«Climate Change Risk Assessment»

Land Desertification
Agronomy Sector and Livestock Sector

AUA COORDINATOR
CHRISTOS A. KARAVITIS
ASS. PROFESSOR,
WATER RESOURCES MANAGEMENT
SECTOR OF WATER RESOURCES MANAGEMENT
DEP. OF NRD & AGRICULTURAL ENGINEERING
AUA

ΥΠΟΥΡΓΕΙΟ ΓΕΩΡΓΙΑΣ, ΑΓΡΟΤΙΚΗΣ
ΑΝΑΠΤΥΞΗΣ
ΚΑΙ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

ΤΜΗΜΑ ΠΕΡΙΒΑΛΛΟΝΤΟΣ

ADVANCED ENVIRONMENTAL STUDIES S.A.

G. KARAVOKYRIS & PARTNERS
CONSULTING ENGINEERS S.A.

DION. TOUMAZIS & ASSOCIATES

AGRICULTURAL UNIVERSITY OF ATHENS

6 Οκτωβρίου 2016

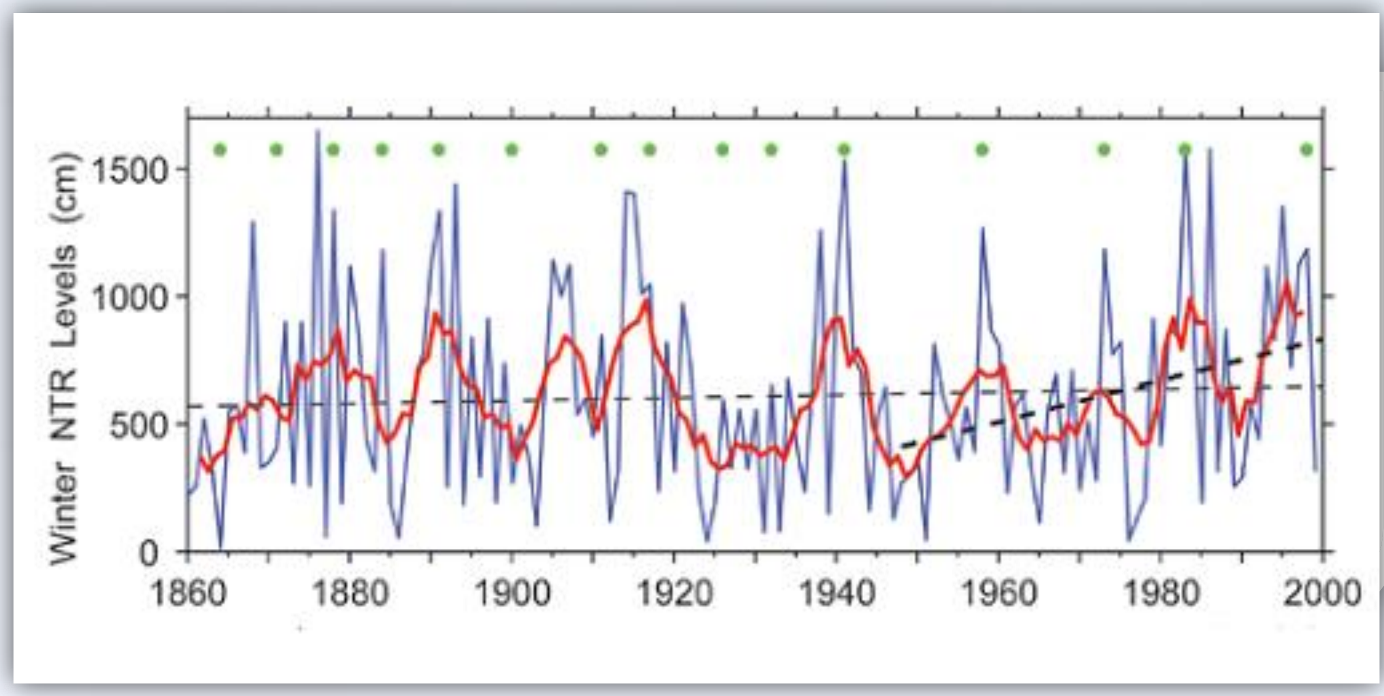
The transforming Environment

Christos A. Karavitis
Ass. Professor,
Water Resources Management

INTERLOCKING CRISES

- CLIMATIC SHIFTS AND CHANGES
- MEGARUPTURES
- METABOLISM
- SOCIO-POLITICAL CONTEXT
- TRANSBOUNDARY INTERDEPENDENCIES
- FAST PACE OF TECHNOLOGICAL DEVELOPMENT

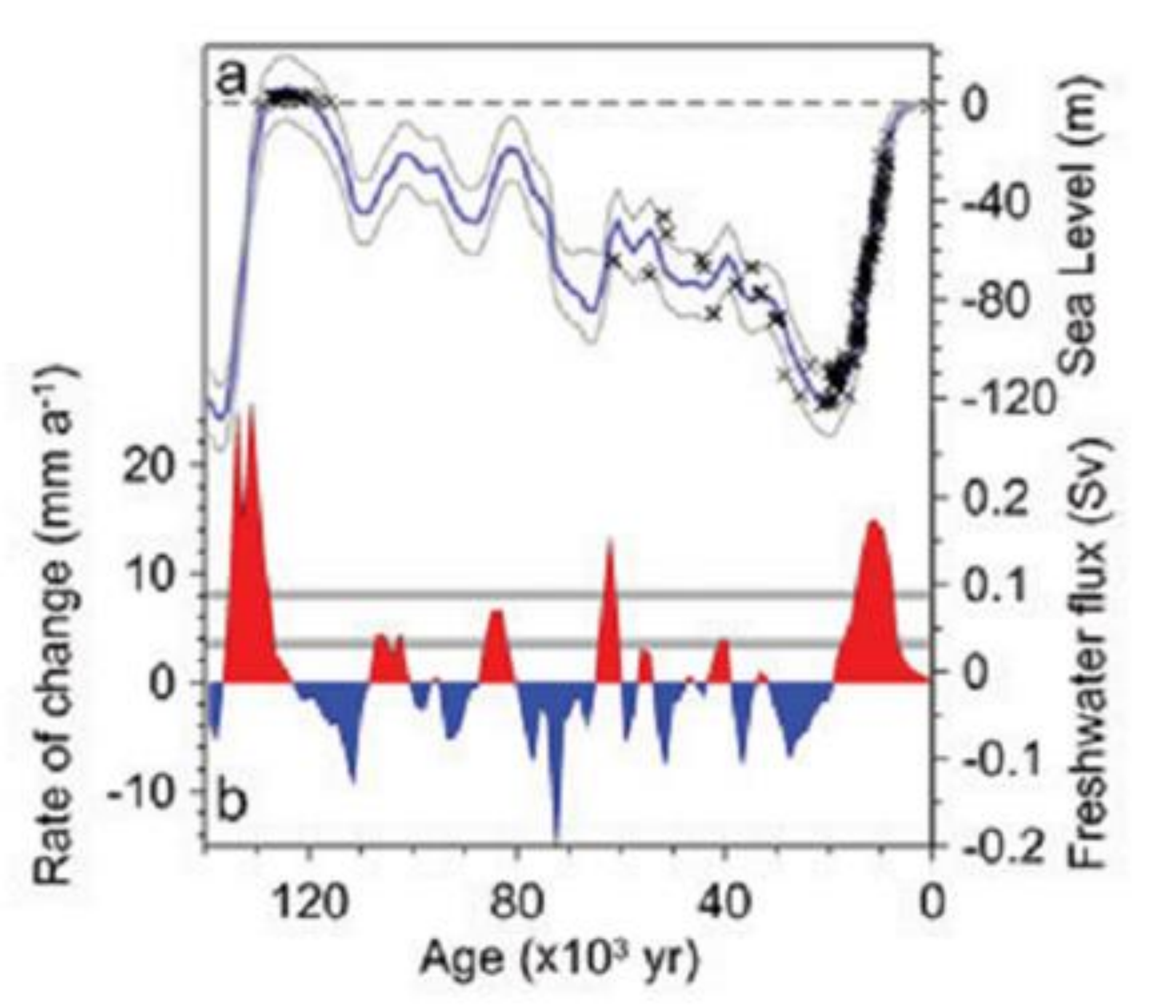
Winter sea water level at San Francisco



Adapted, from Bromirski et al., 2003

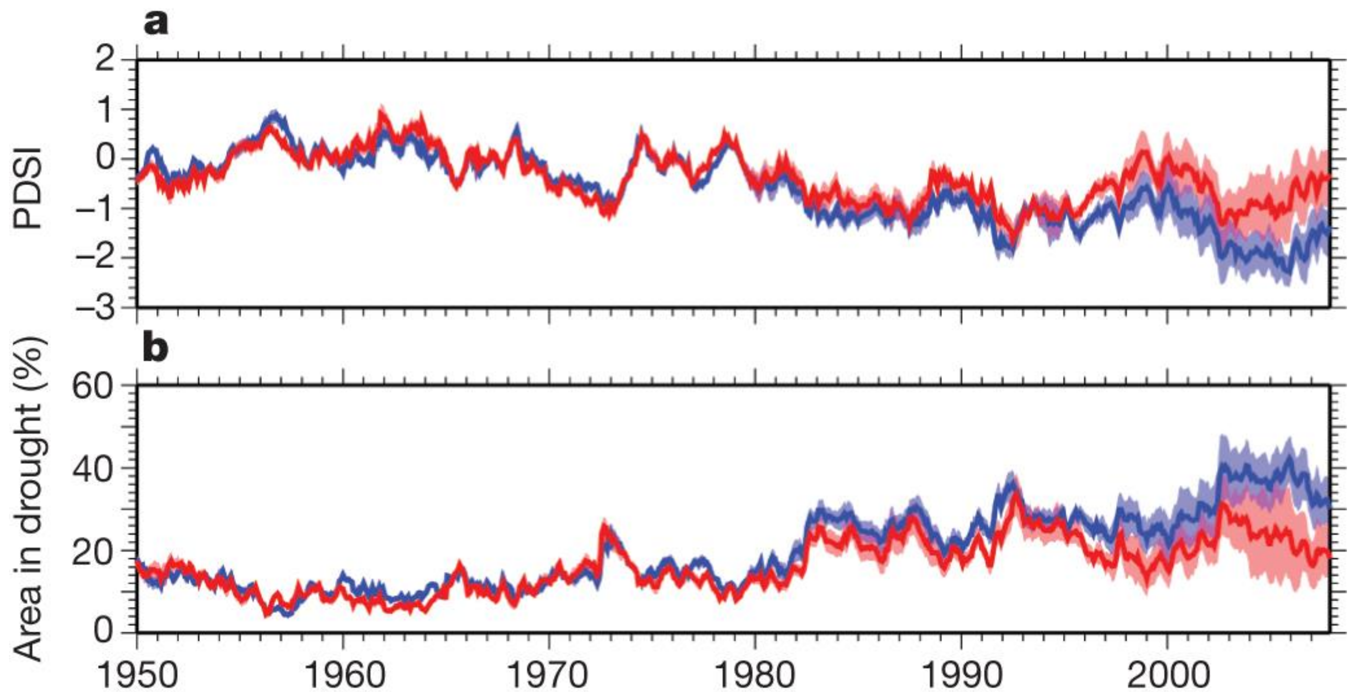
Weather and Climate Extremes in a Changing Climate, USCCSP, 2008

Record of sea-level (130,000 years ago)



Rahmstorf, 2007

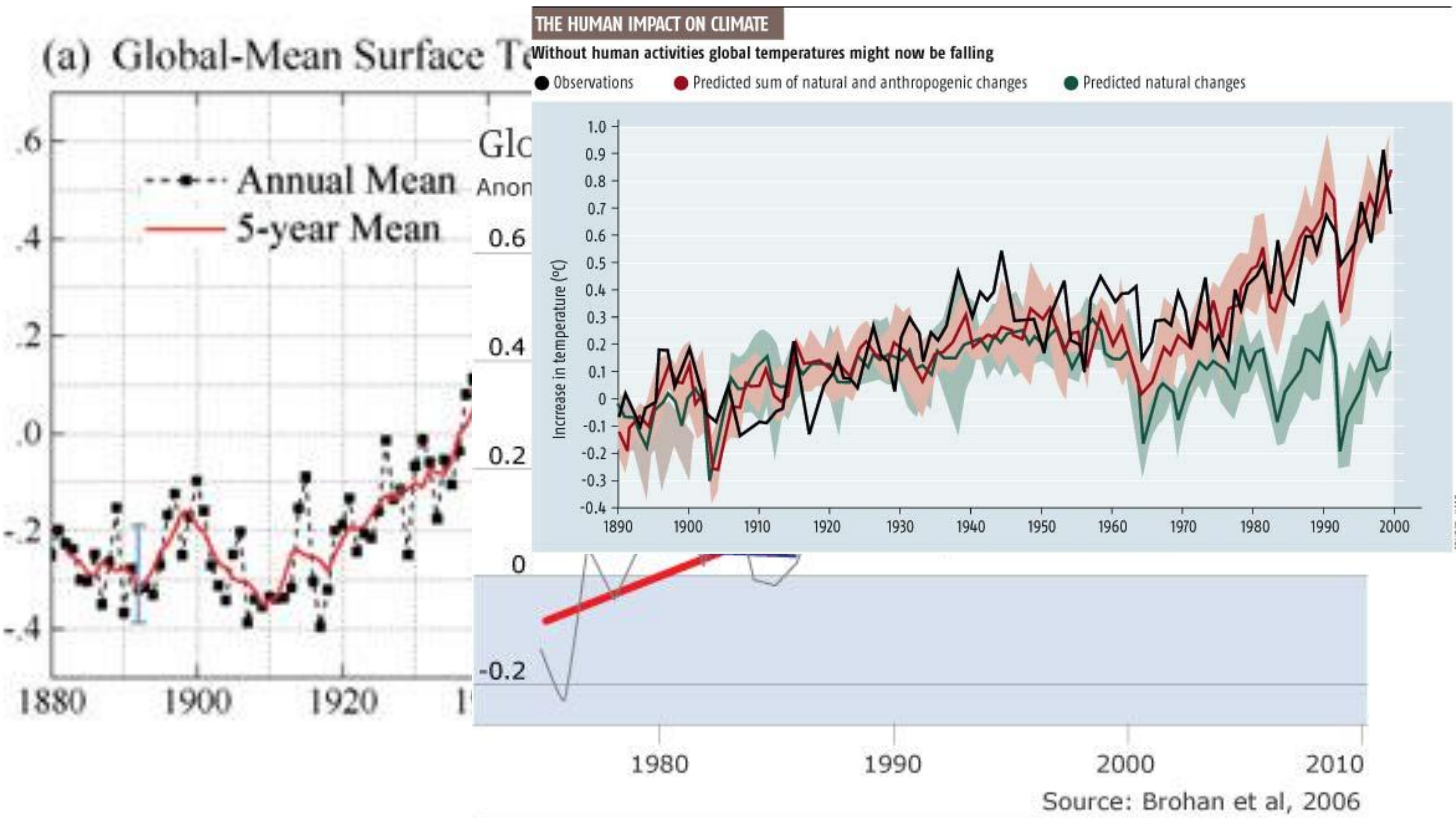
Global average time series of the PDSI and area in drought.
Little change in global drought over the past 60 years



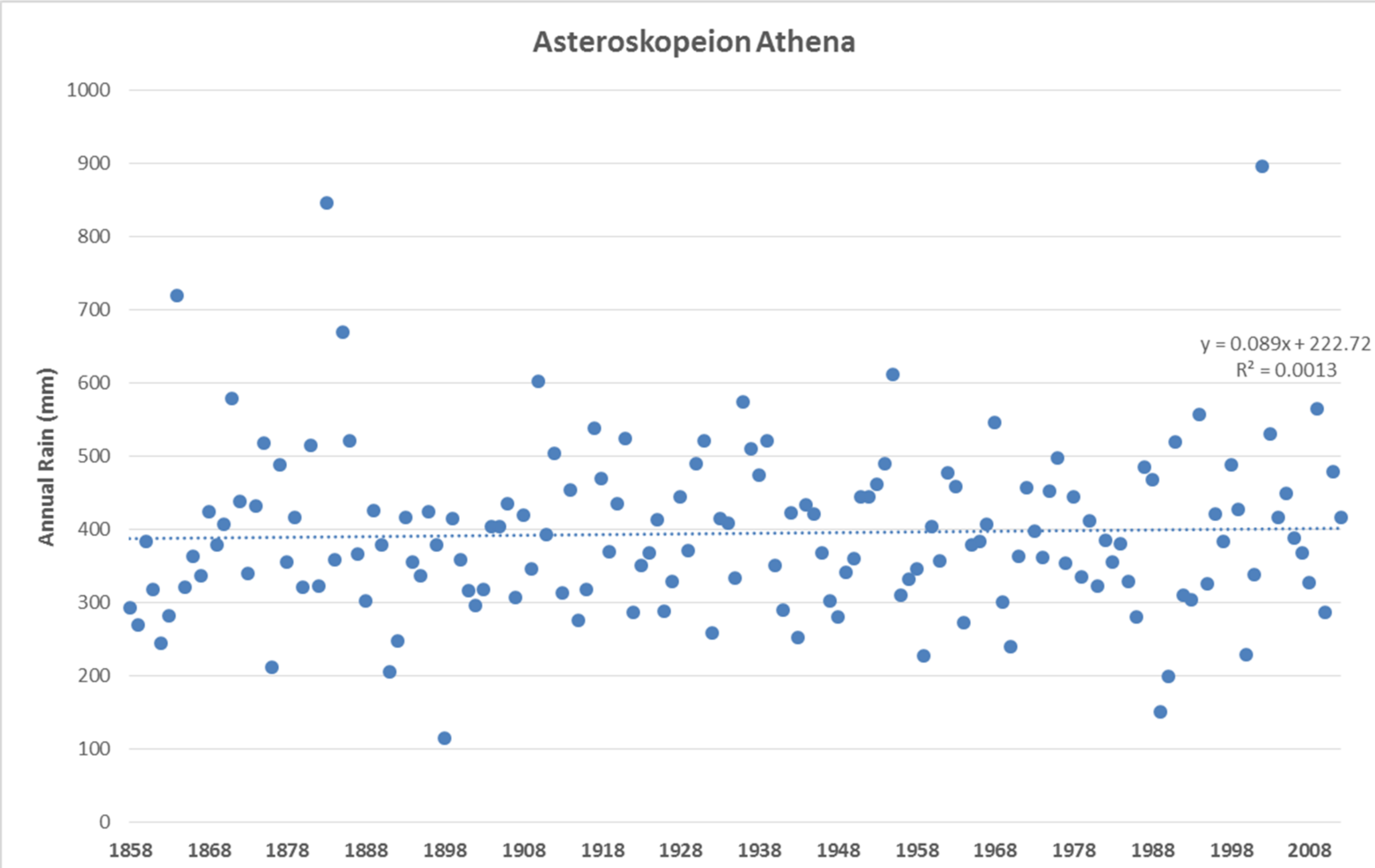
a, PDSI_Th (blue line) and PDSI_PM (red line). **b**, Area in drought (PDSI <−3.0) for the PDSI_Th (blue line) and PDSI_PM (red line). The shading represents the range derived from uncertainties in precipitation (PDSI_Th and PDSI_PM) and net radiation (PDSI_PM only). Uncertainty in precipitation is estimated by forcing the PDSI_Th and PDSI_PM by four alternative global precipitation data sets. Uncertainty from net radiation is estimated by forcing the PDSI_PM with a hybrid empirical–satellite data set and an empirical estimate. The other near-surface meteorological data are from a hybrid reanalysis–observational data set. The thick lines are the mean values of the different PDSI data sets. The time series are averaged over global land areas excluding Greenland, Antarctica and desert regions with a mean annual precipitation of less than 0.5 mm d^{-1}

J Sheffield et al. Nature **491**, 435-438 (2012) doi:10.1038/nature11575

nature



(a) Global-Mean Surface Te
Annual Mean
5-year Mean
Glo
Anon
THE HUMAN IMPACT ON CLIMATE
Without human activities global temperatures might now be falling
Observations
Predicted sum of natural and anthropogenic changes
Predicted natural changes
Increase in temperature (°C)
SOURCE: UCAR
Source: Brohan et al, 2006


Asteroskopeion Athena
Annual Rain (mm)
1000
900
800
700
600
500
400
300
200
100
0
1858
1868
1878
1888
1898
1908
1918
1928
1938
1948
1958
1968
1978
1988
1998
2008
y = 0.089x + 222.72
R² = 0.0013

Department of Plant Science

Agronomy Sector

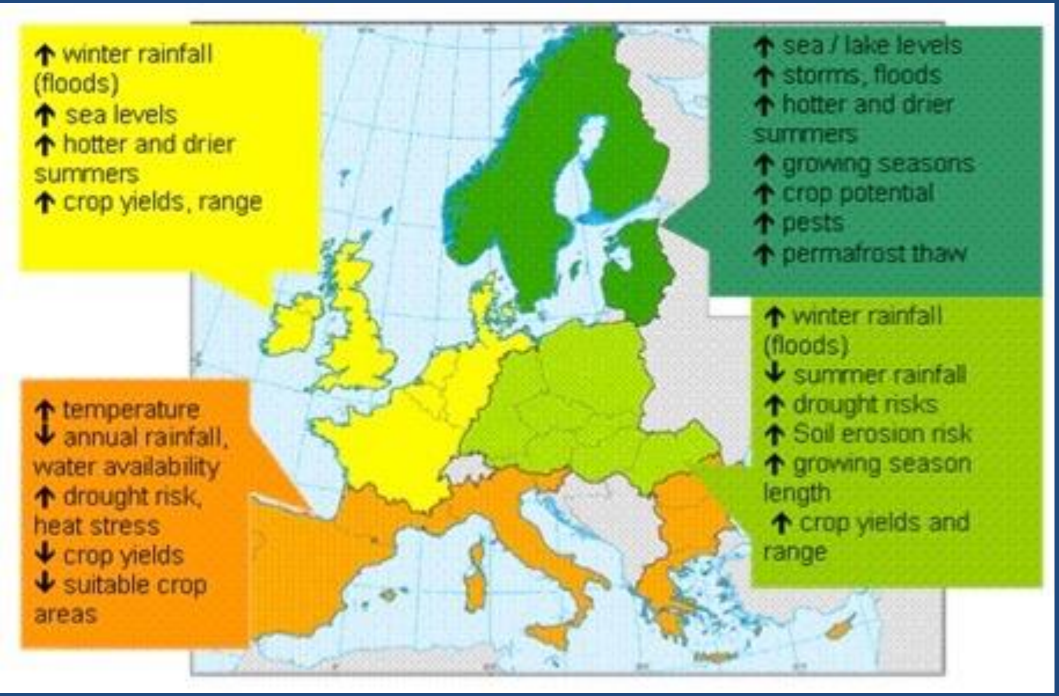
Dr. Dimitrios Voloudakis

Prof. Garyfalia Economou

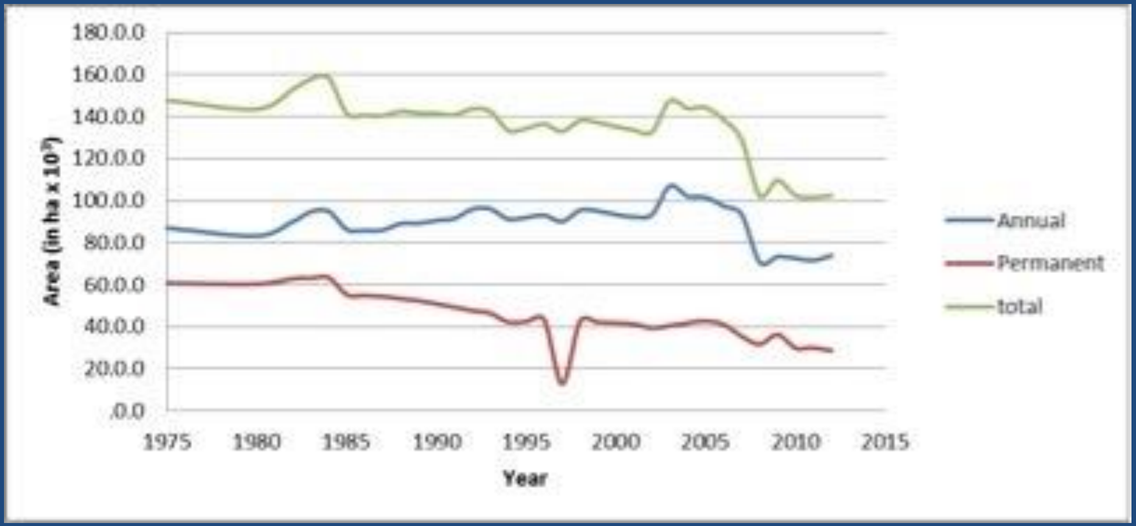
Ass Prof. Christos Karavitis (Dep. NRD & Agr. Engineering)

Description

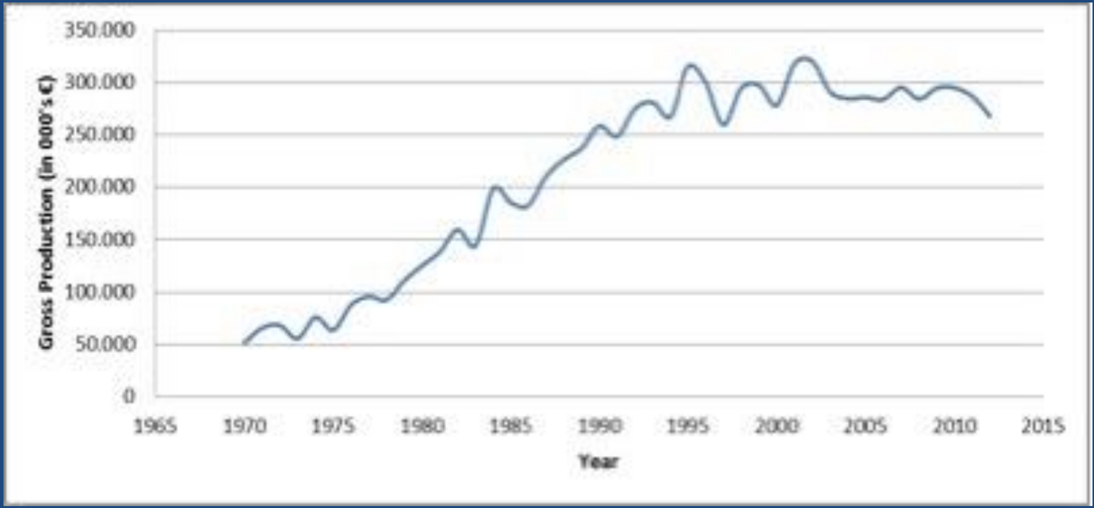
- According to E.U. Cyprus belongs to zone 4 which is the most vulnerable to climate change
- The combination of direct and indirect consequences of climate change on crop productivity in Cyprus is presented on the bases of a crop simulation model and indicative existing pertinent rules by CCRA



The total surface for both annual and permanent crops from 1975 to 2012



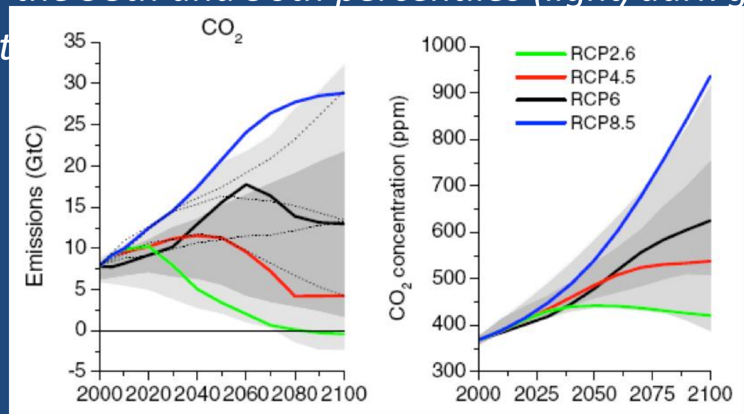
The annual gross agronomic production during the period 1970-2012



- ***List of Cyprus sub-regions studied in this report.***
- *WESTERN- Western Coastal Areas (the greater area of Paphos)*
- *SOUTHERN- Southern Coastal Areas (the greater area of Limassol)*
- *SOUTHEASTERN- Southeastern Coastal Areas (the greater area of Famagusta, Ayia Napa and Larnaca)*
- *INLAND- Continental Lowland Areas (the greater area of Nicosia)*
- *MOUNTAIN- Higher Elevation Areas (the central part of Troodos mountains).*

- The risk metrics for the crop production sector (RM)
- RM1 Crop yield using wheat as a reference C3 rainfed arable crop
- RM2 Crop yield using potato (November sowing) as a reference irrigated vegetable crop for Spring-Summer production
- RM3 Crop yield using potato (July sowing) as a reference irrigated vegetable crop for Autumn production
- RM4 Crop yield using maize as a reference C4 irrigated arable crop
- RM5 Crop yield using olive as a reference C3 tree
- RM6 Crop yield using grapevine as a reference C3 fruiting berry

•*Emissions of CO_2 across the RCPs (left), and trends in concentrations of carbon dioxide (right). Grey area indicates the 98th and 90th percentiles (light/dark grey) of the values from the literature). The dott* … *cenario*



- **RCP8.5** - a future with little curbing of emissions, with a CO_2 concentration continuing to rapidly rise, reaching 940 ppm by 2100.
- **RCP4.5** - CO_2 concentrations are slightly above those of RCP 6.0 until after mid-century, but emissions peak earlier (around 2040), and the CO_2 concentration reaches 540 ppm by 2100.

For the six plant cases studied in this research, AquaCrop was applied in wheat, potato (November and July sowing) and maize, while olive and grapevine were investigated on the context of the current literature research.

The following climatic parameters on a daily base were used for estimating climate change impacts on annual crops using AquaCrop.

1. Temperature (Higher and Lower)
2. Relative Humidity
3. Solar Radiation
4. Air velocity
5. Rainfall
6. CO_2 concentration

Results of the analysis

Y<-20%	-20% <Y<-5%	-5%<Y<0	%Yield change (Y)	0 >Y> 5%	5% >Y> 20%	Y>20%

– RCP4.5 RCP8.5

RCP4.5					
1991-2010 / 2041-2060	Western	Southern	Mountain	Inland	Southeastern
Wheat					
Potato (November sowing)					
Potato (July sowing)					
Maize					
Olive					
Grapevine					

RCP8.5					
1991-2010 / 2041-2060	Western	Southern	Mountain	Inland	Southeastern
Wheat					
Potato (November sowing)					
Potato (July sowing)					
Maize					
Olive					
Grapevine					

RCP4.5					
1991-2010 / 2071-2090	Western	Southern	Mountain	Inland	Southeastern
Wheat					
Potato (November sowing)					
Potato (July sowing)					
Maize					
Olive					
Grapevine					

RCP8.5					
1991-2010 / 2081-2060	Western	Southern	Mountain	Inland	Southeastern
Wheat					
Potato (November sowing)					
Potato (July sowing)					
Maize					
Olive					
Grapevine					

A second level of evaluation of climate change impacts was the confidence assessment of the metrics

	Confidence assessement	Level
RCP4.5	Crop yield	+
	Extreme climatic events	-
	Pests and Weeds	- -
	Aridity/drought	- -
	Confidence assessement	Level
RCP8.5	Crop yield	-
	Extreme climatic events	--
	Pests and Weeds	--
	Aridity/drought	---

Confidence assessement of the consequences	Level
High consequenses (positive)	+++
Medium consequenses (positive)	++
Low consequenses (positive)	+
Low consequenses (negative)	-
Medium consequenses (negative)	--
High consequenses (negative)	- - -

Limitations

- Climate scenarios and models are future cases affected by multiple factors, which cannot be defined precisely, particularly when studying periods that reach the end of the century
- The estimation of climate change impacts on yields is provided without the effect of other factors affected by climate change such as diseases, pests and weeds that are indirectly taken into account
- Changing climate parameters will affect accordingly and rather positive the development of weeds that will act to compete with crops.
- Similar changes are expected to occur in attacks by various pests and diseases due to the change in the geographical distribution and spread to other regions than today and the competition that would exist with other beneficial insects or organizations making unspecified changes to existing biocontrol mechanisms

- The complex mechanism of photosynthesis and the effect of future changes in various climate parameters such as CO2 and the temperature creates difficulties in exact simulation of the various standards and generates uncertainty.
- In many cases, especially at local level, climate change is only one aspect of future change but not necessarily the most important. For example some impacts of climate change on agriculture, such as the increase in extreme weather events cannot be determined precisely, but it is almost certain that other factors affecting agricultural production such as water resources, transport, infrastructure will be affected immediately

Adaptive capacity

- Assessing structural and organisational adaptive capacity

i. implementation of integrated crop management systems in order to reduce inflows in agro-ecosystems

- A reduction of 30% of the applied amount of fertilizers that will help reduce greenhouse gas emissions, especially nitrogen oxides and reduction of nitrate pollution

- Minimize tilling

- Reduction of plant protection products

ii. expansion of organic agriculture and livestock which aims to improve the balance of greenhouse gases by increasing the organic matter of the soil and the reduction of methane and nitrous oxide emissions.

iii installation of manure management systems

iv. promotion of renewable energy both to meet the energy needs arising from agriculture and for the production of energy to be allocated to other production processes.

v. afforestation of agricultural land and restoring forestry potential

Adaptation practises

Short-term measures

These measures are actions that can be applied directly and are the first "line of defense" against climate change. Some of them are:

-Change In crop establishment date (sowing or planting).

-Change Inputs.

-Measures to conserve water.

Long-term measures

Long-term measures are major structural interventions to address the adverse effects of climate change.

-Change the choice of crops and the use of agricultural land.

-Crop Breeding.

-Change and development of farming methods and management.

Conclusions

- **Five reference crops** (wheat, maize, potato, olive, grapevines).
- **wheat** was simulated under rainfed conditions, while **maize** was simulated as a full irrigated cultivation. **Potato** was projected in two different growing periods, the first established in November and the second in July. Finally, **olive** and **grapevines** were estimated based on previous research and literature findings.
- **RCP4.5 scenario**, showed that **wheat** is going to be favoured in the areas of Mountain and Inland Cyprus for both periods 2041-2060 and 2071-2090 compared to the reference period.
- In the case of **RCP8.5 scenario** the positive effect of climate change on **wheat** was even higher and was expanded to the Western area too.
- **A serious limitation** of the current study was that the impacts of climate change on the quality of the grain were not defined because of the constricted research and field information. Ludwig and Asseng (2006), in the case of Australia, argued that elevated CO_2 reduced grain protein concentration and lower rainfall increased protein levels at all sites. Also, higher temperatures could both increase and decrease protein concentrations.
- Regarding **maize**, for all the scenarios and areas, the proportional yield change was restricted under 5%. This result is generally explained by the fact that maize is a C4 photosynthetic plant with limited absorption ability under higher concentration of CO_2 causing lower net photosynthetic rates than wheat which is a C3 plant. The decrease in precipitation could not directly affect maize's productivity due to the fact that the plant was simulated under full irrigation conditions.
- In the case of **potato,** the projection for the two growing periods (November and July sowing), gave quite controversial results. Specifically, in almost all the cases yields of the July sowing were significant lower compared to November indicating that potato growing in summer is going to face serious climatic restrictions.
- **Olive trees and grapevines** are going to shift their main production areas moving to higher altitudes now considered relatively cool as the Western or Mountain Cyprus. The magnitude of the projection is expected to be greater in the RCP8.5 scenario than RCP4.5.
- **Grapevines** face greater level of uncertainty regarding yield's quality due to the fact that the projected conditions are going to downgrade late varieties which are more sensitive to higher temperatures and

CONCLUSIONS (cont.)

- Regarding **maize**, for all the scenarios and areas, the proportional yield change was restricted under 5%. This result is generally explained by the fact that maize is a C4 photosynthetic plant with limited absorption ability under higher concentration of CO2 causing lower net photosynthetic rates than wheat which is a C3 plant. The decrease in precipitation could not directly affect maize's productivity due to the fact that the plant was simulated under full irrigation conditions.
- In the case of **potato**, the projection for the two growing periods (November and July sowing), gave quite controversial results. Specifically, in almost all the cases yields of the July sowing were significant lower compared to November indicating that potato growing in summer is going to face serious climatic restrictions.
- Olive trees and **grapevine**s are going to shift their main production areas moving to higher altitudes now considered relatively cool as the Western or Mountain Cyprus. The magnitude of the projection is expected to be greater in the RCP8.5 scenario than RCP4.5.
- Grapevines face greater level of uncertainty regarding yield's quality due to the fact that the projected conditions are going to downgrade late varieties which are more sensitive to higher temperatures and

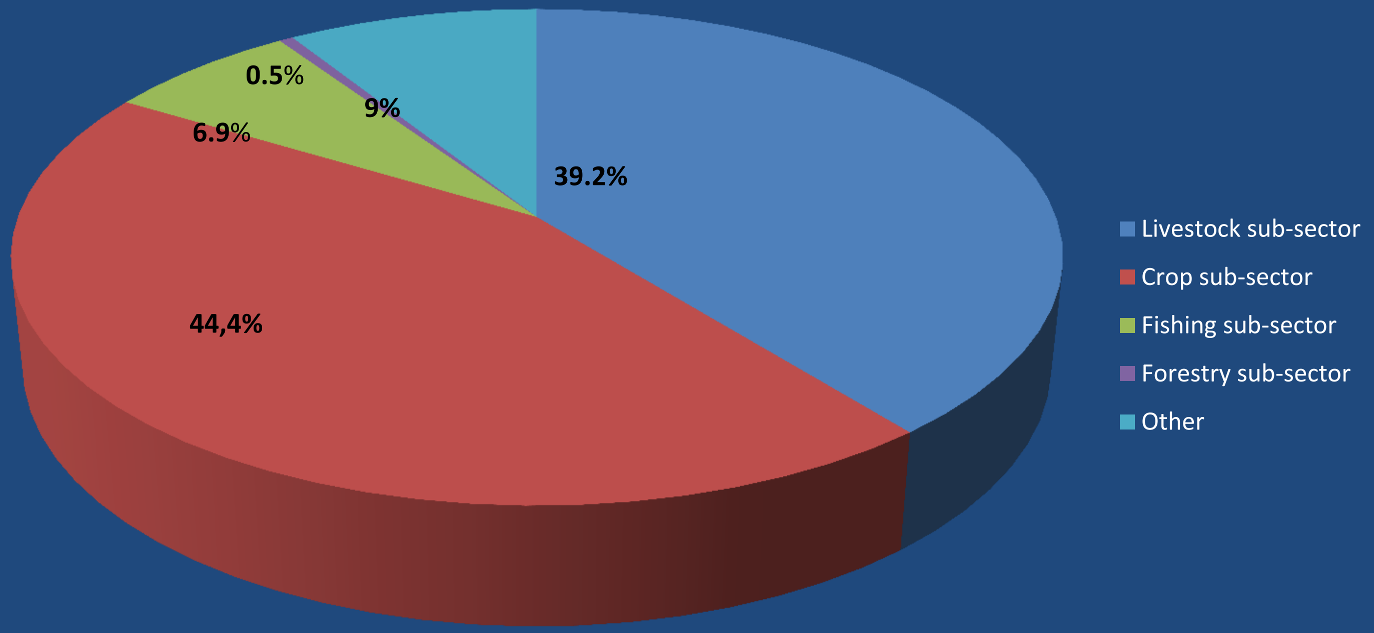
Department of Animal Science and Aquaculture

Livestock Sector

Vasileios Paraskeuas, M.Sc. c.Ph.D.

Livestock Sub Sector

According to the Statistical Service of Cyprus (2012), the value added of livestock sub-sector for 2012 in Cyprus was 39.2% at current prices.



Livestock Sub Sector

- In CCRA climate change report five sub-regions of Cyprus island were studied.

1. **Western Coastal Areas (the greater area of Paphos)**
2. **Southern Coastal Areas (the greater area of Limassol)**
3. **Eastern Coastal Areas (the greater area of Famagusta, Ayia Napa and Larnaca)**
4. **Continental Lowland Areas (the greater area of Nicosia)**
5. **Higher Elevation Areas (the central part of Troodos mountains).**

- Data related with the present climate of Cyprus, reffering to temperature, precipitation, winds and relative humidity were taken into consideration

- Moreover, based on future stimulations the climatic future changes for 2050's and 2080's, for temperature, precipitation, winds, relative humidity, and sea level were studied according to **Climatic Change report for CCRA of Cyprus**.

Livestock Sub Sector

Animal related impacts

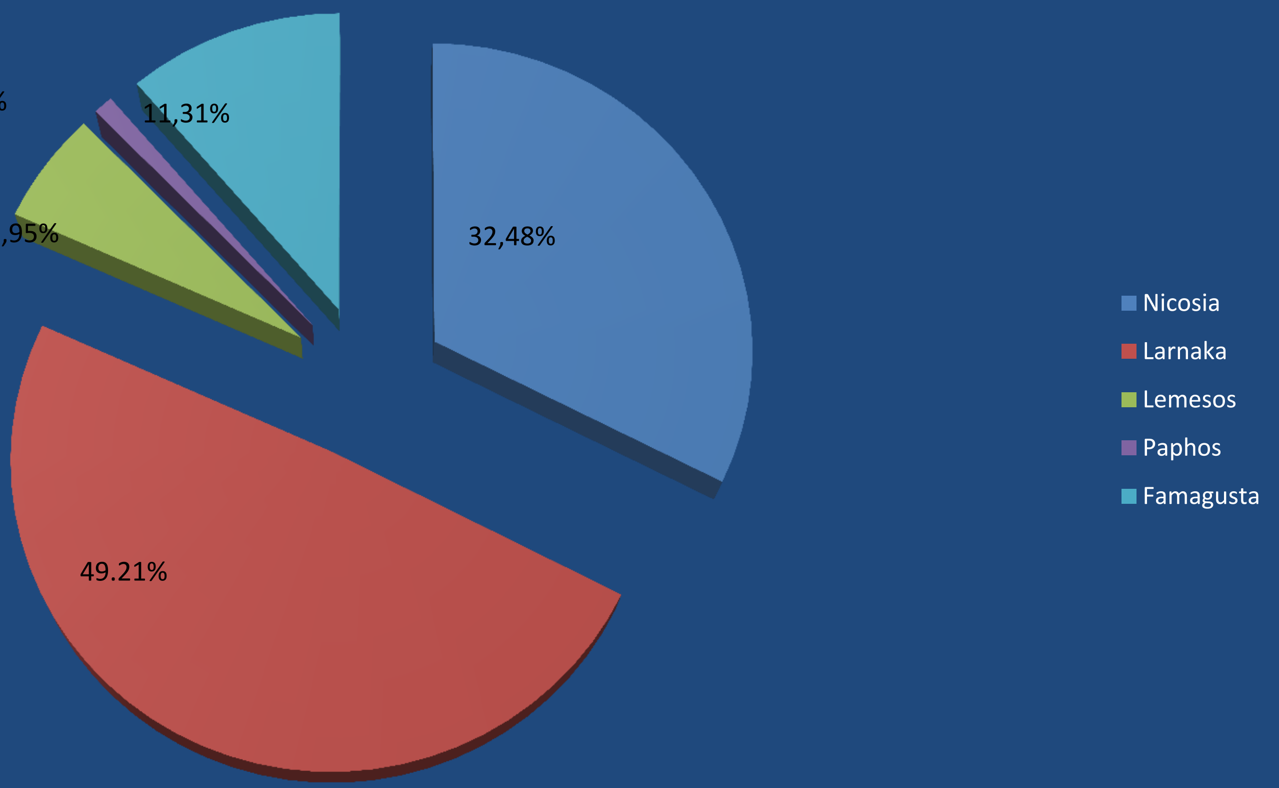
Climate impacts in livestock sector are related with:

1. Heat stress
2. The need for supplemental feed due to grassland productivity problems

Direct impacts of heat stress on livestock productivity was chosen as an illustrative sector, and were related with the types of livestock production of Cyprus island and changes in temperature and their impacts on animal welfare and productivity.

Livestock Sub Sector

Percentage number of cattle in Cyprus per district for 2013 (Cyprus Department of Environment, 2015).



Livestock Sub Sector

Heat stress impact on cattle milk production

- The majority of changes for heat stress are larger in 2080 than in 2050 an for this reason the projections suggest that losses to heat stress only begin to become relevant in the 2050s and the losses will be greater for the 2080s due to greater magnitude of temperature changes.

- 32,48 % of total cattle production is located in Nicosia in which the strongest climate changes will occur, and for this reason will receive the strongest impacts from heat stress.

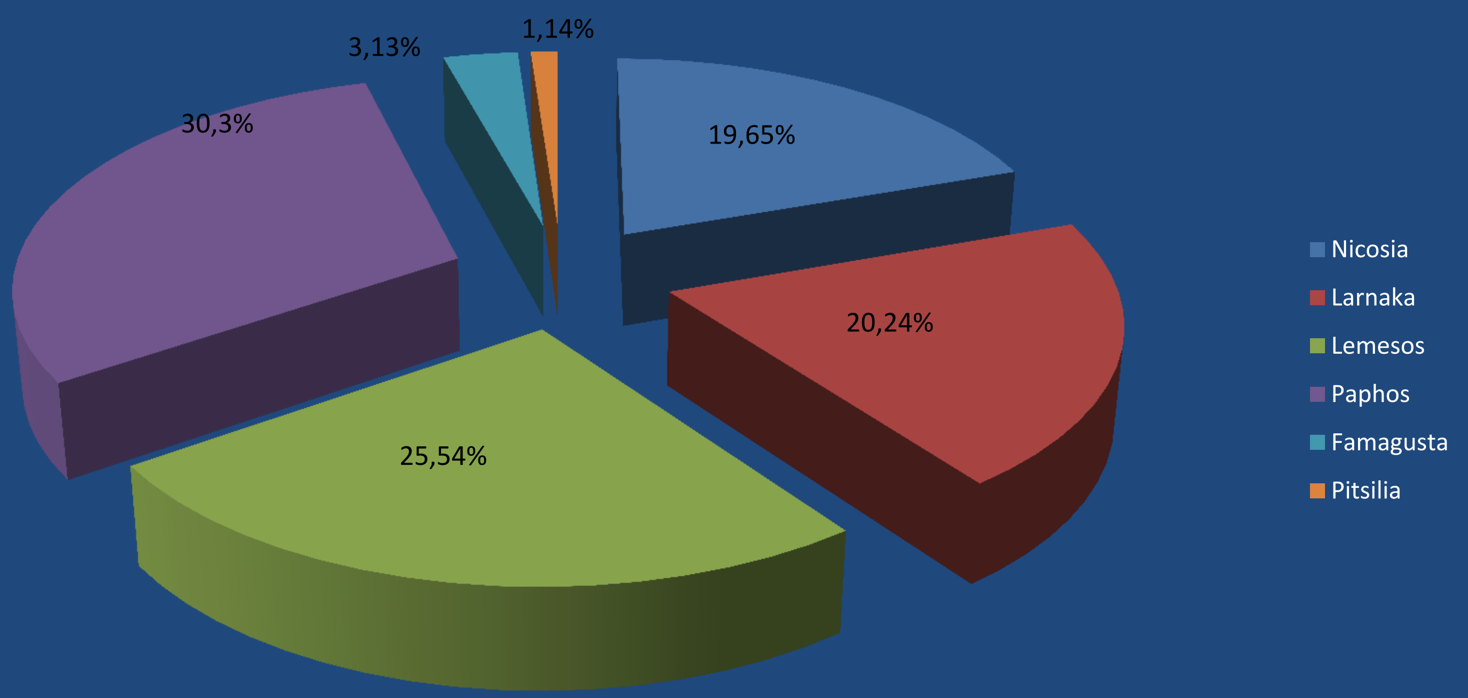
Livestock Sub Sector

Heat stress impacts on meat cattle production

- The breedings for meat cattle production and milk cattle production according 2013 data, are generally occured at 49.21% in Eastern Coastal Areas and 32,48% in Continental Lowland Areas
- Paphos and Nicosia will experience the major temperature increases until the 2080s (High severity scenario) and the lower increases of temperature in 2050s
- For this reason cattle meat production in Cyprus have a possibility to be affected from heat stress in 2050’s and in greater magnitude in 2080’s, in a similar way with cattle milk production

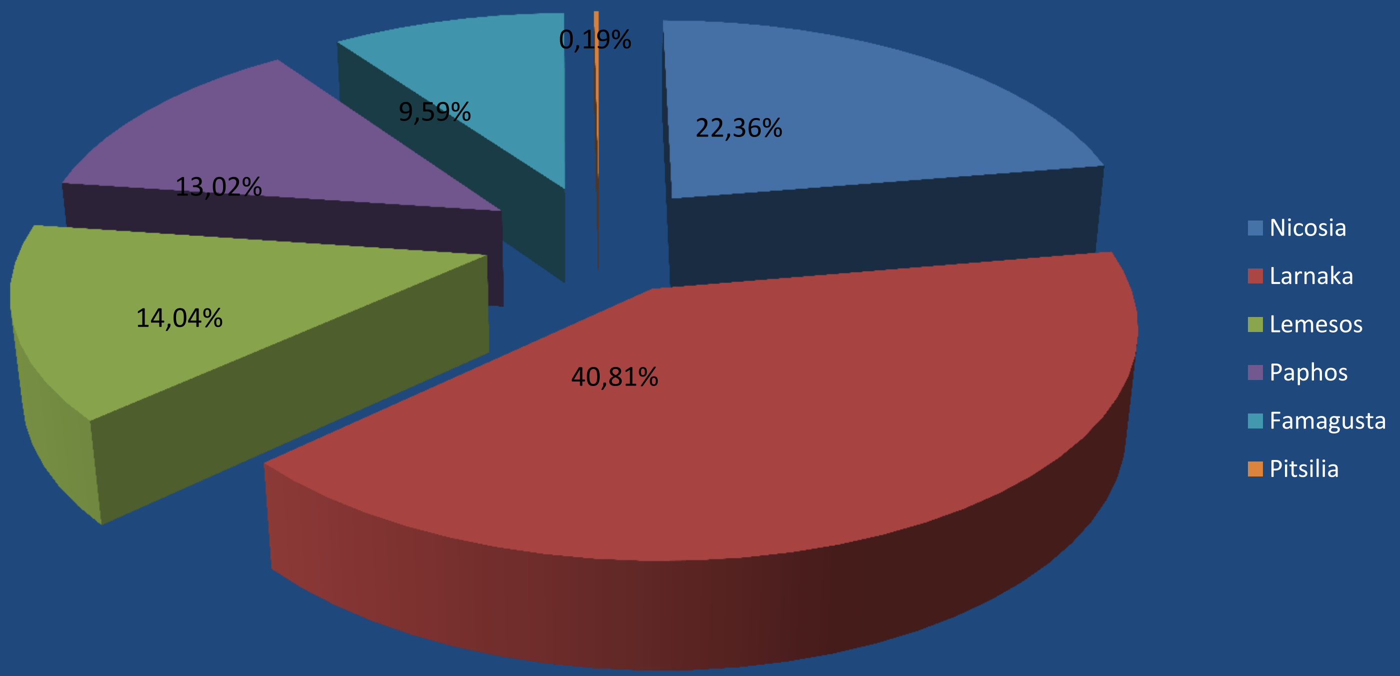
Livestock Sub Sector

Percentage number of goats in Cyprus per district for 2013, respectively (Department of Environment, 2015).



Livestock Sub Sector

Percentage number of sheep in Cyprus per district for 2013, respectively (Department of Environment, 2015).



Livestock Sub Sector

Heat stress impacts on sheep and goat milk and meat production

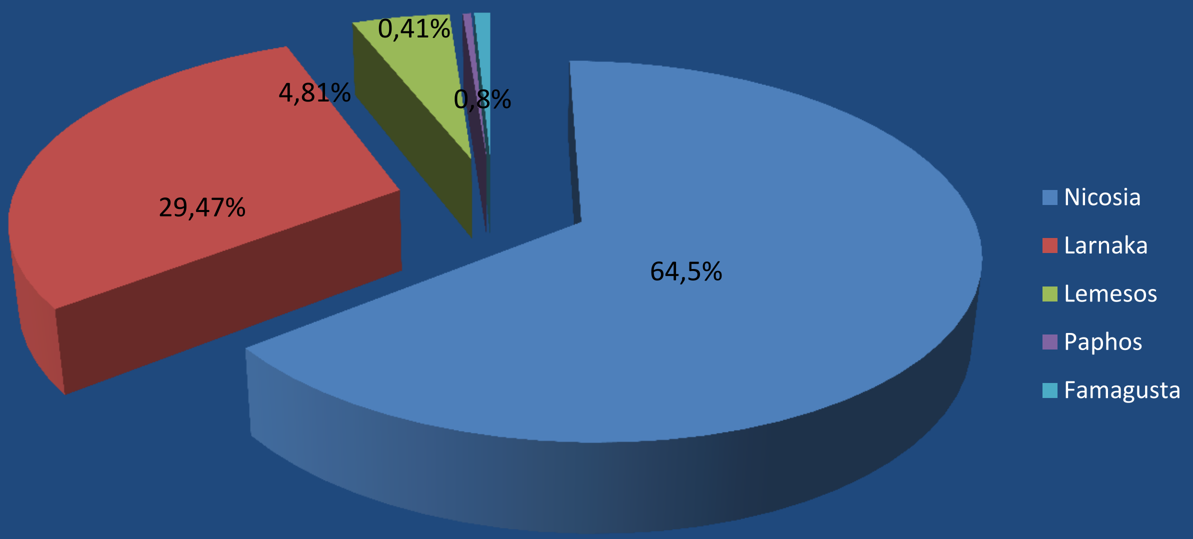
- The striking increases of precipitation in the high elevation and continental lowland areas found in 2050 are absent in 2080.

- The strongest changes are found in high elevation areas, but they are negative and smaller in magnitude than for 2050.

- For the above reasons, the prediction of the climate change impacts on goat and sheep milk and meat production are low confident and the only factor which may has the potential to affect it, is heat stress only for 2080s in which the temperature changes will be greater and more extreme than 2050s.

Livestock Sub Sector

Percentage number of pigs in Cyprus per district for 2011 (Department of Environment, 2013).



Livestock Sub Sector

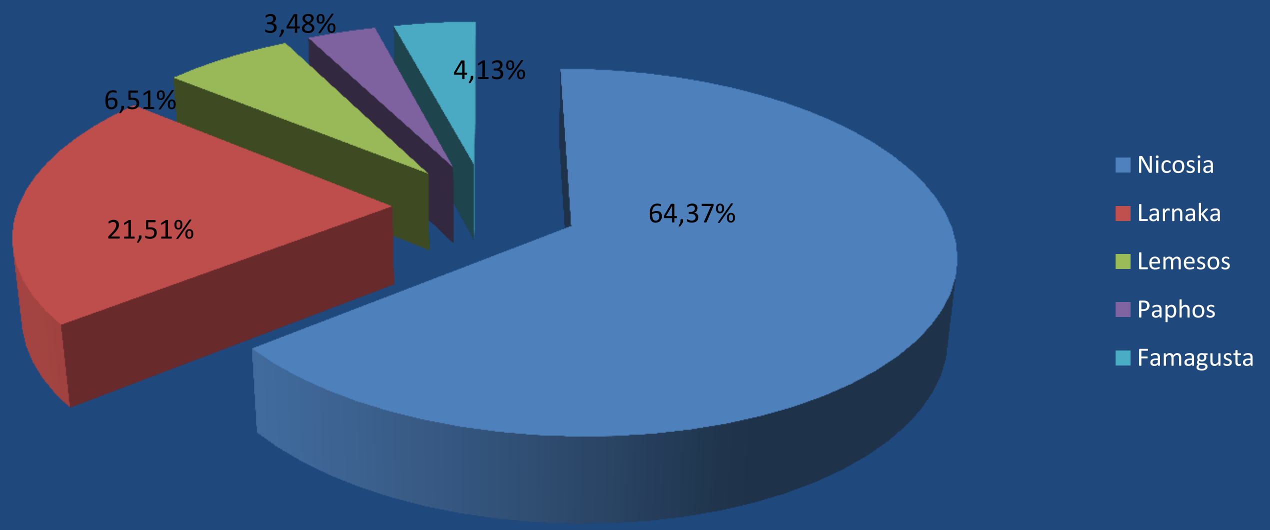
Changes in pork meat production due to heat stress

- Heat stress will have an important impact in pig production of Cyprus, because of the higher increases of temperature in 2050s and 2080s, at continental lowland areas (Nicosia) which have the biggest percentage of pig production (64.50%) in the island.

- This impact will be more important in 2080s than in 2050s due to the magnitude of changes which will occur in these time periods.

Livestock Sub Sector

Percentage number of poultry in Cyprus per district for 2011 (Department of Environment, 2013).



Livestock Sub Sector

Changes in poultry meat and egg production due to the heat stress

- Heat stress will have an important impact in poultry meat and egg production of Cyprus, because of the higher increases of temperature in 2050s and 2080s, at continental lowland areas (Nicosia) which have the biggest percentage of pig production (64.37%) in the island.

- This impact will be more important in 2080s than in 2050s due to the magnitude of changes which will occur in these time periods.

Livestock Sub Sector

Heat stressimpacts on animal transports

- In Nicosia is gathered 32.48% of cattle, 19.65% of sheep, 22.36% of goat, 64.5% of pig and 64.37% of poultry production of Cyprus.
- The impacts of heat stress will be greater in Nicosia as it was predicted in CCRA climate change report for Cyprus, with having greater magnitude in 2050s compared to 2080s.
- As a result, heat stress and high temperatures may have a greater impact on animal transportation at Nicosia in 2080s and in a lower level in 2050s

Livestock Sub Sector

Climate change and cross sectoral risks

- Summer high temperatures and the increase in winter precipitation may have a low effect on changes in crop, grass permanent pasture and meadow in 2050

- Heat stress may affect invasive species, pests and diseases risks and their impact on livestock productivity as well as wildfire due to the changes of summer temperatures and winter rainfalls.

- Water quality impacts on livestock for Cyprus, may be linked with the increase of winter precipitation in 2050, only if toxic blooms of blue-green algae are present.

Livestock Sub Sector

Conclusion

- At Nicosia is gathered 32.48% of cattle, 19.65% of sheep, 22.36% of goat, 64.5% of pig and 64.37% of poultry production of Cyprus
- The impacts of heat stress will be greater in Nicosia having greater magnitude in 2050s compared to 2080s.

Sector of Soil Science & Agricultural Chemistry

Land Desertification

Prof. Consatntinos Kosmas
Penny Vasiliou, M.Sc.
Ass. Prof. Christos A. Karavitis

INTERLOCKING CRISES

- CLIMATIC SHIFTS AND CHANGES
- MEGARUPTURES
- METABOLISM
- SOCIO-POLITICAL CONTEXT
- TRANSBOUNDARY INTERDEPENDENCIES
- FAST PACE OF TECHNOLOGICAL DEVELOPMENT

Methodology used

A list of 30 indicators has been identified using the following sources:

- DEISIRE PROJECT-EU
- European Environmental Agency (EEA) - DPSIR (Driving forces, Pressure, State, Impact, Responses indicators)
- MEDALUS projects - Mediterranean Desertification and Land Use
- MEDRAP – Mediterranean Desertification Regional Action Plan
- DESERTLINKS – DIS4ME

Methodology used

- Each indicator has been described using existing classes based on existing classification systems and research results.

- Weighing indices have been assigned in each class.

CLIMATE							
Annual air Temperature (^oC)	<12	12-15	15-18	18-21	>21		
	1.0	*1.2*	*1.5*	*1.8*	2.0		
Annual rainfall (mm)	<280	280-650	650 -1000	>1000			
	4	*2*	*1.5*	*1.0*			
BG aridity index	<50	50-75	75-100	100-125	125-150	>150	
	1.0	*1.2*	*1.4*	*1.6*	*1.8*	*2.0*	
Annual pot. evapotranspiration (mm)	<500	500-800	800-1200	1200-1500	>1500		
	1.0	*1.2*	*1.5*	*1.8*	*2.0*		
Rain seasonality	<0.19	0.20-0.39	0.40-0.59	0.60-0.79	0.80-0.99	1.00-1.19	>1.20
	1.0	*1.2*	*1.4*	*1.6*	*1.8*	*1.9*	*2.0*
Rain erosivity (mm/h)	<60	60 -90	91-120	121-160	>160		
	1.0	*1.2*	*1.5*	*1.8*	*2.0*		

WATER				
Water quality (µS)	<400	400-800	800-1500	>1500
	1.0	*1.3*	*1.6*	*2.0*
Water quantity	Adequate	Moderate	Low	None
	1.0	*1.3*	*1.6*	*2.0*

Indicators with the corresponding weighing indices for the assessm erosion risk in agricultural areas, pastures, and forests

Indicators	Water erosion		
	Agricultural areas	Pastures and shrubs	Forests
CLIMATE			
Rainfall	0.348		
Rainfall seasonality	0.245	0.654	0.41
Aridity index			0.225
SOIL			
Slope aspect	0.191		
Slope gradient	0.359		
Soil depth	0.082	0.167	0.225
Soil texture		0.115	
Organic matter	0.17		
VEGETATION			
Vegetation cover type	0.089		0.369
Plant cover	0.089	0.305	0.169
FIRES			
Fire risk			-0.417
Burned area		-0.182	0.309
AGRICULTURE			

Methodology used

A forward stepwise multiple regression analysis was applied for each process or cause with dependent variable the desertification risk and independent variables all the indicators assigned for each process using the following linear model:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots\cdots + \beta_\kappa X_\kappa.$$

Where: Y is the dependent variable of desertification risk,

β_0 is the Y intercept

β_1, β_2, etc. are slopes of the regression plane,

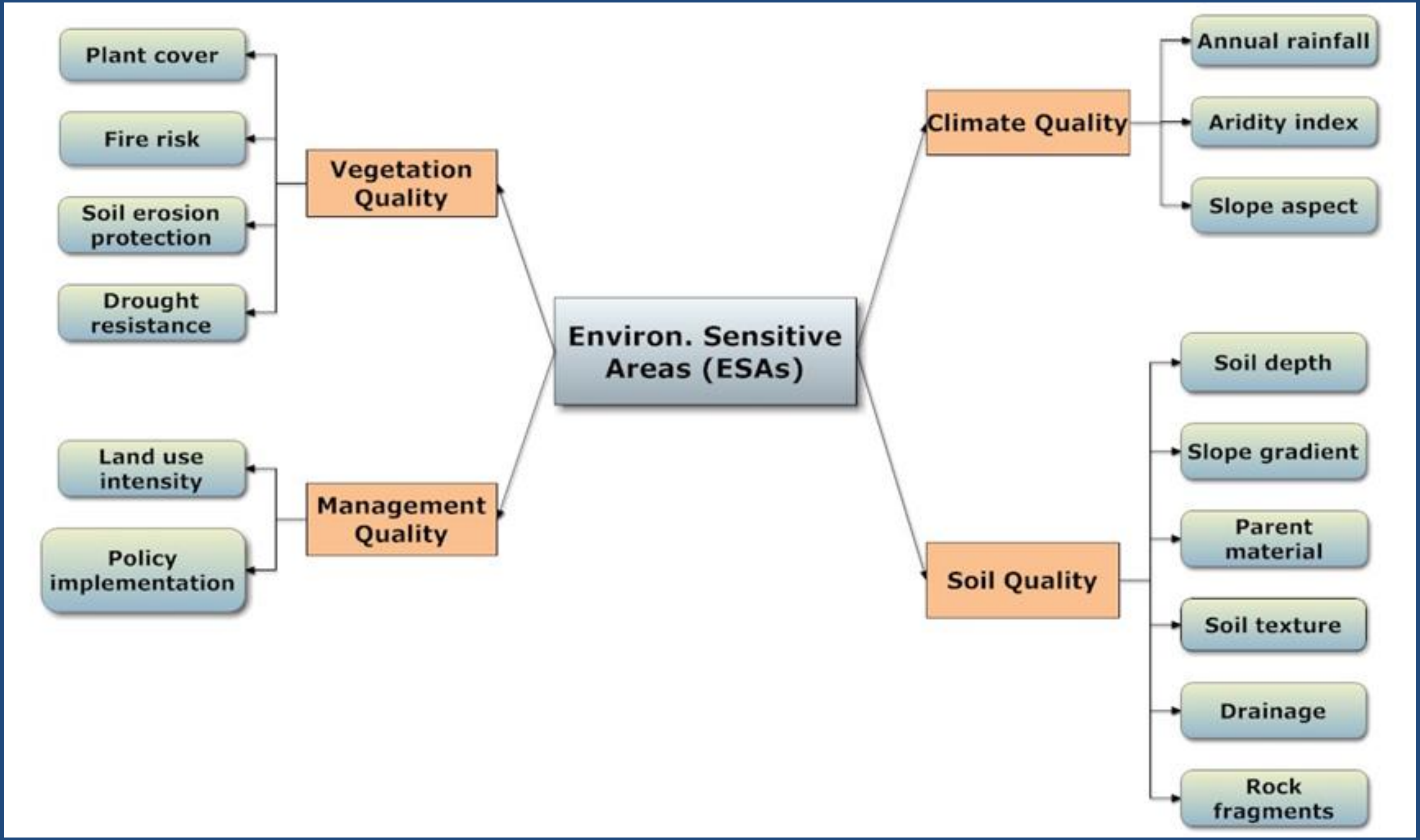
X1, X2, etc. are the independent variables of indicators used.

ESAI = (SQI * CQI * VQI * MQI)1/4

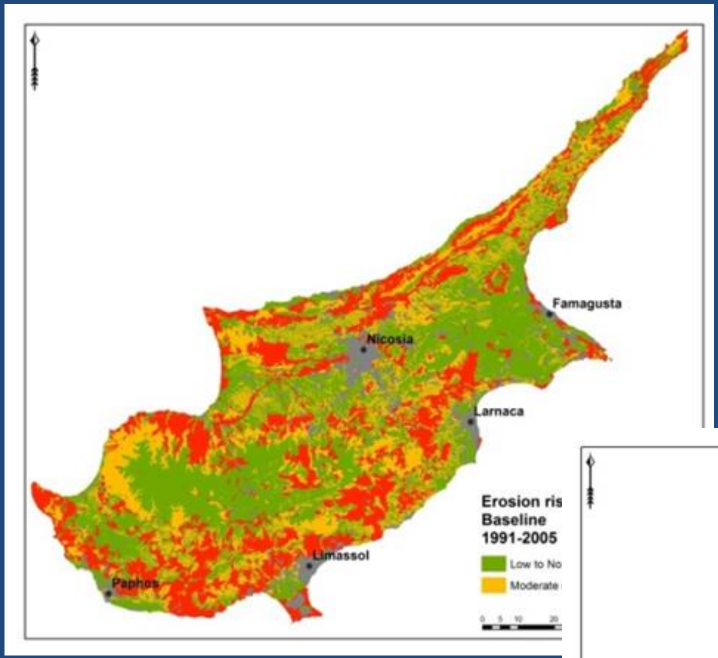
Types of ESAs and corresponding ranges of indices

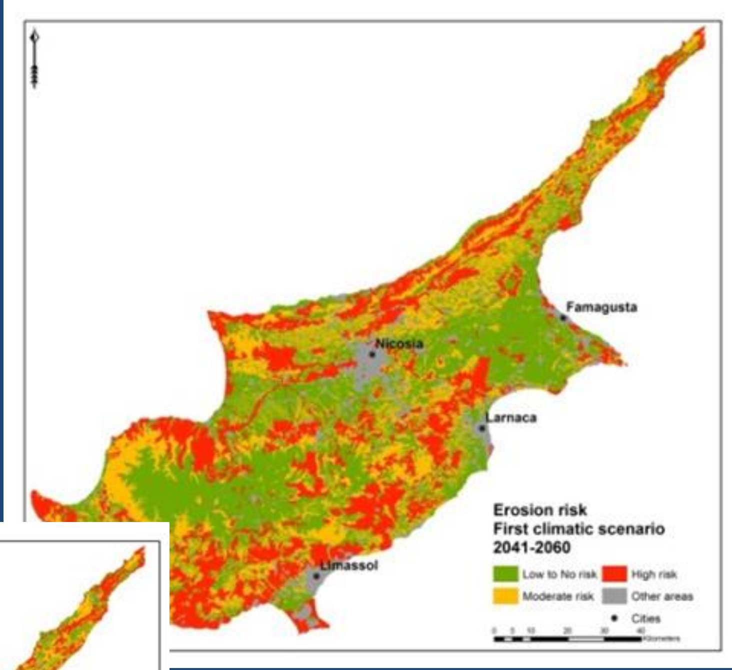
Type	Subtype	Range of ESAI
Critical	C3	>1.53
«	C2	1.42-1.53
«	C1	1.38-1.41
Fragile	F3	1.33-1.37
«	F2	1.27-1.32
«	F1	1.23-1.26
Potential	P	1.17-1.22
Non affected	N	<1.17

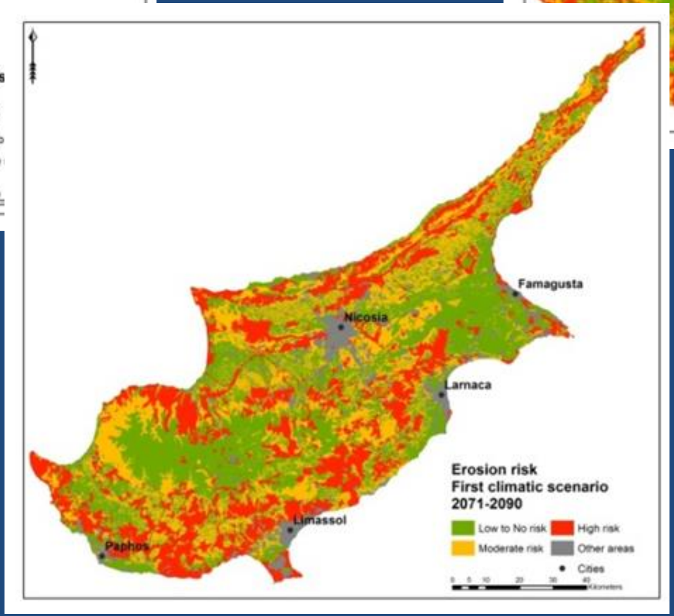
The indicators and qualities used for identification environmentally sensitive areas (ESAs) to desertification



Climatic scenario 1



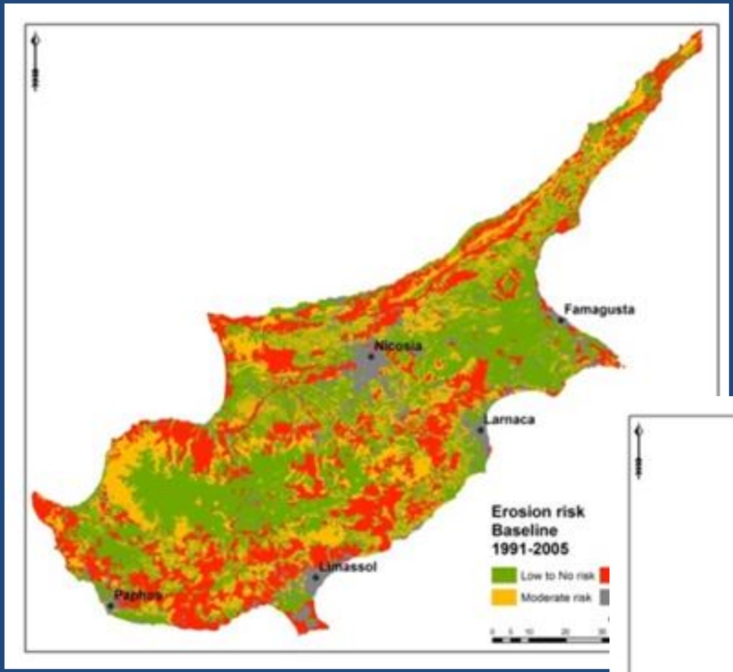


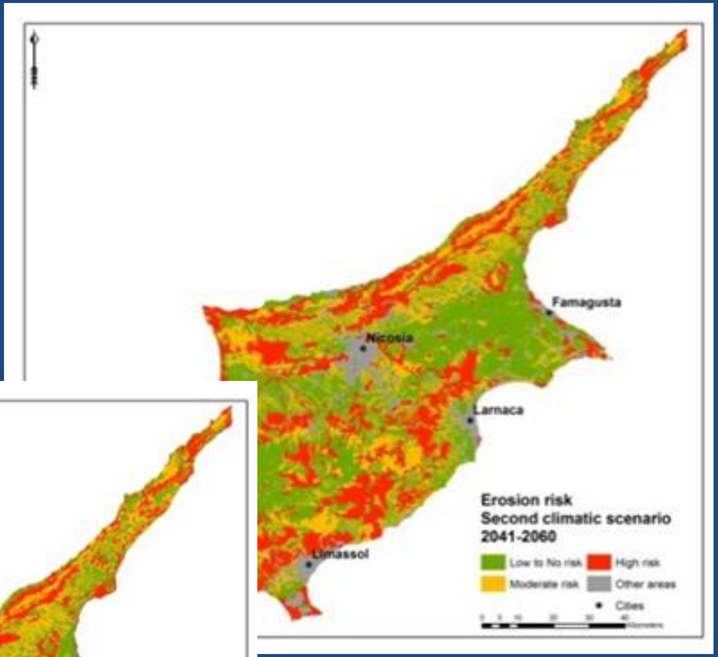


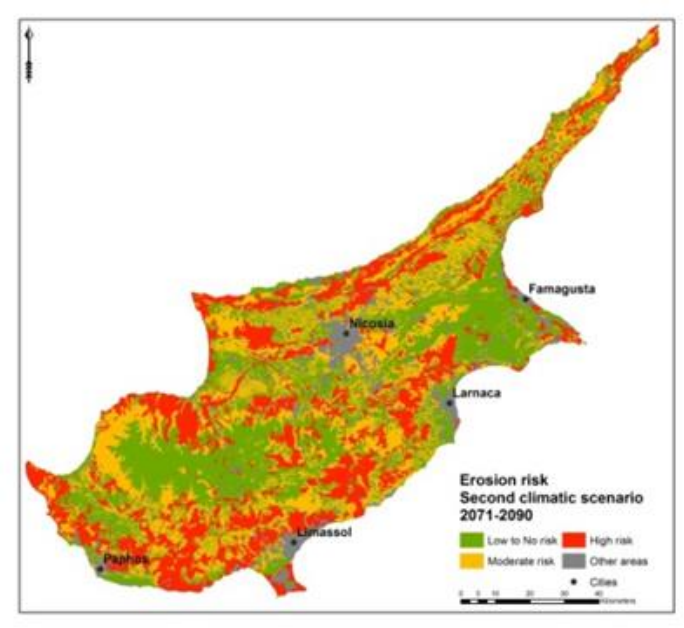
Distribution of erosion risk for the present period, period 2041-2060 and period 2071-2090 for the climatic scenario 1

Erosion risk	Present period		Scenario 1 (period 2041-2060)		Scenario 1 (period 2071-2090)	
	area (ha)	area (%)	area (ha)	area (%)	area (ha)	area (%)
High	244877,1	26,6	244318,4	26,5	246187,5	26,7
Moderate	216772,9	23,5	223136,4	24,2	243223,6	26,4
Low-no risk	399494,7	43,3	382450,7	41,5	359099,5	39,0
Other areas	72144,9	7,8	72144,9	7,8	72144,9	7,8
TOTAL	922050,5	100,0	922050,5	100,0	922050,5	100,0

Climatic scenario 2



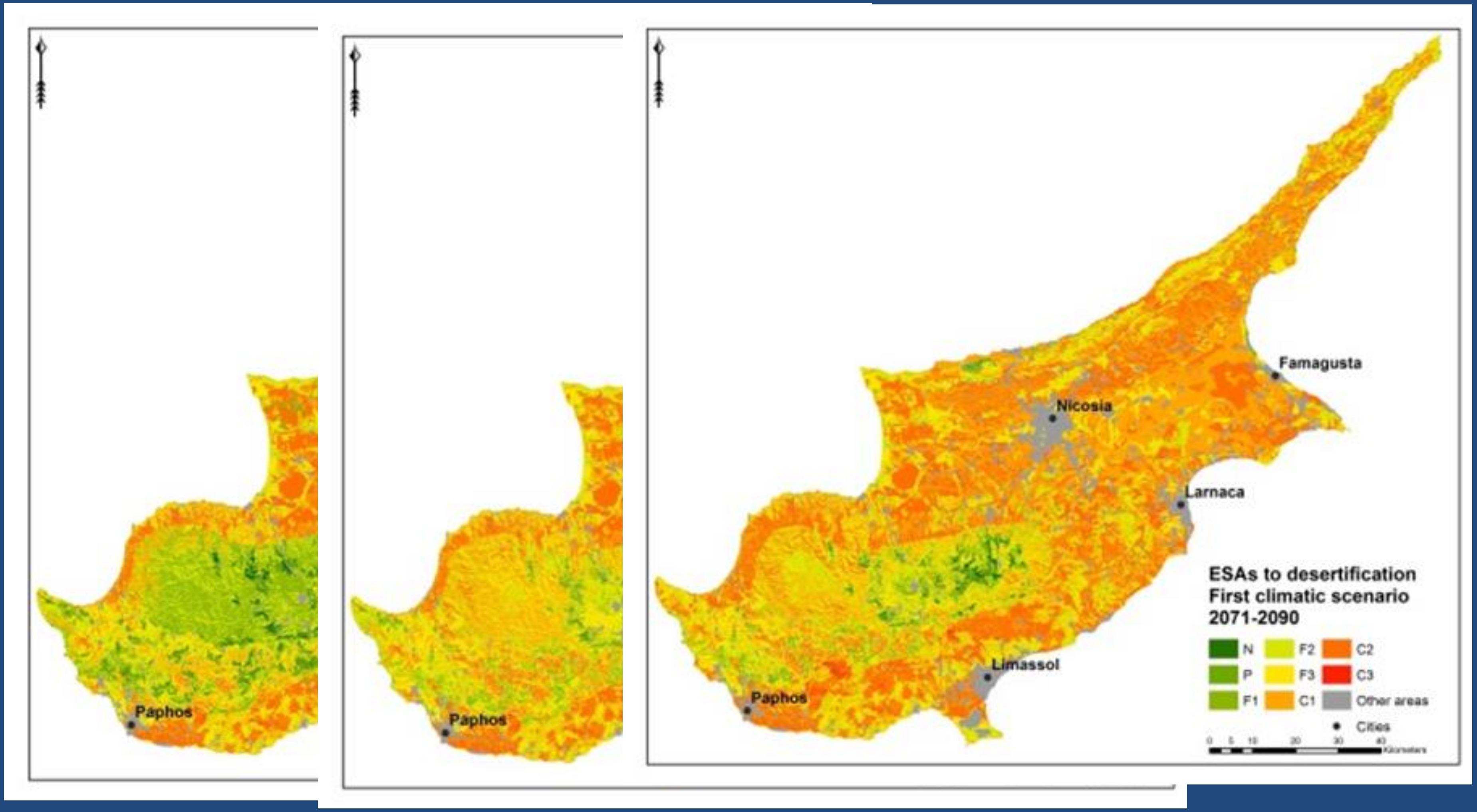




Distribution of erosion risk for the present period, period 2041-2060 and period 2071-2090 for the climatic scenario 2

Erosion risk	Present period		Scenario 2 (period 2041-2060)		Scenario 2 (period 2071-2090)	
	area (ha)	area (%)	area (ha)	area (%)	area (ha)	area (%)
High	244877,1	26,6	248753,5	27,0	242699,2	26,3
Moderate	216772,9	23,5	204597,6	22,2	262659,7	28,5
Low-no risk	399494,7	43,3	395059,5	42,9	344546,7	37,4
Other areas	72144,9	7,8	72144,9	7,8	72144,9	7,8
TOTAL	922050,5	100,0	922050,5	100,0	922050,5	100,0

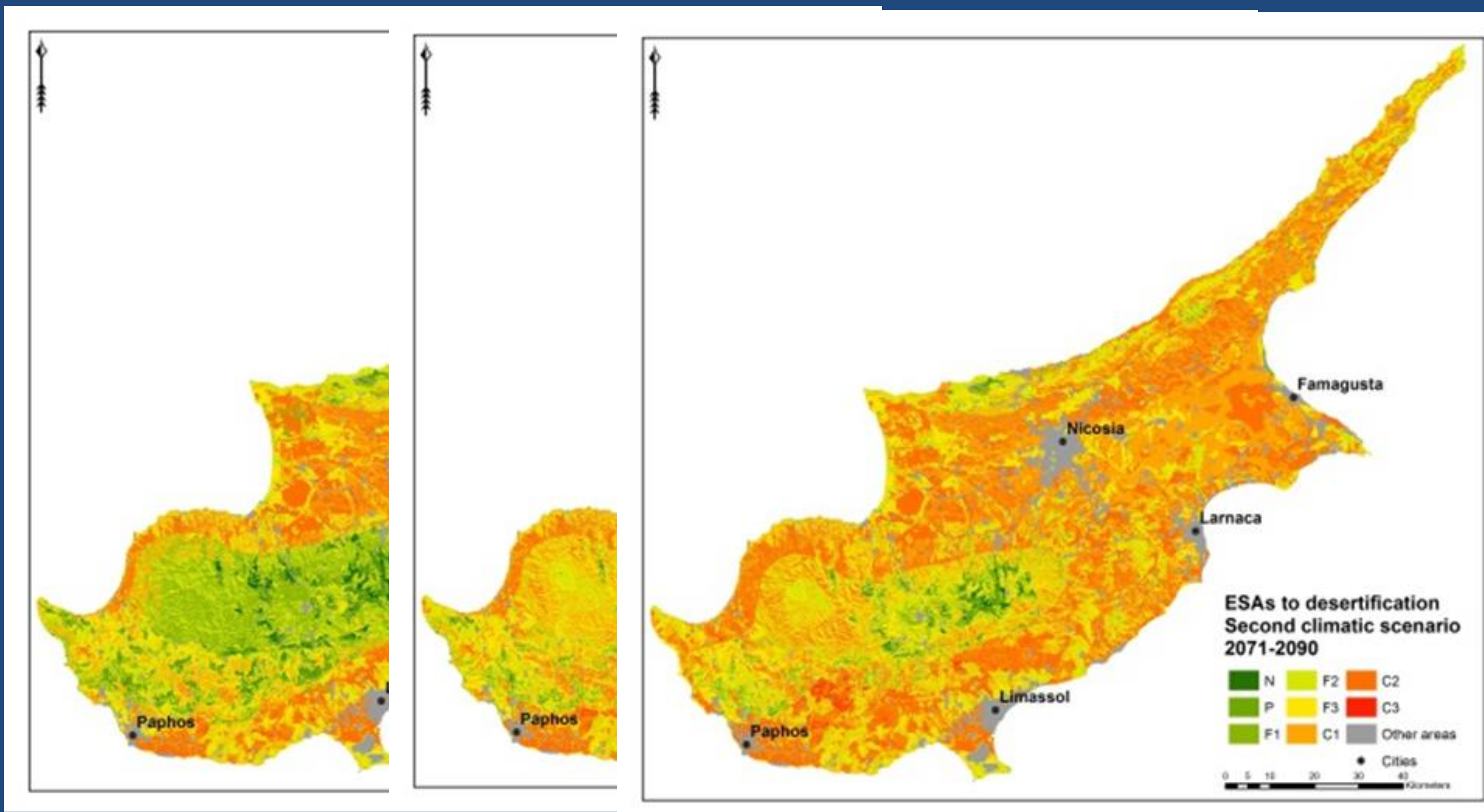
Land desertification risk assessment
Scenario 1



Distribution of environmentally sensitive areas to desertification for the present period, period 2041-2060 and period 2071-2090 for the climatic scenario 1

Environmentally sensitive areas to desertification (ESAs)	Present period		Scenario 1 (period 2041-2060)		Scenario 1 (period 2071-2090)	
	area (ha)	area (%)	area (ha)	area (%)	area (ha)	area (%)
Critical-C3	452,1	0,1	646,7	0,1	1809,6	0,2
Critical-C2	181000,0	19,6	225305,0	24,4	249360,3	27,0
Critical-C1	214132,9	23,2	253736,2	27,5	255099,7	27,7
Fragile-F3	121303,9	13,2	168676,2	18,3	161389,3	17,5
Fragile-F2	185660,5	20,1	157161,3	17,0	144823,3	15,7
Fragile-F1	104167,7	11,3	30134,1	3,3	25615,9	2,8
Potential-P	36207,2	3,9	12694,3	1,4	9994,7	1,1
No threatened-N	6981,3	0,8	1551,8	0,2	1813,0	0,2
Other areas	72144,9	7,8	72144,9	7,8	72144,9	7,8
TOTAL	922050,5	100,0	922050,5	100,0	922050,5	100,0

Land desertification risk assessment
Scenario 2



Distribution of environmentally sensitive areas to desertification for the present period, period 2041-2060 and period 2071-2092 for the climatic scenario 2

Environmentally sensitive areas to desertification (ESAs)	**Present period**		**Scenario 2 (period 2041-2060)**		**Scenario 2 (period 2071-2090)**	
	area (ha)	area (%)	area (ha)	area (%)	area (ha)	area (%)
Critical-C3	452,1	0,1	1014,5	0,1	2626,6	0,3
Critical-C2	181000,0	19,6	229834,5	24,9	253679,9	27,5
Critical-C1	214132,9	23,2	251991,4	27,3	253122,3	27,5
Fragile-F3	121303,9	13,2	166326,8	18,0	159089,6	17,3
Fragile-F2	185660,5	20,1	156405,7	17,0	146100,0	15,8
Fragile-F1	104167,7	11,3	30355,6	3,3	24241,6	2,6
Potential-P	36207,2	3,9	12129,6	1,3	9376,9	1,0
No threatened	6981,3	0,8	1847,5	0,2	1668,5	0,2
Other areas	72144,9	7,8	72144,9	7,8	72144,9	7,8
TOTAL	922050,5	100,0	922050,5	100,0	922050,5	100,0

ΑΝΤΙ ΕΠΙΛΟΓΟΥ

- Climate uncertainty and nonstationarity are more than an intellectual discussion topic and need to be seen as such. The issues have economic, ethical, and moral dimensions.
- We may have live with today's infrastructure decisions for 50 to 100 years and must keep that in mind in our discussions.


ΕΥΧΑΡΙΣΤΩ