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PREVISIONES DE TRANSPORTE ATMOSFÉRICO DE POLEN: ESTUDIO SOBRE LAS ESPECIES DE *PLATANUS* Y *PINUS* EN BARCELONA

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#conama2018

01 MOTIVATION AND OBJECTIVES

Motivation and objectives

- Many people living in large cities suffer from **allergies linked to the presence of airborne pollen**
- Very little is known on pollen **vertical distribution**
- Atmospheric **pollen forecast are scarce** or inexistent

Continuation of an ongoing collaboration started in 2015

Atmos. Chem. Phys., 16, 6805–6821, 2016
www.atmos-chem-phys.net/16/6805/2016/
doi:10.5194/acp-16-6805-2016

Atmospheric Chemistry and Physics Open Access EGU

Near-surface and columnar measurements with a micro pulse lidar of atmospheric pollen in Barcelona, Spain

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Rebeca Izquierdo, Marta Alarcón, Jordina Belmonte, Adolfo Comerón + Oriol Jorba

Motivation and objectives

- Investigate with an air quality forecast system the factors responsible of:
  - Pollen release
  - Pollen dispersion/transport

- By evaluating the model performances against **near-surface concentration** and **backscatter coefficient profile** measurements

02 AIRBORNE POLLEN AND INSTRUMENTS

Airborne pollen and instruments

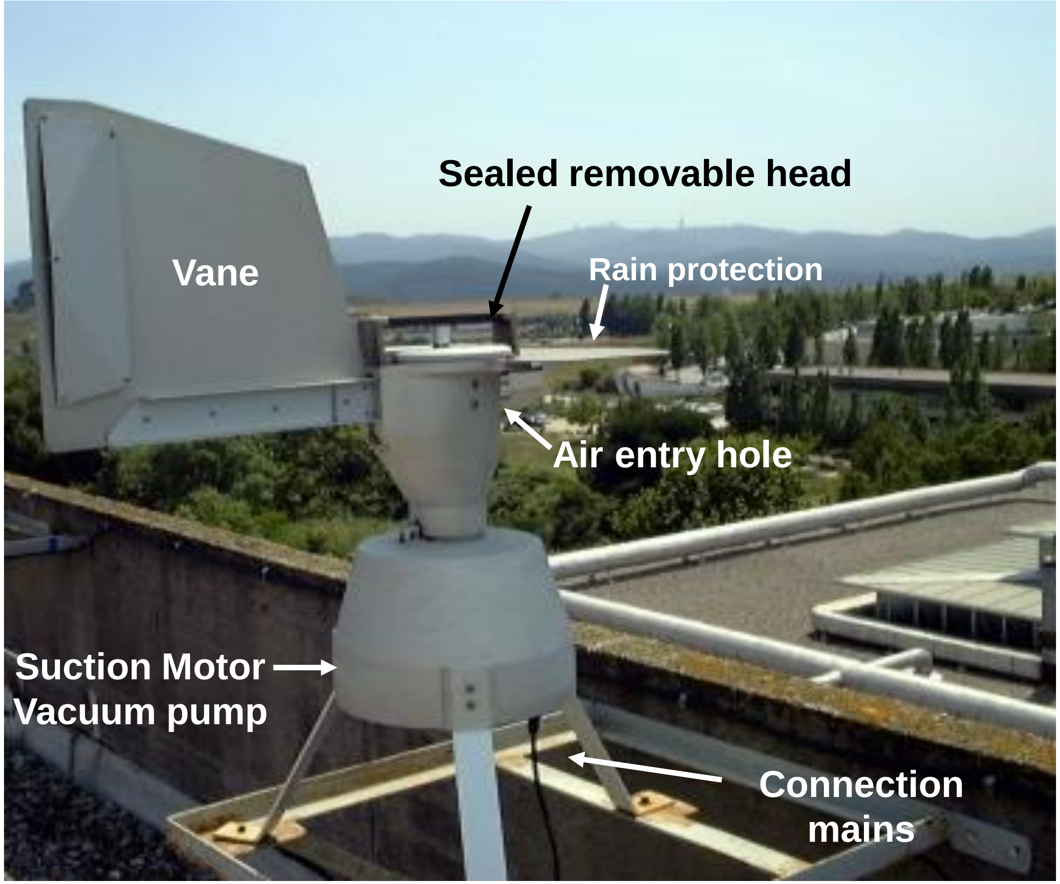
Pollen source

Airborne pollen and instruments

Pollen grains

Airborne pollen and instruments

Airborne pollen concentration: **HIRST collector**



Airborne pollen and instruments

Airborne pollen concentration: methodology

Pollen deposition on drums by impact on a suction system

↓

Preparation of daily and hourly samples

↓

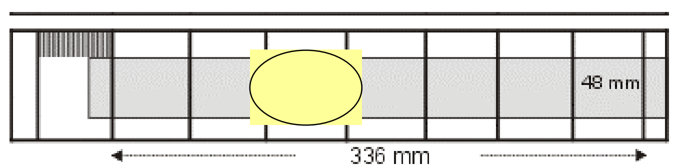
Observation with optical microscope

↓

Pollen identification and counting

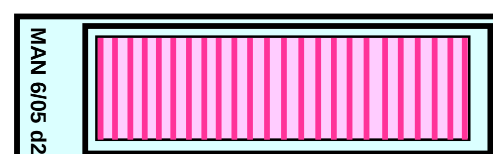
1 week of data are collected on 1 drum covered by a Melinex film coated with a 2% silicon solution as trapping surface

The Melinex film is cut on 7 portions
each portion is 48 mm long and corresponds to a day (24h)



Daily data
4 horitzontal lines

Hourly data
24 verticals lines every 2 mm



Airborne pollen and instruments

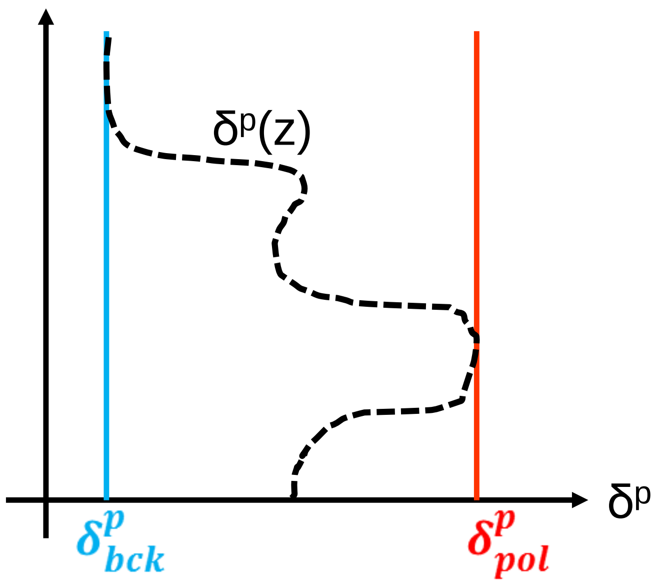
Pollen columnar properties: **MPL lidar**

	MPL (part of MPLNet)
Wavelengths (emission)	532 nm
Wavelengths (reception)	532 nm + 532 nm cross pol.
PRF	2500 Hz
Typical temporal resolution	**30 s**
Vertical resolution	**15**, 30 or 75 m
Max. adquisition range	> 20 km
Products	β_{532}, $\delta_{p,532}$

Airborne pollen and instruments

Pollen columnar properties: **methodology**

Principle:



Pollen contribution ratio (Shimuzu et al., 2004)

$$CR_{pol}(z) = \frac{\left[\delta^{p}(z) - \delta_{bck}\right]\left[1 + \delta_{pol}\right]}{\left[\delta_{pol} - \delta_{bck}\right]\left[1 + \delta^{p}(z)\right]}$$

If $\delta^p(z)=\delta^p_{bck}(z)$, $CR_{pol}(z)=0$

If $\delta^p(z)=\delta^p_{pol}(z)$, $CR_{pol}(z)=1$

Pollen backscatter coefficient:

$$\beta_{pol}(z) = CR_{pol}(z)\beta^{p}(z)$$

$\delta^p_{bck} = 0{,}03$

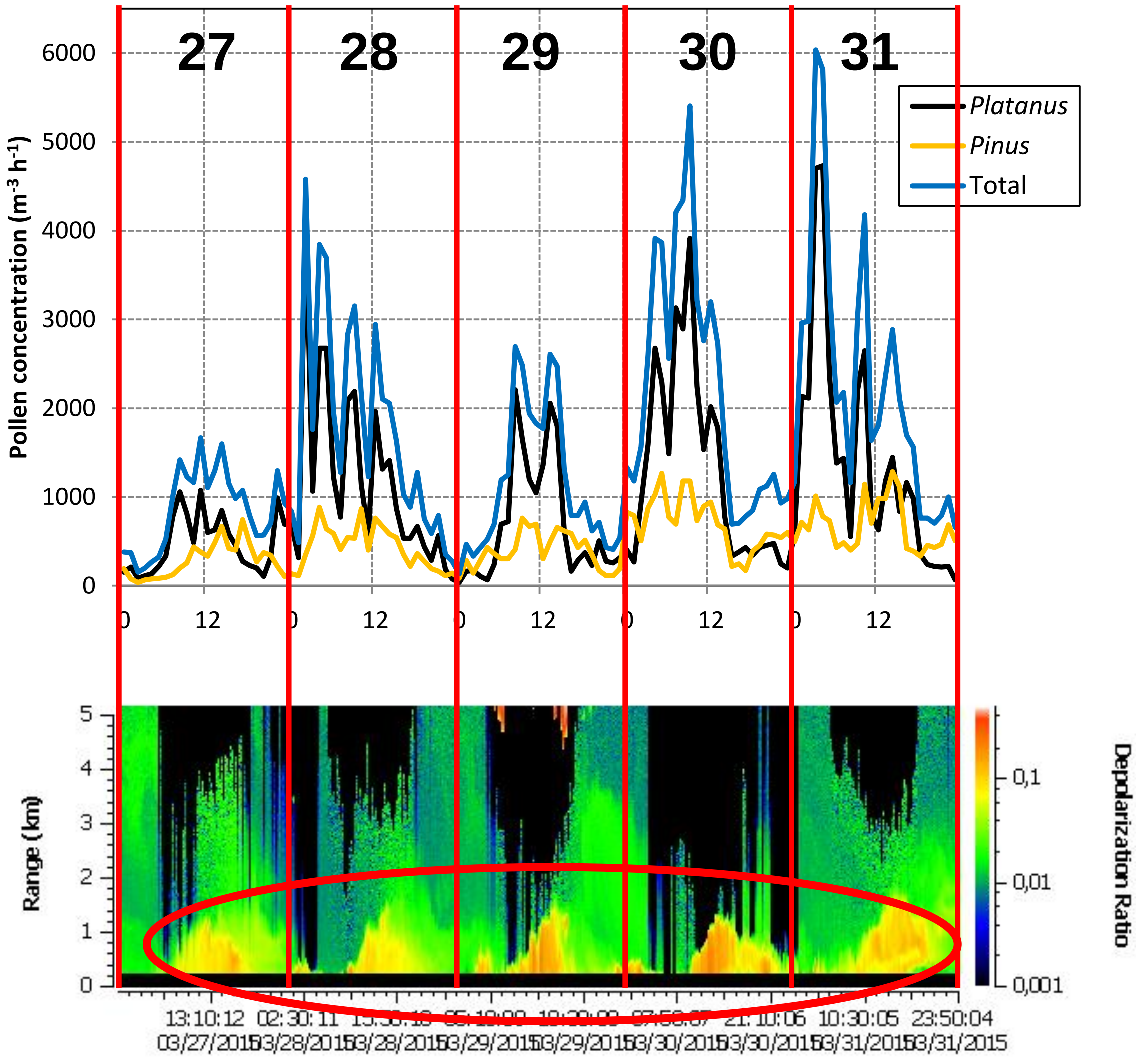
$\delta^p_{pol} = 0{,}40$

03 THE 27-31 MARCH, 2015, POLLINATION EVENT

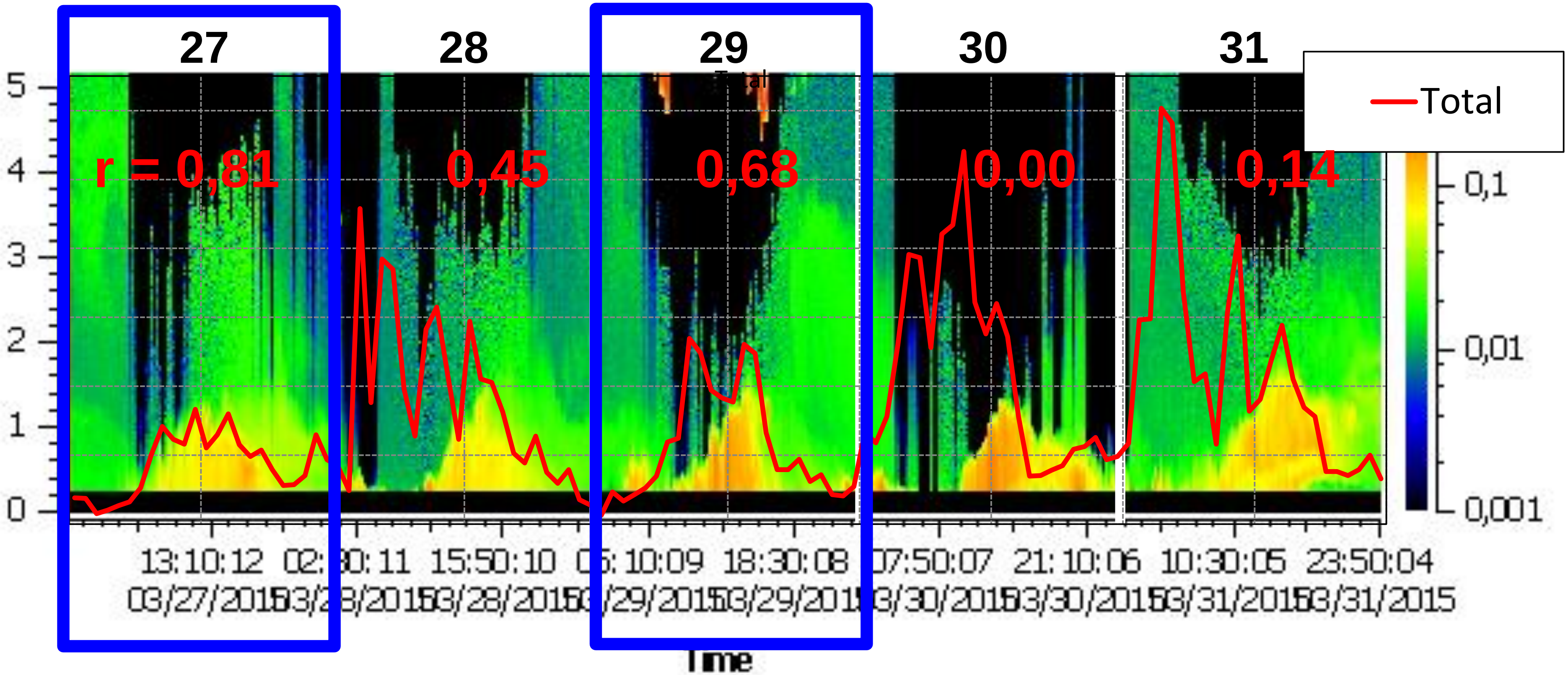
The 27-31 March, 2015, pollination event

Airborne pollen concentration

Profiles of total volume depolarization ratio



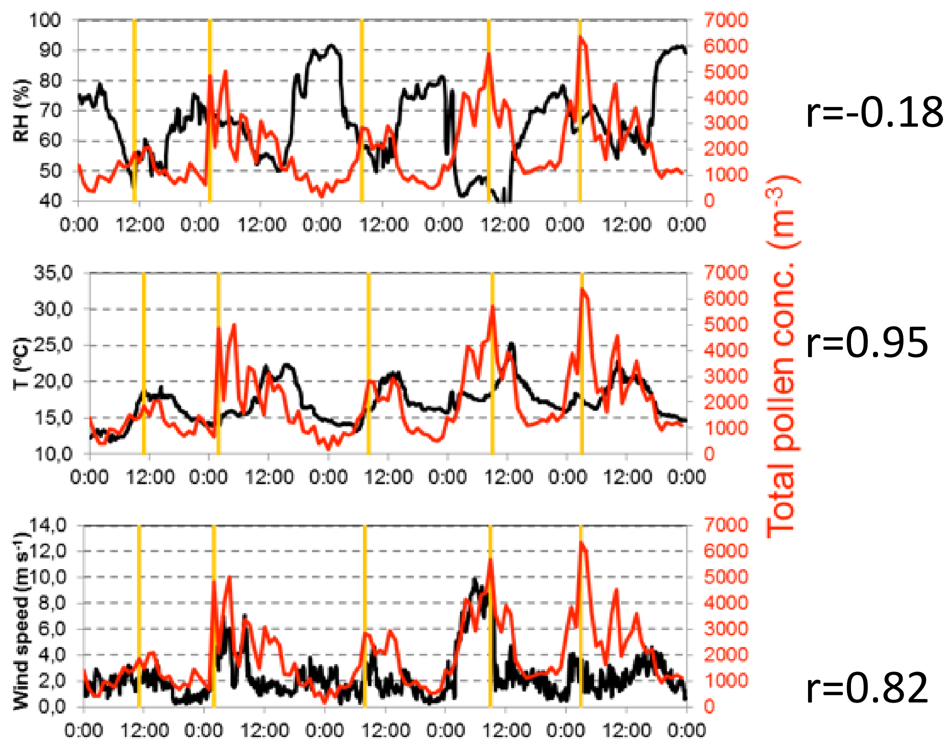
The 27-31 March, 2015, pollination event



Difference between δ^V and δ^p *r*-values< 0,12

The 27-31 March, 2015, pollination event

- Strong correlation of total pollen concentration with wind speed, temperature
- Anti-correlation with RH



04 *PLATANUS* AND *PINUS* TRANSPORT SIMULATION

Platanus and Pinus transport simulation

NMMB/MONARCH: online air quality forecast system developed at BSC (Pérez et al., 2011; Jorba et al., 2012; Spada et al., 2013; Badia et al., 2017)

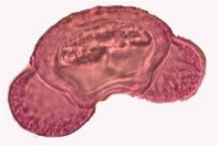
- Meteorology: NMMB (Janjic and Gall, 2012)
- Aerosol scheme: bulk Pinus and Platanus aerosols
- Transport: online scheme, same advection-diffusion as NMMB
- Emission data: Pinus: Cartography of habitats of Catalonia (CREAF)
  Platanus: Barcelona's City Hall Open Data Service

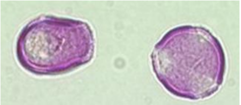
- Horizontal Resolution: 1 km x 1 km
- Vertical Resolution: 48 hybrid sigma-pressure
- Top Atmosphere: 50 hPa
- Time step: 2 s
- Meteorological initial conditions: NCEP Final Analysis

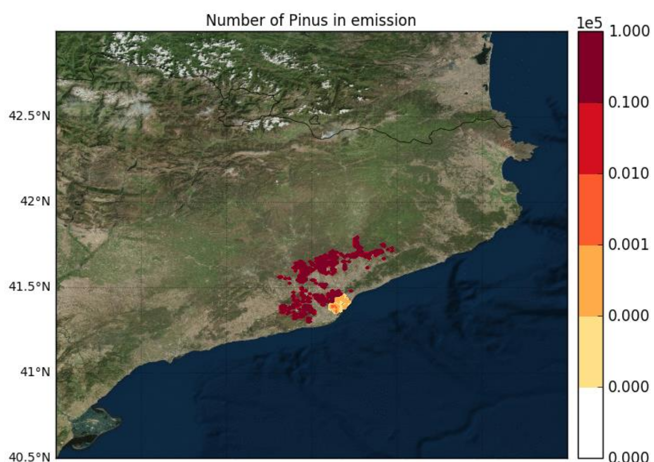
Platanus and Pinus transport simulation

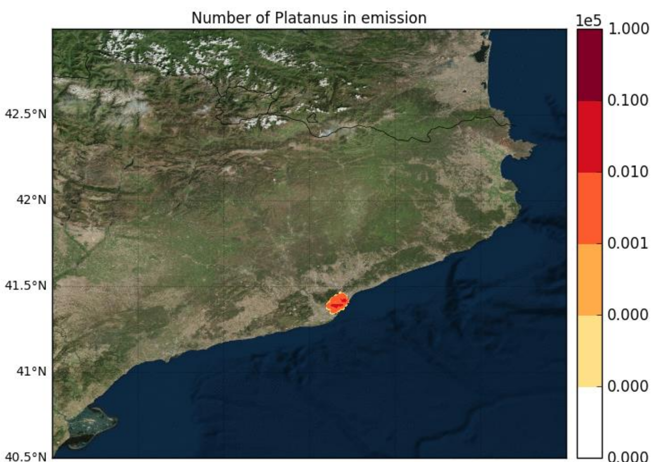
Pollen properties:

	Pinus	*Platanus*
Grain diameter (μm)	59 Jackson & Lyford, 1999	19 Zhang et al., 2014
Density (kg/m³)	560 Jackson & Lyford, 1999	920 Jackson & Lyford, 1999 Zhang et al., 2014









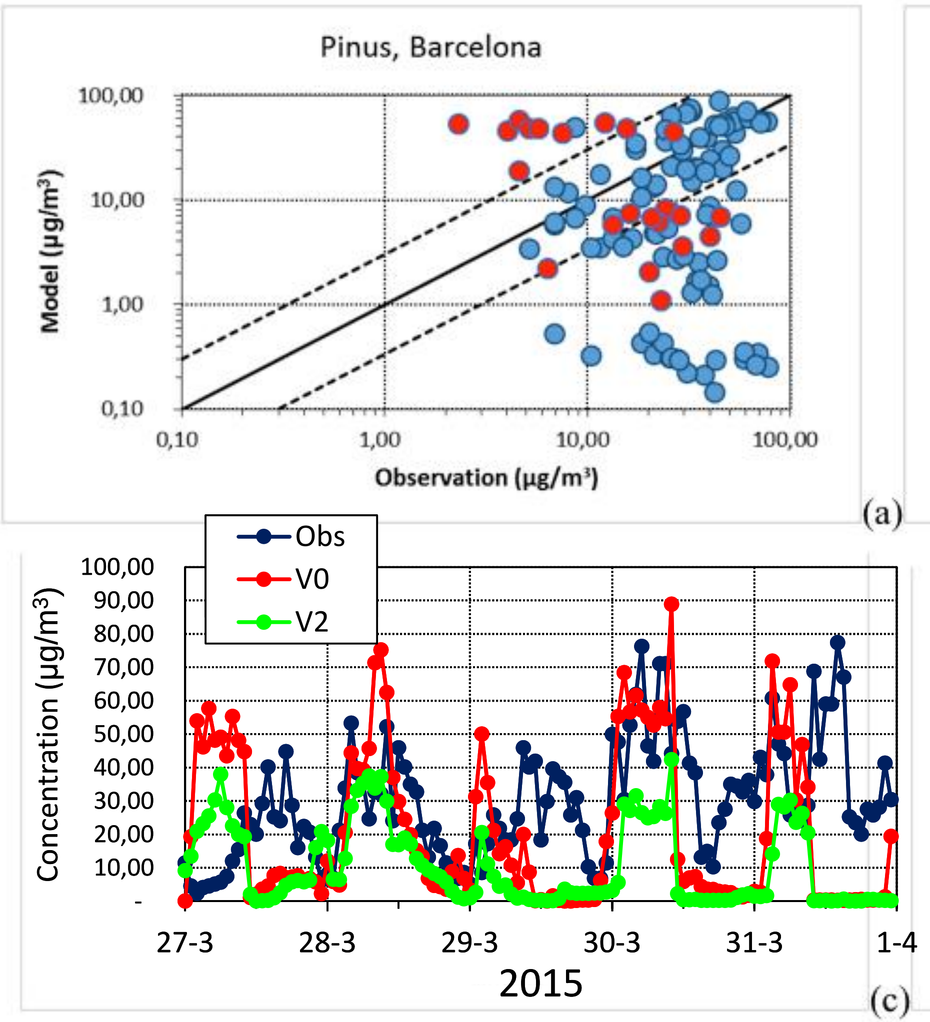
Platanus and Pinus transport simulation

		V0 (first guess)	V1 (low)	V2 (high)
Emission factor (g/day/tree)	Model *Pinus* *Platanus*	Constant **81** (Parker and Blush, 1996) **4,9** (Brichi et al., 2000)	Wind effect scale factor Zhang et al., 2014 **81** (Parker and Blush, 1996) **4,9** (Brichi et al., 2000)	Wind effect scale factor Zhang et al., 2014 **252,22** (Tormo et al., 1996) **120** (Tormo et al., 1996) $E_P = \frac{P_a}{H_s \cdot C} \cdot K_e \cdot u_*$
Sedimentation speed (cm/s)	Ref. *Pinus* *Platanus*	Pérez et al., 2011 **2,17** **0,62**	Jackson & Lyford, 1999 Zhang et al., 2014 **2,8** **1**	Jackson & Lyford, 1999 Zhang et al., 2014 **2,8** **1** $V_{dp} = \frac{\rho_P \cdot g \cdot C_c \cdot d_P^2}{18\mu}$
Initialization		Day0	Day-7	Day-7

$$\beta_{pol}^{mod} = \frac{C_{pol}^{mod} \times 10^3 \times \sigma^*}{LR} * 10^6 \left[Mm^{-1} sr^{-1} \right]$$

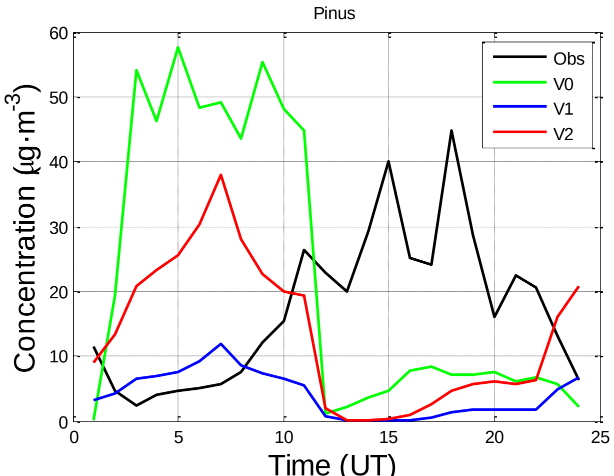
$\sigma^* = 0{,}6\ m^2/g$
LR=50 sr

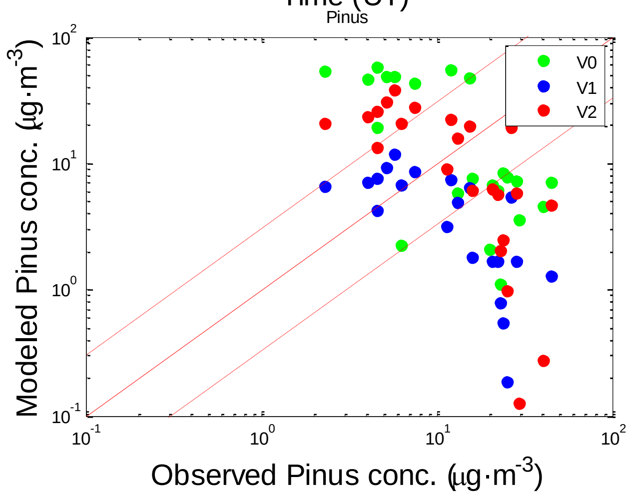
Platanus and Pinus transport simulation



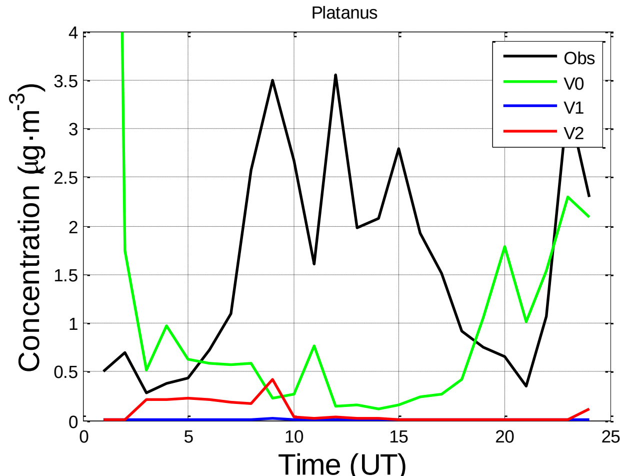
Platanus and Pinus transport simulation

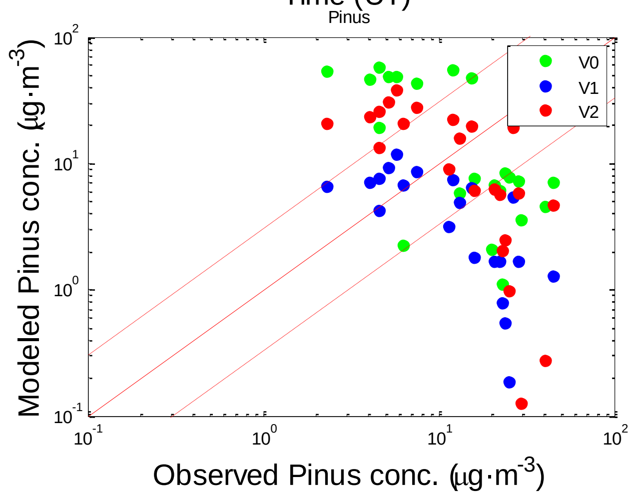
Pinus – 27M





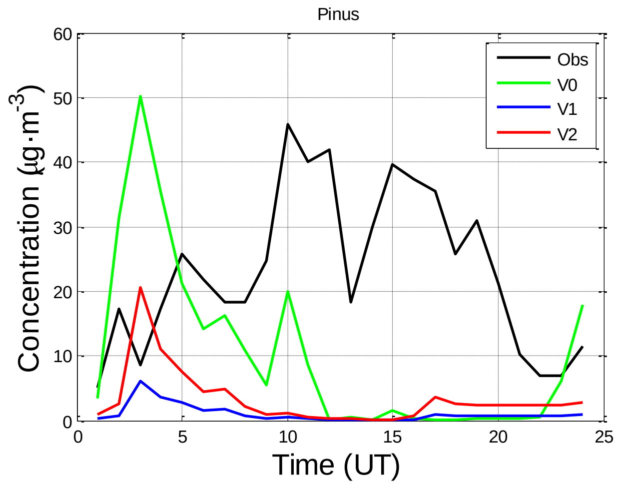
Platanus – 27M

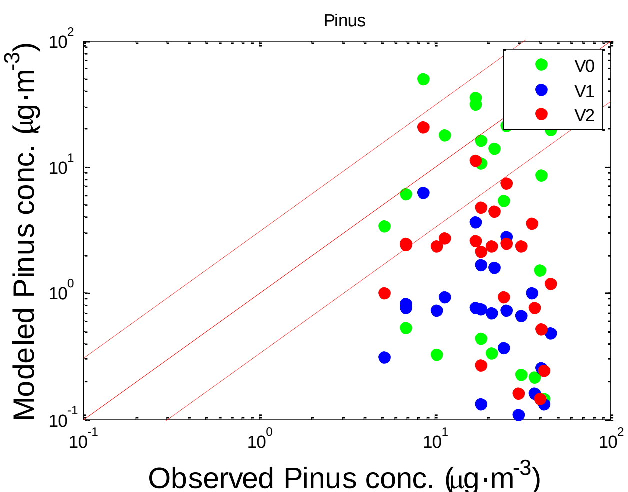




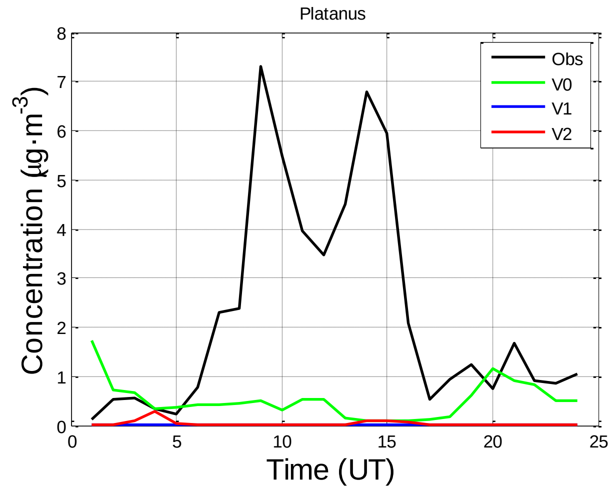
Platanus and Pinus transport simulation

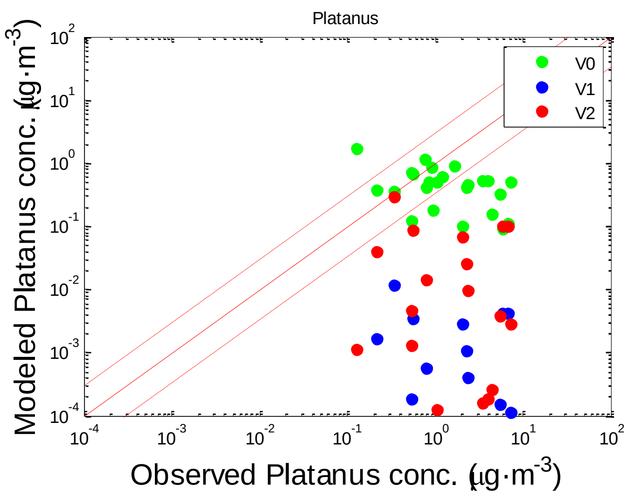
Pinus – 29M





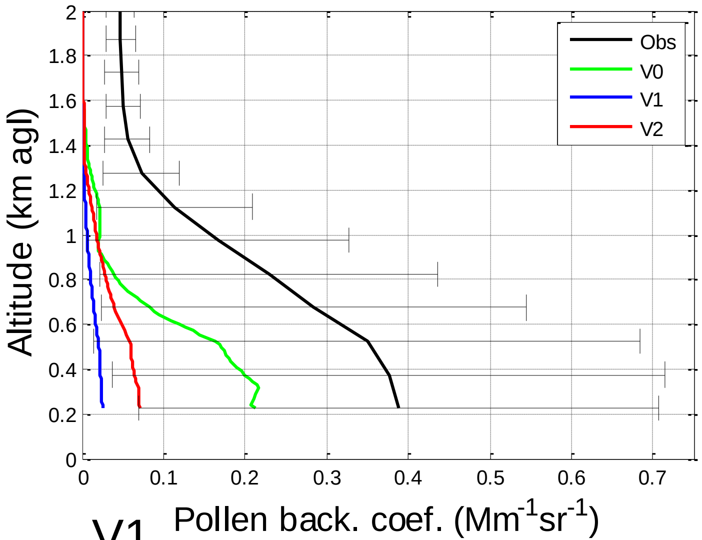
Platanus – 29M



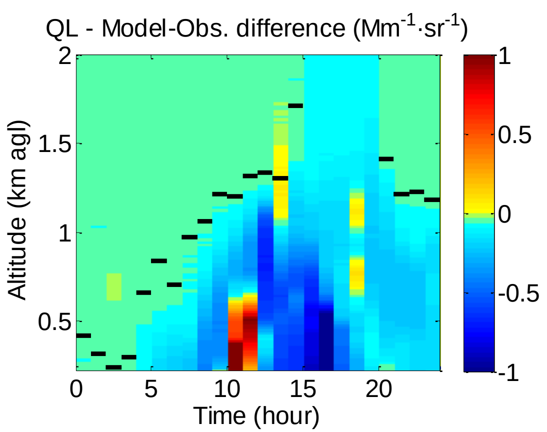


Platanus and Pinus transport simulation

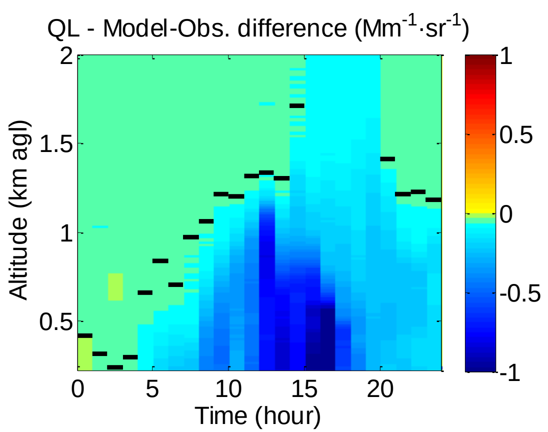
Total– 27M



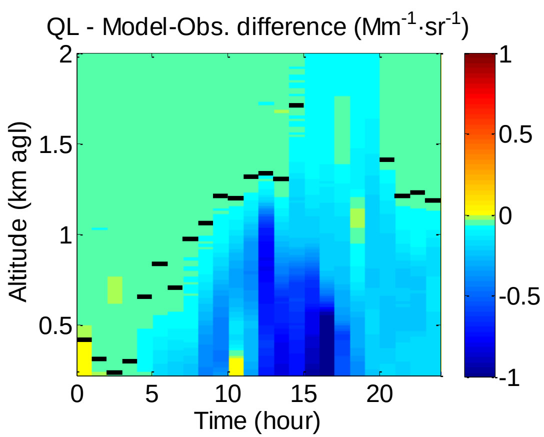
V0



V1

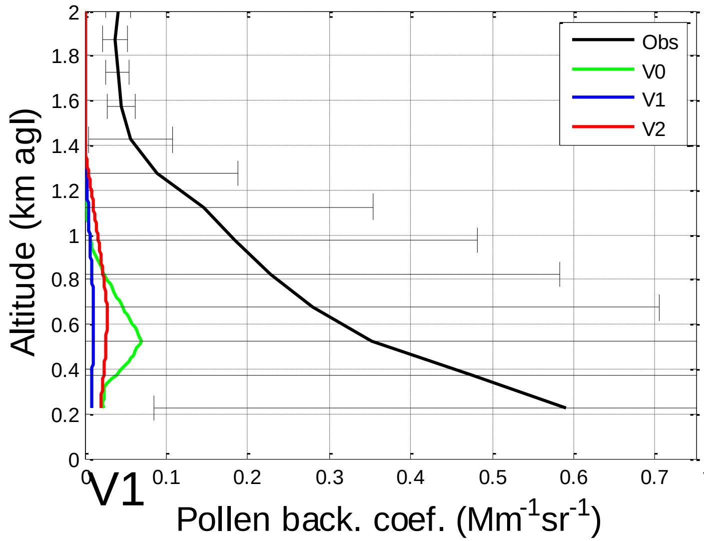


V2

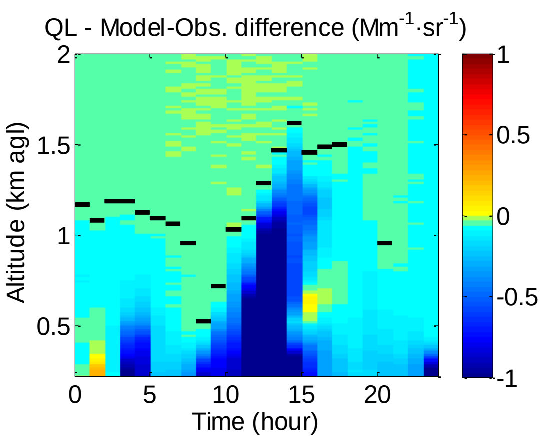


Platanus and Pinus transport simulation

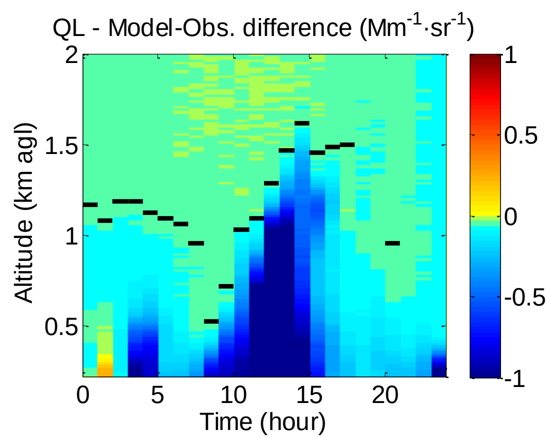
Total– 29M



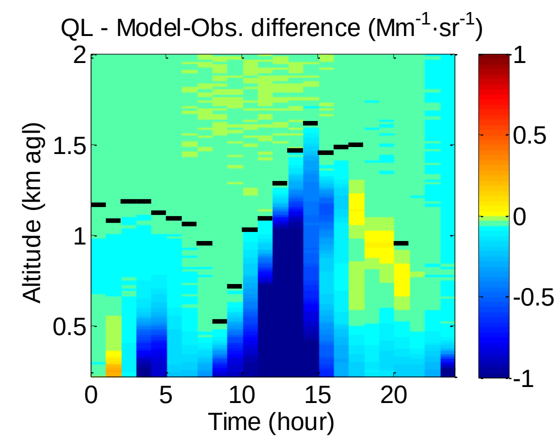
V0

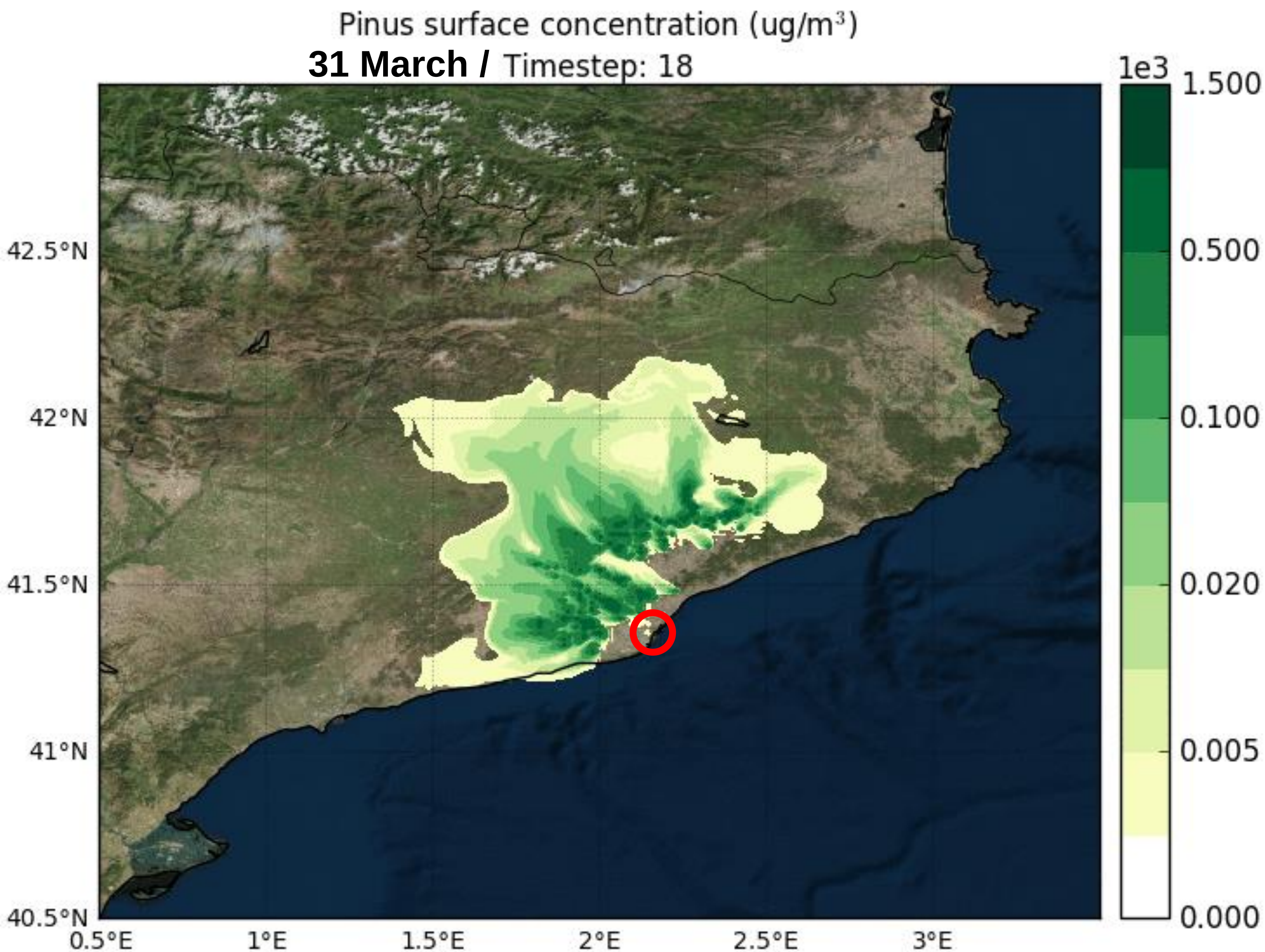


V1



V2




Pinus surface concentration (ug/m³)
31 March / Timestep: 18
1e3
1.500
0.500
0.100
0.020
0.005
0.000
42.5°N
42°N
41.5°N
41°N
40.5°N
0.5°E
1°E
1.5°E
2°E
2.5°E
3°E

05 CONCLUSIONS

Conclusions

- Extremely strong pollination event (Platanus peak > 4700 m-3)
- δV is a good proxy for conc., almost as good as δp → **simple 1β+1δ systems can do the job to track airborne pollen** (not mixed)

- Key factors for pollen modelisation:
  - Emission maps (position and tree density)
  - Emission flux for Pinus and Platanus (high uncertainty)
  - Emission scheme: constant vs. wind driven, dependency of other meteorological variables (T, RH)
  - Sedimentation speed
  - Size of the regional domain considered → recirculation, nesting domains
  - Different pollen types respond differently to these factors

¡Gracias!

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Motivation and objectives

- Investigate with an air quality forecast system the factors responsible of:
  - Pollen release
  - Pollen dispersion/transport
- By evaluating the model performances against **near-surface concentration** and **backscatter coefficient profile** measurements

Listado de puntos:

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- Lorem ipsum dolor sit amet
- Lorem ipsum dolor sit amet

Título

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Título de la diapositiva, letra Calibri 20

Título para la imagen. Letra Calibri 18 negrita, justificado izquierda.