

SPACE Belfast Healthy Cities Webinar:
Co-design of the urban environment
for future generations

The impact of soil, environmental toxins and atmospheric pollutants on human health

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SUPPORTIVE ENVIRONMENTS FOR
PHYSICAL & SOCIAL ACTIVITY,
HEALTHY AGEING & COGNITIVE HEALTH

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What's in our environment?





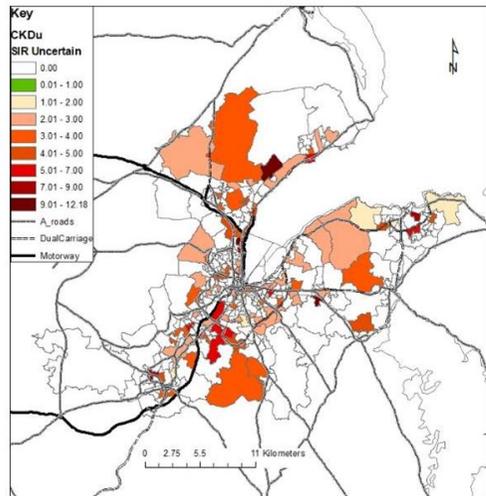
EXPOSURE ANALYSIS REQUIRES AN INTEGRATED APPROACH

SOIL, AIR, NOISE POLLUTANTS



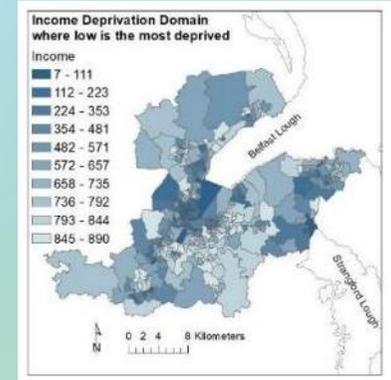
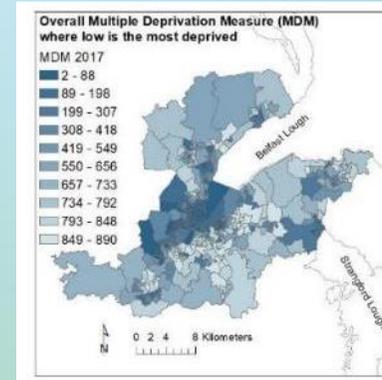
HEALTH DATA

UNITED KINGDOM RENAL REGISTRY (UKRR)



Chronic Kidney Disease (CKD), a collective term for many causes of progressive renal failure is increasing worldwide due to ageing, obesity & diabetes.

DEPRIVATION MEASURES



[Northern Ireland Multiple Deprivation Measure 2017 \(NIMDM2017\) | Northern Ireland Statistics and Research Agency \(nisra.gov.uk\)](http://www.nisra.gov.uk)

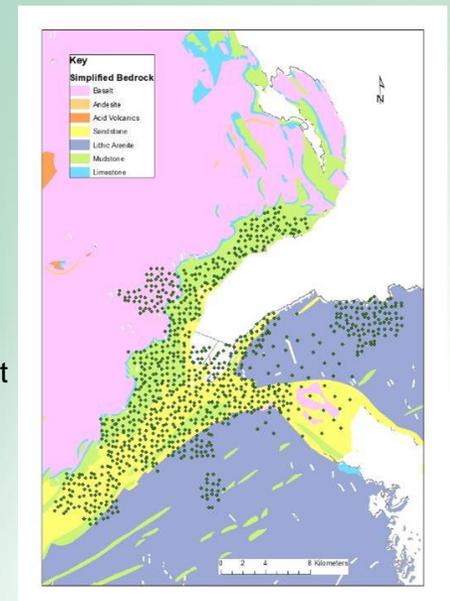
ENVIRONMENTAL DATA SOIL GEOCHEMISTRY

A guide to the Tellus data

Young, M. E. and Donald, A. W. (eds). 2013 Geological Survey of Northern Ireland (GSNI), Belfast.
<http://nora.nerc.ac.uk/509171/>.

Natural sources for Potentially Toxic Elements (PTEs)

- Palaeogene basalts are potential source of cobalt (Co), vanadium (V), chromium (Cr) and nickel (Ni).
- Silurian greywacke and shales (lithic arenites) show elevated levels of arsenic (As) and molybdenum (Mo)





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Mapping Urban Growth

HISTORICAL DEVELOPMENT OF BELFAST

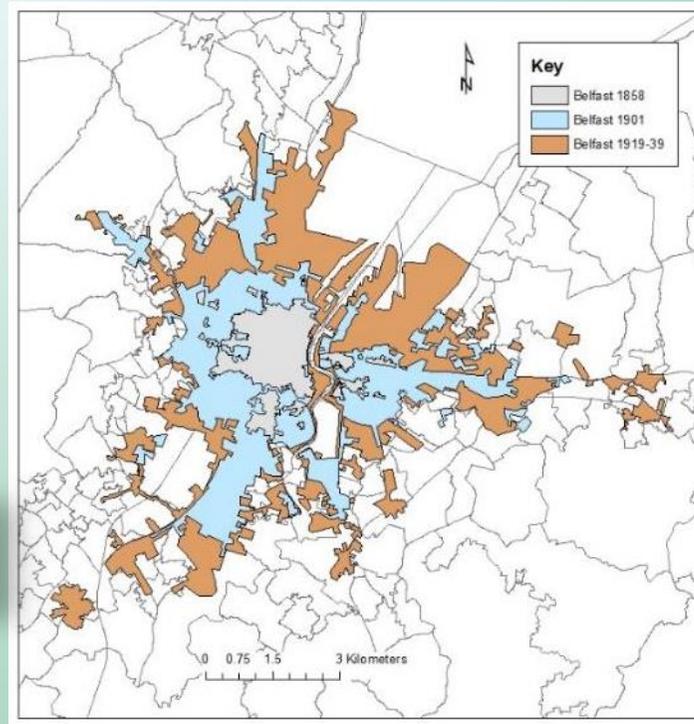
Soils show evidence of legacy and
modern day pollution



<https://flashbak.com/belfast-1955>



Anthropogenic
sources for copper,
(Cu), zinc (Zn), tin
(Sn), antimony (Sb)
and lead (Pb)



<https://flashbak.com/belfast-1955>



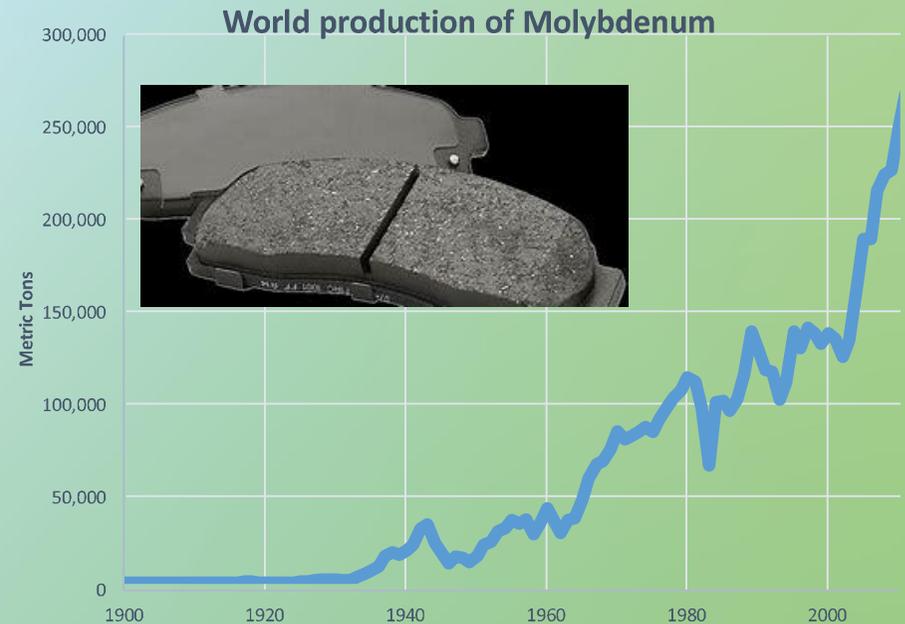


Air and traffic pollution

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- Studies have shown that ultrafine particles (including Pb, Mo and Sb) may become **blood-borne and translocate** to other tissues such as the **liver, kidneys and brain** ^{1,2}
- **Soils show the evidence of air pollution deposition** and the potential impact of the **modern pollutants**
- **Urban soils combined with air pollution data** may be used as a **proxy for the availability of toxins for human intake from environmental pollution**



<https://www.usgs.gov/centers/nmic>

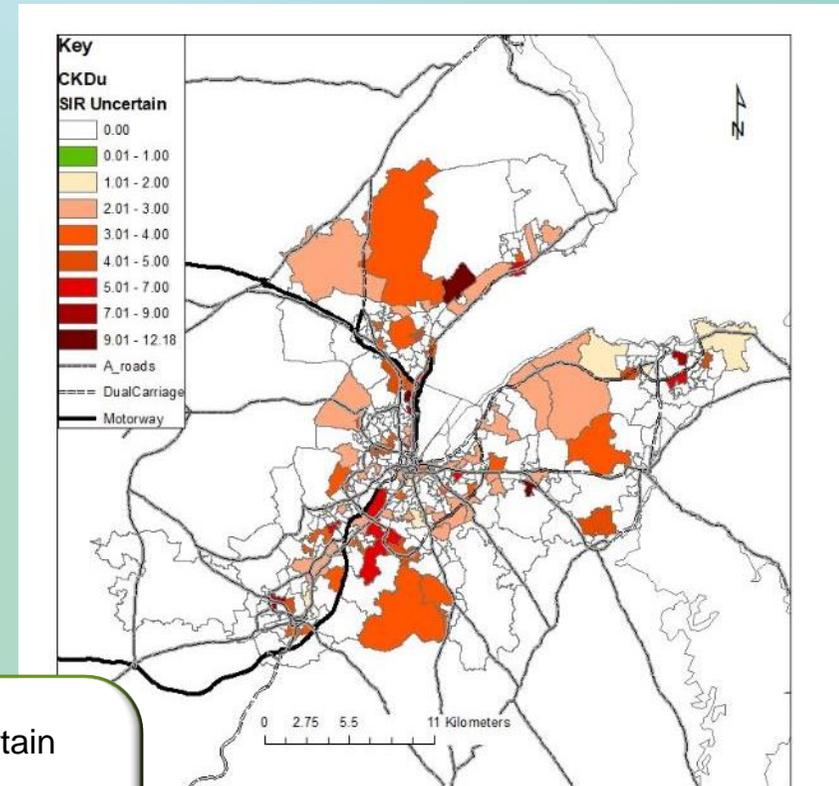
¹ Geiser & Kreyling 1999

² Oberdörster et al. 2005

What do the results show?

The link with Air pollution

- For greater Belfast the strongest correlation with CKDu is found for an elemental balance of **arsenic (As)** and **molybdenum (Mo)**¹
- **The transport networks** may help to shed light on the interpretation
- **Air pollution, traffic and brake wear emissions** have been cited as sources for heavy metals²
- **Both As and Mo** have been linked to **atmospheric pollution** deposition including **traffic pollution**³
- **Brake wear emissions** have been cited as a potentially important **source of Sb and Mo**⁴



CKD with Uncertain aetiology shows SIRs up to 12 times higher than expected for NI's average incidence rates

¹sample size 340 (p -value =0.0391) - 95% confidence level

² Afsar et al. 2019

³Carrero et al. 2013

⁴ Grigoratos & Martini 2015



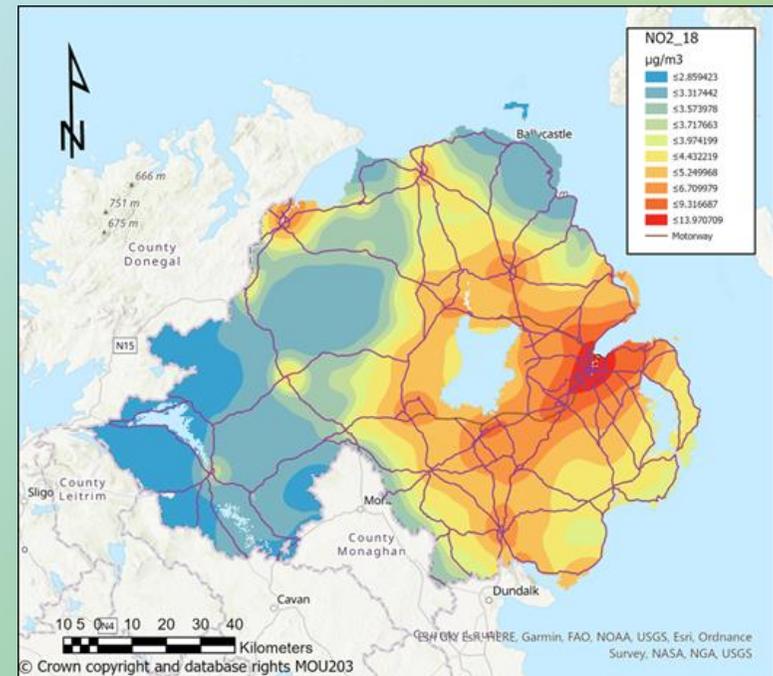
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Analysis using air pollution data with the Tellus survey and UKRR data.

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- A geometric mean value for each geochemical PTE (Co, V, Cr, Ni, Zn, Sn, Pb, Sb, As and Mo) was calculated for each of the 265 SOAs within the greater Belfast urban area.
- Air pollution covariates: Benzene, Carbon Monoxide (CO), Nitrogen oxide (NO_x), Sulphur dioxide (SO₂), particulate matter (as PM₁₀) and fine particulate matter (as PM_{2.5}).
- Methods: The forward-selection method using the selbal algorithm, GLM and spatial regression



McKinley et al. 2020 Applied Computing and Geosciences.
<https://doi.org/10.1016/j.acags.2020.100024>

McKinley et al. 2020 Environ Geochem Health
<https://doi.org/10.1007/s10653-020-00618-y>



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Findings

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- The preliminary findings do support the argument that atmospheric pollution in the form of Carbon Monoxide (CO), Sulphur dioxide (SO₂) and PM_{2.5} exposure deposition and associated toxic metals may negatively affect renal function.
- Further research is required to fully examine the impact of atmospheric pollutants, chronic disease and cognitive health.



**SPACE: GEOSPATIAL
FACTORS IN COGNITIVE
HEALTH OUTCOMES**



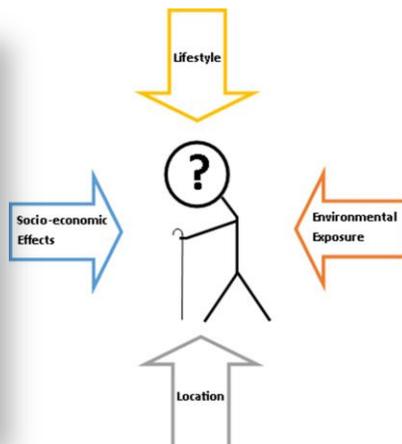
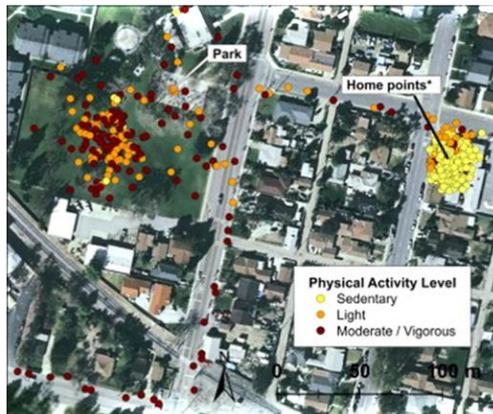
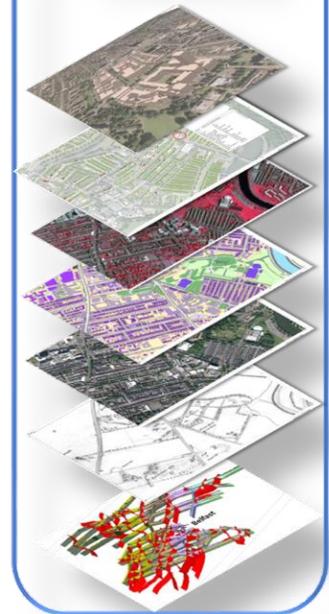
This work was supported by UK Research and Innovation (RS/V016075/1)



ESRC funded Supportive environments for Physical and social Activity, healthy ageing and Cognitive health (SPACE) project, part of the Industrial Strategy Challenge Fund
<https://www.qub.ac.uk/sites/space/>

Exposure Analyses: how the local environment and pollutants synergistically affect our cognitive health outcomes.

Geospatial Data



Innovative, open urban environment geo-portal to progress impact-driven research, policy and practice

Our vision is to provide an open, online, secure, dynamic urban environment geo-portal to support and facilitate future collaborative working with policymakers, industry, research and communities



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Tellus Data

- Department of Enterprise, Trade and Investment (N I)
- 'Building Sustainable Prosperity' fund of the EU Regional Development Programme

UKRR data

- The results shown are from a study which received ethics approval March 2018, NHS National Research Ethics Committee REC reference: 15/EM/0366.

UKRR data

We thank all the UK Renal Centres for providing data to the UK Renal Registry.

- The views and opinions expressed in this article are those of the authors and do not reflect the views of the UK Renal Registry or UK Renal Association.



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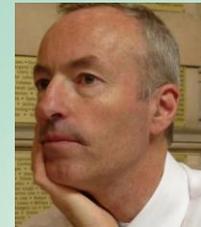
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Healthy Ageing Challenge
Social, Behavioural and
Design Research

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