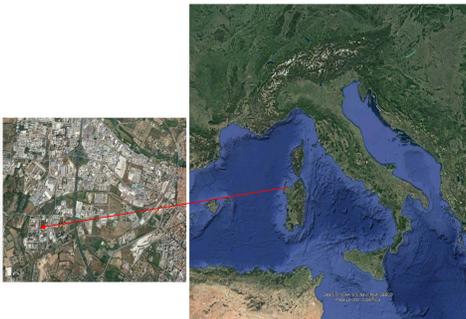


# CLIMATE CHANGE AND ITS IMPACT ON POACEAE AND FAGACEAE POLLEN SEASON IN NORTHERN SARDINIA, ITALY

Airborne pollen data are an important source of information on flowering phenology, because they record the response of plants surrounding the sampling station, rather than the responses of individual plants, as it occurs when direct phenological observation are used. Plant phenology represents a good indicator of vegetation responses to long-term variation to temperatures. Furthermore, several studies have evidenced that aerobiological data series and pollen season are often strongly correlated to climate change.

The study was carried out in North Western Sardinia, Sassari Italy (40° 43' 24" N, 8° 33' 13" E, 120 m s.l.m.).

The aerobiological monitoring station was located in the center of the city very close to a public garden, and it is part of both the Italian and the European-A.I.A. Aeroallergen monitoring Network. Meteorological data were recorded during the same period by an automatic weather station.

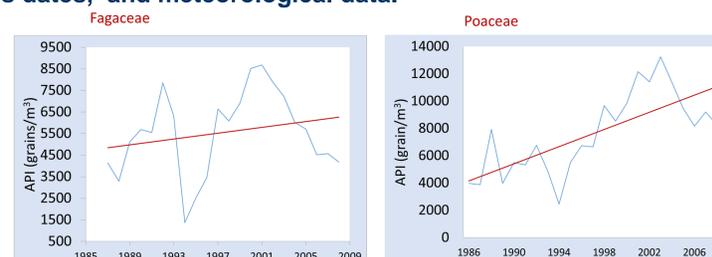


This research aims to analyze airborne pollen data of Poaceae and Fagaceae measured from 1986 to 2008 in a urban area of northern Sardinia (Italy) and to investigate the trends in these data and their relationship with meteorological parameters. Daily pollen concentration data were measured using a Burkard seven-day recording volumetric spore trap. The start of the pollen season was defined as the day when the cumulated daily pollen values reached the 5 % of the total annual pollen count, and the end of the pollen season when the sum of daily counts reaches 90 %. The date of the peak occurrence was defined as the day when the cumulated daily pollen values reached the 50 % of the total annual pollen concentration. The Annual Pollen Index (API) is the total amount of pollen in each year, it is the sum of daily pollen concentration. The correlation between meteorological variables and the different characteristics of pollen seasons was analyzed using Spearman's correlation tests. Simple regression analysis was used to determine the trends in pollen seasons and start pollen seasons dates, and meteorological data.

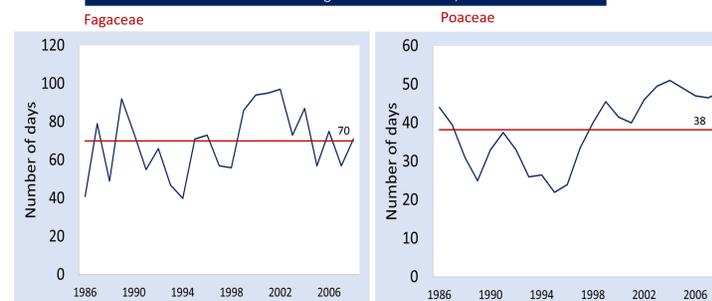


Seasonal characteristics of the airborne Fagaceae pollen in Sassari, 1986-2008

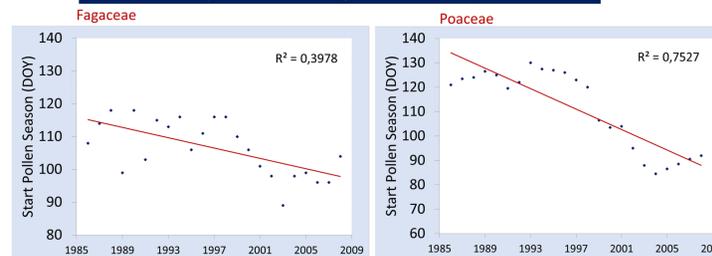
Years	Start DOY	End DOY	Peak DOY	N. days Start-Peak	Duration (days)	API
1986	108	149	138	30	41	550
1987	114	193	152	38	79	4134
1988	118	167	132	14	49	3292
1989	99	191	115	16	92	5114
1990	118	192	143	25	74	5681
1991	103	158	141	38	55	5541
1992	115	181	136	21	66	7855
1993	113	160	138	25	47	6317
1994	116	156	119	3	40	1368
1995	106	177	127	21	71	2493
1996	111	184	117	6	73	3464
1997	116	173	144	28	57	6640
1998	116	172	144	28	56	6078
1999	110	196	157	47	86	6904
2000	106	200	128	22	94	8521
2001	101	196	149	48	95	8678
2002	98	195	138	40	97	7887
2003	89	162	145	56	73	7222
2004	98	185	144	46	87	6017
2005	99	156	150	51	57	5708
2006	96	171	150	54	75	4510
2007	96	153	150	54	57	4566
2008	104	175	149	45	71	4183
Mean	106.5	175.7	139.4	32.9	69.2	5335.8
St. Dev.	8.5	16.0	11.6	15.7	17.5	2160.3
CV (%)	7.9	9.1	8.3	47.9	25.3	40.5
Minimum	89	149	115	3	40	550
Maximum	118	200	157	56	97	8678



Annual Pollen Index of Fagaceae and Poaceae, 1986-2008



Duration of pollen seasonal of Fagaceae and Poaceae, 1986-2008



Start of pollen seasonal of Fagaceae and Poaceae, 1986-2008

Seasonal characteristics of the airborne Poaceae pollen in Sassari, 1986-2008

Years	Start DOY	End DOY	Peak DOY	N. days Start-Peak	Duration (days)	API
1986	121	165	157	36	44	3969
1987	124	163	155	31	39	3881
1988	124	155	149	25	31	7939
1989	127	152	139	12	25	3982
1990	125	158	141	16	33	5494
1991	120	157	144	24	37	5330
1992	122	155	143	21	33	6771
1993	130	156	150	20	26	4850
1994	128	154	156	28	26	2453
1995	127	149	150	23	22	5515
1996	126	150	146	20	24	6734
1997	123	157	150	27	34	6640
1998	120	160	155	35	40	9661
1999	107	152	145	38	45	8540
2000	104	145	136	32	41	9820
2001	104	144	137	33	40	12159
2002	95	141	136	41	46	11398
2003	88	138	128	40	50	13239
2004	85	136	126	41	51	11359
2005	87	136	125	38	49	9462
2006	89	136	117	28	47	8158
2007	91	137	125	34	46	9206
2008	92	140	127	35	48	8245
Mean	111.3	149.4	140.7	29.2	37.9	7600.2
St. Dev.	16.3	9.3	11.6	8.3	9.3	2927.5
CV (%)	14.6	6.2	8.3	28.6	24.7	38.5
Minimum	85	136	117	12	22	2453
Maximum	130	165	157	41	51	13239

The highest Annual Pollen Index occurred in 2001 (8678 p/m<sup>3</sup>) and in 2003 (13239 p/m<sup>3</sup>) respectively for Fagaceae, and Poaceae.

The duration of pollen season was 70 and 38 days per year on average, respectively for Fagaceae, and Poaceae. The longest pollen season appeared in the year 2002 (97 days) and 2004 (51 days), the shortest season occurred in 1994 (40 days) and in 1995 (22 days) respectively for Fagaceae, and Poaceae. The start pollen season dates showed a decreasing trend for the two family analyzed. The dates of start of pollen season advanced over the period examined with a linear mean trend of 0.8, and 2.0 day/year respectively for Fagaceae, and Poaceae.

Spearman correlation coefficients (r) and p values calculated between annual values of API (Annual Pollen Index), duration of seasonal pollen, and start pollen season of Fagaceae and Poaceae and annual average values of several meteorological parameters. N = 23  
Air temperature (Tmin, Tmax, Tmed), relative air humidity (RHmax, RHmin, RHmed), and rainfall (PP).

	API				Duration				Start pollen season			
	Fagaceae		Poaceae		Fagaceae		Poaceae		Fagaceae		Poaceae	
	r	p	r	p	r	p	r	p	r	p	r	p
Tmin	-0.236	0.276	<b>-0.668</b>	0.001	-0.159	0.467	<b>-0.637</b>	0.001	<b>-0.423</b>	0.043	<b>-0.661</b>	0.0008
Tmax	0.156	0.475	-0.093	0.672	0.222	0.307	<b>-0.411</b>	0.051	-0.092	0.674	<b>-0.343</b>	0.108
Tmed	-0.026	0.904	-0.300	0.163	0.151	0.491	<b>-0.536</b>	0.008	-0.158	0.468	<b>-0.493</b>	0.017
RHmin	<b>-0.461</b>	0.027	<b>-0.536</b>	0.009	-0.327	0.127	<b>-0.608</b>	0.002	<b>0.585</b>	0.003	<b>0.717</b>	0.0001
RHmax	<b>-0.369</b>	0.083	<b>-0.701</b>	0.002	-0.336	0.116	<b>-0.812</b>	0.001	<b>0.666</b>	0.0004	<b>0.852</b>	0.0001
RHmed	<b>-0.405</b>	0.056	<b>-0.675</b>	0.001	-0.334	0.118	<b>-0.736</b>	0.001	<b>0.668</b>	0.0006	<b>0.847</b>	0.0001
PP	0.017	0.939	<b>0.415</b>	0.049	-0.050	0.819	0.313	0.144	0.251	0.246	<b>0.364</b>	0.087

In bold: significant values p ≤ 0.05 or p ≤ 0.01

Annual Pollen Index, and duration presented negative correlation with almost all meteorological parameter, and positive with rainfall for the two family of Fagaceae and Poaceae.

Relative to Poaceae family the correlation between duration, start of season pollen, and meteorological parameter were highly significant, excepted for rainfall. In addition, in both species the start of pollen season was clearly positively correlated with RH and negatively correlated with temperature.

In conclusion, this study is an example of how climate change may affect aerobiological data and pollen seasons.