



Applied Remote Sensing Training (ARSET) Program

Assessing Extreme Weather Statistics using NASA Earth eXchange Global Daily Downscaled Projections (NEX-GDDP-CMIP6)

Homework Questions

Question 1

The only model used in NEX-GDDP-CMIP6 downscaling is the NASA GISS model

Answers: (bold correct)

- a. True
- b. False**

Feedback:

The NEX-GDDP-CMIP6 downscales 35 Global Climate Models from various countries and institutions, and the NASA GISS model is one of them.

Question 2

Which geophysical parameter pairs are available in NEX-GDDP-CMIP6 data?

1. surface shortwave radiation, sea level pressure
2. surface minimum temperature, precipitation
3. wind speed, wind direction
4. surface longwave radiation, surface specific humidity

Answers: (bold correct)

- a. Option 1 only
- b. Options 2 and 3 only**

- c. **Options 2 and 4 only**
- d. Options 1, 2, 3 and 4

Feedback

NEX-GDDP-CMIP6 include 9 downscaled geophysical parameters: Relative humidity, specific humidity, precipitation, surface downwelling longwave radiation, surface downwelling shortwave radiation, near-surface wind speed, surface minimum, maximum, and mean temperatures. Sea level pressure is not available.

Question 3

NEX-GDDP-CMIP6 data uses this type of downscaling technique

Answers: (bold correct)

- a. **Statistical**
- b. Dynamical
- c. Hybrid statistical & dynamical

Feedback:

NEX-GDDP-CMIP6 uses the statistical downscaling technique with a Bias Correction/Spatial Disaggregation (BCSD) method.

Question 4

Follow the steps below:

Interactive Dashboard Instructions:

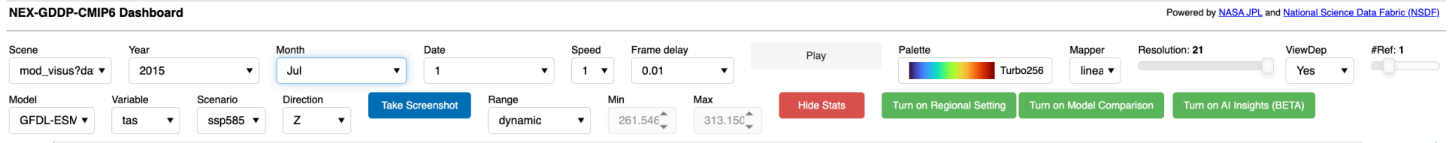
Open the NEX-GDDP-CMIP6 dashboard link.

<https://chpc3.nationalsciencedatafabric.org:12347/dashboards>

- Once the page loads, explore the available tabs and panels.
- Use the dropdown menus and map controls to select variables, indices, regions, and time periods of interest.
- Generate visualizations by adjusting parameters (e.g., model, scenario, time range) and view the corresponding plots and maps.

Go to [NEX-GDDP Dashboard](#). Enter the following options (see the figure below)

Year: 2025, Month: July, Date: 1, Model: GFDL-ESM4, Variable: tas, Scenario: ssp585.



Click the blue button 'Take Screenshot' to download a screenshot of the map image. **Rename the image as 'Q4_tas2025_yourlastname.png'**. Email this image to this address:

arset.homework@gmail.com

Now click on the green button 'Show Stats'. You will see the minimum, average, and maximum temperatures in a line plot below the map window. Hover your mouse over the red circles and note down the average 'tas' value.

The average 'tas' is:

Answers: (bold correct)

- a. 222.762
- b. 258.487
- c. 291.986**
- d. 313.122

Feedback:

The middle point in the line chart shows average 'tas'. When you hover the mouse on this point it shows the average 'tas' value to be 291.986 K.

Part 1 Exercise

Complete the Part 1 exercise then answer the questions below.

GEE Exercise Instructions:

1. Click on the link to open the code on your GEE account/window:
 - a. [Extreme dry and wet events during summer seasons](#)

2. Run the script by clicking on the '**Run**' option in the top menu bar. If any changes are made or comments are added to the script, you can save the script by clicking on the '**Save**' option with a drop-down arrow, choose '**Save as**' and save the script by entering a name in the '**File Name**' window.
3. Examine extreme dry and wet events time series graphs in the 'Console' window.
4. Take screenshots of the dry and wet frequency time series graphs and save them to your computer.
5. Email screenshots for the time series graphs to this address arset.homework@gmail.com.
6. Based on the time series, answer the following questions:

Based on the time series, answer the following questions:

Question 5

Pointing to the time series (hover with the mouse) '**Frequency of Days with Lower than 10 Percentile Daily PR**', you will see the extreme dry event frequency values and years. Point to the highest peak—the frequency value is close to:

Answers: (bold correct)

- a. 26.1
- b. 54.5**
- c. 68.3
- d. 75.8

Feedback:

The highest dry event frequency is close to 54 in year 2054.

Question 6

Pointing to the time series (hover with the mouse) '**Frequency of Days with Higher than 90 Percentile Daily PR**', you will see the extreme wet event frequency values and years. Point to the highest peak. The wet frequency was highest in

Answers: (bold correct)

- a. 2020
- b. 2025
- c. 2032**
- d. 2076

Feedback:

The highest wet event frequency peak is in 2032, the second highest (very close to the first one) is in 2076.

Question 7

Pointing on the trend line time series (hover with the mouse) in both dry and wet event time series you will see the slope and intercept values of the trend lines. The sign of the wet frequency and dry frequency trend lines are:

Answers: (bold correct)

- a. negative, negative
- b. positive, negative
- c. positive, positive
- d. negative, positive**

Feedback:

The trend line for extreme wet (dry) frequency has negative (positive) slope, indicating decrease (increase) in wet (dry) events between 2020 to 2100.

Optional Exercise

In the script, lines 78-80 will allow you to choose a region of your interest (country and state of your interest). Change the options 'United States of America' and 'Nebraska' to the country and state of your interest and re-run the script. Follow the steps above.

Part 2 Exercise

Jupyter Notebook ETCCDI Future Change Map over a country

Complete the Part 2 exercise then answer the questions below.

Jupyter Notebook Exercise Instructions:

1. Open the Binder Hub link. This Binder will be available until **Friday, September 19th**.
<http://ocw-jpl.org/v2/gh/aashishpanta0/nasa-arset-training/HEAD>
2. In the left File Browser, double-click then open the folder named **scripts**.
3. In scripts, double-click **Streaming_via_intake.ipynb** to open it.
4. In the notebook, in the top menu bar, choose Kernel → Restart Kernel and Run All Cells and confirm.

5. Verify that the final cells complete without errors (you should see printed outputs/plots).
6. Return to the scripts folder (left pane). Open **ETCCDI_pr_indices_driver.ipynb**.
7. Run it with Kernel → Restart Kernel and Run All Cells, and confirm.
8. After it finishes, go back to scripts and open ETCCDI_country_stats.ipynb.
9. Run it with Kernel → Restart Kernel and Run All Cells... and confirm.
10. Review the summary statistics and figures.

* If a cell hangs or errors, use Kernel → Restart Kernel and then Run All Cells again.

* To answer the following exercise questions, **you do not need to modify the notebooks. Simply running the provided .ipynb scripts as they are will allow you to complete the exercises.**

* **After September 19th:** For participants who want to use Binder Hub, we provide secured access to the Hub. If you need this option, please [contact us](#) with your name, affiliation, and email address. We will send instructions for accessing the Jupyter Hub.

Question 9

Using the **ETCCDI_country_stats.ipynb** results for Thailand (averaged between 1985–2014), what is the interquartile range (IQR = Q75 - Q25) of the Rx5day (rounded to the nearest millimeter)?

[Go to the left File Browser → Script → Outputs → (ETCCDI_pr_GISS.... Thailand_stats.csv]

Answers: (bold correct)

- a. 38 mm
- b. 42 mm**
- c. 52 mm
- d. 68 mm

Question 10

Based on the summary statistics for the climatological Rx5day in Thailand, which statement best describes the shape of the Rx5day distribution across the country?

[Go to the left File Browser → Script → Outputs → (ETCCDI_pr_GISS..... Thailand_stats.csv and compare mean and median values]]

Answers: (bold correct)

- a. Symmetric distribution (mean ≈ median)
- b. Left-skewed (negative skew, mean < median)
- c. Right-skewed (positive skew, mean > median)**
- d. Bimodal

Question 11

Using the Intake catalog from Jupyter Notebook in scripts, '**Streaming_via_Intake.ipynb**', answer which of the following GDDP models is NOT currently available using the intake catalog? [Look for heading 'List Available Models, Variables, Scenario, Timeranges' in the script]

Answers: (bold correct)

- a. ACCESS-CM2
- b. CanESM5
- c. CESM2
- d. **NESM3**

Feedback:

11 models including ACCESS-CM2 , CanESM5, CESM2, CMCC-CM2-SR5 are currently available. NESM3 is not available as of now.

Question 12

Using the jupyter notebook **ETCCDI_country_stats.ipynb**, compute the multi-year median for country 'Nepal'.

In the script, change the "COUNTRY_NAME = " variable (in Step 2) to 'Nepal' and re-run the notebook (clicking on Restart Kernel and Run All Cells at the top). Refer to the output csv file as needed. Or Scroll down to [8]: 'Spatial statistics table'

The median values is:

Answers: (bold correct)

- a. 158.687
- b. **152.358**
- c. 154.762
- d. 149.514

Feedback:

Statistics from the output: count 222.000000, mean 140.766205, std 41.462986, min 63.851463, q25 102.992514, **median 152.357918**, q75 170.562626, max 216.643051