

2030



- Le Système DORIS actuel
- Les enjeux de la mission GRASP
  - quel instrument DORIS pour GRASP ?
  - quelle horloge pour GRASP ?

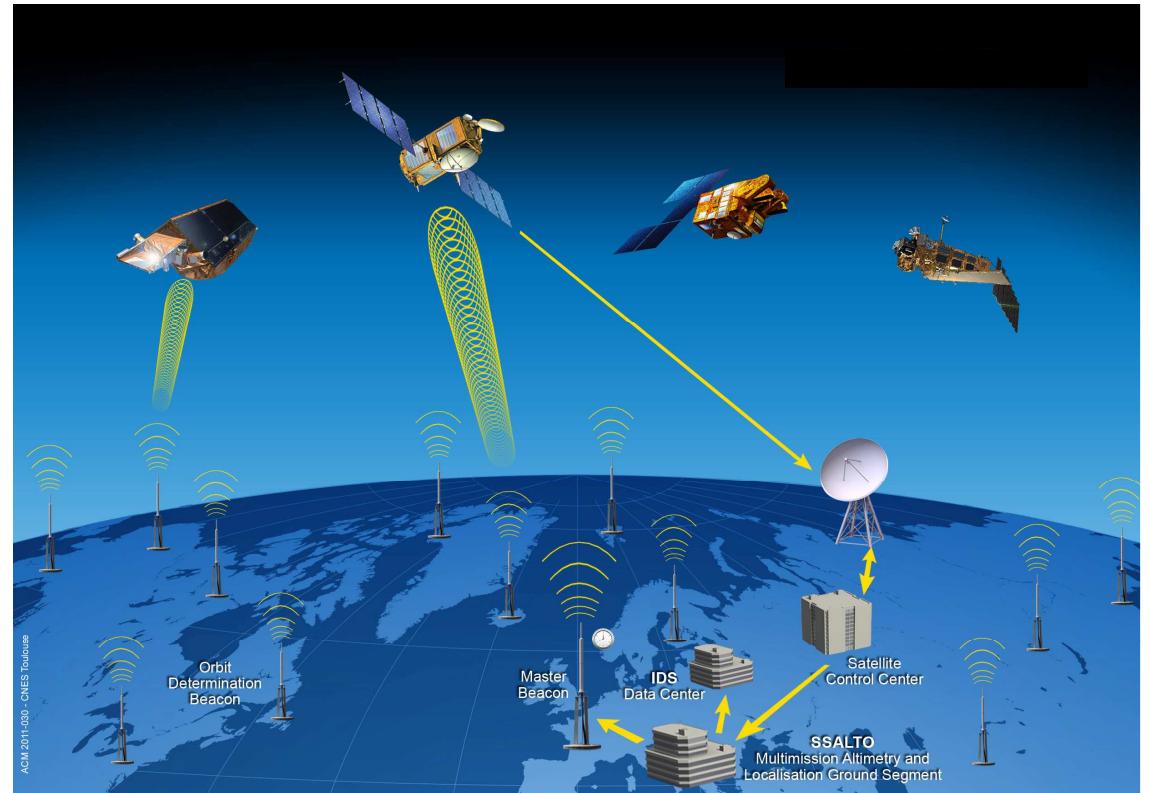


A. Auriol & DORIS Team 23/10/2014

# THE DORIS SYSTEM

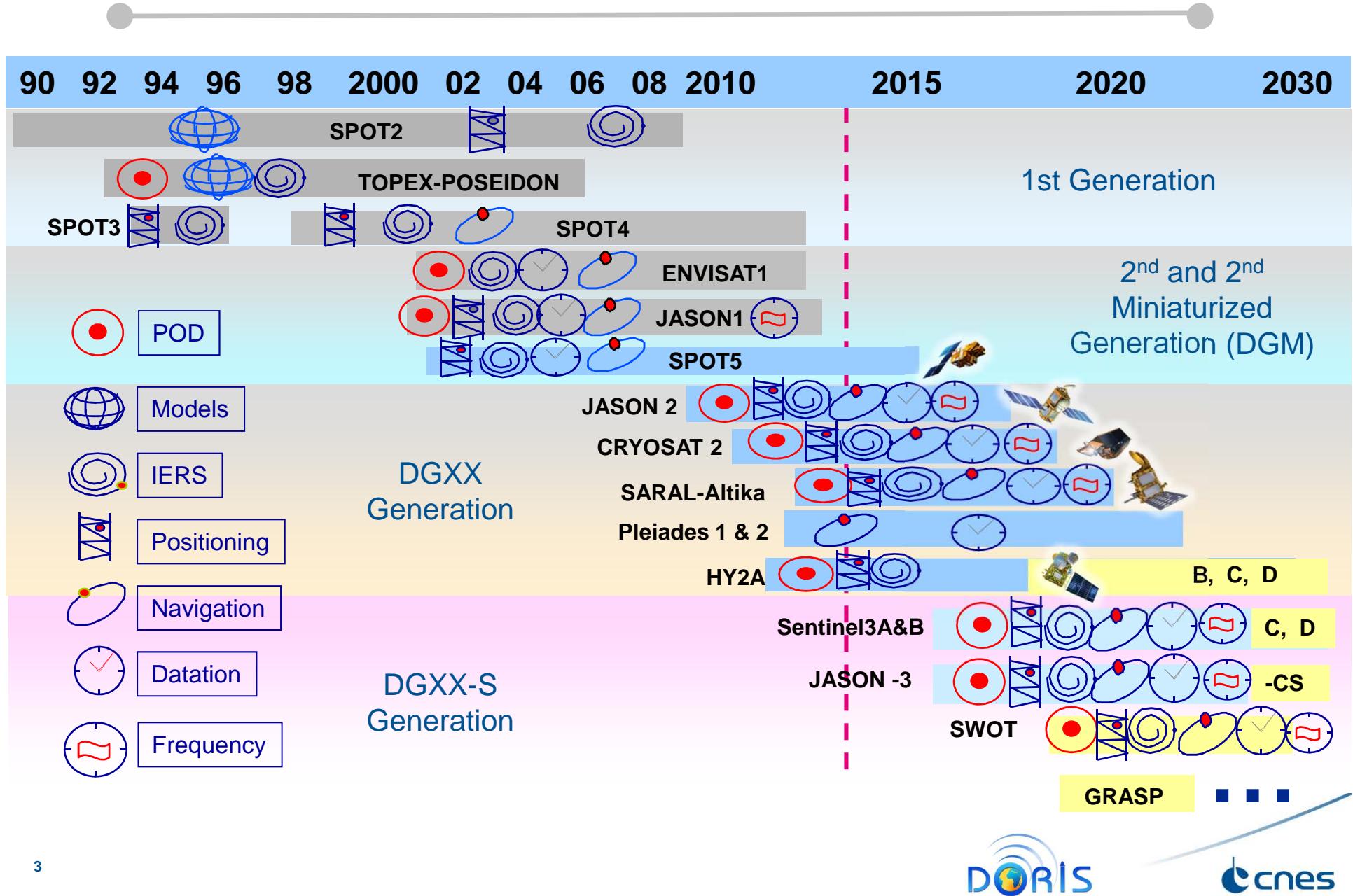
- Designed in early eighties for precise orbit determination of ocean altimetry missions

- Based on Doppler shifts measurements of RF signals transmitted by a world wide beacons network (one way thanks to stability of on board and beacons USOs)



- There is no limitation for the number of satellites carrying DORIS receivers

# THE DORIS Missions



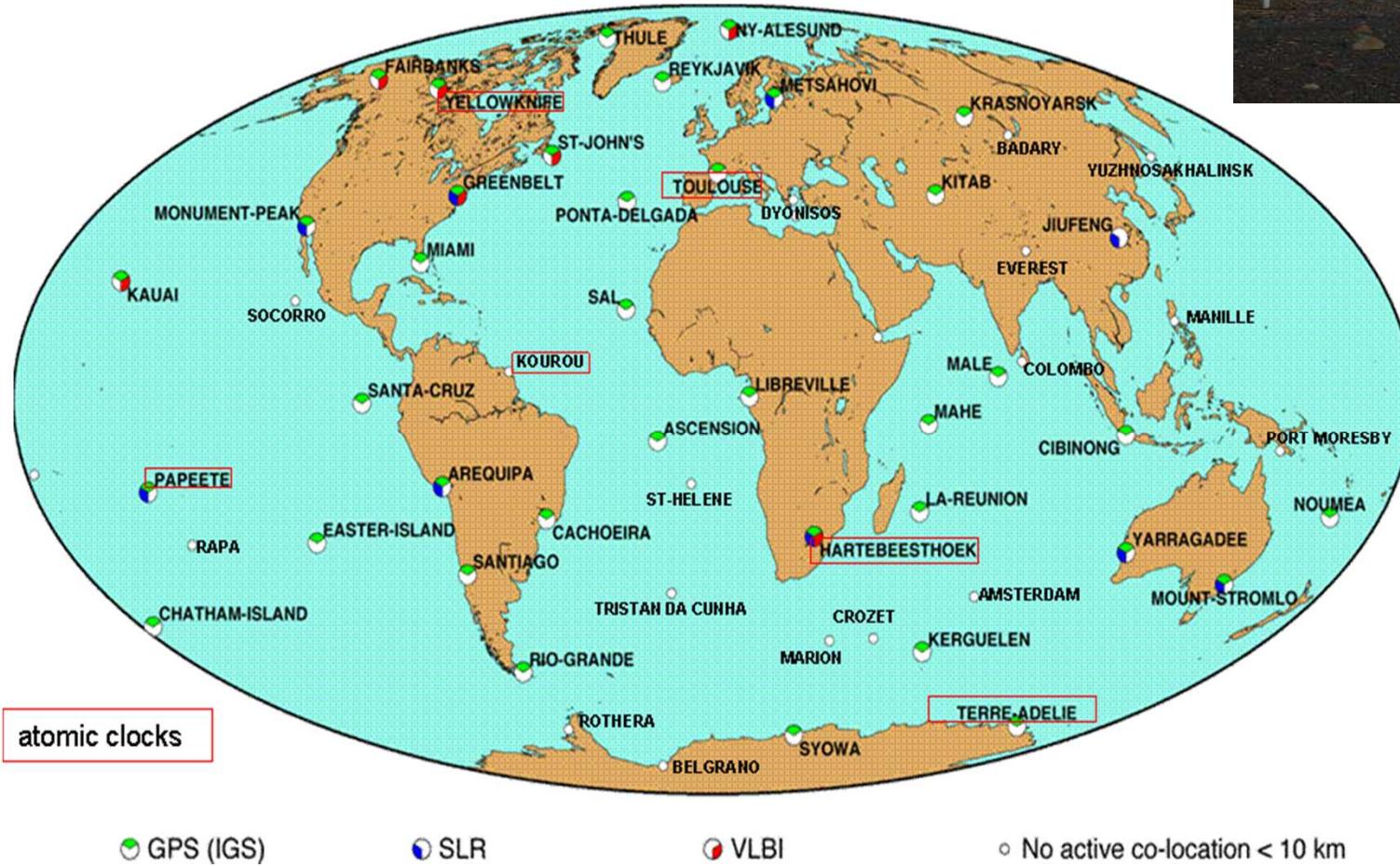
# DORIS : one of the four geodetic techniques

	GNSS	SLR	VLBI	DORIS
Network density / homogeneity	😊	😢	😢	😊
Equip <sup>nts</sup> /Teams stability	😢			
Short term accuracy	😊	😊	😊	😢
Long term series	😢			😊
Calibration / Biases / ref. point	😢 Some missing	😢 Datation Ref. point	😢 Datation Ref. point	😐 Ref. point On going

At centimetre level or less, no technique can give alone the true position.  
 Permanent intercomparisons between different techniques are essential  
 to track down the truth in the midst of biases and noise (RZ)

<u>The best technique for :</u>			
Earth pole motion	😊		
ITRF centre / scale		😊	
Universal Time			😊
Long term phenomena			😊

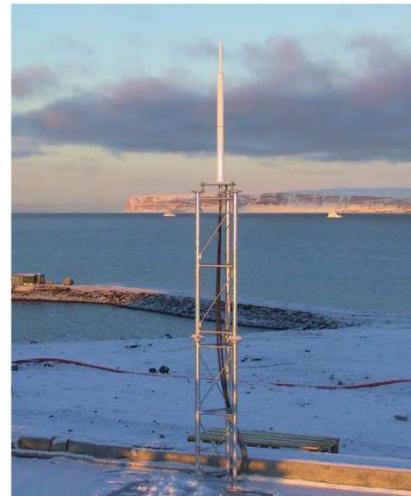
# DORIS Network



# Network maintenance

- DORIS stations are currently revisited to improve the antenna stability

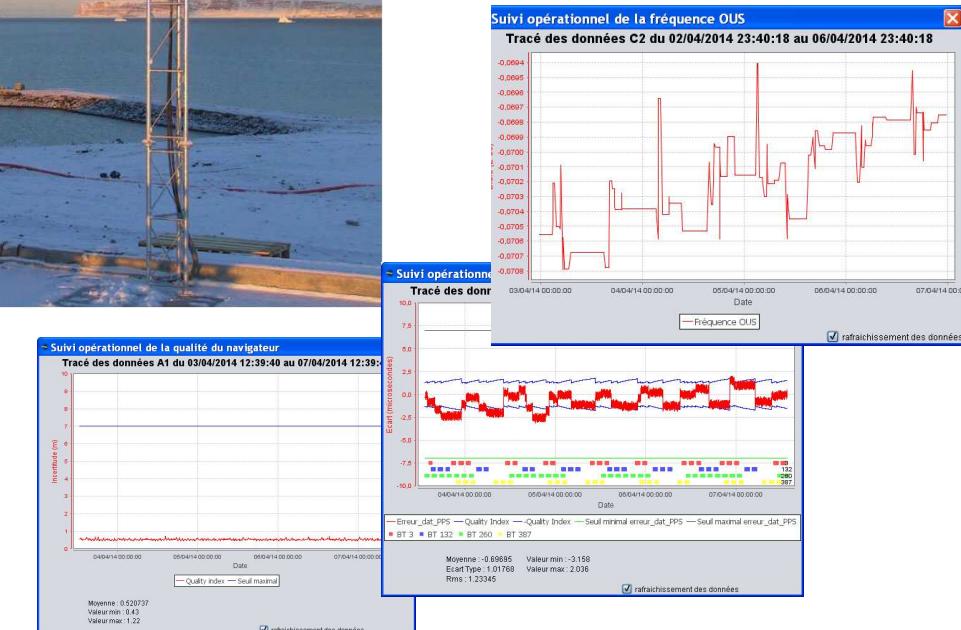
⇒ Centimeter level located tracking network  
⇒ toward millimeter level ?



- CNES DORIS Integrity Team (SALP)

- Monitors permanently the DORIS signal transmitted in space,
- Controls its characteristics,
- Investigates non nominal situations
- Takes corrective actions if needed

- The DORIS beacons are currently remote controlled via the Iridium system



DORIS

cnes

# Current DORIS dual frequency Instrument (DGXX-S)



**BDR**  
**(Redundant DORIS Box)**

2 chains of **7** dual-frequency channels receivers and 1 USO in cold redundancy

Automatic RF antenna switching on active receiver

400 x 370 x 180 (mm) ; 18kg ; 23W

Large autonomy : **Switch On and let it work**

10 MHz distribution for other users with X-isolation

Real time precise positioning / terrestrial or inertial frame  
capacity to provide a pps time tagged in TAI

**Antenna**  
Dual frequency ;  
Hemispherical radiation ;  
h 420mm x f160mm ; 2Kg



# Les enjeux de la mission GRASP

## ➤ Localisation millimétrique : un vrai défi

### ➤ datation des mesures DORIS:

Actuellement  $1\mu\text{s} \Leftrightarrow 7\text{mm}$

=>  $<100\text{ns} (\Leftrightarrow 0,7\text{mm})$  par mesure de phase tri fréquence

### ➤ bruit de l'instrumentation

Actuellement  $\sim 3\text{ mm}$  (dominé par CT,MT OUS)

- Filtrage
- OUS => Maser ?

### ➤ points de référence

#### ➤ centre de phase antenne bord / Centre gravité satellite : plusieurs mm

- Expertise antenne bord/BCMA + interaction ant./structure satellite (carte de correction de phase)
- Maîtrise du CdG SL (ballotage ergols)

#### ➤ centre de phase antenne sol / référence géodésique locale ; act. $\sim 1\text{cm}$

- Meilleure caractérisation antenne (centre de phase, correction de phase) et amélioration des dispositifs d'aide au rattachement (cf. prés. IDS) =>  $< 4\text{mm}$
- Prise en compte environnement : à faire

# Quel instrument DORIS pour GRASP ?

## ➤ Série DGXX-S :

- Obsolescence composants
- Tenue aux radiations

## ➤ DORIS / GRASP :

- One shot ou premier d'une nouvelle série :
  - Mêmes fonctions/performances que DGXX-S sauf datation améliorée
  - plus compact : 5kg/chaîne, 20w
  - plus de capacités de traitement
  - Redondance AD / fiab/durée de vie
- Antenne : inchangée



# Quelle horloge pour DORIS sur GRASP ?

## ➤ mini-OUS :

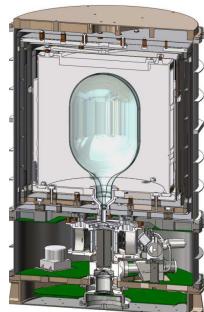
0.6l ; 3w (interne recept. DORIS)

CT, MT :  $\text{qq}10^{-13}$ , LT :  $10^{-11}/\text{j}$

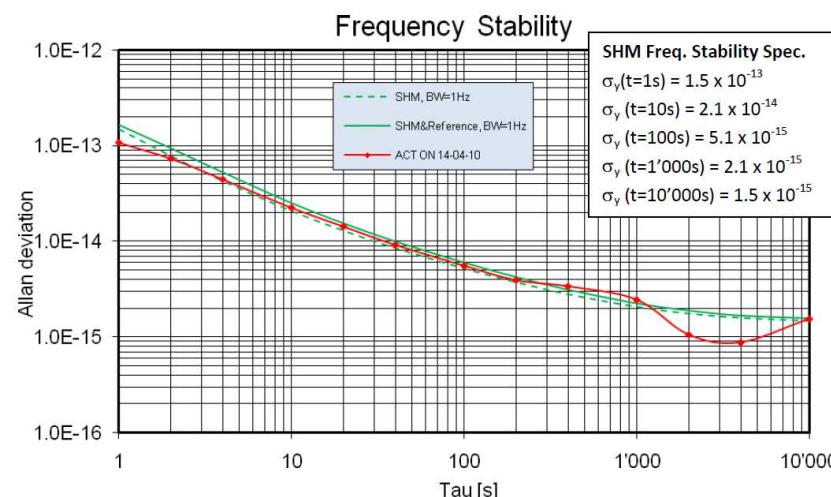


## ➤ horloge atomique :

Maser actif ACES (Spectratime)



## ➤ ! Tenue en radiations



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## ➤ l'instrument DORIS peut accepter une horloge externe et la distribuer à 4 autres utilisateurs





**Merci**

pour votre attention

# Backup slides

# DORIS Ground Antenna Error Budget

Error Type	Error Source	Direction	Max Error	
Manufacturing	2GHz PC centering / radome	Horizontal	$\pm 1\text{mm}$	$\pm 2\text{mm}$
	Alignment ARP/AMP / axis	Horizontal	$\pm 1\text{mm}$	
	2GHz PC position / flange	Vertical	$\pm 1\text{mm}$	$\pm 3\text{mm}$
Characterization	2GHz PC position and associated phase law	Vertical	$\pm 2\text{mm}$	
Survey	Verticality adjustment	Horizontal	$\pm 1\text{mm}$	$\pm 2\text{mm}$
	Local tie survey	Horizontal	$\pm 1\text{mm}$	
	Local tie survey	Vertical	$\pm 1\text{mm}$	$\pm 1\text{mm}$

# Radiative environment TID / alt & i

km / °	0	15	30	45	60	75	90
36000	1062,02	837,09	505,15	369,52	313,98	292,21	291,47
34000	1591,68	1273,07	788,17	548,4	461,56	423,6	411,54
32000	2509,33	2026,37	1248,13	840,76	691,34	627,64	609,29
30000	3858,56	3133,92	1940,93	1282,93	1042,78	938,95	906,6
28000	5783,9	4737,35	2972,89	1942,81	1559,35	1396,68	1348,62
26000	8343,46	6934,36	4425,04	2878,37	2295,66	2047,58	1969,35
24000	11362,21	9632,96	6338,59	4109,87	3246,64	2886,92	2777,21
22000	15777,46	13421,91	8976,2	5846,92	4596,84	4069,04	3912,51
20000	20175,89	17562,4	12104,74	7924,85	6162,78	5451,96	5245,02
18000	24011,77	21454,28	15410,17	10196,69	7836,68	6915,93	6657,84
16000	22585,46	21570,6	16894,15	11385,25	8618,85	7577,93	7284,74
14000	14779,27	16125,29	14741,68	10512,99	7731,49	6744,47	6476,95
12000	6725,73	8552,99	10106,44	8172,61	5779,74	4962,67	4749,26
11000	3269,78	5006,79	7467,25	6662	4626,29	3915,14	3740,56
10000	1724,44	2780,89	5266,56	5325,58	3685,09	3062,75	2913,15
9000	1926,22	2106,92	3818,95	4284,66	3052,35	2495,58	2369,88
8000	3780,52	3120,58	3363,93	3678,61	2839,87	2305,02	2187,22
7000	7953,98	6160,39	4226,75	3880,96	3233,35	2667,89	2540,78
6000	16400,2	12729,73	7344,28	5602,25	4756	4033,64	3860,53
5000	32228,47	24964,25	13978,63	9664,53	8034,36	6967,32	6681,35
4500	43909,04	34171,28	19143,22	12913,86	10625,02	9287,2	8905,32
4000	60984,15	46468,09	26127,29	17374,55	14180,68	12464,9	11957,75
3500	75299,65	58046,68	33198,95	21861,36	17714,66	15633,4	15025,15
3000	79941,44	63062,99	37234,74	24277,23	19491,59	17265,36	16607,48
2500	66696,34	55179,64	34409,08	22134,2	17550,29	15570,3	14956,14
2000	37946,19	33648,06	22851,83	14663,66	11480,94	10153,37	9760,13
1700	20536,29	19050,83	13718,53	8906,63	7001,32	6192,35	5970,18
1500	11730,95	11307,83	8629,75	5682,23	4496	3911,08	3757,43
1400	8370,05	8267	6561,9	4381,07	3379,63	2989,59	2874,24
1300	5699,26	5775,18	4826,08	3284,09	2507,83	2191,91	2087,77
1200	3669,37	3772,93	3396,91	2343,75	1799,89	1574,81	1507,71
1100	2135,46	2283,3	2307,3	1653	1250,18	1128,37	1082,27
1000	1072,35	1292,08	1538,08	1149,1	881,68	789	752,55
900	500,24	706	1016,48	791,03	594,75	542,72	517,83
800	180,39	358,89	653,73	537,49	404,29	375,85	358,89
700	25,82	156,45	389,77	348,51	263,73	252,52	236,77
600	0	49,55	206,88	212,59	162,18	157,88	148,92
500	0	4,53	89,56	115,37	89,64	99,62	92,06

