

Space-Time Reference Systems for Monitoring Global Change and for Precise Navigation in Space



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DFG Research Unit (Second Phase in Preparation)

Motivation

- Accuracy of measurements higher than that of reference frame realizations
- Geodetic/geophysical interpretation and navigational requirements have pushed accuracy requirements
- A consistent framework for all space techniques is missing
- Further progress only possible through a consistent realization and consistent link of all reference systems

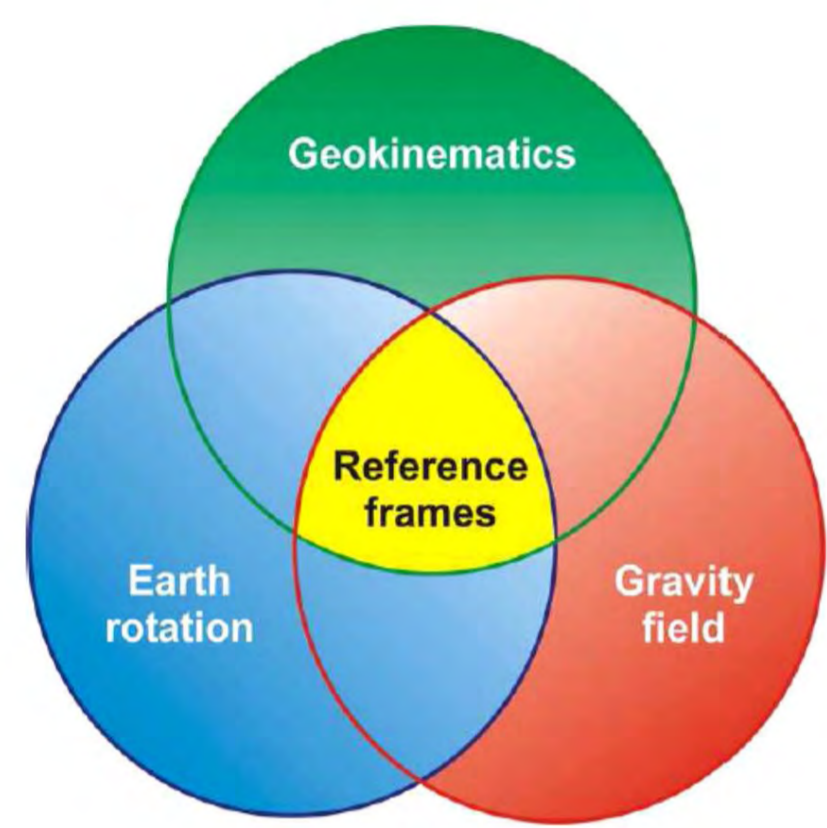


Fig. 1: Reference frames are central for kinematics, rotation and gravity field. This applies to the Earth, the Moon and the planets.

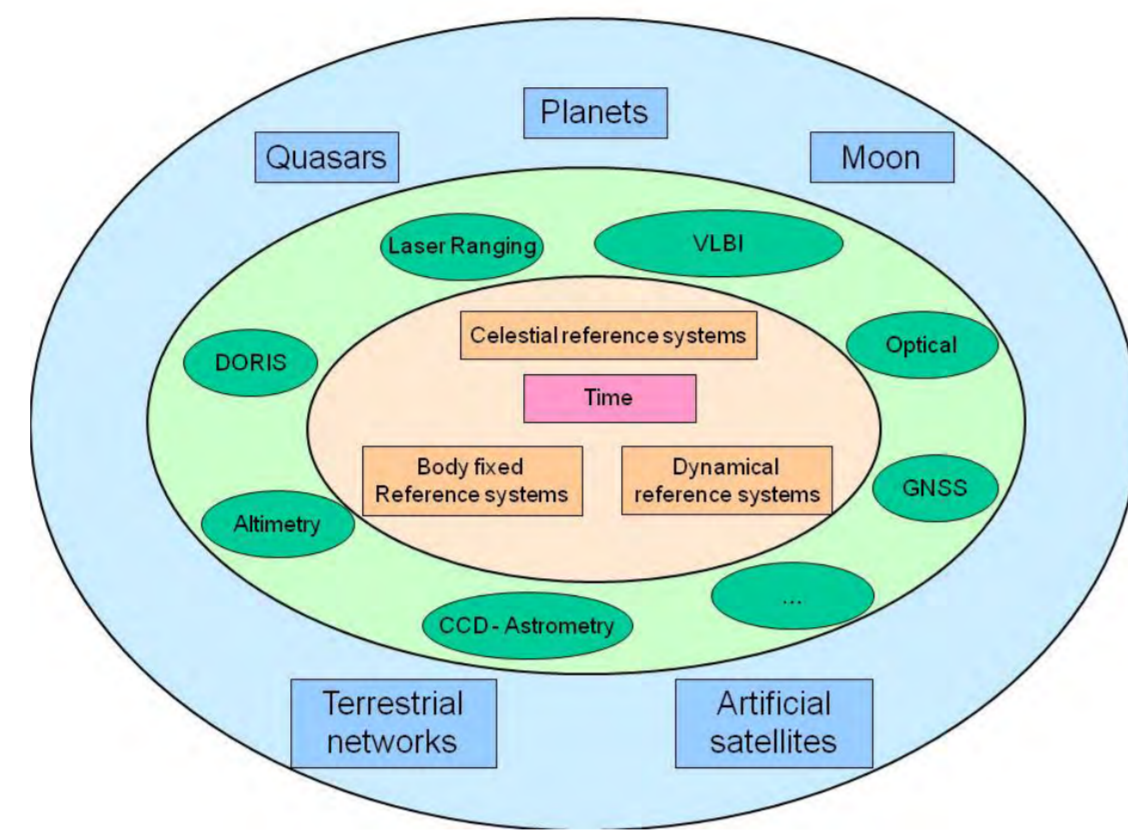


Fig. 2: The world of objects, reference systems and observations covered in this Research Unit

Goals and tasks

Goals defined in Whitebook (Nothnagel et al. 2010)

- G1 Consistency of reference systems
- G2 Definition of high-precision reference systems
- G3 Improvement of physical background models
- G4 Integration of all space-geodetic and astrometric observations
- G5 Realization of next generation reference systems
- G6 Near-real-time determination and availability of reference frames

Tasks defined to reach the goals above

- T1 Refinement of definitions and conventions
- T2 Homogenisation of models for data reduction and parameterisation
- T3 Improvement in the realisation of geocentric, selenocentric and planetocentric reference frames
- T4 Control and improvement of solar system ephemerides
- T5 Realisation of the geodetic datum
- T6 Investigations in relativistic effects in the context of next generation reference frames
- T7 Refinement of co-location of sensors on Earth and in space
- T8 Development of refined combination strategies
- T9 Realisations of links between reference frames
- T10 Investigations in quality and long-term stability of reference frames
- T11 Establishment of real-time reference frames

Structure of the Research Unit

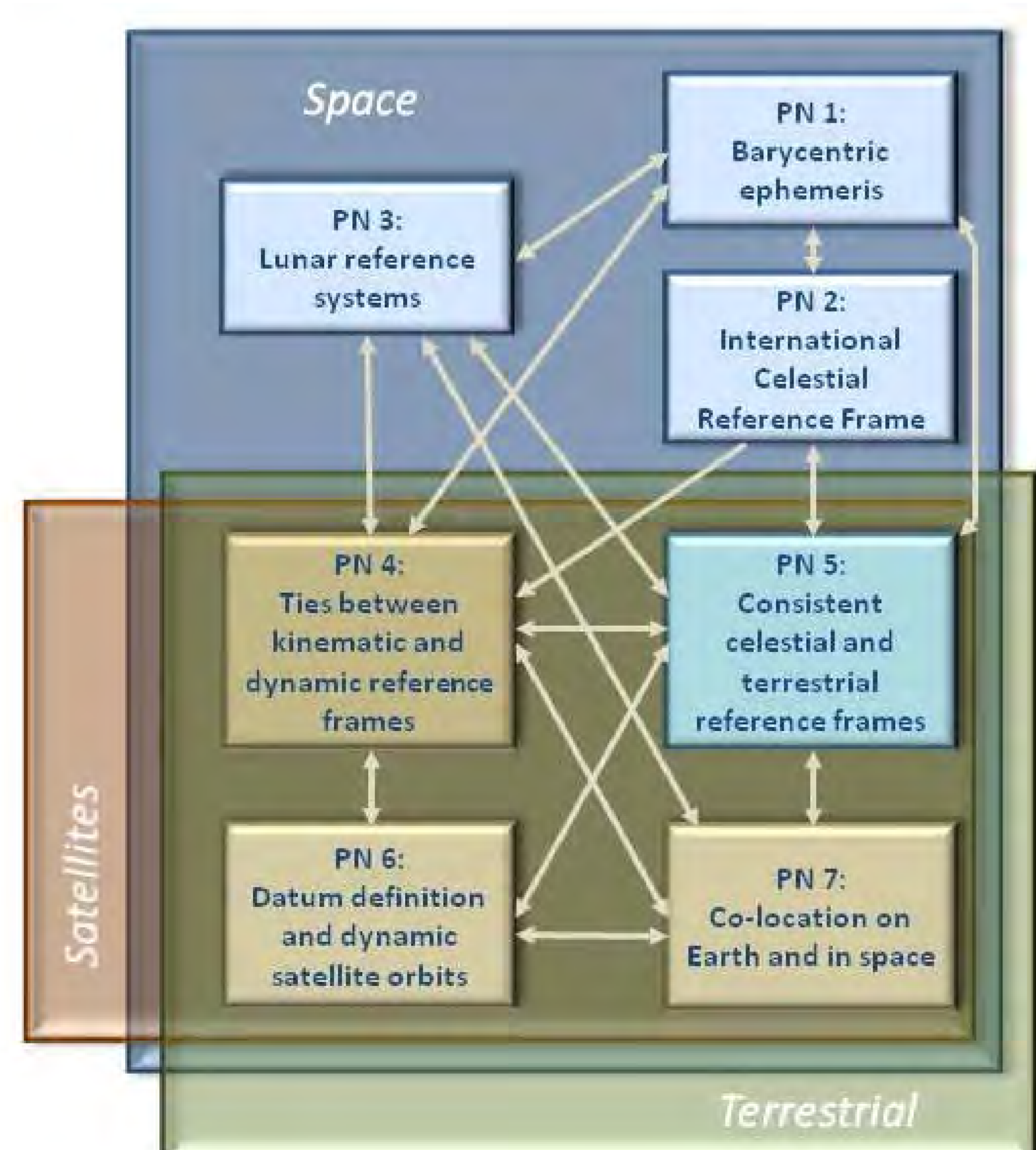
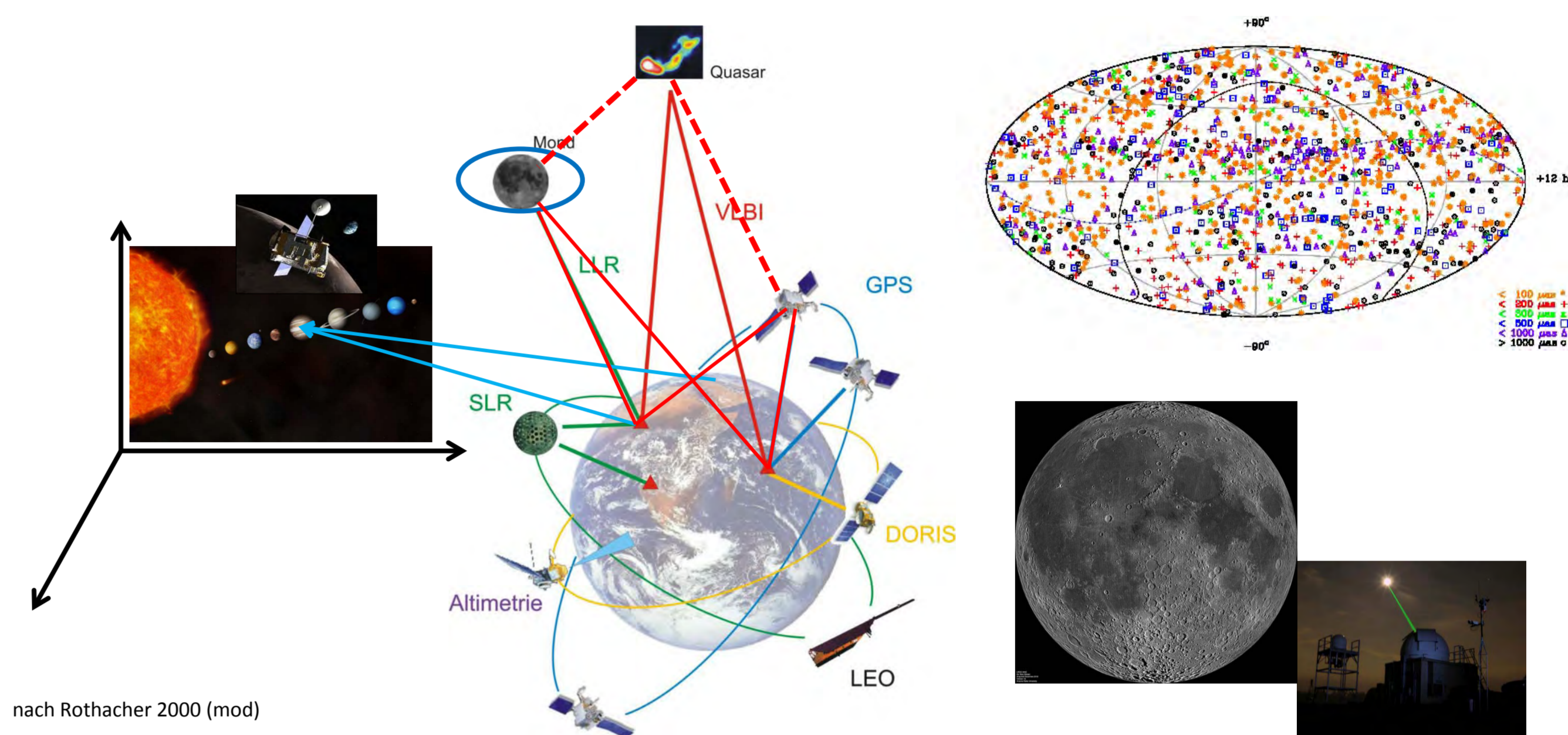


Fig. 3: Projects of the Research Unit

Reference
Nothnagel A., D. Angermann, K. Börger, R. Dietrich, H. Drewes, B. Görres, U. Hugentobler, J. Ihde, J. Müller, J. Oberst, M. Pätzold, B. Richter, M. Rothacher, U. Schreiber, H. Schuh, M. Soffel (2010) Space-Time Reference Systems for Monitoring Global Change and for Precise Navigation. Mitteilungen des Bundesamtes für Kartographie und Geodäsie, Band 44, Frankfurt/Main.

Research areas



nach Rothacher 2000 (mod)

Fig. 4: Solar system ephemeris and space ties

Fig. 5: Celestial reference systems and the moon

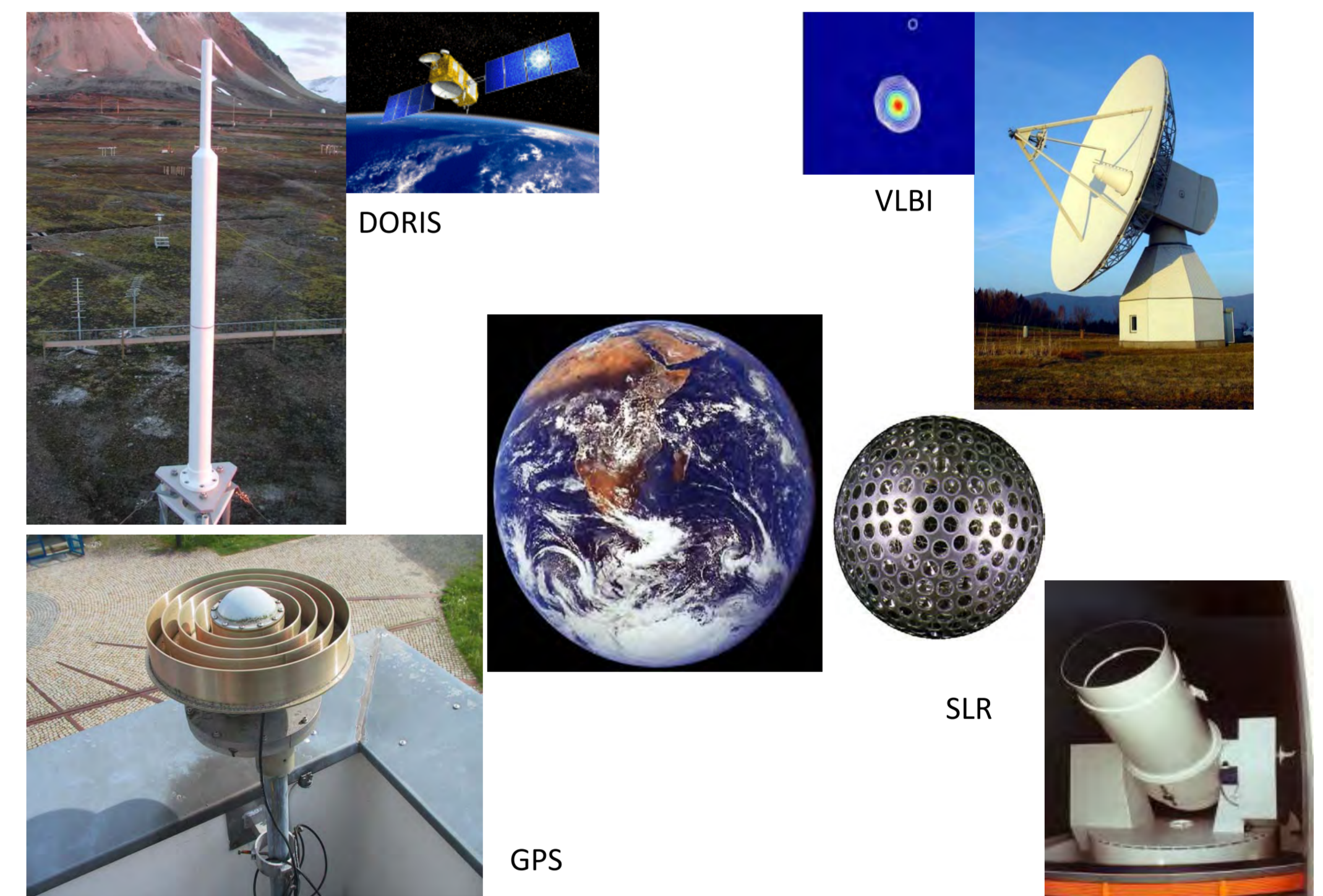


Fig. 6: Earth-bound space-geodetic observing systems



Fig. 7: Tie vectors between observing systems on Earth and in Space

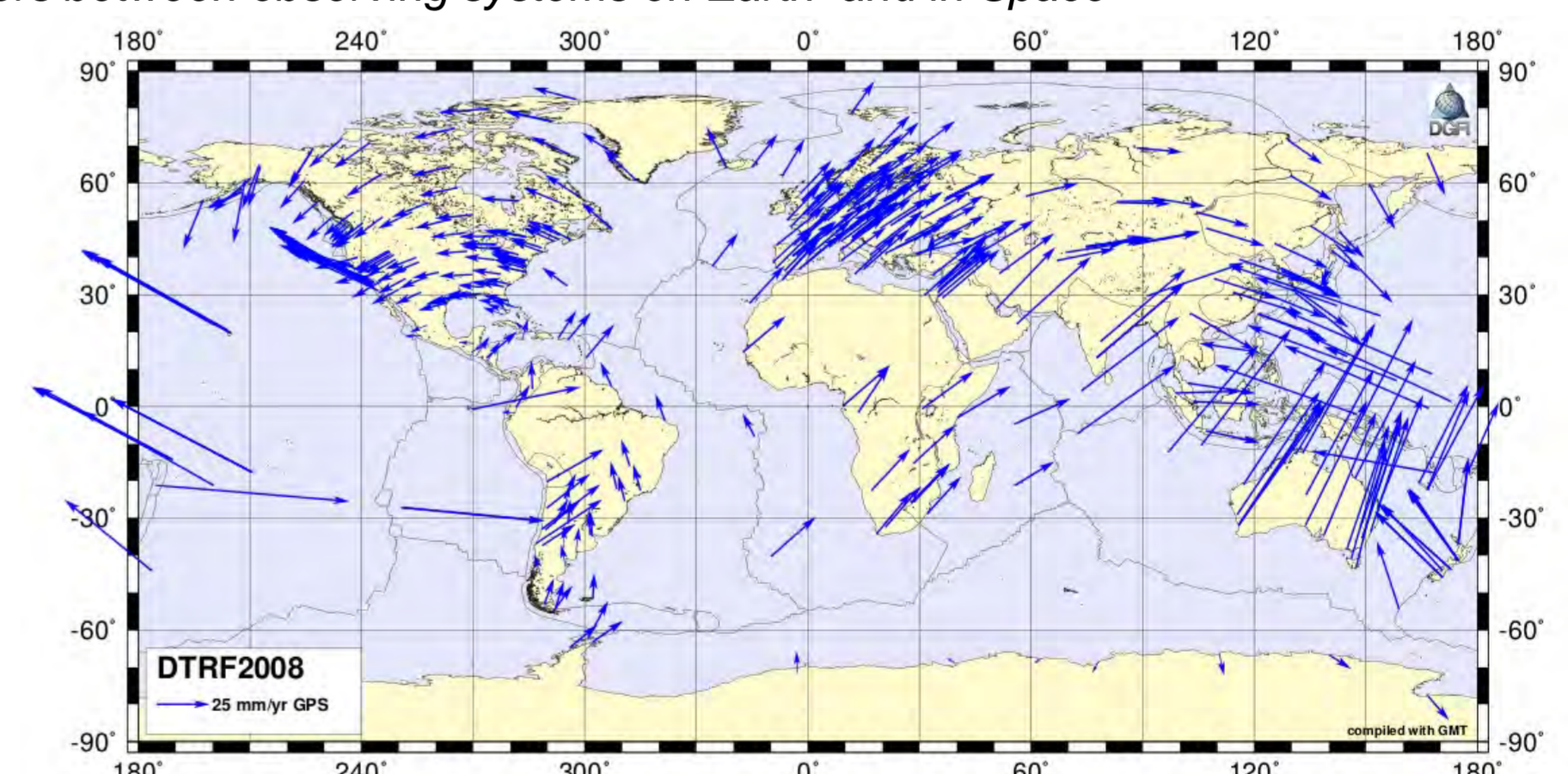


Fig. 8: Terrestrial reference systems, datum definition and geophysical models

Additional benefits of the Research Unit

Additional key achievements

- Advances in methodology
- Application of geodetic methodologies to Moon and planets
- Stronger cooperations between disciplines

Promotion of young scientists

- Integration in a profound network of scientists
- Introduction into global science community
- Dedicated female courses on project management and conflict handling

Impact on Earth-, Moon-, Planetary -System Sciences

- IAG Global Geodetic Observing System (GGOS)
- IAU/IAG Working Group on Planetary Coordinates + Rotational Elements
- IAU Working Group on ICRF-3
- Other IAG/IAU/IERS Working Groups
- Space probe missions (Chang'E-3, Lunar Reconnaissance Orbiter, Venus Express ...)