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Empirical-statistical downscaling

Page 1/240

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(ESD) is a method for estimating how local climatic variables are affected by large-scale climatic conditions. ESD has been applied to local climate/weather studies for years, but there are few – if any – textbooks on the subject. It is also anticipated that ESD will

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become more important and commonplace in the future, as anthropogenic global warming proceeds. Thus, a textbook on ESD will be important for next-generation climate scientists. To sustain Africa's growth, and accelerate the eradication of

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extreme poverty, investment in infrastructure is fundamental. In 2010, the Africa Infrastructure Country Diagnostic found that to enable Africa to fill its infrastructure gap, some US\$ 93 billion per year for the next decade will need to be invested.

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The Program for Infrastructure Development in Africa (PIDA), endorsed in 2012 by the continent's Heads of State and Government, lays out an ambitious long-term plan for closing Africa's infrastructure including trough step increases

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in hydroelectric power generation and water storage capacity. Much of this investment will support the construction of long-lived infrastructure (e.g. dams, power stations, irrigation canals), which may be vulnerable to changes in climatic patterns, the direction

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and magnitude of which remain significantly uncertain.

Enhancing the Climate Resilience of Africa 's Infrastructure evaluates -using for the first time a single consistent methodology and the state-of-the-arte climate scenarios-, the impacts of climate

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change on hydro-power and irrigation expansion plans in Africa's main rivers basins (Niger, Senegal, Volta, Congo, Nile, Zambezi, Orange); and outlines an approach to reduce climate risks through suitable adjustments to the planning and

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design process. The book finds that failure to integrate climate change in the planning and design of power and water infrastructure could entail, in scenarios of drying climate conditions, losses of hydropower revenues between 5% and 60%

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(depending on the basin); and increases in consumer expenditure for energy up to 3 times the corresponding baseline values. In in wet climate scenarios, business-as-usual infrastructure development could lead to foregone revenues in the

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range of 15% to 130% of the baseline, to the extent that the larger volume of precipitation is not used to expand the production of hydropower. Despite the large uncertainty on whether drier or wetter conditions will prevail in the

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future in Africa, the book finds that by modifying existing investment plans to explicitly handle the risk of large climate swings, can cut in half or more the cost that would accrue by building infrastructure on the basis of the climate of the past.

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This study aims to explore and quantify systematic similarities and differences between four major global cropping systems products: the dataset of monthly irrigated and rainfed crop areas around the year 2000 (MIRCA2000), the spatial

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production allocation model (SPAM), the global agroecological zone (GAEZ) dataset, and the M3 dataset developed by Monfreda, Ramankutty, and Foley. The analysis explores not only the final cropping systems maps but

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also the interdependencies of each product, methodological differences, and modeling assumptions, which will provide users with information vital for discerning between datasets in selecting a product appropriate for each intended application.

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Regional climate impact assessments require high-resolution projections to resolve local factors that modify the impact of global-scale forcing. To generate these projections, global climate model simulations are commonly downscaled using a

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variety of statistical and dynamical techniques. Despite the essential role of downscaling in regional assessments, there is no standard approach to evaluating various downscaling methods. Hence, impact communities often have little

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awareness of limitations and uncertainties associated with downscaled projections. To develop a standardized framework for evaluating and comparing downscaling approaches, I first identify three primary characteristics of a

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distribution directly relevant to impact analyses that can be used to evaluate a simulated variable such as temperature or precipitation at a given location: (1) annual, seasonal, and monthly mean values; (2) thresholds, extreme values, and accumulated

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quantities such as 24h precipitation or degree-days; and (3) persistence, reflecting multi-day events such as heat waves, cold spells, and wet periods. Based on a survey of the literature and solicitation of expert opinion, I select a set of

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ten statistical tests to evaluate these characteristics, including measures of error, skill, and correlation. I apply this framework to evaluate the skill of four downscaling methods, from a simple delta approach to a complex asynchronous quantile

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regression, in simulating daily temperature at twenty stations across North America. Identical global model fields force each downscaling method, and the historical observational record at each location is randomly divided by year into two equal parts, such

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that each statistical method is trained on one set of historical observations, and evaluated on an entirely independent set of observations. Biases relative to observations are calculated for the historical evaluation period, and differences between

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projections for the future.

Application of the framework to this broad range of downscaling methods and locations is successful in that: (1) the downscaling method used is identified as a more important determinant of data quality than

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station location or GCM; and (2) key differences between downscaling methods are made apparent. For tests focusing on the general distribution of the variable, all methods except bias correction are relatively successful in simulating observed

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climate, suggesting that if an impact is most sensitive to changes in the mean, even a relatively simple downscaling approach such as $\theta - \Delta\theta +$ will significantly improve simulation of local-scale climate. For tests that focus on the tails of the

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distribution, however, differences do arise between simple vs. quantile-based downscaling methods. Specifically, the latter appears less sensitive to location and more consistently able to reproduce observed climate. In terms of future projections, the

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most notable differences between downscaling methods becomes apparent at the right-hand tail of the distribution, where simple methods tend to simulate much greater increases (up to double the extreme heat days, for some locations) than more complex

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downscaling methods. I conclude by discussing how a standardized evaluation framework may advance our understanding of regional climate impact studies in understanding biases and limitations in results, as well as providing critical input into the

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selection of downscaling methods for future assessments. Given the potential exhibited by this initial test, I explore how this evaluation framework could be expanded in the future to make it even more useful: to the regional scale, for example, by including tests for

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spatial correlations and forcing relationships; or across variables, to capture interactions directly relevant to impact studies, such as heat waves (a function of temperature and humidity, affecting human health, energy demand, and agriculture) or snow

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amounts (a function of precipitation and temperature, affecting infrastructure and ecosystems); or to evaluate a broader selection of climate variables, downscaling methods, and predictor fields.

Climate Change in North America

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**The Future of the World's
Climate
Modelling the Impact of Climate
Change on Water Resources
Development and Evaluation of a
Hybrid Dynamical-statistical
Downscaling Method
From the Past to the Future**

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Nile River Basin

Global Circulation Models (GCMs) are a major tool used for climate change projections under different emission scenarios. However, for assessing the hydrological impacts of

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climate change at watershed scale, GCM outputs cannot be used directly owing to the mismatch in spatial resolution between the GCMs and hydrological models. Thus a downscaling scheme (either statistical or

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dynamical) is employed. For hydrologic impact assessment studies, statistical downscaling is usually preferred over dynamical downscaling and among the variables usually downscaled, precipitation

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*downscaling is more
challenging than downscaling
of other climatological
variables. Therefore, this
book is specifically
focusing on addressing some
of the contemporary issues
in statistically downscaling*

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of precipitation at watershed scale. Studies presented in this book make use of two widely used downscaling methods i.e. multiple linear regression and stochastic weather generator. Also, a new

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*downscaling methodology
using Gene Expression
Programming (GEP) has been
proposed. The issues
discussed and analyzed in
this book will facilitate
further research in the area
of statistical downscaling*

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for hydrologic studies.

*The Earth's average
temperature has risen by
1.4°F over the past century,
and computer models project
that it will rise much more
over the next hundred years,
with significant impacts on*

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weather, climate, and human society. Many climate scientists attribute these increases to the build up of greenhouse gases produced by the burning of fossil fuels and to the anthropogenic production of short-lived

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*climate pollutants. Climate
Change Modeling
Methodologies: Selected
Entries from the
Encyclopaedia of
Sustainability Science and
Technology provides readers
with an introduction to the*

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tools and analysis techniques used by climate change scientists to interpret the role of these forcing agents on climate. Readers will also gain a deeper understanding of the strengths and weaknesses of

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these models and how to test and assess them. The contributions include a glossary of key terms and a concise definition of the subject for each topic, as well as recommendations for sources of more detailed

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information.

*The Mediterranean region
contains a diverse and
interesting climate ranging
from areas with permanent
glaciers to areas of
subtropical, semiarid
regions. The region is*

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*potentially sensitive to
climate change and its
progress has environmental,
social, and economic
implications within and
beyond the region. Produced
by the Mediterranean Climate
Variability and*

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*Predictability Research
Networking Project, this
book reviews the evolution
of the Mediterranean climate
over the past two millennia
with projections further
into the twenty-first
century as well as examining*

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in detail various aspects of the Mediterranean region's climate including evolution, atmospheric variables, and oceanic and land elements. Integrated with this, the book also considers the social and economic problems

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*or vulnerabilities
associated with the region.
Written and reviewed by
multiple researchers to
ensure a high level of
information presented
clearly, Mediterranean
Climate Variables will be an*

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*invaluable source of
information for geologists,
oceanographers, and anyone
interested in learning more
about the Mediterranean
climate. Written by leading
experts in the field
Presents clear, compelling,*

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and concise evidence

*Includes the latest thinking
in Mediterranean climate
research*

*Provides a platform for
knowledge exchange between
different disciplines and
for learning from both*

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*theory and practice in the
context of tourism and
climate change. This book
examines subjects as diverse
as: the European hotel
sector; the North American
cruise tourism industry;
and, New Zealand youth*

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hostels and campervans.

*Climate in Asia and the
Pacific*

*"A Bottom-up Approach to
Climate Adaptation for Water
Resources Management "*

*Producing Biomolecular
Substances with Fermenters,*

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*Bioreactors, and
Biomolecular Synthesizers
A Cross Country Study of
Major Rice Growing States of
India
Dynamical Downscaling of GCM
Simulations
Impacts of Climate Change on*

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Rainfall Extremes and Urban Drainage Systems

Climate change adds uncertainty to already complex global water challenges. Because climate change affects poorer countries and vulnerable populations the

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most, the World Bank strives to mainstream climate change considerations into its operations to inform investment and water resources management decisions. Although no standard method has been adopted yet by

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the Bank, common practice used downscaled projected precipitation and temperature from Global Climate Models (GCMs), as input to hydrologic models. While this has been useful in some applications, they

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often give too wide a dispersion of readings to provide useful guidance for site-specific water resources management and infrastructure planning and design. Rather than design for an uncertain situation selected a

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priori, the so-called “bottom-up” approaches explore the sensitivity of a chosen project to the effects of uncertainties caused by climate change. This book summarizes alternatives explored by a group of

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organizations (such as the U.S. Corps of Engineers, Conservation International, the University of Massachusetts and the Bank) all belonging to the Alliance for Global Water Adaptation (AGWA), to provide

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practitioners with the tools to adapt to the realities of climate change by following a decision-making process that incorporates bottom-up thinking.

Covering the various aspects of water and climate change,

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Climate Change and Water Resources presents the principles of climate change science and its effects on earth's water supply. Utilizing the knowledge and expertise from well-known experts in the field,

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the text provides a broad outline of the many interrelated aspects of climate variations, climate change, and connections to water resources. Designed to help managers with developing strategies, implementing policies,

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and investing in infrastructure and information sources for integrated water resources management, the text addresses many issues regarding climate change and water resources. It also includes adaptation options,

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which are essential to water resource sustainability. The material is divided into four sections. The first part of the book provides an introduction to climate change and considers theoretical aspects and available

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tools. The second part of the book examines the impacts that climate change has on the water sector. The third part focuses on the different adaptation measures needed to minimize the effects of climate change.

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The fourth part presents a number of case studies. Focused on climate change in the water sector, *Climate Change and Water Resources* closely analyzes scientific research and fuels study for a greater

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understanding of climate change and the proper management of water. This text is useful for undergraduate and postgraduate students, scientists, and design engineers as well as those working at research institutes

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and implementing and planning agencies.

Regional climate change studies usually rely on downscaling of global climate model (GCM) output in order to resolve important fine-scale features and

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processes that govern local climate. Previous efforts have used one of two techniques: (1) dynamical downscaling, in which a regional climate model is forced at the boundaries by GCM output, or (2) statistical

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downscaling, which employs historical empirical relationships to go from coarse to fine resolution. Studies using these methods have been criticized because they either dynamical downscaled only a few GCMs, or

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used statistical downscaling on an ensemble of GCMs, but missed important dynamical effects in the climate change signal. This study describes the development and evaluation of a hybrid dynamical-statistical

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downscaling method that utilizes aspects of both dynamical and statistical downscaling to address these concerns. The first step of the hybrid method is to use dynamical downscaling to understand the most important

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physical processes that contribute to the climate change signal in the region of interest. Then a statistical model is built based on the patterns and relationships identified from dynamical downscaling. This

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statistical model can be used to
downscale an entire ensemble of
GCMs quickly and efficiently.

The hybrid method is first applied
to a domain covering Los
Angeles Region to generate
projections of temperature

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change between the 2041-2060 and 1981-2000 periods for 32 CMIP5 GCMs. The hybrid method is also applied to a larger region covering all of California and the adjacent ocean. The hybrid method works well in both

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areas, primarily because a single feature, the land-sea contrast in the warming, controls the overwhelming majority of the spatial detail. Finally, the dynamically downscaled temperature change patterns are

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compared to those produced by two commonly-used statistical methods, BCSD and BCCA. Results show that dynamical downscaling recovers important spatial features that the statistical methods miss. This

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confirms that the dynamical downscaling provides a more credible fine-scale signal for use in the hybrid method.

This book is a collection of overview articles showing how space-based observations,

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combined with hydrological modeling, have considerably improved our knowledge of the continental water cycle and its sensitivity to climate change. Two main issues are highlighted: (1) the use in combination of

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space observations for monitoring water storage changes in river basins worldwide, and (2) the use of space data in hydrological modeling either through data assimilation or as external

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constraints. The water resources aspect is also addressed, as well as the impacts of direct anthropogenic forcing on land hydrology (e.g. ground water depletion, dam building on rivers, crop irrigation, changes in land

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use and agricultural practices, etc.). Remote sensing observations offer important new information on this important topic as well, which is highly useful for achieving water management objectives. Over the

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past 15 years, remote sensing techniques have increasingly demonstrated their capability to monitor components of the water balance of large river basins on time scales ranging from months to decades: satellite altimetry

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routinely monitors water level changes in large rivers, lakes and floodplains. When combined with satellite imagery, this technique can also measure surface water volume variations. Passive and active microwave

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sensors offer important information on soil moisture (e.g. the SMOS mission) as well as wetlands and snowpack. The GRACE space gravity mission offers, for the first time, the possibility of directly measuring

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spatio-temporal variations in the total vertically integrated terrestrial water storage. When combined with other space observations (e.g. from satellite altimetry and SMOS) or model estimates of surface waters and

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soil moisture, space gravity data can effectively measure groundwater storage variations. New satellite missions, planned for the coming years, will complement the constellation of satellites monitoring waters on

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land. This is particularly the case for the SWOT mission, which is expected to revolutionize land surface hydrology. Previously published in *Surveys in Geophysics*, Volume 37, No. 2, 2016

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Climate Change and Water
Resources Management
Hydrology, Climate and Water
Use

Climate Change and Water
Resources

Downscaling Techniques for

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High-Resolution Climate
Projections

Enhancing the Climate

Resilience of Africa's

Infrastructure

Toward the Improvement of

Forecast Bias Over California

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The effects of climate change will mostly be felt on local to regional scales. However, global climate models (GCMs) are unable to produce reliable climate information on the scale needed to assess regional climate-change impacts and variability as a result

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of coarse grid resolution and inadequate model physics though their capability is improving. Therefore, dynamical and statistical downscaling (SD) methods have become popular methods for filling the gap between global and local-to-

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*regional climate applications.
Recent inter-comparison studies
of these downscaling techniques
show that both downscaling
methods have similar skill in
simulating the mean and
variability of present climate
conditions while they show*

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significant differences for future climate conditions (Leung et al., 2003). One difficulty with the SD method is that it relies on predictor-predict and relationships, which may not hold in future climate conditions. In addition, it is now commonly

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accepted that the dynamical downscaling with the regional climate model (RCM) is more skillful at the resolving orographic climate effect than the driving coarser-grid GCM simulations. To assess the possible societal impacts of

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climate changes, many RCMs have been developed and used to provide a better projection of future regional-scale climates for guiding policies in economy, ecosystem, water supply, agriculture, human health, and air quality (Giorgi et al., 1994;

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Leung and Ghan, 1999; Leung et al., 2003; Liang et al., 2004; Kim, 2004; Duffy et al., 2006).

Although many regional climate features, such as seasonal mean and extreme precipitation have been successfully captured in these RCMs, obvious biases of

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simulated precipitation remain, particularly the winter wet bias commonly seen in mountain regions of the Western United States. The importance of regional climate research over California is not only because California has the largest

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population in the nation, but California has one of the most sophisticated water collection and distribution systems in the world. Therefore, adapting California's water management system to climate change presents significant challenges.

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Besides, the strong scale interaction between atmospheric circulation and topography in this region provides a challenging testbed for RCMs. Thus, the success of California winter precipitation forecast over mountains would greatly help

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develop a reliable water management system to adapt to climate change.

Water resource planning and management practices in the southeastern United States may be vulnerable to climate change. This vulnerability has not been

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quantified, and decision makers, although generally concerned, are unable to appreciate the extent of the possible impact of climate change nor formulate and adopt mitigating management strategies. Thus, this dissertation aims to fulfill this need by

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generating decision worthy data and information using an integrated climate change assessment framework.

\r : To begin this work, we develop a new joint variable spatial downscaling technique for statistically downscaling gridded

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climatic variables to generate high-resolution, gridded datasets for regional watershed modeling and assessment. The approach differs from previous statistical downscaling methods in that multiple climatic variables are downscaled simultaneously and

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consistently to produce realistic climate projections. In the bias correction step, JVSD uses a differencing process to create stationary joint cumulative frequency statistics of the variables being downscaled. The functional relationship between

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these statistics and those of the historical observation period is subsequently used to remove GCM bias. The original variables are recovered through summation of bias corrected differenced sequences. In the spatial disaggregation step, JVSD

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uses a historical analogue approach, with historical analogues identified simultaneously for all atmospheric fields and over all areas of the basin under study. \r : In the second component of the integrated assessment

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framework, we develop a data-driven, downward hydrological watershed model for transforming the climate variables obtained from the downscaling procedures to hydrological variables. The watershed model includes

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several water balance elements with nonlinear storage-release functions. The release functions and parameters are data driven and estimated using a recursive identification methodology suitable for multiple, inter-linked modeling components. The model

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evolves from larger spatial/temporal scales down to smaller spatial/temporal scales with increasing model structure complexity. For ungauged or poorly-gauged watersheds, we developed and applied regionalization hydrologic models

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based on stepwise regressions to relate the parameters of the hydrological models to observed watershed responses at specific scales. \r : Finally, we present the climate change assessment results for six river basins in the southeastern United States. The

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historical (baseline) assessment is based on climatic data for the period 1901 through 2009. The future assessment consists of running the assessment models under all IPCC A1B and A2 climate scenarios for the period from 2000 through 2099. The

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climate assessment includes temperature, precipitation, and potential evapotranspiration; the hydrology assessment includes primary hydrologic variables (i.e., soil moisture, evapotranspiration, and runoff) for each watershed.

"A lot of research has been

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carried out using statistical methods in downscaling large-scale GCM outputs to the local site or small-scale region. Using statistical methods, empirical relationships are developed between the large-scale GCM outputs and the local site

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weather variables. In this methodology, it is assumed that these empirical relationships will also hold true even in the future periods of time. Environmental assessment studies for the future decade under the influence of a changing climate is the need of

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the hour. In order to identify the future synoptic weather types, future daily and hourly projections of the weather variables are required. Hence, this research is motivated by the lack of a comprehensive and statistically significant

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downscaling methodology for the various weather variables. The present study is based on the various statistical downscaling techniques developed by the researchers in the past using linear regression model because of the advantage of being less

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computationally intensive. In addition, an attempt has been made to develop an improved statistical downscaling methodology by combining different techniques to develop a robust method with a detailed performance assessment of the

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models. Linear Regression models are derived to downscale daily climate scenarios using NCEP reanalysis datasets for the predictors and weather station data available at Trudeau International Airport for the predictands during the reference

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period 1958-2001. The NCEP predictors are regridded to the GCM scale as the GCM outputs are to be used for deriving future climate projections.

Standardization and Deseasonalization of the predictor variables are carried

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out followed by principal component analysis prior to their introduction into the stepwise regression model. CANESM2 is selected as the GCM model in the present work whose outputs are used as predictors in the NCEP derived regression models. A

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Bias Correction procedure is used to correct the systematic biases present using a quantile-quantile mapping technique on the downscaled variable using CANESM2 predictors. After downscaling the daily climate variables, hourly downscaling

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transfer functions are derived based on the historical relationships of the hourly values with its daily mean as well as other weather predictors where appropriate. For the future climate projections, RCP2.6, 4.5 and 8.5 are used as greenhouse

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gas trajectories representing the change in climate in the future decade." --

This book describes thoroughly the North American Climate of the past 65 million years, with special emphasis on the last 21,000 years, as revealed by

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paleoclimatic observations and climate models. It analyzes weather observations over the past century and satellite measurements of the last few decades to develop a picture of more recent climatic trends. It explains how global climate

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models are used to simulate and project climate, and presents the application of these models to reproduce recent climate variations and predict future North American climate. It answers the critical question of whether observed climate change

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*is due to natural variations or
human activity.*

Sustainable Bioenergy

*Production - An Integrated
Approach*

Beyond Downscaling

*Adapting to the Impacts of
Climate Change*

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*From Global Change to Local
Impacts*

Research Anthology on

Environmental and Societal

Impacts of Climate Change

Climate Change Assessment for

the Southeastern United States

Empirical-statistical

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DownscalingWorld Scientific
Publishing Company
Impacts of Climate Change on
Rainfall Extremes and Urban
Drainage Systems provides a
state-of-the-art overview of
existing methodologies and

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relevant results related to the assessment of the climate change impacts on urban rainfall extremes as well as on urban hydrology and hydraulics.

A practical guide to

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understanding, using and producing downscaled climate data, for researchers, graduate students, policy makers and practitioners.

The quantitative assessment of the impact of climate

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change on water availability
and water resources
management requires
knowledge of climate,
hydro(geo)logical and water
resources models, and
particularly the relationships

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between each of them. This book brings together world experts on each of these aspects, distilling each complex topic into concise and easy to understand chapters, in which both the

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uses and limitations of modelling are explored. The book concludes with a set of case studies using real-life examples to illustrate the steps required and the problems that can be faced in

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assessing the potential
impacts of climate change on
water resource systems. For
students, scientists, engineers
and decision-makers alike,
this book provides an
invaluable and critical look at

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the information that is provided by climate models, and the ways it is used in modelling water systems. A key focus is the exploration of how uncertainties may accrue at each stage of an impacts

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assessment, and the reliability of the resulting information. The book is a practical guide to understanding the opportunities and pitfalls in the quantitative assessment of climate change impacts and

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adaptation in the water
resource sector.

Selected Entries from the
Encyclopedia of Sustainability
Science and Technology
A Standardized Framework for
Evaluating the Skill of

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Regional Climate Downscaling
Techniques

Proceedings of an
International Symposium
(Symposium HS02a) Held
During IUGG 2003, the XXIII
General Assembly of the

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International Union of
Geodesy and Geophysics : at
Sapporo, Japan, from 30 June
to 11 July, 2003

Philosophical and Conceptual
Issues

Climate Change Modeling

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Methodology

An Assessment of
Vulnerability

**This book gives a
comprehensive presentation
of our present
understanding of the Earth's**

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Hydrological cycle and the problems, consequences and impacts that go with this topic. Water is a central component in the Earth's system. It is indispensable for life on Earth in its

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**present form and influences
virtually every aspect of our
planet's life support system.
On relatively short time
scales, atmospheric water
vapor interacts with the
atmospheric circulation and**

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**is crucial in forming the
Earth's climate zones. Water
vapor is the most powerful
of the greenhouse gases and
serves to enhance the
tropospheric temperature.
The dominant part of**

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available water on Earth resides in the oceans. Parts are locked up in the land ice on Greenland and Antarctica and a smaller part is estimated to exist as groundwater. If all the ice

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over the land and all the glaciers were to melt, the sea level would rise by some 80 m. In comparison, the total amount of water vapor in the atmosphere is small; it amounts to ~ 25 kg/m², or

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**the equivalent of 25 mm
water for each column of air.
Yet atmospheric water vapor
is crucial for the Earth's
energy balance. The book
gives an up to date
presentation of the present**

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**knowledge. Previously
published in Surveys in
Geophysics, Volume 35, No.
3, 2014**

**Cambridge, UK : Cambridge
University Press, 1998.**

This book explains in depth

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**the issues and challenges
faced by rice farmers in
India in relation to
production and productivity,
and the possible adaptation
strategies to climate
change. Based on five years**

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of groundbreaking research on emerging trends in cultivation in major rice growing regions in India, it begins by describing production and yield trends across different rice growing

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**regions. It then offers a
comprehensive review of
relevant literature and the
quantification
methodologies and
approaches used to analyze
the impact of climate**

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**change. The book also
analyzes climate change
impacts on rice productivity
and production, applying
field-tested quantification
methods, such as the Just-
Pope production function**

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where time series and cross-section data are simultaneously used for all regions. The results are presented for five geographical regions of India - northern, eastern,

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western, central and southern - for better comparison and readability. The analyses cover scenarios for both mid-century (2021-2050) and end-century (2071-2100),

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and in the context of climate change, they also incorporate both medium and high carbon emission scenarios. Thus the future rice production and productivity trends are

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**clearly projected for making
necessary interventions.
Lastly, the book outlines the
essentials of an enabling
environment policy and
discusses the institutional
and policy options necessary**

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to ensure sustainable rice production in India. It also makes the case for introducing appropriate and affordable adaptation strategies to support farmers in different rice-

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**growing regions. The
cost-benefit analysis of
strategies presented in this
book provides an invaluable
tool for officials at
agriculture departments
planning up-scaling of**

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**agricultural productivity.
The projections are also
useful for policy makers and
planners developing future
investment plans to support
rice production in their
country. Overall, this book is**

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of interest to a wide audience, including professionals and business enterprises dealing with rice, as well as to academic researchers and students. This book focuses primarily

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on the advantages and implications of sustainable bioenergy production in terms of ensuring a more sustainable world despite its growing energy demands. It addresses a new concept

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**that focuses on the
interactions between
different uses of agricultural
land (for example,
agriculture for food, forage
or energy and nature
conservation) and their**

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ecological, economic and societal impacts. This research concept provides new insights into the competition for resources and the synergies between different land uses. This

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**book seeks to improve
people's understanding of
bioenergy's potentials for
the future. It will be of
interest not only to those
involved in sustainable
energy, but also to**

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**environmental planners,
agriculture and soil
specialists, and
environmental policy-
makers.**

**Climate Change and Future
Rice Production in India**

Page 166/240

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**Climate Change and
Hydrological Systems
Environmental Impact
Statement
Second Assessment of
Climate Change for the
Baltic Sea Basin**

Page 167/240

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**The Climate of the
Mediterranean Region
A comparative analysis of
global cropping systems
models and maps**

A comprehensive and practical
guide, providing technical

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background and user context for researchers, graduate students, practitioners and decision makers. This book presents the main approaches and describes their underlying assumptions, skill and

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limitations. Guidelines for the application of downscaling and the use of downscaled information in practice complete the volume.

Containing authoritative and in-depth coverage, Producing

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Biomolecular Materials Using
Fermenters, Bioreactors, and
Biomolecular Synthesizers
examines the bioproduction
systems that support the
controlled, automated, and
quantity growth of proteins.

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The book discusses the substance, character, makeup, and quality of the basic materials used in the production and downstream processing of biomolecular materials: raw materials,

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reagents, intermediates, and consumables. Dr. Hochfield gets right to the point, explaining just what must be done and how to do it effectively, then providing the formula necessary for reaching

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the required value, allowing you to simply plug-in your data and make protein. However, if you actually do need the origin and derivation of any given formula, you can go right to the extensive reference section in

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the Appendix, find the formula you need in the exact form that you need it, without having to wade through numerous pages of extraneous material. This classic work presents unparalleled, detailed, and

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cutting-edge information on bioprocessing systems. A working reference and formulary for producing recombinant, bioactive, or other exotic proteins, peptides, and nucleic acids to specification,

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the text provides coverage of the related technologies, coupled with the extensive biotechnology glossary, manufacturer's directories, extensive references, important formulae, charts, illustrations,

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comprehensive index, emphasis on practical techniques, time-proven methods, and essential applications. These features combine with its ingenious, easy-to-use layout to make it the resource you will consult on

Access Free Downscaling Methodology To Produce A High Resolution a regular basis.

Contains a decision support system (DSS) that can be used to pick the right (sub)class of upscaling or downscaling methods for a particular research project, implemented

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in a DELPHI-computer

program.

This three-volume A-to-Z
compendium consists of over
300 entries written by a team of
leading international scholars
and researchers working in the

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field. Authoritative and up-to-date, the encyclopedia covers the processes that produce our weather, important scientific concepts, the history of ideas underlying the atmospheric sciences, biographical accounts

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of those who have made significant contributions to climatology and meteorology and particular weather events, from extreme tropical cyclones and tornadoes to local winds.

The Earth's Hydrological Cycle

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Security, Society and
Sustainability

Statistical Downscaling and
Bias Correction for Climate
Research

Upscaling and Downscaling
Methods for Environmental

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Research

IFPRI Discussion Paper 01327

*This book is one out of 8 IAEG XII
Congress volumes and deals with
climate change affecting different
natural processes and environments,*

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such as slope dynamics, water courses, coastal and marine environments, hydrological and littoral processes and permafrost terrain. Due to climate change, major effects are also expected on territorial planning and infrastructure, particularly in

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extreme climate regions. The volume and its contents aim to analyze the role of engineering geology and the solutions it may offer with respect to the ongoing environmental changes. Contributions regard the modeling of both the factors and the effects induced by climate change. Potential

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impacts of the climate change on the common practice and routine work of engineering geologists are also analyzed, with particular attention to the risk assessment and mitigation procedures and to the adaptation measures adopted. The Engineering Geology for Society and Territory

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volumes of the IAEG XII Congress held in Torino from September 15-19, 2014, analyze the dynamic role of engineering geology in our changing world and build on the four main themes of the congress: environment, processes, issues and approaches. The congress topics and

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*subject areas of the 8 IAEG XII
Congress volumes are: Climate
Change and Engineering Geology.
Landslide Processes. River Basins,
Reservoir Sedimentation and Water
Resources. Marine and Coastal
Processes. Urban Geology,
Sustainable Planning and Landscape*

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*Exploitation. Applied Geology for
Major Engineering Projects.*

*Education, Professional Ethics and
Public Recognition of Engineering
Geology. Preservation of Cultural
Heritage.*

*This book essentially comprises the
proceedings of the 11th International*

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*Conference of Meteorology,
Climatology and Atmospheric Physics
(COMECAP 2012) that is held in
Athens from 30 May to 1 June 2012.
The Conference addresses
researchers, professionals and
students interested in the following
topics: Agricultural Meteorology and*

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*Climatology, Air Quality, Applied
Meteorology and Climatology,
Applications of Meteorology in the
Energy Sector, Atmospheric Physics
and Chemistry, Atmospheric
Radiation, Atmospheric Boundary
Layer, Biometeorology and
Bioclimatology, Climate Dynamics,*

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*Climatic Changes, Cloud Physics,
Dynamic and Synoptic Meteorology,
Extreme Events, Hydrology and
Hydrometeorology, Mesoscale
Meteorology,
Micrometeorology/Urban
Microclimate, Remote Sensing/
Satellite Meteorology and*

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Climatology, Weather Analysis and Forecasting. The book includes all papers that have been accepted for presentation at the conference.

Commissioned by the Intergovernmental Meeting (IGM) of the Asia-Pacific Network for Global Change Research (APN), this book

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offers a detailed survey of the current status of climate change and climate variability in the Asia-Pacific region, a thorough and thoughtful assessment of climate and security and clear recommendations on the best paths of climate research in the future.

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This book presents results of scientific studies ranging from hydrological modelling to water management and policy issues in the Nile River basin. It examines the physical, hydrometeorological and hydrogeological description of the basin along with analysis in

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understanding the hydrological processes of the basin under the changing land-use stemming from population pressure and increased natural resources tapping. The book discusses the increased impact of climate change on the river flows, and such issues as water availability

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and demand, management and policy to offset the imbalance between demand and available resources. This book will be of interest to researchers, practitioners, water resources managers, policy makers as well as graduate and undergraduate students. It is a useful reference text

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*for ecohydrology, arid zone
hydrology, hydrology of
transboundary rivers and similar
courses.*

*Engineering Geology for Society and
Territory - Volume 1
Remote Sensing and Water
Resources*

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*Empirical-statistical Downscaling
A Federal Perspective*

The Power and Water Sectors

Colorado River Interim Guidelines

for Lower Basin Shortages and

Coordinated Operations for Lake

Powell and Lake Mead

This edited collection of

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works by leading climate scientists and philosophers introduces readers to issues in the foundations, evaluation, confirmation, and application of climate models. It engages with important topics directly

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*affecting public policy,
including the role of doubt,
the use of satellite data,
and the robustness of
models. Climate Modelling
provides an early and
significant contribution to
the burgeoning Philosophy of*

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Climate Science field that will help to shape our understanding of these topics in both philosophy and the wider scientific context. It offers insight into the reasons we should believe what climate models

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*say about the world but
addresses the issues that
inform how reliable and well-
confirmed these models are.
This book will be of
interest to students of
climate science, philosophy
of science, and of*

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*particular relevance to
policy makers who depend on
the models that forecast
future states of the climate
and ocean in order to make
public policy decisions.
This book is an update of
the first BACC assessment,*

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published in 2008. It offers new and updated scientific findings in regional climate research for the Baltic Sea basin. These include climate changes since the last glaciation (approx. 12,000 years ago), changes in the

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recent past (the last 200 years), climate projections up until 2100 using state-of-the-art regional climate models and an assessment of climate-change impacts on terrestrial, freshwater and marine ecosystems. There are

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dedicated new chapters on sea-level rise, coastal erosion and impacts on urban areas. A new set of chapters deals with possible causes of regional climate change along with the global effects of increased

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greenhouse gas concentrations, namely atmospheric aerosols and land-cover change. The evidence collected and presented in this book shows that the regional climate has already started to

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change and this is expected to continue. Projections of potential future climates show that the region will probably become considerably warmer and wetter in some parts, but dryer in others. Terrestrial and aquatic

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ecosystems have already shown adjustments to increased temperatures and are expected to undergo further changes in the near future. The BACC II Author Team consists of 141 scientists from 12

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countries, covering various disciplines related to climate research and related impacts. BACC II is a project of the Baltic Earth research network and contributes to the World Climate Research Programme.

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Across the United States, impacts of climate change are already evident. Heat waves have become more frequent and intense, cold extremes have become less frequent, and patterns of rainfall are likely

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changing. The proportion of precipitation that falls as rain rather than snow has increased across the western United States and Arctic sea ice has been reduced significantly. Sea level has been rising faster than at

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*any time in recent history,
threatening the natural and
built environments on the
coasts. Even if emissions of
greenhouse gases were
substantially reduced now,
climate change and its
resulting impacts would*

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continue for some time to come. To date, decisions related to the management and protection of the nation's people, resources, and infrastructure have been based on records in the recent past, when climate

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was relatively stable.

*Adapting to the Impacts of
Climate Change, part of the
congressionally requested
America's Climate Choices
suite of studies, calls for
a new paradigm-one that
considers a range of*

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possible future climate conditions and impacts that may be well outside the realm of past experience. Adaptation requires actions from many decision makers in federal, state, tribal, and local governments; the

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private sector; non-governmental organizations; and community groups. However, current efforts are hampered by a lack of solid information about the benefits, costs, and effectiveness of various

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adaptation options; climate information on regional and local scales; and a lack of coordination. Adapting to the Impacts of Climate Change calls for a national adaptation strategy that provides needed technical

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*and scientific resources,
incentives to begin
adaptation planning,
guidance across
jurisdictions, shared
lessons learned, and support
of scientific research to
expand knowledge of impacts*

Access Free Downscaling Methodology To Produce A High Resolution *and adaptation.*

Climate change is an issue that has been generating a significant amount of discussion, research, and debate in recent years.

Climate change continues to evolve at a rapid rate and

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continues to have a wide array of effects on everything from temperature to plant life. Beyond the negative environmental impacts, climate change is also proving to be a detriment to society with

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increasingly violent natural disasters and human health effects. It is essential to stay up to date on the latest in emerging research within this field as it continues to develop. The Research Anthology on

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*Environmental and Societal
Impacts of Climate Change
discusses the varied effects
of climate change throughout
all areas of life and
provides a comprehensive
dive into the latest
research on key elements of*

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*society that are affected by
the rapidly increasing
climate. Covering a range of
topics including
reproduction, plants and
animals, and energy demand,
it is ideal for
environmentalists,*

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*policymakers, environmental
engineers, scientists,
disaster and crisis
management personnel,
professionals, government
officials, practitioners,
upper-level students, and
academics interested in*

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*emerging research on the
numerous impacts of climate
change.*

Issues and Actions

*Advances in Meteorology,
Climatology and Atmospheric
Physics*

The Regional Impacts of

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Climate Change

*Tourism and the Implications
of Climate Change*

Water Resources

*Systems--water Availability
and Global Change*

*Statistical Downscaling of
Daily and Hourly Climate*

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Scenarios for the Various Meteorological Variables at Montreal

Downscaling is a widely used technique for translating information from large-scale climate models to the spatial and temporal scales needed to assess local and regional climate impacts,

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vulnerability, risk and resilience. This book is a comprehensive guide to the downscaling techniques used for climate data. A general introduction of the science of climate modeling is followed by a discussion of techniques, models and methodologies used for producing downscaled projections, and the

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advantages, disadvantages and uncertainties of each. The book provides detailed information on dynamic and statistical downscaling techniques in non-technical language, as well as recommendations for selecting suitable downscaled datasets for different applications. The use of downscaled

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climate data in national and international assessments is also discussed using global examples. This is a practical guide for graduate students and researchers working on climate impacts and adaptation, as well as for policy makers and practitioners interested in climate risk and resilience.

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Many challenges, including climate change, face the Nation's water managers. The Intergovernmental Panel on Climate Change (IPCC) has provided estimates of how climate may change, but more understanding of the processes driving the changes, the sequences of the changes, and the manifestation of these

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global changes at different scales could be beneficial. Since the changes will likely affect fundamental drivers of the hydrological cycle, climate change may have a large impact on water resources and water resources managers. The purpose of this interagency report is to explore strategies to improve water

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management by tracking, anticipating, and responding to climate change. Charts and tables.

The study of climate today seems to be dominated by global warming, but these predictions of climatic models must be placed in their geological, paleo-climatic, and astronomical context to create a

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complete picture of the Earth's future climate. The Future of the World's Climate presents that perspective with data and projections that have emerged from more technologically advanced and accurate climate modeling. The book is comprised of 18 new and revised chapters that feature reviews of current climate

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science. The authors are drawn from all over the world and from the highest regarded peer-reviewed groups. Each chapter has undergone major revisions and new content has been added throughout. Authored by the world's leading climate scientists, most of whom are also contributing authors to the IPCC

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Assessment Reports. More than 200 tables, diagrams, illustrations, and photographs Climate modeling technology is more advanced and precise than it was 15 years ago-a major implication featured in this new edition. Encyclopedia of Climate and Weather Climate Change and Engineering

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Geology
Climate Modelling