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Changes in upper organic soil layer as a result of clear-cutting

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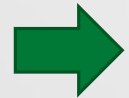
photos by J. Lubojacký

Bark beetle calamity in the Czech Republic and clear-cuts

- Calamity since 2015 (2015-2017: 11.8 M m³)
- Extreme calamity since 2018 (2018-2020: 55.6 M m³)
- Rough estimate of the clearcuts amount: 150.000,-
- Compare to air pollution calamity (1970 – 1989): 100.000,-

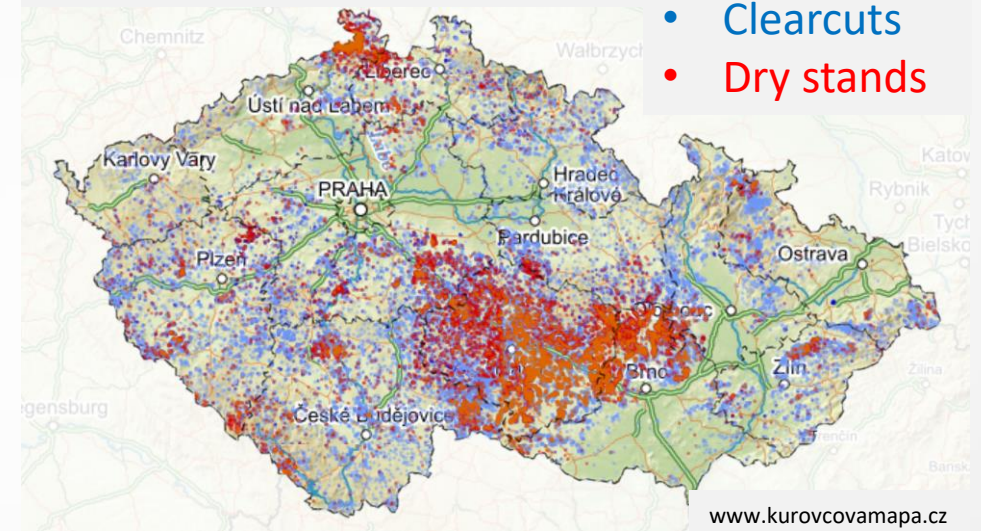
In Czechia we have:

- Ca 1.3 M ha of Norway spruce forests (50 %)
- 1 M ha potentially endangered by b. beetle



CLEARCUTS ECOLOGY = HOT TOPIC

Bark beetle calamity in 2020



Ecological risks on clearcuts

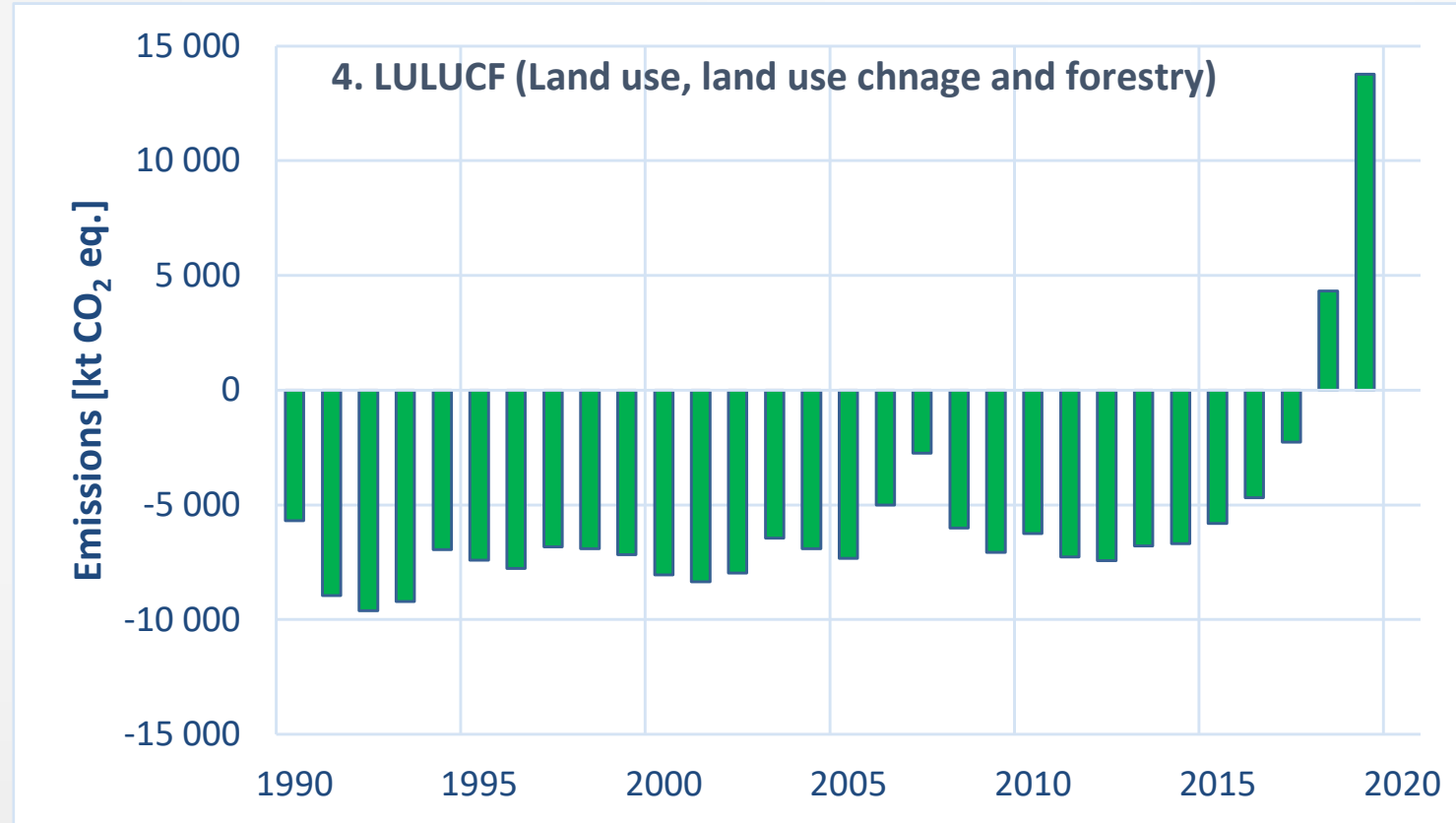
- Maximal clear-cut according to Forest law 1 ha
- Average size of clearcut area 0.3 ha
- Calamity clearcut 10 – 100 ha and even more

Potential risks:

- Changes in temperature conditions (extremes)
- Changes in soil moisture – more wet
- Changes in air moisture – more dry → mesoclimate
- Changes in hydrology (e.g. Floods)
- Soil Erosion
- Carbon sequestration
- Soil organic matter decomposition



Carbon sequestration in LULUCF (Land Use, Land Use Change & Forestry)



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SHOULD FORESTERS BUY EMISSION ALLOWANCES?



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Risk of organic layer decomposition

- More light, higher temperature, enough of humidity
→ increased decomposition of organic matter
(humus layer)

Consequences to:

- Carbon stock (C sequestration)
- Nutrient stock (soil fertility)
- Heavy metal release

The risk is reduced by immediate reforestation

CHANGES IN TREE SPECIES COMPOSITION?



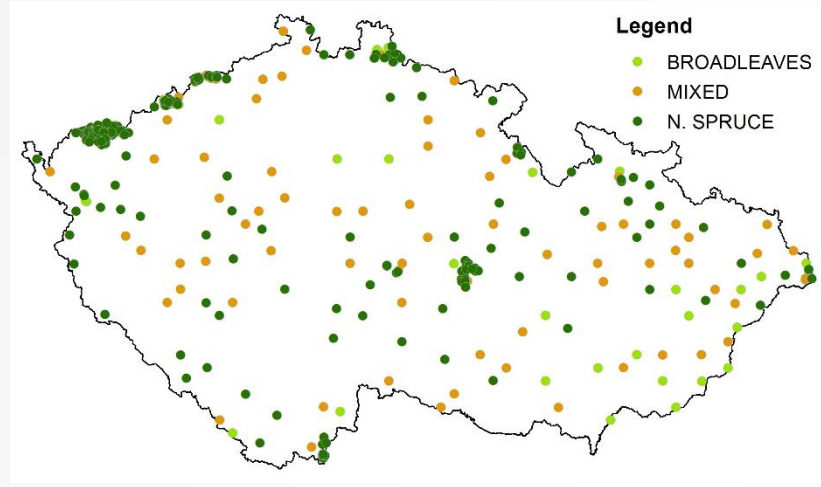
Differences in humus layer / C stock under different tree species



N. Spruce stand



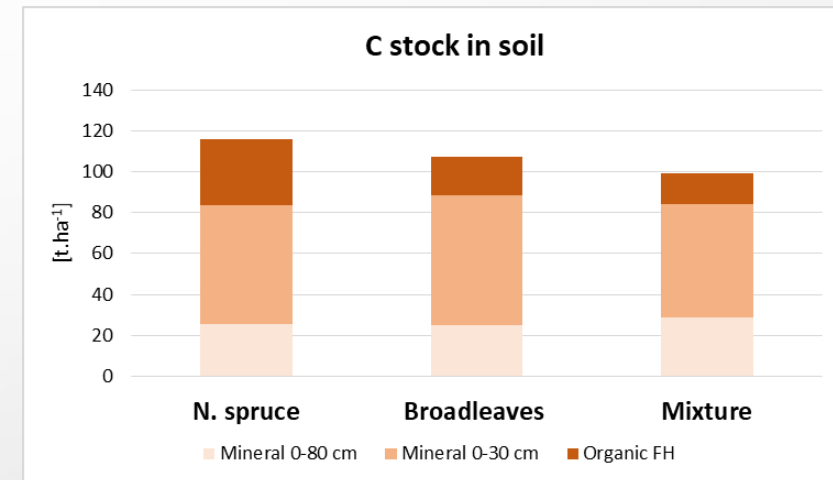
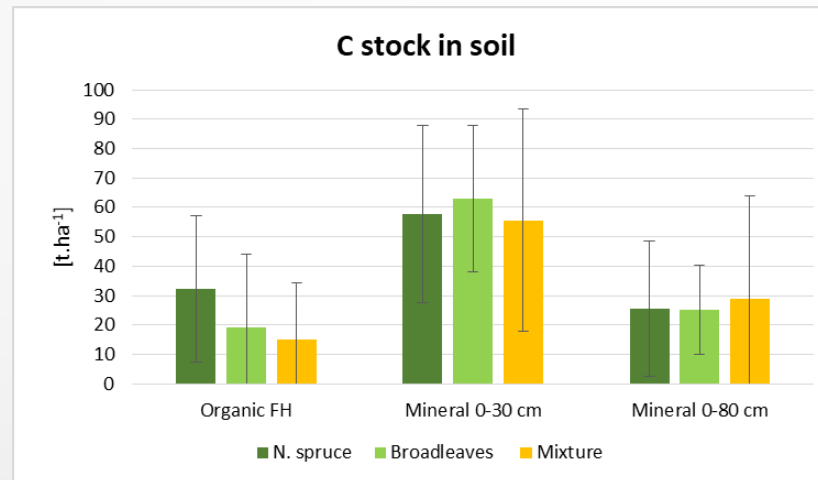
Broadleaved stand



At risk: 30 t of C / ha

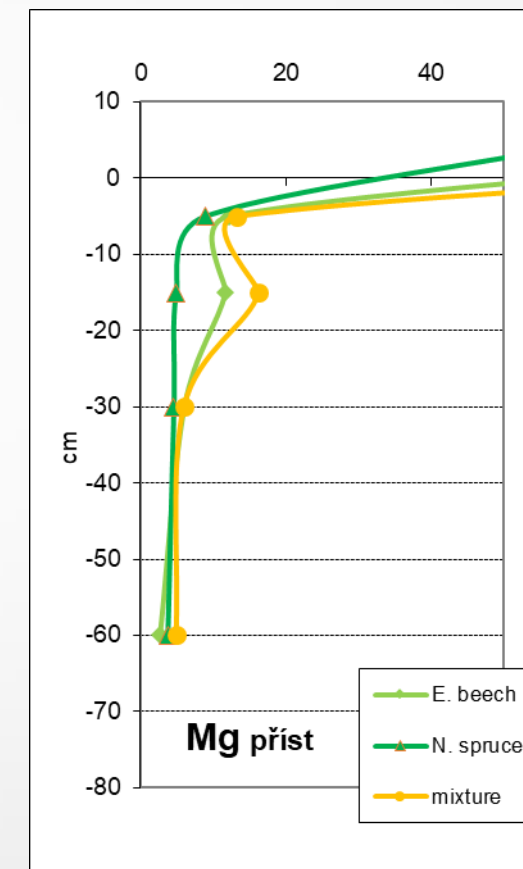
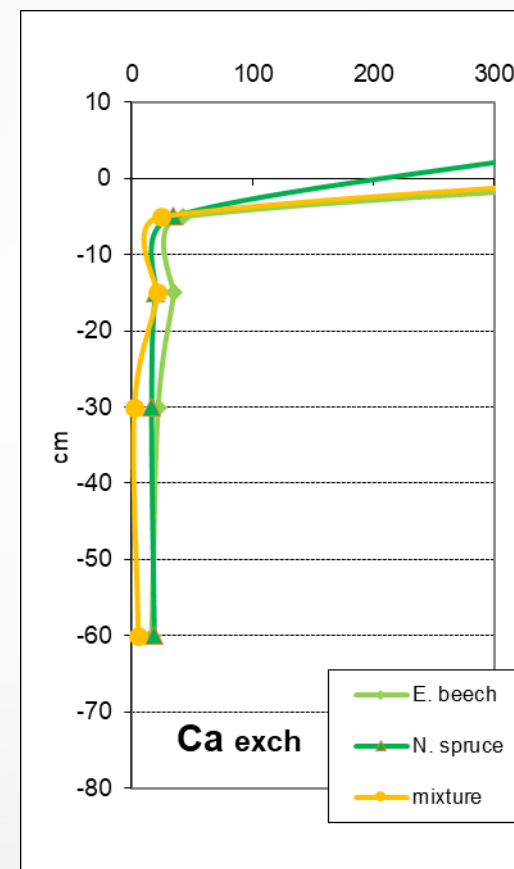
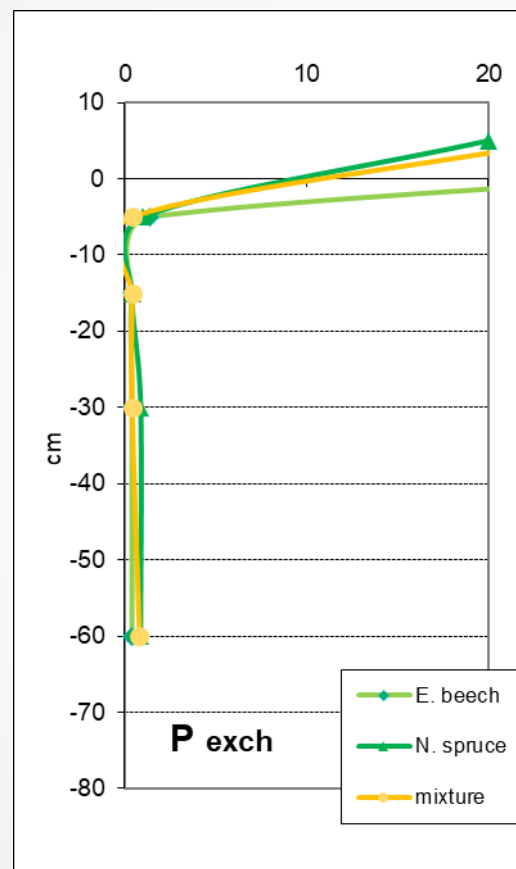
Comp. Broadleaves: 12 t of C / ha

Whole soil profile: 8 t of C / ha



Main stock of nutrients is often located in upper organic soil layer

In the Czech Republic acidic soils on old mother rock with low supply of nutrients – mainly base cations prevail. High atmospheric deposition of acid compounds played also important role during the last century. Exchangeable content of nutrient is often under the deficiency limit which is true mainly for phosphorus, calcium and magnesium.

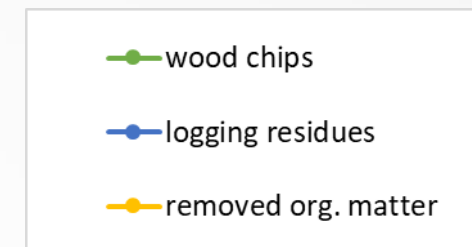
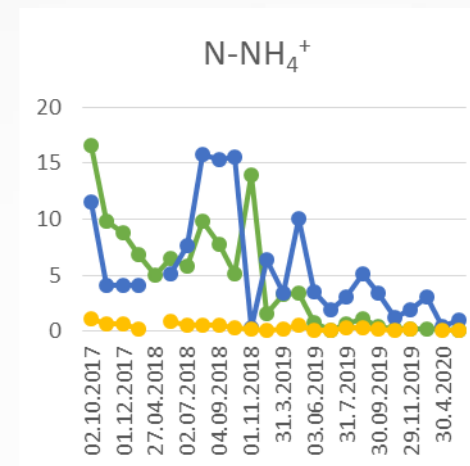
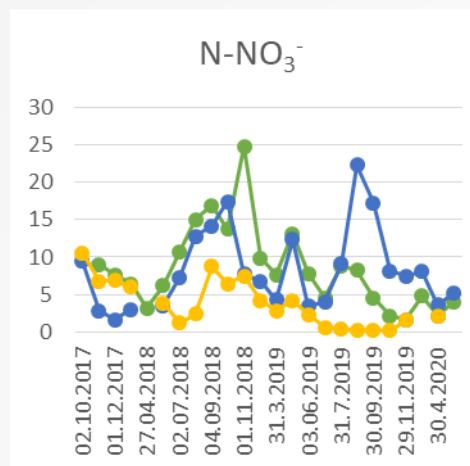
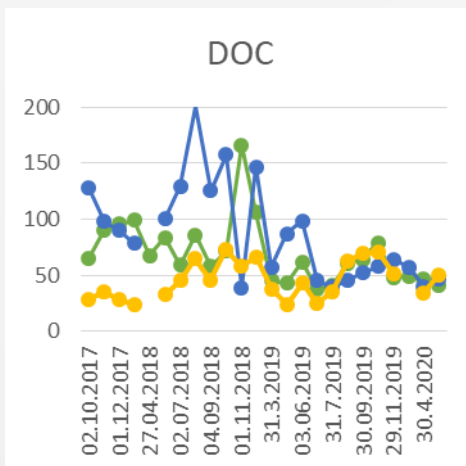


Set of plots Chribska (European beech, Norway spruce, mixed stand; Lausitzer Mts., 530 m a.s.l.)

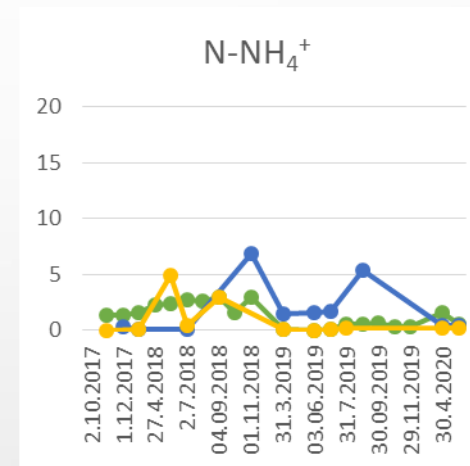
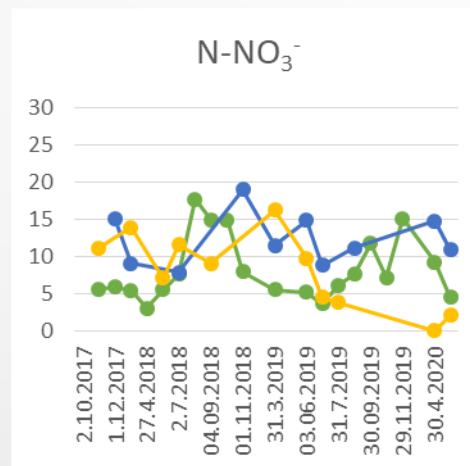
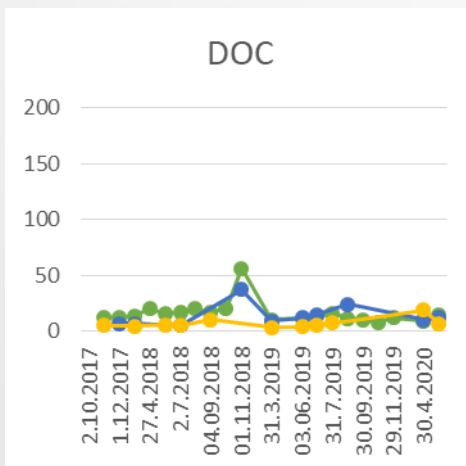


Nutrients and other elements can be released to the soil/stream water

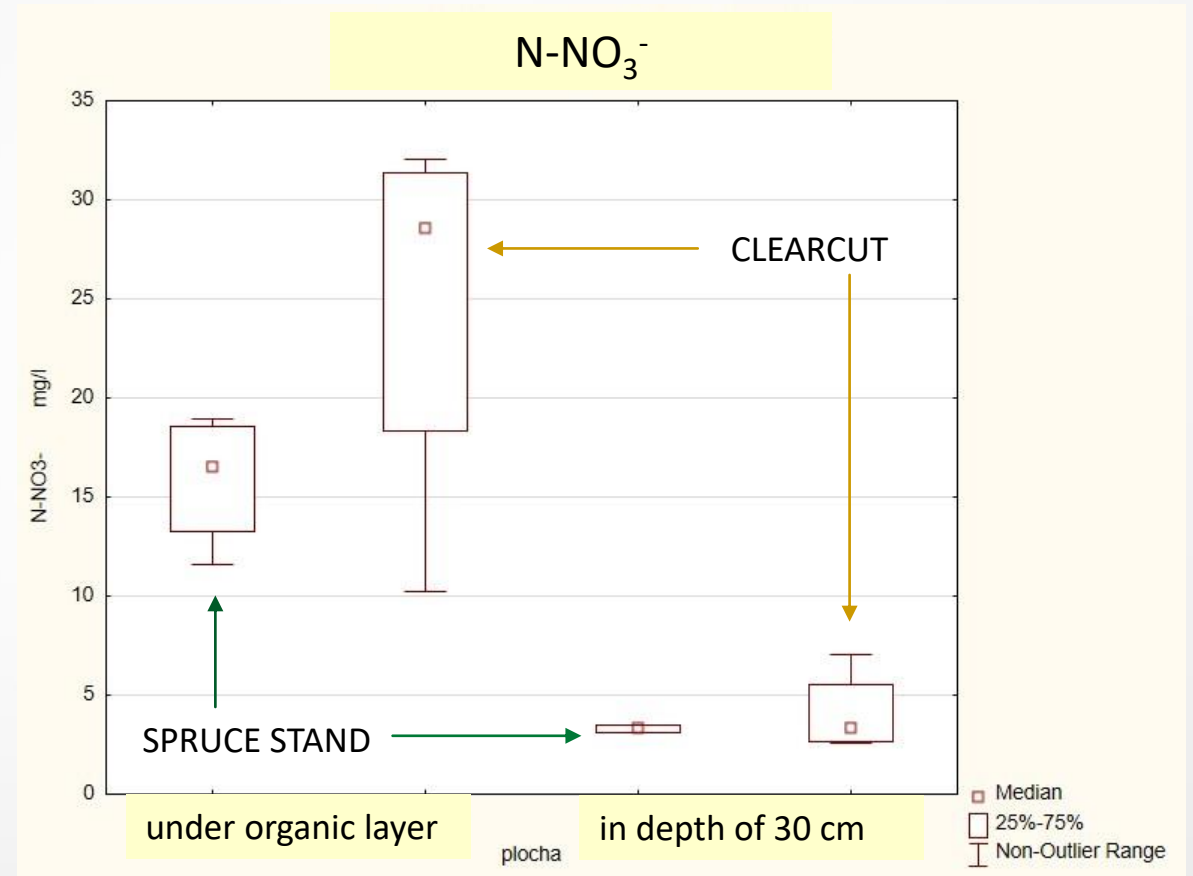
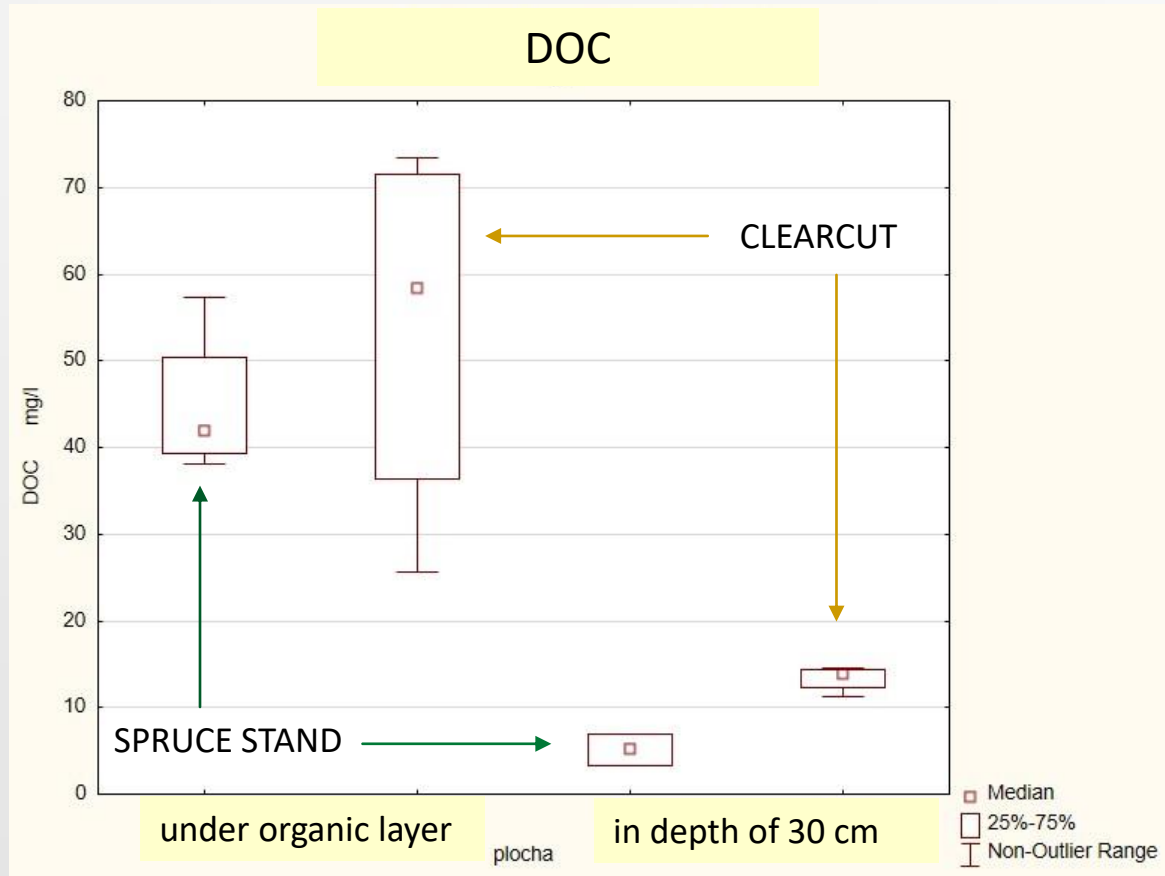
Soil water under soil organic layer



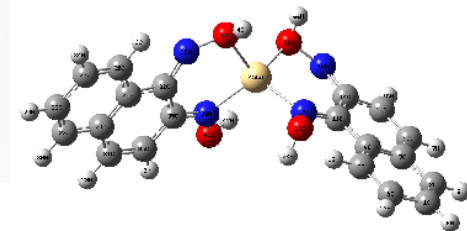
Soil water in 30 cm depth of mineral soil



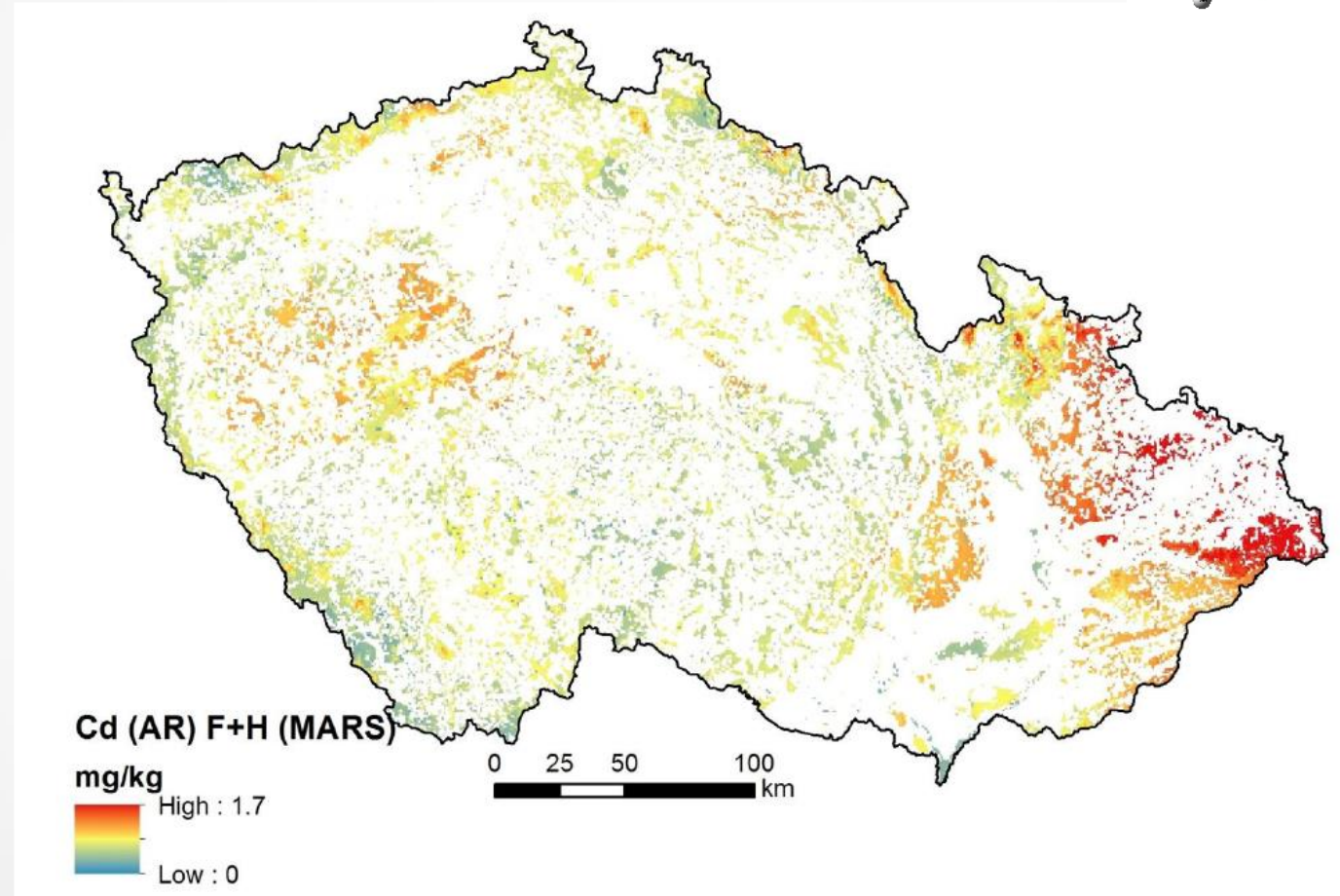
Nutrients and other elements can be released to the soil/stream water



Risk of heavy metals release



- Heavy metals are bound in complex stable structures in the soil organic matter
- They are fixed in higher concentration in organic layer than in mineral soil with exception of geogenous metals
- In some region the risk of heavy metal release can be significant
- Cd, As, Pb, (Hg)



Conclusions

- Extent of clearcuts due to b. beetle is extraordinary in both size and total area
- (Proper) reforestation would minimize risks connected with clear-cut ecology
- Changing the tree species composition, (positive effect on forest stability) will lead to lowered carbon stock in upper organic soil layer (which has to be accepted)
- The nutrient balance has to be carefully evaluated and sustained
- The water quality and heavy metals should be monitored



Thank you for your attention



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