WCRP CORDEX 14-18 OCTOBER 2019 BEIJING, CHINA
ICRC-CORDEX 2019
International Conference On Regional Climate

Parallel Session A: Advances in regional downscaling
A3: Downscaling tools and methods

RCMES-based Statistical Downscaling of CORDEX South Asia RCM output over India

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2. Regional Climate Model Evaluation System
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California Institute of Technology

- The statistical downscaling toolkit provided as a part of the Jet Propulsion Laboratory (JPL)'s Regional Climate Model Evaluation System (RCMES) is utilized to develop a web-based interactive application for statistically downscaling the WCRP Coordinated Regional Climate Downscaling Experiment (CORDEX) South Asia regional climate model (RCM) output to the fine-scale required for local climate impact assessments.

- This web-application is useful to downscale daily maximum and minimum temperature and precipitation over selected locations in India.

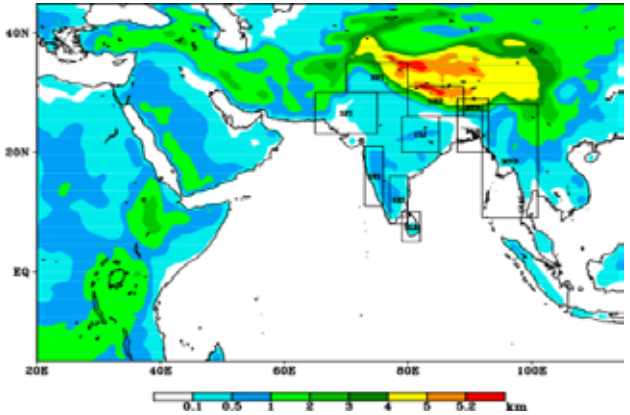
- This web-application will address the users need for correcting the errors in the RCM output that deviates from observations, using four statistical downscaling methods viz., the delta addition, delta correction, quantile mapping, and asynchronous linear regression.

- This user-friendly application will also enhance the visibility and utilization of CORDEX South Asia RCM outputs in the climate impacts community

South Asia Co-ordination @ CCCR, IITM

- **Development of multi-model ensemble projections of high resolution (50km) regional climate change scenarios for South Asia**
  - Generation of regional climate projections at CCCR-IITM
    - Downscaled 6 CMIP5 AOGCMs using ICTP RegCM4 regional climate model for historical period 1951-2005, and for two future scenarios (RCP4.5 and RCP8.5) for the period 2006-2099

      http://cccr.tropmet.res.in/home/cordexsa_datasets.jsp
  - Co-ordination with partner institutions for multi-model ensemble projections – SMHI, CSC, IAES, CSIRO, ICTP…



- **Development of an Earth System Grid Federation (ESGF) data node at CCCR-IITM for CORDEX South Asia**
  - Archival, Management, Dissemination of CORDEX South Asia data
  - Published ~2 TB of IITM-RegCM4 outputs on CCCR-IITM ESGF data node after quality assurance as per CORDEX archival specifications.

ESGF Data Node @ CCCR-IITM

http://cccr.tropmet.res.in/home/esgf_node.jsp

- **Summary of 17 CORDEX South Asia datasets available on ESGF (~20 TB)**
  - IITM-RegCM4: Hist (6); RCP8.5 (6); RCP4.5 (6)
  - SMHI-RCA4 : Hist (10); RCP8.5 (10); RCP4.5 (10); RCP2.6 (5)
  - CSC-REMO2009: Hist (1); RCP8.5 (1); RCP4.5 (1); RCP2.6 (1)

- **CORDEX South Asia Point of Contact (PoC): Dr. R. Krishnan, Executive Director, CCCR, IITM**
- **CORDEX Science Advisory Team (SAT) member: Dr. J. Sanjay, Scientist, CCCR, IITM**

Statistical Downscaling using RCMES

Why do we need to downscale GCM outputs?

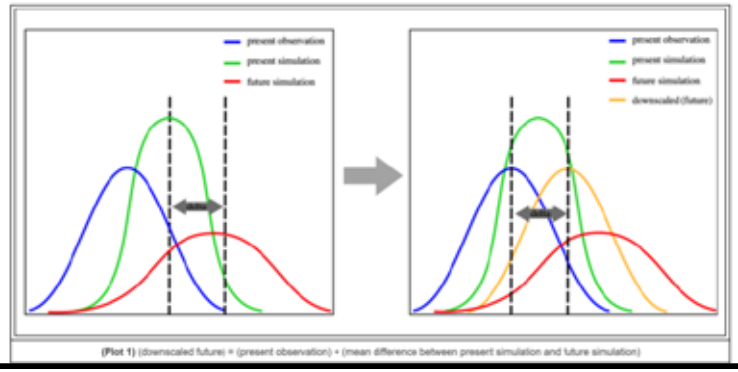
https://rcmes.jpl.nasa.gov/content/statistical-downscaling

Global climate models (GCMs) cannot simulate climate at the local to regional scale.

RCMES utilizes the following statistical downscaling methods used in previous studies (e.g. Stoner et al. 2013).

Method 1: Statistical Downscaling using Delta Addition

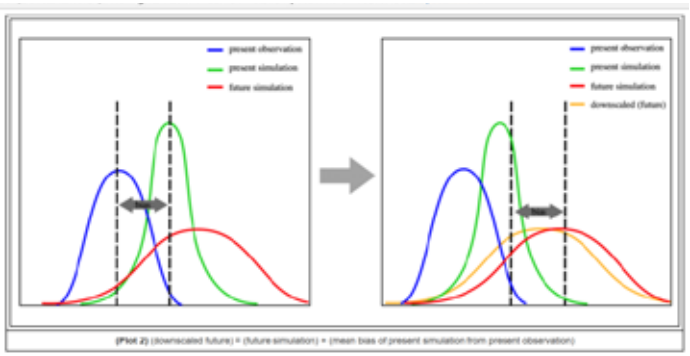
The difference between present and future simulations are added to the present observation



(Plot 1) (downscaled future) = (present observation) + (mean difference between present simulation and future simulation)

Method 2: Statistical Downscaling using Delta Correction

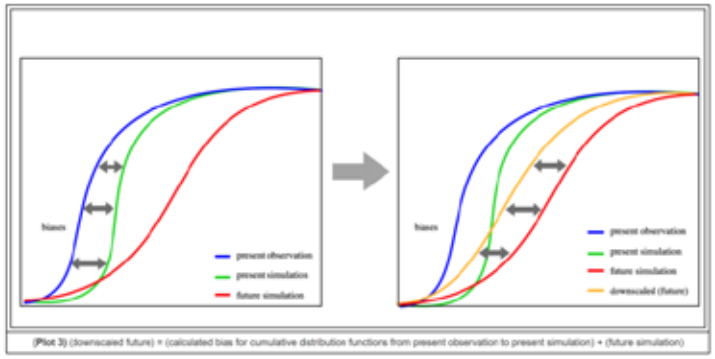
Only mean biases of models are corrected.



(Plot 2) (downscaled future) = (future simulation) + (mean bias of present simulation from present observation)

Method 3: Statistical Downscaling using Quantile Mapping

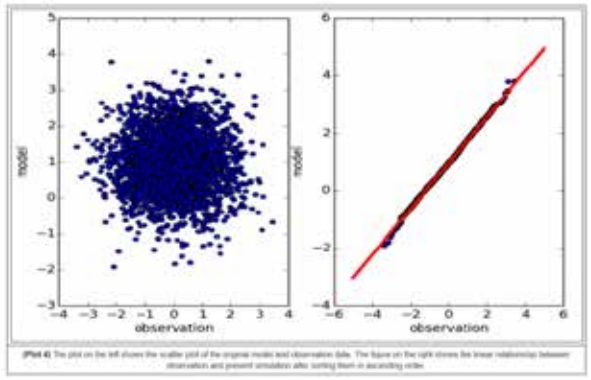
Biases for each percentile are added to the future simulation to correct the biases of each percentile.



(Plot 3) (downscaled future) = (calculated bias for cumulative distribution functions from present observation to present simulation) + (future simulation)

Method 4: Statistical Downscaling using Asynchronous Linear Regression

Finds the linear relationship between the sorted observation and model time series



(Plot 4) The plot on the left shows the scatter plot of the original model and observation data. The figure on the right shows the linear relationship between observation and present simulation after sorting them in ascending order.

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Indian Institute of Tropical Meteorology, Pune, India

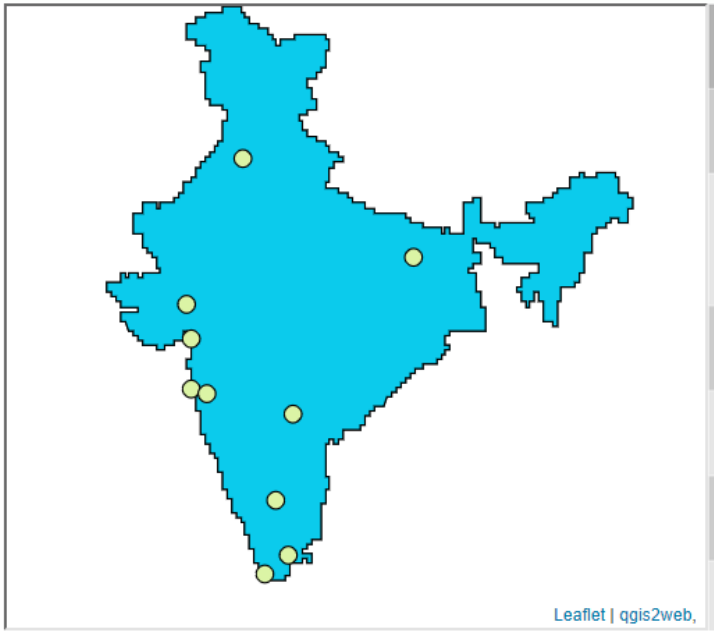
http://cccr-dx.tropmet.res.in:8000/cccrindia/rcmes

Home

RCMES-based Statistical Downscaling of CORDEX South Asia RCM Projections over India

A web-based interactive application is developed (beta-version) to demonstrate the challenges and opportunities of downscaling to fine-scales the available regional climate model (RCM) projections generated in CCCR-IITM under the framework of WCRP CORDEX South Asia.

Variable	Period	Scenario
Max Temperature	Long-term Future 2070-2099	RCP 8.5



IITM-RegCM 4 CORDEX simulations	Driving CMIP5 AOGCM	Contributing CMIP5 Modeling Center
CA	CCCma-CanESM2	Canadian Centre for Climate Modelling and Analysis (CCCma), Canada
GF	NOAA-GFDL-GFDL-ESM2M	National Oceanic and Atmospheric Administration (NOAA), Geophysical Fluid Dynamics Laboratory (GFDL), USA
CN	CNRM-CM5	Centre National de Recherches Me´te´orologiques (CNRM), France
MP	MPI-ESM-MR	Max Planck Institute for Meteorology (MPI-M), Germany
IP	IPSL-CM5A-LR	Institut Pierre-Simon Laplace (IPSL), France
CS	CSIRO-Mk3.6	Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia

Probability distributions of Daily Maximum Surface Air Temperature at 12.58N,77.35E

simulated by CORDEX RCMs during the Calibration Period (1986-2015)

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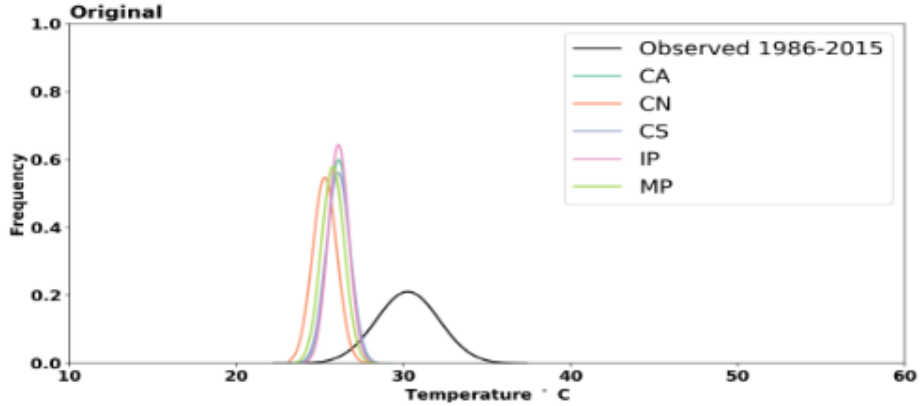
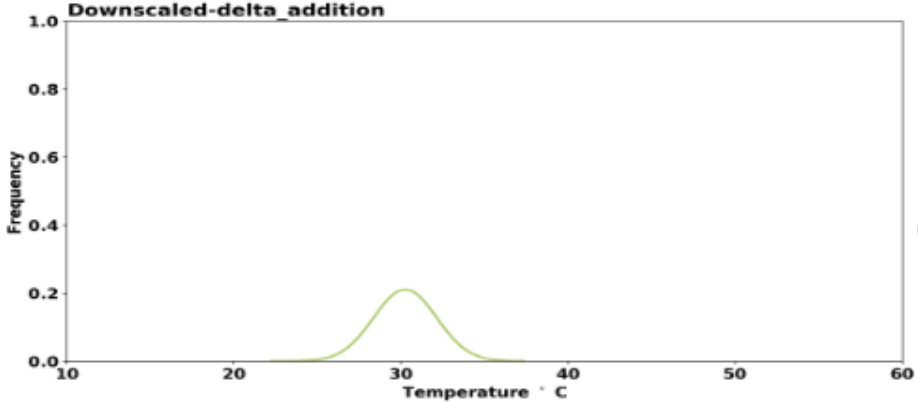
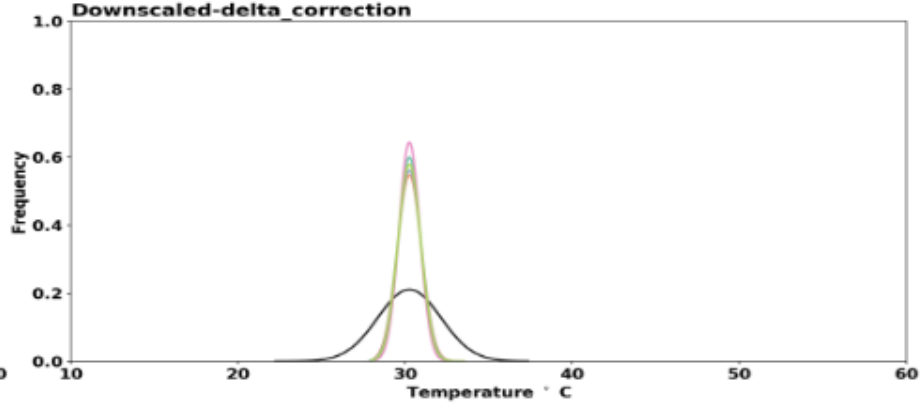
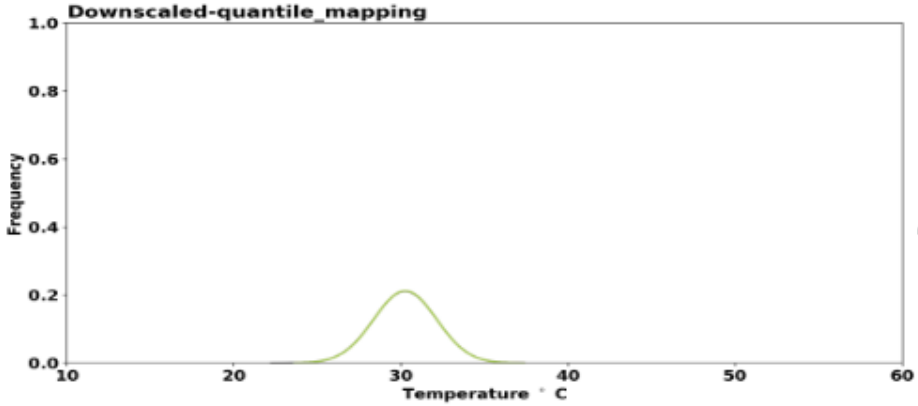


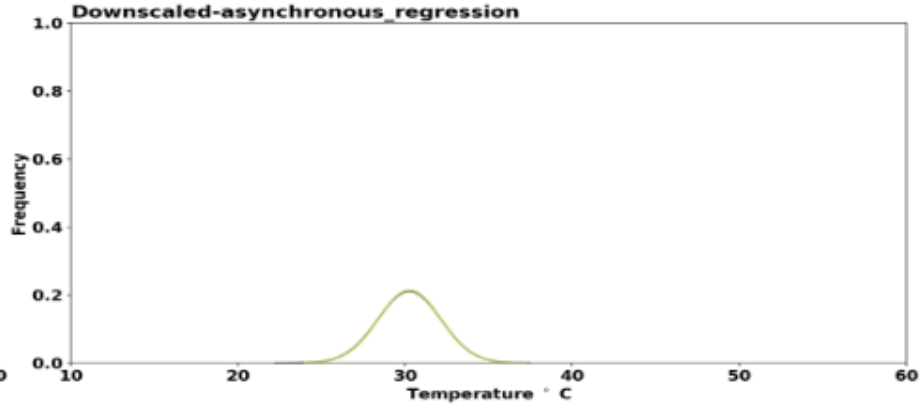
Location 1

Calibration period









Probability distributions of Daily Maximum Surface Air Temperature at 12.58N,77.35E

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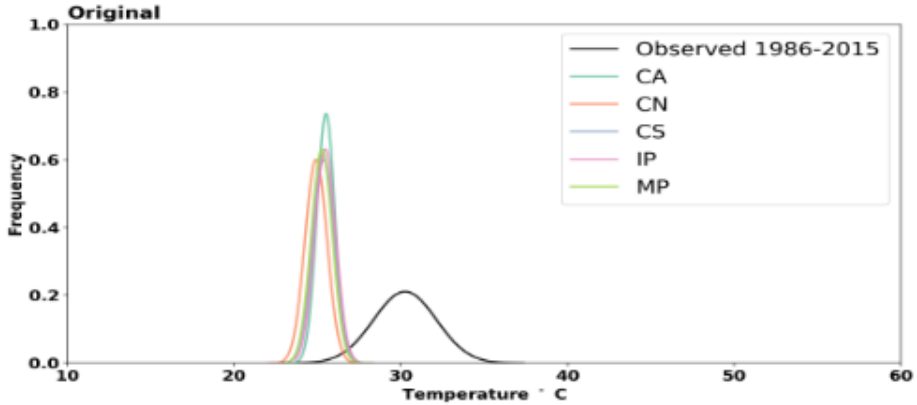
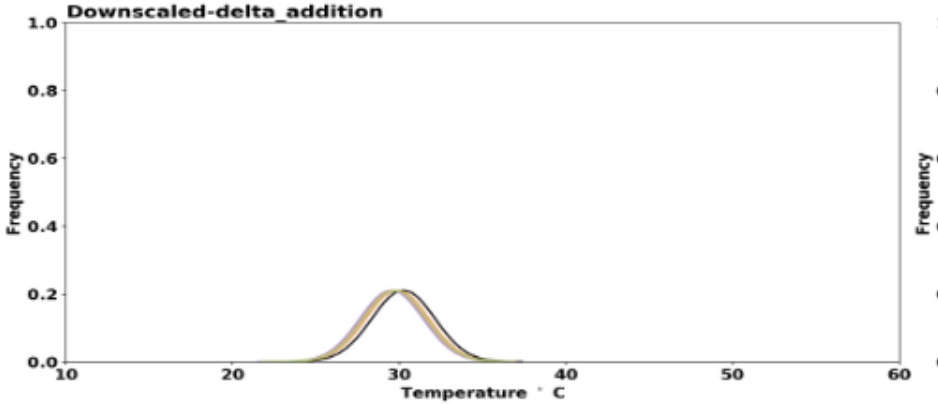
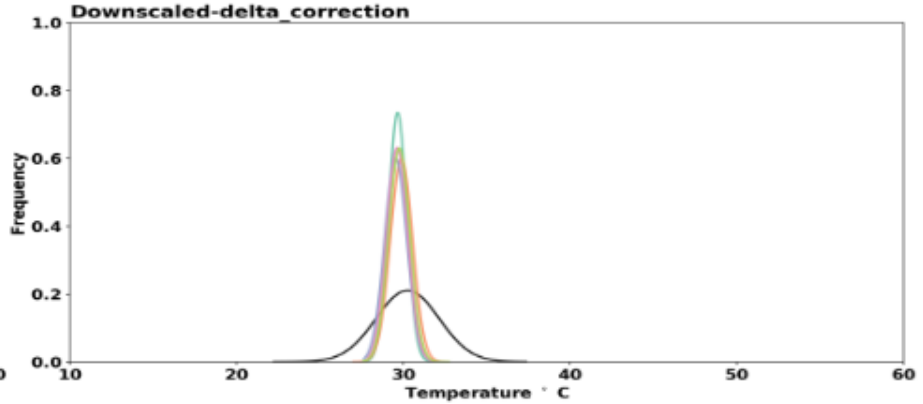
Centre for Climate Change Research

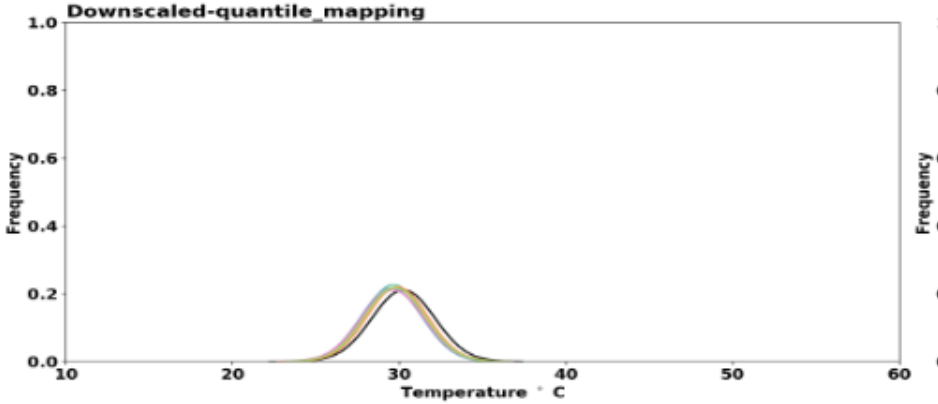


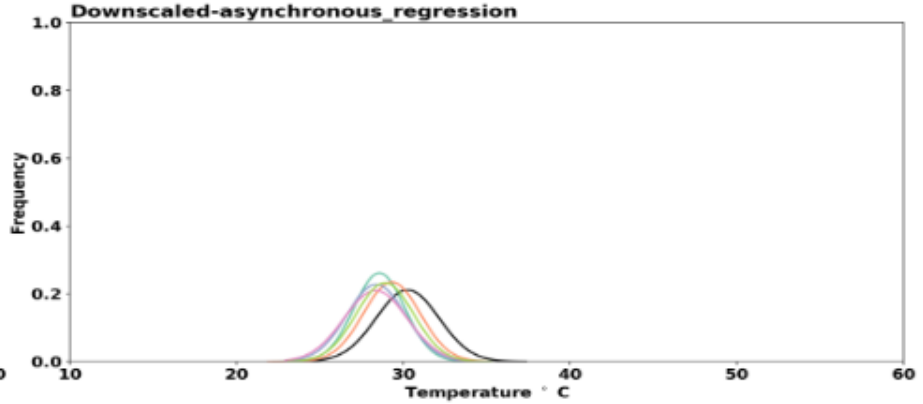
Location 1

Validation period









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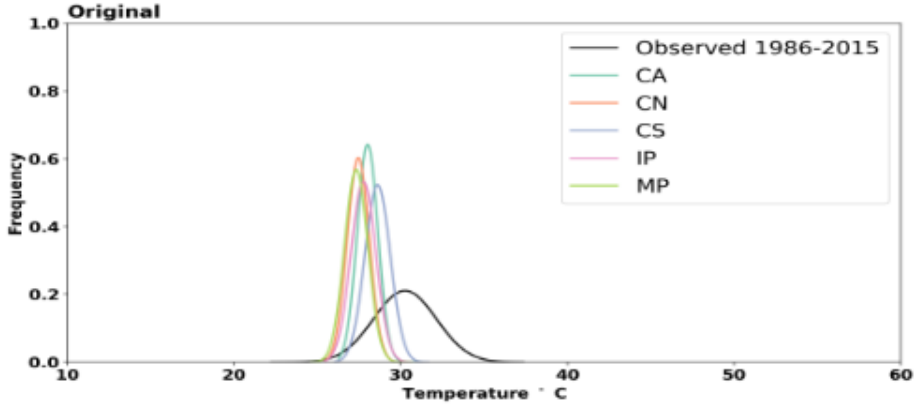
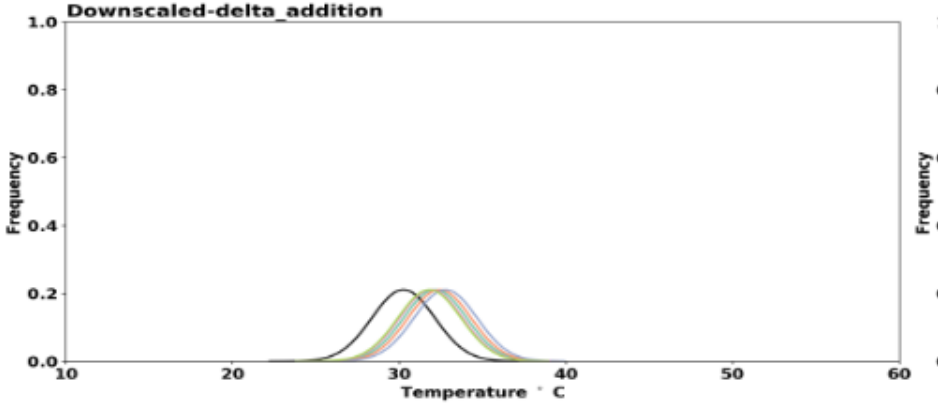
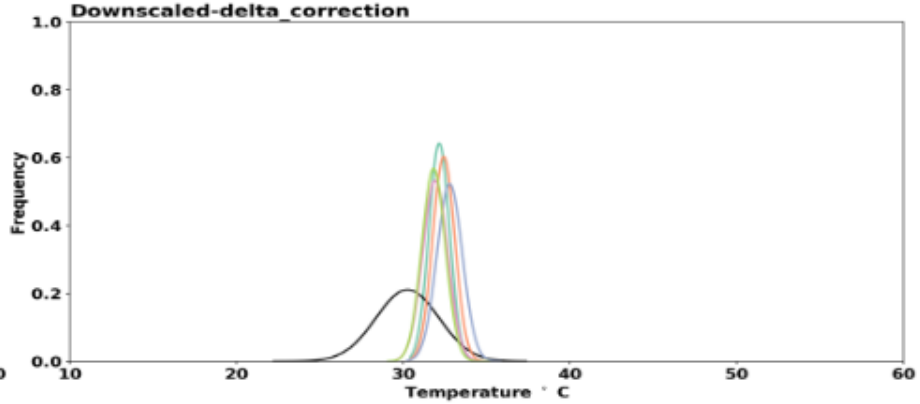


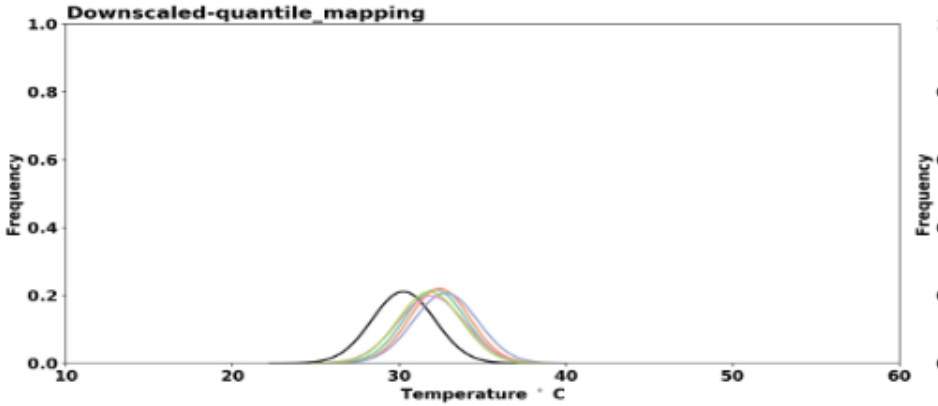
Location 1

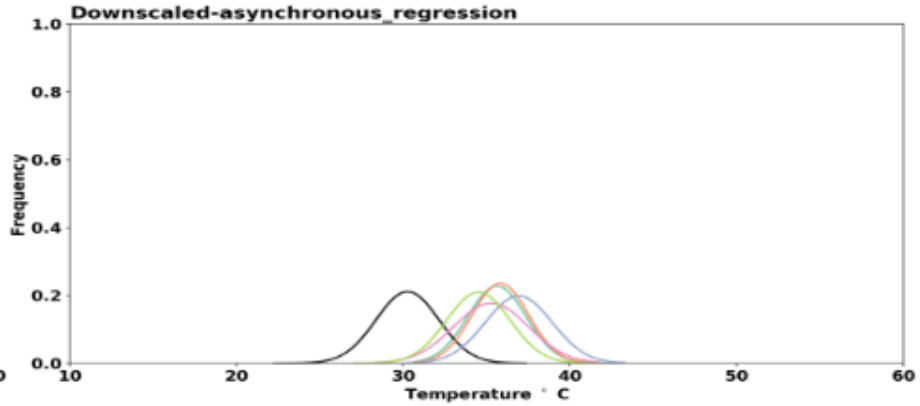
Mid-term Future

RCP8.5









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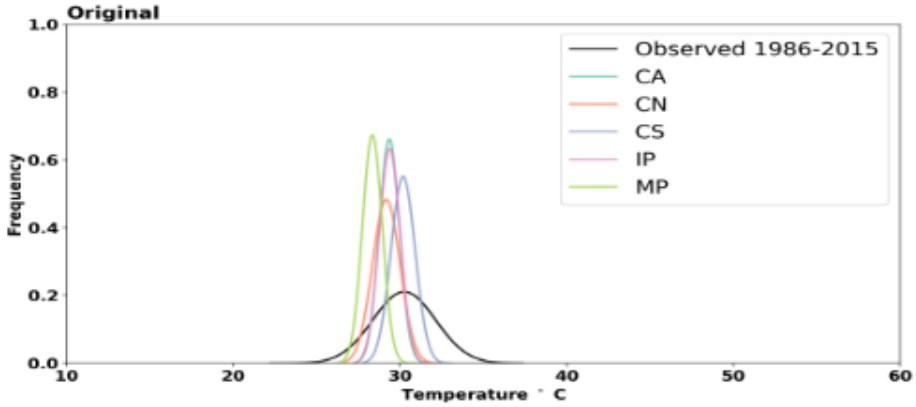
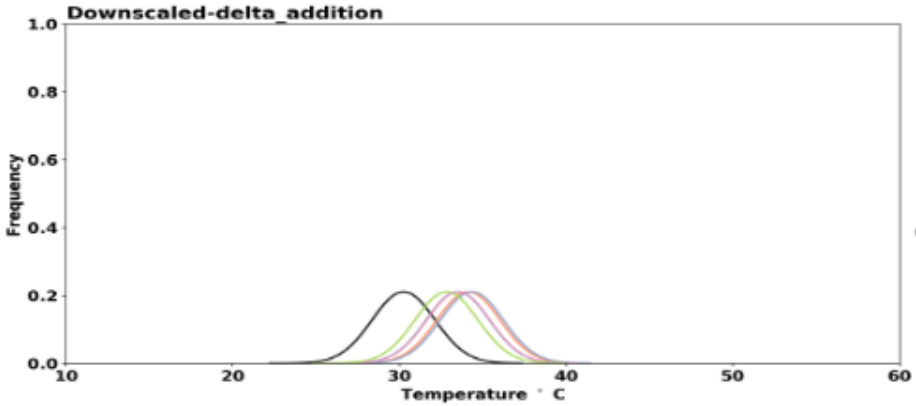
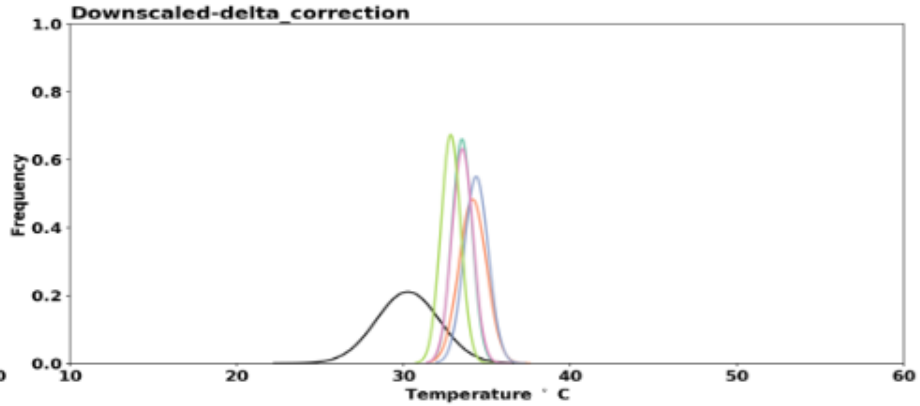


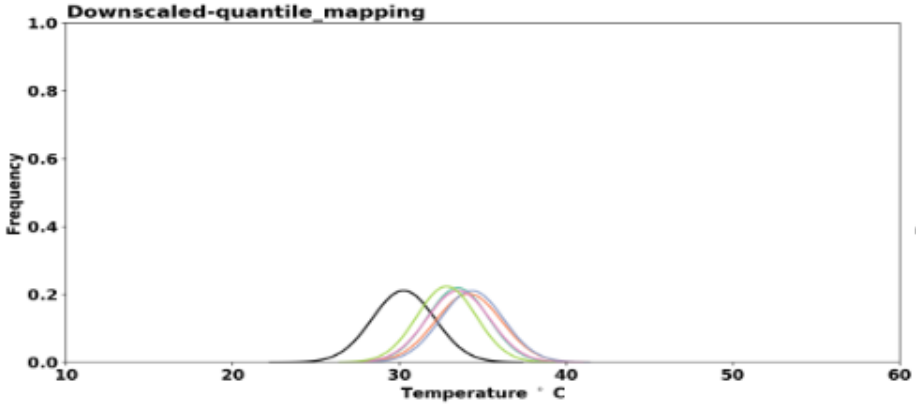
Location 1

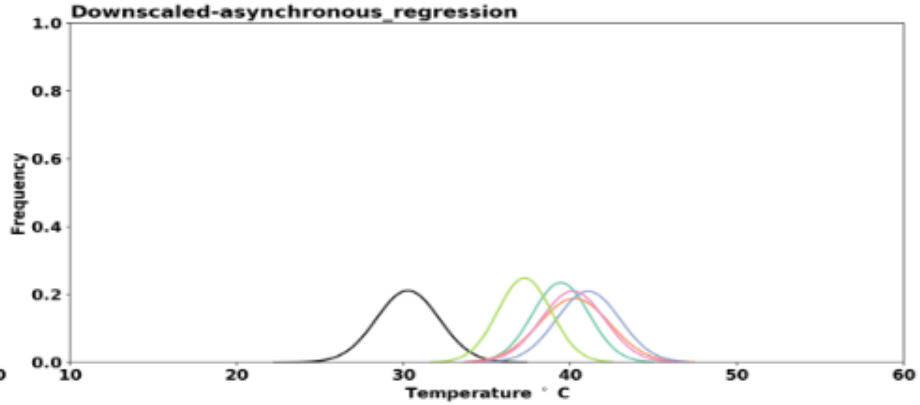
Long-term Future

RCP8.5









Probability distributions of Daily Maximum Surface Air Temperature at 8.29N,76.57E

simulated by CORDEX RCMs during the Calibration Period (1986-2015)

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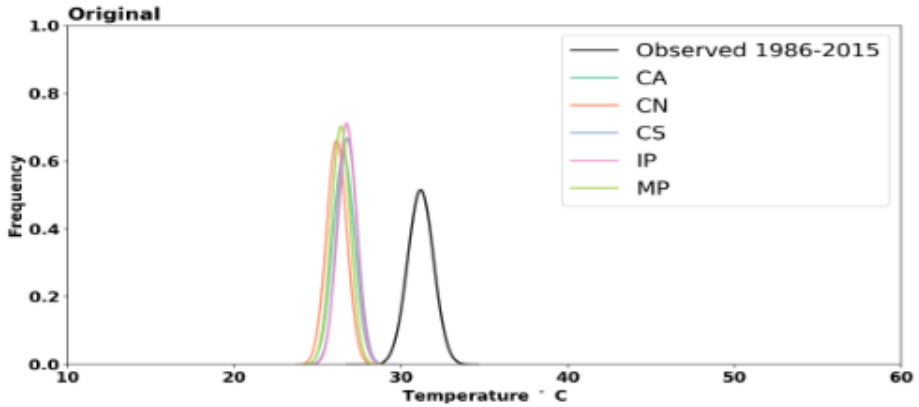
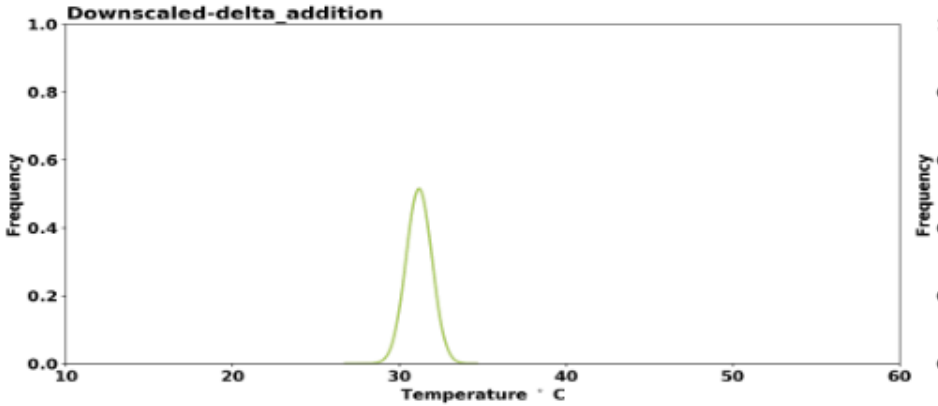
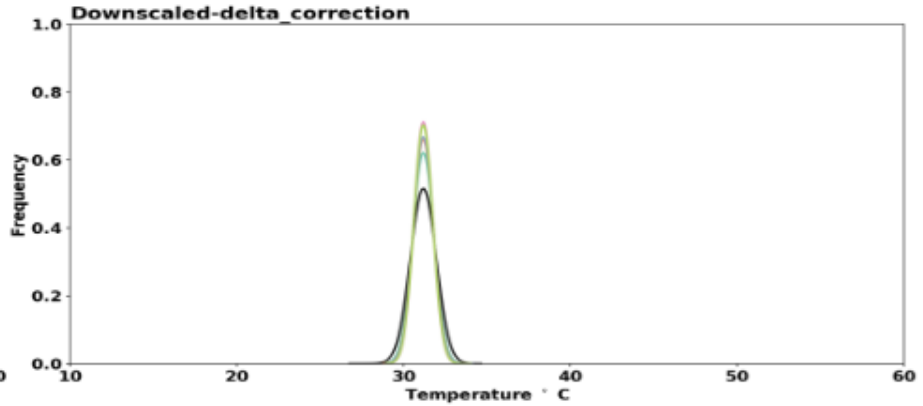


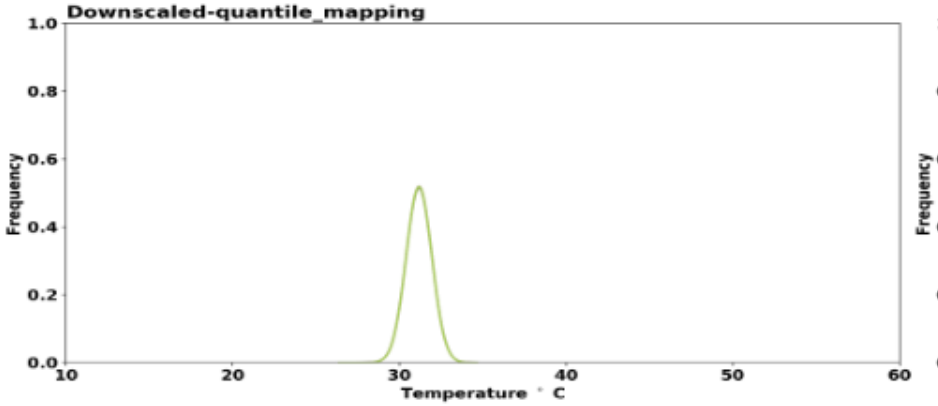
Location 2

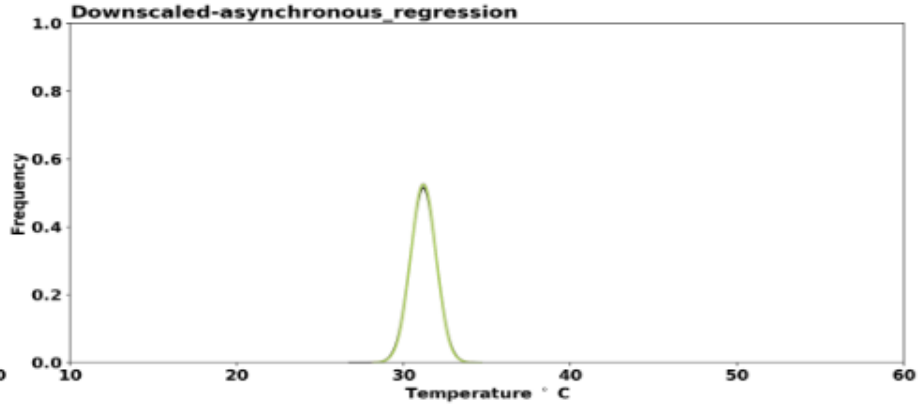
Calibration period

RCP8.5









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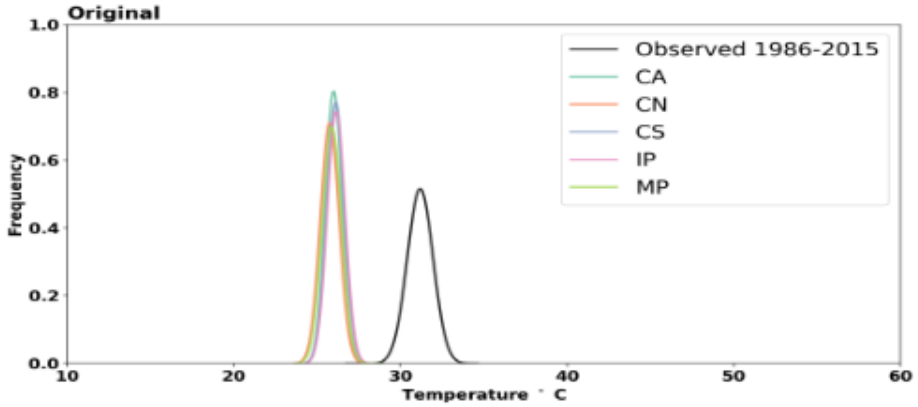
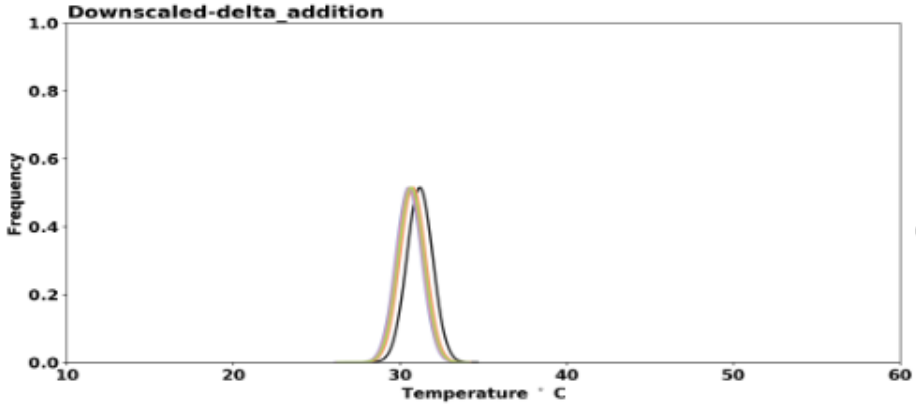
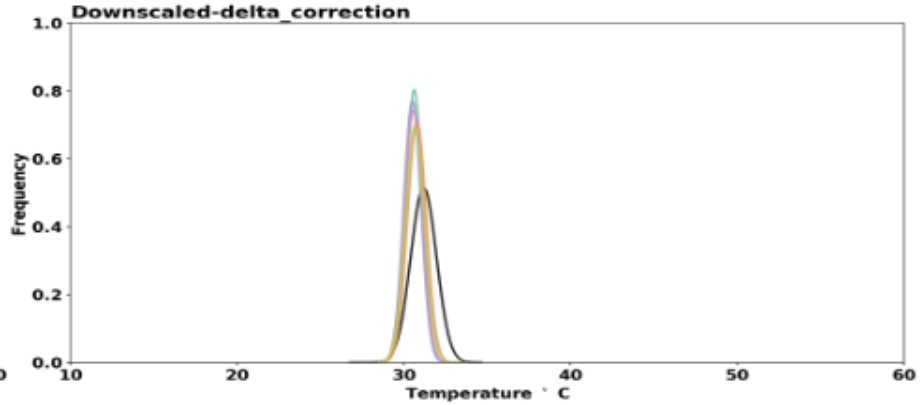


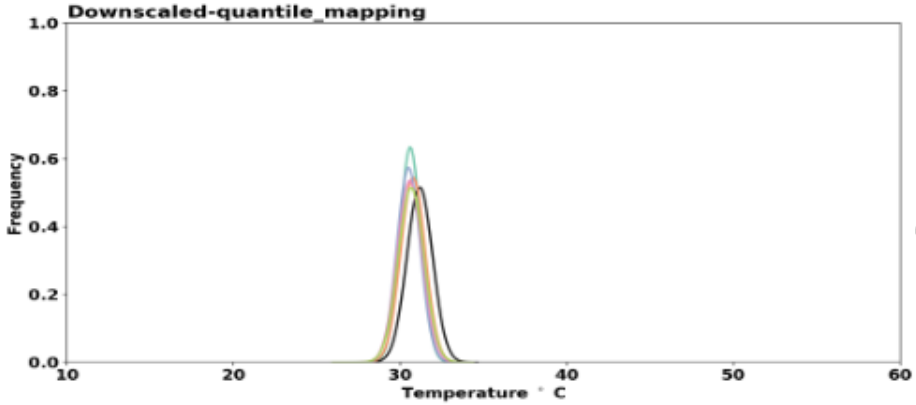
Location 2

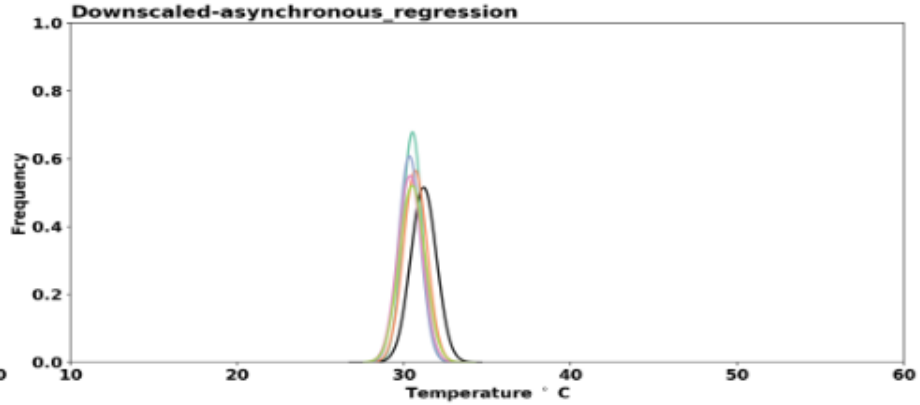
Validation period

RCP8.5









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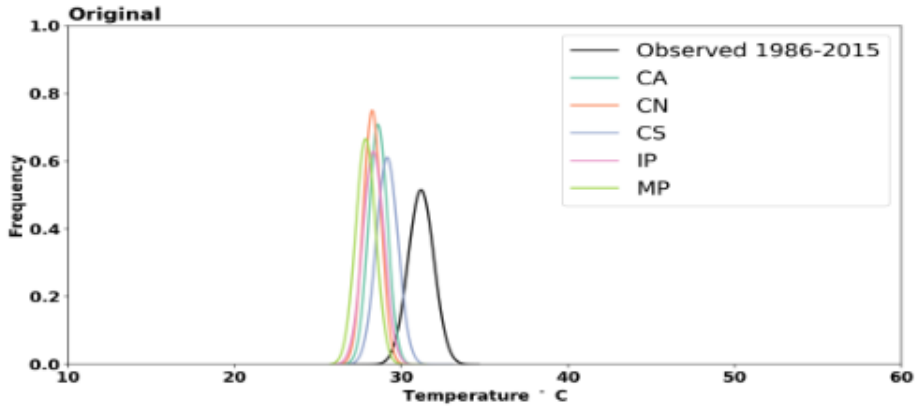
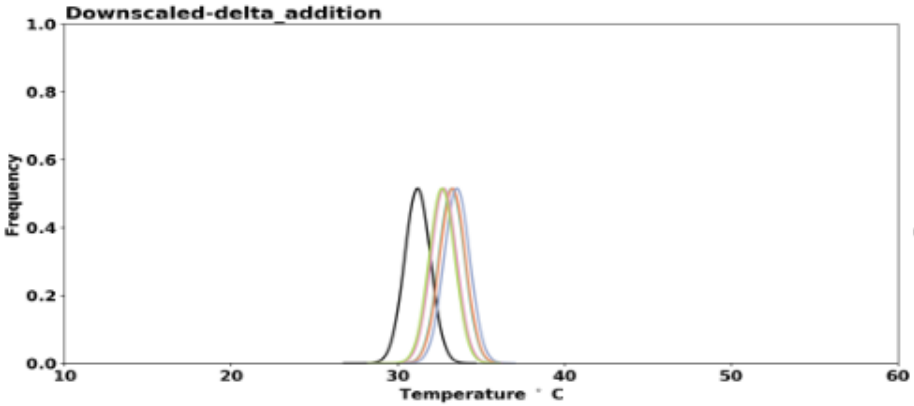
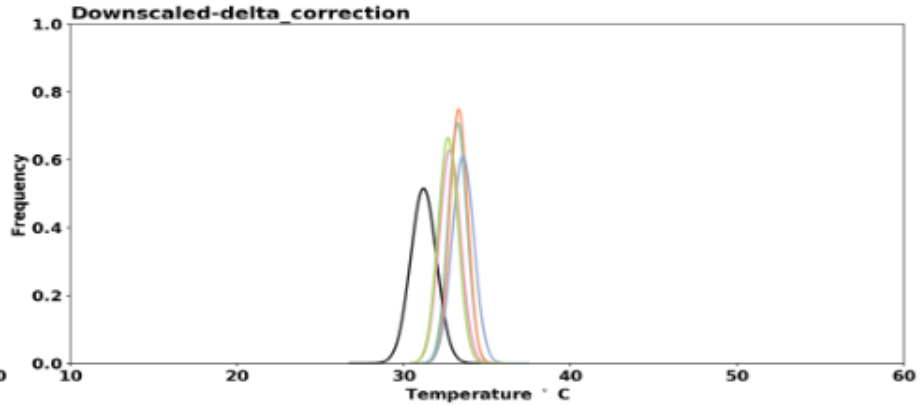


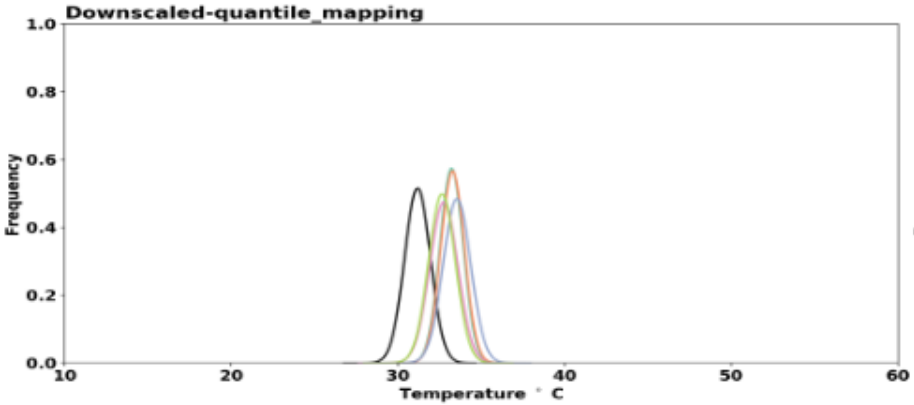
Location 2

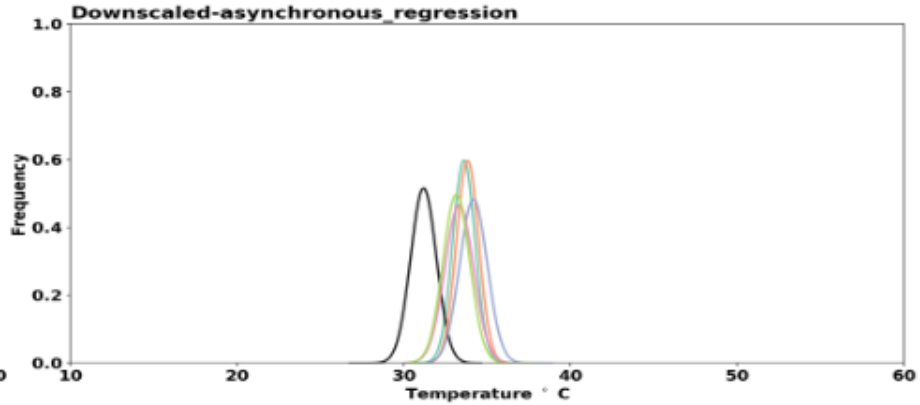
Mid-term Future

RCP8.5









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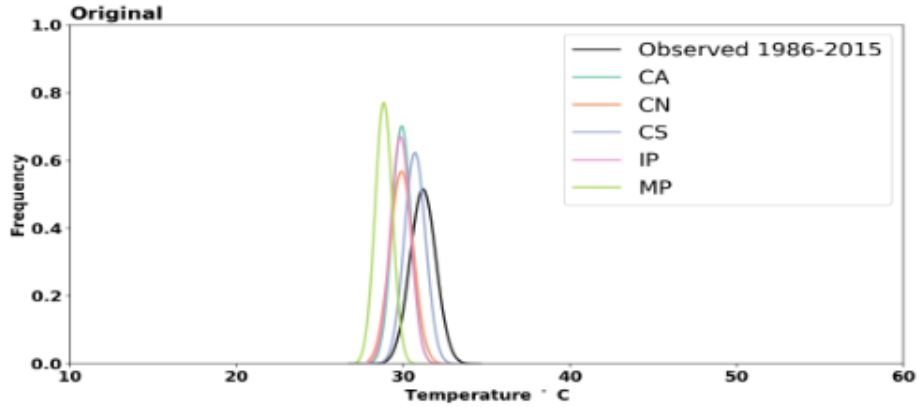
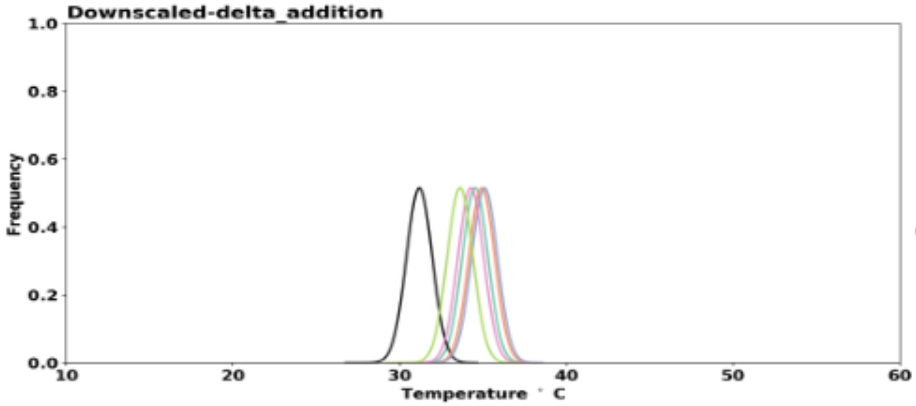
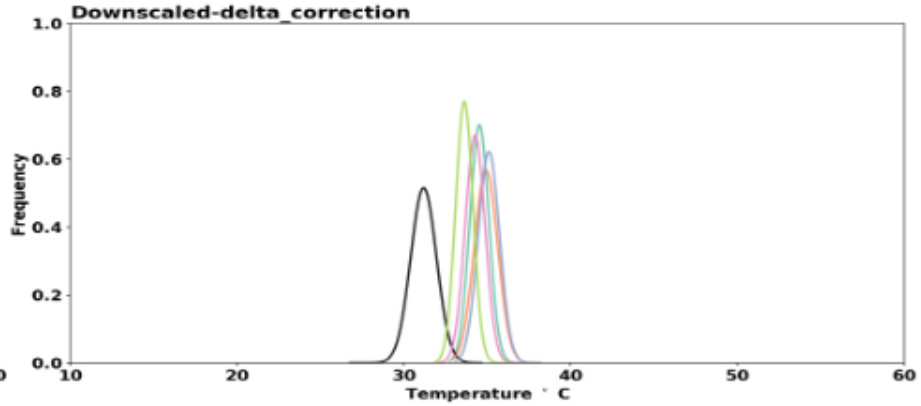


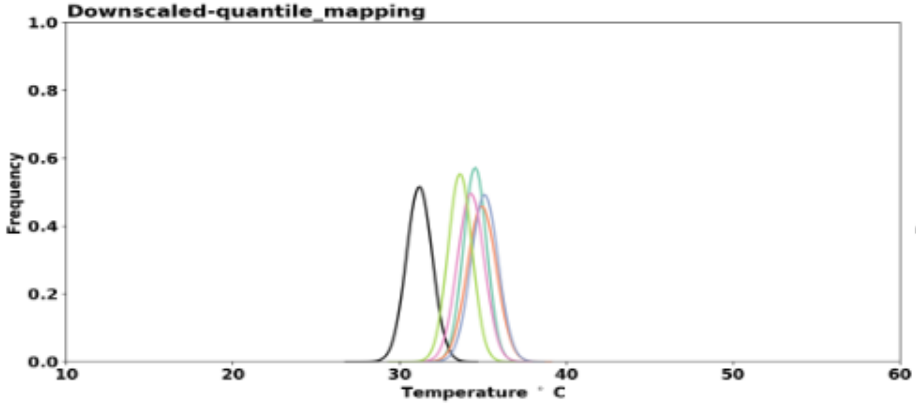
Location 2

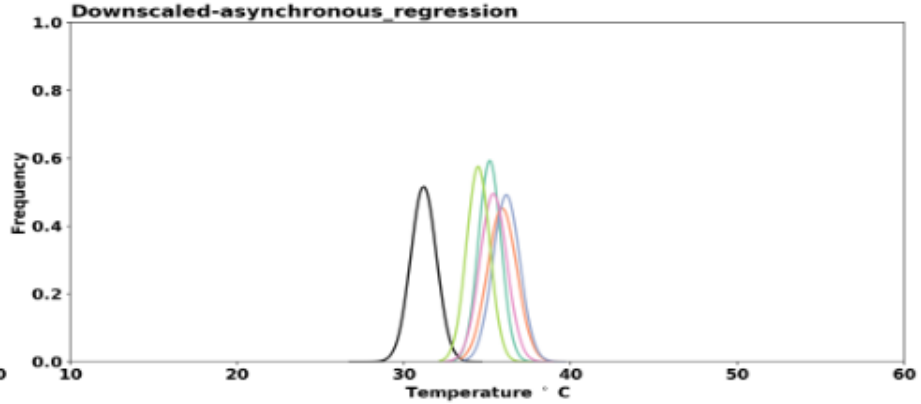
Long-term Future

RCP8.5









- It is expected that the good understanding of the advantages and limitations of the four statistical downscaling methods implemented in this web-application will provide user the local climate change information needed for further developing sectorial based local climate impact assessments.

Thanks for your attention

mahesh.ramadoss@tropmet.res.in

Thank You

- ICRC CORDEX2019
- APN
- JPL-RCMES