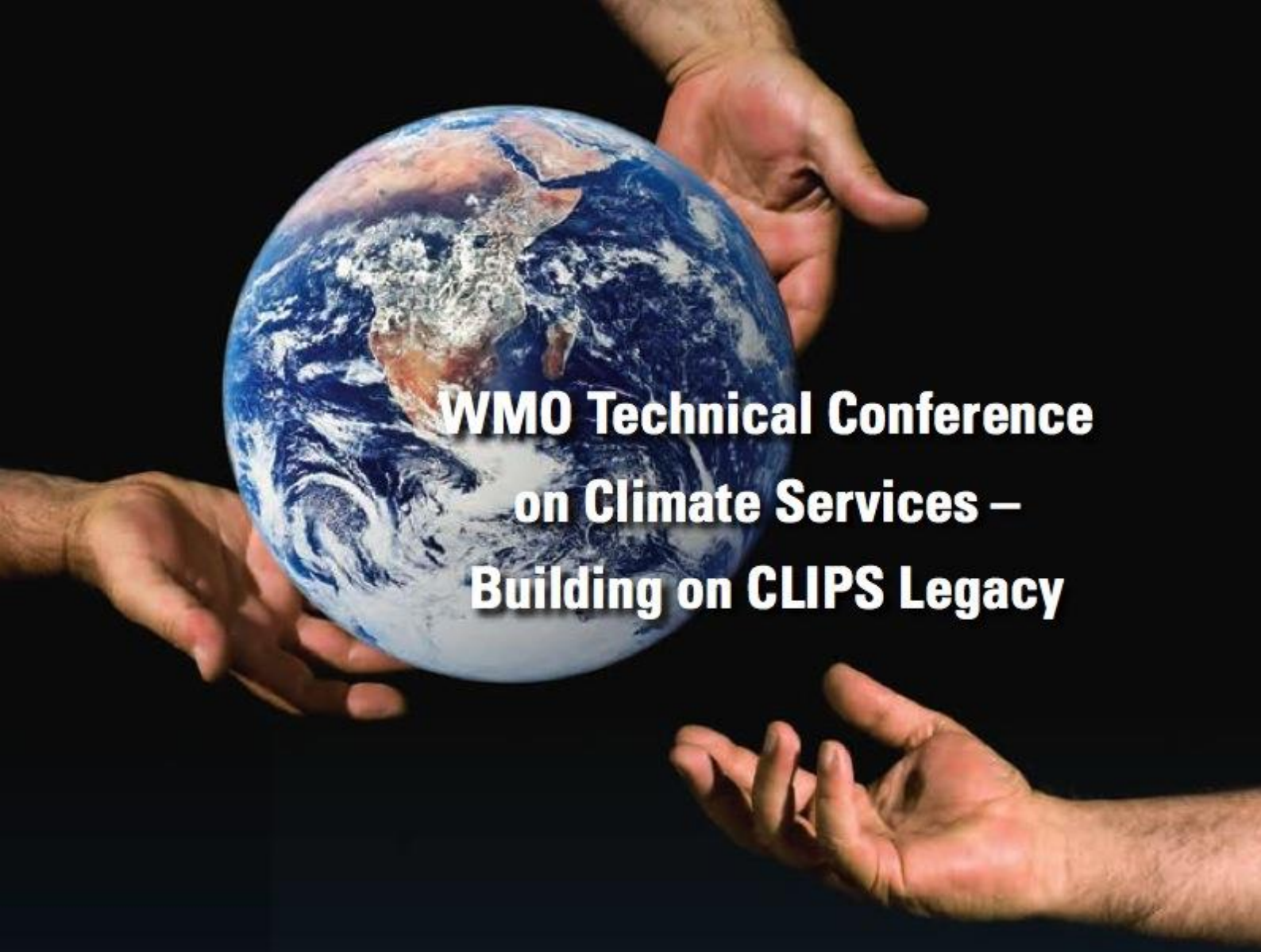

WMO Technical Conference on Climate Services – Building on CLIPS Legacy

in conjunction with the
Sixteenth Session of the Commission for Climatology and
the thirty-fifth Meeting of the Joint Scientific Committee of
the World Climate Research Programme

30 June – 2 July 2014, Heidelberg, Germany

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Abstracts

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WMO Technical Conference on
Climate Services- Building on CLIPS Legacy
(Heidelberg, Germany, 30 June - 2 July 2014)

ABSTRACTS

In conjunction with the Sixteenth Session of the Commission for Climatology and the thirty-fifth Meeting of the Joint Scientific Committee of the World Climate Research Programme

Conference Sponsors:

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World Meteorological Organization

June 2014

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PREFACE

Recognizing the need for an integrated approach to climate services, the World Meteorological Congress at its Twelfth Session established the Climate Information and Prediction Services (CLIPS) project in 1995, as an implementation arm of the World Climate Applications and Services Programme (WCASP). The mission of CLIPS has been "to provide the best possible climate information, including expectations of future conditions, to improve economic and social decisions that will reduce risks and improve economic vitality as well as quality of life." Over the past couple of decades, under the guidance of WMO Commission for Climatology (CCl), CLIPS has been striving to help exploit the existing databases for increasing our climate knowledge and improving the prediction capabilities, and to develop the capacities of the National Meteorological and Hydrological Services (NMHSs) for the delivery of climate information to meet the needs of their users.

The CLIPS project initiative has been instrumental in the development of the concept of WMO Regional Climate Centers (RCCs) as formally designated entities within the WMO Technical Regulations, and their ongoing establishment and operations around the world. CLIPS also played a key role in the development of Regional Climate Outlook Forums (RCOFs) as effective platforms for generating consensus-based seasonal climate outlooks at the regional scale. Parallel and complementary efforts by CCl in coordination with NMHSs, the World Climate Research Programme (WCRP) and other relevant bodies, have enabled systematic production of operational climate information at global and regional levels. These initiatives together with the CLIPS training workshops have helped build capacities for climate services. The CLIPS experience has significantly contributed to the formulation of the Global Framework for Climate Services (GFCS). The vision of the GFCS is to enable society to better manage the risks and opportunities arising from climate variability and change, through the development and incorporation of science-based climate information and prediction into planning, policy and practice. With the advent of the GFCS and following the recommendation of the CCl, the World Meteorological Congress decided that the CLIPS project would conclude in 2015 and that its ongoing activities would be assimilated into the GFCS implementation.

This technical conference, organized on the eve of the sixteenth session of the Commission for Climatology and the thirty-fifth annual meeting of the Joint Scientific Committee (JSC) of WCRP, has been devoted to reviewing CLIPS activities and learning from its rich legacy. The conference shall also consider relevant research and operational issues and challenges, providing guidance for future CCl/WCRP activities and making contributions towards implementation of the GFCS.

The conference consists of eleven Sessions spread over the three days, with the last day featuring a CCl/WCRP joint session. These Sessions shall address the following thematic threads: evolution and achievements of CLIPS, including facilitation of standards and consistency in the preparation of seasonal outlooks through RCCs and RCOFs; importance of the systematic collection and archiving of climate data for reliable climate services; improvements needed to better monitor the climate and to provide outlook products for climate information services at global, regional and

national levels; and research challenges for improving climate predictions at the regional scale.

About 120 delegates from more than 70 countries, including 54 from developing and least developed countries, will participate in the conference. The sessions will feature about 33 invited speakers and 30 poster presenters. The conference also has two sessions of panel discussions.

The expected outcomes of the meeting include improved linkages between climate researchers and operational climate service providers; actions for effective user engagement to optimally exploit the benefits of climate information; and an agenda for joint research that addresses gaps in provision of climate information.

SESSION I
CLIPS Achievements

Chairman: Neil Plummer
Rapporteur: Govindarajalu Srinivasan

Achievements and lessons from CLIPS for building future climate services

A. Mokssit

Direction de la Météorologie Nationale, Morocco

Abstract

(To be submitted)

Developing global infrastructure for seasonal to inter-annual prediction

C. A. dos Santos Coelho

Center for Weather Forecast and Climate Studies (CPTEC), Brazil

National Institute for Space Research (INPE), Brazil

Abstract

This talk will review the developing global infrastructure for seasonal and interannual prediction, including regional and national level activities. International efforts and collaborations addressing CLIPS relevant objectives for effective use of this infrastructure for generating climate outlooks at regional and national scale will also be highlighted. Efforts for standardizing and synthesizing global products and for setting up institutional mechanisms for verification will also be addressed. The talk will be concluded with possible future directions for further improvements in this developing global infrastructure including its relevance to the GFCS.

Creating regional mechanisms for providing climate information: Special focus on RCOFs

A. Kamga Foamouhoue

African Centre for Applications for Development (ACMAD), Niger

Abstract

It is well recognized that Regional Climate Outlook (RCOF) is a credible source of climate information for early warning and early action. It contributes to vulnerability assessments and adaptation to climate change.

Worldwide extension this regional mechanism, growing political commitment for adaptation to climate change, expressed willingness in the disaster management community to move from reactive responses to proactive risk management using climate information is putting pressure on climate service providers to deliver user driven, user relevant climate services.

Lack of legal or regulatory frameworks for use of RCOF products in countries and regions, contingency planning and vulnerability assessment forums organized with little involvement of climate service providers have been noted as major impediments for tailoring and optimal use of RCOF products.

Seamless climate services and its integration to policy, plans and practices for adaptation to climate change and sustainable development are among the main challenges to be addressed in RCOFs.

To satisfy emerging needs and address identified weaknesses, quality management for climate services is required. A procedure for RCOFs product generation is discussed.

Expansion of RCOF product portfolio, strengthening liaison between climate service providers, policy, decision and science communities, development of quality management for climate services, establishment of clearing house involving all stakeholders are proposed for future RCOFs in the GFCS context.

Capacity development in climate and contribution to CLIPS

W. Thiaw

National Oceanic and Atmospheric Administration (NOAA), USA

Abstract

The paper presents the contribution of the National Oceanic and Atmospheric Administration (NOAA)'s African Desk to the WMO Climate Information and Prediction Services (CLIPS). For two decades NOAA has been providing support to African National Meteorological Services (NMSs) to develop capacity in weather and climate forecasting through a residency training program and the delivery of products required for operational monitoring and forecasting of weather and climate. The African Desk is part of the National Centers for Environmental Predictions (NCEP) International Desks (ID), a US contribution to the WMO Voluntary Cooperation Program (VCP).

The residency training program is complemented by a NOAA-USAID climate training workshop series initiated in 2009 that have enabled the training in climate of far more professionals from different regions of the world than NCEP could host in the residency program. The training workshops have been organized for all the ocean basins of the world. A combined of over 300 meteorologists and scientists from around the world have participated in either or both the residency or offsite training programs. The training programs provide an excellent opportunity to evaluate the performance of climate models. Some of the diagnostics and predictions performed in the African Desk are presented.

One of the key missions of the CPC ID is to provide domestic and international agencies with access to real time NCEP operational weather and climate forecasts for any given region of the world. A website has been created and is maintained for this purpose. Products in support of Famine Early Warning System (FEWS) are highlighted.

SESSION II
Global Climate Information

Chairman: Jean-Pierre Céron
Rapporteur: Barbara Tapia

Global climate monitoring information

J. Kennedy, L. Chang'a, D. Arndt, P. Booneeady, O. Bulygina, M. Demircan, M. Semawi, A. Watkins

Met Office, UK

Abstract

Variability in the Earth's climate system occurs at a wide range of time scales from seconds to millennia. These changes shape the societies in which we live and can have profound consequences for health and security. Systematic monitoring of the climate is fundamental to climate services, understanding of the climate system and is an important part of the evidence basis for adaptation. Monitoring can also help raise awareness, interest and understanding of climate variability and change throughout society by relating an individual's direct experiences of weather and climate phenomena to a larger national, regional, global and historical context.

The CCL OPACE 2 Task Team on National Climate Monitoring Products aims to define standard tools that all countries can use to prepare consistent climate monitoring products. These will help build a coherent picture of global climate from the local to global and allow global monitoring efforts – such as the annual State of the Climate Reports – to draw on and synthesize a wider and deeper range of local expertise and information.

Global sub-seasonal and seasonal predictions: Present status and future directions

S. Park

Korea Meteorological Administration (KMA), Republic of Korea

Abstract

Sub-seasonal and seasonal predictions are important and challenging tasks in areas of weather and climate science, because the forecast on the sub-seasonal to seasonal time-scale is very important information for many management decisions in agriculture and food security, disaster risk reduction, water, and health. However, the predictability in this time scale is relatively low, compared to the short-range forecast, because there are significant uncertainties arisen from various climate system components and their complex interactions. Therefore, there has been a growing recognition that the international exchange of climate prediction information is essential to improve the predictability through the multi-model ensemble approach.

The WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (LC-LRFMME) was established by the Korea Meteorological Administration (KMA) and the National Centers for Environment Prediction (NCEP) to enhance and facilitate the international exchange for seasonal prediction information. The goals of the WMO LC-LRFMME are to provide a conduit for sharing of model data from WMO Global Producing Centers (GPC) for long-range forecast and to produce and deliver MME prediction data for mitigating the adverse impact of unfavorable climate conditions and maximizing benefits under favorable conditions. Furthermore, the WMO LC-LRFMME will extend its role to include exchange of sub-seasonal prediction using model data from WMO GPCs making global monthly forecasting products.

Assessment of operational seasonal products on global scale – The global seasonal updates

V. Kryjov[1], G. Kim[2], Y. M. Min[3]

[1] North Eurasia Climate Centre at Hydrometeorological Research Centre of Russia (NEACC), Russia

[2]World Meteorological Organization Lead Center for Long Range Forecast Multi-Model Ensemble (WMO LC LRF-MME), Republic of Korea

[3]APEC Climate Center (APCC), Republic of Korea

Abstract

Nowadays, twelve operational climate centres producing global long range forecasts based on the seasonal simulations by atmospheric and coupled climate models are recognised by WMO as Global Producing Centres (GPC). Their model forecasts provide the basis for global seasonal multi-model forecasts computed at WMO Lead Centre for Long-Range Forecast Multi-Model Ensemble (WMO LC LRF-MME). These seasonal forecasts are published in the Global Seasonal Climate Update and disseminated for NMHSs throughout the world. Assessments of the retrospective and real-time multi-model global seasonal forecasts from WMO LC LRF-MME and other centres not calibrated on the past individual model skill are discussed. In general, forecasts of the circulation characteristics and temperature are the most skilful and outperform climatological forecasts for a large part of the globe, although varying from season to season. Precipitation forecasts are skilful only for the tropics. Methods of multi-model combination calibrated on the past individual model skill are also discussed.

SESSION III
Climate Outlook Forums

Chairman: Serhat Sensoy
Rapporteur: Andre Kamga Foamouhoue

Expanding and tailoring RCOF's products for better climate services

B. Nyenzi

Climate Consult (T) Ltd, Tanzania

Abstract

The term "climate services" refers to the delivery of climate information and predictions from the scientific sources to end-users. A service is a service only when it is used. The goal is to make people use climate services in real-world context. However climate information is just one of the elements in the decision making matrix. NMHSs and other collaborators have great potential to exploit databases of information gathered over many years to provide "effective" climate services that can attractive to be used in decision making. In this case predictions of climate variability over the next season or two (seasonal to inter-annual forecasts) are of immediate relevance.

The Climate Information and Prediction Services (CLIPS) project, in collaboration with other WMO Programmes and other programmes/Institutions, demonstrated the value and eventual socio-economic benefits of climate information and prediction; provided an international framework to enhance and promote climate information and prediction, including the establishment of criteria to measure forecast quality and to permit model inter-comparison; promoted the development of operational climate prediction at regional and national levels; supported capacity building and regional/global collaboration in operational user-targeted climate services; and facilitated the definition, development and the strengthening of a global network of regional/national climate centres.

CLIPS, through the worldwide Regional Climate Outlook Forums (RCOFs) and training workshops, enhanced the capacity of NMHSs in Seasonal and inter-annual Predictions (SIP) and their applications and created ownership of user-targeted climate services at the local level. It facilitated the development of guidelines and methodologies for SIP and applications in climate sensitive sectors (such as food security, water resources, human health and energy) and also provided users with new climate products based on state-of-art scientific understanding and established links between providers of and users of SIPs. Furthermore through this process it promoted development of consensus-based regional/global climate outlooks and joint research with other international climate programmes.

The expanded components of RCOFs would include, among others:

- training of countries and regional experts on climate dynamics, climate analysis and prediction with emphasis on seasonal forecasting and its applications
- Production and update of operational regional and national climate outlooks and related impacts and advice for users covering all seasons for the year;
- Production, dissemination and update of operational regional and national climate outlooks products and related impacts and advice for users covering all seasons for the year;
- Communication between policy, decision, practices , climate science and services communities; and
- Integration of climate information into climate change adaptation and development policies and strategies; and
- Expanding in other regions and application areas and systems.

Expanded RCOFs components are critical building blocks for the Global Framework for Climate Services (GFCS). They provide a great opportunity for the User Interface Platform in GFCS thus enabling better management of the risks of climate variability and change and the adaptation to climate change at all levels.

Developing National Climate Outlook Forums (NCOFs)

G. Srinivasan

Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES)

Abstract

Effective use of available climate information is critical to ensure efficiency and sustainability in climate sensitive sectors. This is true for both the current context and in future, when climate change is expected to impose additional stress. The National Meteorological and Hydrological Services (NMHS) provide weather, climate and hydrological information on a range of time scales to enable key economic sectors such as agriculture, fisheries, water resources, forestry and health.

Availability of seasonal information products from GPCs and consensus outlooks from the RCOFs provide enhanced capacities for addressing risks at national, local and community levels. Climate status and outlooks are useful in supporting decisions regarding contingency planning. Due to inherent uncertainties in seasonal predictions, such products can be better utilized through clearer understanding and discussions amongst stakeholders. The National Climate Outlook Forums (NCOFs) are being developed to meet this need by serving as platforms for sustained dialogue between providers and user of climate information at national level. This would contribute to improved capacities to interpret, translate and communicate probabilistic science-based predictions in user friendly formats to at-risk communities by national and local institutions leading to better climate services.

SESSION IV
Climate Data and Monitoring Systems (including data rescue)

Chairman: Mohammed Samawi
Rapporteur: Ryuji Yamada

The International Surface Temperature Initiative (ISTI) – Providing temperature datasets to support climate services

P. Thorne, J. Lawrimore, K. Willett, J. Rennie, B. Trewin

Bureau of Meterology (BOM), Australia

Abstract

The International Surface Temperatures Initiative (ISTI) was established in 2010, following a submission to the 2010 CCl session by the United Kingdom Meteorological Office. The Initiative's aim is to make available verifiable temperature datasets starting from a common databank of unrestricted data at both monthly and higher (daily and subdaily) resolutions, to support a suite of monitoring products from hourly to century timescales and from location specific to the global mean.

The first full version of the ISTI databank, featuring monthly data from approximately 32,000 stations in over 200 countries, is due for release shortly. A daily data set, which will be especially valuable for global analyses of climate extremes, will be part of the second stage of the project, while data rescue also forms part of ISTI's brief. Essential to the success of the project will be the willingness of National Meteorological Services and others to make data available to the ISTI databank.

Another part of the ISTI project is the benchmarking and assessment of submitted data products, with a view to assessing the strengths and weaknesses of methodological choices made during all stages of processing. Homogenisation methods, an essential part of any climate data processing, are the primary focus in this first stage. Benchmarking will enable quantification of homogeneity uncertainty, better intercomparison of homogenised products and further improvement of the homogenisation algorithms themselves. Assessment will be carried out using a double-blind benchmarking exercise testing homogenisation skill against both the ISTI databank and a number of synthetic analogues to the real world prepared under different assumptions. The benchmarking platform is in an advanced stage of preparation and is expected to be made available in mid-2014.

Climate data management - specifications and good practices

R. Tolasz

Czech Hydrometeorological Institute (CHMI), Czech Republic

Abstract

The World Meteorological Organization (WMO) has been supporting the implementation of Climate Data Management Systems (CDMSs) in developing countries for more than twenty years. From CLICOM at the end of 20th century to CDMS plurality at the beginning of 21st century, a CDMS is an integrated system that facilitates the effective management, analysis, delivery and utilisation of a wide range of integrated climate data. The expert team of CCl OPACE-1 for CDMS was established to continue in preparation of CDMS specification for good working practices with climatological data. The lecture is presented description of main CDMS parts - CDMS Governance, Climate Data, Climate Data Management, Climate Data Analysis, Climate Data Presentation, Climate Data Delivery Services and Core IT Infrastructure.

Ensuring quality and homogeneity in climate data

M. Brunet

Centre for Climate Change, University Rovira i Virgili (URV), Spain

Abstract

Robustness of any climate assessment or climatic service greatly relies on the availability of high-quality and accessible climate time-series. Either operational (e.g. the timely delivery of any climate product or service) or scientific (such as the emerging field of decadal climate predictions) activities also highly depends on accessible historical climate records of quality and homogeneity proven. Both long and short observed climate time-series tend to include either non-systematic or systematic biases that compromise their homogeneity and reduce their quality and usability in climate assessments. These biases have been able to be introduced in time-series when digitising, transferring and managing the observations (non-systematic biases) and due to changeover in the observing conditions (either at the observing sites or its surroundings) and observational practices (systematic biases) that should be minimised and adjusted to make sure the whole time-series is homogeneous or has been homogenised. In this talk, examples of both non-systematic or systematic biases will be discussed, along with the techniques and methods to account for them. The state of the art of climate time-series quality control and homogenisation techniques will be reviewed, as well as the impact and benefits that an enhanced data input will bring to advancing in our knowledge on climate variability and change. In this regard, new developments for the time-series quality control will be presented and discussed, along with the state-of-the-art in homogenisation methods and the need for improving the techniques to adjust the finest time scales (e.g. daily and sub-daily) through exploring biases' properties in the highest statistical order moments by means of parallel measurements.

Satellite-based climate monitoring products & services – An European example

R. Hollmann

Deutscher Wetterdienst (DWD), Germany

Abstract

The EUMETSAT Satellite Application Facility (SAF) on Climate Monitoring (CM), other members of the SAF network and the EUMETSAT Secretariat have developed a sustained capability for a comprehensive generation and provision of Climate Data Records (CDR's) for Global Climate Observing System (GCOS) Essential Climate Variables (ECVs) derived from operational meteorological satellites. The overall aim is to make the resulting CDRs suitable for the analysis of climate variability from seasonal to decadal time scales and beyond. CM SAF works in close collaboration with the EUMETSAT Secretariat to advance the availability, quality and usability of Fundamental and Thematic Climate Data Records (FCDRs and TCDRs).

The TCDRs focus on GCOS ECVs associated with the global energy and water cycle covering upper air water vapour, cloud properties, precipitation, turbulent fluxes over the ocean as well as surface albedo, and radiation fluxes at top of the atmosphere and at the surface. Provided time series range from 8 to about 30 years length. The Climate Data Records (CDR) based on geostationary satellite data have regional/continental coverage (METEOSAT disk), while those based on polar orbiting satellites have a global coverage. All CDRs are made available via web user interfaces at www.cmsaf.eu which also allow applying post-processing procedures, such as the extraction of sub-areas or re-projection.

Beside the usage of the data in global reanalyses, climate model evaluation and improvement, climate services at national meteorological and hydrological services (NMHSs), regenerative energy applications and for climate studies related to the WCRP Grand Challenges another challenge for the CM SAF and the Secretariat is to accustom data sets to fulfil requirements of emerging applications of the European Copernicus Climate Change Service and more general the WMO Global Framework of Climate Services.

It is anticipated that both the existing long-term data records but also data consistent with the long records but delivered with low latency are needed to support monthly/annual reports on the state of the climate, continuously running reanalyses systems and emerging attribution services.

This presentation will give a holistic overview of the currently available, planned and envisaged product portfolio from the EUMETSAT CM SAF and the Secretariat. It will describe the CDRs as well as provide examples how the CDRs are used in climate research and services in Europe and Africa.

SESSION V
Assembling the Climate Services Toolkit

Chairman: Richard Graham
Rapporteur: Caio Augusto dos Santos Coelho

Concept of the climate services toolkits within the Climate Services Information System (CSIS)

S. Mason

International Reasearch Institute for Climate and Society (IRI), USA

Abstract

(To be submitted)

An appraisal of the potential LRF components for the climate services toolkit

B. Mukhopadhyay

India Meteorological Department (IMD), India

Abstract

(To be submitted)

Climate and ocean services in the Pacific

N. Plummer, J. Pahalad, D. Jones, D. Walland

Bureau of Meteorology (BOM), Australia

Abstract

Customer satisfaction, adoption and impact, efficiency and sustainability are characteristics of any good service and these should drive the development of climate services for any country or for a region. For climate services, scientific integrity and robust systems are priorities too.

The Australian Bureau of Meteorology has partnered with many Pacific Island National Meteorological Services for more than twenty years in the development of climate and ocean services. The list of achievements have been considerable and include: more than 20 years of sea level observations; a climate database (CliDE); data rescue initiatives; an operational seasonal forecasting system and service; climate change analyses; climate projections portal; various data portals, including real time for sea level; and application projects, including for health, renewable energy and water management. Considerable funding and support has been provided by the Australian Department of Foreign Affairs and Trade (and formerly through AusAID) and other partners have included major Pacific regional organisations and agencies within Australia.

Challenges for the future include sustaining key systems and services beyond project funding cycles. The Regional Climate Centre model is very important in that regard as is further building climate science and service capability at the national and regional levels. Seamlessly aligning climate with weather services also needs attention if the latter is to most optimally respond to disaster risk reduction.

SESSION VI
Building User Interface for Effective Use of Climate Information

Chairman: Andrew Tait
Rapporteur: John Kennedy

Improving climate risk management at local level-techniques, case studies, good practices and guidelines for World Meteorological Organization members

R. Pulwarty

National Oceanic and Atmospheric Administration (NOAA), USA

Abstract

(To be submitted)

Science-based stakeholder dialogues to tailor climate information

R. C. Stone

International Centre for Applied Climate Sciences (ICACS), Australia

University of Southern Queensland, Australia

Abstract

To ensure science-based stakeholder dialogue to tailor climate information, effort must be made to provide a participatory approach and process that addresses issues across the entire value chain of activity of the designated industry or enterprise. To enhance this stakeholder engagement and dialogue, climate information and forecasts have to address a need that is real and perceived through direct interaction with stakeholders. There needs to be full realisation of the existence of decision options ("decision-points") that are sensitive to the incremental information that the forecasts provide and are compatible with the users and stakeholder's goals (Hansen 2002). This is usually means shifting the focus towards the promotion of user-driven risk-management objectives, rather than only emphasizing the uptake of particular climate information and seasonal forecasting technologies (after Cash & Buizer, 2005). Stakeholders across the entire value chain in an industry environment need to be consulted and information tailored to each of the different industry sectors. Designing fully "end-to-end" systems means that seasonal climate forecast developers should begin their process by going into the field and creating dialogue and listening to stakeholders, learning their perspectives, their problems, and their needs. These conversations with stakeholders generally reveal that they need tailored climate information as one type in a suite of information that can help them manage a broad array of risks. Recommendations for a systematic approach to this entire issue will be presented.

Moving from climate to impact forecasts – Delivering climate services for decision making

J. P. Céron

Météo-France

Abstract

Adaptation to current climate variability represents the first step in our efforts to adapt to climate change and future climate variability.

In this context, the crucial climate information to be provided is about the impacts on the different sectors; notably in the Agriculture, Health, Water Resource and Disaster Risk Reduction domains. Consequently, the provision of climate impact information becomes of major importance, especially at seasonal to interannual time scales which correspond to the Climate risk management related to the current climate variability and which is operationally operated at the 3 levels; Global, Regional and National.

So, after some introductive remarks, the presentation will describe the main component of an impact forecasting suite suitable for operational purposes. Then specific related topics like the evaluation of such information, the different sources of uncertainties, the impact model initialization, the multi-model issues, the evaluation of the use of such information for decision-making will be discussed. In this context, some example of Climate Service prototypes, especially coming from a EU FP7 funded project called EUPORIAS, will be presented. Lastly, a tentative conclusion and future prospects will be proposed.

SESSION VII
Transitioning to GFCS

Chairman: Buruhani Nyenzi
Rapporteur: Tobias Fuchs

Emerging requirements of Global Framework for Climate Services (GFCS)

F. Domingos Freires Lúcio

Global Framework for Climate Services (GFCS), Geneva

Abstract

Climate services that are accurate and provided in user-friendly way are vital for empowering nations, vulnerable communities and socio-economic undertakings in efforts to minimize the impacts of climate variability and climate change, particularly extremes, improve adaptation efforts and support planning.

In the last three decades considerable improvements in our scientific understanding of the planet's climate system have been made. This has made the production of increasingly credible and actionable weekly, monthly and seasonal forecasts viable, resulting in their provision operationally. However, while a few countries have already launched effective climate services, the majority of the world's governments, communities and business sectors, particularly in 70 of the most vulnerable and least-developed countries, do not yet have access to usable and scientifically credible climate information and forecasts.

Recognizing the demand for and benefits of climate services, Heads of State and Government, Ministers, and senior officials from over 150 countries and 70 organizations attended the 2009 World Climate Conference – 3, where they established the Global Framework for Climate Services (GFCS). The GFCS seeks to identify user needs, bring the providers and users of climate services together, develop capacity for using climate services, and build operational climate services that can assist decision makers to reduce vulnerability and adapt to climate impacts in the initial priority areas of agriculture and food security, water, health and disaster risk reduction.

The GFCS has a three prong implementation approach with global, regional and national focus. The global level provides climate prediction products and maintains standards, while the regional focus is on promoting capacity development beyond single nations and the national level focuses on tailoring information products to meet user demands in support of climate-smart solutions.

To facilitate understanding of the critical elements that need to be considered to enable the production and application of effective climate services at regional and national level, and to facilitate the identification of priorities and establishment of appropriate partnerships and coordination mechanisms the GFCS has been facilitating regional and national consultations. In tandem, early implementation of the GFCS, through specific projects in various countries is providing valuable lessons that are being used in the development of guidelines on establishment of frameworks

for climate services at national level and in advancing the overall implementation of the GFCS.

This paper provides details on emerging requirements for the GFCS and lessons learned through the GFCS implementation.

SESSION VIII
Research to Support Operational Climate Service Providers

Chairman: Frederick Semazzi
Rapporteur: Tanja Cegnar

Research needs for understanding regional climate risks on different time-scales

C. Goodess

University of East Anglia (UEA), UK

Abstract

The need to support operational climate service providers through, for example, the GFCS brings new challenges in defining climate research agendas and, in particular, translating research outcomes into useful and usable information for society. The complexities of this 'translation' process mean that the process itself should be considered as a research challenge, with input needed from social and communication, as well as climate science. Climate service users and their needs are extremely diverse – though for the majority a regional or local focus is critical. Thus it is appropriate that these issues are reflected in the WCRP Regional climate information Grand Challenge as well as in the terms of reference of the WCRP Working Group on Regional Climate. The diversity of users and their needs reflects their different decision-making contexts and frameworks - thus understanding these is vital. It may also require some changes in perspective from climate service providers particularly in the context of climate change adaptation where a 'policy first' approach is gaining ground. In the climate science/user interface dialogue, terms such as 'skilful', 'reliable' and 'credible' are increasingly used to describe the desired attributes of predictions. However, the nature of such attributes as well as the uncertainties differs depending on whether one is considering seasonal forecasts, decadal predictions or climate projections. Different underlying research strategies are needed, e.g., when considering climate change projections which cannot be directly verified, and the different nature of the uncertainties needs to be communicated to users. Similarly, it is likely that users will be making different types of decision depending on timescale, e.g., more operational decisions based on seasonal forecasts and more strategic decisions based on longer-term projections. Both the research and communication challenges increase when considering the needs for high-spatial resolution which are frequently expressed by users.

Explaining extreme events from a climate perspective

T. C. Peterson

National Oceanic and Atmospheric Administration (NOAA), USA

Abstract

Attribution of extreme events is a challenging science and one that is currently undergoing considerable evolution. This talk will discuss the evolution of attribution science and examine numerous examples of different approaches that scientists around the world have used to better understand the causes of specific extreme events.

Seasonal to sub-seasonal predictions research to support operational products

A. Kumar

Climate Prediction Center in the National Centers for Environmental Prediction (NCEP) at the National Oceanic and Atmospheric Administration (NOAA), USA

Abstract

In the recent decade, seasonal to sub-seasonal predictions have attained operational statues, for example, currently there are 12 Global Producing Centers (GPCs) for long-range predictions under the purview of WMO. Recent advances notwithstanding, critical research questions in the arena of understanding of climate variability, model improvements, practical design of operational prediction systems, and dissemination and communication of forecast information to users and decision makers remain. The presentation will summarize some of the outstanding issues together with a summary of coordinated research efforts that have specific focus on advancing seasonal to sub-seasonal prediction research to support operational predictions.

Regional assessment of monthly and seasonal forecast ensemble products

F. J. Doblas-Reyes

Institució Catalana de Recerca i Estudis Avançats (ICREA), Spain

Institut Català de Ciències del Clima (IC3), Spain

Abstract

The current status of climate forecasting at monthly and seasonal time scales will be described. The presentation will include illustrations from dynamical ensemble forecast systems and statistical models. The relevance of the forecast quality assessment, the physical mechanisms responsible for skill, reliability and predictability, the benefits of downscaling and calibration, the role of anthropogenic climate change, the relative merits of different methods for ensemble forecast generation and initialisation, a description of approaches to address model uncertainty and the implementation of seamless forecasting systems will also be discussed. A special focus will be on the discussion of operational forecast systems and how they are expected to deal with the emerging climate services, using examples of their application for the renewable-energy sector.

SESSION IX
Inter-annual Prediction & Beyond – Decade to Centuries

Chairman: Francisco Javier Doblas-Reyes
Rapporteur: Vladimir Kryjov

Teleconnections and their representation in climate models: a focus on Africa

R. Graham, A. Arribas, M. Vellinga, D. Rowell

Met Office, UK

Abstract

We discuss seasonal atmospheric responses to modes of sea surface temperature (SST) variability in observations and in the Met Office's seasonal and decadal prediction systems as well as in multi-decadal simulations from CMIP5. We focus on responses in African regional/seasonal rainfall, including variability in season onset timing, and also include results on other variability e.g. in near-surface air temperature and tropical storm frequency, and on global responses to extratropical SST signals. Implications for prediction on seasonal, multi-annual and longer timescales will be discussed.

Decadal variability, its prediction, and the role of the oceans

G. Danabasoglu, A. Karspeck, S. Yeager

National Center for Atmospheric Research (NCAR), USA

Abstract

Because the memory of the ocean vastly exceeds that of the atmosphere, variations in the climate system on seasonal to decadal and longer time scales are thought to be driven primarily by oceanic processes, thus making accurate initialization of past ocean states a key aspect of climate prediction efforts on these time scales. In addition to ocean analysis products from ocean data assimilation, solutions from ocean hindcast experiments can be used to initialize climate prediction experiments. Here, we present an assessment of retrospective decadal prediction skill of sea surface temperature (SST) variability in initialized decadal prediction experiments with the Community Earth System Model (CESM) where both initialization approaches are used. Both sets of decadal prediction simulations result in retrospective SST prediction skill over broad regions of the Indian Ocean, Western Pacific Ocean, and North Atlantic Ocean that is significantly better than reference skill levels from a spatio-temporal auto-regressive statistical model of SST. However, the subpolar gyre region of the North Atlantic stands out as the only region where the CESM initialized predictions outperform uninitialized simulations. This finding is not surprising given the prominent role that the Atlantic Meridional Overturning Circulation is thought to play in decadal and longer time scale variability as it is presumed to contain dynamical memory of the climate system. A brief discussion of challenges associated with decadal variability, mechanisms, and prediction is also presented.

Polar predictability on seasonal to decadal timescales

T. Shepherd

University of Reading, UK

Abstract

Over the last few decades, the polar regions have exhibited some of the most striking manifestations of climate change. Due to the polar amplification of greenhouse warming, the Arctic has been warming at a rate several times faster than the rest of the globe. The largest observed changes in Antarctic climate over the past few decades have occurred during the summer season and have been primarily attributed to the ozone hole. In both cases, there are potential implications at lower latitudes. On shorter time scales, modern seasonal prediction systems mostly rely on teleconnections originating from the tropical regions such as those associated with ENSO. However, recent studies have shown the existence of seasonal predictability associated with interactions in the climate system that involve aspects of mid- and polar latitudes such as soil moisture, snow cover, sea surface temperature, sea ice, solar variability, and stratospheric sudden warmings. Because the forced component of climate predictability is likely to be especially significant in polar regions, the initial-value problem and the forced problem must be considered together. The strong coupling between the different components of these regional climate systems and their interaction with global climate processes calls for an interdisciplinary approach. Accordingly, the WCRP has recently established a “Polar Climate Predictability Initiative” (PCPI) to advance our understanding of the sources of polar climate predictability on a range of timescales ranging from seasonal to multi-decadal. This talk will review the scientific issues that led to the establishment of the PCPI and describe its future plans.

SESSION X
Regional Climate – Science and Operational

Chairman: Albert Martis
Rapporteur: Roberta Boscolo

Performance of downscaling tools (dynamical and statistical models) across selected CORDEX domains

F. Giorgi

International Centre for Theoretical Physics (ICTP), Italy

Abstract

(To be submitted)

Research support for operational activities of Regional Climate Centers (RCCs)

T. Manabe, S. Maeda, A. Shimpo, K. Takano

Tokyo Climate Center (TCC), Japan

Japan Meteorological Agency (JMA), Japan

Abstract

After CCl-15, WMO Cg-16 highlighted the need to develop and sustain linkages between research and operational services to expedite the application of research advances in operational climate services and to ensure ongoing improvement to the GFCS operational practices and outcomes.

The Tokyo Climate Center (TCC) of the Japan Meteorological Agency (JMA) has enhanced collaboration with the research community in recent years. For example, TCC and its Advisory Panel on Extreme Climate Events (established in 2007) comprising prominent climate scientists have intensified communication by more frequent information sharing and discussion mainly with regard to climate system monitoring and analysis. The Panel's Working Group also comprising researchers has provided climate analysis tools to be operationally used by TCC. While the support from the research community has substantially contributed to improving TCC activities, the researchers also enjoy the benefit of such collaboration by promptly receiving operational and detailed data/products including the Japanese 55-year Reanalysis (JRA-55). Such reciprocal collaboration will be important to keep linkages between research and operational services.

RCCs create regional products that support regional and national activities and thereby strengthen capacity of WMO Members in a given region to deliver better climate services to national users.

In its role as a WMO RCC, among its many other functions, TCC monitors world climate conditions with focus on Asia and the surrounding area and issues reports. The collaboration between TCC and researchers has greatly contributed not only to TCC itself but also to improving operational climate services in NMHSs in the region.

Building effective mechanisms for CCl-WCRP work in the regions

R. Martinez

International Research Centre on El Niño (CIIFEN)

Abstract

The Global Framework of Climate Services (GFCS) continues its evolution and keeps relevant challenges ahead. WMO Commission of Climatology is working on the adequate way to contribute to GFCS in different scientific, technical and geographic levels while WCRP established as one of the grand challenges Regional Climate Information.

From the goals established in all the cases is clearly understood the intention to the Global system to serve better to the society. It is also clear, there are new structures, strategic views and an unexplored terrain ahead. To contribute on these new endeavors some pragmatic and effective mechanisms are proposed to work in the regions and connect the global science, observing systems, data management, operational activities, products, services and institutional frameworks to deliver benefits at national level. Two of them are:

- To take advantage of WMO Regional Climate Centers to enhance coordination and networking between, CLIVAR panels, GOOS regional Alliances among others in the specific regions.

- To set up demonstration projects in Latin America and Africa to build up a sustained dialogue and interaction between WCRP scientists from CLIVAR, GEWEX, WGRC, WGSIP, where the scientific progress, new tools, data sets could be shared and incorporated in the operational activities at regional and national level. This could become a positive demonstration of effective co-production of climate services, that can be expanded, measured and further funded.

By connecting the climate science, the operational capacities and the wide community of users at national level, the overlapping of efforts will be reduced. This also intends to minimize a destructive competence by funding promoting integrated initiatives linked with the climate services provision.

The implementation of the proposed mechanisms will benefit to the society but also to climate research community and NMHSs.

SESSION XI
Using Uncertain Information in Decision Making

Co-Chairman: Antonio Busalacchi and Thomas C. Peterson
Rapporteur: Roberta Boscolo and Govindarajalu Srinivasan

Dealing with uncertainties in climate risk management

M. Dilley

World Meteorological Organization (WMO), Geneva

Abstract

Limitations in observational systems, imperfect data and inherent limits to predictability inevitably introduce uncertainty into climate information intended to support decision-making. The implications of uncertainty for decision-makers vary by context, however. This can be seen in three contrasting cases, involving seasonal precipitation outlooks, food security outlooks, and dynamic risk assessment of Rift Valley fever outbreaks for livestock trade regulation.

Widely available consensus precipitation outlooks from regional climate outlook forums provide weighted probabilities of seasonal rainfall totals being above-, near-, or below-normal. The range boundaries of these three categories are seldom specified. Identifying the range of actual precipitation amounts for each class requires an additional step and data which most users to not have. Therefore in most cases, although the probabilities quantify uncertainty, the absence of information about the actual amounts introduces new uncertainties potentially important for decision-making. These forecasts are broadly useful and have been cited as a basis for disaster preparedness and other applications. Yet despite the fact that this type of seasonal forecast is in a sense scientifically correct in the manner in which it conveys uncertainty, the generic, non-specific nature of these forecasts has generated perennial calls for more tailored decision-support products.

Food Security Outlooks were introduced in the Greater Horn of Africa ca. 2003. They are generated on the basis of expert interpretation of the implications of the seasonal precipitation outlook in light of what is known about prevailing food security conditions and non-climatic factors affecting livelihood systems. Food security outlooks are deterministic; no attempt is made to assign probabilities to different possible outcomes. Yet these outlooks continue to be generated by the food security community as a basis for humanitarian interventions by international organizations 10 years later (see http://reliefweb.int/sites/reliefweb.int/files/resources/east_ol_11_2013.pdf). The perceived value of the advance warning provided apparently outweighs the lack of information concerning the degree of uncertainty.

A third example involves an attempt initiated under the auspices of the Red Sea Livestock Trade Commission to develop a model that would allow environmental conditions favorable for outbreaks of mosquito-borne Rift Valley fever to be monitored and anticipated. This information is useful for regulating livestock trade between countries in the Horn of Africa and the Middle East. As most of the time risks of outbreaks are low, one of the main benefits of the model is as a basis for

trade continuation. In times of high risk, signaled by unusually prolonged, heavy rainfall, transmission monitoring can be increased and trade temporarily halted. In this case, however, although the rainfall-to-outbreak relationships have been relatively well established for Kenya, to a region-wide model still remains to be operationalized. One contributing factor for this may be that the scientific tolerance for uncertainty in such a model exceeds the standards required by the users. In the absence of systematically organized and monitored environmental information importing countries resort to no-regrets trade-ban policies as a response to uncertainties generated by lack of information in general.

These cases illustrate that the implications of uncertainty for managing different types of climate-related risks are context dependent. They suggest that how uncertainty is specified, and the degree of uncertainty which can be tolerated – as with other characteristics of user-driven decision-support products – should take into account the particular requirements of specific decision-making needs.

Communicating uncertainties in climate science

P. Luganda

Farmers Media Link Ltd, Uganda

Abstract

Communicating Climate information is loaded with great potential to improve the lives of millions of people globally. Lives can be saved as well as property and infrastructure worth colossal amounts.

The common meaning of uncertainty is negative. Sometimes the public feels that scientists know 'little,' on the issue or that they are hiding something from them. Uncertainty is an obstacle to the public willingness to use the information received.

In the communication of climate forecasts, because of the probabilistic nature of the forecasts in the Climate Outlook Forecasts worldwide, there is likewise a level of mistrust by the audience of the accuracy of the information delivered. The public continues to demand for a deterministic forecast that they can use with a high degree of certainty. The repeated calls by end users to be issued with a more

This calls to communicate climate forecast information with clarity that uncertainty is part and parcel of the science that is all around us. In reality uncertainty is a feature of climate science that will never go away. Science doesn't deal in certainties it weighs up the evidence and tells you which of several possible answers has the most support. Where uncertainties remain, scientists know where to put their efforts into what to investigate next. Getting the message across that uncertainty is not a bad thing, and that we make decisions every day based on less than certain information is an important place to start for communicating uncertainty in Climate Science.

Global systems to support exchange of climate information – WMO WIS/WIGOS

W. Zhang

World Meteorological Organization (WMO), Geneva

Abstract

The facilitation of the worldwide exchange of meteorological information was one of the main drivers for the foundation of the International Meteorological Organization (IMO) in 1873 and WMO, in 1950. The implementation of the World Weather Watch in 1963 is worldwide acknowledged as a major milestone for providing a consistent and packaged system for the exchange of weather and climate data, products and services.

The current world is facing big challenges related to climate variability and change, and is witnessing major global initiatives in order to cope with these challenges. Well-recognised collaborative efforts, such as the United Nations Framework Convention for Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) mechanisms, as well as the recently implemented Global Framework for Climate Services (GFCS) require and feed the international information exchange pertinent to climate. Climate research and climate services changed its focus over the last decades from rather descriptive, large-scale assessments and forecasts to spatially and temporally fine-mashed physical analyses and predictions aiming at the capture of extremes. Such development need to be underpinned by robust and high-quality observations, consistent among the different observing systems and complemented by exhaustive and easily accessible metadata.

The WMO Integrated Global Observing System (WIGOS) is a new framework to enable the existing WMO global observing systems working together as an integrated system to provide more efficiently and effectively the data required for delivery of services across WMO's 12 application areas, and one of the focuses is to enhance climate observ§ations and monitoring capabilities. The WMO Information System (WIS) is the pillar of the WMO strategy for meeting the requirements of all WMO Programmes for routine collection and automated dissemination of observed data and products, as well as data discovery, access and retrieval services for all weather, climate, water and related environmental data, products and information. WIGOS and WIS will enable stakeholders to work better together to make, gather, store, access, exchange and interpret the climate observations they need for the effective delivery of improved climate services to their communities.

Poster Abstracts

Implementing Regional Climate Centers (RCCs) in South America to support the Global Framework for Climate Services (GFCS)

B. Tapia

Dirección Meteorológica de Chile (DMC), Chile

Abstract

The Regional Association lll (South America) established the need to have three Regional Climate Centers (RCC) in order to strengthen its ability to meet the climate information needs of all its members. Currently, the region has two CRCs working to fulfill the mandatory requirements of a CRC. One of these is the CRC for Western South America, which since a year ago, has started its implementation phase, while the second center, CRC for Southern South America is expected to formalize its demonstration phase during the first half of 2014. Both centers have the support of the countries of the region, not only in delivering data and climate information, but also in actively collaborating with the centers and in defining the users needs. The implementation of these centers not only meets a regional demand but also supports the process of implementing the Global Framework for Climate Services (GFCS), especially the regional implementation of one of its pillars, the Climate Services Information System (CSIS). In the near future, the Regional Association lll will require that these RCCs ensure that National Meteorological Services of the region will be able to access, process and convert such global and regional climate information into national climate services, considering areas such as health, reducing disaster risk water resources, and agriculture and food security.

Activities on Eastern Mediterranean Climate Center (EMCC)

S. Sensoy, M. Demircan , M. Ekici, B. Yazici

Turkish State Meteorological Service (TSMS), Turkey

Abstract

In order to strengthen climate studies in the international level, Turkish State Meteorological Service (TSMS) took the initiative and established Eastern Mediterranean Climate Centre (EMCC) running under the Network of Regional Climate Centers (RCC) in RA VI which was built by WMO.

The EMCC started its service in June, 2009 through a website in english at: http://www.emcc.mgm.gov.tr.

Targeted countries determined in coordination with WMO as Greece, Turkey, Cyprus, Syria, Israel, Palestine, Lebanon, Jordan and Egypt.

The products delivered on the website are:

- Monthly seasonal temperature and precipitation forecast
- Climate monitoring for 2m temperatures (TT) and precipitation rates (RR).
- The Eastern Mediterranean Climate Dataset
- Climate projections for countries in the region

Future work idenfined are:

- To verify seasonal prediction products.
- To determine focal point from countries in order to receive more data
- To organize training activities on use and interpretation of products for countries in the region and related sectors
- To create user interface portal.

We believe that these climate prediction and information services contribute to enhanced social and economic resilience and decision making in many climate-sensitive sectors such as water, agriculture, health and disaster risk management in the region.

The ASEANCOF process and seasonal forecasting challenges in Southeast Asia

R. Rahmat, C. Gordon

Centre for Climate Research Singapore (CCRS), Singapore

Meteorological Services Singapore (MSS), Singapore

Abstract

The inaugural ASEAN (Association of Southeast Asian Nations) Climate Outlook Forum (ASEANCOF-1) was held in Singapore from 3-5 December 2013 ahead of the Northeast Monsoon season. This initiative was established with the support of the WMO, and intends to facilitate the production of consensus-based regional seasonal climate outlook on a regular basis. The consensus outlook formulated at ASEANCOF-1 involved experts from leading international climate modelling and prediction centres, as well as representatives from the National Meteorological and Hydrological Services (NMHSs) of ASEAN member states. Some of the key discussions at this (and future) forums revolve around challenges in generation and delivery of seasonal forecasts, and these include sourcing for suitable climate prediction tools, evaluating them, and appropriately combining them into products for consensus outlook. Also important, and currently lacking, is good understanding of sources and limits to seasonal predictability relevant to the region as a whole. As the ASEANCOF is a new initiative, its success and advancement hinge upon capacity development of the region in these aspects of seasonal predictions.

Inter-annual variation of Southwest Monsoon and ENSO in Thailand

K. Sitthichivapak

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Abstract

ENSO (El nino southern oscillation) is a phenomenon comprised of the continued interaction between the oceans and the atmosphere. El Nino and La Nina can have profound effects on global weather and ocean conditions. This study investigates the impact of sea surface temperature (SST) variability over the tropical Pacific on the influence of southwest monsoon pattern.

ECMWF (ERA, Gibson et al, 1997) and IRI data reanalysis 30 years from 1971-2000 have been used in this study. Analysis of monsoon pattern during May found that under normal conditions, mostly the beginning of rainy season is mid May. During a typical warm episode, positive sea surface temperature anomalies, mostly westerly wind prevail the Andaman sea Thailand and the Gulf Thailand, so mostly the beginning of rainy season is the late than neutral year. On the other hand, during a typical cold episode, negative sea surface temperature anomalies, the active southwest monsoon prevail over the Andaman sea Thailand and the Gulf of Thailand as compared to a neutral year, so the beginning of rainy season is earlier than neutral year.

The pattern of the monsoon season from June to September compare with long term periods (1971-2000) found that under El nino condition wind pattern at low level (850 hPa) were active southwest monsoon prevail over Thailand and upper level (200hPa) wind were active easterly wind prevail over Thailand. Conversely, La Nina has opposite, at low level (850 hPa) were weak southwest monsoon prevail over Thailand and upper level (200hPa) wind were weak easterly wind prevail over Thailand.

The influence of the sea surface temperature (SST) over the equatorial central and eastern Pacific affect of southwest monsoon pattern in Thailand and vicinity.

The relationship of winter rainfall in Northern Khorasan to the seasonal multivariate ENSO index

M. H. Devin

Iran Meteorological Organization (IRIMO), Iran

Abstract

As winter precipitation has a profound impact on North Khorasan agriculture, so seasonal precipitation prediction has an important role in agriculture.The effects of spring, summer and autumn Multivariance ENSO Index (MEI) on winter precipitation in North Khorasan have been explored using the Climate Predictability Tool (CPT). The CPT's Canonical Correlation Analysis (CCA) and Multiple Linear Regression (MLR) models have been used. The seasonal MEI has been considered as predictor and winter precipitation of 17 stations of thenorth Khorasan during1986-2008 as predictant. Empirical Orthogonal Functions (EOF) were used in order to reduce the number of predictors, and five principal components, which describe 89% of variance, reselected. We find that there is a weak correlation between spring MEI and winter precipitation and strong correlation with autumn MEI in North Khorasan and Only through determination of MEI phase we can't explain seasonal precipitation anomalies in terms of the sign and the severity.

Drought monitoring in Malaysia

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Malaysian Meteorological Department (MMD), Malaysia

Abstract

The climate of Malaysia generally is characterized by uniform temperature, high humidity, abundant rainfall and light wind. The climate characteristics of the various regions of Malaysia are influenced by the regional summer and winter monsoons, locally termed as southwest and northeast monsoons. These monsoon seasons and the transition, inter-monsoon seasons, account for the various raining and dry seasons. Thus we have the flood seasons, including flash floods season, as well as the dry and hazy seasons. The annual rainfall variability also is quite large especially during the drier seasons or months. Generally Malaysia receives less rain during the positive El Nino occurrence. Thus Malaysia has experienced periods of insufficient water supply caused by extreme dry season. During the El Nino year of 1997/1998, many parts of Malaysia also experienced many months of water rationing as well as transboundary haze caused by forest fire due to the extreme dry weather. Malaysia also has to take steps to adapt to the warmer atmosphere and extreme weather due to global warming which would worsen the extreme dry seasons that could occur in the future. This has led the National Climate Center of Malaysian Meteorological Department to implement the meteorological drought monitoring system. This monitoring system using the Standardized Precipitation Index (SPI) and the monthly rainfall as criteria is endorsed by the National Security Council of the Prime Minister Department. Based on our Standard Operation Procedure (SOP) for drought monitor, we have 3 stages of warning. Firstly the alert stage, when the accumulate total rainfall for the past 3 or 6 months has a deficit of more than 35% from the long term average and the latest month's SPI Index is less than -1.5. Second stage is the warning stage, when the accumulate total rainfall for the past 3 or 6 months has a deficit of more than 35% from the long term average and the latest 3 months' SPI Index is less than -1.5, on condition that the alert stage has been issued earlier. For the danger stage, when the accumulate total rainfall for the past 3 or 6 months has a deficit of more than 35% from the long term average and the latest 3 months' SPI Index is less than -2.0, also on condition that the warning stage has been issued earlier. This monitoring is very important to ensure all water related agencies can make early warning preparedness and strategies to minimize the impact of drought.

Quality control and homogeneity of temperature and precipitation data in Georgia

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Hydrometeorological Department of the National Environmental Agency (NEA), Georgia

Abstract

Both statistical and dynamical methods used for climate change study are highly depended on investigated time series quality and homogeneity. The question is very topical, since frequently changes that are caused by these effects are climate change order and distort significance of long-term trends and dynamical characteristics. 20 long-term temperature and precipitation data series measured in Georgia were studied to detect and correct non-climatic homogeneity breaks. A detailed description of the procedure results is provided and the impact of adjustments on trend estimation is discussed. The two-phased regression model based on the penalized maximal t and F tests and the transPMFred algorithm (for non-zero daily precipitation series) will be used for this reason. The homogeneity tests showed strong inhomogeneity of the original data series, which could have both internal climatic and non-climatic origins. Breaks that were identified by the mentioned homogeneity tests were compared with available metadata containing data such as instrument changes, changes in station location and environment, observation procedures, etc. Significant breaks (significance 95% or more) that coincided with known dates of instrumental changes were corrected using quantile-matching or mean-adjustments. It should also be noted that some significant breaks, which could not be connected to known dates of any changes in the park of instruments or stations location and environment as well the spatial distribution of outliers indicates that they are due to climate variability rather than measurement errors. Corrected series are now available for future studies on detection of climate variability and change.

Importance of the systematic collection and archiving of climate data for reliable climate services in Guinea

A. Diallo

Direction Nationale de la Météorologie, Guinea

Abstract

A National Weather Service package includes a collection process climate information products intended to facilitate risk management and climate perspectives.

To enhance and facilitate the work of users, archiving climate data is a huge to make reliable climate services scientific importance.

Agriculture, management of water resources, health, planning, energy, marine, construction work, disaster management, insurance, etc. . attach great importance to climate and climate services use to make business decisions.

Reliable data of climate services used to develop products climate information and forward them to users in a form that meets their needs.

The finished products can be derived from statistical summaries, predictions and advice. A product of climate information can be as simple as the average rainfall in a given locality or as complex as climate risk analysis assists and has come across a country like the Republic of Guinea by registering place up to 4m of water.

Is North Africa still maintaining the world temperature record?

Y. Al-Fenadi

Libyan National Meteorological Centre (LNMC), Libya

Abstract

Unusual or extreme weather and climate records have a great concern and interest, yet there are often conflicting messages from scientists about whether such events can be fully accepted or it should be revised and corrected with modern techniques and new equipment.

The maximum world temperature is 57.3°C recorded on 13 September 1922 in the Northern African place called Azizia located in Libya and since then no record has officially broken that temperature.

However, an international WMO climate expert team announced on 13th September 2012 that there were many errors which discovered recently make the Azizia temperature record after more than ninety years invalid and no more acceptable.

This work traces the world temperature record and discusses the reasons of the WMO expert team on invalidation Azizia temperature record.

Furthermore, it criticizes the comparison between Azizia temperature and the selected five Libyan stations.

Regional high resolution gridded database based on harmonized national measurements

S. Szalai, Z. Bihari, M. Lakatos, T. Szentimrey, the CARPATCLIM community

Szent Istvan University, Hungary

Abstract

Globalization increases the need for better climate services established on high quality regional databases. Regionality means transnationality in most of cases, especially in case of smaller countries. The Greater Carpathian Region is about half a million km2 (approximately area of Spain), and covered by 10 countries what means 10 different observing networks, data management methods and data policies.

The project Climate of the Carpathian Region developed a high quality regional database keeping the national data policies in mind. The (hydro) meteorological services were invited to participate in the project having access to the national database, i.e. maximum possible data. The national consistency was achieved by using not only the same data management methods, but even the same software avoiding the coding differences. The international consistency was assured by near border data exchange, i.e. no common dataset was established, and the data were exchanged bilaterally on equal basis. On this way, the minimum data have been changed.

The final outcome of the project is a freely available, high resolution (10*10 km spatially, daily temporally) gridded database of 16 meteorological variables and climate atlas for more than 50 variables and indices for 50 years period (1961-2010). The gridding could mean some limitation in the case of high level climate studies only. Applied end-users needs information not at the stations usually, and in such a case, a gridded database can fulfill their requests even better.

As example of services, drought information have been shown in co-operation with the European Drought Observatory of JRC, Ispra.

Long-term homogeneous climate datasets in the Australian Bureau of Meteorology

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Bureau of Meteorology (BOM), Australia

Abstract

Homogenised (high-quality) climate datasets are important for the accurate definition of the current climate, and tracking of climate variations and trends through time.

The Australian Bureau of Meteorology has developed long-term, homogenised climate datasets for Australia covering a wide range of variables. These include the Australian Climate Observations Reference Network – Surface Air Temperature (ACORN-SAT) dataset. There are also homogenised datasets for rainfall, pan evaporation, cloud amount, and surface moisture/dewpoint. A revision of the rainfall dataset and development of new upper-air temperature and humidity datasets are in progress.

The time periods and number of stations included within these datasets differs from variable to variable, based on the availability of data and, in some cases, the use of consistent observing practices. For example, the ACORN-SAT dataset begins in 1910 because of a lack of standardisation of instrument shelters prior to the foundation of the Bureau as a federal government entity in 1908. When developing these data sets, a geographically even station coverage is sought, although the sparsity of observations in remote parts of Australia (especially the western interior deserts) presents considerable challenges.

Further datasets cover tropical cyclones in the broader Australian region, and monthly temperature and (at non-Antarctic sites) precipitation at remote island and Antarctic sites operated by Australia. The development of a homogenised instrumental wind dataset was found to be impractical due to systematic instrument changes and the high sensitivity of wind speed data to changes in local site exposure.

The datasets support climate services in Australia and the assessment of climate change, including changes in climate extremes, through providing a baseline diagnostic for monthly, seasonal and annual climate monitoring, and for the assessment of climate change, including changes in climate extremes. Their use also extends into applications such as assessing long-term changes in fire danger indices and to assist with risk management and defining the suitability of climate zones for agricultural undertakings.

Strengthening climate services in Samoa

A. Porteous, A. Tait

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Abstract

In October 2012, a Sector Engagement Workshop was run in Apia, Samoa by the Ministry of Natural Resources and Environment (MNRE) Meteorological Division, as part of the ICCRAHSS (Integrating Climate Change Risks in the Agriculture and Health Sectors in Samoa) project. The workshop attendees were invited participants from four sectors in Samoa: Agriculture, Health, Forestry and Tourism. The workshop was jointly facilitated by MNRE, sector representatives, and consultants from NIWA (National Institute of Water and Atmospheric Research, New Zealand).

The primary purpose of the workshop was twofold. Firstly, we discussed and documented the key weather and climate factors that can impact (positively and negatively) on the four sectors. Some of these factors, for example, were major storm events, flooding, and droughts. A crucial part of this discussion was the identification of datasets, or other information (e.g. case studies, fieldwork, impact reports, surveys), held by the sectors which will help to classify these events in term of their impacts.

Secondly, we documented the needs of the sectors, regarding weather and climate data and information. This helped to identify the way climate information could be best presented and tailored to sector requirements. We wanted to answer these questions: What kind of information is needed? How often do you need it updated? How site-specific does it need to be? How would you use the information? How would the information be disseminated and communicated? Do you need more capacity to understand and effectively use the information?

The output from the workshop was a summary report with recommendations based on the group discussions. The workshop process and the report recommendations will be presented is this talk.

PRASDES: The regional Andean programme to enhance weather, hydrological climate services and development

R. Martinez

International Research Centre on El Niño (CIIFEN)

Abstract

PRASDES is funded by the Ministry of Foreign Affairs of Finland and implemented by the International Research Centre on El Niño (CIIFEN) with the NMHS from Bolivia, Colombia, Ecuador and Peru and the technical cooperation of the Finish Meteorological Institute (FMI), Finnish Environmental Institute (SYKE) and the Research Institute for Development of France (IRD).

The overall objective is: *To contribute on sustainable human activity by reducing vulnerability to imminent disasters and long-term climate related hazards through the efficient exchange and use of hydrological, meteorological and climatological information in the Andean region.*

PRASDES expected results respond to the specific demands of strategic development sectors, risk management systems and vulnerable communities in three pilot areas for extended services implementation (APSE). They are: The Lake Titicaca Catchment Area (Puno-La Paz in Peru and Bolivia); The Catamayo-Chira basin (Ecuador and Peru); APSE 3: The Mira-Mataje river basin (Colombia and Ecuador).

The expected results are:

ER1: NMHSs and the Andean Region implement and maintain with their own capacities, meteorological, hydrological and climate open source interoperable data bases for regional data exchange, analysis and services;

ER2: NMHSs have strengthened their capacities to provide meteorological and climatological services.

ER3: NMHSs have strengthened their capacities to provide hydrological services.

ER4: NMHSs implement a community-based information system with tailored approaches for strategic development sectors.

ER5: the NMHSs have established and begun implementing a financial sustainability strategy.

PRASDES territorial approach is based *on PRASDES initial activities in 2014 have been mostly related with strengthening of meteorological data bases in NMHS, the design of the integration mechanisms with hydrological data bases and the protocol to enable interoperability between data bases at bi national level.*

Ecuadorian Climate Outlook Forum (ECOF)

R. Mejia

National Institute for Meteorology and Hydrology (INAMHI), Ecuador

Abstract

During the years 2008 to 2010, 87 Climate Forums have been conducted in the area of the Ecuadorian coast. Given the strategic importance of the Guayaquil city, the first 9 Forums, were conducted there. Since X Forum, was itinerant in several major cities of the Ecuadorian coast. (Babahoyo, Quevedo, Portoviejo, Santa Elena). Since August 2010, the NCOF is made at national level, with the logistical support of the National Agency for Risks Management. has been performed twice a month, in different cities across the country.

To date there have been 87 NCOFs, including the most recent, in February 13 at the city of Quininde. In each NCOF, the Local Agency of Risks Management, is actively involved as the main user of the climate outlooks, and invites major stakeholders, decision makers, government agencies, private sector, farmers, researches and academics in each 120

Objetives

The main objetive is to present of oficial version from INAMHI (NMHS), about the seasonal (3 months) climate outlooks, considering the main axes of climate threat, focusing on the El Niño / La Niña events and the conditions attached to the Pacific Ocean, and the influence of other atmospheric systems, such as ITCZ, South Pacific Anticiclon, convection from Amazon basin, etc.

Products

- Maps of seasonal climate outlooks of precipitation and maximun/minimun temperatures for all Ecuador.
- Maps are based in use of terciles calculates with CPT (IRI), and show the tercil with major probability and the climatological normal for the trimester too.
- Maps based on numerical model outputs (WRF) in seasonal scale (3 months).
- Graphics with verification index of CPT with RPS (Ranked Probability Score), so that users know about errors and skills of seasonal predictions
- Graphics with analysis of Niño/Niña years and rains in meteorological stations, in 3 ranks: Normal, Below and Upper Normal. For example: La Niña conditions indicate normal rains in Ecuadorian coast.

Towards implementing climate services in Peru – The project CLIMANDES

S. Gubler[1], G. Rosas[2], D. Acuña[2], C. Oria[2], G. Avalo[2], M. Rohrer[3], M. Croci-Maspoli[1], T. Konzelmann[1], W. Lavado[2], A. Díaz Pabló[2], F. Mauchle[1], A. Rossa[1], G. Seiz[1]

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Abstract

Reliable climate information which is based on meteorological observations form the basis to design appropriate climate change adaptation strategies. Such information are particularly important in highly vulnerable regions such as high mountain areas and developing countries. However, data gaps, outliers or variations that are not due to climate variability in the meteorological time series may lead to erroneous conclusions on climate variability and change.

Module 2 of the project CLIMANDES (Servicios climáticos con énfasis en los Andes en apoyo a las decisiones), a joint project between the World Meteorological Organization (WMO), the National Meteorology and Hydrology Service of Peru (SENAMHI), the Federal Office of Meteorology and Climatology in Switzerland (MeteoSwiss), Meteodat GmbH, and others, aims at providing high-quality climate information to decision makers and implementing climate services in Peru. In this article, we present a strategy to a) improve the quality of climate products used to monitor the climate in two mountainous regions Cusco and Junín in Peru and b) deepen the knowledge on climate dynamics in the Andean country. Major challenges are faced due to the high topographic and climate variability encountered in Peru, the low density of hydro-meteorological stations as well as the lack of metadata and station history in the country. Considering these challenges, different approaches to improve data quality are introduced, and the applicability of homogenization methods are discussed. The homogenized data series are used to calculate climate indicators for monitoring climate change in Peru, support the rural population on appropriate land use adaptation, and, in general, enable informed economic and political decisions in the study region.

Climate services in the Andean region of Peru

G. Avalos, E. Villegas, F. Cubas, A. Días

National Service of Meteorology and Hydrology of Peru (SENAMHI), Peru

Abstract

The National Service of Meteorology and Hydrology of Peru - SENAMHI is generating climate information services based on meteorological observations. It is essential to ensure the quality of data to support policy proposals for adaptation to climate variability and change , particularly in areas such as the Andean region of Peru , where climate information is scarce but also the most varied where extreme events occur intense that directly affect the most vulnerable people with low human development indices and dependent and highly sensitive to climate fluctuations economic activities.

This work shows SENAMHI experience in generating climate services in the Andean region of Peru , associated with the occurrence of low temperatures (frost and snow) and its impacts on health and agricultural activity, it was necessary to identify potential users, designing an outreach strategy and evaluate the impact of information generated, qualitatively. The challenge was to generate information (forecasts) with a good level of confidence in an area of high topographic and climatic variability and low density of weather stations in areas above 3800 meters. Given these challenges, we were able to create this information system with encouraging results.

An integrated climate service for drought monitoring, forecasting and dissemination in Central Italy region

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Institute of Biometeorology (IBIMET), Italy

National Research Council (CNR), Italy

Abstract

An integrated system for a real-time drought monitoring and a medium to long range time forecasts in Tuscany region (Central Italy), based on ground and satellite data, modelling forecast from weeks to months is described. It has been built on different components that represent the state-of-art in term of science knowledge and applied technologies. The real-time monitoring component is based on differents source of information: observed data at weather station sites, satellite estimates and water balance modelling for measuring ecosystems status. The forecast component, based on numerical and empirical models, provides estimates on rainfall expected anomalies scenarios from weeks to months in advance to provide reliable and detailed outlooks for water management related activities. A special attention has been addressed to products dissemination to users: detailed maps and data were provided along with consensus bulletins and more specific open source WebGIS applications customized in order to integrate different datasets, retrospective analyses and share information with decision-makers and other stakeholders.

Characteristics of heat waves over Egypt and East Mediterranean

F. El ashmawy

Egyptian Meteorological Authority (EMA), Egypt

Abstract

Heat waves over Egypt and east Mediterranean have been studied. According to the frequent, intensity and duration .By analysis surface daily mean temperature (Tmax, Tmin, and Tmean) in summer time (June–Jul–August and September) for different station located in north, middle and south Egypt between 1970 and 2012. Classify the heat waves into two types, short and long lasting heat waves, depending on the duration. A short-lasting heat wave is defined as an event more intense than normal daily mean (base period 1961-1990) of one or more standard deviations (from normal daily mean). This event has usually duration of 3 to 6 days. During the long-lasting heat waves events the air temperature is larger than the normal daily mean of one or more standard deviations (evaluated relatively to the normal daily mean) for 7 days or more. The NCEP-NCAR Reanalysis have been used to show characterizing weather patterns, the geopotential field, wind vector, air temperature, and Temperature thickness associated to short and long lasting.

By analysis the observation climate data to quantify the changes in heat wave number, length and intensity between 1970 and 2012.

The result can summarized as hot hays increase and cold night decrease.

The total number of heat wave days (Long and Short Events) is dramatically increased in the last 10 years. Short lasting heat wave more prevailing in summer time .long lasting heat wave less prevailing in Jul and August. The main synoptic patterns of long lasting heat wave as omega shape or blocking system. Short lasting heat wave as ridge in upper level and high pressure in surface causes compression and adiabatic heating in the surface layer. Heat-wave events increases damage to the agriculture, forest-fires, and, also, in term of human health and death loss.

Austrian climate services, a ZAMG contribution to supplement international activities

I. Auer, E. Koch

Central Institute for Meteorology and Geodynamics (ZAMG), Austria

Abstract

Climate services are climate information prepared for and distributed to specific users and/or the public. Austrian Climate services comprise past, present and future datasets and statistical analysis tailored according to the users' requirements. It is important that the distributed information reaches the user in a way that is understood. The challenge is not to duplicate international efforts but to develop meaningful supplements. Making use of international/European collaboration and cooperation ZAMG provides a long-term climate databank (HISTALP) and phenological data (PEP725) for understanding past natural climate variability and the transition into the anthropogenic epoch. Under the auspices of EUMETNET ZAMG has initiated a European wide data rescue activity focusing on long-term climate time series:

In Europe there is a good data coverage since the 1960ies, however to capture the full climate variability including extremes time series are often too short. Although a considerable part of long-term series have already been digitized and made available, there are still millions of data to be recovered and rescued. Due to a number of completed or running activities the number of digital available data has been increasing continuously, however an extended overview has not been made available so far. To get a rough overview on the current situation a questionnaire has been developed and distributed among NMSs within RA VI. As an output tables containing information about already digitized and data waiting to be rescued have been put on the web: https://www.zamg.ac.at/dare/.

HISTALP (http://www.zamg.ac.at/histalp) is a high quality long-term climate database for the Greater Alpine region going back to 1760. The criteria are long-term, dense, homogenized, multiple and user friendly.

The main objective of PEP725 (http://www.pep725.eu) is to promote and facilitate phenological science and research. PEP725 has been establishing a Pan European Phenological database with open access for science, research and education.

Climate services - The base for climate compatible decisions

J. Flückiger Knutti

MeteoSwiss, Switzerland

Abstract

We provide high quality science based information of Switzerland's past, present and future climate. Our information helps decision makers, energy companies, natural hazard managers, the building sector, the agricultural sector and many more to take climate compatible decisions.

Climate projections for Hong Kong based on IPCC AR5

T. C. Lee, H. W. Tong, H. S. Chan

Hong Kong Observatory, Hong Kong China

Abstract

The Fifth Assessment Report (AR5) of the IPCC Working Group I was based on a new set of global climate simulations from the Coupled Model Intercomparison Project Phase 5 (CMIP5) as well as a new set of greenhouse gas concentration scenarios named Representative Concentration Pathways (RCPs). This study pertains to an update and evaluation of Hong Kong's climate based on the new scenarios and the corresponding model simulations.

This study focuses on the temperature and rainfall projections for Hong Kong. CMIP5 models' performance in simulating Hong Kong's present climate (1961-2005) is assessed. The annual mean temperatures of Hong Kong in the 21st century under the RCP4.5 and RCP8.5 scenarios are derived through statistical downscaling on a monthly basis. Projection results suggest that the rising trend of the annual mean temperature will continue for the rest of the 21st century. Based on the RCP4.5 scenario, the central 90% of the model-projected temperature increase by 2100 will range from 1.4 to 3.2 deg C, relative to the average temperature of 1986-2005. For the RCP8.5 scenario, the central 90% of the projected temperature increase by 2100 will range from 3.3 to 5.5 deg C. Similar methodology is applied to the projection of the annual rainfall for Hong Kong in the 21st century, and the projection results will also be presented.

Challenges for harmonising high-resolution regional climate scenarios with present day climate data -- requirements for impact analyses

L. Bärring, R. A.I. Wilcke, T. Landelius, G. Nikulin, P. Dahlgren, P. Undén

Rossby Centre, Swedish Meteorological and Hydrological Institute (SMHI), Sweden

Abstract

Analyses of possible future climate impacts often involves impact models that have been developed and calibrated using present day climate data, often scattered station (point) data. When using such models with climate scenario data, that are gridded, a number of issues arise. Several of these can be handled by means of calibration (bias-correction), but that require high-quality reference data that become increasingly challenging to meet as the spatial resolution of scenario data increase. Another issue is that the ever-increasing size of scenario ensembles strain capacity for impact analyses without adding much. Therefore the questions arise about how to select a representative sub-set of scenarios. In this contribution we will show some resent results where high-resolution scenarios for Europe (CORDEX EUR-11: ~12.5 km) are calibrated using high-resolution regional reanalysis data (EURO4M MESAN: ~5.5 km). Moreover, some early results from scenario-selection tools in development within the EU-Copernicus project CLIP-C will be presented. These preliminary results and developments will be discussed in the light of tools and services available to Swedish stakeholders and policy-makers and interactions with these communities.

The Japanese 55-year reanalysis (JRA-55)

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Abstract

The Japan Meteorological Agency (JMA) has completed the second Japanese global reanalysis, the Japanese 55-year Reanalysis (JRA-55), informally as JRA Go! Go! (as “go” is the Japanese word for “five”), to provide a comprehensive atmospheric dataset suitable for the study of climate change and multi-decadal variability. The data cover a period of 55 years extending back to 1958 when regular radiosonde observations became operational on a global basis. The data assimilation system for JRA-55 is based on JMA’s operational data assimilation system (as of December 2009), which has been extensively improved since the Japanese 25-year ReAnalysis (JRA-25) dataset was produced. JRA-55 is the first global atmospheric reanalysis to apply four-dimensional variational assimilation (4D-Var) to the last half century including the pre-satellite era. JMA continues the production of JRA-55 dataset on a near real-time basis using the same data assimilation system as used for this dataset. The near real-time product is also called JRA-55.

Forecast scores obtained using JRA-55 data show remarkable improvement over those obtained with JRA-25. Scores for the Northern Hemisphere are particularly stable, indicating high temporal consistency in the region. Representation of long-term trends and low-frequency variations has been a major issue in reanalysis. With JRA-55, the temporal consistency of temperature analysis has improved considerably from that of previous instances of reanalysis. These basic performance and quality assessment of the data assimilation system will be shown in the poster**.**

CARPATCLIM - Climate information for climate services in Central Europe

Z. Konkolyne Bihari, T. Kovacs, M. Lakatos, T. Szentimrey

Hungarian Meteorological Service (OMSZ), Hungary

Abstract

The Carpathian Mountains represent the longest and most fragmented mountain chain in Europe. Climate change is expected to result in important changes in the Carpathian climate.

The aim of the “CARPATCLIM – The climate of the Carpathian region” project was the spatial and temporal examination the climate of the Carpathian region using harmonized data and standard methodology. Because of the long term of data and the different methods of measurement and data handling of the numerous countries sharing this region the unified processing of the station datasets is essential. This task was based on the MASH data homogenization method and on the MISH interpolation method, both developed at he project leader Hungarian Meteorological Service.

The target area of the project partly included the territory of the Czech Republic, Slovakia, Poland, Ukraine, Romania, Serbia, Croatia, Austria and Hungary. 415 climate stations and 904 precipitation stations were used in the project to achieve the objectives.

The final outcome of the CARPATCLIM project is a 0.1° (about 10 × 10 km) spatial resolution homogenized and gridded dataset on daily scale for basic meteorological variables and several climate indicators, 37 in total, on different time scales from 1961 to 2010. Data can be downloaded from the homepage of the project, www.carpatclim-eu.org.

In our work we present the most important results of the project.

Contribution of climate research to climate change adaptation

H. Tuomenvirta, K. Pilli-Sihvola

Finnish Meteorological Institute (FMI), Finland

Abstract

Adaptation to the inevitable consequences of the climate change is an integral element of climate policy, alongside with the mitigation of climate change. The precondition for launching the adaptation measures is the recognition of the need for adaptation to climate change in different sectors, which in turn must be based on applied research on adaptation. It is crucial to be able to communicate the results in a way that allows their utilization in decision-making and implementation of the policy measures. In addition, scientific knowledge can provide input to implementation and monitoring of adaptation policies.

We use a framework developed by Vogel et al. (2007) for describing science's influence on decision-making related to environmental problems. We have selected few examples of research and expert service activities of FMI (often together with other research partners) and placed on the "management cycle".

Improvement of simulated monsoon precipitation over South-Asia with a regionally coupled model ROM

P. Kumar, A. Hänsler, D. Sein, W. Cabos, D. Jacob

Helmholtz-Zentrum Geesthacht, Climate Service Center 2.0, Germany

Abstract

A regional coupled atmosphere–ocean model is developed to study the monsoon climate over the CORDEX South Asia domain. Most climate models underestimate observed precipitation over South Asia, but overestimate precipitation over the Bay of Bengal and the equatorial Indian ocean regions. From Global Climate Model (GCM) studies with a focus on the South Asian monsoon region it has been concluded that they have difficulty in simulating the mean climate in this region (Turner and Annamalai, 2012). Regional Climate Models (RCMs) however simulate orographic induced precipitation better, but show limited ability to simulate mean precipitation over land more generally (Lucas-Picher et al. 2011). These systematic differences between climate models and observation's may be related to poorly represented ocean dynamics and SST. For this study, differences in coupled and un-coupled RCM simulations are analyzed to investigate the effect of coupling on simulated climate, especially precipitation spatial patterns.

Climate information products for users: Examples from the German Climate Service Center

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Helmholtz-Zentrum Geesthacht, Climate Service Center 2.0, Germany

Abstract

In 2009, the German Federal Government (BMBF) established the German Climate Service Center (CSC) as part of the Hightech-Strategy for protection against climate change and the German Adaptation Strategy. The fundamental objective of the CSC is to support society (business, administration) to cope with climate risks and opportunities. In the first five years, the CSC developed a set of tools and products in order to provide climate information to users.

These products were mostly developed in close cooperation with the customers and are therefore sector-specific and tailored to the actual user's needs. In the presentation a selection of those user-tailored climate service products such as Climate-Fact-Sheets will be introduced and their application will be highlighted.

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