

HALO

a platform for
Earth observations & geophysics

Christoph Förste & Mirko Scheinert



Earth Observation and Geophysics with HALO:

- *Remote sensing of geoscientific/geophysical parameters and processes on the Earth's surface and in the Atmosphere*
- *Investigation of geophysical and geodynamic processes including climate change induced processes*

Why is HALO of interest for Earth Observation and Geophysics?:

*The HALO aircraft with its **longe-range capability** offers:*

- *to realise measurements in remote resp. outlying areas/regions, which are difficult to access or inaccessible or have no or sparse flight infrastructure*
- *to connect measurements between isolated regions*

In this context the polar and subpolar regions as well as archipelagos are of special interest.

*The **loading capacity** of the HALO aircraft enables common measurements of a complete ensemble of geoscientific instrumentations.*

HALO - Fields of study for Earth observation and geophysics:

- *Quantification of greenhouse gas emissions* = EO-HALO
- *Aerogravimetry*
- *Aeromagnetometry*
- *Airborne GNSS Reflectometry, Scatterometry and Radio Occultation*
- *Laser altimetry*
- *Radio Echo Sounding*

EO-HALO: Quantification of natural greenhouse gas emissions

Topic:

- Quantification of greenhouse gas (GHG) emissions (CO_2 and CH_4)
- Combination of *in situ* and remote sensing methods for atmosphere and landscape.

Important goals:

- Development of **new remote sensing tools and methods** for future satellite instruments
- **Closing the gap** between satellite based and ground measurements to solve the **scaling problems** between local and global gas emission quantifications

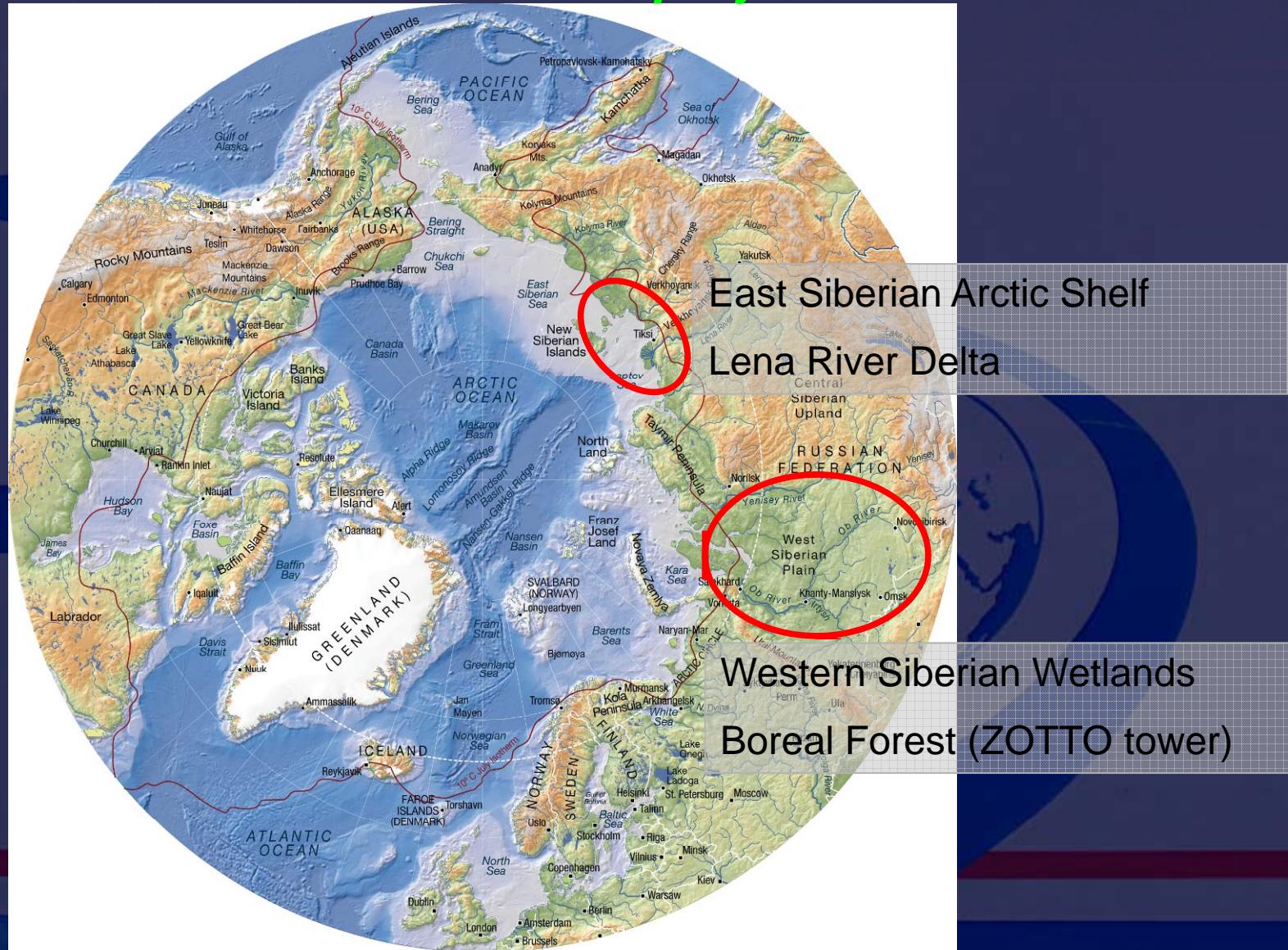
Mission Areas :

The permafrost areas in the northern Hemisphere:

Preferably Russian permafrost (terrestrial and shelf areas), wetlands and boreal forest



Regions of interest for the EO-HALO project:



HALO - Fields of study for Earth observation and geophysics:

- Quantification of natural greenhouse gas emissions

- Aerogravimetry*
- Aeromagnetometry*
- Airborne GNSS Reflectometry, Scatterometry and Radio Occultation*
- Laser altimetry*

- Radio Echo Sounding*

GEOHALO

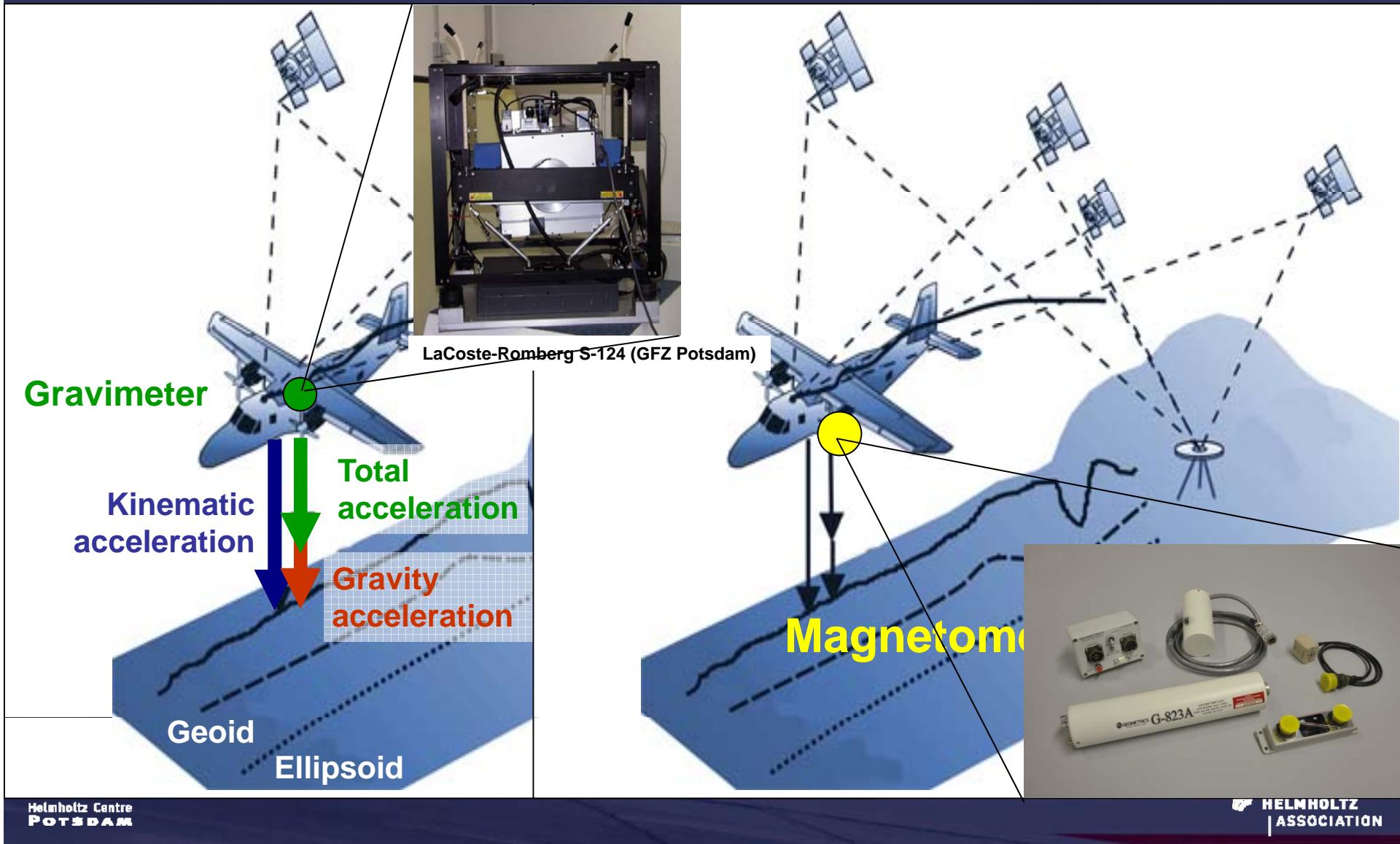
ANTHALO

Aeromagnetometry and Aerogravimetry

Purpose: Mapping of the Gravity Field and the Magnetic Field of the Earth

Instrumentation:

Flight gravimeter and magnetometers + GPS receivers (on-board & on the ground)



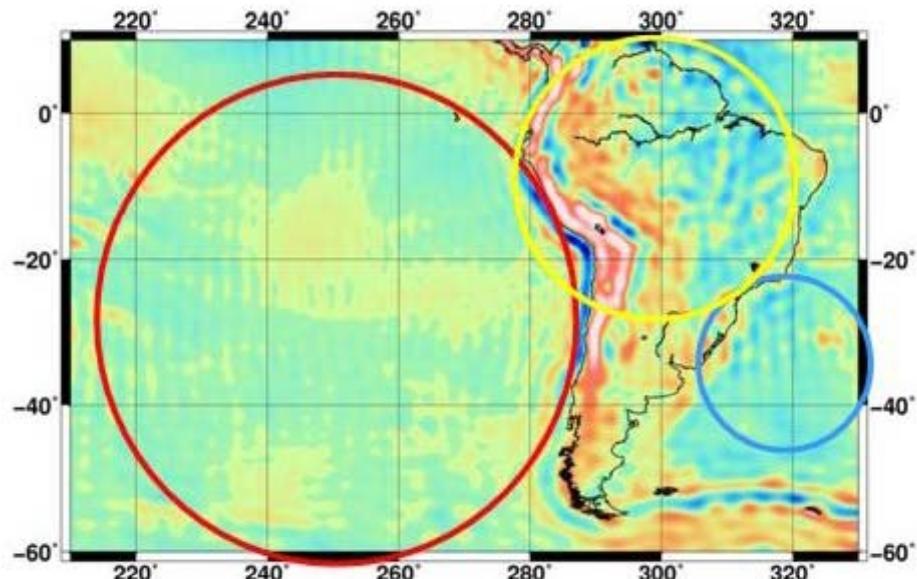
Aeromagnetometry and Aerogravimetry

Purpose:

- Mapping of the Gravity Field and the Magnetic Field of the Earth
- Contributions to global and regional modelling

1. Example:

Reduction of errors (stripes) and increase of the spatial resolution by combination of global satellite-only gravity field models (GRACE) with terrestrial data (among others from aerogravimetry)

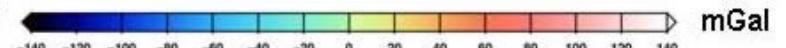


EIGEN-5S



EIGEN-5C

Gravity anomaly



Aeromagnetometry and Aerogravimetry

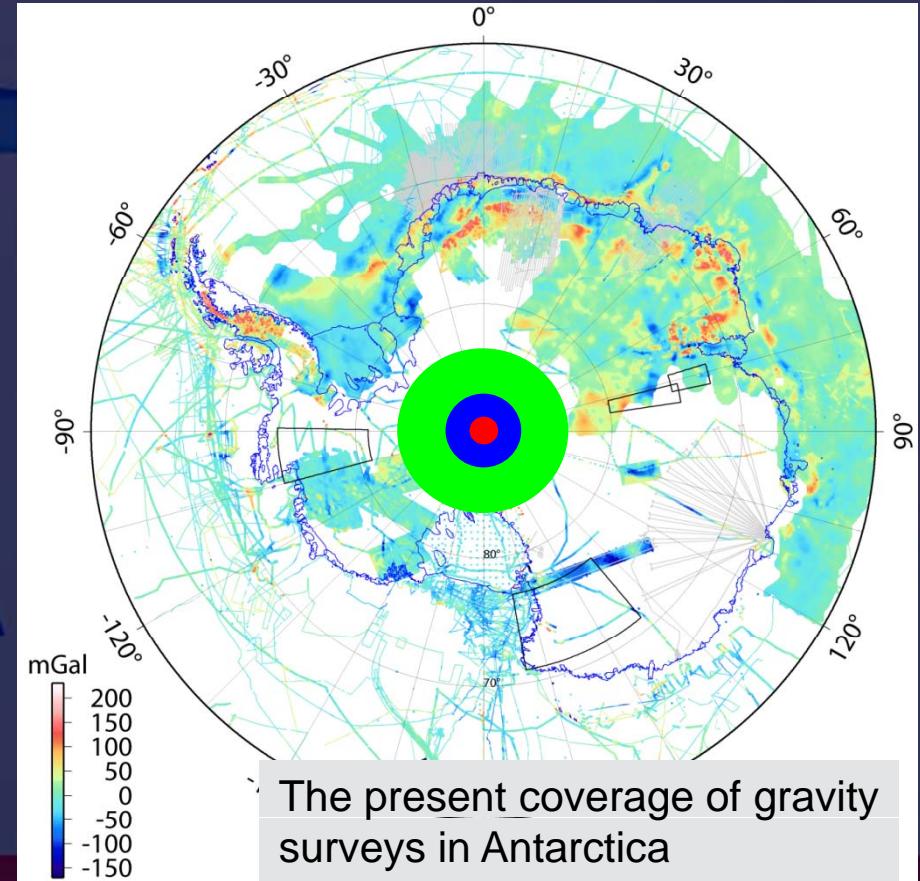
2. Example:

Closing the **polar gap of satellite missions** in the south polar region

CHAMP (87,3°) - Magnetic &
Gravity

GRACE (89,5°) - Gravity

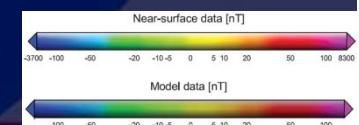
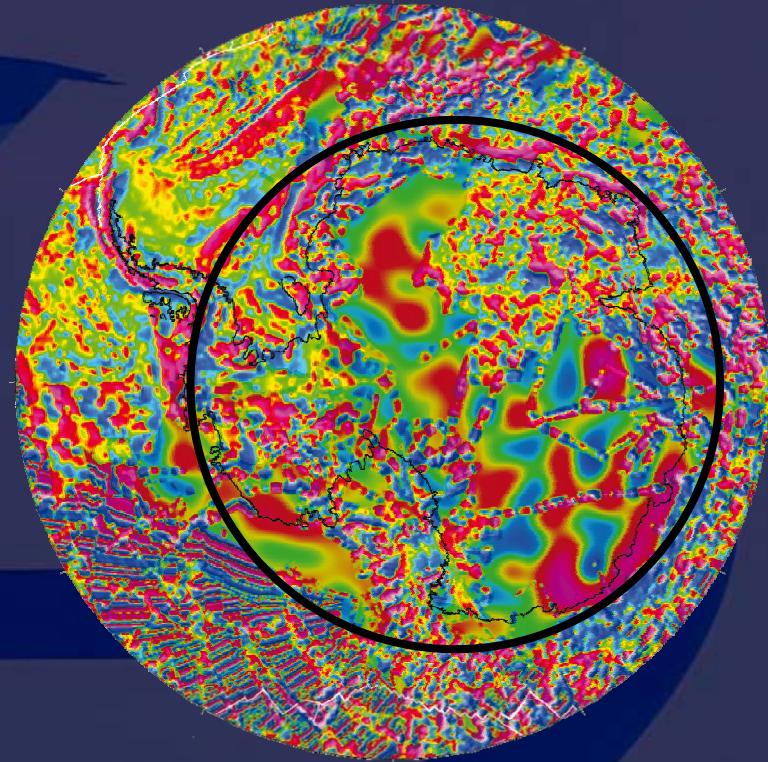
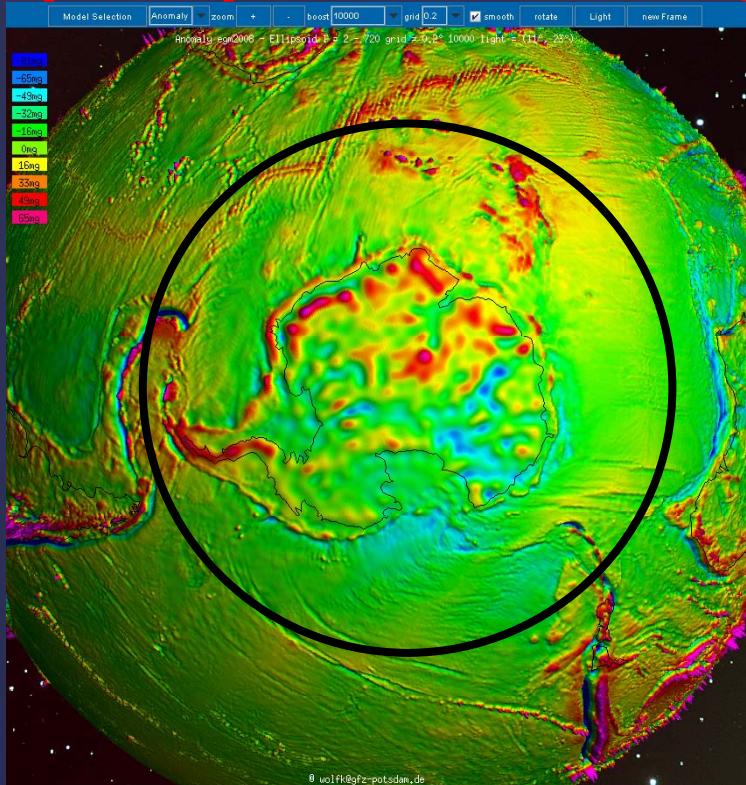
GOCE (96,5°) - Gravity



Aeromagnetometry and Aerogravimetry

2. Example: Closing the polar gap of satellite missions in the south polar region

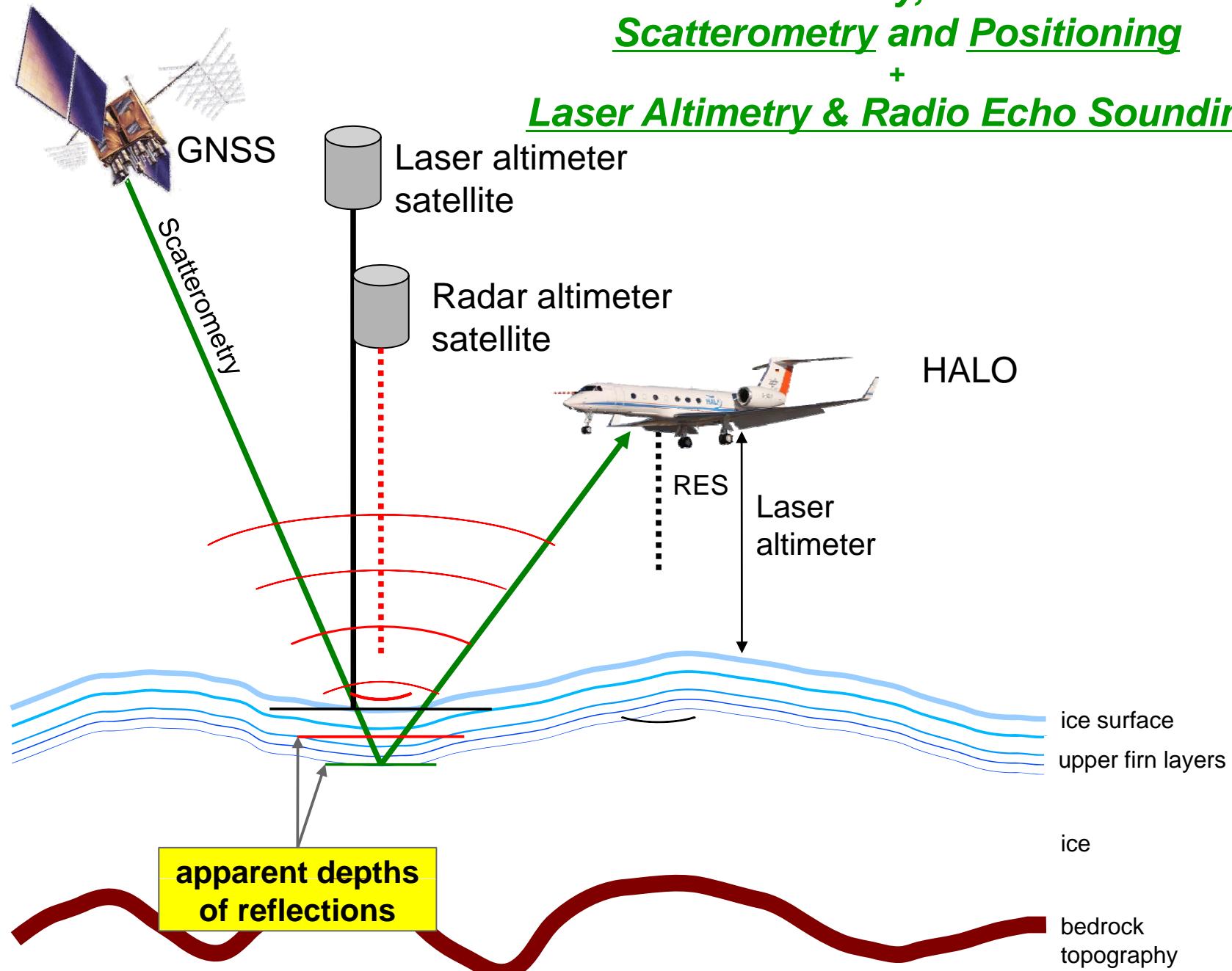
The present spatial resolution of the magnetic and gravity fields in Antarctica:



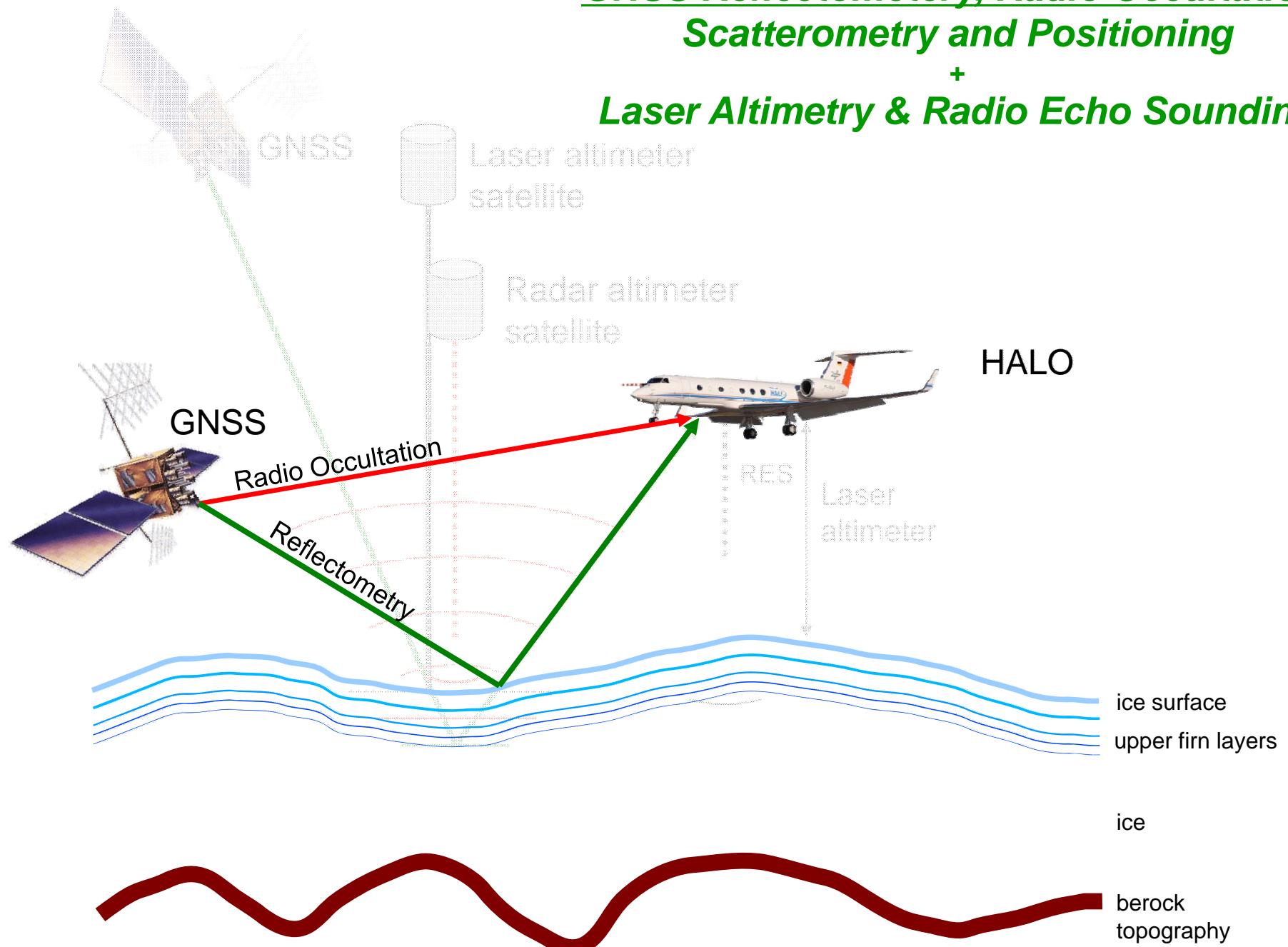
GNSS Reflectometry, Radio Occultation, Scatterometry and Positioning

+

Laser Altimetry & Radio Echo Sounding



***GNSS Reflectometry, Radio Occultation,
Scatterometry and Positioning***
+
Laser Altimetry & Radio Echo Sounding

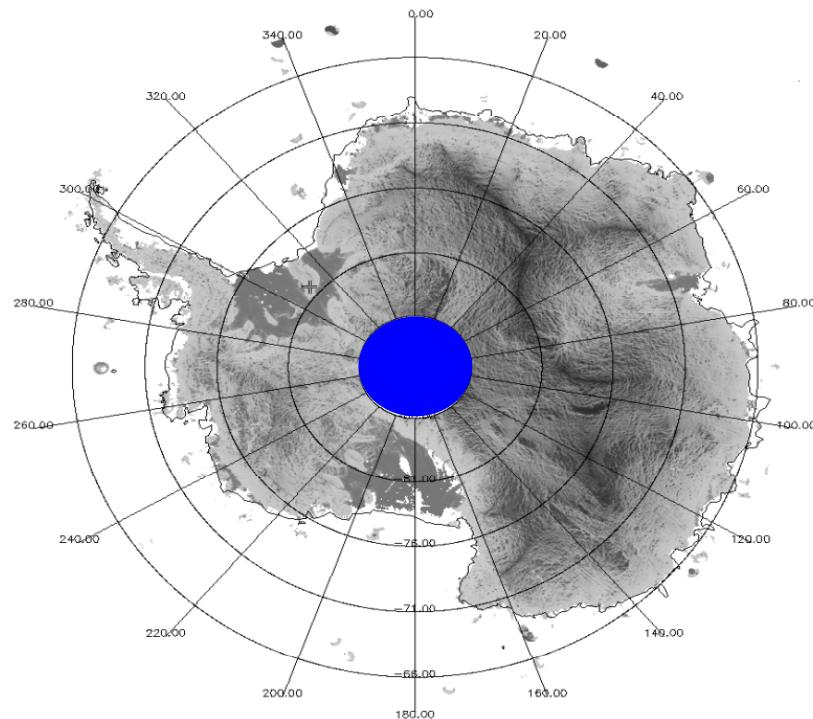


GNSS Reflectometry, Radio Occultation, Scatterometry and Positioning Laser Altimetry & Radio Echo Sounding

Main Scientific Topics:

- 1. Water and ice surface
Ice Topography*
- 2. Bedrock topography*
- 3. Atmospheric parameters
(e.g. water vapour profiles)*
- 4. Precise GNSS positioning
for the magnetic and
gravity measurements*

ICESat (86°) – Laser Altimetry



Digital Elevation Model of Antarctica from ICESat
Source: Goddard Space Flight Center (2009)

Closing the polar gap of satellite missions like ICESat in the south polar region
→ One of the main goals of the ANTHALO mission

Aeromagnetometry and Aerogravimetry

*GNSS Reflectometry⁺, Radio Occultation,
Scatterometry and Positioning
Laser Altimetry & Radio Echo Sounding*



Widespread spectrum of geodetic and geophysical topics



A complete instrumentarium for airborne geodetic and geophysical observations

Contribution to:

Global and regional geodetic and geophysical monitoring of the changing Earth:

- Investigation of the Earth's interior
(core, mantle and crust, Earth rotation)
- Geodynamics (continental drift)
- Ocean surface and dynamic ocean topography, ocean circulation
- Mass changes (ice melting, hydrological cycles)
- Ice surface and topography
- Bedrock topography, subglacial lakes and glacier dynamics

Summary:

HALO – a novel platform for multidisciplinary geoscientific observations during the next decades in the fields of:

- Remote sensing of geoscientific parameters and processes on the Earth's surface and in the Atmosphere***
- Investigation of geophysical and geodynamic processes including climate change induced processes***

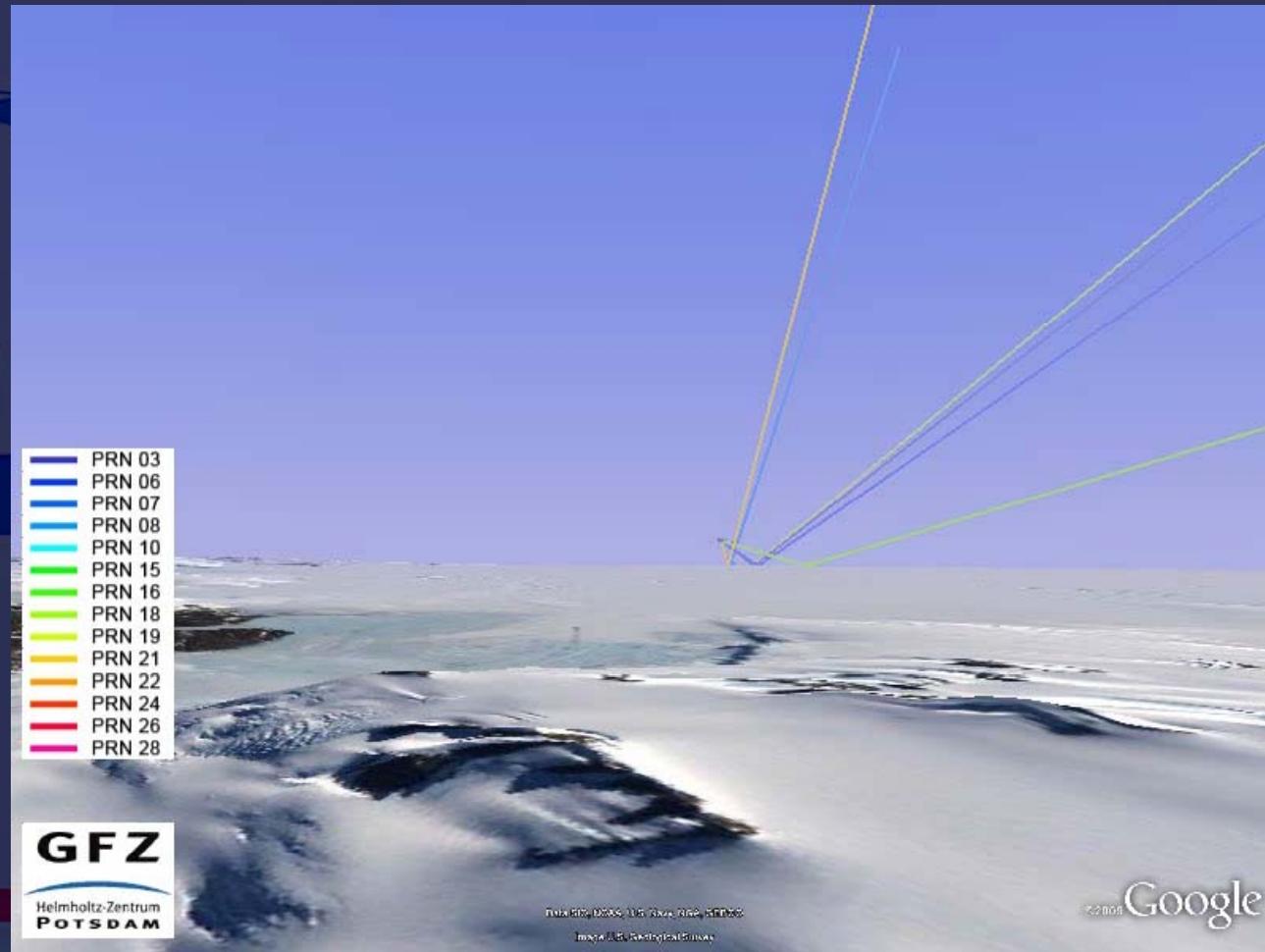
The goal of the presented projects is:

- development of innovative instruments and measurement techniques***
- adaption and certification of the existing and the new instruments on HALO***
- first experiences with the operation of the integrated instrumentations under flight conditions***
- first integrated scientific measurement campaigns***

The first planned missions in this fields during the next years are:

- EO-HALO***
- GEOHALO***
- ANTHALO***

Thank you for your attention!



Thank you for your attention!

