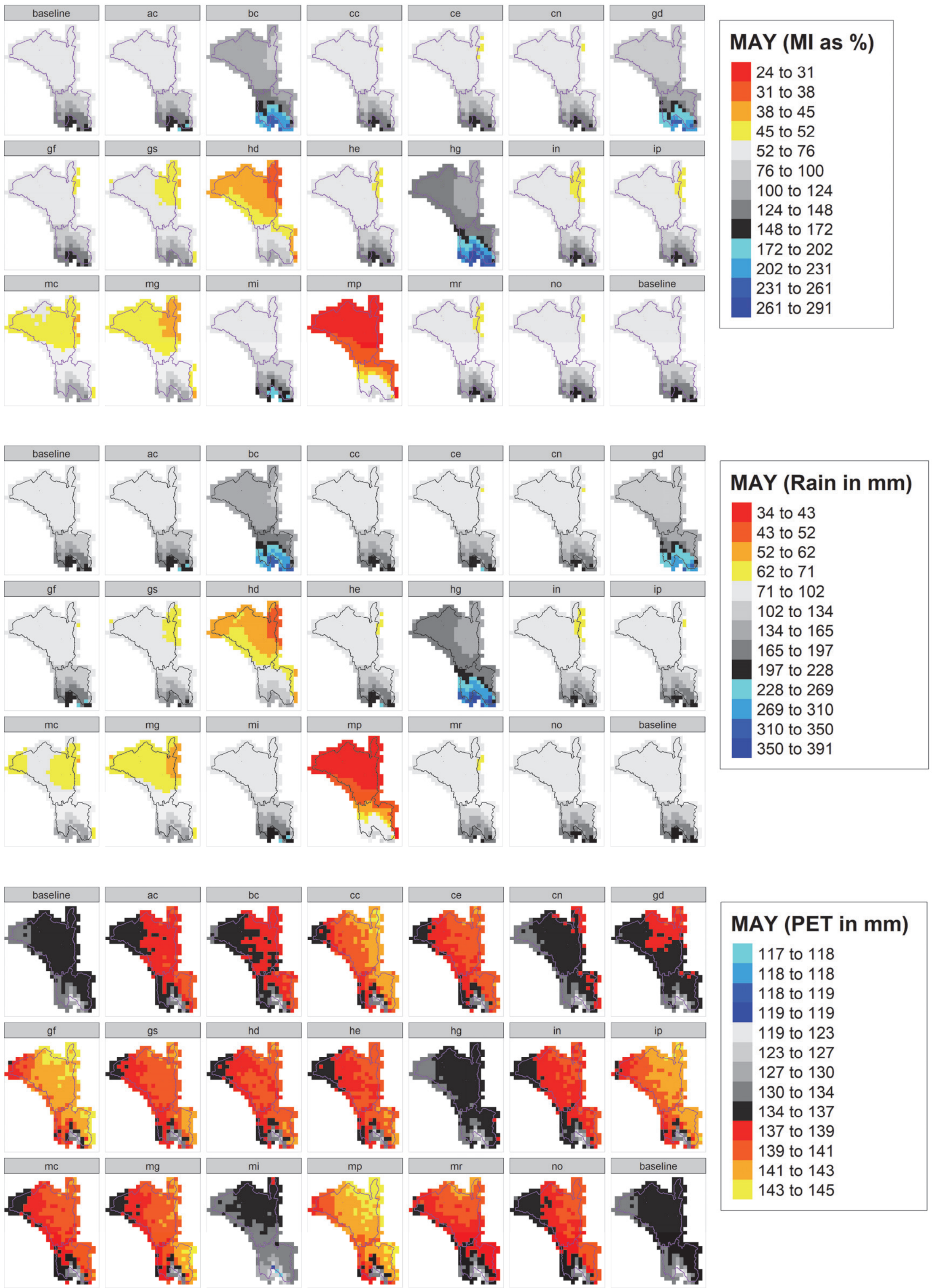


Figure 2.4 shows that although the moisture index is likely to decrease in May, values lower than the baseline conditions are especially likely in the north-eastern section of the downstream area. However, there were four GCMs (hd, mc, mg and mp) that projected moisture index conditions that were beyond the baseline in most of the downstream area. Some GCMs project increases in moisture index beyond baseline conditions in the uplands.

Figure 2.5. Projected mid-21st century changes (RCP4.5) for the project area in June in moisture index (top), precipitation (middle) and PET (bottom)

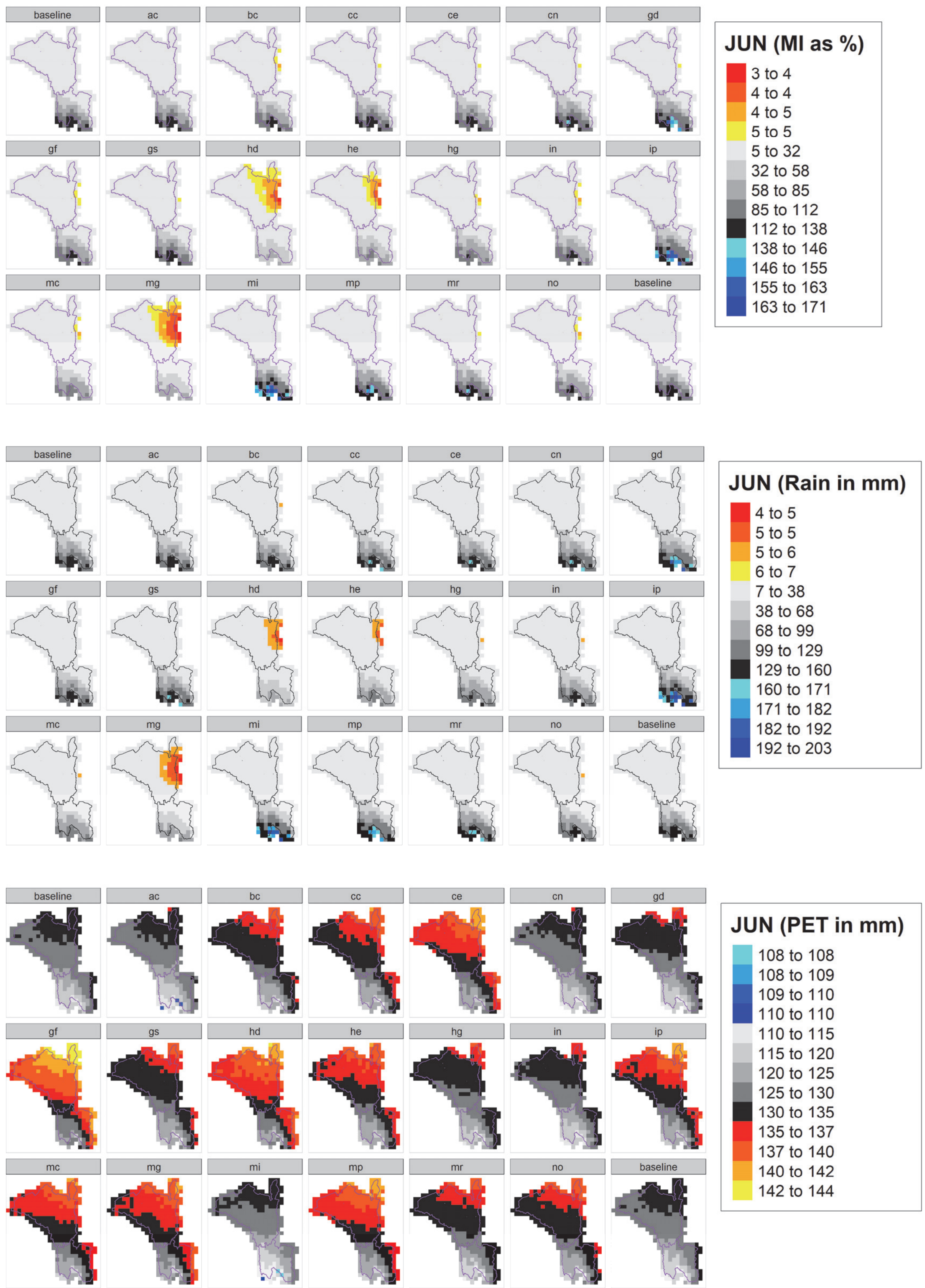


Figure 2.5 shows that a limited number of GCMs project decreases in the June moisture index beyond baseline conditions. However, with a minimum moisture index of 5 percent in the baseline climate, there was not much scope for further decrease in the moisture index. The same situation occurs for the rainfall, with a minimum of 7 mm in the baseline climate.

Figure 2.6. Projected mid-21st century changes (RCP4.5) for the project area in August in moisture index (top), precipitation (middle) and PET (bottom)

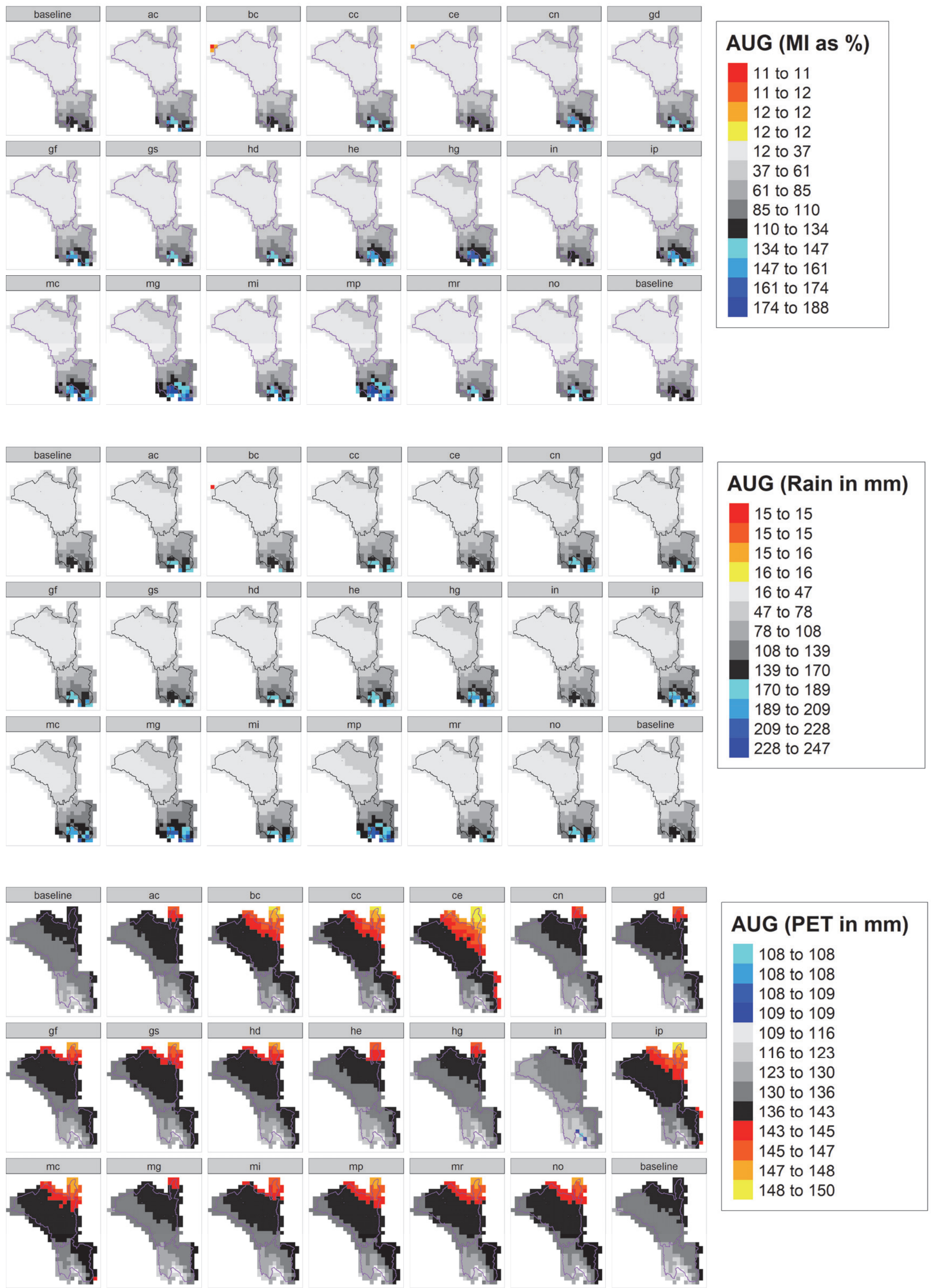


Figure 2.6 shows that the most significant increases in August moisture index will be experienced in the extreme south of the upstream area. This trend follows increases in rainfall, for which there is strong agreement among the GCMs.

Figure 2.7. Projected mid-21st century changes (RCP4.5) for the project area in September in moisture index (top), precipitation (middle) and PET (bottom)

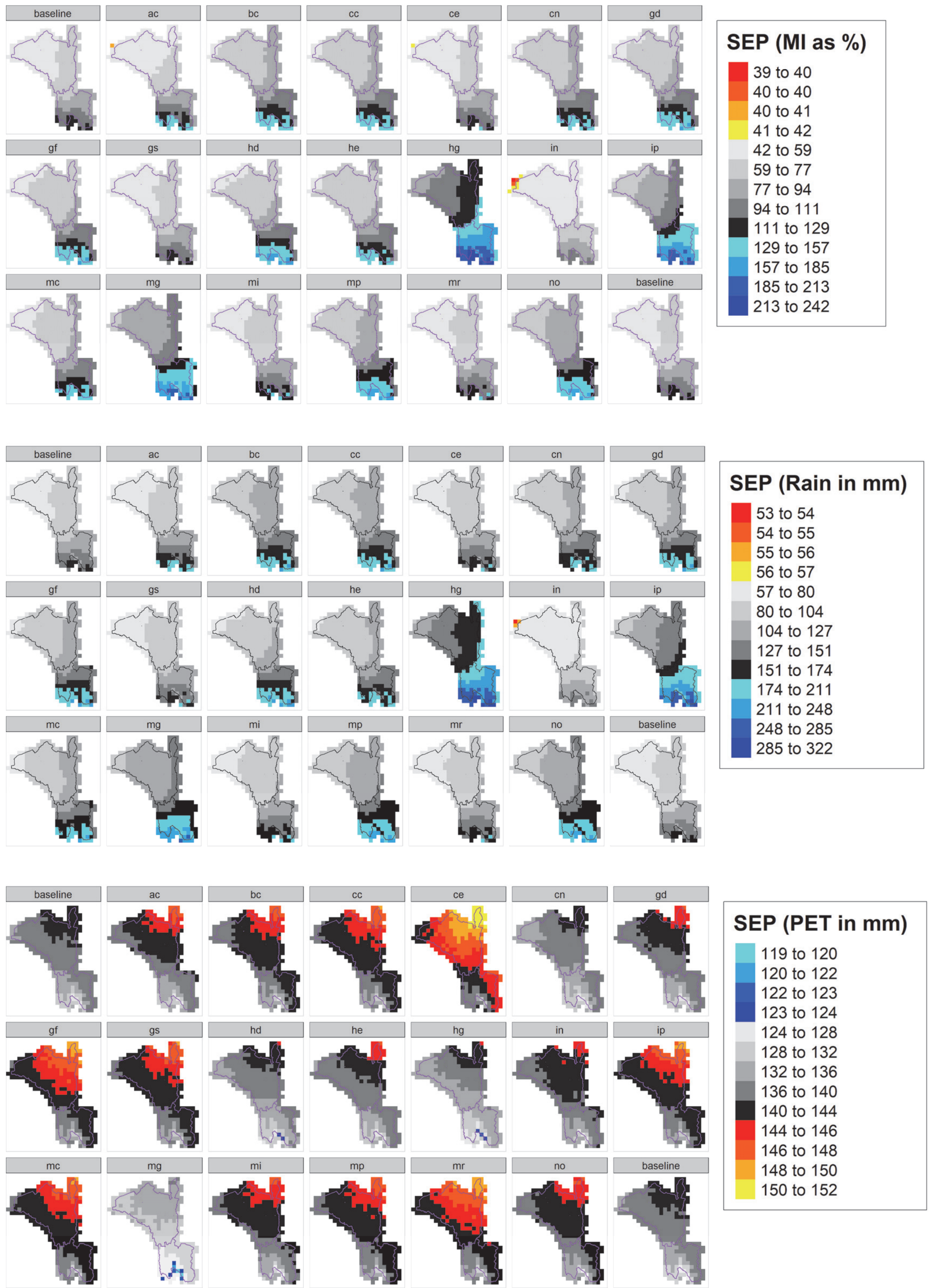


Figure 2.7 shows that in September, a large number of GCMs project that a significant section of the upland area will experience moisture index values beyond the baseline range.

Figure 2.8. Projected mid-21st century changes (RCP4.5) for the project area in October in moisture index (top), precipitation (middle) and PET (bottom)

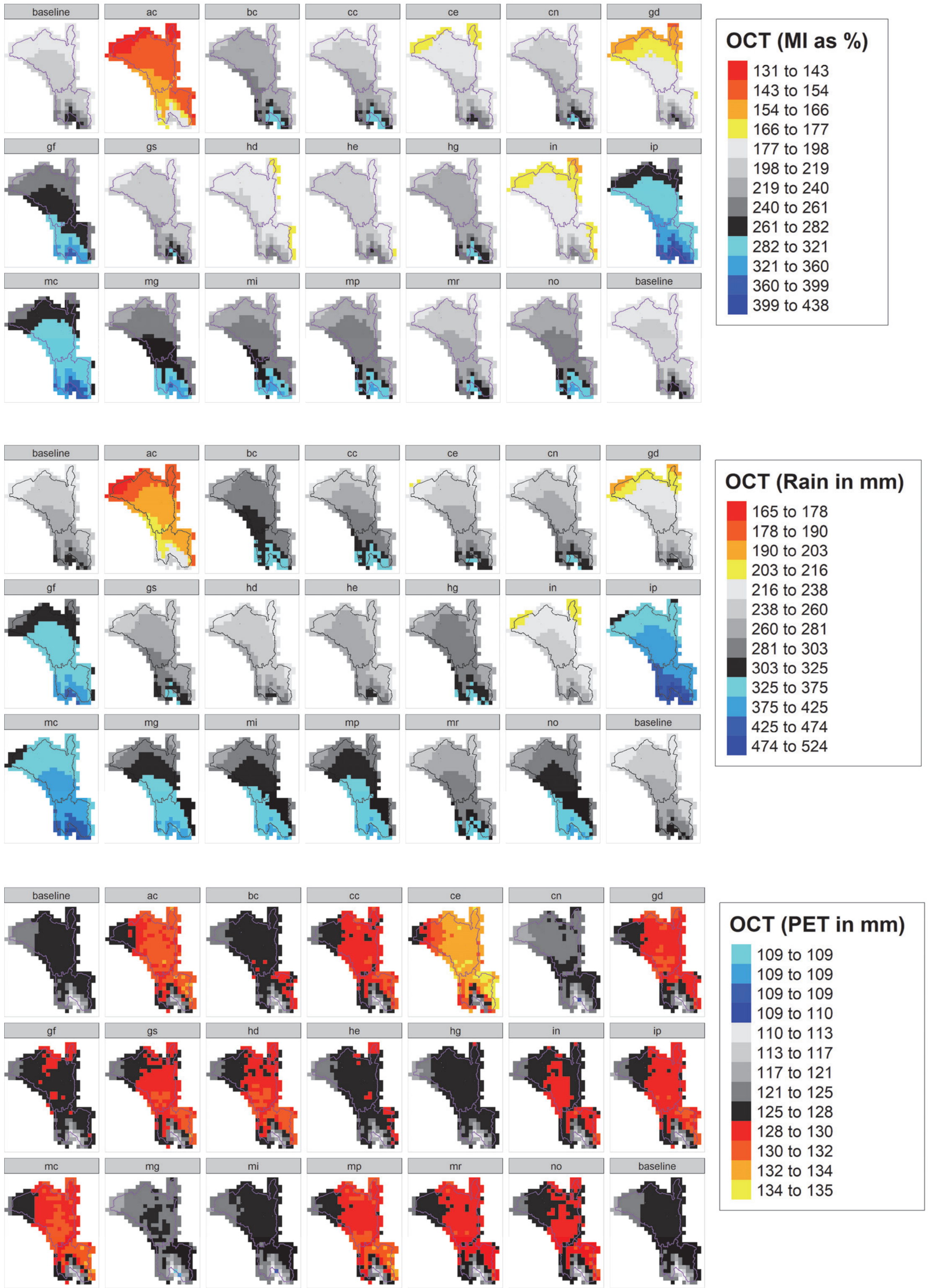


Figure 2.8 shows that although there was model consensus (likely changes) on an increase of moisture index values in October, changes outside the baseline range will be experienced mainly in the upland areas. Some GCMs (ce, gd, in and especially ac) project an opposite trend of a decreasing moisture index in the north. However, even decreasing values beyond the baseline range are above 100 percent.

3. Projected changes in monthly precipitation volumes

Total volumes of precipitation and PET were obtained for the project area after reprojecting the relevant geospatial layers to the equal-area Mollweide projection via the raster:: projectRaster function.

The balance between future and baseline precipitation volumes were obtained by extracting and summing precipitation values from all raster cells that covered the project area. The final total volume was adjusted to compensate for differences between the actual areas of the downstream (3345.0382 km^2) and upstream areas (1477.154 km^2) with the area covered by the sampled grid cells (3299.872 and 1575.423 km^2, respectively)

In an alternative procedure, differences between precipitation volumes also considered the changes in PET and calculated the precipitation difference that would result in the same moisture index in the future and the baseline conditions for each GCM. Calculations for this alternative procedure were as follows, as shown here for GCM hd for the month of January for the downstream area.

- In the baseline climate, total P and PET were 16,210 mm and 17,558 mm respectively, resulting in a moisture index of 0.9232.
- In the future climate, total P and PET were 11,394 mm and 18,318 mm respectively, resulting in a moisture index of 0.6220.
- To return to the baseline moisture index, there is a future precipitation deficit of 701 mm: (16,210 + 701) / 18,318 = 0.9232
- The precipitation deficit of 701 mm corresponds to a volume of 15,139 million l by multiplying the precipitation deficit with the adjusted size of a grid cell (~ 21.5809 km^2)

Table 3.1 shows that, for the downstream area, there are likely precipitation deficits in January and May with 13 GCMs projecting deficits. There are likely precipitation surpluses from August to October, with respectively 16, 18 and 15 GCMs projecting surpluses.

When also considering the maintenance of moisture indices (Table 3.2), the number of GCMs projecting deficits increased from 13 to 14 for May. Likely precipitation surpluses remained from August to October, although the number of GCMs that projected surpluses changed to 17, 16 and 14, respectively.

Table 3.3 shows the projected changes in moisture indices for the downstream area, estimated from total P and PET. The same months identified for Table 3.2 showed likely changes: January and May with likely decreases, and August to October with likely increases.

Tables 3.4 to 3.6 show volumes for the upstream area. The same months can be identified with likely decreases (January and May) and likely increases (August to October) as for the downstream areas. However, also June was identified as a month with likely decreases in the moisture index (13 GCMs, Table 3.6) and volumes when also considering the maintenance of the baseline moisture index (13 GCMs, Table 3.5).

Table 3.1. Projected changes (future – baseline) in precipitation volumes for the downstream area. Statistics are in million l. Negative values are highlighted. GCMs are sorted by annual baseline precipitation.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-103,922	-37,204	-116,367	-227,771	-96,415	-21,030	6,202	11,337	47,850	-7,175	-65,869	-208,290
ce	-29,316	15,495	-89,319	-84,679	-2,918	0	-5,844	-290	11,945	1,791	27,787	-18,344
gd	-125,360	83,076	123,670	136,755	121,541	2,035	7,215	6,690	56,565	-76,540	-227,137	-221,556
in	-18,818	-5,828	-56,131	74,460	-23,763	-8,018	-3,642	-213	-29,165	-56,804	-9,857	65,149
he	-58,102	-4,837	2,140	-116,761	-9,976	-16,349	5,554	26,122	55,141	42,927	175,756	-89,935
ac	-90,704	15,132	176,865	44,454	6,948	5,184	-32,769	20,316	386	-189,046	254,082	-135,688
cc	-29,714	-51,604	-27,148	-4,086	3,069	62	-1,110	12,866	72,485	60,266	53,883	15,473
cn	-28,640	8,406	-7,561	98,356	-1,219	3,530	-1,903	24,547	59,207	25,033	-19,731	-23,404
hg	-116,683	-57,871	-16,711	-24,203	263,053	-3,473	14,120	37,778	227,864	117,161	-46,340	-240,513
gs	20,346	-26,148	19,508	-17,248	-41,332	1,498	6,643	10,934	8,992	57,672	50,348	131,584
gf	-61,180	23,497	23,384	-47,747	-406	-3,897	4,525	9,317	57,765	272,176	210,008	-221,386
mg	-168,712	-96,370	-23,755	141,320	-69,921	-21,552	4,190	45,631	123,893	205,675	186,302	124,900
mr	62,843	65,369	-11,748	-38,103	-14,825	3,569	9,255	6,844	15,592	80,272	101,082	235,013
mi	74,006	31,867	91,668	8,407	15,579	9,902	9,923	11,812	24,869	183,059	50,854	191,125
bc	-96,076	-37,931	-86,529	385,265	203,223	-4,882	1,415	-3,756	75,487	143,049	208,083	-61,574
mc	42,832	40,841	36,300	-51,186	-59,523	-7,616	17,883	34,650	55,751	385,701	-23,803	321,480
no	23,661	139,980	272,811	111,867	-10,458	-4,706	0	19,452	110,259	167,092	-81,572	70,519
ip	-31,264	-32,073	21,070	16,643	-12,880	10,569	-16,306	27,559	150,270	419,464	333,785	83,338
mp	242,658	97,403	216,206	-5,852	-154,889	7,845	3,745	47,785	88,415	205,686	283,964	33

Table 3.2. Projected required changes (future – baseline) in precipitation volumes for the downstream area to maintain the baseline moisture index (see methods). Statistics are in million l. Negative values are highlighted.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-119,061	-43,835	-124,263	-249,840	-104,650	-24,159	3,301	8,582	49,485	-27,236	-97,961	-256,126
ce	-46,404	6,036	-94,737	-86,050	-11,256	-2,737	-11,790	-6,297	-2,700	-42,432	-15,348	-59,208
gd	-154,365	71,567	116,045	126,140	117,684	1,206	6,496	4,468	53,424	-101,501	-268,055	-264,704
in	-25,937	-11,209	-69,768	73,105	-30,547	-8,429	-3,116	2,736	-33,269	-71,891	-19,301	64,379
he	-73,078	-12,723	-3,334	-133,378	-17,596	-18,648	16	24,687	53,719	34,250	140,346	-115,163
ac	-99,633	14,467	175,534	33,636	1,720	5,334	-42,550	18,533	-4,681	-218,528	261,000	-139,073
cc	-42,476	-57,457	-34,142	-21,680	-7,899	-1,835	-5,420	8,337	64,678	38,647	23,474	-10,250
cn	-39,770	6,413	-11,906	104,126	-1,056	3,512	-6,078	23,556	62,242	37,664	-36,831	-40,056
hg	-133,967	-66,916	-24,438	-31,119	264,254	-4,391	9,999	37,060	231,606	110,842	-81,347	-273,438
gs	12,859	-32,417	12,531	-31,202	-50,436	-45	3,161	7,520	1,185	37,346	32,736	110,441
gf	-80,058	10,617	10,211	-83,546	-14,869	-7,651	-1,197	6,297	47,429	258,410	186,444	-264,400
mg	-170,415	-99,178	-28,230	138,683	-78,884	-23,981	1,076	44,536	136,573	215,912	180,258	114,970
mr	57,731	62,364	-15,454	-48,308	-23,549	2,029	6,208	3,270	4,381	58,417	84,585	227,330
mi	72,348	30,522	90,159	7,009	17,809	10,160	7,661	9,230	18,972	182,775	39,629	189,477
bc	-101,963	-43,777	-92,885	377,828	199,148	-6,541	-3,286	-8,589	69,381	133,152	195,764	-72,865
mc	35,345	36,313	28,055	-67,522	-67,770	-10,096	12,490	30,220	47,222	359,168	-39,364	305,002
no	13,577	135,713	268,657	96,017	-17,223	-6,553	-5,287	15,657	104,985	150,727	-110,032	49,376
ip	-37,129	-36,283	14,093	5,246	-25,181	8,182	-21,611	22,598	141,787	400,886	315,155	66,063
mp	232,715	89,442	208,792	-24,622	-169,647	5,111	-1,383	44,068	81,387	181,585	270,830	-17,007

Table 3.3. Projected changes (future – baseline) in moisture index for the downstream area, calculated from total precipitation and PET for the project area. Negative values are highlighted.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-30.12%	-9.36%	-23.22%	-47.20%	-22.49%	-5.27%	0.75%	1.85%	10.69%	-6.34%	-24.88%	-70.04%
ce	-11.68%	1.27%	-17.86%	-16.85%	-2.42%	-0.60%	-2.60%	-1.33%	-0.55%	-9.60%	-3.85%	-16.33%
gd	-37.62%	14.95%	21.71%	24.30%	25.67%	0.27%	1.50%	0.97%	11.34%	-23.49%	-67.39%	-72.79%
in	-6.71%	-2.41%	-12.77%	14.32%	-6.60%	-1.93%	-0.72%	0.62%	-7.03%	-16.83%	-5.03%	18.64%
he	-18.49%	-2.70%	-0.63%	-25.43%	-3.79%	-4.13%	0.00%	5.39%	11.47%	8.08%	35.51%	-32.35%
ac	-25.64%	3.18%	33.59%	6.48%	0.37%	1.24%	-9.11%	4.04%	-0.99%	-50.31%	69.37%	-40.13%
cc	-10.82%	-12.32%	-6.40%	-4.13%	-1.68%	-0.41%	-1.21%	1.78%	13.49%	8.98%	5.97%	-2.88%
cn	-10.17%	1.40%	-2.25%	20.65%	-0.23%	0.81%	-1.36%	5.17%	13.51%	9.12%	-9.52%	-11.37%
hg	-33.69%	-14.14%	-4.57%	-6.03%	58.62%	-1.00%	2.24%	8.15%	50.42%	26.22%	-20.59%	-76.11%
gs	3.32%	-6.94%	2.35%	-5.98%	-10.81%	-0.01%	0.71%	1.62%	0.25%	8.69%	8.45%	31.18%
gf	-20.05%	2.20%	1.87%	-15.42%	-3.13%	-1.65%	-0.26%	1.36%	9.80%	60.60%	47.81%	-72.72%
mg	-44.76%	-21.57%	-5.34%	27.10%	-16.91%	-5.30%	0.24%	9.76%	30.77%	52.11%	47.18%	32.91%
mr	15.02%	13.55%	-2.93%	-9.31%	-5.05%	0.46%	1.40%	0.70%	0.90%	13.57%	21.87%	65.24%
mi	19.00%	6.68%	17.24%	1.37%	3.96%	2.36%	1.74%	2.00%	3.99%	43.55%	10.31%	54.79%
bc	-26.46%	-9.39%	-17.45%	73.20%	43.40%	-1.46%	-0.73%	-1.82%	14.56%	31.37%	50.86%	-20.82%
mc	9.13%	7.83%	5.24%	-12.88%	-14.57%	-2.23%	2.77%	6.44%	9.83%	82.97%	-10.19%	86.60%
no	3.48%	29.31%	50.88%	18.33%	-3.72%	-1.46%	-1.17%	3.35%	22.10%	35.24%	-28.06%	13.94%
ip	-9.64%	-7.84%	2.64%	1.01%	-5.34%	1.81%	-4.79%	4.80%	29.51%	93.48%	81.28%	18.74%
mp	59.72%	18.99%	39.08%	-4.68%	-35.70%	1.12%	-0.31%	9.45%	17.03%	42.07%	70.30%	-4.83%

Table 3.4. Projected changes (future – baseline) in precipitation volumes for the upstream area. Statistics are in million l. Negative values are highlighted. GCMs are sorted by annual baseline precipitation.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-62,072	-211	-56,736	-86,108	-61,942	-48,715	8,430	10,108	54,358	-24,486	-17,198	-62,376
ac	-123,840	18,138	22,978	8,410	9,632	-3,339	-38,929	16,569	19,388	-95,951	107,824	-121,404
ce	-28,270	19,646	-53,863	-47,724	-133	264	-5,233	-1,299	9,934	6,852	23,535	-10,311
in	-15,485	-3,184	-36,207	29,177	-12,045	-11,259	-1,490	-3,594	-23,595	-38,109	-6,904	39,076
he	-56,665	4,945	7,170	-46,250	-2,688	-30,958	-176	23,945	33,472	-15,157	53,323	-44,490
cc	-42,920	-50,134	-15,333	1,377	-765	2,616	-2,652	14,670	46,469	44,592	23,335	18,515
gd	-129,795	74,132	88,135	105,326	91,300	12,296	11,555	10,107	47,994	-21,270	-97,246	-152,408
cn	-19,793	4,335	-8,959	55,128	-8,881	3,376	-6,347	21,988	34,437	15,290	-18,619	-22,803
hg	-75,281	-27,820	-9,514	-29,820	149,655	-14,497	8,309	33,407	151,285	32,730	-30,173	-127,387
gf	-67,929	7,972	11,883	-21,360	5,069	-5,900	2,329	18,330	51,348	137,809	111,988	-142,228
gs	34,625	-13,772	16,613	254	-25,718	2,255	4,429	8,527	3,290	22,446	33,969	69,816
mg	-110,144	-82,963	-19,899	60,246	-46,753	-39,102	2,343	52,771	84,335	110,264	73,139	125,457
bc	-89,935	-44,886	-49,633	180,700	118,076	-6,978	-5,281	-268	46,696	49,827	110,239	-43,681
mr	70,182	69,133	-1,182	-17,079	-13,499	5,387	10,547	7,862	10,664	38,072	54,999	134,025
mi	76,615	39,061	40,660	-16,801	10,624	21,197	13,503	16,279	15,221	91,314	25,389	107,935
mc	24,552	18,600	22,233	-7,919	-44,063	-17,264	11,463	39,435	44,462	201,351	-11,923	166,687
no	36,715	107,612	152,328	58,474	-2,642	-10,106	928	19,744	68,569	88,859	-56,120	56,710
ip	-23,465	-24,624	11,303	14,984	-3,854	25,214	-19,110	33,525	127,632	240,809	180,340	65,223
mp	187,922	78,603	98,783	-3,586	-99,782	11,957	6,248	58,110	70,378	91,064	140,738	3,591

Table 3.5. Projected required changes (future – baseline) in precipitation volumes for the upstream to maintain the baseline moisture index (see methods). Statistics are in million l. Negative values are highlighted.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-76,135	-6,164	-62,721	-98,902	-68,974	-55,480	4,599	7,573	56,460	-37,123	-32,246	-90,499
ac	-138,091	15,675	21,700	1,099	4,209	-2,121	-51,170	14,293	17,779	-109,534	109,814	-130,725
ce	-44,735	10,651	-58,437	-50,719	-6,510	-5,169	-12,100	-8,241	624	-15,644	-994	-35,052
in	-22,419	-7,810	-44,552	26,883	-16,839	-12,235	-360	-1,137	-26,384	-45,999	-14,539	38,377
he	-72,499	-2,203	3,472	-56,382	-9,975	-35,373	-6,312	22,869	33,086	-18,804	33,397	-61,532
cc	-57,380	-56,802	-19,584	-7,692	-9,057	-1,262	-7,820	8,855	40,932	34,425	6,518	5,640
gd	-166,218	61,466	83,498	102,480	89,890	11,699	11,201	7,454	47,435	-29,358	-117,514	-181,959
cn	-32,749	1,743	-11,981	57,971	-9,966	2,706	-11,448	20,192	35,260	17,865	-31,380	-37,772
hg	-91,960	-36,049	-15,546	-36,139	148,465	-16,691	3,394	32,930	155,617	31,114	-47,909	-151,047
gf	-87,678	-4,605	3,074	-40,338	-5,132	-13,378	-5,234	15,816	45,862	135,003	100,560	-169,782
gs	26,817	-19,047	12,099	-6,725	-33,366	-1,452	-351	4,380	-2,247	10,647	24,086	56,069
mg	-114,963	-87,399	-22,903	59,455	-55,734	-45,042	-2,201	51,843	93,322	114,169	67,821	117,386
bc	-95,179	-50,440	-53,853	177,599	113,478	-10,244	-10,706	-5,746	41,992	44,013	102,758	-51,854
mr	67,601	67,804	-1,950	-19,372	-16,790	3,425	7,401	4,149	4,287	29,988	49,739	129,354
mi	77,578	40,786	42,613	-12,072	15,160	23,139	12,177	14,390	12,461	93,885	22,543	110,828
mc	16,744	14,236	16,742	-15,229	-50,184	-22,043	5,252	33,391	37,656	188,009	-21,475	156,173
no	26,350	102,972	149,307	49,936	-8,301	-13,695	-4,969	15,201	64,698	80,048	-71,836	42,963
ip	-30,237	-29,135	6,336	8,682	-12,751	20,564	-25,087	27,493	121,698	229,523	167,766	51,162
mp	177,582	71,716	93,908	-14,045	-109,536	7,433	1,180	53,335	64,623	76,388	130,742	-10,488

Table 3.6. Projected changes (future – baseline) in moisture index for the upstream area, calculated from total precipitation and PET for the project area. Negative values are highlighted.

GCM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
hd	-44.71%	-3.05%	-27.34%	-43.57%	-33.85%	-28.78%	2.47%	3.94%	28.70%	-19.66%	-18.76%	-55.95%
ac	-81.04%	7.89%	9.72%	0.49%	2.08%	-1.19%	-25.92%	7.45%	8.85%	-57.89%	66.26%	-83.79%
ce	-26.09%	5.18%	-25.68%	-23.12%	-3.21%	-2.72%	-6.37%	-4.16%	0.30%	-8.10%	-0.57%	-21.81%
in	-13.43%	-3.89%	-19.16%	12.29%	-8.35%	-6.71%	-0.20%	-0.61%	-13.05%	-24.64%	-8.59%	25.02%
he	-42.36%	-1.08%	1.53%	-25.07%	-4.89%	-18.77%	-3.34%	12.03%	16.59%	-10.18%	19.23%	-38.85%
cc	-33.66%	-27.96%	-8.62%	-3.43%	-4.42%	-0.67%	-4.16%	4.50%	19.95%	18.34%	3.78%	3.59%
gd	-91.91%	29.37%	36.68%	46.75%	45.33%	6.45%	6.18%	3.88%	23.76%	-15.72%	-67.61%	-112.18%
cn	-19.29%	0.88%	-5.31%	26.99%	-5.03%	1.49%	-6.10%	10.57%	17.80%	9.82%	-18.34%	-23.94%
hg	-53.61%	-17.61%	-6.78%	-16.28%	74.95%	-9.05%	1.81%	17.40%	80.11%	16.93%	-27.71%	-94.17%
gf	-50.69%	-2.20%	1.32%	-17.40%	-2.48%	-6.89%	-2.74%	8.23%	22.36%	73.22%	58.95%	-105.07%
gs	16.02%	-9.44%	5.32%	-3.02%	-16.33%	-0.78%	-0.19%	2.25%	-1.10%	5.65%	14.17%	35.63%
mg	-69.28%	-43.52%	-10.16%	27.32%	-27.10%	-23.55%	-1.18%	27.30%	49.35%	62.96%	40.28%	75.42%
bc	-57.29%	-24.97%	-23.71%	80.94%	56.35%	-5.50%	-5.69%	-2.93%	20.56%	23.70%	60.74%	-33.31%
mr	41.00%	34.31%	-0.88%	-8.85%	-8.39%	1.86%	4.00%	2.14%	2.08%	16.06%	29.54%	83.67%
mi	47.53%	20.97%	19.45%	-5.66%	7.87%	13.08%	6.67%	7.52%	6.17%	51.60%	13.46%	72.77%
mc	10.01%	7.09%	7.32%	-6.84%	-24.74%	-11.65%	2.78%	16.95%	18.23%	99.42%	-12.64%	99.86%
no	15.63%	51.22%	66.20%	22.33%	-4.10%	-7.32%	-2.63%	7.80%	31.82%	42.79%	-41.73%	27.30%
ip	-18.12%	-14.50%	2.78%	3.91%	-6.20%	10.89%	-13.28%	13.95%	59.18%	121.97%	98.10%	32.49%
mp	105.36%	35.27%	41.20%	-6.24%	-53.07%	3.94%	0.63%	27.31%	31.46%	40.27%	76.87%	-6.66%

4. Methods

Table 4.1. Mid-21st century GCM datasets obtained from WorldClim 1.4 and analysed in this report

GCM	Code
ACCESS1-0	ac
BCC-CSM1-1	bc
CCSM4	cc
CESM1-CAM5-1-FV2	ce
CNRM-CM5	cn
GFDL-ESM2G	gd
GFDL-CM3	gf
GISS-E2-R	gs
HadGEM2-AO	hd
HadGEM2-ES	he
HadGEM2-CC	hg
INMCM4	in
IPSL-CM5A-LR	ip
MIROC5	mc
MRI-CGCM3	mg
MIROC-ESM-CHEM	mi
MPI-ESM-LR	mp
MIROC-ESM	mr
NorESM1-M	no

Figure 4.1. Sampling grid for baseline and future precipitation and potential evapotranspiration. Map is in Mollweide projection system.