

Table 1: Indicators of climate change (extract)

Year	Atmospheric CO ₂ (ppm)	Global temperature anomaly* (°C; 1951–1980 baseline)	Global mean sea level anomaly* (mm)	Arctic September sea ice (million km ²)	Ocean heat 0–2000 m (10 ²² J)	Atmospheric methane (ppb)
1980	338.91	+0.26	-17.70	7.67		
1985	345.54	+0.12	-13.90	6.70		1657.29
1990	354.06	+0.45	-1.20	6.14		1714.46
1995	360.18	+0.45	5.70	6.08		1748.88
2000	368.96	+0.39	25.00	6.25		1773.22
2005	378.98	+0.68	41.40	5.50	10.17	1774.23
2010	388.75	+0.72	54.90	4.87	14.54	1798.92
2015	399.65	+0.89	75.33	4.62	22.40	1834.19
2020	412.45	+1.01	91.28	4.00	25.53	
2025	425.62	+1.18	107.04	4.75	32.53	

This is an extract of a fuller table compiled by RRE and ChatGPT Full table and data sources below.

* an “anomaly” is the distance each measurement is from a pre-determined average or zero point.

Learning Goal: Analyse data to identify patterns in global change.

Considering **atmospheric carbon dioxide levels**:

1. What is the trend in atmospheric carbon dioxide levels since 1980?

2. Has the rate of change increased or decreased since 1980?

3. Calculate the percentage change for each decade 1980-90, 1990-2000, 2000-2010, 2010-20

1980-90 _____

1990-2000 _____

2000-2010 _____

2010-20 _____

Considering **Arctic September sea ice**:

1. What is the trend in Arctic September sea ice since 1980?

2. Is the trend consistent?

3. Calculate the percentage change for each decade 1980-90, 1990-2000, 2000-2010, 2010-20

1980-90 _____

1990-2000 _____

2000-2010 _____

2010-20 _____

4. Is the trend for Arctic September sea ice the same trend or a different trend to what is observed in the atmospheric carbon dioxide?

5. How do you think atmospheric carbon dioxide is related to Arctic September sea ice?

Learning Goal: Examine data of indicators of climate change (ocean and atmospheric temperatures, sea levels, biodiversity, species distribution, permafrost and sea ice).

1. Which indicators have consistent trends?

2. Which indicators have inconsistent trends?

3. In which year was the Global temperature anomaly the lowest?

4. In which year was the Arctic September sea ice the highest?

Learning Goal: Infer/predict future patterns by examining and interpreting current climate change data.

1. Based on the data in the table, what do you expect will happen to each of the indicators shown in the table over the next 25 years?

2. For each of Atmospheric CO₂, Global temperature anomaly, Global mean sea level anomaly, and Arctic September sea ice, calculate the percentage change between the year 2000 and the year 2025.

Atmospheric CO₂:

Global temperature anomaly:

Global mean sea level anomaly:

Arctic September sea ice

3. If the same percentage change happens in the next twenty five years (2025-2050), predict the value of each indicator by 2050

Atmospheric CO₂:

Global temperature anomaly:

Global mean sea level anomaly:

Arctic September sea ice

Learning Goal: Identify strategies to reduce climate change.

1. Name three things you can do or that you are already doing to help reduce the amount that these indicators will change by

2. For each action you named, explain how you think it will help

3. If reducing climate change was important to you, what other strategies could you explore to reduce climate change?

Year	Atmospheric CO ₂ (ppm)	Global temperature anomaly (°C; 1951–1980 baseline)	Global mean sea level anomaly (mm)	Arctic September sea ice (million km ²)	Ocean heat 0–2000 m (10 ²² J)	Atmospheric methane (ppb)
1979	336.85	+0.16	-23.70	7.05		
1980	338.91	+0.26	-17.70	7.67		
1981	340.11	+0.32	-5.30	7.14		
1982	340.85	+0.14	-11.10	7.30		
1983	342.53	+0.31	-2.70	7.39		
1984	344.07	+0.16	-3.60	6.81		1644.84
1985	345.54	+0.12	-13.90	6.70		1657.29
1986	346.97	+0.18	-13.30	7.41		1670.09
1987	348.68	+0.32	-12.70	7.28		1682.71
1988	351.16	+0.39	-8.00	7.37		1693.19
1989	352.79	+0.27	-3.50	7.01		1704.53
1990	354.06	+0.45	-1.20	6.14		1714.46
1991	355.40	+0.41	1.30	6.47		1724.79
1992	356.09	+0.22	2.00	7.47		1735.47
1993	356.84	+0.23	1.40	6.40		1736.48
1994	358.33	+0.31	2.70	7.14		1742.08
1995	360.18	+0.45	5.70	6.08		1748.88
1996	361.93	+0.33	11.40	7.58		1751.30
1997	363.04	+0.47	16.10	6.69		1754.51
1998	365.70	+0.61	21.90	6.54		1765.57
1999	367.79	+0.38	22.10	6.12		1772.30
2000	368.96	+0.39	25.00	6.25		1773.22
2001	370.57	+0.53	29.60	6.73		1771.29
2002	372.58	+0.63	33.30	5.83		1772.68
2003	375.14	+0.62	35.40	6.12		1777.33
2004	376.95	+0.53	37.60	5.98		1777.13
2005	378.98	+0.68	41.40	5.50	10.17	1774.23
2006	381.15	+0.64	42.90	5.86	12.64	1774.94
2007	382.90	+0.66	43.20	4.27	12.39	1781.33
2008	385.02	+0.54	48.60	4.69	13.26	1787.01
2009	386.50	+0.66	53.50	5.26	13.43	1793.52
2010	388.75	+0.72	54.90	4.87	14.54	1798.92
2011	390.62	+0.61	54.60	4.56	15.39	1803.03
2012	392.65	+0.65	65.40	3.57	16.19	1808.07
2013	395.40	+0.67	67.90	5.21	18.65	1813.42
2014	397.34	+0.75	71.30	5.22	20.11	1822.59
2015	399.65	+0.89	75.33	4.62	22.40	1834.19

2016	403.07	+1.01	79.41	4.53	20.80	1843.18
2017	405.22	+0.91	79.88	4.82	23.59	1849.62
2018	407.61	+0.85	82.32	4.79	24.06	
2019	410.07	+0.98	88.80	4.36	25.44	
2020	412.45	+1.01	91.28	4.00	25.53	
2021	414.70	+0.85	95.67	4.95	27.28	
2022	417.08	+0.89	97.76	4.90	28.19	
2023	419.35	+1.17	103.10	4.38	29.22	
2024	422.79	+1.28	106.76	4.35	30.32	
2025	425.62	+1.18	107.04	4.75	32.53	

Period	1979–2025; 47 annual rows.
CO ₂	NOAA global marine surface annual average, ppm; 2025 preliminary.
CO ₂ source	https://gml.noaa.gov/webdata/ccgg/trends/co2/co2_annmean_gl.csv
Temperature	NASA GISTEMP v4, Zonal Annual Means (ZonAnn.Ts+dSST.csv), Glob column; annual global land-ocean temperature anomaly (°C), relative to 1951–1980. Source: https://data.giss.nasa.gov/gistemp/tabledata_v4/ZonAnn.Ts+dSST.csv
Arctic sea ice	NSIDC September monthly mean extent, million km ² (not annual mean).
Ocean heat	NOAA NCEI upper 0–2000 m heat-content anomaly (10 ²² J), 2005–2025 only in the selected transcribed series. Earlier cells blank.
Methane	NOAA globally averaged marine surface annual mean, ppb; 1984–2017 transcribed; remaining years not transcribed.
Quality caution	Do not interpret blank cells as missing observational records. Several are gaps in this workbook extraction.
Sea level provenance	1979–1992: CSIRO Church & White 2011 reconstruction, 2015 release; 1993–2014: CSIRO satellite altimetry annual series, same archive. 2015–2025 not included in supplied archive and remain blank.
Sea level source	https://www.cmar.csiro.au/sealevel/GMSL_SG_2011_up.html
Alignment method	Reconstruction adjusted by constant -1.24 mm (mean satellite minus reconstruction over 1993–2013, n=21); satellite data unchanged.
Reference level	Relative sea level anomalies in millimetres on the CSIRO satellite series datum; arbitrary zero, not absolute ocean height.
Caution	Joined series is an illustrative classroom composite; historical tide-gauge reconstruction and satellite series differ in methods and uncertainty. Offset is not a calibration of other biases.
Missing years	2015–2025 intentionally blank. A modern NASA/CSIRO satellite annual series is needed to complete these years.
Latest satellite source	https://podaac.jpl.nasa.gov/dataset/NASA_SSH_GMSL_INDICATOR
Current status	Sea level values remain blank: raw numerical source files could not be retrieved. No estimated or fabricated values entered.
Methane displayed table	https://www.ecosciencehub.com/en/data/indicators/atmospheric-ch4