# Contents

## Preface

1 Introductory and Background Material

1.1 Scope and Goals of the Text

1.1.1 Historical Perspective

1.1.2 Organization and Limitations

1.2 Structure of the Neutral Atmosphere and the Main Ionosphere

1.3 D-Region Fundamentals

1.4 The Earth’s Magnetic Field and Magnetosphere

References

2 Fundamentals of Atmospheric, Ionospheric, and Magnetospheric Plasma Dynamics

2.1 The Basic Fluid Equations

2.1.1 Conservation of Mass

2.1.2 Equation of State

2.1.3 Momentum Equation for the Neutral Fluid

2.1.4 Momentum Equations for the Plasma

2.1.5 The Complete Equation Sets

2.2 Steady-State Ionospheric Plasma Motions Due to Applied Forces

2.3 Generation of Electric Fields

2.4 Electric Field Mapping

2.5 Elements of Magnetospheric Physics

2.5.1 The Guiding Center Equations and the Adiabatic Invariants

2.5.2 Magnetohydrodynamics

2.6 Are Ionospheric Electric Fields Real?

2.7 Coordinate Systems

References

3 Dynamics and Electrodynamics of the Equatorial Zone

3.1 Motions of the Equatorial F Region: The Database

3.2 The Equatorial F-Region Dynamo
10.1.4 Temperature Enhancements in the Trough and Stable Auroral Red Arcs
10.1.5 Horizontal Plasma Variations Due to Localized Plasma Production and Heating
10.1.6 Summary

10.2 Intermediate-Scale Structure in the High-Latitude F Region
10.2.1 The Generalized E x B Instability at High Latitudes
10.2.2 Turbulent Mixing as an Alternative to Plasma Instabilities
10.2.3 Diffusion and Image Formation

10.3 Small-Scale Waves in the High-Latitude F Region

10.4 E-Region Layering at High Latitudes

10.5 Plasma Waves and Irregularities in the High-Latitude E Region: Observations
10.5.1 Radar Observations
10.5.2 Rocket Observations of Auroral Electrojet Instabilities
10.5.3 Simultaneous Data Sets
10.5.4 Summary

10.6 Linear Auroral Electrojet Wave Theories
10.6.1 The Gradient Drift Instability
10.6.2 The Two-Stream Instability and Type 4 Radar Echoes
10.6.3 Type 3 Radar Echoes: Are They Due to Ion Cyclotron Waves?
10.6.4 Nonlinear Theories

10.7 Summary
References

Index