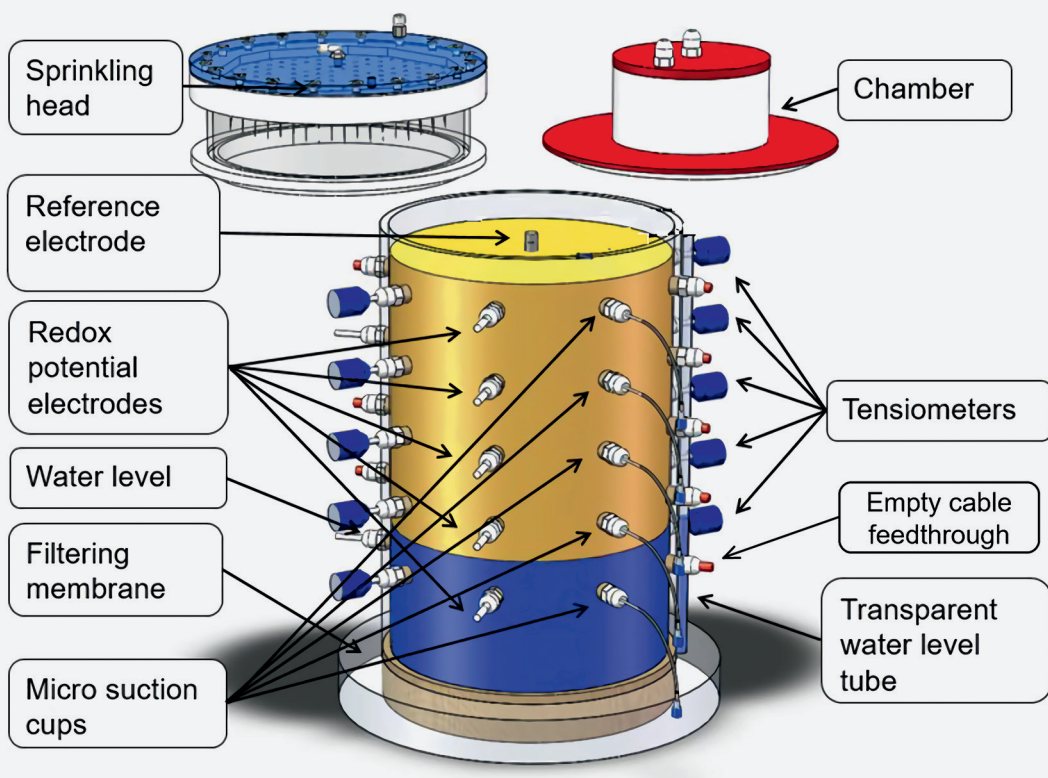




Characterisation of the effect of redox potential on the emission of greenhouse gases using wireless sensing techniques

Jihuan Wang

Energie & Umwelt / Energy & Environment

Band / Volume 554

ISBN 978-3-95806-581-9

Forschungszentrum Jülich GmbH
Institut für Bio- und Geowissenschaften
Agrosphäre (IBG-3)

Characterisation of the effect of redox potential on the emission of greenhouse gases using wireless sensing techniques

Jihuan Wang

Schriften des Forschungszentrums Jülich
Reihe Energie & Umwelt / Energy & Environment

Band / Volume 554

ISSN 1866-1793

ISBN 978-3-95806-581-9

Table of contents

Table of contents.....	I
Acknowledgments.....	IV
Abstract.....	V
Zusammenfassung.....	VII
List of Figures	IX
List of tables.....	XII
List of abbreviation	XIII
Chapter 1	1
Introduction	1
1.1 Greenhouse gas emission.....	2
1.2 Rationale	2
1.2.1 The main influence factors of soil GHG emissions.....	2
1.2.2 Soil microbial N ₂ O emission and consumption process	3
1.2.3 Soil redox potential.....	4
1.3 State of the art.....	5
1.3.1 Measurements of soil Eh and GHG emissions	5
1.3.2 Stable isotope techniques for N ₂ O source partitioning in soils	6
1.3.3 Soils GHG and Eh measurements in the riparian ecosystem.....	6
1.4 Objectives and outline of the thesis	7
Chapter 2	9
Characterizing redox potential effects on greenhouse gas emission induced by water-level changes	9
2.1 Introduction.....	10
2.2 Materials and methods	12

2.2.1 Soil samples.....	12
2.2.2 Experimental design	13
2.2.3 Multistep groundwater level experiments	15
2.2.4 Greenhouse gas flux measurements	15
2.2.5 Identification of N ₂ O source processes	16
2.2.6 Redox potential measurements.....	18
2.2.7 Statistical analysis	19
2.3 Results and discussion.....	19
2.3.1 Soil redox potential	19
2.3.2 Carbon dioxide emission	19
2.3.3 Nitrous oxide emission	22
2.3.4 Implications for GHG emission modelling	24
2.4 Conclusions	27
Chapter 3.....	29
Stable-isotope-aided investigation of the effect of redox potential on nitrous oxide emissions as affected by water status and N fertilization	29
3.1 Introduction	30
3.2 Materials and methods.....	31
3.2.1 Soil characters.....	31
3.2.2 Soil lysimeter experimental setup	31
3.2.3 Experimental procedures	33
3.2.4 N ₂ O flux measurements.....	37
3.2.5 Isotope-ratio measurements.....	37
3.2.6 Eh measurements.....	38
3.2.7 Statistical approach.....	38
3.3 Results	38
3.3.1 Impact of hydrological events on on soil water potential and Eh.....	38
3.3.2 Impact of hydrological events on N ₂ O emissions	41
3.3.3 Variations of $\delta^{15}\text{N}^{\text{bulk}}$, ^{15}N SP and $\delta^{18}\text{O}$ of N ₂ O emissions.....	42
3.3.4 Impact of different hydrological events on mineral N and dissolved N ₂ O concentrations along the soil profile	43
3.4 Discussion.....	45
3.4.1 Effects of Soil Hydrological Conditions on Eh and Dissolved N	45
3.4.2 Changes in N ₂ O emissions in response to changes in soil water potential, Eh, and available N	46
3.5 Conclusions	47
Chapter 4.....	49

Investigating the controls on greenhouse gas emission in the riparian zone of a small headwater catchment using an automated monitoring system	49
4.1 Introduction.....	50
4.2 Methods.....	51
4.2.1 Site description and instrumentation.....	51
4.2.2 Experimental setup	52
4.2.3 Sample collection and laboratory analysis	59
4.2.4 Statistical analysis	60
4.3 Results	60
4.3.1 Meteorology and soil data	60
4.3.2 Variations in soil hydrological state variables and redox potential	61
4.3.3 Variations in GHG emissions	62
4.3.4 Correlation of CO ₂ fluxes with environmental variables.....	63
4.3.5 Correlation of N ₂ O fluxes and CH ₄ fluxes with environmental variables	65
4.3.6 Multivariate regression analysis	66
4.4 Discussion	66
4.4.1 Redox potential monitoring.....	66
4.4.2 Soil respiration.....	67
4.4.3 Soil nitrous oxide emissions and N variations	68
4.4.4 Methane emissions.....	68
4.5 Conclusions.....	69
 Chapter 5	 71
Synopsis	71
5.1 Summary	72
5.2 Synthesis	74
5.3 Perspective.....	77
5.3.1 Soil Eh measurements.....	77
5.3.2 N ₂ O source partitioning using stable isotopes	77
5.3.3 Developing effective measures to mitigate soil GHG emissions	78
 References.....	 79
 Supplementary material.....	 95

Energie & Umwelt / Energy & Environment
Band / Volume 554
ISBN 978-3-95806-581-9