Trace Element Abundance & Human Epidemiology: the Tellus Case Study

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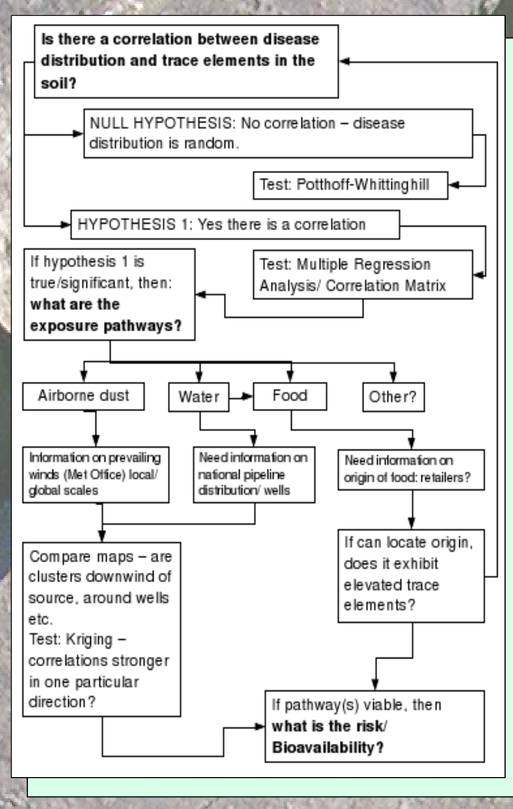
Introduction

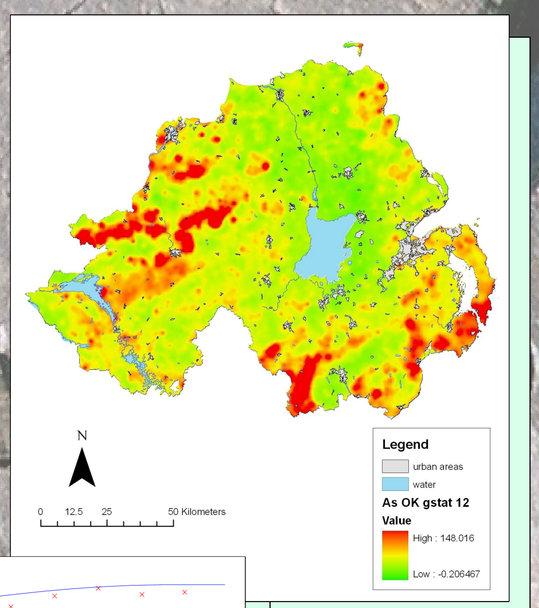
The main aim of this project is to explore spatial correlations between selected trace elements in soils and surface waters, as provided by the Tellus Project and epidemiological data from NICR with regard to spatial disease patterns, in particular cancer, as this accounts for about 25% of total mortality rates in the UK[1]. A further aim is to identify key potential exposure pathways for the selected elements.

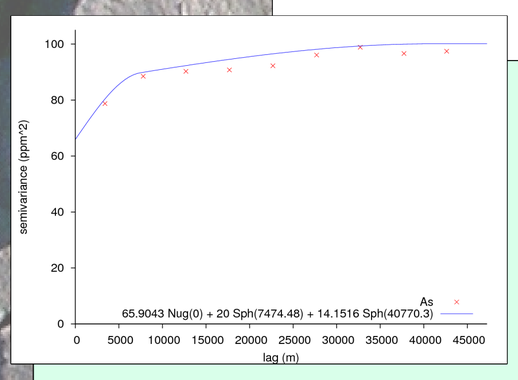
What is Tellus?

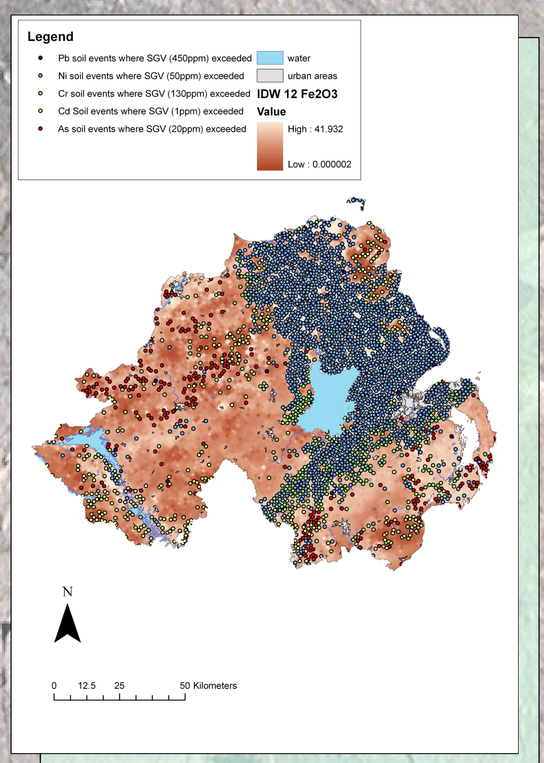
The Tellus Project is the most comprehensive geological mapping project ever undertaken in Northern Ireland. The project was launched in November 2004 to map the whole of Northern Ireland. It was carried out by the Geological Survey of Northern Ireland (GSNI), and was funded by The Department for Enterprise, Trade and Investment (DETINI).

The project consisted of two parts, an airborne geophysical survey and a ground based geochemical survey which collected 13,860 soil, 5,970 stream sediment and stream water samples. These were analysed for more than 50 elements and inorganic compounds. Samples were collected on a grid of one sample site every 2km^2, with soils being collected at depths of 20 and 50cm. Samples within urban areas were collected on a density of 4 samples per km^2 [2]









Methods

Firstly to undertake a literature review (ongoing).

Secondly look at the distribution of relevant trace elements, using Kriging and other interpolators.

Then, as outlined in the simplified scheme (left) test for correlations between disease and trace elements.

Results so far

Arsenic, Cadmium, Chromium, Nickel, Lead, Selenium and Uranium (as one of several possible proxies for Radon) have been studied so far as potential causes or exaggerators of diseases. The map to the left (Arsenic) is an example of this, it was created using Ordinary Kriging (variogram from Gstat below) and 12 neighbours to interpolate between the sample sites. In the case of Arsenic, the hotspots appear to be associated with faulting in metamorphic rocks.

The second map below shows all the sample sites which exceeded the DEFRA Soil Guideline Values for As, Cd, Cr, Ni and Pb. Initially this looks rather alarming, however the majority of sites overlying the Antrim Basalts are also very high in Iron Oxide (Fe_2O_3), which has been shown to be effective in moderating the bioavailability of Arsenic[3] . A significant proportion of the area is also covered by highly organic soils which also has a moderating effect on the bioavailability of some of the other compounds. The actual areas of increased risk therefore are the regions where these moderators are low (Counties of Down and Armagh), where we might expect to see an increase in disease.

References

[1] Swerdlow A, Dos Santos Silva I, & Doll R. *Cancer Incidence and Mortality in England and Wales: trends and risk factors* Oxford University Press, 2001

[2] Tellus Project Overview 2007 http://www.bgs.ac.uk/gsni/Tellus/index.html

[3] Kumpiene J, Lagerkvist A, & Maurice C. *Stabilization of As, Cr, Cu, Pb and Zn in soil using amendments – a review* Waste Management 28 (2008) 215–225

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Department of Enterprise, Trade and Investment
www.detini.gov.uk
N. Ireland Cancer Registry
Geological Survey of Northern Ireland