GEUS

Indicators to discriminate point sources and diffuse sources of pesticides in groundwater

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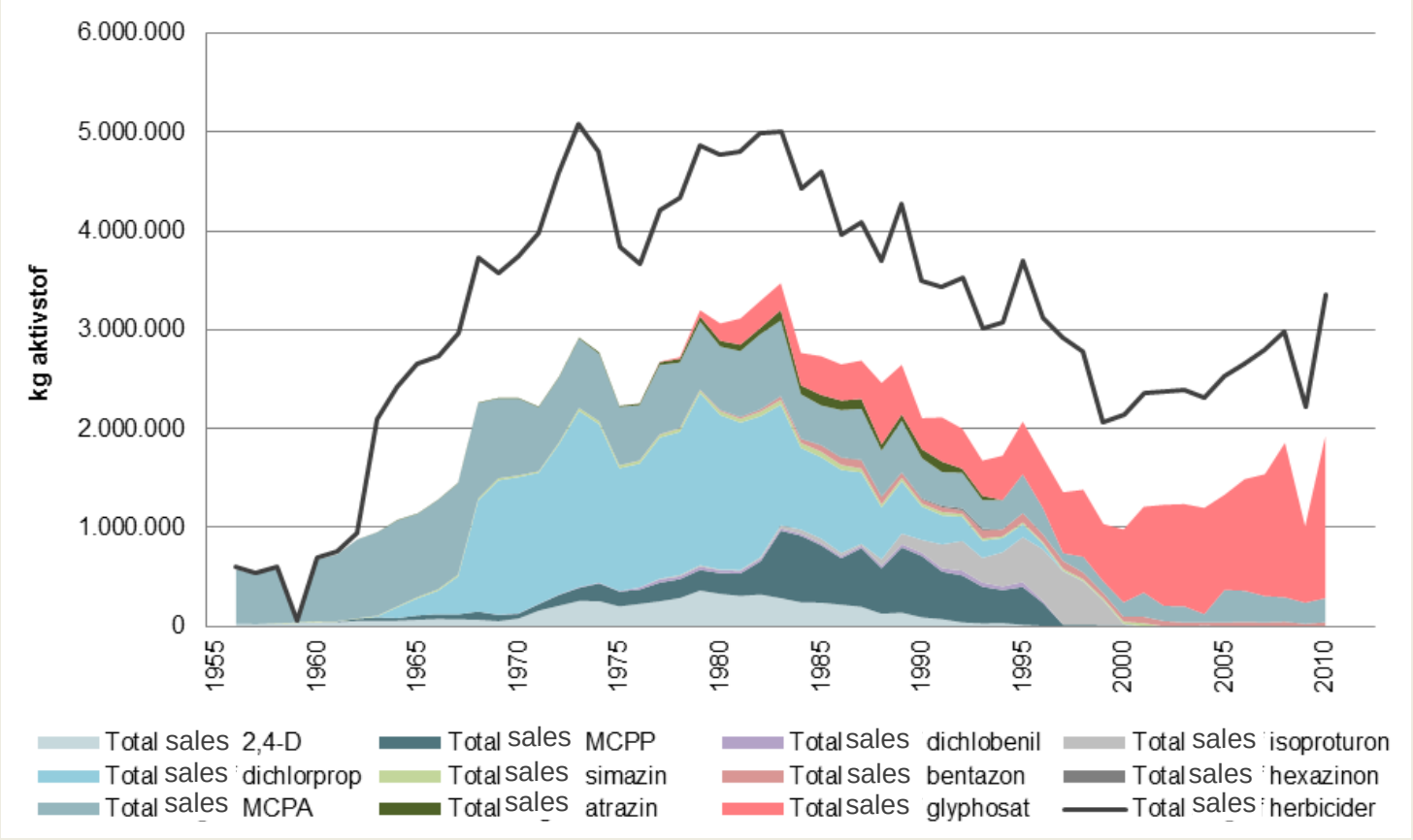
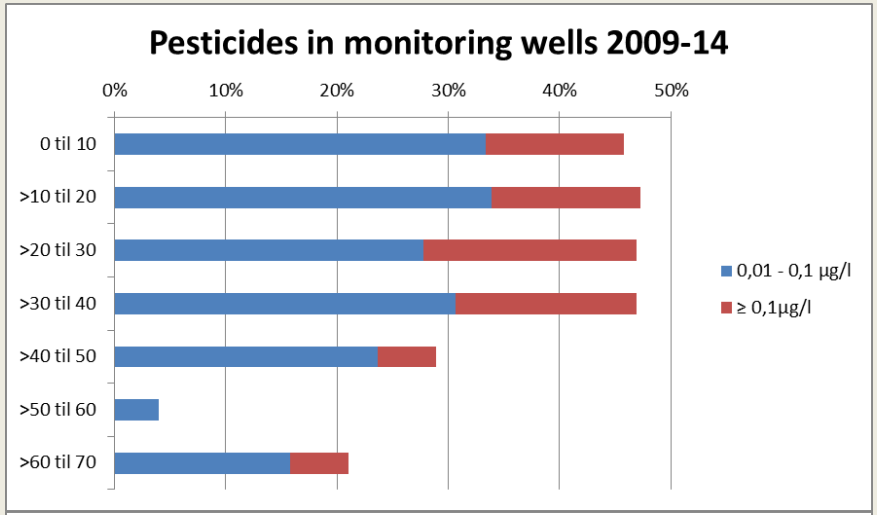
Geological Survey of Denmark and Greenland
Danish Ministry of Energy, Utilities and Climate

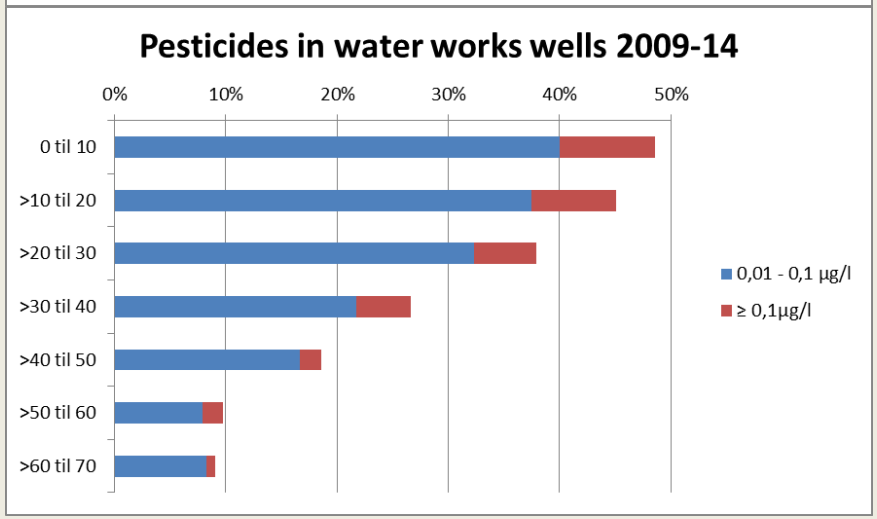
Herbicides sold in DK 1955-2010

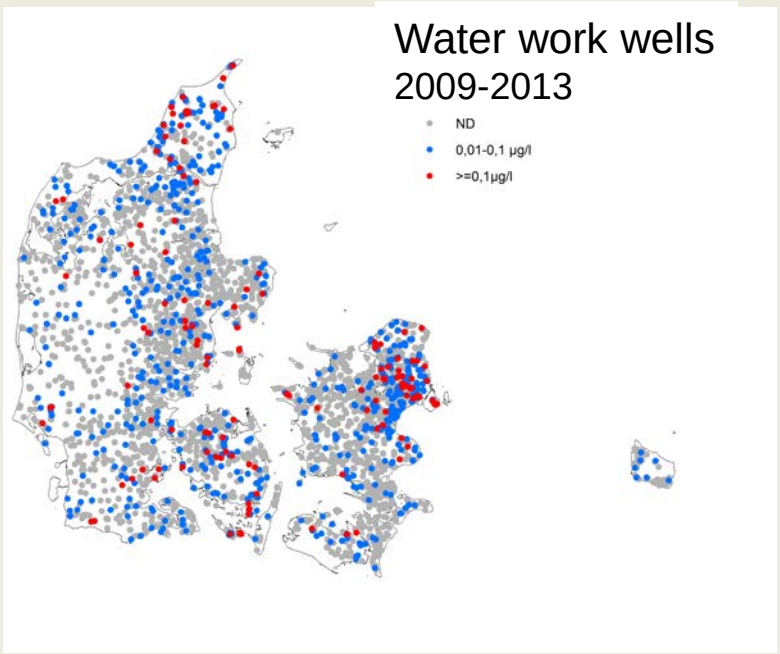
The herbicides sold are not necessaire those we find in ground water



Pesticides in Danish Groundwater



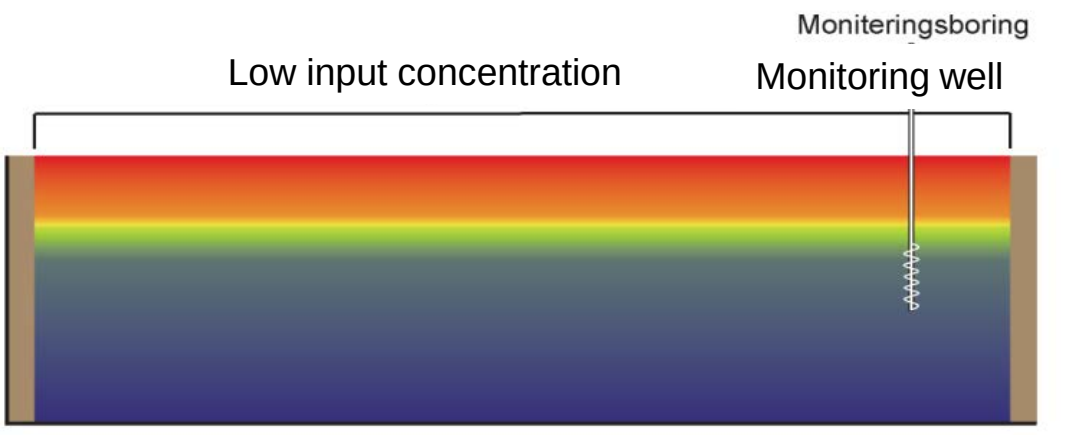




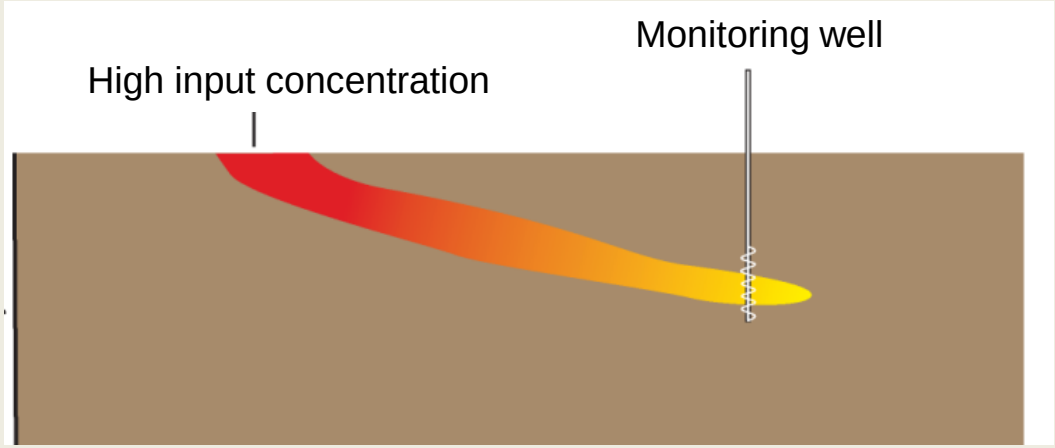
- 12 % of water work wells have > 0,1 µg/l of pesticides
- 50 % of all groundwater monitoring wells have at least one detection of a pesticide

Point and diffuse pesticide loads

Diffus:
Intentional spread in environment



Point source:
Non-intentional spread in environment



Project Idea

Given a pesticide is found in a ground water sample!

Is it possible to tell if it originates from a point source or a diffuse source.??

Pragmatic indicators were established to support decision on relevant reaction.

Questions

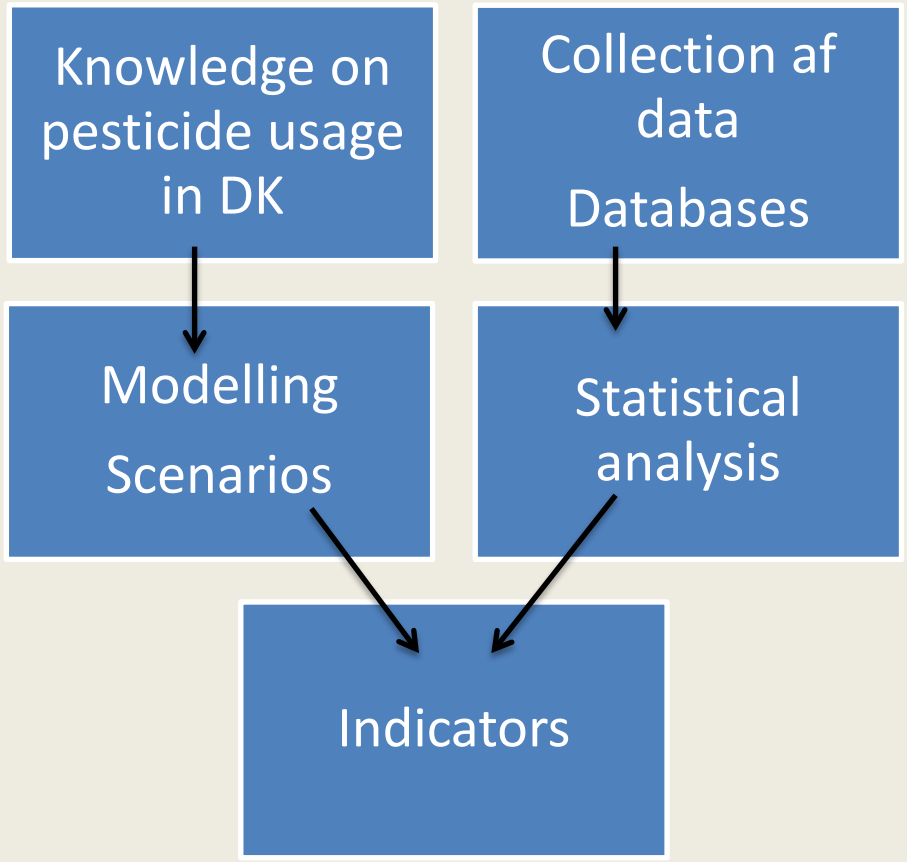
Identify differences in findings from point and diffuse pesticide sources :

- Which compounds occur
- Concentrations found
- Coexistence of substances
- Variations in time and space

Modelling controlling factors influence that might indicate the source of the pesticides present in groundwater:

- Specific chemical properties
- Geology og hydrogeology
- Type of well
- Usage and regulation

Methods


Knowledge on pesticide usage in DK
Collection af data
Databases
Modelling
Scenarios
Statistical analysis
Indicators


Miljøministeriet
Miljøstyrelsen
Skelnen mellem pesticidkilder
[Forside underoverskrift]
[Serietitel og årstal]

Available data

- Only samples with at least one detected pesticide or relevant metabolite were compared (> 0,01 µg/l)
- Known point sources (43 thorough mapped sites by regional authorities)
- Only diffuse sources : Shallow groundwater (< 6 m): in agricultural monitoring areas (520 samples from 1997- 2011)
  - Only below conventional agricultural fields
- Waterworks wells 7.272 samples
- Groundwater monitoring wells 3.811 samples
- All other Available samples (AA) 9.213 samples
- In Denmark the analytical programs of all datasets largely are comparable

Pesticides in special focus

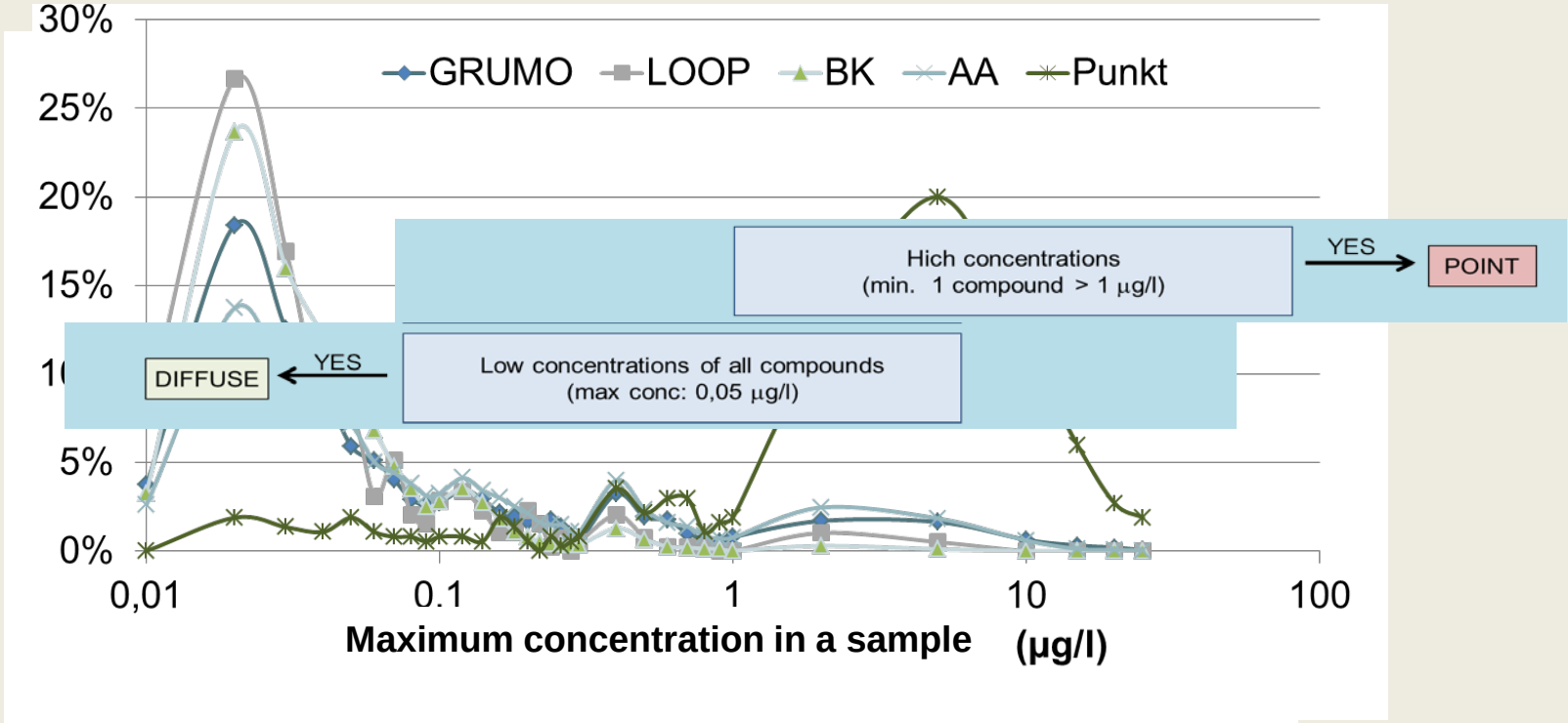
- 2,4-D
- Atrazine
- Bentazon
- Dichlobenil
- Dichlorprop
- Glyphosat
- Hexazinon
- Isoproturon
- MCPA
- MCPP
- Simazine

Results

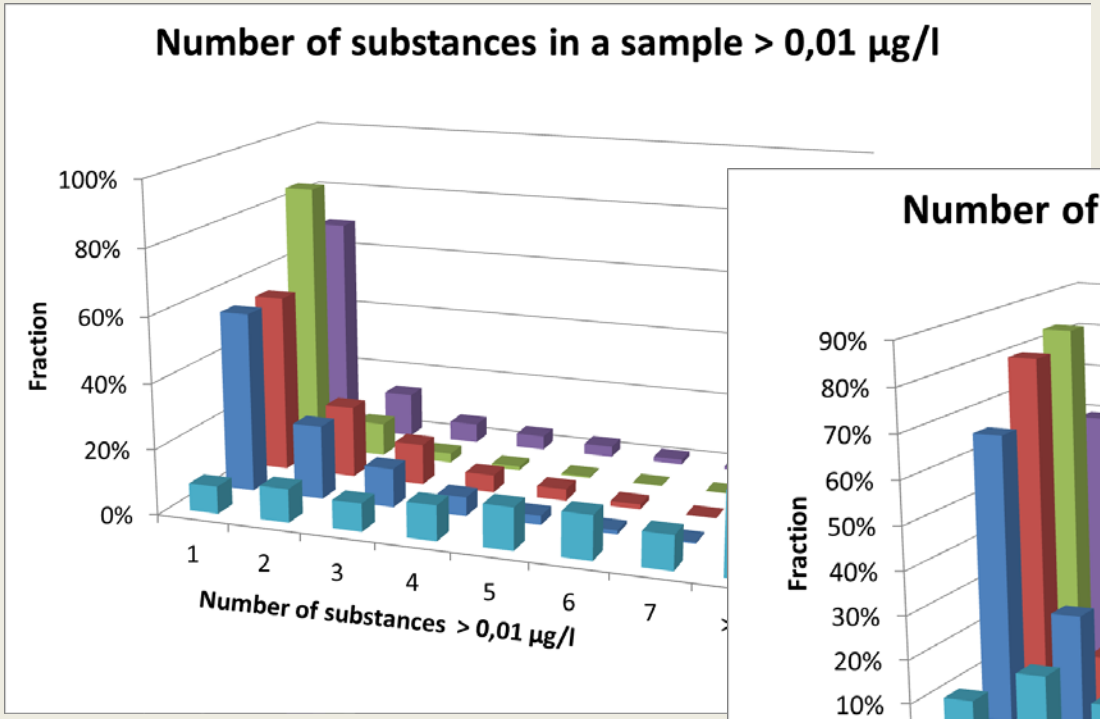
Difference in distribution of concentration

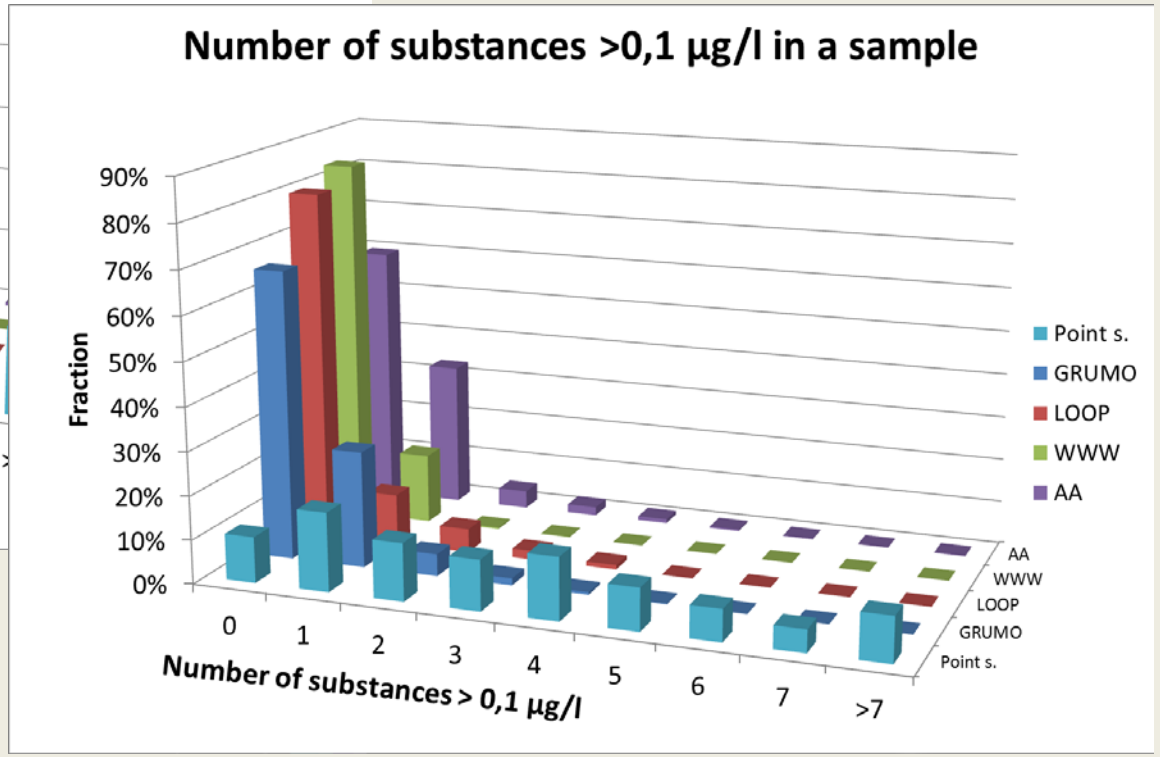
Statistical test samples:

- Sum of pesticides
- Max single pesticide



Differences in number of compounds in a sample

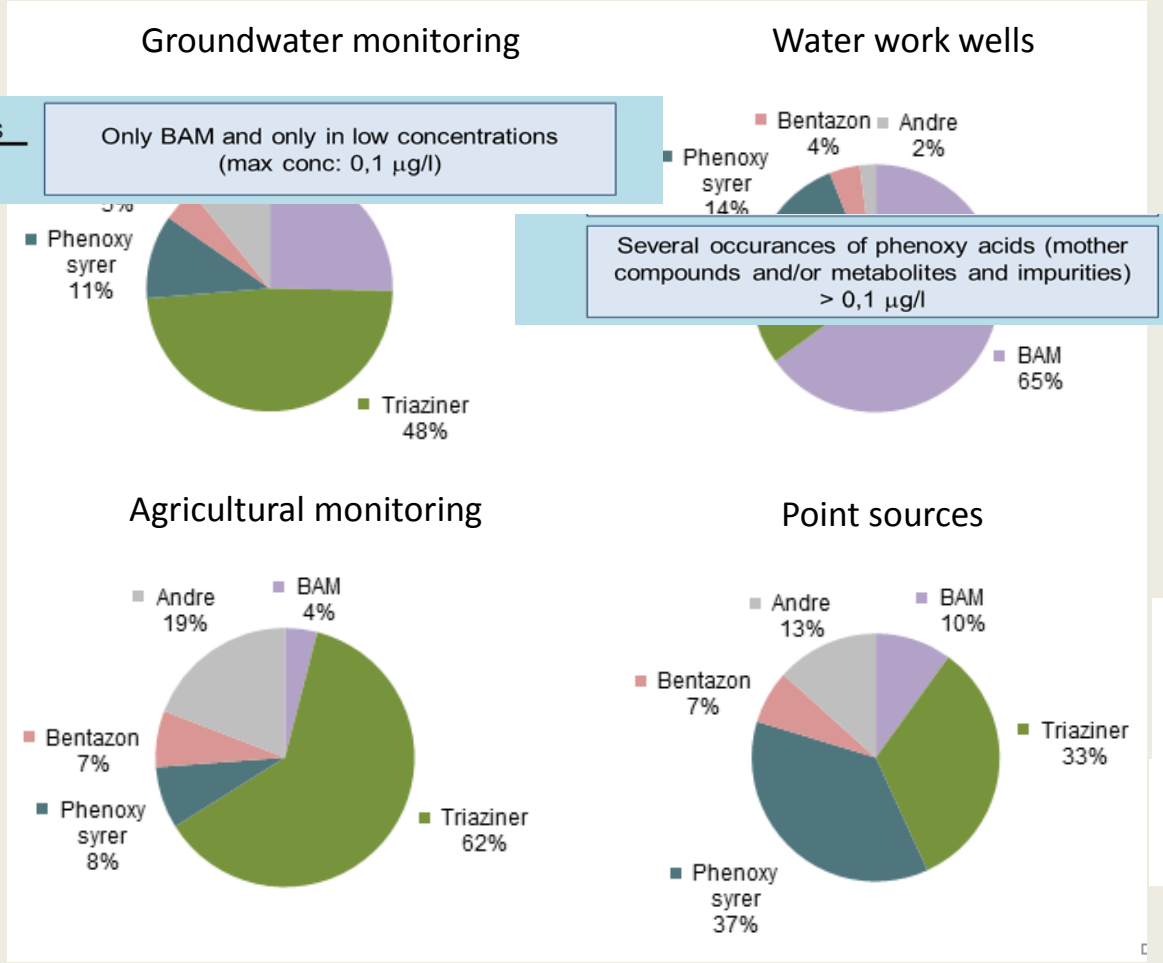




Co-existence of many compounds
(min. 4 compounds > detection limit and/or
min. 2 compounds > groundwater quality level)

YES → POINT

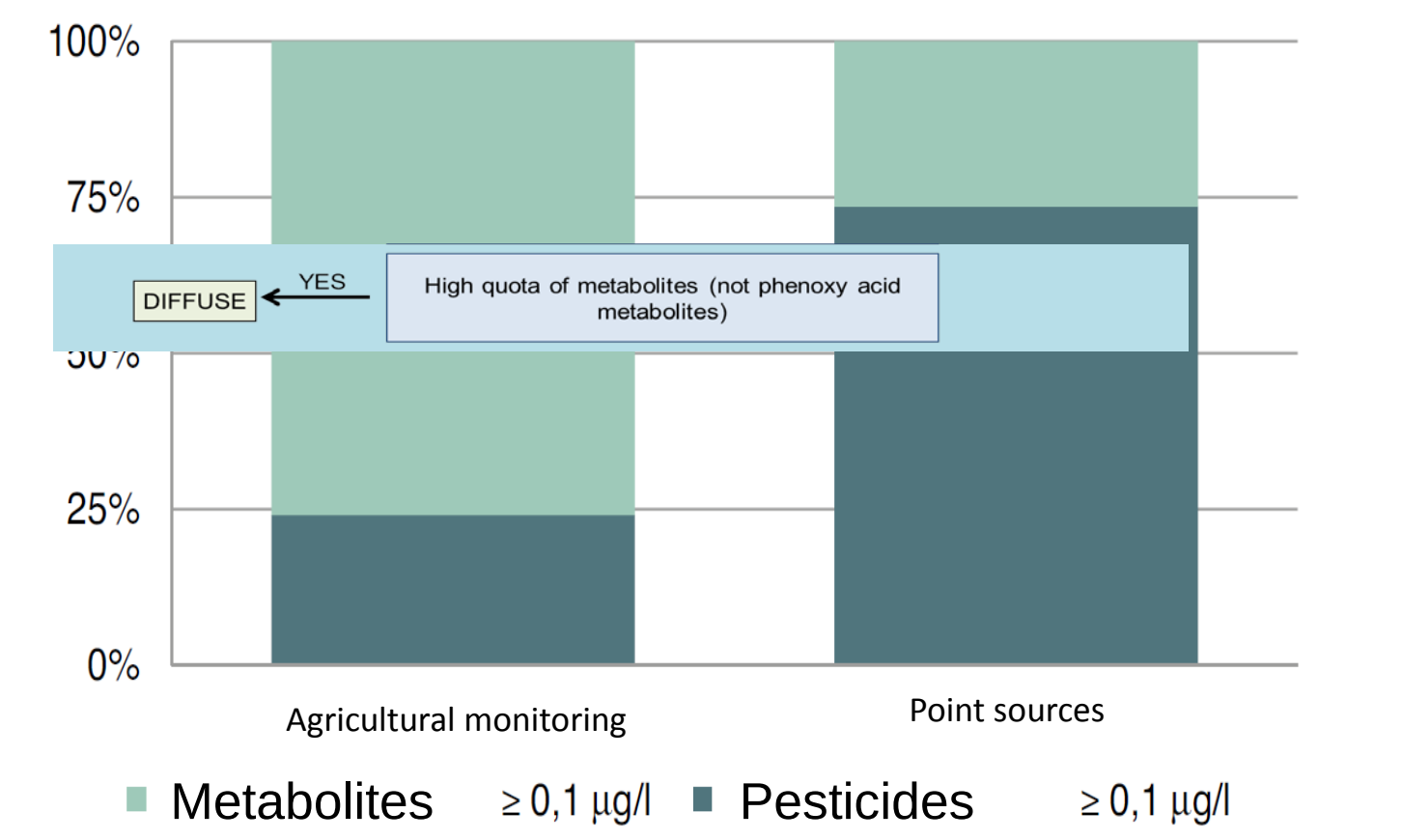
Difference in occurrence of specific compounds and their concentrations



BAM: 2,6dichlorbenzamid
Metabolite of dichlobenil in Prefix or Casseron
Diffuse urban pesticide

Phenoxy acids: group of pesticides and metabolites like 2,4-D, MCPA

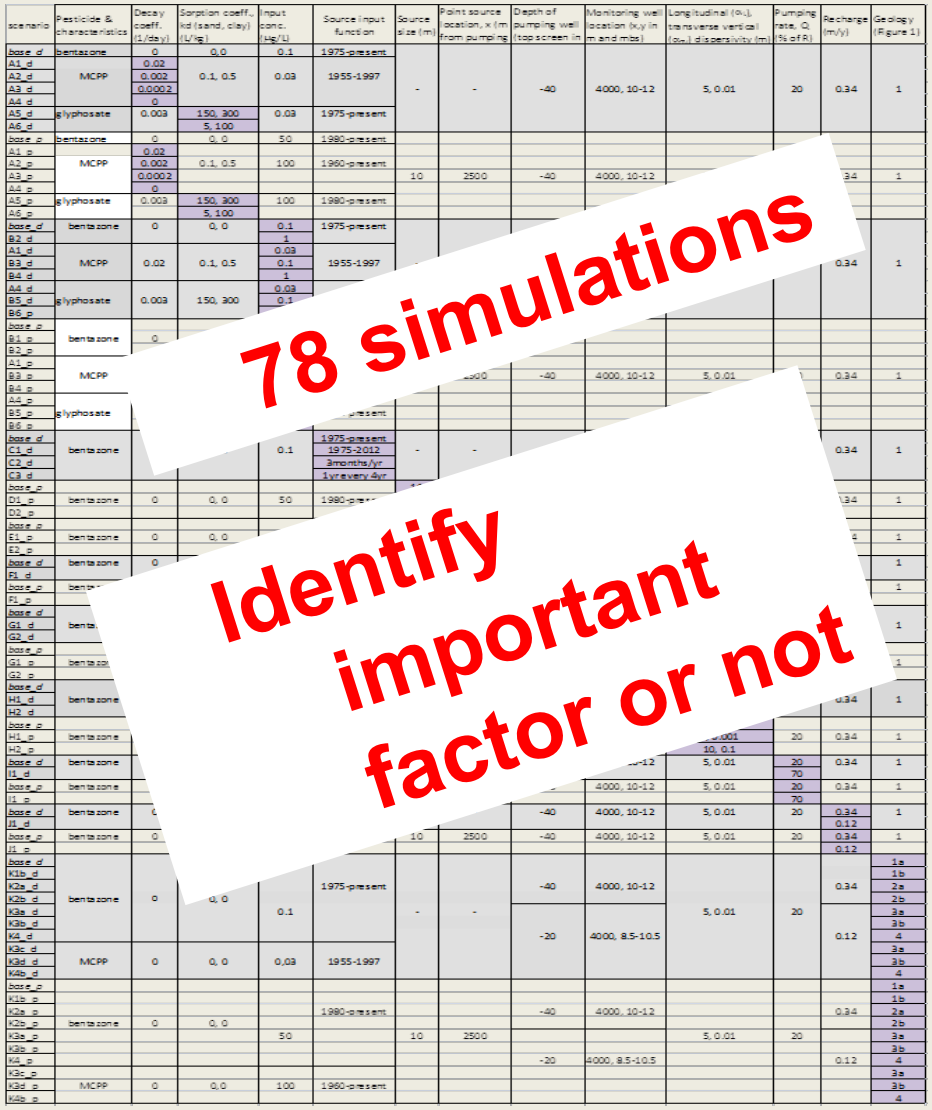
Difference in fraction of active compounds - metabolites



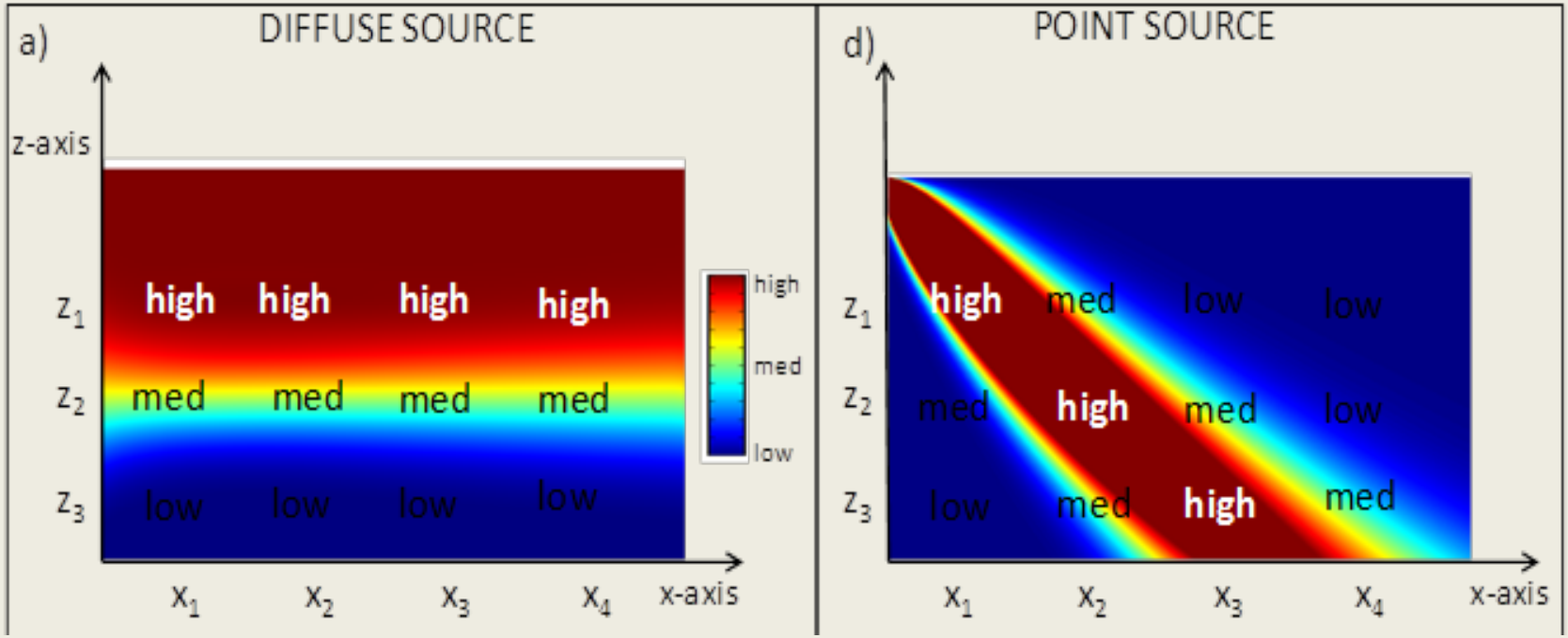
Share of compounds with concentrations ≥ 0,1 µg/l

Input to scenario models

- Type of pesticide
- Pesticide concentration
- Varying input function fore diffuse source (simulating shift in pesticide application)
- Area of point source
- Location of point source
- Location and depth of water work wells
- Location and depth of monitoring wells
- Dispersivity
- Pumping rate in water works wells
- Infiltration
- Geology

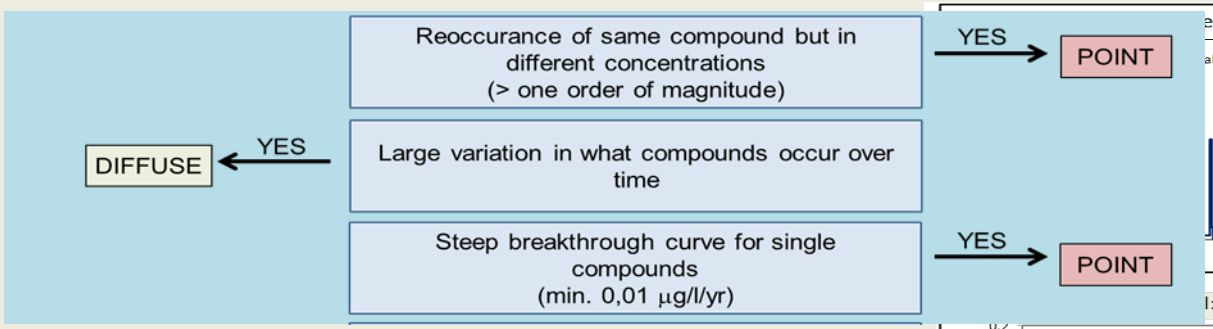


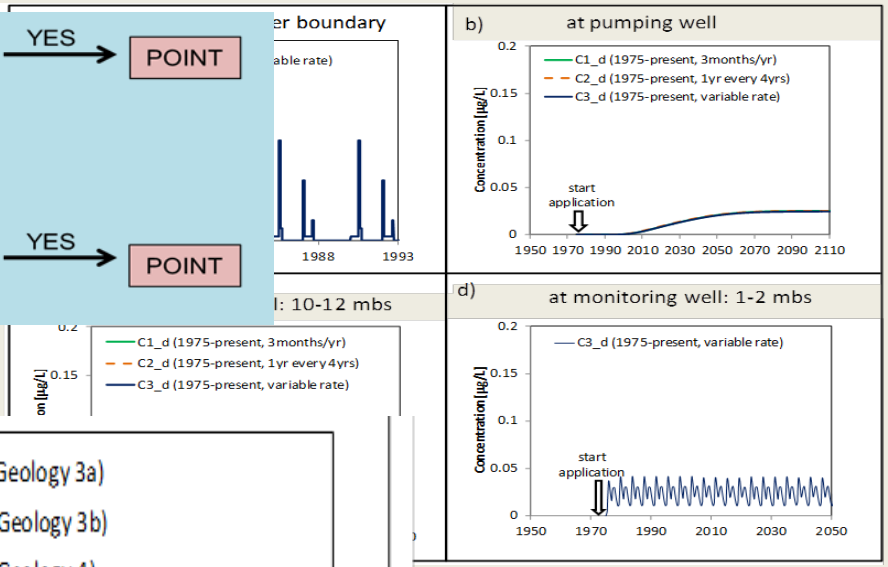
Spatial differences

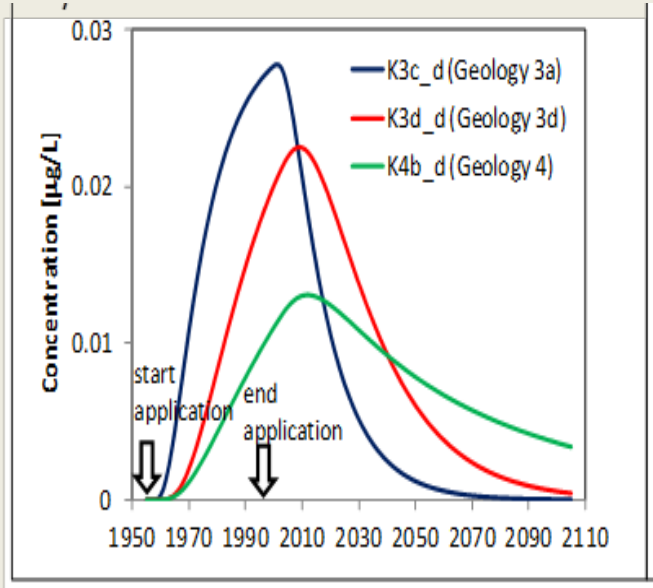


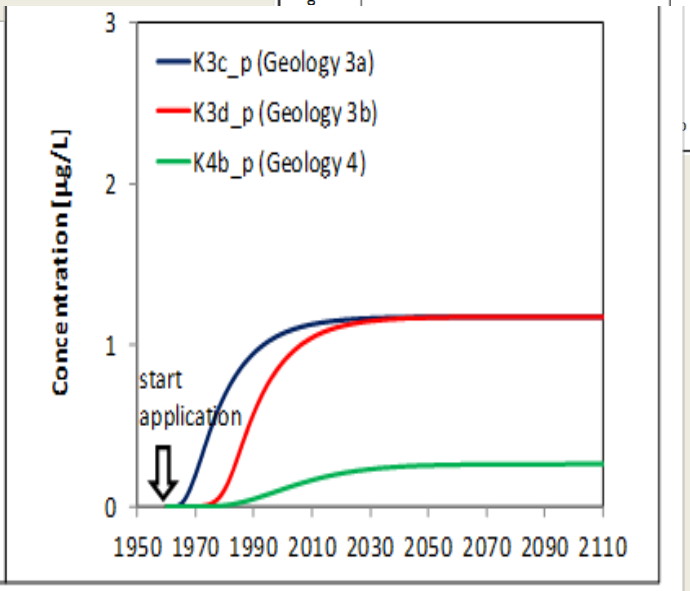
Horisontal variation of same compound(s) within 100 m in deep wells (>10 m)	YES → POINT
Occurance of a compound in an abstaction well which is not present in more shallow wells (The wells should be in hydraulic contadt)	YES → POINT

Differences in trends, model results





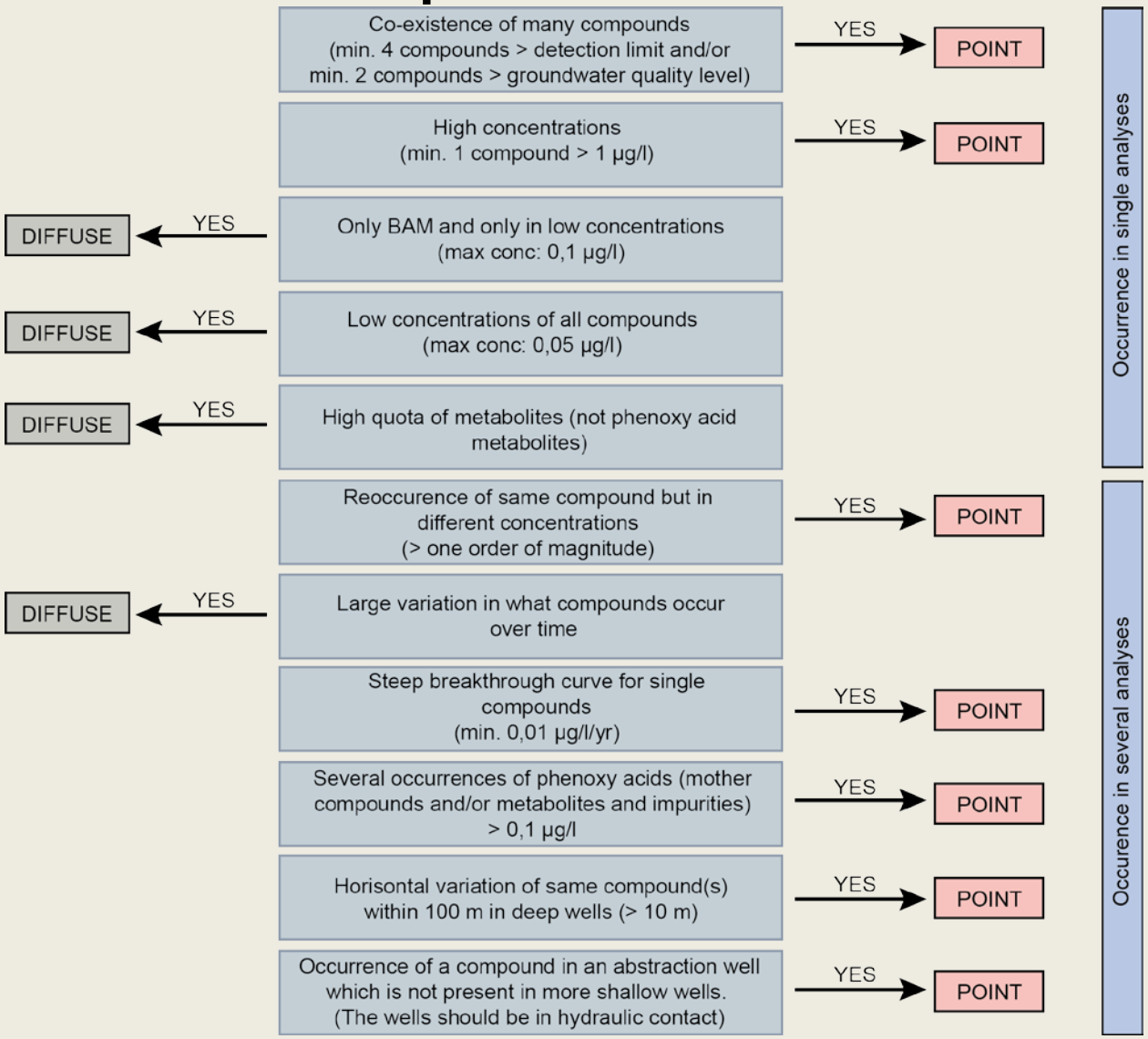




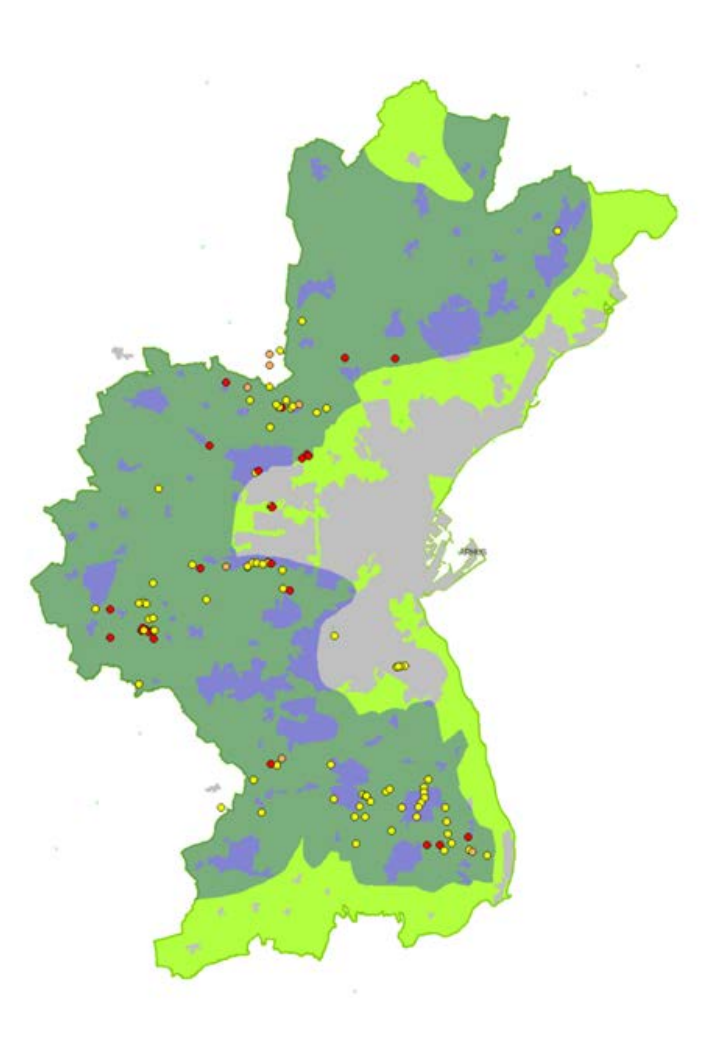
Diffuse source trend
~ 0,001 µg/l/y

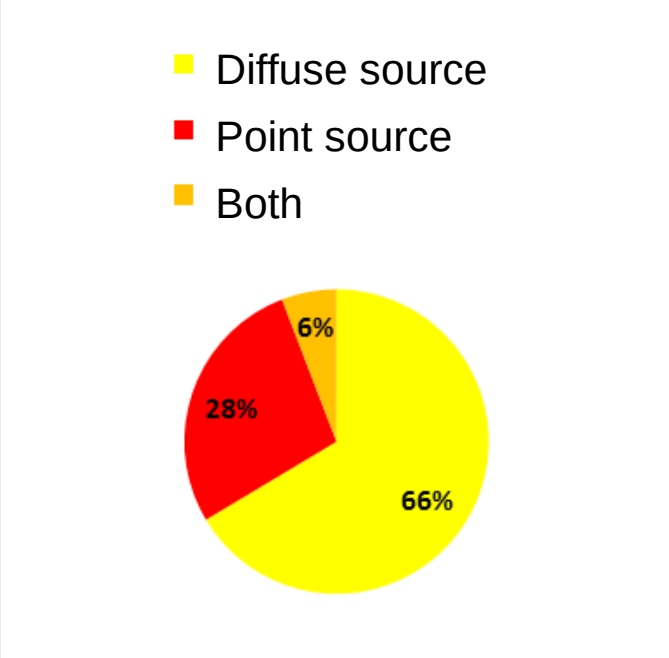
Point source trend
> 0,01 µg/l/y

Final Indicators for discrimination of diffuse and point sources



Use of the indicator in Århus Municipality





Example: Bam and phenoxy acids

DIFFUSE* ← YES — Only BAM and only in low concentrations (max conc: 0,1 µg/l)

Several occurances of phenoxy acids (mother compounds and/or metabolites and impurities) > 0,1 µg/l — YES → POINT