Geophysical Research Abstracts
Vol. 17, EGU2015-7585, 2015
EGU General Assembly 2015

A Novel Bayesian algorithm for Microwave Retrieval of Precipitation from Space: Applications in Snow and Coastal Hydrology

Efi Foufoula (1), Ardeshir M. Ebtehaj (1,2), and Rafael L. Bras (2)

(1) University of Minnesota, St. Anthony Falls Laboratory, Department of Civil, Environmental and Geo-Engineering, Minneapolis MN, United States, (2) Georgia Institute of Technology, School of Civil and Environmental Engineering, Atlanta, GA, United State

Resolving accurately the space-time structure of precipitation over remote areas of the world where in-situ observations are not available is one of the biggest challenges in hydrology in view of the pressure to understand and mitigate climate and human-induced hydrologic and eco-geomorphologic changes. Two especially vulnerable areas are snow covered highlands (earlier snowmelt and changes in land-atmosphere feedbacks affecting storm dynamics and hydrologic response) and coastal areas (threats due to extreme storms and flooding in view of sea level rise and land-use changes affecting hazard potential in these overly populated low land areas). The GPM constellation of satellites offers the potential to retrieve precipitation over these complex surfaces but not without significant new ideas in the retrieval techniques for operational products. Here we present recent results from a new Bayesian inversion Passive Microwave Rainfall Retrieval algorithm (called ShARP) which introduces two main innovations: (1) a new distance metric in the space of retrieval (physically-derived or observational databases of brightness temperature and rainfall profiles) to create neighborhoods whose closeness is judged not on the basis of spatial averages but in terms of spatial structure in the space of spectral brightness temperatures, and (2) computes weights of those elements by minimizing a log-likelihood function plus a prior density of the spatial precipitation gradients. Both innovations rely on extending the typical Least squares (ℓ_2) distance metric used in inverse problems to a mixed $\ell_2 - \ell_1$ metric (via regularization) and showing that this new metric is consistent with the localized small-scale spatial rainfall structure of sharp features embedded within more homogeneous domains. Using the data provided by the Tropical Rainfall Measuring Mission (TRMM) satellite, we demonstrate marked improvements in the ShARP rainfall retrievals in comparison with the standard TRMM-2A12 operational products by analysis of case studies in the Tibetan Highlands and the Ganges-Brahmaputra-Meghna river basin and its coastal delta.