

Contents

Preface	ix
Chapter 1. A Description of the Main Constraints Regulating the Earth Climate	1
1.1. Generalities about the atmosphere and the ocean	1
1.1.1. The atmosphere	4
1.1.2. A brief comparison between some oceans and the atmosphere's main orders of magnitude	9
1.2. A global view of radiative processes	9
1.3. Past climate history	18
1.4. A global evaluation of climate stability	32
1.4.1. Let us consider the first term of equation [1.8]	33
1.4.2. Let us consider the second term of equation [1.8]	37
1.4.3. A global estimate of climate stability considering another source of complexity: the greenhouse effect	43
1.5. Conclusion	47
Chapter 2. The Vertical Dimension of the Energy Processes of the Climate System: Radiative Processes and Radiative–Convective Models	49
2.1. Radiative processes: generalities	50
2.2. Absorption and greenhouse effect	52
2.3. The role of convection	62
2.3.1. Where does the $- F^\pm$ comes from?	64
2.4. Diffusion of solar radiation	78
Chapter 3. The Horizontal Motion of Atmospheric and Oceanic Transport	93
3.1. Energy budget at the top of the atmosphere	93
3.2. Energy exchanges with the surface	98

3.3. Transport by the atmosphere and the ocean	113
3.4. Vertical and horizontal transports: the links	117
3.4.1. What is stable stratification?	124
3.5. Conclusion	141
Chapter 4. A Transition from Quasi-Equilibrium to Forcing from Anthropogenic Source: A Cartography of Predictable Phenomena, Uncertainties and Feedback Related to the Climate Response to Anthropogenic Disturbance	143
4.1. A transitory evolution	144
4.1.1. Presentation of the Intergovernmental Panel on Climate Change (IPCC) and its missions	147
4.1.2. A focus on IPCC productions	148
4.1.3. Examples of IPCC production impacts	150
4.1.4. Complexity, a main feature of the Earth climate system transitory evolution	151
4.2. Global temperature change and the role of feedbacks	178
4.2.1. About models' uncertainties and radiative forcing associated with CO ₂	185
4.2.2. The water vapor feedback	188
4.2.3. The albedo feedback	189
4.2.4. The cloud feedback	190
4.2.5. The lapse-rate feedback	192
4.3. Measured and anticipated impacts: what is predictable?	197
4.3.1. Three generations of model assessments directed toward climate change	198
4.3.2. Socio-economic pathways (SSP) in AR6	205
4.3.3. Articulation between SSP scenarios from AR6 and RCP scenarios from AR5	207
4.3.4. As for the most probable trajectory currently followed	210
4.3.5. Main novelties for the seventh IPCC Assessment Report	213
4.3.6. Method for the evaluation of a probability in IPCC reports	214
Chapter 5. From Scientific Diagnostic to Decision-Making	235
5.1. The role of uncertainties on assessing global warming, accounting for natural variability and estimating climate impacts	236
5.1.1. Process studies and uncertainties	260
5.1.2. From natural variability to climate impacts	279
5.1.3. Zoom about uncertainties and the IPCC	281
5.1.4. Process of uncertainty evaluations by the IPCC as detailed in the Fifth Assessment Report (AR5)	283

5.1.5. Process of uncertainty evaluations by the IPCC as detailed in the Sixth Assessment Report (AR6)	287
5.1.6. Method for the evaluation of a probability in IPCC reports	289
5.2. From global to local climate features: a key shift for the interaction between science and decision-making	290
5.3. From scientific diagnosis to political decision-making.	300
5.4. A word of conclusion	301
Appendix	303
References	327
List of Authors	339
Index	341