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## Microclimate patterns in an agroforestry intercropped vineyard: First results

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# Microclimate patterns in an agroforestry intercropped vineyard : first results

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(1) UMR CESBIO, University Paul Sabatier, Toulouse, France

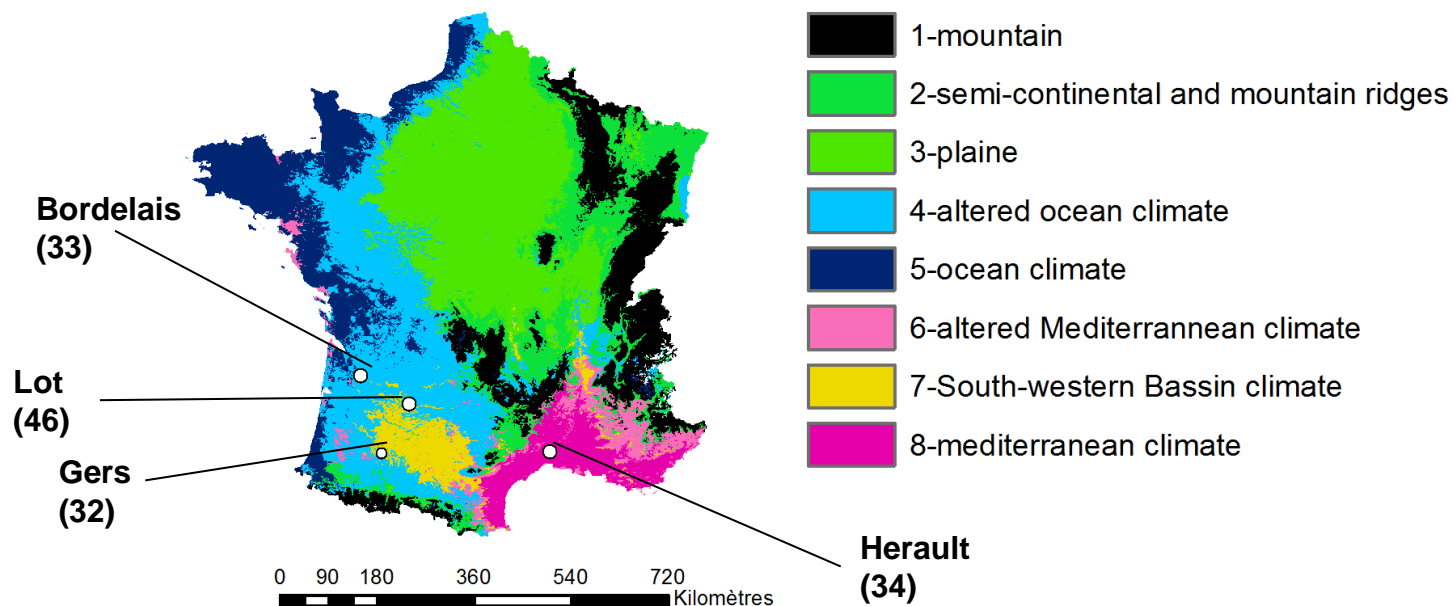
(2) UMR GEODE, University Jean Jaures, Toulouse, France

(3) UMR DYNAFOR, INP-ENSAT, Toulouse, France



Vitiforest

# Vitiforest research project



Joly, Daniel, Thierry Brossard, Hervé Cardot, Jean Cavailhes, Mohamed Hilal, and Pierre Wavresky. 2010. "Types of Climates on Continental France, a Spatial Construction." *European Journal of Geography*. doi:10.4000/cybergeog.23155.



**Vitiforest**

# Vitiforest research project



*Lagardere (32)*



*Lapouyade(33)*



*Lagrezette(46)*



*Restinclières  
(34)*



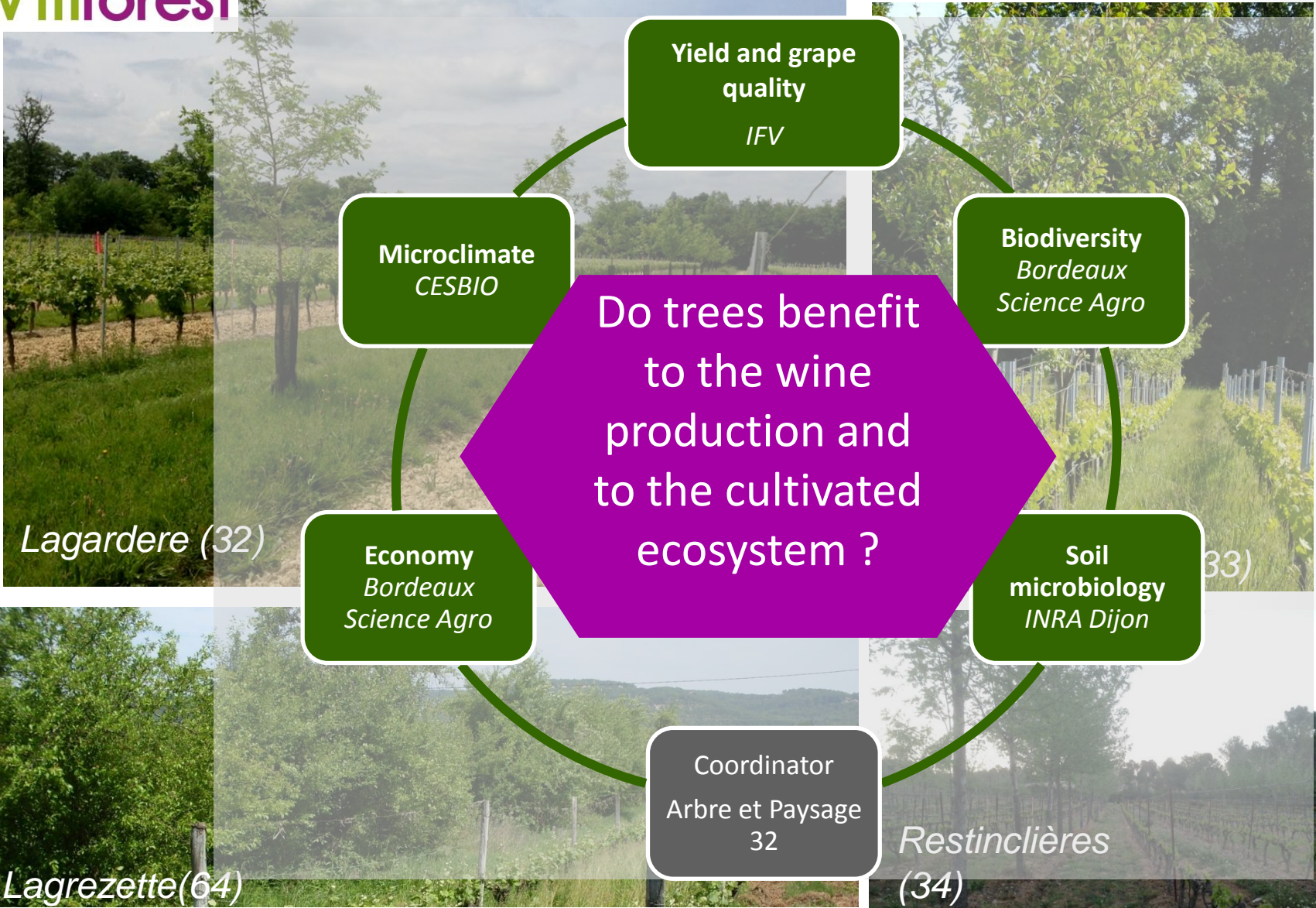
MINISTÈRE  
DE L'AGRICULTURE  
DE L'AGROALIMENTAIRE  
ET DE LA FORÊT

Avec la contribution financière  
du compte d'affectation spéciale  
développement agricole et rural.



**Vitiforest**

# Vitiforest research project



Avec la contribution financière du compte d'affectation spéciale: développement agricole et rural.

# Vine faces climatic challenges

## Climate dynamics

Vine transpiration → Temperature regulation

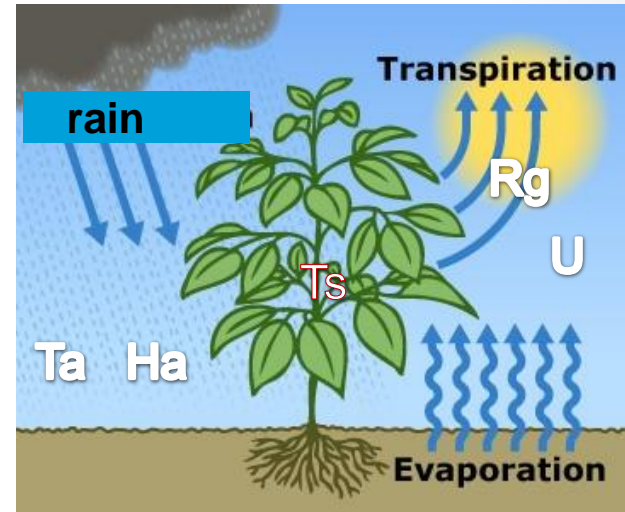
## Extreme events

Extreme temperatures may cause irreversible damage.

Heat waves and droughts may become more frequent and intense in future years (IPCC, 2014)

## Tree regulatory potential

- Water availability
- Transpiration
- Shade
- Wind interception
- Heat radiative transfers



# Main questions

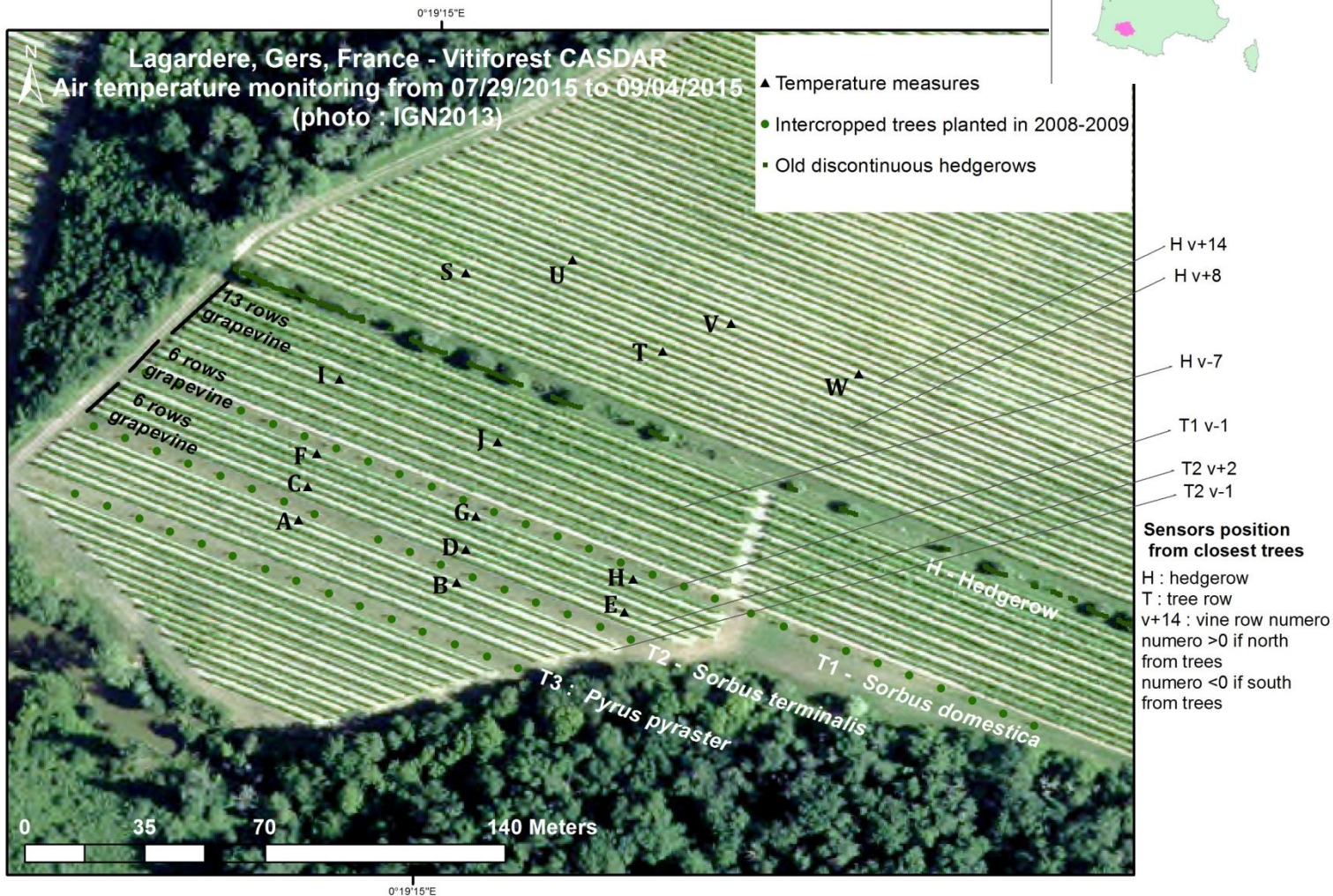
**What is the impact of intercropped trees on temperature dynamics and extreme values ?**

**What is the spatial extent of their effects ?**



# Summer 2015 : a test campaign in Lagardère (32)

1 domain – 15 sites





# Summer 2015 : materiel and method

## Plot

1 domain – 15 sites

## Measures

17 Tair measures (2 repetitions)

36 days from 07/29 to 09/04/2015

Frequency = 20'

Accuracy =  $0.5^{\circ}$  C

Meteo reference in Auch

## Analysis

Rewriting by rolling mean

Sorting daytypes

Daily means and metrics calculation

Classification (Hierchical Cluster Analysis)



# Summer 2015 : classification results

Are the temperature dynamics similar between sites ?

a. Overall time series

b. Daily Mean TS

c. Daily standard deviation TS

d. Daily range TS

e. Daily Minimum TS

f. Hour when min is reached TS

g. Quantile 10% TS

h. Ratio  $T < 15^{\circ} C$  TS

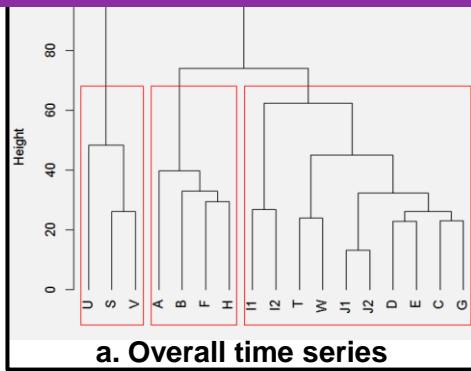
i. Daily maximal TS

j. Hour when max is reached TS

k. Quantile 90% TS

l. Ratio  $T > 35^{\circ} C$  TS

# Summer 2015 : classification results



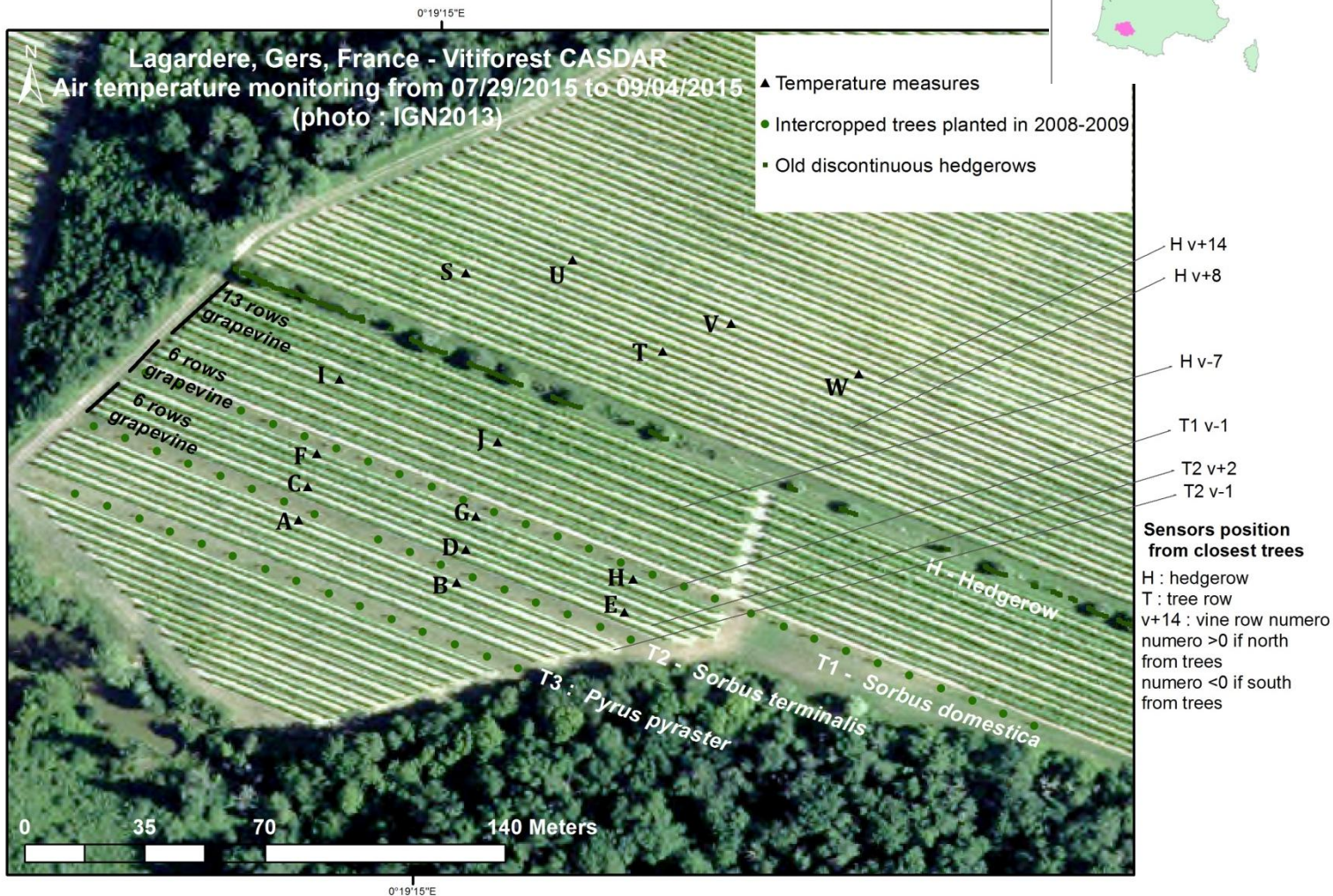
b. Daily Mean TS	c. Daily standard deviation TS	d. Daily range TS

e. Daily Minimum TS	f. Hour when min is reached TS	g. Quantile 10% TS	h. Ratio $T < 15^{\circ} C$ TS

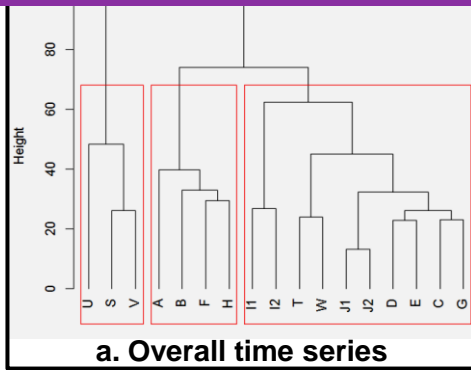
i. Daily maximal TS	j. Hour when max is reached TS	k. Quantile 90% TS	l. Ratio $T > 35^{\circ} C$ TS

# Summer 2015 : a test campaign in Lagardère (32)

1 domain – 15 sites



# Summer 2015 : classification results



→ What are the main climatic parameters responsible for these clusters ?

b. Daily Mean TS

c. Daily standard deviation TS

d. Daily range TS

e. Daily Minimum TS

f. Hour when min is reached TS

g. Quantile 10% TS

h. Ratio  $T < 15^{\circ} C$  TS

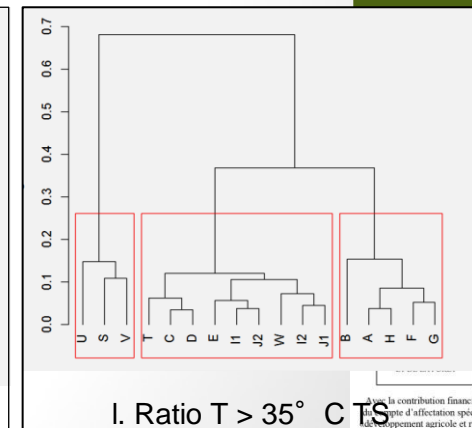
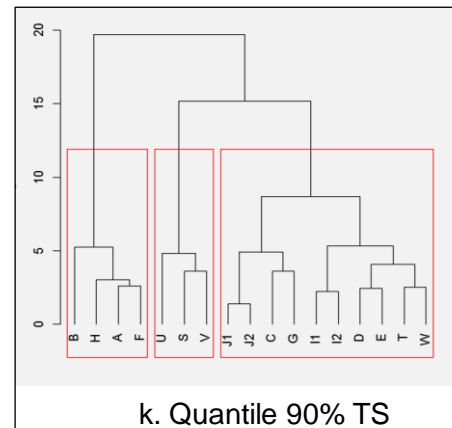
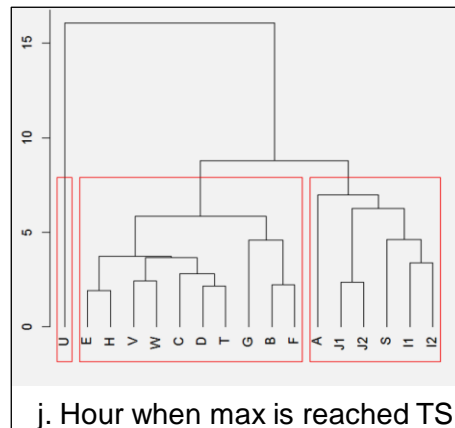
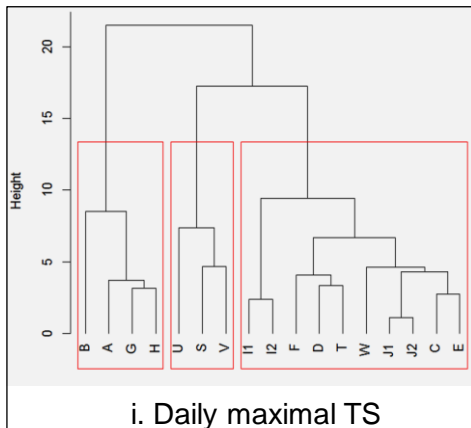
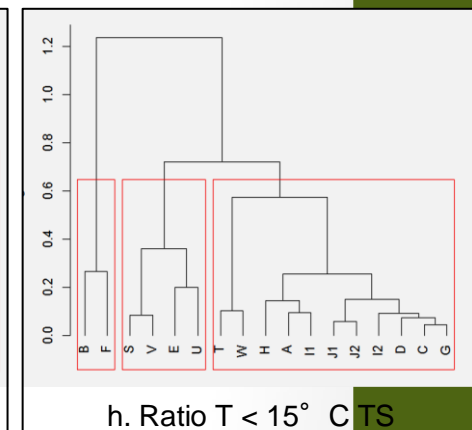
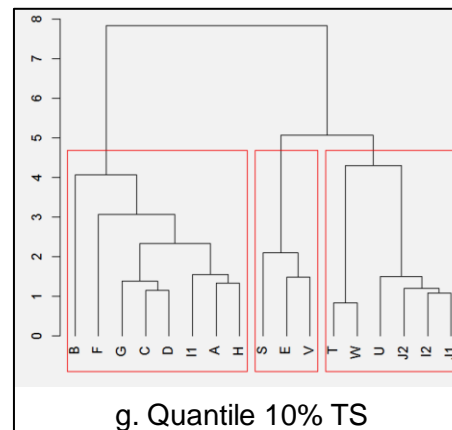
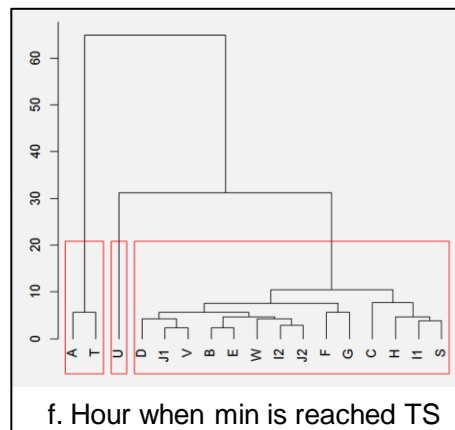
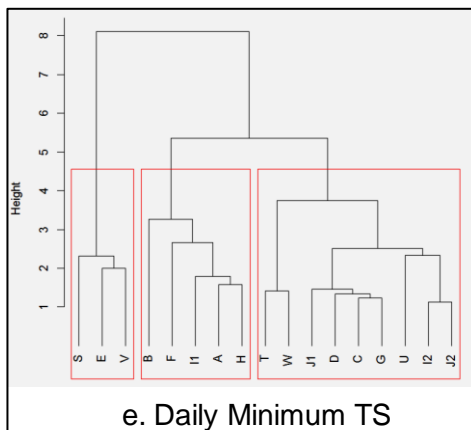
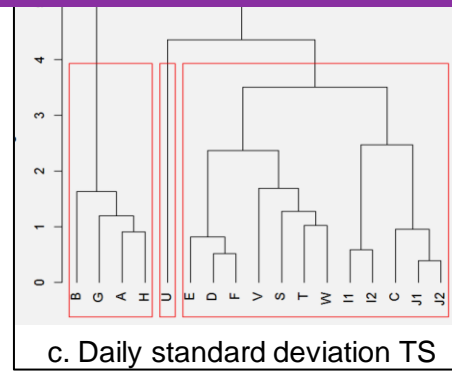
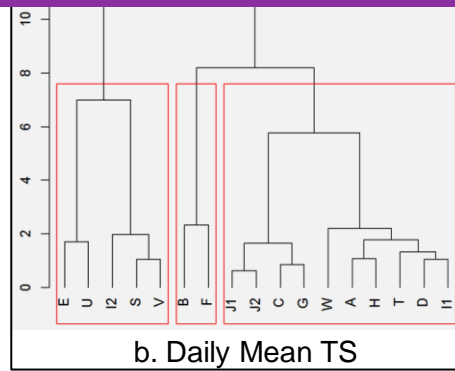
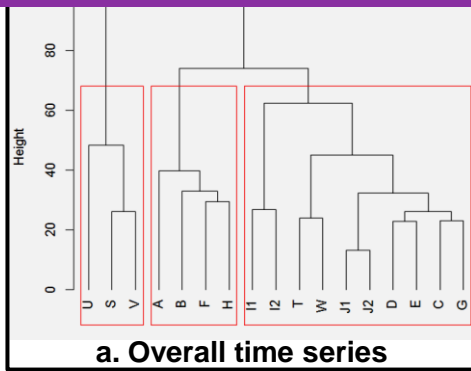
i. Daily maximal TS

j. Hour when max is reached TS

k. Quantile 90% TS

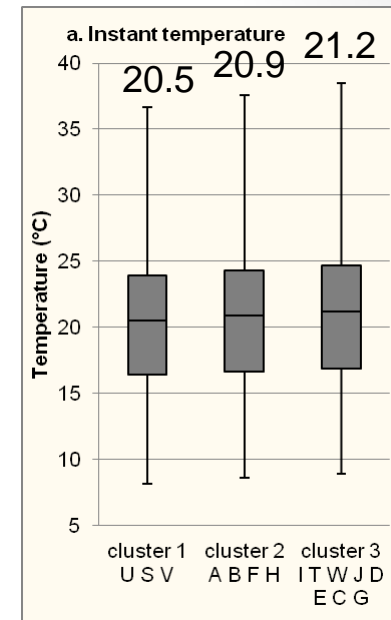
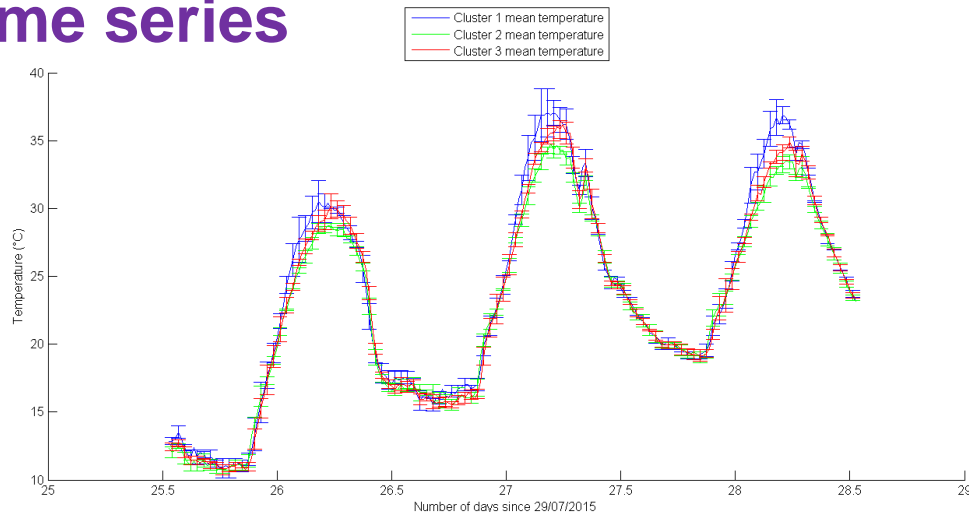
l. Ratio  $T > 35^{\circ} C$  TS

# Summer 2015 : classification results

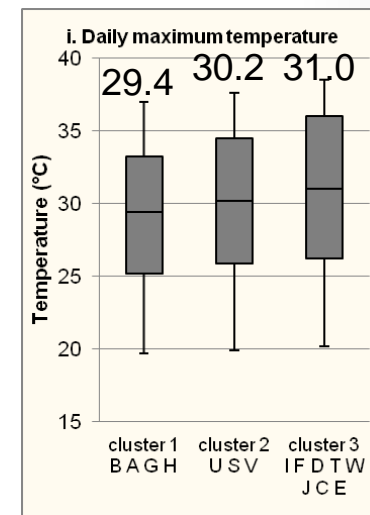
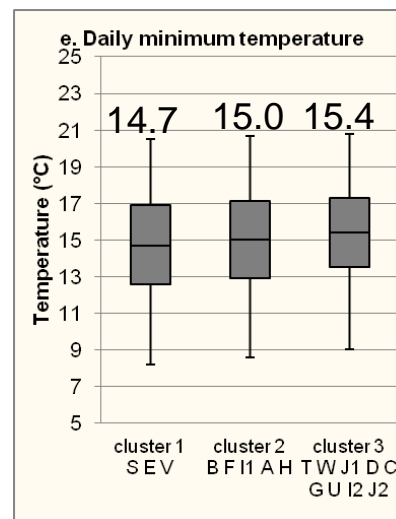
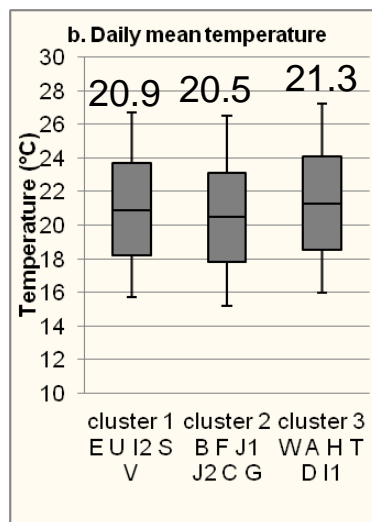


# Summer 2015 : climatic patterns

## Overall time series

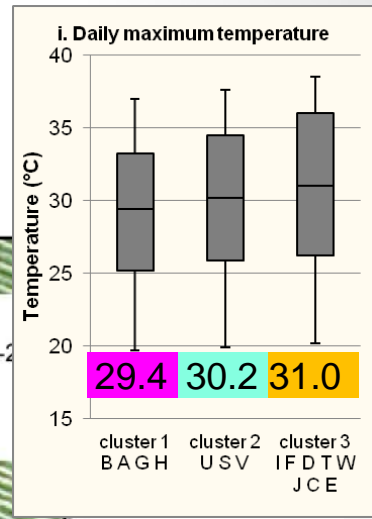


## Daily mean, minimum and maximum





- Intercropped trees planted in 2008-2012
- ▬ Old discontinuous hedgerows



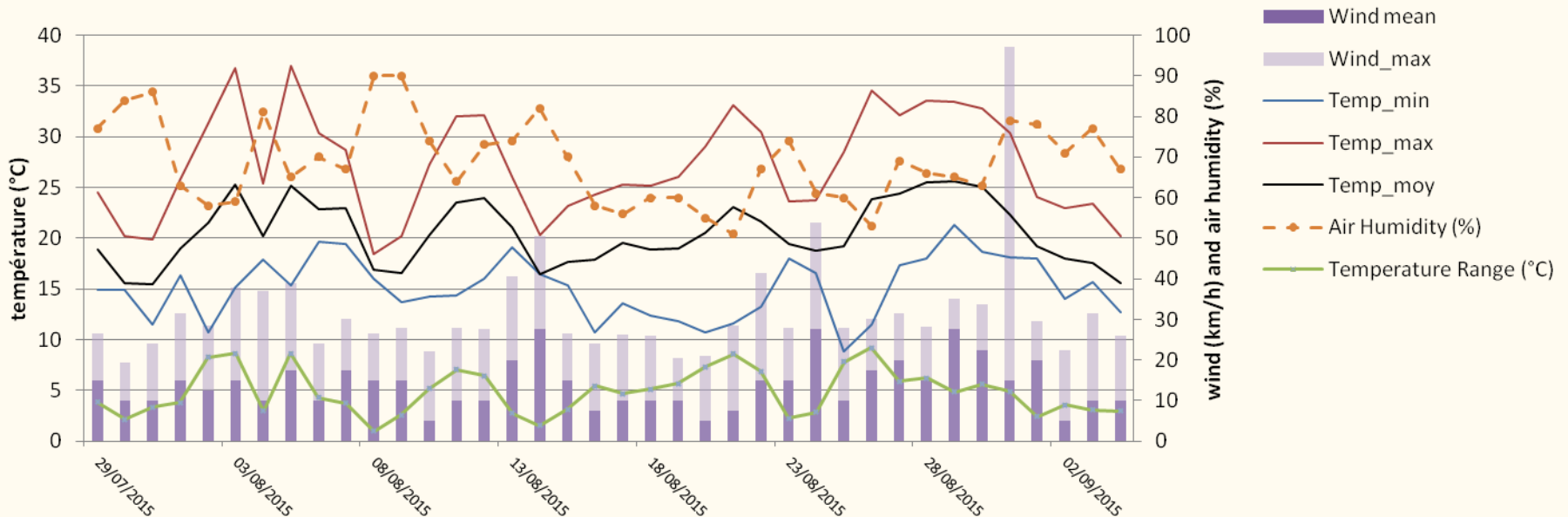
H v+8  
 H v-7  
 T1 v-1  
 T2 v+2  
 T2 v-1

**Sensors position from closest trees**  
 H : hedgerow  
 T : tree row  
 v+14 : vine row number  
 number >0 if north from trees  
 number <0 if south from trees



# Summer 2015 : wheather influence

Climate records at Auch meteorological station (25 km)



## Classification of day types

Wind speed classes X Solar duration classes

Nb days type 1 : cloudy and no wind days	11	29%
Nb. days type 2 : mixed or sunny and no wind days	15	39%
Nb. days type 3 : sunny and windy days	12	32%

# Daily mean

Mean TS		Min	Max	Mean	Std.
DayType1	Cluster 1 : A C D G H I1 T W	15.56	23.89	19.29	2.86
	Cluster 2 : B F	15.12	23.21	18.88	2.87
	Cluster 3 : E I2 J S U V	15.74	24.25	19.57	2.87
DayType2	Cluster 1 : A C D G H I J S T V W	16.28	25.28	20.54	2.61
	Cluster 2 : B F	15.57	24.91	20.12	2.67
	Cluster 3 : E U	16.50	24.89	20.90	2.70
DayType3	Cluster 1 : A B D E F H I1 T W	15.66	26.81	22.40	3.27
	Cluster 2 : C T J	17.43	26.81	22.66	3.07
	Cluster 3 : I2 S U V	16.77	27.33	22.99	3.32

# Daily minimum

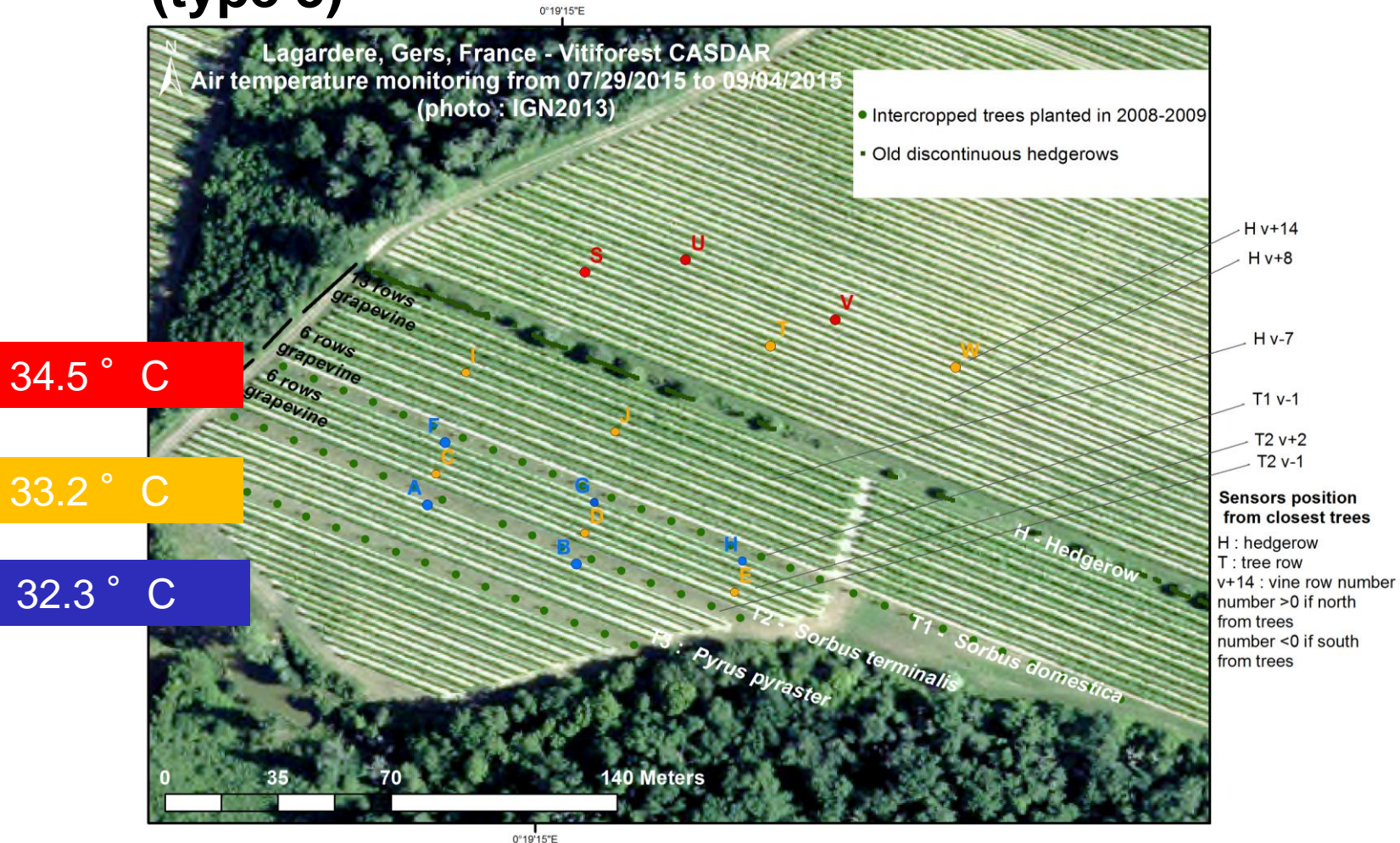
Minimum TS		Min	Max	Mean	Std.
DayType1	Cluster 1 : A C D G H I1 T W	11.50	18.60	15.08	2.33
	Cluster 2 : B F	11.00	18.10	14.76	2.37
	Cluster 3 : E I2 J S U V	11.60	19.00	15.41	2.28
DayType2	Cluster 1 : A B F	8.00	19.10	14.16	2.77
	Cluster 2 : C D E G H I J T U W	8.50	19.10	14.53	2.72
	Cluster 3 : S V	9.00	19.50	14.98	2.72
DayType3	Cluster 1 : A B C D F G H I J T	10.00	21.10	15.35	3.20
	Cluster 2 : E S V	11.00	21.00	15.83	3.10
	Cluster 3 : U W	10.00	20.60	15.34	3.19

# Daily maximum

Maximum TS		Min	Max	Mean	Std.
DayType1	Cluster 1 : A D F G H J T	19.00	36.60	27.15	5.10
	Cluster 2 : B	19.00	35.00	26.08	5.10
	Cluster 3 : C I S U	20.00	37.00	27.65	4.94
	cluster 4 : E V W	19.00	37.50	27.70	5.48
DayType2	Cluster 1 : A B G H	22.50	36.10	28.79	3.69
	Cluster 2 : C D E G J T W	23.00	36.60	29.42	4.01
	Cluster 3 : I S U V	24.00	37.00	30.11	3.97
DayTypes	Cluster 1 : A B F G H	23.50	38.00	32.26	4.01
	Cluster 2 : C D E I J T W	23.50	38.50	33.22	3.92
	Cluster 3 : S U V	25.00	39.50	34.45	4.34

# Summer 2015 : weather influence

## Daily maximum temperatures during warmest days (type 3)



# Conclusion on 2015 results



Maxima temperatures may be mitigated by tree rows right next to vine rows



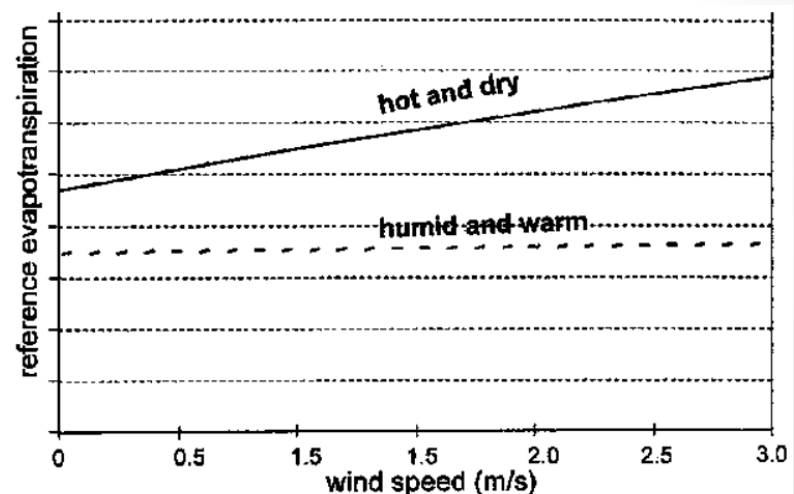
High variability of measurement



Air humidity should be considered in day type classification

Effect of wind speed on evapotranspiration in hot-dry and humid-warm weather conditions

(Chapter 3, Meteorological Data – FAO – online - <http://www.fao.org/docrep/x0490e/x0490e07.htm>)



# Coming soon : 2016 campaign

## A more complete trial

3 vineyards

100 plots

Soil and air temperatures and HR

Continuous records from March to September

Spatialised wind speed

Spatialised solar radiation

## What do drones bring us ?

infra-red thermal images at 20 cm of resolution

2 NDVI captures

→ to calibrate and validate a statistical model

RGB - Domaine de Restinclières (34)



NDVI - Lapouyade (33)



Thank you for your attention !

