team six AQUAHOLIX

MIKE SHE REPORT

Lay emphasis on : Analysis of the relative contributions -(hydrographs) of the sub-catchments during the flood”

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1. Introduction

The Var is a river located in the southeast of France. The Var flows through the Alpes-Maritimes département for most of its length, with a short stretch in the Alpes-de-Haute-Provence département. The Var rises near the Col de la Cayolle (2,326 m) in the Maritime Alps and flows generally southeast for 114 kilometres into the Mediterranean between Nice and Saint-Laurent-du-Var.* Var catchment consist of five sub-catchments: Esteron, Vesubie, Tinée, Upper Var and Lower Var.

Figure 1.: The Var catchment

We set up the hydrological model of the Var River Catchment using MikeSHE. There was a flood event in 1994 on the Var river. This event is the main case of our modelling and this report as well.

Report contains the following parts:

Methods:

- Set up Mike She
- Coupling Mike She with M11

Results

- Calibration of Mike She
- Calibration of M S and M11

Discussion and conclusions

1.1 About Mike-She

MIKE SHE is an integrated modeling framework for simulating all components of the land-phase of hydrologic cycle. That is, with MIKE SHE you can simulate evapotranspiration, overland runoff, channel flow, unsaturated infiltration, and saturated groundwater flow – including the interactions between all these processes.**

2.Methods

2.1 Set up Mike She

We set up the hydrological model of the Var River Catchment using MikeSHE. MikeSHE needs two input map at least, topography and grid domain with the same grid size and we used rainfall distributed in Thiessen polygons corresponding to 6 rain gaugestations. We used the DEM of 300 m resolution. During the set up we followed exactly Tutorial 1.***

Main input datas:

- Topography
- Model domain and grid
- Precipitation

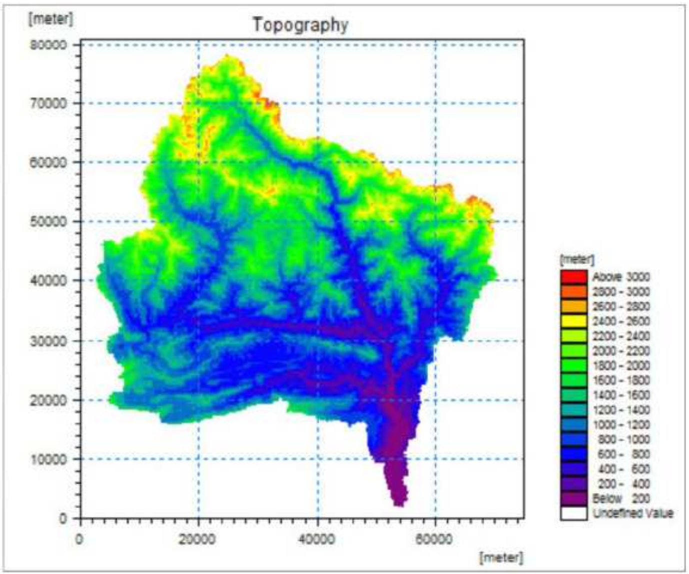

Figure 2. : Topography

These data came from the GIS and Hidrology modelling. Nevertheless, we had to set up the following paramaters NRF, Stickler coefficient, DS, IWD and we need to define our outlet points. The points are along the bridge of Napoleon III where also the discharge was estimated from water level during the flood.

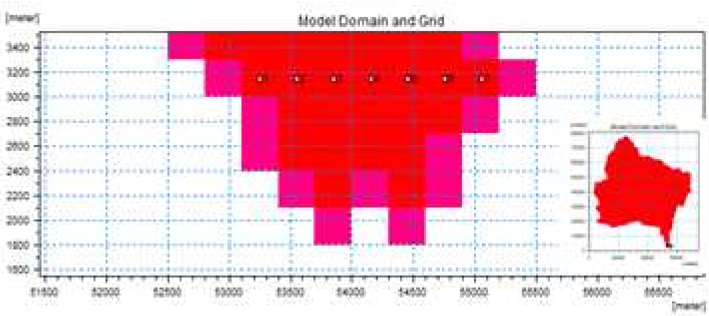

Figure 3 : Defined outlet points

2.2 Coupling Mike SHE and Mike 11

Without river network and using 300 m grid size we are not able to calibrate Mike SHE, that's why we need to set up the coupling of Mike SHE and Mike 11. We kept on every settings in Mike SHE and built Mike 11 into the modell. We need to set up our Mike 11 modell with the following datas which was available on the HydroEurope website ***.

Input datas:

- Network
- Cross-sections
- Boundary coditions
- HD parameters

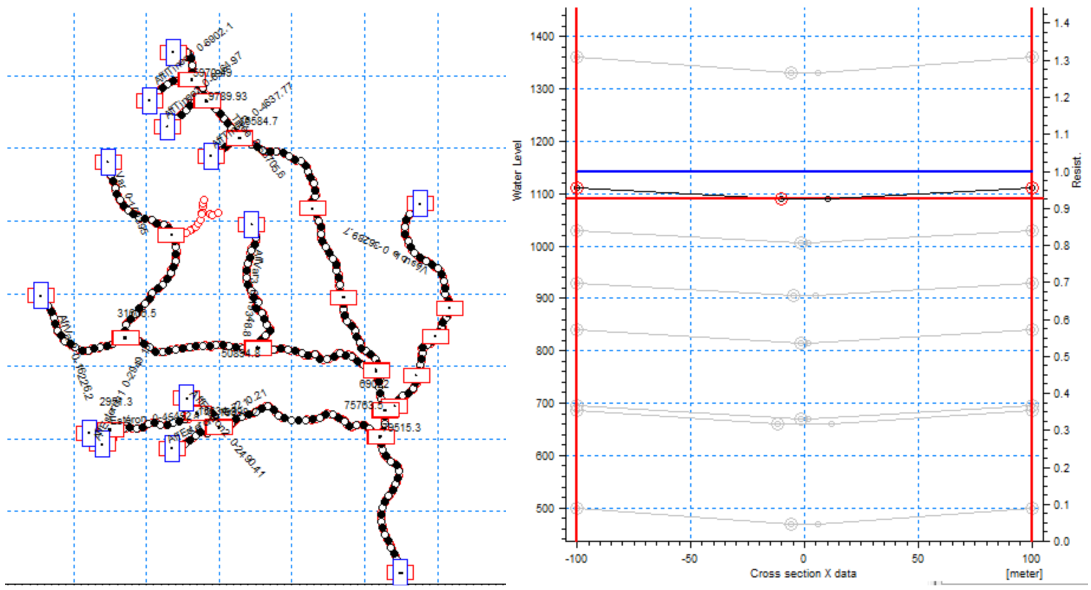

Figure 4 : Network and cross-sections

3.Results and discussion

3.1 Calibrating and results of Mike SHE

After we set up our model we started to calibrate it, but we soon realised it's impossible to get realistic results without river network, because the used grid size (300m) is not able to consider sharp changes in the topography and it also means that water will run off to a channel of the width of the grid size, and discharges were simulated. That's why water depth, velocity and discharge will be underestimated.

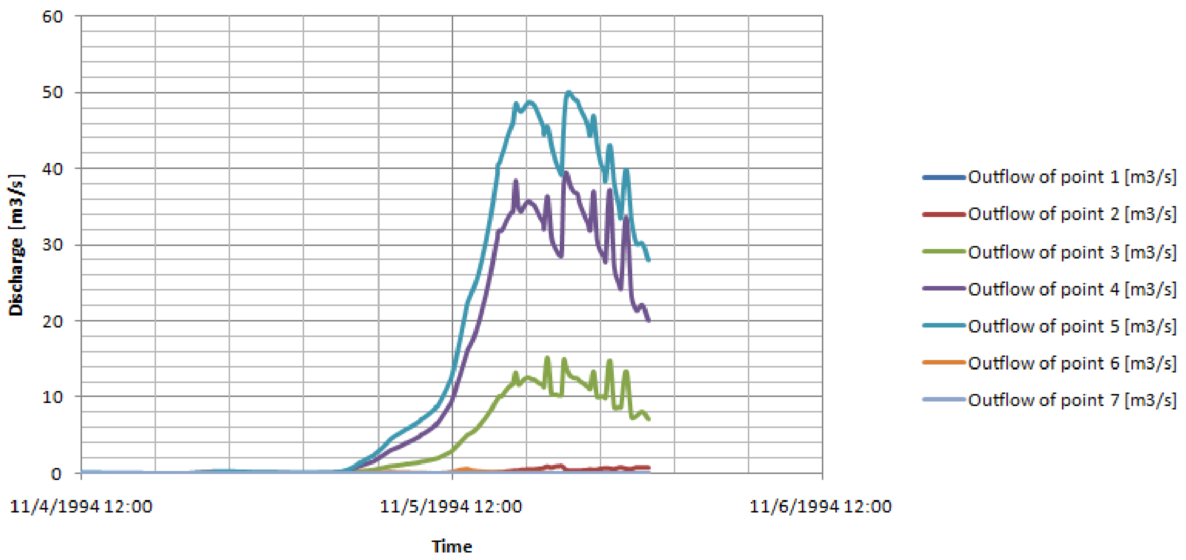

Figure 5 : Discharge of the outlet points

The maximum of simulated overland flow reached 100 m^3/s. This is far less than the observed (estimated) discharge during the flooding event (3600 m^3/s).

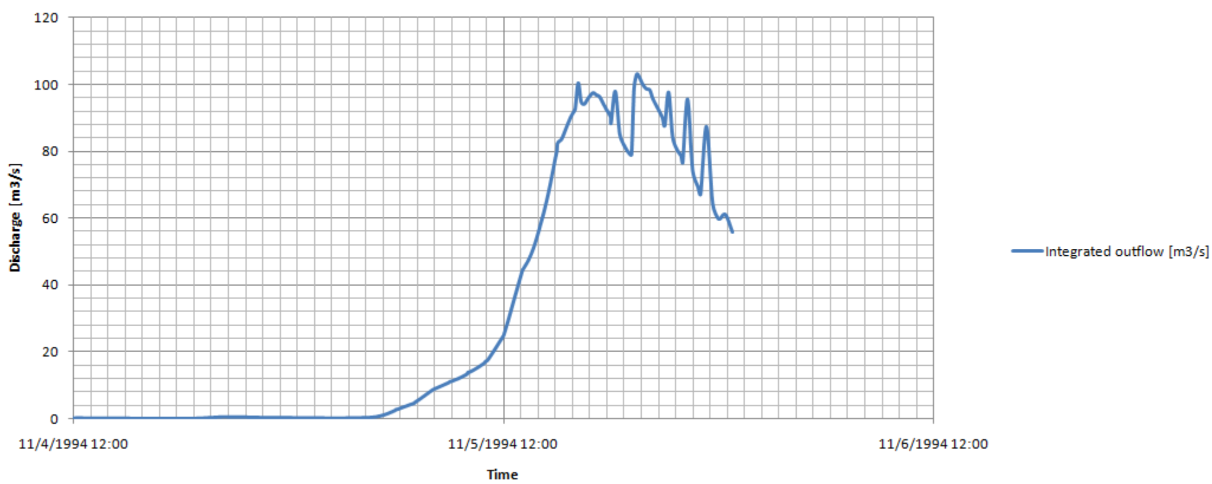

Figure 6 : Integrated discharge

3.2 Calibrating and results of coupling Mike SHE and Mike 11

Since MikeSHE modell without river network underestimated the discharge of the flood event, the river network of Var was built in MikeSHE using Mike11. There is no information or measurement about the Strickler's coefficient,that's why we used this variable for calibration. The sensitivity analysis has shown that the Strickler's bed resistance coefficient influenced the peak discharge slightly. The peak value increases with higher value of Strickler. However the time of the peak is not affected significantly.

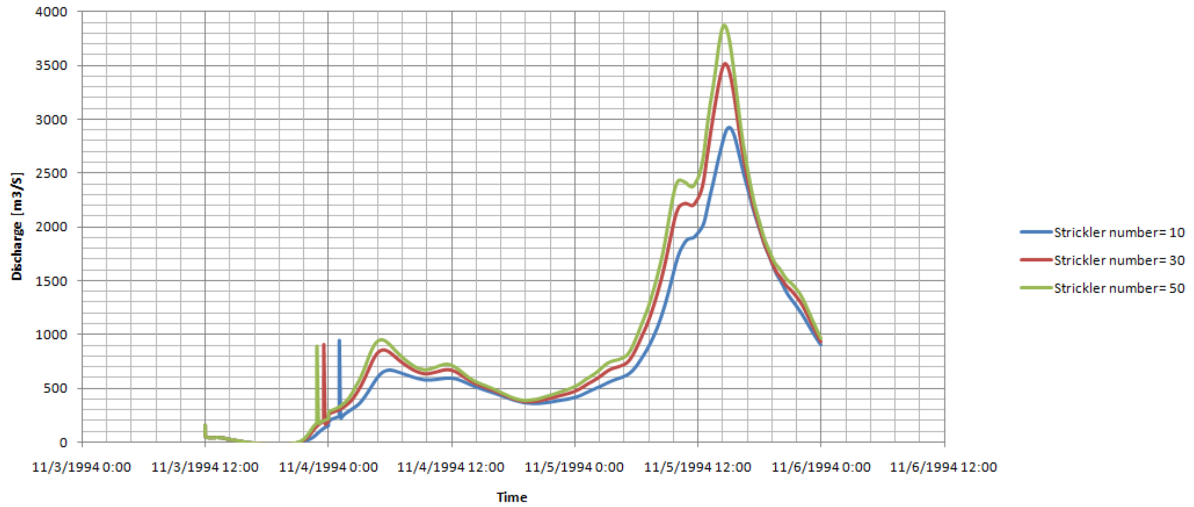

Figure 7 : Sensitivity analysis of Strickler number

During the first calibration the simulation period was one day and we didn't use to calibrate only NRF, and M parameters , we also used detention storage, initial water depth to consider the rainfall event before the simulation period, but we got very small discharge at the beginning of the flood.

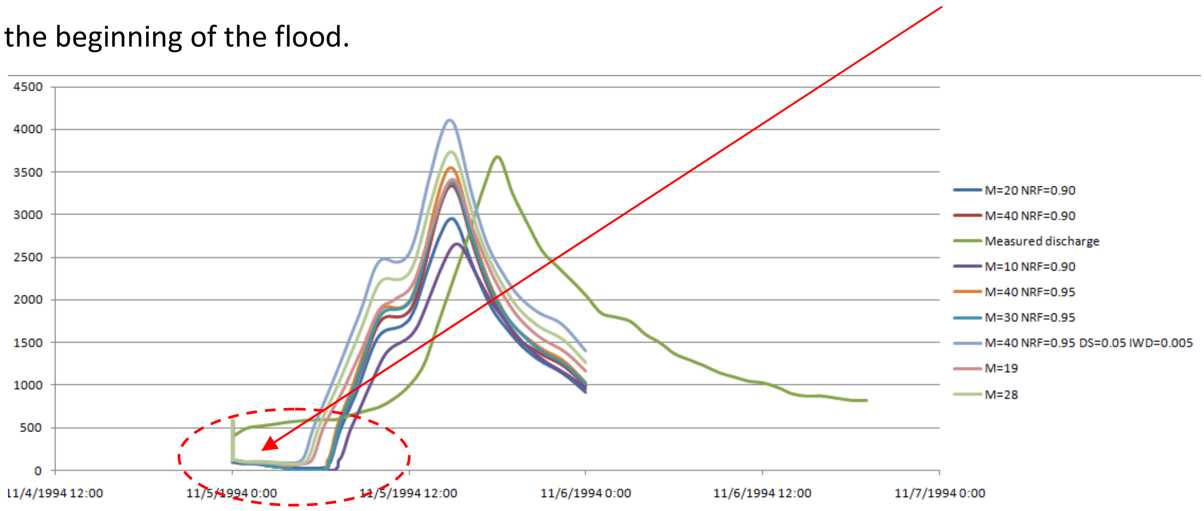

Figure 8 : Start discharge problem

On that score we increased the simulation period to 3 days, and we calibrate with net rainfall fraction which means the fraction of rainfall that is available for infiltration and overland flow and we also calibrate with Strickler number (M) (overland) parameter. We increased Strickler number up to 50 and we see it is too smooth,so we decreased it means much rougher surface that lead to an even slower and smaller peak discharge. Our best results given by using the following parameter values.

Parameter	Value
Simulated period	3 days
Strickler (M)	33
NRF	92
DS	0
IWD	0

Table 1 : Parameters of the most accurate calibration

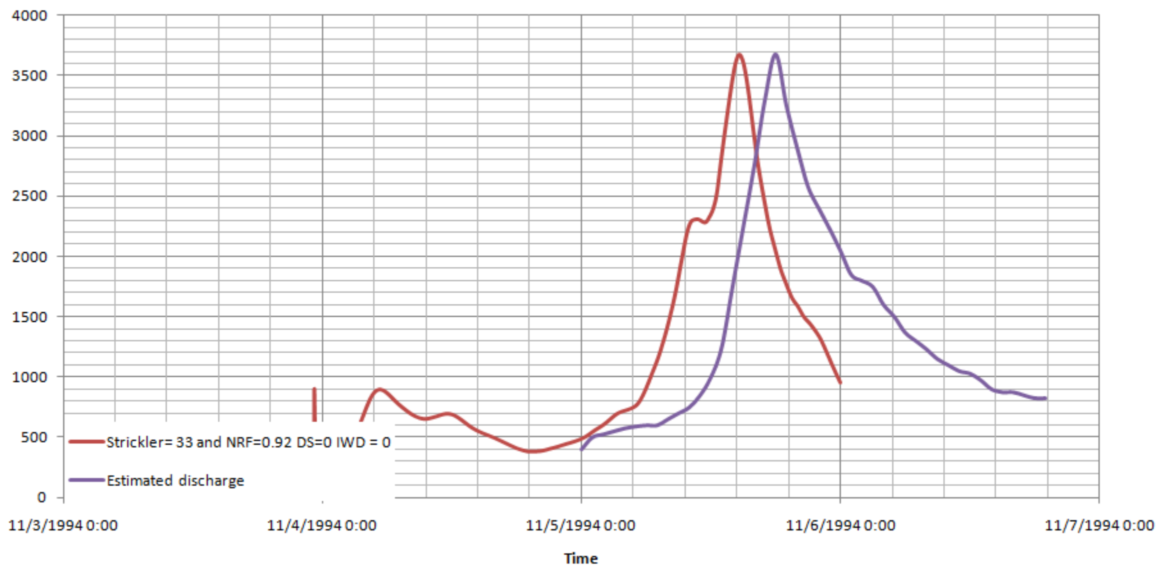

Figure 9 : Result of the calibration

During the calibration, timing of the peak is insensitive to different parameters. Only the ’detention storage ’ parameter could influence the timing of the curve but it can’t change the time of the peak. We need to mention the timing of the curve is not reliable because the discharge is estimated from the height. Our purpose of calibration is to match the peak even if there is a time lag. In the above fig. 9 it has been evident that the peak value is the same with a time lag of 3 hours.

3.3 Analysis of the relative contributions -(hydrographs) of the sub-catchments during the flood

3.3.1 Introduction of Var sub-catchments

Var catchment consists of five sub-catchments namely Esteron, Vesuibe, Tinee, Upper and Lower Var. Our task is to model the catchment as a whole and extract the discharge hydrographs for each of the sub-catchments. The extracted hydrographs have been presented below and relative contributions of them is analysed.

3.3.2 Relative contributions of the sub-catchments

The calibrated model is used for analysing the relative contributions of the sub-catchments. The results show us that the influence of Upper Var and Tinee are the most significant. It takes more than 65% in every scenarios. The influence of the lower Var is very little which is just 2-4%.

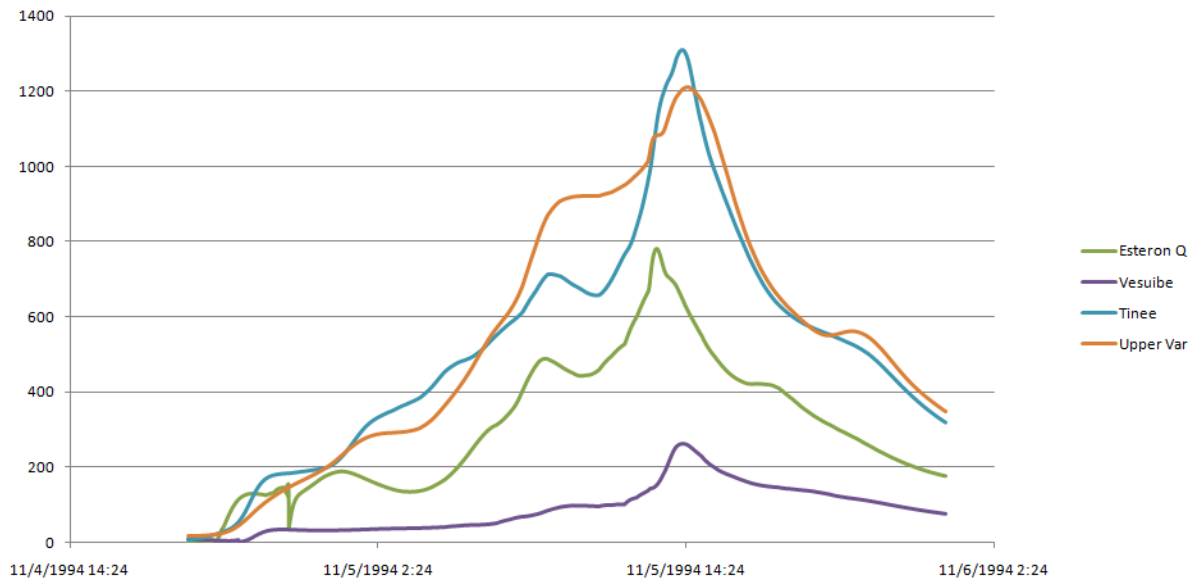

Figure 10 : Hydrographs of sub-catchments (calibrated model)

3.3.3 Do we need calibration to know relative contributions?

We simulated for five different scenarios which contains various parameter values and examined there is a significant difference between the results of scenarios. The following figures show us one of the uncalibrated results. As we see in the figure, there is a huge difference of 300 m^3/sec between calibrated and uncalibrated (scenario 5) results. Amongst all the scenarios, this is the one with the biggest difference. That's why we chose to represent our theory. There is no need for calibration if we want to know the relative distribution of each sub-catchments. We need to highlight that the characteristics of uncalibrated curves are not the same as the calibrated one. So, if we want to know more details from the flood we need to calibrate our models eventually.

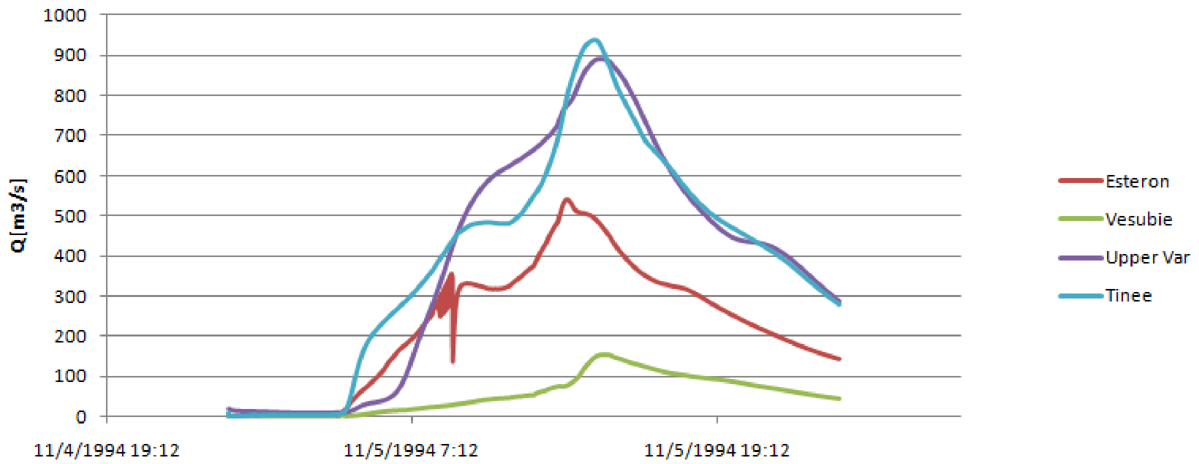

Figure 11 : Hydrographs of sub-catchments (scenario 5)

The following bar chart shows the difference between scenario 5 and the calibrated model.

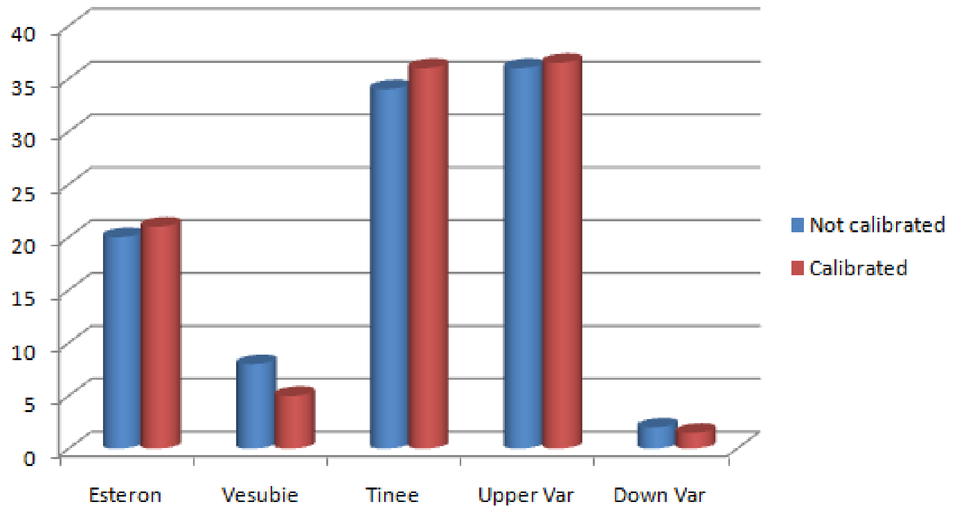

Figure 12 : Relative contributions of sub-catchments during the flood (scenario 5 and calibrated)

The following graph shows the linear relationship between the calibrated and scenario 5 with scenario 5 along the X axis and calibrated model along the Y axis. The points on the graph represents the sub-catchments. The linear correlation coefficient (R^2) is 0.9933 which is nearly equal to 1.0. It means that there is no difference between calibrated model and scenario 5 from the relative contribution point of view.

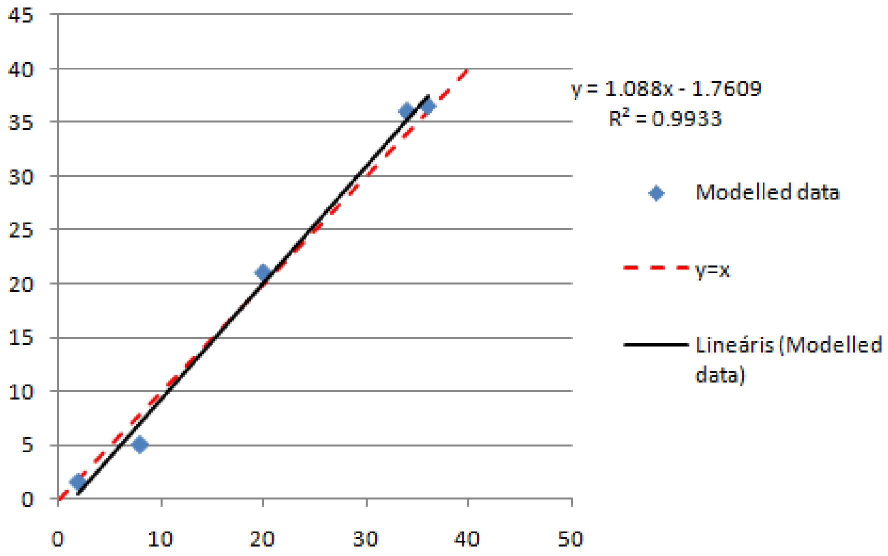

Figure 13 : Relationship between calibrated and scenario 5

4.Conclusions

i) We can't simulate the flood only with MIKE SHE using 300m resolution grid size because it is coarser. So we need to couple it with MIKE 11, a river network model.

ii) Since the discharge is estimated, Q-H curve is not known for this flood. The timing of the peak is not relavant. That is why we need to calibrate only for the peak discharge.

iii) If we want to know the relative contributions of each sub-catchments, we don't need to use calibrated model.

References:

*http://en.wikipedia.org/wiki/Var_(river)

**http://www.dhigroup.com/Software/WaterResources/MIKESHE.aspx

*** http://www.hydroeurope.org/page1601.html