Hydrological data (1977 – 2004) Discharge (Q) from one rain gauge station, rainfall (P) from 19 rainfall stations (Thiesen mean rainfall), parameters temperature, insulation, relative humidity and wind speed from 4 meteorological stations. Daily potential evapotranspiration (EPT) using the Penman modified method (Doorenbos & Pruitt, 1977). Real annual precipitation (EPT) obtained by simplified water balance (ETR = P – Q). The daily ETR values were calculated as ETR = kP. The coefficient (k) between ETR and EPT was 0.93 (1977 – 2004). The mean values of ETR and EPT for the Peixe River watershed are 4.95 mm day\(^{-1}\), 2.95 mm day\(^{-1}\) respectively (Lindner, 2007).

TANK MODEL SAGUARO The Tank Model (Saguara, 1995) with four vertical tanks was applied for the Peixe River Watershed (Fig. 2). Annually calibration (1977-1990) and model validation (1991 – 2004) with hydrographs checking. For the model performance evaluation were applied: coefficient of correlation, coefficient of determination (R\(^2\)), and error indicators such as Relative Error (RE), Volume Standard Error (AVE), Nash coefficient (NS), Nash Logarithmic coefficient (NSLog), Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Logarithmic RMSE (RMSElog) (Setawar et al. 2003, Fujihara et al., 2004). After calibration, the initial storage heights used: 0 mm in tank 1 (Sj), 0 mm in tank 2 (Sj), 60 mm in tank 3 (Sj), and 200 mm in tank 4 (Sj). The best performance of the Tank Model simulation for the whole Peixe River watershed was obtained from the following adjustment: R\(^2\) = 0.847, RE = 0.335, LV = 0.033, NS = 0.849, RMSE = 1.363, MAE = 0.656, RMSElog = 0.197. The mean discharge obtained in the simulation was 2.14 mm day\(^{-1}\). The parameters values are shown in Table 1.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Height of the side outlets mm</td>
<td>Sj</td>
<td>130</td>
<td>A</td>
<td>260</td>
<td>B</td>
</tr>
</tbody>
</table>

Tank Moisture Index (TMI) development

Tank Model with vertical reservoirs represents, schematically, the soil layers from surface to the bottom. Tank Moisture Index (TMI) development

\[
TMI = \frac{1}{3} \sum_{j} S_j (m-j+1)
\]

where \(S_j\) is the storage in reservoir \(j\) at day \(m\) and \(S_{j+1}\) is the storage in reservoir \(j\) at day \(m+1\).

Tank Moisture Index (TMI), for any position \((x_{ij})\) in the reservoirs: Maximum when precipitation is occurring, corresponding to water saturation in the superior reservoir and minimum, corresponding to drought (129), hail and strong winds (40). The last category would not be considered in the present study. It is observed that the major floods occurred in 1983 (39 decrees), 1990 (28), 1997 (19), and 1992 (18), and that the more severe droughts occurred in 2002 (30), 1991 (27) and 2004 (24).

Natural disasters data

The interviews of natural disasters have been published in decrees of “Public Calamity State” (CP) and “Emergency Situation” (SE) signed by mayors and submitted to the National Civil Defense Secretory for recognition (Brazil, 2006). During the period 1977-2004, 330 decrees were established by 25 city halls in the Peixe River watershed. Lindner et al. (2007) classified them in three categories: disaster event (161 decrees), drought (129), hail and strong winds (40). The last category would not be considered in the present study.

Fig. 2 Change of the storage level in reservoirs 1 to 4 due the precipitation and evaporation process, with flow generation: a) storage in S3 to S4, b) storage in S1 to S2, c) storage in S1 to S3, and S4 (storage in S4 is negligible).

Fig. 3 Variations of TMI observed (\(Q_{obs}\)) and calculated (\(Q_{calc}\)) discharge in Peixe River watershed during flood events: (a) July 1983 (b) May 1992.

In July, 1983 (a) TMI was near 3 (normal) TMI increased to 5.1 (wet day 6); 7.9 (very wet day 7) and 9.1 in day 8; discharge of 67.6 mm day\(^{-1}\) (\(Q_{obs}\)) and 51.9 mm day\(^{-1}\) (\(Q_{calc}\)). From 6 to 8 July 1983, 11 municipalities declared “CP” and six, “ES”. In May 1992 (b) an episode of gradual flood reached its peak at day 29 and a sudden increase going above 6, discharge of 43.9 mm day\(^{-1}\) and 43.9 mm day\(^{-1}\) (\(Q_{calc}\)) and TMI increasing.

Fig. 4 Variations of TMI observed (\(Q_{obs}\)) and calculated (\(Q_{calc}\)) discharge in Peixe River by using the Penman modified method (revised 1977).