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

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2. Regional Climate Model Evaluation System

NASA
    Jet Propulsion Laboratory
    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.

• 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](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.

**Method 2: Statistical Downscaling using Delta Correction**
Only mean biases of models are corrected.

**Method 3: Statistical Downscaling using Quantile Mapping**
Biases for each percentile are added to the future simulation to correct the biases of each percentile.

**Method 4: Statistical Downscaling using Asynchronous Linear Regression**
Finds the linear relationship between the sorted observation and model time series.
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.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Period</th>
<th>Scenario</th>
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</thead>
<tbody>
<tr>
<td>Max Temperature</td>
<td>Long-term Future 2070-2099</td>
<td>RCP 8.5</td>
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</tbody>
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<thead>
<tr>
<th>IITM-RegCM 4 CORDEX simulations</th>
<th>Driving CMIP5 AOGCM</th>
<th>Contributing CMIP5 Modeling Center</th>
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<tbody>
<tr>
<td>CA CCCma-CanES M2</td>
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<td>Institut Pierre-Simon Laplace (IPSL), France</td>
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<tr>
<td>CS CSIRO-Mk3.6</td>
<td>Commonwealth Scientific and Industrial Research Organization (CSIRO), Australia</td>
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Probability distributions of Daily Maximum Surface Air Temperature at 12.58N, 77.35E simulated by CORDEX RCMs during the Calibration Period (1986-2015)

Location 1
Calibration period
Probability distributions of Daily Maximum Surface Air Temperature at 12.58N, 77.35E
 simulated by CORDEX RCMs during the Validation Period (1956-1985) under rcp85 Future scenario

Validation period
Probability distributions of Daily Maximum Surface Air Temperature at 12.58N, 77.35E
simulated by CORDEX RCMs during the Mid-term future Period (2041-2070) under rcp85 Future scenario

Location 1
Mid-term Future
RCP8.5
Probability distributions of Daily Maximum Surface Air Temperature at 12.58N,77.35E
simulated by CORDEX RCMs during the Long-term future period (2070-2099) under rcp85 Future scenario

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)

Location 2

Calibration period

RCP8.5
Probability distributions of Daily Maximum Surface Air Temperature at 8.29N, 76.57E
simulated by CORDEX RCMs during the Validation Period (1956-1985) under rcp8.5 Future scenario

Location 2

Validation period

RCP8.5
Probability distributions of Daily Maximum Surface Air Temperature at 8.29N, 76.57E
simulated by CORDEX RCMs during the Mid-term future Period (2041-2070) under rcp8.5 Future scenario

Location 2
Mid-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
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Thank You

• ICRC CORDEX2019
• APN
• JPL-RCMES