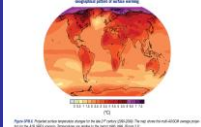


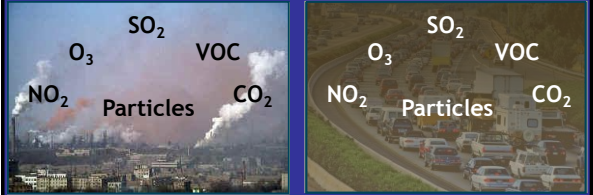
Hyderabad 6-9 December 2012
WAO International Scientific Conference

Climate Change and Respiratory Allergy

Gennaro D'Amato
Director, Division of Respiratory and Allergic Diseases
Department of Chest Diseases
High Speciality Hospital A. Cardarelli
Napoli Italy



What Has Changed over the Last 50 years?

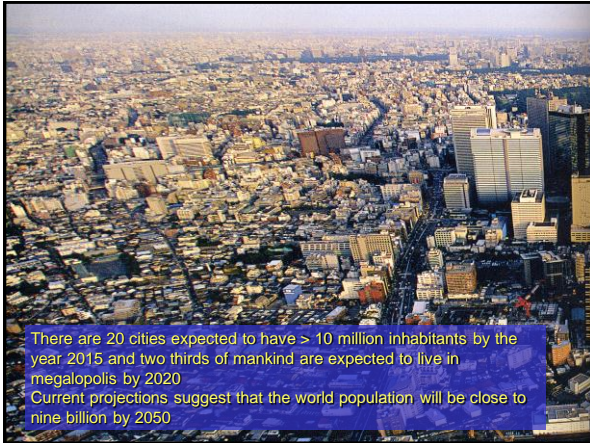


Urbanisation and Pollution

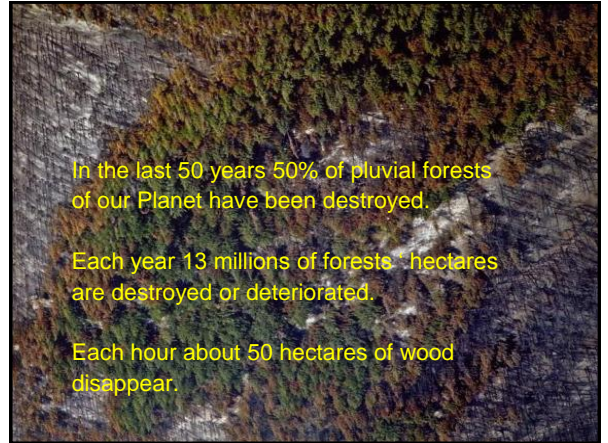
Increased Temperatures

Increased CO₂ levels

Increased Allergy



There are 20 cities expected to have > 10 million inhabitants by the year 2015 and two thirds of mankind are expected to live in megalopolis by 2020
Current projections suggest that the world population will be close to nine billion by 2050



In the last 50 years 50% of pluvial forests of our Planet have been destroyed.

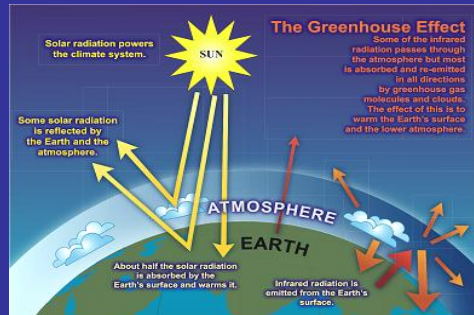
Each year 13 millions of forests hectares are destroyed or deteriorated.

Each hour about 50 hectares of wood disappear.

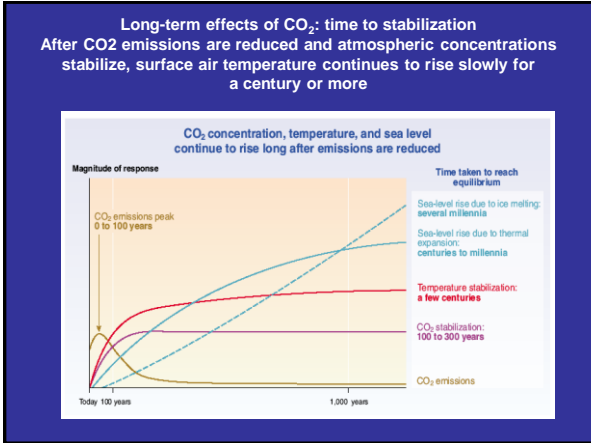
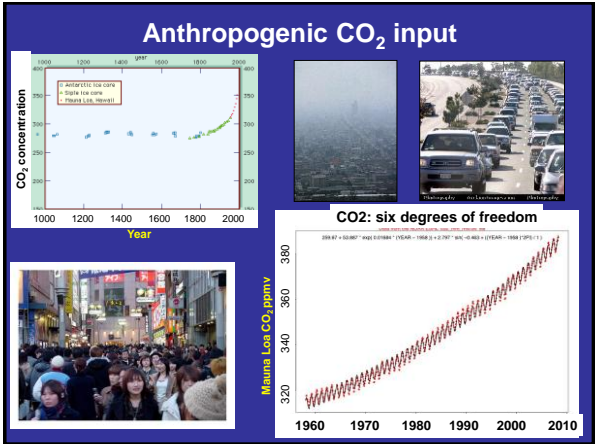
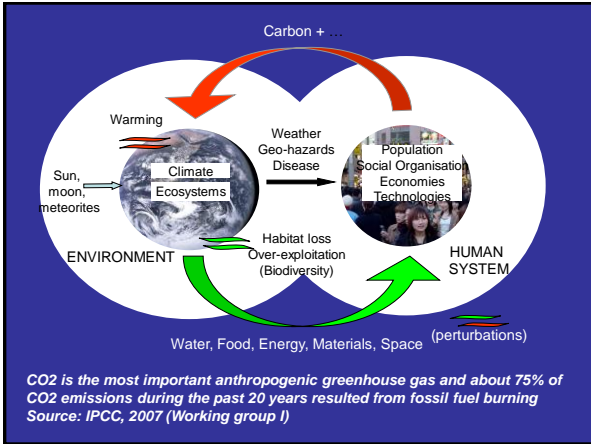


Food cultivation on wasted areas of tropical pluvial forests determined about 35% of deforestation in South America, 70% in African and 50 % in Asian countries.

The greenhouse effect



The International Panel on Climate Change (IPCC) concluded in its Report that global warming is unequivocal and that human activity is the main driving force very likely causing most of the rise in temperatures since 1950



76 Millions of tons of CO₂ produced by Internet in 2002
 650 Millions of tons in 2010

facebook
THE LANCET
 32, Jamestown Road, London, NW1 7BY, UK

D'Amato G, et al
Facebook. A new trigger for asthma?
 The Lancet, Vol 376;Nov20,2010 p1740

D'Amato G, et al
Social Networks : a new source of psychological stress or a way to enhance self-esteem? Negative and positive implications in bronchial asthma. JIACI In press

REVIEW
 Urban air pollution and plant-derived respiratory allergy
 G. D'AMATO
 Division of Pneumology and Allergy, Department of Chest Diseases, Azienda Ospedaliera di Alta Specialità, A. Cardarelli, Naples, Italy

REVIEW
 Effects of climate change on environmental factors in respiratory allergic diseases
 G. D'Amato¹ and L. Cecchi²
¹Division of Pneumology and Allergy, Department of Chest Diseases, High Specialty Hospital "A. Cardarelli", Napoli, Italy; ²Interdepartmental Centre of Biomedicine, University of Florence, Florence, Italy and ³Atopy Clinic, Azienda Sanitaria 10 Rome, Rome, Italy

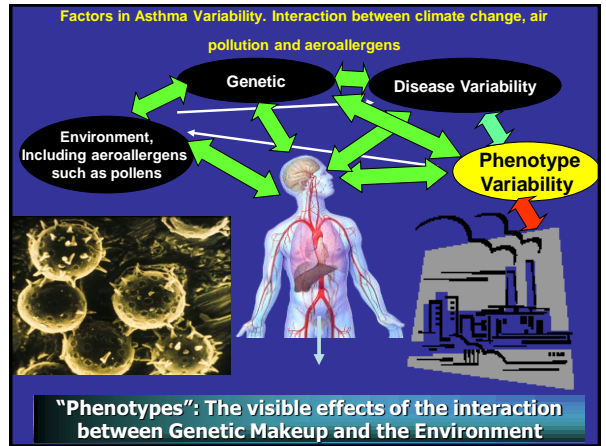
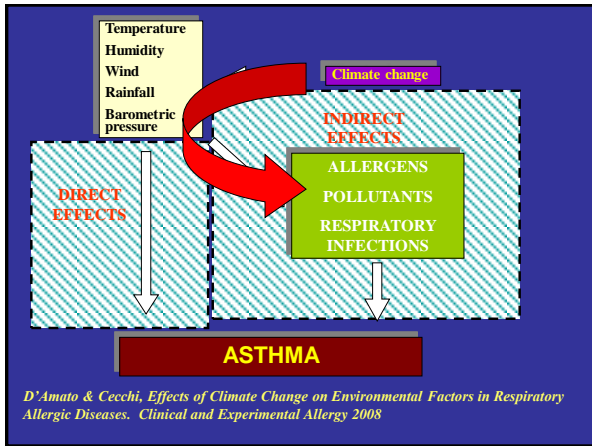
EUROPEAN RESPIRATORY MONOGRAPH
 Volume 7
 Monograph 21, August 2002

The Impact of Air Pollution on Respiratory Health

Edited by
 G. D'Amato and S.T. Holgate

EUROPEAN RESPIRATORY SOCIETY

Current knowledge of effects of climate change on respiratory allergy is provided by epidemiological and experimental studies on the relationship between asthma and environmental factors, such as meteorological variables, airborne allergens and air pollution.



REVIEW

Effects of climate change on environmental factors in respiratory allergic diseases

G. D'Amato* and L. Cecchi^{1,2}

*Division of Respiratory and Allergic Diseases, Department of Chest Diseases, High Speciality Hospital "A.Corderelli", Napoli, Italy; ¹Interdepartmental Center of Bioclimatology, University of Florence, Florence, Italy and ²Allergy Clinic, Azienda Sanitaria 10 Firenze, Florence, Italy

- Earlier start, increase of length and intensity of pollen season
- Increase of pollutants levels
- Increase of heavy precipitation events (e.g. thunderstorms)
- Increased occurrence of episodes of long distance transport of pollen and pollutants
- Reduced susceptibility to upper respiratory infections (due to increase in winter temperatures)

Negative effects

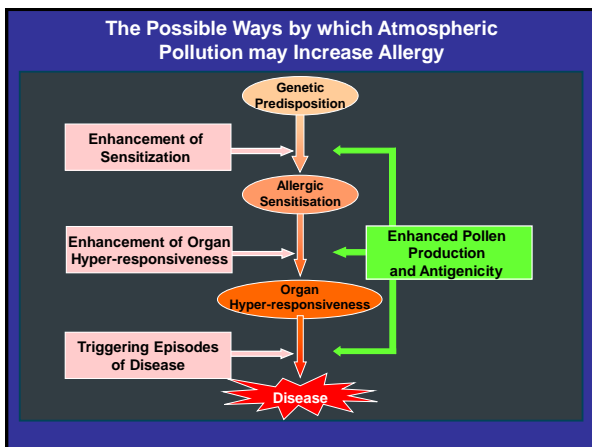
Positive effects

D'Amato & Cecchi, Clin Exp Allergy, 2008

The "urban climate effect"

The plants flower earlier in urban areas than in the corresponding rural areas with earlier pollination of about 2-4 days

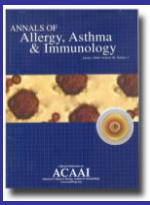
Emberlin et al CEA 1999;
Beggs CEA 2002;
D'Amato et al ERJ2002; Allergy2007; CEA2008; JIACI 2010



What is the Association Between Weather / Climate Variability & Pollen Trends?

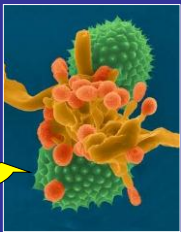
Studies on plant responses to elevated CO₂ indicate that plants exhibit enhanced photosynthesis and reproductive effects and produce more pollen

Emberlin et al CEA 1999
D'Amato et al Allergy 2007



Production of allergenic pollen by ragweed (*Ambrosia artemisiifolia*) is increased in CO₂ enriched atmospheres
Wayne P. et al *Ann Allergy Asthma Immunol.* 2002

A doubling of the atmospheric CO₂ concentration stimulated ragweed-pollen production by 61%



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Primary Care Respiratory Journal (2010), 19(3): 254-259

ORIGINAL RESEARCH

Short-term effects of airborne pollens on asthma attacks as seen by general practitioners in the Greater Paris area, 2003-2007

Bich Tram Huynh¹, Séverine Tuat¹, Clément Turbelli¹, Camille Pelat¹, Lorenzo Cecchi², Genaro D'Amato³, Thierry Blanchon¹, *Isabella Anesi-Maesano¹

Conclusions: For the first time, a significant short-term association was observed between Poaceae pollen counts and consultations for asthma attacks as seen by GPs.

	<i>Betula</i>	<i>Cupressa</i>	<i>Fraxinus</i>	<i>Poaceae</i>
Pollens				
<i>Betula</i>	1.00			
<i>Cupressa</i>	0.31*	1.00		
<i>Fraxinus</i>	0.18*	0.76*	1.00	
<i>Poaceae</i>	0.52*	0.75*	0.77*	1.00
Pollutants				
NO ₂	-0.05	-0.21*	0.10	-0.64*
O ₃	0.41*	0.57*	0.31*	0.85*
SO ₂	0.01	-0.18*	0.12	-0.68*
PM ₁₀	0.04	0.03	0.11	0.00
Meteorological variables				
Mean temperature (°C)	0.04	0.25*	-0.05	0.80*
Relative humidity (%)	-0.41*	-0.56*	-0.34*	-0.70*

*p<0.01


GL 2011

Published as: *Environ Pollut.* 2011 October ; 159(10): 2823-2830

Ozone affects pollen viability and NAD(P)H oxidase release from *Ambrosia artemisiifolia* pollen



Stefania Pasqualini^{1,3}, Emma Tedeschini³, Giuseppe Frenguelli³, Nicole Wopfnar², Fatima Ferreira¹, Genaro D'Amato¹, and Luisa Ederli³

¹Department of Applied Biology, University of Perugia, Perugia, Italy
²Department of Molecular Biology, CD Laboratory for Allergy Diagnosis and Therapy, University of Salzburg, Salzburg, Austria
³Division of Respiratory and Allergic Diseases, 'A. Cardarelli' High Speciality Hospital, Naples, Italy



Highlights

- ▶ O₃ reduces the viability of ragweed pollen. ▶ ROS and allergens of ragweed pollen were not affected by O₃ exposure. ▶ O₃ enhances the activity of the ROS-generating enzyme NAD(P)H oxidase. ▶ O₃ increases ragweed pollen allergenicity through NAD(P)H-oxidase stimulation.

NAD(P)H= nicotinamide adenine dinucleotide phosphate oxidase.

Relation between airborne pollen concentrations and daily cardiovascular and respiratory-disease mortality

"In a time-series study in the Netherlands, we found a strong association between the day-to-day variation in pollen concentrations and that of deaths due to cardiovascular disease, chronic obstructive pulmonary disease, and pneumonia"

Results

Poaceae Betula and Rumex weekly concentrations were positively associated to mortality

Bruneekreef et al, *Lancet*, 2000

Climate Changes favour production also of Airborne Small Allergen-carrying Particles
D'Amato G et al *Allergy* 2007; *Clin Exp Allergy* 2008; *JIACI* 2010

- ✦ Pollen fragments
- ✦ Starch granules and other cytoplasmic granules
- ✦ Non-pollen plant parts (from inflorescences, leaves or Ubbisch bodies)
- ✦ Non-plant particulate matter (allergens transferred through physical contact or by leaching from the surface of the pollen grain to other airborne small particles).



Review article

Thunderstorm-asthma and pollen allergy

Thunderstorms have been linked to asthma epidemics, especially during the pollen seasons, and there are descriptions of asthma outbreaks associated with thunderstorms, which occurred in several cities, previously in Europe (Birmingham and London in the UK and Nurem in Italy) and Australia (Melbourne and Wagga Wagga). Pollen grains can be carried by thunderstorms at ground level, where pollen grains would be inactivated both because of allergic biological aerosols of gaseous/nitric acid, derived from the cytoplasm and which can penetrate deep into lower airways. In other words, there is evidence that under wet conditions or during thunderstorms, pollen grains may, after passage by convective shocks, infuse into the atmospheric part of their airways, including respiratory, allergen-carrying components, which generally (4, 5, 2, 3, 1991) include respiratory, allergen-carrying components, which generally (4, 5, 2, 3, 1991) include respiratory, allergen-carrying components that can reach lower airways including asthma exacerbation in patients suffering from thunderstorm asthma outbreaks are characterized, at the beginning of thunderstorms by a rapid increase of visits for asthma in general practitioner or hospital emergency departments. Subjects without asthma symptoms, but affected by seasonal rhinitis can experience an asthma attack. No unusual levels of air pollution were noted at the time of the epidemics, but there was a strong association with high atmospheric concentrations of pollen grains such as grasses or other allergenic plant species. Therefore, subjects affected by pollen allergy should be informed about a possible risk of asthma attack at the beginning of a thunderstorm during pollen season.

G. D'Amato¹, G. Liccardi¹, G. Frenguelli¹
¹Division of Respiratory Diseases, High Speciality Hospital 'A. Cardarelli', Naples, Italy; ²Department of Paediatric Allergy, University of Padua, Padua, Italy; ³Department of Paediatric Allergy, University of Perugia, Perugia, Italy

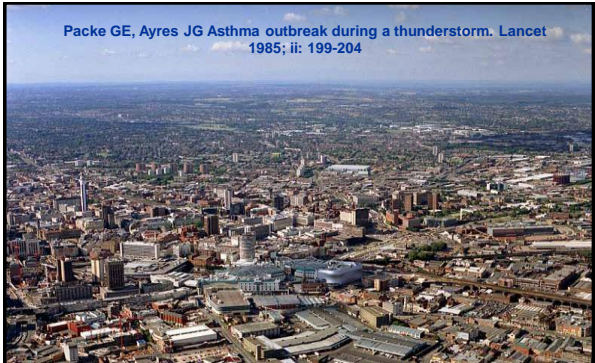
Key words: allergic asthma; thunderstorm asthma; allergen-carrying particles; climate change; environment and allergen-carrying particles; respiratory allergy; thunderstorm asthma

Prof. Genaro D'Amato, Division of Respiratory and Allergic Diseases, Department of Respiratory Diseases, High Speciality Hospital 'A. Cardarelli', Naples, Italy. E-mail: genaro.damato@unina1.it

Received 12 August 2009
Accepted for publication 6 October 2009



Changes are also occurring in the amount, intensity, frequency and type of precipitation as well as the increase of extreme events, like heat waves, droughts, floods and hurricanes



Association between a thunderstorm and an asthma outbreak with 26 asthmatic subjects treated in Birmingham Hospital in 36 hours compared with 2-3 cases in the same time in the days preceding the thunderstorm.

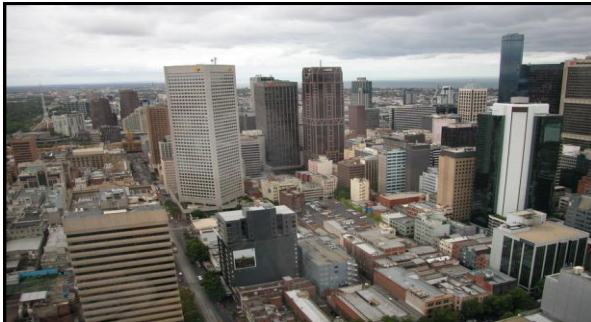
Packe GE, Ayres JG Asthma outbreak during a thunderstorm. Lancet 1985; ii: 199-204



London 25 June 1994
Celenza A et al. Thunderstorms associated asthma: A detailed analysis of environmental factors. BMJ 1996;312:604-607
Thames Regions Accident and Emergency Trainer Association. A major outbreak of asthma associated with a thunderstorm: experience of accident and emergency departments and patients characteristics BMJ 1996;312:601-4



Bellomo R et al. Two consecutive thunderstorm associated epidemics of asthma in Melbourne. Med J Aust 1992; 156: 834-7



Also this phenomenon was followed by a rapid increase in hospital or general practitioner visits for asthma. No unusual levels of air pollution were noted at the time of these epidemics but there was a strong association with grass pollen.



Wagga Wagga 30 oct 1997



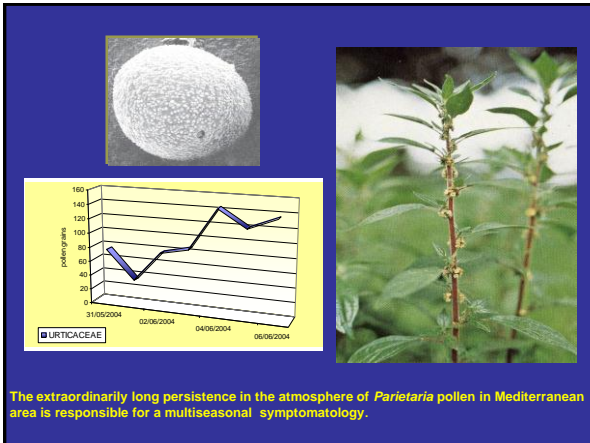
Napoli 4 June 2004 (D'Amato G et al Allergy 2007)

7 patients received treatment in emergency departments and one was admitted to an intensive care unit for acute respiratory insufficiency.

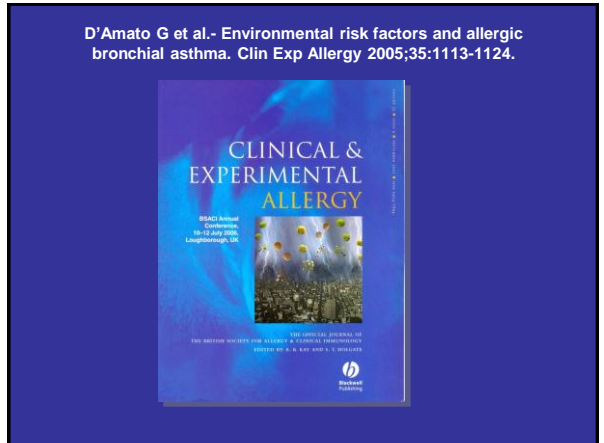


Napoli 4 June 2004 All subjects were allergic to *Parietaria*.

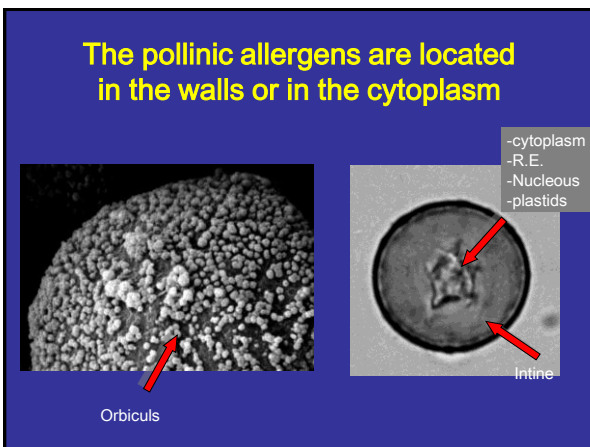
Five subjects had a history of asthma, whereas two had a history of only rhinitis.



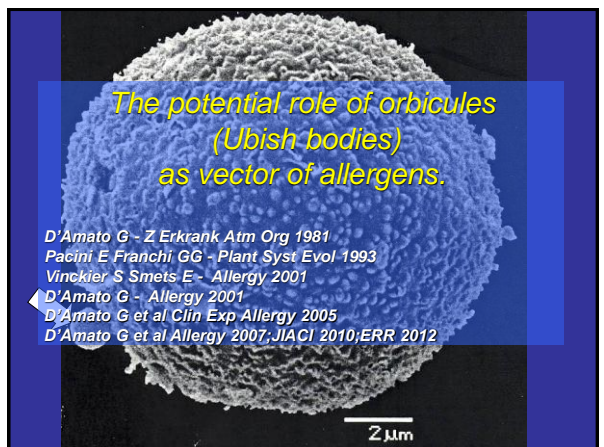
The extraordinarily long persistence in the atmosphere of *Parietaria* pollen in Mediterranean area is responsible for a multiseasonal symptomatology.



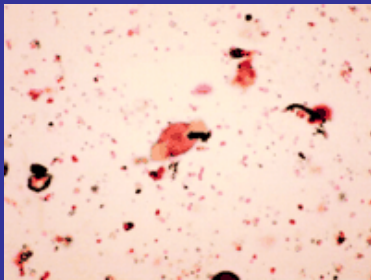
D'Amato G et al.- Environmental risk factors and allergic bronchial asthma. Clin Exp Allergy 2005;35:1113-1124.



The pollinic allergens are located in the walls or in the cytoplasm



Hydrated pollen on a wet surface



Marks G.B. et al. Thorax 2001; 56:468-471
 "the arrival of a thunderstorm was accompanied by a large increase in the concentration of ruptured pollen grains"

Thunderstorm related epidemics of rhinitis and asthma exacerbations

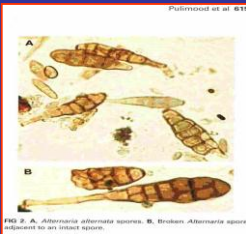


Under wet conditions or during thunderstorms pollen grains may, after rupture by osmotic shock, release part of their cytoplasmic content into the atmosphere.

D'Amato G, et al BMJ 2005; ClinExpAllergy2005;Allergy 2007;JACI2008;JACI2010;ERR2012

Epidemic asthma and the role of the fungal mold *Alternaria alternata*

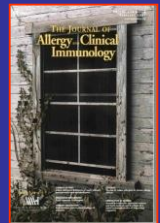
Thomas B. Pulimood, MBBS, MRCP,* Julie M. Corden, BSc,† Clare Bryden, MA, MSc, FRMetS,‡ Linda Sharpley, PhD,§ and Shuaib M. Nasser, MBBS, MD, FRCP, Cambridge, Derby, and Essex, United Kingdom



(Pulimood TB et al. J Allergy Clin Immunol 2007;120:610-17)

Pulimood et al suggest sensitization to *Alternaria* species to play a key role in thunderstorm-related asthma.

Marks Gb and Bush RK It's blowing in the wind: new insights into thunderstorm-related asthma. J Allergy Clin Immunol 2007;120:530-2



Marks and Bush provide a review of environmental factors involved in asthma epidemics, listing necessary conditions to make them possible. They cited fungal spores and grass pollen as the unique airborne allergens that are implicated in the pathogenesis of thunderstorm-related asthma. This is not completely true.

Thunderstorm-related asthma: Not only grass pollen and spores

To the Editor:

Gennaro D'Amato, MD^a
Lorenzo Cecchi, MD^b
Gennaro Liccardi, MD^a

From ^athe Division of Respiratory and Allergic Diseases, Department of Respiratory Diseases, High Specialty Hospital A. Cardarelli, Naples, Italy, and ^bthe Interdepartmental Centre of Bioclimatology, University of Florence, Florence, Italy.
Disclosure of potential conflict of interest: The authors have declared that they have no conflict of interest.

D'Amato G et al. J Allergy Clin Immunol 2008;121:537-38

1- The evidence about thunderstorm related epidemics of rhinitis and asthma exacerbations:

- 1) The occurrence of epidemics is closely linked to thunderstorm
- 2) The thunderstorm related epidemics are limited to late spring and summer when there are high levels of airborne pollen grains
- 3) There is a close temporal association between the arrival of the thunderstorm, a major rise in the concentration of pollen grains and the onset of epidemics

2 - The evidence about thunderstorm related epidemics of rhinitis and asthma exacerbations:

- 4) Subjects with pollen allergy, who stay indoors with window closed during thunderstorm, are not involved
- 5) There are not high levels of gaseous and particulate components of air pollution.
- 6) There is a major risk for subjects who are not under antiasthma correct treatment, but subjects with allergic rhinitis and without previous asthma can experience severe bronchoconstriction.

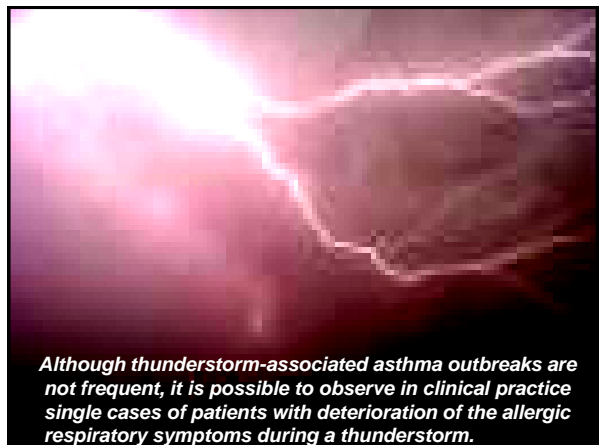


Risk of relapse of thunderstorm-related asthma

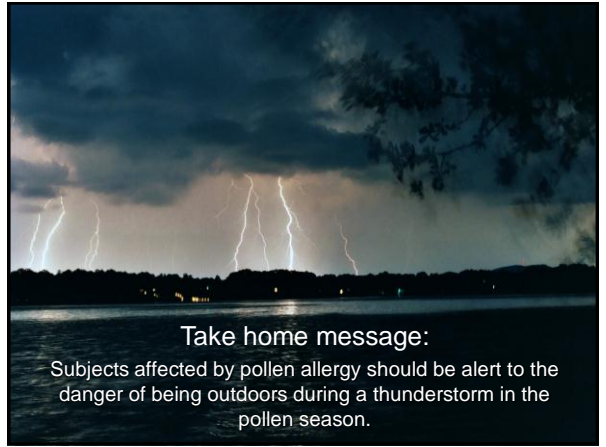
The link between thunderstorm and asthma begins to be known. What is less known is the fact that relapse of thunderstorm-related asthma attacks is possible.

A young lady who experienced near fatal asthma in concomitance with a thunderstorm in June 2004 was admitted again in the emergency room department of Cardarelli hospital in Naples on 24 May 2011 for an attack of near fatal asthma.

During the second admission she was partly protected by regular inhalation (morning and evening) of salmeterol 50 mcg and fluticasone 250 mcg. The diagnosis was the same.




Although thunderstorm-associated asthma outbreaks are not frequent, it is possible to observe in clinical practice single cases of patients with deterioration of the allergic respiratory symptoms during a thunderstorm.



*"He inhaled a breath of humid morning breeze and let in nitrogen, oxygen, argon, xenon & radon, steam, carbon monoxide, nitrogen dioxide, tetra-ethyl lead, benzene, some mould spores, a bacteria fleet, anonymous body hair, a pigeon ectoparasite, anemophilous pollen, a drop of sulphur dioxide flown from a distant factory, and a particle of dust carried by the night sirocco.
In other words he breathed air of the city"*

(Stefano Benni "Achille pi  veloce", Mondadori, Italy, 2003)




WAO Committee on
Climate Change and Allergic Diseases



Measures for reducing the effects of urban air pollution and pollen allergy:

- Decreasing use of fossil fuels and controlling vehicle emissions.
- Reducing the private traffic in towns.
- Improving the public transport.
- Planting in cities non-allergenic trees.

Moreover, eating antioxidant foods might decrease detrimental effect of air pollution.



ERS EAACI Task Force on Climate Change, Air Pollution and Respiratory Diseases

WAO Committee on
Climate Change and Allergic Diseases

Strategies to reduce climate changes and air pollution are political in nature, but citizen and in particular health professionals and societies must raise their voices in the decision process to give strong support for clean policies on both national and international levels.



Fitter AH & Fitter RSR Rapid change in flowering time in british plants. Science, 2002

The average first flowering date of 385 British plant species has advanced by 4.5 days during the past decade compared with the previous four decades: 16% of species flowered significantly earlier in the 1990s than previously, with an average advancement of 15 days in a decade



ORIGINAL ARTICLE AIRWAY DISEASES

Exposure to cadmium-contaminated soils increases allergenicity of *Poa annua* L. pollen

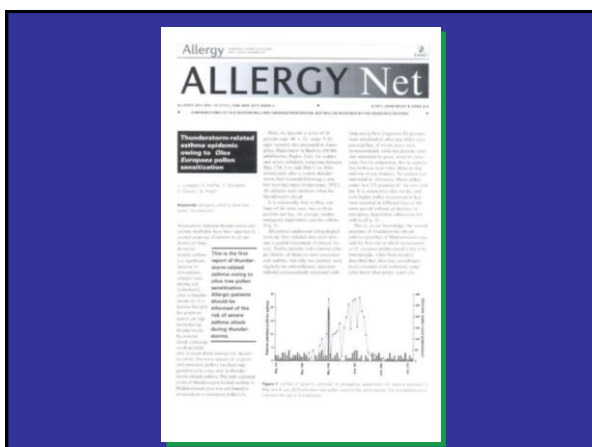
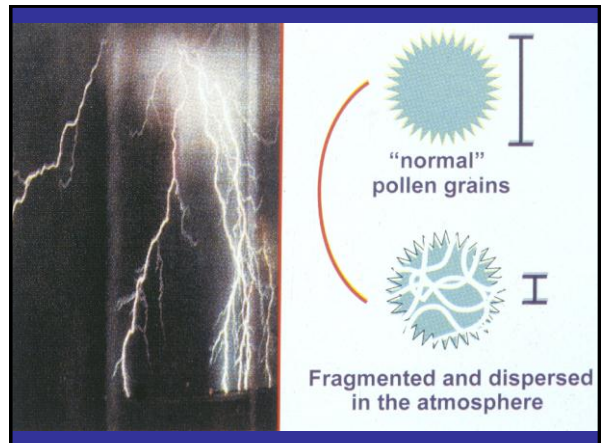
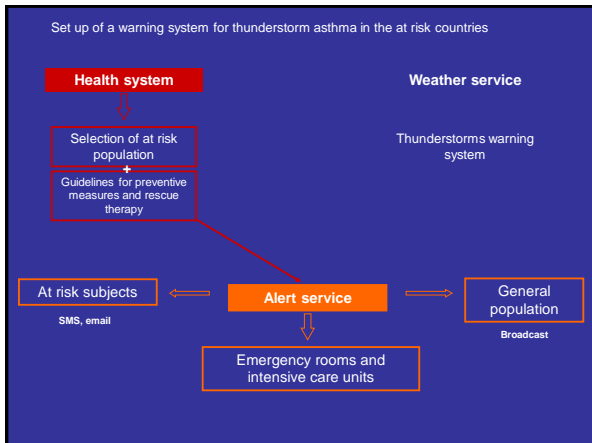
R. Aina¹, R. Asero², A. Ghiani¹, G. Marconi³, E. Albertini³ & S. Citterio¹

¹Dipartimento di Scienze Ambientali, Università di Milano-Bicocca, Milano; ²Ambulatorio di Allergologia, Clinica San Carlo, Palermo Dugnano (MI); ³Dipartimento di Biologia Vegetale e Biotecnologie Agroambientali e Zootecniche, Università degli Studi di Perugia, Perugia, Italy

Allergy 2010; 65: 1313-21

Figure 1 (a) Control (C) and Cd-treated (Cd) *Poa annua* pollen grains. Immunostaining after iodine control (C) and after Cd (Cd) treatment (C + Cd). (b) Iodine-stained control pollen grains (control) and Cd-treated pollen grains (Cd) are indicated by arrows. (c) Percentage of IgE binding pollen grains in control and exposed pollen. Immunostaining after iodine control (C) and after Cd (Cd) treatment (C + Cd). (d) Iodine-stained control pollen grains (control) and Cd-treated pollen grains (Cd) are indicated by arrows. (e) Percentage of IgE binding pollen grains in control and exposed pollen. Immunostaining after iodine control (C) and after Cd (Cd) treatment (C + Cd). The asterisk (*) indicates a statistically significant difference with the control ($P < 0.05$).

GL 2010



Determinants of climate changes

Climate change is occurring as a result of greenhouse gas (GHG) (water, CO₂, CH₄, N₂O), emissions from :

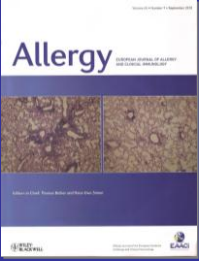
- Anthropogenic factors fossil fuel combustion from energy supply, transport, agriculture, industry, forestry, waste, and commercial and residential buildings.
- Natural factors, like spontaneous combustion (wild fires due to elevated temperatures, volcanoes ...)

66

REVIEW ARTICLE

Projections of the effects of climate change on allergic asthma: the contribution of aerobiology

L. Cecchi^{1*}, G. D'Amato^{2*}, J. G. Ayres^{3*}, C. Galan⁴, F. Forastiere^{5*}, B. Forsberg^{6*}, J. Gerritsen⁷, C. Nunes^{8*}, H. Behrendt^{9*}, C. Akdis^{10*}, R. Dahl¹¹ & I. Annesi-Maesano^{12,*}



Endorsed by EAACI and ERS

Sep; 65(9):1073-81 Allergy, 2010

Packe GE, Ayres JG Asthma outbreak during a thunderstorm. Lancet 1985; ii: 199-204



Association between a thunderstorm and an asthma outbreak with 26 asthmatic subjects treated in Birmingham Hospital in 36 hours compared with 2-3 cases in the same time in the days preceding the thunderstorm.

Environ Pollut. 2011 Oct;159(10):2823-30. Epub 2011 May 24.

Ozone affects pollen viability and NAD(P)H oxidase release from Ambrosia artemisiifolia pollen.

Pasqualini S, Tedeschini E, Frenguelli G, Wopfner N, Ferreira F, D'Amato G, Ederli L.

Department of Applied Biology, University of Perugia, Perugia, Italy
University of Napoli and High Speciality Hospital A.Cardarelli Napoli Italy.

Abstract
Air pollution is frequently proposed as a cause of the increased incidence of allergy in industrialised countries. We investigated the impact of ozone (O₃) on reactive oxygen species (ROS) and allergen content of ragweed pollen (*Ambrosia artemisiifolia*). Pollen was exposed to acute O₃ fumigation, with analysis of pollen viability, ROS and nitric oxide (NO) content, activity of nicotinamide adenine dinucleotide phosphate (NAD(P)H) oxidase, and expression of major allergens. There was decreased pollen viability after O₃ fumigation, which indicates damage to the pollen membrane system, although the ROS and NO contents were not changed or were only slightly induced, respectively. Ozone exposure induced a significant enhancement of the ROS-generating enzyme NAD(P)H oxidase. The expression of the allergen Amb 1 was not affected by O₃, determined from the mRNA levels of the major allergens. **We conclude that O₃ can increase ragweed pollen allergenicity through stimulation of ROS-generating nicotinamide adenine dinucleotide phosphate oxidase.**

Clinical reviews in allergy and immunology



Series editors: Donald F. M. Leung, MD, PhD, and Dennis K. Ledford, MD

Climate change and allergic disease

Katherine M. Shea, MD, MPH¹; Robert T. Truettner, MD, MPH²; Richard W. Weber, MD³; and David B. Peden, MD⁴
¹Chapel Hill and ²Research Triangle Park, NC, and ³Denver, Colorado



J Allergy Clin Immunol 2008;122:443-53

76 Millions of tons of CO₂ produced by Internet in 2002
630 Millions of tons in 2009