Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 154 (2016) 154 – 157

Procedia Engineering

www.elsevier.com/locate/procedia

12th International Conference on Hydroinformatics, HIC 2016

# Validation of TRMM daily precipitation data for extreme events analysis. The case of Piura watershed in Peru

Juan Cabrera[a]*, Raul Tupac Yupanqui[b], Pedro Rau[b]

[a]*Faculty of Civil Engineering, National University of Engineering, 210 Tupac Amaru Av., Lima 25, Peru*
[b]*Institute for Effects Mitigation of El Niño Phenomenom, National University of Engineering, 1150 Tupac Amaru Av., Lima 25, Peru*

**Abstract**

The use of TRMM satellite daily information (Tropical Rainfall Measuring Mission) is proposed to estimate extreme precipitation over ungauged areas and time periods. Assuming precipitation non-stationarity as signal fluctuations due to the ENSO impact, it is possible to find common features between in-situ and TRMM data sets by multi-resolution analysis (MRA) with wavelet transform, especially during the wet period where maximal precipitation series are obtained. This method could be applied on other stations as a regionalization for obtaining rainfall datasets as a solution of data scarcity. It is shown some results obtained into the objectives of a local project of improving the statistical downscaling of TRMM and its applicability in water engineering projects.


Peer-review under responsibility of the organizing committee of HIC 2016

*Keywords:* ENSO, Extreme events, TRMM, Wavelet transform

## 1. Introduction

The Northwestern of Peru is affected continuously for El Niño Southern Oscillation (ENSO). Some of those were classified as extraordinary events in terms of precipitation as in years of 1983 and 1998, resulting in an average increase of daily rainfall around of 900% over Piura lower watershed, which concentrates many of infrastructure

* Corresponding author. Tel.: +511-4811070
*E-mail address:* juancabrera@uni.edu.pe


Peer-review under responsibility of the organizing committee of HIC 2016
doi:10.1016/j.proeng.2016.07.436

placed in ungauged areas. It is proposed the use of TRMM 3B42 v.7 dataset (Tropical Rainfall Measuring Mission), considering a comparison and correction based on available in-situ data. Knowing precipitation non-stationarity could be interpreted as signal fluctuations due to the ENSO impact level, it is possible to find common features between in-situ and TRMM data by multi-resolution analysis (MRA) with wavelet transform, considering maximum extreme events of this region. As is explained in Ref [6], this technique was applied over the Altiplano in the South of Peru, characterized for minimum extreme events.

## 2. Case Study

### *2.1. Study Area and Data*

ENSO represents an ocean-atmospheric phenomenon characterized by above normal sea surface temperatures (SSTs) anomalies [2]. Along Peruvian Northern coast, the influence of SST1+2 region (NOAA, ERSST v3b) is notorious, being proposed for Peruvian specialized agencies the use of ICEN (Coastal El Niño Index) which consists on 3-month SST1+2 running mean [4] for categorize the years. An in-depth description of the climatic context of this region has been developed by Rau [8] and knowing that until today, it is not very clear the quantification of the ENSO impact over hourly or daily events due to the nature of the climatic process, being only possible to find approximate patterns [7].

This study focuses on the Piura watershed covering 6 monthly and 3 daily in-situ stations from SENAMHI, distributed at different altitudes from 10 to 2500 m.a.s.l. (see Fig. 1a). Daily records out of extraordinary ENSO events were completed and validated considering the definition of extreme event as 3-day running means percentile above 90 with a Gamma distribution fit [5]. TRMM 3B42 v7 daily data covers around 19 grids (0.25°x0.25°, ~770 $km^2$/grid) with continuous and complete record. It was analyzed 16 years from 1998 to 2013, taking account the in-situ data availability in the wet period, from January to May, where TRMM data are more reliable [3].

### *2.2. Methodology*

MRA with wavelet is a technique which allows the decomposition of a signal into various resolution levels that retain the main features of the original signal; considering that orthogonal wavelets permit to separate effectively the low and high frequency signal contents at each resolution level, determining a base-trend with a noise series in each resolution, reconstructed in terms of original features. The validation was done by entropy which permits to obtain the resolution decomposition level and compare similarities between in-situ and reconstructed data. These calculations were processed with WATER software [6] in the period where both datasets are available.

To complete data, methodology proposed by Arias [1] which considers a downscaling technique with a temporal disaggregation coefficient was applied. This methodology suggest that daily precipitation could be complete to a period without daily but at least monthly in-situ records, by assuming that total precipitation in a month is distributed proportionally in each daily record for TRMM.

The correction and completion can be verified by the RMSE and determination coefficient ($R^2$) for daily and monthly level.

## 3. Results

### *3.1. Validation of TRMM 3B42*

Altitudinal variation in the watershed has an influence over the ENSO impact level; high altitudinal records as in Huarmaca station (2240 m.a.s.l.) have a $R^2$ of 0.22 with ICEN index and low altitudinal records as in Miraflores station (30 m.a.s.l.), around 0.55. This behaviour is found for a daily scale too and each year is categorized as E-EN: Extreme El Niño, N: Normal, W-EN: Weak El Niño, M-EN: Moderate El Niño, M-LN: Moderate La Niña (see Table 1) for the period from January to May.