Drought: COST 734 and Tuscany regional analysis

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Consultation meeting on the INTEGRATED DROUGHT MANAGEMENT PROGRAMME
Geneva – 15, 16 November 2010

ANALYSIS FOR EUROPE (COST 734)

COST

- COST is an intergovernmental framework for European Cooperation in Science and Technology, allowing the coordination of nationally-funded researches on a European level.

- COST contributes to reducing the fragmentation in European research investments and opening the European Research Area to cooperation worldwide.

Impacts of Climate Change and Variability on European Agriculture
CLIVAGRI – COST 734

www.cost734.eu

Chair Simone Orlandini

Vice chair Pavol Nejedlik

Rapporteur Giampiero Maracchi

Objectives: the evaluation of possible impacts from climate change and variability on agriculture and the assessment of critical thresholds for various European areas.

Geographical impact of the Action

COST Countries : 29

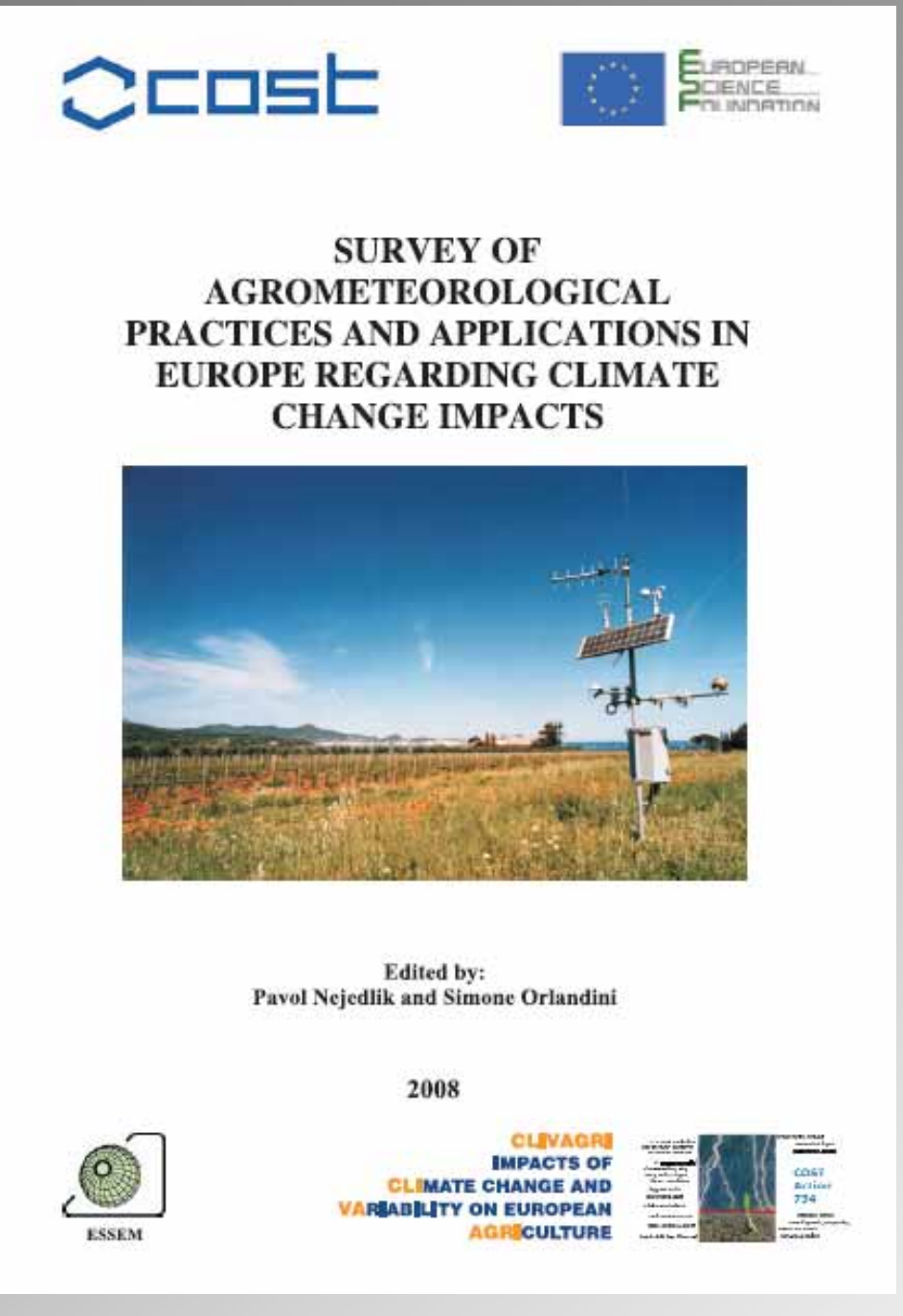
Chair : IT

List of COST country
AT, BE, BG, HR, CY,
CZ, DK, FI, FR, DE, GR,
HU, IE, IL, LU, NL, NO,
Pl, PT, RO, SR, SK, SI,
ES, SE, CH, TR, UK

Non-COST institutions:

National Drought Mitigation Centre, University of Nebraska–Lincoln USA
Lincoln University, Canterbury New Zealand
Joint Research Centre Ispra, Agriculture Unit (ex-Agrifish) Italy
WMO – Agricultural Meteorology Division

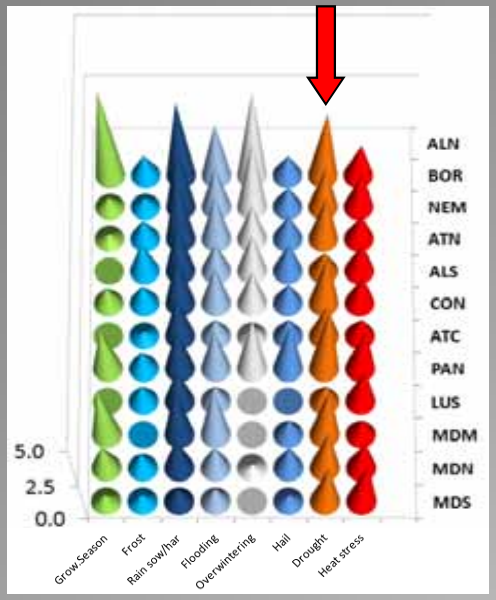
Survey



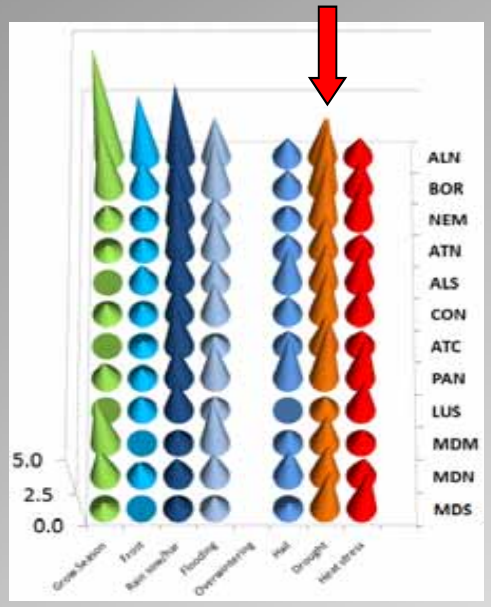
Analysis of answers to five questionnaires disseminated to agronomy experts among COST 734 countries

1. Agroclimatic Indices and Models
2. Trends in Agroclimatic Indices and Model Outputs
3. Satellite Data Records Survey
4. Climate Change Scenarios
5. Risk Assessment and Foreseen Impacts on Agriculture

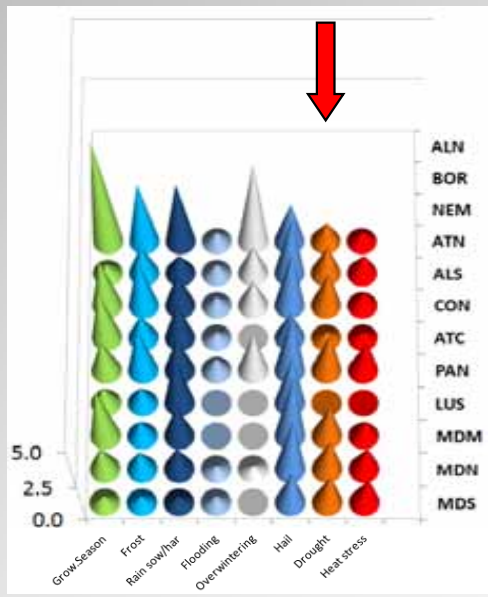
Climatic limitations and vulnerabilities of drought in Europe



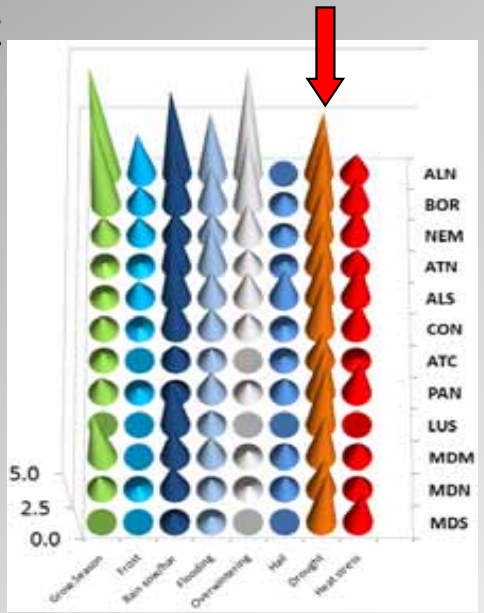
Winter wheat



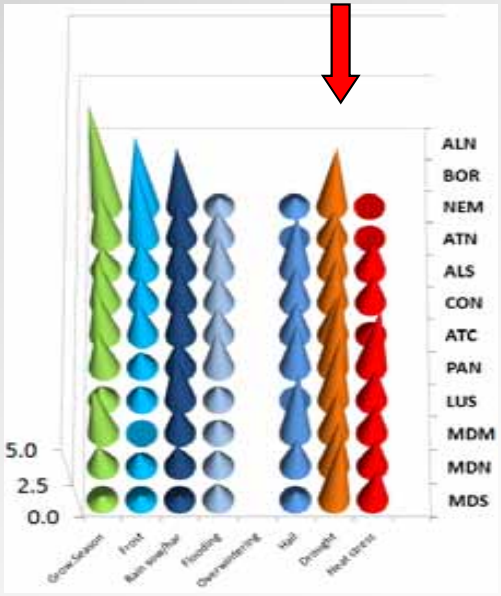
Spring barley



Grain maize



Grassland



Grapevine

Source: Survey of agrometeorological practices and applications in Europe regarding climate change impacts COST 734

Climatic impacts of drought in Europe

	Winter wheat	Spring barley	Grain Maize	Grassland	Grapevine
Alpine North		0.0		0.0	
Boreal	0.5	1.0		0.5	
Nemoral	1.0	1.8	1.0	1.0	
Atlantic North	0.8	0.8	0.3	1.0	0.5
Alpine South	1.0	1.5	1.7	1.8	2.0
Continental	0.4	1.0	1.2	1.2	0.6
Atlantic Central	0.3	0.0	0.7	0.5	0.7
Pannonian	0.7	1.3	2.0	1.3	0.4
Lusitanian	1.0	1.0	2.0	1.0	0.0
Mediterranean North	0.8	0.7	1.3	0.8	1.0
Mediterranean South	0.8	0.0	0.3	0.8	0.6

Source: Survey of agrometeorological practices and applications in Europe regarding climate change impacts COST 734

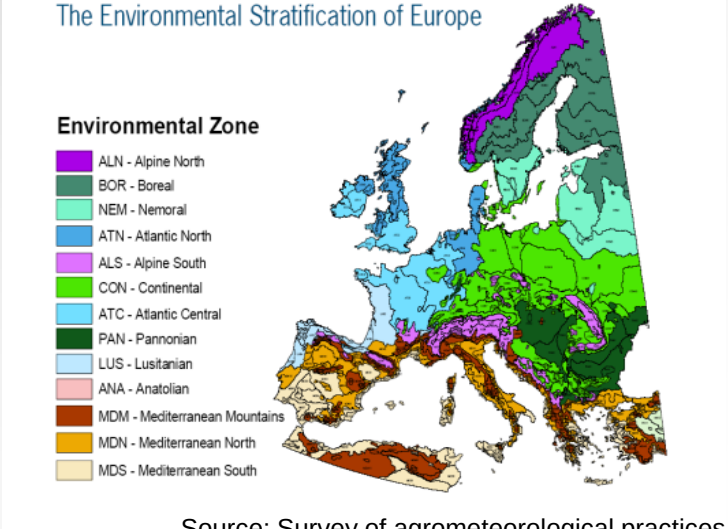
Climate change impacts for 2050 – Perceived by agronomy experts

Grain

	Growth Duration	Overwin-tering	Frost	Suitable harv.	Seasonal variability	Drought	Heat stress	Hail	Pest& Diseases	Weeds	Soil erosion	Nitrogen losses
ALN												
BOR	1.0											
NEM	0.0		-1.0	0.5	1.0	1.0	0.0	0.5	1.0	1.0	1.0	1.5
ATN	1.3		-1.0	0.0	0.5	0.3	0.0	1.0	1.5	0.0	1.0	-1.0
ALS	0.0		0.0	1.0	1.0	1.7	1.3	1.0	1.5	0.5	1.0	0.5
CON	-0.9		-0.8	0.4	0.7	1.2	0.6	0.3	1.3	0.6	1.0	0.6
ATC	0.3		-1.0	1.0	0.7	0.7	0.3	0.7	0.7	0.7	1.3	0.3
PAN	0.0		0.0	0.4	1.7	2.0	1.5	1.0	1.0	1.5	0.8	0.5
LUS	-2.0		-1.0	1.0	1.0	2.0	2.0	0.0	0.0	1.0	1.0	0.0
MDM	-1.0			0.0	0.0	-1.0	-1.0	-2.0	0.0	0.0	0.0	1.0
MDN	-0.8		-0.7	-0.3	0.3	1.3	1.0	-0.1	0.5	0.8	0.8	0.8
MDS	-1.0		-0.3	0.3	0.0	0.3	0.3	0.3	0.5	0.5	0.3	0.3

RED = Positive values imply increases of impacts

GREEN = Negative values imply decreases of impacts



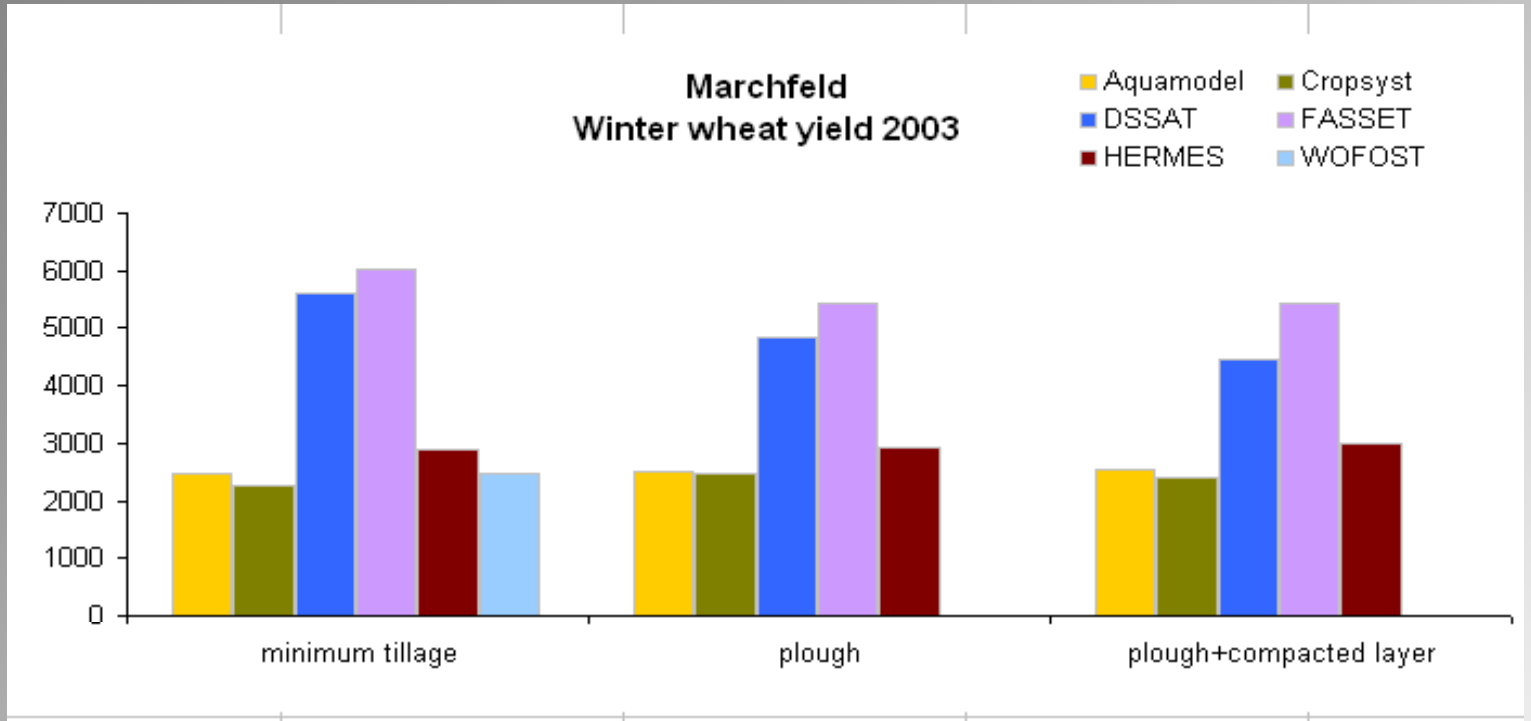
Source: Survey of agrometeorological practices and applications in Europe regarding climate change impacts COST 734

Changes in the median values of selected agroclimatic indicators relative to the 1971-2000 for 2050

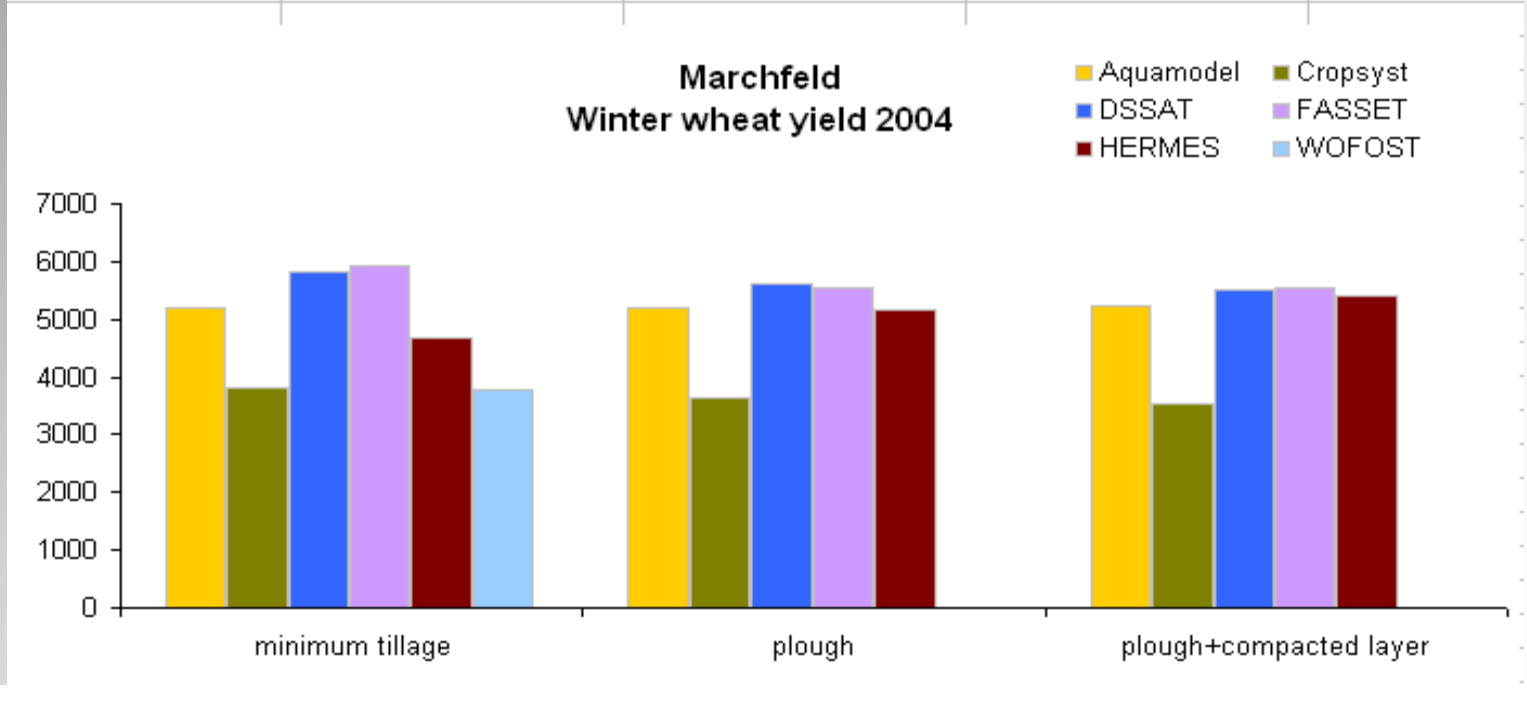
Environmental Zone	Effective global radiation change (%)			Effective growing days change (days)			Huglin index change (%)			Date of the last frost change (days)			Proportion of dry days in AMJ change (%)			Proportion of dry days in JJA change (%)			Proportion of sowing days - early spring change (%)			Proportion of sowing days - fall change (%)		
	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N	E	H	N
ALN	4	8	11	31	29	47	23	29	35	-8	-10	-14	1	1	2	-2	-2	-2	11	11	11	2	3	5
BOR	7	8	10	23	16	33	22	42	27	-6	-11	-7	-2	-1	1	-7	2	-7	7	9	9	6	9	10
NEM	6	8	7	22	12	36	23	40	24	-6	-10	-7	1	1	1	3	11	-2	10	9	12	8	8	11
ATN	0	-1	5	14	5	31	19	28	21	-9	-11	-14	-4	-4	-6	15	21	6	6	6	8	5	6	5
ALS	-1	-1	4	4	0	14	22	30	19	-11	-15	-11	-2	-2	-2	16	18	5	7	8	5	7	6	8
CON	-6	-6	1	-2	-6	10	20	29	19	-8	-12	-10	-2	-2	-4	16	20	8	7	7	6	7	7	9
ATC	-3	-6	1	1	-9	11	19	28	18	-11	-15	-15	-5	-4	-8	15	24	8	4	4	4	4	3	5
PAN	-23	-19	-14	-24	-19	-14	19	28	18	-9	-11	-8	4	5	-1	26	25	18	5	5	4	1	4	6
LUS	-19	-17	-6	-40	-39	-15	22	29	18	-11	-11	-11	10	14	8	38	39	18	4	5	3	2	0	3
MDM	-18	-14	-6	-20	-15	-6	22	27	18	-4	-5	-4	12	10	5	22	21	11	5	5	2	3	3	3
MDN	-15	-11	-6	-16	-11	-4	16	21	14	-27	-28	-27	15	13	5	13	11	5	2	2	0	-1	1	2
MDS	-23	-23	-12	-22	-20	-10	15	21	14	-15	-18	-17	14	13	9	1	1	1	-8	-6	-4	-8	-6	0

AGROCLIMATIC CONDITIONS IN EUROPE UNDER CLIMATE CHANGE, (TRNKA ET AL.,GLOBAL CHANGE BIOLOGY, IN PRESS)

Simulated absolute yields – Winter wheat



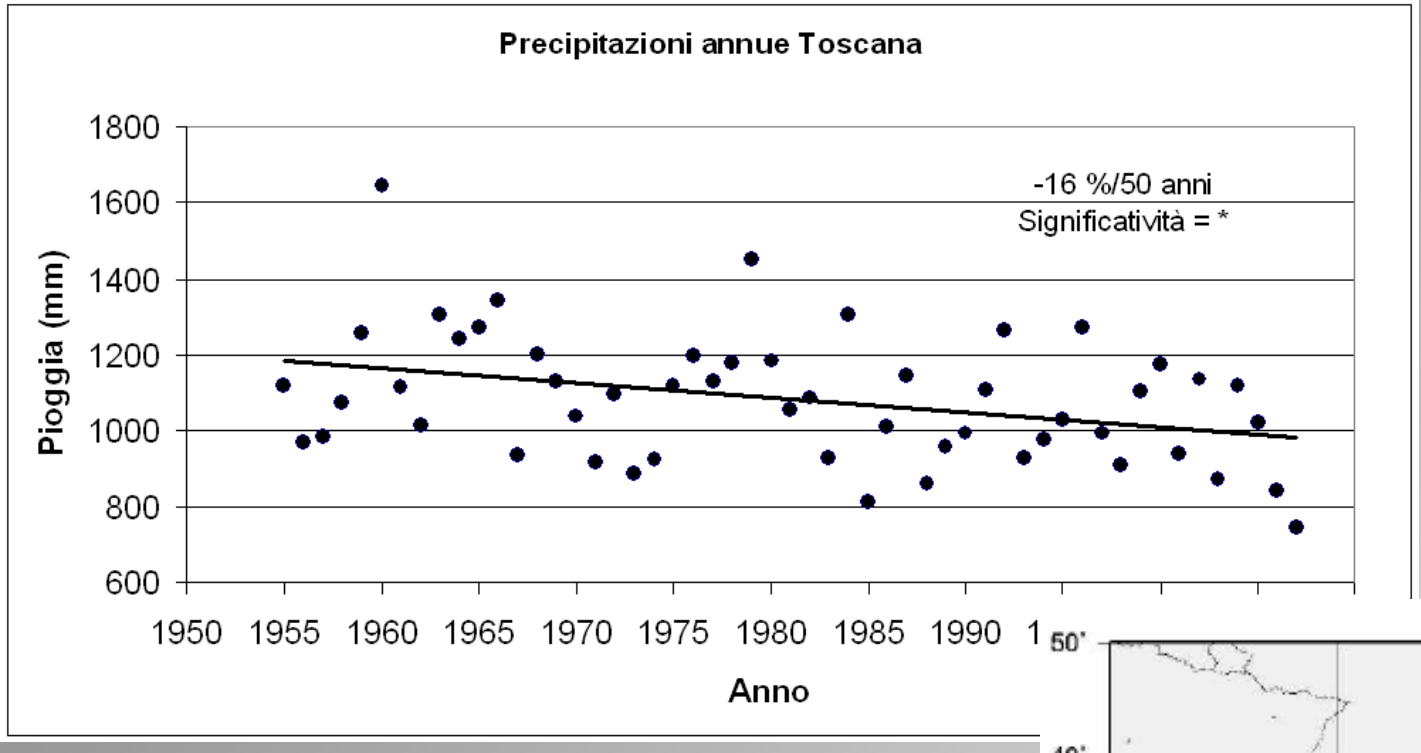
Dry year



Wet year

ANALYSIS FOR TUSCANY

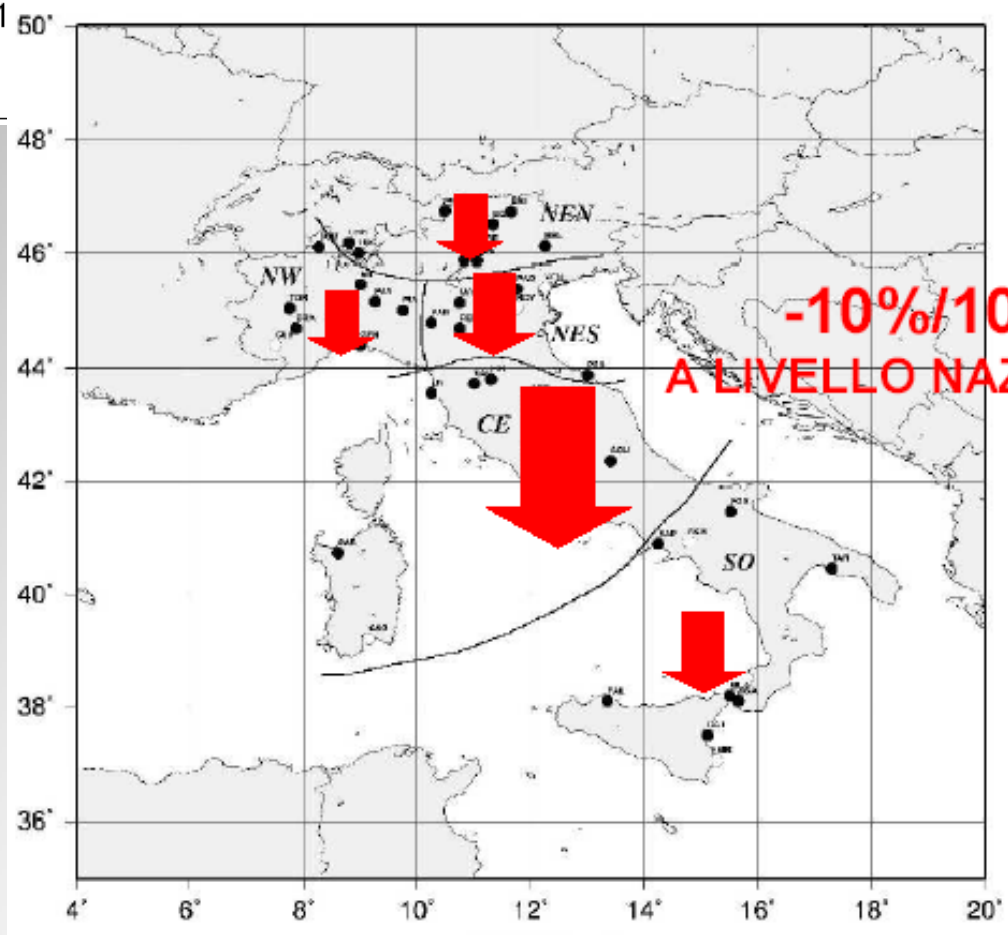
Current trends



Annual rainfall

Rainy days

(Brunetti)



-10%/100y
A LIVELLO NAZIONALE

A system for the water needs monitoring in Tuscany

Annual surface data from ISTAT (National Institute of Statistic): Ratio between 2000 and 2006

Calculation of rate variation respect surface of 2000

Application of variation coefficient on surface of irrigate culture from Census

Crop nursery surface ISTAT 2005

Calculation of update surface

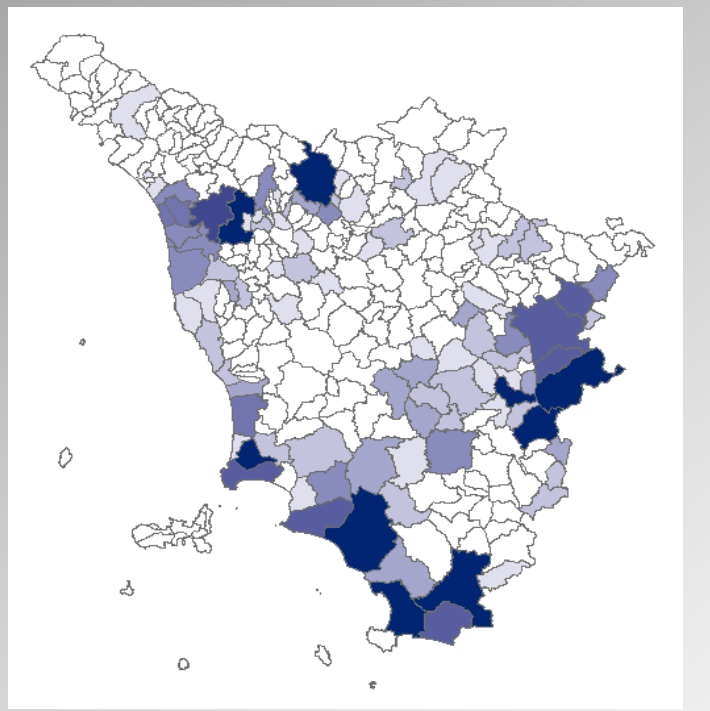
ETP experimental station/ ETP reference station

Cultural water need at municipal scale

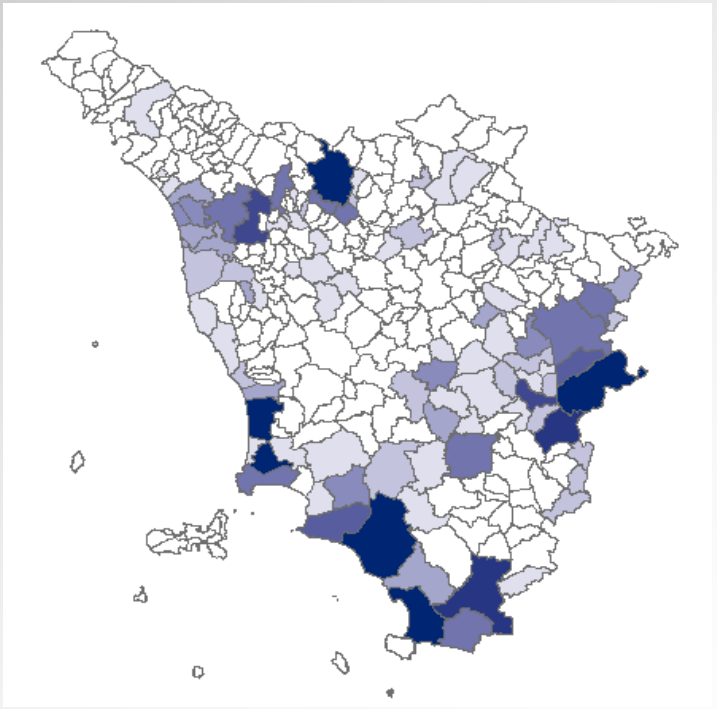
Cultural water need in experimental station

Municipal water need 2000-2008

The provinces with the greatest impact on the water demand are Pistoia, Grosseto, Arezzo and Siena, where the needs are primarily related to the production of floriculture, maize and vegetables



2000



2008

The importance of small reservoirs

Water reservoirs (farm pond) are built to accumulate precipitation. These infrastuctures are very simple and can be classified as:

	Volume (m^3)	High (m)
Big dams	>1.000.000	>15
Small dams	<1.000.000	<15

The small dams include farm ponds. Optimal dimension for cost and maintenance is about 30.000 m^3.

Farm ponds in Tuscany

The number of farm ponds is
2462

The mean dimension is
24.000 m^3

The stored water is about
59 million of m^3

Source: ARSIA, 2006

Farm ponds can provide the total water required for the irrigation of grapevine

	Total surface (ha)	**Irrigated surface with farm ponds**
Grapevine	62599	75754 Over 100%

Energy crop sustainability: water consumption

Many of the crops currently used for biofuel production (sugar cane, oil palm and maize) have high water requirements at commercial yield levels.

The processing of feedstocks into biofuels can use large quantities of water

Biofuels production will affect also water quality due to soil erosion, sedimentation and excess nutrient runoff into surface waters and infiltration into groundwater from increased fertilizer applications

CROP	Annual obtainable fuel yield	Energy yield	ET equivalent	Crop ETP	Rainfed crop ET	Irrigated crop water requirement	
	(L/ha)	(GJ/ha)	(L/l fuel)	(mm/ha)	(mm/ha)	(mm/ha)	(L/l fuel)
Sugar cane	6000	120	2000	1400	1000	800	1333
Maize	3500	70	1375	550	400	300	857
Oil palm	5500	193	2364	1500	1300	0	0
Rapeseed	1200	42	3333	500	400	0	0

Source: IEA, 2007 and FAO

Source: IEA, 2007 modified

	Maize	Agricultural residuals	Forest	SRF poplar, willow
Erosion	Row crop; soil uncovered for long period	Depending on type	Whole-year soil cover	Permanent cover
Soil compaction	Average machinery use	Not heavy machinery use	Deep rooting, permanent crop	Deep rooting, permanent crop
Nutrient leaching	High fertilization	Depending on type	Takes a lot of nutrients	Takes a lot of nutrients
Pesticide pollution	High input use	No additional inputs	No inputs because high competitive	No inputs because high competitive
Water abstraction	**Irrigated**	**No additional irrigation**	**Not irrigated**	**High water demand but no irrigation**
Link to farmland biodiversity	High pesticide use, low weed diversity	No variations	Nesting habitat, winter shelter	Nesting habitat, winter shelter, possible impact on open landscape
Diversity of crop types	Dominant crop in many regions	No variations	Natural	Not very common

WATER and BIOETHANOL production

IN TUSCANY

The agriculture water need is

150 million of m^3

To satisfy the goal of Tuscany region to produce BIOETHANOL (about 12800 ton) the water need is about

160 million of m^3

Analysis of drought perspectives

Thank you for your attention!!!

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