



COST ACTION FP 0703

**Echoes: Expected Climate cHange
and Options for European Silviculture**

Country Report: Major points

CROATIA

22-24 January 2009, Florence - Italy

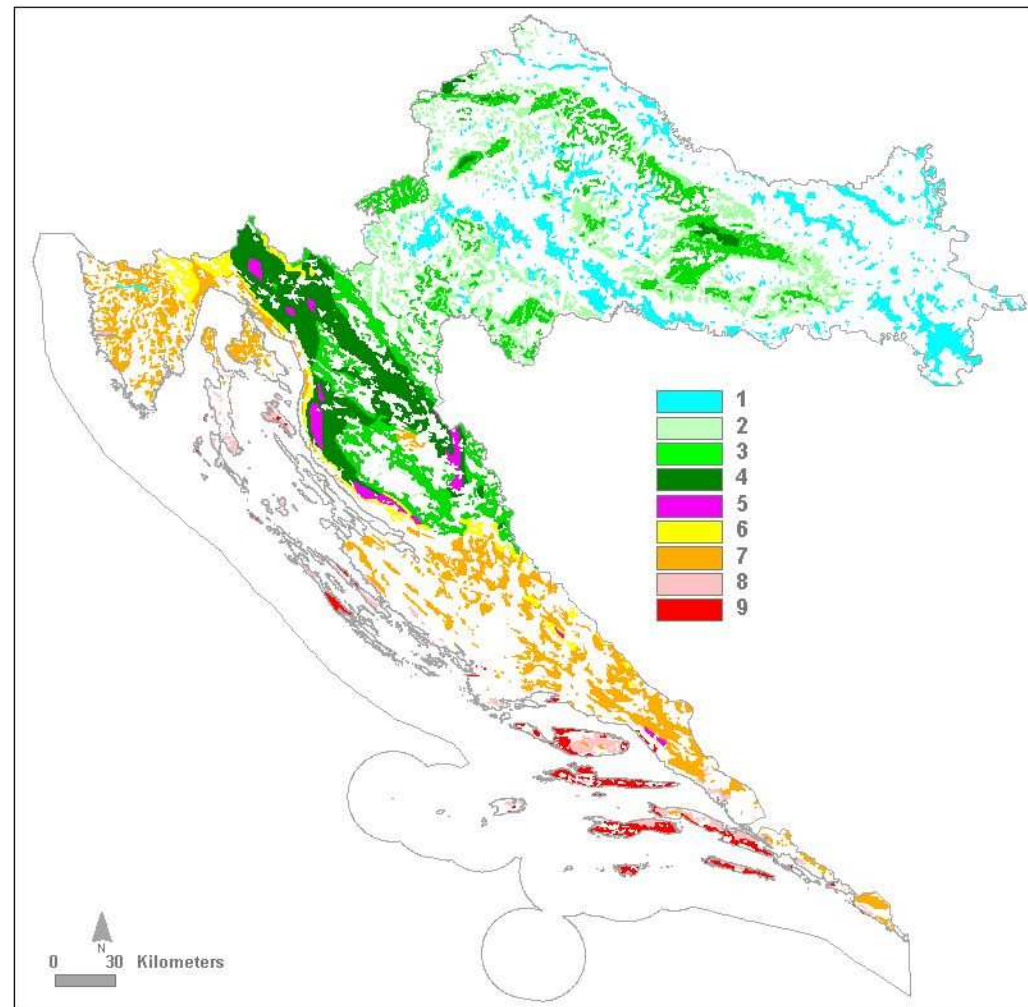
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The distribution of main forest species

- 1) *Quercus robur* L.
- 2) *Quercus petraea* Liebl.,
- 3) *Fagus sylvatica* L.
- 4) *Abies alba* L. & *Fagus sylvatica* L.),
- 5) *Fagus sylvatica* L. & *Pinus mugo* Turra
- 6) *Fagus sylvatica* L.
- 7) *Quercus pubescens* Willd.
- 8) *Quercus ilex* L.
- 9) *Pinus halepensis* Mill.

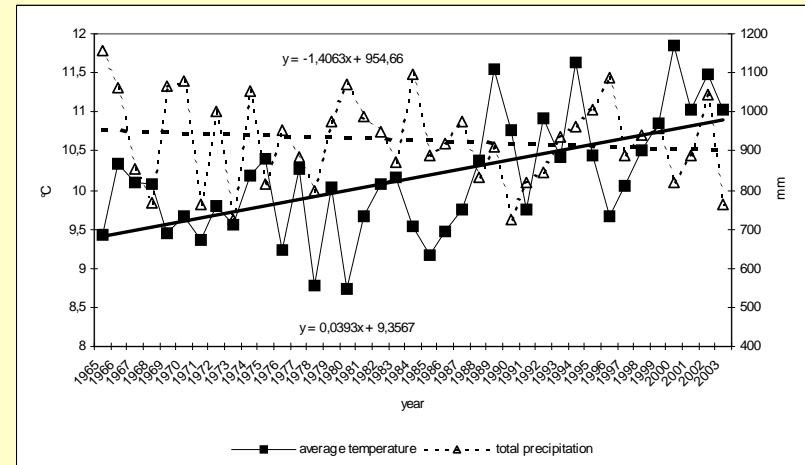


Climate trends

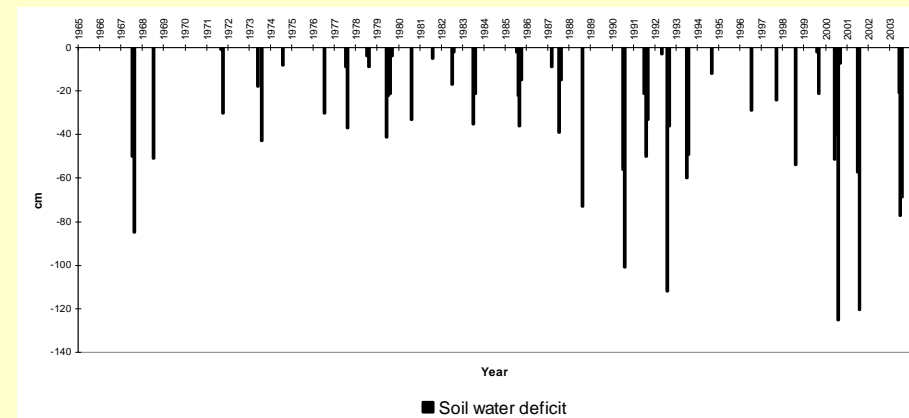
Eastern Croatia, Osijek 1900-1995



Western Croatia, Jastrebarsko 1965-2003



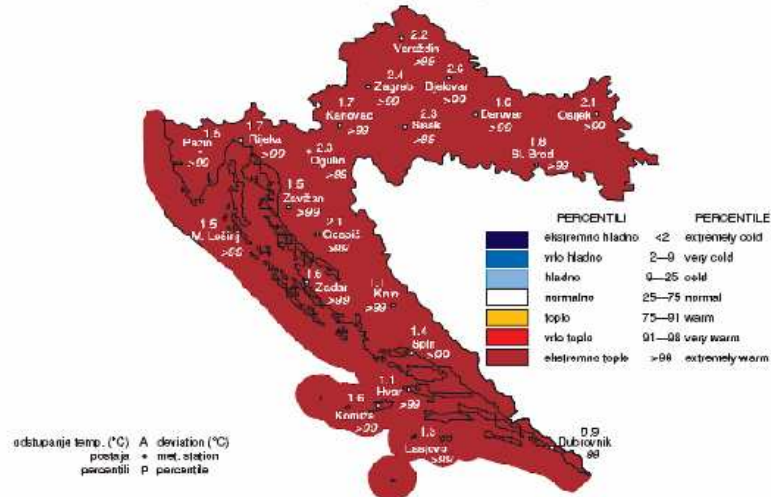
Soil water deficit



•Dry spells in 2000 and 2003 (www.meteo.hr)

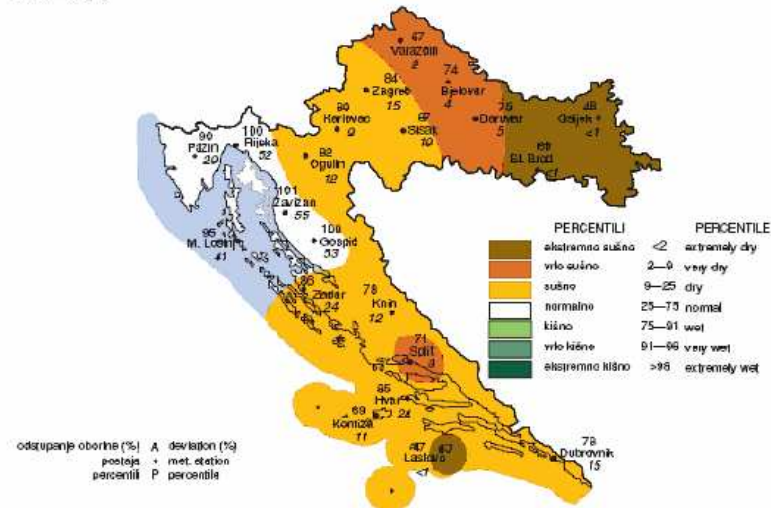
Odstupanje srednje godišnje temperature zraka (°C) za 2000. godinu od prosječnih vrijednosti (1961—1990).

Yearly air temperature anomalies in Croatia for year 2000, from normals 1961—1990.



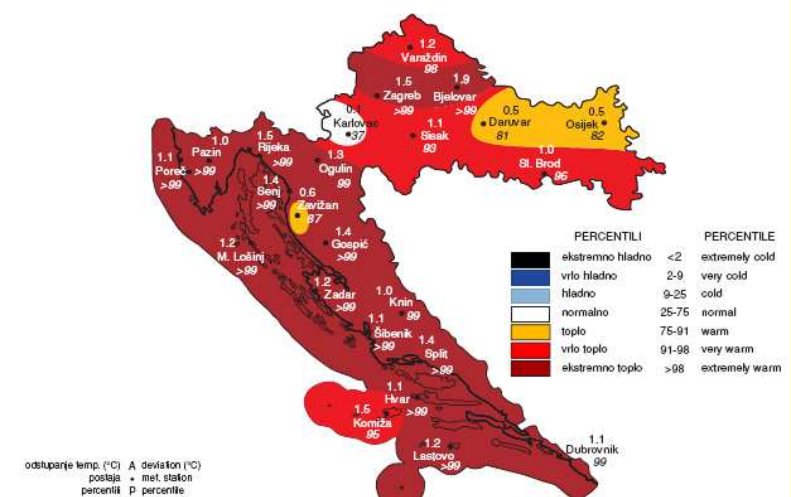
Godišnje količine oborine (%) za 2000. godinu izražene u % prosječnih vrijednosti (1961—1990).

Yearly precipitation amounts of Croatia for 2000 year, expressed as percentage of normals 1961—1990.



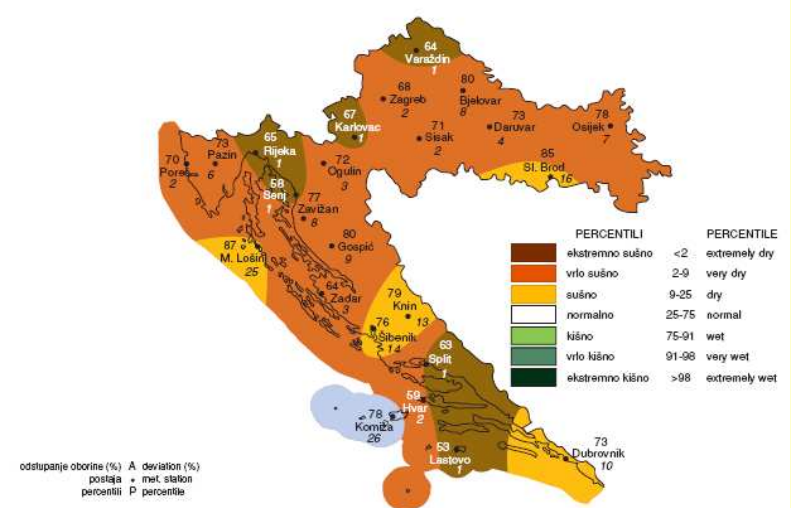
Odstupanje srednje godišnje temperature zraka (°C) za 2003. godinu od prosječnih vrijednosti (1961—1990).

Yearly air temperature anomalies in Croatia for year 2003, from normals 1961—1990.



Godišnje količine oborine za 2003. godinu u odnosu na prosječne vrijednosti (1961—1990), izražene u (%).

Yearly precipitation amounts of Croatia for 2003 year, expressed as percentage of normals 1961—1990.



WG1, WG2

- Droughts (watertable decrease in lowlands i.e Quercus robur forests)
- Quercus robur - the most economic species in Croatia)!!!

TOOLS:

- Groundwater monitoring network
- ICP forest Level 1 and 2
- Permanent provenance trials (phenology)
- Carbon fluxes measurements



*Carpino betuli-Quercetum
roboris*

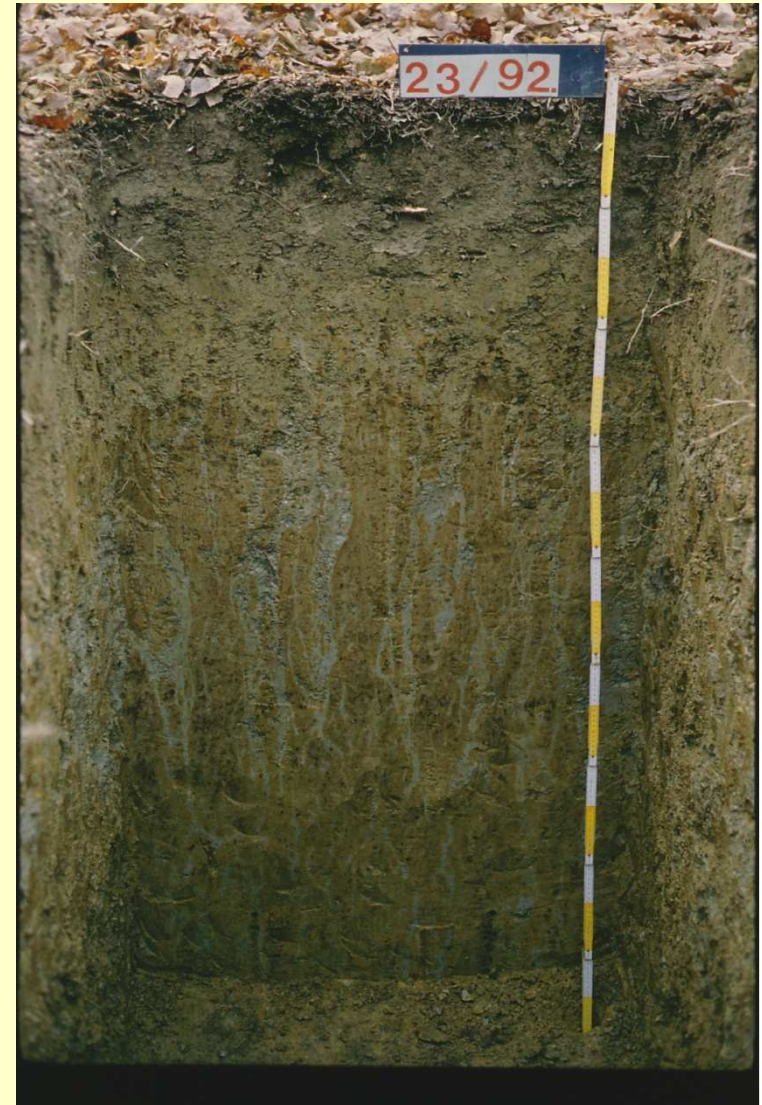
Pseudogley

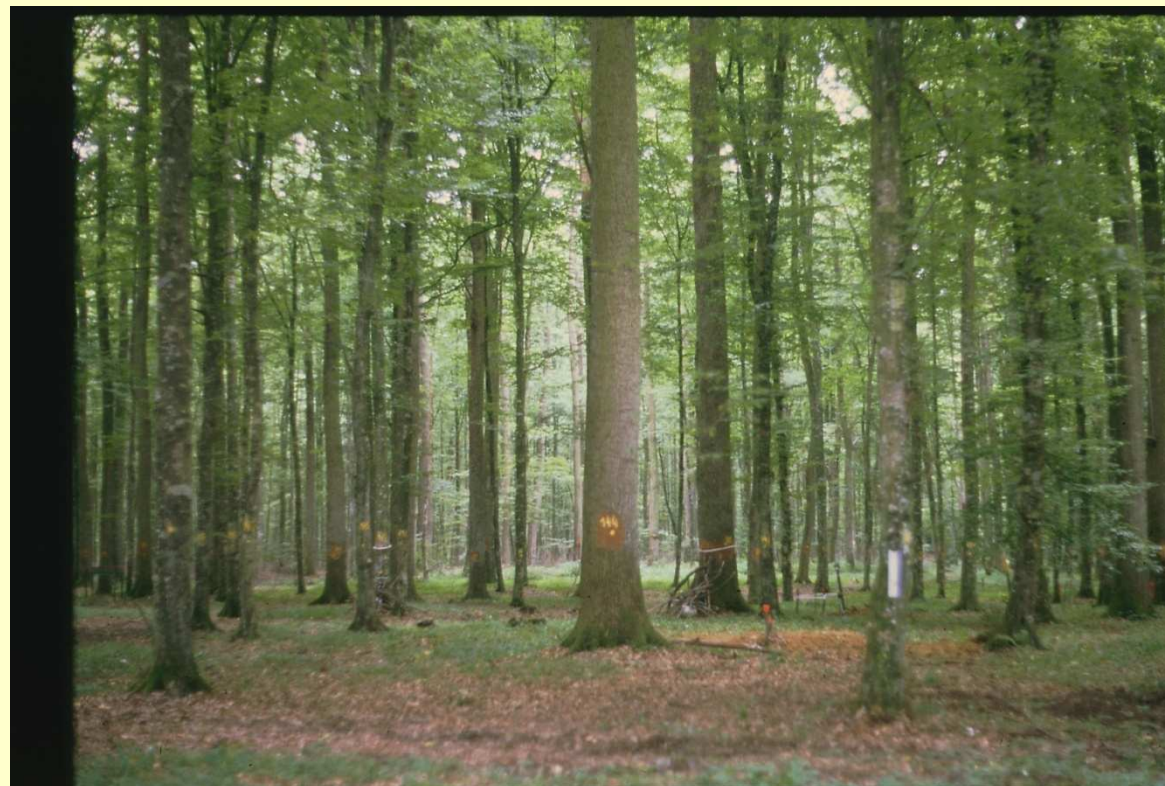
(Pseudoglej, na zaravni)

cutanic, gleyic, stagnic

ALBELUVISOL,

dystric, clayic





*Carpino betuli-Quercetum
roboris*

Pseudoglej
(Pseudoglej na zaravni)

luvic, lixic
PLANOSOL,
albic, dystic





*Genisto elatae-Quercetum
roboris*

Humogley
(Ritska crnica)

histic, mollic
GLEYSOL,
humic, eutric





*Genisto elatae-Quercetum
roboris*

Eugley

(Močvarno glejno,
amfiglej)

**folic,
GLEYSOL,
clayic**





*Frangulo alnetum-
glutinosae*

Eugley
(Močvarno glejno,
amfiglej)

mollic
GLEYSOL
vertic, stagnic





*Frangulo alnetum-
glutinosae*

Eugley

(Močvarno glejno,
amfiglej)



mollic
GLEYSOL,
vertic, stagnic



Genisto elatae-Quercetum roboris

Eugley
(Močvarno glejno,
epiglej)

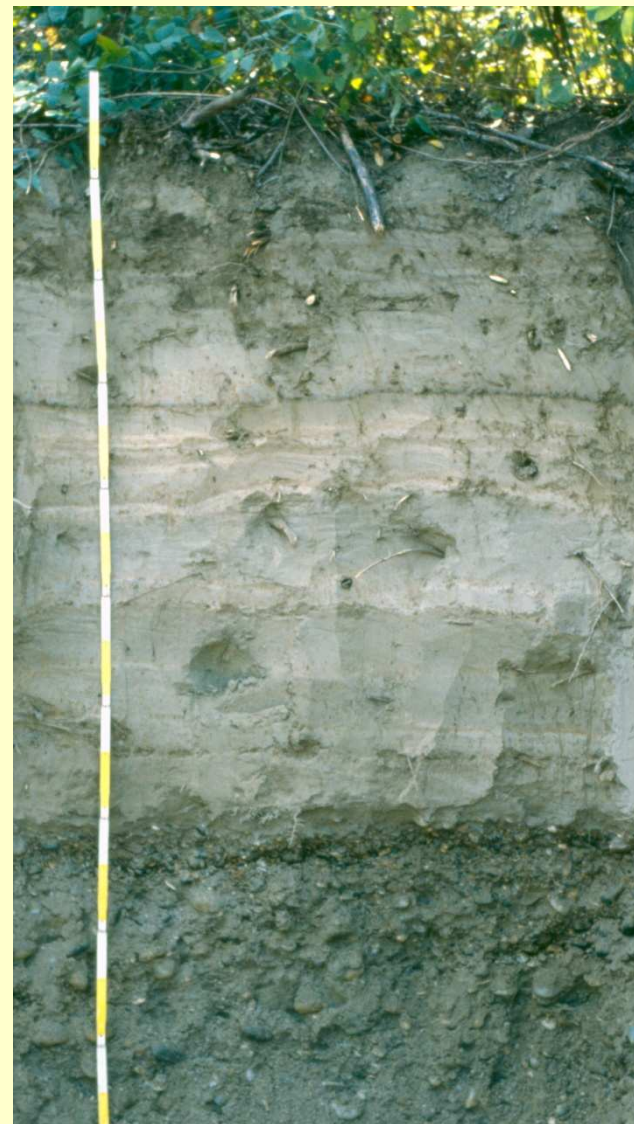
GLEYSOL,
vertic
stagnic





*Salici-
Populetum*

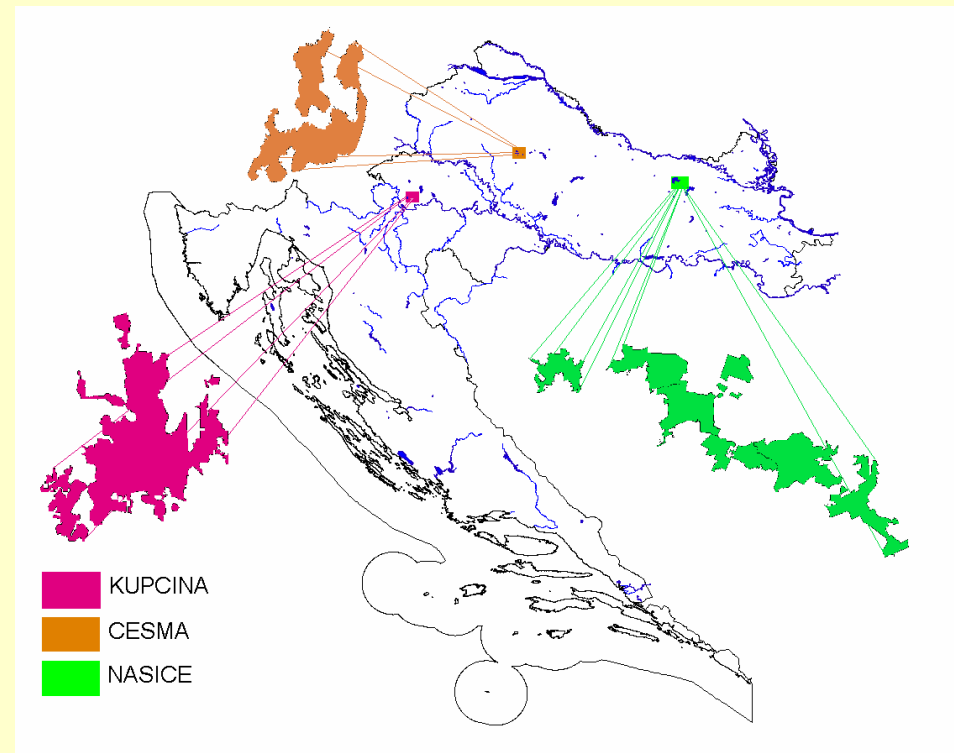
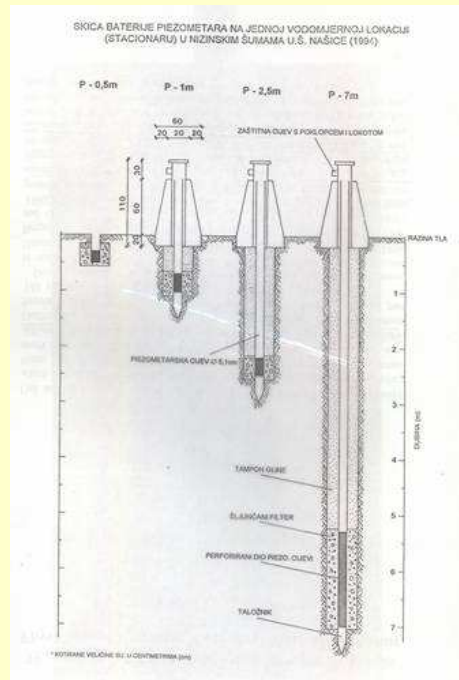
Fluvisol
(Aluvijalno tlo) **folic,
FLUVISOL,
siltic, endoskeletal**

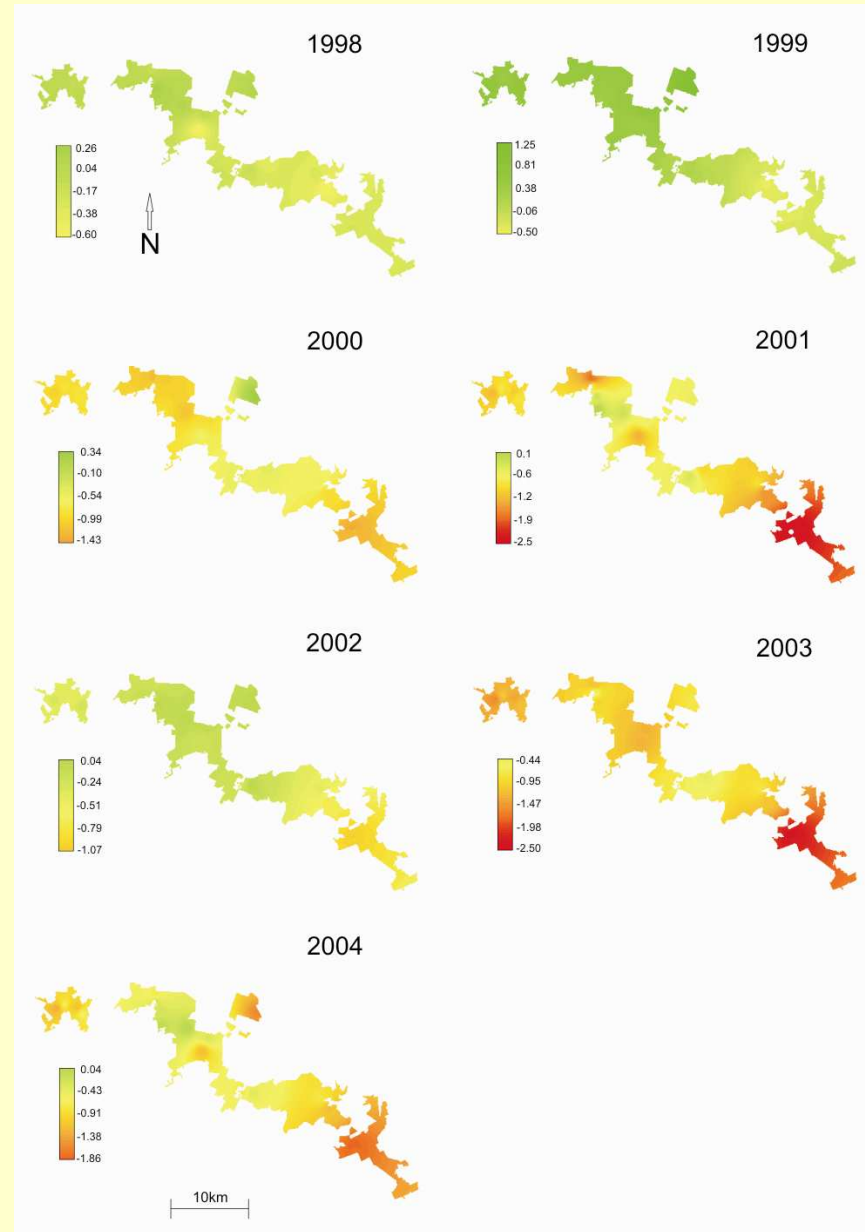
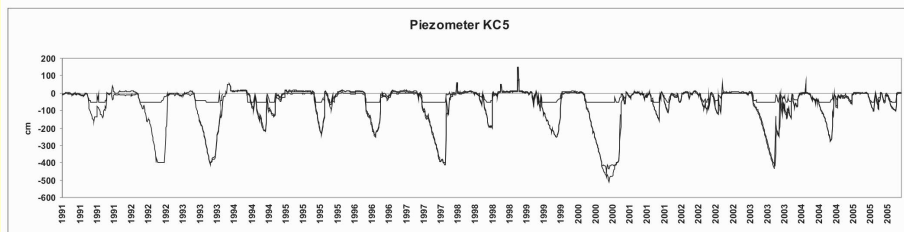
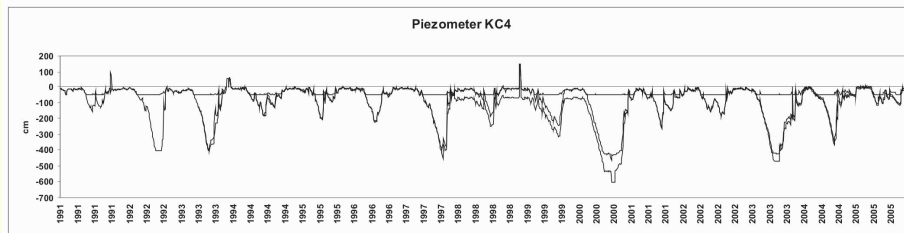
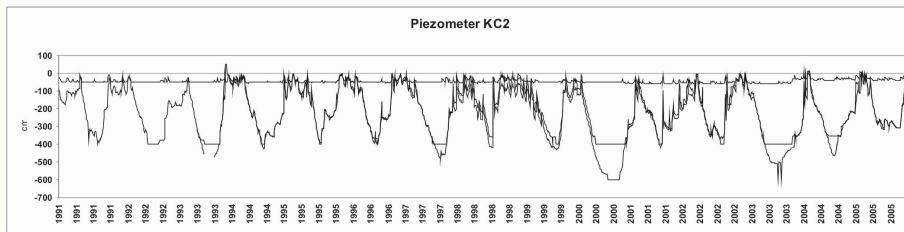
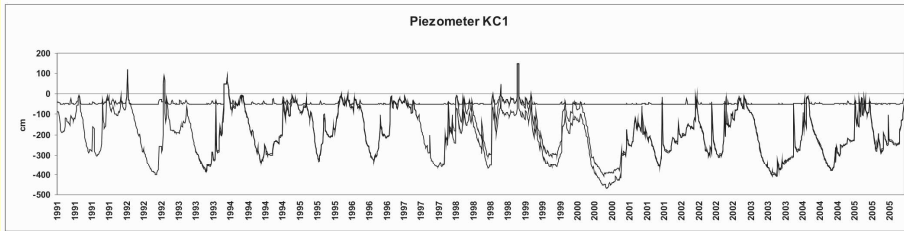
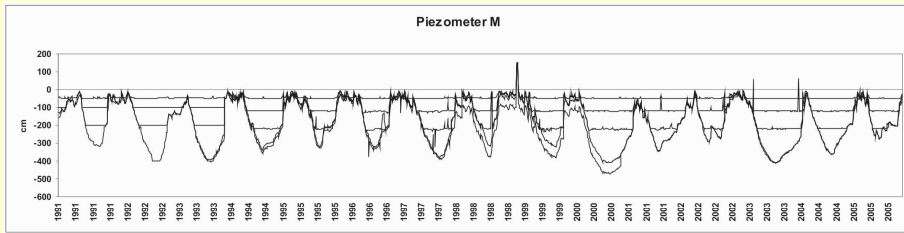


Groundwater monitoring

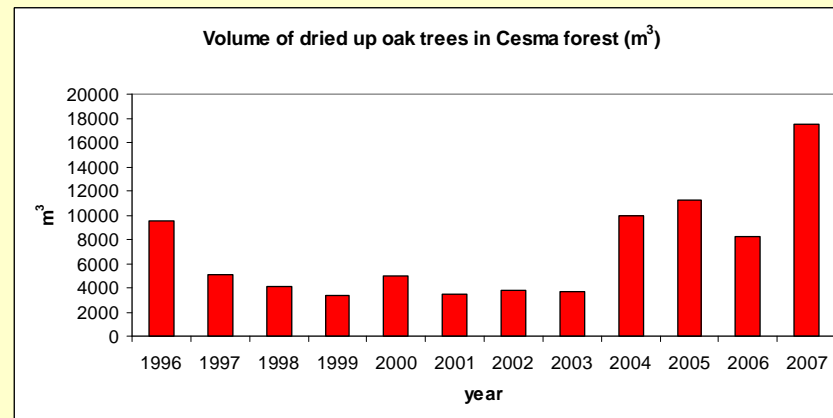
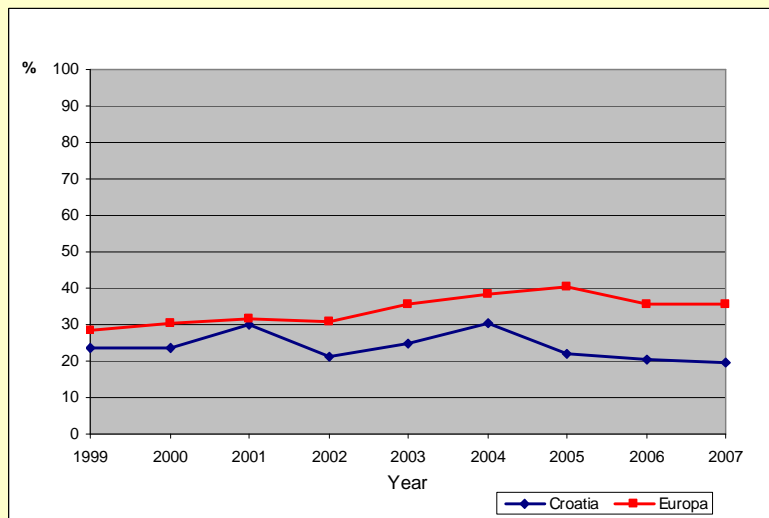


.120 stations in all mayor forest complexes





Oak Forest dieback (ICP Level1 and local inventories)



Level 2 plots



ION DIFFERENCE (ID) %

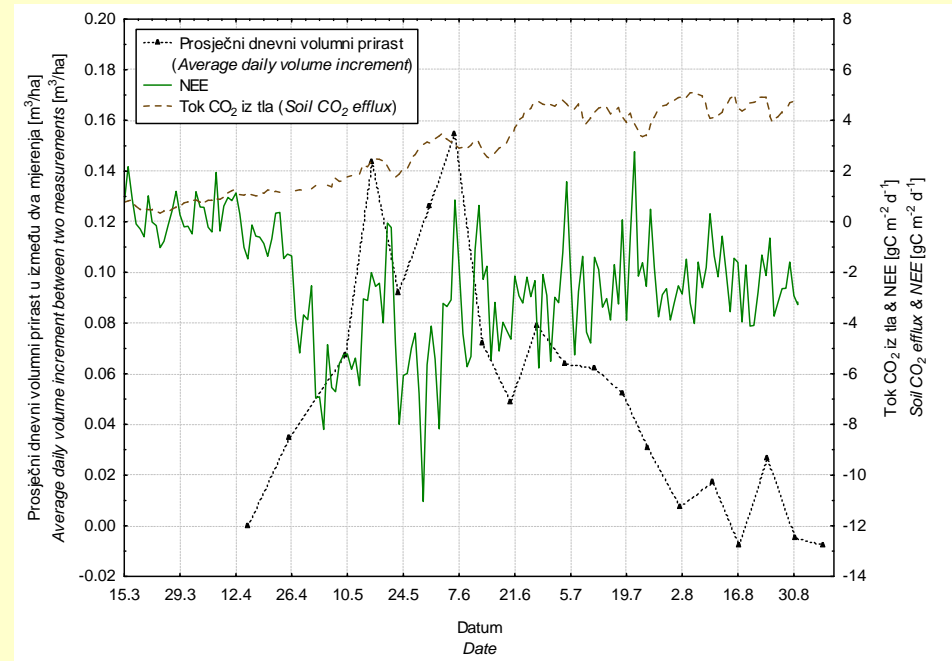
$$\Sigma A = \frac{\text{HCO}_3^-}{61} + \frac{\text{Cl}^-}{35,5} + \frac{\text{SO}_4^{2-}}{16} + \frac{\text{NO}_3^-}{14} = \text{mekv/l}$$

$$\Sigma K = \frac{\text{H}^+}{1} + \frac{\text{NH}_4^+}{14} + \frac{\text{Na}^+}{23} + \frac{\text{K}^+}{39} + \frac{\text{Ca}^{2+}}{20} + \frac{\text{Mg}^{2+}}{12} = \text{mekv/l}$$

$$\frac{\Sigma K - \Sigma A}{\Sigma K + \Sigma A} \times 100 = \text{ID}\%$$

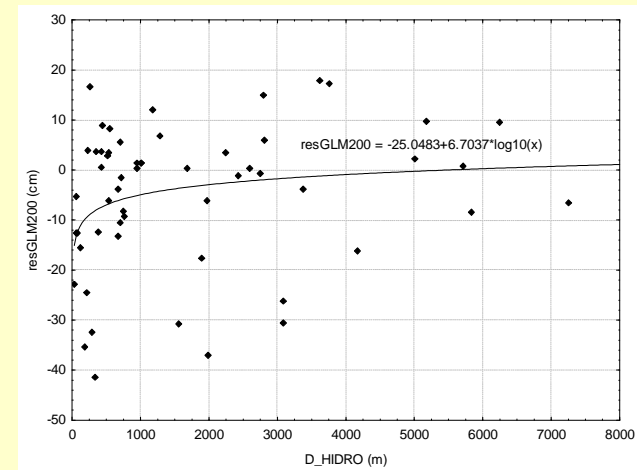
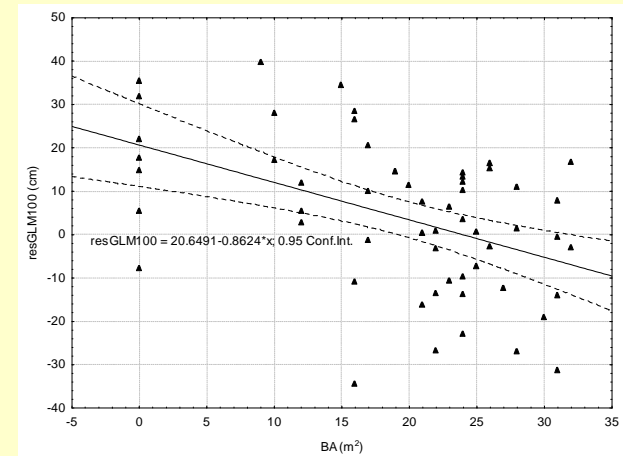
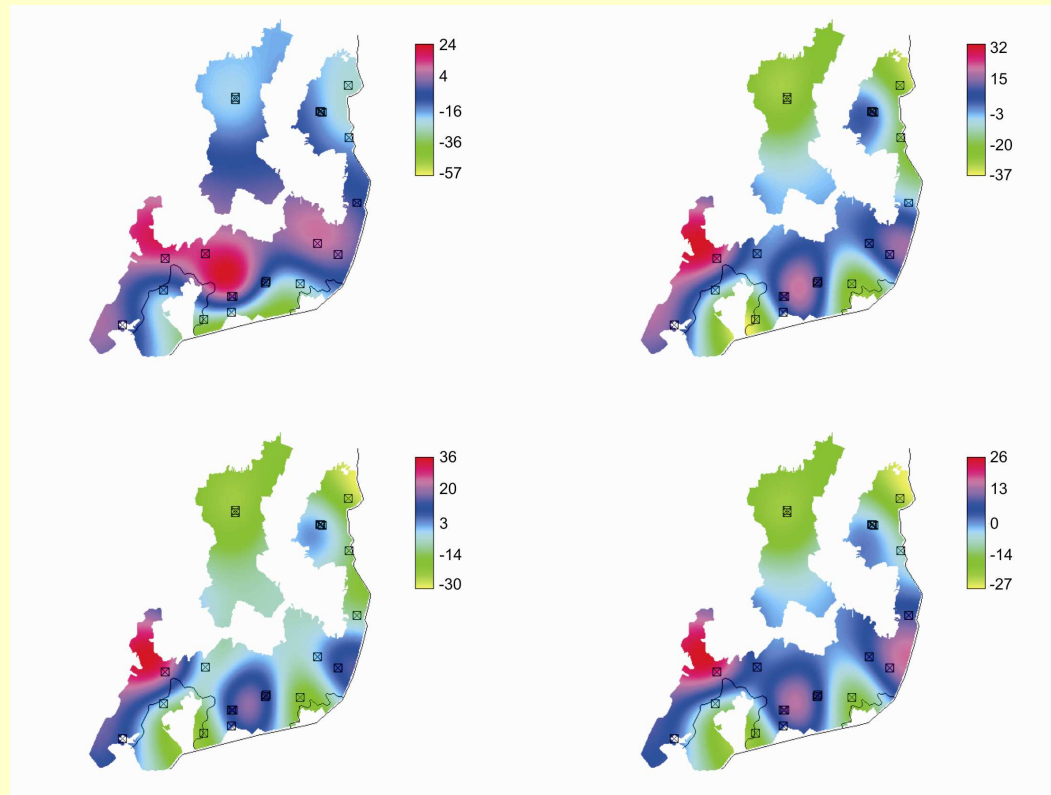
Plot \ Sample	P1-6	P1-15	P1-23	P1-25	P1-36
	ID%				
Troughfall	13,24	25,60	3,10	26,96	8,19
Bulk	58,40	-20,15	12,33	-20,64	-19,40
Lysimeter 10	-5,37	4,41	-3,87	6,52	-0,54
Lysimeter 100	33,70	72,78	30,14	74,31	39,24

Carbon flux measurements

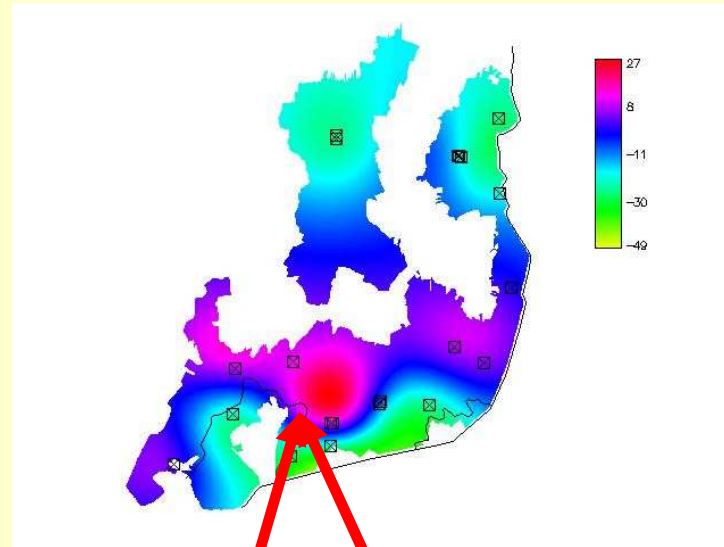


Adaptation

- Estimation of sustainable groundwater regime



Runoff retention



Regeneration (rotation period 130 years)

- **Apropriate planting techniques for specific site conditions**



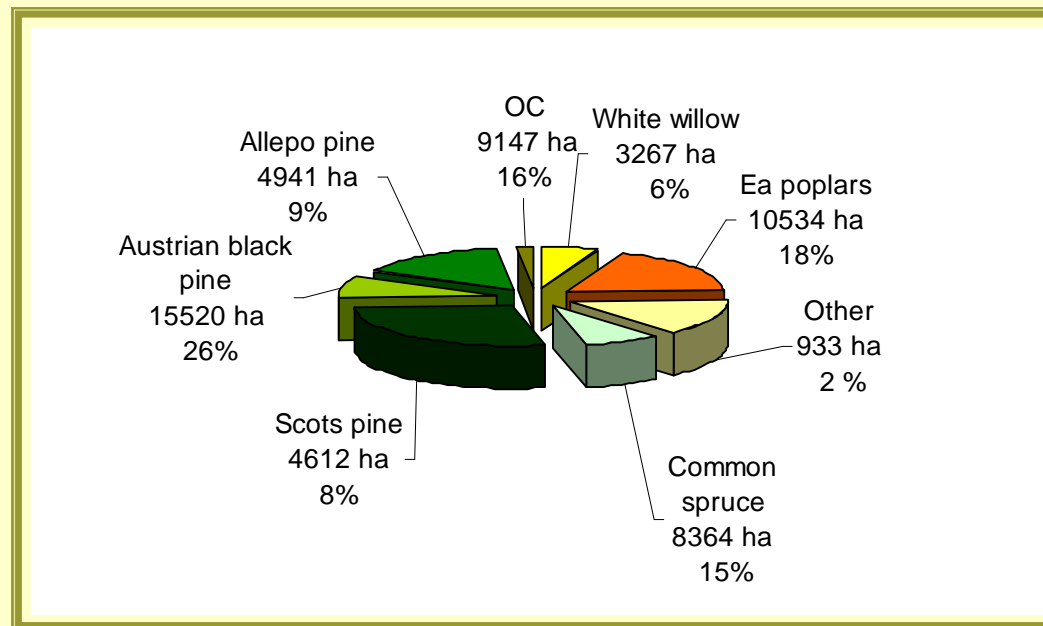
- **More adoptive provenances to regional conditions**
 - Two provenance tests (25 years)
 - Three new established tests in different regions + temp., precip., soil moisture

WG3

Forest cultures and plantations

- Until now primary roles of afforestation in Croatia were:
 - increase of wood production – established about **75 000 ha** of cultures (currently about 3% of covered area under different cultures)
 - possibility of change of structure of forest fund - 513 144 ha or about 21 % of total covered area covered with some kind of forest degradational stage

Share of species in Croatian cultures:





Afforestation today – should aim at serving multiple purposes

- Carbon sequestration after afforestation may be accounted as a sink in national greenhouse gas budgets (the article 3.3 of the Kyoto Protocol)
 - groundwater protection
 - Biomass production
 - soil protection (erosion, runoff)
 - commitments to maintain, enhance and protect biological diversity and other
- The possibilities of increasing productivity of the abandoned agricultural land, also areas with low productive soils not suitable for agriculture

Permanent trial plots in Croatia

- Spring of 1969. a series of comparative trial plots were established in three characteristic ecological forest areas in Croatia
- autochthonous – Scots pine, Austrian black pine, Common spruce
- allochthonous – Douglas fir, European larch, Weymouth pine, Sitka spruce, Douglas fir, European larch and Tulip tree provenances

