Climate Change Information for Decision Making

T.A. Remenyi, N. Earl, P.T. Love, D.A. Rollins, R.M.B. Harris
Climate Futures Programme, Discipline of Geography & Spatial Sciences, University of Tasmania

THE PURPOSE OF THIS DOCUMENT

This document summarises key climate indices useful to operational council staff. The climate indices were selected in direct consultation with council personnel and reflect the operational, tactical and strategic climate information needs for decision makers within all of the local councils of southern Tasmania.

This document expands upon previously produced *local profiles* and has been developed to support decision making across Huon Valley's strategic, operational, service, adaptation and emergency management planning functions.

BACKGROUND

The Climate Change Information for Decision Making - Huon Valley has been developed using outputs from the *Climate Futures for Tasmania Project* and the *Climate Futures Australasian Projections 2019 data archive*, developed by the University of Tasmania's Climate Futures Programme.

All values are based on the projections generated by the Climate Futures Programme, using previously published results. Descriptive documentation and supporting reports can be found here: http://climatefutures.org.au. This document is to be reviewed and updated when more up-to-date information becomes available, or at 5-yearly intervals. It should be considered in conjunction with Huon Valley's policies and strategies, alongside technical and industry standards.

Values given are the multi-model mean from an ensemble of six downscaled global climate models based on the *business as usual* high emissions scenario RCP8.5 (the scenario human society is currenty most closely following). Averaging across the ensemble smooths out the inter-annual variability, revealing the forced climate response. For most variables, the range between climate models is not large relative to the percent change projected into the future.

In order to capture the regional variability, the data were separated into *cool* ($< 25^{th}$ percentile), *average* (between the 25^{th} and 75^{th} percentile) or *warm* ($> 75^{th}$ percentile) grid cells, based on average temperature during the baseline period, 1961–1990. These three groups of values were then analysed and presented separately. This provides councils with greater utility when mangaing a diverse landscape (NB: municiaplities with small spatial extents have limited differences captured across the municipality at $10km^2$ resolution). It is the responsibility of the user to determine which values may be most appropriate for a given application. For example, if building a road over Vinces Saddle, it would be more useful to apply values from the cooler table, whereas for estimating future high-intensity rainfall within Kingston CBD, values from the warmer table would be more appropriate.

CURRENT CLIMATE AND RECENT TRENDS

All Tasmanian municipalities have a temperate, maritime climate with relatively mild winters at low elevations, transitioning towards warm alpine winters at higher elevations. Long-term average temperatures have risen in the decades since the 1950s at a rate of up to 0.1 °C per decade, with this rate expected to increase from 2020 onwards.

Despite covering small geographic areas all municipalities experience marked rainfall gradients, with average annual rainfall from about 600 mm per year at lower elevations and about 1500 mm per year at higher elevations. There has been a decline in average annual rainfall since the mid 1970s, and this decline has been strongest in autumn and enhanced over higher elevation regions.

EXTREME EVENTS

The changes in climate that are most likely to impact upon the each municipality's infrastructure, roads, the local community and the environment are an increase in intensity of extreme events. Potential impacts by 2100 are as follows (following the *business as usual* high emissions scenario RCP8.5):

- Increased evaporation and longer dry periods coupled with more extreme temperatures are likely to enhance the occurrence and intensity of bushfires.
- The frequency of extremely hot days (> 40°C) is projected to increase. Heat wave frequency is projected to remain stable, but will increase in intensity (warmer days and nights).
- The Annual Exceedance Probability (AEP) is a measure of the rarity of an event. Rainfall AEPs are expressed as the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year. Heavier rainfall events are expected within a warmer climate. High daily runoff events are likely to increase, including those that may lead to erosion or flooding.
- Inundation along all coastal frontage will increase due to sea level rise. This means the coastal indunation AEP values for all probability events will increase in intensity. The current 100-year coastal inundation event may become a 50-year event by 2030, and a 5-year event by 2090.

Table 1: **Huon Valley local government area: *Cool subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	8.7	9.2	0.5	5.7	9.7	1	11.9	10.4	1.7	19.5	11.1	2.4	28.3	11.8	3.1	35.7
Average daily maximum temperature (°C)	12.9	13.4	0.5	4.2	14	1.1	8.9	14.7	1.9	14.6	15.6	2.7	21	16.2	3.4	26.2
Average daily minimum temperature (°C)	4.5	4.9	0.4	9.9	5.4	0.9	20.4	6	1.5	33.7	6.7	2.2	49.1	7.3	2.8	62.8
Hottest daily temperature of the year (°C)	32.4	33.2	0.8	2.5	34.1	1.8	5.4	35.1	2.7	8.3	36	3.6	11.1	36.4	4	12.3
Temperature of warmest days [99^{th} percentile] (°C)	27.8	28.6	0.8	2.9	29.4	1.6	5.8	30.6	2.7	9.8	31.8	4	14.4	32.2	4.4	15.8
Temperature of warmest nights [99^{th} percentile] (°C)	13.2	13.7	0.5	3.8	14.1	0.9	7.2	14.7	1.5	11.5	15.4	2.2	16.9	15.7	2.6	19.6
Temperature of coldest nights [1^{st} percentile] (°C)	-2.7	-2.4	0.3	11.3	-2	0.7	24.6	-1.5	1.2	43.4	-0.9	1.8	68.1	-0.3	2.4	90.1
Average annual frost risk days (<2°C)	90	76	-14	-15.6	64	-26	-28.7	49	-41	-45.6	35	-55	-60.8	25	-65	-72.4
Average annual freeze risk days (<0°C)	34	26	-8	-23	21	-13	-39.1	14	-20	-58.8	9	-25	-74.9	5	-29	-85
Average annual summer days (>25°C)	8	10	2	24	13	4	50.8	15	7	78.2	18	10	117.8	20	12	145
Average annual hot days (>30°C)	2	2	1	37.5	3	2	104.6	5	3	207.4	7	5	354	8	7	448.8
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	47100	56100	9000	19.1	67600	20500	43.5	84800	37700	80	111400	64300	136.5	140300	93200	197.9
Average annual evaporation (mm)	724	741	16	2.2	777	52	7.2	819	95	13.1	867	143	19.7	937	212	29.3
Average annual rainfall (mm)	1642	1573	-69	-4.2	1522	-120	-7.3	1512	-129	-7.9	1492	-150	-9.1	1587	-55	-3.3
Seasonal rainfall - Winter (mm)	587	577	-10	-1.7	563	-24	-4.1	583	-4	-0.7	585	-2	-0.3	628	41	7
Seasonal rainfall - Spring (mm)	412	397	-16	-3.8	363	-49	-11.9	358	-54	-13.2	363	-49	-11.9	350	-62	-15.1
Seasonal rainfall - Summer (mm)	283	261	-21	-7.5	269	-14	-4.9	256	-27	-9.4	234	-49	-17.3	258	-25	-8.9
Seasonal rainfall - Autumn (mm)	385	373	-12	-3.2	362	-24	-6.1	349	-36	-9.3	344	-41	-10.8	370	-15	-3.9
Annual maximum daily rainfall (mm)	118	123	5	4	131	13	11.1	132	14	11.6	130	12	9.9	157	39	32.8
Rainfall Extreme - 24hr 10% AEP (mm)[a]	158	162	4	2.5	166	8	5.3	171	14	8.7	177	20	12.6	182	25	15.8
Rainfall Extreme - 24hr 5% AEP (mm)[a]	184	189	5	2.5	194	10	5.3	200	16	8.7	207	23	12.6	213	29	15.8
Rainfall Extreme - 24hr 1% AEP (mm)[a]	245	251	6	2.5	258	13	5.3	266	21	8.7	276	31	12.6	284	39	15.8
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	275	282	7	2.5	290	15	5.3	299	24	8.7	310	35	12.6	319	44	15.8
Rainfall Extreme - 48hr 10% AEP (mm)[a]	209	214	5	2.5	220	11	5.3	227	18	8.7	235	26	12.6	242	33	15.8
Rainfall Extreme - 48hr 5% AEP (mm)[a]	240	246	6	2.5	253	13	5.3	261	21	8.7	270	30	12.6	278	38	15.8
Rainfall Extreme - 48hr 1% AEP (mm)[a]	320	328	8	2.5	337	17	5.3	348	28	8.7	360	40	12.6	371	51	15.8
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	360	369	9	2.5	379	19	5.3	391	31	8.7	405	45	12.6	417	57	15.8
Average annual cummulative Forest Fire Danger Index	415	439	24	5.7	473	58	14	508	93	22.4	559	144	34.7	598	183	44
Sea level - 1% AEP with Freeboard (m)[b]	1.57	1.65	0.08	5.1	1.72	0.15	9.6	1.8	0.23	14.6	2.08	0.51	32.5	2.5	0.93	59.2

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 2: **Huon Valley local government area:** ***Average subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	10.3	10.8	0.5	5.2	11.4	1.1	10.6	12.1	1.8	17.8	12.9	2.7	25.9	13.7	3.4	33
Average daily maximum temperature (°C)	14.5	15.1	0.6	4	15.7	1.2	8.3	16.5	2	13.8	17.4	2.9	20	18.2	3.7	25.3
Average daily minimum temperature (°C)	6	6.5	0.5	8.1	7	1	16.3	7.7	1.7	27.4	8.5	2.4	40	9.2	3.1	51.3
Hottest daily temperature of the year (°C)	34.8	35.5	0.8	2.2	36.5	1.7	4.9	37.3	2.5	7.1	38.4	3.6	10.5	38.9	4.1	11.9
Temperature of warmest days [99^{th} percentile] (°C)	29	29.8	0.9	3	30.6	1.6	5.7	31.8	2.9	9.9	33.1	4.1	14.2	33.5	4.5	15.6
Temperature of warmest nights [99^{th} percentile] (°C)	14.2	14.7	0.5	3.8	15.2	1	7.2	15.9	1.7	12	16.7	2.5	17.3	17.2	3	21
Temperature of coldest nights [1^{st} percentile] (°C)	-1.4	-1	0.3	24.6	-0.7	0.7	51.9	-0.1	1.2	91.3	0.6	1.9	141	1.2	2.5	185.8
Average annual frost risk days (<2°C)	45	35	-10	-21.9	28	-17	-37.6	19	-25	-57	12	-32	-72.2	8	-37	-82.2
Average annual freeze risk days (<0°C)	13	9	-3	-27.7	7	-6	-46	4	-8	-66.4	2	-10	-82.1	1	-11	-90
Average annual summer days (>25°C)	10	13	2	21.5	15	5	44.2	18	7	68.5	21	11	105.8	24	14	134.3
Average annual hot days (>30°C)	2	3	1	37.1	5	2	89.4	7	4	173.3	10	7	283.7	12	9	371.1
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	85900	104100	18200	21.2	127000	41100	47.8	164200	78300	91.2	222200	136300	158.7	289200	203300	236.7
Average annual evaporation (mm)	809	835	26	3.2	870	62	7.6	933	124	15.4	998	189	23.4	1097	288	35.6
Average annual rainfall (mm)	1868	1791	-78	-4.2	1738	-130	-7	1727	-141	-7.6	1705	-163	-8.7	1793	-76	-4
Seasonal rainfall - Winter (mm)	681	670	-12	-1.7	661	-20	-3	678	-3	-0.4	684	3	0.4	724	43	6.3
Seasonal rainfall - Spring (mm)	462	443	-19	-4.1	407	-55	-11.9	403	-59	-12.8	409	-53	-11.5	395	-67	-14.5
Seasonal rainfall - Summer (mm)	305	281	-24	-7.8	281	-24	-7.8	269	-36	-11.7	245	-60	-19.6	264	-41	-13.4
Seasonal rainfall - Autumn (mm)	450	437	-13	-2.8	429	-21	-4.7	416	-34	-7.6	406	-44	-9.7	432	-17	-3.8
Annual maximum daily rainfall (mm)	118	123	5	4	131	13	11.1	132	14	11.6	130	12	9.9	157	39	32.8
Rainfall Extreme - 24hr 10% AEP (mm)[a]	157	162	4	2.8	166	9	5.6	172	15	9.4	179	21	13.7	185	27	17.4
Rainfall Extreme - 24hr 5% AEP (mm)[a]	184	189	5	2.8	194	10	5.6	201	17	9.4	209	25	13.7	215	32	17.4
Rainfall Extreme - 24hr 1% AEP (mm)[a]	244	251	7	2.8	258	14	5.6	267	23	9.4	278	33	13.7	287	43	17.4
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	274	282	8	2.8	290	15	5.6	300	26	9.4	312	37	13.7	322	48	17.4
Rainfall Extreme - 48hr 10% AEP (mm)[a]	209	214	6	2.8	220	12	5.6	228	20	9.4	237	28	13.7	245	36	17.4
Rainfall Extreme - 48hr 5% AEP (mm)[a]	240	246	7	2.8	253	13	5.6	262	23	9.4	272	33	13.7	281	42	17.4
Rainfall Extreme - 48hr 1% AEP (mm)[a]	319	328	9	2.8	337	18	5.6	350	30	9.4	363	44	13.7	375	56	17.4
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	359	369	10	2.8	379	20	5.6	393	34	9.4	408	49	13.7	421	62	17.4
Average annual cummulative Forest Fire Danger Index	508	534	26	5.1	575	67	13.2	619	111	21.8	684	176	34.7	730	223	43.8
Sea level - 1% AEP with Freeboard (m)[b]	1.57	1.65	0.08	5.1	1.72	0.15	9.6	1.8	0.23	14.6	2.08	0.51	32.5	2.5	0.93	59.2

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated* 14^{th} *May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Table 3: **Huon Valley local government area: *Warm subregions***
Projected changes in selected climate variables for each 20-year time period from 2001 to 2100 relative to the baseline period 1961–1990. All values are reported following the RCP8.5 emissions scenario. Changes reported relative to the 1961-1990 baseline period.

Climate Variable	1961–1990	2001–2020			2021–2040			2041–2060			2061–2080			2081–2100		
	value	value	change	% change	value	change	% change	value	change	% change	value	change	% change	value	change	% change
Average annual daily mean (°C)	11	11.5	0.5	4.8	12.1	1.1	9.8	12.8	1.8	16.5	13.6	2.6	23.8	14.3	3.3	30.2
Average daily maximum temperature (°C)	15.4	16	0.6	3.6	16.6	1.2	7.5	17.4	1.9	12.5	18.2	2.8	18	18.9	3.5	22.7
Average daily minimum temperature (°C)	6.6	7.1	0.5	7.7	7.6	1	15.3	8.3	1.7	25.9	9	2.5	37.5	9.7	3.1	47.8
Hottest daily temperature of the year (°C)	35.2	36	0.8	2.4	36.9	1.6	4.7	37.7	2.5	7.1	38.8	3.6	10.2	39.4	4.2	11.8
Temperature of warmest days [99^{th} percentile] (°C)	29.5	30.3	0.8	2.7	31.1	1.5	5.2	32.2	2.7	9.1	33.5	3.9	13.4	33.8	4.3	14.6
Temperature of warmest nights [99^{th} percentile] (°C)	14.7	15.3	0.5	3.5	15.7	1	6.5	16.4	1.6	11	17.1	2.3	15.8	17.6	2.8	19.1
Temperature of coldest nights [1^{st} percentile] (°C)	-1.2	-0.8	0.4	29.6	-0.5	0.7	60.5	0.1	1.3	106.2	0.8	1.9	162.6	1.4	2.6	217
Average annual frost risk days (<2°C)	36	28	-8	-22.6	22	-14	-38.3	15	-21	-58	10	-26	-72.7	6	-30	-83
Average annual freeze risk days (<0°C)	10	7	-3	-28.2	6	-5	-45.6	3	-7	-66.4	2	-8	-81.9	1	-9	-90
Average annual summer days (>25°C)	11	13	2	17.3	15	4	38	17	7	59.6	21	10	92.9	24	13	120
Average annual hot days (>30°C)	3	4	1	32.9	5	2	70.8	7	4	137.3	9	6	214.2	11	8	278.4
Average annual extreme heat days (>40°C)	<1	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA	<1	<1	NA
Mean Minimum Asphalt Critical Viscosity	104900	127900	23000	21.9	156100	51200	48.8	203500	98600	94	275300	170400	162.4	357500	252600	240.8
Average annual evaporation (mm)	837	863	25	3	896	59	7.1	964	127	15.2	1031	194	23.1	1133	295	35.3
Average annual rainfall (mm)	1218	1176	-42	-3.4	1144	-74	-6.1	1141	-77	-6.3	1121	-97	-8	1185	-33	-2.7
Seasonal rainfall - Winter (mm)	415	406	-9	-2.2	398	-17	-4.1	412	-3	-0.8	414	-1	-0.3	442	27	6.4
Seasonal rainfall - Spring (mm)	298	290	-9	-2.9	268	-30	-10.2	263	-36	-12	267	-31	-10.5	254	-44	-14.8
Seasonal rainfall - Summer (mm)	225	212	-13	-5.9	218	-7	-3.2	209	-16	-7	192	-33	-14.5	208	-17	-7.7
Seasonal rainfall - Autumn (mm)	298	295	-3	-1.1	287	-12	-4	283	-15	-5.2	273	-25	-8.5	296	-2	-0.8
Annual maximum daily rainfall (mm)	118	123	5	4	131	13	11.1	132	14	11.6	130	12	9.9	157	39	32.8
Rainfall Extreme - 24hr 10% AEP (mm)[a]	157	162	4	2.7	166	9	5.5	172	15	9.3	178	21	13.5	184	27	17.1
Rainfall Extreme - 24hr 5% AEP (mm)[a]	184	189	5	2.7	194	10	5.5	201	17	9.3	208	25	13.5	215	31	17.1
Rainfall Extreme - 24hr 1% AEP (mm)[a]	245	251	7	2.7	258	14	5.5	267	23	9.3	277	33	13.5	286	42	17.1
Rainfall Extreme - 24hr 0.5% AEP (mm)[a]	275	282	7	2.7	290	15	5.5	300	26	9.3	311	37	13.5	321	47	17.1
Rainfall Extreme - 48hr 10% AEP (mm)[a]	209	214	6	2.7	220	12	5.5	228	19	9.3	237	28	13.5	244	36	17.1
Rainfall Extreme - 48hr 5% AEP (mm)[a]	240	246	7	2.7	253	13	5.5	262	22	9.3	272	32	13.5	281	41	17.1
Rainfall Extreme - 48hr 1% AEP (mm)[a]	320	328	9	2.7	337	18	5.5	349	30	9.3	363	43	13.5	374	55	17.1
Rainfall Extreme - 48hr 0.5% AEP (mm)[a]	359	369	10	2.7	379	20	5.5	392	33	9.3	407	48	13.5	420	61	17.1
Average annual cummulative Forest Fire Danger Index	959	988	29	3	1070	111	11.6	1137	178	18.6	1237	278	29	1289	330	34.4
Sea level - 1% AEP with Freeboard (m)[b]	1.57	1.65	0.08	5.1	1.72	0.15	9.6	1.8	0.23	14.6	2.08	0.51	32.5	2.5	0.93	59.2

[a] *Based on recommendations from Australian Rainfall and Runoff, Book 1 Scope And Philosophy, Chapter 6 Climate Change Considerations, version last updated 14^{th} May 2019.*

[b] *Based on recommendations from Tasmanian Government Department of Premier and Cabinet, Coast Hazards Report, December 2015.*
For exact details reference (from theList): Sea Level Rise Planning Allowances; or Coastal Risk Hazard Bands.

Climate Change Information for Decision Making - Huon Valley

Enquires

Requests and enquiries concerning reproduction rights should be addressed to:
Discipline of Geography & Spatial Sciences; School of Technology, Environment & Design; University of Tasmania
Private Bag 78
Hobart Tasmania 7001
Tel: +61 3 6226 1511
Email: ted-admin@utas.edu.au

Disclaimer