
Contents

Preface	xi
Part 1. Earth Science Remote Sensing	xvii
Introduction to Part 1	xix
Dominique LAFFLY	
Chapter 1. A Brief History of Remote Sensing	1
Dominique LAFFLY	
1.1. History	1
1.2. Fields of application	8
1.3. Orbits, launchers and platforms	10
1.4. The acquired data are digital images	12
1.5. So what is remote sensing? Some definitions	14
1.6. Notes	19
1.7. References	21
Chapter 2. Physics of RS	23
Luca TOMASSETTI	
2.1. Introduction	23
2.2. Remote sensing	23
2.3. Fundamental properties of electromagnetic waves	29
2.3.1. Wave equation and solution	29
2.3.2. Quantum properties of electromagnetic radiation	30
2.3.3. Polarization, coherence, group and phase velocity, the Doppler effect	31

2.4. Radiation quantities	31
2.4.1. Spectral quantities	33
2.4.2. Luminous quantities	34
2.5. Generation of electromagnetic waves	34
2.6. Detection of electromagnetic waves	37
2.7. Interaction of electromagnetic waves with matter	38
2.7.1. Overview	38
2.7.2. Interaction mechanisms	39
2.8. Solid surfaces sensing in the visible and near infrared	41
2.8.1. Wave-surface interaction mechanisms	43
2.9. Radiometric and geometric resolutions	45
2.10. References	46
Chapter 3. Image Quality	47
Dominique LAFFLY	
3.1. Introduction	47
3.2. Image quality – geometry	54
3.2.1. Whiskbroom concept	57
3.2.2. Pushbroom concept	60
3.2.3. Full frame concept	62
3.2.4. Optical geometric distortions	64
3.2.5. Relief distortions	66
3.2.6. Inverse location model	67
3.2.7. Direct location model	69
3.2.8. Root Mean Square (RMS) validation	72
3.2.9. Resampling methods	73
3.2.10. Image geometric quality to assume geographical space continuity	75
3.3. Image quality – radiometry	76
3.3.1. Radiometric model of the instrument	78
3.3.2. Radiometric equalization and calibration	79
3.3.3. Radiometric signal noise reduction (SNR)	81
3.3.4. Radiometric physical value	82
3.3.5. Image quality – resolution	84
3.4. Conclusion	91
3.5. Notes	91
3.6. References	91
Chapter 4. Remote Sensing Products	95
Van Ha PHAM, Viet Hung LUU, Anh PHAN, Dominique LAFFLY, Quang Hung BUI and Thi Nhat Thanh NGUYEN	
4.1. Atmospheric observation	95
4.1.1. Introduction to common atmospheric gases and particles	95

4.1.2. Introduction to meteorological parameters	103
4.1.3. Atmospheric observation from satellite	107
4.2. Land observation.	128
4.2.1. Introduction	128
4.2.2. Land cover/land use classification system	129
4.2.3. Legend	134
4.2.4. Data	134
4.2.5. Methodology	137
4.2.6. Global land cover datasets	154
4.3. Conclusion	158
4.4. References	158
Chapter 5. Image Processing in Spark	163
Yannick LE NIR, Florent DEVIN, Thomas BALDAQUIN, Pierre MESLER LAZENNEC, Ji Young JUNG, Se-Eun KIM, Hyeyoung KWON, Lennart NILSEN, Yoo Kyung LEE and Dominique LAFFLY	
5.1. Introduction	163
5.2. Prediction map generation	164
5.2.1. Spark	164
5.2.2. Implementation	165
5.2.3. Naive method	167
5.2.4. Advanced method.	168
5.3. Conclusion	171
Chapter 6. Satellite Image Processing using Spark on the HUPI Platform	173
Vincent MORENO and Minh Tu NGUYEN	
6.1. Introduction	173
6.2. Presentation of GeoTrellis	174
6.3. Using GeoTrellis in Hupi-Notebook	174
6.3.1. Some core concepts of GeoTrellis.	177
6.3.2. Computation of NDVI	177
6.3.3. Compare two NDVI	178
6.3.4. Descriptive statistics of NDVI per Tile	178
6.3.5. K-means	179
6.4. Workflows in HDFS: automatize image processing	181
6.4.1. Create a jar	181
6.4.2. Monitor the Spark jobs	182
6.4.3. Tune performance of the Spark job	183
6.4.4. Create a workflow in Hupi-Studio.	184

6.5. Visualizations in Hupi-Front	186
6.6. Cloud service.	188
6.7. Development	189
Chapter 7. Remote Sensing Case Studies	191
Van Ha PHAM, Thi Nhat Thanh NGUYEN and Dominique LAFFLY	
7.1. Satellite AOD validation using R.	191
7.1.1. Introduction	191
7.1.2. Datasets	192
7.1.3. Validation methodology	195
7.1.4. Experiments and results	198
7.1.5. Conclusion.	204
7.2. Georeferencing satellite images	204
7.2.1. Introduction	204
7.2.2. Georeferencing methods	205
7.2.3. Datasets and methodology	207
7.2.4. Results and discussion	210
7.3. Conclusion	216
7.4. Appendix: R source code of validation process.	217
7.5. References	222
Conclusion to Part 1	225
Dominique LAFFLY	
Part 2. GIS Application and Geospatial Data Infrastructure	227
Chapter 8. Overview of GIS Application	229
Quang Huy MAN	
8.1. Introduction	229
8.2. Enterprise GIS for environmental management.	230
8.3. GIS and decision-making in planning and management	232
8.3.1. Data quality and control	233
8.3.2. Decision support systems (DSS)	233
8.3.3. Integrating GIS with the DSS	234
8.4. GIS for water-quality management.	235
8.5. GIS for land-use planning.	236
8.6. Application of the technology in LUP and management	240
8.6.1. Computers and software programs applied to LUP and management	241
8.6.2. Application of GIS analysis and MCE in land-use planning and management.	242
8.7. References	243

Chapter 9. Spatial Data Infrastructure	247
Quang Hung BUI, Quang Thang LUU, Duc Van HA, Tuan Dung PHAM, Sanya PRASEUTH and Dominique LAFFLY	
9.1. Introduction	247
9.2. Spatial data infrastructure	247
9.3. Components of spatial data infrastructure	249
9.4. Open standards for spatial data infrastructure	251
9.4.1. Open geospatial consortium (OGC)	251
9.4.2. OGC's open standards	252
9.4.3. Usage of OGC's open standards in SDI.	255
9.5. Server architecture models for the National Spatial Data Infrastructure and Geospatial One-Stop (GOS) portal.	256
9.5.1. GOS portal architecture	256
9.5.2. Standards for GOS portal architecture	257
9.5.3. Taxonomy of geospatial server architecture	257
9.5.4. Three reference architectures for server architecture model.	258
9.6. References	260
List of Authors	263
Index	265
Summaries of other volumes	267