

Effects of low-intensity prescribed surface fires  
on the cycling of organic matter and elements  
in coniferous forests in Germany

**DISSERTATION**

**(kumulativ)**

**zur Erlangung des akademischen Grades doctor rerum naturalium**

**(Dr. rer. nat.)**

vorgelegt dem Rat der Chemisch-Geowissenschaftlichen Fakultät der Friedrich-Schiller-  
Universität Jena

von Dipl.-Geoökologin Kerstin Näthe  
geboren am 12.03.1982 in Potsdam

# Contents

<b>Acknowledgements</b>	i
<b>List of Figures</b>	v
<b>List of Tables</b>	vii
<b>Abbreviations</b>	ix
<b>Manuscript overview</b>	xi
<b>Summary</b>	1
<b>Zusammenfassung</b>	3
<b>Chapter 1 - Introduction</b>	7
1.1 Element cycling in forest ecosystems	7
1.2 Ecosystem disturbances	10
1.2.1 <i>Forest fires as ecosystem disturbances</i>	12
1.2.2 <i>Temporal and spatial distribution of forest fires and the impact of climate change</i>	14
1.2.3 <i>Effects of fires on soil and soil solution</i>	16
1.3 Importance of this study and main objectives	20
1.4 Thesis organization	23
<b>Chapter 2 - Study site and fire manipulation</b>	25
2.1 Study site	25
2.2 Fire manipulation	27
2.2.1 <i>FIRE I</i>	27
2.2.2 <i>FIRE II</i>	28
<b>Chapter 3 – Nätke <i>et al.</i> (2017) <i>Geoderma</i> 305, 394–406:</b>	31
Solid-state <sup>13</sup> C NMR characterization of surface fire effects on the composition of organic matter in both soil and soil solution from a coniferous forest	
<b>Chapter 4 – Nätke <i>et al.</i> (2018) <i>Catena</i> 162, 360–375:</b>	45
Low-intensity surface fire effects on carbon and nitrogen cycling in soil and soil solution of a Scots pine forest in central Germany	

<b>Chapter 5 – Näthe et al. (2018) <i>International Journal of Wildland Fire</i> 27, 471–489:</b>	63
Spatiotemporal variation of aluminium and micro- and macronutrients in the soil solution of a coniferous forest after low-intensity prescribed surface fires	
<b>Chapter 6 - Synthesis and conclusions</b>	83
6.1 Short- and medium-term effects of low-intensity forest fires	84
6.2 Implications for the element cycles in a forest ecosystem	94
6.2.1 <i>Nutrient status in the fire-affected soil</i>	94
6.2.2 <i>Ecosystem's vulnerability</i>	97
6.2.3 <i>Future research</i>	98
<b>References</b>	101
<b>Appendix A – Supplementary material</b>	119
<b>Appendix B – Reprint permissions</b>	135
<b>Curriculum vitae</b>	139
<b>Declaration of authorship   <i>Selbstständigkeitserklärung</i></b>	141