Altenburg & Wymenga ECOLOGISCH ONDERZOEK

A&W-report 1254

PREDICTING THE ANNUAL PEAK FLOOD LEVEL IN THE INNER NIGER DELTA

Commisioned by PARTNERS VOOR WATER Bundeling van krachten

Altenburg & Wymenga ECOLOGISCH ONDERZOEK

A&W-rapport 1254

PREDICTING THE ANNUAL PEAK FLOOD LEVEL IN THE INNER NIGER DELTA

L. Zwarts

Altenburg & Wymenga ECOLOGISCH ONDERZOEK BV
Feanwâlden
2009

Projectnumber	Projectleader	Status
1250pvw.08	L. Zwarts	Final report
Autorisation	Signed	Date
approved	E. Wymenga	10 February 2009

L. Zwarts 2009.
Predicting the annual peak flood level in the Inner Niger Delta.
A&W-rapport 1254. Altenburg & Wymenga, ecological consultants, Feanwâlden.

The study was financed by “Partners for Water”, a joint initiative of six departments of the Government of the Netherlands. “Partners for Water” is a programme that aims to strengthen the international position of the Dutch water sector by uniting forces (private sector, public sector, non-profit sector and knowledge institutes).

The study was done in the framework of Projet PvW 07012 (Mali) : *Gestion intégrée des ressources en eau dans le bassin du Niger en amont de Taoussa – Outil d’aide à la décision*.

Cover photo
Kakagnan, Inner Niger Delta, November 2008

The study was realised by
Altenburg & Wymenga ecological consultants
P.O. Box 32, 9269 ZR Feanwâlden
Phone (0511) 47 47 64, Fax (0511) 47 27 40
e-mail: info@altwym.nl
web: www.altwym.nl

TABLE OF CONTENTS

1. INTRODUCTION

The Inner Niger Delta is one of the largest floodplains in Africa. The topographical maps of the Institut Géographique National (IGN) reveal that the inundation area measures 36 470 km^2, including 5340 km^2 of levees, dunes and other islands within that area. They also show that water coverage declines from 31 130 km^2 in wet periods to 3840 km^2 in the dry period (Fig. 1). The entire floodplain area is included in the 41 195 km^2 designated as a Ramsar Wetland Site of International Importance in January 2004.

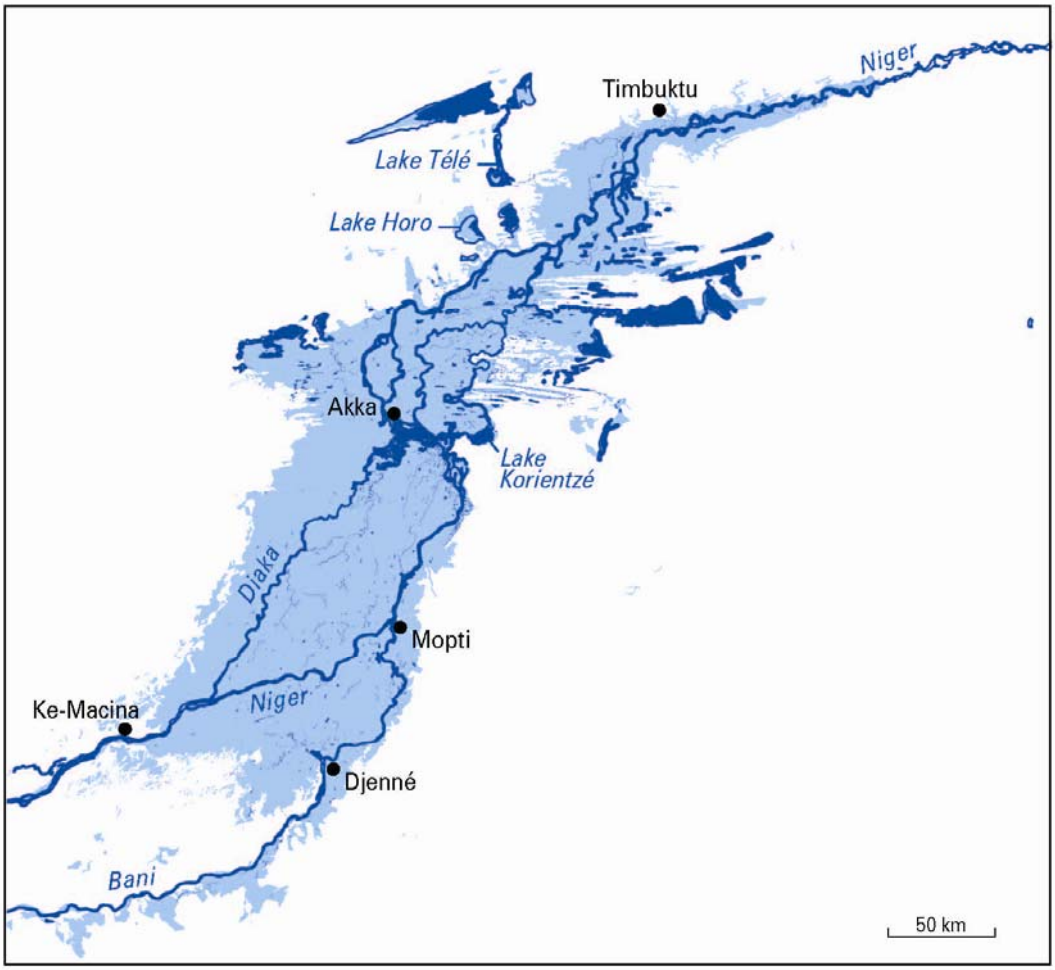


Fig. 1. *The floodplains (light blue) and permanent water bodies (dark blue) of the Inner Niger Delta, as indicated on the topographical maps of the Institut Géographique National (IGN). The maps are from 1956, and based on aerial photographs and field work in the early 1950s, a period with very high floods.*

In the Inner Niger Delta, flood height may reach six metres, slowly engulfing an area of 400 by 100 km. Fortuitously, the seasonal rise and retreat of the flood in this area has been measured daily by the DNH at several hydrological stations over many decades, producing a time series of great value. The water level is low from April to June, and begins to rise in July. In years of low river flow, the water reaches a height of about 3.5 m, peaking in late October. At high river flows, although the water level rises at the same daily rate, it does so over a longer period, peaking at 6 m by late December. Usually, lower-level floods cover floodplains for four months only (October-February), but high floods inundate them for twice as long (September-April). During the flooding (*crue*) and the deflooding (*decrue*) the water

level rises and declines 3-5 cm per day. This gives the opportunity to predict the flood level in a week or in a fortnight. This reports analyses the possibility to predict the peak flood level two or even three months before.

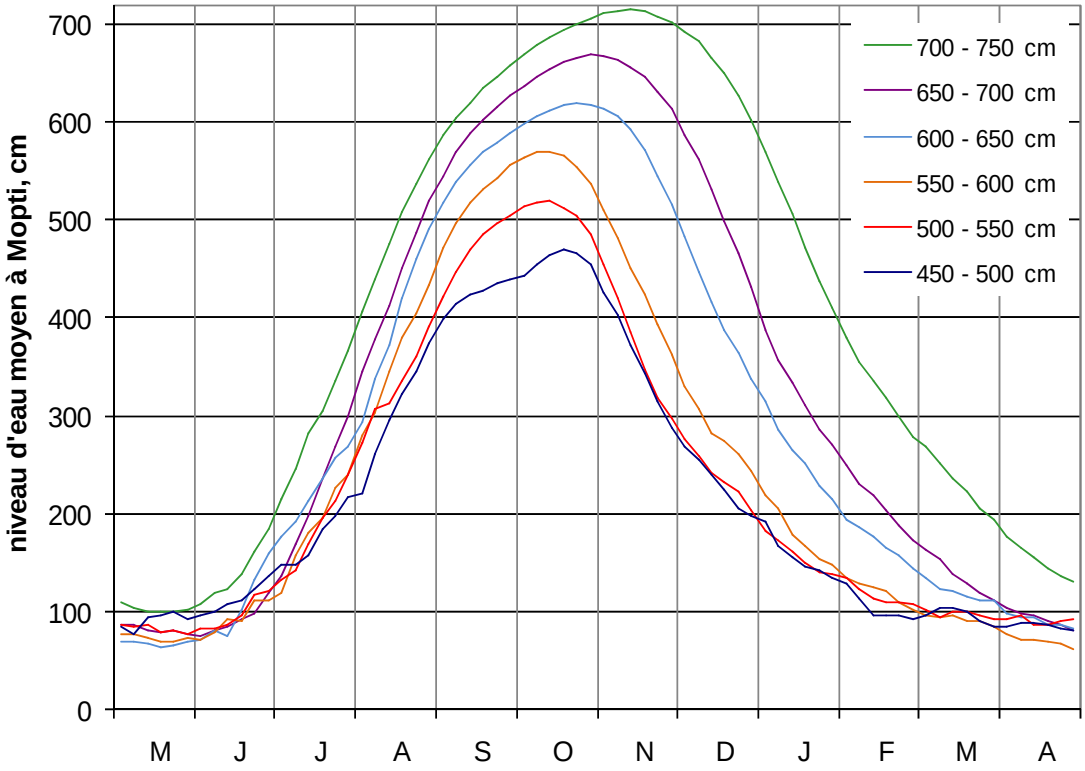


Fig. 2. *Average daily water level in Mopti during the hydrological year (1 May – 31 April) for six different flood level. The daily water level in Mopti has been measured since 1922. The data since 1944 were split up in six categories: years during which the maximal flood level varied between 450 and 500 cm, 500 and 550 cm, etc. From: Zwarts, L. and Grigoras, I. 2005. Flooding of the Inner Niger Delta. - In: Zwarts, L., Beukering van, P., Kone, B. and Wymenga, E. (eds.), The Niger, a lifeline. RIZA/Wetlands International/IVM/A&W, pp. 43-77.*

In a year with a high peak flood level in the Inner Delta, the flood lasts four months longer than in a year with a low flood. As shown in Fig. 2, the wave comes in a wet year one month earlier and continues for an additional three months. To construct this figure, all daily measurements in Mopti since 1944 were subdivided into six categories on the basis of the highest water level in that particular year. There are three years with a maximum flood between 450 and 500 cm (1984/5, 1987/8, 1993/4). For these three years the average water level per date is calculated. The same is done for the other categories: 500 – 550 cm (n = 6), 550 – 600 cm (n = 9), 600 – 650 cm (n = 7), 600 – 650 cm (n = 20) and 650 – 700 cm (n = 12). Besides the fact that the flood wave lasts longer with a higher flood, Fig. 2 shows that the peak level is reached more than a month later if the flood is high.

Fig. 2 shows six flood curves, based on readings of the scale at Mopti. The water level in Mopti is in the dry period, on average, 100 cm on the local scale. In dry years, the flood level rises 380 cm above this level, but in wet years more than 600 cm. Fig. 2 shows that, again on average, the water level in June, and even in July, cannot be used to foretell the peak flood level. However, when the water level in August is still low, one can be rather sure that also the maximum flood level will be low too, while a high floods may be foreseen if the water level in August is high.

Fig. 3 shows the course of the daily water level in Mopti and Akka during nine recent years. Again, there is no relationship between the maximum flood level and the water level in the dry period. Note, for instance, that in 1999 the water level until mid July was low, but nevertheless the peak flood in that year reached a higher level than in the eight other years.

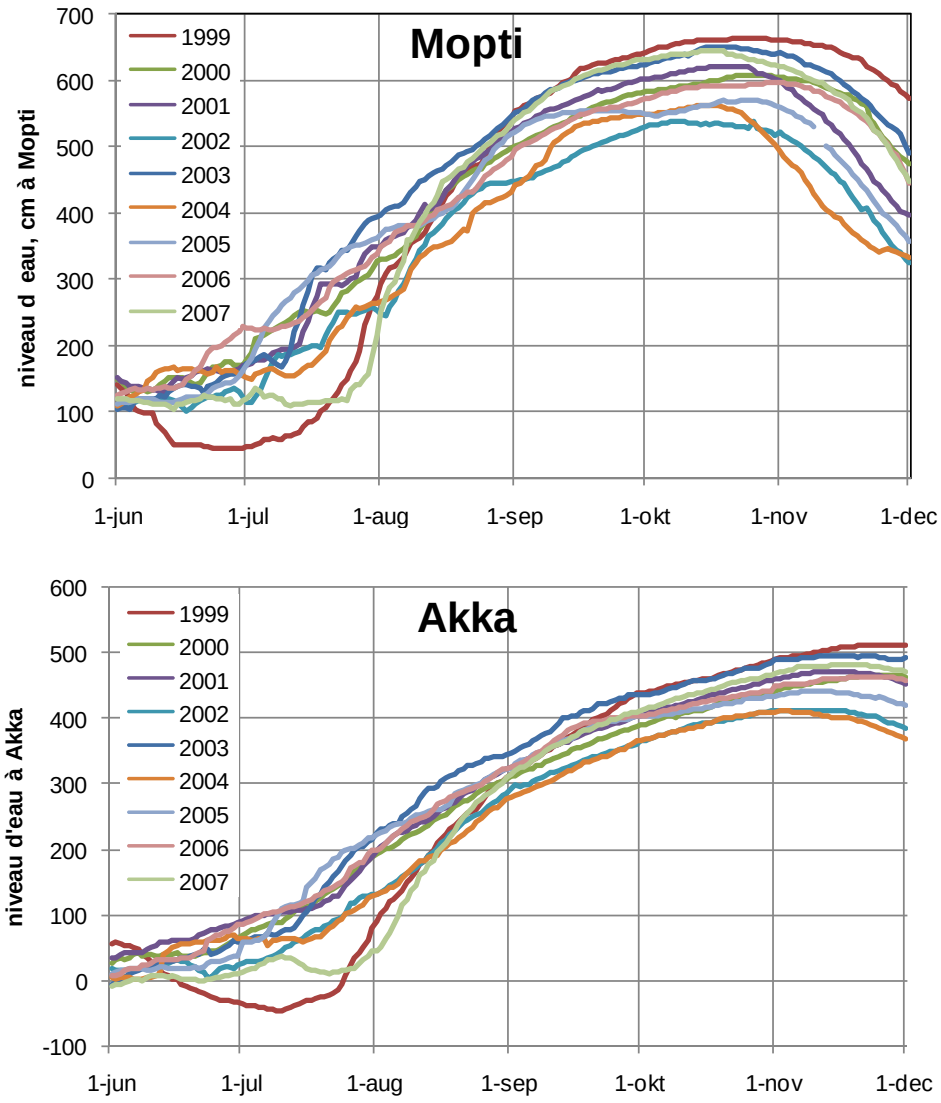


Fig. 3 . *The daily water level in Akka and Mopti between 1 June and 1 December 1999-2007.*

This report concentrates on the *crue* period and attempts to answer 7 questions:

1. What is the seasonal variation in the daily rise of the water level and does this vary between years?
2. What is the relationship between water level in Mopti at a certain date in August and September and the maximum flood level in Mopti.
3. What is the relationship between water level in Mopti at a certain date in August and September and the date at which the maximum flood level is reached in Mopti.
4. As 2 for Akka.
5. As 3 for Mopti.
6. As 2 but using the water level in Mopti to predict the maximum flood level in Akka.

7. As 3 but using the water level in Mopti to predict the date at which the maximum flood level in Akka.

The analysis is based on daily water level measurements at Akka and Mopti between 1956 and 2007. Each dot in Fig. 4, 5 and 5 refers to a year.

Thanks to DNH the daily water level is known for several hydrological stations in the Inner Niger Delta. The picture shows Navon Cissé (DNH) and the scale of Akka.

2. HOW MUCH DOES THE WATER LEVEL RISE PER DAY

The daily flood curves at Akka were used to calculate the daily rise of the water level. On average, the water level starts to rise in early June. The rate of rising gradually increases to reach a maximum of 4 to 6 cm per day between mid July and late August. Later in the season the rise of the water level continues more slowly. Fig. 4 also shows the standard deviations, being 3-4 cm in June and July, but decreasing to 1 cm in September and October. In other words, there is a rather large variation in the rate of flooding between years, especially in the early season.

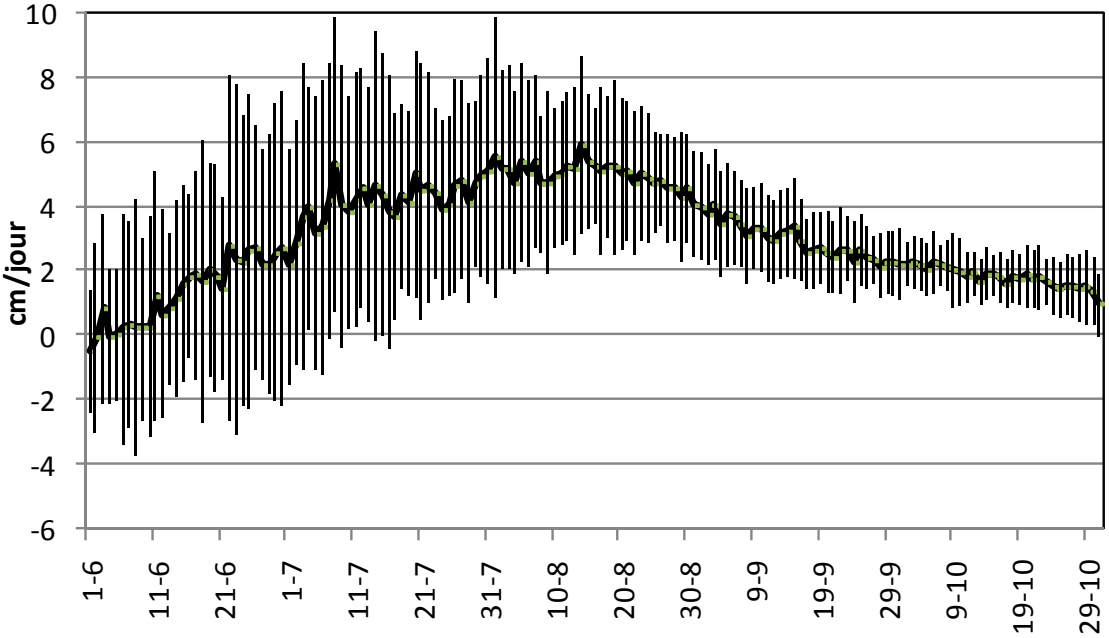


Fig. 4. *The daily rise of the water level at Akka, such as derived from the daily measurements between 1956 and 2007. The bars show the standard deviations.*

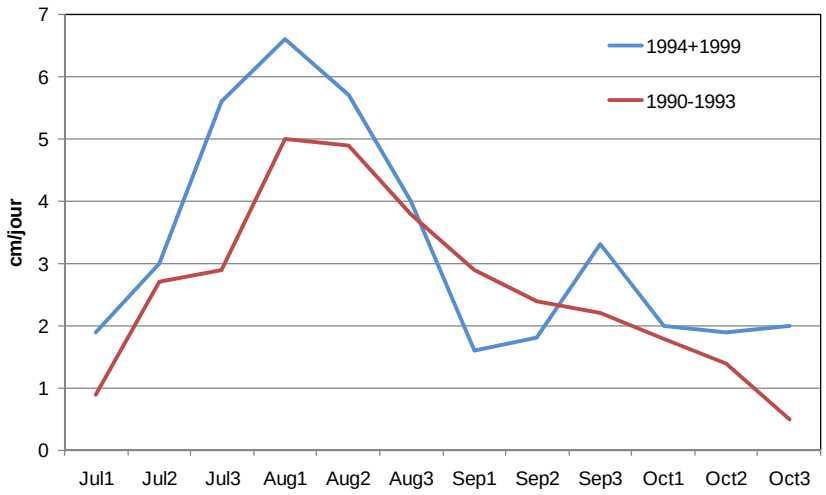


Fig. 5. *The average daily rise of the water level at Akka per 10 day periods in June-October for four dry years (1990-1993; peak flood level: 385 cm) and two recent, wet years (1994, 1999 peak flood: 522 cm).*

A part of the variation in the daily increase of the flood level may be attributed to the peak flood level (Fig. 5). Obviously, the water level rises in wet and dry years at the same rate of 5-6 cm at a maximum, on average, but the period during which this maximal rising takes place is in wet years twice as long as in dry years. The difference is still larger when the dry years are compared to the extremely wet years before 1968 (*average* peak flood level: 572 cm, thus 50 cm above both recent wet years). There is one complication in such an analysis, however. Since 1982, the Selingue reservoir is filled with 2.1 km^3, as a consequence of which the river flow is severely reduced in July and to a lesser degree later in the season. In those wet years before 1982 the flood rose in July at the same rate as in August.

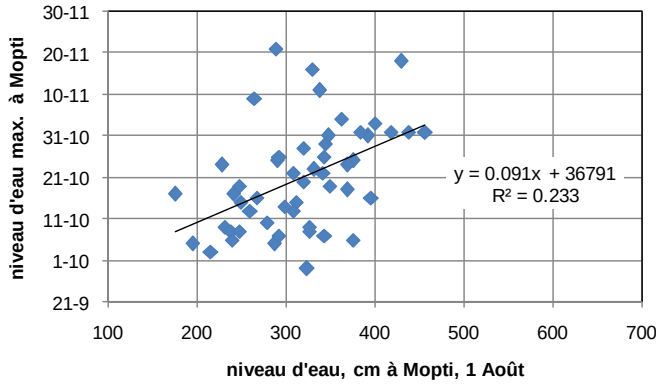
For the present analysis, we may conclude that the degree of flooding shows a clear seasonal variation. It is also obvious that if the flood rises more than average in July, this may indicate that the flood will reach a high peak level.

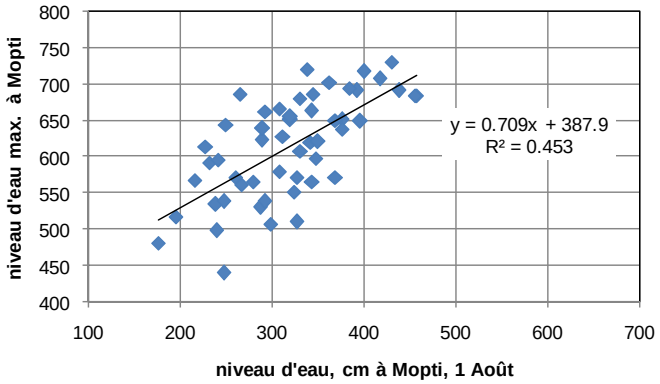
The scale at Akka (26 January 2003).

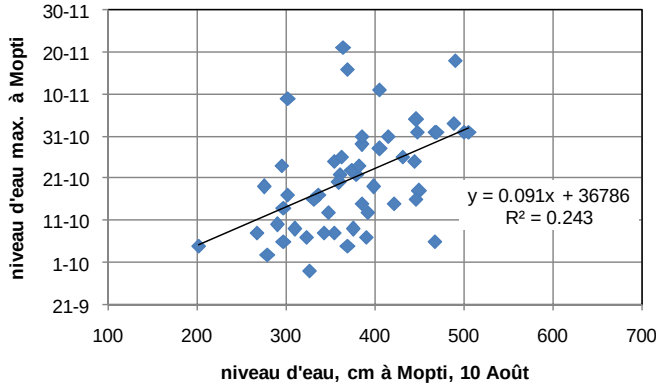
3. PREDICTING THE PEAK FLOOD

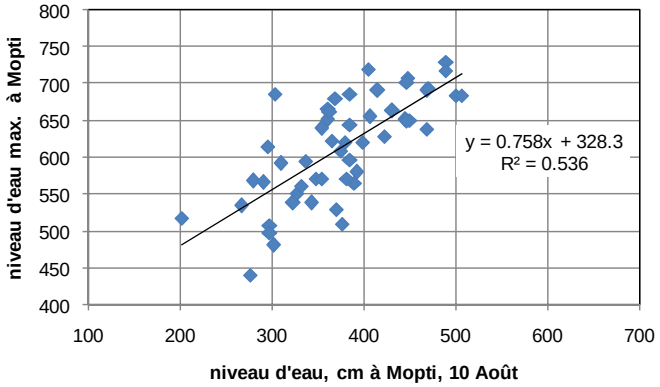
3.1. PEAK FLOOD IN MOPTI, BASED ON THE DATA OF MOPTI

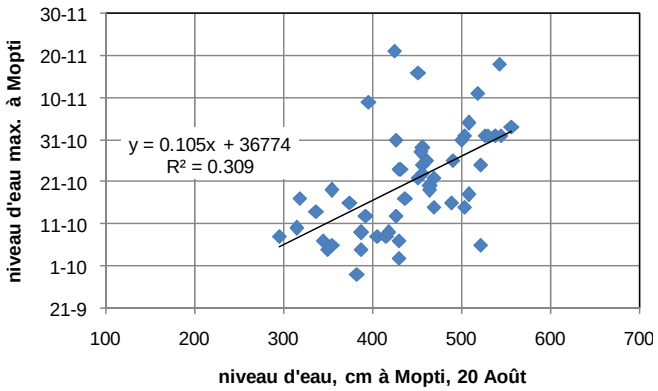
When the water level in Mopti on 1 August is 200 cm, it is possible to predict that the maximal flood level will be reached already in October a peak level of about 500 cm, while it is at the same date already 400 cm, we may predict that the peak flood level will be reached in November and be about 700 cm (upper two graphs in Fig. 6). The scattering around the regression line is rather wide, so the predicted level is not yet precise. Ten days later, the prediction is already better and on 30 August, we may indicate rather accurate the peak flood level and also when it will be reached. During the course of September, the predictions for the flood level become more precise, but the date at which the peak is reached remains difficult to predict.

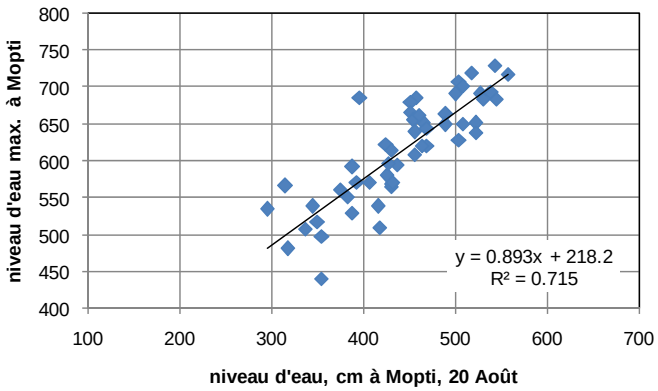


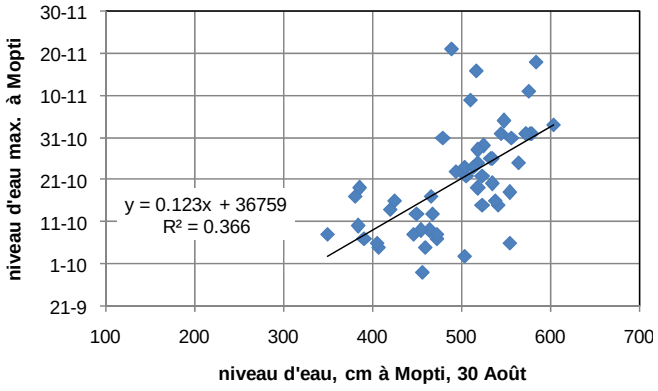


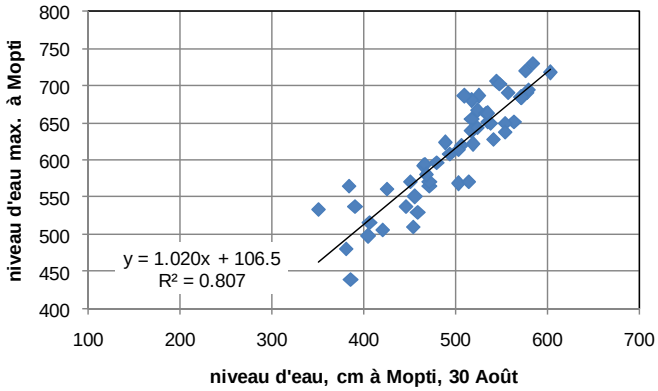


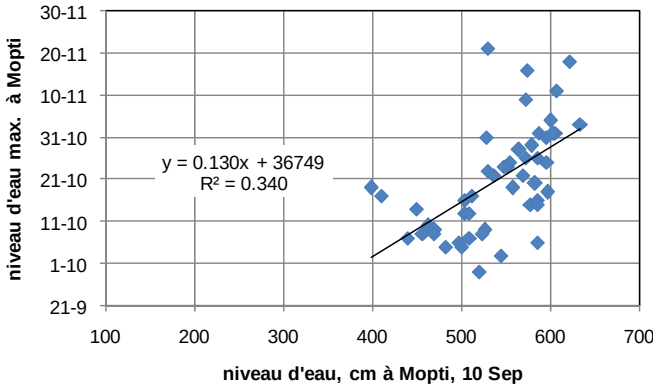


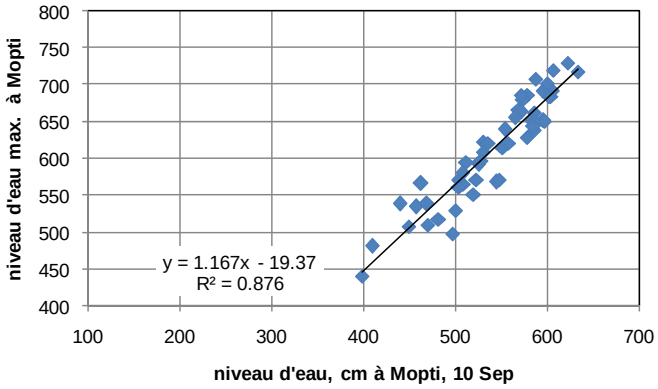

y = 0.105x + 36774
R² = 0.309
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 20 Août

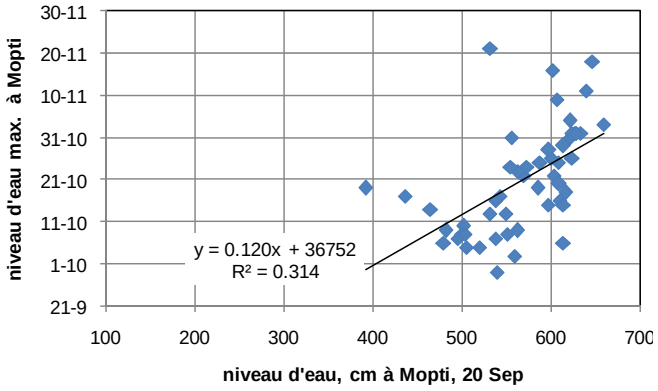

y = 0.893x + 218.2
R² = 0.715
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 20 Août

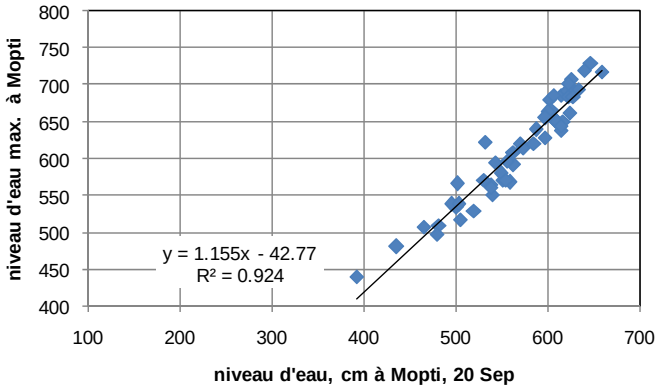

y = 0.123x + 36759
R² = 0.366
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 30 Août


y = 1.020x + 106.5
R² = 0.807
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 30 Août


y = 0.130x + 36749
R² = 0.340
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 10 Sep


y = 1.167x - 19.37
R² = 0.876
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 10 Sep


y = 0.120x + 36752
R² = 0.314
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 20 Sep


y = 1.155x - 42.77
R² = 0.924
niveau d'eau max. à Mopti
niveau d'eau, cm à Mopti, 20 Sep

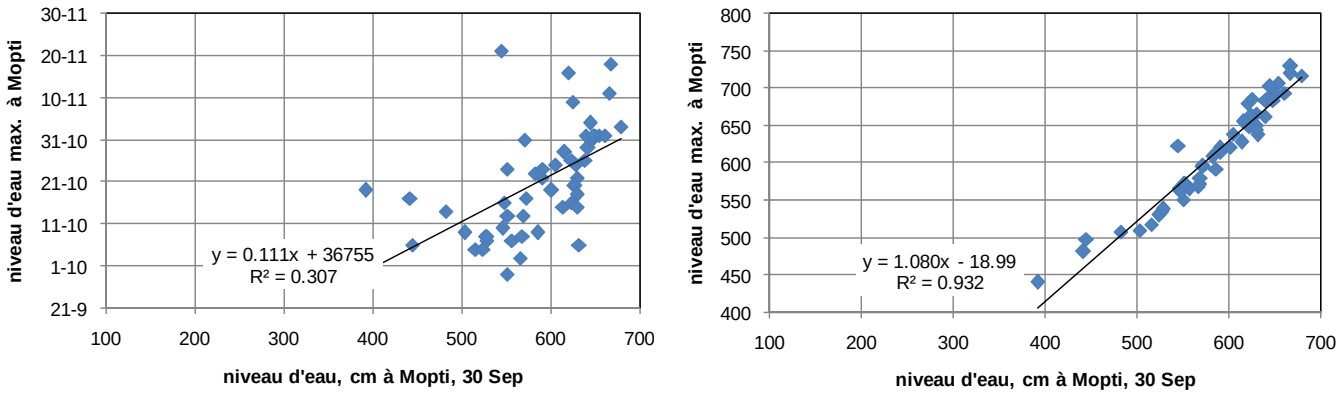
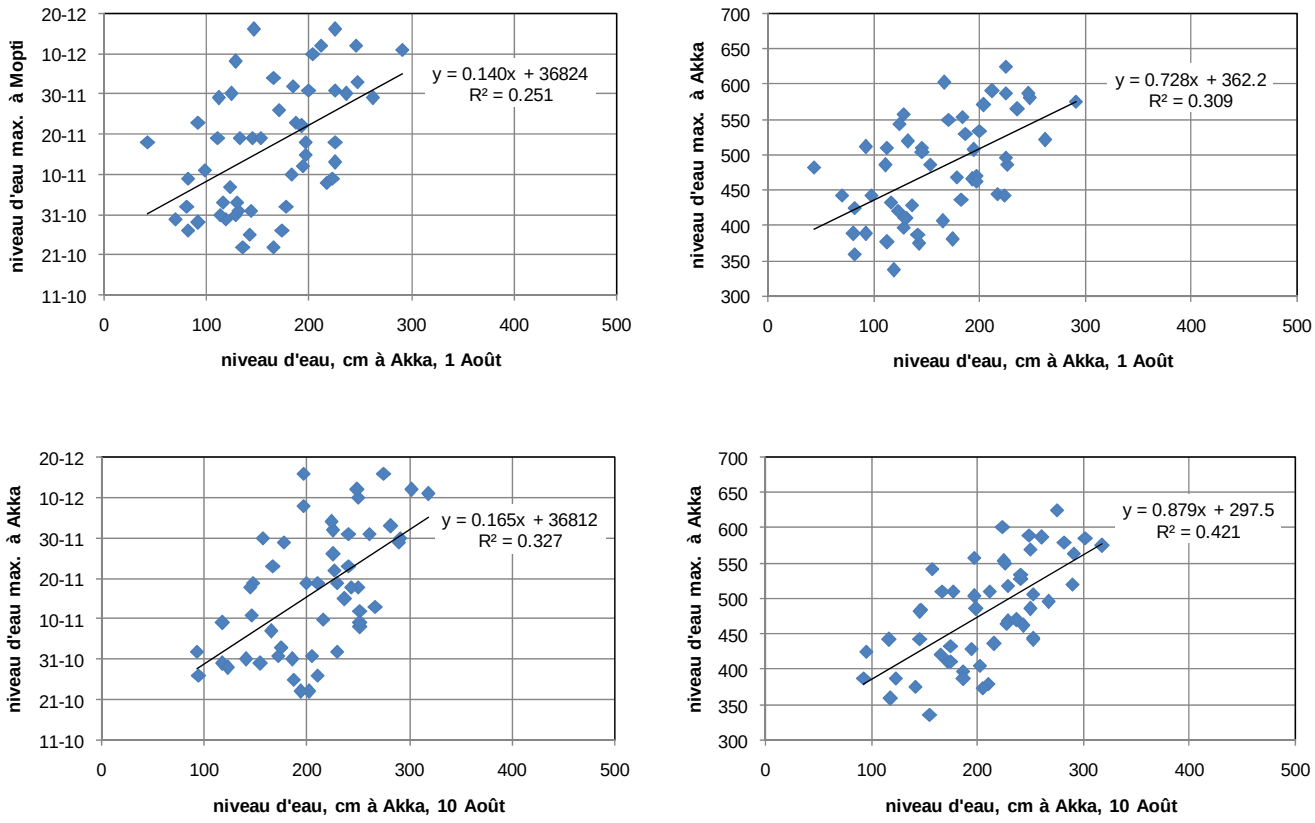
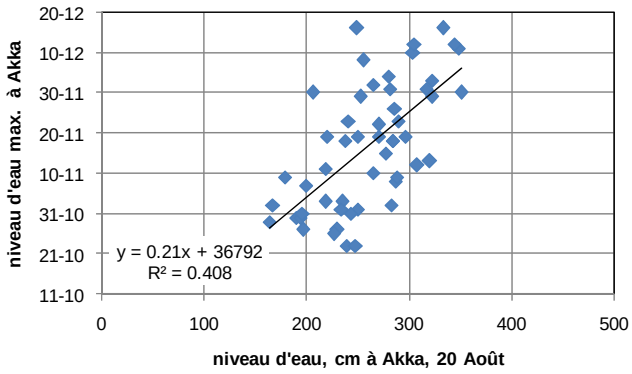


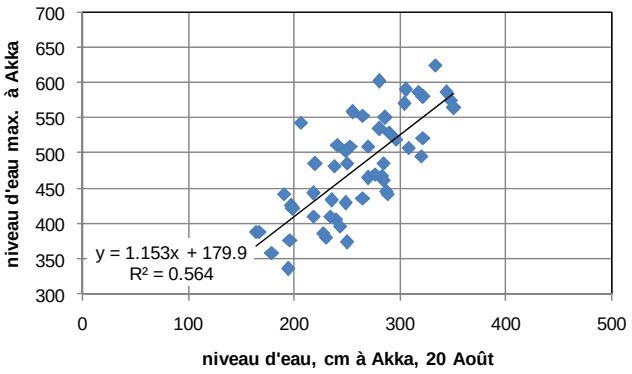
Fig. 6. *The relationship between water level in Mopti at a certain date and the date at which the maximum flood level is reached in Mopti (left). The relationship between water level in Mopti at a certain date and the maximum flood level in Mopti (right).*

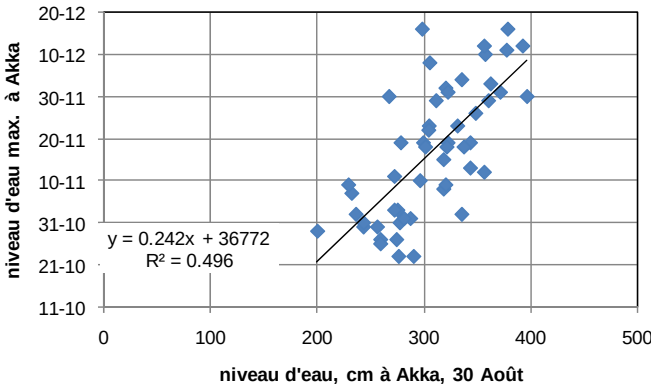
3.2. PEAK FLOOD IN AKKA, BASED ON THE DATA OF AKKA

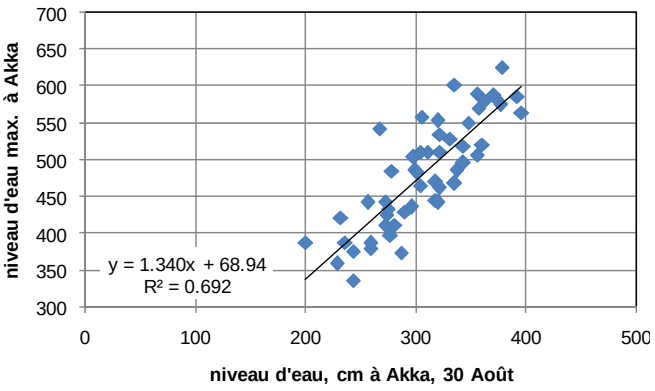
Compared to Mopti, it is more difficult to predict the peak flood in Akka using the measured water levels in Akka in August and September (Fig. 7).

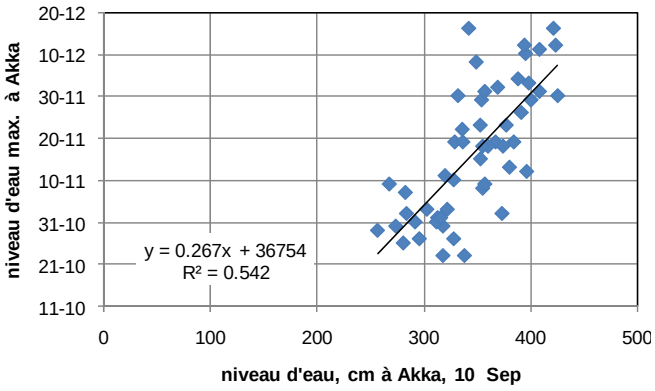


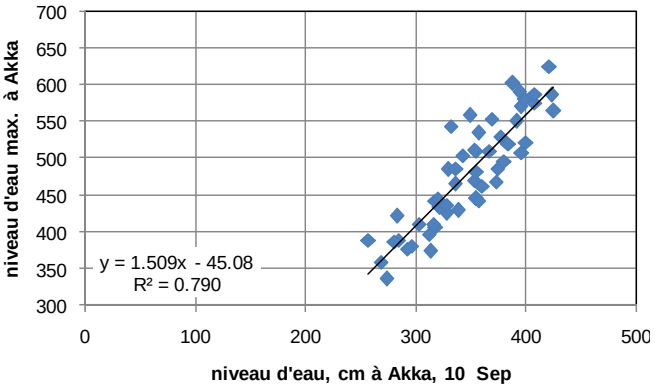

20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
niveau d'eau max. à Akka
y = 0.21x + 36792
R² = 0.408
0
100
200
300
400
500
niveau d'eau, cm à Akka, 20 Août

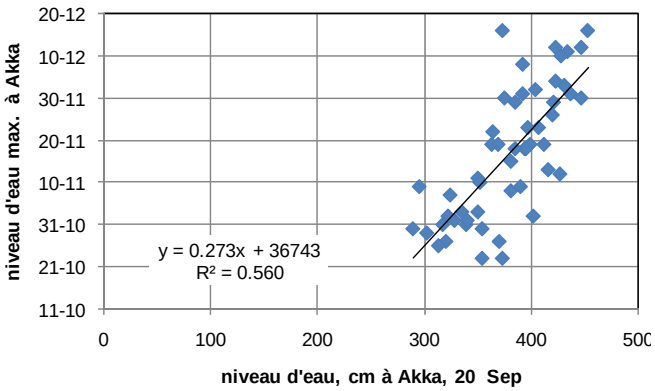

700
650
600
550
500
450
400
350
300
niveau d'eau max. à Akka
y = 1.153x + 179.9
R² = 0.564
0
100
200
300
400
500
niveau d'eau, cm à Akka, 20 Août

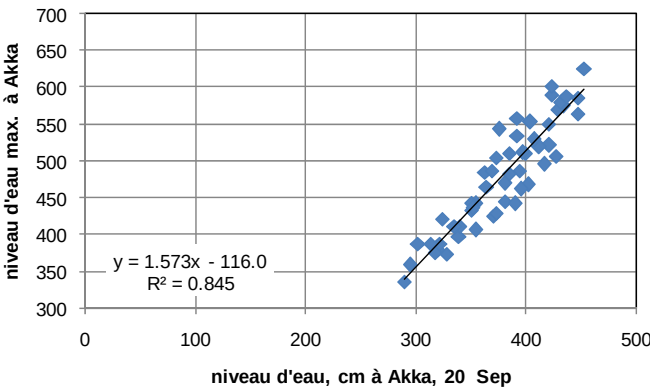

20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
niveau d'eau max. à Akka
y = 0.242x + 36772
R² = 0.496
0
100
200
300
400
500
niveau d'eau, cm à Akka, 30 Août


700
650
600
550
500
450
400
350
300
niveau d'eau max. à Akka
y = 1.340x + 68.94
R² = 0.692
0
100
200
300
400
500
niveau d'eau, cm à Akka, 30 Août


20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
niveau d'eau max. à Akka
y = 0.267x + 36754
R² = 0.542
0
100
200
300
400
500
niveau d'eau, cm à Akka, 10 Sep


700
650
600
550
500
450
400
350
300
niveau d'eau max. à Akka
y = 1.509x - 45.08
R² = 0.790
0
100
200
300
400
500
niveau d'eau, cm à Akka, 10 Sep


20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
niveau d'eau max. à Akka
y = 0.273x + 36743
R² = 0.560
0
100
200
300
400
500
niveau d'eau, cm à Akka, 20 Sep


700
650
600
550
500
450
400
350
300
niveau d'eau max. à Akka
y = 1.573x - 116.0
R² = 0.845
0
100
200
300
400
500
niveau d'eau, cm à Akka, 20 Sep

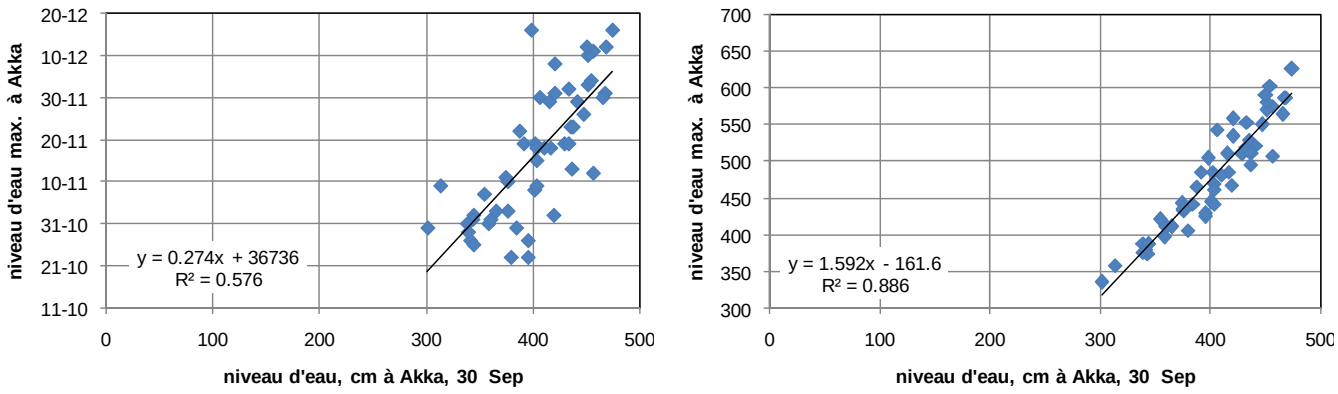
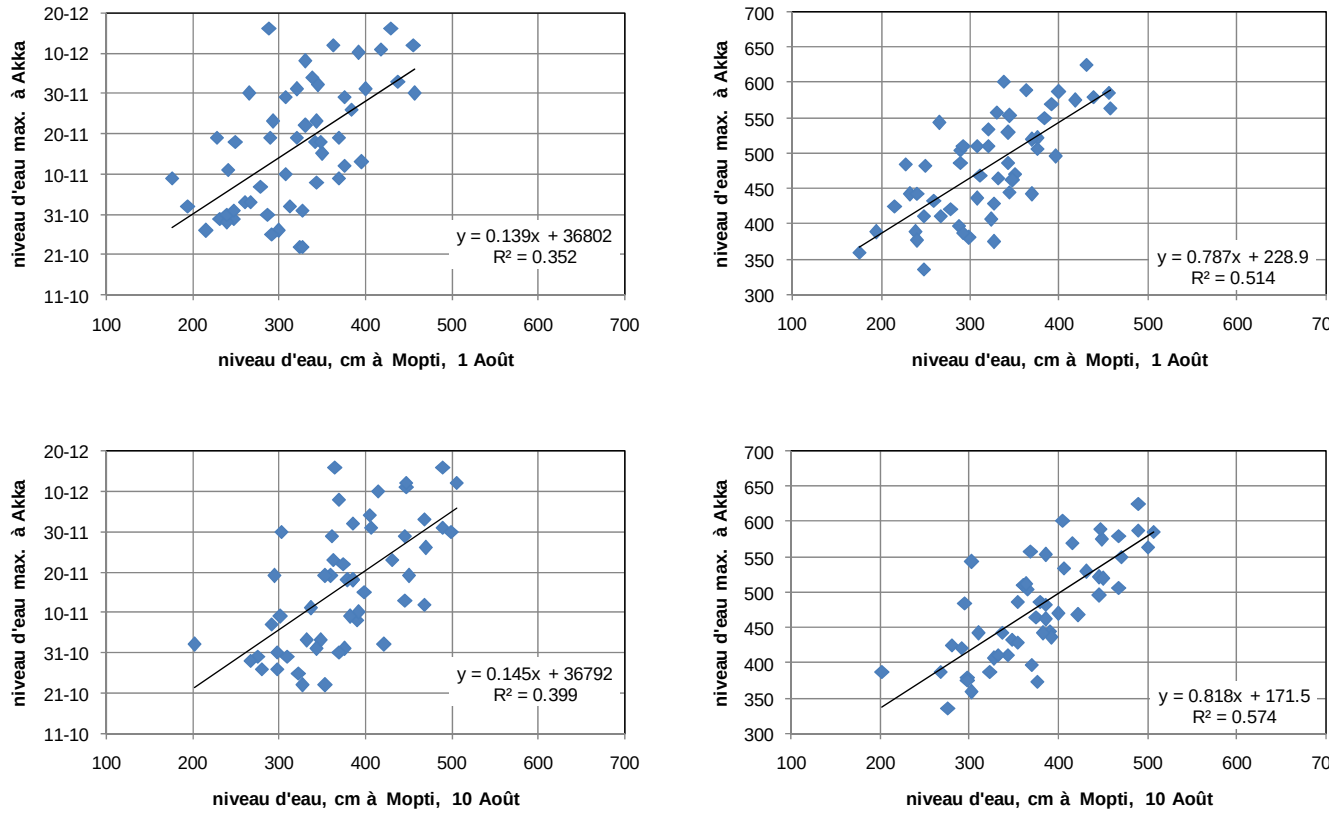
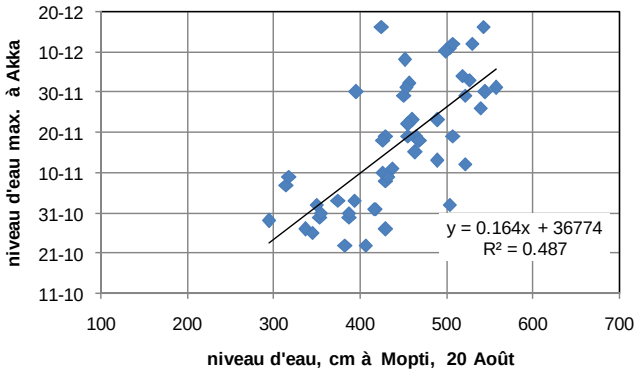


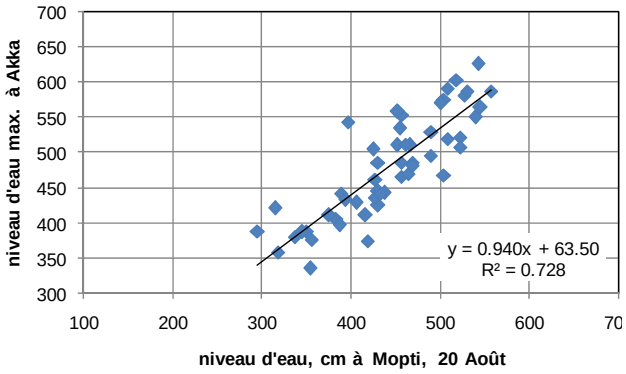
Fig.7. *The relationship between water level in Akka at a certain date and the date at which the maximum flood level is reached in Akka (left). The relationship between water level in Akka at a certain date and the maximum flood level in Akka (right).*

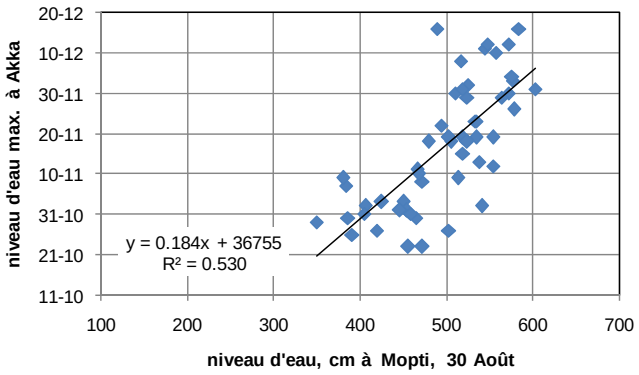
3.3. PEAK FLOOD IN AKKA, BASED ON THE DATA OF MOPTI

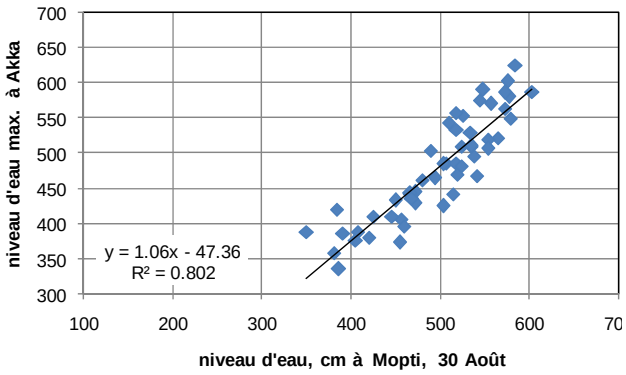
The predicted peak flood at Akka may also be derived from the measured water level in Mopti (Fig. 8). A comparison with Fig. 7 reveals that the predictions derived from the water levels in Mopti are better than the predictions based on the water levels in Akka

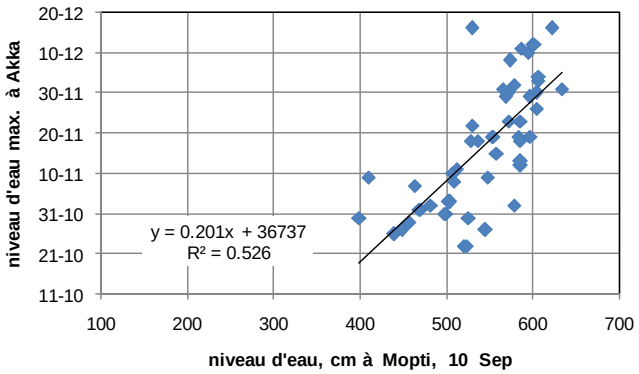


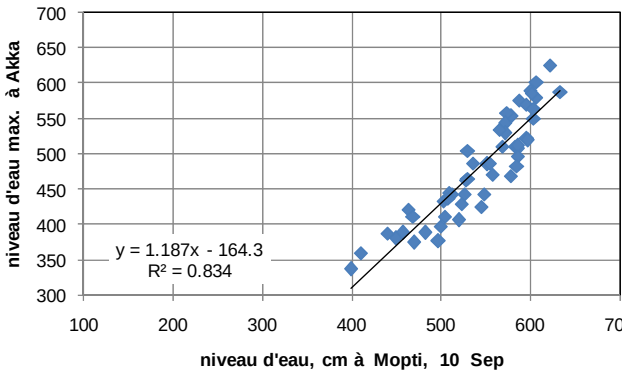

niveau d'eau max. à Akka
20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
100
200
300
400
500
600
700
y = 0.164x + 36774
R² = 0.487
niveau d'eau, cm à Mopti, 20 Août

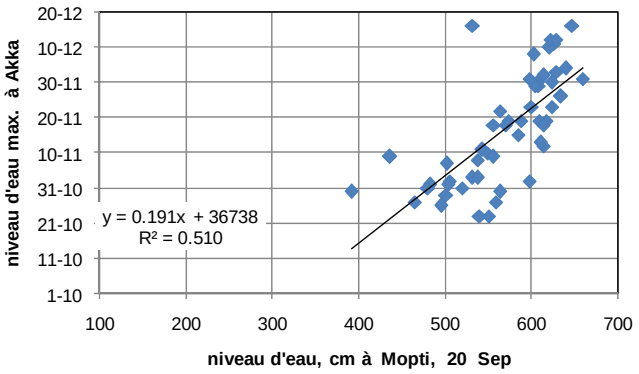

niveau d'eau max. à Akka
700
650
600
550
500
450
400
350
300
100
200
300
400
500
600
y = 0.940x + 63.50
R² = 0.728
niveau d'eau, cm à Mopti, 20 Août

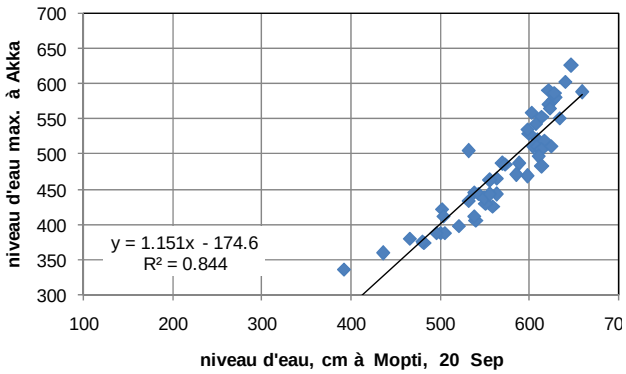

niveau d'eau max. à Akka
20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
100
200
300
400
500
600
700
y = 0.184x + 36755
R² = 0.530
niveau d'eau, cm à Mopti, 30 Août


niveau d'eau max. à Akka
700
650
600
550
500
450
400
350
300
100
200
300
400
500
600
y = 1.06x - 47.36
R² = 0.802
niveau d'eau, cm à Mopti, 30 Août


niveau d'eau max. à Akka
20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
100
200
300
400
500
600
700
y = 0.201x + 36737
R² = 0.526
niveau d'eau, cm à Mopti, 10 Sep


niveau d'eau max. à Akka
700
650
600
550
500
450
400
350
300
100
200
300
400
500
600
y = 1.187x - 164.3
R² = 0.834
niveau d'eau, cm à Mopti, 10 Sep


niveau d'eau max. à Akka
20-12
10-12
30-11
20-11
10-11
31-10
21-10
11-10
1-10
100
200
300
400
500
600
700
y = 0.191x + 36738
R² = 0.510
niveau d'eau, cm à Mopti, 20 Sep


niveau d'eau max. à Akka
700
650
600
550
500
450
400
350
300
100
200
300
400
500
600
y = 1.151x - 174.6
R² = 0.844
niveau d'eau, cm à Mopti, 20 Sep

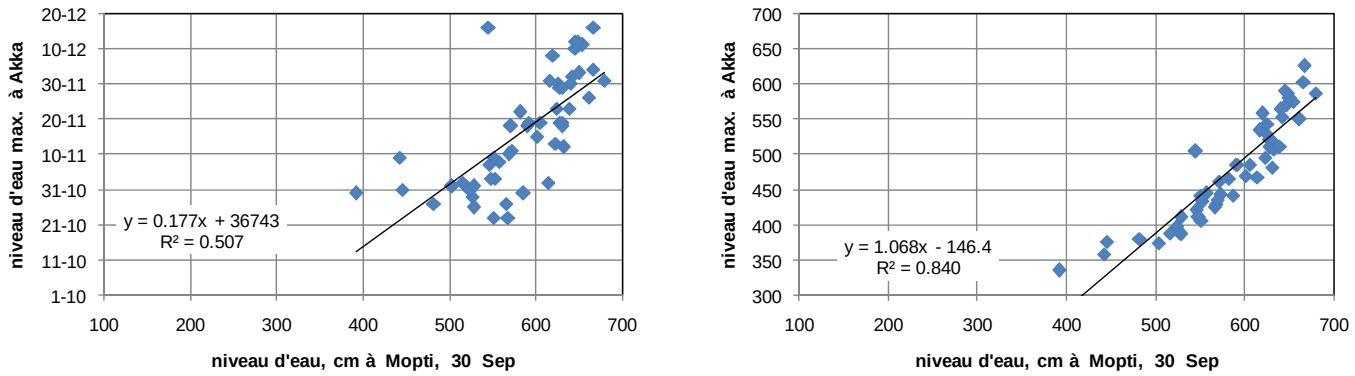


Fig.8. *The relationship between water level in Mopti at a certain date and the date at which the maximum flood level is reached in Akka (left). The relationship between water level in Mopti at a certain date and the maximum flood level in Akka (right).*

The peak flood level may be predicted some months in advance. Using the same methodology, it is also possible to predict the curve during the deflooding, and thus also to predict when floodplains will become accessible for grazing cattle during receding water.

4. TABLES WITH PREDICTED PEAK FLOOD LEVELS

The next three tables give the predicted dates and levels when the flood reaches its peak, such as taken from the regression equations in Figs. 6, 7 and 8. Thus, when the water level in Mopti is 180 cm on 1 August, the prediction is that the water level will reach a peak at 9 October and amounts to 516 cm. When the water level in Mopti is still 180 cm on 10 August, the prediction shifts forward to 4 October and downwards to 465 cm. No prediction is given for a water level of 180 cm at 20 August, and later, because the water level has always be higher than 180 cm on 20 August since the measurements started in 1956.

The tables may be used to find an interpolated value. Thus, if one has read a water level of 180 cm on the scale at Mopti on 5 Aug, the predicted peak will be reached halfway between 9 and 4 October and the peak level halfway between 516 and 465 cm. In the same way, the value may be interpolated if the water level is between 180 and 190 cm.

One should, however, take into account that the predictions given in the table, certainly for (early) August, are not accurate. The scattering around the regressions shown in Figs. 6-8 gives an impression of the error of estimate.

The flooding in the northern Delta is delayed by two months due to the shallow northward slope of the floodplains. As a consequence, the measured flood levels in the southern Delta in September may be used to predict the peak flood level in the northern Delta (usually in December or January).

MOPTI	crue maximal: date à Mopti							crue maximal: niveau d'eau à Mopti						
Cm	1-8	10-8	20-8	30-8	10-9	20-9	30-9	1-8	10-8	20-8	30-8	10-9	20-9	30-9
180	9-10	4-10						516	465					
190	10-10	5-10						523	472					
200	11-10	6-10						530	480					
210	12-10	7-10						537	487					
220	13-10	8-10						544	495					
230	13-10	8-10						551	503					
240	14-10	9-10						558	510					
250	15-10	10-10						565	518					
260	16-10	11-10						572	525					
270	17-10	12-10						579	533					
280	18-10	13-10						586	541					
290	19-10	14-10	6-10					594	548	462				
300	20-10	15-10	7-10					601	556	470				
310	21-10	16-10	8-10					608	563	478				
320	22-10	17-10	9-10					615	571	487				
330	23-10	18-10	10-10					622	578	495				
340	23-10	18-10	11-10					629	586	503				
350	24-10	19-10	12-10	4-10				636	594	512	464			
360	25-10	20-10	13-10	5-10				643	601	520	474			
370	26-10	21-10	14-10	6-10				650	609	529	484			
380	27-10	22-10	15-10	7-10	30-9	29-9	29-9	657	616	537	494	424	396	391
390	28-10	23-10	16-10	8-10	1-10	30-9	30-9	664	624	545	504	436	408	402
400	29-10	24-10	18-10	10-10	3-10	2-10	1-10	672	632	554	515	447	419	413
410	30-10	25-10	19-10	11-10	4-10	3-10	2-10	679	639	562	525	459	431	424
420	31-10	26-10	20-10	12-10	5-10	4-10	3-10	686	647	571	535	471	442	435
430	1-11	27-10	21-10	13-10	6-10	5-10	4-10	693	654	579	545	482	454	445
440	2-11	28-10	22-10	15-10	8-10	6-10	5-10	700	662	587	555	494	465	456
450	2-11	28-10	23-10	16-10	9-10	8-10	6-10	707	669	596	566	506	477	467
460	3-11	29-10	24-10	17-10	10-10	9-10	8-10	714	677	604	576	517	489	478
470	4-11	30-10	25-10	18-10	12-10	10-10	9-10	721	685	613	586	529	500	489
480	5-11	31-10	26-10	20-10	13-10	11-10	10-10	728	692	621	596	541	512	499
490	6-11	1-11	27-10	21-10	14-10	12-10	11-10	735	700	629	606	552	523	510
500	7-11	2-11	28-10	22-10	16-10	14-10	12-10	742	707	638	617	564	535	521
510		3-11	29-10	23-10	17-10	15-10	13-10		715	646	627	576	546	532
520		4-11	30-10	24-10	18-10	16-10	14-10		722	654	637	587	558	543
530			31-10	26-10	19-10	17-10	15-10			663	647	599	569	553
540			1-11	27-10	21-10	18-10	16-10			671	657	611	581	564
550			2-11	28-10	22-10	20-10	18-10			680	668	622	592	575
560			3-11	29-10	23-10	21-10	19-10			688	678	634	604	586
570			4-11	31-10	25-10	22-10	20-10			696	688	646	616	597
580				1-11	26-10	23-10	21-10				698	657	627	607
590				2-11	27-10	24-10	22-10				708	669	639	618
600				3-11	29-10	26-10	23-10				719	681	650	629
610				5-11	30-10	27-10	24-10				729	693	662	640
620					31-10	28-10	25-10					704	673	651
630					1-11	29-10	26-10					716	685	661
640					3-11	30-10	28-10					728	696	672
650					4-11	1-11	29-10					739	708	683
660						2-11	30-10						720	694
670						3-11	31-10						731	705
680							1-11							715
690							2-11							726
700							3-11							737

AKKA	crue maximal: date à Akka							crue maximal: niveau d'eau à Akka						
Cm	1-8	10-8	20-8	30-8	10-9	20-9	30-9	1-8	10-8	20-8	30-8	10-9	20-9	30-9
50	2-11							399						
60	3-11							406						
70	4-11							413						
80	6-11	27-10						420	368					
90	7-11	28-10						428	377					
100	9-11	30-10						435	385					
110	10-11	1-11						442	394					
120	11-11	2-11						450	403					
130	13-11	4-11						457	412					
140	14-11	6-11						464	421					
150	16-11	7-11	25-10					471	429	353				
160	17-11	9-11	27-10					479	438	364				
170	18-11	11-11	29-10					486	447	376				
180	20-11	12-11	31-10					493	456	387				
190	21-11	14-11	2-11	19-10				501	465	399	324			
200	23-11	16-11	5-11	22-10				508	473	411	337			
210	24-11	17-11	7-11	24-10				515	482	422	350			
220	25-11	19-11	9-11	27-10	14-10			522	491	434	364	287		
230	27-11	20-11	11-11	29-10	17-10			530	500	445	377	302		
240	28-11	22-11	13-11	1-11	20-10			537	508	457	391	317		
250	30-11	24-11	15-11	3-11	22-10	13-10		544	517	468	404	332	277	
260	1-12	25-11	17-11	5-11	25-10	15-10		551	526	480	417	347	293	
270	2-12	27-11	19-11	8-11	28-10	18-10		559	535	491	431	362	309	
280	4-12	29-11	21-11	10-11	30-10	21-10	14-10	566	544	503	444	377	324	267
290	5-12	30-11	23-11	13-11	2-11	24-10	17-10	573	552	514	458	393	340	282
300	7-12	2-12	26-11	15-11	5-11	26-10	20-10	581	561	526	471	408	356	297
310		4-12	28-11	18-11	7-11	29-10	22-10		570	537	484	423	372	312
320		5-12	30-11	20-11	10-11	1-11	25-10		579	549	498	438	387	328
330		7-12	2-12	22-11	13-11	4-11	28-10		588	560	511	453	403	343
340			4-12	25-11	15-11	6-11	31-10			572	525	468	419	358
350			6-12	27-11	18-11	9-11	2-11			583	538	483	435	374
360			8-12	30-11	21-11	12-11	5-11			595	551	498	450	389
370			10-12	2-12	23-11	15-11	8-11			607	565	513	466	404
380				4-12	26-11	17-11	11-11				578	528	482	419
390				7-12	29-11	20-11	13-11				592	543	497	435
400				9-12	1-12	23-11	16-11				605	559	513	450
410				12-12	4-12	25-11	19-11				618	574	529	465
420					7-12	28-11	22-11					589	545	481
430					9-12	1-12	24-11					604	560	496
440						4-12	27-11						576	511
450						6-12	30-11						592	526
460						9-12	3-12						608	542
470						12-12	5-12						623	557
480						15-12	8-12						639	572
490						17-12	11-12						655	588
500							14-12							603

MOPTI	crue maximal: date à Akka							crue maximal: niveau d'eau à Akka						
Cm	1-8	10-8	20-8	30-8	10-9	20-9	30-9	1-8	10-8	20-8	30-8	10-9	20-9	30-9
180	29-10	20-10						371	319					
190	30-10	21-10						378	327					
200	31-10	23-10						386	335					
210	2-11	24-10						394	343					
220	3-11	25-10						402	351					
230	4-11	27-10						410	360					
240	6-11	28-10						418	368					
250	7-11	30-10						426	376					
260	9-11	31-10						434	384					
270	10-11	2-11						441	392					
280	11-11	3-11						449	401					
290	13-11	5-11	23-10					457	409	336				
300	14-11	6-11	25-10					465	417	346				
310	16-11	7-11	26-10					473	425	355				
320	17-11	9-11	28-10					481	433	364				
330	18-11	10-11	30-10					489	441	374				
340	20-11	12-11	31-10					496	450	383				
350	21-11	13-11	2-11	21-10				504	458	393	418			
360	23-11	15-11	4-11	23-10				512	466	402	429			
370	24-11	16-11	5-11	25-10				520	474	411	440			
380	25-11	18-11	7-11	26-10	31-7	12-10	12-10	528	482	421	450	287	263	259
390	27-11	19-11	8-11	28-10	31-7	14-10	14-10	536	491	430	461	299	274	270
400	28-11	21-11	10-11	30-10	31-7	16-10	15-10	544	499	440	471	311	286	281
410	29-11	22-11	12-11	1-11	31-7	18-10	17-10	552	507	449	482	322	297	291
420	1-12	23-11	13-11	3-11	31-7	20-10	19-10	559	515	458	493	334	309	302
430	2-12	25-11	15-11	5-11	31-7	22-10	21-10	567	523	468	503	346	320	313
440	4-12	26-11	17-11	6-11	31-7	24-10	22-10	575	531	477	514	358	332	324
450	5-12	28-11	18-11	8-11	31-7	25-10	24-10	583	540	487	524	370	343	334
460	6-12	29-11	20-11	10-11	31-7	27-10	26-10	591	548	496	535	382	355	345
470	8-12	1-12	22-11	12-11	31-7	29-10	28-10	599	556	505	546	394	366	356
480	9-12	2-12	23-11	14-11	31-7	31-10	29-10	607	564	515	556	405	378	366
490	11-12	4-12	25-11	16-11	31-7	2-11	31-10	615	572	524	567	417	389	377
500	12-12	5-12	27-11	18-11	31-7	4-11	2-11	622	581	534	577	429	401	388
510		6-12	28-11	19-11	31-7	6-11	4-11		589	543	588	441	412	398
520		8-12	30-11	21-11	31-7	8-11	6-11		597	552	599	453	424	409
530			1-12	23-11	31-7	10-11	7-11			562	609	465	435	420
540			3-12	25-11	31-7	12-11	9-11			571	620	477	447	430
550			5-12	27-11	31-7	14-11	11-11			581	630	489	458	441
560			6-12	29-11	31-7	15-11	13-11			590	641	500	470	452
570			8-12	30-11	31-7	17-11	14-11			599	652	512	481	462
580				2-12	31-7	19-11	16-11				662	524	493	473
590				4-12	31-7	21-11	18-11				673	536	504	484
600				6-12	31-7	23-11	20-11				683	548	516	494
610				8-12	31-7	25-11	21-11				694	560	528	505
620					31-7	27-11	23-11					572	539	516
630					31-7	29-11	25-11					584	551	526
640					31-7	1-12	27-11					595	562	537
650					31-7	3-12	29-11					607	574	548
660						5-12	30-11						585	558
670						6-12	2-12						597	569
680							4-12							580
690							6-12							591
700							7-12							601