UNCERTAINTY ISSUES IN SWAT MODEL CALIBRATION AT CIRASEA WATERSHED, INDONESIA.

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Background

Hydrological model is a simple presentation of a complex hydrologic system.

climate, soil, land use and land management

process a watershed.

HYDROLOGICAL MODEL

SWAT model.

to predict the effect of land management on water yield, sediment, pesticides and chemical of agricultural products that enter the river or body of water in a watershed which complex with soil, land use and various management over a long time (Neitsch *et al.*, 2005).

determining a watershed management activities

Scenarios ← Statisfatory Calibration and validation

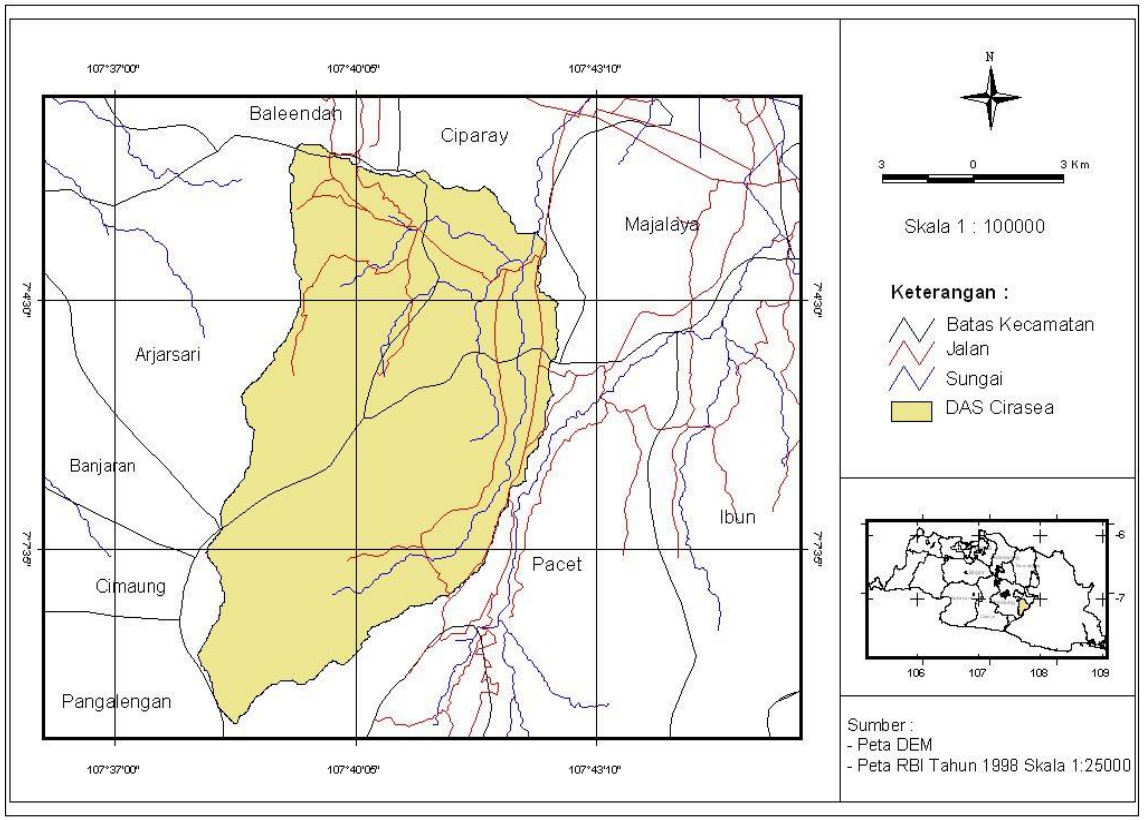
Little difficult, lot of parameters.

The aim of this study

* understand the process of calibration and uncertainty factors that affect the processes occurring in hydrological modeling at the Cirasea watershed using SWAT Model.

* Some of the results of previous research conducted on various watershed (Hernandez *et al*. 2000; Wang *et al*. 2007; Suryani 2005; Reungsang *et al*. 2005; Schuol and Abbaspour 2006) showed the value of Nash-Sutcliffe coefficient is good/satisfactory.

Watershed Condition



7°03'02"-07°17'15" S and 107°37'00"-107°43'10" E

South Bandung Regency, West Java Province with an area of 6,832 ha

Cirasea watershed:

* Degradable watershed (erosion, sedimentation, development of industry area)
* Land use changes (reducing forest area)
* Contributes flood which occur in Bandung Regency.

Climate

- climate type D (moderate wetness level).

Annual precipitation	1.538 mm
MaximumTemperature	27,81 – 30,09°C
Minimum Temperature	18,10 – 19,96°C
Solar radiation	14,66 MJ/m2/hari
Relative Humidity	78 %
ETa	1,443 mm

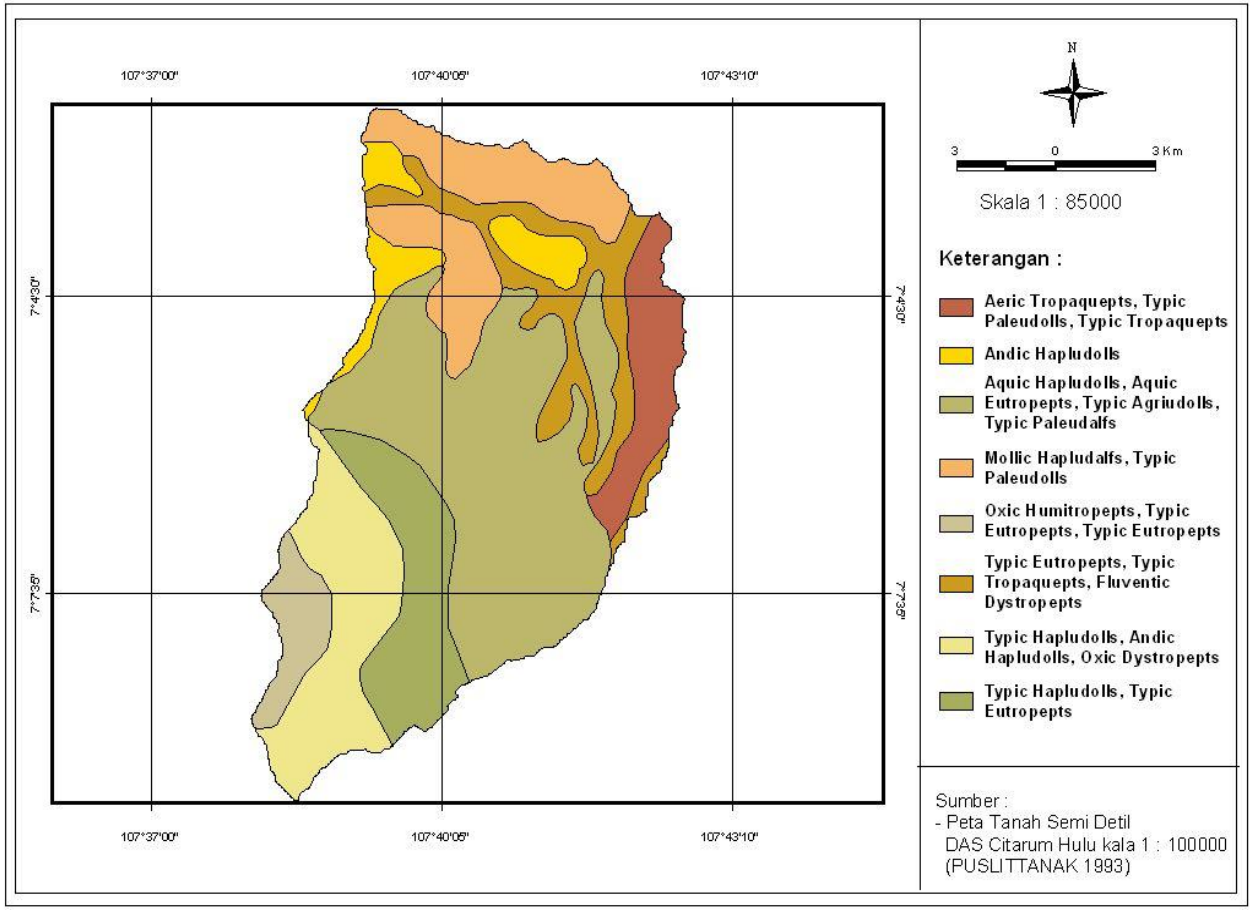
Topography

Flat to mountainous, landforms are plains, hills, alluvial fan, and lungur volcanic cone.

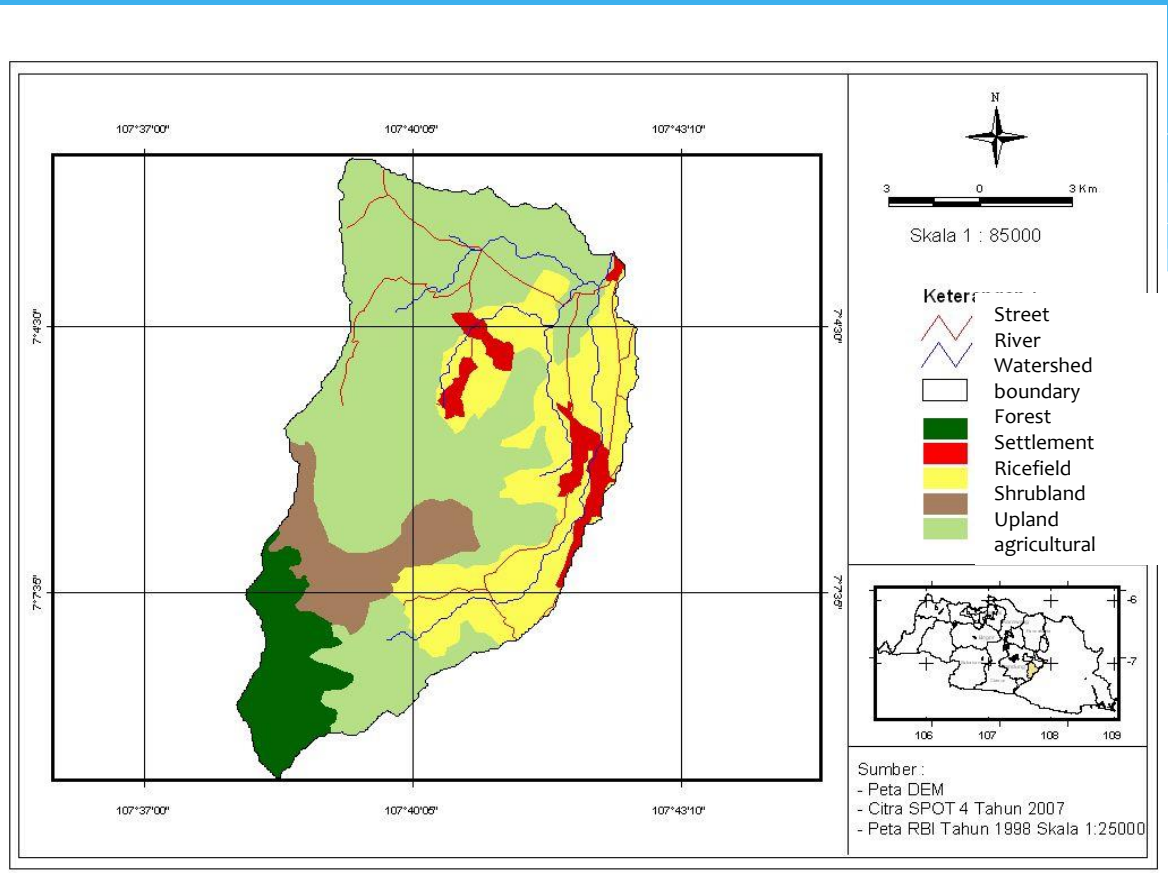
Table 1. Slope class Cirasea Watershed

SLOPE CLASS (%)	AREA (HA)
0 – 8	1,174
8 – 15	816
15 - 25	1,227
25 - 40	1,381
> 40	2,234
TOTAL	6,832

Soil


107°37'00"
107°40'05"
107°43'10"
7°4'30"
7°7'35"
N
3 0 3 Km
Skala 1 : 85000
Keterangan :
Aeric Tropaquepts, Typic Paleudolls, Typic Tropaquepts
Andic Hapludolls
Aquic Hapludolls, Aquic Eutropepts, Typic Agriudolls, Typic Paleudalfs
Mollic Hapludalfs, Typic Paleudolls
Oxic Humitropepts, Typic Eutropepts, Typic Eutropepts
Typic Eutropepts, Typic Tropaquepts, Fluventic Dystropepts
Typic Hapludolls, Andic Hapludolls, Oxic Dystropepts
Typic Hapludolls, Typic Eutropepts
Sumber :
- Peta Tanah Semi Detil DAS Citarum Hulu kala 1 : 100000 (PUSLITTANAK 1993)

Land Use


107°37'00"
107°40'05"
107°43'10"
7°4'30"
7°7'35"
N
3 0 3 Km
Skala 1 : 85000
Street
River
Watershed
boundary
Forest
Settlement
Ricefield
Shrubland
Upland
agricultural
106
107
108
109
Sumber :
- Peta DEM
- Citra SPOT 4 Tahun 2007
- Peta RBI Tahun 1998 Skala 1:25000

Calibration Procedure

* simulation period: 11 years starting from 1998 to 2007

model set up

calibration process.
(January to April 2007).

Validation

Rainy season

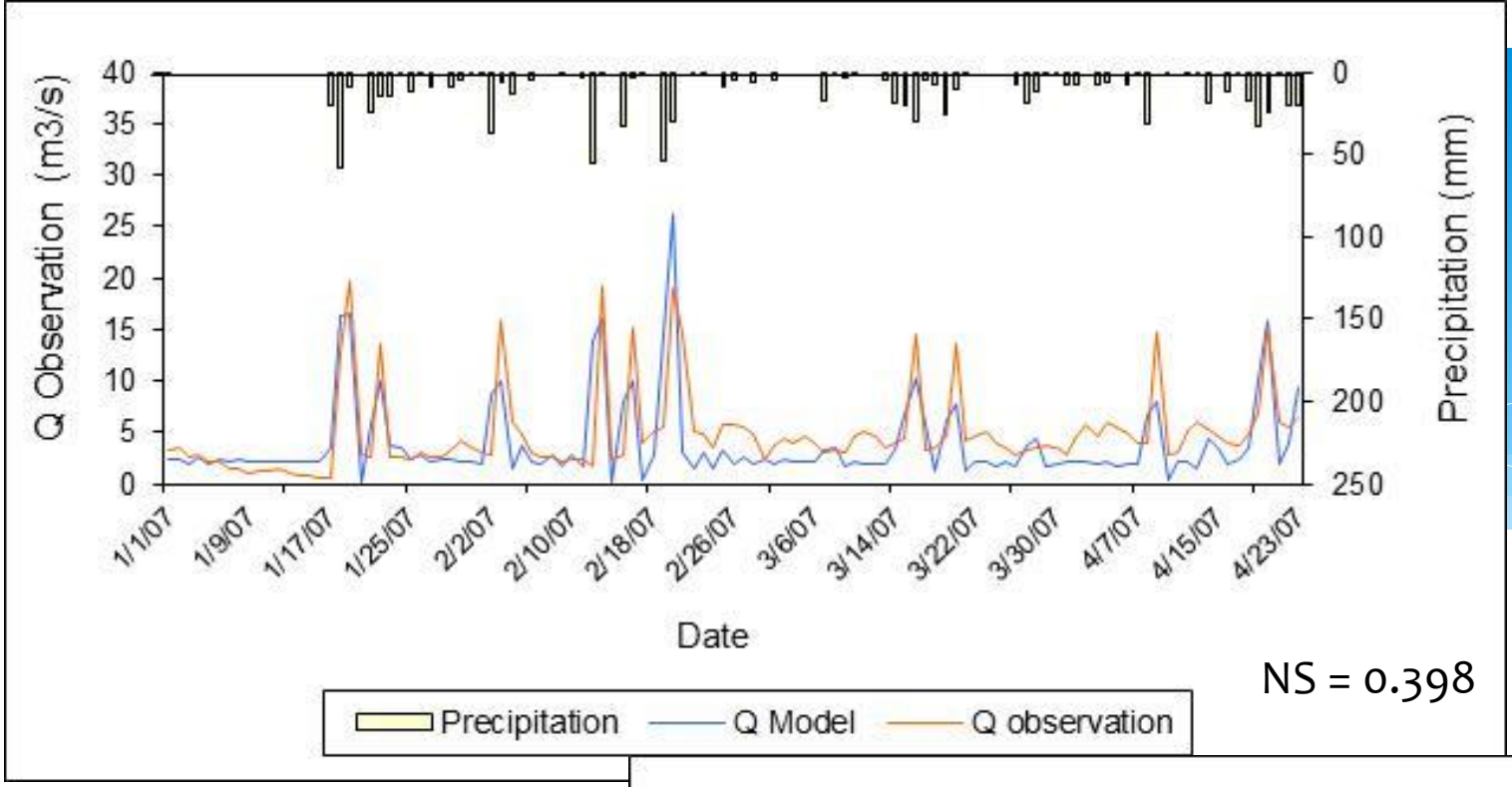
Dry season

SWAT → a 100s parameters

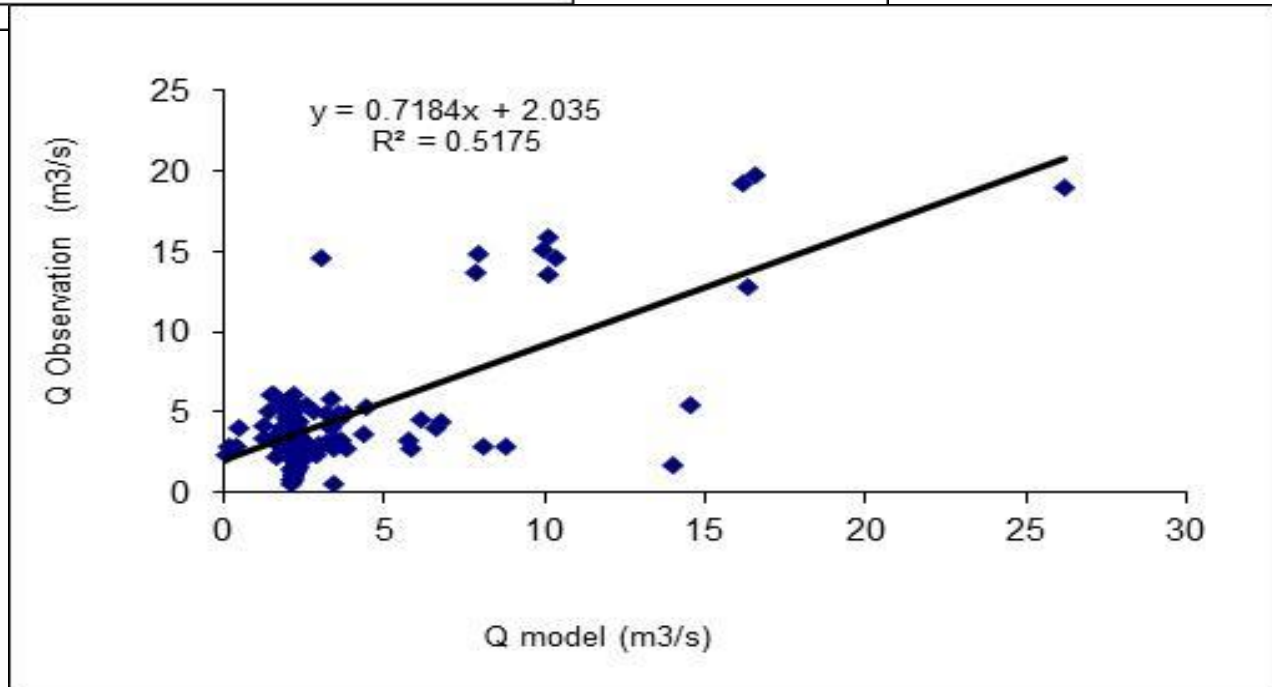
↓

determining the specific parameters which really affect the hydrology of a watershed.

a) the absolute sensitivity analysis in which the value of one parameter is vary while the other parameters remains constant, and
b) the relative sensitivity analysis in which all parameters vary simultaneously



NS = 0.398



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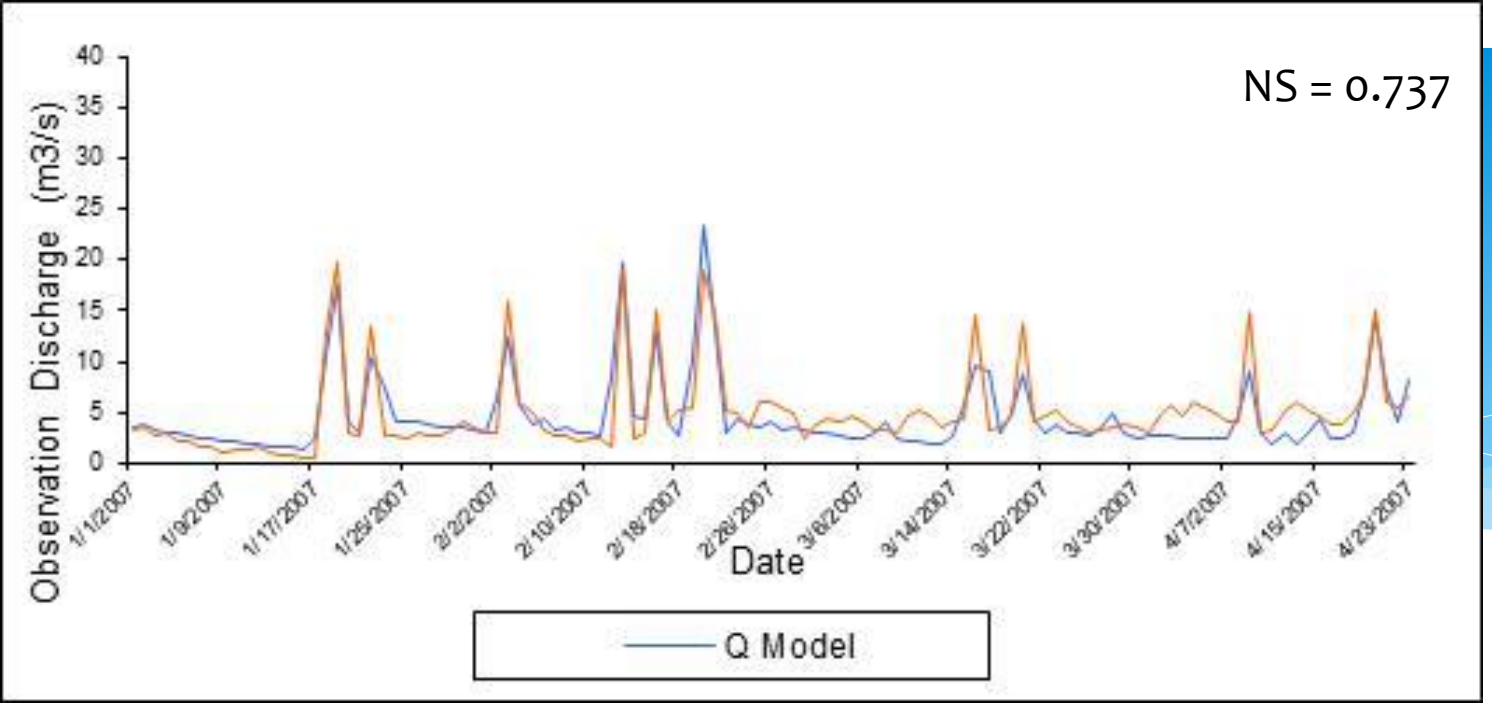
Sensitivity Analysis

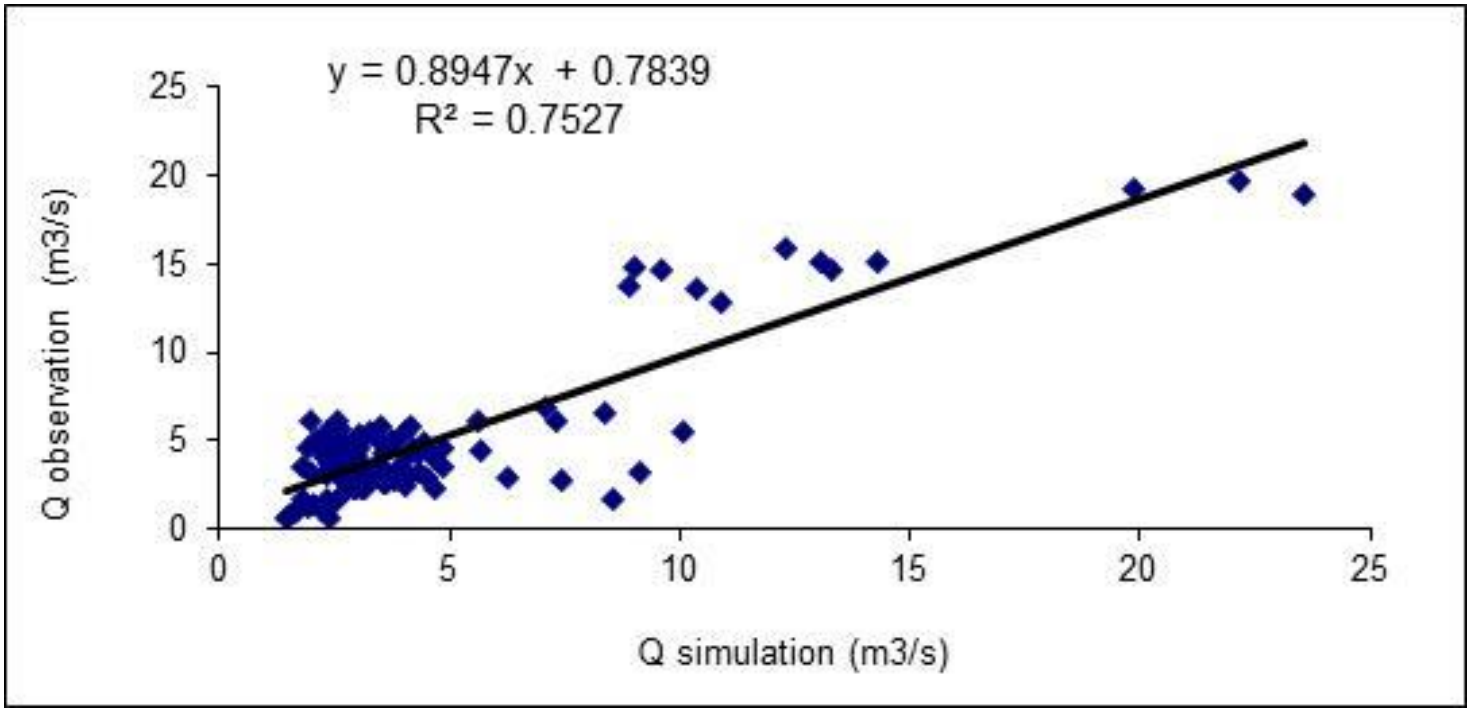
Table 2. Sensitive Parameter included in the calibration procedure

No	Parameter	Definition	Final Parameter Range
1.	Surlag	Surface runoff lag coefficient (days)	3-5
2.	MSK_CO1	Coefficient that controls impact of the storage time constant for normal flow	4.2-7.5
3.	MSK_CO2	Coefficient that controls impact of the storage time constant for low flow	5-10
4.	Gw_delay	Time for water to flow from soil profil to shallow aquifer (days)	13-25
5.	Gwqmn	Threshold depth of water in the shallow aquifer required for return flow to Occur (mm)	3-15
6.	Revapmn	Threshold depth of water in the shallow aquifer for "revap" or percolation to the deep aquifer to occur (mm)	1-15
7.	CN2	Curve number	Real value x (0.75-1.5)
8.	CH_K2	Effective hydraulic conductivity in main channel alluvium (mm/hr)	10-20
9.	ESCO	Soil evaporation compensation factor	0.5-1

Calibration

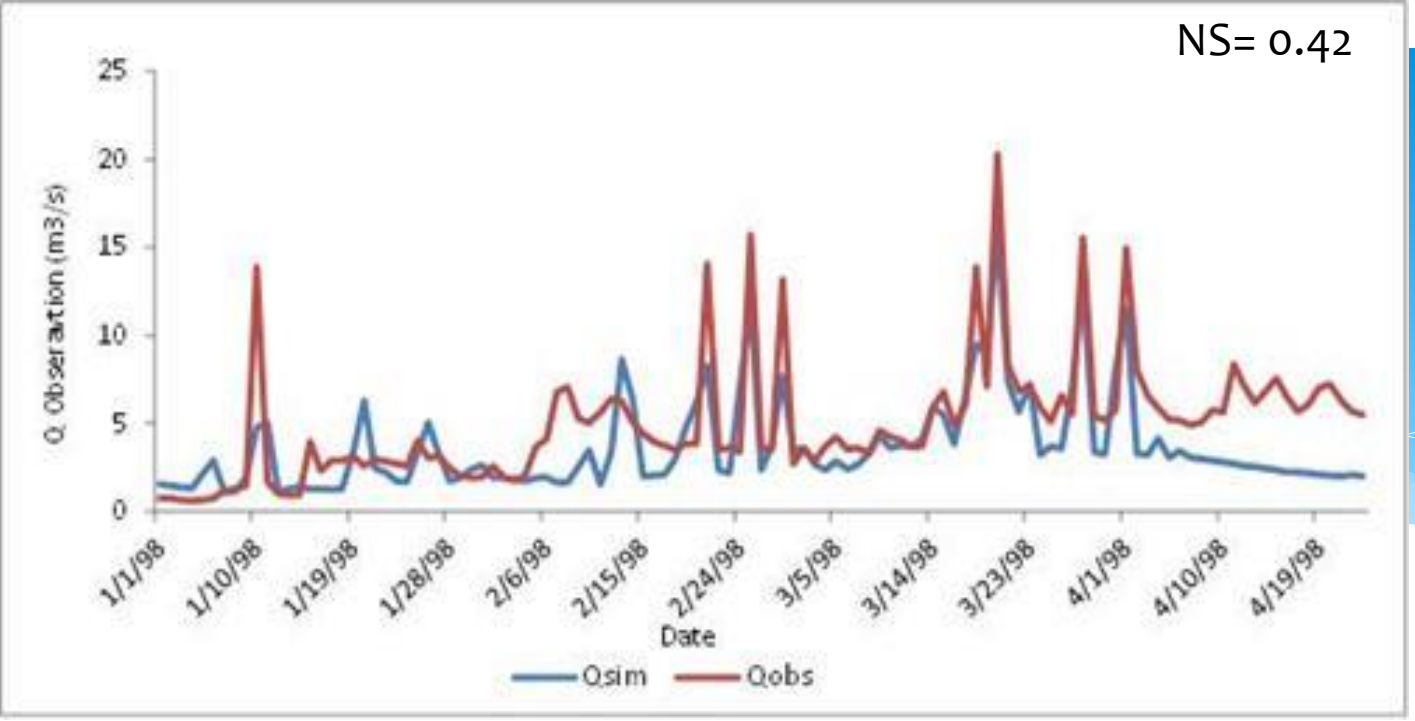
NS = 0.737





Validation

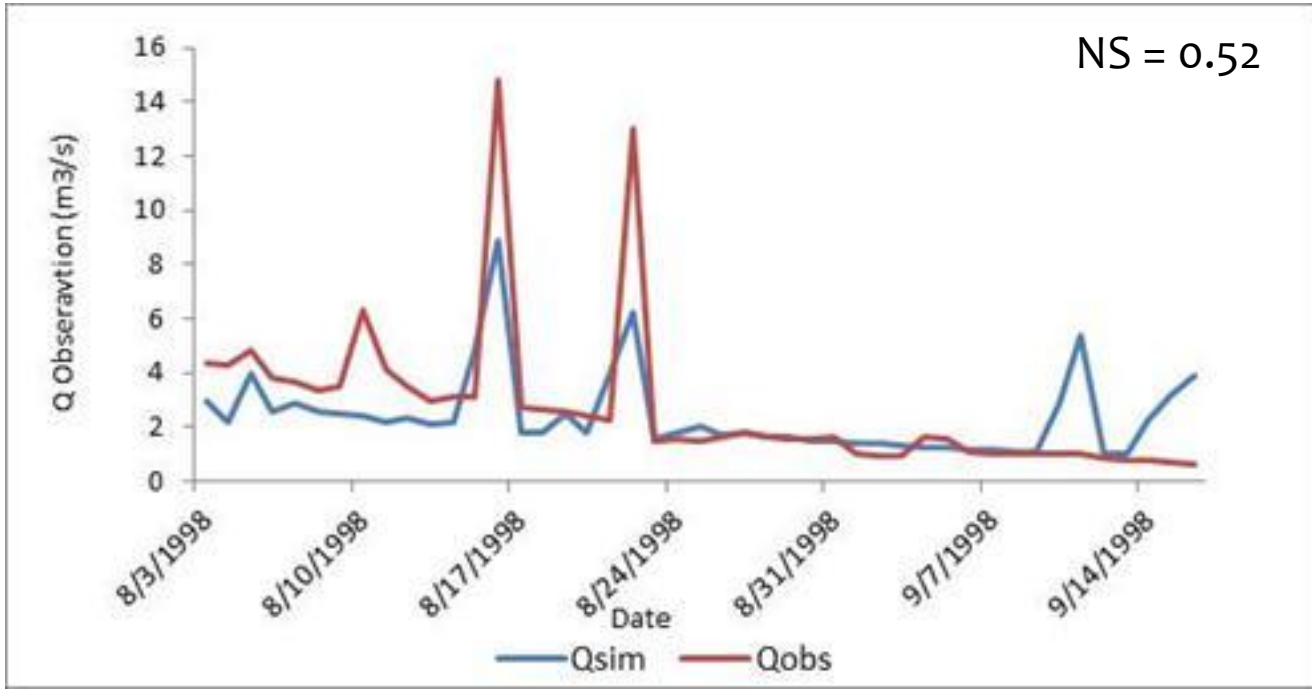
NS= 0.42



Rainy season

Dry season

NS = 0.52



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Name	Area	Daily NS	Monthly NS
Junaidi (2009)	Cisadane Watershed		0.7
Suryani (2005)	Cijalupang watershed		0.52
Ahl *et al.* (2008)	Montana	0.74	0.82
Spruill *et al.* (2000)	Kentucky watershed	0.19	0.89

NS Daily simulation < Monthly simulation

Uncertainty Parameter

CN2, ESCO and MSK_CO2

CN2 value highly influential on the peak discharge generated because the value describes the condition of land use, soil and rainfall in some places. Thus, there is a difference of CN2 that must be applied to each of the calibration and validation period.

ESCO value that describes soil evaporation factor should also differ between rainy season and dry season. In the dry season, because the soil is dry means the less water that will be involved in the process of evaporation.

Water use factors by people around the Cirasea river for farming activities as well as day-to-day needs have not been taken into account in the model.

(Abbaspour and Schuol (2006)).

CONCLUSION

* In the hydrology modeling, both the input parameters and the model is something that is not definite.
* It is because of each input reflect the condition of a watershed at a particular moment/time that cannot be compared to any other time.
* Uncertainty parameter in SWAT modelling at Cirasea watershed include CN2, ESCO and MSK_C02 input.
* Manual calibration is very helpful in understanding the process and uncertainty parameter in a model for small watershed scale.

TERIMA KASIH
THANK YOU