

CHAPTER ONE: INTRODUCTION .....	1
STUDY GOAL AND OBJECTIVES .....	1
REASONS FOR DOING THE STUDY .....	1
<i>TABLE A AGENCIES TARGETED FOR MAJOR R&amp;D FUNDING</i>	
<i>THROUGH THE ARRA (\$ MILLIONS)</i> .....	2
INTENDED AUDIENCE.....	2
SCOPE OF REPORT .....	3
METHODOLOGY .....	3
INFORMATION SOURCES .....	4
ANALYST'S CREDENTIALS.....	4
RELATED BCC REPORTS .....	4
BCC ON-LINE SERVICES.....	5
DISCLAIMER .....	5
CHAPTER TWO: SUMMARY.....	6
<i>SUMMARY TABLE VALUE OF REMOTE SENSING PRODUCTS, BY</i>	
<i>PLATFORM, THROUGH 2014 (\$ BILLIONS)</i> .....	6
<i>SUMMARY FIGURE VALUE OF REMOTE SENSING PRODUCTS, BY</i>	
<i>PLATFORM, 2008-2014 (\$ BILLIONS)</i> .....	7
CHAPTER THREE: OVERVIEW OF THE REMOTE SENSING BUSINESS.....	8
OVERVIEW OF THE REMOTE SENSING BUSINESS .....	8
REMOTELY SENSED PHENOMENA.....	9
<i>TABLE 1 REMOTELY SENSED PHENOMENA</i> .....	10
<i>TABLE 1 (CONTINUED)</i> .....	11
<i>TABLE 2 REMOTE SENSING INSTRUMENTS ACRONYMS</i> .....	11
<i>TABLE 2 (CONTINUED)</i> .....	12
<i>TABLE 2 (CONTINUED)</i> .....	13
FROM SENSOR TO PRODUCT .....	13
<i>TABLE 3 THE 10 BASIC TYPES OF REMOTE SENSING</i>	
<i>INSTRUMENTS</i> .....	13
<i>TABLE 4 THE FOUR REMOTE SENSING PLATFORMS</i> .....	14
<i>TABLE 5 THE 20 MARKET-DRIVEN APPLICATIONS FOR REMOTELY</i>	
<i>SENSED DATA</i> .....	14
THE REMOTE SENSING MARKET.....	14
THE REMOTE SENSING MARKET (CONTINUED) .....	15
THE REMOTE SENSING MARKET (CONTINUED) .....	16
REMOTE SENSING IN THE BUSH ADMINISTRATION .....	17
REMOTE SENSING IN THE BUSH ... (CONTINUED) .....	18
POLICY CHANGES LIKELY DURING THE OBAMA	
ADMINISTRATION .....	19
POLICY CHANGES LIKELY DURING ... (CONTINUED) .....	20
<i>TABLE 6 U.S. GOVERNMENT AGENCY INVOLVEMENT IN</i>	
<i>COMMERCIAL REMOTE SENSING PRODUCTS</i> .....	21
THE REMOTE SENSING BUSINESS BEYOND 2010.....	21

FUTURE DEMAND FOR REMOTE SENSING PRODUCTS.....	22
GLOBAL DEMAND BY REGION .....	22
<i>TABLE 7 REGIONAL DEMAND FOR REMOTE SENSING PRODUCTS</i>	
<i>USED IN ALL APPLICATIONS, THROUGH 2014 (\$ MILLIONS)</i> .....	23
DEMAND BY INSTRUMENT.....	23
<i>TABLE 8 RELATIVE IMPORTANCE OF REMOTE SENSING</i>	
<i>INSTRUMENTS, 2009-2014</i> .....	24
<i>TABLE 9 VALUE OF REMOTE SENSING PRODUCTS, BY</i>	
<i>INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	24
DEMAND BY PLATFORM.....	24
<i>TABLE 10 GLOBAL VALUE OF REMOTE SENSING PRODUCTS FOR</i>	
<i>ALL APPLICATIONS, BY PLATFORM, THROUGH 2014 (\$</i>	
<i>MILLIONS)</i> .....	25
DEMAND BY APPLICATION.....	25
<i>TABLE 11 VALUE OF REMOTE SENSING PRODUCTS, BY</i>	
<i>APPLICATION, THROUGH 2014 (\$ MILLIONS)</i> .....	26
 CHAPTER FOUR: FORCES DRIVING THE REMOTE SENSING	
BUSINESS.....	27
FORCES DRIVING THE REMOTE SENSING BUSINESS .....	27
ECONOMIC-DRIVEN CONSIDERATIONS .....	28
THE RECENT RECESSION .....	28
<i>TABLE 12 EFFECT OF THE RECENT RECESSION ON THE</i>	
<i>WORLDWIDE DEMAND FOR REMOTE SENSING PRODUCTS, BY</i>	
<i>APPLICATION</i> .....	28
<i>TABLE 12 (CONTINUED)</i> .....	29
THE AMERICAN RECOVERY AND REINVESTMENT ACT .....	30
The American Recovery and Reinvestment Act	
(Continued) .....	31
<i>TABLE 13 IMPACT OF ARRA FUNDING ON FEDERAL R&amp;D</i>	
<i>BUDGETS, 2008 AND 2009 (\$ MILLIONS)</i> .....	32
THE FREE DATA MOVEMENT.....	32
The Free Data Movement (Continued) .....	33
THE NASA-METI DIGITAL MAP .....	34
FREE DATA INSPIRED NEW BUSINESS PLANS .....	35
Free Data Inspired New ... (Continued).....	36
U.S. NATIONAL POLICY-DRIVEN CONSIDERATIONS.....	37
COOPERATION ON CLIMATE CHANGE .....	37
Cooperation on Climate Change (Continued).....	38
LATIN AMERICAN AND CARIBBEAN INITIATIVES .....	39
TECHNOLOGY-DRIVEN CONSIDERATIONS .....	39
GPS: A CRITICAL ENABLING TECHNOLOGY.....	40
<i>TABLE 14 NAVSTAR SATELLITES (JUNE 30, 2009)</i> .....	41
<i>TABLE 14 (CONTINUED)</i> .....	42
<i>TABLE 15 GLONASS SATELLITES (JUNE 30, 2009)</i> .....	42

<i>TABLE 15 (CONTINUED)</i> .....	43
<i>TABLE 16 GLOBAL NAVIGATION SATELLITE SYSTEMS</i> .....	44
<i>TABLE 16 (CONTINUED)</i> .....	45
<i>TABLE 17 NAVSTAR ACCURACY (LEVEL ACCURACY)</i> .....	45
<i>TABLE 18 SOURCES AND EFFECTS OF GPS ERRORS</i> .....	45
THE EUROPEAN GEOSTATIONARY NAVIGATION OVERLAY SERVICE.....	45
GIS: THE TAIL THAT WAGS THE DOG.....	46
GIS: The Tail that WAGS the Dog (Continued) .....	47
<i>TABLE 19 RELATIVE IMPORTANCE OF GPS AND GIS TO REMOTE SENSING APPLICATION</i> .....	48
GIS: The Tail that WAGS the Dog (Continued) .....	49
CHAPTER FIVE: ESSENTIAL CONCEPTS IN REMOTE SENSING .....	50
BASIC CONSIDERATIONS.....	50
THE FOUR FORCES OF NATURE.....	51
The Four Forces of Nature (Continued) .....	52
<i>TABLE 20 BASIC TYPES OF SENSING INSTRUMENTS</i> .....	53
THE PIVOTAL ROLE OF ELECTROMAGNETISM .....	53
ACTIVE VERSUS PASSIVE DEVICES.....	54
IMAGING VERSUS NON-IMAGING DEVICES .....	55
<i>TABLE 21 FREQUENCIES USEFUL FOR OBSERVATION</i> .....	55
<i>TABLE 21 (CONTINUED)</i> .....	56
EXTRACTING INFORMATION FROM SIGNALS.....	56
<i>TABLE 22 EFFECT OF TYPICAL PROCESSING LEVELS</i> .....	57
Spatial Resolution .....	57
Temporal Resolution .....	58
Spectral Resolution.....	58
Radiometric Resolution .....	58
FROM SENSOR TO INFORMATION .....	58
From Sensor to Information (Continued) .....	59
Altitude Corrections .....	60
Transposing Data to Maps .....	61
<i>TABLE 23 MAP PROJECTION METHODS</i> .....	61
Atmospheric Corrections .....	62
Object Identification .....	63
<i>TABLE 24 LANDSAT ETM+ BAND IDENTIFICATION AND SPECTRAL RANGE (NANOMETERS)</i> .....	64
<i>TABLE 25 BEST LANDSAT BANDS FOR IDENTIFYING SURFACE FEATURES</i> .....	65
Spectral Enhancement .....	65
Multispectral Enhancement.....	66
Filters.....	67
<i>TABLE 26 FOURIER FILTERS</i> .....	67
GROUND TRUTH .....	68

DATA DISTRIBUTION .....	68
<i>TABLE 27 COMMITTEE ON EARTH OBSERVATION SATELLITES, MEMBERS</i> .....	69
<i>TABLE 27 (CONTINUED)</i> .....	70
<i>TABLE 28 COMMITTEE ON EARTH OBSERVATION SATELLITES: ASSOCIATES</i> .....	70
ESA CENTRE FOR EARTH OBSERVATION .....	71
EROS DATA CENTER.....	72
GEOSPATIAL DATA GATEWAY .....	72
INTEGRATED OCEAN OBSERVING SYSTEM .....	72
NASA DISTRIBUTED ACTIVE ARCHIVE CENTERS.....	73
Alaska Satellite Facility .....	73
Crustal Dynamics Data Information System.....	73
Global Hydrology Resource Center .....	73
Goddard Earth Sciences Data and Information Services Center .....	74
Land Processes .....	74
Level 1 Atmosphere Archive and Distribution System.....	74
Langley Research Center Atmospheric Science Data Center .....	74
National Snow and Ice Data Center .....	74
Oak Ridge National Laboratory.....	75
Ocean Biology Processing Group .....	75
NASA JPL.....	75
Socioeconomic Data and Applications .....	75
NATIONAL AERIAL PHOTOGRAPHY PROGRAM .....	76
NATIONAL ECOLOGICAL OBSERVATORY NETWORK .....	76
NATIONAL OCEAN SERVICE HYDROGRAPHIC DATABASE .....	76
THE SYSTEM-OF-SYSTEMS APPROACH .....	77
<i>TABLE 29 RETURN FROM ENTERING MODELS: AIR</i> .....	78
<i>TABLE 29 (CONTINUED)</i> .....	79
The System-of-Systems Approach (Continued).....	80
CHAPTER SIX: INSTRUMENTS .....	81
INSTRUMENTS .....	81
INSTRUMENTS (CONTINUED) .....	82
DEMAND FORECAST, BY INSTRUMENT.....	83
Instrument Demand by Value .....	83
<i>TABLE 30 VALUE OF REMOTE SENSING PRODUCTS, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	84
Instrument Demand by Growth Rate.....	84
<i>TABLE 31 GROWTH OF ALL REMOTE SENSING PRODUCTS, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	85
ACOUSTIC INSTRUMENTS.....	85
SONAR.....	86

INFRASOUND .....	87
<i>TABLE 32 APPLICATIONS FOR INFRASONIC DETECTION SYSTEMS.....</i>	<i>87</i>
CAMERAS (DIGITAL).....	87
CAMERAS (DIGITAL) (CONTINUED) .....	88
CAMERAS (FILM).....	89
<i>TABLE 33 FILMS USED FOR REMOTE SENSING .....</i>	<i>89</i>
PANCHROMATIC FILMS.....	89
NATURAL COLOR FILMS .....	90
INFRARED FILMS.....	90
ULTRAVIOLET FILMS.....	91
GRAVITATIONAL INSTRUMENTS.....	91
GRAVIMETERS .....	92
GRADIOMETERS .....	92
LASER INSTRUMENTS .....	93
LASER RANGING .....	93
LIDAR.....	93
RADAR .....	94
<i>TABLE 34 RADAR BANDS.....</i>	<i>95</i>
<i>TABLE 34 (CONTINUED).....</i>	<i>96</i>
DOPPLER WEATHER RADAR.....	96
SYNTHETIC APERTURE RADARS.....	96
SYNTHETIC APERTURE RADAR INTERFEROMETRY .....	97
GROUND-PENETRATING RADARS.....	97
<i>TABLE 35 CHARACTERISTICS OF GROUND PENETRATING RADAR</i> <i>(RESOLUTION AND PULSE CHARACTERISTICS).....</i>	<i>98</i>
<i>TABLE 36 COMMERCIALY SIGNIFICANT RADAR SATELLITES (BY</i> <i>SPATIAL RESOLUTION, METER) .....</i>	<i>99</i>
SEISMIC INSTRUMENTS .....	99
<i>TABLE 37 SEISMIC SENSORS (V/METER, HIGHER IS BETTER).....</i>	<i>100</i>
SPECTRAL IMAGING .....	100
MULTISPECTRAL INSTRUMENTS .....	100
<i>TABLE 38 BANDS COMMONLY USED IN REMOTE SENSING.....</i>	<i>101</i>
<i>TABLE 39 ALPHABETICAL LIST OF MOST COMMONLY USED</i> <i>MULTISPECTRAL INSTRUMENTS.....</i>	<i>102</i>
<i>TABLE 39 (CONTINUED).....</i>	<i>103</i>
<i>TABLE 40 INSTRUMENTS BY NUMBER OF SPECTRAL BANDS.....</i>	<i>103</i>
<i>TABLE 40 (CONTINUED).....</i>	<i>104</i>
HYPER SPECTRAL ANALYZERS .....	104
<i>TABLE 41 ALPHABETICAL LIST OF THE MOST COMMONLY USED</i> <i>HYPER SPECTRAL INSTRUMENTS.....</i>	<i>105</i>
<i>TABLE 42 COMMERCIALY SIGNIFICANT HYPER SPECTRAL</i> <i>IMAGING SATELLITES (BY SPATIAL RESOLUTION, METER) .....</i>	<i>106</i>
PLATFORM-OPTIMIZED INSTRUMENTS.....	106
INSTRUMENTS OPTIMIZED FOR AIRBORNE PLATFORMS.....	107

AIRSAR: Airborne Synthetic Aperture Radar .....	107
<i>TABLE 43 AIRSAR – AIRBORNE SYNTHETIC APERTURE RADAR .....</i>	<i>108</i>
<i>TABLE 44 AIRSAR SPECIFICATIONS.....</i>	<i>108</i>
<i>TABLE 45 COMMONLY USED AIRBORNE REMOTE SENSING</i>	
<i>INSTRUMENTS.....</i>	<i>108</i>
<i>TABLE 45 (CONTINUED).....</i>	<i>109</i>
INSTRUMENTS OPTIMIZED FOR AQUATIC PLATFORMS .....	110
R3M .....	110
The FIRST Navy Thermography System .....	110
KEY SPACE-OPTIMIZED INSTRUMENTS.....	111
ASAR: Advanced Synthetic Aperture Radar.....	111
ASTER: Advanced Spaceborne Thermal Emission And	
Reflection Radiometer .....	112
<i>TABLE 46 ASTER PRODUCT SPECIFICATIONS.....</i>	<i>112</i>
ATSR: Along Track Scanning Radiometer .....	113
MODIS: Moderate Resolution Imaging Spectroradiometer.....	113
<i>TABLE 47 MODIS SPECIFICATIONS .....</i>	<i>113</i>
<i>TABLE 48 DETAILED MODIS PRODUCT SPECIFICATIONS .....</i>	<i>114</i>
<i>TABLE 48 (CONTINUED).....</i>	<i>115</i>
<i>TABLE 48 (CONTINUED).....</i>	<i>116</i>
MSS: Multi-Spectral Scanner .....	116
MSS: Multi-Spectral Scanner (Continued) .....	117
<i>TABLE 49 MSS SPECIFICATIONS.....</i>	<i>118</i>
TM: Thematic Mapper.....	118
<i>TABLE 50 THEMATIC MAPPER PLUS SPECIFICATIONS.....</i>	<i>118</i>
INSTRUMENTS OPTIMIZED FOR TERRESTRIAL	
PLATFORMS .....	119
AERI: Atmospheric Emitted Radiance Interferometer.....	119
<i>TABLE 51 AERI: ATMOSPHERIC EMITTED RADIANCE</i>	
<i>INTERFEROMETER .....</i>	<i>119</i>
<i>TABLE 52 AERI SPECIFICATIONS.....</i>	<i>119</i>
CHAPTER SEVEN: PLATFORMS .....	120
PLATFORMS .....	120
<i>TABLE 53 OPERATIONAL COST AND COST TRENDS FOR</i>	
<i>PLATFORMS .....</i>	<i>121</i>
DEMAND BY PLATFORM .....	121
<i>TABLE 54 VALUE OF REMOTE SENSING PRODUCTS FOR ALL</i>	
<i>APPLICATIONS, BY PLATFORM, THROUGH 2014 (\$ MILLIONS) .....</i>	<i>122</i>
<i>TABLE 55 GROWTH OF DEMAND FOR REMOTE SENSING</i>	
<i>PRODUCTS, BY PLATFORM, THROUGH 2014 (%).....</i>	<i>122</i>
MISSION VERSUS PLATFORM.....	122
AIRBORNE PLATFORMS .....	123
MANNED AIRBORNE PLATFORMS .....	124
<i>TABLE 56 MANNED AIRBORNE REMOTE SENSING PLATFORMS .....</i>	<i>125</i>

UNMANNED AIRBORNE PLATFORMS.....	126
AQUATIC PLATFORMS .....	126
THE NOAA FLEET.....	127
<i>TABLE 57 THE NOAA FLEET .....</i>	<i>127</i>
THE ALASKA REGION RESEARCH VESSEL (ARRV).....	128
BUOYS.....	128
<i>TABLE 58 WAVE BUOYS FOR LITTORAL APPLICATIONS .....</i>	<i>129</i>
Buoy (Continued) .....	130
<i>TABLE 59 ARGOS MEMBERS.....</i>	<i>131</i>
NEPTUNE CANADA.....	131
<i>TABLE 60 NEPTUNE CANADA INSTRUMENT LOCATIONS.....</i>	<i>132</i>
<i>TABLE 61 NEPTUNE CANADA INSTRUMENT CAPABILITIES.....</i>	<i>132</i>
SPACE-BASED PLATFORMS .....	133
UNIQUE ASPECT OF SPACE-BASED OPERATIONS .....	133
<i>TABLE 62 THRESHOLDS TO SPACE (KILOMETERS).....</i>	<i>134</i>
Orbital Basics .....	134
Space Weather .....	135
Space Debris .....	136
THE SPACE SHUTTLE.....	136
<i>TABLE 63 REMAINING SPACE SHUTTLE MISSIONS (EXCLUDES</i> <i>ANY CONTINGENCY MISSIONS).....</i>	<i>137</i>
SATELLITES BY REMOTE SENSING MISSION .....	138
The Landsat Legacy .....	138
The Landsat Legacy (Continued) .....	139
The Landsat Legacy (Continued) .....	140
<i>TABLE 64 LANDSAT SERIES REMOTE SENSING SATELLITES.....</i>	<i>141</i>
The Disaster Management Constellation.....	141
<i>TABLE 65 DISASTER MANAGEMENT CONSTELLATION</i> <i>SATELLITES.....</i>	<i>142</i>
KEY SPACE-BASED PLATFORMS .....	142
Key Space-Based Platforms (Continued).....	143
<i>TABLE 66 SIGNIFICANT 20<sup>TH</sup> CENTURY SPACE-BASED</i> <i>PLATFORMS .....</i>	<i>144</i>
<i>TABLE 67 21<sup>TH</sup> CENTURY SPACE-BASED PLATFORMS .....</i>	<i>145</i>
<i>TABLE 68 FUTURE SPACE-BASED PLATFORMS.....</i>	<i>146</i>
<i>TABLE 69 OTHER SPACE-BASED PLATFORMS .....</i>	<i>146</i>
<i>TABLE 69 (CONTINUED).....</i>	<i>147</i>
TERRESTRIAL PLATFORMS.....	147
TERRESTRIAL PLATFORMS (CONTINUED).....	148
<i>TABLE 70 C-MAN BASELINE DATASETS .....</i>	<i>149</i>
EARTHSCOPE.....	150
EARTHSCOPE (CONTINUED) .....	151
CHAPTER EIGHT: APPLICATIONS FOR REMOTE SENSING.....	152
APPLICATIONS FOR REMOTE SENSING .....	152

FORECASTS BY APPLICATION AND GROWTH RATE.....	153
DEMAND BY APPLICATION .....	154
TABLE 71 DEMAND FOR ALL REMOTE SENSING PRODUCTS, BY VALUE, THROUGH 2014 (\$ MILLIONS).....	155
TABLE 72 GROWTH IN DEMAND FOR ALL REMOTE SENSING PRODUCTS, BY APPLICATION, 2009-2014 (CAGR%).....	156
CHAPTER NINE: REMOTE SENSING IN AGRICULTURE.....	157
REMOTE SENSING IN AGRICULTURE.....	157
REMOTE SENSING IN AGRICULTURE (CONTINUED).....	158
TABLE 73 LAND SUITABLE FOR AGRICULTURE (MILLION SQ KM).....	159
TABLE 74 AGRICULTURAL MECHANIZATION (COUNTRIES WITH FEWER THAN ONE TRACTOR PER THOUSAND AGRICULTURAL WORKERS) .....	159
TABLE 75 REGIONS WITH BELOW AVERAGE FOOD PRODUCTION (CEREAL YIELD IN KILOGRAMS PER HECTARE).....	159
FORECASTS FOR AGRICULTURE.....	160
TABLE 76 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN AGRICULTURE, BY REGION, THROUGH 2014 (\$ MILLIONS).....	160
TABLE 77 PROJECTED GLOBAL DEMAND FOR REMOTE SENSING PRODUCTS USED IN AGRICULTURE, BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	161
TABLE 78 PROJECTED GLOBAL DEMAND FOR REMOTE SENSING PRODUCTS USED IN AGRICULTURE, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	161
CHAPTER TEN: REMOTE SENSING IN ARCHEOLOGICAL AND CULTURE SITE PROTECTION .....	162
REMOTE SENSING IN ARCHEOLOGICAL AND.....	162
FORECASTS FOR ARCHEOLOGICAL AND CULTURE SITE PROTECTION .....	163
TABLE 79 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN ARCHEOLOGICAL- AND CULTURE-SITE PROTECTION, BY REGION, THROUGH 2014 (\$ MILLIONS) .....	164
TABLE 80 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN ARCHEOLOGICAL- AND CULTURE-SITE PROTECTION, BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	164
TABLE 81 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN ARCHEOLOGICAL AND CULTURE SITE PROTECTION, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS) .....	165
CHAPTER ELEVEN: REMOTE SENSING IN ATMOSPHERIC RESEARCH ....	166
REMOTE SENSING IN ATMOSPHERIC RESEARCH .....	166



TABLE 82 NASA SATELLITES THAT COLLECT ATMOSPHERIC RESEARCH DATA .....	167
FORECASTS FOR ATMOSPHERIC RESEARCH.....	167
TABLE 83 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN ATMOSPHERIC RESEARCH, BY REGION, THROUGH 2014 (\$ MILLIONS).....	168
TABLE 84 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN ATMOSPHERIC RESEARCH, BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	168
TABLE 85 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN ATMOSPHERIC RESEARCH, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	169
CHAPTER TWELVE: REMOTE SENSING IN BORDER PROTECTION.....	170
REMOTE SENSING IN BORDER PROTECTION .....	170
FORECASTS FOR BORDER PROTECTION.....	171
TABLE 86 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN BORDER PROTECTION, BY REGION, THROUGH 2014 (\$ MILLIONS).....	171
TABLE 87 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN BORDER PROTECTION, BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	172
TABLE 88 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN BORDER PROTECTION, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	172
CHAPTER THIRTEEN: REMOTE SENSING IN CARTOGRAPHY.....	173
FORECASTS FOR CARTOGRAPHY.....	173
TABLE 89 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN CARTOGRAPHY, BY REGION, THROUGH 2014 (\$ MILLIONS).....	174
TABLE 90 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN CARTOGRAPHY, BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	174
TABLE 91 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN CARTOGRAPHY, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	175
CHAPTER FOURTEEN: REMOTE SENSING IN CLIMATE CHANGE STUDIES.....	176
REMOTE SENSING IN CLIMATE CHANGE STUDIES .....	176
FORECASTS FOR CLIMATE CHANGE STUDIES.....	177
TABLE 92 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN CLIMATE CHANGE STUDIES, BY REGION, THROUGH 2014 (\$ MILLIONS).....	177

<i>TABLE 93 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN CLIMATE CHANGE STUDIES, BY PLATFORM,     THROUGH 2014 (\$ MILLIONS)</i> .....	178
<i>TABLE 94 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN CLIMATE CHANGE STUDIES, BY INSTRUMENT,     THROUGH 2014 (\$ MILLIONS)</i> .....	178
CHAPTER FIFTEEN: REMOTE SENSING IN DISASTER MANAGEMENT .....	179
THE DISASTER MANAGEMENT CONSTELLATION .....	179
UN-SPIDER .....	180
FORECASTS FOR DISASTER MANAGEMENT .....	180
<i>TABLE 95 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN DISASTER MANAGEMENT, BY REGION, BY REGION,     THROUGH 2014 (\$ MILLIONS)</i> .....	181
<i>TABLE 96 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN DISASTER MANAGEMENT, BY PLATFORM, THROUGH     2014 (\$ MILLIONS)</i> .....	181
<i>TABLE 97 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN DISASTER MANAGEMENT, BY INSTRUMENT,     THROUGH 2014 (\$ MILLIONS)</i> .....	182
CHAPTER SIXTEEN: REMOTE SENSING IN FORESTRY.....	183
FORECASTS FOR FORESTRY .....	183
<i>TABLE 98 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN FORESTRY, BY REGION, THROUGH 2014 (\$ MILLIONS)</i> .....	184
<i>TABLE 99 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN FORESTRY, BY PLATFORM, THROUGH 2014 (\$     MILLIONS)</i> .....	184
<i>TABLE 100 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN FORESTRY, BY INSTRUMENT, THROUGH 2014 (\$     MILLIONS)</i> .....	184
CHAPTER SEVENTEEN: REMOTE SENSING IN HYDROLOGY AND FRESHWATER RESOURCES MANAGEMENT .....	185
FORECASTS FOR HYDROLOGY AND FRESHWATER RESOURCES MANAGEMENT.....	185
<i>TABLE 101 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN HYDROLOGY AND FRESHWATER RESOURCES     MANAGEMENT, BY REGION, THROUGH 2014 (\$ MILLIONS)</i> .....	186
<i>TABLE 102 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN HYDROLOGY AND FRESHWATER RESOURCES     MANAGEMENT, BY PLATFORM, THROUGH 2014 (\$ MILLIONS)</i> .....	186
<i>TABLE 103 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN HYDROLOGY AND FRESHWATER RESOURCES     MANAGEMENT, BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	187

CHAPTER EIGHTEEN: REMOTE SENSING IN INTELLIGENCE	
GATHERING.....	188
FORECASTS FOR INTELLIGENCE GATHERING .....	188
TABLE 104 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN INTELLIGENCE GATHERING, BY REGION, THROUGH 2014 (\$ MILLIONS).....	189
TABLE 105 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN INTELLIGENCE GATHERING BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	189
TABLE 106 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN INTELLIGENCE GATHERING BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	190
CHAPTER NINETEEN: REMOTE SENSING IN LAND-MINE	
DETECTION .....	191
FORECASTS FOR LAND-MINE DETECTION.....	191
TABLE 107 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAND-MINE DETECTION BY REGION, THROUGH 2014 (\$ MILLIONS).....	192
TABLE 108 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAND-MINE DETECTION BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	192
TABLE 109 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAND-MINE DETECTION BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	193
CHAPTER TWENTY: REMOTE SENSING IN LAND PLANNING .....	194
TABLE 110 PIONEERING STATE AND COUNTY REMOTE SENSING PROGRAMS IN THE U.S. ....	194
FEDERAL LAND ASSET INVENTORY REFORM ACT OF 2009 .....	195
FORECASTS FOR LAND PLANNING .....	195
TABLE 111 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAND PLANNING, BY REGION, THROUGH 2014 (\$ MILLIONS).....	196
TABLE 112 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAND PLANNING BY PLATFORM, THROUGH 2014 (\$ MILLIONS).....	196
TABLE 113 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAND PLANNING BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS).....	197
CHAPTER TWENTY ONE: REMOTE SENSING IN LAW ENFORCEMENT.....	198
REMOTE SENSING IN LAW ENFORCEMENT.....	198
FORECASTS FOR LAW ENFORCEMENT .....	199

<i>TABLE 114 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAW ENFORCEMENT BY REGION, THROUGH 2014 (\$ MILLIONS)</i> .....	199
<i>TABLE 115 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAW ENFORCEMENT BY PLATFORM, THROUGH 2014 (\$ MILLIONS)</i> .....	200
<i>TABLE 116 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN LAW ENFORCEMENT BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	200
CHAPTER TWENTY TWO: REMOTE SENSING IN NATURAL HAZARD MONITORING .....	
FORECASTS FOR NATURAL HAZARD MONITORING .....	201
<i>TABLE 117 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN NATURAL HAZARD MONITORING BY REGION, THROUGH 2014 (\$ MILLIONS)</i> .....	202
<i>TABLE 118 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN NATURAL HAZARD MONITORING BY PLATFORM, THROUGH 2014 (\$ MILLIONS)</i> .....	202
<i>TABLE 119 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN NATURAL HAZARD MONITORING BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	203
CHAPTER TWENTY THREE: REMOTE SENSING IN OCEANOGRAPHY .....	
FORECASTS FOR OCEANOGRAPHY .....	204
<i>TABLE 120 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN OCEANOGRAPHY BY REGION, THROUGH 2014 (\$ MILLIONS)</i> .....	205
<i>TABLE 121 PROJECTED GLOBAL REMOTE SENSING PRODUCTS IN OCEANOGRAPHY BY PLATFORM, THROUGH 2014 (\$ MILLIONS)</i> .....	206
<i>TABLE 122 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN OCEANOGRAPHY BY INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	206
CHAPTER TWENTY FOUR: REMOTE SENSING IN OIL, GAS AND MINERAL EXPLORATION.....	
FORECASTS FOR OIL, GAS AND MINERAL EXPLORATION.....	207
<i>TABLE 123 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN OIL, GAS AND MINERAL EXPLORATION BY REGION, THROUGH 2014 (\$ MILLIONS)</i> .....	208
<i>TABLE 124 PROJECTED GLOBAL REMOTE SENSING PRODUCTS USED IN OIL, GAS AND MINERAL EXPLORATION BY PLATFORM, THROUGH 2014 (\$ MILLIONS)</i> .....	208

<i>TABLE 125 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN OIL, GAS AND MINERAL EXPLORATION BY     INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	209
CHAPTER TWENTY FIVE: REMOTE SENSING IN PUBLIC HEALTH .....	210
REMOTE SENSING IN PUBLIC HEALTH .....	210
<i>TABLE 126 DISEASE-CAUSING CONDITIONS DETECTABLE FROM     SPACE-BASED PLATFORMS</i> .....	211
<i>TABLE 126 (CONTINUED)</i> .....	212
FORECASTS FOR PUBLIC HEALTH .....	212
<i>TABLE 127 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN PUBLIC HEALTH BY REGION, THROUGH 2014 (\$     MILLIONS)</i> .....	213
<i>TABLE 128 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN PUBLIC HEALTH BY PLATFORM, THROUGH 2014 (\$     MILLIONS)</i> .....	213
<i>TABLE 129 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN PUBLIC HEALTH BY INSTRUMENT, THROUGH 2014 (\$     MILLIONS)</i> .....	214
CHAPTER TWENTY SIX: REMOTE SENSING IN RIGHT-OF-WAY MANAGEMENT .....	215
FORECASTS FOR RIGHT-OF-WAY MANAGEMENT .....	215
<i>TABLE 130 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN RIGHT-OF-WAY MANAGEMENT BY REGION, THROUGH     2014 (\$ MILLIONS)</i> .....	216
<i>TABLE 131 PROJECTED GLOBAL SENSING PRODUCTS USED IN     RIGHT-OF-WAY MANAGEMENT BY PLATFORM, THROUGH 2014     (\$ MILLIONS)</i> .....	216
<i>TABLE 132 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN RIGHT-OF-WAY MANAGEMENT BY INSTRUMENT,     THROUGH 2014 (\$ MILLIONS)</i> .....	217
CHAPTER TWENTY SEVEN: REMOTE SENSING IN URBAN AND SUBURBAN APPLICATIONS .....	218
TOWARD A U.S. NATIONAL GEOSPATIAL STRATEGY .....	218
THE NATIONAL SPATIAL DATA INFRASTRUCTURE (NSDI) .....	219
FORECASTS FOR URBAN AND SUBURBAN APPLICATIONS .....	220
<i>TABLE 133 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN URBAN AND SUBURBAN APPLICATIONS BY REGION,     THROUGH 2014 (\$ MILLIONS)</i> .....	220
<i>TABLE 134 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN URBAN AND SUBURBAN APPLICATIONS BY     PLATFORM, THROUGH 2014 (\$ MILLIONS)</i> .....	221

<i>TABLE 135 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN URBAN AND SUBURBAN APPLICATIONS BY     INSTRUMENT, THROUGH 2014 (\$ MILLIONS)</i> .....	221
CHAPTER TWENTY EIGHT: REMOTE SENSING IN WEATHER	
FORECASTING .....	222
FORECASTS FOR WEATHER FORECASTING .....	222
<i>TABLE 136 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN WEATHER FORECASTING BY REGION, THROUGH 2014     (\$ MILLIONS)</i> .....	223
<i>TABLE 137 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN WEATHER FORECASTING BY PLATFORM, THROUGH     2014 (\$ MILLIONS)</i> .....	223
<i>TABLE 138 PROJECTED GLOBAL REMOTE SENSING PRODUCTS     USED IN WEATHER FORECASTING BY INSTRUMENT,     THROUGH 2014 (\$ MILLIONS)</i> .....	223
CHAPTER TWENTY NINE: REMOTE SENSING PATENT REVIEW .....	224
21 <sup>ST</sup> CENTURY PATENTS .....	224
2005 TO JUNE 2009 .....	224
Compression Assembly of Spatial Heterodyne Spectrometer .....	224
General Line of Sight Stabilization System .....	224
Cryogenically Cooled Adjustable Apertures for Infra-Red Cameras.....	225
Cross-Component Superconducting Gravity Gradiometer with Improved Linearity and Sensitivity and Method for Gravity Gradient Sensing .....	225
Vehicle Based Data Collection and Processing System .....	226
Time Domain Electromagnetic Analysis and Inspection System for Conduits.....	226
Volume-Phase Holographic Diffraction Grating Optimized for the Ultraviolet Spectral Region .....	227
Terahertz Imaging for Near Field Objects .....	227
Multispectral Multipolarization Antenna-Coupled Infrared Focal Plane Array .....	228
Image Processing Method and Apparatus Using Self- Adaptive Binarization .....	228
Digital FTIR Spectrometer.....	229
Matrix Transposition in a Computer System.....	229
On/Off Keying Node-to-Node Messaging Transceiver Network with Dynamic Routing and Configuring .....	229
Method and Apparatus for the Estimation of the Temperature of a Blackbody Radiator .....	230
Temperature Measurement Device .....	230

2000 TO 2005.....	231
Systems and Methods for Analyzing Particle Systems	
Using Polarized Scattered Light .....	231
Control of an Optical Fiber Scanner .....	231
Near-IR Human Detector .....	232
Apparatus and Method for Real Time IR Spectroscopy .....	232
VCSEL Assembly with Edge-Receiving Optical Devices .....	233
Sonar-Controlled Apparatus for the Delivery of	
Electromagnetic Radiation .....	233
Mapping Air Contaminants Using Path-Integrated	
Optical Remote Sensing with a Non-Overlapping	
Variable Path Length Beam Geometry .....	233
Methods, Systems and Computer Program Products for	
Generating Weather Forecasts from a Multi-Model	
Superensemble .....	234
Distributed Feedback Surface Plasmon Laser .....	235
Infrared Imager Using Room Temperature Capacitance	
Sensor .....	235
Aerosol Hazard Characterization and Early Warning	
Network .....	236
Tactical Thermal Luminescence Sensor for Ground Path	
Contamination Detection .....	236
Measurement of Brightness, Flow Velocity and	
Temperature of Radiant Media .....	237
Dynamic Light Scattering at Multiple Discrete	
Wavelengths, Using Multiple Mono-Mode Fibres or for	
Detecting the Velocity of Scattering Sensors .....	237
Area Receiver with Antenna-Coupled Infrared Sensors.....	238
Land-mine Detector with a High-Power Microwave	
Illuminator and an Infrared Detector .....	238
Wavelength-Tunable Coupled Antenna Uncooled Infrared	
(IR) Sensor .....	239
Microvalve and Microthruster for Satellites .....	240
Imaging Spectrometer/Camera Having Convex Grating.....	240
Polarization-Tunable Antenna-Coupled Infrared Detector .....	241
20 <sup>TH</sup> CENTURY PATENTS.....	241
1990 TO 1999.....	241
Detector of Halogenated Compounds Based on Laser	
Photofragmentation/ Fragment Stimulated Emission .....	241
Radiation-Hard, Steady-State Imaging Bolometer.....	242
Method and Apparatus for Spectral Analysis of Images .....	242
Method and Apparatus for Measuring Road Surface	
Conditions.....	243

Remote Contamination Sensing Device for Determining Contamination on Insulation of Power Lines and Substations .....	243
Silicon Coated Mylar Beamsplitter.....	244
Spectrometry Using an Optical Parametric Oscillator .....	244
Fast Pattern-Detection Machine and Method .....	244
Passive Optical Wind Profilometer .....	245
Oceanographic and Meteorological Data .....	245
Uncooled Tunneling Infrared Sensor .....	246
Pulsed Intracavity Nonlinear Optical Frequency Converter .....	246
High Resolution Passive Microwave Sensors for Earth Remote Sensing .....	247
Image Processing and Map Production Systems.....	248
1980 TO 1989.....	248
Method and Apparatus for Simulating Phase Coherent Signal Reflections in Media Containing Randomly Distributed Targets .....	248
Image Analyzing Apparatus .....	249
Apparatus and Method for Remote Sensing of Gases, Vapors or Aerosols.....	249
Pressure-Sensitive Optrode.....	250
Process and Equipment for Determining the Density of a Loaded Drilling Fluid from a Deep Well, in Particular an Oil Well .....	250
1970 TO 1979.....	250
Differential Doppler Velocity Sensor .....	250
Signal Processing in Short-Pulse Geophysical Radar System .....	251
Ground Radar System .....	252
Method for Processing Three-Dimensional Seismic Data to Select and Plot Data on a Two-Dimensional Display Surface .....	252
Method and Apparatus for Seismic-Magnetic Prospecting.....	253
Determination of Time Displacement Between Common Information in Seismic Signals.....	253
CHAPTER THIRTY: THE REMOTE SENSING COMMUNITY .....	254
THE REMOTE SENSING COMMUNITY .....	254
THE REMOTE SENSING COMMUNITY (CONTINUED) .....	255
U.S. DEFENSE-RELATED REMOTE SENSING EFFORTS .....	256
U.S. CIVILIAN REMOTE SENSING EFFORTS .....	257
INTEGRATED PROGRAM OFFICE .....	257
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION.....	257
U.S. DEPARTMENT OF COMMERCE .....	257



<i>TABLE 139 MEMBERSHIP OF THE NOAA ADVISORY COMMITTEE</i>	
<i>ON COMMERCIAL REMOTE SENSING</i> .....	258
EUROPEAN SPACE AGENCY .....	258
GROUP ON EARTH OBSERVATIONS.....	259
<i>TABLE 140 FOREIGN REMOTE SENSING ORGANIZATIONS</i> .....	259
<i>TABLE 140 (CONTINUED)</i> .....	260
<i>TABLE 140 (CONTINUED)</i> .....	261
<i>TABLE 141 JAPANESE REMOTE SENSING AND GIS</i>	
<i>ORGANIZATIONS</i> .....	261
COMMERCIAL ENTERPRISES.....	261
DIGITALGLOBE.....	262
EADS ASTRIUM.....	263
GEOEYE.....	263
IMAGESAT INTERNATIONAL N.V. ....	263
RAPIDEYE .....	264
MANAGEMENT ASSOCIATION FOR PRIVATE	
PHOTOGRAMMETRIC SURVEYORS .....	264
SURREY SATELLITE TECHNOLOGY LIMITED .....	265
<i>TABLE 142 EARLIER SSTL SATELLITES</i> .....	265
<i>TABLE 142 (CONTINUED)</i> .....	266
INTERNATIONAL ORGANIZATIONS.....	266
CENTER FOR EARTH RESOURCES OBSERVATION AND	
SCIENCE .....	267
UNOSAT.....	267
<i>TABLE 143 EUROPEAN-BASED REMOTE SENSING</i>	
<i>ORGANIZATIONS</i> .....	268
ACADEMIA .....	268
<i>TABLE 144 UNIVERSITY BASED GIS PROGRAMS</i> .....	269
<i>TABLE 144 (CONTINUED)</i> .....	270
<i>TABLE 144 (CONTINUED)</i> .....	271
<i>TABLE 144 (CONTINUED)</i> .....	272