UNDP Climate Change Country Profiles

Cape Verde

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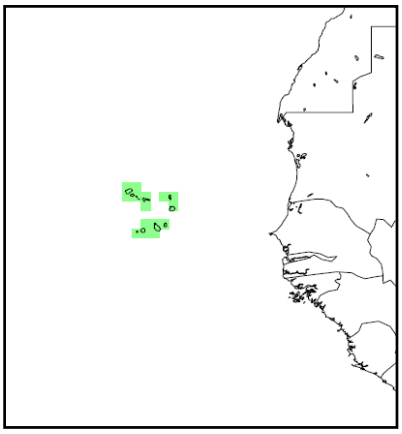
http://country-profiles.geog.ox.ac.uk



General Climate

The islands of Cape Verde are located in the Atlantic Ocean, around 600km from the West coast of Africa, at latitudes of 15-17˚N. Although situated in the arid sub-tropics, the climate of the islands is not as hot or dry as continental regions at the same latitude. Temperatures vary between an average 21-22˚C in the coolest season (NDJ) and 24-25 in the warmest season (MJJ). There is one wet season, between August and October, when the sporadic rainfall averages 90-100mm per month.

Atlantic hurricanes often originate just east of Cape Verde, passing Cape Verde as they travel west towards America.

Recent Climate

Temperature

- Mean annual temperature has increased by 0.6˚C since 1960, an average rate of 0.14˚C per decade.
- The rate of increase is most rapid in the wet season, ASO at 0.23˚C per decade.
- There is insufficient daily observational data available to identify trends in daily temperature extremes.

Precipitation

- Mean annual rainfall over Cape Verde has not changed with any consistent trend since 1960. Some unusually high rainfalls have occurred in NDJ very recent years, which are unusual for this season which is normally very dry.
- There are insufficient daily rainfall observations available from which to determine changes in extremes indices of daily rainfall.

Model Projections of Future Climate

Temperature

- The mean annual temperature is projected to increase by 0.7 to 2.5˚C by the 2060s, and 1.2 to 3.7˚C by the 2090s. The range of projections by the 2090s under any one emissions scenario is 1.0- 2.0˚C.
- Increases in temperature occur at a similar rate in all seasons.

- All projections indicate substantial increases in the frequency of days and nights that are considered as 'hot'[1] in current climate.
    - Annually, projections indicate that 'hot' days will occur on 16-32% of days by the 2060s, and 23-51% of days by the 2090s. Days considered 'hot' by current climate standards for their season are may increase most rapidly in ASO, but the range between model projections is large, occurring on 39-100% of days of the season by the 2090s.
    - Nights that are considered 'hot' for the annual climate of 1970-99 are projected to occur on 23-49% of nights by the 2060s and 31-79% of nights by the 2090s. Nights that are considered hot for each season by 1970-99 standards are projected to occur on 37-100% of nights in every season by the 2090s.
- All projections indicate decreases in the frequency of days and nights that are considered 'cold'[2] in current climate. Cold days and nights do not occur at all by the 2090s in any projections, and only occur under the lowest emissions scenario (B1) by the 2060s.

Precipitation

- Projections of mean annual rainfall averaged over the country from different models in the ensemble are not consistent in projecting either increases or decreases in rainfall. In the dry seasons - NDJ, FMA and particularly in MJJ - the model ensemble tends towards decreases in rainfall, which are small in absolute terms (mm) but represent a large proportion of the total rainfall as a percentage. Projections of change in wet season (ASO) rainfall very significantly between models, ranging between -77% and +87%.

- The changes proportion of total rainfall that falls in heavy[3] events range between increases and decreases in projections from different models.
- The range of changes in 1- and 5-day rainfall maxima in projections from the model ensemble covers both increases and decreases.

[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.

[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.

Other Regional Climate Change Information

- GCMS do not have a fine enough resolution to account for Small Islands like those of Cape Verde, and so projections are based on calculations over ocean surface and do not account for the physical influences of the Islands' land surface (Christensen *et al.,* 2007).
- Climate models suffer from significant errors in simulating the position of the Inter-tropical Convergence Zone in the Tropical Atlantic (Christensen *et al.,* 2007), causing significant systematic errors in the rainfall simulated in this region, and increased uncertainty associated with projected climate changes.
- 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). Uncertainty in potential changes in tropical cyclone contributes to uncertainties in future wet-season rainfall.
- The islands of Cape Verde are likely to 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, see Christensen *et al*. (2007) IPCC Working Group I Report: '*The Physical Science Basis'*, Chapter 11 *(Regional Climate projections*): Section 11.9 *(Small Islands*), and Section 11.2 (*Africa*).

[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			Projected changes by the 2060s			Projected changes by the 2090s		
				Min	Median	Max	Min	Median	Max	Min	Median	Max
Temperature												
	(˚C)	(change in ˚C per decade)		Change in ˚C			Change in ˚C			Change in ˚C		
			A2	0.6	**0.9**	1.1	1.5	**1.8**	2.5	2.5	**3.0**	3.7
Annual	23.2	0.14*	*A1B*	0.5	**1.1**	1.2	1.0	**1.9**	2.2	1.6	**2.5**	3.2
			B1	0.3	**0.9**	1.3	0.7	**1.3**	1.5	1.2	**1.6**	2.2
			A2	0.5	**0.9**	1.2	1.3	**1.8**	2.6	2.4	**3.0**	3.5
NDJ	21.3	0.08	*A1B*	0.5	**0.9**	1.3	1.2	**1.8**	2.3	1.4	**2.4**	3.1
			B1	0.2	**0.9**	1.2	0.7	**1.3**	1.6	1.2	**1.6**	2.2
			A2	0.6	**0.8**	1.1	1.3	**1.8**	2.5	2.5	**2.9**	3.5
FMA	22.4	0.11	*A1B*	0.4	**1.0**	1.3	0.9	**1.8**	2.0	1.5	**2.4**	2.9
			B1	0.3	**0.9**	1.5	0.6	**1.3**	1.6	1.2	**1.5**	2.0
			A2	0.7	**0.9**	1.5	1.5	**1.9**	2.7	2.5	**3.0**	4.1
MJJ	25.0	0.14*	*A1B*	0.6	**1.1**	1.5	1.0	**1.9**	2.3	1.5	**2.7**	3.4
			B1	0.4	**1.0**	1.3	0.8	**1.4**	1.8	1.2	**1.6**	2.5
			A2	0.6	**0.9**	1.3	1.5	**1.8**	2.4	2.4	**2.9**	3.9
ASO	24.1	0.23*	*A1B*	0.6	**1.0**	1.4	1.0	**1.9**	2.2	1.7	**2.6**	3.5
			B1	0.2	**0.9**	1.2	0.8	**1.3**	1.7	1.2	**1.6**	2.4
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	-4	**0**	13	-5	**0**	4	-10	**-2**	6
Annual	36.6	0.6	*A1B*	-3	**0**	7	-9	**-1**	7	-10	**0**	12
			B1	-4	**0**	16	-3	**0**	14	-5	**0**	19
			A2	-1	**0**	1	-4	**0**	3	-5	**0**	4
NDJ	24.0	2.6*	*A1B*	-3	**0**	1	-2	**0**	4	-4	**0**	3
			B1	-2	**0**	2	-3	**0**	3	-2	**0**	2
			A2	-2	**0**	3	-2	**0**	8	-5	**0**	15
FMA	9.4	-0.6	*A1B*	-2	**0**	5	-2	**0**	7	-4	**0**	11
			B1	-2	**0**	7	-2	**0**	9	-2	**0**	8
			A2	-8	**-1**	46	-13	**-1**	2	-37	**-4**	0
MJJ	18.5	0.1	*A1B*	-6	**-1**	19	-24	**-1**	23	-27	**-1**	20
			B1	-12	**0**	46	-9	**-1**	43	-12	**-1**	55
			A2	-5	**-1**	10	-5	**0**	15	-10	**1**	14
ASO	94.1	0.7	*A1B*	-6	**0**	13	-11	**0**	9	-9	**0**	27
			B1	-5	**0**	13	-3	**0**	14	-5	**0**	16
Precipitation (%)												
	(mm per month)	(change in % per decade)		% Change			% Change			% Change		
			A2	-20	**-5**	42	-28	**1**	13	-53	**-8**	18
Annual	36.6	1.7	*A1B*	-20	**-1**	22	-27	**-7**	18	-49	**0**	25
			B1	-17	**1**	34	-28	**2**	31	-25	**-1**	43
			A2	-40	**-1**	14	-78	**-8**	21	-67	**-12**	30
NDJ	24.0	11.0*	*A1B*	-58	**-1**	12	-52	**-2**	31	-52	**-11**	23
			B1	-74	**-4**	21	-57	**-6**	28	-59	**-6**	18
			A2	-22	**-4**	18	-27	**-3**	19	-41	**-5**	35
FMA	9.4	-6.2	*A1B*	-27	**2**	17	-24	**-3**	19	-37	**-3**	34
			B1	-17	**-1**	73	-35	**-4**	21	-14	**-1**	54
			A2	-20	**-5**	46	-41	**-3**	4	-60	**-14**	1
MJJ	18.5	0.3	*A1B*	-21	**-5**	17	-42	**-6**	15	-48	**-7**	16
			B1	-22	**0**	30	-31	**-6**	32	-22	**-4**	42
			A2	-29	**-5**	49	-31	**0**	65	-60	**10**	50
ASO	94.1	0.8	*A1B*	-45	**2**	58	-46	**-5**	41	-77	**0**	87
			B1	-20	**-2**	42	-35	**2**	47	-52	**2**	53

	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	****	****	****	36	**38**	51	55	**64**	80
Annual	****	****	*A1B*	****	****	****	30	**41**	47	38	**53**	60
			B1	****	****	****	23	**32**	39	32	**40**	47
			A2	****	****	****	43	**47**	63	71	**82**	92
NDJ	****	****	*A1B*	****	****	****	38	**48**	62	51	**69**	76
			B1	****	****	****	22	**33**	45	37	**44**	59
			A2	****	****	****	37	**77**	98	72	**99**	100
FMA	****	****	*A1B*	****	****	****	43	**74**	91	64	**93**	99
			B1	****	****	****	20	**36**	73	36	**75**	86
			A2	****	****	****	42	**59**	94	71	**88**	100
MJJ	****	****	*A1B*	****	****	****	40	**66**	93	55	**77**	98
			B1	****	****	****	27	**35**	73	39	**52**	81
			A2	****	****	****	63	**87**	98	95	**99**	100
ASO	****	****	*A1B*	****	****	****	70	**87**	97	87	**98**	99
			B1	****	****	****	44	**77**	89	66	**90**	96
Frequency of Hot Nights (TN90p)												
			A2	****	****	****	36	**37**	49	52	**61**	79
Annual	****	****	*A1B*	****	****	****	30	**40**	47	37	**53**	59
			B1	****	****	****	23	**31**	38	31	**38**	47
			A2	****	****	****	42	**47**	62	69	**81**	91
NDJ	****	****	*A1B*	****	****	****	37	**46**	62	49	**65**	75
			B1	****	****	****	22	**32**	44	37	**45**	59
			A2	****	****	****	38	**75**	98	75	**97**	100
FMA	****	****	*A1B*	****	****	****	45	**72**	92	68	**90**	99
			B1	****	****	****	21	**36**	73	40	**76**	87
			A2	****	****	****	40	**57**	92	68	**87**	100
MJJ	****	****	*A1B*	****	****	****	38	**63**	91	52	**75**	97
			B1	****	****	****	27	**36**	70	40	**53**	80
			A2	****	****	****	69	**85**	97	95	**99**	99
ASO	****	****	*A1B*	****	****	****	71	**85**	96	88	**97**	99
			B1	****	****	****	48	**74**	85	66	**88**	94
Frequency of Cold Days (TX10p)												
			A2	****	****	****	0	**0**	0	0	**0**	0
Annual	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**1**	2	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
NDJ	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	2	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
FMA	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	2	0	**0**	0
			A2	****	****	****	0	**0**	1	0	**0**	0
MJJ	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
ASO	****	****	*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	**1**	2	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
NDJ	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	2	0	**0**	1
			A2	****	****	****	0	**0**	0	0	**0**	0
FMA	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	2	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
MJJ	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	0
			A2	****	****	****	0	**0**	0	0	**0**	0
ASO	****	****	*A1B*	****	****	****	0	**0**	0	0	**0**	0
			B1	****	****	****	0	**0**	1	0	**0**	1

	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	****	****	****	-5	**2**	10	-13	**2**	6
Annual	****	****	*A1B*	****	****	****	-7	**0**	11	-9	**4**	12
			B1	****	****	****	-5	**2**	11	-5	**1**	13
			A2	****	****	****	-15	**0**	22	-21	**-2**	24
NDJ	****	****	*A1B*	****	****	****	-18	**0**	16	-18	**-2**	23
			B1	****	****	****	-11	**3**	16	-12	**0**	16
			A2	****	****	****	-11	**0**	5	-17	**0**	8
FMA	****	****	*A1B*	****	****	****	-11	**0**	10	-17	**0**	10
			B1	****	****	****	-6	**0**	7	-6	**0**	6
			A2	****	****	****	-13	**-1**	7	-15	**-1**	5
MJJ	****	****	*A1B*	****	****	****	-5	**-2**	5	-8	**0**	11
			B1	****	****	****	-8	**0**	6	-8	**0**	15
			A2	****	****	****	-4	**2**	12	-16	**0**	13
ASO	****	****	*A1B*	****	****	****	-4	**0**	14	-10	**3**	19
			B1	****	****	****	-8	**1**	17	-7	**4**	17
Maximum 1-day rainfall (RX1day)												
	mm	*Change in mm per decade*					*Change in mm*			*Change in mm*		
			A2	****	****	****	-2	**1**	7	-4	**0**	11
Annual	****	****	*A1B*	****	****	****	-5	**0**	7	-4	**1**	14
			B1	****	****	****	-3	**0**	8	-2	**0**	9
			A2	****	****	****	-2	**0**	4	-1	**0**	5
NDJ	****	****	*A1B*	****	****	****	-4	**0**	2	-4	**0**	6
			B1	****	****	****	-2	**0**	6	-4	**0**	2
			A2	****	****	****	0	**0**	0	-1	**0**	0
FMA	****	****	*A1B*	****	****	****	0	**0**	0	-1	**0**	0
			B1	****	****	****	0	**0**	0	0	**0**	0
			A2	****	****	****	-4	**0**	3	-3	**0**	2
MJJ	****	****	*A1B*	****	****	****	-1	**0**	3	-1	**0**	10
			B1	****	****	****	-1	**0**	2	-3	**0**	6
			A2	****	****	****	-5	**0**	7	-4	**0**	12
ASO	****	****	*A1B*	****	****	****	-4	**0**	9	-3	**0**	9
			B1	****	****	****	-3	**0**	10	-1	**0**	7
Maximum 5-day Rainfall (RX5day)												
	mm	*Change in mm per decade*					*Change in mm*			*Change in mm*		
			A2	****	****	****	-4	**3**	17	-11	**0**	10
Annual	****	****	*A1B*	****	****	****	-9	**0**	20	-7	**1**	33
			B1	****	****	****	-4	**1**	21	-3	**2**	19
			A2	****	****	****	-4	**0**	8	-2	**0**	7
NDJ	****	****	*A1B*	****	****	****	-9	**0**	6	-8	**0**	8
			B1	****	****	****	-3	**0**	9	-8	**0**	10
			A2	****	****	****	-1	**0**	1	-2	**0**	2
FMA	****	****	*A1B*	****	****	****	0	**0**	0	-2	**0**	0
			B1	****	****	****	-1	**0**	0	-1	**0**	0
			A2	****	****	****	-13	**0**	3	-15	**0**	2
MJJ	****	****	*A1B*	****	****	****	-10	**0**	7	-2	**0**	14
			B1	****	****	****	-2	**0**	4	-5	**0**	15
			A2	****	****	****	-10	**1**	18	-12	**0**	11
ASO	****	****	*A1B*	****	****	****	-6	**0**	24	-6	**0**	25
			B1	****	****	****	-5	**0**	23	-4	**0**	20

(* indicates that the linear trend is statistically significant, **** indicates that insufficient data is available to calculate values.)

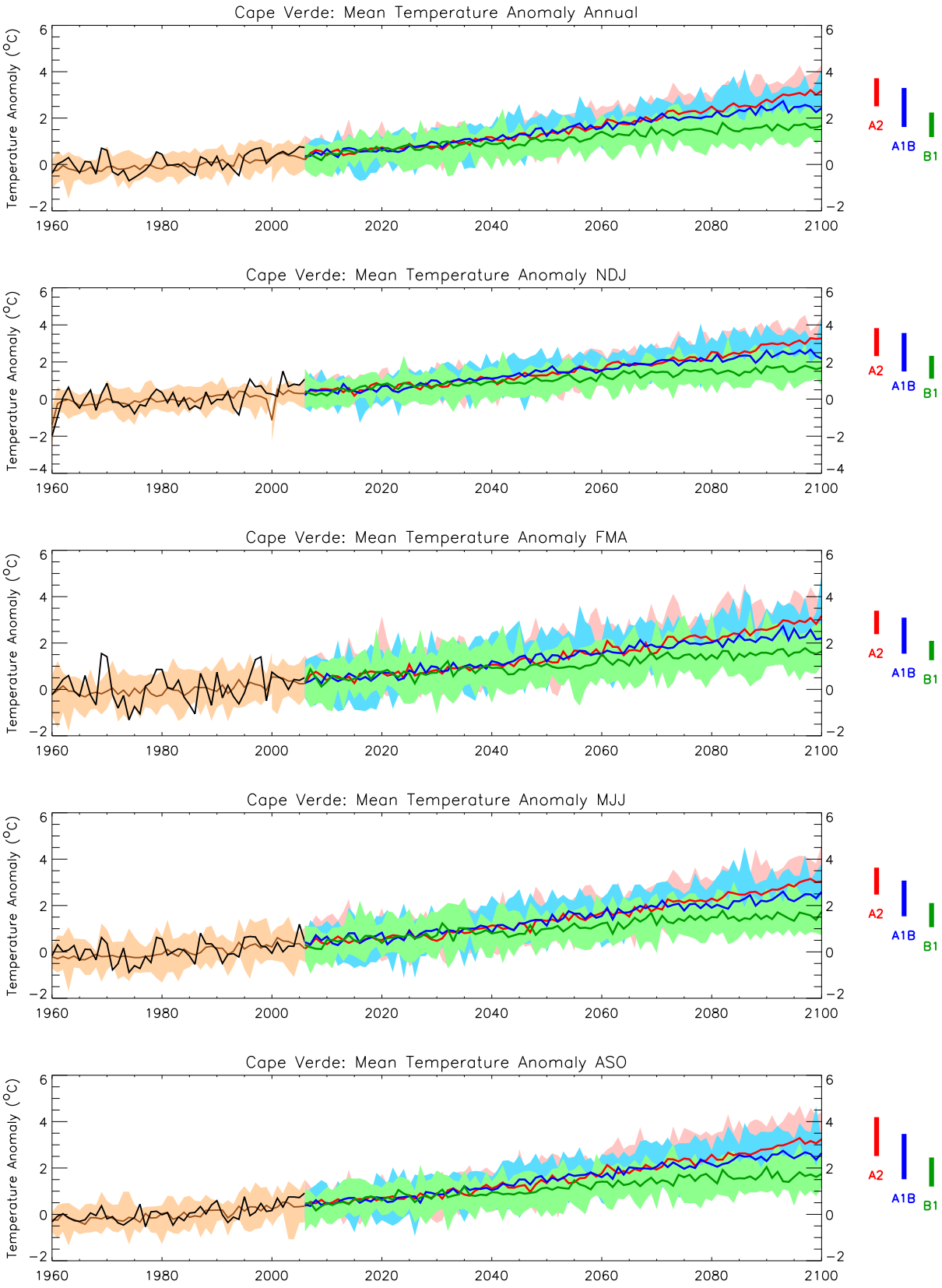


Figure 1: Trends in annual and seasonal mean temperature for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. Black curves show the mean of observed data from 1960 to 2006, Brown curves show the median (solid line) and range (shading) of model 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.

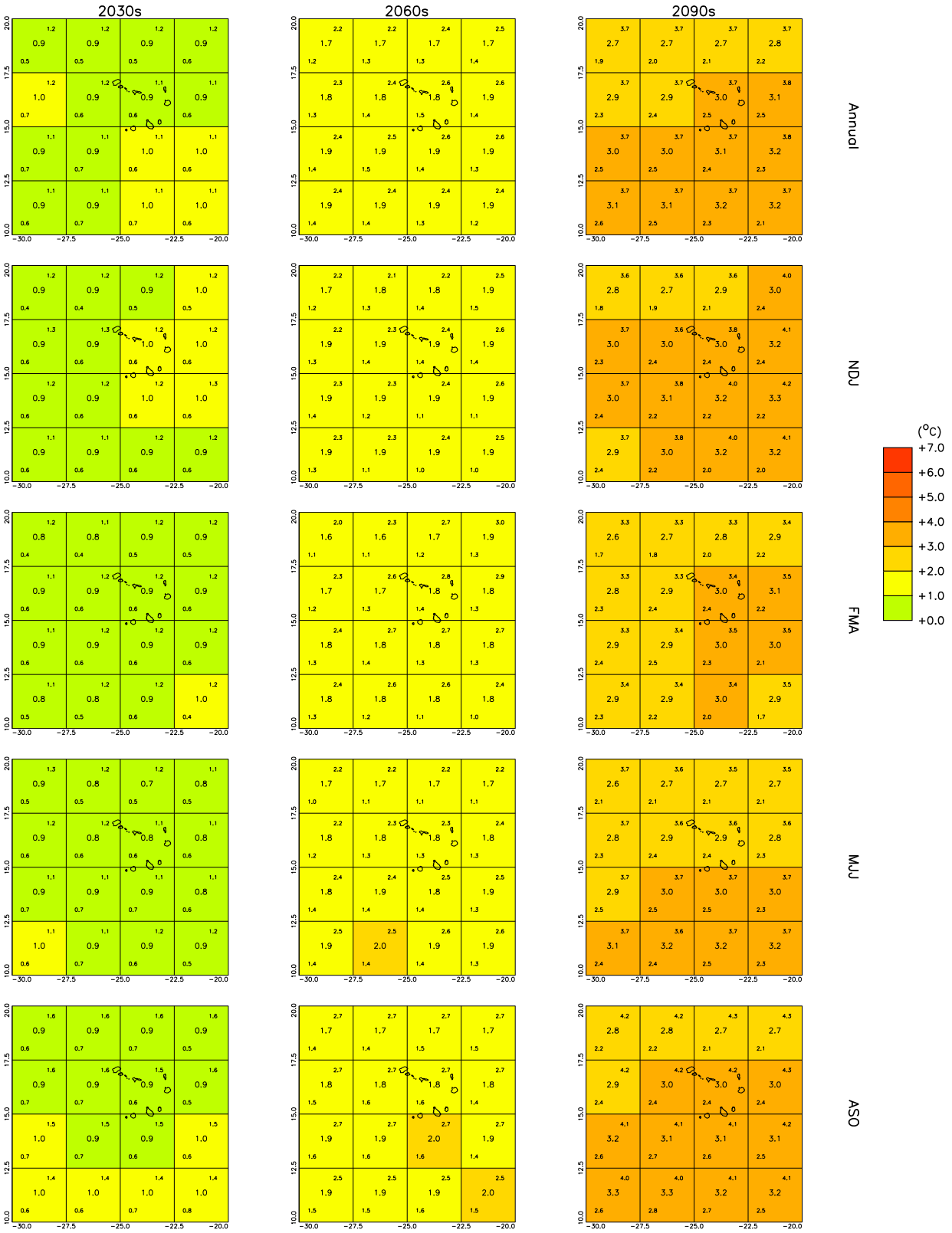


Figure 2: Spatial patterns of projected change in mean annual and seasonal temperature for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. In each grid box, the central value gives the ensemble median and the values in the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

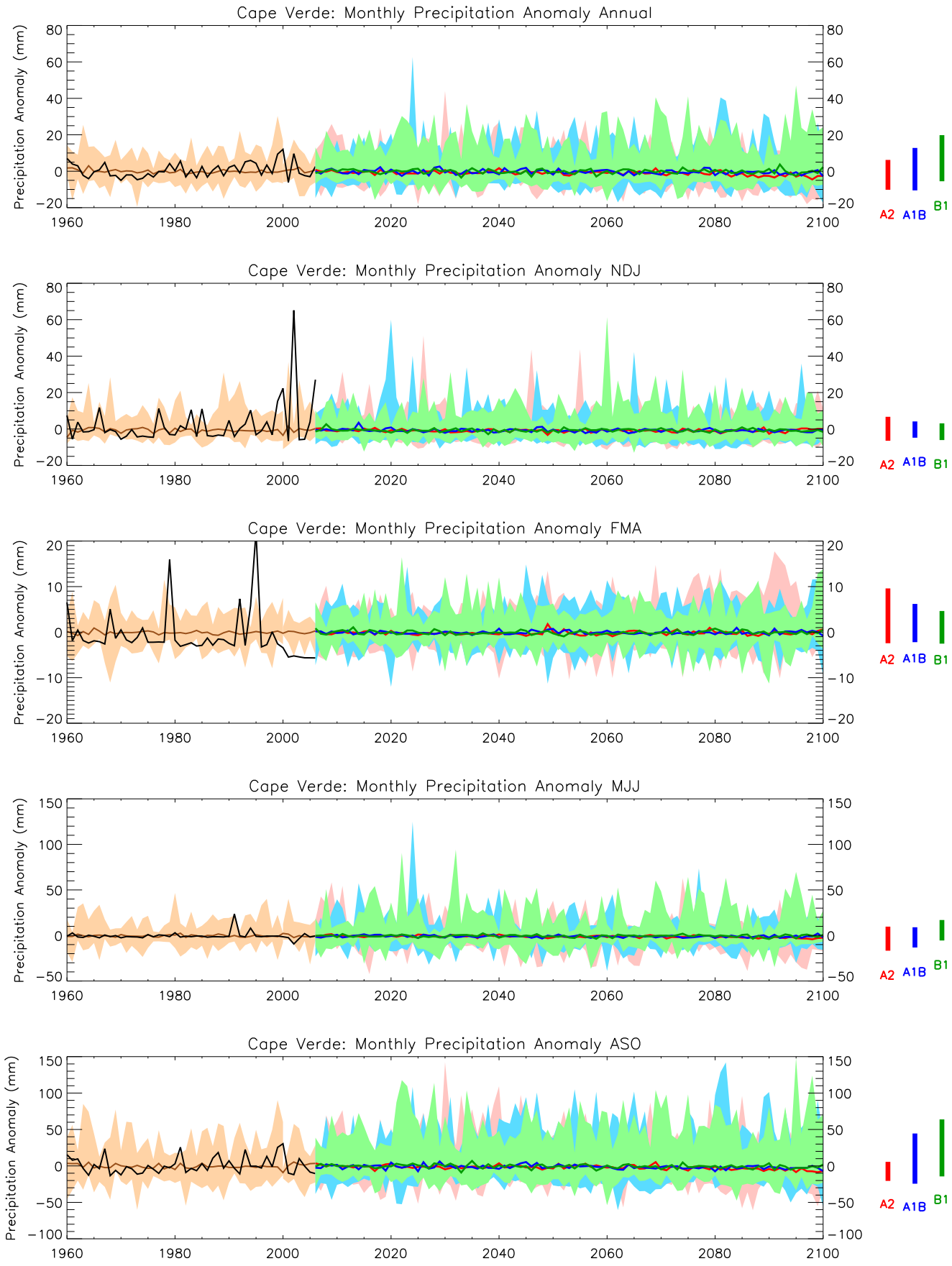


Figure 3: Trends in monthly precipitation for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

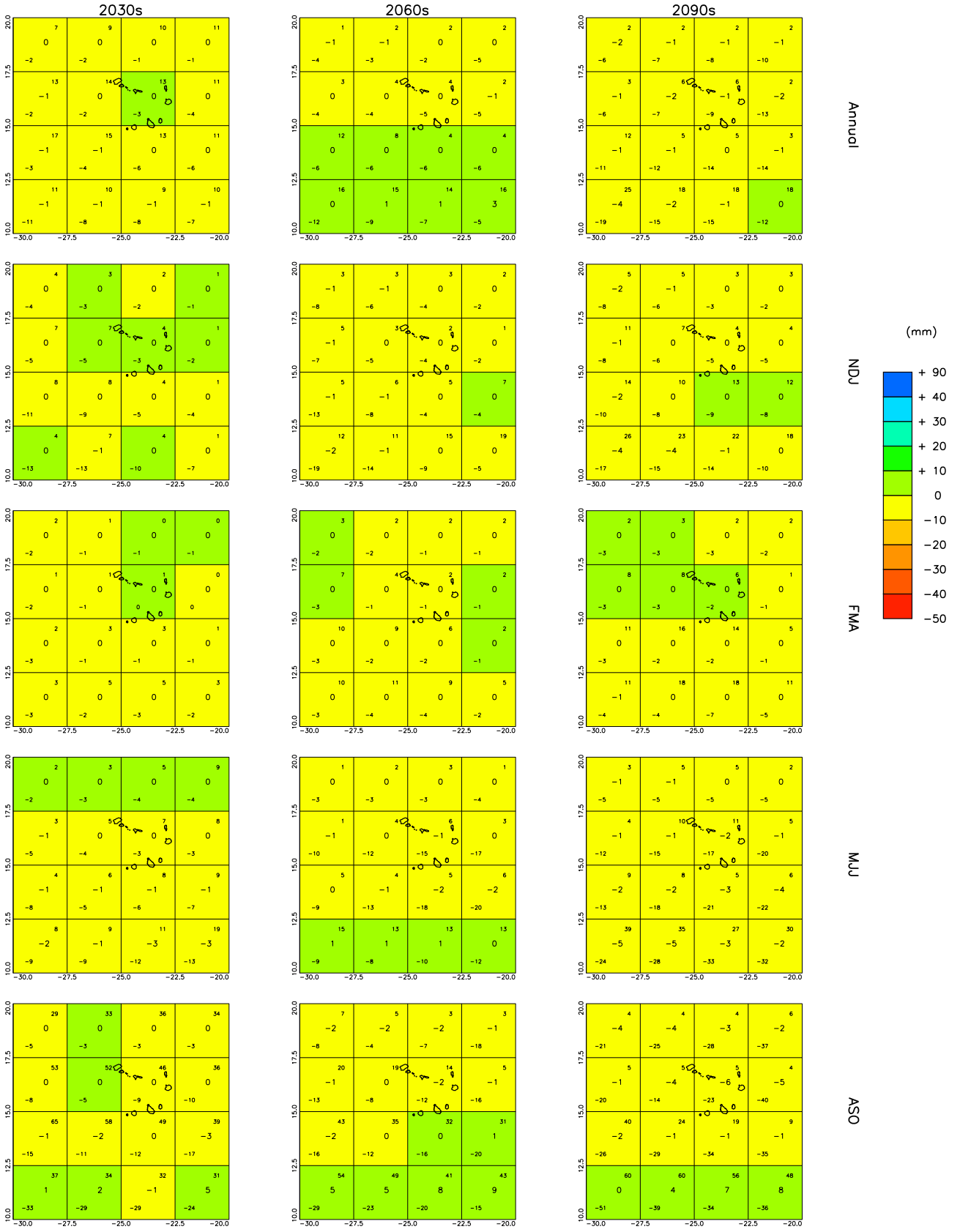


Figure 4: Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999.See Figure 2 for details.

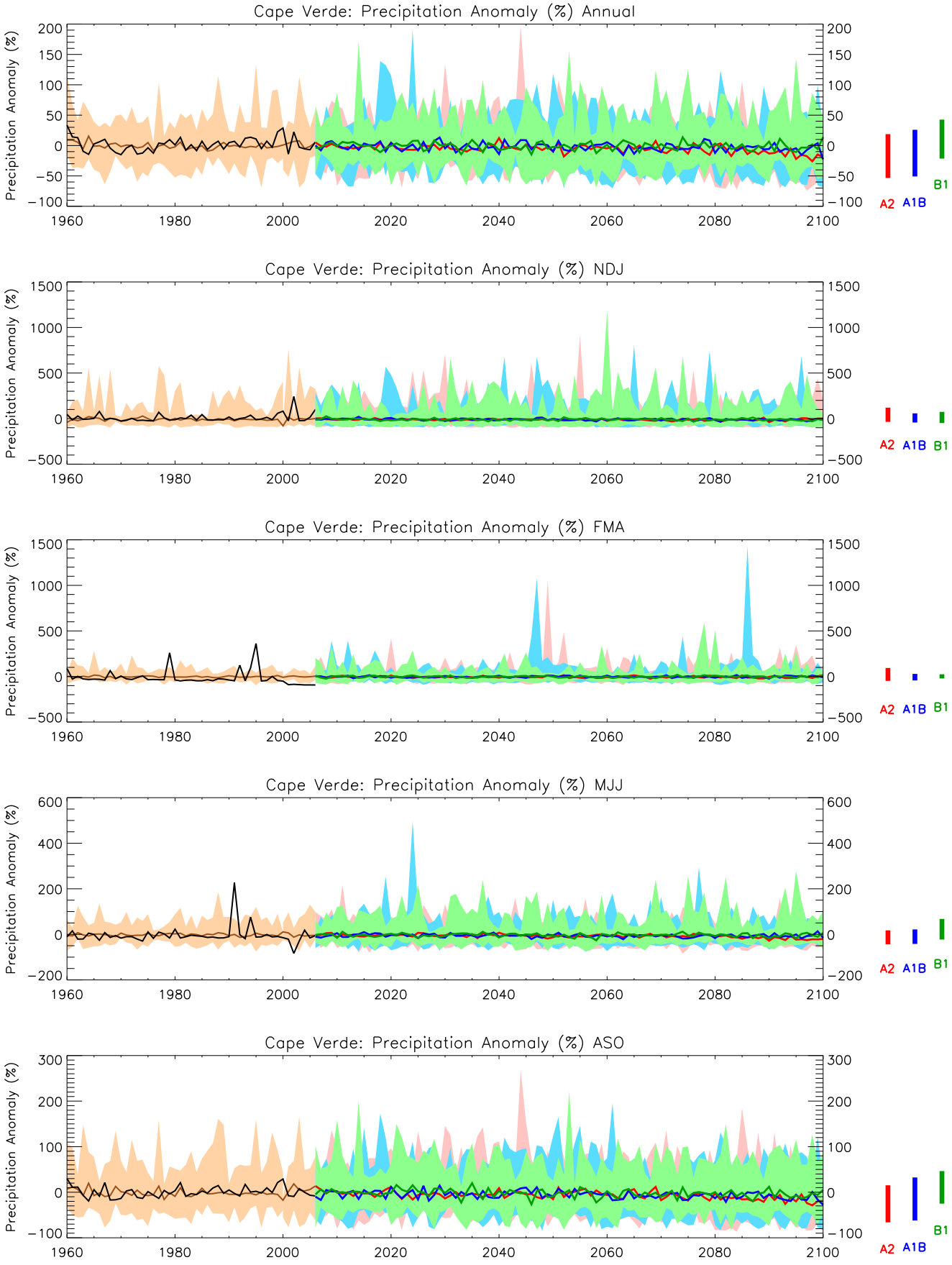


Figure 5: Trends in monthly precipitation for the recent past and projected future. All values shown are percentage anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

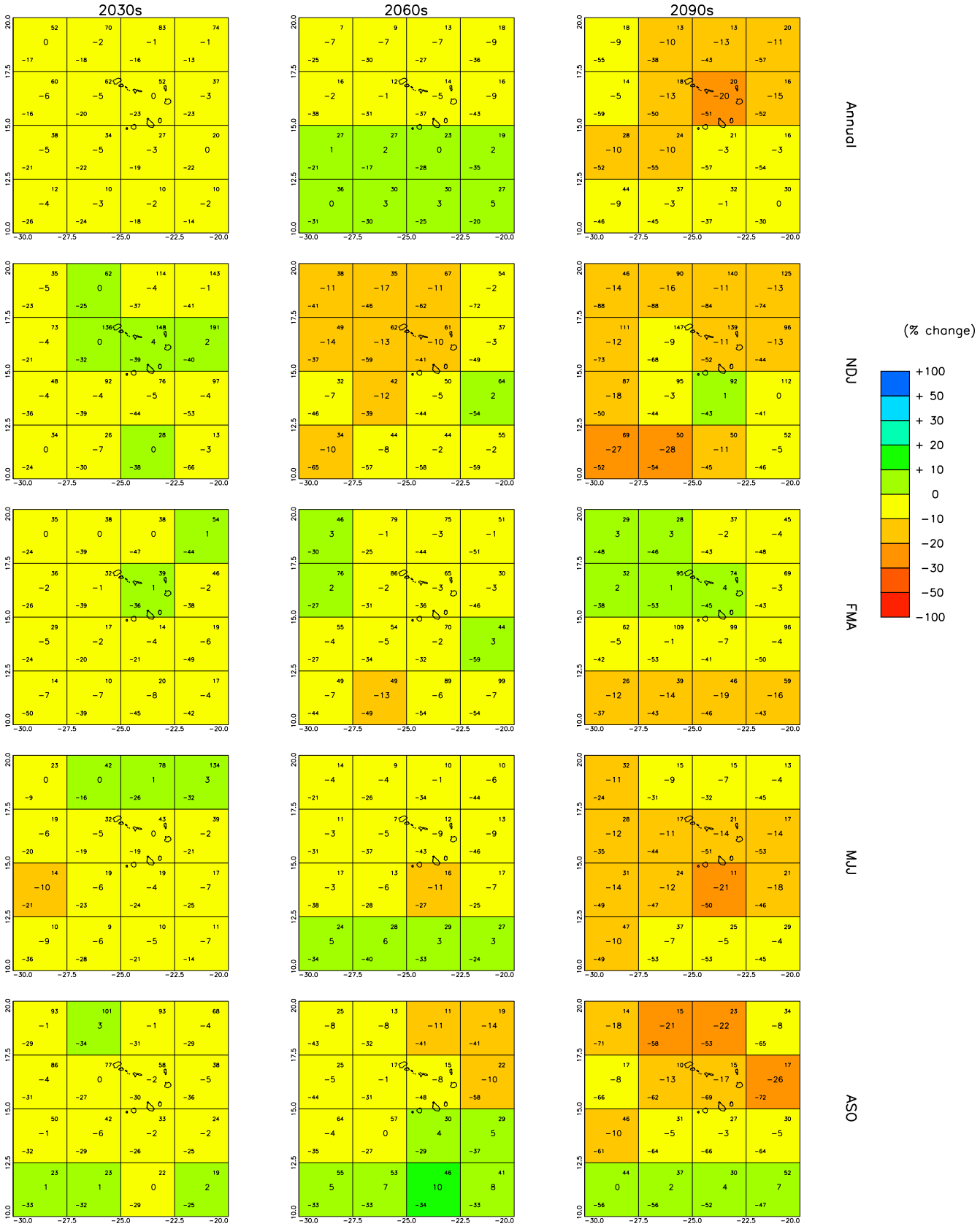


Figure 6: Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are percentage anomalies relative to the mean climate of 1970-1999.See Figure 2 for details.

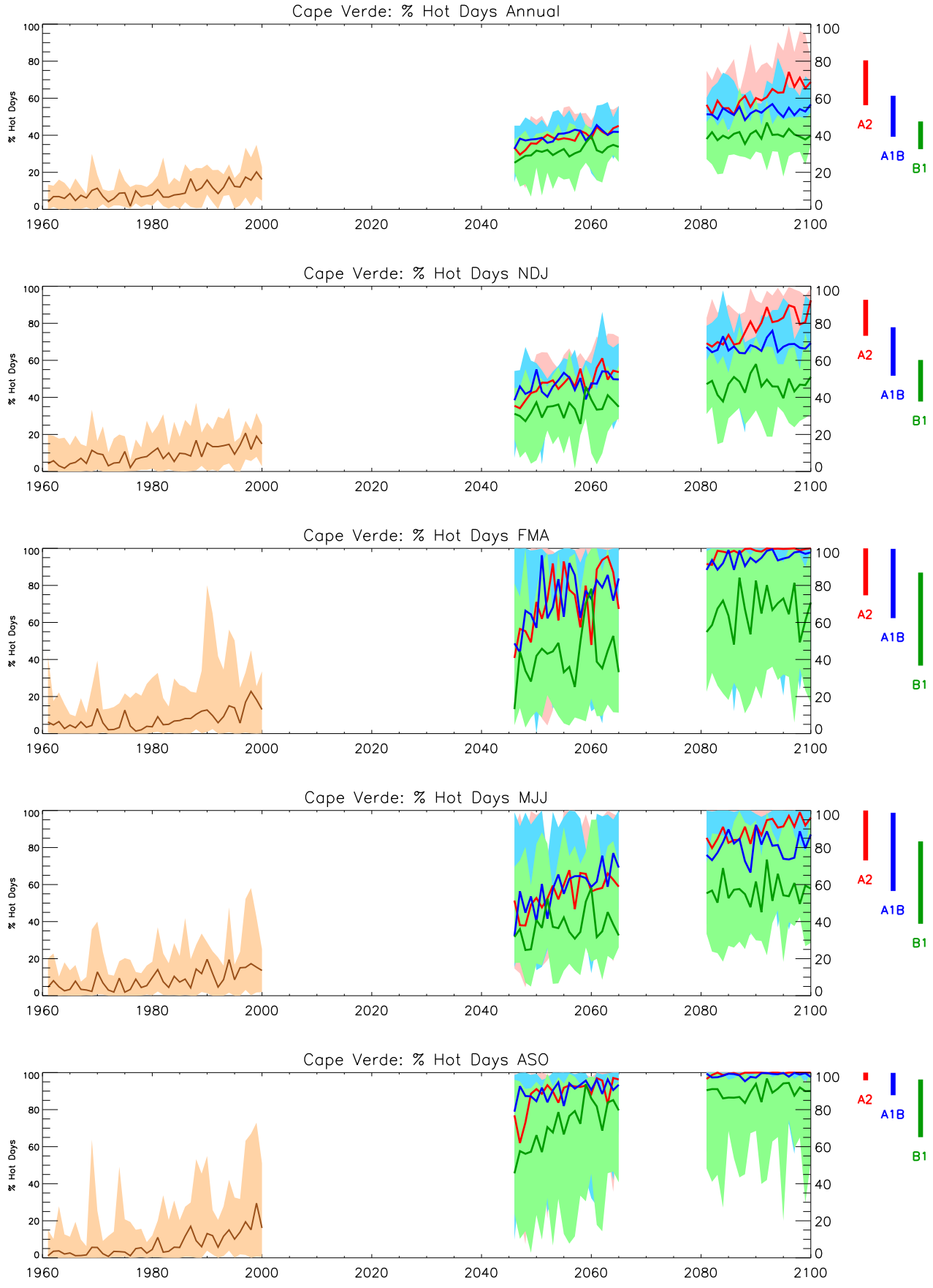


Figure 7: Trends in Hot-day frequency for the recent past and projected future. See Figure 1 for details.

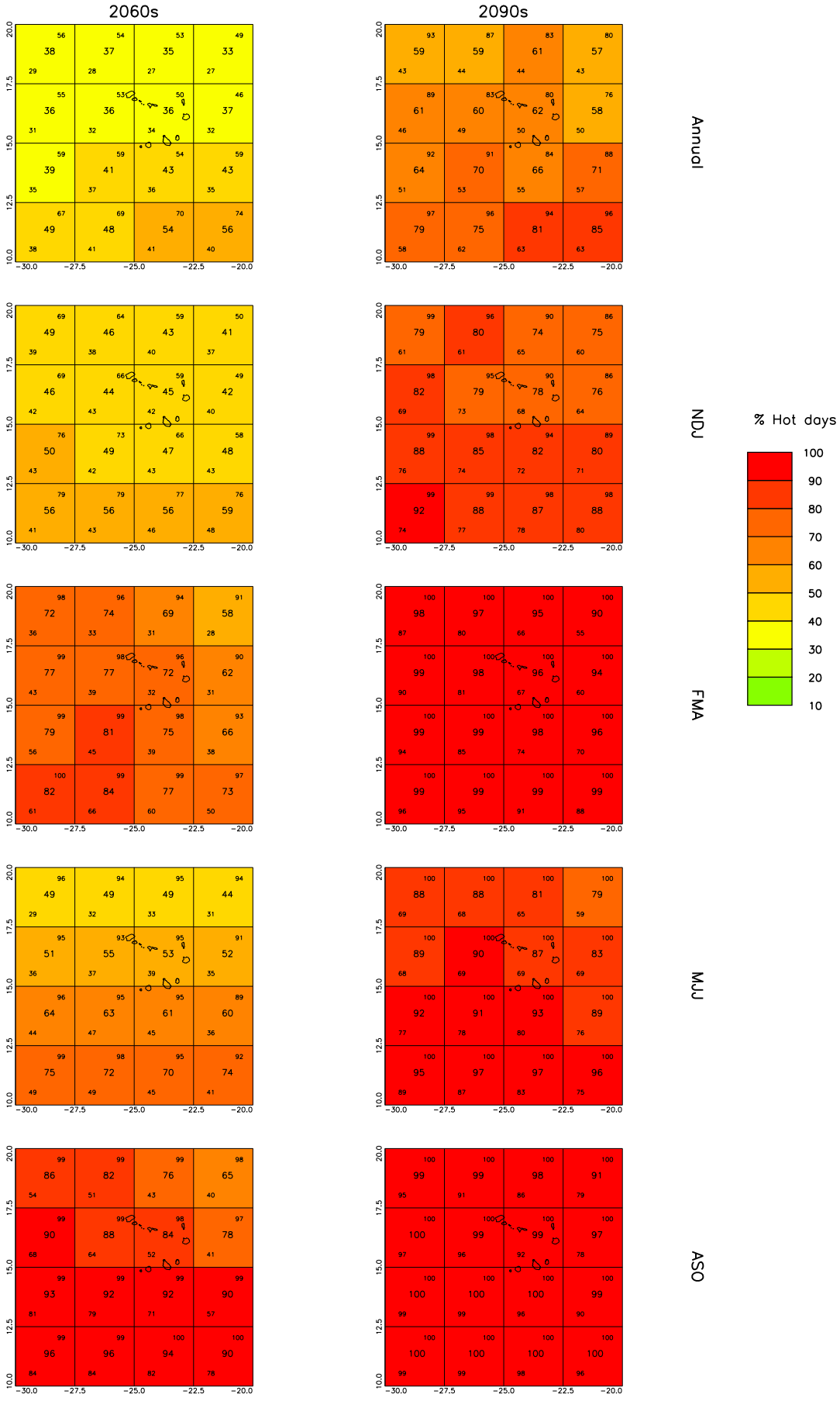


Figure 8: Spatial patterns of projected change in Hot-day frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

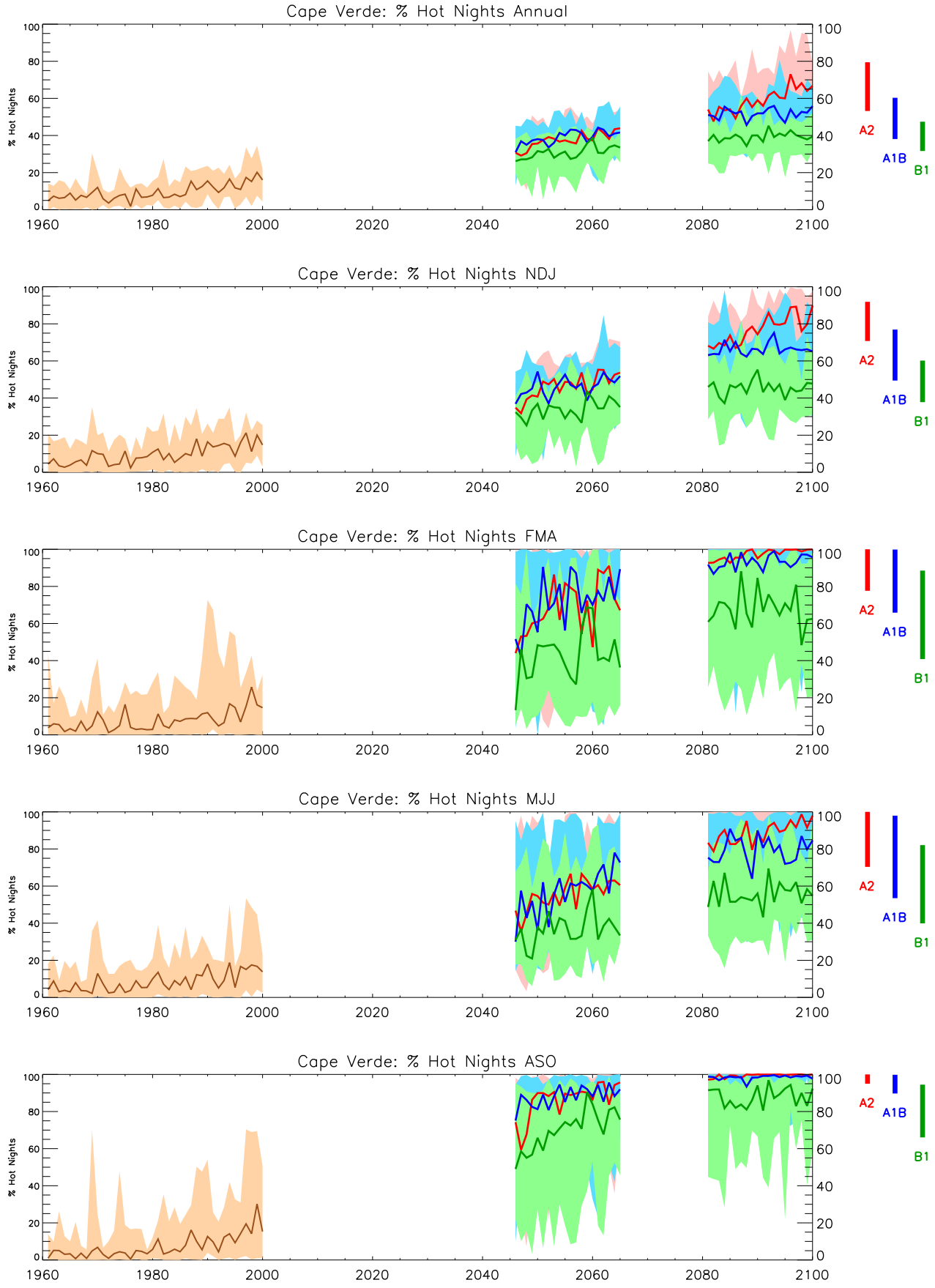


Figure 9: Trends in hot-night frequency for the recent past and projected future. See Figure 1 for details.

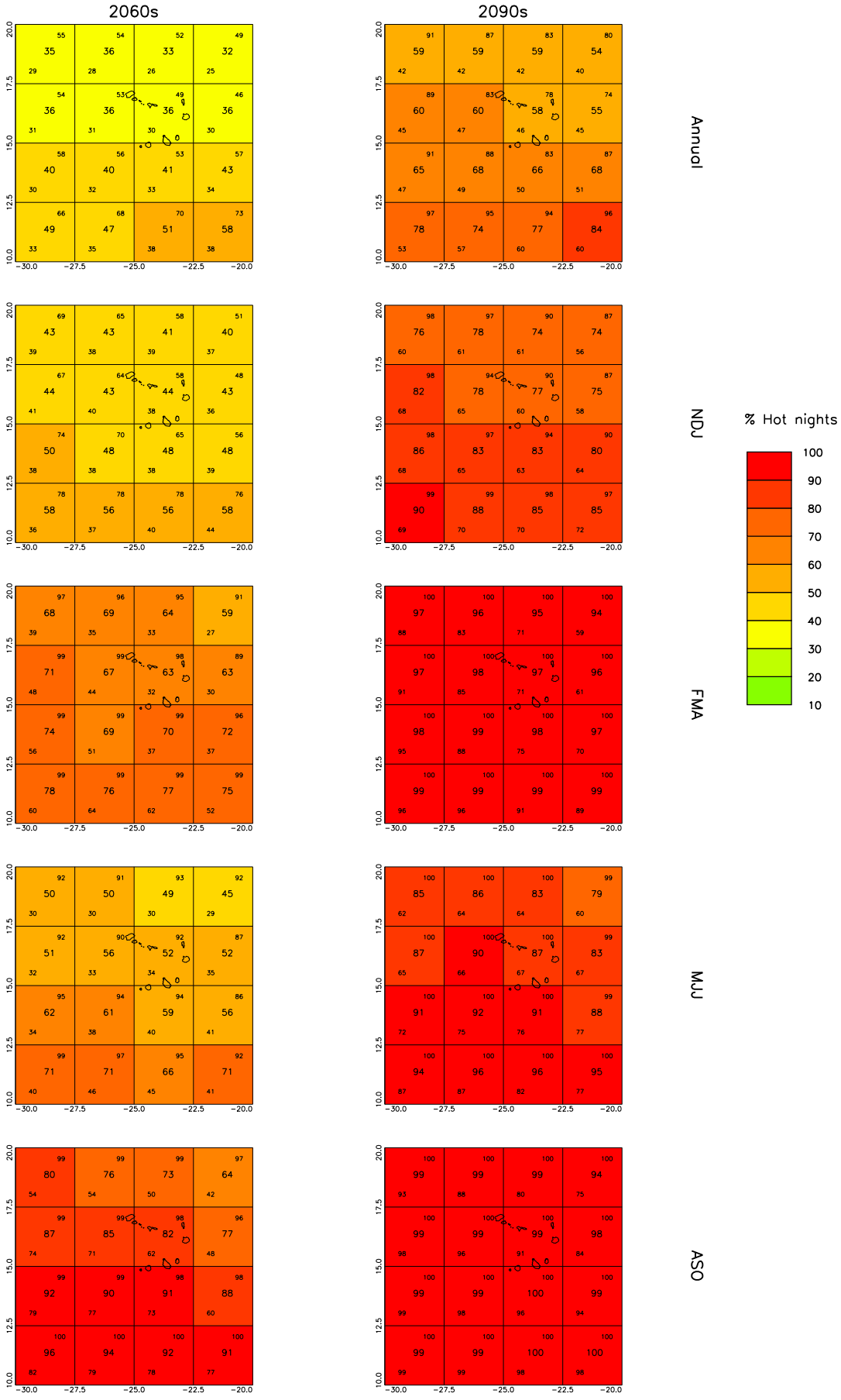


Figure 10: Spatial patterns of projected change in hot-night frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

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

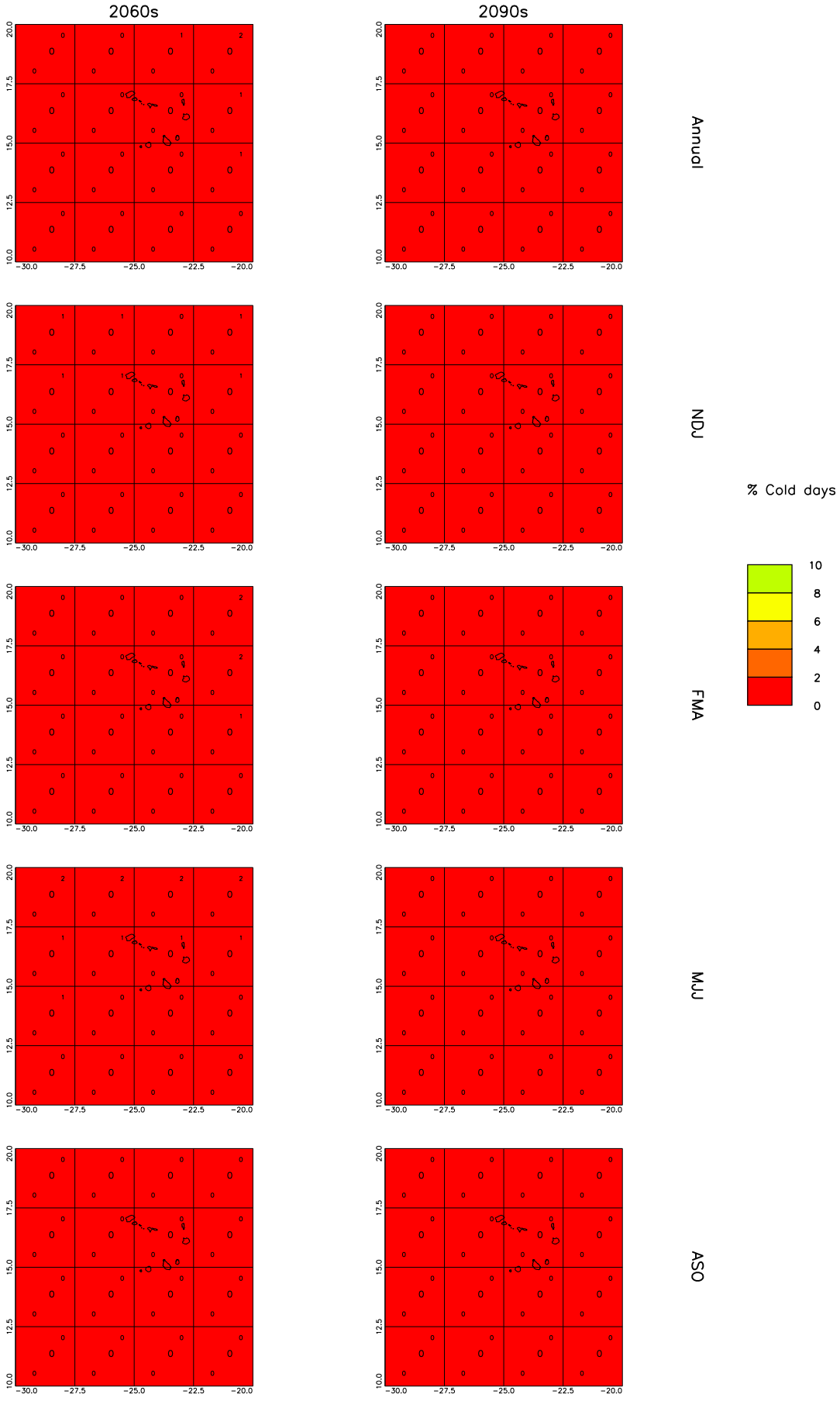


Figure 12: Spatial patterns of projected change in cold-day frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

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

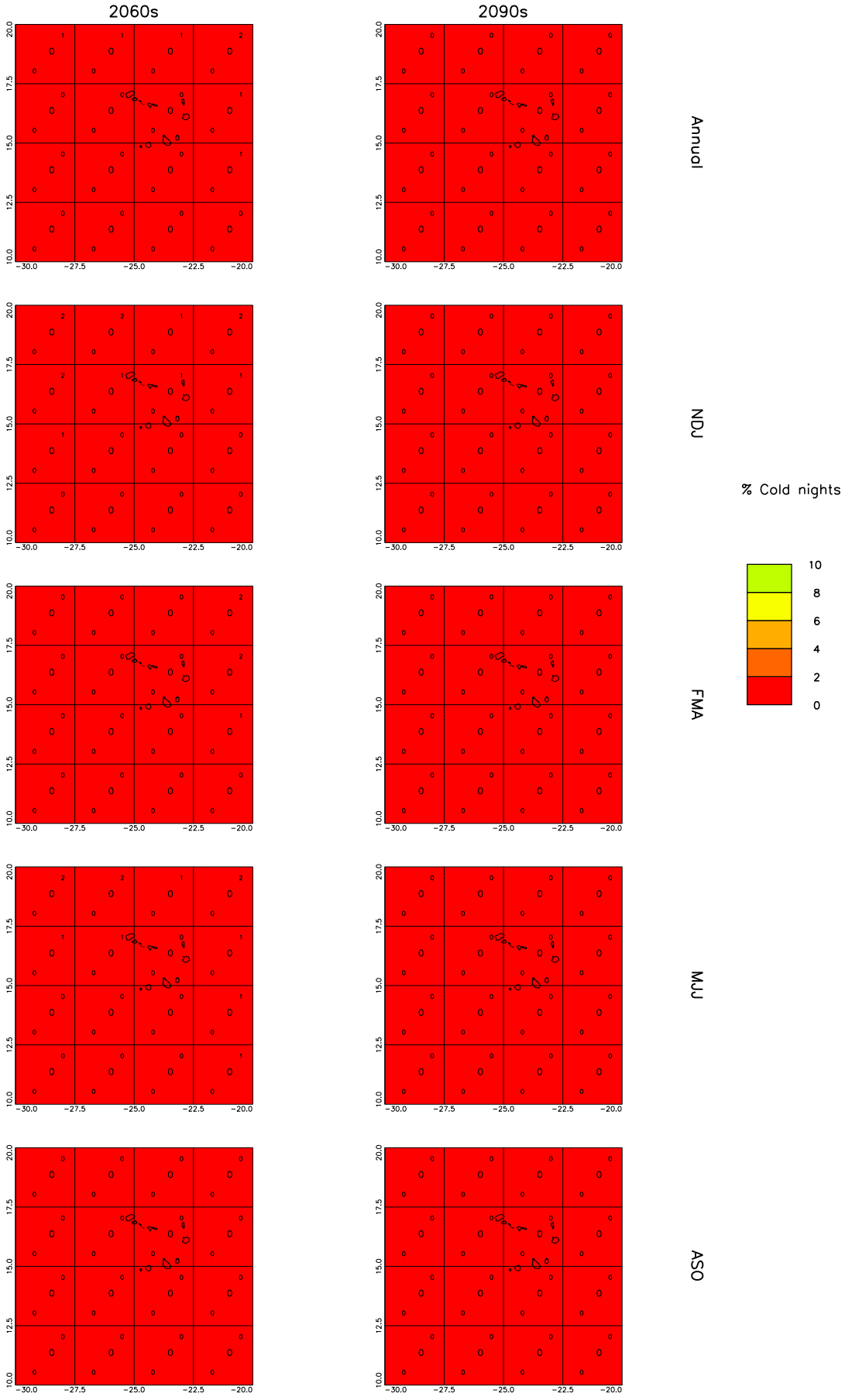


Figure 14: Spatial patterns of projected change in cold-night frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

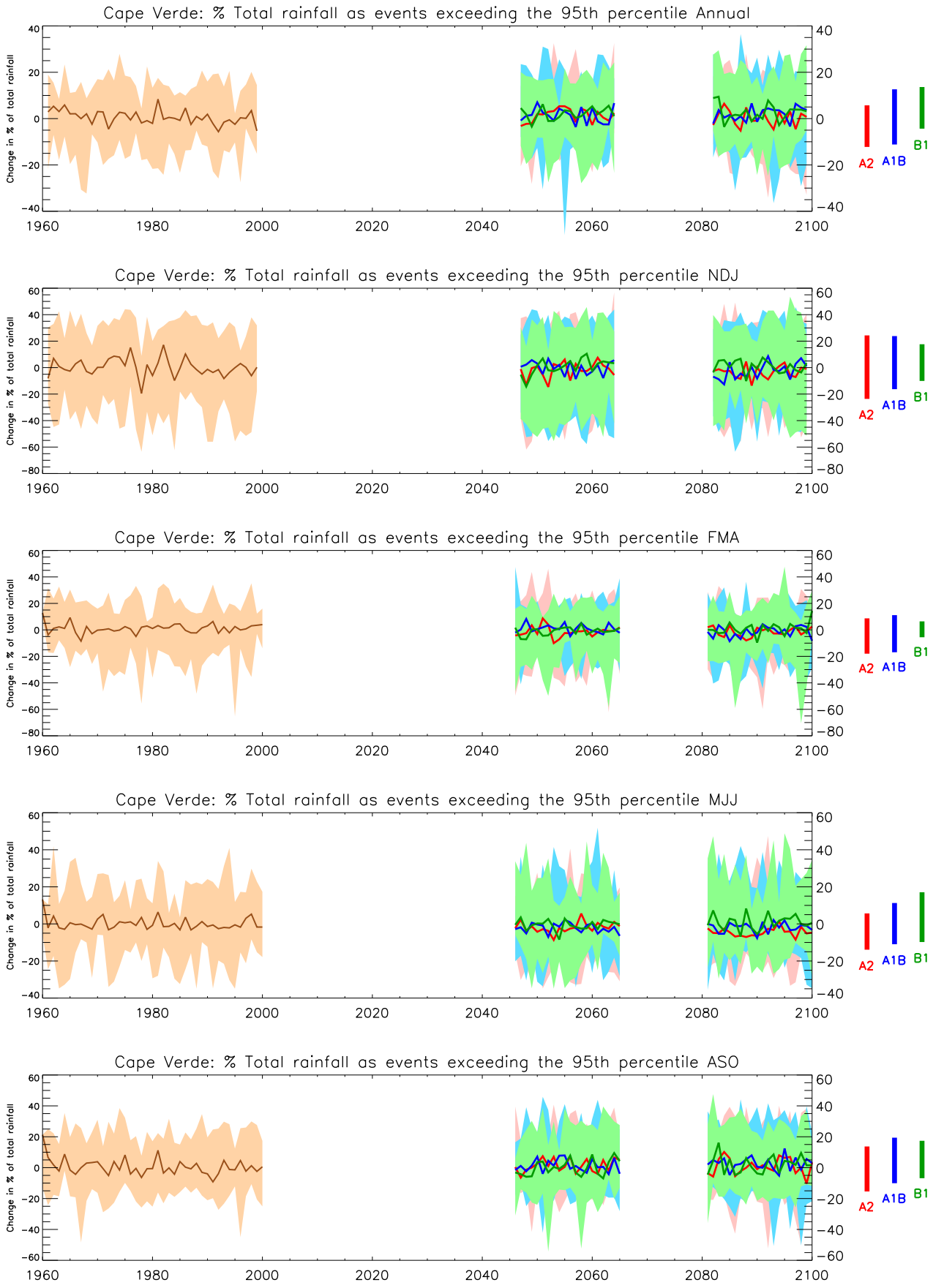


Figure 15: Trends in the proportion of precipitation falling in 'heavy' events for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

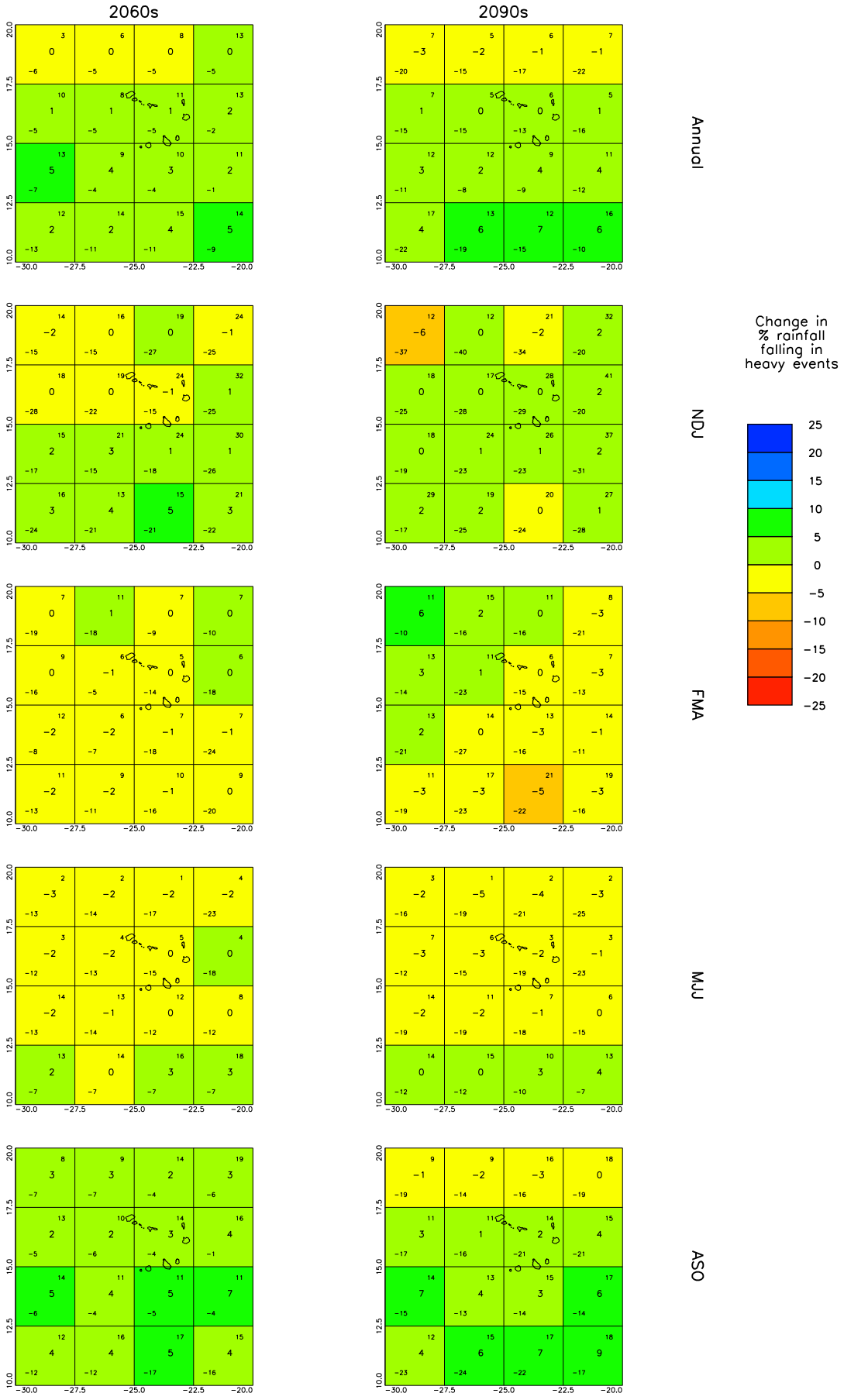


Figure 16: Spatial patterns of projected change in the proportion of precipitation falling in 'heavy' events for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

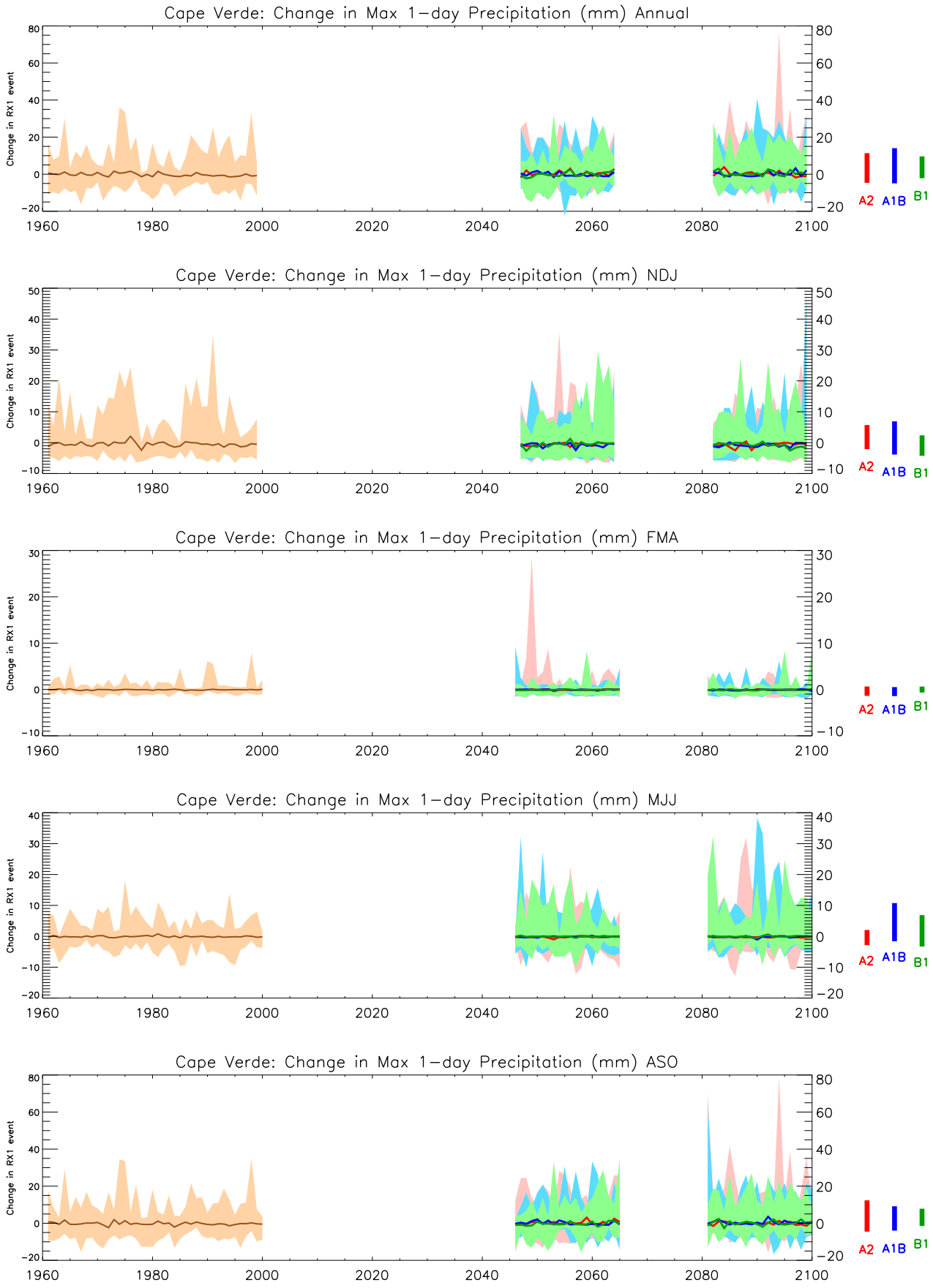


Figure 17: Trends in maximum 1-day rainfall for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

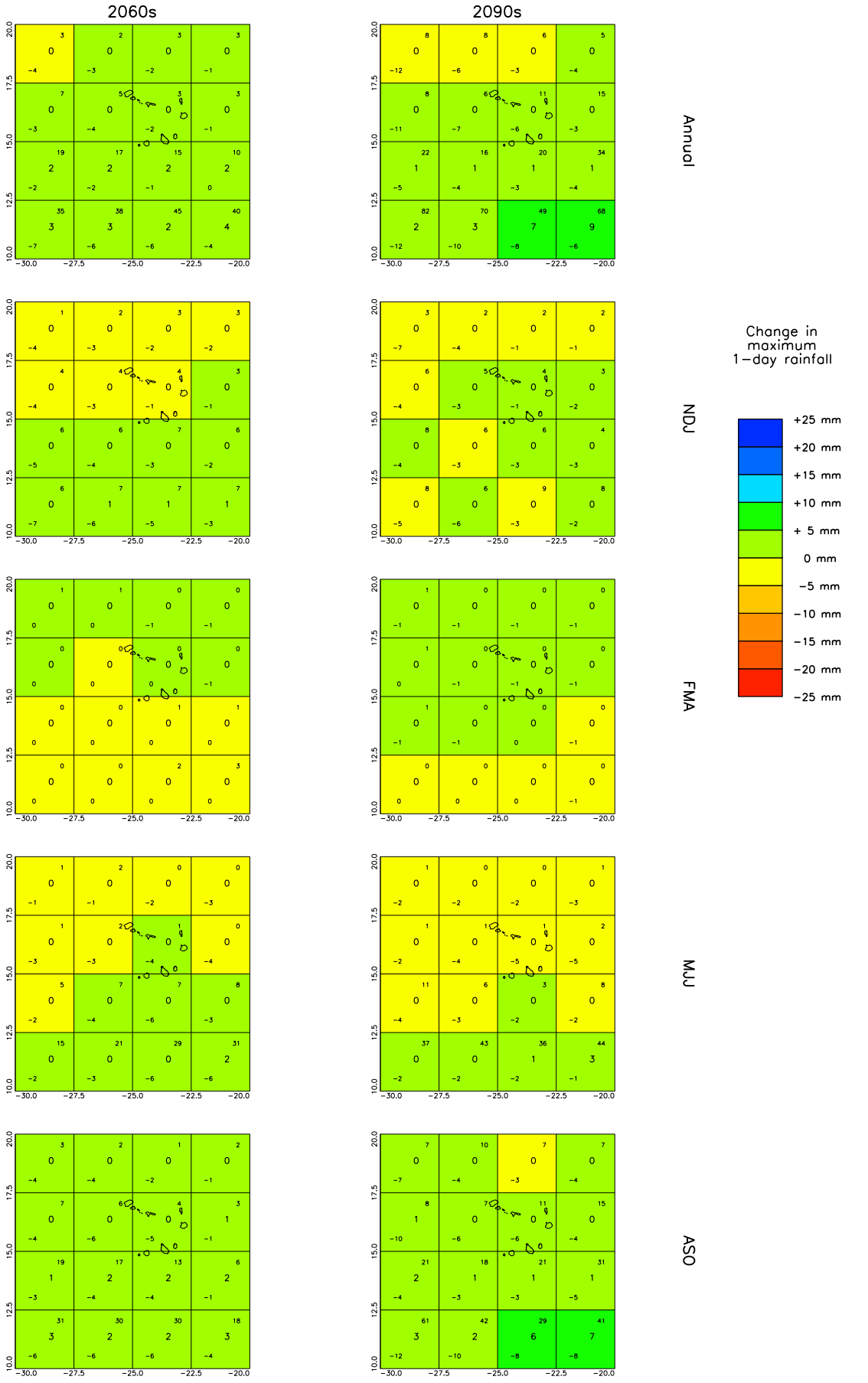


Figure 18: Spatial patterns of maximum 1-day rainfall for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

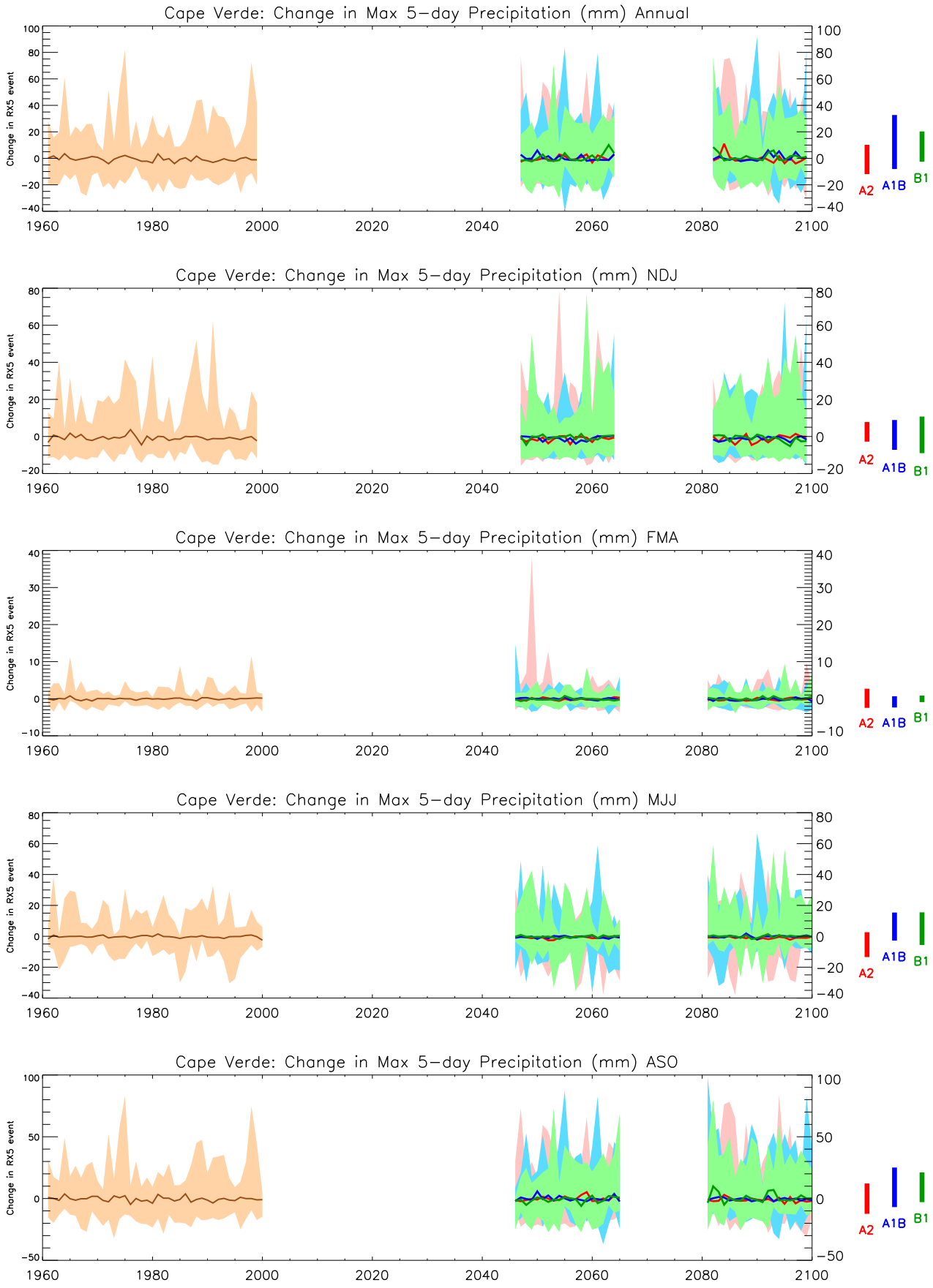


Figure 19: Trends in maximum 5-day rainfall for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

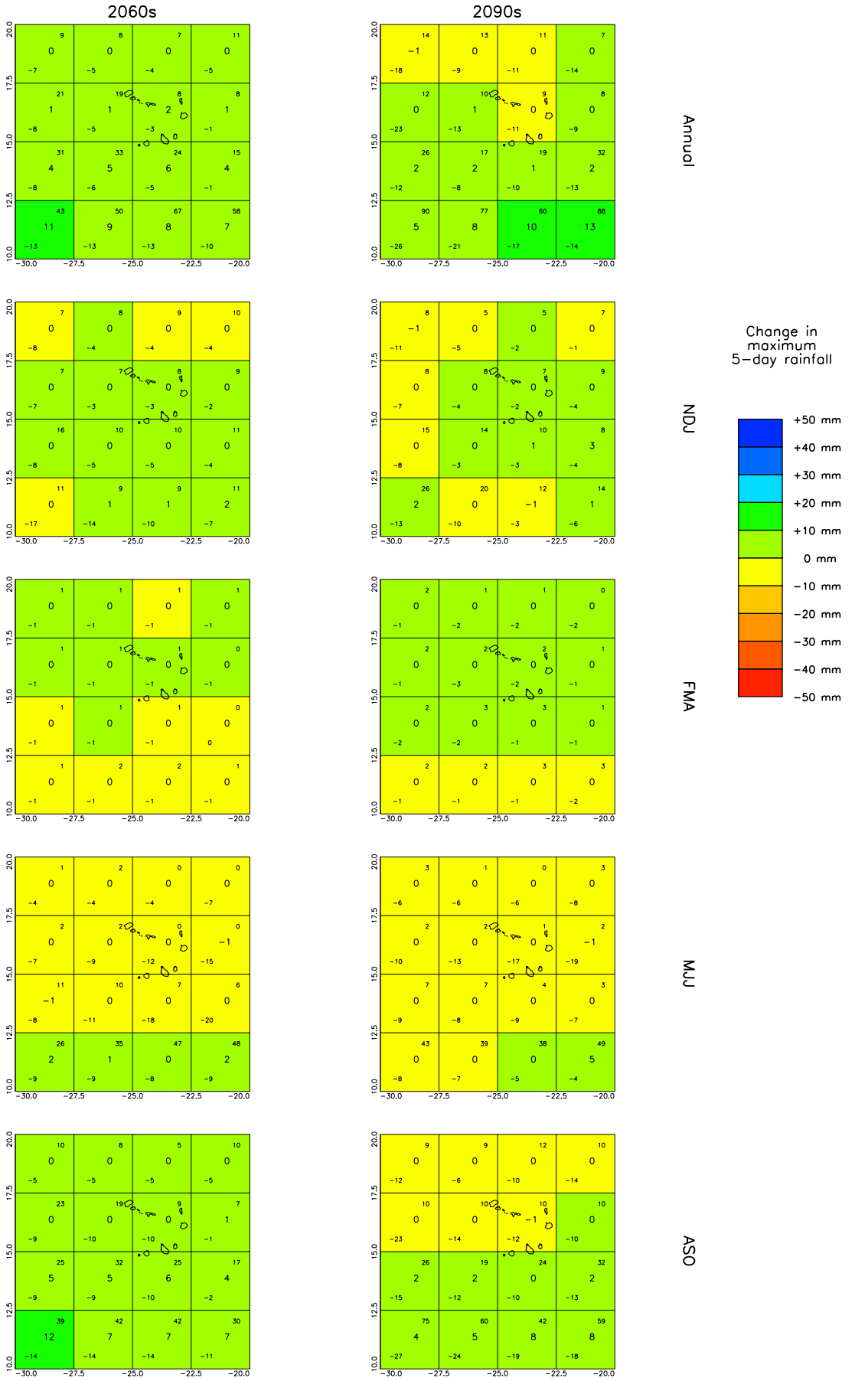


Figure 20: Spatial patterns of projected change in maximum 5-day rainfall for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.