Netherlands Organisation for Scientific Research

Waterafstotende Duinbodems:

Van Molecuul toe Ecosysteem

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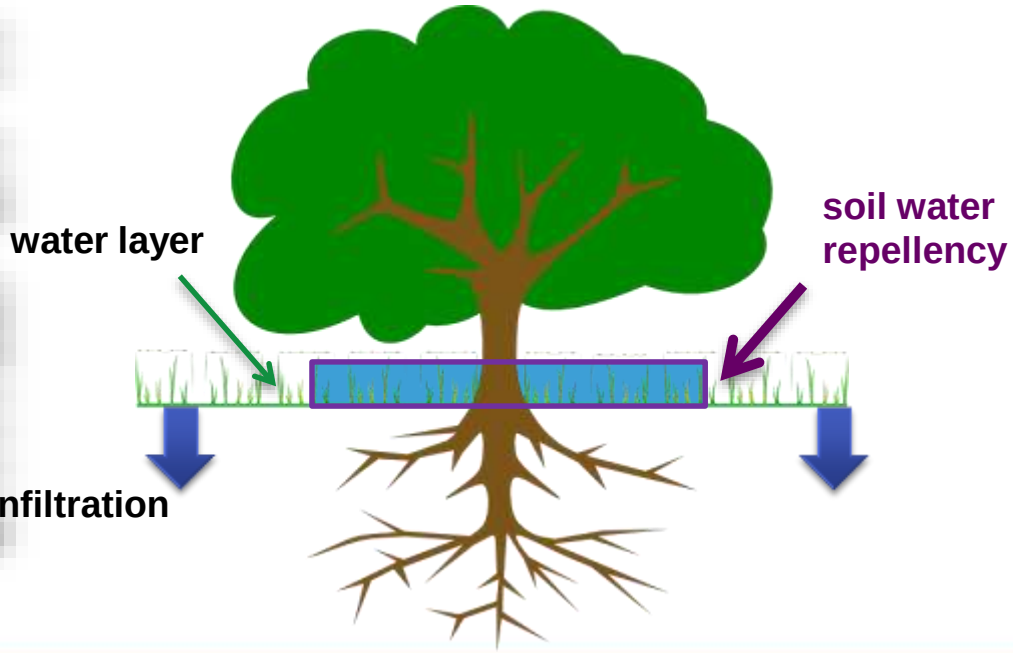
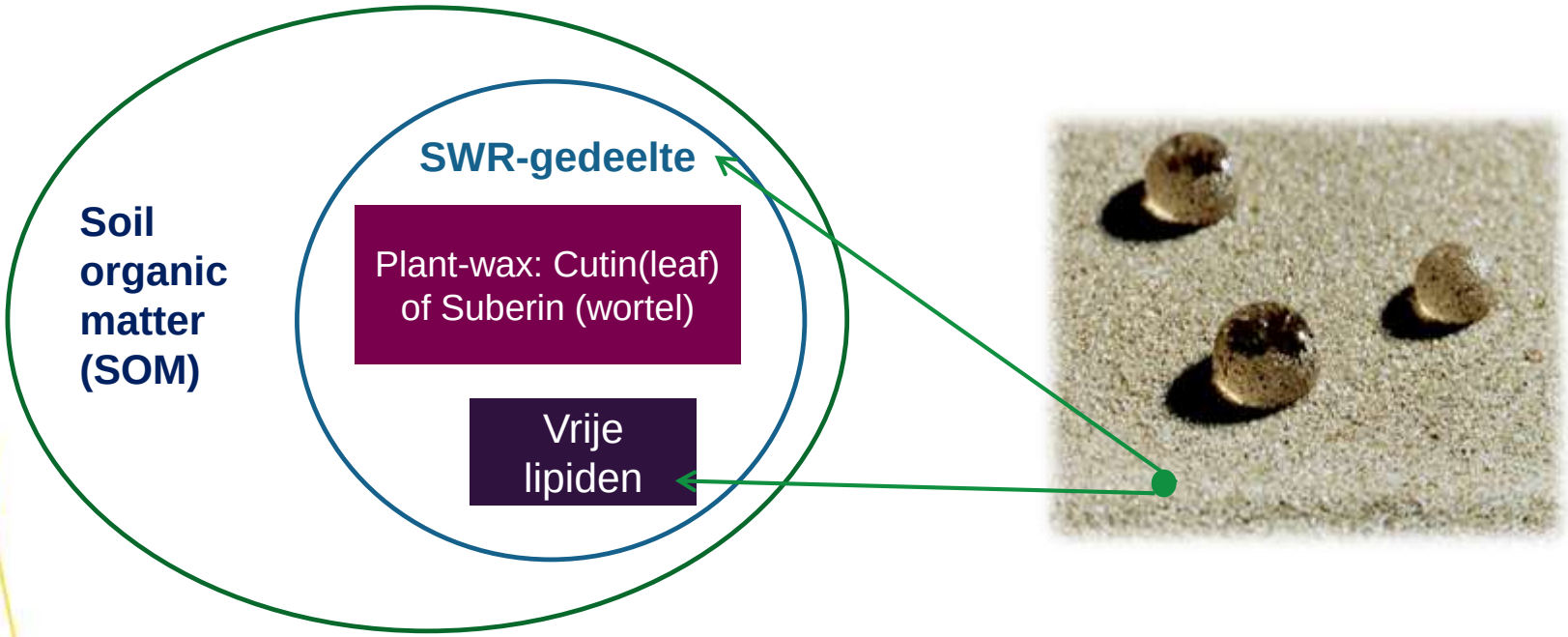
Universiteit Utrecht

Introductie

- Waterafstotende bodems worden overal gevonden.
- Het kan waterinfiltratie voorkomen en zorgen voor erosie en verminderde plantengroei → niet handig van de plant?;
- Afhankelijk van organisch stof, maar welke biomarkers zijn het meest belangrijk?

(Doerr et al., Hydrol. Process. 2007)





Onderzoeksvragen:

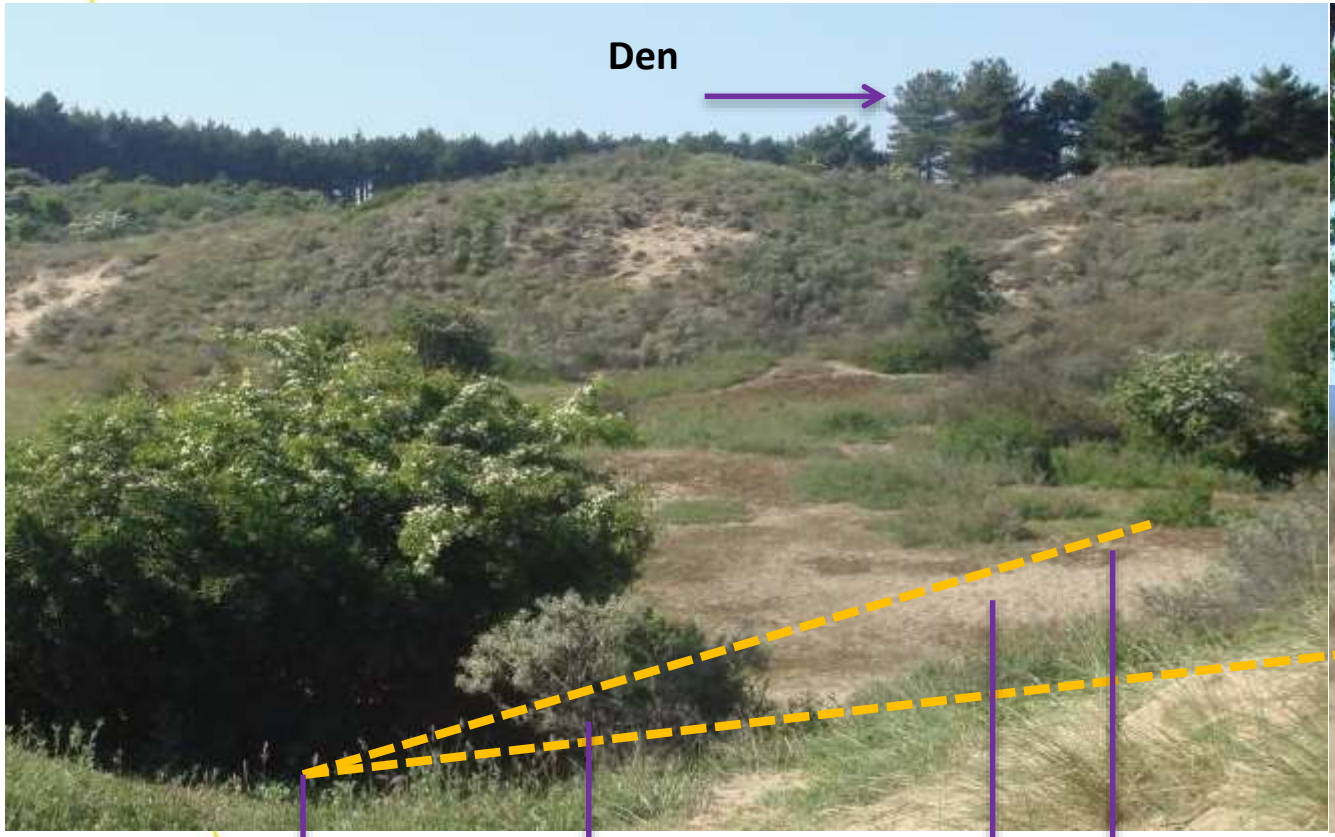
1. SWR-markers: hoe meten?
2. Wat zijn de SWR-markers? vegetatie (blad, wortel), microorganismen
3. Van SWR-marker naar SWR-biomarker?
4. Gevolgen voor ecosysteem?

Field site

National Park Zuid-Kennemerland

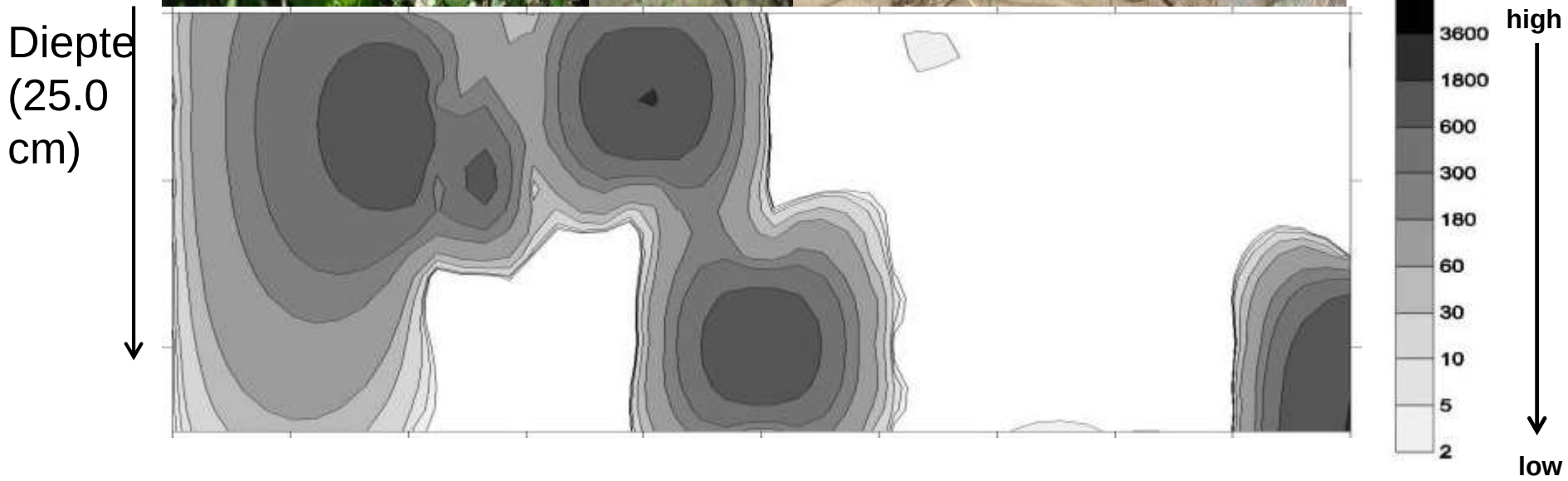
Google Earth

Transecten


Den
Meidoorn
Duindoorn
Algen
Moss ' *Hypnum Lauconosum'*


Eik

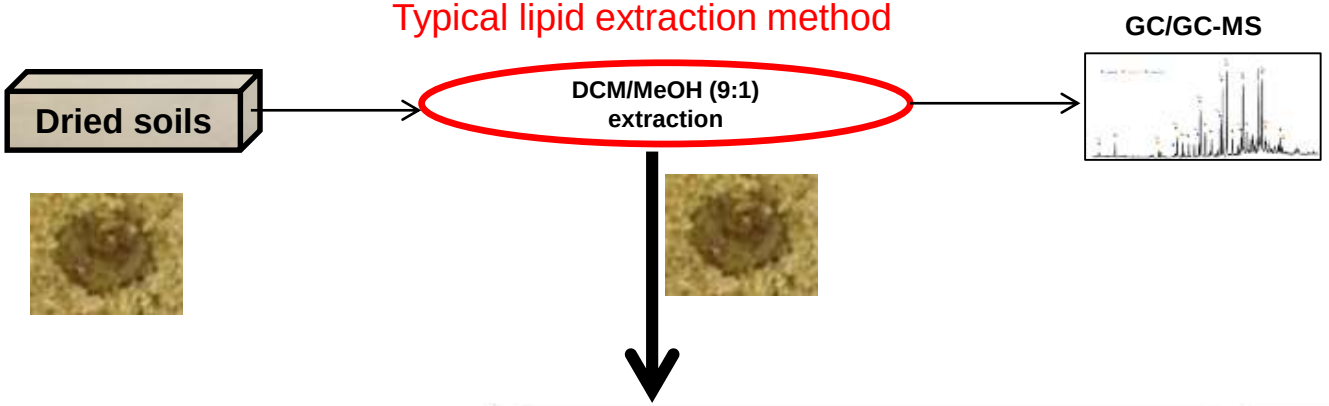

Helm



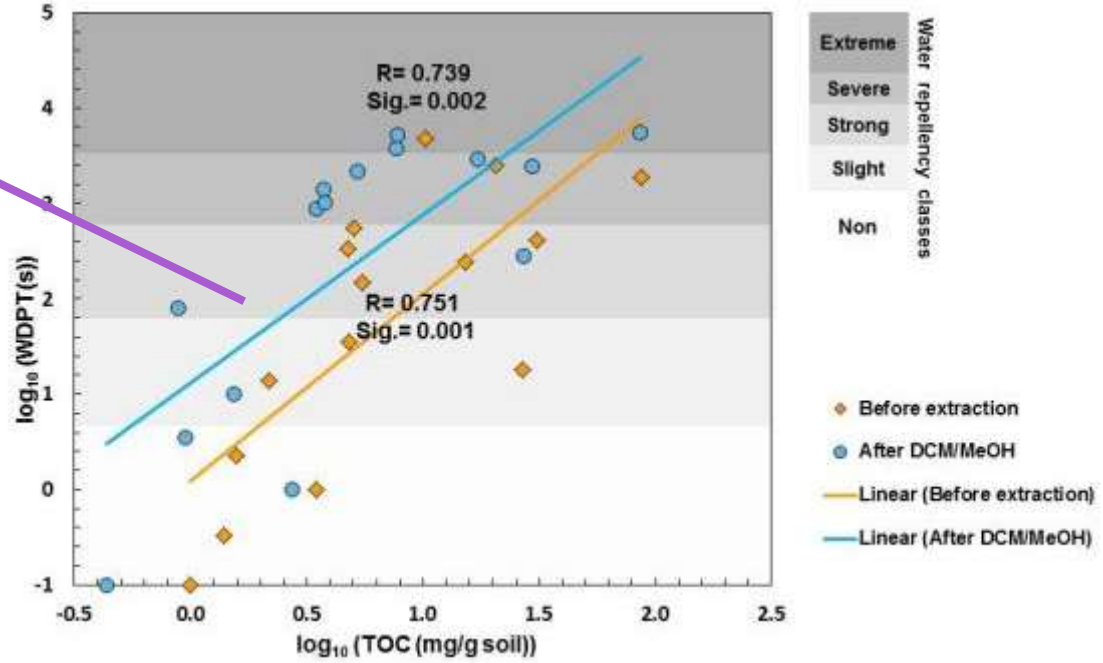
Bodemmonsters zijn verzameld op verschillende dieptes en afstanden

1: SWR-markers hoe meten? Welke bodem-extracties?

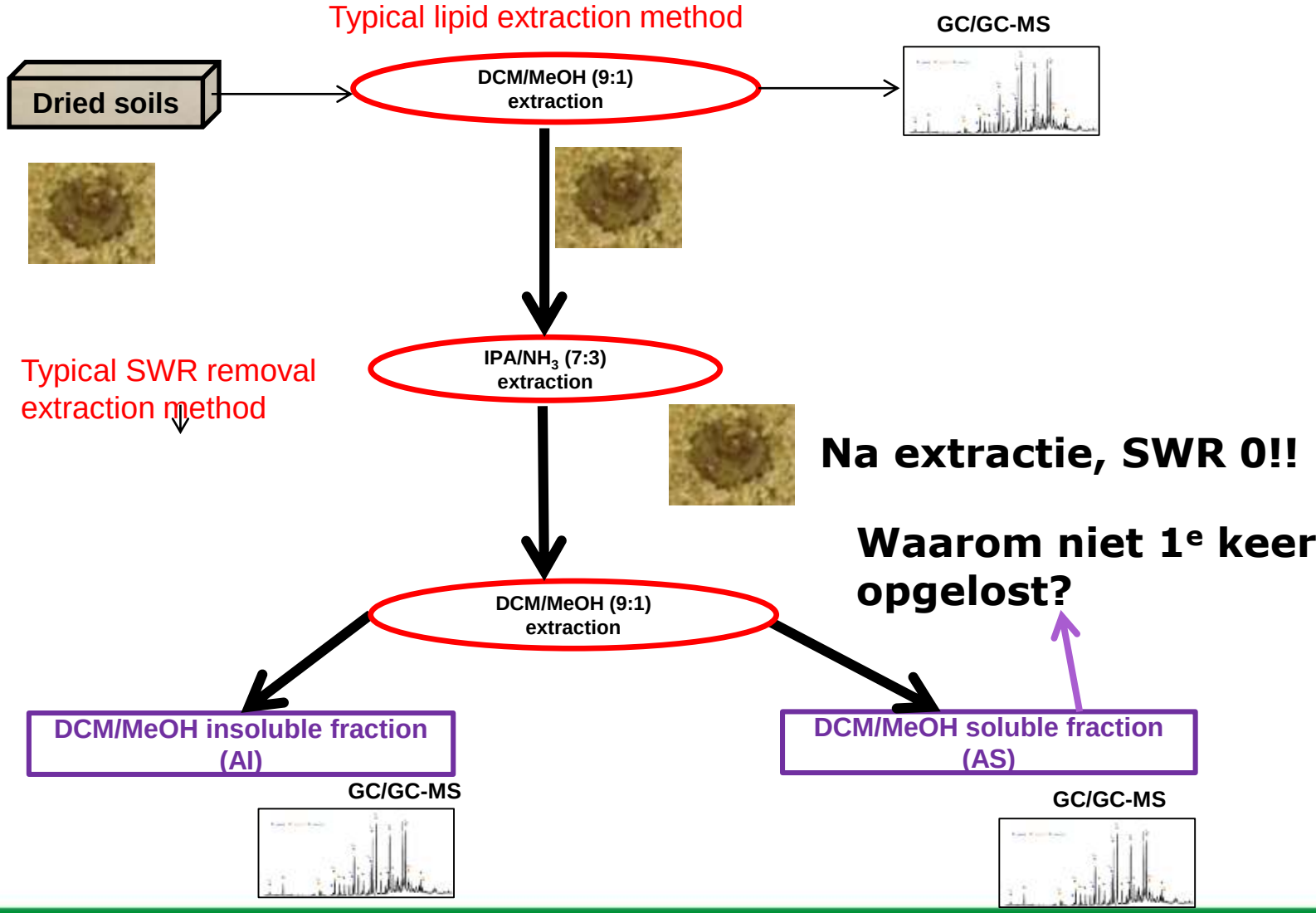
Typical lipid extraction method

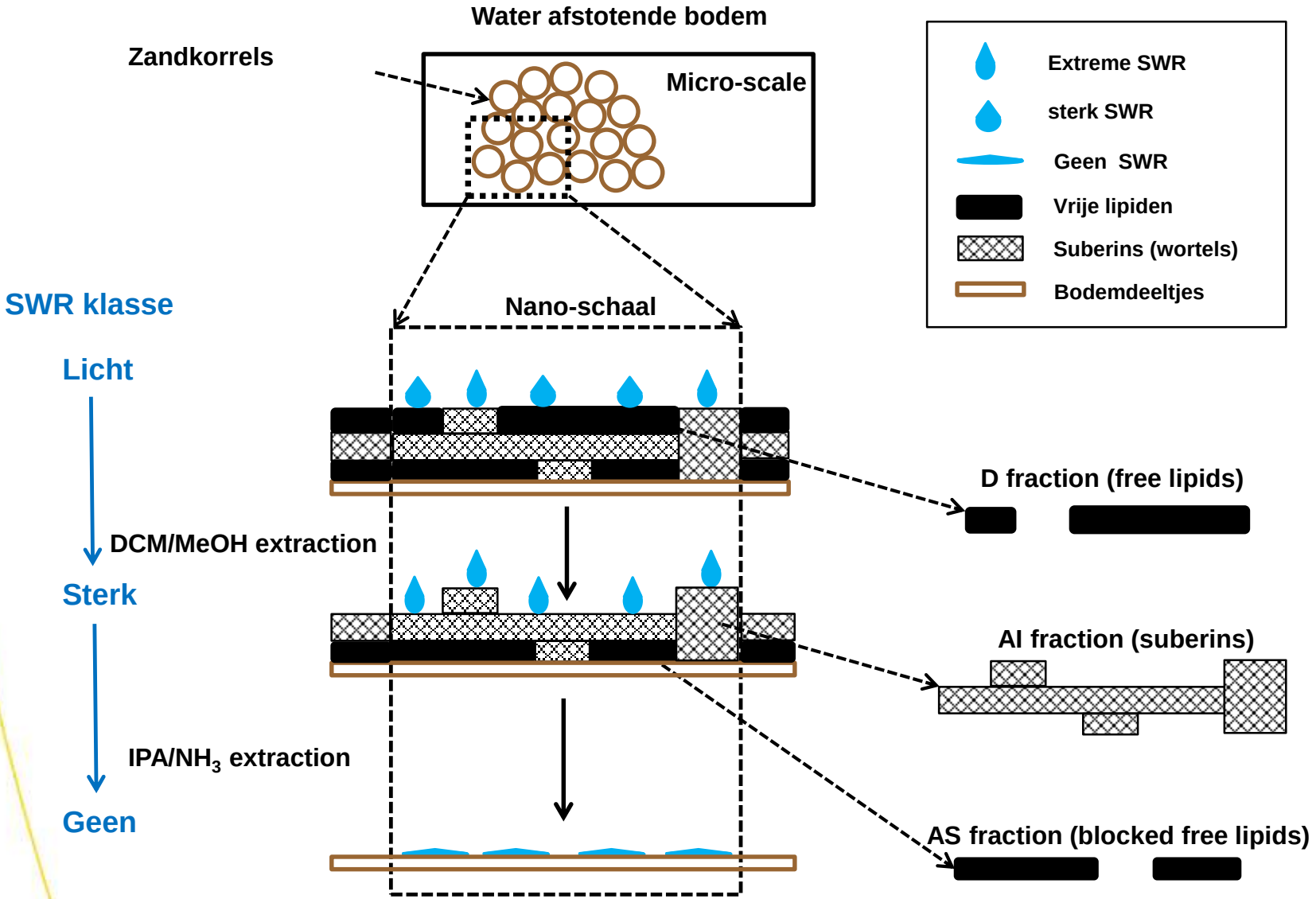


Na extractie, hogere SWR???



1: SWR-markers hoe meten? Welke bodem-extracties?




Water afstotende bodem
Zandkorrels
Micro-scale
Extreme SWR
sterk SWR
Geen SWR
Vrije lipiden
Suberins (wortels)
Bodemdeeltjes
SWR klasse
Licht
Nano-schaal
D fraction (free lipids)
DCM/MeOH extraction
Sterk
AI fraction (suberins)
IPA/NH3 extraction
Geen
AS fraction (blocked free lipids)

2: Wat zijn de SWR-biomakers?

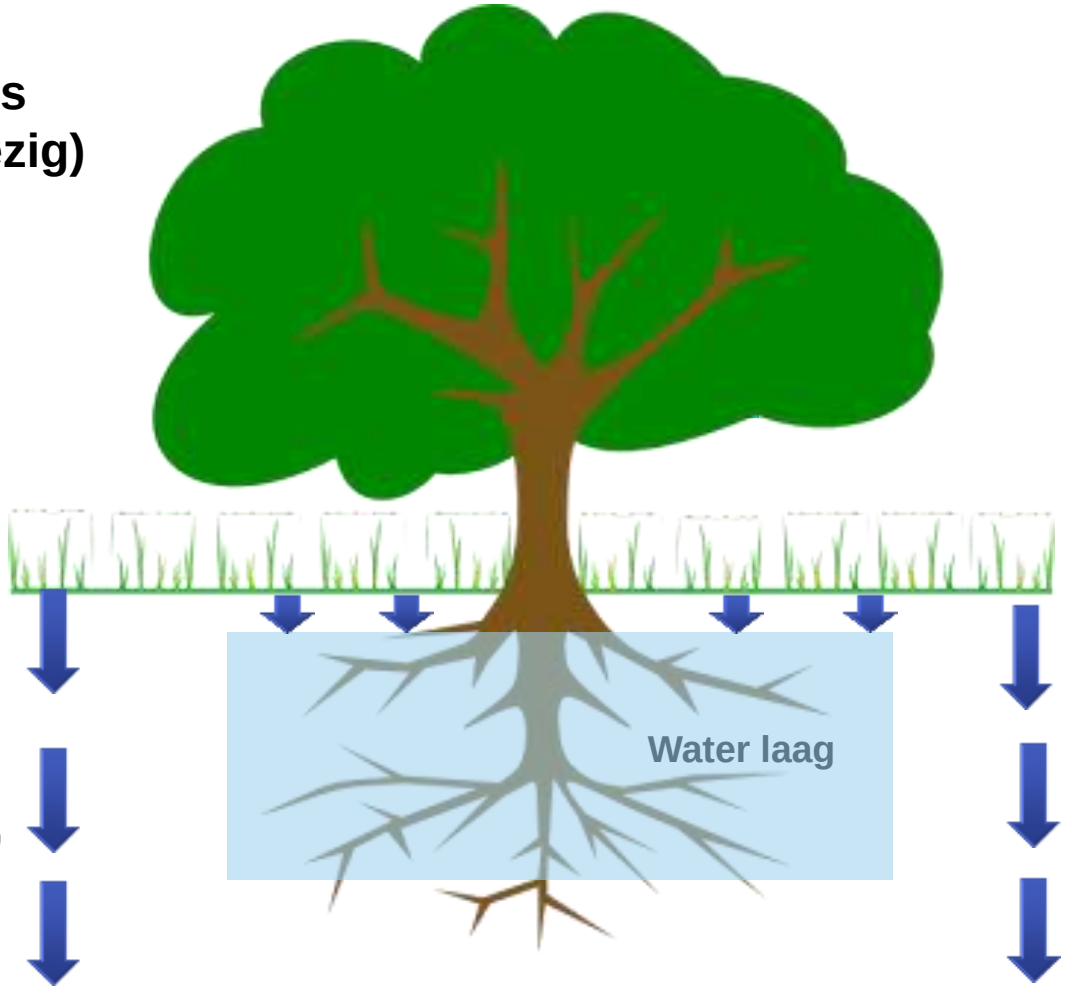
Een klein deel van bodem organisch stof is verantwoordelijk voor SWR

Leaf waxes (meer aanwezig)

Soil water repellency

Wortels (Suberins) (veel sterkere SWR, AI=fractie)

NEW !



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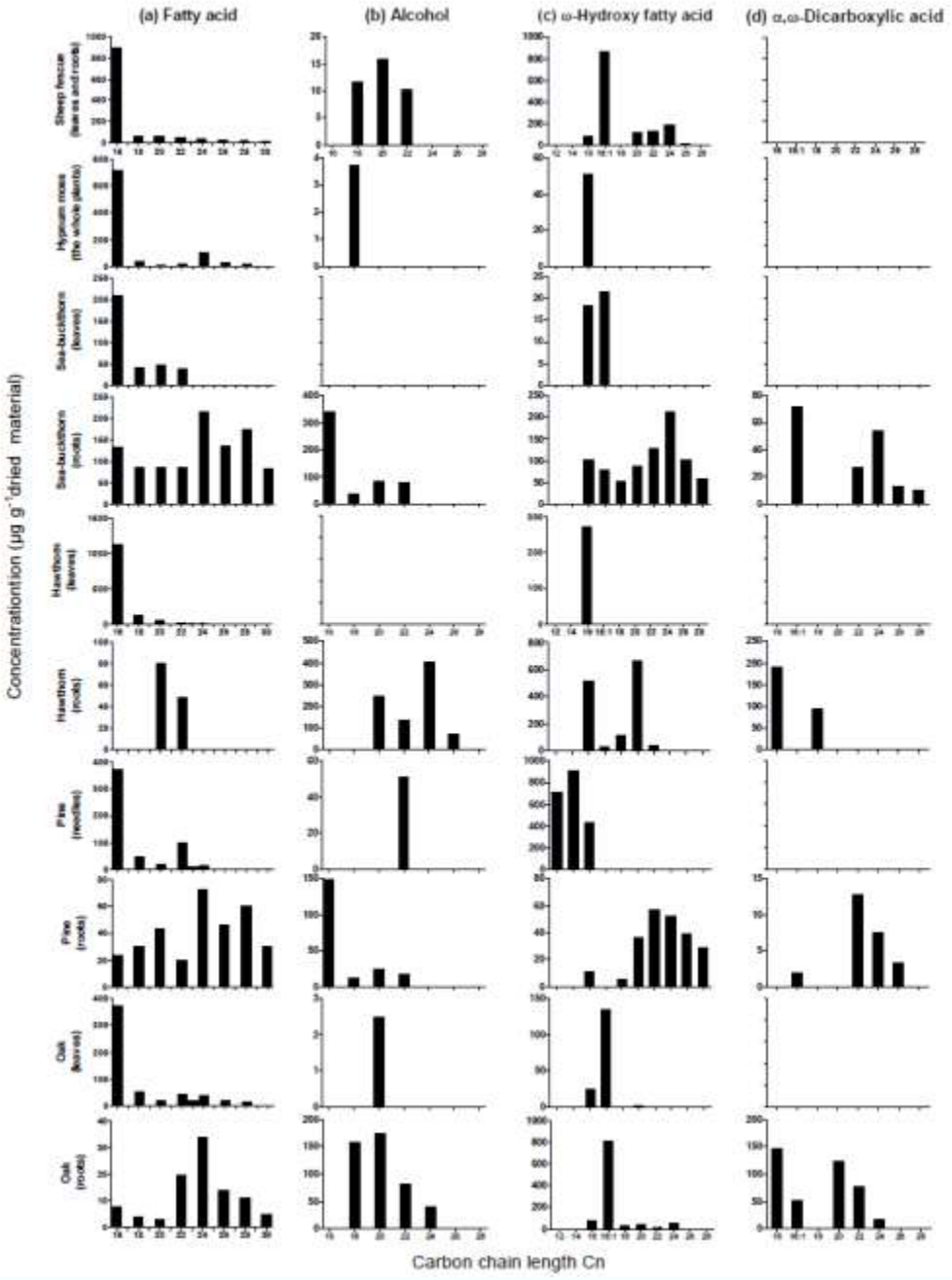
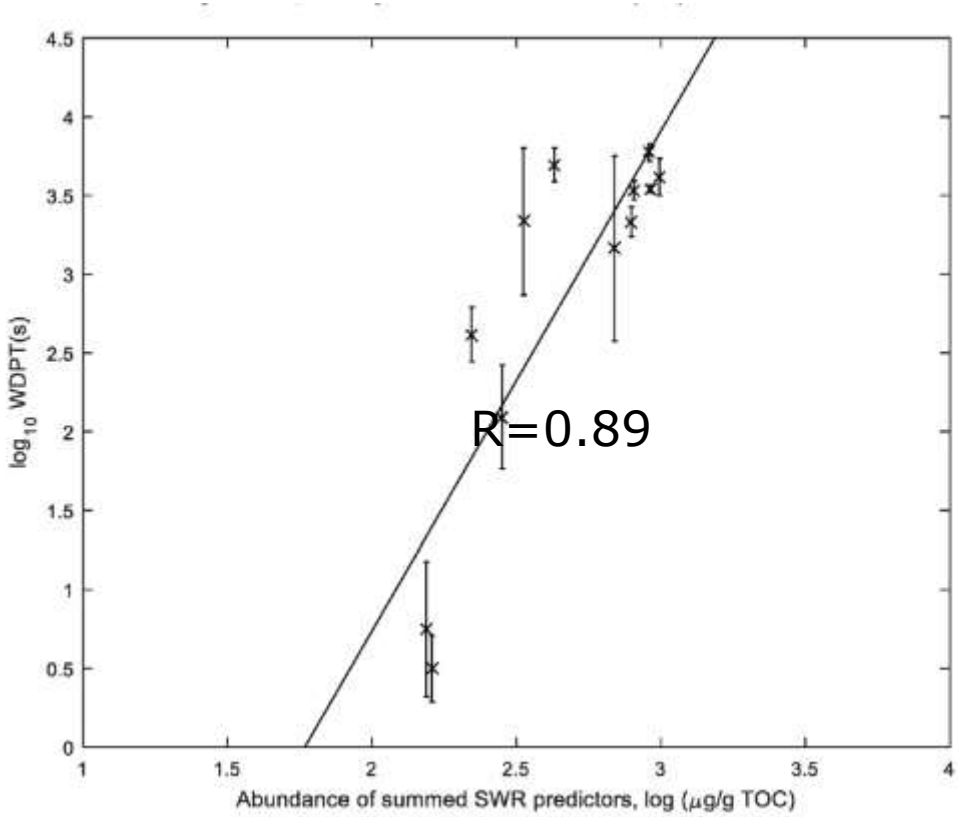
3: Van SWR-makers naar SWR-biomarker

Meest voorkomende SWR-markers in bodem

Via GC/GC-MS



Mao et al. Soil 2015



WDPT test in the lab

Duidelijke relatie tussen meest voorkomende SWR-markers en SWR
Note: ug/g TOC (10^{-6} per gram organisch stof)

Mao et al. Stoten 2016

SWR-markers

Biomarker in vegetatie

Table 6
The left hand part shows the most abundant SWR-markers; the right hand part indicates the main origin of these in plants and biomass types.

SWR-marker signal in soil				Biomarker in vegetation	
SWR-markers name	Profile	Location (m)	Vegetation covering	Biomarker name	Most abundantly found in species
(D) C_{26} alcohol	Topsoil	5	Tufted grass and timothy-grass	Extractable C_{26} alcohol	Leaves of tufted grass and creeping bentgrass
	Topsoil	6	Tufted grass and creeping bentgrass		
(D) C_{24} α,ω-dicarboxylic acid	Topsoil	5	Tufted grass and timothy-grass	Ester-bound C_{24} α,ω-dicarboxylic acid	Roots of red fescue and wood bluegrass
	Topsoil	6	Tufted grass and creeping bentgrass		
(AS) C_{18} alcohol	Topsoil	1	Oak	Ester-bound C_{18} alcohol	Roots of oak
(AS) C_{22} ω-hydroxy fatty acid	Topsoil	6	Tufted grass and creeping bentgrass	Ester-bound C_{22} ω-hydroxy fatty acid	Roots of turfed grass and wood bluegrass
(AS) C_{24} ω-hydroxy fatty acid	Topsoil	4	Wood bluegrass, turfed grass and carex	Ester-bound C_{24} ω-hydroxy fatty acid	Roots of wood bluegrass
(Al) C_{22} ω-hydroxy fatty acid	Topsoil	2	Red fescue, tufted grass and creeping bentgrass	Ester-bound C_{22} ω-hydroxy fatty acid	Roots of turfed grass and wood bluegrass
	Topsoil	4	Wood bluegrass, turfed grass and carex		
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(Al) C_{24} α,ω-dicarboxylic acid	Topsoil	2	Red fescue, tufted grass and creeping bentgrass	Ester-bound C_{24} α,ω-dicarboxylic acid	Roots of red fescue and wood bluegrass

Veel terug te vinden in wortels!

Conclusie: Blokkeren waterinfiltratie vooral in de bodem → voordeel voor vegetatie

Mao et al. Stoten 2016

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Geoderma 232–234 (2014) 328–340

Contents lists available at ScienceDirect

Geoderma

journal homepage: www.elsevier.com/locate/geoderma

Roots induce stronger soil water repellency than leaf waxes

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[c] Department of Marine Organic Biogeochemistry, Royal Netherlands Institute for Sea Research (NIOZ), PO Box 59, 1790 AB Den Burg, The Netherlands

Science of the Total Environment 500–507 (2015) 608–620

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

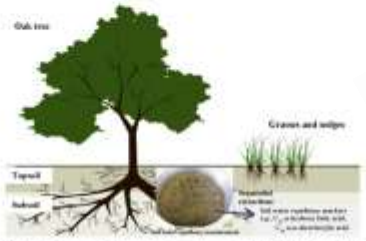
The influence of vegetation on soil water repellency-markers and soil hydrophobicity

Jiefei Mao [a,b,*], Klaas G.J. Nierop [b], Max Rietkerk [a], Jaap S. Sinninghe Damsté [b,c], Stefan C. Dekker [a]

HIGHLIGHTS

- Covering plant species primarily influences soil water repellency and its markers.
- Single long-chain soil water repellency (SWR)-markers positively correlate to SWR.
- Root-derived ω-hydroxy fatty acids and α,ω-dicarboxylic acids predict SWR well.
- The corresponding biomarkers of the SWR predictors are abundant in grass roots.
- Grass roots mainly contribute to the organic matter in topsoils leading to strong SWR.

GRAPHICAL ABSTRACT



Graphical abstract shows that in an ecosystem with oak, grasses and sedges, the roots of vars. tribute differently in the top- and subsoils. The soil water repellency was measured using wate. time test. The soils were extracted sequentially and soil water repellency markers, e.g., C_{22} ω-h, and C_{24} α,ω-dicarboxylic acid, were observed mainly derived from plants.

SOIL

SOIL, 1, 411–425, 2015
www.soil-journal.net/1/411/2015/
doi:10.5194/soil-1-411-2015

Predicting soil water repellency using hydrophobic organic compounds and their vegetation origin

J. Mao[1,2], K. G. J. Nierop[2], M. Rietkerk[1], and S. C. Dekker[1]

4: Gevolgen voor Ecosyteem?

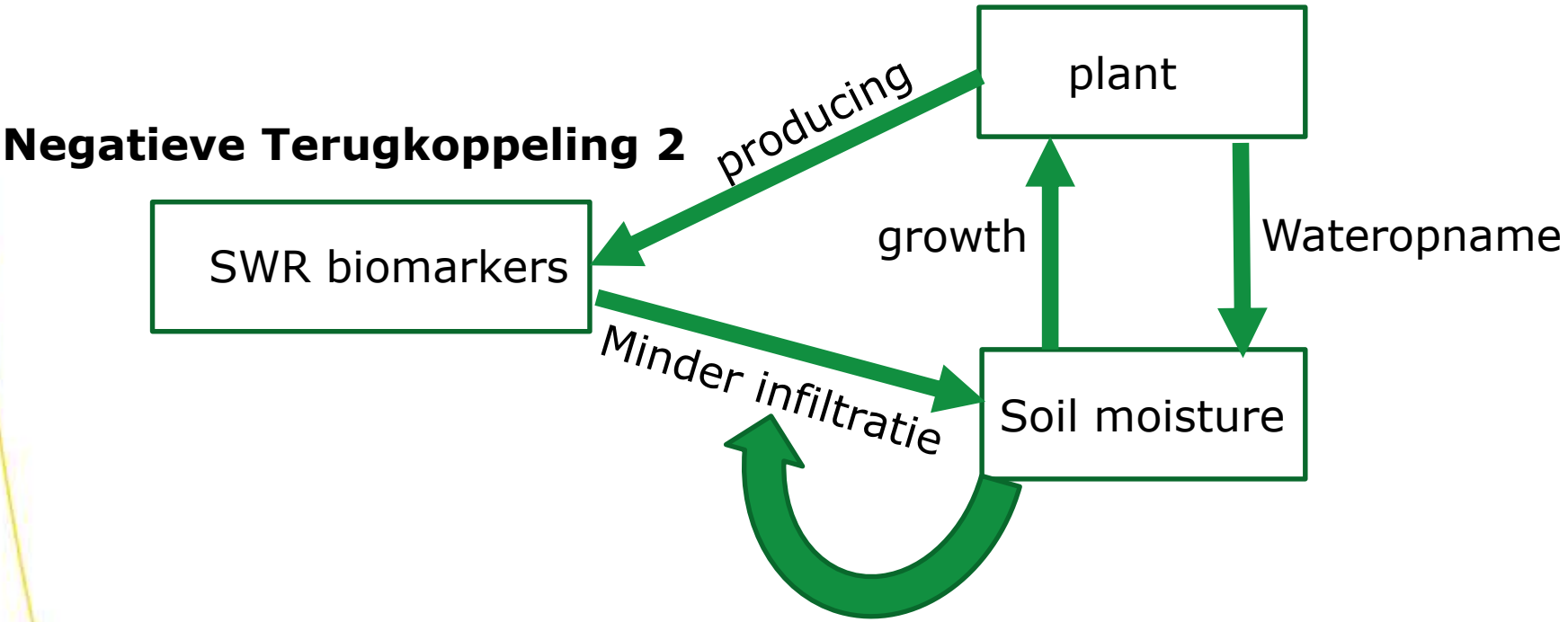
Ecosystems (2016) 19: 1210–1224
DOI: 10.1007/s10021-016-9995-9

ECOSYSTEMS

Soil Water Repellency: A Potential Driver of Vegetation Dynamics in Coastal Dunes

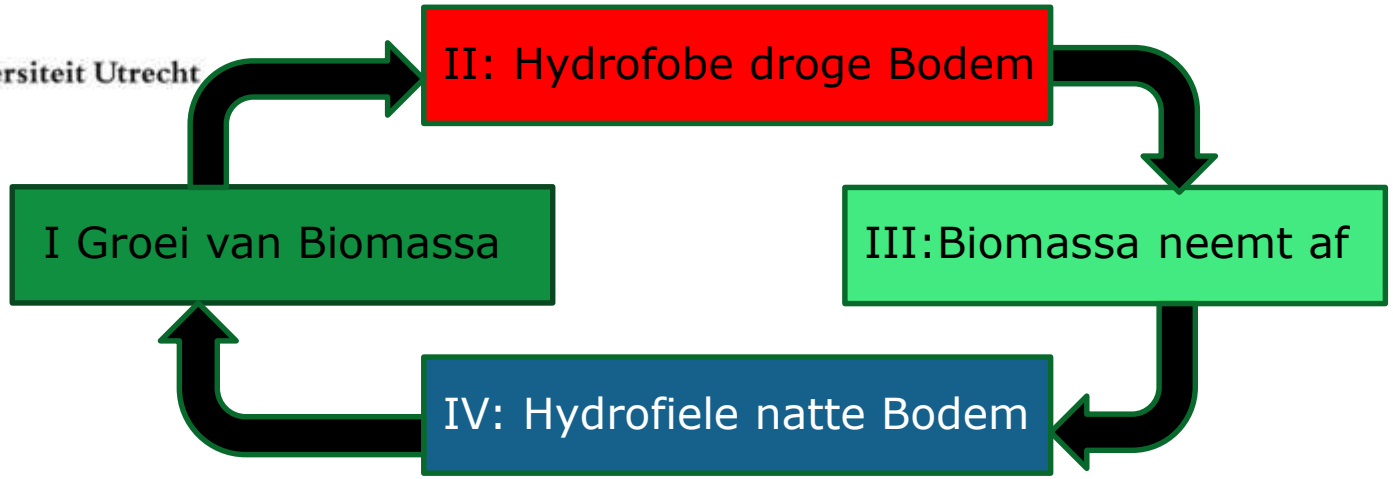
Koen Siteur,[1]* Jiefei Mao,[1,2] Klaas G. J. Nierop,[2] Max Rietkerk,[1] Stefan C. Dekker,[1] and Maarten B. Eppinga[1]

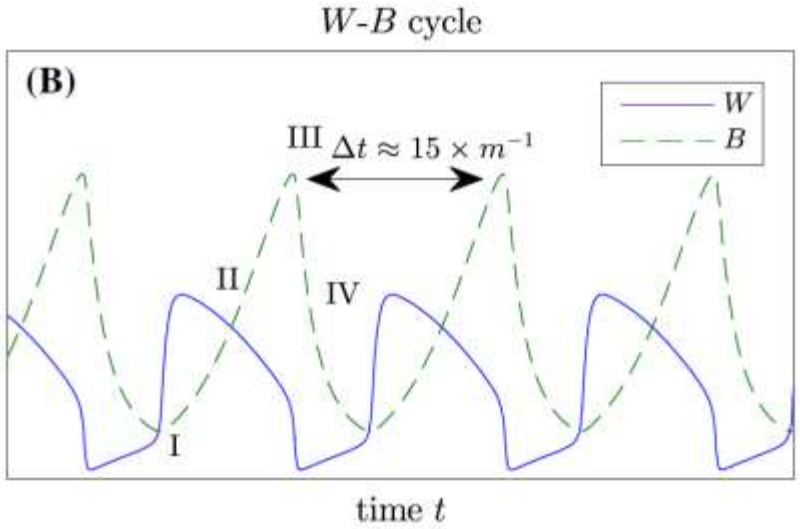
Negatieve Terugkoppeling 1



Positieve Terugkoppeling 1
Bij natte bodems → hydrofiel

- Processen: niet of zelfde tijdschaal.
- Locking: als droog dan blijft droog, tot ineens natte periode





Cyclische ontwikkeling:
Biomassa (B)
watergehalte (W)

Conclusies

1. **SWR-markers: hoe meten?**
   - Via nieuw extractie-schema
   - Hoe met kleiige bodems?
2. **Wat zijn de SWR-markers?**
   - Meest sterke SWR markers zijn de suberins (wortels)
   - Fractie van totale organisch stof
3. **Van SWR-marker naar SWR-biomarker?**
   - SWR-biomarkers in wortels van eik, en vele soorten gras.
4. **Gevolgen voor ecosysteem?**
   - Mogelijkheid tot cyclische ontwikkeling van biomassa