Spatial heterogeneity of risks

Spatial heterogeneity of risks at contaminated sites

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Spatial heterogeneity of risks

- **Background**
- **Benefits**
- **Complications**
- **Conclusions**

Spatial heterogeneity of risks

Background

Spatial heterogeneity a common feature at all contaminated sites:

- **Contaminant concentrations: mm scale to the km scale**
- **Fraction organic carbon, highly variable:**
  - influence on site exposure and transport off site
- **Geohydrology, less variable at site scale:**
  - influence on site exposure and transport off site
- **Risk receptors (humans and ecological), variable in time, difficult to quantify:**
  - influence exposure and effects

Spatial heterogeneity of risks

Background

- Epidemiology and Geography uses spatial risk models
- In many countries: spatial heterogeneity part of risk assessment
- One of the main functions in one of the major software packages for risk assessment (SADA)
- In Sweden ?

Spatial heterogeneity of risks

Benefits of focusing on spatial distribution of risks

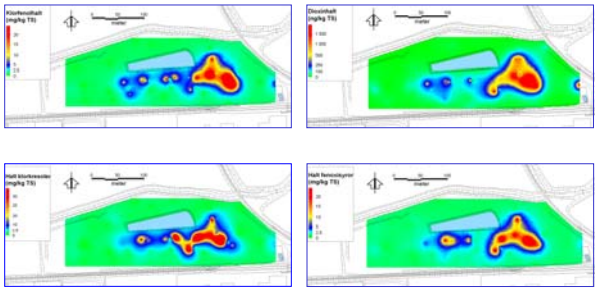
1. ***Demonstrates the difference between spatial distribution of concentrations and risks***

Spatial heterogeneity of risks

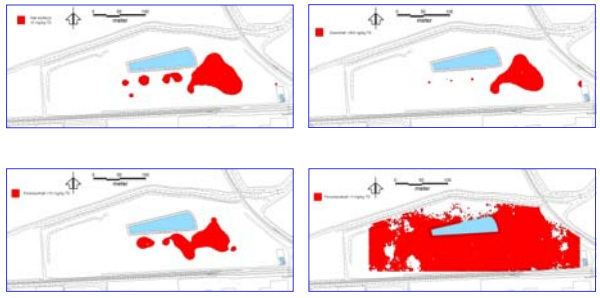
BT Kemi

- ***Former pesticide manufacturing facility***
- ***Soil heavily contaminated by phenoxy acids, chlorophenols, chlorocresols and dioxins***

Spatial heterogeneity of risks



Spatial heterogeneity of risks



Spatial heterogeneity of risks

Benefits of focusing on spatial distribution of risks

2. Risk factors are spatially variable. Assuming central tendency values oversimplifies the risk assessment

Spatial heterogeneity of risks

Bengtsfors, “miljöprojekt EKA”

- *Facility for producing chlorine gas*
- *Site heavily contaminated with mercury and dioxin*
- *Transport to adjoining surface water big concern*

Spatial heterogeneity of risks

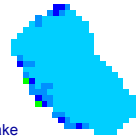
The spatial distribution of <u>calculated</u> relative risk of contaminant transport from the site to the adjoining lake

Calculated transport risk before risk reduction measures

Lake

Risk reduction measures:
-Particle filters
-Sorption filters
-Capping
-Excavation

Calculated transport risk after risk reduction measures

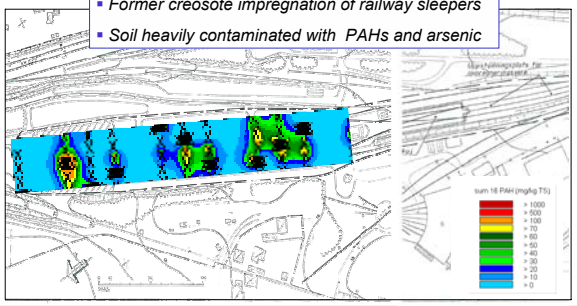


Lake

Spatial heterogeneity of risks

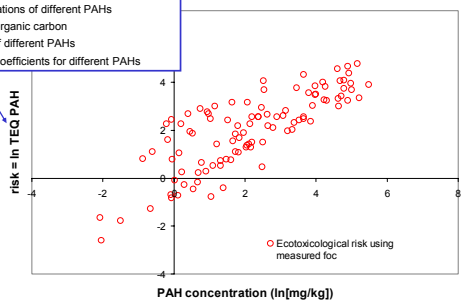
Hässleholm creosote impregnation site

- *Former creosote impregnation of railway sleepers*
- *Soil heavily contaminated with PAHs and arsenic*



Spatial heterogeneity of risks

Risk dependent on:
- Concentrations of different PAHs
- Fraction organic carbon
- Toxicity of different PAHs
- Partition coefficients for different PAHs

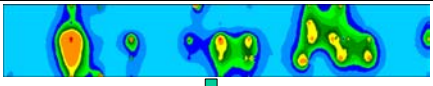


Spatial heterogeneity of risks

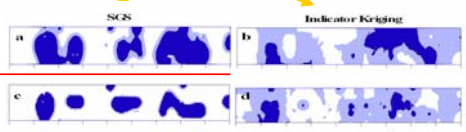
Complications when focusing on spatial distribution of risks

Spatial variability of risk dependent on interpolation techniques and guideline values

Spatial heterogeneity of risks



Interpolation technique



Area where ecotoxicological effect values are exceeded

Area where guideline values for cancerogenic PAHs are exceeded

Blue = high risk = high probability that guideline value is exceeded,

Lightblue = lower risk = low probability that guideline value is exceeded,

Spatial heterogeneity of risks

Conclusions

- **Spatial distribution of risks and concentrations may differ**
- **Assuming average values for risk parameters mat be over simplistic**
- **Different methods of producing risk maps may yield different results which may affect remediation measures and cost**