UNDP Climate Change Country Profiles

Comoros

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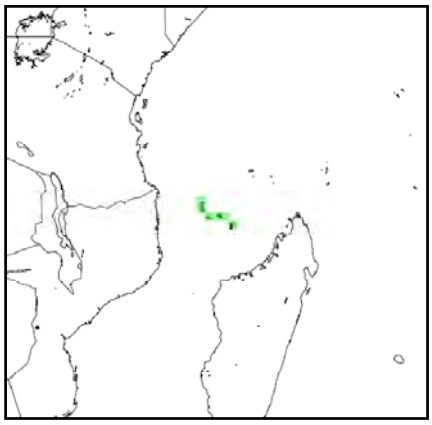
http://country-profiles.geog.ox.ac.uk



General Climate

The Comoros Islands are located in the Indian Ocean, the coasts of East Africa and Madagascar. At latitudes of 11 to 14˚ south of the equator, the climate in the area is tropical. The Comoros Islands experience a long west season between December and June or July, when 200-250mm per month of rain falls. The dry season lasts between August and November, when monthly rainfall totals average 50 to 100mm per month. Average temperatures are lowest in JJA, at 24-25˚C, and highest in DJF, at around 27˚C.

The Comoros Islands lie in the path of Indian Ocean tropical cyclones and hurricanes, which occur between January and April.

Recent Climate Trends

Temperature

- Mean annual temperature has increased by 0.9˚C since 1960, an average rate of 0.19˚C per decade.
- This increase in temperature has been most rapid in MAM, at a rate of 0.22˚C per decade.

- There are insufficient daily observations available to identify trends in daily temperature extremes.

Precipitation

- Mean annual rainfall over Comoros has decreased in recent years, with particularly low rainfalls in the last decade in all seasons.
- Observed decreases in rainfall are greatest over the northern islands of Comoros.

- Insufficient daily rainfall observations are available to identify trends in daily rainfall extremes.

GCM Projections of Future Climate

Temperature

- The mean annual temperature is projected to increase by 0.8 to 2.1˚C by the 2060s, and 1.2 to 3.6˚C by the 2090s. The range of projections by the 2090s under any one emissions scenario is around 0.5-1.5˚C.
- Projected temperature increases occur at a similar rate in all seasons.

- All projections indicate substantial increases in the frequency of days and nights that are considered 'hot' in current climate.
    - Annually, projections indicate that 'hot'[1] days will occur on 30-61% of days by the 2060s, and 44-92% of days by the 2090s. Days considered 'hot' by current climate standards for their season are projected to increase in frequency most rapidly in DJF, occurring on 82-100% of days by the 2090s.
    - Nights that are considered 'hot' for the annual climate of 1970-99 are projected to increase more quickly that hot days, occurring on 31-64% of nights by the 2060s and 44-94% of nights by the 2090s. Nights that are considered hot for each season by current standards are projected to increase most rapidly in DJF, occurring on 80-100% of nights in every season by the 2090s.
- All projections indicate rapid decreases in the frequency of days and nights that are considered 'cold'[2] in current climate. These events are expected to become exceedingly rare, and only occur in some projections under the lowest emissions scenario by the 2060s.

Precipitation

- The range of projections of mean annual rainfall from different models is large and straddles both negative and positive changes (-15% to +39%). Seasonally, the projections show a more coherent picture, with the projections tending towards decreases in JJA and SON rainfall and increases in wet season rainfall (DJF).
    - Projected changes in JJA rainfall by the 2090s range from -47 to +21% with ensemble median values of -2 to -14% and in SON, -36 to +32%, with ensemble median values of -8 to -14%.
    - Projected changes in DJF rainfall by the 2090s range from -17 to +45% with ensemble median values of +3 to +14%.

[1] 'Hot' day or 'hot' night is defined by the temperature exceeded on 10% of days or nights in current climate of that region and season.

[2] 'Cold' days or 'cold' nights are defined as the temperature below which 10% of days or nights are recorded in current climate of that region or season.

- The proportion of rainfall that falls in heavy[3] events in projections tends towards increases, changing by -5 to +14% by the 2090s. Increases in DJF and MAM are partially offset by decreases in JJA.

- The models indicate increases in 1- and 5-day rainfall maxima by the 2090s under the higher emissions scenarios, with 1-day annual maxima changing by -7 to +34mm, and 5-day annual maxima by -11 to +64mm.

Other Regional Climate Change Information

- Tropical cyclones are poorly captured by GCMs and thus potential changes in intensity and tracks of tropical cyclones in the future are very uncertain. Whilst evidence indicates that tropical cyclones are likely to become, on the whole, more intense under a warmer climate as a result of higher sea-surface temperatures, there is great uncertainty in changes in frequency, and changes to storm tracks and their interactions with other features of climate variability (such as the El Niño Southern Oscillation) which introduces uncertainty at the regional scale (Christensen *et al*., 2007).
- The uncertainty in potential changes in tropical cyclones contributes to uncertainties in future wet-season rainfall. Potential increases in tropical cyclone activity, which may not be captured in the GCM projections, may add to the projected increases in wet-season rainfall in the region (Christensen *et al*., 2007).
- The Comoros Islands may be vulnerable to sea-level rise. Sea-level in this region is projected by climate models to rise by the following levels[4] by the 2090s, relative to 1980-1999 sea-level:
    - 0.13 to 0.43m under SRES B1
    - 0.16 to 0.53m under SRES A1B
    - 0.18 to 0.56m under SRES A2

- For further information on climate projections for Africa, see Christensen *et al.* (2007) IPCC Working Group I Report: '*The Physical Science Basis'*, Chapter 11 *(Regional Climate projections*): Section 11.2 *(Africa*).

[3] A 'Heavy' event is defined as a daily rainfall total which exceeds the threshold that is exceeded on 5% of rainy days in current the climate of that region and season.

[4] Taken from the IPCC Working group I (*The Physical Science Basis*): Chapter 10 (Global Climate Projections) (Meehl *et al*., 2007). Regional sea-level projections are estimated by applying regional adjustments (Fig 10.32, p813) to projected global mean sea-level rise from 14 AR4 models.

Data Summary

	Observed Mean 1970-99	Observed Trend 1960-2006		Projected changes by the 2030s Min	Median	Max	Projected changes by the 2060s Min	Median	Max	Projected changes by the 2090s Min	Median	Max
Temperature												
	(˚C)	*(change in ˚C per decade)*		*Change in ˚C*			*Change in ˚C*			*Change in ˚C*		
			A2	0.7	**0.9**	1.2	1.4	**1.9**	2.1	2.4	**3.0**	3.6
Annual	26.0	0.19*	*A1B*	0.6	**1.0**	1.2	1.2	**1.8**	2.1	1.8	**2.3**	3.3
			B1	0.4	**0.8**	1.0	0.8	**1.3**	1.6	1.2	**1.5**	2.0
			A2	0.6	**1.0**	1.2	1.4	**1.9**	2.2	2.2	**3.1**	3.9
DJF	27.2	0.18*	*A1B*	0.5	**1.0**	1.2	1.3	**1.9**	2.2	1.8	**2.4**	3.4
			B1	0.4	**0.8**	1.0	0.8	**1.3**	1.6	1.2	**1.5**	2.1
			A2	0.6	**1.0**	1.1	1.5	**1.9**	2.2	2.4	**3.0**	3.6
MAM	26.9	0.22*	*A1B*	0.6	**1.0**	1.3	1.2	**1.9**	2.1	1.9	**2.4**	3.2
			B1	0.5	**0.8**	0.9	0.8	**1.3**	1.6	1.3	**1.6**	2.1
			A2	0.5	**0.9**	1.2	1.4	**1.9**	2.0	2.3	**3.1**	3.5
JJA	24.4	0.20*	*A1B*	0.5	**0.9**	1.2	1.1	**1.8**	2.1	1.7	**2.3**	3.2
			B1	0.4	**0.7**	1.0	0.8	**1.2**	1.6	1.2	**1.5**	2.0
			A2	0.5	**0.9**	1.2	1.3	**1.7**	2.2	2.2	**3.0**	3.6
SON	25.4	0.16*	*A1B*	0.5	**0.9**	1.4	1.3	**1.7**	2.2	1.8	**2.1**	3.2
			B1	0.4	**0.7**	1.0	0.7	**1.2**	1.6	1.2	**1.4**	1.9
Precipitation												
	(mm per month)	*(change in mm per decade)*		*Change in mm per month*			*Change in mm per month*			*Change in mm per month*		
			A2	-9	**3**	14	-15	**0**	17	-16	**3**	27
Annual	162.9	-7.9*	*A1B*	-16	**2**	9	-7	**5**	18	-15	**1**	31
			B1	-5	**2**	12	-17	**-1**	12	-17	**3**	20
			A2	-16	**11**	35	-16	**10**	45	-20	**21**	64
DJF	236.1	-11.7	*A1B*	-22	**1**	33	-9	**7**	49	-21	**17**	58
			B1	-23	**6**	23	-21	**6**	26	-24	**8**	52
			A2	-15	**1**	30	-32	**8**	32	-32	**7**	55
MAM	221.7	-11.8*	*A1B*	-32	**8**	24	-14	**9**	35	-25	**-1**	73
			B1	-20	**10**	35	-27	**0**	34	-42	**8**	31
			A2	-15	**0**	5	-18	**-3**	5	-21	**-3**	8
JJA	132.3	-5.2	*A1B*	-19	**-2**	8	-17	**-1**	6	-17	**-4**	1
			B1	-9	**0**	6	-16	**0**	8	-19	**0**	13
			A2	-10	**1**	23	-11	**-3**	9	-14	**-5**	7
SON	59.1	-2.0	*A1B*	-11	**-1**	11	-10	**-4**	4	-16	**-5**	6
			B1	-8	**-2**	10	-13	**-3**	6	-18	**-2**	10
Precipitation (%)												
	(mm per month)	*(change in % per decade)*		*% Change*			*% Change*			*% Change*		
			A2	-9	**3**	13	-14	**0**	21	-16	**4**	34
Annual	162.9	-4.8*	*A1B*	-15	**2**	10	-7	**6**	23	-15	**2**	39
			B1	-5	**1**	13	-16	**-1**	10	-15	**2**	25
			A2	-8	**7**	18	-12	**4**	28	-12	**14**	45
DJF	236.1	-5.0	*A1B*	-17	**0**	15	-4	**5**	30	-17	**8**	40
			B1	-12	**3**	16	-13	**3**	13	-13	**3**	37
			A2	-8	**1**	17	-18	**6**	28	-23	**4**	44
MAM	221.7	-5.3*	*A1B*	-18	**5**	16	-10	**5**	25	-18	**-1**	63
			B1	-13	**6**	20	-19	**0**	26	-23	**6**	27
			A2	-35	**0**	30	-44	**-5**	9	-45	**-14**	19
JJA	132.3	-3.9	*A1B*	-45	**-5**	15	-34	**-4**	13	-40	**-9**	9
			B1	-21	**-1**	10	-38	**-2**	14	-47	**-2**	21
			A2	-23	**3**	57	-29	**-9**	16	-36	**-14**	13
SON	59.1	-3.4	*A1B*	-22	**-6**	20	-24	**-8**	11	-34	**-18**	32
			B1	-21	**-10**	45	-38	**-10**	15	-33	**-8**	18

	Observed Mean 1970-99	Observed Trend 1960-2006		Projected changes by the 2030s			Projected changes by the 2060s			Projected changes by the 2090s		
				Min	Median	Max	Min	Median	Max	Min	Median	Max
	% Frequency	Change in frequency per decade					Future % frequency			Future % frequency		
Frequency of Hot Days (TX90p)												
			A2	****	****	****	46	**56**	61	65	**76**	92
Annual	****	****	*A1B*	****	****	****	43	**54**	60	54	**65**	87
			B1	****	****	****	30	**42**	52	44	**49**	61
			A2	****	****	****	74	**92**	99	98	**99**	100
DJF	****	****	*A1B*	****	****	****	78	**90**	98	93	**98**	100
			B1	****	****	****	55	**68**	91	82	**85**	98
			A2	****	****	****	64	**86**	95	96	**99**	100
MAM	****	****	*A1B*	****	****	****	62	**85**	94	86	**97**	99
			B1	****	****	****	42	**71**	92	63	**79**	93
			A2	****	****	****	57	**72**	78	92	**99**	99
JJA	****	****	*A1B*	****	****	****	57	**74**	78	75	**96**	99
			B1	****	****	****	35	**54**	60	47	**67**	76
			A2	****	****	****	47	**63**	70	80	**96**	99
SON	****	****	*A1B*	****	****	****	38	**63**	70	61	**85**	95
			B1	****	****	****	32	**47**	53	45	**50**	67
Frequency of Hot Nights (TN90p)												
			A2	****	****	****	45	**55**	64	62	**77**	94
Annual	****	****	*A1B*	****	****	****	43	**53**	63	54	**65**	90
			B1	****	****	****	31	**41**	55	44	**49**	65
			A2	****	****	****	68	**93**	99	98	**100**	100
DJF	****	****	*A1B*	****	****	****	73	**92**	98	95	**99**	100
			B1	****	****	****	54	**74**	93	80	**89**	99
			A2	****	****	****	66	**85**	97	95	**99**	100
MAM	****	****	*A1B*	****	****	****	64	**85**	96	86	**97**	99
			B1	****	****	****	45	**68**	93	66	**81**	97
			A2	****	****	****	55	**65**	77	86	**98**	99
JJA	****	****	*A1B*	****	****	****	56	**69**	78	64	**93**	99
			B1	****	****	****	32	**49**	57	46	**62**	74
			A2	****	****	****	41	**60**	73	76	**96**	99
SON	****	****	*A1B*	****	****	****	35	**58**	73	52	**83**	97
			B1	****	****	****	30	**44**	56	41	**49**	74
Frequency of Cold Days (TX10p)												
			A2	****	****	****	0	**0**	0	0	**0**	0
Annual	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
DJF	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	0	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
MAM	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	0	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
JJA	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	0	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
SON	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0
Frequency of Cold Nights (TN10p)												
			A2	****	****	****	0	**0**	0	0	**0**	0
Annual	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0
			A2	****	****	****	0	**0**	1	0	**0**	0
DJF	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	0	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
MAM	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
JJA	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	0	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
SON	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0

	Observed Mean 1970-99	Observed Trend 1960-2006		Projected changes by the 2030s Min	Median	Max	Projected changes by the 2060s Min	Median	Max	Projected changes by the 2090s Min	Median	Max
% total rainfall falling in Heavy Events (R95pct)												
	%	*Change in % per decade*					*Change in %*			*Change in %*		
			A2	****	****	****	-1	**2**	10	-5	**5**	14
Annual	****	****	*A1B*	****	****	****	-3	**1**	10	-3	**3**	10
			B1	****	****	****	-4	**0**	5	-3	**4**	10
			A2	****	****	****	-4	**0**	16	-6	**6**	17
DJF	****	****	*A1B*	****	****	****	-4	**0**	12	-4	**3**	12
			B1	****	****	****	-4	**1**	6	-3	**4**	11
			A2	****	****	****	-2	**1**	13	-3	**3**	13
MAM	****	****	*A1B*	****	****	****	-6	**2**	10	-3	**2**	15
			B1	****	****	****	-4	**1**	10	-4	**5**	11
			A2	****	****	****	-11	**-2**	0	-10	**0**	9
JJA	****	****	*A1B*	****	****	****	-8	**-1**	9	-12	**-4**	4
			B1	****	****	****	-8	**-1**	12	-8	**-2**	7
			A2	****	****	****	-10	**-1**	9	-19	**1**	9
SON	****	****	*A1B*	****	****	****	-11	**0**	13	-18	**-3**	11
			B1	****	****	****	-13	**0**	13	-9	**0**	8
Maximum 1-day rainfall (RX1day)												
	mm	*Change in mm per decade*					*Change in mm*			*Change in mm*		
			A2	****	****	****	-3	**1**	11	-2	**4**	34
Annual	****	****	*A1B*	****	****	****	-6	**1**	8	-1	**3**	23
			B1	****	****	****	-5	**2**	11	-7	**4**	18
			A2	****	****	****	-6	**0**	12	-3	**5**	29
DJF	****	****	*A1B*	****	****	****	-5	**1**	6	-1	**3**	19
			B1	****	****	****	-6	**0**	9	-3	**3**	16
			A2	****	****	****	-1	**2**	7	-4	**3**	28
MAM	****	****	*A1B*	****	****	****	-3	**0**	13	-3	**1**	12
			B1	****	****	****	-2	**0**	6	-7	**1**	16
			A2	****	****	****	-3	**-1**	0	-4	**0**	5
JJA	****	****	*A1B*	****	****	****	-2	**0**	3	-3	**0**	1
			B1	****	****	****	-1	**0**	2	-3	**0**	3
			A2	****	****	****	-5	**0**	3	-4	**0**	6
SON	****	****	*A1B*	****	****	****	-1	**0**	3	-6	**-1**	4
			B1	****	****	****	-6	**0**	5	-3	**0**	1
Maximum 5-day Rainfall (RX5day)												
	mm	*Change in mm per decade*					*Change in mm*			*Change in mm*		
			A2	****	****	****	-8	**5**	37	-11	**9**	64
Annual	****	****	*A1B*	****	****	****	-15	**0**	21	-7	**9**	42
			B1	****	****	****	-21	**2**	11	-8	**9**	37
			A2	****	****	****	-13	**0**	41	-11	**11**	56
DJF	****	****	*A1B*	****	****	****	-10	**0**	24	-10	**9**	36
			B1	****	****	****	-18	**-3**	11	-6	**6**	31
			A2	****	****	****	-6	**8**	21	-13	**8**	46
MAM	****	****	*A1B*	****	****	****	-13	**2**	34	-9	**4**	20
			B1	****	****	****	-18	**1**	14	-12	**9**	32
			A2	****	****	****	-8	**-2**	0	-7	**-1**	6
JJA	****	****	*A1B*	****	****	****	-3	**0**	4	-6	**-2**	1
			B1	****	****	****	-4	**0**	3	-6	**0**	6
			A2	****	****	****	-12	**-1**	4	-9	**-1**	9
SON	****	****	*A1B*	****	****	****	-8	**1**	12	-14	**-4**	5
			B1	****	****	****	-12	**-1**	13	-11	**-1**	5

* indicates trend is statistically significant at 95% confidence

**** indicates data are not available

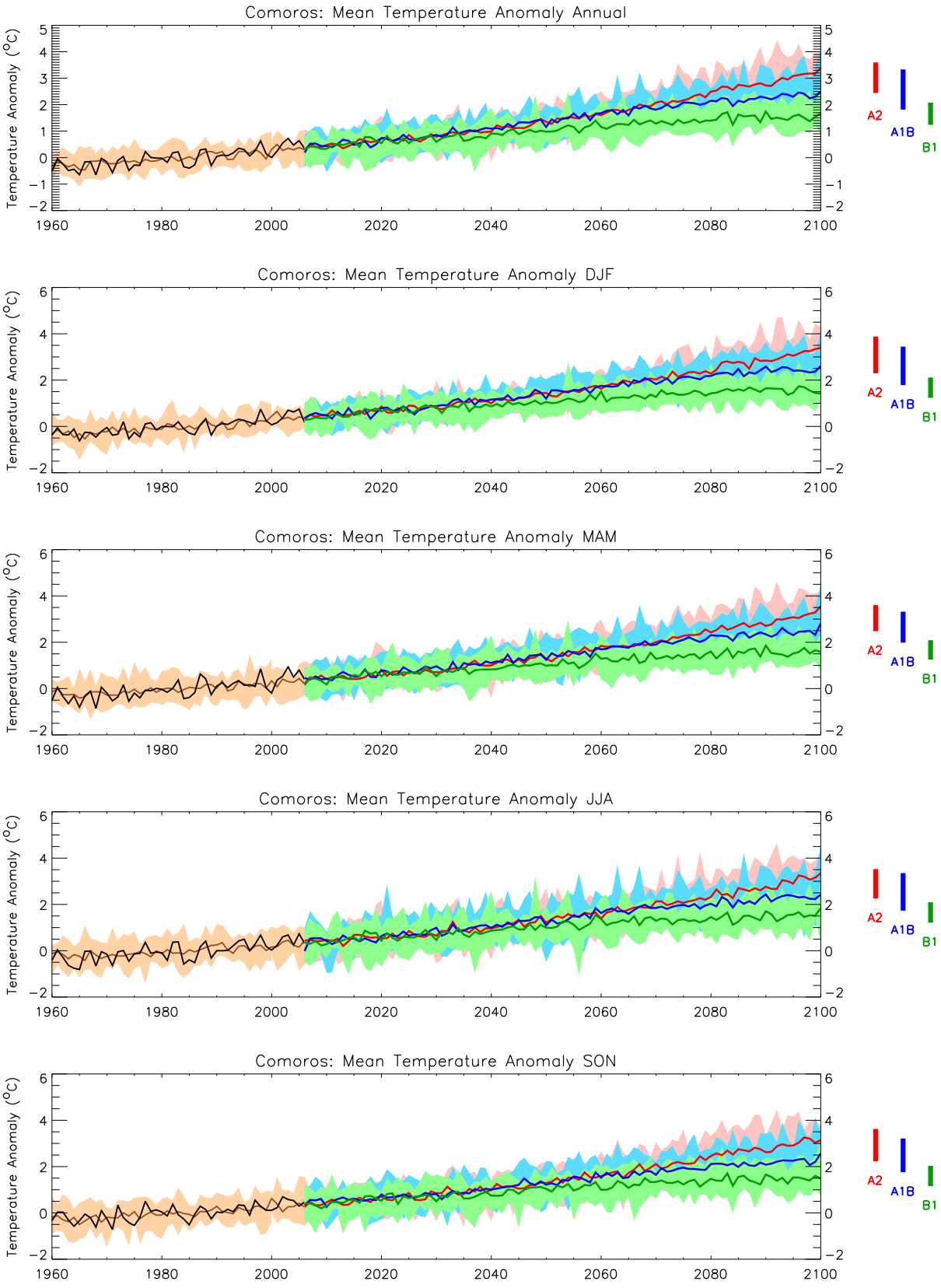


Figure 1: Trends in annual and seasonal mean temperature for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. Black curves show the mean of observed data from 1960 to 2006, Brown curves show the median (solid line) and range (shading) of model simulations of recent climate across an ensemble of 15 models. Coloured lines from 2006 onwards show the median (solid line) and range (shading) of the ensemble projections of climate under three emissions scenarios. Coloured bars on the right-hand side of the projections summarise the range of mean 2090-2100 climates simulated by the 15 models for each emissions scenario.

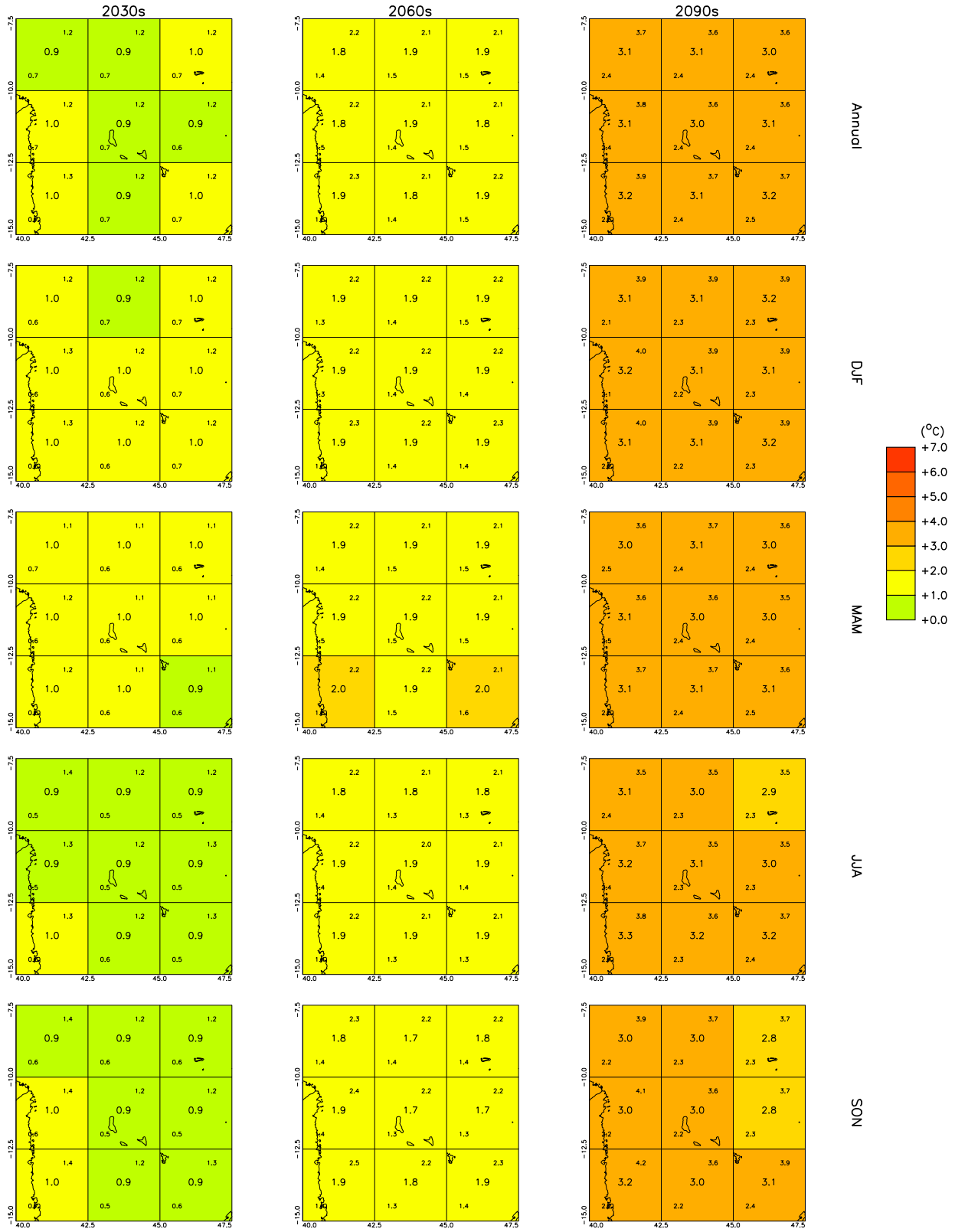


Figure 2: Spatial patterns of projected change in mean annual and seasonal temperature for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. In each grid box, the central value gives the ensemble median and the values in the upper and lower corners give the ensemble maximum and minimum.

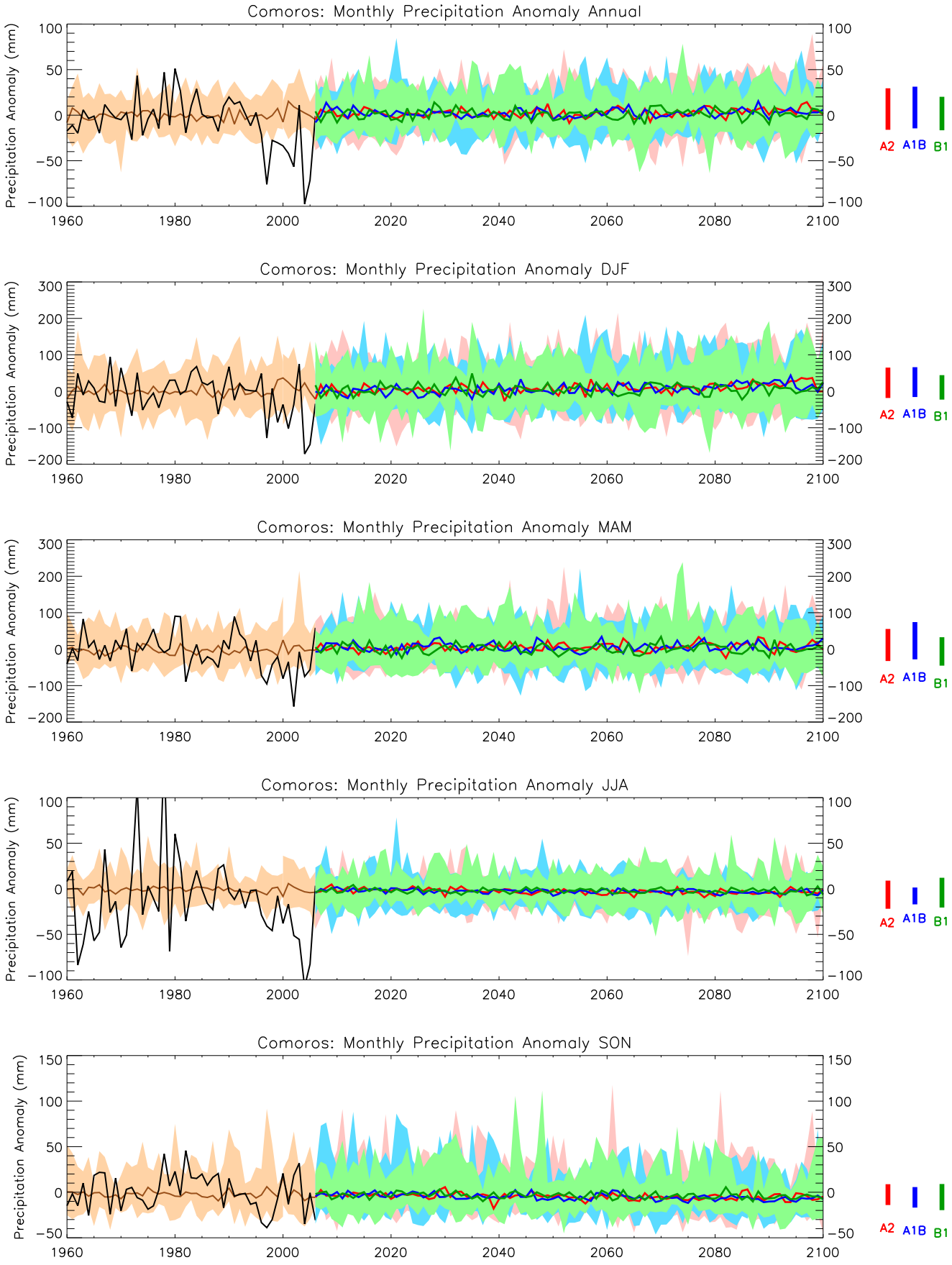


Figure 3: Trends in monthly precipitation for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

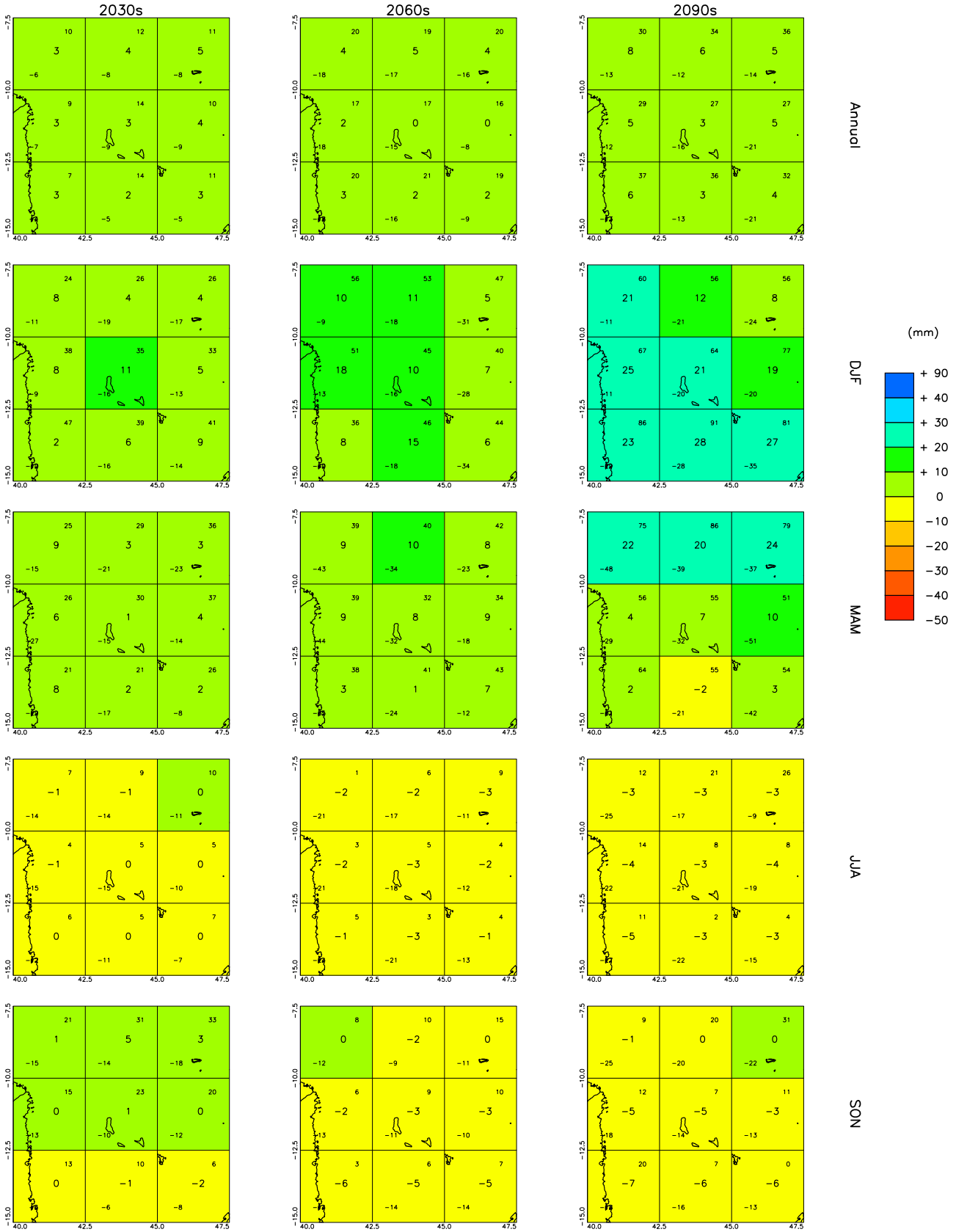


Figure 4: Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999.See Figure 2 for details.

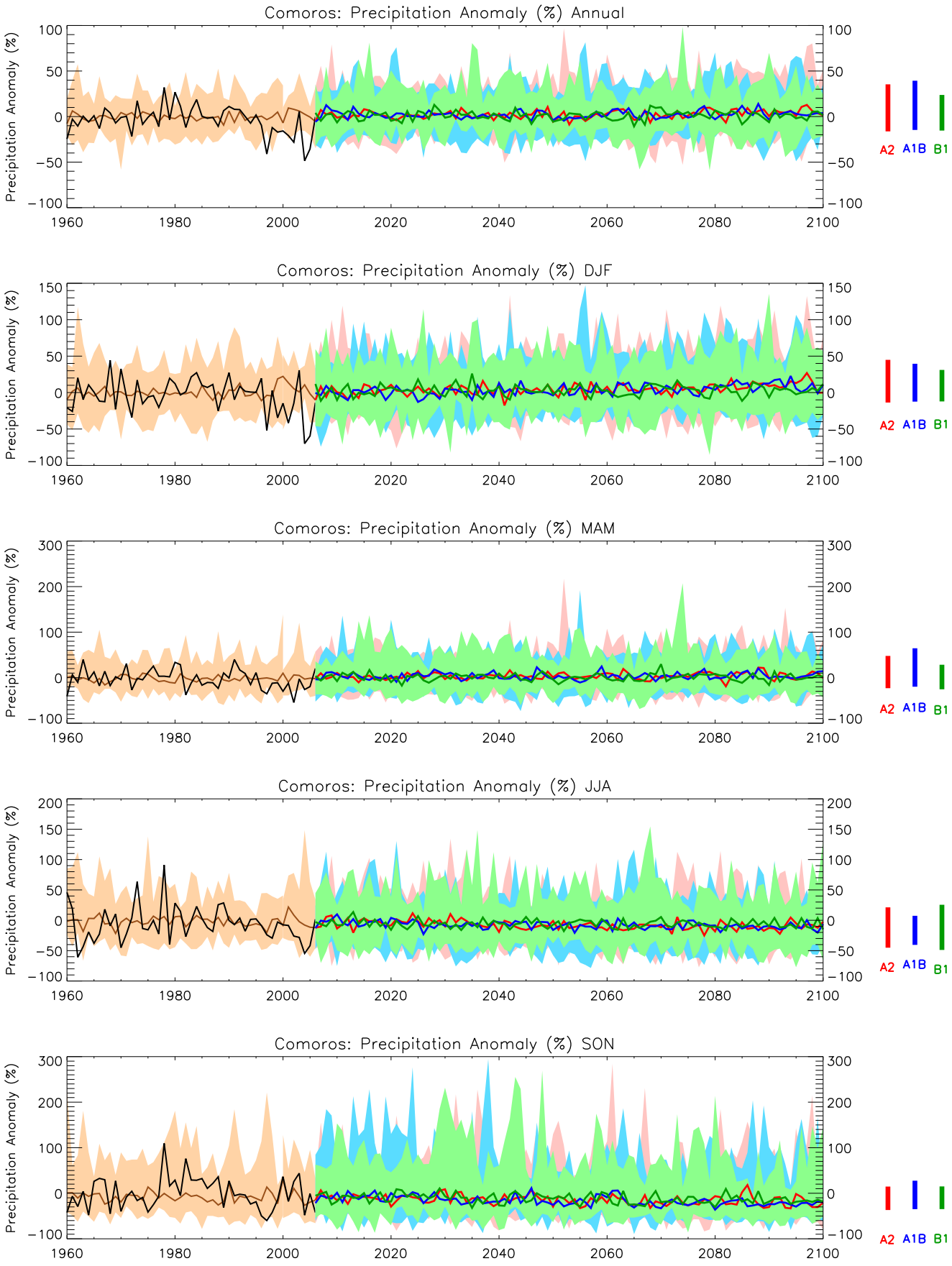


Figure 5: Trends in monthly precipitation for the recent past and projected future. All values shown are percentage anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

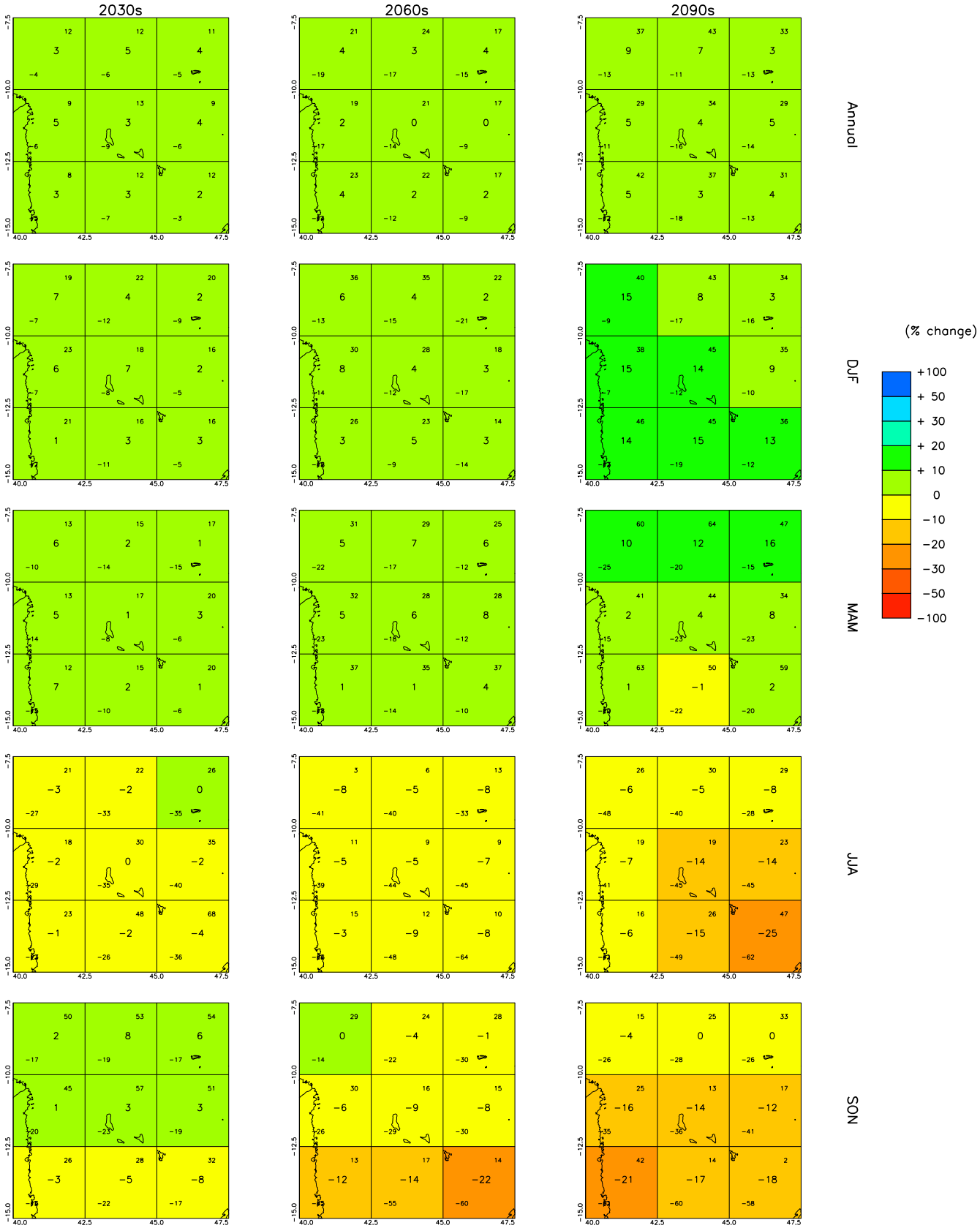


Figure 6: Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are percentage anomalies relative to the mean climate of 1970-1999.See Figure 2 for details.

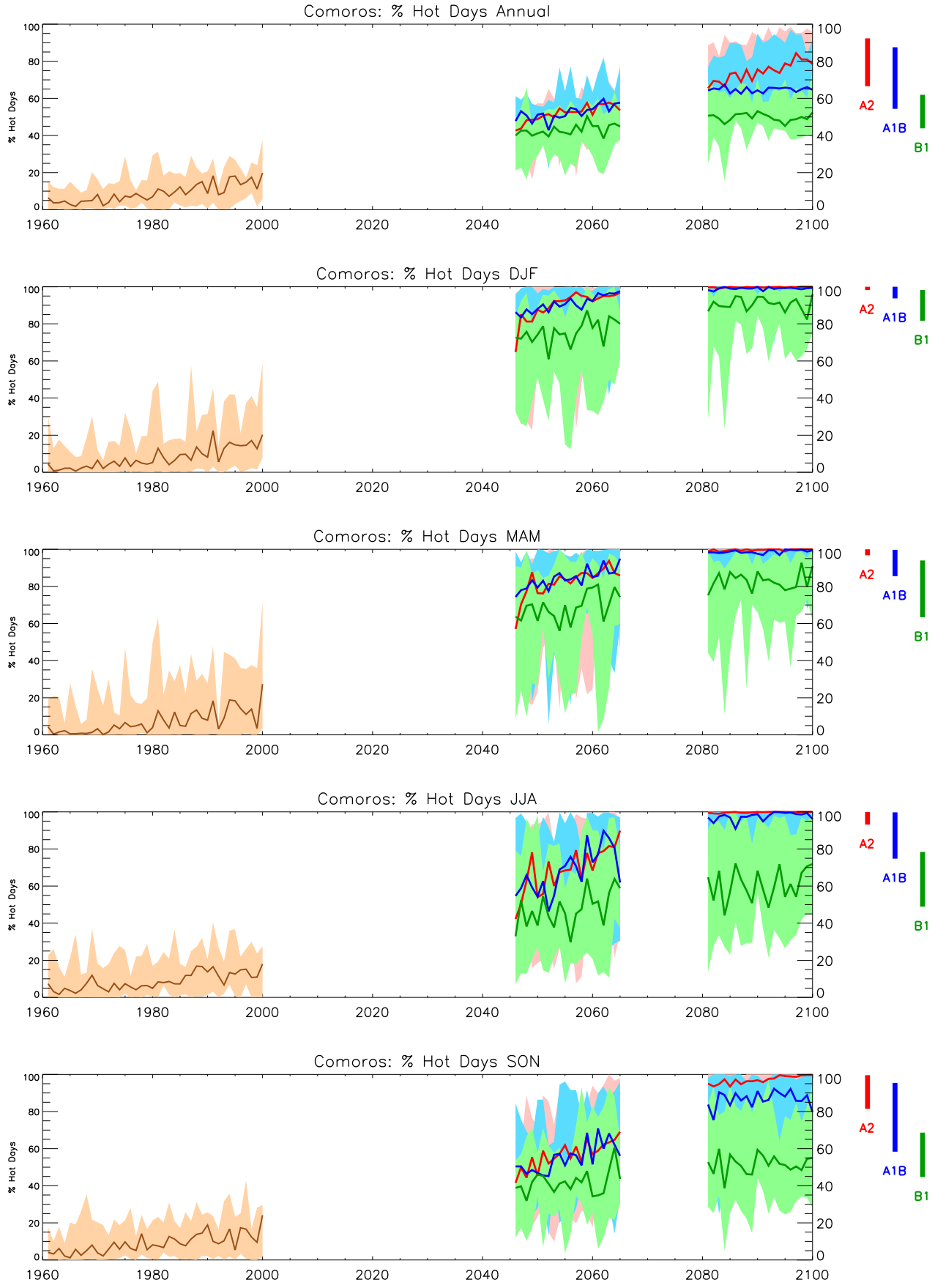


Figure 7: Trends in Hot-day frequency for the recent past and projected future. See Figure 1 for details.

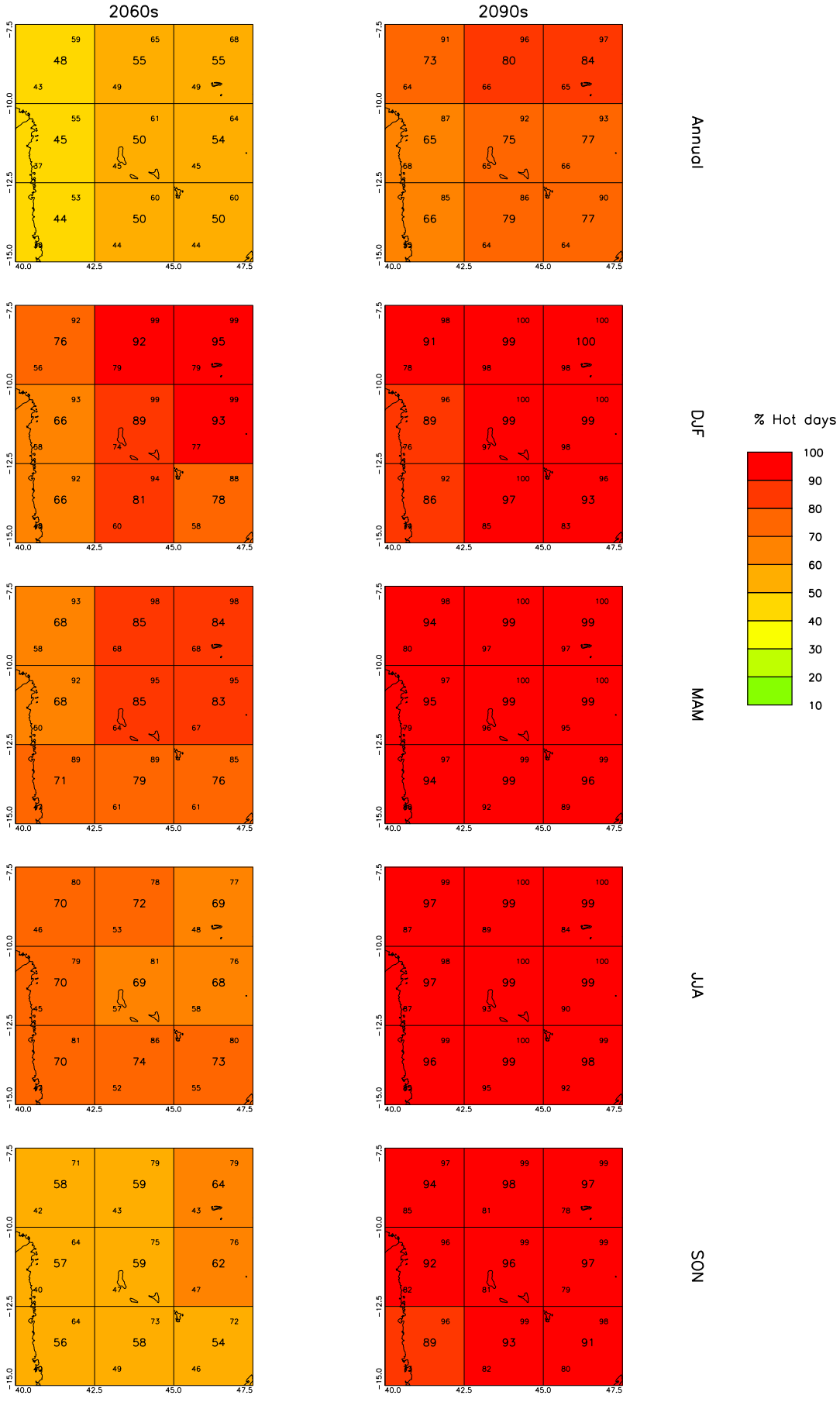


Figure 8: Spatial patterns of projected change in Hot-day frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

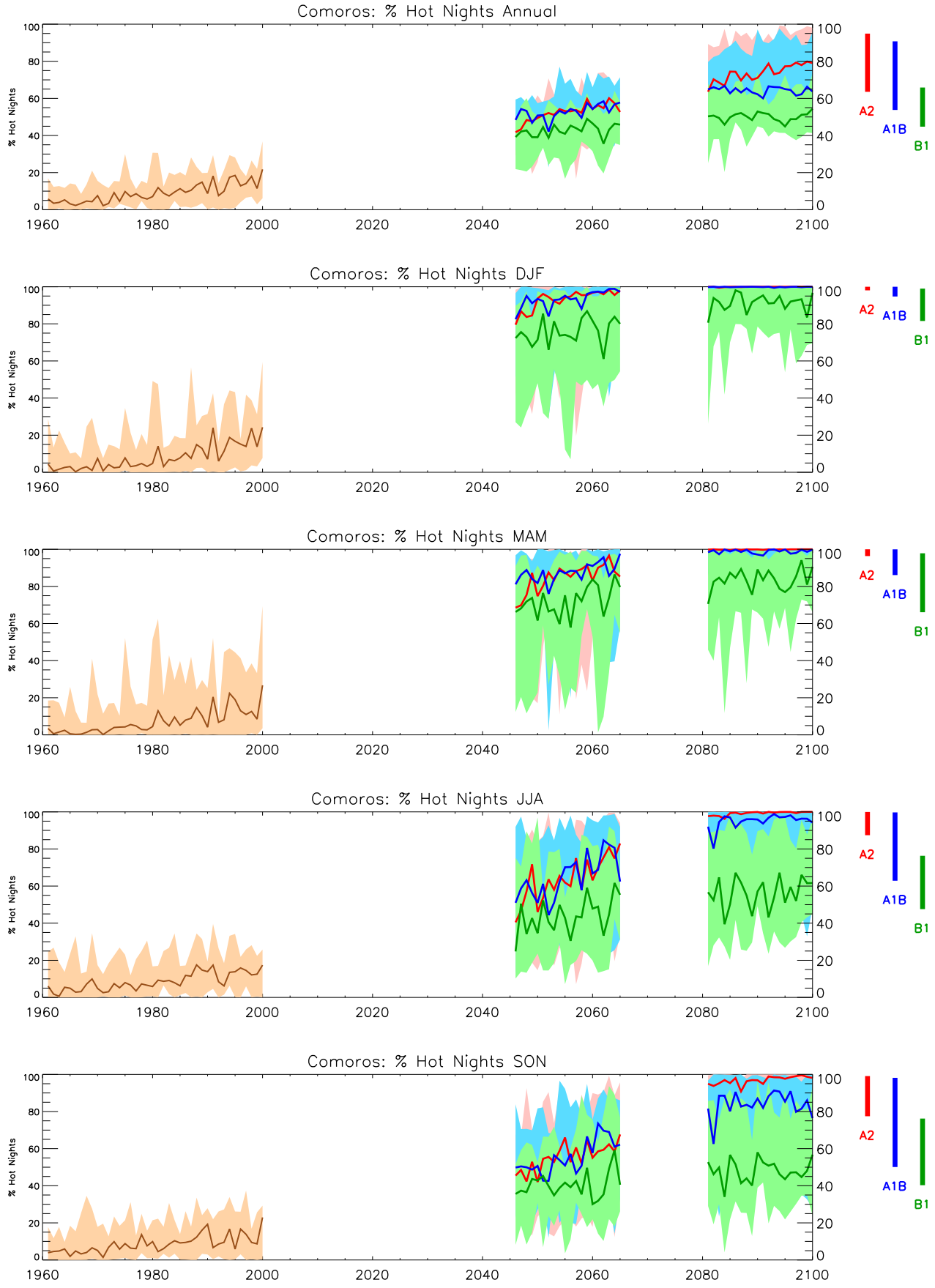


Figure 9: Trends in hot-night frequency for the recent past and projected future. See Figure 1 for details.

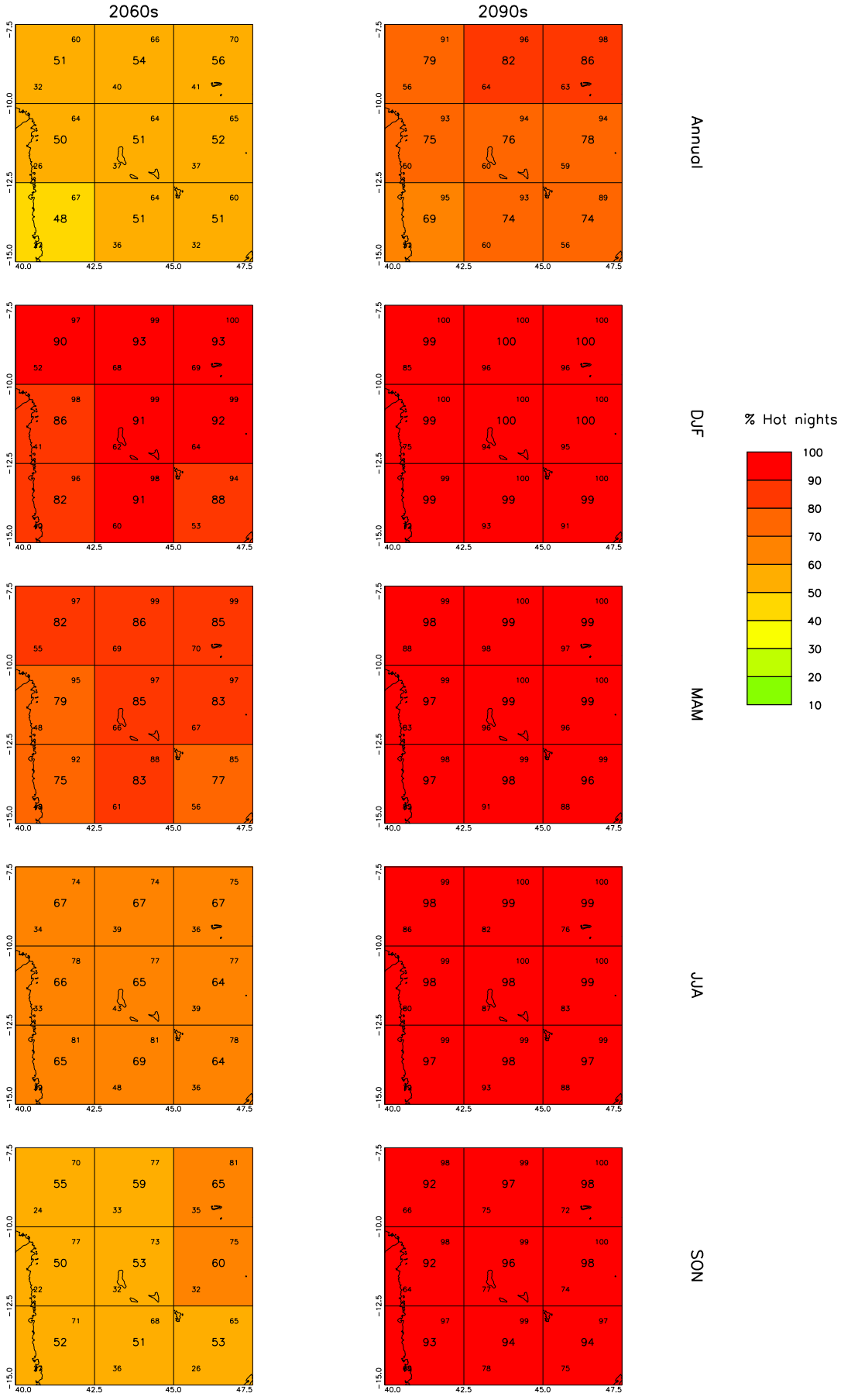


Figure 10: Spatial patterns of projected change in hot-night frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

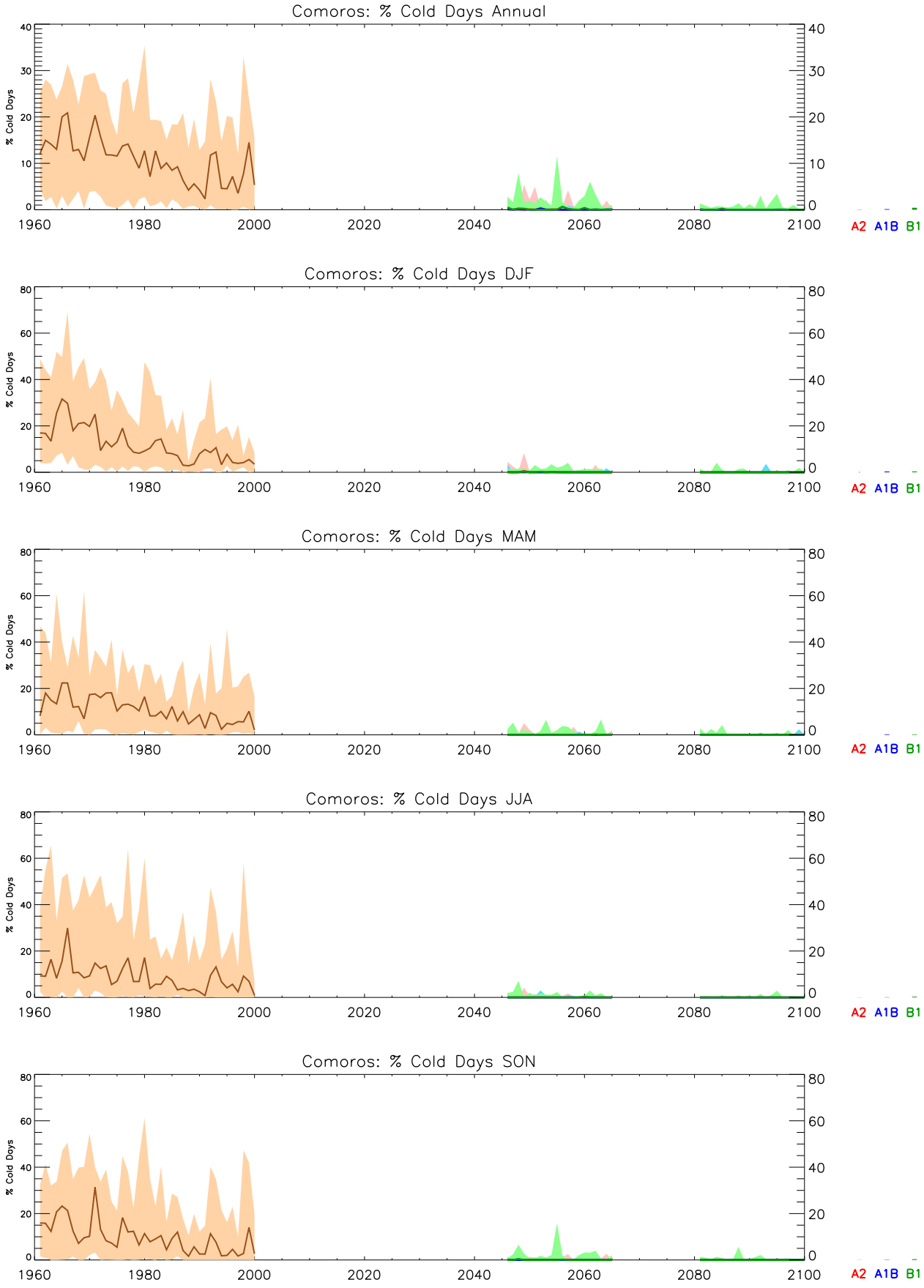


Figure 11: Trends in cold-day frequency for the recent past and projected future. See Figure 1 for details.

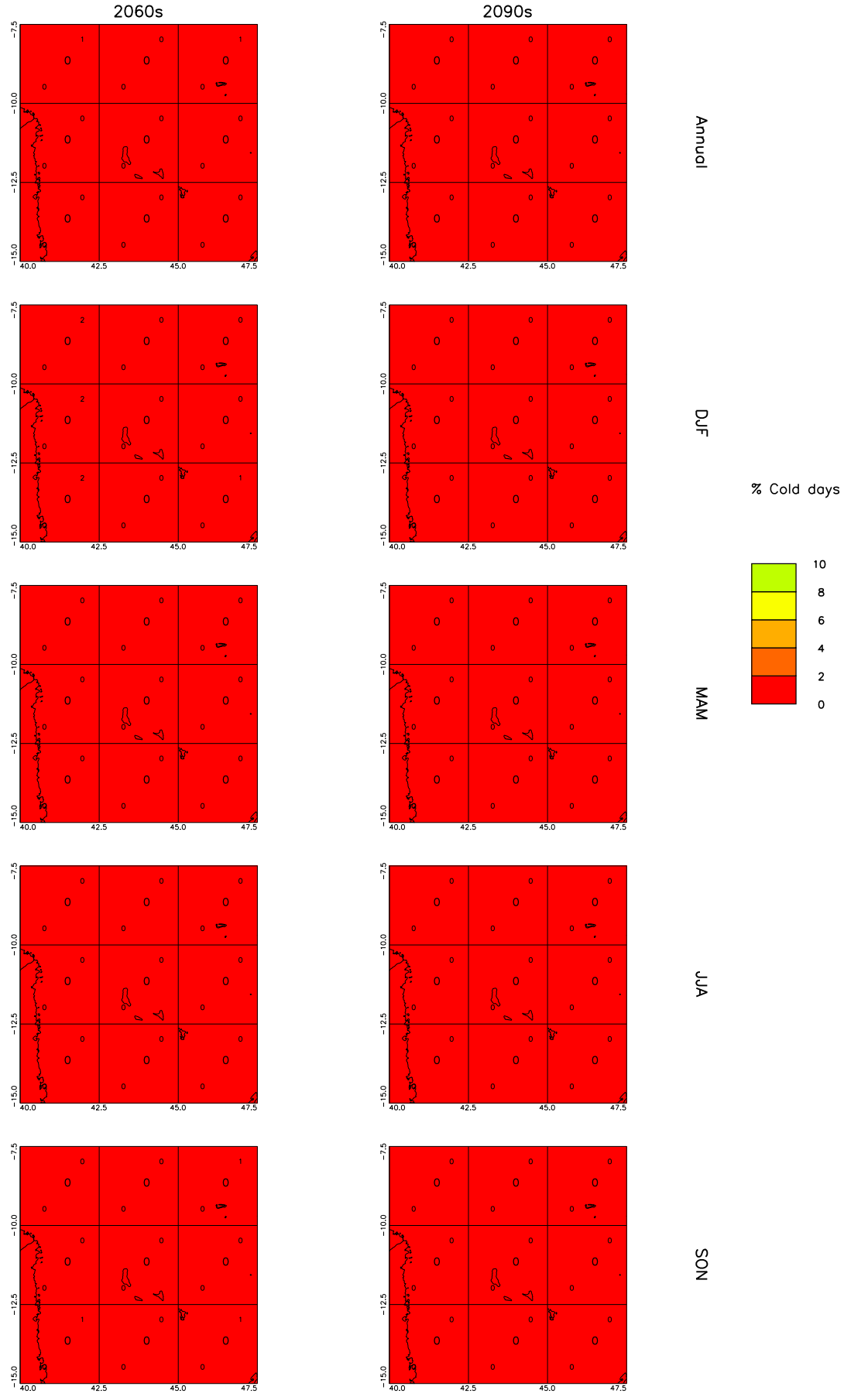


Figure 12: Spatial patterns of projected change in cold-day frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

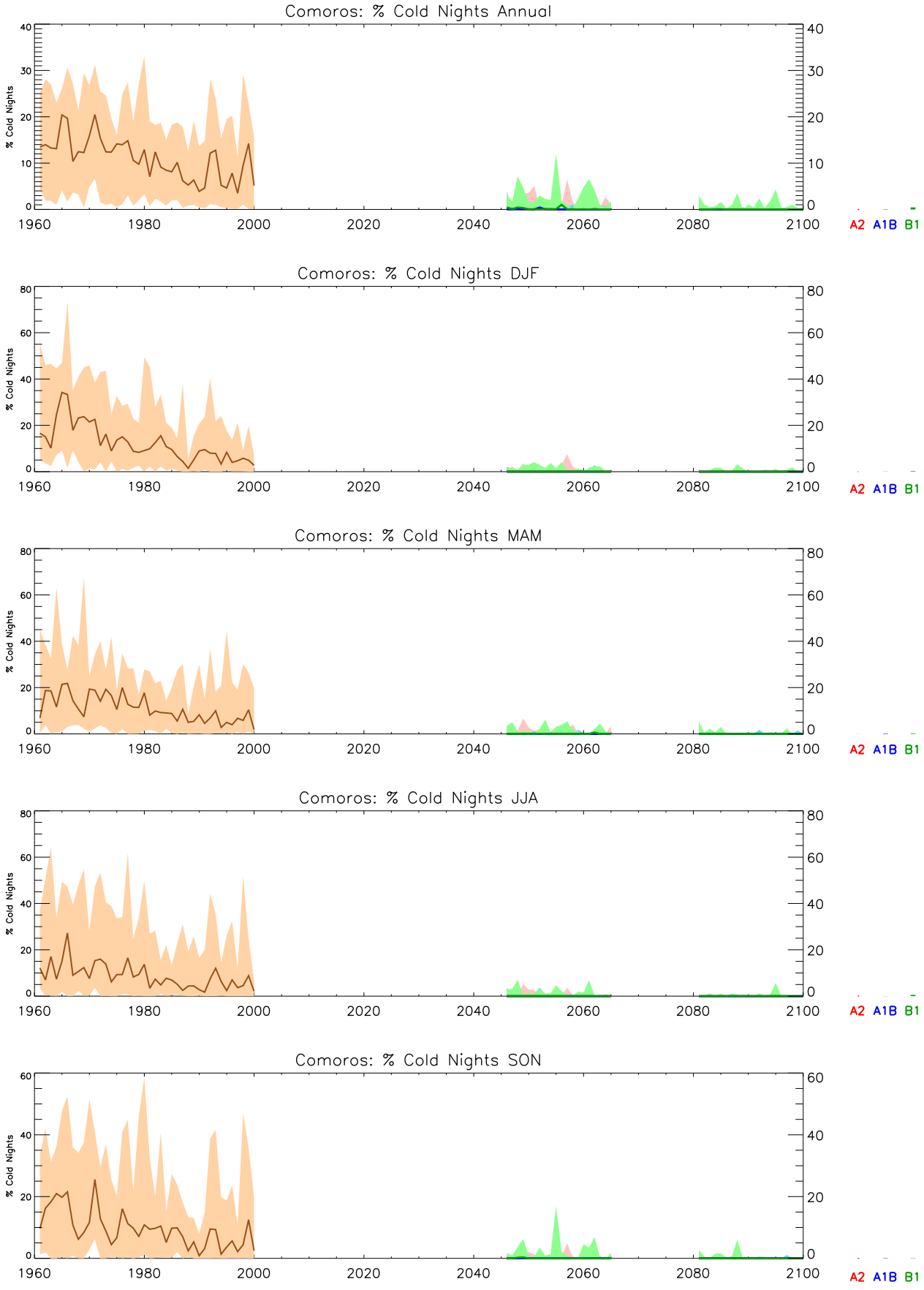


Figure 13: Trends in cold-night frequency for the recent past and projected future. See Figure 1 for details.

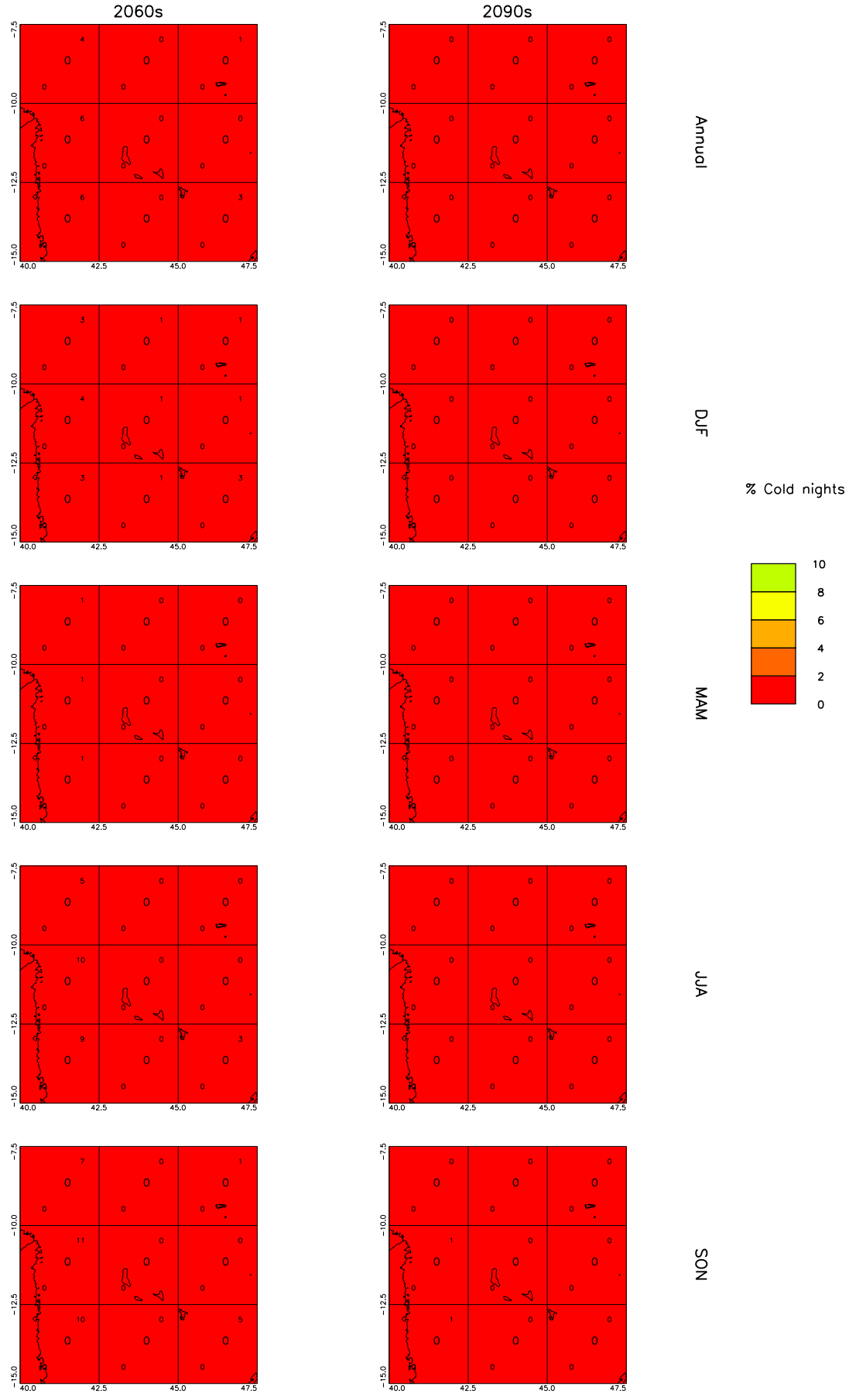


Figure 14: Spatial patterns of projected change in cold-night frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

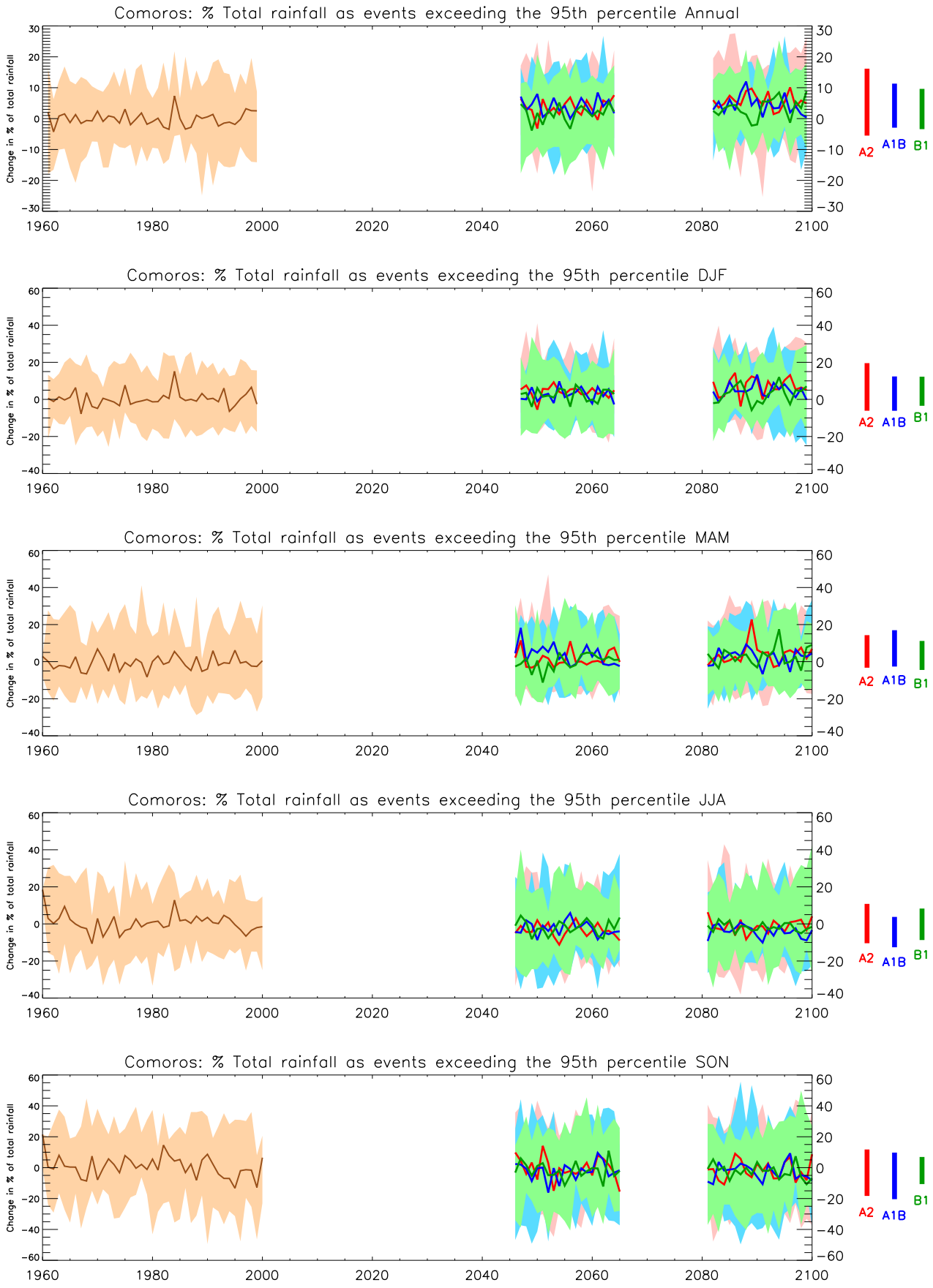


Figure 15: Trends in the proportion of precipitation falling in 'heavy' events for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

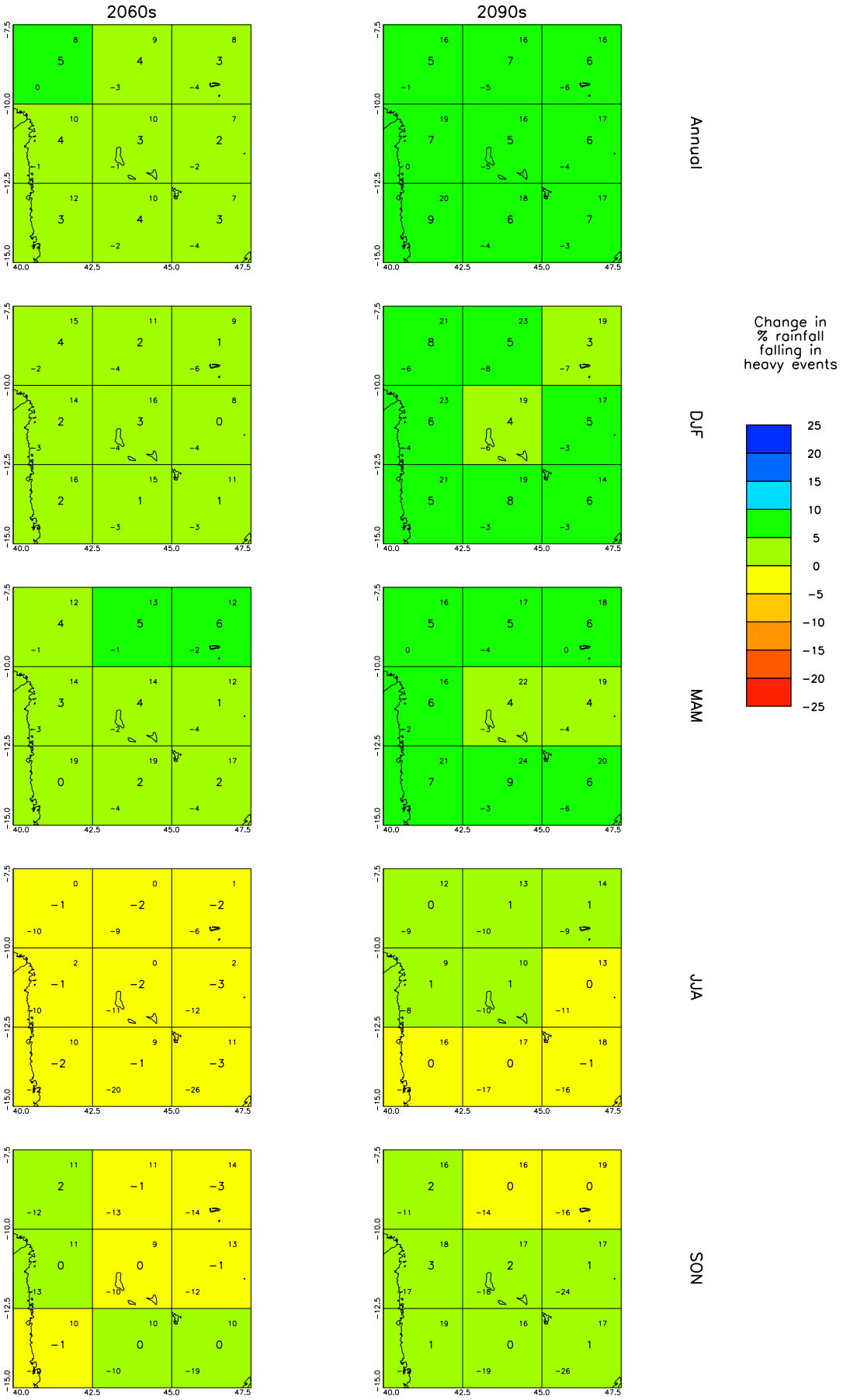


Figure 16: Spatial patterns of projected change in the proportion of precipitation falling in 'heavy' events for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

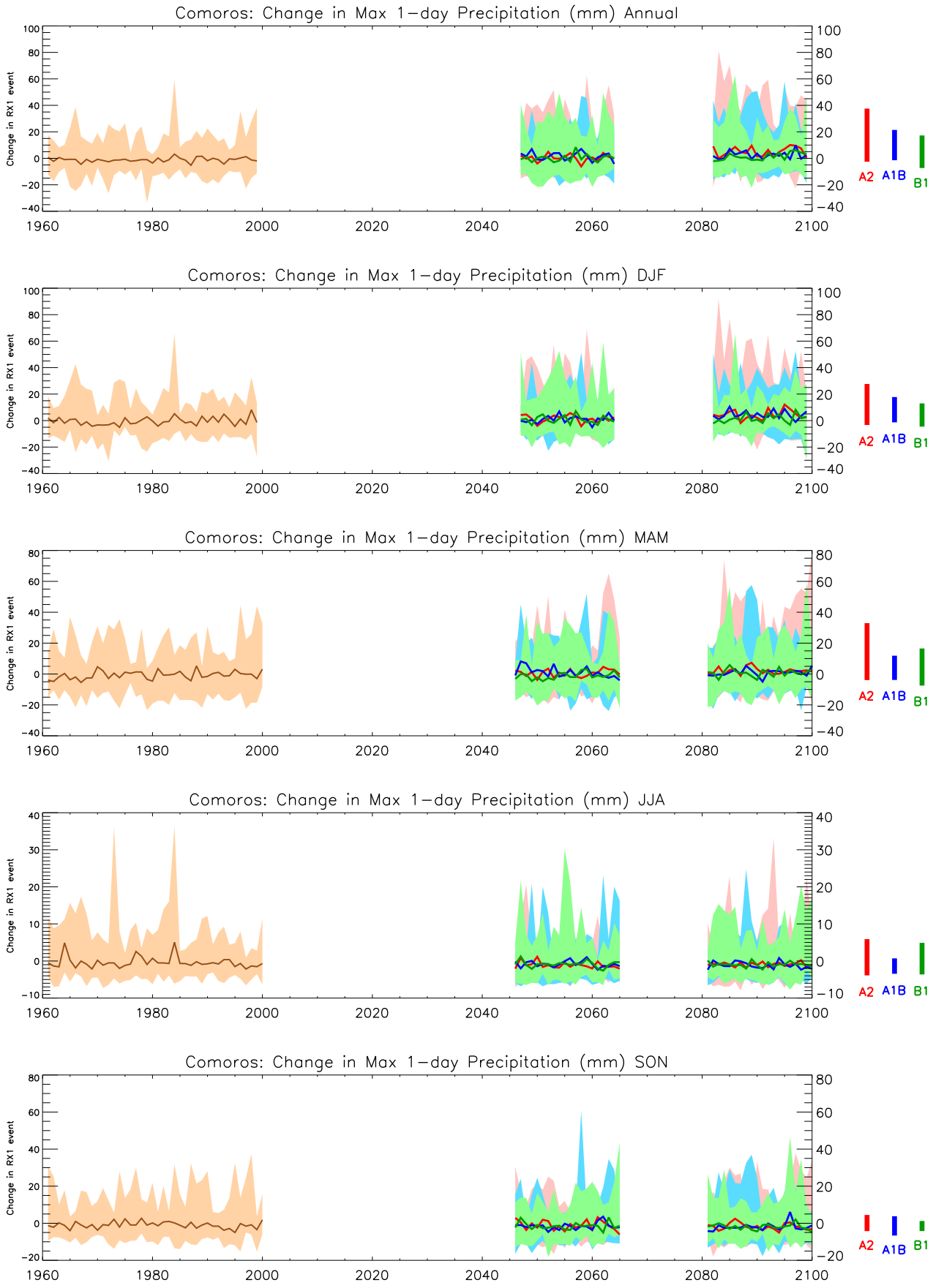


Figure 17: Trends in maximum 1-day rainfall for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

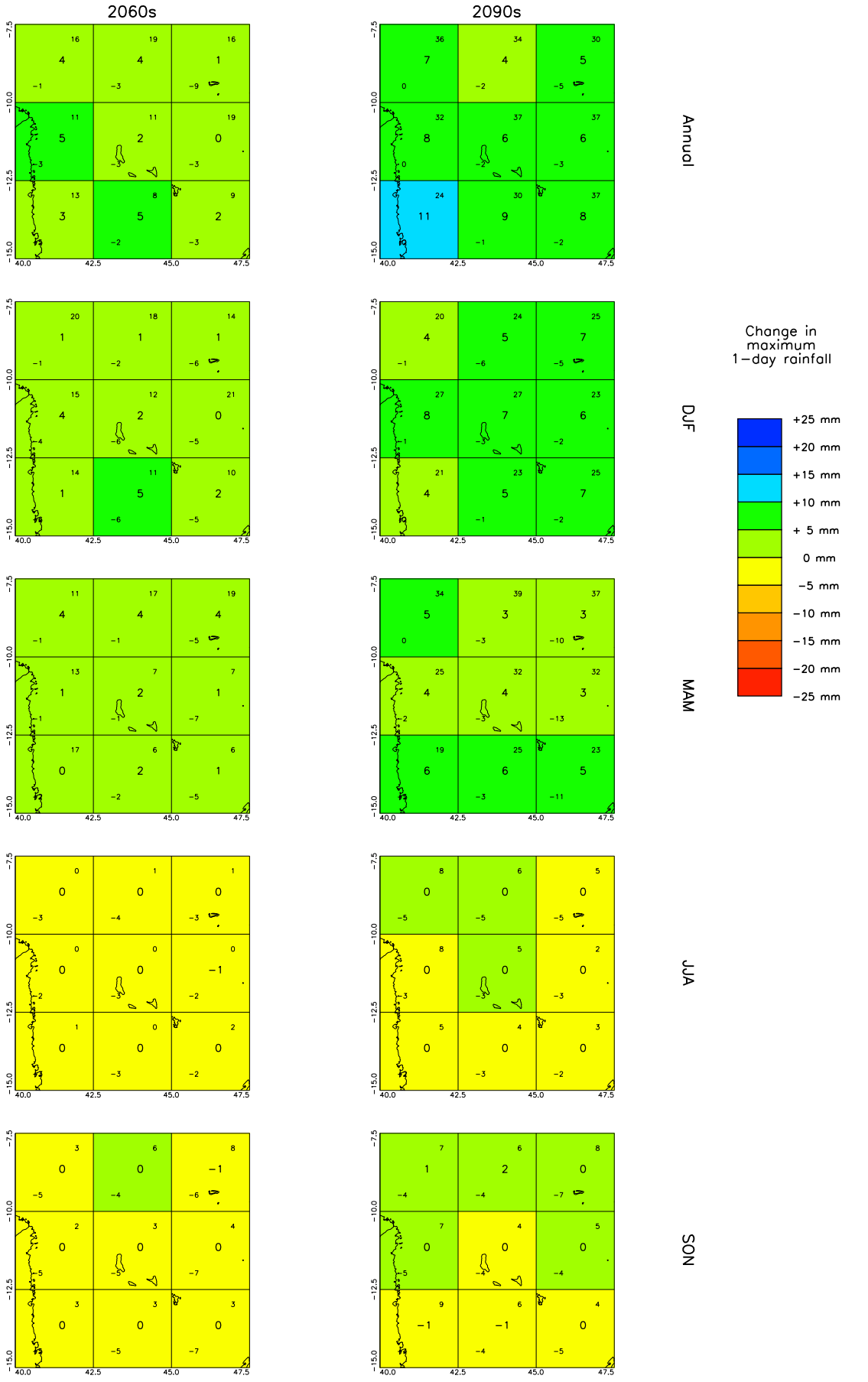


Figure 18: Spatial patterns of maximum 1-day rainfall for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

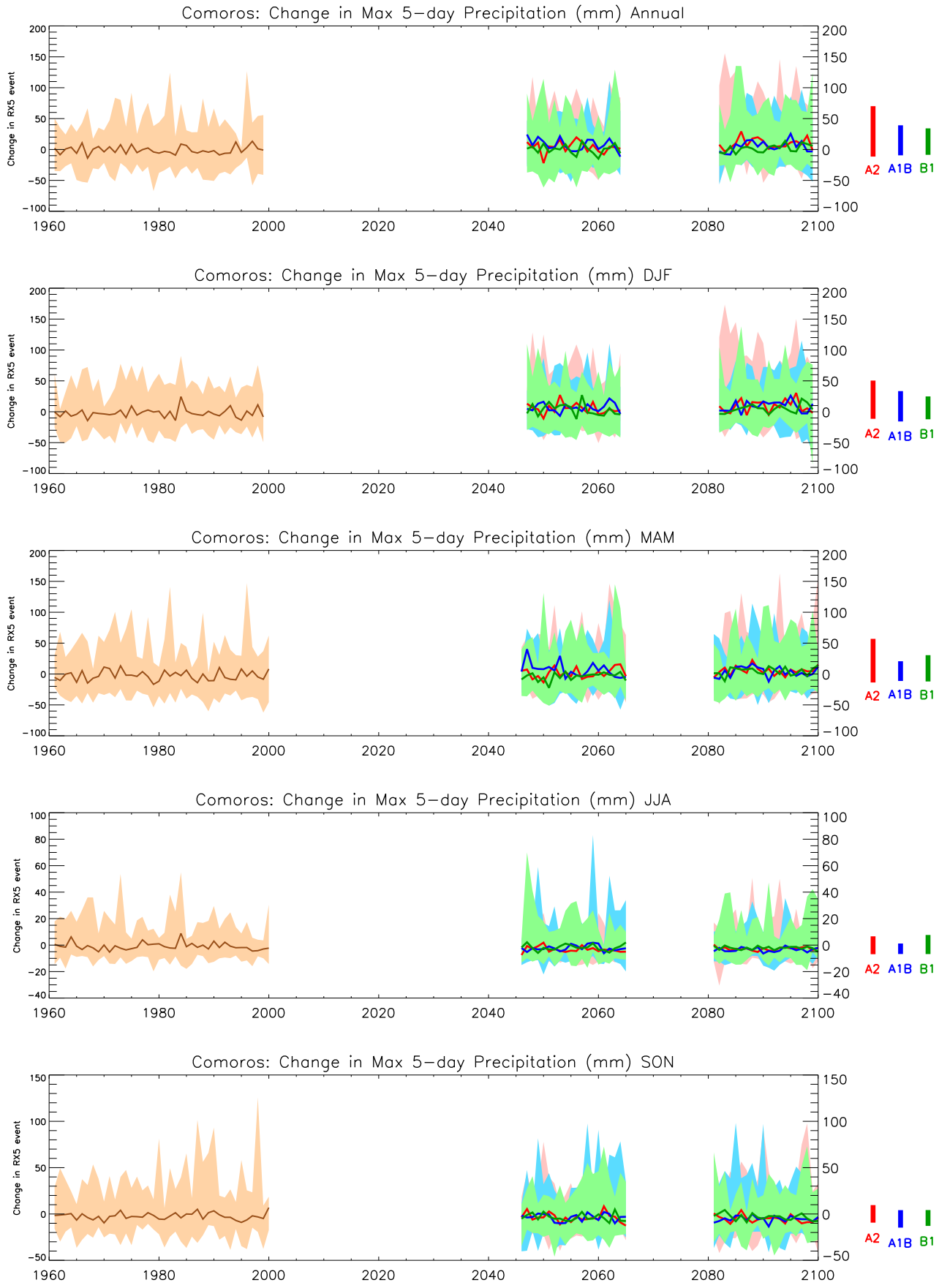


Figure 19: Trends in maximum 5-day rainfall for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

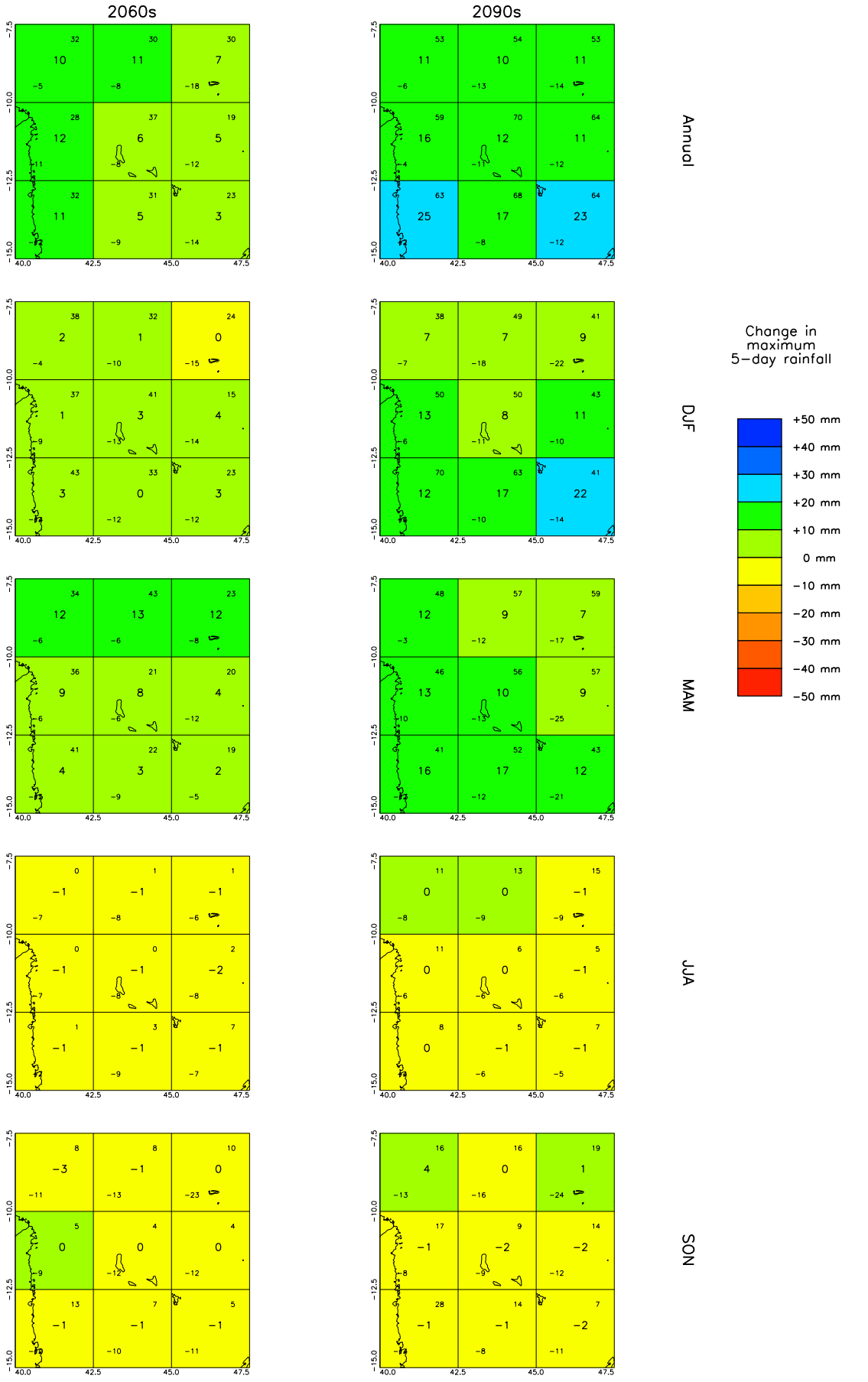


Figure 20: Spatial patterns of projected change in maximum 5-day rainfall for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.