Preface

It has been a great pleasure to successfully complete the first volume of my monograph, the "Atmospheric and Space Sciences: Neutral Atmospheres", in which I have focused on basic atmospheric physics and neutral atmospheric processes. Earth's atmosphere is essentially a thin layer of gas around a solid planet, much like the thin skin around an onion. My goal was and still is to help bridge the gap between historically separated fields of meteorology, space science (sometimes called aeronomy), and planetary sciences. At least I would like to demonstrate how these fields are interconnected and similar type of basics physics is applicable to address the different processes these fields study. The atmosphere consists of several gas layers that are distinguished from each other by the differences in the properties of physical and chemical mechanisms. When I was a Ph.D. student, I remember having reflected on this division and realized how challenging it can be for the members of these fields to communicate with each other about the extent to which different processes are important in the atmosphere. To illustrate this problem of communication I can remember the "Chapman Conference on Atmospheric Gravity Waves and their Effects on General Circulation and Climate" that took place in Honolulu, Hawaii in February 2011. I gave a talk on gravity waves (GWs) with the title "Dynamical and Thermal Effects of Gravity Waves in the Terrestrial Thermosphere-Ionosphere". It was the only conference talk on the direct effects of lower atmospheric GWs on the upper atmosphere. After my talk during the discussion period, one of the scientists had asked me why one would study wave effects in the upper atmosphere. His rationale for this question was: "There is anyway nothing up there in the thermosphere"…

So, the second volume, the "Atmospheric and Space Sciences: Ionospheres and Plasma Environments" will focus primarily on planetary ionospheres and the basic electromagnetic processes (i.e., plasma physics) that govern them. I have retained the focus on Earth's ionosphere, as I had focused more on Earth's neutral atmosphere in the first volume. Often I will use the expressions of "ionospheres" and "planetary ionospheres" interchangeably. I would like to continue the tradition that I have established in the first volume of including basic physics as well as research topics in the same volume. By no means the selected topics cover all aspects of

atmospheric and space sciences. There are many other interesting topics out there that deserve to be included in a more comprehensive text book or monograph and are out of the scope of my book.

Meanwhile, after the publication of the first volume, I have talked to several research colleagues, graduate and undergraduate students on the philosophy of this monograph series. I had the impression that I had, at least, partially achieved my goal of providing a different perspective on atmospheric and space sciences. In general, a rich collection of references have been used in the book, which should serve the reader as an opportunity to investigate some of the details of various research topics. It is my humble intention that the reader will be inspired by the collection of the discussions and different topics in the text or by the art of presentation.

The selection of research topics in the book is not necessarily thought to indicate an evaluation of the significance of these topics with respect to many other topics that I have not covered. My selection only reflects a subjective view of a collection of important research topics. Nevertheless, I find that meteorological effects on the upper atmosphere, which we term as "coupling from below", and "space weather" effects, referred to as "coupling from above", are two highly important rapidly rising areas of research in the atmospheric and space sciences community. Having personal interest and scientific contributions in these topics, I felt obliged to provide some special coverage in this book. I think, various research activities in these two fields make up a significant portion of the recent activities and progress in atmospheric and space sciences. Nevertheless, atmospheric coupling and space weather research provide an excellent motivation toward unifying atmospheric and space physics.

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