Mariani L. Italian Journal of Agrometeorology 10 - 17 (2) 2008

ITALIAN AGRICULTURE AND CLIMATIC RISK

L'AGRICOLTURA ITALIANA E IL RISCHIO CLIMATICO

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Abstract

General characters of climatic risk for Italian agriculture are presented and some ideas about the evolution of this risk are given, in the light of the variability of climate in the Euro-Mediterranean area. In particular it is presented a summary description of the elements of risk for the main crops in the principal agroclimatic zones; in this context, the effect on climatic risk of the climate change of '80 years of twentieth century is discussed and some adaptive answers of the agricultural system are listed; these answers seems rational but also tardy, as a result of significant economic losses.
The distortion in the perception of climate variability is also described as the result of the low attention of public opinion and farmers to quantitative aspects of weather phenomena; the responsibility of some subjects (media, professional organizations, etc.) on this effect in also discussed.
On the base of these facts, a new and more rational approach to climatic variability founded on the fast activation of research organisms on the base of data coming from services that analyze data from meteo stations and atmospheric circulation is proposed; in this context the possible role of Ucea in order to provide early warnings for agriculture and to define mitigation tactics and strategies is also discussed.

Riassunto

Il lavoro rappresenta il tentativo di fornire una descrizione sommaria dei caratteri del rischio climatico per l'agricoltura italiana e di sviluppare alcune idee in merito all'evoluzione di tale rischio alla luce della variabilità del clima in area euro-mediterranea. In particolare viene presentata una sommaria descrizione degli elementi di rischio per le principali colture agrarie italiane in funzione di macroaree agroclimaticamente omogenee. In tale contesto viene collocato il cambiamento climatico del 1989 e la risposta adattativa del sistema agricolo a tale cambiamento viene descritta con alcuni esempi; emerge una risposta razionale ma tardiva e frutto di rilevanti perdite economiche.
L'effetto di distorsione sulla percezione della variabilità climatica è altresì descritto, come risultato dello scarso livello di attenzione dell'opinione pubblica e degli stessi agricoltori agli aspetti quantitativi dei fenomeni; su tale aspetto viene messa in luce l'influenza avuta dai media e da alcune organizzazioni professionali agricole.
In base a tali fatti si giunge a prospettare un nuovo e più razionale approccio alla variabilità climatica fondato sulla rapida attivazione degli enti di ricerca sulla base di dati provenienti da stazioni meteorologiche e strutture circolatorie atmosferiche, in modo tale da fornire allerta precoci all'agricoltura con indicazioni accurate circa strategie e tattiche di mitigazione. Vine infine discusso il possibile ruolo dell'Ucea in tale futuribile contesto.

Introduction

In Italian language the term "rischio" means "probability of a potentially dangerous event that can be quantified by means of suitable statistical methods." This concept is similar to the English term "hazard", whereas the term "risk" has a more economic meaning, because it is referred to the dimension of the injury to persons or things that follows a hazardous event. This premise is important because show the economic implications of climatic risk and show a possible mismatch between Italian and English speakers, with consequences sometimes important because English is, at present, the most important global language.
All natural events, disasters included, are characterized by a risk that, as a rule, can be quantified. This quantitative evaluation is in many cases laborious because it needs technical and statistical analyses sometimes very complex but it must be sustained by the trust that almost nothing is completely unforeseeable in therms of risk (Rosini, 1988).
Farmers and climatic risk live together from about 10,5 thousand years, in other words from the Neolithic revolution; the main consequence of this fact is that a deterministic approach to the relation between mankind and climatic risk is quite reductive. More specifically Leroy Ladurie (2004) said that the history of climate can be seen in the context of the conquests of mankind, and the human progress can be considered as an attempt to freedom the mankind from the "dictatorship of the climate". An example given by the same Leroy Ladurie is represented by the terrible winter 1739-1740, particularly ruinous due to the period of occurrence. In fact this very cold winter followed about fifty years of mild oceanic

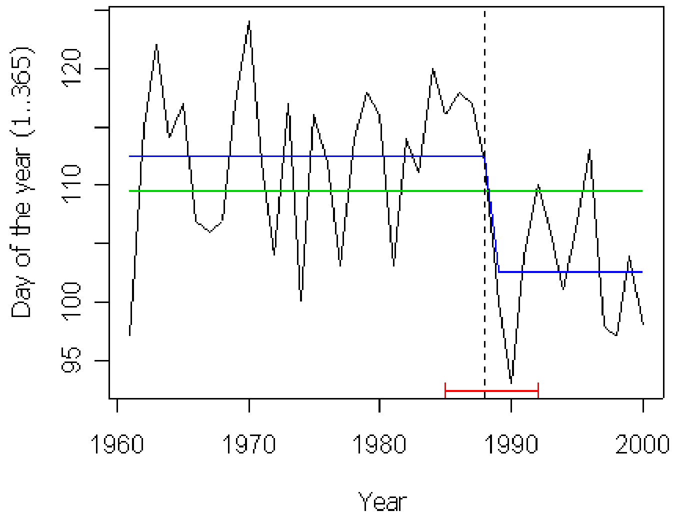

Fig. 1 – Climatic change of '80 years seen analysing the date of leaf unfolding in Germany (data from Chmielewski F.M., Rotzer T., 2001). The analysis, carried out with struchange library of R software, show that the breakpoint drops between 1985 and 1992 with a confidence of 90% and that the most problable year of breakpoint is 1988; the mean date was 112.5 before and 102.5 after the breakpoint.

***Fig. 1** – Cambiamento climatico di fine anni '80 visto attraverso l'analisi della data di apertura delle foglie in Germania (i dati provengono da Chmielewski F.M., Rotzer T., 2001). L'analisi, svolta con la libreria Strucchange del software R, mostra che con una confidenza del 90% il breakpoint cade fra 1985 e 1992 e che l'anno più probabile di breakpoint è il 1988; la data nedia è di 112.5 prima e di 102.5 dopo il breakpoint.*

climate, which determined the total unpreparedness of agriculture and food storage systems; but the author observe also that the total of 200.000 dead registered in France in 1740 is very high but lower than the 600.000 dead of the famine of 1709 and the 1.000.000 of the great famine of 1693; the relative low number of fatalities was the result of mitigation policies based on the transportation of cereals from westerly and easterly areas of France, less affected by the famine.

Climatic risk and policies for adaptation

The theme of adaptation to climate variability is particularly important for agricultural systems, which at present have the very difficult task to guarantee food and other products for a world population of about 6.8 billions of individuals that are expected to reach 9 billions in 2050 (U.S. Census Bureau, 2006). This general evaluation show that it is quite important to consider the lesson of the past, because the answer of agriculture to climatic variability was always founded on adaptive changes in agro-techniques and in genetics of plants and domestic animals.

By this point of view, the agriculture of the origins can be considered the cultural mother of the "green revolution", carried out from '50 years of twentieth century and characterized by rapid improvements in genetics (introduction of dwarf varieties in winter cereals, hybrids in maize, etc.) and agro-techniques (fertilizers, weed control, biocides, etc.). The effect of this revolution was the triplication of the food production in correspondence with the triplication of world population observed in the same years.

These evaluations show that agricultural sector should appreciate that the variability is a normal character of the climate of mid latitudes and should be analyzed quantitatively, with a quick evaluation of any significant change. Unfortunately, in the recent past this approach was often neglected: for example in the '80 years of the past century the European area entered a new climatic phase (Fig. 1, 2 and 3) characterized by the strong prevalence of occidental Atlantic circulation (westerlies). This phase followed a cooler phase, characterized by the alternative dominance of occidental phases and oriental ones, and produced a lot of effects on the whole Euro-Mediterranen area, primarily on thermal and pluviometric regimes. In the same years our newspapers spoken a lot about El Nino Southern Oscillation, tropical phenomenon without immediate effects on our climate and ignored almost totally another index, the North Atlantic Oscillation (Lockwood, 2002), fundamental for our area. The consequence was that people didn't appreciate an abrupt circulation change (breakpoint) that had enormous effects not only for agriculture but also for our energetic system. Now, many years after this breakpoint and with an agricultural system adapted to this new climate, a possible question is: how many farmers think that, with the "global warming", cold and snowy winters are almost impossible and arrives unprepared to each new winter, like French people in 1740? This question underline a cultural problem, represented by the lack of attention to quantitative aspects of weather and climate phenomena and consequently to measurements of meteorological variables, primarily at farm level.

We can give a quite general example of the lack of attention to quantitative aspects of climate considering the urban climate and more specifically the climate of the metropolitan area of Milano, which in the last century appreciate an increase of about 3.5°C in mean yearly temperatures; this increase was the result of three main distinct phenomena[1]:

- global warming (about 0.5°C in a century)
- European warming (about 1°C in a century)
- urban warming (about 2°C in a century).

[1] The relative weight in °C of global, European and urban effects is only a first approximation, because stations useful for the description of three different kinds of phenomena are often the same, and this produce the suspect that global warming is partially a product of urban and European warming or vice-versa. This show another paradox of our epoch: the concern about global warming is accompanied by the progressive degradation of observation networks necessary in order to quantify it.

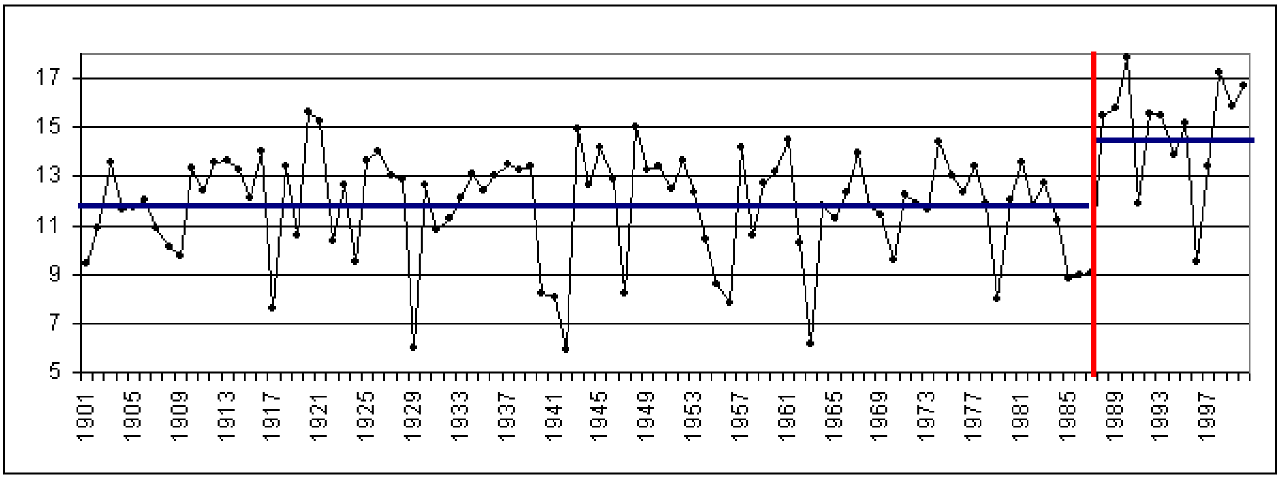

Fig. 2 – Behavior of mean temperature of the first 150 days of the year at De Bilt (Nederlans), a very significant site because it is located in the "bed" of the westerlies. In 1989 this temperature, almost stationary from 1900 shows an abrupt increase (vertical line in bold) that indicates the beginning of the present climatic phase. The average temperature is of about 12°C for the period before the breakpoint and 14.5 for the period after.

Fig. 2 *- Andamento delle temperature medie dei primi 150 giorni dell'anno a De Bilt (Olanda). Nel 1989 tale temperatura, che era pressoché stazionaria dall'inizio del secolo manifesta un brusco aumento (breakpoint – linea verticale in grassetto), portandosi in una nuova fase climatica, anch'essa stazionaria, che persiste tutt'ora. Si osservi che la media del periodo che precede il breakpoint è di circa 12°C mentre quella del periodo post-1989 è di circa 14.5°C.*

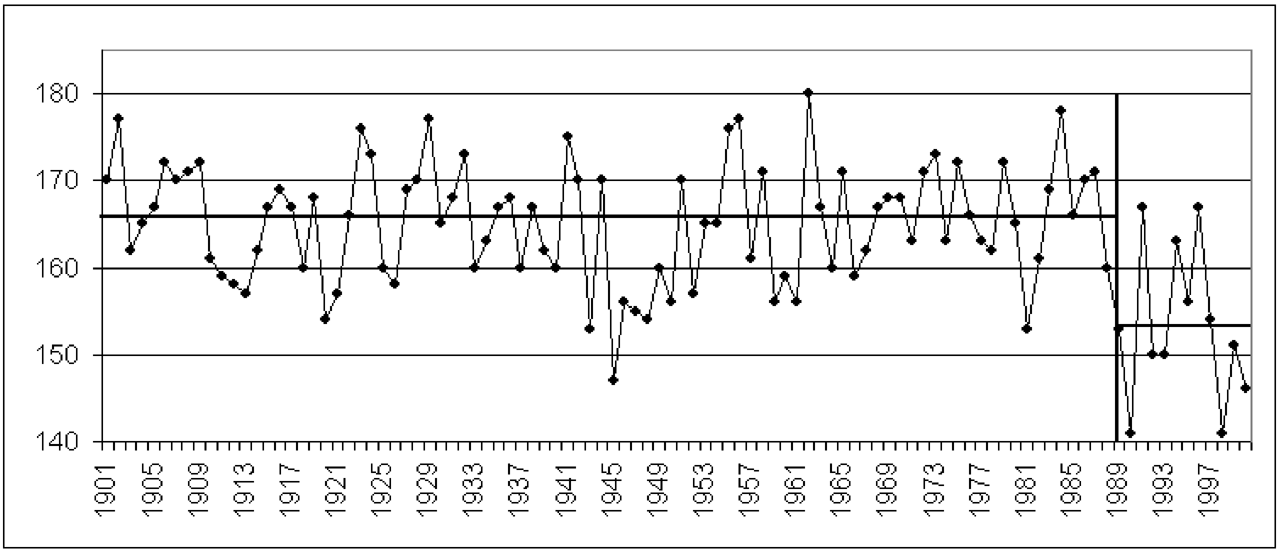

Fig. 3 – Flowering of the black elder (Sambucus nigra) at De Bilt (140=20 of may). It is evident the very strict link between temperature and phenology with flowering data that reacts almost immediately to the increase of temperatures. The average date is about 166 before the breakpoint and 153 after the breakpoint, about two weeks of advance (source of data: van Vliet et al., 2002).

Fig. 3 *– Giorno dell'anno di fioritura del sambuco (Sambucus nigra) a De Bilt (140=20 maggio). Si osservi lo strettissimo legame fra serie meteorologiche e serie fenologiche, con le seconde che reagiscono in modo pressoché immediato al variare delle prime manifestando anch'esse un breakpoint nel 1989 La media del periodo che precede il breakpoint è di circa 166 mentre quella del periodo che lo segue è di circa 153, con un anticipo di 2 settimane nella comparsa della fase di fioritura (fonte dei dati: van Vliet et al., 2002).*

Global warming is the product of a lot of phenomena, partly natural and partly man made; European warming is centered in 1989 and it is the product of an abrupt change of circulation (the causes of this change, fundamental to forecast future changes, are substantially unknown and this should be the subject of specific research programs); urban warming is a well known phenomenon, it is almost entirely man made and the fight against it is possible but always neglected. The relative weight in °C of the above-mentioned kinds of warming gives also an idea of the order of priority for mitigation policies, an order that is always ignored, also due to the emphasis give to global warming by media and our same governments.

In order to evaluate the quantitative aspects of climatic risk it is crucial the role of agrometeorological services, with meteorological and agrophenological networks that give important information about mesoscale aspects of this risk. Furthermore it is quite important the availability of a real time synoptic meteorological network

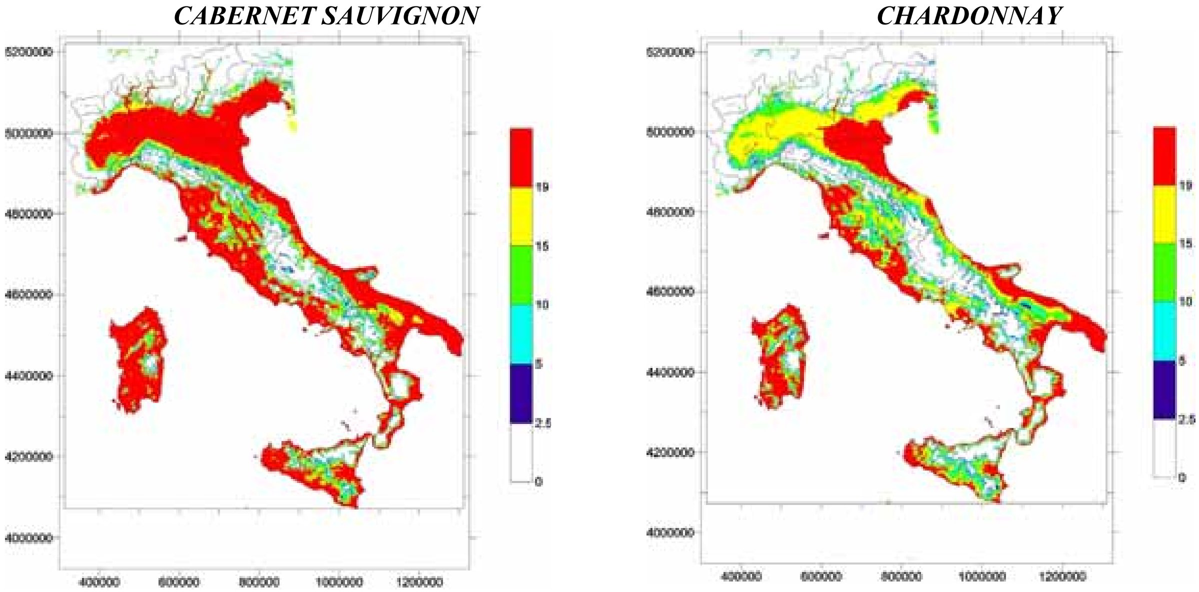

Fig. 4 – Some phenological maps developed by IPHEN project on May 10th 2006. The maps are obtained with a phenological model based on the summation of the Normal Heat Hours obtained from temperature data of Ucea network. The first guess field was corrected by means of data produced by phenological observers.

Fig. 4 – *Alcune mappe fenologiche sviluppate nell'ambito del progetto IPHEN in data 10 maggio 2006. Le mappe sono prodotte con un modello fenologico basato sulla sommatoria delle Ore Normali di Caldo ricavate dai dati di temperatura della rete Ucea. Il campo di first guess è stato corretto con i dati di osservatori.*

representative of the entire territory of our country. This network is today guarantee by Ucea that collects data from about 90 stations (partly belonging to Ucea and partly to the National Meteorological Service of the Air Force). These stations are broadcasted in nearly real time on the web site of Ucea (www.ucea.it) and are useful for mathematical modeling of natural and cultivated vegetation (Fig. 4) or for specific agroclimatic analyses (Fig. 5 and 6).

Climatic risk and Italian agriculture

Vulnerability of crops and cropping systems can be appreciated in the light of the agroclimatic features of the Italian area. The wide latitudinal extension of our country (38 – 46° N) associated with many other generator factors working at different scales (Pinna, 1972; Peixoto e Oort, 1992) gives quite different agroclimatic conditions. Following a general classification, the Italian area can be subdivided in three main climatic zones:

1. **the Alpine Zone AZ**: both precipitation and evapotranspirational demand of atmosphere show their maximum in summer, with a thermal-pluviometric regime close to that of the Central European area (Cfb Koeppen's climate) and with a strong meso and microscale variability mainly due to topoclimatic features. In this area the main limitation for natural and cultivated vegetation is represented by temperature. Furthermore this area is the source of irrigation water necessary for the re-equilibrium of summer water deficit in the Po plain.
2. **the Mediterranean zone - MZ** (Csa Koeppen's climate) is dominated by anticyclonic patterns and represents the main part of the Italian peninsula: in this area the precipitation maximum is in winter and it is strongly opposite in phase with respect to the evapotranpirational demand of atmosphere, which peaks in summer. The consequence is that the principal climatic limitation for crops is represented by summer drought. Drought conditions are almost partially mitigated by the Apennines relief which main effects are the decrease of temperatures and the increase of precipitation.
3. **the Transitional Zone – TZ:** this zone is mainly associated with the large plain characterizing the North part of Italy ad created by two main rivers (Po and Adige) and other minor eastern rivers (Piave, Tagliamento, Isonzo, etc.). This plain is surrounded by high mountains (Alps and Apennines); a wide opening toward East expose the area to winter cold outbreaks of polar continental air from Siberia; on the other hand, the mountain ranges protect the area from the influence of air masses that characterize the climate of Central Europe and of the Mediterranean. According to this, the Po Valley presents a climate of transition between the Mediterranean climate (Koeppen Csa) dominated by anticyclonic patterns and the Central European climate (Koeppen's Cfb), dominated by the mild and humid oceanic air masses advected by westerlies. The transitional character is shown by the precipitation regime that, with two minima (in summer and winter) and two maxima (in spring and fall), is partially opposite in phase with respect to the evapotranpirational request of the atmosphere, which is

maximum in summer. The consequence is a moderate drought during summer which is intermediate between (i) the strong summer drought of the Mediterranean climate and (ii) the absence of summer drought of the Central European climate. The main climatic limitations in TZ area are low temperatures and water availability.

In the light of these three main zones, the principal climatic resources and limitations can be appreciated, with reference to the main groups of crops that are cereals (winter cereals, maize, rice, sorghum) industrial crops (tomato, sugar beet, sunflower), fruit crops (apple, pear, peach, almond, apricot, orange, lemon) and meadows.

<u>Maize</u>**:** The main cultivation area for this crop is the flat plain of North Italy (TZ zone). This area is vocated for mean and late cultivars (classes 500-700 of the FAO scale) as shown by the level of thermal resources expressed as growing degree days. The main climatic limitation for maize is represented by water availability: for maize sown in March-April the flowering phase in TZ zone drops in the first decade of July and the most critical period for water stress drops between 20 days before and 20 days after flowering. Low temperatures in the initial stages can produce slow development associated with temporary symptoms of shortage in macro and micro nutrients.

<u>Winter cereals (soft and durum wheat, barley)</u>: main cultivation areas are represented by (i) flat plain and hilly areas of North Italy (TZ) for soft wheat and barley and (ii) hilly areas of central and southern Italy (MZ) for durum wheat. Thermal resources expressed as growing degree days (base=2-5°C) aren't usually a limiting factor for these crops. Traditional climatic limitations are (i) late frosts (end of April), with negative effects on vegetative and reproductive organs (ii) hot and dry periods during grain ripening (from 20 of May until 20 of June in the North of Italy; from 20 of April until 20 of May in the South) with a syndrome named "stretta" (a kind of risk typical of the Mediterranean climate) (iii) rainy periods during ripening which can enhance the risk of fungal diseases and (iv) strong winds associated with foehn or thunderstorms that can produce lodging during ripening (problem that is enhanced by nitrogen excess).

<u>Rice</u> is mainly cultivate in the flat plains of Po valley (North Italy) which represents one of the northern world areas of cultivation. Rice is a subtropical crop clearly advantaged by warm periods; traditional Italian cultivars belong to Japonica ssp and are cultivated in submersion, an agrotechnique that is justified by risk of low temperatures. Thermal resources expressed as growing degree days (base=10°C) aren't a significant limiting factor. Main climatic limitations are represented by (i) low temperatures during floral development (temperatures below 12°C in July gives sterility of pollen) and (ii) insufficient water availability for submersion (a kind of risk increased significantly in the last years).

<u>Tomato</u>, as field or protected crop is cultivated in many parts of Italy. Thermal resources expressed as growing degree days (base=12°C) aren't usually a significant limiting factor in cultivation areas. Main climatic limita-

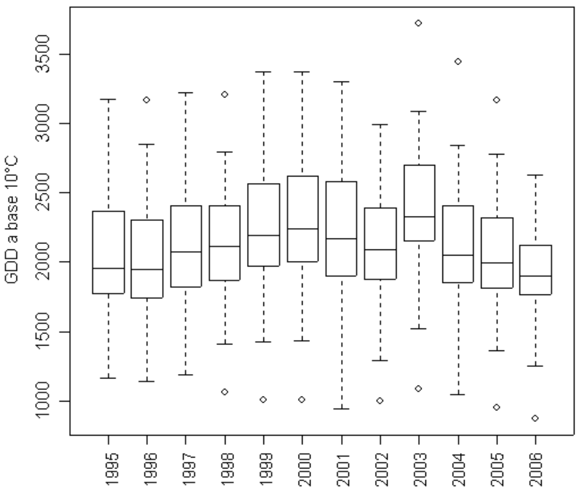

Fig. 5 – Boxplots of yearly growing degree days cumulated on the base temperature of 10°C from the daily data of 90 stations available on Ucea web site (each boxplot represents maximum, upper quartile, median, lower quartile and minimum; outliers are excluded from calculations and represented with circles). A gradual decrease is evident after the high values attained in 2003.

***Fig. 5** – Boxplots delle somme termiche a base 10°C annue ricavate per le serie storiche di 90 stazioni disponibili sul sito Ucea (ogni boxplot rappresenta il valore massimo, il quartile superiore, la mediana, il quartile inferiore ed il minimo; gli outliers sono esclusi dai calcoli e rappresentati da cerchi). Un decremento graduale si osserva dopo gli elevati valori raggiunti nel 2003.*

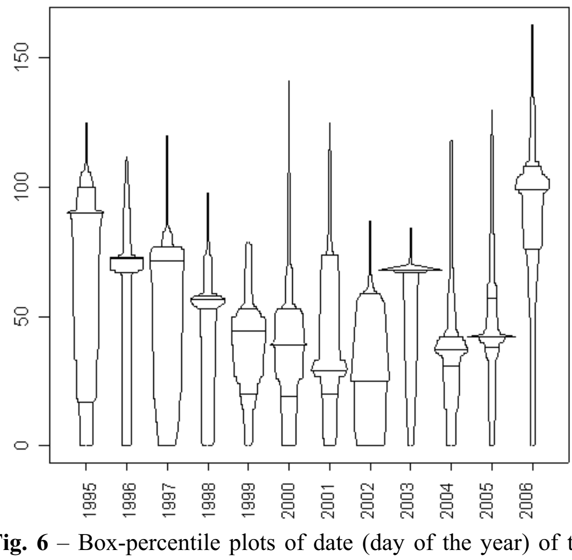

Fig. 6 – Box-percentile plots of date (day of the year) of the last late frost for the 90 stations available on Ucea web site (horizontal lines represent maximum, upper quartile, median, lower quartile and minimum; for more information about the meaning of this kind of plot see Easy and Bafield, 2003). A progressive delay of the last frost can be observed in the last years.

***Fig. 6** – Box-percentile plots della data di ultima data di gelata tardiva per le 90 stazioni disponibili sul sito Ucea (le linee orizzontali rappresentano il valore massimo, il quartile superiore, la mediana, il quartile inferiore ed il minimo; per ulteriori informazioni su questo tipo di grafico si veda in Easy and Bafield, 2003). Negli ultimi anni si osserva un progressivo ritardo nell'ultimo giorno di gelata.*

tion is represented by water availability. Rainy and moist periods can enhance the risk of fungal diseases.
Sunflower is mainly cultivated in the central part of Italy. Thermal exigences are intermediate between maize and sugar beet; thermal resources expressed as growing degree days (base=10°C) aren't a limiting factor in cultivation areas. Main climatic limitations are represented by water availability, with a risk of thermal stress that is maximum between 20 days before and 20 days after flowering.
Sugar beet is mainly cultivated in the North of Italy. Thermal resources expressed as growing degree days (base=4°C) aren't usually a limiting factor in cultivation areas.
Main climatic limitations are (i) late frost, particularly dangerous in the period immediately after the cotyledons development, with death of plants that can determine the need of re-sowing, (ii) cold during spring with the overcome of the cold needs for floral induction and consequent pre-flowering (iii) rainy periods after summer drought that can enhance re – vegetation with loss of sugar and (iv) drought or excess of water that can produce a degradation of technological characters of roots.
Sorghum is mainly cultivated in the central part of Italy due to its tolerance to drought. Thermal resources expressed as growing degree days (base=10°C) aren't a limiting factor in cultivation area. Water limitation is less important than for maize, which is more productive but also more exposed to water stress.
Temperate fruit trees (Apple, Pear, Peach, Apricot, Plum and Kiwifruit) are mainly cultivated in climatic zones AZ and TZ. Thermal resources expressed as growing degree days (base of about 5°C) can be considered a limiting factor only in mountainous areas (Alps, Apennines).
Late frosts are important limitations during budding and flowering phase. Early frost can be important for kiwifruit. Water availability can be a limitation for kiwifruit and in general where high qualitative standards are expected (areas were cultivation is supported by drip or microjet irrigation). Rainy periods during vegetative period can enhance the risk of fungal diseases.
In AZ area, very mild winters can enhance the risk of insufficient satisfaction of cold needs for species and cultivars with higher needs of chill units.
Subtropical fruit trees (Citrus: Orange, Lemon, Clementine, Mandarin and Tangerine) are only cultivated in the Mediterranean (MZ), where thermal resources expressed as growing degree days (base of about 10°C) aren't usually a limiting factor. Main climatic limitations are (i) winter frost (critical temperature = -2°C) and (ii) drought (irrigation water is needed for industrial cultivations).
Wine grapes vineyards: areas vocated to viticulture are spread in the whole territory (climatic zones AZ, TZ, MZ). Thermal resources expressed as growing degree days (base=7-10°C) aren't a limiting factor in typical cultivation areas. About climatic limitations, late frost isn't normally important due to the late budding of vine. Availability of irrigation water can be a limitation in areas were cultivation is supported by drip or microjet irrigation. Rainy periods during vegetative period enhance the risk of fungal diseases.
Olive trees are typical of the Mediterranean zone (MZ) and of some limited areas in the TZ zone, were climate is mitigated by the effect of pre-alpine lakes. The level of thermal resources expressed as growing degree days (base=10°C) isn't usually a limiting factor for typical zones of cultivation. Main climatic limitation is represented by winter extreme frosts (e.g.: frost of January 1985, February 1956 and February 1929) that can produce the death of plants (critical temperature = -9°C). Availability of water can be a limitation for areas were cultivation is supported by drip or microjet irrigation. Rainy periods during vegetative period enhance the risk of fungal diseases.
Meadows: main climatic limitation for forage production are thermal limitation in AZ zone, thermal and water limitation in TZ and water limitation in MZ. High temperatures and water stress stop the development of graminaceous plants that represent the basis for the final production in the great majority of meadows. The use of irrigation for Alfalfa (*Medicago sativa L.*), at present only exceptionally adopted in TZ zone (the main zone of cultivation of this crop) should enhance due to the increase of drought.
The above-mentioned list is only a very preliminary approach to a theme (the climatic risk for different crops) that should be analyzed in a much more detailed way, considering aspects related to local climates and different species and varieties. The following hazards were excluded from this list, due to their characters of generality or, vice-versa, their excessive specificity:

- Water excess and flooding is a significant hazard for whole cultivated crops, with the obvious exception of rice. The level of risk is higher during vegetative phase and lower during winter rest
- Interferences with the action of chemicals (herbicides, pesticides, etc.) like reduction of efficiency or inactivation or drift effects or induction of fytotoxicity can be produced by particular values of meteorological variables (temperature, relative humidity, solar radiation, rainfall and wind) and are strictly related to active principles or commercial formulations
- Cold and rainy periods during flowering represent a problem for plant pollination, particularly relevant for plants pollinated by insects
- Hail is an important hazard for all herbaceous and arboreal plants. Whole Italian area is exposed to this kind of risk, with strong local variability of risk levels.

The observed adaptation

In our economies the mechanisms of adaptation to climatic risk are always active and this is perhaps one of the better aspects of a free economy. A specific example is given by the cultivation of maize in North Italy. After the climate change of the end of '80 years, a significant increase of the hazard of drought was observed and in the most recent years (particularly after the exceptional drought of 2003) the principal answer of farmers was the adoption of crops (winter cereals like soft wheat and barley) with lower productivity but also with lower level of climatic risk. If this climatic phase will prosecute, it is possible to foresee the expansion of other crops like sorghum and sunflower, but this aspect is strictly dependent on European policies and in particular on the future regime of economic aids to production.

The answer to climatic variability was represented by the abovementioned modification of agrotechniques and crop genetics. The modification of the genetical basis of crops is obviously slower in perennial crops (e.g.: fruit trees and vineyards) but in the last years the speed of genetical innovation is significantly limited also for annual crops, due to the fact that the adoption of the new technology of genetic engineering is forbidden or strongly limited.

In Italian area, the Europen climatic change of the end of '80 years produced an abrupt increase of 1-1.5°C in yearly temperatures for the whole territory and a decrease of about 100-150 mm of yearly precipitation in the Mediterranean areas (a substantial stationarity of rainfall in observed in other areas, with a decrease after 2002). About weather types, an increase of the frequence and persistence of summer heat waves was also observed.

Consequences of these facts are:

- the increase of thermal resources
- the increase of the length of the dry season
- the increase of water irrigation needs.

The abrupt increase of thermal resources produced important effects on natural and cultivated vegetation, with an anticipation of phenological phases and particularly of the spring phases that are primarily influenced by temperature (summer phases are infuenced not only by temperature but also by water availability).

In crops like winter cereals and grapevine, this earliness can be quantified in 10-20 days and this phenomenon enhance the risk of late frost for fruit trees and other crops.

For maize, the increased length of frost free period enables the cultivation of later cultivars (FAO classes 700 or 800); on the other hand a disadvantage is the increase of the number of generations of the European corn borer (Ostrinia nubilaris), the main pest for this crop, which is also responsible for the diffusion of fungal diseases producers of mycotoxins.

Rice cultivation in TZ zone show a gradual transition from submerged rice to irrigated rice.

The main adaptation for fruit trees and vineyards is represented by the increase of localized irrigation in the whole Italian area (for industrial fruit cultivations it is always necessary; a gradual increase is observed in vineyards and olive).

Vineyards of the whole Italian area show:

- an increase of the alcohol concentration in wines
- an increase of cultivation of red varieties in cool zones
- an increase and stabilization of quality for wines produced in extreme areas like Alpine zone.
- Obviously the relevance of these phenomena is significantly influenced by the temporal variability of agrotechniques and wine-making technology.

Some final remarks about the role of Ucea

In the above paragraphs an analysis of climatic risk for Italian agriculture was attempted, giving also an idea of its evolution during the last 50 years and of the strategies of adaptation adopted by the agricultural system. It is evident that the adaptive answer of the agricultural system was rational but was also tardy, with decisions assumed as a result of strong economic losses (an important example is given by the destroy of important stocks of corn grains due to the presence of mycotoxines in the hot summer of 2003).

What should be done by the research system against these problems? Probably, on the base of the new climatic phase, the first necessary action was a timely recalculation of the economic profit of different crops in the light of the new features assumed by climatic risk after the change of 1989. On the other hand, research must be activated on the base of data coming from services that can analyze data from meteo stations and atmospheric circulation, in order to provide early warnings for agriculture.

And now we come to speak about Ucea and its 130° anniversary; Ucea is undoubtedly a research structure (and this is shown by the results of projects like CLIMAGRI and PHENAGRI) but, historically, it is also an agrometeorological service and I think that this vocation must remain also in the future. This evaluation is also the product of a relevant evidence: when the season is colder or warmer than normal the effect is the broadcast of a plethora of news about strong economic damages, damages that are often minimized by the final statistics of the year. This approach to climatic risk in agriculture, often promoted by some professional organizations of farmers, is negative in the short period for consumers (that experiences strong and often unmotivated increases of final prices) but in the medium period is also negative for producers, due to the progressive insensitiveness of public powers to their requests, a fact that is quite dangerous in presence of real emergencies.

This means that it is fundamental the presence of a public observatory finalized to broadcast official information in real time about climatic risk, observed damages and mitigation strategies. In other words an UCEA-CRA well coordinated with regional agrometeorological services and Air Force Meteorological service can guarantee the availability of correct data for the whole territory of Italy.

Acknowledgments

The author thanks prof. Tommaso Maggiore and prof. Osvaldo Failla (Università degli Studi di Milano, Dipartimento di Produzione vegetale) for their useful suggestions and comments.

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