Interactive comment on “Does forest replacement increase water supply in watersheds? Analysis through hydrological simulation” by Ronalton Evandro Machado et al.

Anonymous Referee #1

ANSWER:

Questions:

General comments:

I'm sorry for frustrating your expectation as to the contribution of this paper. In Brazil we have heated discussions about the role of forests in the water regime in river basins. Although there are some publications in this line of research, some of the hydrological functions usually ascribed to forests, however, such as to increase rivers water availability are disputable and lack a technical and scientific basis. As the verification of these functions has a high cost and demand a long time, our objective was to bring to this discussion, the use of hydrological modeling tool. SWAT model outputs are less explored to reduce time, cost, and test various configurations in the watershed.

I rewrote the methodology of regionalization in the manuscript:

2.3 Model evaluation

During the analysis period (2012 to 2014) calibration of model was not possible due to inconsistency in the observed data (the measuring station was constantly submerged during the operating period of a reservoir associated with a power station).

Despite the impossibility of calibrating the model for the Pinhal hydrographic basin, we used the hydrological regionalization methodology to validate the behaviour of the model (Vandewiele, 1995; Bardossy, 2007). Hydrological regionalization is a technique that allows transferring information between watersheds with similar characteristics in order to perform calculations, in places where there are no data on the hydrological variables of interest (Emam et al., 2016). This technique becomes a useful tool for water resource management, especially when applied to the most important instruments of the Brazilian water resource policy, the concession of water resources use rights and charging for the use of water resources (Fukunaga et al., 2015).

State Department of Water and Electric Energy (DAEE, 1988), state entity responsible for granting concessions of water resources in the state of São Paulo, developed a hydrological regionalization model and it updated by Wolff (2014). The State São Paulo has an area of approximately 248197 km², located between longitudes -44° 9', and -53° 5', and between latitudes 40° -22' and -22° 39'. Was used data from 172 gauged stations. For each station it was determined the average annual rainfall of the basin (P) multiannual average streamflow (Q), streamflow minimum average of 7 consecutive days with a return period of 10 years ($Q_{7,10}$) and flows with 90 and 95% of permanence in time (Q_{90} e Q_{95}). The hydrological regionalization model evaluation was made by the confidence index (c), which is the product between the correlation coefficient (r) and the agreement index (d), using as estimate value the flows generated by the model and as the standard value, the flows calculated through the gauged stations. All flows evaluated were classified as optimal, with confidence index (c) above 0.85 (Wolff, 2013). Therefore, it can be used to obtain the flows studied that refer to use grants in different States of Brazil.

According to Tucci (2005), hydrological information that can be regionalized can come in the form of variables, parameters or functions. Hydrological function represents the relationship between a hydrological variable and one or more explanatory or statistical variables, such as the flow-duration curve or the relationship between impermeable areas and housing density (Tucci, 2002). The flow-duration curve relates the flow or level of a river and the probability of flowing greater than or equal to the ordinate value, thus being a simple, but concise and widely used method to illustrate the pattern of flow variation over time (Naghettini & Pinto, 2007).
For the construction of the flow-duration curve in this work, the series of simulated flows in the period from 2012 to 2014 was initially put in ascending order. This series was statistically divided into 10 equal intervals. For each interval, the number of flows was counted and the respective cumulative frequencies of the interval were calculated from highest to lowest. For comparison, in the same graph, we plotted and simulated the regionalized flows, according to the DAEE, allowing the verification of sub or overestimation through the simulated curve.
The Nash-Sutcliffe model's efficiency coefficient (Nash and Sutcliffe, 1970) was used to validate the simulation's results, in addition to the visual analysis of the regionalized simulated flow-duration curve. The Nash-Sutcliffe model's efficiency coefficient (NSE - Eq. 2) was used to compare the regionalized and simulated flows in intervals of 5 in 5% probability of occurrence of the flow-duration curve. NSE can range from -∞ to 1, where 1 is the optimal value and values above 0.75 can be considered very good (Moriasi et al, 2007).

I removed a phase "the land use pattern projected in this scenario is just hypothetical and often hard to implement in practice due to the already consolidated land use and occupation, but at the same time, it shows the watershed environmental fragility identified by Adami et al. (2012)." This watershed is important for the water supply to the municipality. The Environmental Services Payment Program (PES) is being implemented.

Specific comments:

P2.L27 add in Brazil

Pinhal River's watershed is located in Brazil between UTM coordinates 250,000 m and 275,000 m (S), 7,490,000 m and 7,520,000 m (N) (UTM Zone 23 S, central meridian 45° W). It consists of approximately 300 Km^2 (Figure 1). It has a tropical highland climate – Cwa, according to the Köeppen classification, with a hot and humid summer and cold and dry winter, and average annual temperature of 25°C. Average annual precipitation is approximately 1240 mm.

P.3L.30 1,240 mm or 1240 mm?

Is one thousand two hundred and forty. Minha dúvida é como representar 1,240 mm or 1240 mm.

Is one thousand two hundred and forty. My question is how to represent: 1,240 mm or 1240 mm?

P.4. Section: SWAT model and input data: Please update with recent SWAT references.

I updated SWAT references:

2.2 The SWAT model and input data

SWAT is a physically based semidistributed watershed-scale computationally efficient continuous-time hydrological model that operates on a daily/subdaily time step (Mohammed et al., 2017). The SWAT model simulates different physical processes in watersheds and which aims at analysing the impacts of changes in land use on surface and subsurface runoff, sediment yield and water quality in agricultural watersheds that were not instrumented (Srinivasan & Arnold, 1994; Douglas et al., 2010; Ligaray et al., 2015). SWAT uses a command structure to propagate runoff, sediments and agrochemicals across the watershed. The model's components include hydrology, climate, sediments, soil temperature, crop growth, nutrient and pesticide loading, and agricultural management (Arnold et al., 1998). The hydrological component of SWAT includes subroutines of surface runoff, percolation, lateral subsurface flow, return flow of shallow aquifer and evapotranspiration (Grusson et al., 2017). SWAT uses a modified formulation of the Curve Number (CN) method (USDA-SCS, 1972) to calculate surface runoff. The Curve Number method relates runoff to soil type, land use and management practices (Arnold et al., 1995). Sediment yield is estimated using the Modified Universal Soil Loss Equation (MUSLE) (Williams & Berndt, 1977).

The model requires as input data daily precipitation, maximum and minimum air temperatures, solar radiation, wind speed and……………..

P.5. and P.5(2). Section Model evaluation.

To see "2.3 Model evaluation" above.

P.7. I don't see the need to report the flowchart by Adami et al. (2012) in this manuscript. I would prefer to see the flowchart of the methodology of the paper.

I reported the flowchart of Adami et al. (2012) by suggestion of the Handling Editor Xuesong Zhang. However, the paper is available in:

http://eduem.uem.br/ojs/index.php/ActaSciTechnol/article/viewFile/10005/pdf