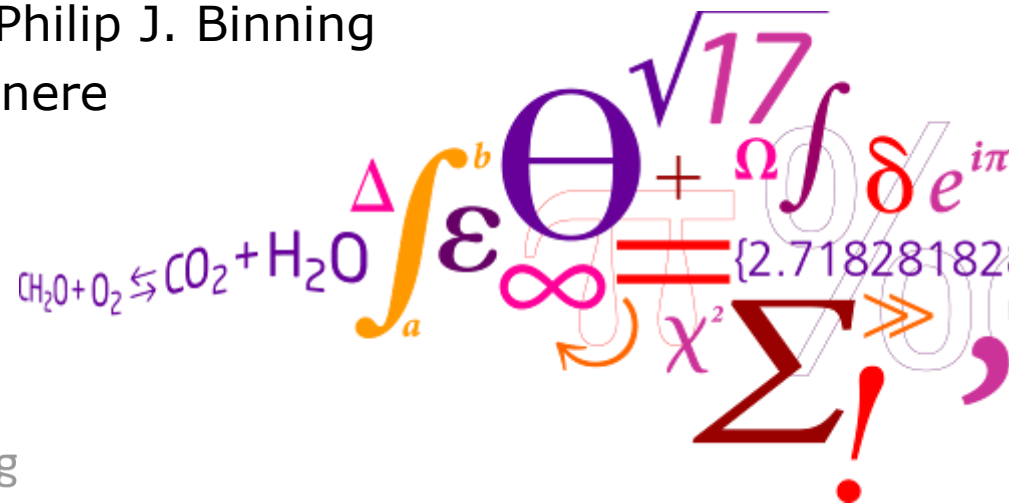


Forurenede grundens påvirkning af vandløb

Poul L. Bjerg,

Ursula McKnight, Anne Sonne, Vinni Rønde, Ellen Nicolajsen,
Mette F. Petersen, Angelina Aisopou, Annika Fjordbøge,
Nanna I. Thomsen, Rick Devlin, Philip J. Binning
og mange andre samarbejdspartnere



DTU Environment

Department of Environmental Engineering



Gamle lossepladser



Industrigrunde



Skjer der indsvivning af forurening ? Hvor og hvor meget? Er det et problem?

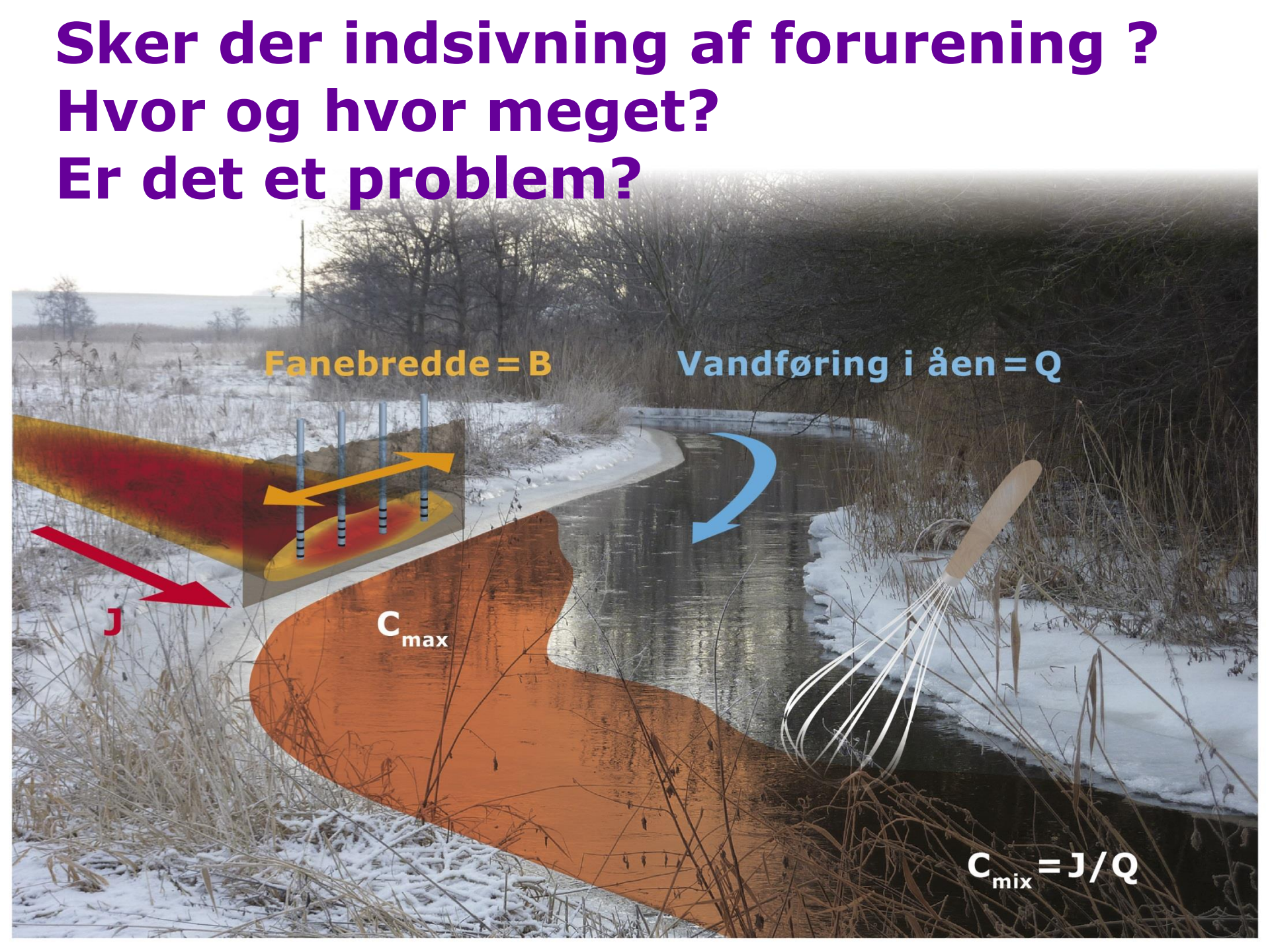
Fanebredde = B

Vandføring i åen = Q

J

C_{\max}

$$C_{\text{mix}} = J/Q$$



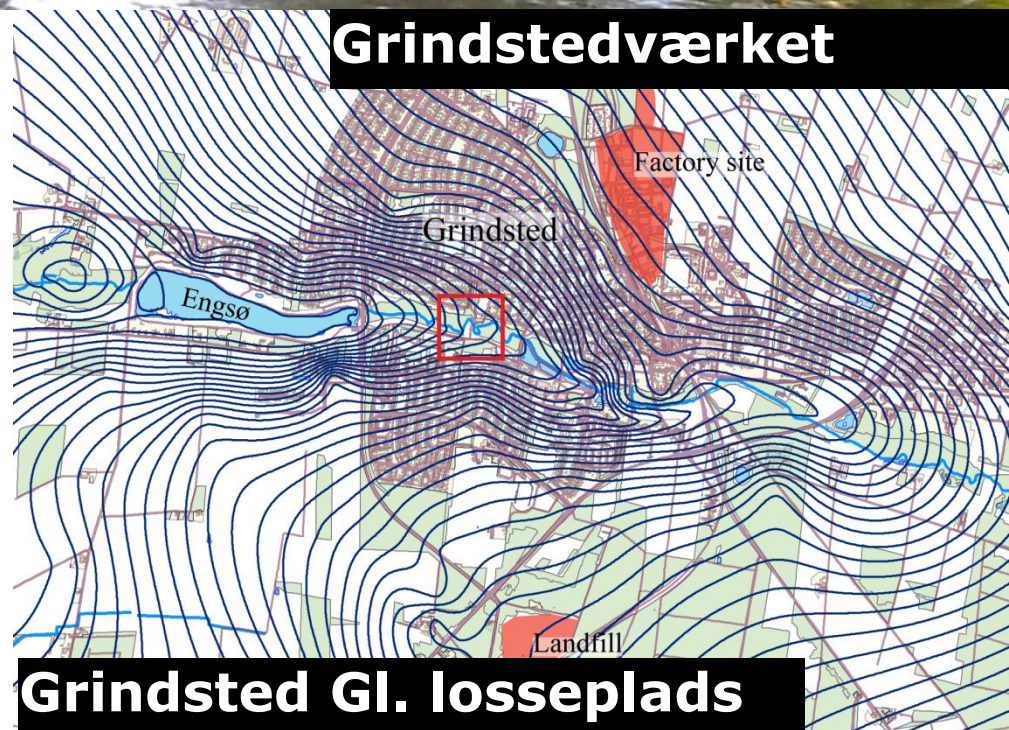
Grindsted Å





Vandføring: 1.5-4 m³/s

- Sandet geologi
- Strømning mod åen
- En blanding af forureninger
- Chlorerede opløsningsmidler
- Pharmaceutiske stoffer
- Chlorid og bromid
- "Lossepladsstoffer"

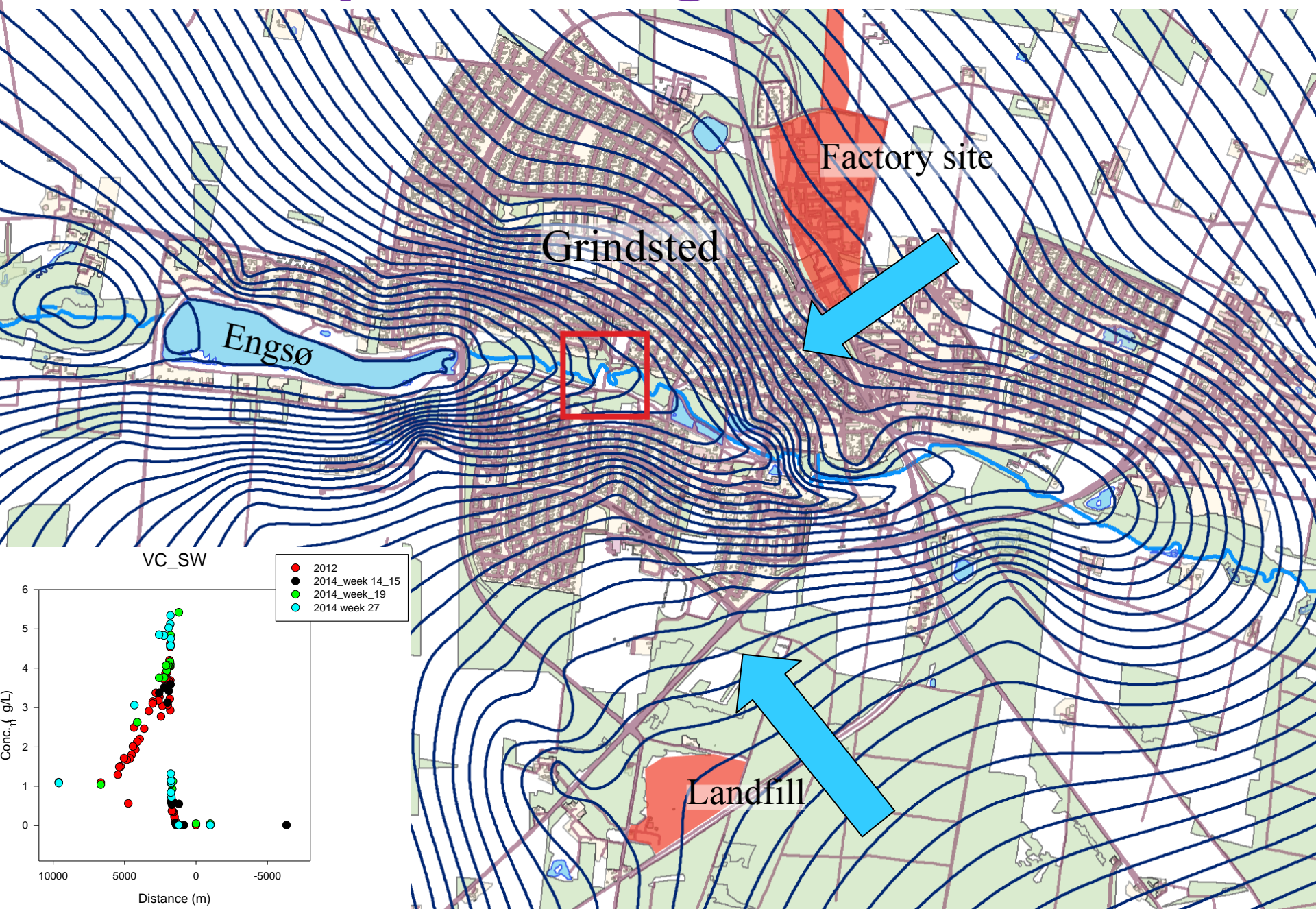


Grindstedværket

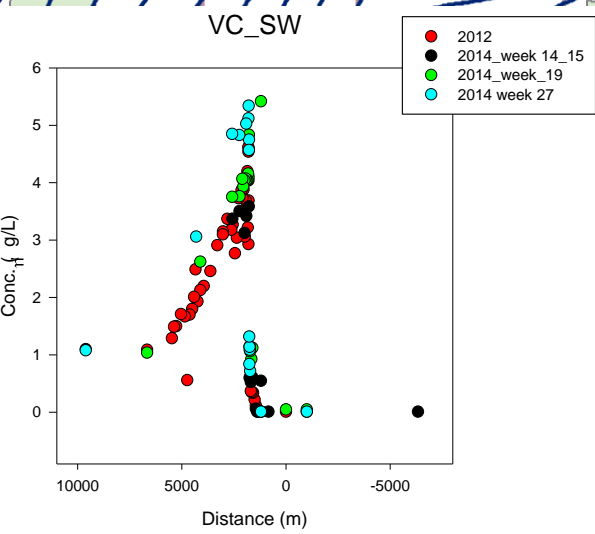
Grindsted Gl. losseplads



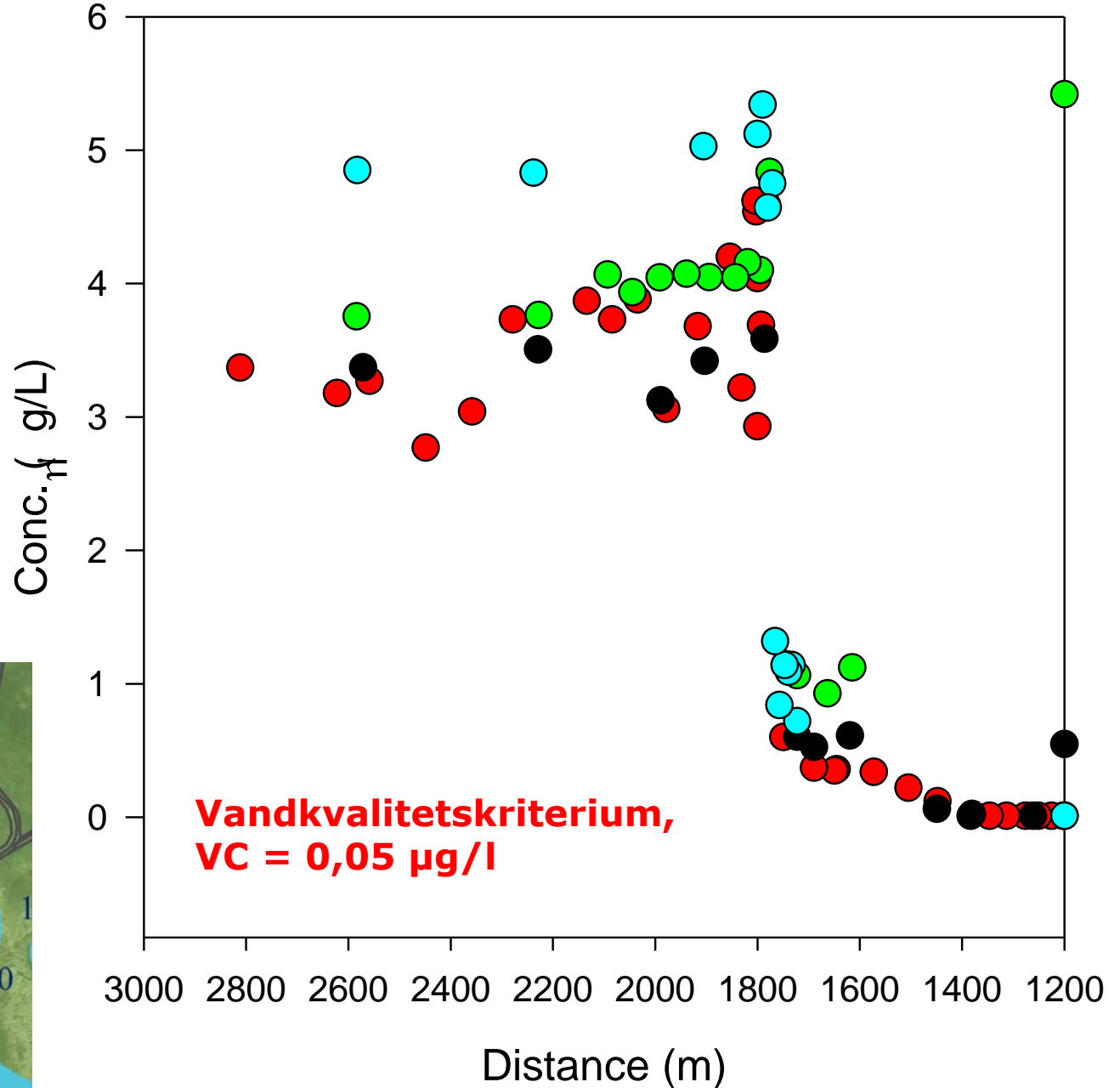
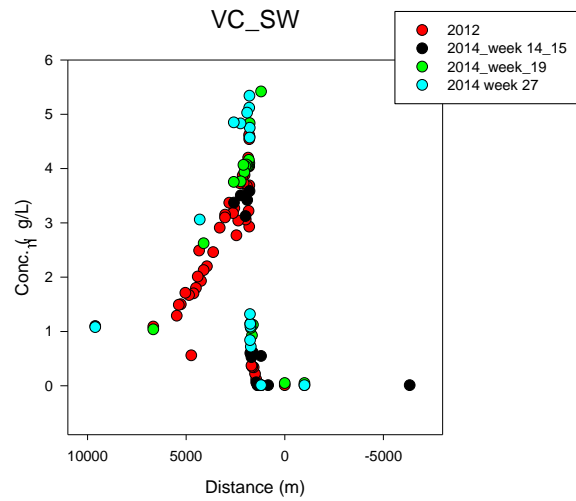
Vandprøver langs Grindsted Å



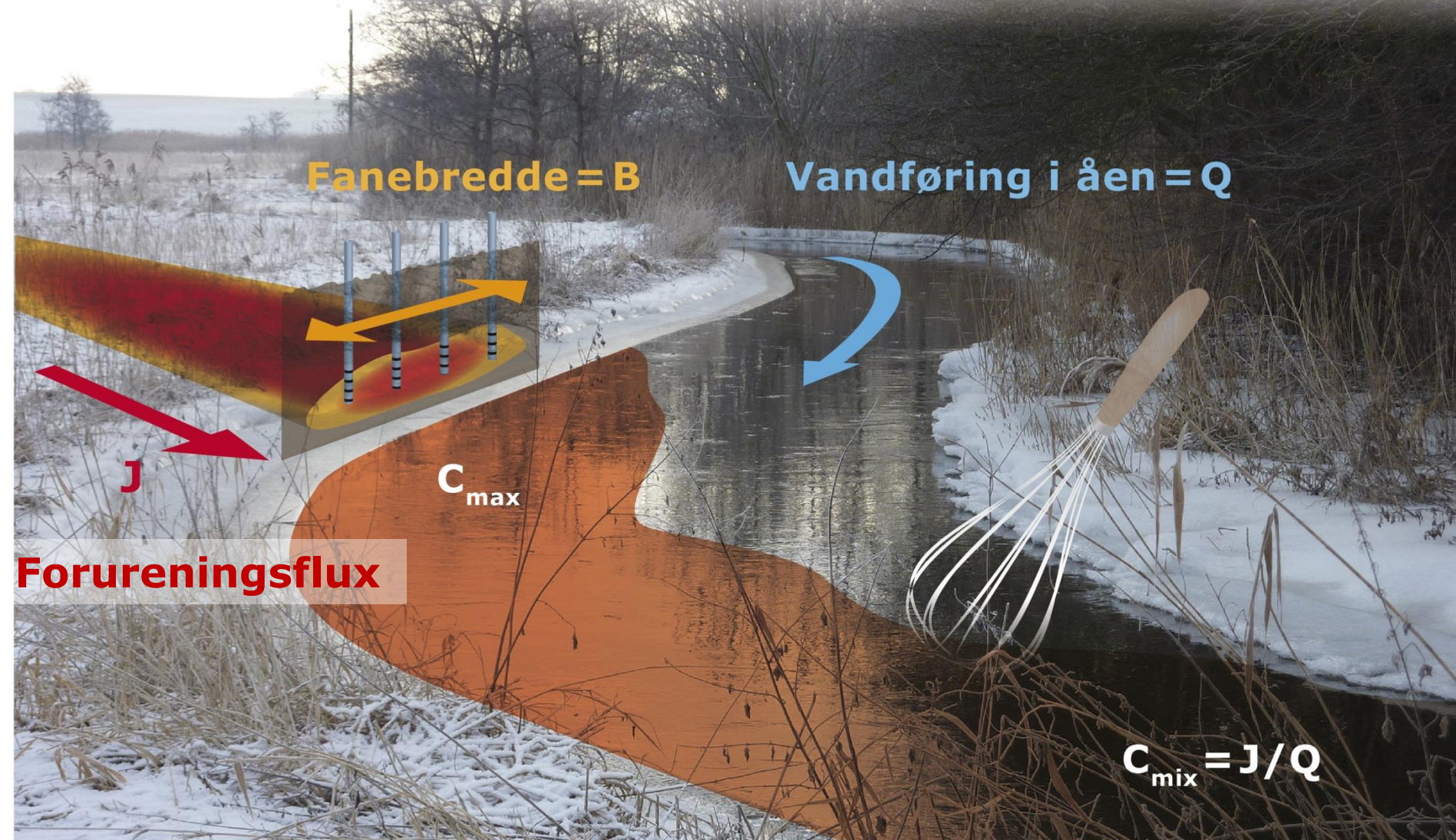
VC_SW



Vinylchlorid i åen



Skjer der indsvivning af forurening ✓
Hvor og hvor meget ?
Er det et problem ✓

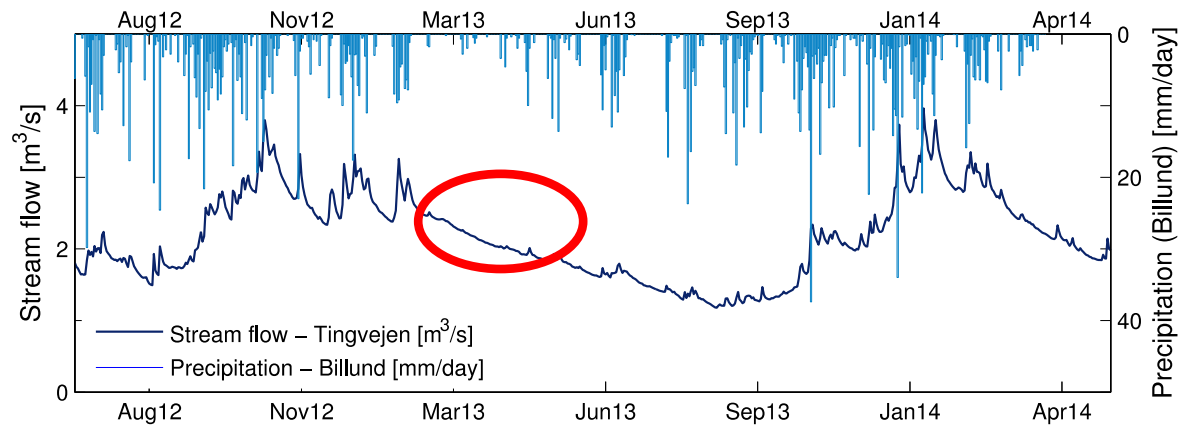
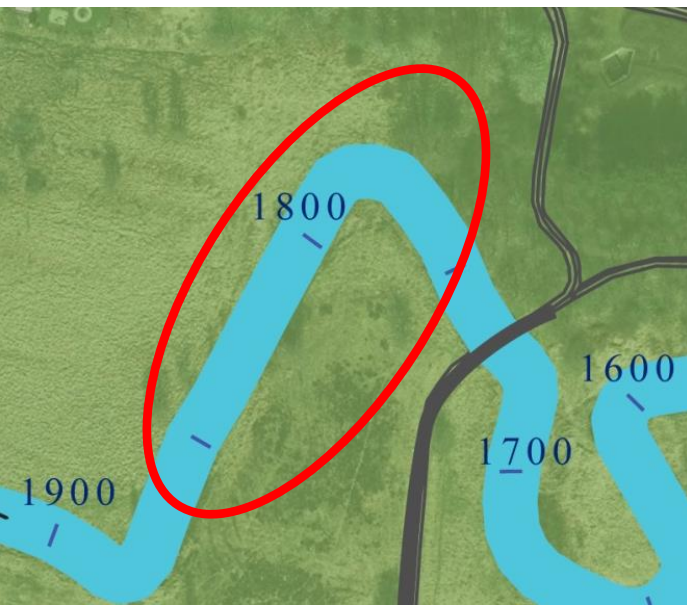
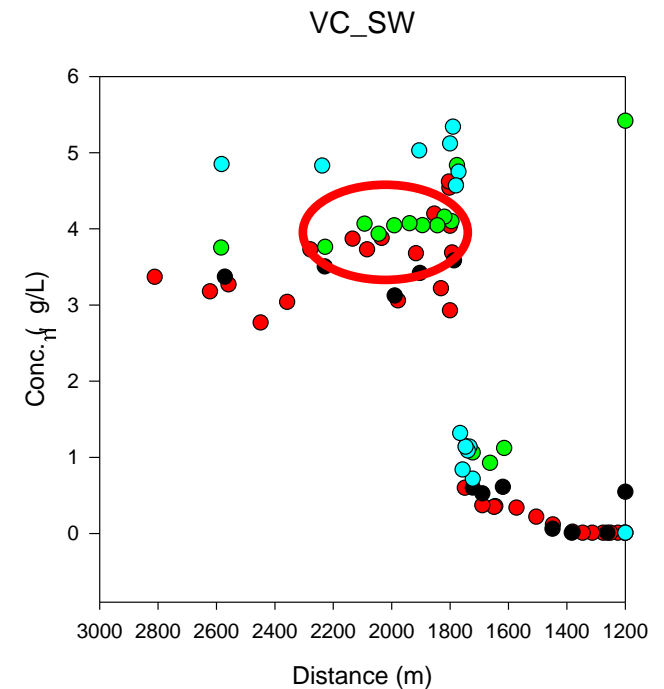


Hvor og hvor meget? Indsivning af vinylchlorid

$$J/Q = C_{\text{mix}} \Rightarrow J = C_{\text{mix}} \cdot Q$$

$$J = 4 \mu\text{g/l} \cdot 2000 \text{ l/s} = 8000 \mu\text{g/s}$$

$$J = 250 \text{ kg/year}$$



Hvor og hvor meget?

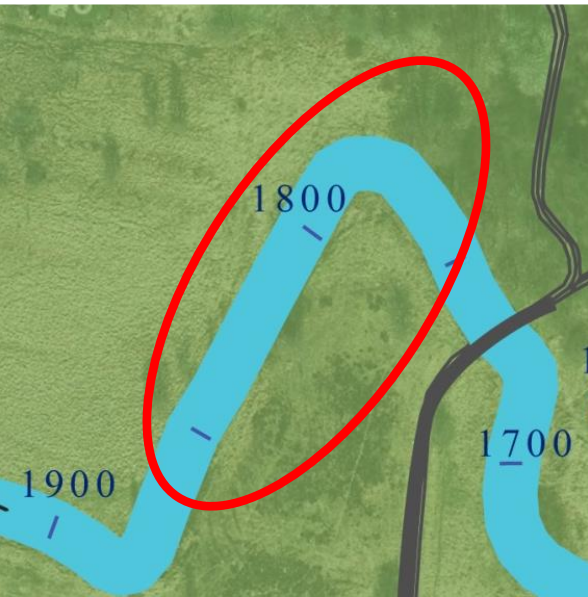
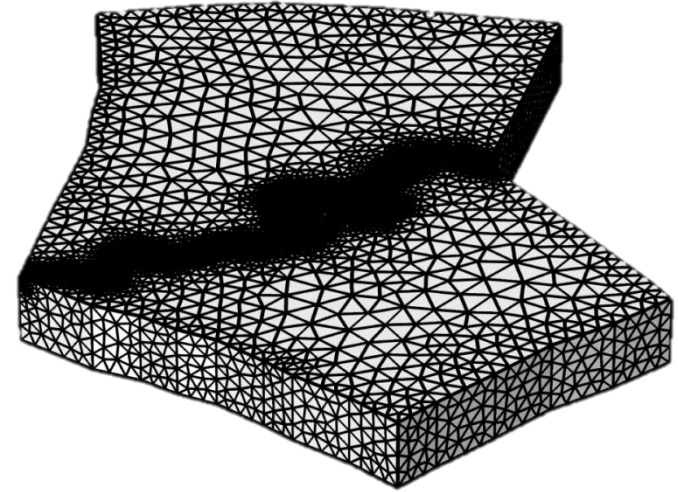
$$J = \sum (Q_{ind, i} \cdot c_i)$$

Darcymetode

- $Q_{ind} = K \cdot I \cdot \text{Areal}$
- Q_{ind} , indstrømning til å
- K , hydraulisk ledningsevne
- I , hydraulisk gradient

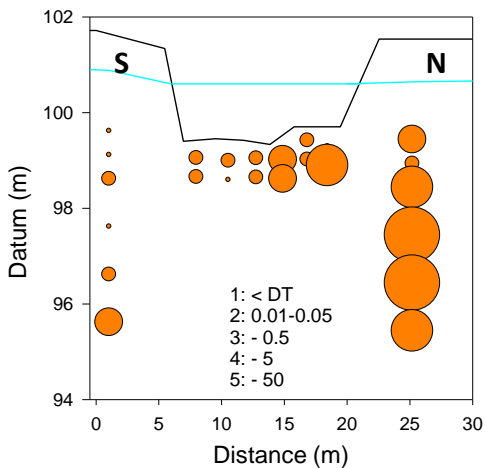
Point Velocity Probe metode

- $Q_{ind} = v \cdot \text{Areal}$
- v = Darcyhastighed fra PVP

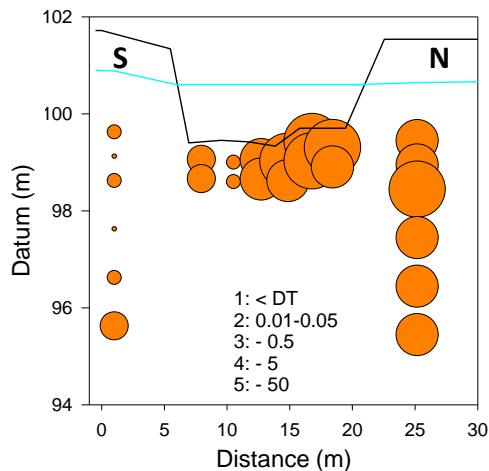


Darcymetode

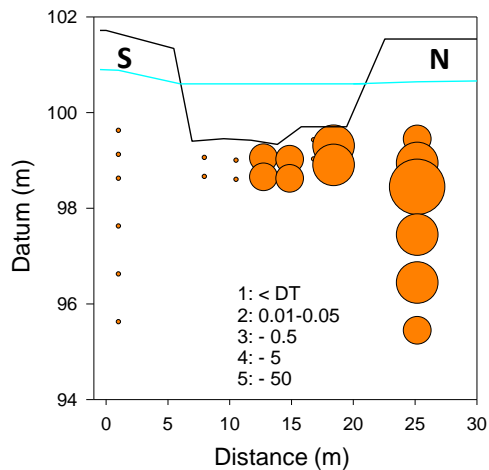
PCE



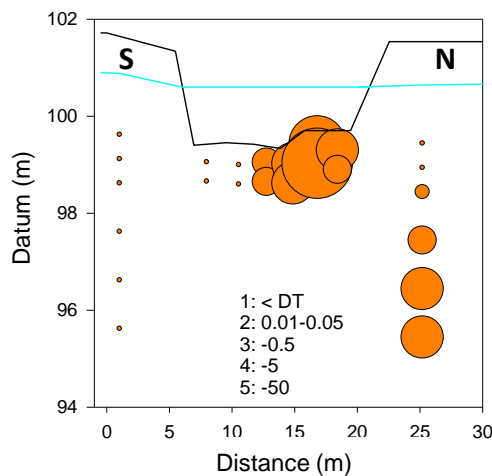
cis-DCE



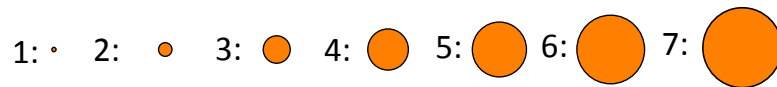
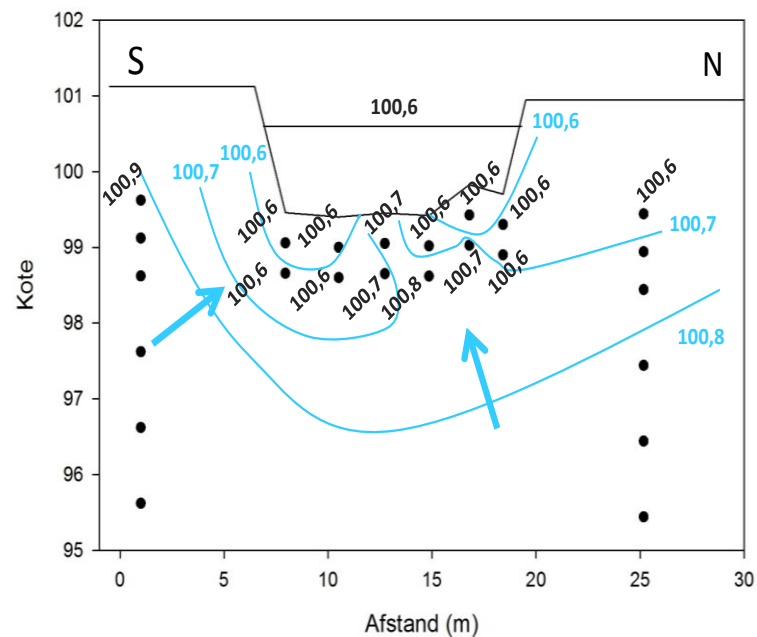
TCE



VC



Strømningsbillede



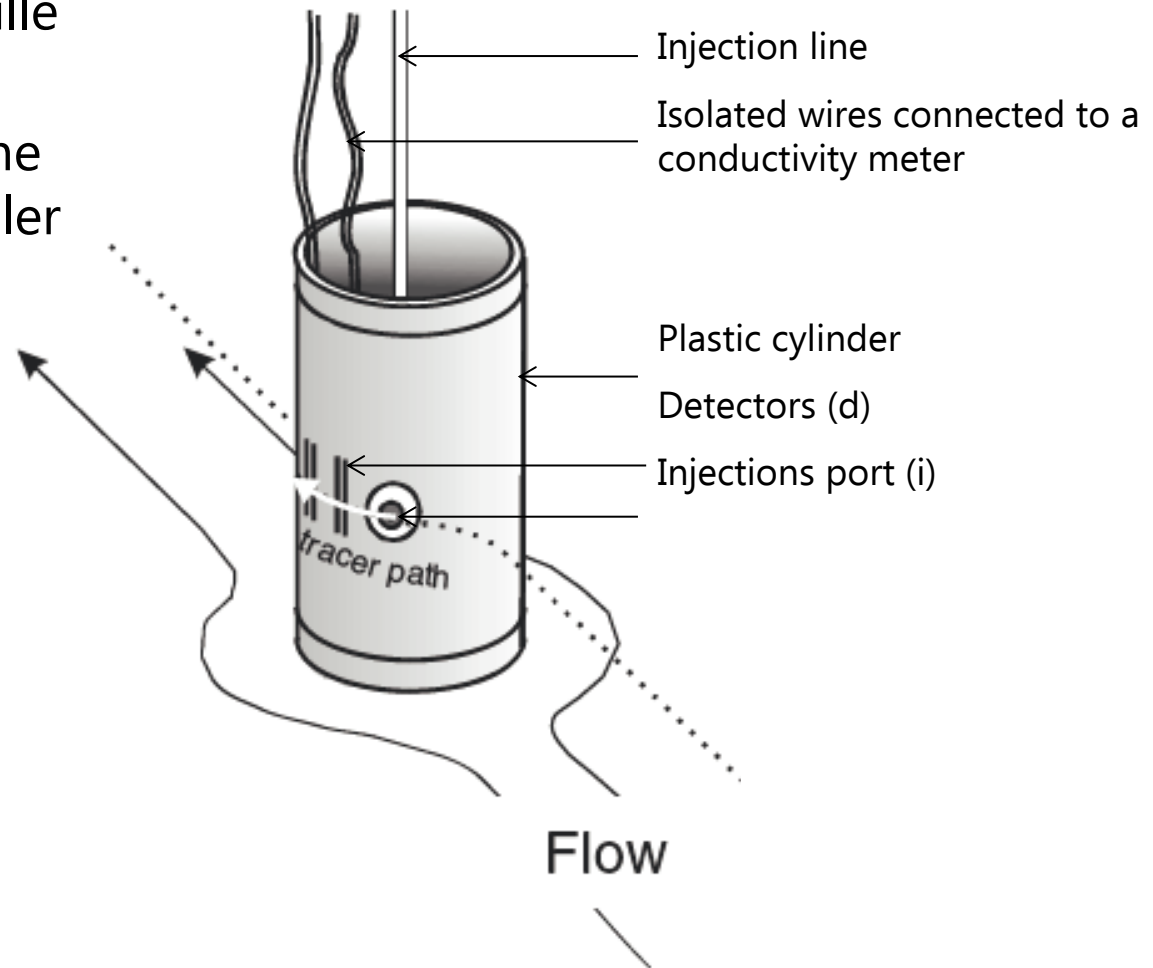
Ex. - **0,5** (PCE) means
the interval from 0,05
to 0,5 $\mu\text{g/L}$

Transect A

The Point-Velocity Probe (PVP)

Rick Devlin, University of Kansas

- Direkte måling af grundvandshastighed på lille skala
- Ikke behov for at bestemme hydraulisk ledningsevne eller hydraulisk gradient

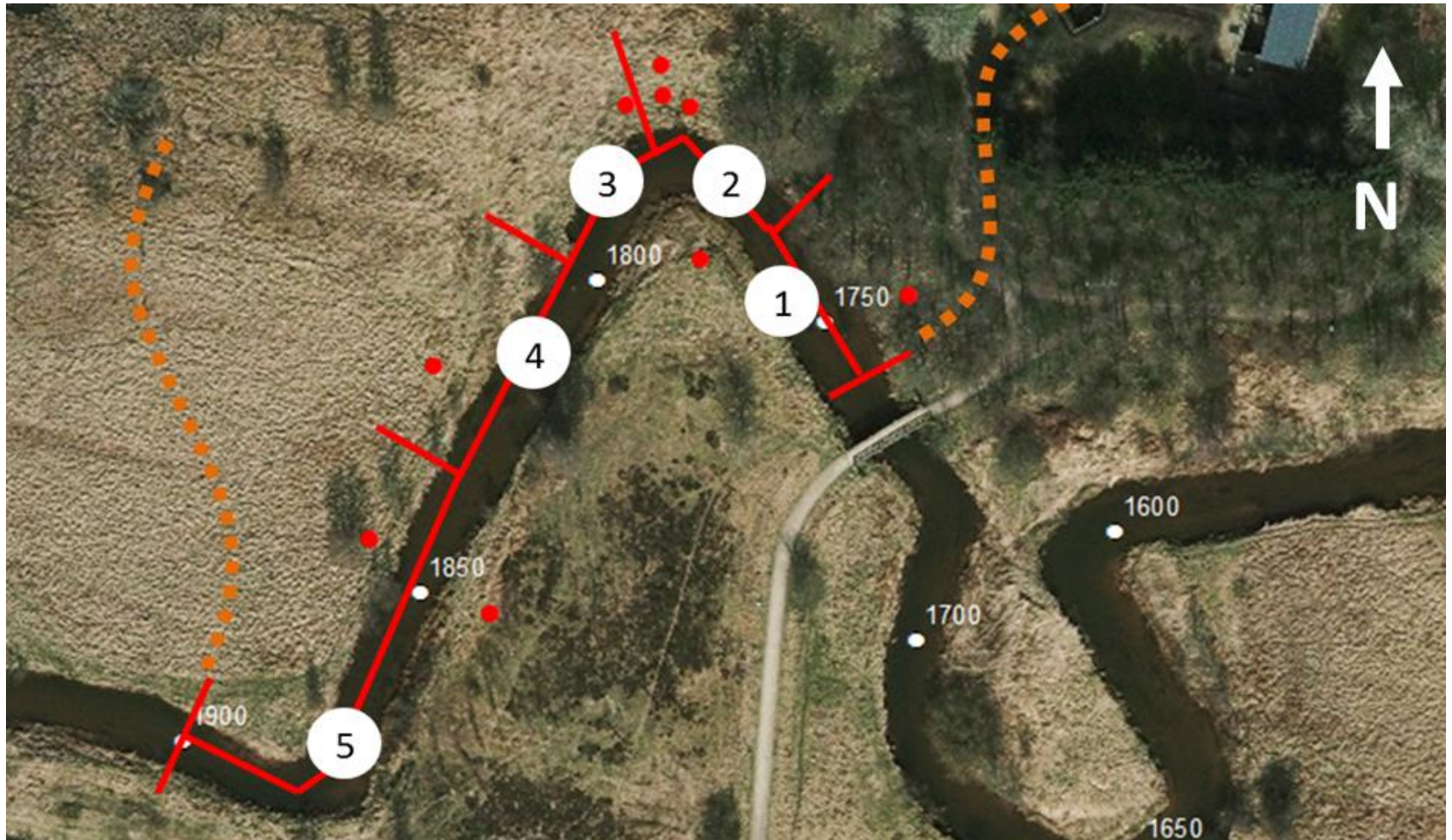


Rønne (2014)

Labaky et al. (2007)



PVP metode: Foreløbig beregning

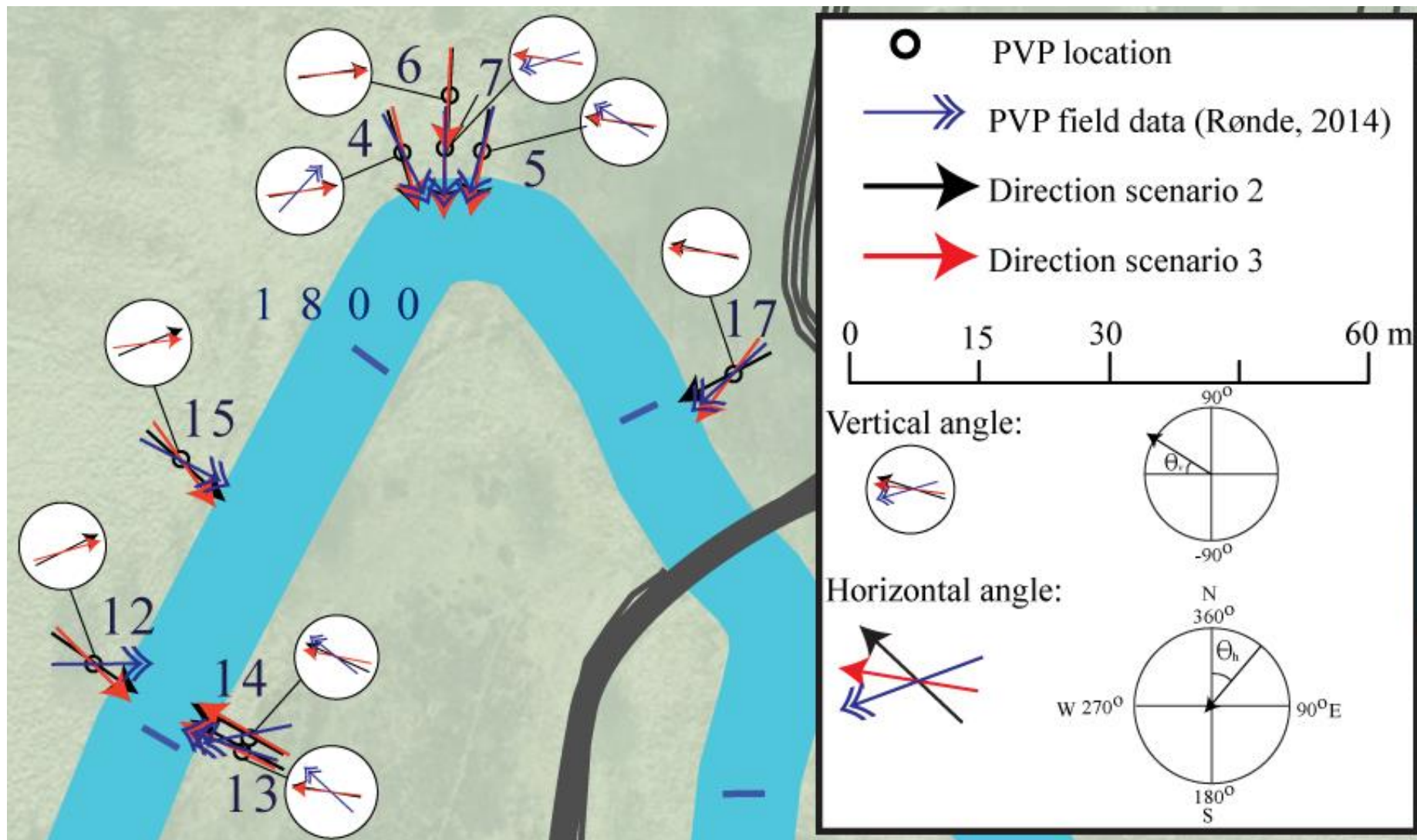


$$J/Q = C_{\text{mix}} \Rightarrow J = C_{\text{mix}} \cdot Q \rightarrow J = \mathbf{250 \text{ kg/år}}$$

PVP approach = **37-48 kg/år**



Feltdata og modelsammenligning: Strømningsretning i specifikke punkter (Nicolajsen, 2014)



GEOCON 2014-2017



Advancing GEOlogical, geophysical and CONtaminant monitoring technologies for contaminated site investigation.

Research institutions



Industry partners



Funding

Danish Council for Strategic Research



Skær der indsigvning af forurening ✓_{NTU}

Hvor og hvor meget?

Er det et problem?



Collaboration

- **Colleagues at DTU Environment**
- **Partners in public authorities, consulting companies and research institutions**

Funding

- **Danish Council for Strategic Research**
- **Region of Southern Denmark**
- **Central Region of Denmark**
- **Capital Region of Denmark**
- **Technical University of Denmark**

REMTEC www.remtec.dk

**Innovative REMediation and assessment TEChnologies
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**Advancing GEOlogical, geophysical and CONTaminant monitoring
technologies for contaminated site investigation (GEOCON)**



Litteratur og links

Danske rapporter

- sara.env.dtu.dk



- www.mst.dk

<http://mst.dk/virksomhed-myndighed/jord/screeningsprincip-for-jordforurening/>

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