P2.19 A COMPARISON OF PRECIPITATION ESTIMATES OVER THE HIMALAYAS AND ANDES

Stephen W. Nesbitt* and Galdino V. Mota
University of Utah, Salt Lake City, Utah

1. INTRODUCTION

Understanding the temporal and spatial distribution of precipitation is crucial in understanding the global water cycle and energy budget. Many projects, including the Tropical Rainfall Measuring Mission (TRMM) have focused on improving precipitation estimates in the tropics. Improving the accuracy precipitation estimates relies on a combination of understanding and improving deficiencies in the physical assumptions of the algorithms, and correcting for the sampling biases contained within the estimates. Validation and intercomparison of the algorithms has been an important goal of the Precipitation Intercomparison Projects (Adler et al. 2001) and TRMM. Over mountainous terrain, these precipitation estimates often diverge; this study compares an often-used rain gauge analysis with a TRMM microwave analysis over two of the most prominent mountain ranges in the Tropics (the Andes and the Himalayas).

2. PRECIPITATION ESTIMATES

Over land, rain gauge networks are available as a validation tool for the various remote sensing estimates. However, the non-linear nature of rainfall makes its measurement by gauges difficult; long sampling times and a dense network are two methods used to help mitigate these problems. One rain gauge dataset available is the GPCC "Monitoring Product" (GPCC, 2002: The Global Precipitation Climatology Centre. http://www.dwd.de/research/GPCC); it is a monthly global 1° x 1° analysis consisting of roughly 7,000 rain gauges. Despite the large number of gauges used in this dataset, in remote regions of the globe, dense, reliable gauge networks often do not exist, data from them are not available, or adequate quality control is not available. As a result, the GPCC gauge data are sparse in many regions of the globe, especially in areas of steep topography.

Despite the significant sampling issues within the GPCC analysis, many global precipitation estimates use the product with a large weighting factor over land. One of these products is the TRMM algorithm 3B43 combined product (Adler et al. 2000). As remote sensing estimates improve, they may be used to evaluate gauge estimates in areas with sparse networks.

Passive microwave precipitation estimates are available over land from the TRMM algorithm 2A12 product. This product statistically links brightness temperature depressions from ice scattering at 85 and 37 GHz with rain rates derived from a cloud resolving model. Error sources in this algorithm include temporal and spatial sampling, inappropriateness of the brightness temperature-rain rate relationship, and surface artifacts including snow cover and coastlines in the current version 5 (C. Kummerow, personal communication). The algorithm's physical assumptions may not be valid in complex terrain where model simulations of Tropical or mid-latitude precipitation may not be appropriate.

* *Corresponding author address:* Stephen W. Nesbitt, 135 S 1460 E Rm. 819, Salt Lake City, UT 84112-0110; E-mail: snesbitt@met.utah.edu

3. EVALUATION OF SATELLITE AND GAUGE PRODUCTS IN THE ANDES AND HIMALAYAS

Fig. 1a. shows the topography (shaded) in the regions of interest. Note that both mountain ranges are adjacent to large low-elevation plains, from which they rise steeply. Fig. 1b shows the mean daily GPCC gauge rainfall for the three-year period December 1997 through November 2000, while Fig. 1c shows the TRMM 2A12 microwave rainfall (1° x 1° analysis) for the same period. The 2A12 estimates are higher in many regions (they are biased higher in most areas globally). They also contain some artifacts (the rain maximum along the northern Chilean coast is an algorithm artifact). However, 2A12 captures the upslope rain maximum in western Peru and Ecuador (Berbery and Collini, 2000) and the summer rainfall maximum in the Kashmir and northern Afghanistan (Luo and Yanai 1984). The gauge coverage in these rain maxima is poor (Fig. 1d) in areas with the biggest differences between microwave estimates (line in Fig. 1d). There are few gauges in the heavy rainfall areas of the Ecuadorian and Peruvian Andes and Kashmir, and those that exist may be located in valley areas away from orographic precipitation. In these areas, careful examination of the remote sensing estimates will improve the spatial accuracy of global precipitation estimates.

The authors would like to acknowledge Ed Zipser (PhD advisor), funding from NASA TRMM; SWN is supported by the NASA Earth System Science Fellowship.

Adler, R. F. et al., 2000: Tropical Rainfall Distributions Determined Using TRMM Combined with Other Satellite and Rain Gauge Information. *J. Appl. Meteor.*, **39**, 2007-2023.
—, et. al., 2001: Intercomparison of Global Precipitation Products: The Third Precipitation Intercomparison Project (PIP–3). *Bull. Amer. Meteor. Soc.*, **82**, 1377-1396.
Berbery, E. H. and E. A. Collini, 2000: Springtime precipitation and water vapor flux over southeastern South America. *Mon. Wea. Rev.*, **128**, 1328-1346.
Kummerow et al, 2001: The Evolution of the Goddard Profiling Algorithm (GPROF) for Rainfall Estimation from Passive Microwave Sensors, *J. Appl. Meteor.*, **40**, 1801-1820.
Luo, H. and M. Yanai, 1984: The Large-Scale Circulation and Heat Sources over the Tibetan Plateau and Surrounding Areas during the Early Summer of 1979. Part II: Heat and Moisture Budgets, *Mon. Wea. Rev.*, **112**, 966-989.
Rudolf, B., H. et al., (1994): Terrestrial precipitation analysis: Operational method and required density of point measurements. *Global Precipitation and Climate Change.*

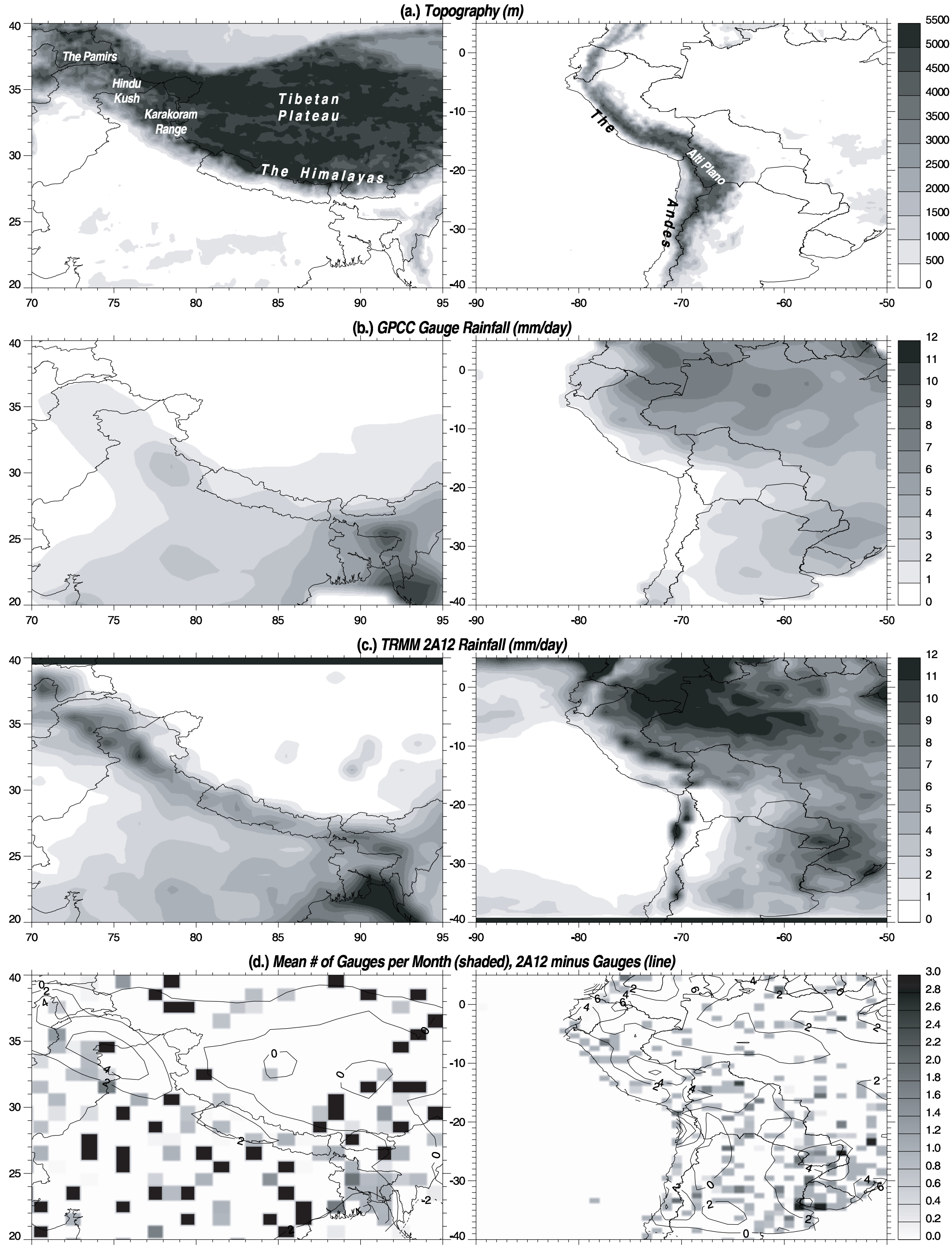

Fig. 1: (a.) Topography of the Himalayas and Andes. (b.) GPCC 1° x 1° gauge-derived rainfall from 12/97 to 11/00. (c.) TRMM 2A12 1° x 1° microwave-derived rainfall for the same period. (d.) Number of GPCC gauges per 1° x 1° box per month (shaded), difference between GPCC and 2A12 rainfall (lines).