



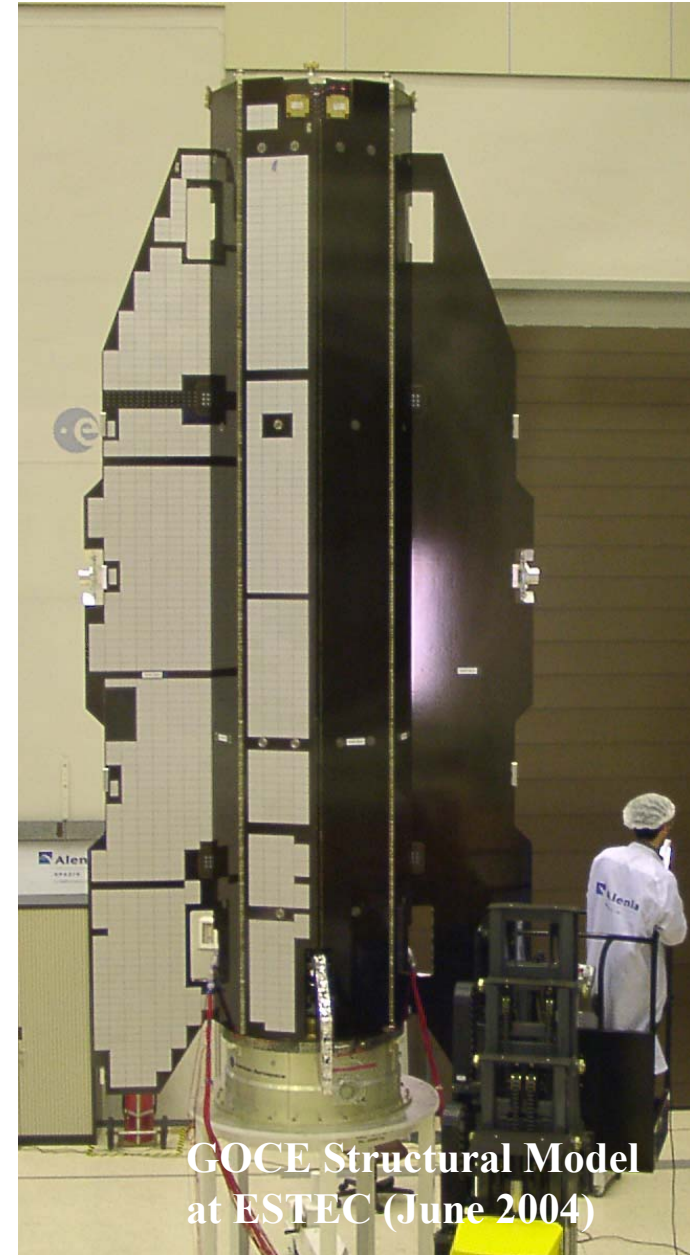
GOCE-GRAND and its Role in the ESA GOCE Ground Segment

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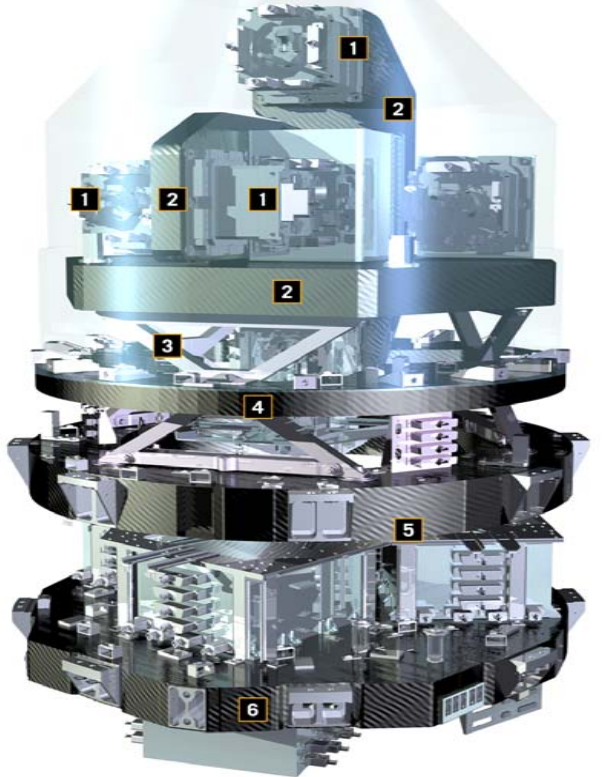
- 1. GOCE-GRAND Project**
 - Overview
 - Status
- 2. ESA GOCE Ground Segment**
- 3. GOCE-GRAND and ESA Ground Segment**
 - Payload Data Segment
 - Cal/Val Team
 - High Level Processing Facility
- 4. Conclusions**



GOCE Mission Goal

Determination of the Earth Gravity Field by Satellite Gravity Gradiometry and GPS high-low SST with an Accuracy of better than 1 mGal for Gravity Anomalies and 2 cm for Geoid Heights at Degree and Order 200.

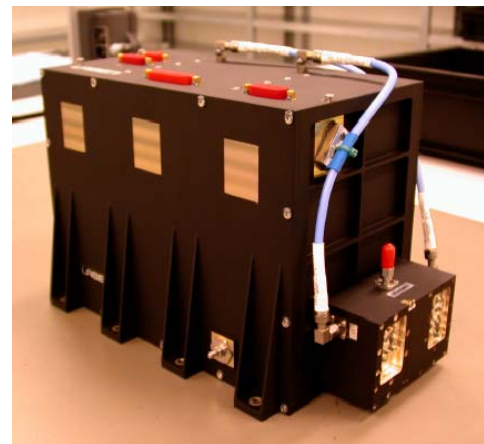
Complete Gravity Gradiometer



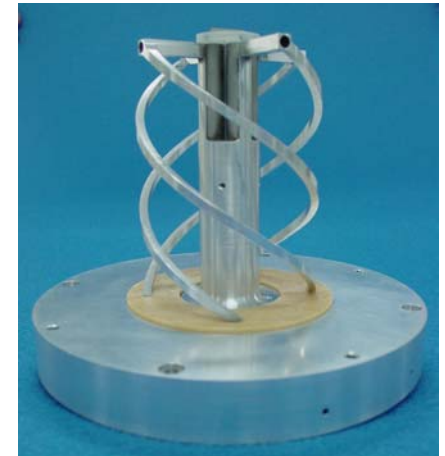
- 1 Accelerometer pair
- 2 Ultra-stable carbon-carbon structure
- 3 Isostatic X-frame
- 4 Panel regulated by heaters
- 5 Intermediate tray
- 6 Electronic panel

GOCE Core Instruments

One-Axis Gradiometer



Lagrange GPS Receiver



GPS Antenna

GOCE-GRAND Project Overview

GOCE-GRAND: GOCE-GRavitationsANalyse D_eutschland

Project Goal:

Development and test of a complete processing chain from GOCE observations (gravity gradiometry and GPS) to gravity field solutions.

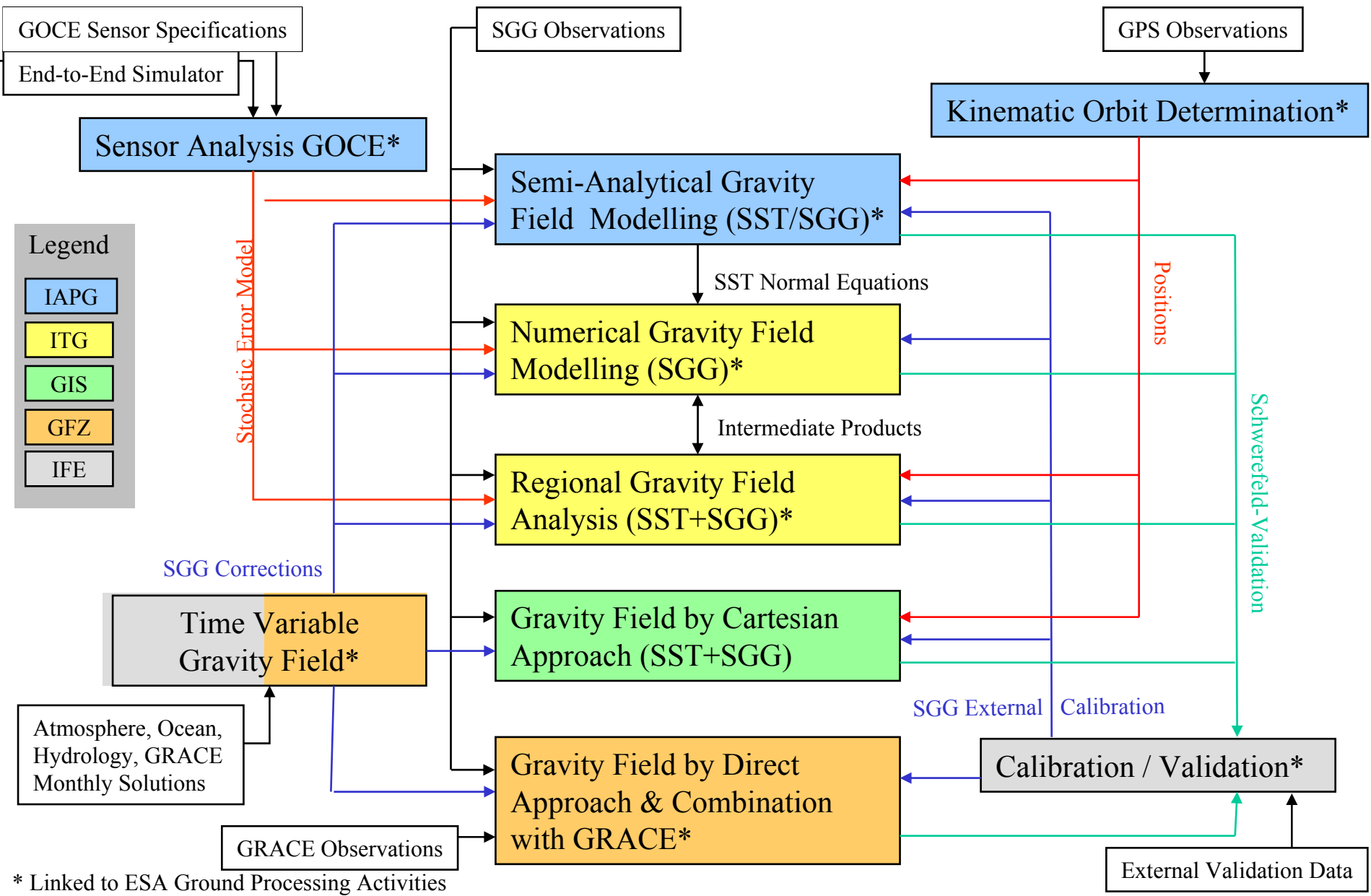
Project Phases:

- 1st Phase from January 2002 to December 2004
- 2nd Phase planned from January 2005 to December 2007

Project Partners:

- Institut für Astronomische und Physikalische Geodäsie Technische Universität München (Rummel, IAPG)
- Institut für Theoretische Geodäsie, Universität Bonn (Ilk, Schuh, ITG)
- Geodätische Institut, Universität Stuttgart (Grafarend, GIS)
- GeoForschungsZentrum Potsdam, Department 1 (Reigber, GFZ)
- Institut für Erdmessung, Universität Hannover (Müller, IFE) as Subcontractor of IAPG

GOCE-GRAND Processing System Layout



GOCE-GRAND Working Groups

For the study of fundamental issues of the GOCE processing chain, which are of concern to all project partners working groups were established. They provide support to all project partners.

Simulation Data (SGG): ITG/IAPG

- Error-free 1 sec SGG data for 30 days
- Error model based IAPG system error analysis

Gravitational Disturbing Forces (Direct, Indirect Tides) and System Transformations: ITG/GIS/IAPG

- Algorithms successfully compared. Remaining differences only due to numerical uncertainties

Numerical Differentiation:

IAPG/GIS/ITG

- Comparison of various mathematical methods and error assessment
- Results show differences due to use of different test data
- Repetition with identical data set

Time-Variable Gravity:

GFZ/IFE/IAPG

- Collection of available models
- Comparison of results

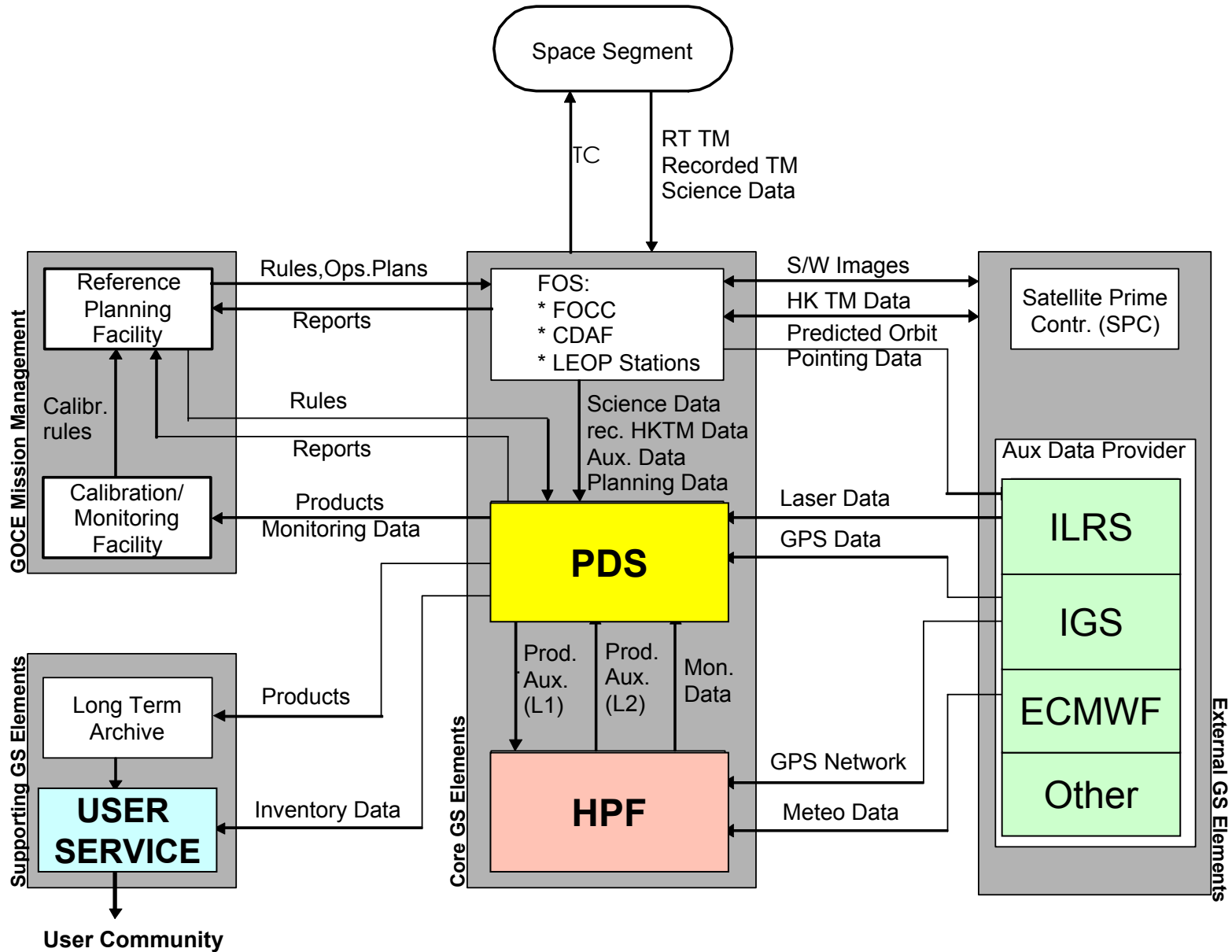
Goal for Phase 1:

Development of algorithms and tools for high resolution gravity field analysis with GOCE data (SST & SGG).

Status Phase 1:

- Project running according to plan. Algorithms for all processing elements have been developed and are currently under implementation.*
- Several working groups within GOCE-GRAND were established in order to check basic algorithms against each other and to generate common test data sets.*
- Test cases were designed based on CHAMP SST observations (as test case for GOCE SST analysis) and based on simulated data for SGG using realistic coloured noise models.*
- At the end of phase 1 all algorithms will be implemented and ready for testing with official GOCE end-to-end simulator test data sets from ESA.*

ESA GOCE Ground Segment Overview



ESA Ground Segment Tasks

Payload Data Segment (PDS)

- Generation of level 1B products from raw data acquired by the Flight Operations Center
- Level 1B products are internal corrected instrumental data sets:
 - Nominal SGG and SSTI (GPS) data sets
 - Monitoring products for SGG and SSTI
 - Calibration products for SGG and SSTI
- Project running

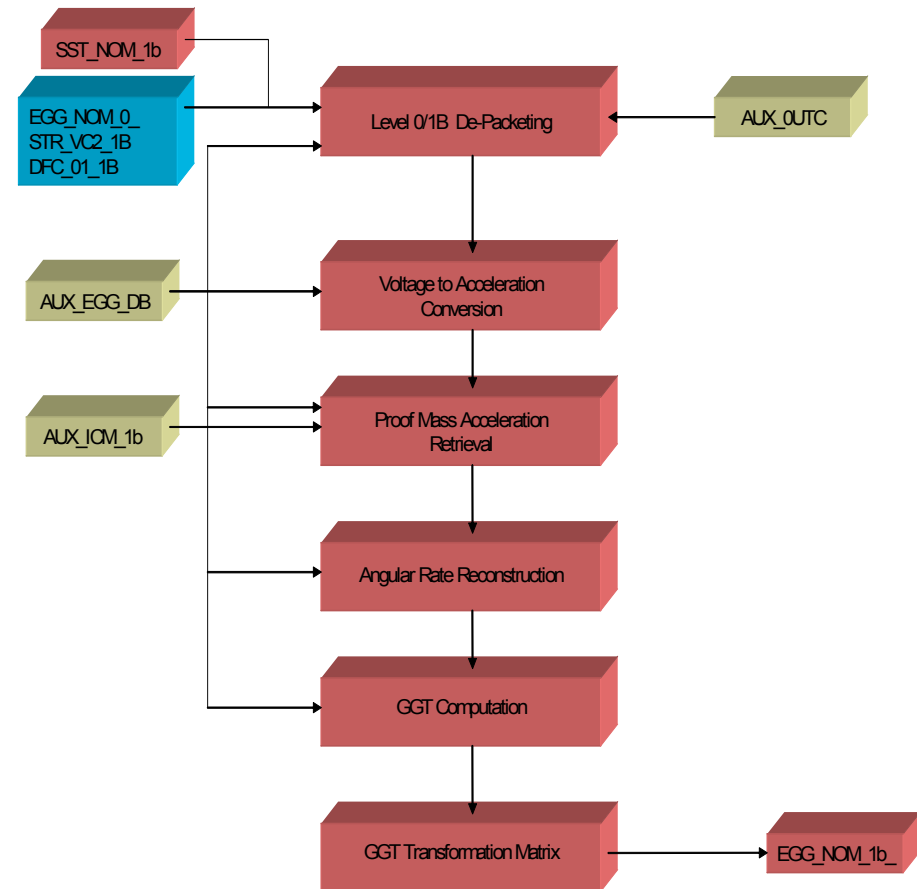
High Level Processing Facility (HPF)

- Generation of level 2 products from level 1b data
- Level 2 products are:
 - External corrected and calibrated instrumental data sets
 - Rapid science orbits and quick-look gravity field models
 - Precise science orbits and final GOCE gravity field models
- Contract ready to be signed

GOCE-GRAND and ESA Ground Segment

Payload Data Segment

- IAPG is sub-contractor of Advanced Computer Systems (ACS) Rome, Italy, who won the contract for development of the PDS.
- GOCE-GRAND sensor analysis strongly is linked to that work.
- IAPG is in charge of defining the complete algorithm chain from level 0 to level 1B data for SGG and SSTI.
- Strong synergy between GOCE-GRAND and the PDS work by getting deep knowledge of the processing chain applied to GOCE raw data.



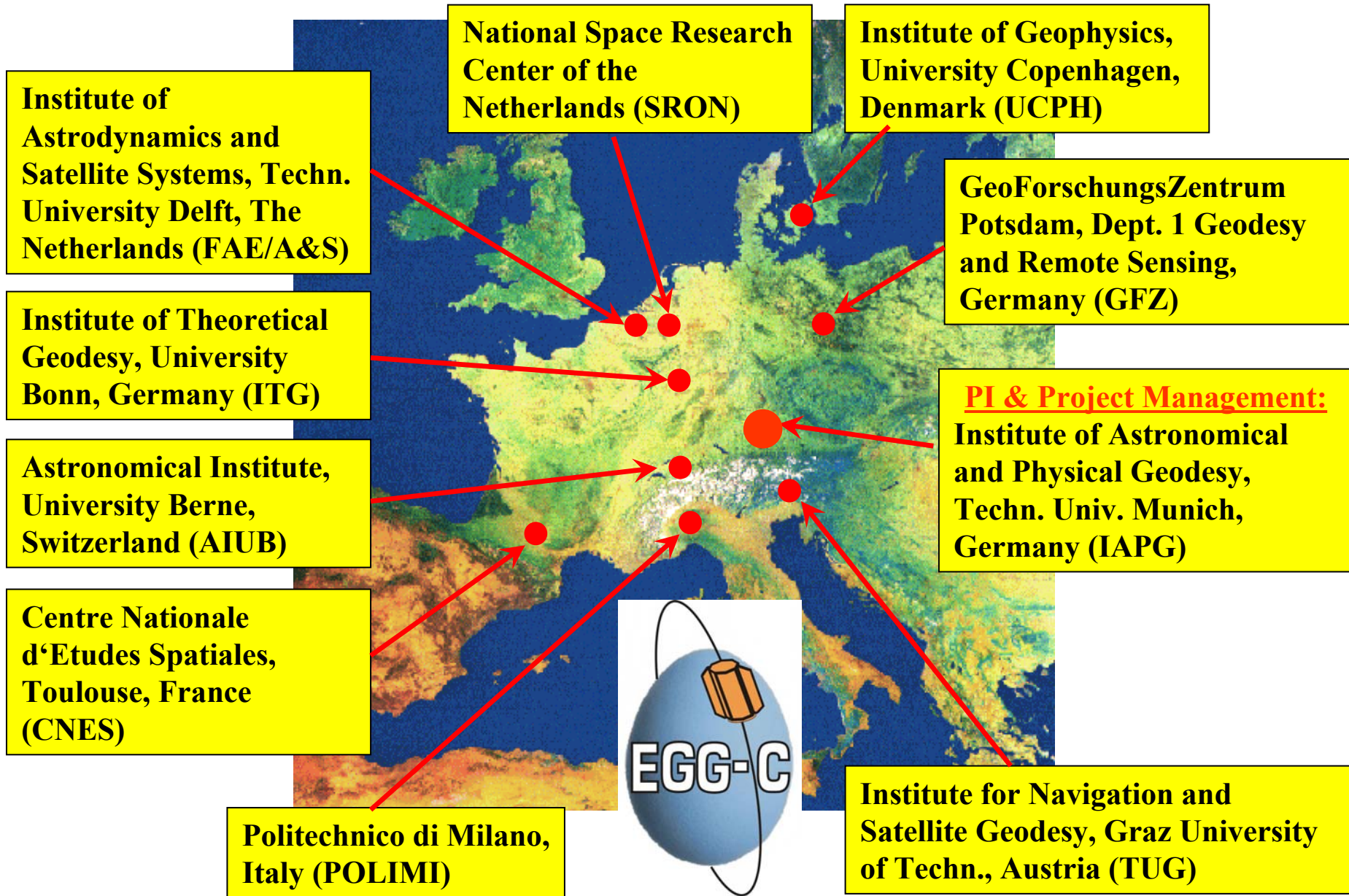
Calibration/Validation Team

- **ESA issued an Announcement of Opportunity in May 2003, targeting in projects to calibrate and validate the GOCE level 1B products.**
- **All together three projects were selected by ESA. Two of them are led by GOCE-GRAND partners. These are:**
 - **GOCE High Level Processing Facility: 10 European institutions led by IAPG (more details later)**
 - **GOCE Calibration and Validation with terrestrial Gravity Data led by IFE (support by N. Sneeuw, Calgary)**
- **Both projects are strongly linked with the work to be performed within GOCE-GRAND.**

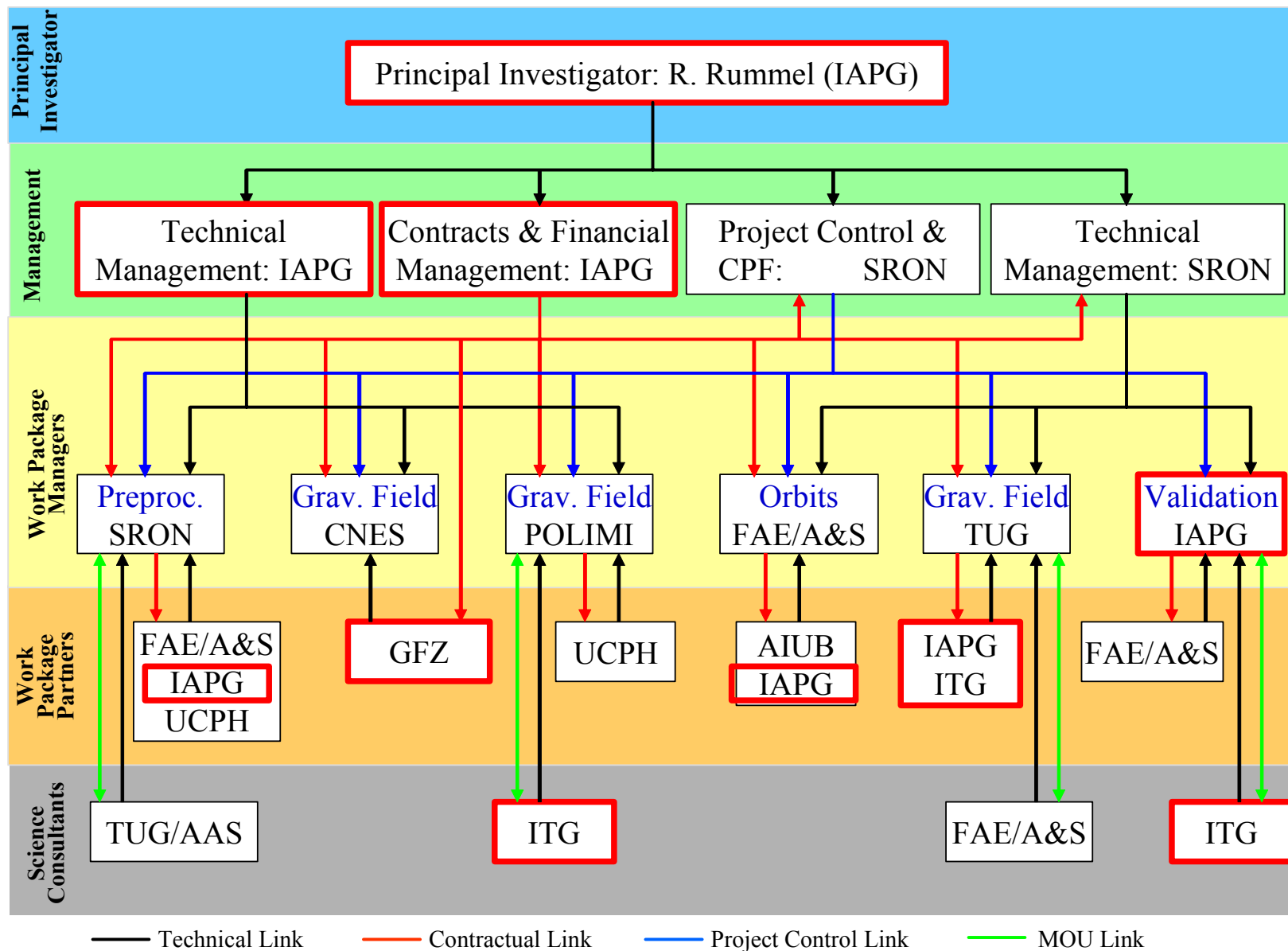
GOCE-GRAND and ESA Ground Segment High Level Processing Facility (HPF)

- **The European GOCE Gravity Consortium (EGG-C) successfully submitted a proposal.**
- **The project started in April 2004 for 6 years covering development of the system and operations for the two measurement operational phases (and a third phase to be decided during the mission).**
- **Three GOCE-GRAND partners are strongly involved in the project: IAPG (lead and several work packages), GFZ and IFE (gravity field determination). This sums up to about 30% of the whole project.**
- **ESA expects a significant national support for this project. GOCE-GRAND represents the national contribution.**

European GOCE Gravity Consortium (EGG-C)

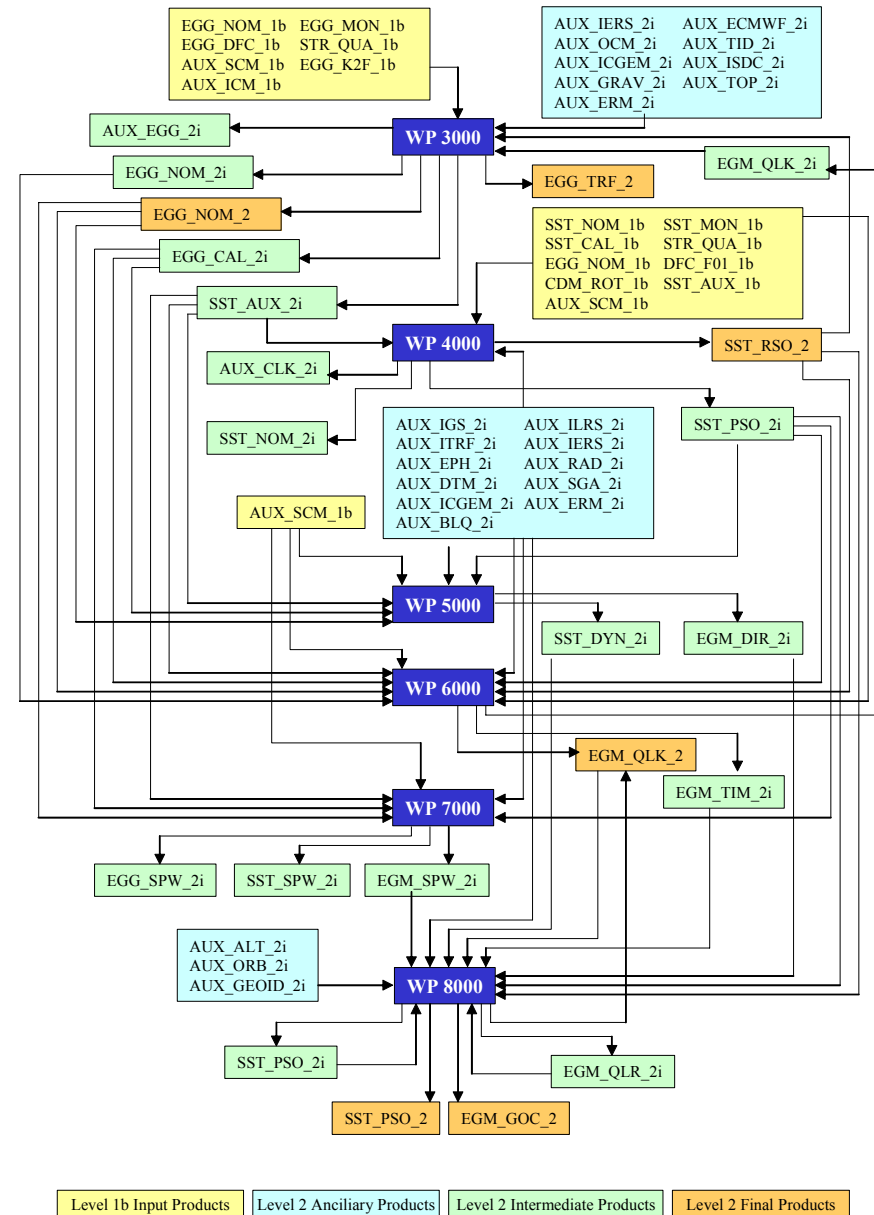


GOCE-GRAND and HPF



HPF Processing Strategy

1. The HPF will use **all level 1b** data and a **variety of ancillary data** for generation of level 2 products.
2. **Intermediate level 2 products** will be generated in all work packages. In most cases they are used as input for another work package.
3. Level 2 products are divided into **quick-look products** targeting for a low latency with reasonable accuracy and **final products** targeting for ultimate precision.



Conclusions

1. The GOCE-GRAND project running according to plan in phase 1. At the end of this phase (Dec. 2004) algorithms for a complete GOCE processing chain have been selected.
2. 5 out of 6 work packages and 4 partners of GOCE-GRAND are involved in ESA ground processing facilities. This is thanks to the possibility to prepare the GOCE-GRAND processing chain in phase 1 of the project and to gain significant expertise for the GOCE system.
3. Phase 2 of GOCE-GRAND is required to implement and test the developed algorithms and to enable full GOCE data exploitation for gravity field processing. This will secure the leading function of German institutes within the GOCE science data processing environment.