

Huong River

Map of River

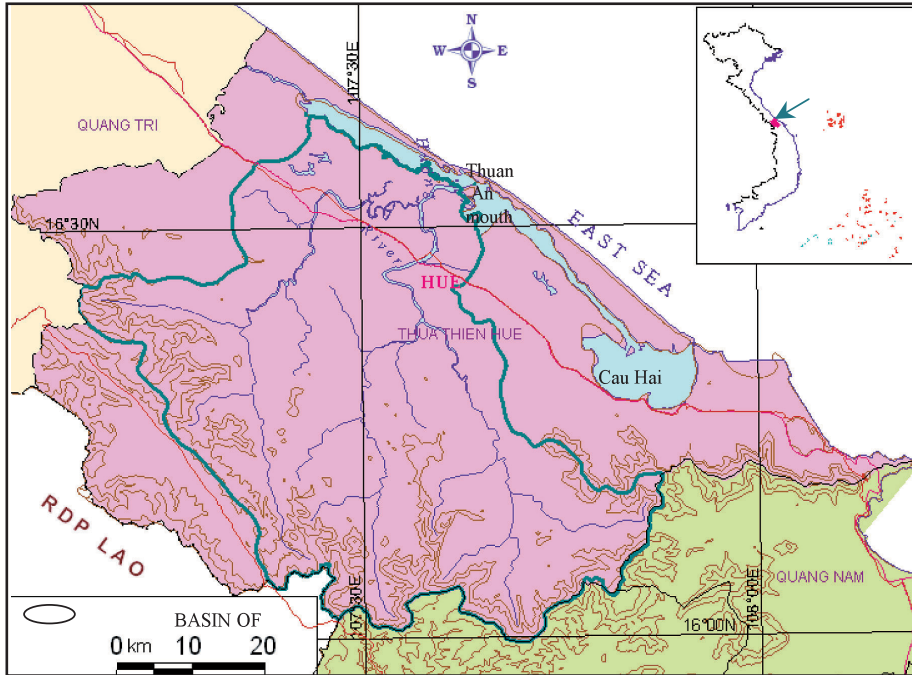


Table of Basic Data

Name: Huong River		Serial No. : Viet Nam-8
Location: Thua Thien Hue Province, Viet Nam	N 16° 00' - 14° 40'	E 107° 07' - 107° 50'
Area: 2,830 km ²	Length of main stream: 104 km	
Origin: Mt. A Tin (1,298 m)	Highest point: Mt. Nui Mang (1,712 m)	
Outlet: Gulf of Bac Bo (Thuan An Mouth)	Lowest point: 0 m	
Main geological features: Sand loam, Pebble, Grave, Detrital shell, Coral limestone, Shale, Sandstone, Andesine, Conglomerate, Sandstone, Siltstone, Shale, Limestone.		
Main tributaries: Khe Hai Nhut River (75.3 km ²), Ca Rum Ba Ram River (219 km ²), Khe Co Moc River (88.3 km ²), Huu Trach River (729 km ²), Bo River (938 km ²)		
Main lakes: None		
Main reservoirs: Duong Hoa reservoirs (435 x 10 ⁶ m ³)*		
Mean annual precipitation: 2,833.5 mm at Hue (1977 ~ 2000)		
Mean annual runoff: 198 m ³ /s (6.25 x 10 ⁹ m ³)		
Population: about 660,000 (1999)	Main cities: Hue City	
Land use: Forest (42.7 %), Rice paddy (10.3 %), Other agriculture (5.91 %)		

*: Under construction

1. General Description

The Huong River, the largest river in Thua Thien Hue Province, has a length of 104 km and a basin area of 2,830 km². It has three main tributaries, namely the Ta Trach, the Huu Trach and the Bo. The Ta Trach River, the Huong River mainstream, originates from the more than 1,700 m height mountain on the northwest of the Bach Ma mountain range. The river then flows in the general direction of southeast to northwest, passing the City of Hue, discharges into the Tam Giang lagoon and finally flows to the sea at the Thuan An mouth.

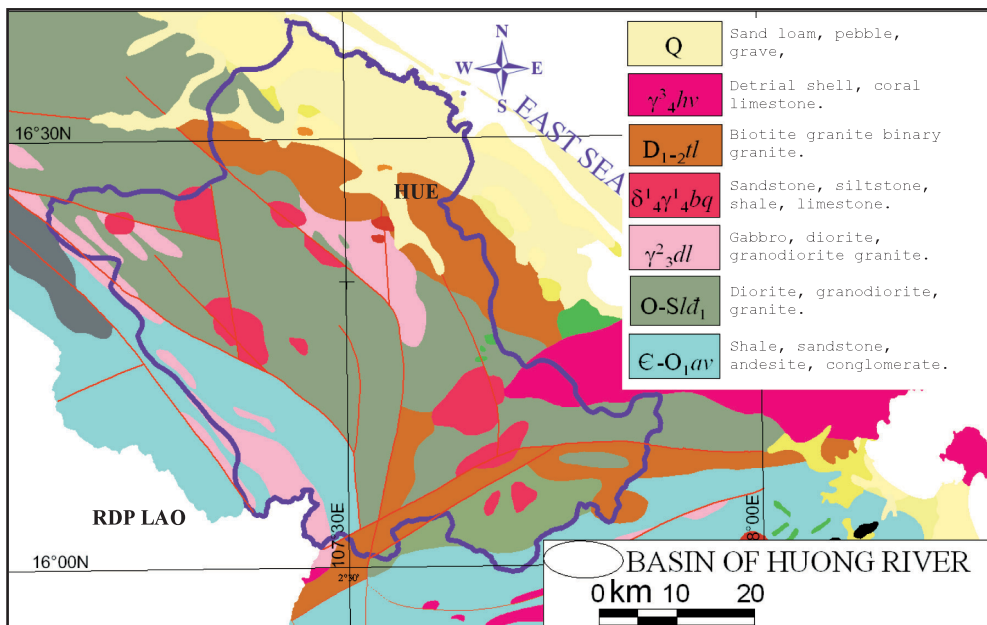
The mean basin altitude is 330 m; the mean basin slope is 28.5%; the mean basin width is 44.6 km; and the mean basin river network density is 0.6 km/km².

Before reaching the sea, the Huong River basin has many branches flowing to lagoon systems that extends about 70 km along the coastline. The lagoons include the Tam Giang lagoon, the Thuy Tu lagoon and the Cau Hai little bay. Besides the Thuan An estuary the lagoon systems have some smaller river mouths linking with the sea.

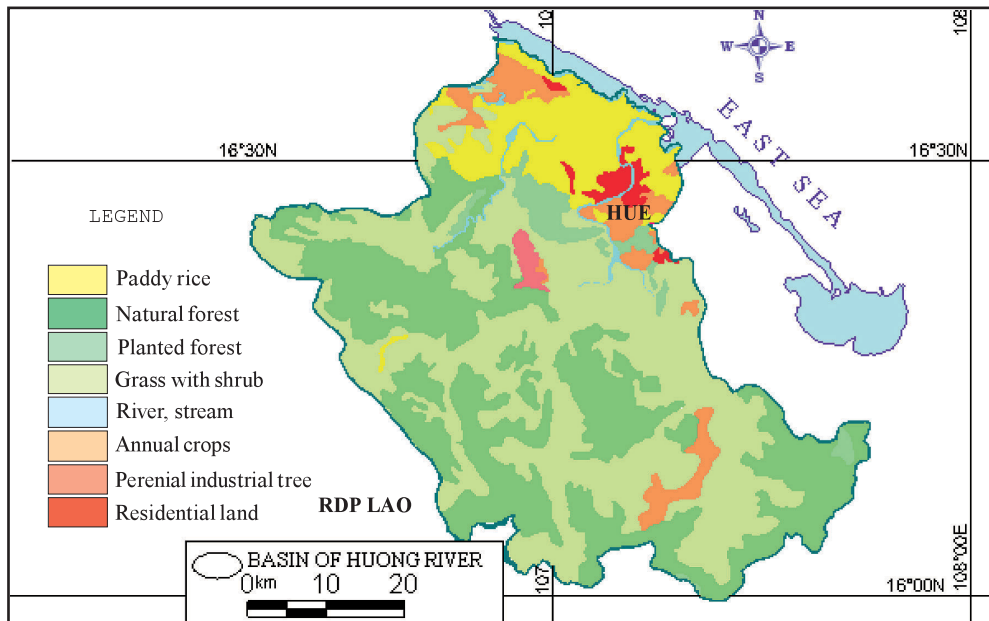
Rainfall in the Huong River basin is very abundant; about 2,500 mm in coastal areas to 3,500 mm in the upper part of the basin. The rainy season usually lasts from September to December. Rainfall in the wet season contributes 67-75% of the total yearly amount of 8.52 km³.

2. Geographical Information

2.1 Geological Map



2.2 Land User Map

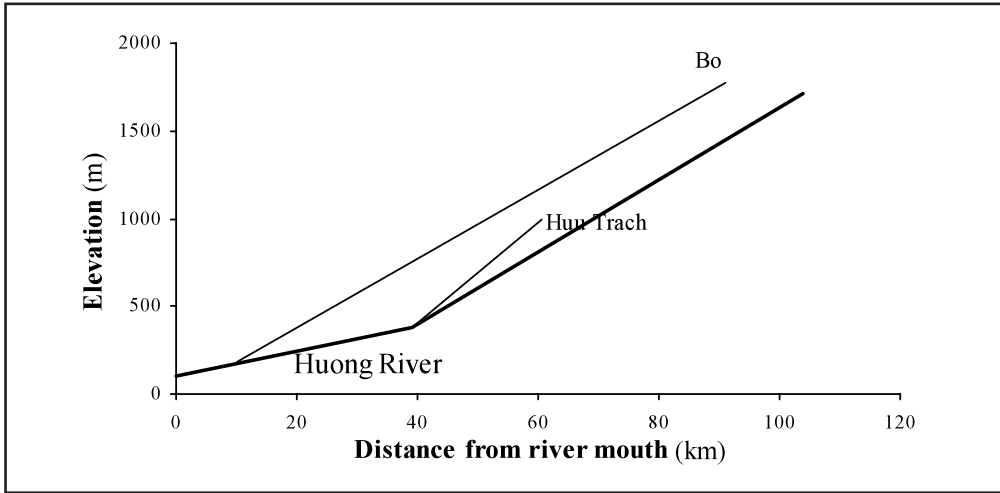


2.3 Characteristics of River and Main Tributaries

No.	Name of river	Length [km] Catchment area [km ²]	Highest peak [m] Lowest point [m]	Cities Population	Land use [%]
1	Huong (Main river)	104 2,830	1,712	Hue	A (5.91) F (42.7) P (10.3)
2	Khe Hai Nhut (Tributary)	15 75.3	1,000	-	
3	Ca Rum Ba Ram (Tributary)	29 219.3	1,200	-	
4	Khe Co Moc (Tributary)	18 88.3	500	-	
5	Huu Trach (Tributary)	51 729	1,000	-	
6	Bo (Tributary)	94 938	1,774	-	

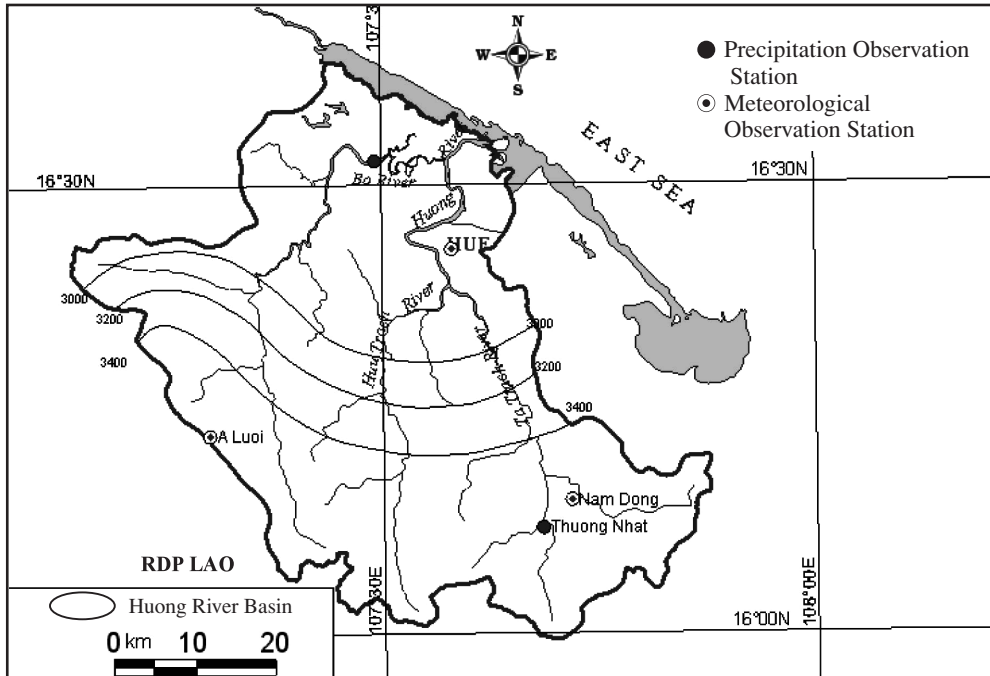
A: Other agriculture land F: Forest G: Grass P: Paddy field

2.4 Longitudinal Profiles



3. Climatological Information

3.1 Annual Isohyet Map and Observation Stations



3.2 List of Meteorological Observation Stations

No.	Station	Elevation [m]	Location	Observation period	Mean annual precipitation [mm]	Mean annual evaporation [mm]	Observation items
48852	Hue	9.616	N: 16° 26' E: 107° 35'	(P) 1960 ~ * (E) 1960 ~ *	2,833.5	933.3	DS, E, P
48191	A Luoi	550	N: 16° 12' E: 107° 15'	(P) 1973 ~ (E) 1974 ~	3,466.4	919.1	DS, E, P
48192	Nam Dong	597.38	N: 16° 10' E: 107° 43'	(P) 1977 ~ (E) 1974 ~	3,634.3	858.5	DS, E, P

DS: Duration of sunshine observed by Helioscope

E: Evaporation by Piche tube

P: Precipitation observed by Pluviometer

Note: * Indicate missing data in some years

3.3 Monthly Climate Data

Station: Hue

Observation items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	20.2	20.8	23.2	26.0	27.9	29.1	29.2	28.7	26.9	25.2	22.9	20.4	25.0	1978 ~
Precipitation [mm]	105.9	58.6	43.7	55.5	129.2	112.4	70.6	143.3	391.6	763.1	632.5	327.4	2,833.5	1977 ~
Evaporation [mm]	43.7	39.7	60.5	78.5	102.9	125.3	142.4	127.7	75.2	54.4	44.6	38.5	933.3	1977 ~
Duration of sunshine [hr]	121.5	112.4	147.9	171.2	220.6	231.4	236.0	217.7	157.9	131.4	91.7	116.2	1,955.8	1985 ~

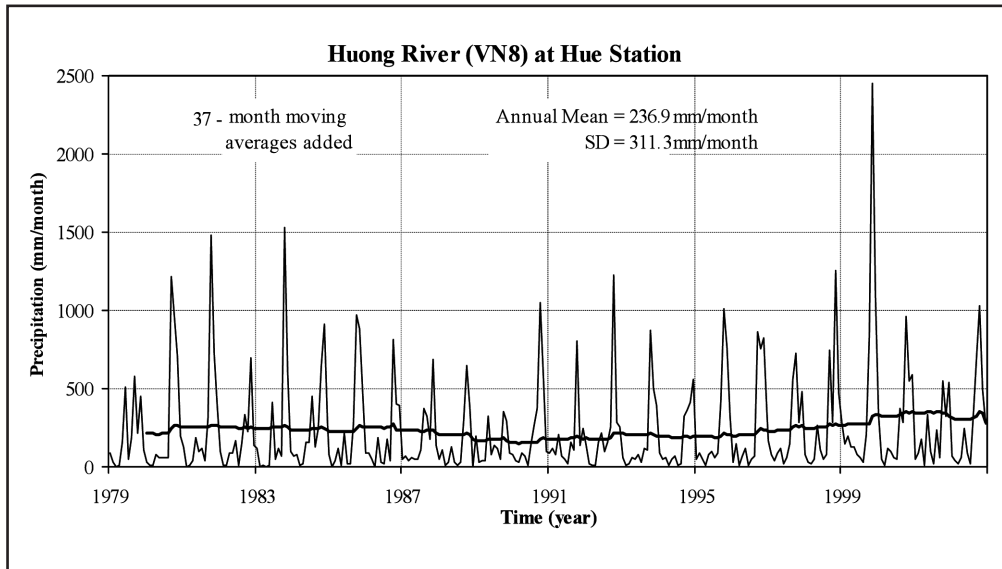
Station: Nam Dong

Observation items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	20.1	21.0	23.6	26.3	27.4	27.9	27.9	27.5	26.1	24.4	22.3	20.2	24.5	1977 ~
Precipitation [mm]	101.5	50.7	52.6	90.1	228.1	215.2	137.6	232.5	455.0	992.0	751.7	327.4	3,634.3	1977 ~
Evaporation [mm]	48.2	51.8	81.3	100.0	101.9	103.1	107.2	97.5	62.3	44.7	32.9	33.0	863.8	1977 ~
Duration of sunshine [hr]	124.2	123.9	171.4	180.8	207.1	210.3	220.4	197.8	155.9	125.6	88.9	72.6	1,878.9	1980 ~

Station: A Luoi

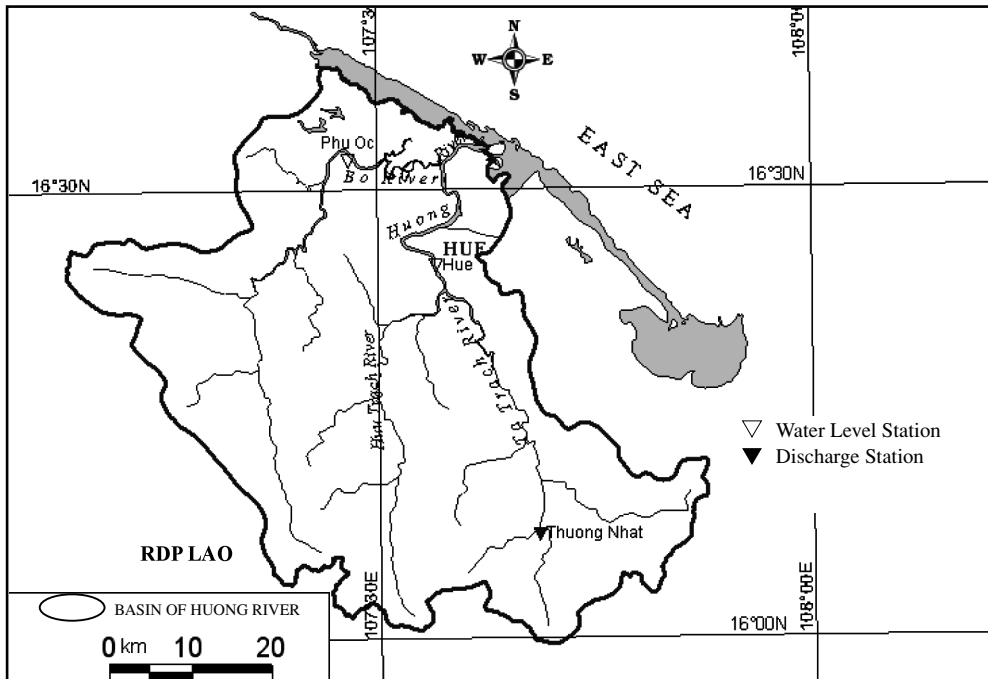
Observation items	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Period for the mean
Temperature [°C]	17.3	18.3	20.6	22.8	24.0	25.0	24.9	24.6	23.0	21.6	19.6	17.6	21.6	1976 ~
Precipitation [mm]	64.8	42.9	66.1	157.3	236.7	198.2	153.8	201.9	407.7	908.6	736.4	293.0	3467.4	1973 ~
Evaporation [mm]	39.6	42.1	59.4	71.2	136.1	129.5	150.7	129.9	61.1	38.2	31.9	29.3	919.1	1974 ~
Duration of sunshine [hr]	127.8	129.7	169.7	173.5	184.0	176.3	190.9	170.6	129.2	117.0	77.7	77.0	1,723.3	1976 ~

3.4 Long-term Variation of Monthly Precipitation



4. Hydrological Information

4.1 Map of Streamflow Observation Stations



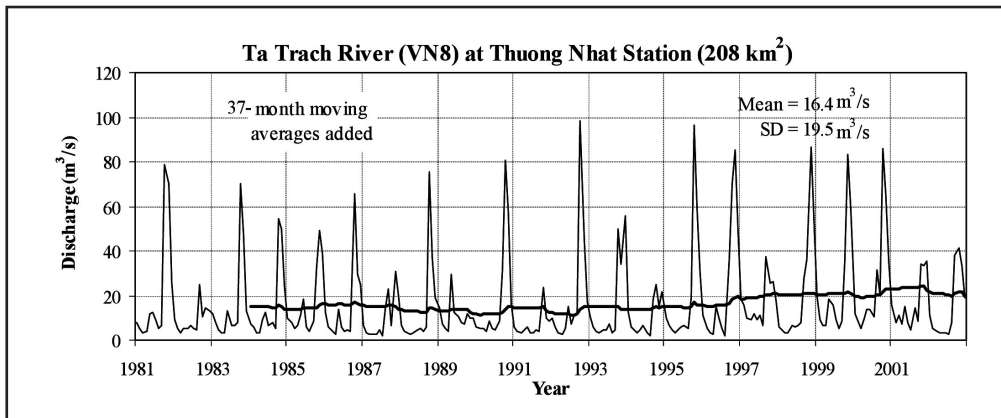
4.2 List of Hydrological Observation Stations

No.	Station	Location	Catchment area (A) [km ²]	Observation period	Observation items ¹⁾ (frequency)
71519	Thuong Nhat	N: 16° 07' 25" E: 107° 41' 14"	208	1981 ~ 2003	H, Q, S

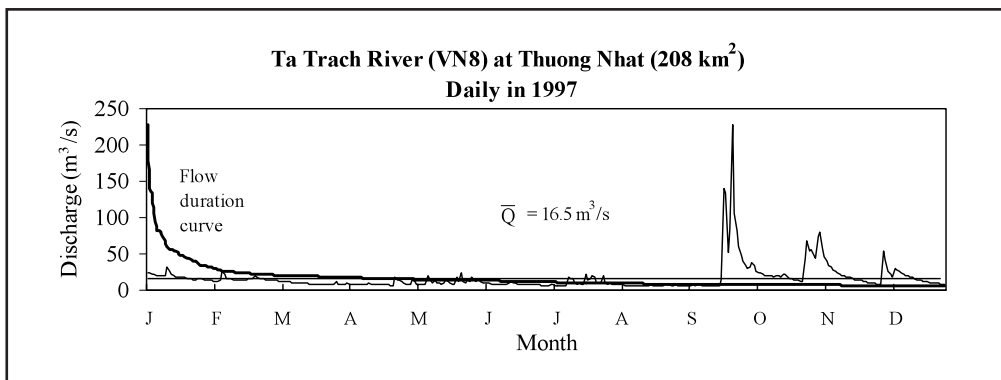
No.	\bar{Q} ²⁾ [m ³ /s]	Qmax ³⁾ [m ³ /s]	\bar{Q} max ⁴⁾ [m ³ /s]	\bar{Q} min ⁵⁾ [m ³ /s]	\bar{Q}/A [m ³ /s/100km ²]	Qmax/A [m ³ /s/100km ²]	Period of statistics
71519	16.4	1,330	156	6.20	7.89	639	1981 ~

- 1) H: Water lever
- P: Precipitation (daily)
- Q: Discharge
- S: Sediment concentration
- 2) Mean annual discharge
- 3) Maximum discharge
- 4) Mean maximum discharge
- 5) Mean minimum discharge

4.3 Long-term Variation of Monthly Discharge



4.4 Annual Pattern of Discharge



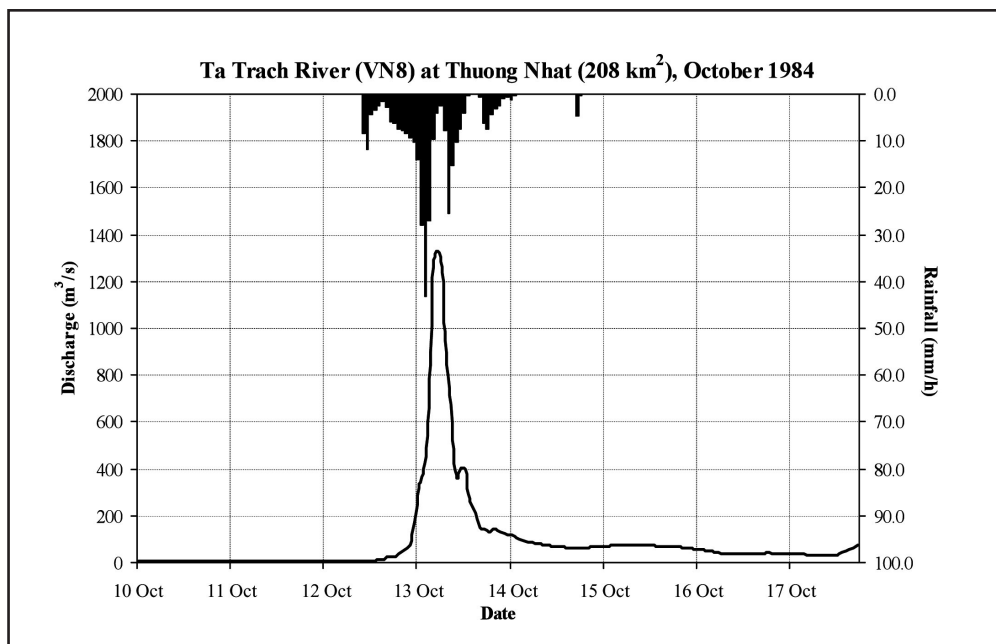
4.5 Annual Maximum and Minimum Discharge

At Thuong Nhat [208 km²]

Year	Maximum ¹⁾		Minimum ²⁾		Year	Maximum ¹⁾		Minimum ²⁾	
	Date	[m ³ /s]	Month	[m ³ /s]		Date	[m ³ /s]	Month	[m ³ /s]
1981	11.8	844	4	2.58	1992	10.7	788	4	2.11
1982	9.6	540	6	2.75	1993	10.24	462	4; 5; 8	3.03
1983	10.30	1,250	6	1.76	1994	10.20	712	8	2.00
1984	10.13	1,330	4	2.40	1995	11.1	621	6	2.87
1985	10.16	892	9	2.26	1996	10.23	941	8; 9	1.84
1986	10.4	638	4; 9	2.18	1997	9.25	373	8; 9	5.61
1987	9.5	618	7; 8	1.46	1998	11.20	788	5	2.68
1988	10.9	755	5	2.06	1999	11.2	771	8	3.84
1989	5.25	721	4	3.35	2000	8.22	879	4	3.59
1990	9.18	745	5	3.17	2001	10.21	568	8	3.46
1991	11.26	84.0	8	2.20	2002	10.6	561	7; 8	2.33

1), 2) Discharge rated according to manual observation of water level.

4.6 Hyetographs and Hydrographs of Major Floods



5. Water Resources

5.1 General Description

Annual specific discharge is unevenly distributed in the basin, varying from $0.040 \text{ m}^3/\text{s}/\text{km}^2$ in the coastal plain to more than $0.080 \text{ m}^3/\text{s}/\text{km}^2$ in the mountainous regions. Long term average annual runoff is about $6.25 \times 10^9 \text{ m}^3$ or $0.071 \text{ m}^3/\text{s}/\text{km}^2$ and the basin runoff depth is 2,210 mm. Flood season lasts for 4-5 months from September-October to December. Flood volume makes up 70-75 % of total annual runoff. The maximum monthly flow usually occurs in November every year.

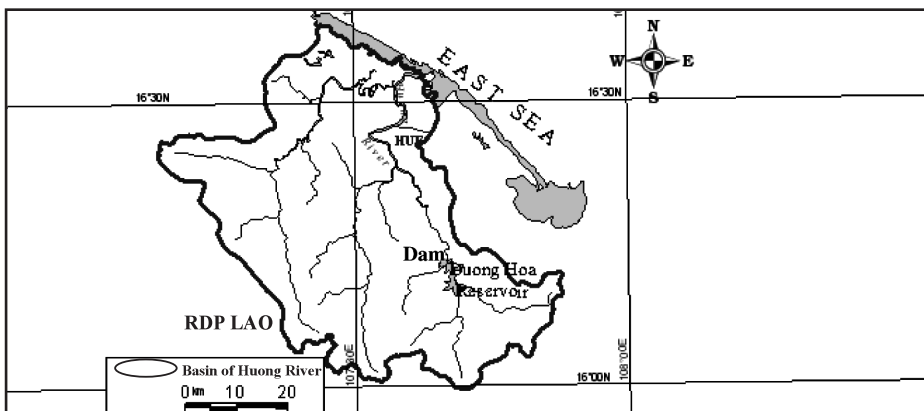
Heavy rainfall and steep basin slopes generate great fluctuations in floods. The maximum discharge Q_{max} is rather large. Observed data at the Thuong Nhat station on the upstream of the Ta Trach River shows that $Q_{\text{max}} = 1,330 \text{ m}^3/\text{s}$ on the 13 of October 1984. In the historical flood in November 1999 the flood peak discharge was $5,320 \text{ m}^3/\text{s}$ ($MQ_{\text{max}} = 9.3 \text{ m}^3/\text{s}/\text{km}^2$) at Binh Dien on the Huu Trach River, and $14,000 \text{ m}^3/\text{s}$ on the Huong River at Kim Long (Hue City). Also, the historical flood in 1953 was very large with $Q_{\text{max}} = 12,500 \text{ m}^3/\text{s}$ at Kim Long; $4,000 \text{ m}^3/\text{s}$ ($MQ_{\text{max}} = 5.26 \text{ m}^3/\text{s}/\text{km}^2$) at Co Bi on the Bo River; $Q_{\text{max}} = 4,000 \text{ m}^3/\text{s}$ ($MQ_{\text{max}} = 7.1 \text{ m}^3/\text{s}/\text{km}^2$) at Binh Dien on the Huu Trach River and $Q_{\text{max}} = 8,000 \text{ m}^3/\text{s}$ at Tuan on the Ta Trach River.

The low flow period lasts for 7-8 months from January to August-September. In the low flow period there are usually small floods (called “tieu man”) in May and June. Hence, the three month low runoff season is not at a fixed time. It may be before or after the “tieu man” flood season, in other words in February to April or June to August. The long term minimum monthly runoff usually occurs in July or August. The long term minimum specific discharge is about $0.005\text{-}0.010 \text{ m}^3/\text{s}/\text{km}^2$. Rainfall in the basin is very abundant, for example, the rainfall total from 1st to 6th of November 1999 was more than 2000 mm in the province. In Hue it was 2,288 mm and at A Luoi 2,270 mm. The maximum daily rainfall in this period at Hue was 978 mm and 758 mm at A Luoi. The maximum 24h rainfall at Hue (from 7h on 2nd of November to 7h on 3rd of November 1999) was 1,384 mm. That is the highest value recorded in Viet Nam up to now.

Intense rainfalls usually generate flash floods in the upper and middle reaches and flooding in the downstream reaches. The flooding depth may surpass 10 m. Large floods may cause bank collapses in rivers and seacoasts and may create new river mouths.

In the low flow season, long periods of hot weather may result in the river ceasing to flow. This allows salt water to penetrate further up the river resulting in a lack of fresh water for domestic use and for production.

5.2 Map of Water Resources Systems



5.3 List of Major Water Resources Facilities

Name of river	Name of dam (Reservoir)	Catchment area [km ²]	Gross capacity [10 ⁶ m ³]	Effective capacity [10 ⁶ m ³]	Purpose	Year of completion
Ta Trach	Duong Hoa*	720	435	-	A, F, P, I	-

A: Agriculture F: Flood Control I: Industrial P: Hydropower

*: Under construction

5.4 Major Flood and Droughts

Date	Peak discharge [m ³ /s]	Rainfall [mm] Duration	Meteorological cause	Dead and missing	Major damages (Districts affected)
1983 10. 30	1,250	1221.5 10.28 - 11.1	Typhoon	-	Hue City
1984 10. 13	1,330	272.4 10.13 - 10.14	Typhoon	-	Hue City
1996 10. 23	941	386.7 10.21 - 10.26	Typhoon	-	Hue City
1998 11. 20	788	347.3 11.18 - 11.28	Typhoon	-	Hue City
1999 11. 2	771	2250.4 10.28 - 11.4	Typhoon	-	Hue City
2000 8. 22	879	199.0 8.21 - 8.22	Typhoon	-	Hue City

5.5 Groundwater and Water Quality

Annual mean suspended sediment concentration is 50-100 g/m³. In general, water quality is still good, but in the Hue City reach of the Huong River the water is polluted by domestic waste and industrial waste that discharge directly into the river without any treatment. Also, river water in the coastal plain is polluted by salinity in the low flow period. Salinity may intrude further than 20 km up the river.

6. Socio - cultural Characteristics

In the river basin there live ethnic people like Viet (Kinh), Ta Oi, Ca Tu, Van Kieu, and so on. Hue City, the main township of Thua Thien Hue Province, is located on the Huong River bank with a population of more than 300,000 people. Hue is the former capital of Viet Nam.

Hue province has been recognised by UNESCO as a world cultural heritage area. Besides, Huong River and Hue City have many beautiful landscapes.

7. References, Data Books and Bibliography

General Department of Tourist, *Vietnamese Culture*.

General Statistical Office: *Statistical Yearbook 1999*, Statistical Publishing House.

Institute of Meteorology and Hydrology (1985): *Main Morphometric Features of Vietnam Rivers*, Hanoi.

Tran Tuat, Tran Thanh Xuan and Nguyen Duc Nhat (1987): *Hydrogeography of Vietnam Rivers*, Science and Technique Publishing House.

Tran Tuat and Nguyen Duc Nhat (1980): *Hydrogeographic Characteristics of Rivers in Viet Nam*, Institute of Meteorology and Hydrology.