



KAPÉ
CRES

Centre for Renewable Energy Sources

CRES' Experience in Renewable Energy Assessment

P. Chaviaropoulos & K. Tigas



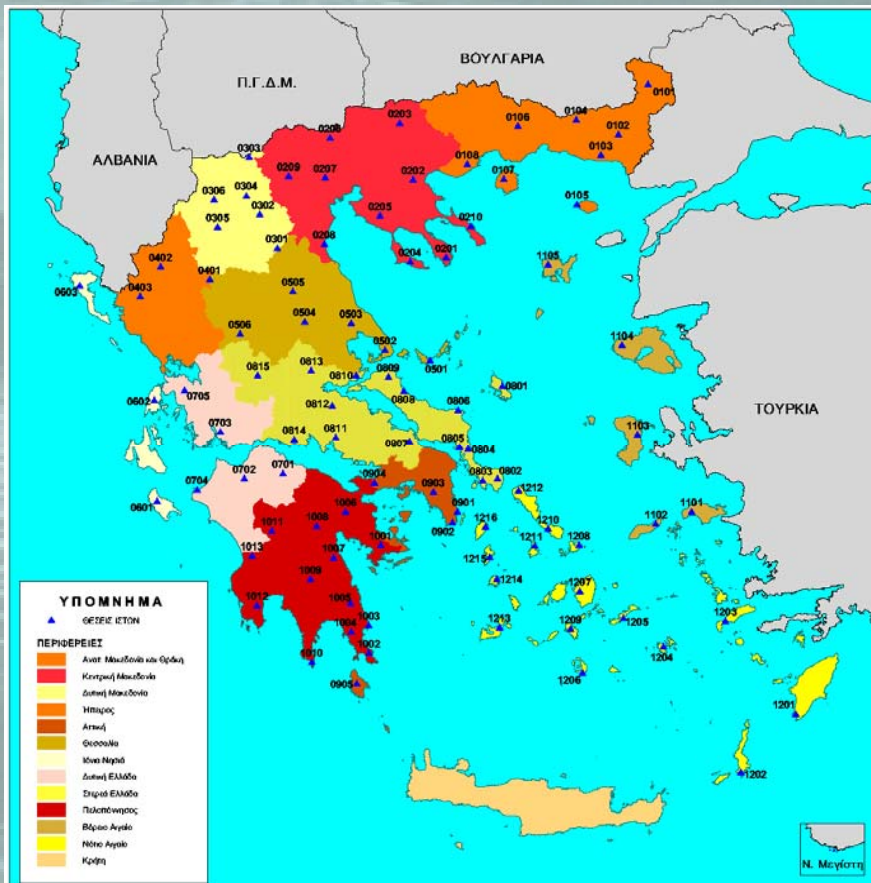
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Wind Energy

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BUILDING THE GREEK WIND ATLAS

One year measurements with 95 met-masts (1999-2000)



Regions	Met-Masts
Ανατολικής Μακεδονίας & Θράκης	8
Κεντρικής Μακεδονίας	10
Δυτικής Μακεδονίας	6
Ηπείρου	3
Θεσσαλίας	6
Ιονίων Νήσων	3
Δυτικής Ελλάδας	5
Στερεάς Ελλάδας	15
Αττικής	5
Πελοποννήσου	13
Βορείου Αιγαίου	5
Νοτίου Αιγαίου	16

Instrumentation of a 10m met-mast



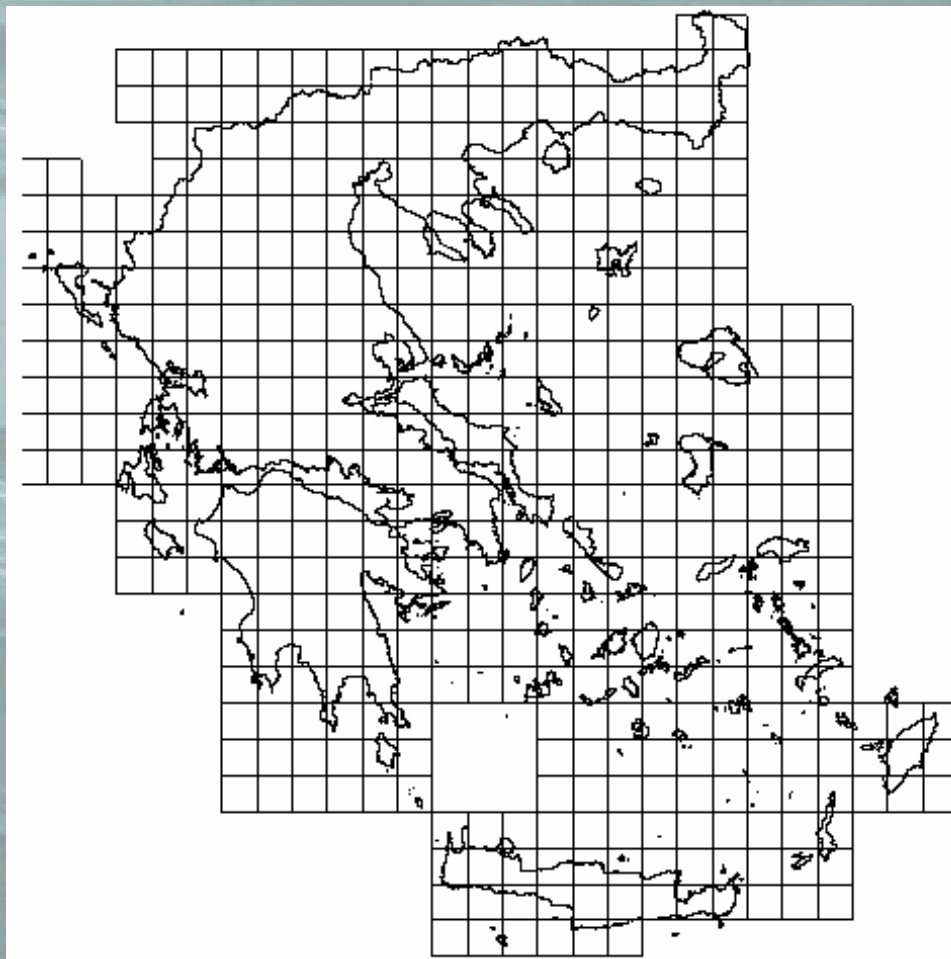
Τεχνικά χαρακτηριστικά ιστών	
Τύπος ιστού	Σωληνωτός
Ύψος ιστού	10m
Καταγραφικό	Stylitis
Ανεμόμετρα	NRG
Ανεμοδείκτες	NRG
Τροφοδοσία ιστού	Μπαταρία (9V)
Συλλογή δεδομένων	Επιτόπου επίσκεψη

Measuring higher today

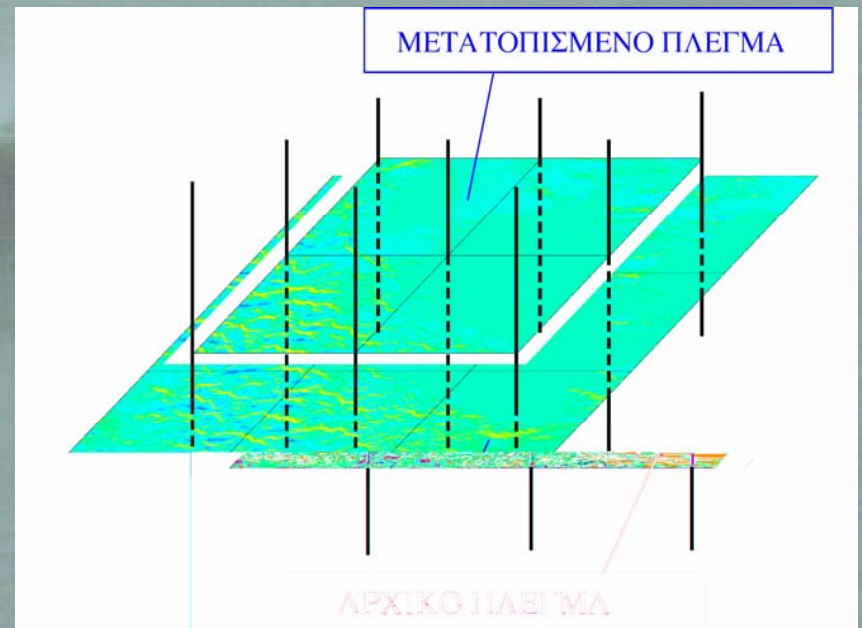
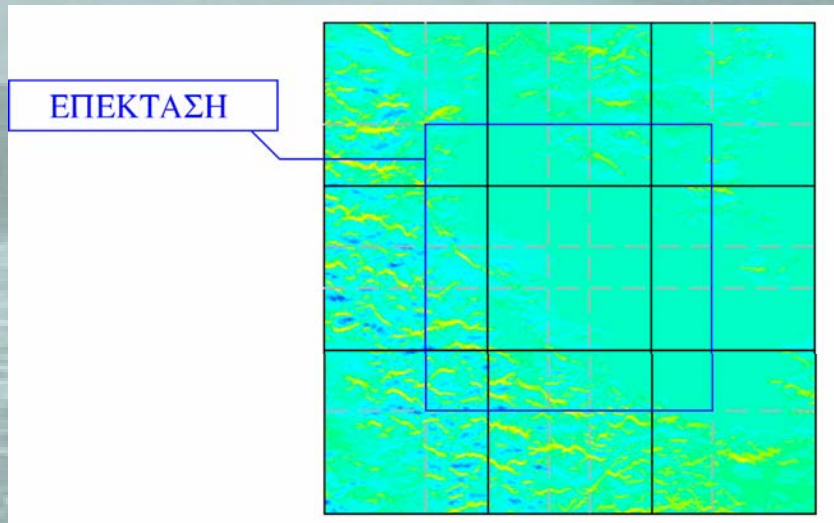


Τεχνικά χαρακτηριστικά ιστών	
Τύπος ιστού	Σωληνωτός
Ύψος ιστού	30m ή 45m
Καταγραφικό	Stylitis 40 ή 100
Ανεμόμετρα	Vector A100 (10/30/42.5/κ)
Ανεμοδείκτες	Vector W200P (10/30/42.5)
Τροφοδοσία ιστού	Φωτοβολταϊκή συστοιχία
Συλλογή δεδομένων	GSM-modem
Επιπλέον στους ιστούς έχουν τοποθετηθεί	
Θερμόμετρο	
Βαρόμετρο	
Αλεξικέραυνο	
Φανός αεροπλοΐας	

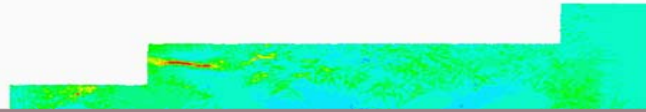
Multi-Block modeling approach



Staggering, grid resolution of 150 m

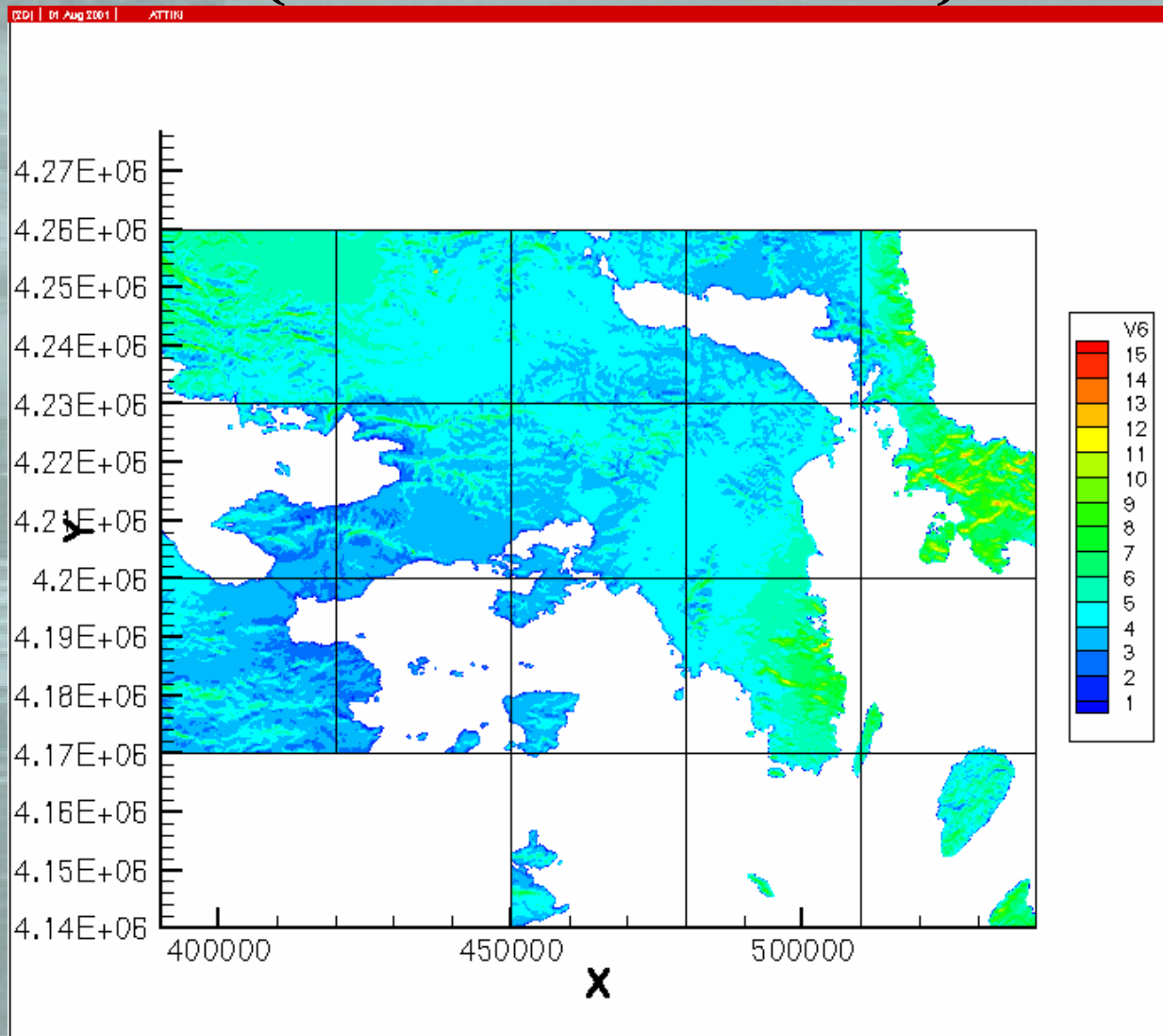


The Greek Wind Atlas



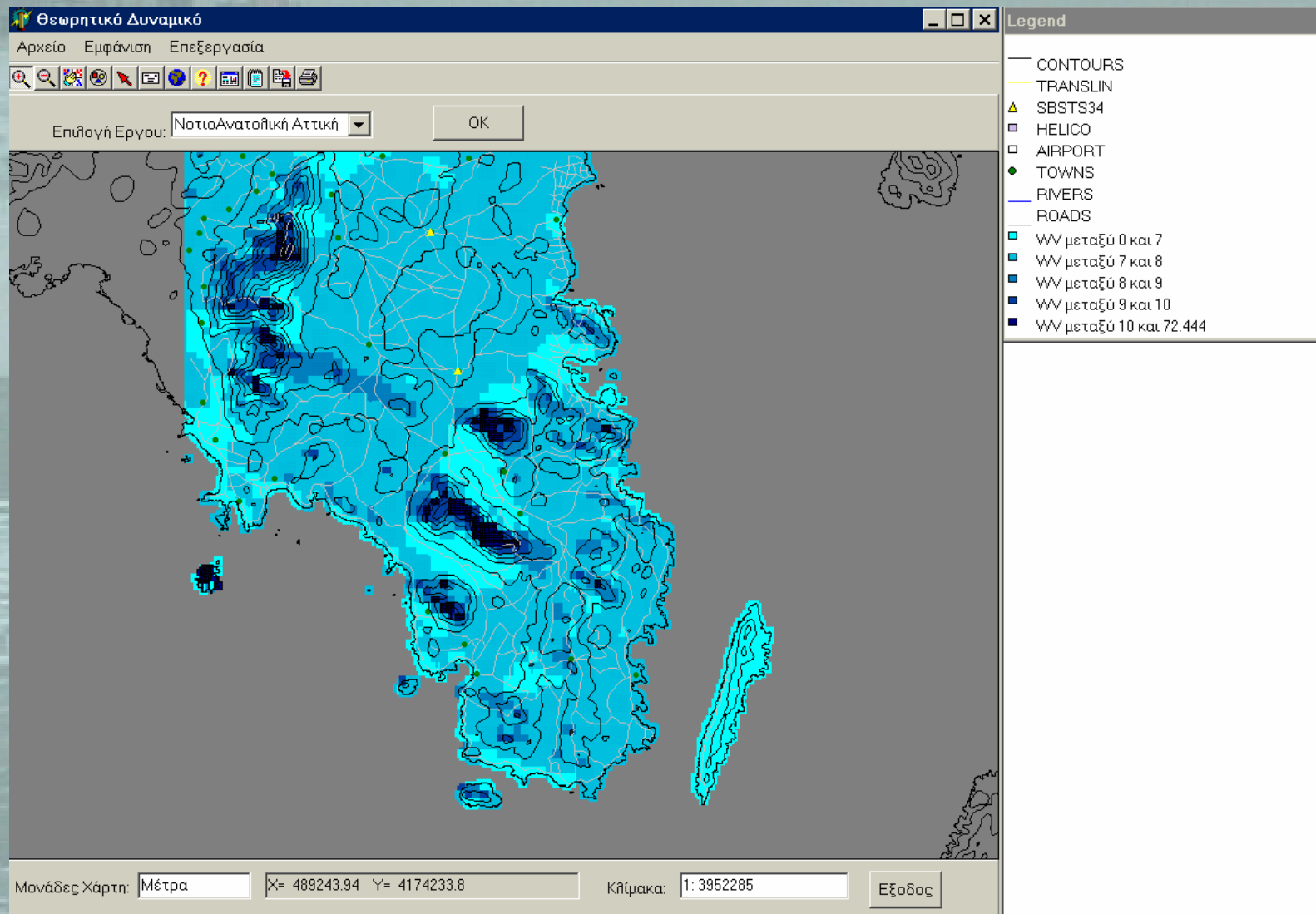
Wind Potential of Attika

(a detail of the Wind Atlas)

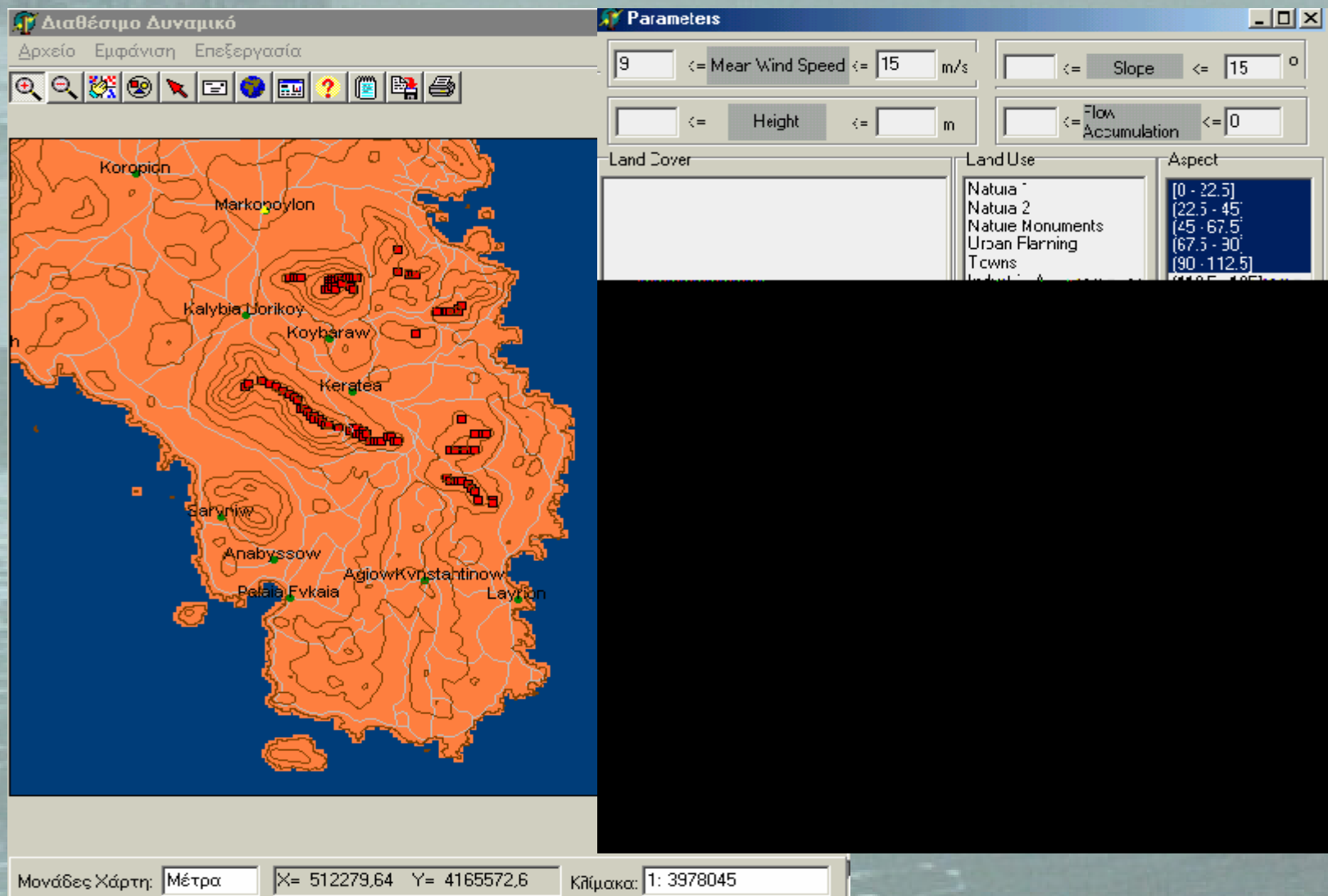


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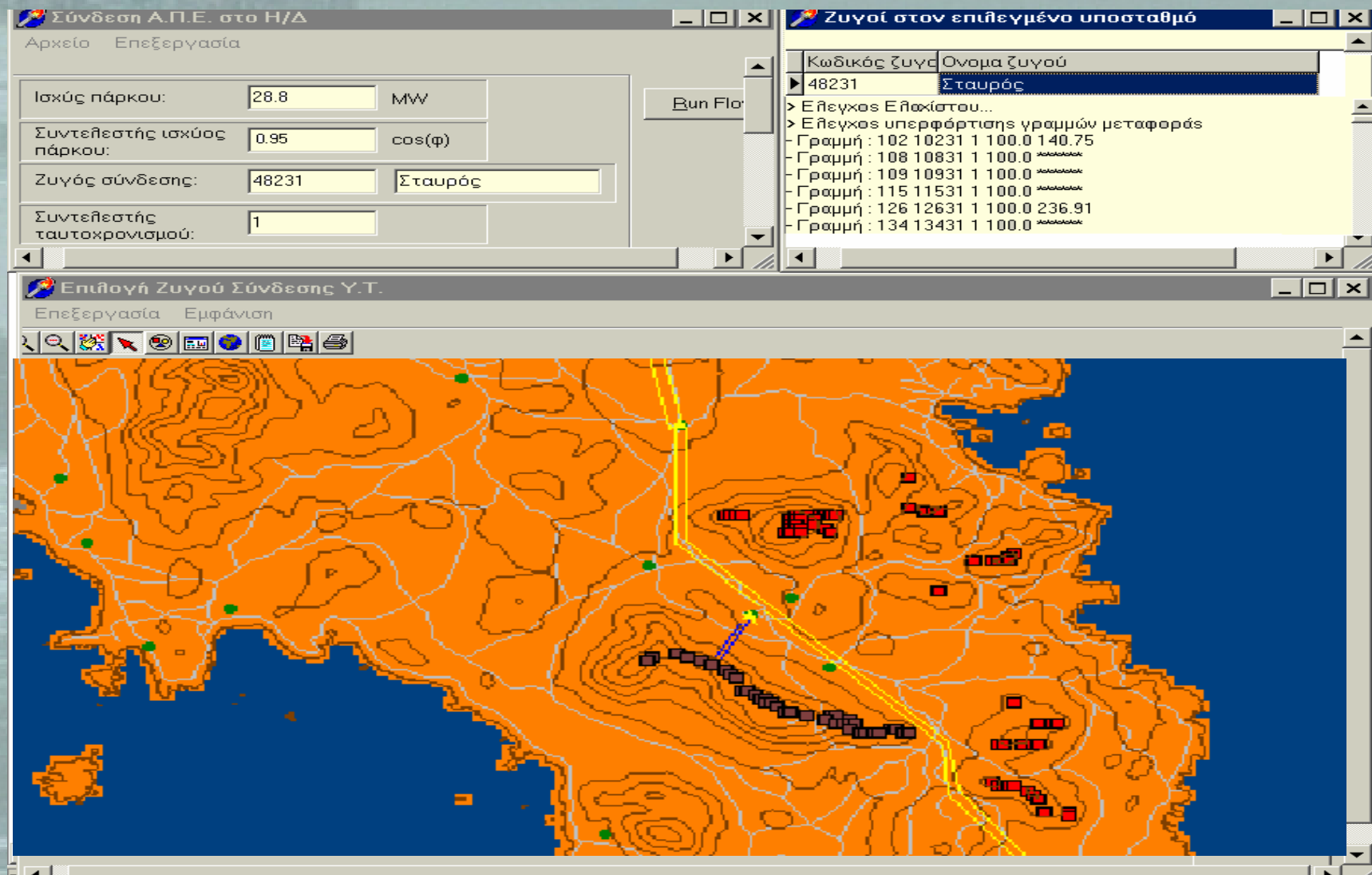
Wind Atlas into GIS



Estimation of available land for installations, interactive geographical analysis



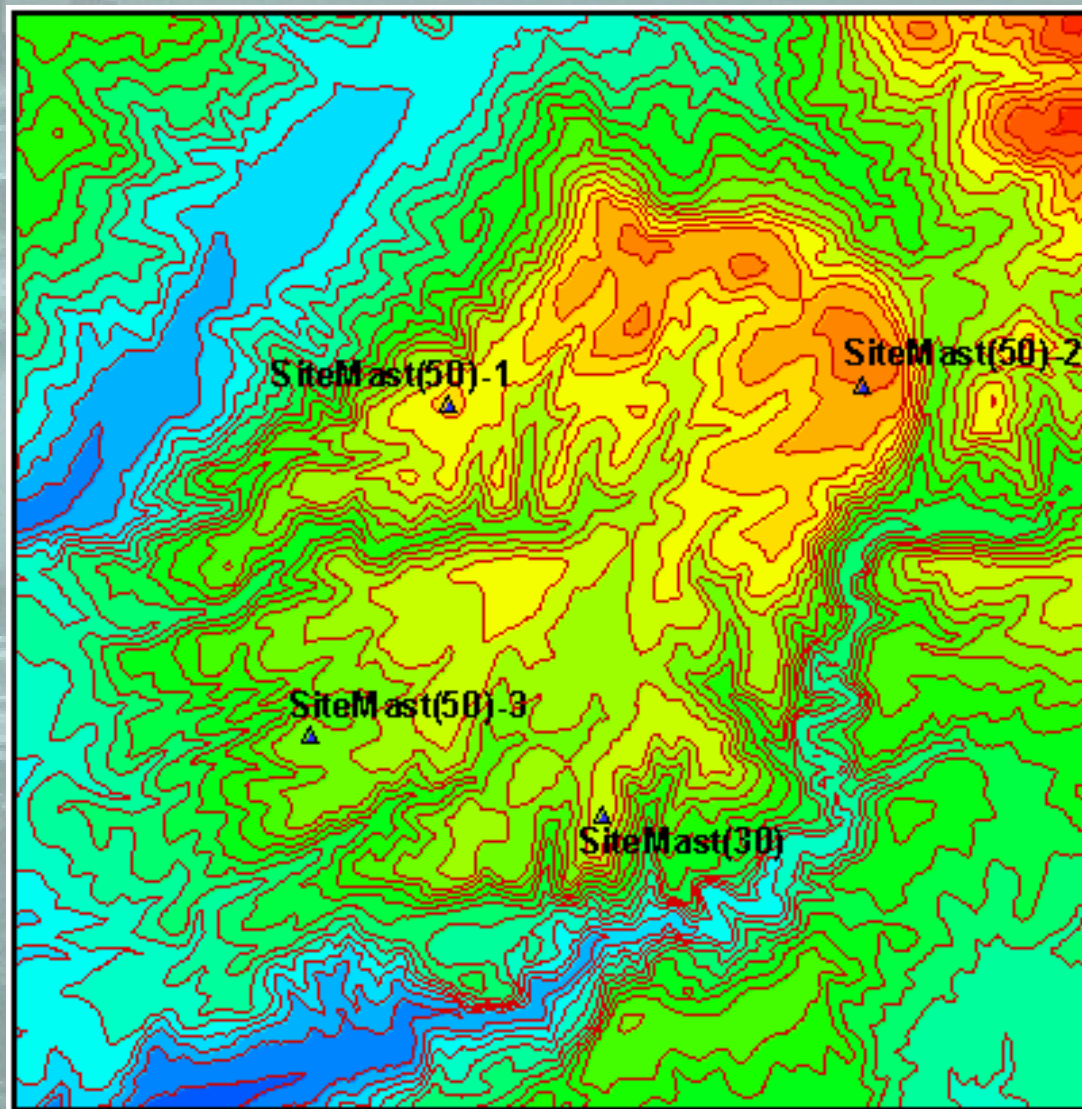
Estimation of grid connection parameters, communication with load flow analysis models



Detailed Wind Farm Design

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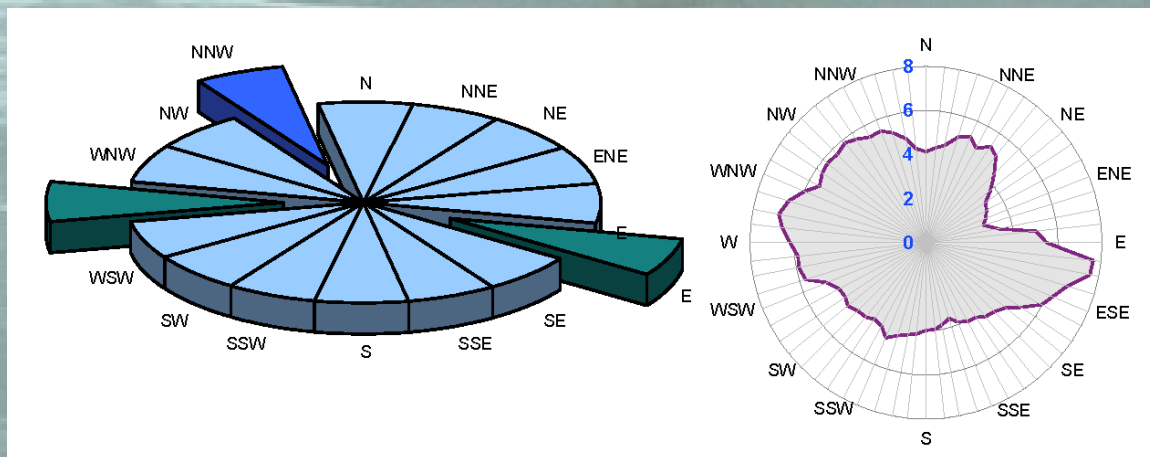
Additional masts inside the wind farm



Data acquisition and measurements analysis (WindRose@)

Mast	SiteMast(50)–1 at 50 m a. g. l.	
Measuring period	19/06/2005–31/03/2008	
Mean wind speed [m/s]	6.2	
Uncertainty of the wind speed mean value [%]	±2.42	
Total number of valid data	146 436	
Included number of calms (< 2 m/s) [%]	8.6	
Missing data [%]	3.0	
Weibull distribution constants		
Scale factor (C) [m/s]	6.9	
Shape factor (k)	1.85	
Best sector in time distribution	W	(12.62%)
Second best sector in time distribution	NNW	(12.27%)

Table 1. Summary of generated three year long SiteMast(50)–1 data at 50 m a. g. l.



Navier-Stokes modelling of the Wind Flow

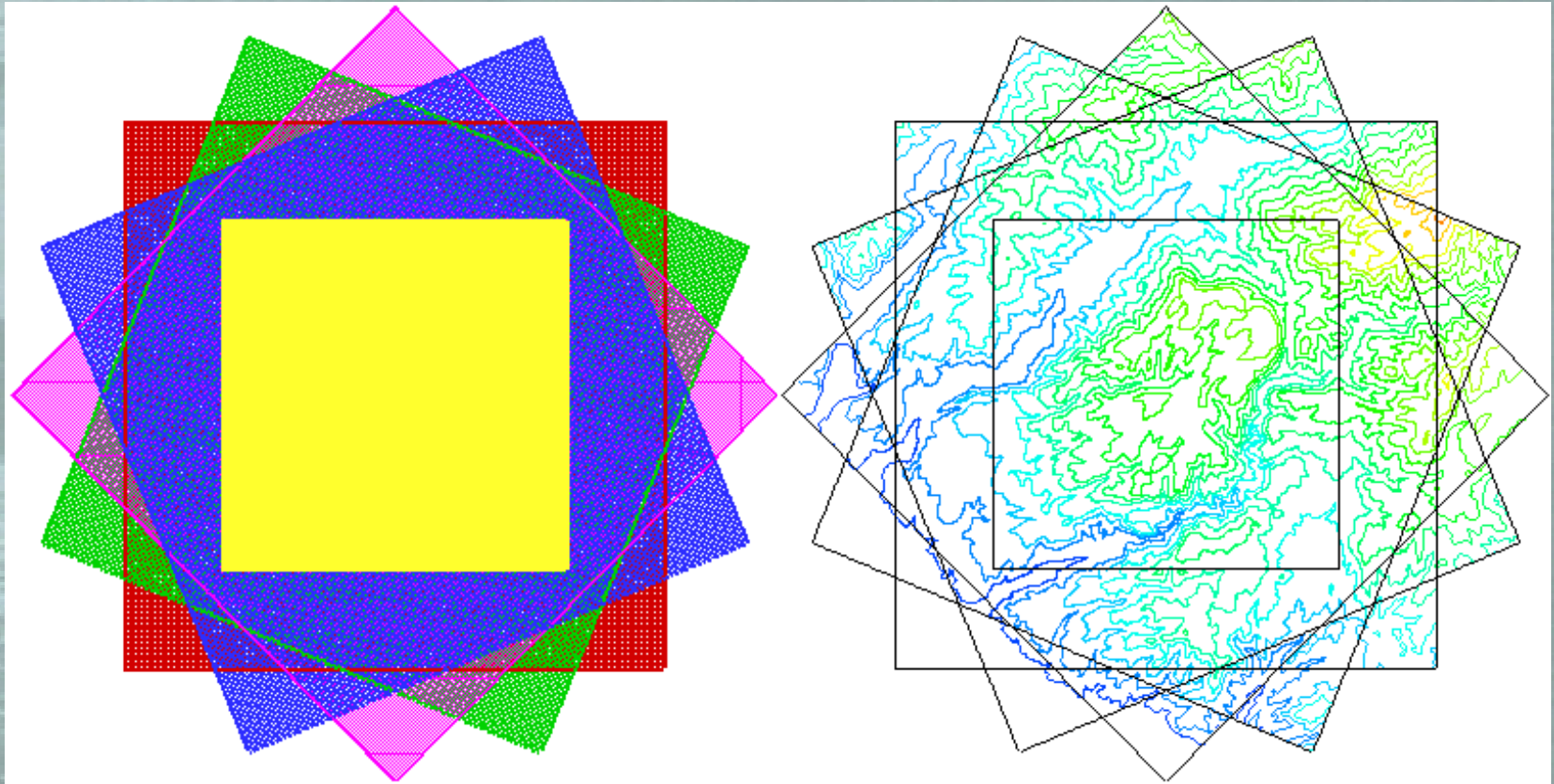
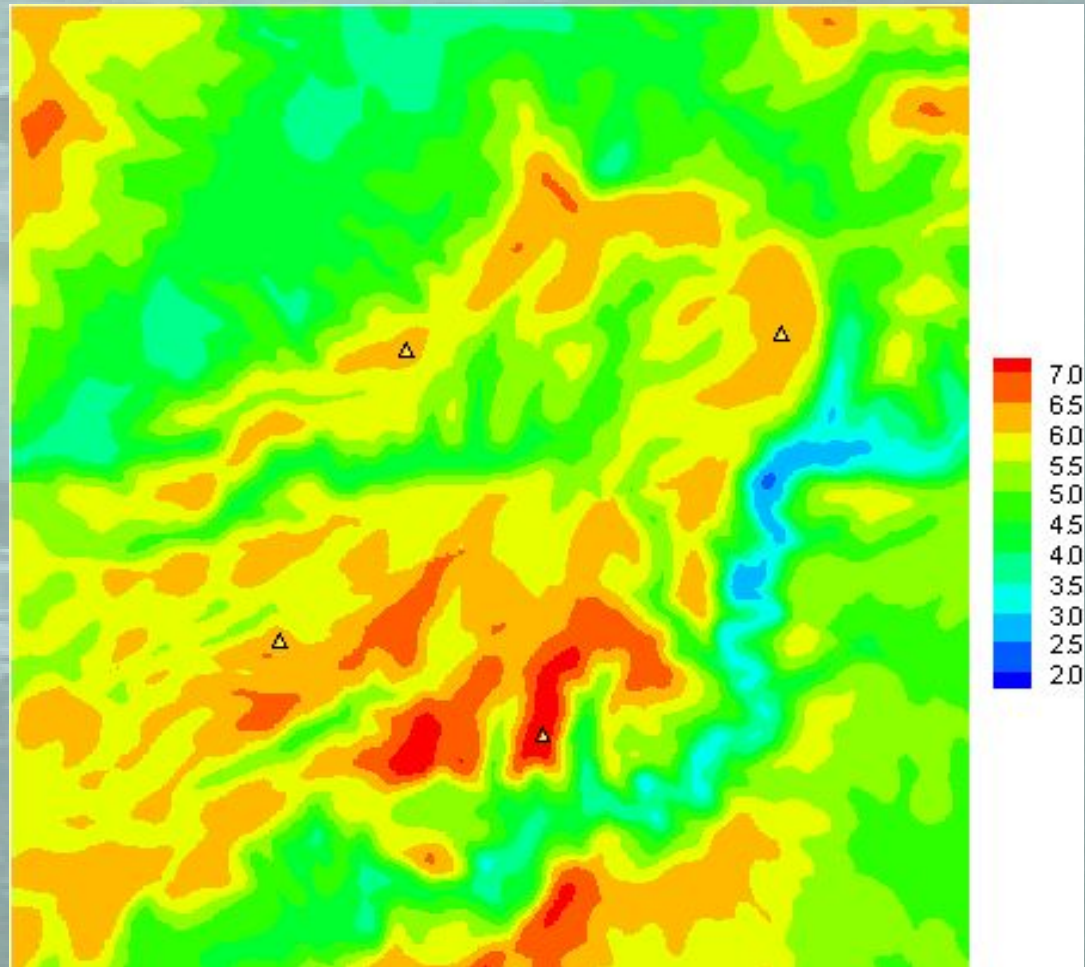
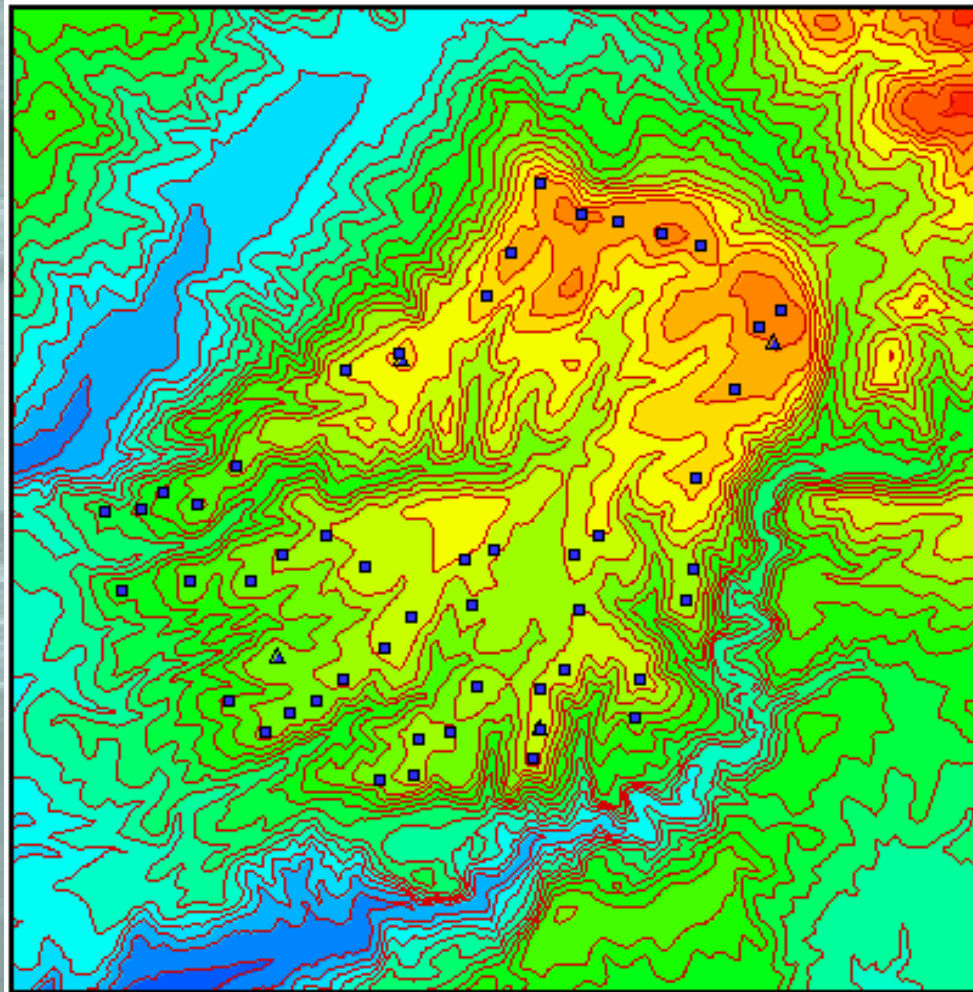


Figure 1. Left: Surface grids generated for wind potential assessment. Right: Terrain contours on individual grids

10-minute average annual wind speed at 80 m a. g. l.



Optimizing the Wind Farm Layout



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Classifying the Turbines

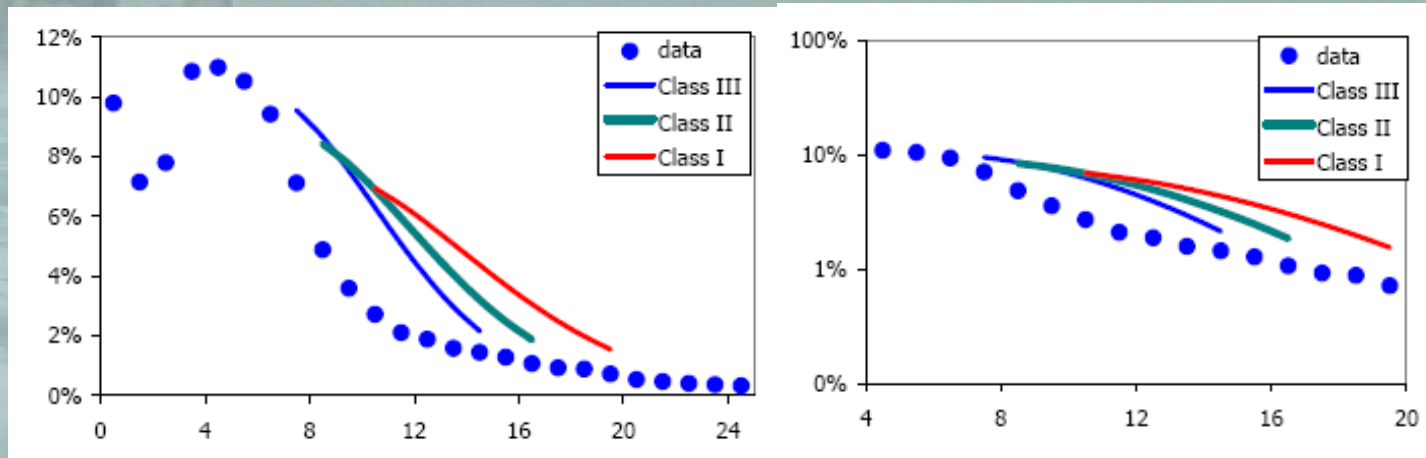
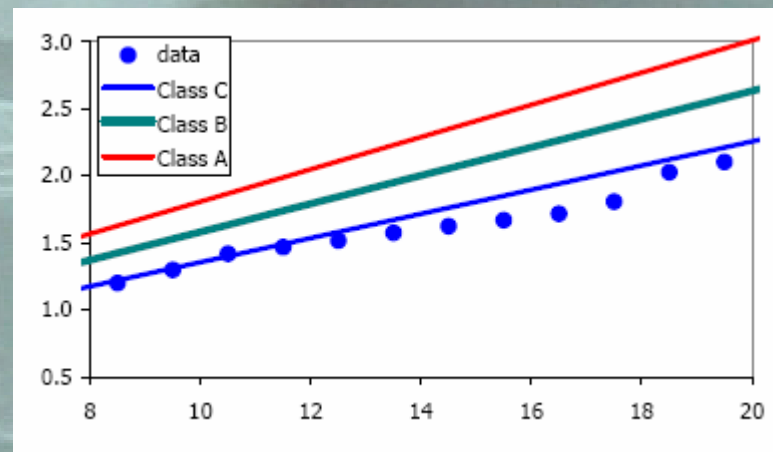


Figure 1. Probability density functions of V_{hub} compared to the design distributions for the three classes



Turbulence standard deviation distribution compared to the design distributions for the different turbulent subclasses

Biomass

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Analysis of theoretical and available potential. Available quantities of agricultural residues

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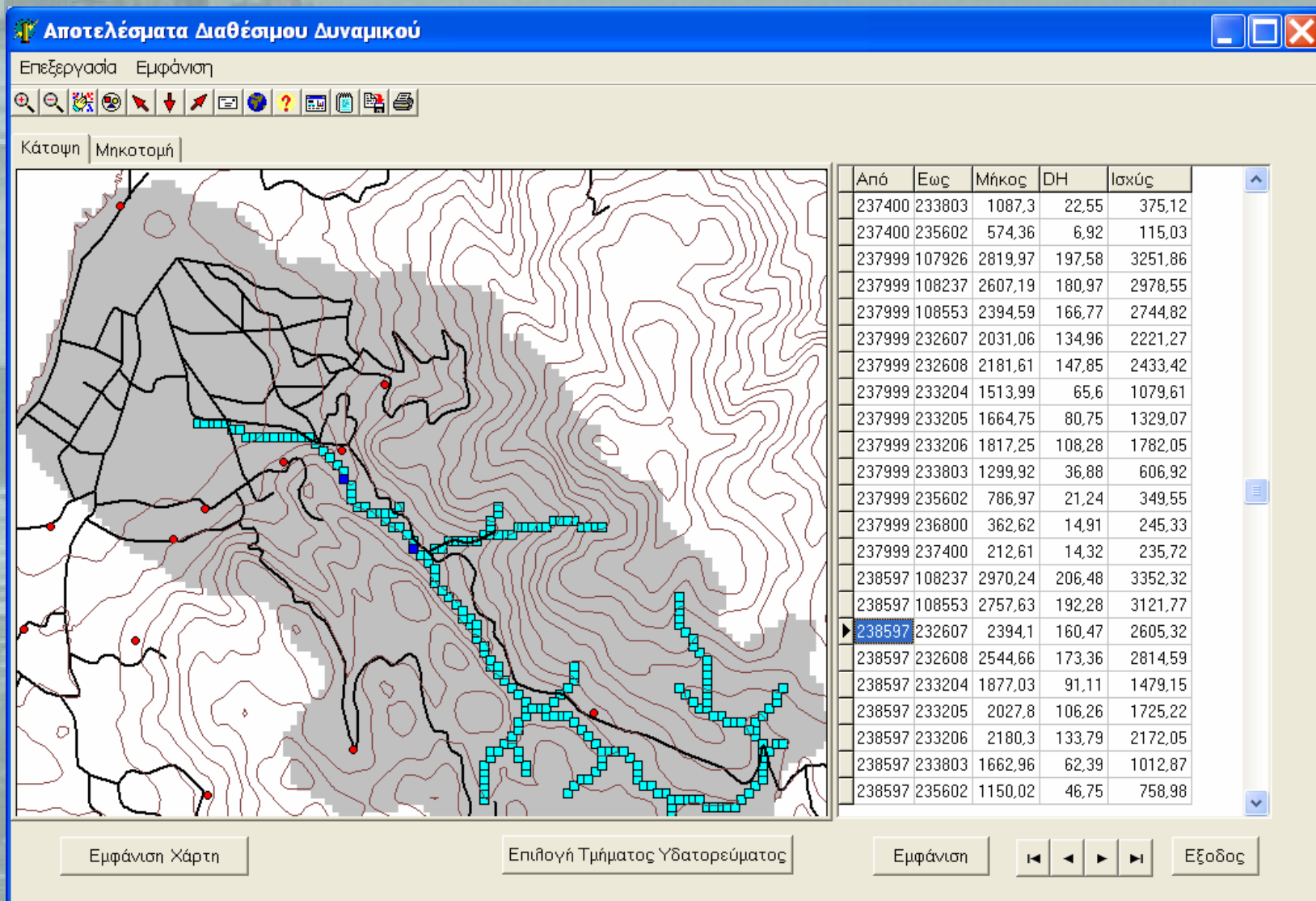
Estimation of optimal exploitation of local resources, communication with mathematical models

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Small Hydro

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Hydrological modeling to assess run off river projects feasibility



Analysis of project feasibility



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ΛΕΚΑΝΗ ΑΠΟΡΡΟΗΣ ΚΑΤΩ ΓΛΑΥΚΟΥ

Χάρτης ενδεικνυμένων περιοχών για εγκατάσταση μικρών υδροηλεκτρικών έργων



Solar Energy

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Analysis of theoretical potential, solar maps



Suggestions for regional RES development, formulation of local *‘action plans’*

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