



# Sampling comparison among Hirst spore traps of the same model

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# Introduction

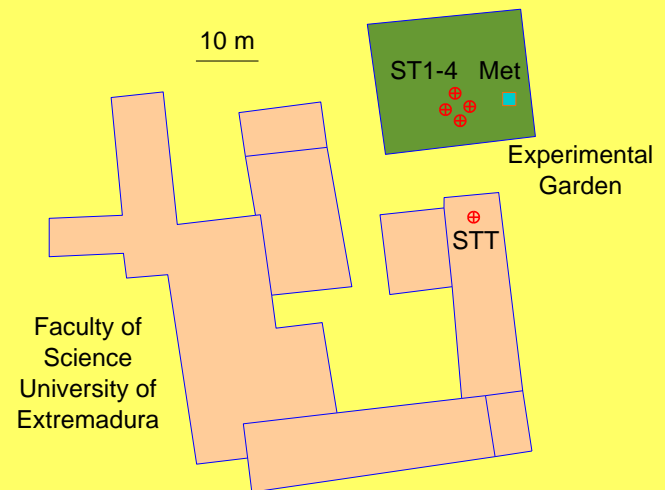
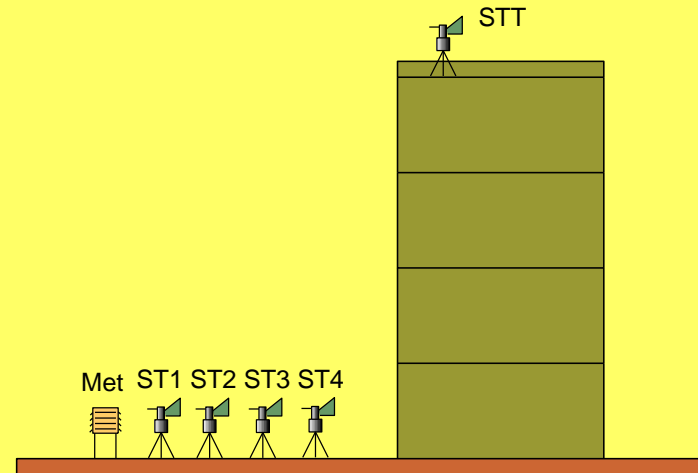
- Sampler comparisons usually done between different types of sampler
- Those comparison made with the aim to asses the most suitable type of sampler
- Comparisons using the same sampler usually comparing different places
- Variability inside the same type of sampler is needed to asses its accuracy

# Objectives

- The aim is to evaluate variability inside the Hirst sampler Burkard seven-day
  - Daily variability
  - Hourly variability
- Comparisons made at the sample place
- To assess the spore traps used for Extremadura Aerobiological Network before putting them in a definitive location

# Material and methods

- 5 seven-day Burkard samplers at the same place
  - 1 sampler at 15 m over a terrace: STT
  - 4 samplers at ground level separated 2 m each other: ST1, ST2, ST3, ST4
  - At least 3 samplers at ground level were working simultaneously
  - 1 automatic meteorological station at ground level: Met



# Samplers



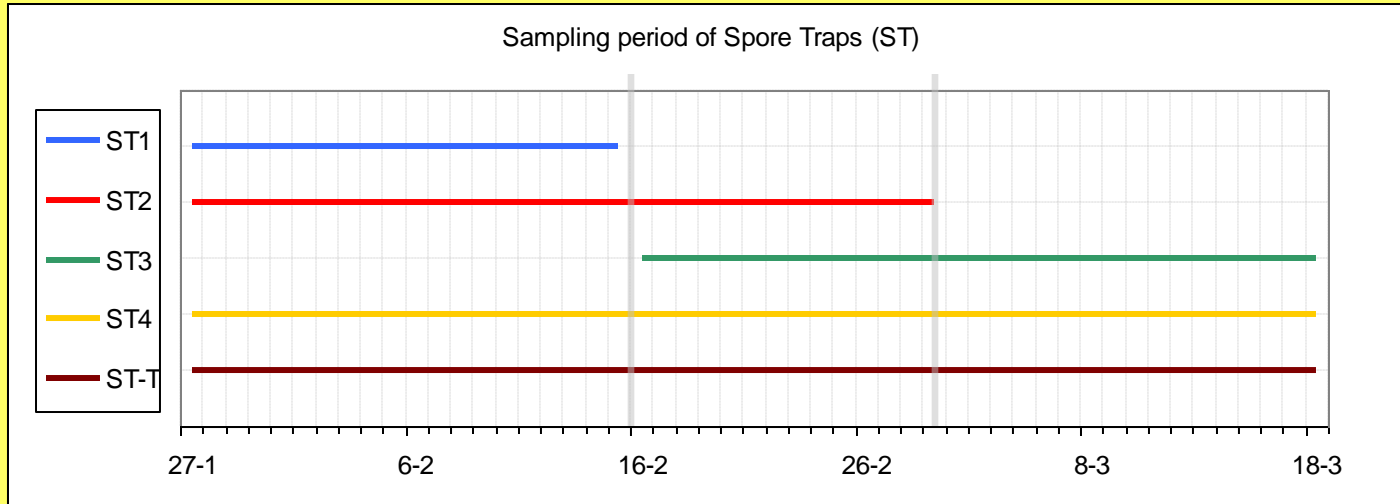
Meteorological station on the left and the four spore traps at the experimental garden on the right

# Material and methods

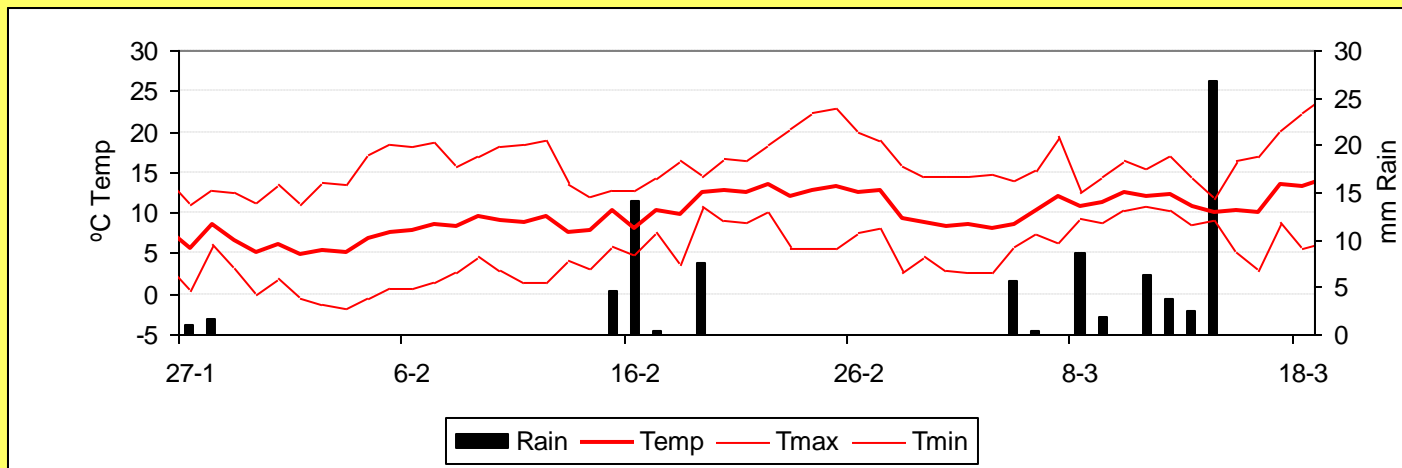
- Place of sampling: Faculty of Science in Badajoz, University of Extremadura, Spain
- Time of sampling: 51 days
  - from 27<sup>th</sup> January to 18<sup>th</sup> March 2011
- Adhesive: White Petrolatum
  - petroleum jelly, soft paraffin, vaseline, CAS number 8009-03-8
- Four longitudinal scans at 400x LM magnification
- Spore traps were calibrated at the beginning of the sampling



# Period studied

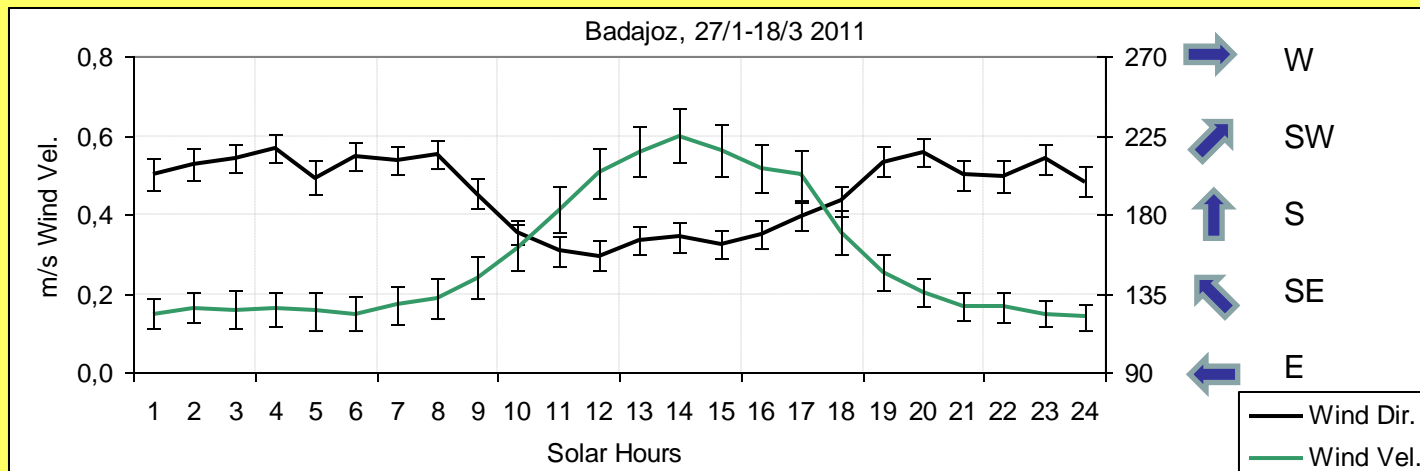
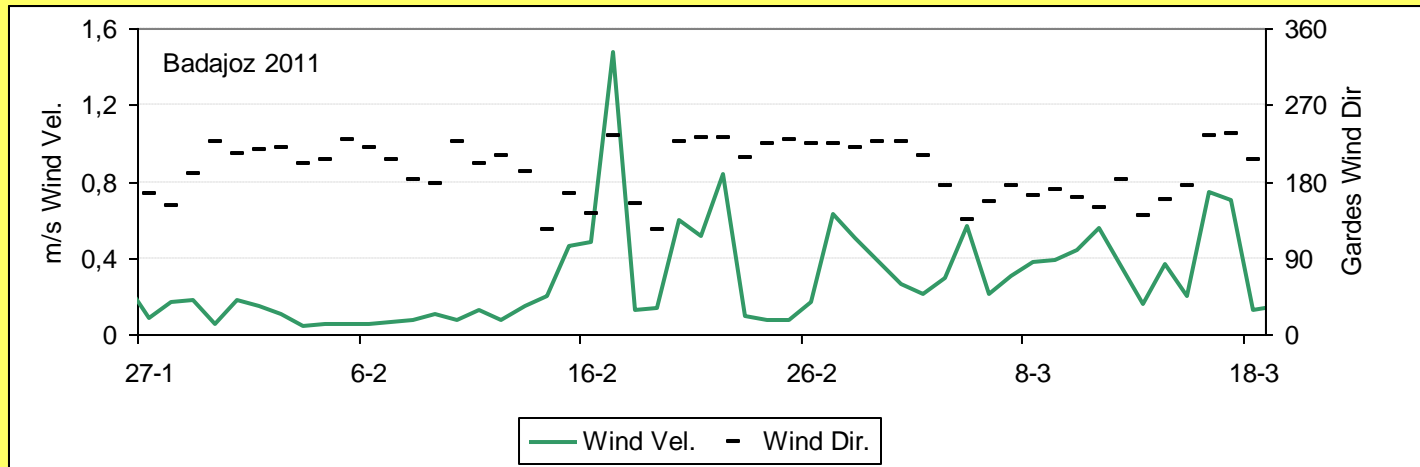


|----- 27/1-15/2:20 days -----| | 16/2-1/3: 14 days -| |---- 2/3-18/3:17 days -----|



Sampling period studied and meteorology.  
Badajoz 2011

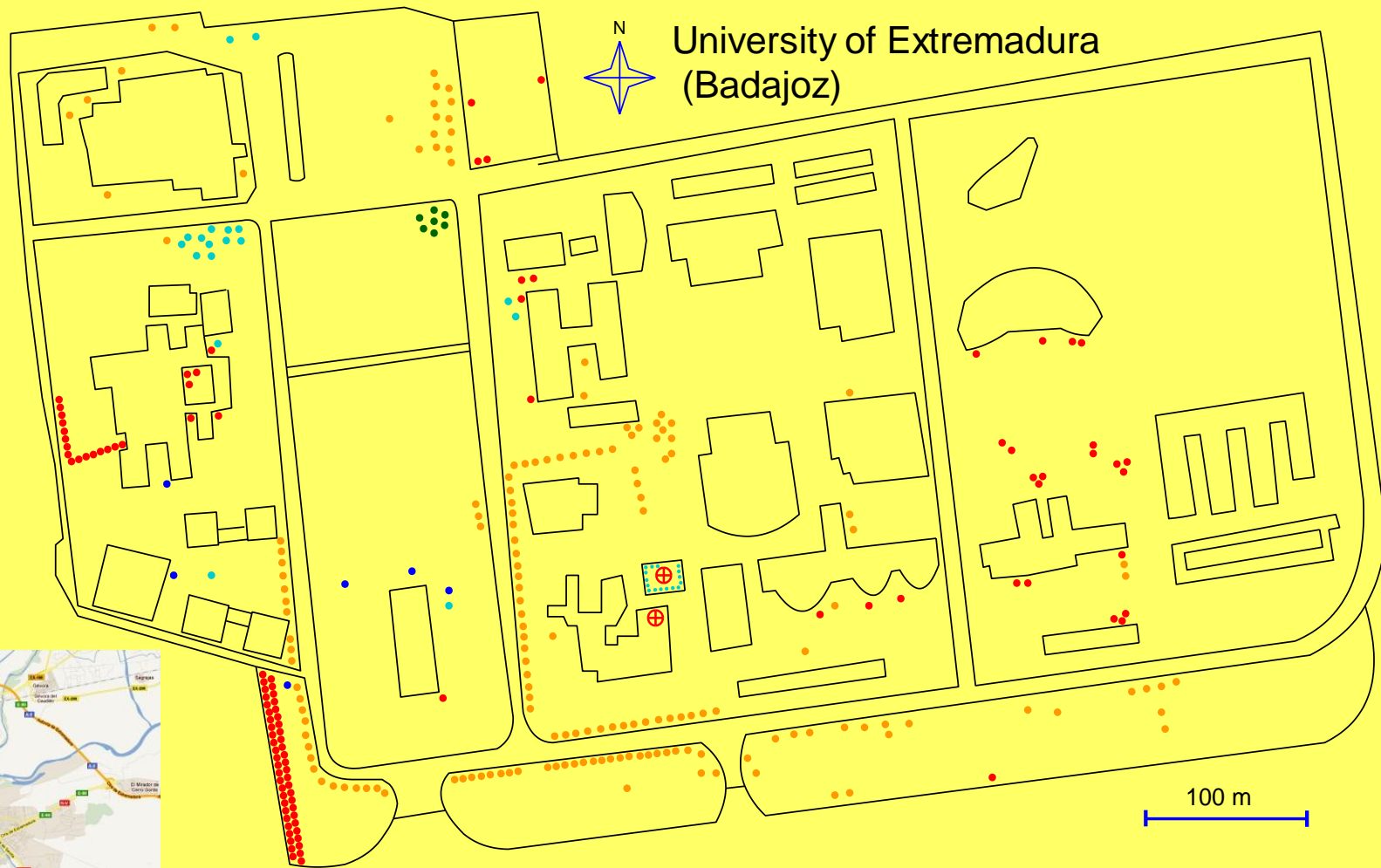
# Daily and hourly wind



Wind speed and direction, daily and hourly average



# Spore traps location



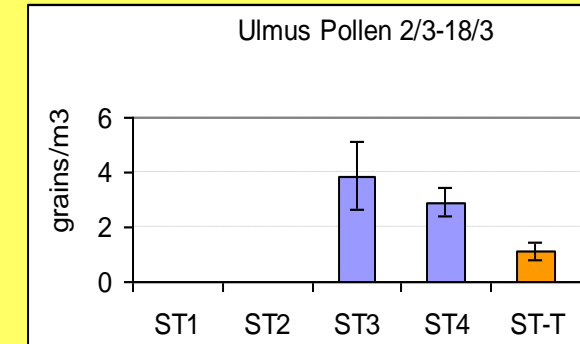
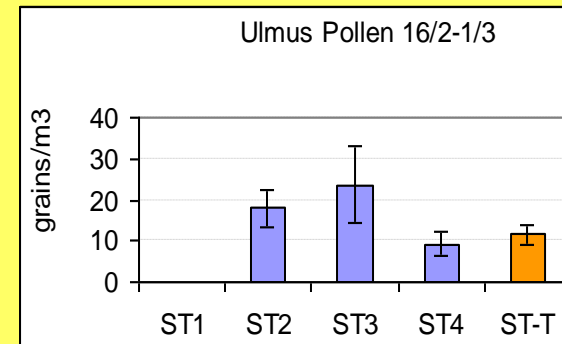
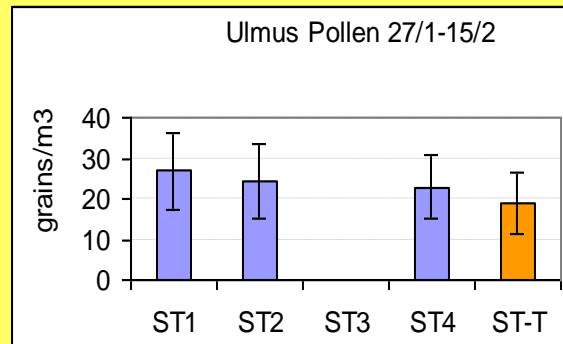
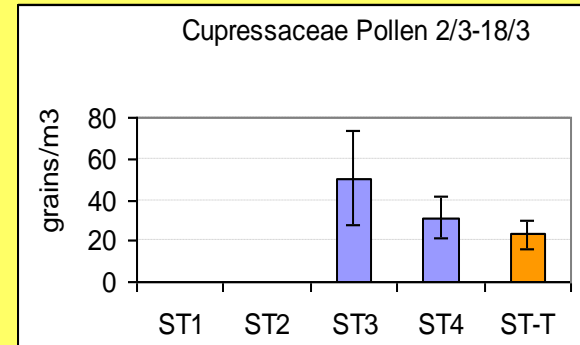
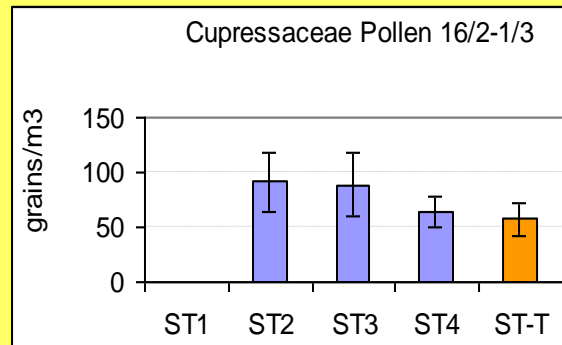
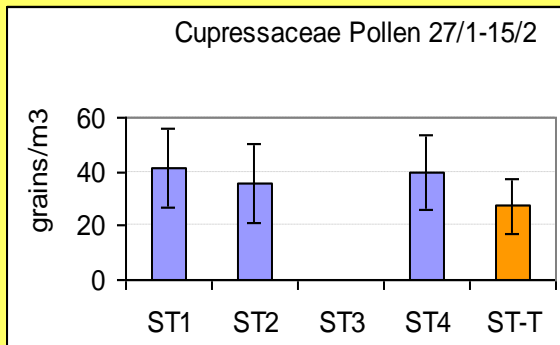
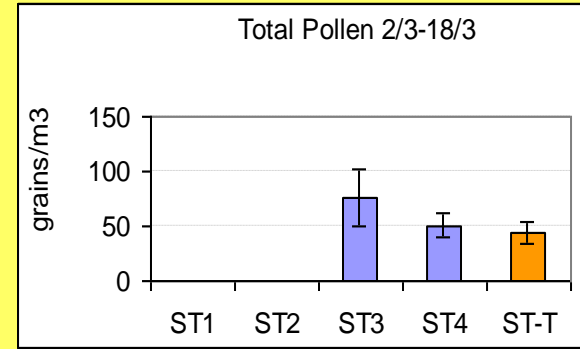
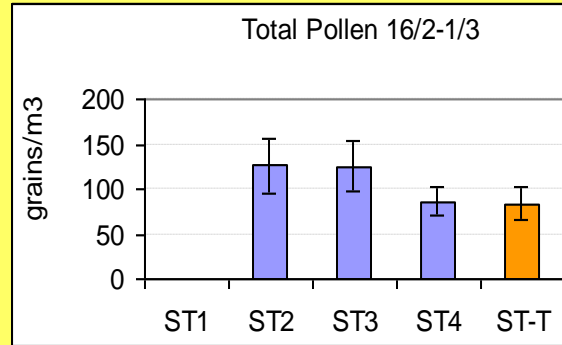
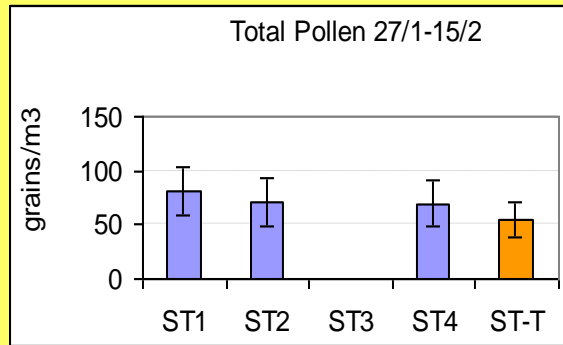
- *Cupressus sempervirens*
- *Cupressus arizonica*
- *Ulmus minor*
- *Cupressus macrocarpa*
- *Platycladus orientalis*
- ⊕ Spore Trap

# Average concentration

Num days	20	34	31	51	51
	<b>ST1</b>	<b>ST2</b>	<b>ST3</b>	<b>ST4</b>	<b>STT</b>
Total	81,3	93,1	98,1	64,6	59,1
Cupressaceae	41,5	58,7	67,8	41,0	34,1
Ulmus	26,8	21,7	12,8	12,5	10,9
Fraxinus-Phillyrea	3,6	3,5	2,5	0,6	1,0
Others	3,3	3,2	3,0	3,0	3,7
Alnus glutinosa	3,3	2,0	0,5	0,9	1,5
Alternaria	2,1	4,6	4,5	2,7	1,6
Urticaceae pp.	1,0	1,3	0,9	0,3	1,3
Poaceae	0,8	1,0	1,7	1,3	1,6
Urtica membranacea	0,6	0,5	2,0	2,5	1,7
Rumex	0,3	1,0	1,6	0,6	1,1
Anthemideae	0,1	0,0	0,0	0,1	0,0
Pinaceae	0,0	0,1	1,4	0,5	0,6
Plantago	0,0	0,0	0,0	0,1	0,0
Platanus hispanica	0,0	0,0	0,4	0,4	0,7
Quercus	0,0	0,0	3,5	0,5	0,7

Average pollen and Alternaria spore concentration per cubic meter sorted according concentration of each type  
Spore Traps: ST1-4 ground level, STT terrace

# Daily data comparisons



Average pollen concentration with standards error in bars

# Daily data comparisons

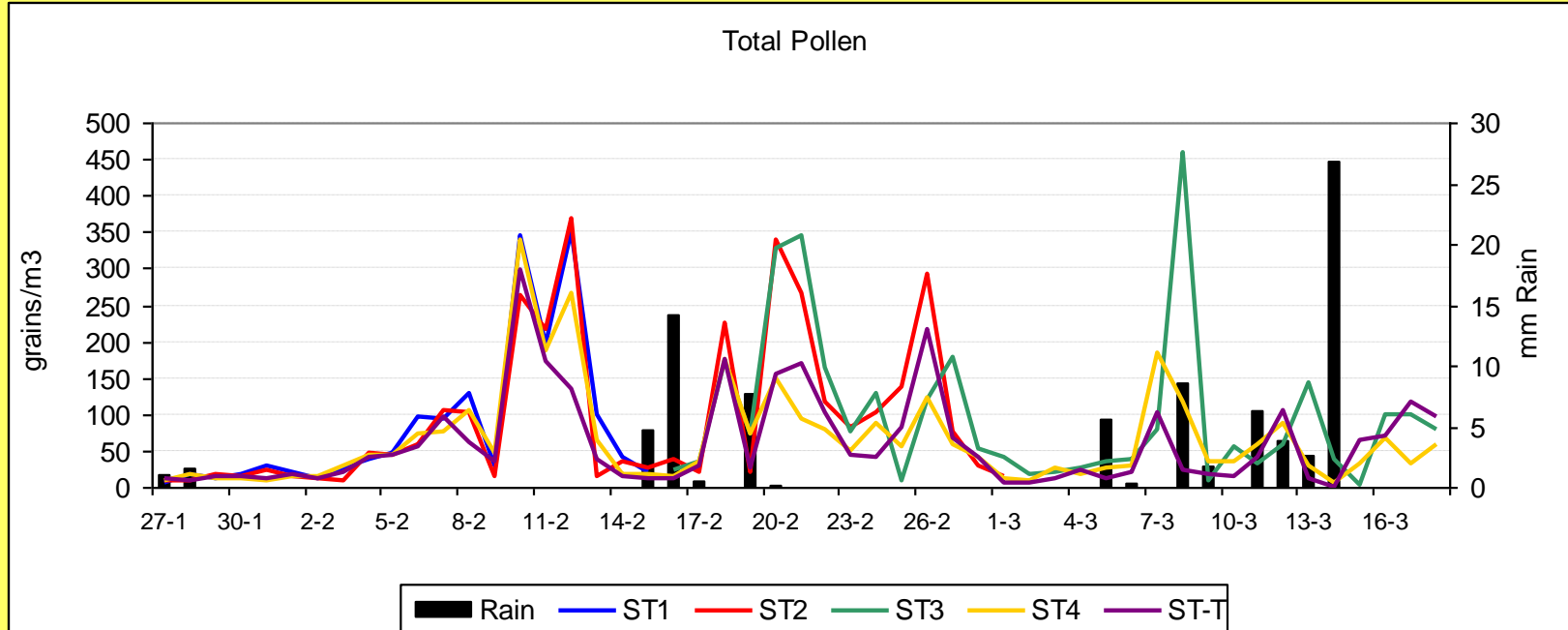
	Total				Cupresaceae				Ulmus		
	t	df	sig.		t	df	sig.		t	df	sig.
ST1-ST2	1,999	19	0,060		0,834	19	0,415		0,983	19	0,338
ST1-ST4	1,908	19	0,072		-0,969	19	0,345		-1,057	19	0,304
<b>ST1-STT</b>	3,096	19	<b>0,006</b>		1,743	19	0,097		2,581	19	<b>0,018</b>
ST2-ST3	-0,197	13	0,847		0,159	13	0,876		-0,567	13	0,580
ST2-ST4	0,359	33	0,722		-0,910	33	0,370		0,193	33	0,848
<b>ST2-STT</b>	2,204	33	<b>0,035</b>		1,893	33	0,067		2,472	33	<b>0,019</b>
ST3-ST4	1,382	30	0,177		0,852	30	0,401		1,615	30	0,117
<b>ST3-STT</b>	2,155	30	<b>0,039</b>		2,141	30	<b>0,040</b>		3,412	30	<b>0,002</b>
<b>ST4-STT</b>	2,827	50	<b>0,007</b>		3,562	50	<b>0,001</b>		3,534	50	<b>0,001</b>

T-test paired comparisons after data normalization using logarithmic transformation,  
In bold statistically significant differences. Degree of freedom: df=n-1.

ST1-4: Spore traps at ground level

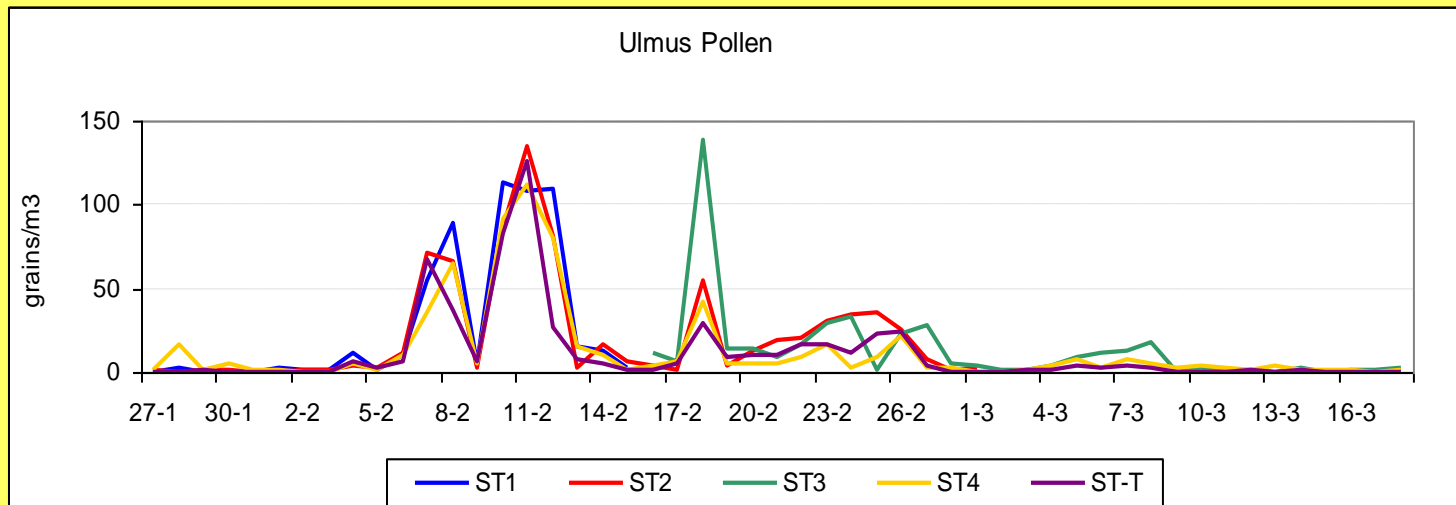
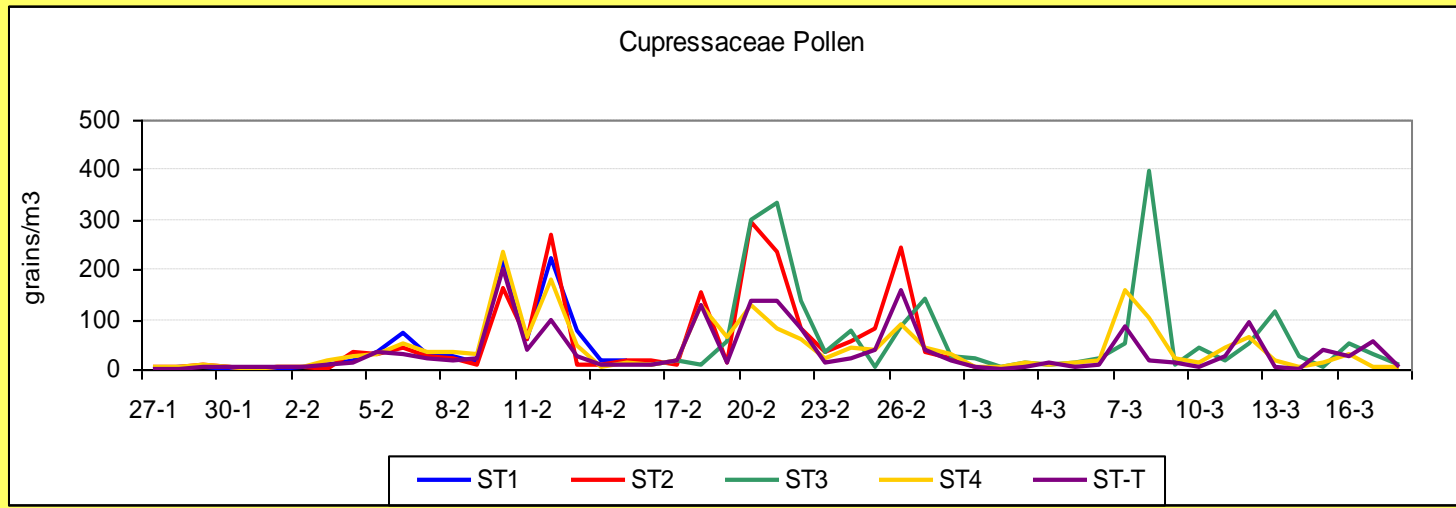
STT: Spore trap over the terrace

# Total daily pollen variation



Total daily pollen concentration for the period studied including all the spore traps  
daily rain appears scaled in the right side

# Cupressaceae and Ulmus



Daily pollen concentration for Cupressaceae and Ulmus pollen types

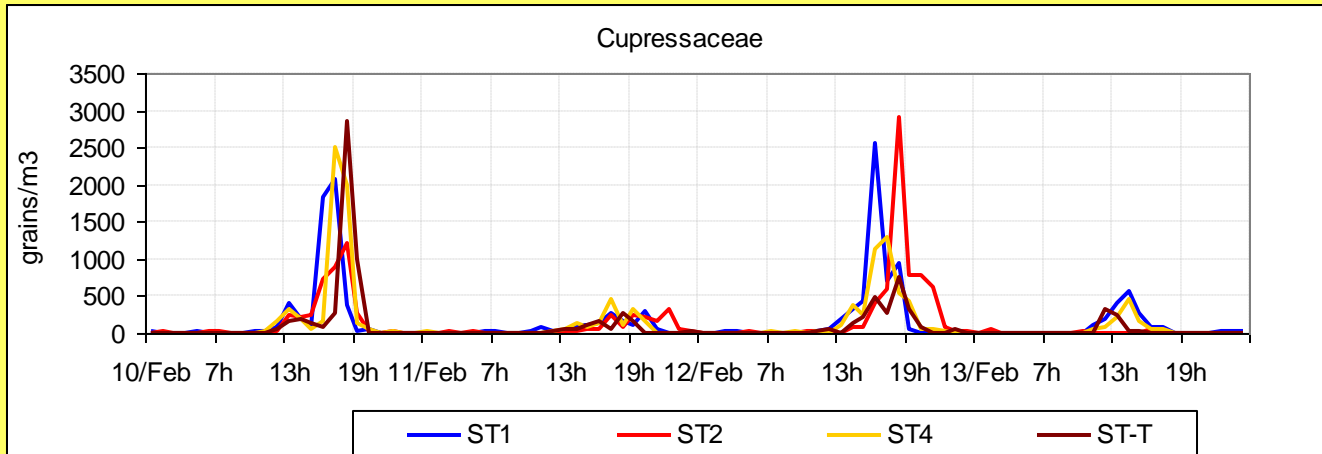
# Hourly comparisons

Cupressaceae	10-13/2 4 days			20-22/2 3 days			7-9/03 3 days		
	t	df	sig.	t	df	sig.	t	df	sig.
ST1-ST2	1,203	95	0,232						
ST1-ST4	-0,839	95	0,404						
<b>ST1-STT</b>	2,559	95	<b>0,012</b>						
ST2-ST3				1,918	71	0,059			
<b>ST2-ST4</b>	-2,041	95	<b>0,044</b>	4,178	71	<b>0,000</b>			
<b>ST2-STT</b>	0,877	95	0,383	2,742	71	<b>0,008</b>			
ST3-ST4				1,104	71	0,273	1,496	71	0,139
<b>ST3-STT</b>				0,424	71	0,673	3,297	71	<b>0,002</b>
<b>ST4-STT</b>	3,864	95	<b>0,000</b>	-0,766	71	0,446	2,965	71	<b>0,004</b>

Ulmus	7-12/2 6 days			18-27/2 10 days		
	t	df	sig.	t	df	sig.
ST1-ST2	0,543	143	0,588			
ST1-ST4	-0,004	143	0,996			
<b>ST1-STT</b>	2,110	143	<b>0,037</b>			
ST2-ST3				0,626	239	0,532
<b>ST2-ST4</b>	-0,760	143	0,448	4,438	239	<b>0,000</b>
<b>ST2-STT</b>	2,561	143	<b>0,011</b>	2,384	239	<b>0,018</b>
<b>ST3-ST4</b>				2,987	239	<b>0,003</b>
<b>ST3-STT</b>				1,232	239	0,219
<b>ST4-STT</b>	3,369	143	<b>0,001</b>	-2,421	239	<b>0,016</b>

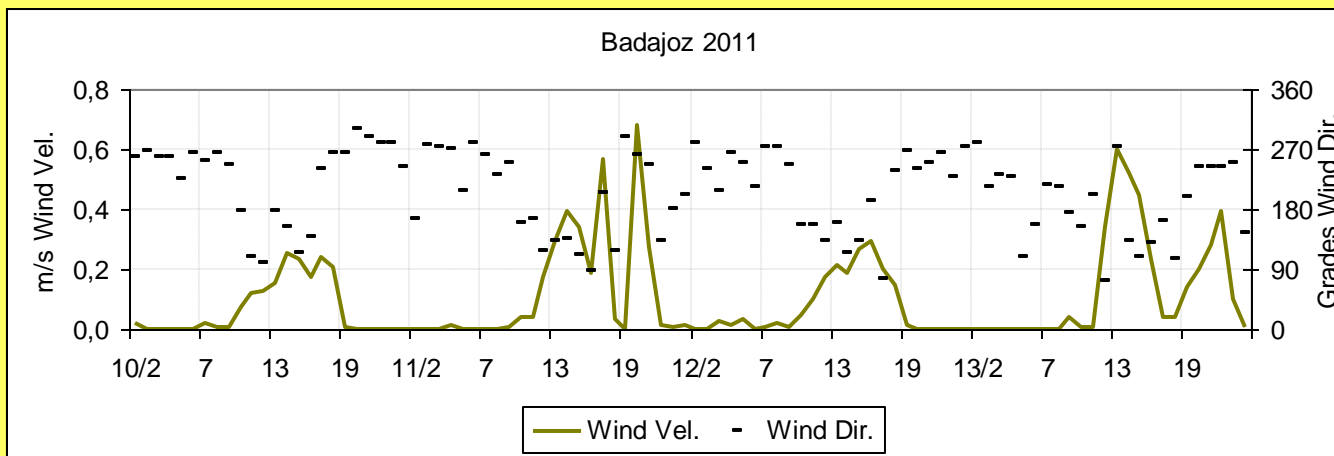
T-test paired comparisons after data normalization using logarithmic transformation,  
In bold statistically significant differences. Degree of freedom: df (n-1).

# Cupressaceae



10/2	ST1	ST2	ST4	STT
17h	2074	891	2506	270
18h	384	1213	1987	2862

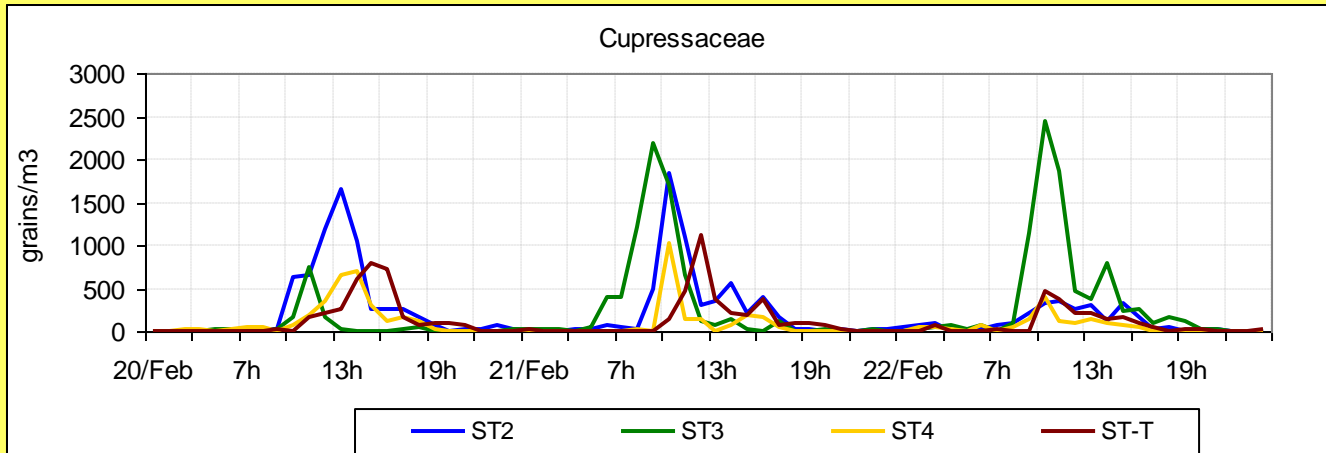
12/2	ST1	ST2	ST4	STT
16h	2550	399	1134	486
17h	707	584	1296	281
18h	952	2918	540	745



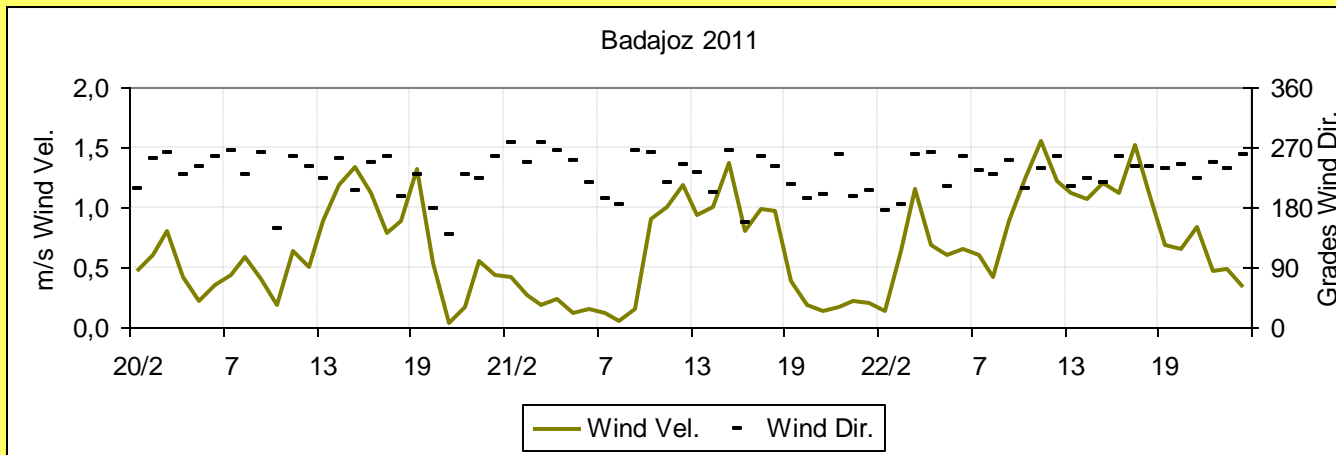
Hourly pollen data for some days, hourly meteorological parameters for the same period.  
Table with hourly peak concentrations data in grains per cubic meter for each spore trap



# Cupressaceae



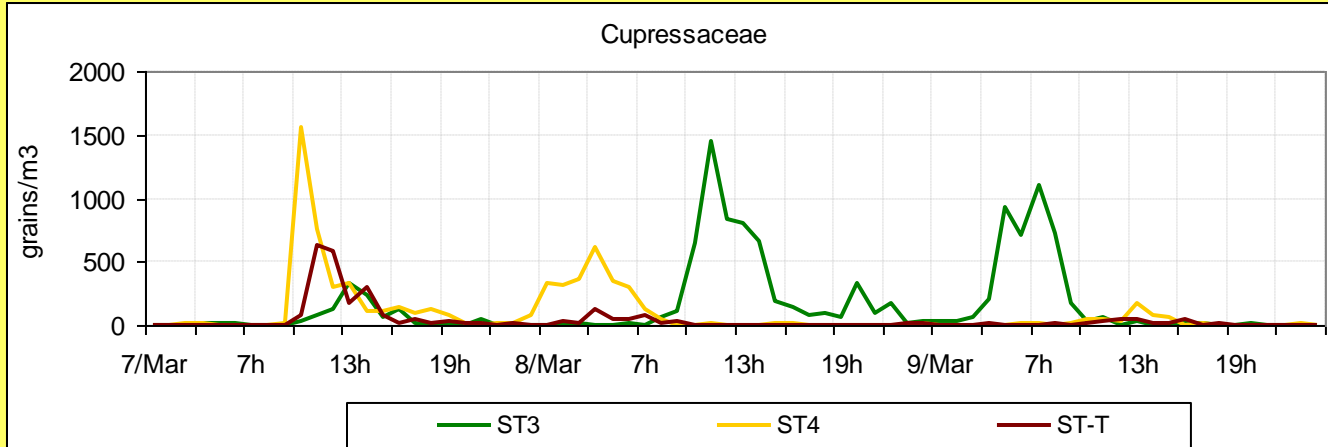
20/2	ST2	ST3	ST4	STT
11h	660	737	192	173
12h	1183	169	343	205
13h	1644	15	655	259
14h	1044	0	706	616
15h	261	0	302	788



21/2	ST2	ST3	ST4	STT
9h	492	2196	10	0
10h	1828	1705	1018	130
11h	1091	660	131	454
12h	307	108	131	1123

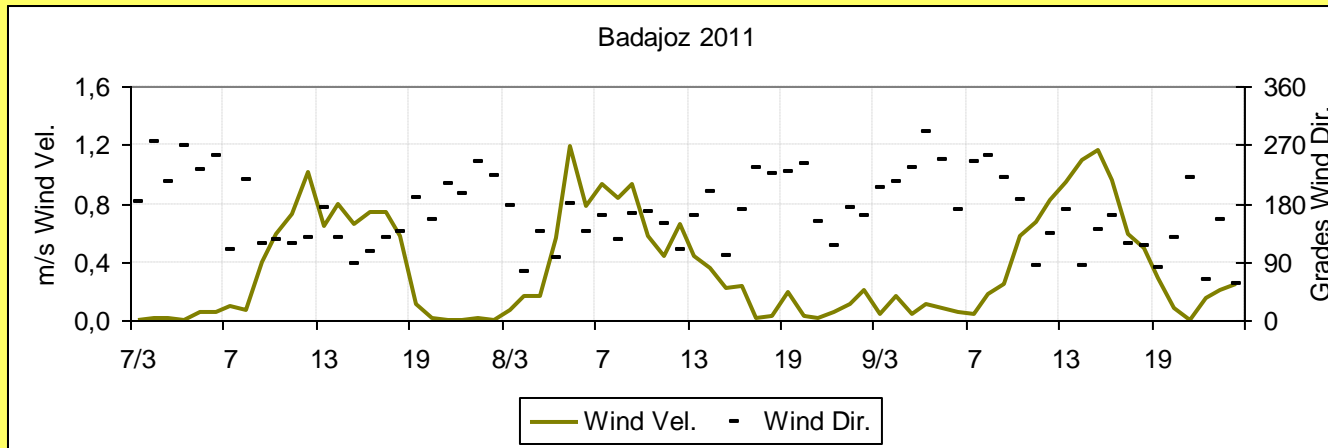
Hourly pollen data for some days, hourly meteorological parameters for the same period.  
Table with hourly peak concentrations data in grains per cubic meter for each spore trap

# Cupressaceae



7/23	ST3	ST4	STT
10h	31	1555	86
11h	77	756	637
12h	123	302	583
13h	338	335	173

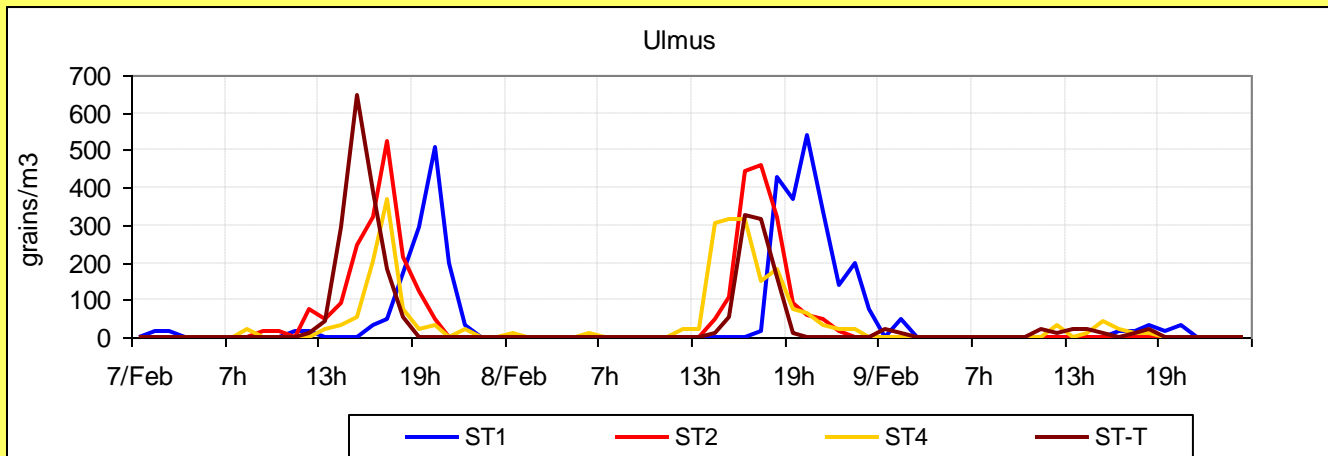
8/23	ST3	ST4	STT
4h	0	616	119
5h	0	346	54
6h	15	302	54
7h	0	130	86
8h	61	54	22
9h	108	0	32
10h	645	0	0
11h	1444	11	0



9/23	ST3	ST4	STT
7h	1106	11	0
8h	722	0	11
9h	169	11	0
10h	31	54	22
11h	61	43	32
12h	0	32	54
13h	31	173	54

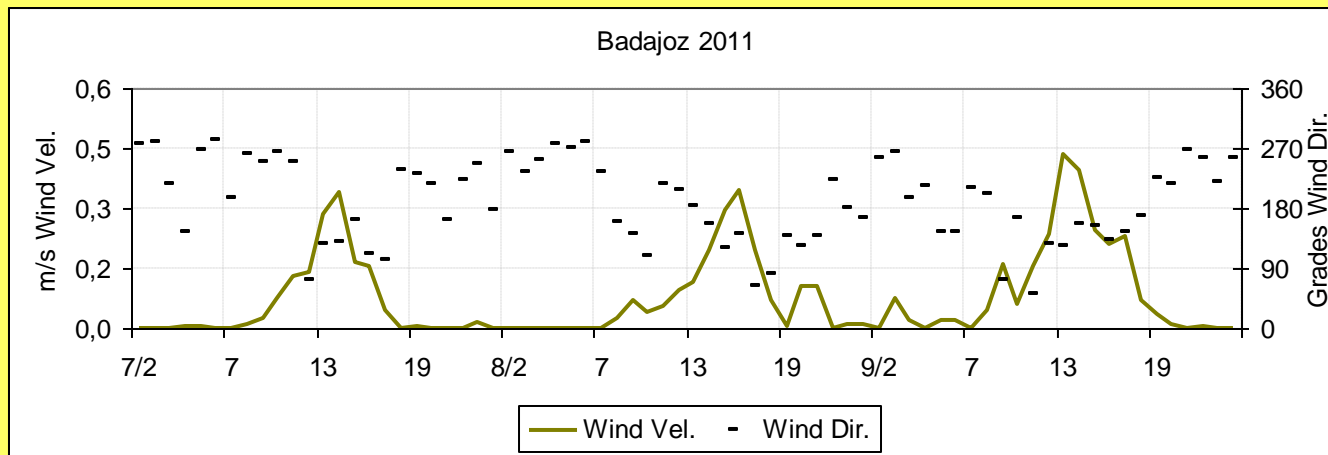
Hourly pollen data for some days, hourly meteorological parameters for the same period. Table with hourly peak concentrations data in grains per cubic meter for each spore trap

# Ulmus



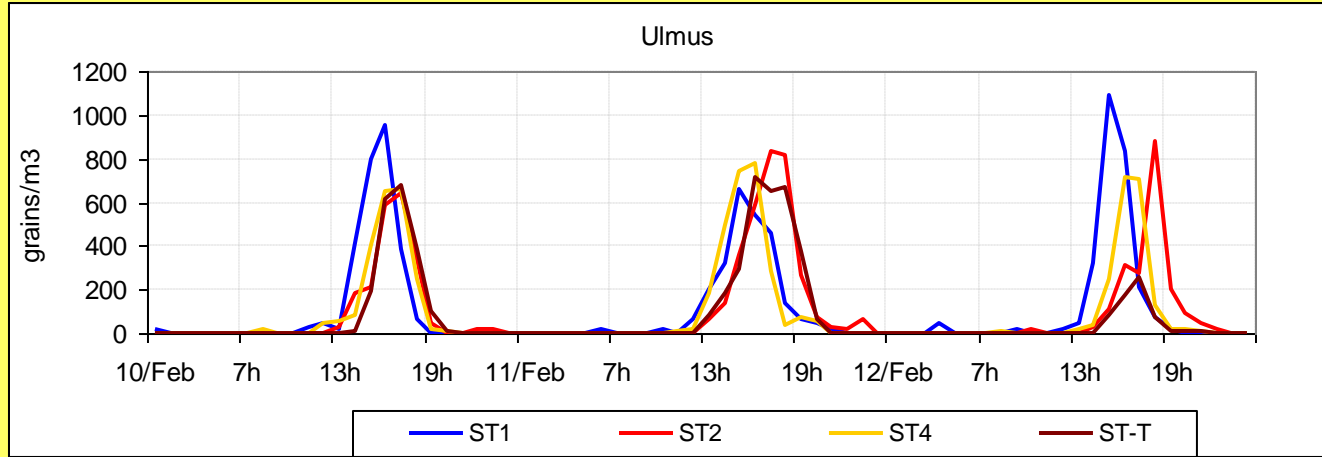
7/2	ST1	ST2	ST4	STT
15h	0	246	54	648
16h	31	323	205	389
17h	46	522	367	184
18h	169	215	76	54
19h	292	123	22	0
20h	507	46	32	0

8/2	ST1	ST2	ST4	STT
15h	0	108	313	54
16h	0	445	313	324
17h	15	461	151	313
18h	430	323	184	162
19h	369	92	76	11
20h	538	61	65	0



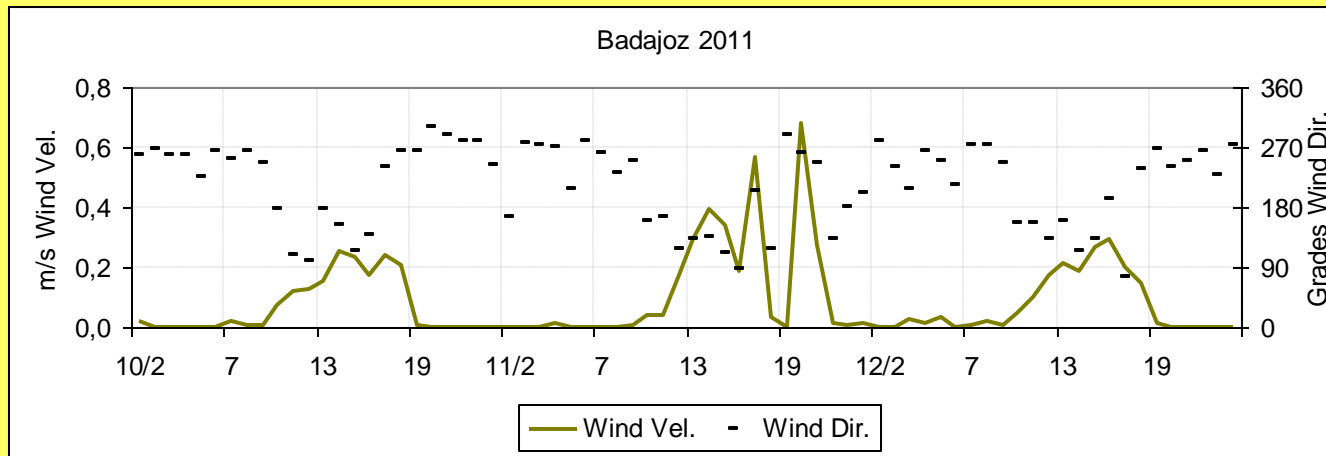
Hourly pollen data for some days, hourly meteorological parameters for the same period.  
Table with hourly peak concentrations data in grains per cubic meter for each spore trap

# Ulmus



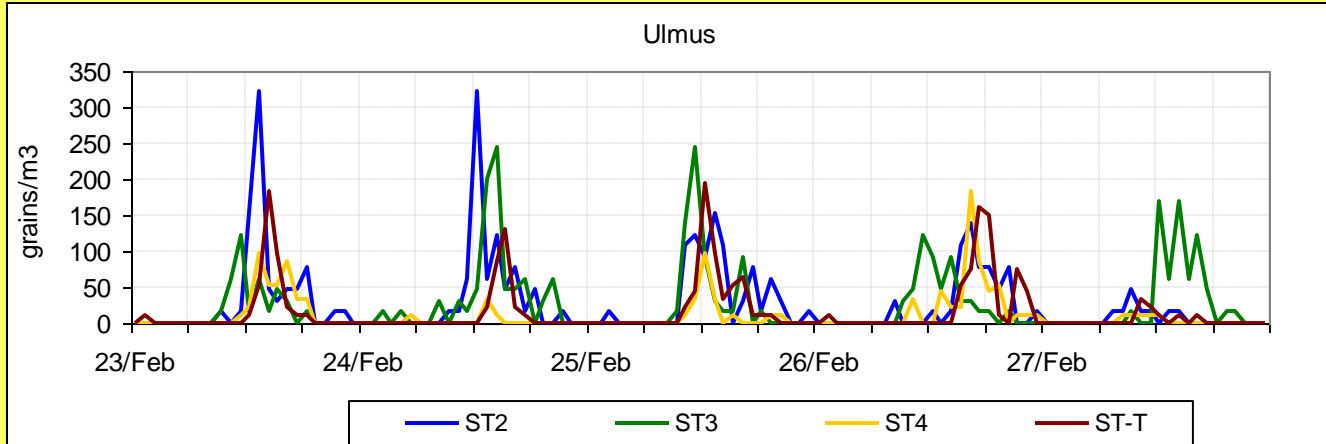
11/2	ST1	ST2	ST4	STT
15h	660	353	745	292
16h	538	584	778	713
17h	461	829	281	648

12/2	ST1	ST2	ST4	STT
15h	1091	108	248	86
16h	829	307	713	173
17h	215	276	702	259
18h	77	876	130	76



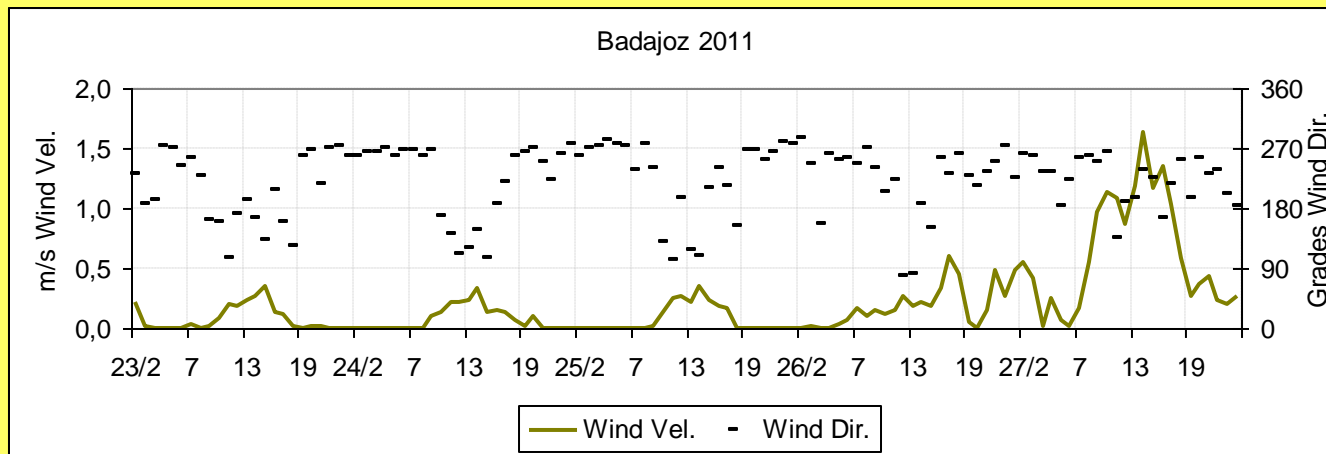
Hourly pollen data for some days, hourly meteorological parameters for the same period.  
Table with hourly peak concentrations data in grains per cubic meter for each spore trap

# Ulmus



23/2	ST2	ST3	ST4	STT
12h	15	123	11	0
13h	154	15	22	11
14h	323	61	97	54
15h	46	15	54	184

27/2	ST2	ST3	ST4	STT
12h	0	123	0	0
13h	15	92	0	0
14h	0	46	43	0
15h	15	92	22	0
16h	108	31	22	54
17h	138	31	184	76
18h	77	15	86	162



Hourly pollen data for some days, hourly meteorological parameters for the same period.  
Table with hourly peak concentrations data in grains per cubic meter for each spore trap

# Conclusions

- There are no statistically significant differences among spore traps at ground level using daily data, nevertheless, with hourly data differences have been found.
- At 15 m height statistically significant differences in pollen capture have been observed.
- Hourly peaks concentration rarely have been recorded at the same time in all spore traps, differences up to 7 hours have been found.
- Pollen concentration at hourly peaks showed differences of double or triple among spore traps.
- Spatial distribution of pollen and spores is far from homogeneous even within two meters away.



# Sampling comparison among Hirst spore traps of the same model

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# Previous works

Place	Km	Sampler	Reference
Pittsburgh (USA) Irdi G, Jones JR, White CM	0,001	2 Burkard	Grana (2002) 21:44-47
Kansas (USA) Merle G. Eversmeyer MG, Kramer CL	0,001	15 Rotorod	Grana (1987) 26:109-112
Padua (Italy) Giorato M, Bordin A, Gemignani C, Turatello F, Marcer G	0,002	2 Lanzoni	Aerobiologia (2003) 19:129-131
Copenhagen (Denmark) Pedersen BV, Moseholm L	0,003	2 Burkard	Aerobiologia (1993) 9:15- 26
Geoa (Italy)	3	2 Burkard	Aerobiologia (2000) 16:233-243
St. Paul, Minnesota (USA)	5,6	2 Rotorod	Aerobiologia (1997) 13:205-208
Manhattan (USA)	10	2 Burkard	Grana (1984) 23:117-122
Huddinge and Stockholm (Sweden)	15	2 Burkard	Aerobiologia (1993) 9:53-67
Trento and S. Michele all'Adige (Italy)	20	2 Burkard	Aerobiologia (1997) 13:199-204
Copenhagen, Malmö (Denmark)	31	2 Burkard	Grana (1981) 20:187-189
Cagliari, Sanluri (Italy)	43	2 Burkard	Grana (1990) 29:87-95
Málaga, Estepona (Spain)	90	2 Burkard	Grana (2000) 39:252-258
Trieste, Lozzo di Cadore (Italy)	141	2 Burkard	Aerobiologia (1992) 8:385-391
Basel, Davos (Switzerland)	189	2 Burkard	Grana (1981) 20:161-16
Toulouse, Bordeaux, Montpellier (France)	191-380	3 Burkard	Grana (1988) 27:183-201
Stockholm, Trondheim, Turku and Vienna	262-1722	4 Burkard	Grana (1996) 35:171-178
Erfurt, Hamburg (Germany)	293	2 Burkard	Allergy (2000)55:176-180
Turku, Kuopio, Oulu (Finland), Tartu (Estonia)	340-741	4 Burkard	Aerobiologia (1989) 5:94-103
Louvain-la-Neuve (Belgium), Basel (Switzerland)	410	2 Burkard	Grana (1983) 22:59-64
Torino-Perugia (Italy)	438	2 Burkard	Aerobiologia (1985) 1:39-45
Tartu (Estonia), Roma/Gotland and Stockholm (Sweden)	490-507	3 Burkard	Grana (1997) 36:366-372
Lublin (Poland), Skien (Norway)	1204	2 Burkard	Ann Agric Environ Med (2004) 11:205-208
Derby (UK), Poznan (Poland).	1237	2 Burkard	Aerobiologia (2002) 18:45-53
Córdoba (Spain), London (UK)	1563	2 Burkard	Grana (1995) 34:189-198
Córdoba (Spain), Poznan (Poland)	2334	2 Burkard	Aerobiologia (2009) 25:55-63