Modelling current and future distributions of selected species

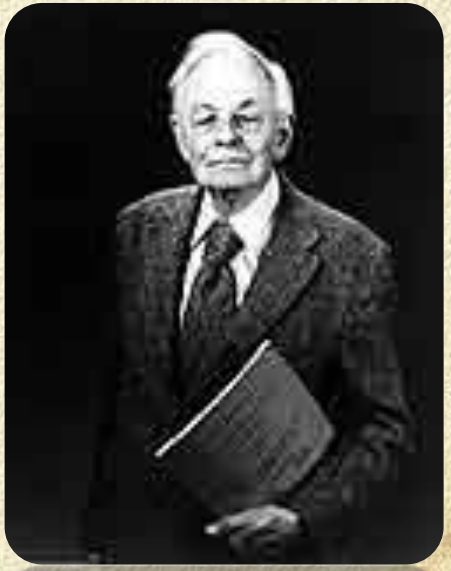
Climate change impacts

Ecological Niche Modelling

Using DIVA-GIS

Ecological niche

- Describes the limits of abiotic and biotic conditions within which a species can survive and reproduce
- The ecological niche
  - has many dimensions

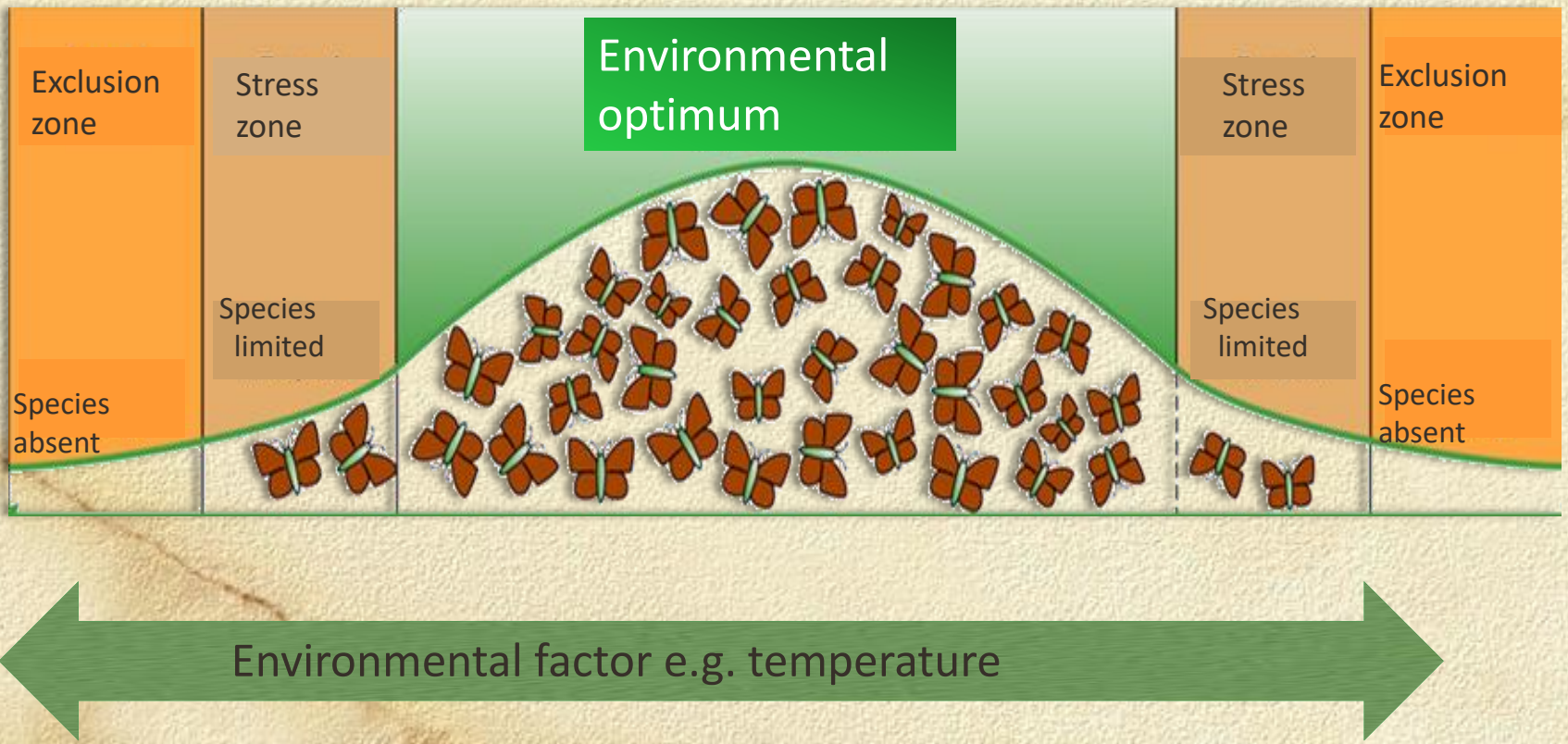


G.E. Hutchinson

Attention!!!

The term ecological niche has no spatial connotation!

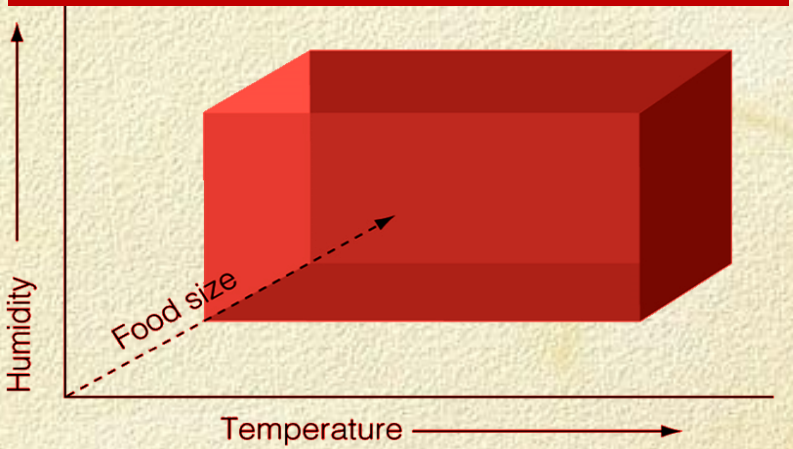
- The distribution of a species is spatially limited **(why?)**
  - For a population to be able to exist in space and time, all abiotic and biotic conditions, including the provision of food to be within the limits



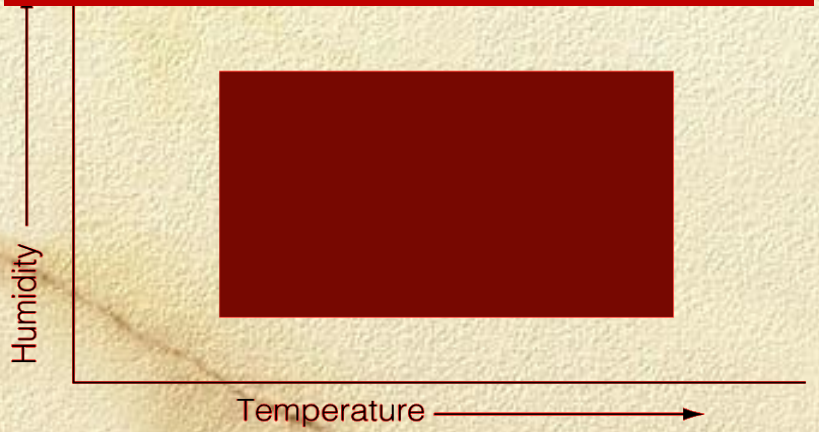
Dimensions of the ecological niche

One dimension

Three dimensions



Two dimensions



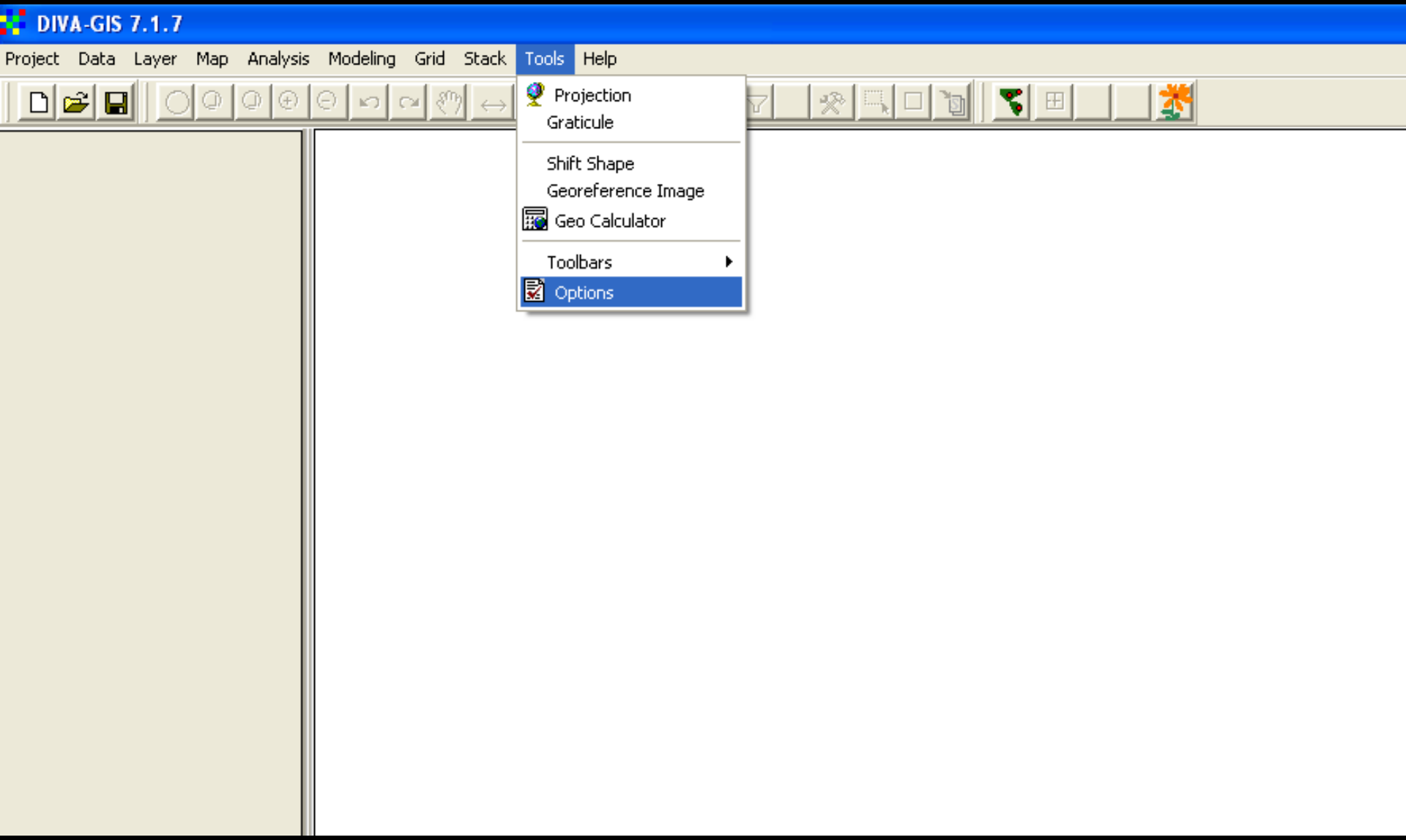
- **Ecological niche=** multidimensional body with n dimensions
- The dimensions can be:
  - temperature
  - humidity
  - salinity
  - pH
  - food size
  - …

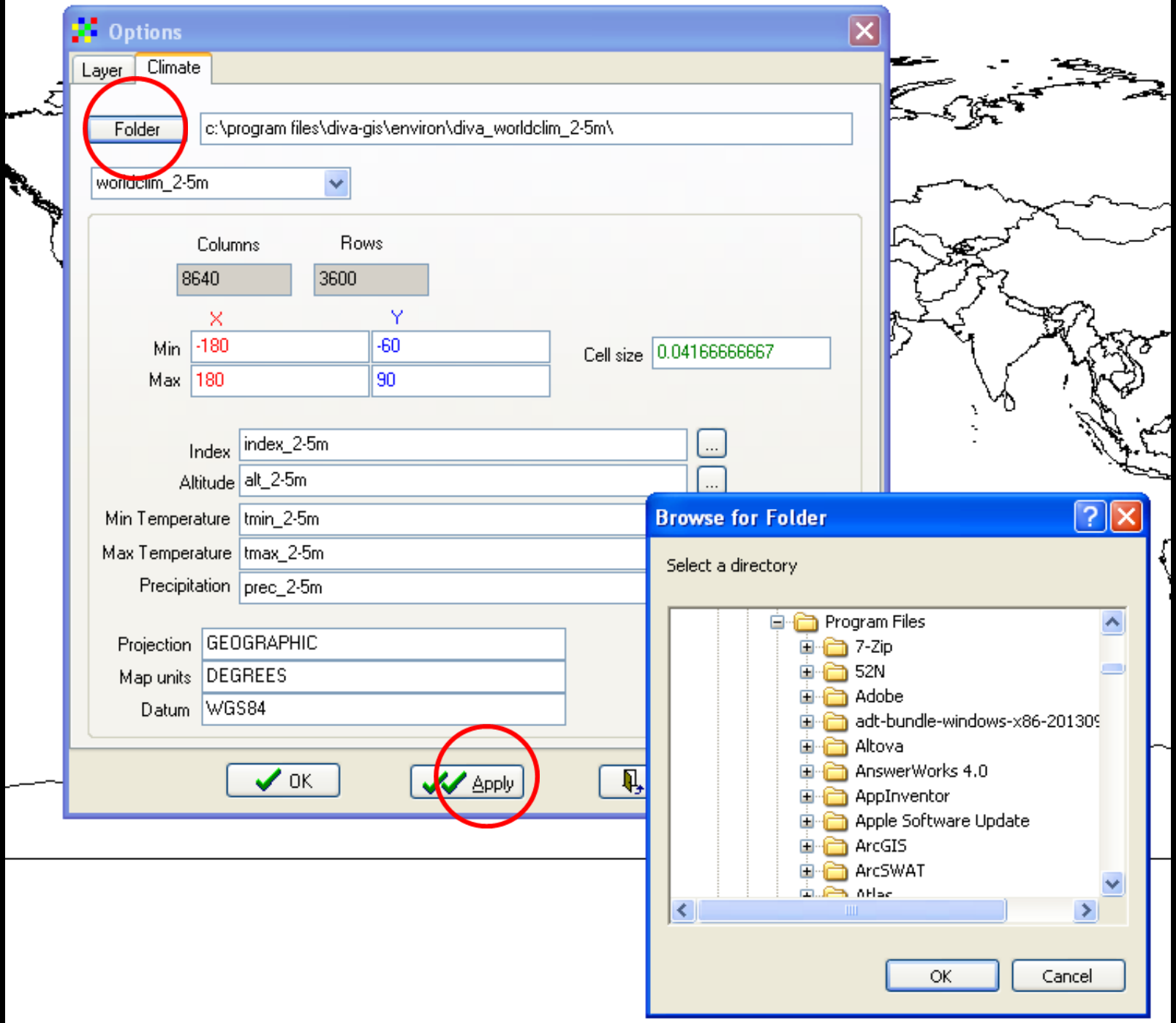
The software DIVA-GIS

- Free at: http://www.diva-gis.org
- Calculates likely species distributions based on species data (presence data) and climatic data (Worldclim)
- Uses the algorithms Bioclim και DOMAIN
- An important tool for the protection of the environment and individual species

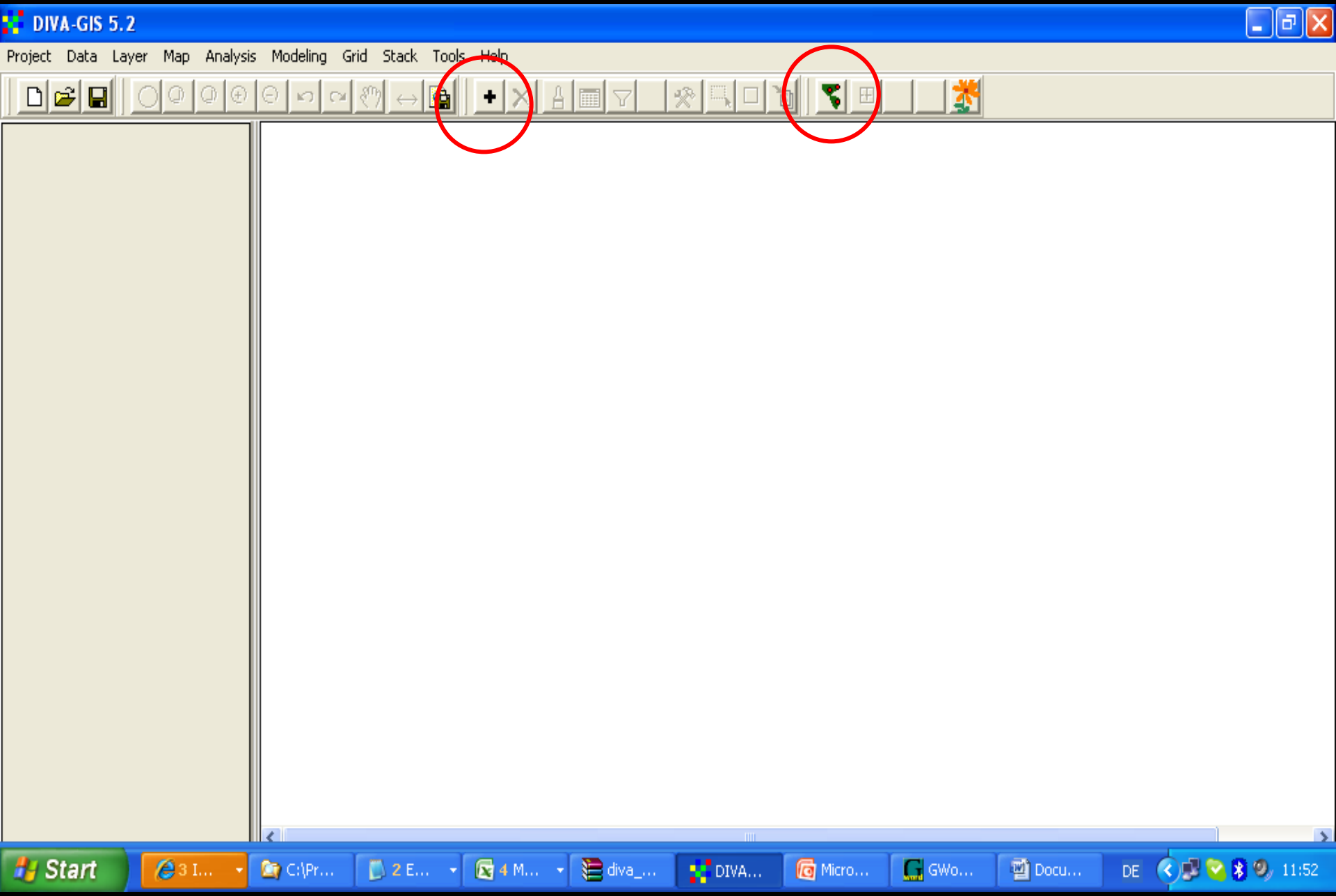
19 climatic factors

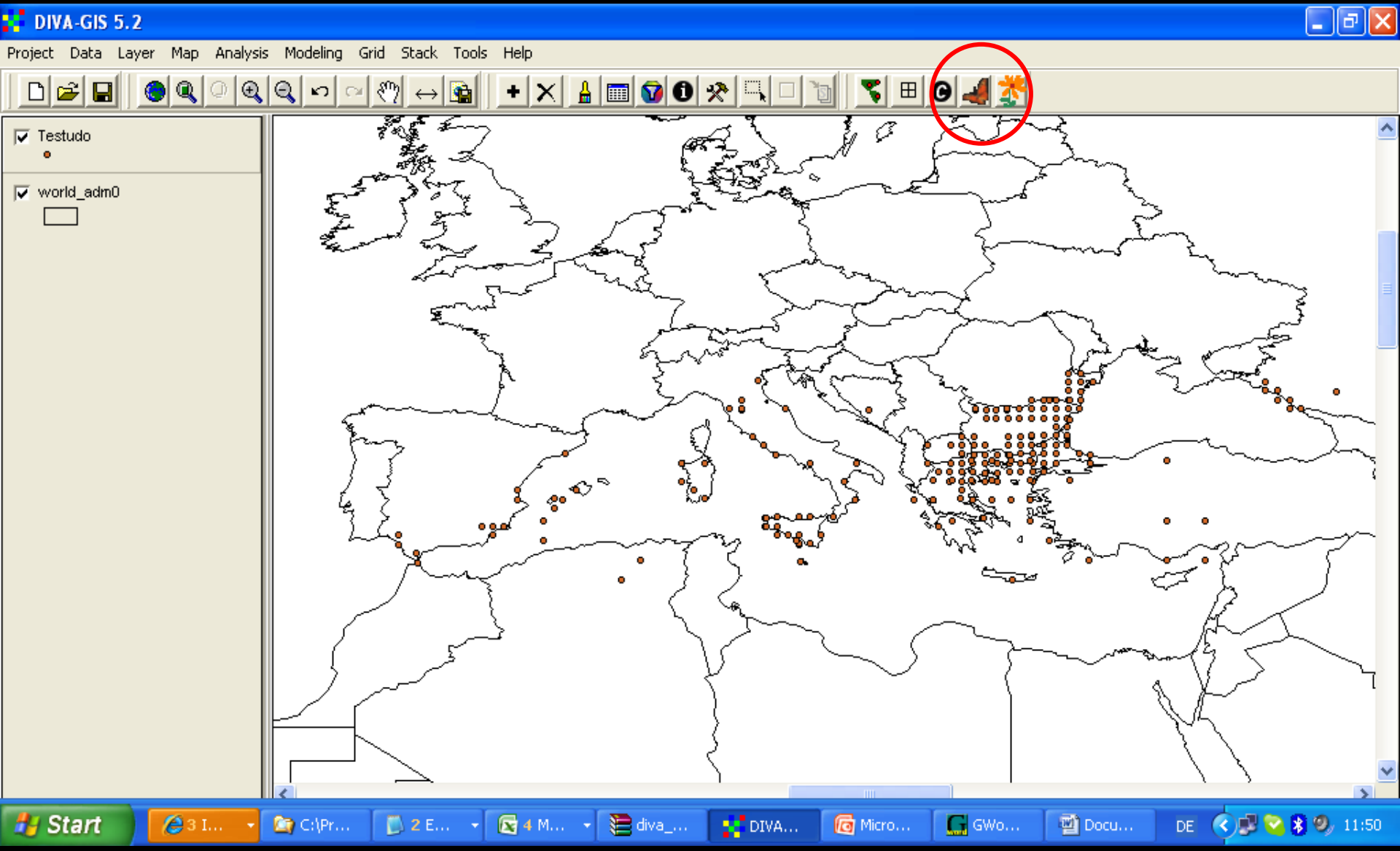
Annual Mean Temperature [1]
Mean Monthly Temperature Range [2]
Isothermality (2/7) (*100) [3]
Temperature Seasonality (STD *100) [4]
Max Temperature of Warmest Month [5]
Min Temperature of Coldest Month [6]
Temperature Annual Range (5-6) [7]
Mean Temperature of Wettest Quarter [8]
Mean Temperature of Driest Quarter [9]
Mean Temperature of Warmest Quarter [10]
Mean Temperature of Coldest Quarter [11]
Annual Precipitation [12]
Precipitation of Wettest Month [13]
Precipitation of Driest Month [14]
Precipitation Seasonality (CV) [15]
Precipitation of Wettest Quarter [16]
Precipitation of Driest Quarter [17]
Precipitation of Warmest Quarter [18]
Precipitation of Coldest Quarter [19]

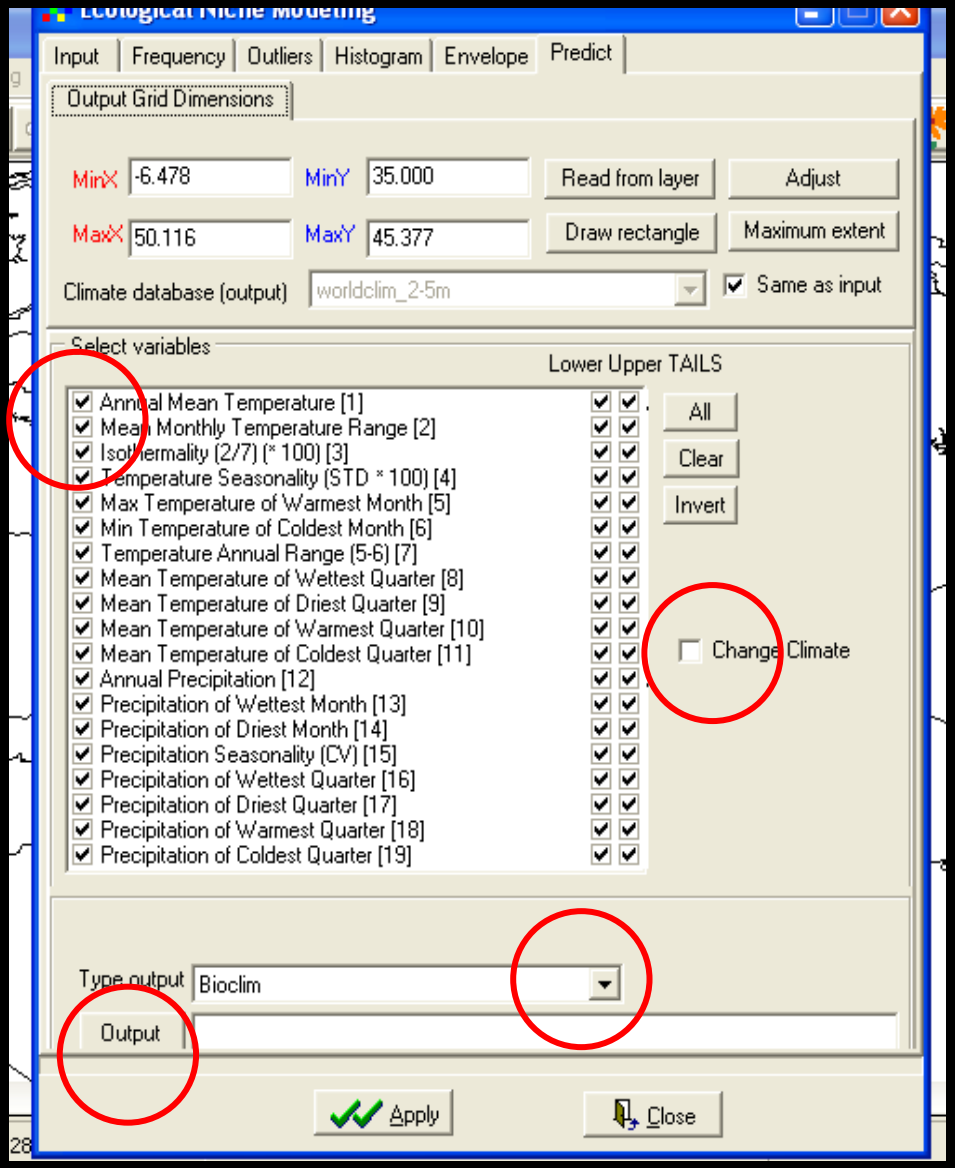

DIVA-GIS 7.1.7
Project
Data
Layer
Map
Analysis
Modeling
Grid
Stack
Tools
Help
Projection
Graticule
Shift Shape
Georeference Image
Geo Calculator
Toolbars
Options

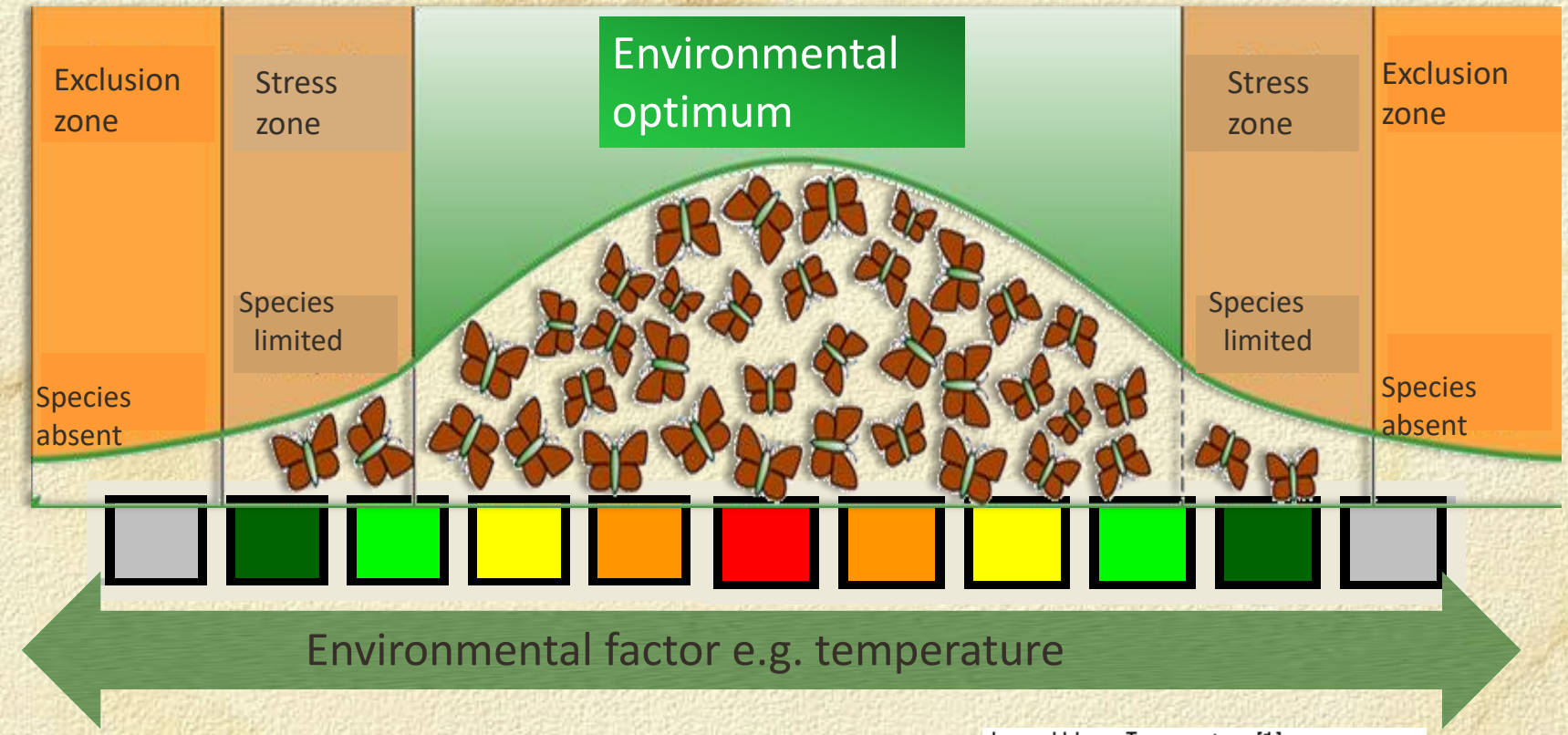

Options
Layer
Climate
Folder
c:\program files\diva-gis\environ\diva_worldclim_2-5m\
worldclim_2-5m
Columns
Rows
8640
3600
X
Y
Min
-180
-60
Max
180
90
Cell size
0.04166666667
Index
index_2-5m
Altitude
alt_2-5m
Min Temperature
tmin_2-5m
Max Temperature
tmax_2-5m
Precipitation
prec_2-5m
Projection
GEOGRAPHIC
Map units
DEGREES
Datum
WGS84
OK
Apply
Browse for Folder
Select a directory
Program Files
7-Zip
52N
Adobe
adt-bundle-windows-x86-20130
Altova
AnswerWorks 4.0
AppInventor
Apple Software Update
ArcGIS
ArcSWAT
OK
Cancel

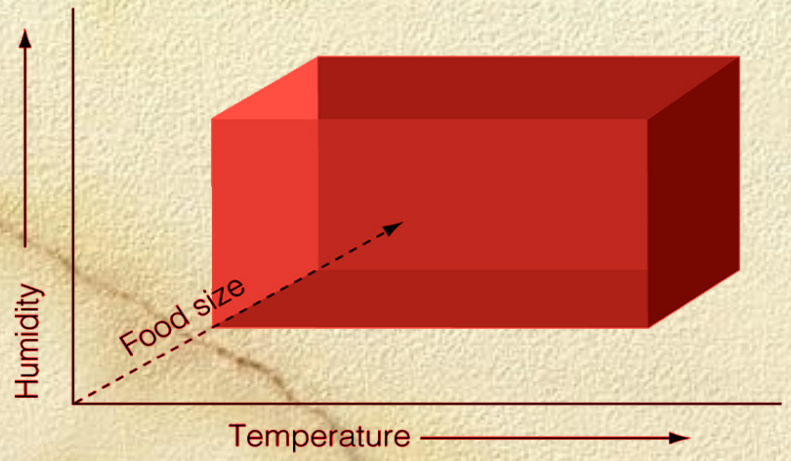
Species	Latitude	Longitude
Testudo_graeca	35	5
Testudo_graeca	35.0025	25.0823
Testudo_graeca	35.0046	25.0811
Testudo_graeca	36.3456	-5.50717
Testudo_graeca	36.3438	-5.50715
Testudo_graeca	36	6
Testudo_graeca	36.8205	14.7197
Testudo_graeca	37.2465	-6.46207
Testudo_graeca	37.2444	-6.46331
Testudo_graeca	37.7208	-2.14837
Testudo_graeca	37.7192	-2.149
Testudo_graeca	37.7137	-1.5818
Testudo_graeca	37.7055	-1.01479
Testudo_graeca	37.7073	-1.01437
Testudo_graeca	37.2645	13.589
Testudo_graeca	37.7055	13.0148
Testudo_graeca	37.7073	13.0139
Testudo_graeca	37.2686	14.1541
Testudo_graeca	37.2699	14.1533
Testudo_graeca	38.1698	15.8562
Testudo_graeca	38.1717	15.8552


DIVA-GIS 5.2
Project Data Layer Map Analysis Modeling Grid Stack Tools Help
Start
3 I...
C:\Pr...
2 E...
4 M...
diva_...
DIVA...
Micro...
GWo...
Docu...
DE
11:52

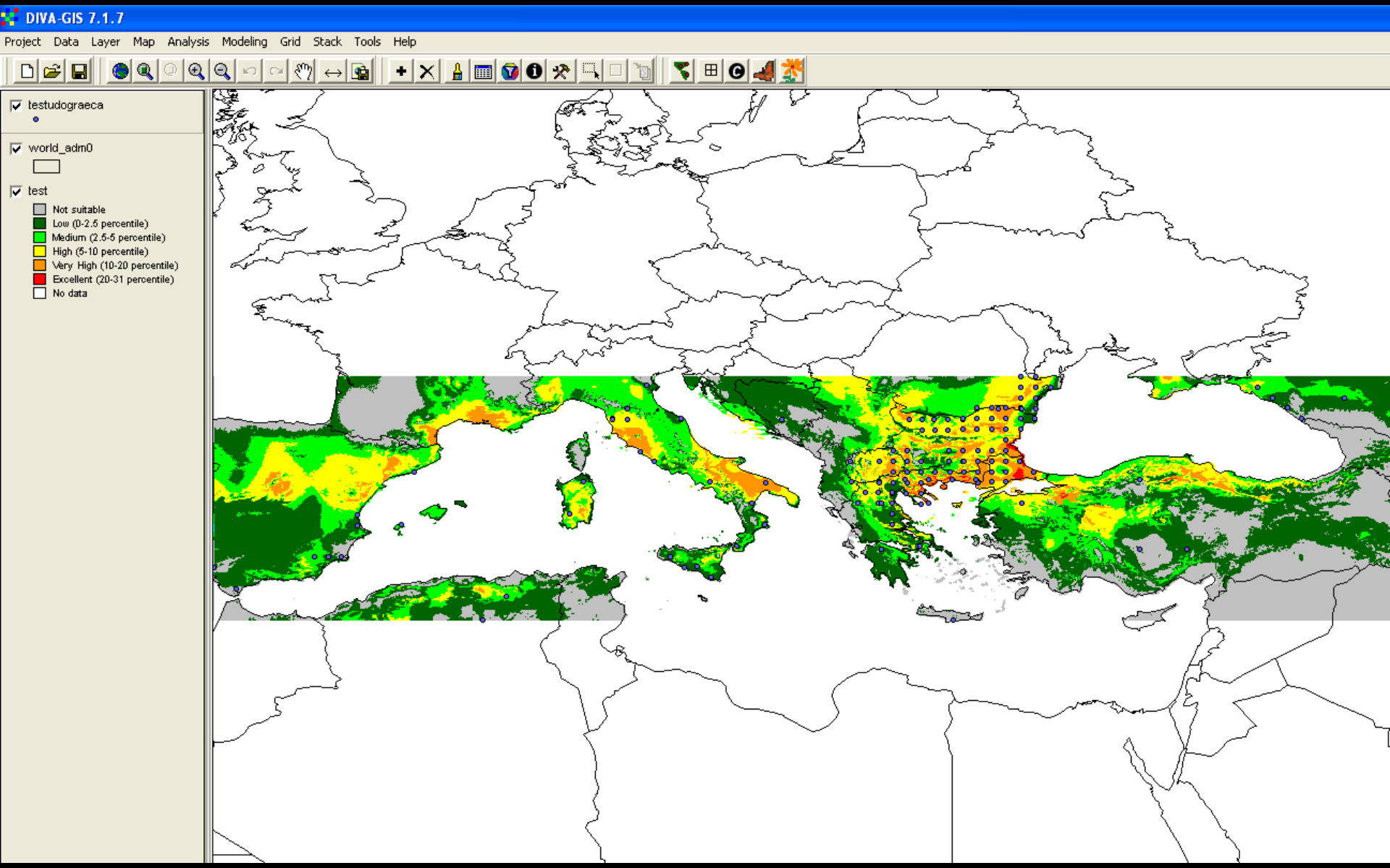

DIVA-GIS 5.2
Project Data Layer Map Analysis Modeling Grid Stack Tools Help
Testudo
world_adm0
Start
DIVA...
11:50

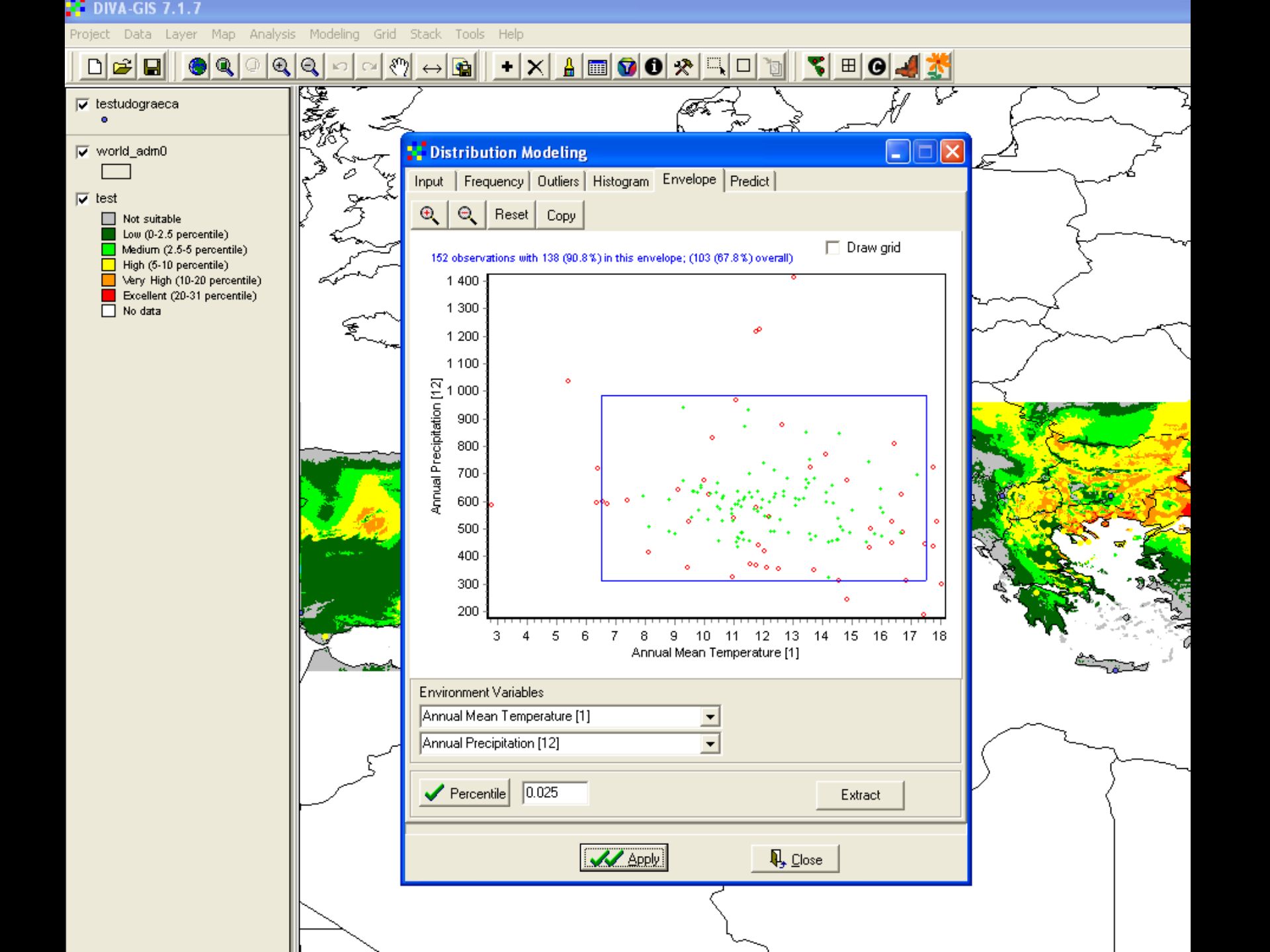

Ecological Niche Modeling
Input
Frequency
Outliers
Histogram
Envelope
Predict
Output Grid Dimensions
MinX
-6.478
MinY
35.000
Read from layer
Adjust
MaxX
50.116
MaxY
45.377
Draw rectangle
Maximum extent
Climate database (output)
worldclim_2-5m
Same as input
Select variables
Lower Upper TAILS
Annual Mean Temperature [1]
Mean Monthly Temperature Range [2]
Isothermality (2/7) (* 100) [3]
Temperature Seasonality (STD * 100) [4]
Max Temperature of Warmest Month [5]
Min Temperature of Coldest Month [6]
Temperature Annual Range (5-6) [7]
Mean Temperature of Wettest Quarter [8]
Mean Temperature of Driest Quarter [9]
Mean Temperature of Warmest Quarter [10]
Mean Temperature of Coldest Quarter [11]
Annual Precipitation [12]
Precipitation of Wettest Month [13]
Precipitation of Driest Month [14]
Precipitation Seasonality (CV) [15]
Precipitation of Wettest Quarter [16]
Precipitation of Driest Quarter [17]
Precipitation of Warmest Quarter [18]
Precipitation of Coldest Quarter [19]
All
Clear
Invert
Change Climate
Type output
Bioclim
Output
Apply
Close





Annual Mean Temperature [1]
Mean Monthly Temperature Range [2]
Isothermality (2/7) (* 100) [3]
Temperature Seasonality (STD * 100) [4]
Max Temperature of Warmest Month [5]
Min Temperature of Coldest Month [6]
Temperature Annual Range (5-6) [7]
Mean Temperature of Wettest Quarter [8]
Mean Temperature of Driest Quarter [9]
Mean Temperature of Warmest Quarter [10]
Mean Temperature of Coldest Quarter [11]
Annual Precipitation [12]
Precipitation of Wettest Month [13]
Precipitation of Driest Month [14]
Precipitation Seasonality (CV) [15]
Precipitation of Wettest Quarter [16]
Precipitation of Driest Quarter [17]
Precipitation of Warmest Quarter [18]
Precipitation of Coldest Quarter [19]


DIVA-GIS 7.1.7
Project Data Layer Map Analysis Modeling Grid Stack Tools Help
testudograeca
world_adm0
test
Not suitable
Low (0-2.5 percentile)
Medium (2.5-5 percentile)
High (5-10 percentile)
Very High (10-20 percentile)
Excellent (20-31 percentile)
No data


DIVA-GIS 7.1.7
Project Data Layer Map Analysis Modeling Grid Stack Tools Help
testudograeca
world_adm0
test
Not suitable
Low (0-2.5 percentile)
Medium (2.5-5 percentile)
High (5-10 percentile)
Very High (10-20 percentile)
Excellent (20-31 percentile)
No data
Distribution Modeling
Input Frequency Outliers Histogram Envelope Predict
Reset Copy
Draw grid
152 observations with 138 (90.8 %) in this envelope; (103 (67.8 %) overall)
Annual Precipitation [12]
1 400
1 300
1 200
1 100
1 000
900
800
700
600
500
400
300
200
3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Annual Mean Temperature [1]
Environment Variables
Annual Mean Temperature [1]
Annual Precipitation [12]
Percentile
0.025
Extract
Apply
Close

Testudo graeca

Predicting current distribution and future distribution (1, 2, 3℃ temperature increase)

Achillea holosericea

Predicting current distribution and future distribution (1, 2, 3℃ temperature increase)

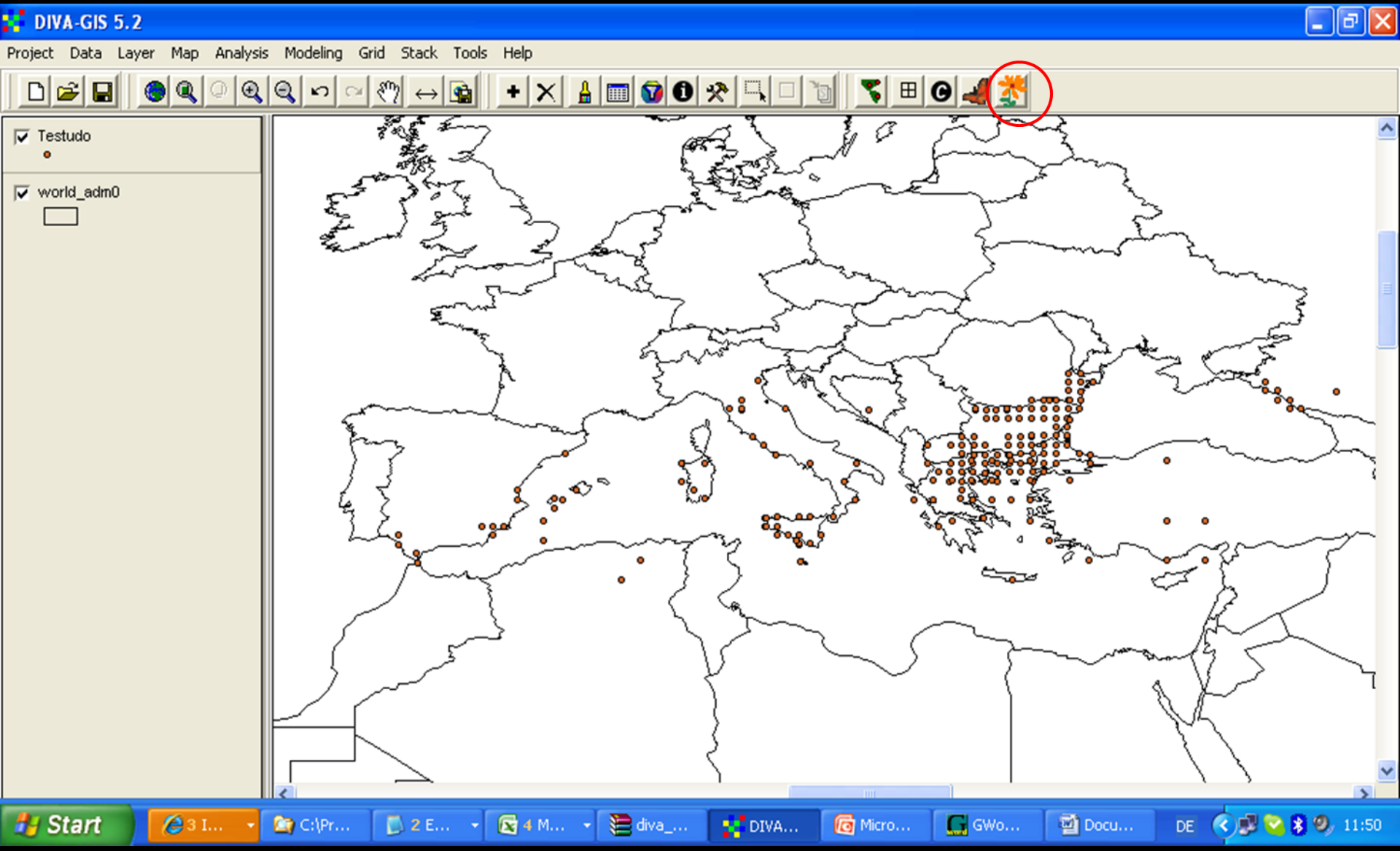
Suitable areas for olive cultivation

current:

Worldclim

future:

CCM3 model (2xCO_2)


DIVA-GIS 5.2
Project Data Layer Map Analysis Modeling Grid Stack Tools Help
Testudo
world_adm0
Start
DE
11:50