

## **Groupe de Recherches de Géodésie Spatiale**

*Adresse postale : GRGS, ENSG– 6-8, Avenue Blaise Pascal – Cité Descartes – CHAMPS sur MARNE  
77455 Marne-La-Vallée Cedex 2 - FRANCE  
E-mail : Michel.Kasser@ensg.ign.fr*

Bureau des Longitudes  
Centre National d'Etudes Spatiales  
Observatoire de Paris  
Institut Géographique National  
Institut National des Sciences  
de l'Univers  
Observatoire de la Côte d'Azur  
Service Hydrographique et  
Océanographique de la Marine  
Observatoire Midi-Pyrénées  
Observatoire Géodésique de Tahiti

**Michel KASSER**  
Directeur Exécutif

# **Announcement of Opportunity - Station Laser Ultra Mobile - FTLRS**

## **Foreword**

The *Groupe de Recherche de Géodésie Spatiale* (GRGS, a group formed by 9 French laboratories performing research in Space Geodesy) and the OCA (Observatoire de la Côte d'Azur, the French operator for SLR and LLR) have wished to make a call to international cooperation for the use of their Ultra Mobile Laser Station (French Transportable Laser Ranging System, FTLRS).

The mobile station showed, through several field experiments (from 1996 to 2005), a very efficient capacity to acquire SLR data of high quality, in completely new sites, with a remarkable reactivity (the station is operational in some 2 days), for modest financial and human costs by comparison to classical stations.

Of another side, the world laser network, federated around the International Laser Ranging Service (ILRS), has currently only very few geographical extension possibilities. Yet, the increase of the world cover is necessary or even sometimes crucial to the follow-up of numerous spatial missions and/or scientific projects.

## **Objectives :**

A call to international cooperation will allow to contribute, on a large geographical scale and during several months or even several years and on several visited sites, to objectives such as :

- to complete the present geographical coverage of the SLR,
- to reinforce some geodetic / geodynamic experiences,
- to contribute to new experiences.

The FTLRS in the context of the spatial geodesy through the world can bring some profits on :

- the network of ILRS tracking,
- the altimetric operations with an oceanographical character,
- the geodetic operations with a geophysical character,
- the absolute positioning,
- the inter-comparison (or co-location) with other laser stations or other techniques such as GPS, VLBI and DORIS.

### **Proposal for scientific cooperation**

The GRGS proposes to any scientific team in charge of a project, where the specific features of the FTLRS could be exploited at best, to send a proposal. The GRGS offers the use of the FTLRS (to the exception of the running costs) and the salaries of the GRGS technical team.

After the project selected, a contract will be established between OCA/CNRS and hosting organisation dealing with financial aspects and including 10% overhead costs for administrative management.


The project will have to pay for all additional expenses : the technical document presented hereunder allows to plan at best the necessary expenses for field operations. The project may ask some time of the FTLRS for 3 years since 2006, but preferably no more than 3/5 months every year, considering its existing work plan for that period. The FTLRS being an operational prototype, no guarantee of proper functioning can be given by GRGS, any project using it will have to accept the corresponding risks of failures, and on another include all necessary insurance to cover the various hazards exposed. The GRGS will give the preference to projects including GRGS or, at least, French researchers.

Any publications concerning the project will have to reference and cite OCA/GEMINI/CNRS and FTLRS team.

Any proposal should be addressed to the GRGS. It will include the following items, in a free form mode :

- description of the team(s), the people included (with a short CV), with the corresponding percentage of their time allowed for the project.
- description of the research theme of the project : indicate the scientific context at a national and international level, show the objectives to be reached on the whole project and the expected results, describe of the considered methodology.
- Financial aspects : expected costs, expected financial support.

The deadline for submission is the 31<sup>th</sup> of March, 2006.

<p>For the GRGS,</p> <p>M. Kasser</p> 	<p><b>Contact (for technical details and logistics):</b></p> <p>OCA/GEMINI – GRGS avenue N. Copernic, F-06130 Grasse</p> <p>P. Exertier and Francis Pierron</p> <p>Tel. : +33 4 93 40 53 53 (Fax: 53 33) E-mail : <a href="mailto:Pierre.Exertier@obs-azur.fr">Pierre.Exertier@obs-azur.fr</a>, <a href="mailto:Francis.Pierron@obs-azur.fr">Francis.Pierron@obs-azur.fr</a></p>
---	--

## Features of the FTLRS.

The French Transportable Laser Ranging Station (FTLRS) is a very compact (a total of 300 kg in 8 containers) and highly mobile satellite laser ranging system (SLR) with a telescope of 13 cm diameter described in Nicolas et al. (2000).

Field campaigns have been carried out between 1996 and 2004 at different locations and for different objectives. In the last years, it has proven to be reliable enough for real field experiments :

- in Corsica (for calibrating altimeter satellites close tidegauges and GPS Buoys, 6 months in 1996 and the same duration in 2002),
- in Crete ( in the framework of the European Gavdos project, 6 months in 2003),
- in Spain (for co-location, 1 month in 2004),
- in Brest, France (for positioning, 2 months in 2004).
- In Ajaccio/Corsica for Jason1 calibration, 6 months in 2005

In each case, the FTLRS was set up and became operational less than 2 days after on site delivery. During 6 months, more than 400 satellite passes can be observed, including LAGEOS under very good weather conditions.

After different analysis, the standard deviation of the FTLRS residuals (normal points) is estimated to 2 mm rms, while a bias (which is stable on a long period of time) has been identified at the level of  $5 \pm 2$  mm (comparison of 3 ranging systems at the Grasse Observatory, 2001). The positioning can be realised with a 3D-error budget of 3 mm, which has been controlled (at least horizontally) via GPS co-locations.

Now, the FTLRS has been declared able to participate to international campaigns in any places around the world, due to its main characteristics of highly transportable system with low operational costs and excellent accuracy.

### ***The FTLRS detailed features :***

- total weight : 300 Kg (~10 containers, heaviest 55 kg)
- Laser : frequency doubled Nd:Yag,  $\lambda = 532$  nm (green), 50 mJ per pulse, 10 Hz, pulse width: 35 ps)
- Photodetector : avalanche photodiode in compensated Geiger mode (CSPAD)
- Telescope : diameter 13 cm, 2 Kg
- Climatic conditions of use : +5 to 35 °c
- Pointing error : < 10 arcseconds rms
- Timing section : Stanford SR 620, rubidium / GPS
- Calibration : external target and removable target fixed to the telescope.
- Satellites to be tracked : from 350 km (ISS) to 10 000 km (Lageos)
- Precision (single shot rms) better than 10 mm for Stella, Starlette, Jason and 14 mm for Lageos
- Stability : 1 mm in a few hours, 2/3 mm on 6 months
- Only one operator for the tracking
- Number of passes / month : 100/200 depending on meteorological conditions, with observations 24h / 24
- Operational time: 95 %
- Mean time of immobilisation for failures : 1 day/month
- Mean time between two laser adjustments : 1 month



## Survey of the last campaigns :

### **Corsica April-September 2002 :**

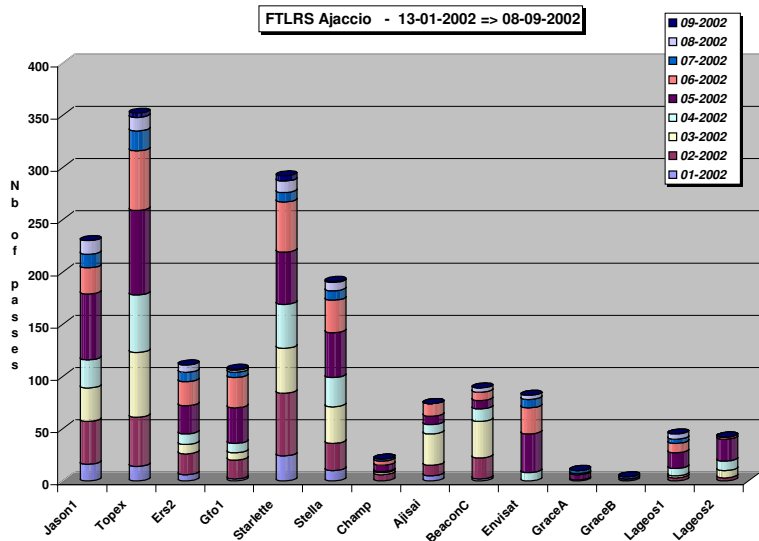
*Calibration/validation TOPEX/Jason1*

Passes :

- 1563 on low satellites
- 87 on Lageos (1 and 2)
- 467 passes in tandem with Grasse

Additional costs ~ 40 K€

Number of implied people : 21 for installation, maintenance and observations



### **Crete April-October 2003 :**

*Calibration of a site within the framework of European project Gavdos*

- 1388 passes (22000 normal points) in 5 months of observations
- Additional costs ~ 70 K€
- Implied people : 12

### **San Fernando, June 2004 :**

*Colocation with the laser station of San Fernando*

- 204 passes (4077 normal points) in 21 observation days.
- Additional costs ~ 12 K€
- Implied people : 7

### **Brest September/October 2004 :**

*Participation to the geophysical projet "oceanic loading"*

- 203 passes (3090 normal points) in 45 observation days.
- Additional costs ~ 17 K€
- Implied people : 9

### **Corsica May-October 2005 :**

*Calibration/validation TOPEX/Jason1*

In progress with 300/400 pass/months

Bias and stability confirmed to some millimetre level

Additional costs ~ 60 K€

Number of implied people : 14

**Summary of prices range for installation and operational costs for campaigns.**

**A. Installation costs :**

-Necessary infrastructure :	
Concrete plate 4m x 6m and, if necessary, enclosure of the site	3/10 K€
Power supply 220V 50 Hertz, ~ 10 KVA	
-Ftlrs transportation cost	1/8 K€
-Insurance	5/6 K€
-Missions for installation and operational set-up ( 2 GRGS people, 10 days)	2/7 K€
<b>Total installation costs</b>	<b>11/31 K€</b>

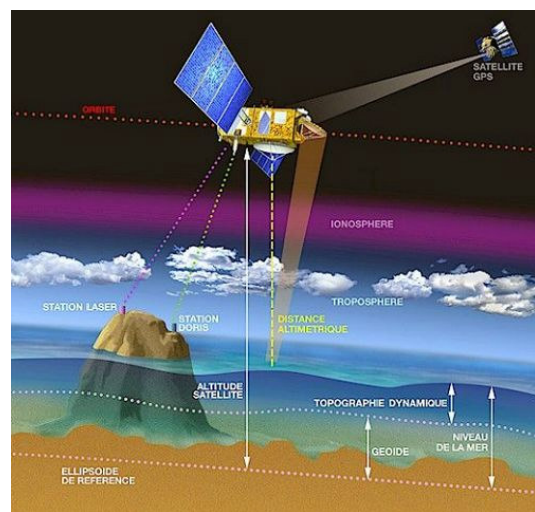
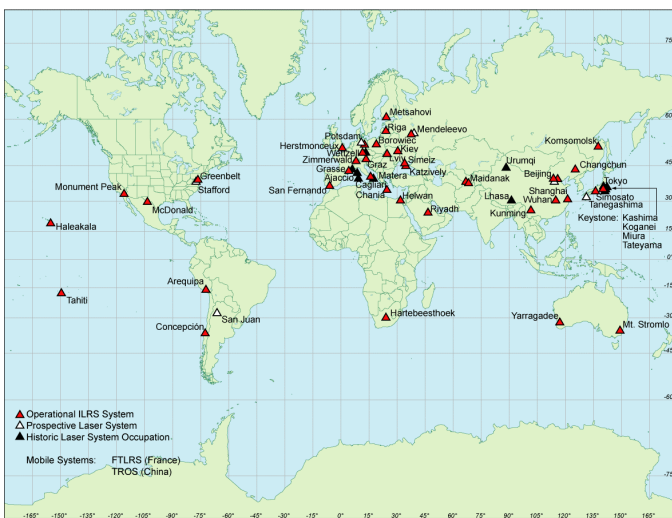
**B. Operational costs :**

Transportation and per diem for GRGS agents : 3/7 K€/month (depending upon the site)  
*Possibility in some cases to have only one GRGS permanent agent if local technicians are available and trained*

Cost with two permanent OCA agents	6/14 K€/month
Phone line, Internet connexion	
Office/shelter of 15/20 m <sup>2</sup> close to the site (20m) for the operator	0,5/1 K€/month
Rental car	1 K€/month
Maintenance hardware	1/2 K€/month
Missions for maintenance (1 GRGS engineer 2 days every month)	1/2 K€/month
<b>Total operational costs</b>	<b>10/20 K€/month</b>

**C. Removal costs :**

-Missions for removing and packing (2 GRGS people, 4 days)	2/6 K€
-Transportation	1/8 K€
-Insurance	5/6 K€
<b>Total removal costs</b>	<b>8/20 K€</b>



*Typical applications for FTLRS : improve world coverage (left), calibrate radar altimeters (right)*