

Contents

1	Introduction	1
1.1	The need of innovative modelling methods	3
1.1.1	Inverse modelling	4
1.1.2	Modelling biodiversity and neutral theory	5
1.1.3	The state of global deforestation	6
1.2	Main objectives of the thesis	7
1.2.1	Chapter 2	8
1.2.2	Chapter 3	8
1.2.3	Chapter 4	8
2	Fast calibration of a dynamic vegetation model	9
2.1	Introduction	9
2.2	Material and methods	10
2.2.1	Nonlinear regression model	10
2.2.2	Parameter estimation	11
2.2.3	General calibration procedure	12
2.2.4	Modelling the dynamics of tropical forest	13
2.2.5	Data generation	14
2.3	Results	16
2.3.1	Virtual data test case	16
2.3.2	Real case - single species group	18
2.3.3	Real data case - multiple species group	21
2.4	Discussion	22
3	Size-structured neutral theory	25
3.1	Introduction	25
3.2	Material and methods	27
3.2.1	Study site	27
3.2.2	The size-structured spatially explicit neutral model	27
3.2.3	Linking model and data	30
3.3	Results	34
3.3.1	Prediction of ecological patterns	34
3.3.2	Global parameter screening	37
3.4	Discussion	40

4	The global state of forest fragmentation	43
4.1	Introduction	43
4.2	Material and methods	44
4.2.1	Database: Hansen's forest cover map	44
4.2.2	The advanced cluster analysis algorithm	44
4.2.3	Compression of labelled forest fragment maps	45
4.2.4	Forest fragment characteristics	45
4.2.5	Structural fragment analysis for different ecoregions	47
4.2.6	Mapping forest conditions in relation to fragmentation	48
4.3	Results	49
4.3.1	Global analysis of forest fragment structure for the year 2000	49
4.3.2	Global analysis of forest fragment condition for the year 2000	53
4.4	Discussion	56
4.5	Conclusion	57
5	Discussion and perspectives	59
5.1	Model calibration and uncertainty assessment	59
5.2	Understanding the mechanisms that shape biodiversity	61
5.3	Analysis of high-resolution forest cover maps	61
5.4	Outlook	63
A	Appendix for Chapter 2	65
A.1	Uncertainty assessment	65
A.2	Identifiability	66
A.3	Model selection	66
B	Appendix for Chapter 3	69
B.1	Parameter screening	69
B.1.1	The morris method for global parameter screening	69
B.1.2	Individual screening results	69
B.2	Calibration	71
C	Appendix for Chapter 4	73
C.1	Data structures of the cluster analysis algorithm	73
C.2	Compression method used on labelled images	73
C.3	Summary of results for a tree cover threshold of 25%	74
C.4	Edge detection method	75
	List of Figures	79
	List of Tables	82
	Bibliography	83