Contents

1 Background and Motivation 1
1.1 Magnetosphere 1
1.2 Electron Radiation Belt Dynamics 1
1.2.1 Response to Geomagnetic Storms 2
1.2.2 Response to Substorms 2
1.2.3 Response to Solar Cycles and Seasons 3
1.3 Basic Theory 4
1.3.1 Single-Particle Orbit Theory 4
1.3.2 Kinetic Theory 7
1.4 Research Contents 9
References 10

2 Local Diffusion 13
2.1 Introduction 13
2.2 Local Radiation Belt Diffusion Model 14
2.2.1 Background Magnetic Field 14
2.2.2 Basic Equation 14
2.2.3 Diffusion Coefficients 16
2.2.4 Numerical Method 19
2.3 Idealized Simulations 21
2.3.1 Chorus 21
2.3.2 Hiss 22
2.3.3 EMIC 27
2.4 Conclusions and Discussions 31
References 35

3 Radial Diffusion 41
3.1 Introduction 41
3.2 Global Radiation Belt Diffusion Model STEERB 42
3.2.1 Background Magnetic Field 42

3.2.2 Basic Equation. 42
3.2.3 Diffusion Coefficients. 44
3.2.4 Numerical Method 47
3.3 Idealized Simulations 49
3.3.1 Steady State 49
3.3.2 Storm-Time Dynamics 49
3.4 Conclusions and Discussions 56
References 58

4 Adiabatic Transport 63
4.1 Introduction. 63
4.2 Improved Global Radiation Belt Diffusion Model STEERB 64
4.2.1 Background Magnetic Field. 64
4.2.2 Basic Equation. 64
4.2.3 Diffusion Coefficients. 65
4.2.4 Numerical Method 65
4.3 Idealized Simulations 67
4.3.1 Fully Adiabatic Transport 67
4.3.2 Combination of Adiabatic and Nonadiabatic Processes 70
4.4 Application 76
4.4.1 Background. 76
4.4.2 Observations 78
4.4.3 Simulations 78
4.5 Conclusions and Discussions 81
References 84

5 Magnetospheric Convection 87
5.1 Introduction. 87
5.2 Global Radiation Belt Convection-Diffusion Model STEERB . . . 88
5.2.1 Background Electromagnetic Fields 88
5.2.2 Basic Equation. 89
5.2.3 Convection and Diffusion Coefficients 89
5.2.4 Numerical Method 90
5.3 Application 91
5.3.1 Background. 91
5.3.2 Inputs. 91
5.3.3 Outputs. 92
5.4 Conclusions and Discussions 96
References 97

6 Summary 101
6.1 Developing of STTERB Model and Obtained Physical Results 101
6.2 Comparison of Radiation Belt Kinetic Models 102
6.3 Future Developments of STEERB Model 104
References 104

http://www.springer.com/978-3-662-46650-6

A Global Kinetic Model for Electron Radiation Belt Formation and Evolution

Su, Z.

2015, XI, 106 p. 46 illus., 39 illus. in color., Hardcover
ISBN: 978-3-662-46650-6