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Simulations of future changes in thermal structure of Lake Erken: proof of concept for ISIMIP2b lake sector local simulation strategy

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S1. Hourly meteorological modelling

S1.1. GRNN description

Generalized regression neuronal networks (GRNN) learn the relationship between input and output variables by developing relationships that replicate previously recorded data. GRNN consists of neurons connected by weighted links which pass information. The weight is calculated using the Euclidean distance between the training sample and the point of prediction. If the distance is large then the weight will be very less and if the distance is small it will put more weight to the output. GRNN is based on the equation:

$$y(x) = \frac{\sum Y_i \cdot exp(-D_i^2/2 \cdot \sigma^2)}{\sum exp(-D_i^2/2 \cdot \sigma^2)}$$

where D_i is Euclidean distance defined as follows:

$$D_i = (X - X_i)^T \cdot (X - X_i)$$

the transpose of the matrix (X-X_i) was denoted as T.

A training procedure is used to find the optimum value of σ minimizing error. For this the observed data set is divided into two parts: a training sample and a test sample. The GRNN procedure is applied on the test data based on training data in order to find the error for different values of σ. And find the minimum error and corresponding value of σ.

GRNNs consist of input, hidden, and output layers. The input layer has one neuron for each predictor variable and feeds the values to each of the neurons in the hidden layer. The hidden layer is divided into two: pattern and summation layers. Each neuron in the pattern layer compute the Euclidean distance and the activation function. The summation layer has two neurons one is the numerator part and another that is the denominator part in the equation above. The numerator part contains summation of the multiplication of training output data and activation function. The denominator is the summation of all activation functions. This layer feeds both the numerator and denominator to the output layer. The output layer contains one neuron which calculates the output by dividing the numerator part of the summation layer by the denominator part.

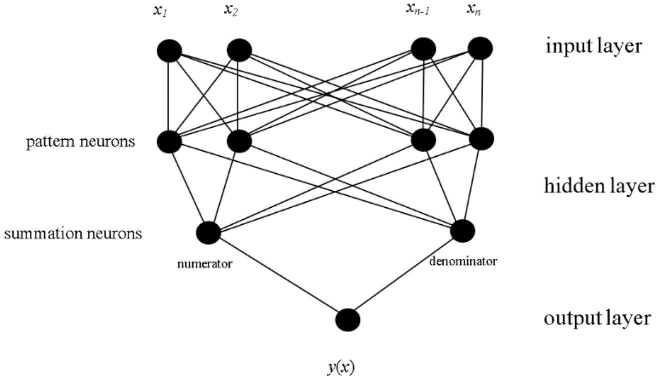


Figure S1. GRNN network architecture.

S1.2. GRNN training and validation.

GRNNs were created using the function *newgrnn* in MatLab R2017a.

S1.2.1. Air temperature GRNN.

The GRNN model to predict hourly air temperature required eight geographical variables: latitude, longitude, time of sunrise and sunset, the solar elevation associated with the predicted hour, the hour, day and month of the predicted time, and three climate variables: mean daily air temperature, daily maximum and minimum air temperature and daily precipitation.

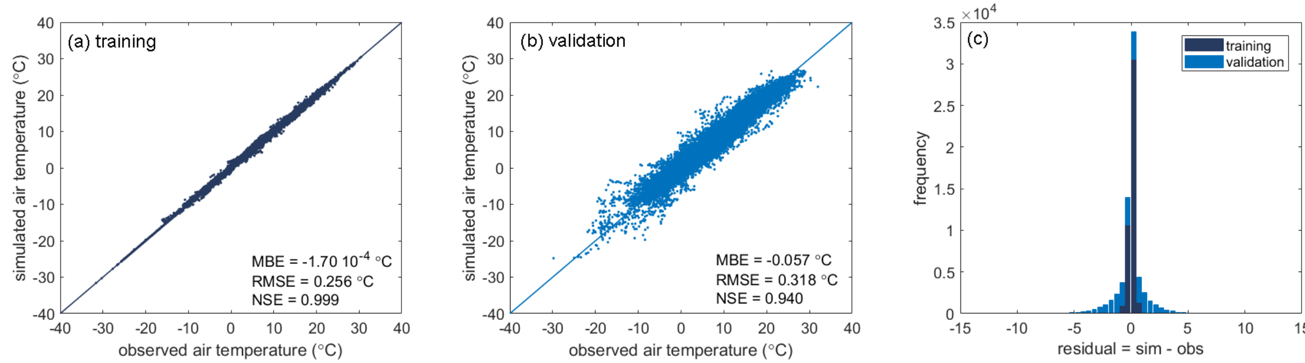


Figure S2. Measured vs predicted air temperature for the (a) training and (b) validation data sets, and (c) frequency distribution of air temperature residuals.

S1.2.2. Short-wave radiation GRNN.

The GRNN model to predict hourly short-wave radiation required eight geographical variables: latitude, longitude, time of sunrise and sunset, the solar elevation associated with the predicted hour, the hour, day and month of the predicted time, and two climate variables: mean daily short-wave radiation and daily precipitation.

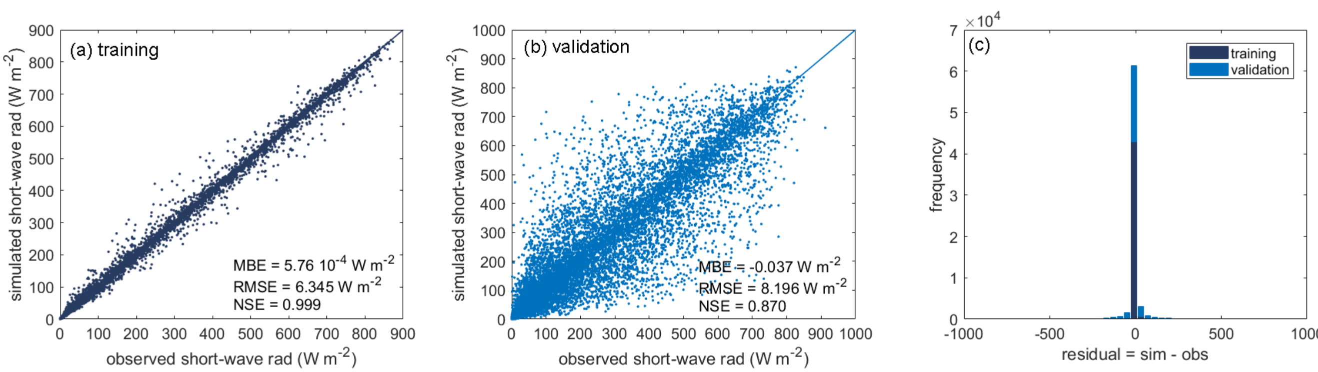


Figure S3. Measured vs predicted short-wave radiation for the (a) training and (b) validation data sets, and (c) frequency distribution of short-wave radiation residuals.

S1.2.3. Relative humidity GRNN.

The GRNN model to predict hourly relative humidity required five geographical variables: latitude, longitude, hour, day and month, and four climate variables: mean daily relative humidity, daily precipitation, hourly air temperature and hourly short-wave radiation from GRNNs models.

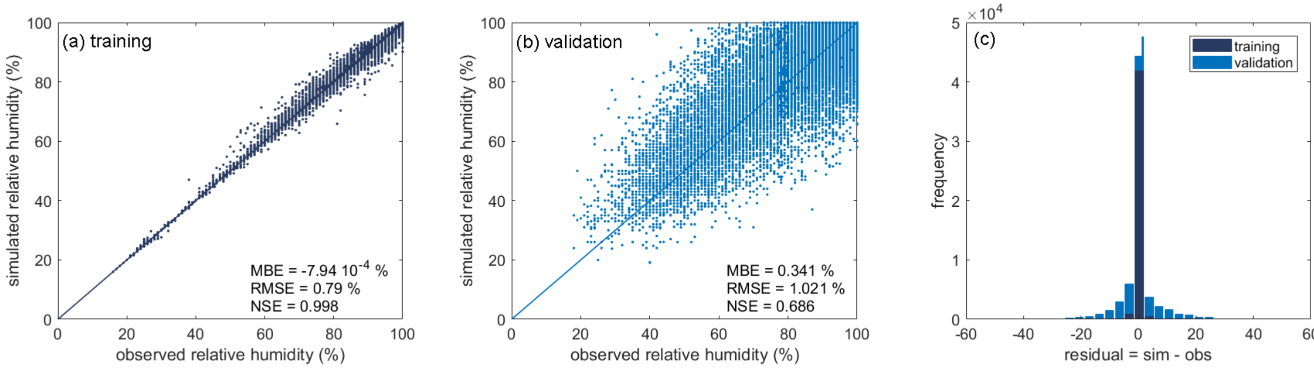


Figure S4: Measured vs predicted relative humidity for the (a) training and (b) validation data sets, and (c) frequency distribution of relative humidity residuals.

S1.2.4. Wind speed GRNN.

The GRNN model to predict hourly wind speed required five geographical variables: latitude, longitude, hour, day and month, and one climate variable: mean daily wind speed.

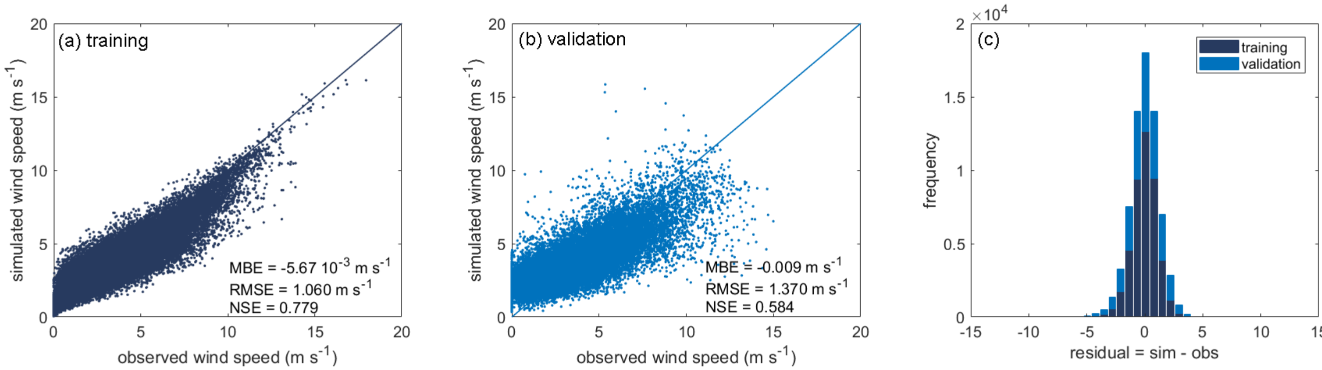


Figure S5. Measured vs predicted wind speed for the (a) training and (b) validation data sets, and (c) frequency distribution of wind speed residuals.

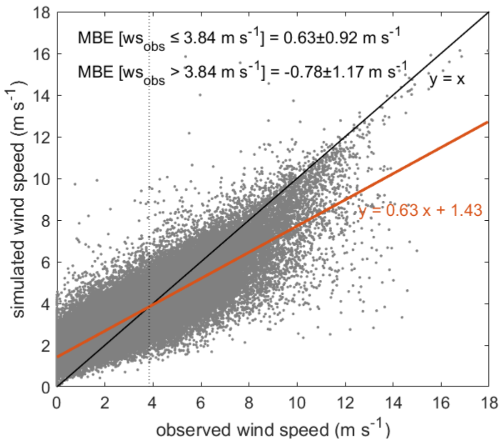


Figure S6. MBE of wind speed predictions using GRNN model.

S2. Lake model performance

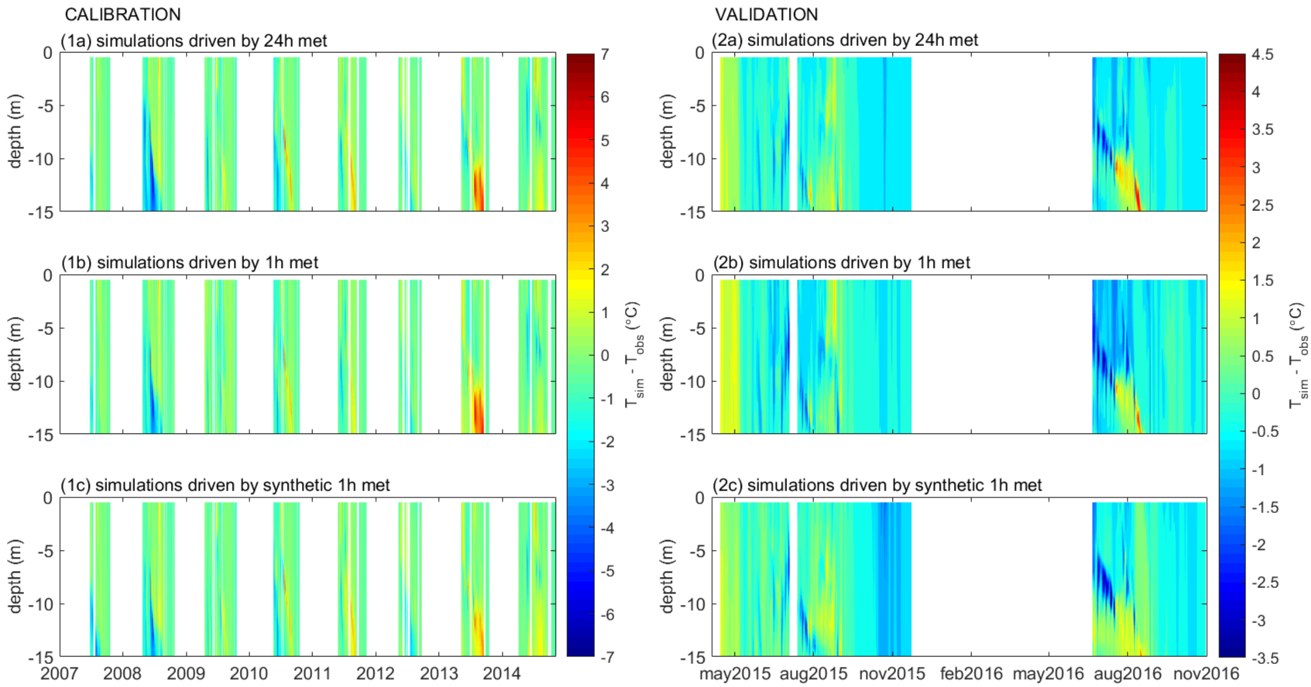


Figure S7. Daily differences between GOTM simulated and observed water temperature in Lake Erken for the calibration (1a)-(1b)-(1c) and validation (2a)-(2b)-(2c) periods: simulations driven by (1a)-(2a) daily meteorological data, (1b)-(2b) hourly meteorological data and (1c)-(2c) synthetic hourly meteorological data.

S3. Climate data projections

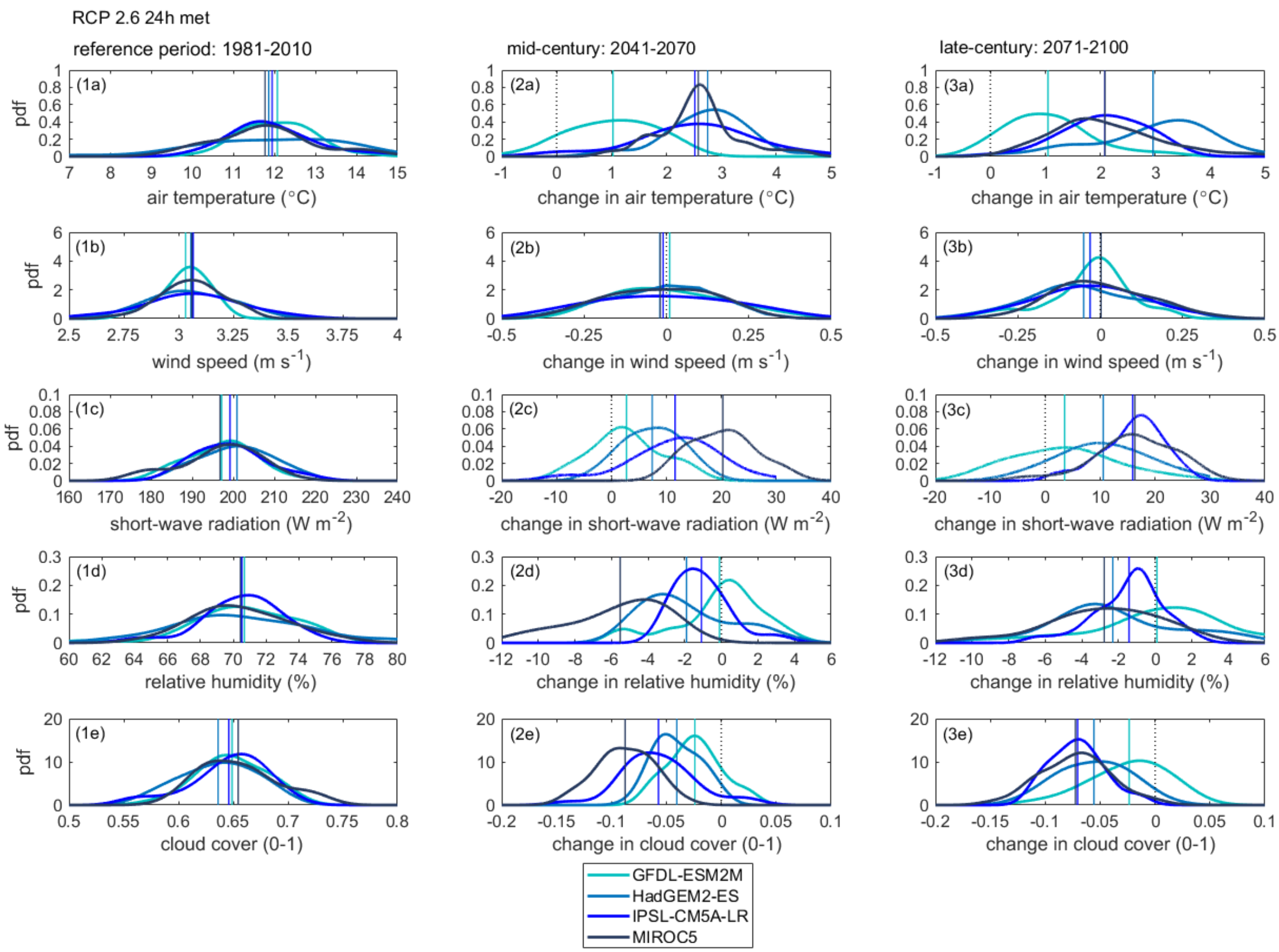


Figure S8. Changes in annually averaged climate model data (from April to September) (2a)-(3a) air temperature, (2b)-(3b) wind speed, (2c)-(3c) short-wave radiation, (2d)-(3d) relative humidity and (2e)-(3e) cloud cover under RCP 2.6, from daily GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.

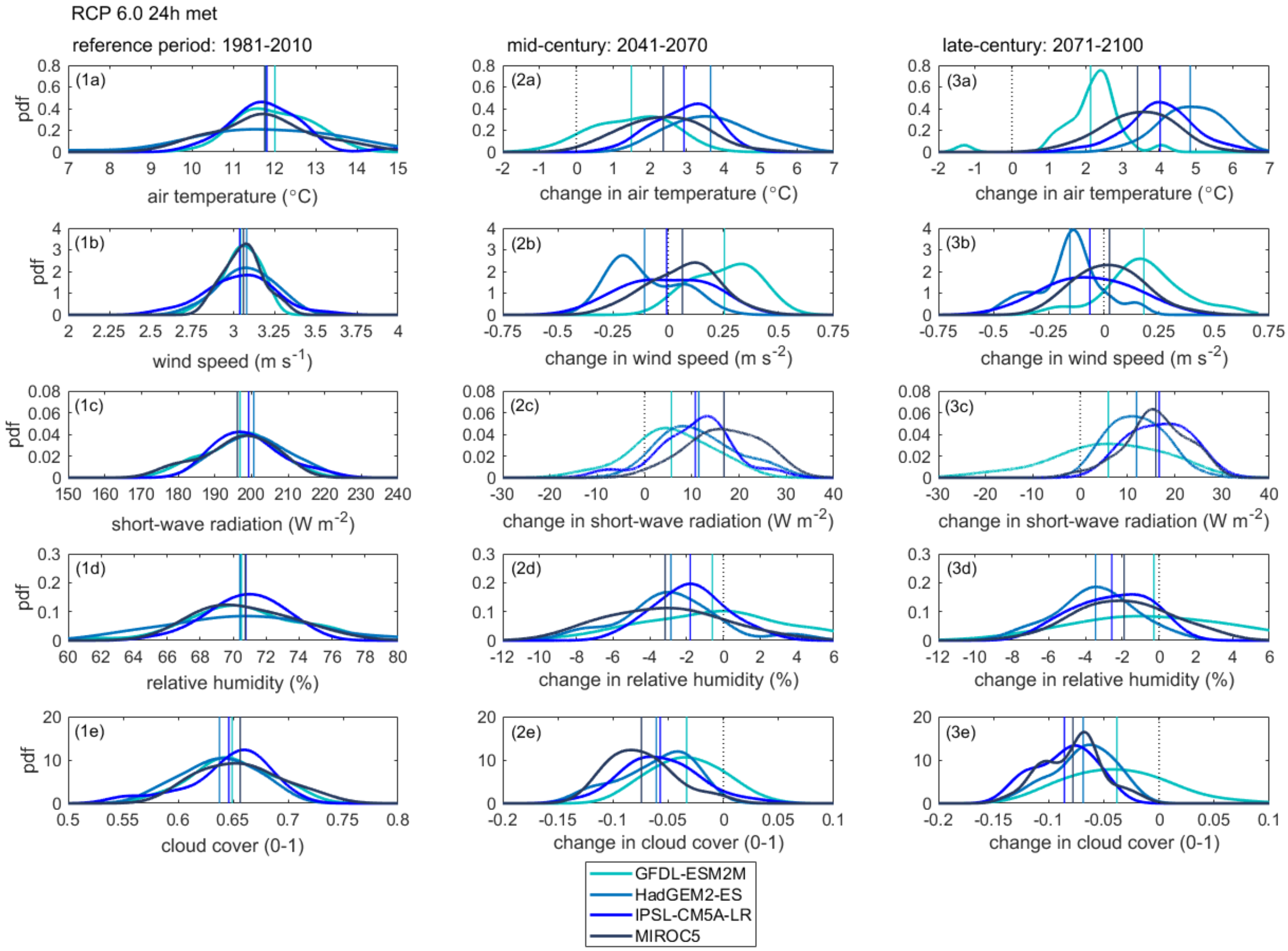


Figure S9. Changes in annually averaged climate model data (from April to September) (2a)-(3a) air temperature, (2b)-(3b) wind speed, (2c)-(3c) short-wave radiation, (2d)-(3d) relative humidity and (2e)-(3e) cloud cover under RCP 6.0, from daily GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.

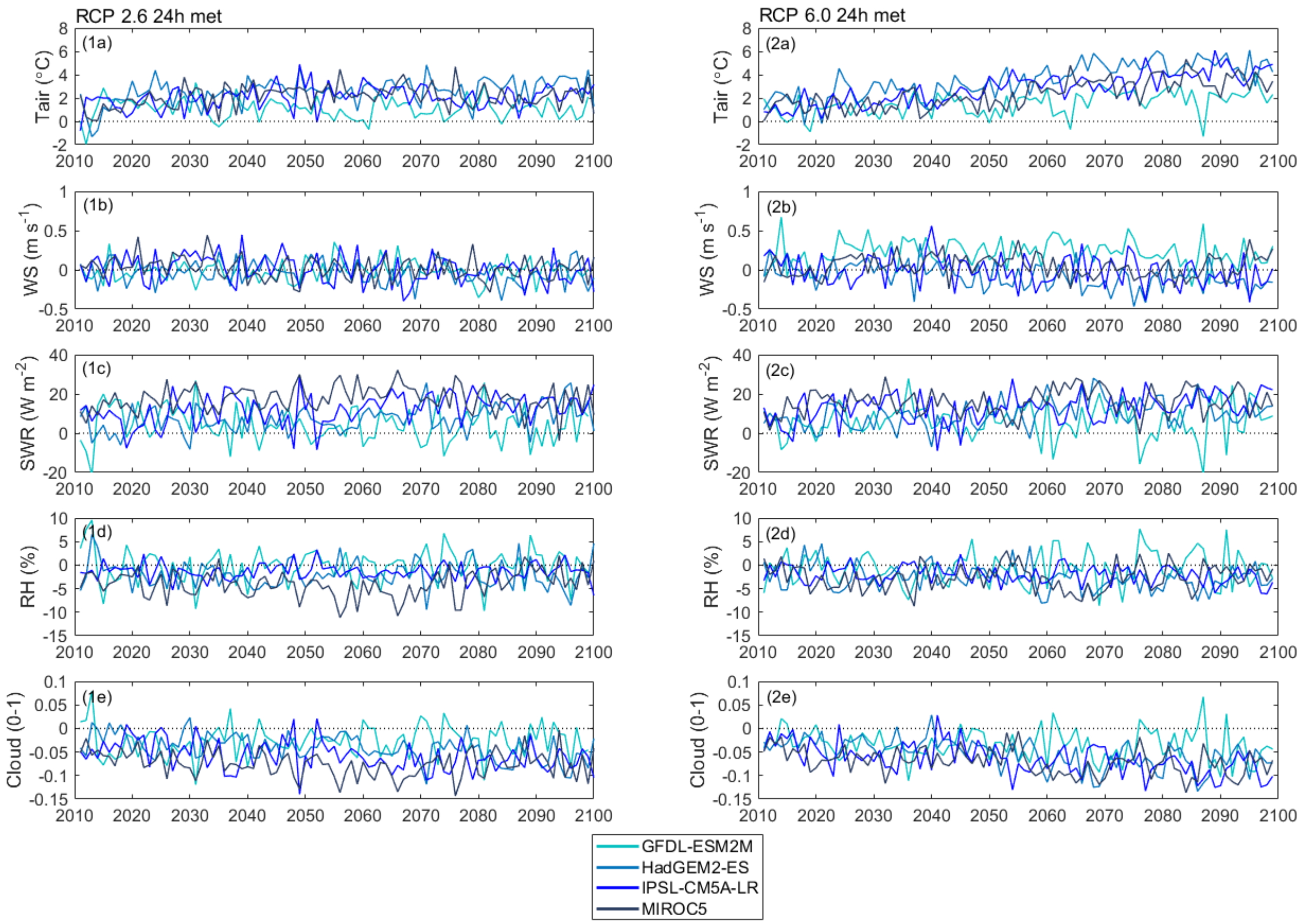


Figure S10. Evolution of annual averaged projected anomalies (from April to September) for (1a)-(2a) air temperature, (1b)-(2b) wind speed, (1c)-(2c) short-wave radiation, (1d)-(2d) relative humidity and (1e)-(2e) cloud cover from daily GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections from 2011 to 2100 under RCP 2.6 and 6.0. Anomalies are relative to reference period (1981-2010).

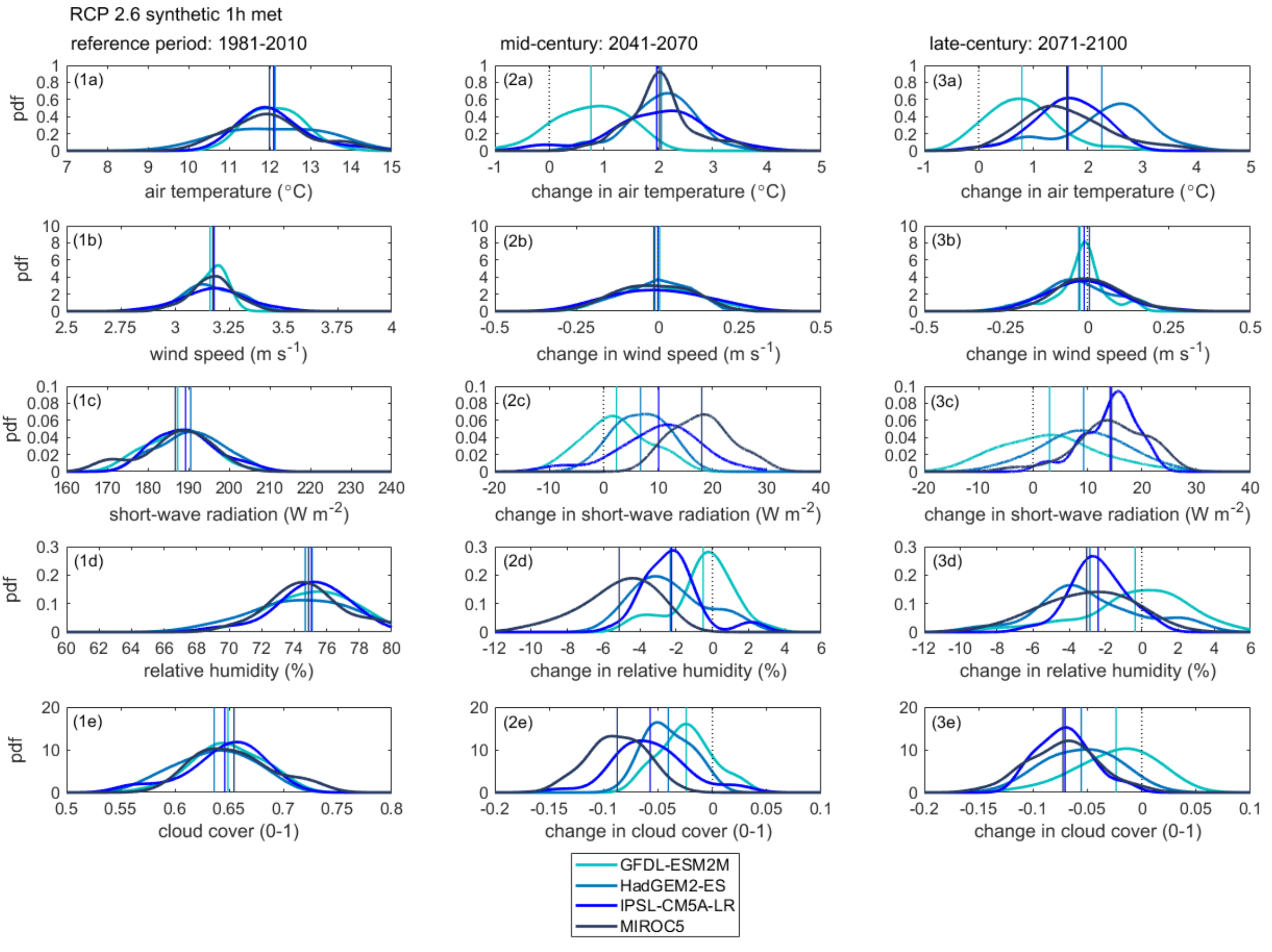


Figure S11. Changes in annually averaged climate model data (from April to September) (2a)-(3a) air temperature, (2b)-(3b) wind speed, (2c)-(3c) short-wave radiation, (2d)-(3d) relative humidity and (2e)-(3e) cloud cover under RCP 2.6, from synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.

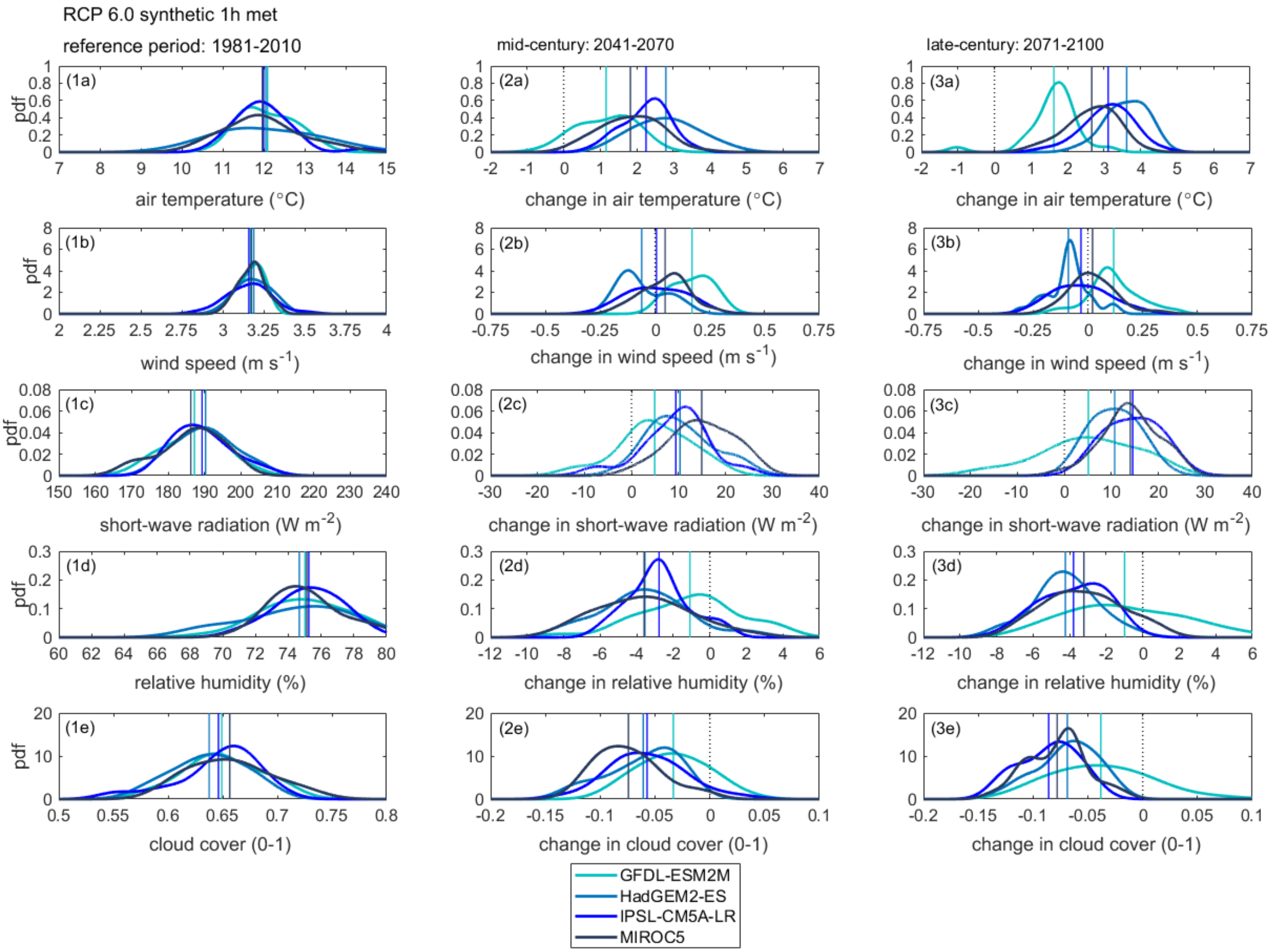


Figure S12. Changes in annually averaged climate model data (from April to September) (2a)-(3a) air temperature, (2b)-(3b) wind speed, (2c)-(3c) short-wave radiation, (2d)-(3d) relative humidity and (2e)-(3e) cloud cover under RCP 6.0, from synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.

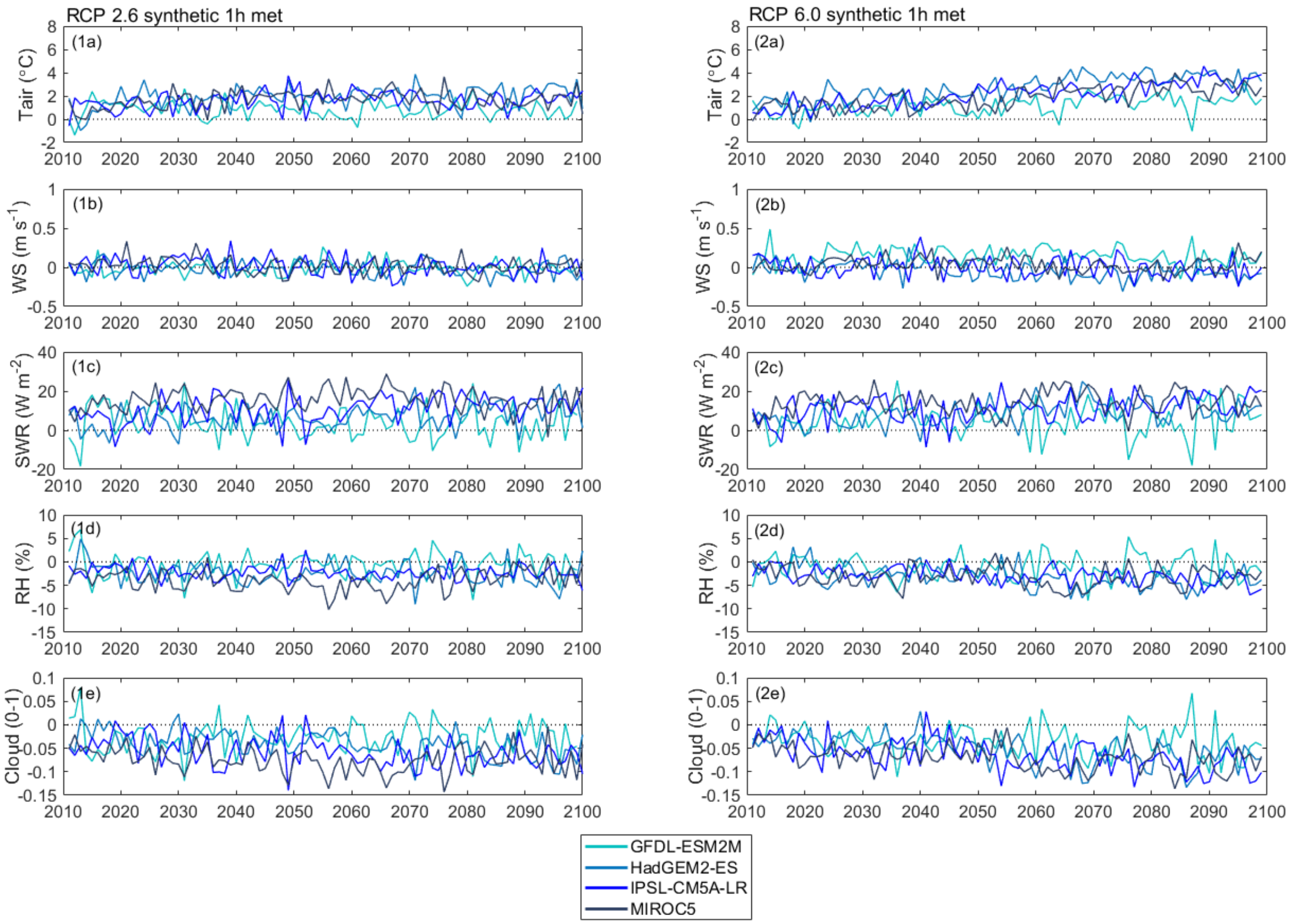


Figure S13. Evolution of annual averaged projected anomalies (from April to September) for (1a)-(2a) air temperature, (1b)-(2b) wind speed, (1c)-(2c) short-wave radiation, (1d)-(2d) relative humidity and (1e)-(2e) cloud cover from synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections from 2011 to 2100 under RCP 2.6 and 6.0. Anomalies are relative to reference period (1981-2010).

Table S1. Average climate model data for reference period (1981-2010), and average projected change in climate model data for mid-century and late-century for RCP 2.6.

		RCP 2.6					
		24hMet			synthetic 1hMet		
		reference period	mid-century	late-century	reference period	mid-century	late-century
air temperature (ºC)	GFDL-ESM2M	12.07	1.03	1.05	12.14	0.77	0.79
	HadGEM2-ES	11.86	2.75	2.96	12.10	2.06	2.27
	IPSL-CM5A-LR	11.95	2.52	2.08	12.10	1.98	1.64
	MIROC5	11.78	2.58	2.09	11.99	2.03	1.62
	ensemble	11.92	2.22	2.05	12.08	1.71	1.58
wind speed ($m\ s^{-1}$)	GFDL-ESM2M	3.03	0.01	-0.03	3.16	0.01	-0.02
	HadGEM2-ES	3.06	-0.02	-0.05	3.17	-0.01	-0.03
	IPSL-CM5A-LR	3.07	-0.01	-0.03	3.18	0.00	-0.01
	MIROC5	3.06	-0.02	0.00	3.18	-0.01	0.01
	ensemble	3.05	-0.01	-0.03	3.17	0.00	-0.01
relative humidity (%)	GFDL-ESM2M	70.68	-0.10	0.10	75.11	-0.51	-0.37
	HadGEM2-ES	70.47	-1.90	-2.31	74.69	-2.32	-2.86
	IPSL-CM5A-LR	70.53	-1.09	-1.42	75.07	-2.25	-2.41
	MIROC5	70.44	-5.53	-2.78	74.89	-5.14	-3.05
	ensemble	70.53	-2.15	-1.60	74.94	-2.56	-2.17
short-wave radiation ($W\ m^{-2}$)	GFDL-ESM2M	197.16	2.74	3.52	187.37	2.35	3.04
	HadGEM2-ES	200.92	7.41	10.56	190.56	6.79	9.31
	IPSL-CM5A-LR	199.22	11.57	15.92	189.30	10.12	14.17
	MIROC5	196.79	20.27	16.31	186.79	18.05	14.44
	ensemble	198.52	10.50	11.58	188.50	9.33	10.24
cloud cover (0-1)	GFDL-ESM2M	0.65	-0.02	-0.02	0.65	-0.02	-0.02
	HadGEM2-ES	0.64	-0.04	-0.06	0.64	-0.04	-0.06
	IPSL-CM5A-LR	0.65	-0.06	-0.07	0.65	-0.06	-0.07
	MIROC5	0.65	-0.09	-0.07	0.65	-0.09	-0.07
	ensemble	0.65	-0.05	-0.06	0.65	-0.05	-0.06

Table S2.Trend analysis from 2011-2100 for air temperature, wind speed, relative humidity, short-wave radiation and cloud cover (ns: not significant) for RCP 2.6.

		RCP 2.6			
		24h met		synthetic 1h met	
		rate ($decade^{-1}$)	p-value	rate ($decade^{-1}$)	p-value
air temperature (ºC)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	0.17	< 0.001	0.14	< 0.001
	IPSL-CM5A-LR	0.10	< 0.05	0.08	< 0.05
	MIROC5	*0.08*	*0.05*	*0.06*	*0.05*
wind speed ($m\ s^{-1}$)	GFDL-ESM2M		ns		ns
	HadGEM2-ES		ns		ns
	IPSL-CM5A-LR	-0.02	< 0.05	-0.01	< 0.05
	MIROC5		ns		ns
relative humidity (%)	GFDL-ESM2M		ns		ns
	HadGEM2-ES		ns		ns
	IPSL-CM5A-LR		ns		ns
	MIROC5		ns		ns
short-wave radiation ($W\ m^{-2}$)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	0.99	< 0.001	0.85	< 0.001
	IPSL-CM5A-LR	1.09	< 0.001	0.99	< 0.001
	MIROC5		ns		ns
cloud cover (0-1)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	-0.005	< 0.001	-0.005	< 0.001
	IPSL-CM5A-LR	-0.004	< 0.001	-0.004	< 0.001
	MIROC5		ns		ns

Table S3. 5th, 25th, 50th, 75th and 95th percentiles from 2011-2100 for air temperature, wind speed, short-wave radiation, relative humidity and cloud cover for RCP 2.6.

		RCP 2.6									
		24h met					synthetic 1h met				
		p5	p25	p50	p75	p95	p5	p25	p50	p75	p95
air temperature (ºC)	GFDL-ESM2M	-0.09	0.56	1.10	1.62	2.60	-0.19	0.40	0.87	1.28	1.92
	HadGEM2-ES	0.49	1.97	2.69	3.33	4.00	0.32	1.46	2.02	2.58	3.17
	IPSL-CM5A-LR	0.25	1.64	2.08	2.73	3.53	0.18	1.27	1.60	2.17	2.67
	MIROC5	0.52	1.52	2.19	2.70	3.78	0.40	1.12	1.67	2.11	3.08
wind speed ($m\ s^{-1}$)	GFDL-ESM2M	-0.22	-0.11	-0.02	0.06	0.23	-0.15	-0.07	-0.02	0.04	0.15
	HadGEM2-ES	-0.28	-0.14	-0.02	0.07	0.20	-0.19	-0.09	0.00	0.05	0.14
	IPSL-CM5A-LR	-0.29	-0.13	0.01	0.13	0.31	-0.18	-0.08	0.01	0.10	0.23
	MIROC5	-0.20	-0.08	0.03	0.12	0.23	-0.14	-0.06	0.02	0.08	0.16
short-wave radiation ($W\ m^{-2}$)	GFDL-ESM2M	-9.36	-2.11	2.92	11.53	18.58	-8.90	-2.09	2.83	10.33	16.55
	HadGEM2-ES	-3.73	2.96	7.68	11.95	18.19	-4.39	2.92	6.77	10.85	15.65
	IPSL-CM5A-LR	-0.28	7.09	13.14	17.71	23.76	0.01	6.18	11.49	16.03	21.04
	MIROC5	7.55	13.27	17.32	22.41	29.46	7.63	11.66	15.87	19.92	24.88
relative humidity (%)	GFDL-ESM2M	-6.34	-2.45	0.28	2.00	4.64	-5.73	-2.10	-0.41	1.03	3.01
	HadGEM2-ES	-5.80	-3.84	-2.35	-0.29	3.75	-5.45	-4.16	-2.47	-0.92	2.26
	IPSL-CM5A-LR	-4.20	-2.42	-1.14	-0.45	1.82	-4.42	-3.20	-2.33	-1.41	0.74
	MIROC5	-9.55	-5.87	-3.67	-1.95	0.63	-7.92	-5.54	-3.85	-2.36	-0.52
cloud cover (0-1)	GFDL-ESM2M	-0.08	-0.05	-0.02	-0.01	0.02	-0.08	-0.05	-0.02	-0.01	0.02
	HadGEM2-ES	-0.09	-0.06	-0.04	-0.02	0.01	-0.09	-0.06	-0.04	-0.02	0.01
	IPSL-CM5A-LR	-0.10	-0.08	-0.06	-0.04	0.00	-0.10	-0.08	-0.06	-0.04	0.00
	MIROC5	-0.12	-0.10	-0.07	-0.06	-0.03	-0.12	-0.10	-0.07	-0.06	-0.03

Table S4. Average climate model data for reference period (1981-2010), and average projected change in climate model data for mid-century and late-century for RCP 6.0.

		RCP 6.0					
		24hMet			synthetic 1hMet		
		reference period	mid-century	late-century	reference period	mid-century	late-century
air temperature (ºC)	GFDL-ESM2M	12.02	1.50	2.14	12.09	1.16	1.63
	HadGEM2-ES	11.78	3.65	4.85	12.05	2.80	3.62
	IPSL-CM5A-LR	11.82	2.93	4.03	12.00	2.25	3.11
	MIROC5	11.77	2.37	3.42	11.97	1.83	2.66
	ensemble	11.85	2.61	3.61	12.03	2.01	2.76
wind speed (m s^{-1})	GFDL-ESM2M	3.05	0.25	0.18	3.17	0.17	0.12
	HadGEM2-ES	3.08	-0.11	-0.15	3.19	-0.06	-0.09
	IPSL-CM5A-LR	3.04	-0.01	-0.06	3.16	0.01	-0.03
	MIROC5	3.06	0.06	0.03	3.18	0.05	0.02
	ensemble	3.06	0.05	0.00	3.17	0.04	0.00
relative humidity (%)	GFDL-ESM2M	70.50	-0.60	-0.28	75.02	-1.09	-0.99
	HadGEM2-ES	70.41	-2.85	-3.45	74.67	-3.56	-4.23
	IPSL-CM5A-LR	70.77	-1.80	-2.57	75.25	-2.78	-3.79
	MIROC5	70.74	-3.17	-1.90	75.13	-3.59	-3.22
	ensemble	70.61	-2.11	-2.05	75.02	-2.75	-3.06
short-wave radiation (W m^{-2})	GFDL-ESM2M	196.88	5.67	5.94	187.22	4.94	5.10
	HadGEM2-ES	200.64	11.47	11.91	190.29	10.33	10.70
	IPSL-CM5A-LR	199.23	10.73	16.70	189.35	9.43	14.55
	MIROC5	196.16	16.82	15.98	186.24	14.95	14.03
	ensemble	196.16	16.82	15.98	186.24	14.95	14.03
cloud cover (0-1)	GFDL-ESM2M	0.65	-0.03	-0.04	0.65	-0.03	-0.04
	HadGEM2-ES	0.64	-0.06	-0.07	0.64	-0.06	-0.07
	IPSL-CM5A-LR	0.65	-0.06	-0.09	0.65	-0.06	-0.09
	MIROC5	0.66	-0.07	-0.08	0.66	-0.07	-0.08
	ensemble	0.65	-0.06	-0.07	0.65	-0.06	-0.07

Table S5.Trend analysis from 2011-2100 for air temperature, wind speed, relative humidity, short-wave radiation and cloud cover (ns: not significant) for RCP 6.0.

		RCP 6.0			
		24h met		synthetic 1h met	
		rate (decade^{-1})	p-value	rate (decade^{-1})	p-value
air temperature (ºC)	GFDL-ESM2M	0.18	< 0.001	0.14	< 0.001
	HadGEM2-ES	0.43	< 0.001	0.32	< 0.001
	IPSL-CM5A-LR	0.42	< 0.001	0.33	< 0.001
	MIROC5	0.34	< 0.001	0.26	< 0.001
wind speed (m s^{-1})	GFDL-ESM2M		ns		ns
	HadGEM2-ES	-0.03	< 0.001	-0.02	< 0.001
	IPSL-CM5A-LR	-0.02	< 0.05	-0.01	< 0.05
	MIROC5		ns		ns
relative humidity (%)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	-0.27	< 0.01	-0.36	< 0.001
	IPSL-CM5A-LR	-0.16	< 0.05	-0.29	< 0.001
	MIROC5		ns		ns
short-wave radiation (W m^{-2})	GFDL-ESM2M		ns		ns
	HadGEM2-ES	1.10	< 0.001	0.97	< 0.001
	IPSL-CM5A-LR	0.96	< 0.01	0.87	< 0.01
	MIROC5		ns		ns
cloud cover (0-1)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	-0.007	< 0.001	-0.007	< 0.001
	IPSL-CM5A-LR	-0.006	< 0.001	-0.006	< 0.001
	MIROC5	-0.004	< 0.01	-0.004	< 0.01

Table S6. 5th, 25th, 50th, 75th and 95the percentiles from 2011-2100 for air temperature, wind speed, short-wave radiation, relative humidity and cloud cover for RCP 6.0.

		RCP 6.0									
		24h met					synthetic 1h met				
		p5	p25	p50	p75	p95	p5	p25	p50	p75	p95
air temperature (ºC)	GFDL-ESM2M	-0.13	0.96	1.60	2.31	2.86	-0.02	0.72	1.26	1.76	2.23
	HadGEM2-ES	1.09	2.49	3.59	4.66	5.83	0.76	1.88	2.74	3.49	4.28
	IPSL-CM5A-LR	0.76	1.74	2.91	3.78	4.75	0.54	1.36	2.26	2.93	3.72
	MIROC5	0.44	1.52	2.42	3.37	4.26	0.36	1.20	1.89	2.66	3.36
wind speed (m s^{-1})	GFDL-ESM2M	-0.08	0.10	0.20	0.34	0.51	-0.07	0.07	0.14	0.23	0.32
	HadGEM2-ES	-0.36	-0.20	-0.10	0.03	0.18	-0.22	-0.12	-0.07	0.03	0.14
	IPSL-CM5A-LR	-0.30	-0.15	-0.02	0.15	0.27	-0.19	-0.10	-0.01	0.11	0.20
	MIROC5	-0.19	-0.06	0.04	0.15	0.27	-0.12	-0.03	0.03	0.10	0.20
short-wave radiation (W m^{-2})	GFDL-ESM2M	-10.59	1.08	5.83	11.70	20.37	-10.17	1.18	4.91	10.59	18.34
	HadGEM2-ES	-0.88	5.15	9.35	14.12	23.82	-1.10	4.57	8.09	12.88	21.38
	IPSL-CM5A-LR	-0.09	8.17	13.60	18.86	24.18	-1.03	6.83	12.08	16.37	21.60
	MIROC5	5.29	12.18	15.96	20.76	26.59	4.96	10.57	14.23	18.35	24.58
relative humidity (%)	GFDL-ESM2M	-6.13	-2.91	-0.21	1.68	5.18	-5.37	-2.79	-1.11	0.69	2.96
	HadGEM2-ES	-6.95	-4.30	-3.00	-1.21	2.01	-7.11	-4.80	-3.40	-1.90	0.97
	IPSL-CM5A-LR	-5.26	-3.35	-2.11	-0.45	0.88	-5.83	-3.92	-2.80	-1.99	-0.16
	MIROC5	-7.14	-4.83	-2.71	-0.70	2.12	-6.78	-4.74	-3.46	-1.73	0.44
cloud cover (0-1)	GFDL-ESM2M	-0.09	-0.05	-0.04	-0.01	0.02	-0.09	-0.05	-0.04	-0.01	0.02
	HadGEM2-ES	-0.12	-0.07	-0.05	-0.03	-0.01	-0.12	-0.07	-0.05	-0.03	-0.01
	IPSL-CM5A-LR	-0.12	-0.09	-0.07	-0.04	-0.01	-0.12	-0.09	-0.07	-0.04	-0.01
	MIROC5	-0.12	-0.09	-0.07	-0.05	-0.02	-0.12	-0.09	-0.07	-0.05	-0.02

S4. Long-term modelled changes in thermal stratification

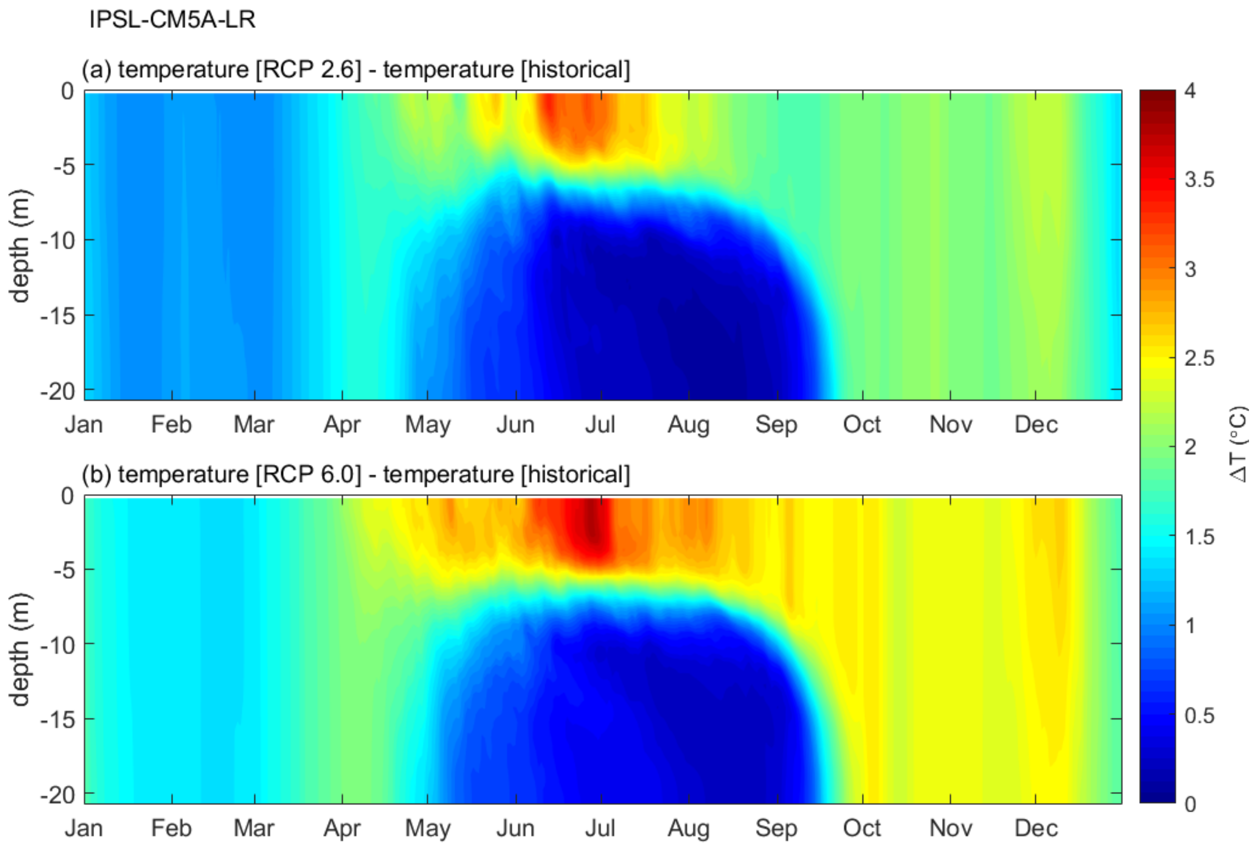
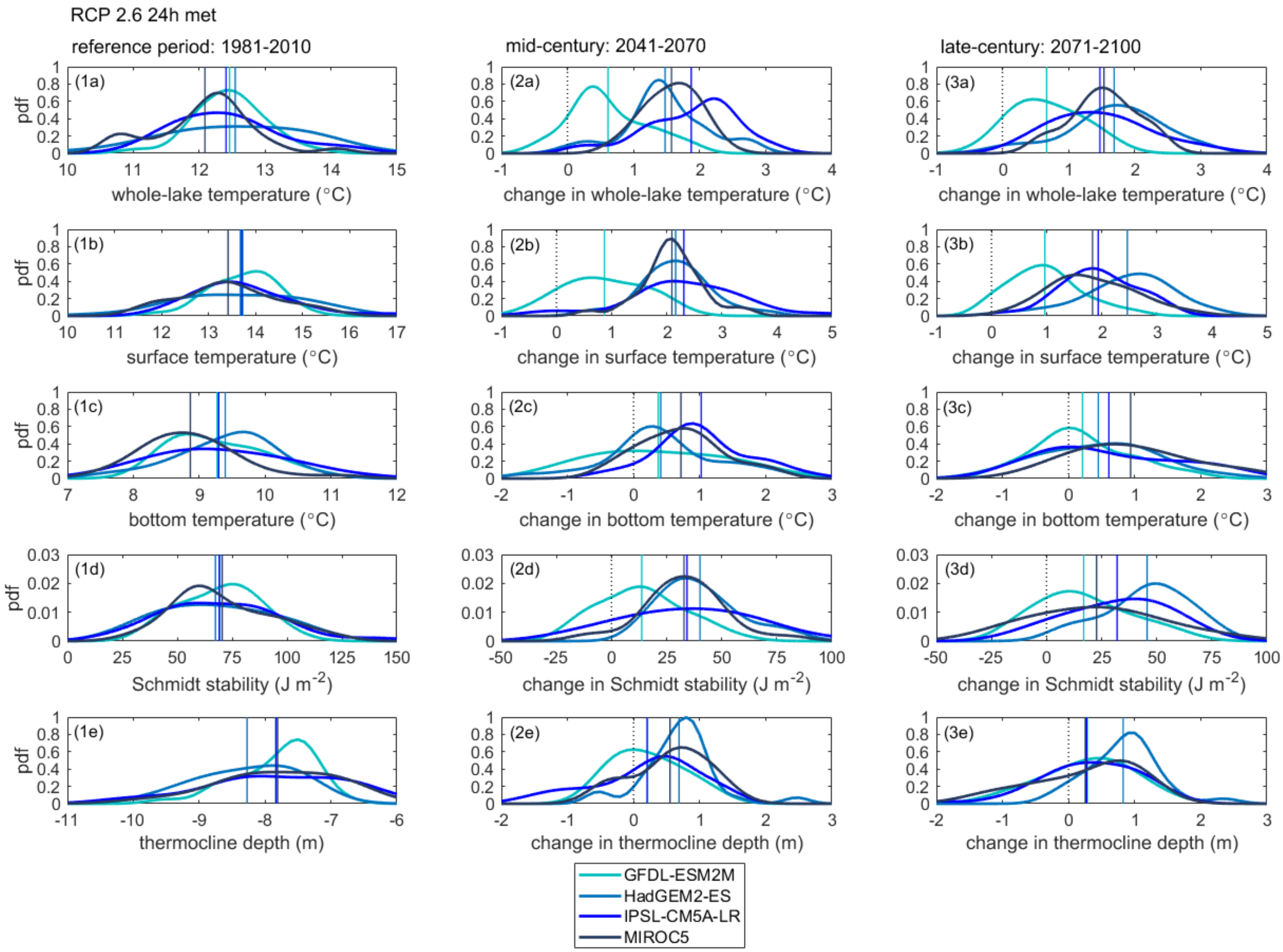


Figure S14. Temperature differences between (a) RCP 2.6 and historical scenarios and (b) RCP 6.0 and historical scenarios from the lake model forced with daily IPSL-CM5A-LR projections



145 **Figure S15. Changes in annually averaged thermal metrics (from April to September) (2a)-(3a) whole-lake temperature, (2b)-(3b) surface temperature, (2c)-(3c) bottom temperature, (2d)-(3d) Schmidt stability and (2e)-(3e) thermocline depth under RCP 2.6, showing results when the lake model was forced with daily GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.**

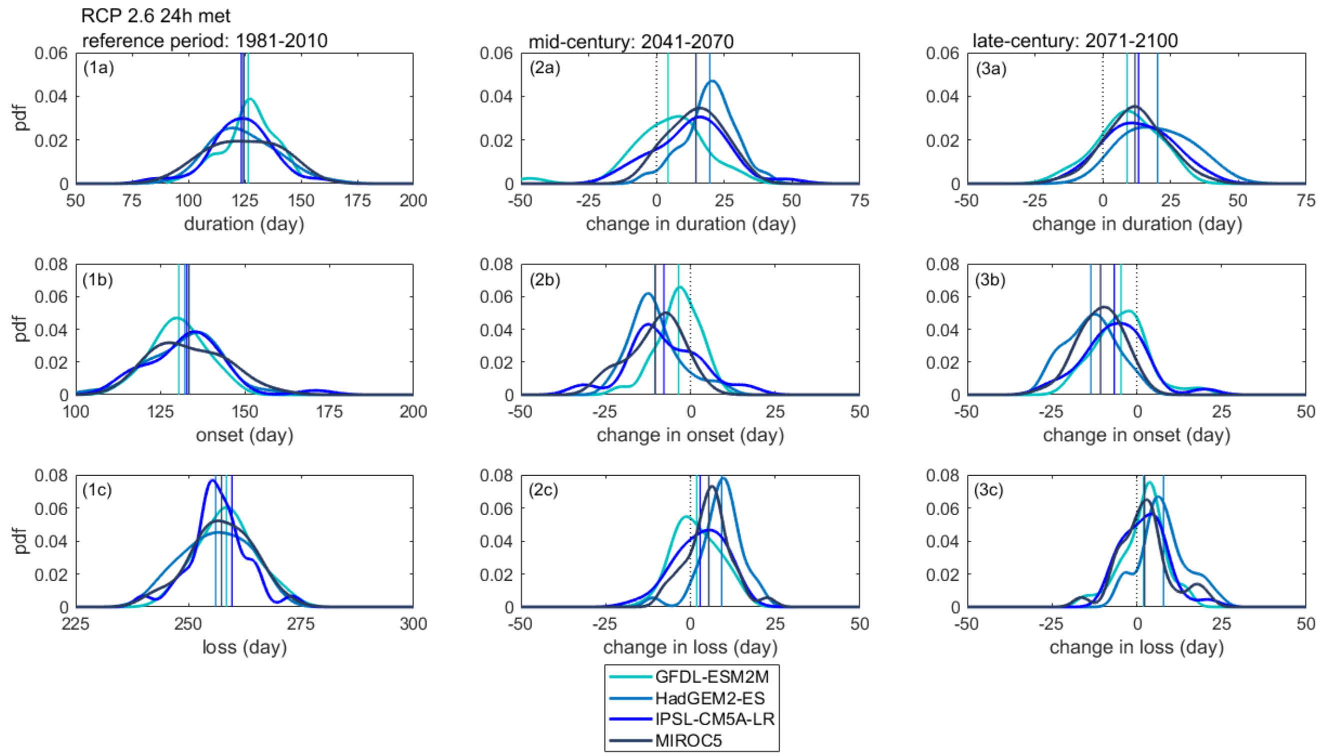


Figure S16. Changes in annually averaged thermal metrics (from April to September) (2a)-(3a) duration, (2b)-(3b) onset and (2c)-(3c) loss of stratification under RCP 2.6, showing results when the lake model was forced with daily GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show and increase and lower than 0 show a decrease.

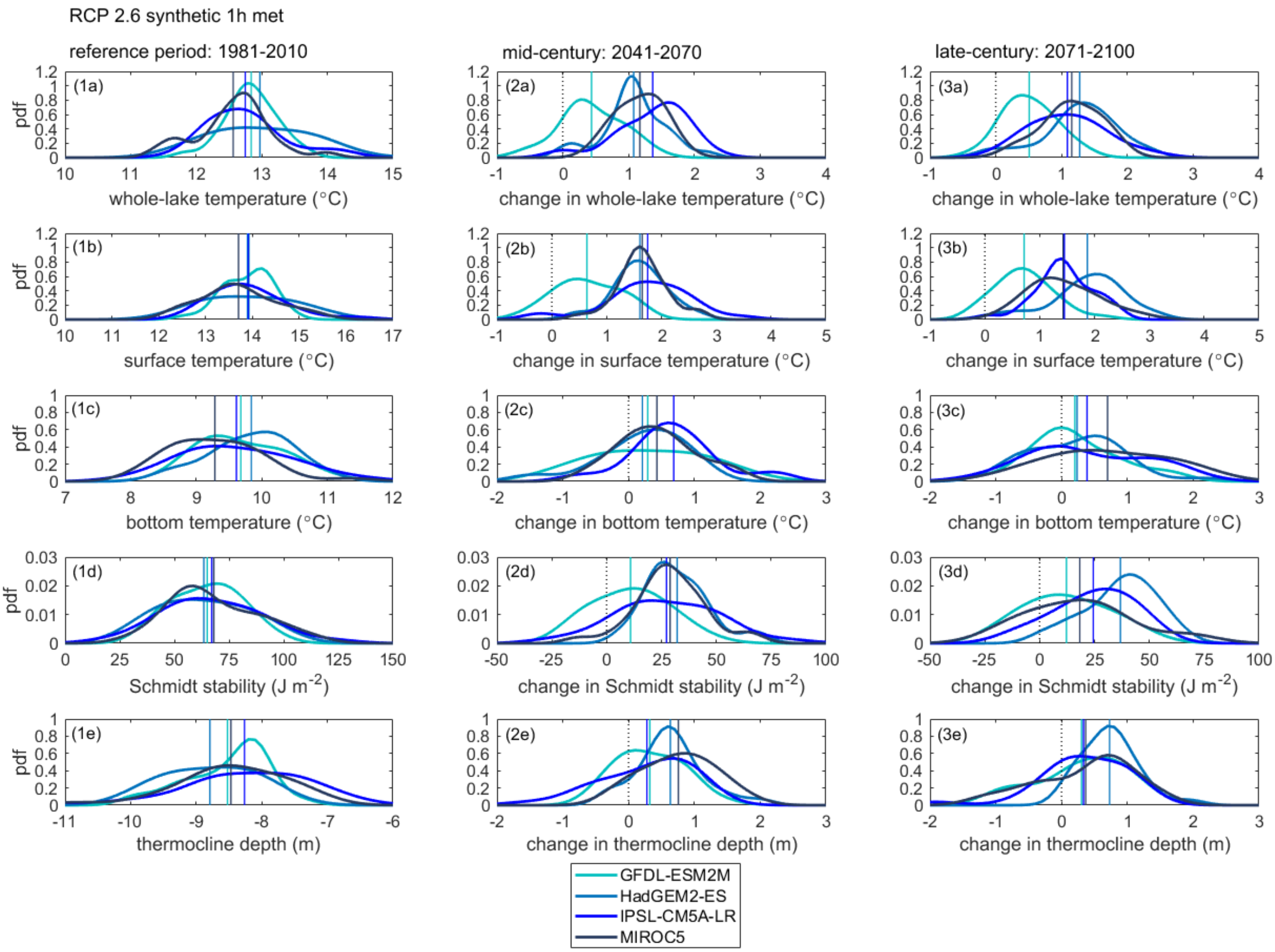


Figure S17. Changes in annually averaged thermal metrics (from April to September) (2a)-(3a) whole-lake temperature, (2b)-(3b) surface temperature, (2c)-(3c) bottom temperature, (2d)-(3d) Schmidt stability and (2e)-(3e) thermocline depth under RCP 2.6, showing results when the lake model was forced with synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.

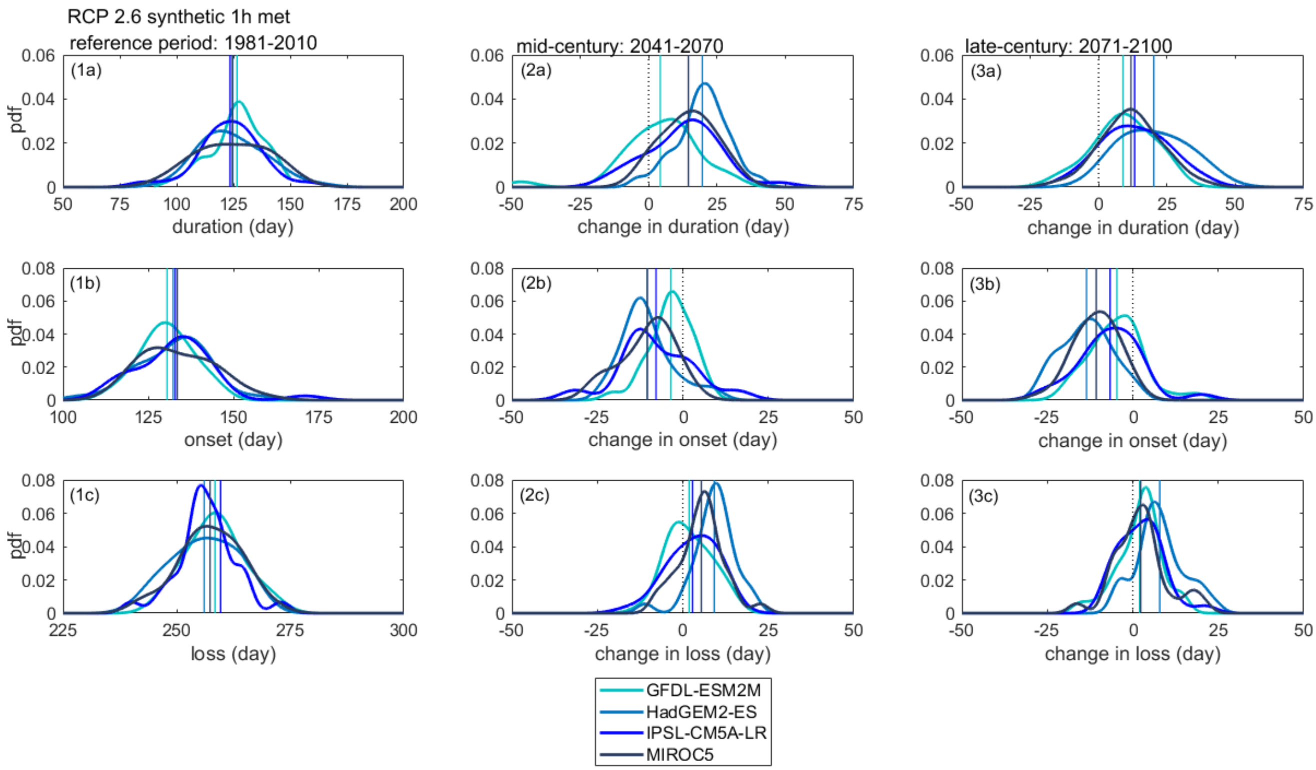


Figure S18. Changes in annually averaged thermal metrics (from April to September) (2a)-(3a) duration, (2b)-(3b) onset and (2c)-(3c) loss of stratification under RCP 2.6, showing results when the lake model was forced with synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show and increase and lower than 0 show a decrease.

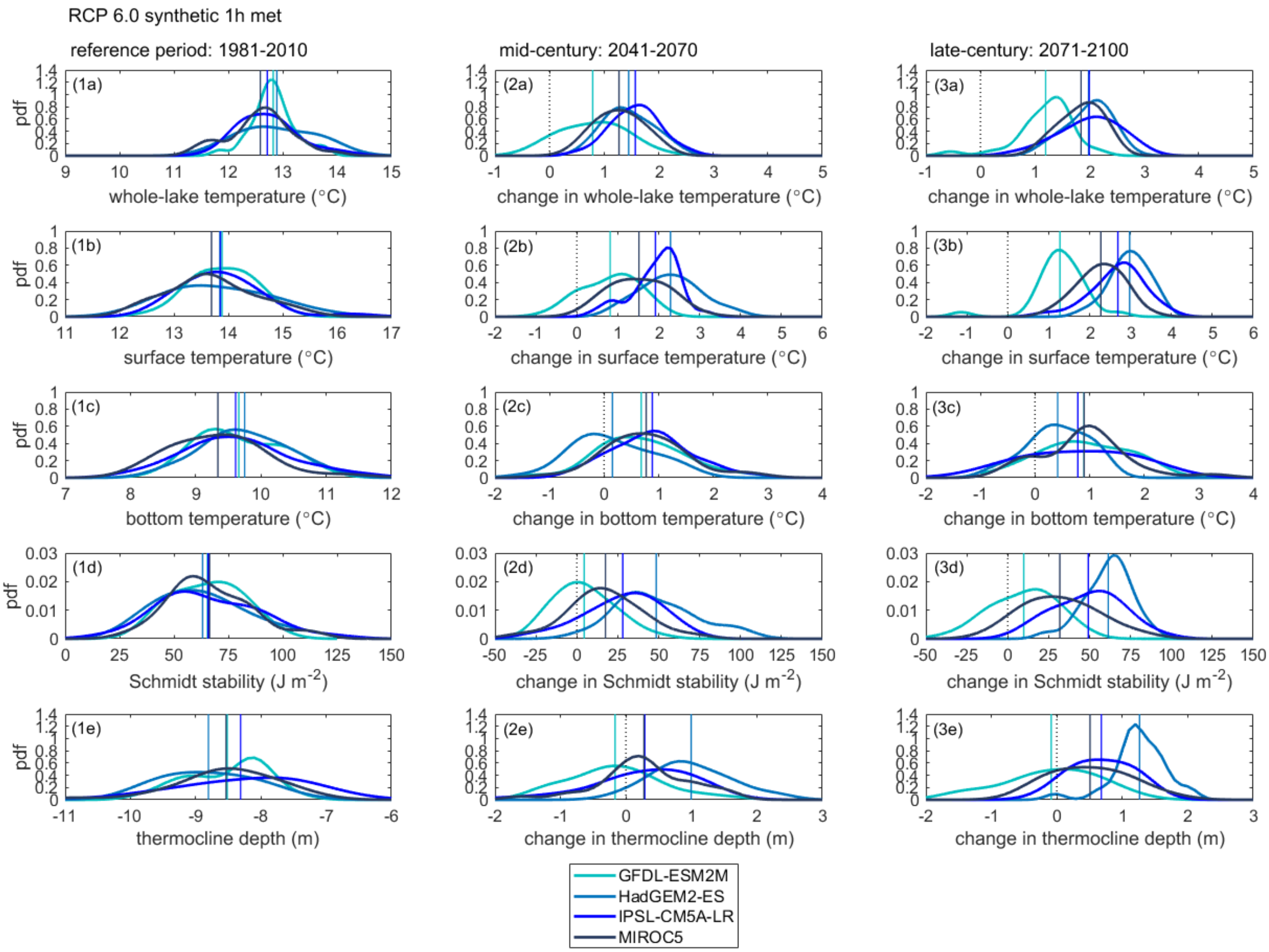


Figure S19. Changes in annually averaged thermal metrics (from April to September) (2a)-(3a) whole-lake temperature, (2b)-(3b) surface temperature, (2c)-(3c) bottom temperature, (2d)-(3d) Schmidt stability and (2e)-(3e) thermocline depth under RCP 6.0, showing results when the lake model was forced with synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show an increase and lower than 0 show a decrease.

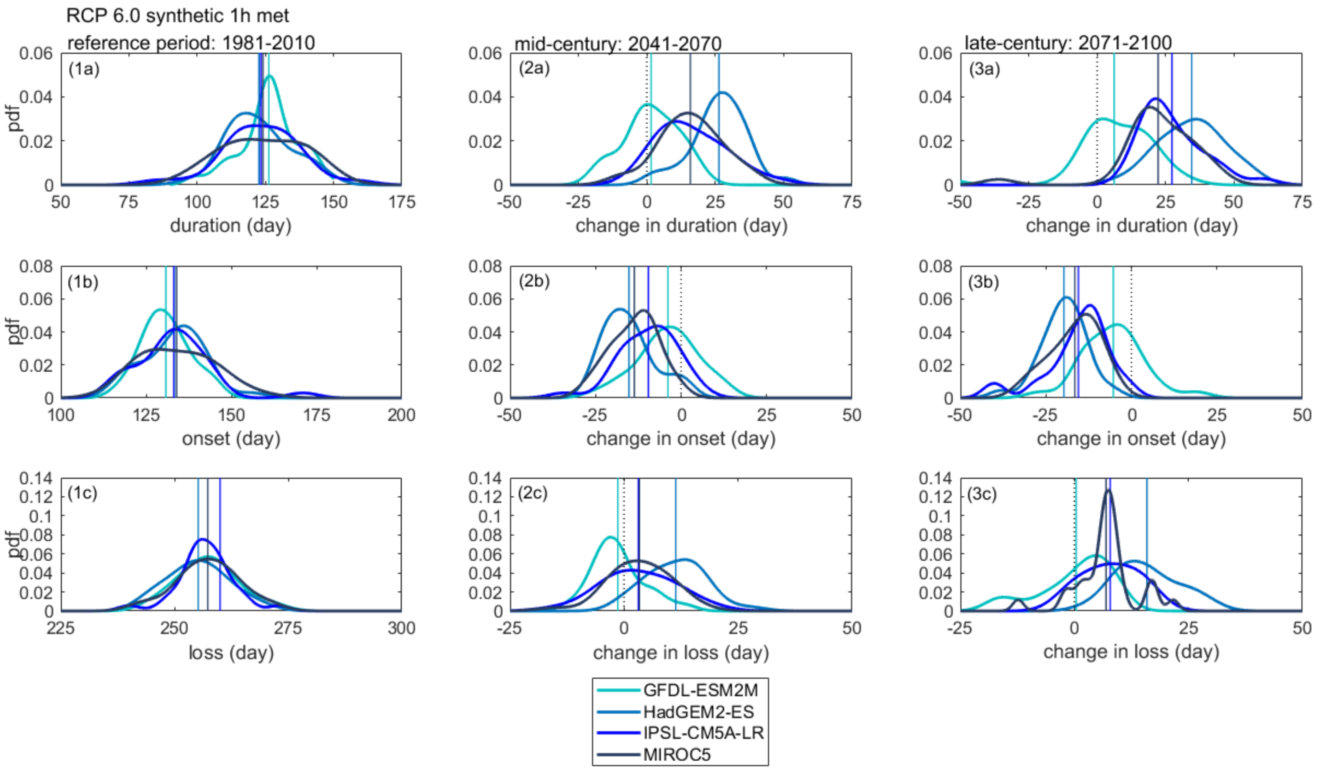


Figure S20. Changes in annually averaged thermal metrics (from April to September) (2a)-(3a) duration, (2b)-(3b) onset and (2c)-(3c) loss of stratification under RCP 6.0, showing results when the lake model was forced with synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections. All changes are for mid-century (2041-2070) and late-century (2071-2100) are relative to reference period (1981-2011). The mean (vertical line) is also shown. Changes in thermal metrics greater than 0 show and increase and lower than 0 show a decrease.

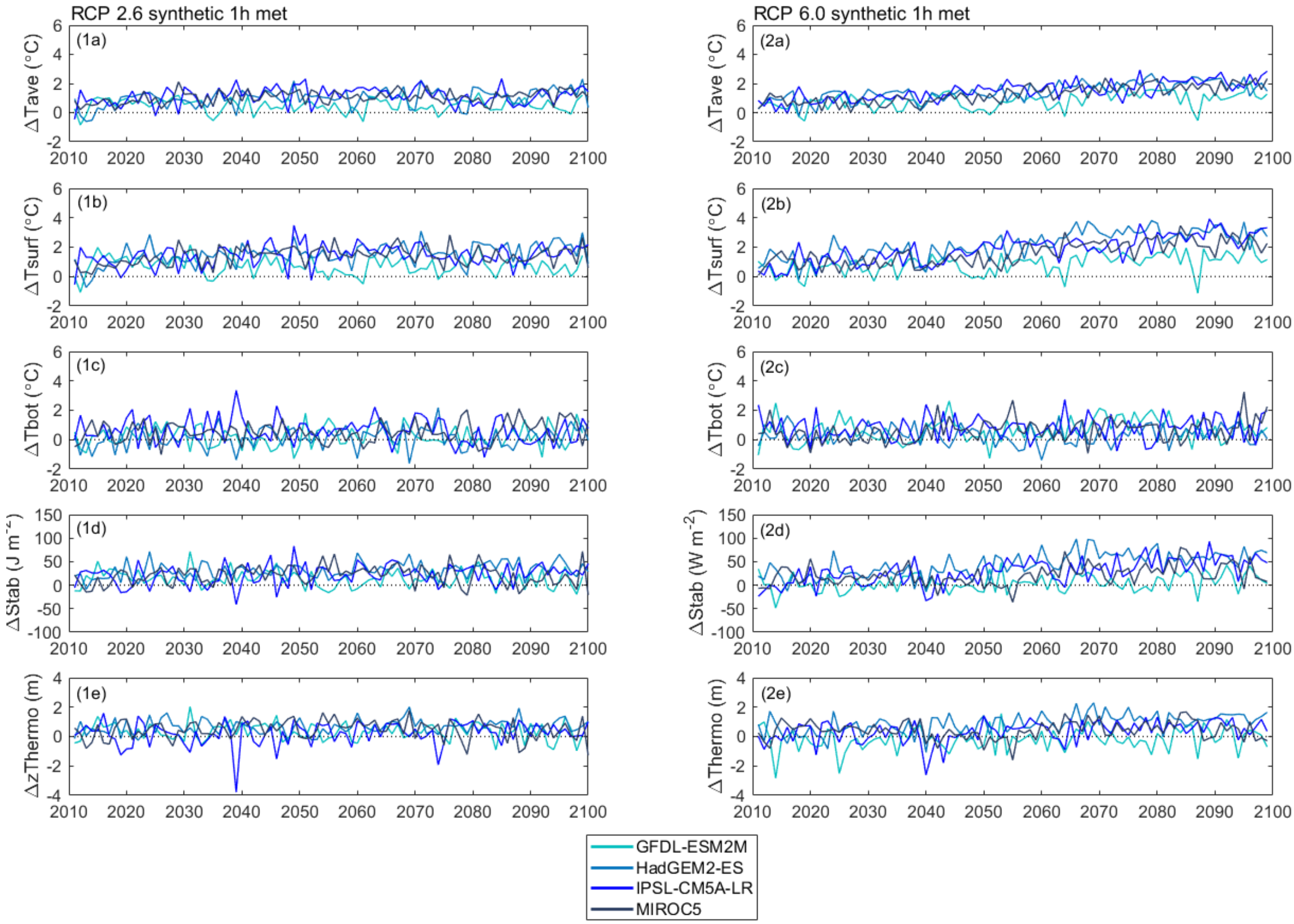


Figure S21. Evolution of annual average projected anomalies (from April to September) for (1a)-(2a) whole-lake temperature, (1b)-(2b) surface temperature, (1c)-(2c) bottom temperature, (1d)-(2d) Schmidt stability and (1e)-(2e) thermocline depth showing results when the lake model was forced with synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections from 2011 to 2100 under RCP 2.6 and 6.0. Anomalies are relative to reference period (1981-2010).

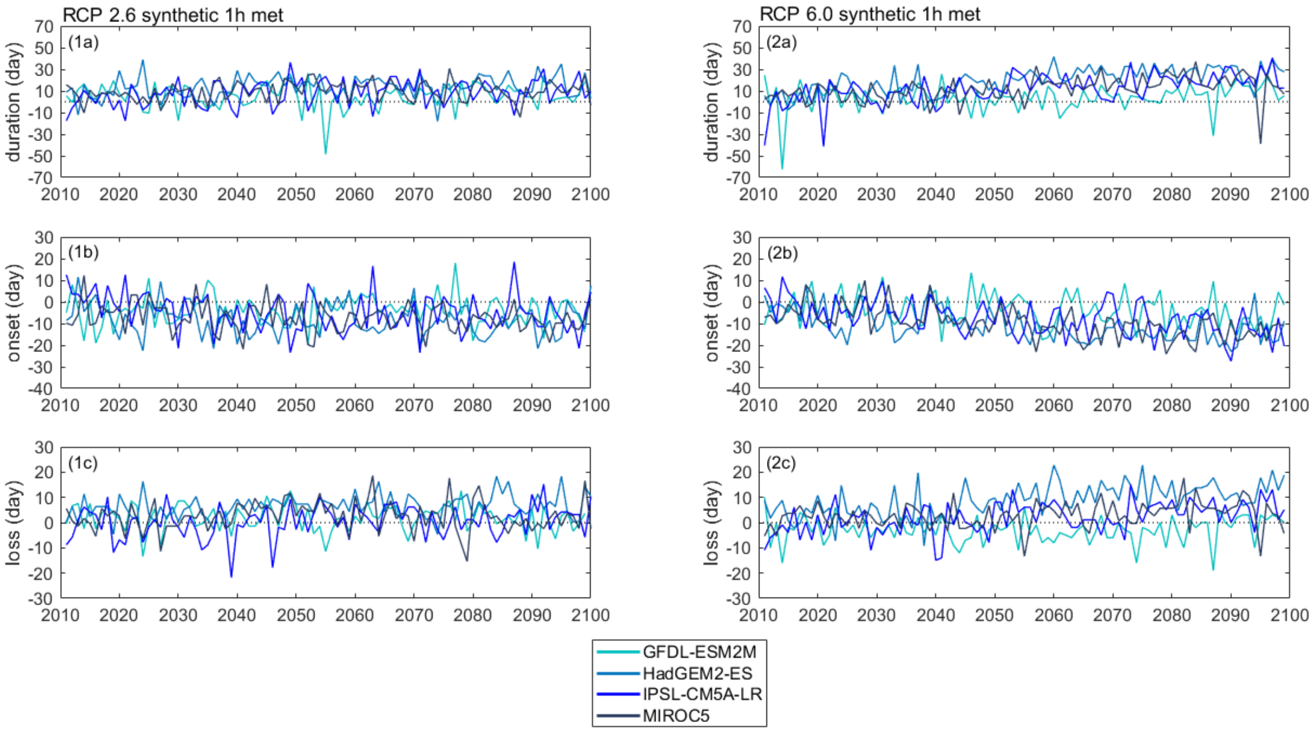


Figure S22. Evolution of annual average projected anomalies (from April to September) for (1a)-(2a) duration, (1b)-(2b) onset and (1c)-(2c) loss of stratification showing results when the lake model was forced with synthetic hourly GFDL-ESM2M, HadGEM2-ES, IPSL-CM5A-LR and MIROC5 projections from 2011 to 2100 under RCP 2.6 and 6.0. Anomalies are relative to reference period (1981-2010).

Table S7. Average thermal metrics for reference period (1981-2010), and average projected change in thermal metrics for mid-century and late-century for RCP 2.6

		RCP 2.6					
		24h met			synthetic 1h met		
		reference period	mid-century	late century	reference period	mid-century	late century
surface temperature (ºC)	GFDL-ESM2M	13.73	0.87	0.97	13.89	0.64	0.72
	HadGEM2-ES	13.67	2.16	2.43	13.92	1.61	1.84
	IPSL-CM5A-LR	13.71	2.31	1.97	13.91	1.75	1.47
	MIROC5	13.42	2.10	1.80	13.70	1.65	1.40
	ensemble	13.63	1.86	1.79	13.86	1.41	1.36
bottom temperature (ºC)	GFDL-ESM2M	9.27	0.37	0.21	9.68	0.29	0.20
	HadGEM2-ES	9.40	0.41	0.43	9.84	0.21	0.23
	IPSL-CM5A-LR	9.30	1.02	0.63	9.61	0.69	0.40
	MIROC5	8.87	0.72	0.96	9.29	0.43	0.72
	ensemble	9.21	0.63	0.56	9.60	0.41	0.39
whole-lake temperature (ºC)	GFDL-ESM2M	12.46	0.61	0.67	12.84	0.44	0.51
	HadGEM2-ES	12.55	1.48	1.65	12.97	1.08	1.25
	IPSL-CM5A-LR	12.41	1.87	1.49	12.75	1.37	1.10
	MIROC5	12.09	1.57	1.53	12.56	1.17	1.15
	ensemble	12.38	1.38	1.34	12.78	1.01	1.00
Schmidt stability (J m^{-2})	GFDL-ESM2M	69.42	13.71	16.85	65.06	10.90	12.22
	HadGEM2-ES	67.39	40.16	45.49	63.48	32.14	36.59
	IPSL-CM5A-LR	69.13	34.25	32.82	67.11	27.32	25.17
	MIROC5	70.45	32.90	21.15	68.08	28.91	16.99
	ensemble	69.10	30.26	29.08	65.93	24.82	22.74
thermocline depth (m)	GFDL-ESM2M	-7.82	0.21	0.27	-8.51	0.32	0.30
	HadGEM2-ES	-8.22	0.64	0.79	-8.76	0.60	0.71
	IPSL-CM5A-LR	-7.77	0.17	0.23	-8.21	0.25	0.31
	MIROC5	-7.78	0.53	0.20	-8.44	0.73	0.31
	ensemble	-7.90	0.39	0.38	-8.48	0.47	0.41
duration (days)	GFDL-ESM2M	127	4	9	130	3	7
	HadGEM2-ES	125	20	20	127	16	16
	IPSL-CM5A-LR	124	13	14	127	11	10

	MIROC5	125	15	11	128	12	10
	ensemble	125	13	13	128	10	11
onset (day)	GFDL-ESM2M	131	-3	-5	131	-3	-4
	HadGEM2-ES	132	-10	-13	133	-8	-10
	IPSL-CM5A-LR	133	-8	-7	133	-7	-6
	MIROC5	134	-10	-10	133	-7	-9
	ensemble	132	-8	-9	132	-6	-7
loss (day)	GFDL-ESM2M	258	2	2	260	2	2
	HadGEM2-ES	256	9	8	259	8	7
	IPSL-CM5A-LR	260	3	3	263	2	1
	MIROC5	257	5	2	260	5	2
	ensemble	258	5	4	261	4	3

Table S8.Trend analysis from 2011-2100 for surface temperature, bottom temperature, whole-lake temperature, Schmidt stability, thermocline depth, duration, onset and loss of stratification (ns: not significant) for RCP 2.6. Italics denote trends with *p*-value > 0.05.

		RCP 2.6			
		24h met		synthetic 1h met	
		rate (decade^{-1})	p-value	rate (decade^{-1})	p-value
surface temperature (ºC)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	0.15	< 0.001	0.13	< 0.001
	IPSL-CM5A-LR	0.09	< 0.05	0.07	< 0.05
	MIROC5	0.07	< 0.05	0.06	< 0.05
bottom temperature (ºC)	GFDL-ESM2M		ns		ns
	HadGEM2-ES		ns		ns
	IPSL-CM5A-LR		ns		ns
	MIROC5		ns		ns
whole-lake temperature (ºC)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	0.10	< 0.001	0.08	< 0.001
	IPSL-CM5A-LR		ns		ns
	MIROC5	0.07	< 0.001	0.05	< 0.01
Schmidt stability (J m^{-2})	GFDL-ESM2M		ns		ns
	HadGEM2-ES	2.66	< 0.001	2.19	< 0.001
	IPSL-CM5A-LR	2.52	< 0.05	1.90	< 0.05
	MIROC5		ns		ns
thermocline depth (m)	GFDL-ESM2M		ns		ns
	HadGEM2-ES		ns	*0.04*	*0.06*
	IPSL-CM5A-LR		ns		ns
	MIROC5		ns		ns
duration (days)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	1.13	< 0.01	0.87	< 0.05
	IPSL-CM5A-LR	1.70	<0.001	1.30	<0.001
	MIROC5		ns		ns
onset (day)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	-0.67	< 0.05		ns
	IPSL-CM5A-LR		ns	-0.84	< 0.05
	MIROC5		ns	*-0.50*	*0.06*
loss (day)	GFDL-ESM2M		ns		ns
	HadGEM2-ES	0.51	< 0.05	0.47	< 0.05
	IPSL-CM5A-LR	0.93	< 0.01	0.53	< 0.05
	MIROC5		ns		ns

Table S9. 5th, 25th, 50th, 75th and 95th percentiles from 2011-2100 for surface temperature, bottom temperature, whole-lake temperature, Schmidt stability, thermocline depth, duration, onset and loss of stratification for RCP 2.6.

		RCP 2.6									
		24h met					synthetic 1h met				
		p5	p25	p50	p75	p95	p5	p25	p50	p75	p95
surface temperature (ºC)	GFDL-ESM2M	-0.24	0.49	0.92	1.55	2.21	-0.25	0.33	0.70	1.19	1.63
	HadGEM2-ES	0.52	1.51	2.04	2.65	3.38	0.34	1.15	1.56	2.01	2.64
	IPSL-CM5A-LR	0.14	1.49	1.94	2.46	3.30	0.07	1.08	1.44	1.95	2.48
	MIROC5	0.49	1.25	1.78	2.28	3.04	0.38	0.92	1.40	1.80	2.49
bottom temperature (ºC)	GFDL-ESM2M	-0.91	-0.22	0.26	0.97	1.69	-0.83	-0.26	0.21	0.80	1.47
	HadGEM2-ES	-1.11	-0.14	0.20	0.85	1.97	-1.13	-0.34	0.18	0.62	1.13
	IPSL-CM5A-LR	-0.67	0.14	0.79	1.61	2.42	-0.62	0.02	0.54	1.19	2.06
	MIROC5	-0.37	0.25	0.78	1.21	2.06	-0.57	0.04	0.50	1.02	1.82
whole-lake temperature (ºC)	GFDL-ESM2M	-0.26	0.27	0.66	1.12	1.54	-0.33	0.22	0.53	0.84	1.14
	HadGEM2-ES	-0.02	1.05	1.40	1.88	2.72	-0.11	0.75	1.06	1.40	1.92
	IPSL-CM5A-LR	0.25	1.07	1.66	2.10	2.79	0.02	0.73	1.20	1.56	2.00
	MIROC5	0.57	1.08	1.44	1.82	2.22	0.33	0.76	1.06	1.41	1.70
Schmidt stability (J m^{-2})	GFDL-ESM2M	-12.27	3.53	14.61	29.34	53.09	-13.47	0.72	12.45	25.00	46.87
	HadGEM2-ES	10.17	24.66	39.50	51.45	74.37	5.48	18.21	30.41	42.31	60.74
	IPSL-CM5A-LR	-14.68	9.44	30.01	45.69	69.24	-14.06	8.49	23.10	37.28	53.67
	MIROC5	-14.47	6.65	26.34	39.99	66.16	-13.07	5.72	23.38	32.90	62.48
thermocline depth (m)	GFDL-ESM2M	-0.69	-0.19	0.32	0.68	1.19	-0.63	-0.02	0.35	0.76	1.26
	HadGEM2-ES	-0.10	0.40	0.82	1.07	1.52	-0.14	0.27	0.67	1.01	1.47
	IPSL-CM5A-LR	-1.27	-0.23	0.30	0.78	1.35	-1.07	-0.16	0.32	0.83	1.17
	MIROC5	-1.17	-0.24	0.42	0.91	1.19	-0.80	0.08	0.58	0.91	1.39
duration (day)	GFDL-ESM2M	-13.60	0.40	8.40	14.40	23.45	-14.63	-1.53	5.47	12.72	19.52
	HadGEM2-ES	3.27	8.27	16.27	24.27	38.27	-3.13	7.87	13.87	18.87	28.87
	IPSL-CM5A-LR	-11.53	0.47	11.47	18.47	28.47	-12.63	-1.63	9.37	17.37	23.37
	MIROC5	-5.57	3.43	11.43	18.43	27.43	-5.30	4.70	10.20	14.70	24.70
onset (day)	GFDL-ESM2M	-17.58	-9.78	-3.53	0.47	8.52	-17.05	-9.00	-3.00	0.25	8.00
	HadGEM2-ES	-23.33	-16.33	-11.33	-5.33	3.67	-19.53	-12.53	-8.53	-4.53	5.47
	IPSL-CM5A-LR	-22.93	-12.93	-5.43	1.07	8.07	-19.43	-11.43	-4.43	2.57	8.57
	MIROC5	-24.53	-14.53	-9.53	-4.53	3.47	-18.80	-11.80	-7.80	-3.80	3.20

loss (day)	GFDL-ESM2M	-9.52	-1.72	2.53	6.53	12.53	-7.50	-1.40	2.60	5.60	8.60
	HadGEM2-ES	-4.07	3.93	7.93	10.93	18.93	0.33	3.33	6.33	9.33	16.33
	IPSL-CM5A-LR	-11.70	-3.70	1.30	6.30	13.30	-8.80	-2.80	1.20	4.20	10.20
	MIROC5	-7.37	-1.37	3.13	6.63	14.63	-6.37	-1.37	2.63	5.63	11.63

Table S10. 5th, 25th, 50th, 75th and 95th percentiles from 2011-2100 for surface temperature, bottom temperature, whole-lake temperature, Schmidt stability, thermocline depth, duration, onset and loss of stratification for RCP 6.0.

		RCP 6.0									
		24h met					synthetic 1h met				
		p5	p25	p50	p75	p95	p5	p25	p50	p75	p95
surface temperature (ºC)	GFDL-ESM2M	-0.44	0.60	1.17	1.67	2.48	-0.31	0.56	0.97	1.28	1.90
	HadGEM2-ES	0.84	2.04	2.93	3.85	4.86	0.57	1.60	2.23	2.89	3.63
	IPSL-CM5A-LR	0.33	1.45	2.56	3.38	4.37	0.21	1.08	1.94	2.48	3.30
	MIROC5	0.51	1.26	1.96	2.82	3.82	0.38	0.99	1.55	2.19	2.89
bottom temperature (ºC)	GFDL-ESM2M	-0.47	0.21	0.81	1.32	2.52	-0.62	0.11	0.64	1.14	2.01
	HadGEM2-ES	-0.57	0.12	0.58	1.14	1.96	-0.68	-0.18	0.28	0.76	1.31
	IPSL-CM5A-LR	-0.53	0.42	1.16	1.67	2.77	-0.52	0.19	0.84	1.34	2.12
	MIROC5	-0.43	0.32	0.82	1.39	2.15	-0.45	0.08	0.68	1.07	2.04
whole-lake temperature (ºC)	GFDL-ESM2M	-0.21	0.59	1.13	1.69	2.20	-0.15	0.42	0.87	1.28	1.62
	HadGEM2-ES	0.73	1.39	1.91	2.81	3.38	0.36	1.09	1.47	1.96	2.40
	IPSL-CM5A-LR	0.76	1.32	1.91	2.69	3.55	0.56	0.98	1.49	1.92	2.55
	MIROC5	0.40	1.10	1.61	2.33	2.92	0.27	0.81	1.21	1.78	2.27
Schmidt stability ($J\ m^{-2}$)	GFDL-ESM2M	-26.27	-15.71	4.27	20.61	44.95	-21.44	-9.23	2.12	19.19	34.64
	HadGEM2-ES	5.22	33.49	52.78	80.02	110.55	2.56	26.60	43.57	63.65	85.76
	IPSL-CM5A-LR	-18.77	16.35	43.58	60.49	90.64	-18.07	9.02	32.09	47.53	69.80
	MIROC5	-4.58	11.07	23.01	46.07	74.25	-7.49	8.49	19.23	36.04	56.54
thermocline depth (m)	GFDL-ESM2M	-1.57	-0.80	-0.43	0.10	1.01	-1.33	-0.60	-0.18	0.32	0.99
	HadGEM2-ES	-0.42	0.51	1.04	1.39	2.06	-0.32	0.56	1.00	1.30	1.81
	IPSL-CM5A-LR	-1.06	-0.17	0.52	0.95	1.31	-0.92	-0.09	0.55	0.87	1.29
	MIROC5	-0.90	-0.12	0.29	0.72	1.29	-0.52	0.09	0.38	0.85	1.41
duration (day)	GFDL-ESM2M	-15.37	-2.52	3.73	12.73	22.78	-14.55	-0.75	5.50	10.50	21.50
	HadGEM2-ES	-0.63	12.37	26.37	34.37	49.42	-2.37	10.38	20.63	28.13	35.63
	IPSL-CM5A-LR	-10.33	7.67	17.67	24.67	40.92	-8.42	6.63	12.63	20.63	32.68

	MIROC5	-8.15	6.90	14.90	22.15	36.95	-5.98	5.07	13.07	17.32	30.12
onset (day)	GFDL-ESM2M	-17.88	-10.83	-3.83	1.42	9.22	-16.47	-9.47	-4.47	0.53	8.58
	HadGEM2-ES	-10.33	7.67	17.67	24.67	40.92	-19.87	-16.87	-12.87	-5.62	3.18
	IPSL-CM5A-LR	-27.18	-15.13	-9.13	-3.13	5.02	-20.45	-13.40	-7.40	-2.40	4.60
	MIROC5	-27.02	-16.97	-10.97	-7.72	2.28	-21.15	-13.35	-10.10	-6.85	4.10
loss (day)	GFDL-ESM2M	-12.48	-4.33	-0.33	4.67	8.72	-11.02	-5.97	-2.97	0.28	4.08
	HadGEM2-ES	-4.23	5.77	10.77	15.77	25.77	-1.28	4.52	8.77	13.77	18.82
	IPSL-CM5A-LR	-9.13	-2.03	3.97	8.97	16.02	-8.05	-1.15	2.10	6.10	11.20
	MIROC5	-5.38	-0.58	3.67	7.67	16.67	-4.35	-0.30	3.70	5.70	11.70

S5. Comparison between long-term thermal metrics derived from daily and hourly climate data.

Table S11. Differences between climate model at daily and synthetic hourly resolutions for RCP 2.6. Where *t, W* and *D* are the t-test, Mann-Whitney-Wilcoxon test and Kolmogorov–Smirnov test statistics, and *df* is the degrees of freedom.

		RCP 2.6				
		test	p-value	t / W/ D	df	
GFDL-ESM2M	air temperature	Welch two sample t-test	< 0.05	2.17	168.22	significant differences
	wind speed	Welch two sample t-test	> 0.05	-0.05	155.57	non-significant differences
	short-wave rad	two sample t-test	> 0.05	0.34	176.00	non-significant differences
	relative humidity	Welch two sample t-test	> 0.05	0.97	164.40	non-significant differences
HadGEM2-ES	air temperature	Two-sample Kolmogorov-Smirnov test	< 0.001	0.34		significant differences
	wind speed	Welch two sample t-test	> 0.05	-0.79	155.91	non-significant differences
	short-wave rad	two sample t-test	> 0.05	0.76	178.00	non-significant differences
	relative humidity	two sample t-test	> 0.05	0.91	178.00	non-significant differences
IPSL-CM5A-LR	air temperature	Welch two sample t-test	< 0.001	3.39	170.17	significant differences
	wind speed	Welch two sample t-test	> 0.05	-0.33	153.76	non-significant differences
	short-wave rad	Wilcoxon rank sum test with continuity correction	> 0.05	4570.00		non-significant differences
	relative humidity	two sample t-test	< 0.001	3.66	178.00	significant differences
MIROC5	air temperature	Welch two sample t-test	< 0.001	3.54	170.34	significant differences
	wind speed	Welch two sample t-test	> 0.05	0.16	157.39	non-significant differences
	short-wave rad	two sample t-test	< 0.05	2.06	178.00	significant differences
	relative humidity	two sample t-test	> 0.05	-0.24	168.39	non-significant differences

Table S12. Differences between climate model at daily and synthetic hourly resolutions for RCP 6.0. Where *t, W* and *D* are the t-test, Mann-Whitney-Wilcoxon test and Kolmogorov–Smirnov test statistics, and *df* is the degrees of freedom.

		RCP 6.0				
		test	p-value	t	df	
GFDL-ESM2M	air temperature	Welch two sample t-test	< 0.05	2.62	165.97	significant differences
	wind speed	Welch two sample t-test	< 0.001	3.36	155.46	significant differences
	short-wave rad	two sample t-test	> 0.05	0.59	176.00	non-significant differences
	relative humidity	Welch two sample t-test	> 0.05	1.06	164.65	non-significant differences
HadGEM2-ES	air temperature	Welch two sample t-test	< 0.001	4.53	164.14	significant differences

	wind speed	Welch two sample t-test	> 0.05	-1.79	153.98	non-significant differences
	short-wave rad	two sample t-test	> 0.05	0.98	176.00	non-significant differences
	relative humidity	two sample t-test	> 0.05	1.43	176.00	non-significant differences
IPSL-CM5A-LR	air temperature	Welch two sample t-test	< 0.001	3.67	166.44	significant differences
	wind speed	Welch two sample t-test	> 0.05	-0.57	152.99	non-significant differences
	short-wave rad	two sample t-test	> 0.05	1.57	176.00	non-significant differences
	relative humidity	two sample t-test	< 0.01	3.31	176.00	significant differences
MIROC5	air temperature	Welch two sample t-test	< 0.001	3.15	166.45	significant differences
	wind speed	Welch two sample t-test	> 0.05	0.53	155.35	non-significant differences
	short-wave rad	two sample t-test	> 0.05	1.89	176.00	non-significant differences
	relative humidity	two sample t-test	> 0.05	1.54	176.00	non-significant differences

Table S13. Differences between thermal metrics when the lake model was forced at daily and synthetic hourly resolutions for RCP 2.6. Where *t, W* and *D* are the t-test, Mann-Whitney-Wilcoxon test and Kolmogorov–Smirnov test statistics, and *df* is the degrees of freedom.

		RCP 2.6				
		test	p-value	t / W / D	df	
GFDL-ESM2M	surface temperature	Welch two sample t-test	< 0.05	2.41	168.40	significant differences
	bottom temperature	Wilcoxon rank sum test with continuity correction	> 0.05	4086.00		non-significant differences
	whole-lake temperature	Welch two sample t-test	< 0.05	2.22	165.55	significant differences
	Schmidt stability	Wilcoxon rank sum test with continuity correction	> 0.05	4369.00		non-significant differences
	thermocline depth	two sample t-test	> 0.05	-0.79	176.00	non-significant differences
	duration	Wilcoxon rank sum test with continuity correction	> 0.05	4305.00		non-significant differences
	onset	two sample t-test	> 0.05	-0.51	176.00	non-significant differences
	loss	two sample t-test	> 0.05	0.21	176.00	non-significant differences
HadGEM2-ES	surface temperature	Welch two sample t-test	< 0.001	4.30	169.55	significant differences
	bottom temperature	two sample t-test	> 0.05	1.62	178.00	non-significant differences
	whole-lake temperature	Two-sample Kolmogorov-Smirnov test	< 0.001	0.33		significant differences
	Schmidt stability	two sample t-test	< 0.01	2.87	178.00	significant differences
	thermocline depth	two sample t-test	> 0.05	1.02	178.00	non-significant differences
	duration	two sample t-test	> 0.05	1.28	178.00	non-significant differences
	onset	two sample t-test	0.05	-1.94	178.00	non-significant differences
	loss	Welch two sample t-test	> 0.05	1.28	162.53	non-significant differences
IPSL-CM5A-LR	surface temperature	two sample t-test	< 0.001	3.78	167.17	significant differences

	bottom temperature	two sample t-test	0.05	1.96	178.00	non-significant differences
	whole-lake temperature	Welch two sample t-test	< 0.001	3.96	166.99	significant differences
	Schmidt stability	two sample t-test	> 0.05	1.71	171.61	non-significant differences
	thermocline depth	Wilcoxon rank sum test with continuity correction	> 0.05	3937.00		non-significant differences
	duration	two sample t-test	> 0.05	0.96	178.00	non-significant differences
	onset	two sample t-test	> 0.05	-1.08	178.00	non-significant differences
	loss	Welch two sample t-test	> 0.05	0.63	169.86	non-significant differences
MIROC5	surface temperature	Welch two sample t-test	< 0.001	3.74	170.46	significant differences
	bottom temperature	two sample t-test	< 0.05	2.24	0.03	significant differences
	whole-lake temperature	two sample t-test	<0.001	4.99	178.00	significant differences
	Schmidt stability	two sample t-test	> 0.05	1.10	178.00	non-significant differences
	thermocline depth	Wilcoxon rank sum test with continuity correction	> 0.05	3547.00		non-significant differences
	duration	two sample t-test	> 0.05	0.63	178.00	non-significant differences
	onset	two sample t-test	< 0.05	-2.18	178.00	significant differences
	loss	two sample t-test	> 0.05	0.58	178.00	non-significant differences

Table S14. Differences between thermal metrics when the lake model was forced at daily and synthetic hourly resolutions for RCP 6.0. Where *t*, *W* and *D* are the t-test, Mann-Whitney-Wilcoxon test and Kolmogorov–Smirnov test statistics, and *df* is the degrees of freedom.

		RCP 6.0				
		test	p-value	t / W / D	df	
GFDL-ESM2M	surface temperature	Welch two sample t-test	< 0.05	2.02	164.90	significant differences
	bottom temperature	two sample t-test	< 0.05	1.99	176.00	significant differences
	whole-lake temperature	Welch two sample t-test	< 0.05	2.81	164.70	significant differences
	Schmidt stability	two sample t-test	> 0.05	0.09	176.00	non-significant differences
	thermocline depth	Wilcoxon rank sum test with continuity correction	< 0.05	3188.50		significant differences
	duration	Wilcoxon rank sum test with continuity correction	> 0.05	3911.00		non-significant differences
	onset	two sample t-test	> 0.05	-0.15		non-significant differences
	loss	Welch two sample t-test	< 0.01	3.04	167.82	significant differences
HadGEM2-ES	surface temperature	Welch two sample t-test	< 0.001	4.45	164.28	significant differences
	bottom temperature	two sample t-test	< 0.05	2.86	176.00	significant differences
	whole-lake temperature	Welch two sample t-test	< 0.001	4.86	157.42	significant differences
	Schmidt stability	two sample t-test	< 0.05	2.65	176.00	significant differences

	thermocline depth	two sample t-test	> 0.05	0.47	176.00	non-significant differences
	duration	Wilcoxon rank sum test with continuity correction	< 0.05	4762.00		significant differences
	onset	Two-sample Kolmogorov-Smirnov test	< 0.05	0.25		significant differences
	loss	Welch two sample t-test	> 0.05	1.62	167.12	non-significant differences
IPSL-CM5A-LR	surface temperature	Welch two sample t-test	< 0.001	3.97	162.74	significant differences
	bottom temperature	two sample t-test	< 0.05	2.08	176.00	significant differences
	whole-lake temperature	Welch two sample t-test	< 0.001	4.54	159.96	significant differences
	Schmidt stability	Welch two sample t-test	< 0.05	2.26	167.86	significant differences
	thermocline depth	Wilcoxon rank sum test with continuity correction	> 0.05	3972.00		non-significant differences
	duration	Two-sample Kolmogorov-Smirnov test	< 0.05	0.22		significant differences
	onset	Two-sample Kolmogorov-Smirnov test	> 0.05	0.13		non-significant differences
	loss	Welch Two Sample t-test	> 0.05	1.52	165.16	non-significant differences
MIROC5	surface temperature	Welch two sample t-test	< 0.001	3.38	165.13	significant differences
	bottom temperature	Wilcoxon rank sum test with continuity correction	> 0.05	4599.00		non-significant differences
	whole-lake temperature	Welch two sample t-test	< 0.001	3.88	166.30	significant differences
	Schmidt stability	two sample t-test	> 0.05	1.71	176.00	non-significant differences
	thermocline depth	two sample t-test	> 0.05	-1.63	176.00	non-significant differences
	duration	Wilcoxon rank sum test with continuity correction	> 0.05	4444.00		non-significant differences
	onset	Wilcoxon rank sum test with continuity correction	> 0.05	3400.00		non-significant differences
	loss	two sample t-test	> 0.05	1.15	176.00	non-significant differences