Book Review

Reviewed by Ali Zahraei

Measuring Precipitation from Space: EURAINSAT and the Future
by Vincenzo Levizzani, Peter Bauer and F. Joseph Turk (Editors)
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A brief introduction presents the major scopes of this book and an overview of its organization. The chapter topics follow the steps to study the climate monitoring and the importance of using satellite technology to study local and global rainfall estimation. This book promotes EURAINSAT, which was a European project that explored the real-time exploitation of data from both LEO and GEO satellites for rainfall estimation and subsequent assimilation into numerical weather prediction models. This European project has promoted both the use of SEVIRI data from the METEOSAT-8 satellite and the Global Precipitation Measurement (GPM) constellation to be launched in the near future. Overall, this book takes the opportunity to introduce the state of the art in the field of measuring precipitation from space.

The book is divided into eight sections and includes the lists of acronyms and symbols.

The first chapter, 'Climate monitoring', concentrates on the climate changes and the importance of the global water cycle observations. It denotes that a comprehensive global observing system is demanded to improve forecasting capabilities of the interrelated Earth system processes.

The second section 'Cloud studies in support of satellite rainfall measurements', begins by introducing the use of cloud top properties (e.g. microphysics) as a tool for direct and indirect measurements of precipitation, including a variety of cloud properties and then focuses on the retrieval of cloud top properties using visible-infrared (VIS-IR), microwave and lightning sensors. Also, this chapter illustrates that neural networks are tools for satellite rainfall estimation, either as a direct approach for sensor fusion, or as an indirect procedure, such as estimation of cloud motion, winds and rain.

Section three, 'Rainfall algorithms', provides an overview of past, present and future perspectives of microwave-based rainfall algorithms. This section includes discussion of both active (radar) and passive (microwave) observation systems. The SSM/I rainfall estimation algorithm, AMSU operational algorithm and consolidation of algorithms for TRMM, AMSR and SSM/I are reviewed; it emphasizes that there needs to be a continual effort to drive the development of sensors and algorithms for synoptic and climate scale requirements. In addition, it explains the application of precipitation radar, including dual-wavelength radar, in-rain profiling and rain-type classification. It further outlines a framework to achieve the prospective goals by new measurement missions and new user demands.

Section 4, 'Blended algorithms', describes different strategies to blend the precipitation estimation from various passive microwave sensors on board meteorological satellites in low Earth orbit with the observations from time-update coincident geostationary-based visible and infrared imagers. A broad range of algorithms could be divided into calibration-based and advection-based estimation algorithms. Several algorithms, such as a rainfall estimation algorithm using cloud patch classification, works with the calibration of infrared observations with microwave-based rainfall estimation. The CMOPRPH algorithm uses a morphing scheme to propagate the observed passive microwave-based (PMW) precipitation field in a backward-forward process between two consecutive PMW overpasses. It also explains that there are several methods to combine other precipitation products.

Section 5, 'Validating satellite rainfall measurement', describes the necessity of rainfall retrieval algorithm validation. It presents different methods for verifying satellite precipitation estimation and the contribution of the rainfall retrieval algorithms errors in the prediction of land surface hydrological variables. It is elaborated that no single verification score can solely justify the ability of an algorithm to estimate rainfall. Rather, a combination of several scores together may characterize both skill and errors.

The discussion of assimilation of numerical weather prediction models with satellite observation is summarized in section 6, 'Modelling precipitation processes and data assimilation for NWP'. The studies are taken from different countries to present dynamic/microphysics models of clouds, aerosol impacts on precipitation processes and rainfall data assimilation experimentation. It has been shown that combined microwave and infrared rainfall estimates, assimilated into meteorological models, might improve short-range precipitation forecasts.

Chapter 7, 'Applications for monitoring weather events', further focuses on the satellite precipitation for extreme events and modelling microphysical signatures of extreme events. It concludes that satellite-based precipitation, as a companion to radar and rain gauges, still needs much more work to be suitable for incorporation into multisensory precipitation analyses. More improvement including, but not limited to, incorporation of increasing numbers of geostationary and polar-orbiting microwave sensors, along with observations from other sensors to produce an optimal precipitation data sets, is required. It also justifies that the advent of the ongoing international microwave constellation of satellites does not undermine the usefulness of blended techniques.

The final chapter, 'The present and future of satellite platforms', reiterates the exceptional importance of the satellite observation systems in the world weather watch. In addition to reviewing several international space-borne measures, it promotes the applicability of multi-frequency microwave satellite observations for space-borne snowfall measurements.

The book is composed of several authors' research works. It is well written and easy to follow. Regardless of minor overlaps between topics and sections, this book covers many important satellite-based precipitation retrieval algorithms, incentives and challenges. Overall, this book is recommended as a state of the art of the current rainfall retrieval algorithms.