Australian aerobiology to monitor environmental change

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Project overview

This ACEAS working group on seeks to collate and analyze historical published data and unpublished pollen count data from different regions of Australia. There are several motivations for this work. Firstly, pollen are routinely used to understand palaeoecological change yet there remains knowledge gaps regarding how modern pollen rain relates to different landscape settings and to different climatic regions. Our study will provide important information on the relationship of land cover changes associated with urbanization and rural land management. Secondly, the pollen assemblage can provide a very cost-effective measure perspective of landscape phenological patterns, including identification of invasive allergenic species. Thirdly, we can gain insights how these are driven by current meteorology, and thus future climates. Fourthly, the workshop will also provide the platform for the establishment of a national pollen count monitoring program with the potential to assist with management of patients with allergic respiratory diseases such as hay fever and asthma that can be triggered by airborne pollens, particularly but not exclusively from grasses.

Our working group will bring together leaders in the measurement and analysis of pollens in Australia. This exciting multi-disciplinary team includes scientists and clinicians with expertise ecology, botany, archaeology, climate change science, allergy, immunology, public health and biostatistics.

Aerobiological surveys of total and specific pollen have been reported for a number of Australian cities from as early as 1935, with peaks in research productivity around the 1960s and 1990s. No previous studies have systematically collated existing knowledge of the aerobiology and ecology of allergenic pollens in Australia. Studies from Melbourne, NSW and elsewhere report the association between airborne grass pollen levels and allergic asthma.

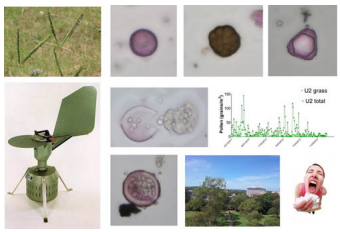
Expanding urbanization and climate change are likely influences of aerobiological distribution of allergenic pollens. It is likely that the relative distribution of pollen from clinically important species, will be affected by changes in temperature, precipitation and CO2 concentrations associated with climate change.

It is important to understand current drivers affecting airborne allergenic pollen levels so that the impacts of climate change on allergenic pollen production and respiratory health can be appreciated. Factors affecting the temporal and regional variations in pollen distribution in Australia have not been determined systematically. This project seeks to synthesise the current data on allergenic pollen sources across Australia into a coherent biogeographical picture of the ecology of Australian allergenic pollen sources.

We will conduct two workshops to address these issues. The first will be in March 11-15 and the second is scheduled for November 4 to 8. The objectives of the ACEAS working group will be as follows:

1) Descriptive systematic review of the recent pollen aerobiology across Australia.
2) Analysis of factors influencing temporal and regional variations in grass pollen distribution in Australia, and the potential impacts of climate and land use changes.

3) Evaluate predictive pollen count forecasting models for different cities.



For further information about this group, please contact the Principal Investigator, Janet Davies

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Products and outcomes

- newsletter articles
- publications and data portal
- media reports

Newsletter articles

This group was featured in the November 2013 TERN newsletter as an example of student involvement in ACEAS' groups. The article can be read by clicking here .

Publications and data portal

Beggs P.J., Katelaris C.H., Medek D., Johnston F.H., Burton P.K., Campbell, B., Jaggard A.K., Vicendese D., Bowman D.M.J.S. Godwin I., Huete A.R., Erbas B., Green B.J., Newnham R.M., Newbigin E., Haberle S.G., and Davies J.M. (2015) *Australian and New Zealand Journal of Public Health* 39(1): 51-55 .

Davies J.M., Beggs P.J., Medek D., Newnham RM, Erbas B, Thibaudon M, Katelaris CH, Haberle SG, Newbigin EJ, Huete AR. (2015) Trans-disciplinary synthesis of the impact of pollen aerobiology on health in Australasia. *Science of the Total Environment*, 534: 85-96. doi:10.1016/j.scitotenv.2015.04.001

http://www.sciencedirect.com/science/article/pii/S0048969715004301

Haberle, S.G., Bowman, D.M.J.S., Nernham, R.M., Johnston, F.H., Beggs, P.J., Buters, J., Campbell, B., Erbas, B., Godwin, I., Green B.J., Huete, A., Jaggard, A.K., Medek, D., Murray, F., Newbigin, E., Thibaudon, M., Vicendese, D., Williamson, G.J. and Davies, J.M. (2014) The macroecology of airborne pollen in Australian and New Zealand urban areas. *PLOS ONE* 9(5): e97925
.

As is required for PlosONE, the source data have been deposited in ACEAS, and a visualisation of these data can be seen here .

Medek D.E., Beggs P.J., Erbas B., Jaggard A.K., Campbell, B., Vicendese D., Johnston F.H., Godwin I., Huete A.R., Green B.J., Burton P.K., Bowman D.M.J.S, Newnham R.M., Katelaris C.H., Haberle S.G., Newbigin E., and Davies J.M. (2015) Regional and seasonal variation in

airborne grass pollen levels between cities of Australia and New Zealand. *Aerobiologia* 32: 289-302. doi 10.1007/s10453-015-9399-x

http://link.springer.com/article/10.1007/s10453-015-9399-x

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Media coverage

The work of the group, both within and beyond ACEAS has attracted much attention. Here are some news reports in the wider media:

Pollen counts not to be sneezed at - Ed Newbigen and Janet Davies in The Conversation (2 October 2013)

Take a deep breath before summer - The Brisbane Times , Climate change making hay fever worse The Sydney Morning Herald (October 3 2014), also covered in an article in

iSENTIA
posted from the Canberra Times (6 October 2014).

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Workshop Reports

- **Workshop 1**
- Workshop 2

Workshop 1 Report (11-15 March 2013)

One of the major triggers for hay fever is the exposure of affected individuals to airborne pollen, particularly grass pollen. It affects up to 3 million Australians and costs our community billions of dollars each year in lost productivity and medical expenses. Australia is a vast continent with many varied climates that each favour the growth of different species of grass as well as a multitude of pollen from other taxa. There has been no consistent reporting of airborne pollen levels across Australia. The short and long term factors driving variations in pollen distribution across Australia have not been determined. The outcomes of this workshop will pave the way for an ongoing program aiming to monitoring airborne pollen levels at a national level.

The ACEAS working group, comprising experts in pollen allergy, botany, public health, palynology, biogeography, climate change science, plant genetics, biostatistics and physics, met for a week in March, 2013.

The group applied themselves diligently to systematically source, collate, describe and analyse pollen count data from 11 Australian sites and 6 New Zealand sites. The methodologies used in pollen sampling and counting were tabulated for each site and the data were formatted in a consistent way to allow for characterisation of the grass pollen season for each site. A geographical gradient in grass pollen season timing and duration was observed. A manuscript describing this outcome is in an early stage of preparation. In addition, the diversity of taxa contributing significantly to airborne pollen levels in each site was analysed. Biogeographic variation in the diversity of airborne pollen was evident. We envisage the first advanced-stage manuscript arising from this analysis will be submitted for publication shortly.

The aim of the second workshop in November 2013 is to complete detailed analysis of ecological factors driving variation in pollen aerobiology initiated in the first workshop. This study will focus on three sites for which long term pollen count data are available and will investigate association between weather parameters, land use and vegetation indices on airborne pollen seasonality and abundance.

Analysis and synthesis of current knowledge of Australian pollen aerobiology is significant for management of allergic disease. Importantly, this study also provides a platform from which the future effects of climate change on pollen distribution can be assessed as a measure of the ecological impact of global warming.

Left to right: Alfredo Huete (University of Technology, Sydney), Bradley Campbell (University of Queensland), Simon Haberle (Australian National University), David Bowman (University of Tasmania), Bircan Erbas (La Trobe University), Edward Newbiggin (University of Melbourne), Janet Davies (University of Queensland), Paul Beggs (Macquarie University), Ian Godwin (University of Queensland), Don Vicendese (La Trobe University), Fay Johnson (University of Tasmania), Alison Jaggard (Macquarie University), Rewi Newnham (Victoria University, New Zealand), Danielle Medek (Australian National University).

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Workshop 2 report (4-8 November 2013)

We gathered again to rekindle friendships and enjoy another opportunity to delve into the

research agenda without distraction. We welcomed new participants Prof. Michel Thibaudon from the National Research for Aerobiological Surveillance, France and Prof. Connie Katelaris, Head Immunology, Westmead Hospital, Sydney.

WS2 focused on biogeographical variation in grass pollen aerobiology across Australia and New Zealand. We continued preparation of manuscripts from WS1: “Pollen allergy and exposure in Australia: what clinicians and patients don’t know”, led by Assoc. Professor Paul Beggs (Macquarie University); and “Regional and seasonal variation in airborne grass pollen levels between cities of Australia and New Zealand” championed by Dr Danielle Medek, an ecologist who just completed fourth year medicine at Australian National University. Recently, Assoc. Professor Simon Haberle (ANU) revised the first paper from the Working Group provisionally accepted by PLoSOne “The macroecology of airborne pollen in Australian and New Zealand urban areas”.

The highlight of WS2 was the convergence of large data sets from phenology and aerobiology. In advance, Prof. Alfredo Huete and his team (Dr Rakhesh Devadas) had prepared remote sensing data packages for each pollen trap location. Longitudinal pollen count datasets were converted to compatible formats for Sydney, Melbourne and Brisbane in Australia, as well as Amiens, Lyon and Montlucon in France. The influence of various parameters on the utility of phenology inferred by remote sensing to describe features of the grass pollen season were evaluated. Sites from the northern and southern hemisphere were compared and contrasted. Mr Don Vicendese, a PhD candidate in biostatistics at LaTrobe University, established highly significant mathematical models to describe the relationship between enhanced vegetative indices and airborne grass pollen levels for each site. Local predictive models of grass pollen aerobiology identified the peak period of grass pollination.

WS2 facilitated achievement of the primary outcome that phenology has utility for informing features of grass pollen aerobiology and that this methodology is applicable to sites across both hemispheres. The report on this work will be led by Prof. Huete, Mr Vicendese, Assoc. Professor Bircan Erbas (LaTrobe University) and Dr Davies. From Victoria University, New Zealand, Prof. Rewi Newnham will lead the group to report development of this methodology to answer the vexing issue regarding the optimum region to which pollen counts can be applied for a particular pollen monitoring site.

Future directions

This ACEAS Working Group had been a fabulous experience in trans-disciplinary research. The outcomes significantly impact upon ecology, climate science and medicine. The synthesis and analysis of currently available pollen count data sets documented clear evidence of regional and seasonal variability in airborne pollen levels. We revealed limitations in the existing data sets and the insufficient capacity to monitor pollen aerobiology in Australia.

We will continue this collaborative research by targeting additional funding opportunities to establish a national standardized pollen allergen monitoring network. As an example of the utility of pollen forecasting, Assoc. Prof. Ed Newbigin (Botany, University of Melbourne) and his team (Dr Edwin Lampugnani) shared the recent launch of the www.melbournepollen.com.au

webpage with pollen forecasting and an interactive symptom survey (Medek et al., EcoHealth DOI: 10.1007/s10393-012-0787-1). Knowledge of current local airborne pollen levels will empower patients with hay fever and allergic asthma to adopt allergen avoidance strategies and improve compliance to prescribed medications, thereby reducing the burden of hay fever and exacerbations of allergic asthma.

The Working Group plans to reconvene at a satellite meeting of the International Congress on Aerobiology convened by Chair Prof Katelaris, Sydney, September 22-26, 2014.

Left to right: Michel Thibaudon (RNSA, France), Ed Newbigin (University of Melbourne), Brad Campbell (University of Queensland), Janet Davies (University of Queensland), Danielle Medek (Australian National University), Connie Katelaris (University of Western Sydney and Westmead Hospital), Simon Haberle (Australian National University), Paul Beggs (Macquarie University), Alison Jaggard (Macquarie University), Fay Johnston (University of Tasmania), Don Vicendese (LaTrobe University), Rewi Newnham (Victoria University, New Zealand) and Alfredo Huete (University of Technology, Sydney).

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