CCT user manual

A.1. Start Climate Change Toolkit (CCT)

CCT, is a standalone program. It has full graphical user interface (GUI) and runs on MS windows operating systems (Fig. A1). Start the program by double clicking on exe file. During the development of the software package has been given emphasis on maintaining a simple, comprehensive and user friendly structure. All the main modules can be accessed through the main menu of the software, and in each module there are several additional options for further analysis.

A.2. Create/Open project (CCT)

To build a new project press Main tab at the left top corner. CCT has a general part (Fig. A2) which user can spatially and temporally extract data of desired region for further analysis. In this part user needs to specify the main database folder (five GCMs with four emission scenarios) and spatial and temporal variation. For spatial variation CCT support the longitude ranges between -179.75 to + 179.75 degree and latitude ranges between -89.75 to 89.75 degree with 0.5 steps. For temporal variation software uses two database for historic (01/01/1970-31/12/2005) and future scenarios (01/01/2006-31/12/2099).

By pressing the **RUN** the specified variables (precipitation and/or temperature) are stored in a destination location where user needs to specify.

After executing this part, the program creates the desired project directories and copies all initial input files and exe file in destination folder (Fig. A3).

A.3. CCT modules

Module A: Global Climate Data Management (GCDM)

CCT provides a module (module A Global Climate Data Management) (Fig. A4) for calculation of monthly and annually averages of precipitation, maximum and minimum temperature for each climate station located in user specified region. In this module user needs to specify the location of their own database "userdatabase" in front of "Input Data" label for further analysis. By pressing **RUN** in first section of the module, CCT summarizes the monthly and annually averages of climate grids in output folder in Excel files. In Second part of the module user can specify two models to compare them and make anomalies analysis. For temporal variation users should specify beginning and ending date of both models. By pressing **RUN** in second of the module, CCT summarize the

monthly and annually anomalies of climate data in "output-anomaly" folder with Excel format. Both output folders will be created as sub folders in "ModuleA-GCDM" folder.

Module B:

In this module user needs to browse the location of data set which need to be downscaled manually through the interface by checking the **Manual** checkbox and then choose the models, scenarios, and variables by check the check box behind each ones. Moreover user could directly browse the data set for downscaling by checking the **Direct** checkbox in interface and then **browse** button in front of "Input Folder" label.

In nest step Output folder need to be specified by **browse** button in front of "Output Folder" label, For downscaling this module needs long term monthly and annually averages of climate grids for two set of data: 1- Future model, and 2- Measured data (which are CRU data or users' local data). These two outputs have been generated after executing Module A.

User could browse the simulation file statistics of models by pressing **browse** button in front of "Simulation File" label. In next step user should specify measured files statistics which often are local measured data by pressing **browse** button in front of "Measured File" label. Bias correction can be applied either by ratio or additive methods. This option need to be selected by user in front of "Correction Method" label. By pressing **RUN** output folder will be created as a sub folder in "ModuleB-BCSD" folder.

Module C:

Interpolation of the climate data to reach to the finer resolution data is applied using Inverse Distance Weight (IDW) algorithm in module C. User needs to specify the input data set which needs to be processed to get finer resolution data same as before (first paragraph of ModuleB). In next step the spatial extent of the region need to be specified. For spatial variation software supports the longitude ranges between -179.75 to + 179.74 degree and latitude ranges between -89.75 to 89.75 degree with 0.5 degree steps. In front of "Method" label user needs to specify if considering elevation impact as a constraint is needed or not. Based on the elevation method a laps rate of -6 ^{o}C km^{-1} is applied to the temperature and a value of 10 mm km^{-1} is applied to the rainfall. Current grid size should be defined in front of "Current Grid Size" label. In the first iteration current grid size would be 0.5 degree and the final grid size would be 0.25. The application can be

used repeatedly, each time halving the previous grid resolution. By pressing **RUN** output folder will be created as a sub folder in "ModuleC-SICD" folder.

Module D:

Frequency and severity of dry and wet periods can be calculated through module D, giving the user the ability of definition of the different dry and wet periods considering different criteria and methods that suit better to the region's climate ore the purpose of each study. For example, several constructs are shown in Table 2. User needs to specify the dry or wet period's definition through interface. For this purpose user needs to give the name of variables in front of "Variables Name" label (e.g. PCP, TMX, TMN), starting date of files (01/01/1970 for historic and 01/01/2006 for future scenarios), starting and ending date of future or past periods need to be specified in separate fields ("File Start Date", "Period Start date", and "period end date"). Period's length (e.g. dry periods: 60,120 days, and wet periods: 1, 2, 3 days) need to be specified in front of "Period Length" label. Threshold value for counting consecutive days (e.g. 2 mm day^{-1}, 35 ^{o}C, and 10^{o} C) and type of operation (less than or greater than) need to be specified in this module. By pressing **RUN** output folder will be created as a sub folder in "ModuleD-CCDA" folder.

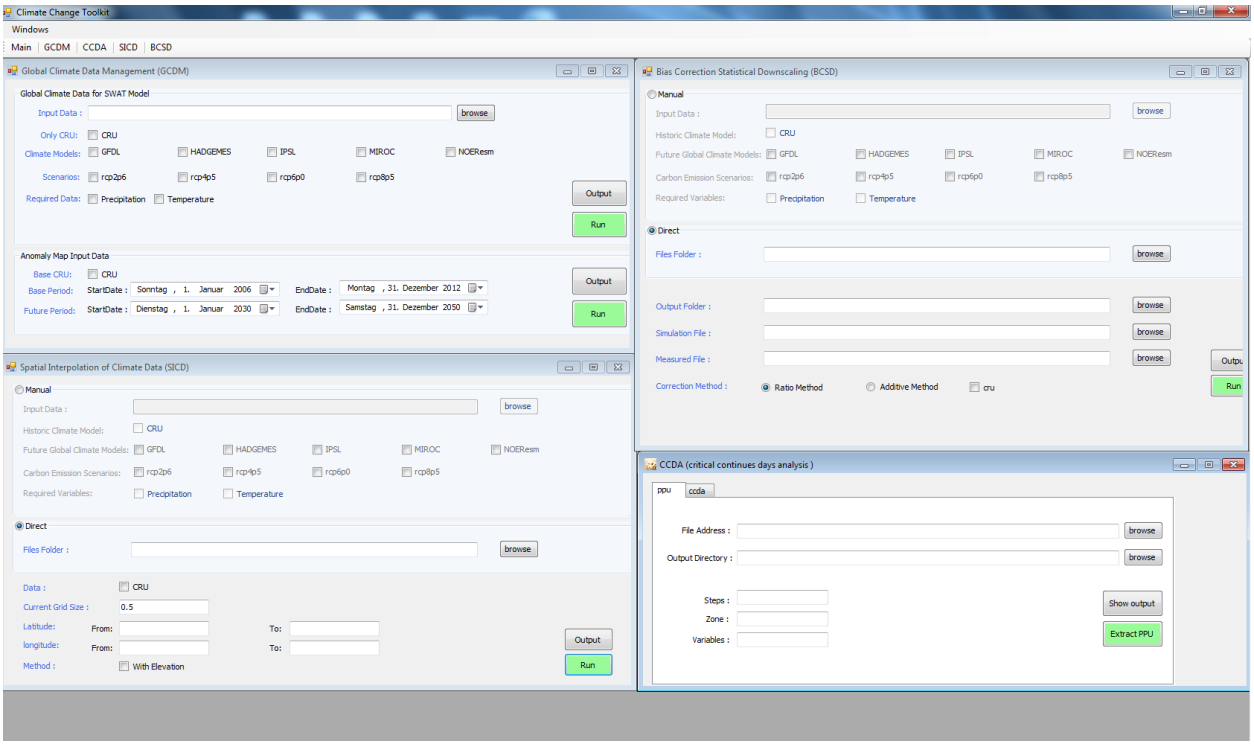

Figure A1. The graphical user interface (GUI) of CCT

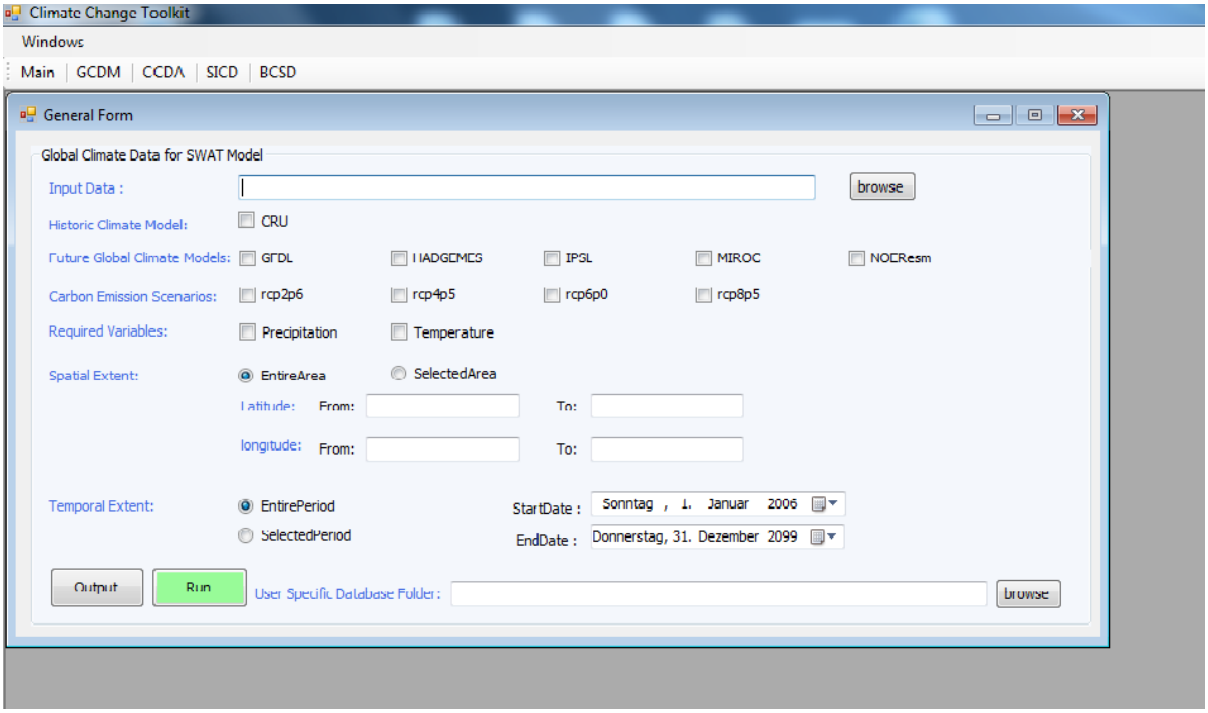

Figure A2. CCT General Inputs

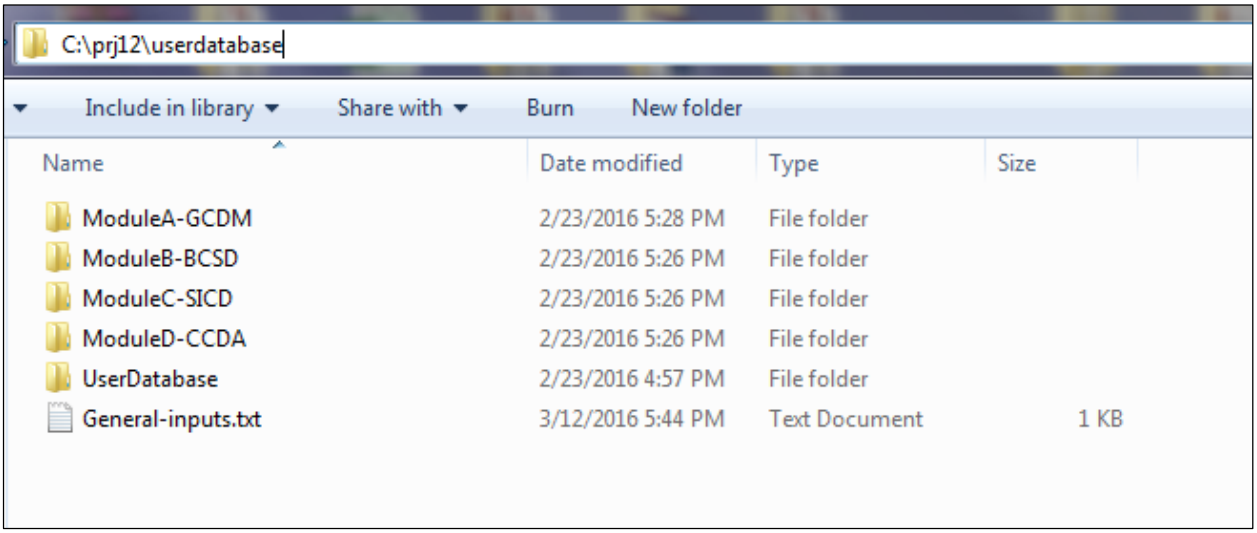

Figure A3. Destination Folder

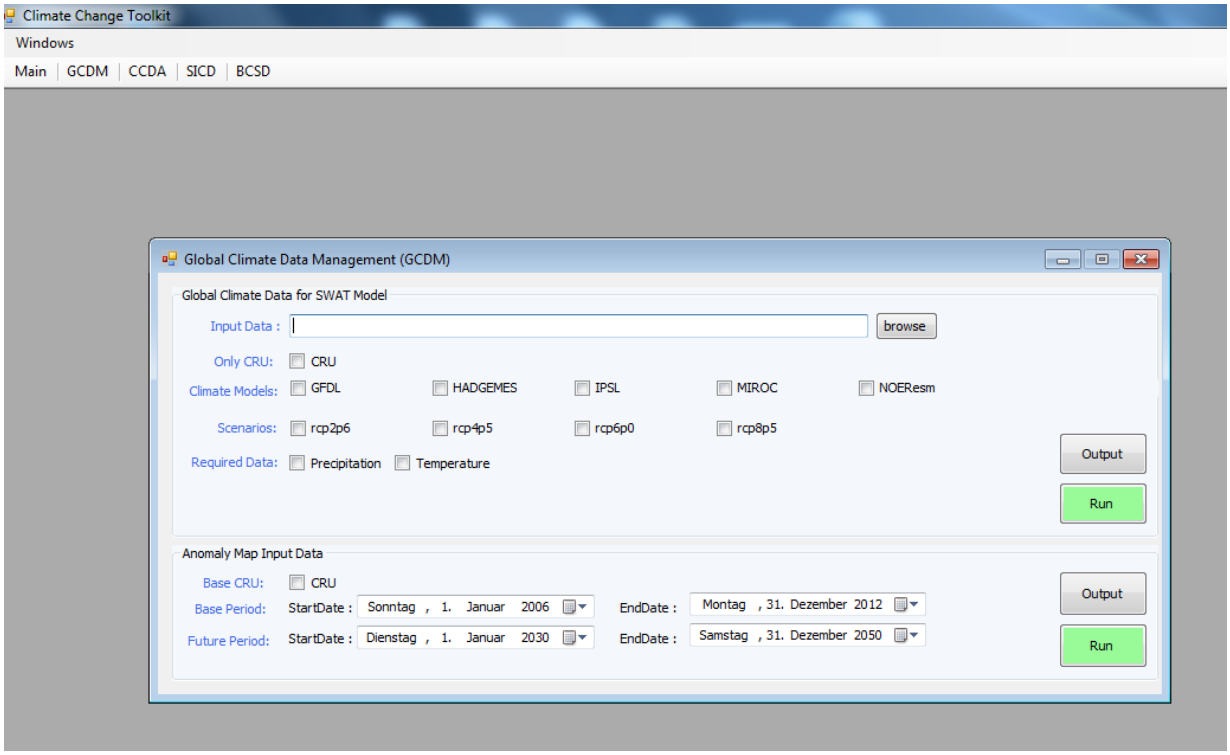

Figure A4. Module A: Global Climate Data Management (GCDM)

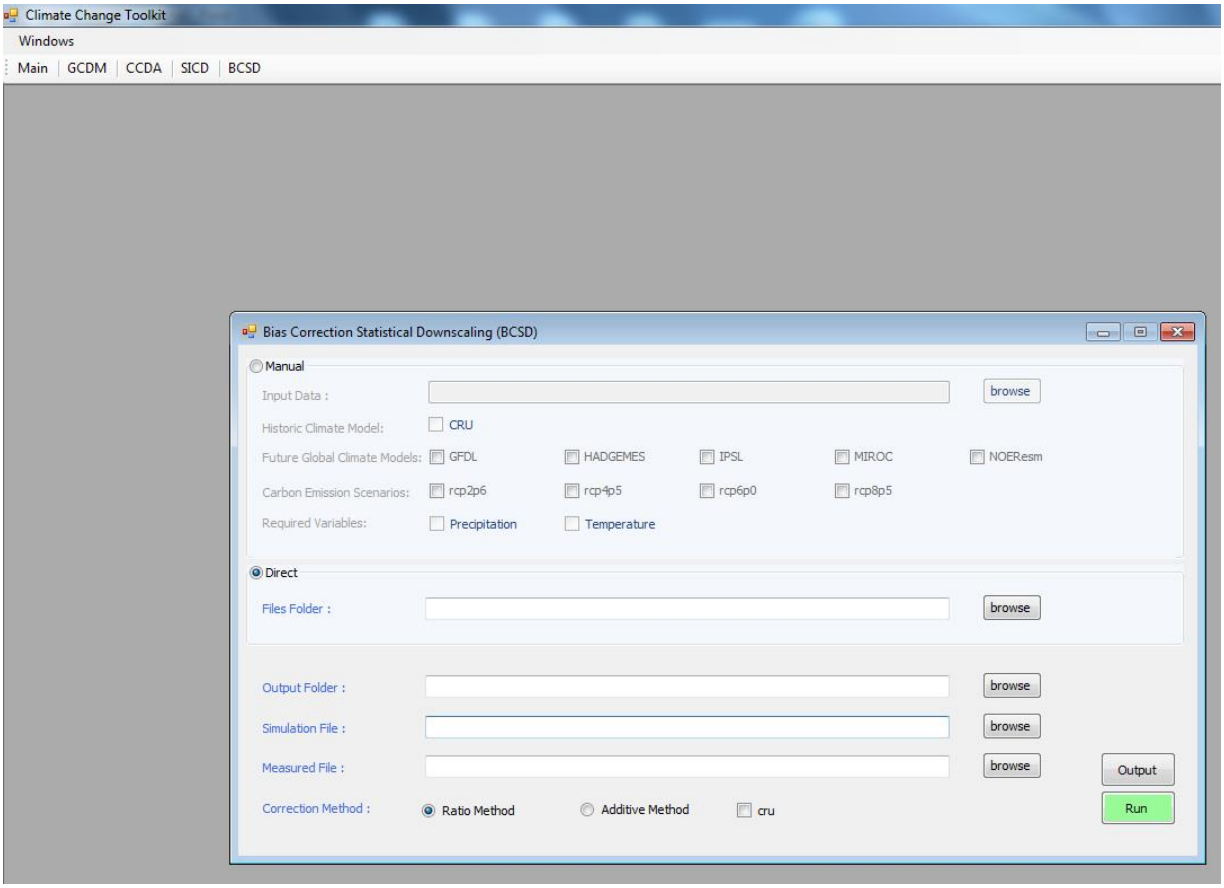

Figure A5. Module B: Bias Correction Statistical Downscaling

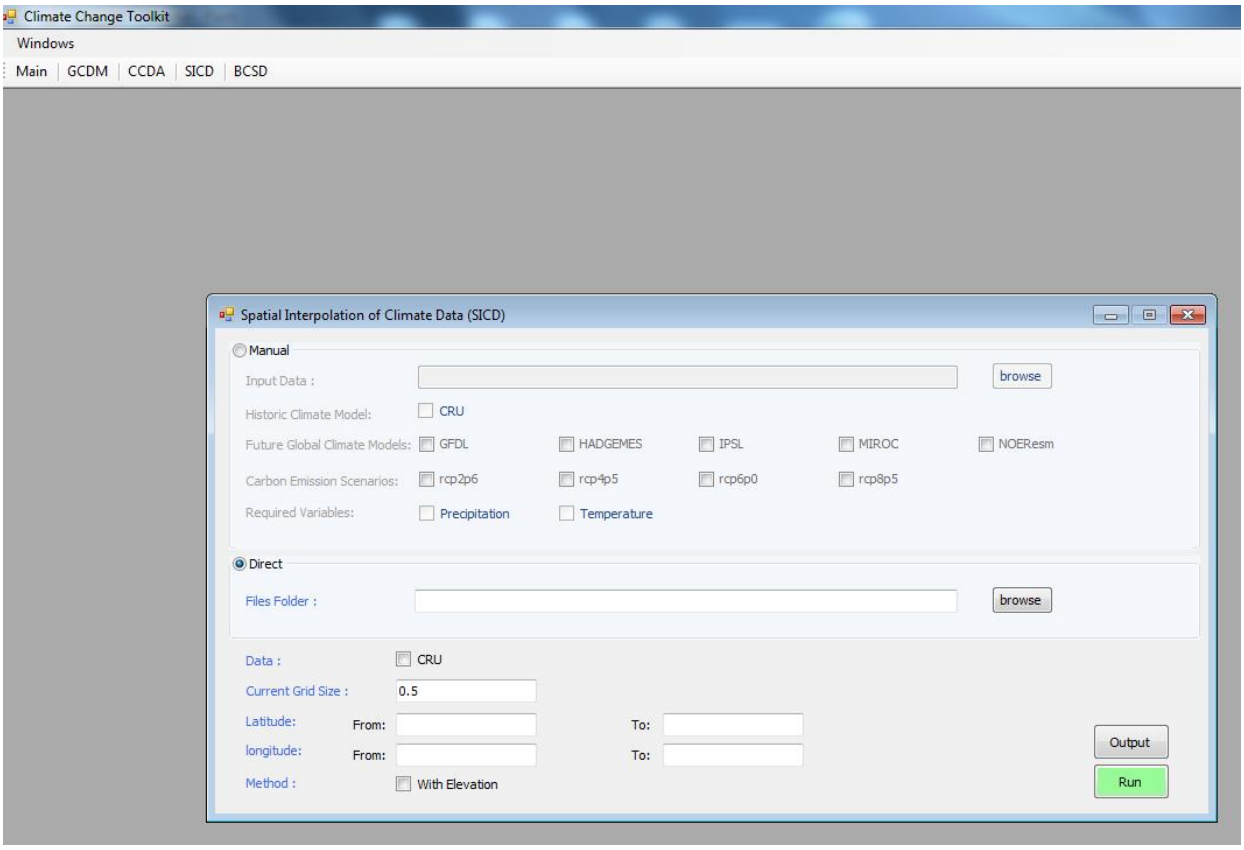

Figure A6. Module C: Spatial Interpolation of Climate Data

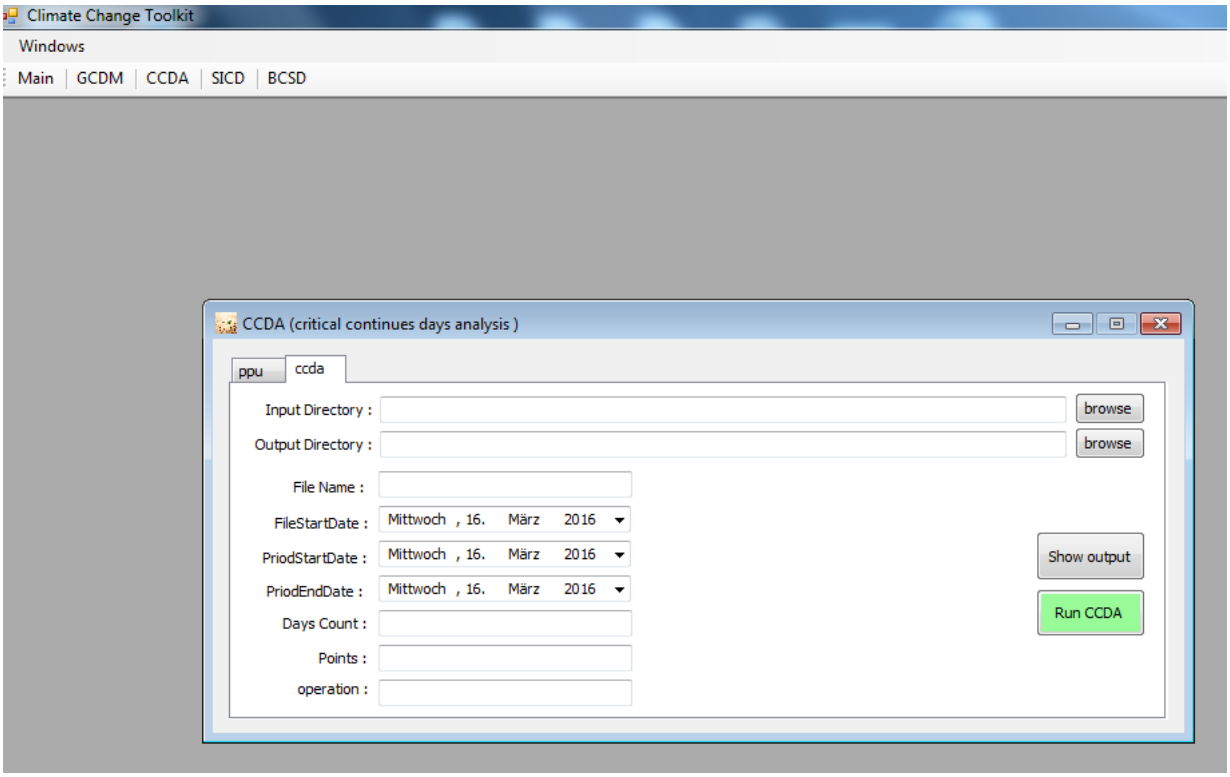

Figure A7. Module D: Critical Continues Days Analyzer