

# Global Warming Forecast using Acceleration Factors

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                          Global Warming forecast  
                          global temperature forecast  
                          CO2 mitigation

## **Abstract**

This publication introduces four methods to forecast the global surface temperature over land and ocean (global warming).

The methods include a parabolic trendline of the last 61 years of global warming and cumulated CO2 emissions.

Two other methods apply the velocity and the acceleration of global warming and cumulative CO2 emissions.

The relation between the global surface temperature change and the change in the cumulative CO2 emissions was determined in previous publications as  $0.000745^{\circ}\text{C}/\text{GtCO}_2$ .

The average result from all four methods for the business as usual CO2 mitigation scenario is  $4.4^{\circ}\text{C}$  ( $4.1^{\circ}\text{C}$  -  $5.0^{\circ}\text{C}$ ).

According to this forecast, the global temperature change will reach  $1.5^{\circ}\text{C}$  in 2031 (9 years from now) and  $2.0^{\circ}\text{C}$  in 2047 (25 years from now).

**Glossary**

ACCO2	acceleration of change in cumulative CO <sub>2</sub> emissions, tCO <sub>2</sub> /y <sup>2</sup> (ton CO <sub>2</sub> per year per year)
Ave	average
BL	baseline of surface temperature change (GW) 1850-1900
CCO2	global cumulative CO <sub>2</sub> emissions according to publication [10] [11], CO <sub>2</sub> emissions produced from fossil fuels and cement production only – land use change is not included
CO2	emissions of Carbon Dioxide, CO <sub>2</sub>
dCO2	change in global cumulative CO <sub>2</sub> emissions (CCO <sub>2</sub> ), tCO <sub>2</sub> /y (ton CO <sub>2</sub> per year)
GtCO2	Giga-ton of CO <sub>2</sub> , 10 <sup>9</sup> ton, 10 <sup>9</sup> ton, 1,000,000,000 ton of CO <sub>2</sub>
GW	Global Warming, global surface temperature above the 1850-1900 baseline, land+ocean, °C
GWA	Global Warming Acceleration, annual change in the Global Warming Rate, °C/y <sup>2</sup> [2]
GWR	Global Warming Rate – average change in global surface temperature per year in the trendline period, °C/y [2]
OWID	Our World in Data – Internet site [10] [11]
Ref	reference
tCO2	ton CO <sub>2</sub>
TL	trendline
VCCO2	velocity of change in cumulative CO <sub>2</sub> emissions, tCO <sub>2</sub> /y

## Business As Usual Scenario

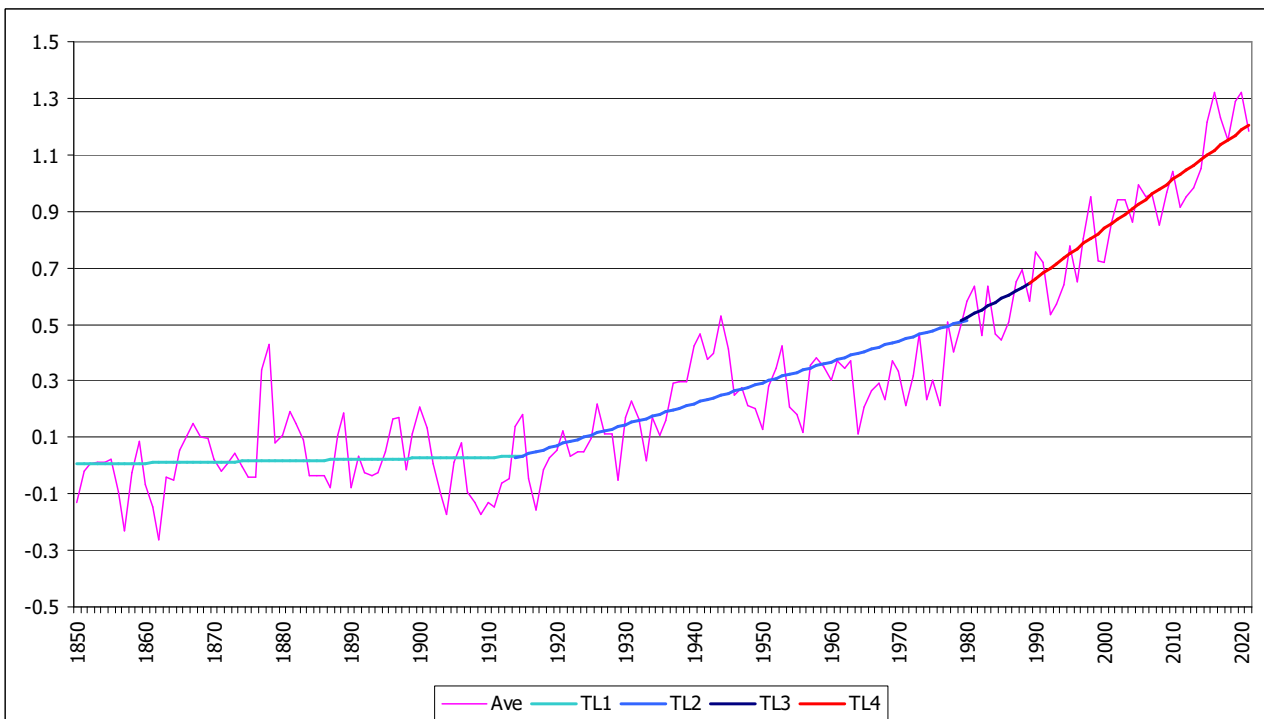
All calculations and estimations in this work are for the Business As Usual (BAU) scenario, the effectiveness of the future CO2 emissions mitigation will be as in the past.

### Part I – Forecast of Global Surface Temperature Change based on Global Warming Rate and Global Warming Acceleration

#### Global Surface Temperature Changes

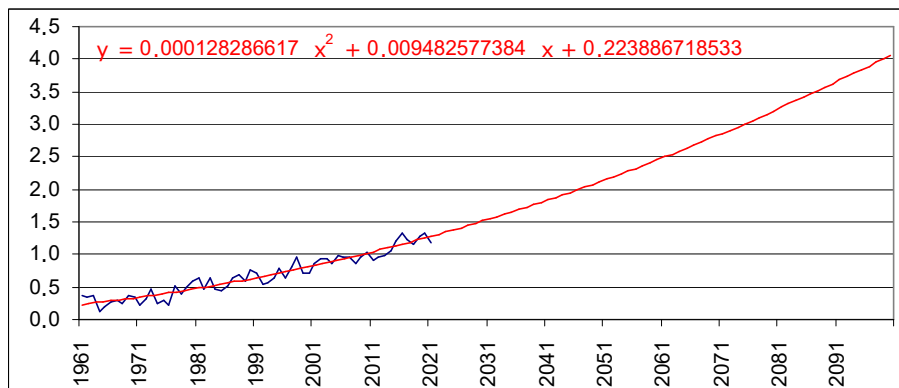
The dataset of global surface temperature changes for land and ocean converted to 1850-1900 baseline is publicly available on DOI:10.5281/zenodo.6386191 [1]. The dataset is based on NASA [5] [6], NOAA [7], and Berkley Earth [8] [9].

Chart 1 - Trendlines, land+ocean, 1850-1900 baseline [°C] [1]



Ave average of all databases [°C]

Chart 2 - GW parabolic trendline 1961-2021 [°C]



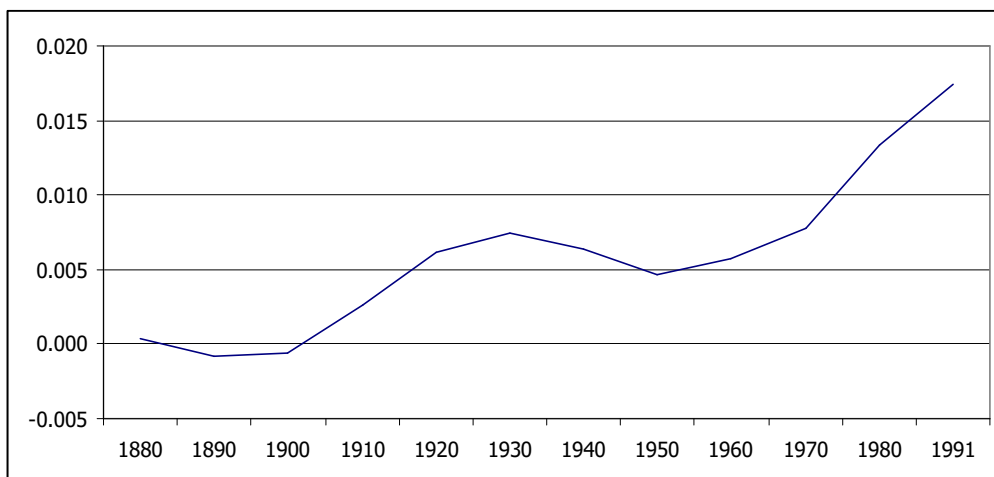
According to the most recent 61 years parabolic trendline, the GW forecast for the year 2100 is 4.07°C above the 1850-1900 baseline.

### Global Warming Rate and Global Warming Acceleration

All details about Global Warming Rate (GWR) and Global Warming Acceleration (GWA) are from the publication "Global Warming Acceleration" [2].

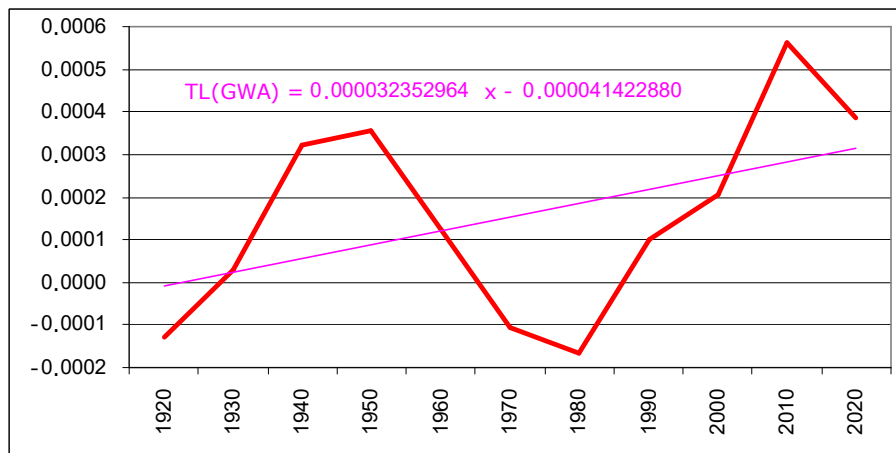
In publication [2], the Global Warming Rate (GWR) was defined as "average change in global surface temperature per year in the trendline period, °C/y", and Global Warming Acceleration (GWA) as "annual change in the global warming rate, °C/y<sup>2</sup>".

Chart 3 - GWR – Global Warming Rate, land+ocean [°C/y] [2]



Axis x is the center of the 61 years trendline period

Chart 4 - GWA - Global Warming Acceleration, land+ocean [°C/y<sup>2</sup>] [2]



Axis x is the end of the 61 years trendline period

Since 1980 the GWA is above zero, which means the Global Warming Rate (GWR) [°C/y] is increasing. The negative slope of GWA between 1980 and 1991 means a slower increase in GWR.

Currently, the Global Warming Acceleration (GWA) is decreasing by 0.0000174°C/y<sup>2</sup> per year (°C/y<sup>3</sup>), however, over the maximum period, the GWA is increasing according to the trendline formula displayed on the above chart. The forecast for the next decade may be based on the last dGWA, but for the longer period, the maximum period trendline formula is more appropriate. Therefore the forecast of the acceleration change till the end of the 21st century is based on the maximum period linear trendline formula, which results in +0.000003235°C/y<sup>3</sup>.

Table 1 - Initial values for forecast [2]

Starting year	TL a	TL b	GW(BL) TL	GWR	GWA	dGWA
			°C	°C/y	°C/y <sup>2</sup>	°C/y <sup>3</sup>
2020	+0.017213	+0.132767	+1.183	+0.017213414	+0.000385144	+0.000003235

Table 2 - GW forecast using GW acceleration approach

year	dGWA °C/y <sup>3</sup>	GWA °C/y <sup>2</sup>	GWR °C/y	GW(BL) °C
2020	+0.0000032	+0.0003851	+0.0172134	1.183
2021	+0.0000032	+0.0003884	+0.0176018	1.200
2022	+0.0000032	+0.0003916	+0.0179934	1.218
2023	+0.0000032	+0.0003948	+0.0183883	1.237
2024	+0.0000032	+0.0003981	+0.0187863	1.256
2025	+0.0000032	+0.0004013	+0.0191877	1.275
2026	+0.0000032	+0.0004046	+0.0195922	1.294
2027	+0.0000032	+0.0004078	+0.0200000	1.314
2028	+0.0000032	+0.0004110	+0.0204110	1.335
2029	+0.0000032	+0.0004143	+0.0208253	1.356
2030	+0.0000032	+0.0004175	+0.0212428	1.377
2031	+0.0000032	+0.0004207	+0.0216635	1.398
2032	+0.0000032	+0.0004240	+0.0220875	1.421
2033	+0.0000032	+0.0004272	+0.0225147	1.443
2034	+0.0000032	+0.0004304	+0.0229451	1.466
2035	+0.0000032	+0.0004337	+0.0233788	1.489
2036	+0.0000032	+0.0004369	+0.0238157	1.513
2037	+0.0000032	+0.0004401	+0.0242559	1.537
2038	+0.0000032	+0.0004434	+0.0246992	1.562
2039	+0.0000032	+0.0004466	+0.0251459	1.587
2040	+0.0000032	+0.0004498	+0.0255957	1.613
2041	+0.0000032	+0.0004531	+0.0260488	1.639
2042	+0.0000032	+0.0004563	+0.0265051	1.665
2043	+0.0000032	+0.0004596	+0.0269647	1.692
2044	+0.0000032	+0.0004628	+0.0274275	1.720
2045	+0.0000032	+0.0004660	+0.0278935	1.748
2046	+0.0000032	+0.0004693	+0.0283627	1.776
2047	+0.0000032	+0.0004725	+0.0288352	1.805
2048	+0.0000032	+0.0004757	+0.0293110	1.834
2049	+0.0000032	+0.0004790	+0.0297899	1.864
2050	+0.0000032	+0.0004822	+0.0302721	1.894
2051	+0.0000032	+0.0004854	+0.0307576	1.925
2052	+0.0000032	+0.0004887	+0.0312462	1.956
2053	+0.0000032	+0.0004919	+0.0317382	1.988
2054	+0.0000032	+0.0004951	+0.0322333	2.020
2055	+0.0000032	+0.0004984	+0.0327317	2.053
2056	+0.0000032	+0.0005016	+0.0332333	2.086
2057	+0.0000032	+0.0005048	+0.0337381	2.120
2058	+0.0000032	+0.0005081	+0.0342462	2.154
2059	+0.0000032	+0.0005113	+0.0347575	2.189
2060	+0.0000032	+0.0005146	+0.0352721	2.224
2061	+0.0000032	+0.0005178	+0.0357899	2.260
2062	+0.0000032	+0.0005210	+0.0363109	2.296
2063	+0.0000032	+0.0005243	+0.0368352	2.333
2064	+0.0000032	+0.0005275	+0.0373627	2.371
2065	+0.0000032	+0.0005307	+0.0378934	2.408
2066	+0.0000032	+0.0005340	+0.0384274	2.447
2067	+0.0000032	+0.0005372	+0.0389646	2.486
2068	+0.0000032	+0.0005404	+0.0395050	2.525
2069	+0.0000032	+0.0005437	+0.0400487	2.565
2070	+0.0000032	+0.0005469	+0.0405956	2.606
2071	+0.0000032	+0.0005501	+0.0411457	2.647
2072	+0.0000032	+0.0005534	+0.0416991	2.689
2073	+0.0000032	+0.0005566	+0.0422557	2.731
2074	+0.0000032	+0.0005598	+0.0428156	2.774
2075	+0.0000032	+0.0005631	+0.0433787	2.817
2076	+0.0000032	+0.0005663	+0.0439450	2.861
2077	+0.0000032	+0.0005696	+0.0445145	2.906
2078	+0.0000032	+0.0005728	+0.0450873	2.951
2079	+0.0000032	+0.0005760	+0.0456634	2.997
2080	+0.0000032	+0.0005793	+0.0462426	3.043
2081	+0.0000032	+0.0005825	+0.0468251	3.090
2082	+0.0000032	+0.0005857	+0.0474109	3.137
2083	+0.0000032	+0.0005890	+0.0479998	3.185
2084	+0.0000032	+0.0005922	+0.0485920	3.234
2085	+0.0000032	+0.0005954	+0.0491875	3.283
2086	+0.0000032	+0.0005987	+0.0497861	3.333
2087	+0.0000032	+0.0006019	+0.0503880	3.383
2088	+0.0000032	+0.0006051	+0.0509932	3.434
2089	+0.0000032	+0.0006084	+0.0516016	3.486
2090	+0.0000032	+0.0006116	+0.0522132	3.538
2091	+0.0000032	+0.0006148	+0.0528280	3.591
2092	+0.0000032	+0.0006181	+0.0534461	3.644
2093	+0.0000032	+0.0006213	+0.0540674	3.698
2094	+0.0000032	+0.0006246	+0.0546920	3.753
2095	+0.0000032	+0.0006278	+0.0553198	3.808
2096	+0.0000032	+0.0006310	+0.0559508	3.864
2097	+0.0000032	+0.0006343	+0.0565851	3.921
2098	+0.0000032	+0.0006375	+0.0572226	3.978
2099	+0.0000032	+0.0006407	+0.0578633	4.036
2100	+0.0000032	+0.0006440	+0.0585073	4.094

## **Part II – Forecast of Global Surface Temperature Change based on Cumulative CO2 Emissions**

The annual changes in cumulative CO2 emissions were calculated in publication “Global Warming: Velocity and Acceleration of Change in Cumulative CO2 Emissions” [3] based on publications [10] [11].

Table 3 - Database of global cumulative CO2 emissions [10] [11]

Source of Data	OWID
Reference	[10] [11]
Baseline year	1749
From year	1750
To year	2020
Period, years	271
CO2 from fossil fuels	Yes
CO2 from cement production	Yes
CO2 from other sources	No
Other GHG	No
Land use change	No
Units	ton CO2
Resolution	1 ton CO2/y

The database is from publication [10] [11], CO2 emissions produced from fossil fuels and cement production only – land use change is not included.

Chart 5 - Annual change in the cumulated CO2 emissions [GtCO2/y]  
[3]

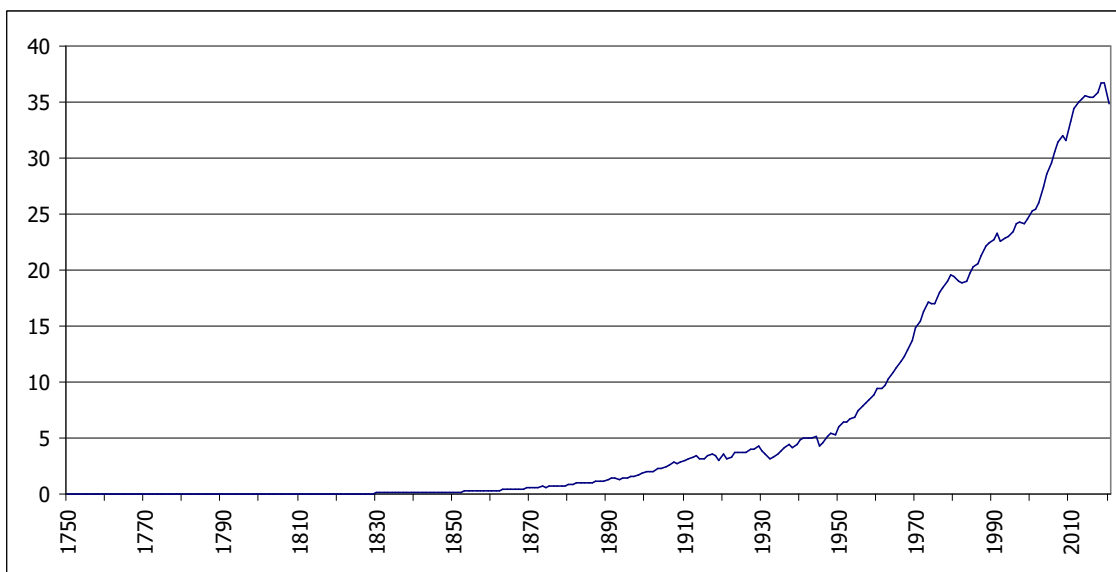
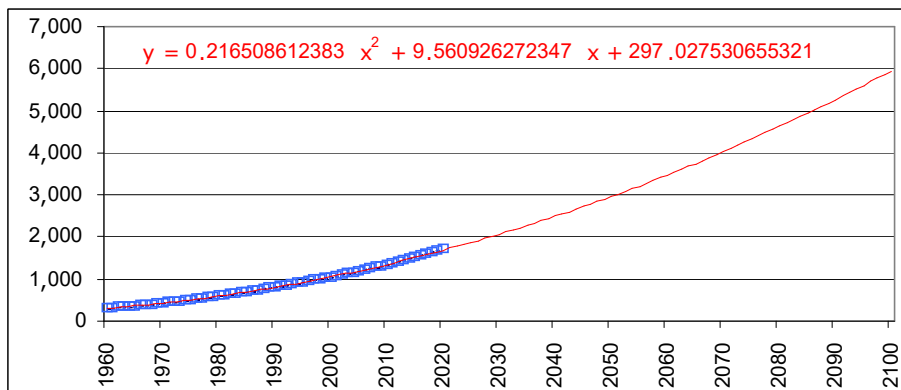


Chart 6 - CCO2 parabolic trendline 1960-2020 [GtCO2] [3]



According to the most recent 61 years parabolic trendline, the CCO2 forecast for the year 2100 is 5,949.53GtCO2.

### Correlation between Cumulative CO2 Emissions and Global Temperature

The correlation between the cumulative CO2 emissions and Global Warming, CO2→GW, was analyzed in publication [4].

Formula 1 - CO2 to global warming, CO2→GW, average GW in two 31 years periods, and CCO2 in the center of the periods [4]

$$CO2 \rightarrow GW = dGW / dCCO2$$

CO2→GW	relation between global cumulative CO2 emissions according to publication [10] [11], CCO2, and the change in global surface temperature, GW, °C/GtCO2
dGW	change in average GW between two 31 years periods, °C
dCCO2	change in CCO2 between the centers of two periods, GtCO2

Two most recent 31 neighboring periods were selected in this work for the determination of CO2→GW: 1961-1991 and 1991-2021.



Table 4 - Application of Formula 1 for the year 2000

		1940-1970	1970-2000	Δ
Center	year	1955	1985	
Ave GW	°C	+0.307	+0.548	+0.241
CCO2	GtCO2	264.04	698.46	434.42
CO2→GW	°C/GtCO2			0.000556

Table 5 - Application of Formula 1 for the year 2021

		1961-1991	1991-2021	Δ
Center	year	1976	2006	
Ave GW	°C	+0.425	+0.938	+0.513
CCO2	GtCO2	524.92	1,212.72	687.80
CO2→GW	°C/GtCO2			<b>0.000745</b>

**CO2→GW = 0.000745°C/GtCO2**

Table 6 - Velocity of change in CO2→GW, VCO2→GW [°C/(GtCO2,y)]

				Δ
Center of Period	year	1985	2006	21
CO2→GW	°C/GtCO2	0.000556	0.000745	+0.000190
VCO2→GW	°C/(GtCO2,y)			<b>+0.000009</b>

**Forecast of Global Warming in 2100 using Parabolic Trendline of Cumulative CO2 Emissions**

Table 7 - Forecast of Global Warming in 2100 using parabolic trendline of cumulative CO2 emissions [°C]

		1875	2100
BL from		1850	
BL to		1900	
BL Center		1875	
CCO2	GtCO2		14.92 5,949.53
ΔCCO2	GtCO2	5,934.61	
CO2→GW	°C/GtCO2	0.00074544	
ΔGW	°C	4.424	
GW	°C		0 4.424

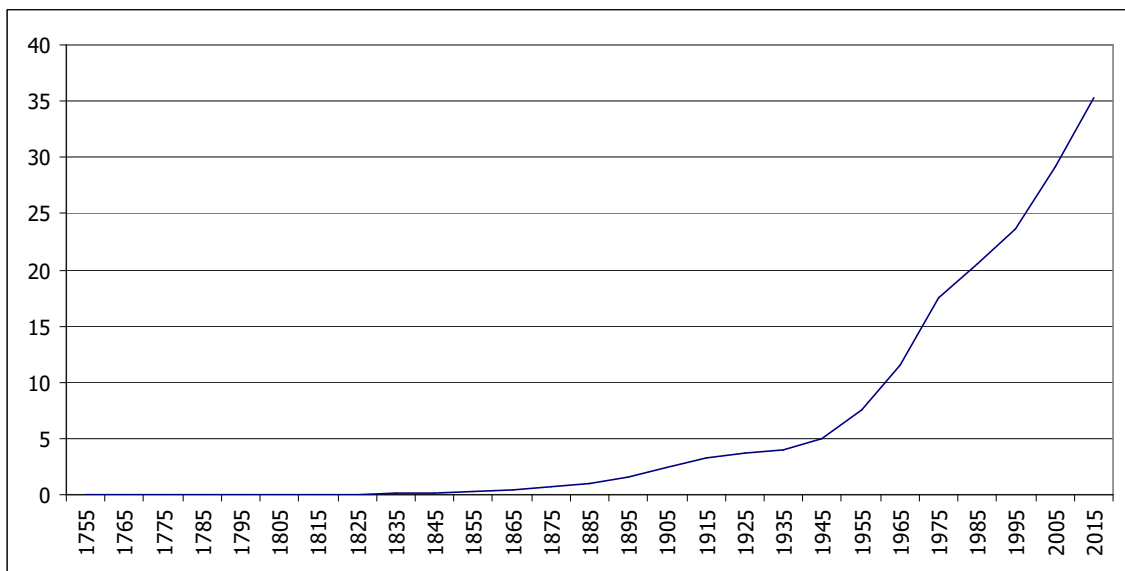
According to the above approach, the GW forecast for the year 2100 is 4.42°C above the 1850-1900 baseline.

## Velocity and Acceleration of Cumulative CO2 Emissions

All details about the Velocity (VCCO<sub>2</sub>) and Acceleration (ACCO<sub>2</sub>) of Cumulative CO<sub>2</sub> Emissions are from the publication "Velocity and Acceleration of Cumulative CO<sub>2</sub> Emissions" [3].

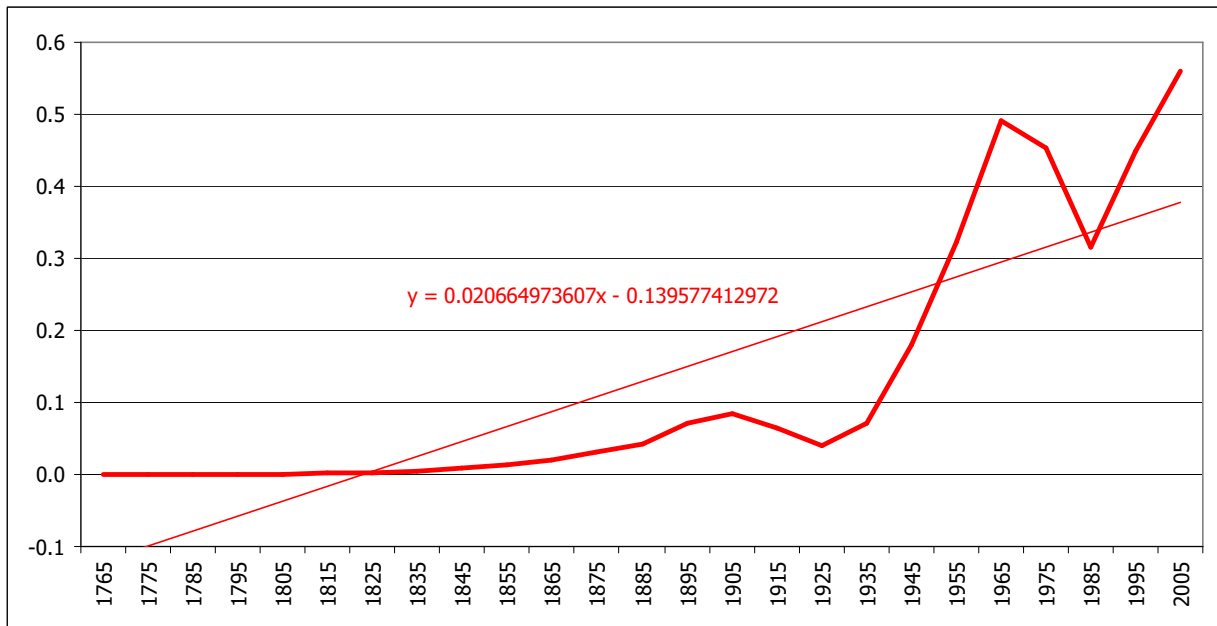
In publication [3], the Velocity of Change in Cumulative CO<sub>2</sub> Emissions (VCCO<sub>2</sub>) was defined as "11 years average of annual changes in cumulative CO<sub>2</sub> emissions, tCO<sub>2</sub>/y" and the Acceleration of Change in Cumulative CO<sub>2</sub> Emissions (ACCO<sub>2</sub>) as "31 years trendline slope of the annual changes in the cumulative CO<sub>2</sub> emissions, tCO<sub>2</sub>/ y<sup>2</sup>".

Chart 7 - Velocity of Change in Cumulative CO<sub>2</sub> Emissions, VCCO<sub>2</sub>  
[GtCO<sub>2</sub>/y] [3]



Axis x is the center of the 11 years period applied for the calculation

Chart 8 - Acceleration of Change in Cumulative CO2 Emissions, ACCO2  
[GtCO2/y<sup>2</sup>], [Giga-ton CO<sub>2</sub> per year per year] [3]



Axis x is the center of the 31 trendline period (2005 is the center of the 1990-2020 trendline period)

Table 8 - Annual change in Acceleration of Cumulative CO2 Emissions,  
dACCO2 [GtCO2/y<sup>3</sup>]

ACCO2 Linear Trendline Formula	$y = 0.020664973607x - 0.139577412972$	
$\Delta y$	10	y
TL a	0.020664974	
dACCO2	0.002066497	GtCO2/y <sup>3</sup>

Table 9 - Starting point for the forecast [3]

Trendline from	Trendline to	Starting year	CO2 GtCO2	VCCO2 GtCO2/y	ACCO2 GtCO2/y <sup>2</sup>	dACCO2 GtCO2/y <sup>3</sup>
1990	2020	2020	1,697	35.33	+0.5590470	+0.0020665

Table 10 - GW forecast using CCO2 acceleration approach

year	dACCO2 GtCO2/y <sup>3</sup>	ACCO2 GtCO2/y <sup>2</sup>	VCCO2 GtCO2/y	CCO2 GtCO2	Δ to BL GtCO2	GW °C
2020	+0.002	+0.569	38.16	1,702	1,687	1.258
2021	+0.002	+0.571	38.73	1,741	1,726	1.287
2022	+0.002	+0.574	39.30	1,780	1,765	1.316
2023	+0.002	+0.576	39.88	1,820	1,805	1.346
2024	+0.002	+0.578	40.45	1,860	1,846	1.376
2025	+0.002	+0.580	41.03	1,901	1,887	1.406
2026	+0.002	+0.582	41.62	1,943	1,928	1.437
2027	+0.002	+0.584	42.20	1,985	1,970	1.469
2028	+0.002	+0.586	42.79	2,028	2,013	1.501
2029	+0.002	+0.588	43.37	2,071	2,057	1.533
2030	+0.002	+0.590	43.96	2,115	2,101	1.566
2031	+0.002	+0.592	44.56	2,160	2,145	1.599
2032	+0.002	+0.594	45.15	2,205	2,190	1.633
2033	+0.002	+0.596	45.75	2,251	2,236	1.667
2034	+0.002	+0.598	46.34	2,297	2,282	1.701
2035	+0.002	+0.600	46.95	2,344	2,329	1.736
2036	+0.002	+0.602	47.55	2,392	2,377	1.772
2037	+0.002	+0.605	48.15	2,440	2,425	1.808
2038	+0.002	+0.607	48.76	2,489	2,474	1.844
2039	+0.002	+0.609	49.37	2,538	2,523	1.881
2040	+0.002	+0.611	49.98	2,588	2,573	1.918
2041	+0.002	+0.613	50.59	2,639	2,624	1.956
2042	+0.002	+0.615	51.21	2,690	2,675	1.994
2043	+0.002	+0.617	51.82	2,742	2,727	2.033
2044	+0.002	+0.619	52.44	2,794	2,779	2.072
2045	+0.002	+0.621	53.06	2,847	2,832	2.111
2046	+0.002	+0.623	53.69	2,901	2,886	2.151
2047	+0.002	+0.625	54.31	2,955	2,940	2.192
2048	+0.002	+0.627	54.94	3,010	2,995	2.233
2049	+0.002	+0.629	55.57	3,066	3,051	2.274
2050	+0.002	+0.631	56.20	3,122	3,107	2.316
2051	+0.002	+0.633	56.83	3,179	3,164	2.358
2052	+0.002	+0.636	57.47	3,236	3,221	2.401
2053	+0.002	+0.638	58.11	3,294	3,279	2.445
2054	+0.002	+0.640	58.75	3,353	3,338	2.488
2055	+0.002	+0.642	59.39	3,412	3,397	2.533
2056	+0.002	+0.644	60.03	3,472	3,457	2.577
2057	+0.002	+0.646	60.68	3,533	3,518	2.623
2058	+0.002	+0.648	61.32	3,594	3,579	2.668
2059	+0.002	+0.650	61.97	3,656	3,641	2.714
2060	+0.002	+0.652	62.63	3,719	3,704	2.761
2061	+0.002	+0.654	63.28	3,782	3,767	2.808
2062	+0.002	+0.656	63.94	3,846	3,831	2.856
2063	+0.002	+0.658	64.59	3,911	3,896	2.904
2064	+0.002	+0.660	65.26	3,976	3,961	2.953
2065	+0.002	+0.662	65.92	4,042	4,027	3.002
2066	+0.002	+0.664	66.58	4,109	4,094	3.052
2067	+0.002	+0.667	67.25	4,176	4,161	3.102
2068	+0.002	+0.669	67.92	4,244	4,229	3.152
2069	+0.002	+0.671	68.59	4,312	4,297	3.203
2070	+0.002	+0.673	69.26	4,382	4,367	3.255
2071	+0.002	+0.675	69.94	4,451	4,437	3.307
2072	+0.002	+0.677	70.61	4,522	4,507	3.360
2073	+0.002	+0.679	71.29	4,593	4,578	3.413
2074	+0.002	+0.681	71.97	4,665	4,650	3.467
2075	+0.002	+0.683	72.65	4,738	4,723	3.521
2076	+0.002	+0.685	73.34	4,811	4,796	3.575
2077	+0.002	+0.687	74.03	4,885	4,870	3.631
2078	+0.002	+0.689	74.72	4,960	4,945	3.686
2079	+0.002	+0.691	75.41	5,036	5,021	3.743
2080	+0.002	+0.693	76.10	5,112	5,097	3.799
2081	+0.002	+0.695	76.80	5,188	5,173	3.857
2082	+0.002	+0.698	77.49	5,266	5,251	3.914
2083	+0.002	+0.700	78.19	5,344	5,329	3.973
2084	+0.002	+0.702	78.90	5,423	5,408	4.031
2085	+0.002	+0.704	79.60	5,503	5,488	4.091
2086	+0.002	+0.706	80.30	5,583	5,568	4.151
2087	+0.002	+0.708	81.01	5,664	5,649	4.211
2088	+0.002	+0.710	81.72	5,746	5,731	4.272
2089	+0.002	+0.712	82.43	5,828	5,813	4.333
2090	+0.002	+0.714	83.15	5,911	5,896	4.395
2091	+0.002	+0.716	83.86	5,995	5,980	4.458
2092	+0.002	+0.718	84.58	6,080	6,065	4.521
2093	+0.002	+0.720	85.30	6,165	6,150	4.585
2094	+0.002	+0.722	86.03	6,251	6,236	4.649
2095	+0.002	+0.724	86.75	6,338	6,323	4.713
2096	+0.002	+0.726	87.48	6,425	6,410	4.779
2097	+0.002	+0.728	88.20	6,513	6,499	4.844
2098	+0.002	+0.731	88.94	6,602	6,587	4.911
2099	+0.002	+0.733	89.67	6,692	6,677	4.977
2100	+0.002	+0.735	90.40	6,782	6,768	5.045

## **Part III – Forecast of Global Surface Temperature Change till 2100**

### **Forecast Methods**

The forecast is done in this work using the following methods:

- Parabolic trendline of Global Warming (GWTL)
- Global Warming acceleration factors (GWA)
- Cumulative CO2 emissions parabolic trendline (CO2TL)
- Cumulative CO2 emissions acceleration factors (CO2A)

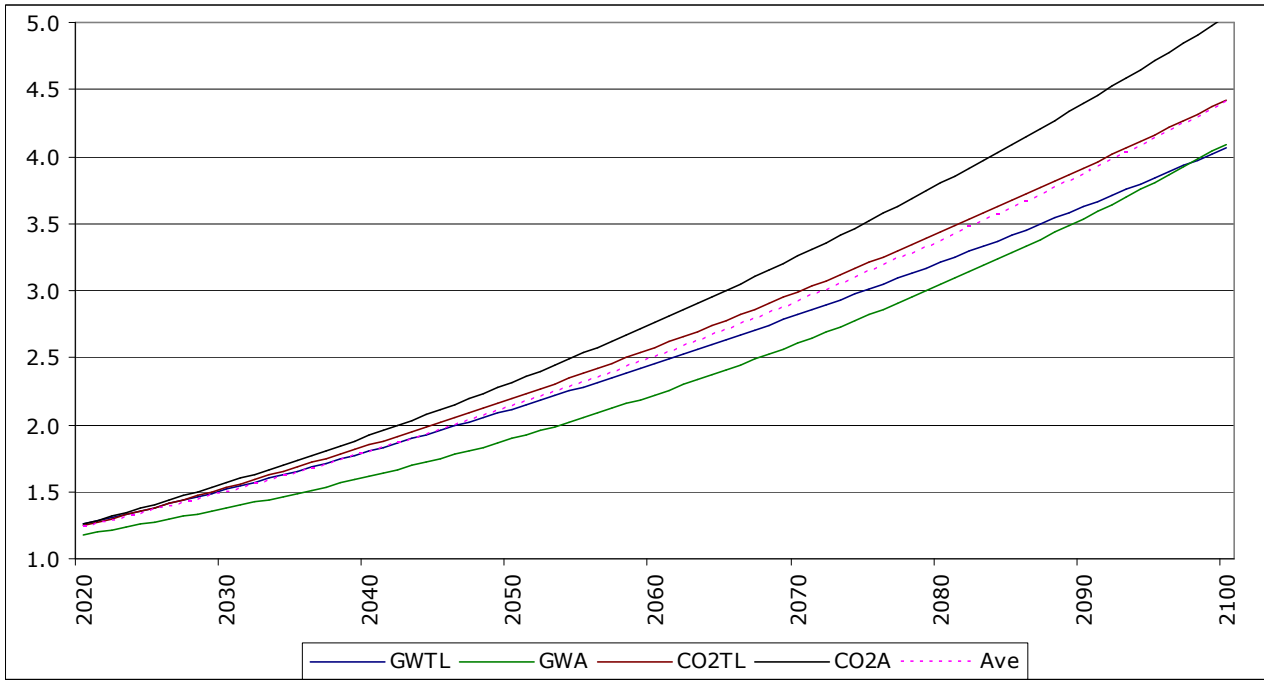
Table 11 - Business as usual (BAU) GW forecast using all methods, °C above 1850-1900 baseline, for land+ocean

year	GWTL	GWA	CO2TL	CO2A	Ave
2020	1.255	1.183	1.246	1.258	1.235
2021	1.280	1.200	1.273	1.287	1.260
2022	1.305	1.218	1.300	1.316	1.285
2023	1.330	1.237	1.328	1.346	1.310
2024	1.356	1.256	1.355	1.376	1.336
2025	1.382	1.275	1.384	1.406	1.362
2026	1.409	1.294	1.412	1.437	1.388
2027	1.435	1.314	1.441	1.469	1.415
2028	1.462	1.335	1.470	1.501	1.442
2029	1.489	1.356	1.500	1.533	1.469
2030	1.516	1.377	1.530	1.566	1.497
<b>2031</b>	1.544	1.398	1.560	1.599	<b>1.525</b>
2032	1.572	1.421	1.591	1.633	1.554
2033	1.600	1.443	1.622	1.667	1.583
2034	1.628	1.466	1.653	1.701	1.612
2035	1.657	1.489	1.684	1.736	1.642
2036	1.686	1.513	1.716	1.772	1.672
2037	1.715	1.537	1.748	1.808	1.702
2038	1.744	1.562	1.781	1.844	1.733
2039	1.774	1.587	1.813	1.881	1.764
2040	1.804	1.613	1.847	1.918	1.795
2041	1.834	1.639	1.880	1.956	1.827
2042	1.864	1.665	1.914	1.994	1.859
2043	1.895	1.692	1.948	2.033	1.892
2044	1.926	1.720	1.982	2.072	1.925
2045	1.957	1.748	2.017	2.111	1.958
2046	1.988	1.776	2.052	2.151	1.992
<b>2047</b>	2.020	1.805	2.087	2.192	<b>2.026</b>
2048	2.052	1.834	2.123	2.233	2.060
2049	2.084	1.864	2.159	2.274	2.095
2050	2.116	1.894	2.195	2.316	2.131
2051	2.149	1.925	2.232	2.358	2.166
2052	2.182	1.956	2.269	2.401	2.202
2053	2.215	1.988	2.306	2.445	2.239
2054	2.249	2.020	2.344	2.488	2.275
2055	2.283	2.053	2.382	2.533	2.313
2056	2.317	2.086	2.420	2.577	2.350
2057	2.351	2.120	2.459	2.623	2.388
2058	2.385	2.154	2.498	2.668	2.426
2059	2.420	2.189	2.537	2.714	2.465
2060	2.455	2.224	2.577	2.761	2.504
2061	2.490	2.260	2.616	2.808	2.544
2062	2.526	2.296	2.657	2.856	2.584
2063	2.562	2.333	2.697	2.904	2.624
2064	2.598	2.371	2.738	2.953	2.665
2065	2.634	2.408	2.779	3.002	2.706
2066	2.670	2.447	2.821	3.052	2.747
2067	2.707	2.486	2.863	3.102	2.789
2068	2.744	2.525	2.905	3.152	2.832
2069	2.782	2.565	2.947	3.203	2.874
2070	2.819	2.606	2.990	3.255	2.918
2071	2.857	2.647	3.033	3.307	2.961
2072	2.895	2.689	3.077	3.360	3.005
2073	2.934	2.731	3.120	3.413	3.049
2074	2.972	2.774	3.164	3.467	3.094
2075	3.011	2.817	3.209	3.521	3.139
2076	3.050	2.861	3.254	3.575	3.185
2077	3.089	2.906	3.299	3.631	3.231
2078	3.129	2.951	3.344	3.686	3.278
2079	3.169	2.997	3.390	3.743	3.324
2080	3.209	3.043	3.436	3.799	3.372
2081	3.250	3.090	3.482	3.857	3.419
2082	3.290	3.137	3.529	3.914	3.468
2083	3.331	3.185	3.576	3.973	3.516
2084	3.372	3.234	3.623	4.031	3.565
2085	3.414	3.283	3.671	4.091	3.614
2086	3.455	3.333	3.719	4.151	3.664
2087	3.497	3.383	3.767	4.211	3.715
2088	3.540	3.434	3.815	4.272	3.765
2089	3.582	3.486	3.864	4.333	3.816
2090	3.625	3.538	3.914	4.395	3.868
2091	3.668	3.591	3.963	4.458	3.920
2092	3.711	3.644	4.013	4.521	3.972
2093	3.754	3.698	4.063	4.585	4.025
2094	3.798	3.753	4.114	4.649	4.078
2095	3.842	3.808	4.165	4.713	4.132
2096	3.886	3.864	4.216	4.779	4.186
2097	3.931	3.921	4.267	4.844	4.241
2098	3.976	3.978	4.319	4.911	4.296
2099	4.021	4.036	4.371	4.977	4.351
2100	4.066	4.094	4.424	5.045	4.407

- GWTL Parabolic trendline of Global Warming
- GWA Global Warming acceleration factors
- CO2TL Cumulative CO2 emissions parabolic trendline
- CO2A Cumulative CO2 emissions acceleration factors
- Ave Average of all approaches

The estimation of the global surface temperature over land and ocean in 2100 for the business as usual scenario is **4.4°C** above the 1850-1900 baseline

Chart 9 - Business as usual (BAU) GW forecast using all methods, °C above 1850-1900 baseline, for land+ocean



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