European Network on New Sensing Technologies for Air Pollution Control and Environmental Sustainability - *EuNetAir*

COST Action TD1105

WGs & MC Meeting at SOFIA (BG), 16-18 December 2015

New Sensing Technologies for Indoor Air Quality Monitoring: Trends and Challenges

Action Start date: 01/07/2012 - Action End date: 30/04/2016 - Year 4: 1 July 2015 - 30 April 2016

HUMAN EXPOSURE TO GRASS POLLEN QUANTIFIED BY ENVIRONMENTAL GENOMICS AND ATMOSPHERIC MODELLING

NATURAL ENVIRONMENT RESEARCH COUNCIL (NE/N003756/1), 2016-19

Carsten Ambelas Skjøth

Function in the Action (WG3 Member)

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COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Scientific context and objectives

- **Background / Problem statement:**
  - Seasonal Allergic Rhinitis reduce quality of life
  - Seasonal Allergic Rhinitis is expensive
    - In some countries total costs exceed costs of Asthma
  - One of the most common causes is grass pollen
    - Many different grass species
    - Sensitisations (25-50%). Sensitisations towards species?
    - Existing optical method do not identify grass pollen at the species level
  - Considerable effects of co-exposure of air pollution
  - Known effects on chemical transformation of aeroallergens
  - No modelling tools that describe grass pollen at the species
- **Objectives**: New detection methods and modelling approaches

A new research project supporting MoU (mainly WG3)

- **Project funded by National Environmental Research Council (2016-2019) ~ 1.7mio€ (page 1)**
- **Using molecular genetics to understand grass species pollen deposition: enhancing bio-aerosol models and implications for human health**

PRIFYSGOL ABERYSTWYTH UNIVERSITY

PRIFYSGOL BANGOR UNIVERSITY

UNIVERSITY OF EXETER

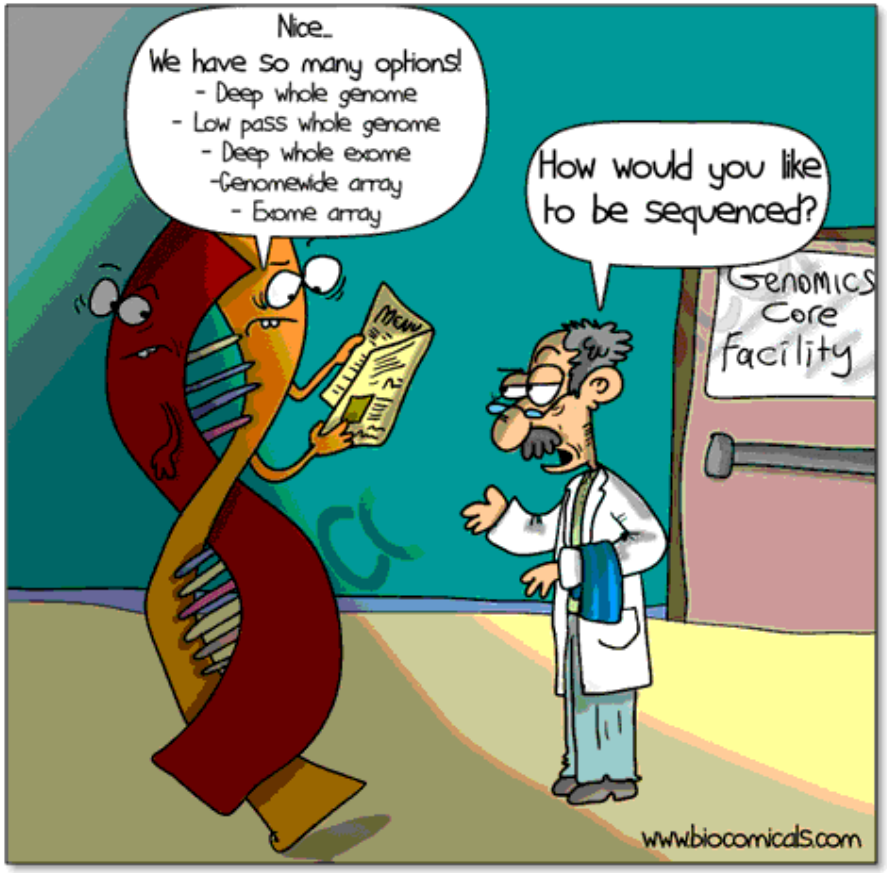
University of Worcester

Met Office

A new research project supporting MoU (mainly WG3)

- **Project funded by National Environmental Research Council (2016-2019) ~ 1.7mio€ (page 2)**

- **Objective 1a:** To collect pollen at up to 16 sites across the United Kingdom, over three annual cycles using volumetric methods
- **Objective 1b:**
  - 2. (a.) shotgun ultra-barcode (UBC) sequencing to identify abundant grass pollen species.
  - (b.) qPCR, to quantify the abundances and temporal variation of up to 15 priority UK grass species
  - (c.) Illumina metabarcoding, to measure the qualitative occurrences of the remaining PCR-amplifiable UK angiosperms



Efficient and sensitive identification and quantification of airborne pollen using next-generation DNA sequencing

KEN KRAAIJEVELD,*† LETTY A. DE WEGER,‡ MARINA VENTAYOL GARCÍA,* HENK BUERMANS,* JEROEN FRANK,* PIETER S. HIEMSTRA‡ and JOHAN T. DEN DUNNEN*
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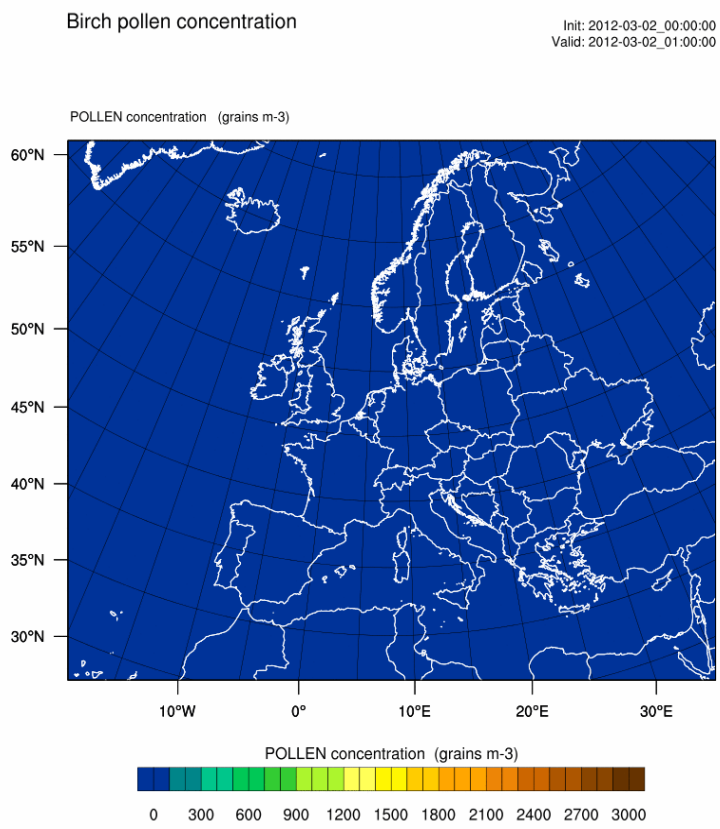
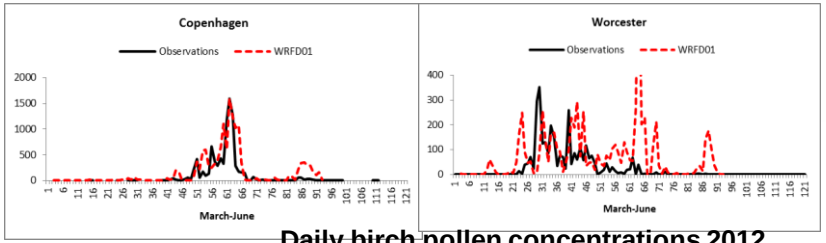
cost
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

A new research project supporting MoU (mainly WG3)

- **Project funded by National Environmental Research Council (2016-2019) ~ 1.7mio€ (page 3)**

- **Objective 2a:** Produce spatial and temporal species level grass distribution maps across the UK
- **Objective 2b:** Further develop next generation atmospheric models using WRF-Chem
  - In-line model – Physical consistent
  - Flexible, applicable worldwide
  - Full feedback between physics, chemistry and biology
  - Current version: 48 layers, 2-way nests, contain bioaerosols (optional, Worcester), chemistry (optional), weather (always), contain numerous physical/chemical packages
  - Birch pollen production use habitats (remote sensing), surface statistics and NPP (remote sensing)
  - Birch seasonality and intensity tested with annual correction (Krieging) in emission model parameters





Daily birch pollen concentrations 2012

cost
EUROPEAN COOPERATION IN SCIENCE AND TECHNOLOGY

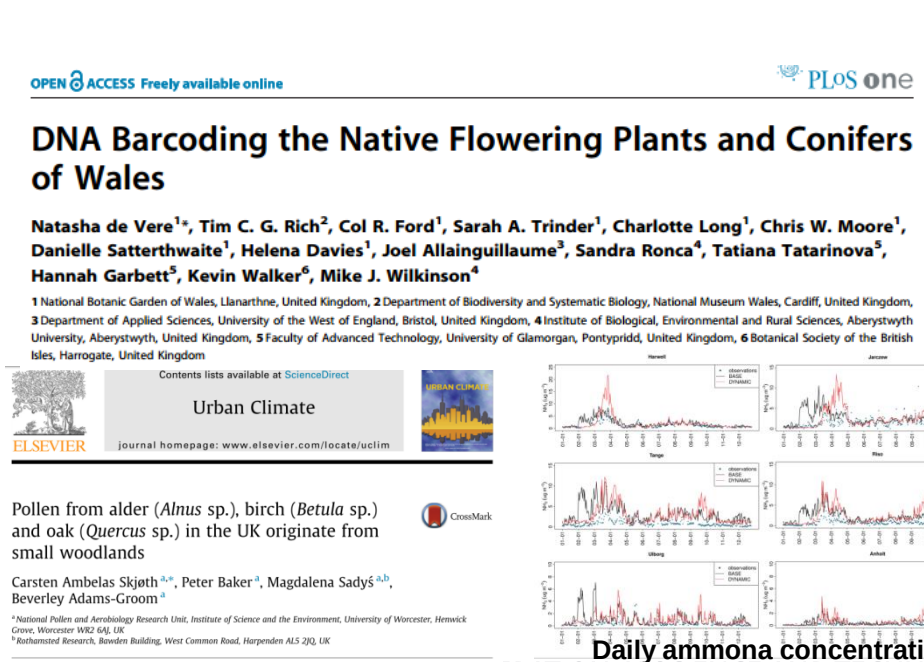
A new research project supporting MoU (mainly WG3)

- **Project funded by National Environmental Research Council (2016-2019) ~ 1.7mio€ (page 3)**

- **<u>Objective 3:</u>Investigate the relationship between taxon-specific grass pollen abundance (spatial and temporal) profiles and asthma exacerbations**
  - **Dispersion: large gradients vertically and horizontally**
  - **Peak concentrations do not always correlate between nearby sites**
  - **Mixed species assemblages contribute to overall load**
  - **Allergenic potential between species likely different**
  - **No robust models available for Europe**

Research Facilities available for the Partner (2/2)

- **Research Facilities in this project:**
- Samplers designed for genomics detection and mobile platform (drone) for sensors
- Methods for sequencing data and DNA barcode library being further developed
- An in-line open-source atmospheric model based on WRF-Chem with pollen (further developed into spores and pathogens)
- Detailed register data (UK)
- Upgrade of HPC facility under construction with Dell Inc.


OPEN ACCESS Freely available online

PLoS one

DNA Barcoding the Native Flowering Plants and Conifers of Wales

Natasha de Vere[1]*, Tim C. G. Rich[2], Col R. Ford[1], Sarah A. Trinder[1], Charlotte Long[1], Chris W. Moore[1], Danielle Satterthwaite[1], Helena Davies[1], Joel Allainguillaume[3], Sandra Ronca[4], Tatiana Tatarinova[5], Hannah Garbett[5], Kevin Walker[6], Mike J. Wilkinson[4]

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Contents lists available at ScienceDirect

Urban Climate

journal homepage: www.elsevier.com/locate/uclim

Pollen from alder (*Alnus* sp.), birch (*Betula* sp.) and oak (*Quercus* sp.) in the UK originate from small woodlands

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Daily ammona concentrations

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Advances in Meteorology
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Research Article

Quality of the Governing Temperature Variables in WRF in relation to Simulation of Primary Biological Aerosols

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Hindawi

This discussion paper is/has been under review for the journal Atmospheric Chemistry and Physics (ACP). Please refer to the corresponding final paper in ACP if available.

Spatial, temporal and vertical distribution of ammonia concentrations over Europe – comparing a static and dynamic approach with WRF-Chem

M. Werner[1], M. Kryza[2], C. Geels[3], T. Ellermann[3], and C. Ambelas Skjøth[1]

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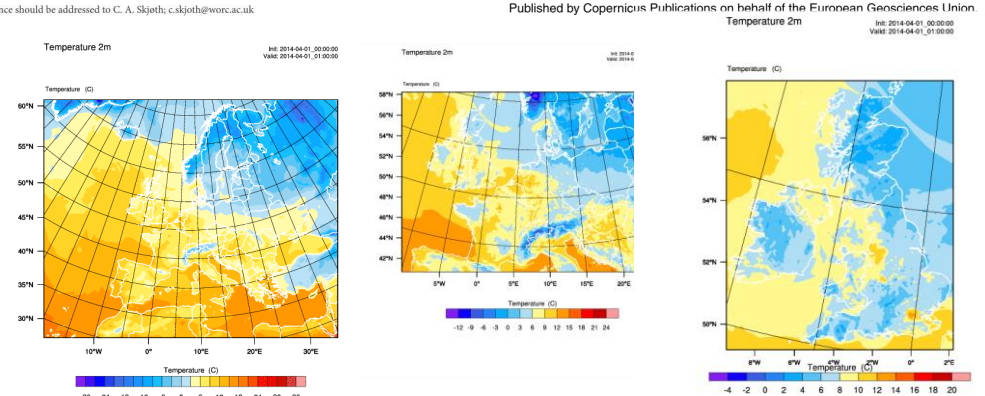
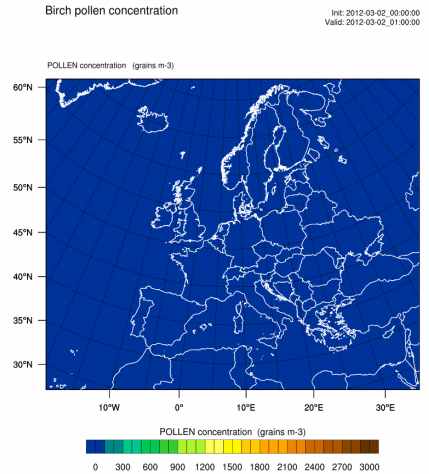


Suggested R&I Needs for future research

- **Preliminary conclusion and research directions:**
- DNA Barcode library established, which will be a BIG advantage
- Sequencing of grass pollen possible
- WRF-Chem as a modelling tool for chemistry-bioaerosol studies looks very promising
- **Future research directions and needs:**
- Directed by 3 research council grant (one presented here).
- Focusing on the detection of grass pollen at the species level and extending to other species
- Further development of WRF-(Bio)Chem and combination with local scale particle dispersion model
- Considering European application along the lines of the NERC grant (as recommended by reviewers). This could be co-exposure modelling, feed-backs and DNA-lab on a chip development/application
- Importantly: New staff members needed at the PhD and Post Doc level (probably 6 in 2016 on detection and modelling of bioaerosols and new sensor technologies. Ask me during the workshop).

Genomics

Thank you for your attention



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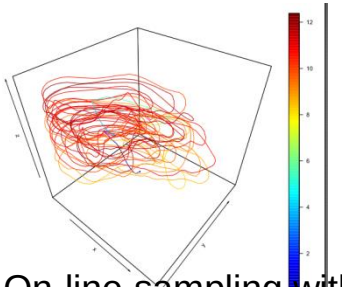
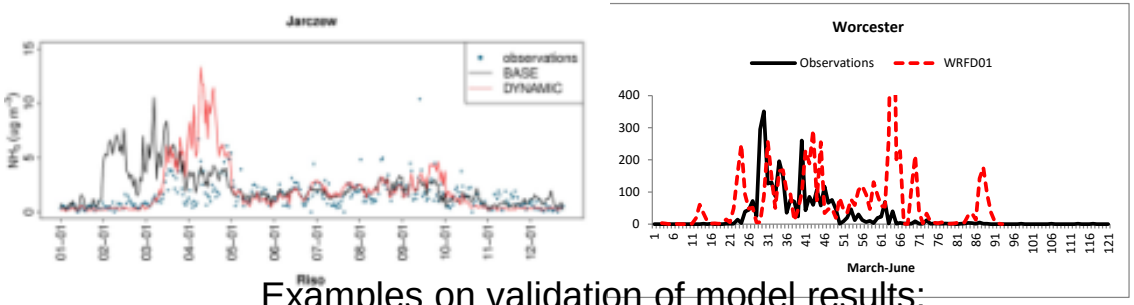
WRF-Chem modellling



On-line sampling with met-sensor on drone

Mobile platform for sensors



Examples on validation of model results:

Ammonia

Birch pollen