Combining rainfall data from rain gauges and TRMM in hydrological modelling of Vinces River Basin in Ecuador

Mijail Arias-Hidalgo (2), Biswa Bhattacharya (1), Arthur Mynett (1,3), Ann van Griensven (1,4)

(1) UNESCO-IHE Institute for Water Education, Delft, The Netherlands , (2) Escuela Superior Politecnica del Litoral, Perimetral Km. 30, EC090112, Guayaquil, Ecuador, (3) Delft University of Technology, Faculty CiTG, P.O.Box 5048, 2600GA Delft, The Netherlands, (4) Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium

The paper presents a way of combining rainfall data from rain gauges and TRMM and using it in the hydrological modelling of Vinces River Basin in the Ecuadorian Lowlands. Nowadays, satellite based rainfall estimates are immensely useful to improve our understanding of spatio-temporal variation of rainfall, particularly for data scarce regions. In this regard, the use of rainfall estimates from Tropical Rainfall Measuring Mission (TRMM), particularly the 3B42 type, have been used by a number of researchers. Roughly two groups of researchers are noticed. One group of researchers has focused on comparing the TRMM rainfall data with the rain gauge data, either to study the spatial and temporal variability, or to test the validity of the TRMM products. The other group of researchers has investigated the potential use of the TRMM in complementing rain gauge data in hydrological studies.

The study area considered in this research is the Vinces River catchment in the Guayas River Basin located in the Ecuadorian coastal region. The catchment exhibit large scale variation in elevation. Annual rainfall varies between 1000 mm and 3500 mm. The mean historical flow at the upper catchment's outlet is 220 m3/s. The area has limited number of rain gauges. In order to improve the understanding of the spatio-temporal variation of rainfall the TRMM rainfall estimates for the period 1999-2006 were considered.

Several time scales (annual, seasonal, monthly, etc.) were considered for bias correction of the TRMM data: The monthly resolution proved to be the finest one with still a high correlation between the two rainfall data sources and accordingly, a monthly bias corrector was developed. Subsequently, the monthly data was disaggregated using the rain gauge data by adopting an empirical disaggregation method.

The generated rainfall time series was incorporated in an existing hydrological model to complement the available rain gauge data to assess the model performance. The results were quite comparable with those using only gauge information. Although the model outcome did not improve remarkably, the contribution of this approach was based on the fact that given a known bias, the satellite data could still be corrected and may resemble the information provided by the rain gauges. Therefore, TRMM may supply valuable information in areas scarcely gauged such as the Andean foothills in the Guayas River Basin.

Keywords: TRMM, rain gauge, rainfall, bias correction, hydrological modelling.