Spatial Correlation for Flood Risk Assessment in Yom River Basin

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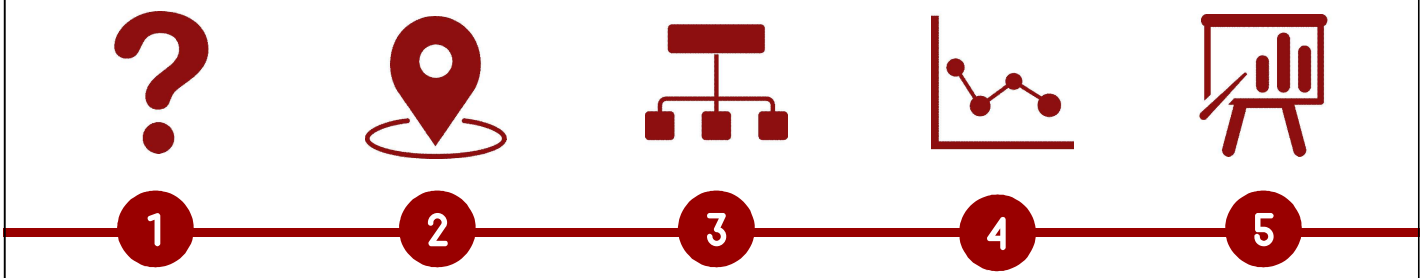
OUTLINES



1. Introduction
2. Study Area & Data
3. Methodology
4. Results & Discussion
5. Conclusions

1. INTRODUCTION

Thailand

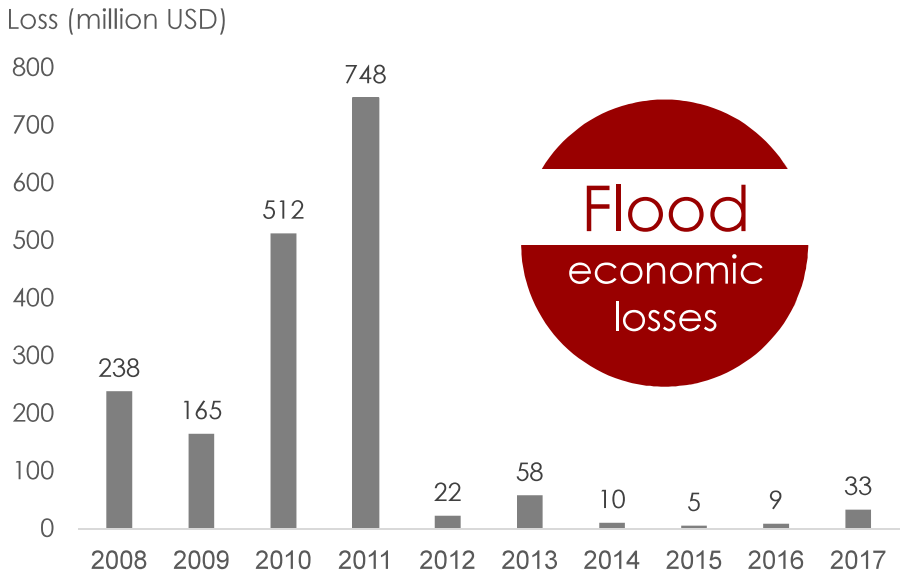


Fig. 1. Flood economic losses in Thailand (2008-2017)

Source: Department of disaster prevention and mitigation

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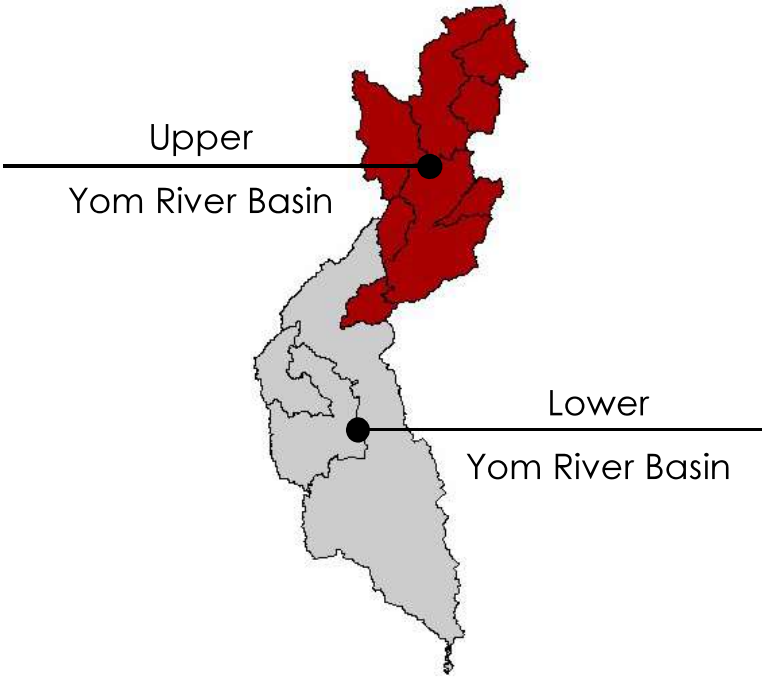
CHARACTERISTICS OF FLOOD IN YOM RIVER BASIN



CHARACTERISTICS OF FLOOD IN YOM RIVER BASIN

Phayao (2018)

Flash Floods

Phichit (2017)

River floods

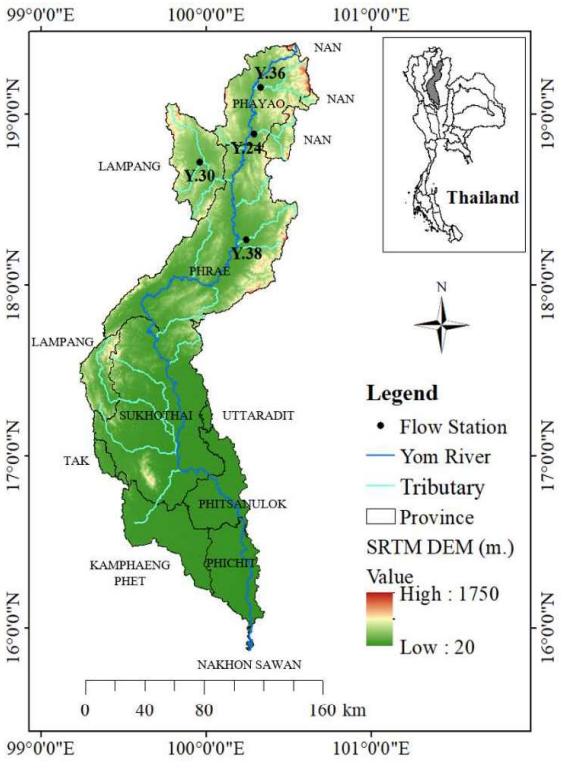


Fig. 2. Map of Yom River Basin and Locations of Selected Flow Stations.

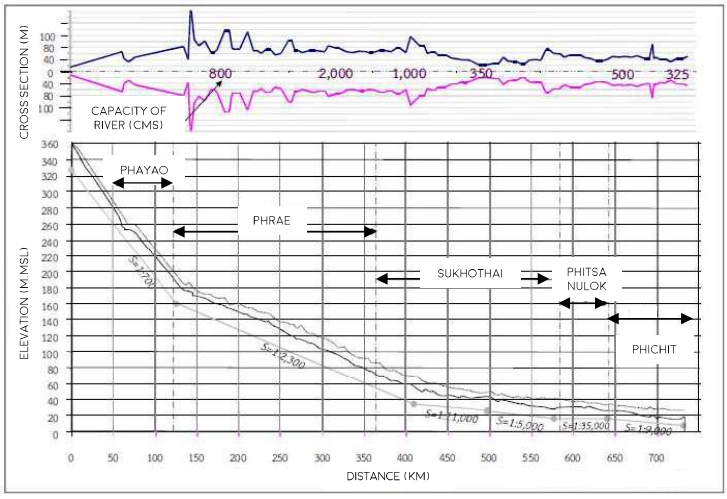
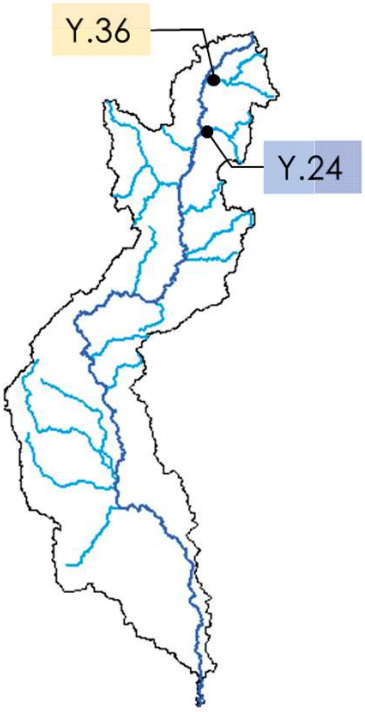


Fig. 3. Cross section and capacity of Yom River.

Sources: Department of Water Resource, Department of Provincial Administration, Hydro and Agro Informatics Institute, SRTM

SPATIAL CORRELATION



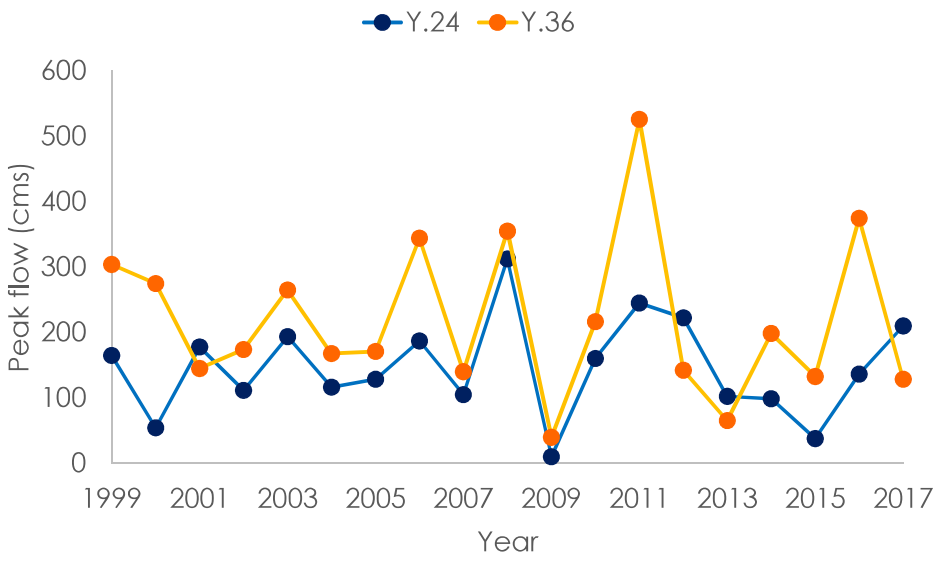


Fig. 4. Peak Flow in Yom River Basin (1999-2016)

Source: Royal irrigation Department

OBJECTIVE

"Develop a spatial correlation of peak flows in sub-basins of Yom River Basin"

2. STUDY AREA AND DATA

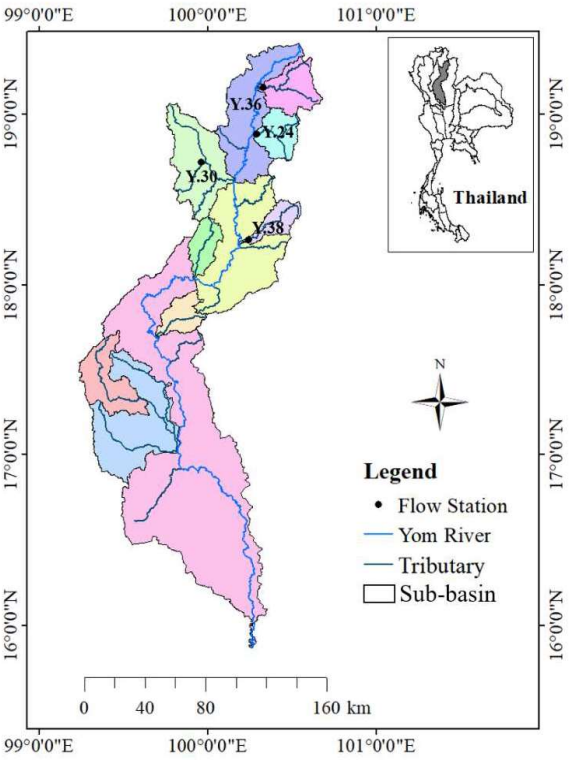


Fig. 5. Locations of Selected Flow Stations.in study area

Yom River Basin

Area = 23,616 km^2
Sub-basins = 11
Provinces = 11

Data

Flow stations = 4
(Y.36, Y.24, Y.30, Y.38)
Located in 4 sub-basins

Duration = 1999-2017 (19 years)

Sources: Royal Irrigation Department,
Department of Water Resource,
Department of Provincial Administration

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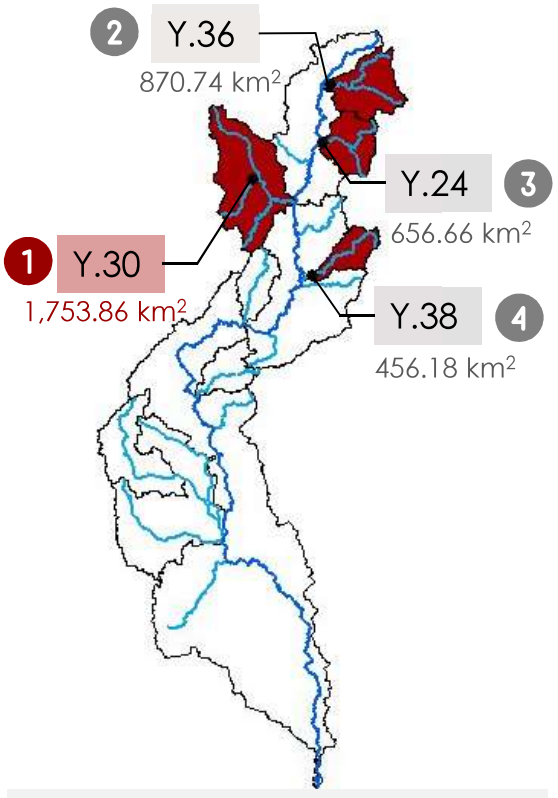


Drainage Area

YOM RIVER BASIN

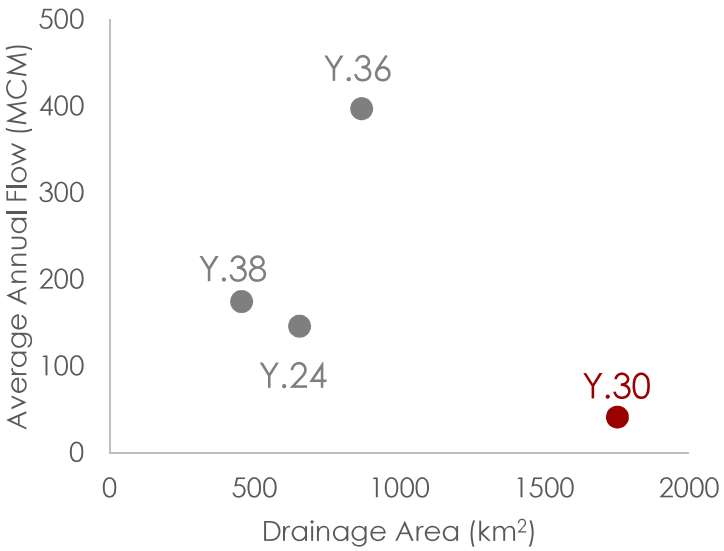
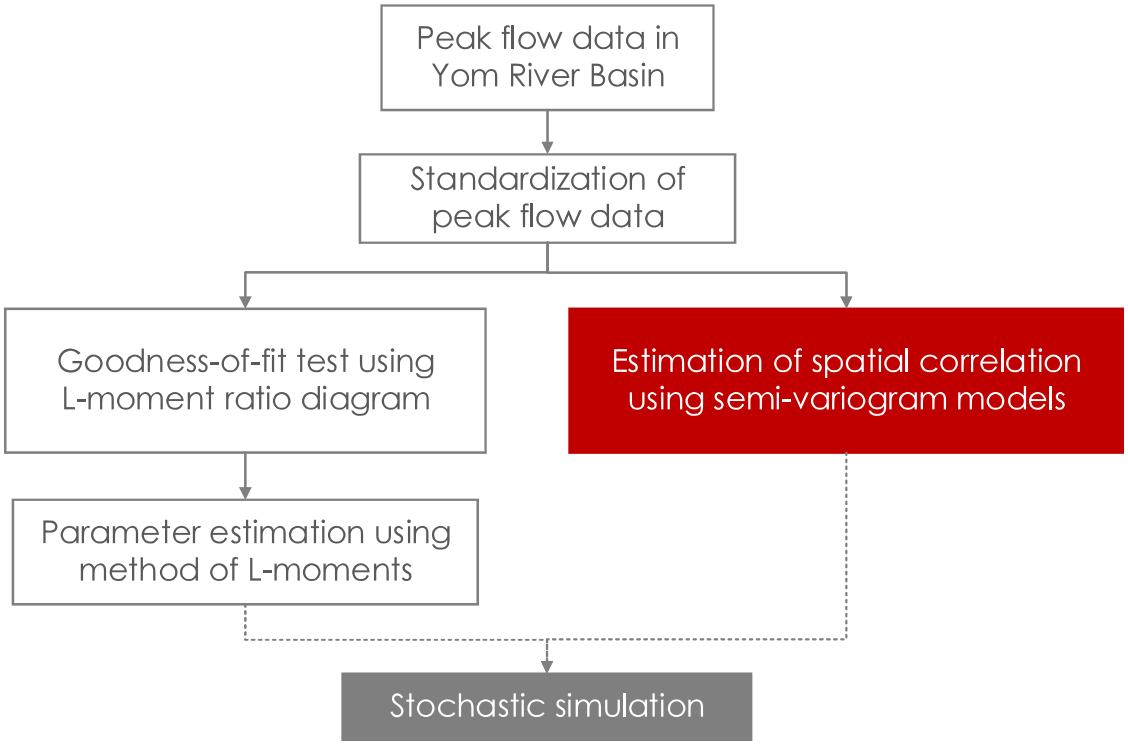


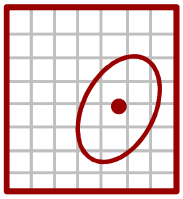
Fig. 6. Relationship between average annual flow and drainage area of selected flow stations in study area

Source: Royal Irrigation Department

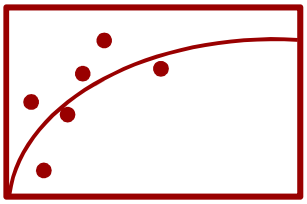
3. METHODOLOGY



4. RESULTS AND DISCUSSION



$$\hat{\alpha} = \frac{l_2}{ln2}$$
$$\hat{u} = l_1 - \gamma\hat{\alpha}$$



1. Goodness-of-fit test using L-moment ratio diagram
2. Parameter estimation using method of L-moments
3. Estimation of spatial correlation using semi-variogram models

GOODNESS-OF-FIT TEST USING L-MOMENT RATIO DIAGRAM

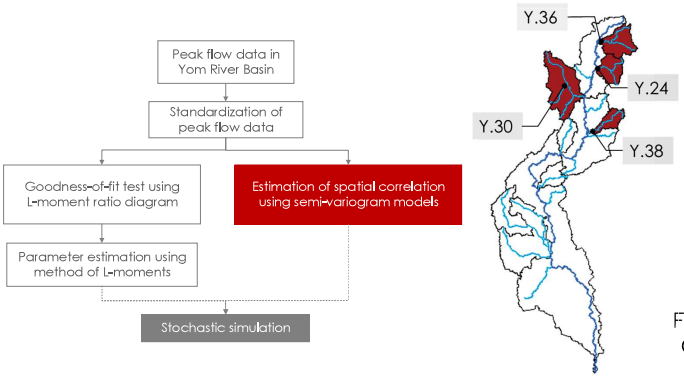
Assumption: Perform the test at the 5% significance level, $\alpha = 0.05$

The probability density function for the **Gumbel distribution**

$$f(x) = \frac{1}{\alpha}\exp\left[-\frac{x-u}{\alpha} - \exp\left(-\frac{x-u}{\alpha}\right)\right]$$

$$, -\infty < x < \infty$$

u = Location parameter
α = Scale parameter



L-MOMENT RATIO DIAGRAM

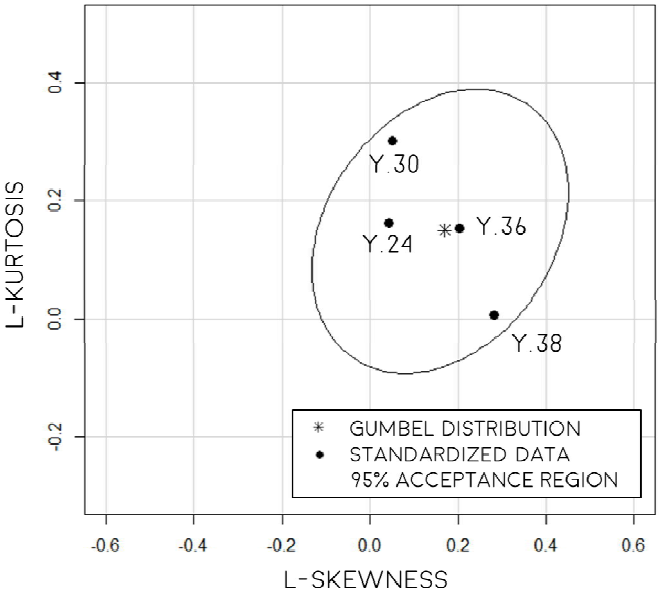


FIG. 7. L-moment ratio diagram with 95% confident intervals for the Gumbel distribution corresponds to the sample size (n=19) at four flow stations in Yom River Basin

ESTIMATED PARAMETERS OF THE GUMBEL DISTRIBUTION WITH THE METHOD OF L-MOMENTS

The **sample L-moments** (l_r)

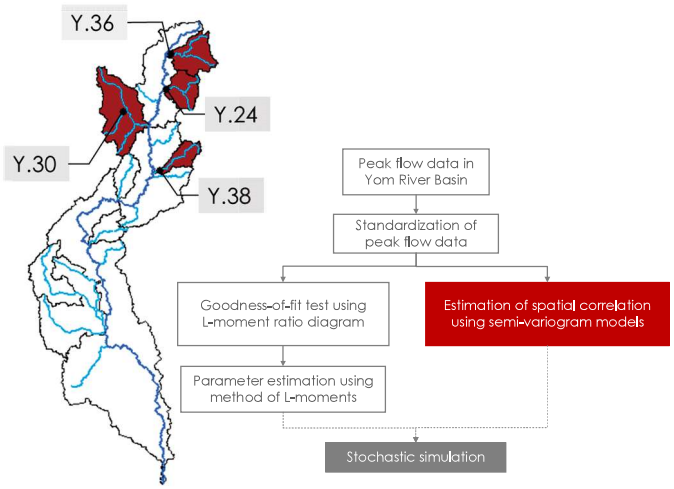
$$l_1 = b_0 \quad (1)$$
$$l_2 = 2b_1 - b_0 \quad (2)$$
$$l_3 = 6b_2 - 6b_1 + b_0 \quad (3)$$
$$l_4 = 20b_3 - 30b_2 + 12b_1 + b_0 \quad (4)$$

Parameter estimators of the Gumbel distribution using the method of L-moments

$$\hat{\alpha} = \frac{l_2}{ln2}$$
$$\hat{u} = l_1 - \gamma\hat{\alpha}$$

γ = Euler's constant (0.5772)

STATION	PARAMETER ESTIMATORS	
	$\hat{\alpha}$	$\hat{u}$
Y.36	0.81	-0.47
Y.24	0.83	-0.48
Y.30	0.80	-0.46
Y.38	0.80	-0.46



ESTIMATION OF SPATIAL CORRELATION USING SEMI-VARIOGRAM MODELS

Assumption: The second-order stationary and isotropic

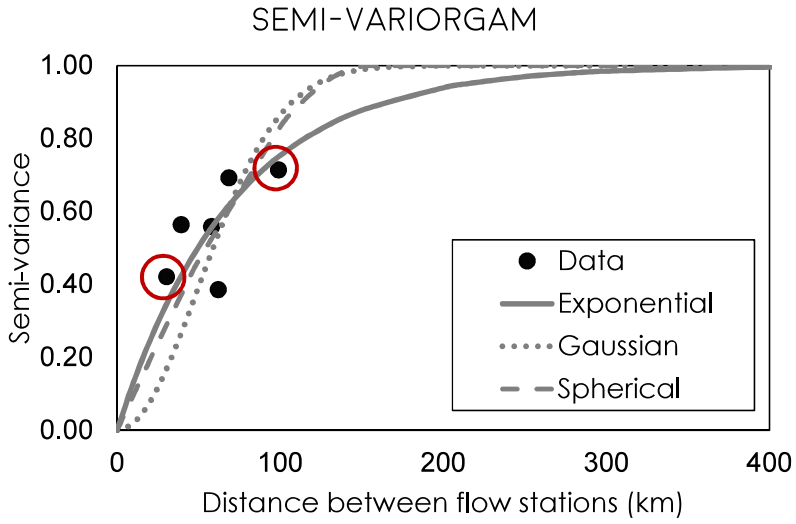


FIG. 8. The experimental semi-variogram model is fitted to the theorectical semi-variogram models

No.	Types of Model	Error of ordinary least squares
1	Exponential	0.070
2	Gaussian	0.208
3	Spherical	0.106

Exponential model:

$$\gamma(h)=1-\exp\left(-\frac{3h}{214.29}\right)$$

Gaussian model:

$$\gamma(h)=1-\exp\left(-\frac{3h^2}{122.47^2}\right)$$

Spherical model:

$$\gamma(h)=\begin{cases}1.5\left(\frac{h}{155.48}\right)-0.5\left(\frac{h}{155.48}\right)^3, & h\le 155.48\\ 1, & h>155.48\end{cases}$$

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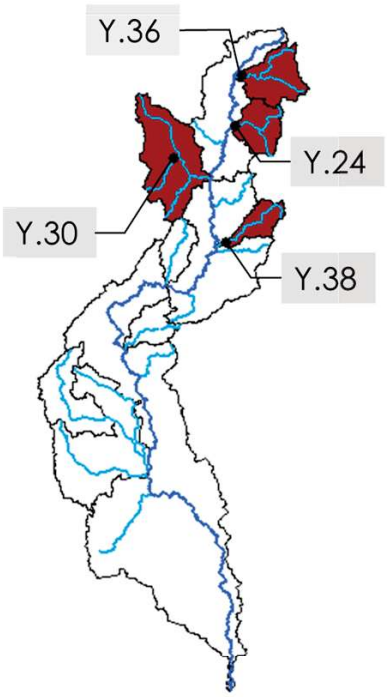
4 FLOW STATIONS IN YOM RIVER BASIN

Table 1. LIST OF ANNUAL PEAK FLOW STATIONS

No.	Station	River	Province	Sub-Basin	Drainage Area (km^2)	Average Annual Flow (MCM)	Maximum Annual Peak Flow (m^3/s)	Year
1.	Y.36	Khuan	Phayao	Mae Nam Khuan	870.74	397.03	525.92	2011
2.	Y.24	Pi	Phayao	Nam Pi	656.66	146.06	312.40	2008
3.	Y.30	Huai Pong	Lampang	Mae Nam Ngao	1,753.86	41.24	78.27	2011
4.	Y.38	Mae Kham Mi	Phrae	Nam Mae Kham Mi	456.18	174.46	500.00	2004

Source: Royal irrigation Department

5. CONCLUSIONS



1. The **annual peak flows** of the stations in Yom River Basin was fitted to **the Gumbel distribution** with 95% confidence interval using **L-moment ratio diagram**.

2. Spatial correlation structure is constructed using the **semi-variogram** under the second-order stationary and isotropic assumption. The sample semi-variogram was best fitted to the **exponential model** with the range of 214.29 km.

3. Understanding the **spatial correlation** of flows from each tributary would be very useful in quantifying risk reduction of each **flood mitigation** option or measure using a **stochastic simulation**.

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THANK YOU

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