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Diagnosing potential discrepancies in satellite rainfall estimates over Ethiopia

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Reliable satellite precipitation estimates are vital over many regions of Africa because of the importance of rainfall monitoring for rain-fed agriculture and water resources. In particular, regions with mountainous terrain pose a major challenge for satellite-based rainfall algorithms because retrievals based upon thermal infrared and microwave observations tend to miss orographic precipitation, often associated with warm temperatures and a weak scattering signal. To investigate the skill of satellite rainfall retrievals over mountainous terrain, we evaluate several satellite-based rainfall algorithms against rain gauge measurements over the mountainous Oromia region in Ethiopia. In particular, we assess the skill of rainfall retrieved from algorithms that only use thermal infrared observations and algorithms that combine both thermal infrared and microwave observations. We also investigate the dependency of retrievals on topography by classifying the relationship between the retrieval errors and elevation. Furthermore, we conduct high resolution simulations using the Weather Research and Forecasting model (WRF) during days with significant retrieval errors to determine how the errors relate to the characteristics of precipitation. A qualitative assessment of the vertical atmospheric structure and microphysical content of simulations reveals the potential sources of underestimation and overestimation in the rainfall algorithms. This study will highlight the importance of understanding regional precipitation systems causing uncertainties in satellite rainfall estimates, with a view toward using this knowledge to improve rainfall algorithms.