Program

This workshop will take place in Santander from the 14th (afternoon) to the 16th (morning) of May 2018.

Monday 14th

- 13:00 – 13:30 Registration **and in-site lunch**
- 13:30 – 14:00 Welcome and info

  Afternoon Session (seasonal and decadal timescales)
- 14:00 – 14:35 **Invited:** Bias adjustment of climate predictions in a climate service context (Francisco Doblas-Reyes)
- 14:35 – 14:55 Process-conditioned bias correction for seasonal forecasting: A case-study with ENSO in Peru (Rodrigo Manzanas)
- 14:55 – 15:15 Reduction of model precipitation bias and impact on summer prediction skill (Constantin Ardilouze)
- 15:15 – 15:35 Seasonal Forecasts from the Copernicus Climate Change Service (Eduardo Penabad)
- 15:35 – 16:05 **Coffee Break**
- 16:05 – 16:40 **Invited:** Re-calibration of long-range forecasts (Jonas Bhend)
- 16:40 – 17:00 Evaluation of re-calibrated decadal hindcast using a common verification framework (Jens Grieger)
- 17:00 – 17:20 The ADAMONT method for statistical adjustment of climate projections and seasonal-to-decadal predictions applicable to energy balance land surface models (Deborah Verfaillie)
- 17:30 – 18:30 Beer (or wine) and posters (see the full list below).
- 20:00 **Social diner** (Santander downtown)

Tuesday 15th

Morning session (Methods and ongoing initiatives)

- 9:00 – 9:35 **Invited:** Thoughts on a conditional, process-oriented approach to bias correction (Ted Shepherd)
- 9:35 – 9:55 Two types of physical inconsistency to avoid in climate services: Lessons learned from the application of univariate quantile mapping to humidity variables (Patrick Grenier)
- 9:55 – 10:15 Why does intensity-dependent bias correction modify the climate change signal? (Martin Ivanov)
- 10:15 – 10:35 A trend adjusting bias correction of climate simulations using RQM (Christian Passow)
- 10:35- 11:00 **Coffee Break**
- 11:00 – 11:30 An overview of the COPERNICUS Sectoral Information System (Carlo Buontempo)

- 11:30 – Bias Correction Intercomparison Project: Applying an ensemble of bias-adjustment methods (Grigory Nikulin)
- 12:00 – 13:00 **RoundTable:** Ongoing BC-ESD intercomparison initiatives (Jose M. Gutiérrez, Mathieu Vrac).
- 13:00 – 14:00 **In-site Lunch**

Afternoon Session (Methods and new developments)

- 14:00 – 14:35 **Invited:** Applications of a high-resolution bias-corrected climate projection ensemble and related science questions (Robert Vautard)
- 14:35 – 14:55 Percentile adjustment function: Application to direct and component-wise bias correction of a multi-variate climate index (Jesús Fernández)
- 14:55 – 15:15 A process-informed statistical framework for the spatial distribution and intensity of orographic precipitation (Paola Marson)
- 15:15 – 15:35 Stochastic downscaling of precipitation: A simple method to adjust the fine-scale precipitation climatology (Silvia Terzago)
- 15:35 – 16:30 **Coffee Break and posters**
- 16:30 – 17:05 **Invited:** Towards a stochastic Model Output Statistics emulator for convection-permitting climate simulations of short-duration precipitation: Application to the CanRCM4 Large Ensemble (Alex Cannon)
- 17:05 – 17:25 Rank Resampling for Distributions and Dependences (R2D2) Bias Correction: Multivariate adjustment of high-dimensional climate simulations (M. Vrac)
- 17:25 – 17:45 Multivariate stochastic bias corrections with optimal transport (Yoann Robin)
- 17:45 – 18:15 **Invited:** Bias Adjustment in the frequency domain (Ashish Sharma)

Wednesday 16th

Morning session (Applications)

- 9:00 – 9:35 **Invited:** Bias of climate model outputs: Implications for climate change impact and adaptation assessment in agriculture (Margarita Ruiz-Ramos)
- 9:35 – 10:10 **Invited:** A study of Climate Change Impact on Crop Yields in West Africa: the role of bias correction and future applications of multivariate state-of-the-art methods (Claudio Piani)
- 10:10 – 10:30 Bias-adjustment for an agro-ecosystem project in Hungary (Péter Szabó)
- 10:30 – 10:50 Bias correction of surface downwelling longwave and shortwave radiation for the EWEMBI dataset (Stefan Lange)
- 10:50- 11:20 **Coffee Break**
- 11:20 – 11:40 Challenges in the bias correction of a multi-variate index under climate change conditions (Ana Casanueva)
- 11:40 – 12:00 Evaluation of various bias correction methods for Mediterranean cities climate projections: Results from the URBANPROOF project (Konstantinos Varotsos)
- 12:30 **Bus to Bilbao airport:** Expected arrival to Bilbao airport at 14:00.

Poster Session:

- **P1:** Seasonal forecast via dynamical systems and bias correction techniques (M.C. Alvarez-Castro)
- **P2:** A stochastic in-run bias correction method for seasonal predictions (L. Batté)
- **P3:** Model selection for DeFoReSt: A strategy for recalibrating decadal predictions (A. Pasternack)
- **P4:** DownscaleR: An R-based package for statistical downscaling and bias correction within the climate4R framework (M. Iturbide)
- **P5:** Downscaling and bias correction for the new CH2018 Swiss climate scenarios (S. Kotlarski)
- **P6:** Bias Correction approaches to assess future variations in IDF curves for the city of Naples (V. Villani)
- **P7:** A Perfect Model Approach to assess the statistical downscaling skills using CDFt over Corsica (H. Omrani)
- **P8:** Bivariate bias correction of monthly temperature and precipitation from regional climate models (R. Sokol Jurkovic)
- **P9:** Impact of bias correction methods on climate downscaled projections over the Pyrenees (P. Amblar-Frnacés)
- **P10:** A proposal for a bias correction metadata model in the framework of METACLIP (METAdata for CLImate Products) (J. Bedia; PREDICTIA Intelligent Data Solutions)
- **P11:** Bias adjustment of projections and predictions as a climate service (H. Loukos; the climate data factory)

Bias adjustment of climate predictions in a climate service context

F. Doblas-Reyes
(ICREA and Barcelona Supercomputing Center, BSC, Spain)

Abstract:

Most examples of climate services that employ climate predictions include a bias adjustment step. A large variety of methods have been used to address the need for bias adjustment so that the user and/or the decision maker can include the resulting climate information in processes that have often been developed using observations. This presentation will illustrate some of these methods and discuss their relative merits. It will also describe how the limitations of current real-time forecast systems, including the bias adjustment methods typically used, fail to satisfy some of the identified user requirements. The relationship of bias adjustment with the multi-model and empirical forecasting approaches will also be part of the illustrations presented.

**Process-conditioned bias correction for seasonal forecasting:
A case-study with ENSO in Peru**

R. Manzanas, J.M. Gutiérrez
(Institute of Physics of Cantabria, CSIC-Universidad de Cantabria, Spain)

Abstract:

An important limitation of bias correction (BC) methods is that they can introduce arbitrary temporal changes which can deteriorate the interannual variability of the raw predictions. To partially alleviate these problems, Maraun et al. (2017) advocated the development of process-informed BC methods, combining the statistical modeling with the knowledge about the relevant processes for the problem under study. However, the application of this type of methods remains unexplored yet for the case of seasonal forecasts. Thus, this work assesses the suitability of a first simple attempt for process-conditioned BC in the context of seasonal forecasting. To do this, we focus on the northwestern part of Peru and bias correct one- and four-month lead seasonal predictions of boreal winter precipitation from the ECMWF System4. In order to include information about the underlying large-scale circulation which may help to discriminate between precipitation affected by different processes, we introduce here an empirical quantile-quantile mapping which runs conditioned on the state of the Southern Oscillation Index (SOI), which is accurately predicted by System4 and is known to affect the local climate. Our results show that a standard implementation in which the quantile-quantile mapping is directly applied over the entire period of study (1981-2010) broadly preserves the temporal structure of the raw model precipitation and, as a consequence, does not improve its unskillful predictions -beyond correcting the mean biases.- Contrarily, the SOI-conditioned version presented here (which is separately applied for three different sets of years; defined according to the terciles of the SOI) can modify the temporal sequence of the raw model output, providing more realistic local time-series, which results in improved ROC Skill Scores and reliability over the entire study area. This suggest that conditioning the bias correction on simple but well-simulated large- scale processes relevant to the local climate may be a suitable approach for seasonal forecasting.

Maraun D, Shepherd TG, Widmann M, Zappa G, Walton D, Gutiérrez, J.M., Hagemann S, Richter I, Soares PMM, Hall A, Mearns LO (2017): Towards process-informed bias correction of climate change simulations. Nature Climate Change DOI: 10.1038/NCLIMATE3418

Reduction of model precipitation bias and impact on summer prediction skill

C. Ardilouze, L. Batté, M. Déqué
(CNRM, Météo France & CNRS, France)

Abstract:

Soil moisture is a well-known source of summer potential predictability, in particular over regions of intense land-atmosphere coupling. However, improving soil moisture initialization in dynamical forecast systems leads to increased temperature and precipitation prediction skill over fewer regions than one could expect. This limitation could originate from model precipitation biases, prone to rapidly spoil the soil moisture anomalies present in the land surface initial conditions. In order to make the most out of soil moisture as a source of prediction skill, we implemented a method to reduce the precipitation bias throughout the model integration. Both the frequency and intensity of precipitation intercepted by the land surface are corrected at each time step. The impact of such a method in terms of model mean climate and boreal summer forecast skill is assessed for several key atmospheric variables.

Seasonal Forecasts from the Copernicus Climate Change Service

E. Penabad, A. Brookshaw
(ECMWF)

Abstract:

TBC

Re-calibration of long-range forecasts

Jonas Bhend
(Federal Office of Meteorology and Climatology, Meteoswiss, Switzerland)

Abstract:

Long-range forecasts are increasingly being used to inform real-world decisions in a variety of sectors. For such forecasts to be useful, aspects of the climatic conditions that are relevant to the respective application are sought to be characterized. Down-stream applications such as impact predictions for floods or drought and seamless products linking forecasts with monitoring require long-range forecasts to be formulated quantitatively rather than as tendencies relative to baseline conditions. Systematic errors therefore have to be corrected to maximize the benefit of long-range forecasts. While calibration is being routinely performed with medium-range weather forecasts, long-range forecasts offer specific challenges that have to be dealt with. Limited predictability and the inherent uncertainty of weather predictions weeks to years ahead require long-range forecasts to be formulated probabilistically. Forecast calibration therefore has to not only correct systematic errors but also adjust forecast spread to be able to generate reliable predictions. Furthermore, limited predictability in conjunction with the relatively small sample of re-forecasts available for calibration often limit the complexity of recalibration methods that can be employed. We illustrate the above challenges with various recent examples and present promising approaches for further development of bias correction and recalibration methods for long-range forecasts.

Evaluation of re-calibrated decadal hindcast using a common verification framework

J. Grieger, A. Pasternack, H.W. Rust, U. Ulbrich
(Freie Universität Berlin, Germany)

Abstract:

Decadal predictions deal with the time scale which is important for decision makers and infrastructural planners for the near-term future. For usability of those predictions it is important to know about their forecast skill. Recent work suggest verification frameworks to answer the key questions whether initialization of the forecast model leads to higher skill in comparison to the un-initialized simulations and whether the spread of the ensemble represents the forecast uncertainty? Initialized model simulations typically have to deal with biases which are dependent on forecast lead time, also known as model drift. Additionally, this behavior can depend on initialization time, i.e. bias and drift can be different for simulations which are initialized in the 1960s in comparison to most recent hindcasts. This study uses a "Decadal Forecast Re-calibration Strategy" (DeFoReSt) which adjusts mean and conditional bias as well as ensemble spread, taking lead time and initialization time into account. A common verification framework is used to analyze the skill of decadal hindcasts simulated with the general circulation model MPI-ESM under the umbrella of MiKlip, which is the German initiative on decadal prediction. For near surface temperature and precipitation it is shown how the initialized simulations perform using the lead time dependent anomaly adjustment recommended by the Decadal Climate Prediction Project (DCPP). Furthermore the improvement through the use of the sophisticated post processing procedure (DeFoReSt) is discussed.

The ADAMONT method for statistical adjustment of climate projections and seasonal-to-decadal predictions applicable to energy balance land surface models

D. Verfaillie (1,2,3), M. Déqué (2), S. Morin (2,3), M. Lafaysse (2,3), J.M. Soubeyroux (4), S. Bernus (4), V. Gouget (4), R. Samacoits (4), P. Lassègues (4), P. Etchevers (4), A.L. Gibelin (4), L. Batté (2), C. Viel (4), L.P. Caron (1), F.J. Doblas-Reyes (1).

(1: Barcelona Supercomputing Center, Spain. 2: Météo France - CNRS, CNRM, France. 3: Centre d'Etudes de la Neige, Grenoble, France. 4. Météo-France – DCSC, France)

Abstract:

Statistical adjustments and dowscaling methods are commonly employed tools to use the output of global climate models and regional climate models for driving impact models, for climate projections or seasonal- to-decadal predictions. Snow on the ground is sensitive to multiple atmospheric drivers, so that several variables must be simultaneously accounted for (temperature, rain and snow precipitation, incoming radiation, wind speed etc.). Here we introduce the ADAMONT method for statistical adjustment of climate projections and seasonal-to-decadal predictions applicable to energy balance land surface models (Verfaillie et al., GMD 2017) and several ongoing and future applications of the method. Briefly, the method is based on quantile mapping applied to daily data (treating data by season and weather patterns), followed by time disaggregation using analog dates from the observation dataset and accounting for various weather patterns. Meteorological observations used for the quantile mapping consist of the regional scale reanalysis SAFRAN, which operates at the massif scale and for 300 m elevation bands. It is available over the French Alps since 1958 and over the entire Pyrenean chain since 1980. Outputs from EURO-CORDEX simulations spanning 6 different RCMs forced by 6 different GCMs under 3 representative concentration pathways scenarios (RCP 2.6, 4.5 and 8.5) were downscaled over Europe and statistically adjusted using the SAFRAN reanalysis. These corrected fields of hourly temperature, precipitation, wind speed, humidity, and short- and longwave incoming radiation were then used to drive the SURFEX/ISBA- Crocus land surface model over the French Alps and the Pyrenees. The main results of this application will be described, with a particular focus on the role played by the various uncertainty components at play and the elevation-dependency of the results. The presentation will then address ongoing and future use of the method for downscaling and adjusting climate projections at a wider geographical scale, at the country level in France, and within the Copernicus C3S Sectoral Information Service "European Tourism". Furthermore, the application of the method for seasonal-to-decadal prediction, which is planned within the H2020 PROSNOW and EUCP projects as well as the ERA4CS MEDSCOPE project, will be introduced.

Thoughts on a conditional, process-oriented approach to bias correction

Ted Shepherd
(University of Reading, UK)

Abstract:

Climate model deficiencies in simulating large-scale dynamics, when considered together with the uncertainty in the atmospheric circulation response to climate change, compound the challenge of bias correction for regional climate change information. It is suggested that a process-oriented approach, conditioned on the large-scale drivers of atmospheric circulation, could be a useful framework for deriving maximum information on model biases. Such an approach can be cast within the framework of a causal network to avoid the pitfalls of a purely correlation-based approach.

Two types of physical inconsistency to avoid in climate services: Lessons learned from the application of univariate quantile mapping to humidity variables

P. Grenier
(Groupe Scénarios et services climatiques, Ouranos, Canada)

Abstract:

Statistical post-processing techniques, including quantile mapping (QM), aim at generating plausible climate scenarios from climate simulations and observation-based reference products. These techniques are not physically-based, and consequently they remedy the problem of simulation biases at the risk of generating a problem of physical inconsistency. Although this concern is often emphasized, it is rarely addressed quantitatively, and views differ on what should and should not count as a type of physical inconsistency (PI). In the case study presented here, PI generated by univariate QM, a technique widely used in climate services, is investigated with relative humidity (RH) and its parent variables, namely specific humidity (SH), temperature and pressure. PI is classified into two types: 1) inadequate value for an individual variable (e.g. RH > 100 %), and 2) breaking of an inter-variable relationship. Scenarios built for this study correspond to twelve sites representing a variety of climate types over North America. Data used are an ensemble of ten 3-hourly global (CMIP5) and regional (CORDEX-NAM) simulations, as well as the CFSR reanalysis. PI of type 1 is discussed in terms of frequency of occurrence and amplitude of supersaturation cases for RH and SH variables. PI of type 2 is investigated with heuristic proxies designed to directly compare the physical inconsistency problem with the initial bias problem. Finally, recommendations are provided for an appropriate use of univariate QM given the potential to generate physical inconsistency of types 1 and 2.

Why does intensity-dependent bias correction modify the climate change signal?

M. Ivanov (1), S. Kotlarski (2), J. Luterbacher (1)
(1: Justus-Liebig University of Giessen, 2: MeteoSwiss)

Abstract:

Climate change impact research and risk assessment require accurate estimates of the climate change signal (CCS, future climate minus current climate). Generally, climate model biases do not cancel out in the calculation of the CCS, so the CCS is also biased. Recent research suggests that model biases are well approximated as being dependent only on the magnitude of the simulated/observed values: a feature named intensity dependence. For example, higher precipitation amounts tend to have larger biases. Therefore, bias-correction methods that apply individual corrections to different model intensities have been shown to improve climate statistics. However, whether or not the resulting modification of the CCS is a beneficial effect, is debatable. The mechanisms of that modification are analytically understood only for the distribution mean of variables that have no zero values (also known as interval variables) such as temperature. Current knowledge is not directly transferable to variables that have a natural zero limit (ratio variables), such as (sub)daily precipitation and wind speed that are of primary importance for assessment of the future severe flooding and wind energy potential. This is because zeros are treated differently than positive values. Here, we present a novel linearised analytical theory of the effect of climate model biases on the CCS of the distribution mean and quantiles. The bias-free CCS is expressed as the sum of a scaled component that describes the removal of intensity-dependent biases and a level component that adjusts the CCS level in accordance with the future change of the positive-event probability or its bias. Adjusting the positive-event probability affects the CCS of the distribution mean and is quantified by an additional "epsilon" component. The theoretical approach can be extended in a straightforward manner for non-linear biases and other climate statistics. The theory reveals that misrepresented model intensities and probability of non-zero (positive) events have the potential to distort raw model CCS estimates. We test the analytical description in a challenging application of bias-correction and downscaling to daily precipitation over alpine terrain, where the output of 15 regional climate models (RCMs) is reduced to local weather stations. The theoretically predicted CCS modification well approximates the modification by the empirical quantile mapping bias correction method, even for the station-RCM combinations with the largest absolute modifications. These results demonstrate that the CCS modification by bias correction is a direct consequence of removing model biases. Therefore, provided that application of bias correction is scientifically appropriate, the CCS modification should be a desirable effect. The analytical theory can be used as a tool to 1) detect model biases with a high potential to distort the simulated CCS and 2) efficiently generate novel, improved CCS datasets. The latter will form the base for supporting climate change adaptation, mitigation, and resilience strategies for end users, stakeholders, and policymakers. Future research needs to focus on developing physically based bias corrections that depend on simulated intensities rather than preserving the raw model CCS.

A trend adjusting bias correction of climate simulations using RQM

C. Passow, R.V. Donner
(Postdam Institute for Climate Impact Research, Germany)

Abstract:

Climate impact studies (CIS) aim to quantify future risks of climate change for the environment and all kinds of living organisms. For this purpose, CIS require plausible and physically realistic representations of the future climate for various scenarios. However, the climate projections of state-of-the-art General Circulation Models (GCMs) or Regional Climate Models (RCMs) still commonly exhibit large systematic biases resulting from a multiplicity of factors like erroneous boundary conditions, imperfect parameterizations, coarse resolution or general misrepresentations of atmospheric processes. During the past decade, a variety of bias corrections methods (BCMs) were developed to remove these biases. A particular successful BCM is quantile mapping (QM). The method is easy to apply, yet it shows remarkable results in removing biases in the full distribution of the simulated climate variable. However, QM and other BCMs struggle to fully respect the multivariable and time-dependent character of the climate system, which can be misleading in the context of a changing climate. Here, we propose an alternative BCM called regression quantile mapping (RQM), a novel combination of linear quantile regression (QR) and the quantile delta mapping (QDM) by Cannon et al. (2015). Unlike other BCMs, RQM adjusts not only the simulated distribution but also the response of the climate variable to changes in time or other variables. Here, we present the concept and performance of our RQM using historical simulations (1960-2005) of precipiation from an RCM of the Euro-CORDEX ensemble. A comparison of the results against observational data shows that RQM generates accurate trends over Europe and that a bias correction taking other climate variables as additional covariates has great potentials.

An overview of the COPERNICUS Sectoral Information System

Carlo Buontempo
(ECMWF)

Abstract:

TBC

Bias Correction Intercomparison Project: Applying an ensemble of bias-adjustment methods

G. Nikulin (1), T. Bosshard (1), R. Wilcke (1), W. Yang (1), L. Bärring (1), J.M. Gutiérrez (2), S. Herrera (3), J. Fernández (3), A. Dobler (4), T. Ioannis (5), A. Koutroulis (5), M. Grillakis (5), A. Dosio (6), M. Vrac (7), R. VAutard (7), T. Noel (7), M. Switnek (8).

1: Swedish Meteorological and Hydrological Institute, Sweeden. 2: Institute of Physics of Cantabria, CSIC-Universidad de Cantabria, Spain. 3: Universidad de Cantabria, Spain. 4: MetNo, Norway. 5: Technical University of Crete. 6: Joint Research Center, Italy. 7: L'Institut Pierre-Simon Laplace. 8: University of Graz, Austria.

Abstract:

We present results from a Bias Correction Intercomparison Project (BCIP). The main driver for initiating the BCIP was a need in a number of European Union projects (FP 6 and 7) to provide bias-adjusted simulations for impact modelling together with information about bias-adjustment-related uncertainties and limitations. Within the BCIP two experiments focusing on different climate zones have been designed, namely: one on the mid-latitude climate taking the Euro-CORDEX simulations (50km) and the second on the tropical climate using the CORDEX-Africa simulations (50 km). 11 bias-adjustment approaches (different methods and the same methods with modifications) have been applied to two regional climate model (SMHI-RCA4 and IPSL-INERIS-WRF331F) simulations over Europe driven by the same global model (IPSL-CM5A-MR) under the RCP8.5 scenario. SMHI-RCA4 on average shows a wet bias over Europe in winter and a mixed pattern in summer: wet in central/northern Europe and dry in southern Europe. IPSL-INERIS-WRF331F has a strong wet bias along some coastal areas in summer and also too wet over the continent in winter. Gridded observations for Europe – E-OBS (v. 10) are used as a reference observational dataset for 1981-2010. A number of various statistics describing climatology are taken for evaluation (the calibration period) and analysis (future scenario) starting from basic seasonal means and ending, with a special emphasize, by high-order statistics as extreme events, variability and climate indices. The analysis shows that in general there is no "best" bias-adjustment method, although some methods are better "balanced" across different statistics for the calibration and scenario periods. Additionally, performance of different approaches depends not only on the bias-adjustment methods but also on the input climate simulations (different kinds of biases).

Applications of a high-resolution bias-corrected climate projection ensemble and related science questions

Robert Vautard
(LCSE/CNRS, France)

Abstract:

TBC

Percentile adjustment function: Application to direct and component-wise bias correction of a multi-variate climate index

J. Fernández (1), A. Casanueva (2), J. Bedia (1), S. Herrera (1), J.M. Gutiérrez (3).

1: Universidad de Cantabria, Spain. 2: Federal Office of Meteorology and Climatology, MeteoSwiss, Switzerland. 3: Institute of Physics of Cantabria, CSIC-Universidad de Cantabria, Spain

Abstract:

Multi-variate climate indices (CIs) are frequently used for many sectoral climate change impact applications. These indices combine two or more essential climate variables that are frequently individually corrected prior to the CI calculation. This poses the question of whether the bias correction (BC) method modifies the inter-variable dependencies and eventually the climate change signal. The direct bias correction of the multi-variate CI stands as an alternative, since it preserves the physical and temporal coherence among the primary variables as represented in the dynamical model output. This comes at the expense of incorporating the individual biases on the CI computation with an effect difficult to foresee, particularly in the case of complex CIs bearing in their formulation non-linear relationships between components. Such is the case of the Fire Weather Index (FWI), a meteorological fire danger indicator frequently used in forest fire prevention and research. In the present work, we test the suitability of the direct BC approach on FWI as a representative multi-variate CI, assessing its performance in present climate conditions and its effect on the climate change signal when applied to future projections. Moreover, the results are compared with the common approach of correcting the input variables separately. To this aim, we apply the widely used empirical quantile mapping method (QM). We introduce the percentile adjustment function (PAF) as a tool to provide insight into the effect of the QM on the climate change signal. Although both approaches present similar results under present climate, the direct correction introduces a greater modification of the original change signal. These results warn against the blind use of QM, even in the case of essential climate variables or uni-variate CIs.

A process-informed statistical framework for the spatial distribution and intensity of orographic precipitation

P. Marson (1,2), S. Materia (1), D. Nychka (3), S. Gualdi (1,4).

1: Euro-Mediterranean Center on Climate Change Foundation, taly; 2: University of Venice, Italy. 3: National Center for Atmospheric Research, US. 4: National Institute of Geophysics and Volcanology, Italy

Abstract:

Precipitation has a direct impact on both the ecosystem and the human society, it affects groundwater and reservoirs, and constitutes a major environmental hazard. The accurate evaluation of the spatial distribution and intensity of precipitation at local scales is crucial for risk assessment and water management, especially in mountainous regions downstream of which human activities may be strongly impacted. Climate models have a rather coarse resolution, are often biased, and in general unable to accurately represent precipitation at local scales. In particular, in regions of complex orography spatial patterns of precipitation exhibit abrupt discontinuities and spatio-temporal variability at a much higher frequency. Statistical approaches can be used to correct model simulations making use of observations. One challenge is to obtain corrected values with an appropriate spatial consistency, yet observed rainfall data are in general too sparse to be representative of the topographic variations of the "true" precipitation field. We develop a new statistical model for inferring orographic precipitation (herafter SMOP) able to: (1) describe the spatial distribution and intensity of precipitation over complex terrain; (2) create interpolated surfaces accordingly; (3) deal with the relative spatial sparsity of observations. SMOP does not rely only on observations but one important innovation is the careful incorporation of scientific knowledge of the processes involved. To this aim, SMOP builds on features of the analytical up-slope-time-delay model by Smith (2003). Making use of atmospheric fields such as winds, temperature, humidity and large-scale fraction of precipitation from numerical climate models or reanalysis, SMOP is able to provide downscaled precipitation producing a physically informed grid refinement, that combines the information carried in observed data. In particular, a 2-dimensional advection equation for the column integrated cloud water density was derived reducing Smith (2003). The equation represents (1) the processes that form clouds due to forced uplift of moist air, (2) the downwind drift of cloud water and (3) its conversion to precipitation.
By discretizing the advection equation and perturbing it by means of stochastic noise, we specify a simultaneous autoregressive model for a spatial Gaussian field representing a latent potential of precipitation, that gets converted in both precipitation occurrence and intensity. The Gaussian field moments depend on both physical quantities and unknown parameters estimated from observed precipitation data. Here we present the methodology, some idealized experiments and a real application to evaluate the model skills and limitations. The approach may be used as the kernel for downscaling techniques applicable to different time-scales, from short-term forecasts, to seasonal predictions up to climate change projections.

Stochastic downscaling of precipitation: A simple method to adjust the fine-scale precipitation climatology

S. Terzago, J. Von Hardenberg, E. Palazzi
(Institute of Atmospheric Sciences and Climate, CNR, Italy)

Abstract:

The spatial resolution currently achieved by global and regional climate models is still insufficient for a correct representation of the structure of precipitation at fine-scales (~1 km) and of extreme precipitation events. In absence of a proper physically-based representation, a common approach to bridge this scale mismatch are stochastic rainfall downscaling techniques. However, these techniques usually provide a statistically homogeneous distribution of fine-scale precipitation in each large-scale grid element, so they usually do not take into account heterogeneities in local precipitation patterns, such as orographic-induced effects, at spatial scales finer than those resolved by the large-scale field to downscale. For this reason, stochastic downscaling techniques may be less reliable than expected particularly in areas with complex topography. Here we test a simple method to introduce realistic fine-scale precipitation patterns into the downscaled fields. The proposed method relies on the availability of a reference fine-scale precipitation climatology from which corrective weights are derived and used to adjust to the downscaled daily precipitation fields. We demonstrate the method by applying it to the Rainfall Filtered AutoRegressive Model (RainFARM) stochastic rainfall downscaling algorithm (Terzago et al., 2018; D'Onofrio et al., 2014; Rebora et al., 2006). The "modified" RainFARM method has been tested focusing on an area of complex topography encompassing the Swiss Alps. First we considered a "perfect model experiment" in which high resolution (4 km) simulations performed with the Weather Research and Forecasting regional model are aggregated to a coarser resolution (64 km) and then downscaled back to 4 km and compared with the original data. Second, the modified RainFARM is applied to the E-OBS gridded precipitation data (0.25 degrees spatial resolution) over Switzerland, where high-quality gridded precipitation climatologies and accurate in-situ observations are available for comparison with the downscaled data. The results of the "perfect model experiment" and the "real case experiment" are discussed and compared, showing the strengths of the method and providing ideas for possible further developments.

Towards a stochastic Model Output Statistics emulator for convection-permitting climate simulations of short-duration precipitation: Application to the CanRCM4 Large Ensemble

Alex Cannon
(Environment and Climate Change Canada, Canada)

Abstract:

Climate models that parameterize convection may not provide credible, unbiased future projections of short duration precipitation extremes. There is increasing evidence that high-resolution convection-permitting climate models (CPMs) provide added value in this context. However, lengths of integrations are short — typically one to two decades for historical and future scenarios — and hence it is difficult to generalize results, for example to different forcing scenarios, from the limited number of realizations that are currently available. On the other hand, it is now possible to run large initial-condition and multi-forcing ensembles of regional climate models (RCMs) that parameterize convection. Can credible information from RCMs and CPMs be combined to leverage the strengths of each modelling system? This presentation provides an overview of efforts to build and apply a stochastic Model Output Statistics (MOS) emulator of daily maximum 1-hr precipitation from a CPM (NCAR HRCONUS WRF) using large-scale covariates, including stability indices, precipitable water, water vapour transport, etc. from a large 50 member initial condition RCM ensemble (CanRCM4 LE). The MOS emulator, which is based on a flexible non-crossing quantile regression framework — the monotone composite quantile regression neural network (MCQRNN) — is being tested over major population centres in Canada using ERA-Interim driven simulations of WRF and CanRCM4. Initial results suggest that the MOS emulator provides well-calibrated probabilistic estimates of short-duration precipitation that improve substantially upon raw CanRCM4 outputs.

Rank Resampling for Distributions and Dependences (R2D2) Bias Correction: Multivariate adjustment of high-dimensional climate simulations

M. Vrac
(LSCE/CNRS/IPSL, France)

Abstract:

Climate simulations often suffer from statistical biases with respect to observations or reanalyses. It is therefore common to correct (or adjust) those simulations before using them as inputs into impactmodels. However,most bias correction (BC) methods are univariate and so do not account for the statistical dependences linking the different locations and/or physical variables of interest. In addition, they are often deterministic, while stochasticity is frequently needed to investigate climate uncertainty and to add constrained randomness to climate simulations that do not possess a realistic variability. I present a new multivariate method of "Rank Resampling for Distributions and Dependences" (R2D2) bias correction that allows adjusting not only the univariate distributions, but also their inter-variable and inter-site dependence structures. Moreover, the proposed R2D2 method provides some stochasticity since it can generate as many multivariate corrected outputs as the number of statistical dimensions (i.e., number of grid-cells x number of climate variables) of the simulations to be corrected. It is based on an assumption of stability in time of the dependence structure – allowing to deal with a high number of statistical dimensions –, that lets the climate model drive the temporal properties and their changes in time. R2D2 is applied on temperature and precipitation reanalyses time series with respect to high-resolution reference data over South-East of France (1506 grid-cells). Bivariate, 1506-dimensional and 3012-dimensional versions of R2D2 are tested over a historical period and compared to a univariate BC. How the different BC methods behave in a climate change context is also illustrated with an application to regional climate simulations over the 2071- 2100 period. The perspectives of improvements include: introducing stochasticity in the dependence itself, questioning its stability assumption, and accounting for temporal properties adjustment while including more physics in the adjustment procedures.

Multivariate stochastic bias corrections with optimal transport

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Abstract:

Bias correction methods are used to calibrate climate model outputs with respect to observational records. The goal is to ensure that statistical features (such as means and variances) of climate simulations are coherent with observations. We have developed a multivariate stochastic bias correction method based on optimal transport. Bias correction methods are usually defined as transfer functions between random variables. Such transfer functions induce a joint probability distribution between the biased random variable and its correction. The optimal transport theory allows us constructing a joint distribution that minimizes an energy spent in the bias correction. This extends the quantile mapping techniques in the multivariate case. We propose also a definition of non-stationary bias correction as a transfer of the model to observational world, and we extend our method in this context. Those methodologies are tested on an idealized 3-variate chaotic system. The correlations between variables appear almost perfectly corrected by our method in those controlled experiments, as opposed to a univariate correction. Our methodology is also tested on 12 grid points of a high resolution regional climate simulations over southern France.

Bias Adjustment in the frequency domain

Ashish Sharma
(University of New South Wales, Australia)

Abstract:

TBC

Bias of climate model outputs: Implications for climate change impact and adaptation assessment in agriculture

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Abstract:

Climate model outputs are helpful tools for the assessment of climate change impacts and adaptation strategies in agriculture. Nevertheless, the biases of model outputs have major implications in such assessments. Although biases have been reduced consistently through the subsequent generations of climate models and projections, for instance by regional climate models (RCMs), biases considered acceptable in climate science can be still hard to manage in biology and engineering related sciences. One of the reasons is the existence of biophysical thresholds, e.g. lethal and damage temperatures, wilting point, etc. Other reason is that biases do not propagate linearly through the modelling chain (i.e. a 20% of bias in precipitation or temperature does not necessarily translate into 20% of yield bias). Precipitation needs special attention. Accurate simulation of precipitation is crucial for rainfed system assessment, as rainfed crop viability depends on precipitation amount, seasonal distribution and extremes. Irrigated crop viability depends on well-designed irrigation systems, that in turn, depend on adequate estimation of supply (precipitation projections) and demand (evapotranspiration projections). Temperature is also crucial for an adequate simulation of crop development. Most bias correction work has focused in temperature and precipitation, while consistency with other variables relevant for agricultural production like radiation, wind speed and relative humidity have been addressed only recently. There are many bias correction techniques available and recent studies have shown that the chosen technique can result in a differential of 10-20% in impact results. Moreover, there is not a best universal technique, but mostly locally tailored solutions. Also, the representativeness of the observational data set used for the correction has proven to be relevant. The proper selection of data and methods, and the correction itself, are highly time-consuming tasks. But they also should be considered highly value-adding tasks. We need a debate about bias correction becoming an added-value climate service and who the providers of such a service would be. A combination of data providers (climate modellers) and users (impact modellers) seems a promising solution.

A study of Climate Change Impact on Crop Yields in West Africa: the role of bias correction and future applications of multivariate state-of-the-art methods

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Abstract:

Climate change is expected to have a negative impact on crop yields in Sub-Saharan West Africa in the mid-21st century. However recent studies suggest that adaptation measures may mitigate or even reverse the negative effects. These impact studies generally rely on some form of bias correction. Here we present results form a process-based crop-yield model developed by the FAO (AquaCrop), used to quantify the impact of climate change on several key cereal crops in the Niger Basin. The crop-yield model was forced with a nine-member ensemble of CGM-RMC pairs to which was applied a simple univariate bias correction on temperature and precipitation. Only RCP4.5 and 8.5 are considered. Results show that management or adaptation factors, such as soil fertility, had a much larger effect on crop yield than the climatic change factors alone. Though very encouraging, these results are based on fairly simple one dimension bias correction methodologies. A shift to multivariate bias correction could, under specific emission scenarios, result in forcing field changes comparable to the impacts themselves. A review of state-of-the-art multivariate bias correction methodologies and their potential effects on impacts projections is presented.

Bias-adjustment for an agro-ecosystem project in Hungary

P. Szabó
(Hungarian Meteorological Service, Hungary)

Abstract:

The Hungarian Meteorological Service (OMSZ) provides climate services on high-resolution multi-decadal RCM projections for impact studies and decision makings in Hungary. Apparent and non-linear climate model biases may lead to incorrect impact results, therefore the utilization of a sophisticated bias correction method is inevitable nowadays. Under an Economic Development and Innovation Operational Programme (GINOP) national project – which focuses on alteration of agro-ecosystems due to climate change – OMSZ has to deliver a subset of bias-adjusted fine-resolution EURO-CORDEX projections to serve the applied impact model. Since there is no royal approach by now, the different methods bring an extra uncertainty factor into the final output products. As a start it seems to be valuable for the project that the five required meteorological variables such as daily minimum-mean-maximum temperature, precipitation and global radiation are corrected with the quantile-mapping method (Gudmundsson et al., 2012). Different number of quantiles are applied and trained with the reference data of CARPATCLIM-HU (Bihari et al., 2017), which is a homogenized, quality-controlled, high-resolution gridded data set available for Hungary on a daily basis over 1961–2010. The adjusted future results are intercompared with the raw climate model outputs and with the results using the the previously widely-employed bias-adjustment, namely the delta-method regarding different (annual, seasonal, daily) climatological time-scales, and also some derived extreme indices in most demand. Although the impact model will utilize the climatic variables from the selected method at a later stage of the project meaning that the quantile-mapping might not be the best bias-adjustment method accurately account for the occurring uncertainties.

Bias correction of surface downwelling longwave and shortwave radiation for the EWEMBI dataset

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Abstract:

Many meteorological forcing datasets include bias-corrected surface downwelling longwave and shortwave radiation (rlds and rsds). Methods used for such bias corrections range from multi-year monthly mean value scaling to quantile mapping at the daily time scale. An additional downscaling is necessary if the data to be corrected have a higher spatial resolution than the observational data used to determine the biases. This was the case when EartH2Observe (E2OBS; Calton et al., 2016) rlds and rsds were bias- corrected using more coarsely resolved Surface Radiation Budget (SRB; Stackhouse Jr. et al., 2011) data for the production of the meteorological forcing dataset EWEMBI (Lange, 2016). This article systematically compares various parametric quantile mapping methods designed specifically for this purpose, including those used for the production of EWEMBI rlds and rsds. The methods vary in the time scale at which they operate, in their way of accounting for physical upper radiation limits, and in their approach to bridging the spatial resolution gap between E2OBS and SRB. It is shown how temporal and spatial variability deflation related to bilinear interpolation and other deterministic downscaling approaches can be overcome by downscaling the target statistics of quantile mapping from the SRB to the E2OBS grid such that the sub- SRB-grid scale spatial variability present in the original E2OBS data is retained. Cross-validations at the daily and monthly time scale reveal that it is worthwhile to take empirical estimates of physical upper limits into account when adjusting either radiation component and that, overall, bias correction at the daily time scale is more effective than bias correction at the monthly time scale if sampling errors are taken into account.

Challenges in the bias correction of a multi-variate index under climate change conditions

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Abstract:

Along with the higher demand of bias-corrected data for climate impact studies, the number of available data sets has largely increased in the recent years. For instance, the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) constitutes a framework for consistently projecting the impacts of climate change across affected sectors and spatial scales. These data are very attractive for any impact application since they offer worldwide bias-corrected data based on Global Climate Models (GCMs). Complementary, the CORDEX initiative has incorporated experiments based on regionally-downscaled bias-corrected data by means of debiasing and quantile mapping (QM) methods. In light of this situation, it is challenging to distill the most accurate and useful information for climate services, but at the same time it creates a perfect framework for intercomparison and sensitivity analyses. In the present study, the trend-preserving ISIMIP method and empirical QM are applied to climate model simulations that were carried out at different spatial resolutions (CMIP5 GCMs and EURO-CORDEX Regional Climate Models (RCMs), at approximately 150km, 50km and 12km horizontal resolution, respectively) in a multi-variate framework. The analysis is carried out for the Wet Bulb Globe Temperature (WBGT), a heat stress index that is commonly used in the context of working people and labour productivity. WBGT for shaded conditions depends on air temperature and dew point temperature, which in this work are individually bias-corrected prior to the index calculation. The aim of this work is twofold: First, the potential added value of bias- corrected RCMs over their bias-corrected GCM counterparts is assessed in present and future climate conditions. For this purpose, we evaluate the resulting WBGT and the models' ability to represent the inter- variable relationships. Secondly, the two bias correction methods are compared in order to screen their strengths and weaknesses in present and future climate conditions.

Evaluation of various bias correction methods for Mediterranean cities climate projections: Results from the URBANPROOF

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Abstract:

LIFE UrbanProof is an EU LIFE funded project which aims to provide a holistic and highly automated approach for supporting municipalities to assess climate change related vulnerabilities and risks, to explore and evaluate the available adaptation options and to develop adaptation strategies, as well as to monitor climate change, vulnerabilities and adaptation. The ongoing project is implemented in four municipalities in three different countries: Strovolos and Lakatamia (Cyprus), Peristeri (Greece) and Reggio Emilia (Italy). One of the important actions of the project is the assessment of the impact of climate change in the partner municipalities. To this aim a set of four RCM simulations carried out in the framework of EURO-CORDEX (Coordinated Regional Climate Downscaling Experiment) under the RCP4.5 and RCP8.5 future emissions scenarios were used. However, the evaluation analysis revealed high deviations between the simulations and the available station data for temperature (both daily maximum and daily minimum) and precipitation. Therefore, a set of different bias correction techniques were analysed for the aforementioned variables. The evaluation analysis between the bias corrected timeseries and the observations revealed that not all techniques can adequately capture the annual cycle and interannual variability of temperatura and precipitation as well as indices related to extreme events. For instance, for temperature (both daily maximum and daily minimum) only two out of the four examined bias corrected techniques were capable to capture the number of heatwave days (number of days with daily maximum temperature higher than 35oC) and the number of tropical nights (number of days with daily maximum temperature higher than 20oC). In addition, the higher the interannual variability of the observed variables the lesser the raw model output seems to be corrected.

Seasonal forecast via dynamical systems and bias correction techniques

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Abstract:

Seasonal forecasts are essential tools to offer early-warning decision support, that can help to reduce the socio-economics related risk associated with anomalous events. Advances in statistical prediction are often linked with the enhance of understanding that usually leads to improve dynamical forecast. Thereby, both approaches are frequently combined in order to increase the robustness of the forecast. Here we show a novel statistical-dynamical approach to ameliorate the quality of probabilistic seasonal forecasting based on General Circulation Model (GCM). We measure the instantaneous metrics defined in Faranda et al. (Scientific Reports, 2017), namely the number of degrees of freedom and the persistence of daily averaged sea-level pressure and precipitation fields in the North Atlantic sector. As a case study, we select the main hydrological basins in Spain and Italy. Combining this information with bias correction techniques and model output statistics (MOS), we present forecasts computed from 1 to 6 months ahead. The dynamical forecast of monthly precipitation is provided by the North American Multi-Model Ensemble (NMME), while ENSEMBLES daily gridded observational dataset (EOBS) for validation with observations.

A stochastic in-run bias correction method for seasonal predictions

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Abstract:

Seasonal prediction systems suffer from systematic errors which make a posteriori bias correction methods a necessary step before extracting relevant information from forecasts. A complementary approach is to address the development of biases during the forecast, by introducing randomly sampled corrections of previously estimated model errors to the model dynamics. The corrections are computed using atmospheric relaxation towards ERA-Interim reanalysis data over the re-forecast period. This method, called “stochastic dynamics” (Batté and Déqué, 2016), is now included in the ARPEGE atmospheric component of the Météo-France operational seasonal forecasting system based on the CNRM-CM coupled climate model. The aim of this contribution is to evaluate the impact of the method on the forecast quality of Météo-France System 6, by comparing re-forecasts for boreal winter (initialized in November) with and without stochastic dynamics. We also justify the choice of the relaxation strength when defining the correction terms by comparing several sets of re-forecasts. Results are consistent with previous findings using a former version of the coupled model.

Model selection for DeFoReSt: A strategy for recalibrating decadal predictions

Pasternack, J. Grieger, H.W. Rust, U. Ulbrich
(Freie Universität Berlin, Germany)

Abstract:

Near-term climate predictions such as decadal climate forecasts are increasingly being used to guide adaptation measures. Due to the uncertainties in initial conditions of weather and climate, forecasts are framed probabilistically. One issue frequently observed for probabilistic forecasts is that they tend to be not reliable, i.e. the forecasted probabilities are not consistent with the relative frequency of the associated observed events. Thus, these kind of forecasts need to be re-calibrated. Moreover, decadal prediction models typically exhibit systematic errors like lead-time dependent uncondtional (drift) and conditional biases. With DeFoReSt, we proposed a "Decadal Climate Forecast Recalibration Strategy", a parametric post-processing approach to tackle these problems. The original approach of DeFoReSt assumes third order polynomials in lead time to capture conditional and unconditional biases, second order for dispersion, first order for start time dependency. Here, we propose not to restrict orders a priori but use a systematic model selection strategy to obtain model orders form the data based on non-homogeneous boosting. We apply DeFoReSt with model selection to the MiKlip system (Germany's initiative for decadal prediction) to identify the relevant predictors for recalibrating this decadal prediction system.

DownscaleR: An R-based package for statistical downscaling and bias correction within the climate4R framework

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Abstract:

The climate4R bundle of R packages provides a unique framework for climate harmonized data access, collocation and post-processing, where most common tasks can be straightforwardly performed using a few lines of code. This allows end-to-end experimental reproducibility and facilitates the description (metadata) and documentation of the whole data flow. Bias correction is one of those tasks and is performed by using the downscaleR package, which implements parametric and non-parametric methods for bias correction and allows for a fine tunning of different configurations. An additional element of climate4R is the User Data Gateway (UDG), a data service providing free access to a variety of state-of- the-art datasets. Here we introduce the climate4R ecosystem and illustrate the main functionalities through a fully reproducible practical case over the Iberian Peninsula, describing the calculation of typical climate indices from an ensemble of future regional climate projections (EURO-CORDEX) and the sensitivity to bias correction including the potential reduction of uncertainty.

Downscaling and bias correction for the new CH2018 Swiss climate scenarios

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Abstract:

A new set of reference climate scenarios for Switzerland is going to be released by the end of 2018. The new scenarios, named CH2018, are based on the EURO-CORDEX regional climate projections and will serve a wide range of user needs and interests. Among others, the scenarios will consist of a detailed technical report, a dedicated web atlas, regional factsheets and a comprehensive set of user-tailored and downloadable data products. The latter partly rely on downscaled and bias corrected RCM data. For this purpose empirical quantile mapping (QM) is employed at different spatial scales. This contribution provides an overview on the CH2018 QM setup, its specific variants and the range of data products. Results in terms of evaluation of the QM-based products both in the historical calibration period and with respect to climate change signals are presented. Advantages but also shortcomings and limitations of the QM approach are highlighted. A particular limitation concerns an artificial spatial climate change pattern for temperature which is introduced by QM and which is connected to variance inflation.

Bias Correction approaches to assess future variations in IDF curves for the city of Naples

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Abstract:

The design of urban hydraulic systems is usually performed using mathematical relationships, namely IDF curves, which express the link between rainfall Intensity (I), Duration (D), and frequency (F). These relationships are estimated interpreting past rainfall records through Extreme Theories Statistical Theories (ETST) under the assumption of steady conditions resulting then unsuitable under climate change. In this perspective, the ongoing variations in climate patterns are posing hard challenges to engineers that should be able to manage in their design the potential variations in extreme rainfall events. Current performances of GCMs, also if dynamically downscaled through RCMs, prevent the use of raw data for such purposes. To bridge the gap, two bias correction procedures suitable for maximum precipitations values are then tested to assess variations in IDF curves. The first procedure is represented by the Equidistance Quantile Matching (EQM) approach proposed by Sivrastav et al. (2014); the second one is a modified version of the Scaled Distribution Mapping (SDM) approach proposed by Switanek et al. (2017). Both exclusively interpret daily-subdaily maximum precipitation observations and the analogous daily data provided by climate projections on current and future time spans in terms of IDF through the Generalized Extreme Value (GEV) approach. In this sense, the EQM considers a statistical relationship between cumulative distribution functions (CDFs) interpreted by GEV of the observed and simulated values in the current period and between CDFs interpreted by GEV of simulated values in the current and future periods. The modified SDM results to be conceptually similar to the EQM but is aimed to preserve the climate signal returned by comparing raw outputs on future and current time spans. Both procedures are evaluated assuming as test case that of the city of Naples (Southern Italy), recently involved in different episodes of urban pluvial flooding due to both extreme rainfall events and the persistent suffering of the urban drainage system. To account for uncertainties in future projections, all climate simulations available for the area in Euro-Cordex multi-model ensemble at 0.11° (about 12 km) are considered under two different concentration scenarios (RCP4.5 and RCP8.5). Both procedures yield results largely influenced by models, RCPs and time horizon of interest; nevertheless, clear indications of increases are detectable although with different magnitude on the different precipitation durations.

A Perfect Model Approach to assess the statistical downscaling skills using CDFt over Corsica

H. Omrani
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Abstract:

General Circulation Models (GCMs) have been widely used to produce long-term projections ? of future climate change scenarios. The CMIP5 experiment provided an ensemble of historical and future climate simulations with a horizontal resolution of hundreds of kilometers. These spatial resolutions are too coarse to evaluate the climate impact on a local scale especially for small islands which are often invisible for GCMs. The statistical downscaling technics allow to produce downscaled projections at a finer scale with relatively low computational cost. At EDF R&D, we use statistical downscaling technics such analogues and CDFt to produce finer climate information at local scale for enegy purposes. Assessing the downscaling skills is a fundamental issue for our studies. In this work we use a Perfect model approach to evaluate the CDFt skills to downscale climate projections (daily temperature and precipitation) over Corsica. The EURO-CORDEX simulations with a horizontal resolution of 11° were used as a pseudo-reference. A set of experiments were conducted to answer a number of questions such as the stationarity hypothesis.

Bivariate bias correction of monthly temperature and precipitation from regional climate models

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(Meteorological and Hydrological Service, Croatia)

Abstract:

Application of two dimensional (bivariate) bias correction method on regional climate model (RCM) simulated near-surface air temperature and total precipitation amount was examined. E-OBS observational dataset of mean monthly temperature and precipitation sum was used. Results of the RegCM4 RCM simulations forced by the four CMIP5 global climate models was bias adjusted/corrected. The simulations cover the historical period with the observed concentrations of the greenhouse gases applied. Quantile mapping was used to correct higher moments of a variable, thus transfer functions were developed for each variable separately for every grid point for the period 1971-1990 and applied to regional model data for the period 1991-2005. For the same period bivariate quantile mapping bias correction method with gamma and normal marginal distributions was used to correct correlation between the two variables. Spearman correlation coefficient was analyzed for the raw RCM data, observational data, univariate bias corrected RCM and bivariate bias corrected RCM. Results indicate benefits of using bivariate adjustment methods, and motivate further application of this methodology on a larger ensemble of the RCM simulations for the historical and projection periods.

Impact of bias correction methods on climate downscaled projections over the Pyrenees

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Abstract:

Climate predictions and projections exhibit drifts to the own model climatology which frequently differs from actual observed climatology. Also downscaling methods may introduce additional biases. In order to facilitate the use of absolute values of downscaled projections often required for climate change impacts studies –previously needed to the adoption of adaptation strategies–, these systematic deviations from observations have to be removed, usually, by means of bias correction techniques. We have focused in this study on downscaled projections of extreme temperatures and precipitations over the very demanding domain of the Pyrenees region. Biases associated to global models, downscaling techniques, representation of mountains, etc. are analyzed and removed using several bias correction techniques. The impact of corrections in some climate indices is also analyzed.

A proposal for a bias correction metadata model in the framework of METACLIP (METAdata for CLImate Products)

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Abstract:

Having an effective way of dealing with data provenance is a necessary condition to ensure the reproducibility of results in any scientific domain, and in particular in climate science, helping to build trust and credibility in research outcomes and data products delivered. METACLIP (METAdata for CLImate Products) is a language-independent framework envisaged to tackle the problem of climate product provenance description. The solution proposed is based on semantics exploiting web standard Resource Description Framework (RDF), through the design of domain-specific extensions of standard vocabularies (e.g. PROV-O) describing the different aspects involved in climate product generation. By introducing semantics in the metadata description, METACLIP ensures an effective communication of the information to a wide range of users with different levels of expertise. We present the METACLIP Framework through an example application within the open source R computing environment and in the context of climate4R, a bundle of climate-oriented R packages, in which a full RDF semantic description of the different elements composing a bias correction product (a climate index future climatology) is produced. A specific on-line application for metadata visualization and interactive exploration is also presented, helping all types of users to trace and understand the provenance of the climate data products.

Bias adjustment of projections and predictions as a climate service

H. Loukos and the climate data Factory team

Abstract:

No abstract available.