WMO

INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

UNEP

INTERGOVERNMENTAL PANEL
ON CLIMATE CHANGE

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Agenda item: 3a
ENGLISH ONLY

"CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS", THE CONTRIBUTION OF WORKING GROUP I TO THE IPCC THIRD ASSESSMENT REPORT

CHANGES TO TAR CHAPTERS FOLLOWING GOVERNMENT REVIEW AND SPM APPROVAL

Changes proposed to be made to the underlying assessment (except for the Technical Summary, which is submitted as part of IPCC-XVII/Doc. 3a), for consistency with the approved Summary for Policymakers (ref. IPCC-XVII/Doc. 3a), and accepted by the Working Group at its Eighth Session (Shanghai, 17-20 January 2001), are attached. The proposed changes will be made to the underlying assessment. The underlying assessment was distributed to governments prior to the Eighth Session (ref. WGI-VIII/Doc. 3). On this understanding, therefore, the underlying assessment is hereby submitted to the Panel for acceptance.

Substantive changes to WGI TAR agreed at IPCC WGI Plenary in Shanghai, January 2001

	Chapt. / App.	Section (& line)	Old text	New text	Reason for change	Date	Name
	Tech Summary	Page 11, Line 32	*Since the beginning of Industrial Era, the atmospheric concentration of* CO_2 *has increased from 280 to 367 ppm*[4] *(31%, Table 1).*	*The atmospheric concentration of* CO_2 *has increased from 280 ppm*[4] *in 1750 to 367 ppm in 1999 (31%, Table 2).*	Clarification to be consistent with Ch 3	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 11, Line 40	N/A – additional sentence after …since 1980 is 0.4%/yr.	The increase is a consequence of CO_2 emissions.	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 11, Line 40	Most of this is due…	Most of the emissions during the past 20 years are due…	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 11, Line 41	…is due to land-use change…	…is predominantly due to land-use change…	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 11, Line 51		After "...El Nino Years" could refer to Box 4.	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 21, Lines 10	Excess CO_2…	Anthropogenic CO_2	We deliberately avoided using the word "excess" to describe the additional CO_2 as a result of man-made emissions and prefer the use of the word "anthropogenic", I think this was also in response to at least a couple of reviewers comments.	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 21, Lines 15	N/A – additional sentence to insert before the sentence starting "Process models..."	The fraction of emitted CO_2 that can be taken up by the oceans and land is expected to decline with increasing CO_2 concentration.	Rational - some text along these	16-01-01	Jo House (Chapter 3)

					lines was removed but we feel it is of key importance that people understand the current sinks cannot be relied upon to operate to the same degree in the future.		
	Tech Summary	Page 21, Lines 20-22	Differences among models apparently have limited effects in evaluations of the recent carbon cycle, but become important when the models are used to make future long-term projections.	"Nevertheless, current models consistently indicate that when the effects of climate change are considered, CO_2 uptake by oceans and land becomes smaller."	Rational – some text along these lines was replaced with the current sentence, but we feel that the climate feedbacks are one of the important things the models consistently tell us and they have a large impact on future carbon predictions	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 30, Line 24	*Models show that the SRES…*	*Models indicate that the illustrative SRES…*	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 30, Lines 25-26	Models indicate that climate change will reduce both land and ocean uptake of CO_2 relative to the situation without climate change.	Carbon cycle **m**odels indicate that the effects of climate change on land and ocean processes will reduce uptake of CO_2.	Clarification	16-01-01	Jo House (Chapter 3)

	Tech Summary	Page 30, Line 30	…carbon sequestration…	…carbon storage…	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 30, Line 31	… maximum possible…	… upper bound for…	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 30, Line 31	N/A – additional sentence after sentence ending *…40 to 70 ppm.*	If all the carbon released by historic land-use changes could be restored to the terrestrial biosphere over the course of the century (e.g. by reforestation), CO_2 concentration would be reduced by 40 to 70 ppm.	Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 30, Line 33	Delete sentence: This is because….biospheric sinks.		Clarification	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 35, Line 40	…are small.	... are small (<0.2 PgC/yr)	Please put back in the size of this sink as it clarifies that it is indeed very small, something we were asked to do by reviewers	16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 55, Figure 9		There was a logical and consistent flow to the existing six figure panels in our original Figure 3.2 of increasing time periods, and also the same scale for comparison. The Figure 3.3 that was added is as panel (b) does not have the same units and is not explained fully in the caption. We would prefer that this panel is either removed altogether or placed at the bottom center of the figure and labeled panel (g) with the fossil fuel trends restored and the whole figure explained fully in the caption as per the original caption of figure 3.3.		16-01-01	Jo House (Chapter 3)
	Tech Summary	Page 71, Figure 24, Lines 5-6	…and panels (b) and (c) show the implied CO_2 emissions, as projected with two fast carbon cycle models, Bern-CC and ISAM.	...and panel (b) shows the ....with a fast carbon cycle model ISAM.	If you still wish to show only one of the fast CC models,	16-01-01	Jo House (Chapter 3)

					please change the figure caption accordingly		
	Tech Summary	Page 71, Figure 24, Lines 8-11	Delete sentence: The model ranges for Bern-CC.... ...carbon cycle response.	[please also not with this figure we will provide an update as the upper label in Panel (a) is wrong and should read WRE1000]		20-01-01	Jo House (Chapter 3)
	Tech Summary	Page 71, Figure 24, Line 11	For each model, the upper and lower bounds are indicated…	The upper and lower bounds for each model are indicated…		20-01-01	Jo House (Chapter 3)

	Chapt. / App.	**Section (& line)**	**Old text**	**New text**	**Reason for change**	**Date**	**Name**
	Ch 1	P12, para 4	N/A - addition	Reference could be made to the FCCC objective in Article 2 re stabilisation. The whole objective could be quoted to put the idea of stabilisation scenarios in context.	Context	10-10-00	Dave (on behalf of Sir John)

No.	**Chapt. / App.**	**Section (& line)**	**Old text**	**New text**	**Reason for change**	**Date**	**Name**
	Ch 2	Exec Summ P4 Ln5 BULLET	The best estimate of global surface temperature changes is a 0.6°C increase since the late 19th Century with a 95% confidence interval between 0.4 and 0.8°C. The additional data for the last 5 years is largely responsible for the increase in temperature of 0.15°C compared to that assessed in IPCC (1996)	The best estimate of global surface temperature changes is a 0.6°C increase since the late 19th Century with a 95% confidence interval between 0.4 and 0.8°C. The additional data for the last 5 years is partly responsible for the increase in temperature of 0.15°C compared to that assessed in IPCC (1996), together with improved methods of analysis and the fact that the Second Assesment Report decided not update the value in the First Assessment Report, despite slight additional warming.	Consistency with SPM	20-01-01	C Folland
	Ch 2	Exec Summ P4 Ln 48 BULLET	The recent 1976-99 warming was largely globally synchronous, but emphasized in the Northern Hemisphere continents during winter and spring, with year-round cooling in the northwest North Atlantic and the Central North Pacific.	The recent 1976-2000 warming was largely globally synchronous, but emphasized in the Northern Hemisphere continents during winter and spring, with year-round cooling in parts of the Southern Hemisphere oceans and Antarctica	Consistency with SPM	20-01-01	C Folland
	Ch 2	Exec Summ P4 Ln 13 BULLET	Analyses of mean daily maximum and minimum temperatures continue to support a reduction in the diurnal temperature range in many parts of the world, with, globally, minimum temperatures increasing at nearly twice the rate of maximum temperatures since about 1950.	Analyses of mean daily maximum and minimum temperatures continue to support a reduction in the diurnal temperature range in many parts of the world, with, globally, minimum temperatures increasing at nearly twice the rate of maximum temperatures between about 1950 and 1993. The rate of temperature increase during this time has been	Consistency with SPM	20-01-01	C Folland

				0.1°C and 0.2°C for the maximum and minimum, respectively. This is about half of the rate of temperature increase over the oceans during this time.			
	Ch 2	Exec Summ P5 line 50 BULLET		Satellites have only been available since 1979. Between 1979 and 2000, based on satellites and balloons, the lower tropospheric trend has been +0.04+-0.11°C/decade and 0.03+-0.10°C/decade respectively. By contrast, surface temperature trends for 1979-2000were greater, att 0.16+-0.06C/°decade. The difference of 0.12 +-0.06°C/decade is clearly statistically significant. This is in contrast to near zero surface temperature trends over 1958-1978 when the lower tropospheric temperature trend was greater than the surface trend by about 0.1°C/decade.	Consistency with SPM	20-01-01	C Folland
	Ch 2	Exec Summ P6 ln2 BULLET		It is very likely that these significant differences in trends between the surface and lower troposphere are real and not solely an artifact of measurement bias, though differences in spatial and temporal sampling are likely to contribute. The differences are particularly apparent in many parts of the tropics and subtropics where the surface has warmed faster than the lower troposphere. In some other regions, e.g. North America, Europe and Australia, lower tropospheric and surface trends are very similar.	Consistency with SPM	20-01-01	C Folland
	Ch 2	P6 ln14 BULLET		The 1990s are likely to have been the warmest decade of the millennium in the Northern Hemisphere and 1998 is likely to have been the warmest year. . Because less data are available, less is known about annual averages prior to 1000 years before the present and for conditions prevailing in most of the Southern Hemisphere prior to 1861.	Consistency with SPM	20-01-01	C Folland
	Ch 2	P6 ln 47 BULLET		Instrumental records of land surface precipitation continue to show an increase of 0.5 to 1%/decade in much of the Northern	Consistency with SPM	20-01-01	C Folland

				Hemisphere mid and high latitudes. A notable exception includes parts of eastern Russia. In contrast, over much of the subtropical land areas rainfall has decreased during the 20th Century (by -0.3%/decade), but this trend has weakened in recent decades. Other precipitation indicators suggest that large parts of the tropical oceans have had more precipitation in recent decades, and precipitation has significantly increased over tropical land areas during the 20th century (2.4%/Century). Increases in precipitation over the tropics are not evident over the past few decades.			
	Ch 2	P7 line 27 FIRST LINE OF BULLET		It is likely that there has been an increase in total cloud cover of about 2% over many mid- to high-latitude land areas since the beginning of the 20th Century	Consistency with SPM	20-01-01	C Folland
	Ch 2	P7 line 36 FIRST LINE OF BULLET		The frequency and intensity of ENSO has been unusual since the mid-1970s compared with the previous 100 years	Consistency with SPM	20-01-01	C Folland
	Ch 2	P7 line 40 FIRST LINE OF BULLET		This recent behaviour of ENSO is related to variations of precipitation and temperature over much of the global tropics and subtropics and some mid-latitude areas.	Consistency with SPM	20-01-01	C Folland
	Ch 2	Line 15 Page 8 BULLET REVISION		In the mid- and high latitudes of the Northern Hemisphere over the latter half of the 20th century it is likely that there has been a 2-4% increase in the frequency of heavy precipitation events reported by the available observing stations	Consistency with SPM	20-01-01	C Folland
	Ch 2	NEW BULLET FOLLOWING Line 17		Trends for severe drought and wet area statistics for 1900-1995 are relatively small over global land areas. However during the last two or three decdaes there are some increases in the globally combined severe dry	Consistency with SPM	20-01-01	C Folland

		Page 8		and wet areas			
	Ch 2	P8 Line 32 REVISED BULLET		Worldwide changes in tropical and extratropical storm intensity and frequency are dominated by interdecadal to multidecadal variations, with no significant trends over the 20th century evident. Conflicting analyses make it difficult to draw definitive conclusions about conclusions about changes in storm activity, especially in the extratropics.	Consistency with SPM	20-01-01	C Folland
	Ch 2	P10, last Para of urban heat island box		Clearly, the urban heat island effect is a real climate change in urban areas, but not representative of larger areas. Extensive tests have shown that the urban heat island effects are no more than about 0.05°C up to 1990 in the global temperature records used in this chapter to depict climate change. Thus we have assumed a one standard deviation uncertainty of zero in global land surface air temperature in 1900 due to urbanisation, linearly increasing to 0.06^{0}C (two standard deviations 0.12 ^{0}C) in 2000.	Consistency with SPM	20-01-01	C Folland
	Ch 2	Table 2.1 P12		BEING UPDATED to 2000	UPDATING AGREED	20-01-01	C Folland
	Ch 2	Table 2.2 P17		BEING UPDATED TO 2000	UPDATING AGREED	20-01-01	C Folland
	Ch 2	Table 2.3 P23		BEING UPDATED TO 2000 PLUS NEW LINE ON SURFACE LOWER TROPOSPHERE DIFFERENCES	UPDATING AGREED	20-01-01	C Folland
	Ch 2	NEW TEXT Ln18		Note that our assessed temperature increase is 0.15^{o}C more than that in the Second Assessment Report. This relatively large increase is explained by the increase in temperature since that Report was completed , improved methods of analysis and the fact that the Second Assesment Report decided not to update the value in the First Assessment Report, despite slight additional warming. The latter decision was likely to have been due to a	Consistency with SPM	20-01-01	C Folland

				cautious interpretation of overall uncertainties which had at that time to be subjectively assessed..			
	Ch 2	Revised Text Lines 29 P24 to Line 37 P25		Between 1979 and 2000, the magnitude of trends between the surface and MSU2LT is most similar in Northern Hemisphere extratropical continents where deep vertical mixing is often a characteristic of the troposphere. For example, in the northern extratropics (20°N to pole) trends for the surface and MSU2LT were 0.27 and 0.21°C/decade respectively (UPDATE to include all 2000), over the North American continent trends were 0.29+-0.23and 0.29+-0.23 °C/decade respectively, with an annual correlation of 0.95, and over Europe the rates were 0.37+-0.36 and 0.39+-0.31°C/decade respectively.. Some additional warming of the surface relative to the lower troposphere would be expected in the winter half year over extratropical Eurasia (warming rates of 0.35+-0.20 and 0.18+-0.18°C/decade respectively), consistent with the vertical temperature structure of the increased positive phase of the Arctic Oscillation (Thompson et al., 2000, Fig. 7). The vertical structure of the atmosphere in marine environments, however, generally reveals a relatively shallow inversion layer (surface up to 0.7 to 2 km) which is cooler and therefore somewhat decoupled from the deep troposphere above (Trenberth et al. 1992, Christy 1995, Hurrell and Trenberth 1996). Not only are local surface versus tropospheric correlations often near zero in these regions, but surface and tropospheric trends can be quite different (Chase et al., 2000). This is seen in the difference between trends since 1979 in the tropical band of over 0.16°C/decade (Table 2.3) and in the southern extratropics as a whole where surface and MSU2LT trends are	CONSISTENCY WITH SPM INCLUDING NEW INFORMATION ON DIFFERENTIAL TEMPERATURE TRENDS TO 2000 AND OTHER MINOR IMPROVEMENTS	20-01-01	C Folland

				+0.09 and –0.02 °C/decade respectively (UPDATE TRENDS TO END 2000). Trends calculated for the differences between the surface and the troposphere (as measured by MSULT particularly) for 1979-2000, are statistically significant globally at 0.12 °C/decade, and even more so over the tropics (0.16. °C/decade). Statistical significance arises because large interannual variations in the parent time series are strongly correlated and so largely disappear in the difference time series (Santer *et al*., 2000b. Christy *et al* 2000). However, they are not significant as implied above over many extratropical regions of the Northern Hemisphere such as North America and Europe and they are also insignificant in some Southern Hemisphere areas. The sequence of volcanic eruption, ENSO events, and the trends in the Arctic Oscillation have all been linked to some of this difference in warming rates (Michaels and Knappenburg, 2000 ; Wigley, 2000 ; Santer *et al.*, 2000b; Thompson *et al.*, 2000) and do explain a part of the difference in the rates of warming (see Chapter 12). The linear trend is a simple measure of the overall tendency of a time series and has several types of uncertainty, temporal sampling uncertainty related to data sets with relatively few measurements, and various forms of measurement error . Temporal sampling uncertainties are present even when the data are perfectly known because trends calculated for short periods are unrepresentative of other short periods, or of the longer term, due to large interannual to decadal variations. Thus confidence intervals for estimates of trend since 1979 due to temporal sampling uncertainty can be relatively large, as high as ±0.2°C/decade below 300 hPa (table 2.3, Santer et al. 2000b).			

				Santer et al estimate that perhaps one third of the difference in warming rates can be accounted for by sampling problems in the surface data, Accordingly, the period 1979-2000 provides limited information on long-term trends, or trends for other 22-year periods. The second type of uncertainty arises from measurement errors due to the factors discussed in section 2.2.3 . One estimate of this uncertainty can be made from comparisons between the various analyses in Table 2.3. For trends below 300 hPa, this uncertainty may be as large as ±0.10°C/decade since 1979, though Christy et al. (2000) estimate the 95% confidence interval as ±0.06°C for the MSU2LT layer average. Summarising, it is very likely that the surface has warmed in the global average relative to the troposphere, and the troposphere has warmed relative to the stratosphere since 1979 (Figure 2.12a,b, Pielke, Sr. *et al*. 1998a,b, Angel 1999, 2000, Gaffen *et al*. 2000a, NRC 2000, Hurrell *et al*., 2000, Stendel *et al*., 2000, Christy *et al*., 2000, Brown *et al*., 2000). However the relative warming is spatially very variable and most significant in the tropics and subtropics. There is evidence that the troposphere warmed relative to the surface in the pre-satellite era (1958-1979, Gaffen *et al*. 2000a, Brown *et al*. 2000), though confidence in this finding is lower. Uncertainties due to limited temporal sampling prevent confident extrapolation of these trends to other or longer time periods (NRC 2000, Santer *et al*. 2000, Hurrell *et al*. 2000, Christy *et al*. 2000). Some physical explanations for changes in the vertical profile of global temperature trends are discussed in			

				Chapter 12, but a full explanation of the lower tropospheric lapse rate changes since 1958 requires further research.			
	Ch 2	P29, line 47 NEW TEXT,		However, although Gaffen et al (2000) found a similar increase over 1960-97, they found a lowering of freezing level over 1979-97 which, at least superficially, is not consistent with glacier recession.	GOVERNMENT COMMENT ON SECOND DRAFT OMITTED	20-01-01	C Folland
	Ch 2	Line 39 P28		Because less data are available, less is known about annual averages prior to 1000 years before the present and for conditions prevailing in most of the Southern Hemisphere prior to 1861	NEW TEXT FOR CONSISTENCY WITH SPM	20-01-01	C Folland
	Ch 2	Page 45 Line 16 - 45		The effects of changes in wind shields on winter precipitation measurements were taken into account for many, but by no means all, of the middle and high latitude observations. Dai et al., (1997b) indicate that instrumental discontinuities are unlikely to significantly impact other observations *Mid and high latitudes* During the 20th Century, annual-zonally averaged precipitation derived from the Global Historical Climate Network (GHCN) data set (Peterson et al., 1997) increased between 6.8 and 11.8% for the zones 30°N to 85°N and by about 2 to 3% between 10°S to 55°S during this time (Figure 2.25 (ii)). The unsteady, but nevertheless highly statistically significant, trend toward more precipitation in mid-to-high latitude regions of the Northern Hemisphere is continuing.	Text corrects incorrect reference to the rate of mid and high latitude precipitation increase (old text referred to autumn values not annual) and new text makes it clear that not all the solid precipitation biases are likely to have been accounted for and therefore totally objective precipitation trend estimates in the mid and	20-01-01	C Folland

					high latitudes are likely biased a few percent too high. Thus we reduce objectively calculated increase by about 2%.		
	Ch 2	Line 30, p53		This has been related to variations of precipitation and temperature over much of the tropics and subtropics, and some mid-latitude areas.	NEW TEXT FOR CONSISTENCY WITH SPM	20-01-01	C Folland
	Ch 2	Page 61 line 39		DELETE THE WORD "CENTRAL"	Word is extraneous	20-01-01	C Folland
	Ch 2	Page 61 line 43 at the extraneous question mark insert the text given		This equates to about a 2% increase in the frequency of the annual maximum 5-day precipitation total falling into the upper ten percentiles (defined as heavy) and a 4% increase in the frequency of the proportion of total annual precipitation falling into the heavy category.	Sentence is added to quantitatively clarify the information presented in Fig. 2.36	20-01-01	C Folland
	Ch 2	Page 66 line Revise bullet on lines 24 –26 to read Delete bullet on lines 34-36		Land-surface and satellite temperature trends for several continental regions that potentially could have been affected by urban heat islands, e.g., North America, Europe, Australia are in close agreement since satellite observations have been available. Therefore, this gives us more confidence that the surface temperature trends are not unduly influenced by urban heat islands.	Two bullets discuss the urban heat island bias relative to the satellite data and only one is necessary. The revised text tries to make it clearer that because of the similarity of satellite and	20-01-01	C Folland

					ground based trends over continents with large commercial urban centers this gives us more confidence that the surface temperature trends are not unduly influenced by urban heat islands		
	Ch 2	Figs 2.1, 2.5-2.10, 2.12, 2.14, 2.16, 2.29		BEING UPDATED TO 2000	AS AGREED	20-01-01	C Folland
	Ch 2	Revised text for Figure 2.36		**Figure 2.36:** Changes in the highest annual 5-day precipitation total (a, b) and in the proportion of the annual total precipitation occurring in the upper 5 percentiles of all daily total precipitation events as defined by the 1961-90 reference period (c, d). Panels (a) and (c) show changes in percent between the first and second half of the time period 1946-1999. The size of the circles is proportional to the change where green reflects increases and brown decreases, and solid circles reflect statistically significant changes. Panels (b) and (d) show the annual time series of the percent of stations in the upper and lower deciles of the relevant distribution and the upper decile can be interpreted to represent the trends in the frequency of heavy precipitation events. Note that the trends in the lower	The new text is needed to better explain the information provided in the figure.	20-01-01	C Folland

				decile are opposite to the upper decile, as the trend to more heavy precipitation events reduces the frequency of stations receiving precipitation from lower 5-day annual maximum total precipitation or the annual proportion of precipitation occurring in the upper 5 percentile of distribution of daily precipitation events. The positive trends for the upper deciles in both panels (b) and (d) are statistically significant at the 5% level (Frich *et al*., 2000).			
	Ch 2	Figure 2.39a		Change the rate of subsurface ocean warming from 0.03°C/decade to 0.04°C/decade	The data was incorrectly truncated instead of rounded.	20-01-01	C Folland
	Ch 2	Figure 2.39b		Insert the words ‘in the Northern Hemisphere’ in the bullet point beginning with 5-10%	Needed to make clear that this does not refer to the Sourthern Hemisphere	20-01-01	C Folland

	Chapt. / App.	**Section (& line)**	**Old text**	**New text**	**Reason for change**	**Date**	**Name**
	Ch 3	Page 1, Line 8	N/A - addition	add two new contributing authors, P.M Cox (UK), P.Friedlingstein	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 3, Line 12	N/A – addition. Add sentence at beginning of bullet.	The present CO2 increase is caused by anthropogenic emissions of CO_2.	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 3, Line 12	…the present CO_2 increase is caused by…	…these emissions are due to…	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 3, Line 14	… increase.	… emissions.	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 3, Line 35	N/A – addition. New sentence to insert at end of bullet.	The new 1990s estimates update the budget derived using SAR methodologies for the Special Report on Land Use, Land Use Change and Forestry (IPCC, 2000a).	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 3, Line 44	including CO_2 and N fertilisation and changes in management practices.	including changes in land management practices and fertilisation effects of increased atmospheric CO2 and nitrogen deposition, leading to increased vegetation and soil carbon.	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 4, Line 41	Increased vertical stratification in the ocean is likely to accompany global warming.	Increased vertical stratification in the ocean is likely to accompany increasing global temperature.	Clarification	6-12-00	K. Maskell
	Ch 3	Page 5, Line 49	±10% uncertainty…	-10% to +30% uncertainty	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 5, Line 55 Exec summary	N/A – additional bullet	New studies with general circulation models including interactive land and ocean carbon cycle components also indicate that climate feedbacks have the potential to increase atmospheric CO2, but with large uncertainty about the magnitude of the terrestrial biosphere feedback.	Clarification	19-01-01	Jo House (Chapter 3)
	Ch 3	Page 6, Line 9	N/A - addition	There is sufficient uptake capacity in the ocean to incorporate 70 to 80% of foreseeable anthropogenic CO_2 emissions to the atmosphere, this process takes centuries due to the rate of ocean mixing. As a result, even several centuries after emissions occurred, about a quarter of the increase in concentration caused by these emissions is	Clarification	19-01-01	Jo House (Chapter 3)

				still present in the atmosphere.			
	Ch 3	Page 6, Line 10	N/A - addition	Add following sentence at beginning of bullet: CO_2 stabilisation at 450, 650 or 1000ppm would require global anthropogenic CO_2 emissions to drop below 1990 levels, within a few decades, about a century, or about two centuries respectively, and continue to steadily decrease thereafter	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 6, Line 10	CO_2 stabilisation requires…	Stabilisation requires…	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 10, Line 33	This calculation however assumes…	This calculation assumes…	Clarification	19-01-01	Jo House (Chapter 3)
	Ch 3	Page 10, Line 35		start new paragraph at beginning of “A higher bound....”	Clarification	19-01-01	Jo House (Chapter 3)
	Ch 3	Page 10, Line 35	Add text after “taken up by the land”	during the past 1 to 2 centuries, i.e. about half of the carbon taken up by the land and ocean combined, will be retained there.	Clarification	19-01-01	Jo House (Chapter 3)
	Ch 3	Page 10, Line 36	…reduction of ≈ 70 ppm.	…reduction of 0.70 x 200 = 140 PgC (≈ 70 ppm)	Clarification	19-01-01	Jo House (Chapter 3)
	Ch 3	Page 13, Line 35	N/A – addition at end of sentence	and interactions between the carbon and nitrogen cycles	Clarification	19-01-01	Jo House (Chapter 3)
	Ch 3	Page 13 Line 25	N/A: additional sentence before sentence starting “Changes in tissue…”	Increased CO_2 concentration may also stimulate nitrogen fixation (Hungate *et al.*, 1999; Vitousek & Field, 1999).	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 14 Lines 11 to 19	Replace existing text	At high CO_2 concentrations there can be no further increase in photosynthesis with increasing CO_2 (Farquhar *et al.*, 1980), except through further stomatal closure, which may produce continued increases in WUE in water-limited environments. The shape of the response curve of global NPP at higher CO_2 concentrations than present is uncertain because the response at the level of gas-exchange is modified by incompletely understood plant- and ecosystem-level processes (Luo *et al.*, 1999). Based on photosynthetic physiology, it is likely that the additional carbon that could be taken up globally by enhanced photosynthesis as a	Clarification	17-01-01	Jo House (Chapter 3)

				direct consequence of rising atmospheric CO_2 concentration is small at atmospheric concentrations above 800 to 1000 ppm. Experimental studies indicate that some ecosystems show greatly reduced CO_2 fertilisation at lower concentrations than this (Körner, 2000).			
	Ch 3	Page 22 Line 15	...primary cause...	...pacemaker...	Clarification	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 22 Line 25	Remove: "and Heinrich"	-	Clarification	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 22, Line 25	Dansgaard-Oeschger and Heinrich events…	Dansgaard-Oeschger events…	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 22 Line 26	....fluctuations associated with longer-lived of these events (Stauffer *et al.*, 1998)	....fluctuations of upto 20ppm associated with longer-lived events (Stauffer *et al.*, 1998, Indermühle *et al.*, 2000) [A. Indermühle, E. Monnin, B. Stauffer, T. Stocker and M. Wahlen, 2000. Atmospheric CO_2 concentration from 60 to 20 kyr BP from Taylor Dome ice core, Antarctica, Geophysical Research Letters **29**, 753-758.]	Clarification	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 22, Line 26	fluctuations associated with the longer-lived of these events (Stauffer *et al.*, 1998)	fluctuations of up to 20 ppm associated with the longer-lived events (Stauffer *et al.*, 1998, Indermühle *et al*., 2000)	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 22, Line 29	…1998…	…1999…	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 26 Line 14	N/A - addition. Add text at end of sentence	, except that estimated ocean uptake is smaller, and land uptake accordingly larger than given in the SRLULUCF (see Table 3.3, footnote i)	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 26 Line 41	....a range of –1.6 to –2.8 PgC/yr....	....a range of –1.5 to –2.8 PgC/yr....	Update	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 32 Line 15	…primary cause…	…pacemeaker…	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 33 Lines 40 to 41	The anthropogenic nitrogen input itself (Holland et al., 1999), and the fate of anthropogenic nitrogen in the ecosystem (Nadelhoffer *et al.*, 1999; Jenkinson *et al.*, 1999), represent major sources of uncertainty.	The anthropogenic nitrogen input itself (Holland et al., 1999), and the fate of anthropogenic nitrogen in the ecosystem (Nadelhoffer *et al.*, 1999; Jenkinson *et al.*, 1999), and changes in ecosystem nitrogen fixation (Vitousek and Field, 1999) represent	Clarification	17-01-01	Jo House (Chapter 3)

				major sources of uncertainty.			
	Ch 3	3.7.3 Page 37, Line 11	N/A – additional text	*Chapeau to 3.7.3, p.37, line 11 (immediately to follow heading of 3.7.3)* Carbon cycle models have indicated the potential for climate change to influence the rate of CO2 uptake by both land (section 3.7.1) and oceans (section 3.7.2) and thereby influence the time course of atmospheric CO2 concentration for any given emissions scenario. Coupled models are required to quantify these effects. Two general circulation model simulations have included interactive land and ocean carbon cycle components (Cox *et al.*, 2000; Friedlingstein *et al.*, 2000). The Cox *et al.* (2000) model was driven by CO2 emissions from the IS92a scenario (Legget *et al.*, 1992) and the Friedlingstein et al. (2000) model was driven by CO2 emissions from the SRES A2 scenario (IPCC, 2000b). Both simulations indicate a positive feedback, i.e. both CO2 concentrations and climate change at the end of the 21st century are increased due to the coupling. The simulated magnitudes of the effect differ (+70 ppm, Friedlingstein *et al.*, 2000; +270 ppm, Cox *et al.*, 2000). In the Cox *et al.* (2000) simulation, which included a DGVM, the increased atmospheric CO2 is caused mainly by loss of soil carbon and in part by tropical forest dieback. The magnitude of the climate-carbon cycle feedback still has large uncertainties associated with the response of the terrestrial biosphere to climate change, especially the response of heterotrophic respiration and tropical forest NPP to temperature (Cox *et al.*, 2000; see sections 3.2.2.3 and 3.7.1). In the following section, simplified models are used to assess these uncertainties.	Clarification	19-01-01	Jo House (Chapter 3)

	Ch 3	Page 37 Line 33	The Bern-CC model was described in Joos *et al*. (2000). It comprises:	The Bern-CC model comprises:	Paper not accepted	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 39 Line 26	Delete the final sentence: "This suggests that the high-CO_2 parametrisations may be unrealistic."	–	Clarification	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 40, Line 21	N/A – additional sentence at end of paragraph	CO_2 stabilisation at 450, 650 or 1000ppm would require global anthropogenic CO_2 emissions to drop below 1990 levels, within a few decades, about a century, or about two centuries respectively.	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 40, Line 35	…estimated to be ≈ 0.1 PgC/yr…	…estimated to be smaller than ≈ –0.1 PgC/yr..	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 40 Line 49	remove text “the most extreme”		Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 40 Line 50	…(2000) that incorporates this DGVM, suggest…	…(2000) suggest…	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 40 Line 49	....as the most extreme of the DGVMs in.....	....as some of the DGVMs in.....	Clarification	29-12-00	Jo House (Chapter 3)
	Ch 3	Page 40 Line 50	......climate-carbon model study of Cox *et al*. (2000) that incorporates this DGVM, suggest; however.....	.....climate-carbon model study of Cox *et al.* (2000), suggest; however.....	Clarification	29-12-00	Jo House (Chapter 3)
	Ch 3	Table 3.3 Page 65, Line 8		after numbers in SRLULUCF column, add reference to footnote “i” after -2.0+/-0.5	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Table 3.3 Page 65, Line 14	1989-1998	1989 to 1998	Clarification	20-01-01	Jo House (Chapter 3)
	Ch 3	Table 3.3 Page 65, Line 16	Change in 1990s column. 3.2±0.2	3.2±0.1	reason: old version of numbers, see table 3.1	20-01-01	Jo House (Chapter 3)
	Ch 3	Table 3.3 Page 65, Line 17	Change in 1990s column. 6.4±0.6	6.3±0.4	reason: old version of numbers, see table 3.1	20-01-01	Jo House (Chapter 3)
	Ch 3	Page 65 Line 37 – footnote i	…consistent with an uptake of…	…tuned to yield an ocean-atmosphere flux of…	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 65 Line 37–	…(IPCC, 1996; Harvey et al., 1997), consistent with an uptake of 2.0 PgC/yr in the	…(IPCC, 1996; Harvey et al., 1997), tuned to yield an ocean-atmosphere flux of 2.0 PgC/yr	Clarification	20-01-01	Jo House (Chapter 3)

		38 footnote i	1980s.	in the 1980s for consistency with the SAR. After re-calibration to match the mean behaviour of OCMIP models and taking account of the effect of observed changes in temperature aon CO2 and solubility, the same model yields an ocean-atmosphere flux of -1.7 PgC/yr for the 1980s and -1.9 PgC/yr for 1989 to 1998.			
	Ch 3	Page 65 Line 38	N/A - addition. Add text at end of sentence	for consistency with the SAR. After re-calibration to match the mean behaviour of OCMIP models and taking account of the effect of observed changes in temperature on CO_2 solubility, the same model yields an ocean-atmosphere flux of – 1.7 PgC/yr for the 1980s and – 1.9 PgC/yr for 1989 to 1998.	Clarification	17-01-01	Jo House (Chapter 3)
	Ch 3	Page 66 Lines 9 and 40	Ocean ^{13}C inventory –1.6 ± 0.7^{c} ^{c} Gruber and Keeling (1999)	Ocean ^{13}C inventory –1.5±0.9^{c} ^{c} Gruber and Keeling (2000)	Update	29-12-00 & 20-12-00	Jo House (Chapter 3)
	Ch 3	Page 66 Table 3.4 Lines 34 and 47	CO2 and N fertilisation –1.7 to –3.1 McGuire *et al*., (2000) and this chapter.	CO_2 fertilisation –1.5 to –3.1 McGuire *et al*., (2000).	Consistency with underlying chapter.	12-12-00 & 20-01-01	Jo House (Chapter 3)

Chapter 6: Changes to be Implemented in Technical Summary and Chapter 6 in light of SPM changes

* Incorporate the SPM sentence (or at least its sense) regarding recovery of stratospheric ozone.
“Assuming full compliance with current halocarbon regulations the positive forcing of the chlorofluorocarbons will be reduced as will the magnitude of the negative forcing from stratospheric ozone depletion as the ozone layer recovers over the 21st century”.
[Sec. 6.4]
* Check total WMGG forcing is 2.43 (not 2.42), and halocarbon forcing is 0.34 (not 0.33).
[Sec. 6.3]
* Consistency with SPM regarding stratospheric aerosols from “explosive” volcanic eruptions, and note the period of “major” volcanic eruptions.
[Sec. 6.9]
* Correction to figure 6.8 panel (d). “Sato” and “Robock” labels to be interchanged. {A new PostScript file is ready}.
[Sec. 6.15.1]

Figure 6.6

* Slight revision of the length bars for “Aviation – induced contrails and cirrus clouds”, to be made consistent with table 6.13.
* “SF6” not included in “Halocarbons”

SRES forcing [Section 6.15.2]

* Relative to 2000, CO$_2$ /Total GHG increases from ≥50% to about 75% in the 21st century.
[Sec. 6.15.2]
* Changes in anthropogenic aerosols “depend on the extent of fossil fuel use and policies to abate polluting emissions.”
[Sec. 6.15.2]
* Combine the direct-plus-indirect aerosol forcing estimate, and compare this to the change in CO$_2$…
[Sec. 6.15.2]
* Referring only to SRES “illustrative” scenarios here.
[Sec. 6.15.2]
* “estimated” → “projected”
[Sec. 6.15.2]
* p.45, 1.14 : “88” → “93” (gases in tables) 6.7, 6.8

<u>Typos, editorial etc.</u>

p.6, line 8 : “solar and” to “solar plus”
p.6, line 48 : “global-mean” before “responses”
p.10, line 23 : “atmosphere” to “climate system”
line 30 : “collocated” to “co-located”

p. 16, line 18 : “is” to “in”
p. 27, line 9 : check whether number should be “–0.23” or “-0.21” to be consistent with entry in Table 6.5
p. 32, line 6 : “the” before “simulations”

p. 36, line 17 : “they serve as” replaces “sufficiently”
p. 41, line 20 : “showed” to replace “ shown”
p. 42, line 11 : insert “there is” before “no”
p. 48, line 39 : change “agent” to “agents”
p. 51, line 21 : end sentence with “forcings”
line 45 : “artifact”; delete “of”
p. 52, line 7 : “areal” to replace “aerial”
p. 53, line 5 : replace “;” by “i.e.,”
line 6 : delete “are considered”
p. 53, line 36 : comma before “due”
line 37 : “Rather” in place of “However”
p. 54, line 31 : “6.10” instead of “6.11”
line 49 : insert “is estimated to have” before “occurred”
line 49 : “large increase” replaces “doubling”
line 50 : insert “biomass burning aerosols” before “and organic”
p. 56, line 8 : insert “source emission” before “estimates”
p. 57 line 7 : “Wetherald” instead of “Wheterald”
p 76, Table 6.1 The Radiative forcing for HFC-134a should be changed from 0.002 to 0.001.

<u>Minor clarifications</u>

Tables 6.7 and 6.8:

- “Radiative efficiency” for total sky or clear-sky only
- Amplify “see text” statements

Hopefully, Fig. 6.2 will be in color. Otherwise, the B&W version will need some newer labels for clarity of plot.

Fig. 6.4 : Check to see whether all acronyms appearing here are explained in the IPCC document.

Fig. 6.6 caption: “BB” is no longer separated into “bc” and “oc” components. Amend sentence.

Based on discussions re: SPM Figure 3 (which is based on Figure 6.6), the chapter and Technical Summary will avoid the use of the word “uncertainty range” and “uncertainty estimate”.

Changes received on 12 Feb:

pg. 2, l. 36 and 44: Land-use section is 6.10, and Solar is 6.11.

pg. 4, l. 20: insert "(halogen-containing compounds)" after "halocarbons"

pg. 5, l. 15: insert "explosive" after "aerosols from"

pg. 6, l. 16: replace "will continue" by "are projected"
, l. 20: insert after end of sent.
"Relative to 2000, the change in the direct plus
indirect aerosol
radiative forcing is projected to be smaller in magnitude
than that of CO2."

pg. 36, l. 25: insert ", explosive" after "episodic"
, l. 46: insert after end of sent.
"Several major volcanic eruptions occurred between 1880 and
1920, and between 1960 and 1991."

pg. 45, l. 14: change "88" to "93"

pg. 47, l. 39: delete "for the most part";
insert "and physical understanding" after "results"

pg. 48, l. 27: insert "(0.35 +/- 0.15 W/m2)" after "ozone"

pg. 56, l. 46: insert after end of sent.
"Relative to 2000,
the change in the
direct plus indirect aerosol radiative forcing is projected to
be smaller in magnitude than that of CO2."

pg. 84, Table 6.7, insert after first sent. of caption:
"Radiative efficiency is defined with respect to
cloudy sky."
, first entry row: replace "see text" by
"(see section 6.12.2)"

pg. 86, Table 6.8, insert after first sent. of caption:

"Radiative efficiency is defined with respect to
cloudy sky."

pg. 89, Table 6.11, entry for "land-use", column 3:
modify as "-0.20[100%]"

pg. 101, Fig. 6.6 caption:
l. 5: delete "for the most part";
l. 6: insert "and physical understanding" after "forcing"
l. 15; insert after "6.11" the following:
"; halocarbons refers to all halogen-containing
compounds listed in Table 6.1"
l. 15-16: replace "Each of these" by "Fossil-fuel burning"

Some revisions to the "Shanghai" revisions: (apologies if you have to undo some changes already performed):

pg. 27, l. 9: the number here "0.23" is correct; leave as it was in the Oct. 00 draft.

pg.54, l. 31: should be "section 6.11" (as it was in the Oct. 00 draft)

pg. 56, l. 8: leave as it was in the Oct. 00 draft

Table 6.5, entry under "Biomass burning" and "Penner et al. and Grant et al.:
replace "Internal mixture of OC and BC" by
Internal/external mixture of OC and BC";
change "0.21" to "0.23"

We have decided not to follow up the original inclination of not using the word "uncertainty range" in the Chapter Summary as well as in Fig. 6.6 and text. This is because we explicitly declare that this has no connection with statistics nor with the use of the word elsewhere in the document. We think there are enough caveats so that there is no ambiguity with the different sense of the word here as compared with its usage in the rest of the document.

Re: your queries:

pg. 52, l. 44: which SRES scenario? Not relevant as all SRES scenarios are similar for 2000 which is what the plot is about.

Table 6.6:

IT IS TRUE THAT A, B, C, AND D ARE NOT EXPLAINED NEITHER IN TABLE NOR IN TEXT. HOWEVER THE INFORMATION IS USED IN SOME OTHER LINES OF THE REMARK COLUMN. WE DO NOT NEED TO EXPLAIN THESE, AND IT WOULD BE ENOUGH TO SAY "Use 4 different ..... concentrations (labelled as A, B, C, and D)".

"Include a parametrisation of cloud nucleation processes" refer to all 3 lines (the first 3 entries on this page - page 81) of the Lohmann et al (2000) study.

"Include a parametrisation of cloud nucleation processes" and "Include the effect of BC absorption in clouds" refer to the Chuang et al (2000b) studies (and covers the last 3 entries in the wide column 2.

Perhaps, leave some space between "sulphate and carb." of the Lohmann et al. study, and the "sulphate" of the Chuang et al. study.

ACTUALLY A MUCH BETTER TABLE was sent TO TSU BUT IT WAS REFORMATTED BY TSU TO PRODUCE THE FINAL DRAFT. IT may BE BETTER TO RETURN TO THE ORIGINAL VERSION. CAN RE-SEND IT IF NEEDED.

It nay read better to convert "use" to "uses" and "include" to "includes" in the entries for this table.

Table 6.7:
You could change the footnotes to letters. OK to whatever TSU wants to do - be careful as there are several footnotes here.

Table 6.10: Direct, min and max are explained in text. Not necessary to add to the Table caption. If needed, you could say "(see section 6.12.3.3)"

	Chapt. / App.	Section (& line)	Old text	New text	Reason for change	Date	Name
	Ch 9	Page 3 Line 23	GHG plus sulfates	greenhouse gas plus sulphates (GS)	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 3 Line 24	GHG-only	greenhouse gas-only (G)	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9 Exec summ	Page 5, line 19	Choice of model makes as large or larger a difference than choice of scenario…	Choice of model makes a difference comparable to choice of scenario…-	Consistency throughout chapter	16-01-01	C. Johnson (TSU)
	Ch 9 Exec summ	Page 5, Line 46	N/A - addition	Beyond 2100, the THC could completely shut down, possibly irreversibly, in either hemisphere if the rate of change in radiative forcing is large enough and applied long enough. The implications of a complete shut down of the THC have not been fully explored.	Clarification & consistency	18-01-01	R. Stouffer
	Ch 9	Page 9, Line 48	Delete (GHG)		Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 11, Line 4	Section 9.3.2.1	Section 9.3.3	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 12, Line 12	forcing stabilized	radiative forcing stabilized	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 14 Line 27	N/A - addition	The impact of uncertainty due to missing or misrepresented processes can, however, be limited by requiring model simulations to reproduce recent observed climate change. To the extent that errors are linear (i.e. they have proportionally the same impact on the past and future changes), it is argued in 12.4.3.3 that the observed record provides a constraint on forecast anthropogenic warming rates over the coming decades that does not depend on any specific model's climate sensitivity, rate of ocean heat uptake and (under some scenarios) magnitude of sulphate forcing and response.	Consistency with SPM	18-01-01	M. Allen
	Ch 9	Page 15, Line 32	$\{\Delta T^2\} = T_f^2 + \{T_m^2\} + \{(T''-T')^2\} = T_f^2 + \sigma^2_M + \sigma^2_N$.	$\{\Delta T^2\} = T_f^2 + \{T_m^2\} + \{T''^2\} = T_f^2 + \sigma^2_M + \sigma^2_N$.	Formula corrected	18-01-01	U. Cubasch (CLA)

	Ch 9	Page 17, Line 29	AMIP2	CMIP2G	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 17, Line 51	N/A – additional sentence	The diagonal is the correlation between G and GS patterns from the same model.	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 19, Line 1	(Brinkop and Sausen, 1999)	(Brinkop 2000, see also Cubasch *et al*, 1999)	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 19, Line 51	N/A – addition to first sentence after “models’ responses”	…for the scenarios considered here.	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9	Page 19, Line 51-52	Thus, the choice of model makes a bigger difference to the simulated response than the choice of scenario.	Thus, the choice of model and the choice of scenario are both important.	Clarification	19-01-01	U. Cubasch (CLA)
	Ch 9 9.3.2.1	Page 19, line 52	…makes a bigger difference…	…makes a comparable difference…	Consistency throughout chapter	16-01-01	C Johnson (TSU)
	Ch 9	Page 20, Lines 4-6	…carried forward into…	…considered in…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 5	…which incorporate…	…that incorporate…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 9	…preliminary…	…draft…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 19	to the IS92a scenario	with the IS92a scenario	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 31	Delete the sentence: The approach used here is therefore one of caution.		Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 43	…in the SAR, it is well…	…employed in the SAR. It is well…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 47	…SRES scenarios are shown…	…SRES scenarios are both shown…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 50	…IS92e and IS92c…	…IS92c and IS92e…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 50	…range for the new…	…range in forcing for the new…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 51	and shifted higher…[delete “shifted”] ….variation in forcing from…	and higher…… variation in emission of…	Clarification	19-01-01	S. Raper
	Ch 9	Page 20, Line 52	Delete “and sulphate aerosols”		Clarification	19-01-01	S. Raper
	Ch 9	9.3.3 page 20, line 52	The shift to higher forcing is mainly due to the reduced future sulphur dioxide emissions of the SRES scenarios compared to the IS92 scenarios, but also due to the revised forcing	The shift to higher forcing is mainly due to the reduced future sulphur dioxide emissions of the SRES scenarios compared to the IS92 scenarios. Secondary factors include generally	Clarification	19-01-01	S. Raper and D. Griggs

			calculations. In addition, the slightly larger cumulative carbon emissions featured in some SRES scenarios has a small effect.	greater tropospheric ozone forcing, the inclusion of climate feedbacks in the carbon cycle and slightly larger cumulative carbon emissions featured in some SRES scenarios.			
	Ch 9	9.3.3 Page 21, line 26	N/A - addition	Add to last sentance: ...in 2100 as a result of generally lower emissions across the whole range of greenhouse gases.	Clarification	24-10-00	S. Raper and D. Griggs
	Ch 9	Page 21, Line 35	…SRES scenarios tends to be shifted higher compared to the range for the IS92 scenarios largely due to the reduced sulphur dioxide emissions in the new scenarios	…SRES scenarios is shifted higher compared to the range for the IS92 scenarios primarily because of the higher forcing as described above. [Delete rest of paragraph up to line 38]	Clarification	19-01-01	S. Raper and D. Griggs
	Ch 9	9.3.3 Page 22 Line 1	In view of the fact that not all AOGCMs are represented, it is fair to say that the range due to differences in emissions and different model responses contribute similar amounts to the range of uncertainty in future global temperature change (Figure 9.15).	By 2100, the differences in the surface air temperature response across the group of climate models forced with a given scenario is as large as the range obtained by a single model forced with the different SRES scenarios (Figure 9.15). Given the quasi-linear nature of the simple model, projections which go outside the range as yet explored by AOGCMs must be treated with caution since non-linear effects may come into play.	Clarification	24-10-00	S. Raper and D. Griggs
	Ch 9 9.3.3	Page 22, Line 2	…contribute similar amounts…	…contribute comparable amounts…	Consistency throughout chapter	16-01-01	C. Johnson (TSU)
	Ch 9	9.3.3 Page 22 Line 12	N/A - additional sentence after last line in paragraph.	The climate effects described here use the SRES scenarios as contained in Nakicenovic et al. (2000). Any feedbacks on the socio-economic development path and hence emissions, as a result of these climate changes have not been included.	Clarification	24-10-00	S. Raper and D. Griggs
	Ch 9	Page 22, Line 21	…Wigley et al. (1996)	…Wigley *et al.* (1996, see also Wigley, 2000)	Clarification	19-01-01	S. Raper
	Ch 9	Page 22, Lines 26-27	…for example, they assume 1999 CO_2 concentrations which were in reality exceeded.	…for example, they require emissions and concentration values during the 1990s below those actually observed.	Clarification	19-01-01	S. Raper
	Ch 9	Page 22, Line 32	(Schimel et al., 1997; Mitchell et al. 2000)	(Wigley *et al.*, 1996, Schimel *et al.*, 1997; Mitchell *et al*. 2000)	Clarification	19-01-01	S. Raper
	Ch 9	Page 22, Line 48	Raper et al. (1996)	Wigley and Raper (1992), Raper *et al*. (1996)	Clarification	19-01-01	S. Raper

	Ch 9	Page 22, Line 54	…included for comparison, where available.	… included for comparison.	Clarification	19-01-01	S. Raper
	Ch 9	Page 23, Line 5	However, the results…	The results…	Clarification	19-01-01	S. Raper
	Ch 9	Page 23, Line 8	…forcing from aerosols scaled to SO2…	…forcing from sulphate aerosols…	Clarification	19-01-01	S. Raper
	Ch 9	Page 23, Line 9	Except for N_2O, all the other anthropogenic greenhouse gas concentrations stabilise…	CH_4 concentrations stabilise…	Clarification	19-01-01	S. Raper
	Ch 9	Page 23, Line 11	…due to this later stabilisation of the other gases…	…due to the later stabilisation of other gases…	Clarification	19-01-01	S. Raper
	Ch 9	Page 23, Lines 22-24	Delete: “the other gas emissions follow…to compare different CO_2 stabilisation targets.”		Clarification	19-01-01	S. Raper
	Ch 9	Page 23 Line 36	N/A - addition	Only one GCM study has considered the regional effects of stabilizing CO_2 concentrations (Mitchell et al 2000). HadCM2, which has an effective climate sensitivity in the middle of the IPCC range (Table 9.1), was run with the S550ppm and S750 ppm stabilization profiles (“S profiles”, Enting et al, 1994, Schimel et al, 1994). Simulations with a simple climate model (Schimel et al,1997) indicate that the global mean temperature response in these profiles is likely to differ by no more than about 0.2^{o}C from the equivalent WRE profiles (Wigley et al, 1996, see Figure 9.16), though the maximum rate of temperature change is likely to be lower with the S profiles. Global mean changes in the GCM experiments are similar to those in IPCC Tech Paper 3. Note that the GCM experiments consider stabilization of CO_2 concentrations only, and do not take into account changes in other gases, effectively assuming concentrations of other gases are stabilized immediately. To allow for ongoing increases in other greenhouse gases, one would have in practice to reduce CO_2 to even lower levels to obtain the same level of climate change. For example, in the IS92a scenario, other trace gases contribute 1.3	Consistency with Synthesis report	18-01-01	J. Mitchell

				W/m^2 to the radiative forcing by 2100. If the emissions of these gases were to continue to increase as in the IS92a scenario, then CO$_2$ levels would have to be reduced by about 95ppm to maintain the same level of climate change in these experiments. Changes in temperature and precipitation averaged over 5 Sub-continental regions at 2100 were compared to those in a baseline scenario based on 1% /year increase in CO$_2$ concentrations from 1990. With both stabilization profiles, there were significant reductions in the regional temperature changes but the significance of the regional precipitation changes depended on location and season. The response of GCMs to idealised stabilization profiles is discussed in 9.3.4.4.			
	Ch 9	Page 26, Line 47	collapse in the THC	shut down of the THC	Clarification	19-01-01	R. Stouffer
	Ch 9	Page 26, Line 48	collapse of the THC…	complete shut down of the THC…	Clarification	19-01-01	R. Stouffer
	Ch 9	Page 30, Line 37	…flux correction…	…flux adjustment…	Clarification	19-01-01	R. Stouffer
	Ch 9	Page 35, Line 3	Delete: …due to the warmer surface…		Clarification	18-01-01	U. Cubasch
	Ch 9	Page 37, Line 33 to Page 38, Line 16	Delete text	Insert all of Extremes table and associated introductory paragraph, starting, "Table 1…"	Clarification	20-01-01	G. Meehl (CLA)
	Ch 9	Page 37, Line 47 Table 9.6	Table 9.6 has to be made consistent with the Table in the SPM	Table 9.6 has to be made consistent with the Table in the SPM	Clarification	20-01-00	U. Cubasch (CLA)
	Ch 9	Page 38, Lines 2-8	Footnote to Table 9.6 has to be made consistent with the Table 1 footnote in the SPM.	Footnote to Table 9.6 has to be made consistent with the Table 1 footnote in the SPM.	Clarification	20-01-00	U. Cubasch (CLA)
	Ch 9	Page 38, Line 18	N/A – additional text to insert after table	Hot days refers to a day whose maximum temperature reaches or exceeds some	Clarification	20-01-01	G. Meehl (CLA)

				temperature that is considered a critical threshold for impacts on human and natural systems. Actual thresholds vary regionally, but typical values include 32^{o}C, 35^{o}C, or 40^{o}C.			
	Ch 9	App 9.1 Page 40, Line 4	The justification was comparisons of temperature projections from this model and some AOGCMs (for example SAR Fig. 6.13).	The justification for using the simple model for this purpose was the model's ability to simulate AOGCM results in controlled comparisons spanning a wide range of forcing cases (for example SAR Fig. 6.13).	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 8	Thus a range of results…	In this way a range of results…	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Lines 9-10	The ability of the tuned models is tested by comparisons with the AOGCM results in the DDC data set and where available…	The validity of the tuning is tested by comparisons with AOGCM results in the DDC data set and, where available,…	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 11	Delete: (Harvey et al., 1997)		Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 13	…coupled AOGCMs.	…coupled AOGCMs (Harvey *et al*., 1997)	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Lines 13-14	Simple models also allow the quantification of the effect of uncertainties in the climate sensitivity and the ocean heat uptake. Potentially other simple models could also be used, for example, Watterson (2000), Visser et al. (2000)	Simple models also allow the effect of uncertainties in the climate sensitivity and ocean heat uptake to be quantified. Potentially, other simple models (for example, Watterson (2000), Visser et al. (2000)) could be used in a similar way.	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Lines 23-26	Delete: The question arises as to why apparently good simple model simulations were obtained with the original……a good result was obtained.		Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Lines 28-30	Delete: This value for the GFDL_R15_a model…was compensated by a relatively low value of T_{2x}.		Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 32	…appropriate for…	…appropriate to…	Clarification	19-01-01	S. Raper

	Ch 9	App 9.1 Page 40, Line 36	The range here is smaller…	The range here is much smaller…	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40 Line 38	N/A - additional text after the sentence: A decrease in the strength of the thermohaline circulation leads to an increased heat flux into the ocean.	In the UD/EB model a weakening of the thermohaline circulation is represented by a decline in the upwelling rate (see SAR). An instantaneous 30% decline in the UD/EB model upwelling rate gives rates of sea level rise comparable to that seen in the GFDL model over a period of 500 years. Thus a 30% decline in the UD/EB model upwelling rate represents a collapse in the thermohaline circulation.	Clarification	24-10-00	S. Raper and D. Griggs
	Ch 9	App 9.1 Page 40 Line 38-	N/A - additional text after the sentence: A decrease in the strength of the thermohaline circulation leads to an increased heat flux into the ocean. Delete sentence lines 40-42: The rate of sea level rise from thermal expansion….in the GFDL model control run.	In the UD/EB model a weakening of the thermohaline circulation is represented by a decline in the upwelling rate (see SAR). The rate of sea level rise from thermal expansion for a collapse in the thermohaline circulation in the UD/EB model is tuned to match that which occurs for an induced collapse in the GFDL model control run. An instantaneous 30% decline in the UD/EB model upwelling rate gives rates of sea level rise comparable to that seen in the GFDL model over a period of 500 years. Thus a 30% decline in the UD/EB model upwelling rate represents a collapse in the thermohaline circulation.	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 42	Delete sentence: This is achieved by proportional changes in the UD/EB model upwelling rate.		Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Lines 49-50	…heat flux into the ocean so errors tend to accumulate.	…heat flux into the ocean. Errors therefore tend to accumulate.	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 53	…UD/EB model that are adjusted relate to correctly simulating the greater surface temperature…	…UD/EB model are adjusted in order to correctly simulate the greater surface temperature…	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 40, Line 55	…which govern…	…that govern…	Clarification	19-01-01	S. Raper

	Ch 9	App 9.1 Page 41, Line 6	…upwelling which is scaled…	…upwelling that is scaled…	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 41, Line 7	…parameters are as in Raper et al. (1996)	…parameters are as used in the SAR (Kattenberg *et al*., 1996, Raper *et al*., 1996)	Clarification	19-01-01	S. Raper
	Ch 9	App 9.1 Page 41, Line 14	…zero upwelling	…a collapse of the THC	Clarification	19-01-01	S. Raper
	Ch 9	Page 69 to 83	Figures 9.10a to e, 9.11a to e and 9.12a to e	Upper and lower figures combined into one. Latest model data included (CMIP)	Clarity Accuracy	09-01-01	U. Cubasch (CLA)
	Ch 9	Page 90	Figure 9.19b	HadCM2 graphs made consistent with other runs.	Accuracy	09-01-01	U. Cubasch (CLA)
	Ch 9	Page 102	Figure 9.31	Figure 9.31 has to be made consistent with the “Extremes Table” in the SPM	Clarification	20-01-01	U. Cubasch (CLA)

Chapter 9, insert on page 22 before line 1 (Proposed by Sir John and Ulrich, 23 Jan)

“Considering the six illustrative scenarios, the bars on the right hand side of Figure 9.14 show that scenarios A1F1 and B1 alone, define the top and bottom of the range of projected temperature changes respectively. Towards the middle of the range the scenario bars overlap, indicating that most of the projections fall within this region. In the corresponding sea level rise figure, because of the greater inertia in the ocean response, there is a greater overlap in the projected response to the various scenarios (c.f. Chapter 11). In addition, the sea level range for a given scenario is broadened by inclusion of uncertainty in land ice estimates.”

TAR Chapter 10

Text on page 3, lines 32-48

The following conclusions are based on seasonal mean patterns at sub-continental scales emerging from current AOGCM simulations. Based on considerations of consistency of changes from two IS92a-type emission scenarios and preliminary results from two SRES emission scenarios within the range of these four scenarios:

- It is very likely that: Nearly all land areas will warm more rapidly than the global average, particularly those at high latitudes in the cold season; in Alaska, northern Canada, Greenland, northern Asia, and Tibet in winter and central Asia and Tibet in summer the warming will exceed the global mean warming in each model by more than 40% (1.3 to 6.9°C for the range of models and scenarios considered). In contrast, the warming will be less than the global mean in south and southeast Asia in JJA, and in southern south America in winter.
- It is likely that: Precipitation will increase over northern mid-latitude regions in winter and over northern high latitude regions and Antarctica in both summer and winter. In DJF, rainfall will increase in tropical Africa, show little change in southeast Asia and decrease in central America. There will be increase or little change in JJA over south Asia. Precipitation will decrease over Australia in winter and over the Mediterranean region in summer. Change of precipitation will be largest over the high northern latitudes.

Box 1 Fig 2 pg 15 line 24: Change (‘Increase’) to (‘Small Increase’)

Box 1 Fig 2 Pg 15 line 26: Change (‘Decrease’) to (Small Decrease’)

Pg 66, Fig 10.6: Change (‘Increase’) to (‘Small Increase’) and Change (‘Decrease’) to (‘Small decrease’)

Pg 4 line 7: change “likely” to “very likely”

	Chapt. / App.	**Section (& line)**	**Old text**	**New text**	**Reason for change**	**Date**	**Name**
	Ch 11	Page 3 Line 26	*Append to old text*	... (as with other ranges of uncertainty, we do not imply that the central value is the best estimate)	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 4 Line 11	*Append to old text*	It is very likely that 20th century climate change has made a contribution to 20th century sea level rise.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 5 Line 5	*Append to old text*	Glacier retreat will continue and the loss of a substantial fraction of the total glacier mass is likely. Areas that are currently marginally glaciated are most likely to become ice-free.	New text in Exec Summ, copied from chapter text	16-01-01	J. Gregory (CLA)
	Ch 11	Page 10 Line 22	*Append to old text*	The rates are means over the periods indicated, while a quadratic fit is used to obtain the acceleration, assumed constant. Under this assumption, the rates apply to the midpoints (1950 and 1975) of the periods. Since the midpoints are 25 years apart, the difference between the rates is 25 times the acceleration. This relation is not exact because of interannual variability and non-constant acceleration.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 10 Tab 11.2	CSM GS	CSM 1.3 GS	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 11 Tab 11.3 Row 5	Volume (sea level equivalent)[cd]	Sea level rise equivalent[d]	Clarification	16-01-01	J Gregory (CLA)
	Ch 11	Page 11 Tab 11.3 Row 5	*On the figures for Greenland and Antarctica (Columns 5 and 6), add superscript c; no change to the numbers*	2.85[c] *for Greenland* 25.71[c] *for Antarctica*	Clarification	16-01-01	J Gregory (CLA)
	Ch 11	Page 11 Line 27	After isostatic rebound and sea water replacing grounded ice.	For the ice sheets, sea level rise equivalent is calculated with allowance for isostatic rebound and sea water replacing grounded ice, and this therefore less than the sea level equivalent of the ice volume.	Clarification	16-01-01	J Gregory (CLA)
	Ch 11	Page 11	Peninsula	Peninsula, which have a total area of 0.14 x	Clarification	16-01-01	J. Gregory

		Line 23		10^6 km^2 (Weideck and Morris, 1996)			(CLA)
	Ch 11	Page 18 Line 19	200 000	140 000	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 22 Line 38	of about 1000 years (Figure 11.3)	of order a few thousand years (Figure 11.5)	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 22 Line 45	past 6,000 years	past 6,000 years, with a descreasing contribution in the last few thousand years	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 23 Line 9	It would be inconsistent to combine contributions from ongoing glacial melt with solutions in which the rheological parameters have been inferred without allowing for this possibility.	The occurrence of such sea level maxima places a upper limit on the magnitude of glacial melt in recent millennia (e.g. Peltier, 2000), but it would be inconsistent to combine estimates of ongoing glacial melt with results of calculations of isostatic rebound in which the rheological parameters have been inferred assuming there is no ongoing melt.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 24 Line 14	*Append to old text*	(Section 11.3.1)	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 24 Tab 11.8	*Following the line for Nakiboglu and Lambeck (1991) in the Table, insert a line:*	Douglas (1991), Global, ICE-3G/M1, 1.8 ± 0.1	Omission	16-01-01	J. Gregory (CLA)
	Ch 11	Page 25 Line 26	observed rates of rise	observed rates of relative sea level rise	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 25 Line 40	five	six	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 25 Line 40	similar PGR corrections	PGR corrections derived from global models of isostatic adjustment	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 25 Line 53	For the upper bound, we use the average of estimates using global PGR models of 1.8 mm/yr, plus an allowance for systematic uncertainties, to give a value of 2.0 mm/yr during the 20th century.	For the upper bound, we adopt a limit of 2.0 mm/yr, which includes all recent global estimates with some allowance for systematic uncertainty. As with other ranges (see Box 1), we do not imply that the central value is the best estimate.	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 26 Line 7	very long records	very long tide-gauge records	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 27 Line 16	Shum et al. (1999) and Guman et al. (1999) have combined data from the less accurate GEOSAT altimeter data (late 1986 to late 1988) with ERS and TOPEX/POSEIDON data, using in situ tide-gauge data for cross-		Delete because references not published	16-01-01	J. Gregory (CLA)

			calibration. They find a global sea-level trend of 1.0 ± 2.1 mm/yr over the 12 year period.				
	Ch 11	Page 28 Line 27	*Append to old text*	(Section 11.3.1)	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 28 Line 43	1990.	1990. The 20th century terms for Greenland and Antarctica are derived from ice sheet models because observations cannot distinguish between 20th century and long-term effects. See Section 11.2.3.3.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 29 Line 19	The terrestrial storage terms may offset some of this acceleration.	If the terrestrial storage terms have a negative sum (Section 11.2.5), they may have offset some of the acceleration in recent decades.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 29 Line 22	*Append to old text*	The sum of terms not related to recent climate change is -1.1 to +0.9 mm/yr (i.e. excluding thermal expansion, glaciers and ice caps, and changes in the ice sheets due to 20th century climate change). This range is less than the observational lower bound of sea level rise. Hence it is very likely that these terms alone are an insufficient explanation, implying that 20th century climate change has made a contribution to 20th century sea level rise.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 29 Line 50	six illustrative		Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 29 Line 51	*Append to old text*	The results are given as sea level change relative to 1990 in order to facilitate comparison with previous IPCC reports, which used 1990 as their base date.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 30 Line 20	*Append to old text*	See Table 11.2 for thermal expansion from AOGCM experiments for the 20th century.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 33 Line 30	experiments.	experiments. Results were extrapolated to 2100 for experiments ending at earlier dates.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 34 Line 12	*Append to old text*	The methods used to make the sea level projections are documented in detail in the Appendix to this chapter.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 34 Line 38	-0.19 to +0.10 m	-0.21 to +0.11 m	Correction	16-01-01	J. Gregory (CLA)

	Ch 11	Page 34 Line 44	0.02 m	0.02 m or less	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 34 Line 44	0.19 m	0.18 m	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 34 Line 45	relative to their central value	expressed as a fraction of their central value	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 39, Line 21	(Huybrechts et al., 1991)	(Huybrechts et al., 1991; see also Oerlemans, 1991, Van de Wal and Oerlemans, 1994)	Directed by plenary – increased support for Greenland melting scenarios	14-12-00	J.A. Church, J.M. Gregory, (CLAs)
	Ch 11	Page 39, Line 27	(Figure 11.16)	(Figure 11.16) (see also Letreguilly et al., 1991)	Directed by plenary – increased support for Greenland melting scenarios	14-12-00	J.A. Church, J.M. Gregory, (CLAs)
	Ch 11	Page 39 Line 36	would be eliminated	would be largely eliminated	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 40 Line 25	no direct observational evidence	no conclusive observational evidence (from monitoring of surface elevation, 11.2.3.2)	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 41 Line 17	the WAIS expert panel	a recent expert panel	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 41 Line 45	*Insert*	It is valuable to note that the reduction in the uncertainty of estimation of the long-term ice sheet imbalance reported in sections 11.3.1 and 11.4 came from indirect constraints and the synthesis of information of different types. Such syntheses offer promise for further progress.	Moved text	16-01-01	J. Gregory (CLA)
	Ch 11	Page 42 Line 46	It is valuable to note that the reduction in the uncertainty of estimation of the long-term ice sheet imbalance reported in sections 11.3.1 and 11.4 came from indirect constraints and the synthesis of information of different types		Moved text	16-01-01	J. Gregory (CLA)
	Ch 11	Page 43 Line 38	Minster et al., 1999		Correction	16-01-01	J. Gregory (CLA)

	Ch 11	Page 64 caption Line 1	200 000	140 000	Correction	16-01-01	J. Gregory (CLA)
	Ch 11	Page 65 caption Line 6	plus the small water loading term	including a small water loading term (not shown)	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 70 caption Line 2	*Append to old text*	Note that uncertainties in land ice calculations have not been included.	Clarification	16-01-01	J. Gregory (CLA)
	Ch 11	Page 76 caption Line 4	*Append new text*	Note that projected temperatures over Greenland are generally greater than globally averaged temperatures (by a factor of 1.2 to 3.1 for the range of AOGCMs used in this chapter). See Table 11.12 and Fig 9.10c.	Consistency with TS	14-12-00	J.A. Church, J.M. Gregory, (CLAs)
	Ch 11	Refs	*Add new refs*	Letreguilly, A., P. Huybrechts, N. Reeh, 1991: Steady-state characteristics of the Greenland ice sheet under different climates. *J Glaciology*, **37**, 149-157. Oerlemans, J., 1991: The mass balance of the Greenland ice sheet: sensitivity to climate change as revealed by energy balance modelling. *Holocene*, **1,** 40-49. Van de Wal, R.S.W. and J. Oerlemans, 1994: An energy balance model for the Greenland ice sheet. *Glob Planetary Change*, **9,** 115-131	Directed by plenary – increased support for Greenland melting scenarios	14-12-00	J.A. Church, J.M. Gregory, (CLAs)

Chapter 11 Pages 63-65, Figures 11.3-11.5: The captions are correct, but the graphics are in the wrong places. The graphic for Figure 11.3 is currently on Page 65, for Figure 11.4 on Page 63, and for Figure 11.5 on Page 64. Chapter 11 Page 70: Figure 11.10c was omitted.

Chapter 11 – Changes associated with land ice uncertainties

Prepared 16-01-01 for the Shanghai Plenary by J M Gregory and J A Church, CLAs

In response to referees' comments, we have carefully reevaluated the uncertainties associated with the land ice calculations. As a result we have expanded some uncertainties for improved consistency with the published literature. Consequently we propose a number of small changes to results, and addition of extra descriptive text. Where we have supplied replacement paragraphs below, the changed parts are italicised.

Page 4 Lines 19-26, replace with:

- thermal expansion of 0.11 to 0.43 m, accelerating through the 21st century,
- a glacier contribution of *0.01 to 0.23* m,
- a Greenland contribution of *-0.02 to 0.09* m,
- an Antarctic contribution of *-0.17 to 0.02* m.

Including thawing of permafrost, deposition of sediment, and the ongoing contributions from ice sheets as a result of climate change since the Last Glacial Maximum, we obtain a range of global-average sea-level rise from *0.11 to 0.77* m. This range reflects systematic uncertainties in modelling.

Page 4 Lines 28-33, replace with:

For the 35 SRES scenarios, we project a sea-level rise of *0.09 to 0.88* m for 1990 to 2100, with a central value of *0.48* m. The central value gives an average rate of *2.2-4.4* times the rate over the 20th century. If terrestrial storage continued at its present rates, the projections could be changed by *-0.21 to +0.11* m. *For an average AOGCM, the SRES scenarios give results which differ by 0.02 m* or less for the first half of the 21st century. By 2100, they vary over a range amounting to about 50% of the central value. Beyond the 21st century, sea-level rise will depend strongly on the emissions scenario.

Page 16 Line 28, delete the sentence beginning "The direct", and insert a new paragraph as follows:

The model results for Greenland exhibit substantial interannual variability. Furthermore, because of rising temperatures during the 20th century, the contribution for recent decades is larger than the average for the century. These points must be borne in mind when comparing with results of the direct observation methods for short periods in recent decades (sections 11.2.3.1 and 11.2.3.2). Note also that the observational results include the ongoing response to past climate change as well as the effect of 20th century climate change.

Page 16 Line 54, replace the text from “Some palaeoclimatic data …” to the end of the paragraph with:

Some palaeoclimatic data from central Greenland ice cores indicate that variations in precipitation during the Holocene are related to changes in atmospheric circulation rather than directly to local temperature (Kapsner et al., 1995; Cuffey and Clow, 1997), such that precipitation might not increase with temperature (in contrast with Clausen et al., 1988). For glacial-interglacial transitions, the ice cores do exhibit a strong positive correlation between temperature and precipitation (Dansgaard et al., 1993; Dahl-Jensen et al., 1993; Kapsner et al., 1997; Cuffey and Marshall, 2000), as simulated by AOGCMs for anthropogenic warming. Although other changes took place at the glacial-interglacial transition, this large climate shift could be argued to be a better analogue for anthropogenic climate change than the smaller fluctuations of the Holocene. To allow for changes in circulation patterns and associated temperature and precipitation patterns, we have used time-dependent AOGCM experiments to calculate the Greenland contribution (Section 11.5.1).

Page 30 Line 35, delete the sentence beginning “Glaciers”.

Page 31 Line 8-10, delete the sentence beginning “Lack of information”.

Page 31 Line 15, insert two new paragraphs:

Glaciers and ice caps on the margins of the Greenland and Antarctic ice sheets are omitted from these calculations, because they are included in the ice sheet projections below. These ice masses have a large area (Table 11.3), but experience little ablation on account of being in very cold climates. Van de Wal and Wild (2000) find that the Greenland marginal glaciers contribute an additional 7% to glacier melt in a scenario of CO_2 doubling over 70 years. Similar calculations using the AOGCM IS92a results give a maximum contribution of 14 mm for 1990-2100. For the Antarctic marginal glaciers, the ambient temperatures are too low for there to be any significant surface runoff. Increasing temperatures will increase the runoff and enlarge the area experiencing ablation, but their contribution is very likely to remain small. For instance, Drewry and Morris (1992) calculate a contribution of 0.012 mm/yr/°C to the global glacier mass balance sensitivity from the glacier area of 20 000 km^2 which currently experiences some melting on the Antarctic Peninsula.

Lack of information concerning glacier areas and precipitation over glaciers, together with uncertainty over the projected changes in glacier area, lead to uncertainty in the results. We assess this as ±40%, matching the uncertainty of the observed mass balance estimate of Dyurgerov and Meier (1997b)”.

Page 32 Line 12, replace the phrase “because of the larger precipitation increases and smaller temperature rise in the ablation zone” with “because of the larger precipitation increases and the seasonality of temperature changes (less increase in summer) predicted by AOGCMs, and the smaller temperature rise in the ablation zone”.

Page 32 Line 15, insert an additional paragraph:

The use of a range of AOGCMs represents the uncertainty in modelling changing circulation patterns, which lead to both changes in temperature and precipitation, as noted by Kapsner et al. (1995) and Cuffey and Clow (1997) from the results from Greenland ice cores. The range of AOGCM thermodynamic and circulation responses gives a range of 4-8%/°C for Greenland precipitation increases, generally less than indicated by ice-cores for the glacial-interglacial transition, but more than for Holocene variability (Section 11.2.3.4). If precipitation did not increase at all with greenhouse warming, Greenland local sensitivities would be larger, by 0.05-0.1 mm/yr/°C (see also Table 11.7). Given that all AOGCMs agree on an increase, but differ on the strength of the relationship, we include an additional uncertainty of 0.02 mm/yr/°C on the Greenland local sensitivities, being the product of the standard deviation of precipitation increase (1.5%/°C) and the current Greenland accumulation (1.4 mm/yr sea level equivalent, Table 11.5).

Page 32 Line 20, replace the sentence beginning “An additional uncertainty” with:

We include a separate uncertainty of the same size to reflect the possible sensitivity to use of different high-resolution geographical patterns of temperature and precipitation change (the T106 ECHAM4 pattern was the only one available).

Page 32 Line 28, append:

We include an uncertainty of 0.08 mm/yr/°C on the local sensitivity, which is its inter-model standard deviation, to reflect the spread of precipitation changes as a function of temperature.

Page 32 Table 11.12, replace the table, in order to add an extra column:

Experiment	Greenland	Antarctica

	Sea-level rise (m) 1990-2090	Sensitivity (mm/yr/°C)		$\Delta T/\Delta T_g$	$1/P\ dP/dT$ (%/°C)	Sea-level rise (m) 1990-2090	Sensitivity (mm/yr/°C)		$\Delta T/\Delta T_g$
		dB/dT_g	dB/dT				dB/dT_g	dB/dT	
CGCM1 GS	0.03	0.13	0.10	1.3	2.7	-0.02	-0.12	-0.11	1.1
CSIRO Mk2 GS	0.02	0.16	0.08	2.0	5.9	-0.07	-0.37	-0.33	1.1
CSM 1.3 GS	0.02	0.15	0.05	3.1	7.8	-0.04	-0.31	-0.27	1.1
ECHAM4/OPYC3 GS[a]	-	0.03	0.03	1.2	6.5	-	-0.48	-0.32	1.5
GFDL_R15_a GS[b]	-	0.12	0.06	1.9	4.1	-	-0.18	-0.22	0.8
HadCM2 GS	0.02	0.10	0.07	1.4	4.0	-0.04	-0.21	-0.17	1.2
HadCM3 GSIO	0.02	0.09	0.06	1.4	4.5	-0.07	-0.35	-0.28	1.3
MRI2 GS	0.01	0.08	0.05	1.6	4.4	-0.01	-0.14	-0.12	1.2
DOE PCM GS	0.02	0.14	0.06	2.2	5.6	-0.07	-0.48	-0.30	1.6

Page 33 Line 4 Table 11.12, add an extra footnote:

$1/P\ dP/dT$	Fractional change in ice-sheet average precipitation as a function of temperature change.

Page 33 Line 13, replace “0.14-0.70” with “0.11-0.77”.

Page 33 Table 11.13 caption Line 33, replace “glacier and Greenland” with “land ice”.

Page 33 Table 11.13, replace the table, in order to update the uncertainties:

Experiment	Sea-level rise (m) 1990-2100									
	Expansion		Glaciers		Greenland		Antarctica[a]		Sum[b]	
	min	max	min	max	min	max	min	max	min	max
CGCM1 GS	0.43		0.03	0.23	0.00	0.07	-0.07	0.02	0.45	0.77
CSIRO Mk2 GS	0.33		0.02	0.22	-0.01	0.08	-0.12	-0.04	0.29	0.60

ECHAM4/OPYC3 GS^c		0.30		0.02	0.18	-0.02	0.03	-0.17	-0.06	0.19	0.48
GFDL_R15_a GS^c		0.38		0.02	0.19	-0.01	0.09	-0.09	-0.01	0.37	0.67
HadCM2 GS		0.23		0.02	0.17	-0.01	0.05	-0.09	0.00	0.21	0.48
HadCM3 GSIO		0.24		0.02	0.18	0.00	0.05	-0.13	-0.03	0.18	0.46
MRI2 GS		0.11		0.01	0.11	0.00	0.03	-0.04	0.00	0.11	0.31
DOE PCM GS		0.19		0.01	0.13	-0.01	0.06	-0.13	-0.04	0.12	0.37
Range		0.11	0.43	0.01	0.23	-0.02	0.09	-0.17	0.02	0.11	0.77
Central value		0.27		0.12		+0.04		-0.08		0.44	
SAR 7.5.2.4	Best estimate	0.28		0.16		+0.06		-0.01		0.49	
	Range									0.20	0.86

Page 33 Line 36, replace footnote (a) to Table 11.1.3 with:

(a) Note that this range does not allow for uncertainty relating to ice-dynamical changes in the West Antarctic ice sheet. See Section 11.5.4.3 for a full discussion.

Page 34 Lines 14-17, replace with:

For the complete range of AOGCMs and SRES scenarios and including uncertainties in land-ice changes, permafrost changes and sediment deposition, global average sea-level is projected to rise by *0.09-0.88* m over 1990-2100, with a central value of *0.48* m (Figure 11.12). The central value gives an average rate of *2.2-4.4* times the rate over the 20th century.

Page 34 Line 23-26, delete the text from "They included" to "In addition", beginning the following sentence with “Ice sheet mass balance”, and insert a new paragraph after line 29 as follows:

In addition, Warrick et al. included an allowance for ice-dynamical changes in the West Antarctic ice sheet. The range we have given does not include such changes. The contribution of the WAIS is potentially important on the longer term, but it is now widely agreed that major loss of grounded ice from the WAIS and consequent accelerated sea-level rise are very unlikely during the 21st century. Allowing for the possible effects of processes not adequately represented in present models, two risk assessment studies involving panels of experts concluded that there was a 5% chance that by 2100 the WAIS could make a substantial contribution to sea level rise, of 0.16 m (Titus and Narayanan, 1996) or 0.5 m (Vaughan et al., 2000). These studies also noted a 5% chance of WAIS contributing a sea level fall of 0.18 m or 0.4 m respectively. (See 11.5.4.3 for a full discussion.)

Page 40 Line 49, append “while Titus and Narayanan give 0.18 m”.

Page 71, replace Figure 11.11 with a revised version.

Page 72, replace Figure 11.12 with a revised version. Replace the corresponding figure in the Technical Summary and the Summary for Policymakers.

Page 72, append to the caption of Figure 11.12:

Note that this range does not allow for uncertainty relating to ice-dynamical changes in the West Antarctic ice sheet. See 11.5.4.3 for a full discussion.

Add the following references:

Clausen, H. B., N. S. Gundestrup, S. J. Johnsen, R. A. Bindschadler and H. J. Zwally, 1988: Glaciological investigations in the Crete area, Central Greenland. A search for a new drilling site. *Annals of Glaciology*, 10, 10-15.

Dahl-Jensen, D., S.J. Johnsen, C.U. Hammer, H.B. Clausen and J. Jouzel, 1993: Past accumulation rates derived from observed annual layers in the GRIP ice core from Summit, Central Greenland. In: Ice in the climate system, W.R. Peltier (ed), NATO ASI Series, I 12, pp. 517-532.

Dansgaard, W., S.J. Johnsen, H.B. Clausen, D. Dahl-Jensen, N.S. Gundestrup, C.U. Hammer, C.S. Hvidberg, J.P. Steffensen, A.E. Sveinbjoernsdottir, J. Jouzel and G.C. Bond, 1993: Evidence for general instability of past climate from a 250-kyr ice-core record. *Nature*, 364, 218-220.

Drewry, D.J. and E.M. Morris, 1992: The response of large ice sheets to climatic change. *Philosophical Transactions of the Royal Society of London* B, 338, 235-242.

Chapter 11 – New Appendix

Prepared 16-01-01 for the Shanghai Plenary by J M Gregory and J A Church, CLAs

This proposed Appendix provides detailed documentation of the methods used in Chapter 11 to make sea level projections.

Appendix 11.1: Methods for projections of global-average sea-level rise

This Appendix describes the methods used in this report to make sea-level rise projections for the SRES scenarios for the 21st century. The results are discussed in section 11.5.1.2 and shown in Figure 11.12 and Appendix II.

Global-average sea-level rise $h(t)$ is a function of time t and is expressed relative to the level in 1990. It comprises several components, which are all zero at 1990:

$$\Delta h(t) = X(t) + g(t) + G(t) + A(t) + I(t) + p(t) + s(t)$$

The components are sea-level rise due to:

X	thermal expansion.
g	loss of mass of glaciers and ice caps.
G	loss of mass of the Greenland ice sheet due to projected and recent climate change.
A	loss of mass of the Antarctic ice sheet due to projected and recent climate change.
I	loss of mass of the Greenland and Antarctic ice sheets due to the ongoing adjustment to past climate change.
p	runoff from thawing of permafrost.
s	deposition of sediment on the ocean floor.

The components X, g, G and A are estimated for each of 35 SRES scenarios using the projections of an upwelling-diffusion energy-balance (UD/EB) model calibrated separately for each of seven AOGCMs (Appendix 9.1).

Thermal expansion X is obtained directly from the thermal expansion $X_m(t)$ projected by the UD/EB model:

$$X(t) = X_m(t) - X_m(1990)$$

No uncertainty is included in this term, because the uncertainty is sufficiently represented by the use of a range of AOGCMs.

The term g from glaciers and ice caps is estimated using the global average temperature change $T_m(t)$ projected by the UD/EB model. First, we obtain the loss of mass g_u with respect to the glacier steady state without taking contraction of glacier area into account.

$$g_u(t) = g_{1990} + \int_{1990}^{t} (T_{1990} + \Delta T_b + T_m(t') - T_m(1990)) \frac{\partial B_g}{\partial T_g} \mathrm{d}t'$$

where g_{1990} is the sea-level rise from glaciers and ice caps up to 1990 calculated from AOGCM results without contraction of glacier area, T_{1990} is the AOGCM global average temperature change at 1990 with respect to the climate of the late 19th century, T_b = 0.15 K the difference in the global average temperature between the late 19th century and the glacier steady state (see 11.5.1.1) and B_g/ T_g is the sensivity of global glacier mass balance for constant glacier area to global-average temperature change, expressed as sea-level equivalent (from Table 11.11). Second, we estimate the loss of mass g_u with respect to the glacier steady state taking into account contraction of glacier area. This is done by using an empirical relationship between the loss of mass for changing and for constant area. The relationship was obtained by a quadratic fit to the AOGCM IS92a results of section 11.5.1.1.

$$g_s(t) = 0.934 g_u(t) - 1.165 g_u^2(t)$$

for g_u and g_s in metres. Third, we calculate the change since 1990.

$$g(t) = g_s(t) - g_s(1990)$$

The uncertainty $g(t)$ on this term is calculated assuming an uncertainty of ±40% (standard deviation) in the mass balance sensitivities, as discussed in section 11.5.1.1.

$$\boldsymbol{d}g(t) = 0.40 g(t)$$

The term G from the Greenland ice sheet is calculated according to

$$G(t) = \int_{1990}^{t} (T_{1990} + T_m(t') - T_m(1990)) \frac{\mathrm{d}B_G}{\mathrm{d}T_g} \mathrm{d}t'$$

where $\mathrm{d}B_G/\mathrm{d}T_g$ is the sensitivity of the Greenland mass balance to global-average temperature change, expressed as sea-level equivalent (from Table 11.12). The uncertainty on this term comprises two components, as discussed in section 11.5.1.1. The first uncertainty is a mass balance uncertainty

$$\boldsymbol{d}G_1(t) = \int_{1990}^{t} (T_{1990} + T_m(t') - T_m(1990)) \frac{\Delta T_G}{\Delta T_g} \boldsymbol{d}m_G \ \mathrm{d}t'$$

where m_G = 0.05 mm/yr/ C and $\Delta T_G/\Delta T_g$ is the ratio of Greenland average temperature change to global average temperature change (from Table 11.12). The first uncertainty is the combination in quadrature of 0.03 mm/yr/ C from ablation parametrisation, 0.03 mm/yr/ C from high-resolution patterns, and 0.02 mm/yr/ C from precipitation changes, as discussed in section 11.5.1.1. The second uncertainty is an ice-dynamic uncertainty

$$\boldsymbol{d}G_2(t) = 0.1 G(t)$$

The term A from the Antarctic ice sheet is calculated according to

$$A(t) = \int_{1990}^{t} (T_{1990} + T_m(t') - T_m(1990)) \frac{\mathrm{d}B_A}{\mathrm{d}T_g} \mathrm{d}t'$$

where $\mathrm{d}B_A/\mathrm{d}T_g$ is the sensitivity of the Antarctic mass balance to global-average temperature change, expressed as sea-level equivalent (from Table 11.12). Ice-dynamical uncertainty for the Antarctic is not included and is discussed in section 11.5.4.3. There is no uncertainty for ablation. Precipitation change uncertainty is calculated as discussed in section 11.5.1.1 according to

$$\boldsymbol{d}A(t) = \int_{1990}^{t} (T_{1990} + T_m(t') - T_m(1990)) \frac{\Delta T_A}{\Delta T_g} \boldsymbol{d}m_A \ \mathrm{d}t'$$

where m_A = 0.08 mm/yr/ C and $\Delta T_A/\Delta T_g$ is the ratio of Antarctic average temperature change to global average temperature change (from Table 11.12).

The uncertainties on the above terms are combined in quadrature.

$$dh_v = \sqrt{(dg)^2 + (dG_1)^2 + (dG_2)^2 + (dA)^2}$$

The remaining terms are calculated assuming they contribute to sea-level rise at a constant rate, independent of AOGCM and scenario, thus:

$$I(t) = \int_{1990}^{t} \frac{\mathrm{d}I}{\mathrm{d}t'}\,\mathrm{d}t' \qquad p(t) = \int_{1990}^{t} \frac{\mathrm{d}p}{\mathrm{d}t'}\,\mathrm{d}t' \qquad s(t) = \int_{1990}^{t} \frac{\mathrm{d}s}{\mathrm{d}t'}\,\mathrm{d}t'$$

The rates each have a range of uncertainty. For d*I*/d*t*, this is 0.0-0.5 mm/yr (section 11.3.1, Table 11.9), for d*p*/d*t* 0-0.23 mm/yr (the upper bound is more precisely 25 mm divided by 110 yr, section 11.2.5), for d*s*/d*t* 0-0.05 mm/yr (section 11.2.6, Table 11.9). The central rates are 0.25, 0.11 and 0.025 mm/yr for the three terms. We denote *I* calculated at the minimum rate by I_{min} and at the maximum rate by I_{max}; similarly for *p* and *s*. The minimum projected sea-level rise $h_{\mathrm{min}}(t)$ for a given AOGCM and SRES scenario is given by

$$\Delta h_{\mathrm{min}}(t) = X(t) + g(t) + G(t) + A(t) - 2dh_v(t) + I_{\mathrm{min}}(t) + p_{\mathrm{min}}(t) + s_{\mathrm{min}}(t)$$

and the maximum is

$$\Delta h_{\mathrm{max}}(t) = X(t) + g(t) + G(t) + A(t) + 2dh_v(t) + I_{\mathrm{max}}(t) + p_{\mathrm{max}}(t) + s_{\mathrm{max}}(t)$$

In these formulae, h_v has been doubled to convert from an uncertainty to a range, following Box 11.1.

Table 11.16: Parameters used in sea-level projections to simulate AOGCM results.

AOGCM	T_{1990} (C)	g_{1990} (m)	B_g/ T_g (mm/yr C)	$\mathrm{d}B_G/\mathrm{d}T_g$ (mm/yr /•C)	$\mathrm{d}B_A/\mathrm{d}T_g$ (mm/yr / C)	$\Delta T_G/\Delta T_g$	$\Delta T_A/\Delta T_g$
CSIRO Mk2	0.593	0.022	0.733	0.157	-0.373	2.042	1.120
CSM 1.3	0.567	0.021	0.608	0.146	-0.305	3.147	1.143
ECHAM4/OPYC3	0.780	0.027	0.637	0.029	-0.478	1.153	1.484
GFDL_R15_a	0.635	0.015	0.576	0.121	-0.177	1.879	0.799
HadCM2	0.603	0.027	0.613	0.096	-0.214	1.441	1.239
HadCM3	0.562	0.021	0.622	0.085	-0.354	1.443	1.288
DOE PCM	0.510	0.017	0.587	0.136	-0.484	2.165	1.618

Changes to Appendix II.5.1, for clarity and consistency with modified land ice uncertainties in Chapter 11

Append to the note on page 30 line 21 as follows:
The sum of the components listed in Appendices II.5.2-5 does not equal the values shown above owing the addition of other terms. See Section 11.5.1 for details.

Replace the values in the "Models minimum" table, page 30 lines 24-36, as follows:

Year	A1B	A1FI	A1T	A2	B1	B2
1990	0	0	0	0	0	0
2000	6	6	6	6	6	6
2010	13	13	13	13	13	13
2020	22	22	24	21	22	23
2030	34	33	36	31	32	34
2040	48	47	49	44	42	45
2050	63	66	64	58	52	56
2060	78	89	77	75	63	68
2070	93	113	89	93	72	79
2080	107	137	99	113	80	91
2090	119	160	106	133	87	103
2100	129	182	111	155	92	114

Replace the values in the "Models maximum" table, page 30 lines 42-54, as follows:

Year	A1B	A1FI	A1T	A2	B1	B2
1990	0	0	0	0	0	0
2000	29	29	29	29	29	29
2010	63	63	65	64	64	65
2020	103	104	110	104	105	109
2030	153	153	164	149	151	159
2040	214	214	228	204	203	216
2050	284	291	299	269	259	277
2060	360	386	375	343	319	344
2070	442	494	453	430	381	414
2080	527	612	529	526	444	488
2090	611	735	602	631	507	566
2100	694	859	671	743	567	646

	Chapt. / App.	Section (& line)	Old text	New text	Reason for change	Date	Name
	Ch 12	Exec Summary, Page 3, line 28	Insert extra sentence before “Estimates…”	The warming over the past 100 years is very unlikely to be due to internal variability alone as estimated by current models	Sentence from SPM, which is a helpful summary	20-01-01	D.Karoly
	Ch 12	Page 4, Line 52	…the rate of warming…	…the rate of anthropogenic warming…	Clarification	20-01-01	M. Allen
	Ch 12	Page 4, Line 143	…model simualted…	…model-simulated…	Typo	20-01-01	D.Karoly
	Ch 12	Page 4, Line 147	Insert at end of present sentence	Most studies find that, over the last 50 years, the estimated rate and magnitude of warming due to increasing concentrations of greenhouse gases alone are comparable with or larger than the observed warming. Furthermore, most models estimated that take into account both greenhouse gases and sulphate aerosols are consistent with		20-01-01	D.Karoly
	Ch 12	Page 5, Lines 131- Page 6, Line 117	Delete Synopsis section	Insert SPM text on detection and attribution completely	The SPM is the best agreed summary	20-01-01	D.Karoly
	Ch 12	Page 16, Line 21	…and increased more rapidly in the 1950s.	…and increased more rapidly in the 1950s, though not as fast as greenhouse gases.	Accuracy	09-01-01	J. Mitchell (CLA)
	Ch 12	Page 16, Line 121	…in the 1950s.	…in the 1950s, though not as fast as greenhouse gas emissions.	Response to Govt comment	20-01-01	D.Karoly
	Ch 12	Page 20, Line 125	(Gaffen et al, 2000; National Academy of Sciences, 2000)	(Parker et al, 1997; Gaffen et al, 2000)	Govt comment	20-01-01	D.Karoly
	Ch 12	Page 25, Line 133	Section 12.2.3.2	Section 12.2.3.3		20-01-01	D.Karoly
	Ch 12	Page 29, Line 145	Insert sentence from Figure caption	The best agreement between model simulations and observations over the last 140 years is found when both anthropogenic and natural factors are included (Stott et al, 2000c, Fig. 12.7c). These results show that the forcings included are sufficient to explain the observed changes but do not exclude the possibility that other forcings also have	Ensure consistency with SPM	20-01-01	D.Karoly

				contributed.			
	Ch 12	Fig 12.2	The dotted line …upper bound on observed internal variabilty	The dotted line therefore provides a conservative (high) estimate of observed internal variability at all frequencies. New sentence:- Differences between the spectra shown here and the corresponding figure in Stouffer et al (2000) shown in figure 8.18 are due to the use here of a longer (1861-2000) observational record, as opposed to 1881-1991 in 8.18. That figure also shows 2.5-97.5% uncertainty ranges, while for consistency with other figures in this chapter, the 5-95% range is displayed here.			
	Ch 12	Page 52 Table 12.2	The 1990 greenhouse gas forcing for GFDL_R30 = 2.7	The 1990 greenhouse gas forcing for GFDL_R30 = 2.1	Correction	09-01-01	J. Mitchell (CLA)
	Ch 12	Page 31, Line 21		After “scenario”: Allen et al (2000b) quote a 5-95% (“very likely”) uncertainty range of 0.11-0.24°C/decade for the decades 1996-2046 under the IS92a scenario, but given the uncertainties and assumptions behind their analysis, the more cautious “likely” qualifier is used here. For comparison, the simple model tuned to the results of 7 AOGCMs used for projections in Chapter 9 gives a range of 0.12-0.22°C/decade under the IS92a scenario, although it should be noted that this similarity may reflect some cancellation of errors and equally good agreement between the two approaches should not be expected for all scenarios, nor for timescales longer than the few decades for which the Allen et al (2000b) approach is valid.		22-01-01	M. Allen
	Ch 12	Page 31, Line 28		Insert new paragraph: It must be stressed that the approach illustrated in Figure 13 only		22-01-01	M. Allen

				addresses the issue of uncertainty in the large-scale climate response to a particular scenario of future greenhouse gas concentrations. This is only one of many interlinked uncertainties in the climate projection problem, as illustrated in Figure 13.2. Research efforts to attach probabilities to climate projections and scenarios are explored in Chapter 13, Section 5.2.3.			

	Chapt. / App.	**Section (& line)**	**Old text**	**New text**	**Reason for change**	**Date**	**Name**
	Ch.13	End of 13.5.2.3		Efforts to make explicit probabilistic forecasts of the climate response to a given emissions scenario for the near future have been made using the current observed climate trajectory to constrain the "forecasts" from several GCMs (Allen et al 2000). More details on this technique are given in Section 12.4.3.3.	Completeness	**20-01-01**	**L Mearns**

	Ch 14	Page 1, Line 9	N/A - Additon	Contributing Author R. J. Stouffer (USA)	Completeness	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Lines 3-4	Many factors…. climate changes may be.	Further work is required to improve the ability to detect, attribute, and understand climate change, to reduce uncertainties, and to project future climate changes. In particular, there is a need for additional systematic observations, modelling and process studies. A serious concern is the decline of observational	Consistency with SPM	09-02-01	B. Moore (CLA)

				networks.			
	Ch 14	Page 2, Line 6	Replace “Arrest” with “Reverse”	Replace “Arrest” with “Reverse”	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Lines 9-10	*Expand the observational…spatial coverage.*	*Sustain and expand the observational foundation for climate studies by providing accurate, long-term, consistent data including implementation of a strategy for integrated global observations.*	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Line 16	*Estimate better future…and aerosols.*	*Understand better the mechanisms and factors leading to changes in radiative forcing; in particular, improve the observations of the spatial distribution of greenhouse gases and aerosols.*	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Lines 26-28	*Understand and characterise*….prognostic capabilities generally.	*Understand and characterise the important unresolved processes and feedbacks, both physical and biogeochemical, in the climate system.* Increased understanding is needed to improve prognostic capabilities generally.	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Line 32	N/A –additional sentence after …*climate variability.*	*Address more completely patterns of natural climate variability including the occurrence of extreme events.*	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Lines 39-40	*Explore more fully….model calculations.*	*Improve methods to quantify uncertainties of climate projections and scenarios, including development and exploration of long term ensemble simulations using complex models.*	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 2, Lines 46-47	*….with emphases on improving the simulation of regional impacts and extreme weather events.*	*….with a focus on the simulation of climate variability, regional climate changes, and extreme events.*	Consistency with SPM	09-02-01	B. Moore (CLA)

	Ch 14	Page 2, Lines 54, 55 and Page 3, Line 1	*Link more formally….components of the Earth system.*	*Link more effectively models of the physical climate and the biogeochemical system, and in turn improve coupling with descriptions of human activities.*	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 3, Lines 6-13	*Accelerate internationally progress*….relevant to decision making.	Cutting across these foci are crucial needs associated with strengthening international co-operation and coordination in order to better utilize scientific, computational, and observational resources. This should also promote the free exchange of data among scientists. A special need is to increase the observational and research capacities in many regions, particularly in developing countries. Finally, as is the goal of this assessment, there is a continuing imperative to communicate research advances in terms that are relevant to decision making.	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 11, Line 38	N/A – additional new paragraph	We note that the Subsidiary Body for Scientific and Technical Advice (SBSTA) recognised the importance of an Integrated Global Observing Strategy Partnership in developing observing systems for the oceans and terrestrial carbon sources and sinks in the global carbon cycle and in promoting systematic observations.	Consistency with SPM	09-02-01	B. Moore (CLA)
	Ch 14	Page 5, Line 25	….investigations are needed (see Section 8.4.1…)	….investigations are needed to reach the objective of avoiding dependence on flux adjustment (see Section 8.4.1…)	Clarification	09-02-01	B. Moore (CLA)
	Ch 14	Page 8, Line 19	….particularly carbon and nitrogen.	…carbon, nitrogen, phosphorous, sulfur, iron, and silicon.	Clarification	09-02-01	B. Moore (CLA)
	Ch 14	Page 10, Line 41	….observations over the arctic of ocean….	….observations over the arctic including ocean….	Clarification	09-02-01	B. Moore (CLA)

	Ch 14	Page 11, Line 32	…calibrated network of stations for monitoring…	…calibrated network for monitoring…	Clarification	09-02-01	B. Moore (CLA)
	Ch 14	Page 11, Line 33	….carbon sinks is central.	….carbon sources and sinks is central.	Clarification	09-02-01	B. Moore (CLA)
	Ch 14	Page 11, Line 35	… data sets so that model intercomparision activities can move…	…data sets that allow model intercomparision activities to move…	Clarification	09-02-01	B. Moore (CLA)
	Ch 14	Page 13, Lines 50-51	Delete text …since patterns of predicted….of soil moisture.	Sentence ends "…is an essential step."	Clarification	09-02-01	B. Moore (CLA)

	Glossary	-	Various	**-**	For consistency with other WGs	14-12-00	A. Baede, D. Griggs, N. Leary, R. Swart *et al*.
	Glossary			**Proxy** A *proxy* climate indicator is a local record that is interpreted, using physical and biophysical principles, to represent some combination of climate-related variations back in time. Climate related data derived in this way are referred to as *proxy data*. Examples of proxies are: tree ring records, characteristics of corals, and various data derived from ice cores.	Clarification	20-01-01	A. Baede