The Geographic Climate Information System Project (GEOCLIMA): Overview and preliminary results

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The project GEOCLIMA

The project **GEOCLIMA** (http://www.geoclima.eu/) aims at developing an integrated Geographic Information System (GIS) allowing the user to manage, analyze and visualize the information which is directly or indirectly related to climate and its future projections in Greece. The main components of the project are:

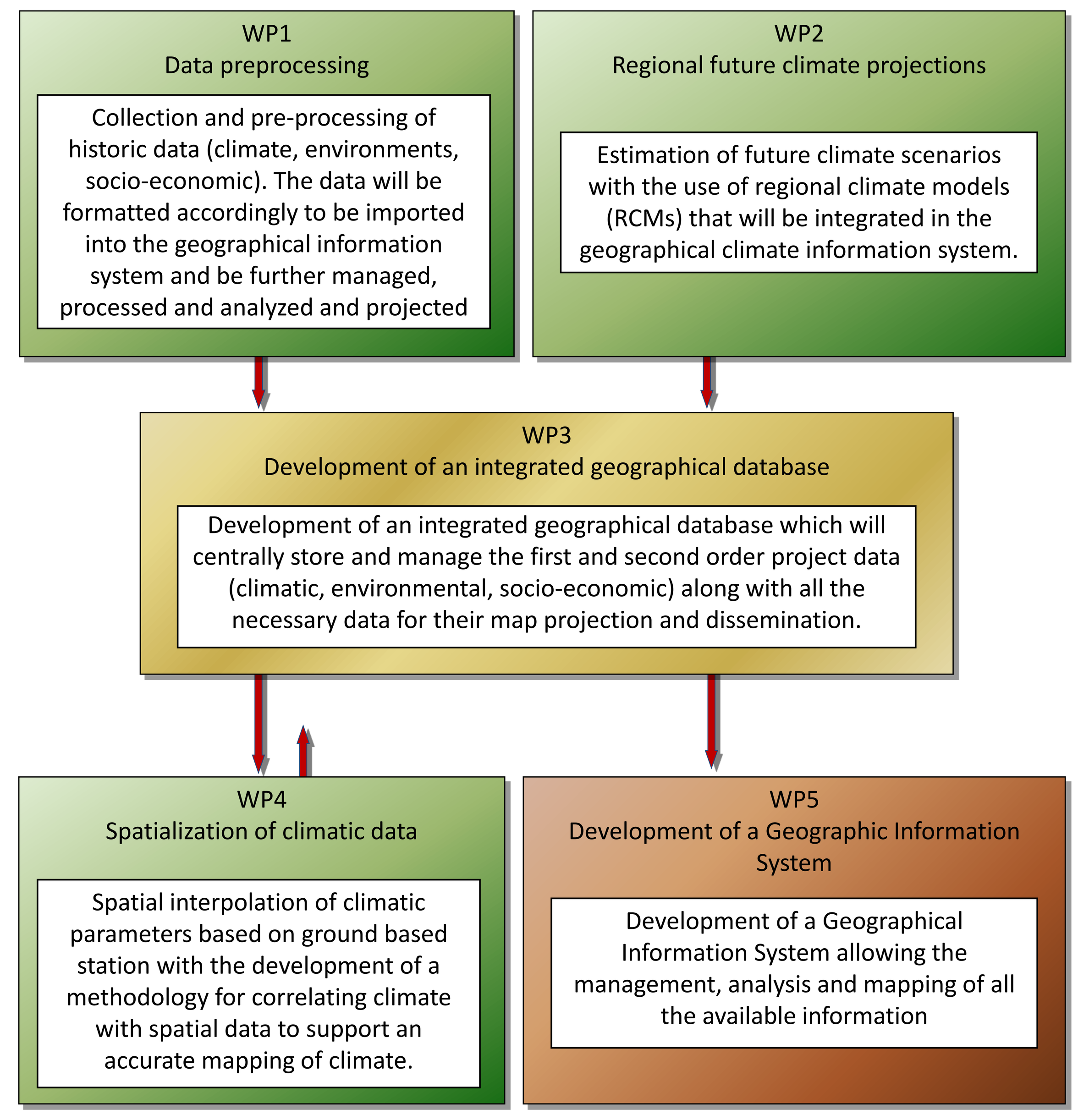
1) Collection and homogenization of climate and environmental related information for Greece (WP1)

2) Estimation of future climate change, based on existing regional climate model simulations and on the high resolution climatic simulation (10 Km) that will performed for Greece

3) Compilation of an integrated uniform geographic database which will collect and organize past and the present climate related information for Greece, the observed climate change and the future projections.

4) Mapping of first and second order climate data and creation of digital thematic maps, that will present clearly with high spatial (~20 Km) and temporal resolution (monthly, seasonal, yearly) the past and present climate and the future projections

5) Development of an integrated Geographic Information System that will allow the management, analysis and mapping of the climate information that will be produced within the framework of this project. The GIS will allow user interaction through a web portal (WP5)



Regional climatic simulations

Convective Parameterization Scheme	Set-up	Simulation
Grell	Fritsch Chappell	GRFC-D
Grell-beta version	Fritsch Chappell	GRFC-B
Emanuel	l_0=0.0011 a=0.2	MIT-D
Emanuel	l_0=0.01 a =0.1	MIT-B1
Emanuel	l_0=0.01 a=0.2	MIT-B2
Emanuel	l_0=0.01 a=0.3	MIT-B3

Table 1: Model experiments with different convective schemes

High resolution (10 Km x 10 Km) climatic simulations are currently performed for the 1960-2100 time slice over Greece with the RegCM3 regional climate model. The model has been optimized with a set of six yearly simulation with different setups for the convective scheme (Table 1). The simulated fields of near surface temperature, precipitation and cloudiness were compared to observed values over 84 Greek stations. Simulations using MIT convective scheme include changes in the relaxation rate *a* (kg/m^{2}sK) and the warm cloud autoconversion threshold l_0 (kg/kg). More details in *Mystakidis et al., 2012*.

It is evident that RegCM3 reproduces well the major characteristics of the observed annual distribution of temperature, precipitation and cloud cover over Greece (Table 2). However, the best model performance is reached primarily with MIT-B1 and secondarily by GRFC-B schemes (See Table1). Specifically, simulations using the MIT-B1 convective scheme reduce RMSE in temperature by 20%, in cloudiness by 10% and in precipitation by 40% compared to the default scheme GRFC-D (*Mystakidis et al., 2012*).

	Temperature		
	RMSE (°C)	R	NSD
GRFC-D	2.29	0.85	1.17
GRFC-B	2.25	0.85	1.11
MIT-D	1.95	0.86	1.19
MIT-B1	1.8	0.86	1.16
MIT-B2	1.81	0.86	1.16
MIT-B3	1.81	0.86	1.17

	Precipitation		
	RMSE (mm)	R	NSD
GRFC-D	327.0	0.51	1.45
GRFC-B	201.8	0.54	1.13
MIT-D	273.8	0.47	1.23
MIT-B1	197.7	0.44	1.05
MIT-B2	203.9	0.46	1.06
MIT-B3	203.0	0.49	1.08

	Cloud cover		
	RMSE (%)	R	NSD
GRFC-D	5.81	0.62	1.34
GRFC-B	6.19	0.64	1.21
MIT-D	6.86	0.62	1.24
MIT-B1	5.21	0.62	1.24
MIT-B2	5.31	0.62	1.24
MIT-B3	5.3	0.63	1.23

Table 2: RMSE, correlation (R) and normalized standard deviation (NSD) values between modeled and observed values of near surface temperature, precipitation and cloud cover based on simulations using different convective schemes.

Trend analysis of climatic time series

A database of climatic time series from the network of Hellenic National Meteorological Service has been developed for the period 1956-2010. Initially a quality test was applied to the raw data and then missing data have been imputed with a regularized expectation – maximization algorithm to complete the climatic record. Next, a quantile – matching algorithm was applied in order to verify the homogeneity of the data. The processed time series were used for trend analysis of the time series of maximum and minimum air temperature and precipitation for the period 1956-2010. It is shown that peak temperature extremes are becoming warmer, especially for the minimum temperatures, while precipitation is decreasing over the area although with variable local significance.

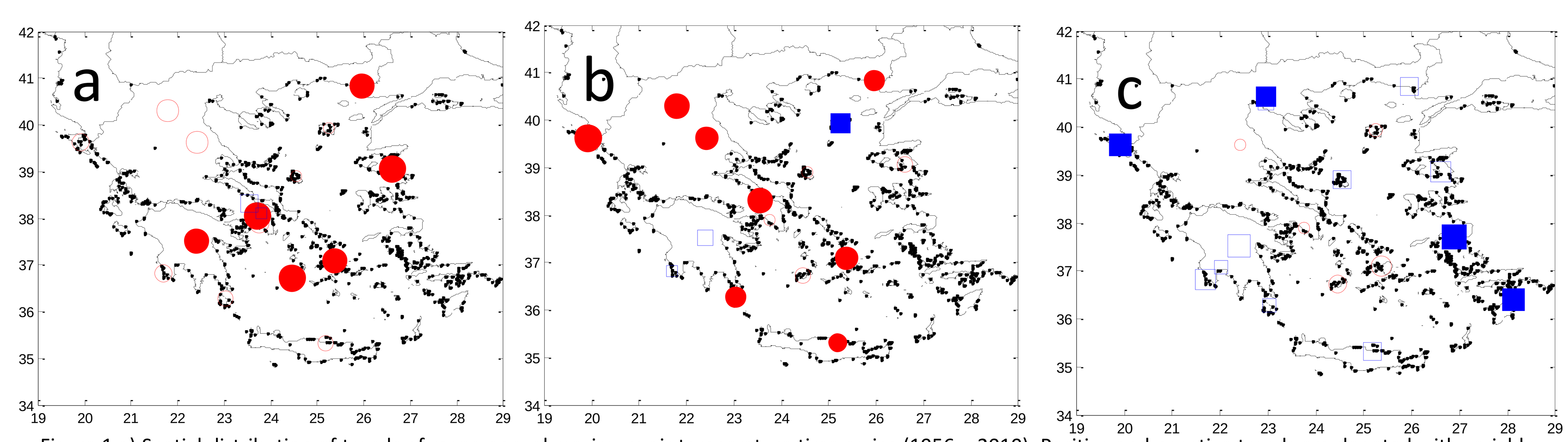


Figure 1 a) Spatial distribution of trends of mean annual maximum air temperature time series (1956 – 2010). Positive and negative trends are denoted with variable size red cycles and blue squares, respectively. Filled cycles and squares indicate statistically significant trends b) Same as Figure 1a for mean annual minimum air temperature c) Same as Figure 1a for annual precipitation.

Relationship of climatic variables with geophysical features over Greece

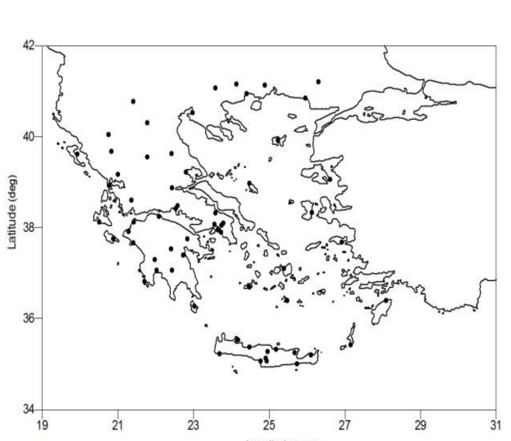


Figure 2. Spatial distribution of the stations used.

The relationship of climatic variables with geographic features over Greece was investigated. Seasonal and annual climate normals of temperature, rainfall, humidity, sunshine duration, days of rainfall, days of snow, etc. covering the period from 1975 to 2004, from 85 meteorological stations of the Hellenic National Meteorological Service network were included in the analysis. Several geographical and environmental parameters such as altitude, location, slope, aspect, distance to coast, sea/land ratio and vegetation index obtained from a coastline dataset, a digital elevation model and a land cover database were examined for their dependencies with climatic elements.

The relationship of a climate element with each geographical variable was investigated by means of graphical (e.g. scatter plots) and statistical scores. The results were used to assess the ability of each geographical parameter to explain part of the spatial variability of a climate variable. Backward stepwise linear regression was used to obtain a surface that gives the best fit to the measured climatic data.

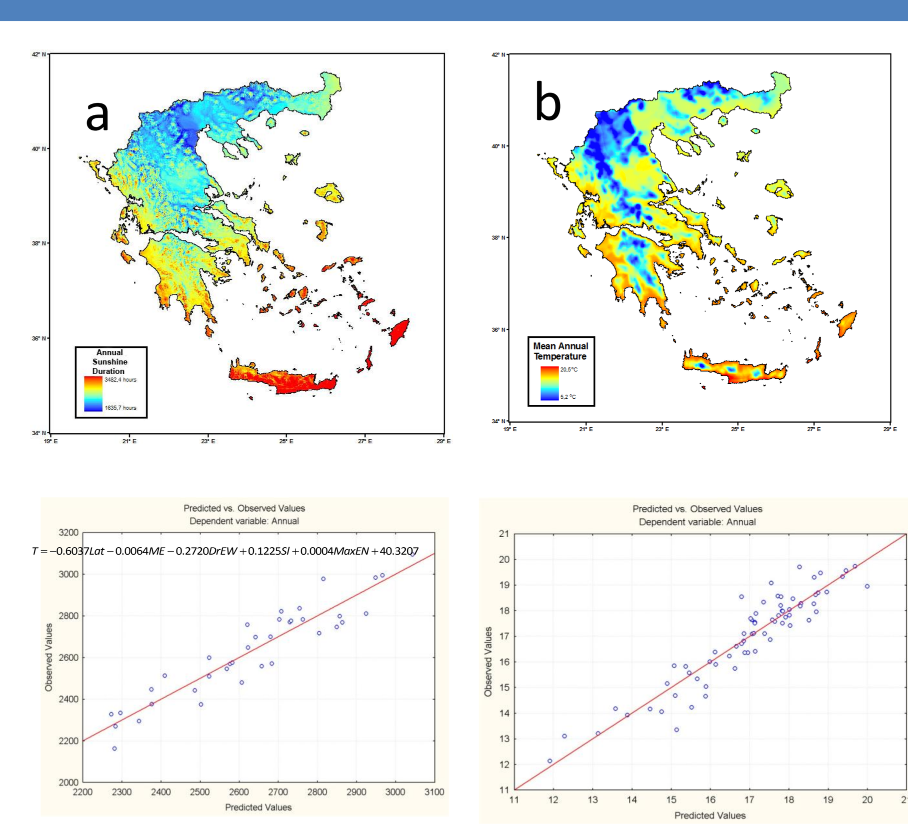


Figure 3 a) Map of annual temperature using the developed regression model and predicted vs. observed scatter plot. Regression model and comparison statistics are also indicated in the graph b) As in Figure 3a but for mean annual total sunshine duration.

References

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