Assessment of Global Change by Geodetic Techniques

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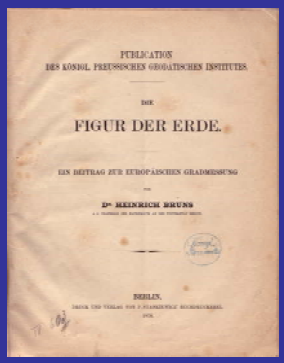
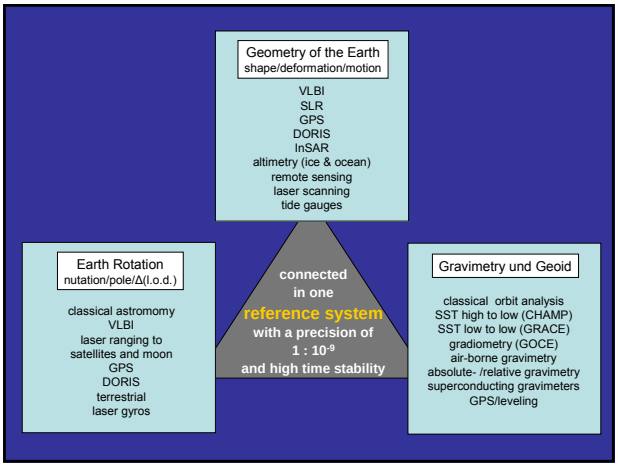
nature, 18.08.2005



Heinrich Bruns, 1848 - 1919

from
- horizontal angles
- vertical angles
- astronomical positioning
- levelling and
- pendulum measurements

to the
„Bruns polyhedron“



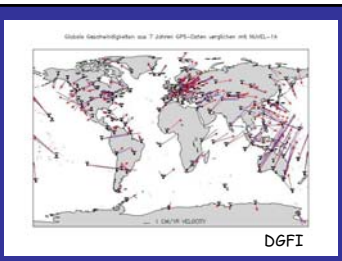
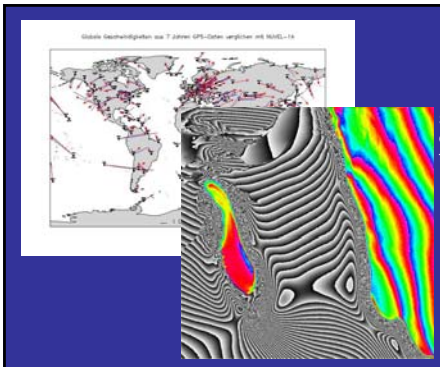


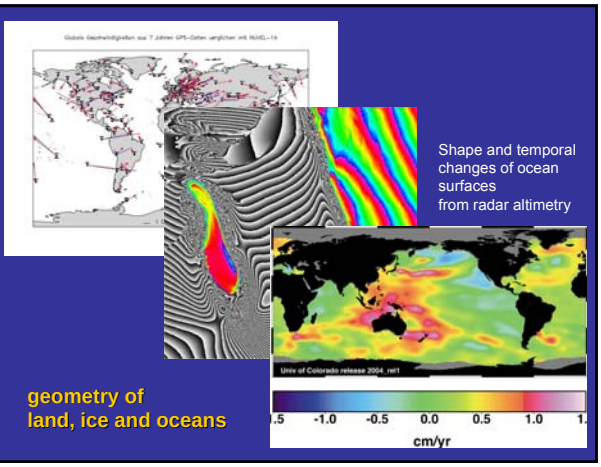
plate motions from
geodetic space techniques

**geometry of
land, ice and oceans**



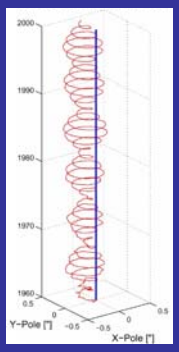
Shape and velocities
of major ice shields
from InSAR

**geometry of
land, ice and oceans**



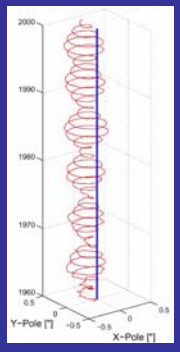
Shape and temporal
changes of ocean
surfaces
from radar altimetry

**geometry of
land, ice and oceans**



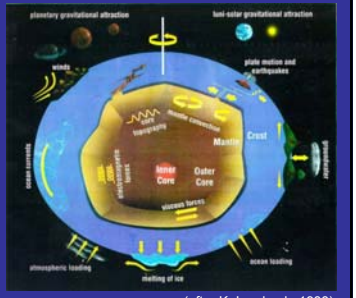
40 years of polar motion
from
GPS,
Very Long Baseline Interferometry
and
satellite laser ranging

**Earth rotation from
VLBI and SLR**

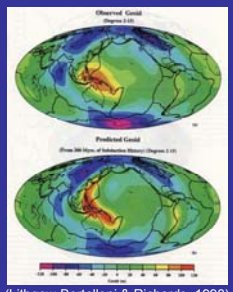


**Earth rotation from
VLBI and SLR**

reflects all mass change
and exchange of angular momentum
between
the components
of Earth system



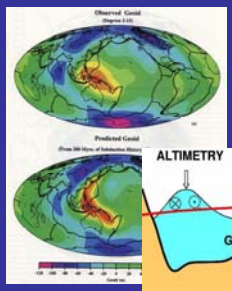
(after K. Lambeck, 1988)



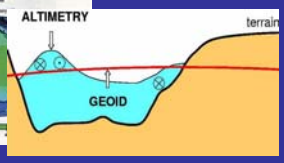
(Lithgow-Bertelloni & Richards, 1998)

A look into the Earth's mantle

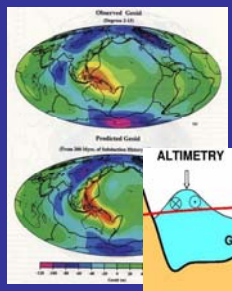
**Gravity and geoid from
satellite gravimetry**

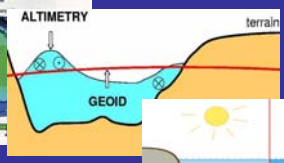


geoid – a level relative to which ocean circulation is measured

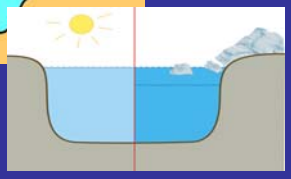


Gravity and geoid from satellite gravimetry

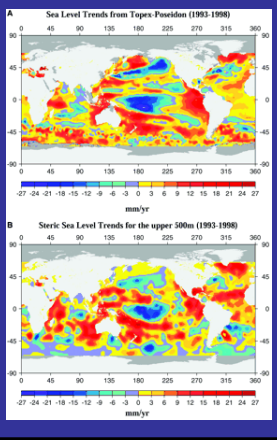




sea level rise: temporal gravity allows to discern thermal expansion from ice melting



Gravity and geoid from satellite gravimetry



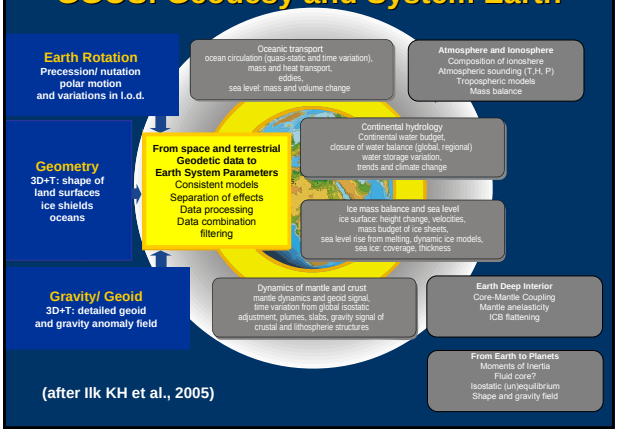
Sea level

Sea level change from satellite altimetry (T/P altimetry, 1993-1998)

Sea level change due to thermal expansion (temperature at depth 500m, 1993-1998)

(Cabanes, Cazenave & LeProvost, 2001)

GGOS: Geodesy and System Earth



(after Ilk KH et al., 2005)

GALILEO-System

ESA-ENVISAT

geometry of land, ice and oceans

Satellite laser ranging and VLBI-Teleskop at Wettzell observatory

Earth rotation from VLBI and SLR

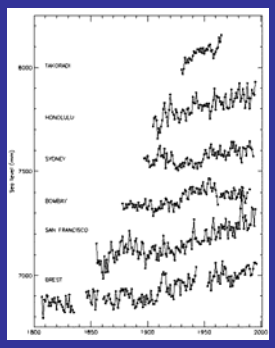
ESA-Mission
GOCE
launch 2007

Gravity and geoid from satellite gravimetry

The Challenges

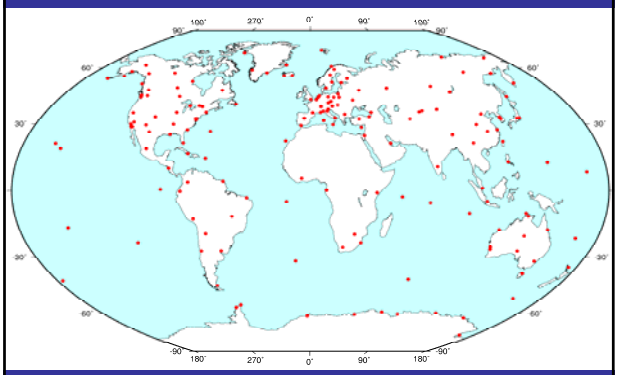
- Global change quanities are small and difficult to detect
- They are often not directly observable but are to be derived from combination of complementary observation and sensor systems and from models
- In order to understand them as global process they have to be scaled relative to the dimension of the Earth

sea level recordings at 6 tide gauges



"from local recordings to global phenomena"

global GPS network



The future role of regional networks

1. calibration and validation of satellite data
2. regional densification in space and time
3. separation and identification of effects

new role of
regional geodetic monitoring networks:
- an opportunity for a FIG - IAG alliance -

in the regions there is
- awareness for the specific Global Change and natural hazards
- geodetic know-how
- expertise and familiarity with the local boundary conditions
- contact with regional authorities
- love for the own country