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INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE

UNEP

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"CLIMATE CHANGE 2001: IMPACTS, ADAPTATION AND VULNERABILITY", THE CONTRIBUTION OF WORKING GROUP II TO THE IPCC THIRD ASSESSMENT REPORT

CHAPTER CHANGES FROM THE FINAL GOVERNMENT REVIEW

Changes proposed to be made to the underlying assessment (except for the Technical Summary, which is separately submitted as IPCC-XVII/Doc. 3c, Add. 1), for consistency with the approved Summary for Policymakers (ref. IPCC-XVII/Doc. 3c), and accepted by the Working Group at its Sixth Session (Geneva, 13-16 February 2001), are attached. The proposed changes will be made to the underlying assessment. The underlying assessment was distributed to governments prior to the Sixth Session (ref. WGII-VI/Doc. 3). On this understanding, therefore, the underlying assessment is hereby submitted to the Panel for acceptance.

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IPCC Working Group II Chapter Modifications
Based on Review Editor and Final Government Review Comments; Some editorial comments included, others will be included after copy-edit
February 16, 2001

Chapter 1: Overview of Impacts, Adaptation, and Vulnerability to Climate Change
No major changes

Chapter 2: Methods and Tools

Page 1: For Contributing Authors, add the following country affiliations: Ahmed (Bangladesh), Ayton (UK), Petschel-Held (Germany), and North (USA)

Page 9, line 4-5: Delete “starting from 1910 when the first stations were put in place..”
Reason: Simplification of presentation

Page 9, line 7: replace “from 90 years to <10 years” with “widely”
Reason: Simplification of presentation

Chapter 3: Developing and Applying Scenarios

Page 5, paragraph 1, L13: 14-80 cm 9-88 cm

Page 8, Executive Summary, L4-17: Change "*Changes in the frequency and intensity of extreme climate events* can also be expected. Under greenhouse gas forcing up to 2100, there is very high confidence that daytime maximum and minimum temperatures will increase, accompanied by an increased frequency of hot days. There is also high confidence that heat waves will become more frequent, while the number of cold waves and of frost days (in applicable regions) will decline. Increases in high intensity precipitation events are expected at many locations, the number of wet spells will increase at mid and high latitudes in winter, while the frequency of summer drought will increase in many interior continental locations (all high confidence). There is medium confidence in a more El Niño-like mean state of the circulation in the tropical Pacific and that El Niño events themselves could increase in intensity. While there is low confidence in an increased frequency of tropical cyclones, their peak wind intensity and mean and peak precipitation intensities are expected to increase (high confidence). Increases in the average intensity of mid-latitude storms and in the frequency of hail and lightning are all assigned medium confidence. Finally, the likelihood of two singular events that imply potentially major impacts – a complete shutdown of the ocean thermohaline circulation and the disintegration of the West Antarctic Ice Sheet – is very low for the period up to 2100, but may increase substantially in successive centuries depending on the rate of climate change during the 21st century."

to read

"*Changes in the frequency and intensity of extreme climate events* can also be expected. Based on the conclusions of the Working Group I report, and the likelihood scale employed there, under greenhouse gas forcing up to 2100, it is very likely that daytime maximum and minimum temperatures will increase, accompanied by an increased frequency of hot days. It is also very likely that heat waves will become more frequent, while the number of cold waves and of frost days (in applicable regions) will decline. Increases in high intensity precipitation events are likely at many locations while Asian summer monsoon precipitation variability is also likely to increase. The frequency of summer drought will increase in many interior continental locations and it is likely that droughts, as well as floods, associated with El Niño events will intensify. The peak wind intensity and mean and peak precipitation intensities of tropical cyclones are likely to increase, while the direction of changes in the average intensity of mid-latitude storms cannot be determined using current climate models."

Page 14, Section 3.3.1, L7: greehouse greenhouse

Page 14, Section 3.3.2.1, L6: (Klein Goldewijk, 2000; (Klein Goldewijk, 2001;

Page 22, Section 3.4.6.1, paragraph 3, L4: human health at the large scale: 26% of the human health in some regions. Overall, 26% of the

Page 26, Section 3.5.4.2, L3: Jones, 1996 CSIRO, 1997

Page 27, Section 3.5.4.4, paragraph 6, L3: (Mearns *et al.*, 1998, 1999, 2000; (Mearns *et al.*, 1998, 1999, 2001;

Page 27, Section 3.5.4.4, paragraph 6, L4: Whetton *et al*. (2000) Whetton *et al*. (2001)

Page 27, Section 3.5.4.4, paragraph 6, L4: Mearns *et al*. (1999, 2000) Mearns *et al*. (1999, 2001)

*Page 29, Section 3.5.4.5, L54: Omission to read (see Chapter 9, WG I ~~and Table 3-10, below~~).

Page 36, Section 3.8.2, paragraph 2, L9: 14-80 cm 9-88 cm

Page 37, Section 3.8.3.2, paragraph 2, L7-8: Omit the entire sentence: "~~To summarise this information, Figure 3-3 depicts the upper and lower estimates of the decadal rate of seasonal temperature and precipitation change for all thirty-two regions.~~"

Page 37, Section 3.8.3.2, end of paragraph 2: Omit Figure 3-3

*Page 39, Section 3.8.5, L50-52: Substitute "Table 3-10 summarises current knowledge and confidence levels in relation to a number of types of extreme weather and climate events (see Chapter 1 for a typology), and illustrates how climate extremes may be, and to some extent have been, applied in impact assessments."

to read

"Table 3-10 summarises projected changes in a number of types of extreme climate events and their likelihood taken from the Working Group I, Technical Summary (see Chapter 1, Table 1-1 for a typology). Table 3-10 also provides representative examples, drawn from different sectors and regions, of impacts that would expected with high confidence conditional on the occurrence of a given change in climate extremes."

Page 53, Table 3-2, footnote a: Revise to read (note that this revision is contingent upon a revision to Table 3-9):

"*Future*: values for 2010, 2050 and 2100 are for the range of emissions from 35 SRES scenarios using a simple model (Data from S.C.B. Raper, Chapter 9, WG I). Note that these ranges differ from those presented by Working Group I (see Table 3-9, footnote c for explanation)."

Page 60, Table 3-9: Add footnote c to heading of column 5, as follows: "CO_2 concentration[c]" and revise footnote c d and d e

Page 60, Table 3-9: Insert footnote c to read:

[c] Modelled values are not the same as those presented by Working Group I (WG I, Appendix II), which were based on simulations using two different carbon cycle models for the 6 illustrative SRES emissions scenarios. Both models produce very similar results to the model applied here for a mid-range climate sensitivity; discrepancies in the high and low estimates are attributable to differences in the modelled climate-carbon cycle feedback.

Page 60, Table 3-9: Revise values for sea-level rise:

2050
2 5
29 32
2100
14 9
80 88

Pages 61-62, Table 3-10: Substitute existing Table 3-10 with Table SPM-1 and its caption, as approved in the IPCC Plenary: (See Next page

Examples of impacts resulting from projected changes in extreme climate events

Projected changes during the 21st century in extreme climate phenomena and likelihood*	**Representative examples of projected impacts ** (all *high* confidence of occurrence in some areas***)**
Simple extremes	
Higher maximum temperatures, more hot days and heat waves**** over nearly all land areas (Very likely*)	• Increased incidence of death and serious illness in older age groups and urban poor [TS, 4.7] • Increased heat stress in livestock and wildlife [TS, 4.2, 4.3] • Shift in tourist destinations [Table TS-2, TS, 5.7] • Increased risk of damage to a number of crops [Chapter 5] Increased electric cooling demand and reduced energy supply reliability [Table TS-4, TS 4.5]
Higher [Increasing] minimum temperatures, fewer cold days, frost days and cold waves**** over nearly all land areas (Very likely*)	• Decreased cold-related human morbidity and mortality [TS, 4.7] • Decreased risk of damage to a number of crops, and increased risk to others [Chapter 5] • Extended range and activity of some pest and disease vectors [TS, 4.2, 4.3] • Reduced heating energy demand [TS, 4.5]
More intense precipitation events (Very likely*, over many areas)	• Increased flood, landslide, avalanche, and mudslide damage [TS 4.5] • Increased soil erosion [TS, 5.2.4] • Increased flood runoff could increase recharge of some floodplain aquifers [Chapter 4] • Increased pressure on government and private flood insurance systems and disaster relief [Table TS-4, TS, 4.6]
Complex extremes	
Increased summer drying over most mid-latitude continental interiors and associated risk of drought (Likely*)	• Decreased crop yields [TS 4.2] • Increased damage to building foundations caused by ground shrinkage [Table TS-4] • Decreased water resource quantity and quality [TS, 4.1, 4.5] • Increased risk of forest fire [TS, 5.4.2]
Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities (Likely*, over some areas)*****	• Increased risks to human life, risk of infectious disease epidemics and many other risks[TS, 4.7] • Increased coastal erosion and damage to coastal buildings and infrastructure [TS, 4.5, 7.2.4] • Increased damage to coastal ecosystems such as coral reefs and mangroves [TS, 4.4]
Intensified droughts and floods associated with El Niño events in many different regions (Likely*) [See also under droughts and intense precipitation events]	• Decreased agricultural and rangeland productivity in drought- and flood-prone regions [TS 4.3] • Decreased hydro-power potential in drought-prone regions [TS 5.1.1, Fig TS-7]
Increased Asian summer monsoon precipitation variability (Likely*)	• Increase in flood and drought magnitude and damages in temperate and tropical Asia [TS, 5.2.4]
Increased intensity of mid-latitude storms (Little agreement between	• Increased risks to human life and health [TS 4.7] • Increased property and infrastructure losses [Table TS-4]

current models)****	• Increased damage to coastal ecosystems [TS 4.4]

* Likelihood refers to judgmental estimates of confidence used by Working Group I: *very likely* (90-99% chance); *likely* (66-90% chance). Unless otherwise stated, information on climate phenomena is taken from Working Group I, Summary for Policymakers

** These impacts can be lessened by appropriate response measures

*** High confidence refers to probabilities between 2-in-3 and 95% as described in Footnote 4

**** Information from Working Group I, Technical Summary, Section F.5

***** Changes in regional distribution of tropical cyclones are possible but have not been established

Page 65: Omit Figure 3-3 and Figure caption

Chapter 4: Hydrology and Water Resources

Summary: first bullet:

There are apparent trends in streamflow volume – both increases and decreases – in many regions. These cannot all be definitively attributed to changes in regional temperature or precipitation. However, widespread accelerated glacier retreat and shifts in streamflow timing in many areas from spring to winter are more likely to be associated with climate change.

p3 Section 4.1: About halfway through the third paragraph, add (Falkenmark, 1999) after "and over the next few decades"

p11 end of Section 4.3.6.2."0" Add: A general conclusion, consistent across many studies, is that the effects of a given climate change scenario vary with catchment physical and land cover properties, and that small headwater streams may be particularly sensitive to change (as shown in northwestern Ontario, for example, by Schindler et al. (1996))

p13 Section 4.3.7, after "about 1000 years later." Add: There are other examples: Lake Manitoba, for example, was dry during the warm mid-Holocene (Teller & Last, 1982).

p16 Section 4.3.10

i. Add at end of first complete paragraph, after "waste storage facilities."
Polluting material may also be washed into rivers and lakes following inundation of waste sites and other facilities located on floodplains.

ii. half way through second complete paragraph, amend to:
Fang and Stefan (1997) showed by simulation that winter…

iii. after this sentence, ending “anoxic zone disappear.”, add
Observations during droughts in the boreal region of northwestern Ontario showed that lower inflows and higher temperatures produce a deepening of the thermocline (Schindler et al., 1996).

iv. Delete last two sentences (beginning “Based on modeling…”) of the second complete paragraph.

p17 Section 4.3.11

i. add in the first paragraph after Rabus & Echelmeyer, 1998)
, the Canadian Rockies (Schindler, 2001),

ii. add to end of first paragraph
, and rates of retreat are generally accelerating (Haeberli et al., 1999). The World Glacier Monitoring Service (www.geo.unizh.ch/wgms) monitors glacier mass balances and publishes annual reports on glacier fluctuations.

p20 Section 4.4.3

i. middle of paragraph. Delete from “Across much of….” to end, and replace with

Under this scenario, and similarly under the corresponding HadCM3 scenario, net irrigation requirement per unit irrigated area would generally decrease across much of the Middle East and Northern Africa, due to increased precipitation, while most irrigated areas in India would require more water. The extra irrigation requirements per unit area in most parts of China would be small; the HadCM3 scenario leads to a greater increase in northern China. Other climate models would give different indications of regional changes in irrigation requirements. On the global scale, increases and decreases in net irrigation requirements largely cancel, and there is less difference between different climate models: under two scenarios considered (Doll & Siebert, 2001) the global net irrigation requirements would be increased, relative to the situation without climate change, by between 3.5 and 5% by 2025, and between 6 and 8% by 2075. Actual changes in withdrawals would be dependent on changes in the efficiency of irrigation water use.

The Doll & Siebert reference will be changed ASAP.

p22 Section 4.5.2, last paragraph:
Change first sentence to…”Table 4-7 gives an indication of the potential effect of stabilising….”

change sentence to….”stabilisation scenario, but this study – using just the HadCM2 climate model – suggests…”

p24 Section 4.5.3

last sentence of last paragraph in the section: change to

The costs under the drier scenario are considerably higher than those estimated by Hurd et al. (1999), reflecting partly the different approaches used and partly the spatial variability in the effect of climate change considered by Frederick & Schwarz (1999).

Table 4.7 Caption

Add to the end of the last sentence: ": other climate models could give different indications of the effect of stabilisation."

Additional references

Falkenmark, M. (1999) Forward to the future: a conceptual framework for water dependence. Ambio 28, 356-361.

Schindler, D.W., Bayley, S.E., Barker, B.R., Beaty, K.G., Cruikshank, D.R., Fee, E.J., Schindler, E.U. & Stainton, M.P. 1996, The effects of climatic warming on the properties of boreal lakes and streams at the Experimental Lakes Area, northwestern Ontario. Limnology and Oceanography 41, 1004-1017.

Teller, J. & Last, W. 1982, Pedogenic zones in post-glacial sediments of Lake Manitoba, Canada. Earth Surface Processes and Landforms 7, 367-379.

Schindler, D.W. 2001 The cumulative effect of climate warming and other human stresses on Canadian freshwaters in the new millennium. Canadian Journal of Fisheries and Aquatic Science 58, 1-12.

Haeberli, W., Frauenfelder, R., Hoelzle, M. & Maisch, M. 1999, On rates and acceleration trends of global glacier mass changes. Geografisker Annaler Series A – Physical Geography 81A, 585-591.

Chapter 5: Ecosystems and Their Goods and Services

Page 1: Add Camille Parmesan (USA) to list of contributing authors

Page 27, 5.3.4, line 7-14, replace current text with:

Thirteen ranges of percentage changes in tropical crop yields spanning selected climate change scenarios—with no account taken of adaptation—appear in Table 5-4. Each

range is differentiated by geographic location and crop. Of the thirteen, ten of the ranges encompass changes that are exclusively less than current yields. In three, a portion of the range was either approximately no different from current yields or slightly above. In the tropics, most crops are at or near theoretical temperature optimums and any additional warming is deleterious to yields. Thirty ranges of percentage changes in temperate crop yields also appear in Table 5-4. Of the thirty, six of the ranges encompass changes that are exclusively more than current yields. In another seven, either half or more of the changes were more than current yields. In yet another seven, less than half of the changes extended above current yields. The remaining ten ranges encompassed changes that were exclusively less than current yields. Hence, in two-thirds of the cases, temperate crop yields were benefited at least some of the time by climate change.

New work on climate change scenarios (Mitchell *et al.*, 2000) generated with stabilized radiative forcing at 550 ppm and 750 ppm equivalent CO_2, and unstabilized radiative forcing (i.e., unmitigated emissions) in the HadCM2 was used to simulate major cereal yield response globally in 2080 (Arnell *et al.*, 2001). The pattern of yield changes with unstabilized forcing duplicates the one described above: generally positive changes at mid and high latitudes overshadowed by reductions in yields at low latitudes. Stablization at 550 ppm ameliorates yield reductions everywhere, although substantial reductions persist in many low latitude countries. Stabilization at 750 ppm produces a pattern of yield response intermediate to the 550 ppm and unstabilized forcing scenarios, with anomalous yield increases in mid latitudes relative to 550 ppm due to interactions between atmospheric CO_2, temperature and moisture. More studies are needed before confidence levels can be assigned to understanding of the agricultural consequences of stabilization, although this work is an important step.

Page 29, 3rd Para, line 8: Insert after “is not large.”

A small number of studies in Table 5-4 compare yield changes with and without agronomic adaptation. Percentage changes in yields across a range of climate change scenarios for those studies are shown in Figure 5-2. Each pair of vertical bars represents the range of percentage changes by crop, with and without adaptation, for each study. Clearly, adaptation ameliorates yield loss (and enhances yield gains) in most instances. However, in the examples included, adaptation does not always offset yield losses relative to current yields. Adaptation….

Figure 5-2 Revised:

Caption to "new" Figure 5.2

Figure 5.2. Ranges of percentage changes in crop yields (expressed in the vertical extent of the vertical bars only) spanning selected climate change scenarios—with and without agronomic adaptation—from paired studies in Table 5-4. Each pair of ranges is differentiated by geographic location and crop. Pairs of vertical bars represent the range of percentage changes with and without adaptation. Endpoints of each range represent the collective high and low percentage change values derived from all climate scenarios used in the study. The horizontal extent of the bars is not meaningful.

Insert new reference as follows:

Arnell, N. W., M. G. R. Cannell, M. Hulme, R. S. Kovats, J. F. B. Mitchell, R. J. Nicholls, M. L. Parry, M. T. J. Livermore, and A. White. 2001. The consequences of CO2 stabilization for the impacts of climate change. Climatic Change, in press.

Table 5-3: Change top legend to read…
2nd sentence: For inclusion in the table, each study needed to meet 2 of the following 3 criteria: species or processes changing over time; the regional temperature changing over time; and a significant…
Bold sentence to read: When considering those species that have shown a change, 86 % are changing in the manner expected with global warming, while 14% are changing in the opposite direction.

Chapter 6: Coastal Zones and Marine Ecosystems

Page 19, 6.4.4 Coastal Wetlands, first paragraph:
Add italicized sentences:

A recent estimate by Nicholls *et al.*, (1999) suggests that by the 2080s sea-level rise could cause the loss of up to 22% of the world's coastal wetlands. Although there would be significant regional variations (Michener *et al.*, 1997) such loss would reinforce other adverse trends of wetland loss resulting primarily from direct human action, *estimated by DETR (1999) to be about 40% of 1990 values by the 2080s. The stabilisation scenarios developed by DETR (1999) show a large reduction in wetland losses to 6-7 % compared with the unmitigated emissions scenario (13 %).*

Page 23, Section 6.5.1 Socioeconomic Impacts as part of Vulnerability Assessments, second paragraph
Add italicized sentences:
The initial global vulnerability assessment has been revised based on scenarios for global sea-level rise derived from the l Hadley Centre's HadCM2 ensemble simulations and HadCM3 simulations for greenhouse gas only forcing (Nicholls *et al*., 1999). This assessment indicated that by the 2080s the potential number of people flooded by storm

surge in a typical year will be more than five-times higher than today (using a sea-level rise of 0.38 m 1990 to 2080) and that between 13 to 88 million people could be affected even if evolving protection is included. *Broadly similar results are given in the study undertaken by DETR (1999) and also reported by Arnell et al., (2001). However, they note that the flood impacts of sea-level rise are reduced by the emissions scenarios leading to stabilisation of carbon dioxide. By the 2080s the annual number of people flooded is estimated to be 34 million under the 750 ppm scenario and 19 million under the 550 ppm scenario.*

Chapter 7: Human Settlements, Energy and Industry

Page 8, second paragraph of section 7.2.2
Wording changes to clarify the contents of Table 7-1 and Box 7-1. This is in response to comments by China and both of the review editors that the explanation is still confusing. Table 7-1 does not change, except to correct some spellings and dates in the notes to the table.

In the second paragraph of section 7.2.2 on page 8, replace the second sentence with the following language.

…Table 7-1 shows the author team's judgments, based on the available literature, about the vulnerability of different types of settlement to various aspects of climate change. The horizontal axis differentiates vulnerability according to the type of settlement, the capacity to adapt, and the mechanism through which the settlement is affected by climate change. Examples include: 1) the resource base of settlements economically dependent on activities such as agriculture, forestry, fishing, hunting and gathering, or tourism may be affected; 2) housing and infrastructure may be affected in coastal areas, riverine floodplains, and islands sensitive to flooding, in steeplands sensitive to landslides, and urban/wildland boundaries sensitive to fires; 3) the health and productivity of urban populations may be affected directly through air pollution, heat waves, and heat island effects. The vertical axis identifies twelve different types of climate change impact in descending order of global importance. Vulnerabilities are rated as low, medium or high magnitude as described in Box 7-1. The information in Table 7-1 is generally presented as a range, reflecting the diversity of settlements within each broad class. The final column shows the level of confidence that the author team assigns to each type of climate impact. Table 7-1 depicts vulnerabilities for the years between approximately 2050 and 2080, since much of the available literature concentrates on the effects of climate change of a magnitude roughly corresponding to that expected in that period. Figure 7-2 provides the scores on the individual scales described more fully in Box 7-1. See also Moss and Schneider (1999).

The rest of the paragraph becomes a new paragraph as follows:

The negative impacts in Table 7-1 would be generally less negative or even positive in some regions before 2050, but greater than shown and becoming more negative in more regions after 2100. The table is not intended to show that only specific types of

settlements would be harmed (or helped) in certain ways by certain changes; rather, that settlements of certain types are probably particularly vulnerable to certain types of climate changes or conditions. The table emphasizes the most salient effects that appear to be characteristic of certain types of settlements and mechanisms that might make the settlements more or less sensitive to climate change.

In the last paragraph on the page, strike all of the language beginning "…Impacts on settlements are ranked…" This information has been incorporated into the language above.

Changes to Box 7-1 are shown in italics.

Box 7-1. *Development of Scales for Assessing Potential Vulnerability of Human Settlements to Effects of Climate Change and Confidence in the Certainty of the Impacts*

Climate affects the stability of the resources supporting human systems. *One way to assess the potential impact of climate change on human systems is by using a qualitative scale that expresses the vulnerability of settlements to various kinds of climate effects (e.g., floods) in terms of how potentially disruptive these climate effects are expected to be for various types of human settlements (based on differences in their economic base, location, size, and adaptability). The definitions in the rating system below are derived from standard environmental impact assessment language and are intended to apply to local climate impacts. However, the scale may be used nationally if the nation is small and homogeneous, or if most of the population lives in settlements of a certain type.*

Magnitude Ratings (Size of Impacts)

- Low: Impacts of changed climate are not distinguishable from normal background variability in weather impacts or else there is little noticeable effect.
- Moderate: Resources or sectors are affected noticeably, and even substantially, but the effect is not destabilizing and recovery is rapid.
- High: Impacts are large and sometimes catastrophic. Resources or settlements are destabilized with little hope for near-term recovery.

A semi-quantitative approach is used with a 5-point confidence scale *to indicate* the certainty of the effects *of the climate change*. The author team subjectively rated confidence based on the literature in four dimensions: consensus among experts (*Consensus*), extent to which underlying *theory and* data is developed (*Theory*), quality of model results (*Model Results*), and consistency of observational evidence (*Observations*). The scores were used to create a four-sided polygon, as shown in Figure 7-2. All four dimensions were weighted equally to determine the area of the polygon and an overall confidence score.

$$Polygon\ Area = 0.5 \bullet (Theory \bullet Observations + Observations \bullet Model\ Results + Model\ Results \bullet Consensus + Consensus \bullet Theory)$$

The overall confidence score assigned was assigned based on the area of the polygon. For example, to rate a "4" for "high confidence", the polygon had to have an area between 16

and 25, greater than the area of a polygon ratings of 4 but less than 5 on all four dimensions.

Confidence Ratings *(Certainty of Impacts)*

1. Very Low: Impacts are extremely difficult to predict (confidence is less than 5%) (*Polygon Area* = 0-8).
2. Low: Impacts are regularly much greater or less than the median value (confidence is less than 1 in 3) (*Polygon Area* = 8-18).
3. Medium: Impacts are regularly greater or less than the median value (confidence is 1 in 3 or greater) (*Polygon Area* = 18-32).
4. High: There is noticeable variation in the size of impacts (confidence is 2 in 3 or greater) (*Polygon Area* = 32-50).
5. Very High: There is little variation in impact among scenarios, within a settlement type (confidence is 95%) (*Polygon Area* =50)._____END BOX 7-1

Page 11, line 26 on page 11**:** Add text in italics to respond to reviewer's request to expand treatment be given to fisheries and consequences for coastal communities

…as a result *of fishermen following high-valued stocks to other locations, making do with lower-valued stocks, or even abandoning fishing altogether* (see Chapter 6,10,14,15,17). *Other communities may benefit if high-valued stocks become more accessible.*

Page 17, paragraph 4. We suggest the following rewording beginning at line 22 in response to government comment:

…Increased cloudiness can reduce energy production from some solar. Wind energy production would be reduced if wind speeds increase above or fall below the acceptable operating range of the technology. Changes in growing conditions could affect production of biomass, as well as prospects for carbon sequestration in soils and forest resources. Climate change could worsen current trends in depletion of biomass energy stocks in Africa, which is expected to become drier (Chapters 3, *10*). The impact on biomass elsewhere is less clear, and may include enhancement of growth due to higher rainfall in Africa as well.

The portion of renewable energy sources of total energy supply varies among countries, both developed and developing. In the U.S. in 1998, renewable sources provided roughly 7% of gross energy consumption, about half of that as hydroelectric energy (Energy Information Administration 1999a) In other countries, both developed and developing, the percentages will vary. For example, biomass accounts for 5% of North African, 15% of South African, and 86% of sub-Saharan (minus South Africa) energy consumption, while in Cote d'Ivoire, the Democratic Republic of Congo, Ethiopia, Mozambique, and Zambia, the vast majority of on-grid electricity generation comes from hydropower (Energy Information Administration 1999b). Hydroelectricity represents the primary source of electricity in Canada and most South and Central American countries, with the

highest reliance in Paraguay and Brazil (99% and 87% of generating capacity, respectively) (Energy Information Administration 1999c). Although perhaps scalable to new climate niches, *larger percentages of renewables (especially hydroelectricity) in a country's energy supply might make the country relatively more sensitive to climate (Chapters 10, 11, 12). However, fossil fuel extraction may be adversely affected by increased wind and wave action, heavy precipitation, shoreline erosion, and permafrost melting may also adversely affect fossil energy extraction in regions where this applies (Chapter 16). In addition, thermal power plants can be adversely affected by loss of cooling water due to low flows (Chapter 12).*

In a warmer climate…

Editorial Changes:

- Page 2, para 1 *Munasinghe 2000,* not Munasinghe et al.
- Page 2, last para. "While GCM-*projected…"*
- Page 3, para 2 remove second period and space before the final sentence
- Page 3, last para. "…which offers more dilution for pollutants*)…[close Parens]"*
- Page 3, para 4. Titus and *Narayanan*
- Page 4, para 5 remove second period in middle of second line
- Page 5 para 1 "The ~~*of the*~~ SAR identified the most…"
- Page 5 para 2 "… , pollution control ~~*and climate change*~~ **(not clear)**,"
- Page 5 para 4 "…The Third Assessment Report assesses their relative importance and the certainty/confidence for the conclusions reached. ~~*To correct for that shortcoming…"*~~
- Page 5, para 5. *Munasinghe 2000*
- Page 5, para 6. "…settlement effects discussed in this chapter…. *[add period*]"
- Page 5, para6. "…services such as fire protection*, [add comma]* and may…"
- Page 6, 1st partial para…reduce risks this way. *[add period]"*
- Page 6, last para UN 2000 should be *United Nations 2000 [2 places]*
- Page 7, second bullet Energy Information Administration should be *EIA*
- Page 8, 1st para. *Hardoy et al. 2000*
- Page 8, 1st para. Remove period after "…global environment"
- Page 8-9 see substantive change 1.
- Page 10 para 5"…rarity ~~*these*~~ *of* extreme…"
- Page 10 para 5 "…telecommunication and traffic ~~*condition*~~ *connection* are broken"
- Page 11, para 4 "types of *marine* species"
- Page 12, para 1 Watson et al. Should be IPCC 1998
- Page 12 . Section number on page should be 7.2.2.2
- Page 13 para 0 "*In the 2070s*, over 70% *of the people in settlements* (over 90% by the 2080s)~~*of the people in settlements*~~*…"*
- Page 13 para 1 "…~~*shows*~~ for Japan shows about 861 square km of land is *currently* below high water…"
- Page 13, para 2 "…ease population *and* assets…"
- Page 14, para 3. *Meze-Hausken*

- Page 15 para 2 "…airborne bacteria ~~*on*~~ in lungs and *on* food."
- Page 15 para 5 "From review of the developing country cities that *are* members of the 69 urban agglomerations…"
- Page 16 para 0 "Atmospheric and air…could lead to ~~*more*~~ **(**1%-20%**)**…"
- Page 17, para 1 "… *(Herrington et al. 1997),* while…"
- Page 17, para 3. "Increased cloudiness can reduce *solar* energy production. ~~*from some solar.*~~*…"*
- Page 17, para 4 substitute EIA for Energy Information Administration [three times]
- Page 17, para 5 "… month to six weeks, and …[no period]"
- Page 17, para 5 Kerry et al. 1999) [close parentheses] …"
- Page 18, para 0 remove orphan parenthesis in second line
- Page 18, para 1 second sentence has a double period
- Page 18 para 1 "Urbanization , rising incomes, and warmer incomes could combine to *increase the* energy used for space cooling, already a major concern…"
- Page 18, para 2 add a comma after "For example" at the beginning of 2nd sentence
- Page 18, para 4 "… the year 2030 ~~*temperature (4° C was*~~ then considered …, but now *is* probably at the upper…"
- Page 19 para1 *Changnon 1996a*
- Page 19 para 4 "cover*age* and"
- Page 20 para 2 "…Boulder, CO *(NCAR 1997)* …"
- Page 20 para 3 "~~*the*~~ ***an*** order of magnitude"
- Page 20 para 4 "…(Fankhauser *1995*)…"
- Page 20 para 5 …(e.g., *Schneider 1997*)…
- Page 21 para 0 "… *+13%* to +19%…"
- Page 21 para 0 … China Country Study *Team…*
- Page 21 para 2 *Kwadijk and Rotmans 1995*
- Page 21 para 3 Smith et al. *1999*
- Page 22 second bullet "…landslides ~~*of*~~ *or* flooding…"
- Page 23, Section 7.5.3 second dash ...[double period at end. Should be single]
- Page 24, dash 2 Smith and Handmer *1984*
- Page 24, dash 3 "…California *and* Sydney, Australia."
- Page 24, dash 3 …*widths and* grades…
- Page 24, dash 3 "…~~*Disaster Research 197, May 1996*~~ *Topping 1996…"*
- Page 24 last line …*Spronkensmith* and Oke…
- Page 25 first dash"… *Hardoy et al. 2000* [twice]…"
- Page 26 Institutional networks, last dash "…World Bank *1999…"*
- Page 26 1st full para "…~~*World Resources 1996*~~ *WRI 1996*…"
- Page 27 para 6 "…Urban water resources are already *in* extremely short *supply…"*
- Page 28 para 1 "…vulnerable to sever*e* storms, floods,…"
- Page 28 para 3 "…Wilbanks and Wilkinson *2001…"*
- Page 28, last para …*Charlot-Valdieu et al. (1999)…*
- Page 29 para 1 "…*climate change, vulnerability, and adaptation* on the basis of research evidence…"

- Page 29 para 1 "… settlements *are hard to forecast,* at least partly because the ability to ~~*forecast*~~ *project* climate change…"
- Page 29, second bullet "…More reliable climate change ~~*(forecasts)*~~ *scenarios* at the scale of urban and even smaller areas.
- Page 29 4th bullet "…and what can reasonably be expected…{take out comma]"
- Page 29 4th bullet "…and traditional and local adaptation. [take out second period]…"
- Page 30 para 0 "…networks, and improving…"

Tables and Figures:

- Page 38, Table 7-1. Change all first line to **Bold Face (no italics)**. For all High Capacity show Footnote 1. All Low Capacity Footnote 2
- Page 38 Note 1. Smith, D.I. 1998 is Smith et al. 1999. Changdon 1996 is *Changnon 1996b*. *Add Evans and Clague 1997.*
- Page 38 Note 2 Add References: : *Rosquillas 1998; Magaña 1999*
- Page 38 Note 5 *Changnon* and Glantz 1996
- Page 39 Note 12 Rosenberg et al. 1992 should be *Rosenberg 1993*; add *Gleick 2000.*
- Page 39 note 17. *Changnon 2000* instead of Changnon in PielkeJr. and Pielke Pielke Sr.

Chapter 8: Insurance and Other Financial Services

Page 2, para 1 - Line 3 – replace "a monitor" with "an integrator"
Line 4 – replace "it represents" with "they represent"
Line 7 – Insert "ordinary and" after "of"
Line 7 – Add new sentence to end of paragraph: "There is high confidence that climate change and anticipated changes in weather-related events perceived to be linked to climate change would increase actuarial uncertainty in risk assessment, and thus in the functioning of insurance markets."
Reason: Responds to requests for confidence statements from Japan on Page 9, lines 17-21 of the draft SPM and to those from Canada on Page 9, lines 17 and 18 of the draft SPM, and aligns text with SPM.

Page 2, para 2 - Line 1 – insert "ordinary and" after "of". Insert "global" after "Yearly"
Reason: Responds to comment from China on Page 9, line 6-8 of SPM and clarifies that the
Line 2 – replace "large" with "extreme". replace "10" with "10.3". Replace "4" with "3.9"
Line 4 – replace "9" with "9.2"
Line 5 - Insert after "industrialized countries." "As a measure of increasing insurance industry vulnerability, the ratio of global property/casualty insurance premiums to weather-related losses—an important indicator of adaptive capacity--fell by a factor of

three between 1985 and 1999. Chapter 15 discusses insurance issues for North America in depth."

Page 2, para 3 (Footnote 1) - Line 1 – Insert (data in this report are unadjusted in this report for purchasing power parity)

Reason: Responds to comment from US on page 9, lines 6-10 of the SPM

Line 3 – replace "spare parts" with "finished products"
Line 5 – insert "or businesses" after "households"
Line 8 – after "diversity of sources" insert "compiled by Munich Re for the period 1950-1999"
Line 11 – insert "million" after "25"
Line 13 – after "subsidence" insert "(e.g., approaching as much as US $1 billion per year during periods of low rainfall in the UK – see Figure 8-3)"

Page 2, para 4 - Line 1 - Before "Demographic…" insert "The costs of weather events have risen rapidly, despite significant and increasing efforts at fortifying infrastructure and enhancing disaster preparedness. These efforts dampen to an unknown degree the observed rise in loss costs, although the literature attempting to separate natural from human driving forces has not quantified this effect."

Reason: Responds as well as possible to comment from US on Page 8, lines 36-41 of SPM. While the question cannot be answered based on available literature, the text addition helps clarify the reasons why such factorial analysis is complicated.

Line 4 – change "precipitation and flooding events" to "precipitation, flooding, and drought events (10.1, 10.2, 11.1.2)."

Reason: Flooding was added based on Contact Group on paragraph 8a at WG2 Plenary

Line 5 – After "in" insert the damage cost of non-weather-related and" Change "losses" to "disasters"
Line 6 – Change "events to "disasters"

Page 3, para 2 - Line 5 – Replace "may have to be reconsidered" with "can be expected to change."

Reason: Responds to comment from Saudi Arabia on Page 9, lines 20-21 of SPM by wording in a clearly non-policy-prescriptive manner.

Page 3, para 4 - Line 3 - Replace "in some cases." with "in one case."

Reason: Responds to comment of Saudi Arabia on Page 9, line 37 of SPM . Aligns text with SPM

Page 3, para 7 (first para in 8.1) - Line 2 – after "insurance," add "disaster preparedness/recovery,"

Reason: Responds to request from Delegate during WG2 plenary to make more use of the terminology of natural disasters.

Line 5 – change "it represents" to "they represent"

Page 4, para 1 - Line 1- Before "Changnon et al., 2000" insert "Mills 1996;"

Page 4, para 2 - Line 4 – insert “ordinary and” after “of”

Page 4, para 3 - Line 4 – Change “1960s” to “1950s”

Page 5, Section 8.2.2 para 1 - Line 2 – Change “1999a” to “2000”

Page 6, para 1 - Line 4 – Change “would reduce” to “has reduced observed”. Replace “It would be extremely difficult to “The literature has not attempted …”

Page 8, para 1 - Line 1- after “insurers” add (Mills et al., 2000)

Page 8 para 4 - Line 6 – After “climate change” insert “e.g. increased flooding)

Page 8, para 5 - Line 2 – change “this” to “loss growth”. After “absence of” insert “commercial”

Page 8, para 7 - Line 2 – Insert “(Table 8-2)” aftger “segment”

Paga 8, para 8 - Line 4 – Change “9.1” to “9.2”

Page 9, para 1 - Line 2 – Insert “and insurance reserves and surplus (i.e. adaptive capacity).” after “economic losses”

Page 9, para 2 (Footnote 3) - Line 5 – Insert “and even more in the United Kingdom” afgter “2.5 billion US$”

Page 9, para 4 - Delete entire paragraph, i.e. “Although the vast majority …. 760 US$ per capita income.” It is duplicated as first paragraph of section 8.5.1

Page 9, para 5 - Line 1 – Insert “Mills et al., 2000).” After “views on climate change”

Page 9, para 6 - Line 1 – Replace “7.44%” with “7.4%”

Page 9, para 7 - Line 6 – insert “(See Figure 15-6 for North America)” after “(Figure 8-5)”.

Page 10, para 4 - Line 1 – Insert “of weather-related events” before “globally”

Page 10, para 7 - Line 6 – insert “billion” after “7 US$”

Page 11, para 4 - Line 1 – Insert “actuarial” after “alike is”
Line 4 – replace “to” with “and”

Page 11, para 6 - Line 1 – Insert “for” after “to pay”
Line 9 – Insert “(see Figure 15-8)”

Page 12, para 1 - Line 6 – insert "; Mills et al., 2000" after "PCS, 2000"

Page 12, para 3 - Line 3 – Delete all (3) quote marks

Page 12, para 6 - Line 6 – Insert "insurance" before "segment"

Page 13, para 2 - Line 1 – Replace "the approximately 50" with "36 out of 426 specifically attributed"
Line 3 – Delete extra period
Line 6 – Insert "(Chapter 15.2.7) after "USA"
Line 7 – Replace "rendered insolvent" with "brought to the brink of insolvency"
Line 8 – replace "property" with "home"

Page 13, para 4 - Line 1 – Replace "PML's" with "PMLs"

Page 13, para 5 - Line 2 – Insert (Munich Re 2000) after "globally"
Line 5 – replace "ENSO" with "El Nino" ← include tilde over "n". insert "and reinsurers" after "insurers"
Line 6 – insert "often" before "capped"

Page 13, para 7 - Line 2 – Insert missing period after "…..1999)"
Line 3 – Delete unnecessary comma after "1999"

Page 14, para 3 - Line 6 – Insert missing period after "….1999)"

Page 14, para 4 - Line 2 – Correct spelling of "between"

Page 14, para 5 - Line 4 – Insert missing period after "…2000)"

Page 15, bullet 1 - Line 5 – change "linkage" to "linkages"

Page 15, first para after Box 8-1 - Line 2 – insert "(see section 15.2.7) after "Hurricane Andrew"

Page 16, para 8 - Line 1 – delete "here"

Page 17, para 3 - Line 4 – replace "would be" with "were"

Page 17, para 4 - Line 1 – insert "(reliability and/or physical damage)" afgter "vulnerability"
Line 5 – insert "lightning damages," after "via"
Line 9 – Insert "; Table 15-5" after "1998b"

Page 18, para 1 - Line 3 – Insert "(in poor and wealthy countries alike)" after "consumers"

Page 21, para 3 - Line 2 – insert "(see Figure 8-6)." after "poor countries". Replace "Weather-related loss events" with "Natural disasters"
Line 4 – insert "25% of he economic losses and" after "In contrast,"
Line 5 – insert footnote at end of sentence: "Data in this paragraph differ somewhat from that in Figure 8-6 due to differences in aggregation and end dates for the time series, and inclusion of non-weather-related natural disasters."

Page 21, para 6 - Line 1 – insert "--especially those reliant on primary production as a major source of income--" after "Developing countries".

Reason: Responds to comment from Australia on Page 9, line 36 of SPM. Aligns text with SPM.

Page 27, Acknowledgments - Line 7 – insert "Eugene Lecomte," after "Mojdeh Keykhah"

Table 8-1 & TS-4. Extreme climate-related phenomena and their effects on the insurance industry: observed changes and projected changes during the 21st century. (After Table 3-10 in Chapter 3, this volume, and Munich Re, 1999b, p. 106). **NOTE TO TYPESETTERS – Place grey-shaded columns (3-5) first**

Type of event relevant to insurance sector	Relevant timescale	Changes in extreme climate phenomena	Observed changes	Projected changes	Sensitive Sectors / Activities	Sensitive insurance branches**
			Likelihood			
Temperature extremes						
Heat wave	Daily-weekly maximum	Higher maximum temperatures, more hot days and heat waves*** over nearly all land areas	Likely *, (mixed trends for heatwaves in several regions)	Very likely*	Electric reliability, human settlements	Health, life, property, business interruption
Heat wave' droughts	Monthly-seasonal maximum				Forests (tree health), natural resources, agriculture, water resources, electricity demand and reliability, industry, health, tourism	Health, crop, business interruption
Frost, frost heave	Daily-monthly minimum	Higher [Increasing] minimum temperatures, fewer cold days, frost days and cold waves*** over nearly all land areas	Very Likely *, (cold waves not treated by WG1)	Very likely*	Agriculture, energy demand , health, transport, human settlements	Health, crop, property, business interruption, vehicle
Rainfall/precipitation extremes						
Flash flood	Hourly-daily maximum	More intense precipitation events	Likely * over many Northern Hemisphere mid- to high latitude land areas	Very likely*, over manyareas	Human settlements	Property, flood, vehicle, business interruption, life, health

Flood, inundation, mudslide	Weekly-monthly maximum				Agriculture, forests, transport, water quality, human settlements, tourism	Property, flood, crop, marine, business interruption
Summer drought, land subsidence, wildfire	Monthly-seasonal minimum	Increased summer drying and associated risk of drought	Likely*, in a few areas	Likely* over most mid-latitude continental interiors (lack of consistent projections in other areas)	Forests (tree health), natural resources, agriculture, water resources, (hydro) energy supply, human settlements	Crop, property, health
Snowstorm, ice storm, avalanche	Hourly-weekly	Increased intensity of mid-latitude storms***	Medium likelihood* of increase in Northern Hemisphere, decrease in Southern Hemisphere	Little agreement among current models	Forests, agriculture, energy distribution and reliability, human settlements, mortality, tourism	Property, crop, vehicle, aviation, life, business interruption
Hailstorm	Hourly				Agriculture, property	Crop, vehicle, property, aviation
Drought and floods	Various	Intensified droughts and floods associated with El Nino events in many different regions [See also under droughts and extreme precipitation events]	Inconclusive information	Likely*	Forests (tree health), natural resources, agriculture, water resources, (hydro) energy supply, human settlements	Property, flood, vehicle, crop, marine, business interruption, life, health

(Table 8-1 and TS-4, cont'd).

Wind extremes						
Mid-latitude windstorm	Hourly-daily	Increased intensity of mid-latitude storms***	No compelling evidence for change	Little agreement between current models	Forests, electricity distribution and reliability, human settlements	Property, vehicle, aviation, marine, business interruption, life
Tornadoes	Hourly				Forests, electricity distribution and reliability, human settlements	Property, vehicle, aviation, marine, business interruption
Tropical storms, including cyclones, hurricanes and typhoons[8]	Hourly-weekly	Increase in tropical cyclone peak wind intensities, mean and peak precipitation intensities****	Wind extremes not observed in the few analyses available; Insufficient data for precipitation	Likely*, over some areas	Forests, electricity distribution and reliability, human settlements, agriculture	Property, vehicle, aviation, marine, business interruption, life
Other extremes						
Lightning[10]	Instantaneous	Refer to entries above for higher temperatures, increased tropical and mid-latitude storms	Refer to relevant entries above	Refer to relevant entries above	Electricity distribution and reliability, human settlements, wildfire	Life, property, vehicle, aviation, marine, business interruption
Tidal surge (in association with onshore gales), coastal inundation	Daily	Refer to entries above for increased tropical cyclones, Asian summer monsoon, and and intensity of mid-latitude storms	Refer to relevant entries above	Refer to relevant entries above	Coastal zone infrastructure, agriculture and industry, tourism	Life, marine, property, crop
Flood and drought	Seasonal	Increased Asian summer monsoon precipitation variability	Not treated by WG I	Likely*	Agriculture, human settlements	Crop, property, health, life

* Likelihood refers to judgmental estimates of confidence used by Working Group I: *very likely* (90-99% chance); *likely* (66-90% chance). Unless otherwise stated, information on climate phenomena is taken from Working Group I, Summary for Policymakers and Technical Summary. These likelihoods refer to the observed and projected changes in extreme climate phenomena and likelihood shown in shaded columns one to three of this table.

**High confidence refers to probabilities between 2-in-3 and 95% as described in Footnote 4 of SPM WGII

*** Information from Working Group I, Technical Summary, Section F.5

**** Changes in regional distribution of tropical cyclones are possible but have not been established

Page 36, Table 8-2 - Please round off the data in columns 2 and 3 (Share of World Market in 1998 and Premiums as % of GDP in 1998) to one decimal place rather than two, e.g. 7.72 becomes 7.7. Round off the data in column 4 to zero decimal places, e.g 1021.20 becomes 1021.

Page 38, Figure 8-1 (and TS version as well) - Make timestep on x-axis into regular 5-year intervals, rather than odd intervals used at present
Change "unknown" to "0/unknown" in the legend
Line 5 of caption – insert "(e.g. as shown in Fig 8-6)." after "included"

Page 39, Figure 8-3 - Add a secondary y-axis to the right-hand side of the figure, denoted in US$. The maximum value is US$ 1 billion, and corresponds to 690 on the existing scale for British pounds

Page 41, Figure 8-5 - Replace "non-life" with "property/casualty" in the legend
Line 4 of caption – insert "(and associated reserves and surplus, not usable to pay catastrophe losses)" after "considerable revenues"
Line 6 – insert "(1993)" after "single year"

Page 42, figure 8-6 - Reinsert comment rows computing weather-related fraction of total costs and data labels above bars (inadvertently dropped during production of last draft). (Information provided to TSU via spreadsheet)
Caption – Line 1 – Insert "Regional" before "Insurance". Insert "and non-weather" after "weather-"
Caption – Line 5 – Add following to end of caption: "Total costs are higher than those summarized in Figure 8-1 due to the restriction of Figure 8-1 losses to those from large catastrophic events. Rounding errors may appear in data labels."

Note: additions reflect assimilation of comments received by governments in the final SPM review and from government delegates to the WG2 Plenary in Geneva, as well as corrected typographical errors and edits for clarity and consistency between TS, SPM, and main chapter. Supplemental linkages are made with other chapters of the TAR in a few cases. No new literature has been introduced. Paragraph numbers include fractional paragraphs at the top or bottom of pages. Footnotes are counted as paragraphs for this purpose.

Chapter 9:Human Health

p.1, Contributing authors: delete "P.Reiter (USA)"

p.3, Para 2, line 3: add (shown in bold) "limited **resources, such as** access to air conditioning"

p. 3, Para 2, line 7: Rewrite to read: "but no equivalent predictions **are** available"

p.3, Para 3/1: "Any **regional** increases"

p.3, Para 3/7: "indicate **the susceptibility of** vulnerable populations to the adverse effects . ."

p.3, Para 5/10: "changes in potential **infectious** disease transmission . ."

p.3, Para 6, line 2: Rewrite to read: [medium **to high** confidence]

p.3, final line: "**In the latter study,** regional increases . . ."

p.4, Para 1/3: Insert sentence: "For some diseases, such as malaria in the Sahel, Western equine encephalitis in North America and tick-borne encephalitis in Europe, a net decrease may occur."

p.4, Para 3/3-4: "with **net** beneficial effects . . . and **net** negative effects in the developing world."

p.4, Para 5/4: replace "the many ways in which" with "how"

p.4, Para 6/2: "sequence of **environmental and social** impacts"

p.4, Para 6/3: "cannot **yet** be made"

p.5, second bullet point, line 4: replace "highly-aggregated" with "global/regional"

p.7, third line point, final sentence: "In accordance with **point** 2 above, **each change in health outcome** must be . . ."

Page 9, Para 1, line 8: Reword to read: "did not have significantly *different* annual heat related mortality *compared to* cold regions."

p.12, Para 4/3: "Bobak **and Roberts**"

p.12, Para 6/3: Brauer **1999**

p.13, Para 2/3: **Sillman and** Samson, **1995**

p.13, Para 3/10: "Climate change may **affect the length** of . . ."

p.15, Para 2/2: delete "human development,"

p.16, Para 1/6: "to the **subsequent** resurgence"

p.16, Para 1/9: "in the **recent** resurgence"

p.16, Para 2/5: "infection **in Tanzania** associated with"

p.16, Para 3/1: "transmission **entail** single epidemics or **a sequence** of epidemics"

p.16, Para 4/4: Restructure sentence: “However, in South America the southern limits of malaria distribution may be affected . . .”

p.16, Para 4/6: replace “overlaps” with “coincides”

p.16, Para 5, last sentence: “A **particular** concern . . . malaria in **ex-USSR** countries . . . . infrastructure has [delete] diminished (e.g. …)”

Page 17 section 9.7.1.1: In line 8 of para 2, amend sentence to read: "Recent studies, using that revised model applied to the UK HADCM2 GCM scenarios, project a global increase . .

Para 4, line 4, replace "(business as usual)" with "(unmitigated)".

p.17, Para 2/8: “Recent studies, using that revised model **and the UK HADCM2 scenarios, project . . .”**

p.17, Para 2/11-12: “does not take into account that **much** of this additional population at risk is [delete] in middle or high income . . .”

last line of that para: Arnell et al, **2001**

p.17, Para 4/4: replace “business as usual” with “unmitigated”

p.21, Para 3/3: delete “primarily”

Final 4 sentences of that para: delete “and low enough in winter to suspend the life cycle.” Delete “Higher temperatures enhance proliferation of the infectious agent within the tick, although” Start next sentence with “Temperatures above the optimum . . .”

p.22, Para 3/1: Insert new sentence: “The abovementioned study, showing a northward extension of the tick population in Sweden in association with warmer winters, was accompanied by an increase in the annual number of cases of tick-borne encephalitis reported within Sweden.”

Next sentence: replace “that feed for only a limited time in the spring” with “each of which feeds for a few days during spring-summer”

p.23, Para 3/2: “giardia, and other **infections,** have been triggered”

line 3: add “Curriero et al., 2001”

Chapter 10: Africa

Page 1: Change A. Abdelkado to A. Allali

Page 6, Section 10.1.3.2, Para 1, line 2: Insertion: “calendars *that* are closely…”

Page 6, Section 10.1.3.2, Para 1, line 4: delete “some of which are unique to the continent”

Page 6, Section 10.1.3.2, Para 1, line 8: Add: La Nina *may have* caused… in response to government comment

Page 32, Paragraph 1, Section 10.2.5.2, line 5
Delete: “On the Senegal Coast” from “On the Senegal coast, Jallow et al (1996) estimate that the capital of the Gambia….
Reason: Avoid confusion of the location of Gambia relative to the Senegal coast.

Page 40. Section 10.4, para 7, line 1: Replace “Given the diversity of constraints facing many nations, the overall capacity for Africa to adapt to climate change is currently very low.” with “A diversity of constraints facing many nations limit the overall adaptive capacity for Africa.” for simplification

Page 43, Section 10.4.3.2, Paragraph 5, line 1: Insert: Climate change offers some opportunities *for development*.

Chapter 11: Asia

Page 4, Footnote, Line3
Replace "5-32" with "5-33".
Replace "32-68" with "33-67".
Replace "68" with "67".

Page 6, Para4: Replace the first statement with "Each sub-region has its priority adaptation sector for its own situation" to avoid an arbitrary conclusion suggested by China Government.

Page 9, Para5, 2nd sentence: Added the following sentence at the end for further explanation.
"and observations also reveal a $1^{o}C$-$2^{o}C$ fall in temperature in some parts of south eastern China"

Page 9, Para4: Added the following sentence after "(Pilifosova et al., 1997) for further explanation and add a reference to the reference list.

" and in the arid regions of China, air temperature has increased obviously since the 1970s (Chen, L., 1995)."

' Added a reference (Chen, L., 1995) to the reference list.

Page 11, Para3, Line1-2: Delete "(Chen et al., 1992)" in the text and a reference list.

Page 21, Para4: Replace "Mekong and Yangtze(Changjing)" with "Yangtze(Changjing) and Mekong" to correspond with the following text.

Page 24, Para3: Added "per capita" after "about seven-fold" for clarification.

Page 24, Para4, 3rd sentence: Replace the following with this sentence for correction of number.
"As shown in Figure 11-8, net grain import in Asia was 20.3 Mt in 1961, but increased to 80.9 Mt by 1998."

Page 25, Para2, Line 7: Replace "280" with "258" and Replace "240" with "64" for correction.

Page 27, Para4: Delete "but a decline is possible in South China" for consistency.

Page 28, Para2: Replace "Table 11-8" with "Table 11-7 for correction.
Replace "more than" with "about".

Page 31, Para3: Added "Mt" after "20.7" for clarification.

Page 45, Para1: Delete "Similarly, an increase..... in North China" because no appropriate reference.

Page 55, Reference list: Ren, G., H. Wu and Z. Chen, 2000:....
Replace "11(in press)" with "11(3), 322-330".

Page 16, Para4, Line10: Replace "Glover and Jessup, 1999" with Barber and Schweithelm, 2000" for more appropriate reference.

Delete "Glover and Jessup" from the reference list and add the following reference.
"Barber, CV and J. Schweithelm, 2000: Trial by Fire: Forest Fire and Forestry Policy in Indonesia's Era of Crisis and Reform. World Resource Institute, Forest Frontiers, World Wide Fund for Nature(WWF)-Indonesia, Telapak Indonesia Foundation, 448pp.

Chapter 12: Australia and New Zealand

General:
All text using “Nino” or “Nina” should be changed to “Niño” and “Niña” respectively (use find or search facility for this).

In references, all publisher references to “CSIRO” (not those in titles of reports or papers) could be changed to “Commonwealth Scientific and Industrial Research Organisation” if

thought appropriate. We do not think this is necessary, as it is recommended below that it be spelt out where it first appears in the text (p.8), and is in any case well known in Australia.

Numerous text citations to references have been updated.

Specific
p.2, index 12.5.2.
Delete “Climate change and” to be consistent with heading in text.

p.3, par.4, line 2.
Clarify “marginal”: Change to “in some Australian alpine regions already near these limits, and in the…”

p.4, section 12.1.1, par.1, line 3.
Clarify: “…, a very arid interior, and rainfall which varies substantially on seasonal, annual and decadal timescales, whereas…”

p.6, section 12.1.2, par. on settlements and infrastructure, line 2.
Clarification: “events affecting economically important infrastructure.”.

p.6, section 12.1.2, par.9, line 2. Settlements and Industry.
Clarification: Change “expensive” to “economically important”

p.6, section 12.1.3, par2, line 2.
Delete “Average return on agricultural assets is low.”, as this is repeated on next line. (references apply to first sentence of paragraph.)

p.7, section 12.1.4, par.3, line 4
Add reference after “…quadrants” to “(Collins and Della-Marta, 1999)”

p.7, section 12.1.4, par.3, line 5.
Clarification. “winter-rainfall-dominated region…”

p.7, section 12.1.4, par.3, line 8.
Clarification. Change “presumably” to “predominantly”.

p.7, section 12.1.4, par4, end.
In response to a request from Australia to refer to coral core evidence we agree to add relevant references, although there is not the time or space to discuss the results in detail. Add: “A growing body of evidence is being obtained about past climate variability from coral cores (eg., see Isdale et al., 1998; Lough and Barnes, 1997; Quinn et al., 1998).”

Associated new references are:

Isdale, P. J., B. J. Stewart, K. S. Tickle, and J. M. Lough, 1998: Palaeohydrological variation in a tropical river catchment: a reconstruction using fluorescent bands in corals of the Great Barrier Reef, Australia. *The Holocene* **8**,1-8.

Lough, J. M., and D. J. Barnes, 1997: Several centuries of variation in skeletal extension, density and calcification in massive *Porites* colonies from the Great Barrier Reef: a proxy for seawater temperature and a background of variability against which to identify unnatural change. *Journal of Experimental Marine Biology & Ecology* **211**, 29-67.

Quinn, T. M., T. J. Crowley, F. W. Taylor, C. Henin, P. Joannot, and Y. Join, 1998: A multicentury stable isotope record from a New Caledonia coral: interannual and decadal sea surface temperature variability in the SW Pacific since 1657 AD. *Paleoceanography* **13**:412-426.

p.7, section 12.1.4, par.5, line 3.
Power et al., 1999a

p.7, section 12.1.4, par.5, line 9.
Clarification. “in the frequency of intense…”

p.8, section 12.1.5.1, par.1, lines 1- 3 and 5.
Spell out acronyms as follows:
“by the Commonwealth Scientific and Industrial Research Organisation (CSIRO, 1996a) or the National Institute of Water and Atmosphere, NIWA (Renwick et al., 1998b).”
“..slab-ocean global climate model (GCM) simulations and from transient coupled ocean-atmosphere GCMs (AOGCMs).”
line 5. “regional climate model (RCM) at…”

p.8, section 12.1.5.1, par.2, line 1
Clarification: Replace “These figures” with “Figures 12-1 a and b …”

p.8, section 12.1.5.1, par.3, line 3
Delete “the” before “Whetton”. Insert “a” into CSIRO (1996a)”

p.8, section 12.1.5.1, par.3, end.
Clarification requested by Australia: Add at end of paragraph:
As discussed by Whetton (1999), both sets of scenarios use results from several coupled models, but the use of the SRES emissions scenarios leads to greater warmings in Hulme and Sheard (1999), than those based on the IS92 emission scenarios in CSIRO (1996). Nevertheless, the Hulme and Sheard (1999) results are preliminary in that they use scaled results from non-SRES simulations, rather than actual GCM simulations with SRES emissions.

p.8, section 12.1.5.1, par.4, line 1. and p.8, section 12.1.5.1, par.5, line 5.
Insert “a” into “CSIRO (1996a)”

p.8, section 12.1.5.1, par.5, line 7.
Change Arnell (2000) to 1999.

p.9, section 12.1.5.1, par7, line 7.
Cross-reference: After “Statistical downscaling” insert “(discussed in detail in Chapter 3)”.

p.9, section 12.1.5.1, par.8, lines 2 and 3.
Change “AGCM” to “GCM”

p.9, section 12.1.5.1, par.9, line 10.
Change 2000 to 2001.

p.9, section 12.1.5.1, par.9, line 10.
Change Mullen to Mullan.

p.9, section 12.1.5.2, par.2, line 2.
Change Pittock and Jones, 1999 to 2000.

p.10, section 12.1.5.3, par.1, line 6.
Williams et al., 2001 not “in press”.

p.10, section 12.1.5.3, par.2, line 1.
Reviewers’ comments suggest that a more specific reference is needed to the study which forms the basis of the scenarios used in later work on changes in storm surges in Australia as in Figure 12-4.

Insert after Table 3-10, “and Walsh and Ryan, 2000)”

p.10, section 12.1.5.3, par.3, line 2.
Replace “the El Nino – Southern Oscillation” by “ENSO”.

p.10, section 12.1.5.4, par.1, line 1.
Spell out acronym: “with the IPCC Special Report on Emissions Scenarios (SRES) have…”

p.12, section 12.3.1, par.2, line 3.
CSIRO (1996a)

p.13, section 12.3.2, par.4, line 9.
Replace “op.cit.” by “1997”.

p.14, section 12.3.3, par.1, lines 2 and 3.
References and numbers need correction.
line 2. '..in Australia (Ghassemi et al., 1995; MDBC, 1999)."
line 3. ".. to increase to 12.5 million hectares in the next 50 years (PMSEIC, 1999)."

p.14, section 12.3.3, par.1, line9.
"water by about…"

p.15, section 12.4.1, par.1, line 4.
Pouliquen-Young

p.16, section 12.4.2, par3, line 9.
Clarification: "for 0.5°C global average warming above the present annual averages …"
line 10: "At 2°C global average warming…"

p.16, section 12.4.3, par1, line 4.
Add insert thus: "These stresses, in combination with climatic factors, have…"

p.16, section 12.3.3, par.2, line 3 from end.
Put "Acacia" in italics.

p.17, section 12.4, par.1, line8.
CSIRO (1996a).

p.17, section 12.4.5, par.1, lines 2 and 3.
This needed to be updated and made more precise. Change 1997 to 1999. Insert after "wetlands of" "the Herbert River catchment of", and after "Northern Queensland" add "between 1943 and 1996."
Insert new reference, p.52:
Johnson, A.K.L., S.P. Ebert and A.E. Murray, 1999: Distribution of coastal freshwater wetlands and riparian forests in the Herbert River catchment and implications for management of catchments adjacent the Great Barrier Reef Marine Park. Environmental Conservation **26**, 299-235.

p.17, section 12.4.5, par.1, line 6.
Replace "op cit." by 1999.

p.17, section 12.4.5, par.2, line 3.
Insert hyphen, thus: "Ramsar-recognised…"

p.18, section 12.4.6, par.2, line 3.
Reference is CSIRO (1996a)

p.18, section 12.4.6, par.3, line 1.
Australia suggested discussion of effects of river flows on estuaries to go in section 12.3.2. We think it is better injected into section 12.4.6 thus:

Insert after "…for riverine ecosystems" the words "and estuaries (Loneragan and Bunn, 1999; Vance et al., 1998), and…

Add relevant references as follows:
Loneragan, N. R., and S. E. Bunn, 1999: River flows and estuarine ecosystems: implications for coastal fisheries from a study of the Logan River, SE Queensland. *Australian Journal of Ecology* **24,** 431-440.

Vance, D. J., M. Haywood, D. Heales, R. Kenyon, and N. Loneragan, 1998: Seasonal and annual variation in abundance of post-larval and juvenile banana prawns *Penaeus merguiensis* and environmental variation in two estuaries in tropical northeastern Queensland: a six year study. *Marine Ecology Progress Series*, 21-36.

p.18, section 12.4.7, par.1, line 1.
Spell out "kilometers"

p.18, section 12.4.7, par.2, lines 5 and 6.
Clarification. Change as follows: "This episode was associated with generally record high SSTs over most of the GBR region. This was due to the combined effect of global warming trends due to the enhanced greenhouse effect and regional summer warming due to the El Nino event, the combined effects of which caused SSTs to exceed bleaching thresholds (Lough, 1999). Three …"

p.19, section 12.4.7, par.4, line 2.
This needs to be updated to take account of the revised warmings suggested by the SRES scenarios, which could be higher than according to the older IS92 scenarios. Change from "may still be in the range of 2 – 3°C by 2100." to "may, according to the SRES global warming scenarios, be in the range 2 – 5°C by 2100."

p.19, section 12.4.7, par.4, line 4.
Clarification: Add insert thus: "…which they correlate with increasing average SSTs."

p.19, section 12.4.7, par.4, line 7.
Clarification: Add at end of paragraph "..in the 21st century, especially if regional SSTs reach levels not experienced by the corals of the GBR during the Holocene."

Page 19, para 5, line 4: Delete "may", substitute "would"
Add after "coral reefs" (high confidence)

p.19, section 12.4.7, par.6, at end.
Add re consequences (Australian comment): "Coastal wetlands are thought to be nursery areas for many commercially important fish (eg., barramundi), prawns, and mudcrabs."

p.21, section 12.5.1, par.2, line 1.
Reference is Russell (1998)

p.21, section 12.5.1, par.3, line 5.
Second reference is O'Meagher *et al*., 2000.

p.21, section 12.5.1, par.4, line 1.
Put brackets around "1999 a and b"

p.21, section 12.5.1, par.4, line 1.
Reference is Statistics New Zealand, 1998b

p.21, section 12.5.2, par.2, lines 3-4.
Correction: "Doubled CO_2 and increased temperature would result in ….C_4 grasses (Howden *et al*., 1999a).

p.22, section 12.5.3, par.3, line 3.
Reference is CSIRO (1996a)

p.22, section 12.5.3, par.3, lines 4 and 5 and Figure 12-3.
Various reviewers complained that this Figure was difficult to understand. We have converted it into bar graph form, which is clearer, added some more explanation, and related it to the SRES scenarios. The sentence "Response surfaces were constructed across the full range of uncertainty in the CSIRO (1996) scenarios (Figure 12-3)" should now read:
"Response surfaces were constructed across the full range of uncertainty in the CSIRO (1996a) scenarios, and are shown in bar graph form in Figure 12-3. Estimated increase in yield due to physiological effects of a doubling of actual atmospheric CO_2 is about +24%. The analysis assumes that the regional distribution of cropping is unaffected. (This is not completely accurate, but changes at the margins of present areas would not change the total yield much.) The best variety of wheat is used under each scenario, with (a) the current planting dates, and (b) optimal planting dates for each scenario. Note that yield reaches a maximum at about 1ºC warming in (a) but about 2ºC in (b), and that yield drops rapidly with decreases in rainfall. Under the SRES scenarios, warmings in Australian wheat growing areas would exceed 2°C and could be well in excess of 6°C by 2100, while actual CO_2 concentrations could be between 540 and 970 ppm."

The caption would read:
Figure 12-3. Percentage change in average annual total Australian wheat yield for a doubling of actual CO_2 (to 700 ppm) and a range of changes in temperature and rainfall. Yield response is shown for rainfall changes of +20% (unshaded), 0 (stippled), and -20% (dark shading), for warmings of zero to +4ºC.

See attachment for revised Figure 12-3.

p.23, 3 lines from bottom.
Add return (new paragraph.)

p.24, section 12.5.4, par.2, line 4.
Reference is Statistics New Zealand, 1999.

p.24, section 12.5.4, par.4, line 1.
Clarification: "…reviews this and other recent work…"

p.24, section 12.5.4, par.6, line 6.
Change "opossums" to "possums"

p.24, section 12.5.4, par.2, line 4.
Reference is Statistics New Zealand, 1999.

p.27, section 12.5.5, par.5, line 3.
Reference is White, 2000

p.27, section 12.5.5, par.5, line 4.
Reference is "QDPI 1996"

p.29, section 12.5.8, par.3.
Correct line spacing.

p.31, section 12.6.1, par.9, lines 2-3.
Note correction to earlier interim set of recommended changes. The cited reference is to "Walsh and Ryan (2000)", not "Wash and Ryan…"

p.31, section 12.6.1, par.5, line 8.
Change "Aust." to "AU"

p.31, section 12.6.1, par.7.
New par. after "were also assessed."

p.31, section 12.6.1, old par.8, end
Insert ")".

Figure 12-4 and corresponding text on p.31, section 12.6.1, par.9.

Some reviewers sought clarification of the scenarios used for this storm surge study. We must point out that we are here summarising what was done in the study, which preceded the findings of WG1,and is in fact based on findings reported in Walsh and Ryan (2000), which will be added to the citations. It should be regarded as a sensitivity study for conditions which may be experienced during the 21st century. A more precise description is provided of what was done.

Changes to the text are as follows:
line 1. Change "storm surges" to "storm tides"

line 2-3. to read “for the present climate, and for an enhanced greenhouse climate where, based on the findings of Wash and Ryan (2000), the central pressure of tropical cyclones was lowered by about 10 hPa, the standard deviation of central pressure (a measure of variability) was increased by 5hPa, but the numbers were unchanged.”
line 5-6. Change “for a 20% increase in maximum TC intensity” to “under the above enhanced greenhouse conditions”.

On the Figure 12-4, labels would be changed for the y-axis to read “Storm Tide Height (m)”, and on the upper curve to read “enhanced greenhouse climate”.

The caption would be altered to read:
Figure 12-4: Simulated return periods (average time between events) of storm tides in Cairns, Queensland, for the present climate (lower curve), and for an enhanced greenhouse climate (upper curve) assuming a 10 hPa lowering of central pressures, and increased variability (an additional 5hPa standard deviation) of tropical cyclones. Anticipated mean sea-level rise should be added to these estimates. Uncertainty ranges of the simulations are shown (Walsh et al., 2000).

The additional references is:
Walsh, KJE and BF Ryan, 2000: Tropical cyclone intensity increase near Australia as a result of climate change. Journal of Climate 13, 3029-3036.

p.32, section 12.6.2, par.1, line 2, and par.2, line 3.
Change “Aus.” to “AU”.

p.32, section 12.6.2, par.2, line 4.
Clarification: Insert “of the cost” after “and 33%”

p.33, section 12.6.4, par.3, end.
Reviewer wants discussion of biosecurity risk. Add at end: Also, as the potential range of certain agricultural pests such as fruit fly (section 12.5.7) and disease vectors such as mosquitos (sector 12.7.1) increases, possible transfer of such pests and diseases through tourism may become an increasing issue.

p.34, section 12.7.1, par.2, line 2.
Reference is CSIRO, 1996a

p.34, section 12.7.1, par.5, line 2.
Reference is Russell, 1998. Species to be spelled out: Change “*A.*” to “*Aedes*” in both cases.

p.34, section 12.7.1, par.6, line 7.
Clarification: “present climate change scenarios…”.

p.37, section 12.7.6, par.4, line 3.
Reference is “Statistics New Zealand, 1998a”

p.39, section 12.8.2, par.3, line 4.
References: (CSIRO, 1996b; Pittock and Jones, 2000; Jones, 2000)

p.40, section 12.9.6, par.4, line 7.
Clarity: move comma from before to after “vulnerability”
Line 8: Delete return at end of line 8 so that next sentence is in same paragraph.

References:
[See separate listing of answers to queries from copyeditor. Others, are listed here, possibly with some repeated from copyedit version.]

Anon., 1996. Change to: QDPI, 1996
Anon., 1999. Change to: MAF, 1999
Mpelasoka et al., 2000. Change to Mpelasoka et al., 2001. Same details except “in press”.
Mullan et al., 2000. Change to: Mullan, A.B., Wratt, D.S.and Renwick, J.A., 2001: Transient model scenarios of climate changes for New Zealand. Weather and Climate (In Press).

p.57, references, Walsh et al., 1999
replace “in press” by: CSIRO Atmospheric Research, Aspendale, 84 pp.

Captions:

Figure 12-2.
Reference to Mullan et al., 200 to become: Source Mullan et al., 2001.

Figure 12-5.
Requested clarification: Risk response surface incorporating cumulative probability plots (in shaded box) for climate change magnitudes as indicated on x- and y-axes. Indicated percent probabilities are probabilities of climate change in northern Victoria in 2070 lying within each shaded area (thus there is a 100% probability of climate lying within the shaded square, and a 50% probability of climate lying within the innermost region). The probability (in percent) of irrigation water demand exceeding the farm supply cap in any one year, for indicated climate change, is indicated by the oblique lines. The critical threshold (heavy line) is set at a 50% chance of exceeding the cap (Jones, 2000).

Figure 12-6.
Further clarification: Replace last line with “its probability of being exceeded would be increased (Jones, 2000).”

Chapter 13: Europe

Page 1: List of Contributing Authors:
Change Kedziora to K dziora; Nemesova to Nemešová
Reason: missing Polish and Slovak characters

Page 2
Last bullet, line 2 from bottom
Change “south. This” to “south and in the European Arctic. This”
Reason: government reviewer=s comment, consistency

Page 5, para 2 line 2 from bottom
Change “os these issuses” to “of these issues”

Page 7, 13.1.3.4 line 5 from bottom
Change “Nino” to “Niño”

Page 7, line 2 from bottom
Change “Muller” to “Müller”

Page 11, bullet 1 line 1
Change “K/decade” to “^{o}C/decade” (twice)

Page 13, 13.2.1.1.1 para 2 lines 1-2 from bottom
Change “Hladny” to “Hladný”, and “Kasparek” to “Kašparék”, and “Hlav_ova” to “Hlav ova”, “_underlik” to “ underlik”

Page 17, last line before A[Insert Table 13-4 here]≅
Change shorebird populations TO shorebird and marine fish populations
Reason: government reviewer=scomment

Page 18, last para l. 1
Change: Alatalo 1998 TO Alatalo 1998, Molau 2001
Reason: government reviewer=s request

Page 23, 13.2.2.1.1 line 5
Change 3.5 _mol TO3.5 mol

Page 38, bullet 2, lines 2-3
Change cultivars≅.....Species TO cultivars (Goodman *et al.*, 1987), considering strictly the principles of biosafety in order to avoid possible negative impacts of this technique. Species
Reason: reviewers=request

Page 40, bullet 10
Change sectors (though TO sectors, some of which may be positive (though
Reason: government reviewer=s request

Page 53,
ref. to Molau (2000) should read: Molau, U. (2001) Tundra plant responses to experimental and natural temperature changes, Memoirs of the National Institute of Polar Research, Special Issue 54 (in press).

ref. To Molau & Larsson should read: Molau, U. & Larsson, E. L. (1999) Seed rain and seed bank along an alpine altidudinal gradient in Swedish Lapland, *Canadian Journal of Botany* **78:** 728-747.
Reason: government reviewer=s request

Chapter 14:Latin America

Page 2, paragraph 2, last line, under "Climate, Extreme Events and Water Resources":
Old text: "……These phenomena may well be a sign of the changes associated with climate change".

New text: "……These phenomena may well be a sign of the changes associated with climate change, as they are already impacted by ENSO phenomena and extreme events".

Page 2, paragraph 3, line 3, under "Climate, Extreme Events and Water Resources":
Old text: "It has been well established that glaciers in Latin America have receded in recent decades.".

New text: "It has been well established that glaciers in Latin America, particularly those along tropical Andes, have receded in recent decades.".

Page 3, paragraph 1, line 2-3:
Old text: "However, with the current rate of deforestation of no more than 10% in Amazonia as a whole, discharge observations across the basin do not exhibit any significant trends yet".

New text: "However, with the current rate of deforestation of no more than 10% in Amazonia as a whole, discharge observations across the basin do not exhibit, up to now, any significant trends".
Reason: Accept comment by Wang, China

Page 3, paragraph 2, last sentence:
Old text: "Even though it is uncertain how global warming may affect the frequency and intensity of some extreme events, extraordinary combination of hydrological ad climatic conditions have historically produced (natural) disasters in Latin America".

New Text: "Even though it is uncertain how global warming may affect the frequency and intensity of some extreme events, the infrequent overlapping of hydrological and weather/climate events have, historical, given rise to disasters, whose frequency may be enhanced by such warming".

Page 3, under El Niño, third sentence:
Old text: "El Niño affects precipitation and temperature in the region. El Niño is related to dry conditions in northeast Brazil……..."

New text: "El Niño influences differentially precipitation and temperature in different parts of the region, for example, it is related to dry conditions in northeast Brazil,……..."

Page 3, last 2 lines:
Old text: "Coastal inundation steaming from sea-level rise or flatland flooding may therefore become serious climate change related problems for ecology of mangroves and the associated human economy".

New text: "Coastal inundation steaming from sea-level rise or flatland flooding due to climate change may therefore affect seriously mangroves ecology and associated human economy".
Reason: Comment by Wang, China: comment accepted with lead authors modification.

Page 4, under Human Health, last sentence:
Old text: "Socioeconomic and health problems could be exacerbated in critical areas fostering migrations from rural and coastal areas into major cities, deepening national and, at times, international conflicts. Therefore, under climate change conditions the risks for human health in Latin America may increase."

New text: "Some economic and health problems could be exacerbated in critical areas, fostering migrations from rural and small urban settlements into major cities, giving rise to additional stress at national level and, at times, adversely affecting international relations between neighboring countries. Therefore, under climate change conditions the risks for human health in Latin America may increase"

Page 5, under 14.1.1, 4th line of 1 paragraph:
Old text: "…….even if a decline of the population rates were possible. One of the critical……."

New text: "…….even is a decline of the population growth rates were possible. One of the critical…….".

Page 8, 4th paragraph:

Old text: “Streamflow in La Plata River basin, particularly at the El Negro, Paraguay, Paraná and Uruguay Rivers, ……..”

New text: “Streamflow in the River Plate basin, particularly at the Negro, Paraguay, Paraná and Uruguay Rivers, ……..”

Page 11, 1st. paragraph, second sentence:
Old text: “Due to the semi-arid conditions of this area, their economy is strongly affected (Quin and Neal, 1982;…….)”.

New text: “Due to the semi-arid conditions of this area, their economy is strongly affected (Canziani et al., 1997; Quinn and Neal, 1982;…….)”.
NOTE: The following reference must be added to the reference list: “Canziani, O.F., MP Prieto, R.M. Quintela, Vulnerability of the Oases between 29 and 36 S, to drier conditions in the high Andes, Vulnerability Study UNDP-SECyT, Project UNDP Arg 95 / G / 31, 1997.”

Page 11, paragraph 3, line 2:
Old text: “Cold and warm fronts, tropical cyclones and severe convergence are some of the most frequent phenomena that produce floods, droughts, mud and snow slides, heat waves, frosts and climate related fires throughout Latin America”.

New text: “Cold and warm fronts, tropical cyclones and severe convergence are some of the most frequent phenomena that produce floods, droughts, mud and snow slides, heat waves, frosts and climate related fires throughout Latin America”.
Reason: Comment by Wang, China: comment accepted.

Page 16, under Natural Ecosystems, 1st paragraph, 3rd line:
Old text: “……grasslands and wetlands (e.g., Pantanal and Iberá). Natural ecosystems…..”

New text: “……grasslands and coastal wetlands, mainly along the Caribbean and Atlantic coastlines, and inland freshwater wetlands, such as Pantanal and Iberá. Natural ecosystems…..”

Page 26, under section 14.2.3 Sea Level Rise, 3rd paragraph: in order to take care of the comment the Lead Authors will make the following change:
Old text: “……the expansion of the agricultural activity, and land use changes. Hurricanes would exacerbate those impacts”.

New text: “……the expansion of the agricultural activity, and land use changes.”.

Chapter 15: North America

Page 1 – Under the list of Contributing Authors, add the name "R. Pulwarty (USA)" after J. Patz and before D. Scott.

Page 2 – first sentence under Climate Trends and Scenarios: Change statement in parentheses to read "e.g. seasonal reductions in precipitation in some areas"

Page 3, after Par. 4 - ADD: "Responses to recurring and emerging water quality and quantity problems will provide opportunities to develop and test adaptive management options" [RESPONSE TO REVIEWER'S COMMENT]

Page 4, after Par. 1 in Marine Fisheries: ADD: "Projected climate changes have the potential to affect coastal and marine ecosystems, with impacts on the abundance and spatial distribution of species important to commercial and recreational fisheries. Tthe degree of the impact is likely to vary within a wide range, depending on the species and community characteristics and the regional specific conditions (chapter 6, section 6.3.1)." [RESPONSE TO REVIEWER'S COMMENT]

Page 4, last Par. In Marine Fisheries: CHANGE: " experience" to "experiences" [RESPONSE TO REVIEWER'S COMMENT]

Page 5, Par. 3 of Human Settlements and Infrastructure: ADD "barrier islands and coastal margins" after "drainage basins." [RESPONSE TO REVIEWER'S COMMENT]

Page 5, Par. 1 of Tourism: ADD "beaches" after "parks" [RESPONSE TO REVIEWER'S COMMENT]

Page 6 – Line 1 (4th paragraph under heading Public and Private Insurance and Disaster Relief Systems) in the sentence "Recent extreme events have led to a number of constructive responses by insurers…..", delete the word "constructive".

Page 9 - 7th sentence of 2nd paragraph of section 15.1.3 change text to read: "The largest increases have been in the northern Atlantic and Pacific coastal regions. Some regions have experienced seasonal decreases in precipitation."

PAGE 9, SEC. 15.1.2.2, PAR. 2: CHANGE FIRST TWO SENTENCES TO

"A second feature concerns urban land use extending into previously undeveloped or less developed areas including agricultural lands, forested areas, wetlands, barrier islands and other coastal margins. In the case of urban encroachment on forested areas, climate change effects on human use and value of forest ecosystems are likely to be significant

but are very poorly understood (Binkley and Van Kooten, 1994)." [RESPONSE TO REVIEWER'S COMMENT]
Page 10, Sec. 15.1.3, line 5: AFTER "duration" ADD: "(Meko et al., 1991)" [RESPONSE TO REVIEWER'S COMMENT]

Page 10, Sec. 15.1.3, line 6: REPLACE "millenia" WITH: "long periods" [RESPONSE TO REVIEWER'S COMMENT]

Page 10, Sec. 15.1.3, line 7: AFTER "today" ADD: "(Woodhouse and Overpeck, 1998)" [RESPONSE TO REVIEWER'S COMMENT]

Page 15, Sec. 15.2.1.2, par. 1: REPLACE WITH : "Water quality changes may be driven by changes in hydrologic flowpaths in a watershed associated with changes in patterns of precipitation and evapotranspiration and by changes in total flow in streams and rivers or in water level or duration of ice-cover in temperate lakes. In regions such as the Precambrian shield where watersheds are predicted to become drier in spring and summer, concentrations of dissolved organic material reaching lakes and streams from their catchments will decrease, increasing the water clarity and changing physical and thermal regimes by increasing the average thermocline depths in small, stratified lakes, for example (Schindler et al., 1996; Snucins and Gunn 1995; Perez-Fuentetaja et al., 1999). In contrast, in the Great Lakes and other large lakes where DOC concentrations are low, thermocline depths are determined by area or wind fetch, and are not affected by DOC (Fee et al., 1996). Models for the Great Lakes indicate that rapid spring warming may cause shallower and steeper thermoclines (reviewed by Magnuson et al., 1997). For lakes and streams receiving flow from both deep and shallow groundwater sources, drier watersheds could cause the major ion chemistry to be dominated more by the deep baseflow water sources (Webster et al., 1996)." [RESPONSE TO REVIEWER'S COMMENT]

Page 15 – 2nd paragraph of section 15.2.1.3 (Flood Risks). Add (also, see 15.3.2.7) after the second sentence, i.e. "….recent example of the importance of this coupling (also, see 15.3.2.7)."

Page 15 – 2nd paragraph of section 15.2.1.3. After the fifth sentence, add the following sentence plus the reference citation: i.e. "…..material in the coastal sediments. Hypoxia existed for approximately 3 weeks (Paerl et al., 2000). This estuary is….."

Page 15 – 2nd paragraph of section 15.2.1.3. After the last sentence, add the reference Paerl et al, 2000, i.e. "…in the future (Paerl et al., 2000; Kilborn, 1999; Stevens, 1999)."

Page 15, Sec. 15.2.1.3, Par. 2: AFTER "…material in the coastal sediments" CHANGE REMAINDER OF PARAGRAPH TO:

"especially in the estuaries and westernmost Pamlico Sound. The Albemarle-Pamlico Estuarine System provides fully half of the area used as nursery grounds for commercially important fish from Maine to Florida. These waters are a vitally important

feeding area for small sport fish and menhaden, and an important nursery for flounder, weakfish, shrimp and crabs. At the time, there was considerable concern that the release of nutrients and consumption of oxygen as the deposited organic material decomposes would cause physical stresses, disrupting the coastal food web and commercial fisheries for a significant time period (Paerl et al., 2000). As it turned out, the mesohaline estuaries west of the Pamlico Sound sustained the greatest damage from pollution that was washed in and deposited to the bottom muds (Burkholder et al. 2000). Pamlico Sound was protected from high impacts because much of the pollution settled out in the estuaries, and because of its high flushing exchange with the ocean relative to the estuaries. The high dilution provided by the extreme runoff associated with Hurricane Floyd was a 'saving grace' that appeared to buffer the pollution effects, so that no fish kills were reported throughout the system (Burkholder et al. 2000). However, concerns remain about chronic, more long-term impacts from the pollution that remained behind in the estuaries." [RESPONSE TO REVIEWER'S COMMENT]

Page 18, Sec. 15.2.2.1.4, Par. 2, end: DELETE "gypsy moth (Williams and Liebhold, 1998)" [INCORRECT REFERENCE]

Page 19 – 3rd paragraph of section 15.2.2.2.1 (Mountains), 1st sentence. Change the spelling of "sib-alpine lakes" to "sub-alpine lakes".

Page 20, Sec. 15.2.2.3.3, Par. 1: ADD AFTER "(see 15.2.2.3.4)" : "Coastal and Marine biota also are vulnerable to changes in upwelling, current dynamics, freshwater inflow, salinity, water temperatures and other processes affecting food webs and nursery areas (Boesch et al, 2000). [RESPONSE TO REVIEWER'S COMMENT]

Page 20, Sec. 15.2.2.3.3, Par. 2, line 1: REPLACE " both" WITH "the Gulf, Atlantic, and Pacific" [RESPONSE TO REVIEWER'S COMMENT]

Page 20, Sec. 15.2.2.3.3, Par. 2, line 2: CHANGE "impact" TO "impacts" [RESPONSE TO REVIEWER'S COMMENT]

Page 24, Sec. 15.2.3.1.2, last Par.: ADD AFTER "will be made." :

"This may be due to the ability of the agricultural production community to respond with great flexibility to a gradually changing climate. Typically, extreme weather poses a significant challenge to individual farming operations that may lack the spatial diversity and financial resources of large integrated corporate enterprises with production capabilities in one or more areas." INSERT PARAGRAPH BREAK [RESPONSE TO REVIEWER'S COMMENT]

Page 24, Sec. 15.2.3.1.3, Par. 1: BEGINNING OF LAST SENTENCE, INSERT: " It should be noted, therefore, " [EDITORIAL CHANGE]

Page 25, Box 15-1, Line 2: CHANGE BEGINNING OF SENTENCE TO: "In the Protocol, human-induced land-use changes and forestry activities (afforestation,

reforestation, deforestation) are mentioned as sinks of greenhouse gases for which sequestration credits can be claimed...." [RESPONSE TO REVIEWER'S COMMENT]

Page 27, Sec. 15.2.3.3: AT THE END OF THE FIRST PARAGRAPH IN THE SECTION ADD: "Projected climate changes have the potential to affect coastal and marine ecosystems through changes in coastal habitats, upwelling, temperature, salinity and current regimes. Such changes may affect the abundance and spatial distribution of species important to commercial and recreational fisheries (Boesch et al., 2000)." [RESPONSE TO REVIEWER'S COMMENT]

Page 28, Sec. 15.2.3.3, Par. 1 Line 4: AFTER "…by the fact that" ADD "some" [RESPONSE TO REVIEWER'S COMMENT]

Page 28, Sec. 15.2.3.3: INSERT THE FOLLOWING AT THE END OF THE SECTION**:**

"The available evidence suggests that there are likely to be impacts on fisheries arising, for example, from changes in current dynamics, temperature-dependent distribution and food web dynamics. These impacts will be variable across species and locations and are difficult to forecast with any precision. Because the effects of exploitation and environmental change can be synergistic, it will be increasingly important to consider changing environmental conditions in future fisheries management (Boesch, et al. 2000). (see Chapter 6 for further discussion)." [RESPONSE TO REVIEWER'S COMMENT]

Page 30, Sec. 15.2.4.1.2, Line 2: AFTER "injuries," ADD: " toxic contamination or ingestion," [RESPONSE TO REVIEWER'S COMMENT]

Page 30, Sec. 15.2.4.1.2.2: ADD AT END OF SECTION: "Inundations of sites containing toxic wastes, sewage, animal wastes, agrichemical products and wastes by flood waters may result in immediate exposure to humans, contamination of edible fish, and long-term contamination of flooded living structures (see 15.2.1.3 and 15.2.4.2.2.2)." [RESPONSE TO REVIEWER'S COMMENT]

Page 30, Sec. 15.2.4.1.2.3: AFTER "…an average of two hurricanes per year make landfall along the" CHANGE TEXT TO:

"…coastline of the continental United States (Hebert et al., 1993). There has been considerable interdecadal variability in the number of landfalling hurricanes in the United States (Pielke and Pielke, 1997). Meanwhile, FEMA…" [RESPONSE TO REVIEWER'S COMMENT]

Page 33, Sec. 15.2.4.2.2.2, END OF FIFTH PARAGRAPH, ADD: "Contamination of water bodies by animal and human wastes can stimulate harmful algae such as *Pfiesteria* that have been demonstrated to cause illness in humans and death in some species of fish. (Burkholder et al., 2000)." [RESPONSE TO REVIEWER'S COMMENT]

Page 33, Sec. 15.2.4.2.2.2 END OF SIXTH PARAGRAPH, ADD: "Land use management should include consideration of water supply and quality." [RESPONSE TO REVIEWER'S COMMENT]

Page 34, Sec. 15.2.4.2.3, line 2: DELETE "(Morris et al., 1989)" [RESPONSE TO REVIEWER'S COMMENT]

Page 37, Sec. 15.2.5.3, line 3: INSERT "Gulf and" BEFORE "Atlantic Coast" [RESPONSE TO REVIEWER'S COMMENT]

Page 40, Sec. 15.2.6, Par. 2, CHANGE LAST SENTENCE TO:

"This may have considerable consequences for the provision of recreational opportunities in coastal communities, particularly if associated with increased storm frequency." [RESPONSE TO REVIEWER'S COMMENT]

Page 40, Sec. 15.2.6, Par. 2, ADD THE FOLLOWING PARAGRAPH AFTER PAR. 2:

"Coastal zones are among the most highly valued recreational areas and are primary tourist destinations. Houston (1996) estimated that 85% of all tourist revenues in the United States are earned by coastal states, and there are as many as 180 million recreational visitors to US coasts every year (Boesch et al., 2000). Sea level rise in beach areas backed by sea walls or other development that precludes landward migration, would lead to the loss of beach area through inundation or erosion and pose an increased threat to the recreation infrastructure concentrated along the coast (sea-front resorts, marinas, piers, etc.). Beach nourishment is widely used to project highly valued recreational beaches. One study estimated that this adaptation strategy would cost US$14 to 21 billion to preserve major US recreational beaches from a 50 cm sea level rise (Wall, 1998b). Furthermore, impacts to ecologically important wetlands and coral reefs could also have major implications for sport fishing and diving related tourism activities in coastal regions. The risk to coastal recreation is most prominent in warm-weather destinations in the southern United States and small island nations in the Caribbean (see Chapter 17 and section 15.3.2.10), where tourism is a leading sector of the economy." [RESPONSE TO REVIEWER'S COMMENT]

Page 43, Sec. 15.2.7.2, Par. 3, Line 2: CHANGE "US$14 billion (Cdn$20 billion)" TO "US$15 billion (Cdn$22 billion)" [CORRECTED REFERENCE; SEE NEXT RESPONSE]

Page 43, Sec. 15.2.7.2, Par. 3, Line 3: CHANGE "(Insurance Bureau of Canada, 2000)" TO "Emergency Preparedness Canada, 2000)". [CORRECTED REFERENCE]

Page 46, Sec. 15.3.2.2, Par. 1: ADD AT END OF PARAGRAPH: "(Cohen et al., 2000)" [RESPONSE TO REVIEWER'S COMMENT]

Page 48, Sec. 15.3.2.5, Par. 2: CHANGE "(Anonymous, 1999a)" TO "(Anonymous, 1999)"; DELETE "(Anonymous 1999b)" [CORRECTED REFERENCE]

Page 48 – 4th paragraph of section 15.3.2.5 (Great Lakes). Add the following new paragraph and reference after the 4th paragraph, i.e. "…questions (Mills and Craig, 1999).

There have also been studies of alternative scenarios for lake level management. Decision support systems can facilitate this process (Chao et al, 1999)."

Page 50, Sec. 15.3.2.8, Par. 5: ADD AT END OF PARAGRAPH:

"Outside of MBIS, there have been few impact studies on North American boreal and Arctic freshwater fisheries (Weatherhead and Morseth, 1998). Some information is available on terrestrial wildlife and
Arctic marine fisheries (Chapter 16). Others have outlined the potential for freshwater ecosystem impacts, including loss or reduction of deltaic lakes, increased pondwater temperatures, side effects of permafrost thaw (including sedimentation of rivers), and changes in primary productivity depending on nutrient levels (Rouse et al., 1997; Schindler et al., 1997; Meyer et al., 1999)." [RESPONSE TO REVIWER'S COMMENT]

Page 52, Sec. 15.3.2.9, Par. 3: DELETE "(Morrison and Wolf, 1999)" [INCORRECT REFERENCE]

Page 53 – 2nd paragraph of section 15.3.2.10 (US-Caribbean Border). Add the following sentence and new paragraph to the end of the section, i.e. "….sector in the region (Alm et al., 1993). Narrow beaches combined with projected sea level rise contribute to the vulnerability of the tourism sector to changes in climate (Gable, 1997). Potential consequences of changes in extreme events (e.g. hurricanes) are not well defined. Other trends, such as changing demographic patterns, may exacerbate impacts. Recent large losses of life due to rainfall-induced floods, mud-flows and land-slides reflect increasing concentrations of residents in high risk areas (Rodriguez, 1997; Pulwarty, 1998)."

Page 65: CHANGE "Miller, K.A., G. Sethi…" TO "Miller, A., G. Sethi…" [INCORRECT INITIALS OF LEAD AUTHOR]

NEW REFERENCES:

Burkholder, J.M., H.B. Glasgow, and R. Reed, 2000: Impacts from Hurricane Floyd on Water Quality in the Neuse River and Estuary, and the Pamlico Sound, p. 26. In: North Carolina Water Resources: The Year of the Hurricanes: Abstracts and presentations and posters at the Annual North Carolina Water Resources Research Conference, March 30, 2000. North Carolina State University, Raleigh, N.C. IPS No. 4. Water Resources Research Institute of the University of North Carolina, Raleigh, N.C.

Boesch, D.F., J.C. Field, and D. Scavia (eds.), 2000: The Potential Consequences of Climate Variability and Change on Coastal Areas and Marine Resources: Report of the Coastal Areas and Marine Resources Sector Team, U.S. National Assessment of the Potential Consequences of Climate Variability and Change, U.S. Global Change Research Program. NOAA Coastal Ocean Program Decision Analysis Series Number 21. NOAA Coastal Ocean Program, Silver Springs, MD, 163 pp.

Fee, E.J., Hecky, R.E., Kasian, S.E.M., and Cruikshank, D.R., 1996: Effects of lake size, water clarity, and climatic variability on mixing depths in Canadian Shield lakes. Limnol. Oceanogr. 41: 912-920.

Gable, F., 1997: Climate change impacts on Caribbean coastal areas and tourism. *Journal of Coastal Research*, **24**, 49-70.

Hebert, P.J., J.D. Jarrell, and M. Mayfield, 1993: The deadliest, costliest, and most United States hurricanes of this century (and other frequently requested hurricane facts). NOAA Technical Memorandum NWS NHC-31, February 1993, National Hurricane Center, Coral Gables, FL. 41pp.

Houston, J., 1996: International tourism and United States beaches. Shore and Beach, 64 (2), 3-4.

Last, J., 1993. Global change: Ozone depletions, greenhouse warming and public health. Annual Review of Public Health. 14, 115-136.

Leatherman, S. 1989. Beach response strategies to accelerated sea-level rise. In: Coping with Climate Change. J. Topping, (ed.) Cimate Institute, Washington, DC U.S.A.

Magnuson, J.J., Assel, R.A., Bouser, C.J., Dillon, P.J., Eaton, J.G., Evans, H.E., Fee, E.J., Hall, R.I., Mortsch, L.R., Schindler, D.W., Quinn, F.H. and Webster, K.H.: 1997. Potential effects of climate change on aquatic systems: Laurentian Great Lakes and Precambrian Shield Region. Hydrol. Process. 11: 825-872.

Meko, D. M. Hughes, and C. Stockton, 1991: Climate Change and Climate Vulnerability: The Paleo Record. Pp. 71-100 in Managing Water Resources in the West Under Conditions of Climate Uncertainty, National Research Council, Proceedings of a Colloquium November 14-16, 1990 Scottsdale, Arizona, National Academy Press, Washington, DC. 358 pp.

Meyer, J.L., M.J. Sale, P.J. Mulholland and N.L. Poff, 1999. Impacts of climate change on aquatic ecosystem functioning and health. Journal of the American Water Resources Association, 35, 1373-1386.

Paerl, H.W., Bales, J.D., Ausley, L.W., Buzzelli, C.P., Crowder, L.B., Eby, L.A., Go, M., Peierts, B.L., Richardson, T.L., and J.S. Ramus, 2000: Hurricanes' hydrological, ecological effects linger in major U.S. estuary. *EOS, Transactions, American Geophysical Union*, **81** (40), 457-462.

Pérez-Fuentetaja, A., Dillon, P.J., Yan, N.D., and McQueen, D.J. 1999. Significance of dissolved organic carbon in the prediction of thermocline depth in small Canadian Shield lakes. Aquatic Ecology 33: 127-133.

Pielke, R.A. Jr. and Pielke R.A. Sr., 1997: Hurricanes: Their Nature and Impacts on Society. Wiley, Chichester, U.K. 279 pp.

Pulwarty, R., 1999: Hurricane impacts in the context of climate variability, climate change and coastal management policy on the eastern U.S. seaboard. In: Downing, T.,

Olsthoorn, A. and R. Tol (eds): *Climate, Change and Risk*. Routledge, London. pp. 173-204.

Rodriguez, H., 1997: A socio-economic analysis of hurricanes in Puerto Rico: An overview of disaster mitigation and preparedness. In Diaz, H. and R. Pulwarty, *Hurricanes: Climate and Socio-Economic Impact*. Springer-Verlag, Heidelberg. pp. 121-146.

Schindler, D.W., P.J. Curtis, S.E. Bayley, B.R. Parker, K.G. Beaty and M.P. Stainton. 1997. Climate induced changes in the dissolved organic carbon budgets of boreal lakes. Biogeochemistry. 36, 9-28.

Schindler, D.W., S.E. Bayley, B.R. Parker, K.G. Beaty, D.R. Cruikshank, E.J. Fee, E.U. Schindler and M.P. Stainton. 1996. The effects of climatic warming on the properties of boreal lakes and streams at the Experimental Lakes Area, Northwestern Ontario. Limnol. Oceanogr. 41: 1004-1017.

Snucins, E.J. and Gunn, J.M. 1995. Coping with a warm environment: behavioral thermoregulation by lake trout. Trans. Amer. Fish. Soc. 124: 118-123.

Wall, G. 1998b. Climate change, tourism, and the IPCC. Tourism Recreation Review, 23 (2) 65-68.

Weatherhead, E.C. and C.M. Morseth (eds.) 1998. Climate Change, Ozone and Ultraviolet Radiation. Chapter 11, in AMAP Assessment Report: Arctic Pollution Issues, Arcitic Monitoring and Assessment Programme (AMAP), Oslo, Norway. Pp. 717-774.

Webster, K.E., Kratz, T.K., Bowser, C.J., and Magnuson, J.J.R.W.J. 1996. The influence of landscape position on lake chemical responses to drought in northern Wisconsin. Limnol. Oceanogr. 41: 977-984.

Chapter 16:Polar Regions (Arctic and Antarctic)

Page 3, line 1, insert “and Greenland” after “West Antarctic”.
Reason: recommendation of Government reviewer.

Page 3, Line 3, end the sentence after “level rise”.
Reason: to avoid misunderstanding regarding the contribution of the cryospheric changes to sea level rise.

Page 3, bullet 7, line 3, end of line after “species assemblages” add “and a loss of some polar species.”

Reason: recommendation of Government reviewer.

Page 8, second last para, line 10: remove words “it seems clear that”.
Reason: the current statement is too strong.

Page 8, last para, line 1: remove “from the top of the atmosphere”.
Reason: to clarify the text.

Page 16, last para of box 16.1. Before the last sentence (beginning with “This could…”) insert: “More warmer water species will migrate poleward and compete for existing niches and some existing populations may take on a new dominance. These factors may change the population distribution and value of the catch”.
Reason: recommendation of Government reviewer.

Page 23, line 5-8 from bottom –
Suggest the following change: "The direct growth responses of evergreen dwarf shrubs to increased temperatures are small (Havstrom et al + other refs). This is in contrast to the growth rates of graminoids, forbs and deciduous dwarf shrubs (Henry and Molau + other refs). In the Arctic, where these growth forms are abundant, there is a significant increase in plant biomass in response to increased temperatures in summer (Henry and Molau 1997).

Page 27, Section 16.2.8.2.2: Change title to read “Buildings and industrial facilities”

Page 27, Section 16.2.8.2.2: At end of para, add “ There will be reduced demand for heating energy with warmer climate. (Anisimov, 1999)

Page 29, Sea level rise bullet (last para): replace first two sentences with the following. “Projected climate change in polar regions will have a critical impact on global sea levels. Expected sea level rise is in the range 0.09 m to 0.88 m by 2100 using the SRES scenarios (see WG1, Chapter 11). Increased melt of the Greenland ice sheet and of Arctic glaciers, and possible thinning of the West Antarctic ice sheet, are expected to make important contributions.”

Reason: recommendation of Government reviewer and final changes to WG1 report.

Page 31, “Hydrates” bullet, line 6, insert “a” after “even”, so that it reads: “temperature rise by even a few degrees C…”
Reason: obvious.

In references add: Anisimov,O., 1999, Impacts of Anthropogenic Climate Change on Heating and Air Conditioning of Buildings, Meteorology and Hydrology, 6: 10-17. (In Russian)

Chapter 17: Small Island States

Page 2, 2nd sentence, final paragraph:

- Delete extra line which unintentionally breaks up sentence. Sentence should read:

"A number of atmosphere-ocean GCms have been analysed for the Atlantic, Caribbean, Pacific, and Indian Ocean regions, and the Mediterranean Sea."
Justification: Obvious typo, and noted by reviwers (China)

Page 3, 2nd bullet point (Sea-Level Rise), first sentence:

- Insert the word "**be**" between 'will' and 'regional'

Justification: Obvious typographical error noted by authors.

Page 3, 4th bullet point, 2nd sentence:

- At the beginning of the sentence add the following text:

"While it is acknowledged that human-induced stresses are contributing to their degradation, these systems……widespread bleaching." (The language in the existing text remains unchanged).
Justification: Additional language is response to reviewer comment (China)

Page 6, Section 17.1.3, 2nd paragraph, line 7:

- Insert the word "western" between 'For instance,' and 'Kiribati'.

Justification: Respone to reviewer comment, which authors accept.

Page 10, final paragraph of section 17.1.4.3.5, 3rd sentence:

- Amend sentence 'The analysis projected…….considered preliminary', to read as follows: "Although the preliminary analysis implies that there might be a small decrease in cyclone formation, an increase in system intensity is projected".

Justification: Clarification by authors to remove ambiguity in interpretation.

Page 11, Section 17.2.2.1, Sea-Level Rise, penultimate line of paragraph 1:

- Delete the word "In"at the start of the last sentence, and replece with "On".
- Delete words "8.6%" in parentheses and replace with ("**80%**").
- Delete words "see also Chapter 6, this volume" at end of paragraph.

The final sentence of the paragraph now reads thus:
"On Majuro Atoll, Marshall Islands, land loss based on the Bruun rule is estimated to be nearly 60 ha of dry land (80% of the total land area) from a 1m rise in sea-level (IPCC, 1998).
Justification: First deletion is editorial and reads better. Second deletion is in response to review comment (Kiribati), with which the authors concur. Third deletion is required since the information to which the text refers no longer exists in chapter 6.

Page 12, 17.2.3: Beach and Coastal Changes

- At the end of paragraph 3, insert new subheading **17.2.3.1** titled:
  Response, Adaptation and Management

Justification: Suggestion from review comments that subheadings should be added (China). The authors concur in part and agree to insert one subheading only. It is recalled that in the first review, a USA reviewer felt the section was well-written and coherent. Authors concur with earlier reviewer and believe that too many subheadings will affect smooth flow of paragraph.

Page 14, Section 17.2.4.1, Coral Refs, last sentence of paragraph 3:

- Delete word "detailed" from sentence. Sentence should now read as follows:

"A**n** assessment of the literature on coral bleaching is provided in Chapter 6 of this volume."
Justification: Suggested by Chapter 6 CLA and authors concur.

Page 18, Section 17.2.7, Tourism, paragraph 3:

- Amend paragraph "A high proportion of…Small Island States (Wall, 1996)", to read as follows:

"A high proportion of tourism in the Small Island States is motivated by the desire of visitors from developed countries of the north (their largest market) to escape the cold winters. Small Island States are becoming increasingly concerned that projected milder winters in these markets, could reduce the appeal of these islands as tourist destinations (Martin and Bruce, 1999). It is projected that tourism could be further harmed by increased airline fares, if greenhouse gas mitigation measures (e.g. levies and emission charges) were to result in higher costs to airlines servicing routes between the main markets and the Small Island States (Wall, 1996)."
Justification: Response to review comment (China). Authors remain convinced that original language was clear and is consistent with the literature. However, authors have agreed to insert a few additional words which might improve clarity for readers whose native language is not English.

Page 19, Section 17.2.8.2, Fisheries:

- Delete the word "many" in second sentence (line 3 of paragraph), and insert the word "some" in its place, so that the sentence now reads:

"The impacts of climate change on fisheries are complex, and in some cases are indirect."
Justification: Authors believe this amendment is more accurate.

Page 19, Section 17.2.8.2, Fisheries:

- Delete the word "and"at end of line 1, and place a period after the word "coasts". The next sentence should then begin with the words "These include mangroves…".

The full sentence then reads:

"Many breeding grounds for commercially important fish and shell fish are located in shallow waters near coasts. These include mangroves, coral reefs, seagrass beds and salt ponds, all of which are likely to be affected by climate change".

The remainder of the paragraph is unchanged.
Justification: Simple, but necessary edit to complete the message conveyed in the text.

Page 20, Section 17.2.8.2, Fisheries, last paragraph:

- Amend the paragraph "A number of management….(IPCC, 1998) to read:

"A number of management strategies for minimizing the adverse effects of climate change on fish stocks have been proposed. These measures, many of which are already being implemented in some island states, include the conservation, restoration and enhancement of vital habitats such as mangroves, coral reefs and seagrass beds; the establishment and management of marine reserves and protected areas for identified critical species; and the implementation of bilateral and multilateral agreements and protocols for the exploitation and management of shared fisheries (migratory and straddling stocks) (IPCC, 1998; **NEW REF. TO BE ADDED)**. Aquaculture may also be considered by island states, as another means of reducing stress on wild stocks. However, great precaution must be taken to ensure that the measure does not exacerbate existing problems of habitat loss and competition for nutrients (Carvalho and Clarke, 1998; see als Chapter 6, section 6.6.4, this volume).
Justification: Response to review comment (USA). The authors accept recommendation to insert additional clarifying language. However, this required a slight reordering of the previous text to ensure that coherence was maintained.

Page 21, Section 17.2.9.2, Human Health, paragraph 5:

- Change first letter in words "small island states" to upper case, to read "Small Island States".

Justification: Obvious editorial change.

TO BE ADDED TO LIST OF REFERENCES:

Carvalho, P. and B. Clarke, 1998: Ecological sustainability of the South Australian coastal aquaculture management policies. *Coastal Management*, **26**, 281-290.

Chapter 18: Adaptive Capacity to Climate Change in the Context of Sustainable Development and Equity

In Australia/New Zealand portion, rewrite 4th bullet reading: “Adaptation responses maybe constrained by conflicting short and long-term planning horizons.” to be consistent with Chapter 12 text.

Chapter 19: Lines of Evidence for Vulnerability to Climate Change: A Synthesis

Page 1: Add A. Iglesias (Spain) as a contributing author

General: Change "lines of evidence" to "reasons for change" when discussing figure 19-7

Page 3, in paragraph beginning "It does not appear…." At the end of the paragraph add

- "For simplification, we group different levels of temperature increase into "small", "medium" and "large." "Small" denotes global mean temperature increases of up to approximately 2^{o}C; "medium" denotes a global mean temperature increase of approximately 2^{o}C to 3^{o}C; and "large" denotes a global mean temperature increase beyond approximately 3^{o}C."

Page 3, Observations bullet will be modified to be made consistent with the changes in the SPM: End of Page 3 Change to read: "…observations have been documented in about 100 physical processes and ~ 450 biological species or communities, in terrestrial and polar environments. Line 5: Over 90% (~99% physical, ~80% biophysical)

Page 4, 1st line, 2nd sentence, write to read: There are preliminary…from flooding and droughts in some locations. It is generally difficult…

Page 4, "Aggregate Impacts" bullet, delete the second and third sentences, "Some studies find…." And "However, given the uncertainties…."

Page 16, 19.2.2.4.2: 2nd para, 3rd line: Change to read "flooding *and droughts* in some locations" (Chapters 10, 11, 15)

Page 17, 19.2.3: 1st para, line 1, change to read: "documented in about 100 physical processes and ~450 biological species or communities, in terrestrial and polar environments. Over 90% (~99% physical, ~80% biophysical)

Page 17, 19.2.3: 1st para line 7, remove: "in all continents"

Page 18, insert between para 3 and 4:
In Figure 19.2, about sixteen studies examining glaciers, sea ice, snow cover extent/snow melt or ice on lakes or streams were selected that observe over 150 sites. Of these ~150 sites, 67% (~100) show change in one or more variable(s) over time. Of these ~100 sites, about 99% exhibited trends in a direction expected, given scientific understanding of known mechanisms that relate temperatures to the physical processes that affect change in that variable. The probability of this number of sites showing directional changes by chance is much less than 0.00001.

Page 18, 3rd para: Reword to read: "The sample of studies shown in Figure 19-2 was drawn from a literature survey with keywords…
Last sentence: Most of the biophysical studies included … between the two (see Chapter 5).

4th para: Rewrite to read: There are preliminary…from flooding and droughts in some locations. It is generally difficult…

Bullet 3: "in many diverse environments, that…reveal a coherent impact of ….

Page 26, last paragraph. After second sentence, ending "one of the major uncertainties in the outputs of climate change models." Insert

- "This is particularly true for estimates of precipitation, and as a result estimates of water sector impact, for example, can vary widely depending on the choice of GCM."

Insert a footnote at the end of the new sentence on page 26,

- "For example, Frederick and Schwarz, 1999 found that climate changes estimated in the southeastern United States in the 2030s under the Canadian Climate Change scenario result in an estimated $100 billion per year in damages. The estimate may be the result of internal model variability and does not fully account for adaptive responses or lower damages from reduced flood risks. Nonetheless it demonstrates the high sensitivity of water resources to extreme changes in climate."

Page 32, second bullet, last sentence, add "Frederick and Schwarz, 1999" after "Arnell, 1999."

Page 51, Section 19.8.2.3, third line, replace "monetary" with "market."

Page 54, after Fraser (et al.), insert:

- Frederick, K. D. and G. E. Schwarz. 1999. ASocioeconomic Impacts of Climate Change on U.S. Water Supplies.≅ *Journal of the American Water Resources Association* 35 (6): 1563-1583.

Page 70. Figure 19-2 and caption will change to reflect changes to the SPM.

Page 72. We have submitted a revised version of Figure 19-6. Replace the caption with,

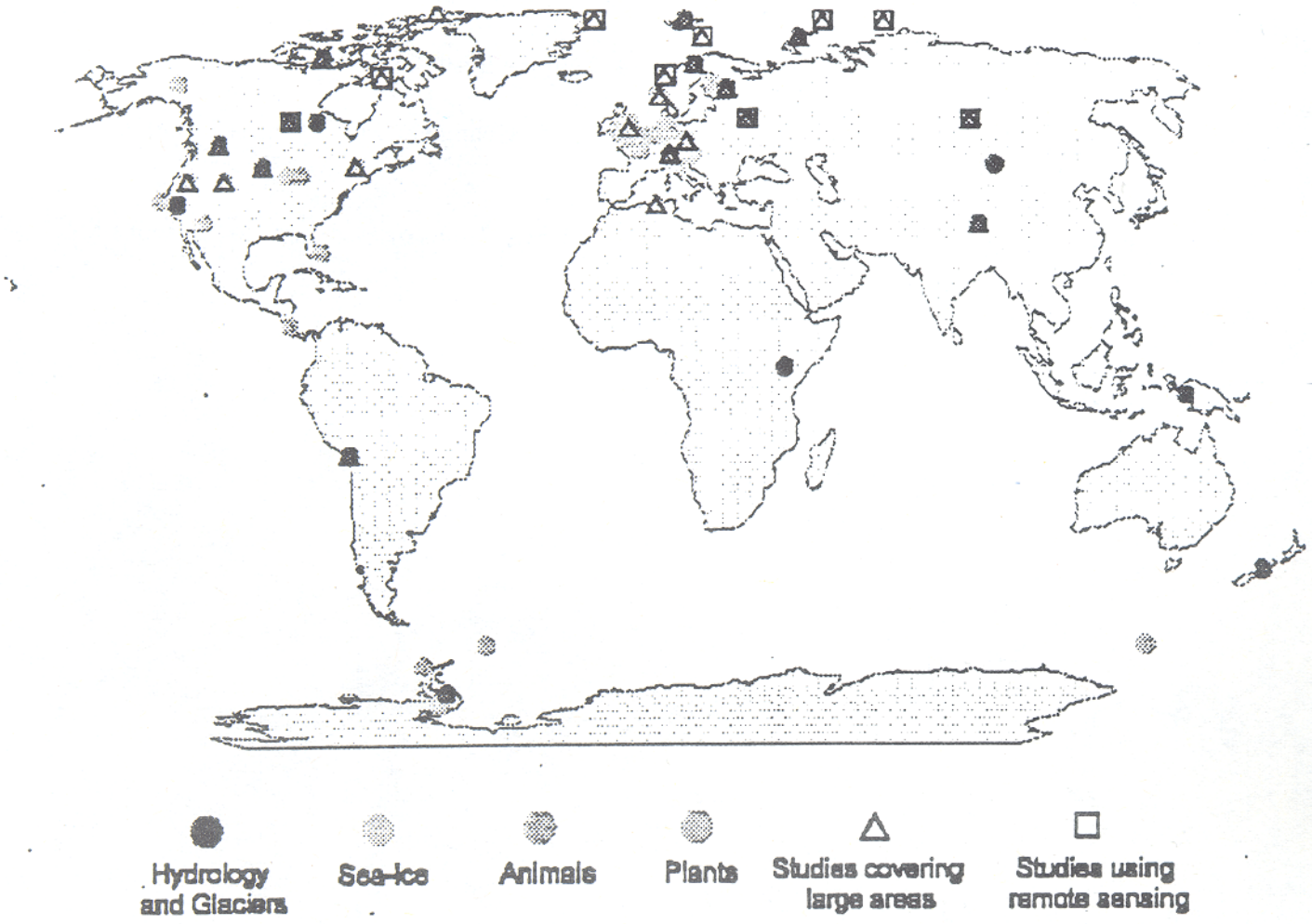
- Stability of the North Atlantic thermohaline circulation computed with the CLIMBER model (Petoukhov et al., 2000). The degree of shading indicates the probability of a THC collapse. Light shading stands for low probability and dark shading for high probability. The higher the hydrological sensitivity (HHS = high hydrological sensitivity, LHS = low hydrological sensitivity), or the faster the rate of temperature increase, or the greater the magnitude of temperature increase, the more likely the instability of the THC.

Figure 19-2: New Caption to Match revised figure according to SPM deliberations: Observed impacts of temperature-related regional climate change in the 20th century: *Hydrology and Glaciers* – Glacier retreat, decrease in snow cover extent/earlier

snowmelt, and reduction in annual duration of lake and river ice; *Sea-ice* -- Decline in sea-ice extent and thickness; *Animals* – poleward and elevational shifts in range, alteration in species abundance, changes in phenology (including earlier reproduction and migration), and physiological and morphological adaptation; *Plants* – Change in abundance and diversity, change in phenology (including earlier flowering), and change in growth. Studies that cover large areas and that use remote sensing methods are indicated. ~50 studies were selected according the following criteria: (1) hydrology/sea-ice studies that report long-term trends in observed variables (timeperiods of studies range from ~20 to 150 years); (2) terrestrial and marine ecosystem studies that associate trends in observed change(s) with trends in regional climate data for >/= 20 years (timeperiods of studies range from ~20 to 50 years). Of the ~100 physical processes and ~450 biophysical species that exhibited change, over 90% (~99%/~80% physical/biophysical) are consistent with well-known mechanisms of system responses to climate.

Sources: *Hydrology and Glaciers; Sea-ice* -- Ames and Hastenrath (1996); Cavalieri et al. (1997),
Dettinger and Cayan (1995), Dowdeswell et al. (1997), Dyurgerov and Meier (1997), Greene et al. (1999), Groisman et al. (1994), Haeberli and Beniston (1998), Hastenrath (1995), Johannessen et al. (1999), Kaser (1999), Kratz et al. (in press), Magnuson et al. (2000), Maslanik et al. (1996), Rothrock et al. (1999), Schindler et al. (1990), Vinnikov et al. (1999). *Animals and Plants* -- Barber et al. (2000), Bergmann (1999), Bezzel and Jetz (1995), Bradley et al. (1999), Brown et al. (1999), Crick et al. (1997), Crick and Sparks (1999), Cunningham and Moors (1994), Dunn and Winkler (1999), Ellis (1997), Ellis et al. (1997), Fleming and Tatchell (1995), Forchhammer et al. (1998), Fraser et al. (1992), Gatter (1992), Grabherr et al. (1994), Pauli et al. (1996), Hasenauer et al. (1999), Jarvinen (1994), Loeb et al. (1997), Ludwichowski (1997), Mason (1995), McCleery and Perrins (1998), Menzel and Fabian (1999), Parmesan (1996), Parmesan et al. (1999), Post et al. (1997), Post and Stenseth (1999), Pounds et al. (1999), Ross et al. (1994), Sagarin et al. (1999), Slater (1999), Smith (1994), Smith et al. (1999), Sparks (1999), Thomas and Lennon (1999), Visser et al. (1998), Winkel and Hudde (1996, 1997), Zhou et al. (1995).

Figure 19-7: Change “lines of evidence” to “reasons for change” when discussing figure 19-7. Modify caption to be consistent with SPM



19-2

Figure SPM-1: Locations at which systematic long-term studies meet stringent criteria documenting recent temperature-related regional climate change impacts on physical and biological systems. Hydrology, glacial retreat, and sea-ice data represent decadal to century trends. Terrestrial and marine ecosystem data represent trends of at least 2 decades. Remote-sensing studies cover large areas. Data are for single or multiple impacts that are consistent with known mechanisms of physical/biological system responses to observed regional temperature-related changes. For reported impacts spanning large areas, a representative location on the map was selected.

In Draft...Final Technical Adjustments to be Made to Illustration

Additional Changes to Technical Summary and Chapters Based on SPM Deliberations

Change title of Chapter 19 to "Vulnerability to Climate Change and Reasons for Concern: A Synthesis"

In all chapter discussions, including Figure 19-7, change "Lines of evidence" to "Reasons for Concern"