Comparing perceptions of climate-related environmental changes for Tuvalu, Samoa, and Tonga: Supplementary information[1]

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Part I: Results for the first two qualitative questions

This section presents additional results for the first two qualitative questions of our survey:

(1) "Do you perceive any changes concerning the weather in the last years since you remember? If so, try to list at least five and explain each one and whether they have effect (either positive or negative) on the island you are living on, on the sea, on plants, animals and your livelihood."

(2) "Do you think there will be changes concerning the weather, the environment, the sea, the plants and animals in the future? If so, please name at least five and explain their consequences for your livelihood and the life on the islands."

[1] This is the online appendix from: Beyerl, K., Mieg, H.A., & Weber, E. (2019): Comparing perceptions of climate-related environmental changes for Tuvalu, Samoa, and Tonga. In: Klöck, C. & Fink, M. (eds.): *Dealing with climate change on small islands: Towards effective and sustainable adaptation?* (pp. 143–174). Göttingen: Göttingen University Press. https://doi.org/10.17875/gup2019-1215.

Table S1: Categories for qualitative data for changes of weather patterns

Changes of weather patterns	Tuvalu		Samoa		Tonga	
	present	future	present	future	present	future
General change / great change / worse		25		18	1	21
Change of weather (patterns) / unpredictable	6	6	12	13	13	14
Change of seasons (general)	4				23	15
• Longer dry season / drought	5	2	9	2		
• Wet / rainy season		1				
○ Shorter / less intense	2	1	2			
○ More intense			1			1
• Hot season (warmer/longer) / cold season warmer/shorter	11	3	1		11	4
○ Cyclone season	1				1	
○ Unregularly / mixed up / unpredictable seasons	6		10		14	8
○ Strong wind in different season	1					
Change of climate / climate change	2	3		1	23	21
Global warming	1	1	2	3		
Temperature (general)						
• Warmer / very hot / increased heat of the sun	32	9	50	18	55	52
• Colder / lack of sunshine					1	
• More extremes	1				1	
• Quick change of temperatures					9	
Wind (general)			1			
• Strong wind (stronger, more frequent, unpredictable)	9	1	3		3	1
• Less wind						1
• Storms / cyclones / hurricanes (unspecified)	2		5		8	5
○ More	2	2	6	8	4	3
○ Less	1					
• Less thunderstorms	2					
• More thunderstorms	1		1			
Rain (general)	1		1			
No or less rain / drought / lack of water (general)	31	13	34	9	11	
More rain / too much rain / intense and heavy rain			21	1	25	8

Table S2: Categories for qualitative data for changes of and effects on the abiotic environment

Changes of and effects on abiotic environment	Tuvalu		Samoa		Tonga	
	present	future	present	future	present	future
Air pollution			4	1		
Water pollution (general and also by rubbish taken to the sea by the water)					5	
Environmental pollution / degradation / damage / change general	1			14	10	18
Affected ozone layer			1	1		
Changes of the sea (general / affects the land)		7	2	1		
Changes of the land / soil (general)	2	2		1		1
Erosion (unspecified) / loss of land	1	1	1	3	8	8
Erosion due to human activities (sand/coral/mineral mining, deforestation)		1		7		
Flooding (unspecified)	1		7	3		
Rising sea temperature				1		
Sea Level Rise (general)	10	2	11	11	33	54
• Flooding with seawater / inundation	6	1	4	8	10	7
• Salt water intrusion / salty groundwater	4	3			2	
• Erosion / degrading or changing coastlines	6	2	9	4	17	20
• Higher waves	2		3	3		2
• Melting poles / icebergs			2	3		
• No sea level rise	2					
Changed tides / king tides (incl. moon)	5	2	2		6	1
Changed sea currents	2					1
Rough seas / strong waves	2		2		1	
Storm surges			3	1		
Effects of (no) rain on land and soils						
• Erosion / change of relief (unspecified)			2	1	10	7
• Landslides			3	2		
• Flooding			16		14	2
• Runoff			4			
• Dried up (soil, rivers, water resources)	4	2	15	1		
• Fills up water resources			1		16	1
• No groundwater					1	
Effects of human developments						
• New building projects (wharf)						1
• Use of chemicals						1

Table S3: Categories for qualitative data for changes of geophysical hazards

Geophysical Hazards	Tuvalu		Samoa		Tonga	
	present	future	present	future	present	future
Natural disasters / hazards			2	3	2	1
More tsunamis	6	1	2	3	9	14
More earthquakes	1	1	1	1	9	7

Table S4: Categories for qualitative data for changes of plants

Terrestrial plants (incl. crops / plantations)	Tuvalu		Samoa		Tonga	
	present	future	present	future	present	future
Affect plants / crops / gardens (unspecified)	43	21	40	33	104	38
Names of mentioned species						
• Pulaka (smaller, withered)	5	1				
• Taro	1				1	
• Coconut (smaller coconuts)	2					
• Less mangroves			2		1	1
• Tausunu	1					
• Lautii	1					
• Breadfruit (smaller not on season)	4	1			2	
• Banana (smaller)	4					
• Mangos (smaller fruits)				1		
• Pandanus	1					
• Potatoes	1					
• Cucumbers	1					
• Pawpaw (bigger fruits)	2					
• Yams					1	
• Cassava					1	
Trees: less / unhealthy / dying and dead	14	3		4	10	6
Edible plants / Vegetables / Fruits (less / TO more)	4	3	1	3	18	4
Loss medicinal and traditional plants				1	8	5
(New) grasses affected / Invasive species	1	1	1			
More weeds			1			
Affected coastal vegetation				1	13	9
Effects of climatic and weather changes						
• Temperature / hot sun / quick change	4	2	11	4	37	12
• Rain helps plants			2		16	
• Drought / Lack of water	13	3	15	1	10	2
• Sea level rise, salt water intrusion, erosion, • flooding with seawater	3	1	1		16	10
• Flooding (rain / unspecified) / erosion	1		4		11	2
• Strong wind / Cyclones	2		2	1	8	4
• Change of seasons / planting and ripe times	2	1	3		9	1
Natural disasters (unspecified and earthquake, tsunami)					2	1
Effects of human activities					1	1
• Deforestation / cutting of trees		2	4	15		1
• Pollution				1		
• Use of Fertilizers	2					
• Development / building projects	1	1				
• Change of farming practices	1	1				
Diseases / Pests / special insects	1			1		
Bush fires / Fire hazard due to drought			7	1		

Table S5: Categories for qualitative data for changes of marine life

Changes of Marine Life	Tuvalu		Samoa		Tonga	
	present	future	present	present	future	present
General / destruction / decrease	6	8		13	21	7
Migration of marine life				1		
Restoration marine resources				1		
Number of fish (unspecific)	1					
• Decline / decrease	1	2	1	2	3	4
• Increasing change		2				
Turtles (unspecific)	1					
Shells (less)			1	1	1	3
Seaweed (increase/decrease)	1					2
Coral Reef						
• Growing	1	1				
• Unhealthy / coral bleaching		1	1	4		3
Less mangroves					1	
Effects of climatic changes, pollution, etc.						
• Temperature	1	1		1	8	1
• Sea level rise / higher tides / light				1	1	2
• pollution due to erosion					1	
• Earthquakes					1	
Effects of human activities						
• Pollution				5	1	
• Fishing practices / overfishing					3	1
• Coral / sand mining & land reclamation / erosion		1		4	1	1
• Marine reserve				1		

Table S6: Categories for qualitative data for unspecific changes

Unspecific	Tuvalu		Samoa		Tonga	
	present	future	present	future	present	future
Depends on God	1	3				
All living things affected / will die		3	2			
No changes (hopefully)		2				1
Not sure / don't know		4		1		1

Table S7: Categories for qualitative data for changes of terrestrial animals

(Terrestrial) Animals	Tuvalu		Samoa		Tonga	
	present	future	present	future	present	future
Affect animals / less animals / smaller animals	10	12	9	18	41	12
Animals migration / habitat loss				7		1
Names of mentioned species						
• Pigs	2			1	3	
• Chicken	1		2	3	1	
• Birds (less, e.g. pigeons)	1	1	2			
• Bats			1			
• Mosquitoes (increase)			2		3	
Effects of climatic and weather changes		1				
• Temperature	2	1	3	3	19	5
• Drought / lack of water	5	1	2	1	2	1
• Rain / flooding / (rain helps)					8	
• Sea level rise / flooding seawater			1		1	
• Change of seasons					5	1
• Cyclones				1	2	
• Natural disasters (earthquake, tsunami)					1	
• Less food for animals					1	3
Effects of human activities						
• Deforestation			1	4		
• Consumption				2		
Diseases / pests / health effects / new insects			1	1	15	5

Part II: Results for the third qualitative question

This section presents results for the third qualitative question: "What do you think are the reasons for changes in weather and environment?"

Table S8: Categories for human activities and societal change as reason for perceived environmental change

	Tuvalu	Samoa	Tonga
Human activities			
• General	21	33	34
• Population growth / overpopulation	3	1	
• Deforestation / cutting of trees / destroying habitats	7	13	1
• Pollution general ((dirty) environment)	3	5	2
o Air		4	1
– Burning general	1	1	
– Burning of trees / firewood	1		1
– Burning of chemicals	1		
– Burning of rubbish (instead of recycling); burning also steel and aluminum	4	1	9
– Burning of plastics		5	5
– Cars, motorbikes, motorboats, trucks	8	5	1
– Fossil fuels (oil / gas) / release of gases	11	2	3
– Smoking	1		
– Gas cylinder for cooking instead of firewood	1		
– Increase CO2 / release GHG / methane / poisonous gases / carbon emission	1	9	
– Refrigerator gases		1	
o Land / Soil	1	2	
o Sea / Water	1	3	
• Sand and coral mining / land reclamation / mineral mining		3	1
• Modern and new technologies / machines / factories (in wealthy countries) / industries / industrial activities / inorganic products	12	14	
• Electricity use / non-renewable energy		2	
• Overuse / abuse/ consumption patterns / high demands / no wise use		4	5
• Overfishing / chemicals for fishing		1	
• Use / burning of chemicals / poisonous materials	1	1	
• Dumping of (toxic) wastes / litter	1	4	
• Cities and towns			
• Infrastructure development projects		1	
o New bridge			
o New wharf			2
o Building of seawall	1		
o Building of floorshore (foreshore)			
o Building of river dams			
• Different building materials (corrugated iron)	1		
• Farming practices / use of fertilizer	1		
Societal change			
• New denominations	2		
• Advance in knowledge / work of scientists	9		

• Modernization / development in livelihood / imported canned foods	1		1
• Greed / economic activities	2	4	
• Authorities don't control / government failure		1	
• Migration / Immigration / new cultures / urban drift	2		
• Bad manners of youth	1		
• Irresponsible behaviour, not taking care of environment / laziness / selfish behaviour / value money more than consequences	3	8	

Table S9: Categories for natural processes as reason for perceived environmental change

	Tuvalu	Samoa	Tonga
Natural Processes / everything changes	3	5	18
Global warming	1	5	4
Climate change	1	2	
Ozone depletion / ozone hole		2	2
UV rays		1	
Change in temperature / higher temperatures		1	2
Sea level rise	5	2	2
Melting of poles	1	2	1
Increased heat of the sun	5	1	
El Niño			5
Hurricanes / strong winds	1		1
Drought	2		
Erosion / changing relief of the earth		3	

Table S10: Counts for the category "God as reason for perceived environmental change"

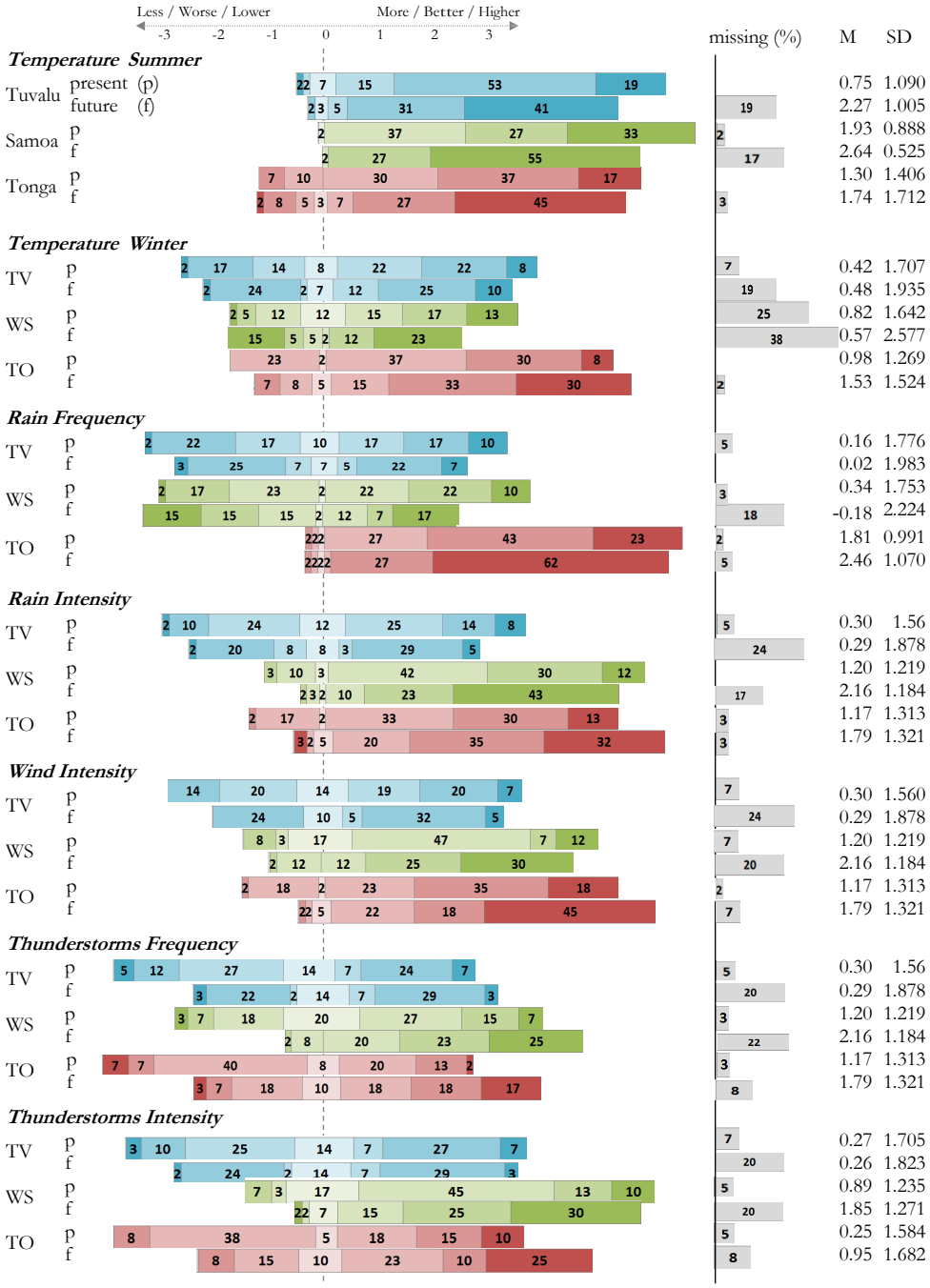
	Tuvalu	Samoa	Tonga
God	8	3	7
End of time	1		

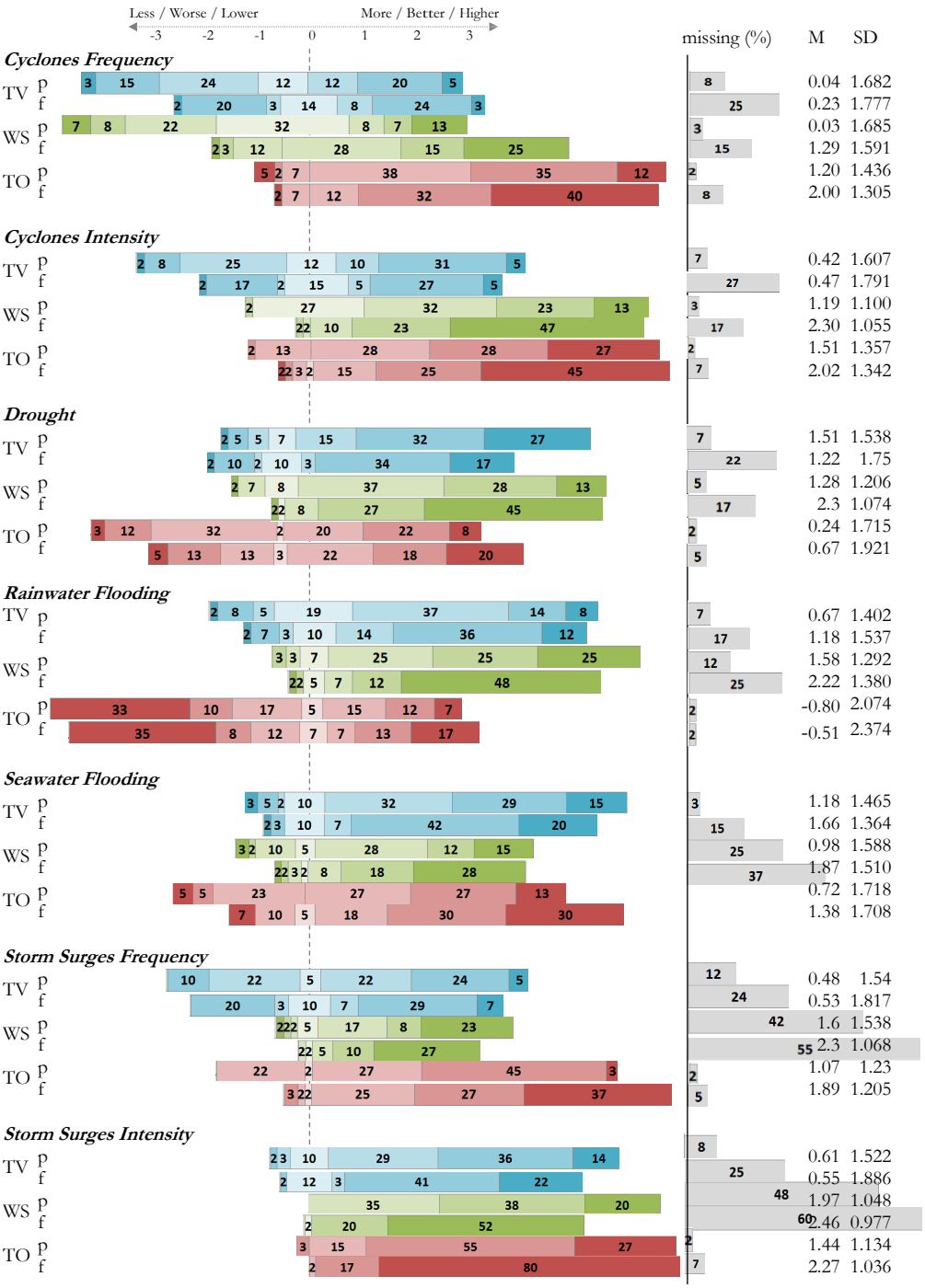
Table S11: Counts for the category "Don't know the reason for perceived environmental change"

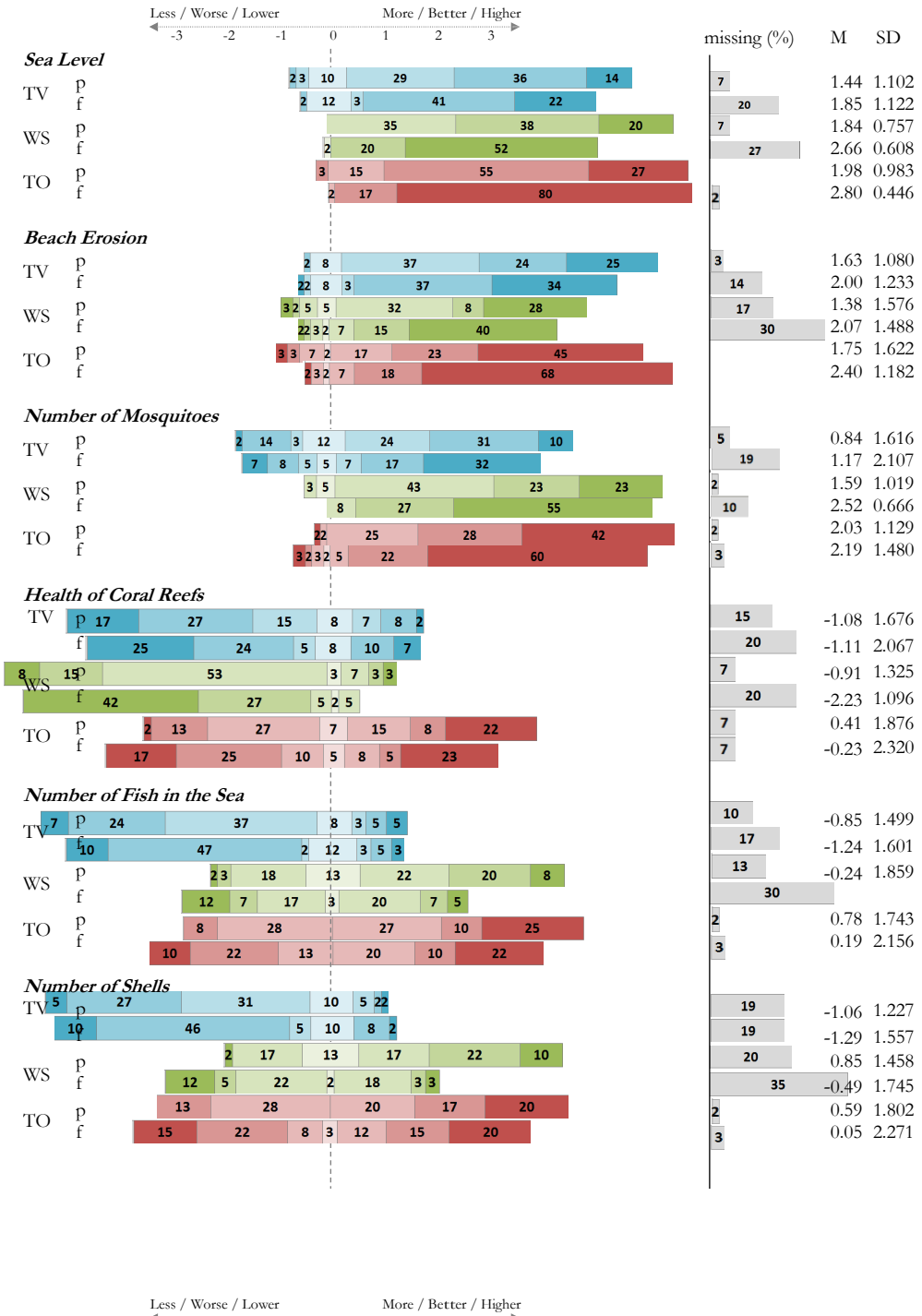
	Tuvalu	Samoa	Tonga
Don't know / missing / none	9	14	0

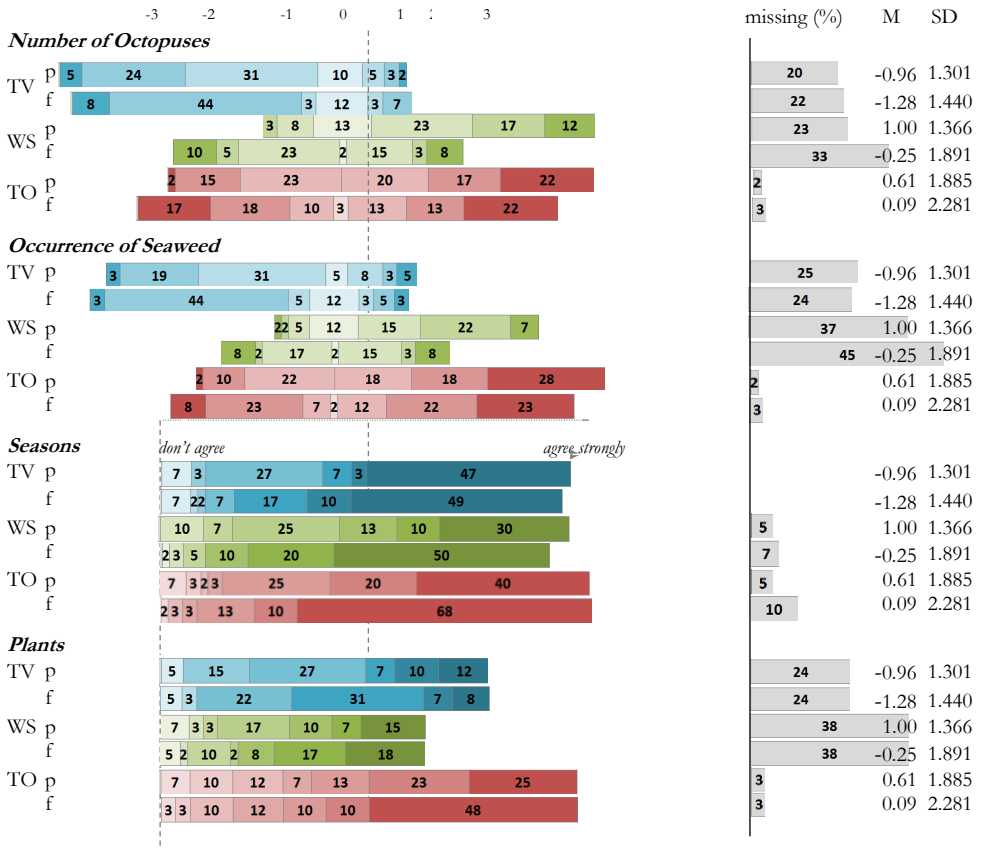
Part III: Distribution of responses to quantitative questions

This section presents the distribution of responses (in percent) to the quantitative questions about perceptions of climate-related environmental changes; this includes percentage of missing values, mean values, and standard deviations (legend and color code are found below).


Less / Worse / Lower
More / Better / Higher
-3 -2 -1 0 1 2 3
missing (%)
M
SD
Temperature Summer
Tuvalu present (p) 22 7 15 53 19 0.75 1.090
future (f) 2 3 5 31 41 19 2.27 1.005
Samoa p 2 37 27 33 2 1.93 0.888
f 2 27 55 17 2.64 0.525
Tonga p 7 10 30 37 17 1.30 1.406
f 2 8 5 3 7 27 45 3 1.74 1.712
Temperature Winter
TV p 2 17 14 8 22 22 8 7 0.42 1.707
f 2 24 2 7 12 25 10 19 0.48 1.935
WS p 2 5 12 12 15 17 13 25 0.82 1.642
f 15 5 5 2 12 23 38 0.57 2.577
TO p 23 2 37 30 8 0.98 1.269
f 7 8 5 15 33 30 2 1.53 1.524
Rain Frequency
TV p 2 22 17 10 17 17 10 5 0.16 1.776
f 3 25 7 7 5 22 7 0.02 1.983
WS p 2 17 23 2 22 22 10 3 0.34 1.753
f 15 15 15 2 12 7 17 18 -0.18 2.224
TO p 2 2 2 27 43 23 2 1.81 0.991
f 2 2 2 2 27 62 5 2.46 1.070
Rain Intensity
TV p 2 10 24 12 25 14 8 5 0.30 1.56
f 2 20 8 8 3 29 5 24 0.29 1.878
WS p 3 10 3 42 30 12 1.20 1.219
f 2 3 2 10 23 43 17 2.16 1.184
TO p 2 17 2 33 30 13 3 1.17 1.313
f 3 2 5 20 35 32 3 1.79 1.321
Wind Intensity
TV p 14 20 14 19 20 7 7 0.30 1.560
f 24 10 5 32 5 24 0.29 1.878
WS p 8 3 17 47 7 12 7 1.20 1.219
f 2 12 12 25 30 20 2.16 1.184
TO p 2 18 2 23 35 18 2 1.17 1.313
f 2 2 5 22 18 45 7 1.79 1.321
Thunderstorms Frequency
TV p 5 12 27 14 7 24 7 5 0.30 1.56
f 3 22 2 14 7 29 3 20 0.29 1.878
WS p 3 7 18 20 27 15 7 3 1.20 1.219
f 2 8 20 23 25 22 2.16 1.184
TO p 7 7 40 8 20 13 2 3 1.17 1.313
f 3 7 18 10 18 18 17 8 1.79 1.321
Thunderstorms Intensity
TV p 3 10 25 14 7 27 7 7 0.27 1.705
f 2 24 2 14 7 29 3 20 0.26 1.823
WS p 7 3 17 45 13 10 5 0.89 1.235
f 2 2 7 15 25 30 20 1.85 1.271
TO p 8 38 5 18 15 10 5 0.25 1.584
f 8 15 10 23 10 25 8 0.95 1.682

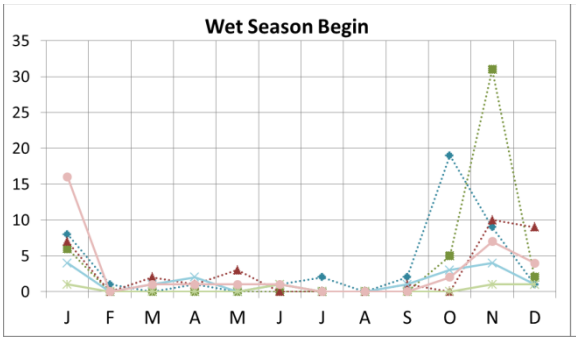

Less / Worse / Lower
More / Better / Higher
-3 -2 -1 0 1 2 3
missing (%)
M
SD
Cyclones Frequency
TV p 3 15 24 12 12 20 5 8 0.04 1.682
f 2 20 3 14 8 24 3 25 0.23 1.777
WS p 7 8 22 32 8 7 13 3 0.03 1.685
f 2 3 12 28 15 25 15 1.29 1.591
TO p 5 2 7 38 35 12 2 1.20 1.436
f 2 7 12 32 40 8 2.00 1.305
Cyclones Intensity
TV p 2 8 25 12 10 31 5 7 0.42 1.607
f 2 17 2 15 5 27 5 27 0.47 1.791
WS p 2 27 32 23 13 3 1.19 1.100
f 22 10 23 47 17 2.30 1.055
TO p 2 13 28 28 27 2 1.51 1.357
f 2 2 3 2 15 25 45 7 2.02 1.342
Drought
TV p 2 5 5 7 15 32 27 7 1.51 1.538
f 2 10 2 10 3 34 17 22 1.22 1.75
WS p 2 7 8 37 28 13 5 1.28 1.206
f 22 8 27 45 17 2.3 1.074
TO p 3 12 32 2 20 22 8 2 0.24 1.715
f 5 13 13 3 22 18 20 5 0.67 1.921
Rainwater Flooding
TV p 2 8 5 19 37 14 8 7 0.67 1.402
f 2 7 3 10 14 36 12 17 1.18 1.537
WS p 3 3 7 25 25 25 12 1.58 1.292
f 22 5 7 12 48 25 2.22 1.380
TO p 33 10 17 5 15 12 7 2 -0.80 2.074
f 35 8 12 7 7 13 17 2 -0.51 2.374
Seawater Flooding
TV p 3 5 2 10 32 29 15 3 1.18 1.465
f 2 3 10 7 42 20 15 1.66 1.364
WS p 3 2 10 5 28 12 15 25 0.98 1.588
f 22 3 2 8 18 28 37 1.87 1.510
TO p 5 5 23 27 27 13 0.72 1.718
f 7 10 5 18 30 30 1.38 1.708
Storm Surges Frequency
TV p 10 22 5 22 24 5 12 0.48 1.54
f 20 3 10 7 29 7 24 0.53 1.817
WS p 2 2 2 5 17 8 23 42 1.6 1.538
f 22 5 10 27 55 2.3 1.068
TO p 22 2 27 45 3 1.07 1.23
f 3 22 25 27 37 2 5 1.89 1.205
Storm Surges Intensity
TV p 2 3 10 29 36 14 8 0.61 1.522
f 2 12 3 41 22 25 0.55 1.886
WS p 35 38 20 48 1.97 1.048
f 2 20 52 60 2.46 0.977
TO p 3 15 55 27 2 1.44 1.134
f 2 17 80 7 2.27 1.036

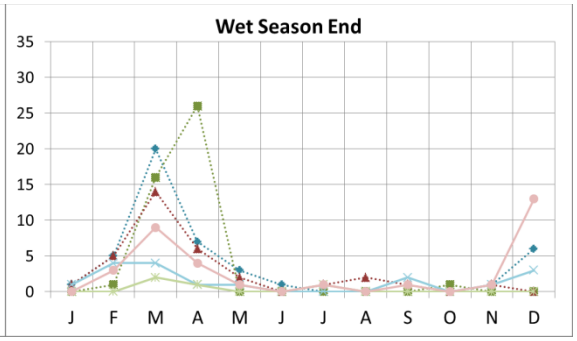

Less / Worse / Lower
More / Better / Higher
-3 -2 -1 0 1 2 3
missing (%)
M
SD
Sea Level
TV p 2 3 10 29 36 14 7 1.44 1.102
f 2 12 3 41 22 20 1.85 1.122
WS p 35 38 20 7 1.84 0.757
f 2 20 52 27 2.66 0.608
TO p 3 15 55 27 1.98 0.983
f 2 17 80 2 2.80 0.446
Beach Erosion
TV p 2 8 37 24 25 3 1.63 1.080
f 22 8 3 37 34 14 2.00 1.233
WS p 3 2 5 5 32 8 28 17 1.38 1.576
f 2 2 3 2 7 15 40 30 2.07 1.488
TO p 3 3 7 2 17 23 45 1.75 1.622
f 2 3 2 7 18 68 2.40 1.182
Number of Mosquitoes
TV p 2 14 3 12 24 31 10 5 0.84 1.616
f 7 8 5 5 7 17 32 19 1.17 2.107
WS p 3 5 43 23 23 2 1.59 1.019
f 8 27 55 10 2.52 0.666
TO p 22 25 28 42 2 2.03 1.129
f 3 2 3 2 5 22 60 3 2.19 1.480
Health of Coral Reefs
TV p 17 27 15 8 7 8 2 15 -1.08 1.676
f 25 24 5 8 10 7 20 -1.11 2.067
WS p 8 15 53 3 7 3 3 7 -0.91 1.325
f 42 27 5 2 5 20 -2.23 1.096
TO p 2 13 27 7 15 8 22 7 0.41 1.876
f 17 25 10 5 8 5 23 7 -0.23 2.320
Number of Fish in the Sea
TV p 7 24 37 8 3 5 5 10 -0.85 1.499
f 10 47 2 12 3 5 3 17 -1.24 1.601
WS p 2 3 18 13 22 20 8 13 -0.24 1.859
f 12 7 17 3 20 7 5 30
TO p 8 28 27 10 25 2 0.78 1.743
f 10 22 13 20 10 22 3 0.19 2.156
Number of Shells
TV p 5 27 31 10 5 2 2 19 -1.06 1.227
f 10 46 5 10 8 2 19 -1.29 1.557
WS p 2 17 13 17 22 10 20 0.85 1.458
f 12 5 22 2 18 3 3 35 -0.49 1.745
TO p 13 28 20 17 20 2 0.59 1.802
f 15 22 8 3 12 15 20 3 0.05 2.271
Less / Worse / Lower
More / Better / Higher

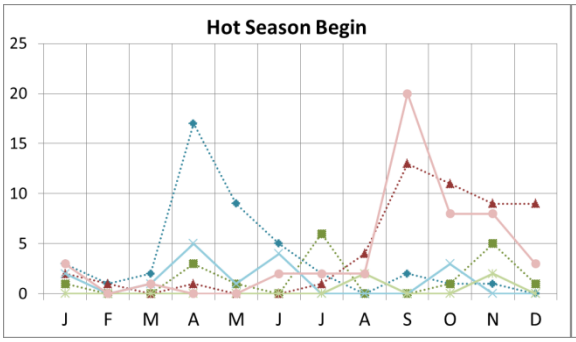


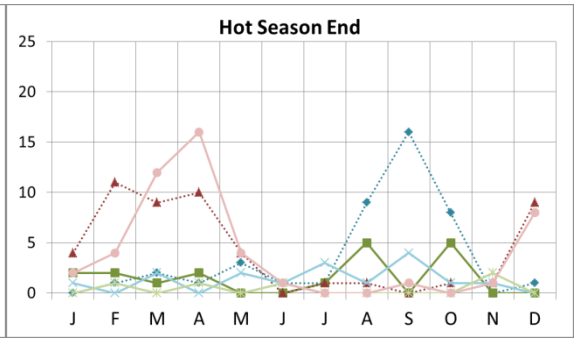
Note: darker shades mean stronger change/ stronger agreement.

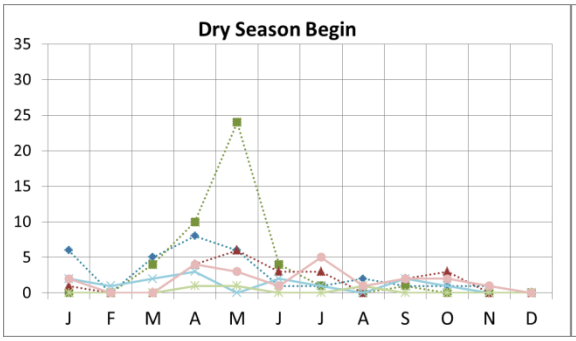
Figure S1: Distribution of responses (in percent) to the quantitative questions about perceptions of climate-related environmental changes; percentage of missing values, mean values, standard deviations

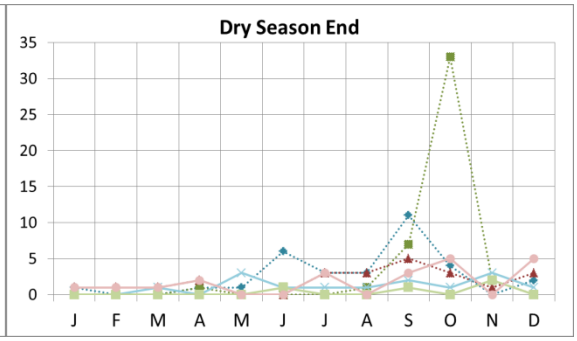

Wet Season Begin
35
30
25
20
15
10
5
0
J F M A M J J A S O N D

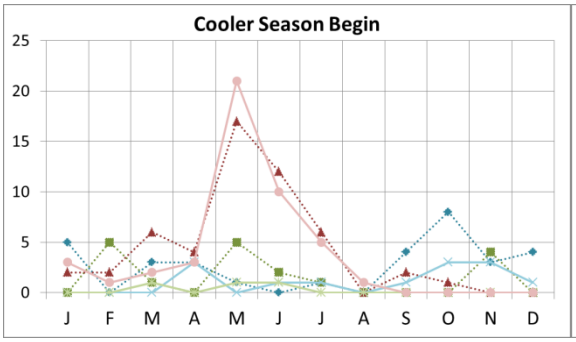

Wet Season End
35
30
25
20
15
10
5
0
J F M A M J J A S O N D

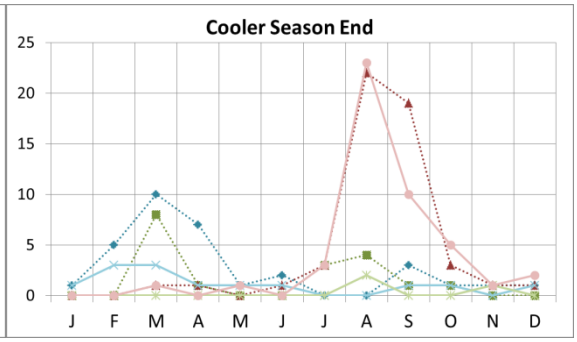

Hot Season Begin
25
20
15
10
5
0
J F M A M J J A S O N D


Hot Season End
25
20
15
10
5
0
J F M A M J J A S O N D


Dry Season Begin
35
30
25
20
15
10
5
0
J F M A M J J A S O N D


Dry Season End
35
30
25
20
15
10
5
0
J F M A M J J A S O N D


Cooler Season Begin
25
20
15
10
5
0
J F M A M J J A S O N D


Cooler Season End
25
20
15
10
5
0
J F M A M J J A S O N D

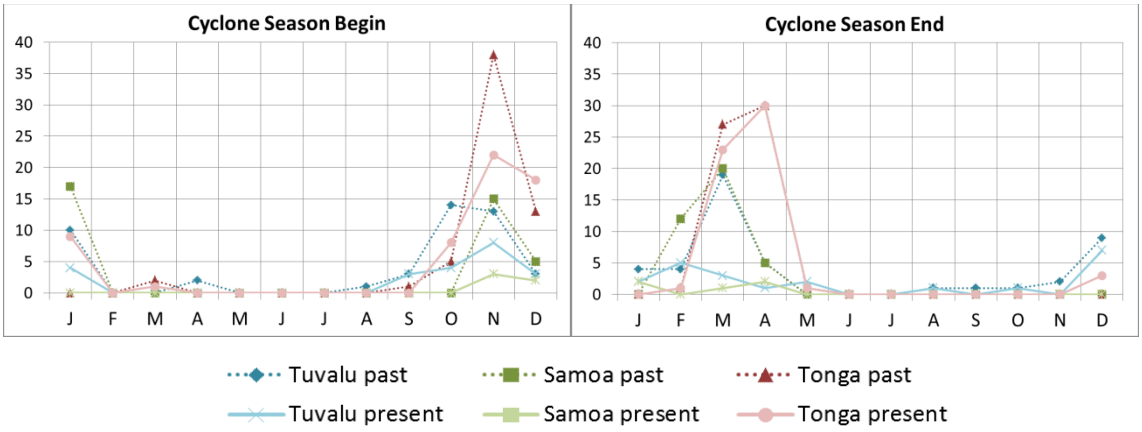


Figure S2: Perception of begin and end of seasons in the past and present, red boxes stand for theoretical "objective" begin and end

Part IV: Variables based on factor analyses and results of ordinal correlation analyses

Table S12: Variables and composite variables based on factor analyses

Final variable	Initial variables
Temperature summer	-
Temperature winter	-
Drought	-
Seasons	-
Plants	-
Sea level rise	-
Mosquitoes	-
Flooding with rainwater	-
Rain	Rain frequency Rain intensity
Storms	Wind intensity Frequency thunderstorms Intensity thunderstorms Frequency cyclones Intensity cyclones Frequency of storm surges Intensity of storm surges
Sea life	Number of fish in the sea, Number of shells, Number of octopuses, Occurrence of seaweed, Health of coral reefs
Flooding seawater	Beach erosion, Damage due to king tides, Flooding with seawater

Table S13: Ordinal correlations (Spearman Rho) of climate-related environmental changes with selected socio-demographic variables for Tuvalu

Tuvalu *(Spearman Rho)*	Age	Years on sland	Gender	Number of nhabitants	Distance to the sea	Ownership	Plant for daily diet	Sell fruits nd vegetables	Fish for daily diet	Sell fish	Education	Daily activities n nature	Socio-economic status	Religiousness self-assessment	Religiousness church activities	Religiousness overall
Present																
Temperature summer	-.159	.046	.081	-.193	-.132	-.146	-.245	-.164	.008	-.112	-.008	.054	.159	.262	.040	.076
Temperature winter	.100	-.094	-.255	.396*	-.136	-.173	-.123	.049	-.122	.102	-.185	.167	-.226	-.280*	-.274	-.276
Rain+	.267*	.076	-.122	.488**	-.294*	-.275*	-.007	-.003	-.332*	-.076	-.187	.286	-.129	-.200	-.501**	-.482**
Drought	-.079	.071	-.211	.066	-.001	-.060	-.125	-.037	-.028	-.214	-.032	.331*	.184	-.074	-.443**	-.451**
Wind and storms+	.217	0.00	-.200	.575**	-.187	-.201	.112	.007	-.173	.026	-.329*	.325*	-.151	-.406**	-.588**	-.588**
Seasons	-.243	.151	.225	-.535**	.173	.317*	.090	-.022	.119	.033	.246	-.213	.293*	.381**	.336*	.363*
Plants	.007	.227	-.193	-.148	-.180	-.032	.002	-.065	.192	-.015	.162	.498**	.349*	.516**	.212	.250
Flooding with rainwater	.192	.089	.107	.136	.214	-.011	.125	.023	-.114	.007	.047	.008	.049	-.277*	-.219	-.241
Number of mosquitoes	-.145	.027	.174	-.212	.030	-.009	-.215	-.015	.104	.117	-.012	.063	.118	.073	.194	.196
Sea Level	.109	.161	-.305*	.187	-.061	.104	.083	-.171	-.102	-.036	-.143	.280	.000	-.034	-.270	-.267
Flooding with sea water+	.022	.201	-.155	.180	-.014	.115	0.00	-.157	-.037	-.025	-.021	.311*	.061	.084	-.172	-.158
Sea life+	-.051	-.167	.184	-.360*	.054	.075	.046	.189	.300*	-.121	.248	-.160	-.008	.086	.179	.143
Future																
Temperature summer	-.205	.042	.387**	-.437**	.311*	-.270	-.150	.049	.048	-.160	-.057	-.060	.089	.338*	.061	.093
Temperature winter	.075	-.190	-.159	.394*	-.049	-.157	-.092	.141	-.145	-.011	.012	.210	-.229	-.317*	-.282	-.273
Rain+	.165	.017	-.162	.595**	-.027	-.220	-.078	.067	-.380**	.062	-.130	.240	-.151	-.514**	-.524**	-.505**
Drought	-.134	-.185	.096	-.035	.054	-.158	-.061	.264	.038	-.248	.281	-.072	.083	-.346*	-.298	-.349*
Wind and storms+	.169	-.096	-.216	.542**	-.078	-.159	.033	.063	-.269	.021	-.195	.291	-.203	-.522**	-.467**	-.469**
Seasons	-.172	.105	.232	-.608**	.095	.242	-.035	.038	.140	.002	.246	-.137	.231	.354**	.374*	.392*
Plants	.361*	.310*	.240	-.547**	.020	.364*	.126	-.021	.229	.233	.438**	.093	.192	.341*	.276	.266
Flooding with rainwater	.128	.076	-.016	.104	.056	-.046	-.118	-.099	-.206	.056	-.213	.066	.071	-.188	-.164	-.194
Number of mosquitoes	-.030	.080	.265	-.174	.112	-.075	-.003	-.009	.123	-.062	.160	-.188	.293*	.184	.286	.282
Sea Level	.026	.177	-.044	-.201	.121	.124	.193	.132	.089	.054	.060	.018	.156	.054	.100	.084
Flooding with sea water+	-.049	.110	-.056	-.040	.203	.036	-.095	-.182	-.077	-.042	-.105	.045	.117	.264	-.009	-.001
Sea life+	-.019	-.057	.119	-.235	-.216	.053	-.014	.238	.157	.090	.220	.064	-.042	.229	.213	.189

*b = 0.05; **=p.0.01 (two-tailed); + = composite variables*

Table 14: N for ordinal correlations of climate-related environmental changes with selected socio-demographic variables for Tuvalu

Tuvalu (N)	Age	Years on sland	Gender	Number of nhabitants	Distance to he sea	Ownership	Plant for daily diet	Sell fruits nd vegetables	Fish for daily diet	Sell fish	Education	Daily activities n nature	Socio-economic status	Religiousness self-assessment	Religiousness church activities	Religiousness overall
Present																
Temperature summer	56	57	56	43	57	55	57	57	57	57	55	43	56	53	43	41
Temperature winter	54	55	54	41	55	53	55	55	55	55	53	41	54	51	42	40
Rain^{+}	55	56	55	42	56	54	56	56	56	56	54	42	55	53	44	41
Drought	54	55	54	42	55	53	55	55	55	55	53	41	54	52	42	40
Wind and storms^{+}	56	57	56	43	57	55	57	57	57	57	55	43	56	53	44	41
Seasons	55	56	55	42	56	55	56	56	56	56	54	43	55	53	42	41
Plants	45	45	45	34	45	44	45	45	45	45	43	33	45	42	36	34
Flooding with rainwater	54	55	54	41	55	53	55	55	55	55	53	41	54	51	41	39
Number of mosquitoes	55	56	55	43	56	54	56	56	56	56	54	42	55	53	43	41
Sea Level	54	55	54	41	55	53	55	55	55	55	53	42	54	51	42	40
Flooding with sea water^{+}	56	57	56	43	57	55	57	57	57	57	55	43	56	53	43	41
Sea life^{+}	54	55	54	41	55	53	55	55	55	55	53	42	54	51	42	40
Future																
Temperature summer	47	48	47	40	48	46	48	48	48	48	46	35	47	45	39	37
Temperature winter	47	48	47	40	48	46	48	48	48	48	46	35	47	45	39	37
Rain^{+}	45	46	45	40	46	44	46	46	46	46	45	33	45	44	40	38
Drought	45	46	45	39	46	44	46	46	46	46	44	33	45	44	38	36
Wind and storms^{+}	48	49	48	42	49	47	49	49	49	49	47	35	48	46	41	39
Seasons	54	55	54	41	55	54	55	55	55	55	53	42	54	52	41	40
Plants	45	45	45	34	45	44	45	45	45	45	43	33	45	42	36	34
Flooding with rainwater	48	49	48	39	49	47	49	49	49	49	47	36	48	45	39	37
Number of mosquitoes	47	48	47	41	48	46	48	48	48	48	46	35	47	45	40	38
Sea Level	46	47	46	39	47	45	47	47	47	47	45	35	46	44	39	37
Flooding with sea water^{+}	50	51	50	41	51	49	51	51	51	51	49	38	50	47	41	39
Sea life^{+}	50	51	50	41	51	49	51	51	51	51	49	38	50	47	40	38

$^{+}$ = *composite variables; varying N due to pairwise deletion*

Table S15: Ordinal correlations (Spearman Rho) of climate-related environmental changes with selected socio-demographic variables for Samoa

Samoa *(Spearman Rho))*	Age	Years on Island	Gender	Number of inhabitants	Distance to the sea	Ownership	Plant for daily diet	Sell fruits and vegetables	Fish for daily diet	Sell fish	Education	Daily activities in nature	Socio-economic status	Religiousness self-assessment	Religiousness church activities	Religiousness overall
Present																
Temperature summer	.190	.138	-.169	-.396**	-.115	-.005	.045	.208	.428**	.306*	-.065	.295*	-.079	.272*	.457**	.462**
Temperature winter	.153	.092	-.054	-.312	.131	.078	.035	-.140	.054	-.055	.079	.060	-.063	.171	.494**	.492**
Rain+	-.007	.197	-.102	-.340*	-.046	.027	.169	.004	.156	.055	-.120	.136	-.022	.027	.465**	.474**
Drought	.229	.175	-.016	-.236	-.188	-.119	.226	.351**	.359**	.339*	-.211	.367**	-.306*	.002	.263	.246
Wind and storm+	.164	-.020	-.076	-.577**	-.250	.055	.060	.285*	.325*	.325*	-.145	.435**	-.130	.136	.533**	.509**
Seasons	-.103	-.192	.183	.307*	.021	.222	-.168	.113	-.151	-.064	.071	-.098	.018	.072	-.148	-.126
Plants	-.104	-.254	-.018	-.226	-.112	-.236	-.242	.102	-.070	0.000	-.041	.104	.229	.094	.086	.105
Flooding with rainwater	.017	-.096	.051	-.202	-.006	.111	-.048	.045	.287*	.236	.029	.156	-.147	.214	.292*	.304*
Number of mosquitoes	-.139	-.203	-.142	.054	.158	.099	-.224	-.189	.163	.146	.165	.087	.032	.144	.238	.283*
Sea Level	-.019	-.115	-.070	-.290*	-.339*	-.201	.049	.204	.294*	.236	-.076	.277	.013	.300*	.398**	.450**
Flooding with sea water+	.117	-.034	-.067	-.620**	-.380*	-.141	.154	.325*	.344*	.344*	-.118	.577**	-.052	.347*	.501**	.526**
Sea life+	.137	.084	.057	-.152	-.212	-.023	.004	-.063	-.047	-.033	-.172	-.061	.038	.035	-.170	-.162
Future																
Temperature summer	.189	.217	-.118	.012	-.148	.215	-.185	.128	.271	.244	-.026	.080	-.053	.380**	-.051	.004
Temperature winter	.259	.300	-.141	-.409*	.036	-.050	.253	.011	.141	.060	-.176	.130	-.111	.162	.457**	.433**
Rain+	.148	.225	-.090	-.287	-.029	-.059	.276	-.004	.276	.247	-.008	.163	-.197	-.011	.440**	.434**
Drought	.356*	.259	-.093	-.141	-.276	.233	.010	.266	.201	.153	-.121	.292	-.155	.123	.190	.145
Wind and storm+	.260	.163	-.005	-.212	-.124	.106	.042	.078	.219	.174	-.179	.221	-.159	.092	.475**	.440**
Seasons	.030	-.034	-.032	.096	-.072	.225	-.151	.101	-.145	-.092	.027	.050	.052	.233	-.151	-.123
Plants	-.261	-.296	-.021	-.087	-.232	-.055	-.271	.045	-.018	.056	-.072	.182	.105	.152	.023	.049
Flooding with rainwater	.192	.073	.099	-.204	-.281	-.111	.018	-.003	.209	.138	-.084	.020	.061	.063	.168	.183
Number of mosquitoes	-.157	-.248	-.195	.345*	.220	.167	-.427**	-.301*	.012	.102	.044	-.171	.004	.018	-.040	-.032
Sea Level	-.126	-.065	-.221	.036	-.199	-.108	-.241	-.162	.040	-.014	-.098	-.104	.130	.033	.030	.046
Flooding with sea water+	.081	.010	-.068	-.512**	-.381*	-.179	.069	.121	.364*	.250	-.135	.380*	-.069	.168	.415**	.429**
Sea life+	.134	.161	.067	-.129	-.099	-.237	.242	-.181	.148	-.032	-.149	.041	.063	.003	.090	.086

*$^{*}p = 0.05$; **=p*0.01 (two-tailed);* $^{+}$ *= composite variables*

Table S16: N for ordinal correlations of climate-related environmental changes with selected socio-demographic variables for Samoa

Samoa (*N*)	Age	Years on island	Gender	Number of inhabitants	Distance to the sea	Ownership	Plant for daily diet	Sell fruits and vegetables	Fish for daily diet	Sell fish	Education	Daily activities in nature	Socio-economic status	Religiousness	self-assessment	Religiousness	church activities	Religiousness	overall
Present																			
Temperature summer	58	57	59	50	46	53	57	57	57	57	58	51	59	56	56	56	56	56	53
Temperature winter	44	44	45	38	33	40	43	43	43	43	45	38	45	45	45	43	43	43	43
Rain^{+}	59	58	60	51	47	53	58	58	58	58	59	52	60	57	57	57	57	57	54
Drought	56	55	57	49	44	50	55	55	55	55	56	50	57	54	54	54	54	54	51
Wind and storms^{+}	59	58	60	51	47	53	58	58	58	58	59	52	60	57	57	57	57	57	54
Seasons	56	55	57	48	44	51	55	55	55	55	56	49	57	54	54	54	54	54	51
Plants	37	37	37	31	25	34	37	37	37	37	36	32	37	36	36	35	35	35	34
Flooding with rainwater	52	51	53	46	43	49	51	51	51	51	52	46	53	50	50	51	51	51	48
Number of mosquitoes	58	57	59	51	46	52	57	57	57	57	58	52	59	56	56	56	56	56	53
Sea Level	55	54	56	49	45	50	54	54	54	54	55	50	56	53	53	54	54	54	51
Flooding with sea water^{+}	50	49	51	43	39	46	49	49	49	49	50	43	51	49	49	48	48	48	46
Sea life^{+}	58	57	59	50	46	52	57	57	57	57	58	51	59	56	56	56	56	56	53
Future																			
Temperature summer	49	48	50	42	39	44	49	49	49	49	49	43	50	47	47	47	47	47	44
Temperature winter	36	36	37	31	27	32	36	36	36	36	37	31	37	37	37	35	35	35	35
Rain^{+}	49	48	50	43	38	45	48	48	48	48	49	45	50	47	47	47	47	47	44
Drought	49	48	50	42	38	44	48	48	48	48	49	43	50	47	47	47	47	47	44
Wind and storms^{+}	53	52	54	46	42	48	52	52	52	52	53	47	54	51	51	51	51	51	48
Seasons	53	52	54	46	43	49	53	53	53	53	54	47	54	51	52	52	52	52	49
Plants	37	37	37	31	25	34	37	37	37	37	36	32	37	36	36	35	35	35	34
Flooding with rainwater	44	43	45	39	36	41	43	43	43	43	44	39	45	42	42	42	42	42	39
Number of mosquitoes	53	52	54	47	42	47	52	52	52	52	53	48	54	51	51	51	51	51	48
Sea Level	43	42	44	36	34	39	43	43	43	43	43	37	44	41	41	42	42	42	39
Flooding with sea water^{+}	43	42	44	37	34	39	42	42	42	42	43	37	44	42	42	41	41	41	39
Sea life^{+}	51	50	51	43	39	46	50	50	50	50	50	45	51	48	48	48	48	48	45

$^{+}$ = *composite variables; varying N due to pairwise deletion*

Table S17: Ordinal correlations (Spearman Rho) for ordinal correlations of climate-related environmental changes with selected socio-demographic variables for Tonga

Tonga *(Spearman Rho)*	Age	Years on Island	Gender	Number of inhabitants	Distance to the sea	Ownership	Plant for daily diet	Sell fruits and vegetables	Fish for daily diet	Sell fish	Education	Daily activities in nature	Socio-economic status	Religiousness self-assessment	Religiousness church activities	Religiousness overall
Present																
Temperature summer	.011	.203	-.050	.234	.191	.056	-.232	.032	-.027	.033	-.241	-.359**	.069	.175	-.089	-.047
Temperature winter	.023	.062	-.069	.128	.032	-.040	-.215	-.051	-.090	-.056	-.332*	-.444**	.054	.339**	-.159	-.140
Rain+	.034	.115	-.047	.311*	-.140	.038	-.111	.125	-.010	-.210	-.069	-.012	.286*	.299*	.049	.134
Drought	.088	.098	-.032	.366**	.198	.088	-.279*	-.030	-.145	.016	-.049	-.449**	.211	.212	-.114	-.101
Wind and storms+	.014	.079	-.162	.112	-.113	.021	.005	.148	-.098	-.223	-.094	-.203	.105	.285*	-.147	-.062
Seasons	.175	.190	-.114	.025	-.032	.176	-.054	-.046	.129	.002	.106	.309*	.345**	-.144	-.068	-.059
Plants	.209	.186	-.384**	.050	-.166	.198	.102	.116	.177	-.176	-.025	.188	.200	.188	-.043	.011
Flooding with rainwater	-.133	.023	-.078	.318*	.268*	.110	-.368**	.012	-.159	-.027	-.148	-.365**	-.078	.417**	-.024	.068
Number of mosquitoes	-.094	.233	-.140	.054	.010	.009	-.316*	.067	-.047	.110	.089	-.024	.021	.154	-.117	-.068
Sea Level	-.127	-.071	-.138	.203	-.096	-.003	-.172	-.037	.094	-.068	-.043	-.006	.146	.017	-.073	-.052
Flooding with sea water+	-.062	.164	.125	.126	-.323*	.187	.064	.091	.172	-.031	.061	.160	-.033	.101	.139	.201
Sea life+	.149	.043	-.029	.112	.270*	-.077	-.300*	.011	.021	.146	-.212	-.245	-.047	.211	-.305*	-.284*
Future																
Temperature summer	-.049	.182	.071	-.030	.248	.005	-.160	.124	-.028	.140	-.275*	-.117	.010	.167	.059	.111
Temperature winter	-.045	-.003	.023	.059	.015	-.105	-.316*	-.094	-.116	-.094	-.330*	-.312*	.001	.191	-.160	-.151
Rain+	.043	.164	-.213	.200	-.210	.052	.067	.146	.047	-.114	-.042	-.019	.328*	.172	.025	.083
Drought	.106	.029	-.008	.359**	.218	.013	-.260	-.017	-.229	-.103	.030	-.395**	.354**	.208	-.192	-.191
Wind and storms+	.103	.090	-.032	.035	.040	.004	.022	.054	-.199	-.330	-.130	-.108	.086	.276*	-.055	.019
Seasons	-.064	.085	.067	-.061	-.033	.047	.001	-.201	.064	-.005	.004	.132	-.004	-.092	-.064	-.061
Plants	.249	.153	-.393**	.123	-.108	.235	.082	.012	.267*	-.153	-.138	.127	.128	.153	-.017	.019
Flooding with rainwater	-.170	-.063	-.111	.215	.228	.064	-.349**	-.037	-.282*	-.182	-.052	-.336**	-.087	.304*	-.099	-.019
Number of mosquitoes	-.249	.051	-.022	-.181	-.067	-.118	-.168	-.140	.092	.148	.126	.175	-.011	-.067	.017	.025
Sea Level	-.100	.030	-.054	.151	.090	.131	.112	.111	-.003	-.167	-.158	.013	.169	-.035	.071	.081
Flooding with sea water+	-.054	.003	.084	-.008	-.253	.242	.061	-.047	.025	-.204	.048	.247	-.142	-.130	.202	.234
Sea life+	.042	.005	-.041	-.025	.188	-.004	-.299*	-.004	.137	.244	-.146	-.273*	-.201	.098	-.206	-.188

$^{*}p = 0.05$; **=p.0.01 (two-tailed); $^{+}$ = composite variables

Table S18: N for ordinal correlations of climate-related environmental changes with selected socio-demographic variables for Tonga

Tonga (N)	Age	Years on island	Gender	Number of inhabitants	Distance to the sea	Ownership	Plant for daily diet	Sell fruits and vegetables	Fish for daily diet	Sell fish	Education	Daily activities in nature	Socio-economic status	Religiousness self-assessment	Religiousness church activities	Religiousness overall
Present																
Temperature summer	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Temperature winter	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Rain^{+}	58	57	59	59	58	57	59	59	59	59	57	58	57	57	58	57
Drought	58	57	59	59	58	57	59	59	59	59	57	58	57	57	58	57
Wind and storms^{+}	58	57	59	59	58	57	59	59	59	59	57	58	57	57	58	57
Seasons	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Plants	57	56	58	58	57	56	58	58	58	58	56	57	57	56	57	56
Flooding with rainwater	58	57	59	59	58	57	59	59	59	59	57	59	57	57	58	57
Number of mosquitoes	58	57	59	59	58	57	59	59	59	59	57	58	57	57	58	57
Sea Level	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Flooding with sea water^{+}	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Sea life^{+}	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Future																
Temperature summer	57	56	58	58	57	56	58	58	58	58	57	57	57	56	57	56
Temperature winter	58	57	59	59	58	57	59	59	59	59	58	58	57	57	58	57
Rain^{+}	57	56	58	58	57	56	58	58	58	58	56	58	56	56	57	56
Drought	56	55	57	57	56	55	57	57	57	57	56	57	55	55	56	55
Wind and storms^{+}	57	56	58	58	57	56	58	58	58	58	56	57	56	56	57	56
Seasons	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Plants	57	56	58	58	57	56	58	58	58	58	56	57	57	56	57	56
Flooding with rainwater	58	57	59	59	58	57	59	59	59	59	57	59	57	57	58	57
Number of mosquitoes	57	56	58	58	57	56	58	58	58	58	56	57	56	56	57	56
Sea Level	58	57	59	59	58	57	59	59	59	59	57	58	57	57	58	57
Flooding with sea water^{+}	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58
Sea life^{+}	59	58	60	60	59	58	60	60	60	60	58	59	58	58	59	58

$^{+}$ = *composite variables; varying N due to pairwise deletion*

Part V: Other information

Table S19: places of residence of survey respondents

Tuvalu			
Funafuti			
Alapi	2	Niutao	1
Elisalas Residence	1	Serala	1
Fakaifou	18	Te Vao	1
Funafuti	7	Tuvalu side	1
Kavatoetoe	4	Vaiaku	7
Lofeagai	2	Vao side	1
Nanumasa	1		
Vaitupu			
Asau	6	Tegao Village	1
Tefagaefa	1	Tumaseu	4
Samoa: *Upolu*			
Afega	8	Samatau	1
Alafua	1	Sapoe	8
Fuanai	1	Tanugamanono	1
Laulii	2	Toamua	1
Letogo	1	Toomatogi	1
Letolto	1	Tuanai	11
Matautu-uta	2	Tufuiopa	2
Matautuutu	1	Uaoala	1
Matauufunuta	1	Utulaelae	3
Moataa	2	Vaimea (part of Apia)	1
Motootua	3	Vaitele	1
Nuu	1	Vaitele-Uta (Apia)	1
Papaloloa	1	Vaivase-Uta	1
Tonga			
Lifuka			
Ha'ato'u	2	Koulo	5
Hihifo	7	Pangai	2
Holopeka	3	Pangao	1
Tongatapu			
'Ahau	5	Patangata (Nuku'alofa area)	20
Kanokupolu	5	Sopu / Nuku'alofa	9

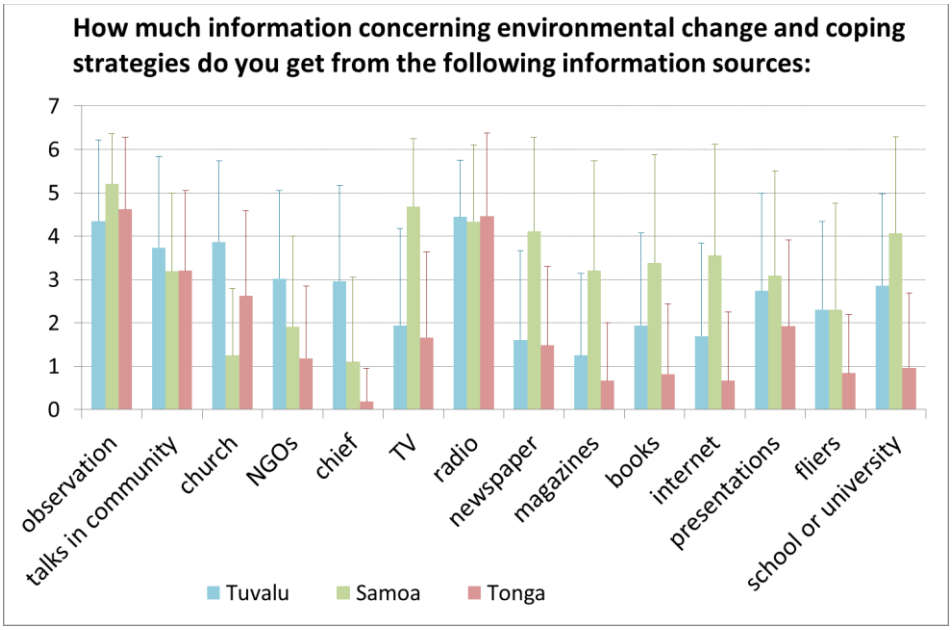


Figure S3: Mean values and standard deviations for the ranking of sources of information

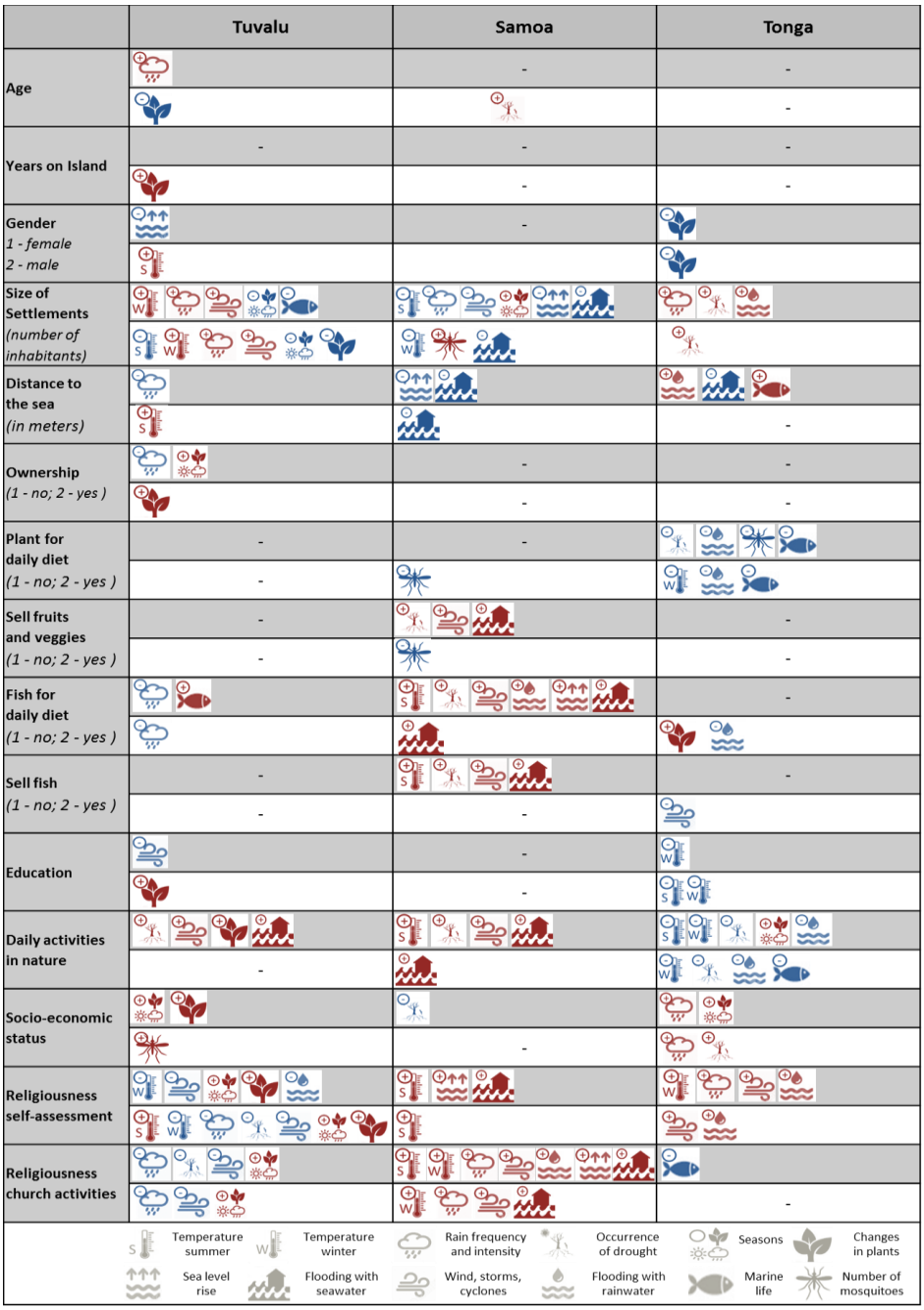


Figure S4: Significant ordinal correlations (Spearman Rho, $p \leq 0.05$, two-sided) between socio-demographic variables and perceived climate-related environmental changes