

Assessment of Global Change by Geodetic Techniques

Reiner Rummel
Astronomische und Physikalische Geodäsie
Technische Universität München
rummel@bv.tum.de

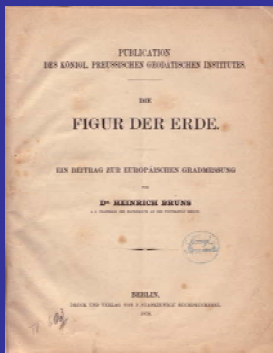
XXII International FIG Congress, Munich, October 10-12, 2006



CBC News Online | Dec. 12, 2005



nature, 18.08.2005

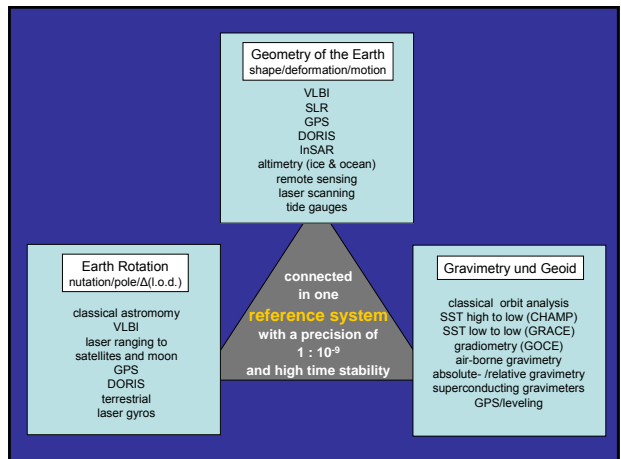


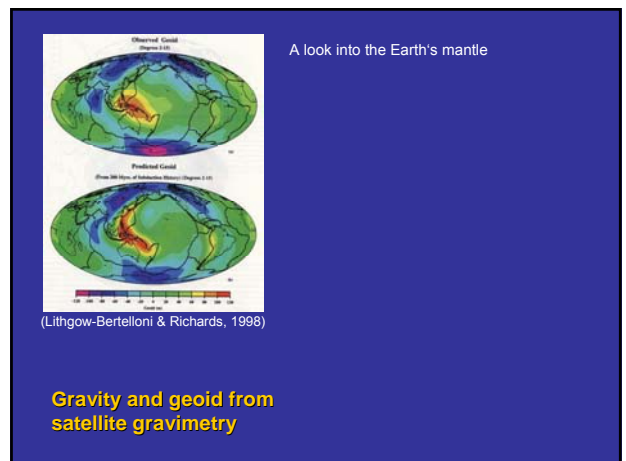
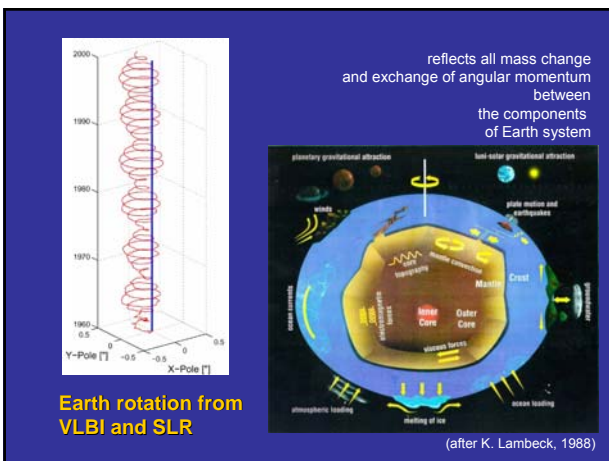
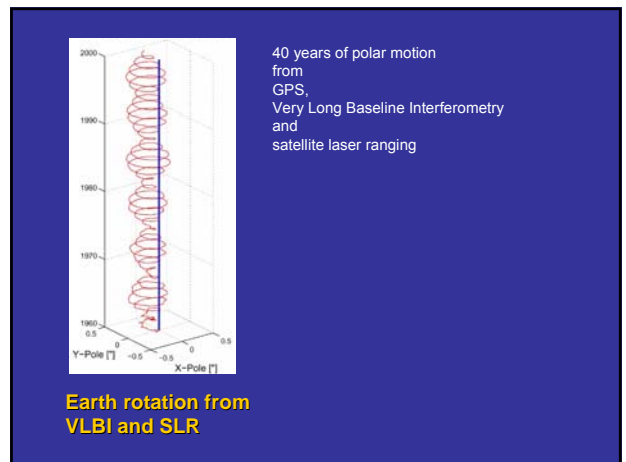
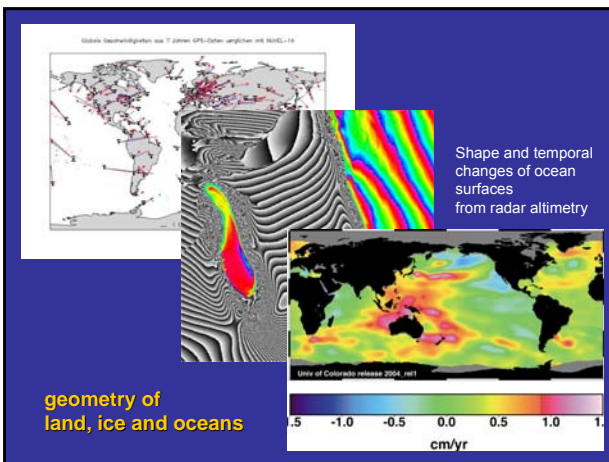
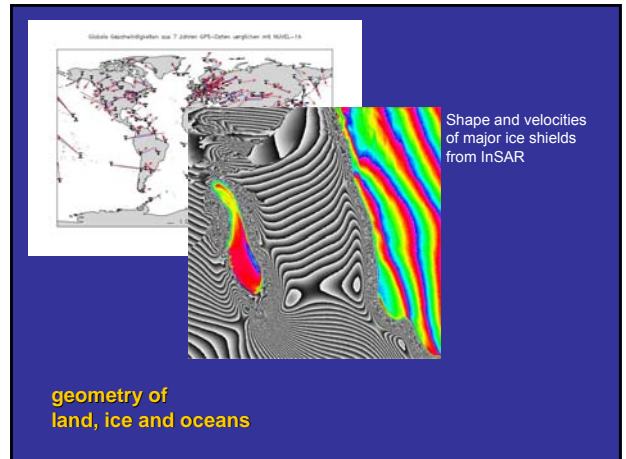
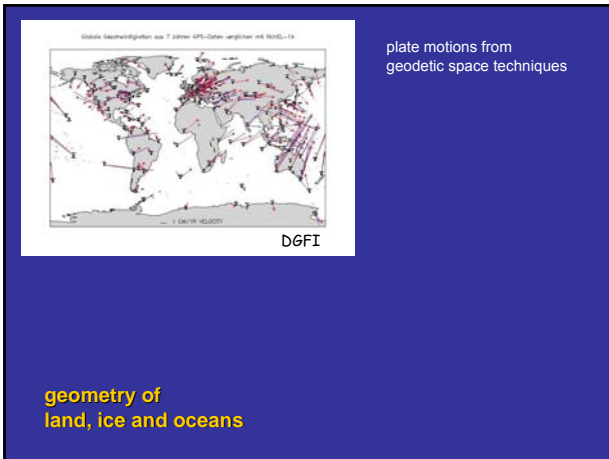
Heinrich Bruns, 1848 - 1919



from

- horizontal angles
- vertical angles
- astronomical positioning
- levelling and
- pendulum measurements to the „Bruns polyhedron“





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

Earth Rotation
Precession/ nutation
polar motion
and variations in I.o.d.

Geometry
3D-T: shape of land surfaces
ice shields
oceans

Gravity/ Geoid
3D-T: detailed geoid
and gravity anomaly field

From space and terrestrial Geodetic data to Earth System Parameters
Consistent models
Separation of effects
Data processing
Data combination
filtering

Oceanic transport
ocean circulation (quasi-static and time variation),
mass and heat transport,
eddies,
sea level, mass and volume change

Atmosphere and Ionosphere
Composition of ionosphere
Atmospheric sounding (T, H, P)
Tropospheric models
Mass balance

Continental hydrology
Continental water budget,
closure of water balance (global, regional)
water storage variation,
floods and climate change

Ice mass balance and sea level
Ice surface: height change, velocities,
mass budget of ice sheets,
sea level rise from melting, dynamic ice models,
sea ice: coverage, thickness

Dynamics of mantle and crust
mantle dynamics and geoid signal,
time variation from global isostatic
adjustment, plumes, slabs, gravity signal of
crustal and lithospheric structures

Earth Deep Interior
Core-Mantle Coupling
Mantle anelasticity
ICB flattening

From Earth to Planets
Moments of inertia
Fluid core?
Isostatic (un)equilibrium
Shape and gravity field

(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



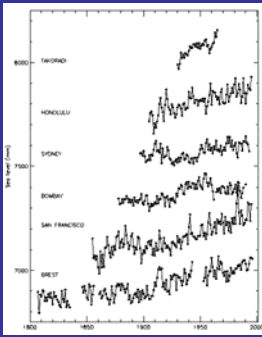
ESA-Mission
GOCE
launch 2007

Gravity and geoid from satellite gravimetry


The Challenges

- Global change **quantities 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**

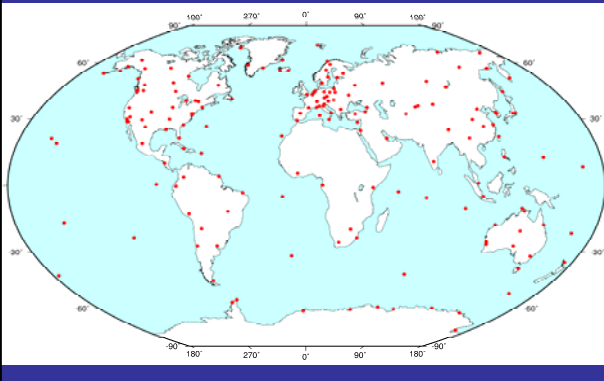
sea level recordings at 6 tide gauges



“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