

TABLE OF CONTENTS

Introduction	XI
Acknowledgements.....	XIII
Chapter 1 – The Sun	1
1. The formation of the stars and the Sun.....	1
2. The characteristics of the Sun	7
3. A representation of the Sun.....	11
4. The internal structure of the Sun	11
5. The photosphere, solar radiation, the solar wind	17
6. The thermal profile of the solar atmosphere	24
7. Solar dynamics	27
7.1. Sunspots. The solar cycle. Prominences and eruptions	27
7.2. Coronal holes. Fast wind	37
7.3. The large-scale structure: coronal streamers.....	40
7.4. Coronal mass ejections	42
7.5. An index of solar activity.....	45
8. The Sun: at the source of space weather.....	46
Chapter 2 – The Earth.....	49
1. The Earth within the solar system	49
2. The internal structure of the Earth: the geomagnetic field	53
3. The atmosphere of the Earth	58
3.1. The homosphere	58
3.2. The heterosphere, the thermosphere, the ionosphere	61
4. The magnetosphere.....	68
4.1. The magnetosphere and the network of currents	70
4.2. The polar lights	79
4.3. Magnetic storms and sub-storms.....	86
4.4. High altitude lightning flashes	89
Chapter 3 – Toward a space weather	91
1. The consequences of solar aggressions on our technological environment	93
1.1. Pipelines.....	93
1.2. Transmission of electricity.....	94
1.3. Railways.....	97

1.4. Telecommunications.....	98
1.5. Spacecraft launches	101
1.6. Satellite flight.....	103
1.7. The reentry of spacecraft into the atmosphere	110
1.8. Space debris and its effects.....	111
2. Other impacts of solar activity	114
2.1. Biological effects.....	114
2.2. The climate.....	117
2.3. Insurance companies	119
2.4. Military defence	120
2.5. Tourism and education of the public.....	121
3. Space weather in order to forecast.....	121
3.1. Its birth certificate	121
3.2. A science that is still in its early stages and its applications	125
3.3. Toward maturity: the intense space weather storms of October-November 2003	128
Appendices	133
1 – The density and kinetic energy of a gas	135
2 – The internal nuclear processes of the Sun	138
3 – The electromagnetic field	141
4 – The dipolar magnetic field.....	145
5 – The doppler effect and the wavelength.....	150
6 – Photometric quantities.....	153
7 – The blackbody.....	157
8 – A comprehensive view of electromagnetic waves.....	160
9 – The magnetic field and the movement of particles, frozen plasma and fields	163
10 – Kinetic pressure and magnetic pressure	166
11 – The Coriolis force	167
12 – Kepler's laws	171
13 – Sidereal time and solar time	174
14 – The characterization of magnetic activity by means of indexes	177
15 – The variation in molecular concentration with altitude.....	179
16 – Elements of atmospheric chemistry	181
17 – The movement of a charged particle in a magnetic field tube.....	184
18 – The calculation of the position of the magnetopause.....	187
19 – The planets of the solar system in the glare of the Sun.....	189
20 – The Moon in the glare of the Sun	198
21 – Comets, meteors and asteroids in the glare of the Sun.....	201
22 – Orbital parameters	205

TABLE OF CONTENTS	IX
23 – Space weather instruments	209
A few useful constants.....	217
References	219
Word glossary	221
Glossary of names, acronyms and logos.....	233
Index	239