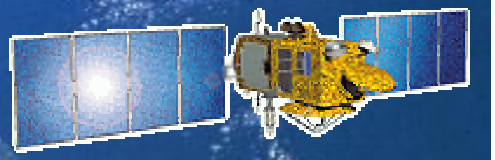


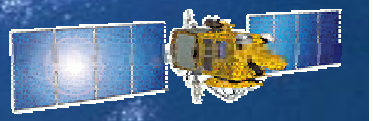
First results of the FTLRS during the 2002 Corsica campaign for the JASON-1 calibration and validation experiment

J. Nicolas ,
P. Bonnefond , P. Exertier , and Ph. Berio

13th International Laser Ranging Workshop
Washington - October 2002

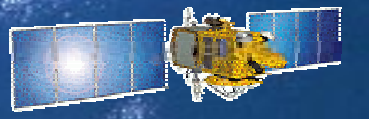
Observatoire de la Côte d'Azur
CERGA
Grasse, France

Overview



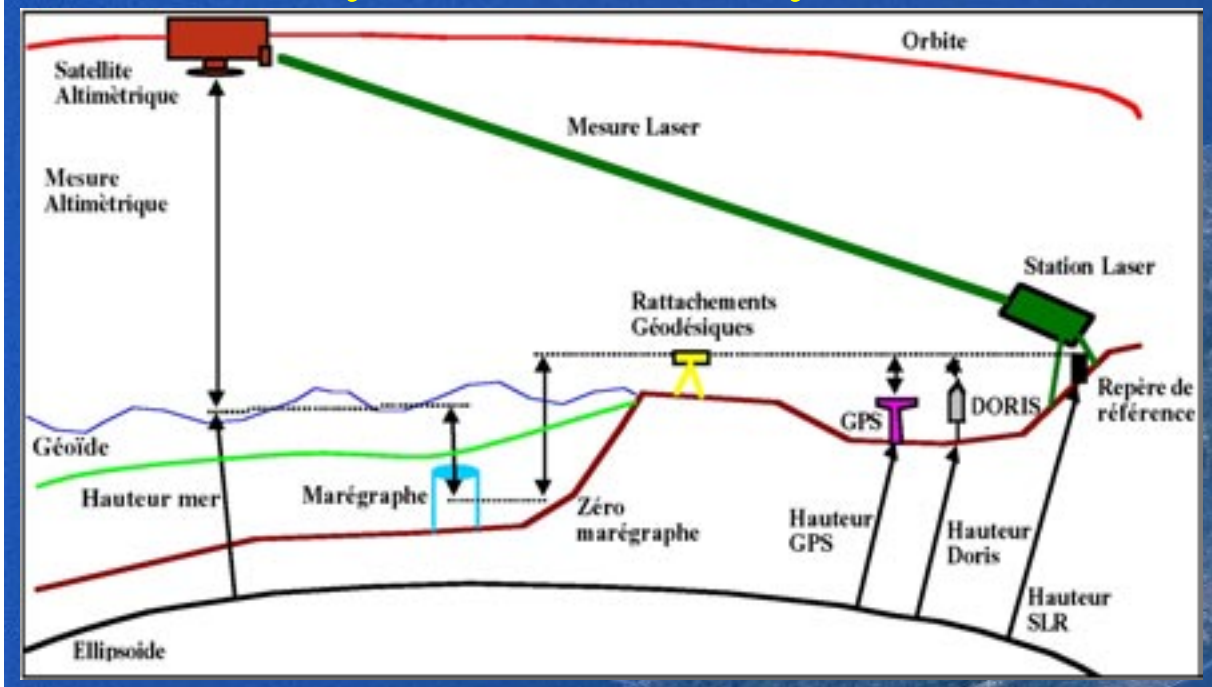
- Introduction
- Corsica Campaign description
  - experiment objectives
  - site presentation
- First results
  - data
  - positioning
  - short arc orbit
- Conclusion and prospects

Introduction



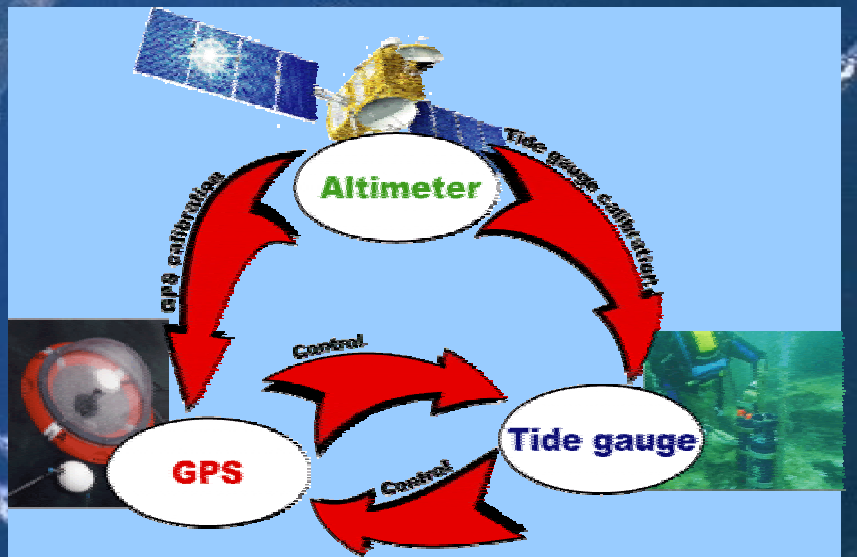
- Monitoring the secular mean sea level variations
  - ⇨ Monitor the vertical reference frame
  - ⇨ Monitor the radar altimeters
- Need of absolute calibration campaigns with
  - precision/accuracy below 10 mm
  - reduced costs and manpower
  - easy to transport/intall equipment
  - studies to be renewed at different places and/or regular time scales
- A good mean: the French Transportable Laser Ranging Station

Experiment presentation

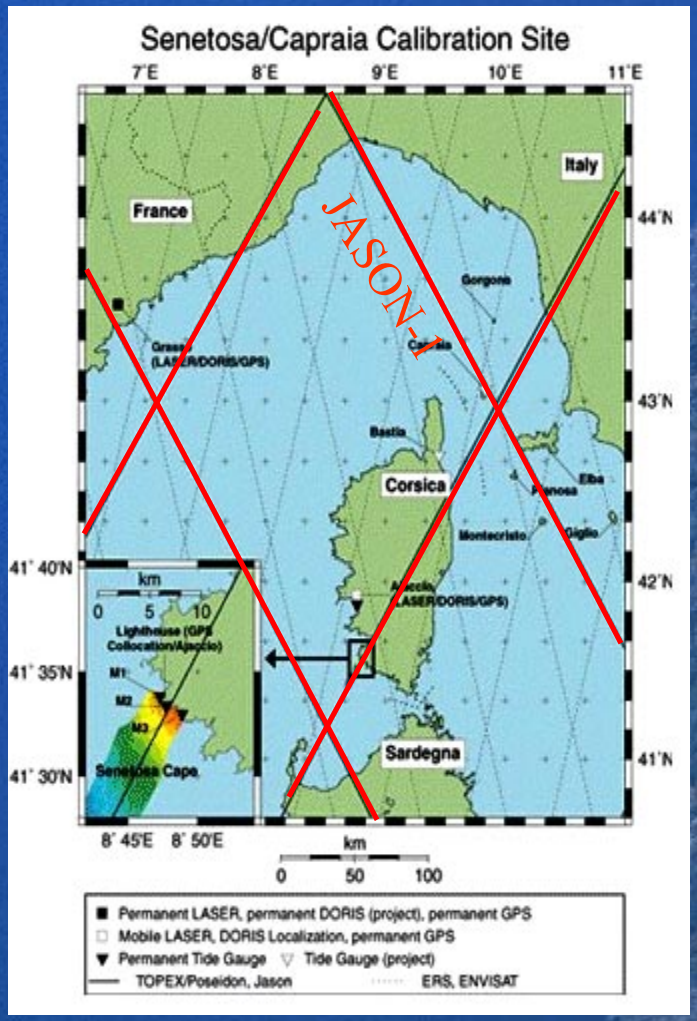


Altimeter calibration = precisely compare
- altimeter data
- satellite altitude above the sea level

⇨ precise orbit
⇨ precise sea level

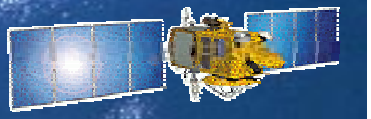


Corsica configuration



- Distance between the FTLRS and the satellite ground tracks
  - T/P and JASON-1 : 25 km
  - ERS and ENVISAT : 5 km west

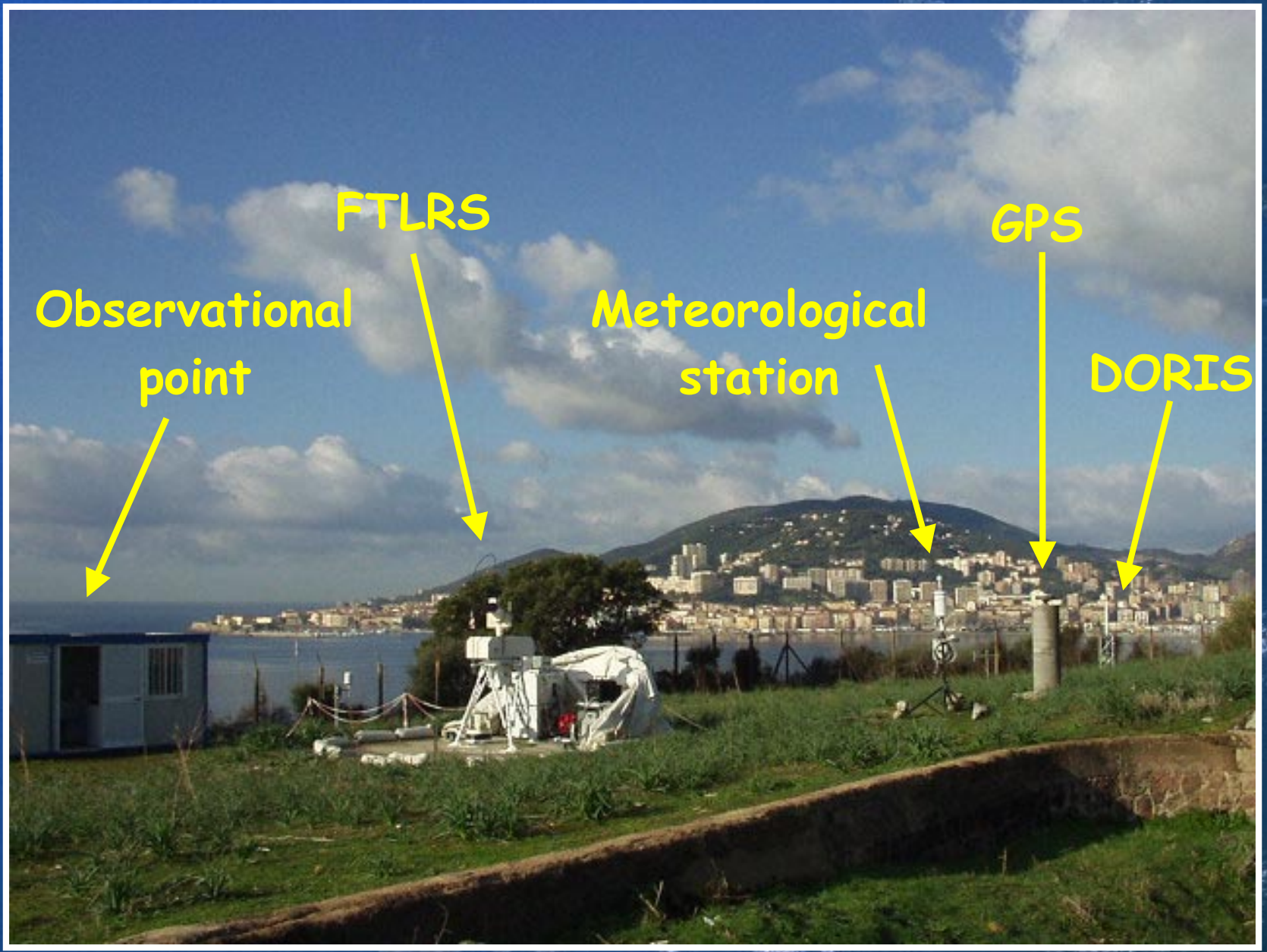
Instrumentation



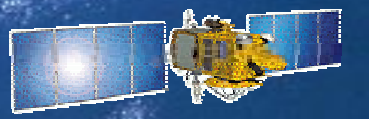
- Ajaccio
  - FTLRS (13/01 - 08/09)
  - permanent GPS receiver
  - DORIS beacon
  - 1 tide gauge
- Senetosa Cape
  - 3 tide gauges
  - GPS receivers and reference points
  - GPS buoys

FTLRS set up

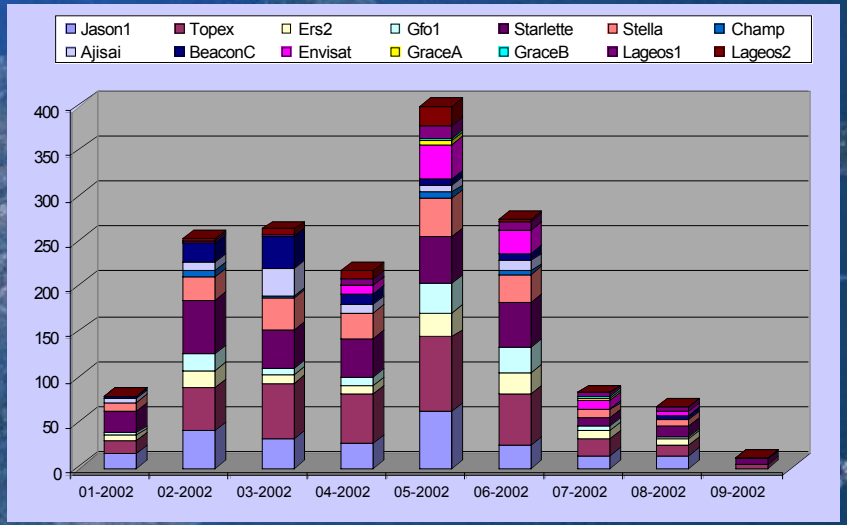
- 2-3 days for set up and tuning
- FTLRS set up in a pliable tent
- observational point in a small mobile home

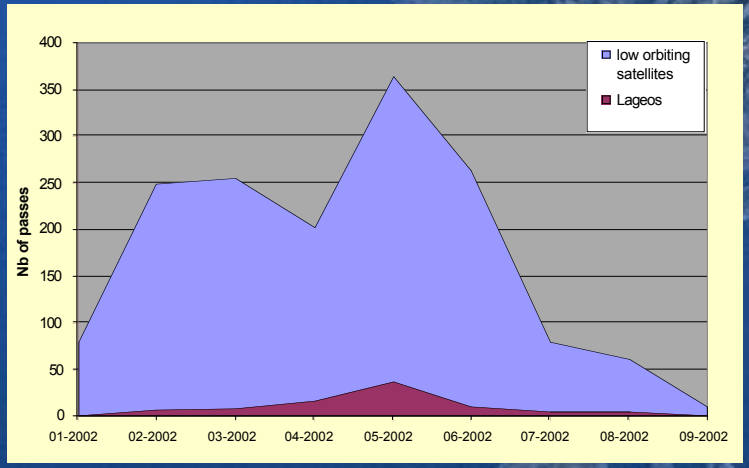

FTLRS
GPS
Observational point
Meteorological station
DORIS

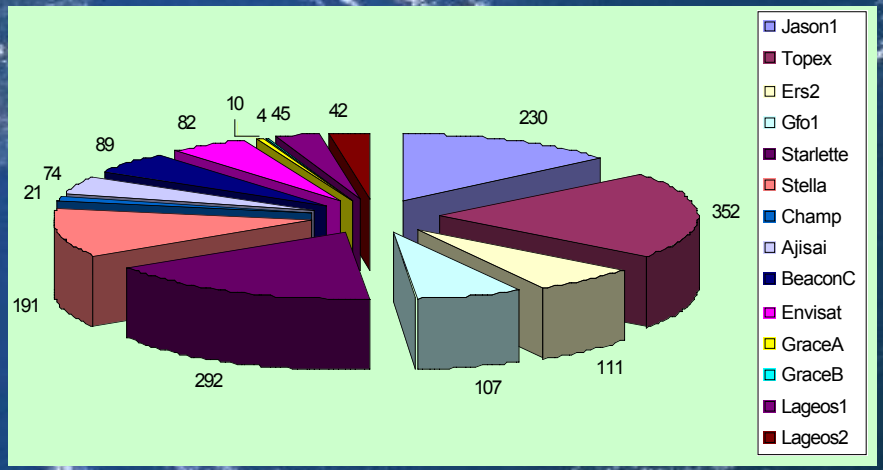
FTLRS observations



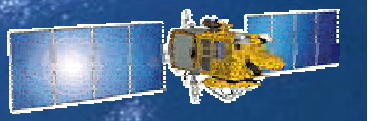
- Total pass number: 1,650
  - LEO: 1,563
  - LAGEOS: 87

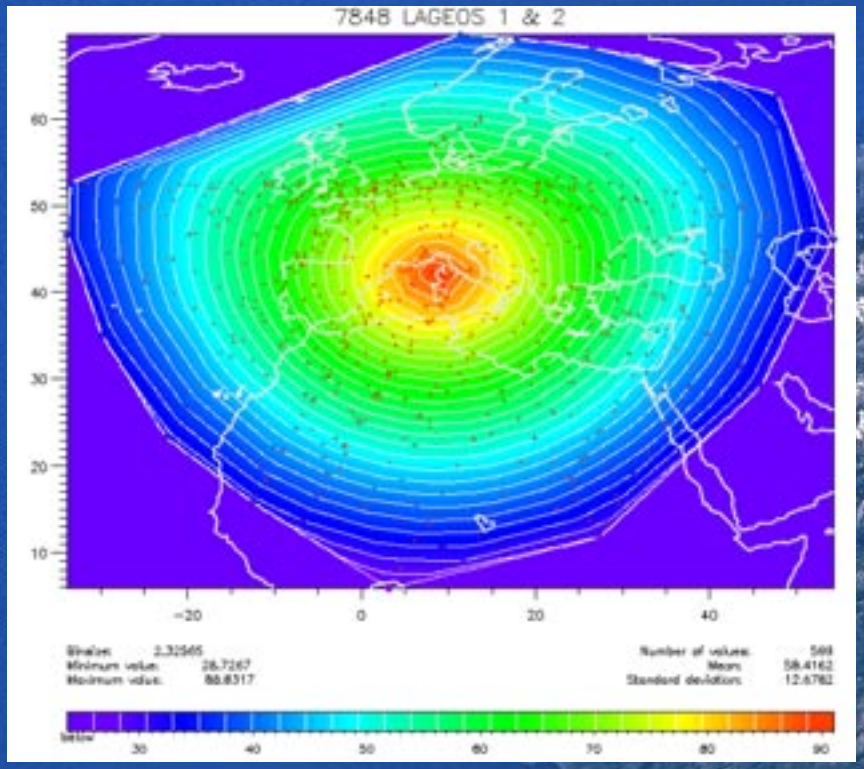


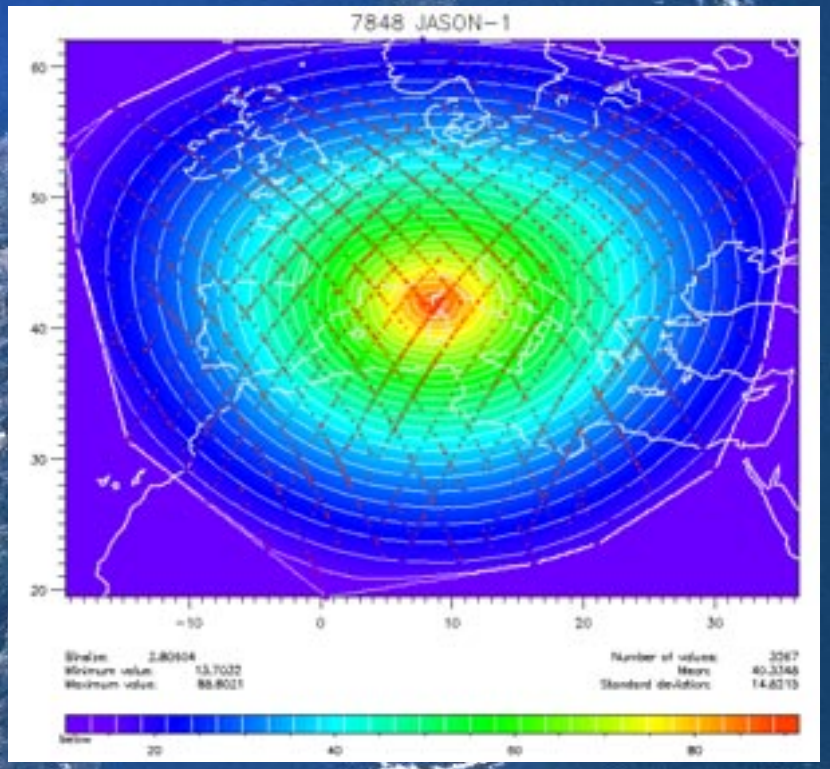


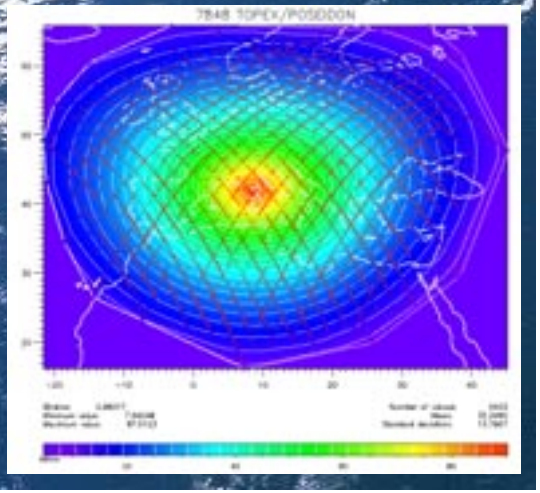


Observation distribution

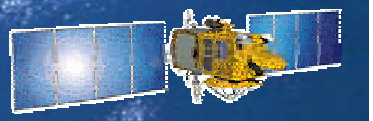








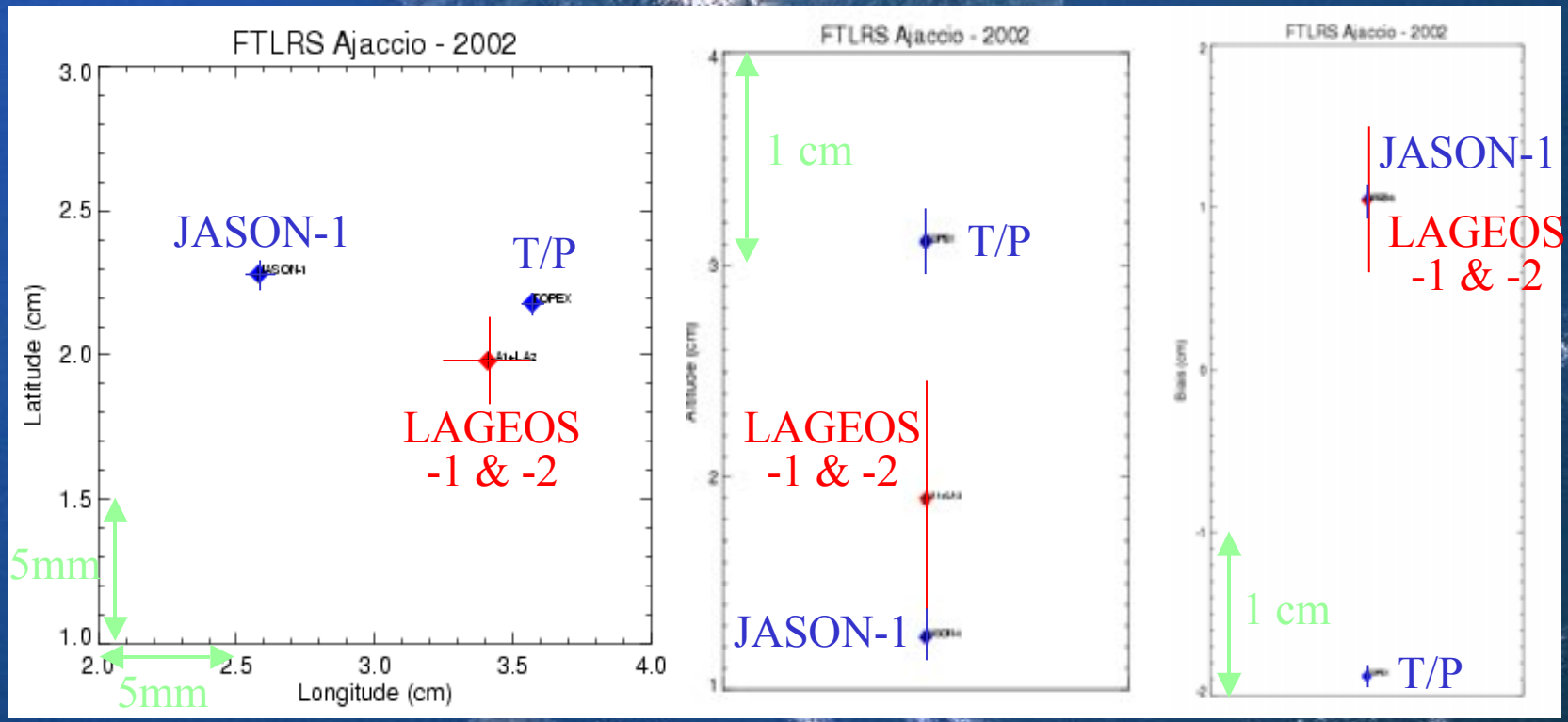
Station positioning



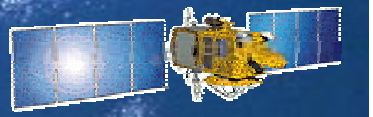
- Station coordinates and range bias computation on the whole campaign
- Reference orbit quality
  - LA 1 & 2 ➔ 2 cm
  - T/P ➔ 2 cm radial, 5-6 cm along and across track
  - JASON-1 ➔ 1 cm radial, 2.7 cm along track, and 3 cm across track
- Comparison of different positioning solutions
  - LAGEOS -1 & -2 (277 NP on LA1 + 323 NP on LA2 = 600 NP)
  - JASON-1 (3,268 NP)
  - TOPEX/POSEIDON (6,411 NP)

FTLRS coordinates and range bias

- Uncertainty on the vertical positioning
  - LA 1 & 2 ➔ 10 mm
  - JASON-1 ➔ 3 mm
- Uncertainty on the range bias
  - LA 1 & 2 ➔ 8 mm
  - JASON-1 ➔ 2 mm

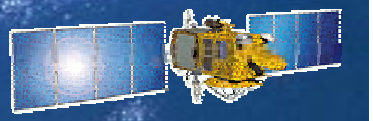


Results



- Remarks on the FTLRS positioning
  - agreement between LA 1 & 2 and JASON-1 vertical coordinate
  - lower determination for JASON-1 solution for the horizontal components (lower orbit quality)
  - agreement between the LA 1 & 2 solution and the recent local ties made by the IGN (Sept. 2002)
- Remarks on the range bias
  - agreement between LA1 & LA2 and JASON-1 solutions
  - problem of the T/P LRA correction ➔ range bias of ~ 2 cm
- Final values
  - coordinates ➔ LA1 & LA2 solution
  - range bias ➔ 1 cm
- FTLRS range bias origin
  - 5 mm found at Grasse during the collocation experiment
  - tuning differences between Grasse and Ajaccio
  - return level differences between LAGEOS and JASON-1
  - calibration target range uncertainty (a few mm)

Orbit validation

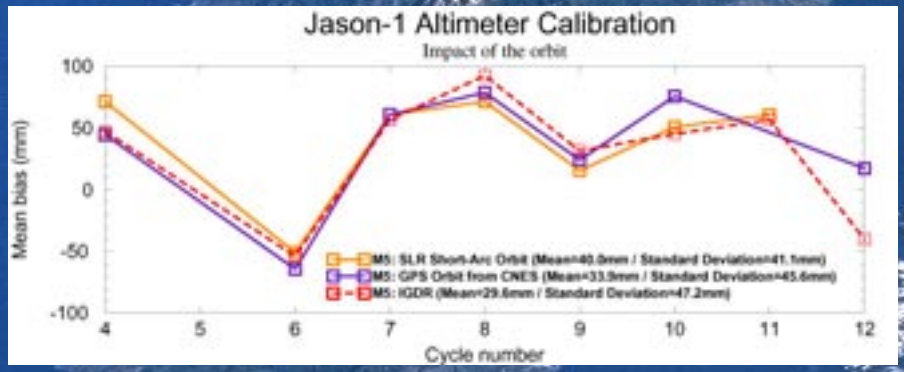


- SLR short-arc orbit (geometrical approach) with FTLRS + European stations
  - validate orbit computed by other institutes (CNES, GSFC, JPL)
  - monitor the orbit quality at the 1 cm level
- method accuracy mainly depends on
  - SLR data quality (measurements and correction)
  - reference frame quality
- Error budget of the method < 1 cm

Results

- Better stability for SLR
- Altimeter bias change up to 10 mm
- Standard deviation notably improved with short-arc orbits (23 mm from root square difference)

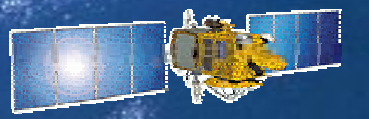
Sea level - altimeter data
with different orbits



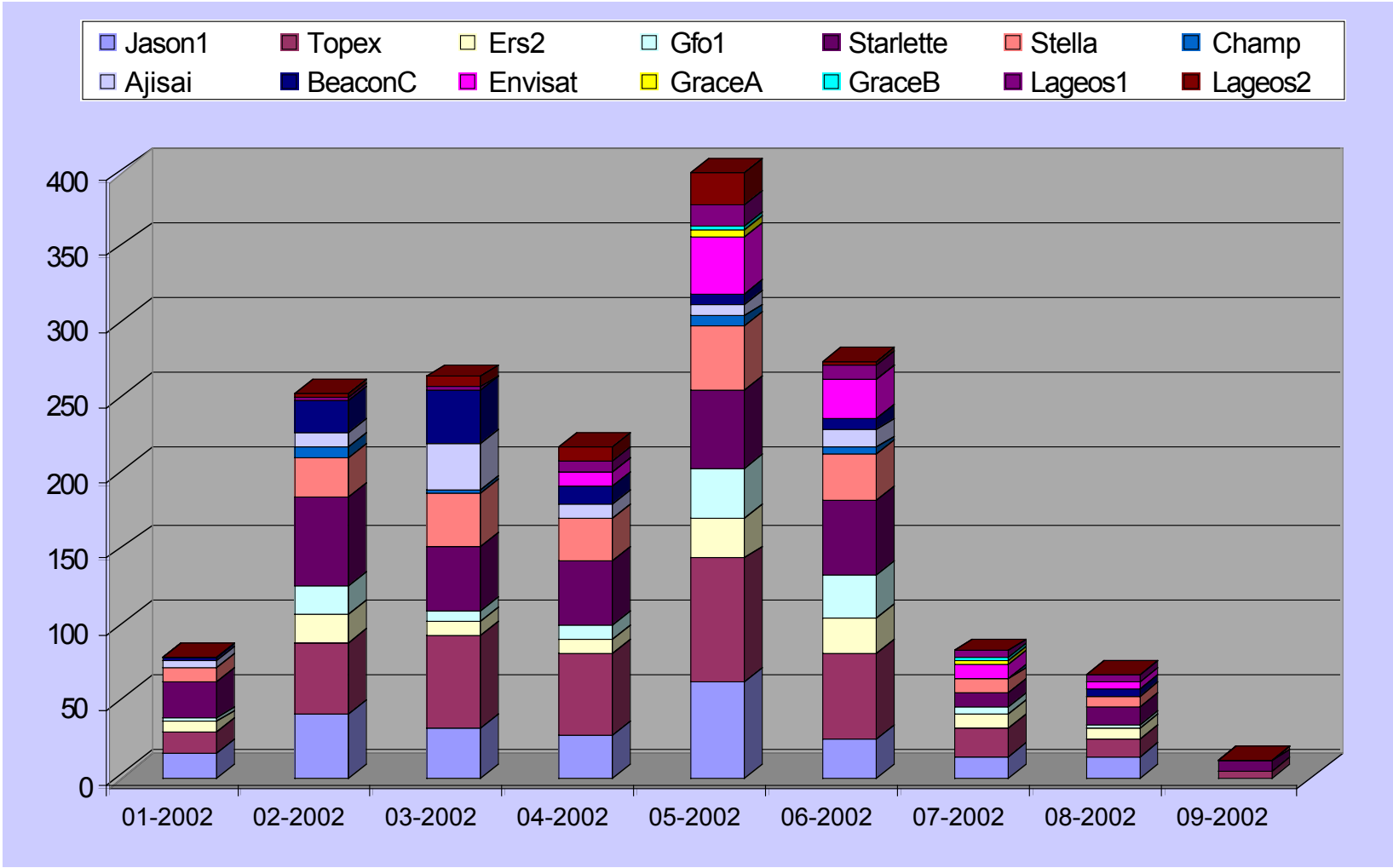
- Quasi-immediate validation of JASON-1 and T/P orbits

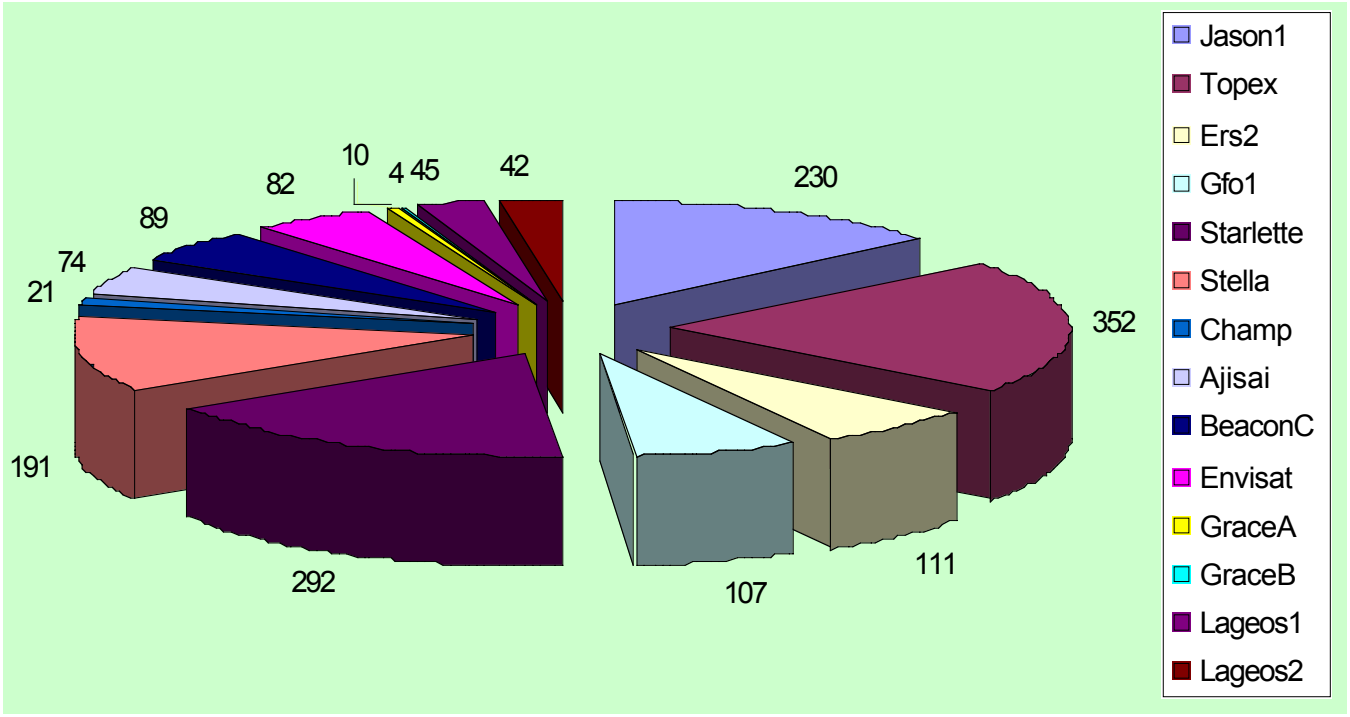
More information and continuously updated results on
http://grasse.obs-azur.fr/cerga/gmc/calval

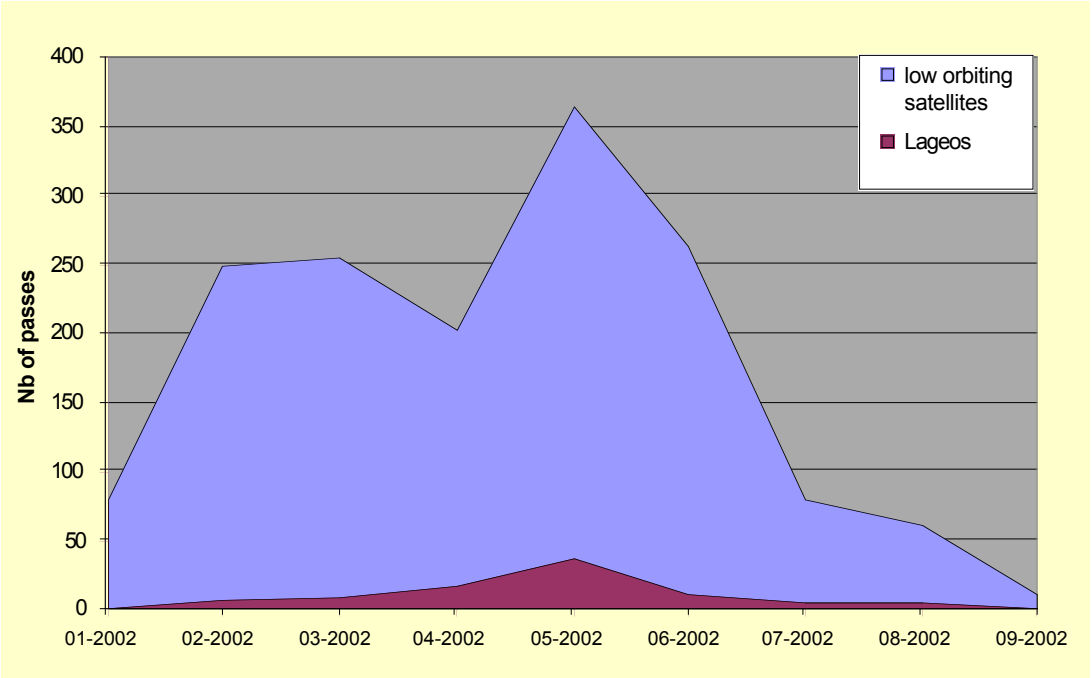
Conclusion and prospect

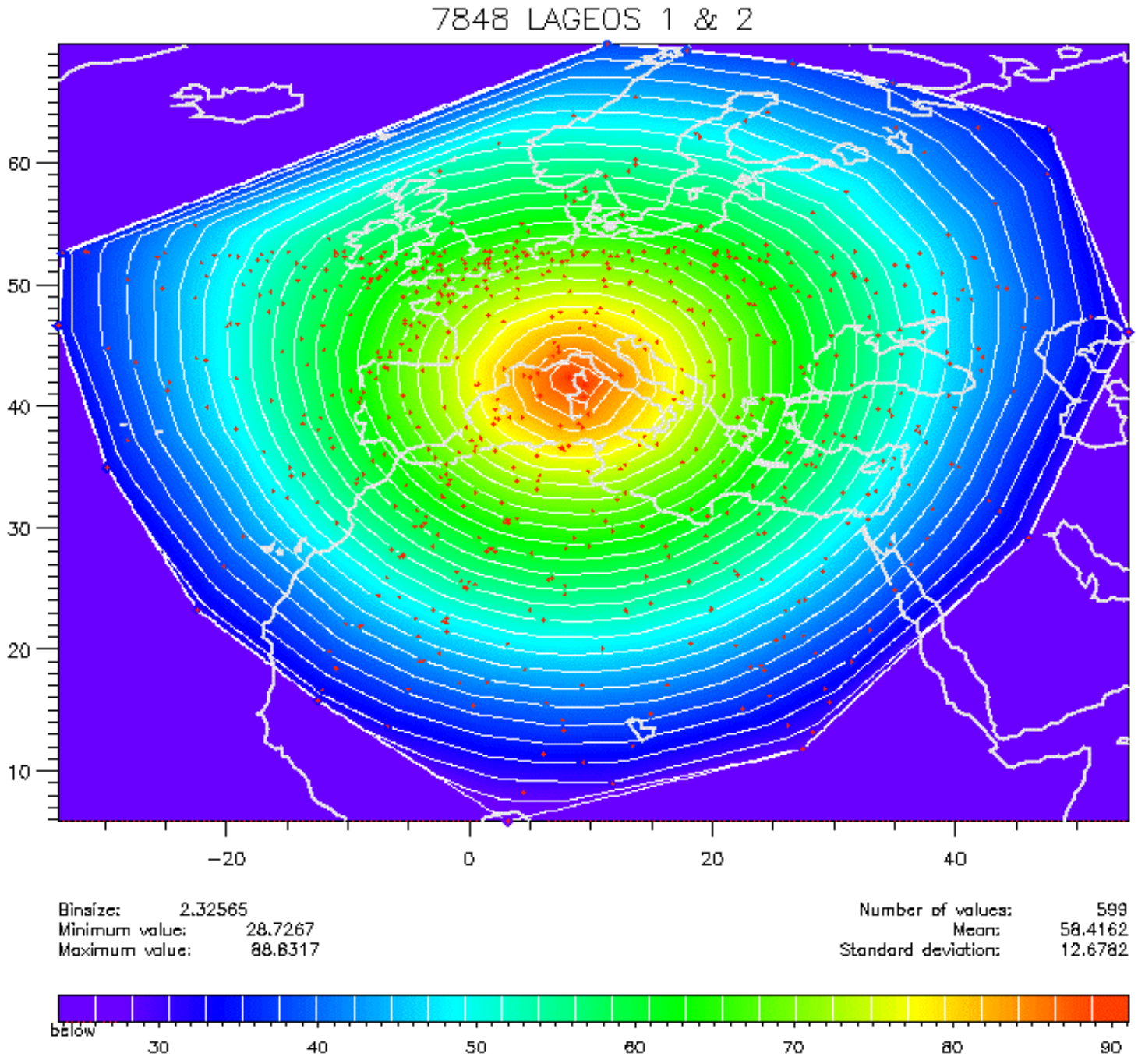


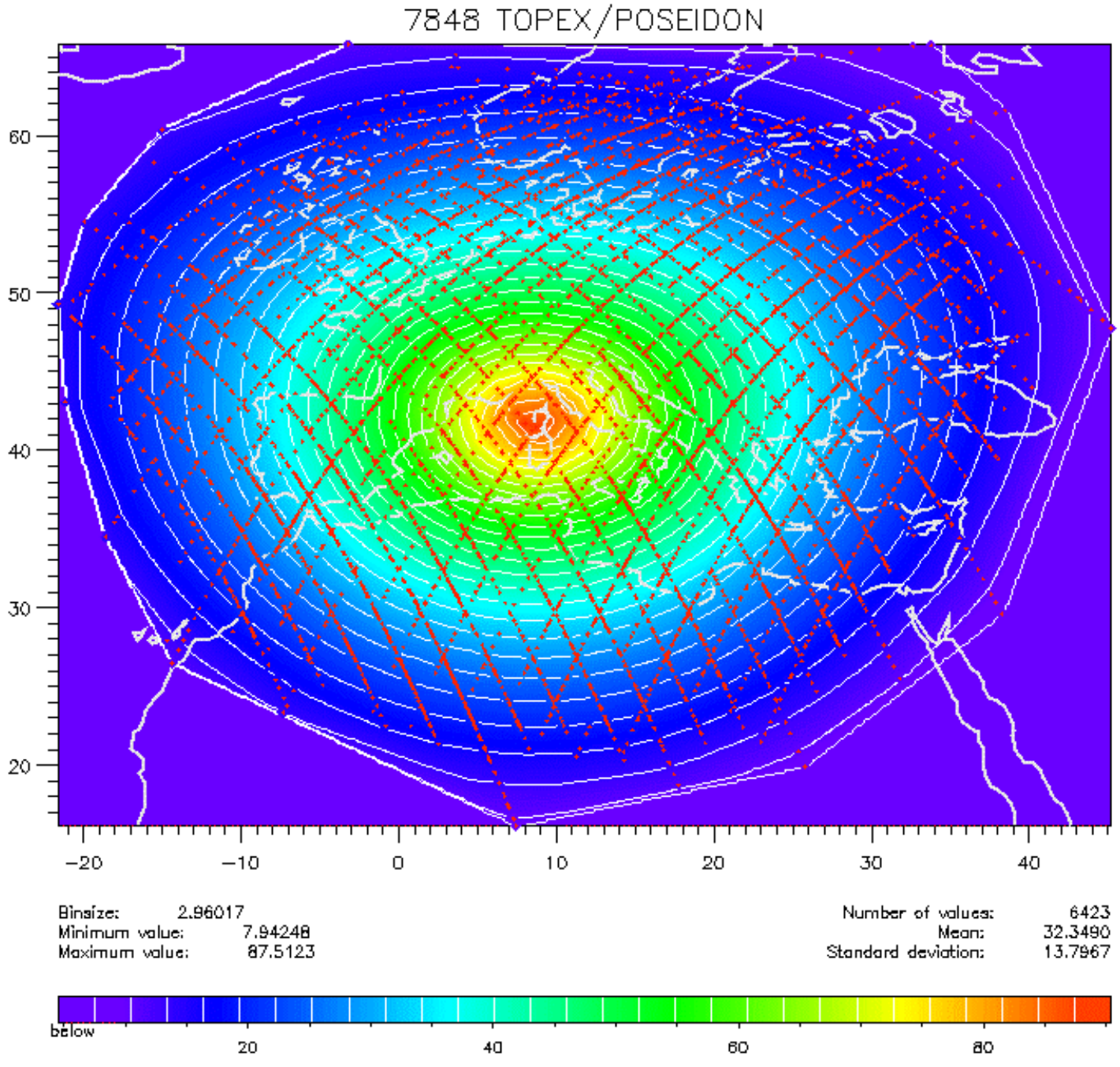
- Problem in the choice of the T/P LRA correction ➔ biases of 1-4 cm for European stations using photodiode detector
- Confirmation of the validation of the FTLRS new performances
- Success of the campaign in spite of poor meteorological conditions
- 1 cm level reached for the orbit validation and the station positioning
- Same kind of experiment planned for 2003 in Gavdos

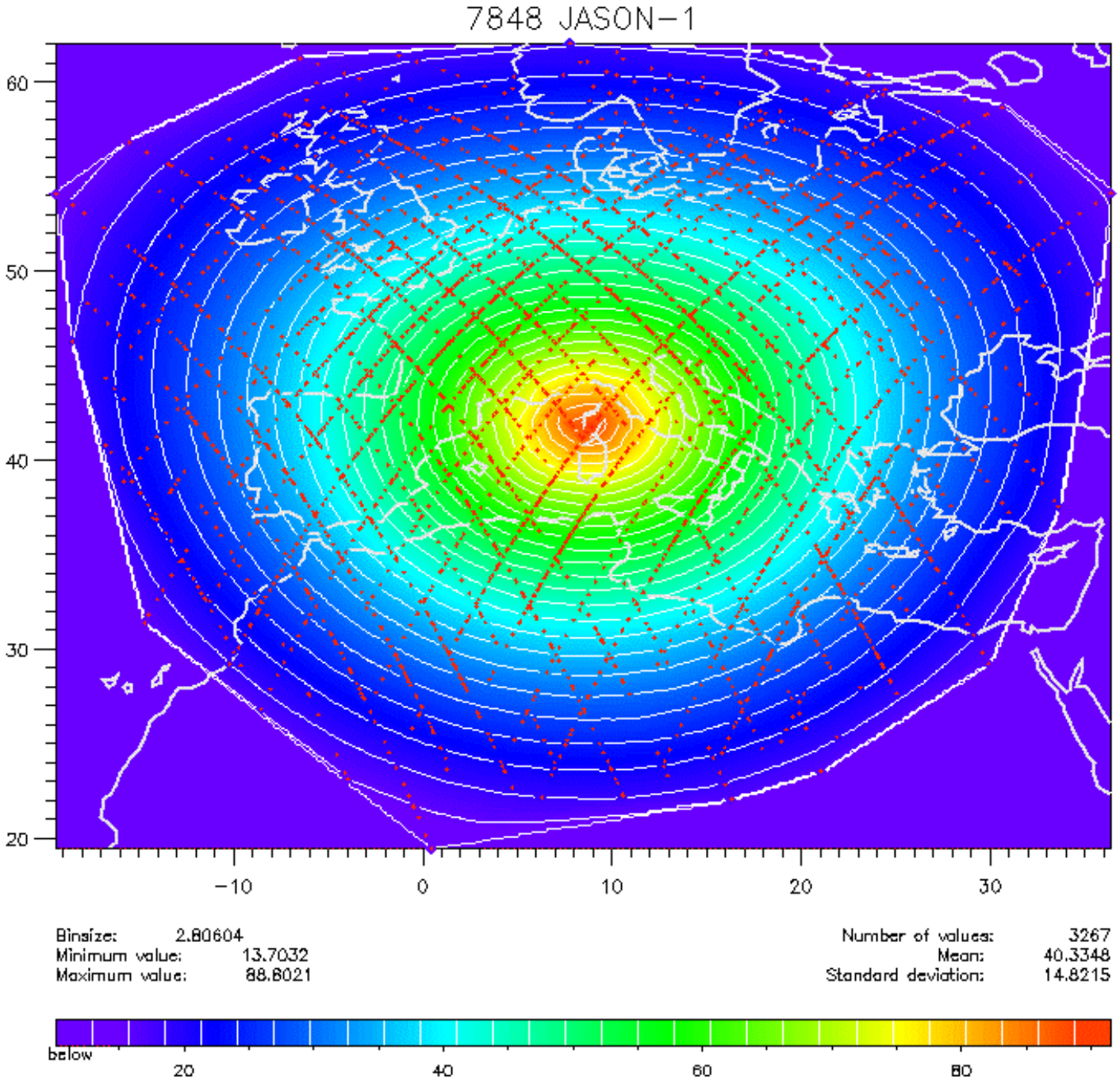

Jason1
Topex
Ers2
Gfo1
Starlette
Stella
Champ
Ajisai
BeaconC
Envisat
GraceA
GraceB
Lageos1
Lageos2
400
350
300
250
200
150
100
50
0
01-2002
02-2002
03-2002
04-2002
05-2002
06-2002
07-2002
08-2002
09-2002


10
4 45
42
82
89
74
21
191
292
230
352
111
107
Jason1
Topex
Ers2
Gfo1
Starlette
Stella
Champ
Ajisai
BeaconC
Envisat
GraceA
GraceB
Lageos1
Lageos2

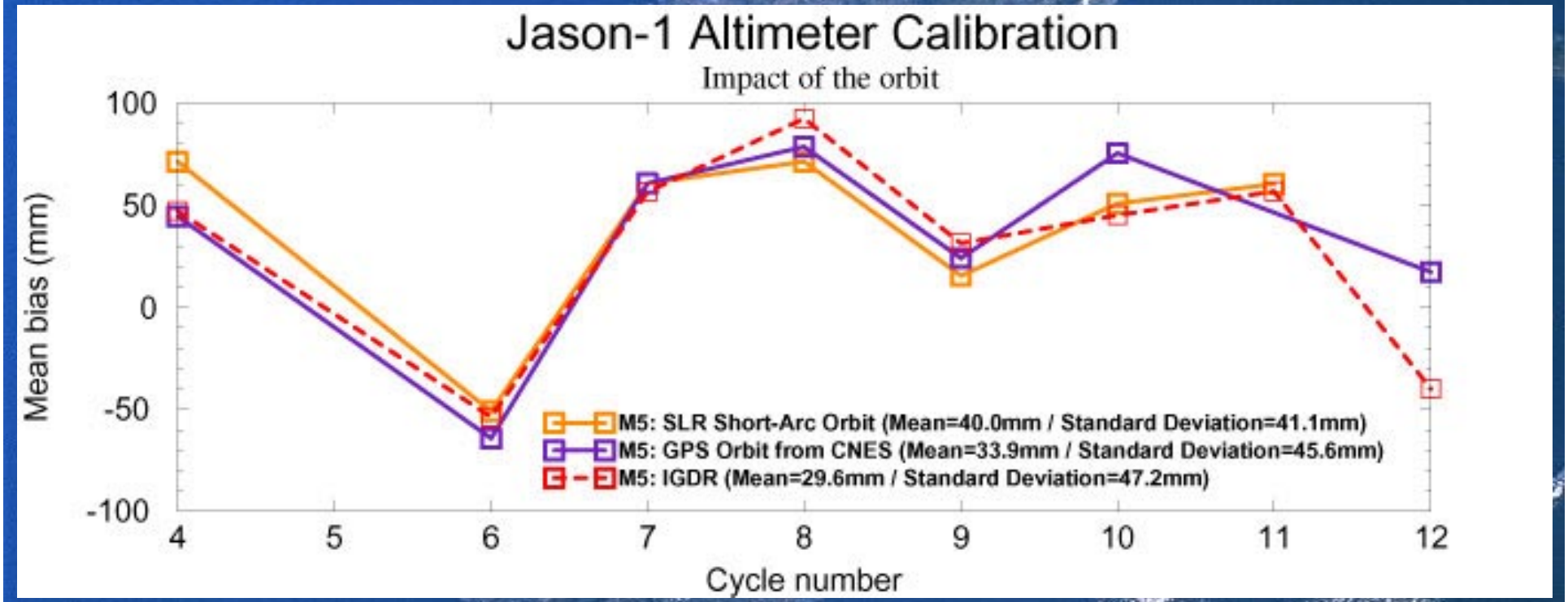

Nb of passes
400
350
300
250
200
150
100
50
0
01-2002
02-2002
03-2002
04-2002
05-2002
06-2002
07-2002
08-2002
09-2002
low orbiting satellites
Lageos

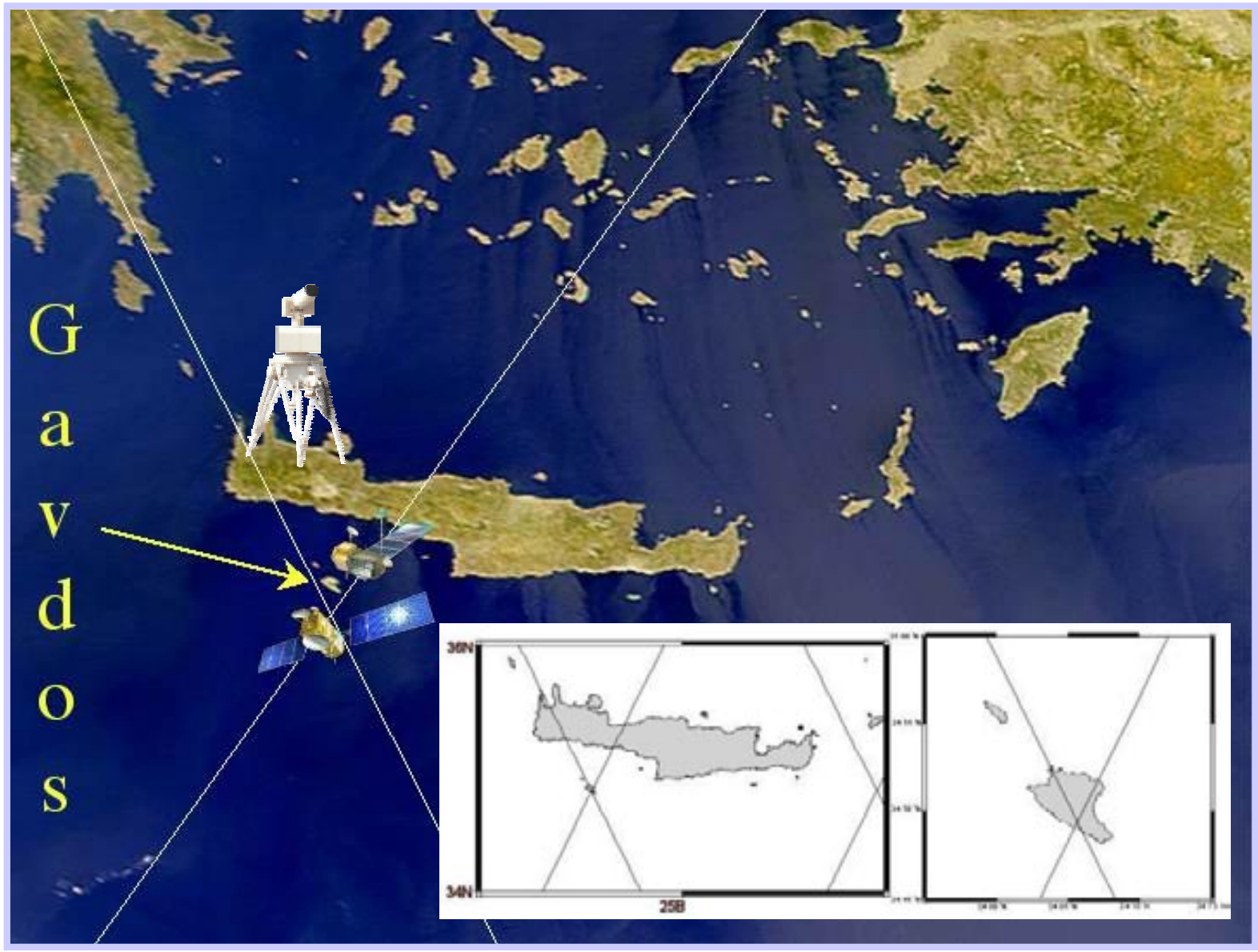

7848 LAGEOS 1 & 2
60
50
40
30
20
10
−20
0
20
40
Binsize: 2.32565
Minimum value: 28.7267
Maximum value: 88.8317
Number of values: 599
Mean: 58.4162
Standard deviation: 12.6782
below
30
40
50
60
70
80
90


7848 TOPEX/POSEIDON
60
50
40
30
20
−20
−10
0
10
20
30
40
Binsize: 2.96017
Minimum value: 7.94248
Maximum value: 87.5123
Number of values: 6423
Mean: 32.3490
Standard deviation: 13.7967
below
20
40
60
80


7848 JASON-1
60
50
40
30
20
-10
0
10
20
30
Binsize: 2.80604
Minimum value: 13.7032
Maximum value: 88.8021
Number of values: 3267
Mean: 40.3348
Standard deviation: 14.8215
below
20
40
60
80

Sea level - altimeter data with different orbits




Gavdos
36N
34N
25E

Acknowledgments to all the participants to the FTLRS 2002 Corsica campaign !