Restoring depleted soil minerals to stop biodiversity loss in dry heathlands?

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ONDERZOEKCENTRUM B ware

BODEMBERGSMA

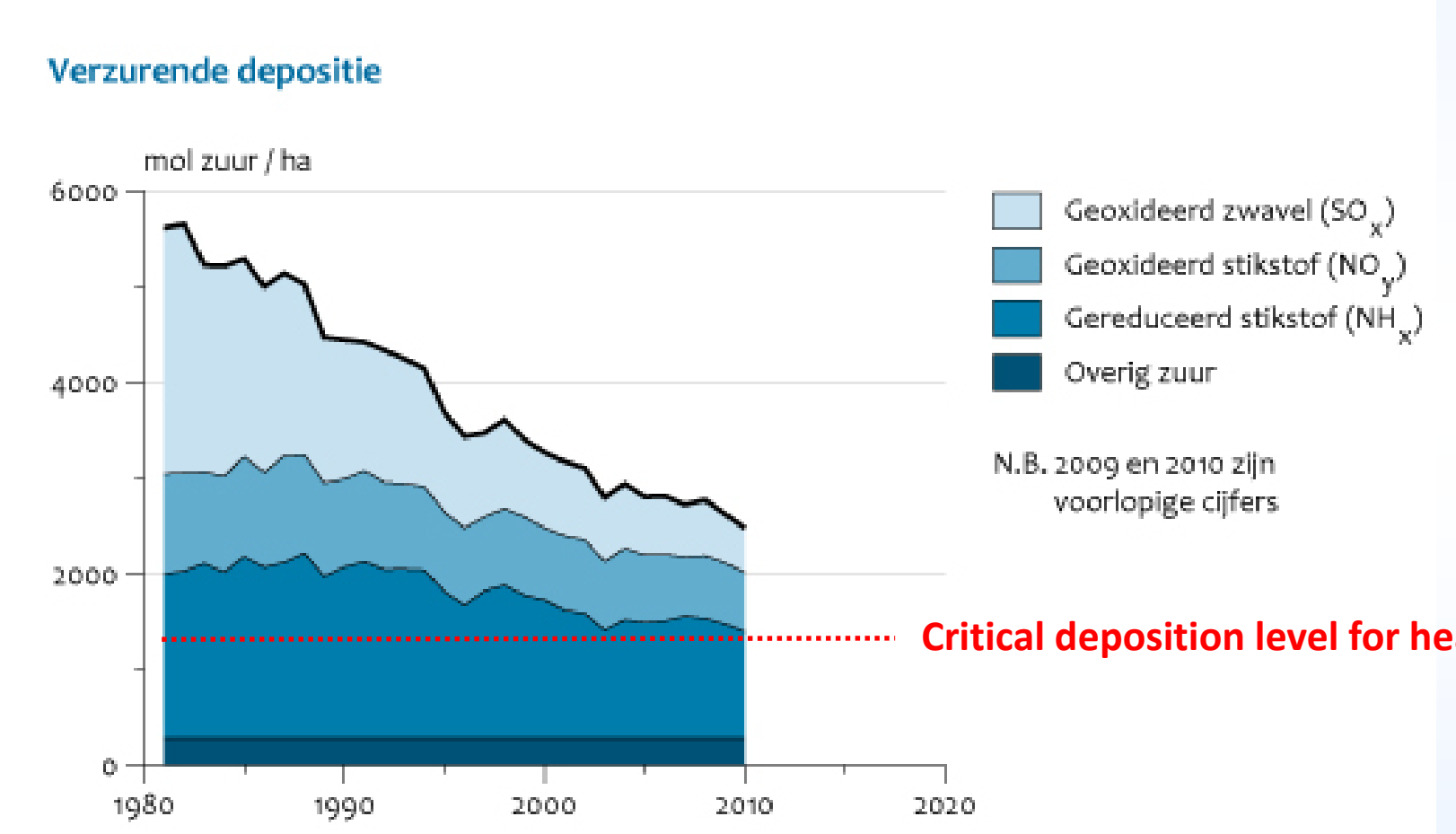
Stichting Bargerveen for ecosystem restoration

Rock dust addition in heathlands

- Why – Problems and causal mechanisms
- How – Practical ways of application
- What - Where are we now what is our current state of knowledge

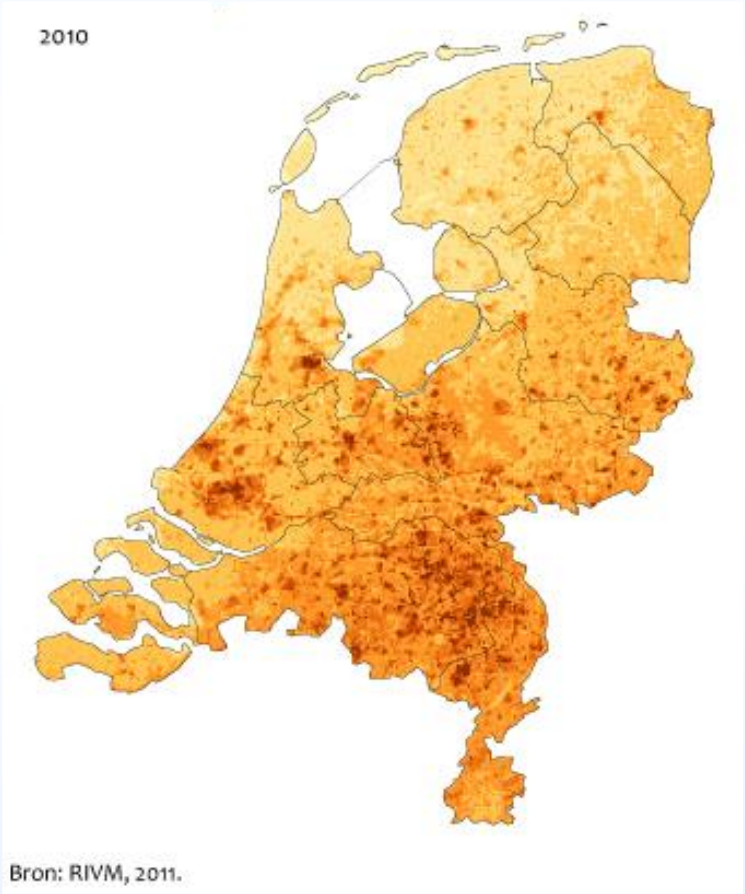
Lowland heathlands: biodiversity in decline

Average acid deposition in 2010

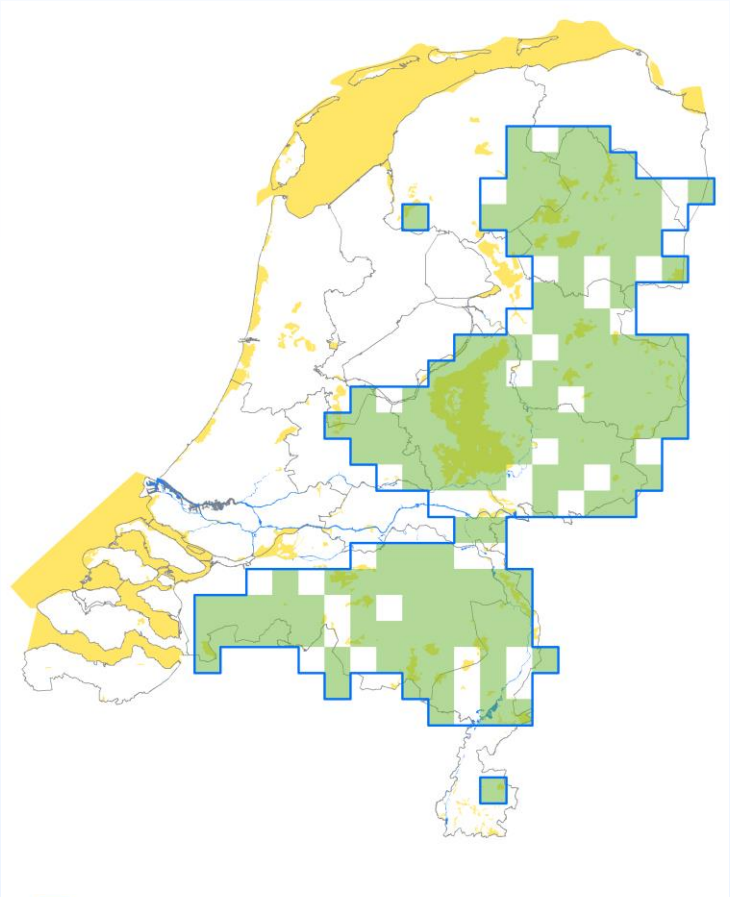


RIVM, 2011 / www. compendiumvoordeleefomgeving.nl

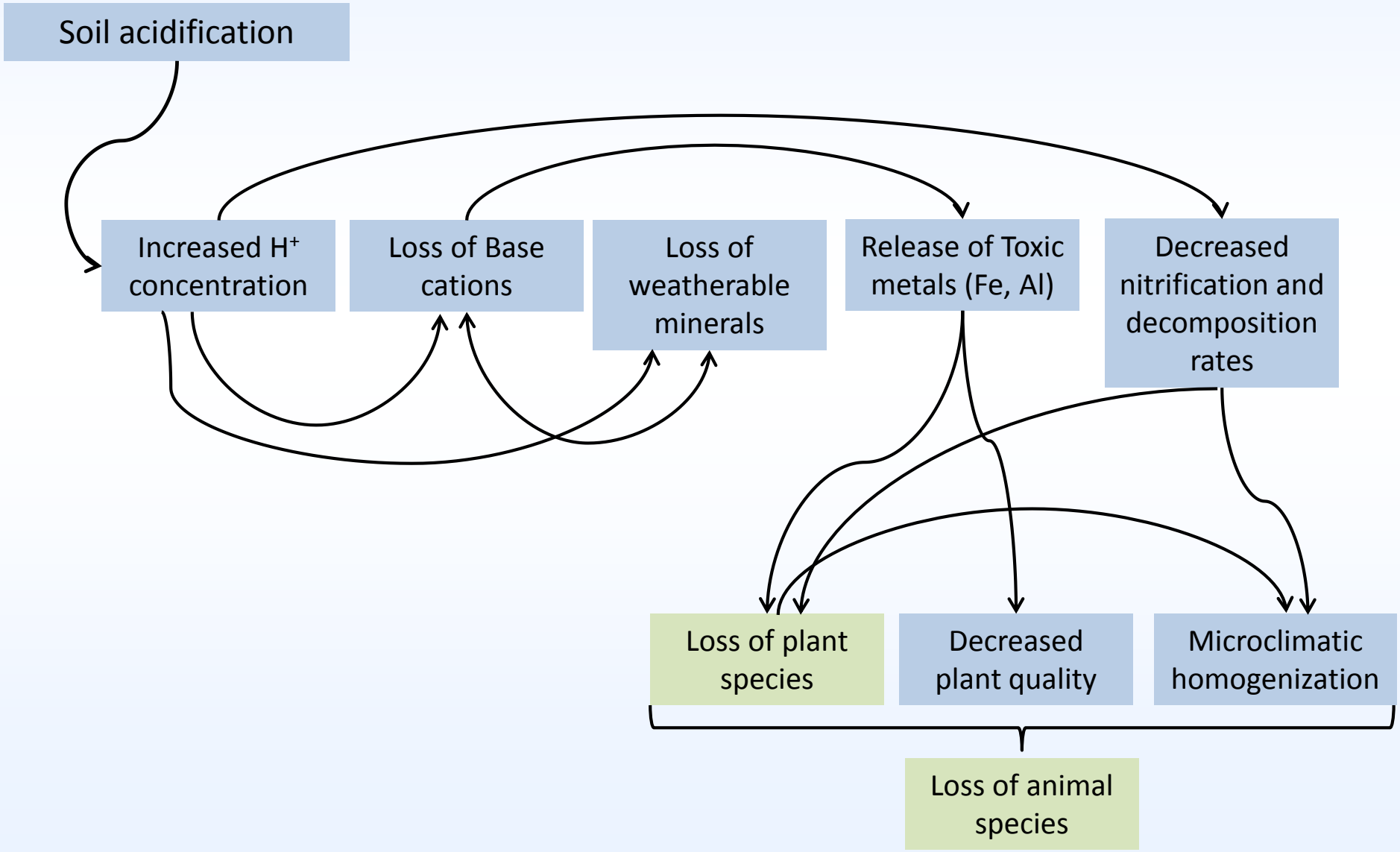
Acid deposition in 2010



Bron: RIVM, 2011.



The soil acidification cascade

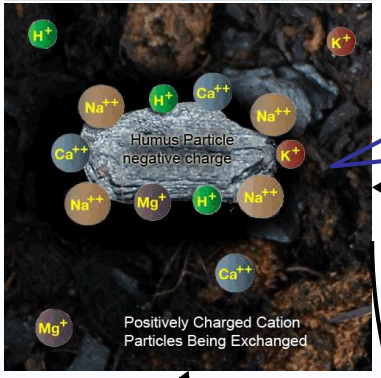


Soil minerals are the natural pool of base cations

Soil mineral pool

Soil base saturation

K-Feldspar
Plagioclase, etc



Mg^{2+} K^{+} Ca^{2+}

H^{+}

Weathering: release of Mg, Ca, K, etc.

$2H^{+}$

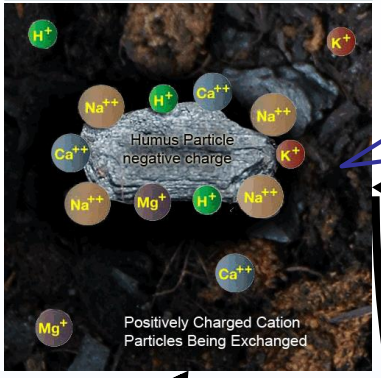
Ca^{2+}

Influence of increased acidification (1)

Soil mineral pool

Soil base saturation

K-Feldspar
Plagioclase, etc



Mg^{2+} K^{+} Ca^{2+}

H^{+}

Increased weathering rates

$2H^{+}$

Ca^{2+}

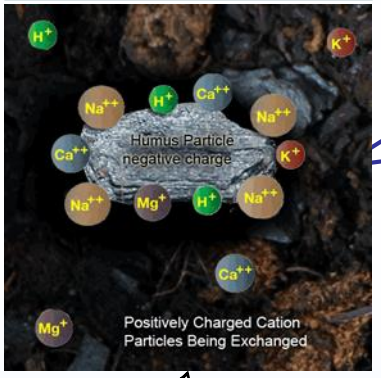
Increased Cation displacement and leaching

Influence of increased acidification (2)

Soil mineral pool

Soil base saturation

K-Feldspar
Plagioclase, etc



H^+
Al^{3+} Fe^{3+}

Eventually…

How big is man's influence on soil mineral depletion?

Quite big…

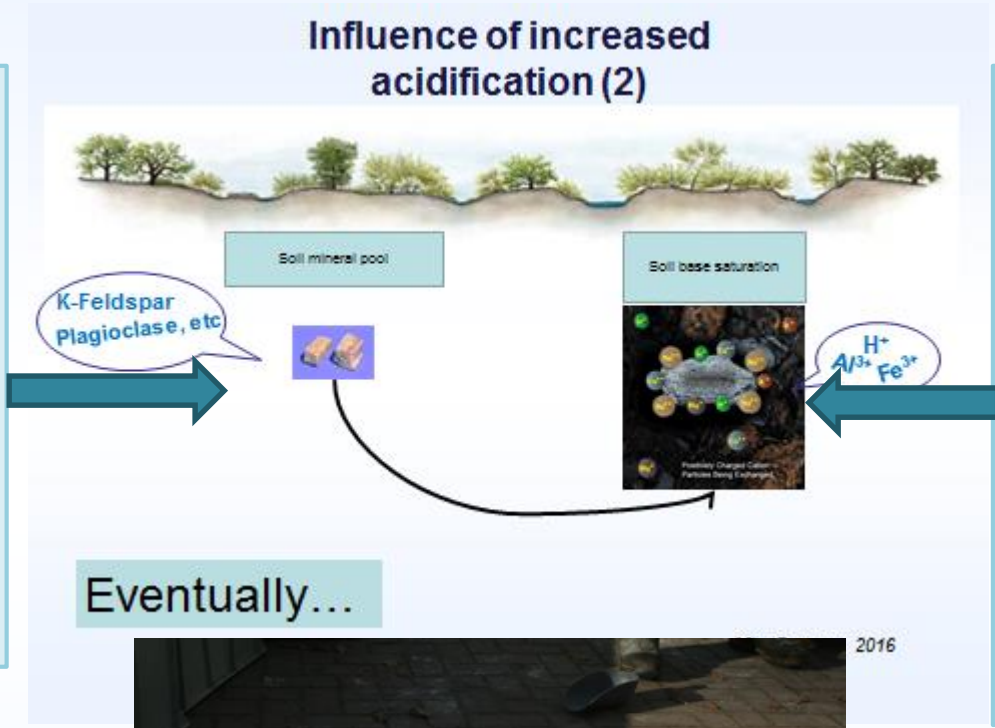
Mineral	Major elements	75 years % decline	11.500 years % decline
K-Feldspar	K, Na	27.18	58.71
Plagioclase	Na, Ca	40.54	67.88
Muscovite	K	51.53	68.06
Chlorite	Mg	40.88	98.18
Epidote	Ca	1.14	85.28
Biotite	K, Mg, Fe micronutrients	42.34	85.19

- 30-40% decline in major minerals in 75 years old soil!
- Roughly half compared to old soil
- Striking is that minerals with high resistance to weathering deplete very fast (K/Na minerals)

→ This equates quite well with the total man induced surplus acid deposition in the Netherlands (roughly 40% of total deposition)

Can we remediate soil acidification?

Rock dust:
Ground igneous rock; rich in minerals
- Aims at restoring mineral pool
- Release of cations through weathering
- Too slow release?



Lime:
CaCO3/MgCO3
- Aims at restoring base saturation
- Fast release through dissolution
- Quick release of Ca and Mg
- Too fast?
- Too much Ca/Mg?
- No Na, K, P, etc…

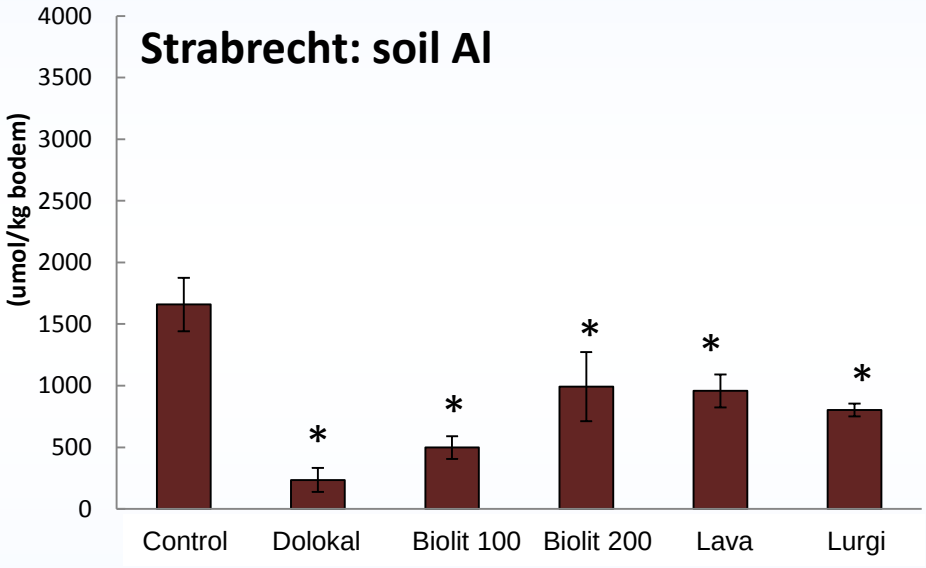
Field experiments

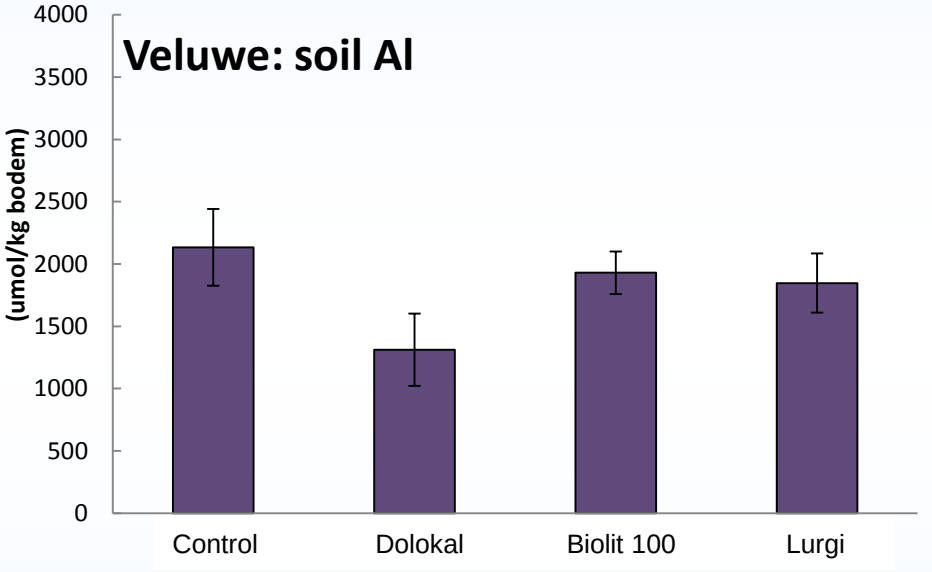
	Strabrecht	Hoge Veluwe
	10 m * 10m, n=5	**15 m * 15 m, n=5**
Control		
Biolit 100µm	10 ton/ha	10 ton/ha
Biolit 200µm	10 ton/ha	
Vulkatec/Lava	15 ton/ha	
Lurgi / Portanef 500µm	10 ton/ha	10 ton/ha
Dolokal 15% Mg	4 ton/ha	
Dolokal 5% Mg		4 ton/ha

Questions/scope

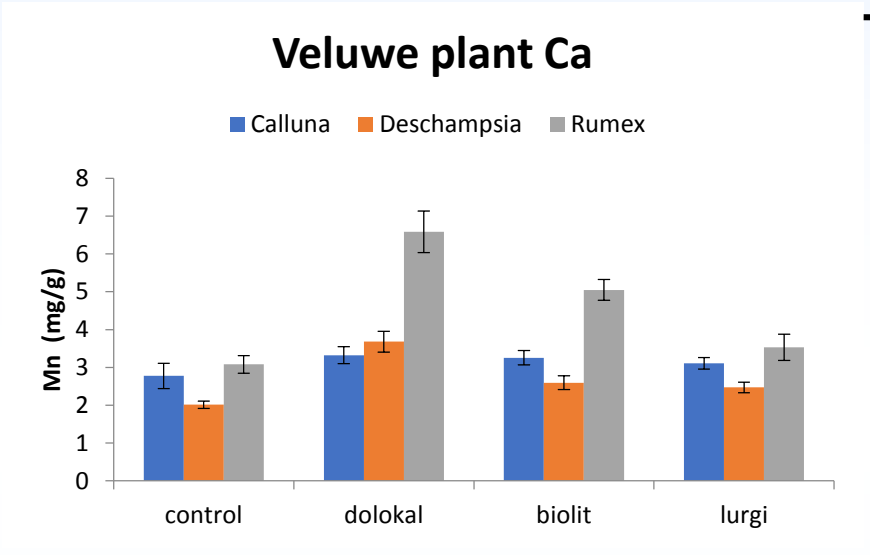
- How does rock dust application effects on soil and plant chemistry differ in respect to lime addition and control?
- Does rock dust and/or lime addition lead to increased decomposition rates of soil organic matter?
- How do higer trophic levels respond to liming of rock dust application?
  - Herbivore response
  - Detritivore response

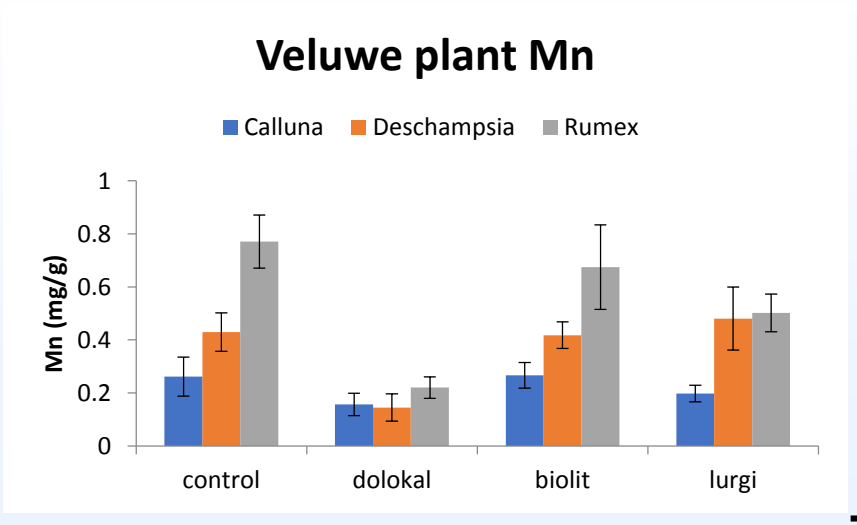
Preliminary results: soil

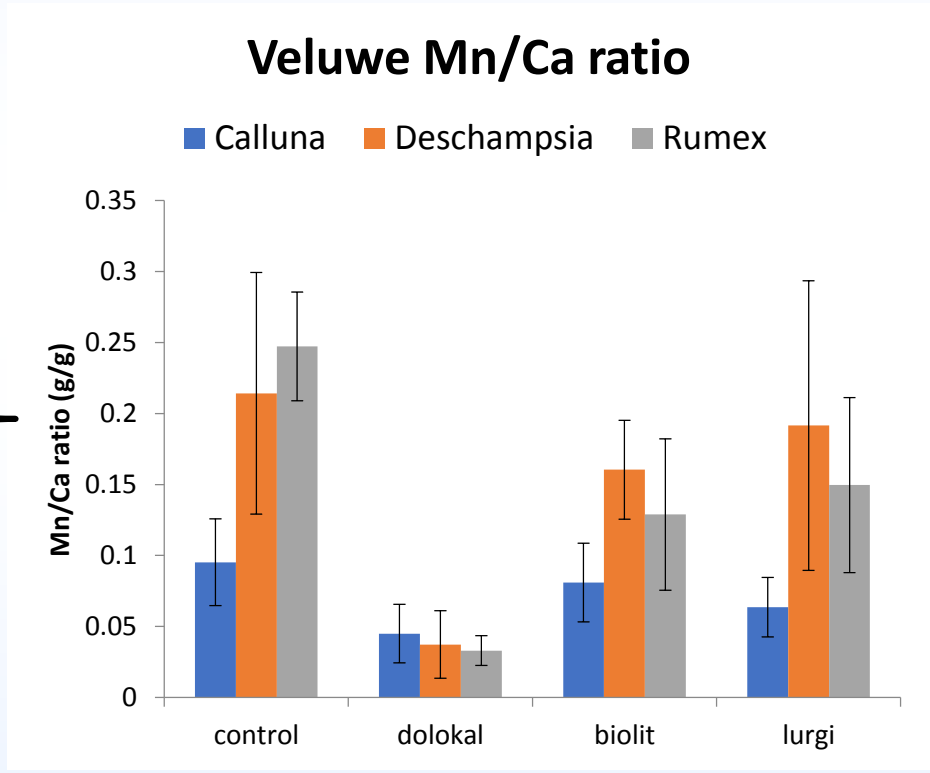




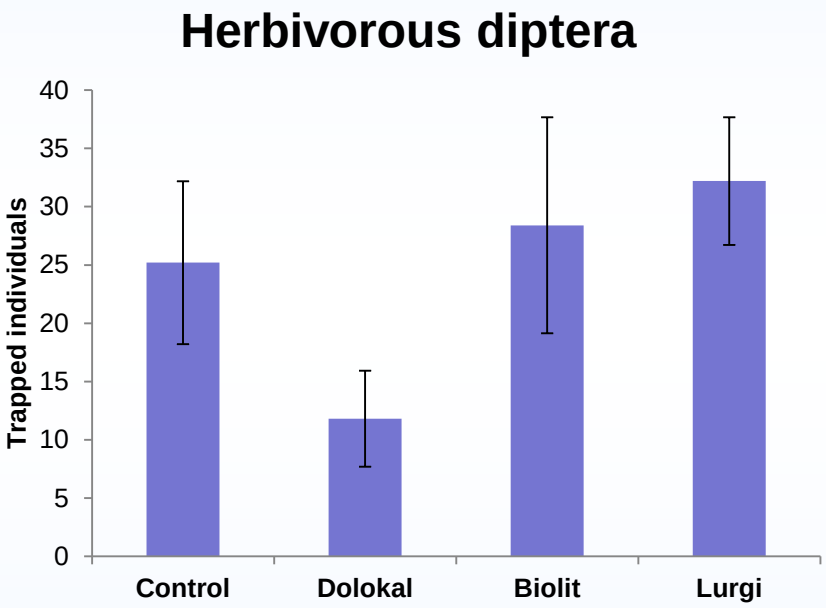
Preliminary results: plant chemistry

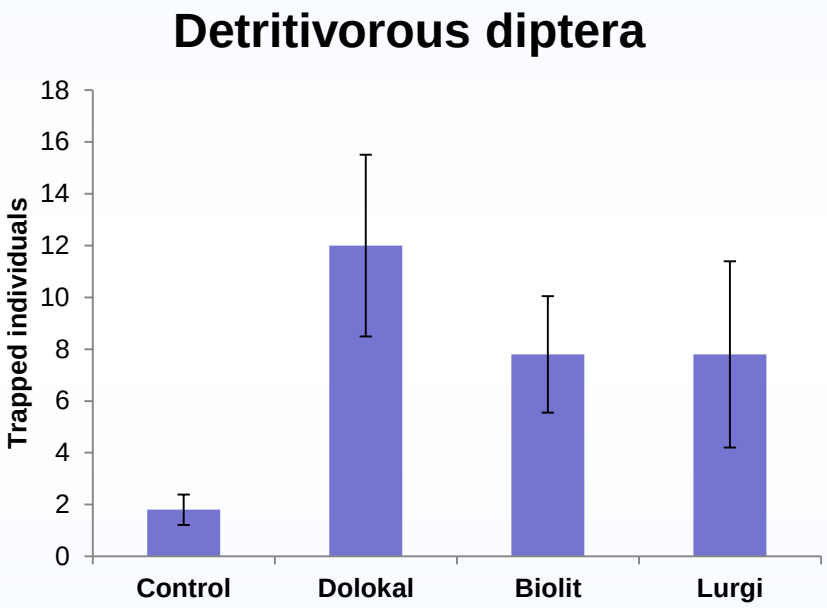






Preliminary results: invertebrates





Preliminary Conclusions

- All treatments are showing an effect at the short term
  - Liming shows fastest (significant) effects on soil and plant chemistry
  - However, liming also shows negative effects on plant quality
    - Mn deficiency for plant and animals?
- Dipteran community shift also indicates an increase in soil decomposition rates
  - In the sweet spot, or too much?
- Rock dusting seems a promising alternative measure to mitigate soil acidification compared to liming
  - No negative effects on herbivores
  - However, effects are slower (as expected)
  - But results are so far only preliminary