APPLICATION OF NUMERICAL SIMULATION TO THE STUDY OF ATMOSPHERIC ALLERGENIC POLLEN IN CATALONIA (NE SPAIN)

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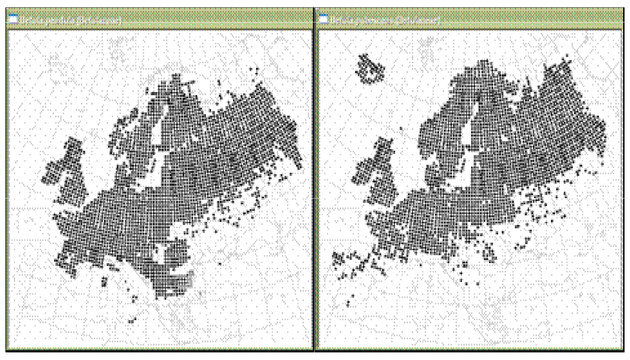
Introduction

The aim of this work is to analyze the role of long-distance transport in determining the concentration of airborne *Betula* pollen observed in the pollen records from eight aerobiological stations across Catalonia. To discriminate between the long-range transport and the local influence, we hypothesized that long distant transport was indicated by simultaneous peaks at the majority of the Catalan monitoring stations, taking into account that birch plants are not present around most of them. Afterward, we used atmospheric back trajectories and the synoptic charts to describe the flux responsible for the transport for the days of pollen arrival. Finally, we applied a source-receptor model to infer the probable source regions of the birch pollen arriving to Catalonia.



Distribution maps of the most common birch species (*Betula pendula* Roth. and *Betula pubescens* Ehrh) in Europe

Material & Methods

Pollen record

- 8 monitoring stations across Catalonia, NE Spain.
- Daily samples with a Hirst sampler analyzed with the standard Spanish methodology (Galán et al. 2007)
- Period 1994 -2009, from 1st March to 31th May

Atmospheric transport

- Backward isentropic 96-h back-trajectories at 1500 m asl, starting at 12 UTC from (41.8º N, 1.5º E) with Hybrid Single-Particle Lagrangian Integrated Trajectory model (HYSPLIT-4) (NOAA) (Draxler & Rolph 2003).
- Synoptic charts from the FNL/GDAS (NOAA) archive

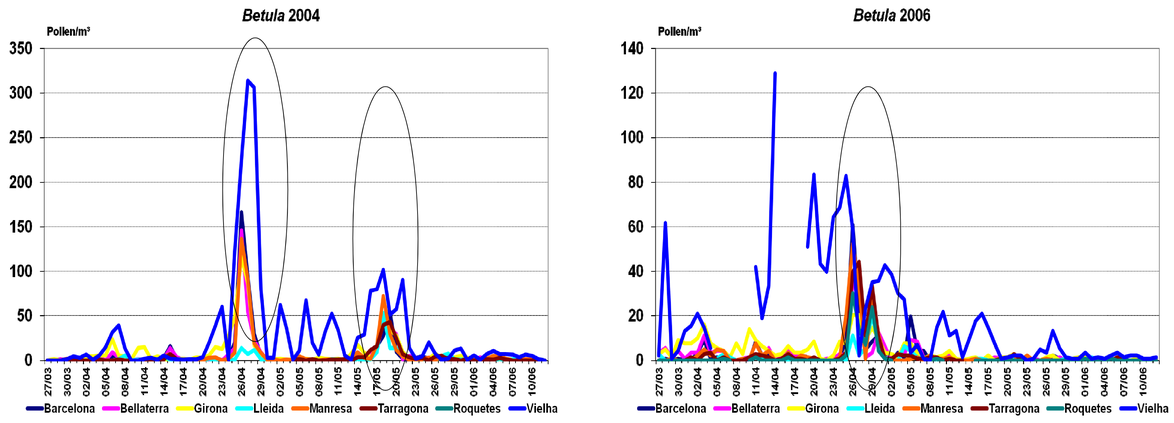
Source areas

- source-receptor model based on the Seibert methodology (Seibert et al., 1994)
- grid with 2601 cells of 1º x 1º lat/lon
- two back trajectories per day (00 and 12 UTC). A total of 2392 trajectories
- 72-hours long
- 60-min time steps. A total of 172224 end points.
- 1st March to 31th May
- period 1997-2009
- logarithmic mean pollen concentration

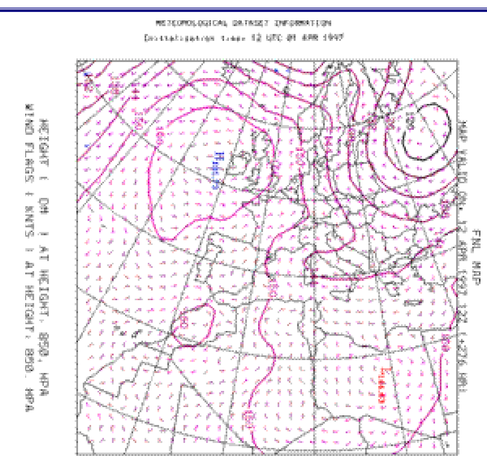
Results

Year	Barcelona	Bellaterra	Girona	Lleida	Manresa	Tarragona	Tortosa	Vielha
1994	26/03 08/04 12/04	26/03 08/04 12/04 01/05						
1995	09/04	09/04						
1997	29/03 02/04 **12/04** 21/04	29/03 02/04 **12/04** 21/04	28/03 02/04 missing 21/04	29/03 04/04 **12/04** 21/04	30/03 02/04 **12/04** 21/04	29/03 03/04 **12/04** 21/04		
1999	**03/04** 06/04 **13/05**	**03/04** 06/04 **13/05**	**03/04** 06/04 **13/05**	**03/04** 06/04 **13/05**	**03/04** 07/04 **13/05**	**03/04** - **13/05**		
2001	29/05	28-30/05	29/05	29/05	29/05	29/05		
2002	22/03 21/04 23/04	22/03 21/04 23-25/04	23/03 21/04 25/04	- 21/04 25/04	23/03 22/04 25/04	22/03 21/04 25/04		
2003	01/04	01/04	01/04	02/04	missing	01/04		
2004	05/04 **25/04** **18/05**	05/04 **25/04** **17/05**	05/04 **25/04** **17/05**	- **25/04** **17/05**	- **25/04** **17/05**	- missing **18/05**		05/04 **26/04** **17/05**
2005	13/04 22/04	13/04 22/04	13/04 22/04	13/04 -	12-13/04 22/04	13/04 -		- 22/04
2006	**26/04** **29/04**	**27/04** **30/04**	**26-27/04** **29/04**	**26/04** **29/04**	**26/04** **29/04**	**27/04** **29/04**	**26/04** **29/04**	**25/04** **29/04**
2007	**15/04** **19/04**	**15/04** **19/04**	**15/04** -	**16/04** **20/04**	**15/04** -	**15/04** **19/04**	**15/04** **19/04**	missing **18-21/04**
2008	07/04 26/04	07/04 26/04	07/04 25/04	06/04 25/04	07/04 26/04	- 26/04	07/04 27/04	06/04 25/04
2009	**24/04**	**24/04**	**24/04**	**24/04**	**24/04**	**24/04**	**24/04**	**24/04**

Betula pollen episodes observed in Catalonia (dd/mm of the pollen peak).
In bold the episodes of special interest for the coincidence in all or most of the sampling points.

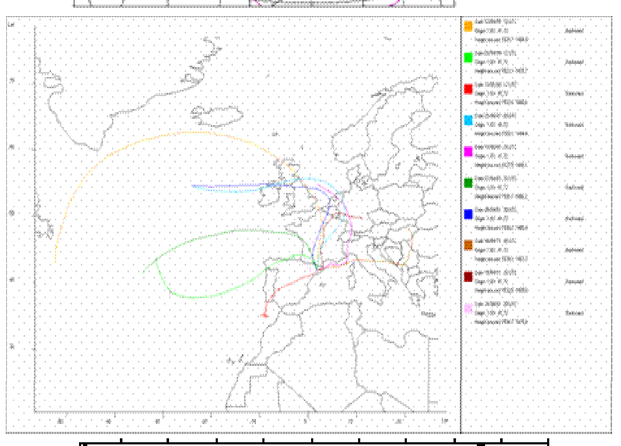


Mean daily airborne birch pollen concentrations in the Catalan stations for 2004 and 2006. The fact that birch pollen peaks appeared simultaneously in different stations across the Catalan geography indicated a broad scale phenomenon, dominating over the local influence.

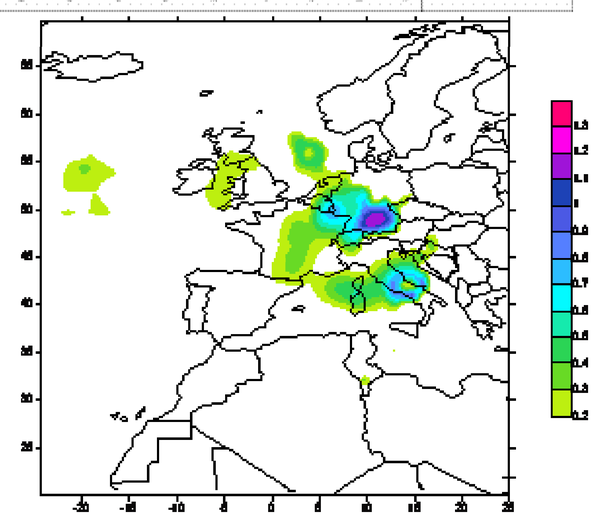


Geopotential height 850 hPa 97/04/12 (12 UTC)

A northern flux was the responsible of the pollen arrivals, with a synoptic situation characterized by the presence of a high pressure system in North Europe



Back trajectories at 1500 m high for the peak day corresponding to each episode showed a northern provenance



Areas contributing to *birch* pollen concentrations (p/m3), inferred from the source-receptor model applied to spring pollen counts (1 March to 31 May) at the Catalan stations for the period 1997-2009

Conclusions

This study has been centred in birch pollen episodes in which the transport could cover thousand of kilometres. Long range transport and probable source areas in central Europe were well described with Hysplit back trajectories and the application of a source-receptor model (SRM). SRM showed that the area in Europe from Switzerland to central Germany**,** with a strong core in the Black Forest Region (SW of Germany)**,** was the most probable area of emission responsible of the pollen peaks collected in Catalonia. This region is covered by extensive birch forests.

This long range transport can have consequences in the understanding of modern pollen genetic diversity and also give some clues for future interpretations of fossil pollen diagrams. Also, because of the reported allergenicity of the birch pollen and its cross reactivity with pollen from other related species (*Alnus*, *Corylus*) present in the territory, the correct understanding of the pollen dispersal is an urgent demand of the health care system.

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