Future Satellite Gravity Missions

Activities in Germany

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and many further colleagues in Germany

Activities in Germany

- Recent satellite gravity field missions
- Future gravity field missions
  - Short-term
  - Long-term

Recent gravity field missions

- Major role in development, realisation and operation of CHAMP, GRACE and GOCE
- Long tradition in gravity field recovery (EIGEN-GRACE05S, EIGEN-5C,ITG-GRACE03, EGG08)
- GOCE processing:
  - ESA-HPF (High-Level Processing Facility) with strong German contribution (lead R. Rummel, Munich)
  - REAL GOCE (lead W. Schuh, Bonn): data analysis, cal/val, final products
- CHAMP/GRACE processing:
  - Consistent re-processing (lead F. Flechtner, GFZ)

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Recent missions (2)

- DFG priority program “Mass transport and mass distributions in the system Earth”
  - 2006 – 2012 (lead J. Kusche, IGG Bonn)
  - Maximum exploitation of GRACE/GOCE in terms of Earth system research
  - www.massentransporte.de

Future missions: short-term

- NASA/JPL (lead M. Watkins) and EADS/Astrium:
  - „copy“ of GRACE
  - K-band ranging, with refined instrumentation
- GFZ (lead F. Flechtner) and STI („GRAF“)
  - Use German technology
  - GRACE-like, with optical link
  - Various scenarios (altitude, separation, accuracy)
- Meeting at GFZ on October 21, 2009
  - „Combine“ both concepts, financial constraints
  - Define further strategy towards realisation

Future missions: long-term

- DLR call for the study of novel Earth observation concepts in 2009
  - 3 proposals dedicated to gravity field missions
  - None was selected

- ESA calls
  - “Monitoring and modelling individual sources of mass distribution and transport in the Earth system by means of satellites” – completed in 2009
  - “Assessment of a Next Generation Gravity Mission to monitor the variations of Earth’s gravity field”

    - 2 proposals with German contribution accepted,

    Alenia, GIS, IAPG and EADS/Astrium, GFZ, IGG Bonn

Future missions: long-term (2)

- Study on novel concepts and technology
  - Funded by BMBF, R&D Geotechnologien-Program
  - Partners from universities and industry
  - Lead N. Sneeuw Stuttgart, start August 2009

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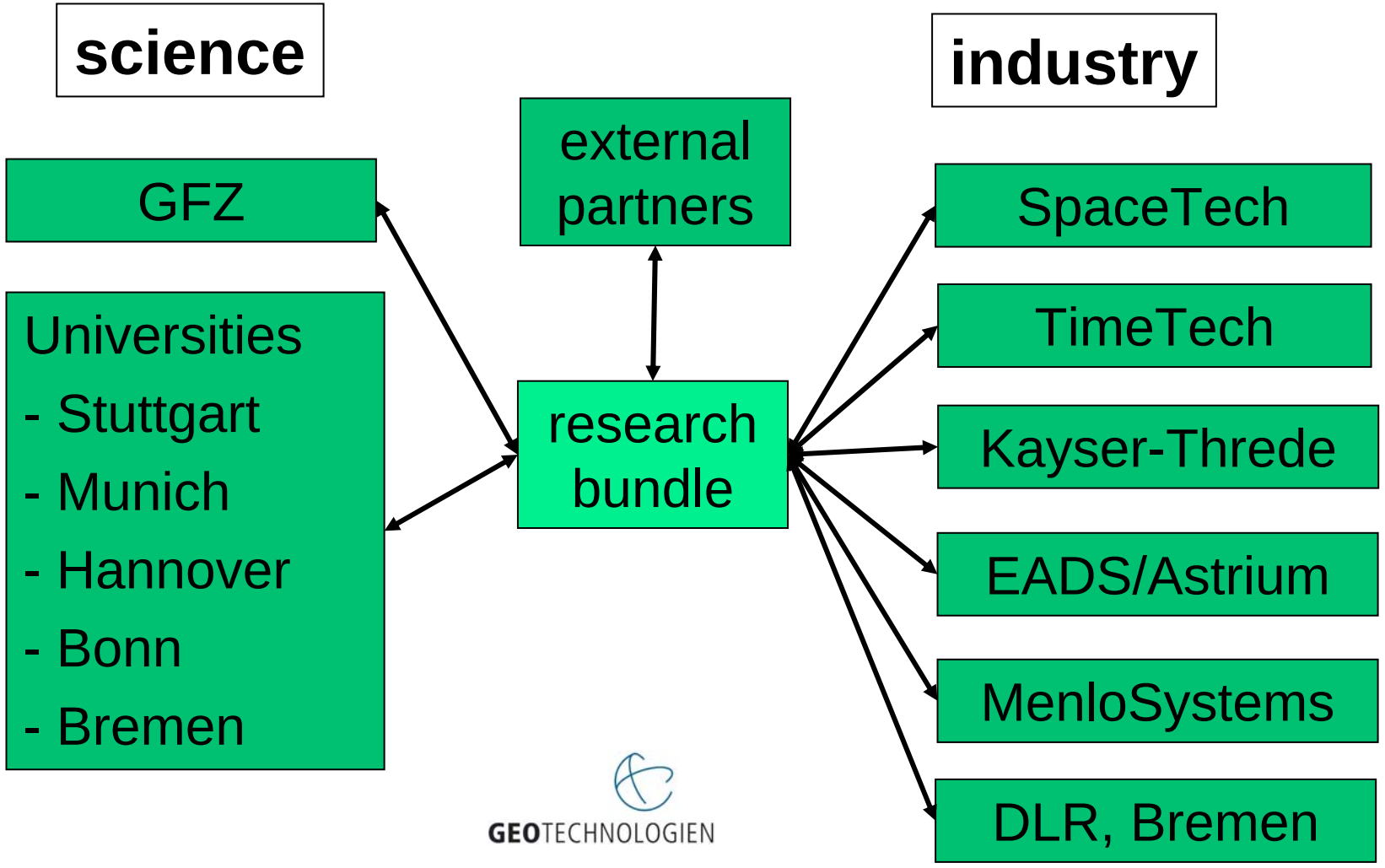
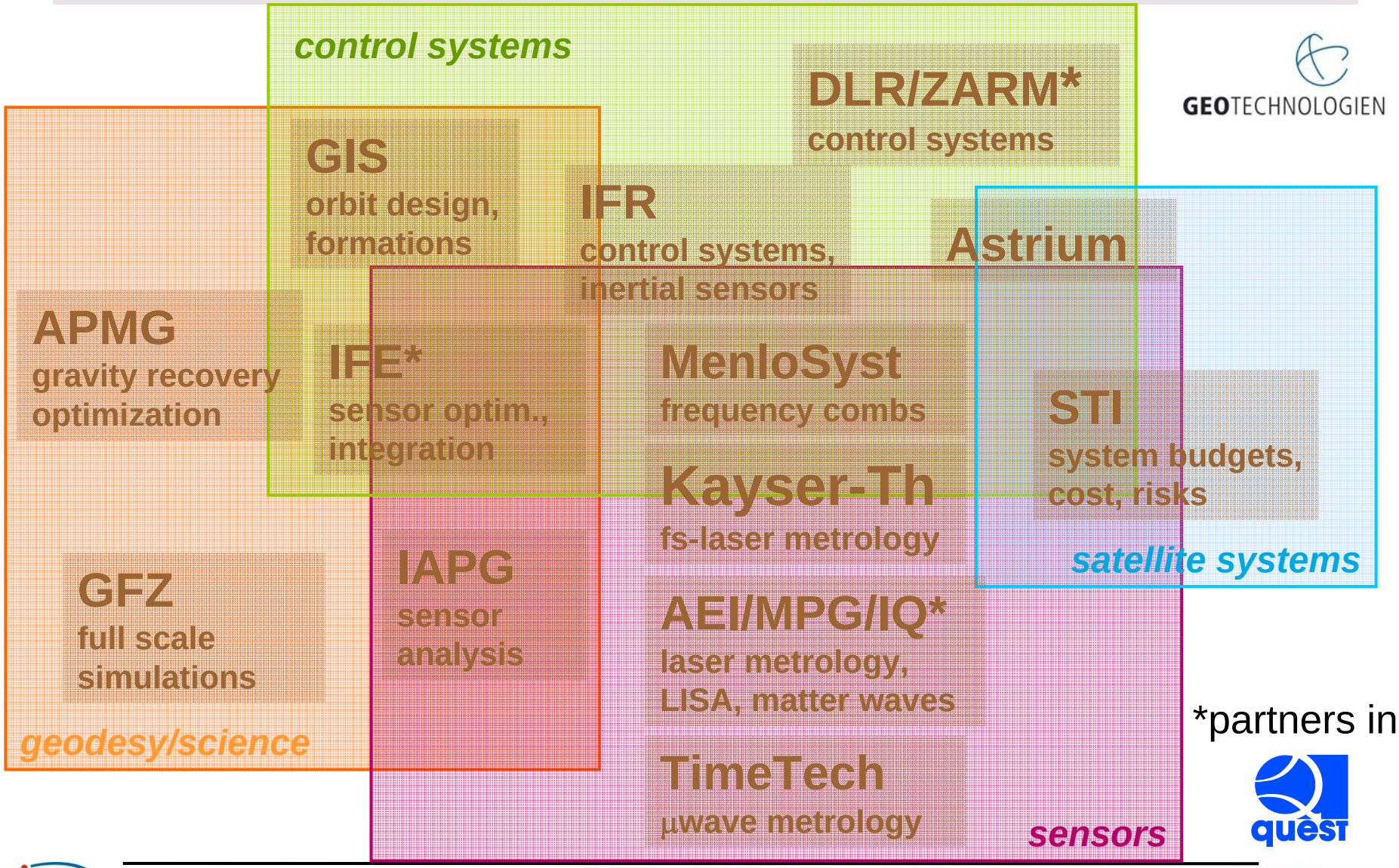
- Task group on next generation gravity field missions within the centre of excellence QUEST
  - University of Hannover, Physics + Geodesy
  - DFG funding, excellence initiative
  - New professorship (Jakob Flury) on Precision Geodesy on Earth and in Space

quest

BMBF: Partners in Science and Industry



Project Areas and Participating Teams



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*partners in

QUEST

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Leibniz Universität Hannover

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QUEST Centre for Quantum Engineering and Space-Time Research

QUEST TG7:

Gravity Field Mission of the Next Generation

- **One of 9 "task groups" in QUEST**
- **Idea: combine various competences**
  - **IfE: Geodesy, science requirements**
  - **AEI: Interferometry, LISA, LISA Pathfinder**
  - **IQ: Quantum gyros and accelerometers**
  - **IFAM: Numerical computation**
  - **ZARM: satellite dynamics, drag-free control**
- **Start of TG7 in 2008**

Conclusions

New Generation Gravity Field Missions

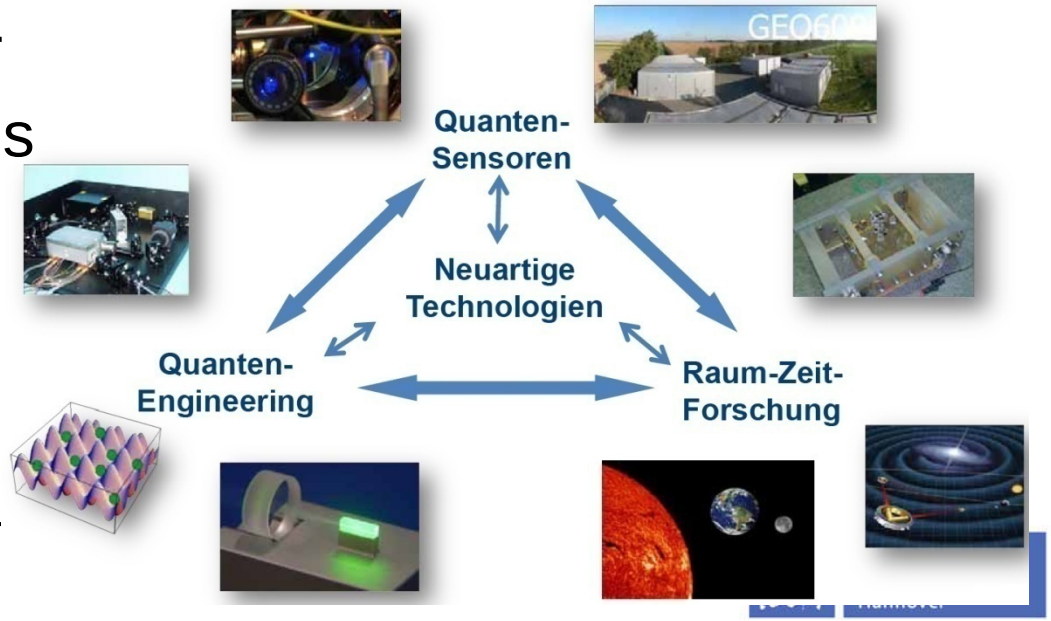
- Various interests and activities in Germany
  - at universities
  - in industry
  - at agencies ?!
  - partly in international cooperation
- Support/integration of other international initiatives

QUEST Centre for Quantum Engineering and Space-Time Research

New excellence cluster at Leibniz Universität Hannover
(Physics, Mathematics, Geodesy)

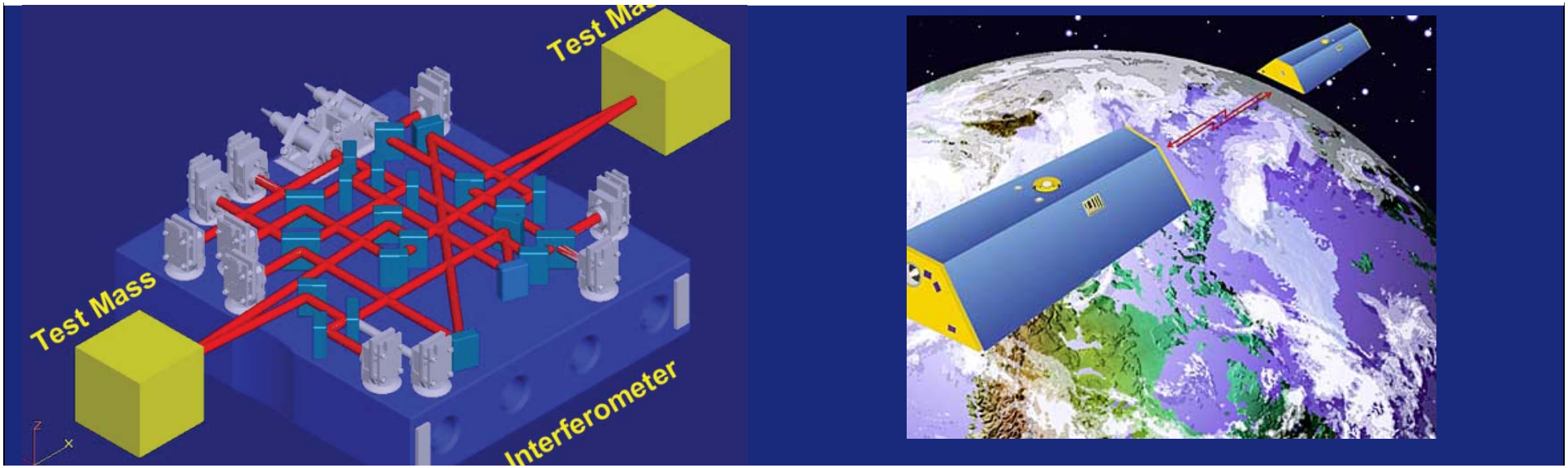
Further partners

- MPI for Gravitational Physics (Albert-Einstein-Institut, AEI)
- ZARM (Bremen)
- PTB (Braunschweig)
- Laser Zentrum Hannover
- 60 new research positions
- 6.5 Mio € per year
- 5 years

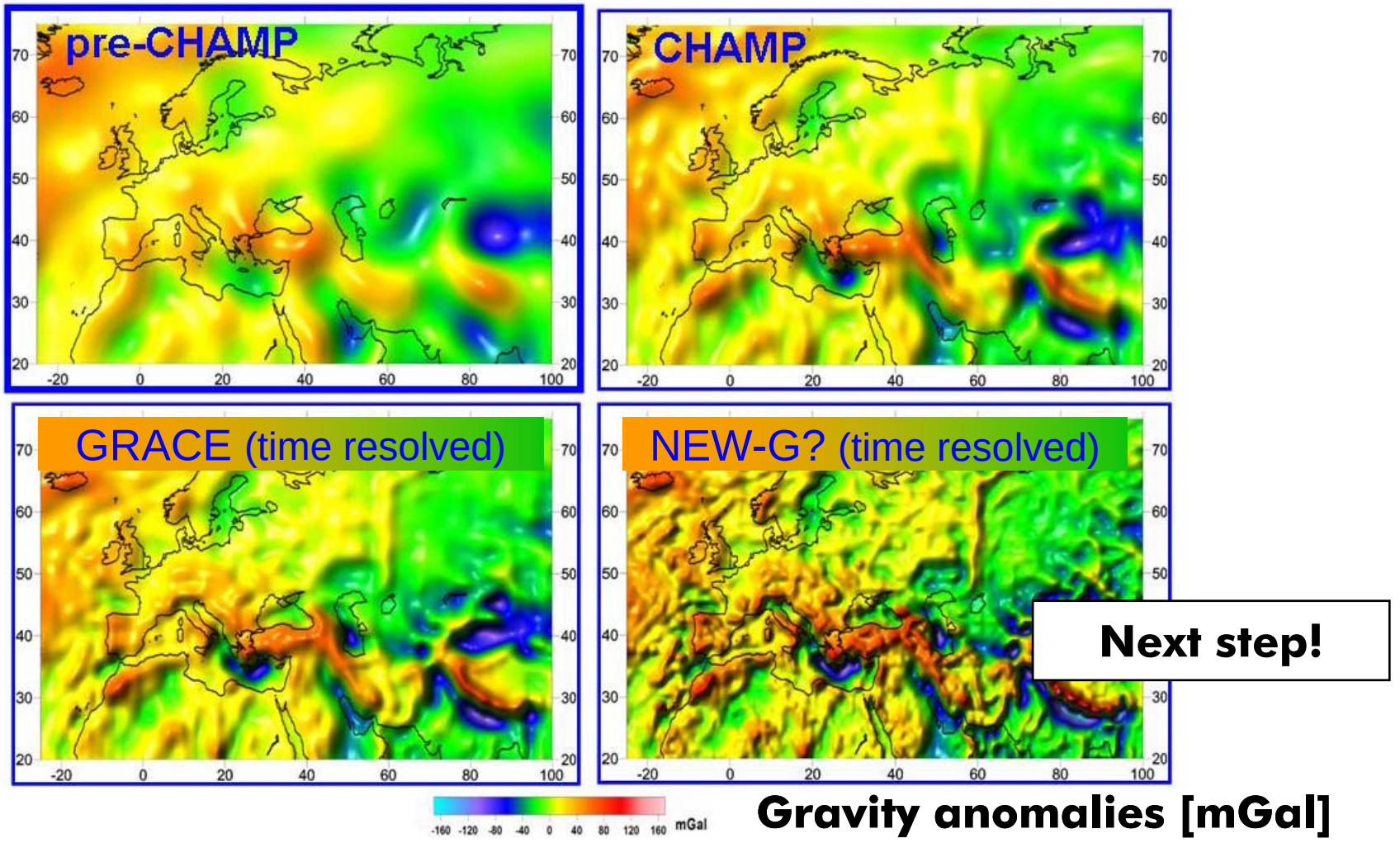


Goals for the next generation

- GRACE and GOCE follow-on
- Drag-free technology
- Laser interferometry - Gradiometry
- Multiple satellite/orbit configurations
- De-Aliasing, Signal separation



Development of Gravity Fields

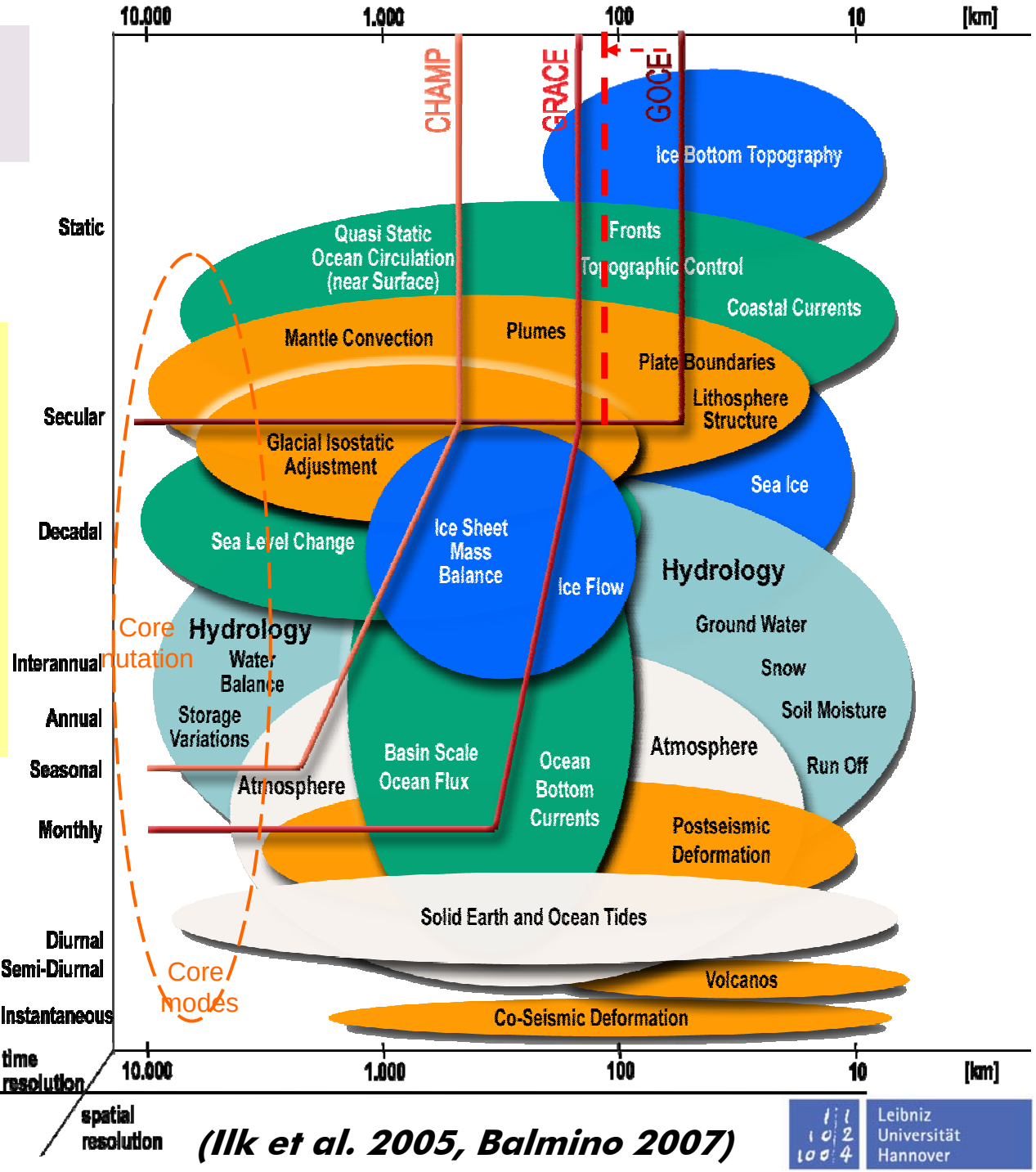


Next step!

Gravity anomalies [mGal]

Mass effects

space and time scales of time-variable geoid due to
Solid Earth
Ocean
Ice
&
Hydrology



(Ilk et al. 2005, Balmino 2007)