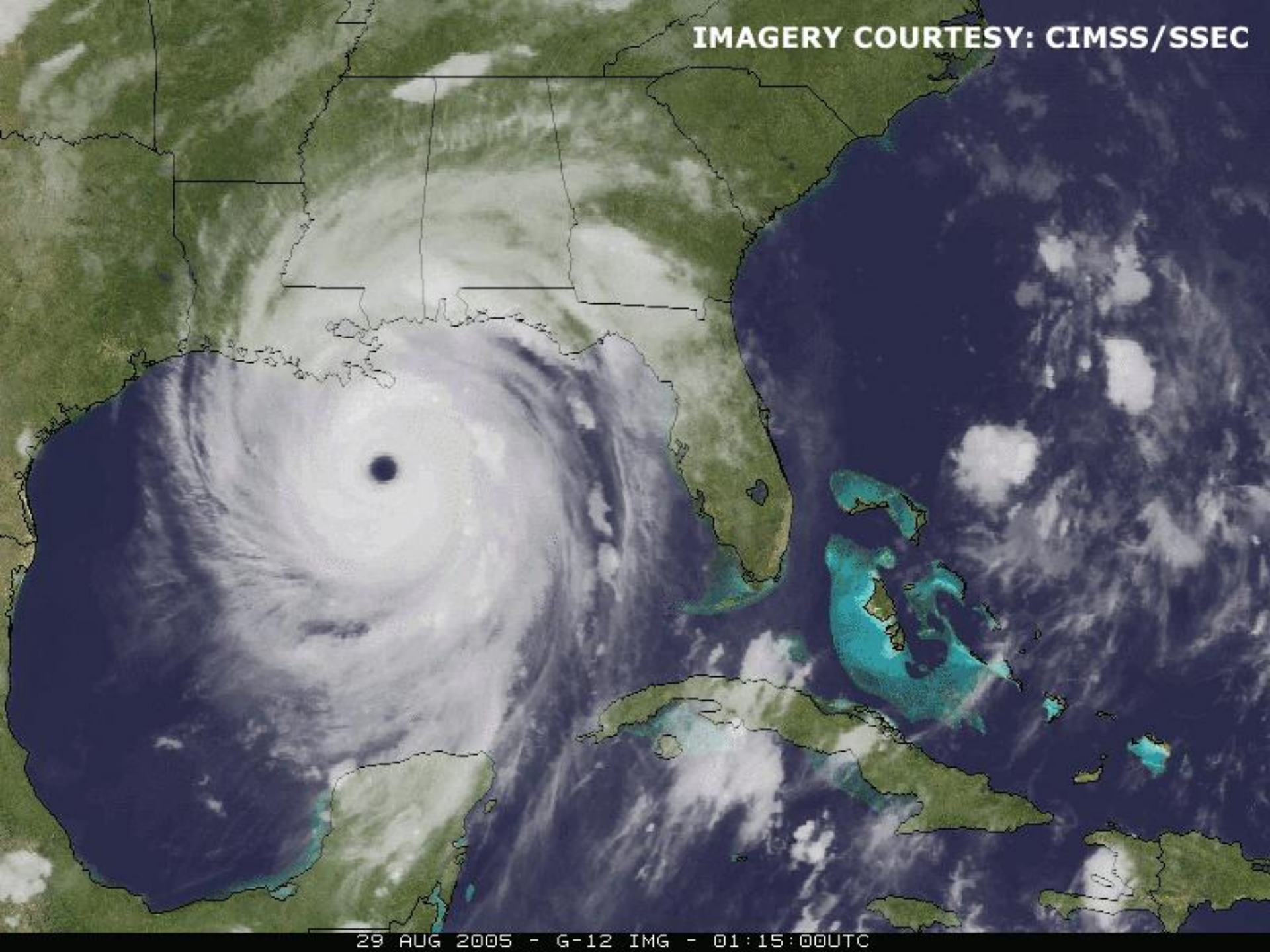
Hydrology (CT2310)

Prof. dr. ir. H.H.G. Savenije

Lezing 'Neerslag'


IMAGERY COURTESY: CIMSS/SSEC
29 AUG 2005 - G-12 IMG - 01:15:00UTC

Neerslag Metingen:

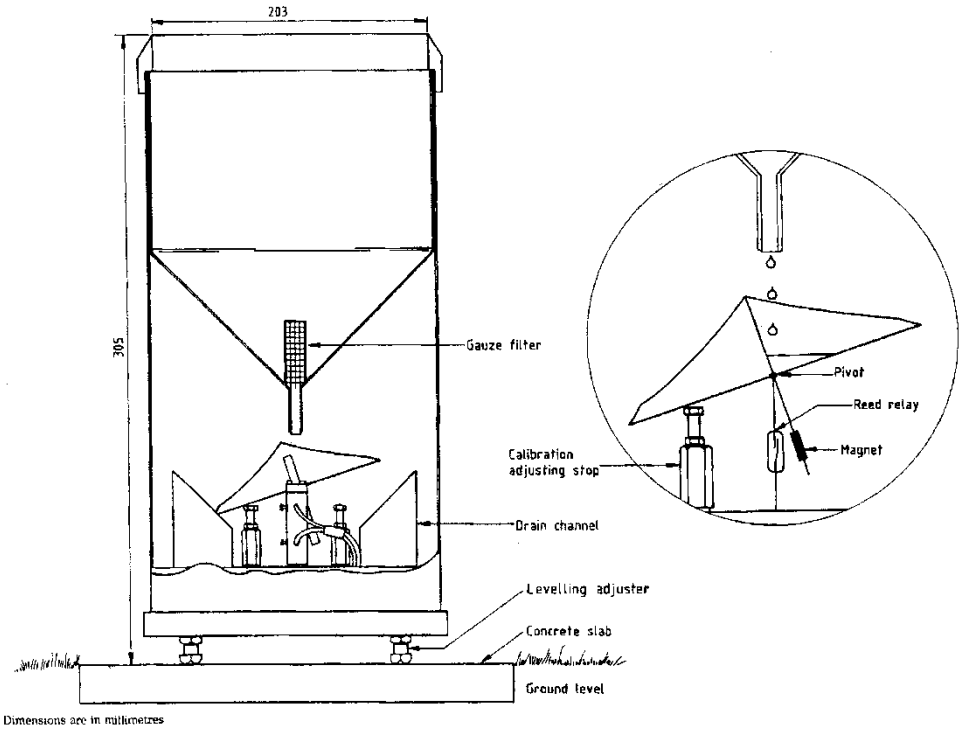
-Punt metingen:

Trechter (handmatig)

Tipping Bucket

Wegende regenmeter

Optische regenmeter



Tipping bucket

Voorbeeld: data file afkomstig van een tipping bucket regenmeter

```
Date,Time,Rainfall (mm)
8/27/03,04:10:00 PM,0.6
8/27/03,04:11:00 PM,0.4
8/28/03,11:06:00 PM,0.2
8/28/03,11:27:00 PM,0.2
8/28/03,11:43:00 PM,0.2
8/28/03,11:55:00 PM,0.2
8/29/03,12:01:00 AM,0.2
8/29/03,12:06:00 AM,0.2
8/29/03,12:12:00 AM,0.2
8/29/03,12:18:00 AM,0.2
8/29/03,12:24:00 AM,0.2
8/29/03,12:30:00 AM,0.2
8/29/03,12:37:00 AM,0.2
8/29/03,12:44:00 AM,0.2
8/29/03,12:51:00 AM,0.2
8/29/03,12:58:00 AM,0.2
8/29/03,01:06:00 AM,0.2
8/29/03,01:14:00 AM,0.2
8/29/03,01:22:00 AM,0.2
8/29/03,01:31:00 AM,0.2
8/29/03,01:40:00 AM,0.2
8/29/03,01:50:00 AM,0.2
```

Note:
(mm) is accumulated rain
for the minute indicated
As multiple of 0.2 mm

Neerslag Metingen:

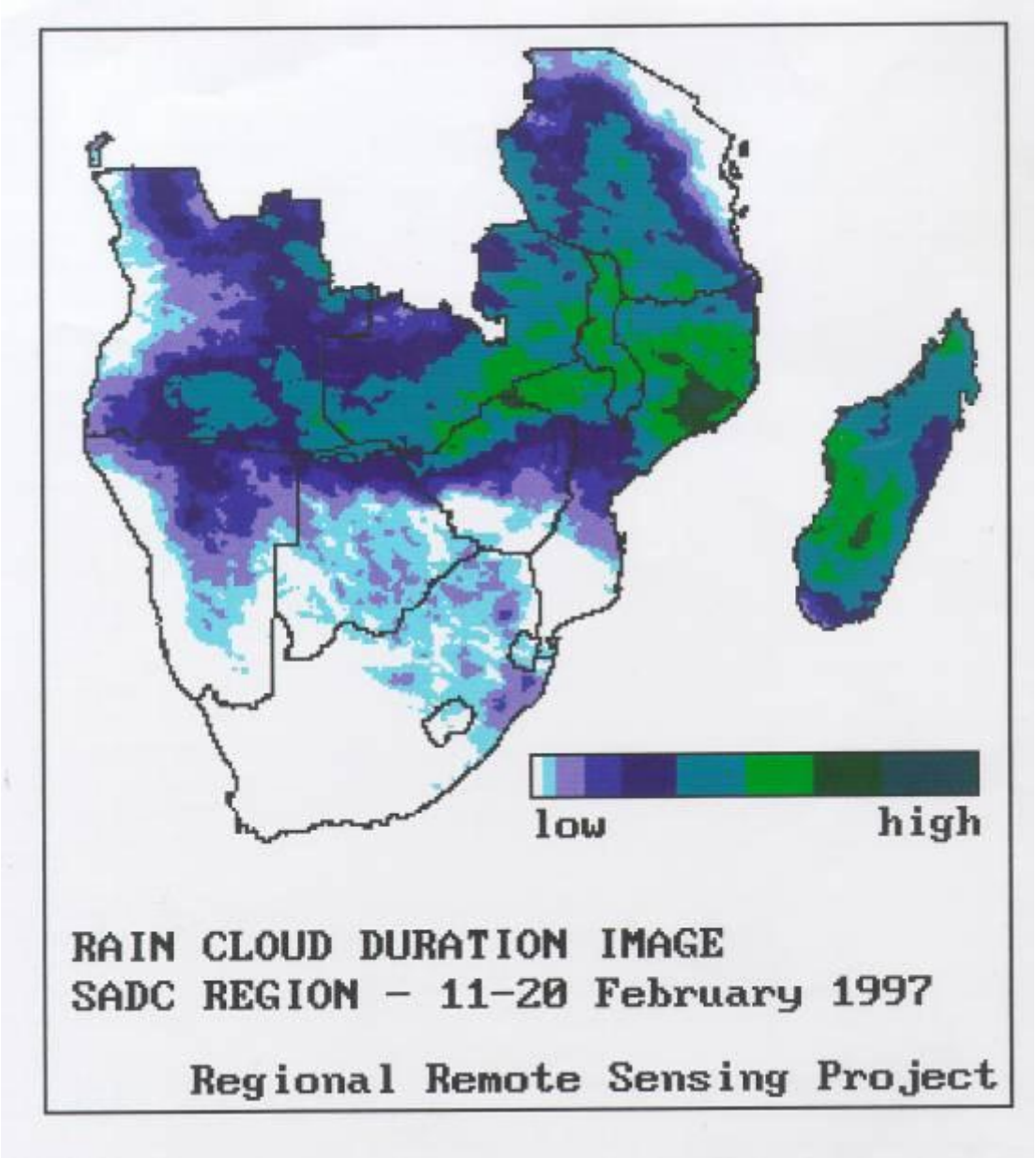
-Punt metingen

-Gebieds geintegreerd
- Sateliet
  - (CCD, TRMM)
- Radar

-GSM booster stations

Radar:

e.g. www.wetteronline.de



Kenmerken van Neerslag

- Intensiteit i: de flux per eenheid van oppervlak, meestal in mm/h, of m/s
- Hoeveelheid d: integraal van de intensiteit, in mm of m (heeft wel altijd een duur t zodat de flux $P=d/t$)
- Duur t: tijdsduur van de neerslag
- Frequentie f: de kans van optreden, $f=1/T$, waarbij T de gemiddelde tijd is die tussen gebeurtenissen verstrijkt.
- Uitgestrektheid: een maat voor de afmeting van de gebeurtenis gegeven de intensiteit, duur en frequentie.

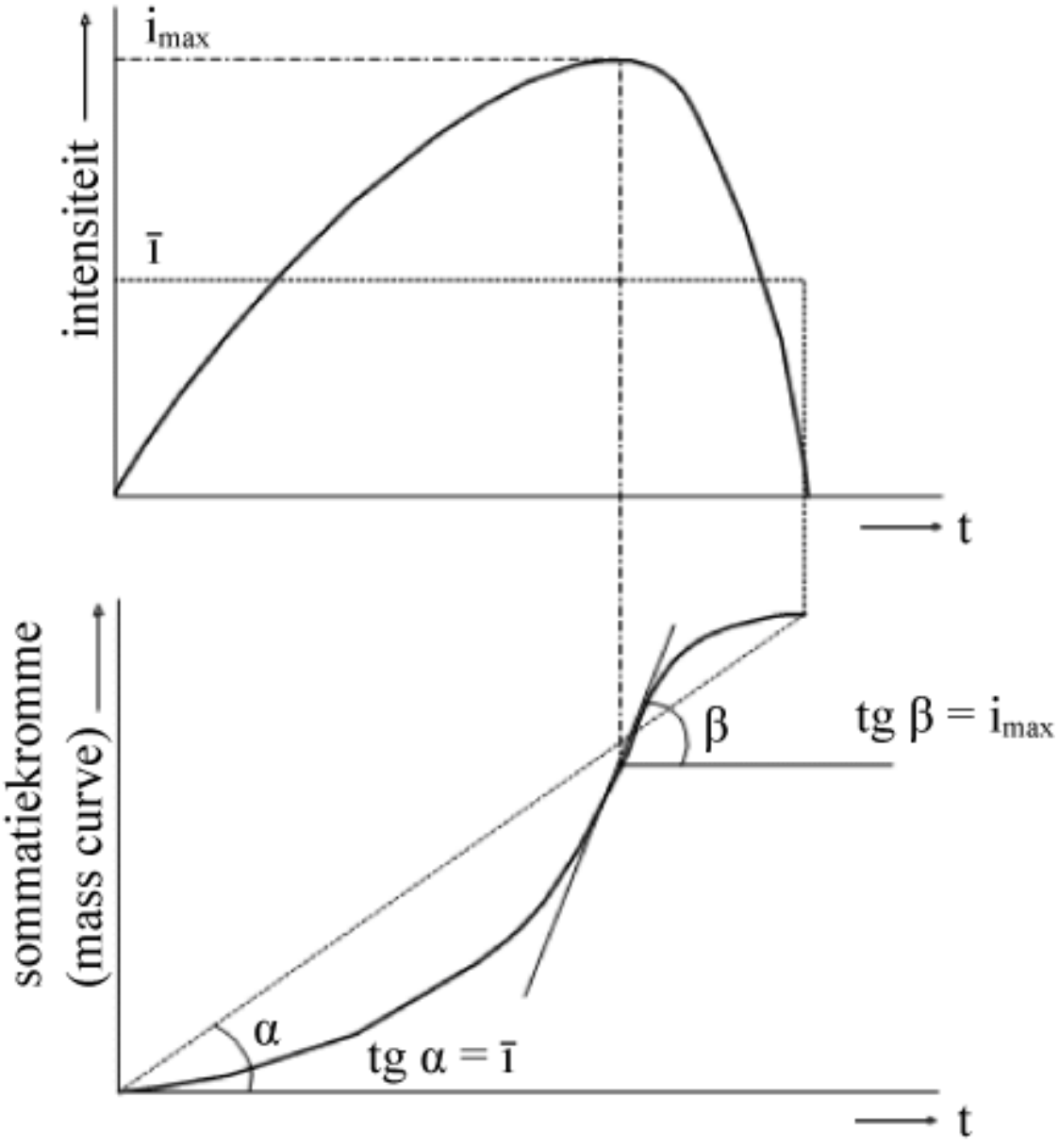
Hyetograph

Hyetograph: $i(t)$

Mass Curve: $d(t)$

$$d = \int_0^t i \, \mathrm{d}t \qquad P = \bar{i} = d / t$$

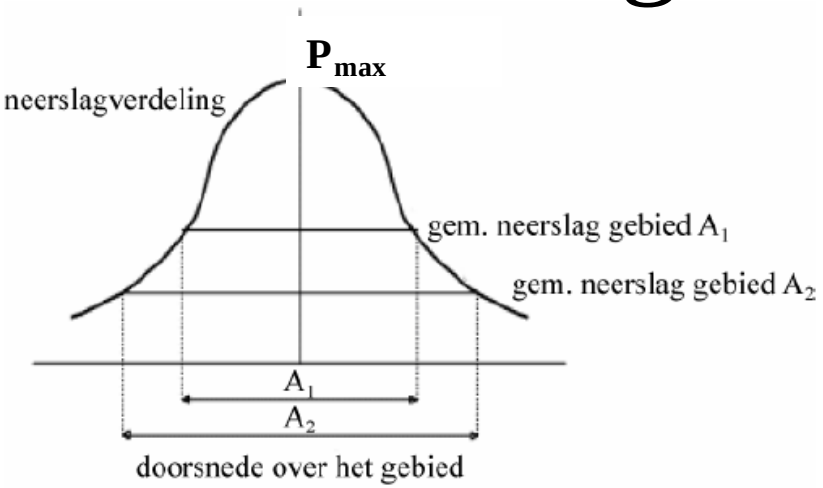
Isohyeten: lijnen van gelijke neerslag



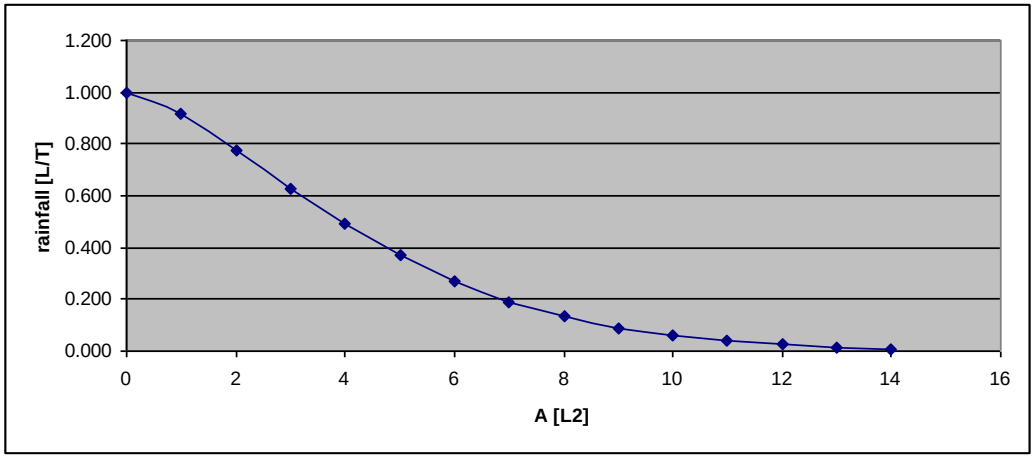
Hyetograph

Mass curve

Gebiedsgrootte-effect



Figuur 6.13 - Gebiedsgrootte-effect



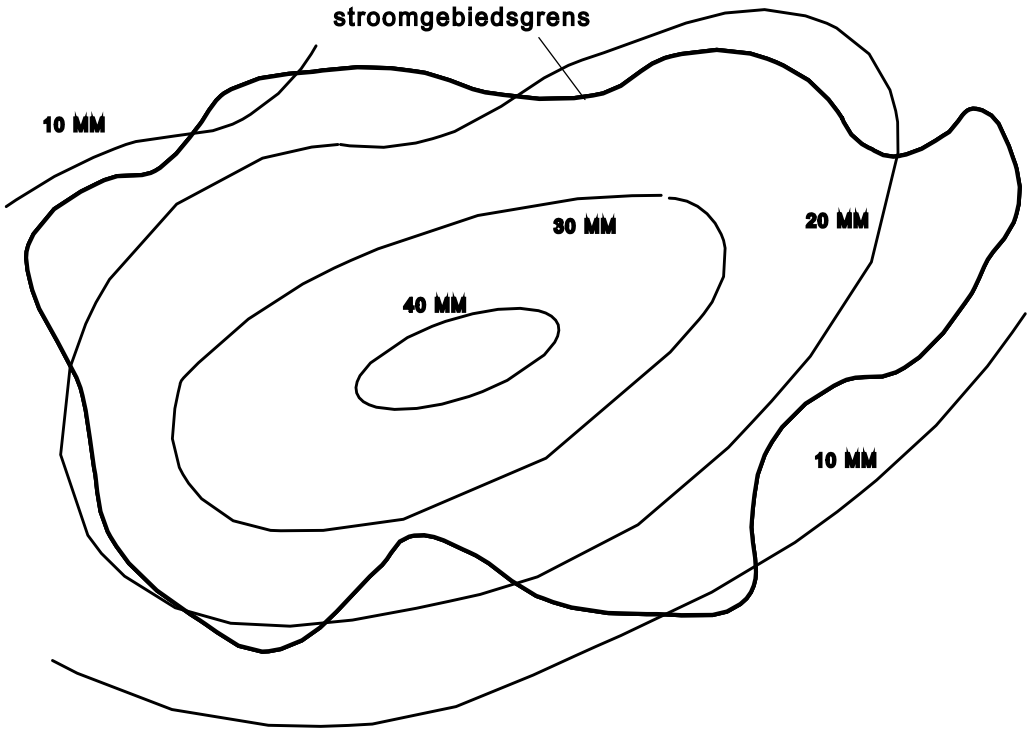
$$\bar{P} = P_{\max} \exp\left(-\left(\frac{A}{k}\right)^{n}\right)$$

Gebiedsneerslag:

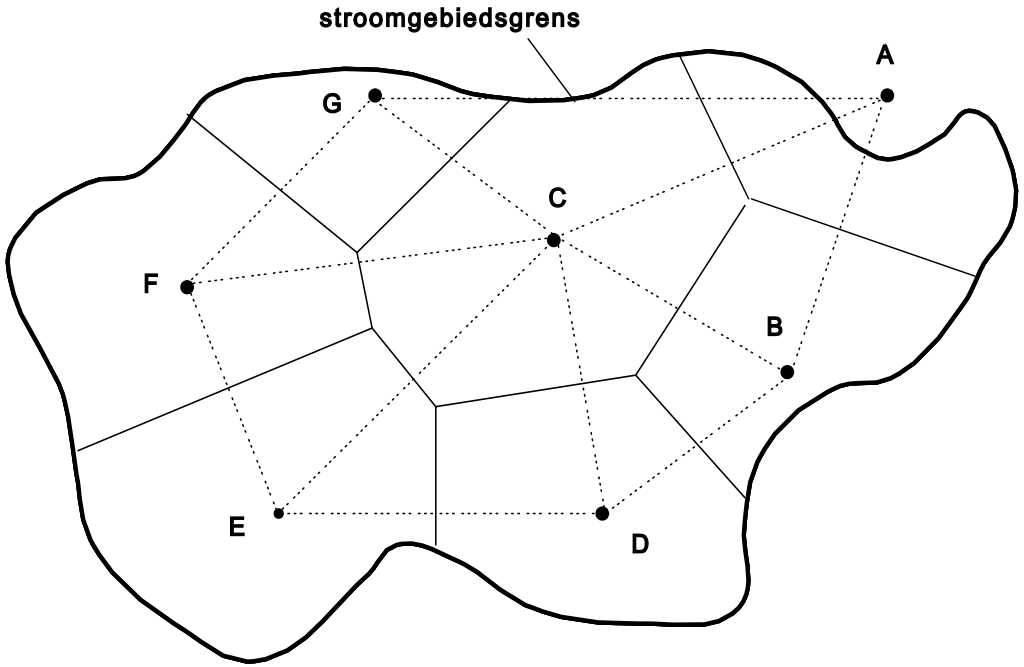
Interpolatie technieken

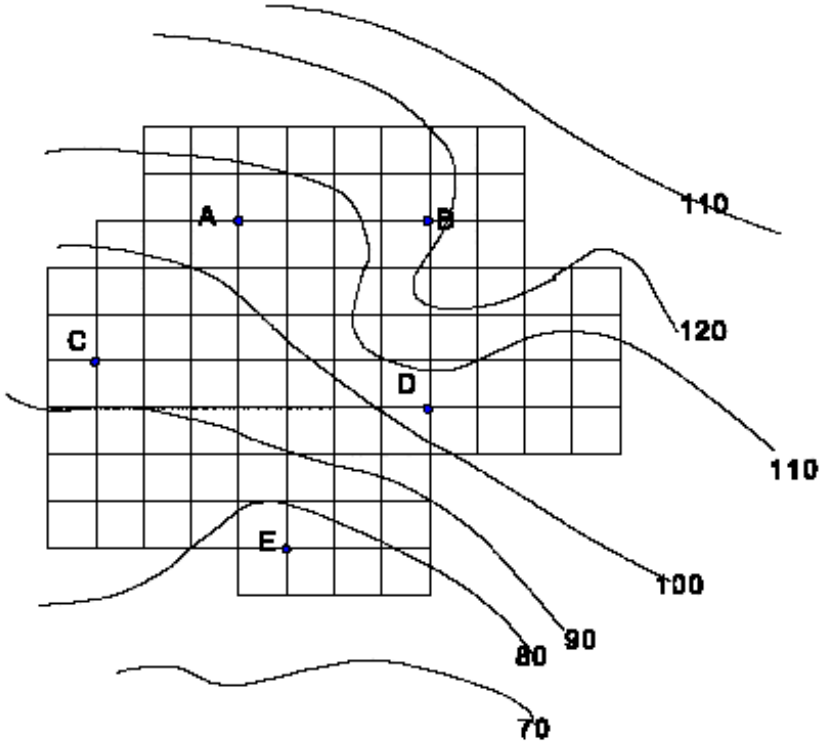
-Thiessen (nearest neighbour)
-Contourlijnen (isohyeten)
-Kriging
-Inverse distance

Contouring



Thiessen



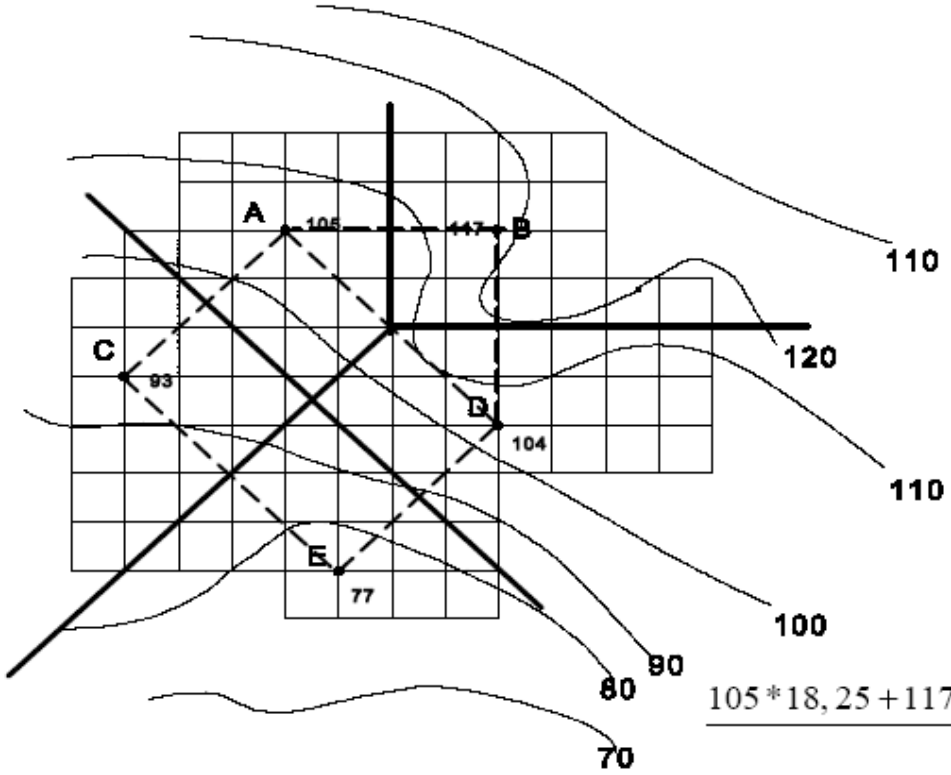


Isohyetenmethode

Voor elk interval moet de oppervlakte van het interval worden vermenigvuldigd met de gemiddelde neerslag op dat interval. Vervolgens worden de bijdragen van elk interval bij elkaar opgeteld en gedeeld door de totale oppervlakte.

$$\frac{115*23+115*51+105*104+95*88+85*80+75*26}{23+51+104+88+80+26} = 98\text{mm/maand}$$

Thiessenpolygoon



$$\frac{105*18,25+117*18+93*18,25+104*22,25+77*16,25}{93} = 100\text{mm/maand}$$

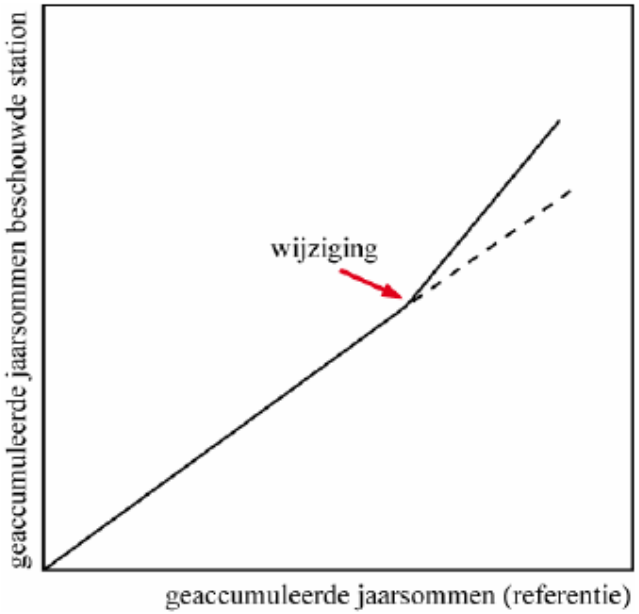
Vervolgens kunnen het aantal hokjes per meetstation en de neerslag in een meetstation worden bepaald (linker tabel). De neerslag is afgeleid van het isohyetenpatroon.

Station	Oppervlakte (aantal hokjes)	Neerslag (mm/maand)
A	18,25	105
B	18,00	117
C	18,25	93
D	22,25	104
E	16,25	77
totaal	93	

Interval (mm/maand)	Oppervlakte (Mm^2)
110 – 120	23
120 – 110	51
110 – 100	104
100 – 90	88
90 – 80	80
80 – 70	26

Double Mass

$$y_k = \sum_{i=1}^{m} x_{i,k}$$

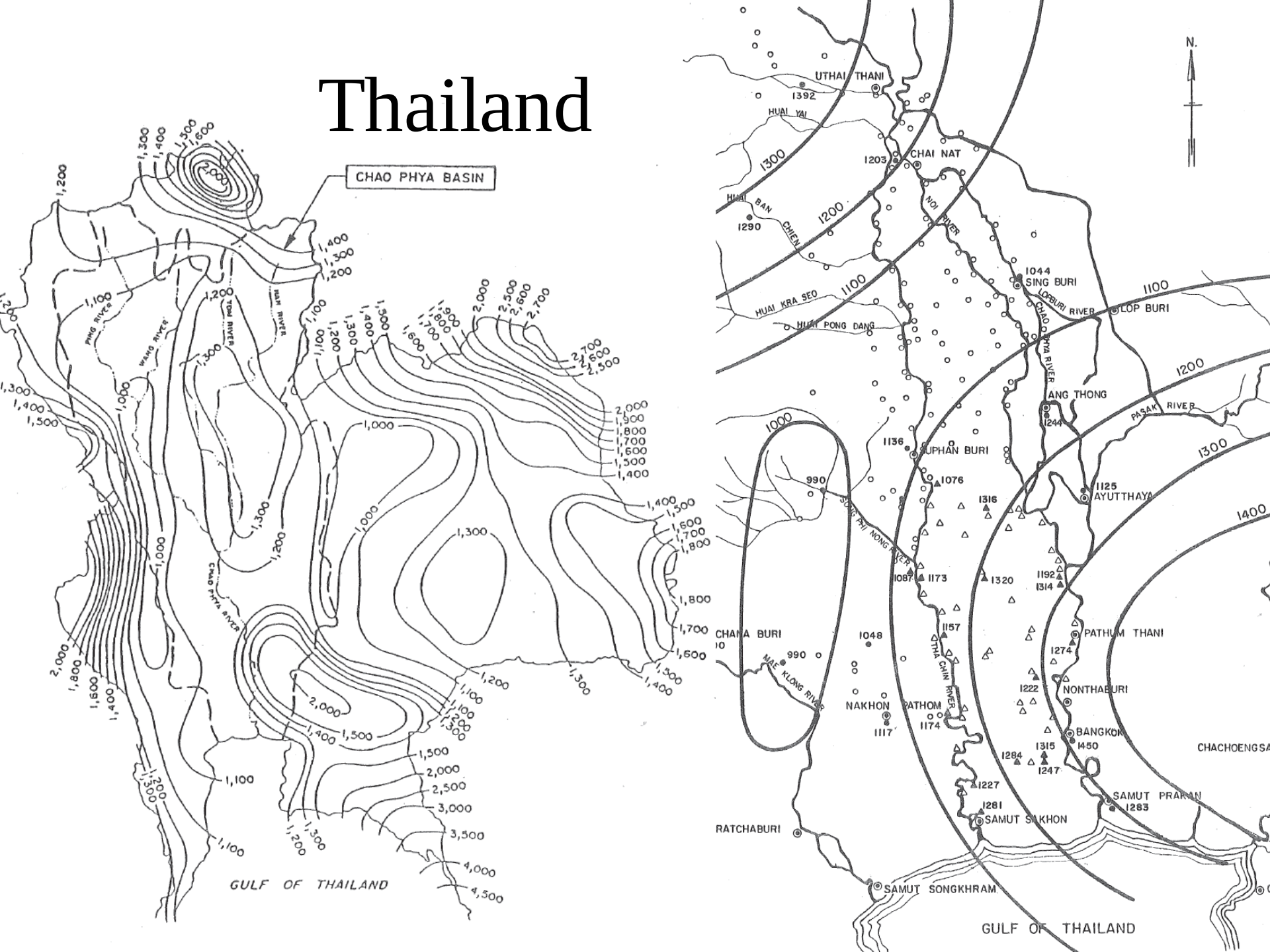


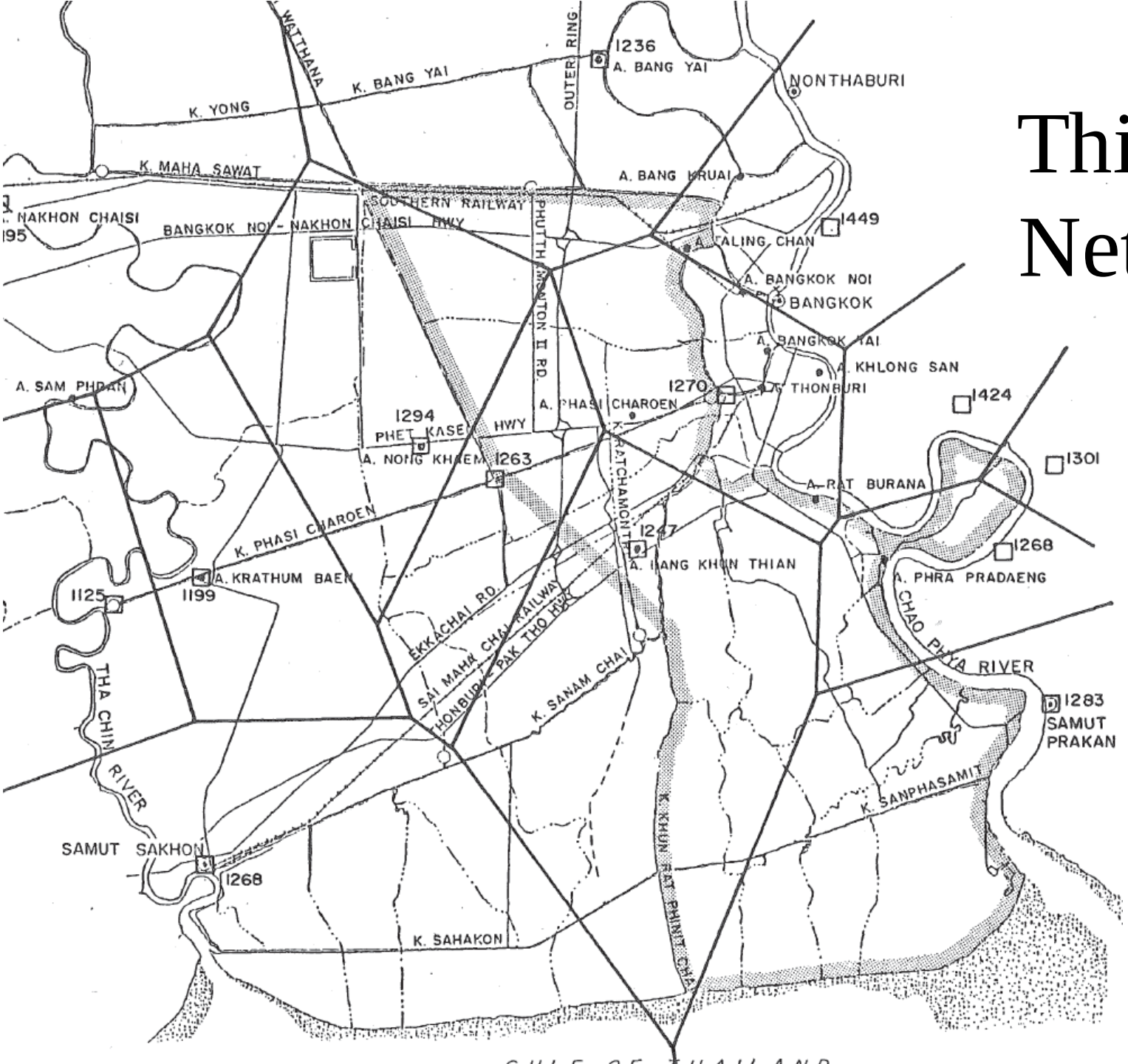
Figuur 5.12 - Dubbele sommatiekromme

n stations *j*
m years *i*

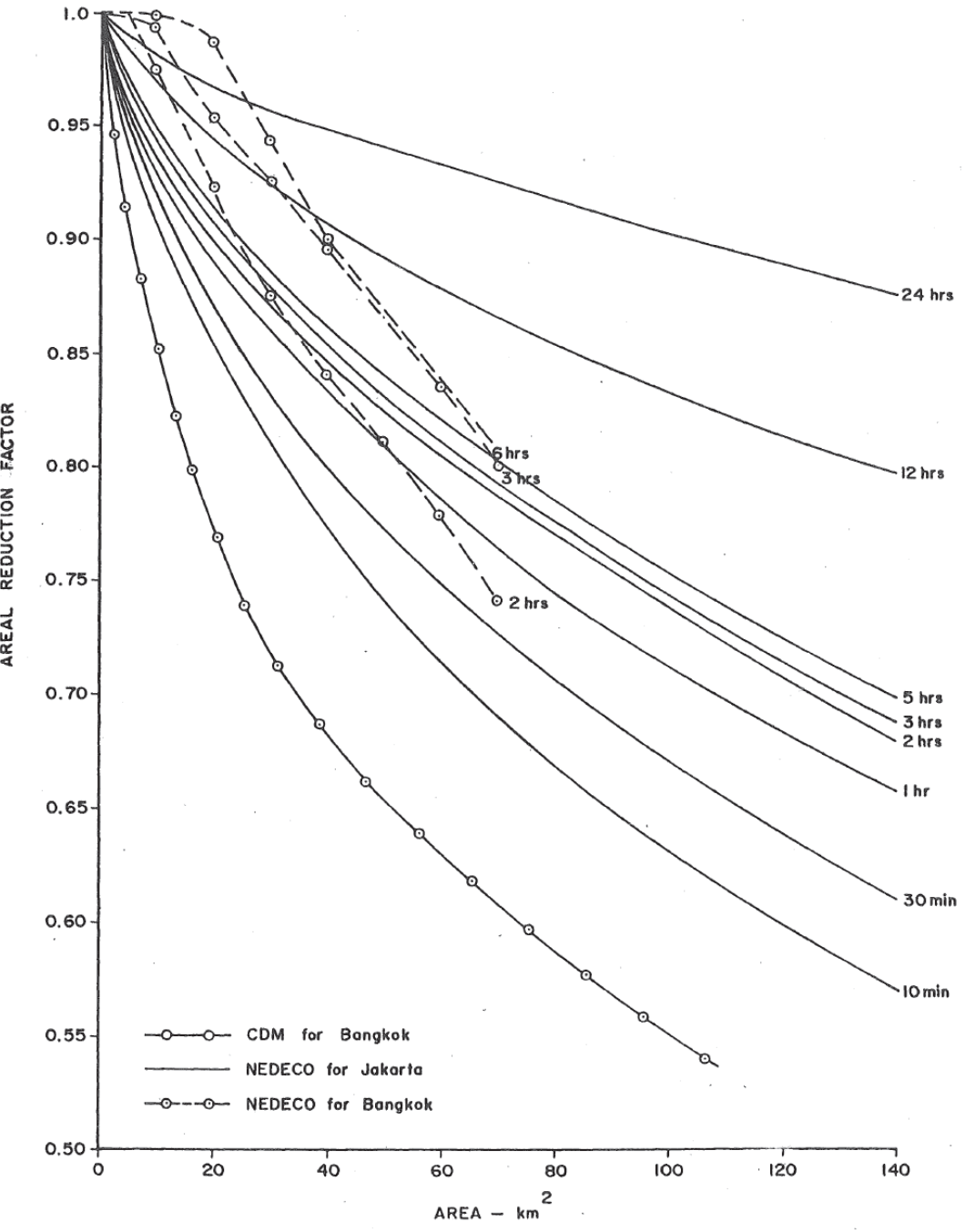
$$\bar{y} = \sum_{i=1}^{m} \left(\frac{1}{n} \sum_{j=1}^{n} x_{i,j} \right)$$

Thailand


CHAO PHYA BASIN
PING RIVER
WANG RIVER
YOM RIVER
NAN RIVER
CHAO PHYA RIVER
GULF OF THAILAND
N.
UTHAI THANI
1392
HUAI YAI
CHAI NAT
1203
HUAI BAN CHIEN
1290
NOI RIVER
1044
SING BURI
LOPBURI RIVER
LOP BURI
HUAI KRA SEO
HUAI PONG DANG
CHAO PHYA RIVER
ANG THONG
1244
PASAK RIVER
1136
U THONG
1076
990
SUPHAN BURI
1125
AYUTTHAYA
1316
SUPHAN BURI
1087
1173
1320
1192
1314
CHAINA BURI
1048
1157
PATHUM THANI
1274
MAE KLONG RIVER
THA CHIN RIVER
NAKHON PATHOM
1174
1222
NONTHABURI
1117
BANGKOK
1450
1315
1284
1247
CHACHOENGSA
1227
SAMUT PRAKAN
1283
1281
SAMUT SAKHON
RATCHABURI
SAMUT SONGKHRAM
GULF OF THAILAND

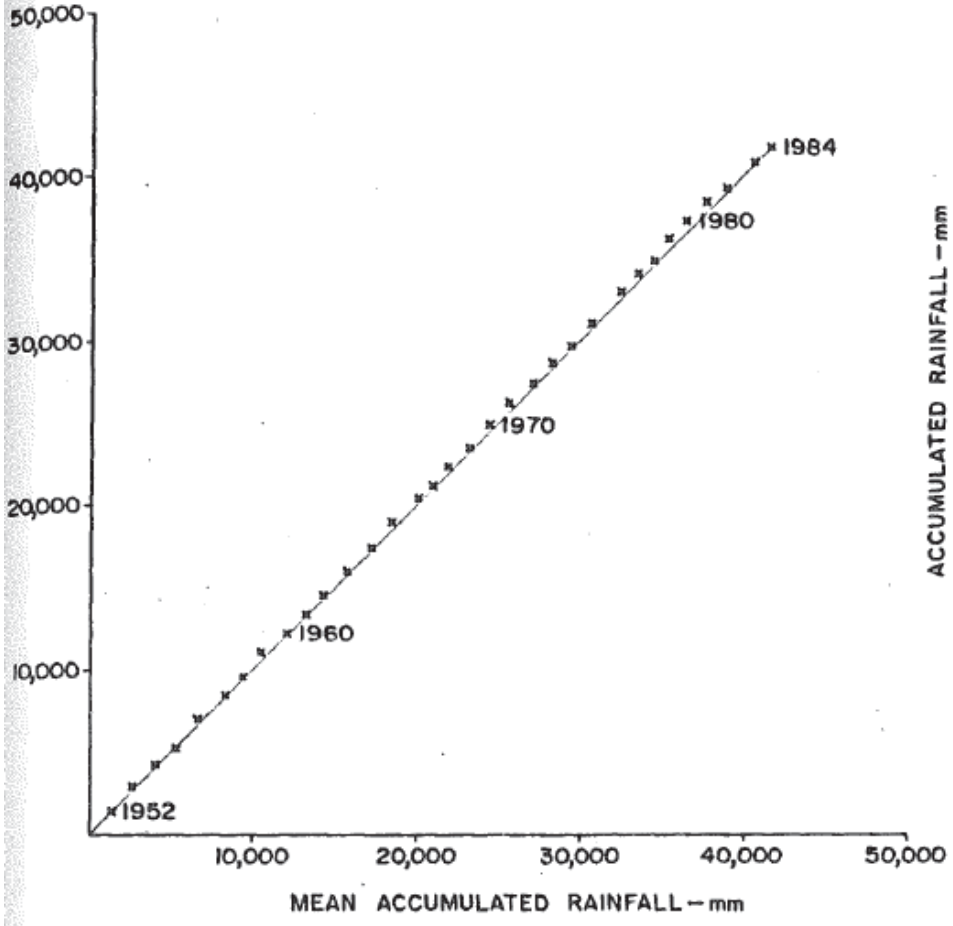


Thiessen Network

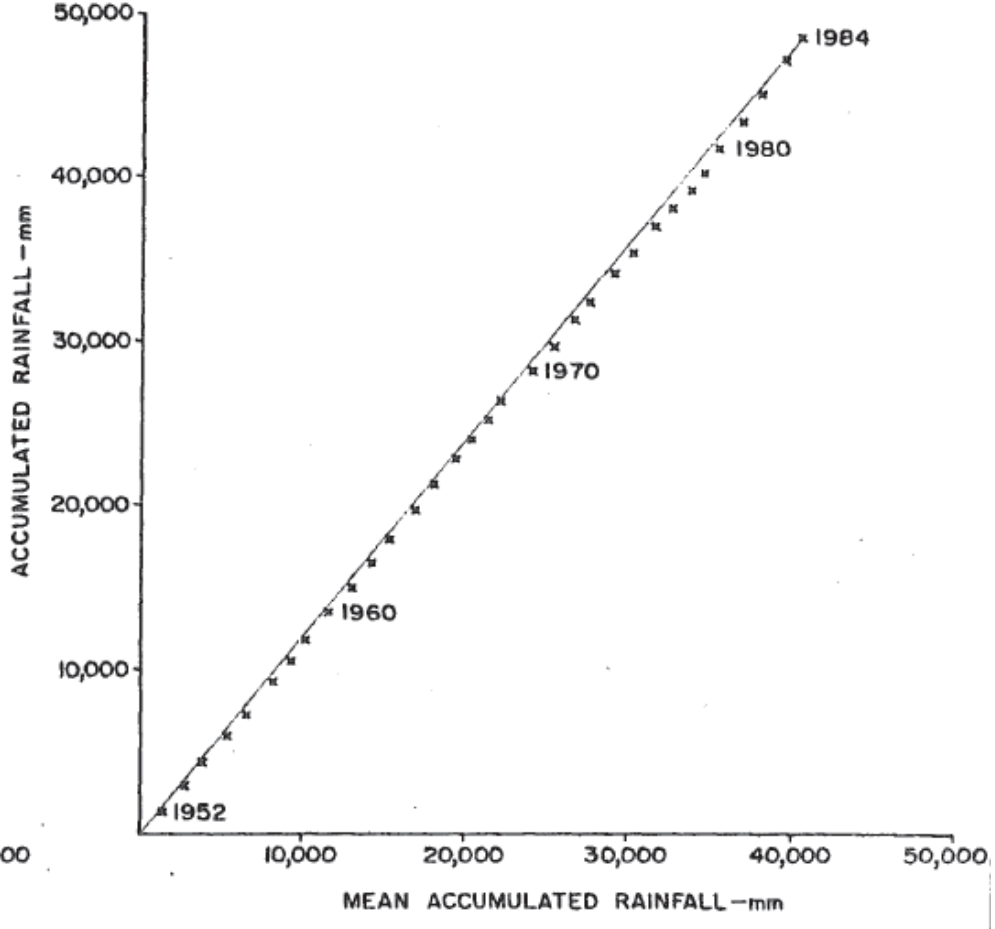


Areal Reduction Factor

Double Mass

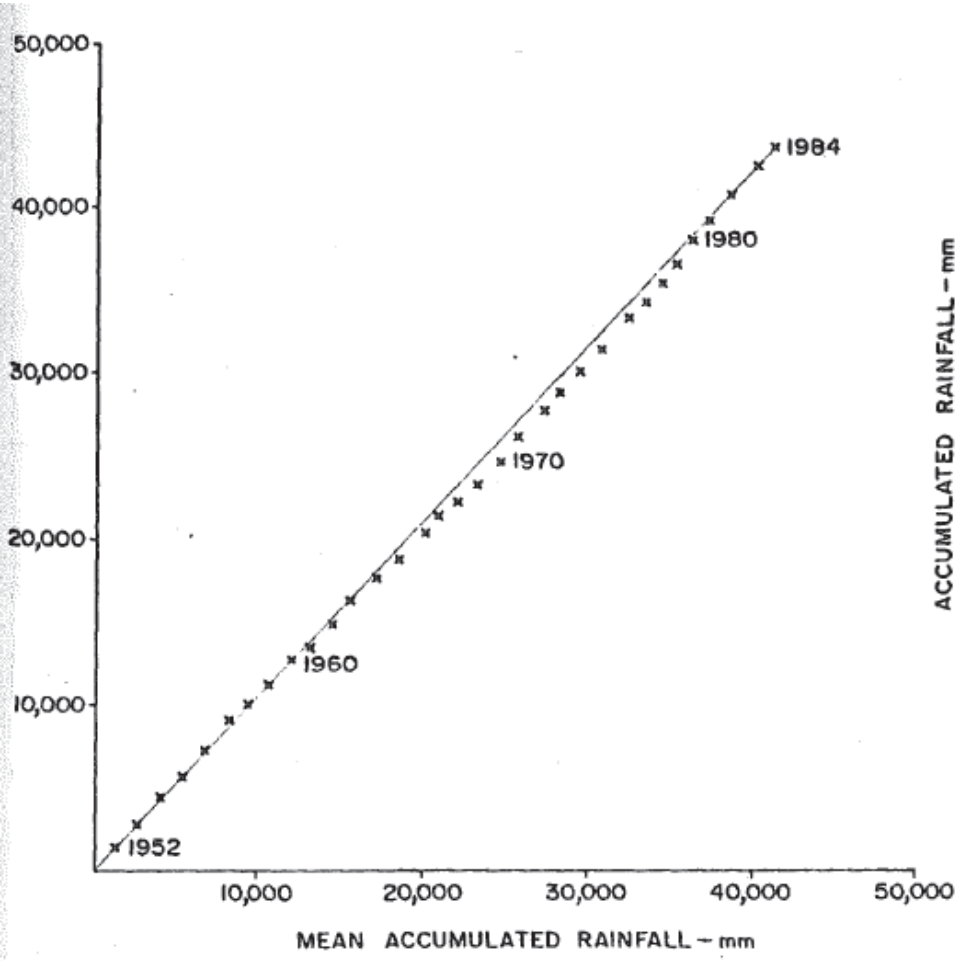


STATION 52012 - A. MUANG SAMUT PRAKAN

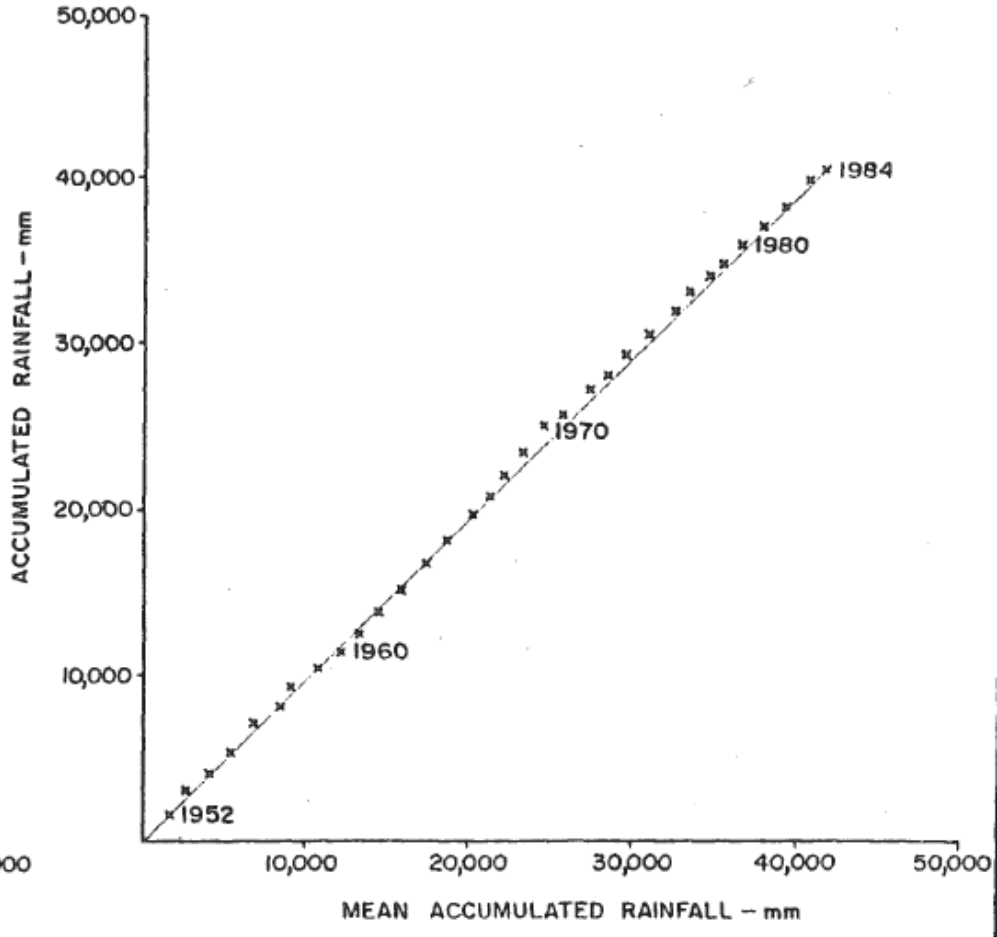


STATION 41013 - BANGKOK METROPOLIS (MD)

Double Mass cont.

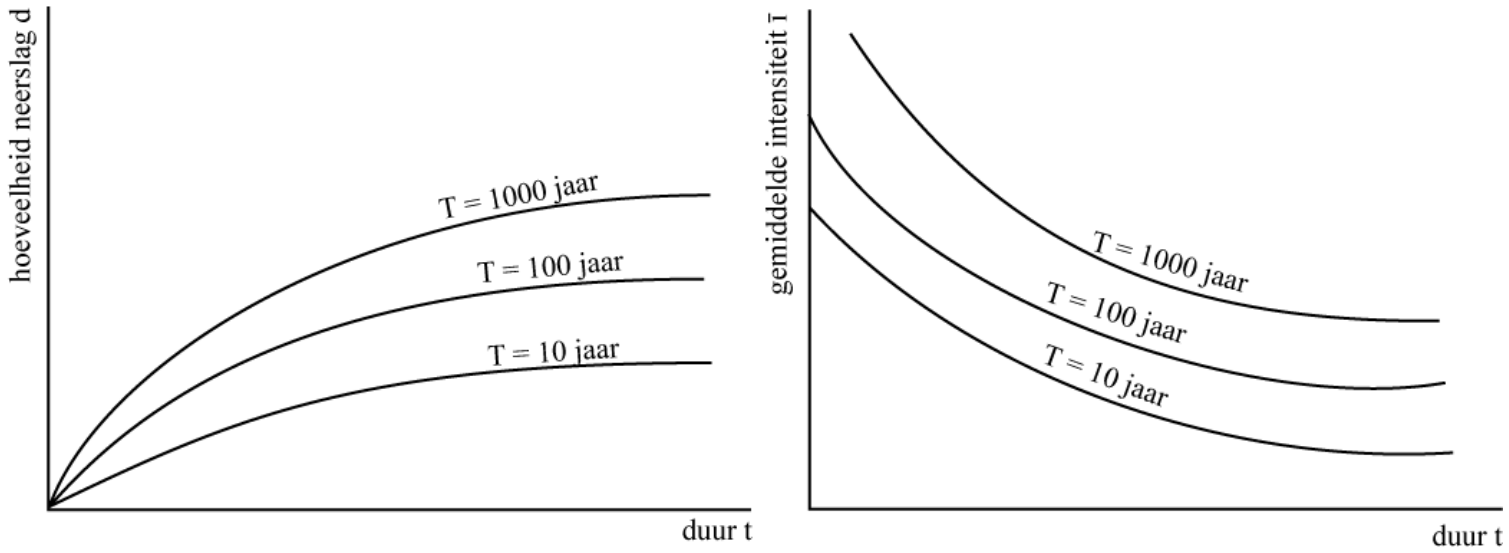


STATION 41230 - PHASI CHAROEN REGULATOR

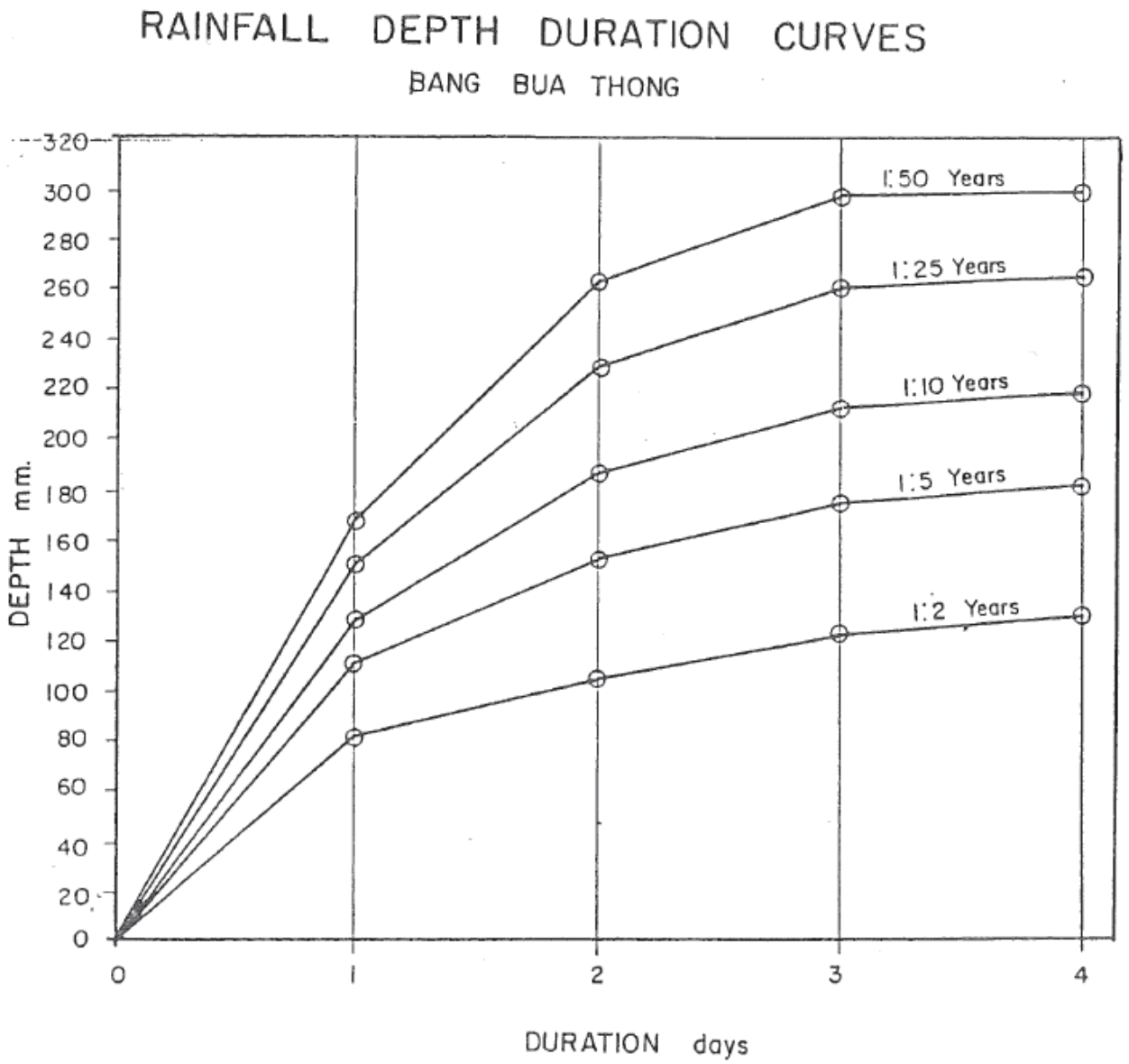


STATION 31042 - A. BANG YAI

Frequentie, Herhalingstijd, Duur en Intensiteit



Bangkok


RAINFALL DEPTH DURATION CURVES
BANG BUA THONG
DEPTH mm.
320
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
0
1
2
3
4
DURATION days
1:50 Years
1:25 Years
1:10 Years
1:5 Years
1:2 Years