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APPENDIX 1: APPROACHES FOR DEVELOPING CLIMATIC SCENARIOS FROM GCM INFORMATION A1

Some standard methods of scenario construction are outlined below. Most impact assessments relying on GCM outputs for scenarios have adopted one of the alternatives described. For further details, readers are referred to the examples cited. Useful reviews of climatic scenario development are provided by Giorgi and Mearns (1991) and Pittock (1993).

A1.1 Equilibrium changes

Two methods are commonly used for computing the change in climate between the modelled control and 2 x CO_2 conditions for each grid box: by calculating the difference or 'delta' (i.e., 2 x CO_2 minus control), or the ratio (i.e., 2 x CO_2 divided by control) between pairs of values. The former method is usually preferred for considering temperature changes and the latter for precipitation changes. Note that if ratios are applied to temperatures, data should be converted from the relative Celsius scale to the absolute Kelvin scale (0°C = 273.15K).

A1.2 Scaling to the baseline

Since GCM outputs are not generally of a sufficient resolution or reliability to estimate regional climate even for the present-day (i.e., via the control run), it is usual for baseline observational data to be used to represent the present-day climate. These are then adjusted to represent the 2 x CO_2 climate, either by adding the deltas or multiplying the ratios described above (Box A1). The method implicitly assumes, therefore, that any systematic errors in the control run are also present in the experiment. A further note of caution concerns the application of precipitation ratios derived from GCM outputs to baseline precipitation in dry regions. If the GCM indicates that precipitation increases due to a shift in circulation, this increase expressed as a percentage has little effect when multiplied by the low baseline value, producing an unrealistic scenario. In such cases, the discretionary use of differences rather than ratios might be appropriate.

A1.3 Transient changes

The procedure for constructing transient scenarios is somewhat different. Firstly, the problem of drift in the control run (see Section 6.5.3) makes the selection of an averaging period problematic. Some workers use the full control period for averaging, others a period at the beginning, and still others a period in the control run corresponding to the equivalent period in the perturbation run.

Second, the requirements for scenario information from transient model outputs are either for discrete or continuous estimates. Discrete estimates provide values for time slices in the future (for example, decadal averages of change relative to the control). Continuous estimates refer to year-by-year values throughout the projection period. A simple method of scenario construction, developed for use in deliberations by IPCC Working Group II (TSU, 1994) is described in Box A2.

A1.4 *Missing variables*

In the absence of information on changes in certain climatic variables important for impact assessment, values of these variables are usually fixed at baseline levels. Given the sometimes strong correlations between variables under present-day climate, this procedure should be adopted with caution. An alternative involves invoking these statistical relationships to adjust missing variables according to changes in predicted variables.

A1.5 Time resolution

It is usually assumed that monthly adjustments made to climatic variables can be applied equally to data at shorter, within-month time steps. In the absence of information about the year-to-year variability of climate, it is further assumed that this remains the same under the scenario climate as during the baseline period. Recently, methods have been reported that make use of the daily data that are available from a limited number of GCM simulations. The statistical properties of these data can be used to generate stochastic weather data sets suitable as inputs to impact models.

A1.6 Sub-grid-scale data

One of the major problems faced in applying GCM projections to regional impact assessments is the coarse spatial scale of the estimates. Typically, GCM data are available at a horizontal grid point resolution of, at best, some 200 kilometers. Several methods have been adopted for developing regional GCM-based scenarios at sub-grid scale:

(1) The study area baseline is combined with the scenario anomaly of the nearest centre of a grid box (e.g., Bultot *et al.*, 1988; Croley, 1990). This has the drawback that sites which are in close mutual proximity but fall in different grid boxes, while exhibiting very similar baseline climatic characteristics, may be assigned a quite different scenario climate.

(2) The scenario anomaly field is objectively interpolated, and the baseline value (at a site or interpolated) is combined with the interpolated scenario value (e.g., Parry and Carter, 1988; Cohen, 1991). This overcomes the problem in (1), but introduces a false precision to the estimates.

(3) Experiments are conducted with regional 'fine mesh' climate models, which use inputs from GCMs and are then run (nested) at a higher spatial resolution (e.g., see the review by McGregor *et al.*, 1993). This is a physically-based method of accounting for important local forcing factors such as surface type and elevation, which GCMs are unable to resolve. A number of model runs have been conducted for regions in Europe and North America (e.g., Giorgi *et al.*, 1992) and Australia (e.g., McGregor and Walsh, 1993), and at least one (agricultural) impact study has been reported based on the outputs from a nested model (Mearns and Rosenzweig, 1993).

(4) Statistical relationships are established between observed climate at local scale and at the scale of GCM grid boxes. These relationships are used to estimate local adjustments to the baseline climate from the GCM grid box values (e.g., Wilks, 1988; Karl *et al.*, 1990; Wigley *et al.*, 1990). A variant of this approach relates local climate to objective measures of historical circulation types and then determines a scenario climate on the basis of the circulation type computed from GCM predictions (e.g., Bardossy and Plate, 1992). A weakness of both of these methods is that they assume that the relationships between sub-grid scale and large-scale climate will not change under GHG forcing.

A1.6 Composite scenarios

A number of studies have combined the anomaly fields from several scenarios (e.g., GCMs, historical) into one scenario using either dynamical/empirical reasoning (e.g., Pearman, 1988; Ackerman and Cropper, 1988; Robock *et al.*, 1993) or averaging (e.g., Santer *et al.*, 1990). Composite scenarios of this type are not generally realistic at a global scale, as they are based on a range of source scenarios, each having different assumptions and regional parameterizations. However, they have become useful in impact assessment both because they are relatively simple to apply and because they can provide information on between-model uncertainty of projections (Viner and Hulme, 1992).

A1.7 Scaling GCM outputs to global projections

It has become common to use simple climate models rather than GCMs to estimate the effects on future global temperatures of alternative GHG emission scenarios (IPCC, 1990a, 1992a). Their attractiveness as policy tools makes it desirable to use these scenarios in impact studies. However, since only global estimates are provided they cannot be used directly in regional assessments. A method of overcoming this problem makes use of GCM information in conjunction with the global estimates, whereby the GCM estimates of regional changes are scaled according to the ratio between the GCM estimate of global temperature change and that provided in the simple scenario (for example, for a doubling of CO_2). An example of how this technique can be used in developing transient scenarios is shown in Box A2.

A1.8 Selecting models

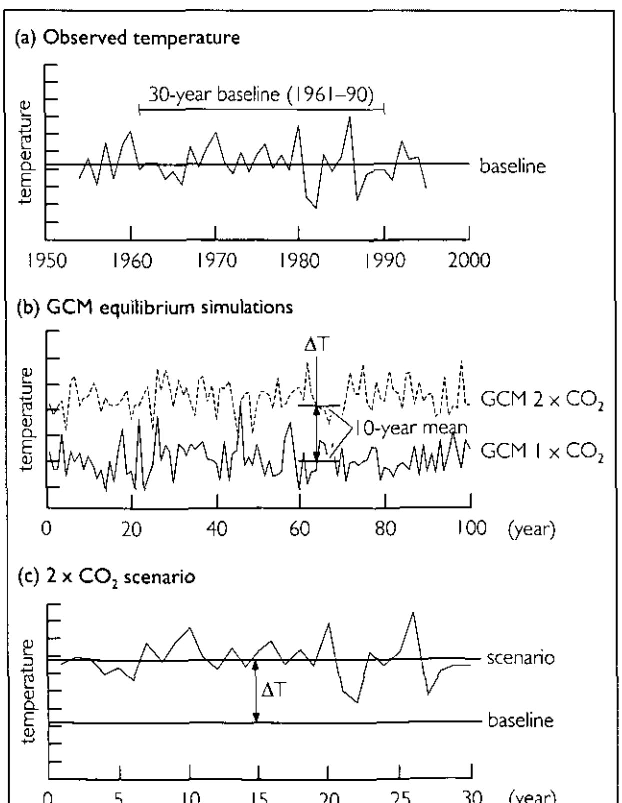
Many GCM simulations have been conducted in recent years, and it is not easy to choose suitable examples for use in impact assessments. In general, the more recent simulations are likely to be more reliable as they are based on recent knowledge, and they tend to be of a higher spatial resolution than earlier model runs. The IPCC has undertaken a GCM intercomparison exercise, which should provide useful information on model reliability and uncertainties (EPRI, 1994). It is strongly recommended that recent reviews of GCMs be consulted before selection. The National Center of Atmospheric Research, Boulder, Colorado, USA has been acting as a clearing house for GCM data from different modelling groups. In addition, the Model Evaluation Consortium for Climate Assessment (MECCA) at Macquarie University, New South Wales, Australia has developed a prototype compact disc, MECCA CD, which contains data from GCMs and a protocol for their distribution and use.

BOX A1
SCENARIOS FROM EQUILIBRIUM GCM OUTPUTS

To illustrate how equilibrium GCM outputs are commonly used to develop climatic scenarios, let us consider that the climatic variable of interest is June surface air temperature at a site, S. A long time series of mean June temperatures is available from a meteorological station at the site (Figure (a)). GCM estimates of monthly mean temperature for a model grid point adjacent to or interpolated to site S have been obtained for an equilibrium 2 x CO2 simulation, accompanied by estimates for a control simulation assuming present-day atmospheric greenhouse gas (GHG) concentrations (Figure (b)).

The climatological baseline is selected as the most recent standard 30-year averaging period for which observations are available (1961–1990; Figure (a)). Note that this period encompasses notable extreme events and some cyclicity at a decadal time scale.

The GCM estimates for the control and equilibrium 2 x CO2 simulations are shown in Figure (b) as annual values of mean June temperature. Climate modellers usually provide model results only for a period during which the global mean annual temperature approximates equilibrium (often a 10-year period). A similar period is also selected from late in the control run, as it often takes several decades for the modelled 1 x CO2 atmosphere to equilibriate. The difference between the mean equilibrium control and mean equilibrium 2 x CO2 temperature is then computed, and this is applied as an adjustment to each annual baseline value of June temperature at site S (Figure (c)).



BOX A2
SCENARIOS FROM TRANSIENT GCM OUTPUTS

A simple method of constructing scenarios based on transient GCM outputs has been developed at the Climatic Research Unit, UK for use in the IPCC WG II Second Assessment (TSU, 1994). The method is adapted from ideas originally proposed by Santer *et al.* (1990), and links information on the regional pattern of climate change from transient GCM simulations with output from a set of simple models which determine the global temperature response to given assumptions about future greenhouse gas emissions and concentrations (MAGICC).

MAGICC is described elsewhere in this report (Box 3). In order to obtain time dependent regional scenarios from the global mean temperature changes estimated by MAGICC, information is required from transient runs with GCMs. Results from three coupled ocean-atmosphere GCM experiments have been used in this exercise: the UK Hadley Centre model (UKTR; Murphy, 1994, Murphy and Mitchell, 1994), the Max Planck Institute, Hamburg model (ECHAM1-A; Cubasch *et al.*, 1992) and the Geophysical Fluid Dynamics Laboratory, Princeton model (GFDL89; Manabe *et al.*, 1991, 1992). Each model has been run over different time horizons and with slightly different assumptions about GHG concentrations.

All models are affected by the cold start problem (cf. Section 6.5.3), making it difficult to assign dates to the transient climate changes projected with these models. To overcome this, the time development of mean annual global temperature change was obtained using MAGICC, which starts with a pre-industrial climate and accounts for the GHG and sulphate aerosol forcing up to 1990. The model was run for the IS92a emissions scenario (including sulphates) assuming the mid-range climate sensitivity (2.5°C). The mean annual global temperature change was computed for the years 2020 and 2050 as 0.53°C and 1.16°C, respectively. These values have been used to identify the decades in three transient GCM runs where the global mean annual temperature changes are equivalent (see Table I). In addition to overcoming the cold start problem, this method also harmonizes the different radiative forcing scenarios used in each experiment.

To construct the scenarios, differences (or ratios) have been computed between the mean climate during the identified decades and equivalent decades in the control run simulation. These differences (ratios) can then be used as adjustments to the climatological baseline following the methods described in Appendix 1, Section A1.2.

It should be stressed that the levels of warming shown in Table I are mean annual global averages and represent only the mid-range climate sensitivity as determined by MAGICC. They are illustrative of the differences in seasonal and geographical pattern of climate change between the three GCMs, and are not intended to embrace the range of uncertainties attributable to different climate sensitivities, to alternative GHG emissions scenarios or to less tangible sources of error. For example, for a high emissions scenario (e.g., IS92f) combined with high climate sensitivity (4.5°C) the corresponding values of global warming for 2020 and 2050 are 0.81°C and 1.91°C, respectively. For a low emissions scenario (e.g., IS92c) and low climate sensitivity (1.5°C), the respective values are 0.34°C and 0.65°C. Therefore, the adoption of alternative assumptions would yield quite different regional scenarios.

An additional limitation of the approach is that the pattern of change derived from the GCMs does not reflect the likely pattern attributable to sulphate forcing (sulphates are treated only at a global scale by MAGICC). Transient experiments with GCMs which include both GHG and sulphate forcing have only recently been completed (Taylor and Penner, 1994).

Notwithstanding their limited range of representativeness, the scenarios described above still exhibit large inter-regional and between-model differences. To illustrate this, three locations have been arbitrarily selected to represent temperate (Beijing), semi-arid (Bulawayo) and oceanic (Havana) environments. Table II shows winter and summer temperature and precipitation changes estimated by the three GCMs for 2020 and 2050 at the nearest GCM grid boxes to these locations.

Table I. Ten-year periods in the three transient GCM simulations assumed to be equivalent to the decades centred around 2020 and 2050 in the MAGICC model simulations (with increase in global mean surface air temperature of 0.53°C and 1.16°C, respectively, relative to 1990). Source: TSU (1994).

	Equivalent years in GCM		
YEAR	GFDL89	ECHAM1-A	UKTR
2020	18–27	35–44	24–33
2050	36–45	48–57	49–58

continued ...

... continued

Table II. Model-simulated changes in seasonal (December to February–DJF; June to August–JJA) temperature and precipitation at grid boxes representing three contrasting sites: Beijing, Bulawayo and Havana. Values are from transient GCM simulations and represent mean climate in 2020 and 2050 following procedures described in the text. Source of data: TSU (1994).

GCM	Change in climate by 2020				Change in climate by 2050			
	Temperature (°C)		Precipitation (%)		Temperature (°C)		Precipitation (%)	
	DJF	JJA	DJF	JJA	DJF	JJA	DJF	JJA
	Beijing, China (39.93°N, 116.28°E)							
GFDL89	0.4	0.5	-18	+9	2.8	1.1	-5	0
UKTR	1.5	1.0	+82	+20	2.5	1.5	+70	+28
ECHAM1-A	0.7	0.4	-20	+15	1.0	1.5	+5	-13
	Bulawayo, Zimbabwe (20.15°S, 28.62°E)							
GFDL89	-0.1	0.2	+1	+6	1.7	1.6	-7	+32
UKTR	0.3	0.1	+34	+84	2.0	2.0	+27	+77
ECHAM1-A	0.6	0.9	-1	-21	1.0	2.1	+14	-45
	Havana, Cuba (23.17°N, 82.35°W)							
GFDL89	0.7	0.7	+11	+17	0.9	0.9	+7	-8
UKTR	0.8	0.7	+28	+14	1.0	1.2	-10	-12
ECHAM1-A	0.7	0.5	-13	-3	0.3	0.7	+10	-19

APPENDIX 2: A SELECTION OF CLIMATE IMPACT ASSESSMENTS, SHOWING THE STUDY REGION, SECTORS CONSIDERED, CLIMATIC SCENARIOS ADOPTED AND ANALYTICAL METHODS EMPLOYED

A2

REGION	SECTORS	CLIMATIC SCENARIOS	APPROACH	STUDY METHODS	REFERENCE
Globe	Agr, For, Wat, Ene	GCM Equilibrium $2 \times CO_2$	Parallel sectoral assessments	Modelling	Strzepek and Smith (in press)
Globe	Agr, For, Eco, Ene	GCM Equilibrium $2 \times CO_2$	Integrated	Modelling	Alcamo, 1994
Globe	Hea	GCM Equilibrium $2 \times CO_2$	Sectoral	Modelling	Martens *et al.*, 1994
Brazil	Agr, Ene, Ind, Hea, Urb, Wat	Temporal analogue	Parallel sectoral assessments	Modelling; qualitative	Magalhães and Neto, 1989
China	Sea, Eco, Agr, Ene	GCM Equilibrium $2 \times CO_2$ (Composite)	Parallel sectoral assessments	Modelling	Hulme *et al.*, 1992
Iceland, Finland, Canada, N. USSR, Japan	Agr	GCM Equilibrium $2 \times CO_2$; temporal analogue	Sectoral	Modelling	Parry *et al.*, 1988a
Indonesia, Malaysia & Thailand	Sea, Wat, Agr, Coa, Fis	GCM Equilibrium $2 \times CO_2$	Parallel sectoral assessments	Modelling	Parry *et al.*, 1992
Ireland	Agr, For, Eco, Wat, Sea, Fis	Expert judgement	Parallel sectoral assessments	Expert judgement; modelling	McWilliams, 1991
Japan	Wat, Agr, For, Fis, Eco, Coa, Ene, Urb, Hea	Various	Parallel sectoral assessments	Expert judgement; modelling	Nishioka *et al.*, 1993
Kenya, Brazil, Ecuador, India, S. USSR, Australia	Agr	Temporal analogue	Sectoral	Modelling; empirical survey	Parry *et al.*, 1988b
Missouri, Illinois, Nebraska, Kansas, USA (MINK)	Agr, For, Ene	Temporal analogue	Integrated	Modelling	Rosenberg, 1993
UK	Sea, Eco, Agr, For, Coa, Wat, Ene, Ind, Tra, Fin, Rec	GCM Equilibrium $2 \times CO_2$ (Composite)	Parallel sectoral assessments	Expert judgement; modelling	Department of the Environment, 1991
USA	Sea, Agr, For, Wat	GCM Equilibrium $2 \times CO_2$	Parallel sectoral assessments	Modelling	Smith and Tirpak, 1990
Vietnam	Agr, Hea, Ene, For, Fis,	Expert judgement, temporal analogue??	Parallel sectoral assessments	Modelling; qualitative	Ninh *et al.*, 1991
Zimbabwe, Kenya, Senegal, Chile	Agr	Expert judgement	Sectoral	Modelling	Downing, 1992

Agr: agriculture For: forestry Ene: energy supply and demand Wat: water resources Sea: sea level rise Coa: coastal zone Eco: natural ecosystems Fis: fisheries Ind: industry Urb: urban areas Fin: financial sector Hea: human health Tra: transport Rec: recreation and tourism

APPENDIX 3: ABBREVIATIONS, ACRONYMS AND CHEMICAL FORMULAE

A3

AIM	Asia-Pacific Integrated Model
ASLR	Accelerated Sea Level Rise
BaU	Business-as-Usual
BGMV	Bean Golden Mosaic Virus
CO_2	Carbon Dioxide
CEC	Commission of the European Communities
CEOS-IDN	Commission on Earth Observing System-International Data Network
CETA	Carbon Emissions Trajectory Assessment Model
CFC	Chlorofluorocarbon
CGE	Computable General Equilibrium (models)
CH_4	Methane
CRU	Climate Research Unit
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
DICE	Dynamic Integrated Climate Economy
DMI	Dynamic Macroeconomic Interindustry (models)
ECHAM 1-A	Max Planck Institute for Meteorology ECMWF Hamburg model Version 1-a
EPIC	Erosion-Productivity Impact Calculator
ESCAPE	Evaluation Strategies to Address Climate Change by Adapting to and Preventing Emissions
FAO	Food and Agriculture Organization
GCAM	Global Change Assessment Model
GCM	General Circulation Model
GDP	Gross Domestic Product
GEMS	Global Environmental Monitoring System (UNEP)
GFDL	Geophysical Fluid Dynamics Laboratory
GHG	Greenhouse Gas
GIS	Geographical Information Systems
GNP	Gross National Product
GRID	Global Resource Information Database (UNEP)
HDP	Human Dimensions of Global Environmental Change Programme
HEM	Harmonization of Environmental Monitoring
IBSNAT	International Benchmark Sites Network for Agrotechnology Transfer
ICSU	International Council of Scientific Unions
IGBP	International Geosphere-Biosphere Programme
IIASA	International Institute for Applied Systems Analysis
IMAGE	Integrated Model to Assess the Greenhouse Effect
IPCC	Intergovernmental Panel on Climate Change
IRIA	Integrated Regional Impact Assessment
ISRIC	International Soil Reference and Information Center
ISSC	International Social Science Council
LDC	Less Developed Country
MAGICC	Model for the Assessment of Greenhouse-Gas Induced Climate Change
MERGE	Model for Evaluating Regional and Global Effects of GHG reduction policies
MINK	Missouri, Iowa, Nebraska, Kansas study on the US Corn Belt
NATO	North Atlantic Treaty Organization
NCAR	National Center of Atmospheric Research, Boulder, Co, USA
NDU	National Defence University
NOAA	National Oceanographic and Atmospheric
AVHRR	Administration, Advanced Very High Resolution Radiometer
N_2O	Nitrous Oxide
OECD	Organization of Economic Cooperation and Development
ppmv	parts per million by volume
SCOPE	Scientific Committee on Problems of the Environment
TSU	Technical Support Unit (IPCC Working Group II)
UKTR	United Kingdom Meteorological Office Transient Model
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
VBD	Vector Borne Disease
WMO	World Meteorological Organization
WCP	World Climate Programme
WCIRP	World Climate Impact Assessment and Response Strategies Studies Programme
WRI	World Resources Institute

APPENDIX 4: SOME INTERNATIONAL DATA SOURCES OF INTEREST IN CLIMATE IMPACT ASSESSMENT STUDIES

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Table I: Data Sources

Type of data	Source	Spatial/temporal resolution	Content
Projections			
Population	IPCC[1]	7 regions and global/ totals in 2100	Total population (various projections)
Economic development	IPCC[1]	4 regions and global/trends 1990-2100	GNP (average annual rate–various projections)
Gas and aerosol emissions	IPCC[1]	Global/annual rates 1990, 2025 and 2100	IS92a-f scenarios: CO_2, CH_4, N_2O, CFCs, Halocarbons, SO_x
Radiative forcing	Wigley/Raper[2]	Global/annual up to 2100	IS92a-f scenarios and various assumptions
Climate change	NCAR[3]	Gridded (various resolutions)/ daily, monthly and seasonal (time series or time slice up to 2100)	Equilibrium GCM (various models); Transient GCM (various models); Temperature, precipitation and other variables
"	CRU[4]	Gridded (various resolutions) and globally averaged/monthly, seasonal and annual (time series or time slice up to 2100)	Equilibrium GCM (various models, inc. composite); Transient GCM (various models); 1-dimensional model (MAGICC); Temperature, precipitation and other variables
Sea level rise	CRU[5]	Global/annual up to 2100	MAGICC (for any given emissions scenario)
Agriculture, forestry and fisheries	FAO[6]	Regional, global/ totals in 2010	Area, production, trade, consumption and other data
Current baseline			
Population	UN[7]	National/annual	Total population/urban population (various projections)
Economic growth	World Bank[8]	National/annual	GNP, GDP
Climate	CDIAC[9]	Global stations/ monthly (historical time series)	Temperature, precipitation, cloudiness atmospheric pressure
"	UNEP/GRID[10]	Global 0.5° lat:lon grid/ 1931–1960 period monthly means	Temperature, precipitation,
"	CRU[11]	Global 5° lat:lon grid/ 1961–1990 period monthly means Europe 0.5° lat:lon grid/ 1961–1990 period monthly means	Temperature, precipitation Temperature(max, min), precipitation, sunshine, windspeed, vapour pressure, rain days, frost days
"	ECMWF/WCRP[12]	Global 2.5°, 1.125°, 0.5° lat:lon grid/ daily, monthly for individual years	Temperature, precipitation, atmospheric pressure
Land use/cover	UNEP/GRID[13]	Global 0.5° lat:lon grid/recent	Major ecosystem complexes based on maps and observations
"	UNEP/GRID[14]	Global 1° lat:lon grid/ 1960–1979	Predominant vegetation types, cultivation intensity and seasonal albedo based on maps
"	UNEP/GRID[15]	Global 1° lat:lon grid	Wetlands (derived)
Agriculture, forestry and fisheries	FAO[5]	National, regional, global/ 1970, 1980, 1990	Area, production, trade, food supply and other data
General environment	UNEP[16]	National	Water, air, health and other environmental measures
Soil	UNEP/GRID[17]	Global 2 minute grid	FAO/UNESCO Soil Map of the World
"	UNEP/GRID[18]	Global 1° grid	Zobler soil type (based on UNESCO/FAO maps), soil texture, surface slope and other properties
Soil degradation	ISRIC[19]	Global	UNEP World Atlas of Desertification
Global vegetation index	UNEP/GRID[20]	75°N-55°S on 8.6 minute grid/ 1982–1991	NOAA AVHRR Monthly Global Vegetation Index based on satellite data
Natural resources	WRI[21]	National/annual	Energy, raw materials, agriculture, forestry and many others
Human health	WHO[22]	National/annual	Distribution of and mortality from major diseases
Other data			
Elevation/Bathymetry	UNEP/GRID[23]	Global 5 minute grid	Integrated database derived from map information
Boundaries	UNEP/GRID[24]	Global (vector format)	World Databank II: Coastlines, islands, lakes, reefs, ice shelves, glaciers, rivers, canals, railways, administrative boundaries

Notes for Table I:

1) Intergovernmental Panel on Climate Change (Leggett *et al.*, 1992)
2) Wigley and Raper (1992)
3) National Center of Atmospheric Research, Boulder, Colorado, USA (information from R. Jenne and D. Joseph)
4) Climatic Research Unit, University of East Anglia, Norwich, UK (Viner and Hulme, 1994)
5) As 4 (Wigley and Raper, 1992; Warrick *et al.*, 1993)
6) Food and Agriculture Organization of the United Nations (FAO, 1992b; 1993)
7) United Nations (1991; 1992)
8) World Bank (1991)
9) Carbon Dioxide Information and Analysis Center, Oak Ridge, Tennessee, USA (Burtis, 1992)
10) United Nations Environment Programme/Global Resource Information Database (GRID–Geneva, 6, rue de la Gabelle, CH-1227 Carouge, Geneva, Switzerland). Climate data–Leemans and Cramer (1990)
11) As 4 (Jones *et al*, 1986a,b; Hulme, 1994; Hulme *et al.*, 1995b, in press)
12) European Centre for Medium Range Weather Forecasting, Reading, UK/World Climate Research Programme (ECMWF, 1993)
13) As 10 (Olson *et al*, 1985)
14) As 10 (Matthews, 1983; 1985)
15) As 10 (Matthews and Fung, 1987)
16) United Nations Environment Programme (UNEP, 1987)
17) As 10 (FAO/UNESCO, various dates)
18) As 10 (Zobler, 1986)
19) International Soil Reference and Information Center (UNEP, 1992)
20) As 10 (Tarpley, 1991)
21) World Resources Institute (WRI, 1992)
22) World Health Organization (WHO, 1990)
23) As 10 (Haxby *et al*, 1983)
24) As 10 (CIA, 1972)

Table II: Information About Data Sources

Name (and media)	Source	Contents
ACCIS (Hardcopy)	UNEP[1]	Information services and computerized database
HEM (Hardcopy, Disk)	UNEP/GEMS[2]	Data banks; inventory of international research organizations and programmes; directory of environmental monitoring
INFOTERRA (Disk, Hardcopy)	UNEP[3]	Directory of information sources
Master Directory (Network)	NASA[4]	Scientific data information service
CEOS-IDN (Network)	MECCA/NASA/ NASDA/ESA[5]	Directory of remotely sensed data

Notes for Table II:

1) ACCIS (1990)
2) Harmonization of Environmental Monitoring (UNEP/Global Environmental Monitoring System), Fritz (1990); Hicks (1993)
3) International Referral System for Sources of Environmental Information (UNEP, 1987)
4) National Aeronautics and Space Administration (Beier, 1991)
5) Commission on Earth Observing System-International Data Network (NASA/National Aeronautics and Space Development Agency/European Space Agency)