3. Cross-Cutting Issues and Multisector Approaches

The tools described in this part of the compendium encompass a broad range of applications. Some groups of tools address important cross-cutting themes such as use of climate or socioeconomic scenario data. Others such as decision analysis provide more detail on tools that might be most applicable to a particular step of the vulnerability and adaptation assessment process. Others still, such as stakeholder analysis, encompass not only a set of tools but also, in some instances, a partial framework that prescribes a process or an approach to undertaking several steps of a complete assessment.

3.1 Development and Application of Scenarios

The documents and techniques described in this section of the compendium (see Table 3.1) address the development and use of scenario data in the vulnerability and adaptation assessment process. The IPCC guidelines address this application generally, discussing a wide range of issues related to the application of both climate scenarios and socioeconomic scenarios. Several tools are descried that provide access to data and guidance to support the development and application of scenarios. The techniques that follow are more specific methods that can be used for downscaling climate data or developing socioeconomic scenarios.

The downscaling techniques described here can be used to produce small-scale climate data of the type often required by impact models and to develop future climate scenarios at local and national scales. Downscaling techniques represent only one particular way of generating climate change scenarios. Some of the techniques detailed here require considerable expertise and experience (e.g., dynamical downscaling), while others are relatively straightforward and easy to use (e.g., MAGICC/SCENGEN, SDSM, and weather generators).

The approaches to socioeconomic scenario construction, also listed in Table 3.1, are mostly part of larger frameworks, with the exception of the UKCIP scenarios. While users might consider employing an approach that is derived from a framework similar to that which they are implementing, the approaches described can be used independently of their parent frameworks. In practice, the process of developing scenarios will depend on the nature of the planned assessment. None of the following approaches provides a “one size fits all” method for developing socioeconomic futures, but should instead be viewed as informing a necessarily ad hoc process.

Table 3.1 Development and application of scenarios

3.1.1 General tools
IPCC-TGCIA Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment
The Climate Impacts LINK Project
NCEP Global Ocean Data Assimilation System (GODAS)
RClimDex
SimCLIM
UKCIP02 Climate Change Scenarios
Climate Information and Prediction Services (CLIPS) Project and Regional Climate Outlook Forums (RCOFs)
3.1.2 Climate downscaling techniques
Statistical Downscaling
Statistical DownScaling Model (SDSM)
Dynamical Downscaling
MAGICC/SCENGEN
Weather Generators
COSMIC2 (COuntry Specific Model for Intertemporal Climate Vers. 2)
PRECIS (Providing REgional Climates for Impacts Studies)
3.1.3. Socioeconomic scenarios
Developing Socioeconomic Scenarios: For Use in Vulnerability and Adaptation Assessments
Adoption of Existing Socioeconomic Scenarios
Qualitative and Quantitative Scenarios Emphasizing Stakeholder Input
UKCIP Socio-Economic Scenarios

3.1.1 General tools

IPCC-TGCIA Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment

Description	The Intergovernmental Panel on Climate Change (IPCC) Data Distribution Centre (DDC) www.ipcc-data.org provides access to data sets, climate and other scenarios, and other materials (e.g., technical guidelines on use of scenarios). The DDC operates under the oversight of the Task Group on Data and Scenario Support for Impact and Climate Assessment (TGICA), which was established by the IPCC to facilitate wide availability of climate change-related data and scenarios to enable research and sharing of information across the three IPCC working groups. There are four technical guideline documents: (1) General Guidelines on the use of Scenario Data for Climate Impact and Adaptation Assessment (2007); (2) Guidelines for Use of Climate Scenarios Developed from Regional Climate Model Experiments; (3) Guidelines for Use of Climate Scenarios Developed from Statistical Downscaling Methods; (4) Future climate in world regions: an intercomparison of model-based projections for the new IPCC emissions scenarios (Regional Scatter Diagrams). There is also a visualisation tool, providing maps of observed and projected climate variables and a help desk.
Appropriate Use	Scenario data should be applied as part of a greater methodological framework for climate change vulnerability and adaptation assessment (see Chapter 2).
Scope	All regions and sectors. IPCC approved data and technical guidelines on its use
Key Output	The data available from the DDC should be used in conjunction with the technical guidelines. Primarily designed to serve the impacts, adaptation and vulnerability research community. Also of potential interest to policy makers, planners and the general public. The DDC provides technical guidelines and three types of data: observed global climate data sets, nonclimatic (other environmental, socio-economic and emissions) baseline and scenario information, and results from global climate model experiments.
Key Input	Queries and user feedback.
Key Tools	Data visualisation, data archive, technical guidelines on use of data.
Ease of Use	Depends on techniques employed.
Training Required	Depends on guidelines employed.
Training Available	No formal training offered.
Computer Requirements	Browser for data access. Additional software may be required to process some of the data. Details are provided on the DDC site www.ipcc-data.org.
Documentation	Available at http://www.ipcc-data.org/guidelines/TGICA_guidance_sdciaa_v2_final.pdf
Applications	Not applicable.

IPCC-TGCIA Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment (cont.)

Contacts for Framework, Documentation, Technical Assistance	Guidelines: Tim Carter, Finish Environment Institute; Tel: +358.9.40300.315; e-mail: tim.carter@vyh.fi. Data: IPCC Document Distribution Center, e-mail: ipcc.ddc@uea.ac.uk; website: http://ipcc-ddc.cru.uea.ac.uk. or Dr. Michael Lautenschlager, IPCC DDC Manager; Tel: +49.404.1173.297; e-mail: lautenschlager@dkrz.de.
Cost	Guidelines and data are provided free of charge.
References	IPCC-TGICA, 2007: *General Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment*. Version 2. Prepared by T.R. Carter on behalf of the Intergovernmental Panel on Climate Change, Task Group on Data and Scenario Support for Impact and Climate Assessment, 66 pp.

The Climate Impacts LINK Project

Description	The Climate Impacts LINK dataset at the BADC (http://badc.nerc.ac.uk/data/link/) contains output data from a large number of numerical climate models and experiments from the Hadley Centre (at the UK Met office). The data are mainly from the global HadCM3 and regional HadRM3 models, and these data are available for use by the climate impact research community. The BADC website contains additional documentation on the format of the data, output variables and structure of the archive. The data themselves are available via ftp and http. The Climate Impacts LINK Project is funded by the UK Department of the Environment, Food and Rural Affairs (DEFRA).
Appropriate Use	While the data are available to researchers, it is recommended that expert advice on the most appropriate model output to use be sought. For LINK data, this advice should come from the UK Met Office scientists who produced the data.
Scope	The model outputs have global and regional coverage, and are available as daily and monthly mean fields. Typically, the data contain various output atmospheric fields, though in some cases ocean variables are also available.
Key Output	The ouput model data are widely used for a number of climate change studies.
Key Input	Some understanding of the background to the model experiments, so that the most appropriate data can be used for a particular study.
Ease of Use	As above.
Training Required	As above.
Training Available	None.
Computer Requirements	None.
Documentation	See the BADC LINK webpage (http://badc.nerc.ac.uk/data/link/) for more information and web links.
Applications	Numerous climate change studies.
Contacts for Tools, Documentation, Technical Assistance	BADC helpdesk: badc@rl.ac.uk The British Atmospheric Data Centre, Space Science and Technology Department R25 - Room 2.122, CCLRC Rutherford Appleton Laboratory, Chilton, nr Didcot, Oxfordshire, OX11 0QX, England, UK; Tel: +44.1235.44. 64.32; Fax: +44.1235.44.63.14. UK Met Office: http://www.metoffice.gov.uk/
Cost	No charge is made for academic use of these data. Commercial users should contact the UK Met Office for more information.
References	None.

NCEP Global Ocean Data Assimilation System (GODAS)

Description	The Global Ocean Data Assimilation System (GODAS) is developed at the National Centers for Environmental Prediction (NCEP) using the Geophysical Fluid Dynamics Laboratory's Modular Ocean Model version 3 (MOM.v3) and a three-dimensional variational data assimilation scheme. A retrospective global ocean reanalysis for 1979-2004 has been generated, and is used to initialize the oceanic component of the NCEP Climate Forecast System (CFS). The historical data set and real time update of the ocean analysis provide a valuable data set for use in research and operational communities.
Appropriate Use	GODAS can be used to study the mean climate, as well as the sub-seasonal, seasonal and interannual variability of the ocean.
Scope	GODAS provides ocean temperature, salinity and velocity for the domain 75°S to 65°N.
Key Output	The GODAS web site contains data links, data validations and global oceanic monitoring products (http://www.cpc.ncep.noaa.gov/products/GODAS/).
Key Input	None.
Ease of Use	Users can extract the data using a Fortran program or download the plots from the GODAS web site.
Training Required	None.
Training Available	None.
Computer Requirements	Web browser and a desktop with Unix system.
Documentation	Documentation is provided on the GODAS web site.
Applications	Global oceanic monitoring products shown on the GODAS web site.
Contacts for Tools, Documentation, Technical Assistance	Dr. Yan Xue, Climate Prediction Center, NCEP; e-mail: Yan.Xue@noaa.gov.
Cost	None.
References	Behringer, D.W. and Y. Xue. 2004. Evaluation of the global ocean data assimilation system at NCEP: The Pacific Ocean. Eighth Symposium on Integrated Observing and Assimilation Systems for Atmosphere, Oceans, and Land Surface, AMS 84th Annual Meeting, Washington State Convention and Trade Center, Seattle, Washington. Behringer, D.W. 2007. The Global Ocean Data Assimilation System (GODAS) at NCEP. 11th Symposium on Integrated Observing and Assimilation Systems for the Atmosphere, Oceans, and Land Surface, AMS 87th Annual Meeting, San Antonia, TX.

RClimDex

Description	RClimDex is software that computes a total of 27 climate extreme indices recommended by the WMO CCl/CLIVAR/JCOMM joint Expert Team on Climate Change Detection and Indices (ETCCDI). These indices have been used to evaluate past changes in climate extremes. RClimDex runs in R, free software that provides an environment for statistical analysis.
Appropriate Use	RClimDex is used to generate indices for climate extremes from daily station data.
Scope	RClimDex was designed to analyze daily station data for all parts of the world. By applying the same tool in different parts of the world and generating the same types of indices, analyses conducted in different parts of the world can be compared, and merged together to seamlessly form a spatial map across the world.
Key Output	The final output is a set of indices for climate extremes.
Key Input	This tool requires daily values of station precipitation amount, and maximum and minimum temperatures.
Ease of Use	The software has a friendly graphical user interface. Programming skill is not required. Anyone who is able to use a computer should be able to run the software.
Training Required	Training is generally not required to run the software. However, the interpretation and future analysis of the indices requires some knowledge of climatic analysis.
Training Available	Training has been provided through ETCCDI organized workshops.
Computer Requirements	The software runs in MS-Windows, Linux and Unix. The statistical environment R needs to be installed before running the RClimDex. There is no special hardware requirement; a typical office PC, or any workstation should be sufficient.
Documentation	A user manual, in both English and Spanish, is available at http://cccma.seos.uvic.ca/etccdi.
Applications	This software has been used in ETCCDI workshops (see references below).
Contacts for Tools, Documentation, Technical Assistance	RClimDex was developed by Xuebin Zhang and Yang Feng of Environment Canada on behalf of the ETCCDI. For details and technical assistance contact Dr. Xuebin Zhang, Climate Research Division, Environment Canada, 4905 Dufferin Street, Toronto, Ontario, Canada, M3H 5T4; Tel: +1.416.739.4713; Fax: +1. 416.739.5700; e-mail: Xuebin.Zhang@ec.gc.ca.
Cost	RClimDex and the R environment are free. RClimDex is available at http://cccma.seos.uvic.ca/etccdi, and R is available at http://www.r-project.org.

RClimDex (cont.)

References	Aguilar, E., T.C. Peterson, P. Ramírez Obando, R. Frutos, J.A. Retana, M. Solera, I. González Santos , R.M. Araujo, A. Rosa Santos, V.E. Valle, M. Brunet India, L. Aguilar, L. Álvarez, M. Bautista, C. Castañón , L. Herrera, R. Ruano, J.J. Siani, F. Obed, G.I. Hernández Oviedo, J.E. Salgado, J.L. Vásquez, M. Baca, M. Gutiérrez, C. Centella, J. Espinosa, D. Martínez, B. Olmedo, C.E. Ojeda Espinoza, M. Haylock, R. Núnez, H. Benavides and R. Mayorga. 2005. Changes in precipitation and temperature extremes in Central America and Northern South America, 1961-2003. *Journal of Geophysical Research – Atmospheres* 110: D233107, doi:10.1029/2005JD006119. Alexander, L.V., X. Zhang, T.C. Peterson, J. Caesar, B. Gleason, A.M.G. Klein Tank, M. Haylock, D. Collins, B. Trewin, F. Rahimzadeh, A. Tagipour, K. Rupa Kumar, J. Revadekar, G. Griffiths, L. Vincent, D.B Stephenson, J. Burn, E. Aguilar, M. Brunet, M. Taylor, M. New, P. Zhai, M. Rusticucci and J.L. Vazquez-Aguirre. 2006. Global observed changes in daily climate extremes of temperature and precipitation. *Journal of Geophysical Research – Atmospheres* 111: DO5109, Klein Tank, A.M.G., T.C. Peterson, D.A. Quadir, S. Dorji, Z. Xukai, T. Hongyu, K. Santhosh, U.R. Joshi, A.K. Jaswal, R.K Kolli, A. Sikder, N.R. Deshpande, J. Revadekar, K. Yeleuova, S. Vandasheva, M. Faleyeva, P. Gomboluudev, K.P. Budhathoki, A. Hussain, M. Afzaal, L. Chandrapala, H. Anvar, P.D. Jones, M.G. New and T. Spektorman. 2005. Changes in daily temperature and precipitation extremes in Central and South Asia, *Journal of Geophysical Research – Atmosphere* 111: doi:10.1029/2005JD006316. New, M., B. Hewitson, D.B. Stephenson, A. Tsiga, A. Kruer, A. Manhique, B. Gomez, C.A.S. Coelho, D.N. Masisi, E. Kululanga, E. Mbambalala, F. Adesina, H. Saleh, J. Kanyanga, J. Adosi, L. Bulane, L. Fortunata, M.L. Mdoka and R. Lajoie. 2006: Evidence of trends in daily climate extremes over southern and west Africa, *Journal of Geophysical Research-Atmospheres* 111: D14102, doi:10.1029/2005JD006289. Peterson, T.C., X. Zhang, M. Brunet India and J.L.V. Aguirre.2007. Changes in North American extremes derived from daily weather data. *Journal of Geographical Research-Atmospheres*, submitted. Vincent, L.A., T.C. Peterson, V.R. Barros, M.B. Marino, M. Rusticucci, G. Carrasco, E. Ramirez, L.M. Alves, T. Ambrizzi, M.A. Berlato, A.M. Grimm, J.A. Marengo, L. Molion, D.F. Moncunill, E.Rebello, Y.M.T. Anunciação, J. Quintana, J.L. Santos, J. Baez, G. Coronel, J. Garcia, I. Trebejo, B. Bidegain, M.R. Haylock and D. Karoly. 2005. Observed trends in indices of daily temperature extremes in South America 1960-2000. *Journal of Climate* 18:5011-5023. Zhang, X., E. Aguilar, S. Sensoy, H. Melknyan, U. Taghiyeva, N. Ahmed, N. Kutaladze, F. Rahimzadeh, A. Taghipour, T.H. Hantosh, P. Albert, M. Semawi, M.K. Ali, M. Halal, A. Al-Shabibi, A. Al-Oulan, A. Zatari, I. Al Dean Khalil, R. Sagir, M. Demircan, M. Eken, M. Adiguzel, L, Alexander, T.C. Peterson and T. Wallis. 2005a. Trends in Middle East climate extremes indices during 1930-2003. *Journal of Geophysical Research – Atmospheres* 110:D22104, doi:10.1029/2005JD006181. Zhang, X. G. Hegerl, F.W. Zwiers and J. Kenyon. 2005b. Avoiding inhomogeneity in percentile-based indices of temperature extremes, *Journal of Climate* 18:1641– 1651.

SimCLIM

Description	SimCLIM is a flexible software package that links data and models in order to simulate the impacts of climatic variations and change, including extreme climatic events, on sectors such as agriculture, health, coasts or water resources. SimCLIM is a user-friendly "open-framework" system that can be customized and maintained by users. It contains tools for importing and analyzing both spatial (monthly, seasonal) and time-series (hourly, daily or monthly) data. For generating scenarios of future climate and sea-level changes, SimCLIM uses a "pattern scaling" method that involves the use of spatial data from complex atmosphere-ocean general circulation models (or AOGCMs) together with projections of global-mean climate changes. Standard tools presently include: degree-day model; domestic water tank model; extreme event analyzer; coastal erosion model; and data browser. Specific versions of SimCLIM are also available that interface with DHI hydrologic models and with ICASA crop models (DSSAT).
Appropriate Use	SimCLIM can be used to: describe baseline climates; examine current climate variability and extremes; generate climate and sea-level change scenarios; assess present and future climatic risks; assess present and future adaptation measures; conduct sensitivity analyses; examine sectoral impacts; examine uncertainties; facilitate integrated impact assessments.
Scope	SimCLIM contains a custom-built GIS and can thus be applied spatially to any geographic area and spatial resolution, from global to local. It also contains site-specific tools for examining time-series climate data and driving site-specific impact models.
Key Output	Spatial and site-specific scenarios of climate and sea-level changes (including changes in the risks of extreme events) and their sector impacts. Formats include spatial images, time-series projections, and graphical and tabular output.
Key Input	AOGCM and observed climate data are provided with SimCLIM for global and regional scenario generation, as well as some daily and monthly station data. Depending on user requirements, additional data for national and local situations can be included in the package. Other spatial and time-series data can be imported into the system by the user.
Ease of Use	Very user-friendly software. User and technical manuals are provided.
Training Required	For the basic functions, little training is required for users familiar with climate science. Training is advisable for users with limited background in climate change or for those who wish to gain experience with the full functionality of the system.
Training Available	Training sessions are held regularly depending on the demand. A training version of the model, called *TrainCLIM*, is also available and has been used extensively for purposes of training in climate change vulnerability and adaptation assessment.
Computer Requirements	Personal computer.
Documentation	The users and technical manuals can be obtained from CLIMsystems Ltd by request: info@climsystems.com
Applications	Used extensively in New Zealand (where it is called CLIMPACTS), Australia and North America, as well as in various Pacific Island Countries. A recent example was an application for studies conducted for the Asian Development Bank, 2005: http://www.adb.org/Documents/Reports/Climate-Proofing/
Contacts for Tools, Documentation, Technical Assistance	CLIMsystems Ltd, P.O. Box 638, Waikato Mail Centre, Hamilton 3240, New Zealand; e-mail: info@climsystems.com; website: www.climsystems.com.
Cost	Individual and site licenses available, at low-to-medium cost depending on user category.

SimCLIM (cont.)

References	Warrick, R.A. and G. Cox. 2007. New developments of SimCLIM software tools for risk-based assessments of climate change impacts and adaptation in the water resource sector. In M. Heinonen (ed.), Proceedings of the Third International Conference on Climate and Water. Helsinki, Finland, 3-6 September 2007. SYKE, Helsinki, p. 518-524. Warrick, R.A. In press. From CLIMPACTS to SimCLIM: the Development of an Integrated Model for Assessing Impacts and Adaptation to Climate Change and Variability. In C.G. Knight and J. Jaeger (eds.), *Integrated Regional Assessment: Challenges and Case Studies*. Cambridge University Press, UK. Warrick, R.A., W. Ye, P. Kouwenhoven, J.E. Hay and C. Cheatham. 2005. New Developments of the SimCLIM Model for Simulating Adaptation to Risks Arising from Climate Variability and Change. In Zerger, A. and Argent, R.M. (eds.) MODSIM 2005. International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2005, pp. 170-176. Warrick, R.A. 2006. Climate Change Impacts and Adaptation in the Pacific: Recent Breakthroughs in Concept and Practice. In Chapman, R., Boston, J. and Schwass, M. (eds.) *Confronting Climate Change: Critical Issues for New Zealand*. Wellington: Victoria University Press. Warrick, R.A. 2007. SimCLIM: Recent Developments of an Integrated Model for Multi-scale, Risk-based Assessments of Climate Change Impacts and Adaptation. Proceedings of the 2007 ANZSEE Conference on Re-inventing Sustainability: A Climate for Change, held 3-6 July 2007, Noosaville, Queensland, Australia, http://www.anzsee.org/2007conference/conference_papers.asp.

UKCIP02 Climate Change Scenarios

Description	The UKCIP02 climate change scenarios provide four alternative descriptions of how the climate of the UK might evolve over the course of this century.
Appropriate Use	The UKCIP02 scenarios have become a standard reference for impacts and adaptation work in the UK. Ways in which they have been used can be broadly divided into research, communication and decision- and policy-making.
Scope	The climate change scenarios cover only the UK (though underlying model output is also available for the Republic of Ireland), meaning their scope is limited to UK-based climate impacts and adaptation.
Key Output	The information contained in UKCIP02 is provided to users in three main ways: (i) Headline messages - provide a national overview of the main changes described by UKCIP02. They also include historic trends, to allow recent observations to be compared with future projections. (ii) Published material - explains the science behind UKCIP02, examines historic climate trends in the UK and gives more information about the projected future changes. It includes a range of prepared maps & graphs to help visualise the changes described. (iii) Numerical information - provides the basis for the changes described by UKCIP02, allowing further processing and analysis (e.g. as input to other modelling software). Much has been converted to GIS-format files in order to facilitate its use. A series of datasets of historic climate of the UK provide information on the observed climate.
Key Input	None required for headline messages and published material. Numerical information requires users to complete a registration form. Use of UKCIP02 is most effective if users dedicate some time to understand how the scenarios were produced, what they offer and the uncertainties involved. Their use is enhanced through use of the other UKCIP tools.
Ease of Use	No information available.
Training Required	No information available.
Training Available	None provided.
Computer Requirements	No information available.
Documentation	UKCIP02 briefing report and science report; Scenarios Gateway web-pages (www.ukcip.org.uk/scenarios/ukcip02).
Applications	Set of case studies is being developed. Ways in which they have been used can be broadly divided into research, communication and decision- and policy-making.
Contacts for Tools, Documentation, Technical Assistance	Richard Westaway
Cost	No charge.
References	Hulme et al. 2002. Climate Change Scenarios for the United Kingdom: The UKCIP02 Briefing Report. 15pp. Hulme et al. 2002. Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report. 120pp.

Climate Information and Prediction Services (CLIPS) Project and Regional Climate Outlook Forums (RCOFs)

Description	Climate Information and Prediction Services (CLIPS) is a project of the World Meteorological Organization (WMO) designed to assist in the provision of climate information and predictions for improved economic and social decision making, and thereby support sustainable development. CLIPS builds on the rapidly developing atmospheric and oceanographic research (e.g. atmospheric predictability beyond weather prediction, ocean predictability, regional circulation indices such as ENSO and NAO, ocean-atmosphere interactions, etc.) as well as the wealth of climate data, experience and expertise within the National Meteorological Hydrological Services (NMHSs) and related entities and provides a framework to deliver operational user-targeted climate services. The CLIPS project is an effective framework within which regional climate variability and change information and the associated adaptation issues can be integrated. Development of training curricula, training workshops and regional showcase projects are key components of CLIPS. The Regional Climate Outlook Forums (RCOFs), promoted by WMO along with other international agencies, constitute an important vehicle in developing countries for providing advanced information on the future climate information for the next season and beyond, and for developing a consensus product from amongst the multiple individual predictions (based on ensembles of different dynamical climate model outputs, statistical relationships between surface ocean and continental anomalies, validated by some human expertise) . RCOFs stimulate the development of climate capacity in the NMHSs and facilitate end-user liaison to generate decisions and activities that mitigate the adverse impacts of climate variability and change and help communities to build appropriate adaptation strategies. There is a great potential for the regional climate activities that currently take place under RCOFs and through CLIPS training to expand, through the actions of the WMO regional associations and the NMHSs, the use of currently available downscaling tools to more countries and to include information on climate change scenarios assembled by the World Climate Research Programme (WCRP), such as climate projections created for the IPCC Fourth Assessment Report (AR4). This would enable NMHSs to contribute to their national communications to the UNFCCC and to develop or enhance their dialogue with users of climate information on climate risks and vulnerability (especially their governments), and would also support improved regional coordination on climate matters, standardization of tools and increased evaluation (feedback) on model outputs. While there is a range of climate modeling and downscaling tools is available today, there is as yet no global framework to train and apply these tools to meet the user needs. CLIPS/RCOFs provide this framework and bring value to the model applications and their data and facilitate their access to the users.
Appropriate Use	It is important that appropriate partnerships with the application sectors are put in place to understand the user needs. It is most appropriate to develop RCOFs for groups of nations having common climate information needs. Effective networking of the representatives of climate information providers and user sectors from the participating countries is also essential for successful operation of RCOFs. It is important for producers of climate predictions at seasonal to inter-annual scales to demonstrate the potential benefit that users can draw for their application by using the forecasts. This can easily be done using hindcasts.

Climate Information and Prediction Services (CLIPS) Project and Regional Climate Outlook Forums (RCOFs) (cont.)

Scope	CLIPS framework is applicable at the local, national, regional and global level. RCOFs operate at sub-continental scale.
Key Output	Training workshops, CLIPS curriculum, tailored climate products, regional climate outlooks, guidance on best practices in CLIPS operations, verification and user liaison, consensus-based climate products (e.g., WMO El Niño/La Niña Updates and seasonal climate outlooks issued by the RCOFs), downscaled climate prediction products for national/regional levels, etc.
Key Input	National/regional/global climate data, climate prediction products from WMO Global Producing Centres (GPCs) for long range forecasts and WMO Regional Climate Centres (RCCs)/RCC Networks, data on climate-sensitive sectors for impact assessment.
Ease of Use	Requires expertise in climate processes, analysis and modeling, and knowledge of climate-related risk management aspects.
Training Required	Training required in downscaling of climate prediction/projections to appropriate regional/national scales, verification, and development of user liaison. Training is also required for the generation of tailored climate products.
Training Available	WMO supports limited CLIPS training through its global series of workshops. Training is also an integral component of the RCOF process. In addition, there are other international agencies providing training on CLIPS- and RCOF-related topics.
Computer Requirements	High-performance computing facilities are required to run regional climate models. However, for statistical downscaling and development of regional/national climate products, a personal computer with the latest technology with relatively high processing, memory and storage capacities will be adequate. A high-speed internet connectivity will be most essential to access global/regional climate products.
Documentation	CLIPS Brochures and related guidance documents and meeting reports.
Applications	CLIPS has been promoted worldwide, and a number of CLIPS Focal Points exist in many countries. RCOFs are active in Africa, South America, Central America, Asia and Pacific Islands. For more information, please visit http://www.wmo.int/pages/prog/wcp/wcasp/clips/outlooks/climate_forecasts.html.
Contacts for Tools, Documentation, Technical Assistance	Chief, World Climate Applications & CLIPS Division, World Climate Programme Department, World Meteorological Organization,7bis, Avenue de la Paix, Case Postale No. 2300, 1211, Geneva 2, Switzerland; Tel: +41.22.730.8377; Fax: +41.22.730.8042; e-mail: wcac@wmo.int.
Cost	WMO facilitates free access to some specialized climate prediction software as well as climate prediction/projection products, through its Members and partnering agencies. Resources will be required to organize training sessions and RCOF operations.

Climate Information and Prediction Services (CLIPS) Project and Regional Climate Outlook Forums (RCOFs) (cont.)

References	CLIPS brochures and RCOF links available at WMO World Climate Applications and Services Programme and CLIPS web pages: http://www.wmo.int/pages/prog/wcp/wcasp/wcasp_home_en.html Coping with the Climate: A Way Forward, A multi-stakeholder review of RCOFs. 2000. http://iri.columbia.edu/outreach/publication/irireport/PretoriaSumRpt2.pdf. Palmer, T.N., A. Alessandri, U. Andersen, P. Cantelaube, M. Davey, P. Délécluse, M. Déqué, E. Díez, F.J. Doblas-Reyes, H. Feddersen, R. Graham, S. Gualdi, J.-F. Guérémy, R. Hagedorn, M. Hoshen, N. Keenlyside, M. Latif, A. Lazar, E. Maisonnave, V. Marletto, A. P. Morse, B. Orfila, P. Rogel, J.-M. Terres and M. C. Thomson. 2004. Development of a European multi-model ensemble system for seasonal to inter-annual prediction (DEMETER). Bulletin of the American Meteorological Society 85: 853-872. http://ams.allenpress.com/amsonline/?request=get-abstract&doi=10.1175/BAMS-85-6-853 Patt, A.G. and J. Winkler. 2007. Applying Climate Information in Africa: An Assessment of Current Knowledge. Written in support of NOAA, Boston University and the International Institute for Applied Systems Analysis (IIASA). http://www.iiasa.ac.at/Publications/Documents/XO-07-006.pdf .

3.1.2 Climate downscaling techniques and regional models

Statistical Downscaling

Description	Downscaling is a method for obtaining high-resolution climate or climate change information from relatively coarse-resolution global climate models (GCMs). Typically, GCMs have a resolution of 150-300 km by 150-300 km. Many impacts models require information at scales of 50 km or less, so some method is needed to estimate the smaller-scale information. Statistical downscaling first derives statistical relationships between observed small-scale (often station level) variables and larger (GCM) scale variables, using either analogue methods (circulation typing), regression analysis, or neural network methods. Future values of the large-scale variables obtained from GCM projections of future climate are then used to drive the statistical relationships and so estimate the smaller-scale details of future climate (see also weather generators).
Appropriate Use	Statistical downscaling may be used whenever impacts models require small-scale data, provide suitable observed data are available to derive the statistical relationships.
Scope	All locations.
Key Output	Small scale information on future climate or climate change (maps, data, etc).
Key Input	Appropriate observed data to calibrate and validate the statistical model(s). GCM data for future climate to drive the model(s).
Ease of Use	Difficult to apply from first principles since it requires access to large data sets and considerable expertise to derive the statistical relationships. User-friendly software to facilitate use is available (see SDSM — Statistical DownScaling Model, on next table).
Training Required	Considerable knowledge and experience is required to work from first principles. Use of packages like SDSM, however, requires relatively little training.
Training Available	A training course for SDSM was held in late 2002, but there are currently no plans for future courses.
Computer Requirements	Personal computer.
Documentation	Numerous publications in the scientific literature. The SDSM package provides a list of the most useful such publications arranged by category.
Applications	Widely applied in many regions and over a range of climate impact sectors. For a specific example, see Wilby et al. (1999) in References below.
Contacts for Framework, Documentation, Technical Assistance	SDSM may be obtained by registering at https://co-public.lboro.ac.uk/cocwd/SDSM/.
Cost	SDSM is free.

Statistical Downscaling (cont.)

References	Wilby, R.L. and T.M.L. Wigley. 1997. Downscaling general circulation model output: A review of methods and limitations. *Progress in Physical Geography* 21:530-548. Wilby, R.L. and T.M.L. Wigley. 2000. Downscaling general circulation model output: A reappraisal of methods and limitations. In *Climate Prediction and Agriculture,* M.V.K. Sivakumar (ed.). Proceedings of the START/WMO International Workshop, 27-29 September 1999, Geneva. International START Secretariat, Washington, DC, pp. 39-68. Wilby, R.L., L.E. Hay, and G.H. Leavesley. 1999. A comparison of downscaled and raw GCM output: Implications for climate change scenarios in the San Juan river basin, Colorado. *Journal of Hydrology* 225:67-91. Wilby, R.L., T.M.L. Wigley, D. Conway, P.D. Jones, B.C. Hewitson, J. Main, and D.S. Wilks. 1998. Statistical downscaling of general circulation model output: A comparison of methods. *Water Resources Research* 34:2995-3008.

Statistical DownScaling Model (SDSM)

Description	SDSM is a user-friendly software package designed to implement statistical downscaling methods to produce high-resolution monthly climate information from coarse-resolution climate model (GCM) simulations. The software also uses weather generator methods to produce multiple realizations (ensembles) of synthetic daily weather sequences.
Appropriate Use	SDSM can be used whenever impact assessments require small-scale climate scenarios, provided quality observational data and daily GCM outputs for large-scale climate variables are available.
Scope	All locations.
Key Output	Site-specific daily scenarios for maximum and minimum temperatures, precipitation, humidity. SDSM also produces a range of statistical parameters such as variances, frequencies of extremes, spell lengths.
Key Input	Quality observed daily data for both local-scale and large-scale climate variables to calibrate and validate the statistical model(s). Daily GCM outputs for large-scale variables for future climate to drive the model(s). The current version (4.2) contains observed data libraries for use in model calibration, and GCM data for making future projections.
Ease of Use	The user-friendly software is largely self explanatory. It comes with comprehensive instructions for use.
Training Required	Requires little training for those familiar with climate science but it requires expert knowledge and reiterated efforts to establish realistic and accurate statistical relationships.
Training Available	There are currently no plans for any training courses.
Computer Requirements	SDSM 4.2 has been tested on the following minimum specifications: PC Windows 98/NT/2000/XP (it may also work on Windows 95 but has not been tested on this OS); Memory - 5 MB RAM, 48 MB ROM; Processor - 133 MHz; Coding language - Visual Basic 6.0. Note: for older machines SDSM may work but may crash or take longer to perform certain analyses when large data sets are processed.
Documentation	Numerous publications in the scientific literature. User's manual at https://co-public.lboro.ac.uk/cocwd/SDSM/SDSMManual.pdf.
Applications	Widely applied in many regions and over a range of climate impact sectors. See References (below) for examples of applications.
Contacts for Framework, Documentation, Technical Assistance	New users can register and download the software package at https://co-public.lboro.ac.uk/cocwd/SDSM/.
Cost	SDSM is free.
References	Please see https://co-public.lboro.ac.uk/cocwd/SDSM/refs.html for a full list of SDSM references.

Dynamical Downscaling

Description	Downscaling is a method for obtaining high-resolution climate or climate change information from relatively coarse-resolution global climate models (GCMs). Typically, GCMs have a resolution of 150-300 km by 150-300 km. Many impacts models require information at scales of 50 km or less, so some method is needed to estimate the smaller-scale information. Dynamical downscaling uses a limited-area, high-resolution model (a regional climate model, or RCM) driven by boundary conditions from a GCM to derive smaller-scale information. RCMs generally have a domain area of 106 to 107 km^2 and a resolution of 20 to 60 km.
Appropriate Use	Dynamical downscaling can be used whenever impacts models require small-scale data.
Scope	All locations.
Key Output	Small-scale information on future climate or climate change.
Key Input	Typically six-hourly, gridpoint GCM data for future climate to drive the RCM.
Ease of Use	Requires considerable expertise in climate modeling — for specialists only.
Training Required	Considerable knowledge and experience required.
Training Available	No specific training courses available.
Computer Requirements	Same computer requirements as a GCM — i.e., high-level supercomputer or massive parallel computer.
Documentation	Numerous publications in the scientific literature.
Applications	Widely applied in many regions and over a range of climate impact sectors. For a specific example, see Hay and Clark (2003) in References below.
Contacts for Framework, Documentation, Technical Assistance	None.
Cost	High. Impractical except for academic or government institutions.
References	Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (eds.). Cambridge University Press, Cambridge, UK, pp. 583-638. Hay, L.E. and M.P. Clark. 2003. Use of statistically and dynamically downscaled atmospheric model output for hydrologic simulations in three mountainous basins in the western United States. *Journal of Hydrology* 282:56-75. Leung, L.R., L.O. Mearns, F. Giorgi, and R.L. Wilby. 2003. Workshop on regional climate research: Needs and opportunities. *Bull. Amer. Met. Soc.* 84:89-95. Giorgi, F., B. Hewitson, J. Christensen, M. Hulme, H. Von Storch, P. Whetton, R. Jones, L. Mearns, and C. Fu. 2001. Regional climate information — Evaluation and projections. In *Climate Change 2001. The Scientific Basis, Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change,* J.T. Houghton, Y.

MAGICC/SCENGEN

Description	MAGICC/SCENGEN is a user-friendly software package that takes emissions scenarios for greenhouse gases, reactive gases, and sulfur dioxide as input and gives global-mean temperature, sea level rise, and regional climate as output. MAGICC is a coupled gas-cycle/climate model. It has been used in all IPCC reports to produce projections of future global-mean temperature and sea level change, and the present version reproduces the results given in the IPCC Third Assessment Report (TAR). MAGICC can be used to extend results given in the IPCC TAR to other emissions scenarios. SCENGEN is a regionalization algorithm that uses a scaling method to produce climate and climate change information on a 5° latitude by 5° longitude grid. The regional results are based on results from 17 coupled atmosphere-ocean general circulation models (AOGCMs), which can be used individually or in any user-defined combination.
Appropriate Use	Can be used whenever future atmospheric composition, climate or sea level information is needed.
Scope	All locations.
Key Output	MAGICC gives projections of global-mean temperature and sea level change. SCENGEN gives the following regional outputs on a 5° latitude by 5° longitude grid: changes in or absolute values of temperature and precipitation, changes in or absolute values of temperature and precipitation variability, signal-to-noise ratios based on intermodel differences or temporal variability, and probabilities of temperature and precipitation change above a specified threshold. The software also quantifies uncertainties in these outputs.
Key Input	Emissions scenarios for all gases considered in the SRES (Special Report on Emissions Scenarios) scenarios: CO_2, CH_4, N_2O, CO, NOx, VOCs, SO_2, and the primary halocarbons considered by the Kyoto Protocol (including SF6). The user also has control over various climate model and gas-cycle model parameters.
Ease of Use	The user-friendly software is largely self explanatory. It comes with a user manual and a technical manual.
Training Required	Requires little training for those familiar with basic climate science.
Training Available	A training course for an earlier version was held in 2000, but there are currently no plans for future courses.
Computer Requirements	• Windows 95/98/NT/2000/XP • 64 MB RAM • 100 MB free disk space
Documentation	Numerous publications in the scientific literature.
Applications	Widely applied in many regions and over a range of climate impact sectors. See References below.
Contacts for Framework, Documentation, Technical Assistance	The primary developer, Tom Wigley, can be contacted at wigley@ucar.edu. See also: http://www.cru.uea.ac.uk/~mikeh/software.
Cost	MAGICC/SCENGEN is free.

MAGICC/SCENGEN (cont.)

References	Santer, B.D., T.M.L. Wigley, M.E. Schlesinger, and J.F.B. Mitchell. 1990. Developing Climate Scenarios from Equilibrium GCM Results. Max-Planck-Institut für Meteorologie Report No. 47, Hamburg, Germany. Wigley, T.M.L. and S.C.B. Raper. 1992. Implications for climate and sea level of revised IPCC emissions scenarios. *Nature* 357:293-300. Wigley, T.M.L. and S.C.B. Raper. 2001. Interpretation of high projections for global-mean warming. *Science* 293:451-454. Wigley, T.M.L. and S.C.B. Raper. 2002. Reasons for larger warming projections in the IPCC Third Assessment Report. *Journal of Climate* 15:2945-2952. Other information is given in the atmospheric chemistry, climate projections, and sea level chapters of the IPCC TAR Working Group 1 report, Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, D. Xiaosu, and K. Maskell (eds.). 2001. *Climate Change 2001: The Scientific Basis*. Cambridge University Press, New York. Wigley,T.M.L., Raper,S.C.B., Hulme,M. and Smith,S. 2000. The MAGICC/SCENGEN Climate Scenario Generator: Version 2.4, Technical Manual, Climatic Research Unit, UEA, Norwich, UK, 48pp. Wigley, T.M.L. 1993. Balancing the carbon budget. Implications for projections of future carbon dioxide concentration changes. *Tellus* 45B:409-425. Raper, S.C.B., T.M.L. Wigley, and R.A. Warrick. 1996. Global sea level rise: past and future. In *Sea-Level Rise and Coastal Subsidence: Causes, Consequences and Strategies,* J. Milliman and B.U. Haq (eds.). Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 11-45.

Weather Generators

Description	Weather generators are not, strictly speaking, downscaling techniques, but are often used in conjunction with the techniques outlined in this section. A weather generator is a statistical model used to generate realistic daily sequences of weather variables — precipitation, maximum and minimum temperature, humidity, etc. Such data are often referred to as synthetic data. Usually precipitation sequences are generated first, and other data sequences are derived using statistical relationships between these data and precipitation, with different relationships used for wet and dry days. Precipitation is divided into an occurrence process (i.e., whether the day is wet or dry) modeled as a Markov chain, and an amount process (the amount of precipitation on a wet day) sampled randomly from an appropriate distribution, such as a Gamma distribution. By using different random seeds, a large number of sequences can be generated, all of which have the same statistical properties as the original data used to calibrate the statistical model — akin to realizations from a set of parallel universes. This is a crucial factor in assessing uncertainties associated with the chaotic nature of daily weather variability. The SDSM software has a weather generator component.
Appropriate Use	Weather generators are used whenever impacts models require small-scale data on a daily time scale, provided suitable observed data are available to derive the statistical relationships.
Scope	All locations.
Key Output	Station-level information on future precipitation, maximum and minimum temperatures, humidity, etc.
Key Input	Appropriate observed data to calibrate and validate the statistical model(s). GCM data for future climate to drive the model(s).
Ease of Use	There are a number of weather generator software packages requiring different levels of expertise for their use (see References below). The user-friendly software in SDSM's weather generator component is largely self explanatory and comes with comprehensive instructions for use.
Training Required	Requires little training for those familiar with basic climate science.
Training Available	There are currently no plans for future courses.
Computer Requirements	Personal computer. Specific requirements will depend on the selected weather generator.
Documentation	Numerous publications in the scientific literature. The earliest papers date from the 1960s.
Applications	Widely applied in many regions and over a range of climate impact sectors. See References below.
Contacts for Framework, Documentation, Technical Assistance	New users of SDSM can register at http://www.sdsm.org.uk/.
Cost	Depends on the weather generator. SDSM, for example, is free.

Weather Generators (cont.)

References	Nicks, A.D., L.J. Lane, and G.A. Gander. 1985. Weather generator. In *USDA-Water Erosion Prediction Project: Hillslope Profile and Watershed Model Documentation*, D.C. Flanagan and M.A. Nearing (eds.). USDA-ARS National Soil Erosion Research Lab. Report No. 10, West Lafayette, IN. Richardson, C.W. 1981. Stochastic Simulation of daily precipitation, temperature and solar radiation. *Water Resources Research* 17:182-190. Wilby, R.L., Hay, L.E. and G.H. Leavesley. 1999. A comparison of downscaled and raw GCM output: implications for climate change scenarios in the San Juan river basin, Colorado. *Journal of Hydrology* 225:67-91. Wilks, D.S. and R.L. Wilby. 1999. The weather generation game: A review of stochastic weather models. *Progress in Physical Geography* 23:329-357. (See also SDSM.)

COSMIC2 (COuntry Specific Model for Intertemporal Climate Vers. 2)

Description	The COSMIC2 model provides climate-change impact modellers and policy analysts a flexible system that can produce a full range of dynamic country-specific climate-change scenarios. The need for this type of modeling capability was discussed at the IPCC Asia-Pacific Workshop on Integrated Assessment Models held in Tokyo in 1997. That Workshop aimed at improving communication between experts in a variety of disciplines and policy analysts/policy makers. One goal was to expand the use of integrated-assessment modelling for addressing the potential impacts of climate change in a way that better reflected the experiences of researchers from developing countries. These researchers (and others at universities around the world) may not have access to state-of-the-art transient general circulation model (GCM) simulations. The expense of running these supercomputer models limits their availability and ease of use. The COSMIC2 model helps remove this limitation. COSMIC2 can provide easy access to credible climate-change scenarios that are consistent with the state-of-the-art, fully coupled, transient ocean-atmosphere GCM simulations.
Appropriate Use	Can be used for estimating country level climate change. The climate change scenarios can be used in impact, vulnerability, and adaptation assessments.
Scope	Provides country level (158 countries) climate change and sea level rise estimates from 2000 up to 2200 for 28 emission scenarios. These include the initial IPCC stabilization scenarios, SRES, and post-SRES CO2 stabilization scenarios.
Key Output.	Monthly mean temperature and precipitation along with annual global mean temperature change, sea level rise, and equivalent CO2 concentration.
Key Input	The user chooses one of 14 GCM's, the country, one of 28 emission scenarios and various climate model parameters (climate sensitivity, sulphate scenario, and sulphate forcing) along with the terminal year.
Ease of Use	The installation and use assume average competence with personal computers. There is a built-in help facility.
Training Required	Requires some familiarity with climate change literature. IPCC publications would provide all necessary background information.
Training Available	Training courses for an earlier version (COSMIC) were held in various countries under the US Department of Energy Country Studies Program. There are currently no plans for additional courses.
Computer Requirements	Personal computer with Windows XP/2000/9X operating system.
Documentation	Numerous publications in the scientific literature.
Applications	COSMIC is in use by 130 research groups in 50 countries.
Contacts for Framework, Documentation, Technical Assistance	COSMIC2 was developed by: Michael E. Schlesinger, Department of Atmospheric Sciences, University of Illinois at Urbana-Champaign; e-mail: schlesin@atmos.uiuc.edu. Larry J. Williams, Global Climate Change Research, Electric Power Research Institute; e-mail: ljwillia@epri.com.
Cost	The software is free. Send request to Larry J. Williams (ljwillia@epri.com)

COSMIC2 (COuntry Specific Model for Intertemporal Climate Vers. 2) (cont.)

References	Schlesinger, M.E. and S. Malyshev, 'Changes in near-surface temperatures and sea level for the Post-SRES CO2-stabiliztion scenarios', *Integrated assessment*, 2: 95-110. Schlesinger, M.E., S. Malyshev, E.V. Rozanov, F. Yang, N.G. Andronova, B. de Vries, A. Grübler, K. Jiang, T. Masui, T. Morita, J. Penner, W. Pepper, A. Sankovski and Y. Zhang, '2000: Geographical distributions of temperature change for scenarios of greenhouse gas and sulfur dioxide emissions.', *Tech. Forecast. Soc. Change*, 65, 167-193. Williams, Larry J., Shaw, Daigee, Mendelsohn, Robert: 1998,'Evaluating GCM Output with Impact Models', *Climatic Change*, 39: 111-133. Yohe, Gary and Schlesinger, Michael E.: 1998,'Sea-Level Change: The Expected Economic Cost of Protection or Abandonment in the United States', *Climatic Change*, 38: 337-472.

PRECIS (Providing REgional Climates for Impacts Studies)

Description	PRECIS is essentially a regional climate modeling system. It is based on the third generation of the Hadley Centre's regional climate model (HadRM3), together with user-friendly data processing and a visualization interface. Its flexible design allows for applications in any region of the world. Like any other regional climate model, PRECIS is driven by boundary conditions simulated by general circulation models (GCMs). To facilitate the application, boundary conditions simulated by the Hadley Centre GCM experiments forced by four SRES marker scenarios are supplied with the software.
Appropriate Use	PRECIS can be used to generate finer-resolution, physically consistent regional climate projections when GCM outputs are not sufficient to provide regional details as required by V&A assessment.
Scope	Any region in the world (with a minimum area of 5,000km by 5,000 km) given that sufficient observed data are available to validate model outputs.
Key Output	(Typically) hourly climate variables at approximately 50 km horizontal resolution.
Key Input	Modeling domain, details of the driving GCM experiment, length of integration, specification of output files.
Ease of Use	Requires considerable expertise in climate modeling.
Training Required	Considerable knowledge and experience required.
Training Available	Attendance at training workshops (funded from a variety of UK Government sources over the years) are a pre-condition of provision of PRECIS. To date workshops have been held in South Africa, Cuba, Bhutan, Brazil, India, Turkey, Argentina, Ghana, and five in the United Kingdom. Hadley Centre staff are subsequently available (via email etc.) for consultation. Further workshops are planned..
Computer Requirements	A PC running the Linux operating system is required. It should have a minimum specification of a 1GHz processor, 500 Mb of memory, 60 Gb of disk space, and a tape drive to allow offline storage. A PC with a 1.4 GHz Athlon processor takes approximately 4~6 months to carry out a 30-year simulation.
Documentation	Information on PRECIS is available at http://precis.metoffice.com/ and covers aspects such as availability, support and requirements.
Applications	The model has been provided for use in several regions, including south Asia, central America, southern Africa and China. PRECIS modelling underlies sectoral impacts modelling work within Defra-funded research projects in India and China.
Contacts for Framework, Documentation, Technical Assistance	The Regional Modelling Group at the Hadley Centre, Met Office, Hadley Centre, FitzRoy Road, Exeter, Devon, EX1 3PB, United Kingdom, Tel: +441344.854938; Fax: +44.1344.854898; e-mail: précis@metoffice.com.

PRECIS (Providing REgional Climates for Impacts Studies)

Cost	The PRECIS DVD will be supplied to institutions free of charge (subject to the terms of the PRECIS license agreement) by the Hadley Centre only in conjunction with a PRECIS workshop . In keeping with the objectives behind the development of PRECIS, priority will be given to training users in developing countries, providing funding can be found to deliver the courses. The software, together with a suite of supporting materials and boundary condition data, are provided free of charge to developing countries and countries with economy in transition. Users from institutions in developed countries will be assessed a charge of 5000 Euros plus 17.5% VAT. This charge contributes to the costs of development and providing training.
References	Please see http://precis.metoffice.com/other_links.html for links to projects, reports and publications.

3.1.3 Socioeconomic scenarios

Developing Socioeconomic Scenarios: For Use in Vulnerability and Adaptation Assessments	
Description	This UNDP manual provides approaches to developing scenarios of the future, both without climate change and with climate change and adaptation. The first part of the guidance is consistent with the IPCC's *Special Report on Emissions Scenarios*: development of qualitative "storylines" of the future and selection of proxy values to represent important elements of socioeconomic conditions, all supplemented by research and quantitative data, as appropriate. The second part of the guidance demonstrates an approach to sectoral scenarios by using quantitative indicators to calculate food security. Moreover, the guidance recommends a stakeholder involvement process.
Appropriate Use	The guidance can be used in analyses of vulnerability and adaptation to climate change at local, sectoral, regional, and national scales. Thus, the scenarios can contribute to developing countries' National Communications, National Adaptation Programmes of Action (NAPAs), and grant proposals to, e.g., the Global Environment Facility (GEF).
Scope	Local, sectoral, regional, and national.
Key Output	A qualitative or qualitative and quantitative description of the social and economic characteristics of a sector or geographical location as they exist currently and may evolve in the future. The descriptions are focused on key variables, called proxy values, which summarize or otherwise simplify relevant information.
Key Input	Qualitative and/or quantitative information on the sector or region of interest.
Ease of Use	Depends on complexity of data gathering and analytic techniques chosen — from rigorous stakeholder input and other qualitative methods to complex, model-based techniques.
Training Required	No training required, unless unfamiliar models are chosen for use.
Training Available	No formal training currently offered.
Computer Requirements	None, unless project teams choose computer-based methods.
Documentation	Developing Socioeconomic Scenarios: For Use in Vulnerability and Adaptation Assessments. May 2001. Available at http://ncsp.undp.org/report_detail.cfm?Projectid=151.
Applications	Has been piloted in several countries; will be used in conjunction with the UNDP's Adaptation Policy Framework to develop adaptation strategies, policies, and measures (see APF summary table in Chapter 2).
Contacts for Framework, Documentation, Technical Assistance	Bo Lim, Chief Technical Advisor, National Communications Support Programme, UNDP-GEF, Room 1607, 304 East 45th St, NY, NY 10017, USA; Tel: 1.212.906.5730; Fax: 1.212.906.6568; e-mail: bo.lim@undp.org.
Cost	No cost.
References	See Documentation above and APF summary table in Chapter 2 (http://ncsp.undp.org/report_detail.cfm?Projectid=151).

Adoption of Existing Socioeconomic Scenarios

Description	The UNEP Handbook describes an approach to developing sectoral assessments of impacts and adaptation. In general, analysts are encouraged to use existing scenarios of both socioeconomic conditions and climate change, to integrate them, and to develop adaptation strategies. The definition of socioeconomic includes demographic and economic data, technology, legislation, culture, decision-making processes – "everything that shapes a society." Table 2.1 in the handbook lists relevant variables for each of the sectors covered (water resources, coastal zones, agriculture, human health, energy, forestry, livestock and grasslands, wildlife and biodiversity, and fisheries). Sources for data-based scenarios are given, and using multiple scenarios is recommended. Specific guidance is sparse.
Appropriate Use	The Handbook can be used for analyses of sectoral impacts and adaptation to climate change.
Scope	Local, sectoral, regional, and national. However, sources for existing socioeconomic scenarios are global and regional only, except for the World Bank, which includes countries.
Key Output	Scenarios that are either "borrowed" from the literature or "inspired" by historical trends and geographical analogues.
Key Input	Qualitative and/or quantitative information on the sector of interest.
Ease of Use	Relatively easy, especially if literature sources are used instead of primary data gathering and scenario development.
Training Required	No training required.
Training Available	No formal training currently offered.
Computer Requirements	None, although data may be downloaded from sources such as the World Bank and manipulated by spreadsheet or other computer-based programs.
Documentation	Feenstra, J.F., I. Burton, J.B. Smith, and R.S.J. Tol (eds.). 1998. *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies*. Version 2.0. Available at http://www.falw.vu.nl/images_upload/151E6515-C473-459C-85C59441A0F3FB49.pdf
Applications	The first phase of the Netherlands Climate Change Study Assistance Programme (NCCSAP) lists 17 countries where socioeconomic scenarios are being or will be developed. The projects' synopses explicitly mention development of climate scenarios and socioeconomic scenarios to be used in the impact and adaptation studies. Information is on http://www.ivm.falw.vu.nl/Research_projects/index.cfm/home_subsection.cfm/subsectionid/CBFAAE8F-05BA-4EA0-A7C17193212663D0. The book 'Climate Change in Developing Countries' mentioned on this site may be of interest as well.
Contacts for Framework, Documentation, Technical Assistance	Dr. Michiel van Drunen, Institute for Environmental Studies, Vrije Universiteit, Amsterdam; e-mail: michiel.van.drunen@ivm.falw.vu.nl
Cost	No cost.
References	See Documentation above.

Qualitative and Quantitative Scenarios Emphasizing Stakeholder Input

Description	The second and third steps of the Adaptation Policy Framework (APF) (see Chapter 2 for a description of the entire framework), assessing current vulnerability and characterizing future climate risks, involve developing socioeconomic scenarios (called "conditions and prospects"). Technical Paper 6 is devoted to guidance on this topic. Users are advised to include indicators (qualitative or quantitative or a mix of both) in five categories: demography, economics, natural resource use, governance/policy, and culture. The baseline should include current adaptations to current climate. Users are then given guidance on constructing storylines of the future and exploring at least two significantly different but possible futures.
Appropriate Use	The guidance on socioeconomic scenarios is designed as part of a larger process of developing adaptation strategies, policies, and measures. Other analyses that interact with socioeconomic scenarios are climate risks and vulnerability analyses. Crosscutting guidance is given on involving stakeholders and increasing adaptive capacity.
Scope	Local, sectoral, regional, and national. The APF will be most useful at the local and sectoral levels.
Key Output	Scenarios that include demographic, economic, governance/policy, and cultural indicators and data.
Key Input	Qualitative and/or quantitative information from various sources, including expert and stakeholder input.
Ease of Use	The whole APF process requires a substantial commitment of time and resources; the scenario portion can be developed using existing data and stakeholder input or more sophisticated methods such as tailored computer-based models.
Training Required	No training required.
Training Available	Formal training is being planned but is not currently offered.
Computer Requirements	None.
Documentation	See http://ncsp.undp.org/report_detail.cfm?Projectid=151 for the User's Guidebook and the Nine Technical Papers.
Applications	GEF projects in Latin America are being designed using the APF, but it has not yet been employed in the projects.
Contacts for Framework, Documentation, Technical Assistance	Bo Lim, Chief Technical Advisor, National Communications Support Programme, UNDP-GEF, Room 1607, 304 East 45th St, NY, NY 10017, USA; Tel: 1.212.906.5730; Fax: 1.212.906.6568; e-mail: bo.lim@undp.org.
Cost	No cost.
References	See Documentation above.

UKCIP Socio-Economic Scenarios

Description	The UKCIP socio-economic scenarios (SES) describe how society may change in the future in accordance with policy decisions made in the future. The SES should be used together with climate change emission scenarios to produce an integrated assessment of potential impacts under climate change.
Appropriate Use	The SES can be used in climate change impacts and vulnerability and assessments, and to consider the capacity different types of future worlds will have to cope with climate change.
Scope	They should be used for UK-based studies only.
Key Output	A description of future worlds in which climate changes might occur.
Key Input	Various social and economic indices.
Ease of Use	Users generally find these difficult to apply as they are not quantitative, and those used to assessing physical climate impacts may not feel comfortable dealing with socio-economic issues. Where the SES have been used, they have been found to have a major impact on study findings.
Training Required	Understanding of SES and their application is helpful.
Training Available	No formal training supplied, but UKCIP can advise on application.
Computer Requirements	None.
Documentation	Technical report on SES. Reference below.
Applications	The SES have been used in a number of UKCIP scoping studies. Some of them are included in the report (reference below). Also see the UKCIP website (www.ukicp.org.uk) for further information on applications.
Contacts for Tools, Documentation, Technical Assistance	Megan Gawith, Scientific Officer, UKCIP; e-mail: megan.gawith@ukcip.org.uk.
Cost	None.
References	UK Climate Impacts Programme. 2001. Socio-economic scenarios for climate change impact assessment: a guide to their use in the UK Climate Impacts Programme. UKCIP, Oxford.

3.2 Decision Tools

The tools described in this section assist analysts in making choices between adaptation options (Table 3.2). Some of these tools rely on a single monetary metric and focus on a single decision criterion (e.g., benefit-cost analysis, cost-effectiveness). Others enable the user to define and incorporate more than one such decision criterion (e.g., MCA and the three examples of which, TEAM, Adaptation Decision Matrix, and screening of adaptation options, are included in this section). Other tools are more generally aimed at supporting decision and policy makers who are faced with identifying and appraising the selection and implementation of adaptation measures, taking into account the institutions involved and affected when pursuing given adaptation options.

Table 3.2. Decision tools

Policy Exercise
Benefit-Cost Analysis
Cost-Effectiveness
Multicriteria Analysis (MCA)
Tool for Environmental Assessment and Management (TEAM)
Adaptation Decision Matrix (ADM)
Screening of Adaptation Options
Climate-Related Risks Estimate as Indicators of Necessity for Adaptation Responses
Costing the Impacts of Climate Change in the UK
Identifying Adaptation Options
UKCIP Adaptation Wizard
Adaptation Actions
Business Area Climate Impacts Assessment Tool (BACLIAT)
Nottingham Declaration Action Pack (NDAP)
Community-based Risk Screening Tool – Adaptation & Livelihoods (CRiSTAL)

Policy Exercise

Description	A flexible structured method designed to synthesize and assess knowledge from several relevant fields of science for policy purposes directed toward complex, practical management problems. Policy exercise techniques provide an interface between scientists, academics, and policy makers. At the heart of the process are scenario writing ("future histories," emphasizing nonconventional, surprise rich, but still plausible futures) and scenario analyses via the interactive formulation and testing of alternative policies that respond to challenges in the scenario. These scenario based activities typically take place in an organizational setting reflecting the institutional feature of the issues that are addressed.
Appropriate Use	Policy exercise can be used to generate adaptation options or evaluate already identified adaptation options, especially in the early phases of regional adaptation studies when there is a strong need to structure the problem or in later phases to determine if sectoral policy responses might support or undermine each other.
Scope	All regions, all sectors.
Key Output	Scenarios that inform the adaptation decision process and increase understanding of the organizational and institutional setting in which the process is carried out.
Key Input	Views and ideas of representatives from key institutions.
Ease of Use	Depends on participation of experienced facilitators.
Training Required	Little or no training would be required for participants. Facilitators and support staff require specialized training.
Training Available	No formal training offered. Sources of assistance in organizing a policy exercise can be obtained from contact listed below.
Computer Requirements	Use of personal computers may be necessary to support the variety of models that the exercise might employ.
Documentation	Toth, F.L. 1998. Policy exercises: Objectives and design elements. *Simulation and Games* 19:235-255. Toth, F.L. 1998. Policy exercises: Procedures and implementation. *Simulation and Games* 19:256-276.
Applications	Southeast Asia (see References below). The exercises involved senior national-level policy makers and senior analysts exploring policy responses under different climate change and impact scenarios.
Contacts for Framework, Documentation, Technical Assistance	Ferenc Toth, International Atomic Energy Agency, Wagramer Str. 5 P.O. Box 100, A-1400, Vienna, Austria; Tel: +43.1.2600.22787; e-mail: F.L.Toth@iaea.org.
Cost	No cost to obtain documentation and supplementary information. Cost of implementing will depend upon the scope of inquiry.

Policy Exercise (cont.)

References	Brewer, G.D. and M. Shubik. 1979. *The War of Game: A Critique of Military Problem Solving*. Harvard University Press, Cambridge, MA. Toth, F.L. and E. Hizsnyik. 2005. Managing the inconceivable: participatory assessments of impacts and responses to extreme climate change. International Institute for Applied Systems Analysis. Working Paper FNU74. Toth, F.L. 1992a. Global change and the cross-cultural transfer of policy games. In *Global Interdependence*. D. Crookall and K. Arai (eds.). Springer, Tokyo, pp. 208-215. Toth, F.L. 1992b. Policy implications. In *The* Potential Socioeconomic Effects of Climate Change in South-East Asia, M.L. Parr, M. Blantran de Rozari, A.L. Chong, and S. Panich (eds.). United Nations Environment Programme, Nairobi, Kenya, pp. 109-121. Toth, F.L. 1992c. Policy responses to climate change in Southeast Asia. In *The Regions and Global Warming: Impacts and Response Strategies,* J. Schmandt and J. Clarkson (eds.) Oxford University Press, New York, pp. 304-322. Toth, F.L. 2003. State of the art and future challenges for integrated environmental assessment. *Integrated Assessment* 4(4):250-264.

Benefit-Cost Analysis

Description	This approach uses a conceptual framework for analyzing an adaptation measure by identifying, quantifying, and monetizing the costs and benefits associated with the measure. Spreadsheet software is often used to facilitate analysis; however, the specific approaches used are highly dependent on the measure under consideration. This tool can be used to determine whether the benefits of the adaptation measure outweigh the costs, whether net benefits are maximized, and how the measure compares to other options.
Appropriate Use	A benefit-cost analysis is useful when the adaptation being considered is likely to involve significant expenditures of capital and labor. Benefit-cost analyses of adaptation responses often involve a high degree of uncertainty when quantifying nonmarket goods and services as well as when anticipating the direction and magnitude of climate change.
Scope	All locations; all sectors; national or site-specific.
Key Output	A monetary comparison of the costs and benefits of a proposed adaptation measure.
Key Input	Quantitative values for all significant costs and benefits associated with the proposed response.
Ease of Use	A major undertaking, involving extensive research and economic analysis.
Training Required	Knowledge in economics as well as training in estimating the monetary values of costs and benefits. Knowledge of physical sciences related to benefits.
Training Available	Contact Stratus Consulting for more information (see Contacts below).
Computer Requirements	Lotus 1-2-3 or Excel spreadsheet software helpful.
Documentation	The World Bank. Environmental Assessment Sourcebook: Vol. 1. Policies, Procedures, and Cross-Sectoral Issues. Published October 1996 by World Bank ISBN: 0-8213-1843-8 SKU: 11843 Vol. 2. Sectoral Guidelines. Published September 1995 by World Bank ISBN: 0-8213-1844-6 SKU: 11844 Vol. 3. Guidelines for Environmental Assessment of Energy and Industry Projects. Published December 1994 by World Bank ISBN: 0-8213-1845-4 SKU: 11845 Available at http://publications.worldbank.org/ecommerce/catalog/product-detail?product_id=194213&
Applications	Used to evaluate sea level rise adaptation options in Maine, USA.
Contacts for Tools, Documentation, Technical Assistance	Bob Raucher, Stratus Consulting, P.O. Box 4059, Boulder, CO 80306 USA; Tel: +1.303.381.8000; Fax: +1.303.381.8200; e-mail: braucher@stratusconsulting.com; website: http://www.stratusconsulting.com/.
Cost	Price of Vol. 1: $ 22.00. Price of Vol. 2: $ 30.00. Price of Vol. 3: $ 22.00. Analysis entails a high cost in terms of time for an economic analyst. Method can be modified if financial constraints prohibit a full-scale analysis.
References	Smith, J.B., S.E. Ragland, R.S. Raucher, and I. Burton. 1997. Assessing Adaptation to Climate Change: Benefit-Cost Analysis. Report to the Global Environment Facility, prepared by Hagler Bailly Services, Inc., Boulder, CO, USA. Tol, R.J.S. 2000. Equitable Cost-Benefit Analysis of Climate Change. In *Efficiency and Equity of Climate Change Policy,* Carlo Carraro (ed.). Dordrecht, The Netherlands: Kluwer Academic Publishers. 368pp.

Cost-Effectiveness

Description	Cost-effectiveness analysis takes a predetermined objective and seeks ways to accomplish it as inexpensively as possible. Unlike cost-benefit analysis, the level of the benefit is treated as an external given, and the objective of the analysis is to minimize the costs associated with the achievement of this specified objective.
Appropriate Use	Cost-effectiveness on the adaptation side might be used when, under different climate change scenarios, a required minimum level of a public good or service (e.g., flood protection) is specified and the option to deliver this good at the lowest cost is sought. Also particularly applicable to those cases where the analyst may be unwilling or unable to monetize the most important policy impact. Cost-effectiveness is generally more applicable for individual project decisions that are applying decision rules or procedures which have already been determined in policy, strategic, or program decisions.
Scope	All regions. Can be difficult to apply to those sectors where the market does not apply a satisfactory measure of value for costs.
Key Output	Ranking of alternatives relative according to cost-effectiveness.
Key Input	Cost data for a specified level of policy outcome.
Ease of Use	Can be a significant undertaking. Valuing nonmarket goods can require knowledge of specialized techniques.
Training Required	Knowledge of economics as well as training in estimating the monetary values of costs, especially nonmarket values.
Training Available	Contact Stratus Consulting for more information (see Contacts below).
Computer Requirements	Personal computer.
Documentation	Boardman, A.E., D.H. Greenberg, A.R. Vining and D.L. Weimer. 1996. *Cost-Benefit Analysis: Concepts and Practice.* Prentice Hall, Upper Saddle River, NJ, USA.
Applications	Analysis of pathways to stabilization. See also UKCIP and APF frameworks in Chapter 2.
Contacts for Framework, Documentation, Technical Assistance	Bob Raucher, Stratus Consulting, P.O. Box 4059, Boulder CO 80306; Tel: +1.303.381.8000; e-mail: braucher@stratusconsulting.com; website: http://www.stratusconsulting.com/
Cost	Method can entail a high cost in terms of time for an economic analyst.
References	Goulder, L.H. and S.H. Schneider. 1999. Induced technological change and the attractiveness of CO_2 emissions abatement policies. *Resource and Energy Economics* 21:211-253. Ha-Duong, M., M. Grubb, and J.C. Hourcade. 1997. Influence of socioeconomic inertia and uncertainty on optimal CO_2 emission abatement. *Nature* 390:270-273. Wigley, T.M.L., J. Edmonds, and R. Richels. 1996. Economic and environmental choices in the stabilization of atmospheric CO_2 concentrations. *Nature* 379(6582):240-243.

Multicriteria Analysis (MCA)

Description	MCA describes any structured approach used to determine overall preferences among alternative options, where the options accomplish several objectives. In MCA, desirable objectives are specified and corresponding attributes or indicators are identified. The actual measurement of indicators need not be in monetary terms, but are often based on the quantitative analysis (through scoring, ranking and weighting) of a wide range of qualitative impact categories and criteria. Different environmental and social indicators may be developed side by side with economic costs and benefits. Explicit recognition is given to the fact that a variety of both monetary and nonmonetary objectives may influence policy decisions. MCA provides techniques for comparing and ranking different outcomes, even though a variety of indictors are used. MCA includes a range of related techniques, some of which follow this entry.
Appropriate Use	Multicriteria analysis or multiobjective decision making is a type of decision analysis tool that is particularly applicable to cases where a single-criterion approach (such as cost-benefit analysis) falls short, especially where significant environmental and social impacts cannot be assigned monetary values. MCA allows decision makers to include a full range of social, environmental, technical, economic, and financial criteria.
Scope	All regions, all sectors.
Key Output	A single most preferred option, ranked options, short list of options for further appraisal, or characterization of acceptable or unacceptable possibilities.
Key Input	Criteria of evaluation as well as relevant metrics for those criteria.
Ease of Use	Depends on the particular MCA tool employed. All rely on the exercise of some expert judgment.
Training Required	Choice and application of appropriate MCA technique require some expertise, but can be acquired fairly easily.
Training Available	The United Kingdom Department for Transport Local Government and the Regions (see Documentation) provides nontechnical descriptions of MCA techniques, potential areas of application, and criteria for choosing between different techniques, and sets out the stages involved in carrying out MCA.
Computer Requirements	Personal computer.
Documentation	DEFRA. 2003. Use of multi-criteria analysis in air quality policy: A Report. DTLR. 2001. Multi Criteria Analysis: A Manual. ETR. 1999. Review of Technical Guidance on Environmental Appraisal: A Report by Economics for the Environment Consultancy (http://www.defra.gov.uk/environment/economics/rtgea/8.htm).
Applications	World Commission on Dams. Integrated Decision Making Framework. (http://www.dams.org/report/contents.htm). World Conservation Union Office for West Africa. Sustainable Development Planning Process (http://www.iucn.org/themes/wetlands/). Tyndall Center for Climate Change Research. Framework for Carbon Mitigation Projects (http://www.tyndall.ac.uk/publications/working_papers/wp29.pdf).

Multicriteria Analysis (MCA) (cont.)

Contacts for Framework, Documentation, Technical Assistance	For general information and contact information for sources of assistance for particular tools: Stratus Consulting, P.O. Box 4059, Boulder CO 80306; Tel: +1.303.381.8000; Fax: 303.381.8200; e-mail: jsmith@stratusconsulting.com.
Cost	Depends on particular MCA tool applied, but in general is inexpensive.
References	Bell, M.L., B.F. Hobbs and H. Ellis. 2003. The use of multi-criteria decision-making methods in the integrated assessment of climate change: implications for IA practitioners. Socio-Economic Planning Sciences 37(4):289-316. Hamalainen, R.P. and R. Karjalainen. 1992. Decision support for risk analysis in energy policy. *European Journal of Operational Research* 56:172-183. Jones, M., C. Hope, and R. Hughes. 1990. A multi-attribute value model for the study of UK energy policy. *Journal of the Operational Research Society* 41:919-929 Pearman, A.D., P.J. Mackie, A.D. May, and D. Simon. 1989. The use of multi-criteria techniques to rank highway investment proposals. In *Improving Decision Making in Organisations,* A.G. Lockett and G. Islei (eds.). Springer Verlag, Berlin, pp. 158-165.

Tool for Environmental Assessment and Management (TEAM)

Description	This software package creates graphs and tables that allow experts to compare the relative strengths of adaptation strategies using both quantitative and qualitative criteria. TEAM assists the user in evaluating issues such as equity, flexibility, and policy coordination. The user lists the strategies across the top of the table and the evaluation criteria down the side, and then enters a score indicating the relative performance of each strategy under the various criteria. This table can then be used to construct a variety of graphs of the data. It will not necessarily identify the optimal strategy (unless one strategy outperforms all others in all criteria), but is instead designed to allow the user to more clearly see the strategies' relative strengths and weaknesses.
Appropriate Use	TEAM is useful when it is important to consider a wide range of criteria and to explicitly identify unquantifiable and uncertain aspects associated with potential adaptations. It should be used in conjunction with other decision-making tools (e.g., cost-benefit analysis, discussion and workshops with key decision-makers).
Scope	All locations; covers coastal zones, water resources, agriculture, as well as a general assessment component; national or site-specific.
Key Output	Relative effectiveness of alternative adaptation measures across a range of criteria.
Key Input	A ranking of how well policy objectives are met using alternative strategies.
Ease of Use	Relatively easy to apply; more rigorous results require more analysis; only basic computer skills are needed.
Training Required	A user with an understanding of key policy objectives could achieve proficiency in 1 to 2 days.
Training Available	Contact Susan Herrod-Julius for more information (see Contacts below).
Computer Requirements	IBM-compatible 386 with a 3.5" drive and a mouse; Microsoft Windows 3.1 and Excel 5.0c spreadsheet software.
Documentation	The user's manual can be obtained from Ms Susan Herrod Julius (see the email given below). See also the web site http://www.epa.gov/eims/global/team1.pdf.
Applications	Used in China, Costa Rica, Venezuela, Trinidad, Italy, Egypt, and Malawi.
Contacts for Tools, Documentation, Technical Assistance	Susan Herrod-Julius, 8601D, U.S. EPA Headquarters. Ariel Rios Building, 1200 Pennsylvania Avenue, N.W., Washington, DC 20460; Tel: 202.564.3394; e-mail: herrod-julius.susan@epa.gov.
Cost	Free to obtain documentation.
References	Smith, A., H. Chu, and C. Helman. 1996. Tool for Environmental Assessment and Management: Quick Reference Pamphlet. Decision Focus Incorporated, Washington, DC. Smith, A., H. Chu, and C. Helman. 1996. Documentation of Tool for Environmental Assessment and Management. Decision Focus Incorporated, Washington, DC. Burton, I., J. Smith, and S. Lenhart. 1998. Adaptation to climate change: Theory and assessment. In *Handbook on Methods for Climate Change Impact Assessment and Adaptation Strategies,* J. Feenstra, I. Burton, J. Smith, and R. Tol (eds.). UNEP and Vrije Universiteit Amsterdam, Amsterdam, The Netherlands. Herrod Julius, S. and Scheraga, J.D. The TEAM Model for Evaluating Alternative Adaptation Strategies.

Adaptation Decision Matrix (ADM)

Description	The ADM uses multicriteria assessment techniques to evaluate the relative effectiveness and costs of adaptation options. Users are asked to specify criteria that will be used to evaluate options and weight the criteria. Scenarios of current climate and climate change can also be used. Users are asked to give a score (e.g., 0 to 5) on how well each criterion is met under a particular scenario for each option. The scoring can be based on detailed analysis or expert judgment. Scores can be multiplied by weights and summed up to estimate which options best meet the criteria. The scores can be compared to relative costs to assess cost-effectiveness.
Appropriate Use	This approach is useful when many important benefits of meeting policy objectives cannot be easily monetized or expressed in a common metric. However, detailed research and analysis are needed to provide a basis for the evaluation; otherwise the scoring may be mainly subjective.
Scope	All locations; all sectors; national or site-specific.
Key Output	Relative cost-effectiveness of alternative adaptation measures.
Key Input	A ranking of how well policy objectives are met using alternative strategies; estimated costs of adaptation measures.
Ease of Use	Relatively easy to apply; more rigorous results require more analysis; only basic computer skills are needed.
Training Required	A user with an understanding of key policy objectives could achieve proficiency in 1 to 2 days; however, additional training may be required to develop skill in estimating costs of adaptation measures.
Training Available	Contact Stratus Consulting for more information (see Contacts below).
Computer Requirements	IBM-compatible 286; Lotus 1-2-3 or Excel spreadsheet software helpful.
Documentation	Benioff, R. and J. Warren (eds.). 1996. *Steps in Preparing Climate Change Action Plans: A Handbook.* Washington, DC: U.S. Country Studies Program. USCSP. 1999. *Climate Change: Mitigation, Vulnerability, and Adaptation in Developing Countries*, U.S. Country Studies Program, Washington, DC
Applications	Used by participants in the U.S. Country Studies and UNEP assistance programs (e.g., Kazakhstan, Cameroon, Uruguay, Bolivia, Antigua, Estonia, Pakistan and Barbuda).
Contacts for Tools, Documentation, Technical Assistance	Joel Smith, Stratus Consulting, P.O. Box 4059, Boulder, CO 80306 USA; Tel: +1.303.381.8000; Fax: +1.303.381.8200; e-mail: jsmith@stratusconsulting.com; website: http://www.stratusconsulting.com/.
Cost	No cost for documentation or diskette with template of the decision matrix.
References	Mizina, S.V., J.B. Smith, E. Gossen, K.F. Spiecker, and S.L. Witkowski. 1999. An evaluation of adaptation options for climate change impacts on agriculture in Kazakhstan. *Mitigation and Adaptation Strategies for Global Climate Change* 4:25-41.

Screening of Adaptation Options

Description	This matrix-based decision-making tool sets up a series of criteria that allow the user to narrow the list of appropriate adaptation measures. The user sets up a table with evaluation criteria across the top: Will the measure target a high-priority area? Will it address targets of opportunity? Is it likely to be effective? Will it generate other benefits (e.g., economic, environmental)? Is it inexpensive? Is it feasible? The user can insert or substitute other criteria if they are more appropriate. The user then evaluates each measure against these criteria, entering a simple "yes" or "no" in the cells. This tool is frequently combined with expert judgment.
Appropriate Use	This is a useful tool at the beginning of the decision-making process, allowing the user to create a manageable although possibly subjective list of options, which can then be analyzed more rigorously.
Scope	All locations; all sectors; national or site-specific.
Key Output	A simple matrix, clearly showing the strengths and weaknesses of a wide range of options.
Key Input	Basic summary information about options under consideration.
Ease of Use	Depends on specific application.
Training Required	Requires background knowledge of both the options and the climate change issue being addressed.
Training Available	Contact Stratus Consulting for more information (see below).
Computer Requirements	IBM-compatible 286; Lotus 1-2-3 or Excel spreadsheet software helpful.
Documentation	Benioff, R. and J. Warren (eds.). 1996. Steps in Preparing Climate Change Action Plans: A Handbook. U.S. Country Studies Program, Washington, DC. USCSP. 1999. Climate Change: Mitigation, Vulnerability, and Adaptation in Developing Countries, U.S. Country Studies Program, Washington, DC
Applications	Used by several participants in the U.S. Country Studies and UNEP assistance programs (e.g., Kazakhstan, Cameroon, Uruguay, Bolivia, Antigua, Barbuda, Estonia, and Pakistan).
Contacts for Tools, Documentation, Technical Assistance	Joel Smith, Stratus Consulting, P.O. Box 4059, Boulder, CO 80306; Tel: +1.303.381.8000; Fax: +1.303.381.8200; e-mail: jsmith@stratusconsulting.com; website: http://www.stratusconsulting.com/.
Cost	No cost to obtain documentation or diskette with template of the decision matrix.
References	Mizina, S.V., J.B. Smith, E. Gossen, K.F. Spiecker, and S.L. Witkowski. 1999. An evaluation of adaptation options for climate change impacts on agriculture in Kazakhstan. *Mitigation and Adaptation Strategies for Global Climate Change* 4:25-41.

Climate-Related Risks Estimate as Indicators of Necessity for Adaptation Responses

Description	Adaptation measures could be taken when climate-related risks to economic objects, environment or people's lives arise. The methodology of climate risk assessment outlines a three step process: (1) to estimate probability of dangerous weather event or climate anomaly on the given territory; (2) to evaluate social damage as correlation between people's number in the endangered region and damage probability; "fuzzy set" method could be used for complex risk estimation; (3) to calculate damage expressed in relative or monetary units taking into account GDP.
Appropriate Use	This tool is useful when it is necessary to make decision about adaptation measures.
Scope	All regions and sectors.
Key Output	A quantitative estimate of climate-related risks for specific objects and processes in various economic and social spheres.
Key Input	Meteorological data about recurrence and intensity of the dangerous weather events and climate anomalies, cost data including GDP, population in the specific region.
Ease of Use	Depends on specific application.
Training Required	"Fuzzy set" method requires training in use of statistical software. Knowledge of economics and estimating the monetary values of costs and benefits is needed.
Training Available	No formal training currently offered. Sources of assistance / consulting can be obtained from contact listed below.
Computer Requirements	Personal computer.
Documentation	Numerous publications in the scientific literature.
Applications	Whirlwind probability assessment for the third power-generating unit of Leningrad nuclear power station.
Contacts for Tools, Documentation, Technical Assistance	Nina Kobysheva, Voejkov Main Geophysical Observatory, 194021 Karbyshev Str. 7, St. Petersburg, Russian Federation; Tel: +7.812.297.4390; Fax: +7.812.297.8661; e-mail: director@main.mgo.rssi.ru or kobyshnv@main.mgo.rssi.ru.
Cost	Depends on particular application.
References	Akentyeva, E.M. 2006. Climate-related risks for power generation, transportation and consumption in Russian Federation. In Proceedings - Living with Climate Variability and Change: Understanding the Uncertainties and Managing the Risks, Espoo, Finland. Kobysheva, N.V. and M. V. Klueva. 2000. Estimation of risk of forest fires. *Risk Excellence Notes* 2(6). Kobysheva, N.V. 2007. Adaptation measures in oil and gas industry. International Conference "Adaptation strategies in fuel – energy sector" Nignij Novgorod, Russian Federation. Kobysheva, N.V. 2007. The problems of weather and climate related safety and sustainable development in technical sphere. Fifth International Conference "Actual Problems of Industrial Safety: from Projecting to Insurance, St. Petersburg, Russian Federation.

Costing the Impacts of Climate Change in the UK

Description	This costing guidance describes a method for calculating the cost of climate impacts and explains how to compare these to the costs of adaptation measures.
Appropriate Use	The proposed method is flexible enough to be applied across a wide range of scales from broad aggregated impacts on a sub-national region to well-defined disaggregated impacts on a particular receptor. The guidance is provided through two reports (Overview Report and Implementation Report), a series of case studies and a web-based spreadsheet tool (limited in terms of sectors and impacts scope). The Overview Report, including a specific set of case studies, is designed to provide guidance to the non-economists who need to commission and interpret costing studies, whereas the more detailed Implementation Report is aimed at providing guidance for economists who need to undertake these studies.
Scope	The guidance has been specifically developed for use within the UK, but could be further developed to work elsewhere. This would necessitate the development of costing matrices for the direct and knock-on effects of the identified impacts. The web-based spreadsheet tool has also been specifically developed for use with in the UK. The principles and concepts of the methodology are transferable and can provide a framework for broader application. Sectors specifically supported through the provision of impact matrices include coastal zones, water resources, agriculture, and buildings and infrastructure. Impacts on non-market goods or services are difficult to value, and so the guidance includes individual guidance for valuing the impacts on habitat and biodiversity, human health, recreation and amenity, cultural objects, leisure and working time, and non-use benefits.
Key Output	Specifically identified physical impacts are converted into monetary values and then, after calculating the resource costs of adaptation options, information is available to support the weighing up of the costs and benefits of the adaptation options towards choosing the preferred option. This assessment of adaptation options is seen to take place within a risk assessment framework that accounts for the risks and uncertainty (e.g., UKCIP risk framework).
Key Input	Inputs include identifying and measuring (quantifying) climate impacts in physical units (e.g., through a climate impact assessment); impact valuations matrices that allow for the identification of costs/unit of direct impacts of climate change and knock-on (higher-order) effects. This includes both market price data that should be readily available. Also required are the values associated with impacts on non-market goods or services which result from conducting primary valuation studies. Also required are the costs of adaptation options such as those required to support a cost-benefit analysis.
Ease of Use	The guidance, including the web-based spreadsheet version and case studies does provide the non-economist with the ability to obtain a preliminary understanding of the potential costs. It is intended, however, for an economist to undertake a more comprehensive assessment of the costs for a particular concern.
Training Required	Training is required, including using this guidance in conjunction with a risk assessment procedure (e.g., UKCIP risk framework). For a more detailed analysis it is essential that an experienced economist be involved.
Training Available	Training is not available at this time. The guidance and availability of case studies and the web-based spreadsheet version of the tool do provide a limited learning environment.
Computer Requirements	The costing reports, case studies and web-based spreadsheet version are all available from the UKCIP website and are accessible using any web browser software. The web-based spreadsheet costing tool requires Microsoft Excel.
Documentation	The costing reports, case studies and web-based spreadsheet version are all available from the UKCIP website (www.ukcip.org.uk/resources).

Costing the Impacts of Climate Change in the UK (cont.)

Applications	Case studies included with the report include: agriculture: the cost of not meeting irrigation needs; transport disruption: the cost of time lost due to short-term disruptions; water resources: the cost of increasingly stringent effluent standards; and flooding: the cost of flood alleviation.
Contacts for Tools, Documentation, Technical Assistance	Roger Street, Technical Director, UK Climate Impacts Programme; e-mail: roger.street@ukcip.org.uk or through enquiries at: enquiries@ukcip.org.uk; or Alistair Hunt, Metroeconomica Limited.
Cost	There is no charge for access to this guidance. It is expected that users of this guidance (and all UKCIP tools) would provide feedback to UKCIP regarding the overall results, as well as comments and suggestions towards improving the guidance. Enhancing the scope of the guidance or developing it for use outside of the UK will necessitate developing the various matrices and costs information, including through primary valuation studies which could be relatively costly depending on the scope and ease of availability of the costing information.
References	Included with the guidance are case studies that demonstrate the use of the costing guidance. Metroeconomica carried out a study of the costs and benefits of climate change associated with different sectors. This is one of the first studies to apply costing methods to sectors on a microscale. Details of this and other cross-regional studies are available on the Defra website at www.defra.gov.uk/environment/climatechange/uk/adapt/research.htm. Final reports are available through the Defra research pages at www2.defra.gov.uk/research/project_data/default.asp (search by "cross regional").

Identifying Adaptation Options

Description	Guidance on the identification and selection of adaptation options that can be used to respond to climate risks.
Appropriate Use	The guidance note is aimed at supporting decision and policy makers who are faced with identifying and appraising the selection and implementation of adaptation measures that address identified climate risks. It is intended to be used as a companion piece to other UKCIP tools such as the Adaptation Wizard; Risk, Uncertainty and Decision-Making Framework; Business Areas Climate Impacts Assessment Tool (BACLIAT), Adaptation Actions database, and the guidance on costing the impacts of climate change.
Scope	The guidance note explores adaptation options relating them to their intended purpose - Building Adaptive Capacity or Delivering Adaptation Actions. It also considers the options in the context of strategic intentions - living with and bearing losses or risks, preventing effects or reducing exposure to risks, sharing responsibility for any losses or risks, or exploiting opportunities. Each of these is further explored through generic examples with real-world specific examples provided.
Key Output	The intention is that after reading this guidance note, decision and policy makers will have the information that will allow them to identify an appropriate set of adaptation options using the other UKCIP tools and guidance.
Key Input	None required.
Ease of Use	The note is targeted for users and has both generic and real-world examples of adaptation options.
Training Required	None.
Training Available	None.
Computer Requirements	The guidance note is available from the UKCIP website and is accessible using any web browser software.
Documentation	This guidance note is available at www.ukcip.org.uk/resources/tools/adaptationoptions.asp.
Applications	None.
Contacts for Tools, Documentation, Technical Assistance	Roger Street, Technical Director, UK Climate Impacts Programme; e-mail: roger.street@ukcip.org.uk or through enquiries at: enquiries@ukcip.org.uk.
Cost	There is no charge for access to this guidance. It is expected that users of this guidance (and all UKCIP tools) will provide feedback to UKCIP regarding the overall results, as well as comments and suggestions towards improving the guidance.
References	None.

UKCIP Adaptation Wizard

Description	The Wizard is a tool to help users adapt to climate change. It is a generic, high-level tool that can be used to raise awareness of the adaptation process, and help those who are preparing to adapt. It is more a decision-support than decision-making tool.
Appropriate Use	The Wizard can help users to: • Teach themselves, their colleagues and wider professional network about climate change impacts and adaptation. • Access the information, tools and resources UKCIP provides to help them deal with climate change. • Assess their vulnerability to current climate and future climate change. • Make a decision, or develop a project, programme, policy or strategy, that is resilient to climate change. • Develop a climate change adaptation strategy The Wizard will not produce a tailor-made climate adaptation strategy at the click of a button. Instead, it will help users generate the information they need to prepare their own adaptation strategy.
Scope	The audience for the Wizard is decision-makers in organizations. It has been developed as a generic tool that can be tailored for the particular application of the user.
Key Output	An adaptation strategy document that includes: a record of the users' vulnerability to current climatic variability; a prioritized list of climate risks; a list of possible adaptation measures to address those risks; adaptation options appraisal; and an implementation strategy.
Key Input	• Time to complete the process • Participation of relevant individuals from within and outside of the organization concerned • An understanding of how decisions are made within the users' organization and how to bring about change • In-house experience and evidence of the consequences of past weather events on the organization or activity • Climate change scenario information • Socio-economic scenario information • Tools or techniques for costing climate impacts and for costing and evaluating adaptation options
Ease of Use	The Wizard is accessible and easy to use.
Training Required	No specific training is required. However, awareness of climate change scenarios and risk assessment methods would be helpful. Specialist skills may be required to complete specific tasks, such as costing climate impacts and adaptation options, and conducting a quantitative risk assessment. These activities can be commissioned separately if necessary and the results incorporated into the process.
Training Available	UKCIP can offer support and advice on application of the Wizard. The level of support available will depend on uptake of the tool.
Computer Requirements	The wizard is web-based and can run using any web browser software. Adobe Acrobat is needed to display some of the tables and most of the reports referred to in the Wizard as sources of information. Microsoft Word would be useful to compile the resulting adaptation strategy document, but any another word processing package would suffice. Should the UKCIP costings tool be used to cost impacts and adaptation options, Microsoft Excel would be required.

UKCIP Adaptation Wizard (cont.)

Documentation	All documentation is contained within the Wizard's website.
Applications	The prototype version of the Wizard was used to inform the development of a new school in Worcestershire, United Kingdom. This case study is available from the Wizard's website. Further case studies are being developed.
Contacts for Tools, Documentation, Technical Assistance	Megan Gawith, Scientific Officer, UK Climate Impacts Programme; e-mail: megan.gawith@ukcip.org.uk.
Cost	There is no charge for using the Wizard. The process of completing the Wizard will, however, incur some costs, the scale of which will be determined by the nature of the application. Costs would arise from, amongst other things: staff time to complete the process, possible associated travel and meeting costs, commissioning further research to fill information gaps where necessary, implementing adaptations.
References	The Wizard is based on the report: Willows, R.I. and R.K. Connell. (eds.). 2003. Climate Adaptation: Risk, Uncertainty and Decision-Making. UKCIP Technical Report. UKCIP, Oxford.

Adaptation Actions

Description	An online searchable database that has been developed and is maintained by UKCIP staff. Adaptation Actions contains examples of activities people in the UK have undertaken to exploit the opportunities that climate change might provide or to adapt to the risks of our changing climate. The database only includes examples of activities that have actually been implemented and does not include adaptation activities that are "a good idea". Users can search the database to see what others have done to adapt and get ideas on how to adapt to reduce their climate risks or exploit opportunities.
Appropriate Use	To stimulate thinking on the types of actions that could be taken to adapt to climate change. Note that this is not a definitive list, and the adaptation actions included in the database have not been validated or endorsed by UKCIP.
Scope	Includes mostly UK but some international actions.
Key Output	Information on examples of different types of adaptation actions.
Key Input	A user-specified sector or searchable field.
Ease of Use	Extremely easy to use.
Training Required	None.
Training Available	None.
Computer Requirements	Access to the internet.
Documentation	All documentation is provided within the database.
Applications	A prompt to identifying adaptation options.
Contacts for Tools, Documentation, Technical Assistance	Jacquie Yeates, Scientific Officer, UKCIP; e-mail: jacquelyn.yeates@ukcip.org.uk.
Cost	None.
References	None.

Business Area Climate Impacts Assessment Tool (BACLIAT)

Description	The UKCIP Business Areas Climate Impacts Assessment Tool (BACLIAT) is a starting point for exploring the implications of climate change on a particular organization or sector. It comprises a simple checklist for assessing the potential impacts of climate change under the following generic headings: logistics, finance, markets, process, people, premises and management implications.
Appropriate Use	BACLIAT can be used by an individual but is of most value when used as the basis of a brainstorming exercise with a group of relevant managers or representatives from the organization or sector in question. It can also be used in more general awareness-raising workshops to illustrate the breadth of impacts that climate change could have.
Scope	BACLIAT can be used at the level of a single organization or an entire industrial sector. It encourages the consideration of both threats and opportunities. Although it was designed for use by a business or sector, it can be used for other non-commercial organizations.
Key Output	A long list of potential impacts of climate change on an organization or sector.
Key Input	• A reasonable knowledge of all aspects of the organization or sector. • The headline messages from UKCIP climate change scenarios. • A short amount of time.
Ease of Use	BACLIAT is accessible and easy to use.
Training Required	None.
Training Available	UKCIP can facilitate BACLIAT workshops where appropriate and where resources permit.
Computer Requirements	None.
Documentation	A Changing Climate for Business is available free of charge from UKCIP either electronically or as a paper publication.
Applications	BACLIAT has been used by several UK trade associations and professional bodies as well as individual companies including Serco's Colnbrook Immigration Centre at Heathrow, Scottish Electrical Contracting, and several small and medium-sized enterprises.
Contacts for Tools, Documentation, Technical Assistance	Kay Johnstone, Project Officer (Business), UK Climate Impacts Programme; e-mail: kay.johnstone@ukcip.org.uk.
Cost	There is no charge for using BACLIAT. The only cost is the time taken to go through the process, which normally takes between one and three hours.
References	Metcalf, G. and K. Jenkinson. 2005. A Changing Climate for Business, UKCIP.

Nottingham Declaration Action Pack (NDAP)

Description	Website providing support to local authorities drawing up Action Plans to tackle climate change. It is structured into five project management stages with council roles divided into: corporate functions; service provider and community leader, and covers both adaptation and mitigation.
Appropriate Use	It is primarily intended to provide guidance to English local authorities drawing up Climate Change Action Plans in accordance with the commitments of signatories to the Nottingham Declaration but could also be of use to any public sector organizations wishing to respond to the challenges of climate change. The adaptation threads of the tool are based on the UKCIP risk framework methodology modified to suit the requirements of UK local authorities.
Scope	The tool is designed for use by all types of English local authorities: district, unitary and county, but could potentially be of use at regional or sub-regional scales.
Key Output	A practical Climate Change Action Plan -- NDAP provides a framework for the production of a comprehensive action plan for a local authority area covering both climate change mitigation and adaptation. However, it is structured to allow selective use to cover only specific areas of local authority operations.
Key Input	NDAP encourages local authorities to identify their local climate risks and vulnerabilities through the use of UKCIP scenarios and the drawing up of a Local Climate Impacts Profile (LCLIP) based on recent local exposure to weather events.
Ease of Use	NDAP provides basic guidance for local authority officers to draw up a Climate Change Action Plan. It is intended to be easy to use and to require little, or no, specialist technical knowledge.
Training Required	NDAP is intended to be sufficiently easy to use that it does not require any specific training (see below).
Training Available	Regional training events were organized following the launch of NDAP version 1 in July 2006. These were focused on some of the basic principles of climate risk impact assessment and adaptation. Currently there is no training available, but this is kept under review.
Computer Requirements	Any system with web access.
Documentation	No documentation beyond the website itself.
Applications	NDAP is currently being used by a number of English local authorities to produce Climate Change Action Plans.
Contacts for Tools, Documentation, Technical Assistance	Laurie Newton, Local Authority Project Manager, UKCIP; e-mail: laurie.newton@ukcip.org.uk.
Cost	Free.
References	See www.nottinghamdeclaration.org.uk.

Community-based Risk Screening Tool – Adaptation & Livelihoods (CRiSTAL)

Description	IUCN, IISD, SEI-US and Intercooperation have developed and tested a project planning and management tool called CRiSTAL (Community-based Risk Screening Tool – Adaptation & Livelihoods). The tool seeks to help project planners and managers to integrate risk reduction and climate change adaptation into community-level projects. CRiSTAL was developed in response to the outcomes of Phase 1 of the Livelihoods and Climate Change project, which examined how ecosystem management and restoration (EM&R) or sustainable livelihoods (SL) projects reduced community vulnerability to climate stress.
Appropriate Use	CRiSTAL can be used by local communities, project planners and project managers.
Scope	CRiSTAL is intended to promote the integration of risk reduction and climate change adaptation into community-level projects. By focusing on community-level projects, CRiSTAL promotes the development of adaptation strategies based on local conditions, strengths and needs.
Key Output	List of project activities that protect/enhance access to and availability of resources that are strongly affected by climate hazards or important to coping.
Key Input	Relevant (regional, national, eco-zone) information on climate change (if available/accessible), as well as information on local climate hazards, impacts, coping strategies, as well as livelihood resources, and project information.
Ease of Use	User-friendly.
Training Required	Training shouldn't be required to use CRiSTAL, as there is a User's Manual available.
Training Available	Training is currently being provided. A training session was held in Mozambique earlier this year for project planners and managers based in Eastern and Southern Africa, and preparations are currently underway for a West Africa version of the training. More is planned for 2008.
Computer Requirements	The self-extracting CRiSTAL file can be downloaded from http://www.sei-us.org/Cristal/Cristal_Setup.exe. If you run this file, the program (and all related files) should be installed on your C: drive in a folder you create named, "CRISTAL". In order to run the program, you simply open the "Session-Setup.xls" file in the CRISTAL folder. You should also make sure your security settings in Excel are set on medium in order to enable the macros to run. This can be done by accessing the Tools menu, then clicking on Options > Security > Macro Security.
Documentation	CRiSTAL tool, field reports and presentations available at: http://www.iisd.org/security/es/resilience/climate_phase2.asp .
Applications	In an effort to render this tool as useful as possible, IUCN, IISD, SEI-US and Intercooperation conducted a series of field tests on planned or ongoing natural resource management projects in Mali, Bangladesh, Tanzania, Nicaragua and Sri Lanka. Project team members travelled to the field sites to work with local project managers and community stakeholders in gathering relevant information, applying the tool and developing recommendations on how to adjust project activities so they take into account local adaptive capacity. Results from the field tests provided constructive feedback on the design and application of CRiSTAL, while the testing process itself has raised awareness of climate change issues in vulnerable communities. The tool provided an entry point for discussing local observations of climate variability and the impacts of climate change in a participatory manner, encouraging communities to look for opportunities to enhance their adaptive capacities. For project planners and managers, CRiSTAL provided a useful framework for understanding the links among climate, livelihoods and project activities.

Community-based Risk Screening Tool – Adaptation & Livelihoods (CRiSTAL) (cont.)

Contacts for Tools, Documentation, Technical Assistance	Anne Hammill, Livelihoods and Climate Change Project Manager, International Institute for Sustainable Development (IISD); e-mail:ahammill@iisd.org.
Cost	Free.
References	None.

3.3 Stakeholder Approaches

Stakeholder approaches in general emphasize the importance of ensuring that the decisions to be analyzed, how they are analyzed, and the actions taken as a result of this analysis are driven by those who are affected by climate change and those who would be involved in the implementation of adaptations. The stakeholder approaches described in this compendium, listed in Table 3.3, represent a way of analyzing the institutional and organizational context of the adaptation strategy planning process more than they do specific tools to be applied to an assessment. Application of the stakeholder network and institution approach might well employ a variety of tools, some of which are listed below. The vulnerability indices approach aims to provide the user with a metric for vulnerability and adaptive capacity, but again, its application would most likely rely on other tools. Agent based social simulation is a modeling approach to stakeholder networks and institutions and might in practice take different forms, depending on the user's aims. Livelihood sensitivity exercise is a means of integrating existing knowledge of climate vulnerability with livelihood analysis. Multistakeholder processes are tools emphasizing dialogue on consensus building, and might well be employed as part of the aforementioned approaches. Scoping, which can be used as the first step of a vulnerability and adaptation assessment, allows users to identify tools and approaches that might be applicable to their particular focus. Global sustainability scenarios can provide insight into future vulnerability and adaptive capacity and their associated quantitative indices might typically serve as an input for other approaches described in this section. The Model of Private Proactive Adaptation to Climate Change (MPPACC) is an analytical tool, which helps to understand the psychological determinants of individual adaptation behaviour. Many of these approaches are relatively new, at least in their application to the climate change problem, and consequently their methods are still being refined.

Table 3.3 Stakeholder approaches

Stakeholder Networks and Institutions
Scoping
Vulnerability Indices
Agent Based Social Simulation
Livelihood Sensitivity Exercise
Multistakeholder Processes
Global Sustainability Scenarios
MPPACC (Model of Private Proactive Adaptation to Climate Change)

Stakeholder Networks and Institutions

Description	The stakeholder networks and institutions approach focuses on understanding those who make the decisions and how they relate to one another. Building adaptive capacity over long time scales depends on understanding these relationships. Institutions can be viewed as the collective rules, norms, and shared strategies that define stakeholder behavior. This approach posits that understanding present capacity is key to predicting how it is likely to evolve in response to future risks. These relationships can be complex, and unraveling them can require the use of a number of tools (see below). Each stakeholder has different objectives, resources, and responsibilities, all of which must be investigated. Some stakeholders may have little voice in the process or may be assigned responsibilities in only part of the issue. New stakeholders may emerge and relationships may alter, particularly in a crisis.
Appropriate Use	Useful in determining the present adaptive capacity and how that capacity might be developed in the future. In general stakeholder approaches are oriented toward research teams that support policy making. They help set the framework for evaluating specific measures, and thus from an early part of the decision process, as well as helping to monitor capability over a longer term.
Scope	Global, but most appropriate at national or local level.
Key Output	Characterization of stakeholders and institutions in terms of levels of participation, positions, and boundaries in policy making. Insight into institutional capacity to adapt.
Key Input	A mixture of quantitative and qualitative data depending on actual tools employed in the approach.
Ease of Use	Varies, but application of some tools requires specialist training in policy analysis. Some can be readily adopted by practitioners.
Training Required	Some training is useful, but expertise in policy analysis is more important than specific analytical techniques.
Training Available	Many training courses on stakeholder engagement exist.
Computer Requirements	Varies.
Documentation	Working papers on institutions, institutional analysis, stakeholders, and case studies are available online.
Applications	See http://www.sei.se/oxford / for examples of applications.
Contacts for Framework, Documentation, Technical Assistance	Dr. Thomas Downing, Stockholm Environment Institute, Oxford Office, 10B Littlegate Street, Oxford, OX1 1QT, United Kingdom; Tel: +44.1865.202070; e-mail: tom.downing@sei.se.
Cost	No cost.

Stakeholder Networks and Institutions (cont.)

References	See http://www.sei.se/oxford/ for links to references. Ziervogel, G. and T. E. Downing. 2004. Stakeholder networks: Improving seasonal forecasts. *Climatic Chang*e 65(1-2):73-101.

Scoping

Description	A major step in designing an assessment of climate impacts, vulnerability, and adaptation is to scope the elements of the study. A spreadsheet has been developed to aid project teams in the scoping phase. The spreadsheet has a list of potential methods — over 70 general techniques that are appropriate in various stages of an assessment. A simple form allows users to choose answers to eight scoping questions. The answers are then used to screen the choice of potentially useful tools. A section of the spreadsheet has common flowcharts of projects (e.g., NAPA and APF) and a set of building blocks that users can link to make their own project diagram.
Appropriate Use	This tool can underpin a project design team or be used to backstop a participatory exercise where teams are required to prepare a poster of their project and explain the overall logic and steps to other teams.
Scope	Global.
Key Output	Project design and inventory of tools.
Key Input	Review and synthesis existing information on vulnerability and adaptation, existing development policies and priorities, adaptation needs and constraints, and a list of potential methods.
Ease of Use	Very simple, all data are in the spreadsheet if users wish to change any assumption.
Training Required	None necessary.
Training available	SEI has used this tool to backstop participatory design exercises.
Computer Requirements	PC Windows with Excel (macro functions work with more recent versions).
Documentation	Contained in the spreadsheet; see also the APF scoping technical paper (TP1). (http://ncsp.undp.org/report_detail.cfm?Projectid=151)
Applications	Flexible use in project design.
Contacts for Framework, Documentation, Technical Assistance	Dr. Thomas Downing, Stockholm Environment Institute, Oxford Office, 10B Littlegate Street, Oxford, OX1 1QT, United Kingdom; Tel: +44.1865.202070; e-mail: tom.downing@sei.se.
Cost	Free, available on the www.vulnerabilitynet.org web site.
References	Downing, T.E. 2003. Scoping Tool for Climate Change Assessment: An Excel Spreadsheet and Toolkit. Stockholm Environment Institute, Oxford, UK.

Vulnerability Indices

Description	Formal vulnerability indices can be helpful as part of an adaptation strategy. Vulnerability is defined by the IPCC as the combination of sensitivity to climatic variations, the probability of adverse climate change, and adaptive capacity. For each of these components of vulnerability, formal indices can be constructed and combined. Methods of aggregating across sectors and scales have been developed in other contexts (e.g., the Human Development Index) and are beginning to be applied to climate change. However, substantial methodological challenges remain — in particular estimating the risk of adverse climate change impacts and interpreting relative vulnerability across diverse situations.
Appropriate Use	They can help identify and target vulnerable regions, sectors or populations, raise awareness, and can contribute to a monitoring strategy. In general stakeholder approaches are oriented toward research teams that support policy making. They help set the framework for evaluating specific measures, and thus from an early part of the decision process, as well as helping to monitor capability over a longer term.
Scope	Global, but most appropriate at national or local level.
Key Output	Matrices of vulnerability indexes, vulnerability maps.
Key Input	A mixture of quantitative and qualitative data depending on actual tools employed in the approach. Examples of vulnerability indices are commonly available, including the Southeast Asia Environmental Framework (contact Vikrom Mathur at the SEI: www.sei.se) and food security scenarios for South Africa and India (contact Tom Downing at the SEI).
Ease of Use	Varies, but application of some tools requires specialist training in policy analysis. Some can be readily adopted by practitioners.
Training Required	Some training is useful, but expertise in policy analysis is more important than specific analytical techniques.
Training Available	A number of groups offer training in vulnerability assessment particularly related to disasters. The Vulnerability Network led by the SEI maintains a web site with discussion forums, a document hotel, and bibliographies: see www.vulnerabilitynet.org.
Computer Requirements	Varies.
Documentation	UNEP has sponsored a project to review formal vulnerability indices and a background paper has been prepared. A summary of the key issues is available as a PowerPoint presentation on the ECI website (see publications at http://www.eci.ox.ac.uk/). See also the Technical Paper 3 of the Adaptation Policy Framework at http://ncsp.undp.org/report_detail.cfm?Projectid=151.
Applications	Vulnerability indices have been used by the Bangladesh Centre for Advanced Studies in Dhaka, South Pacific Applied Geoscience Commission, Association of Small Island States, and Battelle Pacific Northwest Laboratory. The Potsdam Institute for Climate Impact Research has developed an analogous approach on environmental syndromes.
Contacts for Framework, Documentation, Technical Assistance	Dr. Thomas Downing, Stockholm Environment Institute, Oxford Office, 10B Littlegate Street, Oxford, OX1 1QT, United Kingdom; Tel: +.44.1865.202070, e-mail: tom.downing@sei.se. Dr. Antoinette Brenkert, Pacific Northwest National Laboratory, Joint Global Change Research Institute at the University of Maryland, 8400 Baltimore Avenue, Suite 201, College Park, MD 20740-2496, USA; Tel: +1.301.314.6759; Fax: +1.301.314.6760; e-mail: Antoinette.Brenkert@pnl.gov.

Vulnerability Indices (cont.)

Cost	No cost.
References	Downing, T. et al. 2001. *Vulnerability indices. Climate Change Impacts and Adaptation*. UNEP, Policy Series 3: 91 pp. (available at http://www.sei.e-collaboration.co.uk/OPMS/view.php?site=seiproject&bn=seiproject_hotel&key=1097073874)

Agent Based Social Simulation

Description	A computer assisted technique for knowledge elicitation assists in building rules of how people respond to a variety of stimuli and scenarios of environmental and social conditions. Agent based social simulation is a relatively formal approach to stakeholder and institutional analysis. It is a computer programming method that uses software agents to represent the positions, boundaries, and actions of stakeholders. This approach is one of the few means to realistically simulate the behavior of stakeholder networks in the context of the rules, norms, and shared strategies from social and economic institutions. This approach can be applied at various stages of an assessment. One example is that agent based social simulation can incorporate socioeconomic scenarios that are constructed as sets of rules regarding, for example, environmental values, regulation, and economic goals. An advantage of this approach is that the realization of socioeconomic scenarios is the outcome of stakeholder behavior rather than being exogenously imposed in a way that bears little relation to actual decision making processes.
Appropriate Use	Applicable to various stages of the design of a strategy to respond to climate change and its subsequent implementation in specific measures.
Scope	Global, but most appropriate at national or local level.
Key Output	Insight into how the decision making and implementation processes. For example, realistic socioeconomic pathways constructed as the outcome of multiple decisions.
Key Input	A mixture of qualitative and quantitative data.
Ease of Use	Varies, though constructing an agent based social simulation model would require significant expertise.
Training Required	Some training is useful, but expertise in policy analysis is more important than specific analytical techniques when it comes to using and interpreting results of agent based social simulation.
Training Available	Very little experience has been gained regarding these approaches to date, and hence no formal training or certification is available. However, occasional workshops are offered. See documentation section below.
Computer Requirements	Personal computer.
Documentation	Center for Policy Modeling at Manchester Metropolitan University is one of the world leaders in agent based social simulation. The CPM developed a user friendly software package (SDML) to facilitate model development. http://cfpm.org/.
Applications	Agent based social simulation is only beginning to be applied to climate change. Oxford University's Environmental Change Unit is collaborating with the CPM on various applications to integrated assessment of climate policy. Also, the Carnegie Mellon global change program has elements of agent behavior in the Integrated Climate Assessment Model. A European Union project on integrated water resource management (Freshwater Integrated Resource Management Agents, coordinated by the University of Surrey) will develop agent based approaches further.
Contacts for Framework, Documentation, Technical Assistance	Dr. Thomas Downing, Stockholm Environment Institute, Oxford Office, 10B Littlegate Street, Oxford, OX1 1QT, United Kingdom; Tel: +44.1865.202070; e-mail: tom.downing@sei.se.

Agent Based Social Simulation (cont.)

Cost	No cost.
References	West, J.J. and H. Dowlatabadi. 1999. On assessing the economic impacts of sea-level rise on developed coasts. In *Climate Change and Risk*, T.E. Downing, A.A. Olsthoorn, and R.S.J. Tol (eds.). Routledge, New York, pp. 205-220. Ziervogel, G., M. Bithell, R. Washington and T. Downing. 2005. Agent-based social simulation: a method for assessing the impact of seasonal climate forecast applications among smallholder farmers. *Agricultural Systems* 83(1):1-26.

Livelihood Sensitivity Exercise

Description	Livelihood sensitivity mapping exercise is a means of integrating existing knowledge of climate vulnerability with livelihood analysis. It commonly involves stakeholder participation. Initially the exercise can be conducted in the context of rapid workshop breakout group, but eventually can be formalized via the inclusion of expert analysis, impact models, or historical analogues: The exercise involves developing a matrix with three blocks of rows — beginning with ecosystem services (e.g., soil moisture), then livelihood activities (such as crop production) and finally a synthesis based on livelihoods themselves. Climatic stresses (e.g., drought) are listed as columns. Users then fill in the cells — rating the sensitivity of ecosystem services, activities and livelihoods to a range of hazards and stresses. Exposure across the hazards and impacts across the services/activities/livelihoods can be calculated as aggregated indices.
Appropriate Use	Livelihood sensitivity exercise is a useful tool for helping identify vulnerable livelihoods and consequently targeting adaptations that aim to increase the resiliency of particular livelihood strategies to climate change. Livelihood sensitivity exercise is best applied to a single sector or region at any one time. The approach has been used in regional training workshops for the NAPA teams.
Scope	All sectors. Most applicable at a local or regional level.
Key Output	Ranking of vulnerable livelihoods as well as an overall livelihood sensitivity index.
Key Input	Qualitative assessments of sensitivity of livelihoods to climatic threats.
Ease of Use	Easy.
Training Required	A familiarity with livelihoods, expert knowledge elicitation, and vulnerability indicators is helpful.
Training Available	The NAPA workshops have produced a range of presentations and a sample spreadsheet that are available at http://www.unitar.org/ccp/ and www.vulnerabilitynet.org. The spreadsheet includes notes on delineation of livelihoods and an illustrative example based on agriculture in southern Africa.
Computer Requirements	Minimal to none.
Documentation	Available at www.vulnerabilitynet.org.
Applications	See www.livelihood.org.
Contacts for Framework, Documentation, Technical Assistance	Dr. Thomas Downing, Stockholm Environment Institute, Oxford Office, 10B Littlegate Street, Oxford, OX1 1QT, United Kingdom; Tel: +44.1865.202070; e-mail: tom.downing@sei.se.
Cost	Free.
References	See www.livelihood.org. Downing, T.E. 2003. *Livelihood Sensitivity to Climatic Hazards. Annex to Technical Paper 3 of the Adaptation Planning Framework*. SEI, Oxford, UK. (http://ncsp.undp.org/report_detail.cfm?Projectid=151)

Multistakeholder Processes

Description	The aim of multistakeholder processes are to promote better decision making by ensuring that the views of the main actors concerned about a particular decision are heard and integrated at all stages through dialogue and consensus building. The process takes the view that everyone involved in the process has a valid view and relevant knowledge and experience to bring to the decision making. The approach aims to create trust between the actors and solutions that provide mutual benefits (win-win). The approach is people-centered and everyone involved takes responsibility for the outcome. Because of the inclusive and participatory approaches used, stakeholders have a greater sense of ownership for decisions made. They are thus more likely to comply with them.
Appropriate Use	For decisions that require cooperation between many different stakeholders, where a decision made by one group alone might not be complied with by the other groups. They are suitable for situations where dialogue between the different actors is possible and there is willingness to listen to and learn from others to reconcile different interests and reach consensus solutions. There is no one set approach. The exact nature of a given process will depend on the issues to be covered, the specific objectives, the expertise available, the participants, and the time and other resources available.
Scope	Global, national, and local. Can be used with a wide range of structures and levels of engagement.
Key Output	Transparent and inclusive decision making, strengthened stakeholder networks.
Key Input	Expertise in facilitation, willingness of participants to learn, time to allow trust building, quantitative and qualitative information (depending on tools used), participation of key actors.
Ease of Use	The approaches as well as the techniques used are based on common sense. Good planning is a vital part of ensuring a successful outcome and time must be allowed for the design stage of the process.
Training Required	There are a number of good texts available, but additional appropriate training would be beneficial (depending on time, resources, type of process). Need also to design the process to fit the specific needs and circumstances.
Training Available	This is still a new and evolving field. Much experience of using participatory processes at the local level is available but less at national and global levels. Some guidance on approaches is available (see Applications below for examples).
Computer Requirements	Depends on the process.
Documentation	For information about running stakeholder engagement processes: Multistakeholder processes for governance and sustainability, Minu Hemmati, (2002), Earthscan, London. http://www.earthscan.co.uk/.
Applications	Multistakeholder processes have been used in the Aarhus Convention Process, the Bejing+5 Global Forum Online discussions, United Nations sustainable development multistakeholder dialogue, the Environment Council/Shell — Brent Spar Project (see Hemmati above for more information on these) and the Adaptation Policy Framework (APF) (http://ncsp.undp.org/report_detail.cfm?Projectid=151).

Multistakeholder Processes (cont.)

Contacts for Framework, Documentation, Technical Assistance	Dr. Kate Lonsdale, Stockholm Environment Institute, Oxford, OX1 1QT; e-mail: kate.lonsdale@sei.se. Dr. Bo Lim, Chief Technical Advisor, National Communications Support Programme, UNDP-GEF, Room 1607, 304 East 45th St, NY 10017, USA; e-mail: bo.lim@undp.org.
Cost	Depends on the scale of the process.
References	Chambers, R. 2002. Participatory Workshops: A Source Book of 21 Sets of Ideas and Activities. Earthscan. Available from http://www.earthscan.co.uk/. Good source book of information about how to run workshops including lots of practical advice and common mistakes. Coalition for Agrarian Reform and Rural Development (ANGOC) and International Institute of Rural Reconstruction (IIRR). 2001. Enhancing Ownership and Sustainability: A Resource Book on Participation. International Fund for Agricultural Development (IFAD). e-mail: publications@iirr.org. A collection of short reviews of participatory approaches and experiences. Pretty, J.N., I. Guijt, I. Scoones and J. Thompson. 1995. Participatory Learning and Action: A Trainers Guide. International Institute for Environment and Development (IIED). Available from www.earthprint.com. A valuable collection of advice, tips, and methods for participatory approaches. The focus is mostly on participatory rural appraisal but much would also be relevant to APF workshops. Kaner, S., L. Lind, C. Toldi, S. Fisk and D. Berger. 1996. Facilitator's Guide to Participatory Decision-Making. New Society Publishers. An introduction to how to build consensus and make sustainable agreements with groups. Also gives advice on how to handle difficult group dynamics and individuals.

Global Sustainability Scenarios

Description	Scenarios of future vulnerability are poorly framed by existing scenarios developed for bracketing future greenhouse gas emissions. Alternative scenarios of sustainability have been developed in various forms, and these correspond to many of the conditions of vulnerability and adaptive capacity that are of concern to development planners and practitioners. A major suite of sustainability scenarios was developed by the Global Scenarios Group (GSG). These include a conventional wisdom of market forces, a world of increasing degradation and impoverishment, and a sustainability transition. They are similar to scenarios developed for the UNEP Geo assessment. The GSG suite of scenarios includes storylines and quantified indicators for major world regions using the PoleStar scenario tool developed by SEI-Boston.
Appropriate Use	The GSG and PoleStar data can be used to frame national or local scenarios of vulnerability, or to place national development scenarios in context.
Scope	Global to regional; with some extensions they can be used to frame more local scenarios.
Key Output	Quantitative indicators of environmental change, economic conditions, and social welfare that can be linked to climatic vulnerability.
Key Input	The storylines and overview are described in an SEI monograph, Great Transitions (see References below).
Ease of Use	Very little effort is required to appreciate the storylines. PoleStar is not a simple model to understand, although it is well documented. It may take several days to extract the quantitative data and format for specific purposes; it is possible to create new subregions within PoleStar, but that will require additional time and possibly training.
Training Required	None necessary, although further training in PoleStar may be warranted.
Training available	SEI has used this tool in many contexts — contact SEI-Boston for training in PoleStar and the GSG scenarios; SEI Oxford has developed explicit links to climate vulnerability using South Africa and India as examples.
Computer Requirements	PC Windows.
Documentation	GSG web site, monograph and PoleStar software and manual are available through the SEI Boston office: see www.sei.se.
Applications	Global to local socioeconomic scenarios of future climate vulnerability and adaptive capacity.
Contacts for Framework, Documentation, Technical Assistance	Paul Raskin, SEI-Boston for the GSG and PoleStar, 11 Arlington Street, Boston, MA 02116-3411, USA; Tel: +1.617.266.8090; e-mail: praskin@tellus.org. For application to climate change: Dr. Thomas Downing, Stockholm Environment Institute, Oxford Office, 10B Littlegate Street, Oxford, OX1 1QT, United Kingdom; Tel: +44.1865.202070; e-mail: tom.downing@sei.se.
Cost	PoleStar is available for free in a demonstration version, which includes the GSG scenarios. The GSG monograph is available free in an electronic version.
References	P. Raskin, et al. 2002. Great Transition. Stockholm Environment Institute, Boston. http://www.tellus.org/seib/publications/Great_Transitions.pdf

MPPACC (Model of Private Proactive Adaptation to Climate Change)

Description	The Model of Private Proactive Adaptation to Climate Change (MPPACC) is a psychological model, which helps to understand the psychological determinants of individual adaptation behavior. MPPACC separates out the psychological steps to taking action in response to climate change, and allows one to see where the most important bottlenecks occur—including risk perception and perceived adaptive capacity.
Appropriate Use	MPPACC mainly qualifies as a theoretical model, which helps to address the important determinants of individual adaptive behavior in campaigns that have the objective to foster individual adaptation behavior. In taking actions to promote particular adaptations, it would be worthwhile for policy makers to focus on the cognitive barriers mentioned in MPPACC. In addition, MPPACC can offer predictive power to the task of assessing individual adaptive capacity (i.e., the probability of individual adaptation behavior) by measuring the psychological determinants of adaptation behavior through surveys (e.g., by asking people for their perceived ability to avoid damage from climate change impacts). MPPACC is not a tool to assess climate change impacts or vulnerability.
Scope	MPPACC can be applied worldwide, but individual determinants of adaptation behavior vary from culture to culture. Therefore, in most cases MPPACC has to be checked for cultural adequacy.
Key Output	MPPACC is an analytical tool to understand the determinants of individual adaptation behavior.
Key Input	When MPPACC is used as a theoretical tool to understand the determinants of individual adaptation behavior there are no data required.
Ease of Use	Every user who can think psychologically can use the MPPACC.
Training Required	No training is required.
Training Available	No training is required.
Computer Requirements	None.
Documentation	Grothmann, T. and A. Patt. 2005. Adaptive Capacity and Human Cognition: The Process of Individual Adaptation to Climate Change. *Global Environmental Change* 15 (3):199-213.
Applications	No further cases or projects where MPPACC has been applied despite the project presented in Grothmann and Patt (2005).
Contacts for Tools, Documentation, Technical Assistance	Torsten Grothmann; e-mail: Torsten.Grothmann@web.de.
Cost	None.
References	Grothmann, T. and A. Patt. 2005. Adaptive Capacity and Human Cognition: The Process of Individual Adaptation to Climate Change. *Global Environmental Change* 15 (3):199-213.

3.4 Other Multisector Tools

The tools described in this part of the compendium, listed in Table 3.4, are applicable to more than one sector. They provide a general evaluation of adaptation options, are easily adapted to numerous regions and situations, and are frequently used in conjunction with sector-specific tools to develop a comprehensive analysis or in support of a complete framework. Some are focused and produce specific information (e.g., M-CACES provides the user with estimates of the cost of particular adaptations, while CCAV provides insight into impacts of climate variability). Others are more general approaches that can be applied to more than one step of a vulnerability and adaptation assessment (e.g., uncertainty and risk analysis, forecasting by analogy, expert judgment). Several of the tools listed below are disaster risk reduction tools that have been developed in response to numerous climate-related hazards. The application of these tools can provide an effective framework for identifying risks and vulnerabilities, and to build adaptive capacity.

Table 3.4. Other multisector tools

Climatic Change and Variability (CCAV)
Expert Judgment
Historical or Geographic Analogs: Forecasting by Analogy
Uncertainty and Risk Analysis
Estimating Adaptation Costs: M-CACES
Impacts Database
PAGE2002 (Policy Analysis for the Greenhouse Effect)
Resource Approach to Assessment of Climate Change Impact on Human Activity
Comprehensive Hazard and Risk Management (CHARM)
Community-Based Disaster Risk Management Field Practitioners' Handbook
Guidelines for Emergency Assessment
Guidelines on Climate Watches
Natural Disaster Mitigation in Drinking Water and Sewerage Systems: Guidelines for Vulnerability Analysis
Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters
The Good Practice Guide: Community Awareness and Education in Emergency Management

Climatic Change and Variability (CCAV)

Description	A methodology of descriptive statistics to illustrate the changing average conditions and the variability in conditions over time. Climate time-series data can be described according to their average conditions, but of particular importance for vulnerability are the impacts of adaptation to the variability of conditions from year to year. Within the range of climatic conditions is a range of conditions with which humans can cope. This range can be changed with adaptive responses. The climatic conditions can also be described and compared according to the variation of conditions over a particular time period (indicated by the variance).
Appropriate Use	To assess climate change and variability in the context of the coping capacity of human systems.
Scope	All locations; all levels of analysis.
Key Output	Allows user to understand changes not only in average climate conditions but also in extreme conditions.
Key Input	Climate time-series data.
Ease of Use	Easy.
Training Required	No formal training required, although an understanding of climatic data and descriptive statistics is an asset.
Training Available	None identified.
Computer Requirements	None identified.
Documentation	Smit, B., D. McNabb, and J. Smithers. 1996. Agricultural adaptation to climatic variation. *Climatic Change* 33:7-29. Smit, B., I. Burton, R.J.T. Klein, and J. Wandel. 2000. An anatomy of adaptation to climate change and variability. *Climatic Change* 45(1):223-251. Smit, B., I. Burton, R.J.T. Klein, and R. Street. 1999. The science of adaptation: A framework for assessment. *Mitigation and Adaptation Strategies for Global Change* 4(3-4):239-252. Smit, B. 1999. Agricultural Adaptation to Climate Change in Canada. A Report to the Adaptation Liaison Office.
Applications	Applied by Environment Canada's Environmental Adaptation Research Group, and in other climate change and variability research in Canada and Germany.
Contacts for Framework, Documentation, Technical Assistance	Elizabeth Harvey, University of Guelph, Department of Geography, Guelph, ON N1G 2W1; Tel: 519.824.4120 ext. 8961; Fax: 519.837.2940; e-mail: eharvey@uoguelph.ca. Dr. Barry Smit, University of Guelph, Department of Geography, Guelph, ON N1G 2W1 Canada; Tel: 519.824.4120 ext. 3279; Fax: 519.837.2940; e-mail: bsmit@uoguelph.ca. Ian Burton, Adaptation and Impacts Research Division (AIRD), Meteorological Service of Canada, 4905 Dufferin Street, Downsview, ON M3S 5T4, Canada; Tel: 416.739.4314; Fax: 416.739.4297; e-mail: ian.burton@ec.gc.ca.
Cost	None identified.
References	See Documentation above.

Expert Judgment

Description	Expert judgment is an approach for soliciting informed opinions from individuals with particular expertise. This approach is used to obtain a rapid assessment of the state of knowledge about a particular aspect of climate change. It is frequently used in a panel format, aggregating opinions to cover a broad range of issues regarding a topic. Expert judgment is frequently used to produce position papers on issues requiring policy responses and is integral to most other decision-making tools.
Appropriate Use	This approach is most useful either in conjunction with a full research study or when there is insufficient time to undertake a full study. It is important to be aware, however, of the subjective nature of expert judgment and the need to select a representative sample of experts to cover the full spectrum of opinion on an issue.
Scope	All locations; all sectors; national or site-specific.
Key Output	Current information on any area of climate change and subjective assessment of potential adaptation options.
Key Input	Knowledge of experts' respective areas of expertise.
Ease of Use	Easy to apply.
Training Required	Requires knowledge of policy issues and available experts. More training may be required to assemble an expert panel, formulate questionnaires, and interpret and aggregate expert opinions.
Training Available	Informal training offered; contact Ian Burton (see below) for information.
Computer Requirements	None.
Documentation	Not applicable.
Applications	UK, Mackenzie Basin in Canada, Finland.
Contacts for Tools, Documentation, Technical Assistance	Ian Burton, Adaptation and Impacts Research Division (AIRD), Meteorological Service of Canada, 4905 Dufferin Street, Downsview, ON M3S 5T4, Canada; Tel: 416.739.4314; Fax: 416.739.4297; e-mail: ian.burton@ec.gc.ca.
Cost	Cost depends on the fee charged by the experts.
References	Cohen, S.J. (ed.). 1997. Mackenzie Basin Impact Study. No. En 50_118/1997_IE. Environment Canada, Downsview, Ontario. Smith, J.B. and D.A. Tirpak. 1990. The Potential Effects of Global Climate Change on the United States. Report to Congress, U.S. EPA, Washington, DC.

Historical or Geographic Analogs: Forecasting by Analogy

Description	This qualitative tool is a method for evaluating the effectiveness of potential adaptation strategies by comparing observed adaptations to past climate extremes in different geographic locations, sectors, or time periods. This method compares events that have had a similar effect in the recent past to the likely impact of future events associated with climate change, assuming that lessons can be learned from such past experience and then applied to future situations. These compared situations can generally share several important characteristics such as time scale, severity, reversibility, impacted sector, or aggravating factors, and point out how well actual adaptation response worked or did not work.
Appropriate Use	This approach is useful during the initial survey stages of evaluating adaptation strategies to avoid duplicating research or to narrow the list of feasible options, and is generally used in conjunction with a quantitative evaluation of adaptation options. This approach does not provide a method to weigh the trade-offs among different adaptation options, but instead provides insight into how the adaptation process may work. Also, an example of adaptation in one place at a particular time is not always applicable to a future adaptation at a different place. This approach has not seen extensive use recently.
Scope	All locations; all sectors; national or site-specific.
Key Output	A broad perspective on previous research and attempted strategies used to address similar situations.
Key Input	General information on other adaptation issues: research done, approaches used, problems encountered. Often performed by a multidisciplinary panel of experts, including relevant members of the research community such as climatologists, meteorologists, hydrologists, entomologists, and epidemiologists.
Ease of Use	Relatively easy to use, although the robustness of the comparison depends on the extent of the user's knowledge of the situations being compared.
Training Required	Requires a background understanding of the adaptation issues being compared.
Training Available	Contact Michael Glantz for more information (see Contacts below).
Computer Requirements	None.
Documentation	Glantz, M., and J. Ausubel. 1998. Impact assessment by analogy: Comparing the impacts of the ogallala aquifer depletion and CO_2 induced climate change. In *Societal Responses to Regional Climate Change: Forecasting by Analogy.* M. Glantz (ed.). Westview Press, Boulder, CO, USA.
Applications	Used in U.S. EPA-supported project on analogous forecasting of the societal responses to the regional impacts of global warming. Also used to evaluate fisheries in Poland, Mexico, and the Far East.
Contacts for Tools, Documentation, Technical Assistance	Michael Glantz, University Corporation for Atmospheric Research, P.O. Box 3000, Boulder, CO 80303 USA; Tel: +1.303.497.8117; e-mail: glantz@ucar.edu.
Cost	Low cost to obtain documentation.

Historical or Geographic Analogs: Forecasting by Analogy (cont.)

References	Glantz, M. (ed.). 1998. *Societal Responses to Regional Climatic Change: Forecasting by Analogy*. Westview Press, Boulder, CO, USA. Coastal: Hands, E.B. 1983. The Great Lakes as a test model for profile responses to sea level changes. In *CRC Handbook of Coastal Processes and Erosion,* Komar, P.D. (ed.). CRC Press, Boca Raton, pp. 167-189. N. Mimura and H. Nobuoka. 1995. Verification of the Bruun Rule for the estimation of shoreline retreat caused by sea-level rise. In *Coastal Dynamics* 95, W.R. Dally and R.B. Zeidler (eds.). American Society of Civil Engineers, New York, pp. 607-616. Parkinson, R.W. (ed.) 1994. Sea-level rise and the fate of tidal wetlands. *Journal of Coastal Research* 10:987-1086. Health: FAO. 1998. *An El Niño Primer*. FAO Rome. (http://www.fao.org/). Jury, M.R. 1996. Malaria forecasting project. In *Workshop on Reducing Climate-Related Vulnerability in Southern Africa*. *Victoria Falls, Zimbabwe, October 1-4, 1996*. SADC/NOAA/NASA. NOAA, OGP, Silver Spring, MD, USA.

Uncertainty and Risk Analysis

Description	This approach can be applied through critical review of available literature and data or through data analysis using software programs. Uncertainty and risk analysis allows the user to address the errors and unknowns often associated with data and information used to evaluate climate change adaptation measures. A key element of uncertainty and risk analysis is defining the decision criterion that is most appropriate for the question at hand. Uncertainty and risk can be assessed qualitatively, using probability ratings such as slight, moderate, and high. Uncertainty can also be assessed quantitatively, using decision analysis tools (e.g., decision trees) or sensitivity analyses such as Monte Carlo analysis. This method is often used in conjunction with other assessment techniques.
Appropriate Use	This tool is an important step in any assessment of climate change adaptation measures. Quantitative analyses using decision theory or simulation techniques are most useful when evaluating the data used for benefit-cost or similar quantitative analyses.
Scope	All locations; all sectors; national or site-specific.
Key Output	Depending on the method used, a quantitative or qualitative estimate of the uncertainty or risk associated with data being used to evaluate an adaptation measure.
Key Input	Information and data used for other analyses of an adaptation measure.
Ease of Use	Relatively easy to apply.
Training Required	Requires an understanding of the policy objectives and adaptation measures being considered. Monte Carlo and other quantitative analyses require training in specific techniques and uses of statistical software.
Training Available	Contact Stratus Consulting for more information (see below).
Computer Requirements	IBM-compatible 286; Lotus 1-2-3 or Excel spreadsheet software; @Risk, Crystal Ball software applications.
Documentation	U.S. EPA. Guidelines for Preparing Economic Analyses. U.S. Environmental Protection Agency, Washington, DC. Available at http://yosemite.epa.gov/ee/epa/eed.nsf/webpages/Guidelines.html.
Applications	Used to help determine total programmatic effectiveness of the Global Environment Facility (GEF).
Contacts for Tools, Documentation, Technical Assistance	Joel Smith, Stratus Consulting, P.O. Box 4059, Boulder, CO 80306 USA; Tel: +1.303.381.8000; Fax: +1.303.381.8200; e-mail: jsmith@stratusconsulting.com; website: http://www.stratusconsulting.com/.
Cost	Documentation is free. Cost of analysis varies depending on type of analysis used; quantitative analyses are more time consuming and costly.
References	Brklacich, M. and B. Smit. 1992. Implications of changes in climatic averages and variability on food production opportunities in Ontario, Canada. *Climatic Change* 20:1-21. Katz, R.W. 2002. Techniques for estimating uncertainty in climate change scenarios and impact studies. *Climate Research* 20:167-185.

Estimating Adaptation Costs: M-CACES

Description	M-CACES, a Windows-based software program, is required by the U.S. Army Corps of Engineers for the preparation of water resources construction and rehabilitation cost estimates for projects with federal costs exceeding US$2 million. The Unit Price Book associated with M-CACES provides production rates, unit costs, and crew composition for the United States. Price escalation for inflation is used to adjust pricing to the project schedule and to fully fund the estimate.
Appropriate Use	Useful for estimating the costs of large natural resources construction projects (including dams, shoreline protection, and ecosystem rehabilitation). Best used for final rather than initial cost analyses due to the amount of time and data required to complete.
Scope	Designed for the United States, but can be adapted to other countries; multiple sectors; site-specific.
Key Output	Cost estimate for natural resources projects.
Key Input	Quantity take-offs from drawings, specifications and references.
Ease of Use	Requires extensive data on the costs associated with the project. Relatively easy to apply if data are available; more rigorous results require more analysis.
Training Required	Training is suggested to acquire skill in developing quality cost estimates and customizing databases for site-specific or project-specific elements.
Training Available	Building Systems Design (see Contacts below) offers monthly training classes.
Computer Requirements	IBM compatible computer with Windows 95 or later operating system.
Documentation	Supplemental construction cost information is published in USA by R.S. Means Company, Inc., Publishers & Consultants, +1.617.585.7880, or Dodge Cost Systems, McGraw Hill Information Systems Company, +1.800.544.2678.
Applications	Used as an internal tool by the U.S. Army Corps of Engineers to estimate construction and rehabilitation costs of water resources projects. Also used by the U.S. Department of Defense, the U.S. Department of Energy, and the U.S. Environmental Protection Agency.
Contacts for Tools, Documentation, Technical Assistance	*Tools and Documentation:* Roy Braden, Cost Engineering Branch, Headquarters, U.S. Army Corps of Engineers, USA; Tel: +1.202.761.1495; e-mail: Roy.E.Braden@usace.army.mil. *Technical Assistance:* Building Systems Design, Inc., 1175 Peachtree St., 100 Colony Square, Suite 1900, Atlanta, GA 30361 USA; Tel: +1.404.876.4700; Fax: +1.404.876.0006.
Cost	Cost of obtaining and running the model depends on scale of project.
References	None available.

Impacts Database

Description	The impacts database is a web-based database of climate / weather-related impacts as reported in the media. It enables the user to assess the impacts of a particular climatic event thereby enabling them to plan for future events of its kind.
Appropriate Use	The tool is useful in assessing what impacts may result from extreme weather events. It is not for use in distinguishing whether a particular weather event was a result of climate change
Scope	The majority of impacts documented in the impacts database are UK-based. However, there are certain instances of impacts outside of the UK.
Key Output	User-specified search results supplied in the form of a summary for each example plus the source of the full document.
Key Input	A user-specified sector or searchable field.
Ease of Use	Extremely easy to use.
Training Required	None.
Training Available	None.
Computer Requirements	Access to the internet.
Documentation	All documentation is supplied within the database.
Applications	Use in UKCIP presentations - this tool has only recently become available.
Contacts for Tools, Documentation, Technical Assistance	Anna Steynor, Scientific Officer, UK Climate Impacts Programme; e-mail: anna.steynor@ukcip.org.uk.
Cost	None.
References	None.

PAGE2002 (Policy Analysis for the Greenhouse Effect)

Description	PAGE2002 is a spreadsheet probabilistic model written in Excel with the @RISK add-in. The model calculates regional and global impacts of climate change, and social costs of different greenhouse gases. It also calculates the costs of abatement and adaptation. It is an Integrated Assessment Model starting from emission projections, and carrying uncertainties throughout the calculations.
Appropriate Use	The model is designed to explore the impacts and social costs under any user-specified emission scenarios. It can be used to calculate optimal abatements.
Scope	The model is global in scope, with a user-defined focus region. It calculates to 2200 by default.
Key Output	The model and the results obtained with it are the key outputs.
Key Input	Emission scenarios and about 80 parameter probability distributions covering both scientific and economic inputs.
Ease of Use	Designed to be transparent and easy to use.
Training Required	A single session with the model developer is all that is normally required.
Training Available	The model developer will offer advice and support under contract.
Computer Requirements	PC running Excel and @RISK.
Documentation	PAGE2002 is described in detail in Hope C, 2006, "The marginal impact of CO2 from PAGE2002: An integrated assessment model incorporating the IPCC's five reasons for concern", Integrated Assessment, 6, 1, 19-56.
Applications	Several analyses performed for the GB Office of Gas and Electricity Markets who paid for the development of the model. PAGE2002 was the main model used for the impact calculations in the UK Government's Stern report.
Contacts for Tools, Documentation, Technical Assistance	Dr Chris Hope, Judge Business School, University of Cambridge.
Cost	The model is free to use, on the condition that any publications resulting from the use of the model include Dr Chris Hope as an author. The model developer will provide advice and support under contract.

PAGE2002 (Policy Analysis for the Greenhouse Effect) (cont.)

References	Alberth, S. and C. Hope. 2007. Climate modelling with endogenous technical change: Stochastic learning and optimal greenhouse gas abatement in the PAGE2002 model. *Energy Policy* 35: 1795-1807. Dietz S, C. Hope and N. Patmore. 2007. Some Economics of 'Dangerous' Climate Change: Reflections on the Stern Review. *Global Environmental Change* 17(3-4):311-325. Dietz, S., C. Hope, N. Stern and D. Zenghelis. 2007. Reflections On The Stern Review (1), A Robust Case for Strong Action to Reduce the Risks of Climate Change. *World Economics* 8(1):121 - 168. Hope, C. and D. Newbery. 2007. Calculating the social cost of carbon. Chapter 2 of Grubb, M., T. Jamasb and M. Pollitt (eds.), *Delivering a Low Carbon Electricity System: Technologies, Economics and Policy*, Cambridge University Press. Hope, C. 2005. Integrated Assessment Models. Chapter 4 in Helm, D. (ed.), *Climate Change Policy*, Oxford University Press. Hope, C. 2006. The marginal impacts of CO2, CH4 and SF6 emissions. *Climate Policy* 6(5):537 - 544. Hope, C. 2006. The marginal impact of CO2 from PAGE2002: An integrated assessment model incorporating the IPCC's five reasons for concern. *Integrated Assessment* 6(1):19-56. Hope, C. 2006. The social cost of carbon: what does it actually depend on? *Climate Policy* 6(5):566 - 572. Hope, C. 2007. Discount rates, equity weights and the social cost of carbon. *Energy Economics*. Available online 12 January 2007 at www.sciencedirect.com. Hope, C. 2007. PAGE Modeling system. Chapter 2 of the Yale Symposium on the Stern Review, Yale Center for the Study of Globalization, http://www.ycsg.yale.edu/climate/stern.html. Wahba, M. and C. Hope. 2006. The marginal impact of carbon dioxide under two scenarios of future emissions. *Energy Policy* 34(17):3305-3316.

Resource Approach to Assessment of Climate Change Impact on Human Activity

Description	Resource approach allows decision makers to include information on climate conditions and their change directly in economic analysis. The climate resources estimation helps to represent spatial distribution of climate resources for given field of human activity and to evaluate total climate resources for concrete region and to compare them over the whole country. This methodology creates opportunities to compare climate resources for different economic sectors in various regions at present and in the future and to choose the regions that could be optimal for development of specific activity taking into account probable climate change. Particularly, this approach provides some tools to assess vulnerability of regions and economic sectors to climate change in terms of climate resources change. Resource approach involves 5 steps: (1) to select specific indexes of climate impact on objects and processes in a given economy sector, (2) to calculate these impact indexes both at present and for the future using results regional climate projections, (3) to convert climate impact indexes from initial physical units to relative (non-dimensional) units, (4) to estimate climate resource for a given economy sector in each region of the country, and (5) to compare climate resource values in different regions and choose the optimal ones.
Appropriate Use	Resource approach is relevant to decision makers who are responsible for regional planning of economic activity, strategic planning of a given economy sector, ensuring the sustainable development of the region's economy. This information can be also used for concrete applications including the estimation of economic value for land.
Scope	All regions, all economic sectors.
Key Output	The values of climate resources and evaluation of adaptation potential to climate change for various economic branches in all regions of a given country expressed in relative and monetary (for some sectors) units.
Key Input	Meteorological data for specific climate impact index calculations, results of regional climate projections.
Ease of Use	Relatively easy to apply, only basic computer skills are needed.
Training Required	Requires little training, but it requires expert knowledge to choose appropriate climate impact indexes.
Training Available	No formal training currently offered. Sources of assistance / consulting can be obtained from contacts listed below.
Computer Requirements	Personal computer.
Documentation	Encyclopedia of climate resources of Russia. 2005, 319 pp., Gidrometeoizdat, St. Petersburg.
Applications	Applications across a wide range of regions in Russian Federation in the following sectors: building construction, land use planning, power grid planning.
Contacts for Tools, Documentation, Technical Assistance	Nina Kobysheva, Voeikov Main Geophysical Observatory, 194021 Karbyshev Str. 7, St. Petersburg, Russian Federation; Tel: +7.812.2974390; Fax: +7.812.297.8661; e-mail: director@main.mgo.rssi.ru or kobyshnv@main.mgo.rssi.ru.
Cost	Depends on breadth of assessment.

Resource Approach to Assessment of Climate Change Impact on Human Activity (cont.)

References	Akentyeva, E.M. 2005. New approaches to the climate resource estimation. In Proceedings - *GCOS Regional Workshop for Eastern and Central Europe, Leipzig, Germany* [CD-ROM computer file]. Kobysheva, N.V. and O.B. Iljina. 2001. Methodology of climate resource estimation in Leningrad region. *Meteorology and climatology* 9:17-24. Kobysheva, N.V. 2005. Climate as a Natural Resource for Integrated Planning and Management. In Proceedings - *Technical Conference "Climate as a Resource", Beijing, China* [CD-ROM computer file].

Comprehensive Hazard and Risk Management (CHARM)

Description	CHARM is defined as a comprehensive hazard and risk management tool for use within an integrated national development planning process. It aims to facilitate greater collaboration between risk reduction projects at all levels (though mostly at the national level with participation from stakeholders for decision-making) and across sectors to enhance sustainable development. CHARM takes all hazards into account across the whole country.
Appropriate Use	This tool can be used for mainstreaming disaster risk reduction into ongoing national development planning processes. It aims to address all hazards including natural and human-induced, and also to help identify measures that can be implemented in all phases of disaster management (prevention, preparedness, response, and recovery). The emphasis is on bringing a wide range of stakeholders together for risk reduction to enhance effectiveness of the combined efforts.
Scope	National level.
Key Output	The immediate output of the CHARM process is to develop a matrix summarizing national risks and risk reduction measures (or "treatment options") that considers the activities of all agencies. Planners then target the gaps identified in the matrix. Step 1 – Context established Step 2 – Risks identified Step 3 – Risks analyzed Step 4 – Risks evaluated Step 5 – Risks treated and results evaluated
Key Input	Step 1 – Identification of national development priorities, organizational issues, and initial risk evaluation criteria Step 2 – Identification of hazard, vulnerable sectors, and impacts Step 3 – Assessment of risks with stakeholders based on agreed indicators, such as frequency of hazards, potential impacts, etc. Step 4 – Determination of acceptable levels of risks and priorities for action Step 5 – Selection of risk reduction measures; assignment of roles and responsibilities for all partners; evaluation against agreed criteria
Ease of Use	Readily usable by those with experience in policy analysis, developing work plans, and inter-agency planning.
Training Required	Knowledge of tools for each step is needed (e.g. to rank development challenges, develop budgets).
Training Available	Training is available through broad stakeholder consultation workshops involving both national and regional stakeholders. SOPAC has also developed a manual.
Computer Requirements	Word processing and spreadsheets
Documentation	SOPAC. 2001. Comprehensive Hazard Risk Management Regional Guidelines for Pacific Island Countries. Suva: South Pacific Applied Geosciences Commission. Guideline and manual available in print or on CD (see Contacts below).
Applications	CHARM has been used for planning in Palau, Kiribati, Vanuatu, Fiji, and Tonga, and it has also been aligned to the Joint Australia-New Zealand Risk Management Standard.
Contacts for Tools, Documentation, Technical Assistance	SOPAC Secretariat, Private Mail Bag, GPO, Suva, Fiji Islands; Tel: +679.338.1377; Fax: +679. 3370040. Atu Kaloumaira, Community Risk Programme Advisor; e-mail: atu@sopac.org. Noud Leenders, Community Risk Management Advisor; e-mail: noud@sopac.org.

Comprehensive Hazard and Risk Management (CHARM) (cont.)

Cost	Free.
References	See Documentation.

Community-Based Disaster Risk Management Field Practitioners' Handbook

Description	The handbook briefly explains the concept of community-based disaster risk management (CBDRM) and provides practical tools that can be applied in community-level programming. The Handbook is divided into four parts: (1) an introduction to CBDRM, (2) specific step-by-step exercises, (3) cross-cutting issues of gender and communication, and (4) disaster risks in Southeast Asia. The tools in Section 2 cover seven types of activities in CBDRM: (1) Selecting the community (2) Rapport building and understanding the community (3) Participatory disaster risk assessment (4) Participatory disaster risk management planning (5) Building/training a community disaster risk management organization (CDRMO) (6) Community-managed implementation (7) Participatory monitoring and evaluation The resource pack for risk identification (Step 3) includes instructions and guiding questions for the most commonly used participatory assessment tools, e.g. constructing timelines, hazard maps, rankings, and calendars.
Appropriate Use	This handbook is a comprehensive how-to guide that can be used to assist project teams working at the local level to ensure the participation of community members in reducing disaster risks. Each of the seven steps, particularly Step 3, is clearly outlined, along with simple instructions for group exercises, information to gather, and stakeholders to involve.
Scope	Community level.
Key Output	Overall: "The CBDRM process should lead to progressive improvements in public safety and community disaster resilience. It should contribute to equitable and sustainable community development in the long term." Step 1 – Priority vulnerable communities identified Step 2 – Trust between community and project members; understanding of community needs among project members Step 3 – Disaster risks identified and community members understand these risks Step 4 – Community disaster risk management plan Step 5 – CDRMO established and equipped with skills to implement their disaster risk management plan Step 6 – Planned activities implemented effectively and on time, with participation of stakeholders Step 7 – Appropriate indicators of program success developed and progress measured, with participation of stakeholders

Community-Based Disaster Risk Management Field Practitioners' Handbook (cont.)

Key Input	Step 1 – Information on various criteria developed by decision makers Step 2 – Information about the community and efforts to develop relationships/understanding with community members Step 3 – Range of qualitative and quantitative data about the hazards, vulnerabilities, and capacities in the community Step 4 – Dialogue among stakeholders to identify needed measures Step 5 – Identification of CDRMO members and training Step 6 – Responsibilities carried out by members; periodic reviews Step 7 – Range of qualitative and quantitative data about activities' impacts; dialogue between stakeholders
Ease of Use	Readily usable.
Training Required	Some training or experience in working at the local level would be useful.
Training Available	Contact Zubair Murshed at mzubair@adpc.net or adpc@adpc.net.
Computer Requirements	• None for community risk identification exercises • Word processing and spreadsheet skills for program planning and implementation, depending on complexity of local activities • GIS optional for community disaster risk assessment (Step 3)
Documentation	Abarquez, I. and Z. Murshed. 2004. Community-Based Disaster Risk Management: Field Practitioners' Handbook. Bangkok: Asian Disaster Preparedness Center. Can be downloaded from http://www.adpc.net/pdr-sea/publications/12Handbk.pdf.
Applications	This methodology has been used in several communities throughout South and Southeast Asia.
Contacts for Tools, Documentation, Technical Assistance	Information Manager, PDR SEA, Asian Disaster Preparedness Center (ADPC), P.O. Box 4, Klong Luang, Pathumthani 12120, Thailand; Tel: +66.2.516.5900 to 5910; Fax: +66.2.524.5360; e-mail: adpc@adpc.net; website: www.adpc.net.
Cost	Free.
References	Arcilla, M.J.D., Z.G. Delica et al. (eds.). 1998. 4B: Project Development, Monitoring and Evaluation in Disaster Situations. Quezon City, Philippines, Citizen's Disaster Response Center. Gutteling and Wiegman, 1996. Exploring Risk Communication: Advances in natural and technological hazards research, Kluwer Academic Publishers, Dordrecht, The Netherlands.

Guidelines for Emergency Assessment

Description	These guidelines provide advice on the organization of emergency assessments, starting with an introduction of key concepts and then outlining each step. The steps are roughly laid out in the order required during an assessment. The chapter on fieldwork notes some basic principles that should underlie activities, such as participation, inclusion or marginal groups, looking out for biases, etc. Results of the general assessment can indicate where more technical assessment is needed. The framework can be easily adapted to incorporate climate change issues as it provides fairly general guidelines on the assessment process.
Appropriate Use	Aimed at generalists in the Red Cross Red Crescent community conducting an assessment to provide an overview of the situation. The guidelines cover the following steps, some of which may overlap: (1) Planning (2) Office tasks (3) Fieldwork (organization and management) (4) Analysis (5) Reporting The chapter on fieldwork includes detailed descriptions of various types of information gathering exercises and issues to consider for each one, including tips on establishing trust, cultural sensitivities, suggested questions, and extensive checklists that were compiled by sector specialists. It gives very clear, easily understandable directions for carrying out activities. The chapter on analysis provides worksheets team members may use to synthesize information. These are largely based on IFRC's vulnerability and capacity framework (see References).
Scope	Local affected areas.
Key Output	• Planning – Determination of whether an assessment is needed, objectives and terms of reference, and type of assessment (rapid/detailed/continual). • Office tasks – Arrangements for coordination, required resources identified, team assembled and briefed, key locations identified. • Fieldwork – Sufficient information gathered in selected locations on issues identified during planning phase. • Analysis – Identification of the main problems, affected populations, and local capacity; recommendations for further action. • Reporting – Clear, concise reports following a recommended format: summary; background information; details and assumptions; needs, coping strategies, and assistance; program proposals.

Guidelines for Emergency Assessment (cont.)

Key Input	The guidelines recommend that each of these steps are generally undertaken sequentially, so that the output of the planning phase is used as an input to the office-based tasks, and so on. • Planning – Information from secondary sources on the nature of the emergency and urgency of an assessment • Office tasks – Objectives and terms of reference; information on potential team members' skills • Fieldwork – Secondary information, interviews with community members and authorities, group exercises, household visits, etc. • Analysis – Summaries of information that have been checked for consistency, discussion among team members. • Reporting – Results of the analysis.
Ease of Use	Readily usable by anyone conducting an assessment.
Training Required	None.
Training Available	Contact regional and country offices: http://www.ifrc.org/who/delegations.asp
Computer Requirements	None, although word processing and spreadsheets may be useful for analysis and reporting.
Documentation	IFRC. 2005. Guidelines for Emergency Assessment. Geneva: International Federation of the Red Cross and Red Crescent Societies.
Applications	Based on IFRC's experience in conducting assessments following disasters around the world.
Contacts for Tools, Documentation, Technical Assistance	International Federation of Red Cross and Red Crescent Societies, PO Box 372, CH-1211, Geneva 19, Switzerland; Tel: +41.22.730.4222; Fax: +41.22.733.0395; e-mail: secretariat@ifrc.org; website: www.ifrc.org.
Cost	Free.
References	IFRC. 1999. Code of conduct for the International Red Cross and Red Crescent Movement and Non-Governmental Organizations in Disaster Relief. Geneva: International Federation of the Red Cross and Red Crescent Societies, http://www.ifrc.org/publicat/conduct/code.asp. IFRC. 1999. Vulnerability and capacity assessment: an International Federation guide. Geneva: International Federation of the Red Cross and Red Crescent Societies, http://www.ifrc.org/what/disasters/dp/planning/vcaguidelines.asp . IFRC. 2000. Better Programming Initiative: options for better aid programming in post-conflict settings. Geneva: International Federation of the Red Cross and Red Crescent Societies. Sphere Project. 2003. Humanitarian Charter and Minimum Standards in Disaster Response. Geneva: Sphere Project, http://www.sphereproject.org/handbook/index.htm.

Guidelines on Climate Watches

Description	These guidelines describe how to establish a climate watch system and the information required in a climate watch. Governments typically react to extreme climate events through "crisis management" rather than through continuous risk reduction. Decision makers have cited the lack of information about approaching climate hazards with sufficient notice to take action. Climate watches aim to deliver this necessary, accurate information to end-users through the National Meteorological Services (NMSs) in a timely and useful manner.
Appropriate Use	This tool targets "the special situation and needs of smaller NMSs, which have limited resources" in establishing the system and issuing climate watches. The process is based on continuous collaboration with climate information users, and it should serve as a mechanism to initiate preparedness activities to limit impacts from climate anomalies (e.g. excessive rainfall over several months). The guidelines discuss the rationale for a climate watch system, current activities and capacity in NMSs, characteristics and operation of a climate watch system, format and criteria for issuing a climate watch, and various annexes, including examples of climate watches. Climate watch format: • A standard heading, issuing authority, and time and date of issue • Areas for which the advice is current (the appropriate regions) • Period during which the climate watch is valid • Where appropriate, an indication of the reason for the climate watch, which may include graphical information • Relevant skill of long range forecasts • Possible follow-on effects of the climate anomaly • Date at which the next update will be issued
Scope	National level; meteorological services.
Key Output	Information about significant climate anomalies for the forthcoming season(s) that may have substantial impacts on a sub-national scale. (1) Establishment of national climate watch system (2) Capacity built for the climate watch system (3) Operation of national climate watch (4) Climate watch system evaluated
Key Input	• A network of observation stations; an understanding of the current and recent past climate of the region in question; linkage with regional/global monitoring systems; dissemination channels to reach users; partnerships with key stakeholders • Understanding of users' needs; criteria for issuing a Climate Watch defined (e.g. average rainfalls below a certain level for the season); technical training; strengthening of communication links • Monitoring and analysis of climate data; communication with other organizations that maintain their observation systems; communication with intermediaries to translate information for user groups • Periodic reviews of the system and process; dialogue with users on their needs to identify gaps in dissemination or content
Ease of Use	Usable by national meteorological services.
Training Required	Requires expertise in meteorology/climatology and understanding of climate information users' needs.

Guidelines on Climate Watches (cont.)

Training Available	See Contacts.
Computer Requirements	Software for forecasting and word processing.
Documentation	WMO. 2005. Guidelines on Climate Watches. Geneva: World Meteorological Organization.
Applications	None identified.
Contacts for Tools, Documentation, Technical Assistance	Omar Baddour, Chief, World Climate Data and Monitoring Programme, WMO, 7bis Ave. de la Paix, C.P. 2300, CH-1211, Geneva 2, Switzerland; Tel: 41.22.730.8268 or 41.22.730.8214; Fax: 41.22.730.8042; e-mail: obaddour@wmo.ch.
Cost	Free.
References	Technical documents published under the WMO World Climate Data and Monitoring Programme (WCDMP).

Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters

Description	One of the problems following disasters is that damaged areas are often reconstructed quickly and without adequate resources. The result is that vulnerability is reconstructed rather than reduced. This tool helps to assess the direct and indirect socio-economic impacts of disasters, and to identify the most affected areas and priority areas for recovery. It outlines the conceptual and general methodological aspects of estimating the asset damage, losses in the flows of goods and services, as well as any effects on the macroeconomy. The handbook is divided into five sections: 1. Methodological and conceptual framework 2. Assessing impacts in social sectors 3. Assessing impacts on infrastructure 4. Assessing impacts in economic sectors 5. Assessing impacts in cross-sectoral areas, such as the environment, gender, and employment
Appropriate Use	This type of assessment should follow the emergency phase of a man-made or natural disaster, so it will not interfere with urgent humanitarian activities. Sufficient quantitative information on damages is also more likely to be available after that period. The tool is good for organizations that want to understand a wider range of disaster risks. By assessing the direct and longer-term indirect socio-economic impacts, organizations then have a better idea of how to reduce the risks in future programs that may have development or environmental goals. The tool can be adapted to comprehensively assess socio-economic impacts of climate change. Sections 2-5 include a definition of the sector, an overview of likely direct and indirect damages, the quantitative and qualitative information needed, possible information sources, general instructions on analyzing the data, and issues to consider in assessing macroeconomic impacts arising from damages in that sector. It is not a step-by-step guide, but rather gives an overview of general steps to be taken in each assessment.
Scope	National or sub-national level; sectoral.
Key Output	A measurement, summarized in table form and in monetary terms where possible, of the impacts of disasters on the society, economy and environment of the affected country or region. Results are divided into direct, indirect and macroeconomic effects (employment, the balance of payments, public finances, and prices and inflation). The disaster may also have benefits, so the assessment refers to the net effect. The assessment identifies the key geographical areas and sectors affected, together with corresponding reconstruction priorities. It can provide a way to estimate the country's capacity to undertake reconstruction on its own and the extent to which financial and technical cooperation are needed. For the longer term, it may identify the public policy changes and development programs to address these needs.
Key Input	Quantitative and qualitative information on conditions both before and following the disaster. The assessment team must decide on the balance between precision and speed in conducting the assessment. "Shadow prices" may be used to try to take into account the indirect effects and externalities of disasters.
Ease of Use	Experience with economic valuation and assessing damage in specific sectors required. The use of market vs. social prices will depend on the availability of information and time to conduct the assessment.
Training Required	Specialist knowledge in each sector.

Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters (cont.)

Training Available	Instituto Latinoamericano y del Caribe de Planificación Económica y Social (ILPES), ECLAC's training division, offers courses on various economic and social issues of the region. ILPES, Av. Dag Hammarskjöld 3477, Vitacura, Casilla 179-D, Santiago, Chile; Tel: +56.2.210.2506/7; Fax: +56.2.206.6104; e-mail: cursosilpes-cepal@eclac.cl.
Computer Requirements	Various software programs are recommended for some assessments, e.g. Redatam by CELADE (see References) or other GIS programs (ArcView, MapInfo, IDRISI, or GISMAP)
Documentation	ECLAC. 2003. Handbook for Estimating the Socio-Economic and Environmental Effects of Disasters. Santiago, Chile: Economic Commission for Latin America and the Caribbean. www.proventionconsortium.org/toolkit.htm Hardcopies available at: ECLAC Publications, Casilla 179D, Santiago, Chile; Fax: +56.2.210.2069; e-mail: publications@eclac.cl.
Applications	The handbook has been used throughout Latin America and the Caribbean. Assessments following the Indian Ocean disaster also used the methodology, particularly in the cases of Indonesia and India.
Contacts for Tools, Documentation, Technical Assistance	Ricardo Zapata-Martí, Focal Point for Disaster Evaluations, Economic Commission for Latin America and the Caribbean, Av. Presidente Masaryk 29, 11570 México, D.F., Apartado Postal 6-718, México D.F.; Tel: +52.55.5263.9600; Fax: +52.55.5531.1151; e-mail: cepal@un.org.mx , izapata@un.org.mx.
Cost	Free.
References	Redatam software: http://www.eclac.cl/redatam/default.asp?idioma=IN The Handbook, sample reports, and case studies: http://siteresources.worldbank.org/INTDISMGMT/Resources/guidelines.htm

Natural Disaster Mitigation in Drinking Water and Sewerage Systems: Guidelines for Vulnerability Analysis

Description	These guidelines provide the basic tools to evaluate the vulnerability of a drinking and sewerage system to various natural hazards. These systems are vital to development, as well as to ensuring a return to normalcy following a disaster. Conducting this vulnerability analysis helps identify preparedness and mitigation measures to limit risks. It also identifies the response mechanisms that should be put into action in the event of a disaster. The risk of damage to water systems increases with factors such as uncontrolled growth in urban areas, deficiencies in infrastructure, and climate change. The guide is divided into four sections: (1) Planning (2) Principles of vulnerability analysis (3) Description of hazards and impacts (4) Conducting a vulnerability analysis for specific hazards
Appropriate Use	The tool is ideally used during the disaster preparedness phase to identify and implement mitigation measures. It is aimed at engineers and technical personnel of water service companies to project how the water systems will perform in the event of the disaster and to minimize damage. Vulnerability and probabilities of damage are expressed as various formulae. The guide provides an overview for each section with issues to consider at each step. It also includes checklists (e.g. characteristics of an emergency operations center and the emergency committee; components of an emergency response plan), matrices to describe system vulnerabilities (formats provided in annexes), and extensive information on impacts on water systems from earthquakes, volcanoes, hurricanes, floods, etc. in Chapter 3 and annexes.
Scope	Water systems (with coverage being sub-national, municipal, etc.)
Key Output	• Planning – Emergency committee established within the water company, with roles and responsibilities defined; emergency operations center established; partnerships with national organizations established. • Vulnerability analysis – Identification and quantification of deficiencies in the physical system and the organization's capacity to provide services in a disaster; strengths of the physical system and the organization identified; recommendations for mitigating disaster impacts. • Mitigation and emergency response plans for administration/operational aspects – Identification of roles and responsibilities, resources required, and measures to reduce vulnerability. Measures may include: improvements in communication systems, provision of auxiliary generators, frequent line inspections, detection of slow landslides, repair of leaks and planning for emergency response. • Mitigation and emergency response plans for physical aspects – Identification of roles and responsibilities, resources required, and measures to reduce vulnerability. Measures may include: retrofitting, substitution, repair, placement of redundant equipment, improved access, etc.

Natural Disaster Mitigation in Drinking Water and Sewerage Systems: Guidelines for Vulnerability Analysis (cont.)

Key Input	• Planning – Information on: national standards, institutional coordination, and resources available for preparedness and response; and dialogue with partners • Vulnerability analysis – Information on: organizational and legal aspects, availability of resources, hazards and likely impacts on the water system, current state of system and operating requirements, sensitivity of components to hazards, and the response capacity of the services. • Mitigation and emergency response plans – Information from the vulnerability analysis, priorities for implementing measures, and resources available.
Ease of Use	Can be used as an overview for the emergency committee, although the vulnerability analysis should be conducted by a team of specialists.
Training Required	Vulnerability analysis requires extensive experience in the design, operation, maintenance, and repair of a drinking water and sewerage system's components.
Training Available	The Virtual Campus of Public Health is a consortium of institutions led by PAHO/WHO for continuing education. http://www.campusvirtualsp.org/eng/index.html.
Computer Requirements	Various specialized software, word processing, and spreadsheets.
Documentation	PAHO. 1998. Natural Disaster Mitigation in Drinking Water and Sewerage Systems: Guidelines for Vulnerability Analysis. Washington, DC: Pan American Health Organization, Regional Office of the World Health Organization, http://www.paho.org/English/DD/PED/natureng.htm.
Applications	Used throughout Latin America and the Caribbean. Case study in documentation from Limon, Costa Rica, to assess earthquake vulnerability.
Contacts for Tools, Documentation, Technical Assistance	Emergency Preparedness and Disaster, Relief Coordination Program, Pan American Health Organization, 525 Twenty-third Street, N.W., Washington, D.C. 20037, USA; Fax:+1.202.775.4578; e-mail: disaster@paho.org. Contact lists for the Americas during a disaster: http://www.paho.org/english/DD/PED/contactos.htm
Cost	Free.
References	Bibliography available in document.

The Good Practice Guide: Community Awareness and Education in Emergency Management

Description	During the emergency period, a well-prepared community can reduce the impacts from the disaster. Community members often play a large role in providing relief for each other. This tool presents best practices, ideas, plans, and suggestions for educating the community on disaster preparedness, rather than a how-to guide on communications. The broad framework can be easily adapted for specific communities. The guide provides the following information: 1. Introduction to the issue and how to get people's attention 2. Planning a campaign, with information on a range of communication tactics 3. Evaluating a campaign 4. Working with the media, partners and sponsors, and the community 5. Information resources
Appropriate Use	The guide aims to assist in planning and implementing community awareness and education campaigns. It is aimed at local government authorities, health services, police, fire services, schools, and other community organizations. It lays out the basic steps of an awareness campaign, describes communication tactics (e.g. print/electronic communications, giveaways, special events, etc.), and outlines a method for evaluating the campaign's performance.
Scope	Local level
Key Output	Step 1 – Target audience identified Step 2 – Target audience's needs and wants identified Step 3 – Key message developed Step 4 – Measurable objectives identified Step 5 – Tactics chosen Step 6 – Required resources secured Step 7 – Awareness and education campaign implemented Step 8 – Awareness and education campaign evaluated and documented results available
Key Input	Step 1 – Information on vulnerable groups and potential partners in reaching them Step 2 – Discussions with community representatives and members; review of existing sources of information (newspapers, radio, etc.) Step 3 – Identification of hazards and priority messages Step 4 – Development of campaign objectives and concrete indicators to measure changes Step 5 – Identification of effective information sources and delivery methods for the target audience, as well as the required resources Step 6 – Partnerships developed; information on available staff and financial resources Step 7 – Commitment of staff and volunteers; definition of roles, responsibilities, and a timetable for activities Step 8 – Review of the campaign against indicators, e.g. through surveys, observation, or discussions
Ease of Use	Readily usable.
Training Required	None.
Training Available	See Contacts below.

The Good Practice Guide: Community Awareness and Education in Emergency Management (cont.)

Computer Requirements	None.
Documentation	EMA. 2000. The Good Practice Guide: Community awareness and education in emergency management. Canberra: Emergency Management Australia. http://www.crid.or.cr/digitalizacion/pdf/eng/doc12728/doc12728.htm
Applications	Based on EMA's experience in Australia, but easily adaptable to other contexts.
Contacts for Tools, Documentation, Technical Assistance	Emergency Management Australia, PO Box 1020 Dickson, Australian Capital Territory 2602, Australia; Tel: 61.2.6256.4600; Fax: 61.2.6256.4653; e-mail: ema@ema.gov.au.
Cost	Free.
References	References included in document on case studies, additional methodologies, communication tips, etc. Documents on local risk management, community education, community preparedness, and related sites (mostly in Spanish): http://www.crid.or.cr/crid/MiniKitCommunityParticipation/documentos_interes_participacion_comunitaria_ing.html#capacitacion EMA publications on community evacuation coordination, flood warnings, and other response activities at: www.ema.gov.au