During the last decade, several research groups have focused their activity on the development of satellite sensor technology and its operation in order to obtain real-time estimates of rainfall on a global scale. The usefulness of these measurements is clear for both global circulation models and hydrological modelling at smaller scales as in the case of little or no instrumented watersheds. These measurements would thereby support the management capacity of water resources, improve weather forecasting and natural disasters and provide scientific rigor to help take informed decisions. Currently, satellite-based rainfall estimation is subject to a number of errors due to instrumental nature of the measurement system, theoretical simplifications and complex relationships between the observed variables and rain, among other reasons (Nikolopoulos *et al.*, 2010; Semire *et al.*, 2012). This may limit its use in hydrological applications, so reducing these errors is fundamental to hydrological application.

The aim of the thesis is to evaluate the usefulness of two satellite-based rainfall estimation products, by means of a distributed hydrological model in an extratropical Mediterranean basin, as an alternative to the estimation of precipitation in regions where conventional gauges are scarce or non-existent. The study area is the river Jucar basin, which is located east of the Iberian Peninsula (Valencia, Spain). It has a drainage area of 21,500 km^2, average flow of 43 m^3/s, average rainfall of 500 mm and average temperature of 14 º C. The terrain consists of mountain ranges of the Iberian system, a continental shelf and coastal plain, with altitudes up to 1770 msnm. Satellite products have a daily temporal resolution and spatial resolution of 0.25º (PERSIANN) and 0.04° (PERSIANN-CCS). These products estimated rainfall from multiple geosynchronous satellites (GOES, GMS, Meteosat) that are updated with information from satellites with passive microwave sensors (TRMM, NOAA, DMSP). The hydrometeorological information based on land (rain, flow, temperature and information from reservoirs) have been provided by the Spanish Meteorological Agency and the Automated System of Hydrological Information of Jucar River Basin Authority for a period from 01 January 2003 to 31 October 2009.

In order to characterize the error of satellite-based rainfall estimation, we compare it with the reference rainfall, by means of statistical tools that allow to synthesis the analysis and to have more detailed view of the errors. Thus, to quantify the degree of dependence, we used the correlation analysis with the Pearson and Kendall statistical test. In addition, we obtained index Nash-Sutcliffe efficiency (E), ratio of the root mean square error and standard deviation of the observations (RSR), error in volume (Ev), detection statistics, double mass curve and graphic techniques. Regarding the performance of the hydrological model, it was evaluated by efficiency indices and graphical techniques in calibration, validation and error propagation.

The results, specific to the study area, indicate that spatial correlations between satellite estimated rainfall and reference rainfall to annual scale is acceptable, less acceptable to monthly scale, but poor to daily scale. In winter, the daily correlation is weaker, because the precipitation is more concentrated in mountainous areas and perhaps this orographic effect is not well detected by satellites. By contrast, in summer the opposite pattern is observed, with significant positive correlation, possibly due to higher presence of dry days (zero value). This is reflected in higher values with the Pearson coefficient in summer, since the presence of zeros favors greater correlation. The Kendall coefficient best represents these cases, because it contrasts the effect of extreme values (minimum values in this case). We also get high errors with maximum rainfall and often overestimate light rainfall.

In general, the PERSIANN-CCS product overestimates, while PERSIANN underestimates at different basin aggregating scales. In addition, PERSIANN has a higher rate of rain detection, but also of false alarms. The rain detection is less in the Albaida subbasin (coastal area with torrential rains and likely SCM in fall) that in the Pajaroncilo subbasin (mountainous area with orographic rain). That is, these differences in detection by both satellite products are being influenced by climatic and physiographic features of the area, which coincides with what reported by Hossain and Huffman (2008).

The volume error (Ev) referred to rainfall, for all levels of basin aggregation, underestimated with PERSIANN and overestimated with PERSIANN-CCS. This error will have consequences for hydrological modelling. However, from a modelling point of view, the error is easier to correct with overestimation than underestimation. Albaida basin (1301 km^2) has better performance in terms of index Nash-Sutcliffe efficiency (E) referred to rainfall estimation with the two satellite products, possibly due to greater presence of convective rainfall that the satellite better identifies, which coincides with what reported by Ebert *et al* (2007). Whereas smaller basin as Pajaroncillo (861 km^2) has better performance in Ev but only with the product PERSIANN-CCS. In this regard, orographic rain in Pajaroncillo (altitude of 1009 to 1726 msnm) is not well detected by the satellites because the mountains emit variable radiation that difficult the detection of satellite with passive microwave sensors, which is reported by Levizzani (2008): but this effect appears to decrease with a better resolution of satellite.

The parameter calibration of the hydrological model TETIS has allowed to improve the modelling performance. In addition, various authors performed a calibration of the hydrological model to improve performance with products from satellite-based rainfall estimation (Stisen y Sandholt, 2010; Bitew y Gebremichael, 2011b; Bitew *et al.*, 2011; Jiang *et al.*, 2012; Moreno *et al.*, 2012). Thus, in hydrological modelling, we obtained "unsatisfactory" performance with PERSIANN, whereas with PERSIANN-CCS become "successful" performance. The results are encouraging for PERSIANN-CCS and it seems that the error of overestimating rainfall volume is better corrected in hydrological modelling. Finally, we show that the higher spatial resolution satellite product has better performance. Similar results were obtained Nikolopoulos *et al*. (2010) with KIDD (4 km) for TRMM-3B42 products (0.25°) and Kidd (25 km). On the other hand, when modelling with PERSIANN, a coarse spatial resolution of rainfall raster data and the error of rainfall volume underestimation are negatively affecting the model results, as there is insufficient rain to feed the hydrological cycle, although this possibly is dampening with a with highest probability of detecting rain PERSIANN.

As the hydrological model tries to maintain a behavior similar to the observed flow (since the calibration strategy is a function of the flow and not a component of the water balance), we obtain that the correction factor for evapotranspiration is reduced by 71% with PERSIANN and increases by 32% with PERSIANN-CCS to finally obtain reduced evapotranspiration with PERSIANN and increased with PERSIANN-CCS. Similar behavior is reported in the evapotranspiration component with underestimation of PERSIANN rain, by Bitew and Gebremichael (2011b) y Moreno *et al.* (2012).

With respect to rainfall error propagation at the hydrological simulation, the volume error of rain is damped through the process of rainfall-runoff transformation, unlike the rainfall error in terms of E and RSR, worsen with hydrological modelling, except in smaller basins as Pajaroncillo (861 km^2) and Albaida (1,301 km^2).

In order to improve the possibilities of practical use of satellite rain, we implemented a Bayesian model to combine information from gauges with PERSIANN-CCS rainfall at different gauge densities, in the mountainous subbasin Pajaroncillo. Results, specifically to the study area, indicate that the average value of the estimated rainfall with PERSIANN-CCS improves with densities of 100 km^2/gauge or less. On the contrary, for densities higher of 100 km^2/gauge, the average value worsens in a range of 20 to 200%, as increases the density of the network of rain gauges. Similar behaviour was found with the other statistics. Thus, it is clearly a significant improvement in the statistics for a density less than 100 km^2/gauge, with increased POD, CSI, PC and HSS, and reduction of FAR. Furthermore, there is a remarkable improvement of FBIAS in all gauges densities, with the exception of 45 km^2/gauge density. Rain efficiency ratings E, RSR and Ev are stabilized at a density less than 100 km^2/gauge.

With regard to hydrological modelling using a Bayesian model, the performance obtained are "good" to "very good" with densities below 100 km^2/gauge. In addition, the best performance was achieved for a density of 72 km^2/gauge, when the base flow was adequately reproduced as well as the shape of the recession curve. The model also detects most peak flows and days that they occur, but underestimates its maximum value by 37%. This underestimation could be due to the presence of mountains, as Pajaroncillo rainfall stations tend to be in the valley and therefore underestimate the orographic rainfall (Ebert *et al.*, 2007; Álvarez, 2011). Regarding the rainfall error propagation, the rainfall error volume is damped for all gauge densities (except with a density of 431 km^2/gauge) but worsen in terms of E and RSR, except for densities lower to 172 km^2/gauge.

As a final conclusion, we can say that the new product for satellite-based rainfall PERSIANN-CCS, in addition to increasing the spatial resolution of PERSIANN, also improve its reliability for its use in hydrological modelling, especially if combined with rain gauge data, becoming the starting point for further research.