ASSESSMENT OF COMMON REGIONAL PHENOLOGICAL FEATURES OF COTTON BASED ON THE VEGETATION CONDITION INDEX (VCI)

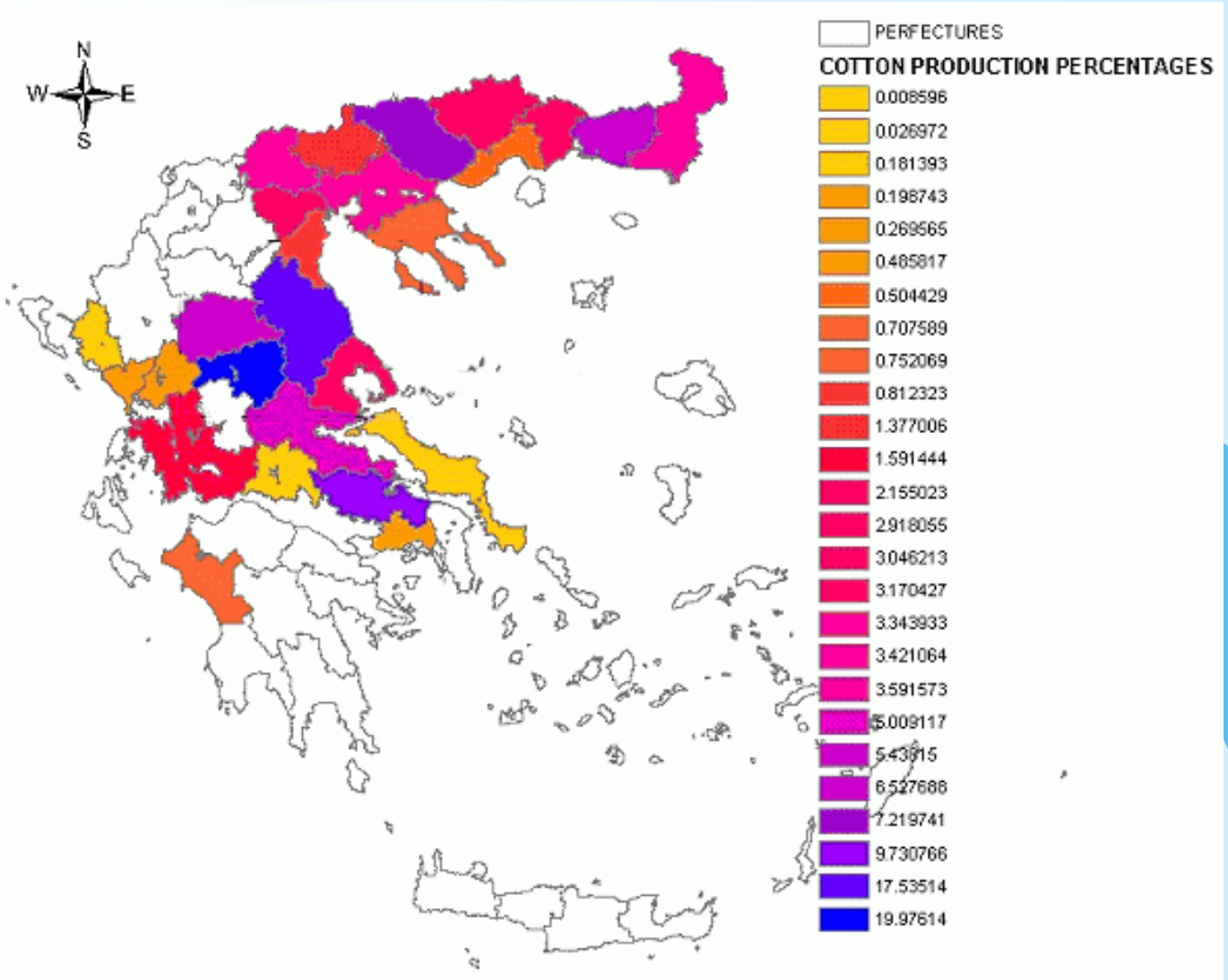
Tsiros E., N.R. Dalezios and C. Domenikiotis

Laboratory of Agrometeorology
School of Agricultural Sciences
University of Thessaly, Greece

OBJECTIVES

- *use of Vegetation Condition Index for the assessment of cotton phenological features*
- *zoning of cotton productive areas*
- *cotton production assessment for different climatic zones*

Study Area


N
W
E
S
PERFECTURES
COTTON PRODUCTION PERCENTAGES
0.008596
0.026972
0.181393
0.198743
0.269565
0.465817
0.504429
0.707589
0.752069
0.812323
1.377006
1.591444
2.155023
2.918055
3.046213
3.170427
3.343933
3.421064
3.591573
5.009117
5.43815
6.527686
7.219741
9.730766
17.53514
19.97614

DATA SET

Satellite Data

- 18 years x 36 NDVI images (1 image per ten-days) with 8x8 km spatial resolution.

Statistical Data for Cotton

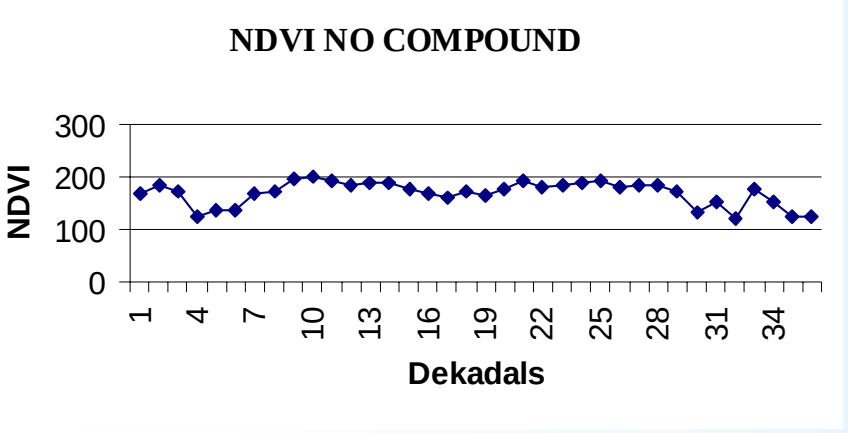
- Cotton production data for the same period were provided by the National Statistical Service of Greece

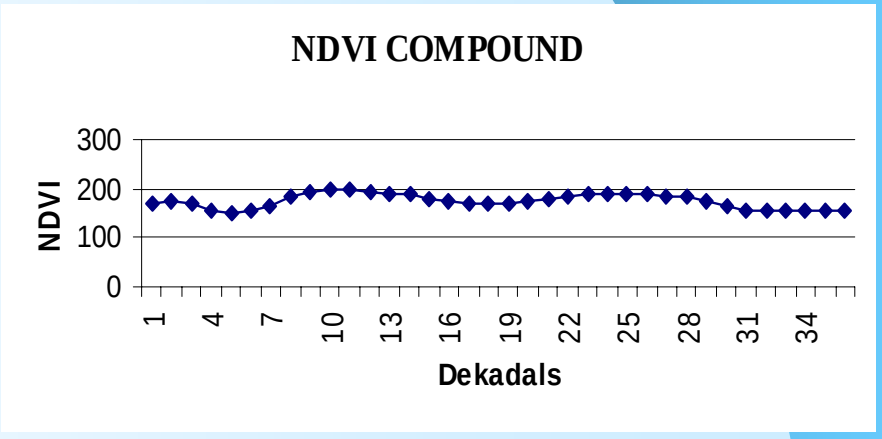
METHODOLOGY

Step 1: *Filtering – Maximum Value Composite (MVC)*:

- Composition of daily maps of NDVI

- Noise removal:
  - Maximum Value Composites
  - Filtering: “4253 compound twice” (Van Dijk,1987)





Step 2: Vegetation Condition Index (VCI):

$$VCI = 100 * \frac{NDVI - NDVI_{\min}}{NDVI_{\max} - NDVI_{\min}}$$

An extension of the NDVI

Based on the concept of ecological potential of an area given by geographical resources such as:

-climate,

-soil variation,

-vegetation type and quantity, and

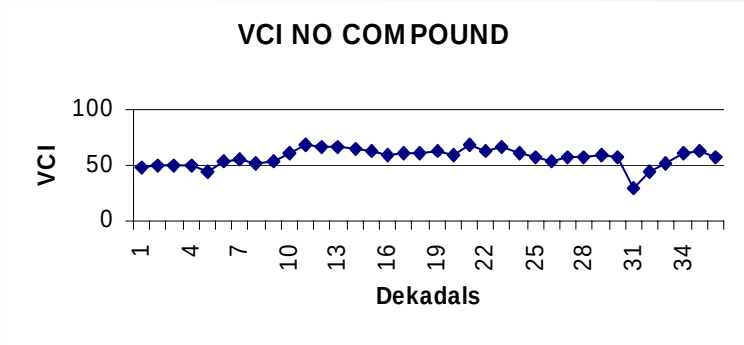
-topography of the area.

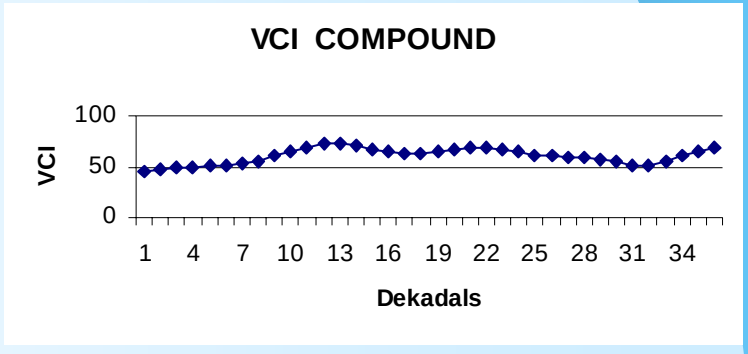
Separates the short-term weather signal to long-term ecological signal

Provides a quantitative estimation of weather impact on vegetation (Kogan,1990)

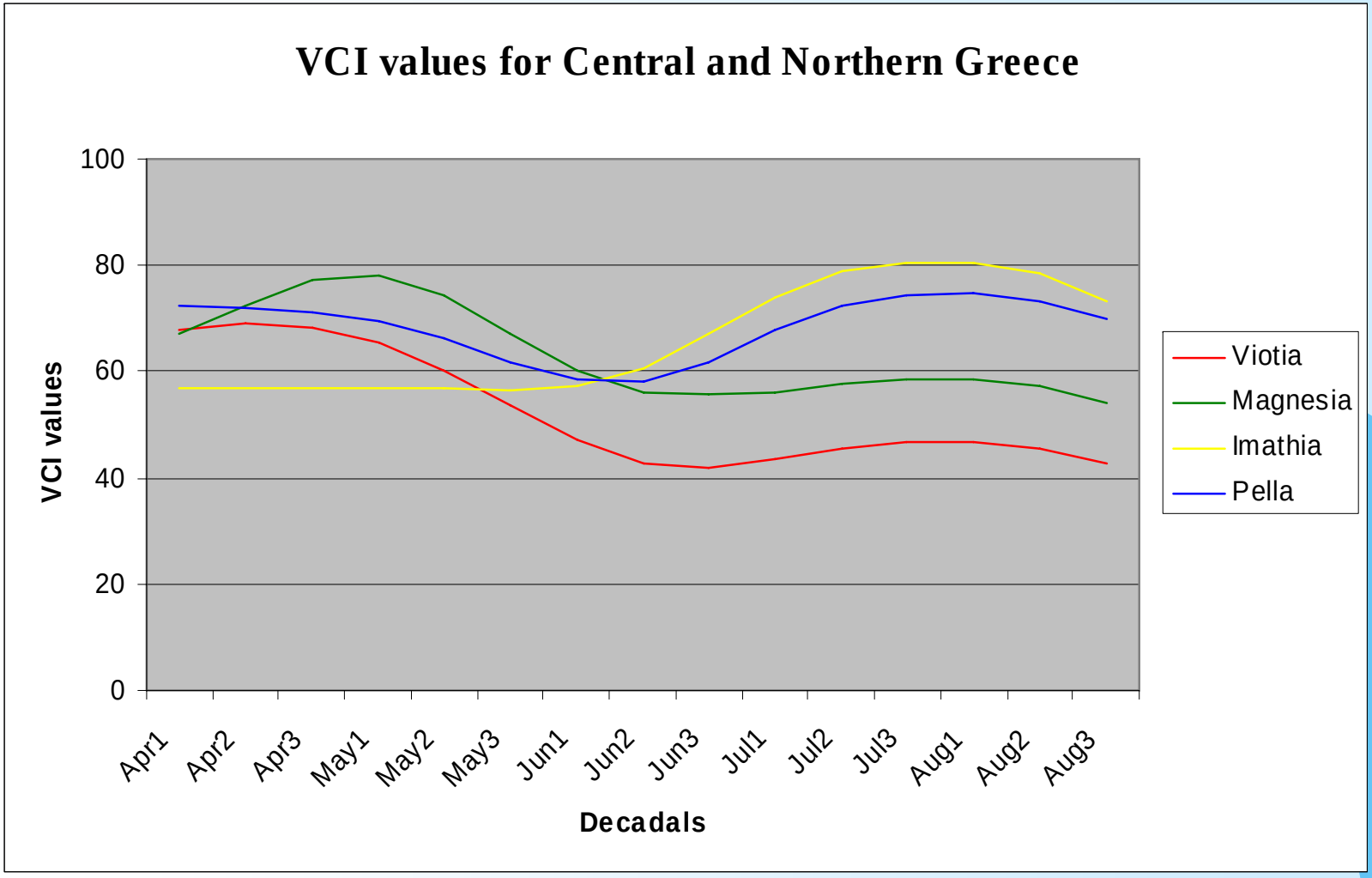
Values $0 \leq VCI \leq 100$ (0 -> unfavorable conditions, 100 -> optimal conditions)

Estimated for the period 1981 - 1999

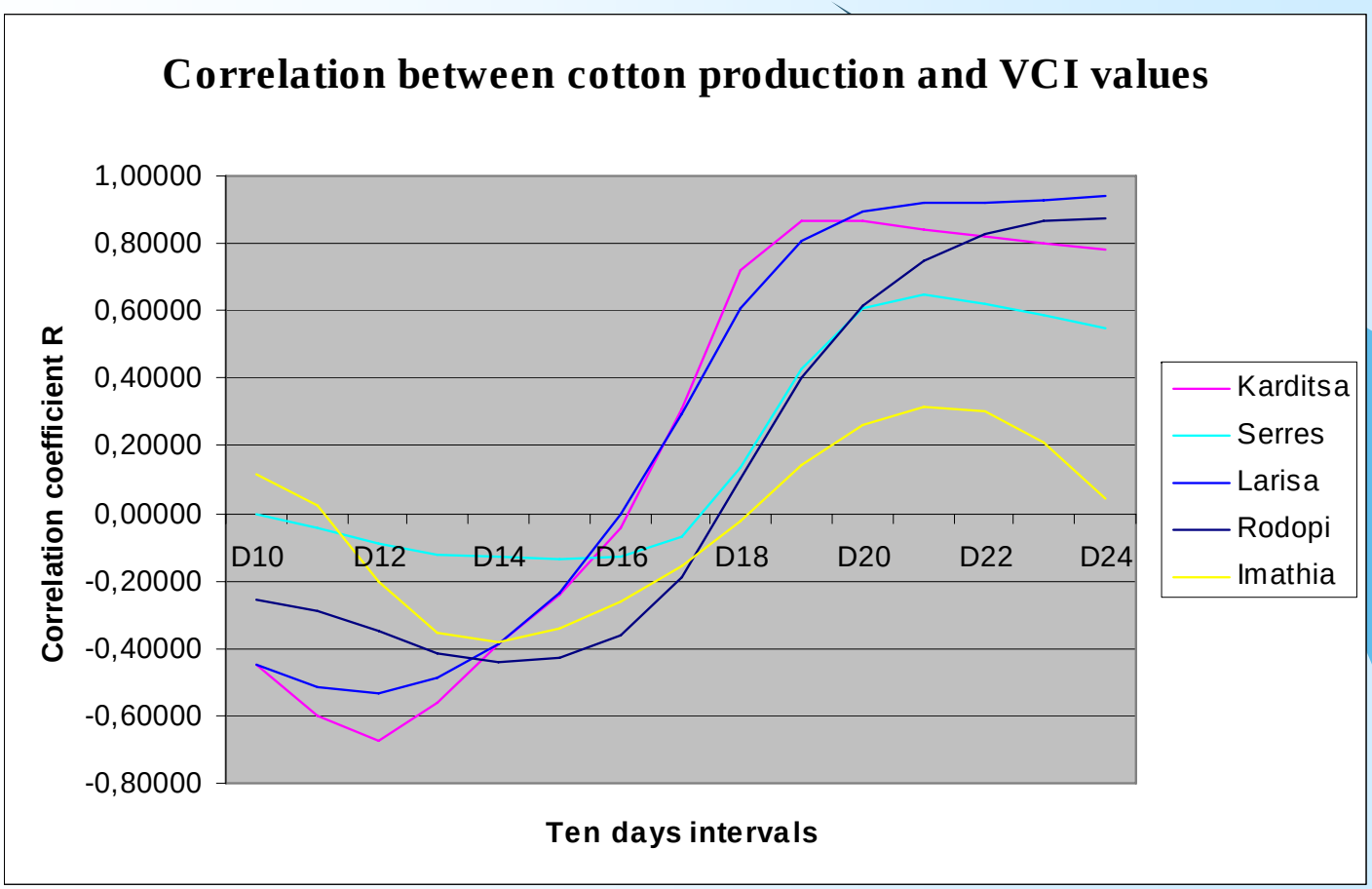




VCI values for Central and Northern Greece



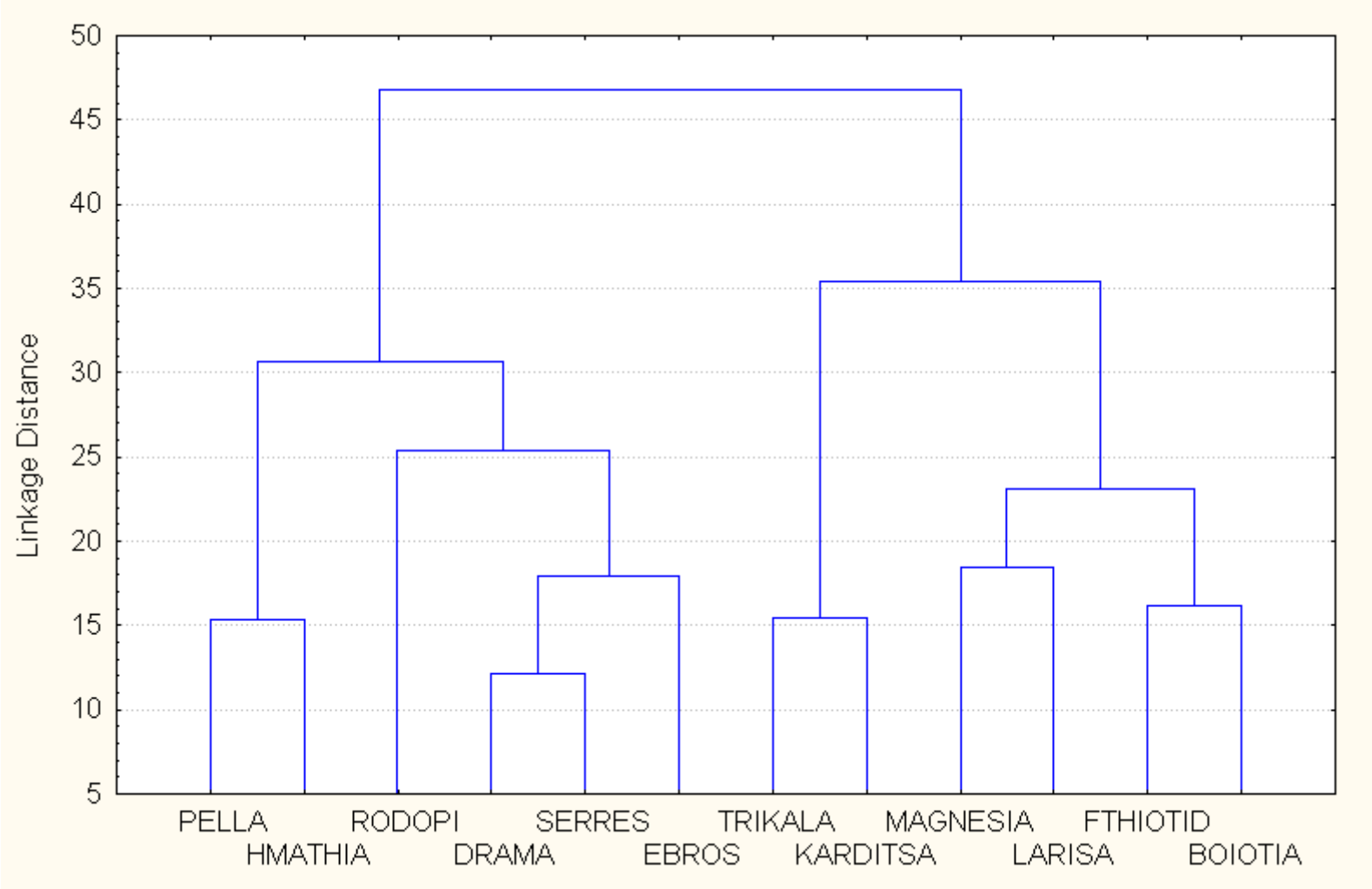
Correlation per prefecture between VCI values and cotton production



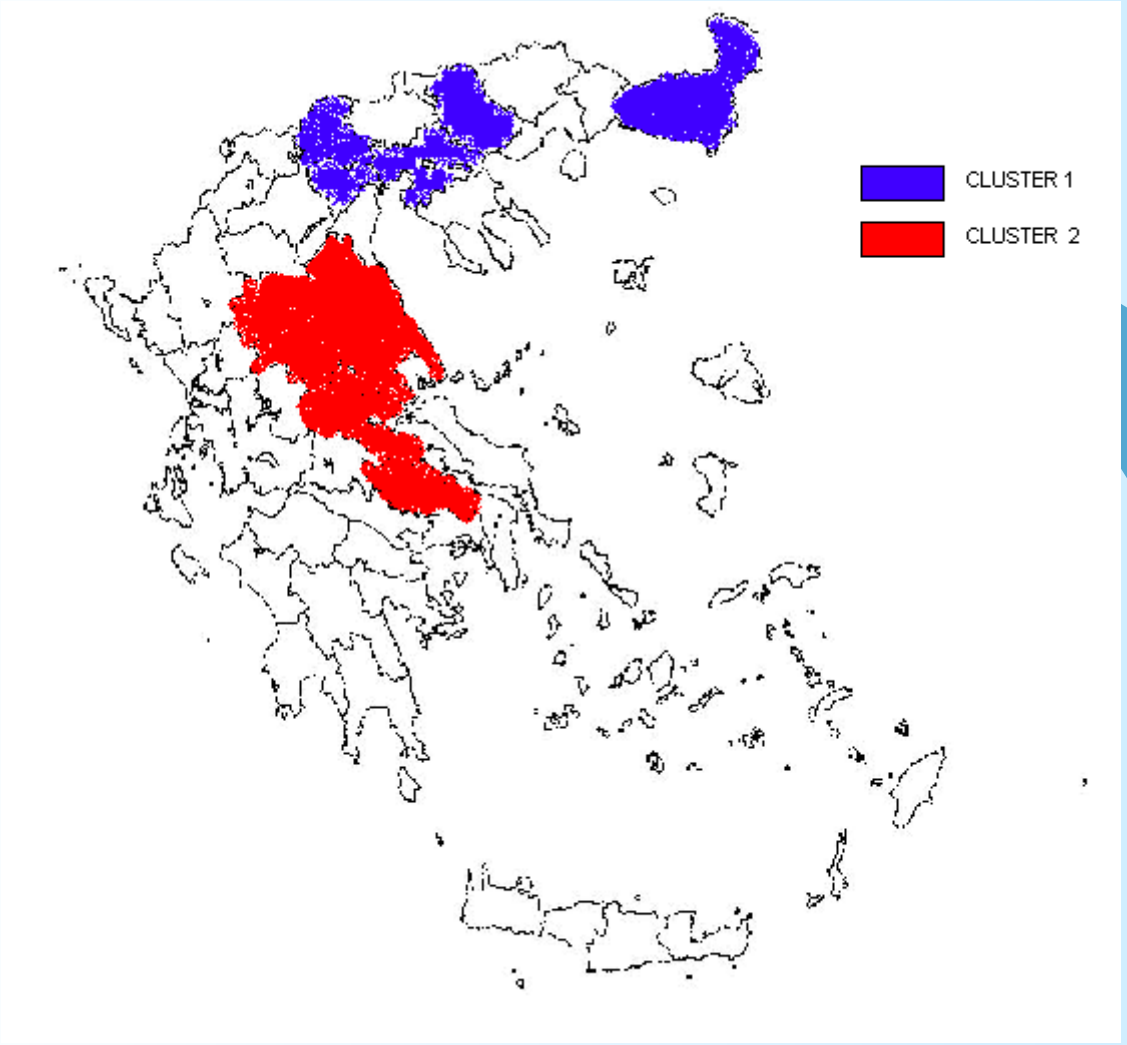
Correlation between VCI values and cotton production

Maximum correlation between VCI values and production		
Prefecture	Correlation Coefficient (R)	Decadal of appearance
Larisa	0.95	August 3rd
Magnesia	0.83	August 2nd
Karditsa	0.87	July 1st
Trikala	0.69	July 2nd
Viotia	0.82	August 1st
Fthiotida	0.77	August 3rd
Imathia	0.62	August 1st
Pella	0.81	August 1st
Serres	0.65	August 1st
Drama	0.57	June 1st
Rodopi	0.87	August 2nd
Evros	0.76	August 2nd

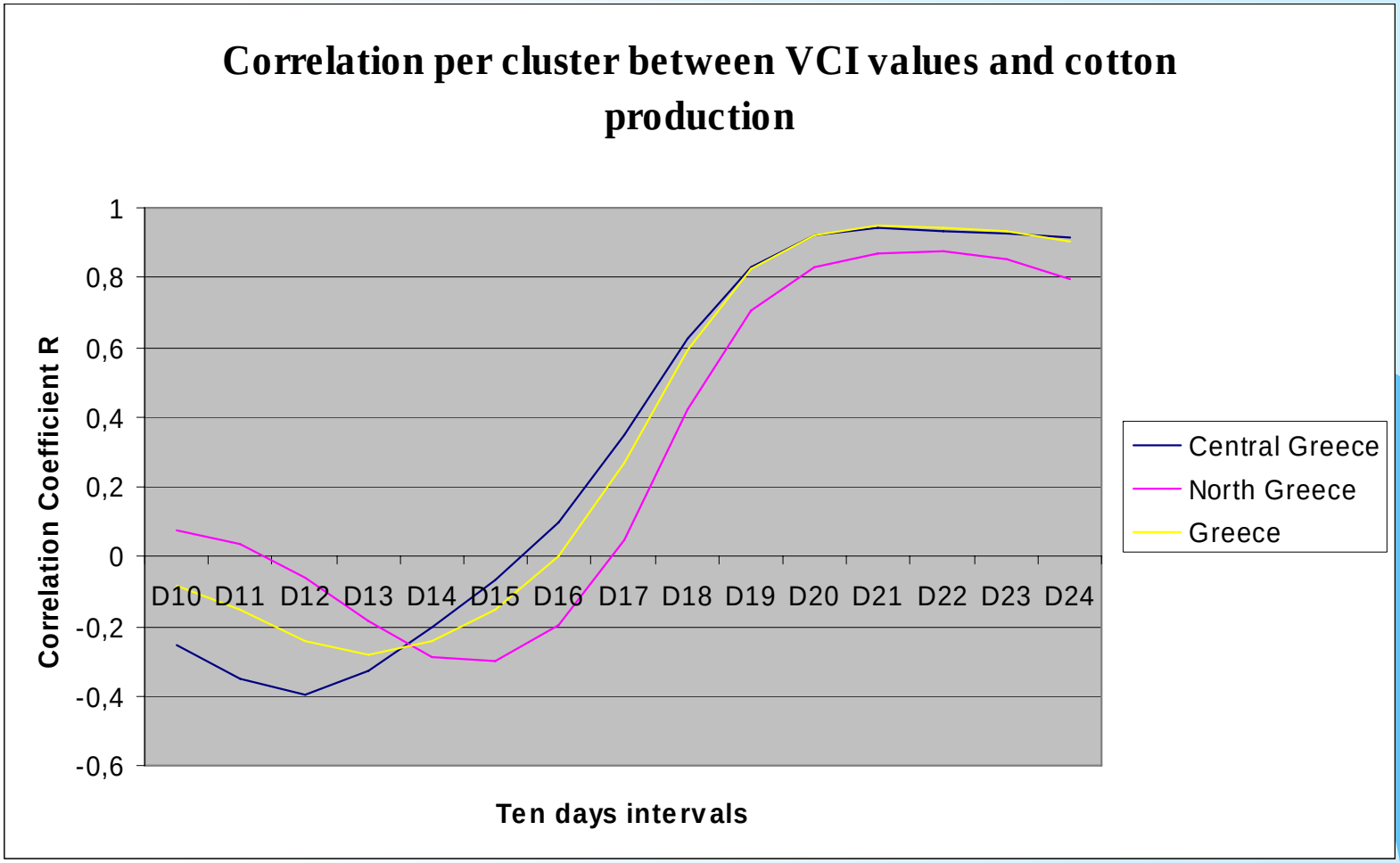
Step 3: Cluster Analysis

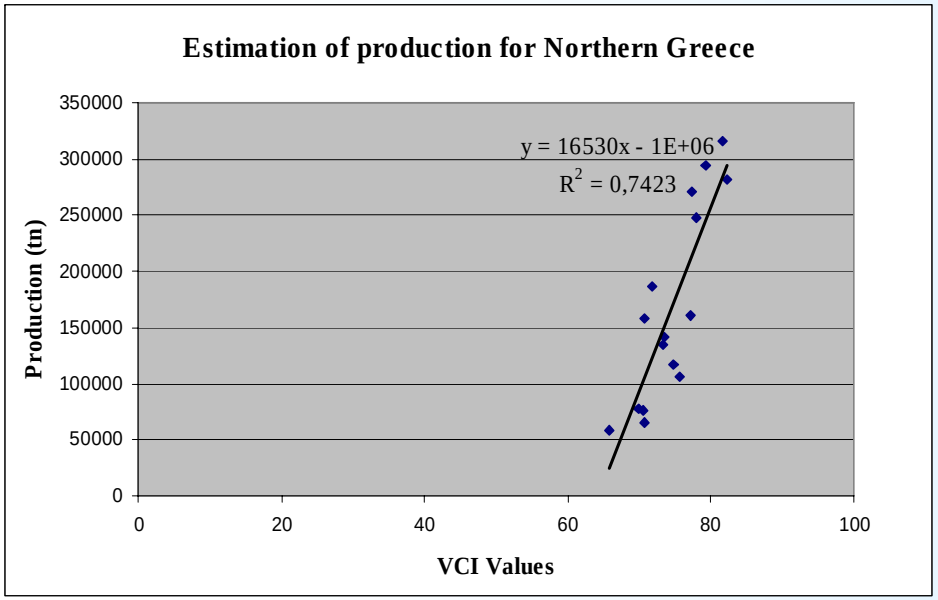


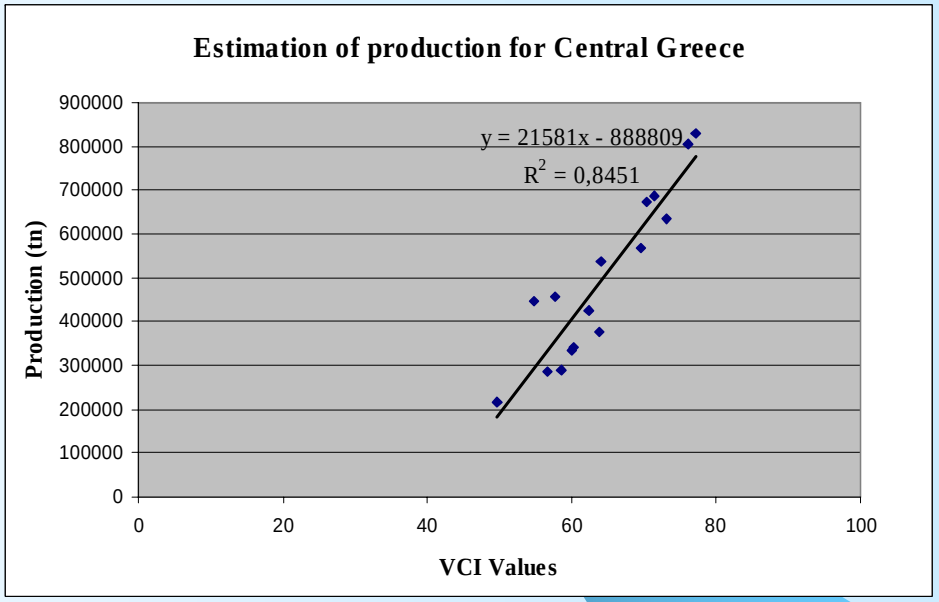
Geographical distribution of the clusters

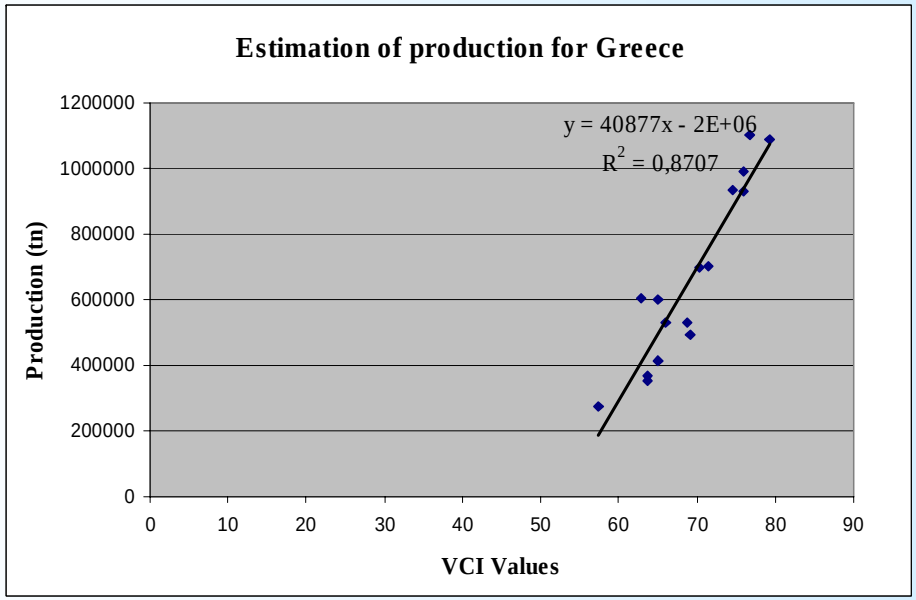


Correlation per cluster between VCI values and cotton production




Estimation of production for Northern Greece
y = 16530x - 1E+06
R2 = 0,7423
Production (tn)
VCI Values
0
50000
100000
150000
200000
250000
300000
350000
0
20
40
60
80
100


Estimation of production for Central Greece
y = 21581x - 888809
R2 = 0,8451
Production (tn)
VCI Values
0
100000
200000
300000
400000
500000
600000
700000
800000
900000
0
20
40
60
80
100


Estimation of production for Greece
y = 40877x - 2E+06
R2 = 0,8707
Production (tn)
VCI Values
0
200000
400000
600000
800000
1000000
1200000
0
10
20
30
40
50
60
70
80
90

Step 4: Production assessment per cluster

Equations of estimation:

Northern Greece: Cotton production(tn) = 16530x - 1E+06 (R^2 = 0,75)
Central Greece: Cotton production(tn) = 21581x - 888809 (R^2 = 0,85)
Greece: Cotton production(tn) = 40877x - 2E+06 (R^2 = 0,87)

Production Prediction for North and Central Greece for the year **1998**			
Zone	Production (tn)	Predicted production(tn)	Percentage departure
Central	722370	689512	4.5%
Northern	310738	375549	20%
Greece	1033108	1195560	15%

Production Prediction for North and Central Greece for the year **1999**			
Zone	Production (tn)	Predicted production(tn)	Percentage departure
Central	733862	693145	5.5%
Northern	458875	370158	19%
Greece	1192737	1192335	0.03%

CONCLUSIONS

- VCI has the advantage to isolate ground from weather depended conditions
- at the prefecture level VCI does not provide consistent cotton production assessment
- clustering can identify similarities in VCI evolution during the growing season and can be used for zoning areas of cotton production
- VCI can be proved a useful tool for monitoring and forecasting the cotton production (when applied to the growing season) at regional level