

Climate Change Toolkit (CCT)



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Warsaw, June 2017

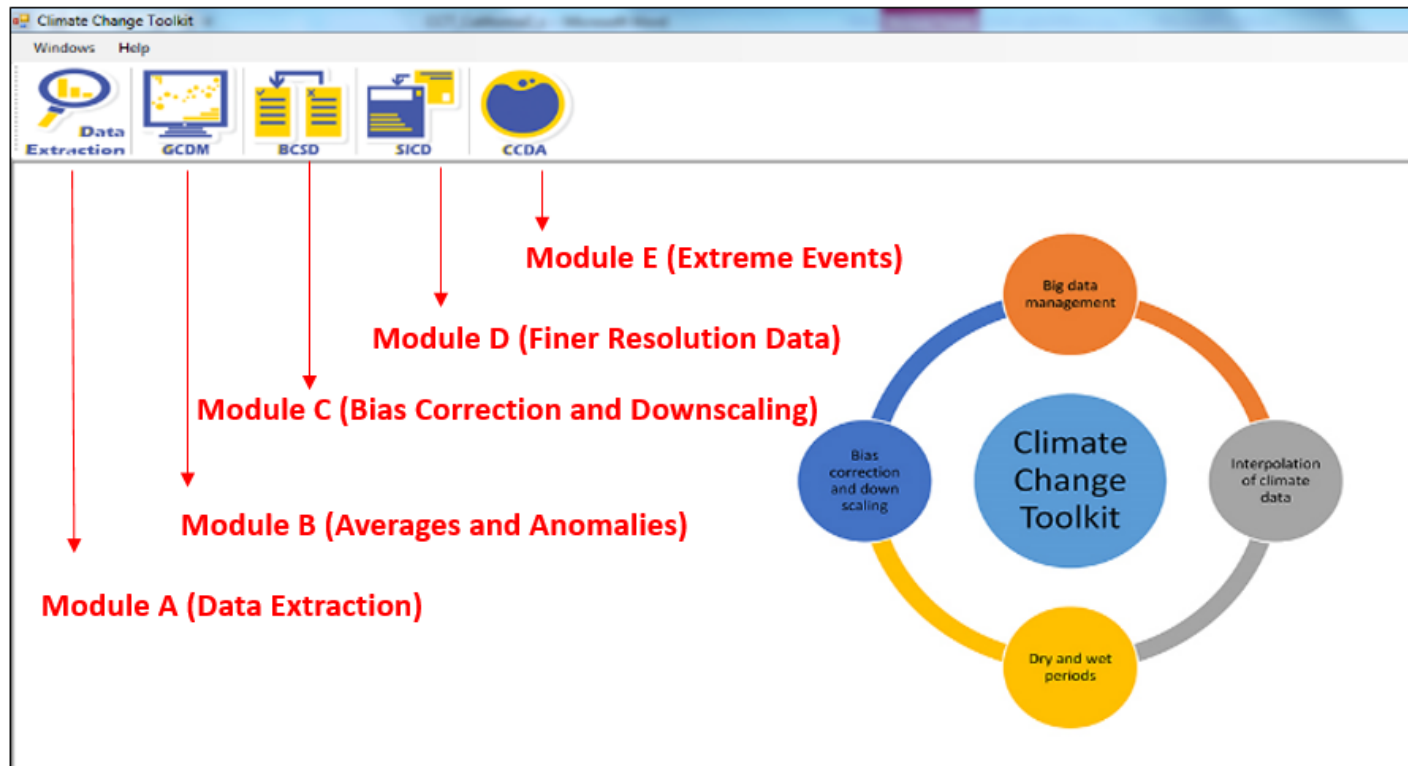


Steps in Climate Change Analysis

- Collect historic measured data
- Collect GCM climate change data (find, extract from NetCDF format, reformat for SWAT, etc...)
- Downscale/bias correct climate change data
- Interpolating to finer resolution
- Run hydrologic model with future data

Climate Change Toolkit (CCT)

- Collect historic measured data
- Collect GCM climate change data (find, extract from Netcdf format, reformat for SWAT, etc...)
- Downscale/bias correct climate change data
- Interpolating to finer resolution
- Run hydrologic model with future data
- Analysis of extreme events



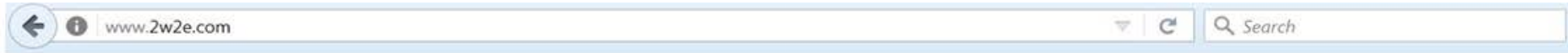
Data Archive

- Consists of 5 global GCMs and 4 emission scenarios (CMIP5) from ISI-MIP (1950-2100) at 0.5 degree resolution
- Historic CRU data (1970-2012) at 0.5 degree resolution
- SWAT-formatted precipitation, max and min temperature

GCM	Scenarios	Institute
GFDL-ESM2M	RCPs 2.6,4.5,6,8.5	NOAA/Geophysical Fluid Dynamics Laboratory (USA)
HadGEM2-ES	RCPs 2.6,4.5,6,8.5	Met Office Hadley Centre (United Kingdom)
IPSL-CM5A-LR	RCPs 2.6,4.5,6,8.5	Institute Pierre-Simon Laplace (France)
MIROC	RCPs 2.6,4.5,6,8.5	AORI, NIES and JAMSTEC (Japan)
NoerESM1-M	RCPs 2.6,4.5,6,8.5	Norwegian Climate Center (Norway)

Module A: Data Extraction

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Climate Change Data for SWAT model (CMIP5)

Select Area	Select Models	Select Scenarios	Select Data Type
<input type="text" value="From Latitude"/>	GCM1 <input type="checkbox"/>	scenario1 <input type="checkbox"/>	Precipitation <input type="checkbox"/>
<input type="text" value="To Latitude"/>	GCM2 <input type="checkbox"/>	scenario2 <input type="checkbox"/>	Temperature <input type="checkbox"/>
<input type="text" value="From Longitude"/>	GCM3 <input type="checkbox"/>	scenario3 <input type="checkbox"/>	
<input type="text" value="To Longitude"/>	GCM4 <input type="checkbox"/>	scenario4 <input type="checkbox"/>	
	GCM5 <input type="checkbox"/>	historic <input type="checkbox"/>	
	HistoricData <input type="checkbox"/>		

Extract and Download

Module A: Data Extraction

- Spatial extraction Lat: -89.75 to 89.75 Long: -179.75 to +179.75

Windows Help

Data Extraction Calculate Average Anomaly Bias Correction Interpolation CCDAnalyzer

General Form

Climate Data

Main Database Folder :

Historic Climate Data: HistoricData ObservedData

Future Climate Models: GCM1 GCM2 GCM3 GCM4 GCM5 HistoricData

Carbon Emission Scenarios: Scenario1 Scenario2 Scenario3 Scenario4 Historic HistoricData

Climate Variables: Precipitation Temperature

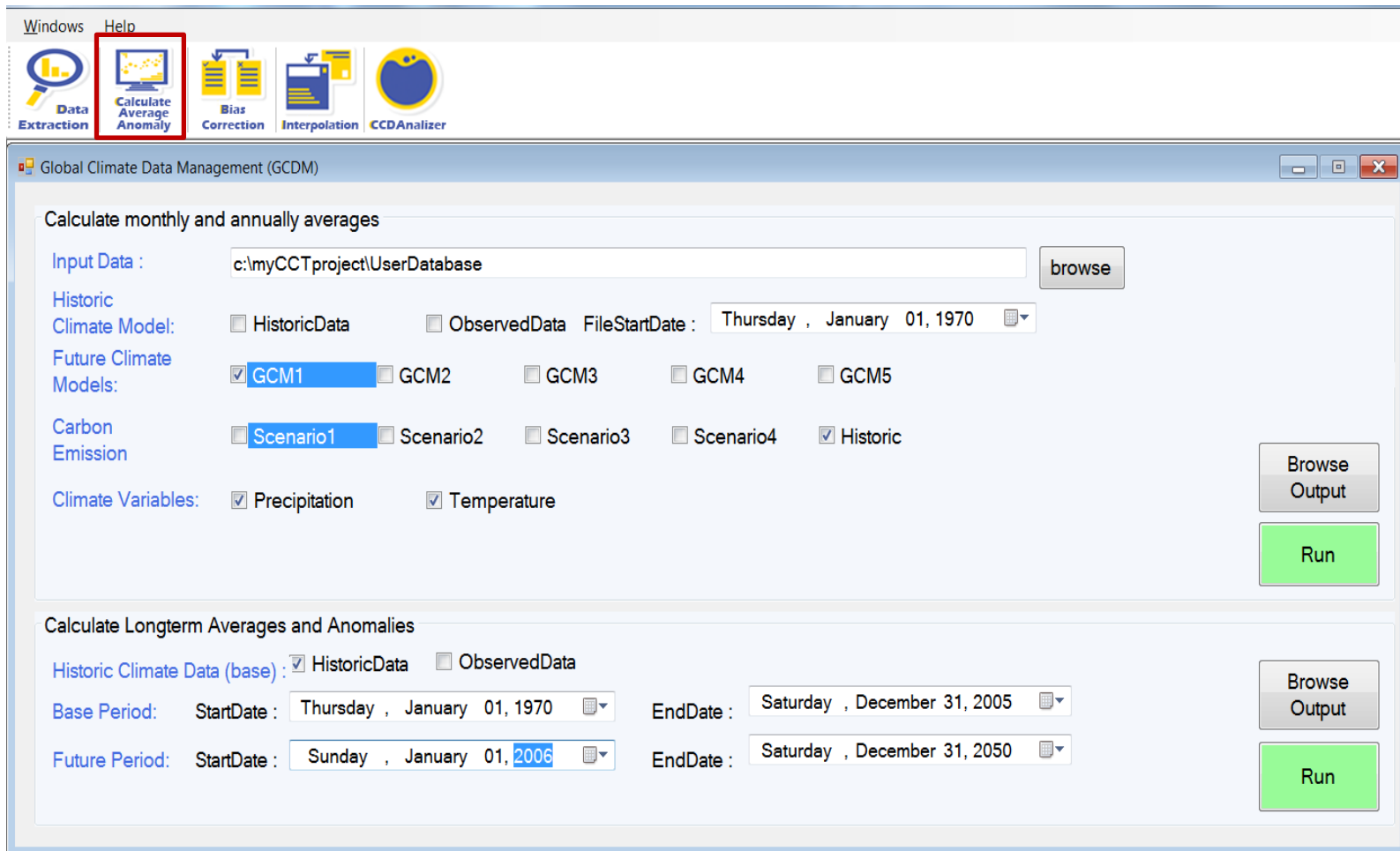
Spatial Extent to Extract: Latitude: From: To:
 longitude: From: To:

Temporal Extent to Extract: EntirePeriod SelectedPeriod StartDate :
 EndDate :

User Project Folder:

Module B: Global Climate Data Management (Averages and Anomalies)

- Calculate monthly and annually averages and anomalies at each grid point



Module C: Bias Correction Statistical Downscaling

- For precipitation: multiplicative correction
- For temperature: additive correction

Windows Help

Data Extraction Calculate Average Anomaly **Bias Correction** Interpolation CCDAnalyzer

Bias Correction Statistical Downscaling (BCSD)

Manual browsing of data

Input Data : c:\myCCTproject\UserDatabase

Historic Climate Data: HistoricData ObservedData

Future Climate Models: GCM1 GCM2 GCM3 GCM4 GCM5

Carbon Emission Scenarios: Scenario1 Scenario2 Scenario3 Scenario4 Historic

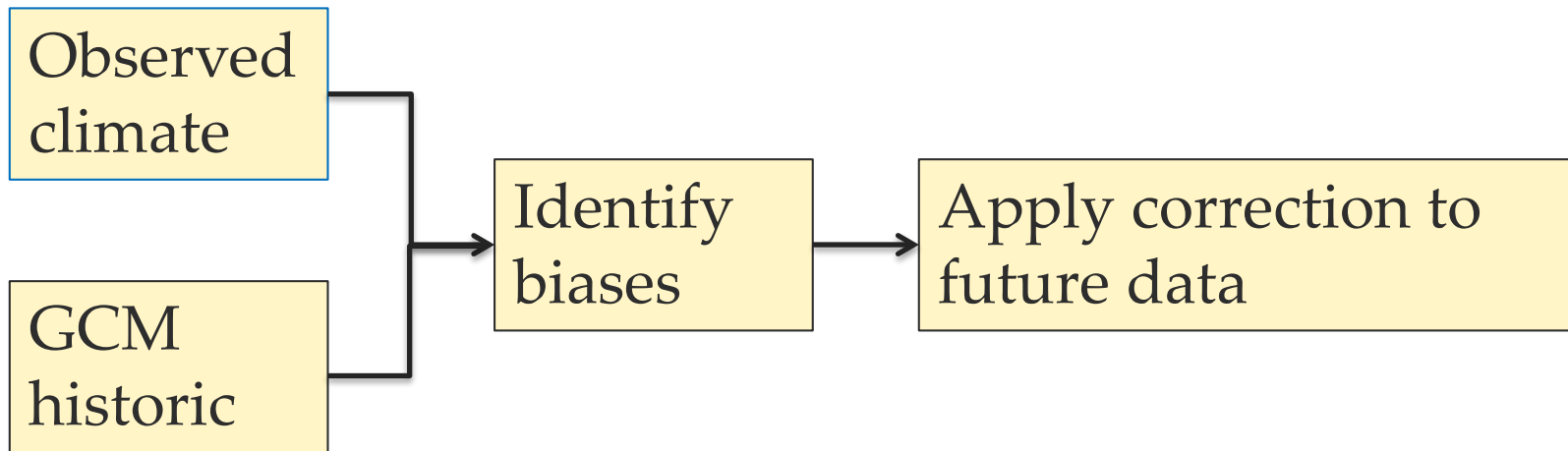
Climate Variables: Precipitation Temperature

GCMs Longterm Statistics: C:\myCCTproject\InputBiasCorrection\GCM_Longterm_GCM1_Historic_pcp_TotalReport.xlsx

Historic Longterm Statistics: C:\myCCTproject\InputBiasCorrection\Historic_Longterm_GCM1_Historic_pcp_TotalReport.xlsx

Correction Method : Ratio Method Additive Method Observed

Bias correction



Module D: Spatial Interpolation of Climate Data

- Inverse Distance Weight Method (IDW)

Windows Help

Data Extraction Calculate Average Anomaly Bias Correction **Interpolation** CCDAnalyzer

Spatial Interpolation of Climate Data (SICD)

Manual browsing of data

Input Data : c:\myCCTproject\UserDatabase

Historic Climate Data: HistoricData ObservedData

Future Climate Models: GCM1 GCM2 GCM3 GCM4 GCM5

Carbon Emission Scenarios: Scenario1 Scenario2 Scenario3 Scenario4 Historic

Climate Variables: Precipitation Temperature

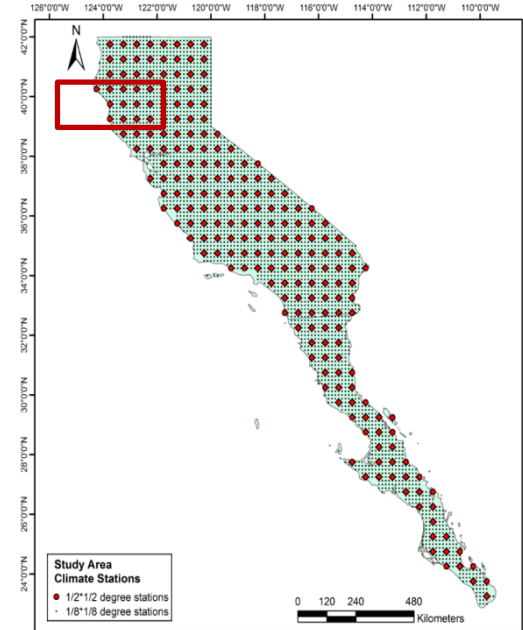
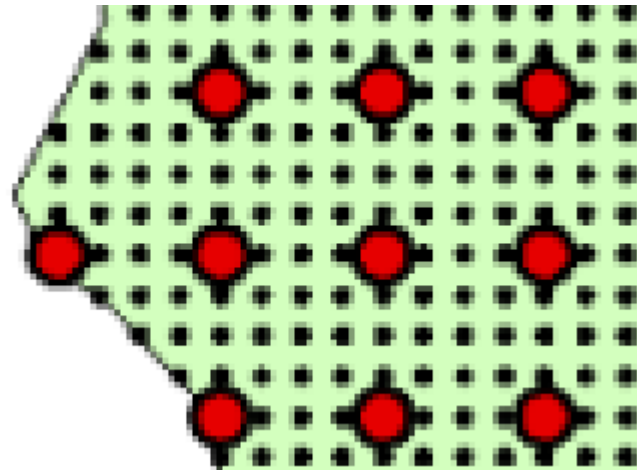
Method : Considering Elevation

Current Grid Size : 0.5

Latitude: From: 25 To: 40

longitude: From: 44 To: 63

Module D: Spatial Interpolation of Climate Data



Module E: Critical Consecutive Days Analyzer

The screenshot shows the CCDAnalyzer software interface. The title bar reads "CCDA (Critical Continues Days Analysis)". The main window contains several configuration sections:

- inputCCDA**: A tab labeled "InputCCDA from Swatcup outputs" with a sub-tab "ccda".
- Climate Data**:
 - Main Database Folder: c:\myCCTproject\Bias-Correted (with a "browse" button)
 - Historic Climate Data: HistoricData ObservedData
 - Future Climate Models: GCM1 GCM2 GCM3 GCM4 GCM5
 - Carbon Emission Scenarios: Scenario1 Scenario2 Scenario3 Scenario4 Historic
 - Climate Variables: Precipitation Temperature
- Spatial Extent to extract**:
 - Latitude: From: 25 To: 40
 - Longitude: From: 44 To: 63
- Temporal Extent to extract**:
 - EntirePeriod (selected) SelectedPeriod
 - StartDate: Sunday, January 01, 2006
 - EndDate: Thursday, December 31, 2099
- User Project Folder**: c:\myCCTproject\inputCCDA (with a "browse" button)

Buttons include "Browse Output" and a green "Run" button.

Module E: Critical Consecutive Days Analyzer

Region	Wet Period	Dry Period
<p style="text-align: center;">Regions Tropical</p>	<p>What is the frequency of:</p> <p>Period Length > 2 days precipitation > 50 mm/day</p>	<p>What is the frequency of:</p> <p>Period Length > 60 days precipitation < 2 mm/day .and. max temperature > 30° C</p>
<p style="text-align: center;">Regions Semi-Arid</p>	<p>What is the frequency of:</p> <p>Period Length > 1 day precipitation > 20 mm/day</p>	<p>What is the frequency of:</p> <p>Period Length > 120 days precipitation < 2 mm/day .and. max temperature > 35° C</p>

California example: Flood analysis

Table 4

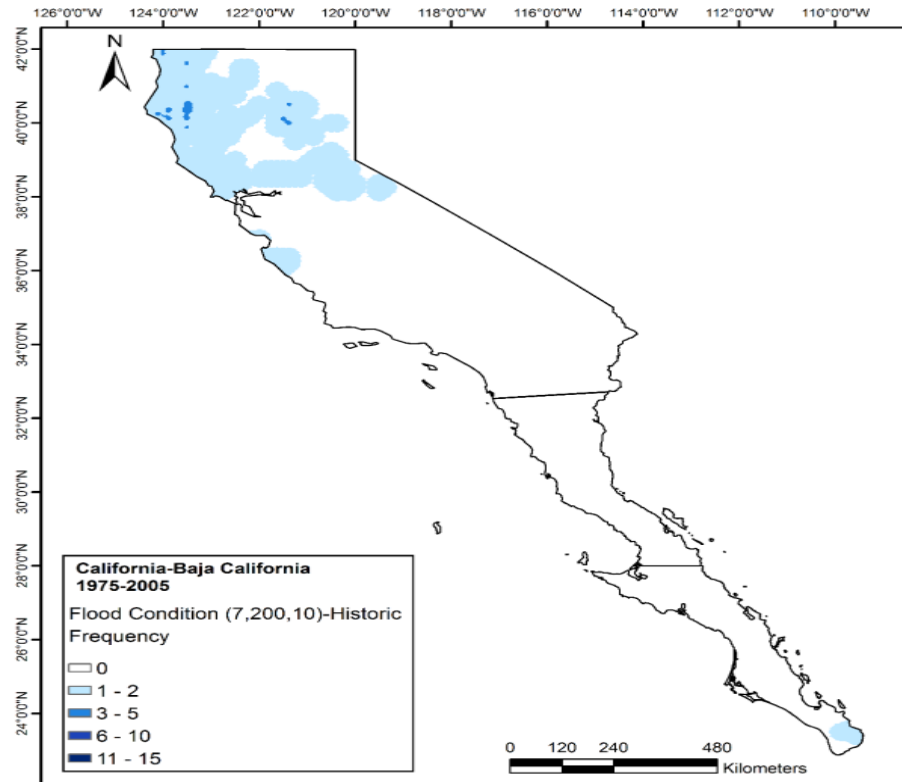
Records of historic flooding conditions in California.

Region	Year	Precipitation (mm)	Duration (Day)	Return period (years)
California	1909	1,458	20	12,000
1 North of Los Angeles	1933-1934	300	7	
2 Santa Ana River basin	February (4-7) 1937	200	4	450
3 Los Angeles	1938	254	5	
4 California (Shasta County)	December 1955	390	1	
5 California-Wester Nevada	1986	740	10	
6 California-Calistoga	1986	740	10	1,000
7 California-Sacramento	1986	250	11	
8 Northern California-Sierra Nevada	1996-1997	760	16	

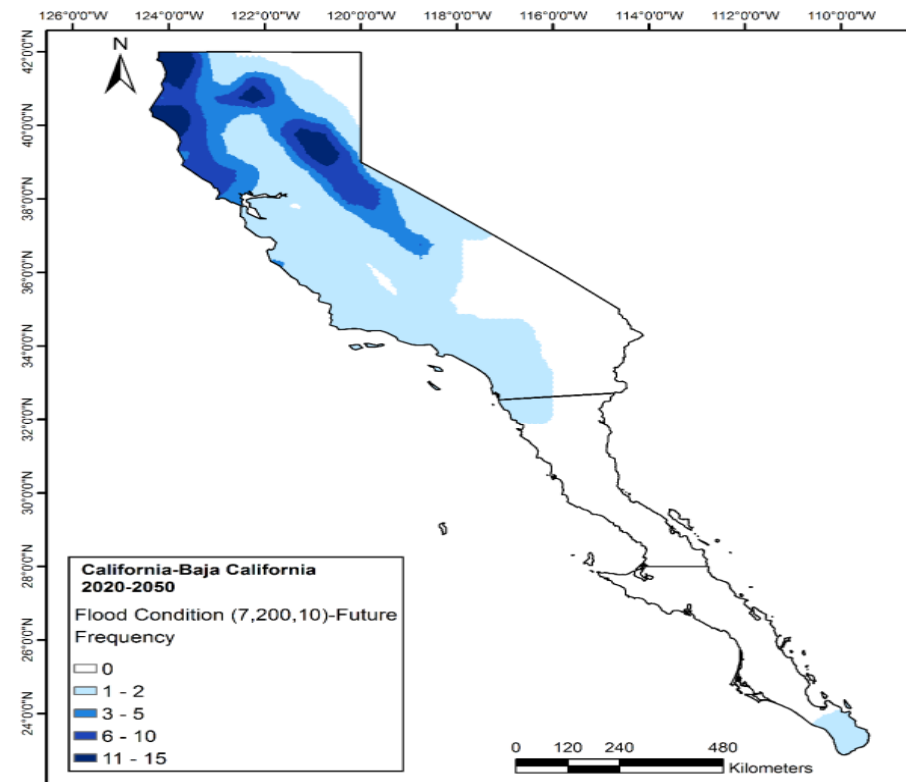
California Results- Flood analysis

Flood condition: 7 days rainfall, more than 200 mm, min 10 mm/d

Historic (1975-2005)



Future (2020-2050)

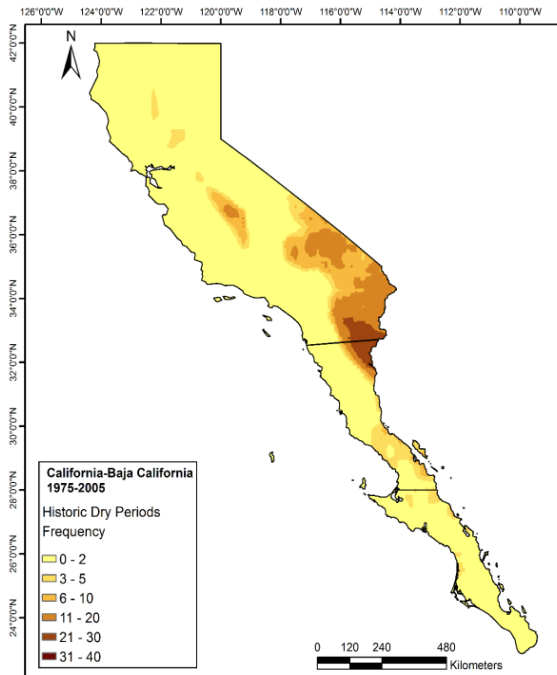


California Results- Dry periods

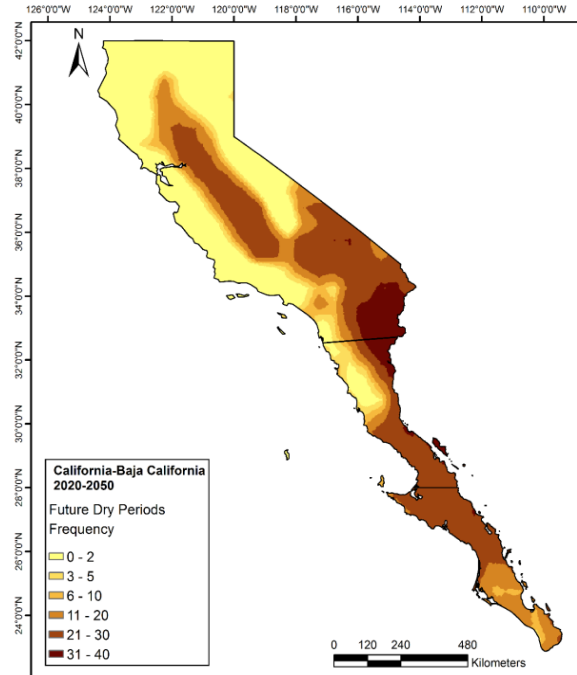
Period Length > 60 days
precipitation < 2 mm/day **.and.** max temperature > 30° C

Frequency of dry periods increased from 0-2 to 30-40 times

Historic (1975-2005)



Future (2020-2050)

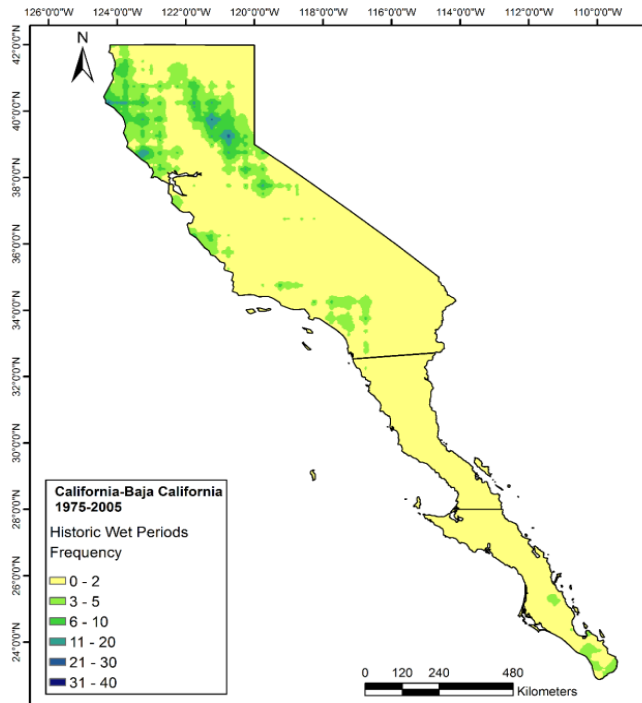


California Results- Wet periods

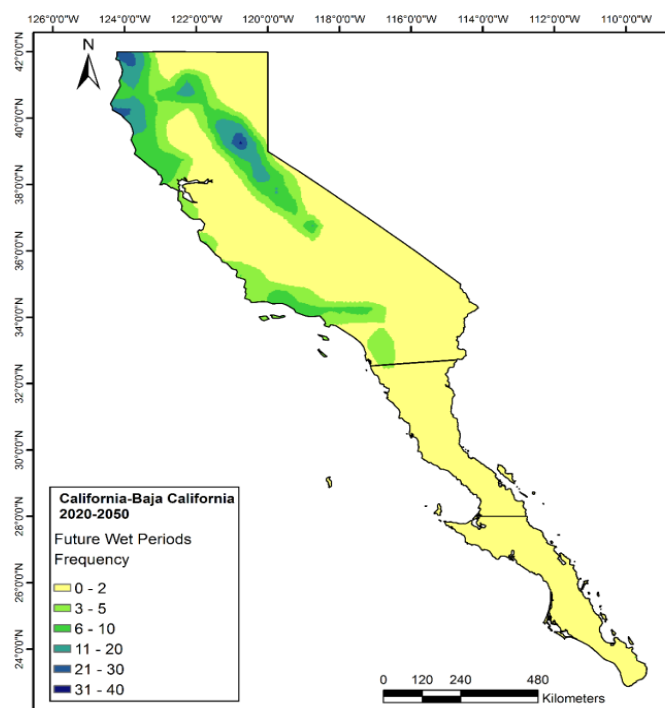
Period Length > 2 days, Precipitation > 50 mm day⁻¹

Frequency of wet periods: 0-2 to 31 – 40 times

Historic (1975-2005)



Future (2020-2050)



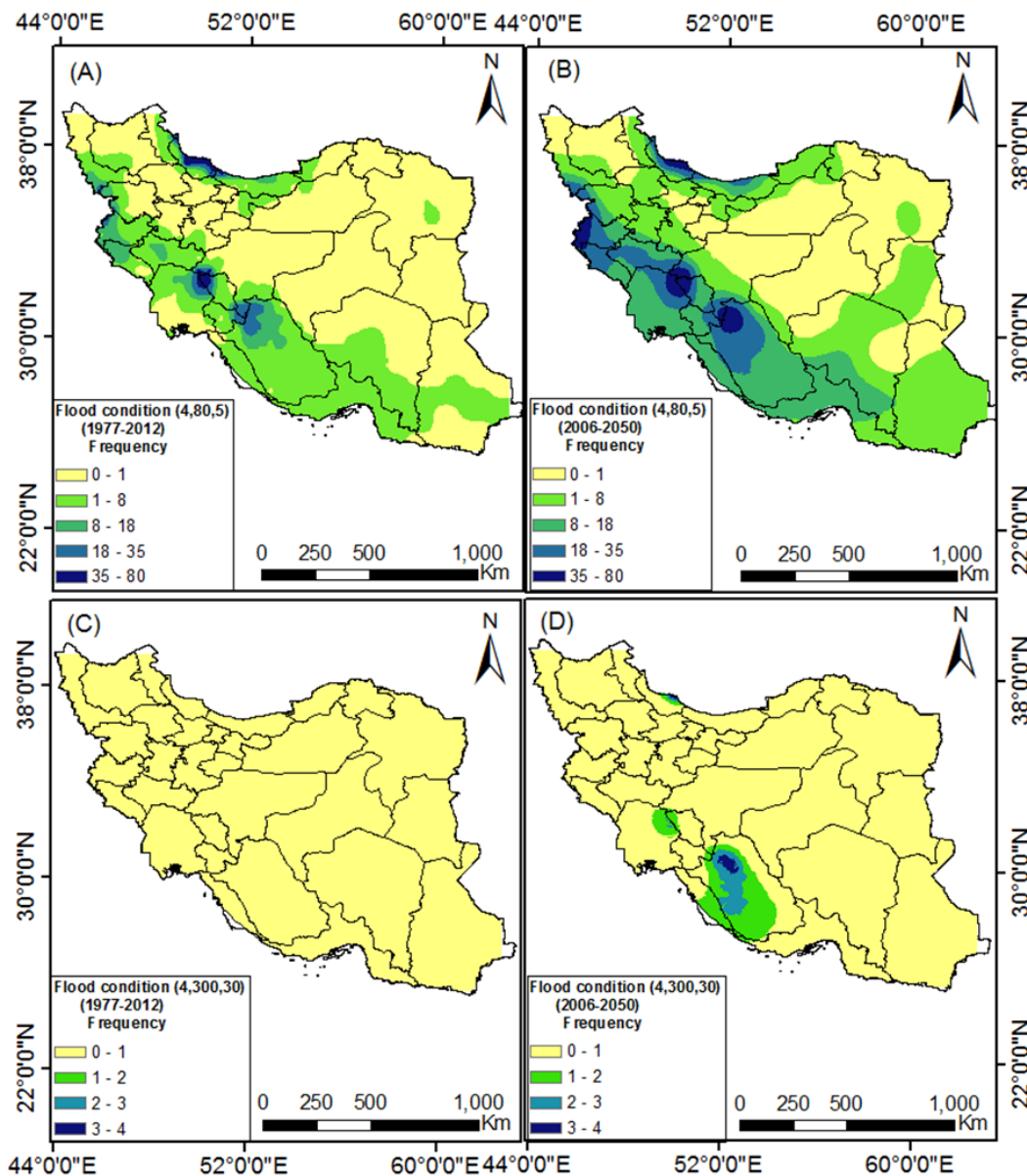
Iran Floods

Table 1

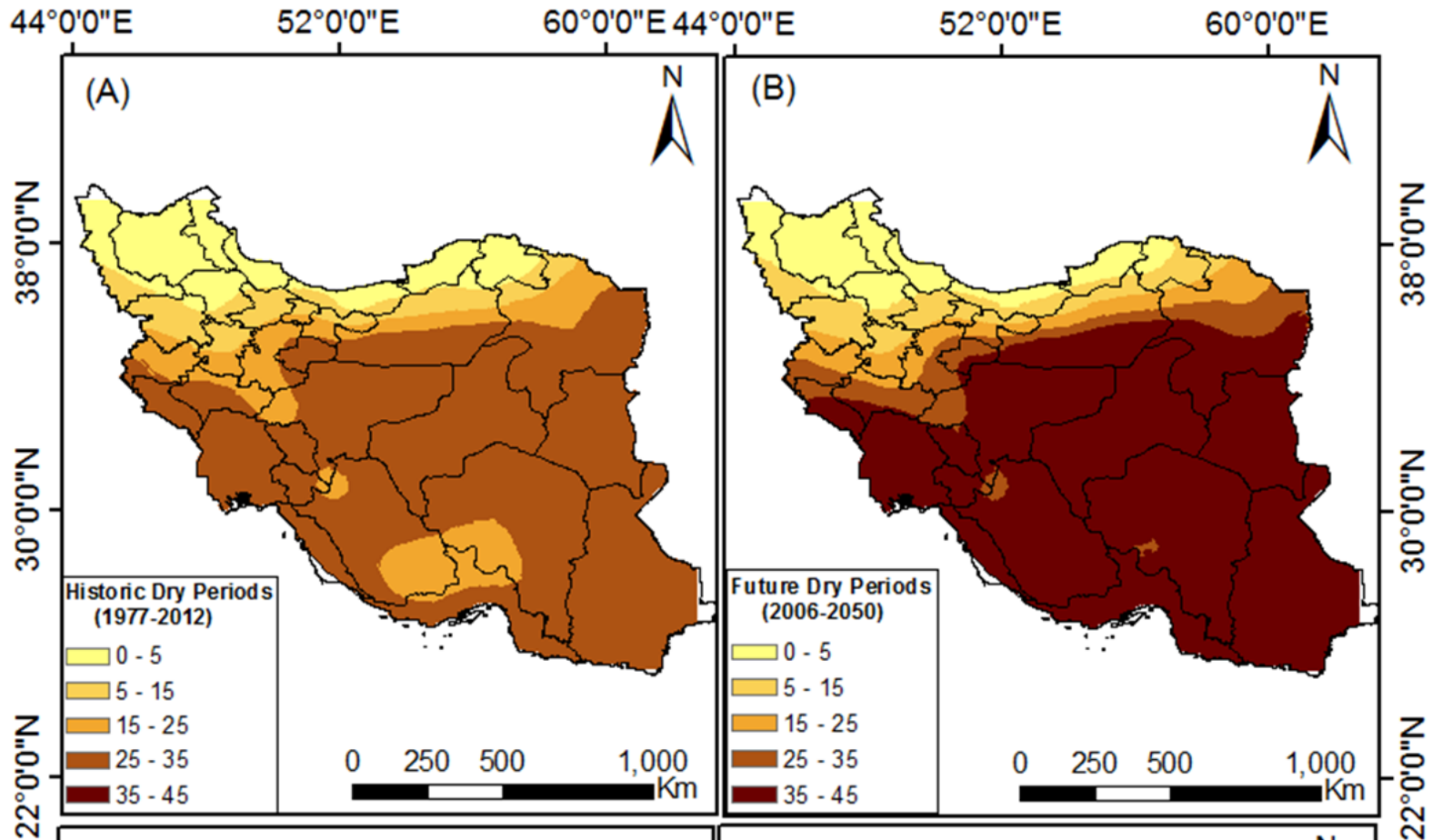
Reference criteria to study extreme floods.

province	date	Duration precipitation day	Total precipitin mm	Damage	
				Fatalities	Buildings
Golestan	11 August	2	140		4,000 buildings
East Azerbaijan	April 14 to April 17, 2017	2	55	42 deaths	-
Kurdistan		3	53	5 deaths	
Golestan	September 2, 2016	1	68	4 deaths	900
Ilam			325		
Lorestan	October 28, 2015	3	121	9	-
Tehran	19 July 2015	1	34	30 people injured	-
Mazandaran	19 and 20 July 2015	2	166.1		-
Qazvin	30 March 2015	1	31.1	77 people injured	-
Sistan	30 January 2017	4	118	1 death	-
Fars	13 February 2017	6	360	-	-

Iran Floods



Frequency of 150 consecutive days where rainfall < 2 mm and for the 1977-2012 period and 2006-2050



Products



SWAT-CUP 2012

SWAT-CUP is a program for calibration of SWAT models.

[Read more](#)

[Download SWAT-CUP](#)



Climate Change Toolkit

Climate Change Toolkit (CCT) is a program, which handles all climate change analysis' tasks in one package. [Read more](#)

[Download CCT](#)



SWAT-MODSIM coupled model

The coupled SWAT-MODSIM model is a program that links the SWAT and MODSIM models for better integrated water resource planning and management. [Read more](#)

[Download SM](#)



Global ET observation

The main objective of this program and the linked database are to prepare a framework allow users to profit from MODIS-NASA available Actual Evapotranspiration (AET) observations to calibrate SWAT hydrological model. [Read more](#)

[Download GlobalET](#)



Previous Projects

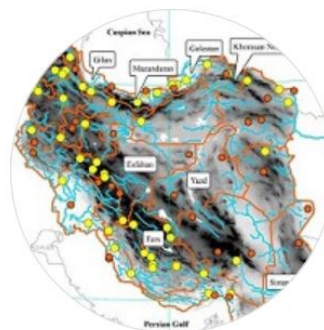


Europe project

A continental-scale hydrology and water quality model for Europe: Calibration and uncertainty of a high-resolution large-scale SWAT model

[Read more](#)

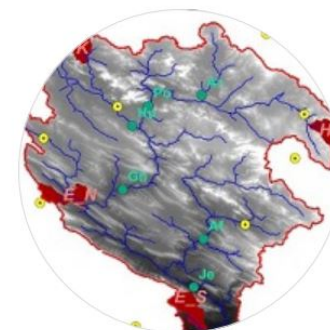
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Iran Project

Assessing the impact of climate change on water resources in Iran [Read more](#)

[Download Article](#)



Karkheh River Basin Project

Analyses of the impact of climate change on water resources components, drought and wheat yield in semiarid regions: Karkheh River Basin in Iran [Read more](#)

[Download Article](#)



Data

We have provided the necessary data for building a SWAT model of Global, Iran and Karkheh River Basin.

Karkheh River Basin (KRB)

The KRB (approximately 51,000 km²) stretches from the Zagros Mountains to the Hoor-Al-Azim Swamp, which is a trans-boundary wetland located at the Iran-Iraq border.

Select & Download

Iran

IRAN is located between 25 to 40 north latitude and 44 to 63 east longitude and an area of 1,648,195 km². The altitude varies from - m to 5670 m.

Select & Download

Global

We have prepared the global soil and landuse data compatible with Soil and Water Assessment Tool (SWAT) format. For further information feel free to contact us.

Select & Download

Iran

DEM
Resolution 500 m

Soil
Resolution 1000 m

Landuse
Resolution 500 m

Climate
PCP, TMP, 0.5 deg

Close

Karkheh River Basin (KRB)

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