



CENTRE NATIONAL D'ÉTUDES SPATIALES



MICROMEGA: a CNES project in Phase 0

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The Micromega project: Mini-Constellation of Research Orbiters for Mapping the Earth Gravity Anomalies

Concept proposed by G. Balmino in 2006

Mission proposed to CNES at its prospective seminar (March 2009)

Entering into phase 0 study mid-2009

Mission group:

Richard Biancale (CNES)

Sylvain Bonvalot (IRD)

Michel Diamant (IPGP)

Bernard Foulon (ONERA)

Steven Hosford (CNES)

André Laurens (CNES)

Marie-Françoise Lalancette (SHOM)

Guillaume Martelet (BRGM)

Isabelle Panet (IGN)

Guillaume Ramillien (CNRS)

Scientific objectives for a future mission of space gravimetry, *Micromega report, March 2009*

Isabelle Panet, Guillaume Ramillien, Alix Lombard

1 – Hydrology Johannes Riegger, Andreas Güntner

2 – Cryosphere Benoît Legrésy, Richard Coleman, Reinhard Dietrich

3 – Ocean circulation Marie-Hélène Rio, Chris Hughes

4 – Ocean level Philip Woodworth, Marie-Hélène Rio, Chris Hughes

5 – Solid Earth Bert Vermeersen

6 – Geodesy Georges Balmino, Reiner Rummel

With support letters from

Georges Balmino, Richard Coleman, Reinhard Dietrich, Will Featherstone, Andreas Güntner, Chris Hughes, Kurt Lambeck, Benoît Legrésy, Marie-Hélène Rio, Johannes Riegger, Reiner Rummel, Daniel Shaddock, Paul Tregoning, Bert Vermeersen, Philip Woodworth, Michaël Sideris on behalf of the International Association of Geodesy (IAG), C.K. Shum on behalf of the Space Missions Working Group of IAG-GGOS.



Scientific supporting (45p) report for MICROMEGA

Objectifs scientifiques pour une future mission de gravimétrie spatiale

Projet Microméga Mars 2009

Groupe Mission Microméga

Avec des contributions / lettres de soutien de :
Alix Lombard, Georges Balmino, Reiner Rummel, Bert Vermeersen, Johannes Riegger, Andreas Güntner, Marie-Hélène Rio, Philip Woodworth, Paul Tregoning, Kurt Lambeck, Will Featherstone, Daniel Shaddock, Michaël Sideris au nom de l'International Association of Geodesy (IAG),
C.K. Shum au nom du Space Missions Working Group of the IAG-GGOS.

Introduction

1 – Géodésie

- 1.a – Situation actuelle et objectifs scientifiques
- 1.b – Performances requises
- 1.c – Références
- 1.d – *Lettre de soutien : Georges Balmino, Reiner Rummel*

2 – Terre solide

- 2.a – Situation actuelle et objectifs scientifiques
- 2.b – Performances requises
- 2.c – Références
- 2.d – *Lettre de soutien : Bert Vermeersen*

3 – Hydrologie

- 3.a – Situation actuelle et objectifs scientifiques
- 3.b – Performances requises
- 3.c – Références
- 3.d – *Lettre de soutien : Johannes Riegger, Andreas Güntner*

4 – Cryosphère

- 4.a – Situation actuelle et objectifs scientifiques
- 4.b – Performances requises
- 4.c – Références

5 – Circulation océanique

- 5.a – Situation actuelle et objectifs scientifiques
- 5.b – Performances requises
- 5.c – Références
- 5.d – *Lettre de soutien : Marie-Hélène Rio*

6 – Niveau de la mer

- 6.a – Situation actuelle et objectifs scientifiques
- 6.b – Performances requises
- 6.c – Références
- 6.d – *Lettre de soutien : Philip Woodworth, Marie-Hélène Rio*

Conclusion et synthèse

Annexe 1 : *Lettre de soutien de Paul Tregoning, Kurt Lambeck, Will Featherstone & Daniel Shaddock*

Annexe 2 : *Lettre de soutien de l'International Association of Geodesy*

Annexe 3 : *Lettre de soutien du GGOS' Space Missions Working Group*

Phase 0.1 :

to identify the needs, technical and programmatic aspects in terms of:

- *Mission* analysis: feasibility of proposed orbital configurations according to performance simulations (normal pendulum, cartwheel, double tandem mission...) ;
- *Payload* : inventory of inter-satellite link devices (RF, laser) and annex systems ;
- *Satellite platform* : definition of specifications with regard to the payload.

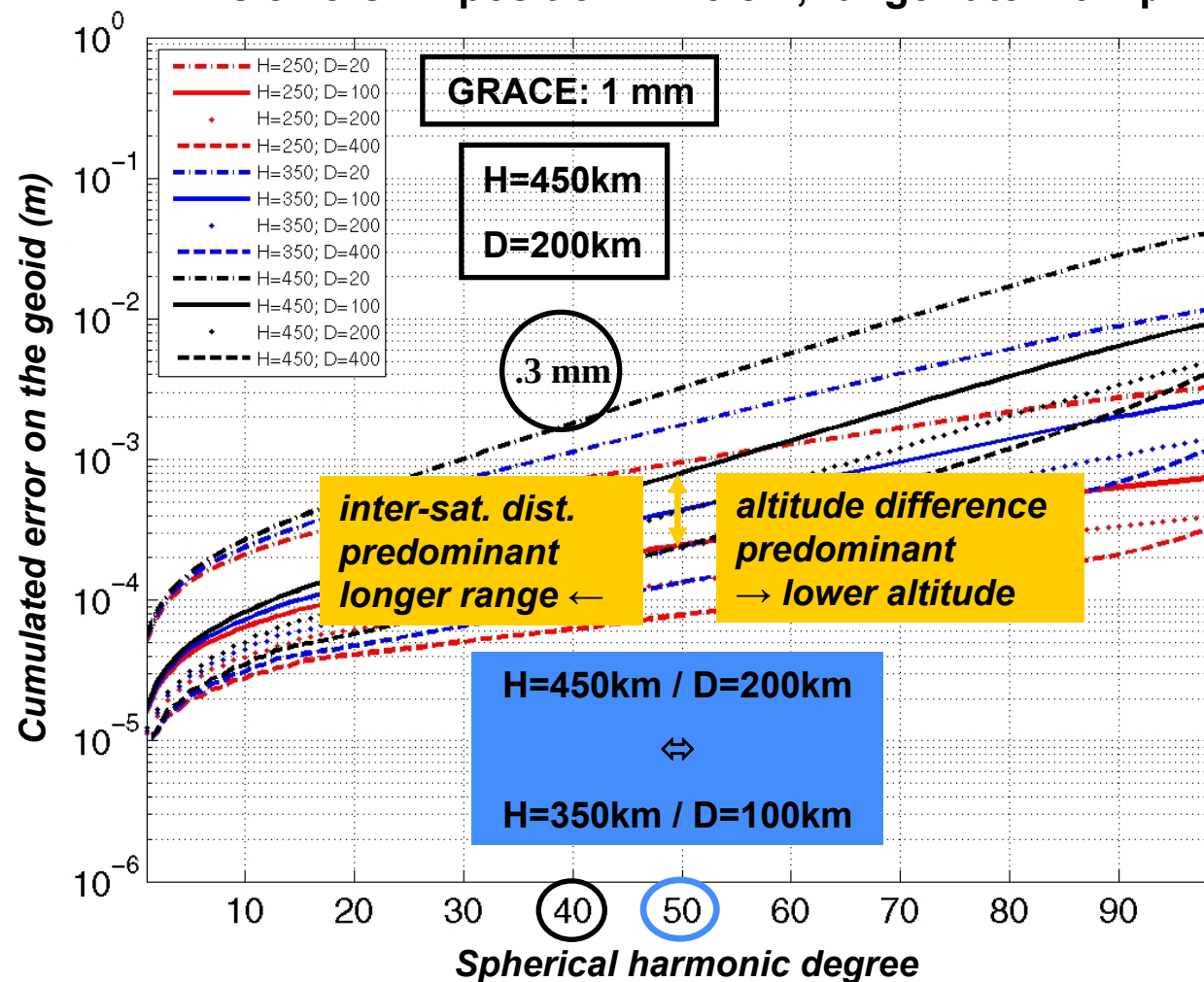
Phase 0.2 :

- to consolidate the technical studies for payload and satellite ;
- to classify the different scenarios ;
- to specify payload and satellite architecture ;
- to estimate cost and development plan.

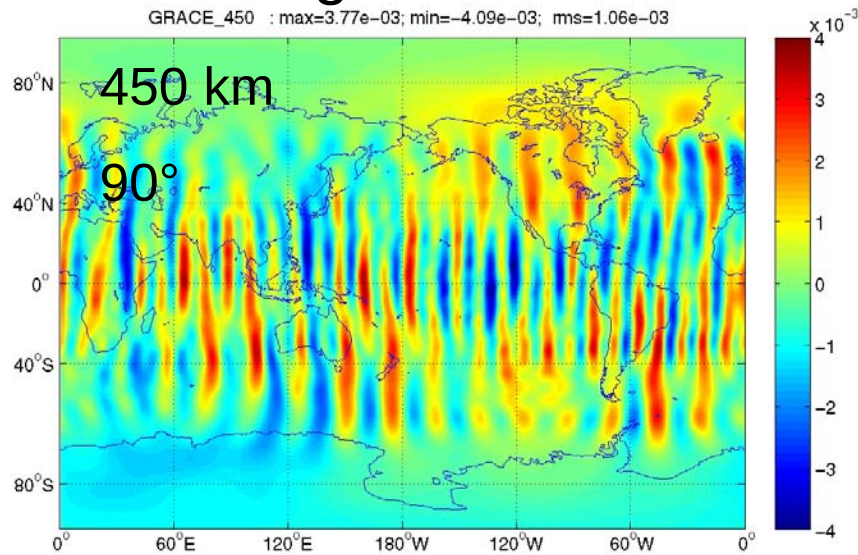
In parallel :

discussion with other space agencies (DLR for instance) for cooperation (common phase 0 studies)

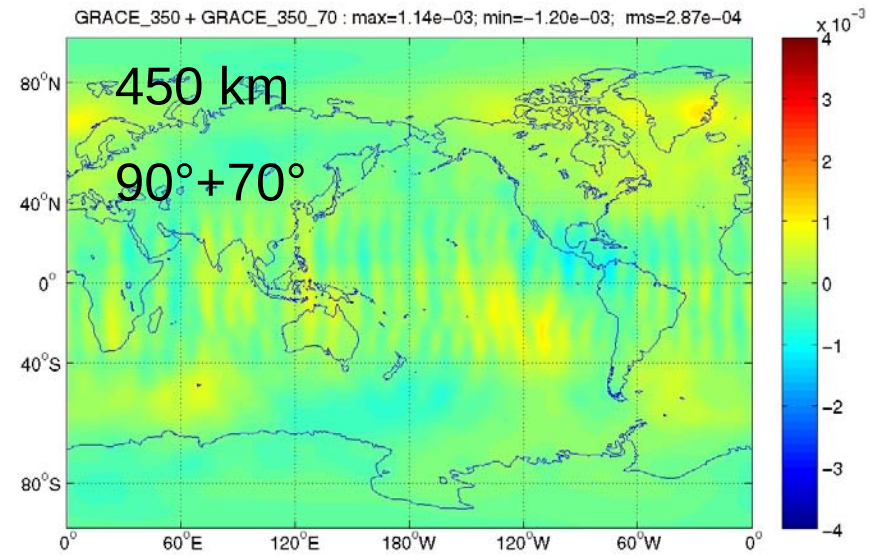
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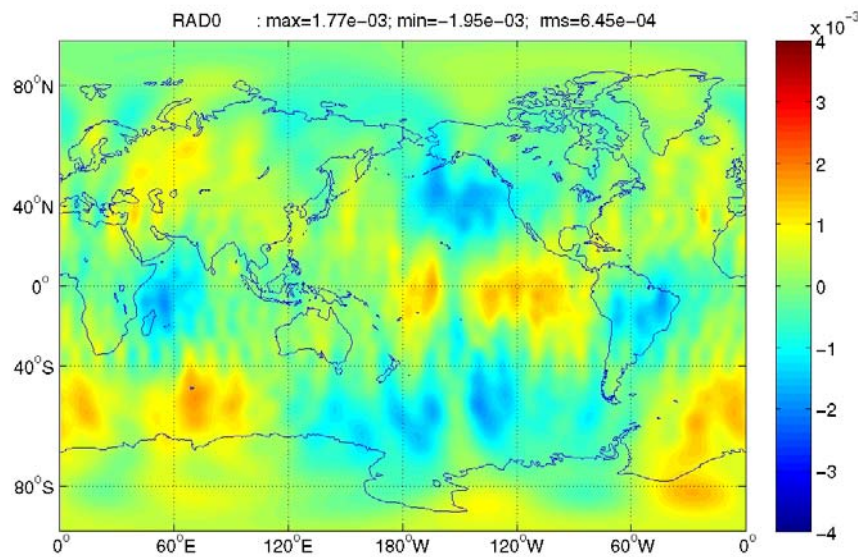
Single tandem



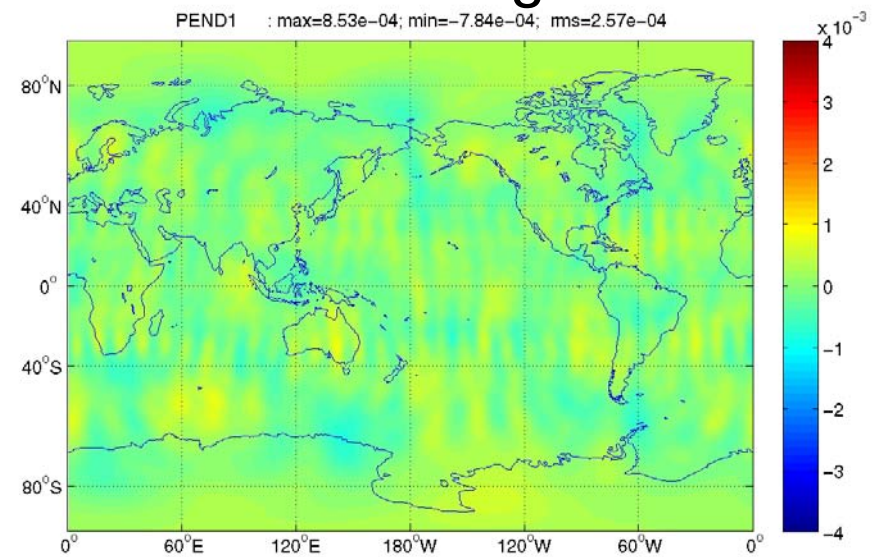
Double tandem



Cartwheel



Pendulum configuration



from degree 5 to 40

- analytical simulations of tandem mission types have allowed to study the sensitivity to gravity field according to measurement type, altitude and inter-satellite distance
- numerical simulations have been appropriate to study different orbital configurations (tandem, pendulum, cartwheels) considering remaining aliasing problems
- most realistic and feasible scenarios should be now evaluated in CNES phase 0 study considering technical aspect as well
- nevertheless such a project can only be realized within a cooperation framework
- we thanks for the strong support from the GRACE scientific community