Model-based Source Partitioning of Eddy Covariance Flux Measurements

Anne Klosterhalfen
Model-based Source Partitioning of Eddy Covariance Flux Measurements

Anne Klosterhalfen
# TABLE OF CONTENTS

Abstract I
Zusammenfassung III
Table of Contents VII
List of Figures IX
List of Tables XII
List of Abbreviations and Variables XIII

1. General Introduction and Motivation 1
   1.1. Land-atmosphere exchange of carbon dioxide and water vapor 2
     1.1.1. Water cycle and water vapor fluxes 2
     1.1.2. Carbon cycle and carbon dioxide fluxes 3
   1.2. Eddy covariance flux measurements 5
   1.3. Source partitioning approaches 7
   1.4. Motivation and objective 9

2. Multi-site Calibration and Validation of a Net Ecosystem Carbon Exchange Model for Croplands 11
   2.1. Introduction 12
   2.2. Material and methods 14
     2.2.1. The AgroC model 14
     2.2.2. Study sites and data availability 15
     2.2.3. Model setup and initialization 16
     2.2.4. Model calibration 17
   2.3. Results and discussion 19
     2.3.1. Calibration and validation of AgroC 19
     2.3.2. Calibration with NEE data 27
   2.4. Conclusions 32
   2.5. Acknowledgements 32

3. Sensitivity Analysis of a Source Partitioning Method for H₂O and CO₂ Fluxes Based on High Frequency Eddy Covariance Data: Findings from Field Data and Large Eddy Simulations 33
   3.1. Introduction 34
   3.2. Material and methods 36
     3.2.1. Study sites 36
     3.2.2. Source partitioning based on high frequency data - SK10 37
3.2.3. Large eddy simulations 41
3.3. Results and discussion 44
  3.3.1. Source partitioning of field data 44
  3.3.2. Large eddy simulations 50
3.4. Summary and conclusions 58
3.5. Acknowledgements 59

4. Source Partitioning of H₂O and CO₂ Fluxes Based on High Frequency Eddy Covariance Data: a Study Sites Comparison 61
  4.1. Introduction 62
  4.2. Material and methods 63
    4.2.1. Source partitioning after Scanlon and Kustas (2010) - SK10 63
    4.2.2. Source partitioning after Thomas et al. (2008) - TH08 64
    4.2.3. Study sites and data processing 66
    4.2.4. Evaluation of source partitioning results 68
    4.2.5. Analysis of source partitioning approaches 68
  4.3. Results and discussion 69
    4.3.1. Evaluation of source partitioning results 71
    4.3.2. Analysis of source partitioning approaches 77
  4.4. Conclusions 81
  4.5. Acknowledgements 82

5. Final Conclusions 83

Appendix 87
  A. The AgroC model 87
  B. Source partitioning based on high frequency data 98
  C. Study sites comparison 107

References 121

Acknowledgements 131
Model-based Source Partitioning of Eddy Covariance Flux Measurements
Anne Klosterhalfen