



# FUTMON

## Bodemvocht kwaliteit en element budgetten

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## Inhoud

- Protocol van bemonstering en analyses bodemvocht
- Verbeterde bemonsteringsstrategie en gegevensverwerking
- Rapportage van gegevens aan EU
- Effect van nieuwe strategie op elementfluxen





## Protocol bemonstering

- United nations economic commission for europe convention on long-range transboundary air pollution.  
**International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests**
  - *Manual on methods and criteria for harmonized sampling, assessment, monitoring and analysis of the effects of air pollution on forests*
    - Part IV Sampling and Analysis of Needles and Leaves
    - Submanual on soil solution collection and analysis



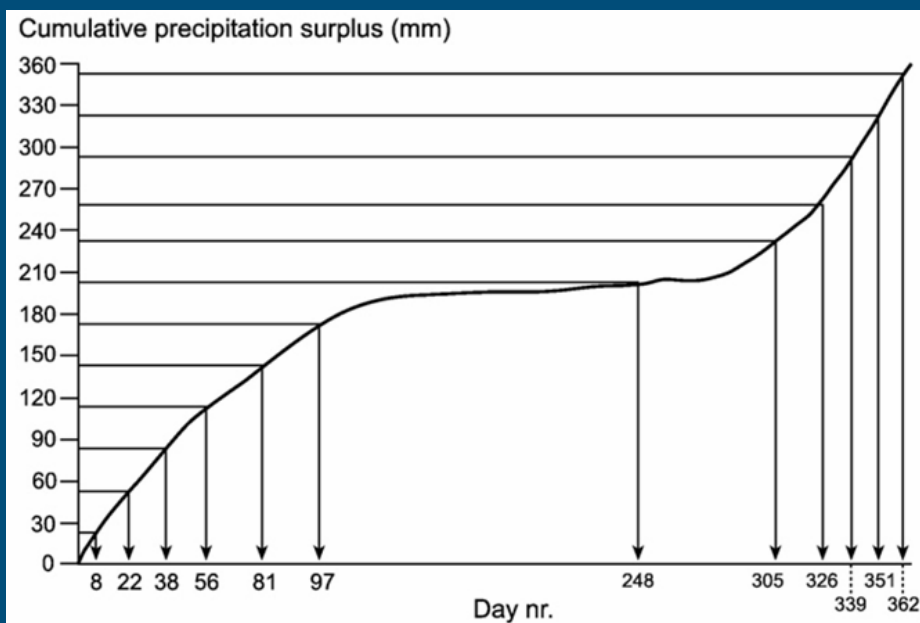
## Protocol bemonstering

- De methoden voor bodemvocht zijn niet geheel voorgeschreven.  
**Hiervoor heeft Nederland een methode ontwikkeld waarmee de onzekerheid in de elementbudgetten berekend kan worden.**
  - Brus et al. 2010. *sampling strategy for estimating plot average annual fluxes of chemical elements from forest soils*. Geoderma.



# Protocol

“elke maand”: afhankelijk van gemiddelde neerslag



# Bemonstering blad op 5 locaties





# Bemonstering blad

- Levels I and II plots:
  - mandatory: N, S, P, Ca, Mg and K
  - optional: Zn, Mn, Fe, B, Pb, Cu, Cd and C

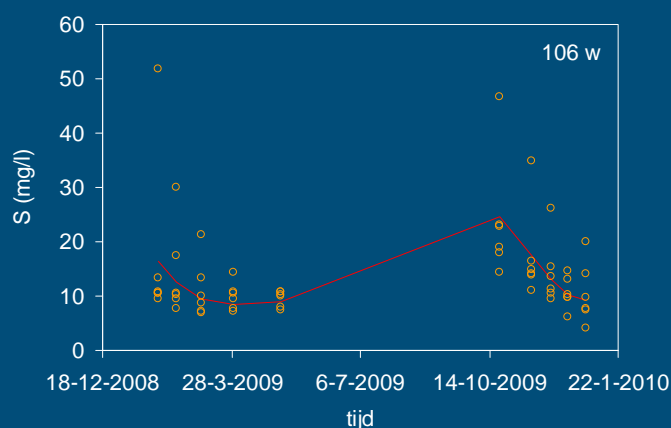
# Bemonstering bodemvocht op 2 locaties



## ■ Levels I and II plots:

- mandatory: pH, EC, K, Ca, Mg, NO<sub>3</sub>, SO<sub>4</sub>, HCO<sub>3</sub>, Al, DOC
- optional: Na, Al<sub>labile</sub>, Fe, Mn, P, NH<sub>4</sub>, Cl, Cr, Ni, Zn, Cu, Pb, Cd, Si

## Voorbeeld van data

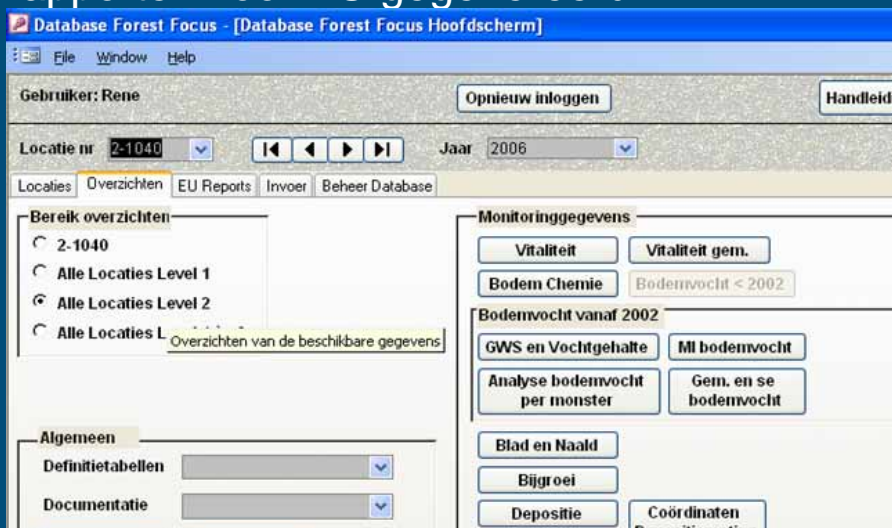


- De gemiddelde worden aan EU aangeleverd.

# Protocol database



- Data zijn verzameld in Forest Focus database (bevat NL data)
  - Hiermee zijn rapporten voor EU gegenereerd



# Element fluxen



- Verbeterde bemonsteringsstrategie: geeft onzekerheid in de elementbudgetten.
  - De Vries et al. 2010. *Impacts of design and estimation methods on nutrient leaching of intensively monitored plots in the Netherlands*. Journal of Environmental Monitoring.



# Element fluxen

## Flux 2003-2005 afhankelijk van methode

element	depth	Hardenberg (Douglas)		Zeist (Eik)		Dwingeloo (Grove den)	
		nieuw	referentie	nieuw	referentie	nieuw	referentie
SO4	15	21 (2)	30	13.1 (0.5)	15.3	8.3 (0.3)	7.8
	80	35 (4)	28	8.1 (0.2)	7.79	3.9 (0.6)	4.8
NO3	15	28 (1)	28	23 (2)	32	2 (1)	4
	80	21 (2)	21	9 (2)	18	1 (1)	1
NH4	15	0.93 (0.06)	1.0	0.66 (0.09)	0.90	0.35 (0.09)	0.92
	80	0.09 (0.02)	0.14	1.2 (0.5)	3.3	0.8 (0.3)	0.64
Al	15	22 (2)	27	14.7 (0.6)	16.3	8.6 (0.4)	8.1
	80	35 (2)	30	6.2 (0.1)	5.8	1.7 (0.4)	2.4
Ca	15	9.7 (0.5)	9.9	11.9 (0.8)	16	3 (1)	3
	80	3.7 (0.2)	3.6	1.9 (0.1)	3.0	2.3 (0.8)	1.7
Mg	15	7.6 (0.4)	7.8	7.1 (0.5)	9.1	3.8 (0.3)	3.7
	80	5.9 (0.3)	5.3	3.8 (0.1)	3.7	1.0 (0.2)	0.9

Nauwkeurigheid.... is heel goed



# Elementbudgetten: depositie en uitspoeling

	Flux kg ha <sup>-1</sup> j <sup>-1</sup>	Hardenberg	Zeist	Dwingeloo
SO4-S	Total deposition	19	16.5	15.1
	Bodem uitspoeling	36	8.1	3.9
	<b>Total Budget</b>	<b>-17</b>	<b>8.5</b>	<b>11.2</b>
NO3-N	Total deposition	14	6	12
	Bodem uitspoeling	21	8	1
	<b>Total Budget</b>	<b>-7</b>	<b>-2</b>	<b>11</b>
NH4-N	Total deposition	30.9	24.6	31.9
	Bodem uitspoeling	0.1	1.2	0.8
	<b>Total Budget</b>	<b>30.8</b>	<b>23.4</b>	<b>31.1</b>
Al	Bodem uitspoeling	35.2	6.2	1.7
Ca	Total deposition	12.2	3.6	6.5
	Bodem uitspoeling	3.8	1.9	2.3
	<b>Total Budget</b>	<b>8.4</b>	<b>1.7</b>	<b>4.3</b>
Mg	Total deposition	6.6	3.6	5.7
	Bodem uitspoeling	6	3.8	1
	<b>Total Budget</b>	<b>0.6</b>	<b>-0.2</b>	<b>4.7</b>

30.9

↓

+

30.8

↓

0.1

Uitspoeling Al: voortgang van verzuring!





- Bemonstering, analyses en dataverwerking
- Deelname in ringonderzoeken voor de analyses
- Publicaties:
  - De Vries, Wieggers en Brus 2010. *Impacts of sampling design and estimation methods on nutrient leaching of intensively monitored forest plots in the Netherlands*. J. of Env. Mon.
  - Brus, De Gruijter en De Vries. 2010. *sampling strategy for estimating plot average annual fluxes of chemical elements from forest soils*. Geoderma.
  - Van Dobben & De Vries 2000. *Relation between forest vegetation, atmospheric deposition and site conditions at regional and European scales*. Env. Poll.



## Afsluiting

De Vries et al 2010

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RSC Publishing

de Vries et al.  
Nutrient leaching  
Hilborn et al.  
Heavy metals

Song et al.  
Rare earth element environmental  
geochemistry  
Cagnoli et al.  
Exposure to Cd/Cr/Cu/Fe quantum dots



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