ICP Forests

Comparison of soil solution sampling techniques in a Norway spruce forest in Finland

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- Tension lysimeters – suction cups
- Zero-tension lysimeters

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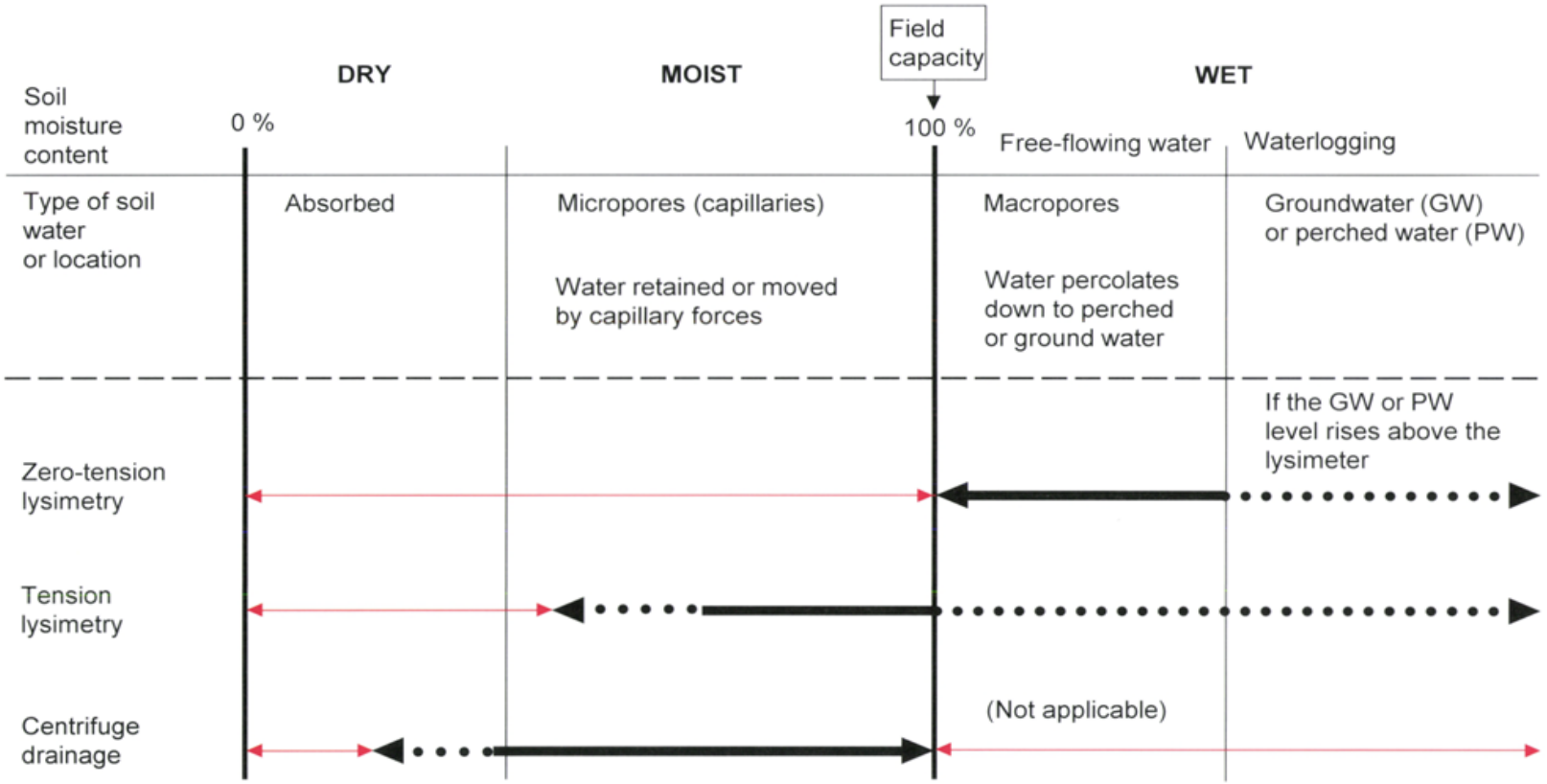

Figure 4. The soil water fractions sampled by zero-tension lysimetry, tension lysimetry and centrifuge drainage (thick black lines). Thethin red lines indicate the fractions that cannot be sampled. The actual fractions sampled by tension lysimetry can vary depending on the size of the vacuum applied and the moisture content of the soil during sampling (dotted lines). Similarly the amount of adsorbed water sampled by centrifuge drainage depends on the magnitude of the centrifugal force applied.

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Soil solution – an indicator of

- Nutrient availability / heavy metal toxicity
- Nutrient / heavy metal leaching
- Soil acidification
- Soil forming processes

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Comparison between tension (T) and zero-tension (Z) soil solution (Derome et al. 2000)

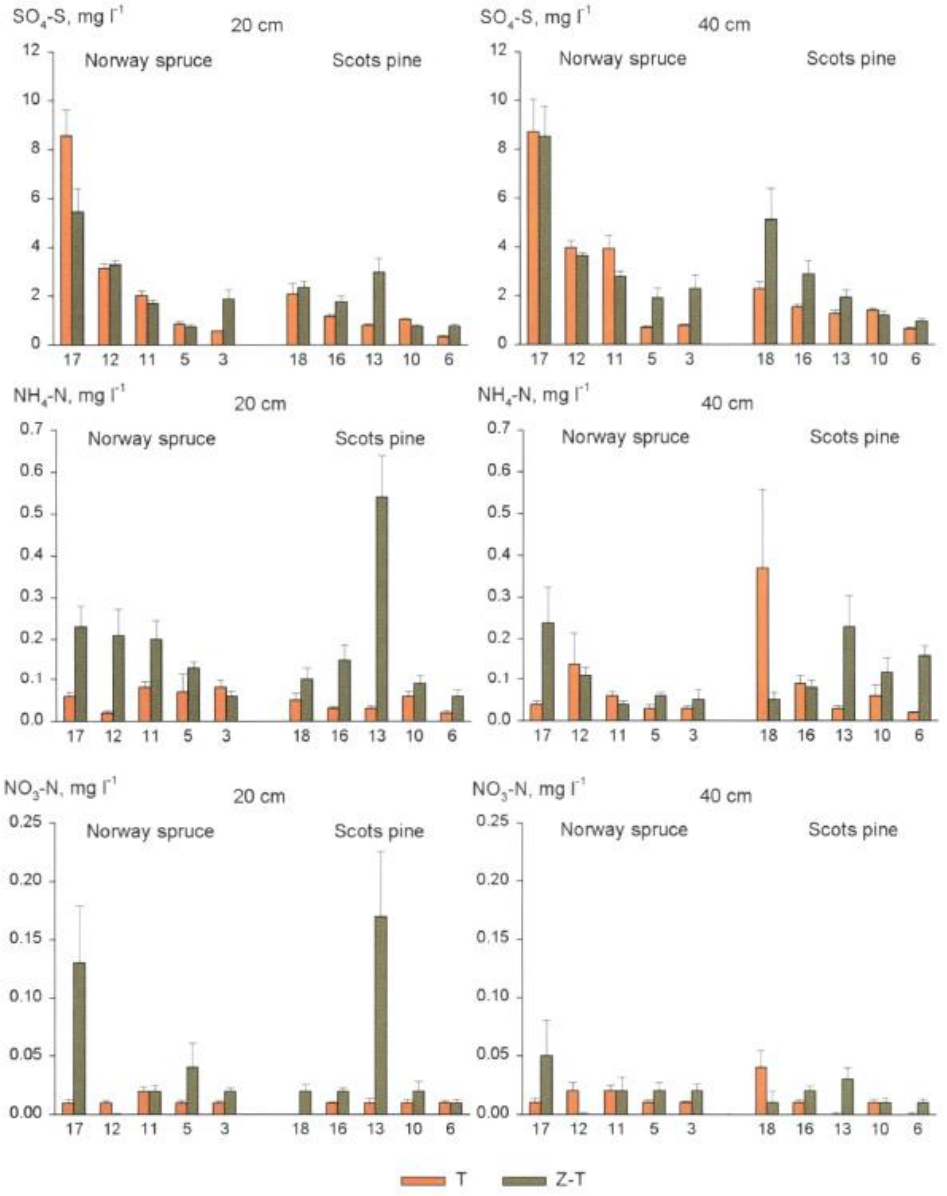

Figure 6. Mean SO_4-S, NH_4-N and NO_3-N concentrations in soil solution collected at depths of 20 and 40 cm using tension (T) and zero-tension lysimeters (Z-T) in Norway spruce and Scots pine stands during the snowfree season in 1998 and 1999. The numbers refer to the monitoring plots, which are arranged in order from south to north.

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Soil solution – an indicator of

- Nutrient availability / heavy metal toxicity
- Nutrient / heavy metal leaching
- Soil acidification
- Soil forming processes

Soil solution – sampled by

- Tension lysimeters
  - ➢ nutrient uptake by vegetation
  - ➢ soil buffering and neutralizing processes
- Zero-tension lysimeters
  - ➢ movement of ions and compounds between the soil horizons

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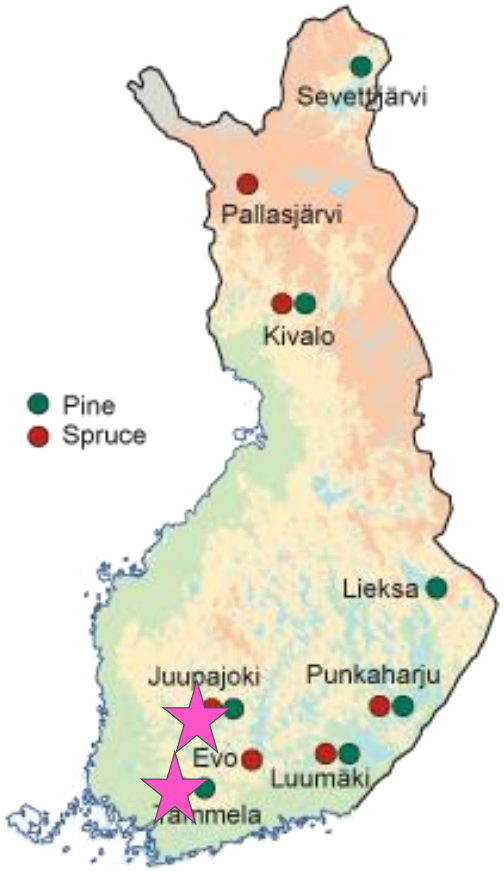
Juupajoki Level II site 11



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Characteristics of the stands (measured 2009-2010)

	Juupajoki 'damaged'	**Tammela 'reference'**
Main tree species	Norway spruce	Norway spruce
Stems ha^{-1}	852	663
Stem volume m3 ha^{-1}	419	360
Basal area m2 ha^{-1}	38	33
Arithmetic mean height, m	21	22
Mean diameter, cm	26	26
Stand age	90	70
C/N ratio	28	31
N concentration in needles	1.26 %*	1.21 %*

*Average conc. In all ICP forest needle conc. 1.18% (Norway spruce)

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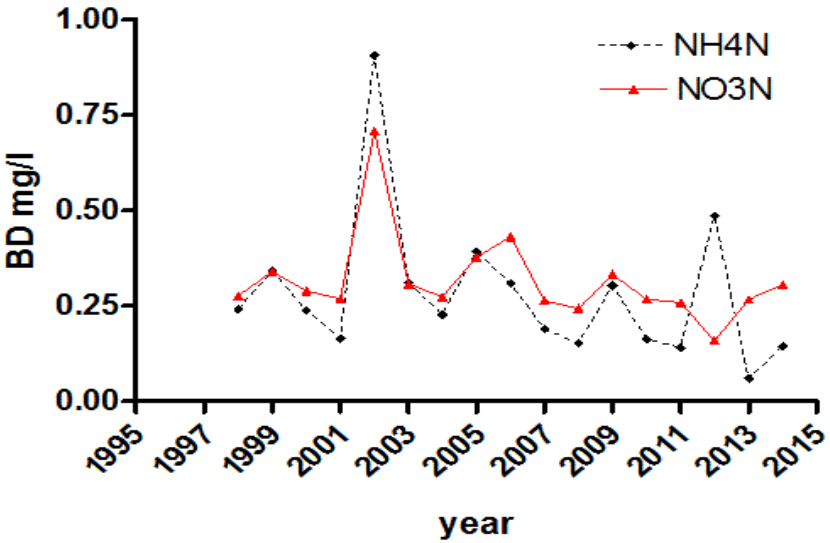
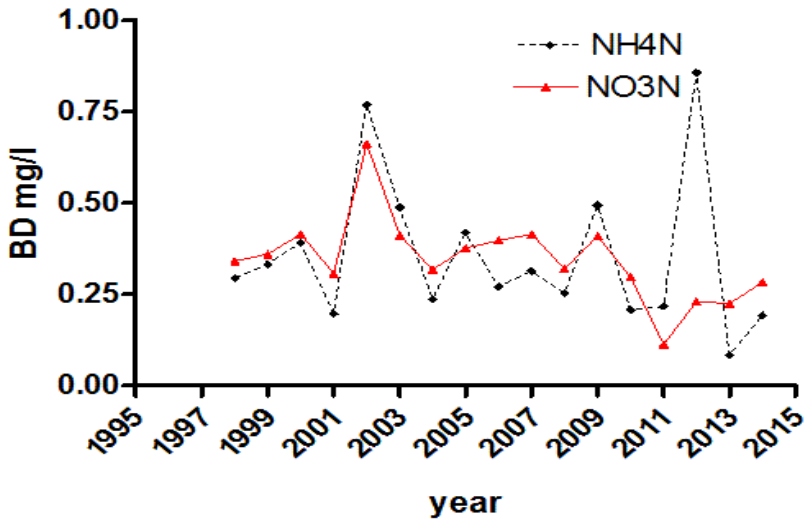
Bulk deposition (open area): NO_3N and NH_4N concentrations

Juupajoki



NO3N R^2= -0.10
NH4N R^2= -0.09

Tammela



NO3N R^2= -0.28*
NH4N R^2= -0.01

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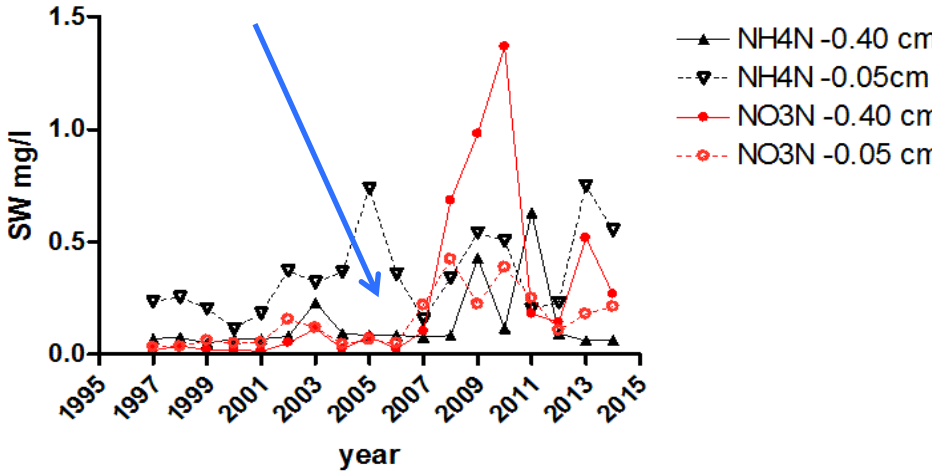
Zero-tension NH_4N and NO_3N soil solution concentrations in Juupajoki and Tammela Norway spruce plots at depth of -5 cm ja -40 cm

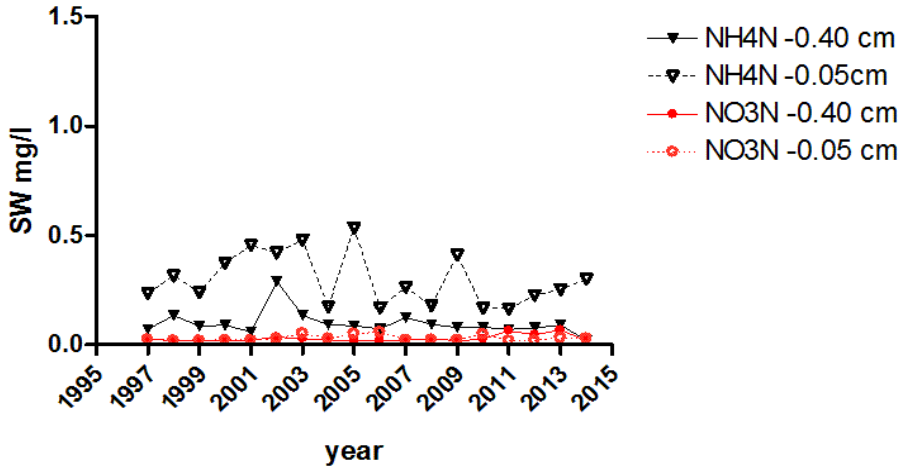
Juupajoki

Thinning (2006)



NO3N -05 cm R^2= 0.39***, slope 0.01 mg/l/year
-40 cm R^2=0.27*, slope =0.03 mg/l/year
NH4N -05 cm R^2=0.26*, slope = 0.009 ml/l/year
-40 cm R^2=0.27

Tammela



NO3N -05 cm R^2= 0.02
-40 cm R^2=0.24*, slope=0.001 mg/l/year
NH4N -05 cm R^2=0.10
-40 cm R^2=0.09

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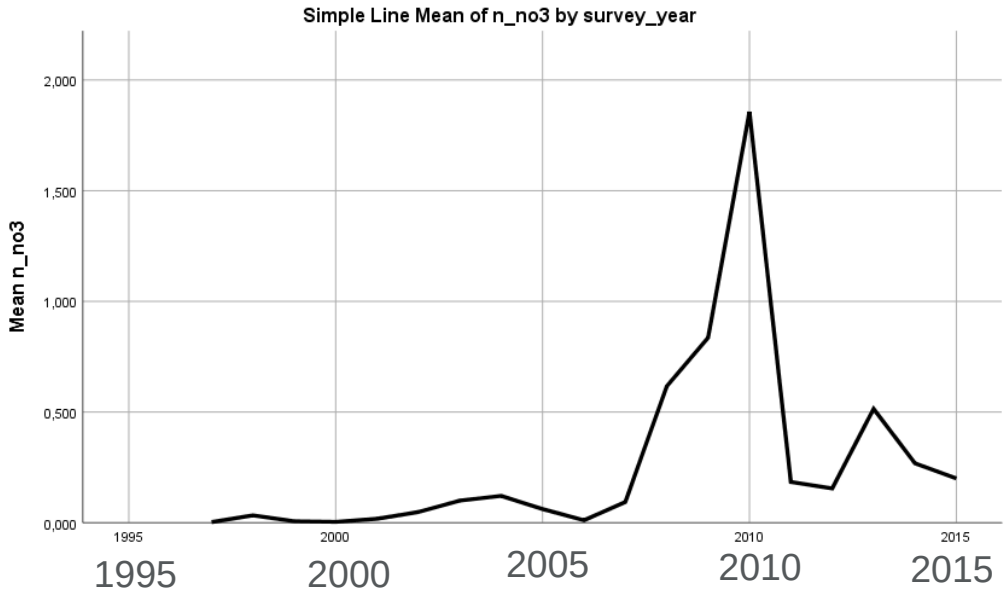
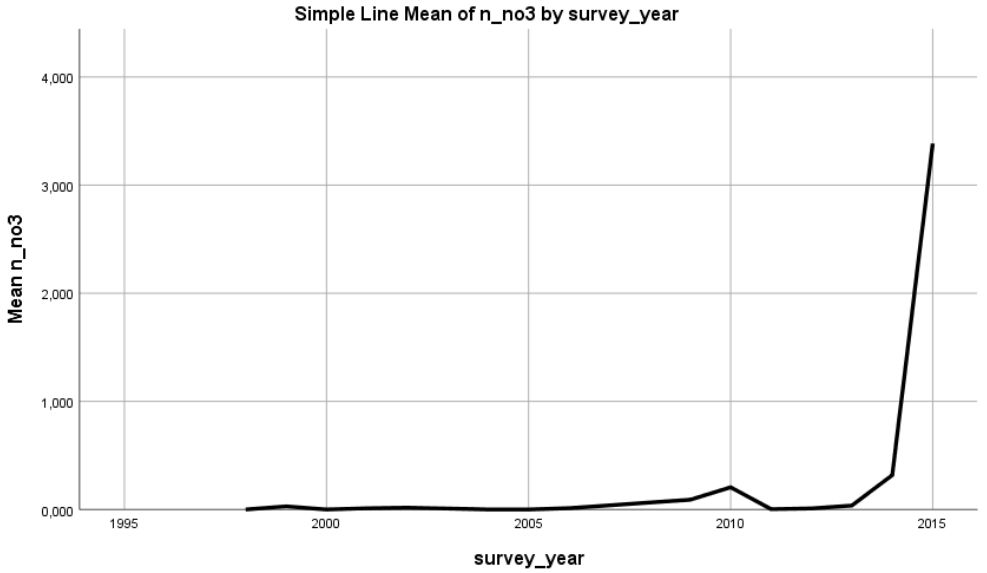
NO_3-N 1997-2015
Zero-tension 40cm



NO_3-N 1997-2015
Tension 40cm



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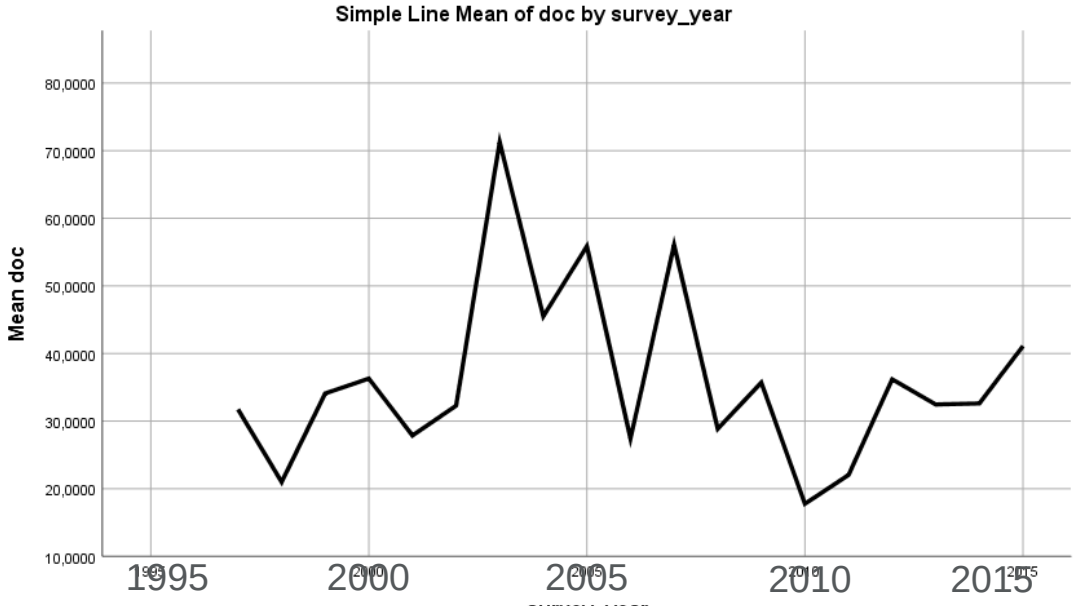
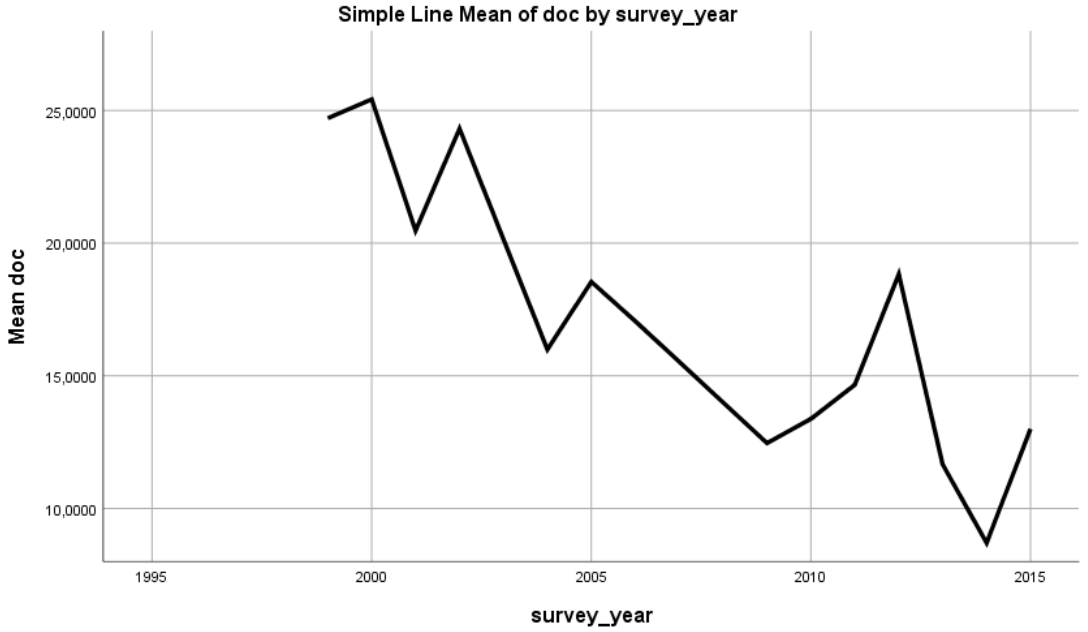
DOC 1997-2015
Zero-tension 20cm



DOC 1997-2015
Tension 20cm



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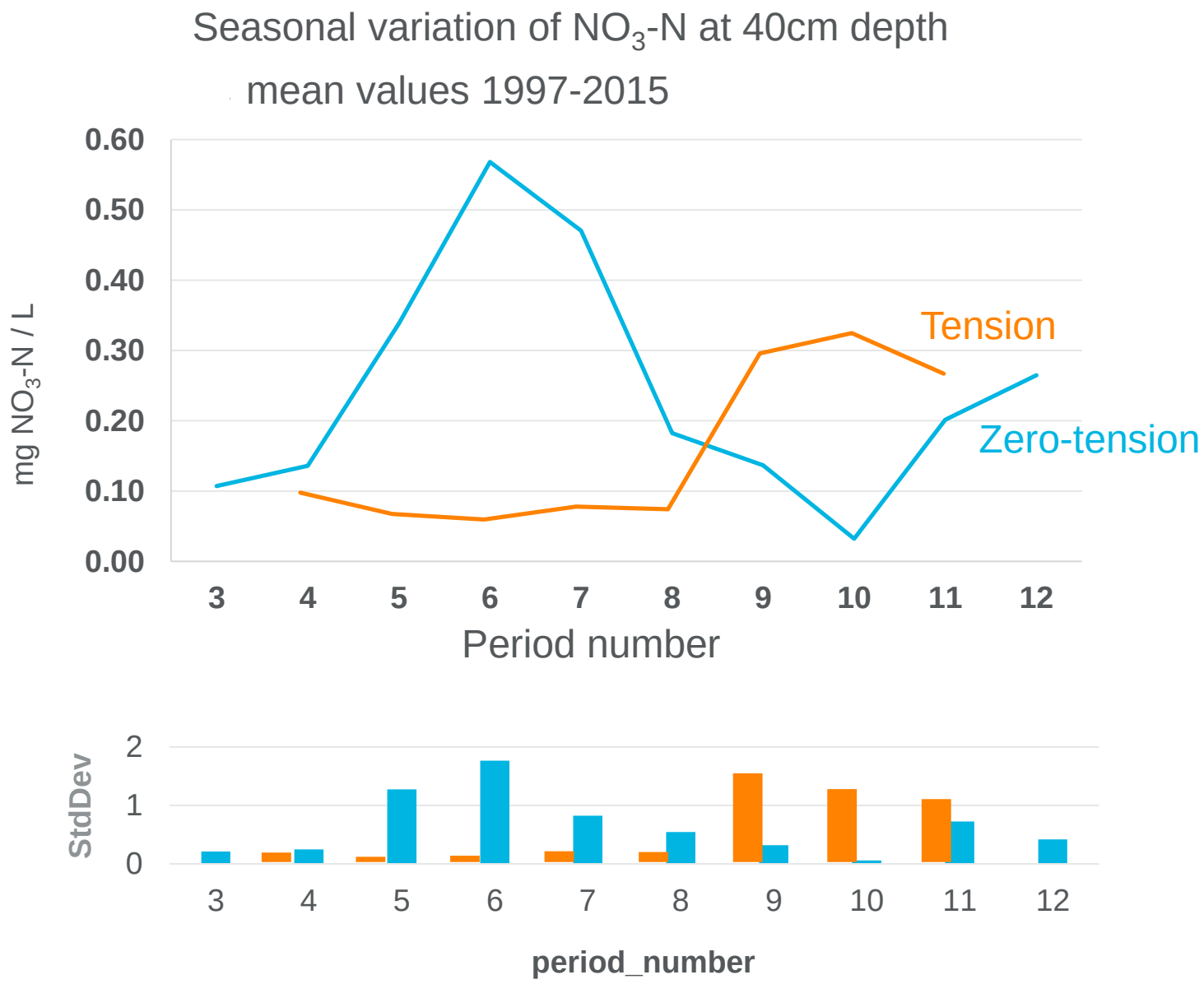

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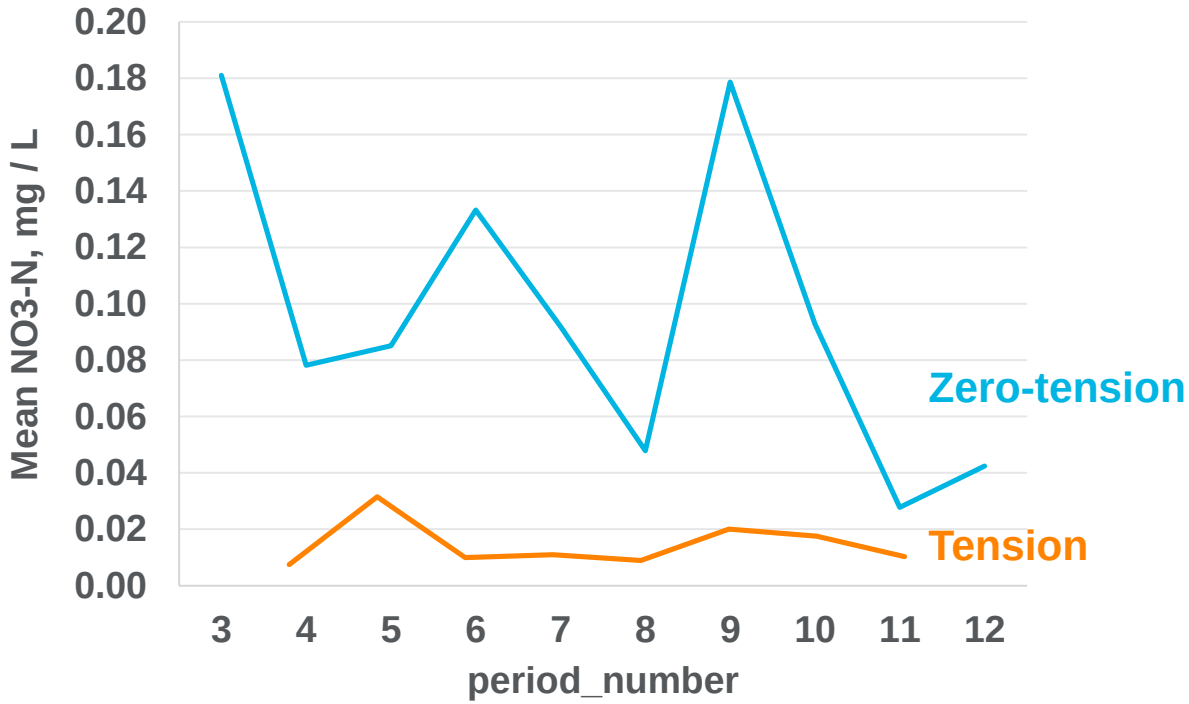
Seasonal NO_3-N variation at 20cm depth, mean values 1997-2015



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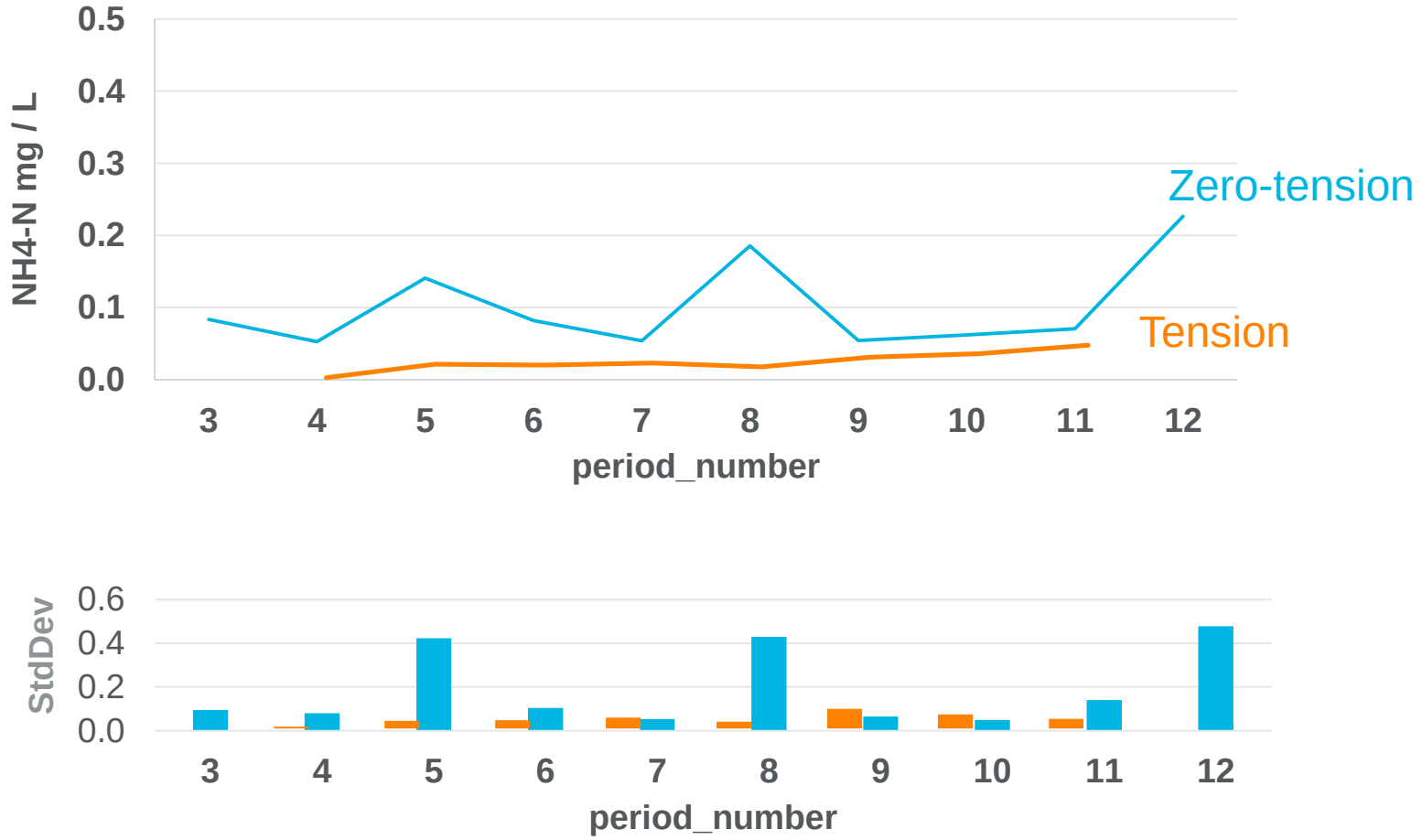
Seasonal variation of NH_4-N at 40cm depth



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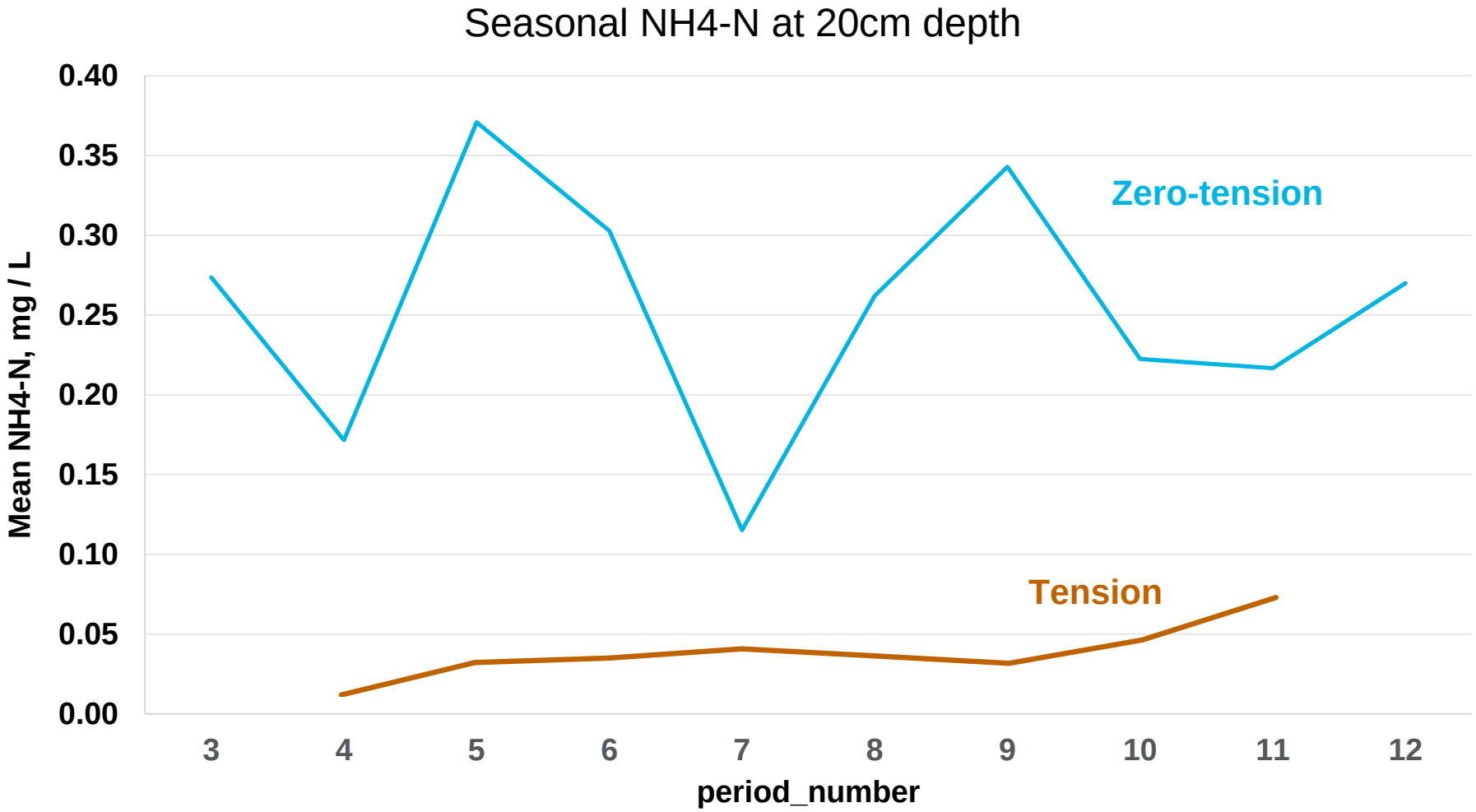

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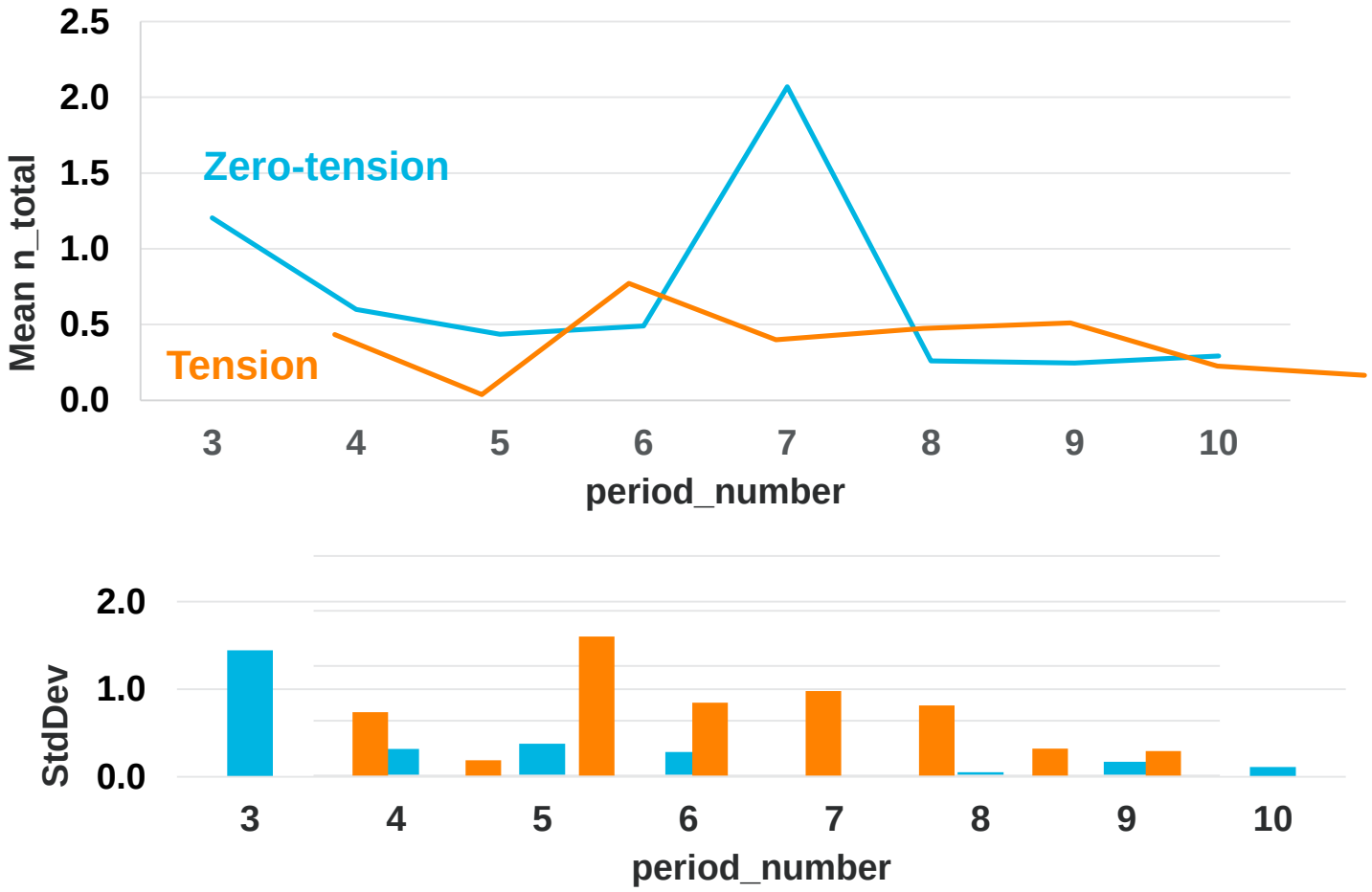
Seasonal variation of total-N at 40cm depth



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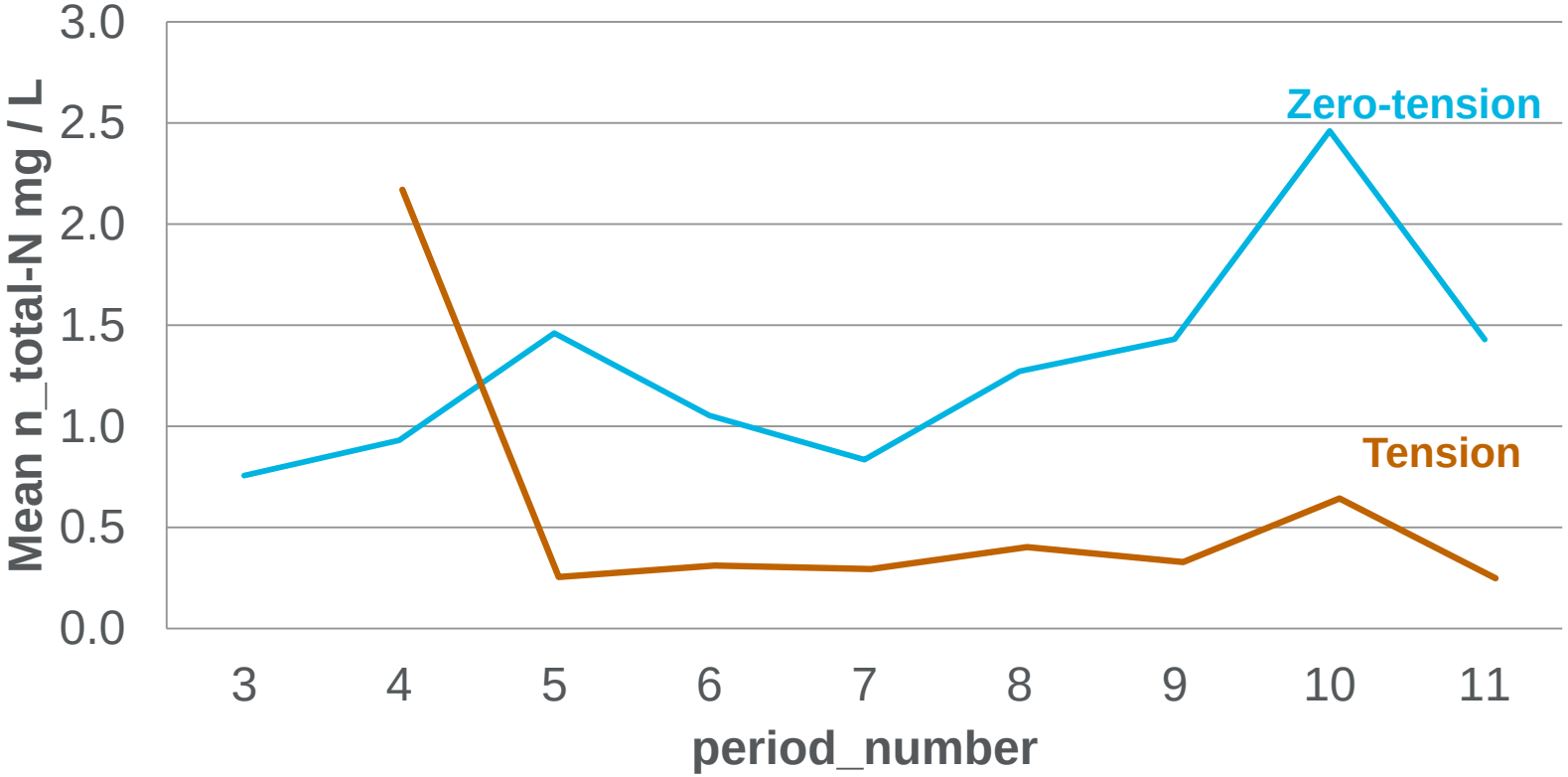
Seasonal total-N at 20cm depth



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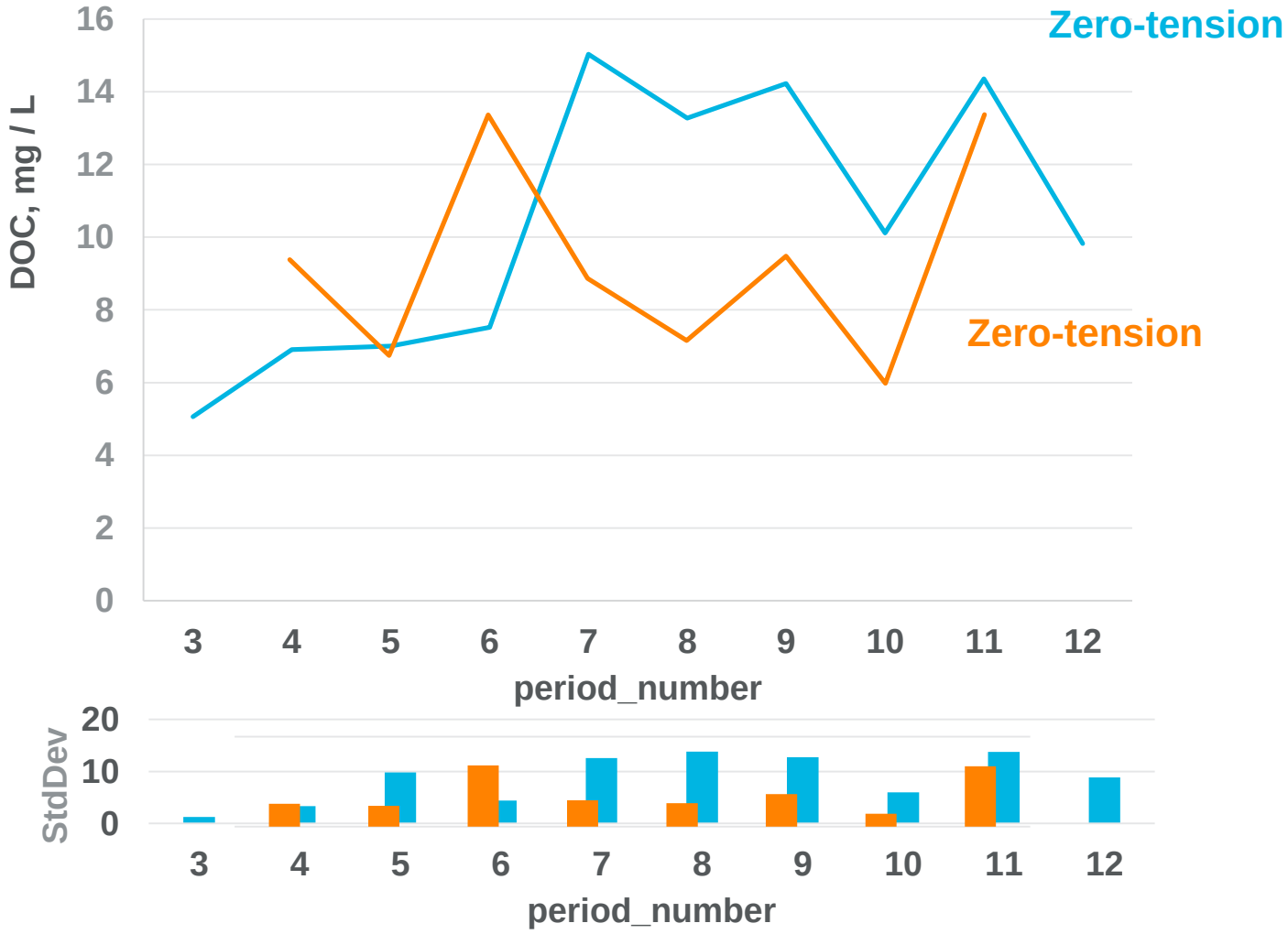
Seasonal variation of DOC at 40cm depth



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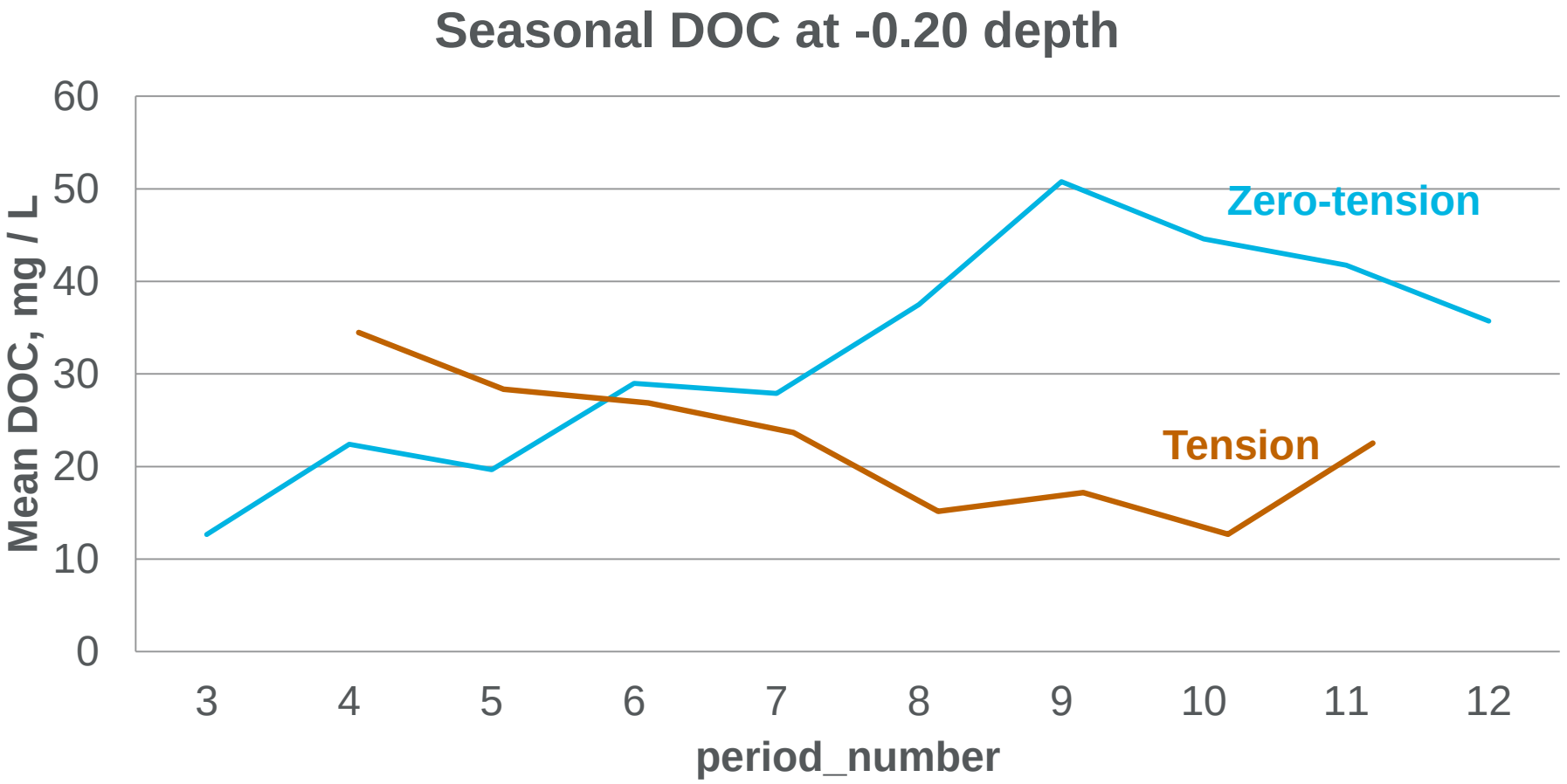

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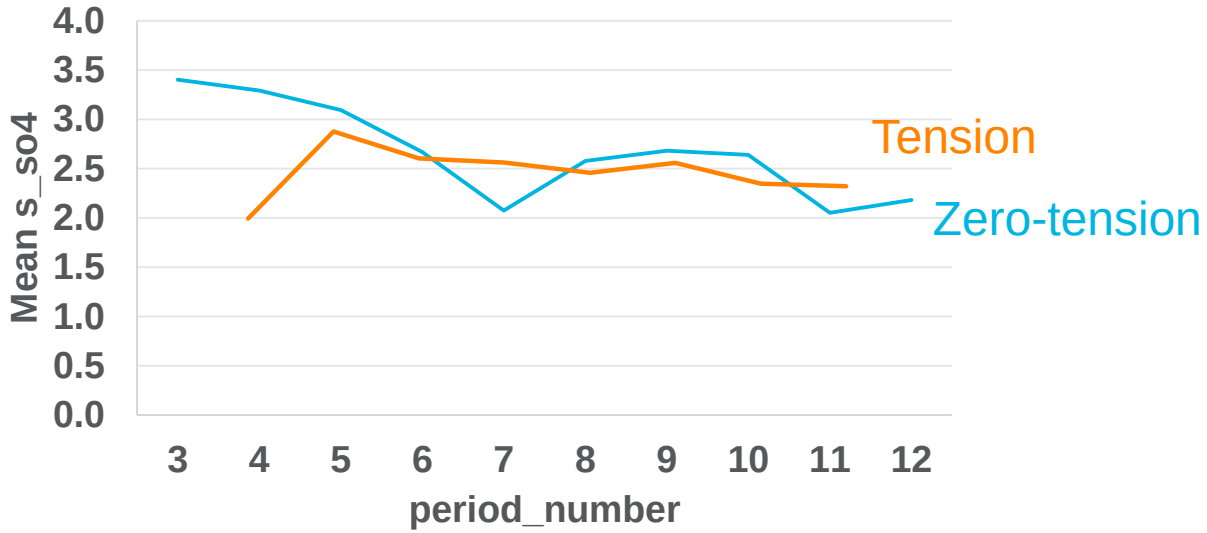
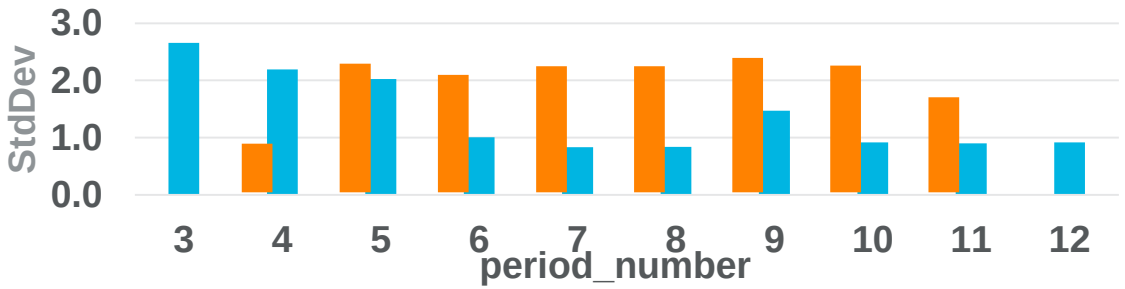
Seasonal variation SO4-S at 40cm depth





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Conclusions

- The two different sampling techniques represent distinct "soil water worlds"
- However, factors causing the differences largely unclear
- Thorough investigations needed

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