WORKING GROUP I CONTRIBUTION TO THE IPCC FIFTH ASSESSMENT REPORT CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS

Final Draft Underlying Scientific-Technical Assessment

A report accepted by Working Group I of the IPCC but not approved in detail.

Note:

The final draft Report, dated 7 June 2013, of the **Working Group I contribution to the IPCC 5th Assessment Report "Climate Change 2013: The Physical Science Basis" was accepted but not approved in detail by the 12th Session of Working Group I and the 36th Session of the IPCC on 26 September 2013 in Stockholm, Sweden**. It consists of the full scientific and technical assessment undertaken by Working Group I.

The Report has to be read in conjunction with the document entitled "Climate Change 2013: The Physical Science Basis. Working Group I Contribution to the IPCC 5th Assessment Report - Changes to the underlying Scientific/Technical Assessment" to ensure consistency with the approved Summary for Policymakers (IPCC-XXVI/Doc.4) and presented to the Panel at its 36th Session. This document lists the changes necessary to ensure consistency between the full Report and the Summary for Policymakers, which was approved line-by-line by Working Group I and accepted by the Panel at the above-mentioned Sessions.

Before publication the Report will undergo final copyediting as well as any error correction as necessary, consistent with the IPCC Protocol for Addressing Possible Errors. Publication of the Report is foreseen in January 2014.

30 September 2013

ipcc

INTERGOVERNMENTAL PANEL ON climate change

WORKING GROUP I – TWELFTH SESSION
Stockholm, 23-26 September 2013

WG-I: 12th/Doc. 2b, Annex II
(12.VIII.2013)
Agenda Item: 5
ENGLISH ONLY

WORKING GROUP I CONTRIBUTION TO THE IPCC FIFTH ASSESSMENT REPORT (AR5), CLIMATE CHANGE 2013: THE PHYSICAL SCIENCE BASIS

Annex II: Climate System Scenario Tables - Final Draft Underlying Scientific-Technical Assessment

(Submitted by the Co-Chairs of Working Group I)

Confidential – This document is being made available in preparation of WGI-12 only and should not be cited, quoted, or distributed

NOTE:

The Final Draft Underlying Scientific-Technical Assessment is submitted to the Twelfth Session of Working Group I for acceptance. The IPCC at its Thirty-sixth Session (Stockholm, 26 September 2013) will be informed of the actions of the Twelfth Session of Working Group I in this regard.

IPCC Secretariat

c/o WMO • 7bis, Avenue de la Paix • C.P. 2300 • 1211 Geneva 2 • Switzerland
telephone : +41 (0) 22 730 8208 / 54 / 84 • fax : +41 (0) 22 730 8025 / 13 • email : IPCC-Sec@wmo.int • **www.ipcc.ch**

WMO UNEP

Annex II: Climate System Scenario Tables

Editorial Team: Michael Prather (USA), Greg Flato (USA), Pierre Friedlingstein (UK/Belgium), Chris Jones (UK), Jean-François Lamarque (USA), Hong Liao (China), Phil Rasch (USA)

Contributors: Olivier Boucher (France), François-Marie Bréon (France), Tim Carter (Finland), Bill Collins (UK), Frank Dentener (European Union/Netherlands), Ed Dlugokencky (USA), Jean-Louis Dufresne (France), Jan Willem Erisman (Netherlands), Veronika Eyring (Germany), Arlene Fiore (USA), James Galloway (USA), Jonathan Gregory (UK), Ed Hawkins (UK), Chris Holmes (USA), Jasmin John (USA), Tim Johns (UK), Fiona Lo (USA), Natalie Mahowald (USA), Malte Meinshausen (Germany), Colin Morice (UK), Vaishali Naik (USA/India), Drew Shindell (USA), Steven J. Smith (USA), David Stevenson (UK), Peter Thorne (USA/Norway/UK), Geert Jan van Oldenborgh (Netherlands), Apostolos Voulgarakis (UK/Greece), Oliver Wild (UK), Don Wuebbles (USA), Paul Young (UK)

Date of Draft: 7 June 2013

Introduction

Annex II presents, in tabulated form, data related to historical and projected changes in the climate system that are assessed in the chapters of this report (see Section 1.6). It also includes some comparisons with the TAR and AR4 results. These data include values for emissions into the atmosphere, atmospheric abundances and burdens (integrated abundance), effective radiative forcing (ERF, includes adjusted forcing from aerosols, see Chapters 7 and 8), and global mean surface temperatures and sea level. Projections from 2010 to 2100 focus on the RCP scenarios (Moss et al., 2010; Lamarque et al., 2010; 2011; Meinshausen et al., 2011a; van Vuuren et al., 2011; see also Chapters 1, 6, 8, 11, 12, 13). Projections also include previous IPCC scenarios (IS92a, SRES A2 and B1, TAR Appendix II) and some alternative near-term scenarios for CH_4 and short-lived pollutants that impact climate or air quality. Emissions from biomass burning are included as anthropogenic. ERF from land use change is also included in some tables.

Where uncertainties or ranges are presented here, they are noted in each table as being a recommended value or model ensemble mean/median with a 68% confidence interval (16–84%, ±1 sigma for a normal distribution) or 90% confidence interval (5–95%, ±1.645 sigma for a normal distribution) or statistics (standard deviation, percentiles, or minimum/maximum) of an ensemble of models. In some cases these are a formal evaluation of uncertainty as assessed in the chapters, but in other cases (specifically Tables AII.2.1, 3.1, 4.1, 5.1, 6.10, 7.1–4, and 7.5) they just describe the statistical results from the available models, and the referenced chapters must be consulted for the assessed uncertainty or confidence level of these results. In the case of Table AII.7.5, for example, the global mean surface temperature change (°C) relative to 1986–2005 is a statistical summary of the spread in the CMIP ensembles for each of the scenarios: model biases and model dependencies are not accounted for; the percentiles do not correspond to the assessed uncertainty derived in Chapters 11 (Section 11.3.6.3) and 12 (Section 12.4.1); and statistical spread across models cannot be interpreted in terms of calibrated language (Section 12.2).

The RCP scenarios for emissions include only anthropogenic sources and use a single model to project from emissions to abundances to radiative forcing to climate change (Meinshausen et al., 2011a; 2011b). We include projected changes in natural CO_2 sources and sinks for 2010–2100 based on this assessment (Chapters 6, 12). Present-day natural and anthropogenic emissions of CH_4 and N_2O are assessed and used to scale the RCP anthropogenic emissions to be consistent with these best estimates (Chapters 6, 11). Current model evaluations of atmospheric chemistry and the carbon cycle, including results from the CMIP5 and ACCMIP projects, are used to project future composition and ERF separately from the RCP model (see Sections 6.4.3, 11.3.5, 12.3). Thus, projected changes in greenhouse gases, aerosols and ERF evaluated in this report may differ from the published RCPs and from what was used in the CMIP5 runs, and these are denoted RCP$^{\&}$. The CMIP5 climate projections used for the most part the RCP concentration pathways for WMGHG and the emissions pathways for O_3 and aerosol precursors. Such differences are discussed in the relevant chapters and noted in the tables.

For each species, the abundances (given as dry air mole fraction: ppm = micromoles per mole (10^{-6}); ppb = nanomoles per mole (10^{-9}); and ppt = picomoles per mole (10^{-12})), burdens (global total in grams, 1 Tg = 10^{12} g), average column amount (1 Dobson Unit (DU) = 2.687×10^{16} molecules per cm^2), AOD (mean aerosol optical depth at 550 nm), ERF (effective radiative forcing, W m^{-2}), and other climate system quantities are calculated for scenarios using methodologies based on the latest climate chemistry and climate carbon models (see Chapters 2, 6, 7, 8, 10, 11, 12). Results are shown for individual years (e.g., 2010 = year 2010) and decadal averages (e.g., 2020^{d} = average of years 2016 through 2025), although some ten-year periods are different, see table notes. Year 2011 is the last year for observed quantities (denoted 2011* or 2011^{obs}). Results are shown as global mean values except for environmental data focusing on air quality (AII.7.1–AII.7.4), which give regional mean surface abundances of O_3 and $PM_{2.5}$. Results for global mean surface temperature (AII.7.5 and AII.7.6) only show raw CMIP5 data or data from previous assessments. For best estimates of near-term and long-term temperature change see Chapters 11 and 12, respectively. Results for global mean sea level rise (AII.7.7) are assessed values with uncertainties described in Chapter 13.

Chemical Abbreviations and Symbols

Well Mixed Greenhouse Gases (WMGHG)

CO_2	carbon dioxide (KP, Kyoto Protocol gas)
CH_4	methane (KP)
N_2O	nitrous oxide (KP)
HFC	hydrofluorocarbon[1] (a class of compounds: HFC-32, HFC-134a, …) (KP)
PFC	perfluorocarbon (a class of compounds: CF_4, C_2F_6, …) (KP)
SF_6	sulphur hexafluoride (KP)
CFC	chlorofluorocarbon (a class of compounds: $CFCl_3$, CF_2Cl_2, …) (MP, Montreal Protocol gas)
HCFC	hydrochlorofluorocarbon[1] (a class of compounds: HCFC-22, HCFC-141b, …) (MP)
CCl_4	carbon tetrachloride (MP)
CH_3CCl_3	methyl chloroform (MP)

Ozone and Aerosols, and their Precursors

O_3	ozone (both stratospheric and tropospheric)
NO_X	sum of NO (nitric oxide) and NO_2 (nitrogen dioxide)
NH_3	ammonia
CO	carbon monoxide
NMVOC	a class of compounds comprising all non-methane volatile organic compounds (i.e., hydrocarbons that may also contain oxygen, also known as biogenic VOC or NMHC)
OH	hydroxyl radical
$PM_{2.5}$	any aerosols with diameter less than 2.5 micrometers
BC	black carbon aerosol
OC	organic carbon aerosol
SO_2	sulphur dioxide, a gas
SO_X	oxidized sulphur in gaseous form, including SO_2
$SO_4^{=}$	sulphate ion, usually as sulphuric acid or ammonium sulphate in aerosol

List of Tables

[1] A few HFCs and HCFCs are very short lived in the atmosphere and therefore not well mixed.

Table AII.2.2: Anthropogenic CH_4 emissions (Tg yr^{-1})
Table AII.2.3: Anthropogenic N_2O emissions (TgN yr^{-1})
Table AII.2.4: Anthropogenic SF_6 emissions (Gg yr^{-1})
Table AII.2.5: Anthropogenic CF_4 emissions (Gg yr^{-1})
Table AII.2.6: Anthropogenic C_2F_6 emissions (Gg yr^{-1})
Table AII.2.7: Anthropogenic C_6F_{14} emissions (Gg yr^{-1})
Table AII.2.8: Anthropogenic HFC-23 emissions (Gg yr^{-1})
Table AII.2.9: Anthropogenic HFC-32 emissions (Gg yr^{-1})
Table AII.2.10: Anthropogenic HFC-125 emissions (Gg yr^{-1})
Table AII.2.11: Anthropogenic HFC-134a emissions (Gg yr^{-1})
Table AII.2.12: Anthropogenic HFC-143a emissions (Gg yr^{-1})
Table AII.2.13: Anthropogenic HFC-227ea emissions (Gg yr^{-1})
Table AII.2.14: Anthropogenic HFC-245fa emissions (Gg yr^{-1})
Table AII.2.15: Anthropogenic HFC-43-10mee emissions (Gg yr^{-1})
Table AII.2.16: Anthropogenic CO emissions (Tg yr^{-1})
Table AII.2.17: Anthropogenic NMVOC emissions (Tg yr^{-1})
Table AII.2.18: Anthropogenic NO_X emissions (TgN yr^{-1})
Table AII.2.19: Anthropogenic NH_3 emissions (TgN yr^{-1})
Table AII.2.20: Anthropogenic SO_X emissions (TgS yr^{-1})
Table AII.2.21: Anthropogenic OC aerosols emissions (Tg yr^{-1})
Table AII.2.22: Anthropogenic BC aerosols emissions (Tg yr^{-1})
Table AII.2.23: Anthropogenic nitrogen fixation (Tg-N yr^{-1})

AII.3: Natural Emissions

Table AII.3.1a: Net land (natural and land use) CO_2 emissions (PgC yr^{-1})
Table AII.3.1b: Net ocean CO_2 emissions (PgC yr^{-1})

AII.4: Abundances of the Well Mixed Greenhouse Gases

Table AII.4.1: CO_2 abundance (ppm)
Table AII.4.2: CH_4 abundance (ppb)
Table AII.4.3: N_2O abundance (ppb)
Table AII.4.4: SF_6 abundance (ppt)
Table AII.4.5: CF_4 abundance (ppt)
Table AII.4.6: C_2F_6 abundance (ppt)
Table AII.4.7: C_6F_{14} abundance (ppt)
Table AII.4.8: HFC-23 abundance (ppt)
Table AII.4.9: HFC-32 abundance (ppt)
Table AII.4.10: HFC-125 abundance (ppt)
Table AII.4.11: HFC-134a abundance (ppt)
Table AII.4.12: HFC-143a abundance (ppt)
Table AII.4.13: HFC-227ea abundance (ppt)
Table AII.4.14: HFC-245fa abundance (ppt)
Table AII.4.15: HFC-43-10mee abundance (ppt)
Table AII.4.16: Montreal Protocol greenhouse gas abundances (ppt)

AII.5: Column Abundances, Burdens, and Lifetimes

Table AII.5.1: Stratospheric O_3 column changes (DU)
Table AII.5.2: Tropospheric O_3 column changes (DU)
Table AII.5.3: Total aerosol optical depth (AOD)
Table AII.5.4: Absorbing aerosol optical depth (AAOD)
Table AII.5.5: Sulphate aerosol atmospheric burden (TgS)
Table AII.5.6: OC aerosol atmospheric burden (Tg)
Table AII.5.7: BC aerosol atmospheric burden (Tg)
Table AII.5.8: CH_4 atmospheric lifetime (yr) against loss by tropospheric OH
Table AII.5.9: N_2O atmospheric lifetime (yr)

AII.6: Effective Radiative Forcing

Table AII.6.1: ERF from CO_2 (W m^{-2})
Table AII.6.2: ERF from CH_4 (W m^{-2})
Table AII.6.3: ERF from N_2O (W m^{-2})
Table AII.6.4: ERF from all HFCs (W m^{-2})
Table AII.6.5: ERF from all PFCs and SF_6 (W m^{-2})

AII.7: Environmental Data

Tables

AII.1: Historical Climate System Data

Table AII.1.1a: Historical abundances of the Kyoto greenhouse gases

Year	CO_2 (ppm)	CH_4 (ppb)	N_2O (ppb)
PI*	278 ± 2	722 ± 25	270 ± 7
1755	276.7	723	272.8
1760	276.5	726	274.1
1765	276.6	730	274.2
1770	277.3	733	273.7
1775	278.0	736	273.1
1780	278.2	739	272.4
1785	278.6	742	271.9
1790	280.0	745	271.8
1795	281.4	748	272.1
1800	282.6	751	272.6
1805	283.6	755	272.1
1810	284.2	760	271.4
1815	284.0	765	271.5
1820	283.3	769	272.9
1825	283.1	774	274.1
1830	283.8	779	273.7
1835	283.9	784	270.5
1840	284.1	789	269.6
1845	285.8	795	270.3
1850	286.8	802	270.4
1855	286.4	808	270.6
1860	286.1	815	271.7
1865	286.3	823	272.3
1870	288.0	831	273.0
1875	289.4	839	274.7
1880	289.8	847	275.8
1885	290.9	856	277.2
1890	293.1	866	278.3
1895	295.4	877	277.7
1900	296.2	891	277.3
1905	297.4	912	279.2
1910	299.3	935	280.8
1915	301.1	961	282.7
1920	303.3	990	285.1
1925	304.7	1020	284.3
1930	306.6	1049	284.9
1935	308.4	1077	286.6
1940	310.4	1102	287.7
1945	310.9	1129	288.0
1950	311.2	1162	287.6
1955	313.4	1207	289.6
1956	314.0	1217	290.4
1957	314.6	1228	291.2
1958	315.3	1239	291.7

1959	316.0	1251	292.1
1960	316.7	1263	292.4
1961	317.4	1275	292.5
1962	318.0	1288	292.5
1963	318.5	1301	292.6
1964	319.0	1314	292.6
1965	319.7	1328	292.7
1966	320.6	1343	292.9
1967	321.5	1357	293.3
1968	322.5	1372	293.8
1969	323.5	1388	294.4
1970	324.6	1403	295.2
1971	325.6	1419	296.0
1972	326.8	1435	296.9
1973	328.0	1451	297.8
1974	329.2	1467	298.4
1975	330.2	1483	299.0
1976	331.3	1500	299.4
1977	332.7	1516	299.8
1978	334.3	1532	300.2
1979	336.2	1549	300.7
1980	338.0	1567	301.3
1981	339.3	1587	302.0
1982	340.5	1607	303.0
1983	342.1	1626	303.9
1984	343.7	1643	304.5
1985	345.2	1657	305.5
1986	346.6	1670	305.9
1987	348.4	1682	306.3
1988	350.5	1694	306.7
1989	352.2	1704	307.8
1990	353.6	1714	308.7
1991	354.8	1725	309.3
1992	355.7	1733	309.8
1993	356.6	1738	310.1
1994	358.0	1743	310.4
1995	359.9	1747	311.0
1996	361.4	1751	311.8
1997	363.1	1757	312.7
1998	365.2	1765	313.7
1999	367.2	1771	314.7
2000	368.7	1773	315.6
2001	370.2	1773	316.3
2002	372.3	1774	317.0
2003	374.5	1776	317.6
2004	376.6	1776	318.3
2005	378.7	1776	319.1
2006	380.8	1776	319.8
2007	382.7	1781	320.6
2008	384.6	1787	321.4

2009	386.4	1792	322.3
2010	388.4	1798	323.2
2011*	390.5 ± 0.3	1803 ± 4	324 ± 1

Table AII.1.1a (continued)

Year	SF_6 (ppt)	CF_4 (ppt)	C_2F_6 (ppt)	C_6F_{14} (ppt)
PI*	0	40	0	0
1900	0	35	0	0
1910	0	35	0.1	0
1920	0	35	0.1	0
1930	0	36	0.2	0
1940	0	37	0.3	0
1950	0	39	0.5	0
1960	0.1	43	0.6	0
1970	0.3	51	0.8	0
1980	0.8	60	1.2	0
1990	2.4	68	1.9	0
2000	4.5	76	2.9	0
2010	7.0	78.3	4.1	0
2011*	7.3 ± 0.1	79.0	4.2	0

Table AII.1.1a (continued)

Year	HFC-23 (ppt)	HFC-32 (ppt)	HFC-125 (ppt)	HFC-134a (ppt)	HFC-143a (ppt)	HFC-227ea (ppt)	HFC-245fa (ppt)	HFC-43-10mee (ppt)
PI*	0	0	0	0	0	0	0	0
1940	0.1	0	0	0	0	0	0	0
1950	0.3	0	0	0	0	0	0	0
1960	0.7	0	0	0	0	0	0	0
1970	1.6	0	0	0	0	0	0	0
1980	3.7	0	0	0	0.2	0	0	0
1990	7.9	0	0.1	0	0.6	0	0	0
2000	14.8	0	1.3	14	3.1	0.1	0	0
2010	23.2	4.1	8.2	58	10.9	0.6	1.1	0
2011*	24.0	4.9	9.6	63 ± 1	12.0	0.65	1.24	0

Notes:
Abundances are mole fraction of dry air for the lower, well mixed atmosphere (ppm = micromoles/mole, ppb = nanomoles/mole, ppt = picomoles/mole). Values refer to single-year average. Uncertainties (5–95% confidence intervals) are only given for 2011 when more than one laboratory reports global data. Pre-industrial (PI*, taken to be 1750 for GHG) and present day (2011*) abundances are from Chapter 2, Tables 2.1 and 2.SM.1; see also Chapter 6 for Holocene variability (10 ppm CO_2, 40 ppb CH_4, 10 ppb N_2O). Intermediate data for CO_2, CH_4, and N_2O are from Chapters 2 and 8, Figure 8.6. See also Appendix 1.A. Intermediate data for the F-gases are taken from Meinshausen et al. (2011).

Table AII.1.1b: Historical abundances of the Montreal Protocol greenhouse gases (all ppt)

Year	CFC-11	CFC-12	CFC-113	CFC-114	CFC-115	CCl_4	CH_3CCl_3	HCFC-22
PI*	0	0	0	0	0	0	0	0
1960	9.5	29.5	1.9	3.8	0.0	52.1	1.5	2.1
1965	23.5	58.8	3.1	5.0	0.0	64.4	4.7	4.9
1970	52.8	114.3	5.5	6.5	0.2	75.9	16.2	12.1
1975	106.1	203.1	10.4	8.3	0.6	85.5	40.0	23.8
1980	161.9	297.4	19.0	10.7	1.3	93.3	81.6	42.5

1985	205.4	381.2	37.3	12.9	2.8	99.6	106.1	62.7
1990	256.2	477.5	67.6	15.4	4.7	106.5	127.2	88.2
1995	267.4	523.8	83.6	16.1	6.8	103.2	110.3	113.6
2000	261.7	541.0	82.3	16.5	7.9	98.6	49.7	139.5
2005	251.6	542.7	78.8	16.6	8.3	93.7	20.1	165.5
2010	240.9	532.5	75.6	16.4	8.4	87.6	8.3	206.8
2011*	238 ± 1	528±2	74.3±0.5	15.8	8.4	86±2	6.4±0.4	213±2

Table AII.1.1b (continued)

Year	HCFC-141b	HCFC-142b	Halon 1211	Halon 1202	Halon 1301	Halon 2402	CH_3Br	CH_3Cl
PI*	0	0	0	0	0	0		
1960	0.0	0.0	0.00	0.00	0.00	0.00	6.5	510
1965	0.0	0.0	0.00	0.00	0.00	0.00	6.7	528
1970	0.0	0.0	0.02	0.00	0.00	0.02	0.0	540
1975	0.0	0.2	0.12	0.01	0.04	0.06	7.4	546
1980	0.0	0.4	0.42	0.01	0.24	0.15	7.7	548
1985	0.0	0.7	1.04	0.02	0.74	0.26	8.2	549
1990	0.0	1.2	2.27	0.03	1.66	0.41	8.6	550
1995	2.7	6.3	3.34	0.04	2.63	0.52	9.2	550
2000	11.8	11.4	4.02	0.04	2.84	0.50	8.9	550
2005	17.5	15.1	4.26	0.02	3.03	0.48	7.9	550
2010	20.3	20.5	4.07	0.00	3.20	0.46	7.2	550
2011*	21.4±0.5	21.2±0.5	4.07	0.00	3.23	0.45	7.1	534

Notes:
See Table AII.1.1a. For present-day (2011*) see Chapter 2. Intermediate years are from Scenario A1, WMO Ozone Assessment (WMO, 2010).

Table AII.1.2: Historical effective radiative forcing (ERF) (W m^{-2}), including land use change (LUC)

Year	CO_2	GHG Other*	O_3 (Trop)	O_3 (Strat)	Aerosol (Total)	LUC	H_2O (Strat)	BC Snow	Con–trails	Solar	Volcano
1750	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	–0.001
1751	–0.023	0.004	0.000	0.000	–0.002	0.000	0.000	0.000	0.000	–0.014	0.000
1752	–0.024	0.006	0.001	0.000	–0.004	–0.001	0.000	0.000	0.000	–0.029	0.000
1753	–0.024	0.007	0.001	0.000	–0.005	–0.001	0.000	0.000	0.000	–0.033	0.000
1754	–0.025	0.008	0.002	0.000	–0.007	–0.002	0.000	0.001	0.000	–0.043	0.000
1755	–0.026	0.010	0.002	0.000	–0.009	–0.002	0.000	0.001	0.000	–0.054	–0.664
1756	–0.026	0.011	0.003	0.000	–0.011	–0.002	0.000	0.001	0.000	–0.055	0.000
1757	–0.027	0.013	0.003	0.000	–0.013	–0.003	0.000	0.001	0.000	–0.048	0.000
1758	–0.028	0.014	0.003	0.000	–0.014	–0.003	0.000	0.001	0.000	–0.050	0.000
1759	–0.028	0.015	0.004	0.000	–0.016	–0.004	0.000	0.001	0.000	–0.102	0.000
1760	–0.029	0.016	0.004	0.000	–0.018	–0.004	0.000	0.001	0.000	–0.112	–0.060
1761	–0.029	0.017	0.005	0.000	–0.020	–0.004	0.000	0.002	0.000	–0.016	–1.093
1762	–0.029	0.017	0.005	0.000	–0.021	–0.005	0.001	0.002	0.000	–0.007	–0.300
1763	–0.029	0.018	0.006	0.000	–0.023	–0.005	0.001	0.002	0.000	–0.018	–0.093
1764	–0.028	0.018	0.006	0.000	–0.025	–0.006	0.001	0.002	0.000	–0.022	–0.021
1765	–0.026	0.018	0.006	0.000	–0.027	–0.006	0.001	0.002	0.000	–0.054	–0.003
1766	–0.024	0.018	0.007	0.000	–0.029	–0.006	0.001	0.002	0.000	–0.048	0.000
1767	–0.022	0.018	0.007	0.000	–0.030	–0.007	0.001	0.003	0.000	–0.036	0.000
1768	–0.020	0.018	0.008	0.000	–0.032	–0.007	0.001	0.003	0.000	0.016	0.000
1769	–0.017	0.018	0.008	0.000	–0.034	–0.008	0.001	0.003	0.000	0.050	0.000

1770	–0.014	0.018	0.009	0.000	–0.036	–0.008	0.001	0.003	0.000	0.081	0.000
1771	–0.011	0.018	0.009	0.000	–0.038	–0.008	0.001	0.003	0.000	0.055	0.000
1772	–0.008	0.018	0.009	0.000	–0.039	–0.009	0.001	0.003	0.000	0.052	–0.070
1773	–0.005	0.018	0.010	0.000	–0.041	–0.009	0.001	0.003	0.000	0.016	–0.020
1774	–0.003	0.018	0.010	0.000	–0.043	–0.010	0.001	0.004	0.000	–0.002	–0.005
1775	–0.001	0.018	0.011	0.000	–0.045	–0.010	0.001	0.004	0.000	–0.038	–0.001
1776	0.001	0.018	0.011	0.000	–0.046	–0.010	0.001	0.004	0.000	–0.045	0.000
1777	0.002	0.018	0.011	0.000	–0.048	–0.011	0.001	0.004	0.000	–0.036	0.000
1778	0.003	0.018	0.012	0.000	–0.050	–0.011	0.001	0.004	0.000	0.017	–0.067
1779	0.003	0.018	0.012	0.000	–0.052	–0.012	0.001	0.004	0.000	–0.034	–0.071
1780	0.003	0.018	0.013	0.000	–0.054	–0.012	0.002	0.004	0.000	–0.069	–0.018
1781	0.004	0.018	0.013	0.000	–0.055	–0.012	0.002	0.005	0.000	–0.057	–0.004
1782	0.004	0.018	0.014	0.000	–0.057	–0.013	0.002	0.005	0.000	–0.028	–0.001
1783	0.006	0.018	0.014	0.000	–0.059	–0.013	0.002	0.005	0.000	–0.065	–7.857
1784	0.009	0.018	0.014	0.000	–0.061	–0.014	0.002	0.005	0.000	–0.059	–0.522
1785	0.012	0.018	0.015	0.000	–0.062	–0.014	0.002	0.005	0.000	–0.046	–0.121
1786	0.017	0.018	0.015	0.000	–0.064	–0.014	0.002	0.005	0.000	–0.022	–0.027
1787	0.021	0.018	0.016	0.000	–0.066	–0.015	0.002	0.005	0.000	–0.001	–0.002
1788	0.027	0.018	0.016	0.000	–0.068	–0.015	0.002	0.006	0.000	0.034	–0.133
1789	0.033	0.019	0.017	0.000	–0.070	–0.016	0.002	0.006	0.000	–0.033	–0.041
1790	0.038	0.019	0.017	0.000	–0.071	–0.016	0.002	0.006	0.000	–0.058	–0.009
1791	0.044	0.019	0.017	0.000	–0.073	–0.016	0.002	0.006	0.000	–0.056	–0.001
1792	0.050	0.020	0.018	0.000	–0.075	–0.017	0.002	0.006	0.000	–0.051	0.000
1793	0.055	0.020	0.018	0.000	–0.077	–0.017	0.002	0.006	0.000	–0.065	0.000
1794	0.060	0.021	0.019	0.000	–0.079	–0.018	0.002	0.006	0.000	–0.064	–0.157
1795	0.066	0.022	0.019	0.000	–0.080	–0.018	0.002	0.007	0.000	–0.027	0.000
1796	0.070	0.023	0.020	0.000	–0.082	–0.018	0.002	0.007	0.000	–0.033	–0.781
1797	0.075	0.023	0.020	0.000	–0.084	–0.019	0.002	0.007	0.000	–0.043	–0.071
1798	0.079	0.024	0.020	0.000	–0.086	–0.019	0.002	0.007	0.000	–0.045	–0.016
1799	0.084	0.025	0.021	0.000	–0.087	–0.020	0.003	0.007	0.000	–0.047	–0.002
1800	0.088	0.025	0.021	0.000	–0.089	–0.020	0.003	0.007	0.000	–0.055	0.000
1801	0.092	0.026	0.022	0.000	–0.091	–0.020	0.003	0.007	0.000	–0.021	–0.154
1802	0.096	0.026	0.022	0.000	–0.093	–0.021	0.003	0.008	0.000	–0.010	–0.048
1803	0.099	0.026	0.023	0.000	–0.095	–0.021	0.003	0.008	0.000	–0.033	–0.011
1804	0.103	0.026	0.023	0.000	–0.096	–0.022	0.003	0.008	0.000	–0.040	–0.230
1805	0.106	0.026	0.023	0.000	–0.098	–0.022	0.003	0.008	0.000	–0.046	–0.070
1806	0.109	0.026	0.024	0.000	–0.100	–0.022	0.003	0.008	0.000	–0.036	–0.016
1807	0.112	0.026	0.024	0.000	–0.102	–0.023	0.003	0.008	0.000	–0.057	–0.002
1808	0.114	0.026	0.025	0.000	–0.104	–0.023	0.003	0.008	0.000	–0.065	0.000
1809	0.116	0.026	0.025	0.000	–0.105	–0.024	0.003	0.009	0.000	–0.065	–6.947
1810	0.117	0.026	0.025	0.000	–0.107	–0.024	0.003	0.009	0.000	–0.070	–2.254
1811	0.118	0.027	0.026	0.000	–0.109	–0.024	0.003	0.009	0.000	–0.072	–0.836
1812	0.119	0.027	0.026	0.000	–0.111	–0.025	0.003	0.009	0.000	–0.072	–0.308
1813	0.118	0.028	0.027	0.000	–0.112	–0.025	0.004	0.009	0.000	–0.069	–0.109
1814	0.117	0.029	0.027	0.000	–0.114	–0.026	0.004	0.009	0.000	–0.064	0.000
1815	0.115	0.030	0.028	0.000	–0.116	–0.026	0.004	0.009	0.000	–0.062	–11.629
1816	0.113	0.031	0.028	0.000	–0.118	–0.026	0.004	0.010	0.000	–0.052	–4.553
1817	0.110	0.032	0.028	0.000	–0.120	–0.027	0.004	0.010	0.000	–0.048	–2.419
1818	0.107	0.034	0.029	0.000	–0.121	–0.027	0.004	0.010	0.000	–0.053	–0.915
1819	0.104	0.035	0.029	0.000	–0.123	–0.028	0.004	0.010	0.000	–0.054	–0.337

1820	0.101	0.037	0.030	0.000	–0.125	–0.028	0.004	0.010	0.000	–0.059	–0.039
1821	0.099	0.038	0.030	0.000	–0.127	–0.028	0.004	0.010	0.000	–0.065	0.000
1822	0.097	0.040	0.031	0.000	–0.128	–0.029	0.004	0.010	0.000	–0.066	0.000
1823	0.096	0.041	0.031	0.000	–0.130	–0.029	0.004	0.011	0.000	–0.068	0.000
1824	0.097	0.042	0.031	0.000	–0.132	–0.030	0.004	0.011	0.000	–0.059	0.000
1825	0.098	0.043	0.032	0.000	–0.134	–0.030	0.005	0.011	0.000	–0.052	0.000
1826	0.100	0.044	0.032	0.000	–0.136	–0.030	0.005	0.011	0.000	–0.044	0.000
1827	0.103	0.045	0.033	0.000	–0.137	–0.031	0.005	0.011	0.000	–0.018	0.000
1828	0.106	0.045	0.033	0.000	–0.139	–0.031	0.005	0.011	0.000	–0.008	0.000
1829	0.109	0.045	0.034	0.000	–0.141	–0.032	0.005	0.011	0.000	–0.006	0.000
1830	0.111	0.045	0.034	0.000	–0.143	–0.032	0.005	0.012	0.000	0.002	0.000
1831	0.113	0.044	0.034	0.000	–0.145	–0.032	0.005	0.012	0.000	0.002	–1.538
1832	0.114	0.043	0.035	0.000	–0.146	–0.033	0.005	0.012	0.000	–0.020	–1.229
1833	0.114	0.041	0.035	0.000	–0.148	–0.033	0.005	0.012	0.000	–0.035	–0.605
1834	0.114	0.039	0.036	0.000	–0.150	–0.034	0.005	0.012	0.000	–0.038	–0.223
1835	0.113	0.037	0.036	0.000	–0.152	–0.034	0.005	0.012	0.000	–0.033	–4.935
1836	0.112	0.036	0.037	0.000	–0.153	–0.034	0.005	0.012	0.000	0.017	–1.445
1837	0.112	0.035	0.037	0.000	–0.155	–0.035	0.006	0.013	0.000	0.055	–0.523
1838	0.112	0.035	0.037	0.000	–0.157	–0.035	0.006	0.013	0.000	0.051	–0.192
1839	0.114	0.036	0.038	0.000	–0.159	–0.036	0.006	0.013	0.000	0.028	–0.069
1840	0.117	0.037	0.038	0.000	–0.161	–0.036	0.006	0.013	0.000	0.027	–0.047
1841	0.121	0.038	0.039	0.000	–0.162	–0.036	0.006	0.013	0.000	0.007	–0.013
1842	0.127	0.040	0.039	0.000	–0.164	–0.037	0.006	0.013	0.000	–0.006	–0.003
1843	0.135	0.041	0.039	0.000	–0.166	–0.037	0.006	0.013	0.000	–0.013	–0.052
1844	0.142	0.042	0.040	0.000	–0.168	–0.038	0.006	0.014	0.000	–0.024	–0.014
1845	0.149	0.043	0.040	0.000	–0.169	–0.038	0.006	0.014	0.000	–0.026	–0.003
1846	0.155	0.044	0.041	0.000	–0.171	–0.038	0.006	0.014	0.000	–0.024	–0.071
1847	0.160	0.044	0.041	0.000	–0.173	–0.039	0.007	0.014	0.000	–0.062	–0.020
1848	0.163	0.045	0.042	0.000	–0.175	–0.039	0.007	0.014	0.000	–0.018	–0.005
1849	0.166	0.046	0.042	0.000	–0.177	–0.040	0.007	0.014	0.000	0.043	–0.001
1850	0.167	0.046	0.042	0.000	–0.178	–0.040	0.007	0.014	0.000	0.024	–0.100
1851	0.167	0.047	0.043	0.000	–0.180	–0.040	0.007	0.015	0.000	0.016	–0.075
1852	0.166	0.048	0.044	0.000	–0.182	–0.041	0.007	0.015	0.000	0.020	–0.050
1853	0.164	0.049	0.045	0.000	–0.184	–0.041	0.007	0.015	0.000	0.011	–0.025
1854	0.162	0.050	0.046	0.000	–0.185	–0.041	0.007	0.016	0.000	–0.010	0.000
1855	0.160	0.051	0.047	0.000	–0.187	–0.042	0.007	0.016	0.000	–0.027	0.000
1856	0.158	0.052	0.048	0.000	–0.189	–0.042	0.007	0.016	0.000	–0.037	–0.425
1857	0.156	0.054	0.049	0.000	–0.191	–0.042	0.008	0.016	0.000	–0.037	–1.425
1858	0.155	0.055	0.050	0.000	–0.192	–0.043	0.008	0.017	0.000	–0.020	–1.100
1859	0.154	0.057	0.050	0.000	–0.194	–0.043	0.008	0.017	0.000	–0.007	–0.400
1860	0.154	0.058	0.051	0.000	–0.196	–0.043	0.008	0.017	0.000	0.029	–0.175
1861	0.153	0.060	0.052	0.000	–0.198	–0.044	0.008	0.018	0.000	0.036	–0.075
1862	0.153	0.061	0.053	0.000	–0.199	–0.044	0.008	0.018	0.000	0.013	–0.225
1863	0.154	0.062	0.054	0.000	–0.201	–0.044	0.008	0.018	0.000	0.006	–0.325
1864	0.156	0.063	0.055	0.000	–0.203	–0.045	0.008	0.018	0.000	–0.017	–0.175
1865	0.158	0.064	0.056	0.000	–0.205	–0.045	0.009	0.019	0.000	–0.018	–0.075
1866	0.162	0.066	0.057	0.000	–0.206	–0.045	0.009	0.019	0.000	–0.021	–0.025
1867	0.167	0.067	0.058	0.000	–0.208	–0.046	0.009	0.019	0.000	–0.037	–0.025
1868	0.173	0.068	0.059	0.000	–0.210	–0.046	0.009	0.020	0.000	–0.039	0.000
1869	0.180	0.070	0.059	0.000	–0.212	–0.046	0.009	0.020	0.000	–0.005	0.000

1870	0.188	0.071	0.060	0.000	–0.213	–0.047	0.009	0.020	0.000	–0.028	–0.025
1871	0.195	0.073	0.061	0.000	–0.215	–0.047	0.009	0.020	0.000	0.025	–0.025
1872	0.202	0.075	0.062	0.000	–0.217	–0.047	0.009	0.021	0.000	0.012	–0.025
1873	0.208	0.077	0.063	0.000	–0.219	–0.048	0.010	0.021	0.000	0.015	–0.050
1874	0.212	0.079	0.064	0.000	–0.220	–0.048	0.010	0.021	0.000	0.000	–0.075
1875	0.215	0.081	0.065	0.000	–0.222	–0.049	0.010	0.022	0.000	–0.015	–0.025
1876	0.218	0.083	0.066	0.000	–0.224	–0.049	0.010	0.022	0.000	–0.029	–0.100
1877	0.219	0.084	0.067	0.000	–0.226	–0.049	0.010	0.022	0.000	–0.033	–0.150
1878	0.219	0.086	0.067	0.000	–0.227	–0.050	0.010	0.022	0.000	–0.041	–0.100
1879	0.221	0.088	0.068	0.000	–0.229	–0.050	0.010	0.023	0.000	–0.044	–0.050
1880	0.222	0.089	0.069	0.000	–0.231	–0.050	0.011	0.023	0.000	–0.039	–0.050
1881	0.224	0.091	0.070	0.000	–0.233	–0.051	0.011	0.023	0.000	–0.007	–0.025
1882	0.228	0.092	0.071	0.000	–0.234	–0.051	0.011	0.024	0.000	–0.019	–0.025
1883	0.232	0.094	0.072	0.000	–0.236	–0.052	0.011	0.024	0.000	–0.031	–0.725
1884	0.238	0.096	0.073	0.000	–0.238	–0.052	0.011	0.024	0.000	0.018	–3.800
1885	0.244	0.098	0.074	0.000	–0.240	–0.053	0.011	0.024	0.000	0.002	–2.525
1886	0.250	0.100	0.075	0.000	–0.241	–0.053	0.011	0.025	0.000	–0.014	–0.975
1887	0.258	0.102	0.075	0.000	–0.243	–0.053	0.012	0.025	0.000	–0.033	–1.350
1888	0.266	0.104	0.076	0.000	–0.245	–0.054	0.012	0.025	0.000	–0.037	–0.575
1889	0.274	0.106	0.077	0.000	–0.247	–0.054	0.012	0.026	0.000	–0.041	–0.975
1890	0.283	0.107	0.078	0.000	–0.248	–0.055	0.012	0.026	0.000	–0.041	–0.800
1891	0.293	0.108	0.079	0.000	–0.250	–0.055	0.012	0.026	0.000	–0.020	–1.000
1892	0.302	0.109	0.080	0.000	–0.252	–0.056	0.012	0.026	0.000	0.004	–0.525
1893	0.311	0.110	0.081	0.000	–0.254	–0.056	0.013	0.027	0.000	0.035	–0.350
1894	0.319	0.111	0.082	0.000	–0.255	–0.057	0.013	0.027	0.000	0.072	–0.125
1895	0.325	0.111	0.083	0.000	–0.257	–0.057	0.013	0.027	0.000	0.052	–0.050
1896	0.330	0.112	0.083	0.000	–0.259	–0.058	0.013	0.028	0.000	0.023	–0.150
1897	0.334	0.113	0.084	0.000	–0.261	–0.058	0.013	0.028	0.000	–0.003	–0.475
1898	0.336	0.114	0.085	0.000	–0.262	–0.059	0.014	0.028	0.000	–0.012	–0.450
1899	0.337	0.115	0.086	0.000	–0.264	–0.059	0.014	0.028	0.000	–0.017	–0.175
1900	0.339	0.117	0.087	0.000	–0.266	–0.060	0.014	0.029	0.000	–0.028	–0.075
1901	0.341	0.120	0.088	0.000	–0.268	–0.061	0.014	0.029	0.000	–0.043	–0.025
1902	0.344	0.123	0.089	0.000	–0.270	–0.061	0.015	0.030	0.000	–0.048	–0.075
1903	0.349	0.127	0.090	0.000	–0.272	–0.062	0.015	0.030	0.000	–0.036	–1.900
1904	0.355	0.130	0.091	0.000	–0.274	–0.062	0.015	0.031	0.000	0.011	–1.275
1905	0.362	0.134	0.092	0.000	–0.276	–0.063	0.016	0.032	0.000	–0.016	–0.475
1906	0.369	0.138	0.092	0.000	–0.278	–0.063	0.016	0.032	0.000	0.028	–0.225
1907	0.376	0.141	0.093	0.000	–0.280	–0.064	0.016	0.033	0.000	–0.001	–0.150
1908	0.383	0.145	0.094	0.000	–0.282	–0.064	0.017	0.033	0.000	0.020	–0.325
1909	0.389	0.148	0.095	–0.001	–0.284	–0.065	0.017	0.034	0.000	–0.002	–0.150
1910	0.395	0.151	0.096	–0.001	–0.286	–0.065	0.017	0.035	0.000	–0.006	–0.075
1911	0.400	0.155	0.097	–0.001	–0.288	–0.066	0.018	0.035	0.000	–0.032	–0.050
1912	0.406	0.159	0.098	–0.001	–0.289	–0.066	0.018	0.035	0.000	–0.045	–0.025
1913	0.412	0.163	0.100	–0.001	–0.290	–0.067	0.019	0.035	0.000	–0.042	–0.800
1914	0.419	0.167	0.101	–0.001	–0.291	–0.068	0.019	0.035	0.000	–0.033	–0.350
1915	0.427	0.171	0.102	–0.001	–0.292	–0.068	0.019	0.035	0.000	0.013	–0.150
1916	0.436	0.175	0.103	–0.001	–0.293	–0.069	0.020	0.035	0.000	0.068	–0.100
1917	0.445	0.180	0.104	–0.001	–0.294	–0.069	0.020	0.035	0.000	0.086	–0.075
1918	0.453	0.185	0.105	–0.001	–0.296	–0.070	0.021	0.035	0.000	0.121	–0.050
1919	0.460	0.189	0.107	–0.002	–0.297	–0.071	0.021	0.035	0.000	0.073	–0.025

1920	0.466	0.193	0.108	–0.001	–0.298	–0.071	0.022	0.035	0.000	0.039	–0.025
1921	0.472	0.196	0.109	–0.001	–0.302	–0.072	0.022	0.036	0.000	0.012	–0.300
1922	0.476	0.199	0.110	–0.002	–0.305	–0.073	0.022	0.036	0.000	–0.013	–0.100
1923	0.481	0.201	0.111	–0.002	–0.309	–0.073	0.023	0.036	0.000	–0.025	–0.050
1924	0.486	0.203	0.113	–0.002	–0.313	–0.074	0.023	0.036	0.000	–0.029	–0.075
1925	0.491	0.205	0.114	–0.002	–0.317	–0.075	0.024	0.036	0.000	–0.015	–0.075
1926	0.497	0.207	0.115	–0.002	–0.321	–0.076	0.024	0.036	0.000	0.020	–0.050
1927	0.503	0.210	0.116	–0.002	–0.325	–0.076	0.025	0.036	0.000	0.063	–0.050
1928	0.510	0.214	0.117	–0.002	–0.328	–0.077	0.025	0.037	0.000	0.033	–0.050
1929	0.517	0.218	0.119	–0.002	–0.332	–0.078	0.025	0.037	0.000	0.028	–0.225
1930	0.523	0.222	0.120	–0.003	–0.336	–0.079	0.026	0.037	0.000	0.048	–0.200
1931	0.530	0.226	0.122	–0.003	–0.338	–0.080	0.026	0.037	0.000	0.009	–0.125
1932	0.536	0.230	0.124	–0.003	–0.340	–0.081	0.027	0.038	0.000	–0.016	–0.125
1933	0.542	0.234	0.126	–0.003	–0.341	–0.081	0.027	0.038	0.000	–0.029	–0.250
1934	0.548	0.237	0.128	–0.003	–0.343	–0.082	0.027	0.039	0.000	–0.027	–0.100
1935	0.555	0.241	0.130	–0.003	–0.345	–0.083	0.028	0.039	0.000	–0.008	–0.125
1936	0.563	0.244	0.133	–0.003	–0.347	–0.084	0.028	0.040	0.000	0.068	–0.075
1937	0.570	0.247	0.135	–0.003	–0.349	–0.085	0.029	0.040	0.000	0.089	–0.075
1938	0.577	0.251	0.137	–0.003	–0.350	–0.086	0.029	0.040	0.000	0.080	–0.075
1939	0.584	0.254	0.139	–0.004	–0.352	–0.087	0.029	0.041	0.000	0.094	–0.125
1940	0.590	0.257	0.141	–0.004	–0.354	–0.088	0.030	0.041	0.000	0.070	–0.075
1941	0.595	0.261	0.143	–0.004	–0.358	–0.089	0.030	0.042	0.000	0.057	–0.075
1942	0.598	0.264	0.146	–0.004	–0.362	–0.090	0.030	0.042	0.000	0.030	–0.075
1943	0.599	0.267	0.148	–0.004	–0.366	–0.092	0.031	0.043	0.000	–0.005	–0.150
1944	0.599	0.270	0.150	–0.004	–0.370	–0.093	0.031	0.043	0.001	–0.011	–0.075
1945	0.599	0.273	0.152	–0.004	–0.374	–0.094	0.032	0.043	0.001	0.019	–0.075
1946	0.599	0.276	0.154	–0.005	–0.378	–0.095	0.032	0.044	0.001	0.025	–0.050
1947	0.598	0.279	0.156	–0.005	–0.382	–0.096	0.032	0.044	0.002	0.093	–0.050
1948	0.598	0.283	0.158	–0.005	–0.386	–0.097	0.033	0.045	0.002	0.146	–0.075
1949	0.601	0.287	0.161	–0.005	–0.390	–0.099	0.033	0.045	0.002	0.123	–0.025
1950	0.604	0.291	0.163	–0.005	–0.394	–0.100	0.034	0.046	0.002	0.110	–0.075
1951	0.608	0.296	0.168	–0.005	–0.409	–0.102	0.034	0.046	0.002	0.037	–0.050
1952	0.615	0.302	0.173	–0.006	–0.424	–0.103	0.035	0.047	0.002	0.045	–0.100
1953	0.623	0.308	0.178	–0.006	–0.439	–0.105	0.036	0.047	0.003	0.025	–0.075
1954	0.631	0.315	0.183	–0.006	–0.455	–0.106	0.036	0.048	0.003	0.003	–0.125
1955	0.641	0.323	0.188	–0.006	–0.470	–0.108	0.037	0.048	0.003	0.015	–0.050
1956	0.651	0.332	0.193	–0.007	–0.485	–0.109	0.038	0.049	0.003	0.064	–0.050
1957	0.662	0.341	0.198	–0.007	–0.500	–0.111	0.038	0.050	0.004	0.129	–0.025
1958	0.673	0.349	0.203	–0.007	–0.515	–0.112	0.039	0.050	0.004	0.194	0.000
1959	0.685	0.358	0.208	–0.008	–0.530	–0.114	0.040	0.051	0.004	0.159	0.000
1960	0.698	0.366	0.213	–0.008	–0.546	–0.116	0.041	0.051	0.004	0.151	0.000
1961	0.709	0.374	0.218	–0.008	–0.563	–0.117	0.041	0.051	0.004	0.110	–0.200
1962	0.719	0.383	0.223	–0.009	–0.580	–0.119	0.042	0.051	0.004	0.051	–0.250
1963	0.727	0.392	0.228	–0.009	–0.598	–0.120	0.043	0.050	0.005	0.038	–0.300
1964	0.735	0.402	0.233	–0.010	–0.615	–0.122	0.044	0.050	0.005	0.019	–2.000
1965	0.748	0.412	0.239	–0.011	–0.632	–0.123	0.045	0.050	0.005	0.008	–1.500
1966	0.762	0.424	0.244	–0.011	–0.650	–0.125	0.046	0.050	0.006	0.012	–0.825
1967	0.778	0.437	0.249	–0.012	–0.667	–0.126	0.047	0.049	0.007	0.055	–0.350
1968	0.794	0.451	0.254	–0.013	–0.684	–0.127	0.048	0.049	0.008	0.086	–0.375
1969	0.811	0.466	0.259	–0.014	–0.701	–0.129	0.049	0.049	0.009	0.077	–1.075

1970	0.828	0.483	0.264	–0.014	–0.719	–0.130	0.050	0.049	0.009	0.092	–0.600
1971	0.846	0.500	0.270	–0.016	–0.722	–0.131	0.050	0.049	0.009	0.082	–0.225
1972	0.865	0.519	0.277	–0.017	–0.725	–0.132	0.051	0.049	0.009	0.076	–0.100
1973	0.885	0.538	0.284	–0.018	–0.728	–0.134	0.052	0.049	0.010	0.044	–0.150
1974	0.904	0.558	0.290	–0.019	–0.732	–0.135	0.053	0.050	0.010	0.023	–0.250
1975	0.920	0.578	0.297	–0.021	–0.735	–0.136	0.054	0.050	0.010	0.006	–0.575
1976	0.938	0.598	0.304	–0.022	–0.738	–0.137	0.055	0.050	0.010	–0.003	–0.525
1977	0.960	0.617	0.310	–0.024	–0.741	–0.138	0.056	0.050	0.011	0.040	–0.200
1978	0.987	0.636	0.317	–0.026	–0.745	–0.138	0.057	0.051	0.011	0.129	–0.075
1979	1.018	0.656	0.324	–0.027	–0.748	–0.139	0.058	0.051	0.012	0.167	–0.325
1980	1.046	0.675	0.330	–0.029	–0.751	–0.140	0.059	0.051	0.012	0.150	–0.125
1981	1.066	0.696	0.335	–0.031	–0.763	–0.141	0.061	0.051	0.012	0.147	–0.125
1982	1.085	0.717	0.339	–0.033	–0.775	–0.141	0.062	0.050	0.012	0.094	–0.150
1983	1.110	0.737	0.343	–0.035	–0.788	–0.142	0.063	0.050	0.012	0.091	–2.400
1984	1.136	0.757	0.348	–0.037	–0.800	–0.143	0.064	0.049	0.013	0.016	–1.125
1985	1.158	0.776	0.352	–0.038	–0.812	–0.143	0.065	0.049	0.014	0.011	–0.400
1986	1.180	0.795	0.356	–0.040	–0.824	–0.144	0.065	0.049	0.015	0.012	–0.375
1987	1.208	0.813	0.360	–0.042	–0.836	–0.144	0.066	0.048	0.016	0.015	–0.300
1988	1.240	0.832	0.365	–0.044	–0.848	–0.145	0.067	0.048	0.017	0.095	–0.225
1989	1.266	0.853	0.369	–0.046	–0.861	–0.145	0.067	0.047	0.018	0.151	–0.175
1990	1.287	0.872	0.373	–0.048	–0.873	–0.146	0.068	0.047	0.019	0.118	–0.150
1991	1.305	0.888	0.375	–0.050	–0.878	–0.146	0.068	0.046	0.019	0.126	–0.150
1992	1.318	0.900	0.376	–0.052	–0.883	–0.146	0.069	0.045	0.020	0.137	–3.700
1993	1.332	0.909	0.378	–0.054	–0.888	–0.147	0.069	0.045	0.022	0.063	–1.850
1994	1.354	0.916	0.379	–0.055	–0.893	–0.147	0.069	0.044	0.024	0.027	–0.725
1995	1.381	0.923	0.380	–0.056	–0.897	–0.147	0.070	0.043	0.025	0.020	–0.300
1996	1.404	0.930	0.382	–0.057	–0.902	–0.148	0.070	0.043	0.027	0.003	–0.175
1997	1.428	0.937	0.383	–0.057	–0.907	–0.148	0.070	0.042	0.028	0.016	–0.150
1998	1.459	0.944	0.385	–0.057	–0.912	–0.148	0.071	0.041	0.029	0.062	–0.100
1999	1.489	0.952	0.386	–0.056	–0.917	–0.148	0.071	0.041	0.031	0.104	–0.050
2000	1.510	0.957	0.388	–0.056	–0.922	–0.149	0.071	0.040	0.033	0.127	–0.050
2001	1.532	0.961	0.389	–0.055	–0.920	–0.149	0.071	0.040	0.033	0.114	–0.050
2002	1.563	0.965	0.390	–0.055	–0.918	–0.149	0.071	0.040	0.033	0.108	–0.050
2003	1.594	0.969	0.391	–0.054	–0.916	–0.149	0.071	0.040	0.034	0.042	–0.075
2004	1.624	0.973	0.393	–0.053	–0.913	–0.149	0.071	0.040	0.038	0.012	–0.075
2005	1.654	0.976	0.394	–0.053	–0.911	–0.149	0.071	0.040	0.040	–0.011	–0.075
2006	1.684	0.981	0.395	–0.052	–0.909	–0.150	0.071	0.040	0.042	–0.016	–0.075
2007	1.711	0.986	0.396	–0.052	–0.907	–0.150	0.071	0.040	0.044	–0.017	–0.125
2008	1.736	0.992	0.398	–0.051	–0.904	–0.150	0.072	0.040	0.046	–0.025	–0.100
2009	1.762	0.999	0.399	–0.051	–0.902	–0.150	0.072	0.040	0.044	–0.027	–0.100
2010	1.789	1.005	0.400	–0.050	–0.900	–0.150	0.072	0.040	0.048	0.001	–0.100
2011	1.816	1.015	0.400	–0.050	–0.900	–0.150	0.073	0.040	0.050	0.030	–0.100

Notes:
See Figure 8.18, also Sections 8.1 and 11.3.6.1. To get the total ERF (Effective Radiative Forcing) all components can be summed. Small negative values for CO_2 prior to 1800 are due to uncertainty in PI values. GHG other* includes only WMGHG. Aerosol is the sum of direct and indirect effects. LUC includes land use land cover change. Contrails combines aviation contrails (~20% of total) and contrail-induced cirrus.

Table AII.1.3: Historical global decadal-mean global surface-air temperature (°C) relative to 1961–1990 average

Year	HadCRUT4			GISS	NCDC
	Lower (5%)	Median (50%)	Upper (95%)	Median (50%)	Median (50%)

1850[d]	–0.404	–0.320	–0.243		
1860[d]	–0.413	–0.335	–0.263		
1870[d]	–0.326	–0.258	–0.195		
1880[d]	–0.363	–0.297	–0.237	–0.296	–0.291
1890[d]	–0.430	–0.359	–0.299	–0.361	–0.370
1900[d]	–0.473	–0.410	–0.353	–0.418	–0.434
1910[d]	–0.448	–0.387	–0.334	–0.435	–0.430
1920[d]	–0.297	–0.242	–0.193	–0.311	–0.311
1930[d]	–0.166	–0.116	–0.070	–0.172	–0.161
1940[d]	–0.047	–0.002	+0.042	–0.085	–0.063
1950[d]	–0.106	–0.061	–0.017	–0.134	–0.136
1960[d]	–0.093	–0.054	–0.014	–0.104	–0.086
1970[d]	–0.113	–0.077	–0.041	–0.058	–0.060
1980[d]	+0.052	+0.095	+0.135	+0.118	+0.109
1990[d]	+0.221	+0.270	+0.318	+0.275	+0.272
2000[d]	+0.400	+0.453	+0.508	+0.472	+0.450
1986–2005 minus 1850–1900	+0.61 ± 0.06			N/A	N/A
1986–2005 minus 1886–1905	+0.66 ± 0.06			+0.66	+0.66
1986–2005 minus 1961–1990	+0.30 ± 0.03			+0.31	+0.30
1986–2005 minus 1980–1999	+0.11 ± 0.02			+0.11	+0.11
1946–2012 minus 1880–1945	+0.38 ± 0.04			+0.40	+0.39

Notes:
Decadal average (1990[d] = 1990–1999) median global surface air temperatures from HadCRUT4, GISS, and NCDC analyses. See Chapter 2, Sections 2.4.3 and 2.SM.4.3.3, Table 2.7, Figures 2.19, 2.20, 2.21 and 2.22, and also Figure 11.24a. Confidence intervals (5–95% for HadCRUT4 only) take into account measurement, sampling, bias and coverage uncertainties. Also shown are temperature increases between the CMIP5 reference period (1986–2005) and four earlier averaging periods, where 1850–1900 is taken as pre-industrial for the temperature record. Uncertainties in these temperature differences are 5–95% confidence intervals.

AII.2: Anthropogenic Emissions

See discussion Figure 8.2 and Section 11.3.5.

Table AII.2.1a: Anthropogenic CO_2 emissions from fossil fuels and other industrial sources (FF) (PgC yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2000[d]	6.82	6.82	6.82	6.82	6.90	6.90	7.10	6.92 ± 0.80	6.98 ± 0.81	6.76 ± 0.71	6.98 ± 0.81
2010[d]	8.61	8.54	8.39	8.90	8.46	8.50	8.68	8.38 ± 1.03	8.63 ± 1.07	7.66 ± 1.64	8.27 ± 1.68
2020[d]	9.00	9.79	8.99	11.38	11.01	10.00	10.26	8.46 ± 1.38	10.24±1.69	8.33 ± 1.82	10.30 ± 1.87
2030[d]	7.21	10.83	9.99	13.79	13.53	11.20	11.62	6.81 ± 1.49	10.93±1.83	9.20 ± 1.55	12.36 ± 2.25
2040[d]	4.79	11.25	11.47	16.69	15.01	12.20	12.66	4.61 ± 1.60	11.82±1.84	10.04 ± 1.42	15.09 ± 2.15
2050[d]	3.21	10.91	13.00	20.03	16.49	11.70	13.70	2.96 ± 1.80	11.37±1.84	11.14 ± 1.55	18.15 ± 2.56
2060[d]	1.55	9.42	14.73	23.32	18.49	10.20	14.68	1.77 ± 1.06	9.96 ± 2.17	13.22 ± 2.05	21.49 ± 2.42
2070[d]	0.26	7.17	16.33	25.75	20.49	8.60	15.66	0.75 ± 0.90	7.86 ± 1.94	14.57 ± 1.88	23.62 ± 2.43
2080[d]	–0.39	4.62	16.87	27.28	22.97	7.30	17.00	–0.09 ± 0.99	5.17 ± 1.77	15.51 ± 2.29	24.47 ± 2.70
2090[d]	–0.81	4.19	14.70	28.24	25.94	6.10	18.70	–0.30 ± 1.09	5.13 ± 1.53	14.24 ± 1.81	25.30 ± 2.86
2100[d]	–0.92	4.09	13.63	28.68	28.91	5.20	20.40	–0.63 ± 1.17	4.64 ± 1.34	12.78 ± 1.35	25.28 ± 2.73

Notes:
Decadal mean values (2010[d] = average of 2005–2014) are used for emissions because linear interpolation between decadal means conserves total emissions. Data are taken from RCP database (Meinshausen et al., 2011a;

http://www.iiasa.ac.at/web-apps/tnt/RcpDb) and may be different from yearly snapshots; for 2100 the average (2095–2100) is used. SRES A2 and B1 and IS92a are taken from TAR Appendix II. RCPn.n[&] values are inferred from ESMs used in CMIP5. The model mean and standard deviation is shown. ESM fossil emissions are taken from 14 models as described in Jones et al. (2013) although not every model has performed every scenario. See Chapter 6, Sections 6.4.3, 6.4.3.3, and Figure 6.25.

Table AII.2.1b: Anthropogenic CO_2 emissions from agriculture, forestry, land use (AFOLU) (PgC yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	SRES-A2	SRES-B1	IS92a
2000[d]	1.21	1.21	1.21	1.21	1.07	1.07	1.30
2010[d]	1.09	0.94	0.93	1.08	1.12	0.78	1.22
2020[d]	0.97	0.41	0.38	0.91	1.25	0.63	1.14
2030[d]	0.79	0.23	–0.43	0.74	1.19	–0.09	1.04
2040[d]	0.51	0.21	–0.67	0.65	1.06	–0.48	0.92
2050[d]	0.29	0.23	–0.48	0.58	0.93	–0.41	0.80
2060[d]	0.55	0.19	–0.27	0.50	0.67	–0.46	0.54
2070[d]	0.55	0.11	–0.04	0.42	0.40	–0.42	0.28
2080[d]	0.55	0.02	0.20	0.31	0.25	–0.60	0.12
2090[d]	0.59	0.03	0.24	0.20	0.21	–0.78	0.06
2100[d]	0.50	0.04	0.18	0.09	0.18	–0.97	–0.10

Notes:
See AII.2.1a.

Table AII.2.1c: Anthropogenic total CO_2 emissions (PgC yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000[d]	8.03	8.03	8.03	8.03
2010[d]	9.70	9.48	9.32	9.98
2020[d]	9.97	10.20	9.37	12.28
2030[d]	8.00	11.06	9.57	14.53
2040[d]	5.30	11.46	10.80	17.33
2050[d]	3.50	11.15	12.52	20.61
2060[d]	2.10	9.60	14.46	23.83
2070[d]	0.81	7.27	16.29	26.17
2080[d]	0.16	4.65	17.07	27.60
2090[d]	–0.23	4.22	14.94	28.44
2100[d]	–0.42	4.13	13.82	28.77

Notes:
See AII.2.1a.

Table AII.2.2: Anthropogenic CH_4 emissions (Tg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
PI								202 ± 28	202 ± 28	202 ± 28	202 ± 28
2010[total]								554 ± 56	554 ± 56	554 ± 56	554 ± 56
2010[anthrop]								352 ± 45	352 ± 45	352 ± 45	352 ± 45
2010[d]	322	322	321	345	370	349	433	352 ± 45	352 ± 45	352 ± 45	352 ± 45
2020[d]	267	334	315	415	424	377	477	268 ± 34	366 ± 47	338 ± 43	424 ± 54
2030[d]	238	338	326	484	486	385	529	246 ± 31	370 ± 47	354 ± 45	490 ± 63
2040[d]	223	337	343	573	542	381	580	235 ± 30	368 ± 47	373 ± 47	585 ± 75
2050[d]	192	331	354	669	598	359	630	198 ± 25	361 ± 46	385 ± 49	685 ± 88
2060[d]	169	318	362	738	654	342	654	174 ± 22	346 ± 44	395 ± 50	754 ± 96
2070[d]	161	301	359	779	711	324	678	169 ± 22	328 ± 42	390 ± 50	790 ±101

2080[d]	155	283	336	820	770	293	704	162 ± 21	306 ± 39	369 ± 47	832 ±106
2090[d]	149	274	278	865	829	266	733	155 ± 20	298 ± 38	293 ± 37	882 ±113
2100[d]	143	267	250	885	889	236	762	148 ± 19	290 ± 37	267 ± 34	899 ±115

Table AII.2.2 (continued)

Year	MFR	CLE	MFR*	CLE*	Rog^L	Rog^U	AME^L	AME^U
2000[d]	366	366	303	303				
2010[d]			193	335			332	333
2020[d]			208	383	240	390	294	350
2030[d]	339	478	229	443	217	428	293	376
2040[d]							295	404
2050[d]					178	454	291	426
2060[d]							275	434
2070[d]							254	436
2080[d]							201	430
2090[d]							183	417
2100[d]					121	385	167	406

Notes:
For all anthropogenic emissions see Box 1.1 (Figure 4), Section 8.2.2, Figure 8.2, Sections 11.3.5.1.1–3, 11.3.5.2, 11.3.6.1. Ten-year average values (2010[d] = average of 2005–2014; but 2100[d] = average of 2095–2100) are given for RCP-based emissions, but single-year emissions are shown for other scenarios. RCPn.n = harmonized anthropogenic emissions as reported. SRES A2 and B1 and IS92a are from TAR Appendix II. AR5 RCPn.n[&] emissions have ± 1-sigma (16–84% confidence) uncertainties and are based on the methodology of Prather et al. (2012) updated with CMIP5 results (Holmes et al., 2013; Voulgarakis et al., 2013). Projections of CH_4 lifetimes are harmonized based on PI (1750) and PD (2010) budgets that include uncertainties in lifetimes and abundances. All projected RCP abundances for CH_4 and N_2O (AII.4.2–3) rescale each of the RCP emissions by a fixed factor equal to the ratio of RCP to AR5 anthropogenic emissions at year 2010 to ensure harmonization between total emissions, lifetimes, and observed abundances. Natural emissions are kept constant but included as additional uncertainty. Independent emission estimates are shown as follows: MFR/CLE are the maximum feasible reduction and current legislation scenarios from Dentener et al. (2005; 2006), while MFR*/CLE* are the similarly labeled scenarios from Cofala et al. (2007). REF^L/REF^U are Lower/Upper bounds from the reference scenario of van Vuuren et al. (2008), while POL^L/POL^U are the Lower/Upper bounds from their policy scenario. AME^L/AME^U are Lower/Upper bounds from Calvin et al. (2012). Rog^L/Rog^U are Lower/Upper bounds from Rogelj et et. (2011).

Table AII.2.3: Anthropogenic N_2O emissions (TgN yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
PI								9.1 ± 1.0	9.1 ± 1.0	9.1 ± 1.0	9.1 ± 1.0
2010^{total}								15.7 ± 1.1	15.7 ± 1.1	15.7 ± 1.1	15.7 ± 1.1
$2010^{anthrop}$								6.5 ± 1.3	6.5 ± 1.3	6.5 ± 1.3	6.5 ± 1.3
2010[d]	7.7	7.8	8.0	8.25	8.1	7.5	6.2	6.5 ± 1.3	6.5 ± 1.3	6.5 ± 1.3	6.5 ± 1.3
2020[d]	7.4	8.2	8.1	9.5	9.6	8.1	7.1	6.1 ± 1.2	6.8 ± 1.3	6.3 ± 1.2	7.7 ± 1.5
2030[d]	7.3	8.5	8.8	10.7	10.7	8.2	7.7	6.1 ± 1.2	7.1 ± 1.4	7.0 ± 1.4	8.6 ± 1.7
2040[d]	7.1	8.7	9.7	11.9	11.3	8.3	8.0	6.0 ± 1.2	7.2 ± 1.4	7.8 ± 1.5	9.6 ± 1.9
2050[d]	6.3	8.6	10.5	12.7	12.0	8.3	8.3	5.2 ± 1.0	7.1 ± 1.4	8.4 ± 1.6	10.3 ± 2.0
2060[d]	5.8	8.5	11.3	13.4	12.9	7.7	8.3	4.8 ± 0.9	7.1 ± 1.4	9.1 ± 1.8	10.8 ± 2.1
2070[d]	5.7	8.4	12.0	13.9	13.9	7.4	8.4	4.8 ± 0.9	7.0 ± 1.3	9.6 ± 1.9	11.2 ± 2.2
2080[d]	5.6	8.2	12.3	14.5	14.8	7.0	8.5	4.7 ± 0.9	6.8 ± 1.3	9.9 ± 1.9	11.7 ± 2.3
2090[d]	5.5	8.1	12.4	15.2	15.7	6.4	8.6	4.6 ± 0.9	6.8 ± 1.3	9.9 ± 1.9	12.3 ± 2.4
2100[d]	5.3	8.1	12.2	15.7	16.5	5.7	8.7	4.4 ± 0.9	6.7 ± 1.3	9.8 ± 1.9	12.6 ± 2.4

Notes:
See notes Table AII.2.2.

Table AII.2.4: Anthropogenic SF_6 emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	5.70	5.70	5.70	5.70	6.20	6.20
2010[d]	6.14	5.68	7.43	6.93	7.60	5.60
2020[d]	2.87	3.02	9.19	8.12	9.70	5.70
2030[d]	1.96	2.89	9.58	9.83	11.60	7.20
2040[d]	1.53	3.32	9.68	11.14	13.70	8.90
2050[d]	0.76	3.77	9.78	12.07	16.00	10.40
2060[d]	0.51	4.28	9.92	13.69	18.80	10.90
2070[d]	0.42	4.87	10.05	13.72	19.80	9.50
2080[d]	0.32	5.53	10.00	14.79	20.70	7.10
2090[d]	0.19	5.99	9.86	15.96	23.40	6.50
2100[d]	0.07	6.25	9.37	16.79	25.20	6.50

Notes:
For this and all following emissions tables, see Table AII.2.2. RCPn.n = harmonized anthropogenic emissions as reported by RCPs (Lamarque et al., 2010; 2011; Meinshausen et al., 2011a). SRES A2 and B1 and IS92a from TAR Appendix II.

Table AII.2.5: Anthropogenic CF_4 emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	11.62	11.62	11.62	11.62	12.60	12.60
2010[d]	13.65	10.69	19.10	11.04	20.30	14.50
2020[d]	12.07	8.77	22.84	11.67	25.20	15.70
2030[d]	7.36	8.47	23.46	12.29	31.40	16.60
2040[d]	5.06	8.68	23.77	12.22	37.90	18.50
2050[d]	2.95	9.04	23.73	12.37	45.60	20.90
2060[d]	2.24	8.95	23.70	11.89	56.00	23.10
2070[d]	2.07	9.04	23.45	11.81	63.60	22.50
2080[d]	1.52	9.51	22.91	11.58	73.20	21.30
2090[d]	1.22	10.50	21.98	11.14	82.80	22.50
2100[d]	1.11	11.05	20.56	10.81	88.20	22.20

Table AII.2.6: Anthropogenic C_2F_6 emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	2.43	2.43	2.43	2.43	1.30	1.30
2010[d]	4.29	2.34	2.62	2.50	2.00	1.50
2020[d]	4.98	1.76	2.66	2.61	2.50	1.60
2030[d]	2.33	1.80	2.69	2.75	3.10	1.70
2040[d]	1.15	1.94	2.63	2.74	3.80	1.80
2050[d]	0.55	2.03	2.56	2.79	4.60	2.10
2060[d]	0.34	2.03	2.49	2.71	5.60	2.30
2070[d]	0.26	1.99	2.50	2.74	6.40	2.20
2080[d]	0.16	1.93	2.36	2.74	7.30	2.10
2090[d]	0.10	1.97	2.26	2.68	8.30	2.20
2100[d]	0.09	2.01	2.09	2.63	8.80	2.20

Table AII.2.7: Anthropogenic C_6F_{14} emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000[d]	0.213	0.213	0.213	0.213
2010[d]	0.430	0.430	0.429	0.430

2020[d]	0.220	0.220	0.220	0.220
2030[d]	0.123	0.123	0.123	0.123
2040[d]	0.112	0.112	0.112	0.112
2050[d]	0.109	0.109	0.109	0.109
2060[d]	0.108	0.108	0.108	0.108
2070[d]	0.106	0.106	0.106	0.106
2080[d]	0.103	0.103	0.103	0.103
2090[d]	0.097	0.097	0.097	0.097
2100[d]	0.090	0.088	0.088	0.090

Table AII.2.8: Anthropogenic HFC-23 emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	10.4	10.4	10.4	10.4	13.0	13.0
2010[d]	9.1	9.1	9.1	9.1	15.0	15.0
2020[d]	2.4	2.4	2.4	2.4	5.0	5.0
2030[d]	0.7	0.7	0.7	0.7	2.0	2.0
2040[d]	0.4	0.4	0.4	0.4	2.0	2.0
2050[d]	0.3	0.3	0.3	0.3	1.0	1.0
2060[d]	0.1	0.1	0.1	0.1	1.0	1.0
2070[d]	0.1	0.1	0.1	0.1	1.0	1.0
2080[d]	0.0	0.0	0.0	0.0	1.0	1.0
2090[d]	0.0	0.0	0.0	0.0	1.0	1.0
2100[d]	0.0	0.0	0.0	0.0	1.0	1.0

Table AII.2.9: Anthropogenic HFC-32 emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	3.5	3.5	3.5	3.5	0.0	0.0
2010[d]	20.1	20.1	20.1	20.1	4.0	3.0
2020[d]	55.4	55.4	55.4	55.4	6.0	6.0
2030[d]	71.2	71.2	71.2	71.2	9.0	8.0
2040[d]	78.8	78.8	78.8	78.8	11.0	10.0
2050[d]	76.5	76.5	76.5	76.5	14.0	14.0
2060[d]	83.6	83.6	83.6	83.6	17.0	14.0
2070[d]	92.7	92.7	92.7	92.7	20.0	14.0
2080[d]	95.4	95.4	95.4	95.4	24.0	14.0
2090[d]	91.0	91.0	91.0	91.0	29.0	14.0
2100[d]	82.7	82.7	82.7	82.7	33.0	13.0

Table AII.2.10: Anthropogenic HFC-125 emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000[d]	8	8	8	8	0	0	0
2010[d]	29	18	10	32	11	11	1
2020[d]	82	29	9	63	21	21	9
2030[d]	108	32	9	79	29	29	46
2040[d]	122	31	10	99	35	36	111
2050[d]	122	30	10	115	46	48	175
2060[d]	138	27	11	128	56	48	185
2070[d]	157	24	11	139	66	48	194

2080[d]	165	24	12	144	79	48	199
2090[d]	161	23	12	147	94	46	199
2100[d]	150	23	12	148	106	44	199

Table AII.2.11: Anthropogenic HFC-134a emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000[d]	72	72	72	72	80	80	148
2010[d]	146	140	139	153	166	163	290
2020[d]	173	184	153	255	252	249	396
2030[d]	193	208	159	331	330	326	557
2040[d]	209	229	163	402	405	414	738
2050[d]	203	248	167	461	506	547	918
2060[d]	225	246	172	506	633	550	969
2070[d]	252	260	175	553	758	544	1020
2080[d]	263	299	177	602	915	533	1047
2090[d]	256	351	175	651	1107	513	1051
2100[d]	239	400	171	696	1260	486	1055

Table AII.2.12: Anthropogenic HFC-143a emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	7.5	7.5	7.5	7.5	0.0	0.0
2010[d]	23.1	14.0	7.0	23.2	9.0	8.0
2020[d]	59.1	17.4	5.4	34.1	16.0	15.0
2030[d]	74.7	20.3	6.0	38.5	22.0	21.0
2040[d]	81.8	23.1	6.6	45.1	27.0	26.0
2050[d]	79.0	25.6	7.1	49.8	35.0	35.0
2060[d]	86.1	25.9	7.7	52.3	43.0	35.0
2070[d]	94.2	28.2	8.3	54.1	51.0	35.0
2080[d]	95.1	33.5	8.7	52.7	61.0	35.0
2090[d]	88.7	39.6	9.0	50.2	73.0	34.0
2100[d]	79.2	45.1	9.1	47.3	82.0	32.0

Table AII.2.13: Anthropogenic HFC-227ea emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	1.7	1.7	1.7	1.7	0.0	0.0
2010[d]	7.0	5.3	6.9	8.5	12.0	13.0
2020[d]	2.6	1.4	2.5	2.7	17.0	18.0
2030[d]	0.9	0.3	0.8	0.7	21.0	24.0
2040[d]	0.8	0.2	0.7	0.7	26.0	30.0
2050[d]	0.4	0.1	0.3	0.4	32.0	39.0
2060[d]	0.2	0.0	0.1	0.2	40.0	40.0
2070[d]	0.1	0.0	0.1	0.1	48.0	39.0
2080[d]	0.1	0.0	0.1	0.1	58.0	38.0
2090[d]	0.1	0.0	0.0	0.1	70.0	36.0
2100[d]	0.1	0.0	0.0	0.1	80.0	34.0

Table AII.2.14: Anthropogenic HFC-245fa emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	11	11	11	11	0	0
2010[d]	42	46	53	74	59	60
2020[d]	32	86	65	143	79	80
2030[d]	7	95	67	186	98	102
2040[d]	0	97	68	181	121	131
2050[d]	0	95	69	163	149	173
2060[d]	0	87	70	150	190	173
2070[d]	0	82	71	138	228	170
2080[d]	0	80	70	129	276	166
2090[d]	0	81	68	123	334	159
2100[d]	0	83	65	130	388	150

Table AII.2.15: Anthropogenic HFC-43-10mee emissions (Gg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000[d]	0.6	0.6	0.6	0.6	0.0	0.0
2010[d]	5.6	5.6	5.6	5.6	7.0	6.0
2020[d]	7.2	7.2	7.2	7.2	8.0	7.0
2030[d]	8.1	8.1	8.1	8.1	8.0	8.0
2040[d]	9.4	9.4	9.4	9.1	9.0	9.0
2050[d]	10.8	10.8	10.8	10.4	11.0	11.0
2060[d]	11.1	11.1	11.1	12.1	12.0	11.0
2070[d]	11.0	11.0	11.0	13.9	14.0	11.0
2080[d]	11.0	11.0	10.9	16.2	16.0	11.0
2090[d]	10.7	10.7	10.7	18.9	19.0	11.0
2100[d]	10.5	10.5	10.5	21.4	22.0	10.0

Table AII.2.16: Anthropogenic CO emissions (Tg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000[d]	1071	1071	1071	1071	877	877	1048
2010[d]	1035	1041	1045	1054	977	789	1096
2020[d]	984	997	1028	1058	1075	751	1145
2030[d]	930	986	1030	1019	1259	603	1207
2040[d]	879	948	1046	960	1344	531	1282
2050[d]	825	875	1033	907	1428	471	1358
2060[d]	779	782	996	846	1545	459	1431
2070[d]	718	678	939	799	1662	456	1504
2080[d]	668	571	879	759	1842	426	1576
2090[d]	638	520	835	721	2084	399	1649
2100[d]	612	483	798	694	2326	363	1722

Table AII.2.16 (continued)

Year	MFR	CLE	REF^L	REF^U	POL^L	POL^U
2000[d]	977	977	708	1197	706	1197
2010[d]			771	1408	769	1408
2020[d]			755	1629	705	1611
2030[d]	729	904	707	1865	592	1803
2040[d]			695	2165	620	2002
2050[d]			591	2487	482	2218

2060[d]	504	2787	363	2409
2070[d]	450	3052	328	2558
2080[d]	438	3279	268	2635
2090[d]	410	3510	259	2714
2100[d]	363	3735	253	2796

Table AII.2.17: Anthropogenic NMVOC emissions (Tg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	CLE	MFR
2000[d]	213	213	213	213	141	141	126	147	147
2010[d]	216	209	215	217	155	141	142		
2020[d]	213	197	214	224	179	140	158		
2030[d]	202	201	217	225	202	131	173	146	103
2040[d]	192	201	222	218	214	123	188		
2050[d]	179	191	220	209	225	116	202		
2060[d]	167	180	214	202	238	111	218		
2070[d]	152	167	204	194	251	103	234		
2080[d]	140	152	193	189	275	99	251		
2090[d]	132	145	182	182	309	96	267		
2100[d]	126	141	174	177	342	87	283		

Table AII.2.18: Anthropogenic NO_X emissions (TgN yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000[d]	38.2	38.2	38.2	38.2	32.0	32.0	37.0
2010[d]	38.8	37.9	38.0	39.5	39.2	36.1	43.4
2020[d]	36.5	35.9	35.7	41.5	50.3	39.9	49.8
2030[d]	32.2	34.7	33.7	41.0	60.7	42.0	55.2
2040[d]	30.1	32.5	32.7	37.2	65.9	42.6	59.6
2050[d]	28.9	29.3	30.6	33.8	71.1	38.8	64.0
2060[d]	27.1	25.7	28.2	31.8	75.5	34.3	67.8
2070[d]	24.1	22.4	24.0	30.3	79.8	29.6	71.6
2080[d]	20.9	19.5	20.3	29.0	87.5	25.7	75.4
2090[d]	18.6	18.6	18.1	27.4	98.3	22.2	79.2
2100[d]	16.4	18.1	16.4	26.4	109.2	18.7	83.0

Table AII.2.18. (continued)

Year	MFR	CLE	REF^L	REF^U	POL^L	POL^U
2000[d]	38.0	38.0	29.1	41.6	29.1	41.6
2010[d]			26.0	50.2	23.9	50.1
2020[d]			26.3	60.4	21.6	59.2
2030[d]	23.1	42.9	24.4	71.8	16.5	67.4
2040[d]			21.5	86.3	14.1	75.3
2050[d]			17.0	101.7	11.6	83.3
2060[d]			13.2	115.7	11.4	89.8
2070[d]			12.0	127.5	10.5	94.6
2080[d]			11.5	137.2	9.6	97.2
2090[d]			12.0	146.2	8.8	100.1
2100[d]			13.0	155.0	8.0	104.0

Notes:
Odd nitrogen (NOx) emissions occur as NO or NO_2, measured here as Tg of N.

Table AII.2.19: Anthropogenic NH_3 emissions (TgN yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	CLE	MFR
2000[d]	38.5	38.5	38.5	38.5	53.4	53.4
2010[d]	43.5	42.4	43.1	43.5		
2020[d]	47.5	43.5	43.3	48.1		
2030[d]	50.8	45.2	46.2	52.1	69.8	69.8
2040[d]	53.2	46.3	49.8	55.6		
2050[d]	55.5	46.4	53.0	58.4		
2060[d]	58.4	46.0	56.5	60.6		
2070[d]	61.2	45.2	59.5	62.4		
2080[d]	63.3	44.3	60.9	63.8		
2090[d]	65.2	43.9	62.1	65.3		
2100[d]	67.0	43.6	61.8	66.9		

Table AII.2.20: Anthropogenic SO_X emissions (TgS yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000[d]	55.9	55.9	55.9	55.9	69.0	69.0	79.0
2010[d]	54.9	54.8	55.8	51.9	74.7	73.9	95.0
2020[d]	44.5	50.3	49.9	47.6	99.5	74.6	111.0
2030[d]	30.8	43.2	42.7	42.3	112.5	78.2	125.8
2040[d]	20.9	35.0	41.9	33.5	109.0	78.5	139.4
2050[d]	16.0	26.5	37.8	26.8	105.4	68.9	153.0
2060[d]	13.8	21.0	34.0	23.0	89.6	55.8	151.8
2070[d]	11.9	16.7	23.5	20.3	73.7	44.3	150.6
2080[d]	9.9	13.2	15.9	18.3	64.7	36.1	149.4
2090[d]	8.0	12.0	12.7	14.9	62.5	29.8	148.2
2100[d]	6.7	11.4	10.8	13.1	60.3	24.9	147.0

Table AII.2.20. (continued)

Year	MFR	CLE	REF^L	REF^U	POL^L	POL^U
2000[d]	55.6	55.6	50.6	76.4	50.6	76.4
2010[d]			53.1	81.8	52.7	78.7
2020[d]			56.9	84.8	47.7	77.8
2030[d]	17.9	58.8	60.1	86.7	29.8	76.3
2040[d]			52.5	82.9	19.0	72.0
2050[d]			44.2	72.3	12.4	61.7
2060[d]			32.8	73.9	9.5	52.9
2070[d]			30.5	77.7	7.8	49.8
2080[d]			29.6	81.1	6.2	50.5
2090[d]			22.8	84.5	5.1	52.5
2100[d]			18.0	88.0	4.0	54.0

Notes:
Anthropogenic sulphur emissions as SO_2, measured here as Tg of S.

Table AII.2.21: Anthropogenic OC aerosols emissions (Tg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	MFR*	CLE*
2000[d]	35.6	35.6	35.6	35.6	81.4	81.4	81.4	35.0	35.0
2010[d]	36.6	34.6	36.2	35.6	89.3	74.5	85.2	29.2	34.6

2020[d]	36.6	30.8	36.1	34.5	97.0	71.5	89.0	28.6	32.6
2030[d]	35.3	29.2	36.0	33.2	111.4	59.9	93.9	27.9	30.9
2040[d]	32.3	28.0	36.4	31.6	118.1	54.2	99.8		
2050[d]	30.3	26.8	36.5	30.1	124.7	49.5	105.8		
2060[d]	29.6	25.0	35.7	28.5	133.9	48.6	111.5		
2070[d]	28.2	22.8	34.4	27.4	143.1	48.3	117.2		
2080[d]	27.0	20.7	33.4	26.4	157.2	46.0	122.9		
2090[d]	26.4	19.9	32.7	25.1	176.2	43.8	128.6		
2100[d]	25.5	19.5	32.2	24.1	195.2	41.0	134.4		

Notes:
For both MFR* and CLE* 23 Tg is added to Cofala et al. (2007) values to include biomass burning.

Table AII.2.22: Anthropogenic BC aerosols emissions (Tg yr^{-1})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	MFR*	CLE*
2000[d]	7.88	7.88	7.88	7.88	12.40	12.40	12.40	7.91	7.91
2010[d]	8.49	8.13	8.13	8.06	13.60	11.30	13.00	6.31	8.01
2020[d]	8.27	7.84	7.77	7.66	14.80	10.90	13.60	5.81	7.41
2030[d]	7.03	7.36	7.53	7.04	17.00	9.10	14.30	5.41	7.01
2040[d]	5.80	6.81	7.39	6.22	18.00	8.30	15.20		
2050[d]	5.00	6.21	7.07	5.67	19.00	7.50	16.10		
2060[d]	4.46	5.56	6.48	5.22	20.40	7.40	17.00		
2070[d]	3.99	4.88	5.75	4.88	21.80	7.40	17.90		
2080[d]	3.70	4.23	5.15	4.66	24.00	7.00	18.70		
2090[d]	3.55	4.01	4.70	4.43	26.80	6.70	19.60		
2100[d]	3.39	3.88	4.41	4.27	29.70	6.20	20.50		

Notes:
For both MFR* and CLE* 2.6 Tg added to Cofala et al. (2007) values to include biomass burning.

Table AII.2.23: Anthropogenic nitrogen fixation (Tg-N yr^{-1})

Year	Historical	SRES A1 + Biofuel	SRES A2	SRES B1	SRES B2	FAO2000 Baseline	FAO2000 Improved	Tilman& 2001	Tubiello& F 2007
1910	0.0								
1920	0.2								
1925	0.6								
1929	0.9								
1935	1.3								
1940	2.2								
1950	3.7								
1955	6.8								
1960	9.5								
1965	18.7								
1970	31.6								
1971	33.3								
1972	36.2								
1973	39.1								
1974	38.6								
1975	43.7								
1976	46.4								
1977	49.9								
1978	53.8								

1979	57.4								
1980	60.6								
1981	60.3								
1982	61.3								
1983	67.1								
1984	70.9								
1985	70.2								
1986	72.5								
1987	75.8								
1988	79.5								
1989	78.9								
1990	77.1								
1991	75.5								
1992	73.7								
1993	72.3								
1994	72.4								
1995	78.5								
1996	82.6					77.8	77.8		
1997	81.4								
1998	82.8								
1999	84.9								
2000	82.1							87.0	
2001	82.9								
2002	85.2								
2003	90.2								
2004	91.7								
2005	94.2								
2007	98.4								
2010		104.1	101.9	101.7	96.5				
2015		- - -	- - -	- - -	- - -	106.8	88.0		
2020		122.6	110.7	111.2	100.9			135.0	
2030		141.1	117.6	118.4	103.3	124.5	96.2		
2040		153.3	130.7	122.2	103.5				
2050		165.5	131.1	123.2	101.9			236.0	
2060		171.3	134.0	121.4	99.2				
2070		177.0	132.1	117.5	95.6				
2080		180.1	138.1	111.6	91.5				205
2090		186.0	146.5	108.8	91.3				
2100		192.5	149.8	104.1	91.0				

Notes:
See Chapter 6, Figure 6.30 and Erisman et al. (2008) for details and sources.

AII.3: Natural Emissions

Table AII.3.1a: Net land (natural and land use) CO_2 emissions (PgC yr^{-1})

Year	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2000[d]	–1.02 ± 0.87	–1.14 ± 0.87	–0.92 ± 0.93	–1.14 ± 0.87
2010[d]	–1.49 ± 1.02	–1.85 ± 0.96	–1.03 ± 1.65	–1.30 ± 1.64
2020[d]	–1.24 ± 1.35	–2.83 ± 1.47	–1.79 ± 1.95	–1.43 ± 1.82
2030[d]	–1.28 ± 1.53	–2.84 ± 1.59	–2.37 ± 1.54	–1.76 ± 2.22

2040[d]	–1.21 ± 1.33	–3.25 ± 1.58	–2.27 ± 1.46	–2.15 ± 2.13
2050[d]	–1.00 ± 1.53	–3.07 ± 1.54	–1.98 ± 1.57	–2.35 ± 2.45
2060[d]	–0.76 ± 0.83	–2.80 ± 1.83	–2.46 ± 2.01	–2.71 ± 2.38
2070[d]	–0.68 ± 0.84	–2.59 ± 1.73	–2.40 ± 2.06	–2.57 ± 2.42
2080[d]	–0.15 ± 0.81	–2.04 ± 1.48	–2.22 ± 2.12	–1.96 ± 2.64
2090[d]	–0.03 ± 0.99	–2.12 ± 1.38	–2.77 ± 1.96	–1.63 ± 2.70
2100[d]	0.36 ± 0.95	–1.54 ± 1.25	–2.13 ± 1.32	–1.27 ± 2.90

Notes:
Ten-year average values are shown (2010[d] = average of 2005–2014). CO_2 emissions are inferred from ESMs used in CMIP5 (Jones et al., 2013). See notes AII.2.1a and Chapter 6, Sections 6.4.3, 6.4.3.3, and Figure 6.24.

Table AII.3.1b: Net ocean CO_2 emissions (PgC yr^{-1})

Year	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2000[d]	–2.09 ± 0.19	–2.14 ± 0.32	–2.10 ± 0.17	–2.14 ± 0.32
2010[d]	–2.44 ± 0.22	–2.50 ± 0.42	–2.44 ± 0.20	–2.53 ± 0.43
2020[d]	–2.70 ± 0.26	–2.75 ± 0.46	–2.59 ± 0.22	–3.02 ± 0.51
2030[d]	–2.59 ± 0.30	–2.98 ± 0.52	–2.69 ± 0.22	–3.47 ± 0.54
2040[d]	–2.22 ± 0.32	–3.16 ± 0.56	–2.88 ± 0.27	–3.96 ± 0.67
2050[d]	–1.83 ± 0.33	–3.22 ± 0.60	–3.16 ± 0.31	–4.47 ± 0.76
2060[d]	–1.52 ± 0.30	–3.12 ± 0.63	–3.52 ± 0.36	–4.92 ± 0.84
2070[d]	–1.23 ± 0.23	–2.82 ± 0.61	–3.79 ± 0.41	–5.24 ± 0.97
2080[d]	–0.99 ± 0.27	–2.46 ± 0.59	–4.02 ± 0.44	–5.40 ± 1.14
2090[d]	–0.85 ± 0.26	–2.22 ± 0.53	–3.96 ± 0.43	–5.45 ± 1.18
2100[d]	–0.77 ± 0.26	–2.14 ± 0.47	–3.84 ± 0.42	–5.44 ± 1.22

Notes:
See AII.3.1.a.

AII.4: Abundances of the Well Mixed Greenhouse Gases

Table AII.4.1: CO_2 abundance (ppm)

Year	Observed	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	Min	RCP8.5[&]	Max
PI	278 ± 2	278	278	278	278	278	278	278			
2011[obs]	390.5 ± 0.3										
2000		368.9	368.9	368.9	368.9	368	368	368			
2005		378.8	378.8	378.8	378.8					378.8	
2010		389.3	389.1	389.1	389.3	388	387	388	366	394	413
2020		412.1	411.1	409.4	415.8	416	411	414	386	425	449
2030		430.8	435.0	428.9	448.8	448	434	442	412	461	496
2040		440.2	460.8	450.7	489.4	486	460	472	443	504	555
2050		442.7	486.5	477.7	540.5	527	485	504	482	559	627
2060		441.7	508.9	510.6	603.5	574	506	538	530	625	713
2070		437.5	524.3	549.8	677.1	628	522	575	588	703	810
2080		431.6	531.1	594.3	758.2	690	534	615	651	790	914
2090		426.0	533.7	635.6	844.8	762	542	662	722	885	1026
2100		420.9	538.4	669.7	935.9	846	544	713	794	985 ± 97	1142

Notes:
For observations (2011[obs]) see Chapter 2; and for projections see Box 1.1 (Figure 2), Sections 6.4.3.1, 11.3.1.1, 11.3.5.1.1. RCPn.n refers to values taken directly from the published RCP scenarios using the MAGICC model (Meinshausen et al., 2011a; 2011b). These are harmonized to match observations up to 2005 (378.8 ppm) and project future abundances thereafter. RCP8.5[&] shows the average and assessed 90% confidence interval for year 2100, plus the

min-max full range derived from the CMIP5 archive for all years (P. Friedlingstein, based on Friedlingstein et al., 2006). 11 ESMs participated (BCC-CSM-1, CanESM2, CESM1-BGC, GFDL-ESM2G, HadGem-2ES, INMCM4, IPSLCM5-LR, MIROC-ESM, MPI-ESM-LR, MRI-ESM1, and Nor-ESM1-ME), running the RCP8.5 anthropogenic emission scenario forced by the RCP8.5 climate change scenario (see Figure 12.36). All abundances are mid-year. Projected values for SRES A2 and B1 and IS92 are the average of reference models taken from the TAR Appendix II.

Table AII.4.2: CH_4 abundance (ppb)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
PI	720	720	720	720				722 ± 25	722 ± 25	722 ± 25	722 ± 25
2011[obs]								1803 ± 4	1803 ± 4	1803 ± 4	1803 ± 4
2000	1751	1751	1751	1751	1760	1760	1760				
2010	1773	1767	1769	1779	1861	1827	1855	1795 ± 18	1795 ± 18	1795 ± 18	1795 ± 18
2020	1731	1801	1786	1924	1997	1891	1979	1716 ± 23	1847 ± 21	1811 ± 22	1915 ± 25
2030	1600	1830	1796	2132	2163	1927	2129	1562 ± 38	1886 ± 28	1827 ± 28	2121 ± 44
2040	1527	1842	1841	2399	2357	1919	2306	1463 ± 50	1903 ± 37	1880 ± 36	2412 ± 74
2050	1452	1833	1895	2740	2562	1881	2497	1353 ± 60	1899 ± 47	1941 ± 48	2784 ± 116
2060	1365	1801	1939	3076	2779	1836	2663	1230 ± 71	1872 ± 59	1994 ± 61	3152 ± 163
2070	1311	1745	1962	3322	3011	1797	2791	1153 ± 78	1824 ± 72	2035 ± 77	3428 ± 208
2080	1285	1672	1940	3490	3252	1741	2905	1137 ± 88	1756 ± 87	2033 ± 94	3624 ± 250
2090	1268	1614	1819	3639	3493	1663	3019	1135 ± 98	1690 ± 100	1908 ± 111	3805 ± 293
2100	1254	1576	1649	3751	3731	1574	3136	1127 ± 106	1633 ± 110	1734 ± 124	3938 ± 334

Notes:
RCPn.n refers to values taken directly from the published RCP scenarios using the MAGICC model (Meinshausen et al., 2011b) and initialized in year 2005 at 1754 ppb. Values for SRES A2 and B1 and IS92 are from the TAR Appendix II. RCPn.n[&] values are best estimates with uncertainties (68% confidence intervals) from Chapter 11 (Section 11.3.5) based on Holmes et al. (2013) and using RCP[&] emissions and uncertainties tabulated above. For RCP[&] the PI, year 2011 and year 2010 values are based on observations. RCP models used slightly different PI abundances than recommended here (AII.1.1, Chapter 2).

Table AII.4.3: N_2O abundance (ppb)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
PI	272	272	272	272				270 ± 7	270 ± 7	270 ± 7	270 ± 7
2011[obs]								324 ± 1	324 ± 1	324 ± 1	324 ± 1
2000	316	316	316	316	316	316	316				
2010	323	323	323	323	325	324	324	323 ± 3	323 ± 3	323 ± 3	323 ± 3
2020	329	330	330	332	335	333	333	330 ± 4	331 ± 4	331 ± 4	332 ± 4
2030	334	337	337	342	347	341	343	336 ± 5	339 ± 5	338 ± 5	342 ± 6
2040	339	344	345	354	360	349	353	342 ± 6	346 ± 7	346 ± 7	353 ± 8
2050	342	351	355	367	373	357	363	346 ± 8	353 ± 9	355 ± 9	365 ± 11
2060	343	356	365	381	387	363	372	349 ± 9	360 ± 10	364 ± 11	377 ± 13
2070	344	361	376	394	401	368	381	351 ± 10	365 ± 12	374 ± 13	389 ± 16
2080	344	366	386	408	416	371	389	352 ± 11	370 ± 13	384 ± 15	401 ± 18
2090	344	369	397	421	432	374	396	353 ± 11	374 ± 14	393 ± 17	413 ± 21
2100	344	372	406	435	447	375	403	354 ± 12	378 ± 16	401 ± 19	425 ± 24

Notes:
See notes Table AII.4.2.

Table AII.4.4: SF_6 abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	Obs
2011[obs]							7.3 ± 0.1
2010	7.0	6.9	7.0	7.0	**7**	7	

2020	8.9	8.7	10.3	9.9	11	9
2030	9.7	9.7	14.1	13.4	15	12
2040	10.4	10.9	17.9	17.6	20	15
2050	10.8	12.3	21.7	22.1	26	19
2060	11.0	13.8	25.6	27.2	32	23
2070	11.2	15.6	29.5	32.6	40	27
2080	11.3	17.6	33.4	38.1	48	30
2090	11.4	19.9	37.3	44.1	56	33
2100	11.4	22.3	41.0	50.5	65	35

Notes:
Projected SF_6 and PFC abundances (Tables AII.4.4–7) taken directly from RCPs (Meinshausen et al., 2011a). Observed values shown for year 2011.

Table AII.4.5: CF_4 abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	Obs
2011 [obs]							79.0
2010	84	83	85	83	92	91	
2020	93	90	99	91	107	101	
2030	99	95	115	99	125	111	
2040	103	101	130	107	148	122	
2050	106	107	146	115	175	135	
2060	108	113	162	123	208	150	
2070	109	119	177	131	246	164	
2080	110	125	193	138	291	179	
2090	111	131	207	146	341	193	
2100	112	138	222	153	397	208	

Table AII.4.6: C_2F_6 abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	Obs
2011 [obs]							4.2
2010	4.1	3.9	3.9	3.9	4	4	
2020	6.2	4.8	5.0	5.0	5	4	
2030	7.9	5.5	6.2	6.1	6	5	
2040	8.6	6.3	7.3	7.2	7	6	
2050	8.9	7.1	8.4	8.4	9	7	
2060	9.1	7.9	9.4	9.6	11	8	
2070	9.2	8.8	10.5	10.7	14	8	
2080	9.3	9.6	11.5	11.8	17	9	
2090	9.3	10.4	12.5	13.0	20	10	
2100	9.3	11.3	13.4	14.1	23	11	

Table AII.4.7: C_6F_{14} abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2010	0.07	0.07	0.07	0.07
2020	0.13	0.13	0.13	0.13
2030	0.16	0.16	0.16	0.16
2040	0.18	0.18	0.18	0.18
2050	0.20	0.20	0.20	0.20
2060	0.21	0.21	0.21	0.21

2070	0.23	0.23	0.23	0.23
2080	0.25	0.25	0.25	0.25
2090	0.27	0.27	0.27	0.27
2100	0.28	0.28	0.28	0.28

Table AII.4.8: HFC-23 abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011[obs]							24.0	24.0	24.0	24.0
2010	22.9	22.9	22.9	22.9	26	26	23.2 ± 1	23.2 ± 1	23.2 ± 1	23.2 ± 1
2020	27.2	27.2	27.2	27.2	33	33	26.6 ± 1	26.6 ± 1	26.6 ± 1	26.6 ± 1
2030	27.0	27.0	27.1	27.1	35	35	26.3 ± 1	26.3 ± 1	26.3 ± 1	26.3 ± 1
2040	26.5	26.5	26.6	26.6	35	35	25.7 ± 1	25.8 ± 1	25.8 ± 1	25.8 ± 1
2050	25.8	25.9	25.9	26.0	35	35	24.9 ± 1	25.0 ± 1	25.1 ± 1	25.1 ± 1
2060	25.0	25.1	25.1	25.3	35	34	24.0 ± 1	24.2 ± 1	24.3 ± 1	24.4 ± 1
2070	24.1	24.2	24.4	24.6	34	34	23.0 ± 1	23.4 ± 1	23.4 ± 1	23.6 ± 1
2080	23.3	23.3	23.5	23.8	34	33	22.1 ± 1	22.5 ± 1	22.6 ± 1	22.8 ± 1
2090	22.4	22.5	22.7	23.0	34	33	21.2 ± 1	21.6 ± 1	21.8 ± 1	22.1 ± 1
2100	21.6	21.6	21.9	22.3	33	32	20.3 ± 1	20.8 ± 1	21.0 ± 1	21.3 ± 1

Notes:
RCPn.n HFC abundances (Tables AII.4.8–15) are as reported (Meinshausen et al., 2011a). SRES A2 and B1 and IS92a (where available) are taken from TAR Appendix II. Observed values are shown for 2011 (see Chapter 2, and AII.1.1). The AR5 RCPn.n[&] abundances are calculated starting with observed abundances (adopted for 2010) and future tropospheric OH changes using the methodology of Prather et al. (2012), updated for uncertainty in lifetime and scenario changes in OH using Holmes et al. (2013) and ACCMIP results (Stevenson et al., 2013; Voulgarakis et al., 2013). Projected $RCP_{\&}$ abundances are best estimates with 68% confidence range as uncertainties. See also notes Tables AII.4.2 and AII.5.9.

Table AII.4.9: HFC-32 abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011[obs]							4.9	4.9	4.9	4.9
2010	5.7	5.7	5.7	5.7	1	1	4.1 ± 0	4.1 ± 0	4.1 ± 0	4.1 ± 0
2020	21.0	21.0	21.1	21.1	3	3	23.8 ± 2	24.0 ± 2	24.0 ± 2	24.0 ± 2
2030	34.7	35.2	35.5	35.8	4	4	38.1 ± 5	39.1 ± 5	39.1 ± 5	39.2 ± 5
2040	41.1	41.9	42.4	43.6	6	5	44.7 ± 6	46.7 ± 6	46.9 ± 6	47.8 ± 6
2050	41.9	42.8	43.9	46.2	7	7	44.3 ± 7	47.6 ± 7	48.2 ± 7	50.3 ± 8
2060	43.1	43.8	45.6	48.8	9	8	45.0 ± 7	49.6 ± 8	50.6 ± 8	53.8 ± 8
2070	47.9	48.1	50.7	54.7	11	8	49.4 ± 8	54.9 ± 8	56.8 ± 9	60.3 ± 9
2080	51.3	50.5	54.0	58.6	14	8	53.8 ± 9	58.2 ± 9	61.4 ± 10	64.7 ± 10
2090	51.0	49.6	52.8	58.2	17	8	54.0 ± 9	56.9 ±10	60.6 ± 10	64.4 ± 11
2100	47.5	45.6	47.4	53.8	20	8	50.5 ± 9	51.8 ± 9	55.2 ± 10	59.6 ± 11

Table AII.4.10: HFC-125 abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011[obs]								9.6	9.6	9.6	9.6
2010	7.1	6.4	5.7	7.7	2	2	0	8.2 ± 1	8.2 ± 1	8.2 ± 1	8.2 ± 1
2020	27.4	14.3	7.6	25.7	8	8	2	30.9 ± 1	16.3 ± 1	9.6 ± 1	27.6 ± 1
2030	60.0	23.2	9.2	48.5	16	16	12	64.1 ± 3	25.2 ± 2	10.9 ± 1	51.0 ± 3
2040	90.5	29.7	10.6	72.0	24	24	40	95.5 ± 7	31.9 ± 3	12.2 ± 1	75.9 ± 5
2050	114.5	34.0	11.8	97.6	34	33	87	119.5 ± 11	36.6 ± 4	13.3 ± 2	103 ± 8
2060	133.4	36.0	12.9	122.9	45	43	137	139.0 ± 15	39.0 ± 5	14.4 ± 2	130 ± 12

2070	154.8	35.8	13.9	147.1	58	49	177	160.8 ± 20	39.4 ± 6	15.5 ± 2	156 ± 16
2080	176.2	34.8	14.8	168.7	72	54	210	183.2 ± 24	39.1 ± 6	16.6 ± 2	180 ± 20
2090	192.3	34.0	15.5	185.8	89	57	236	200.9 ± 29	38.7 ± 7	17.4 ± 3	199 ± 25
2100	200.2	33.2	15.8	198.9	107	58	255	210.5 ± 34	38.1 ± 7	18.0 ± 3	215 ± 30

Table AII.4.11: HFC-134a abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011								63 ± 1	63 ± 1	63 ± 1	63 ± 1
2010	56	56	56	56	55	55	94	58 ± 3	58 ± 3	58 ± 3	58 ± 3
2020	96	95	90	112	111	108	183	97 ± 5	98 ± 5	91 ± 5	117 ± 5
2030	122	129	109	180	170	165	281	123 ± 9	132 ± 9	110 ± 8	184 ± 11
2040	142	154	121	245	231	223	401	143 ± 12	157 ± 12	122 ± 10	249 ± 17
2050	153	175	129	311	299	293	537	150 ± 15	178 ± 16	130 ± 12	314 ± 24
2060	160	187	135	370	382	352	657	155 ± 16	192 ± 19	137 ± 14	373 ± 32
2070	175	193	141	423	480	380	743	168 ± 18	200 ± 21	143 ± 15	427 ± 39
2080	191	205	144	471	594	391	807	184 ± 21	216 ± 23	148 ± 16	476 ± 47
2090	200	229	144	517	729	390	850	193 ± 23	242 ± 26	150 ± 18	524 ± 56
2100	199	262	141	561	877	379	878	192 ± 25	275 ± 30	148 ± 19	570 ± 64

Table AII.4.12: HFC-143a abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011							12.0	12.0	12.0	12.0
2010	10.2	9.4	8.4	10.8	3	2	11 ± 1	11 ± 1	11 ± 1	11 ± 1
2020	33.9	17.8	10.1	28.2	10	9	37 ± 1	19 ± 1	12 ± 1	29 ± 1
2030	72.1	26.8	12.1	46.8	20	18	75 ± 2	28 ± 1	14 ± 1	48 ± 1
2040	109.9	36.0	14.0	65.6	32	29	13 ± 4	38 ± 1	16 ± 1	67 ± 2
2050	142.1	45.4	16.0	85.7	45	43	144 ± 6	47 ± 2	18 ± 1	88 ± 3
2060	168.6	54.0	18.1	105.2	62	57	170 ± 8	56 ± 3	20 ± 1	107 ± 4
2070	196.1	61.4	20.1	123.2	81	68	197 ± 11	64 ± 3	22 ± 1	126 ± 6
2080	222.2	69.7	22.2	138.7	103	77	223 ± 14	73 ± 4	24 ± 2	142 ± 8
2090	242.0	80.2	24.0	150.2	129	85	243 ± 17	85 ± 5	26 ± 2	154 ± 9
2100	252.9	92.6	25.6	157.9	157	90	254 ± 20	98 ± 6	28 ± 2	163 ± 11

Table AII.4.13: HFC-227ea abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011							0.65	0.65	0.65	0.65
2010	1.43	1.28	1.42	1.56	2	2	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1	0.6 ± 0.1
2020	2.81	2.10	2.78	3.30	5	6	2.0 ± 0.1	1.5 ± 0.1	2.0 ± 0.1	2.4 ± 0.1
2030	2.48	1.71	2.44	2.77	10	10	2.0 ± 0.1	1.3 ± 0.1	2.0 ± 0.1	2.2 ± 0.1
2040	2.09	1.35	2.04	2.29	14	15	1.8 ± 0.1	1.1 ± 0.1	1.8 ± 0.1	2.0 ± 0.2
2050	1.74	1.06	1.68	1.92	19	21	1.6 ± 0.2	1.0 ± 0.1	1.6 ± 0.2	1.8 ± 0.2
2060	1.35	0.81	1.31	1.55	25	27	1.3 ± 0.2	0.8 ± 0.1	1.3 ± 0.2	1.5 ± 0.2
2070	1.04	0.61	1.01	1.23	32	31	1.1 ± 0.2	0.6 ± 0.1	1.1 ± 0.2	1.3 ± 0.2
2080	0.81	0.45	0.78	0.99	40	34	0.9 ± 0.2	0.5 ± 0.1	0.9 ± 0.2	1.1 ± 0.2
2090	0.63	0.34	0.59	0.79	49	35	0.8 ± 0.2	0.4 ± 0.1	0.8 ± 0.2	0.9 ± 0.2
2100	1.43	1.28	1.42	1.56	2	2	0.6 ± 0.2	0.3 ± 0.1	0.6 ± 0.2	0.8 ± 0.2

Table AII.4.14: HFC-245fa abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011							1.24	1.24	1.24	1.24
2010	7.5	7.3	8.2	9.5	8	8	1.1 ± .2	1.1 ± .2	1.1 ± .2	1.1 ± .2
2020	12.1	19.3	18.1	31.5	17	17	10.2 ± 1.1	18.9 ± 2	16.4 ± 2	31.0 ± 4
2030	7.4	28.2	21.3	51.2	23	23	6.6 ± 1.5	29.2 ± 4	21.6 ± 3	53.1 ± 8
2040	2.3	31.2	22.6	61.7	29	29	2.2 ± 1.0	33.0 ± 6	23.7 ± 4	63.8 ± 10
2050	0.6	31.9	23.3	62.0	36	38	0.7 ± 0.5	34.1 ± 7	24.6 ± 5	64.4 ± 12
2060	0.2	30.6	23.8	59.1	46	43	0.2 ± 0.2	32.9 ± 7	25.3 ± 5	61.7 ± 13
2070	0.0	28.2	24.2	55.3	58	44	0.1 ± 0.1	30.8 ± 7	25.9 ± 5	58.1 ± 13
2080	0.0	26.4	24.3	51.5	72	43	0.0 ± 0.1	29.3 ± 7	26.4 ± 6	54.4 ± 12
2090	0.0	25.8	23.6	48.0	88	42	0.0 ± 0.0	28.6 ± 6	26.0 ± 6	51.0 ± 12
2100	0.0	26.0	22.3	47.3	105	40	0.0 ± 0.0	28.6 ± 6	24.9 ± 6	50.6 ± 11

Table AII.4.15: HFC-43-10mee abundance (ppt)

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
2011							- - -	- - -	- - -	- - -
2010	0.52	0.52	0.52	0.52	1	1	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
2020	1.46	1.46	1.46	1.47	2	1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1	1.2 ± 0.1
2030	2.09	2.11	2.12	2.14	2	2	2.0 ± 0.2	2.1 ± 0.2	2.1 ± 0.2	2.1 ± 0.2
2040	2.61	2.64	2.66	2.68	3	2	2.7 ± 0.3	2.8 ± 0.3	2.8 ± 0.3	2.8 ± 0.3
2050	3.13	3.17	3.22	3.23	3	3	3.3 ± 0.4	3.4 ± 0.4	3.4 ± 0.4	3.4 ± 0.4
2060	3.56	3.61	3.70	3.83	4	3	3.7 ± 0.6	3.9 ± 0.6	4.0 ± 0.6	4.1 ± 0.6
2070	3.78	3.81	3.96	4.52	4	4	3.9 ± 0.7	4.3 ± 0.7	4.3 ± 0.7	4.9 ± 0.7
2080	3.89	3.88	4.08	5.27	5	4	4.1 ± 0.8	4.4 ± 0.8	4.6 ± 0.8	5.8 ± 0.9
2090	3.93	3.87	4.10	6.14	6	4	4.2 ± 0.8	4.5 ± 0.8	4.7 ± 0.9	6.7 ± 1.0
2100	3.91	3.81	3.99	7.12	7	4	4.2 ± 0.9	4.4 ± 0.9	4.6 ± 0.9	7.9 ± 1.2

Table AII.4.16: Montreal Protocol greenhouse gas abundances (ppt)

Year	CFC-11	CFC-12	CFC-113	CFC-114	CFC-115	CCl_4	CH_3CCl_3	HCFC-22
2011*	238 ± 1	528 ± 2	74.5 ± 0.5	15.8	8.4	86 ± 2	6.4 ± 0.4	213 ± 2
2010	240.9	532.5	75.6	16.4	8.4	87.6	8.3	206.8
2020	213.0	492.8	67.4	15.8	8.4	70.9	1.5	301.8
2030	182.6	448.0	59.9	15.1	8.4	54.4	0.2	265.4
2040	153.5	405.8	53.3	14.4	8.4	40.3	0.0	151.0
2050	127.2	367.3	47.4	13.6	8.4	29.2	0.0	71.1
2060	104.4	332.4	42.1	12.9	8.3	20.0	0.0	31.5
2070	85.2	300.7	37.4	12.3	8.3	13.6	0.0	13.7
2080	69.1	272.1	33.3	11.6	8.2	9.3	0.0	5.9
2090	55.9	246.2	29.6	11.1	8.2	6.3	0.0	2.6
2100	45.1	222.8	26.3	10.5	8.1	4.3	0.0	1.1

Table AII.4.16 (continued)

Year	HCFC-141b	HCFC-142b	Halon 1211	Halon 1202	Halon 1301	Halon 2402	CH_3Br	CH_3Cl
2011*	21.4 ± 0.5	21.2 ± 0.5	4.07	0.00	3.23	0.45	7.1	534
2010	20.3	20.5	4.07	0.00	3.20	0.46	7.2	550
2020	30.9	30.9	3.08	0.00	3.29	0.38	7.1	550
2030	34.4	31.2	2.06	0.00	3.19	0.27	7.1	550
2040	27.9	23.3	1.30	0.00	2.97	0.18	7.1	550

2050	19.3	14.9	0.78	0.00	2.71	0.12	7.1	550
2060	12.4	9.0	0.46	0.00	2.43	0.07	7.1	550
2070	7.7	5.2	0.26	0.00	2.16	0.05	7.1	550
2080	4.7	3.0	0.15	0.00	1.90	0.03	7.1	550
2090	2.9	1.7	0.08	0.00	1.66	0.02	7.1	550
2100	1.7	0.9	0.05	0.00	1.44	0.01	7.1	550

Notes:
Present day (2011*) is from Chapter 2; projections are from Scenario A1, WMO Ozone Assessment (WMO 2010).

AII.5: Column Abundances, Burdens, and Lifetimes

Table AII.5.1: Stratospheric O_3 column changes (DU)

Year	Obs	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1850		17	17	17	17
1980	11	15	15	15	15
2000	269 ± 8	276 ± 9	276 ± 9	276 ± 9	276 ± 9
2010	0	2	–1	1	–2
2020		4	0	3	2
2030		8	4	7	5
2040		9	7	10	9
2050		12	10	13	12
2060		13	12	14	15
2070		13	11	15	16
2080		12	11	16	15
2090		13	12	16	18
2100		15	13	17	20

Notes:
Observed O_3 columns and trends taken from WMO (Douglass and Filetov, 2010) subtracting tropospheric column O_3 (AII.5.2) with uncertainty estimates driven by polar variability. CMIP5 RCP results are from Eyring et al. (2013). The multi-model mean is derived from the CMIP5 models with predictive (interactive or semi-offline) stratospheric and tropospheric ozone chemistry. The absolute value is shown for year 2000. All other years are differences relative to (minus) year 2000. The multi-model standard deviation is shown only for year 2000; it does not change much over time; and, representing primarily the spread in absolute O_3 column, it is larger than the standard deviation of the changes (not evaluated here). All models used the same projections for ozone depleting substances. Near-term differences in projected O_3 columns across scenarios reflect model sampling (i.e., different sets of models contributing to each RCP), while long-term changes reflect changes in N_2O, CH_4, and climate. See Section 11.3.5.1.2.

Table AII.5.2: Tropospheric O_3 column changes (DU)

Year	CMIP5				ACCMIP			
	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1850	–10.2	–10.2	–10.2	–10.2	–8.9	–8.9	–8.9	–8.9
1980	–2.0	–2.0	–2.0	–2.0	–1.3	–1.3	–1.3	–1.3
2000	31.1 ± 3.3	31.1 ± 3.3	31.1 ± 3.3	31.1 ± 3.3	30.8 ± 2.1	30.8 ± 2.1	30.8 ± 2.1	30.8 ± 2.1
2010	1.1	0.6	0.8	0.8				
2020	1.0	0.9	1.0	2.1				
2030	0.6	1.5	1.4	3.5	–1.3	1.0	–0.1	1.8
2040	0.5	1.6	2.1	4.5				
2050	0.0	1.7	2.4	5.7				
2060	–0.7	1.3	2.6	7.1				
2070	–1.6	0.5	2.3	8.1				
2080	–2.5	–0.1	2.0	8.9				

2090	–2.8	–0.4	1.5	9.5				
2100	–3.1	–0.5	1.1	10.2	–5.4	–2.2	–2.6	5.3

Table AII.5.2 (continued)

Year	A2	B1	IS92a	CLE	MFR
1850					
1980					
2000	34.0	34.0	34.0	32.6	32.6
2010	1.7	0.8	1.5		
2020	4.2	1.6	3.1		
2030	6.8	1.9	4.7	1.5 ± 0.8	–1.4 ± 0.4
2040	8.6	1.8	6.1		
2050	10.2	1.0	7.6		
2060	11.7	0.0	8.9		
2070	13.2	–0.9	10.0		
2080	15.3	–1.9	11.1		
2090	18.0	–2.8	12.1		
2100	20.8	–3.9	13.2		

Notes:
RCP results from CMIP5 (Eyring et al., 2013) and ACCMIP (Young et al., 2013). For ACCMIP all models have interactive tropospheric ozone chemistry and are included, in contrast to the CMIP5 multi-model mean which includes only those models with predictive (interactive or semi-offline) stratospheric and tropospheric ozone chemistry. The absolute value is shown for year 2000. All other years are differences relative to (minus) year 2000. The multi-model standard deviation is shown only for year 2000; it does not change much over time; and, representing primarily the spread in absolute O_3 columns, it is larger than the standard deviation of the changes across individual models (not evaluated here). SRES values are from TAR Appendix II. CLE/MFR scenarios are from Dentener et al. (2005; 2006): CLE includes climate change, MFR does not. See Section 11.3.5.1.2.

Table AII.5.3: Total aerosol optical depth (AOD)

Year	(Min)	Historical	(Max)	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1860[d]	0.056	0.101	0.161	0.094	0.101	0.092	0.100
1870[d]	0.058	0.102	0.162	0.095	0.102	0.094	0.101
1180[d]	0.058	0.102	0.163	0.095	0.102	0.094	0.101
1890[d]	0.059	0.104	0.164	0.098	0.104	0.096	0.103
1900[d]	0.058	0.105	0.166	0.099	0.105	0.097	0.104
1910[d]	0.059	0.107	0.169	0.101	0.107	0.099	0.106
1920[d]	0.060	0.108	0.170	0.102	0.108	0.100	0.107
1930[d]	0.061	0.110	0.173	0.104	0.110	0.101	0.109
1940[d]	0.061	0.111	0.175	0.105	0.111	0.103	0.110
1950[d]	0.060	0.115	0.181	0.108	0.115	0.106	0.113
1960[d]	0.064	0.122	0.192	0.116	0.122	0.113	0.120
1970[d]	0.065	0.130	0.204	0.123	0.130	0.120	0.128
1980[d]	0.066	0.135	0.221	0.127	0.135	0.124	0.133
1990[d]	0.068	0.138	0.231	0.129	0.138	0.126	0.135
2000[d]	0.068	0.136	0.232	0.127	0.136	0.124	0.134
2010[d]				0.127	0.137	0.124	0.133
2020[d]				0.123	0.134	0.122	0.132
2030[d]				0.117	0.130	0.119	0.130
2040[d]				0.111	0.126	0.118	0.126
2050[d]				0.108	0.123	0.117	0.124
2060[d]				0.106	0.119	0.116	0.121
2070[d]				0.105	0.116	0.110	0.120

2080[d]			0.103	0.114	0.107	0.118
2090[d]			0.102	0.112	0.106	0.118
2100[d]			0.101	0.111	0.105	0.117
Number of models	21		15	21	13	19

Notes:
Multi-model decadal global means (2030[d] = 2025–2034, 2100[d] = 2095–2100) from CMIP5 models reporting AOD. The number of models for each experiment indicated in the bottom row. The full range of models (given only for historical period for AOD and AAOD) is large and systematic in that models tend to scale relative to one another. Historical estimates for different RCPs vary because of the models included. RCP4.5 included the full set of CMIP5 models contributing aerosol results (21). The standard deviation of the models is 28% (AOD) and 62% (AAOD) (N. Mahowald, CMIP5 archive; Lamarque et al., 2013; Shindell et al., 2013). See Sections 11.3.5.1.3 and 11.3.6.1.

Table AII.5.4: Absorbing aerosol optical depth (AAOD)

Year	(Min)	Historical	(Max)	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1860[d]	0.00050	0.0035	0.0054	0.0033	0.0035	0.0031	0.0035
1870[d]	0.00060	0.0035	0.0054	0.0033	0.0035	0.0032	0.0036
1180[d]	0.00060	0.0036	0.0054	0.0034	0.0036	0.0032	0.0036
1890[d]	0.00060	0.0036	0.0055	0.0035	0.0036	0.0033	0.0037
1900[d]	0.00070	0.0037	0.0056	0.0035	0.0037	0.0033	0.0038
1910[d]	0.00070	0.0038	0.0057	0.0036	0.0038	0.0034	0.0038
1920[d]	0.00070	0.0038	0.0058	0.0036	0.0038	0.0034	0.0039
1930[d]	0.00070	0.0038	0.0057	0.0036	0.0038	0.0034	0.0038
1940[d]	0.00070	0.0038	0.0057	0.0036	0.0038	0.0034	0.0039
1950[d]	0.00070	0.0038	0.0058	0.0036	0.0038	0.0034	0.0039
1960[d]	0.00080	0.0040	0.0059	0.0038	0.0040	0.0036	0.0040
1970[d]	0.00090	0.0042	0.0065	0.0040	0.0042	0.0038	0.0043
1980[d]	0.00100	0.0046	0.0073	0.0044	0.0046	0.0042	0.0046
1990[d]	0.00110	0.0049	0.0079	0.0047	0.0049	0.0044	0.0049
2000[d]	0.00120	0.0050	0.0084	0.0048	0.0050	0.0045	0.0051
2010[d]				0.0050	0.0051	0.0046	0.0051
2020[d]				0.0050	0.0050	0.0045	0.0050
2030[d]				0.0047	0.0049	0.0045	0.0049
2040[d]				0.0043	0.0048	0.0044	0.0047
2050[d]				0.0041	0.0046	0.0044	0.0046
2060[d]				0.0039	0.0044	0.0043	0.0045
2070[d]				0.0037	0.0042	0.0041	0.0044
2080[d]				0.0037	0.0040	0.0039	0.0043
2090[d]				0.0036	0.0039	0.0038	0.0043
2100[d]				0.0036	0.0039	0.0038	0.0042
Number of models		14		11	14	10	12

Notes:
See notes AII.5.3.

Table AII.5.5: Sulphate aerosol atmospheric burden (TgS)

Year	(Min)	Historical	(Max)	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1860[d]	0.09	0.61	1.42	0.60	0.61	0.57	0.60
1870[d]	0.10	0.62	1.45	0.62	0.62	0.59	0.61
1180[d]	0.12	0.65	1.49	0.64	0.65	0.61	0.64
1890[d]	0.16	0.68	1.57	0.67	0.68	0.64	0.66
1900[d]	0.21	0.73	1.65	0.73	0.73	0.70	0.72
1910[d]	0.23	0.79	1.80	0.79	0.79	0.76	0.78

1920[d]	0.23	0.83	1.84	0.83	0.83	0.80	0.81
1930[d]	0.24	0.87	1.94	0.88	0.87	0.85	0.86
1940[d]	0.25	0.93	2.05	0.95	0.93	0.91	0.92
1950[d]	0.27	1.03	2.21	1.05	1.03	1.01	1.01
1960[d]	0.31	1.25	2.67	1.29	1.25	1.24	1.23
1970[d]	0.35	1.48	3.14	1.52	1.48	1.45	1.47
1980[d]	0.37	1.58	3.33	1.62	1.58	1.54	1.58
1990[d]	0.37	1.59	3.31	1.63	1.59	1.55	1.60
2000[d]	0.37	1.55	3.17	1.59	1.55	1.53	1.56
2010[d]				1.57	1.59	1.52	1.54
2020[d]				1.43	1.54	1.43	1.51
2030[d]				1.21	1.44	1.33	1.44
2040[d]				1.03	1.31	1.34	1.31
2050[d]				0.94	1.16	1.29	1.20
2060[d]				0.90	1.05	1.24	1.13
2070[d]				0.86	0.96	1.06	1.08
2080[d]				0.81	0.88	0.92	1.05
2090[d]				0.76	0.85	0.86	0.98
2100[d]				0.71	0.83	0.80	0.94
Number of models		18		12	18	10	16

Notes:
See notes AII.5.3. The standard deviation of the models is about 50% for sulphate, OC, and BC aerosol loadings (N. Mahowald, CMIP5 archive; Lamarque et al., 2013; Shindell et al., 2013).

Table AII.5.6: OC aerosol atmospheric burden (Tg)

Year	(Min)	Historical	(Max)	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1860[d]	0.34	1.08	2.7	1.09	1.08	1.13	1.12
1870[d]	0.35	1.09	2.7	1.10	1.09	1.14	1.13
1180[d]	0.36	1.09	2.7	1.11	1.09	1.15	1.14
1890[d]	0.35	1.10	2.8	1.12	1.10	1.16	1.15
1900[d]	0.36	1.11	2.8	1.12	1.11	1.16	1.15
1910[d]	0.33	1.10	2.8	1.11	1.10	1.15	1.15
1920[d]	0.34	1.08	2.7	1.09	1.08	1.12	1.13
1930[d]	0.33	1.07	2.6	1.07	1.07	1.11	1.12
1940[d]	0.33	1.07	2.6	1.07	1.07	1.11	1.12
1950[d]	0.36	1.08	2.6	1.08	1.08	1.11	1.12
1960[d]	0.41	1.13	2.7	1.13	1.13	1.17	1.17
1970[d]	0.46	1.20	2.9	1.22	1.20	1.26	1.24
1980[d]	0.54	1.28	3.1	1.32	1.28	1.36	1.33
1990[d]	0.53	1.38	3.3	1.44	1.38	1.48	1.43
2000[d]	0.53	1.41	3.5	1.47	1.41	1.52	1.46
2010[d]				1.59	1.21	1.55	1.29
2020[d]				1.59	1.12	1.56	1.26
2030[d]				1.56	1.08	1.55	1.25
2040[d]				1.47	1.06	1.57	1.22
2050[d]				1.41	1.04	1.57	1.20
2060[d]				1.40	1.01	1.56	1.17
2070[d]				1.36	0.96	1.55	1.14
2080[d]				1.33	0.92	1.55	1.13
2090[d]				1.32	0.90	1.54	1.10

2100[d]			1.30	0.89	1.55	1.09
Number of models	19		12	19	10	17

Notes:
See notes AII.5.5.

Table AII.5.7: BC aerosol atmospheric burden (Tg)

Year	(Min)	Historical	(Max)	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1860[d]	0.037	0.059	0.127	0.058	0.059	0.057	0.059
1870[d]	0.039	0.063	0.133	0.062	0.063	0.061	0.064
1180[d]	0.040	0.068	0.139	0.066	0.068	0.065	0.069
1890[d]	0.043	0.075	0.149	0.070	0.075	0.070	0.076
1900[d]	0.045	0.082	0.156	0.076	0.082	0.075	0.083
1910[d]	0.048	0.089	0.167	0.081	0.089	0.081	0.091
1920[d]	0.049	0.092	0.167	0.083	0.092	0.082	0.095
1930[d]	0.049	0.090	0.161	0.082	0.090	0.081	0.092
1940[d]	0.051	0.091	0.162	0.082	0.091	0.082	0.093
1950[d]	0.053	0.094	0.165	0.085	0.094	0.085	0.096
1960[d]	0.061	0.102	0.179	0.094	0.102	0.094	0.105
1970[d]	0.071	0.115	0.201	0.107	0.115	0.107	0.117
1980[d]	0.088	0.141	0.245	0.130	0.141	0.130	0.144
1990[d]	0.098	0.157	0.274	0.146	0.157	0.145	0.161
2000[d]	0.101	0.164	0.293	0.153	0.164	0.152	0.169
2010[d]				0.170	0.174	0.157	0.170
2020[d]				0.169	0.174	0.152	0.164
2030[d]				0.144	0.166	0.147	0.153
2040[d]				0.120	0.155	0.144	0.138
2050[d]				0.103	0.141	0.138	0.127
2060[d]				0.091	0.126	0.127	0.118
2070[d]				0.081	0.110	0.113	0.110
2080[d]				0.075	0.094	0.101	0.106
2090[d]				0.071	0.087	0.092	0.102
2100[d]				0.068	0.084	0.087	0.099
Number of models		19		13	19	11	17

Notes:
See notes AII.5.5.

Table AII.5.8: CH_4 atmospheric lifetime (yr) against loss by tropospheric OH

Year	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]	RCP2.6^	RCP4.5^	RCP6.0^	RCP8.5^
2000	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3
2010	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3				
2020	11.0 ± 1.3	11.2 ± 1.3	11.2 ± 1.3	11.2 ± 1.3				
2030	10.8 ± 1.3	11.3 ± 1.4	11.3 ± 1.4	11.4 ± 1.4	10.6 ± 1.4	11.4 ± 2.1	11.1 ± 1.4	11.2 ± 1.4
2040	10.6 ± 1.3	11.3 ± 1.4	11.4 ± 1.4	11.8 ± 1.4				
2050	10.2 ± 1.3	11.3 ± 1.4	11.5 ± 1.4	12.2 ± 1.5				
2060	9.9 ± 1.3	11.2 ± 1.4	11.6 ± 1.4	12.6 ± 1.6				
2070	9.9 ± 1.4	11.2 ± 1.5	11.8 ± 1.5	12.6 ± 1.7				
2080	10.4 ± 1.5	11.1 ± 1.5	11.9 ± 1.6	12.6 ± 1.8				
2090	10.4 ± 1.6	10.9 ± 1.6	11.7 ± 1.7	12.6 ± 1.8				
2100	10.6 ± 1.6	10.7 ± 1.6	11.4 ± 1.8	12.5 ± 1.9	10.7 ± 1.6	10.1 ± 1.5	11.1 ± 1.8	12.1 ± 2.0

Notes:

RCPn.n& lifetimes based on best estimate with uncertainty for 2000–2010 (Prather et al., 2012) and then projecting changes in key factors (Holmes et al., 2013). All uncertainties are 68% confidence intervals. RCPn.n^ lifetimes are from ACCMIP results (Voulgarakis et al., 2013) scaled to 11.2 ± 1.3 yr for year 2000; the ACCMIP mean and standard deviation in 2000 are 9.8 ± 1.5 yr. Projected ACCMIP values combine the present day uncertainty with the model standard deviation of future change. Note that the total atmospheric lifetime of CH_4 must include other losses (e.g., stratosphere, surface, tropospheric chlorine), and for 2010 it is 9.1 ± 0.9 yr, see Chapter 8, Section 11.3.5.1.1.

Table AII.5.9: N_2O atmospheric lifetime (yr)

Year	RCP2.6&	RCP4.5&	RCP6.0&	RCP8.5&
2010	131 ± 10	131 ± 10	131 ± 10	131 ± 10
2020	130 ± 10	131 ± 10	131 ± 10	131 ± 10
2030	130 ± 10	130 ± 10	130 ± 10	130 ± 10
2040	130 ± 10	130 ± 10	130 ± 10	129 ± 10
2050	129 ± 10	129 ± 10	129 ± 10	129 ± 10
2060	129 ± 10	129 ± 10	129 ± 10	128 ± 10
2070	129 ± 11	128 ± 11	128 ± 10	128 ± 11
2080	128 ± 11	128 ± 11	128 ± 11	127 ± 11
2090	128 ± 11	128 ± 11	127 ± 11	127 ± 11
2100	128 ± 11	127 ± 11	127 ± 11	126 ± 11

Notes:
RCPn.n& lifetimes based on projections from Fleming et al. (2011) and Prather et al. (2012). All uncertainties are 68% confidence intervals.

AII.6: Effective Radiative Forcing

Table AII.6.1: ERF from CO_2 (W m^{-2})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000	1.51	1.51	1.51	1.51	1.50	1.50	1.50
2010	1.80	1.80	1.80	1.80	1.78	1.77	1.78
2020	2.11	2.09	2.07	2.15	2.16	2.09	2.13
2030	2.34	2.40	2.32	2.56	2.55	2.38	2.48
2040	2.46	2.70	2.58	3.03	2.99	2.69	2.83
2050	2.49	2.99	2.90	3.56	3.42	2.98	3.18
2060	2.48	3.23	3.25	4.15	3.88	3.20	3.53
2070	2.43	3.39	3.65	4.76	4.36	3.37	3.89
2080	2.35	3.46	4.06	5.37	4.86	3.49	4.25
2090	2.28	3.49	4.42	5.95	5.39	3.57	4.64
2100	2.22	3.54	4.70	6.49	5.95	3.59	5.04

Notes:
RCPn.n ERF based on RCP published projections (AII.4.1–3) and TAR formula for RF. See Chapter 8, Figure 8.18, Section 11.3.5, 11.3.6.1, Figure 12.3. SRES A2 and B1 and IS92a calculated from abundances in AII.4.1–3.

Table AII.6.2: ERF from CH_4 (W m^{-2})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000	0.47	0.47	0.47	0.47	0.48	0.48	0.48
2010	0.48	0.48	0.48	0.48	0.51	0.50	0.51
2020	0.47	0.49	0.49	0.54	0.56	0.53	0.56
2030	0.42	0.50	0.49	0.61	0.62	0.54	0.61
2040	0.39	0.51	0.51	0.70	0.68	0.54	0.67
2050	0.36	0.50	0.53	0.80	0.75	0.52	0.73
2060	0.32	0.49	0.54	0.90	0.81	0.51	0.78

2070	0.30	0.47	0.55	0.97	0.88	0.49	0.82
2080	0.29	0.44	0.54	1.01	0.95	0.47	0.85
2090	0.28	0.42	0.50	1.05	1.01	0.44	0.88
2100	0.27	0.41	0.44	1.08	1.07	0.41	0.92

Notes:
See notes AII.6.1.

Table AII.6.3: ERF from N_2O (W m^{-2})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	IS92a
2000	0.15	0.15	0.15	0.15	0.15	0.15	0.15
2010	0.17	0.17	0.17	0.17	0.17	0.17	0.17
2020	0.19	0.19	0.19	0.19	0.20	0.20	0.20
2030	0.20	0.21	0.21	0.23	0.24	0.22	0.23
2040	0.22	0.23	0.24	0.26	0.28	0.25	0.26
2050	0.23	0.25	0.26	0.30	0.32	0.27	0.29
2060	0.23	0.27	0.29	0.34	0.36	0.29	0.32
2070	0.23	0.28	0.33	0.38	0.40	0.30	0.34
2080	0.23	0.30	0.36	0.42	0.44	0.31	0.37
2090	0.23	0.31	0.39	0.46	0.49	0.32	0.39
2100	0.23	0.32	0.41	0.49	0.53	0.32	0.41

Notes:
See notes AII.6.1.

Table AII.6.4: ERF from all HFCs (W m^{-2})

Year	Historical	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2011*	0.019				
2010		0.019	0.019	0.019	0.020
2020		0.038	0.034	0.030	0.044
2030		0.056	0.046	0.036	0.069
2040		0.071	0.055	0.040	0.091
2050		0.083	0.061	0.042	0.110
2060		0.092	0.064	0.044	0.128
2070		0.104	0.066	0.046	0.144
2080		0.116	0.069	0.047	0.159
2090		0.124	0.074	0.047	0.171
2100		0.126	0.080	0.046	0.182

Notes:
See Table 8.3, 8.A.1, Section 11.3.5.1.1. ERF is calculated from RCP published abundances (Meinshausen et al., 2011a; http://www.iiasa.ac.at/web-apps/tnt/RcpDb) and AR5 radiative efficiencies (Chapter 8).

Table AII.6.5: ERF from all PFCs and SF_6 (W m^{-2})

Year	Historical	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2011*	0.009				
2010		0.009	0.009	0.010	0.009
2020		0.012	0.011	0.013	0.012
2030		0.014	0.013	0.017	0.015
2040		0.015	0.014	0.021	0.019
2050		0.015	0.016	0.025	0.022
2060		0.016	0.017	0.029	0.026

2070	0.016	0.019	0.033	0.031
2080	0.016	0.021	0.038	0.035
2090	0.016	0.023	0.042	0.039
2100	0.016	0.026	0.045	0.044

Notes:
See notes AII.6.4.

Table AII.6.6: ERF from Montreal Protocol greenhouse gases (W m^{-2})

Year	Historical	WMO A1
2011*	0.328	
2020		0.33 ± 0.01
2030		0.29 ± 0.01
2040		0.24 ± 0.01
2050		0.20 ± 0.01
2060		0.17 ± 0.02
2070		0.15 ± 0.02
2080		0.13 ± 0.02
2090		0.11 ± 0.02
2100		0.10 ± 0.02

Notes:
See Table 8.3, 8.A.1. ERF is calculated from AR5 radiative efficiency and projected abundances in Scenario A1 of WMO/UNEP assessment (WMO 2010). The 68% confidence interval shown is approximated by combining uncertainty in the radiative efficiency of each gas (±6.1%) and the decay of each gas since 2010 from Table AII.4.16 (±15%). All sources of uncertainty are assumed to be independent (see Chapters 2, 8).

Table AII.6.7a: ERF from stratospheric O_3 changes since 1850 (W m^{-2})

Year	AR5	CCMVal-2
1960		0.0
1980		–0.033
2000		–0.079
2011*	–0.05	
2050		–0.055
2100		–0.075

Notes:
AR5 results are from Chapter 8, see also Sections 11.3.5.1.2, 11.3.6.1. CCMVal-2 results (Cionni et a. 2011) are the multi-model average (13 chemistry-climate models) running a single scenario for stratospheric change: REF-B2 scenario of CCMVal-2 with SRES A1B climate scenario.

Table AII.6.7b: ERF from tropospheric O_3 changes since 1850 (W m^{-2})

Year	AR5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
1980		0.31 ± 0.05	0.31 ± 0.05	0.31 ± 0.05	0.31 ± 0.05
2000		0.36	0.36	0.36	0.36
2011*	0.40				
2030		0.32	0.38	0.36	0.44
2100		0.17	0.27	0.27	0.60 ± 0.11

Notes:
AR5 results from Chapter 8, see also Sections 11.3.5.1.2, 11.3.6.1. Model mean results from ACCMIP (Stevenson et al., 2013) using a consistent model set (FGKN), which is similar to the all-model mean. Standard deviation across models shown for 1980s decade is similar for all scenarios except for RCP8.5 at 2100, which is twice as large.

Table AII.6.8: Total anthropogenic ERF from published RCPs and SRES (W m^{-2})

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	A1B	B1	IS92a	AR5 Historical
1850	0.12	0.12	0.12	0.12					0.06
1990	1.23	1.23	1.23	1.23	1.03	1.03	1.03	1.03	1.60
2000	1.45	1.45	1.45	1.45	1.33	1.33	1.33	1.31	1.87
2010	1.81	1.81	1.78	1.84	1.74	1.65	1.73	1.63	2.25
2020	2.25	2.25	2.15	2.32	2.04	2.16	2.15	2.00	
2030	2.52	2.67	2.52	2.91	2.56	2.84	2.56	2.40	
2040	2.65	3.07	2.82	3.61	3.22	3.61	2.93	2.82	
2050	2.64	3.42	3.20	4.37	3.89	4.16	3.30	3.25	
2060	2.55	3.67	3.58	5.13	4.71	4.79	3.65	3.76	
2070	2.47	3.84	4.11	5.89	5.56	5.28	3.92	4.24	
2080	2.41	3.90	4.60	6.60	6.40	5.62	4.09	4.74	
2090	2.35	3.91	4.93	7.32	7.22	5.86	4.18	5.26	
2100	2.30	3.94	5.15	7.97	8.07	6.05	4.19	5.79	

Notes:
Derived from RCP published CO_2-eq concentrations that aggregate all anthropogenic forcings including greenhouse gases plus aerosols. These results may not be directly comparable to ERF values used in AR5 because of how aerosol indirect effects are included, but results are similar to those derived using ERF in Chapter 12 (see Figure 12.4). Comparisons with the TAR Appendix II (SRES A2 and B1) may not be equivalent because those total RF values (TAR II.3.11) were made using the TAR Chapter 9 Simple Model, not always consistent with the individual components in that appendix (TAR II.3.1–9). See Chapter 1, Sections 11.3.6.1, 12.3.1.3–4, Figures 12.3–4. For AR5 Historical, see AII.1.2 and Chapter 8.

Table AII.6.9: ERF components relative to 1850 (W m^{-2}) derived from ACCMIP

Year		WMGHG	Ozone	Aerosol	ERF Net
1930		0.58 ± 0.04	0.09 ± 0.03	–0.24 ± 0.06	0.44 ± 0.07
1980		1.56 ± 0.10	0.30 ± 0.10	–0.90 ± 0.22	1.00 ± 0.26
2000		2.30 ± 0.14	0.33 ± 0.11	–1.17 ± 0.28	1.51 ± 0.33
2030	RCP8.5	3.64 ± 0.22	0.43 ± 0.12	–0.91 ± 0.22	3.20 ± 0.33
2100	RCP2.6	2.83 ± 0.17	0.14 ± 0.07	–0.12 ± 0.06*	2.86 ± 0.19
2100	RCP4.5	4.33 ± 0.26	0.23 ± 0.09	–0.12 ± 0.06*	4.44 ± 0.28
2100	RCP6.0	5.60 ± 0.34	0.25 ± 0.05	–0.12 ± 0.06*	5.74 ± 0.35
2100	RCP8.5	8.27 ± 0.50	0.55 ± 0.18	–0.12 ± 0.03	8.71 ± 0.53

Notes:
Radiative forcing and adjusted forcing from the ACCMIP results (Shindell et al., 2013) are given for all well mixed greenhouse gases (WMGHG), ozone, aerosols, and the net. Original 90% confidence intervals have been reduced to 68% confidence to compare with the CMIP5 model standard deviations in AII.6.10. Some uncertainty ranges (*) are estimated from the 2100 RCP8.5 results (see Chapter 12). See Sections 11.3.5.1.3, 11.3.6.1, Figure 12.4.

Table AII.6.10: Total anthropogenic plus natural ERF (W m^{-2}) from CMIP5 and CMIP3, including historical

Year	SRES A1B	RCP2.6[&]	RCP4.5[&]	RCP6.0[&]	RCP8.5[&]
1850s[H]	–0.19 ± 0.19		–0.12 ± 0.07		
1986–2005[H]	1.51 ± 0.44		1.34 ± 0.50		
1986–2005	1.51 ± 0.44	1.31 ± 0.47	1.30 ± 0.48	1.29 ± 0.51	1.30 ± 0.47
2010[d]	2.18 ± 0.53	1.97 ± 0.50	1.91 ± 0.53	1.90 ± 0.54	1.96 ± 0.53
2020[d]	2.58 ± 0.57	2.33 ± 0.47	2.27 ± 0.51	2.16 ± 0.55	2.43 ± 0.52
2030[d]	3.15 ± 0.60	2.50 ± 0.51	2.61 ± 0.54	2.41 ± 0.60	2.92 ± 0.57
2040[d]	3.77 ± 0.72	2.64 ± 0.47	2.98 ± 0.55	2.72 ± 0.58	3.52 ± 0.60
2050[d]	4.32 ± 0.73	2.65 ± 0.47	3.25 ± 0.56	3.07 ± 0.61	4.21 ± 0.63
2060[d]	4.86 ± 0.74	2.57 ± 0.50	3.50 ± 0.59	3.40 ± 0.60	4.97 ± 0.68
2070[d]	5.32 ± 0.79	2.51 ± 0.50	3.65 ± 0.58	3.90 ± 0.65	5.70 ± 0.76

2080[d]	5.71 ± 0.81	2.40 ± 0.46	3.71 ± 0.55	4.27 ± 0.69	6.31 ± 0.81
2090[d]	6.00 ± 0.83	2.44 ± 0.49	3.78 ± 0.58	4.64 ± 0.71	7.13 ± 0.89
2081–2100	5.99 ± 0.78	2.40 ± 0.46	3.73 ± 0.56	4.56 ± 0.70	7.02 ± 0.92

Notes:
CMIP5 historical and RCP results (Forster et al., 2013) are shown with CMIP3 SRES A1B results (Forster and Taylor, 2006). The alternative results for 1986–2005 with CMIP5 are derived from: all models contributing historical experiments (1986–2005[H]), and the subsets of models contributing to each RCP experiment (next line, 1986–2005). For SRES A1B the same set of models is used from 1850 to 2100. Values are ten-year averages (2090[d] = 2086–2095) and show multi-model means and standard deviations. See Chapter 12, Section 12.3 and discussion of Figure 12.4, also Figure 1.15, Sections 8.1, 9.3.2.2, 11.3.6.1, 11.3.6.3. Due to lack of reporting, for RCP8.5 the 2081–2100 result contains one fewer model than the 2090[d] decade, and for A1B the 1850s result has just 5 models and the 2081–2100 result has 3 fewer models than the 2090[d] decade.

AII.7: Environmental Data

Table AII.7.1: Global mean surface O_3 change (ppb)

	HTAP				SRES			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1	CLE	MFR
2000	27.2 ± 2.9	27.2 ± 2.9	27.2 ± 2.9	27.2 ± 2.9	27.2 ± 2.9	27.2 ± 2.9	28.7	28.7
2010	0.1	0.1	0.0	0.1	1.2	0.6		
2020	–0.3	–0.2	–0.2	0.6	2.8	1.1		
2030	–1.1	–0.1	–0.3	1.0	4.4	1.3	0.7 ± 1.4	–2.3 ± 1.1
2040	–1.5	–0.3	–0.3	1.2	5.3	1.3		
2050	–1.9	–0.8	–0.4	1.5	6.2	0.8		
2060	–2.4	–1.3	–0.5	1.8	7.1	0.2		
2070	–3.0	–1.9	–1.0	1.9	8.0	–0.5		
2080	–3.5	–2.5	–1.5	1.9	9.2	–1.1		
2090	–3.8	–2.8	–2.1	1.9	10.6	–1.7		
2100	–4.2	–3.0	–2.8	1.9	11.9	–2.5		

Table AII.7.1 (continued)

	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	30.0 ± 4.2	30.0 ± 4.2	30.0 ± 4.2	30.0 ± 4.2	28.1 ± 3.1	28.1 ± 3.2	28.1± 3.1	28.1 ± 3.1
2010	–0.4	–0.2	–0.6	–0.1				
2020	–0.9	–0.3	–0.9	0.7				
2030	–1.8	–0.2	–1.1	1.5	–1.4	0.3	–0.6	1.7
2040	–2.3	–0.3	–1.2	2.0				
2050	–2.9	–0.9	–1.5	2.5				
2060	–4.0	–1.7	–1.9	2.9				
2070	–5.4	–2.8	–2.8	3.1				
2080	–6.4	–3.7	–3.9	3.0				
2090	–6.9	–4.1	–4.8	2.8				
2100	–7.2	–4.3	–5.6	2.7	–6.3	–3.5	–4.9	3.4

Notes:
HTAP results are from Wild et al. (2012) and use the published O_3 sensitivities to regional emissions from the HTAP multi-model study (HTAP 2010) and scale those O_3 changes to the RCP emission scenarios. The ±1 standard deviation (68% confidence interval) over the range of 14 parametric models is shown for year 2000 and is similar for all years. Results from the SRES A2 and B1 scenarios are from the TAR OxComp studies diagnosed by Wild (Prather et al., 2001; 2003). CLE and MFR results (Dentener et al., 2005; 2006) include uncertainty (standard deviation of model results) in the change since year 2000, and CLE alone includes climate effects. The CMIP5 and ACCMIP results are from V. Naik and A. Fiore based on Fiore et al. (2012) and include the standard deviation over the models in year 2000, which is similar for following years. This does not necessarily reflect the uncertainty in the projected change, which may be smaller, see Fiore et al. (2012). The difference in year 2000 between CMIP5 (4 models) and ACCMIP (12

models) reflect different model biases. Even though ACCMIP only has three decades (2000, 2030, 2100), the greater number of models (5 to 11 depending on time slice and scenario) makes this a more robust estimate. See Chapter 11, ES, Section 11.3.5.2.2.

Table AII.7.2: Surface O_3 change (ppb) for HTAP regions

			N. America			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000	36.1 ± 3.2	36.1 ± 3.2	36.1 ± 3.2	36.1 ± 3.2	36.1 ± 3.2	36.1 ± 3.2
2010	–0.8	–1.1	–0.1	–1.5	1.5	0.4
2020	–1.9	–2.3	–0.9	–1.4	3.6	0.5
2030	–3.7	–2.7	–1.5	–1.1	5.3	–0.1
2040	–4.6	–3.2	–1.9	–1.1	6.2	–0.8
2050	–5.6	–3.9	–2.4	–0.9	6.9	–1.9
2060	–6.5	–4.6	–3.0	–0.7	7.9	–2.9
2070	–7.5	–5.3	–4.0	–0.7	8.8	–3.8
2080	–8.2	–6.1	–4.9	–0.7	10.3	–4.5
2090	–8.5	–6.4	–5.7	–0.8	12.2	–5.2
2100	–8.9	–6.6	–6.7	–0.9	13.9	–6.1

Table AII.7.2 (continued)

			Europe			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000	37.8 ± 3.7	37.8 ± 3.7	37.8 ± 3.7	37.8 ± 3.7	37.8 ± 3.7	37.8 ± 3.7
2010	–0.5	–0.3	–0.1	–0.7	1.5	0.3
2020	–1.4	–1.3	–0.7	–0.2	3.7	0.6
2030	–3.0	–1.4	–1.1	0.1	5.7	0.2
2040	–3.8	–1.9	–1.5	0.1	6.7	–0.3
2050	–4.6	–2.7	–2.0	0.3	7.7	–1.2
2060	–5.6	–3.5	–2.6	0.4	8.8	–2.1
2070	–6.6	–4.3	–3.3	0.4	9.8	–3.0
2080	–7.5	–5.1	–4.2	0.2	11.3	–3.8
2090	–8.0	–5.6	–5.2	–0.1	13.4	–4.6
2100	–8.5	–6.0	–6.4	–0.2	15.1	–5.6

Table AII.7.2 (continued)

			S. Asia			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000	39.6 ± 3.4	39.6 ± 3.4	39.6 ± 3.4	39.6 ± 3.4	39.6 ± 3.4	39.6 ± 3.4
2010	1.5	1.4	0.3	1.4	2.7	1.8
2020	1.6	2.2	0.0	3.9	6.1	3.3
2030	0.5	3.4	–0.6	5.0	8.9	3.9
2040	0.3	3.5	–0.1	5.5	10.4	4.1
2050	0.2	2.9	0.0	5.2	11.7	2.9
2060	–0.1	1.1	0.4	5.1	12.7	1.5
2070	–1.0	–1.2	–0.2	4.9	13.6	–0.1
2080	–2.6	–3.9	–1.7	4.9	14.5	–1.5
2090	–4.4	–5.0	–3.0	4.1	15.1	–3.0
2100	–6.8	–6.0	–4.7	4.0	15.0	–4.6

Table AII.7.2 (continued)

			E. Asia			

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	A2	B1
2000	35.6 ± 2.7	35.6 ± 2.7	35.6 ± 2.7	35.6 ± 2.7	35.6 ± 2.7	35.6 ± 2.7
2010	1.0	0.6	0.5	1.3	2.0	1.1
2020	0.5	0.6	0.4	2.5	4.6	1.9
2030	–1.4	0.2	0.6	2.8	6.8	2.1
2040	–2.7	–0.8	1.4	1.8	8.0	2.0
2050	–3.8	–2.5	1.4	1.4	9.1	0.9
2060	–4.8	–3.6	0.9	1.4	10.2	–0.3
2070	–6.0	–4.6	–0.7	1.2	11.2	–1.4
2080	–6.9	–5.5	–2.2	1.0	12.5	–2.4
2090	–7.4	–5.8	–3.5	0.7	13.9	–3.4
2100	–8.0	–6.0	–4.9	0.5	14.9	–4.6

Notes:
HTAP results from Wild et al. (2012), see Table AII.7.1.

Table AII.7.3: Surface O_3 change (ppb) from CMIP5/ACCMIP for continental regions

	Africa							
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	33.8 ± 4.3	33.8 ± 4.3	33.8 ± 4.3	33.8 ± 4.3	33.1 ± 4.1	33.1 ± 4.1	33.1 ± 4.1	33.1 ± 4.1
2010	–0.7	–0.1	–1.2	–0.2				
2020	–1.0	0.2	–1.5	0.9				
2030	–1.9	0.5	–1.8	1.7	–1.4	0.9	–1.3	2.4
2040	–2.0	0.6	–1.8	2.6				
2050	–2.3	0.2	–2.0	3.2				
2060	–2.6	–0.3	–2.2	3.7				
2070	–3.2	–1.2	–2.8	4.0				
2080	–3.6	–2.3	–3.7	4.1				
2090	–4.1	–3.0	–4.5	4.1				
2100	–4.8	–3.3	–5.2	4.1	–4.9	–2.9	–4.9	5.0

Table AII.7.3 (continued)

	Australia							
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	23.3 ± 4.6	23.3 ± 4.6	23.3 ± 4.6	23.3 ± 4.6	23.7 ± 3.5	23.7 ± 3.5	23.7 ± 3.5	23.7 ± 3.5
2010	–1.3	–1.1	–0.8	–0.9				
2020	–1.7	–1.4	–1.0	–0.6				
2030	–2.3	–1.3	–1.4	0.0	–1.8	–0.4	–1.4	0.9
2040	–2.6	–1.2	–1.7	0.5				
2050	–3.0	–1.5	–1.9	0.9				
2060	–3.7	–1.9	–2.0	1.5				
2070	–4.4	–2.4	–2.5	1.8				
2080	–5.0	–2.9	–3.1	1.9				
2090	–5.0	–3.1	–3.5	1.9				
2100	–5.2	–3.2	–4.0	2.0	–4.3	–2.5	–4.0	3.1

Table AII.7.3 (continued)

	Central Eurasia							
	CMIP5				ACCMIP			

Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	38.7 ± 5.3	38.7 ± 5.3	38.7 ± 5.3	38.7 ± 5.3	32.5 ± 6.2	32.5 ± 6.2	32.5 ± 6.2	32.5 ± 6.2
2010	–0.6	–0.6	–0.6	–0.5				
2020	–1.6	–1.2	–1.2	0.5				
2030	–3.2	–1.3	–1.4	1.4	–1.9	–0.1	–0.3	1.8
2040	–4.5	–1.9	–1.7	1.6				
2050	–5.7	–2.9	–2.2	1.8				
2060	–7.2	–4.2	–3.0	2.8				
2070	–9.1	–5.4	–4.3	3.0				
2080	–10.6	–6.5	–6.0	2.9				
2090	–11.2	–6.8	–7.2	2.6				
2100	–11.5	–7.0	–8.1	2.6	–8.5	–3.8	–5.6	4.3

Table AII.7.3 (continued)

	EU							
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	40.4 ± 6.0	40.4 ± 6.0	40.4 ± 6.0	40.4 ± 6.0	33.6 ± 5.2	33.6 ± 5.2	33.6 ± 5.2	33.6 ± 5.2
2010	–0.4	–0.5	–0.5	–0.4				
2020	–1.5	–1.3	–1.2	0.3				
2030	–3.2	–1.7	–1.7	1.1	–1.6	0.6	–0.4	2.3
2040	–4.6	–2.4	–2.3	1.4				
2050	–6.1	–3.5	–3.0	1.8				
2060	–8.0	–4.9	–4.1	2.4				
2070	–10.4	–6.3	–5.8	2.6				
2080	–12.2	–7.6	–7.6	2.3				
2090	–13.0	–8.0	–9.2	2.1				
2100	–13.4	–8.1	–10.3	2.0	–9.4	–3.5	–7.2	4.9

Table AII.7.3 (continued)

	East Asia							
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	46.3 ± 4.9	46.3 ± 4.9	46.3 ± 4.9	46.3 ± 4.9	41.0 ± 5.5	41.0 ± 5.5	41.0 ± 5.5	41.0 ± 5.5
2010	0.8	0.6	0.1	1.1				
2020	–0.1	0.8	–0.1	2.7				
2030	–2.3	0.5	0.4	3.8	–1.8	1.0	0.4	3.2
2040	–3.9	–0.9	1.1	3.8				
2050	–5.8	–3.3	1.0	3.7				
2060	–8.0	–5.4	0.2	3.9				
2070	–10.2	–7.3	–1.6	3.6				
2080	–12.1	–8.8	–4.0	3.3				
2090	–13.2	–9.4	–6.3	2.9				
2100	–13.9	–9.6	–8.0	2.8	–11.4	–5.9	–6.6	4.6

Table AII.7.3 (continued)

	Middle East							
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	45.9 ± 3.1	45.9 ± 3.1	45.9 ± 3.1	45.9 ± 3.1	45.7 ± 5.4	45.7 ± 5.4	45.7 ± 5.4	45.7 ± 5.4
2010	–0.4	0.5	–0.7	0.5				

2020	–1.5	0.4	–1.4	2.5				
2030	–3.3	0.6	–1.6	3.8	–2.8	0.9	–1.1	4.1
2040	–3.6	0.2	–2.0	4.4				
2050	–4.6	–0.9	–2.6	4.7				
2060	–6.0	–2.7	–3.5	5.2				
2070	–8.1	–4.9	–4.2	5.1				
2080	–9.9	–7.1	–5.9	5.1				
2090	–11.3	–8.4	–8.2	4.8				
2100	–12.4	–9.0	–9.9	4.6	–11.7	–7.5	–9.8	5.0

Table AII.7.3 (continued)

N. America								
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	40.7 ± 5.1	40.7 ± 5.1	40.7 ± 5.1	40.7 ± 5.1	34.3 ± 5.5	34.3 ± 5.5	34.3 ± 5.5	34.3 ± 5.5
2010	–0.9	–1.2	–0.6	–1.0				
2020	–2.1	–2.4	–1.4	–0.5				
2030	–4.3	–2.8	–1.8	0.1	–2.5	–0.7	–0.8	1.3
2040	–5.7	–3.6	–2.5	0.3				
2050	–7.2	–4.6	–3.1	0.6				
2060	–9.1	–5.8	–4.4	1.0				
2070	–11.4	–7.1	–6.2	1.2				
2080	–13.2	–8.3	–8.1	1.2				
2090	–13.8	–8.5	–9.6	1.0				
2100	–14.1	–8.8	–10.9	0.9	–10.5	–4.7	–8.7	3.4

Table AII.7.3 (continued)

S. America								
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	25.3 ± 4.2	25.3 ± 4.2	25.3 ± 4.2	25.3 ± 4.2	23.7 ± 3.9	23.7 ± 3.9	23.7 ± 3.9	23.7 ± 3.9
2010	–1.4	–0.6	–1.2	–0.3				
2020	–2.1	–1.2	–1.8	0.3				
2030	–2.9	–1.2	–2.1	0.6	–2.3	–0.6	–1.8	1.2
2040	–2.9	–1.3	–2.3	1.1				
2050	–3.2	–1.7	–2.6	1.3				
2060	–3.6	–2.5	–2.9	1.5				
2070	–4.3	–3.6	–3.5	1.5				
2080	–5.1	–4.5	–4.2	1.1				
2090	–5.5	–5.0	–4.7	0.7				
2100	–5.7	–5.2	–5.3	0.4	–5.0	–4.0	–5.2	2.0

Table AII.7.3 (continued)

South Asia								
	CMIP5				ACCMIP			
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000	34.4 ± 3.9	34.4 ± 3.9	34.4 ± 3.9	34.4 ± 3.9	33.7 ± 4.6	33.7 ± 4.6	33.7 ± 4.6	33.7 ± 4.6
2010	1.3	0.9	–0.1	1.3				
2020	1.4	1.6	–0.2	3.1				
2030	0.7	2.7	–0.1	3.9	0.6	2.3	–0.4	4.6
2040	0.6	2.8	0.3	4.0				

2050	0.4	1.6	0.4	3.6				
2060	–0.5	–0.7	0.3	3.2				
2070	–2.0	–3.2	–0.5	2.9				
2080	–3.9	–5.7	–2.0	2.7				
2090	–5.7	–6.7	–3.3	2.2				
2100	–7.1	–7.3	–4.5	1.9	–7.2	–6.1	–4.5	3.6

Notes:
See notes for AII.7.1. For definition of regions, see Figure 11.23 and Fiore et al. (2012).

Table AII.7.4: Surface particulate matter change ($\log_{10}$[$PM_{2.5}$ (microgram/m^3)]) from CMIP5/ACCMIP for continental regions

Africa				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000		1.17 ± 0.23		
2030	0.00	0.04	–0.01	0.01
2050	–0.02		–0.02	0.01
2100	0.00	–0.01	–0.03	–0.02

Table AII.7.4 (continued)

Australia				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2000		0.65 ± 0.32		
2030	–0.04	0.03	–0.01	0.01
2050	–0.06		–0.02	–0.04
2100	0.00	0.00	–0.03	–0.01

Table AII.7.4 (continued)

Central Eurasia				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		0.59 ± 0.17		
2030	–0.07	–0.01	–0.05	–0.06
2050	–0.12		–0.08	–0.09
2100	–0.13	–0.11	–0.11	–0.12

Table AII.7.4 (continued)

Europe				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		0.81 ± 0.09		
2030	–0.20	–0.10	–0.13	–0.24
2050	–0.31		–0.25	–0.33
2100	–0.32	–0.28	–0.37	–0.38

Table AII.7.4 (continued)

East Asia				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		1.04 ± 0.16		
2030	–0.04	–0.02	0.01	0.01
2050	–0.24		0.07	–0.17
2100	–0.31	–0.33	–0.21	–0.30

Table AII.7.4 (continued)

Middle East				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		1.10 ± 0.27		
2030	–0.06	–0.02	–0.05	–0.03
2050	–0.08		–0.06	–0.03
2100	–0.11	–0.11	–0.10	–0.12

Table AII.7.4 (continued)

North America				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		0.51 ± 0.15		
2030	–0.16	–0.10	–0.10	–0.15
2050	–0.20		–0.16	–0.17
2100	–0.20	–0.19	–0.24	–0.21

Table AII.7.4 (continued)

South America				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		0.71 ± 0.11		
2030	–0.05	–0.04	–0.04	–0.03
2050	–0.10		–0.05	–0.07
2100	–0.11	–0.11	–0.09	–0.12

Table AII.7.4 (continued)

South Asia				
Year	RCP2.6	RCP4.5	RCP6.0	RCP8.5
		1.02 ± 0.11		
2030	0.04	0.02	0.03	0.05
2050	–0.05		0.07	0.00
2100	–0.16	–0.24	–0.06	–0.11

Notes:
Decadal average of the $\log_{10}[PM_{2.5}]$ values are given only where results include at least 4 models from either ACCMIP or CMIP5. Results are from A. Fiore and V. Naik based on Fiore et al. (2012) using the CMIP5/ACCMIP archive. Due to the very large systematic spread across models, the statistics were calculated for the log values, but Figure 11.23 shows statistics for direct $PM_{2.5}$ values. Due to the large spatial variations no global average is given. Model mean and standard deviation are shown for year 2000; differences in $\log_{10}[PM_{2.5}]$ are shown for 2030, 2050 and 2100. See notes for AII.7.3 and Figure 11.23 for regions, see also Chapter 11, ES.

Table AII.7.5: CMIP5 (RCP) and CMIP3 (SRES A1B) global mean surface temperature change (°C) relative to 1986–2005 reference period. Results here are a statistical summary of the spread in the CMIP ensembles for each of the scenarios. They do not account for model biases and model dependencies, and the percentiles do not correspond to the assessed uncertainty in Chapters 11 (11.3.6.3) and 12 (12.4.1). The statistical spread across models cannot be interpreted as uncertainty ranges or in terms of calibrated language (12.2).

	RCP2.6					RCP4.5				
Years	5%	17%	50%	83%	95%	5%	17%	50%	83%	95%
PI*			–0.61					–0.61		
1986–2005			0.00					0.00		
2010d	0.19	0.33	0.36	0.52	0.62	0.22	0.26	0.36	0.48	0.59
2020[d]	0.36	0.45	0.55	0.81	1.07	0.39	0.48	0.59	0.74	0.83
2030[d]	0.47	0.56	0.74	1.02	1.24	0.56	0.69	0.82	1.10	1.22
2040[d]	0.51	0.68	0.88	1.25	1.50	0.64	0.86	1.04	1.35	1.57
2050[d]	0.49	0.71	0.94	1.37	1.65	0.84	1.05	1.24	1.63	1.97
2060[d]	0.36	0.69	0.93	1.48	1.71	0.90	1.13	1.44	1.90	2.19

2070[d]	0.20	0.70	0.89	1.49	1.71	0.98	1.20	1.54	2.07	2.32
2080[d]	0.15	0.62	0.94	1.44	1.79	0.98	1.27	1.62	2.25	2.54
2090[d]	0.18	0.58	0.94	1.53	1.79	1.06	1.33	1.68	2.29	2.59

Table AII.7.5 (continued)

	RCP6.0					RCP8.5				
Years	5%	17%	50%	83%	95%	5%	17%	50%	83%	95%
PI*			–0.61					–0.61		
1986–2005			0.00					0.00		
2010d	0.21	0.26	0.36	0.47	0.64	0.23	0.29	0.37	0.47	0.62
2020[d]	0.33	0.40	0.55	0.70	0.90	0.37	0.51	0.66	0.84	0.99
2030[d]	0.40	0.59	0.74	0.92	1.17	0.65	0.77	0.94	1.29	1.39
2040[d]	0.59	0.73	0.95	1.21	1.41	0.93	1.13	1.29	1.68	1.77
2050[d]	0.69	0.92	1.15	1.52	1.81	1.20	1.48	1.70	2.19	2.37
2060[d]	0.88	1.08	1.32	1.78	2.18	1.55	1.88	2.16	2.74	2.99
2070[d]	1.08	1.28	1.58	2.14	2.52	1.96	2.25	2.60	3.31	3.61
2080[d]	1.33	1.56	1.81	2.58	2.88	2.31	2.65	3.05	3.93	4.22
2090[d]	1.51	1.72	2.03	2.92	3.24	2.63	2.96	3.57	4.45	4.81

Table AII.7.5 (continued)

	SRES A1B				
Years	5%	17%	50%	83%	95%
PI*			–0.61		
1986–2005			0.00		
2010[d]	0.15	0.22	0.34	0.44	0.62
2020[d]	0.27	0.37	0.52	0.76	0.91
2030[d]	0.47	0.59	0.82	1.04	1.38
2040[d]	0.65	0.90	1.11	1.36	1.79
2050[d]	0.92	1.14	1.55	1.65	2.14
2060[d]	1.12	1.40	1.75	1.98	2.67
2070[d]	1.40	1.60	2.14	2.39	3.12
2080[d]	1.61	1.80	2.30	2.75	3.47
2090[d]	1.76	1.96	2.54	3.05	3.84

Notes:
This spread in the model ensembles (as shown in Figures 11.26a and 12.5, and discussed in Section 11.3.6) is not a measure of uncertainty. For the AR5 assessment of global mean surface temperature changes and uncertainties see: Section 11.3.6.3 and Figure 11.25 for the near-term (2016–2035) temperatures; and Section 12.4.1 and Tables 12.2–3 for the long-term (2081–2100). See discussion about uncertainty and ensembles in Section 12.2, which explains how model spread is not equivalent to uncertainty. Results here are shown for the CMIP5 archive (Annex I, frozen as of March 15, 2013) for the RCPs and the similarly current CMIP3 archive for SRES A1B, which is not the same set of models used in AR4 (Figure SPM.5). Ten-year averages are shown (2030[d] = 2026–2035). Temperature changes are relative to the reference period (1986–2005, defined as zero in this table), using CMIP5 for all four RCPs (G. J. van Oldenborgh, http://climexp.knmi.nl/; see Annex I for listing of models included) and CMIP3 for SRES A1B (22 models). The warming from pre-industrial (PI* = 1850–1900) to the modern reference period (1986–2005) is derived from HadCRUT4 observations as 0.61°C (C. Morice; see Chapter 2 and AII.1.3).

Table AII.7.6: Global mean surface temperature change (°C) relative to 1990 from the TAR

Years	A1B	A1T	A1FI	A2	B1	B2	IS92a	A1B
PI*	–0.33	–0.33	–0.33	–0.33	–0.33	–0.33	–0.33	–0.33
1990	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2000	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.16
2010	0.30	0.40	0.32	0.35	0.34	0.39	0.27	0.30

2020	0.52	0.71	0.55	0.50	0.55	0.66	0.43	0.52
2030	0.85	1.03	0.85	0.73	0.77	0.93	0.61	0.85
2040	1.26	1.41	1.27	1.06	0.98	1.18	0.80	1.26
2050	1.59	1.75	1.86	1.42	1.21	1.44	1.00	1.59
2060	1.97	2.04	2.50	1.85	1.44	1.69	1.26	1.97
2070	2.30	2.25	3.10	2.33	1.63	1.94	1.52	2.30
2080	2.56	2.41	3.64	2.81	1.79	2.20	1.79	2.56
2090	2.77	2.49	4.09	3.29	1.91	2.44	2.08	2.77
2100	2.95	2.54	4.49	3.79	1.98	2.69	2.38	2.95

Notes:
Single-year estimates of mean surface air temperature warming relative to the reference period 1990 for the SRES scenarios evaluated in the TAR. The pre-industrial estimates are for 1750, and all results are based on a simple climate model. See TAR Appendix II.

Table AII.7.7: Global mean sea level rise (m) with respect to 1986–2005 at 1 January on the years indicated. Values shown as median and *likely* range, see Section 13.5.1.

Year	SRES A1B	RCP2.6	RCP4.5	RCP6.0	RCP8.5
2007	0.03 [0.02–0.04]	0.03 [0.02–0.04]	0.03 [0.02–0.04]	0.03 [0.02–0.04]	0.03 [0.02–0.04]
2010	0.04 [0.03–0.05]	0.04 [0.03–0.05]	0.04 [0.03–0.05]	0.04 [0.03–0.05]	0.04 [0.03–0.05]
2020	0.08 [0.06–0.10]	0.08 [0.06–0.10]	0.08 [0.06–0.10]	0.08 [0.06–0.10]	0.08 [0.06–0.10]
2030	0.12 [0.09–0.15]	0.13 [0.09–0.16]	0.13 [0.09–0.16]	0.12 [0.09–0.15]	0.13 [0.10–0.16]
2040	0.17 [0.13–0.22]	0.17 [0.12–0.22]	0.17 [0.13–0.22]	0.17 [0.12–0.21]	0.19 [0.14–0.24]
2050	0.23 [0.17–0.29]	0.22 [0.16–0.28]	0.23 [0.17–0.29]	0.22 [0.16–0.28]	0.25 [0.19–0.32]
2060	0.29 [0.21–0.38]	0.26 [0.18–0.34]	0.28 [0.20–0.36]	0.27 [0.19–0.35]	0.33 [0.24–0.42]
2070	0.36 [0.26–0.47]	0.31 [0.21–0.40]	0.34 [0.24–0.44]	0.33 [0.24–0.43]	0.41 [0.31–0.53]
2080	0.44 [0.31–0.57]	0.35 [0.23–0.47]	0.40 [0.28–0.53]	0.40 [0.28–0.52]	0.51 [0.37–0.66]
2090	0.52 [0.36–0.68]	0.39 [0.26–0.53]	0.46 [0.32–0.61]	0.47 [0.33–0.62]	0.62 [0.45–0.81]
2100	0.60 [0.41–0.79]	0.43 [0.28–0.60]	0.52 [0.35–0.70]	0.54 [0.37–0.72]	0.73 [0.53–0.97]

References

Calvin, K., et al., 2012: The role of Asia in mitigating climate change: Results from the Asia modeling exercise. Energy Economics, 34, S251-S260.

Cionni, I., V. Eyring, J. Lamarque, W. Randel, D. Stevenson, F. Wu, G. Bodeker, T. Shepherd, D. Shindell, and D. Waugh, 2011: Ozone database in support of CMIP5 simulations: results and corresponding radiative forcing. Atmospheric Chemistry and Physics, 11, 11267-11292.

Cofala, J., M. Amann, Z. Klimont, K. Kupiainen, and L. Hoglund-Isaksson, 2007: Scenarios of global anthropogenic emissions of air pollutants and methane until 2030. Atmospheric Environment, 41, 8486-8499.

Dentener, F., D. Stevenson, J. Cofala, R. Mechler, M. Amann, P. Bergamaschi, F. Raes, and R. Derwent, 2005: The impact of air pollutant and methane emission controls on tropospheric ozone and radiative forcing: CTM calculations for the period 1990-2030. Atmospheric Chemistry and Physics, 5, 1731-1755.

Dentener, F., et al., 2006: The global atmospheric environment for the next generation. Environmental Science & Technology, 40, 3586-3594.

Douglass, A. and V. Fioletov, 2010: Chapter 2, Stratospheric Ozone and Surface Ultraviolet Radiation in Scientific Assessment of Ozone Depletion: 2010. Global Ozone Research and Monitoring Project-Report No. 52, Geneva, Switzerland: World Meteorological Organization.

Erisman, J. W., M. A. Sutton, J. Galloway, Z. Klimont, and W. Winiwarter, 2008: How a century of ammonia synthesis changed the world. Nature Geoscience, 1, 636-639.

Eyring, V., et al., 2013: Long-term ozone changes and associated climate impacts in CMIP5 simulations. Journal of Geophysical Research, doi:10.1002/jgrd.50316.

Fiore, A. M., et al., 2012: Global Air Quality and Climate. Chem. Soc. Rev., 41, 6663-6683, doi:10.1039/C2CS35095E.

Fleming, E., C. Jackman, R. Stolarski and A. Douglass, 2011: A model study of the impact of source gas changes on the stratosphere for 1850-2100. Atmospheric Chemistry and Physics, 11, 8515-8541.

Forster, P. M., T. Andrews, P. Good, J. M. Gregory, L. S. Jackson, and M. Zelinka, 2013: Evaluating adjusted forcing and model spread for historical and future scenarios in the CMIP5 generation of climate models. Journal of Geophysical Research, 118, 1139–1150.

Friedlingstein, P., et al., 2006: Climate-carbon cycle feedback analysis: Results from the C4MIP model intercomparison. Journal of Climate, 19, 3337-3353.

Holmes, C. D., M. J. Prather, A.O. Søvde, and G. Myhre, 2013: Future methane, hydroxyl, and their uncertainties: key climate and emission parameters for future predictions, Atmospheric Chemistry and Physics, 13, 285–302, doi:10.5194/acp-13-285-2013

HTAP, 2010. Hemispheric Transport of Air Pollution 2010, Part A: Ozone and Particulate Matter. Geneva, Switzerland: United Nations.

Jones, C. D., E. Robertson, V. Arora, E. Shevliakova, L. Bopp, P. Cadule,et al., 2013: 21st Century compatible CO2 emissions and airborne fraction simulated by CMIP5 Earth System models under 4 Representative Concentration Pathways. Journal of Climate, doi:10.1175/JCLI-D-12- 00554.1.

Lamarque, J. F., et al., 2010: Historical (1850-2000) gridded anthropogenic and biomass burning emissions of reactive gases and aerosols: methodology and application. Atmospheric Chemistry and Physics, 10, 7017-7039.

Lamarque, J. F., G. P. Kyle, M. Meinshausen, K. Riahi, S. J. Smith, D. P. Van Vuuren, A. J. Conley, and F. Vitt, 2011: Global and regional evolution of short-lived radiatively-active gases and aerosols in the Representative Concentration Pathways. Climatic Change, 109, 191-212.

Lamarque, J. F., et al., 2013: The Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP): overview and description of models, simulations and climate diagnostics. Geoscience Model Development, 6, 179-206.

Meinshausen, M., S. J. Smith, K. Calvin, J. S. Daniel, et al., 2011a: The RCP greenhouse gas concentrations and their extensions from 1765 to 2300. Climatic Change, 109, 213-241.

Meinshausen, M., T. M. L. Wigley, and S. C. B. Raper, 2011b: Emulating atmosphere-ocean and carbon cycle models with a simpler model, MAGICC6-Part 2: applications. Atmospheric Chemistry and Physics, 11, 1457–1471.

Moss, R. H., J. A. Edmonds, K. A. Hibbard, M. R. Manning, S. K. Rose, D. P. van Vuuren, T. R. Carter, et al., 2010: The next generation of scenarios for climate change research and assessment. Nature, 463, 747-756.

Prather, M. J., C. D. Holmes, and J. Hsu, 2012: Reactive greenhouse gas scenarios: Systematic exploration of uncertainties and the role of atmospheric chemistry. Geophysical Research Letters, 39, L09803, doi:10.1029/2012GL051440.

Prather, M., Ehhalt, D., et al., 2001: Chapter 4, Atmospheric Chemistry and Greenhouse Gases, in Climate Change 2001: The Scientific Basis, ed. J. T. Houghton et al., pp.239-287. Cambridge, UK: Cambridge University Press.

Prather, M., M. Gauss, T. Berntsen, et al., 2003: Fresh air in the 21st century? Geophysical Research Letters, 30, 1100, doi:10.1029/2002GL016285, 2003.

Rogelj, J., et al., 2011: Emission pathways consistent with a 2°C global temperature limit. Nature Climate Change, 1, 413-418.

Shindell, D.T., J.-F. Lamarque, M. Schulz, M. Flanner, et al., 2013: Radiative forcing in the ACCMIP historical and future climate simulations. Atmospheric Chemistry and Physics, 13, 2939-2974, doi:10.5194/acp-13-2939-2013.

Stevenson, D. S., P. J. Young, V. Naik, J. F. Lamarque, D. T. Shindell, A. Voulgarakis, et al., 2013: Tropospheric ozone changes, radiative forcing and attribution to emissions in the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP). Atmospheric Chemistry and Physics, 13, 3063–3085.

van Vuuren, D. P., et al., 2008: Temperature increase of 21st century mitigation scenarios. Proceedings of the National Academy of Sciences of the United States of America, 105, 15258-15262.

van Vuuren, D., J. Edmonds, et al., 2011: The representative concentration pathways: an overview. Climatic Change, 109, 5-31, doi 10.1007/s10584-011-0148-z

Voulgarakis, A., et al., 2013: Analysis of present day and future OH and methane lifetime in the ACCMIP simulations. 21 Atmospheric Chemistry and Physics, 13, 2563-2587.

Wild, O., A.M. Fiore et al., 2012: Modelling future changes in surface ozone: a parameterized approach. Atmospheric Chemistry and Physics, 12, 2037-2054.

WMO. 2010. Scientific Assessment of Ozone Depletion: 2010. Global Ozone Research and Monitoring Project—Report No. 52, Geneva, Switzerland: World Meteorological Organization.

Young, P. J., et al., 2013: Pre-industrial to end 21st century projections of tropospheric ozone from the Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP), Atmospheric Chemistry and Physics, 13, 2063-2090, 10.5194/acp-13-2063-2013, 2013.