**NIAM activity on PM2.5**

As one of our first activities in NIAM we would like to look at how countries are addressing PM2.5 pollution, including how they model it, how they assess the health impacts, and how this feeds into policy. As a first step we are gathering information on current work in this area towards organisation of a virtual meeting in November.

If you are interested in participating please register your interest with an e.mail to [h.apsimon@imperial.ac.uk](mailto:h.apsimon@imperial.ac.uk). And if you are already working in this area we shall be grateful if you can also send a response to the questions below which will help us in planning a focus on this topic.

1. **Modelling PM2.5**

If you model PM2.5 concentrations in your country:- **For Cyprus:**

1. Do you use GAINS, or independent modelling- in which case please give brief details.

**We use independent modelling (WRF-CHEM).**

1. What distance scales do you cover- e.g. European, national, city: and with what spatial and temporal resolution?

**We cover the national scale (Cyprus) at ~2.5 km horizontal resolution, 10 second timestep, hourly model output.**

1. What components of PM2.5 do you include- e.g. primary PM2.5, secondary inorganic aerosol, secondary organic aerosol, natural dust etc?

**We include primary and secondary organic and inorganic aerosol, natural dust, and sea salt.**

1. What emissions data do you use e.g. a national inventory. Are there particular sources you think are uncertain, missing, or would like to discuss?

**We use a high-resolution (1km) national inventory, as well as the EDGAR emission inventory. We think that (winter) residential combustion sources may be missing to a large extent.**

1. Have you undertaken validation of your model against measurements, and if so what measurements do you have available to use

**We validate against the national monitoring station network, and using the FAIRMODE benchmark methodology and DELTA tool.**

1. What do you think are the most important uncertainties or aspects of PM2.5 modelling that you would like to discuss

**Diurnal variability, and urban sources.**

1. **Assessing health impacts**

The health impacts of PM2.5 are a major driver to reduce air pollution.

1. We are interested in how you use data on concentrations of PM2.5, either modelled or measured or both, to assess human exposure and health impacts?

**To estimate cardiovascular disease mortality attributable to *modelled and/or satellite-derived total* PM2.5, we currently apply recent hazard ratio functions from the Global Exposure Mortality Model (GEMM) (Burnett et al., 2018) derived by 41 cohort studies in 16 countries. Before that we estimated reduced premature mortality rates based on integrated exposure-response (IER) functions (Burnett et al., 2014). For the calculation of the relative risk (RR) factors we used the parameters used for the global burden of disease study (GBD) for 2015 (Cohen et al., 2017). Country level baseline mortality rates for each of the diseases representative of the year 2015 and the population data for the countries included in our domain are taken from the WHO Global Health Observatory (http://www.who.int/gho/database/en/).**

1. If you undertake such assessments of health impacts of PM2.5, do you follow WHO guidance and base this on total mass of PM2.5, or do you focus on particular components and/or differentiate relative toxicity?

**Currently only total mass of PM2.5 is assessed. We have deployed a research line to study particular components and/or differentiate relative toxicity (i.e. BC and OC).**

1. What health impacts do you consider e.g. mortality, asthma etc; and what risk coefficients do you use?

**We apply recent hazard ratio functions from the Global Exposure Mortality Model (GEMM) (Burnett et al., 2018). Uncertainty ranges are expressed as the 95% confidence intervals (95% CIs), adopted from Burnett et al. (2018).**

**Prior to that we estimated reduced premature mortality rates based on integrated exposure-response (IER) functions (Burnett et al., 2014). For the calculation of the relative risk (RR) factors we used the parameters used for the global burden of disease study (GBD) for 2015 (Cohen et al., 2017).**

**In GEMM the following disease categories are analysed: Lower Respiratory Infections (LRI), chronic obstructive pulmonary disease (COPD), LC, ischaemic heart disease (IHD), cerebrovascular disease (CEV) leading to stroke, all previously addressed in GBD assessments (IER approach), and a new one referred to as ‘other non-communicable diseases, oNCD’.**

**The respective burden of disease is analysed for the following age groups: below 5 years, 5–14, 15–29, 30–49, 50–69, and 70 and older.**

1. Do you assess the economic costs of health impacts, and if so what do you include e.g. life years lost, hospital/medical costs, loss in productivity/working days lost etc.?

**The monetary valuation of the risk of premature death relies on non-market valuation methods. The Value of Statistical Life (VLS) is the most widely used metric to monetize premature mortality risks associated to air pollution and is applied in our studies to calculate the benefits (i.e. cost benefit analysis from applying emission reducing policies.**

1. **Policy applications**

We are also interested in the application of your work, particularly as input to development of policy.

1. How do you relate your work to environmental goals e.g. compliance with regulations, or comparison with WHO guidelines?

**We are involved in the Forum for Air Quality Modelling over Europe (FAIRMODE) and through a national project for updating the National Air Quality Action Plan for Cyprus.**

1. **Publications**

Have you published your work, in which case please give references is available?

Air quality modelling over the Eastern Mediterranean: Seasonal sensitivity to anthropogenic emissions

GK Georgiou, J Kushta, T Christoudias, Y Proestos, J Lelieveld

Atmospheric Environment 222, 117119

Evaluation of EU air quality standards through modeling and the FAIRMODE benchmarking methodology

J Kushta, GK Georgiou, Y Proestos, T Christoudias, P Thunis, C Savvides, ...

Air Quality, Atmosphere & Health 12 (1), 73-86

Modelling study of the atmospheric composition over Cyprus

J Kushta, GK Georgiou, Y Proestos, T Christoudias, J Lelieveld

Atmospheric Pollution Research 9 (2), 257-269

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| Air quality modelling in the summer over the eastern Mediterranean using WRF-Chem: chemistry and aerosol mechanism intercomparison  GK Georgiou, T Christoudias, Y Proestos, J Kushta, P Hadjinicolaou, ...  Atmospheric Chemistry and Physics 18 (3), 1555-1571 |

Regulating ammonia emissions within Common Agricultural Policy: Costs and benefits

E Giannakis, J Kushta, GK Georgiou, A Bruggeman, J Lelieveld

European Association of Agricultural Economists, 289718, DOI: 10.22004/ag.econ.289718

Costs and benefits of agricultural ammonia emission abatement options for compliance with European air quality regulations

E Giannakis, J Kushta, A Bruggeman, J Lelieveld

Environ Sci Eur 31, 93, doi:10.1186/s12302-019-0275-0

Exploring the economy-wide effects of agriculture on air quality and health: Evidence from Europe

E Giannakis, J Kushta, D Giannadaki, GK Georgiou, A Brugemann, J Lelieveld

Science of Total Environment, Vol.663, 889-900, <https://doi.org/10.1016/j.scitotenv.2019.01.410>

1. **Questions**

Are there particular aspects of questions that you would like NIAM to address on PM2.5, including at the virtual meetings proposed for November.

Please e.mail your response to Helen ApSimon: h.apsimon@imperial.ac.uk