Chapter I

1 Introduction 1-33

1.1 Earth’s Atmosphere 1
1.2 Ionosphere 2
1.3 Electrical Conductivity of the Ionosphere 4
1.4 E-region Dynamo 6
1.5 F-region Dynamo 8
1.6 Equatorial Ionosphere-Thermosphere System 10
1.7 Equatorial Electrojet (EEJ) and Counter Electrojet (CEJ) 12
1.8 Equatorial Ionization Anomaly (EIA) 16
1.9 Neutral Anomaly (NA) 18
1.10 Equatorial Electron Temperature Anomaly (EETA) 18
1.11 Equatorial Temperature and Wind Anomaly (ETWA) 19
1.12 Equatorial Spread F (ESF) 20
1.12.1 Linear Theory of the Rayleigh-Taylor Instability 21
1.12.2 Ambient Ionosphere-Thermosphere conditions controlling the ESF generation 25
1.13 Geomagnetic Storms: Onset and Development 30
1.14 Present Study 32

Chapter II

2 Experimental Techniques and Methodology 34-53

2.1 Introduction 34
2.2 Vertical Incidence Ionosonde 35
2.2.1 Ionosonde Principle 35
2.2.2 General Description of the KEL IPS-42 Digital Ionosonde 37
2.2.3 Transmitter 39
2.2.4 Receiver 39
2.2.5 Frequency Generation 40
2.2.6 Noise Interference Suppression 40
2.2.7 Antenna System 40
2.2.8 Ionogram Presentation 41
2.3 Proton Precession Magnetometer 42
2.4 Multi-Wavelength Dayglow Photometer (MWDPM) 43
2.4.1 Hydroxyl (OH) airglow 43
2.4.2 Method of OH Rotational Temperature Estimation 45
2.4.3 Emission line of Atomic Oxygen (O(1D) 630.0 nm red line emission)

2.5 Total Electron Content (TEC) measurements using Global Positioning System (GPS)

2.6 Conclusions

Chapter III
3 Seeding Perturbations for Equatorial Spread F
3.1 Introduction
3.2 Generation mechanism of ESF
   3.2.1 Factors affecting the local growth rate of the R-T instability
3.3 Seeding Perturbations for ESF
3.4 Database used in the Present Study
3.5 Observations of the Seed Perturbations
3.6 Discussion
3.7 Conclusions

Chapter IV
4 Duration of Equatorial Spread F and its impact on L-band scintillations
4.1 Introduction
4.2 Main results on Scintillation Morphology
4.3 Database used in the Present Study
4.4 Results
   I: Duration of ESF- an analysis on seasonal, solar activity and geomagnetic activity aspects
   II: Dependence of the duration of the L-band scintillations in the EIA region on the duration of ESF over the magnetic equator
4.5 Conclusions

Chapter V
5 Equatorial and low latitude Ionosphere Thermosphere System Response to Geomagnetic storms
5.1 Introduction
   5.1.1 Disturbance Electric Field
      5.1.1.a Prompt Penetration Electric Field
      5.1.1.b Ionospheric Disturbance Dynamo Electric Field
   5.1.2 Storm time Thermospheric Changes
5.2 Data and Analysis
5.3 Importance of the Storm Period under Study
5.4 Response to the Geomagnetic Storms of August 2005
   5.4.1 Geomagnetic Conditions
   5.4.2 Latitudinal Variations of VTEC
   5.4.3 Response of the F-layer height to the Storm
   5.4.4 Thermospheric Composition Changes during the Storm
   5.4.5 Observation of a Large scale TAD
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.5</td>
<td>Response to the Geomagnetic Storms of January 2005</td>
<td>118</td>
</tr>
<tr>
<td>5.5.1</td>
<td>Geomagnetic Variations</td>
<td>118</td>
</tr>
<tr>
<td>5.5.2</td>
<td>Temporal Evolution of the Equatorial Ionization Anomaly (EIA)</td>
<td>120</td>
</tr>
<tr>
<td>5.5.3</td>
<td>Variations in the Ionospheric F-layer bottom height</td>
<td>125</td>
</tr>
<tr>
<td>5.5.4</td>
<td>Observation of F3 layer during the storm on day 18</td>
<td>128</td>
</tr>
<tr>
<td>5.6</td>
<td>Conclusions</td>
<td>130</td>
</tr>
<tr>
<td>6</td>
<td>Additional Stratification in the Equatorial and low latitude</td>
<td>131-148</td>
</tr>
<tr>
<td>6.1</td>
<td>Introduction</td>
<td>131</td>
</tr>
<tr>
<td>6.2</td>
<td>F3 layer occurrence over the Equatorial and low latitude</td>
<td>133</td>
</tr>
<tr>
<td>6.3</td>
<td>General features of the F3 layer over Trivandrum</td>
<td>135</td>
</tr>
<tr>
<td>6.4</td>
<td>Statistics of occurrence of the F3 layer over Trivandrum</td>
<td>137</td>
</tr>
<tr>
<td>6.5</td>
<td>Dawn and Dusk F3 layer Observations</td>
<td>139</td>
</tr>
<tr>
<td>6.6</td>
<td>Geomagnetic Conditions</td>
<td>141</td>
</tr>
<tr>
<td>6.7</td>
<td>Sheffield University Plasmasphere Ionosphere Model (SUPIM)</td>
<td>144</td>
</tr>
<tr>
<td>6.8</td>
<td>Model Calculations and Inputs</td>
<td>145</td>
</tr>
<tr>
<td>6.9</td>
<td>Model Results and Discussion</td>
<td>147</td>
</tr>
<tr>
<td>6.10</td>
<td>Conclusions</td>
<td>148</td>
</tr>
<tr>
<td>7</td>
<td>Summary and Future Scope</td>
<td>149-152</td>
</tr>
<tr>
<td>7.1</td>
<td>Summary and Conclusions</td>
<td>149</td>
</tr>
<tr>
<td>7.2</td>
<td>Future Scope</td>
<td>151</td>
</tr>
<tr>
<td>References</td>
<td></td>
<td>153-184</td>
</tr>
</tbody>
</table>