

# Saharan dust, allergenic pollen and high air pollution: *A detrimental spring cocktail for the English population*

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# Background – the news in 2014

## The Telegraph

Saharan dust prompts 'very high' air pollution threatening sick and elderly

Anyone suffering from sore eyes or throat is advised to cut back on physical exertion while those with heart and lung problems are warned to take extra care



David Cameron's car was covered in a light coating of red dust on Monday morning Photo: Steve Back

By James Edgar

 Print this article

## MailOnline



**Sand-ageddon! Britain is covered in layer of dust after African storms carry in sand from the SAHARA desert 2,000 miles away (and even Cameron's car got hit)**

- Unusual atmospheric conditions have blown up sandstorm from Africa
- Thin layer of dust seen today in areas including Cornwall and London
- 10/10 air pollution forecast for London for tomorrow and Wednesday
- Temperatures hit 20.9C yesterday and today is expected to be as hot

By MARK DUELL

## MailOnline

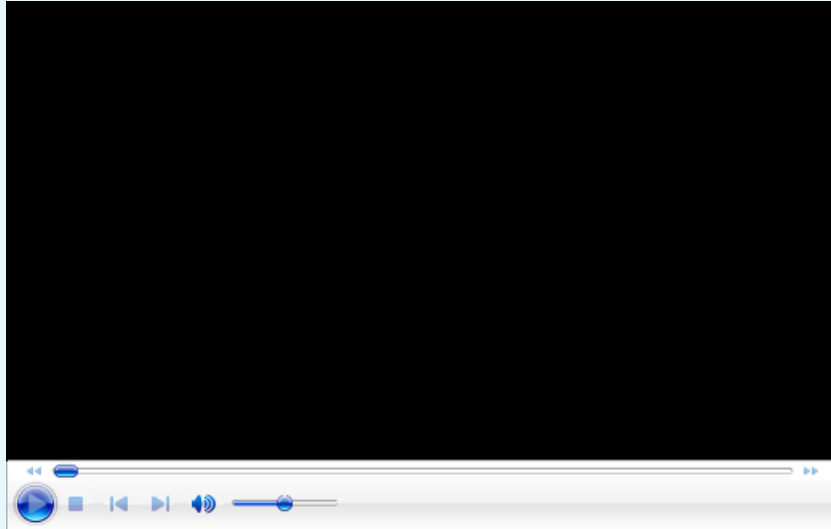


**Sales of hay fever treatments soar after smog and Saharan dust blanketed parts of the UK**

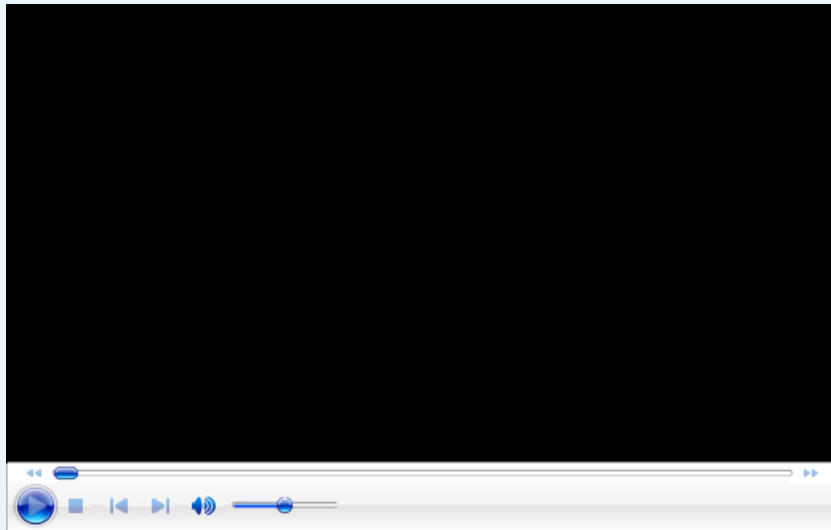
- Antihistamine sales were 84% higher in the first week of April this year than in the same week last year due to the freak weather conditions
- Sales were particularly high in London and the South East of England
- People with asthma, hay fever and breathing problems suffered most

By EMMA INNES

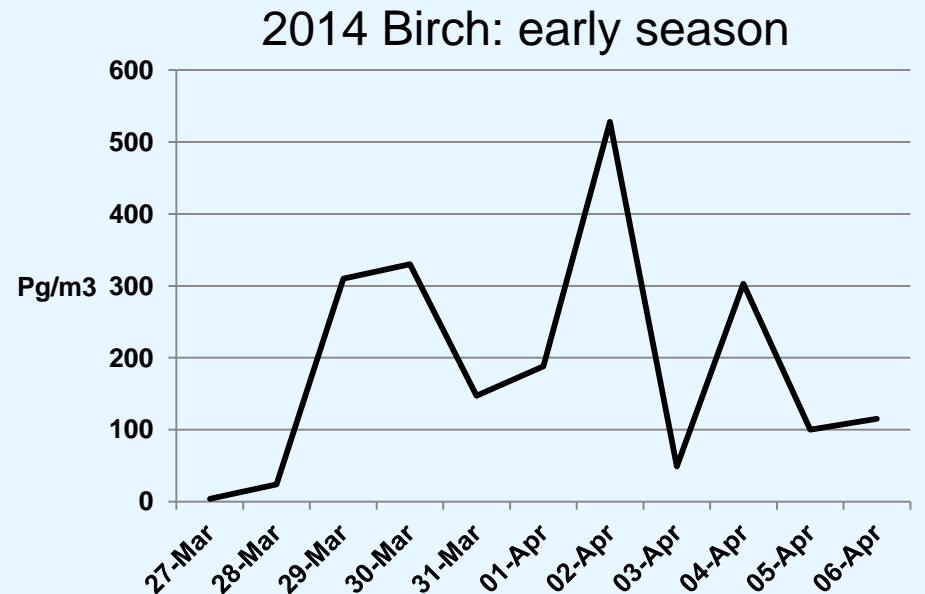
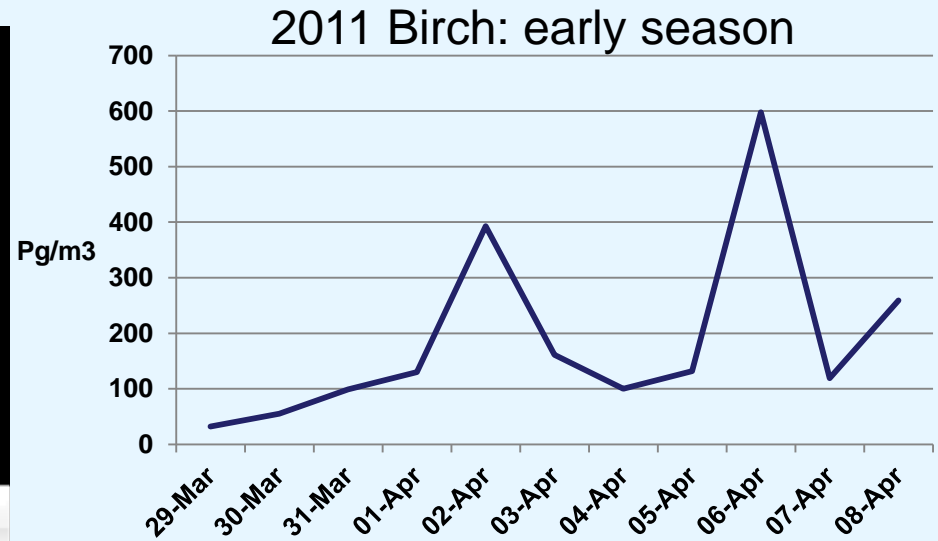
# Examples of Saharan dust in the UK and birch pollen



UK Met Office: <https://www.youtube.com/watch?v=ENoZiZ6gZXk>



UK Met Office: <https://www.youtube.com/watch?v=olox15yVrHQ>



# Scientific background

## › **The cocktail effect:**

- › 1) Co-exposure affect sensitive patients
- › 2) Air pollution affects allergenic potency

## › **The weather effect**

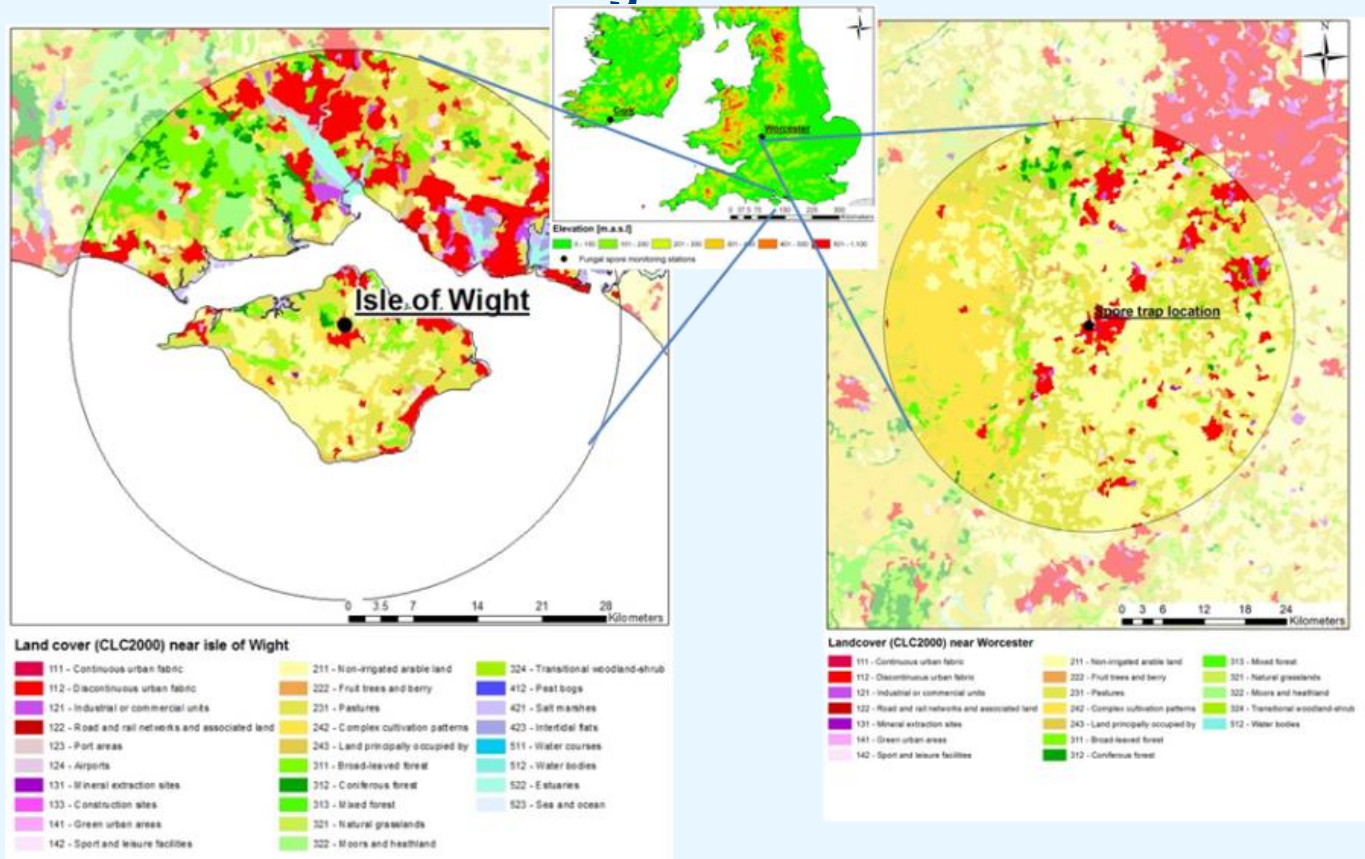
- › 1) Certain weather types promotes Long Distance Transport of chemical and aerosols (chemical, mineral and biological)
- › 2) Certain weather types promotes high air pollution events

# Questions:

- › **Does weather with air pollution episodes and/or Saharan dust enables import of foreign pollen into central parts of UK?**
  - › **Air masses must originate from the south**
  - › **Air masses may contain elevated air pollution?**
  - › **Air masses may show sign of import of foreign pollen**
- › **If so:**
  - › **Severe air pollution events may be accompanied with foreign pollen?**
  - › **Increased risk for co-exposure?**
  - › **Increased risk for change in allergenic potency?**

# Observational methods - pollen

- › Daily concentrations with a HIRST trap
  - › Daily data from Worcester: 2005-14
  - › Additional episodes complemented with data from Isle of Wight





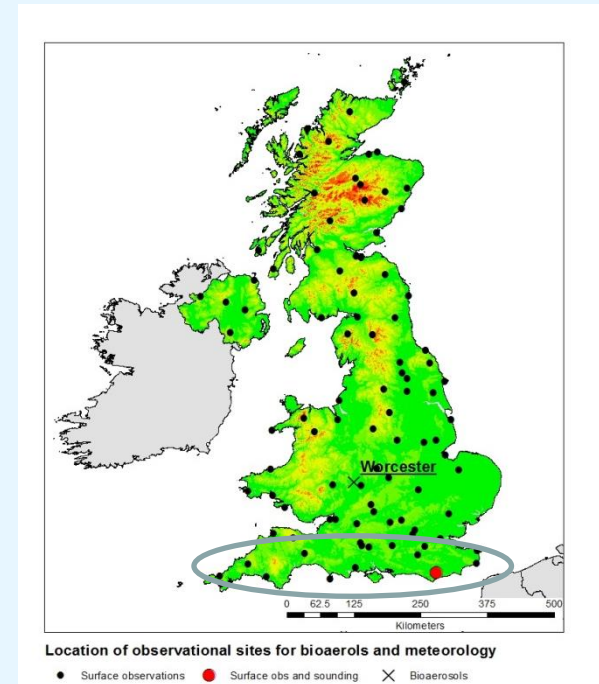
# Observational methods – air quality and meteorology

## › Air quality

- › PM10m concentrations
- › Three sites in southern UK
- › Method: Filter pack, daily mean values

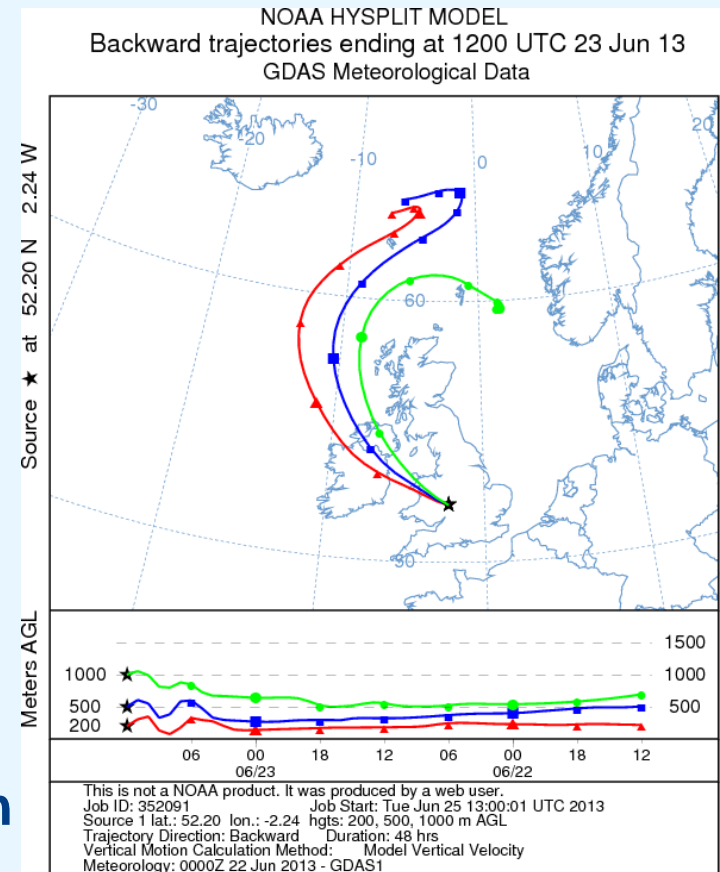
## › Meteorology

- › Surface observations from UK network with hourly data
- › Atmospheric soundings in Southern UK



# Model calculations with HYSPLIT

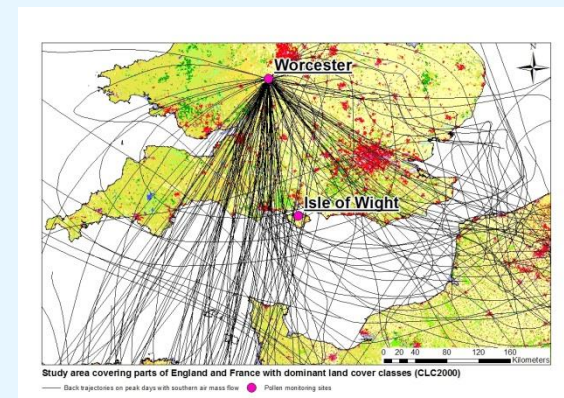
- › **Trajectory/Particle disp. modelling**
  - › A mathematical model that use meteorological data
  - › Simulate atmospheric transport using eq. from atmosph. physics
  - › Idea: Simulate path of one (or many) particles
  - › Can go forward
  - › Can go backward
  - › Efficient for analysing aeroallergens<sup>[2]</sup>
  
- › Analysing all episodes with southern flow in birch pollen season
- › Focus on 2014 episode





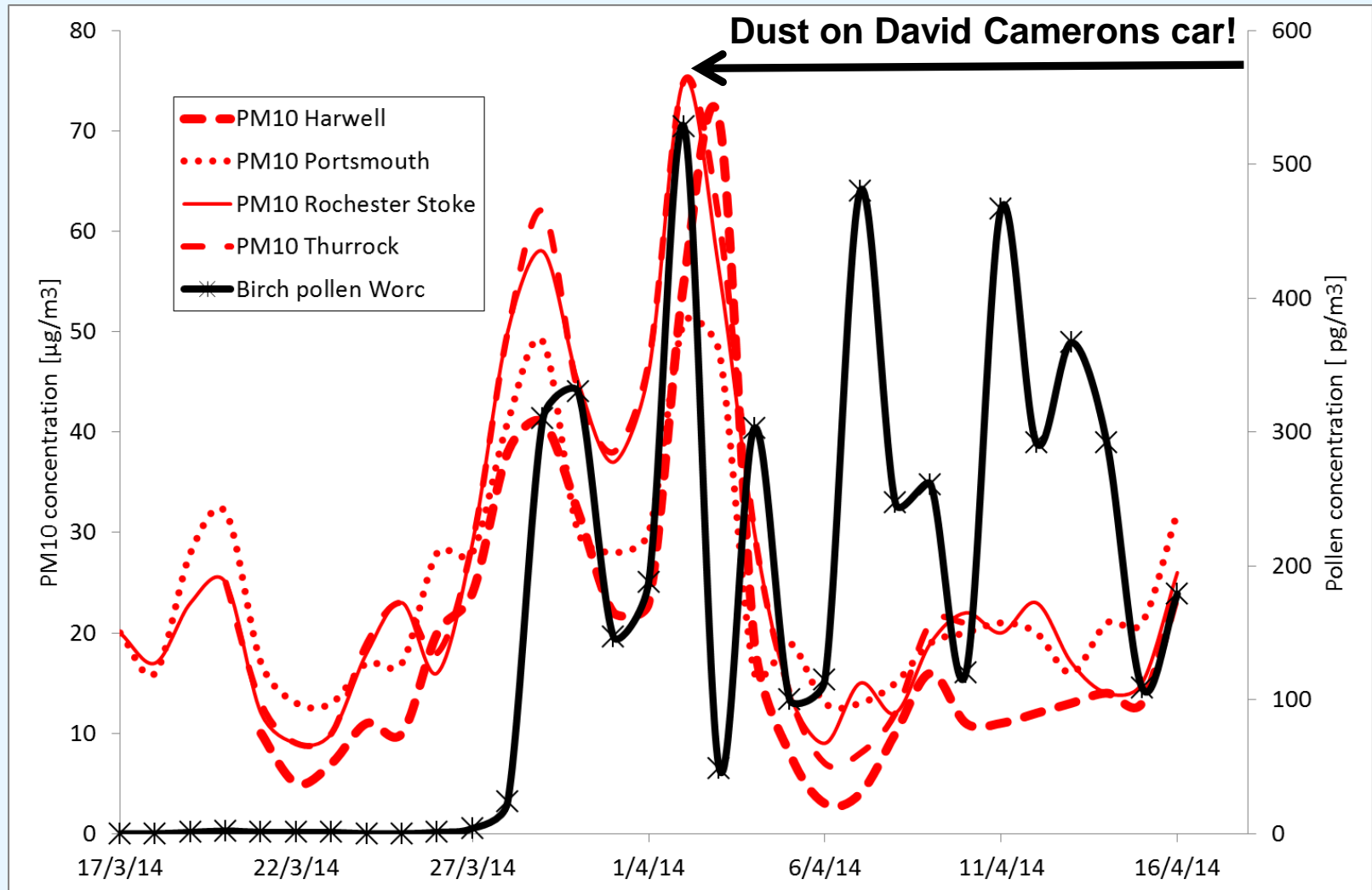
# Results – air quality data (all episodes)

Date	Daily birch pollen count Worcester	Daily birch pollen count Isle of Wight	PM10 Harwel	PM10 Portsmouth	PM10 Rochaster stoke	PM10 Thurrock
02April2005	260	119	<b>39</b> (19)	<b>35</b> (20)	<b>45</b> (20)	<b>51</b> (22)
22April2005	207	66	<b>35</b> (19)	<b>34</b> (20)	<b>33</b> (20)	<b>39</b> (22)
23April2005	464	64	27 (19)	18 (20)	<b>37</b> (20)	<b>41</b> (22)
21April2006	270	18	<b>29</b> (24)	<b>23</b> (22)	-	<b>25</b> (24)
24April2006	403	N/A	<b>35</b> (24)	<b>30</b> (22)	-	<b>27</b> (24)
02May2006	185	65	<b>24</b> (24)	<b>21</b> (22)	<b>21</b> (22)	<b>19</b> (24)
09May2006	248	27	25 (24)	24 (22)	29 (22)	34 (24)
14April2007	146	140	33 (28)	45 (31)	30 (25)	34 (26)
26April2008	117	54	19 (19)	-	23 (24)	21 (22)
06April2009	107	16	<b>31</b> (22)	<b>53</b> (34)	<b>42</b> (26)	<b>53</b> (32)
09April2009	129	91	13 (22)	21 (34)	13 (26)	16 (32)
14April2009*	114	42	23 (22)	31 (34)	31 (26)	37 (32)
24April2010*	351	134	<b>40</b> (22)	<b>58</b> (35)	-	<b>57</b> (27)
01April2011	130	47	13 (27)	14 (25)	-	20 (40)
02April2011	393	15	<b>14</b> (27)	<b>21</b> (25)	-	<b>22</b> (40)
06 April2011	598	113	15 (27)	23 (25)	-	22 (40)
07 May 2013	133	32	-	<b>24</b> (16)	<b>28</b> (15)	<b>33</b> (16)
29 March 2014	113	310	<b>41</b> (21)	<b>49</b> (26)	<b>58</b> (30)	<b>62</b> (30)
30 March 2014	27	330	32 (21)	40 (26)	45 (30)	44 (30)
31 March 2014	8	147	22 (21)	28 (26)	37 (30)	38 (30)
01 April 2014	191	188	23 (21)	30 (26)	46 (30)	47 (30)
02 April 2014	329	528	55 (21)	<b>51</b> (26)	<b>75</b> (30)	<b>75</b> (30)
03 April 2014	356	49	<b>71</b> (21)	48 (26)	56 (30)	61 (30)
04 April 2014	28	303	19 (21)	16 (26)	30 (30)	30 (30)



\*Episode extends with a few hours into following or preceding day. PM10 numbers in bold red correspond to a local maximum. PM Numbers in bracket is the mean value during the pollen season. 2012 had no episodes with air masses originating from South.

# Results – 2014 episode (pollen and PM10)

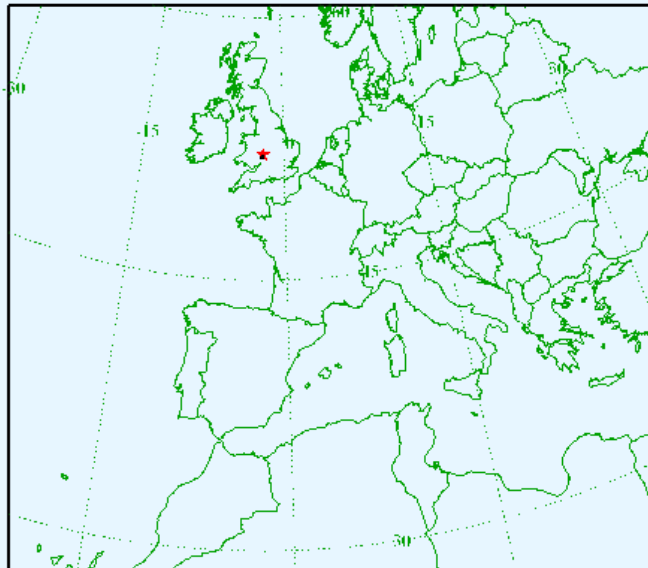


# Results – 2014 episode (meteorology & model calculations)

01 April, 00UTC

NOAA HYSPLIT MODEL

PARTICLE POSITIONS AT 23 UTC 31 Mar 14

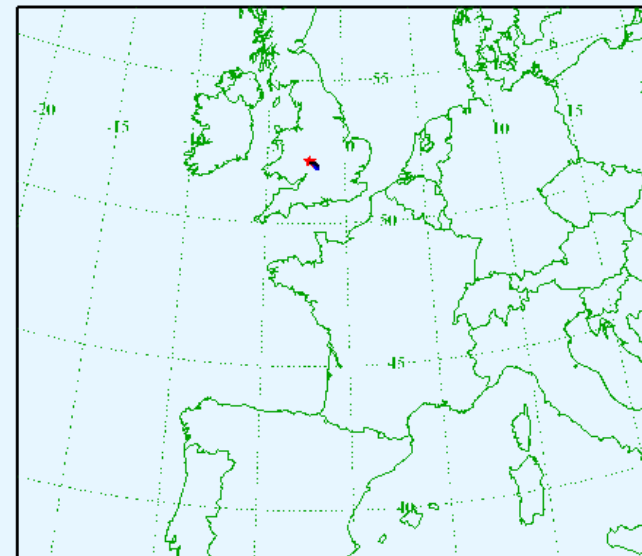


LAYER (m): < 1000 < 2000 < 3000 < 4000 < 5000  
NUMBER OF PARTICLES ON GRID: 473

02 April, 12UTC

NOAA HYSPLIT MODEL

PARTICLE POSITIONS AT 11 UTC 02 Apr 14



LAYER (m): < 500 < 1000 < 1500 < 2000 < 2500  
NUMBER OF PARTICLES ON GRID: 510

- › **Soundings showed: High wind speeds, low level inversion. Surface observations showed: no precipitation -> both cause limited removal of pollen, particles and gasses.**

# Discussion

- › **Import of birch pollen happens almost every year on southern flows**
  - › **Elevated air pollution (PM10) frequently observed on southern flows**
  - › **Saharan dust reported in 2008, 2011, 2014.**
  - › **Birch pollen at Isle of Wight pollen unlikely to be local in 2014 and 2011 due to southern flows at IoW.**
  - › **Cocktail effect depends on the path of the air masses during LDT episodes.**
    - › **Land based route of air masses: Risk of 'PM10 + Local Pollen + Foreign Pollen+ Dust'**
    - › **Sea based route: Risk of 'PM10 + Local Pollen + Dust'**
- Pollen slide on 2014 episode had pollen native to Africa/Southern Europe**

# Conclusion

- › **Meteorology cause a synchronisation of natural events causing:**
  - › **Release and dispersion of pollen**
  - › **Photochemical reactions causing chemical air pollution**
  - › **LDT episodes of mineral dust**
  
- › **Cocktail effects can cause:**
  - › **Co-exposure, affecting personal thresholds**
  - › **Enhanced transformation of aeroallergens**
  
- › **Cocktail effect a likely cause to severe problems for large fractions of the UK population in spring 2014**

# Acknowledgements:

- › **Danish Research Council for funding the SUPREME project**
- › **Steven Pooter and UK Met Office for pollen data from Isle of Wight**
- › **UK Met office for verifying surface observations and you-tube video**
- › **University of Wyoming for atmospheric sounding**