Adaptation of prune growing to increased climatic variability

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CONGRES INTERNATIONAL DU PRUNEAU

Presentation

- Introduction: what is ACMG work?
- Short history of climate changes around Agen
- Visible impacts on the prune industry and means for adaptation?
  - How Science and dialog with producers can help keep going a sustainable production?

INTRODUCTION

Association Climatologique de la Moyenne Garonne et du Sud-Ouest

Experimental Centre for Climate Scourges
Specialized on Fruits and Vegetables

- Agroclimatology
- Applied research on frost, hail, rain, water storage,
- Services for farmers: irrigation, remote sensing, …
- Water management
- Environment

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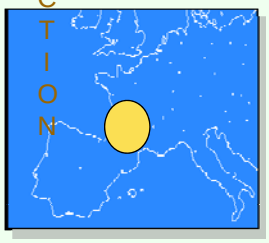
INTRODUCTION

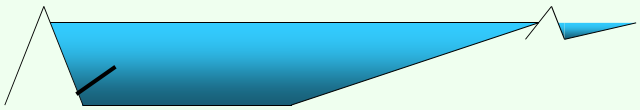
Applied research on climate mitigations

- hail, since 1963
- rain, since 1976
- frost since 1959



Specialized on irrigation management and research on precise irrigation and remote sensing

Applied research on water storage and water management since 1994.



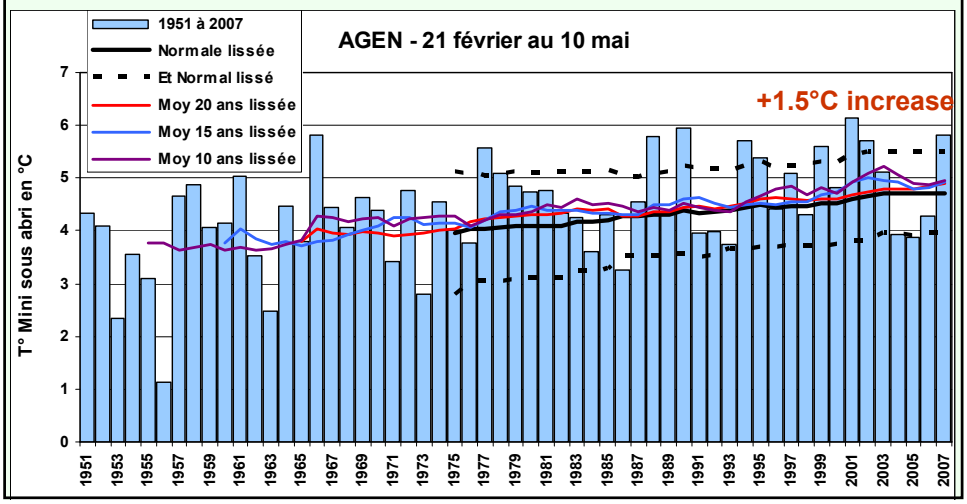
Objective of this workshop

- **To share past experiences in weather impacts on the prune industry**
- **To bring up a rational and scientific strategy for increasing and securing a sustainable production of prune d'Ente**

What are the main climate scourges?

- Frost
- Hail
- Drought
- Soil water saturation (lack of air)
- Wind gusts
- Atmospheric and pollution influences on diseases and insects

Variation of average minimal temperature from 20/02 till10/05 since1951 around Agen



Les conséquences du réchauffement climatique sur la floraison des arbres fruitiers à feuilles caduques

Jean-Michel LEGAVE

INRA, UMR Développement et Amélioration des Plantes, 2 place viala - 34060 Montpellier

legave@supagro.inra.fr

'là, gît la difficulté, que souvent les fruits ne viennent pas tels dans notre lieu qu'en celui dont nous avons tiré la greffe, à cause de la différence des climats'

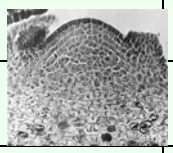
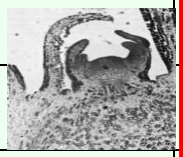
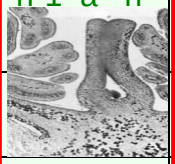
Olivier de Serres, 0

Théâtre d'Agriculture et mesnage des cham

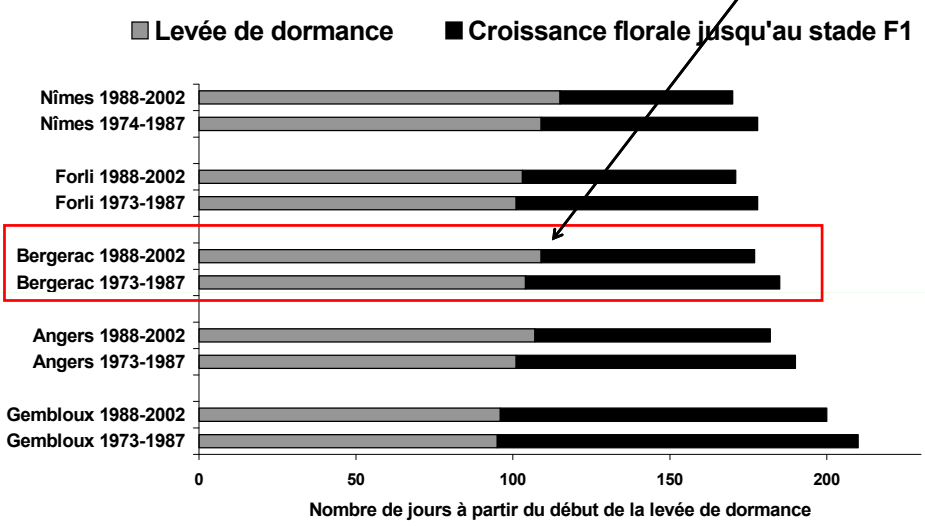
INRA

Institut National de la Recherche Agronomique

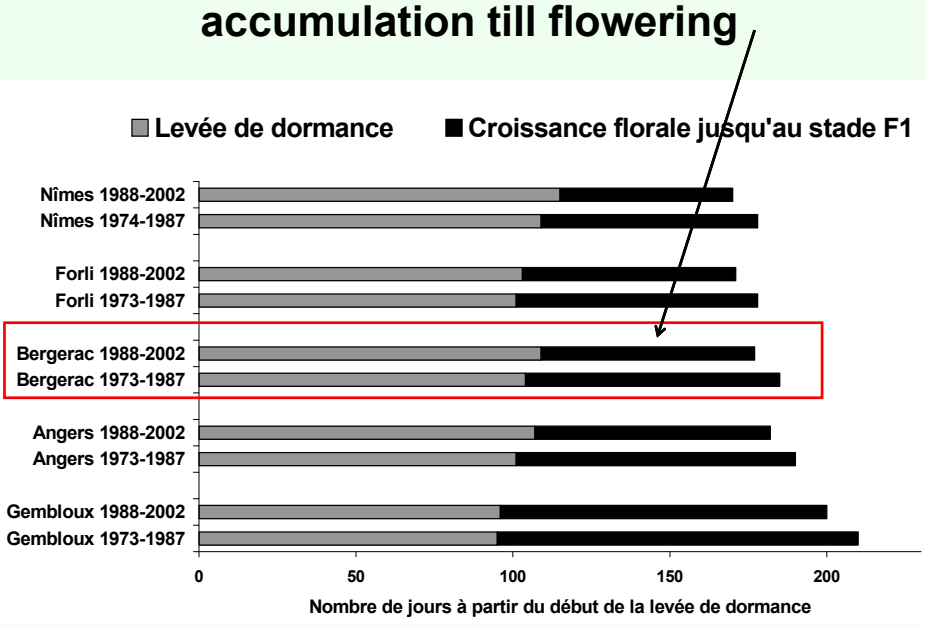
Warm south wave in late winter kills ovaries

Induction florale	Initiation florale	Dormance florale	Croissance florale	Floraison (1ères fleurs)
printemps - été année n-1	été - automne n-1	automne - hiver n-1 à n	hiver - printemps n	hiver - printemps n
				
Contrôle hormonal / croissance Aucun effet direct T°	Croissance ralentie T° élevées (>25°C) peu néfastes	Besoins en T° 'froides' T° élevées (>15°C) néfastes	Besoins en T° 'chaudes' T° optimales en début de croissance = T° modérées	T° élevées favorables/ pollinisation néf. /ovules T° < 0°C néfastes

It needs now more time for the winter chilling



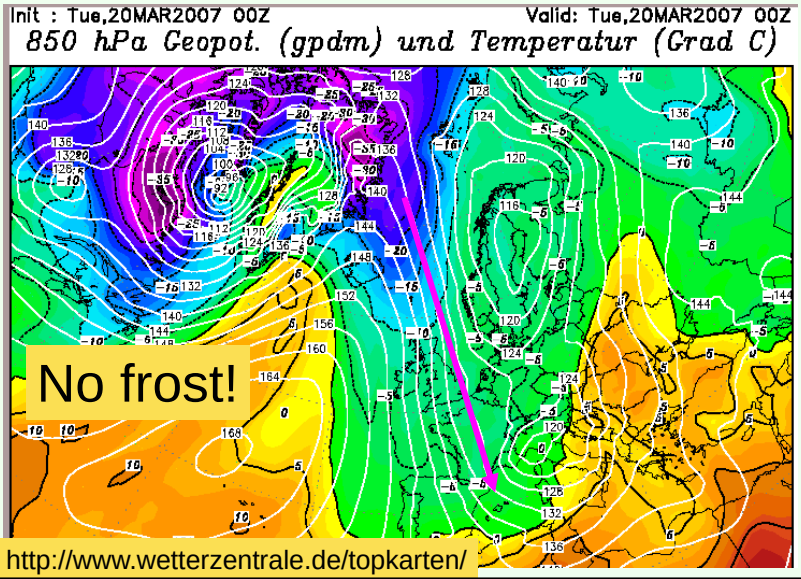
while it takes less time for the post-rest heat accumulation till flowering



A paradox!

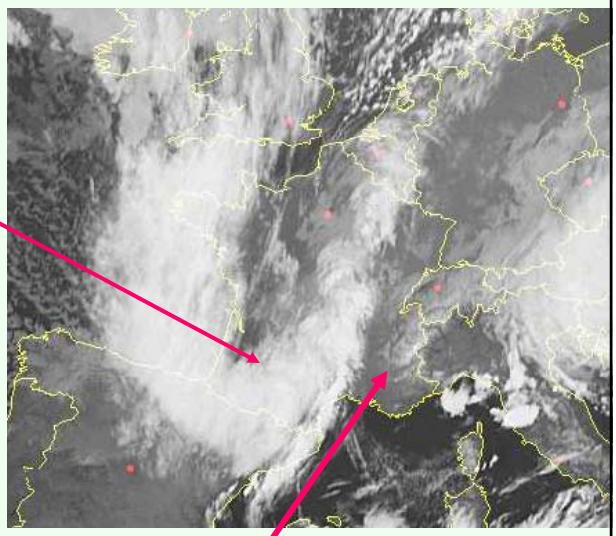
While winter and spring gets warmer, with less nights with frost, the risk of staying along a cold wave persists.

When the cold air comes through the ocean, there is moisture and less risks



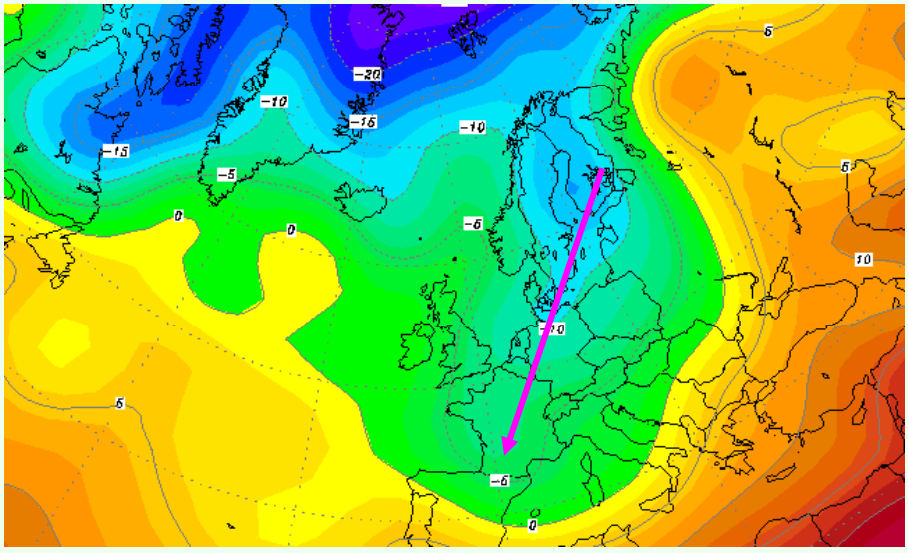
Clouds are reducing heat losses by infra red rays

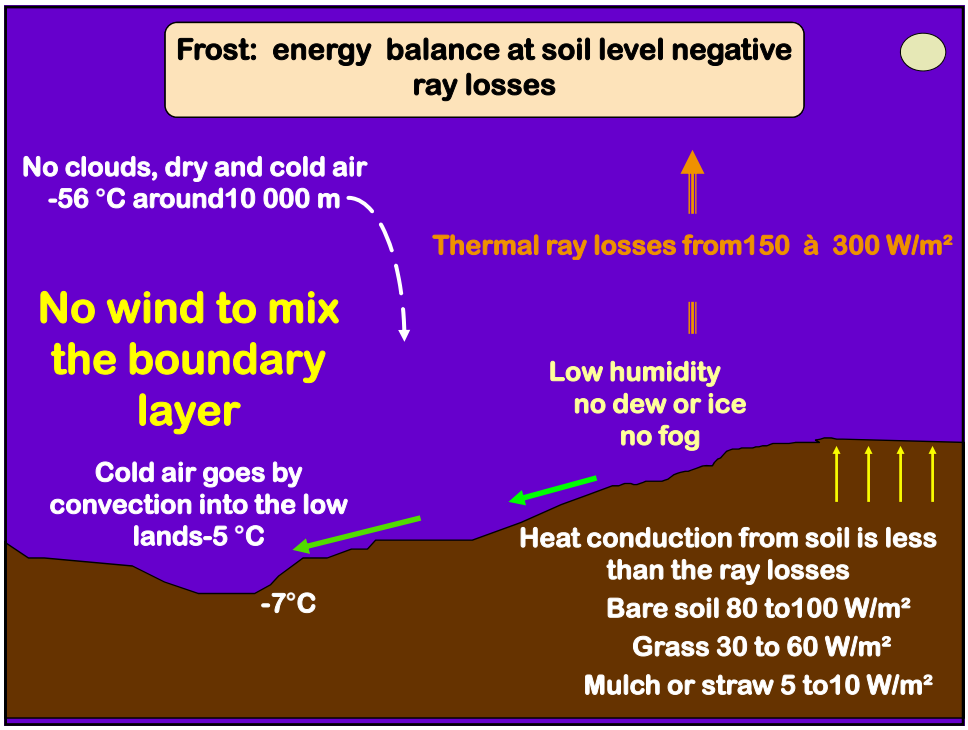
Images EUMETSAT via Topkarten



While here there is frost

When it comes from land, there are more risks as it happened around April 20th 1991





For the future

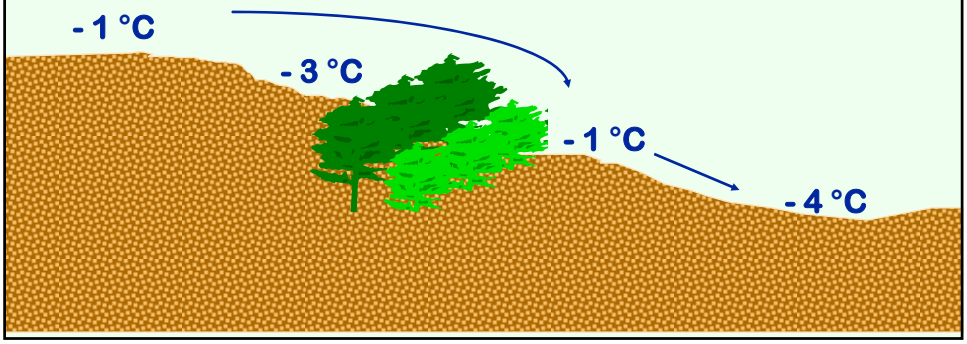
Be prepared to loose one year every 7 or 10 = insurance

Be applying principles of passive frost protection

Be ready for active frost protection

Passive frost reduction: GAIN of + 1 °C

An hedge or wind break will reduce the cold inflow of air produced on near by cold fields
Soil will be maintained as bare as possible for letting the heat conduction to rise at soil level



Active frost reduction: GAIN of + 2 to +3°C

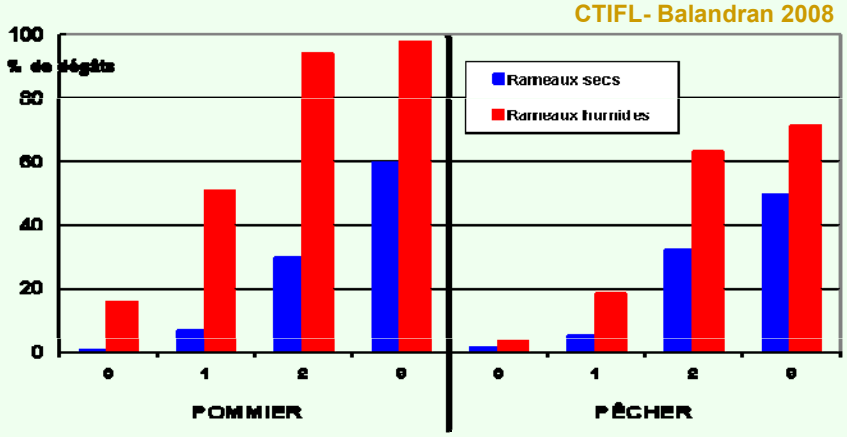
With sprinklers over or under the vegetation
The risk is soil asphyxia

With wind machine of driers (frost buster)
The risk is not enough energy

Drying the vegetation makes it more resistant to frost!

Example of tests showing the increase of damages
Dry vegetation
Moisten vegetation

CTIFL- Balandran 2008



Pommier - variété Golden Delicious - Baisse de température de 1°C par heure et maintien à -2°C pendant 3 heures – Stade H – seuil critique -1,6°C
Pêcher - variété Ivoire® Monnivo cov - Baisse de température de 1°C par heure et maintien à -3°C pendant 3 heure – Stade F – seuil critique -2,2°C

Tools for drying

Wind machine

Frostbusteur

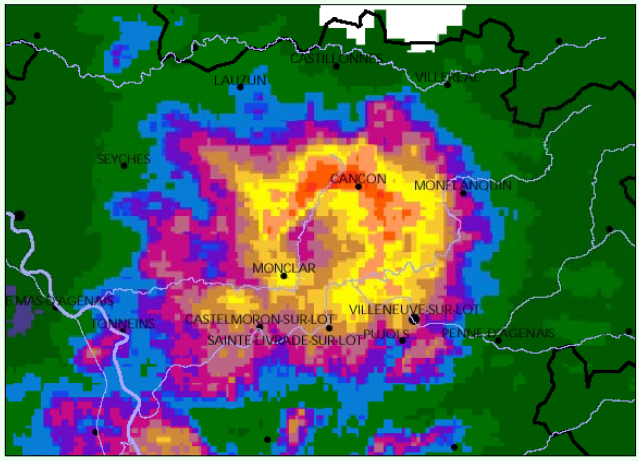
To use also for preventing some diseases and fruit cracking

For the next future

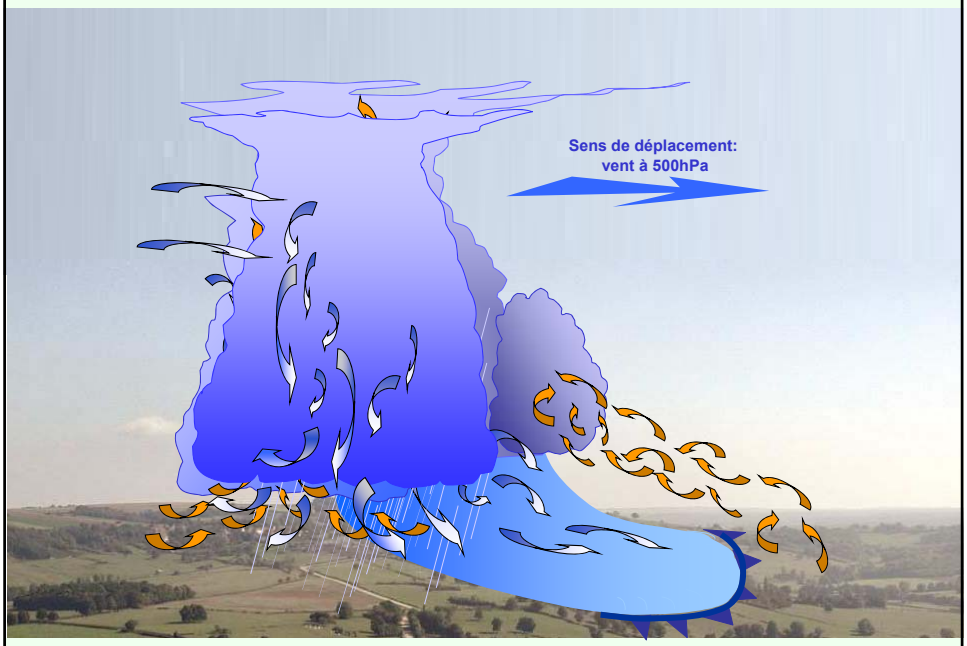
- **Research on ways to increase the natural resistance of trees**
- **Applied research for tree driers**
- **Improve the frost forecasts**

Risks due to storms

- **Hail**
- **Wind gusts**
- **Soil saturation**



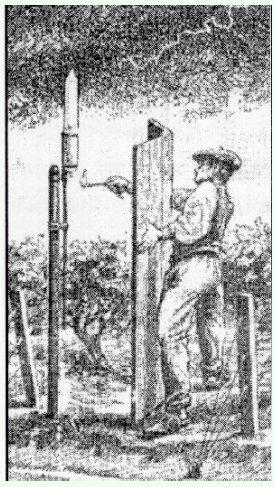
ACMG - Radar picture of super cellular storm on July 2006 over Cancon



With more available energy storms are stronger

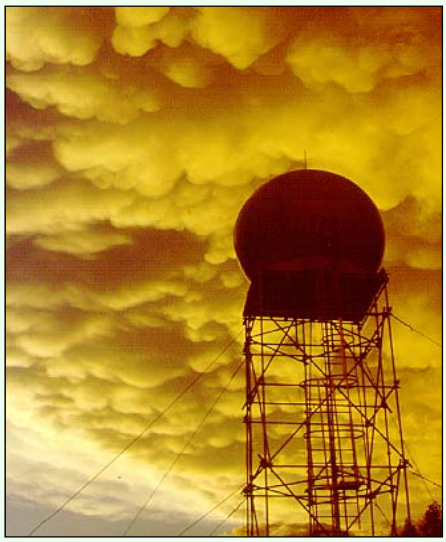
ACMG and weather modification

- **ACMG started hail prevention in 1962/63 using rockets making just a big blow (sound) (Aristotle's hypothesis)**
- **It pushed to put silver iodide (Ice Nucleis) in the small rockets (12 grams) released in the cloud base (1964)**



1981 - 1984

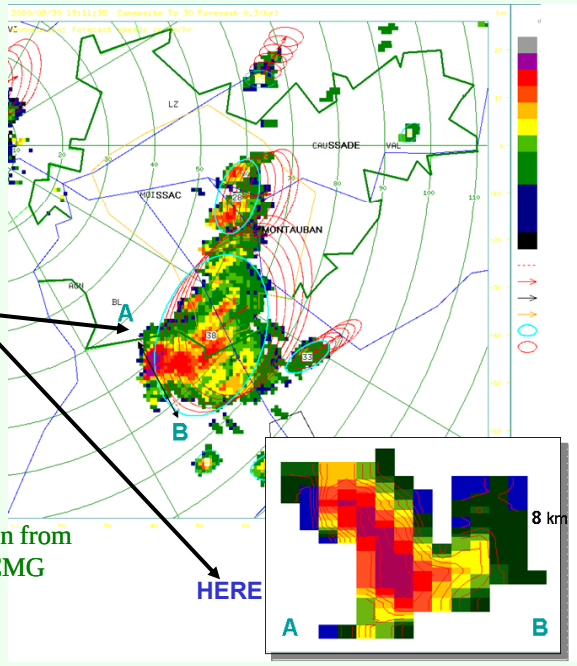
Storm and hail climatology with a 5 cm radar and a network of 500 hail pads and 100 rain gauges with Météo France



Test of hygroscopic seeding

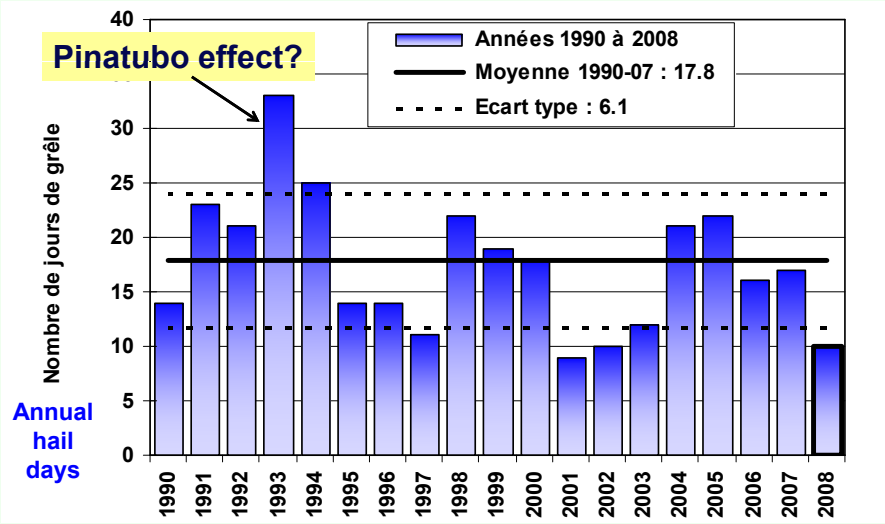
1994 to 2000

Seeding zone



Example of a thunderstorm producing hail.
TITAN presentation from the RADAR of ACMG

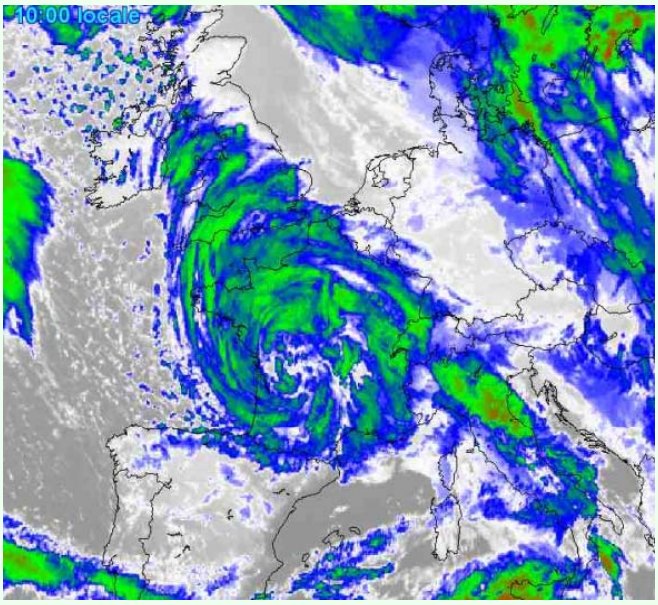
Hail prevention persisted from 1994 till 1998 with two aircrafts and only with one until 2000; but the risk still exist



For the next future

- **Applied research for hail protection with hail nets**
- **Improve the wind protection against gust winds**
- **Look for another type of pruning more adapted for these objectives**

Last example of a wind gust this winter over South-West of France as the Ocean is warmer than usual



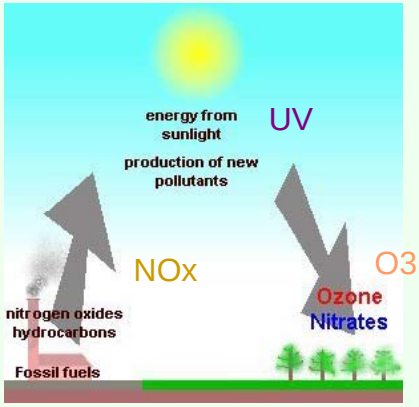
24 01 2009

Climatic changes and others!

- **Pollution by human activities (burning fossil carbons) produces aerosols and gazes as NOx and Ozone that are affecting the trees as they do harm on people.**

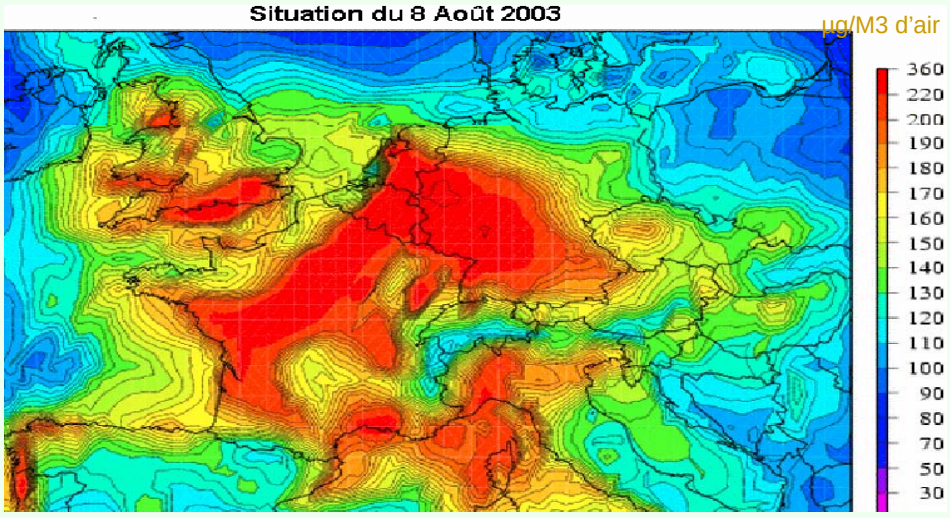
Ozone from low layers oxidizes stomata skins

Jean-François Berthoumieu Février 2006 – ACMG
acmg@acmg.asso.fr



It is not the ozone that protects us form Uvs

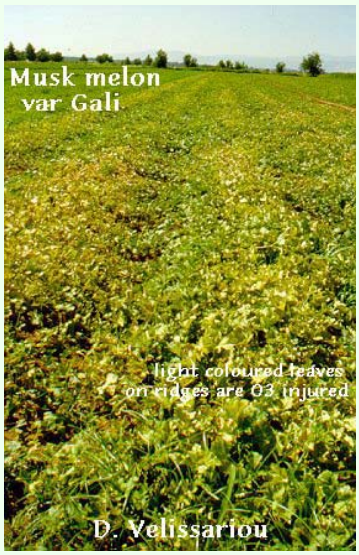
Ozone level on August 8th 2003



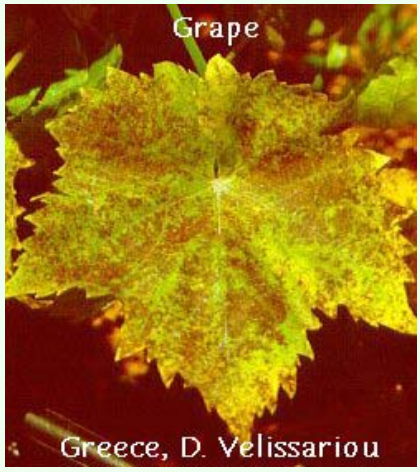
Plants are also breathing this same air

Source Prév'air -INERIS

Examples of impacts



The ideal conditions for bacterial and mushroom type diseases



- http://www.ncl.ac.uk/airweb/

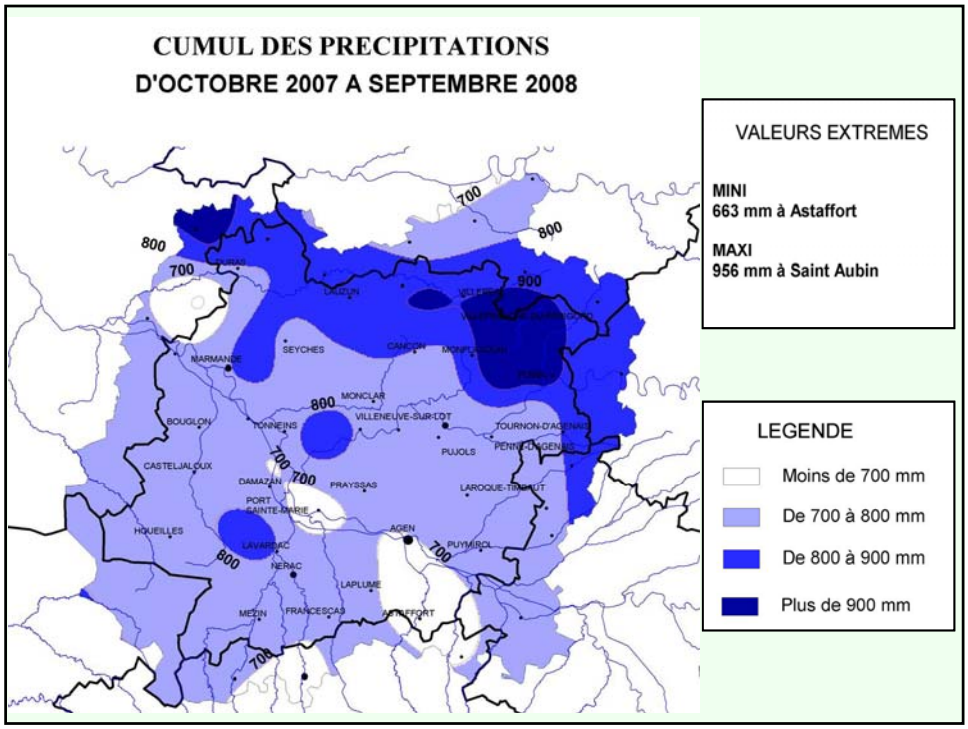
Used as a Bio Indicateur

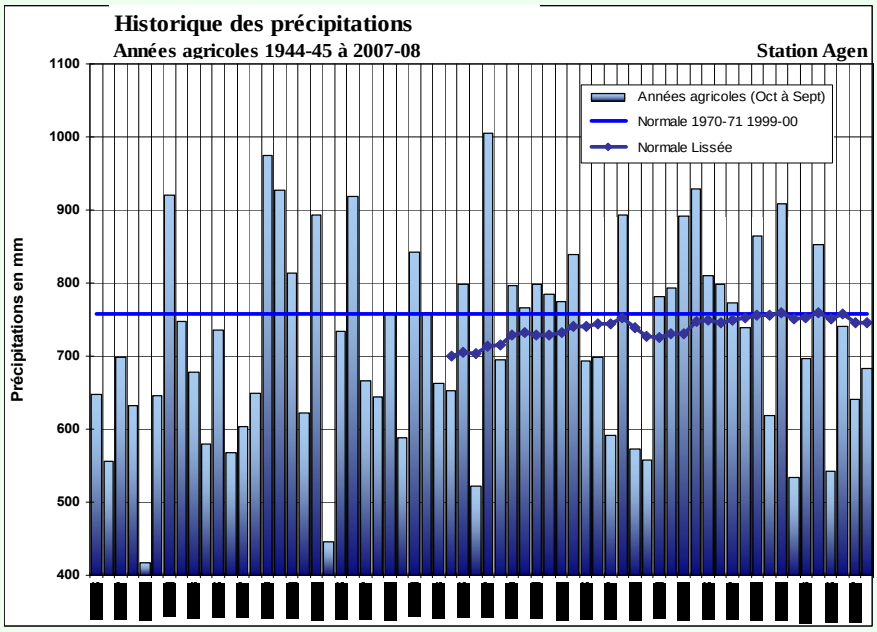
For the next future

- **Applied research for ozone influence on prune productions**
- **To look for means for reducing this negative impact**
- **To look for better adapted varieties**

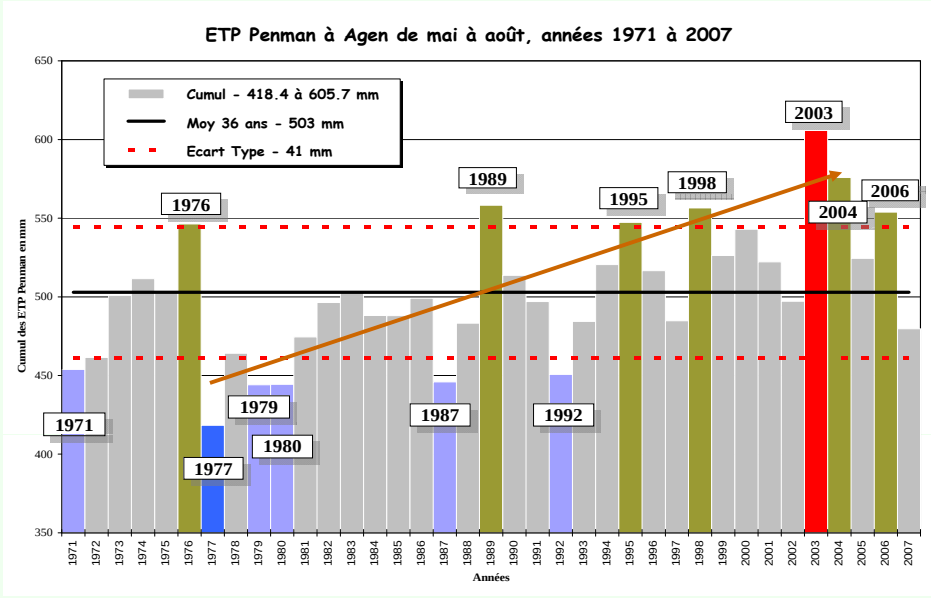
Climatic changes and others!

- **Pollution by human activities (burning fossil carbons) produces aerosols that are reducing the rain efficiency**
- **Natural variability of rain is increased**





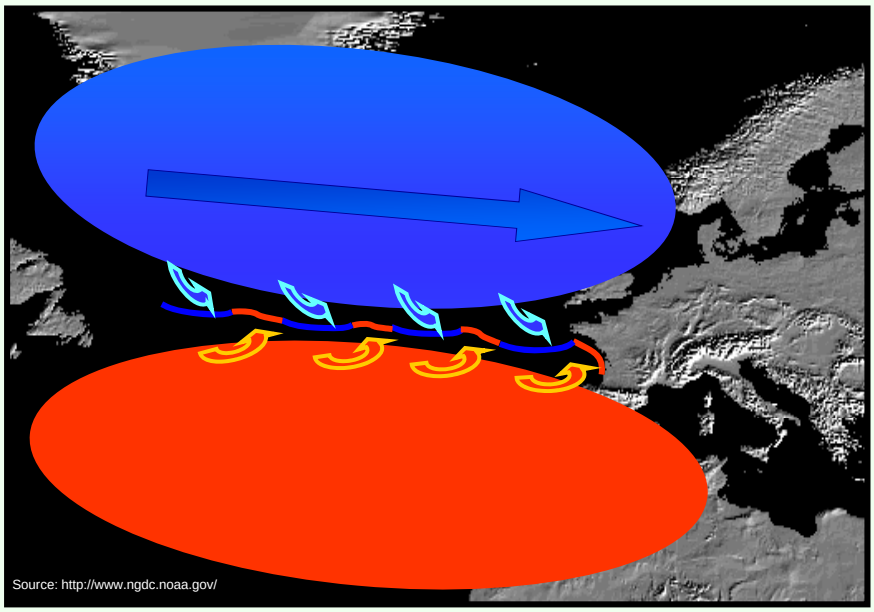
From 400 to 1000 mm of rain on a random way



While the climatic demand (Eto) is increased

It means that:

- **Irrigation is needed every year for maintaining a leveled production**
- **Over year water storage of water shall be developed**
- **Principles of precise irrigation have to be generalized for improving the water efficiency and for avoiding risks of stresses by lack of water or lack of air**

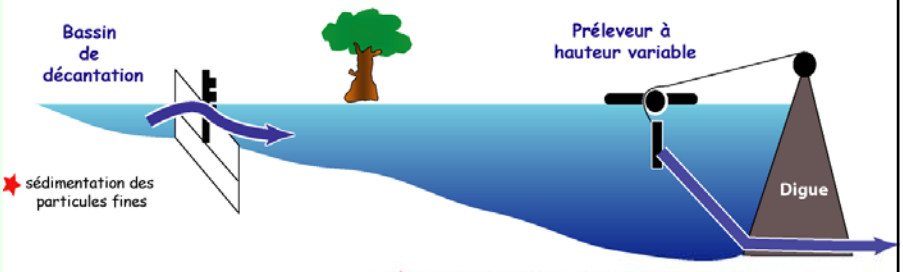


France has not petrol but has blue gold (rain)

Exemple de lac de 2ème génération
Lac du Moulin d'Arasse de 1 million de m³

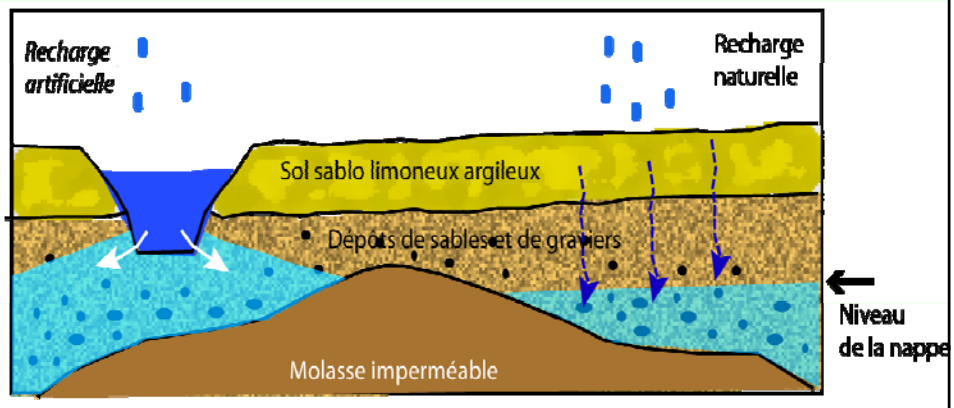
It just need to store more on smarter barrages

De 50 000 m³ à plusieurs millions



- diminution du taux de nitrates d'amont en aval
- rejet d'une eau de meilleure qualité physico-chimique :
  - température de l'eau
  - pH
  - oxygène dissous

Or to start refueling underground storages of recoverable water



Principles of drought mitigation for the prune industry

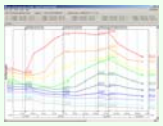
- Irrigation management as already applied by ACMG in the prune area of production.
- Plus research on precise irrigation see at www.precirieg.net
- Plus research on means for extending the precise knowledge of one point over a large area see at www.telerieg.net

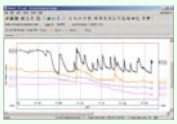
Irrigation management

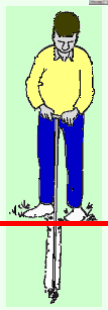
The tools of ACMG and partners

Every week

in continue





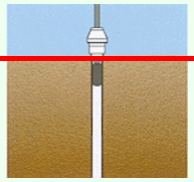


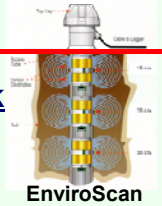
GSM
GPRS

1985

2004

2006





SENTEK

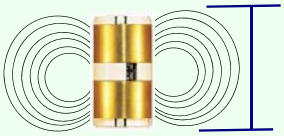
Gravimetric
Neutron probe

Diviner 2000

EnviroScan

EasyAG

Units of sensor output



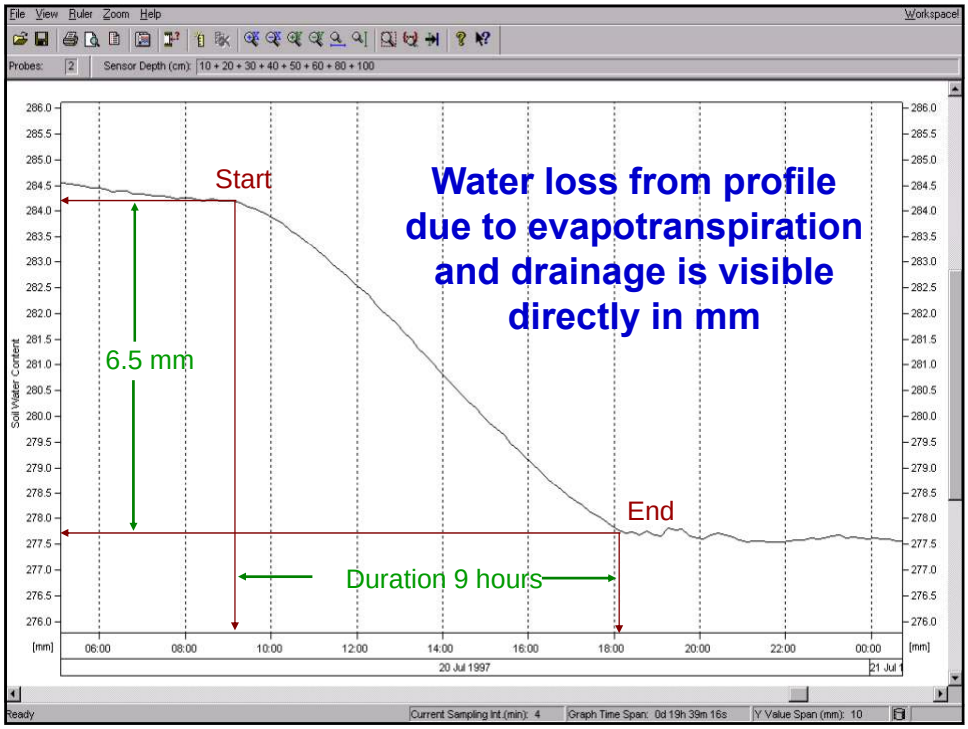
Vertical measurement influence

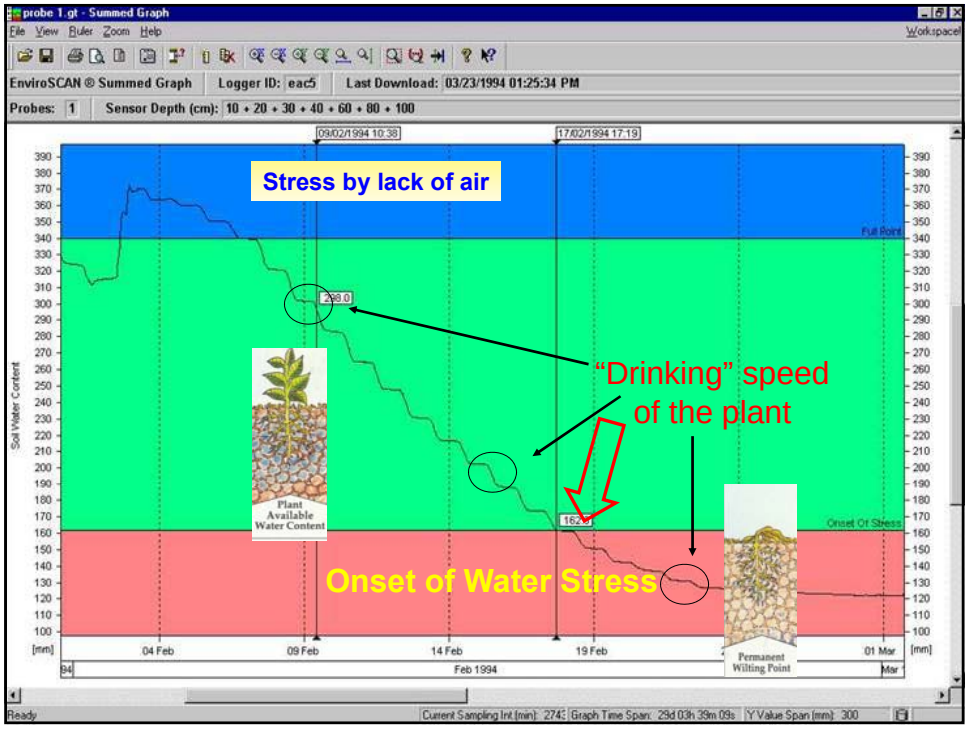
10 cm = 100 mm

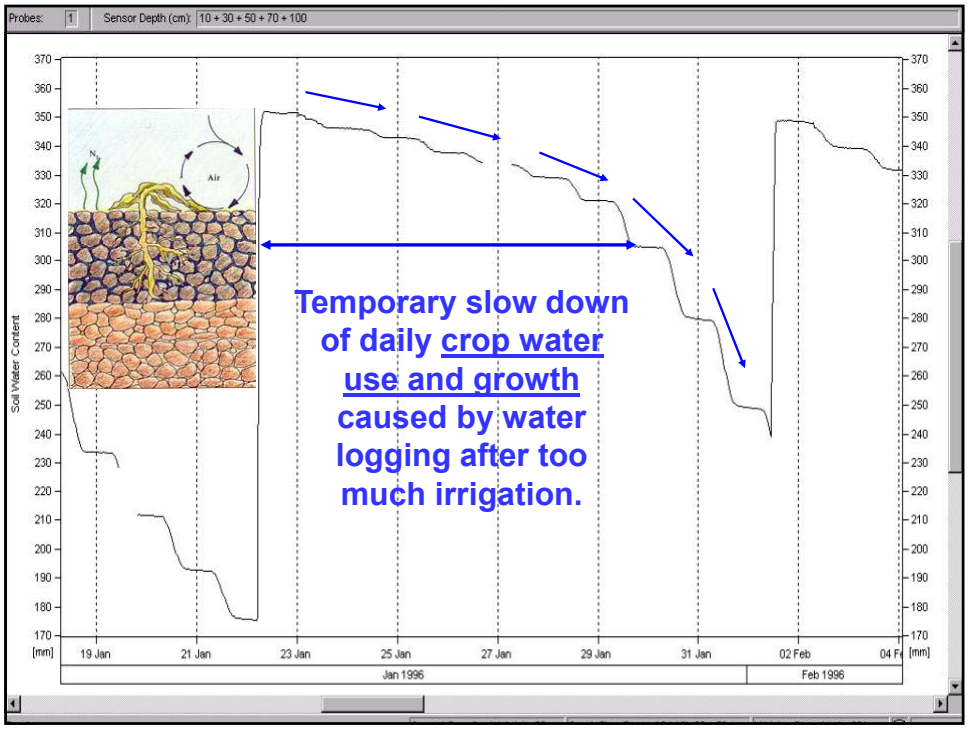
Data from each sensor is expressed as millimetres water per 10 cm soil

mm water / 100 mm soil ≈ % moisture

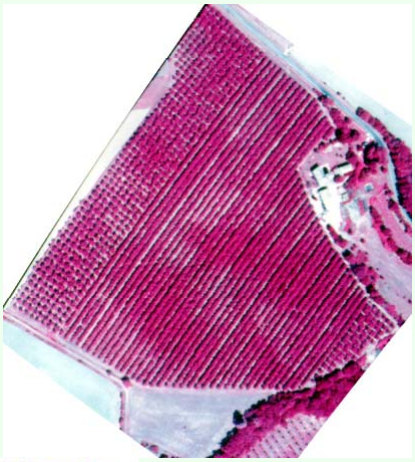
Photo - Bourran

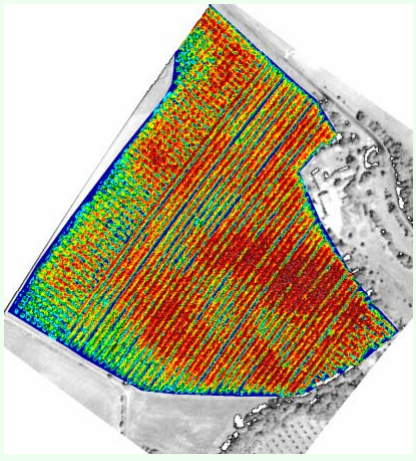

Start
Water loss from profile due to evapotranspiration and drainage is visible directly in mm
6.5 mm
End
Duration 9 hours
Soil Water Content
20 Jul 1997


Stress by lack of air
"Drinking" speed of the plant
Onset of Water Stress
Plant Available Water Content
Permanent Wilting Point
Soil Water Content
Feb 1994

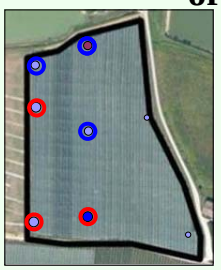


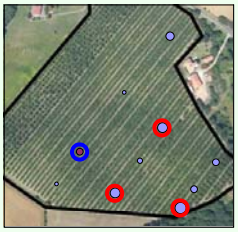
Soil heterogenity is taken into account

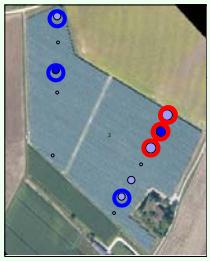


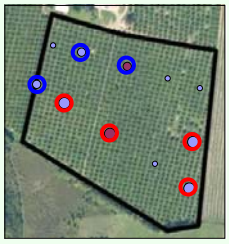


Protocol for the determination of the location of the probe



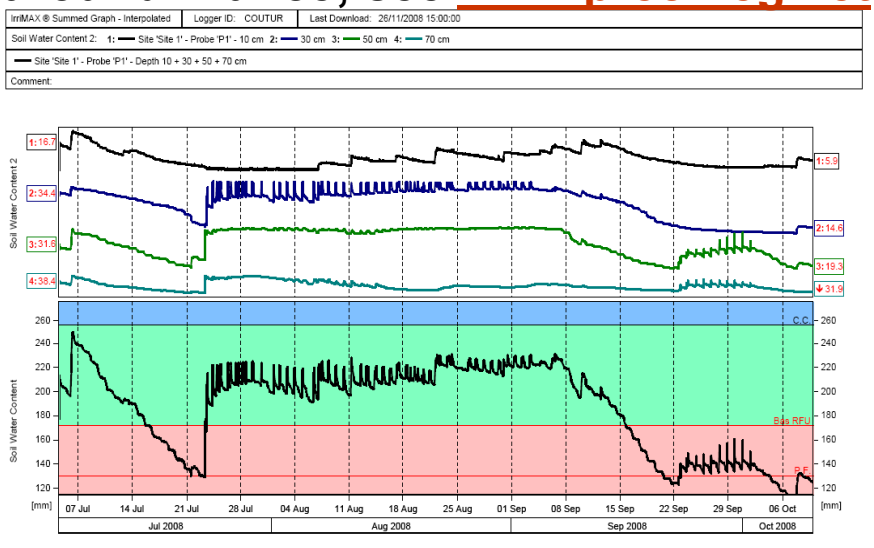




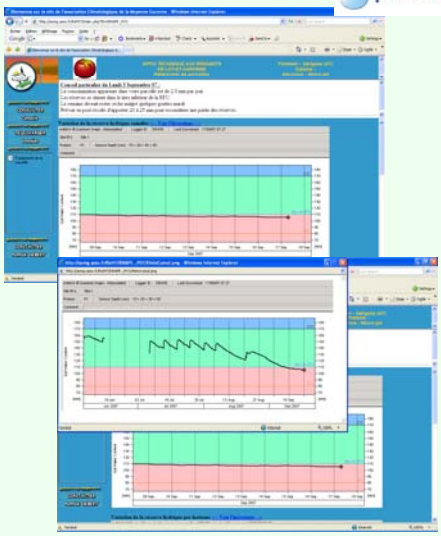


2007 - 2008

Allowing to apply principles of precise irrigation over more than 100 farms around France; see www.precirieg.net



Using Internet as a mean for transferring to the fields



Ap duel

La d n 2009

Association Climatologique
de la Moyenne-Garonne
Aérodrome d' Agen
47520 Le Passage
Tél 05.53.77.08.40
Fax 05.53.68.33.99

APPUI TECHNIQUE AUX IRRIGANTS
Campagne 2007

Bulletin n° 8 Expédié le Lundi 9 Juillet 07
Suivi par 07 - C. CAZENAVE

Parcelle n° 01 "Loys"
Culture Prune Enherbé P1
Variété 707
Densité 6 X 7
Situation Coteau
Nature du sol Boulbènes
Date de semis ou de plantation 1986
Mode d'irrigation Asp. Sous Frondaison 3.5 mm/h
Profondeur de l'échantillonnage en cm 70

Irrigant n° A022
M. Serge BARRET
"Gagne"
47210 MAZIERES NARESSE

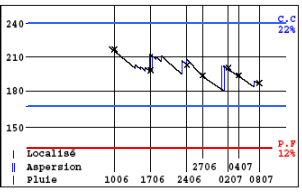
Réserve Facilement Utilisable en mm RFU = 72
Réserve Utilisable en mm RU = 108

Taux d'humidité en %
Maximum (C.C.) 22
Minimum (P.F.) 12

Mesuré le Lun. 9 Juillet 07

Déficit en mm	X 53
Horizons	Réserves en mm % %
0-20	42
20-40	50
40-60	59
60-70	36

X secteur sonde



CONSEIL PARTICULIER

Envoyé par Fax : 05.53.01.47.61

La consommation apparente dans votre parcelle est de 3.0 mm par jour.

Les réserves se situent dans le tiers inférieur de la RFU.

La pluie de dimanche n'a réhumidifié que très superficiellement.

Le temps reste instable jusqu'à mercredi avec des risques d'averses.

Aussi attendre à mercredi-jeudi pour une irrigation qui sera à moduler selon les cumuls de pluie.

Apporter entre 15 et 25 mm.

Difficulties

Principles of Nordic Anglo-Saxon ecology are applied all around the world making more difficult the water management in new like Mediterranean zones as we are here concerned because of the climatic change

For the next future

- **To apply principles of precise irrigation (maybe RDI) on much more surfaces**
- **To develop and to write down principles of a Mediterranean Ecology where intelligent management of water is possible**

Gracias

MERCI

Thank you

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