EDITORIAL

The Second Precipitation Intercomparison Project (PIP-2)

This volume focuses on the topic of precipitation retrieval from passive microwave (PMW) satellite measurements and the progress that has been made in this area through two internationally sanctioned intercomparison programs: the Precipitation Intercomparison Project (PIP) established within the National Aeronautical and Space Administration's WetNet Project, and the Algorithm Intercomparison Project (AIP) established as part of the Global Precipitation Climatology Project. Papers in this issue developed as an outgrowth of these projects, primarily from the second WetNet PIP, but also from the third AIP. Along with other things, both these projects stressed the intercomparison of a number of satellite precipitation algorithms designed for use with measurements from the Special Sensor Microwave/Imagers (SSM/Is) flown on Defense Meteorlogical Satellite Program (DMSP) satellites.

The *Journal of the Atmospheric Sciences* (*JAS*) has been chosen as a forum for this collection of papers because it is now evident that the PMW methodology of detecting rain and quantifying rain rate has matured to the point where we are able to make fundamental discoveries about precipitation on various scales that have been heretofore beyond reach based on conventional measuring systems. Moreover, since many of the rain algorithms are explicitly based on radiative transfer and cloud models of the atmosphere, the algorithms themselves have become an integral part of mainstream atmospheric science. In this context, the expectation of making new discoveries concerning tropical latent heating processes, the role of low-latitude diabatic heating in forcing global circulation patterns, and the basic global climatological nature of precipitation were the motivating factors behind the development of the joint U.S.–Japan Tropical Rainfall Measuring Mission (TRMM), a newly launched satellite experiment that went into space on Thanksgiving Day, 27 November 1997.

Therefore, although precipitation remote sensing has not been a major topic area for *JAS* in the past, there is now sufficient evidence that passive microwave remote sensing of rain and other hydrological variables can produce new knowledge about atmospheric behavior. From this perspective, this special issue provides an opportunity for *JAS* readers to examine a possibly unfamiliar subject and to broaden their horizons in an area that has become increasingly important in atmospheric science research.

There are two basic categories of papers in this volume. The first involves studies that focus on the results, data, or general methods associated with the PIP-2 and AIP-3 intercomparison projects. The second involves studies that examine the underlying physical principles of the subject of passive microwave sensing of rain. There are six papers that belong to the first category. Smith et al. and Ebert and Manton provide the results summarizations on PIP-2 and AIP-3 projects, respectively. Berg et al. review the performance of the first and second generation U.S. Navy operational SSM/I algorithms (D-Matrix and Cal/Val), which were important operational milestones in the early days of SSM/I. The Kidd et al. paper adroitly tackles the oftentimes contentious subject of the merits of statistical algorithms versus physical algorithms, and provides a provocative justification why the statistical approach is still a valid recourse in seeking to estimate rainfall. The Ferraro et al. paper addresses a specialized topic within satellite precipitation retrieval, the problem of precipitation detection (or screening in the lexicon of the algorithm developers), and describes straightforward methods to solve this problem for different types of oceanic and continental surfaces, methods that were developed for the SSM/I operational rain algorithm at the National Environmental Satellite Data Information Service. Finally in the first category of papers, Ritchie et al. examine the nature of differences that can be found in the various sources of SSM/I data, a particularly important subject when trying to establish climate benchmarks from satellite datasets.

In the second category of papers, Wentz and Spencer describe a new algorithm approach that offers a consistent and systematic means to simultaneously retrieve surface wind speed, water vapor, cloud liquid water, and precipitation from SSM/I measurements within a unified physical framework. Liu and Curry describe the basic slope relationship between the low-frequency emission signature and the high-frequency scattering signature for different precipitation regimes as a means to better categorize different types of precipitation and their climatological nature. Panegrossi et al. describe a detailed analysis concerning the necessity for consistency in the measurement–model brightness temperature manifolds that arise with physical algorithms whose microphysical underpinnings are derived from cloud model outputs of vertical hydrometeor profiles. Tesmer and Wilheit describe a new PMW cloud radiation model, based on recent microphysical observations available from the Tropical Ocean Global Atmosphere Coupled Ocean–Atmosphere Response Experiment (TOGA COARE) and designed to improve brightness temperature–rain rate relationships used in PMW precipitation algorithms. Turk et al. examine how spatial resolution degradation impacts the interpretation of the rain signal based on analysis of high-resolution aircraft radiometer and radar measurements obtained during TOGA COARE. Spencer et al. investigate the properties of the rain and ice signals in SSM/I measurements after the 1991 eruption of Mount Pinatubo and the concomitant cooling of SSTs and tropospheric temperatures, arguing the existence of a feedback link between the general thermodynamic state of the atmosphere and precipitation efficiency. Finally, Bauer et al. explore the possibilities of combined optical–infrared–microwave algorithms in the context of the TRMM experiment, seeking improved ways to overcome spatial resolution limitations in the PMW measurements.

This is an exciting era for passive microwave-based remote sensing. As research on the global hydrological cycle begins to accelerate, this type of measurement, treated carefully, can be used to detect much of the atmospheric water cycle process. In the next era of satellites, in which PMW radiometers will have increased spatial resolution, better signal to noise properties, and more frequency diversity, and in which active cloud and precipitation radars will be used in conjunction with the advanced radiometers, analysis of the global water cycle will become highly dependent upon the satellite algorithms used to transform radiation measurements into physical variables. The authors of this volume hope these papers help elucidate some of the important concepts and methods that will be used in these algorithms, as well as describing the current state of the art in PMW precipitation retrieval science.

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