CHAPTER 1

INTRODUCTION

1.1 Background. Material presented in this Part B, Doppler Radar Theory and Meteorology, of the Federal Meteorological Handbook No. 11 (FMH-11) was provided from a number of sources. The basic material for chapters dealing with Doppler meteorological radar and those that treat meteorological and hydrological phenomena detectable by the radar was provided by the staff of the National Oceanic and Atmospheric and Oceanographic Administration (NOAA), Environmental Research Laboratories (ERL), National Severe Storms Laboratory (NSSL); and the National Weather Service (NWS) Hydrologic Research Laboratory (now the Office of Hydrologic Development). Most of this material remains unchanged since the original 1990 version of Part B which this version replaces. The updates were primarily provided by the National Weather Service's Warning Decision Training Branch, Radar Operations Center (ROC) subject matter experts, and a support services contractor. The updates included in this version update the material to the last software of the legacy Radar Data Acquisition (RDA) (Build 10.2) and Radar Product Generator (RPG) (Build 6). In addition, updated meteorological applications have been added in the later chapters.

1.2 Purpose and Scope. Part B of this Federal Meteorological Handbook is intended to provide the professional meteorologist with the background in radar meteorology necessary to make effective use of the WSR-88D in an operational forecast and warning environment. The information in this Handbook should help the increasing number of users of WSR-88D product data and Level II data apply these data to their responsibilities. Recommended changes/corrections to this manuscript are welcome and should be sent to: **http://www.roc.noaa.gov/Feedback/**.

1.3 Organization and Content. Part B is organized into eight chapters and four appendices that present the Handbook material for two general areas dealing with Doppler weather radar fundamentals and radar meteorology. This chapter, Chapter 1, provides background information and an overall summary of contents.

1.3.1 Doppler Meteorological Radar Fundamentals. Chapter 2 introduces the reader to the Weather Surveillance Radar-1988, Doppler (WSR-88D) unit and presents fundamental concepts of Doppler weather radar. It is provided as background for those users who desire an in-depth understanding of the WSR-88D. (Knowledge of physics and graduate-level statistics will be helpful.)

Chapter 3 continues the in-depth presentation of Chapter 2 with a detailed explanation of the physics of radar data acquisition. Data sampling is discussed along with the propagation of

electromagnetic waves in the atmosphere. (Knowledge of physics and graduate-level statistics will be helpful.)

Chapter 4 summarizes the fundamental concepts presented in Chapters 2 and 3 for the reader without a background in physics and graduate-level statistics. Doppler radar principles are addressed, as are inherent data sampling problems.

1.3.2 Radar Meteorology. Chapter 5 reviews the theory and application of physical principles of the measurement process of particle size distribution and the reflectivity-rainfall relationship. Chapter 6 presents an introduction to the interpretation of Doppler velocity patterns. It is intended to familiarize the reader with the use of base Doppler velocity products to analyze significant meteorological events by exhibiting the differences that result from changes in an idealized wind field. It displays patterns resulting from vertical and horizontal variations in the wind field and discusses a technique to quantitatively derive a vertical profile of the horizontal wind. (The reader is assumed to understand solid geometry.)

Chapter 7 distinguishes between stratiform and convective precipitation. It describes the development and organization of mesoscale convective systems. (The presentation is non-mathematical, presuming a familiarity with the concepts and terminology of radar meteorology.)

Chapter 8 describes the evolutions and life cycles of various types of convective precipitation cells. It distinguishes between thunderstorm complexes composed of single and multiple cells. Storm motion and organization are related to the environmental wind profile. Reflectivity structure and Doppler velocity patterns are related to different types and evolutionary stages of severe thunderstorms. In addition, hail and turbulence are related to base data fields. (Although non-mathematical, the presentation level presumes a working knowledge of thunderstorm meteorology and attendant phenomena.)

The WSR-88D images used in Part B are from the many diverse NEXRAD agency user display systems available. The list of the primary user display systems is in the Definition of Terms section in Part A of this Handbook. In addition, figures from the proof-of-concept National Severe Storms Laboratory Warning Decision Support System (WDSS) and the National Climatic Data Center (NCDC) Level III/product archives via the NCDC NEXRAD Viewer are used. These diverse displays are used to ensure the best representative examples of the phenomena being depicted are presented.

1.3.3 Appendices. Appendices A and B provide amplification to Chapters 2, 3, and 5. Appendix C contains a listing of acronyms and abbreviations while Appendix D is a glossary of terms.