

Suriname

C. McSweeney¹, M. New^{1,2} and G. Lizcano¹

1. School of Geography and Environment, University of Oxford.
2. Tyndall Centre for Climate Change Research

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



General Climate

Suriname is located in from 2 to 7° north of the Equator and has a typically warm and moist tropical climate. Mean air temperature is 25-27.5° throughout the year in the north, and a little cooler, at around 23-25°C in the southern regions. Suriname experiences two 'wet' seasons; a major wet season when most of the country receives 250-400mm per month between May and July, and a minor wet season bringing around 150-200mm per month in November to January.

Inter-annual variations in climate in this region are caused by the El Niño Southern Oscillation (ENSO). El Niño episodes dry conditions throughout the year, and bring warmer temperatures between June and August, whilst La Niña episodes wetter conditions throughout the years and cooler temperatures between June and August.

Recent Climate Trends

Temperature

- Mean annual temperature has increased by 0.2°C since 1960, an average rate of 0.05°C per decade. This rate of warming is less rapid than the global average.
- The rate of increase is most rapid in MJJ at ~0.1°C per decade. The warming is more rapid in the west of the country.
- There is insufficient daily observed data to identify trends in daily temperature extremes for most seasons, but where data are available a significant increasing trend is evident.
 - The average number of 'hot'¹ days per month in DJF has increased by 7.5 (an additional 24% of days²) between 1960 and 2003.
 - The average number of 'hot' nights per year increased by 102 (an additional 28% of nights) between 1960 and 2003.

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 The increase in frequency over the 43-year period between 1960 and 2003 is estimated based on the decadal trend quoted in the summary table.

Precipitation

- Mean annual rainfall over Suriname has not changed with any discernible trend since 1960.
- There is not sufficient daily precipitation data available to determine trends in the daily variability of rainfall.

GCM Projections of Future Climate

Temperature

- The mean annual temperature is projected to increase by 0.8 to 3.1°C by the 2060s, and 1.3 to 4.7 degrees by the 2090s. The range of projections by the 2090s under any one emissions scenario is around 1.5°C.
- The projected rate of warming is similar in all seasons, but more rapid in the southern, interior regions of the country than in the northern, coastal regions.
- All projections indicate substantial increases in the frequency of days and nights that are considered 'hot' in current climate.
 - Annually, projections indicate that 'hot' days will occur on 20-59% of days by the 2060s, and 20-81% of days by the 2090s. Days considered 'hot' by current climate standards for their season are projected to occur on 20-98% of days of the season by the 2090s, with the fastest rates on increase in ASO and FMA.
 - Nights that are considered 'hot' for the annual climate of 1970-99 are projected to occur on 38-93% of nights by the 2060s and 56-99% of nights by the 2090s. Nights that are considered hot for each season by 1970-99 standards are projected to occur on 59-99% of nights in every season by the 2090s, with the fastest rates of increase in ASO and NDJ.
 - Projected increases in 'hot' days and nights are more rapid over coastal and ocean regions than in the continental interiors in this region.
- All projections indicate decreases in the frequency of days and nights that are considered of 'cold'³ in current climate. 'Cold' days are expected to become exceedingly rare, occurring on maximum of 5% of days in the year, and potentially not at all, by the 2090s. 'Cold' nights do not occur at all by the 2090s in any season or under any emissions scenario.

Precipitation

- Projections of mean annual rainfall from different models in the ensemble project a wide range of changes in precipitation for Suriname. Ensemble median values of change by the 2060s, however, are consistently negative for all seasons and emissions scenarios. Projections vary between -65% to +40% by the 2090s with ensemble median changes of -5 to -9%.

³ '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 total rainfall that falls in heavy⁴ events does not show a consistent direction of change, but tend towards positive changes, particularly in the southern parts of the country in the seasons NDJ and FMA.
- Maximum 1- and 5-day rainfalls show little consistent change, but tend towards positive changes in the seasons NDJ and FMA in the southern parts of the country.

Additional Regional Climate Change Information

- Model simulations show wide disagreements in projected changes in the amplitude of future El Niño events, contributing to uncertainty in climate projections for this region.
- Suriname's low-lying coastal plains are vulnerable to any sea-level rise that occurs due to global warming. Sea-level in this region is projected by climate models to rise by the following levels⁵ by the 2090s, relative to 1980-1999 sea-level.
 - 0.18 to 0.43m under SRES B1
 - 0.21 to 0.53m under SRES A1B
 - 0.23 to 0.56m under SRES A2
- For further information see Christensen *et al.* (2007) IPCC Working Group I Report: '*The Physical Science Basis*', Chapter 11 (*Regional Climate projections*): Section 11.6 (*South and Central America*).

⁴ 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.

⁵ 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		
Annual	25.4	0.05	A2	0.7	1.3	1.7	1.7	2.5	3.1	2.9	4.0	4.7
			A1B	0.5	1.4	1.8	1.3	2.5	3.0	2.0	3.2	4.3
			B1	0.4	1.0	1.4	0.8	1.6	2.3	1.3	2.0	2.8
NDJ	25.4	0.05	A2	0.8	1.4	1.8	1.8	2.5	3.3	3.0	4.0	4.8
			A1B	0.3	1.4	1.8	1.3	2.4	3.0	2.0	3.2	4.4
			B1	0.3	0.9	1.8	0.8	1.6	2.3	1.4	2.1	3.1
FMA	25.1	0.02	A2	0.5	1.2	1.9	1.6	2.2	3.3	2.7	3.8	4.7
			A1B	0.7	1.3	2.1	1.4	2.3	3.2	1.9	3.0	4.2
			B1	0.3	0.8	1.3	0.8	1.7	2.2	1.1	2.0	2.7
MJJ	25.1	0.10*	A2	0.7	1.2	1.7	1.5	2.4	3.6	2.6	3.8	5.6
			A1B	0.4	1.3	1.7	1.2	2.4	3.4	1.9	3.2	4.6
			B1	0.3	0.9	1.8	0.7	1.6	2.9	1.2	2.1	3.2
ASO	25.9	0.05	A2	0.8	1.3	1.8	1.7	2.6	3.4	3.0	4.2	5.4
			A1B	0.6	1.4	2.0	1.3	2.6	3.5	1.8	3.3	4.5
			B1	0.4	1.0	1.6	0.9	1.9	2.5	1.3	2.2	3.1
Precipitation												
	(mm per month)	(change in mm per decade)		Change in mm per month			Change in mm per month			Change in mm per month		
Annual	184.3	0.9	A2	-12	-4	10	-28	-7	9	-41	-5	13
			A1B	-10	-1	13	-26	-5	5	-37	-6	20
			B1	-10	-1	9	-15	-1	11	-25	-6	14
NDJ	142.4	1.6	A2	-20	-3	6	-32	-3	6	-38	-1	18
			A1B	-18	-1	19	-29	-5	6	-38	-1	20
			B1	-23	0	13	-25	-1	15	-31	-4	14
FMA	200.8	4.0	A2	-15	-1	9	-29	-4	4	-64	-1	18
			A1B	-23	0	11	-42	-6	14	-65	-6	17
			B1	-10	0	14	-18	-3	3	-36	-5	22
MJJ	296.1	1.5	A2	-26	0	17	-42	-9	21	-76	-10	43
			A1B	-9	0	22	-39	-8	10	-63	-7	32
			B1	-18	0	10	-29	2	18	-35	-8	23
ASO	96.9	-3.0	A2	-13	-1	25	-22	-4	32	-42	-3	52
			A1B	-13	-1	19	-25	-2	31	-26	-2	56
			B1	-18	-1	21	-18	-2	34	-19	-1	47
Precipitation (%)												
	(mm per month)	(change in % per decade)		% Change			% Change			% Change		
Annual	184.3	0.5	A2	-27	-5	18	-45	-8	29	-65	-9	20
			A1B	-21	-4	20	-41	-8	16	-59	-5	40
			B1	-24	-1	11	-32	-3	16	-40	-7	33
NDJ	142.4	1.1	A2	-48	-13	13	-64	-12	22	-77	-13	61
			A1B	-38	-8	26	-59	-8	48	-77	-8	25
			B1	-37	0	18	-44	-5	21	-62	-12	22
FMA	200.8	2.0	A2	-30	-4	22	-46	-13	34	-58	-8	55
			A1B	-28	-7	28	-33	-16	25	-59	-13	37
			B1	-17	1	27	-32	-8	8	-39	-11	53
MJJ	296.1	0.5	A2	-36	0	18	-39	-4	30	-61	-5	21
			A1B	-9	-1	16	-31	-7	14	-50	-5	35
			B1	-25	0	10	-41	1	12	-36	-4	33
ASO	96.9	-3.1	A2	-33	-9	41	-78	-15	53	-91	-16	85
			A1B	-42	-9	53	-74	-18	56	-87	-16	126
			B1	-41	-3	34	-52	-10	56	-87	-11	76

	Observed Mean	Observed Trend	Projected changes by the 2030s			Projected changes by the 2060s			Projected changes by the 2090s			
	1970-99	1960-2006	Min	Median	Max	Min	Median	Max	Min	Median	Max	
	% Frequency	Change in frequency per decade				Future % frequency			Future % frequency			
Frequency of Hot Days (TX90p)												
Annual	****	****	A2	****	****	****	24	48	59	45	61	81
			A1B	****	****	****	24	44	56	29	61	72
			B1	****	****	****	20	35	45	20	43	54
NDJ (DJF)	14.1	(5.56*)	A2	****	****	****	45	54	67	59	79	90
			A1B	****	****	****	37	58	67	56	70	80
			B1	****	****	****	25	42	52	41	52	64
FMA (MAM)	****	****	A2	****	****	****	33	63	67	51	84	91
			A1B	****	****	****	40	60	70	32	74	89
			B1	****	****	****	28	45	56	20	62	75
MJJ (JJA)	****	****	A2	****	****	****	28	47	67	46	67	89
			A1B	****	****	****	25	41	70	35	53	85
			B1	****	****	****	18	27	55	27	43	66
ASO (SON)	****	****	A2	****	****	****	57	70	87	66	90	98
			A1B	****	****	****	53	64	90	61	80	95
			B1	****	****	****	35	52	74	53	61	90
Frequency of Hot Nights (TN90p)												
Annual	15.5	6.52*	A2	****	****	****	53	72	93	88	94	99
			A1B	****	****	****	53	71	93	77	87	99
			B1	****	****	****	38	52	77	56	65	93
NDJ (DJF)	****	****	A2	****	****	****	61	87	93	92	98	99
			A1B	****	****	****	54	86	93	76	95	99
			B1	****	****	****	39	69	75	57	78	95
FMA (MAM)	****	****	A2	****	****	****	59	78	95	89	97	99
			A1B	****	****	****	68	79	94	81	93	99
			B1	****	****	****	42	59	81	62	76	89
MJJ (JJA)	****	****	A2	****	****	****	61	85	98	95	98	99
			A1B	****	****	****	61	77	98	84	97	99
			B1	****	****	****	45	55	89	59	73	96
ASO (SON)	****	****	A2	****	****	****	72	84	98	91	99	99
			A1B	****	****	****	70	81	98	86	96	99
			B1	****	****	****	51	62	81	72	82	94
Frequency of Cold Days (TX10p)												
Annual	****	****	A2	****	****	****	0	1	5	0	0	0
			A1B	****	****	****	0	2	6	0	0	3
			B1	****	****	****	0	3	6	0	1	5
NDJ (DJF)	****	****	A2	****	****	****	0	1	4	0	0	0
			A1B	****	****	****	0	1	3	0	0	1
			B1	****	****	****	1	2	3	0	1	2
FMA (MAM)	****	****	A2	****	****	****	0	1	4	0	0	1
			A1B	****	****	****	0	1	3	0	0	1
			B1	****	****	****	0	2	4	0	1	3
MJJ (JJA)	****	****	A2	****	****	****	0	1	3	0	0	1
			A1B	****	****	****	0	1	5	0	0	1
			B1	****	****	****	0	3	6	0	1	3
ASO (SON)	****	****	A2	****	****	****	0	1	9	0	0	0
			A1B	****	****	****	0	2	9	0	0	7
			B1	****	****	****	0	2	8	0	1	7
Frequency of Cold Nights (TN10p)												
Annual	****	****	A2	****	****	****	0	0	0	0	0	0
			A1B	****	****	****	0	0	0	0	0	0
			B1	****	****	****	0	0	1	0	0	0
NDJ (DJF)	****	****	A2	****	****	****	0	0	1	0	0	0
			A1B	****	****	****	0	0	0	0	0	0
			B1	****	****	****	0	0	0	0	0	0
FMA (MAM)	****	****	A2	****	****	****	0	0	0	0	0	0
			A1B	****	****	****	0	0	0	0	0	0
			B1	****	****	****	0	0	0	0	0	0
MJJ (JJA)	****	****	A2	****	****	****	0	0	0	0	0	0
			A1B	****	****	****	0	0	0	0	0	0
			B1	****	****	****	0	0	1	0	0	0
ASO (SON)	9.3	(-1.21)	A2	****	****	****	0	0	1	0	0	0
			A1B	****	****	****	0	0	1	0	0	0
			B1	****	****	****	0	0	1	0	0	0

	Observed	Observed	Projected changes by the			Projected changes by the			Projected changes by the			
	Mean	Trend	2030s			2060s			2090s			
	1970-99	1960-2006	Min	Median	Max	Min	Median	Max	Min	Median	Max	
% total rainfall falling in Heavy Events (R95pct)												
	%	Change in % per decade				Change in %			Change in %			
Annual	****	****	A2	****	****	****	-4	2	10	-8	4	12
			A1B	****	****	****	0	2	10	-8	4	13
			B1	****	****	****	-1	2	8	-1	3	10
NDJ (DJF)	****	****	A2	****	****	****	-11	1	12	-11	0	19
			A1B	****	****	****	-7	0	15	-12	1	20
			B1	****	****	****	-10	2	10	-7	1	13
FMA (MAM)	****	****	A2	****	****	****	-7	1	10	-14	0	16
			A1B	****	****	****	-16	-1	5	-22	1	18
			B1	****	****	****	-13	0	8	-16	-3	9
MJJ (JJA)	****	****	A2	****	****	****	-5	3	11	-12	5	18
			A1B	****	****	****	-3	3	7	-11	4	23
			B1	****	****	****	-2	2	11	-5	3	11
ASO (SON)	****	****	A2	****	****	****	-17	-1	19	-39	-1	32
			A1B	****	****	****	-26	0	16	-31	3	34
			B1	****	****	****	-22	4	14	-41	2	26
Maximum 1-day rainfall (RX1day)												
	mm	Change in mm per decade				Change in mm			Change in mm			
Annual	****	****	A2	****	****	****	-4	1	8	-7	2	34
			A1B	****	****	****	-2	1	5	-6	3	38
			B1	****	****	****	-1	0	7	-2	1	12
NDJ (DJF)	****	****	A2	****	****	****	-1	0	4	-1	0	9
			A1B	****	****	****	-1	0	7	-2	0	8
			B1	****	****	****	-2	0	5	-1	0	4
FMA (MAM)	****	****	A2	****	****	****	-1	0	2	-2	0	12
			A1B	****	****	****	-3	0	1	-4	0	4
			B1	****	****	****	-3	0	1	-2	0	2
MJJ (JJA)	****	****	A2	****	****	****	-5	1	7	-8	2	30
			A1B	****	****	****	-2	0	9	-6	3	35
			B1	****	****	****	-2	1	7	-5	1	11
ASO (SON)	****	****	A2	****	****	****	-4	0	5	-9	0	13
			A1B	****	****	****	-4	0	3	-5	0	14
			B1	****	****	****	-2	0	3	-8	0	8
Maximum 5-day Rainfall (RX5day)												
	mm	Change in mm per decade				Change in mm			Change in mm			
Annual	****	****	A2	****	****	****	-7	3	13	-10	3	43
			A1B	****	****	****	-2	2	7	-9	4	71
			B1	****	****	****	-2	2	13	-7	6	19
NDJ (DJF)	****	****	A2	****	****	****	-7	0	9	-8	0	24
			A1B	****	****	****	-4	0	19	-9	0	20
			B1	****	****	****	-9	0	17	-4	0	8
FMA (MAM)	****	****	A2	****	****	****	-4	0	7	-10	0	18
			A1B	****	****	****	-8	-1	4	-14	-1	13
			B1	****	****	****	-8	0	4	-8	-1	10
MJJ (JJA)	****	****	A2	****	****	****	-9	1	16	-13	3	35
			A1B	****	****	****	-5	0	12	-13	6	67
			B1	****	****	****	-3	2	13	-12	3	14
ASO (SON)	****	****	A2	****	****	****	-8	-1	11	-14	-2	23
			A1B	****	****	****	-7	0	7	-9	0	22
			B1	****	****	****	-5	-1	8	-14	1	15

* indicates trend is statistically significant at 95% confidence

**** indicates data are not available

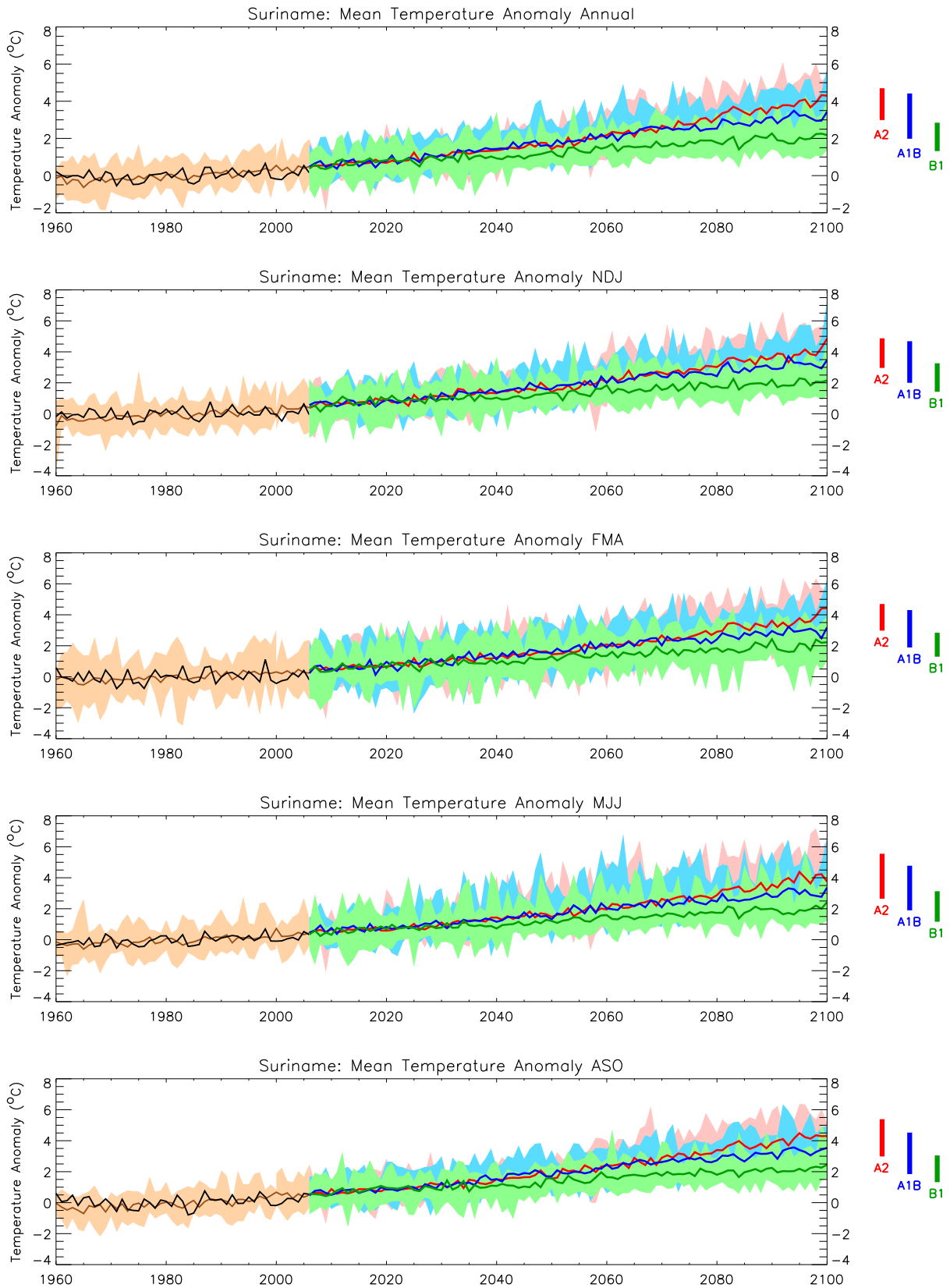


Figure 1: Trends in annual and seasonal mean temperature for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. Black curves show the mean of observed data from 1960 to 2006, Brown curves show the median (solid line) and range (shading) of model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

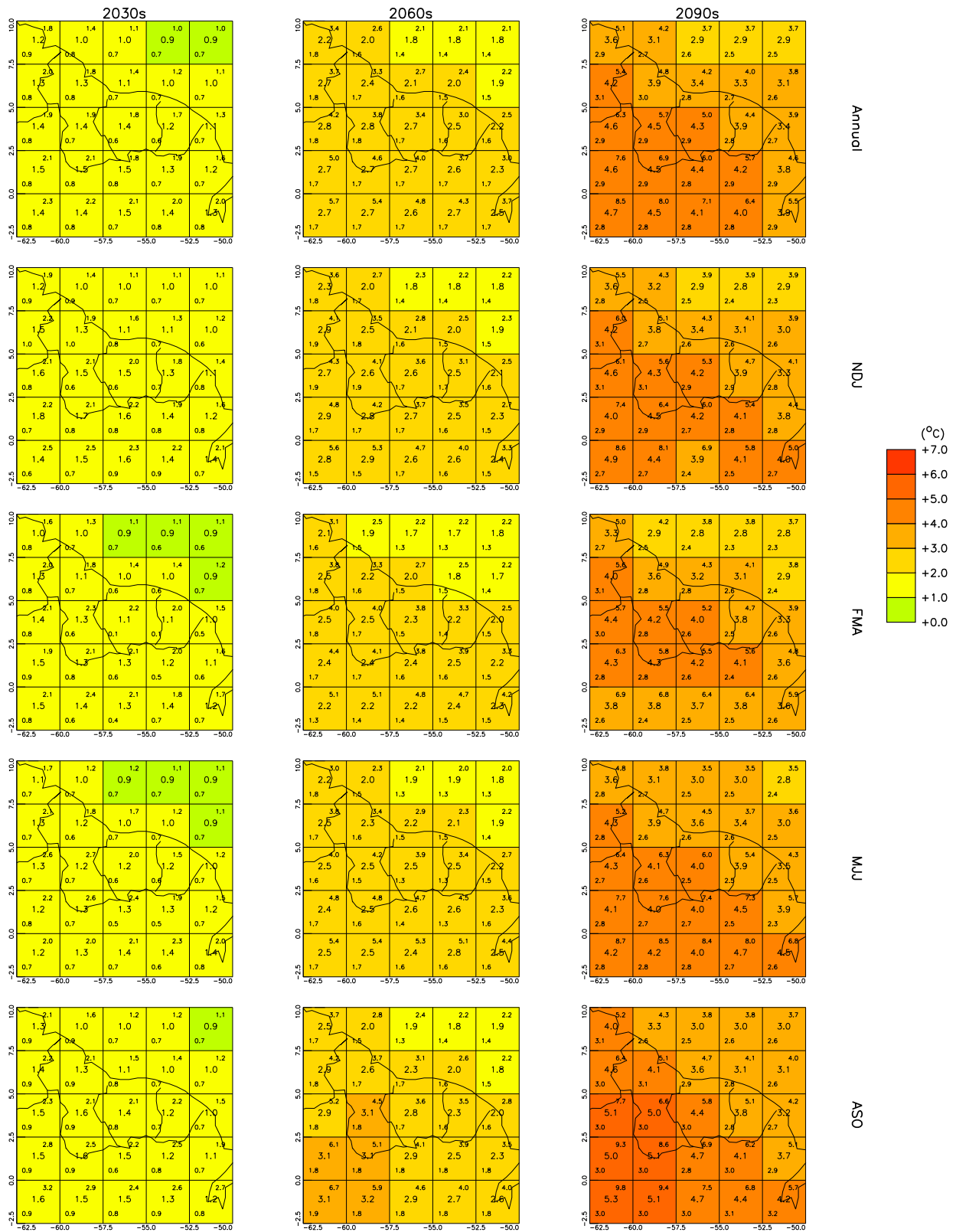


Figure 2: Spatial patterns of projected change in mean annual and seasonal temperature for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. In each grid box, the central value gives the ensemble median and the values in the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

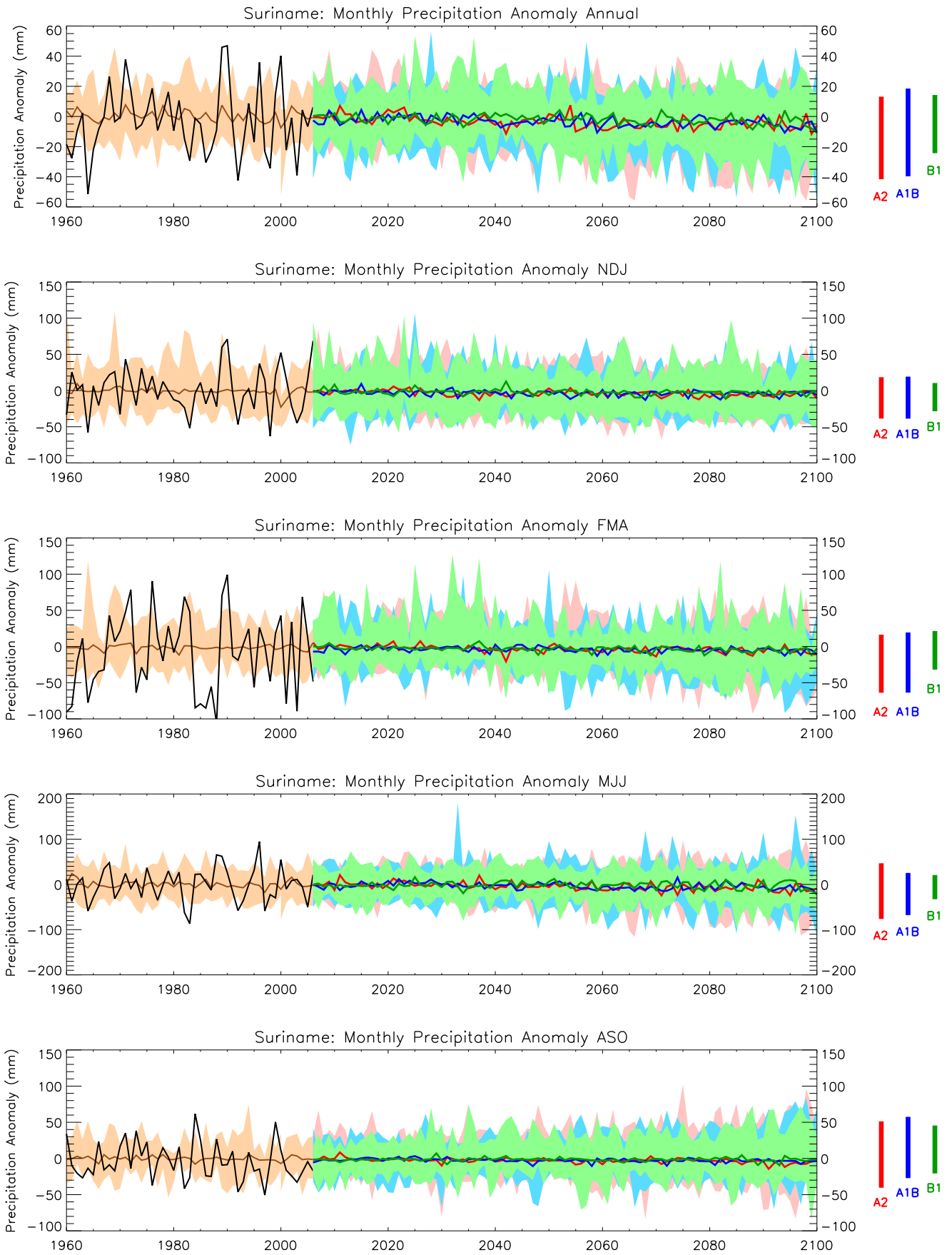


Figure 3: Trends in monthly precipitation for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

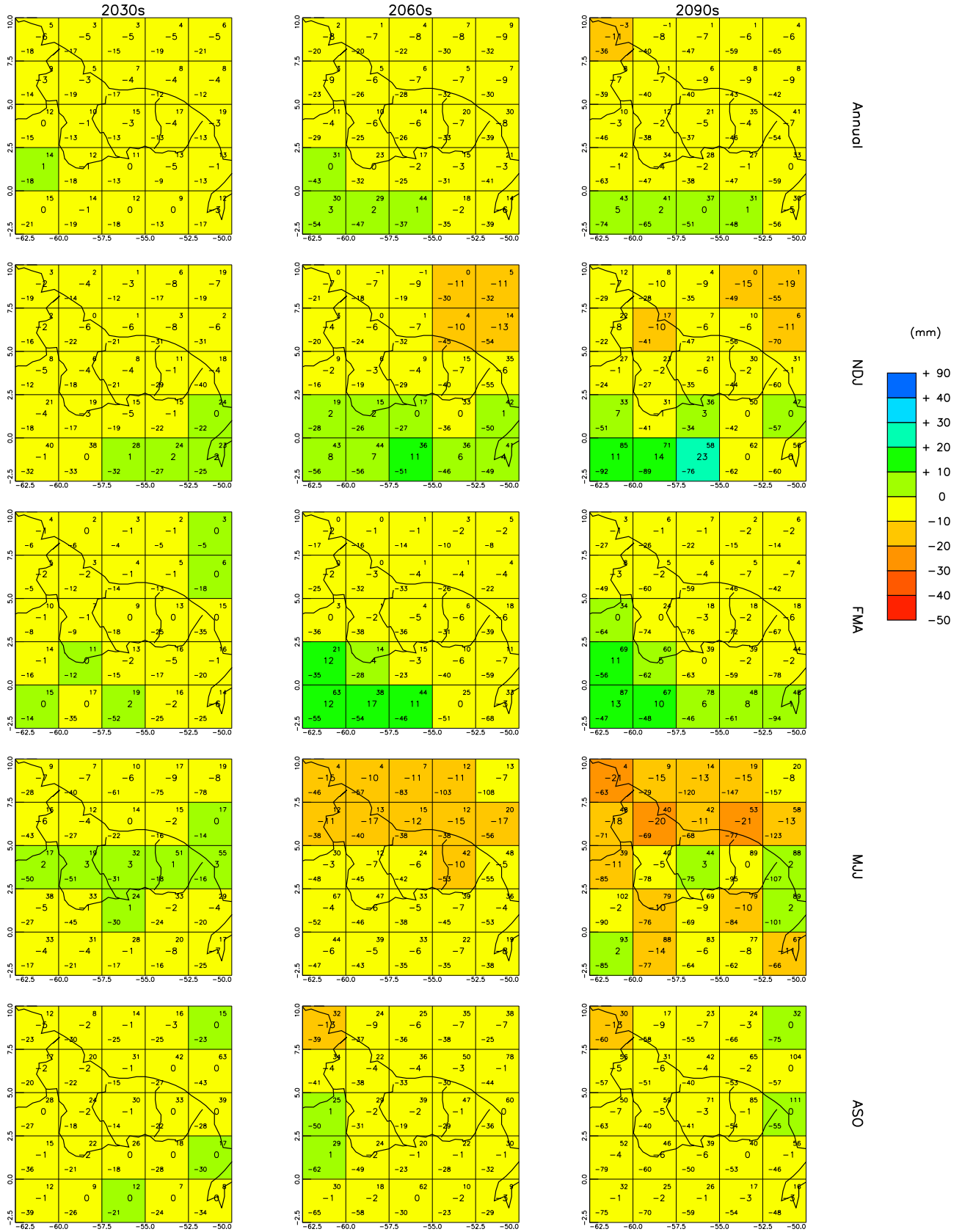


Figure 4: Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

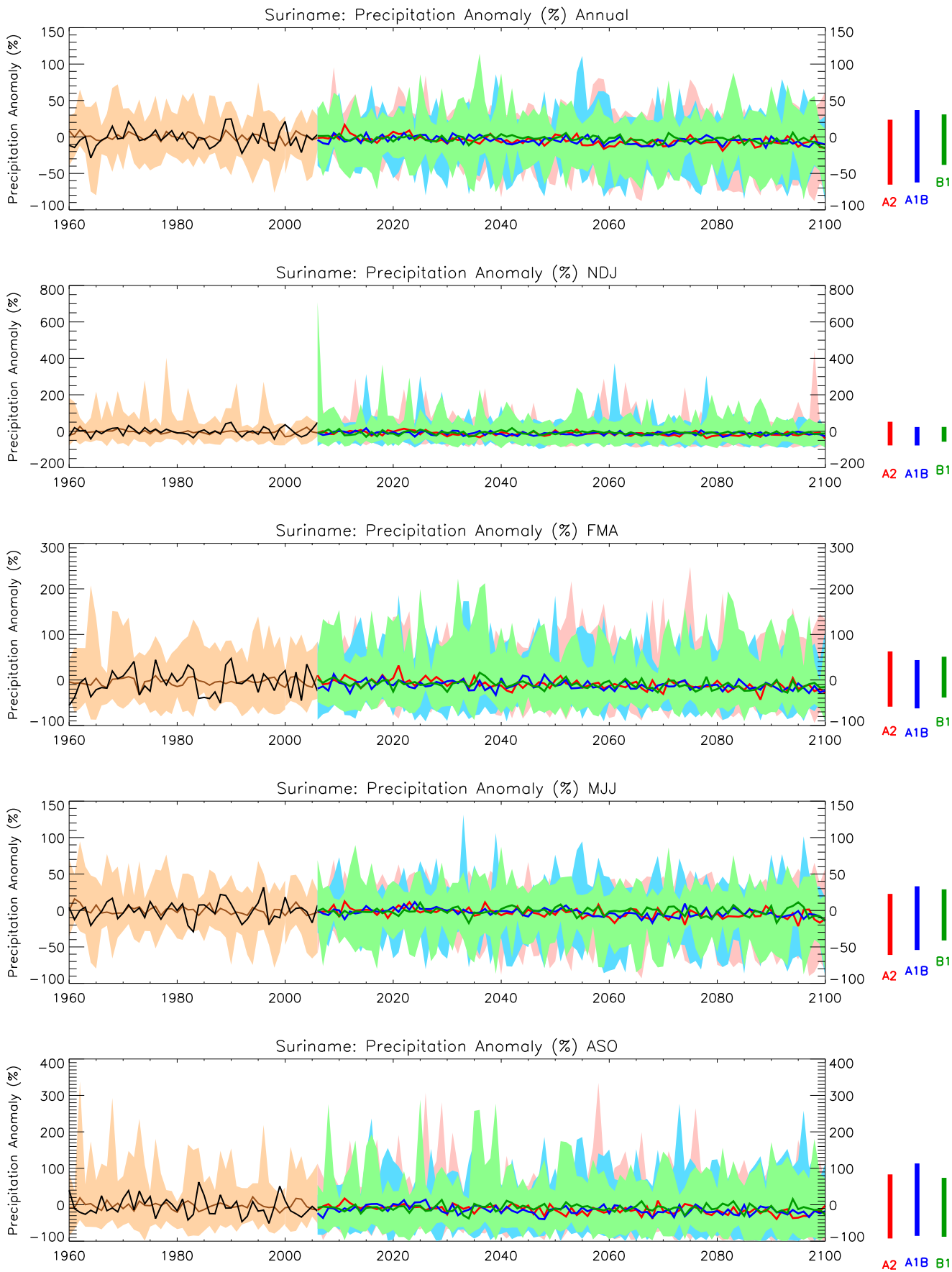


Figure 5: Trends in monthly precipitation for the recent past and projected future. All values shown are percentage anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

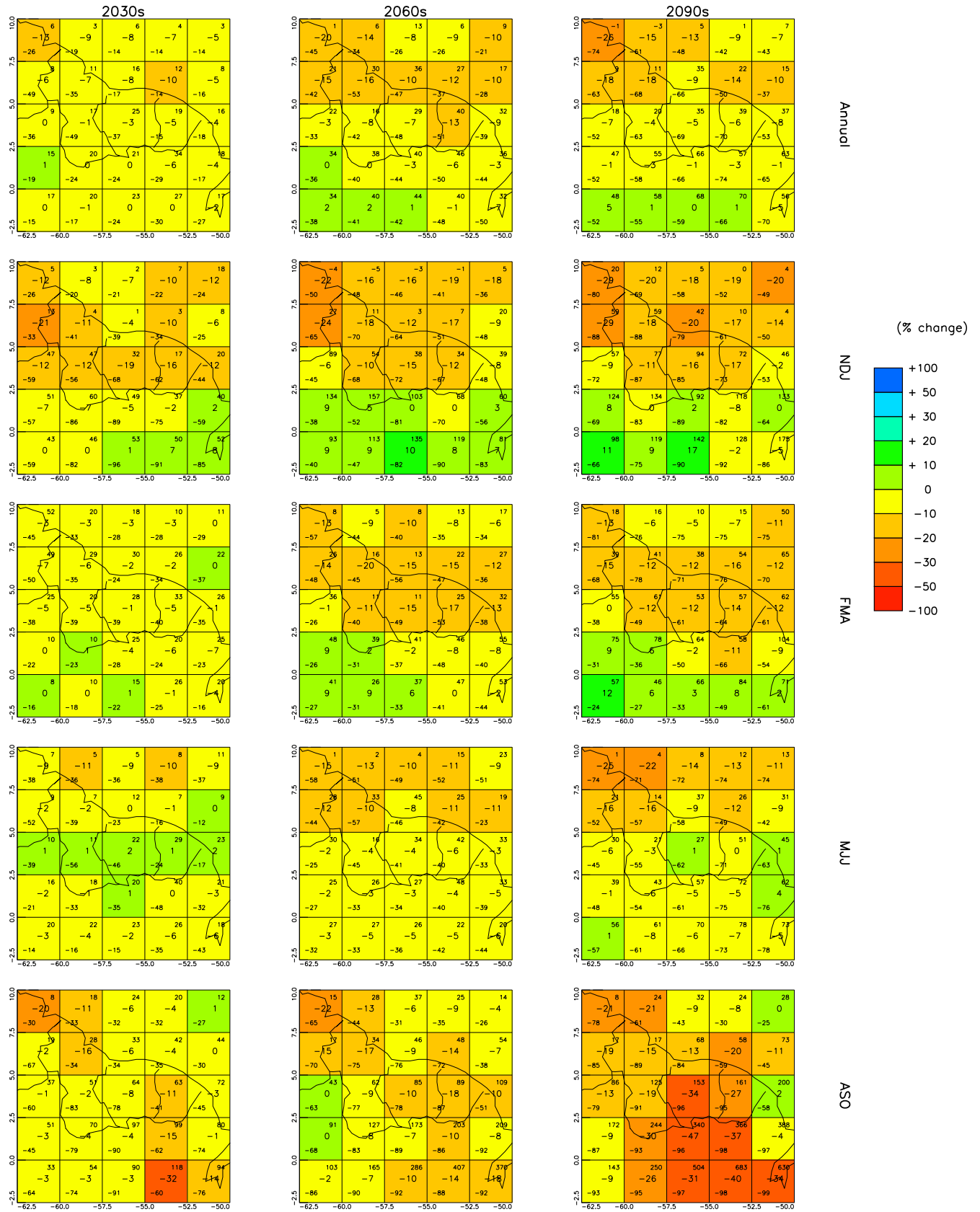


Figure 6: Spatial patterns of projected change in monthly precipitation for 10-year periods in the future under the SRES A2 scenario. All values are percentage anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

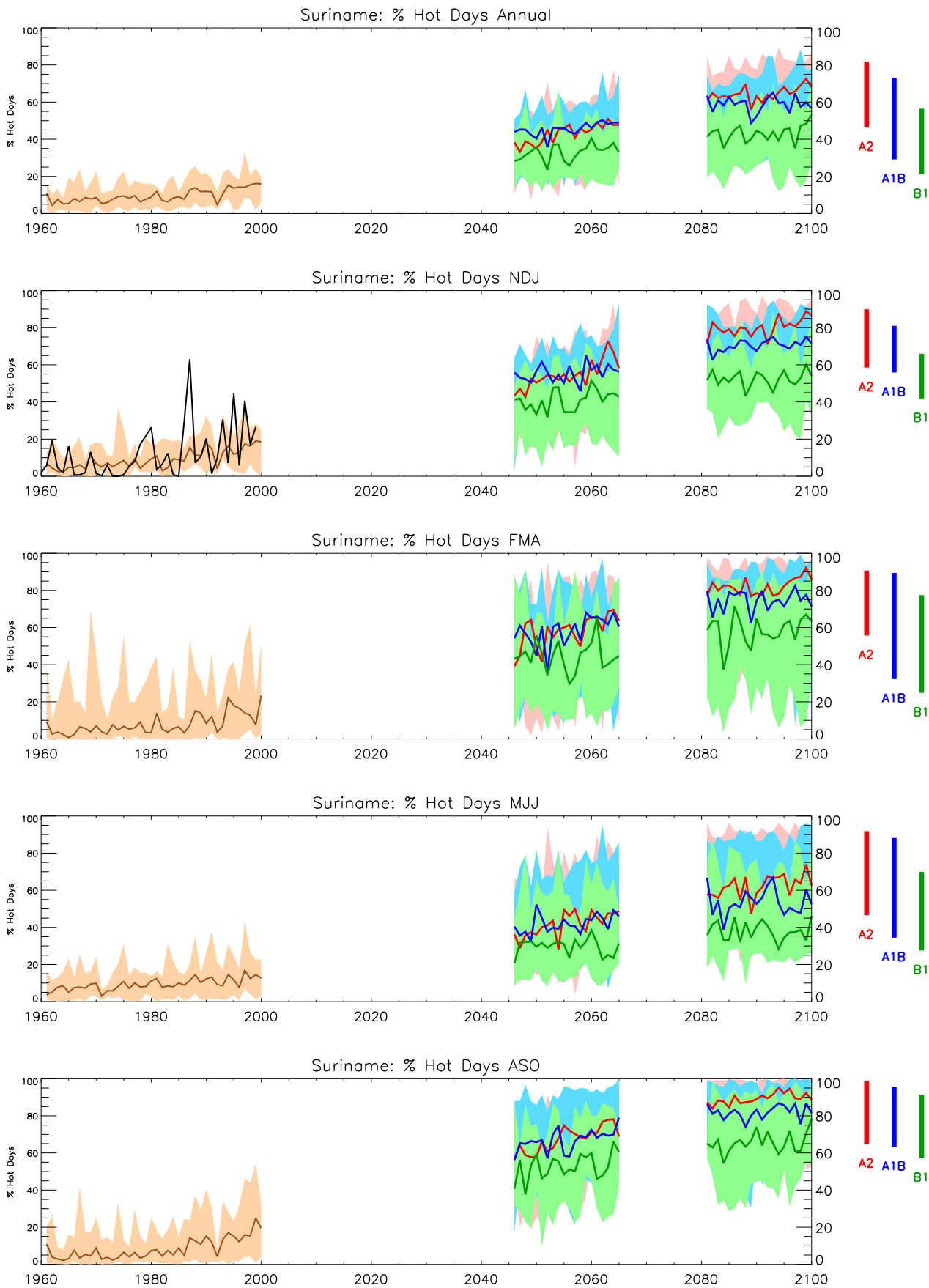


Figure 7: Trends in Hot-day frequency for the recent past and projected future. See Figure 1 for details.

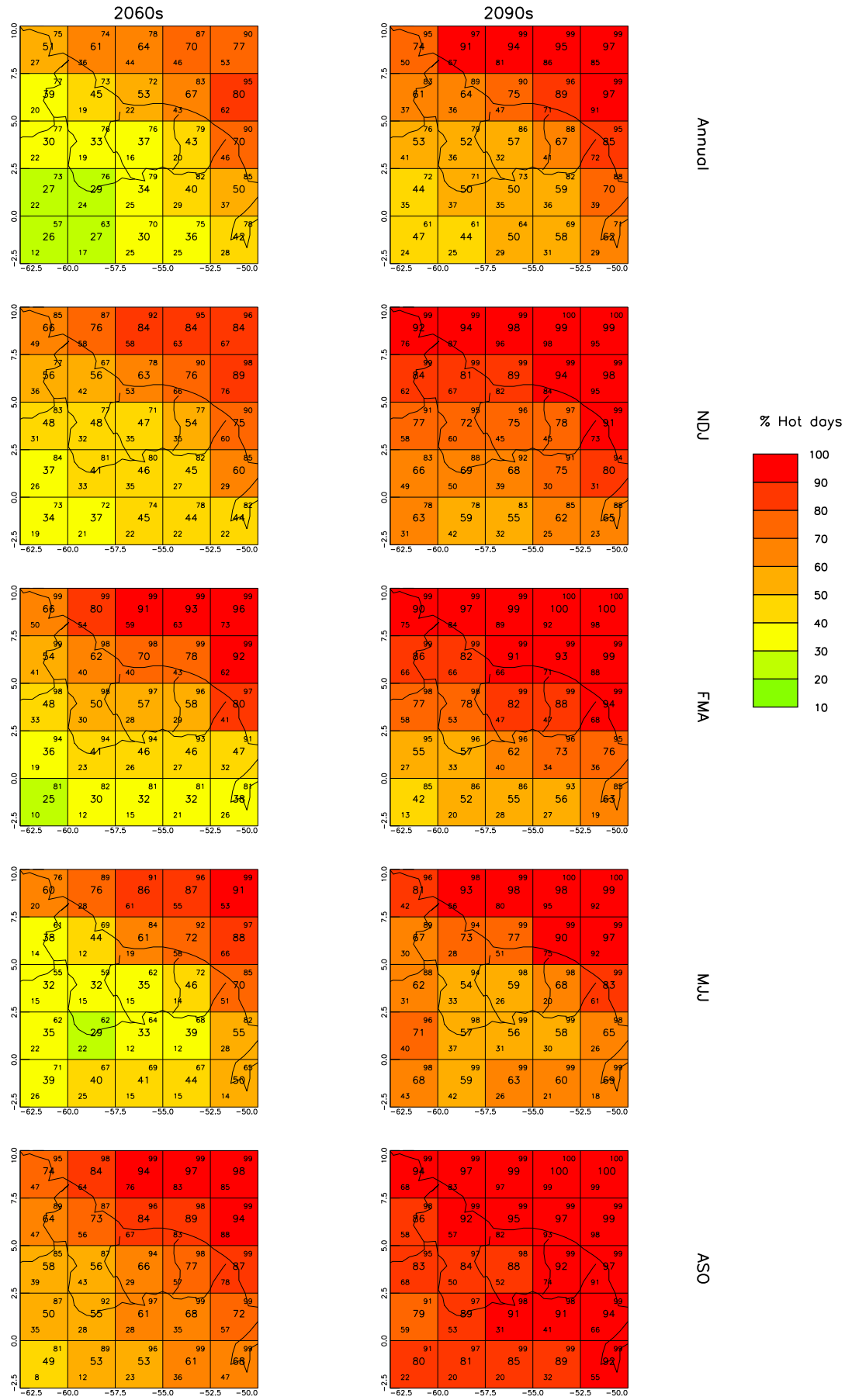


Figure 8: Spatial patterns of projected change in Hot-day frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

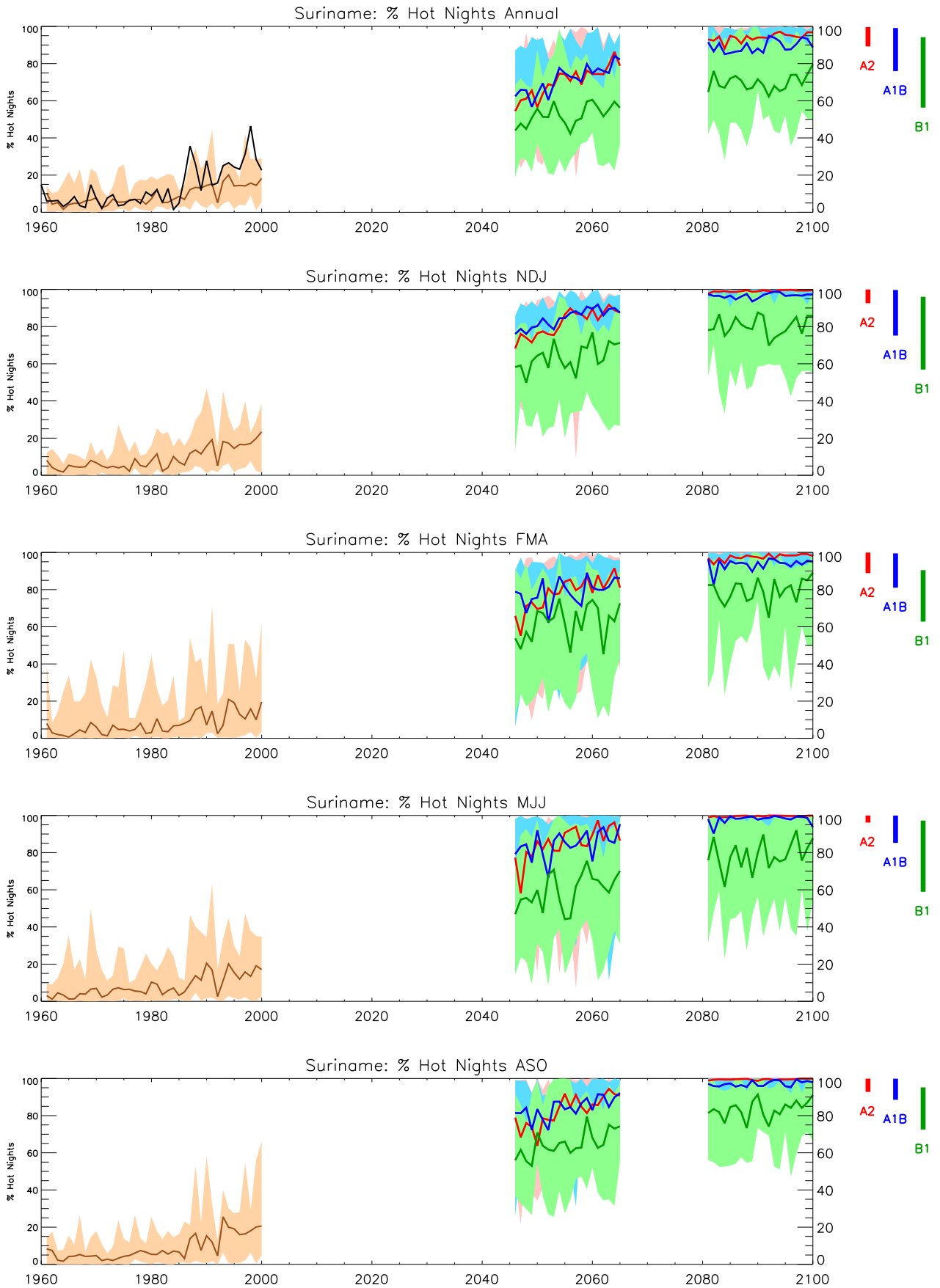


Figure 9: Trends in hot-night frequency for the recent past and projected future. See Figure 1 for details.

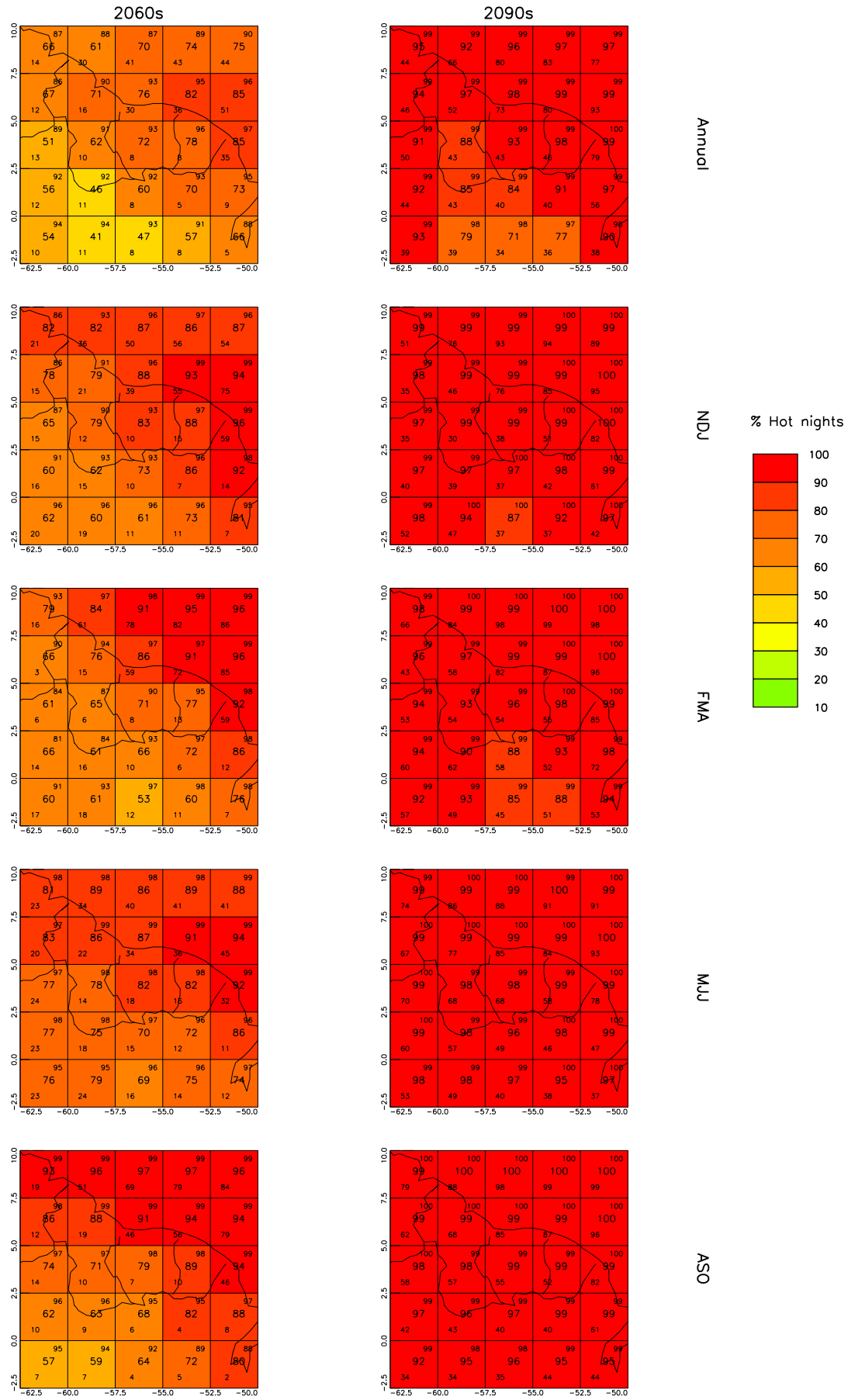


Figure 10: Spatial patterns of projected change in hot-night frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

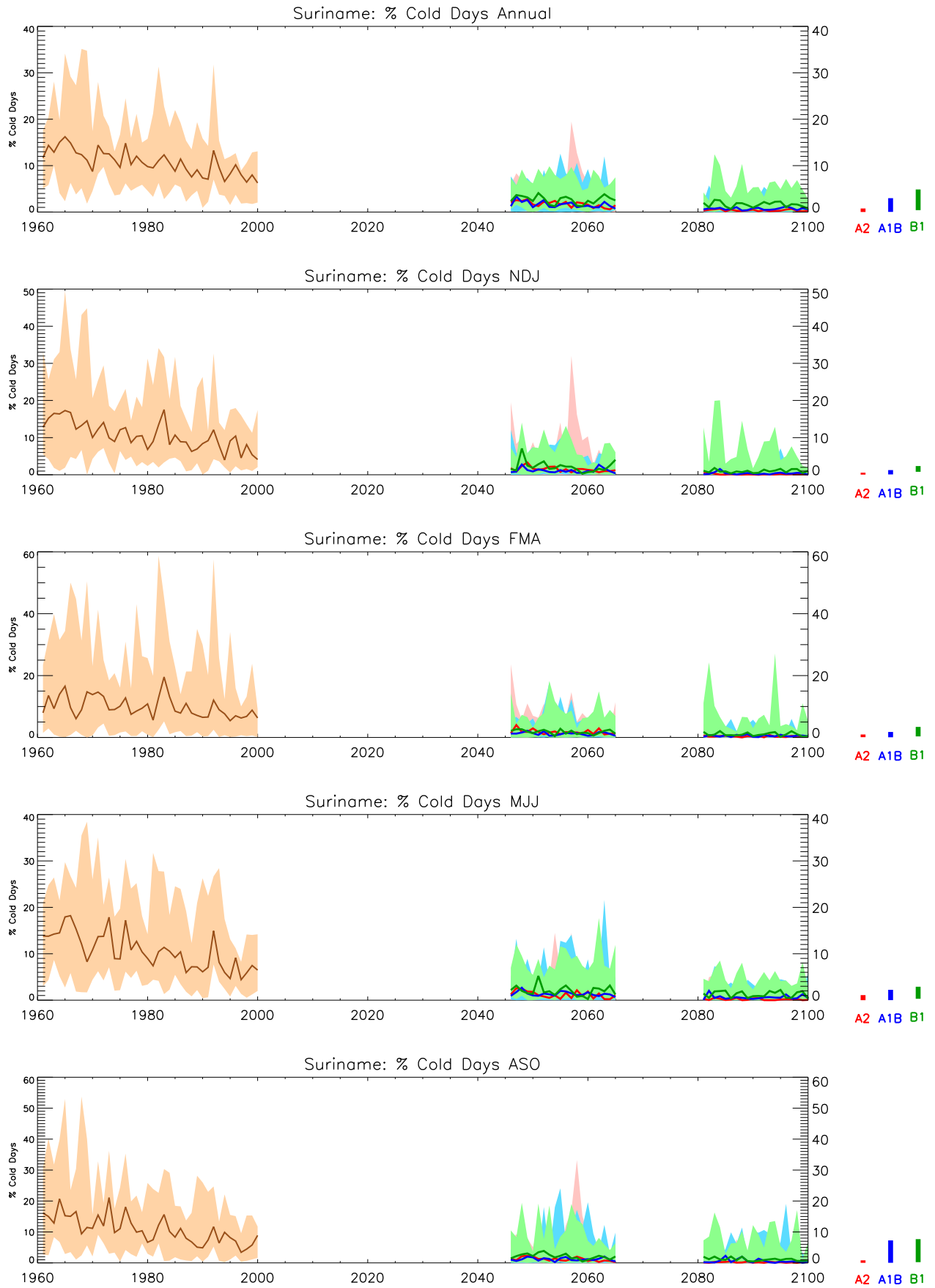


Figure 11: Trends in cold-day frequency for the recent past and projected future. See Figure 1 for details.

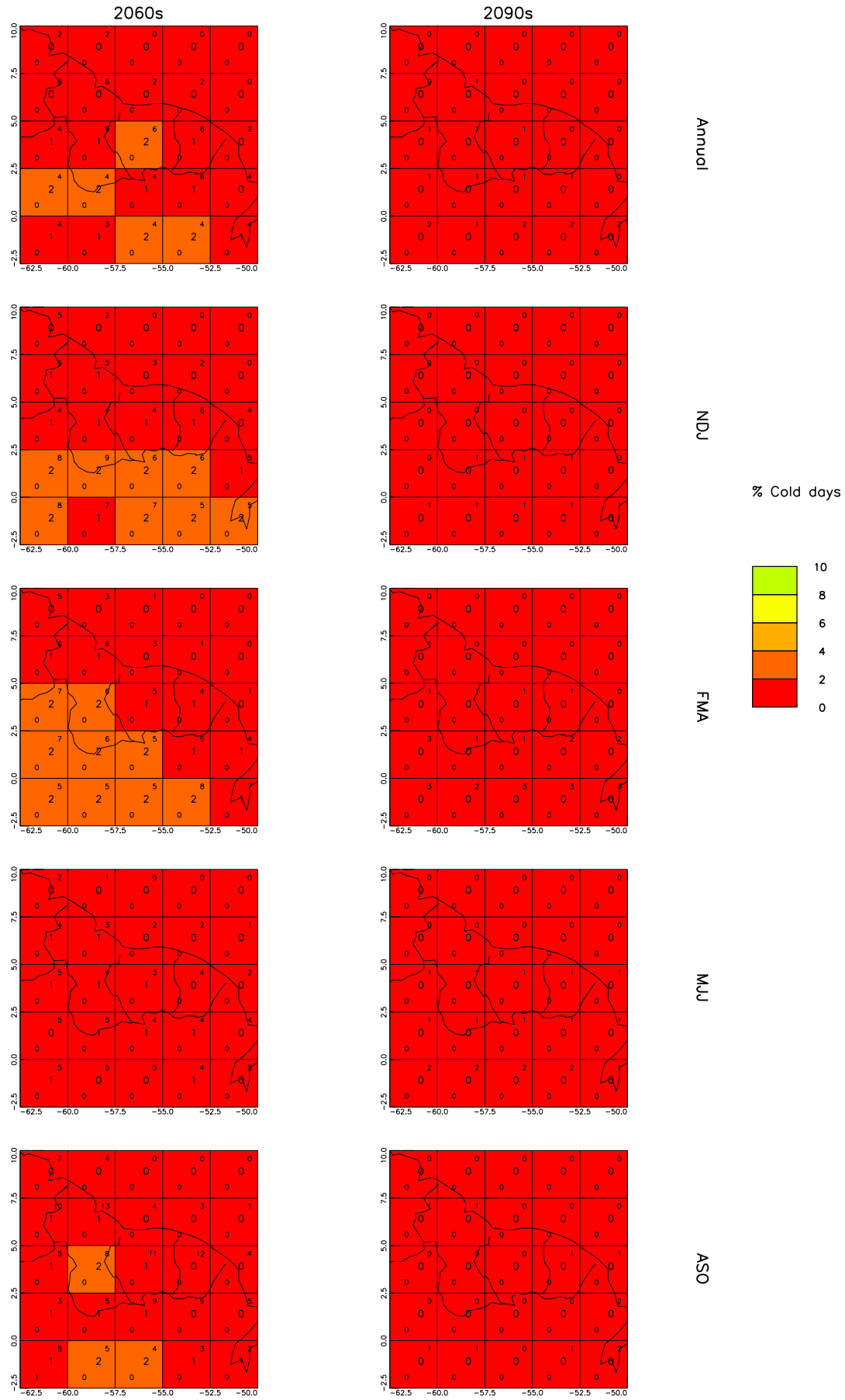


Figure 12: Spatial patterns of projected change in cold-day frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

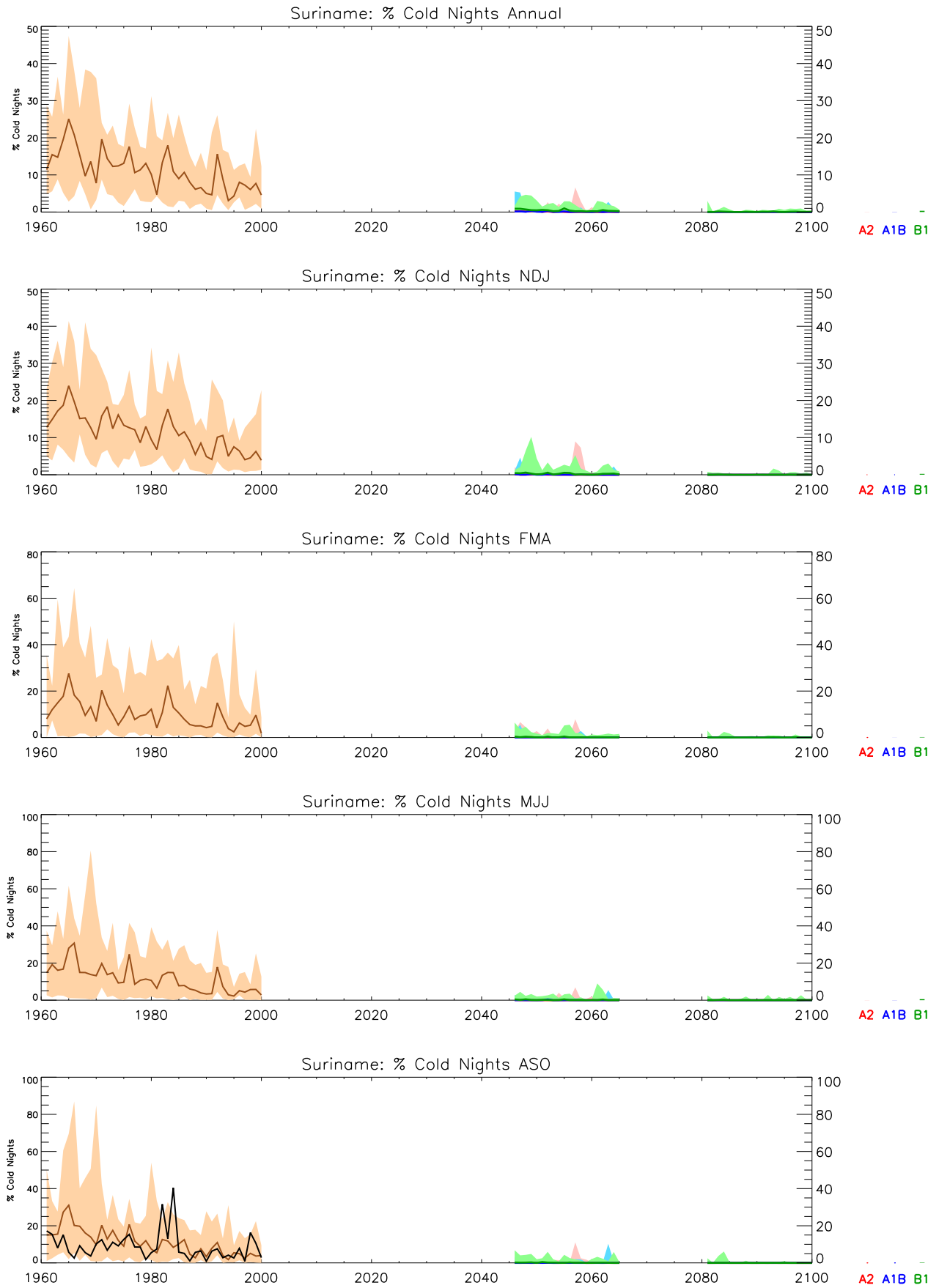


Figure 13: Trends in cold-night frequency for the recent past and projected future. See Figure 1 for details.

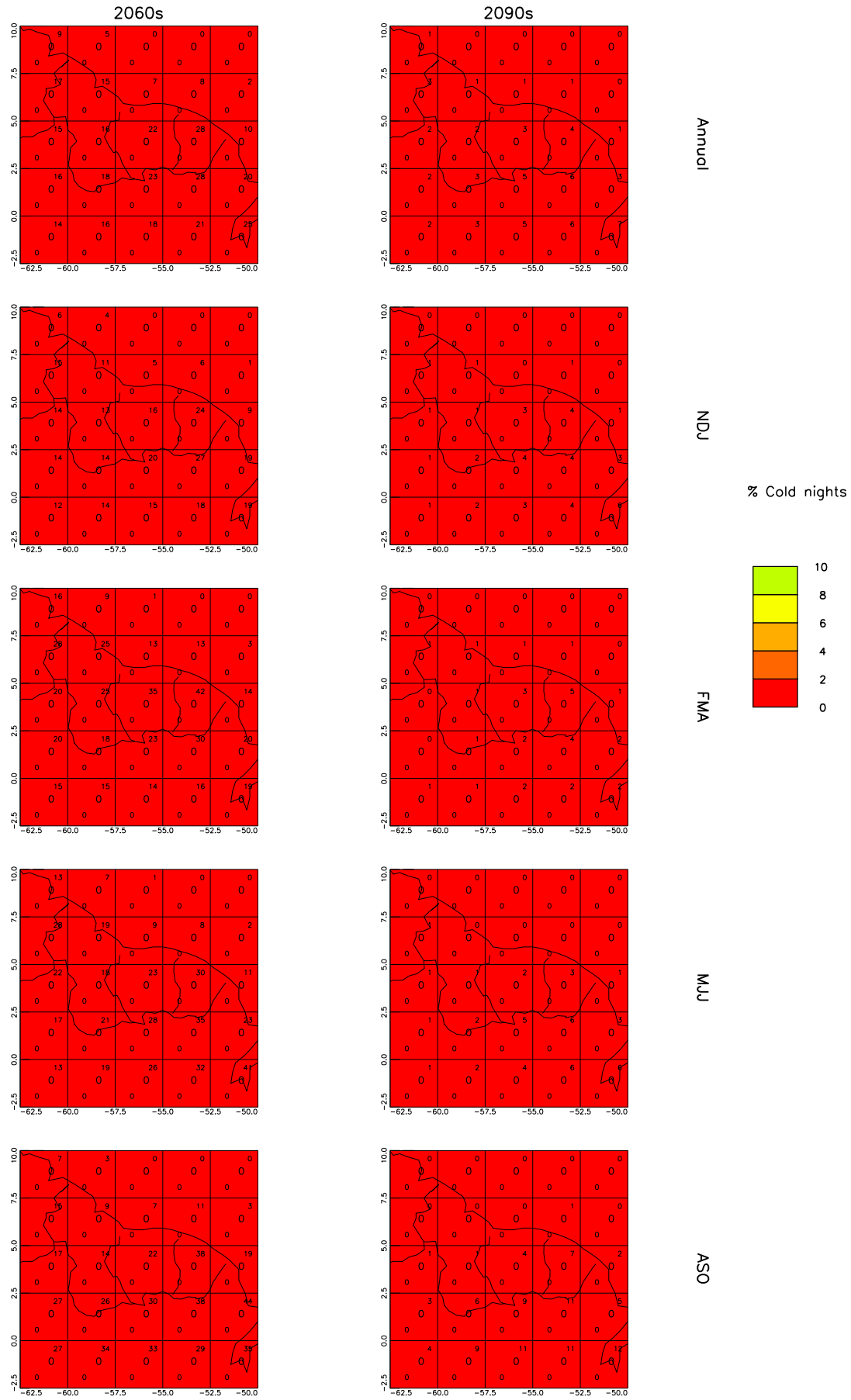


Figure 14: Spatial patterns of projected change in cold-night frequency for 10-year periods in the future under the SRES A2 scenario. See Figure 2 for details.

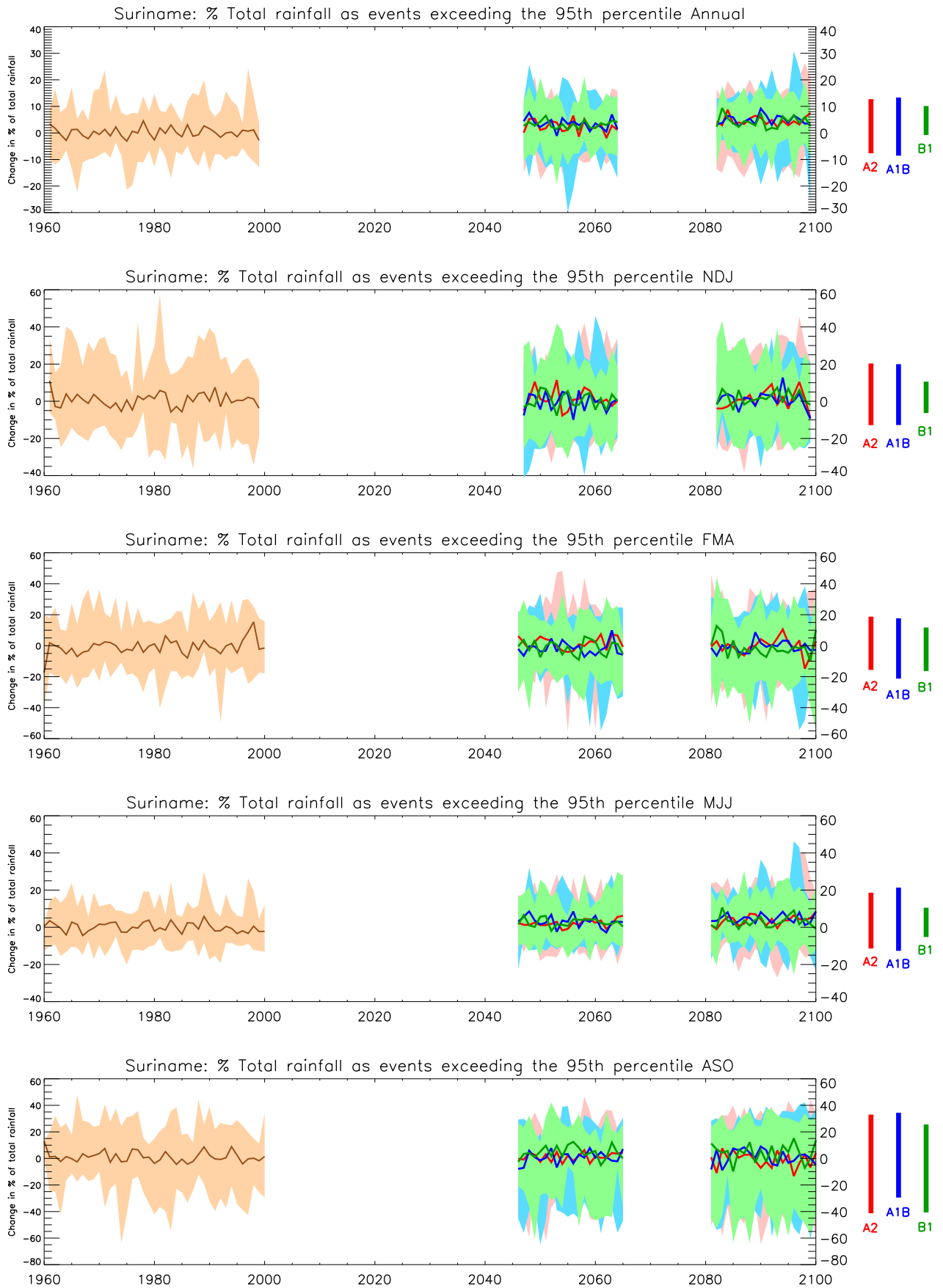


Figure 15: Trends in the proportion of precipitation falling in 'heavy' events for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

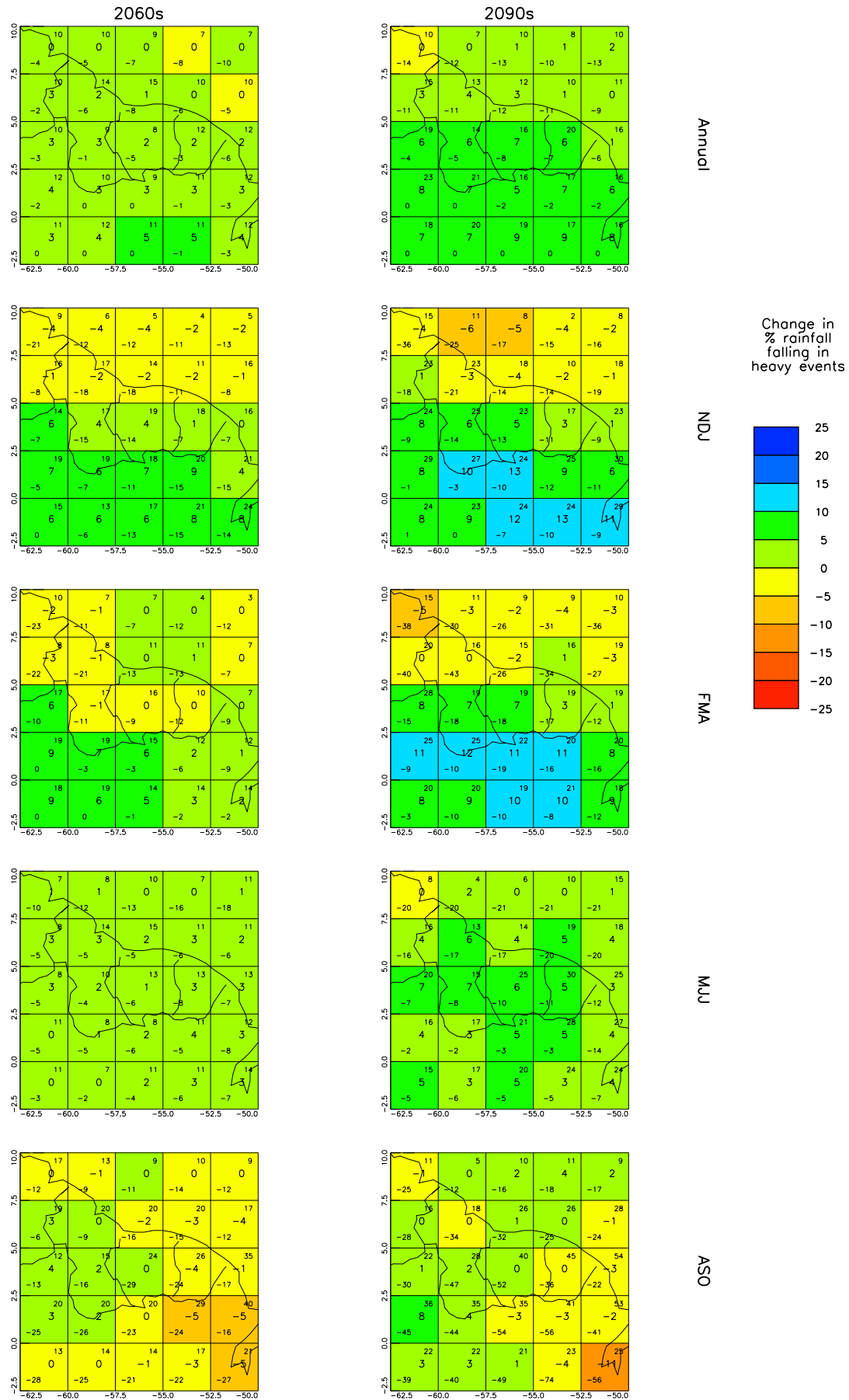


Figure 16: Spatial patterns of projected change in the proportion of precipitation falling in 'heavy' events for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

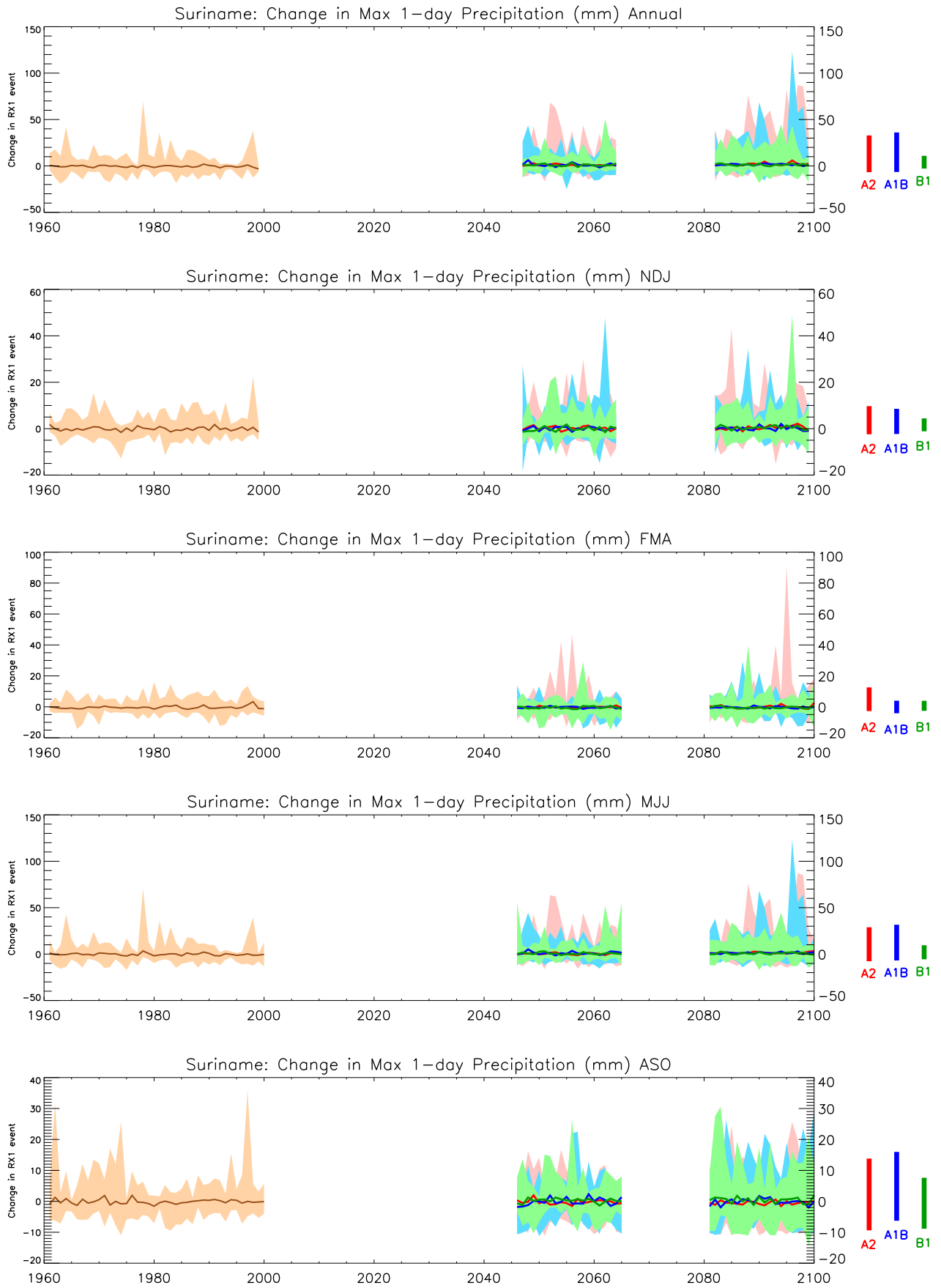


Figure 17: Trends in maximum 1-day rainfall for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

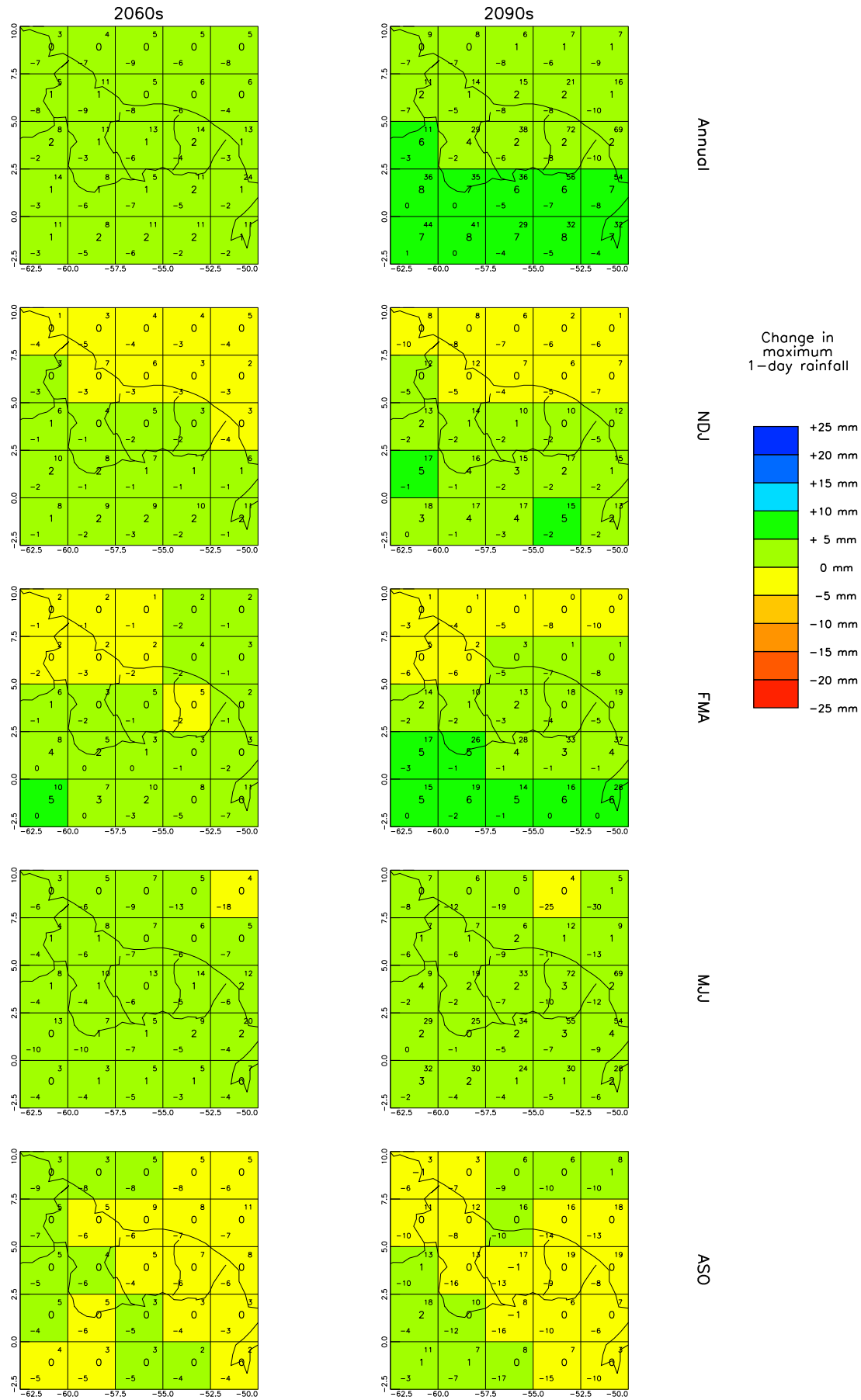


Figure 18: Spatial patterns of maximum 1-day rainfall for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.

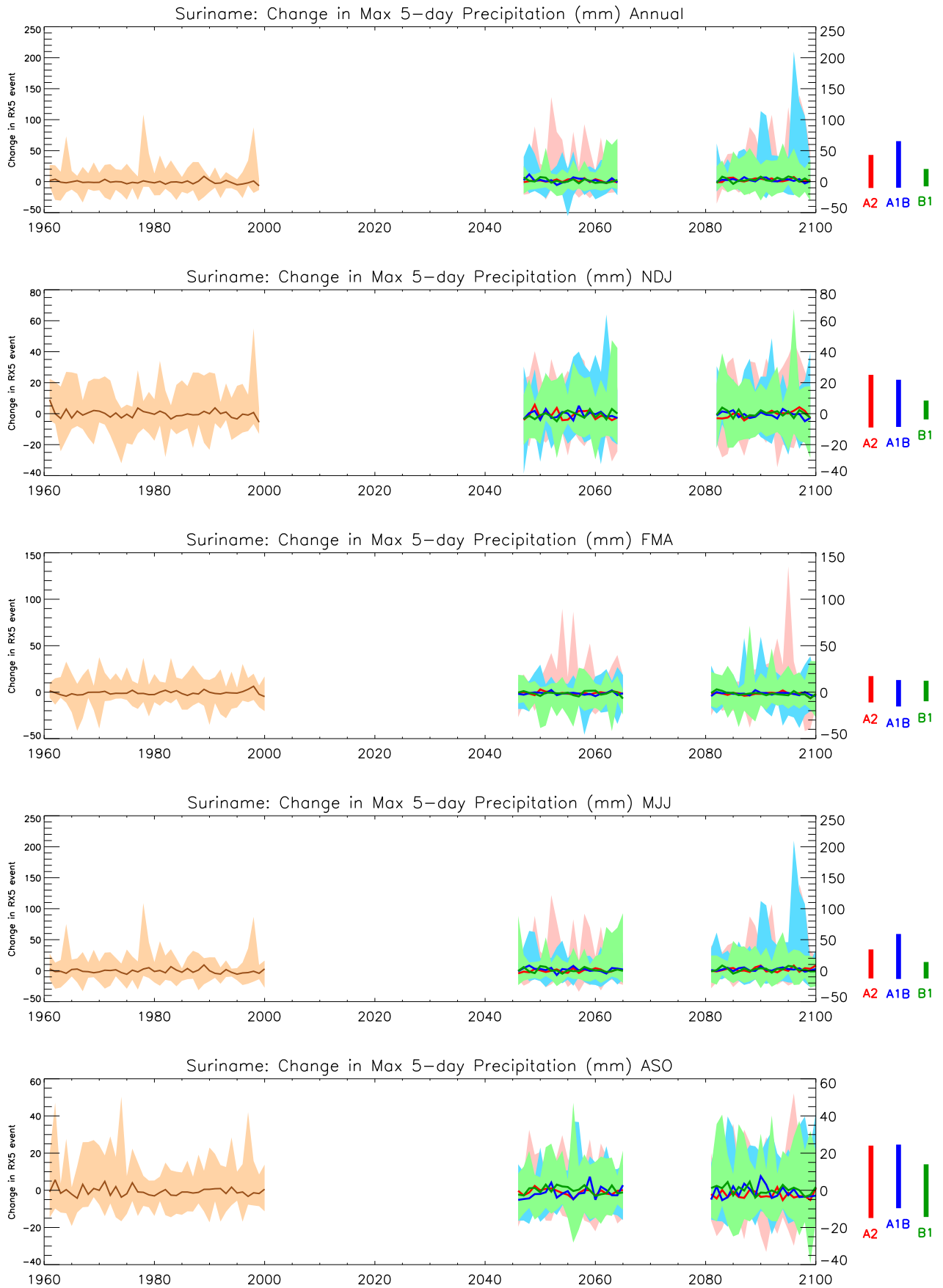


Figure 19: Trends in maximum 5-day rainfall for the recent past and projected future. All values shown are anomalies, relative to the 1970-1999 mean climate. See Figure 1 for details.

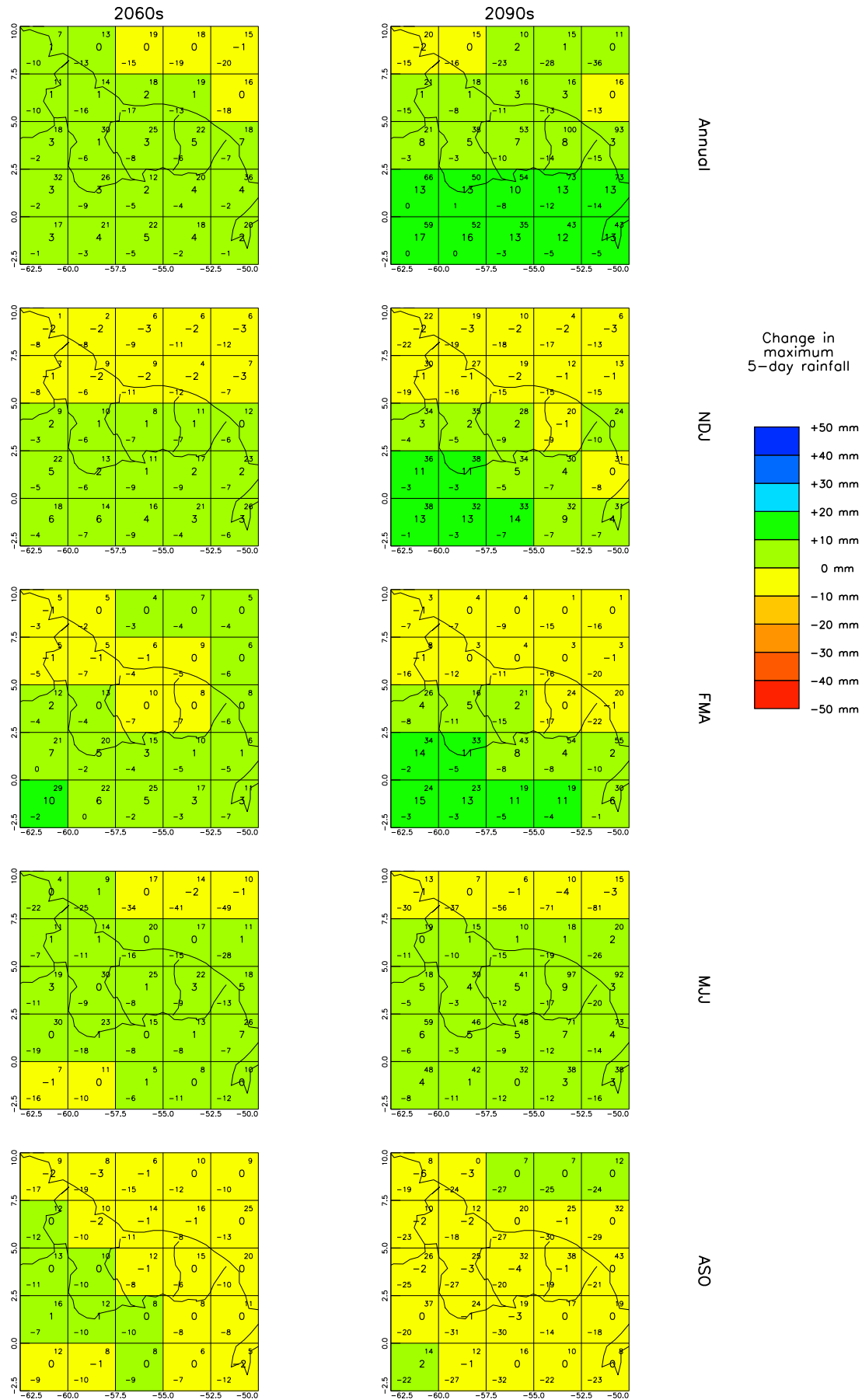


Figure 20: Spatial patterns of projected change in maximum 5-day rainfall for 10-year periods in the future under the SRES A2 scenario. All values are anomalies relative to the mean climate of 1970-1999. See Figure 2 for details.