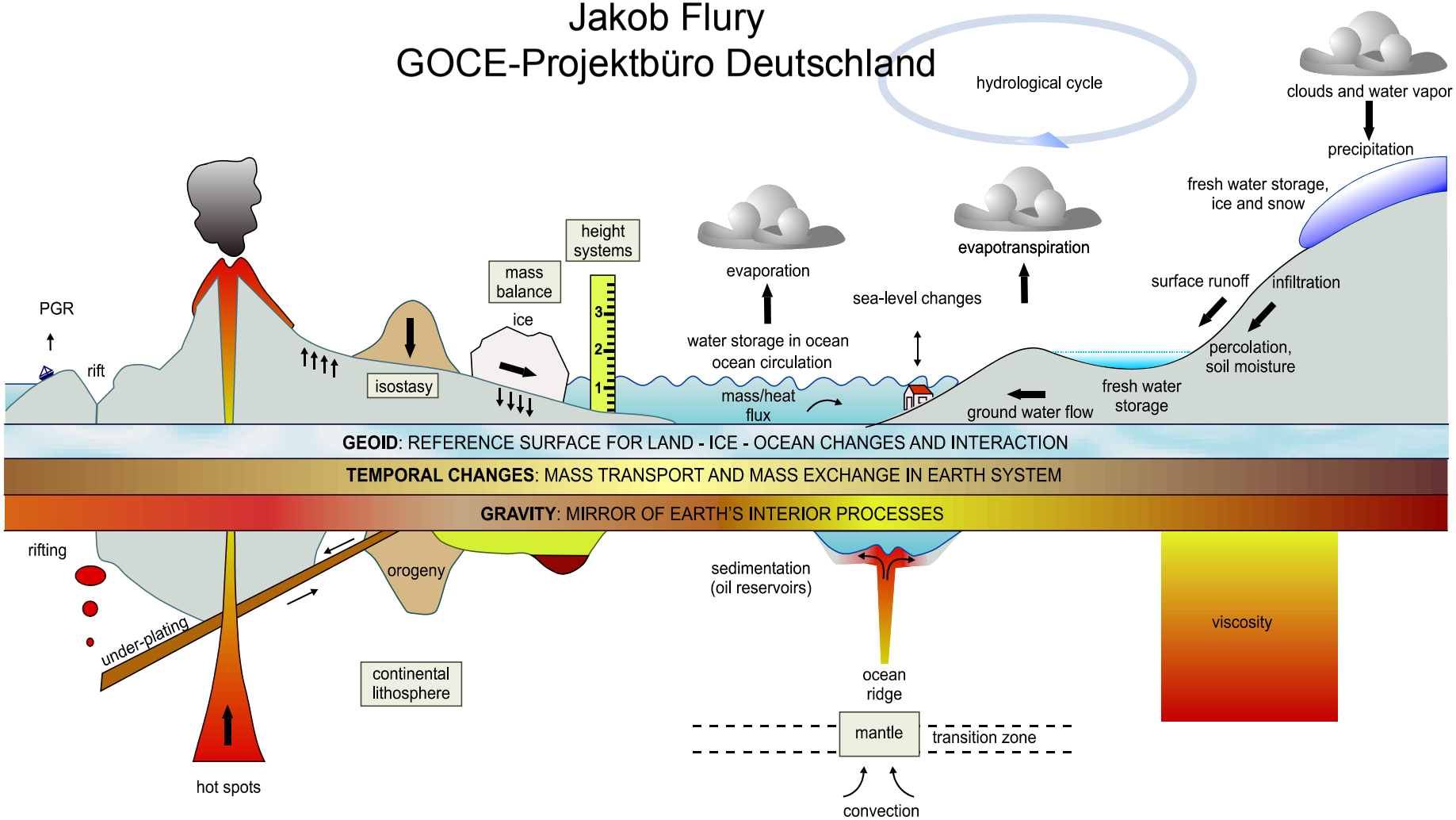
Mass Transport and Mass Distribution in the Earth System

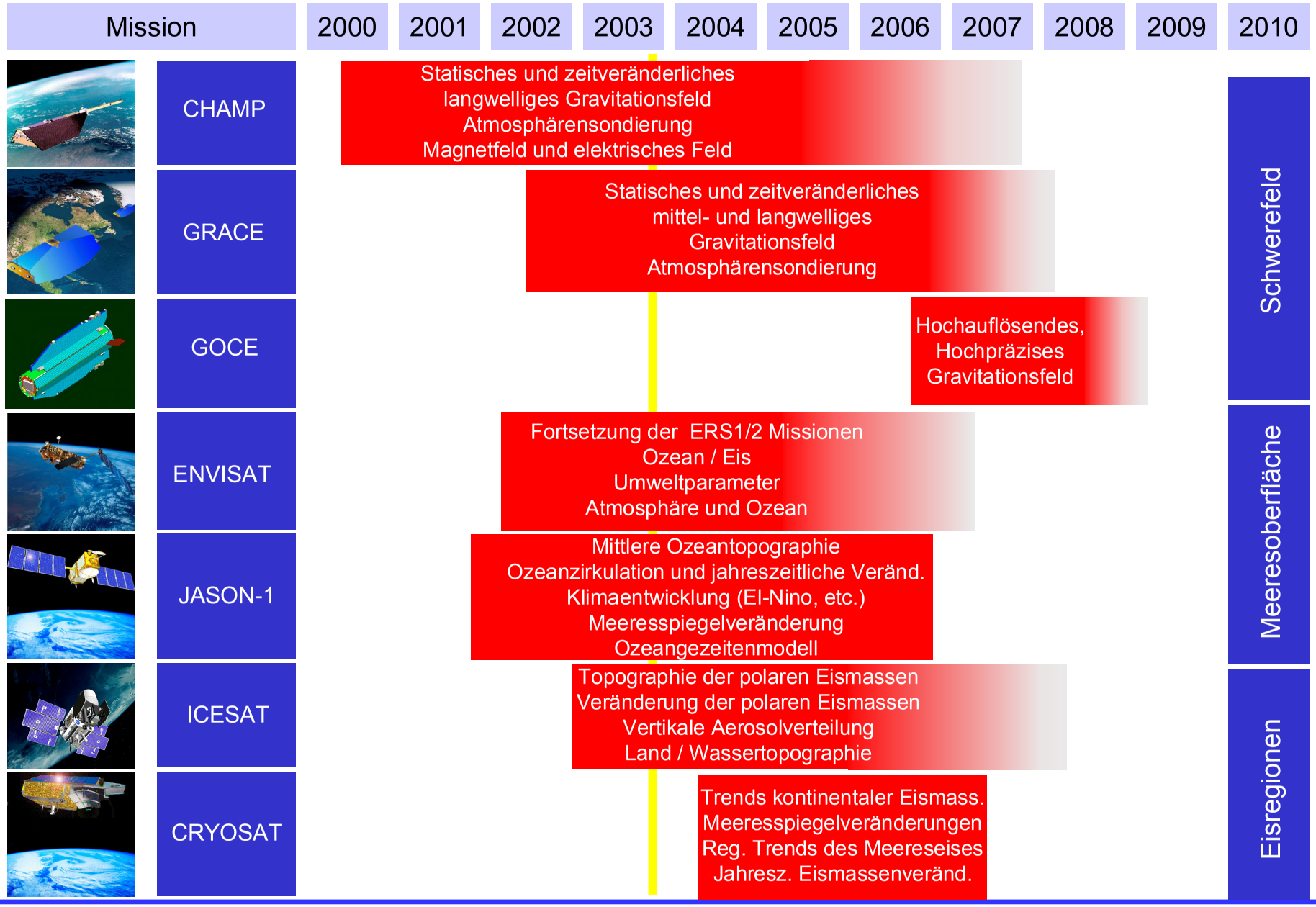
Antrag für ein DFG-Schwerpunktprogramm

Jakob Flury
GOCE-Projektbüro Deutschland



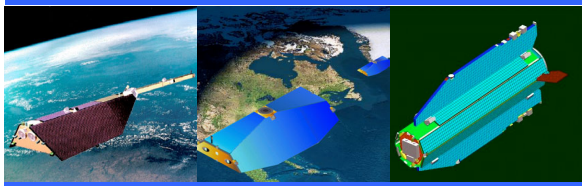
Satellite Missions for Earth Observation

A Decade of Earth Observation by Satellites



Mass Transport in the Earth System

gravity field missions



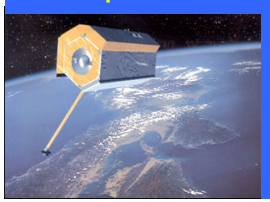
CHAMP GRACE GOCE

altimetry missions

Envisat Jason-1

CryoSat ICESat

complementary remote sensing



TerraSAR, topography, sea surface temperature, winds, salinity, soil moisture etc.

from satellite sensor data to mass signals
consistent combination of missions, reference systems, data preparation for model assimilation, regional representations, filtering, error models, separation of signal components, mass balance, complementary data

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

atmosphere

hydrological cycle
continental water budget, closure of global and regional water balance, water storage variation, trends 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

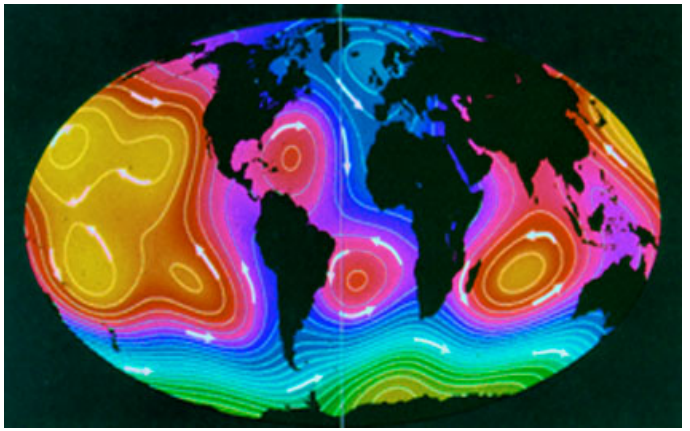
dynamics of mantle and crust
mantle dynamics and geoid signal, geoid time variation from glacial isostatic adjustment, plumes, slabs, gravity signal of crustal and lithosphere structure

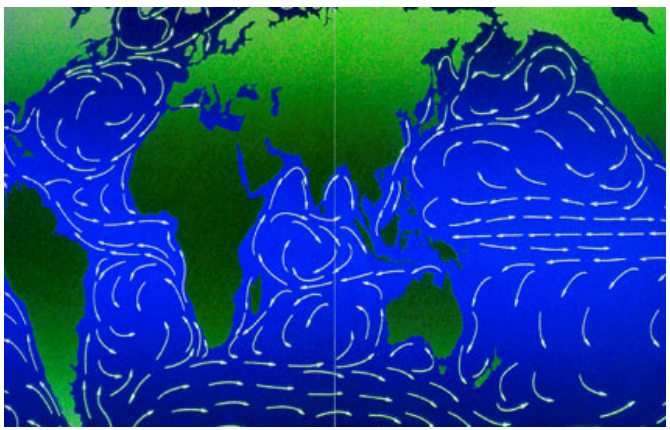
oceanic transports

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

GOCE, GRACE, CHAMP, altimetry

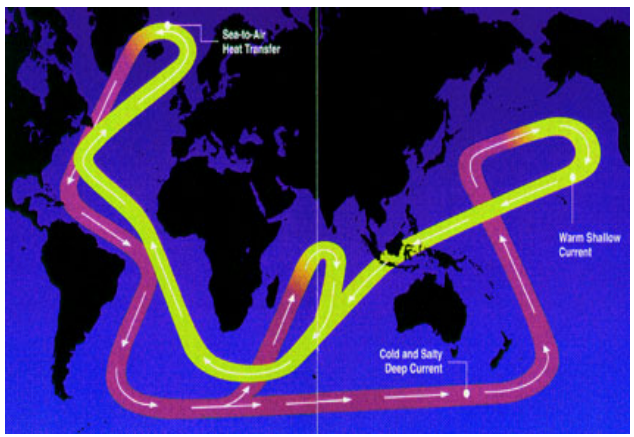
sea surface topography



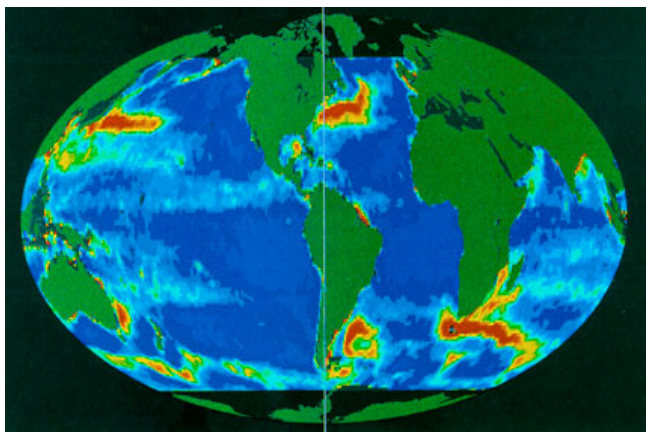


global circulation

deep ocean currents and climate



sea level anomalies

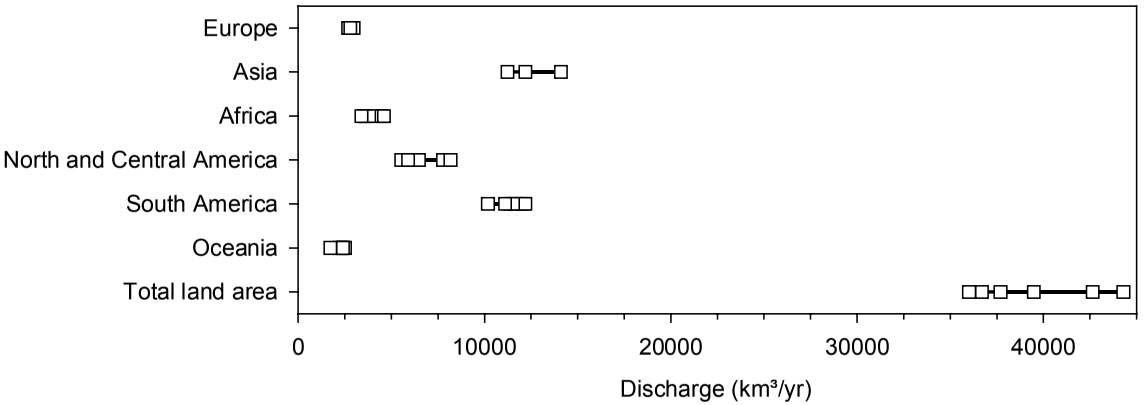


hydrological cycle

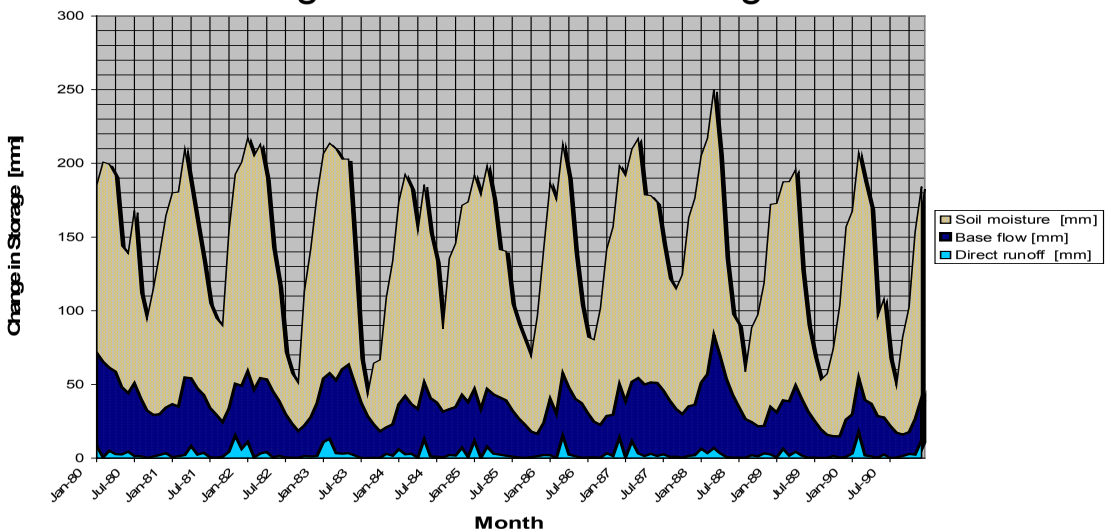
continental water budget,
closure of global / regional water balance,
water storage variation,
evapotranspiration,
trends and climate change

GRACE, altimetry

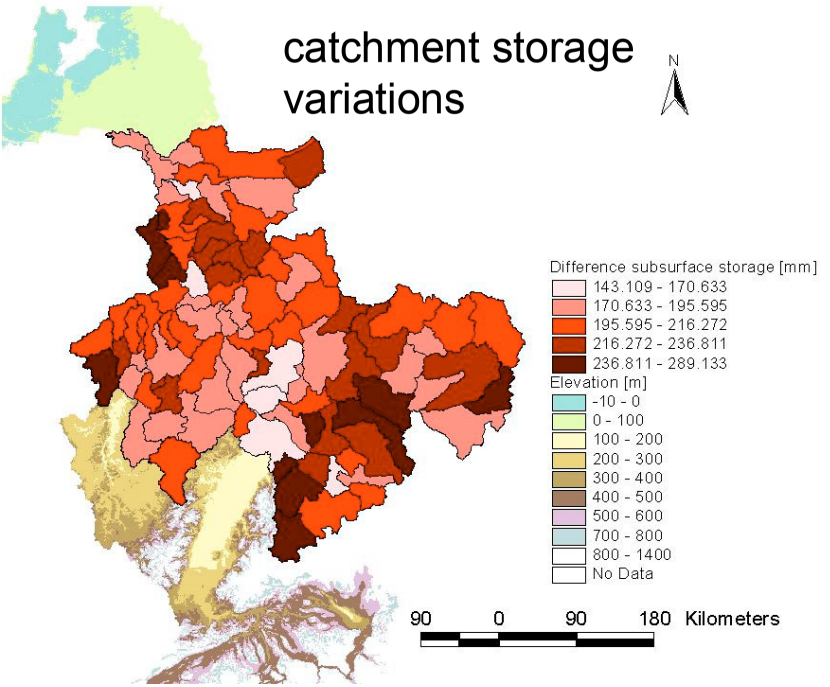
continental runoff budget



exchange between water storages



catchment storage variations

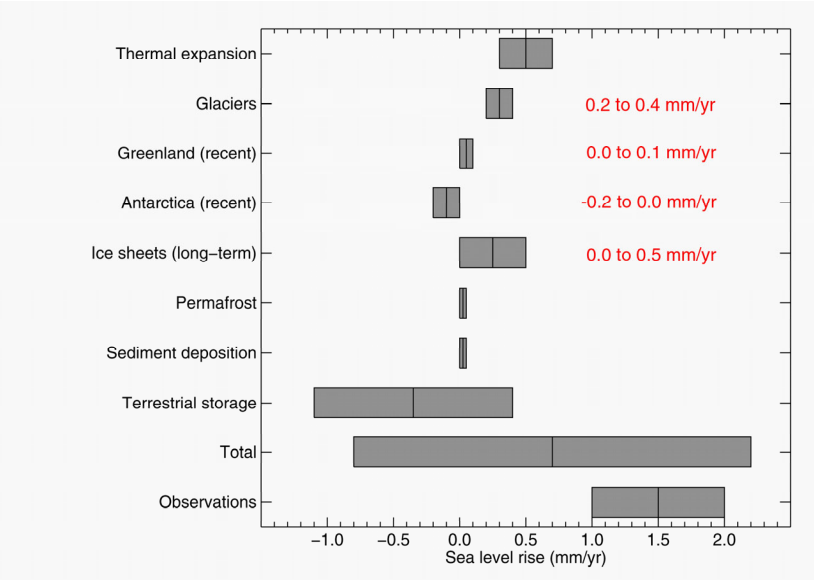


ice mass balance and sea level

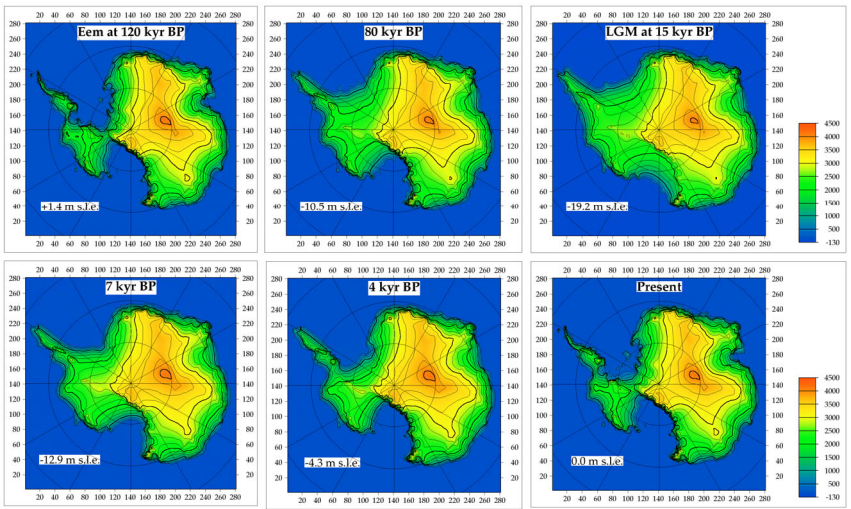
ice surface: height change, velocities,
mass budget of ice sheets,
sea level rise from melting,
dynamic ice models, sea ice: coverage, thickness

GRACE, GOCE, CryoSat,
ICESat, GPS, InSAR, ...

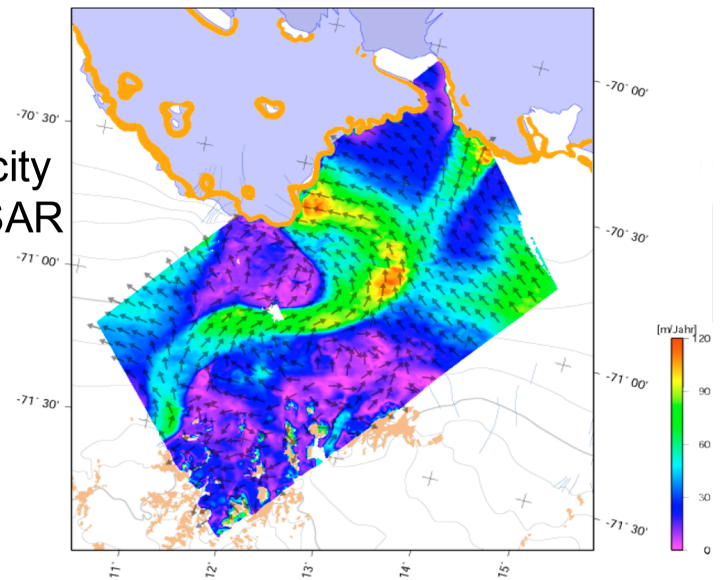
sea level contributions



mass balance from dynamic ice models



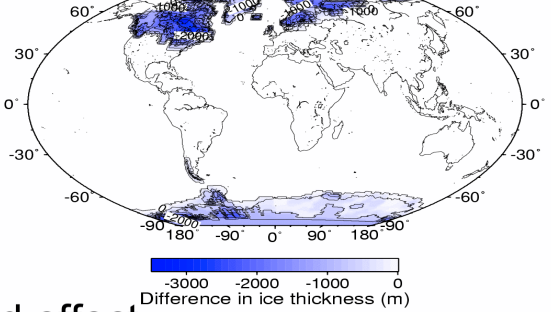
ice velocity from InSAR



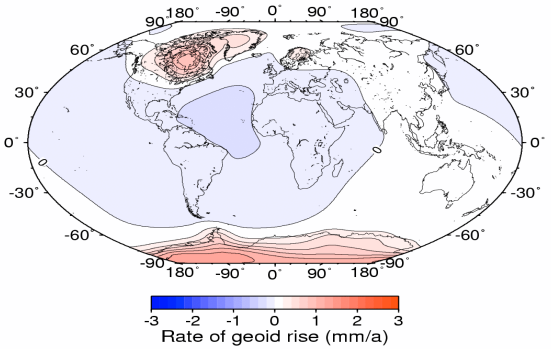
dynamics of mantle and crust

mantle dynamics and geoid signal,
geoid time variation from glacial isostatic adjustment, plumes, slabs,
gravity signal of crustal and lithosphere structure

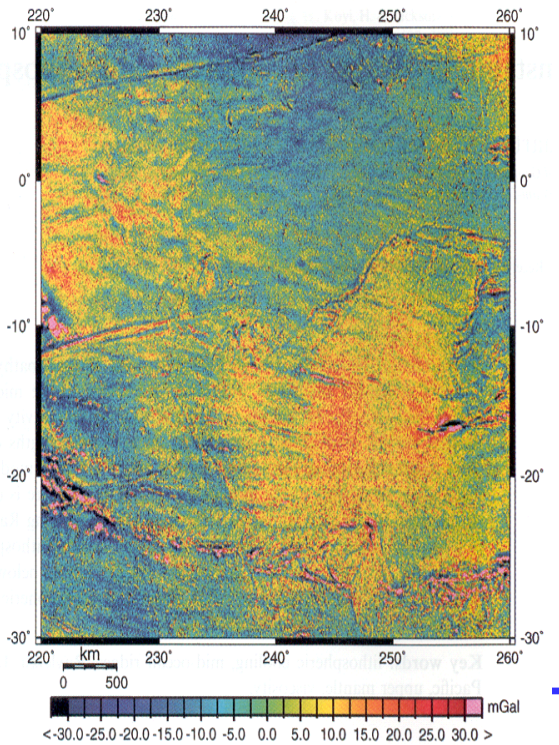
GRACE, GOCE, seismics, InSAR, ...



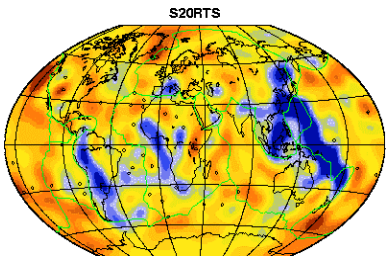
GIA geoid effect

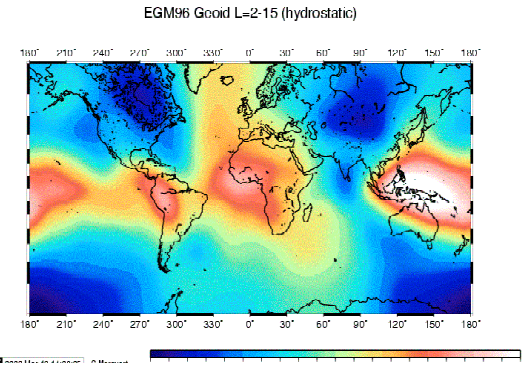


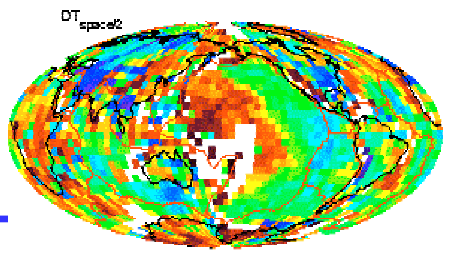
sublithospheric convection



seismic structure, geoid and dynamic topography



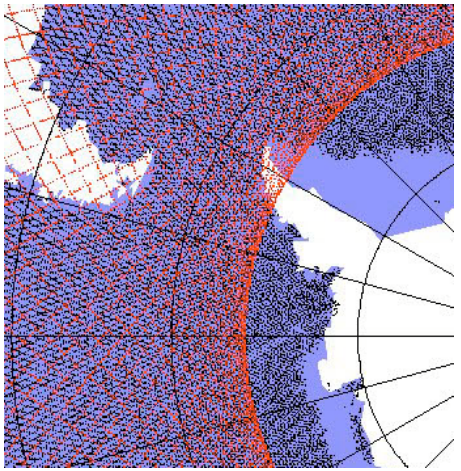


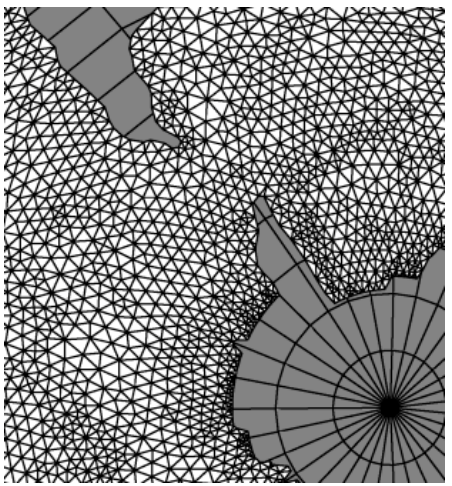


from satellite sensor data to mass signals

consistent combination of missions,
reference systems,
data preparation for model assimilation,
regional representations,
filtering,
error models,
separation of signal components,
mass balance,
complementary data

different representations

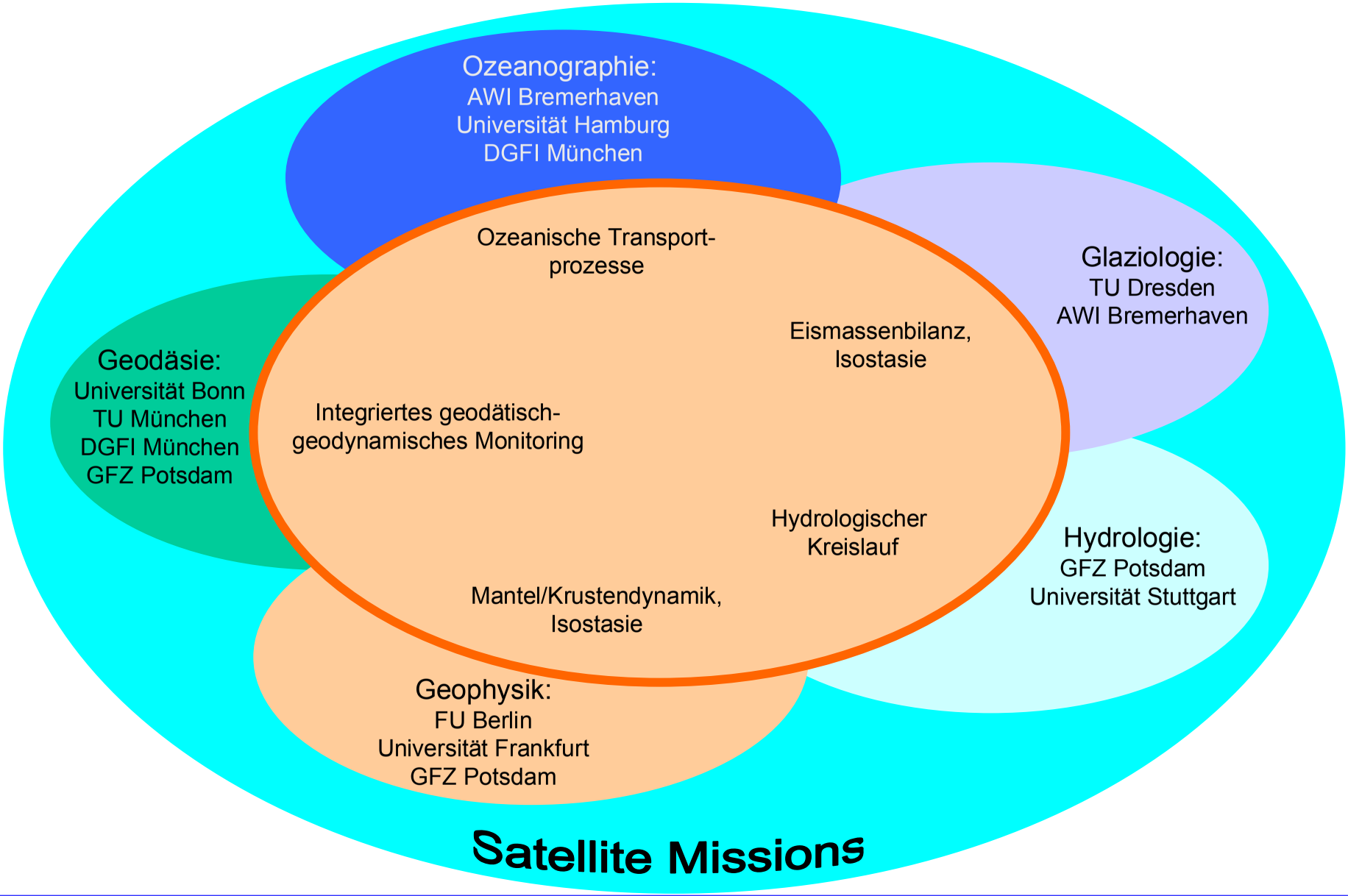




Separation Toolbox

regional characteristics	*special satellite configurations*
time characteristics	*complementary data*
spectral characteristics	*complementary missions*
known parameters	*exchange of mass model results*
...	...

Cooperation of Geosciences



Coordination

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- Prof. H. J. Götze, FU Berlin (Krustendynamik)
- Prof. R. Dietrich, TU Dresden (Eismassenbilanz)
- Prof. H. Miller, AWI Bremerhaven (Eismassenbilanz)
- Dr. C. Haas, AWI Bremerhaven (Eismassenbilanz)
- Dr. Ph. Huybrechts, AWI Bremerhaven (Eismassenbilanz)
- Prof. W. Zahel, Univ. Hamburg (Ozeanische Transporte)
- Dr. J. Schröter, AWI Bremerhaven (Ozeanische Transporte)
- Prof. A. Bardossy, Univ. Stuttgart (Hydrologischer Kreislauf)
- Dr. J. Riegger, Univ. Stuttgart (Hydrologischer Kreislauf)
- Dr. B. Merz, GFZ Potsdam (Hydrologischer Kreislauf)
- Dr. A. Güntner, GFZ Potsdam (Hydrologischer Kreislauf)
- Prof. K. H. Ilk, Univ. Bonn (Schwerefeld, Koordination)
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- Prof. R. Rummel, TU München (Schwerefeld)
- Dr. J. Flury, TU München (Schwerefeld, Koordination)
- Dr. W. Bosch, DGFI München (Altimetrie)

Conclusions

- Gravity and geometry data from satellite missions together open the way to measure and model mass related processes.
- In the coming years the satellite data situation is extaordinarily favourable.
- Let's make the best of this situation with a priority research program.